

# Building timber auxiliary forts in the Lower Rhine Delta in the Netherlands (AD 40–140)

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**Zusammenfassung** – Nach detaillierten Analysen der Ausgrabungen von neun hölzernen römischen Kastellen am Rhein Delta (Niedergermanischen Limes) in Vechten, Utrecht, De Meern, Woerden, Bodegraven, Zwammerdam, Alphen aan den Rijn, Leiden-Roomburg und Valkenburg (Süd-Holland) sowie von einem Kleinkastell in Valkenburg-Marktvelde können nahezu 40 Bauphasen unterschieden werden. Sie sind die Grundlage für den hier präsentierten Vergleich. Die frühkaiserzeitlichen Kastelle wurden alle aus Holz gebaut. Die später häufig anzutreffende kombinierte Holz- und Steinbauweise ist erst ab etwa 160 n. Chr. feststellbar. Frühe Kastelle wurden aus Bauhölzern errichtet, die den umliegenden Wäldern entstammen. Dagegen ist von etwa 70 n. Chr. an das meiste Holz aus Nutzwäldern entnommen, dadurch wurden im Laufe der Zeit andere Baumarten bevorzugt genutzt.

Es gibt viele Unterschiede zwischen diesen Kastellen in den West-Niederlanden und denen im weiteren Verlauf der Rheingrenze. Layout, Baustil und Bautechniken zeigen markante Variationen. Dies könnte eine Beziehung zwischen den Soldaten, die die Kastelle bauten, ihrer Herkunft und ihren Bautraditionen aufzeigen, die sich aus der Kenntnis eisenzeitlicher Bautechniken in Holz erschließen lässt. Einige Kastelle wurden in einer Tradition gebaut die man von den Elbgermanen, der Przeworsk Kultur und möglicherweise auch von den Batavern kennt. Andere Kastelle zeigen wiederum Ähnlichkeiten zum *murus gallicus* aus Gallien.

**Schlüsselwörter** – Römerzeit, Kastelle, Rheinmündung, Dendrologie, Fälljahr, Feuchtboden

**Title** – Building timber auxiliary forts in the Lower Rhine Delta in the Netherlands (A.D. 40–140)

**Summary** – After studying the excavations of the nine Roman timber auxiliary forts in the Rhine delta at Vechten, Utrecht, De Meern, Woerden, Bodegraven, Zwammerdam, Alphen aan den Rijn, Leiden-Roomburg and Valkenburg (South Holland) and the fortlet at Valkenburg-Marktvelde, almost 40 building phases are distinguished. Subsequently these are the base of this comparative study.

The early forts in the research area were all built of timber. After several rebuilding phases only from AD 160 onward many of them were rebuilt in stone and wood. First, the forts had been constructed with wood supply from nearby forests, while after AD 70 most wood derived from managed woodlands. Later on the taxa of preferred trees also changed.

Many differences occur between these forts in the West-Netherlands, and also abroad. Layout, building style and techniques show a striking variation. This might point to a similar relation between the soldiers who built the forts, their origin and their building traditions as appears from research at Iron Age building techniques in timber. Some forts have been built in a tradition known from Elbgermanen and Przeworsk culture and possibly also the Batavians. Other forts show similarities with the *murus gallicus* from the (recruitment) area of the Gauls.

