Steentil, an early stone bridge in the monastic landscape of Groningen, the Netherlands

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Abstract

Restoration of a historic bridge near Aduard, Groningen known as Steentil *revealed an early predecessor. A sample of wood from a pile of this early bridge is dated by Radiocarbon to the last 2 decades of the 13th century.*

Keywords: Medieval bridge, Radiocarbon dating, monastic landscape, Groningen

1 Introduction

In the Late Middle Ages, the marsh and peat districts of the present provinces of Groningen and Friesland were converted into monastic landscapes in short time. Numerous monastic orders settled in the wetlands, contributing considerably to the transformation of a semi-natural into a cultural landscape. In 1192, a Cistercian monastery was founded at Aduard in Eastern Lauwers Frisia, which quickly became the focus of development of the Groningen marsh region. The Aduard monastery possessed over 5,000 hectares of cultivated land and was very active in peat reclamation for economic purposes, which required a well-maintained network of waterways, waterworks like sluices and country-roads. Yet little is known about the manner how these roads crossed over waterways, and whether bridges were constructed for this purpose.

The restoration of the historic bridge located near Aduard, Groningen (a monument listed as Steentil, meaning 'stone bridge') in 2009 offered an opportunity to gain more insight in this medieval water-engineering. Indeed, it revealed an early predecessor dating to the end of the 13th century, which was an unexpected surprise.

The location of this bridge is shown in figure 1.

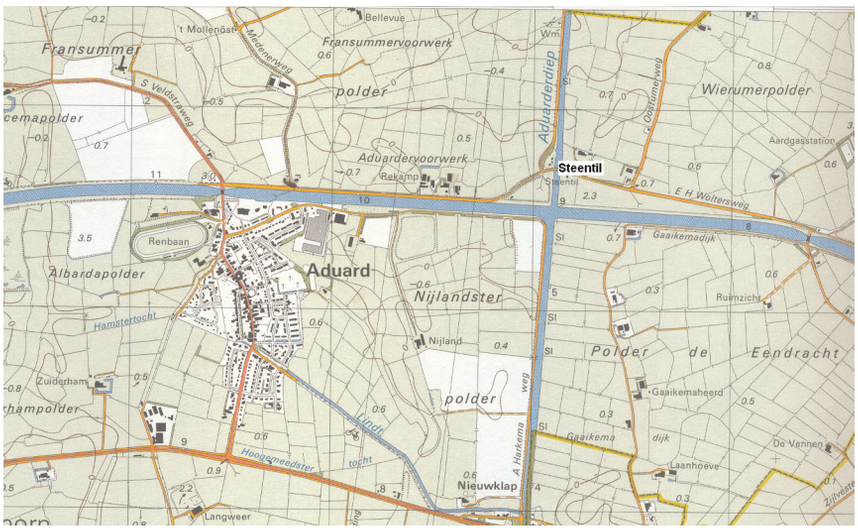

Figure 1 a) Location of the Steentil bridge near Aduard, province of Groningen (topographical map 1:25.000).

