SALT MARSH ARCHITECTURE

Catalogue, technology and typological development of early medieval turf buildings in the northern coastal area of the Netherlands.

D. Postma

Master thesis University of Groningen

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For Spruit
WORD OF THANKS

This Master thesis concludes my education in the archaeology of Northwest Europe at the University of Groningen (NLD). Many people have been of great support to me over the years, but I would like to thank the following people in particular.

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“There must have been reasons, therefore, beyond ignorance, to uphold such a persistent tradition of turf building.”

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F.B. Postma / D. Postma
F.B. Postma / D. Postma
F.B. Postma / D. Postma
1 INTRODUCTION & BACKGROUND INFORMATION

1.1 INTRODUCTION

1.1.1 Prelude

Few things stimulate our imagination on ancient life like a full-scale house reconstruction. What was it like to live in pre- or protohistoric times? Museum cabinets display the fragments of agricultural implements, pottery sherds and broken animal bones, but the house provides the setting in which we visualise the farmer with a bowl of hot beef stew. Buildings are the all-important backdrop to so many aspects of life, today, but also in the past. Children were born in here, people spun wool for clothing, made tools in the smithy and kept their livestock in the byre. It is not difficult to explain why reconstructed buildings – this ranges from Palaeolithic huts to 17th century longhouses – are a central feature in many heritage museums.

Whilst visiting the reconstruction of an early 20th century turf hut (plaggenhut), Jan Vonk (fig. 6a) decided that a reconstruction would also suit the Yeb Hettinga Skoalle in Firgum (FR). He is a committee member at this local heritage museum, which includes a modest archaeological section (archeologisch steunpunt). Jan soon found support from his fellow committee members and set to work. Archaeological publications of a variety of early medieval settlements showed that turf buildings are typical of the coastal region around Firdgum in this particular period, but did these buildings look anything like the historical plaggenhuten? The latter are known primarily from the province of Drenthe. Internet searches revealed several reconstructed buildings in museums all over the Netherlands, but none represented an early medieval building and none incorporated turf walls.

Jan decided to contact the Groningen Institute of Archaeology (GIA) at the University of Groningen (RUG) to see if they could be of any help. The GIA has a long tradition of research into rural settlements (see Waterbolk 2009 for a recent overview) and also had its share of building reconstructions, mainly through the work of Otto Harsema (1980, 1995a and 1995b) and Carlo Huijts (1992). Unfortunately for Jan, however, earlier research had not revealed much about the construction of the type of building he was aiming to reconstruct. But all hope was not lost. The researcher he had managed to get in touch with is Johan Nicolay, who has a keen professional interest in the terp region. Nicolay realised that the reconstruction of a turf-walled building may also lead to interesting research opportunities, so the chance in his view should not be left unexploited.

Ultimately, the author was asked to take up the challenge as a terminal project (afstudeeropdracht) – needless to say the offer was gladly accepted. It was clear from the start that drawing up a sensible reconstruction proposal would require a thorough investigation. It was decided to first put together a catalogue of excavated buildings, study traditional turf construction and refine the region’s building typology. The results of this quest are presented in this thesis.

1.1.2 Surprising research potential

Without getting ahead of things already, it can safely be said that the results of this study contrast sharply with traditional views on turf construction. Even during the preparatory phase this led to the publication of a separate article, in which many of the near-endless possibilities of turf have been set out (Postma 2010; see footnote 62). The article’s main objective is to demonstrate how an apparently worthless material can nonetheless fulfil many different purposes, far more than the construction of buildings, dykes and water wells. The practical value of turf is hard to imagine without the experience of actually having worked with it, and it is furthermore obscured by the negative image turf has received as a building material in the past.

Turf’s negative image has most explicitly been portrayed by Brunskill, Noble and Voskuil. In his book on the history of walls, Voskuil devotes just two sections to the use of turf. It is concluded that turf walls could not be built up higher than they are thick, and that they have poor load bearing capabilities.1 Brunskill (1987, 51), in his illustrated handbook of vernacular architecture, states that traditional turf walls “were thick, irregular, and required protection unless used for purely temporary shelters.” Noble has experimented with turf construction since the late 1970’s and is more appreciative of the material. He values its ready availability, good thermal qualities and the ease with which it can be worked, but the material also has its downsides: “Whatever positive things may be argued for turf walling, one negative feature is quite clear – feal [i.e. turf] walls could not be load

---

1 Voskuil (1979, 6 and 106-108); reference is made to: Trier, B., 1969. Das Haus im Nordwesten der Germania Libera. Münster (see pages 73-74).
Such underestimating views should now be disposed of; turf can offer as many possibilities as any other building material.

As the veil of turf-related prejudices slowly lifted in the course of this study, the turf-walled buildings started to show their true academic potential. Instead of investigating an architectural sidetrack, these so-called Leens type buildings shed a whole new light on key aspects of ancient architecture. It appears that our remarkable northern coastal area may well hide unique opportunities for the archaeological research of settlements. This was already suggested by the famous excavations at Ezinge, but its full potential with regard to the research of early medieval buildings has long eluded us. As will become clear in the following chapters, this potential clearly is of international significance.

1.2 BACKGROUND INFORMATION

1.2.1 Setup and contents
The first chapter is concerned with background information on the aims of this study, the applied method of approach and the physical geography of the research area. The research area consists mainly of the former salt marshes in the provinces of Friesland and Groningen (figs 1.1 and 2.1). The general name terp region is often used to denote this region (see 1.2.2). For this study, however, the northern tip of the province of North-Holland has been added to the research area. Two important sites have been excavated there, which contribute greatly to the interpretation of buildings from the terp region.

The second chapter consists of a catalogue of Roman Iron Age and early medieval turf-walled buildings, excavated in the research area. Main buildings (i.e. houses and large outbuildings) form its focal point, but smaller outbuildings have been described and illustrated as well. Turf-built structures like house platforms, dykes and water wells have also been excavated in the Netherlands, but these are not discussed. The same goes for sunken-floor huts; they are relatively well-represented in the archaeological record, but it was unfeasible to include them in this study.

The third chapter contains a thematic discussion of technological data from the catalogue. The dataset for the research area, however, is not sufficient to support satisfactory conclusions on all main aspects of local building traditions. To resolve this, historically documented buildings and structures excavated in other regions have been incorporated in the discussions. These analogies provide a useful means for comparison and have been an invaluable source of inspiration (see 1.3.2). The four main subjects are turf walls, primary timber structures, secondary timber structures and remaining features (e.g. fire places, gables and thatch). The discussions in this chapter are key to the interpretation of early medieval turf buildings in the terp region. They may also have implications for the study of archaeological buildings elsewhere.

Chapter 4 focuses on typo-chronological developments. The use of turf walls instead of wall posts and outside posts, makes it hard to compare buildings from the littoral with those excavated in the sandy soils, further inland. As a consequence, emphasis has long been put on the constructional differences between turf and timber buildings. In chapter 4, the weight of these differences is nuanced by further outlining the characteristics of the so-called Leens architecture. This makes it possi-
ble to place the turf buildings in a wider interregional context and to discern typo-chronological similarities with timber buildings in surrounding areas. It also sheds light on the functional use of different types of main buildings.

In the final chapter, a hypothetical reconstruction of a Leens A type building is presented. The discussions in earlier chapters serve as the basis for the proposal. In order to illustrate the character of such a building, some thoughts on living conditions are also discussed in chapter 5.

1.2.2 Physical geography and terp concept

A physical-geographical subdivision can be made between the low-lying coastal plain and the peat moors and higher sandy soils that lie behind it (fig. 1.1). The coastal plain consists of virtually level salt marshes (kwelders; fig. 3.6), sometimes spanning tens of kilometres in width. It was formed during the Holocene when marine sediments were deposited through periodic inundation. Flooding and sedimentation continued until the area was dyked in around the 12th-13th century AD and have gradually levelled out all relief in the Pleistocene underground.

Artificial dwelling mounds, however, can also be found in other regions. In the Netherlands, terp-like dwelling mounds are known from the west coast and wetland areas along the major river systems. The same applies to the coastal (salt marsh) region of Northwest Germany and South-West Denmark. Moreover, centuries of building activities and maintenance work have resulted in thousands of “farm mounds” throughout the North Atlantic region (Bertelsen & Lamb 1993). To a large extent, these mounds appear to be related to coastal occupation, but not always to areas of regular flooding. When terpen or the terp region are mentioned in this study, the dwelling mounds and salt marshes of Groningen and Friesland are meant, unless it is stated otherwise.

The sandy region to the south of the salt marshes is not susceptible to (marine) flooding. It forms a plateau that reaches up to c. 15 m above sea level and lies mostly in the province of Drenthe. Unlike the terp region, it has been inhabited continuously since Palaeolithic times. During the Holocene, the build-up of marine sediments obstructed the drainage of fresh water from the plateau. This resulted in the formation of vast peat moors on the verge of sand and clay soils. It is still uncertain when the peat soils were occupied, but settlement mounds, called veenterpen, are known from this region from the Late Middle Ages (Casparie 1988). Due to draining and subsequent oxidation of the peat, as well as large scale commercial exploitation, virtually nothing of these soils survives.

The physical-geographical situation in the north of the Netherlands is of great importance to the study of ancient buildings in the coastal region. Saline conditions in the salt marshes meant that the vast expanses of the terp region were entirely without woodland. Only timber from wrecked ships and driftwood could be collected along the shoreline. The nearest source of fresh timber were the drier parts (e.g. levees) of the peat soils, but these wet and barren soils normally only produce gnarled (knoestig) and crooked timber. If longer and straighter sections were desired, it might have been necessary to import these from the Drenthe plateau or beyond. Despite the scarcity of reliable timber resources, the salt marshes did not fall short on another type of building material; they provided an inexhaustible supply of clay-rich turf, well-suited for construction purposes (fig. 1.3; see 3.1.2.2).

By the time the salt marshes were colonised (c. 6th century BC), permanently dry areas only remained where sandy ridges protruded far into the coastal plain. As a consequence, coastal occupation concentrated on the relative heights of the marsh bars and levees (fig. 1.2). There, the settlers raised dwelling mounds, called terpen, to protect themselves from the floods. Because of this, the coastal zone has come to be known as the terp region and many terpen are indeed still visible in the landscape today.

5 The translations of terp-related terms used here, are similar to those explained in J. Boersma, 2005; Dwelling mounds on the salt marshes: The terpen of Friesland and Groningen. In: L.P. Louwe Kooijmans et al. The Prehistory of the Netherlands, vol. 2. Amsterdam University Press, pp. 557-560. In his article, Boersma gives a short introductory description of the terp concept (in English).
Fig. 1.3. Cutting salt marsh turf for the construction of a test wall at the local heritage museum in Firdgum (FR). The undercutting tool that is used to lift the turves (zodenlichter) is also shown in fig. 3.6a. For the location, see fig. 3.5. Left: Dries Bosma, chairman of the Yeb Hettinga Skoalle; right: author.

1.3 SOURCES OF INFORMATION

1.3.1 Research area

As far as the research area is concerned (see 1.2.1 for a definition), all sites with reasonably intact ground plans of turf-built main buildings have been included in the catalogue. In some cases no plans have been published, but the building’s description contains valuable information. Because of the limited scale of this study, investigations had to be confined to excavation reports and literature at hand or otherwise easily obtainable. This means that no efforts were made to verify or supplement the published data through original fieldwork documentation. For making sure that all relevant buildings were studied, the recent overview by Waterbolk (2009, 221-222) was very useful. A less extensive overview, which includes a reinterpretation of the settlement at Leens, is presented in Knol’s (1993) doctoral thesis. De Langen (1992) discusses two previously unpublished turf building excavations (Foudgum and Boornbergen-Kloesewier).

Waterbolk’s book is the product of decades of research on prehistoric buildings in the north of the Netherlands. These buildings are often preserved as posthole arrangements in the sandy subsoil. Analyses of their plans from a technological point of view, however, have aided significantly in the recognition of key architectural details. Work by Huijts (1992) has been particularly important in this. Waterbolk has subsequently used the insights to discern more subtypes and further outline the technological developments they reflect. His book is structured and provides clear plans for all building types. As such, it is an indispensable resource for all students of architectural (pre)history in the province of Drenthe and surrounding areas, but also further afield.

It might be considered a disappointment, therefore, that so little is known about the turf buildings from the terp region, or turf buildings in general, for that matter. The effects are especially clear in Waterbolk’s treatment of the Leens type; only five ground plans are presented this section and they all show considerable differences (Waterbolk 2009, 90-92). Essentially, after 90 years (since the 1920’s) of fruitful settlement research this is all noteworthy information on buildings from the terp region, from the entire Early Middle Ages! In other regions, too, turf buildings are likely to have been a common feature for many centuries, or even millennia. Hopefully this study can provide some tools to start filling in these gaps.

Since the early 1990’s, large archaeological terp excavations have only taken place in Friesland, notably at Wijndalum-Tjitsma (1991-1993), Leeuwarden-Oldehoofsterkerkhof (2004-2006) and Hallum (2007). All three excavations focus on the Early Middle Ages and further underline the central role of turf buildings in the terp region in this period. In the publications of these sites, efforts have been made to incorporate turf buildings into existing views of post-Roman socio-political

4 For suggestions on the age of turf construction see section 1.3.2.1.
developments (see also Nicolay 2005, 70). Little progress, however, has been made in understanding the actual construction methods.

A valuable first attempt at ‘understanding’ turf construction is the discussion of the Wijnaldum structures by Gerrets & De Koning (1999). At Wijnaldum it was noted that posts and postholes were lacking in many of the excavated turf buildings. This presented the excavators with a challenge for their interpretation, because turf-built walls were generally considered incapable of being load bearing (e.g. Voskuil 1979, 16). Gerrets & De Koning successfully question this traditional view, even though a lack of practical know-how hindered them from drawing firm conclusions.

A full page of endnotes shows that the authors made considerable efforts to investigate the concept of turf construction (Gerrets & De Koning 1999, 122). In the endnotes, they elaborate on their discussion of archaeological visibility problems, building dimensions, wall thicknesses, timber inner structures and the carrying capacity of turf walls. They also list turf building sites in the Netherlands, Germany and Denmark; their unfinished remains to be of great importance to this study. For the first time, the documented buildings have enabled a further typological subdivision of Leens type architecture. They also demonstrate a transition from wide turf-walled houses (?) to entirely timber-built structures in the Carolingian period.

It is possible that more turf buildings have been excavated in the terp region than this study has brought to light. Numerous settlement sites have been investigated over the years, but the presence of turf will not generally be evident from the title of their publications. Also, turf has not been the subject of any major research programme, so its presence may not always be highlighted in the summaries. Many older excavations have not been published at all.

For this study, digital inventories and databases have been explored to see if additional information could be gathered. This was not the case. The governmental inventory of archaeological sightings and excavations (ARCHIS2) has very limited possibilities for searching individual record contents. This means that all descriptions of registered settlements would have to be checked manually to establish whether turf-built structures are mentioned in a site’s description. This is an unfeasible task, because of the vast amount of known settlement sites (i.e. terpen) in the research area.

The e-Depot for Dutch Archaeology (EDNA) does allow the descriptions to be searched collectively. Short summaries are provided for all de-

<table>
<thead>
<tr>
<th>Archaeological site in catalogue:</th>
<th>Date (c.) of turf buildings</th>
<th>Primary reference(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ezinge (GR)</td>
<td>2nd-3rd century AD</td>
<td>Van Giffen 1936</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>De Langen &amp; Waterbolk 1989</td>
<td></td>
</tr>
<tr>
<td>Foudgum (FR)</td>
<td>8th-9th century AD</td>
<td>De Langen 1992</td>
<td></td>
</tr>
<tr>
<td>Hallum (FR)</td>
<td>8th-9th century AD</td>
<td>Tuinstra &amp; Vethuis in prep.</td>
<td></td>
</tr>
<tr>
<td>Heveskeskooster (GR)</td>
<td>2nd-5th and 9th-13th century AD</td>
<td>Borrsma 1988</td>
<td></td>
</tr>
<tr>
<td>Leens (GR)</td>
<td>6th-9th century AD</td>
<td>Van Giffen 1940</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Knoel 1993</td>
<td></td>
</tr>
<tr>
<td>Leeuwarden (FR)</td>
<td>5th/10th century AD</td>
<td>Nicolay 2008b</td>
<td></td>
</tr>
<tr>
<td>Wijnaldum (FR)</td>
<td>5th-9th century AD</td>
<td>Gerrets &amp; De Koning 1999</td>
<td></td>
</tr>
<tr>
<td>Den Burg (NH)</td>
<td>Roman Iron Age-Carolingian period</td>
<td>Woltering 1974 and 1975</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Woltering et al. 1994</td>
<td></td>
</tr>
<tr>
<td>Den Helder (NH)</td>
<td>9th century AD or later</td>
<td>Van Es 1973a</td>
<td></td>
</tr>
<tr>
<td>not in catalogue:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boornbergum-Kloesewier (FR)</td>
<td>10th century AD</td>
<td>De Langen 1992</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>fragment of byred building; wall placed on wattle screen footing</td>
<td></td>
</tr>
<tr>
<td>Ulrum (GR)</td>
<td>8th century AD (incl. 14C date)</td>
<td>Groenendijk 2006</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>fragment of turf wall and timbers</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.1. Archaeological sites with turf buildings in the research area.

An English translation of the full synthesis has been included in the publication.
1.3.2 Analogies

To view the early medieval turf buildings in the terp region in a wider Northwest European context, many other turf (and stone or timber) buildings have been studied in the course of this thesis. This includes archaeological examples, but also historical buildings which have been described in contemporary reports or 20th century surveys. Initially, difficulties were encountered in locating relevant publications. As a consequence, the representativeness of the collected data could not be properly established; it appears that very few comprehensive studies on turf buildings have been carried out anywhere in Northwest Europe. Uncertainties with regard to cultural relationships between turf buildings in the North Sea and North Atlantic region may undermine the solidity of analogies. It is felt, however, that turf buildings along these northern coasts are more closely related than scholars are currently able to confirm.

Attention for archaeological remains of turf buildings has mainly been restricted to excavations in the research area. However, as one of the primary aims of this study is to fully reconstruct a turf building, much attention has been paid to historic and ethnographic sources from other areas. The latter provide detailed information on turf building techniques, thatches, maintenance work, secondary use of timber and several other points of interest. Many new insights could never have been acquired through archaeological evidence alone.

In particular, the Dutch plaggenhutten, Icelandic turf farms and Scottish blackhouses have been highly informative. Background information on all three is provided in the following sections. For the benefit of future research, a list of sites with excavated turf main buildings has been included for the

---

6 www.edna.nl; last accessed on 12 March 2010.
8 Possibly, remains of turf walls have also been found at Paddepoel and Middelstum-Boerdamsterweg, but I have not verified this. For these sites, reference has respectively been made to Es, W.A. van, 1970. Paddepoel, excavations of frustrated terps, 200 B.C.–250 A.D. Palaeohistoria 14, 187-352; and Boersma, J.W., 2005. Colonists on the clay. The occupation of the northern coastal region. In: L.P. Louwe Kooijmans et al. (red.), The prehistory of the Netherlands. Amsterdam, 561-576.
The Netherlands and England and Scotland. For Iceland, a comprehensive list has already been published elsewhere. In the fourth section, sites from other countries are listed.

1.3.2.1 The Netherlands (outside research area)

An important source of information on the construction of turf houses are the surveys by Klaas Uilkema, published by Van Olst (1991). This historic farm researcher had taken up a keen interest in turf houses and documented several specimens from 1914-1934, when the last were still in use (figs 3.51 and 3.50). Many of the buildings can best be denoted as turf huts (plaggenhutten), for they were small and ill-maintained and served only as temporary shelters or belonged to poverty-stricken peat labourers (often squatters). Some plaggenhutten, however, clearly were well-built and might have been of a more traditional type of construction (Postma 2010, 15).

During this study a visit was paid to the Veenpark (peat museum) at Barger-Compascuum in Drenthe, where different varieties of plaggenhutten have been preserved or reconstructed. Turf has not been used as an element of structural importance in their construction – a modern structure is hidden in the walls – but they do illustrate the general character of such buildings (fig. 3.15). Little is known about the relationship between the well-built plaggenhutten and early medieval buildings in the terp region; much research is needed here.9

At present, there are few excavated structures that might shed light on this relationship, if indeed there is any. Most have been excavated in the peat soils in the northern and western parts of the Netherlands (figs 1.4 and 1.5).10 There are also older turf-walled buildings, excavated in the Assendelver Polders in the province of North-Holland (Iron Age and Roman Iron Age) and the fortified settlement at Oost-Souburg, province of Zeeland (10th century AD). The latter are not very different from buildings in the terp region, but they are not the same either (fig. 1.6).

The buildings unearthed in the Assendelver Polders do stand out more clearly and can be devided into two categories.11 One category concerns the odd-shaped wall-ditch structures (fig. 1.7). The second category is represented by an Early Iron Age building (site Q) with double-faced wattle walls (fig. 1.8). This structure was particularly well-preserved and still contained the original turf (and clay?) packing between the wall facings. It might be a late example of Bronze Age buildings.

9 Voskuil (1979, 106-109) provides some useful footnotes, with references also to plaggenhutten in the southern provinces of Noord-Brabant and Zuid-Limburg. A short description of how a simple plaggenhut was built on the peat soils is presented by Sijderius (2010). Reference has also been made to Jans, J., 1967. Landelijke bouwkunst in Oost-Nederland. Enschede

10 In addition to the sites discussed below, reference has been made to turf-walled houses excavated south-west of Groningen (c. 11th/12th-14th century AD; some unpublished) and at Kethel (12th-13th century AD; and similar buildings in the town of Portugaal). For the first, see Klungel, A.E. 1971. Veertepen ten Zuidwesten van Groningen. Boer en Sprede 17, 188-196; and also Giffen, A.E. van, 1931. Het terpje bij Het Wold, in de maas van het Eelderdiepje bij Peize. Mededeleningen omtrent het systematisch oudheidkundig onderzoek verricht in de jaren 1928-30. JVT 13/14, 44-46. For Kethel, see Hoek, C., 1974. Kethel. Rotterdamse Jaarboekje. 106-110.

11 The main publication of the Assendelver buildings is referenced in table 1.2, but for a more recent (summarising) article, see Therkorn 2005.
which appear to have been constructed in a similar fashion (fig. 1.9).\textsuperscript{12}

Although the excavated structures are all very interesting for the ‘grand narrative’ of turf construction, their relevance to early medieval buildings in the terp region has remained uncertain. For that reason, they have not been discussed in any detail in this study. Sites outside the research area are listed in table 1.2.

\begin{itemize}
\item E.g. IJzereef & Altena (1991), Huijts (1992, 37-66) and Fokkens (2005, 75-76).
\item Double wattled walls have also been mentioned with regard to prehistoric turf construction in Scotland (Loveday 2006, 89). The hypothesis that specific types of turf construction date back so far is intriguing – Loveday argues for turf-walled buildings as early as the Neolithic (also Evans 1969). Arguably it shows that the use of turf in the early medieval terp region may be related to much older building traditions, in stead of primarily being an adaptation to local physical-geographical conditions. This may also have implications for our interpretation of buildings from the sandy soils, where turf would not have been preserved anyway, but nevertheless may still have been used in one way or the other.
\end{itemize}

1.3.2.2 Iceland

The best-known examples of existent turf buildings, probably are the turf farms and churches in Iceland (fig. 3.52). A survey of several farm buildings has been published in German by Sacher (1938). An overview by Ágústsson (1998) contains information on construction methods as well, but it is written in Icelandic.\textsuperscript{13} The Icelandic buildings have been of great value to this study, because they are the only turf-built structures for which traditional construction methods have survived. In other countries, turf had generally been replaced by longer lasting building materials at an earlier stage.

Turf buildings in Iceland remained the primary form of housing for all layers of society, well into the 20\textsuperscript{th} century. This has enabled much of the sophisticated building methods to be preserved, along with the structures. Important work in documenting these methods is being carried out by the Skagafjörður Historical Museum in Glaumbær, North Iceland. They have published an English introductory booklet that highlights important aspects of the local turf building tradition (Sigurðardóttir 2008).

In addition to this, the museum has set up a heritage craft school (Fornverkaskólinn) that teaches traditional building skills and continues to record and preserve vernacular construction methods and their terminology. The courses follow the conservation guidelines set out in the Icelandic cultural heritage management law and the instructors work as professional turf builders. They are actively

\begin{itemize}
\item Both Sacher and Ágústsson discuss individual turf types (e.g. klambra and strengir), but their descriptions and illustrations are not accurate. A more detailed and more reliable resource is the booklet by Sigurðardóttir (2008), discussed below.
\end{itemize}
involved in the upkeep of old buildings and the preservation of their historical integrity.

To gain more insight in long-lost peculiarities of Dutch turf construction, a four-day course has been taken at the Fornverkaskólinn as part of this study (figs 1.10 and 1.11).

It is evident, now, that this has been financed by the Groningen University. During this visit a lecture on turf buildings in the Netherlands was given by the author at Hólar University. Fruitful discussions on turf construction and its archaeology have been conducted with researchers at the university's archaeological department and archaeologists visiting from the National Museum of Iceland and other (international) research organisations. Also, an interesting lecture was followed on archaeo-entomology in turf buildings, given by Magnus Hellqvist (then at Högskolan Dalarna, Sweden). In between set activities, several historic turf buildings, archaeological sites and ongoing excavations were visited in the Skagafjörður area. The efforts made by the historical museum at Glaumbær in preserving regional turf building traditions, have kindly been set out to me by museum director Sigríður Sigurðardóttir. I am also greatly indebted to Ragnheiður Traustadóttir, project director at the archaeological department at Hólar, for demonstrating their newly developed excavation methodology for three-dimensional documentation and for supplying me with useful literature from the department’s library. There are many other people who have been of great assistance to me in Iceland, and subsequently; I have named them all at the beginning of this thesis.

Icelandic construction methods differ considerably from those in the early medieval the terp region, but the course has helped to identify some universal preconditions for working with turf. This background knowledge has been of key importance for the interpretation of archaeological and historical turf buildings.

Due to the absence of woodland, turf construction has been Iceland’s main form of architecture since its colonisation by Vikings in the late 8th and early 9th century AD (Ólafsson & Ágústsson 2006, 10; Vésteinsson without date, 116-121). Many construction techniques that have been documented in surviving buildings, can also be discerned in older structures, suggesting continuity of traditions for over 1000 years or more (fig. 1.12). Nevertheless, a lot can still be learnt about the development of Icelandic building techniques. Scholars have long approached the excavated buildings from a historical point of view, because the locations of important farms were already known. This has been financed by the Groningen University. During this visit a lecture on turf buildings in the Netherlands was given by the author at Hólar University. Fruitful discussions on turf construction and its archaeology have been conducted with researchers at the university’s archaeological department and archaeologists visiting from the National Museum of Iceland and other (international) research organisations. Also, an interesting lecture was followed on archaeo-entomology in turf buildings, given by Magnus Hellqvist (then at Högskolan Dalarna, Sweden). In between set activities, several historic turf buildings, archaeological sites and ongoing excavations were visited in the Skagafjörður area. The efforts made by the historical museum at Glaumbær in preserving regional turf building traditions, have kindly been set out to me by museum director Sigríður Sigurðardóttir. I am also greatly indebted to Ragnheiður Traustadóttir, project director at the archaeological department at Hólar, for demonstrating their newly developed excavation methodology for three-dimensional documentation and for supplying me with useful literature from the department’s library. There are many other people who have been of great assistance to me in Iceland, and subsequently; I have named them all at the beginning of this thesis.

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Table 1.2. Archaeological sites with turf buildings outside the research area.
known from the Icelandic sagas. Archaeological investigations, therefore, initially served mainly to confirm a building’s location or the identity of its former occupant. As a result, little attention was paid to constructional details. It is not until recent years that more detailed archaeological evidence is becoming available, shedding more light on typological and technological developments. Their typological development (fig. 1.13) has been briefly discussed by Ólafsson & Ágústsson (2006).

Recent publications still focus on individual excavations and almost exclusively have been written in Icelandic, but syntheses for a wider scholarly audience should become available in the not too distant future. A comprehensive overview of previous farmhouse excavations is provided by Vésteinsson (2004, 74). The excavation of a multi-phase longhouse at Vatnsfjörður, Vestfirðir, has more recently been reported on by Edvardsson & McGovern (2005). Berson (2002) discusses many byres excavated in South Iceland.

1.3.2.3 Scotland

In Scotland, the archaeological approach to turf construction is also a fairly recent development. Wilkinson (2009) provides a summary of the current state of affairs and outlines points of interest for future research. Important pioneering work has been conducted by Bruce Walker and colleagues since the 1960’s.17 Their research, however, leans heavily on historical sources, because there are few excavated turf buildings to supplement the data.18

A rare exception is the group of post-medieval buildings excavated in 1995-2000 at the Highland township Easter Raits.19 These form the main basis for the full-scale reconstructions at the Highland Folk Museum in Newtonmore (fig. 1.14). The reconstructions follow on earlier work by Ross Noble, who built a turf-walled house at the museum’s previous location in Kingussie in the early 1980’s.

Both projects provide valuable insights in the possibilities and limitations of turf construction, although some compromises have been made with regard to the quality of the turf and its application (see 3.1.3.3). This has led to structural failures on more than one occasion, including the collapse of turf walls in the Kingussie house, a year after its completion. From an academic point of view, however, the failures are just as interesting as the successes, and the reports on the projects highlight both (Noble 1984; 2003).

Possibly, the construction techniques discussed by Walker and Noble – Noble’s methods also derive from historical sources – can be recognised in older structures. The so-called blackhouse in particular, may be seen as a predecessor to post-medieval turf buildings, even though later specimens were mostly stone-built (fig. 1.15). There are good indications that earlier (pre-improvement) longhouses were indeed constructed with turf outer walls (Holden 2004, 2; Fairhurst 1969, 145). Again, the archaeological data is insufficient to support any firm conclusions, but historical photographs, contemporary descriptions and constructional rudiments in stone-built houses, clearly

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17 Fenton & Walker (1981); Walker (2006; 2008) and Walker & McGregor (1996b). See also the discussion of load bearing capacities of turf walls (chapter 3.1.2).
18 It is becoming more apparent that many of the stone wall remains of crofts and longhouses scattered across the Scottish landscape, can actually be interpreted as the foundation courses of turf walls, not the remains of entirely stone-built structures. Such foundation courses are common in Iceland, where they are thought to prevent ground- and surface water from syphoning up into the turf (pers. comm. Helgi Sigurðsson, professional turf builder at the Skagafjörður Heritage Craft School, Tyringsstadbær, Iceland, June 2009). For Scotland this practise is well-illustrated through a photograph of the mill at Amol, Lewis, taken by Erskine Beveridge in 1900 (www.scran.ac.uk; SCRAN-ID: 000-000-513-586-C). With regard to the combined use of turf and stone, reference has been made to Fenton, A., 1968. Alternating Stone and turf – an obsolete building practise. *Folk Life* 6, 94-103.
As far as the origin of blackhouses is concerned, an introduction by the Vikings in the late 8th or 9th century AD is often suggested (e.g. Armit 2002, 213-214; Holden 2004, 2; Wilkinson 2009, 29). Key in this, is the fact that rectangular(ish) plans of blackhouses contrast sharply with the indigenous cellular architecture from earlier periods (post-Roman Iron Age). Similarities with turf houses of the Sami in Norway have also been noted (Walker 2006, 21-22; 2008, 89-90). 

Coordinated by the Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS), which employs the help of local communities to record Scotland’s vanishing rural settlements. Since its launch in 2006, the project has positively identified turf building sites in Skye and Aberdeenshire (pers. comm. Brian Wilkinson, interpretation officer SRP, 15-3-2010). Remains of a turf building have also been noted at Finlaggan in Islay (www.scran.ac.uk; SCran-ID: 000-000-150-127-C). For ways of locating previously surveyed structures in Scotland see footnote 26.

For examples of (drawings of) photographs and cited descriptions of turf-built houses, see Loveday (2006), Walker (2006) and Wilkinson (2009). A drawing by McGregor and translations of contemporary descriptions have been included in Postma (2010). See also footnote 17.

Turf house remains have also been discovered during surveys run by Scotland’s Rural Past (SRP). This is a five year project coordinated by the help of local communities to record Scotland’s vanishing rural settlements. Since its launch in 2006, the project has positively identified turf building sites in Skye and Aberdeenshire (pers. comm. Brian Wilkinson, interpretation officer SRP, 15-3-2010). Remains of a turf building have also been noted at Finlaggan in Islay (www.scran.ac.uk; SCran-ID: 000-000-150-127-C). For ways of locating previously surveyed structures in Scotland see footnote 26.

In some cases the eroded remains of turf walls can still be recognised in the fields (fig. 1.16).21

Illustrate its likeliness (fig. 3.18).20
However, no intermediate sequence can be established to positively link early Viking long-houses to post-medieval blackhouses – perhaps because their turf walls have been ploughed under over the centuries. Archaeologists have uncovered several Viking Age and Late Norse buildings, which enables some research into their origins. Graham-Campbell & Batey (2005) present an overview and critically assess the problems surrounding the identification of indigenous and foreign influences on their construction (see also Armit 2002, 186-214).  

Whether or not Scottish blackhouses can be seen as late survivors of a Scandinavian building tradition, they form a valuable ethnographic analogy for this study. Especially their construction characteristics and maintenance needs have been well-documented and published in extensive research reports by Historic Scotland. These include some of the work on turf by Walker, mentioned above, but also provide overviews of other types of earth construction, as well as traditional thatching techniques. Another important publication, which discusses the timber inner structures associated with turf buildings and blackhouses, is Walker’s article on the Celtic cuppill.  

More information on early turf buildings is now becoming available through ongoing archaeological surveys and excavations. Hopefully, this will allow for a greater archaeological depth in future studies of Scottish turf construction and enable a more detailed assessment of the origins and development of Scotland’s longhouses. If a synthesis is to be produced, the evidence from earlier fieldwork should also be incorporated. Many survey and excavation reports are scattered, as is the case in the Netherlands, but in Scotland they should be

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22 Graham-Campbell & Batey (2005) mention the use of turf in Viking Age (c. 800-1050 AD) longhouses at Jarlshof (p. 156), Buckquoy (pp. 161, 163), Brough of Birsay (p. 165-166), Pool (p. 171), the Udal (p. 173) and Drimore Machair (p. 175-176). It appears not to have been used at any of the Late Norse (c. 1050-1350 AD and beyond) sites. See also footnote 25.  


24 Walker (2008); I am very grateful to Bruce Walker for discussing turf and cuppill construction so extensively with me in the course of this study.  

25 At Underhoull in Unst, Shetland, a (Norse?) longhouse with turf and stone wall is currently being excavated as part of the Viking Unst Project, run by the Bradford University (Bond et al. 2009, 163). Interestingly, only its seaward side was stone-faced. Several other (excavated?) turf building sites in Scotland, are discussed by Dixon (2002; 2009). Reference has also been made to: McCullagh, R.P.J., 2000. The Excavation of a turf long-house at Lairg, Sutherland. In: Baldwin, John R. (ed.), The Province of Strathnaver. The Scottish Society for Northern Studies, Edinburgh, 173-193.
relatively easy to trace through the internet. In the course of this study only two publications of excavated sites were come across (table 1.3).

### 1.3.2.4 Other countries

Turf buildings have also been documented in many other countries, both historically and through archaeological excavations. It is interesting to note that all regions with a turf building tradition seem to border on the North Sea and North Atlantic coast. A Scandinavian origin has been suggested for many building types, but it is still uncertain whether the use of turf in itself is indicative of ‘Scandinavian’ architecture.

Further to the south and east, the use of clay (rammed or as mud bricks) has been documented. Examples come from Ireland to the Balkans, to the Mediterranean, Middle East and Africa. Earth’s isolating properties are beneficial both in hot and cold climates, so the clay/turf dichotomy may simply be the result physical-geographical differences. A more detailed understanding of turf technology is needed to explain the motivations for building with this material.

Some information on historic turf construction methods in Ireland, is provided by Ó Danachair (1957). Evans (1979, 119) depicts a building cut from peat deposits and Walker (2006, 9-11) discusses similar ‘moss-houses’ in relation to Scottish turf construction. Walker (2006, 2-3, 21-22) also provides references to descriptions of Nebraska ‘soddies’ and studies on Sami houses in Norway. Closer to home, Groenewoudt depicts a couple of turf-walled Moorhütte (lit. moor huts) and sheepechts documented in Germany. Quite unique is the fact that in Germany a group of ‘historical’ turf buildings has been excavated. These buildings are represented by “rounded-rectangular ditch structures,” dated to the 17th-19th century and interpreted as transhumance-related night shelters (German: stadl). Traces of turf have been noted in the upper layers of the ditches, suggesting that they reflect the trajectory of turf walls. This interpretation seems plausible, but the exact method of construction remains unclear.

Saefelt (1967) discusses turf buildings excavated in the Northwest German and South-West Danish terp region, but unfortunately provides very few references for his sources. Saefelt’s study appears not to have been consulted for later excavation reports from this region. This is unfortunate, because it contains interesting ideas on the socioeconomic context of turf architecture. Some of these are discussed in more detail further on (see 3.4.4 and 4.1.1).

Thematic articles, discussing turf buildings excavated elsewhere, are those by Mahler (1993) and Stummang Hansen & Sheehan (2006). They respectively discuss turf-built shielings and churches in the North Atlantic region, both using evidence from the Faroe Islands as a starting point. In these northerly regions, archeo-entomological re-

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26 Registered sites and monuments are listed in the online Canmore database (http://canmore.rcahms.gov.uk). A particularly good starting point for drawing up a list of available data would be Archaeology Scotland’s yearly inventory Discovery and Excavation in Scotland (DES). Its index does not include ‘turf’, but ‘creel house’ will lead to post-medieval turf-built houses. ‘Blackhouse’ and ‘longhouse’ may lead to (partially) turf-built structures of older dates. It is of great value that the full run of DES (from 1947 onwards with the exception of the five most recent volumes) is available online (http://ads.aids.ac.uk/catalogue/library/des). Individual volumes can easily be searched with normal PDF-software and offer good opportunities for pin-pointing surveyed and excavated turf-built structures. Sites listed in Medieval Britain and Ireland can be searched in a similar way (http://ads.aids.ac.uk/catalogue/library/mnt). The magazines Medieval Archaeology (http://ads.aids.ac.uk/catalogue/library/med_arch/medarch_indexs.cfm) and Proceedings of the Society of Antiquaries of Scotland (http://ads.aids.ac.uk/catalogue/library/psas/psasGeneralIndexs.cfm) have also been digitized, providing good possibilities to search the contents of their articles. General indexes have also been provided for these magazines, which may well reduce the search to a handful of PDF-files instead of many individual volumes. Searchable bibliographies are the Vernacular Architecture Group Bibliography (http://ads.aids.ac.uk/catalogue/library/vaghbi) and the British and Irish Archaeological Bibliography (www.biab.ac.uk).

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30 Regarding Norse settlement on the Faroe Islands, there has been made to Dahl, S., 1970. The Norse Settlement of the Faroe Islands. Medieval Archaeology 14, 60-73. Evidently, a settlement with three different types of buildings, all built of turf, has been excavated at Argisbrekka (Mahler 1993, 489).
search has provided interesting insights in the use of turf buildings (e.g. Buckland et al. 1993; Smith 1996; Panagiotakopulu 2004; Kenward & Carrot 2006).

For most countries, however, information on turf building traditions is hard to come by. Useful overviews remain Stoklund’s (1984) and McGovern’s (1990) articles on building traditions and the archaeology in the ‘northern world’. In these, many settlement sites in Norway, British Northern and Western Isles, Scotland, Faeroes, Iceland, Greenland and the North American continent are discussed – though it has not been specified for all excavated buildings if they have indeed been built with turf. Excavation reports of turf-built main buildings, stumbled upon in the course of this study, are listed in table 1.4. A more exhaustive overview, however, would be welcome – the same goes for foregoing tables.


### Table 1.4. Archaeological sites with turf buildings in other countries.

<table>
<thead>
<tr>
<th>Archaeological site</th>
<th>Date (c.) of turf buildings</th>
<th>Primary reference(s)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>England:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Houndtor; Hutholes, Devon (fig. 3.42)</td>
<td>7th/8th-14th century</td>
<td>Beresford 1979</td>
<td>turf walls assumed; transition from wattle and turf, via stone and turf, to stone walls; Danish influence suggested by historic evidence</td>
</tr>
<tr>
<td>Tresmorn, Cornwall</td>
<td>10th-14th century AD</td>
<td>Beresford 1971</td>
<td>turf walls assumed; transition from wattle and turf, via clay, to stone walls</td>
</tr>
<tr>
<td><strong>Germany:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tofting, Eiderstedt (fig. 3.11)</td>
<td>2nd-4th century AD</td>
<td>Bantelmann 1955</td>
<td></td>
</tr>
<tr>
<td>Elsienhof, Eiderstedt (fig. 3.44)</td>
<td>8th-9th century AD</td>
<td>Bantelmann 1975</td>
<td></td>
</tr>
<tr>
<td>Archsum-Melenknop (figs 3.14 and 3.46) and Wemningstedt (fig. 3.47), Sylt</td>
<td>1st-3rd century AD</td>
<td>Kossack et al. 1975; Harck et al. 1992</td>
<td>incl. well-preserved 50 m long turf building (probably long-house), with outbuildings</td>
</tr>
<tr>
<td>Alt-Archsum, Sylt</td>
<td>8th-10th century AD</td>
<td>Kossack et al. 1975; Harck et al. 1992</td>
<td></td>
</tr>
<tr>
<td><strong>Denmark:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vålgard, Aegersund</td>
<td>13th-14th century BC</td>
<td>Lomborg 1976</td>
<td>buildings with wall-ditch</td>
</tr>
<tr>
<td>Nødskov Hede, Lomborg</td>
<td>possibly 10th/11th century AD</td>
<td>Steensberg 1952</td>
<td>small main buildings and outbuildings; sandy soils (heath land)</td>
</tr>
<tr>
<td><strong>Sweden:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hellborg, Thy</td>
<td>pre-Roman/Roman Iron Age</td>
<td>Bech 1985</td>
<td>incl. analyses of building lengths</td>
</tr>
<tr>
<td><strong>Norway:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ogna, Rogaland</td>
<td>7th century BC</td>
<td>Skjølsvold 1970</td>
<td>building with wall-ditch</td>
</tr>
<tr>
<td>Ase; Bjarkøy (fig. 3.53); Br; Bøstad; Gimsoy; Leknes; Steigen; Tjøtta</td>
<td>1st-10th century AD</td>
<td>Johansen &amp; Solstad 1978</td>
<td>eight Norwegian court-sites (tunleggene); probably gabled building complexes</td>
</tr>
<tr>
<td>Borg, Lofoten</td>
<td>5th/6th-10th century AD</td>
<td>Munch et al. 2003</td>
<td>two large buildings (Borg I): 64x7-8 m and 80x7.5-7.9 m (interior); reconstructed in 1995</td>
</tr>
</tbody>
</table>
2 CATALOGUE OF TURF BUILDINGS

This catalogue presents an overview of turf buildings from the research area. The research area primarily consists of the former salt marshes in the provinces of Friesland and Groningen (terp region), but two sites from North-Holland have also been included (fig. 2.1). One of these is located on the island of Texel. The selection comprises main buildings and the largest outbuildings; sunken-floor huts have not been included. The plans and descriptions are meant to form an objective dataset and serves as the basis for the discussions in following chapters. It is hoped that the dataset will also be of use to students of turf structures elsewhere.

As will be argued more extensively in the next chapter, the use of buildings as houses (i.e. a building in which people live) cannot be deduced solely by the presence of a fire place (see 3.4.2). Nor can the absence of a fire place exclude a living function. Therefore, only the term building has been used in the descriptions below. This term implies the presence of a roof, but it is neutral with regard to the structure’s function.

In a similar manner, the complete absence of timber elements, including postholes, does not per definition prove the absence of a timber structure. Pad stones and other raised footings have been documented for the Bronze Age or perhaps even earlier, so, in theory, they could have been used in any subsequent period (see 3.2.2.1).

Apart from a complete absence of posts, it is also possible to find just a limited number of posts lacking in places we would normally expect to find them. In excavation reports or typo-chronological studies, these empty spaces are often filled in with X or + signs. A common assumption in this is that buildings are symmetrical along their length. Interpretations of a post’s function (e.g. roof support) may have been used to extrude post arrangements over a greater part of the building’s interior. In reality, however, many other explanations may be thought up for a post’s absence, in addition to post-abandonment processes or poor preservation conditions. The interpretation of a building’s ground plan, therefore, should in first instance focus on trying to confirm a post’s absence, a process that preferably starts during excavation.

The presence of posts, on the other hand, in particular of arcade posts (binnenstijlen), in itself tells us nothing of their function. Only through indirect reasoning can we conclude on specific functions for specific types of posts. Such interpretations

Fig. 2.1. Location of sites in the catalogue. For a paleo-geographical map of the region, see fig. 1.1.

32 See, for example, the discussion of Leens building 5 in section 2.5.6.
always remain open for discussion. Very little is known for certain about prehistoric superstructures and this should be borne in mind when 'objectively' describing excavated buildings. A priori functional interpretations serve only to blind the reader for these uncertainties, so 'roof supporting post' and other functional denotations have been avoided in this catalogue.

An exception had to be made for posts that can be interpreted as 'kettle supports', because there is no commonly accepted term to denote single posts that stand noticeably alone in the building's interior and/or next a fire place. To emphasise that it concerns a functional interpretation, 'kettle support' has always been placed between quotation marks in the catalogue.

The archaeological sites are presented in alphabetical order. Basic background information is given in short introductions for each site. Subsequently, the buildings are described individually. When possible, ground plans and cross-sections are also provided. Measurements in the original publications have been checked against the published plans and photographs. As a result, the dimensions given in this catalogue might differ from those initially stated by the excavator. Additional measurements have also been taken from the plans and photographs, as it was beyond the limits of this study to consult the original excavation plans.

Care has been taken to provide precise and reliable dimensions, but due to poor preservation or the small scale of some of plans a modest margin of error cannot be avoided. It may also be added that post-abandonment processes (e.g. erosion or sagging), 'sketchy' drawing techniques, a limited understanding of turf construction and the many stages between outlining a feature in the field and the publication of its plan, may also affect the accuracy. In short, appropriate flexibility is desired when working with the data.