**Key words** – Early and Middle Roman period, auxiliary forts, Rhine Delta, Dendrology, Wetlands

## 1. Introduction

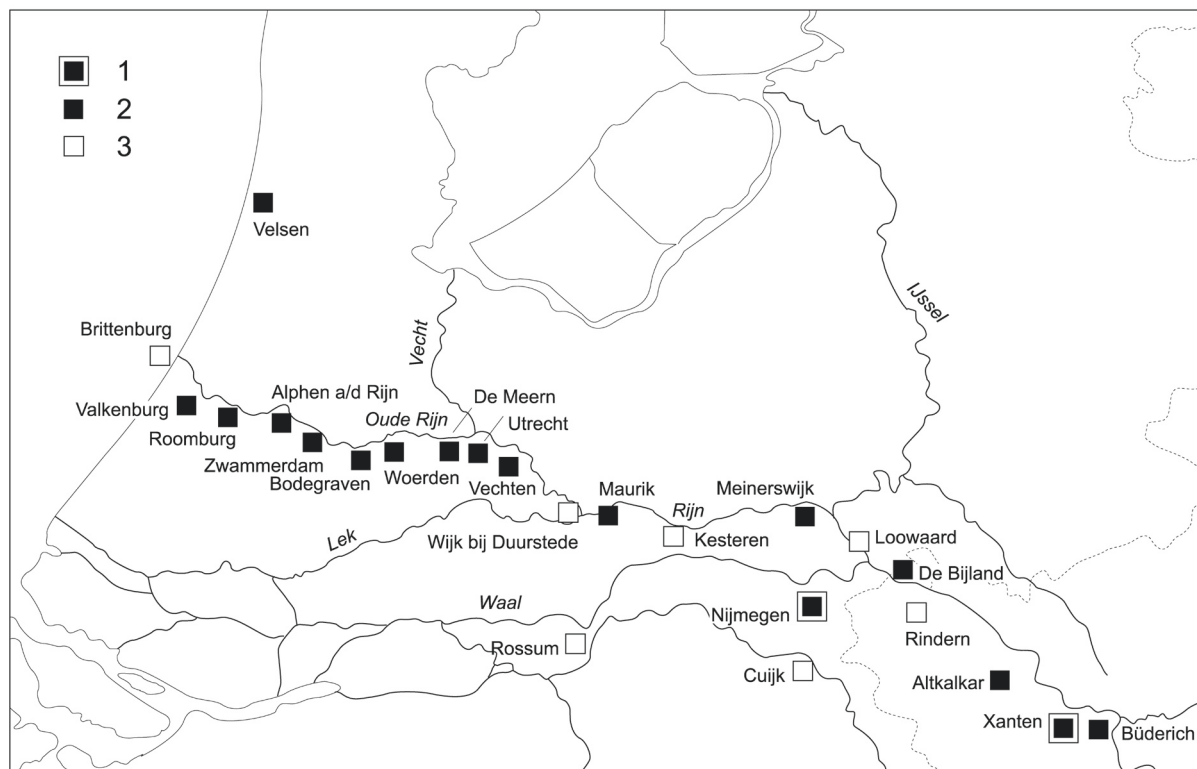
During the course of the first century AD the Roman army's building campaigns at the south bank of the Lower Rhine River must have caused a grand metamorphosis of the river area. Remains of nine timber auxiliary forts and a fortlet have been found in the West-Netherlands, in the Rhine delta (**fig. 1**). An auxiliary fort was built on the river front between Vechten, near Utrecht, and the North Sea coast every 12–15 kilometres, and later on even closer. These forts were constructed of timber and turf and had dimensions of 1–1,5 hectare (ha). They were small in comparison to contemporary forts in other parts of the Roman Empire's frontier zone. Yet, with ramparts of some five meters in height and even higher towers, these forts must have made an enormous impression on the local population.

There are also indications of a Roman military presence further upstream, though few traces of this can be found in the area today. The Rhine

has destroyed most of the evidence, except for dredge finds and some structures in Arnhem-Meinerswijk<sup>1</sup>.

What information about the forts in the Rhine delta do we have? The timber remains in the wetland area provide a lot of information. But the way in which the remains have been documented varies. Sometimes the location is known and small scale excavations give us some insights into the building phases. Other forts have been studied and analysed more extensively. In some cases, the research took place over a century ago, while at other sites parts of forts were excavated only recently.

Despite these differences in levels of research and publication, I have been able to reconstruct almost 40 building phases of the nine forts at Vechten, Utrecht, De Meern, Woerden, Bodegraven, Zwammerdam, Alphen aan den Rijn, Leiden-Roomburg and Valkenburg (South Holland-ZH) and the fortlet at Valkenburg-Marktvelde (**fig. 1**). The reconstruction is based



**Fig. 1** Research area: fortifications in the Lower Rhine area in the Early and Middle Roman period.  
1: fortress; 2: auxiliary fort; 3: probable auxiliary fort.

on information from excavation reports, articles and other publications, photographs and field drawings of old and new excavations. These last two mentioned items were very important sources for this research. They are fascinating to study and show many details.

In this paper, I will make a comparison between the forts and discuss their similarities and differences and how these might be explained. Most of the auxiliary forts in the research area were founded in the early 40's AD. Only in the last quarter of the second century AD, around 160, the greater part was rebuilt in stone. That is much later than in other regions of the Roman Empire, such as Britannia, the most of Germania Inferior and in areas to the east.

Wood was available in the surrounding area and was used for building the forts<sup>2</sup>. I will deal with the use and supply of wood for the Roman army in the Rhine delta, a focus of my colleague Pauline van Rijn's research, in connection with the building campaigns of the forts. Van Rijn is, amongst others, a member of the research group of "A Sustainable Frontier? The establishment of the Roman frontier in the Rhine delta" at

the Radboud University of Nijmegen (see acknowledgements)<sup>3</sup>.