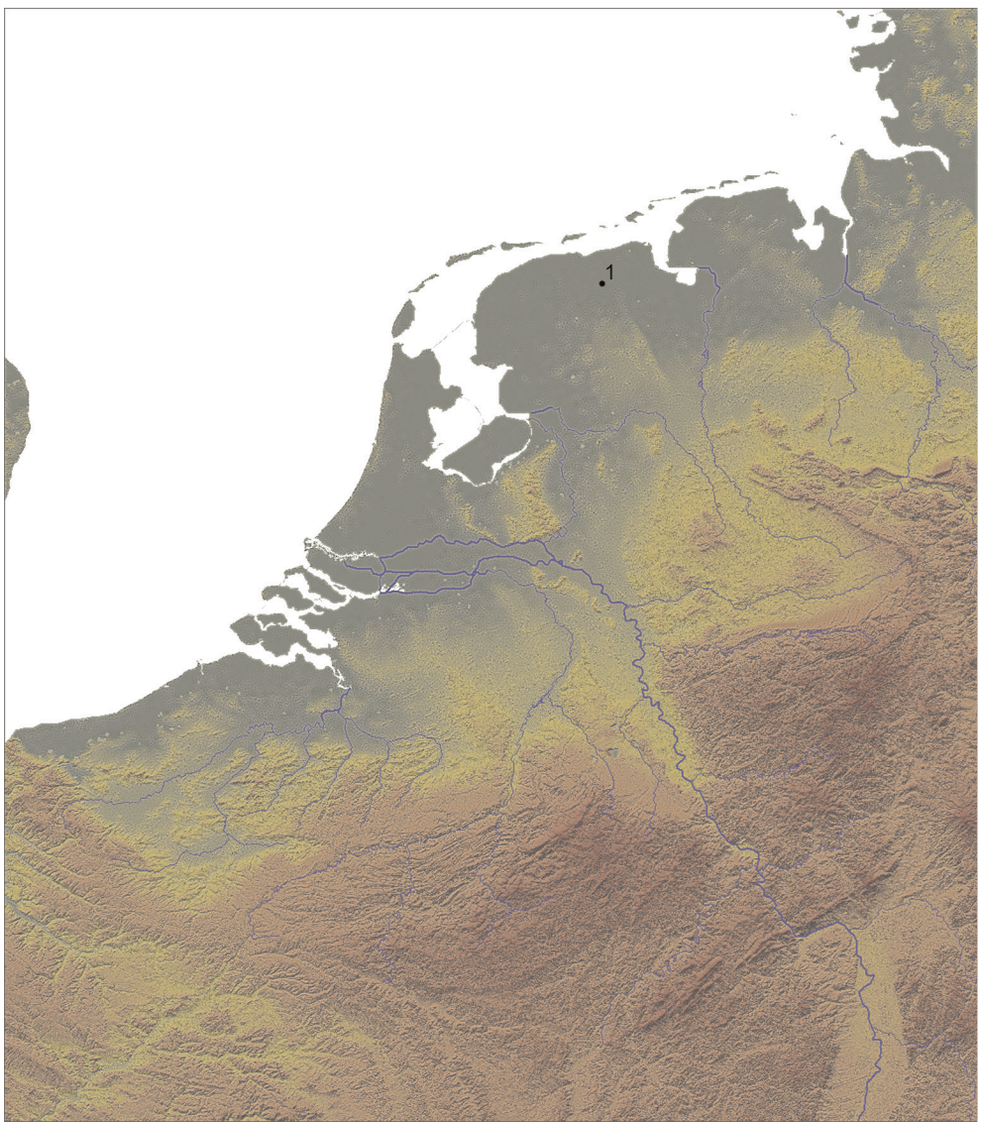

Figure 1 b) Location of Aduard in the Netherlands.

2 An unexpected find

During preparation of the restoration of the present bridge, research in the records indicated that a stone bridge, mentioned for the first time in 1417, may already have been in existence around 1400. At that time, the monks from Aduard were supposed to dig the canal known as Aduarderdiep (Friso & Holstein 2010).

The earliest indication on a map dates to 1560 (the 'van Skrooten map'). The oldest picture of the bridge dates to 1675 (the 'Hoge Justitiekamer map'), which shows a three-arched bridge constructed on two brick foundation abutments (fig. 2). This is very different from the present bridge, which was constructed by order of the Province of Groningen in 1722. It is characterised by two land abutments and a wide span. However, the original stone bridge may have been one-arched too, as the then existing bridge was to be extended "with two arches" according to a resolution dating from 1637 (Friso & Holstein, 2010, 43f).

Figure 2 Oldest known depiction (1675) of the three-arched Steentil (source: Groninger Archieven, toegang 817, inv.nr. 1059).

For the restoration of the present bridge in 2009, the water of the Aduarderdiep was pumped away from the building trench. This enabled the inspection of the land abutments of the 1722 bridge. Members of the local historical society discovered a configuration of vertical wooden piles in the heavy clay at the bottom of the watercourse, adjacent to both brick abutments. They realised the importance of this observation and reported the find to the first author. The presence of large medieval bricks suggested a medieval origin. Yet, the use of such bricks at a distance of only 1.5 kilometres from the Aduard monastery is not surprising.