Unless it is stated otherwise, all measurements have been taken as follows.

- **building dimensions:**
  - interior widths and lengths, between walls marked out by:
    - turf:
      - inner wall face to inner wall face
    - wattle:
      - heart to heart (of stakes)
    - trenches:
      - heart to heart (of trenches, unless stakes or posts are visible)
    - timber elements:
      - heart to heart (for posts) or heart to inner wall face/facing (for post to wall)

In the final section of this chapter, concluding remarks are made on the representativeness of the dataset and the influence of archaeological visibility on the quantity and quality of the available data. Shortcomings of conventional excavation methodology are also discussed.

2.1 EZINGE

2.1.1 Introduction to the site

The excavation in the terp of Ezinge was conducted in 1925-1934, under the supervision of A.E. van Giffen (1936). Knol (1993, 128-129) lists the most important preliminary reports, but the site has not been fully published. Its development has been studied by De Langen & Waterbolk (1989) and Waterbolk (2009) has included some of the buildings in his recent typo-chronological study. The site is well-known for the good preservation of its archaeology. Its socio-economic character, however, remains uncertain. According to Knol (1993, 134), the terp's size does not preclude an agrarian function, but it may also have been the home of tradesmen or a local elite.33

The discovery of well-preserved building remains drew worldwide attention to Van Giffen's excavation. The number of buildings excavated at Ezinge remains exceptional to this day, but unfortunately only timber-built structures have been recognised. Turf buildings must have been present in greater numbers than is suggested by the trench plans, but they were probably overlooked by the excavators (Gerretse & De Koning 1999, 109).

The buildings at Ezinge change their orientation in the course of the Late Roman Iron Age or Early Middle Ages A (De Langen & Waterbolk 1989, 92-93). The settlement’s layout shifts from a radial pattern in period 6 (150-300 AD; fig. 4.3), with buildings orientated towards the centre of the terp, to a linear layout in period 7 (300-500 AD). Sunken-floor huts appear around the same time, as do new types of pottery. According to Knol (1993, 129-133), no hiatus in the terp’s occupation can be established for the 4th century AD. Another interesting feature is that the oldest turf buildings that can be discerned, predate the changes in settlement layout and building orientation.34

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33 Local wealth is hinted at by the appearance of Late Roman Iron Age imports, for example. This includes Oxfordshireware from England.

34 The same might be argued for the sunken-floor huts. Originally these have been assigned to period 7 (300-500 AD), in which the new settlement layout is first visible. However, Van
Three turf-walled buildings have been included in this catalogue. Apart from the fact that the structures have turf outer walls, they hardly differ from the ‘timber’ buildings depicted in the same trench plan. Waterbolk (2009, 77) considers most of these to belong to the Noordbarghe type.

### 2.1.2 Building 70

Building 70 has an interior width of 5.9 m, but only 8 m of its interior length has been excavated (fig. 2.2; De Langen & Waterbolk 1989; Knol 1993, 128-134; Waterbolk 2009, 197-198). The occupation period to which it belongs has been dated to 150-300 AD. No entrances are visible. Concerning the bonding pattern, only stretchers have been drawn in. One or two headers are shown in the stretch of turf wall extending beyond the end of building, but they may have belonged to another building. No wall thickness can be established with certainty.

A ditch indicates the likely presence of a wattle inner wall facing. On the basis of the plan, it is tempting to interpret part of the ditch as a double drain, but a byre function is by no means certain. An argument against it is the fact that one of the ‘drains’ branches off. The apparent doorway in the short end of the building, is very narrow (c. 60 cm). Several posts have been noted but no clear arrangement can be discerned. Two parallel rows of posts stand at a distance of 1.6-2 m from the inner wall facings and 2 m apart. If the posts are viewed as pairs, a bay size of 2 m seems likely.

Giffen initially interpreted these as the houses of Anglo-Saxon immigrants, without paying much attention to their orientation or stratigraphical relationship with other buildings. The selection of huts depicted by De Langen & Waterbolk (1989, 93) corresponds to the block-shaped settlement layout, but many other Grubenhäuser are clearly orientated towards the centre of the terp (Van Giffen 1936, appendix 2, fig. 1). Evidently, some may well be attributed to period 6.

At least four have been recognised in total, but of one only a corner has been excavated. It is shown as an unnumbered structure in between buildings 70 and 71 on the plan of period 6 (fig. 4.3). Stretches of turf on other plans (e.g. Van Giffen 1936, appendix 2, figs 3-4) show that turf was probably used as a building material in other buildings as well. It has also been applied in the construction of sunken-floor huts (e.g. Van Giffen 1936, table 6, fig. 2).

Whilst describing the turf buildings from Ezinge, inconsistencies were noted in the scales of the studied plans. On the basis of the trench plans published by Van Giffen (1936, 45), Waterbolk (2009, 198) and De Langen & Waterbolk (1989, 86), the interior width of building 2 (period 1c) can respectively be calculated at 5.8 m, 5.6 m, and 5.45 m. Knol (1993, 133) has not included a scale at all. Building 72, the largest of the turf buildings, yields interior widths of 5 m (Waterbolk 2009, 199) and 6.2 m (De Langen & Waterbolk 1989, 92), but in a separate plan, Waterbolk (2009, 77) does provide an interior width of 6 m. Through this, it has been concluded that the scale of Waterbolk’s trench plans is incorrect. The measurements in this catalogue have therefore been taken from the plan by De Langen & Waterbolk – the depicted plans have been taken from Waterbolk, but their scale has been adjusted.

In total, seven of the presumably eight main postholes have been documented. According to Waterbolk, the rectangular feature is also a post-hole. The posts form two parallel rows, which stand at a distance of 1.2 m from the inner wall face and 3.7 m apart. The eastern row has a total length of 5.5 m, providing an average bay size of 1.8 m. If the posts are viewed as pairs, it becomes clear that of the three that are complete, the middle one has been placed at an angle to the building’s central axis. Waterbolk assigns the building to the Noordbarghe type.

Waterbolk (2009, 77) interprets this feature as a pit, but the presence of turves is clear from the trench plan (fig. 2.3).
2.1.4 Building 72

Building 72 has an interior width of 6.2 m, but its original length can no longer be established (fig. 2.4; De Langen & Waterbolk 1989; Knol 1993, 128-134; Waterbolk 2009, 72, 77, 193-198). The archaeological remains shown in the plan, are spread out over a distance of 28 m. Disconnected turf wall sections and slight differences in their orientation, however, cast doubt on whether building 72 was much longer than 12.5 m. The occupation period to which it belongs has been dated to 150-300 AD. No entrances can be discerned. A wall trench and stakes indicate the use of a wattle inner wall facing. The turf wall has a thickness of c. 80 cm. A course of headers is visible in the long wall, whereas stretchers have been indicated for the short end wall. This might suggest that at least two patterns were used to create a strong bond.

Two parallel rows of eight and nine postholes have been documented. According to Waterbolk (2009, 77), who considers the building to be of the Midlaren type, the two largest features in the centre, are also postholes. The smaller one, supposedly, is another kind of ‘hole’. The arcade posts stand 1.2 m from the inner wall facing and 3.9 m apart. If they are viewed as pairs it becomes clear that all have been placed at a slight angle to the building’s central axis, giving the post arrangement a skewed appearance. This is reflected in the southern short end wall. The bay size is c. 2 m in most cases. The bay in which the southern-most centre post has been placed, however, is much larger (2.8 m). The width of the bay directly to the south, on the other hand, is slightly less than average (1.7 m). One pair of posts, seemingly with postholes of normal diameter, has been placed outside the southern short end wall.

2.2 FOUDGUM

2.2.1 Introduction to the site

In 1966, the Foudgum (FR) terp was partially excavated due to road work planning. H.T. Waterbolk coordinated the excavation and the results have been published by De Langen (1992, 173-186). In total, fourteen levels were documented at intervals of 15-30 cm, most of which cut through more than a single settlement layer. De Langen studied the trench plans and discerns five occupation phases (I-V), dating from the Roman Iron Age until (at least) the Carolingian period. Each phase is discussed and illustrated individually. Unfortunately, a more detailed chronology could not be established, because the finds were grouped together for large parts of each level during the excavation.

Although fragments of turf walling have been noted for several occupation phases, only phase IV has produced clearly recognisable buildings. Two of these are included in the catalogue, but the third might be equally interesting. It is a square measuring 2.6x2.1 m internally, but with a wall thickness of 2.1 m for the eastern wall and 2.8 m for the northern wall! No interpretation is offered by De Langen. If the thickness of this wall is a product of its height, as seems to be the case in some other buildings (see 3.4.4), this might be what the archaeological remains of a turf-built tower would look like.57

57 It would be premature to suggest that this actually is a tower. However, in the context of turf structures I have been able to establish so far, this structure stands out very clearly. The original site documentation should be checked to see if more details can be added to the picture and to confirm that it is not, for example, the turf covering of a floor or house platform. I have not come across any parallels, though a small structure excavated at Niens (DE) does seem to show some similarities (Brandt 1991, 108). Further analogies might be found in the turf-built towers along the Roman limes (see for example the reconstruction drawing by M.J. Moore in Walker & McGregor (1996b, 1), reproduced also in Breeze (2006, 60)).
2.2.2 Main building

The largest building has an interior width of 4.1 m (fig. 2.5; De Langen 1992, 176-179). Only 18.5 m of its original interior length has been excavated – longitudinal measurements have been taken from the trench plan (not illustrated here), because it shows slightly more of the building’s length. The building is assigned to occupation phase IV, which dates from the Carolingian period.

According to De Langen (1992, 178), the building’s southern end has been extended later during this phase. Both building stages are interpreted with long walls extending for over a metre beyond the byre end. Supposedly, this might have been a method to prevent the walls from skewing, because the terp’s surface slopes downwards quite steeply in this direction. Judging from the good building properties of salt marsh turves, however, such a measure seems like an unnecessary precaution (see 3.1.2.2). Moreover, it does not provide an explanation for the nearly dug away stretch of turf wall directly outside this end of the building. A more satisfactory interpretation is that the building has been extended twice. This is also supported by the position of the last pair of posts (see below).

The oldest walls indicate an original interior length of at least 15 m. Wall thicknesses vary from c. 87 cm for the eastern wall to c. 120 cm for the western wall. In some places, individual turves have been drawn in, demonstrating that an overall wall thickness of c. 90-100 cm is most likely. The variable thickness might be the result of post-abandonment processes (e.g. sagging or erosion) but no cross-sections have been published through which this can be confirmed. On average, the turves measure c. 45-50x25 cm. As far as the bonding pattern is concerned, only headers appear to have been used. Transverse turves in the southern end of the western wall suggest that the courses overlap each other at straight angles to create a strong bond at the corners.

In the short end wall of the primary building phase, a door frame was constructed of two posts and a threshold. The posts are placed almost 1 m apart. The entrance was not situated exactly in the centre, but slightly towards the west, so that the building could be entered alongside the byre drain. There might have been a turf gangway here, but, if so, no trace of it survived. A new door frame was constructed when the building was first extended. This time, the threshold was fitted to the side of the posts, whereas the posts appear to have been placed on top of it in the first phase. No indications have been found for a fixed door frame in the second extension.

A patch of small of squarish turves in the western half of the building, indicates that the floor surface was made of turf. The byre drain is banked with turf on both sides and was at least 13 m long. In the southern end of the building, a horizontal reinforcement beam of 2.4 m was preserved in situ. An interesting detail is that the drain is situated off-centre, just like the doorways but towards the other side of the building. Through this, an asymmetrical byre layout has been created.

Because the drain and doorway have been placed off-centre in opposite directions, the drain was blocked off by the short end wall. No indications for openings through this wall are visible in the plan. The long eastern wall, however, does show an opening (c. 30 cm). The byre drain’s eastern side appears not to have continued all the way down at this point. It cannot be excluded that the turves have simply been dug away during excavation, or at an earlier stage, but it seems reasonable to suggest that byre drained through the side of the house.

On the basis of stakes, only one double cattle box can be discerned, but considering the length of the drain more may have been present. On the western side of the building, no indications for partitioning were found at all. Bearing in mind that the floor level has been preserved on this side, it is unlikely that stakes or stake holes have been missed by the excavator. Their absence is probably the result of the byre’s asymmetrical layout.

Two rows of arcade posts have been documented standing 0.8-1 m from the inner wall face and 2.3-2.5 m apart. The average bay size is 1.6 m. Originally, both rows comprised at least 7 posts, to which an extra post was probably added for each of the two extensions (fig. 2.5). This is suggested by one of the posts having been placed within the short end wall. In the western row, four posts do not have a counterpart, which suggests that they might have been added as additional supports at a later stage. If the posts are viewed as pairs it be-
comes clear that two pairs in particular, have been placed at an angle to the building’s central axis.

One loose post has been placed against the inside of the western wall in the first extension. Its function is unclear. Two posts in the eastern half of the building might relate to the byre drain’s side exit.

A turf-built structure with the same wall thickness is shown directly to the west of the main building’s byre area. It has an interior length of 7.5 m, but the continuation of the western long wall beyond the outer face of the northern short end wall, suggests that it might have been longer. Its width is uncertain, because the line of the southern short end wall turns inward in a strange manner. No traces of a timber structure have been found and no doorway can be discerned in the remaining wall parts.

De Langen (1992, 178) has interpreted the structure as an annex, but it is not specified if the walls of both structures tie in with each other. Ideally, their (stratigraphical) relationship would have been studied through cross-sections. The construction of an annex can hardly be excluded on the basis of the plan alone, but no annexes have been noted in any building in the dataset. A more satisfactory explanation is that the walls belong to an older building, which has now been shown partially overlain by the later building. The long narrow outbuilding that is discussed in the next section, has also been built over this earlier building. It provides a ready example of how turf structures can overlap each other in such a way that more than one building is visible in a single excavation plan (compare also Wijnaldum 5; fig. 2.40).

2.2.3 Long narrow outbuilding

A 20 cm thick layer that overlies some of the phase IV-A features and extends beyond the existing yard boundaries, indicates that the terp was extended and raised in phase IV-B. After this, a long free-standing turf structure was built, with interior dimensions of >13x2.6 m. The long walls are only c. 50-60 cm thick, but the southern short end wall is considerably thicker: c. 100 cm (northern end is missing). This might be an indication that it concerns a gabled building.

Another constructional detail is the continuation of the long walls beyond the southern end of the building. The good construction qualities of salt marsh turves (see 3.1.2.2) make the use of wall props seem like an unnecessary precaution, but the published information provides little help in reaching a more satisfactory interpretation. Regarding the fact that the terp surface slopes down towards the south, however, it might be possible that an entire section of the building has been dug away. If that is the case, the thicker wall section can be interpreted an interior partition.

No posts or postholes have been noted for this building.

2.3 HALLUM

2.3.1 Introduction to the site

In the summer of 2007, the planned construction of a nursing home led to the partial excavation of the terp of Hallum (FR). The excavation followed on an exploratory excavation in March of the same year. The excavation was conducted by Archaeological Research & Consultancy (ARC), under supervision of S.J. Tuinstra. The report is due to be published shortly (Tuinstra et al. in prep.).

The terp section was excavated with a mechanical digger, in a number of levels c. 30 cm apart. The levels were made to slope down with the terp layers as much a possible. Before documentation, the levels were cleaned with a special planing device for the digger. Two large cross-sections through the western flank of the terp, have been included in the site’s publication. The excavation primarily focused on the early medieval expansion of the terp, although Roman Iron Age layers have also been noted. These were covered by natural salt marsh deposits, without anthropogenic disturbances. This is thought to indicate a break in the occupation in the 4th century AD (Nicolay in prep., 210-215).

The cross-sections show that many of the turf-walled buildings are well-preserved, with their walls standing up to heights of 70 cm (fig. 2.15). Despite the good state of preservation, the ground plans are often unclear and fragmentary. According to the excavators, this is the result of successive buildings being (re)built on slightly different locations (Tuinstra & Veldhuis in prep., 28). Because of this, the remains of earlier buildings ended up in the yard, where they were vulnerable to disturbances by later digging activities and trampling by cattle. This explanation, however, is not supported by the cross-sections, so other factors must also have played a part in creating poor documentation possibilities (see 2.9.2).

Hallum’s primary value for the study of turf buildings lies in the fact that it is the first excavation where a distinction can be made between two subtypes of the Leens type (Tuinstra & Veldhuis in prep., 27). Subtype A is long and narrow, B is short and wide. Other characteristics, however, may be added to these subtypes, as will be demonstrated in chapter 4. In addition to this, the site is

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38 I am greatly indebted to Sierd Jan Tuinstra (ARC) for placing a concept version of the excavation report at my disposal.
the first to illustrate the transition from turf-walled buildings to the use of outside posts and wattle (without turf). The typology of these buildings is also discussed in chapter 4.

The constructional details of the turf walls are hard to make out with certainty from the published plans. In most plans, the wall thickness varies considerably and appears to differ from what can be calculated on the basis of photographs. Because of this, very few wall thicknesses are provided in the descriptions below.

Another constructional detail that cannot be studied on the basis of the ground plans, is the occurrence of posts in wall tops. These can be seen in some of the cross-sections. Tuinstra & Veldhuis (in prep., 28, 45, 65) suggest that the roof structures were attached to such posts, but if this were correct, large numbers should also be visible in the ground plans. As this is not the case, no specific attention has been paid to their presence in the descriptions below. If comparable situations are discovered in future excavations, however, it certainly is a feature that deserves to be studied more closely.

2.3.2 Building 1

Building 1 is shown in three successive excavation levels, but it comes out clearest in the plan of level 8 (fig. 2.6; Tuinstra & Veldhuis in prep., 32-33, 38-39, 59-60). The building can also be discerned in the eastern cross-section of the trench (fig. 2.7). It has interior dimensions of >14.3x4.4-4.7 m. Perhaps 4.4 m is most likely, because this is almost similar to the interior width of its stratigraphical successor, building 6 (>15.8x4.3 m). In level 7 (not illustrated here) an interior width of only 4 m is suggested. It is uncertain, however, whether all of the associated turf walls indeed belong to the same structure. The presence of a second stretch of turf walling in plan 8 also indicates that several structures overlapped each other in this part of the terp. Unfortunately, the cross-section does not clarify the stratigraphical situation. The description in this catalogue has only been based on the plan of level 8.

Tuinstra & Veldhuis assign the building to the Early Middle Ages A (phase V) and point out that it probably remained in use into the early Merovingian period (phase VI). This means that it must have been contemporaneous to at least one of the buildings numbered 3, 4 and 5. These are located on another yard directly to the south.

39 The interior width measured diagonally along the edge of the excavation trench, between the wall lines drawn in by Tuinstra & Veldhuis, corresponds with the width in the cross-section (both 5.2 m). This confirms that the walls assigned to building 1 in the plan of level 8, are the same as those seen in the cross-section.

40 Two breaks in the long walls, shown in the plan of level 7 (not illustrated here), have been interpreted as opposing entrances.
Veldhuis (in prep., 33) date the building to the Early Middle Ages A (phase V). It must have been quite early in this phase, because the structure is succeeded by building 4 in the same period. An interesting feature is the turf partition in its interior.

No entrances or signs of a timber inner structure have been noted.

### 2.3.4 Buildings 4 and 5
Hallum buildings 4 and 5 closely overlie each other and are very similar in plan (fig. 2.9); they may just as well be discussed together. Building 4 has been dated to the Early Middle Ages A (phase V) and is stratigraphically later than building 3 (Tuinstra & Veldhuis in prep., 35). Building 5 is later still, and dates from the transitional period between the Early Middle Ages A and the Merovingian period (phase VI; Tuinstra & Veldhuis in prep., 40-41).

The northern corner of building 4 is missing in the current plan, but it was visible at a lower level (8; not illustrated here). This wall section has not been incorporated into fig. 2.9, because no reliable calibration points are included in the plans. It suffices, here, to point out that the wall line drawn in by Tuinstra & Veldhuis is accurate. Thus, building 4 has interior dimensions of 14.2x6.5 m.

The length suggested for building 5 should also be quite accurate, because its northern short end wall is visible in the site’s cross-section (not illustrated here). In the main text, however, Tuinstra & Veldhuis (in prep., 41) state a minimum length of 15 m, which is more than the plan suggests. The width drawn in the trench plan, is the same as for building 4 (6.5 m). On the basis of the plan, however, it cannot be excluded that building 5 was actually wider. In the building’s original description, the excavators propose a (exterior?) width of 8 m, but they do not motivate their decision.

No interior features or entrances can be made out in the plans. According to Tuinstra & Veldhuis (in prep., 35), a post was found in building 4, but it is also pointed out that the post may have belonged to a later structure. Posts can also be seen in the cross-sections of the buildings (not illustrated here; Tuinstra & Veldhuis, in prep., 60-61), but it is uncertain whether they truly belong to these buildings. The fact that no posts or postholes were noted in the excavation levels, might suggest that they do not.

### 2.3.5 Building 6
Hallum building 6 has interior dimension of >15.8x4.3 m (fig. 2.10) – the interior wall line suggested in the plan, may be adjusted slightly in the northwestern end of the building. It has been dated to the Early Middle Ages A (phase V; Tuinstra & Veldhuis in prep., 32-34). In a stratigraphical sense, building 6 appears to be a direct successor of building 1, which is roughly the same size (>14.3x4.4-4.7 m, but probably 4.4 m wide). In total, 3 posts of varying diameters have been documented in the plan. Presumably these are arcade post (binnenstijlen).

### 2.3.6 Building 7
Hallum building 7 has interior dimensions of 8.4x3.7 m – Tuinstra & Veldhuis (in prep., 42-43) state 8.8x4.2 m, but this is not supported by the plan (fig. 2.11). It has been dated to the (Early) Merovingian period (phases VI-VII) and overlies building 5. Two cross-sections show a wall thickness of c. 60 cm for the northern short end wall and c. 75 cm for the northern long wall (fig. 2.12). The thickest wall seems to be constructed with courses two turves wide, while the narrow wall probably consists of single headers. It is unclear, construction-wise, why one of the long walls would need to be thicker. Their colours, however, show that each wall has been constructed with material from a different source. Perhaps this re-

Fig. 2.9 (top). Hallum 4 and 5.

Fig. 2.10 (bottom). Hallum 6.
reflects a different date of construction; one of the walls might have been reused from an earlier structure.

The thicker wall appears to have a slightly wider foundation course (c. 87 cm), although it cannot be established for certain that it is the lowest course. A probable entrance is visible in the southern short end wall. The opening is c. 120 cm wide. The northern short end wall appears to have been without an entrance. A turf wall in the building’s interior might be taken to indicate an interior partition, but its continuation through (and beyond?) the southern long wall is unusual. It should be taken into consideration, therefore, that this section belongs to an earlier structure.

In total, 8 main posts have been observed in the building’s interior. By means of dendrochronological analysis, it has been established that two of these were felled in 508 AD, which provides a terminus post quem for the use of this building. Four posts have been analysed by Bottema-Mac Gillavry (in prep., 184). Two are oak (Quercus), 14.5 and 12 cm in diameter of which 4-5 cm is sapwood. The other two are birch (Betula), 3.5-9.5 cm wide and 5-5.5 cm thick, and Hazel (Corylus), 4.5 cm in diameter and with a branch removed with an axe.

Six posts stand in a row on the northern side of the building, parallel to the wall. The plan seems to suggest that some positions contained two posts and that two other positions were empty, but it is likely that this row consisted of 6 arcade posts (binnenstijlen) at any given time. The average bay size, then, was only c. 1.3 m. This is more or less similar to that of building 11 (1.2 m). Two posts have been found where another row of arcade posts might be expected, at a distance of 1.4 m from the first row. These posts do not, however, stand directly opposite from any of the other posts. Furthermore, they were pulled over, while the others had remained upright.

Possibly their position is the result of one of the post pairs having been placed at an angle to the building’s central axis, but this is not certain. Tuijnstra & Veldhuis (in prep., 41) also mention two postholes being observed in the southern row, but these cannot be seen in the published plan. Regarding the depth at which the northerly posts have been preserved (22-28 cm), it is remarkable that the southern side is so incomplete. It has been argued for Leens building 5 that arcade posts stood only on one side of the building (see 2.5.6), but this seems not to be the case at Hallum. Bearing in mind that the southern wall is also less well-preserved, the fragmentary state of this side of the building can best be attributed to disturbances by later occupation. The differences in posthole depth may have been caused by the building’s construction on the sloping side of a terp.

A number of planks and stakes have been found in the building’s interior, but their function remains unclear. Some of the stakes stand in short rows. The alignment of these rows does not fit in with that of building 7, so the stakes probably do not belong to the same structure.

2.3.7 Building 11
Hallum building 11 has interior dimensions of 14x5.3 m (fig. 2.13). It has been dated to the
Merovingian period and might have remained in use into the transition towards the Carolingian period (phases VII-VIII; Tuinstra & Veldhuis in prep., 39, 63). Although a lot of the structure’s turf walling seems to have been preserved, its plan is not very clear. Possible entrances can be seen in the eastern and southern walls.

In total, 6 posts were found in the building’s interior. These have been interpreted by the excavator as the remains of two parallel rows of arcade posts (binnenstijlen), standing c. 2 m apart. The suggested bay size is only 1.2 m on average, quite similar to that of building 7 (1.3 m).

2.3.8 Building 13
Hallum building 13 has interior dimensions of >13.4x5.4 m (figs 2.14 and 2.15). It has been dated to later stages of the Merovingian period (phase VII; Tuinstra & Veldhuis in prep., 43, 62-63). No entrances can be made out with certainty. The northern end of the structure probably had a turf-built interior partition.

Only 1 post has been noted in the plan, but a second post can be seen in the northern short end wall in the cross-section. Although the latter does not seem to continue all the way down to the building’s floor level, it is possible that this building had a central row of posts, which is not seen in any similar early medieval building in this catalogue. Another possibility, however, is that the single centre post served as a ‘kettle support’. Such posts have also been noted at Heveskesklooster (per. I-phase 1), Leens (building 5) and Den Burg (building EMA-7; figs 2.17, 2.33 and 2.48).

2.3.9 Building 17
The interior dimensions of Hallum building 17 are >15.5x5.6 m, but their exactness may be questioned (fig. 2.16). The building’s construction has been dated to the Carolingian period, but it was used mainly during the transition towards the Ottonian period (phases IX-X; Tuinstra & Veldhuis in prep., 47-48). No turf-built interior features or entrances can be identified. A stretch of turf in the central area of the northern end of the building is not discussed explicitly by the excavators, but seems to have been interpreted as belonging to another structure. Judging from the plan, it is also possible that it relates to a byre function. There are no other indications, however, to support the presence of a byre in this building.

In total, 2 posts or postholes can be seen in the plan. These might have been arcade posts (binnenstijlen).

2.4 Heveskesklooster

2.4.1 Introduction to the site
The terp of Heveskesklooster was excavated by the University of Groningen in 1982-1988, as the result of expansion plans for the seaport of Delfzijl. Having developed into a monastic site in the Late Middle Ages, the terp of Heveskesklooster was granted highest priority to be rescued by means of archaeological excavation. A preliminary report has been published by Boersma (1988). In the south-western part of the excavation trench, remains of several buildings and house platforms were found. The structures can be divided into two non-consecutive occupation phases: period I (50-375/425 AD) and period II (800-1300 AD).
The buildings from period II are turf-built, but unfortunately no plans of these have been published. The report does include plans of the Roman Iron Age buildings. These have initially been described as timber-built structures, but one appears also to have incorporated a turf component. Its construction might have been more dependent on turf than is suggested at first. A section of turf in another subphase, has been interpreted as part of a house platform, but peculiarities in its construction suggest that it might actually be a building.

Perhaps, by inference, the use of turf can also be assumed for the third ‘timber’ building (per. I-phase 2; not illustrated here). This has also been done for a similar structure at Den Burg (fig. 2.47). However, only the buildings for which the use of turf is certain have been included in this catalogue.

2.4.2 Period I-phase 1

The oldest building has been attributed to occupation phase 1 of period I (50-375/425 AD). Four small posts are all that remains of its original wall but suffice to demonstrate an interior width of 7.9 m (fig. 2.17). The building’s length is uncertain, because there is a clear gap between the rows of arcade posts (binnenstijlen) and the four posts further to the north. Moreover, the four posts do not line up with the arcade or wall posts. The minimum length indicated by the arcade posts is 13.8 m.

No turf can be seen as part of the wall construction, so it remains uncertain whether this building actually classifies as a turf-walled building. Features in its interior, however, do show that turf was applied as a building material. Two distinct courses of turves can be seen, with a total length 9.3 m. There are no cross-sections to confirm that the posts and turves relate to the same building, but they do have the same orientation.

An interesting detail is that the turf courses provide the building with an asymmetrical layout. The most obvious interpretation for the longer strip is that it was a raised walkway. The eastern turves may well relate to a reinforced byre drain. It appears that a fire place was located just north of the presumed walkway and byre drain. Arguably, its location indicates that the building itself was not much longer than the rows of arcade posts. A single posthole can be seen next to the fire place and may therefore be interpreted as a ‘kettle support’.

At least 15 arcade posts or postholes can be made out, not counting the four in the north. Two postholes contain 3 posts, which suggests that maintenance work had to be carried out during the building’s period of use. Some postholes stand out of line or overlap earlier postholes, disturbing the clarity of the ground plan. Those which still contain an actual post, however, clearly indicate the existence of two rows of arcade posts, standing 3.6-4.6 m apart. If the posts are viewed as pairs it becomes obvious that the bay size is c. 3.6 m. It is hard to establish with certainty the angle at which the pairs have been placed, in relation to the building’s central axis, but it is clear that not all stood at straight angles.

2.4.3 Period I-phase 3

At first sight, the trench plan of period I-phase 3 (50-375/425 AD) does not appear to show any building remains (fig. 2.18). A section of turf walling has been interpreted as the edge of a raised house platform. There are, however, some inconsistencies in this interpretation. First of all, it is
noticeable that no turf walls have been noted for the three earlier platforms. Furthermore, the wall is c. 80 cm thick, whereas a thickness of c. 45 cm seems to be the standard for platform edges (e.g. compare De Langen 1992, 177). But this evidence is not conclusive; more convincing is the fact that the turves make a sharp bend at both ends of the longest wall section. The courses of other wall sections can clearly be seen crossing over at straight angles. One of these corners is located halfway along the northern edge of the platform, which is an unlikely place for a platform edge to change its course.

A likelier interpretation, therefore, is that the turves belong to the short end wall of a building. Only the turves towards the lower parts of the platform have been preserved. If this hypothesis is correct, the building had an interior width of 7.3 m. This is 0.6 m less than the building from phase 1, but similar, it appears, to the building from phase 2 (Boersma 1988, 73). Nothing can be said about the structure’s length, nor its interior layout.

2.4.4 Period II-building 1
Building 1 was only partially preserved (no plan published; Boersma 1988, 77-78). Its wall is c. 1 m thick and built with “two rows of turves.” It belongs to occupation phase II, which dates from 800-1300 AD. A piece of alder has been radiocarbon-dated to the last quarter of the 9th century. The function of this piece of timber, however, is not specified, nor is its place of recovery.

No mention is made of a primary timber structure.

2.4.5 Period II-building 2
Building 2 has interior dimensions of 18x5.5 m, with a wall thickness of c. 100 cm (no plan published). A fire place was found in the higher end of the building, slightly further up the terp (Boersma 1988, 77-78).

No mention is made of a timber inner structure.

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42 GrN-15093: 1160±20 BP.
2.4.6 Period II-building 3
The third building from occupation phase II (800-1300 AD), has an interior length of 16 m (no plan published; Boersma 1988, 77-78). Its width is estimated at 5 m and it has a wall thickness of c. 100 cm. The western half of the building is taken up by rectangular pits, c. 2x1 m in plan and more than 1 m deep. In relation to these, reference is made to pits in the building excavated at Den Helder (fig. 2.49). It is also pointed out, however, that a definitive relationship between the pits and the building could not be established.

No mention is made of a timber inner structure.

2.5 Leens
2.5.1 Introduction to the site
The excavation at Leens-Tuinsterwierde appears to have been the first Dutch excavation that produced clear ground plans of turf-walled buildings. To this day, the plans are still among the best-defined and certainly the most numerous. The excavation was conducted in 1939, under supervision of A.E. van Giffen, and published shortly after (Van Giffen 1940). The excavated mound was one of two terpen locally known as the Tuinster Wierden, which are situated on a higher part of the marsh bar. The terp was c. 4 m high and is described by the excavator as being homogeneous in colour (Van Giffen 1940, 32). It has been taken down in seven horizontal levels (A-G), with a total height of 3 m. Unfortunately, very few finds have been collected during the excavation, so it is not possible to date individual features.

A short reconsideration of the site has been published by Knol (1993, 124-132). Knol has numbered the eight largest buildings and discerns a minimum of eleven occupation phases. It is argued that the distance between the excavation levels is too great (25-40 cm) to allow for a more detailed reconstruction of the site's development. According to Knol, the occupation at Leens started towards the end of the 6th or the beginning of the 7th century AD. The youngest buildings date from the beginning of the 9th century AD, at the latest. Approximate dates for individual buildings can only derive from dividing the total period of occupation over the number of excavation levels – and allowing for some discretion. This has been done for the table in the appendix.

In total, 11 building locations can be discerned, not including the sunken-floor huts. Apart from the buildings at location 8, all were turf-built and have therefore been included in this catalogue. Building 8 is briefly discussed in chapter 4 (fig. 4.9; see 4.1.3). The turf buildings at location 1 show a remarkable sequence of place continuity (fig. 2.22) and a lot of the other buildings have also been ‘rebuilt’ on the same location. Analysis of their plans, however, indicates that the buildings at each location may well have had different functions (see 4.1).

The drawing technique and scale used for the published trench plans, initially appear unsuitable for taking detailed measurements from. For buildings 1b and 1g, however, detailed plans have also been included, which show exactly the same building dimensions and wall thicknesses. Further comparison demonstrates that the sketched-in bonding patterns in the trench plans, are stylised versions of individual turves in the separate plans. This means that the trench plans from Leens are also very accurate.43

2.5.2 Location 1
2.5.2.1 Building 1a
Building 1a has an interior width of 3.8 m and walls c. 1.2 m thick. Both short ends are missing, revealing only 8 m of its original length (fig. 2.19). The large cross-section through the buildings at location 1, shows that building 1b was constructed within the same walls as 1a. There is slight difference in their wall thicknesses, however, as well as their interior widths. Presumably, this is the result of the plan of building 1a being placed so low that a thin turf (tumble?) layer was interpreted as part of the wall. This layer can be seen in the cross-section through location 1, just above floor level (fig. 2.21). A low height of the excavation level is also suggested by the fragmented appearance of the turf wall in the plan. The cross-section clearly illustrates that building 1a and 1b are actually the same building; a detailed description is provided in the

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43 Waterbolk has pointed out that the best building plans in settlement research were drawn up "when the digging institutes still managed their own finances and had experienced personnel, which worked according to the traditions set up by Van Giffen since the 1920's" (Waterbolk 2009, 2; my translation). This is clearly borne out by the drawings from Leens.
next section, because building 1b has also been illustrated in a separate detailed plan.

2.5.2.2 Building 1b

Building 1b has also been published in a separate plan (fig. 2.20). Its interior dimensions are 7.9x4.3 m. No entrance can be discerned. The height of the northern wall was still over 120 cm at the time of the excavation. In the cross-section in fig. 2.21, this wall has been drawn in with a slightly tapered shape, but the photographic documentation shows that the wall actually tilts outwards and was built with vertical wall faces (Van Giffen 1940, fig. 20; it is also recognisable in fig. 2.22 but not so clearly). Later buildings drifted slightly towards the north, causing floor layers to build up against the older wall. As a consequence, more outward pressure was applied to the northern wall. This might explain its pushed-over appearance. The southern wall still stood to a height of at least 0.9 m, does not have later floor levels butting up against it and clearly also shows vertical wall faces.

The wall thickness is just over 100 cm, but the eastern short end wall is 120 cm thick. Several individual turves have been drawn in on the separate plan, which provides some basic information on the bonding system. Some space was allowed for between the turves, as if they were mortared together like modern building bricks. This is not shown in the photograph of the cross-section, however, so the turves were probably slightly larger than the plan suggests. Half the thickness of the wall seems likely for the headers: c. 50 cm. The stretchers have been drawn in three next to each other, and four in the thicker eastern wall, indicating a width of c. 30-33 cm.

Because an excavation level might cut through several courses, it is possible that more than one pattern is represented in a plan. Three can be recognised in building 1b: only headers (two turves wide), only stretchers (three turves wide) and a combination of headers and stretchers (one row of headers in the centre and one row of stretchers on either side). The stretchers in the last pattern were either cut to a smaller size (50x25 cm) or had to be trimmed during construction to produce the desired wall thickness. At the corners, the courses overlap at straight angles to create a strong corner bond.

In total, 8 arcade posts (binnenstijlen) have been documented, standing in two rows 1.1-1.3 m from the inner wall face and 2.1 m apart. The average bay size is 1.7 m. If the posts are viewed as pairs it becomes obvious that one of the middle pairs has been placed at a considerable angle to the building’s central axis. The posthole depth shown in the cross-section suggests that the posts were not dug in very deep – assuming that the drawing is accurate in this respect, too.

2.5.2.3 Building 1c

Building 1c has interior dimensions of 7.8x3.2 m, with a wall thickness of c. 110 cm (fig. 2.23). No entrance can be discerned. The sketched-in bonding pattern is the same as in the trench plan of Leens building 1b. This suggests a similar combination of headers has been used.

According to the plan, arcade posts (binnenstijlen) have been used in this building, too, but they have been placed off-centre. The posts are shown in a slightly different location than the posts in building 1a and 1b, however, so it is certain that it concerns another set of posts. There are 7 posts, arranged in two rows set 2 m apart. The bay size is 1.7 m on average. If the posts are viewed as pairs it
becomes obvious that the complete pairs have been placed at straight angles to the building’s central axis. The post which counter-post is missing, however, stands closer to the eastern pair than it does to the pair on the other side (1.4 and 1.8 m resp.). This is similar to the corresponding post in building 1b, which might be an indication that this pair also stood at an angle to the building’s central axis.

2.5.2.4 Building 1d

Building 1d (not illustrated here) is only partially visible in the trench plan, because it is overlain by building 1e. The c. 120 cm thick turf wall marks out an interior length of at least 11.2 m. No width can be established for this building. The turves have been sketched in in a similar manner as was done for the trench plan of building 1b (not illustrated here). This suggests a similar combination of headers has been used.

No posts or postholes have been noted.

2.5.2.5 Building 1e

Building 1e has interior dimensions of 5.6x3.6 m, with a wall thickness of c. 100 cm (fig. 2.24). A probable entrance is visible in the eastern short end wall. It is of interest that the sketched-in turves now display a different bonding system than was noted for previous buildings at this location. Instead of subsequent courses overlying each other at straight angles, the corner turves appear to ‘swing round’. Unfortunately, no separate plans depicting this feature in more detail have been published (but see fig. 2.26).

No posts or postholes have been noted.

2.5.2.6 Building 1f

Building 1f has interior dimensions of 11.6x4.8-5.4 m (fig. 2.25). A c. 80 cm wide entrance is visible in the eastern short end wall. The cross-section through location 1 (fig. 2.21) shows that the interior wall faces lean outwards steeply at the height at which this plan was drawn (c. 2.36 m +NAP). As a consequence, a slight raise in the excavation level quickly leads to an increased width, which explains its apparent variability. For the same reason, the wall thickness is shown to vary from under 80 cm to over 120 cm. The outward slope of the wall also explains why the sketched-in bonding pattern is unclear – though it bears closest resemblance to that of its predecessor building 1e.

No posts or postholes have been noted.
Building 1g

Building 1g has also been drawn in a separate plan (fig. 2.26). It has interior dimensions of 11.4x4.6 m with a wall thickness varying from c. 100 cm to over 120 cm. The northern wall, however, is not nearly as straight as the southern one, indicating that it may have sagged outwards. A similar situation has been noted for building 1f. Assuming that the southern wall resembles the original situation more accurately, the wall thickness is c. 100 cm. An entrance is visible in the eastern short end wall.

The bonding pattern is also more clearly defined in the southern wall. Two patterns can be seen that were previously noted in the plan of building 1b. They consist of only headers (two turves wide) and a combination of headers and stretchers (one row of headers in the centre and one row of stretchers on either side). Thinner lines also indicate a course with stretchers, this time four turves wide instead of three. The turves’ dimensions, therefore, must have been 50x25 cm to produce a similar wall thickness for all patterns. This corresponds well to the size of individual turves drawn in the plan.

In the corners, the bonding pattern shows greater similarity to that of buildings 1a-1c than it does to the corner patterns in the intermittent buildings 1e-1f. Yet, a faint trace of turves ‘swinging round’ is visible in the south-western corner. It is interesting that this occurs in combination with the more angular corner bond, previously described for building 1b (see 2.5.2.2). Does this mean that the ‘swinging round’ corner pattern alternated with the ‘straight angle’ corner pattern? It cannot be excluded that the excavation level was placed so low that the top of an earlier wall became visible, even though it could not have been building 1f, because its wall does not directly overlie that of building 1g – another (unrecognised) building would have to have lain in between. A similar combination of bonding patterns has only been noted in the plan of building 4a (fig. 2.31).

In total, 9 arcade posts (binnenstijlen) and a large number of stakes have been documented. The former stand 1-1.2 m from the inner wall face and 2.6 m apart, with an average bay size of 1.7 m. If the posts are viewed as pairs it becomes obvious that the single-most eastern pair was placed at an angle to the building’s central axis. The cross-section in fig. 2.21, suggests that the posts were hardly dug into the ground.

It appears that the posts in the northern row are connected to the wall by wattle partition screens, indicating that this side of the building was used as a byre. Also relating to this function is the stake spread further towards the centre of the building. These stakes probably held in place horizontal beams, which reinforced the byre drain. It appears from the stake spread that the drain continued to the westernmost post. On the southern side no indications for cattle boxes or a drain have been documented. The locations of the drain and cattle boxes show that the byre had an asymmetrical layout.

An interesting situation occurs when the separate plan is compared to what is shown in the trench plan (fig. 2.27). First of all, a different pair of posts has been placed at an angle to the building’s central axis. Moreover, the single post in the western part of the building stands further from the other posts and is square in section, instead of round. These discrepancies cannot have been caused by the scale of the plans, because another trench overview (Van Giffen 1940, fig. 17; not illustrated here) does depict building 1g with exactly the
same characteristics as in the separate plan. It appears that two versions of building 1g exist.

The deviant plan strongly suggests that the single post in the western part of the building, does not belong to the arcade posts in the eastern end. Even though no fire place can be discerned, the post can probably be interpreted as a ‘kettle support’. A short row of stakes show that parts of the building were probably divided by a wattle interior partition.

2.5.3 Location 2
2.5.3.1 Building 2b

Building 2b has an interior length of at least 11.2 m and is 4.3 m wide (fig. 2.28). No entrances can be discerned. In the plan, the northern wall appears to have been a lot wider than its southern counterpart, but this may have been caused by sagging or other post-abandonment processes. The southern wall is c. 100 cm thick. The sketched-in turves suggest a bonding pattern similar to that of building 1b.

A horizontal beam lies across the floor in the building’s interior. Its function is unclear. Two posts can be made out to the west of this beam, but too little is visible to relate them to any timber structure. In the eastern end of the building six arcade posts (binnenstijlen) have been documented. The northern row stands 1 m from the inner wall face, the southern row 1.2 m. The average bay size is 1.8 m. If the posts are viewed as pairs it becomes obvious that the eastern pairs are placed at an angle to the building’s central axis. The plan of building 2c suggests that a fourth pair might have stood close the eastern short end wall (fig. 2.29).

2.5.3.2 Building 2c

Building 2c has interior dimensions of >11.2x3.7 m (fig. 2.29). Its walls are c. 100 cm thick, but no clear bonding pattern can be made out. No entrances can be discerned.

In total, 7 arcade posts (binnenstijlen) have been documented, with a possible eighth in the side of the trench. It is difficult to speak of a northern and a southern row, because the posts fall apart in two groups. The southern posts stand just 0.5 m from the inner wall face, the northern posts 1 m. The groups stand 3.8 m apart, indicating that an additional pair might have stood in the middle, with bay sizes of 1.9 m. The eastern-most pair stands very close (0.4 m or less) to the short end wall. If the posts are viewed as pairs it becomes obvious that two have been placed at an angle to the building’s central axis.

2.5.4 Building 3c

Building 3c has an interior length of >19 m (fig. 2.30). The outer wall has a thickness of c. 100 cm. A narrower wall (c. 80 cm) spans the width of the building’s interior and divides it into two rooms. The western room has an interior width of 5 m, the eastern room appears to have tapered in to 4.8 m on the southern side. A fragment of another wall is visible the eastern room. It might belong to a later building, the faint traces of which have been sketched in on the trench plan of level C (e.g. Knol 1993, 127; not illustrated here).

No entrances, posts or postholes have been noted.

2.5.5 Location 4
2.5.5.1 Building 4a

Building 4a has interior dimensions of >8.4x4 m (fig. 2.31). Its walls are c. 80-100 cm thick. In the south-eastern corner, the turves have been laid at straight angles, but in the northeastern corner they ‘swing round’. This might be an indication that course with these two patterns alternated to form a strong bond. A similar combination might have been used in building 1g (fig. 2.26).

44 Van Giffen (1940, fig. 17) published a cross-section that incorporates this building. It is less informative than the cross-section through the buildings on location 1 and has therefore not been included in the catalogue. What it does show however, is that a lot of turf (tumble?) has collected on the outside of this building’s northern wall. Presumably this explains its greater thickness in plan.
No indications for arcade posts (binnenstijlen) have been noted by the excavator, though the presence of other timber elements demonstrates that the state of preservation must have been good. Just inside the northern wall, two stakes are visible, standing 1.4 m apart. These might have belonged to cattle boxes, but it is by no means certain. Stronger evidence for a byre function are the two horizontal beams, held in place by stakes, and a turf-built walkway. The beams reinforced the sides of a byre drain. Approximately 2.2 m of the drain can be seen in the plan, but the length of the walkway might be an indication that it used to be longer. The off-centre position of the walkway and the presence of a drain on one side, provide the byre with an asymmetrical layout.

The byre function suggests that there was an entrance in the eastern short end wall, but it cannot be made out with certainty.