Excavations in the wet environment of the research area have provided an extraordinary quantity of wood records of the forts, and also of roads, watchtowers and river quays. These data have provided insights into the Roman supply systems over time and have made it possible to reconstruct the different types of wetland woodlands from which supply took place. The results show a use of different taxa through time, the use of import wood and indications of local woodland management.

Before discussing the use and origin of the timber and the comparison of the forts, I will start with a short overview of the archaeological-historical context in which the forts of the lower Rhine delta were built.

## 2. Early fortifications along the Rhine in the Netherlands

The river area between Vechten and the North Sea (**fig. 1**) offers exceptional information for

this research. Due to the high-water levels in this wetland area artefacts, especially organic material, are very well preserved. The structures along the Lower Rhine are also well preserved in subsurface, as hardly any post-Roman river erosion occurred. This is in contrast to the central and eastern part of the Dutch river area<sup>4</sup>.

The first signs of Roman occupation in the Rhine-Meuse delta relate to the military campaigns of Augustus by Agrippa. A large military base at the Hunerberg in Nijmegen had already been built probably between 19–16 B.C.<sup>5</sup>. The camp had been evacuated only in or shortly after 16, or at the latest in 12 B.C. Auxiliary troops had their fort nearby, at the Kops Plateau. In the first decennia of the first century some small camps arose in that area<sup>6</sup>. Meanwhile, the first forts appeared along the Rhine at Vechten<sup>7</sup> (**fig. 1**) and, somewhat later, around AD 10–20, most probably also at Arnhem-Meinerswijk and – some kilometres to the west – Driel<sup>8</sup>. North of the river Rhine a fort with a harbour was built in the Oer-IJ region, at Velsen, and was connected with the forts on the Rhine through the river Vecht<sup>9</sup>.

### *2.1. Then, the 40's*

In the early 40's a systematic expansion of the number of forts on the left bank of the Rhine took place. Some nine new auxiliary forts were built of which at least four are dated between AD 40–45. Until recently, it was generally accepted that only Valkenburg was built in AD 39/40 during the reign of Caligula<sup>10</sup>. Other forts were supposed to have been erected only in or shortly after AD 47, the year Claudius ordered general Corbulo to withdraw his troops to the Rhine river's left bank<sup>11</sup>. However, recent excavations have fundamentally changed this theory as founding dates around AD 40 have been established for Alphen aan den Rijn<sup>12</sup>, De Meern<sup>13</sup> and presumably also for Woerden<sup>14</sup>.

It is probable that two forts east of Vechten were also part of this building campaign<sup>15</sup>. These forts from the early 40s were probably built as part of Caligula's expeditions in AD 39/40 against the tribes of the Chauki and Chatti<sup>16</sup> and as part of the preparations to cross the North Sea and conquer Britannia<sup>17</sup>. Caligula's successor, Claudius, would have continued Caligula's planned building campaign for this reason. It was Claudius who eventually conquered Britannia in AD 43. The implication is that the chain of forts at the Lower Rhine arose during the reign of Caligula instead of that of Claudius.

The forts that probably do relate to Claudius, and possibly to his governor Corbulo and the events around the year 47, are those at Utrecht (Dom Square), Zwammerdam and Leiden-Roomburg<sup>18</sup>. Yet this year does not appear to be a 'sacred' date. Founding dates before 47 are well imaginable. After recent research of old excavations at Utrecht that were conducted in 1949 and 1956, for example, it was pointed out that there was pottery that could be dated from AD 40 onwards<sup>19</sup>. Of course, one needs more than pottery to date a site, like coins and dendrochronological dates. Still, this tells us that the year 47 is of less importance than had been assumed earlier.

The first signs of Roman occupation at Bodegraven were supposed to be dated in the 60's AD. This was established by two dendrochronological dates of a gateway's posts in the summer of AD 61 (the felling date). The remains of the fort at Bodegraven could well be of a somewhat later date than the ones mentioned before, but not as late as AD 61. This date actually appears not to relate to the oldest building phase of the fort<sup>20</sup>. The wood samples belong to a rebuilding phase or to the repair of the gateway. Finds of pottery support a date earlier than AD 61, possibly in the early 40s<sup>21</sup>. When these four forts were built, the nearest neighbour distance between the nine forts was reduced from 15 to circa five kilometres.

The remains of the forts in the research area show several phases of repair and rebuilding, each time using timber and turf. These activities appear not always to have taken place at the same time. The only simultaneous rebuilding campaign of almost all forts in the region started around AD 70, after they had been burnt down during the Batavian revolt in AD 69/70. Meanwhile, several new forts were built to the east of Vechten, probably at Rijswijk/Wijk bij Duurstede, Maurik, Kesteren and Randwijk, some kilometres to the east of Kesteren<sup>22</sup> (**fig. 1**).