The configuration of wooden piles appeared original, and the local historical society was asked to document this apparent foundation. The measurements provided insight into the construction: the poles were grouped into two densely placed grids, adjacent to the land abutments, spanning *c*. 10.5 m and with a width of 4.5 m. For the 1722 bridge, these dimensions are 13.0 m and 6.5 m, respectively.

A plan of the site, with the features discussed indicated, is shown in figure 3.

A sample of one of the piles was taken by sawing off the upper end for determination of the wood and dating by dendrochronology. The trunk which was sampled measured 60 cm in diameter. The wood species appeared to be willow. Unfortunately, the number annual rings was only 45, which made the sample unsuitable for dendrochronological dating. Therefore, it was decided to date the wood by radiocarbon.

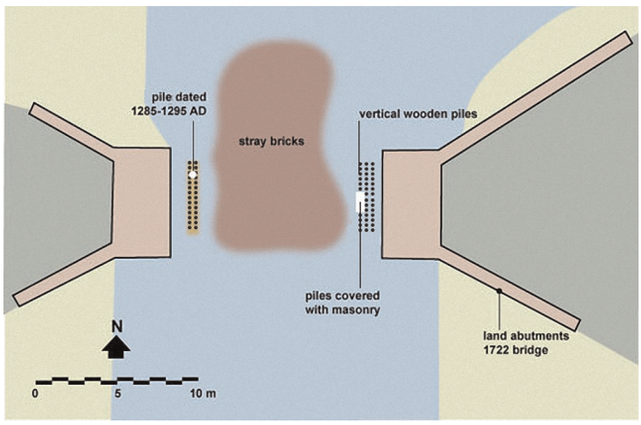

Figure 3 Plan of the wooden piles found in 2009, belonging to the first Steentil bridge (source: F. den Haring, Historische Vereniging Aduard).

3 Radiocarbon dating

A large sample of the willow wood was made available for radiocarbon dating. We choose to date the sample by radiometry (the so-called conventional method), because this method enables measuring large samples to the highest precision possible. About 200 grams of wet wood from the outer rings were used. The wood was chemically pretreated by the standard AAA (Acid-Alkali-Acid) procedure, to remove possible contaminants and to isolate the datable fraction (Mook & Streurman 1983).

The pre-treated material was combusted into pure CO2 gas, of which the ^{14}C radioactivity is measured by proportional gas counting (Van der Plicht 2005). The ^{14}C date of the Steentil sample was determined as 685±15 BP (laboratory number GrN-32447). The date was calibrated using the Intcal09 curve (Reimer *et al*. 2009), yielding a calendar age of 1285-1295 AD (1-sigma confidence interval). At the 2-sigma level this would be 1280-1300 AD (fig. 4). The numbers are rounded to the nearest 5.

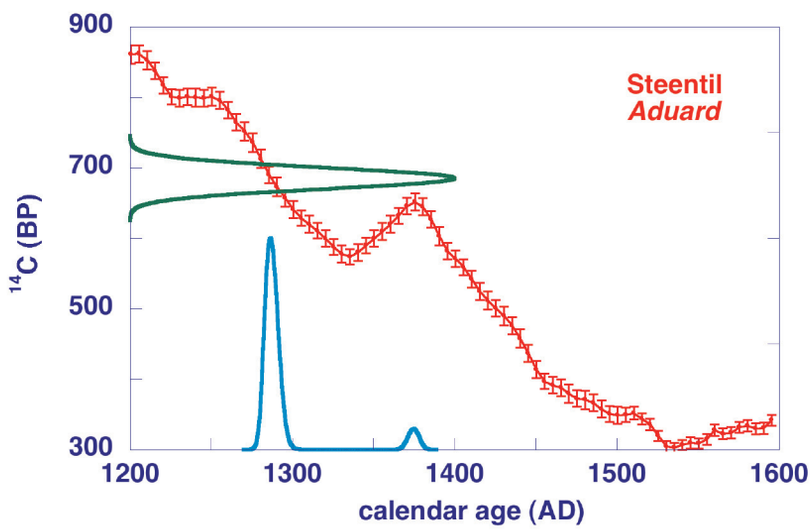

Figure 4 Calibration of the ^{14}C date for sample GrN-32447, 685±15 BP. The relevant part of the calibration curve (red), the 14C measurement (green) and the calibrated probability distribution (blue) are shown. The significant probability for the date is 1285-1295 AD. In theory, the second peak is a posssible solution as wel, but with a very small probability (<10%).