2.5.5.2 Building 4b

Building 4b has an interior dimensions of >12.8x5 m (fig. 2.32). The wall thickness is c. 100 cm. The sketched-in bonding pattern is unclear, but the turves appear to ‘swing round’ in the corners.

No entrances, posts or postholes have been noted. Because of its open interior, greater width and different position and orientation it seems unlikely that building 4b is the direct successor of building 4a.

2.5.6 Building 5

Building 5 is one of the best-preserved buildings at Leens (fig. 2.33). Its interior measures 18x4.4 m, although the northern part tapers in to 4 m. The walls are c. 80 cm thick and the turves ‘swing round’ in both southern corners. Like building 6, it is orientated N-S, perpendicular to the other buildings at Leens. The reason for their deviant orientation is unclear. In total, 3 entrances are visible; one in the southern short end wall and two in the long walls, directly opposite each other. A fireplace can be seen against the eastern wall.

In total, 7 arcade posts (binnenstijlen) have been documented. Four are connected to the wall by a row of stakes and the same was probably the case with the two posts that stand in between. Stakes also line the greater part of the inner wall face, indicating the presence of a wattle inner wall face. The posts in the southern part of the building stand 1.2 m from the inner wall face. It is noticeable, however, that no posts can be seen in the western side of the interior. It is tempting to mirror the posts on the eastern side, as Van Giffen has originally done by inserting small + signs (not in current plan). The stakes, however, are well-preserved in this section and there are no other signs that indicate arcade posts were ever present here.

45 Knol (1993) just numbers it as building 4, instead of 4b.
The remaining post has been placed next to the fire place. It stands at a distance of 3.8 m from the last post in the southern part of the building, so it might be possible that another post stood in between with normal bay sizes of 1.9 m. Perhaps it is significant that it also stands just 0.8 m from the inner wall face, which is 40 cm less than the other posts. This might be an indication that the separate post served a different purpose altogether: that of a kettle support?

2.5.7 Building 6

Building 6 has an interior width of 6 m and a remaining length of only 6.5 m (fig. 2.34). Its turf outer walls are c. 80 cm thick. The sketched-in bonding pattern suggests that the turves ‘swing round’ in the corners. An entrance is visible in the southern short end wall. Like building 5, this building is orientated N-S instead of E-W. No timber elements have been noted.

2.5.8 Location 7

2.5.8.1 Building 7a

Building 7a has interior dimensions of >21.6x4.6 m (fig. 2.35). In the plan of excavation level B, no turf wall has been indicated for this building, but one has been drawn in on another trench plan in the site’s publication (not illustrated here). Moreover, its successors also have a turf wall. A threshold indicates that an entrance is situated in the northern long wall. Presumably, another entrance was situated directly opposite in the southern long wall, but this wall section has been disturbed. The eastern short end wall may also have had an entrance, because a gap is visible in the row of stakes. The evidence is not conclusive, however.

In total, 12 arcade posts (binnenstijlen) are shown in two rows, standing 1 m from the wall and 2.6 m apart. The spread of posts is limited to the eastern end of the building, even though stakes have been preserved further towards the western end. The average bay size is 1.6 m. If the posts are viewed as pairs it becomes obvious that only five are complete. There probably were at least seven pair, but the two western posts no longer have a counterpart. Several pairs have been placed at an angle to the building’s central axis.

The stakes from the wattle inner wall facing can be followed along the greater part of the building’s length. In the plan of excavation level A (not illustrated here), in situ remains of wattle have been drawn in between some of these stakes, just west of the threshold. At least two double cattle boxes are marked out along the northern side of the building. There are no indications for cattle box partitions on the southern side. At various places, 10 smaller posts stand directly outside the inner wall facing.

2.5.8.2 Building 7b

Building 7b has only been preserved along its northern side, over a length of 6 m (fig. 2.36). It is located on the same location as the wall of building 7a, but a slight difference in orientation indicates that it does belong to another building. Its construction is very similar to that of its predecessor, with arcade posts (binnenstijlen), double cattle boxes and stakes along the walls, again with wattle
preserved in situ. It has a c. 80 cm thick turf outer wall. No posts have been noted on the outside of the inner wall facing.

2.5.8.3 Building 7c
Building 7c has originally been numbered 7a by Knol (1992, 125). Its location, however, slightly further south, indicates that it is actually another building. This is confirmed by a section of the wattle inner wall facing from building 7a being visible slightly further north in the same excavation level (A). Again, only the northern part of the byre has been preserved, over a length of 9.5 m (fig. 2.36). The method of construction is similar to that of its predecessors: c. 80 cm thick turf wall, wattle inner wall facing, arcade posts (binnenstijlen) and at least 4 double cattle boxes. The arcade posts stand 1 m from the inner wall facing. Smaller posts have been found directly outside the wall facing.

2.6 LEEUWARDEN

2.6.1 Introduction to the site
The excavation at Leeuwarden-Oldehoofsterkerkhof (FR) was conducted in 2004-2006 and is published by Dijkstra & Nicolay (2008). The planned construction of a parking garage led to the partial excavation of this terp, the existence of which had been discovered through the excavation of the church foundations in 1968-1969. To a certain extent, the fieldwork has been hampered by the work on the parking garage, but the cooperation between archaeologists and contractors was good enough to enable a detailed documentation of terp layers and other features. The area under investigation was excavated in a number of levels, c. 25-30 cm apart, with a mechanical digger. The levels sloped down slightly towards the east and roughly followed the slope of the terp layers. Because of the uneven surface of these layers, however, it was not feasible to match the excavation levels exactly (Dijkstra 2008, 15-20). When a new excavation level had been made, the digger was equipped with a special clay plane, which can slice thin layers of the level’s surface to bring out features more clearly.

Chapters in the substantial publication present new insights in the region’s physical geography, the source, use and secondary use of timber and the secondary use of ship’s timber, to name but a few. These aspects are important for the study of local building traditions and formed a valuable starting point for this thesis. Other chapters of the

46 Planing the levels by hand, as is common practise for excavations in sandy soils, is extremely hard in the terp region. Even if the deposits contain enough sand to get a clean cut without smearing, the clay still makes the soil stick to the spade. The mechanical planing devise sometimes smears a little along the edges and may scratch the surface if something gets caught between the blades, but, overall, it makes a much more ‘readable’ level than could ever be accomplished with standard digger attributes. It also gets rid of loose soil, which would otherwise adhere to people’s boots in a most resilient way.
publication discuss pottery, metal finds, stone, slag, Roman leather and micro- and macro-botanical remains. Everything is brought together in a thorough synthesis at the end of the book, in which our views on current research topics are brought up to date (Dijkstra et al. 2008; see Nicolay in prep. for a recent update).47 The main topics are politics, physical geography of the landscape, material culture and social status, subsistence, burial rites, shipping and local building traditions.

Concerning the use of construction timber, the following remarks are of particular relevance. Oak (Quercus) is the prevalent timber species in the Roman Iron Age and Carolingian period – from intermittent periods not enough material survived to draw any firm conclusions. In the Carolingian period, however, ash (Fraxinus) appears to have been just as important as oak (Hänninen et al. 2008, 208-209). Moreover, oak from the Roman Iron Age was of inferior quality. Secondary use of timber, including ship’s timber (Vlierman 2008), has also been noted for these periods and is seen as an indication that good construction timber was scarce in the coastal region.48

Of most buildings excavated at Leeuwarden, only fragments were preserved. Nevertheless, the publication provides one of the clearest discussions on architectural developments in the terp region to this date. The earliest settlement traces at Leeuwarden date from the second half of the 1st century AD and the oldest building remains have been dated to the 2nd century. A break in the occupation is thought to have occurred around 300 AD and probably lasted until the middle of the 5th century AD. Around that time, new pottery forms and new types of fibulae appear in the terp region. It is still debated whether (and to what extent) these imports indicate the arrival of immigrants. These would have come from the Elbe-Weser triangle and Schleswig-Holstein (both Northwest Germany). In the first half of the 6th century AD, gold bracteates from Jutland (DNK) start to appear in the Dutch terp region (Dijkstra et al. 2008, 310).

Leeuwarden’s primary importance for the study of turf buildings, lies in the rareness of its structures rather than their number or good state of preservation. The building remains are presented in a chapter by Nicolay (2008b). The Roman Iron Age buildings are characterised by relatively large interior widths (c. 6-6.5 m), arcade posts (binnen-rij of wooden uprights) and wattled walls. In the best-preserved examples, horizontal beams were preserved in situ, indicating that the original ground surfaces probably also survived intact. Nevertheless, no indications for turf walls have been found for this period. The early medieval buildings have a different orientation, are less wide and do have turf-built walls. Two of these are described below.49

2.6.2 Building 7

Building 7 (Nicolay 2008b, 57-59) is represented by a turf wall, part of a byre drain, 2 cattle box partitions and 9 arcade posts (figs 2.37 and 2.38). The building has an interior width of 5 m and was over 12 m in length. A ditch can be seen nearly 1.5 m outside the northern wall. No entrances or fire places have been found. One of the posts has been dendrochronologically dated to 510±8 AD, which provides a terminus post quem for the abandonment of the building. An early medieval date is also supported by pottery from the Early Middle Ages A, found in the layers overlying the building.

According to the cross-section, the turf wall had a remaining height of 36 cm. Despite this, it has not been documented in any of the excavation levels. Of the northern wall c. 5 m has been documented. It is c. 80-90 cm thick and c. 60 cm of its original height remained at the time of excavation. It cannot be established if the wall had vertical faces, because the cross-section has been partially disturbed by later digging activities.50 The cross-section does show that the turf wall was placed at the same height as the original floor level (i.e. has not been dug in).

47 The publication is in Dutch but the synthesising chapter, which includes a discussion of the local turf building traditions, has been translated into English. The captions of all the figures in the book are also in given English.

48 It is remarked that in Wijulaan, too, nearly all timber show signs of secondary use (Hänninen et al. 2008, 208, referencing a personal communication by D.A. Gerrets).

49 A number of smaller buildings has also been well-preserved. These include a narrow building (14) with a very uneven floor surface and several sunken-floor features (Nicolay 2008b, 62-70). All of these show vertical-sided walls, c. 40-50 cm thick. At the time of excavation the walls of building 14 still stood to a height of 70 cm.

50 More cross-sections have been taken from the northern wall, but these have not been published.
A short section of the byre drain is visible in the south-eastern part of the building. It appears to deepen in south-easterly direction, but this has probably also been caused by the terp’s surface sloping down in that direction. For the same reason, it is uncertain how far the drain continued towards the northwest, because part of it might have been dug away. What can be established, however, is that the drain was not positioned in the centre of the byre.

The cross-section indicates that some sort of raised platform was constructed next to the drain, instead of a separate walkway. The drain itself is indicated by two layers of dung infill. Directly next to this, further towards the centre of the building, four steps can be seen with a total height of c. 30 cm. The steps are c. 7.5 cm high on average, which is a common thickness for salt marsh turves. Presumably, this stepped profile is the result of a turf-built reinforcement, meant to support the higher floor surface on the south-eastern side of the byre.

In total, 7 posts were found in the northwestern part of the building. They form two rows that stand c. 1 m from the inner wall face and 3 m apart. If these arcade post (binnenstijlen) are viewed as pairs it becomes obvious that at least one pair has been placed at an angle to the building’s central axis. The posts are made of oak (Quercus), but it could not be established whether they have been reused (Hänninen et al. 2008, 207).

2.6.3 Building 41

Building 41 has been documented during the 1969 excavation (trench 3), but its plan is included in the 2008 publication (Nicolay 2008b, 60-61). The building is positioned right across the old Roman Iron Age platform. Its age is uncertain, but on stratigraphical grounds a date towards the end of the Early Middle Ages (D) has been suggested.

The interpretation of the building’s plan is not without difficulty. The turf wall is c. 80-90 cm thick (fig. 2.39). A layer denoted “culture layer” can probably be interpreted as a floor surface or part of the building’s infill, although in some places it does extend beyond the walls. Together, the turf wall and culture layer suggest interior dimensions of 13x8 m. A fire place can be seen in the centre of the northeastern part of the building and a possible second one, located further towards the northwestern long wall, is pointed out by Nicolay.

In total, 8 posts or postholes can be discerned, but their arrangement is not very clear. Some of the posts have been placed against or just in front of the inner wall face, others stand at a distance of 1.5-2.5 m. A row of ‘dots’ along the northeastern edge of the floor surface suggests the use of a wattle inner wall facing.

2.7 WIJNALDUM

2.7.1 Introduction to the site

The excavation in the terp of Tjitsma near Wijnaldu (FR) was conducted in 1991-1993 and is published (in English) by Besteman et al. (1999). The excavation formed a part of the larger Frisia Project, which had been set up to gain a better understanding of the region’s cultural-historical development. Unique about the excavation was the close cooperation between the archaeological de-
tachments of the universities of Groningen (RUG/GIA) and Amsterdam (UvA/AAC) and the State Service for Archaeological Investigations in the Netherlands (RCE). This brought together different views on the region’s history. An important aspect was to investigate the occupation (dis)continuity in the terp region in the 4th-early 5th century AD. A change in the settlement’s layout might be indicative of reoccupation in the Early Middle Ages and changes have also been noted in the types pottery and other artefacts.

Wijnaldum has produced a golden disc-on-bow brooch, part of which was acquired by the Fries Museum in 1954. Other parts were recovered with a metal detector several years later. The brooch shows similarities to jewellery from the Sutton Hoo royal ship burial. This has given rise to the idea that Wijnaldum was the seat of a (royal) Frisian elite. To a certain extent, the notion is supported by the presence of a gold- and silversmith at Wijnaldum, indicated by evidence that was collected through intensive sieving. Other researchers are more sceptical and point towards a more general prosperity of this part of Friesland in the 6th-7th century AD. Whether or not this ‘golden age’ saw its own Frisian king, still is a matter of discussion (e.g. Nicolay 2005).

The turf buildings at Wijnaldum are of importance to this study because of the well-researched and multi-disciplinary framework in which they can be placed. They have not produced the clearest ground plans, but do show some interesting features. The publication of Wijnaldum also marks (the start of) a turning point in the perception of turf buildings (see 1.3.1). Gerrets & De Koning have tried to let go of popular assumptions in turf construction by looking also at Icelandic turf buildings. Preliminary thoughts on the load bearing capacity of turf walls, general observations on building widths and a list of relevant archaeological and historical sites resulted in a full page of endnotes (Gerrets & De Koning 1999, 122). It has provided valuable starting points for this study. In the main text, however, descriptions of the actual buildings have remained unfinished and in most cases unfortunately also without ground plan.

From the Roman Iron Age occupation (period I/II: 175-300/350 AD) two turf-built platforms have been documented, but little information could be gathered regarding the construction of buildings.

Fig. 2.40. Wijnaldum 5, phases a-c.

Fig. 2.41. Wijnaldum 5, cross-sections.

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52 If the site’s original documentation is consulted in the future, the smaller outbuildings and other turf-built structures should also be studied. Several sunken-floor huts (e.g. SH5 and SH7) and a number of house platforms are particularly well-preserved. Sunken-floor hut 4 might provide a means of calculating the original height of the wall head (see footnote 82).
2.7.2 Building 5 (phases a-c)

Building 5b has an interior width of 5 m, but lengthwise only part of it (>6.9 m) was preserved (figs 2.40 and 2.41; Gerrets & De Koning 1999, 106-108). The structure has been dated to 425-550 AD (period III). Cross-sections through the walls provide relatively good insights in the build-up of turf walls in this part of the excavation trench. They demonstrate that at least three buildings are represented in the plan. Differences in the depth and orientation of the walls, show that the single wall in the building’s interior is the oldest (building 5a). Its northern short (end?) wall is hardly visible in the plan but stands out clearly in the F-F’ cross-section.

The oldest structure is overlain by the H-shaped remains of a strictly north-south orientated building (5b). A third phase, building 5c, has a similar orientation as building 5a and comprises the lower and most of the eastern part of the H-figure. Two short wall sections in the western part of the plan, probably also belong to building 5c; according to the cross-section H-H’, the northern wall overlies the wall of building 5b.

The turves are c. 75 cm long in all three phases. The bonding system shows only headers, which span the entire width of the wall.54 The oldest walls were preserved up to a height of 60 cm and demonstrate more or less vertical wall faces. Gerrets & De Koning remark that “sections of sod walls have clearly not a conical shape but are completely vertical inside and outside for all sod buildings, during all occupation phases.” Two fire places have been found, one of which was renewed at least once. No entrances can be discerned. The floors have been made with turves placed on their side.

Apparently, no posts have been found in these buildings.

2.7.3 Building 7

Building 7 has an interior width of only 3.7 m (no plan published; Gerrets & De Koning 1999, 111). It has been dated to 650-750 AD (period V). It had a fire place (H5) that was made from a layer of pottery sherds covered with loam. Fragments of another building (S24) were found on the same house platform and also yielded a fire place. A row of posts stood along the inside of the walls, c. 1 m apart.

2.7.4 Building 22 (phases a-b)

Building 22 is the best-preserved building from period VI (AD 750-800; Gerrets & De Koning 1999, 113-115). Traces of occupation are abundant for this period, but very little has been recovered of the actual buildings. As far as 22 is concerned, there are several indications that the published plan represents more than a single building (figs 2.42 and 2.43). Unlike building 5, however, the palimpsest is caused by the succession of a turf-built structure by a timber building. Because of the height difference between upright standing turf walls and dug in timber elements, features of both buildings were visible in the same excavation level.

The distinction can be made on the basis of slightly different alignments of the wall trench, a line of five posts and the turf wall. Posts B, F, J, L and N stand neatly in line and are of similar diameter and depth. Only L stands a few centimetres out of line and there is a gradual increase in depth towards the southern end of the row. The regular interval of 1.9-2.1 m also suggests that the posts belong together. Post B stands at a distance of 46 cm from the turf wall, but this decreases to 0 cm at the opposite end of the line, making it very unlikely that the posts and the wall are contemporaneous. The wall trench, on the other hand, does run parallel to the five posts. Therefore, it can be

Figure 2.42. Wijnaldum 22, phases a-b.

Figure 2.43. Wijnaldum 22, cross-sections.

53 These short wall sections remain a peculiarity. If they both belong to the same structure, they create a narrow passage for which I do not have a parallel. It cannot be excluded, however, that the walls belong to corner points of two entirely different buildings, situated mainly towards the west of this trench (compare Hallum buildings 13 and 8 in the trench plan; Tuinstra & Veldhuis in prep., appendix 8). In that case, the parallel stretch of turf wall further towards the east, also belongs to different building.

54 Gerrets & De Koning (1999, 106) state that the turves were laid down horizontally “with the former vegetation layer on top.”
argued that they do belong to the same structure (building 22b). A similar combination of wall trench and arcade posts (binnenstijlen) has recently been discovered at Hallum (see also 4.2.1). There, outside posts have also been noted; presumably posts D and E also belong to building 22b.

Concerning the turf-built structure, it remains uncertain whether all of the long turf wall indeed belongs to a single phase. Main reason for doubting this is that a sideways displacement can be seen between the middle section of the wall and the section at either end. Perhaps this is brought on only by partial sagging of the wall, but it is hard to confirm this without the aid of cross-sections. The same goes for establishing the relationship between the long wall and the shorter walls that stand at straight angles to it. The walls are c. 65-75 cm thick. No interior width or length can be established for this building, nor have any fire places or entrances been noted.

Two posts (C and K) are wider and were dug in deeper than the other posts. A line drawn between these two runs almost parallel to the turf wall, at a distance of c. 47-67 cm from the inner wall face. It is possible that they belong to the first phase of building 22 (a). The distance between the posts is 4.7 m, which might be an indication that another post stood somewhere in between. If the possibility is considered that post C stands out of line, post A might also be attributed to this group. It has not been dug in as deep as the other two posts, but it does create a line that runs exactly parallel to the turf wall. The bay size between posts A and C is 2.3 m; this is half the distance between posts F and K.

2.7.5 Building 27

Building 27 has interior dimensions of 3x7.8 m (figs 2.44 and 2.45; Gerrets & De Koning 1999, 111-112). It has been dated to 650-750 AD (period V) and was constructed directly on top of sunken-floor hut 5. Its turf wall is c. 60 cm thick and still stood to a height of 40 cm at the time of excavation. The south-eastern corner shows that the header courses cross over at straight angles to create a strong corner bond.

In total, 8 postholes have been documented, five of which stand 10-15 cm inside the wall. One of these is located near the centre of the eastern short end wall, but not enough remains to positively identify no. 27 as a two-aisled building. Moreover, the posts along the inside of the wall seem to suggest it was a single-aisled structure.

2.7.6 Building 30

Building 30 is perhaps the best-preserved building from Wijnaldum (fig. 2.46; Gerrets & De Koning 1999, 115). It has been dated 850-900/950 AD (period VIII) and has an interior width of 4 m. Despite its good preservation, no plan of the building has been published and the building’s description has been limited to only six lines and a photograph. The width of the turf outer wall is not specified in the description, but on the basis of the photograph it can be estimated to be about 70 cm.

The photograph also shows that a byre drain runs along the entire length of the building, apparently widening and deepening towards one end. It appears to start off in the centre of the building’s...
interior, but is clearly placed off-centre in lower end of the picture. In this part of the building, two lighter patches of turf are visible, which might indicate the presence of a turf-built walkway alongside the drain. The features provide the byre with an asymmetrical layout.

The recovery of stones along the interior side of the wall, has led to notion that roof-supporting posts had been placed on pad stones. On the basis of the published material, however, the claim can hardly be justified. It would be interesting to know how many stones were found, how high and how deep they were set in the wall and whether post-holes have also been noted.

2.7.7 Building 34

Building 34 has an interior width of 5 m and a wall thickness of 70 cm (Gerrets & De Koning 1999, 111; no plan published). No length can be established. It has been dated to 650-750 AD (period V) and contains a fire place constructed of a layer of pebbles, covered with loam. The fire place is located close to the eastern wall.

No indications for posts have been found.

2.8 OUTSIDE THE TERP REGION (NORTH-HOLLAND)

2.8.1 Den Burg

2.8.1.1 Introduction to the site

Following earlier archaeological observations in the 60’s, a large excavation was carried out on the island of Texel (NH) in 1971-1975. The excavation was conducted by the State Service for Archaeological Investigations in the Netherlands (then ROB), under the direction of W.A. van Es. Main objective was to determine the relationship between early medieval settlement traces at this site and those in the town of nearby Den Burg. The excavation levels were placed c. 10-15 cm apart, each being planed by hand before documentation. They did not follow the contours of the (natural) underground.

Texel is essentially a continuation of boulder clay outcrops and sand dunes that line the west coast of the Netherlands. These protected inland clay deposits and peat lands from marine erosion. All of the peat has now been washed away in the area around Texel, but up to the Late Middle Ages it was probably still present in considerable quantities (Woltering 1975, 10).

In addition to early medieval settlement traces, many structures (main buildings, outbuildings and barrows) from earlier periods were excavated, dating back as far as the Middle Bronze Age. The excavation results have been published in English reports by Woltering (1975 and 2000), but these do not contain plans of the buildings from the 1st millennium AD. The plans in this catalogue have been taken from other publications (Woltering 1974; Woltering et al. 1994).

The buildings from the Late Bronze/Middle Iron Age are characterised by a timber inner structure and walls indicated by rows of stakes. Woltering (1975, 23) compares them to the Elp type buildings, which Huijts (1992) has reconstructed with turf walls. At Den Burg, however, no direct evidence for turf walls has been found for these buildings. At other locations within the large excavated area, concentrations of postholes and pits have been interpreted as settlement sites, but actual house plans could not be discerned. For the Late Iron Age, wall traces are also lacking; only a few buildings are identifiable through the posthole remains of their primary timber structures (Woltering 1975, 26). It probably concerns three-aisled buildings, with rows of arcade posts (binnenstijlen) placed c. 3 m apart (compare fig. 2.47).

Into the next occupation phase, dated to the Early/Middle Roman Iron Age, buildings maintained the same orientation. Clusters of postholes and fire places indicate the presence of buildings, but few clear plans could be discerned. Turf-lined water wells have also been noted for this period. They are the earliest artificial drink water supply to be linked to the occupation at Den Burg. The building at site IV, is the oldest to be associated with a sunken-floor hut, but only fragments of the building were preserved. Settlement site V probably is slightly later and shows a similar “disorderly appearance.” Although Woltering (1975, 26) provides no further details, he states that at this location “the few remains indicate that sods were used as a building material.” It seems that the stakes were replaced by turf in the Roman Iron Age – Woltering (1974, 329) suggests this more specifically in an earlier article. Three of the Roman Iron Age buildings (RIA nos 9-11) have been described below.

Towards the Early Middle Ages (EMA), the orientation of the buildings changed significantly (Woltering 1975, 28-33). Sunken-floor huts were common in this period and some have been interpreted as weaving sheds on the basis of loom weight finds. It is uncertain whether there

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55 For one of the Middle/Late Bronze Age barrows the specific use of heather turves has been noted (Woltering 1975).

56 A cross-section through two sunken-floor huts has been included in the publication as a black and white photograph (Woltering 1975, plate VII). It shows that their walls were still standing up to heights of c. 50 cm. They are c. 40-45 cm thick, though it has not been verified if the cross-section was taken at straight angles. The older walls consist of thicker turves which have probably been cut in sandy soils, because they are very
was occupation continuity between the Roman Iron Age and early medieval period, because there are hardly any finds that date from the 4th-5th century AD with certainty.

Concerning the timber inner structures, Woltering notes that some of the buildings (EMA nos 1, 2, 6-9 and 11) are longer and show a partially single-aisled ground plan. In the remaining part of the buildings, arcade posts have still been used. Woltering interprets the three-aisled sections as byres, but little further evidence is provided to support this notion. Indications for cattle box partitions have only been found occasionally. One building (EMA-9) was at least 60 m long, nearly half of its length (29 m) being taken up by the presumed byre area. The other buildings were shorter and appear to have been around 25-30 m in length. The ‘byre’ area of building 1 is complete and is 12 m long (total length is probably 25 m). The (interior?) widths of these buildings range from 5 m (nos 1, 2 and 6) to over 6.5 m (no. 9).

An interesting observation is that only the three-aisled sections have turf-built walls. The remaining sections are comparable to buildings of the late Odoorn types, which have outside posts. Woltering interprets these as living areas. Another characteristic of the Odoorn type buildings is interior partitioning, which can also be seen at Den Burg. One of these buildings (EMA-7) is discussed below.

Single- and (entirely?) three-aisled plans have also been excavated form this period. The trench plan showing the locations of the early medieval buildings (not illustrated here), demonstrates that the single-aisled buildings (EMA nos 3, 5 and possibly 12 and 15) were narrower than the partially single-aisled buildings (Woltering 1975, 29). The three-aisled structures (EMA nos 4, 10, 13 and 14) are also narrower. EMA-4 is the only three-aisled building for which traces of a turf wall have been documented. All three post arrangements remained in use throughout the Earle Middle Ages.

It appears that the transition from wattle to turf-built walls led to a rapid heightening of the building locations at Den Burg (Woltering 1975, 34-35). This process began during the 2nd and 3rd centuries AD at site VIII, which also yielded the earliest signs of turf construction. In some places the raised layers have grown over 1.5 m thick.

Late medieval occupation at Den Burg, is thought not to have continued from the Carolinian period without interruption (Woltering 1975, 33-34). Changes occurred in the location and spatial layout of the settlements and there are very few sunken-floor huts. The buildings are exclusively characterised by an open interior, with rows of stout wall posts. In a single case traces of a turf wall have been noted directly outside these posts, suggesting that turf might long have remained an optional building material. These structures do not have outside posts and traces of cattle boxes are also absent, but turf-lined drains do still indicate the presence of byres. According to Woltering, their layout is similar to that of Den Helder building 1 (fig. 2.49).

57 A photograph of a cross-section through the turf-walled ‘byre’ area of early medieval building 8, has been published by Woltering (1975, plate VI.2). It shows a wall thickness over 100 cm and an interior width of c. 5 m, but the section has been taken at an angle. An off-centre drain, indicating an asymmetrical byre layout, can also be made out. A walkway has also been mentioned. Unfortunately, the quality of the photograph is too poor for it to be discussed in detail in this study and no plan has been published.

58 Woltering (1975, 30) classifies the buildings as Odoorn B, but for the plan of early medieval buildings 7 and 3 (figs 2.48 and 4.5), the Odoorn C type fits better (Waterbolk 2009, 86-91). No plans have been published of the other buildings.
2.8.1.3 Roman Iron Age building 11
Roman Iron Age building 11 (RIA-11) does provide a clear ground plan, but lacks any sign of walling material (fig. 2.47; Woltering 1974, 327). The plan shows two successive rows of arcade posts (binnenstijlen), with respective lengths of 12 and 12.5 m and standing 3.6 and 3.2 m apart. The average bay sizes respectively are 1.7 and 1.8 m. Because the more or less contemporary buildings have turf-built walls, Woltering assumes that the same material was used for this building. The presence of a ditch indicates that the building probably was not wider than 8 m.

2.8.1.4 Early medieval building 7
Early medieval building 7 (EMA-7) probably had an interior length of 30 m and is 5.3 m wide (fig. 2.48). Its length is based on the assumption that the differently orientated posts, at either end of the building, form part of its short end walls (see also below). The structure has not been precisely dated by the excavators, but on typo-chronological grounds Waterbolk (2009, 90) suggests the 8th century AD (see also 4.1.3).

EMAT has been included in this catalogue because a stretch of turf wall (3.8 m) has been found alongside the arcade posts. In the plan it is only c. 35-40 cm thick, but no cross-sections are available to establish its thickness more reliably – a cross-section through the thee-aisled section of building EMA-8 shows that the turf walls were probably thicker (Woltering 1975, plate VI:2; see also footnote 57). Although one of its ends matches up with the wall of the middle section, the turf wall’s trajectory differs slightly from that of the other wall sections. This, however, is a feature also seen in the byre areas of contemporary buildings in Drenthe (e.g. Waterbolk 2009, 91, figs 61a and c).

In total, 12 arcade posts were documented in this part of the building, including two which have been incorporated in the interior partition. The rows stand 3 m apart and the average bay size is 1.8 m, counting only the four complete pairs in the middle. The bay size between the last pair and the pair in the interior partition is larger: 2.1 m. The same distance can be seen between the incomplete pairs at the other end of the rows. Arguably, this strengthens the notion that the end of the building has been reached here. All pairs, including those consisting of outside posts, have been placed at a slight angle to the building’s central axis, giving the building’s plan a somewhat skewed appearance.

2.8.2 Den Helder
2.8.2.1 Introduction to the site
A small part of the terp Het Torp, near the town of Den Helder (NH), has been excavated by the State Service for Archaeological Investigations in the Netherlands (then ROB) in 1965-1966. Prior to this, a trial excavation had been conducted by the Institute of Pre- and Protohistory (IPP) of the University of Amsterdam. The ROB excavation is published in a short English article by Van Es (1973a).

Unfortunately, the site has not been dated very precisely. Van Es points out that the oldest layer that shows signs of human influence (layer
I), contained sherds that “might be of Carolingian date.” Two turf-walled buildings were discovered at some distance above this layer. One of the buildings was only visible in a cross-section that cut through the structures at an angle, but building 1 can also be studied in plan and has therefore been included in this catalogue.

2.8.2.2 Building 1

In its first phase (a), building 1 has interior dimensions of \( >16 \times 5.5-5.7 \text{ m} \) (figs 2.49 and 2.50; Van Es 1973a). The plan is incomplete, because the cross-section and the area west of it have been taken down too far in one go. Another area, shown as a wide blank streak, had already been disturbed by the digging of a trial-trench at the start of the excavation. Two large pits can be seen in the south-western side of the byre area. One has been bisected by the cross-section and is 1 m deep. Van Es suggests that they were used for storage purposes, but no further evidence is provided to support this. Patches of burnt clay have been documented above habitation level b in the cross-section, and a central fire place is visible in phase c. No traces of a fire place have been noted for the first phase.

The cross-section shows that the turf walls have been rebuilt at least twice. The walls of the first phase are preserved best. The southern wall clearly shows battered faces, but it cannot be excluded that this is the result of erosion or the intensive reuse of this location during later occupation phases. In the plan it is shown that the walls have been built up with a simple pattern of headers. They are c. 120 cm thick at the base, but the short end wall is thicker (c. 1.4 m). It appears that the turves spanned the entire width of the wall and crossed over at straight angles to create a strong corner bond. According to Van Es (1973a, 344), no indications for a wattle (or other) wall finish have been found.

A byre drain and raised walkway are visible in the building’s interior. These have also been constructed of turf and are clearly discernable in the cross-section. The byre drain is located off-centre, next to the walkway. As a result, the byre has an asymmetrical layout. Stakes in the plan indicate that horizontal beams were probably used to reinforce the drain’s turf-built edges.

The walkway continues slightly beyond the last arcade posts (binnensijlen), giving it a total length of 12 m. The drain, on the other hand, appears only to reach to where the cross-section is made (5.5 m inside). The turf wall has a different thickness on both sides of the cross-section. Bearing in mind its tapered cross-section, it can be concluded that the western excavation level was not taken down as far as the eastern one.\(^6\) The drain lies deeper than the walkway, which might explain why it cannot be followed over its entire length; part of the drain still lay under the excavation level. At the other end, the drain can be followed towards the outside of the building.

Several posts and postholes have been found. Clearest are the rows of posts that stand directly along the inner wall faces. They stand 5.5-5.7 m apart, with an average bay size just under 2 m. Van Es (1973a, 343) describes the outer posts as “stout” and with the bark still attached. Some posts are round in section, but most have been split in half. If the posts are viewed as pairs it becomes obvious that almost all have been

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\(^6\) Van Es (1973a, 344) states that the opposite was the case, but this does not seem to be supported by the published plan. No heights for the levels have been provided in the plan.
placed at straight angles to the building’s central axis. In the south-eastern corner two posts are visible; one is set inside the wall face and the other just in front of it. Judging by their difference in size, it is likely that the thickest post belongs to the primary timber structure. Its counterpart is visible as a posthole on the opposite side of the byre. This last pair stands at an angle to the building’s central axis.

Only one cattle box partition has been preserved on the northern side of the byre. The southern side has remained more or less intact but nevertheless yielded no indications for the presence of cattle boxes. This fits in with the asymmetrical layout of the byre.

Arcade posts are present on both sides of the walkway and have smaller diameters than the wall posts. The layout of the northwestern part of the building is less well-defined. This does not appear to have been the result of poor preservation conditions, however, because the wall posts and part of the turf wall are still clearly visible.

2.9 Concluding Remarks on Dataset

2.9.1 Representativeness

In comparison to the number of known terp sites, the sample of building plans in this catalogue is still very small.\(^{61}\) The sample does cover most of the Dutch terp region, however, and all periods from the Roman Iron Age to the closing years of the Early Middle Ages. The most noticeable shortcoming, in this respect, is the lack of recent and well-researched excavations in the province of Groningen. The sample’s representativeness is furthermore dependent on the typological variability of these buildings and their development through time. Insufficiencies with regard to these are outlined in chapter 4.

In some cases, the entire Early Middle Ages are represented in a single excavation (e.g. Wijnaldum and Hallum). This provides a means of studying architectural developments without the biasing effects of having to compare different sites. The published information on these sites, however, provides limited possibilities of further deepening the research on turf buildings. Buildings at Hallum have unclear ground plans and few cross-sections are provided to clarify (or confirm) stratigraphical relationships. The structures are better documented at Wijnaldum, but only a small selection of the plans and cross-section have been included in the publication. A renewed interpretation of the site’s original documentation might serve to verify the chrono-typological picture that is sketched on the basis of this catalogue. Perhaps a similar approach can also be applied to Den Burg, which occupation also spans the entire Early Middle Ages.

Concerning constructional details (i.e. building techniques), the current dataset offers very little reliable information. Poor archaeological visibility might have played a part in this, but the height to which some of the turf walls were still standing at the time of excavation strongly suggests that a much more detailed documentation should be possible. The fact that so little attention is paid to the documentation of constructional details does not appear to have been caused by a lack of interest in turf structures. This is a comforting observation, because, in a general sense, turf construction has long been regarded as a peripheral architectural phenomenon, even in the terp region (e.g. Voskuil 1979, 109).

It appears that the lack of technical know-how had a far greater negative influence. Perhaps more cross-sections would have been taken if turf structures had been compared to brick-walled buildings, rather than contemporary timber buildings. The latter are normally only documented in straightforward horizontal excavation levels – postholes are bisected though. When brick-walled buildings are excavated, on the other hand, brick sizes, bonding patterns, repairs and extensions are documented. In hindsight, similar objectives should have been applied to turf buildings.

In a recent introductory overview of traditional turf applications, it has been suggested that the material played a much more prominent role in ancient society than archaeological evidence has so far accounted for (Postma 2010).\(^{62}\) It is likely that experience built up through many generations has led to a wide variety of construction techniques. This is well illustrated by the Icelandic turf building tradition (Sigurðardóttir 2008). It can be expected that different techniques (or preferences) evolved in different regions in the Netherlands as well. The resolution with which technical detail has been documented, however, does not allow for such subtleties to be identified. This is were the current dataset falls short the most.

2.9.2 Visibility and reliability

Undoubtedly, the documentation of constructional details has suffered from turves’ poor archaeological visibility. In the terp region, however,

\(^{61}\) Zoetbrood et al. (2006, 49) count 2,328 terpen in the clay region of Friesland and Groningen.

\(^{62}\) Turf applications discussed in this article, are grave mounds, houses, walkways in byres, raised byre entrances (ramps), house platforms, terpen, water wells, paths and roads (through peat lands), field walls, defensive works, dykes, flooring in lofts, roofing material, fertiliser, mattresses, clothing, saddles and saddle pads under packsaddles. It is likely that many more purposes existed.
where turf walls have sometimes been preserved up to 50-100 cm in height, the visibility of turves is hampered by the build-up of turf-filled terp layers around the walls. The effects are aptly illustrated by Nicolay:  

“...The visibility of archaeological remains in terp settlements varies considerably, depending on a number of factors. As a result, dug in features are clearly recognisable if the infill differs from the layers in which they have been placed. If a feature with a ‘dirty’ infill is dug into a refuse layer, this already becomes a lot harder. The same goes for wall fragments, built up with clean turves during the Early Middle Ages. In layers meant to heighten the terp, which are often of the same material, the walls can only be recognised through the regular placement of the turves. In rainy or very sunny weather conditions, however, the distinction can hardly be made any more.

Furthermore, the recognition and interpretation of features is complicated by disturbing activities that have already been performed at times when the terp was occupied. As a house or yard went out of use, the associated ditches and pits will have been filled up [NB this is often also done with turves] and the remaining structures are levelled. In doing so, turf walls may have been removed at ground level, making them unrecognisable for archaeologists. In addition, part of the features are disturbed or disappear completely through the digging of water wells, pits and ditches in younger higher-up occupation levels.”

The homogeneous make-up of the Leens terp allowed Van Giffen’s team to recognise the turf buildings. Overcast weather conditions and sun glasses were important preconditions at Wijnaldum. Experiences done up at Wijnaldum, led Gerrets & De Koning (1999, 109) to conclude that “it is very likely that sod buildings were also present at the terpen of Ezinge and Tritsum but that due to poor conservation circumstances these buildings were not recognised by the excavators.” Weather may also work to one’s advantage, however, because at the same excavation it was noticed that “after some days of rain sod walls appeared, which had not been recognised before” (Gerrets & De Koning 1999, 106). In peaty areas, on the other hand, turves may only become visible as the excavation level dries out. This causes the turves to shrink and the joints to appear as cracks.

Evidently, bad preservation conditions and a reduced contrast between feature and context do have negative effects on the visibility of turf structures, but they cannot account for all loss of information. Many of the turf walls that were hardly discernable in plan, come out clearly in the cross-sections. Yet, cross-sections are seldom used specifically to document turf buildings. Moreover, excavation levels are often placed at large intervals (30 cm). This severely limits the possibilities of recognising and properly documenting a turf structure. The discrepancy between well-preserved cross-sections and poor ground plans is particularly clear for the buildings at Hallum, but it is also noticeable at other sites. At Leeuwarden, for example, the southern wall of building 7 still stood to a height of 36 cm, but it has not been documented in plan. A lot of information is lost by excavating these three-dimensional structures in two-dimensional excavation levels.

The use of indiscriminating excavation levels, however, can also lead to an abundance of information. This has complicated the interpretation of at least two Wijnaldum buildings. In building 5, the entangled fragments of three successive buildings were visible in the same level (fig. 2.40). Only with the aid of cross-sections could any sense be made of this palimpsest. For building 22 a combination of upright standing, as well as dug in features mislead the excavators (fig. 2.42). A cross-section through this building would probably have shown the ditch dug into layers butting up against or even sealing in the earlier turf wall.

Poor preservation and limited archaeological visibility, possibly worsened by undesirable weather conditions and the limitations of conventional excavation practises, in combination with a limited understanding of turf construction, will inevitably affect the reliability of a structure’s interpretation. Pressures in commercial archaeology may contribute to this, especially when the stratigraphical situation is more complex than anticipated and limited means are available to adjust the excavation methodology accordingly. For the most part, this will affect the reliability of technical details discernable in published drawings.

It is felt that the documentation of general characteristics has not suffered very much, although appropriate flexibility will always be desired when working with the data. Many of the plans have been published on a small scale, which makes it difficult to take accurate new measurements. It is very important that measurements can be verified through the published plans, because in several
instances the dimensions provided in a building’s description did not match up with the plan. Similar problems, however, affect the study of timber buildings and good criteria for publishing ground plans have previously been set out by Waterbolk (2009, 3).

The greatest distortions can be expected in relation to timber elements, because many of the bi-
sected postholes show that posts were not dug in very deep. None of the turf walls discussed in the catalogue have been dug in, which means that (dug in) posts may be still visible in excavation levels placed below the turf walls. In the terp region such a bias might be recognisable in plans from the Roman Iron Age (e.g. fig. 2.47). Perhaps it can also explain the absence of walls in many late medieval buildings. The extent to which it has affected ground plans from the Early Middle Ages is discussed in chapter 4.1.1.

The opposite side of the coin, of course, is that postholes might not be visible if an excavation level cuts only through the higher parts of a turf wall. In theory, this can lead to an overrepresenta-
tion of turf buildings without a timber structure. Only when posts have been enclosed by the gradual build-up of floor deposits, can upright standing turf walls and dug in posts be visible in the same excavation level. Even then, however, a post’s visibility may be hampered by postholes being filled up with turf. This practise was noticed at Wijnaldum (Gerrets & De Koning 1999, 106). The use of pad stones is also of relevance, but neither appear to have been common practise (for pad stones see 3.2.2.1). Thus, the reliability of a building’s plan is very much dependent on a clean and well-planed excavation level and the excavator’s attention to detail.
3 THE TECHNOLOGY OF A COASTAL BUILDING TRADITION

An analysis of regional building typology is of great importance for the reconstruction of an ancient building. It leads to a far more detailed insight in the applied construction methods than could ever be established on the basis of a single plan. It is no news for archaeologists in the northern parts of the Netherlands, that the study of typology, technology and reconstruction are closely connected. Waterbolk recently put it as follows:

“Often a certain excavated house plan is used for a full-scale reconstruction. In doing this, it is of great importance to know of which type the specimen is. Because only then can one establish which postholes are essential and which are of lesser importance or coincidental. In his dissertation of 1992, the architect Carlo Huijts proposed a series of reconstructions for the house types, which I had described in 1980. Since then, our knowledge of the house plans has grown tremendously and a new study would be appropriate.”

Huijts managed to reconstruct so many buildings because a good typo-chronological framework was already available to him. Waterbolk subsequently discerned new building types, partially because the reconstructions helped him in his understanding of the technology behind specific post arrangements. Their research focuses mainly on the sandy region of Drenthe, however, so for this study their results would have to be translated to suit the ground plans in the nearby terp region. It was expected at the outset that this would require some, but not many adjustments, and the addition of a turf wall, of course.

However, the existing typologies and reconstruction models soon proved to provide little footing for the reconstruction of a Leens type building. Posts and postholes are only found in small numbers in turf buildings. Where they do occur, they have been arranged as arcade posts (binnenstijlen), which are no longer found in contemporary buildings in surrounding areas. And what about the turf-built walls? Were these only local additions to a widespread building type? Or were they actually of structural importance? If so, how does this affect the ground plan of a building? And how can we base a complete reconstruction on such ground plans? The vicious circle of typology, technology and reconstruction, which served Waterbolk and Huijts so well, would have to be built up from scratch for the early medieval terp region.

Regardless of this, Huijts’ research also demonstrates the importance of understanding relevant construction methods. It is essential for the interpretation of excavated ground plans. Huijts, being an architect, could identify structural weaknesses in specific timber structures, and come up with solutions or alternative interpretations in a way that regular archaeologists could not. But what knowledge has survived of turf construction? The discussion by Gerrets & De Koning (1999) of the buildings at Wijnaldum (FR), culminated in the hypothesis that turf walls probably were load bearing. This clashed head-on with existing ideas of turf construction (see quotes in 1.1) and demonstrated that a more thorough understanding of its characteristics was needed.

To resolve this shortcoming, detailed information has been collected in Iceland and Scotland at the start of this study (see relevant sections in 1.3.2). During this period, the endless possibilities of turf usage became increasingly evident (Postma 2010), but the buildings that were studied also cast doubt on other long-held presumptions. They demonstrated that many typical features of archaeological reconstructions in the Netherlands, may actually be less obvious than they appear at first. What do we know for certain about the minimum pitch of thatched roofs? Are there any historical buildings that demonstrate the necessity of projecting eaves (dakoverstek)? Have any timbers been collected from water wells, that confirm the ingenious theory Huijts thought up for the introduction of double posts (dubbelstijlen)?

Some characteristics of archaeological reconstructions derive entirely from superficial comparisons with historical buildings (e.g. turf walls cannot be load bearing), or from the unfounded assumption that traditional materials have always been used in the same way (e.g. reed thatch requires a minimum pitch of 45°). Others have been the subject of meticulous investigation (e.g. the introduction of braces (schoeren)), but what all of them have in common is that they have always remained largely hypothetical.

This chapter discusses the main characteristics of the buildings from the catalogue. The themes of the sections range from the obvious “timber species” to the less common “interior partitions,” but the dataset has also yielded information on lofts.