During the first stage the system of forts and watchtowers probably aimed to protect against Germanic invasions, as mentioned above, and to create a safe corridor for transport as preparation for the invasion of Britannia in AD 43. Only later on, probably by the end of the first century, was this corridor turned into a frontier zone. An overland road or path must have connected the forts at that time. The first evidence of a road, however, only dates to AD 99/100. Most likely there was an earlier road linking the forts in the area, traces of which have not yet been found.





Fig. 2 Detail of a barrack: floor and foundation of one of the barrack walls at Alphen aan den Rijn, dated ca. AD 41/42.

From 160 onwards most of the forts were partly transformed into stone buildings. In the first stage the defences and the *principia* were built in stone; later on some other main buildings were also raised in stone. Other buildings, like barracks, were still erected of wood. The occupation of most forts along the Rhine and their associated settlements, the *vici*, must have ended in the last quarter of the third century AD<sup>23</sup>.

### 3. Research on wood

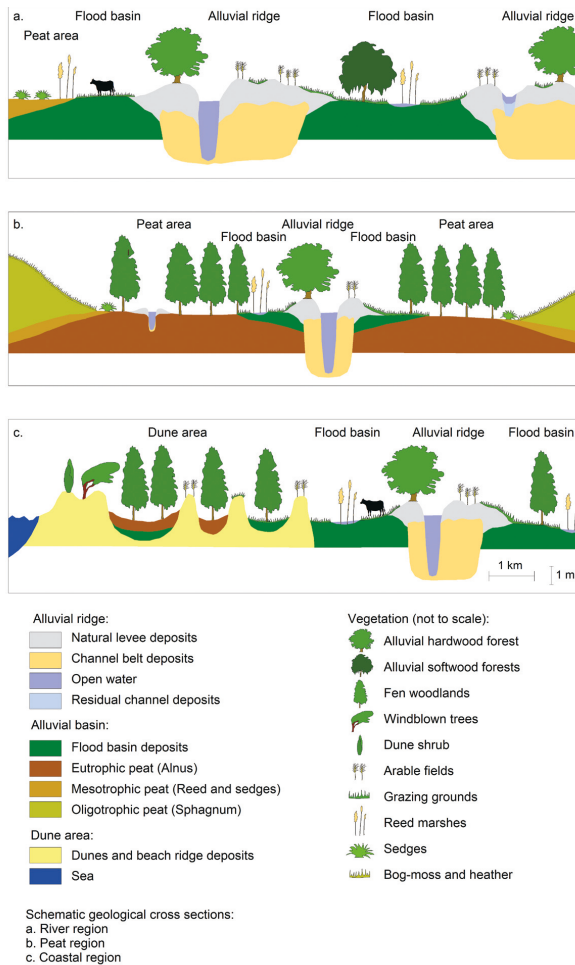
During the period of circa 250 years in which wood was needed to build the forts, tons of wood were collected in the building campaigns. As stated above, between circa AD 40 and 150 the forts were built in timber. After that, during the stone phase of the next 100 years, wood was still necessary for some timber buildings and for the foundations of stone buildings. Wood was used not only for forts but also for roads, watchtowers, river quays and *vici*<sup>24</sup>.

Pauline van Rijn did important research on the use and origin of timber in the forts of the Lower Rhine delta between circa AD 40–150. Some of

her research questions are: Where did the wood come from? Did it come from local woodlands or was it imported, from natural woodlands or production forests? She investigated more than 6.000 wood records. The earliest wood data were collected from excavations in the 1930s and 1940s at the Roman fort at Valkenburg, mostly consisting of identification of the wood taxa and sometimes information on the dimensions of the timber. From the 1980s onwards large quantities of construction timber in the field have been archived with new methods: this concerned “a systematically recording of first the dimensions of the wood, secondly the method of conversion of the tree trunk into timber for construction, thirdly tool marks, fourthly the form and sharpening of posts and poles”<sup>25</sup>. The excavations of the Roman fort at Alphen aan den Rijn in 2001–2002 provided important wood data. Besides lots of timber from barracks (fig. 2), including the floors, posts and beams of gateways, angle towers and foundations of two phases of ramparts have also been investigated<sup>26</sup>.