Quite often, the excursions ('wiggles') in the calibration curve deteriorates the precision, but in this case the sample happens to be within a time range enabling inference of a very precise historical date range.

4 Discussion

In the coastal zone, wood species used for vertical constructions during the Late Middle Ages ranges from alder to ash, with occasionally oak. Oak as a local building material was long available in the sandy parts of Groningen, but became scarce during the 16th century, requiring an increase in import of oak timber (Groenendijk & Van Rijn 1996). In the clay region there has always been a shortage of oak. Alder (*Alnus*) was the most popular wood species for foundation purposes, as this tree was abundant in both clay and peat regions and in the stream valleys of the sand regions. Trunks of *Alnus* are well capable of carrying vertical loads and are resistant to rot when applied below the ground water level. Willow (*Salix*), in spite of being a typical wetland species and easily available, is not suitable for timber, as it is very soft, flexible and susceptible to rot. Following Wiselius (1994), the mechanical strength index is 26 and the durability grade is V, which indeed means wood classifications unfavourable for construction purposes. In domestic building therefore willow may be used for wattle work, but it is unknown in over-ground structures (Casparie *et al.* 1995). The use of willow for foundation purposes under the medieval Steentil seems rather anomalous and suggests that immediate availability was more important than structural demands at the time.

Yet, willow has been used in vertical structures, even in the Cistercian monastery at Aduard itself. The second abbey church of the monastery rested completely on pile grids, the number of wooden piles being estimated as 12,500. They measure between 10 and 35 cm in diameter and with lengths not exceeding 2.40 m. Despite the lack of wood determinations in these older excavations, a 1976 test pit in the monastery area produced pile grids only consisting of willow and birch (Praamstra & Boersma 1977, 187). So we may conclude that willow must have been known in monastic building engineering, including foundations in a wet and weak subsoil.

There is little doubt that monks, or building contractors with ample experience under supervision of the Cistercian monastery, constructed the first Steentil bridge at a distance of 1.5 km from Aduard. They chose untreated willow and were not concerned about the bark left. Though we are ignorant about the lengths of the piles, the willow pile sampled may have exceeded the average length of 2.40 m as encountered in the 1976 trench in Aduard. However, we think that the builders had no intention to reach the firm Pleistocene subsoil, as its top lies more than 10 m below Ordnance Level here. Was it the heavy clay, allowing to found on the basis of the sticky property of clay (*kleef* in Dutch) that encouraged them to do so? This might well be the case, compared with the shallow foundation depths found in the monastery itself. Whatever the consideration of the constructors might have been, the application has been successful, as is clearly proven by the perfect condition of the wood after 700 years (fig. 5). Though the wood had become very weak, the trunk itself still retained its original shape. The flattening of the upper ends suggests that the piles were meant to carry a weight, probably spread over transverse beams. A possible transverse beam was encountered in 2010 as a stray find, but mistakenly remained undocumented. On the other hand, part of the pile grid was covered directly with masonry of large medieval bricks[1] and it may be that the piles were kept upright only by means of a wooden frame around the edges. Both foundation constructions, with and without intermediate transverse beams, occur with medieval buildings in the weak Groningen soil.