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Waterbolk (2009, 5); my translation.
(vlieringen), gables (topgevels) and a previously unidentified type of byre. The main objective is to translate the data from the ground plans into a well-founded understanding of relevant building technology. The interpretations are central to the drafting up of a typological framework and reconstruction proposal, respectively in chapters 4 and 5.

The ethno-historical approach that has been so beneficial to our understanding of turf construction, is extended to elucidate also other aspects of ancient rural architecture. The relevance of the Scottish and Icelandic analogies has been enhanced, where possible, by searching for similar practises closer to home. A variety of archaeologival and historical data is used for this, particularly from the Dutch west coast, the sandy soils in the province of Drenthe and the Northwest German coastal region. This leads to important reconsiderations on the minimum pitch of thatched roofs, the shape of primary timber structures and the necessity of earthfast posts for their stability.

3.1 TURF WALLS

3.1.1 Confusing terminology (turf vs. sod)

Of relevance to this section is the use of the generic term turf. The terminology of turf construction, or earth construction in general, is as diverse as the terminology associated with masonry (Walker 2005, 153). This is well illustrated by the study of North Icelandic building traditions, carried out by the Skagafjörður Historical Museum in Glaumbær (Sigurðardóttir 2008). Sigurðardóttir lists eleven types of turf, each with its own name, shape and purpose. In other countries, names might also be linked to particular turf types (e.g. divot, fale, dekkerplaggen). Many types are characterised by a combination of turf species (e.g. peat turf, heather turf, kleizode) and/or a typical shape (e.g. flat, rectangular, wedge-shaped).

The combination of species and shapes results in a wide range of turf names. Several of these remained in use long enough to be preserved in our modern-day lexicon (e.g. turf, sod, plag). Other names may survive in more traditional contexts and might still be traceable in written historical or ethnographical sources (e.g. fale, divot, klömmbrunnaes). Possibly, a single type of turf had different names in different regions. It will be a challenge for scholars to record or recover these names and determine their meanings. During this process the terminology will have to be used in a conscientious way, so as not to cause confusion when the matter is studied internationally.

Walker (2005, 153) aptly demonstrates the potential problems that may otherwise arise: “The Scots, for example, burn ‘peat’ while the Irish burn ‘turf’; the Scots build with ‘turf’, the Irish with ‘sods’, whilst the Scots use a ‘sod’, in this case a piece of sandy turf, to bank the fire at night to prevent the peats from burning away before morning.” A similar use of ‘sods’ around fire places is known from the district of North Twente in the Netherlands. They are called braandplaggen (lit. fire turves) or sod’d’n (sods) in local dialect (Hes-selink-van de Riet 1981, 127). In modern archaeology, however, ‘plaggen’ is more generally linked to ‘plaggen soils’, a Dutch term used widely in archaeo-ecological research. Although the plaggen used in this Plaggenwirtschaft (i.e. farming on soils enriched with turf and manure) might not be dissimilar to braandplaggen, they need not be the same either.

The variable use of ‘turf’ and ‘sod’ can be detected in many Northwest European languages. A non-exhaustive scroll through the literature provides the following names for a turf block:

<table>
<thead>
<tr>
<th>Language</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>turf</td>
</tr>
<tr>
<td>Icelandic</td>
<td>torf</td>
</tr>
<tr>
<td>Norwegian</td>
<td>torv</td>
</tr>
<tr>
<td>Danish</td>
<td>tørv/tær (plag for heather turf)</td>
</tr>
<tr>
<td>Dutch</td>
<td>zode (also plag, often but not exclusively for heather turf)</td>
</tr>
<tr>
<td>Irish</td>
<td>sod</td>
</tr>
<tr>
<td>German</td>
<td>Sode</td>
</tr>
<tr>
<td>Low German</td>
<td>sood</td>
</tr>
<tr>
<td>Old Frisian</td>
<td>såhe</td>
</tr>
<tr>
<td>North Frisian</td>
<td>suad (suar)/tid (ed)</td>
</tr>
</tbody>
</table>

These are the general names for a turf block (i.e. the element used for construction purposes). Languages that use a variant of the term sod, however, also use the term turf, but for a slightly different purpose. Like the Irish, as described by Walker, ‘turf’ in Dutch, Danish and German applies to ‘sods’ taken specifically from peat soils. In practice, this means that a Dutch researcher will be tempted to use the term sod as a translation for his native zode, rather than turf. This misleads his Scottish colleague into thinking that “a piece of sandy turf” is meant. Vice versa, the book title Scottish Peat Construction (Walker 2006) is read as Scottish Peat Construction by the Dutch (or German, Danish or Irish) researcher.

67 Saefiel (1967, 69) also mentions the North Frisian term ide-wêr, which he translates as Raasentof-weg (grass turf road). A Dutch equivalent is the street name Srajdie (i.e. sod way) near Easternmar in Friesland. It is tempting to suggest that the origin of these names goes back on turf-built roads, perhaps transecting the boggy peat lands between the sandy soils and the salt marshes (Postma 2010, 25-26).
Depending on where and for what purpose the blocks are used, they may be cut from a wide range of soils, each with several possible vegetation species. Both elements (soil and vegetation) determine the turf species and bring even more terms into view: e.g., bog, moss (mose/moos), moor (moor/moer/moeras/myr), marsh and salt marsh (kwelder), fen (veen), peat, grass (gras/græs/raesen), heath (heide/hede), sand (zand) and clay (klei). These terms are often used in combination with those listed above: peat turf, turf moor, kleizode and heideplag. They can also be combined with each other: peat moor. Without delving into the matter too deep, it is obvious that a clear and universal terminology is desired if turf construction is to be studied in an international context.

3.1.2 Sources and properties

3.1.2.1 Sources and properties

Very little research has been done to establish the exact make-up and source of turf found in archaeological contexts in the terp region. Bearing in mind that earth blocks make a heavy load, it can be expected that building material was preferably sourced locally, although access to waterways might have offered some transport opportunities. Over land, perhaps only the lightweight bolsterveen (fibrous peat turf; see below) could be imported over greater distances. It may have provided a good source for the higher areas of the sandy soils, where clay turf is less likely to have been at hand. Good heather turf, on the other hand, may have been available in more parts of the sandy soils and loam (or clay) mixed with a variety of materials can make an equally good building material.

Local sourcing, in a general sense, is evident from some of the excavated buildings. In the terp region, the salt marsh stratigraphy is clearly recognisable in wall turves (fig. 2.12) and buildings excavated in peaty areas, have indeed been built with peat turves (e.g., Casparie 1988, 200; Besteman & Guiran 1987, 312, 321). A rare case in which the turf’s source has been studied in more detail, concerns a number of Roman Iron Age water wells at Uitgeest-Dorregeest (NH). The site lies in a former salt marsh area, just behind the sand dunes along the Dutch west coast. Further inland, vast expanses of peat were available. Analyses of botanical micro- and macrofossil remains, beetles and mites, confirm that the turves were taken from grazed, treeless, moist and slightly brackish meadows (Van Geel et al. 2003, 878).

During several recent terp excavations in the northern coastal region, disturbed salt marsh surfaces and pits were noted along the outer rims of associated terp phases. At Hoxwier (FR), pits had been dug into an old part of the salt marsh, when a marine influence was no longer present (Nieuwhof & Prummel 2007, 16). Stagnating fresh water, however, kept groundwater levels high and occasionally led to inundation, as is indicated by fine

68 Walker & McGregor (1996b, 45-73); Hadrian’s wall and the Antonine wall have both (initially) been built with turf, using mudwall blocks where suitable turf was not available (e.g., in woodlands; Walker 2006, 6). For a discussion of the construction of clay-walled longhouses in the Solway coastal area in northern England, see Jennings (2002).

69 An interesting situation occurs in a sunken-floor hut at Den Burg. It has initially been built with heather turves and is succeeded by a building of salt marsh turves (see footnote 56).
clay deposits that filled the depressions. Similar pits have been found at Leeuwarden, but these were deeper and their bottom layers had been heavily disturbed (Nicolay 2008b, 89). In both cases, the excavators conclude that the pits are probably the result of turf cutting activities.

Nicolay rightly points out that it is “likely that for the raising or expansion of the settlement, quite randomly picked layers in the direct vicinity of the terp were used for cutting turves. For the construction of walls for buildings and the lining of water wells, on the other hand, a specific type of soil will have been sought after.” It has not been possible to link the turves in turf-built structures directly to any of such pits. Hopefully more detailed information on the sourcing of turf will become available in the near future. The mineralogical make-up of the turves should also be studied more closely.20

More detailed information on turf sources and building characteristics has been documented for other countries, mainly through historical and ethnographical research. Of great value is Bruce Walker’s research on turf construction in Scotland. Indispensable for getting a true feel for what makes good building turf, however, have proven to be the experiences in Icelandic turf construction, done up at the heritage craft school in Skagafjörður. Visits to the reconstructed turf buildings at Barger-Compascuum (NLD) and Newtonmore (SCO) have also been highly beneficial (see relevant sections in 1.3.2).

A feature that most (if not all) good building turves have in common is that they are cut from wetland sources. High groundwater levels are an important precondition for the development of tough interwoven root mats. Mineral sediments can be present in the turf in widely varying quantities, particularly sand, silt and clay. Peat generally contains very few of these sediments, whereas the Dutch salt marsh turves contain great quantities of sand and fine marine clay. It appears that most wetland soils can be used for construction purposes, providing that heed is given to each species’ particular demands. Ripened (clay) soils, on the other hand, crumble too easily to make a good quality building material.

The Icelandic tradition of turf construction also demonstrates a preference for wetland turf (fig. 3.1). In several publications, this has led to the idea that specifically peat (veenturf) was used for construction purposes (e.g. Urbančzyk 1999, 120; Steinberg 2004, 61). In reality, peat soils are a rare commodity in Iceland; perhaps this misinterpretation is the result of the terminological complexities discussed in the previous section.

Most peat layers only contain dead vegetable matter, pressed together into a compact mass that can easily be cut without trimming. Depending on the type of peat that is used, shrinkage may be considerable (fig. 3.2). Peat turves, therefore, will have to be thoroughly dry before they are used for construction purposes. This means that turves cut from bogs (laagveen), probably are not suitable for the construction of buildings; by the time the blocks have dried, they have become too hard to trim without the aid of a saw. These turves are better used as a fuel source. Turves taken from peat moor layers higher up (hoogveen) also tend to shrink, but they are more fibrous and do not warp as much. Perhaps, if they are carefully cut to regular sizes, they might not need to be trimmed too much during construction. It seems that this turf species can indeed be used for construction purposes, but it will have to be dried very well if the

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20 Nicolay 2008b, 89; my translation. An example where the detailed study of turf species has lead to interesting insights, is the excavation of Roman fort near Strageath (SCO). It has been established that good quality turves were carried uphill and lesser quality turves downhill, each to be used where the quality of the turf best suited the demands of particular parts of the fort’s ramparts (Walker 2006, 12-13; referencing Frere, S.S. & I.I. Wilkes, 1989. Strageath: Excavations within the Roman fort, 1973-’86 (= British Monograph Series 9). London (see pages 17-18)).

21 For an exemplifying case study of historic turf, see Carter et al. (1997).
structural integrity of a free-standing wall is not to be compromised (fig. 3.3).

The uppermost layers of a peat moor are even more fibrous, providing that long droughts and deep frosts have not transformed it to peat dust. In the Netherlands, this turf species is known as bolsterveen. It contains a lot less water than the lower layers and therefore also shrinks considerably less. When dry, it is extremely lightweight and easy to trim with a (serrated) knife or other cutting tool. It makes a good, albeit flammable building material (see also 3.1.3.5).

Heather turf does contain green (i.e. alive) root matter, but its growing on sandy soils can result in sand contents being too high for the construction of walls. Sand does not stick together naturally, but crumbles as the turf dries out. It can be expected that heather turves preferably have also been taken from areas with high groundwater levels, where a thick vegetation horizon has developed on top of the sand. Similar heather turf can also be found as a top layer on bedrock or peat soils (fig. 3.4).

The same demands apply to a wide range of grasses; too much sand (or ripened clay) will cause the turf to fall apart. So, again, wetland locations with organically rich soils are preferred. In Iceland, turves are cut from sedge (zegge) marshes, where deep root systems allow the turf to be cut up to a depth of 30 cm. The more or less continuous flow of (sub)surface water deposits sediments here, but it also rinses out excess material (fig. 3.1). As a result, one might expect, the amount of sediment will not normally exceed the holding capacity of the vegetation, although some variability in turf quality cannot excluded. When a block or strip is cut from these soils, the dense mat of tough roots maintains this balance as the turf dries.

It results in very good building material, which hardly shrinks and retains a lot of its flexibility.

Apart from regular peat vegetation, ‘moist’ heather and marshy grassland, there are many other species that produce a usable turf. Walker (2006, 5-8) describes the basic characteristics of several of these. The effects of different mineralogical make-ups is also discussed, but not the characteristics of heavy marine clay and saline living conditions. The saline living conditions will have influenced the type of vegetation on local turfs in the early medieval terp region. Moreover, regular flooding may have resulted in the deposition of too much mineral sediment, in particular

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when regular flooding occurred. This will have influenced the quality of salt marsh turves. In order to get a better idea of how salt marsh turves behave, a test wall has been built at the local heritage museum at Firdgum. The insights gained from this are set out in the next section.

3.1.2.2 Test wall (incl. permeability and load bearing capacity)

The unique characteristics of salt marsh turf (i.e. high sand/clay content and salt marsh vegetation) may cause it to react differently to construction work than other turf species (see 3.1.2.1). To provide more certainty in this, a small test wall was built on the museum premises at Firdgum, in the fall of 2009. In order to match the early medieval building material as closely as possible, the turves were cut in a modern salt marsh outside Friesland’s northern sea dyke (fig. 3.5).

Locally, the salt marsh contains patches with a very high sand content, shown as higher spots on the height map. Turves cut from these locations, measuring 50x25x8 cm, broke when they were lifted; the salt marsh vegetation forms a dense mat, but it does not root very deep and therefore could not hold the sandy block together. Just a few meters further towards the shoreline, the clay content was higher. Turves that were cut there could be lifted without any problem (fig. 3.6). Even though the sand and silt content is still high in these turves, the intermittent clay layers serve as a binding element. It is suspected, however, that the sand grains prevent the clay from cracking as it dries, much like tempering does for pottery. The combined result is a tough and slightly flexible building block.

In total, around 50 turves have been lifted and transported to Firdgum, where the wall was built with a straightforward bonding system (fig. 3.7). All turves, except for those in the top layer, were stacked grass side down. They were flattened off during construction to ensure a snug fit and keep the courses level, which are two important preconditions in Icelandic turf construction. The resultant wall measured 45x95 cm in plan and is 88 cm high (8 cm per course). Afterwards, the wall faces were trimmed with a sharp spade.

Because the turves had been used on the same day they were cut, some shrinkage was expected to occur as the walls dried out. Also, the vegetable matter was at risk of rotting if the turves did not dry soon enough. This indeed happened to one of the remaining turves, which had been left outside in a shaded area where it could not dry sufficiently. Even though the salt content is very high – white salt crystals appeared on the turves that were

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73 Personal communication Helgi Sigurðsson (professional turf builder), Skagafjörður Heritage Craft School, Tyrtingsstaðir (ISL), June 2009.
taken inside – fungal growth became visible within a few weeks. The wall itself had been built in a shaded, but otherwise well-ventilated location and was therefore not affected at all. Because it was built in late fall, however, it did not dry until spring 2010. In the meantime, an unusually cold winter had struck the Netherlands, but the wall did not crumble or turn to dust, as would probably have happened with moist peat turves.

The wall’s moist state meant that the vegetation in the lower courses had not died off. Contrary to what is often believed, the turf wall of a building should not be allowed to turn green again (see 3.1.3.3). Because the vegetation started to regenerate in springtime, the wall faces were re-trimmed in early June.  

Several months of hot and sunny weather helped to dry the wall naturally, killing off the vegetation (fig. 3.8). Only the top and bottom courses remain green.

Late summer in 2010 brought several days of near-tropical rainfall, which flooded several parts of the Netherlands. In Firdgum the rain washed away the thin layer of dust which had formed on the wall’s surface. The short protruding roots now give the wall a stubble-like feel, similar to Icelandic turf walls (fig. 3.9). A year after its construction, no erosion gullies can be seen that might suggest the wall will soon wash away. It appears that salt marsh turves suffer little from exposure to the elements.

Concerning the turf’s strength and permeability, the following is of importance. When first built, the wall was flexible and swayed sideways slightly as one leaned against it. After drying, however, it has stiffened-up completely and hardly any movement now occurs when a man of average posture pushes full-weight against its long side. Standing or jumping on the wall top causes no damage, even if all pressure is concentrated on the outer edge or on one of the corners. Presumably, the clay and sand absorb the downward pressures, whereas the shallow but dense root mats hold the wall together horizontally. Measurements taken when the wall had dried demonstrate that salt marsh turves do not shrink.

It has also been noticed during construction, that the turves were easier to handle when they had settled for a while. This makes them less likely to break. Allowing sufficient ‘resting time’ will also help to prevent fungal growth in thicker or less well-ventilated walls and ensure that the vegetation does not regenerate. It is not advisable, however, to let the turves dry out completely before

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74 No archaeo-botanical research was incorporated in this first experiment, but subsequent (non-exhaustive) analyses of the wall’s vegetation has shown that the following species have regenerated on the wall in 2010:
- fescue (zwengras; Festuca sp.)
- red fesue (rood zwengras; Festuca rubra)
- saltmarsh-grass (kweldergrass; Puccinellia sp.)
- common knotgrass (gewoon varkenengras; Polygonum aviculare)
- common orache (uitstaande melde; Atriplex patula)
- spear-leaved orache (spiesmelde; Atriplex prostrata)
- common sorrel (veldzuring; Rumex Acetosa)
- sheep’s sorrel (schapenzuring; Rumex acetosella)
- fat-hen (melganzevoet; Chenopodium album)
- sea-milkwort (melkkruid; Glaux maritima)
- sea aster (zeeaster; Aster tripolium)
- horned pondweed (zannichellia; Zannichellia sp.)
- hawkweed (havikskruid; Hieracium sp.; uncertain identification)

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74 Thanks is to Arnoud Maurer (archaeology student at University of Groningen) for the identifications. Samples were collected by the author on 5 June and 29 August 2010 (English names through World Biodiversity Database: http://nlbif.eti.uva.nl/bis; last accessed 25-10-2010). Note that these samples might also contain species transported to the turf wall after the turves were cut (e.g. by birds).
construction, because the high clay content will make them too hard to trim. Spring seems to be the best time to build, because the summer months provide ample time for the wall to dry out and settle. Turf on roofs will need some time to bond before the autumn and winter storms set in.

The results of this small-scale experiment correspond well with the results of tests carried out by Bruce Walker and Chris McGregor at the University of Dundee (SCO). Their load bearing test demonstrated that “a well-built clay turf wall 200 mm [20 cm] thick can easily carry a two storey domestic building with a slate roof.” Most walls in the catalogue are four or five times as thick! The Gordon Haumont house, built in Nebraska (USA) in 1885, also serves to illustrate the load bearing capacity of turf walls. This mansion-like house had two stories and stood for 87 years before it was demolished. It is likely, therefore, that turf walls in early medieval buildings in the terp region, could have served as (durable) roof-bearing elements.

In Iceland, too, clay is considered a desirable ingredient, though its value, there, lies mainly in its waterproofing qualities. It seems that turf cut from peat bogs was preferred for this in Scotland, because the material’s high vegetable oil content repels water after the turf has dried. Peat turves have often been documented as an underthatch in Scottish blackhouses (see 3.4.5).

To test clay turf’s waterproofing qualities, Walker and McGregor carried out a different test at the British Research Establishment (BRE) at East-Kilbride (SCO). They subjected a well-dried clay turf panel, 10 cm thick, to 5 years average Scottish rainfall in 3.5 days: “the moisture eventually penetrated the wall but not sufficiently to collect in the measurement containers. The BRE technicians and scientists were surprised since the same test carried out on grade A engineering bricks results in water penetration measured in litres.” Perhaps salt marsh turf also makes a good thatching material.

**3.1.3 Wall construction**

**3.1.3.1 Wall dimensions**

Due to a lack of cross-sections almost all of the wall thicknesses in the catalogue, had to be taken from excavation plans. This is not the preferred method, because sagging, erosion and other post-abandonment processes might lead to different thicknesses being visible at different levels. This can be observed in the plan of Den Helder building 1 (figs 2.49 and 2.50). The excavation levels have been taken down to different heights on either side of the cross-section, resulting in different wall thicknesses in the plan. Thus, cross-sections are an essential tool in the documentation of turf walls (see also 2.9.2).

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75 Personal correspondence Bruce Walker (building historian, formerly Historic Scotland and University of Dundee), 29 December 2009.
76 Walker (2006, 35-36); with kind permission, the drawing by Walker has also been reproduced in Postma (2010, 21).
77 Personal communication Helgi Sigurðsson (professional turf builder), Skagaþforður Heritage Craft School, Tyrfigsstaðir (ISL), June 2009.
Nevertheless, wall thicknesses established for the catalogued buildings give a fairly consistent impression. Gerrets & De Koning (1999, 111) have previously pointed out that small outbuildings and main buildings have different wall thicknesses. From the buildings studied in the course of this thesis, it is clear that the smallest outbuildings, such as sunken-floor huts, generally have a wall thickness of c. 45-50 cm. These have not been included in the catalogue (but see footnote 56). Larger outbuildings have wall thicknesses of c. 50-60 cm (Wijnaldum 27; Foudgum outbuilding; Hallum 7). Exceptional are the buildings at Leens, which all have a wall thickness of 80-120 cm, irrespective of their size.\(^79\)

For the main buildings, wall thicknesses vary from 70 cm (Wijnaldum 22 and 34) to a maximum of 120 cm (Leens 1a, 1d and 3a), but most buildings show wall thicknesses of 80-100 cm. In several cases the wall thickness indicated in the plans is so variable that the original width cannot be determined. This is particularly clear in Leens building 1f (80-120 cm), but also in many of the buildings excavated at Hallum (Tuinstra & Veldhuis in prep.). The wall thickness suggested for Den Burg building EMA-7 probably was more similar to that of its neighbour (EMA-8; c. 100 cm (\(?)\) instead of 35-40 cm).

Another feature discernable in some of the buildings, is that a short end wall is thicker than the long walls. This might be an indication that the building was gabled (see 3.4.4). A thicker section of turf wall in Hallum building 7, may have been reused from an older building.

It has been argued for the Northwest German coastal region, that the turf walls are no more than low mounds. Such wall banks have been noted in cross-sections through 2\(^{nd}\)-3\(^{rd}\) century AD buildings at the terp site of Tofting (fig. 3.10). They differ from the vertical-sided turf walls excavated in Denmark. Bantelmann (1957, 44-46), therefore, considers the possibility that the low banks are a regional variation. They might reflect a lesser dependence on turf and other earth-based materials for the construction of walls in Central Europe. The fully fledged turf walls in Danish Jutland, then, could be related to a more northerly tradition. In recent years, this regional distinction has been incorporated in a discussion on the origin of early medieval migrants in the Dutch terp region (Nicolay 2005, 75-76). Nicolay’s conclusions are based on artefactual evidence as well, but the turf wall argument can be nuanced.

From a technological point of view, it is doubtful if low turf banks offer any significant advantage. The banks will obviously prevent rainwater from collecting around the timber elements, but when the posts are placed in the banks, as suggested by Bantelmann, the turf itself will constantly keep the posts damp. This would nullify most of the benefits. To prevent this the posts would have to be placed on the inside of the (freestanding) banks – this will still not prevent the posts from rotting at

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\(^79\) The sunken-floor huts have thinner walls.
ground level though. The construction suggested by Bantelmann, therefore, seems useful only for creating more distance between high groundwater levels and the aboveground timber sections. It is unlikely, however, that high groundwater levels were a problem on the terp of Tofting.80

A more convincing argument against Bantelmann’s interpretation, lies in the plan of one of the excavated buildings at Tofting (fig. 3.11). Even though cross-sections through this building serve as the basis for his reconstruction, the plan clearly shows that the turf and wattle walling belong to successive buildings. The first building is constructed with turf-built walls and has a rounded short end.81 The posts and stakes of the second building have been placed right through the heart of this wall – or whatever remained of the wall by then – and continue onward beyond the turf wall to form less rounded corners. The rounded end is the only turf wall section not to be distorted by this palimpsest. Indeed, this section of the wall is entirely without timber elements, which means that originally it must have stood up to eaves height and probably was not a low mound.

The published cross-sections demonstrate that turf walls in the Dutch terp region are often preserved up to heights of 30 cm or more. The long walls of Leens building 1 stood to heights of 90 and 120 cm! Considerable wall heights have also been noted in more recent excavations (Wijnaldum 5: 60 cm; Leeuwarden 7: 60 cm; Hallum 13: 70 cm). No indications, however, have been found for the original wall height of turf walls.82 On the basis of well-preserved wattle screens and dimensions provided in historical descriptions of Scottish creel houses, a wall height of 1.8-2 m may be suggested (see 3.3.2.1). Tests with clay (salt marsh) turves indicate that with thicknesses of 70-120 cm, such walls could have been load bearing and quite durable (see 3.1.2.2).

Because none of the walls were dug into the underground, their good preservation means that several decimetres of floor surfaces, maintenance debris, tumble and perhaps even thatching materials may also have been preserved. These layers are absolutely absent in buildings from the sandy regions. Excavations in the terp region, therefore, may provide a unique opportunity to study the layout, use and maintenance of ancient buildings – these opportunities have not previously been explored.

It would be interesting to establish whether individual layers can be identified and interpreted through the use of thin sections (slijpplaatjes). Depending on the state of conservation – this can be very good in terpen – archaeo-botanical sampling may shed light on thatching materials (see 3.4.5). In Greenland, Iceland, Faroe, Norway and the British Isles, archaeo-entomological research has already demonstrated that turf buildings are a potentially very rich source of information (e.g. Buckland et al. 1993; Smith 1996; Panagiotakopulu 2004; Kenward & Carrot 2006).

3.1.3.2 Interior partitions

Only in a few cases have indications for turf-built interior partitions been found. The clearest example is shown in the plan of Leens building 3c (fig. 2.30). Although it cannot be ascertained through cross-sections that the wall is indeed con-

80 Rainwater can run off towards the sides of the terp. Moreover, if high groundwater levels had been a problem, it might be expected that the interior posts would also have been encased in turf, which is not the case. Nevertheless, the topic of wall banks needs further looking into, because low banks have been used for two sheep cots surveyed by Klaas Uilkema (KU-76, KU-187; see Van Olst 1991b, 104-105, 388-389) and buildings depicted on a 16th century painting of the town of Zierikzee (ZL; Van Heeringen 1995, 131-133). An important question that would need to be answered is whether these are the remnants of earlier turf buildings, a rudimentary (non-functional?) feature or if they actually served a specific purpose.

81 This is the only Continental turf building with rounded ends that I have come across so far. Rounded corners have been noted for some of the buildings at Leens, but these are angular on the inside.

82 A possible means of calculating an original wall height might be provided by Wijnaldum sunken-floor hut 4 (fig. 3.48; Gerrets & De Koning 1999, 112-113). The structure has been partially dug into the side of the terp, leading to one of the walls being placed at floor level, while the wall on the opposite side is placed higher. The height difference is reflected in the wall thicknesses, so it can be calculated at which thickness to height ratio both walls reach the same height. In order to do this, however, the site’s original documentation will have to be checked, because the dimensions provided in the hut’s description do not correspond to those in the drawing.
nected to the outer wall, this does seem to be the most likely interpretation. With a thickness of 80 cm the partition wall is slightly thinner than the outer wall (100 cm). A second, but apparently more complex interior partitioning is shown in the plan of Hallum building 3 (fig. 2.8). The plan provides little certainty on the wall’s thickness. A third interior partition is recognisable in Hallum building 13 (fig. 2.14). Wijnaldum building 5b also appears to have a turf-built partition (fig. 2.40). The outer wall is 75 cm thick, while the partition does not reach beyond 65 cm.\(^{83}\)

The discrepancies in the thicknesses of interior and outside walls are an interesting feature. Assuming that both sections were built to the same height – or at least that the outer wall was not higher – it might be considered an indication that the outer wall was put under greater stress. An obvious explanation would be that the outer wall was load bearing and the interior wall was not.

Interior partitions are a characteristic feature in the (presumed) living areas of contemporary timber buildings. It is perhaps not surprising that the buildings mentioned above are all relatively wide (4.8–5.7 m). This distinguishes them from contemporary outbuildings, as will be discussed in more detail in the next chapter (see 4.1.2).

3.1.3.3 Wall faces

Almost all of the well-preserved turf walls show straight vertical wall faces. This has also been noticed by Gerrets & De Koning (1999, 106) for Wijnaldum: “Often in reconstructions of sod buildings the top of the walls is smaller than the bases. At Wijnaldum-Tjitsma, however, sections of sod walls have clearly not a conical shape but are completely vertical inside and outside for all sod buildings, during all occupation phases.” For the catalogued buildings, battered wall faces are only shown in the cross-section of Den Helder building I (fig. 2.50).

As Gerrets & De Koning state, reconstructions of turf buildings are often provided with battered outer wall faces. It remains unclear, however, why the walls should get thinner as they rise. No convincing archaeological evidence is available to support the notion and historically documented structures show vertical wall faces (figs AD, 3.51 and 3.50). The same goes for turf buildings in Iceland. It appears that the idea of turf walls needing battered faces finds its origin in the assumption that turf walls cannot be load bearing, or even self-supportive.\(^{84}\) It is clear from the discussion of tests with clay turves, that this is incorrect (see 3.1.2.2).

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\(^{83}\) An interior partition-like wall has also been noted for the peat turf building excavated at Neerwolde (fig. 1.4) and several buildings at the fortified site of Oost-Souburg in Zeeland (Van Heeringen 1995, 130-135). At Neerwolde, the interior wall overlies a couple of fire places, which suggests that it is not an original feature. Perhaps it once functioned as an outer wall.

\(^{84}\) Battered wall faces are also suggested by Noble (1984, 77-78 and 2003, 47), Izereef & Van Regteren Altena (1991, 76), Huigs (1992, 57-41, 55-57) and Van Heeringen (1995, 130). Van Heeringen (1995, 132) follows Voskuil’s (1979, 16) lead in assuming that “turf walls cannot be built up higher than they are wide” (my translation). Perhaps such a view forms the backdrop for tapered cross-sections in many of the reconstructions. Van Heeringen does not mention battered wall faces being observed in cross-sections during excavation (but see the
Not only is there no specific need to apply battered wall faces, it can even be argued that a tapered cross-section is undesirable. It is of relevance, in this respect, that the turf walls were probably not supposed to grow green again after construction. This might seem counterintuitive at first, because a turf’s strength is largely dependent on the root matter. This has given rise to the idea that “continued root growth is an essential part of the way turf walls stand” (Noble 2003, 48). There is no archaeological evidence to support this.

The Icelandic turf building tradition suggests that bare walls are actually more likely. There, turf walls are always trimmed and not allowed to go green again, if it can be prevented (fig. 3.52). If the outside does get covered with vegetation, excess moisture is held within the wall. This leads to fungal growth on the inner wall face and the dead vegetable matter in the wall’s core to rot. Because Icelandic walls are built with separate wall faces, which tie into the wall’s rammed earthen core, the loss of dead vegetable matter will ultimately cause structural failure. The roots of new vegetation will not penetrate deep enough to maintain the bond between wall face and earthen core.

Early medieval walls in the terp region do not have separate wall faces, but the old root mats do appear to have been of importance to the wall’s horizontal solidity (see 3.1.2.2). Water can enter a sloping outer wall face relatively easily from the side, through seams, porous vegetation mats and sandy layers. This is less likely to happen with vertical wall faces. Presumably, the common occurrence of vertical wall faces in the dataset indicates that the original vegetation was not desired to regenerate.

Vertical wall faces alone are not enough to prevent a wall from turning green again. It is also necessary that the turves are dried sufficiently before construction and they must be able to dry out further after the wall is finished. Trimming the wall faces helps to get rid of protruding vegetation and allows rainwater to run off as swiftly as possible. In Iceland, much of the trimming and smoothing is done with a special turf cutting scythe (Sigurðardóttir 2008, 10), but a sharp spade or pairing iron (kantensteker) may also be used. Hay-knives are known to have been used for this purpose in Ireland (Ó Danachair 1957, 63).

3.1.3.4 Technical details

The current dataset does not enable a detailed study of technical details. Such details may provide insight into wall footings, turf types (i.e. species and shapes), bonding systems, additional strengthening, mortars, renders, repairs, extensions

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85 Sigurðardóttir (2008, 10-12); personal communication Helgi Sigurðsson (professional turf builder), Skagafjarður Heritage Craft School, Týrfingsstaðir (ISL), June 2009.
86 A turf wall at Kloesewier (FR) was noted to have been placed on a wattle screen (De Langen 1992, 118). The use of stone foundation courses is not common in the Netherlands, due to a lack of stones (at least in the terp region and peat areas). Some buildings, particularly the wall-ditch structures in the Assendelfter Polders (see 1.3.2.1), are characterised by the use of a ditch. Sometimes the ditch must have surrounded the wall (fig. 2.47), but in other buildings the ditch and the wall appear to have followed the same course (fig. 1.7).
and so on. It is likely that regional as well as chronological developments will be discernable. Technical differences can also be expected between buildings and other turf-built structures, such as house platforms, small outbuildings, water wells and dykes.

An interesting peculiarity, previously pointed out elsewhere (Postma 2010), concerns the use of herringbone patterns. Such patterns are common in Iceland (figs 3.57, 3.58 and 1.12) and Scotland and are often seen in turf-lined water wells in the southern North Sea area as well (figs 3.12 and 3.13). For the Continent, however, it has not been observed with certainty in any excavated building! Only the plan of the building at Tofting (DEU) suggests that diagonally (or vertically) stacked turves might have been used (fig. 3.11). Perhaps it is significant that this is the only building with a rounded short end wall. The only herringbone pattern to have been documented in cross-section, and not relating to a water well, is a ‘garden wall’ at Archsum in Sylt, Germany (fig. 3.14). Possibly, a Roman Iron Age house platform at Wijnaldum was also constructed using a herringbone pattern (Gerrets & De Koning 1999, 99).

So far, turf walls have seldom been documented through longitudinal cross-sections. This may have had a biasing effect on the occurrence of herringbone patterns, but it cannot explain everything – transverse cross-sections confirm the use of horizontally stacked turves, even though bonding systems cannot be made out exactly (e.g. fig. 2.12). More detailed documentation is needed to establish how clear-cut the discrepancy truly is. An interesting research question is whether the use of a herringbone pattern is a regional characteristic or a chronological (c. 9th–10th century?) development.87

3.1.3.5 Maintenance (incl. life span and recycling)

Due to the lack of technical details in the current dataset (see 3.1.3.4), little can be said on maintenance work and repairs in early medieval turf buildings specifically. However, the practise of raising *terp* and floor layers during occupation, as is clearly illustrated by cross-sections from Hallum (e.g. fig. 2.15), suggests that detailed information on these matters is likely to have been preserved in turf structures in the *terp* region. Perhaps some of this unique information can be collected during future excavations, through a detailed documentation of well-preserved buildings. But a general knowledge of turf construction will be indispensable if one is to distinguish between original features and later alterations. For the benefit of an early recognition and correct interpretation of turf structures, a rough framework of maintenance needs and practises is outlined in this section. It has been based primarily on historical and ethnographical analogies.

The upkeep of turf buildings in Iceland, teaches us that timely maintenance is crucial to their durability.88 In particular when leaks start to form in the roofing material, too much water will penetrate into the wall core if repairs are not carried out soon enough. This causes the turves to break apart, for most types, only Glaumbaerjarhnaus is comparable to Continental construction methods. It still differs, however, in being used in combination with *strengir*. Such intermittent courses with strips of turf have not been noted elsewhere. The herringbone pattern in Scotland may be what is denoted feal (fale/fail etc.) in historic descriptions.89

87 It should be borne in mind that different types of turves may have been used for more or less similar herringbone patterns. In Iceland there are at least four: klímbruhnaus, klumbra, kviðhnaus, Glaumbaerjarhnaus and kantsnidda (Sigurðardóttir 2008). Because of the use of separate wall faces and an earthen core

88 Personal communication Helgi Sigurðsson (professional turf builder), Skagafjörður Heritage Craft School, Tyrfingststær (ISL), June 2009.
because water expands with frost and fungal growth quickens the decomposition of root matter (Sigurðardóttir 2008, 12; fig. 3.15). Eventually, the moisture will also affect the primary timber structure. A similar exponential increase in the deterioration of organics, has also been noted with regard to thatch on Scottish blackhouses (see 3.4.5).

Because of the ease with which a building’s decline can suddenly speed up, the life span of turf structures is impossible to capture in a universal estimate. Well-built structures may collapse within years if their maintenance is insufficient, but poorly built structures can stand for decades if they are properly kept. Life span estimates based on experimental archaeology and historical descriptions by travellers, vary from 3 to over 40 years. There are many examples, however, in which far greater life spans have been documented. The two-storey Gordon Haumont house in Nebraska (USA), for example, stood for 87 years before it was demolished (fig. 3.16). Even some of the more modestly built plaggenhutten in the Netherlands, constructed from bolsterveen peat turves, are known to have lasted up to 100 years (Gerding 1995, 23).

Especially when buildings comprise more than a single room, repairs, interior reorganisations and extensions may lead to a considerable ‘joint life span’. Such a “steady development,” as Ólafsson & Ágústsson (2006, 27) put it, has also been noticed in turf farm complexes in Iceland and Greenland. Because the building as a whole was never entirely demolished, the farm at Glumhp (ISL) can be considered to be well over 300 years old (figs 3.52 and 3.57). Yet, most individual building materials will not be much older than a number of decades.

An important contextual difference between ancient structures and the majority of modern buildings, is that the former functioned in traditional agrarian societies, in which annual cycles directed many aspects of life. Like peat cutting, cutting turf for construction purposes probably was a seasonal activity, most likely conducted in springtime (see 3.1.2.2). This way, wintertime damage to roofs and walls could be repaired with new thickly rooted turves. The oncoming summer provided ample time for the wall turves to dry out and settle and the roof turves to bond, before the fall and winter storms returned and put them to the test.

Although repairs to turf buildings may be more frequent than in modern buildings, they need not be seen as overly time consuming affairs. When repairs are carried out on Icelandic turf buildings, only the damaged parts are replaced. These can simply be cut out with a spade and then built back

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89 Wilkinson 2009, 17; with several references.
up again (fig. 3.17).\textsuperscript{90} If the remaining wall sections are solid enough, no heed is paid to bonding the old and the new turves together. In fact, an entirely different bonding system may have been used in the new section, depending on the quality of the available turf and the repair man’s own preferences.

A similar ‘flexible attitude’ towards maintenance work has been noted for turf buildings in Scotland. Wilkinson reproduces a late 18\textsuperscript{th} century description of turf houses in East Sutherland, in which maintenance work is shown to have had an add-

\textsuperscript{90} Personal communication Helgi Siguðsson (professional turf builder), Skagafjörður Heritage Craft School, Tyrfingsstaðir (ISL), June 2009.
tional advantage: “Once in three years, all the earthy parts of these houses is [sic] thrown on the dunghill and new houses built again of the same materials.” The benefits have been more explicitly portrayed by Marshall in 1794:

“Those huts were built of sods or thick turf, taken from the pasture lands, and having remained a few years in the capacity of the walls, were pulled down and spread over the arable fields as manure; another square of rock being laid bare, and another set of sods piled up for the same purpose.”

It is doubtful whether the tenants also looked upon the repairs as a waste of time. Nevertheless, turf construction grew to be widely discouraged by landowners from the 18th century onwards (Wilkinson 2009, 18). New regulations either encouraged or demanded the use of stone for the construction of walls, sometimes with high penalties if tenants failed to comply.

The so-called Articles of Set of 1879, did the same with regard to blackhouses in Lewis, Outer Hebrides (SCO). It states that “the dwelling-houses to be erected by the tenants on their respective possessions, shall be built of stone and lime, or of stone and clay pinned and harled with lime, or with stone on the outside face, and turf or sod on the inside.” Clearly, these demands are there for esthetical reasons, not for improvements in a technical sense. On the contrary; when using stone as an outer skin rainwater is trapped behind it, causing the turf infill to decay (Walker 2006, 36).

In spite of the discouraging measures, turf continued to be used well into the 19th century (e.g. Noble 1984, 69) and even longer in the Outer Hebrides (see 1.3.2.3). Of particular interest is that old turf-related practises appear to have been upheld in some of the stone-built blackhouses, albeit in a slightly altered fashion:

“In the spring, one of the first jobs of the year was to empty the byre. In most places the easiest way of doing this was to dismantle the whole end of the byre and fork the waste into awaiting creels [wicker baskets] or a cart. In some cases the byre was big enough to allow a cart to be driven in and some had turf or specially constructed end walls to make to process less labour intensive (fig. 3.18). The manure was removed to the field where, along with seaweed from the beach, it was used to fertilise the crops (Holden 2004, 45).”

Soot from the fire place, adhering to the wall’s surface, will have further contributed to the fertil-

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93 SRO, Seafield Muniments: GD 248/38/1; reproduced in Noble (1984, 68).

ity of the turf waste. This has also been noted for thatched roofs, which were sometimes subjected to similar (annual) recycling procedures (see 3.4.5). At the same time, however, soot and warm air are important factors in preserving the turf, having a profound effect on the building’s life span (see 3.4.2).

Archaeological evidence from Scottish sites suggest that this ‘flexible maintenance attitude’, as one might call the recycling practises described above, is not a recent development. In a probable Late Norse longhouse, excavated at Sandwick on the island of Unst, it appears that “the north gable is of less strong construction than the other walls and it has been suggested that this was to enable it to be dismantled at the end of winter to facilitate cleaning out the byre. This feature has also been identified at Jarlshof House 6 (Phase VI) and at Underhoull” (Graham-Campbell & Batey 2005, 184; all sites located in Shetland).

For Jarlshof it might also be suggested for the main building. In its first phase, the short end wall of the byre is only represented by a row of post-holes, while the other wall sections are built of (turf and) stone. Possibly these postholes relate to a more easily removable short end wall. It is likely that this was constructed of turf, because, by the time the byre was extended, so much earth had collected outside that the byre fluids drained in the wrong direction.

Perhaps a flexible maintenance attitude can also be recognised in a Dutch scene described by Klaas Uilkema. Uilkema was an early researcher and surveyor of historical farms, who had taken up a keen interest in plaggenhutten (Van Olst 1991a, 226-228). In one of his notes he writes:

“A turf hut is often provided with a stone wall by lifting the wall plate and the whole roof with it, by means of a lever. This was done gradually, first on one side and then also on the other. Underneath the lifted wall plate, a stone wall is built up. Like so:”

“When the wall is mortared and it supports the wall plate, the pole is pulled out from underneath (kicked out). Prior to this, a beam is laid down underneath the wall plate and between the walls. The house now has beams [i.e. crossbeams]: Above, these beams and the bricks, too, are indicated with dots. Afterwards the house straight away has become higher.”

Whether this classifies as maintenance may be open for discussion, but the practises described above do illustrate how traditional buildings may have been approached in an entirely different manner than people in industrialised societies are

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95 (Hamilton 1956, 107-109, 158). The main building’s initial construction has been dated around 800-850 AD, “although not necessarily beginning much before the mid-ninth century” (Graham-Campbell & Batey 2005, 156). The period II extensions are placed in phase V, which dates from the late 11th-early 12th century, indicating a period of use of c. 250 years (Graham-Campbell & Batey 2005, 180).

familiar with. Quite unlike modern buildings, turf buildings are alive and in need of constant attention. The same probably applied to many other organic buildings in the ancient North Sea and North Atlantic region.

Maintenance work is indeed still carried out on buildings today, but we strive to avoid it through the application of imperishable materials (e.g. brickwork, ceramic roof tiles and synthetic window frames). It is a process that may have started in the late medieval period, when posts were first (commonly) placed on pad stones. As a result, the close and dynamic relationship between people and their houses has eventually been lost. With regard to turf construction, a flexible maintenance attitude appears only to have survived as part of the Icelandic turf building tradition, because only turf does not allow such approach to be avoided.\footnote{The differences are also clear in modern approaches to historical buildings. Historical timber buildings allow ‘passive’ conservation, providing that raised post footings have been used. In the worst-case scenario, timber that is exposed to the elements may be impregnated with artificial preservatives (e.g. PEG). For turf buildings, conservation in this manner has only ever been undertaken for the excavated Adalstratti longhouse in Reykjavík, Iceland (on display in City Museum); it will not be possible with surviving turf buildings. The integrity of historical turf buildings in Iceland, is safeguarded though careful documentation before maintenance work or renovation commences. Inevitably, this method of conservation implies the gradual replacement of all original building material. This should not be regarded as a loss, however, but merely as the continuation of the building’s own history, as is clearly illustrated by the discussion of the Glaumbær farm at the beginning of this section. By adhering to the same traditional building techniques, the original ‘lively’ character of ancient buildings has been preserved in turf buildings in Iceland. It is also recognisable in the thatch of Scottish blackhouses (see 3.4.5), but with regard to turf walling blackhouses have lost their relevance when the transition to stonework was made. Only historical descriptions and rudimentary features now bear witness of}

3.1.4 Living conditions

In the Netherlands, conventional views on living conditions in turf buildings are mainly based on descriptions of early 20\textsuperscript{th} century plaggenhutten (lit. turf huts). In the same period, the production of stone coal and artificial fertilisers was taking over from large scale peat exploitations. As the price of peat fell, poverty stricken peat labourers (often squatters) were seldom able to afford more than such simple turf-built ‘huts’ (fig. 3.20). These were either improvised shelters – sometimes they were built overnight – or existing buildings deprived of timely maintenance. The sheer contrast between the situation in the peat lands of Drenthe and surrounding areas, and the ever more thriving areas along the west coast, drew the attention of national media. The dreadful appearance of primitivid-looking earth houses served well to portray the dilapidated state of its occupants (fig. 3.21). Life in turf-built structures has now become inextricably linked to the dramatic images of these plaggenhutten.