Besides this circa 500 dendrochronological analyses have been performed on oak as well as on ash and elm. These data are important for the chronology of course, but, as van Rijn states, they





**Fig. 3** Cross-sections through the three types of landscape in which the Roman defence system of the Lower Rhine was built, a. river region, b. peat region, c. coastal region.

also “can often provide the ages of the trees at the time of felling, in cases where the total number of rings are known or can be estimated.” Van Rijn continues: “This gives supplementary information on the character of the woodlands where the wood was felled”<sup>27</sup>. Van Rijn has been able to answer the question about whether the woodland had been exploited or regularly managed at an earlier date.

#### 4. Landscape

Before discussing the wood data, it is useful to give an overview of the landscape and the possible sources of wood<sup>28</sup>. The river Rhine runs from east to west through the central part of the Netherlands. In the east of the country the river is flanked by Pleistocene cover sand areas. The forts of this research are situated in the middle and

west parts of the Netherlands. During the Roman occupation, this area could be characterised as a wet area with – from the east to the west – river deposits, an extended peat area and coastal deposits in the west (fig. 3).

The river area in the east, between Vechten and Woerden (fig. 1), consisted of meandering rivers and a wide zone of levees. These were built up of fertile river sediment, crevasses and basin clay sediment. Research on pollen sometimes shows indications of mixed woodland fringes and alder woodland. West of the fort of Woerden the Rhine entered the peat area. On both sides the river was bordered by low narrow natural levees. Behind these levees the fen peat stretched out with a mixed wetland-woodlands environment on the flood plains.

Mesotrophic peat with reed and sedge swamps was to be found deeper inland and farther away from the river's influence. It was followed by an extensive area of oligotrophic treeless sphagnum peat. The peat was drained by small streams that formed tributaries of the Rhine.

At the fort of Leiden-Roomburg the Rhine reached the coastal area, a zone of low sandy ridges of marine sediments, separated by depressions filled with peat. Pollen studies show that the dunes had a natural vegetation of mostly dune shrubs with sea buckthorn, juniper and alder carr in the peaty depressions.

In the Rhine estuary fresh water and sea water collided. At storm tide the sea would cause destructive flooding. Limitations on woodland growth would have been the consequence of regular flooding by salt water around the estuary, long-time human habitation and exploitation of the ridges for agriculture and wood gathering.

#### 5. Use and origin of the wood

Combining these data with the research on the landscape it appears that this spectrum of used wood species shows similarities with that of riverine woodland on levees<sup>29</sup>. Van Rijn assumes that construction wood from the local woodland on the levees was used for the layout of the military defence system, perhaps complemented with alder wood from the flood basins and fen woodlands. The wood that has been used in construction is partly “gnarly and crooked”. That would, according to van Rijn, not be the case had the wood been imported<sup>30</sup>.

Van Rijn's research shows that a wide spectrum of species was used for the construction