Under the bridge, a collection of stray moulded bricks was found. It looked like a pavement but its distribution and composition were random. Therefore, this 'pavement' is likely the result of the demolition of the first and the second stone bridge. So, it is imaginable that the

Figure 5 Poles of the wooden foundation at the bottom of the Aduarderdiep next to the present eastern land abutment; the upper ends are flattened and the sapwood of the trunk is still present (photo: H.A. Groenendijk).

original foundation consisted of vertical piles with joisted beams, the latter being removed when the three-arched bridge was demolished, to be replaced by the 1722 design. On the other hand, the observation of masonry directly placed on the vertical piles points to joisting by means of a wooden frame around the pile's edges. Bricks were produced at the Aduard monastery and were already widely used during the end of the 13th century.

5 Conclusion

The precisely dated age range of the willow pile firmly establishes the felling period of the tree between 1285 and 1295 AD. The pile was part of a vertical construction driven into the heavy clay to support the land abutments of a brick stone bridge crossing the Aduarderdiep. As written sources suggest, the Aduarderdiep has been dug around 1408 (Mol & Delvigne 2010, 166ff); consequently the first mentioned stone bridge crossing the Aduarderdiep cannot predate the digging. However, our result shows that the bridge is older. This leaves open two possibilities. One, the 1285-1295 bridge crossed a natural predecessor of the present Aduarderdiep, a branch of the Peizerdiep system, and the canal was dug at a later date using the ancient stream bed. Two, the Aduarderdiep is at least a hundred years older and was already in existence around 1285-1295. We consider the second possibility more likely, for two reasons. First, at the location of the Steentil an ancient course of the Peizerdiep has not been observed. The nearest stream deposits are located a few hundred metres to the east. Second, the builders constructed a foundation 'in the monastic way', *i.e.* using wooden piles, like they did for the Aduard monastery previously. If the old Peizerdiep was still in its natural state by then, a simple ford would also suffice to cross this watercourse.

We assume that the first Steentil bridge was constructed by order of the Cistercian monks, who introduced the engineering of raising brick structures on weak subsoils. The excavation of the Aduarderdiep was conceived to improve the freshwater discharge of the hinterland and the water transport of goods and persons. The construction of a bridge added the opportunity of regulating both road and water traffic. The relatively wide span of 10.5 m between the bridge

abutments enabled an easy passage of freight vessels, and it is likely that their passage was in some way controlled by the Aduard monastery.

At present, the Steentil is the oldest stone bridge observed in the monastic landscape of the northern coastal region of the Netherlands. Yet an even older bridge support, made of oak, was found in the Westerwolde district of Groningen. This wooden construction bridged a man-made stream and dates back to the early 12th century, when monasteries were not yet present in the northern region and brick was not available.[2] The discussion concerning the influence of the monasteries on the semi-cultivated landscape of the northern Netherlands, as it existed at the end of the High Middle Ages, has only just begun (for Aduard: Mol & Delvigne 2010). The presumption of a drastic change gains ground, as the scale of interference is more and more understood as a result of correlated measures, taken by the monasteries, foremost the Cistercians. This comprises the improvement of waterways, the cutting of peat and the embankment of the expanding tidal inlets. However, exact data on monastic interventions, other than written evidence, are rare. The Steentil find sheds light on both water and road management at the end of the 13th century.

The comprehensive report on the Steentil restoration project (Friso & Holstein, 2010) is not clear concerning the meaning of the single wooden pile dated. We are however convinced that the wood sampled, measured by radiometry and yielding a very precise historic date range, takes away all doubts concerning the age of the wood. Theoretically, the piles could originate from an older structure, being recycled, but this is contradicted by the presence of bark. We have no knowledge about the lengths and possible traces of earlier use. We consider earlier use not very likely. The trunks could only survive below the ground water level, as willow is very sensitive to rot. Moreover, the extraction of such piles from a wet soil like peat or clay seems hardly feasible. Therefore we conclude that the piles discovered in 2010 under the Steentil belong to an original construction dating from the late-13th century.

All piles, including the one sampled, were left in the soil and once more have disappeared under the water surface.

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Notes

1. Weblog F. den Haring (chairman to the Historische Vereniging Aduard) dd. 12.09.2009 and personal communication.
2. The find was made in 2009 in the municipality of Vlagtwedde; kind information of drs J. Molema, Libau, Groningen.

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