Indoor humidity and exposure to dust and soot, obviously was higher in early medieval turf buildings than is acceptable in modern society. The use of turf specifically, however, does not appear to have made matters any worse. This is suggested by recent Dutch research on the indoor environment of Icelandic turf buildings. Van Hoof & Van Dijken (2008, 1029) conclude that “indoor biological contaminations induced by turf seem to have had a minor influence on human health. The amount of invertebrates was very small, as is common in cold climates. This number was even smaller due to the saline material surface of the turf walls. None of the invertebrates found are known as perpetrators of diseases.”

Instead of any problems deriving directly from the use turf, the burning of biomass fuels and insufficient ventilation proved to pose the greatest health concern, because “exposure to [the] combustion products can lead to lower respiratory infections, chronic obstructive lung disease and lung cancer, and is associated with tuberculosis.” These problems would not have been any worse if turf was used instead of wattle and daub, or bricks, for that matter. Perhaps even the contrary can be argued, because the good thermal qualities of turf reduced the need for heating and thereby also the amount of harmful combustion products. Some of the Icelandic turf buildings do not have a fire place

old maintenance attitudes. In Iceland, the flexible maintenance attitude has survived along with the historical buildings and the turf building tradition, and it should therefore be regarded as an integral part of its cultural heritage. In this respect, Icelandic turf construction forms a unique material (i.e. the buildings) and technical (i.e. the construction methods), but also conceptual (!) relic of ancient building practises.
in the living area at all, because warm air from the kitchen and heat generated by the inhabitants was sufficient in these well-insulated buildings. Moreover, Van Hoof & Van Dijken state that in turf dwellings “the building material absorbs suspended matter from the air due to its hygroscopic character.”

3.2 PRIMARY TIMBER STRUCTURE

3.2.1 Timber

3.2.1.1 Species

Of all catalogued sites, only Leeuwarden has produced a reasonable amount of information on timber species. Hänninen et al. (2008, 206-209) conclude that oak (eik; Quercus) is the prevalent species in the Roman and Carolingian period, although in the Carolingian period ash (es; Fraxinus) appears to be nearly as important. Other species include birch (berk; Betula), alder (els; Alnus) and willow (wilg; Salix). Due to the absence of woodland in the salt marshes, all timber has either been imported or washed ashore. It is noticeable that the oak timber was of inferior quality in the Roman period. Its gnarled (knoestig) appearance suggests that the close-by (c. 5 km) peat soils served as the primary sourcing grounds for timber, although larger pieces might have been imported from further away.

Timber analysis at Hallum (FR) has mainly focussed on one building (Hallum 7; fig. 2.11). It is a small but well-preserved turf structure, dated to the (Early) Merovingian period (c. 6th-7th century AD) and with interior dimensions of 8.4x3.7 m. Four of its main posts have been analysed by Bottema-Mac Gillavry (in prep., 184). Two are oak, 14.5 and 12 cm in diameter of which 4-5 cm is sapwood. The two remaining posts are birch, 3.5-9.5 cm wide and 5-5.5 cm thick, and hazel (hazelaar; Corylus), 4.5 cm in diameter and with a branch that has been removed with an axe. Because this building is small in comparison to other buildings with arcade posts (binnenstijlen), it is uncertain whether the use of different timber species is also representative of larger structures – presumably, the best materials were preserved for the most important buildings. Bearing this in mind, however, it is interesting to note that the results do not contradict the picture at Leeuwarden.

A lesser reliance on oak as a primary building material, has also been noted for other settlement sites. 98 Hänninen et al. (2008, 207) compare the situation at Leeuwarden to Sneek (FR), where a building from the 1st century AD has been excavated. This building was constructed with main posts of alder (52%), birch (36%) and oak (12%). Oak played a more important role at Leeuwarden and Hallum, but it is clear that an absolute preference for oak was not the case at any of these sites.

Unfortunately, too little information is available to draw firm conclusions relating specifically to turf construction in the Early Middle Ages A and Merovingian period (EMA-B). The data from Hallum suggests that the situation was not very different. This could reflect an incapability to obtain suitable timber, but it can also point towards the existence of less strict building requirements than archaeologists might expect.

3.2.1.2 Secondary use (incl. ship’s timber)

At Leeuwarden, oak (Quercus) in particular shows signs of secondary use (Hänninen et al. 2008, 209) and indications were found at Wijndalum for the secondary use of timber on a large scale (Gerrets & De Koning 1999, endnote 60). Although archaeological evidence is still scarce, it can be expected that reusing old timber in new structures was common practise in past societies, not just in the woodless terp region. Analysis of the timber from (mainly) water wells at Middaren, a large settlement on the northern tip of the Drenthe plateau, demonstrates that timber has also been reused frequently in the sandy regions (Hänninen 2008).

A specific variety of secondary use concerns the application of ship’s timber, taken either from repaired, demolished or wrecked ships. In the terp region, reused ship’s timber has been found at reference is made to Roesdahl, E., 1982. Viking Age Denmark. London, 17-18. The Iron Age structures excavated at Rotterdard-Hartelkanaal and Spijkenisse 17-34 (ZH) also show a greater reliance on less durable timber species, in particular alder, ash and willow (Vermeer & Brinkkemper 2005, 57).
Leeuwarden (Vlierman 2008) and Anjum (FR; Bottema-Mac Gillavry in Nicolay et al. 2010, 155-162). The use of ship’s timber can also be deduced from rivet (klinknagel) finds at Wijnaldum, Hallum and several burial sites. Some of the Wijnaldum rivets come from datable layers, all from periods between 425-850 AD (N = 33). The datable rivets from Hallum also fall within this time frame.

It is hard to relate ship’s timber directly to the construction of buildings. At Wijnaldum, the rivets were found high up on the terp. This makes it likely that they relate to activities within the settlement, rather than being a by-product of ship construction (Reinders & Aalders 2007, 23). In a settlement context, however, ship’s timber may also have been used as a fuel source. Only at Leeuwarden can ship’s timber be linked directly to the construction of a building (building 4, Roman Iron Age), but it does not concern the building’s primary structure.

The distribution of rivet finds, in general, is limited to coastal areas around the North Sea and Baltic Sea and stems from a Scandinavian ship building tradition (clinker-built ships). Finds are known from Russia, Scandinavian countries and England. Scotland has so far been an empty spot on the map, but rivets have been found there in several Early Viking Age (c. 9th century AD) burials and settlements.

Concerning the last category, Graham-Campbell & Batey (2005, 167, 173) mention the Brough of Birsay and Pool in Orkney. The long building at Pool is thought to have had a turf-built superstructure, on what appears to be a stone-faced footing. The artefact assemblage is dominated, as the authors put it, by iron items, mostly rivets. A similar situation characterises a sub-rectangular building at the Brough of Birsay. It, too, has stone-faced walls, presumably with a turf backing and superstructure. According to Graham-Campbell & Batey, the building is furthermore “distinguished by the lack of any available space outside its walls – with cliffs to both sides – and by the presence in the artefact assemblage of many boat rivets. It is presumed that this indicates the re-use of ship’s timbers in the construction rather than the building of actual boats in this unlikely location!”

The reuse of ship’s timber in roof structures has also been documented in surviving Scottish buildings. An obvious example are the boat roofed sheds, in which the roof structure is made of an upturned boat (fig. 3.22). Loose ship timbers have also been noted in small cuppilled (see 3.2.2.4) structures in the Caithness district (fig. 3.23; e.g. Walker et al. 1996, 56). Ship’s timber is one of many materials recorded for the construction of traditional longhouses in the Hebridean Islands, the so-called blackhouses (Walker & McGregor 1996a, 21).

Another source of reusable timber is driftwood, but currently no evidence is available to confirm its use in buildings in the terp region. The same

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99 For Wijnaldum, see Aalders et al. (2005) and Reinders & Aalders (2007); for Hallum, Daleman et al. (in prep., 138). References regarding to rivet finds from burial sites are provided by Reinders & Aalders (2007) and Overmeer (2008).


101 For burials, see Graham-Campbell & Batey (2005, 113-142).

102 Arguably this indicates the use of a more or less intact (part of a) ship. The presence of many rivets in the building’s interior – Graham-Campbell & Batey do not specify how many were found – suggests that the ship strakes were still fixed together when they were applied to the superstructure. If these had been taken apart, to be used as separate planks, the rivets would probably have ended up outside the building.
goes for whalebone and bog oak (*eik; Quercus*).*\(^{103}\)

Whalebone and bog oak are known to have been used for the construction of blackhouses (Walker & McGregor 1996a, 21; see also 3.2.2.4). The location of the terp region, between vast expanses of peat land and the North Sea, suggests that these materials may have been collected. They appear, however, not to have been a primary resource.

It is evident that secondary use of timber occurs in areas with good access to woodland (sandy region), as well as woodless areas with access to extensive trading networks (terp region). This makes it questionable whether secondary use in itself actually reflects the availability of timber. It has been suggested that secondary use might be indicative of a timber shortage (e.g. Hänninen et al. 2008, 208), but there is little concrete evidence to support this. Moreover, pre-industrialised societies used and reused their resources more efficiently than people in modern consumer-based (i.e. waste producing) economies do.

Especially in rural communities, the use and reuse of timber probably fitted in with existing agricultural cycles. These cycles incorporate specific (annual) moments for harvesting nature’s products, including timber – consider the trimming of pollard willows, for example. As a result, people must have been accustomed to well-established, age old and efficient cycles of collecting, using and reusing timber. Most material would have been reused until all of it had been reduced to splinters and ashes or could no longer be retrieved from dug in features, like water wells. In fact, it would be far more surprising to find usable materials gone to waste without reason, even in wooded areas. An important question to ask is how this culturally integrated recycling process has influenced construction techniques in buildings (see 3.2.1.3).*\(^{104}\)

### 3.2.1.3 Shapes and sizes

Currently, very little information on timber diameters in turf buildings is available. The diameters established for Hallum building 7, discussed above (see 3.2.1.1), are rather small (2x oak, 14.5 and 12 cm, incl. 4-5 cm sapwood; 1x birch, 3.5-9.5 cm wide, 5-5.5 cm thick; 1x hazel, 4.5 cm, branch removed with axe). The birch post has such a small diameter that Bottema-Mac Gillavry consid-

\(^{103}\) The use of bog timber for construction purposes has also been mentioned by Groenewoudt (2009, 157). Reference is made to Sprengel, C., 1827. *Ueber den Ackerbau und die Viehzucht auf den Hochoomern Hannovers (= Möglinsche Annalen der Landwirthschaft 19; see pages 549-550).

\(^{104}\) Perhaps indications for this have survived in reused timber in water wells?

\(^{105}\) Bottema-Mac Gillavry (in prep., 184); my translation. The term originally used is *middenzaander*: what was meant is that the post probably was not part of the primary timber structure.
The question concluded with in the previous section, how timber reuse has influenced construction techniques in buildings, is relevant to the practical study of timber remains, but it also has important theoretical implications. After all, secondary use affects or perhaps even limits constructional possibilities. Its influence is obvious in boat-roofed sheds (fig. 3.22), because part of the building’s structure is the reused timber, but the application of loose ship’s timbers may also have had its influence. This is caused primarily by the fact that most ship types hardly incorporate straight timbers. Timbers can be straightened (or bent) through the use of fire, but this was probably not a common practise for the construction of buildings. If ship’s timber has indeed been reused in buildings, the applied construction technique must have been such that it allowed for a satisfactory incorporation of the deviant (curved) pieces.

In practise, the same can be said for newly sourced timber. Huijts (1992, 13-14) acknowledges that the availability of building materials plays an important role in the development of local construction techniques. Tradition, the building’s function, subsistence means and local economy are also of importance. Another factor, however, are the shape and size of available building materials. Huijts does not account for these, but does point out that “in nature, curved prevails over straight; as soon as the opposite is the case, human influence is recognisable.”

Modern woodland management schemes have a profound influence on timber growth. Trees are planted simultaneously, are supported with poles and their lower branches are trimmed. This stimulates them to grow straight up; naturally grown timber has a much more crooked character. This is even more so in wetland areas, like the peat belt behind the salt marshes. These peat soils, however, are exactly where most of the timber at Leeuwarden appears to have been collected and the same probably applies to many other settlements in the terp region (see 3.2.1.1). The effect that small-sized timber must have had on the construction of buildings, has previously been stressed for (Roman) Iron Age buildings in the Assendelver Polders (NH). The arcade posts (binnenstijlen) of these ‘timber’ buildings are thought to have served a roof supporting function. Therkorn (1987, 188) writes of this:

“… the posts used at all of the sites, aside from site Q, were not anywhere near what one could call massive. The roof supports usually had diameters not exceeding 15 cm [original stressing]. Some might even have been called ‘stakes’ had they not been found in a location which pointed to their being principal posts. The average post diameter at site L, for example, is 11 cm (n = 7; S = 2.39)! Posts such as these do not leave much room for a sturdy mortise; at the most, some notching may have been involved. It is equally inconceivable that the wood used for the framework of the superstructure exceeded the roof supports in diameter. One had best imagine a superstructure that was somewhat flexible rather than very solid.

If the above is accepted, superstructure frames must have been rather simple, and sometimes not totally effective.”

Because the actual posts are not preserved in the sandy region, Huijts chooses only to use straight timbers in his reconstruction models. More specifically, he states that “curved posts, for example, may have been applied, of course, but using these in a reconstruction is an admission of weakness.” For the sandy region, which form the focal point of Huijts’ research, this might be an understandable position, because excavated buildings are represented only by soil discolourations and good construction timber was obtainable nearby. At the same time, however, by using this as a starting point, one (a priori) locks out something we know very little about: the influence of the shape and size of timber on local building traditions.

The timber situation in the terp region stresses the consequences more clearly. The evidence presented in the last three sections, albeit still scarce, clearly demonstrates that the use of small diameters, softer species, reused and crooked timber, are factors that must all be taken into account. The premise used by Huijts, therefore, does not work for research in the terp region. What implications this has on the applied construction technique is further discussed in section 3.2.2.4.

3.2.2 Post arrangements and superstructures
3.2.2.1 Footings (incl. pad stones)
Post arrangements such as they appear in excavation levels, might be biased by the height difference between dug in posts and upright standing turf walls (see 2.9.2). An excavation level set relatively high in a turf-walled structure, need not show any sign of a timber inner structure (and vice versa). Furthermore, many posts appear not to have been dug in very deep, which means that they may also be missed at lower levels. Ideally, cross-sections should be used to determine the height of floor-surfaces and excavation levels should be placed accordingly to confirm the presence or absence of posts with more certainty.


107 Huijts 1992, 21; my translation.
Adding to these difficulties is the fact that pad stones may have been used to increase the life span of primary timber structures. Particularly in the woodless terp region, this could have been of value, theoretically speaking. The use of wooden ‘post shoes’ has been documented in the Meuse estuary as early as the Early Iron Age (Trierum 2005, 599). It is likely that people using such post pads were (or have become) aware of their preserving effect on posts. Yet, their use appears to relate primarily to construction on extremely soft undergrounds, mainly peat soils.

Within the research area, the use of pad stones has only been suggested for Wijnaldum building 30 (fig. 2.46). Very little information, however, has been published on this building. Without further evidence, it is equally likely that the stones supported posts which had rotted through at ground level, or served another purpose altogether. Even if the stones did serve as pad stones, it could not have been common practise; the gradual heightening of floor layers, as clearly illustrated in cross-sections from Hallum (fig. 2.15) and Leens (fig. 2.21), would have enclosed and preserved many more pad stones than the current dataset can account for – or pits should be seen where they were extracted. Apparently, assuming that pad stone ‘technology’ was available, digging posts into the ground was not considered a waste of timber.

The latter is also suggested by the fact that no other measures were taken to prolong the life span of dug in posts. Charring their bottom ends, for example, would also have helped (Zimmermann 2006, 299). Even though numerous post stumps were well-preserved in the terp layers, this practise has not been noted for any of the excavated buildings. Another preserving measure is not to remove the bark, which enlarges the post’s diameter and thus delays its decay (Zimmermann 2006, 300). The presence of bark has been noted for Den Helder building 1 (Van Es 1973a, 343), but these posts were cleft, which would have nullified any preserving effects.

If no efforts were made to preserve the timber inner structure, we have learned something important about the way people perceived the limited availability of timber – not as a major problem. Whether this was caused by good preservation conditions in the terp’s surface layers, rapid raising of floor layers, timely replacement of posts or short building life spans, remains to be investigated.

3.2.2.2 Post arrangements

Only one type of post arrangement is common in the catalogued turf buildings: (1) arcade posts (binnenstijlen). Present in far lesser numbers are (2) centre posts, (3) only wall posts and (4) arcade posts in combination with wall posts. Outside posts in combination with a turf wall have only been noted for Leens buildings 7a and 7c (figs 2.35). The limited and irregular spread of these posts, however, suggests that they are more likely to relate to maintenance work than to be part of the building’s original structure. The plan of Den Burg building EMA-7 also suggests a clear-cut distinction between outside posts and turf walls (fig. 2.48; see 3.2.2.4).

A single row of posts (arrangement no. 2) has been noted for two small turf-walled buildings at Hallum (10 and 18; not illustrated here). A similar arrangement was used in later wattled outbuildings (Hallum 21 and 22; not illustrated here). Hallum building 13 demonstrates that centre posts might be found also in wider (5.4 m) buildings, though the function of this particular post remains doubtful (figs 2.14 and 2.15).

A single-aisled arrangement with wall posts (no. 3), also appears to be restricted to small outbuildings (Wijnaldum 7 and 27; fig. 2.44). Walls posts may be characteristic of Wijnaldum building 30 as well, but with an interior width of 4 m this building is not particularly large either (fig. 2.46). Den Helder building 1 is the only building to show post arrangement number 4. If outside posts, however, are indeed an alternative for a turf wall, then Den Burg EMA-7 is not dissimilar (fig. 2.48).

In post arrangement number 1, the double rows of arcade posts generally stand 2–2.5 m apart. Their distance to the inner wall faces (or facings) varies from 80 cm to 2 m (possibly c. 50 cm in Wijnaldum 22a). This suggests that the distance from the arcade posts to the inner wall faces, is primarily determined by the total interior width of the building, and not so much by the amount of space needed in the outer aisles.

It is noticeable that two of the turf-walled Roman Iron Age buildings at Ezinge have a wider central aisle: 3.7–3.9 m (buildings 71 and 72; figs 2.3 and 2.4 resp.). In the third (Ezinge 70), on the other hand, the width is similar to that of later buildings (2 m). Two other buildings that stand out are Leeuwarden 7 and Den Burg EMA-7 (both 3 m). It is unclear what the reason for these differences is (but see 4.1.1).

The average bay size, that is the distance between post pairs, also is a stable factor: 1.7–2.2 m. The only exceptions are Hallum building 1 (fig. 2.6), which provides 2.2 m on the basis of 2 posts, and Hallum buildings 7 and 11, with respective averages of 1.3 m and 1.2 m (figs 2.11 and 2.13). For Hallum 1 it might be suggested that the slightly greater distance is the result of one of the pairs standing at an angle to the building’s central axis. This has led to similar variability in bay sizes.
in some of the Leens buildings (e.g. figs 2.20 and 2.26).

As far as the reconstruction of timber superstructures is concerned, there are two noticeable features to which specific attention has been paid in this study. The first concerns the restricted distribution of arcade posts in Den Helder building 1 and Den Burg EMA-7. The second deals with pairs of arcade posts that have been placed at an angle to the building’s central axis. Both matters are discussed in the following two sections.

3.2.2.3 Lofts

For four buildings, the partial absence of arcade posts (binnenstijlen) cannot be explained in a satisfactory manner through poor archaeological visibility: Leens buildings 1g (fig. 2.26) and 5 (fig. 2.33), Den Helder building 1 (fig. 2.49) and Den Burg’s early medieval building 7 (fig. 2.48). This section focuses on the last two.

The plan of Den Helder building 1 clearly demonstrates how both rows of arcade posts (binnenstijlen) extend as far as the byre’s gangway and then stop. This is very unlikely to have been caused by poor preservation conditions or restricted visibility, because loose stakes and two rows of wall posts can still be followed further towards the northwestern end of the building. The use of wall posts may provide an answer as to why the arcade posts are not needed elsewhere in this building. The wall posts have been described as “stout” by the excavator (quoted in 3.2.1.3) and may have been used as roof supporting posts. In any case, it is evident that the arcade posts did not to support the roof (primarily).

What, then, were they used for? For the northeastern row it can be suggested that they held in place the wattle cattle box partitions, even though only a couple of these have been documented. The byre’s asymmetrical layout, however, does not permit such an interpretation for the south-western posts. Van Es (1973a, 343) also recognised their superfluity and suggests that they “may have been used in the construction of the central gangway.” It remains unspecified, however, what type of construction this could have been. Perhaps a more satisfactory interpretation is that the arcade posts supported a loft over the byre area.

The plan of Den Burg building EMA-7 shows an overlap of two trusses between the sections with arcade and outside posts. The latter supported the roof in the wall-post section, as is demonstrated in the next section. If arcade posts were meant to do the same in the turf-walled section, there was no need for such an overlap. In other words, the arcade posts served a purpose that could not be appointed to roof supporting posts; a loft supporting function is again the most obvious. This interpretation ties in well with the conclusion that salt marsh turf makes strong load bearing walls (see 3.1.2.2).

Such an interpretation brings into question the function of arcade posts in other turf-walled buildings. It is of significance that indications for primary timber structures have almost exclusively been found in relatively narrow buildings (4.7 m or less; see 4.1.1). The discrepancy is too great to be the result of poor archaeological visibility or small sample sizes. Nor can it be argued that the byre function required a double row of arcade posts, because, similar to Den Helder building 1, cattle boxes were restricted to one side of the byre only (see 3.3.2.3). From this point of view it is not difficult to explain why arcade posts do not continue throughout Leens buildings 1g and 5.

3.2.2.4 Tied vertical posts or Celtic cuppills?

Aboveground structural elements are perhaps the most difficult features to reconstruct. Direct evidence is very rare and almost always concerns the secondary timber structure (e.g. thresholds, wattle screens and byre drain reinforcements). The most important timber finds have been discussed by Hekker (1984). Hekker demonstrates that pegged (pen-), mortice and tenon (pen-en-gat-), sometimes anchored (geborgd), and halved joints (keeperbindingen) have all been used in prehistoric times. Prefabrication of the primary timber structure, using triangulay cleft posts, has been argued for (Roman) Iron Age sites like Feddersen Wierde and Ezinge (Hekker 1984, 41). The use of slanting posts, vertical posts and even tiebeams (here: dek balken) had already been applied in some buildings well before the Early Middle Ages. No evidence, however, directly relates to early medieval turf buildings in our current research area.

In the Netherlands, prehistoric buildings are generally reconstructed with tied arcade posts (gekop-
pelde binnenstijlen; fig. 3.55b). Cross-sections through postholes and the finds discussed by Hekker do not argue against this type of construction, but it remains unclear how the superstructures were given their stability. In general, the use of earthfast posts is deemed necessary for this. As far as could be established for the terp region, however, the main posts were not dug very deep at all (e.g. Leens 1b and 1g, Wijnaldum 22). It is highly questionable, therefore, whether earthfast posts were sufficient in this exposed and windy coastal area.

Three obvious solutions have been explored: (1) stability was provided by the turf wall, (2) braces were used or (3) another method of stabilisation was used. The first depends mainly on the height and stability of the turf wall. Providing that turf walls were as strong as they appear to have been (see 3.1.2.2), this seems to be a reasonable possibility.

The use of braces (schoren), on the other hand, option 2, is less likely. Huijts has paid much attention to this and concludes that transverse braces were only introduced in the first bow-sided (Odoorn C' type) buildings in the 9th century AD. For lengthwise stability “the extra support of earthfast posts would remain indispensable to many of these [Gasselte B' type] buildings well into the 13th century A.D.” (Huijts 1992, 205). The use of true frames, therefore, meaning timber structures which are locked together in a three-dimensional form, need not be expected in early medieval turf buildings in the terp region.

For the third option (another method of stabilisation was used), valuable insights are provided through the research by building historian Bruce Walker. In a recent article, Walker (2008) outlines the characteristics of Celtic cuppill construction and the – still very meagre – evidence for its use on the NorthWest European Continent. Possibly his findings have great implications for the conceptualisation of prehistoric architecture. In essence, the Celtic cuppill is similar to cruck (kruggebint) construction, but there are some essential differences in the details of its application. Walker (2008, 73) describes it as follows:

“the Celtic ‘cuppill’ structure is not a ‘framed’ structure as utilised in the English and Welsh cruck frame [‘kruggebintframe’]. Rather it is a series of trusses [gebinten], usually with curved timbers, rigid in themselves but lightly pinned together using a series of ‘pans’ or purlins [gor-dingen], to produce an inherently stable structure.”

Its “inherently stable structure” makes the Celtic cuppill of great interest to this study. It might seem surprising if a cuppill’s non-framed and “lightly pinned together” character is considered, and yet earthfast posts are not essential for its construction. The Celtic cuppill’s lateral stability derives naturally from curving the principal posts (here: krom-stijlen) inward towards the apex of the truss. A simple tiebeam (i.e. transverse beam = dwarsbalk) absorbs the outward pressures (fig. 3.24). When several trusses are lined up without bracing, however, the structure “will have a tendency to rack,” as Walker (2005, 156) puts it, “that is lean sideways along its length.” According to Walker, the addition of turf, clay or masonry wailing may counteract this, but another solution common in cuppill construction is to place one or more trusses at an angle to the building’s central axis.

Walker (2008, 77) draws a comparison with playing cards to illustrate its effect:

“If two cards are held vertically and parallel to each other and a third card is placed on top to span between the verticals the cards collapse. It the same experiment is carried out with the vertical cards at an angle and the top card placed parallel to the ends of the cards, the third card can be supported. The same effect can be achieved by placing the majority of the cupples at right angles to the lateral wall but with one angled cupple providing the stability.”

This peculiarity has not been recognised during early surveys of Scotland’s historic buildings. As a result, many parallelogram ground plans, which may be the result of using this technique, have been recorded as being rectangular. A review of the records by Walker, shows that the Celtic cuppill has produced three typical ground plans (fig. 3.25). Similar arrangements have been discerned in most (if not all) buildings in the catalogue. The clearest examples are those of Leens buildings 1b and 1g (figs 2.20 and 2.26). It shows that an inherently stable structure could be constructed without the aid of earthfast posts, long before true frames came into use (c. 13th century AD).
The second reason why the Celtic cuppill is of interest to this study, is its ability to incorporate totally different types and qualities of building material. These materials may even be combined in a single truss. Its forgiving character is aptly described by Walker (2008, 74-75):

"According to Richard Harris, any piece of timber has to have two flat surfaces to make a successful joint. He admits that French carpenters manage with one flat surface on each timber. When Celtic cupples are studied the timbers range from four dressed surfaces through roughly squared timber, thicknessed timber, split logs to round timber and, in a surprising number of instances, the curved principals of a cuppill are formed using whales’ jaw bones [fig. 3.26]. There are also a remarkable number of Celtic cuppills formed from sections of twisted hedgerow timber [haaghout; fig. 3.27], driftwood, second-hand timber and anything else that comes to hand, skilfully pinned together to form a continuous curve with up to seven separate sections in a single curve."

Evidently, the key to combining different shapes, sizes and altogether completely different materials, lies in the ability to use several shorter pieces for a larger element. The mortise and tenon joints used in modern timber constructions would make this an unfeasible exercise, but through the ingenious use of simple pegs (pennen) it becomes a relatively straightforward task. Walker (2008, 75-76) continues on the construction method as follows:

"[forming a continuous curve] is achieved mainly by the use of clasped joints formed by flattening short sections of the timbers where the joint is to be made, holding these together whilst pegholes are drilled at angles which results in the pegs clasping the timbers together [fig. 3.28]. The pegs used are always of a harder timber than the principal timber and are square or faceted in cross-section, and slightly larger than the peghole. When driven home these pegs cut into the sides of peghole and form a grip similar to modern timber connectors thus eliminating any tendency to revolve on the peg. This effectively eliminated the need for shoulders [borsten; i.e. an upstanding ridge to prevent movement] on the joint."

The use of cuppills has not yet been studied in a wider Continental context, but many of the building plans do allow for a cuppill-based reconstruction. Van Es has suggested the use of crucks – in this context these are analogous to Celtic cuppills – for some of the buildings excavated in the Netherlands. His conclusions have been disputed by

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Huijts (1992, 119-121, 127, 165-167), but there are some historical examples of crucks from the Continent, notably in West Flanders, Normandy and the Luneburg Heath in Germany. Rare images from ancient Scandinavia, believed to represent contemporary buildings, also hint at a curved construction technique. Best-known are the Hunninge stone, which interpretation is uncertain, and the Oseberg tapestry (fig. 3.29).

The hogback stones from Scotland and England are thought to have been modelled on contemporary buildings too (Schmidt 1994, 129-159). Some of these grave covers show triangular ridge pieces (fig. 3.30), similar to the ‘crossing-over cuppill-blades’ (kromstijlen) on the Oseberg tapestry. Eaves (dakranden) can also be made out. Other specimens show roof cladding and armed Vikings (?) feasting inside (fig. 3.31). Another house-shaped art piece, apparently influenced by the same architectural tradition, is the Polish Cammin casket (Schmidt 1994, 137). Arguably, the same argument may be applied to certain (Scandinavian) objects found in the terp region, such as the early medieval sword pommel from Maarhuizen, Groningen (fig. 3.32; Knol 2010, 50).

Schmidt (1994, 129-159) discusses the evidence in relation to building customs in Viking Age Denmark, but, like Huijts, eventually concludes against the idea of cruck(-like) structures. Anno 2010, however, their arguments are in need of reconsideration. Schmidt (1994, 155), for example, states on the basis of a building survey published in the 1960’s, that “this type of construction is not [original emphasis] found in the areas settled by Vikings from Scandinavia.” This is clearly not borne out by later surveys and discussions (Dixon 2002; Walker 2008).

Huijts’ reasoning is more substantial. There are five essential arguments that he puts forward. An important observation is the introduction of double posts (dubbelstijlen) in certain areas of the buildings (fig. 3.33). This relates to the gradual opening up of the interior of Roman Iron Age and early medieval buildings; a lengthy process spanning several centuries. In his first argument, Huijts (1992, 121, 167) points out that (1) when this ‘new’ construction method was introduced, it was not applied to the entire building at once, even though there where no technical impediments that prohibited this. He does not, however, consider a
functional impediment. The causal relation between arcade posts and lofts, demonstrated for the early medieval terp region in the previous section, provides a more obvious explanation for the lengthy transition. Probably only the areas without a loft were cleared from arcade posts.

Secondly, Huijts (1992, 121) states that (2) the use of double posts in itself makes one suspicious of the use of crucks, because cruck trusses are rigid by themselves and do not require a second post. There is no reason for suspicion, however, because one of the double posts may have been a wall post, connected to a tiebeam that protruded outwards beyond the (curved) principle. Attaching one of the wall posts to the primary timber structure in this manner provides the wall with extra stability and explains the ‘double posts’ in the ground plan. Huijts (1992, 167) also states that (3) a combination of curved posts and vertical walls is impossible to achieve, but there is no reason why this should be the case.

Another point Huijts (1992, 167) puts forward is that (4) the placement of the primary timber structure outside the wall, as would be the interpretation of the Odoorn type buildings (see below), would leave it exposed to the elements. As a consequence, it is argued, large overhanging eaves (dakoverstek) would have been necessary to protect the outside posts. It is rather doubtful, however, whether overhanging eaves were actually ever applied in ancient buildings at all (see 3.2.2.5). Bearing in mind that no efforts were made to prolong the life of dug in posts (see 3.2.2.1), it seems far more likely that the exposure of timber was not considered a major problem to begin with (see also footnote 119).

Huijts’ (1992, 121) strongest argument is that (5) a clear difference can be noticed between the depths and diameters of double posts and the last remaining arcade posts. The latter are dug in much deeper. Huijts argues that if one of the double posts related to a cruck-like truss, its mechanical load would have been similar to that of the arcade posts, resulting in similar depths and diameters. Instead, the double posts both show a lesser depth and diameter. Thus, Huijts concludes, together they bore the same load as a single arcade post does. The tiebeam they supported had to be of a greater diameter than the double posts for it to span the building’s interior without additional support.

This reasoning is key to Huijts’s reconstruction of early medieval and later timber buildings: a sturdy tiebeam to span the open interior and double posts support its weight (fig. 3.33). His interpretation also argues against the proposition made above, that “one of the double posts may have been a wall post, connected to a tiebeam that protruded outwards beyond the (curved) principle.” However, the hypothesis that arcade posts related to the presence of a loft provides an equally valid explanation for their greater depth and diameter. Perhaps the lofts were quite heavily loaded?115

The combination of arcade and wall posts is typical of Peelo and Wijster type buildings, which Waterbolk (2009, 73, 80-85) dates to the 1st-5th centuries AD. In later periods, arcade posts remain in use in the wide Zelhem type buildings (fig. 4.12), but they are no longer needed in the narrower Odoorn type structures. Illustrative of the latter are the buildings excavated at Rijnsburg, a coastal town in the province of Zuid-Holland (fig. 3.34 and 3.35). The longer building is of the Odoorn B type, the shorter one can be classified as Odoorn C (Waterbolk 2009, 86-89). The Odoorn types are key in a technological development that ultimately led to main posts being placed outside the walls.

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114 For an example with depth indications see Huijts 1992, 132.
115 In the terp region, the loft supporting function of arcade posts did not lead to deep postholes or great post diameters (see 3.2.2.1 and 3.2.1.3 resp.). This might have been the result of a different means of subsistence, leading to different types and quantities of stored goods, or it was simply the effect of having little timber to spare.
It is of interest that the longer structure at Rijnsburg is one of few Dutch buildings for which the use of crucks has already been argued. Van Es does so because the placement of outside posts against the wall does not allow them to be interpreted as ‘slanting outside props.’ The trusses indeed show a cuppill-like (skewed) post arrangement (compare fig. 3.25). At least two of the three complete post pairs have been placed at an angle to the building’s central axis. The skewed arrangement in itself, however, does not prove the use of arch-shaped trusses; Huijts’ reconstruction with tied double wall posts might be applicable here, as long as triangular-shaped roof trusses provided them with lateral stability (fig. 3.33).117

But the short building is different. Posthole cross-sections indicate that the outside posts formed the primary timber structure. Their depth differs little from that of the wall posts, but their greater diameters confirm that they constituted a heftier part of the structure. This building Van Es (1973b, 285) reconstructs with slanting outside props instead of crucks. If that were the case, however, much thinner outside posts would have sufficed. Another interpretation, discussed by Huijts (1992, 143) in relation to a transitional variant of the Odoorn B type buildings, is that these ‘props’ had been placed vertically. A vertical onset is indeed suggested by the cross-sections, but this interpretation would not explain their greater diameter either. Moreover, placing outside posts vertically, hardly produces a stable structure. In the short Rijnsburg building it would furthermore enlarge the span by 2 m, because the posts stand 1 m outside the wall. There is no apparent reason why this could have been desirable. On the contrary even, it comes across as a waste of timber and roofing material, rather than a technological improvement.

If the outside posts are interpreted with a more arch-like inward curve, their position makes perfect sense. The added distance from the wall probably means that the trusses only entered the building’s interior at wall top height. Thereby, an obstacle-free interior was created; the result of a growing desire, first portrayed in the selective outward movement of arcade posts in the Roman Iron Age.

The essential question to be answered in this study, of course, is to what extent Leens type buildings also had a cuppill-like superstructure. The close typological relationship between Leens and Odoorn type structures is extensively discussed in the next chapter. It suffices here to focus on the technical implications of this relationship. The plan of Den Burg building EMA-7 is of particular importance, because it comprises an Odoorn type as well as a Leens type section (fig. 2.48). No cross-sections through its outside posts have been published, but, judging from the plan, they do appear to have made up the primary timber structure. A subtle skewing again indicates a cuppill-like post arrangement.

As was pointed out in the discussion of lofts (see 3.2.2.3), the two-truss overlap between arcade post and outside posts demonstrates that both post types served a different function. Although the arcade posts may have contributed indirectly to the support of the roof, it was not their primary function. Nevertheless, the roof supporting outside posts do not continue along the entire length of the building. This means that the turf wall supported the roof at this end of the building.

A significant detail is that the footings of both roof supporting elements (outside posts and turf wall), do not stand in line with each other. The turf wall stands further towards the centre of the building. This fits in well with the image presented above, that the outside posts only entered the building’s interior at wall top height. It means that the roof structure could be the same over both parts of the building. The only difference was that the principal rafters (here: kapgeibintbenen) rested on top of the turf wall in one part, while they continued towards the ground in the rest of the building, curving further outward as they descended.

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116 Van Es (1973b, 285). Van Es refers to similar outside post arrangements he has previously related to cruck construction. Reference is made to the discussion of buildings at Wijster, Ede and Bennekom on page 276 in the same publication, as well as his original study of the Wijster settlement: Van Es, W.A., 1967. Wijster: a native village beyond the imperial frontier. Groningen (also in Palaeohistoria 11). See also footnote 112. 117 Note that this is not the case in Huijts’ reconstructions; the buildings are still dependent on earthfast posts for their stability.
A similar variability in principal length can be seen in Celtic cuppills in Scotland. The posts may form only roof trusses (fig. 3.23), but they can also be placed in recesses halfway up a wall (fig. 3.28). It is equally possible that they continued all the way towards the ground (fig. 3.26) or even were dug in (fig. 3.24). All of these are but variations on the same theme.

It is harder to prove a cuppill-like truss construction if only load bearing turf walls have been used, but the arcade posts can help with this. Because of their loft supporting function, it is not necessary for the posts to continue all the way to the roof structure. Perhaps it is altogether undesirable, if the loft space had to be kept free from obstacles. The lack of a triangular-shaped top piece meant that they lacked lateral stability, assuming that braces were not used either. Presumably, the transverse beams that tied them together spanned the width of the building. Through this, sufficient stability derived from connecting these tiebeams to the base of the roof trusses or resting them on the turf wall. Why, then, were pairs of arcade posts also placed at an angle to buildings’ central axes?

An obvious explanation is provided by Leens building 5 (fig. 2.33). Its good state of preservation suggests that the single row of arcade posts is an original feature. Here, too, however, the spacing between the posts is irregular, as if they had been part of post pairs, some of which placed at an angle. The distance between the most northerly arcade post in the byre area and the single post next to the fire place, is double the normal bay size.
This shows that the posts that supported the cattle box partitions, as well as the probable kettle support, were probably attached to either a principal rafter or a tiebeam, rather than a random point along the roof’s structure. The irregular spacing of the dug in posts, thus, reflects that the roof trusses were arranged in a cuppill-like fashion. The same must have applied to arcade posts in other turf-walled buildings.

Although this interpretation explains the odd arrangement of loft supporting posts, it does raise an entirely different question: why were the roof trusses placed at an angle? Archaeological buildings in the Netherlands are generally reconstructed with hipped roofs (schilddaken), which are stable because of their hips sloping down at either end of the building. Perhaps the above discussion indicates that (fully) hipped roofs were not so common in the early medieval terp region? The use of gables is of particular importance here – it is discussed in detail in section 3.4.4.

3.2.2.5 Roof structures (incl. overhanging eaves)

Having established the use of a Celtic cuppill-like primary roof structure (see 3.2.2.4), this section deals mainly with the elements that closed this structure, serving as a substratum for thatch. It also questions the necessity of having projecting eaves (dakoverstek). The reason for placing one or more roof trusses (kapgebinten) at an angle to the building’s central axis, as is reflected in the cuppill-like arrangement of loft-supporting arcade posts, is causally related to the use of gables and is therefore discussed in section 3.4.4. There, some insight is given as to whether the roofs were gabled (i.e. zadeldak) or hipped (i.e. schilddak).

The study of ancient roof structures almost per definition suffers from a lack of direct evidence. Indeed, no identifiable roof timbers were found at any of the catalogued sites. Roof parts recovered during excavations outside the terp region, on the other hand, are too few and too variable to sustain general conclusions on early medieval roof structures (e.g. Hekker 1984; Schmidt 1994, 89-128). Two rare Danish finds have nonetheless been included in the discussion of thatch, at the end of this chapter. It concerns a wattle gable from Hedeby and rafters from Halkær, which help to illustrate that the pitch of a thatched roof may well be less than 45° (see 3.4.5).

A general feature of the Scottish Celtic cuppills is the use of purlins (gordingen). These connect the trusses along the length of the building (fig. 3.36). It often includes also a ridge tree (nokbalk). At least one longitudinal beam is needed to connect them securely and bring in effect the stabilising effect of their skewed arrangement, but generally c. 3-5 are applied. Subsequently, rafters (sporen) are placed at straight angles over the purlins. It is also possible that the ‘rafters’ were laid on horizontally, rather like a closed series of purlins (fig. 3.24). The same variability has been noted for roof structures in Iceland (e.g. Sacher 1938). In both areas, the use of purlins as a top

![Fig. 3.36. Roof structure of the blackhouse at 42 Arnol in Lewis, Outer Hebrides (SCO). For plan and cross-sections, see fig. 3.54.](image-url)
layer appears to have been confined primarily to barns and sheds and other ‘lesser’ buildings. Applying just a few purlins to stabilise the structure and then adding a top layer of rafters, creates a greater distance between the (slightly sagging) underthatch and the cuppills (i.e. trusses). This enables good ventilation and allows soot from the fireplace to cover the most important timbers, both of which are important preconditions for their preservation (see 3.4.2).

Because the rafters are not so much needed for the stability of the roof structure, an even wider range of materials can be used than were listed for the construction of the actual cuppills (for the latter see 3.2.2.4). In Orkney (SCO), the use of flagstones (i.e. flat stones) has been recorded and pantiles (dakpannen) may have been applied for the same purpose (Walker et al. 1996, 23). Another, presumably less common method, but suitable for areas where timber was a scarce commodity, is the use of rope (fig. 3.37). The ropes are tied tightly between the purlins and the gap between the bottom purlin and the wall top bridged with flagstones or planks (Walker et al. 1996, 22-23). In the Western Isles, rope has also been used lengthwise along the roof.

Mostly, however, timber rafters have been recorded. These may come as wattle panels (vlechtwerk) or a wide range of slats (latten). Slats were the preferred method in many historically documented blackhouses (fig. 3.36). More accurately they can be denoted driftwood, cabers (palen), ship’s timber (fig. 3.23), bog oak (veeneik), brushwood (kreupelhout) and whalebones, particularly shoulder blades (Walker et al. 1996, 21-23; Walker & McGregor 1996a, 5).

Driftwood has long been the primary timber resource in Iceland, often being used in a similar manner as in Scotland (fig. 3.38). Possibly, salt in the driftwood aids in the preservation of the timber inner structure. As a top layer the use of finer timber, such as brushwood [kreupelhout], and flagstones has been recorded (Sacher 1938, 8; Ágústsson 1998, 59). The general idea of binding cuppills with horizontal timbers (purlins) and making sure that the gaps are filled before the thatch is applied, also seems plausible for the terp region.

The second subject to be discussed in this section, is the use of projecting eaves (dakoverstek). These are a common feature in archaeological reconstructions in the Netherlands, but the concept has primarily been based on the assumption that wattle (and daub) walls need to be protected from the rain. Depending on the height of the walls, the eaves (dakrand) would need to project a considerable distance to keep the entire wall dry (fig. 3.39). It has even been suggested that the wall itself was moved inward for its own protection, sacrificing, as Meijlink (2006, 215) puts it, some of the interior space of the building. The roofed space gained on the outside, might have been used for stalling cattle or as outdoor storage space. Without further evidence to support this, however, it is highly questionable whether the matter was truly of such weight that buildings were starting to be turned inside out for it.

There are two reasons in particular why the construction of large overhangs seems unlikely. First of all, the desire to shelter the outer wall of a building is not a given. This is aptly illustrated by historical farm buildings surveyed by Klaas

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118 Personal communication Helgi Sigurðsson (professional turf builder), Skagafjarður Heritage Craft School, Tyrfingsstaður (ISL), June 2009.
Uilkema in the early 19th century. Several build-
ingss still had daubed or even turf-built walls, but
none have an overhang great enough to protect
their walls from the fury of the elements (fig.
3.40). The same observation applies to the
buildings depicted by Voskuil (1979, 61-73) in his
discussion of wattle and daub walling. Throughout
the course of this study, it has remained unclear
where the notion of overhanging eaves has come
from; no relevant sources are referred to in any of
the studied publications.

Ancient renders (here: *afwerklagen*; e.g. daub)
may have been more resilient than archaeological
reconstructions have so far suggested. A possible
indication for this comes from a burnt down build-
ing excavated at Midlaren, on the northern tip
of the Drenthe plateau. Analysis of the baked daub
fragments revealed the presence of a thin (c. 3-5
mm) layer on several pieces with a flat surface. The
layer is clearly distinguishable on the basis of
its texture, which is notably finer than the daub
itself and lacks any visible signs of tempering. The
layer was applied as an additional render on the
outside of the wattle and daub walls, presumably
as a protective outer shell.

Regarding finishes on walls in historical Scottish
buildings, Walker & McGregor (1996b, 86) men-
tion the recording of a render that was “finished in
places with what appears to be a skim coat of cow
sharn [i.e. *afwerklaag van het afroomsel van mest*].
This treatment is also known in Scotland on clay
thatched roofs where it is used to provide a tough
waterproof skin.” Furthermore, the use of seaweed
in waterproofing mortars (*metselspecies*) is known
from early Roman contexts. It is possible that
similar technology has been used for the prepara-
tion of renders in later periods. Voskuil (1979,
73) notes that in the province of Zuid-Limburg,
the lower 50-70 cm of walls were sometimes smeared
with tar.

Another option is that daubed walls were sub-
jected to a more intensive maintenance cycle. This
has also been suggested for the maintenance of
thatch (see 3.4.5). Furthermore, the possibility
should be considered that daub functioned primar-
ily as an interior finish, protected on the outside by
a (more easily renewable?) turf wall. Impressions
of wattle in daub fragments have been found at
Wijnaldum (Gerrets & De Koning 1999, 109-121
Personal correspondence Bruce Walker (building historian,
formerly Historic Scotland and University of Dundee), 29
December 2009.)
This might indicate that wattle and daub has indeed been used in combination with turf outer walls in the early medieval terp region, but it does not appear to have been standard practice.