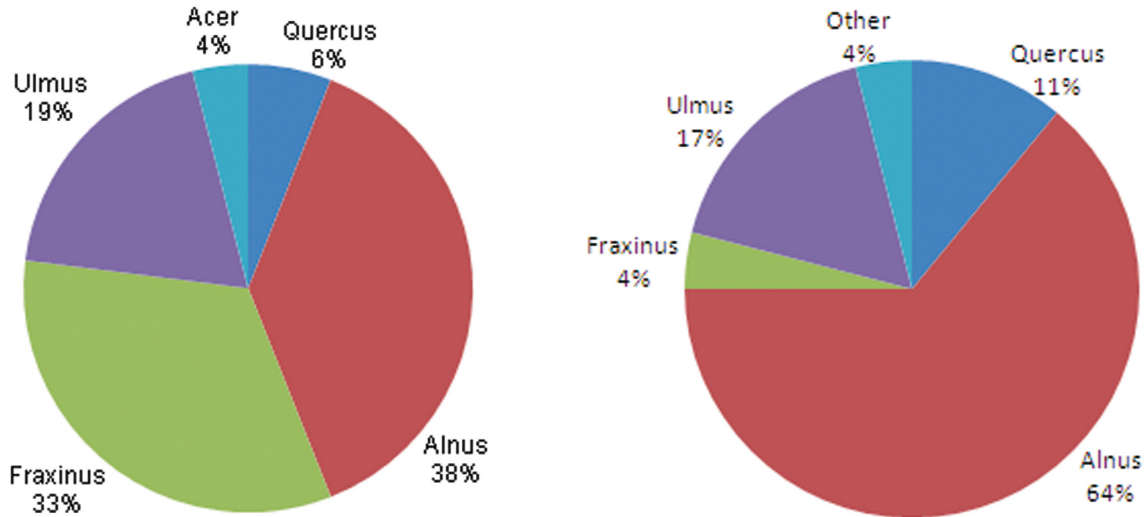


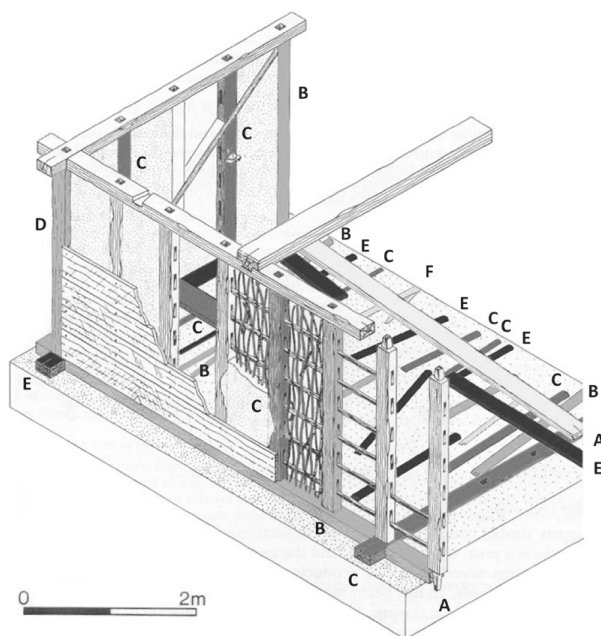
Fig. 4a-b Relative amounts of wood taxa used for timber by the Roman army in the western Lower Rhine delta between AD 40 and 140, the forts in the early Roman period (N=1227) (left) and middle Roman period (N=767) (right).

of the forts and the quays that accompanied them, between AD 40 and 70<sup>31</sup>. Alder (*Alnus*), ash (*Fraxinus excelsior*) and elm (*Ulmus*) appear to be the most common species. Oak (*Quercus*) and field maple (*Acer campestre*) were less common (fig. 4a). Other species were used for wickerwork, wicker mats and faggots<sup>32</sup>.

Van Rijn can conclude that all taxa were used randomly in the structures (fig. 5): “No distinction was made with regard to either the function of the structure or the various construction elements within a structure. Beams, uprights, posts or

planks showed a similar distribution to that of the total structures. Selection was based in the first place on availability and, in the cases where large trunk diameters were needed, on the size of the available tree trunks. Alder and elm seem to have offered the best material for timber of larger dimensions”<sup>33</sup>.

After AD 70 the wood spectrum changed remarkably. Van Rijn showed that a strong increase in the use of alder occurred, while ash, elm and field maple had almost disappeared (fig. 4b). She concludes that the riverine woodland on the



- A: *Acer campestre*: field maple
- B: *Fraxinus excelsior*: ash
- C: *Alnus*: alder
- D: *Quercus*: oak
- E: *Ulmus*: elm
- F: *Sambucus*: elder

Fig. 5 Random use of wood taxa in a barrack.

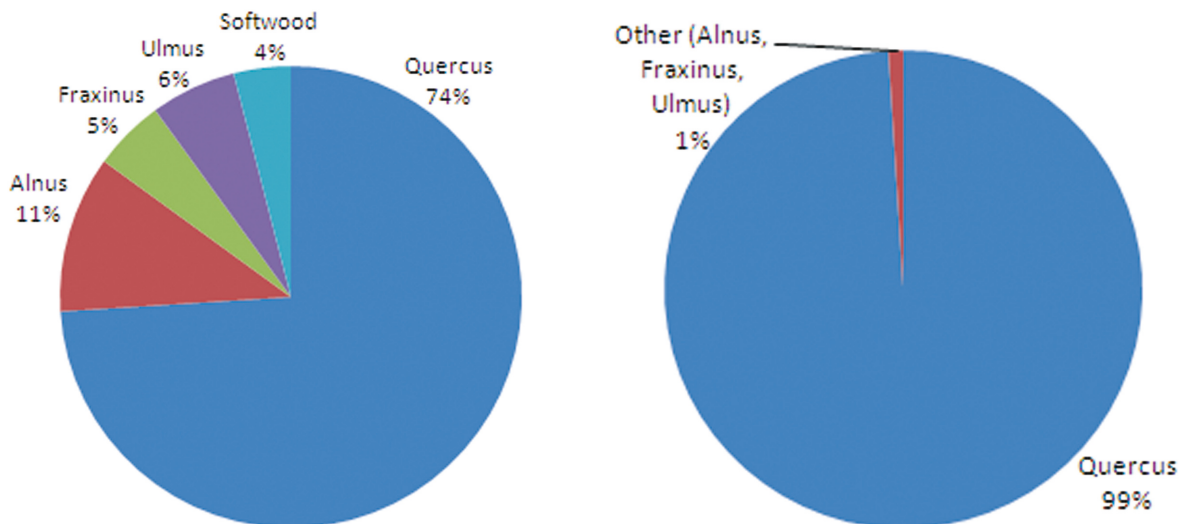


Fig. 6a-b Relative amounts of wood taxa used for timber by the Roman army in the western Lower Rhine delta between AD 40 and 140, the roads from AD 99/100 (N=168) (left) and AD 123/125 (N=491) (right).

levees had become scarce. Detailed investigation pointed out that from the late first century onwards the construction wood of alder was made out of trees which had more or less the same diameters, and consisted of straight stems without side branches<sup>34</sup>. Van Rijn assumes that this alder wood came from managed, coppiced alder woodlands. “These woodlands were probably located on the low-lying parts of the levees, in the flood basins and the fen woodlands. The flood plains and low levees with their heavy clay sediments near the river would have provided excellent growing conditions”<sup>35</sup>. Coppiced woodland provides more suitable construction wood per hectare than natural woodland<sup>36</sup>. Assuming that production woodland occurred in the Rhine delta as early as the last quarter of the first century, as van Rijn states, it means that the landscape was already adapted to the increased demand for construction wood.

At the same time the use of oak strongly increased. The selection of oak seems to have been limited to the construction and maintenance of roads and the river infrastructure, especially the building campaigns of AD 99–100 and AD 123–125<sup>37</sup>. Van Rijn remarks that “after deducting the share of oak used for these two building campaigns, the most obvious shift in the spectrum is the importance of alder, used for timber and round wood in all sites and contexts” (cf. fig. 4b with 6a-b)<sup>38</sup>.

As Kooistra concluded “analysis of wood data has demonstrated that wood for the construction of the forts, but also for later building activities,

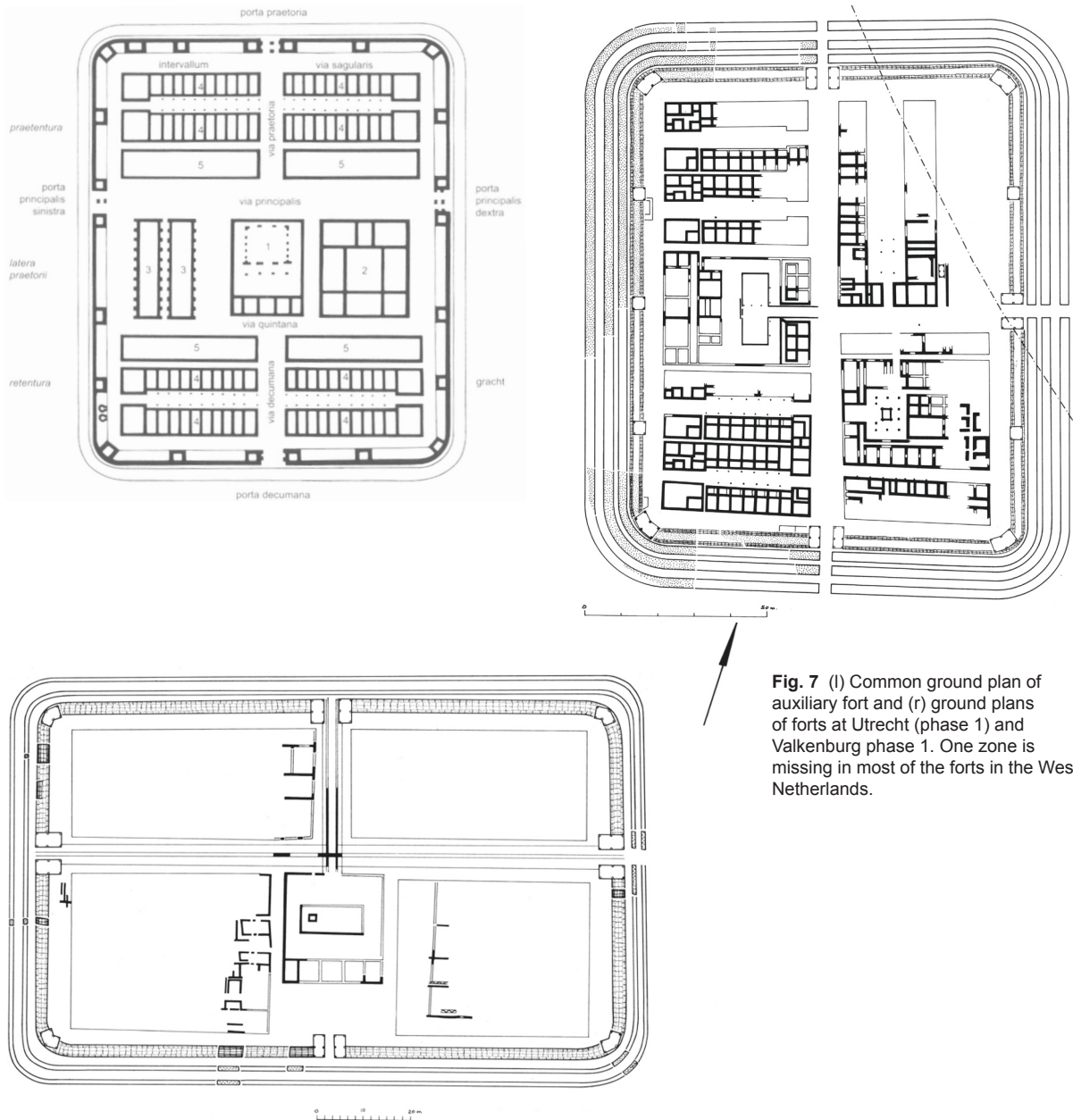
was acquired from the woodland in the limes zone”<sup>39</sup>. The woodland on the levees and alluvial ridges delivered most of the wood that was used for building the forts around AD 40. According to van Rijn only the high levees in the central peat region still carried substantial areas of natural mixed woodlands before AD 70. The natural woodlands on the levees in the eastern river region and western coastal region were most probably already largely deforested, as these areas were relatively densely populated during the Roman period<sup>40</sup>. That leads to the assumption that the part of the Roman army that was stationed in the eastern region mainly exploited the flood basins and the fens downstream along the river Vecht (fig. 1).