Perhaps the most substantial argument for overhanging eaves concerns Huijts’ assessment of Noordbarge building 3 (Early Roman Iron Age). It is of particular interest here, because the alternative interpretation involves a turf wall. In the ground plan, the trench of an enclosure can be seen to stop at a short distance (c. 0.5 m) from the wall trench of the building (fig. 3.41). Huijts discusses the possibility of a turf wall having filled the gap, but eventually dismisses the idea in favour of low overhanging eaves: “Such a wall setup does not agree with the walls which have posts on the outside of the ‘dividing element’ [i.e. wall trench]. The ground pressure [of the stacked turves] required these posts on the inside.” Instead, low overhanging eaves must have been used.

The assumption underlying this ground pressure argument (that turf walls sag and need additional support) is unfounded. Turf-built walls may well have served as load bearing elements, depending on the type of turf available (see 3.1.2). The placement of the wall posts on the outside, at best suggests that they were preferred not to be visible. Constructing a turf wall around them, would have offered far better protection from the elements than a 50 cm overhang.

A second argument against large overhangs is that their disadvantages probably outweighed the unprotected state of wattle and daub. In addition to the reduction of interior space (by moving the walls inwards), overhanging eaves have a negative effect on the amount, length and diameter of timber that is required for the construction of the roof. This, in combination with a larger area of thatch, adds more weight to the roof, which means that the lower part of the structure also had to be made stronger. More importantly, we may presume, overhanging roofs are more susceptible to storm damage. They can be dislodged or blown off entirely if they are not sufficiently secured in place. The construction of overhanging eaves seems less advantageous than archaeologists currently take into consideration, in particular for woodless and exposed coastal areas like the terp region.

3.3 SECONDARY TIMBER STRUCTURES

3.3.1 Timber

Little detailed information is available for secondary timber elements. It can be expected that the variety of species that was used for these, was greater than what has been established for primary timber structures (for the latter see 3.2.1.1). Furthermore, the smaller timbers are likely to have been (freshly cut) branches, whereas the larger elements may have been reused from older primary timber structures.

3.3.2 Post arrangements

3.3.2.1 Wall facings (incl. wall height)

Wall facings, as defined here, differ from wall faces in that they stand in front of the wall, instead of being part of it (wall faces are discussed in section 3.1.3.3). Wall facings on the interior side of a turf wall are likely only to have been meant as a (decorative/protective?) finishing. In several plans in the catalogue, the presence of stakes can clearly be seen along a turf wall and sometimes even the wattling has remained in situ (fig. 2.36). Little detailed attention has been paid to this matter in the publications of these buildings. This makes it hard to establish for certain whether some spacing was allowed for between the wattle and the turf. Some distance may be expected, because timber that stands in contact with turf will have difficulties drying properly, causing it to rot more easily.

Very few indications exist for the application of daub, though daub fragments with wattle impressions have been found at Wijnaldum. This suggests that the wattle may indeed have been finished off with daub in some turf houses, but it

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122 The wattle and daub remains from Wijnaldum have been dated to 425-550 AD (period I), which means that they predate the wattle and daub structures excavated at Hallum (see fig. 4.1).

123 Huijts (1992, 103-104); my translation.

124 Personal communication Helgi Sigurðsson (professional turf builder), Skagafjörður Heritage Craft School, Týringstaðir (ISL), June 2009. In the turf buildings at Elisenhof (DEU) there does indeed seem to be some spacing between wattle and turf (fig. 3.44).
cannot be stated with certainty on the basis of their descriptions (Gerretts & De Koning 1999, 109-110). Leaving the wattle as it is, has the benefit of allowing warm air and soot to reach the inner wall face, drying the turf and preventing rot and fungal growth (see 3.1.3.5). If future excavations happen to confirm the use of wattle and daub in turf-walled house, the hypothesis should be explored that the daub served mainly decorative purposes.

Excavations at Dartmoor in South-West England have yielded wattled buildings. They are more or less rectangular in plan (e.g. Beresford 1971; Beresford 1979). Many successive building phases are represented by thousands of stake holes (fig. 3.42). No indications for roof supporting posts were found, however. Therefore, there must have been an ‘invisible’ load bearing element. Younger buildings that overlie the stake holes had stone-faced walls with a turf backing. These can be interpreted as a transition from entirely turf-built walls to the solid stone walls of still younger buildings. Unfortunately, no turf remained in situ in the earliest type of buildings.

The combination of wattle and turf is well-known from contemporary descriptions of post-medieval turf buildings in Scotland, appropriately called creel (i.e. basket) houses. The descriptions illustrate that the wattle was first constructed to a height of c. 1.8 m and the turf then built up around it until a roof could be set on top of the wall. In one instance, mention is made of an oval spot being enclosed with poles. A rare example of such a house might have been excavated at Macewan’s Castle in Argyll (fig. 3.43; Marshall 1983, 137-140). This turf building has walls 75-90 cm thick, at least seven courses high, and is thought by the excavator to date from the 15th century AD. Its plan is clearly oval and no post-holes can be associated with this structure. Unfortunately, however, no indications for an actual creel-like element were noted either.

Elisenhof, an 8th-9th century AD terp site in Northwest Germany, has produced a wattle inner wall facing (Bantelmann 1975, 120-121). Again, no turf wall was noted for this building, but many of its contemporaries did have turf-built walls (fig. 3.44. The wattle section has a total original height of c. 2 m. Perhaps, regarding also the wall heights for creel houses, c. 1.8-2 m can also be suggested for longhouses in the early medieval terp region.

Scholars currently draw a fairly sharp line between turf buildings, on the one hand, and wattled...
buildings on the other (e.g. Dijkstra et al. 2008, 325; Nicolay in prep., 228-229). The examples provided above, however, demonstrate that one need not exclude the other. The combination of turf and wattle desires more attention in future excavations. When studying the matter it should also be borne in mind that upright turf walls and dug in stakes may not always be visible in the same excavation level, possibly creating a bias.

3.3.2.2 Interior partitions
Wattle interior partitions have only been noted for one of the Leens 1g plans (fig. 2.27). It is only represented by stakes; additional door (?) posts, which are often part of interior partitions (e.g. figs 2.48, 4.12, 4.5 and 4.8), are not visible. This might be an indication that the partition served primarily to fence off the byre area and not to divide the interior into two entirely separate rooms. Turf-built partitions are more common and are discussed in section 3.1.3.2.

3.3.2.3 Cattle boxes
In total, 8 turf buildings in the catalogue yielded indications for cattle boxes. These are Foudgum main building (fig. 2.5), Leens 1g (fig. 2.26), Leens 5 (fig. 2.33), Leens 7a-c (figs 2.35, 2.36), Leeuwarden 7 (fig. 2.37) and Den Helder 1 (fig. 2.49). The boxes are marked out by short rows of stakes, between arcade posts and the wall. The stakes noted in the byre area of Leens building 4a are not part of a row and the distance between them (1.4 m) may be an indication that they relate to something other than cattle box partitions (fig. 2.31). The partitions stand 1.7-2 m apart, so that two head of cattle could be stalled per box.

Noticeable features are the restriction of cattle boxes to relatively narrow main buildings and the positioning of all cattle boxes on one side of the byre. These appear to be characteristic specifically of early medieval buildings in the Dutch terp region (see 3.4.3 and 4.1.1).

3.3.2.4 Entrances
The entrances that could be discerned in the catalogued buildings, are mostly positioned in one of the short end walls (fig. 2.26). Depending on the length of the building, it seems, two opposing entrances are sometimes present in the long walls (fig. 2.33). The only entrances with in situ timber structures are those in the short end walls of Foudgum main building (fig. 2.5). In Leens building 7a, only a threshold was preserved in the northern long wall (fig. 2.35). Each of the two successive door frames at Foudgum represents a different type of construction. The doorposts were placed on top of the threshold in the building’s primary phase, whereas the door frame was constructed with the threshold attached to the doorposts in the first extension. The first type does not require the posts to be dug in, which might explain why no doorposts were noticed in many other buildings, even when the entrance itself was clearly visible.

Equally interesting are the well-defined buildings with no discernable entrance at all (fig. 2.20). If these buildings did have an opening somewhere in their walls, these might have been visible only at a higher level. For the well-preserved turf building at site Q, in the Assendelver polders (fig. 1.8), it was noted that even part of the wattled wall face continued under the threshold (Therkorn et al. 1984, 356). This also shows that entrances were sometimes constructed above floor level.\footnote{Saefel (1967, table 7, fig. 19) reconstructs the turf-walled buildings from Elisenhof with an entrance in the roof. This seems unpractical for regular buildings, but it may be an option to consider for buildings used for hay storage; compare the photograph of the Icelandic hay barn at Laufás, which seems to have had two roof entrances (Saefel 1967, table 11, fig. 27).}

3.4 Remaining features

3.4.1 Floors
The make-up of floors has not yet been subjected to any detailed research.\footnote{Saefel & Veldhuis in prep., 64; not illustrated here.} The remains of successive timber floors have been discerned in the cross-section through Hallum building 8, but no constructional details could be documented (Tuinstra & Veldhuis in prep., 64; not illustrated here). In Foudgum main building (fig. 2.5), indications were found for the use of turves as a floor and the same has been noted for buildings at Wijnaldum (Gerrets & De Koning 1999, 106). It is not known if these were covered with specific beddings or if additives were used to reduce dust levels. Walker & McGregor (1996b, 91) mention that blood may have been used for the latter.
Turf buildings may provide good opportunities for future research of floor surfaces. Because turf walls have not been dug into the underground, their presence in the excavation level indicates that floor levels are also likely to remain in situ. The excavation methodology will need to be adjusted to enable an early recognition and detailed documentation of turf buildings, but if this can be achieved ample opportunities should arise for thin section, archaeo-botanical and archaeo-entomological analyses (see 3.1.3.1).

3.4.2 Fire places

Relatively few fire places have been found, although a couple of fine examples were excavated at Wijnaldum (buildings 7 and 34; no plans published). These respectively were constructed with a layer of pottery sherds and pebbles, covered over with loam. Fire places have also been found in Wijnaldum 5 (fig. 2.40), Den Burg EMA-7 (fig. 2.48), Leens building 5 (fig. 2.33), Leeuwarden building 41 (fig. 2.39), Heveskesklooster period I-phase 1 (fig. 2.17) and at Hallum, including building 1 (figs 2.6 and 2.7). Some of these are situated in the centre of the building’s interior, while others are located near or against the wall.

The central fire place in early medieval building 7 at Den Burg, is accompanied by a squarish post which can probably be interpreted as a kettle support (fig. 2.48). Kettle supports can also be seen in Leens building 1g (fig. 2.27) and 5 (fig. 2.33), the Heveskesklooster building (fig. 2.17) and possibly Hallum building 13 (fig. 2.14). The posts line up with the overhead timber structure in most buildings, showing that they were probably attached to one of the roof trusses for additional support.

Apart from this, construction characteristics of fire places, nor their placement within the buildings have been subjected to any detailed analyses here, but some peculiarities do arise from the occurrence of a fire place in a small outbuilding at Wijnaldum (building 7; no plan published). This building has an interior width of only 3.7 m and another structure (S24) with a fire place, stood on the same platform at the same time. This raises the question if a fire place can always be taken to indicate a function as living space.

Fire places may also be present in areas or buildings used as workshops. An obvious example of such a building would be a smithy. At Midlaren (DR), hammer-slag was recovered from sunken-floor huts, implying the presence of a fire place in an outbuilding (Nicolay 2008a, 136). Excavations at Kootwijk and Putten, both in the province of Gelderland, revealed the presence of ‘outdoor’ cooking sheds (bakhuises; Blom et al. 2005, 62-63). These are small buildings, represented in the trench plan by only six postholes and a burnt patch where the fire place was located. Theoretically speaking, such a type of building may also have been used to smoke fish and meat (i.e. smoke houses). A likely smoke house or cooking shed from the research area, is the turf-built structure outside EMA-3 at Den Burg (fig. 4.5).

Of particular interest is Therkorn’s (1987, 210-214) analysis of building usage in the Assendelver Polders. Some of the excavated buildings were found to have a fire place in the byre area. The cattle stalling function is not always borne out by the presence of stall box partitions, but cow and sheep dung in the floor deposits do support such an interpretation. Also, substantial amounts of pottery sherds were disposed off in this part of the building, while the other end of the building (the presumed living area) was kept clean. In some cases, a fire place was noted in both parts of the building.

The fire places in the byre areas alternated with layers of byre deposits. This indicates that they were renewed regularly (annually?). Therkorn concludes that the byres were used for other purposes in summertime, when the animals were out in the fields.

These observations demonstrate that an interpretation as ‘house’ or ‘living room’ should be based on more than just the presence of a fire place. This need not be a problem in the terp region, because floor layers are likely to survive in situ if turf walls have been preserved (see 3.1.3.1). Analysis of the floor deposits may lead to a more detailed and a more reliable interpretation of the building’s use.

Apart from providing direct heat through radiation, which can serve a variety of purposes, a fire also emits smoke and hot gasses, which warm the air in the building. Smoke and warm air have a profound influence on the maintenance needs of organic structural elements. Warm air dries the turf walls, preventing fungal growth and delaying the
root matter’s decay. Smoke, on the other hand, covers the timbers (and the turf) with soot and tar (fig. 3.45, discouraging wood borers and other insects to infest it (Walker & McGregor 1996a, 27). It has been documented for Scottish black-houses, that thatches benefit from a lit fire in the same way (see 3.4.5). Soot particles that saturate the thatch and adhere to the turf, add to their value as crop fertilisers.

3.4.3 Byres (incl. asymmetrical layout)

Apart from the cattle box partitions already discussed in section 3.3.2.3, byres are also indicated by raised turf-built walkways and byre drains. The latter have often been reinforced with horizontal timbers, held in place with short stakes. An interesting characteristic of all three features is that they occur only on one side of the byre. This asymmetrical byre layout is clearly visible in Foudgum main building (fig. 2.5), Leens building 4a (fig. 2.31), Leeuwarden building 7 (figs 2.37 and 2.38) and Den Helder building 1 (figs 2.49 and 2.50). The cattle boxes and byre drains are always found on the right-hand side when entering from the byre end. This consistency supports the notion that the interiors of Leens building 1g (fig. 2.26) and even building 5 (fig. 2.33) are more complete than might be expected at first sight (see also 3.2.2.3 and 4.1.1).

All of these buildings date from the Late Merovingian or Carolingian period, but the asymmetrical byre is not a Late Merovingian/Carolingian invention. This is borne out most clearly by Leeuwarden building 7 (figs 2.37 and 2.38), which is older (425-525 AD). Its central aisle is a lot wider than what has been noted for other early medieval buildings (see 3.2.2.2), which gives the building a more Roman Iron Age ‘feel’ (see 4.1.1). The building from Heveskesklooster period I-phase 1 actually dates from the Roman Iron Age and probably also has an asymmetrical byre layout, though this cannot be stated with absolute certainty (fig. 2.17).

The turf-walled Roman Iron Age buildings at Ezinge do not show (clear) byre indicators at all, even though cattle box partitions and drains were clearly visible in earlier buildings at this site (figs 4.2 and 4.3). Building 72 (fig. 2.4) might belong to the recently discerned Midlaren type, but at Midlaren no indications for byre partitions have been found either (Nicolay & Waterbolk 2008; Waterbolk 2009, 72-77). The best-preserved counterparts

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133 Personal communication Helgi Sigurðsson (professional turf builder), Skagafjörður Heritage Craft School, Tyrningsstaðir (ISL), June 2009.
of Ezinge building 71 (fig. 2.3) are those of the Noordbarge type. This type does have a double-sided byre layout, at least in the buildings from the sandy regions (Waterbolk 2009, 79). Perhaps this indicates that the asymmetrical byres were introduced in the terp region in the Roman Iron Age, where they coexisted with double-sided byres for some length of time.

In the course of this thesis, asymmetrical byre layouts have not been observed in any buildings outside the research area (but see 4.3). The byred buildings excavated relatively nearby at Northwest German coastal sites, all show the well-known double-sided layout. The plans from early medieval Elisenhof (8th-9th century AD) illustrate this well (fig. 3.44). Further north, at Archsum-Melkenkop and Wenningstedt on the island of Sylt, the Early Roman Iron Age buildings also have a double-sided byre (figs 3.46 and 3.47). This is an important observation, because this region is regarded as a possible area of origin for turf-walled buildings in the terp region (Nicolay 2005, 70; in prep., 224-232; Dijkstra et al. 2008, 323-328).

3.4.4 Gables

Whether early medieval roofs in the terp region were gabled (zadeldak) or hipped (schilddak) is hard to establish on the basis of archaeological remains. The interpretation of arcade post (binnenvestijlen) as loft supporting posts (see 3.2.2.3) further complicates the situation. This is well illustrated by Leens building 2c (fig. 2.29) and Ezinge building 72 (fig. 2.4). At Leens the last arcade posts stand only 40 cm or less from the interior wall face and at Ezinge the last pair stands between the turf wall and the wattle inner wall facing. Traditionally these arrangements might have been linked to the construction gables, but such an interpretation cannot be supported if the arcade posts only reach up to the floor of the loft (= height of wall head?).

The only clear timber-based indications for a gable are shown in Den Helder building 1 (fig. 2.49). Its arcade posts have been supplemented with wall posts, which continue far towards the short end wall and can probably be interpreted as roof supporting posts. Their positions so close to the short end wall, presumably is the result of the wall being gabled. An interesting detail that strongly supports this interpretation, is that the short end wall is thicker than the other wall sections (c. 140 cm instead of 120 cm). Wall thicknesses may be influenced by many factors, like the quality of the turf, the preferred bonding system and the weight of the roof, but when variable wall thicknesses are detectable in a single building, these factors are not so likely to play a role. In that case, differences in wall heights are the most likely cause.

The causal relation between wall height and wall thickness is uniquely illustrated by Wijnaldum sunken-floor hut 4 (fig. 3.48).134 Because this building was partially built into the terp’s sloping flank, one of its walls was placed at floor level. This means that it had to be built up higher to reach the same height as its counterpart, resulting in a different wall thickness on each side of the building. Turning the argument around, we may conclude that the short end wall in Den Helder building 1 must also have been built up higher than the long walls: a gabled wall.135

134 The scale has been omitted from the drawing, because the dimensions it suggests do not correspond to those provided in the hut’s description (see also footnote 82).
135 Many Icelandic buildings have turf-built gables, but this does not seem to have resulted in short end walls being thicker. Presumably, this was not necessary because the double-faced walls are thicker anyway (c. 1.5 m or more).
There are several other buildings for which similar differences in wall thickness have been noted. The difference is clearest in the narrow outbuilding at Foudgum (fig. 2.5). Its short wall (c. 100 cm) is almost twice as thick as its long walls (c. 50-60 cm), although it cannot be excluded that the short wall is actually an interior partition. In Leens building 1b (fig. 2.20), a fourth row of stretchers appears to have been added to the east-

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136 Different wall thicknesses have also been noted in cross-sections through Hallum building 7 (figs 2.11 and 2.12). Here, however, the thicker wall is the long wall and the turves used for its construction have been taken from a different source. If both walls have indeed been used in building 7, it seems most likely that the thicker one has been reused from an earlier structure (see 2.3.6).
ern short end wall. The other wall parts show only three rows. As a result, the short end wall is c. 120 cm thick, while the other wall sections do not reach much over 100 cm. A lack of cross-sections currently inhibits any firm conclusions on the basis of wall thicknesses, but the use of gables certainly is something to take into consideration.

Elaborating on this, the height of the gables can first be discussed. It has been argued above that turf walls can be built up to considerable heights, particularly if clay-rich salt marsh turves are used (see 3.1.2.2). When the process of constructing a gable is taken into view more closely, however, a potential problem soon arises. The construction of a gable requires the turf wall to be built up beyond the maximum height of the building’s corners, which provide stability to the turf wall.\(^{137}\) The gable itself, therefore, is largely dependent on its own stability. This means that the gabled wall is more likely to become unstable than the other wall sections. Precisely how unstable, and whether this was still within the builder’s limits of acceptance, is hard to establish.

However, if a fully fledged turf gable was indeed too great a risk, there are obvious ways of avoiding instability problems. First of all, the gables do not have to be entirely turf-built; a half-hipped roof (schilddak met halve eindzijden) may have been used to meet the gable halfway. A good example of this can be seen in the last more or less complete Frisian longhouse at Warten (fig. 3.49).

Another option is that (part of) the gable was constructed of a lighter material, like timber paneling or wattle. This was common in historically documented turf buildings in the Netherlands. An interesting specimen surveyed by Uilkema in the early 20\(^{th}\) century, clearly shows how the turf part of the gable was constructed slightly higher than the other wall sections (fig. 3.50). Planks were used for the top section.

In a turf farm near Ruinen (DR), built as recently as 1920, a half-hipped roof and a lightweight gable top were combined (fig. 3.51). In this case, however, the turf-built section is of the same height as the rest of the wall. A gable setup like this would not have resulted in a thicker short end wall. It demonstrates that turf buildings with the same wall thickness all way round might still have been gabled.

Of relevance here, is that Saefelt (1967, 24) considers gables a typical feature of early medieval turf buildings in the Northwest European salt marshes. Saefelt links the “Friesengiebel” (lit. Frisian gable) to sheep breeding communities around the North Sea. The remnants of this widespread tradition are still recognisable in the supposed “Giebel-Taxe” (lit. gable tax) in England and the turf-built farmhouses in Iceland (fig. 3.52). Perhaps the Norwegian court sites may also be added to the list (fig. 3.53). These elaborate turf-built structures date from the 1\(^{st}\)–10\(^{th}\) century AD (Johansen & Søbstad 1978, 47). Their open short end walls are reminiscent of Icelandic turf buildings and probably also indicate the use of gables. At the trading centre of Hedeby (DEU), a wattle gable has been recovered from a 9\(^{th}\) century AD building (Schmidt 1994, 92-93, 122).

Unfortunately, Saefelt does not provide sufficient archaeological evidence to support his theories. Huijts’ (1992) reasoning is more substantial, but he concludes on hipped roofs for all but one of the reconstructed building types. A good reason for doing the same for buildings in the terp region, would be that hipped roofs are more aerodynamic. This might be beneficial in such an exposed and windy coastal region. But hipped roofs cannot have been a necessity, as is demonstrated by two Roman period buildings from the province of South Holland. Even though they stood close to the western coast at Kethel and the Nieuwlandse

\(^{137}\) It is sometimes assumed that the corners are the weakest points, because historic photographs often show them being held up by timber braces (e.g. Therkorn 1987, 208). It is more likely, however, that this is the result of using moist peat turves, which shrink considerably when they dry (see 3.1.2). This causes the walls to tear apart at the corners. Perhaps it also explains the corner prop found outside the peat turf building at site Q in the Assendelver Polders (fig. 1.8; Therkorn 1987, 191-192).
Polder near Schiedam, it is very likely that these buildings were gabled (Hekker 1984, 42-43).

Perhaps the construction of roof structures can further elucidate the situation for the early medieval terp region. It has been demonstrated that the roof structures on Leens type buildings, probably consisted of a series of roof trusses (kapgebinten; see 3.2.2.4). These rested on top of the wall and were connected along the building’s length with purlins (gordingen). Hips (eindschilden) could have stabilised these roofs, because they slope down onto the short end walls. Such a setup can also be seen in the hipped roof on the blackhouse at 42 Arnol (SCO; figs 3.36 and 3.54).

In half-hipped or gabled roofs, however, this simple form of buttressing is far less effective or not present at all. The purlins probably rested on the gable tops, but because of the extra height of the gables this could probably not have provided sufficient stability. Wind pressure on the roof could push the gable over. Rigid frames, on the other hand, using braces (schoren), are not likely to have been in use in the Early Middle Ages. They were probably only introduced in the lower part of buildings in the 13th century AD (Huijts 1992, 205). In other words, gabled roofs on turf buildings were not particularly stable, unless another other form stabilisation was used.

It is interesting to note, therefore, that roof trusses in lofted Leens type buildings were arranged in a Celtic cuppill-like manner. This means that one or more roof trusses were placed at an angle to the building’s central axis, creating a non-framed but still inherently stable roof structure (fig. 3.25). Such an arrangement would not have been necessary if the roofs were hipped, but the technique can nonetheless be recognised in all reasonably well-preserved turf buildings with arcade posts (e.g. figs 2.20 and 2.26) – the arcade posts reflect the arrangement of the roof trusses (see 3.2.2.4). This suggests that many three-aisled buildings in the early medieval terp region, were indeed gabled or half-hipped.

3.4.5 Thatch (incl. materials, pitch and life span)

With regard to turf buildings in the terp region, only three thatching materials have been suggested in excavation reports or subsequent discussions. These are turf, reed and straw. All three can be traced back relatively easy to the use of reed and straw in historical times or comparisons with Iceland’s vernacular architecture. When it comes to archaeological evidence, however, little certainty can be provided. The same goes for roof pitches (dakhellingen) in archaeological reconstructions. It is commonly assumed that reed or straw thatched roofs need to slope down at an angle of at least 45°, but there is no research to sustain this for pre-medieval periods.

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138 The Dutch language has no translation for thatch; in general only the (non-generic) terms rietdak (lit. reed roof) and strodak (lit. straw roof) are used. Perhaps, by analogy with the German Weichdach (e.g. Saeftel 1967, 39), the term weekdak (lit. soft roof) can be suggested.

139 Turf, perhaps in combination with straw or reed, is suggested for the buildings at Wijnaldum (Gerrets & De Koning 1999, 107-108) and the remains of reed thatch have been recovered from a building excavated at Wierhuizen, province of Groningen (Hekker 1984, 43), referencing Van Giffen, A.E., 1918. Verkort verslag, opgraving te Wierhuizen 1917. JVT 2, 4-22.

Hekker (1984, 43) has previously pointed out, that roofs with a lesser pitch may have been more desirable than modern reed thatching practises suggest. It reduces heat loss, wind pressure and the amount of timber needed for its construction. All three are of importance when the exposed and woodless terp region are being discussed. Huijts (1992, 23) acknowledges these benefits and adds that arcade and wall posts show little difference in posthole depths, in the majority of prehistoric buildings. This could be an indication that there is little height difference aboveground, too: a slight roof pitch (but see also 3.2.2.4). Huijts’ sources on thatching requirements, however, suggest a pitch range from 45° to 80°, with an optimum between 60° and 70°. It is understandable, therefore, that Huijts is reluctant to opt for anything less than 45°.

A daub fragment found at Midlaren (DR) indeed suggests that a steep pitch was used in a building (11) of the Midlaren B type, dated to the 2nd-early 3rd century AD. It has recently been analysed by Varwijk (2010, 23-24) and is believed to suggest a pitch of 50°, assuming that only straight timbers were used. Yet, it is evident from archaeological finds from Denmark that a pitch of 45° was not the minimum. Schmidt (1994, 124) points out that “at Halkær some reused pine rafters […] had dowel holes [deuvelgaten] in the top from dowelled laths [rietlatten], which suggested that also this roof from the high medieval period had been thatched in spite of its pitch of only 39°.” A wattle gable recovered from a 9th century AD building at the trading centre of Hedeby (DEU), demonstrates a pitch of only 34° (Schmidt 1994, 92-93, 122).

In the Netherlands, too, slight pitches are not unknown. Moreover, their relevance to archaeological reconstructions has already been stressed by Hekker: “The common belief that reed thatches require a steep pitch, can be refuted on the basis of old farms on the Kampereiland, which have a pitch of 33-35°.” The early 18th century Frisian longhouse at Warten, also has a pitch of 34° (Mulder 1996, 11). Apparently, a wider range of pitches, including very slight ones, should be taken into account when making archaeological reconstructions.

To gain a better understanding of the factors involved in thatching, the origin of the 45° assumption will be looked into more closely below. Also, analogies with Scottish blackhouses and Icelandic turf farms have been applied to further explore traditional thatching methods. This sheds new light on the choice of materials, roof pitches and life spans, but also highlights the benefits of recycling thatch.

Regarding the choice of thatching materials, many more are possible than the three which have been mentioned above. This is well demonstrated in a study on Scottish thatching traditions by Hekker 1984, 43; my translation.
Walker, McGregor and Stark. In addition to turf, reed and straw, they also mention the use of grass, flax (vlas), rush (rus, incl. biezenknoppen), iris (gele lis), sedge (zegge), bracken (adelaarsvaren), dock (zuring), heather, juniper (jeneverbes), broom (brem), seaweed and eelgrass (zeegras). Such a variety of materials to choose from, also has the benefit of being able make repair damaged thatches in different seasons. This is known to have led to thatches looking rather like a patchwork of different materials.

In many historical buildings the thatch has been applied to a more or less watertight substratum, called an underthatch. The main purpose of the underthatch is to keep the timbers dry when the top layer gets saturated. It can be made of the same material as the top layer, but a combination of materials is also possible. In Orkney, for example, flagstones have sometimes been used for this (Walker et al. 1996, 23) and Ágústsson (1998, 59) depicts a similar setup in an Icelandic building.

Generally, the underthatch consists of organic materials. Birch (Betula) bark is often mentioned, in particular for areas with a strong Scandinavian influence. It has also been used for the stock-stove houses in Shetland (Walker 2006, 31), which were imported as prefabricated houses from Norway, rolls of bark included. For Iceland, Sacher (1938, 8) lists the use of heather, moss ("Felsenmoos"), rushes ("Binsen"), marram ("Strandhafer") and sedge ("Riedgras"). It has also been documented that a layer of dried dung (c. 5 cm thick) was used as an underthatch.

The use of turf as an underthatch, appears to have been a particularly widespread and common

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More specifically, Walker et al. (1996, 25-28) list and exemplify the use of:
- peat turf – mineral-based turf is known from Iceland (Sigurðaróttir 2008, 15) and the Netherlands (heather turves have been used for KU-16; fig. 3.51; Van Olst 1991b, 45) and is likely to have been used in other countries;
- straw (strot): barley (gerst), bere (i.e. gerst), oat (haver), rye (rogge) and wheat (tarwe);
- grass: mostly marram (helm; Ammophila arenaria) and couch grass (kweek; Agropyron/Elytrigia repens);
- flax (vlas; Linum usitatissimum);
- reed: mostly common water-reed (riet; Phragmites communis/australis), reed mace (kleine lisaddodde; Typha angustifolia) and great reed mace (grote lisaddodde; T. latifolia);
- rush (rus): mostly common rush (biezenknoppen; Juncus conglomeratus), soft rush (pitrus; J. effusus) and hard rush (zeegroene rus; J. inflexus);
- iris (gele lis; Iris pseudacorus);
- sedge (zegge): mostly great pendulous sedge (hangende zegge; Carex pendula) – normally used to form the ridge

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Fig. 3.55a-b. Exterior and interior of the reconstructed Iron Age building at Orvelte, Drenthe (NLD). The bottom photograph shows the use of tied arcade posts (gekoppelde binnenstijlen), which are a common interpretation for reconstructions in the Netherlands.
practise. A turf with clay layers is preferred in Iceland, because of its waterproofing qualities. Walker (2006, 31-32) describes why peat turf was the desired material for Scottish buildings: “The underthatch is always cut from a peat bog where there is a high vegetable-oil content in the turf. The underthatch is then applied to the roof in warm dry weather and a fire is lit within the building. The combined effect of the heat from the fire and the heat from the sun dries the oils in the turf creating a waterproof material.” Turf underthatches have also been documented in Ireland (Evans 1969, 56).

A turf underthatch cannot be tied to the roof structure in the same way as reed thatches, because the turves are likely to sag and tear under their own weight (fig. 3.55). In Scotland and Iceland, therefore, rafters or purlins that make up the top layer of a roof structure, are placed closely together (figs 3.37 and 3.38; see section 3.2.2.5). It is interesting to note that a 5th century AD boat grave with a plank-built roof, has been excavated at Fallward in Germany (fig. 3.57). It appears that the planks were pegged at the top to a ridge tree-like beam, running the length of the structure. The use of planks in this manner is reminiscent of the roof structure on the 42 Arnol blackhouse (fig. 3.36). The distance between the planks is small enough for the structure to have supported a turf underthatch. Is it analogous to roof structures in contemporary buildings?

The pitch of a roof is partially dependent on the waterproofing qualities of locally available thatching materials. Both factors (pitch and material) determine the thatch’s life span, but good ventilation and smoke are also of key importance. In this respect, preservation conditions in ancient building were far better than in modern buildings.

In traditional blackhouse life, the doors were closed only at night and in stormy weather, thus providing good ventilation throughout the day (Walker et al. 1996, 9). A draft is not appreciated in modern-day society, however, so great efforts are made to restrict ventilation as much as possible. In addition, so-called closed roof constructions are now increasingly being preferred over the traditional open type of thatching. This means that a thatch is completely sealed off on the interior side, making it entirely dependent on the weather to dry sufficiently. A closed roof construction also prevents smoke rising up through the thatch, which might otherwise have served as an important preservative (see also 3.4.2). This, however, had already come to an end when chimneys were introduced.

The preserving effects of ventilation and smoke permeation are considerable. They should not be left out of the equation when estimates are made of the life spans of ancient thatches. This is well illustrated by observations in blackhouses in the Outer Hebrides (SCO). Walker et al. (1996, 8) discuss the maintenance needs of the building at 42 Arnol (figs 3.36 and 3.54) and point out the following:

“If the fire has to be put out for any length of time fungal growths can be observed in those parts of the thatch not impregnated with soot. This illustrates the delicate balance that exists in these structures between use and maintenance. Thatched houses in the Uists that have been abandoned and sealed up in recent years have usually lost the roof over the kitchen end of the house within nine months of the abandonment; but the remaining roof, then well ventilated, will often last for years.”

Modern comfort demands (and health and safety regulations) do remove these factors from the equation, putting additional stresses on the life span of a thatch. Nevertheless, a long life span is yet another modern demand. This creates a conflicting situation, which can best be circumnavigated by steepening the roof’s pitch – synthetic reed thatches are now also available though. The Dutch Federation of Thatchers provides the fol-
allowing life spans for modern reed thatches at different pitches.\textsuperscript{145}

The federation strongly advises never to apply a reed thatch when the pitch is less than 25° – this is emphasised in bold print and followed by an exclamation mark. For short roof slopes (up to 2.5\textdegree\,m), a pitch of 35° is regarded the minimum and for longer slopes 45° or more are preferred. It needs pointing out, however, that the average life span is being pulled down by the so-called esthetic life span, which is shorter than the thatch’s functional life span. When esthetical issues are less of a problem, a properly executed and well-maintained reed thatch can remain watertight for up to 50 years.\textsuperscript{146}

For the reconstruction of ancient buildings, archaeologists in the Netherlands refer to modern thatching requirements. It is not taken into account that the added benefits of good ventilation, smoke permeation and shorter roof slopes will have enabled similar life spans at lesser pitches, providing that the quality of the thatching material is more or less the same. Perhaps this can explain the use of slighter pitches in buildings from Hedeby, Halker, Kampereiland and Warten (33-39° instead of 45°). Furthermore, the life spans of ancient thatches were probably functional life spans, rather than esthetical life spans. This means that patchwork repairs may once have been a common method for further delaying a full thatch replacement another year or two.

It should also be borne in mind, however, that ancient thatches were perhaps never desired to last as long as modern thatches to begin with. Or even half as long, for that matter. Aiming for a maximum life span is by no means a given, even though it is the standard in today’s society. If shorter life spans were acceptable in the past, still slighter pitches might have sufficed. This would have allowed for a further reduction of heat loss, wind pressure and timber requirements, but there are also other benefits.

Here, ethnographic analogies can provide important insights. It has already been pointed out elsewhere, that the occupants of Scottish blackhouses and Icelandic turf farms were well-acclimatised to the occasional seepage coming in through the roof (Postma 2010, 21-22). The Gaelic language even has a word for this type of water: 

\textit{snighe} (Grant 2007, 151). Efforts were made to keep it within bounds, of course, but if water did manage to find its way through, it was not \textit{per se} considered a major problem.

Sometimes thatches were not granted enough time to spring a leak in the first place. This, too, has been documented for Scottish blackhouses. Because soot-laden thatches make good crop fertilisers, it was hardly a loss to replace them regularly (Holden 2004, 45). Grant (2007, 160) states that thatches were sometimes pulled off and thrown out into the fields on an annual (!) basis.

The use of turf or other impermeable materials as underthatches, will have restricted the amount of soot that could penetrate into the thatch. It has been suggested, therefore, that the use of underthatches in blackhouses is a fairly recent modification. Their introduction might have been “brought about by the disapproval of the landlord to the practise of manuring with sooted thatch” (Holden 2004, 38). It was found that some of the surveyed blackhouses only had a partial underthatch, in which case it was noticeable that “the area of unturfed roof related directly to the area under potatoes” (Walker & McGregor 1996a, 9).\textsuperscript{147} In this manner the old manuring practise managed to continue well into the 20\textsuperscript{th} century.

It is not known if thatches have been used as fertilisers in other regions (with marginal soils?). Perhaps the widespread use of turf underthatches suggests that they were not, but it is impossible to say this with certainty. The background of such practises, however, is characterised by regular repairs and timely replacement, perhaps in accordance to (annual) agricultural cycles. This fits in with the flexible maintenance attitude discernable in turf construction in Scotland and Iceland (see 3.1.3.5).

If the thatch was not enriched with smoke from the fire place, regular recycling is still a possibility to take into consideration. Perhaps this is best argued on the basis of so-called \textit{potstallen} (deep litter houses). In these, turves and other materials were added to the dung during wintertime, when the cattle stayed indoors. The enriched dung mix was carted out each spring and spread out over the land as fertiliser. Over time, this resulted in thick \textit{plaggen} soils (\textit{esdekken}). It is possible that fresh turfs and straw were used for this purpose, but from an efficiency point of view the recycling of old material seems just as likely. Besides, the introduction of this type of byre was probably not a sudden affair, but more likely a product evolved

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\textsuperscript{145} Dutch Federation of Thatchers (www.riet.com/pdf/hellingshoek.pdf, last accessed 12 July 2010). 
\textsuperscript{146} Dutch Federation of Thatchers (www.riet.com/levensduure.html, last accessed 29 July 2010). 
\textsuperscript{147} A noticeable difference with turf thatched houses in the Netherlands (e.g. KU-16; fig. 3.51; Van Olst 1991b, 45) and those documented in the German or Danish salt marshes (e.g. Saeftel 1967, 40), is that the turf stratum is placed on top of the reed (or straw, etc.) thatch. This helps in weighing down the lighter materials, but one may wonder whether this also allowed the thatch to be impregnated with soot.

from older traditions. The (annual) renewal of thatches and their recycling as stall bedding, may well have been one of these traditions.

When it comes to discerning similar practises in Dutch archaeology, the discussion is likely to remain very much a hypothetical one. There appears to be no known evidence to support either very long or extremely short life spans of thatches. An important observation, however, is that a life span of up to ten years should already be feasible for reed thatches with a pitch of only $25^\circ$ (table 5), without taking smoke-based preservation and patchwork repairs into account. For farm buildings of modest dimensions, like longhouses and their early medieval variants, replacing a thatch once per decade cannot have been an enormous investment – one has only to compare the surface and accessibility of these roofs with those on post-medieval barns.

If pitches become too slight, however, other practical objections may sometimes become involved. The presence of a loft or second floor, for example, could be a reason to opt for a steeper pitch, regardless of heat loss and other disadvantages. This appears to have been a criterium in some of the Icelandic turf buildings. The farms surveyed by Edwin Sacher (1938) in 1936, demonstrate a pitch range from $52^\circ$, over Glaumbaer’s lofted guesthouse with luxury interior panelling, to no more than $15^\circ$ over the associated sheep houses (figs 3.57 and 3.58; Sacher 1938). Roofs on the hay barn at Marbæli and the kitchen at Jaðar do not reach beyond $10^\circ$. A similar discrepancy between living area and non-lofted byre can be seen in the blackhouse at 42 Arnol, Lewis (fig. 3.54). Its roof starts off at $45^\circ$ and slopes down to about $20^\circ$ over the byre end of the building.\(^\text{148}\) Bearing in mind the high annual precipitation in this region, $20^\circ$ is a slight pitch indeed.

If a greater range of pitches and a flexible maintenance attitude were ever the standard in Dutch prehistory, it is likely that traditions came to an end during the Late Middle Ages. Gothic building traditions are known to have led to steeper pitches in urban contexts (De Vries 1984, 49) and would have resulted in longer-lasting thatches. This must have been beneficial in early towns, where the required thatching materials grew ever scarcer as agricultural activities became restricted to the (distant) countryside. Fire hazard eventually also become an issue of concern, of course.

Around the same time, farm buildings were increasing considerably in size (e.g. Waterbolk 2009, 94-105) – and they continue to do so until this day. This had a negative effect on the length and accessibility of roof slopes and the amount of material required to thatch them. It need not be surprising, therefore, that new thatching methods also became common in rural areas in the course of the second millennium AD. Gothic architecture and urbanisation are less of a concern in the (relatively) conservative Scottish Highlands and Iceland. Thatching methods preserved in these regions, probably provide a better insight in early medieval thatches than modernised ‘traditional’ thatching in the Netherlands does.

Perhaps archaeological investigations can provide more certainty in the choice of thatching materials, because their remains may be found in the layers that cover old floor layers. These layers might have been preserved if turf walls are still standing (see 3.1.3.1). This means that excavations in the terp region are likely to provide a unique opportunity to examine such layers in more detail. If floor and debris layers can be identified during excavation and sampled accordingly, interesting research opportunities may arise. Research in Greenland, Iceland, Faroe, Norway and the British Isles indeed confirms that this is a rich source of information, not just with regard to thatching materials (e.g. Buckland et al. 1993; Smith 1996; Panagiotakopulu 2004; Kenward & Carrot 2006; see also Schelvis 1995).

\(^{148}\) Walker & McGregor (1996a, 8): the slope of this roof is not per definition a response to the scarcity of timber, because it also has positive effects on the internal air flow. The convection current created by the lengthwise slope of the roof, serves to ventilate and thereby preserve organic construction materials (thatch). It also protects the cattle from smoke inhalation and resultant chest complaints and exposes the inhabitants to a regular solution of ammonia from the dung in the byre area, which helps to cure tuberculosis (Walker & McGregor 1996a, 27-28).

### Table 3.1. Life spans of reed thatches at different roof pitches, according to the Dutch Federation of Thatchers

<table>
<thead>
<tr>
<th>Pitch</th>
<th>Maximum life span</th>
<th>Average life span</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>$25^\circ$</td>
<td>up to 10 years</td>
<td>5 years</td>
<td>strongly advised against</td>
</tr>
<tr>
<td>$30^\circ$</td>
<td>8-18 years</td>
<td>12 years</td>
<td>short roof slopes only</td>
</tr>
<tr>
<td>$45^\circ$</td>
<td>20-40 years</td>
<td>28 years</td>
<td></td>
</tr>
<tr>
<td>$50^\circ$</td>
<td>30 years and above</td>
<td>40 years</td>
<td></td>
</tr>
</tbody>
</table>
The discussion presented above, however, also demonstrates that establishing which materials were used for thatching will not be a straightforward exercise. Flooring and storage materials from the loft, tumble from collapsing wall tops and other non-thatch related organics, may be represented in the same deposits. Because of this, it is of key importance to start with careful examination and sampling during excavation. A combined analyses of thin sections, archaeo-botanical and archaeo-entomological samples will be needed to disentangle and correctly interpret the infill.

In the turf house at Ruinen (fig. 3.51), a layer of turves 10 cm thick was used as a floor layer for the loft, on top of which hay was stored (Van Olst 1991b, 44-45). In such a situation, both materials can end up on top of the floor layers without meaning that the roof was thatched with hay and turf.

3.5 SUMMARY AND CONCLUSION

3.5.1 Turf walls

The terminology that is associated with turf construction is very diverse and might cause problems in the communication between scholars, in particular when the subject is discussed internationally. Turf can be used as a generic term for ‘earth’ blocks, but it is often used specifically to denote peat turf. Turf can be subdivided in different types, each of which is characterised by a typical shape and/or turf species. The latter is a combination between vegetation species and mineralogical make-up. No overview of turf types exists for Northwest Europe, but a combination of archaeological and historical research may change this. It is important to use a clear and universal terminology.

Little research has been done on the sources and properties of specific turf species, but there it is likely that the material was sourced locally. More detailed examination of vegetation species and mineralogical make-up needs to be collected during future excavations. Historical and ethnographi-
cal data from Scotland and Iceland give a general idea of the characteristics of certain turf species. Good construction turves were available in the peat lands and salt marshes, but probably also in the sandy region, wherever high ground water levels allowed tough root matter to form or dead organic fibres to be preserved.

A test wall at the local heritage museum in Firdgum (FR), shows that turves from the salt marshes differ considerably from other turf species. The salt marsh vegetation does not root very deep, but the roots do form a tough mat. The sand content is also relatively high, but it alternates with thin clay layers which help to keep the block together. Turves that are cut from these soils create a strong load bearing wall, which can also resist considerable outward pressures when a simple bonding system is used. They do not shrink and probably are very durable, suffering little from their exposure to the elements. The observations correspond well with laboratory tests at the University of Dundee (SCO), which also suggest that clay turves are suitable for thatching.

Research on living conditions in Icelandic turf buildings, demonstrates that the use of turf in itself does not create unhealthy situations. The salinity of the turves also contributes to this, because it reduces the amount of invertebrates. Of greater concern would be the exposure to combustion products, in particular if biomass fuel has been used. Much depended also on the amount of ventilation within the building. In turf-walled buildings, some of the suspended matter was absorbed, because of the hygroscopical character of the turves.

Due to a lack of cross-sections, little reliable data is available on the thicknesses of turf walls, but measurements taken from ground plans do paint a reasonably consistent picture. They suggest wall thicknesses of c. 45-50 cm for small outbuildings (e.g. sunken-floor huts), c. 50-60 cm for larger outbuildings and c. 70-120 cm for main buildings, with a preference for c. 80-100 cm.

It has been suggested for buildings in Northwestern Germany, that the turf walls were only low mounds. A reinterpretation of the ground plan on which this notion was based (fig. 3.10), however, shows that the original interpretation is incorrect. In the terp region, turf walls often still survive up to heights of 30 cm or more, although 60-120 cm have also been documented on a number of occasions. The walls were probably higher when first constructed (see 3.5.3). Because of their large remaining height, it is likely that floor layers and later deposits (e.g. maintenance debris) are also preserved within the buildings. If the excavation methodology is adjusted to allow a detailed documentation and interpretation of these deposits, potentially very rich and unique research opportunities may arise.

A small number of buildings has yielded indications for turf-built interior partitions. The partition walls are often slightly thinner than the outside walls, which suggests that the outer walls were put under greater pressure: load bearing walls. The walls are constructed with vertical wall faces and were not supposed to grow green again after construction. This implies that the turves were dried to a certain degree before construction and had sufficient time to further dry out afterwards. This makes springtime the most likely period for construction. The wall faces were probably trimmed to allow surface water to run off swiftly. The lack of longitudinal cross-sections means that little can be said about technical details of turf construction, although the occasional transverse cross-sections show that a bonding system with horizontally stacked turves was probably common.

In addition to the use of good quality building material and careful construction, timely maintenance is of key importance to the durability of a turf building. As a consequence, no universal life span estimate can be given and historically documented life spans range from 3 to more than 100 years. Icelandic and Scottish sources suggest that maintenance work fitted in with existing agricultural cycles, possibly using the debris of repaired wall sections as a fertiliser on the fields. They demonstrate that organic buildings were approached with what has been denoted a ‘flexible maintenance attitude’. Unlike stone- and timber-built structures, which allow ‘passive’ upkeep and preservation, such a flexible approach to maintenance work cannot be avoided with turf buildings. The concept has been lost in modern-day society, but excavations of Viking Age buildings in Scotland suggest that a flexible maintenance attitude was once widespread. With regard to turf construction, it appears now only to survive through the ongoing maintenance of Icelandic buildings.

3.5.2 Primary timber structure

Detailed analyses of timber remains are few and far between, but the data that are available suggest that different species of timber were used for early medieval buildings in the terp region. There was no absolute preference for oak (eik; Quercus), diameters were rather small and bark was often left attached. Fresh timber was not available locally, due to the saline conditions in the salt marshes, but it appears to have been imported from the peat soils further inland. Perhaps larger pieces had to be imported from the sandy soils or elsewhere.

Secondary use of timber was common in the early medieval terp region, but also in other regions, regardless of the local availability of timber.
Secondary use in itself, therefore, says little about timber shortages. Posts were dug in and cannot have been commonly placed on pad stones – and yet no other measures were taken to prolong the life of these posts. This suggests that the absence of nearby woodland was not perceived as a major problem. It is possible that ship’s timber was also reused for buildings in the terp region, but no conclusive evidence has been found to definitively link it to a building’s primary timber structure. The same goes for the use of driftwood, whalebone and bog oak.

Only one type of post arrangement is common in the catalogued turf buildings: arcade posts (binnenstijlen). Smaller structures may show the use of centre posts or only wall posts. Den Helder building 1 (fig. 2.49) has a unique combination of wall and arcade posts; it demonstrates that arcade posts did not form the primary roof support. It is suggested that arcade posts indicate the presence of a loft (vliering). This notion is strongly supported by early medieval building 7 from Den Burg (fig. 2.48) and implies that turf walls were the roof supporting elements.

The apparent use of ‘lesser quality’ timber (crooked wetland timber, curved ship’s timber, driftwood, etc.), implies that the primary timber structure was such that it could incorporate these materials. The possible effects of the shape and size of these timbers have not been accounted for in Huijts’ (1992) reconstruction models, but they cannot be avoided when it concerns the woodless terp region. This has drawn the attention also to Celtic cuppill construction, a type of construction documented for traditional (long)houses in Scotland and recently published on by Walker (2008). Cuppils are characterised, among other things, by their ability to incorporate a wide variety of building materials (e.g. hedgerow timber, driftwood, ship’s timber, whalebone) whilst using only simple pegged joints (penverbindingen).

No archaeological remains are known that can demonstrate the use of any particular type of primary timber structure in the early medieval period directly. According to Huijts (1992), true frames (i.e. structures locked together in a three-dimensional form), which use braces (schoren), were not fully effective in timber buildings until the 13th century AD. Because of this, earlier buildings are believed to have been dependent on earthfast posts for their stability, but posts appear to have hardly been dug in in buildings from the terp region. This raises the question whether stability through earthfast posts, would have sufficed in such an exposed and windy coastal area.

Dug in posts are not a necessity in Celtic cuppill construction. The trusses (gebinten) are rigid in themselves, often through the use of curved timbers, but straight timbers have also been documented. The cuppill blades (gebintsstijlen) are connected by a tiebeam (dwarsbalk). Contrary to the English and Welsh use of crucks (kromstijl-/kruggebinten), however, cuppils do not form a framed structure. Nor do they require the use of braces; lengthwise stability is created by placing one or more trusses at an angle to the building’s central axis. Walker (2008) has discerned three typical ground plans that result from this technique and similar characteristics have been recognised in all well-preserved ground plans in the research area. This demonstrates that stable timber structures were already applied here as early as the Roman Iron Age, at the least, without the need for earthfast posts.

Earlier objections against the use of cruck-like structures in Scandinavian countries and the Netherlands, forwarded respectively by Schmidt (1994) and Huijts (1992), can be refuted on the basis of new insights. Contemporary artefacts suggest that Viking Age buildings in Scotland and Denmark had an arch-shaped cross-section. A reinterpretation of the Odoorn type buildings from Rijnburg (ZH; fig. 3.34), demonstrates that arch-shaped trusses were also used in earlier (Carolingian) periods in the Netherlands. In the smallest building, the distance between the outside posts and the wall probably meant that the roof supporting timbers only entered the building’s interior at wall top height. This way an obstacle-free space was created inside. It is the result of a growing desire, first portrayed in the (selective) outward movement of arcade posts in Roman Iron Age buildings.

A subsequent comparison with Den Burg building EMA-7 (fig. 2.48), allows the use of arch-shaped cuppils also to be assumed for Leens type buildings. This building’s ground plan demonstrates that the Odoorn and Leens type buildings essentially had the same type of roof structure, but also that outside posts (Odoorn B-C types) and turf walls (Leens types) were exchangeable roof supporting elements. The notion that arcade posts were not used as roof supports, raises the question why these, too, are arranged in a cuppill-like manner (i.e. with one or more pairs at an angle). The beams which they supported could well have been attached to the roof trusses (kapgebinten) or allowed to rest on the turf walls, which would have provided sufficient stability for the loft supporting structure. It is concluded that the arrangement of arcade posts reflects the position of the roof trusses. Thus, one or more of these were placed at an angle to the building’s central axis. The reason for this relates to the use of gabled (zaeldaken) or half-hipped roofs (daken met halve eindschilden) and is therefore discussed in more detail in relation to gables (see 3.5.4)
The use of cuppill-like trusses requires longitudinal beams to connect them and provide stability to the structure. This makes it likely that purlins (gordingen) were used for roof structures in the early medieval terp region. Traditional buildings in Iceland and Scotland demonstrate how the roof could further be closed off with rafters (sporen) of a wide variety of materials (e.g. ship’s timber, bog oak, whalebone, brushwood) or other materials (e.g. wattle panels). This top layer supported the thatch. Roofs are often provided with projecting eaves (dekoverstek) in archaeological reconstructions, but the correctness of such interpretations can be questioned. The idea that projecting eaves were necessary for the protection of wattle and daub walls is believed to derive from unfounded assumptions. Historically documented buildings do not support large overhangs either and there are good reasons to suggest that they were actually not a desirable feature at all.

3.5.3 Secondary timber structures
Wattle wall facings have been used for some of the turf buildings, but traditionally they were not a standard feature. Post-medieval descriptions of creel (i.e. wicker basket) houses in Scotland, and an 8th-9th century AD wattle wall facing from the archaeological site Elisenhof (DEU), suggest that wall heights of 180-200 cm are also plausible for turf-walled buildings in the terp region.

Timber-built interior partitions were not a common feature in Leens type buildings either. The only example comes from a turf building at Leens, but it lacks any sign of substantial posts (doorposts?) and probably served only to fence off the byre area. More substantial interior partitions were constructed of turf (see 3.5.1). Cattle boxes were also built of wattle panels and were c. 1.7-2 m wide. They occur only on the right-hand side of the byre (when the building is entered from the byre end; see also 3.5.4).

Entrances cannot always be made out clearly, but those that can are mostly situated in the short end walls and sometimes also in the long walls. The construction of timber doorframes may have been such that no dug in posts needed to be used. This can explain why postholes are lacking in so many entrances, their positions being marked out only by openings in the turf walls. Some buildings do not appear to have had an entrance at all, but in these cases the threshold was probably placed some distance above the ground.

3.5.4 Remaining features
There are some indications for the use of turf floors and remains of a timber floor have been observed in a small building at Hallum, but no detailed research has been carried out on this subject. Because of the height to which many turf buildings are preserved in the terp region, good opportunities may arise for a variety of detailed (micro- and macroscopic) analyses of floor deposits. Possibly this will also enable research into the choice of thatching materials, but careful documentation and sampling during excavation are essential preconditions.

Fire places have previously not been subjected to detailed analyses either, but it is evident that they were located either in the centre of a building or close to one of the long walls. Their presence may be an indication that the room or building was used to live in, but other interpretations (e.g. smithy) are equally possible. A living function should not be assumed on the basis of fire places alone. In several cases a single post was noted next to the fire place. These can be interpreted as kettle supports. Their alignment with other posts suggests that the kettle supports were attached to the roof trusses (kapgebinten) for additional support. Heat and soot, emitted by the fire, have a great affect on the life span of a building. They help to preserve the wall and roof turves, as well as other organic materials, by preventing fungal growth and/or infestation by wood boring insects.

In addition to cattle box partitions (see 3.5.3), the presence of byres can also be indicated by turf-built walkways and byre drains. For the buildings in the catalogue, all three features point towards an asymmetrical byre layout. This previously unidentified type of byre, appears to be typical of the Late Merovingian and Carolingian terp region, although it was probably introduced here in the course of the Roman Iron Age. The cattle boxes are always located on the right-hand side (when entering the building through the byre end).

Posthole arrangements in Leens type buildings, initially seldom made it possible to establish the use of gables (topgevels). In some buildings, however, one of the short end walls is thicker than the other wall sections. This indicates that this part of the wall was probably built up to a greater height: a gabled wall. The use of gables might explain why the roof trusses (kapgebinten) were arranged in a Celtic cuppill-like manner (see 3.5.2); presumably a gabled roof (zadelak) or half-hipped roof (dak met halve eindschilden) did not provide sufficient stability by itself. Similar post arrangements also occur in buildings with the same wall thickness all way round. This could be explained by the use of lighter materials (e.g. wattle or planks), but it is hard to establish this with certainty. Saeftel (1967) suggests that gables can be associated with early medieval (sheep breeding) communities in the North Sea and North Atlantic region. Substantial evidence to support this is
scarce, but for the terp region the dataset does not argue against it.

The common assumption that (reed/straw) thatched roofs require a minimum roof pitch of 45°, is based on the requirements of modern thatched roofs and should not be applied uncritically to archaeological reconstructions. Contrary to modern (esthetical) thatches, soot from the fire place, good ventilation and patchwork repairs may have prolonged the (functional) life span of thatches on ancient buildings. Traditional Scottish thatching, on the other hand, demonstrates that the recycling of thatches as a fertiliser may lead to their regular replacement. They were sometimes even replaced on an annual basis. The practise is reminiscent of the flexible maintenance attitude, which is essential for turf construction in general (see 3.5.1), and it would not have allowed much time for a thatch to go bad in the first place. Even if longer rotation times were aimed for, pitches a lot less than 45° may have sufficed.

Archaeological remains from Denmark and the settlement at Midlaren (DR) suggest a pitch range of 34°-50°. Traditional buildings and longhouses in Scotland and Iceland, however, demonstrate that pitches of 10°/20° (over sheep houses/byres) to 60° (over lofted buildings) should also be taken into consideration. The preference for relatively steep pitches in modern thatched buildings, has probably been affected by (post-)medieval developments in architecture. It is also clear that a far greater selection of materials may have been used for thatching than archaeologists currently take into account (list provided in footnote 142). Debris layers that contain the remains of thatching materials may survive on top of floor layers. These have already been the subject of detailed research in North Atlantic countries, but remain an unexplored territory in the terp region.
This chapter deals with the typological subdivision of early medieval buildings in the research area. It distinguishes between three subcategories of a turf-walled type and one wide timber-built type. The considerations that lead up to this subdivision are set out in detail in each section, but the main characteristics of the building types are also summarised at the end of this chapter.

Previously, little was known about buildings in the early medieval terp region (see 1.3.1). This contrasted sharply with the state of knowledge for neighbouring regions, in particular for the sandy soils of Drenthe (see Waterbolk 2009). At best, buildings from the terp region could be lumped together under a common denominator: Leens type. However, since the excavation at Leens (GR) in 1939, where the type takes its name from, more plans have become available, demonstrating that the Leens type is by no means a typological side-track. These turf-walled buildings were used throughout the entire Early Middle Ages (c. 425/450-1025 AD), at the least. But were all Leens type buildings the same? Were there not different subtypes? Where did this tradition come from and how did it develop during all these centuries? What happened to it in the second millennium AD? And most importantly, why do these buildings strike us as being so different from their neighbouring contemporaries?

It is high time to fill in the gaps, but clearly this is not a case of simply trying to identify well-known post arrangements in a new collection of ground plans. There are many Leens type buildings that show no sign of dug in posts at all. And what should we think of their turf-built walls? Are these merely the result of having no timber to spare, or do they relate to a specific cultural group? The discussions in this chapter lead to a typological framework that is based on more than post arrangements alone. Elaborating on the technological interpretations in the previous chapter, the typological likeness between Leens and Odoorn type buildings can be demonstrated. It has also been possible, however, to pinpoint surprising regional differences.

Huijts (1992, 15) rightly pointed out that a specific building type is not merely the product of locally available building materials. Tradition, function, business type and economy can also affect the shape of a building. Waterbolk recently put it as follows:

“{In a cultural-historical sense, the ground plan first of all reflects the region’s building tradition. In an ecological sense, the building expresses the adaptation to the local natural situation and the type of exploitation that results from this. In a social sense, peculiarities in the construction of a building, its size or interior layout, may be an illustration of the social position of its builder within the local community.”}^150

This implies that the study of buildings should be able to shed light on the technological side of building traditions, cultural relationships, business types, economy, adaptation to local environmental conditions, social statuses and more. In other words, building plans are something worth researching. In practice, however, as Van der Velde (2010, 179-181) pointed out in his review of Waterbolk’s book, these topics have seldom been explored in settlement research in the Netherlands. Van der Velde also misses the influence of Carolingian annexation on local building traditions. “Waterbolk.” Van der Velde concludes, “has given an important initial impetus to the field of study (after all, everything starts with setting up a typology), but nothing more than that. Deepening continued research is much desired.”^151

It may come as a surprise that the previously so intangible Leens type architecture, actually shows great potential for taking settlement research to a higher level. The lack of intricate post arrangements forces one to lean more heavily on the analyses of other features (e.g. interior widths, interior partitioning and byre areas). Not just the presence of these features is important, their structural absence may be equally informative. It is demonstrated in the discussions below, that a typological categorisation may indeed be linked to other aspects of live. The typological framework and functional interpretations are still largely hypothetical, but they do form a first step towards identifying what the expected “cultural-historical,” “ecological” and “social” influences on ancient building traditions looked like.

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^150 Waterbolk (2009, 4); my translation.
^151 Van der Velde (2010, 180); my translation.
4.1 TURF BUILDINGS

4.1.1 Leens A (outbuilding)

The Leens A type buildings have been defined by Tuinstra & Veldhuis (in prep., 27) as long and narrow. Illustrative are Hallum buildings 1 (>14.3x4.4-4.7 m; figs. 2.49 and 2.50) and 6 (>15.8x4.3 m; fig. 2.10), which both have arcade posts (binnenstijlen). Similar dimensions and post arrangements can be seen in Foudgum main building (>18.5x4.1 m; fig. 2.5) and Leens buildings 5 (18x4-4.4 m; fig. 2.33) and 7a (>21.6x4.6 m; fig. 2.35), which all have an asymmetrical byre layout (see 3.4.3).\(^{152}\)

This provides a functional interpretation for this type of building: byre.

Two other buildings with arcade posts and asymmetrical byre layout are Leens buildings 1b (7.9x4.3 m; fig. 2.20 and 2.22) and 1g (11.4x4.6 m; fig. 2.26), but these are noticeably shorter than the first buildings. Wijnaldum building 30 probably also belongs to this group (fig. 2.46). It has an interior width of 4 m and an asymmetrical byre layout, but its length cannot be determined very precisely on the basis of the published material.

An overview of buildings with byres and/or arcade posts is presented in fig. 4.1. In addition to similarities in byre layout and post arrangements, the graph illustrates that the three shorter buildings are also of similar width and date as the longer buildings. All of the buildings mentioned above cluster in the width category of 4-4.7 m. On the basis of these similarities it can be suggested that the shorter buildings also belong to the Leens A type.

The variable length of the Leens A type buildings stems mainly from the addition of a ‘non-byre area’. Such an extension is particularly clear in the plans of Leens buildings 5 and 7a. Their byres respectively comprise only 10.2 and 12.8 m of the total interior lengths, which is little more than the byre lengths in shorter buildings (7.9-8.2 m). Direct access to the extended part of the building is provided through opposing side entrances in the long walls. The shorter buildings have only a single entrance in one of the short walls. In the northern end of Leens building 5, a fire place can be seen against the wall. This is a feature it has in common with Hallum building 1.\(^{153}\)

Archaeologists often consider the presence of a fire place indicative of a living function, but fire places may also be found in rooms and buildings used for other purposes (see 3.4.2).

The apparent absence of interior partitioning might be considered to object against a living function. Interior partitions are a common feature in contemporary buildings in the sandy region, where they were used to divide the byre area from the rest of the interior (Waterbolk 2009, 87-93). They are mostly represented by extra posts, which presumably formed a door frame and held in place a wattle screen. Partitioning has been noted for some turf buildings, but apparently it was not desired in the typical Leens A type structures. Only Leens building 1g has produced indications for an interior partition, but it consisted only of stakes (fig. 2.27). No extra posts have been noted. It appears that they served primarily to fence off the byre area, rather than divide the whole building into two different rooms. Perhaps the extensions were used as some sort of workshop, like a smithy, for example.

Comparison between the long and short Leens A type buildings, demonstrates that the arcade posts do not always extend throughout the entire length of the building. Most clearly this can be seen in Leens buildings 5 (fig. 2.33) and 7a (fig. 2.35). It has also been noted for one of the plans of Leens building 1g (fig. 2.27), but the added length apparently was not great enough to necessitate additional entrances in the long walls in this building. The restricted spread of arcade posts need not be surprising, however, because they supported a loft, not the roof (see 3.2.2.3).

These observations are also of importance for the interpretation of similar buildings without arcade posts. Within the current dataset, 33 (49\%) of a total of 67 (probable) turf-walled buildings have no arcade or centre posts and 31 (46\%) have no wall and outside posts either (see the appendix). Of the 19 turf-less ‘timber’ buildings with surviving wall traces (stakes or wall trench), on the other hand, only Hallum 9 (5\%) lacks a main timber structure. It seems very unlikely that this discrepancy can be entirely contributed to poor archaeological visibility.

\(^{152}\) Originally, Hallum building 23 (>14x4.7 m) could also be attributed to this group, but in my view its suggested width is rather doubtful. First of all, its current south-western long wall is very similar in shape and position to that of building 11, which directly overlies it; presumably this wall does not belong to building 23. Also supportive of this, are the two square features in its south-eastern short end wall, which, by comparison with Den Burg building EMA-3 (fig. 4.5), can probably be interpreted as doorposts (for further discussion of this analogy, see 4.1.2). If they can likewise be taken to indicate the centre of the short wall, Hallum 23 should actually be 5.6 m wide. This would make it a Leens B type building, which also explains why it appears to have an interior partition.

\(^{153}\) It appears that Hallum building 1 also has opposing entrances in its long walls, as is suggested in the trench plan of level 7 (Tuinstra & Veldhuis in prep.; not illustrated here). In this plan, the interior width of building 1 is a lot less than in the plan of level 8 (4 m instead 4.4-4.7 m), which probably indicates that at least one of the walls does not belong to building 1. For that reason, the plan has not been discussed in this thesis.
Fig. 4.1. Graph of widths and dates of turf and timber buildings in the research area. Included are all buildings for which a reasonably certain date and width have been established. For exact specifications, see the appendix.

Key:
- line = turf-walled
- line/dot = outside posts (instead of turf)
- dots = neither
- black = arcade posts (binnenstijlen)
- red = arcade posts + asymmetrical byre
- blue = no arcade posts + asymmetrical byre
- green = no arcade posts + no asymmetrical byre
This raises the question whether there is a fundamental difference between 4-4.7 m wide turf buildings with arcade posts, and those of similar size without arcade posts. Loft supporting arcade posts may also support cattle box partitions, but they are by no means a necessity. This is clearly demonstrated by the ground plans of contemporary buildings in adjacent regions. The 5th–6th century Eursinge type, for example, as well as the 6th–8th century Odoorn types, often have cattle box partitions, but they do not have arcade posts (fig. 4.12; Waterbolk 2009, 86-91). Evidently, the absence of arcade posts does not exclude a byre function.

In addition, not all byres need to have had cattle boxes. This is best illustrated on the basis of Leens building 4a (>8.4x4 m). Its byre function is indicated by a turf walkway and off-centre drain, but the building appears not to have had any arcade posts or cattle boxes (fig. 2.31). A possible explanation for this is provided by Friedrich Saeftel with regard to a terp excavation in Northwest Germany:

“In the houses of this Elisenhof settlement, constructed approximately in the 8th century AD on a high creek levee in the Eider estuary, the oldest farm buildings had no byre area with fixed cattle boxes. Their outer walls were wattled. Winter stalling in byres with a fixed layout for the customary two oxen or cows, first started with, and in relation to, the construction of manor farms. [...] Stockbreeding in the non-dyked in foreland areas around the settlement, then developed from distinct sheep holding (with only a few cows?) to the keeping of sheep as well as dairy cattle.”

If the development Saeftel sketches can also be applied to the Dutch terp region, this would imply that a period of box-less byres preceded the 8th century AD. The chronological spread of the Leens A type buildings covers this period very well. Three key specimens with arcade posts (Leens 1b and Hallum 1 and 6) date from well within the Early Middle Ages A and Merovingian period (fig. 4.1). It can be expected, therefore, that their plans will portray such a transition if it occurred also in the Dutch terp region. Indeed, if the presence of byre indicators is studied more closely, an interesting subdivision emerges. Almost all buildings with cattle boxes, a byre drain and/or a walkway, date from the transitional period between the Merovingian and Carolingian period or later.

The byre in Den Helder building 1 (figs 2.49 and 2.50) may also be added to this cluster. Although the structure itself has not been dated, it does overlie terp layers with pottery of Carolingian date. The byres at Heveskesklooster period I-phase 1 and Leeuwarden building 7 do not only date from an earlier period, but they are also wider and probably more related to Roman Iron Age building traditions (see below).

Most byres with a fixed layout date from the 8th century AD, as Saeftel’s theory predicts, but two buildings appear to be slightly earlier. The oldest is Leens 4a (fig. 2.31). Although the structure may still be dated to the same transitional period, its early date offers a good explanation for the absence of cattle boxes in this building. It suggests that cattle-related byre elements were gradually introduced (or reintroduced) into byres around this date. Perhaps the presence of just one row of arcade posts, in the otherwise well-preserved Leens building 5 (fig. 2.33), can be explained along similar lines – it probably is the original post arrangement (see 2.5.6 and 3.2.2.3).

The observed changes can be assumed to reflect cultural-economic developments in the terp region. Because the changes occur in byres it is likely that the developments that drive them also occur in an agricultural context. Perhaps it is significant that wool production played an important role in early medieval Frisian economy. This is beautifully illustrated by finely woven woollen cloth fragments, which have been recovered from terp layers on numerous occasions. Indeed, Saeftel also suggests an accent on sheep holding prior to the 8th century AD (see quote above).

Archaeo-zoological research has recently started to further elucidate the history of stockbreeding in this region. Research by Wietske Prummel and her students shows that cattle bones are the most numerous in the Iron Age, shifting towards a prevalence of sheep/goat in the Early Middle Ages in the province of Friesland (Prummel 2006, 42-43; Prummel 2008, 154-155; Prummel & Van Gent, 2010). Towards the end of the Early Middle Ages, when the salt marshes are dyked in, cattle remains become more numerous again. The changes are particularly clear for Roman Iron Age and early medieval Wijnaldum. Up to c. 550 AD, 38-48% of the recovered material consisted of sheep/goat, which is similar to that of cattle (41-50%; Prummel 2006, 45). An increase of sheep/goat remains has also been noted for Hallum (Buitenhuis in prep., 175). Presumably, the numbers reflect a shift in the actual stock selection.

It can be suggested that the Leens architecture has been influenced by these developments in husbandry. Apparently, the reduced dependence on cattle allows for byres without cattle boxes. Sheep houses do not have a fixed layout either. As a

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154 Saeftel (1967, 27); my translation.
result, byres without a loft are only visible as post-
less turf buildings. There do remain some inconsistencies, however, which need further looking into. First of all, the highest numbers of sheep/goat remains are reached in 8th-9th century AD Leeuwarden: 21% cattle against 72% sheep/goat. Wijnaldum also shows a late peak, with 26% cattle and 70% sheep/goat in the Carolingian period. Secondly, in the province of Groningen, cattle appears to have remained most numerous throughout the Early Middle Ages. Sheep/goat is only (relatively) well-represented in Roman Iron Age Heveskesklooster; 27% sheep/goat against 65% cattle, compared to respectively <10% and c. 90% for pre-Roman Iron Age sites in Groningen.

The archaeo-zoological dataset is still very limited, so it is likely that the developments will be further nuanced as research on this matter continues. Hopefully this will also shed more light on the relationship between turf buildings and sheep farming.

Prummel and Van Gent’s conclusions may also provide a context for the two remaining byres in the dataset. These are the ‘timber’ building of Heveskesklooster period I-phase 1 (>13.8x7.9 m; fig. 2.17) and Leeuwarden building 7 (>6x5 m; figs 2.37 and 2.38). With dates respectively from the Roman Iron Age and Early Middle Ages A, both are relatively early buildings with asymmetrical byres. It cannot be ascertained that the nearly 8 m wide structure at Heveskesklooster had turf walls, but there are indications that its successor from the Late Roman Iron Age (period I-phase 3) was a 7.3 m wide turf building (see 2.4.3). The features in the presumed byre area are also turf-built. These features are hard to interpret correctly, but do suggest an early asymmetrical byre layout.

The cattle box partitions, turf walkway and off-centre drain in Leeuwarden building 7, are more convincing evidence for a byre function. This building is much narrower than the one at Heveskesklooster, but it is still slightly wider than the Leens A type buildings discussed above (5 m instead of 4.4-7 m). This need not say much, but its 3 m wide central aisle might suggest that it is more related to Roman Iron Age buildings (see 3.2.2.2). This, thus, a fragile picture emerges of the introduction of asymmetrical byres in a Roman Age building tradition and a continuation of related developments into the Early Middle Ages A. Such an early date fits in with the archaeo-
zoological data.

Perhaps the oncoming changes can also be recognised in the buildings from Ezinge, which all have wattled walls. From period 6 (150-300 AD) onwards, these walls have been placed in narrow wall trenches, a feature highly uncommon in earlier phases (figs 4.2 and 4.3). Also, the wattle-
floor byre drains, located on either side of the byre, have now been departed with. According to Saefelt (1967, 37-38), the use of turf is specifically linked to sheep farming communities in the North Sea region. It might be significant, therefore, that Ezinge’s oldest turf walls stem from period 6.

Saefelt provides little concrete evidence to support his theory, but it is evident from other sources that important changes were taking place in these settlements in the Roman Iron Age (i.e. more or less contemporaneous with the shift in the archaeo-
zoological material). Most importantly, sunken-
floor huts were introduced already in the 4th century AD (De Langen & Waterbolk 1989, 104). The earliest sunken-floor hut at Den Burg also dates from the Roman Iron Age. These small outbuild-
ings are often associated with weaving activities (e.g. Woltering 1975, 30; Nicolay 2008a, 135).

The shortage of building plans from the 4th century AD, is probably caused by (and thought to be indicative of) a hiatus in the occupation of the terp region (e.g. Nicolay 2005, 67-69). Whether or not the abandonment of the salt marshes was full-
scale, is a long-debated topic. It is of particular interest, in this respect, that the traces of Late Ro-
aman and pre-Merovingian architectural develop-
ments are visible on both sides of the hiatus. It appears that the data shortage distorts the speed at which we perceive these developments to have taken place. On the basis of this discussion, it can be suggested that the hiatus was not absolute; it has not caused a clean break in local building tra-
ditions.

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155 It has previously been pointed by Nicolay (2008b, 46) that central aisles are c. 3-4 m wide in the Roman Iron Age. This is well illustrated by the Midlaren, Fochteloo B and Noordbarge type buildings depicted by Waterbolk (2009, 74-79). Buildings of these types have been found at Ezinge in the terp region (figs 2.3 and 2.4). The successive rows of arcade posts in Den Burg RIA-11, which is believed to have had turf walls, stand 3.6 and 3.2 m apart (fig. 2.47) and the oldest building from Heveskesklooster shows a roughly similar situation (fig. 2.17). Den Burg building EMA-7 (fig. 2.48) also has a 3 m wide central aisle, but this relates to the renewed widening of build-
ings towards the later stages of the Early Middle Ages (com-
pare also Odoorn C’ and Gasselte types in Waterbolk 2009, 95-
103).

156 Although it is not borne out by the ground plan, it appears that the oldest building from Ezinge may also have had a turf wall. This is suggested in a discussion of the ritual deposits from this building by Gerritsen (1999, 85). Reference is made to Van Giffen, A.E., 1963. Het bouwoffer uit de oudste hoeve te Ezinge (Gr.). Helinium 3, 246-253.

157 See Nicolay (in prep., 210-215) for a recent overview and discussion.
The greatest change appears to have taken place when a narrower type of building ‘arrived’: Leens A type. It cannot be excluded that the arrival of newcomers had a profound influence on its developments, but an indigenous development cannot be excluded either. Further research and more well-documented buildings are needed to clarify this.
4.1.2 Leens B (house)

Tuinstra & Veldhuis (in prep., 27) define the Leens B type as relatively short and wide. Illustrative are Hallum buildings 3 and 4, which clearly have a greater interior width and smaller length than the Leens A type buildings. Building 4 dates from the Early Middle Ages A and has an interior width of 6.5 m (fig. 2.9). Its length is uncertain, but it cannot have been more than 14.2 m. In the graph in fig. 4.4, this building appears to stand more or less alone. Leeuwarden 7 and Hallum 14 are the only other buildings in close proximity, but these clearly differ from the Leens B type structures. The building at Leeuwarden presumably is a late specimen of an essentially Roman Iron Age building tradition and Hallum 14 is one of the timber-built Zelhem type variants (see 4.1.1 and 4.2.1 resp.).

However, the stratigraphical predecessor and successor of building 4, respectively Hallum 3 and 5, would probably also plot in this part of the graph if their dimensions could have been established with more certainty. Hallum building 3 has been dated to the Early Middle Ages A, has an interior length of >12.7 m and was over 5.7 m wide (fig. 2.8). The width of building 5, dated to the first half of the Merovingian period, is either 6.5 m or >8.3 m (fig. 2.9). Its interior length is 14.2 m, however, so by analogy with building 4 the 6.5 m option seems most likely.

Another diagnostic feature of the Leens B type is the presence of an interior partition, as seen in Hallum building 3. Interior partitions are also characteristic of the timber Zelhem type variant and are not typical of the Leens A type buildings. The latter can be interpreted as byres, some of which clearly lack a living area. Longer specimens do have an extra room, but at best it is only fenced off from the byre area, lacking the substantial (door?) posts we see in contemporary buildings in neighbouring regions (figs 3.34, 4.12, 4.6, 4.8 and 4.5; for Drenthe see Waterbolk 2009, 86-91). Of these, Leens building 3c (>19x4.8-5 m; fig. 2.30) is noticeably longer than Hallum buildings 4 and 5 (c. 14.2 m). An explanation for this is provided in the next section (see 4.1.3). For the remaining buildings, Hallum 13 (fig. 2.14) shows possible indications for centre posts, but this would make it a unique specimen regarding its width (5.4 m). The other early medieval examples are just 2.8-3.7 m wide (see appendix). Perhaps this single post is better interpreted as a kettle support (see 3.4.2).

The other turf buildings (Hallum 3-5, Wijnaldum 5b and Leens 1f, 4b and 6) lack interior posts completely. This is remarkable, because of all turf buildings in the dataset, 54% shows at least some sign of a timber main structure (see 4.1.1). A biasing effect through the use of pad stones is unlikely (see 3.2.2.1).

Although the total number of well-defined B type buildings is still very small, these observations fit in well with the notion that arcade posts served a loft supporting function (see 3.2.2.3) and that a turf wall can be load bearing (see 3.1.2.2). The meaning of Hallum 11 and 17, being relatively wide (5.3 and 5.6 m resp.) lofted buildings, remains unclear – they show no indications of having been used as byres and therefore cannot be attributed to the Leens A type either (but see 4.2.1).

Thus, a second typological category is roughly outlined, distinguishable from the Leens A type mainly through greater interior widths (5-6.5 m) and probably a smaller length (in the region of 14 m). Other characteristics are a post-less interior, load bearing walls and interior partitioning. It is interesting to note that the last three are also characteristic of contemporary buildings in neighbouring regions (figs 3.34, 4.12, 4.6, 4.8 and 4.5; for Drenthe see Waterbolk 2009, 86-91).

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\[158\] Possibly, Hallum building 23 (not illustrated here) should also be attributed to this group (see footnote 152).
Fig. 4.4. Graph of widths and dates of turf and timber buildings in the research area. Included are all buildings for which a reasonably certain date and width have been established. For exact specifications, see the appendix.

Key:
- line = turf-walled
- line/dot = outside posts (instead of turf)
- dots = neither
- black = arcade posts (binnenstijlen) + no interior partition
- red = no arcade posts + interior partition
- blue = arcade posts + interior partition
- green = other post arrangement/no posts + no interior partition
Because the Leens A type buildings are the most numerous in the dataset, these similarities have previously remained unnoticed. Emphasis lay on their points of difference. Arcade posts are typical of Roman Iron Age and earlier building customs, but they remain in use in the early medieval terp region. Outside posts, on the other hand, spread along the entire North Sea’s southern coast in the Early Middle Ages, but are not found in Leens type buildings. Outside posts are thought to indicate an important technological innovation, which made arcade posts redundant. They appear to have been essential also to the development of boat-shaped buildings (Waterbolk 1999). Because of our limited understanding of Leens type architecture, the notion has been forwarded that these innovations were long ‘resisted’ in the terp region (Waterbolk 2009, 209). This view is now in need of reconsideration.

The plan of Den Burg EMA-7 (fig. 2.48) demonstrates that outside posts and turf walls were exchangeable roof supporting elements (see 3.2.2.4). This means that turf construction probably reflects physical-geographical differences, rather than technological trailing. Bearing this in mind, similarities with plans from the sandy soils become apparent (Waterbolk 2009, 86-95). Odoorn type buildings, excavated between the rivers Ems and IJssel, are often longer (16-26 m) than the Leens B type buildings (c. 14 m), but a key factor is that they include a byre area. In the early medieval terp region, the byre was a separate building: Leens A (see 4.1.1). Apart from this, their open interior, load bearing walls and interior partitions make them analogous to Leens B. When a comparison is made with coastal Odoorn type buildings, the similarities are even more obvious. The ground plans from Rijnsburg (NH; fig. 3.34) and Den Burg (fig. 4.5) illustrate this best, but the similarities with byre-less buildings from the trading town of Hedeby (DEU; fig. 4.6) are also evident. The interior dimensions of the short (10.8x5 m) Rijnsburg building do not differ much from a Leens B type building. Again, interior partitioning is present, leaving little reason to doubt its interpretation as a house (Van Es 1973b, 282-285). Like Leens B, there appears to have been no room for a byre area, which automatically draws attention to the building next to it.

The longer (18.8x5.8 m) building has been interpreted as a proper longhouse, with a living and a byre area. The byre function is assumed primarily on the basis that an entrance is visible in the short end wall, but this is hardly a reliable indicator, because similar entrances can be seen in some of the short houses as well (fig. 4.5). A slightly more convincing feature are the pits on one side of its interior. Their purpose is uncertain, but pits have also been noted in the asymmetrical byre at Den Helder (fig. 2.49) and possibly in Heveskesklooster period II-building 3 (no plan published). The absence of arcade posts says nothing about a byre function. In conclusion, a byre function is possible, but not entirely certain.

The notion that the building also contained a living area, however, cannot be held. Apart from the fact that it is wider, its dimensions and the lack of interior partitioning are reminiscent of Leens A type structures (compare Leens 5; fig. 2.33). Another similarity is that the building has only one pair of entrances in the long walls. The (assumed)

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159 Another very similar plan from Den Burg has been published in Woltering et al. (1994, 149).

160 At Rijnsburg the pits are located on the other side of the building.
Longhouses from the sandy soils always have two pairs, which are separated by at least three trusses (Waterbolk 2009, 86-95). This is clearly not the case at Rijnsburg. Regarding the post arrangement and the distance over which the pits occur, only the southern entrances seem plausible.

The ‘pit’ directly south of these entrances further strengthens the analogy with Leens building 5. Presumably, this is a posthole which contained a kettle support. Its position in line with the outside posts, suggests that it was attached at the top to one of the trusses, as is the case with most other kettle supports (see 3.4.2). It is likely that a fire place was situated directly south of this post, in front of the western long wall. Areas like these might have been used as a workshop, but probably not as a living room (see 4.1.1). It appears that the buildings at Rijnsburg, which date from the Carolingian period, are better interpreted as a house and (byred?) outbuilding, just like many turf-built structures in the terp region.

Waterbolk’s (2009, 86-95) typo-chronology of the Odoorn A-C types, shows that buildings from the sandy soils are circa 5-5.5 m wide. Several Leens B type buildings (5-6.5 m) fall well outside this range. The Eursinge and Odoorn C’ types differ very little from Odoorn A-C and are slightly wider: 5-6 m. This, however, still does not encompass all Leens B type buildings. The Zelhem type (7-7.5 m) is wider still, and probably has a timber-built parallel in the terp region (see 4.2.1). This parallel has a width range of 6.7-7.7 m, which is only slightly more than the Leens B type buildings. This might help illustrate the architectural developments in the Early Middle Ages.

In fig. 4.4, Hallum building 14 stands most in line with the widest Leens B type buildings, bearing in mind that Hallum 3 and 5 probably cluster around Hallum 4 (see above). These buildings succeed each other in time and might be taken to indicate a transition from turf walling (Leens B) to the use of wattle and outside posts (Zelhem variant). This has also been suggested by the excavators (Tuinstra & Veldhuis in prep., 44). It is not inconceivable, therefore, that the wider Leens B type buildings have gradually developed into buildings of the Zelhem variant, perhaps widening along the way.

If this is correct, the use of a turf wall in the extremely wide Leeuwarden building 41 (13x8 m), might be easily explained (fig. 2.39). On the basis of its width, this building is comparable only to the timber Zelhem type variant (Hallum 14 and 27; figs 4.10 and 4.11 resp.).

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161 Its width is quite similar to the Hallum buildings (byres?) 11 (14x5.3 m; fig. 2.13) and 17 (>15.5x5.6 m; fig. 2.16).

162 Hallum building 20 (>15.5x>5.8 m) is of a similar type of construction, but unfortunately it could not be plotted because its exact width is uncertain. The excavators, however, suggest an interior width of 8.2 m in the trench plan (excavation level 2). In the description of this building it is not stated on what ground this width has been arrived at and the opposing wall trench has not been recognised in the cross-section (Tuinstra & Veldhuis in prep., 52, 92). If the interior width is correct, this
walled buildings in which a wattle inner wall face has been discerned and it is by far the widest to incorporate arcade posts. These are features it shares with the Zelhem type variant, as is demonstrated further on in this chapter (see 4.2.1). If the latter has evolved from early Leens B type buildings, the use of turf walls instead of outside posts, simply demonstrates that these elements long remained interchangeable in salt marsh architecture. It is likely that the late 8th century transition in Wijnaldum building 22 (figs 2.42 and 2.43), from a turf wall (22a) to outside posts and wattle (22b), also fits this framework.

Although this interpretation fits the scarce amount of data from this period fairly well, it leans heavily on the absence of wide buildings (>6.5 m) from the Early Merovingian period. This might be the result of a bias; if buildings from the Roman Iron Age are also taken into consideration, it becomes noticeable that interior widths of 7-7.9 m already existed at an earlier stage. One of these buildings, Ezinge 80 (>19.5x7.4 m; fig. 4.7), appears to have had an open interior and wattled walls. Arcade posts were still common in previous phases (fig. 4.3), but they have now been replaced by (near-)wall posts. The building may have had turf-built walls, but no evidence has survived to confirm this. If turf walls were indeed lacking, this building might best be regarded as an early example of the wide timber buildings from Hallum (14 and 27), although they are chronologically separated by several centuries. This would undermine the hypothesis that the latter evolved from early medieval turf buildings.

Other wide buildings have been excavated at Heveskesklooster. The oldest building (per. I-phase 1) probably was 7.9 m wide, but it is not entirely certain that it had turf-built walls (fig. 2.17). The younger building (per. I-phase 3) might be a 7.3 m wide building, but it has initially been interpreted as the edge of a house platform and is too poorly preserved support any firm conclusions (fig. 2.18). Are these buildings ‘turf-walled’ parallels of Ezinge 80? If so, do they represent a wide building type that remained in use throughout the first millennium? Their relevance to the development of early medieval houses will have to remain uncertain at this stage, even though the (probable) asymmetrical byre in the oldest Heveskesklooster building, hints at some sort of continuity throughout the 4th century ‘hiatus’ (see 4.1.1). One thing that can be established, is that turf buildings with interior widths around 5-6 m (e.g. Leens 1f and 6; figs 2.34 and 2.25 resp.) and perhaps also with interior partitioning (Leens 3c; fig. 2.30), remained in use into the Carolingian period (fig. 4.4). These were not replaced by timber buildings, as seems to have been the case with their wider counterparts. This implies that a further subdivision of the Leens B type category should be possible. At least two groups will be discernable, one comprising the wider buildings (c. 6.5 m) discussed above and originally labelled Leens B by Tuinstra & Veldhuis (in prep.). The other group contains the narrower (c. 5-6 m) specimens; turf-built versions of the short Odoorn type buildings from Rijnsburg (fig. 3.34) and Den Burg (EMA-3: fig. 4.5) and provisionally attributed to the Leens B category in this thesis. Both groups share the same main characteristics: open interior, load bearing walls and interior partitioning. The differences in width do not allow a further distinction at this point in time. Additional criteria will have to be identified for this.

An interesting aim for future research – apart from fine-tuning this subdivision – would be to establish the (socio-economic) factors that underlay the existence of these two types of houses (?). Is it reflective of occupational differences? Tradesmen/merchants on the one hand and farmers on the other (see 4.3)? Late developments in the narrower buildings will be of relevance to this discussion. They have are discussed in more detail in the next section.

4.1.3 Leens A/B (longhouse)

It has been argued in the previous sections of this chapter, that the Leens A and B type buildings have respectively been used as separate outbuildings (byres?) and houses. Within the last category, a further subdivision between wider (c. 6.5 m) and narrower (5-6 m) buildings existed. The wider buildings are thought to have developed into wattle-walled buildings with outside posts, which are discussed in more detail in section 4.2.1. The current section is concerned with subsequent developments in the narrower Leens B type buildings.

Although there are few early medieval buildings that do not fit neatly within the Leens A and B subdivision, three buildings clearly stand out. These are Leens building 3c (>19x4.8-5 m; fig. 2.30), Heveskesklooster period II-building 2 (18x5.5 m; no plan published) and Den Helder building 1 (>16x5.5-5.7 m; figs 2.49 and 2.50). All three have been dated to the transitional phase between the Merovingian and Carolingian period or later. Leens building 3c has an interior partition, which suggests a living function (see 4.1.2). The area to the west of the partition wall is 5 m wide, so the building falls within the Leens B type range (c. 14x5-6.5 m), but such a classification is not supported by its length. A similar problem arises
when the Heveskesklooster building is studied; its width is suggestive of the Leens B type, but it is well over 14 m long.

Den Helder building 1 has arcade posts (binnenstijlen), an asymmetrical byre layout and was probably also too long to classify as Leens B. Its interior width, on the other hand, falls outside the Leens A type range with 0.8-1 m. There are two long buildings from Hallum (11 and 17) that do not fit in either; they have arcade posts and demonstrate roughly similar interior widths (5.3 m and 5.6 m resp.). These have not, however, produced any sign of cattle box partitions, raised walkways or byre drains, so there is little to support an interpretation as byres. The widest contemporary byres (with fixed layout) are Leens buildings 1g and 7a and they measure only 4.6 m in width (figs 2.26 and 2.35 resp.).

An interpretation that explains most anomalies is provided by Den Burg building EMA-7 (fig. 2.48). It has an interior width of 5 m and probably dates from the 8th century AD (Waterbolk 1999, 110). Characteristic of this building is that it comprises a timber Odoorn C type building, with outside posts, as well as a section with arcade posts. Overlapping post pairs from both sections, indicate that the arcade posts were not intended as the primary roof supports (see 3.2.2.3). In the Odoorn type section, the wattle (?) wall was placed in a narrow wall trench, but the wall was turf-built in the presumed byre area. Because the outside posts do not continue along this part of the building, it has been concluded that the turf wall took over their roof supporting function (see 3.2.2.4). The plan demonstrates how a Leens A type outbuilding (byre?), with turf walls and a loft, could be joined to an Odoorn C type house, with an open interior and interior partitioning.

A 6 m wide parallel has been excavated at Esens, Ostfriesland (DEU), and also dates from the (early) 8th century AD (fig. 4.8). In the Esens building, the narrow wall trench apparently continued throughout the entire building. No traces of a turf wall have been documented. Here, too, arcade and outside posts overlap with two trusses, suggesting a different function for each type of post. The roof supporting outside posts, however, do not continue along the entire length of the building, as is normally the case in contemporary buildings with arcade posts (fig. 4.12). This suggests that a turf wall once stood around the northern end of this building, to support the roof.

The relevance of these buildings to settlement archaeology in the terp region has not gone unnoticed by Waterbolk. In his description of the

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163 Compare also the plan of an early medieval building at Uitgeest (Woltering et al. 1994, 149; see footnote 167).
Odoorn C type, he remarks that “the buildings from Texel and Esens can be considered an intermediate form and they deserve their own type status. They can also be expected in the Dutch terp region.”¹⁶⁴ No timber-built Odoorn type buildings are known from the salt marshes, but we do have their turf-built counterparts: narrow Leens B type buildings. Joining Leens A with Leens B (instead of Odoorn C) would result in a turf-walled equivalent of the Den Burg and Esens buildings, with no outside posts at all.

Perhaps the Den Burg-Esens analogy can provide a useful backdrop for the interpretation of the three deviant turf buildings, mentioned at the beginning of this section. If so, it seems likely that they developed from separate Leens A and B type buildings in the early years of the Carolingian period (fig. 4.4). It would be of interest to establish how widespread this (re)joining process has been and what effect it had on later building types.

Turf walls are more likely to be preserved in the terp region, but this does not eliminate the risk of maintaining a turf/timber dichotomy. The ‘timber’ building at Esens, Germany, probably also had a turf wall, but none was noted during excavation (fig. 4.8; see 4.1.3). For the research area, however, the bias seems to be of modest proportions, because hardly any early medieval ‘timber’ buildings are known from the terp region (see 4.1.1). Of all salt marsh sites in the catalogue (i.e. not including Den Burg), only five ‘full timber buildings’ date from the Early Middle Ages. All others date either from the Roman Iron Age or late medieval period.¹⁶⁵ The timber buildings from the Early Middle Ages are Wijnaldum 22b (figs 2.42 and 2.43) and 33 (no plan published), Leens 8 (fig. 4.9) and Hallum buildings 14 and 27 (figs 4.10 and 4.11).

Wijnaldum building 33 has only been partially excavated, revealing eight large postholes, 25-30

![Fig. 4.9. Leens 8, Groningen (NLD).](image)

4.2 TIMBER BUILDINGS

4.2.1 Zelhem type variant (house)

Because of the height differences between dug in posts and upright standing turf walls, it might be possible that either only turf or timber elements are visible in a single excavation level. This realisation is of importance to the study of prehistoric buildings, because it could exaggerate the distinction between timber and turf buildings. This is well-illustrated by Ezinge buildings 70-72 (figs 2.2, 2.3 and 2.4). All three are thought to be of known ‘timber’ building types, but they also have turf walls. Moreover, the Noordzegte type, to which buildings 70 and 71 have been assigned, is one of few types to suggest the use of turf walls in the sandy region (see 3.2.2.5). Old surfaces do not survive these soils, so all buildings excavated on the Drentse plateau are per definition biased in favour of timber elements.

¹⁶⁴ Waterbolk (2009, 90); my translation.

¹⁶⁵ Roman Iron Age: Ezinge, Heveskesklooster, Leeuwarden; Late Middle Ages: Boornbergum-Kloesewier. There are also sites with just timber buildings, but these are few and do not seem to contradict the picture sketched in this section. The plans from Sneek and Wartena-Wartsiens, for example, have been included in the graphs to illustrate that building widths from Leeuwarden and Ezinge are representative of the period. References to publications of these sites are provided by Waterbolk (2009, 221-222).
has a wattled wall with round stakes, the other has a wall of cleft posts indicated by triangles. Both buildings have an interior width of 5.1 m. At first sight, there seem to be 4 outside posts along the southern side of the buildings, but the two westernmost posts stand in line with the wall posts which are visible between the triangular posts and the water well. For that reason, these stray posts are also likely to have been wall posts. The easternmost post is triangular in section and probably belongs to the other building. This leaves only one possible outside post, placed at a distance of more than 1 m outside the wattled wall. Regarding this large distance, the building’s relatively small interior width and the absence of arcade posts (*binnenstijlen*), it might be suggested that the building is of the Odoorn C type, but the evidence is not conclusive.

The timber buildings at Hallum date from the transitional period between the Merovingian and Carolingian period (fig. 4.4). Both have been divided into smaller rooms (3 in no. 14; at least 2 in no. 27) and have outside posts (figs 4.10 and 4.11). Building 14 also shows a wall post, set in line with the wall itself. The trajectory of the latter is clearly indicated by a narrow wall trench. These are all features the buildings share with the more or less contemporary Odoorn B and C type structures (Waterbolk 2009, 86-91). A noticeable difference, however, is that they have interior widths of 6.7 m (Hallum 14) and 7.7 m (Hallum 27), whereas the Odoorn type buildings are only 5-5.5 m wide.

The only contemporary building type that fits the description is the Zelhem type, a regional variant of the Odoorn C type (Waterbolk 2009, 109). The Zelhem type has a fairly southern distribution; it is found just north of the central river area, in the Province of Gelderland and further towards the east in Westfalen, Germany. Waterbolk, however, also recognises elements of this type in a 7.5 m wide building fragment from Midlaren, on the northern tip of the Drente plateau. Characteristic are the presence of two main posts in the short end walls, set close to each other, and three pairs of arcade posts in the centre part of the building (fig. 4.12). Fragments of both features are also discernible in the plan of Hallum building 27 – this would suggest a maximum length of 17.3 m.

But again there are also differences. First of all, the outside posts in building 27, do not stand in line with the arcade posts. Secondly, the outside posts do not line up with the interior partitioning in either of the Hallum buildings, which is the case in the Zelhem type structures. Wijnaldum building 22b (fig. 2.42) has been dated to the last half of the 8th century and is of unknown width. It, too, is represented by a narrow wall trench, which branches off for an interior partition, and it has outside posts that do not stand in line with the arcade posts. This makes it comparable to the Hallum buildings. Furthermore, at least five arcade posts stand in line, not three as in the Zelhem type. It can be suggested that these northerly buildings

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166 According to Waterbolk (2009, 90), varieties of the Odoorn C type are found throughout the northwestern part of the Netherlands in the 8th century AD, from Westfalen in Germany (Warendorf and Telgte), the central river area (Dorestad), the Veluwe (Kootwijk), along the west coast (Rijnburg, fig. 3.34, and Texel, fig. 4.5) and all the way to the German *terp* region (Niens, Elisenhof) and in Schleswig-Holstein (Hedeby). For its relationship with the Leens type buildings see also sections 4.1.1 and 4.1.3.
represent another, not previously identified variant of the Zelhem type.

4.3 THE END OF LEENS TYPE ARCHITECTURE?

Due to the use of turf buildings in the Roman Iron Age, preliminary thoughts on the origins of Leens type architecture could already be discussed in the earlier sections in this chapter. How the Leens type architecture came to an end, however, is hard to establish. For a subcategory of wide Leens B type buildings, the notion has been forwarded that they evolved into the timber Zelhem type variant. This would have been possible because turf walls and outside posts are exchangeable roof supporting elements (see 3.2.2.4). The transition from turf to outside posts probably started in the transitional phase between the Merovingian and Carolingian period, but an earlier date cannot be excluded (fig. 4.4).

At Hallum, the outbuildings eventually also became timber-built (fig. 4.1, nos. 9, 18, 21 and 22). Because of this, it is tempting to suggest that the development of the Zelhem variant announced the ending of turf-built structures in the northern coastal region. The turf buildings at Leens also terminated in a timber structure at the beginning of the 9th century AD (Leens 8; fig. 4.9). At Wijnaldum, building 22a was replaced by a Zelhem-like structure around the end of the 8th century (fig. 2.42; see 4.2.1). May we not assume that other turf buildings soon followed?

Upon closer inspection it actually becomes apparent that turf construction persisted beyond the chronological boundaries of the current dataset. Turf was still used in fairly large buildings at Heveskesklooster (per. II; no plans published), for example. These are 16-18 m long and 5.5-5.7 m wide and have roughly been dated to 800-1300 AD. Den Helder building 1 (fig. 2.49) also dates from the Carolingian or later periods. It has an asymmetrical byre layout and interior dimensions of >16x5.5-5.7 m. A fragment of another building with a turf wall and byre area has been excavated at Boornbergum-Kloesewier (FR; not illustrated here). It dates from the 10th century AD (De Langen 1992, 120).

Bearing in mind that (some?) byres and narrow Leens B type houses were already starting to be (re)joined in the 8th century AD (see 4.1.3), it is not inconceivable that some of these late turf structures were proper longhouses. Outside the research area, indications have also been found for continued turf construction in the 10th-13th/14th century AD (table 1.2; footnote 10). The evidence is still outside posts have been documented though. The building is just over 22 m in length.

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107 Compare also the third plan from Uitgeest in by Woltering et al. (1994, 149). If the row of stakes can be considered to represent the wall line (with a trench round the outside), the building had an interior width of 8.8 m! Such an interpretation is also supported by the location of the (presumed) doorposts in the opposite long wall; a row of posts stands directly on the inside of this wall and probably served to support the wattle wall. These posts also close in the short ends. Slightly further towards the centre of the building, two rows of arcade posts can be seen along the long walls. These appear to have greater diameters and in some of the postholes the post itself has been preserved. There are eight pairs of posts in total, spanning 5.7 m at the short end and 7 m in the centre section of the building. Two pairs have been placed at an angle to the building’s central axis. The average bay size is just over 2.5 m. In addition to the building’s great width, it is also of interest that the arcade posts are more numerous than in the Zelhem type structures. Moreover, its interior partition does not line up with the arcade posts; perhaps this building also is a variant of the Zelhem type. No
scarce, but does suffice to set up a working hypothesis for the benefit of future research.

Of key importance, initially, is the remarkable Leeuwarden building 41 (fig. 2.39). It has been dated on stratigraphical grounds to the Early Middle Ages D (c. 925-1025; fig. 4.4). Despite this late date, the building has an interior width of 8 m, which probably is why it incorporates arcade posts (binnenstijlen). Its date, width and timber structure suggest it may best be interpreted as the turf-walled equivalent of the Zelhem type variant (fig. 4.4).

If this is correct, the building demonstrates that the transition from turf walls to outside posts cannot be attributed to local physical-geographical differences. The site at Hallum is located along the same coastline as Leeuwarden, but further away from the sandy region and the peat soils (figs 1.1 and 2.1). Therefore, marine influences would have been more or less the same, but timber had to be imported over greater distances. This was even more so the case for Wijnaldum, which lies on the far western coast of Friesland, just about as far away from wooded areas as one could possibly get in the terp region. It is rather surprising, therefore, that people in these ‘far out’ locations switched to timber construction centuries before people in Leeuwarden did.

A possible explanation may be deduced from Nicolay’s (in prep., 235-236) discussion of the economic differences between Hallum, Wijnaldum and Leeuwarden. The excavation at Leeuwarden yielded very few imported goods, whereas Hallum and Wijnaldum are thought be part of an interregional trading network. This network operated along the North Sea’s entire south-eastern coastline. Perhaps this is what provided the financial and logistic means necessary to import the required amounts of construction timber.

Hallum buildings 11 (fig. 2.13) and 17 (fig. 2.16) could perhaps also be interpreted in such a marine-based trading context. They respectively measure 5.3 and 5.6 m in width, but also have arcade posts, indicating they had lofts (see 3.2.2.3). They are the only two buildings in the catalogue that cannot be comfortably attributed to the Leens A or B types (see 4.1.2). Do their larger sizes relate to the storage of merchandise?

According to this trade hypothesis, turf buildings in agricultural contexts may long have missed out on architectural improvements. This might explain the continued use of turf in the other buildings. It also raises the question whether turf walls were still being used in early Gasselte type buildings. The fact that some of the later structures at Boornbergum-Kloesewier belong to the Gasselte A type (Waterbolk 2009, 94), might suggest they were. These buildings eventually became the well-known boat-shaped buildings. De Langen (1992, 118) points out that the Boornbergum buildings are similar to those found in the province of Noord-Holland. One building at Spaarnwoude dates from the 10th-11th century AD and indeed has turf-built walls (fig. 1.5). It even appears to have had an asymmetrical byre layout; the only one outside the research area, so far.

Knol (2010, 57) recently suggested that people from the terp region settled on the peat soils during the 9th and 10th centuries AD, possibly because of hostile Viking activity along the coast. Whatever the reason was, their moving might provide a ready explanation for the presence of late medieval turf buildings in the peat lands. Whether their buildings form a continuation of Leens type architecture is beyond the limits of this study, but it makes an interesting question for future research.

4.4 SUMMARY AND CONCLUSION

4.4.1 Typology

At least four building types can be discerned for the early medieval terp region. These are the turf-walled Leens A, B and A/B types and a variety of the timber-built Zelhem type. Leens A/B and the Zelhem type variant are preliminary denotations. A (timber-built) Odoorn C type building might have been excavated at Leens (building 8; fig. 4.9), but the evidence is not conclusive. Odoorn C type buildings have been recognised somewhere else in the research area, however, namely at Den Burg (NH), but this also is the only non-salt marsh site. The distinction between Leens A and B has recently been established by Tuinstra & Veldhuis (in prep.), but additional diagnostic features have been identified in this study. This has led to new hypotheses on the function, origin, typological development and possible ending of the Leens type buildings. Summaries and conclusions are provided in the sections below.

4.4.1.1 Leens A

Leens A (turf-walled) is relatively narrow, with interior widths of 4.4-7 m. Interior lengths vary from c. 8-18 m. Typical are the plans of Leens buildings 1b (fig. 2.20), 1g (fig. 2.27) and 5 (fig. 2.33), as well as Foudgum main building (fig. 2.5). Leens A can furthermore be identified by:

- absence of interior partitions – at best some wattle fencing may be involved, without large posts (doorposts?; fig. 2.27);
- sometimes presence of arcade posts (binnenstijlen) – in longer buildings they cover only up to c. 13 m of the interior length;
• byre area – sometimes with fixed layout, indicated by cattle boxes, walkway and/or drain (see also 4.4.2).

Because the arcade posts do not continue throughout their entire length of the longer buildings, an open interior is created at one end. A fire place and kettle support may be found there. An entrance is located in one of the short end walls. In the extended buildings, one pair of opposing entrances is added to the long walls to provide access to the open interior section. The arcade posts and byre indicators are diagnostic features for the Leens A type, but they are probably lacking in many similar buildings without loft and fixed byre layout (see 4.4.3, incl. footnote 169). If a fixed byre layout has been used, the cattle boxes are only located one side of the byre (asymmetrical byre layout).

The Leens A type buildings probably are the turf-walled equivalent of some of the short (coastal) Odoorn type buildings (compare characteristics).

4.4.1.2 Leens B
Leens B (turf-walled) is relatively wide, with interior widths of 5.5-6.5 m. Interior lengths lie around 14 m. Typical are the plans of Hallum buildings 4 (fig. 2.9) and 3 (fig. 2.8). Leens B can furthermore be identified by:

• presence of turf-built interior partitions;
• absence of timber inner structure (open interior);
• absence of byre indicators.

Leens B can probably be subdivided into two subtypes, but the distinction cannot be made with certainty on the basis of the current dataset, because of the fragmentary state of most ground plans. It appears that the Leens B category will fall apart into a group of wide (c. 6.5 m) and relatively narrow (5-6 m) buildings. A probable kettle support was found in one of the structures (fig. 2.14). Wijnaldum building 5b (fig. 2.40) may also have had a fire place.

The narrow Leens B type buildings probably are the turf-walled equivalent of some of the short (coastal) Odoorn type buildings (compare characteristics).

4.4.1.3 Leens A/B
Leens A/B (turf-walled) is of moderate width, with interior widths of 5.5-7.7 (8.2?) m. Typical are the plans of Leens building 3c (fig. 2.30) and Den Helder building 1 (figs 2.49 and 2.50). Interior lengths were probably 18 m and more. These buildings essentially are Leens A and B type buildings which have been joined together. Because of this, a combination of the same characteristics can be expected:

• presence of turf-built interior partitions (= Leens B characteristic);
• partial absence of timber inner structure (open interior = Leens B characteristic);
• partial presence of arcade posts (binnenstijlen = Leens A characteristic) – at Den Helder in combination with wall posts; posts may be lacking in non-lofted buildings (fig. 2.30);
• byre area (= Leens A characteristic).

If a fixed byre layout has been used, the cattle boxes are located on one side of the byre (asymmetrical byre layout).

Note that the probable existence of this category has been established on the basis of comparable buildings excavated at either end of the terp region, notably at Den Burg (NH; fig. 2.48) and Esens (DEU; fig. 4.8). These buildings combine Leens A and Odoorn C type buildings (instead of Leens A and Leens B), resulting in the partial presence of outside posts (and wall trench) in their ground plans. The current dataset supports the notion that fully turf-walled specimens can be found in the Dutch terp region, but few available ground plans are not clear enough to sustain a separate type at this stage – the denotation ‘A/B’ is provisional. The plans from Den Burg and Esens suggest that fire places and kettle supports may be found in the central part of the building.

The Leens A/B type buildings probably are the turf-walled equivalent of long (three-partite) Odoorn type buildings, known best from the sandy region.

4.4.1.4 Zelhem type variant
The Zelhem type variant (timber-built) is very wide, with interior widths of 6.7-7.7 (8.2?) m (see also footnotes 162 and 167). Only one plan provides an indication for their length: 17 m. Typical are the plans of Hallum buildings 14 (fig. 4.10) and 27 (fig. 4.11), but also the fragmentary Wijnaldum building 22b (fig. 2.42). The Zelhem type variant can furthermore be identified by:

• presence of outside posts – instead of turf wall;
• presence of narrow wall trenches – to contain wattle (?) instead of turf wall;
• presence of timber interior partitions (also indicated by narrow trench) – possibly with larger posts (doorposts?).
• presence of arcade posts (binnenstijlen) – probably five pairs or more, compared to three in original Zelhem type;

• interior partition(s) and arcade posts do not line up with outside posts – they do in original Zelhem type.

No indications have been found for the presence of byre areas. Possibly two outside posts stood along the short end walls, but the evidence is not conclusive and they might only have been an optional feature.

Note that the existence of this category has been established on the basis of comparable buildings excavated just north of the central river area (province of Gelderland and Westfalen, Germany). Fragments of a building from Midlaren (DR) suggest that it might also have a more northerly distribution (see also footnote 167). The current dataset supports this notion for the terp region, but the few available ground plans are not clear enough to sustain a separate type at this stage – the denomination ‘Zelhem variant’ is provisional.

The Zelhem type variant may have existed also in a turf-walled variant (fig. 2.39; see also 4.4.3).

4.4.2 Origin, development and endings

There are indications that asymmetrical byres were first introduced (developed?) in the terp region in the Roman Iron Age and that buildings with an essentially Roman Iron Age construction (i.e. wide central aisle) were still un un use in the Early Middle Ages A. Architectural developments are obscured by the occupational hiatus in the 4th century AD, which thus would not have been a complete hiatus. The absence of asymmetrical byres outside the terp region (including Roman Iron Age Archsum-Melenknop in Sylt; figs 3.46 and 3.47) also supports the notion that Leens type architecture was developed locally.

Most byres with a fixed layout date from the transitional phase between the Merovingian and Carolingian period or later. No specimens are known that date from the full Merovingian period with certainty. Seafel (1967) previously suggested that the fixed byre layout was reintroduced in the early 8th century AD, which fits in with the data from the terp region. The earliest buildings suggest that byre indicators may have been reintroduced in separate stages.

Concerning the development of the Leens B type, the hypothesis has been forwarded that a wide (c. 6.5 m) subcategory eventually developed into the timber Zelhem type variant, further widening along the way. This transition was possible because turf walls and outside posts are exchangeable roof supporting elements. It seems to have started in the transitional phase between the Merovingian and Carolingian period (late 7th–early 8th century AD), but an earlier date cannot be excluded. The existence of a probable 10th century AD parallel which still uses turf walls, shows that it was a lengthy process (see also 4.4.3).

A second hypothesis states that the relatively narrow (5–6 m) Leens B type buildings were (re)joined to Leens A type structures around the same period. This is key to the development of the provisional Leens A/B type (see 4.4.1.3). The plan of Leens building 8 (fig. 4.9) suggests that these may also have developed into timber buildings with outside posts (probably Odoorn C type), but the evidence is not conclusive. Elsewhere in the research area, turf walls again remain in use throughout the Carolingian period and well into the 11th century AD. Finds from outside the research area suggest that this may have continued until the 11th-12th/14th century AD, at the least. Some of these buildings appear to have developed into Gasselte A type structures, mostly (?) in the peat lands of the northern and western coastal areas.

4.4.3 Functional interpretations

The use of cattle boxes, walkways and/or drains in some of the Leens A type buildings, demonstrates the presence of a byre area. It has been suggested that the asymmetrical layout of these byres relates to a greater reliance on sheep farming, but more research is needed to confirm this relationship. Merovingian byres appear not to have had a fixed layout and can therefore not be identified with certainty. Many buildings from this period, however, have similar interior dimensions and do incorporate arcade posts (binnenstijlen), which are also typical of the Leens A type. This might help with their identification.

No byre indicators have been found in any of the Leens B type buildings. Because they are characterised by short lengths, open interiors and interior partitioning, the hypothesis has been forwarded that Leens B type buildings were byre-less houses. This might explain why such short byres (Leens A) existed in the same period in the same region and why these could be (re)joined to form proper

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168 This probably also implies a local development, rather than the introduction of a ‘package concept’ from elsewhere (e.g. Frankish regions).
longhouses (Leens A/B) in the 8th century AD (see 4.4.1.3).

More difficult to interpreted are the extended Leens A type buildings. These were clearly used as byres as well, but they also include an area without arcade posts or byre indicators. These buildings lack interior partitions, which are believed to mark out the living areas in all early medieval building types in these northerly regions (Eursinge, Odoorn A-C, Zelhem and Leens B types). It can be suggested, therefore, that the non-byre areas were not used to live in; perhaps they were used as some sort of workshop, like a smithy, for example. This can explain the (occasional) presence of fire places.

The probable existence of two subcategories of the Leens B type is equally interesting. Could the distinction between the wide and narrower houses be reflective of occupational differences? It is remarkable that the very wide (8.2 m) Leeuwarden building 41 was still built with turf walls, in spite of its late date (c. 10th century AD). Similar buildings at Hallum (14 and 27) and Wijnaldum (22b) were already constructed with outside posts centuries earlier. On the basis of differences in topographical locations, it has been suggested that access to a major marine-based trading network was the cause for this constructional discrepancy. This would imply that the wide Leens B type and Zelhem variant buildings were the houses of early tradesmen or merchants. Because the narrower Leens B type houses were (re)joined to loose byres (Leens A) around the same time, their functioning in a more agricultural context seems obvious.

The functional interpretations suggested in this chapter, have entirely been based on typological grounds. There are very few plans that do not fit comfortably within the new chrono-typological framework, but it must also be pointed out that well-preserved plans are still in short supply for most building types. The interpretations should therefore be considered as working hypotheses, for which reliable evidence needs to be collected through ongoing excavations. Careful documentation and aimed sampling are essential for the collection of such evidence.
5 RECONSTRUCTION OF AN EARLY MEDIEVAL TURF BUILDING

This chapter presents a first proposal for the reconstruction of a turf-walled building at the local heritage museum in Firdgum (FR). As was stated in the introduction to this study, “few things stimulate our imagination on ancient life better than a full-scale reconstruction of an actual building.” The conclusions reached in the previous two chapters, now make it possible to reconstruct – with some amount of certainty – a Leens type building. But the reconstruction should not be considered as a last and final product; it also offers unique opportunities to put some of the hypotheses to the test. For that reason, the first section of this chapter has been devoted specifically to establishing the aims of the reconstruction.

In subsequent sections, descriptions of specific features of the building provided, eventually leading up to a reconstruction proposal that enables most (if not all) of its aims to be achieved. The final interpretations have all been based on the results of this study, but there is no point in reproducing all considerations that underlie the conclusions. For further argumentation the reader is referred to relevant sections in previous chapters.

5.1 POINTS OF DEPARTURE

5.1.1 Aims

The aims of the reconstruction fall apart into two main categories: commercial aims and academic aims. From a commercial point of view, the project should draw more visitors to Firdgum (FR). Therefore it should appeal to the general public and be safe for visitors to access. The former may be achieved by highlighting the building’s uniqueness: it demonstrates a long-lost building tradition, dependent on a naturally available product which is not commonly perceived as a suitable building material, it reflects a far older type of building than the historical plaggenhutten (lit. turf huts) and is better constructed, and it illustrates the relative economic wealth that is often associated with early medieval terp sites in Friesland, particularly Wijnaldum. For local audiences, but also for people who come to visit the province of Friesland, an emphasis on the building’s ancient Frisian character is desired.

From an academic point of view, the commercial aims should be achieved in a way that corresponds to our current understanding of early medieval buildings in the terp region. This means that the reconstruction is based on representative ground plans and incorporates similar building materials. The latter should approach the quality of the original materials as closely as possible. Where data on specific matters falls short, one should strive to avoid problems in ways that suit the particular style of construction, rather than give in to using modern materials – no hidden waterproofing solutions, like plastic sheeting between layers of turf thatch, and no steel frames inside the walls. The reconstruction should illustrate the technological capabilities of early medieval terp dwellers, but also reflect other aspects of their culture.

Ideally, the building should also enable the execution of so-called living experiments, which might help to illustrate the insulation properties of turf. Also, a long-term monitoring programme is needed to collect detailed information on structural strengths and shortcomings, regeneration of turf vegetation, rate of decay (of timber and turf) and maintenance needs. This will allow for comparisons with academically guided reconstructions elsewhere (see Harsema 1980, 1995a, 1995b and 2006; Noble 1984 and 2003; Beck 2008).

5.1.2 Ground plan

The initial proposal was to reconstruct an early medieval house, preferably of Merovingian date. It should reflect the relative wealth associated with turf house occupation at Wijnaldum. At the outset it was assumed that these houses were proper longhouses, which would enable the neighbouring farmer’s sheep flock to find shelter in the reconstructed byre area. This study, however, has given rise to the idea that byres and houses were actually

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170 Cultural characteristics that might be reflected in the building’s construction, are a sedentary way of life, contemporary material culture, the unique physical-geographical situation (incl. resultant timber shortage), maritime influences, someone’s occupation (farmer, tradesman or merchant?), associated crafts, wealth and social status, interregional relationships and religious beliefs.

171 An earlier academically guided reconstruction was built by the University of Groningen at Orvelte in the late 1970’s (fig. 3.55). It concerns an Iron Age longhouse of the Hijken type. Detailed reports on its construction and subsequent maintenance have been published by Harsema (1980 and 1995b, resp.). In 1979, a living experiment was conducted in cold wintry conditions. Temperatures (inside and outside) were monitored and a report was eventually also published by Harsema (2006). It would be of interest to compare the results of this experiment with the climatological properties of a turf-walled building. Beck (2008) discusses the results of a similar experiment in Denmark. For a critical approach to setting up living experiments, see also Keijzers (1997).
two separate buildings, respectively of the Leens A and B types. These are (re)joined in the (Early) Carolingian period, but the exact layout of these longhouses (provisionally Leens A/B type) is very much hypothetical. No complete ground plans are currently available for the salt marsh region.

The museum premises are too small for the construction of two separate buildings, but it would be possible to reconstruct only a Leens B type building. Indeed, reconstructing the house of a wealthy Merovingian would clearly illustrate the differences with historically documented plaggenhutten (lit. turf huts) and nuance the association of turf with poverty and misery. But we now know that such structures desire the load bearing turf walls to support the c. 6.5 m roof span, without the added support of arcade posts (binnenstijlen). These buildings were probably at the pinnacle of contemporary turf architecture and it may rightfully be questioned whether our attempt at reconstructing one would be successful first time round. It would also mean departing with the idea of providing shelter for neighbouring sheep, which would be regretful seeing that turf house life in this coastal zone may have been closely linked to a largely sheep-orientated economy. Moreover, the building would only be an empty shell, because little is known about the layout of such houses, let alone the function of specific parts of the interior (so-called activity areas).

After deliberation with museum staff, fellow archaeologists and involved organisations, it has been decided to base the reconstruction on an extended Leens A type plan.\(^{172}\) By opting for a specimen from the transitional phase between the Merovingian and Carolingian period (c. 675-750 AD), the incorporation of a fixed byre layout can be justified. Its asymmetrical setup illustrates the reduced dependence on cattle farming and further highlights the unique character of Leens type architecture. It also creates an appropriate setting for the sheep. The addition of a loft over the byre area, supported by arcade posts, also adds to the décor of the structure – this would have to be left out in the reconstruction of a Leens B type building.

To also meet the less academic demands, the plan of a relatively wide (4.5 m) specimen is preferred. This ensures that the large dimensions of these turf structures will still be evident, avoiding the association with dilapidated plaggenhutten. The choice for a fairly long (15 m) byre brings relief for the lack of a proper living area. The extension implies the addition of a pair of opposing doorways in the long walls, which provide access for the visitors. Because this part of the reconstruction does not contain arcade posts, it will clearly demonstrate the load bearing capabilities of turf walls – for most visitors this will be a surprising observation. The fact that the precise function of these extensions cannot yet be established with certainty, allows the audience to fantasise about whether the fire place relates to handicraft (smithy?) or does after all point towards some sort of living function (occupants/household members/slaves?).

Leens building 1g (figs 2.26 and 2.27), Leens building 5 (18x4.4 m; fig. 2.33) and Foudgum main building (>18.5x4.1 m; fig. 2.5) serve as the basis for the reconstruction’s ground plan, the interior dimensions of which are 15x4.5 m. The reconstruction can be built on a house platform, which illustrates the precautions that were necessary to live in the salt marshes before they were

\(^{172}\) Meeting of 12 November 2010, Yeb Hettinga Skoalle, Firdgum.
dyked in. It also avoids digging postholes into the terp of Firdgum – this is a registered monument.

5.2 CONSTRUCTION

5.2.1 Walls

5.2.1.1 source

To match the original building material as closely as possible, the turves are taken from the modern salt marsh outside Friesland’s northern sea dyke. A grassy area with high clay content (i.e. close to the water line) is best suited for construction purposes. The turves are to be cut in springtime and laid to rest for a sufficient amount of time to get rid of excess water and allow them to stiffen up. This makes them easier to handle and prevents fungal growth, rot and the regeneration of vegetation.

5.2.1.2 construction

The turves are stacked horizontally, in level courses and directly on top of the house platform. A simple but effective bonding system is used to hold the wall together. Turves measuring 50x25x8 cm can be lifted relatively easy and still allow sufficient overlap. The courses can be laid with the same patterns as were noted in Leens building Ig (fig. 2.26): three alternating courses with (1) only headers, (2) a combination of headers and stretchers (one row of headers in the centre and one row of stretchers on either side) and (3) only stretchers. This way an initial wall thickness of 100 cm is produced. The courses overlap at straight angles at the corners.

The wall height should fall within the 1.8-2 m range. This creates sufficient head space also for modern (tall) people to walk around inside. An additional row of stretchers is used in the short end wall to enable the construction of a gable (topgevel). The wall faces remain vertical and are trimmed smooth to allow rainwater to run off swiftly. Afterwards, a wall thickness of c. 95 cm remains, or c. 120 cm for the gabled wall. An entrance (c. 100 cm wide) is located in the byre’s short end wall and two more in the long walls which provide access to the extended part of the building.

5.2.2 Primary timber structure

5.2.2.1 source

Timber can be taken from any locally available source and may consist of a variety of species: birch (berk; Betula), alder (els; Alnus), willow (wilg; Salix) and hazel (hazelaar; Corylus), but preferably oak (eik; Quercus) and ash (es; Fraxinus), which appear to have been the prevalent species in the Carolingian period. It may be reused from other structures, as long as it is representative of the timber that was obtainable for people in the early medieval terp region – no tropical hardwoods or modern (scientific section) construction timber. Green wood was probably used most, because the bark is often found still attached. It has the added benefit of being easier to work with during construction. Preferably somewhat crooked wetland timber is collected for the reconstruction, because the peat lands probably were an important sourcing ground for people in the terp region. The diameters should be such that the structure meets modern safety regulations.

5.2.2.2 construction

The primary timber structure comprises the roof structure and the loft (vliering). The former rests on longitudinal beams that run the length of the wall top. This prevents direct contact between the valued roof timbers and the moist turf and spreads...
the load evenly over the wall. The loft is supported by arcade posts (*binnenstijlen*), which are dug in. The roof structure consists of a series of trusses (*spanten*), placed just under 1.7 m apart. They stand close to the inner wall face to keep the span to a minimum and allow sufficient space for the thatch to rest on the wall top – this automatically results in the absence of projecting eaves (*dakoverstek*). The pitch of the roof is kept as slight as possible to minimise the required amount of timber, but it cannot be too slight, because some space is needed to move around and store goods on the loft. A pitch of 40° will do fine.

The trusses are connected by a series of purlins (*gordingen*). The exact number of purlins and whether they also include a ridge tree (*nokbalk*), is arbitrary, but they should be able to support the top layer. For the greater part, therefore, the number of purlins will depend on the strength and durability of the available building materials. The top layer, which serves as a substratum for the thatch, may be constructed of an even wider variety of materials, ranging from rafters (*sporen*) made of cabers (*palen*) or brushwood (*kreupelhout*), to wattle panels or rope. The last option might not be all that out of place in the *terp* region. Locally, even brushwood was absent, but there were vast expanses of grassland, which could have been used to make rope. Perhaps also flax (*vlas*), straw (*stro*) and other fibres were available. For the reconstruction, the (partial) use of rope would be illustrative of the maritime character of life in the *terp* region. A skilful use of rope is important to seafaring communities in general.

The roof trusses are reminiscent of the cruck-like (*krughebint-achtige*) Celtic cuppills. This means that the principal rafters (*spanbenen*) may consist of single timbers, creating a triangular-shaped truss, or several shorter timbers, resulting in a more arch-like trajectory. Different trusses may be combined in a single roof, as long as their basic dimensions are roughly the same (fig. 3.28). No complex joints are needed; only one flattened surface per timber and facetted pegs (*penen*) to clasp the posts together.

A tiebeam (*dwarsbalk*) stops the principals from spreading by forming a rigid truss. To stabilise the structure also in longitudinal direction, one or more trusses are placed at an angle to the building’s central axis. In the supposed workshop area, the tiebeams can be positioned at approximately half the height of the truss, where the span is only around 2.5 m. In the byre area, on the other hand, the beams are required just above the wall top to support the floor of the loft and leave sufficient storage space above. These tiebeams span over 4.5 m and because they also carry the weight of the stored goods, the arcade posts in this area are very welcome.

### 5.2.3 Secondary timber structure

A wattle wall facing appears not to have been standard in Leens type buildings. Where it has been used, the reasons for its application remain uncertain. Was it to protect the soft turf wall? Was it just for decorative purposes? It might be applied in the reconstruction to prevent the sheep from rubbing against and eroding the interior wall faces. In the non-byre area it may serve a more
decorative function, perhaps, but it would be a pity to hide all turf from view.

Wattle panelling is also used for the cattle box partitions and a low fence that stops the animals from walking freely into the supposed workshop. This fencing is not as substantial as the turf-built partitions that can be found in the houses. Presumably a light gate allowed passage from one part of the building to the other. Proper door frames were constructed at the entrances through the turf wall, but their main posts were placed on top of the threshold to prevent direct contact with the moist soil.

5.2.4 Remaining features

The floor is either of bare earth or turves. Because of the great quantities of clay in this region, additives might have been necessary to reduce dust levels. The fire place is located in the centre of the non-byre area and is constructed of pebbles or pottery sherds, covered with clay (loam?). Next to the fire place stands a kettle support, which is attached to a tiebeam for additional support. A turf-rimmed hole in the roof lets out the smoke, drawing in fresh air through the small (c. 30 cm) byre drain outlet at the other end of the building. The byre drain itself is constructed of long horizontal beams, held in place with short stakes and lined on the outside by turves. When the building is entered through the byre’s short end wall, one steps directly on to a raised turf-built walkway.

The drain and cattle boxes are located only to the right of this walkway.

The byre’s short end wall is slightly thicker than the remaining wall sections (see 5.2.1.2), because it concerns a gabled wall. The gable is not full height, however; it supports a half hip (half eindschild). The roof is thatched with thick blocks of clay-rich salt marsh turf, which rest on an under-thatch of long flat turves. These strips overlay each other to prevent water seeping through at the seams. The top layer is allowed to go green again, so it needs to be thick enough to contain sufficient amounts of water without letting it through.\footnote{It was noted on 12 November 2010, after a period of moderate rainfall, that a clear distinction existed in the moisture content of certain wall courses in the test wall at Firdgum (FR; see also 3.1.2.2). The two uppermost layers were fairly wet all the way through, while the course directly below was dry from the top down. The sharpness of this boundary suggests that the transition from one course to the next, somehow forms an obstacle for the water. It also suggests that a top layer of 16 cm or more should suffice for the roof of the reconstruction. The slope of this roof is longer, which results in greater quantities of water travelling over the lower roof section, but I expect that any negative effects that result from this will be compensated by the fact that the roof slopes down – the top course on the test wall is completely level.}
The grass protects the roof against drought and erosion.
The building is constructed in such a way, that the most costly parts of the timber structure do not come in direct contact with the turf. Should sagging occur, causing the roof turves to touch the purlins (*gordingen*), for example, measures should be taken to correct this. Turf will always be slightly moist, so timber that touches it will decay sooner than free-standing timber. No measures are taken to prevent the arcade posts from rotting at ground level, but the gradual raising of floor levels, caused by the accumulation of dung and the trampled-down remains of stall bedding, may have compensated for the decay of the posts. Possibly the lower sections of the posts were sealed in by these deposits before they rotted through completely.

To get the maximum life span out the turf-built elements, it is of great importance that the roof remains green and the walls remain bare. A poorly maintained roof may suffer from the effects of drought and direct impact of rain, whereas the wall will start to rot when a grass cover keeps it moist. It might be found necessary to dig a trench around the outside of the walls, to prevent water syphoning up into the lower courses. When for some reason cracking or sagging does occur in the roof or the wall, repairs should be made as soon as possible, because the rate of deterioration will increase exponentially. Damaged sections can simply be cut out and replaced with new material (flexible maintenance attitude).

Good ventilation and a lit fire are also of major influence on the building’s life span. Both could probably be taken for granted in the past, when doors stood open all day and the embers in the fire lay smouldering, waiting to be rekindled at night. The timbers and turf are kept dry by the warm air and as they slowly get covered by a layer of soot, fungal growth and infestation by wood boring insects is prevented. Such ‘lived-in’ conditions have also been re-created in Scottish museum blackhouses at Arnol (fig. 3.54) and Colbost (fig. 1.15), as well as the 17th century turf house reconstructions at the Highland Folk Museum in Newtonmore (figs 1.14 and 3.45). To establish the possible life span of a Leens type building, a similar setup should be aimed for at Fidgum.
APPENDIX

This appendix contains a list of turf and timber buildings from the sites discussed in the catalogue, with the addition of Sneek, Wartena-Warsiens and Wierhuizen. The buildings for which the interior width and date can be established with reasonable certainty, are plotted in figs 4.1 and 4.4. Italics indicate that the stated post arrangement, wall type or byre layout is likely but not entirely certain. All dimensions are given in metres.

An asterisk indicates that no exact date is available for the building. These dates (for Leens and Heveskesklooster per. 1) have been established by dividing the total duration of the site’s occupation by the number of excavation levels. Some discretion is allowed for by subsequently expanding the building’s date with the date of one over- and underlying excavation level.

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<td>turf</td>
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<td>(centre?)</td>
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<td>4.2</td>
<td>centre</td>
<td>turf</td>
<td>800-1000 AD</td>
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<td>centre</td>
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<tr>
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<td>+ arcade + outside</td>
<td>wattle (trench)</td>
<td>675-750 AD</td>
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<td><strong>Heveskesklooster (HK)</strong></td>
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<td>50-300 AD*</td>
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<td>L1a</td>
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<td>turf</td>
<td>575-645 AD* (G)</td>
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<td>L1b</td>
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<td>575-680 AD* (F)</td>
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<td>610-720 AD* (E)</td>
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<td>L1e</td>
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<td>-</td>
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<td>645-755 AD* (D)</td>
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<td>680-790 AD* (C)</td>
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<td>720-825 AD* (B)</td>
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<tr>
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<td>3.7</td>
<td>-</td>
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<td>610-720 AD* (E)</td>
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<tr>
<td>L1j</td>
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<td>4.2</td>
<td>-</td>
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<td>645-755 AD* (D)</td>
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<td>720-825 AD* (B)</td>
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<td>L1m</td>
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<td>-</td>
<td>turf</td>
<td>610-720 AD* (E)</td>
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<td>4.8-5.0</td>
<td>-</td>
<td>turf</td>
<td>645-755 AD* (D)</td>
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<td>L4a</td>
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<tr>
<td>L4b (Knol 4)</td>
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<td>turf</td>
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<td>(4.0-)4.4</td>
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<tr>
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**Leeuwarden (LW)**

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<td>LW41</td>
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**Sneek**<sup>1</sup> (S)

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<td>425-550 AD</td>
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<tr>
<td>W7</td>
<td>?</td>
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<td>-</td>
<td>turf</td>
<td>650-750 AD</td>
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<tr>
<td>W26</td>
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<td>4.0</td>
<td>-</td>
<td>turf</td>
<td>550-650 AD</td>
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<tr>
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<td>wall</td>
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<td>W30</td>
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<tr>
<td>W34</td>
<td>?</td>
<td>5.0</td>
<td>-</td>
<td>turf</td>
<td>650-750 AD</td>
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**Wartena-Warsten (WW)<sup>1</sup>**

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<td>425-550 AD</td>
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<td>3.7</td>
<td>-</td>
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<tr>
<td>W26</td>
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<tr>
<td>W34</td>
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<td>5.0</td>
<td>-</td>
<td>turf</td>
<td>650-750 AD</td>
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<sup>1</sup> Measurements after Waterbolk (2009, 71).
<sup>2</sup> Dates after Nicolay (in prep., 213).
The following buildings could not be plotted in figs 4.1 and 4.4, because their width or date is uncertain.

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<td>turf</td>
<td>Carolingian or later</td>
<td>asym.</td>
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<td>RIA-9</td>
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<td>6 (int.?)</td>
<td>posts</td>
<td>turf</td>
<td>Roman Iron Age</td>
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<td>RIA-10</td>
<td>&gt;10 (int.?)</td>
<td>5.5 (int.?)</td>
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<tr>
<td>RIA-11a</td>
<td>&gt;12</td>
<td>&gt;3.6</td>
<td>arcade posts</td>
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<td>Roman Iron Age</td>
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<tr>
<td>RIA-11b</td>
<td>&gt;12.5</td>
<td>&gt;3.2</td>
<td>arcade posts</td>
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<td>Roman Iron Age</td>
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<tr>
<td>EMA-1</td>
<td>prob. 25-30</td>
<td>5</td>
<td>comb. arcade / outside + wall</td>
<td>partially turf / wattle (trench)</td>
<td>Early Middle Ages</td>
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<td>EMA-2</td>
<td>prob. 25-30</td>
<td>5</td>
<td>comb. arcade / outside + wall</td>
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<td>EMA-7</td>
<td>&gt;30</td>
<td>5.3</td>
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<td>partially turf / wattle (trench)</td>
<td>8th century AD?</td>
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<td>EMA-9</td>
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<td>partially turf / wattle (trench)</td>
<td>Early Middle Ages</td>
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<tr>
<td>Woltering et al. 1994, no. 5</td>
<td>10.8</td>
<td>4.8</td>
<td>wall + outside</td>
<td>wattle</td>
<td>Early Middle Ages</td>
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<td>Hallum (H)</td>
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<td>H3</td>
<td>&gt;12.7</td>
<td>&gt;5.7</td>
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<td>turf</td>
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<td>H5</td>
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<td>480-525 AD</td>
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<td>H20</td>
<td>&gt;15.5</td>
<td>possibly c. 8.2 (&gt;5.8)</td>
<td>arcade (trench)</td>
<td>wattle (trench)</td>
<td>925-1025 AD</td>
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<td>H23</td>
<td>&gt;14</td>
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<td>480-525 AD</td>
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<td>L1d</td>
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<td>L7b</td>
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<td>720-825 AD* (B)</td>
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<td>L7c</td>
<td>&gt;9.5</td>
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<td>arcade (+ outside?)</td>
<td>turf + wattle</td>
<td>720-825 AD* (B)</td>
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<td>Van Giffen B</td>
<td>&gt;5.7</td>
<td>3.3</td>
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<td>720-825 AD* (B)</td>
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<td>Van Giffen C</td>
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<td>720-825 AD* (B)</td>
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<td>Wierhuizen1</td>
<td>&gt;15</td>
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<td>arcade</td>
<td>wattle</td>
<td>Early Roman Iron Age?</td>
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<td>W5a</td>
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<td>W5c</td>
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<td>750-800 AD</td>
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<td>W22b</td>
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<td>750-800 AD</td>
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ABBREVIATED PERIODICALS & BOOK SERIES

ARN .................................................. Annual Review of Anthropology
BAE ................................................... Building and Environment
BAEE ................................................ Bulletin voor archeologische experimenten en educatie
BRGK ................................................ Berichten der Römisch-Germanischen Kommission
BROB ................................................ Berichten van de Rijksdienst voor het Oudheidkundig Bodemonderzoek (Proceedings of the State Service for Archaeological Investigations in the Netherlands)
DES ................................................... Discovery and Excavation in Scotland
DVF ................................................... De Vrije Fries
GAJ ................................................... Glasgow Archaeological Journal
GAS .................................................. Groningen Archaeological Studies
Jaarverslag SHBO ................................... Jaarverslag Stichting Historisch Boerderij-Onderzoek.
JAS ................................................... Journal of Archaeological Science
JDA ................................................... Journal of Danish Archaeology
JRSAI ................................................ Journal of the Royal Society of Antiquaries of Ireland
JVT ................................................... Jaarverslag van de Vereniging voor Terpenonderzoek
NAR .................................................. Nederlandse Archeologische Rapporten
NDV .................................................. Nieuwe Drentse Volksalmanak
NOAR ................................................ Norwegian Archaeological Review
PPS ................................................... Proceedings of the Prehistoric Society
PSAS ................................................ Proceedings of the Society of Antiquaries of Scotland
ROB RAM ........................................... Rijksdienst voor het Oudheidkundig Bodemonderzoek; Rapportage Archeologische Monumentenzorg
SAJ .................................................. Scottish Archaeological Journal
TAMS ................................................ Transactions of the Ancient Monuments Society
TAN .................................................. Technical Advice Note. Historic Scotland, Edinburgh.
TOR ................................................... TOR, meddelanden från Institutionen för Nordisk Fornkunskap vid Uppsala Universitet.

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