Decades later, the greater part of the wood came from the wetland woodland in the flood basins and the fen woodlands. To cope with the disappearance of these resources, the Roman army probably found a permanent solution through the development of alder copses on the edge of the levees and in the flood basins. These copses could provide both timber and firewood<sup>41</sup>. Production woodland must have started in the late first century.

## 6. Wood supply and local population

Besides the research on use and origin of the timber for building the forts in the Lower Rhine area, another aim of van Rijn’s research was to investigate to what extent the local population





**Fig. 7** (l) Common ground plan of auxiliary fort and (r) ground plans of forts at Utrecht (phase 1) and Valkenburg phase 1. One zone is missing in most of the forts in the West-Netherlands.

was involved in supplying the Roman army. For that part of the research the carrying capacity of the landscape with regard to wood had to be investigated<sup>42</sup>. Estimations of the yields of the Roman woodlands are made<sup>43</sup> and insight is gained into the required amounts of construction and fire wood for the Roman army and their associates<sup>44</sup>. Also the quantities needed for farms and barns and fuel in the rural settlements have been calculated and integrated into the calculations<sup>45</sup>.

The research concluded that the rural population in the area was probably much more involved in provisioning the Roman army between AD 40 and 140 than had previously been

assumed. This holds especially true for wood and cereals<sup>46</sup>. The authors state that “the provisioning with timber and fuel seems to have been much more a solely military matter that was carried out by the soldiers themselves. Such activities would have posed too much of a logistical problem for the rural population, certainly at periods of heightened activities, for example the transport of large quantities of wood from alder wetlands to the places of construction”<sup>47</sup>. The assumption is that the employment of the rural population in establishing wood supplies might have started with the development of alder copses in the middle Roman period, as discussed above.

It is interesting to look at the possible influences of these changes in the wood procuring process and in the wood supply. Did the alternation of the available wood spectrum influence the construction of the forts?

### 7. Building the forts: one building programme?

In addition to the insights into use and origin that timber remains give, these remains also provide information about building techniques and building styles. One might expect that the forts, being built in a small area and in a rather short period of time, would have looked more or less alike. The analysis of the nine forts and the fortlet in the research area showed many similarities but even more differences between them.

Similarities include their rectangular shape, their small size and their position in the landscape, which was extremely close to the river and at a crossing of the Rhine and a river branch<sup>48</sup>. The internal division in only two parts instead of three, the *praetentura* and the *latera praetorii*, is very characteristic of the forts in the West-Netherlands (fig. 7)<sup>49</sup>. Much more common, especially in a later stage, is a division into three parts like almost all other forts show (e.g., in the Rhine and Danube region and in Britannia)<sup>50</sup>.

Other similarities are the location of the roads through the fort, the *via principalis* and the *via praetoria*, the location of the *principia* (the headquarters) in the middle of the rear zone, and the width of the ramparts (circa three metres, or 10 Roman feet – *pes monetalis* – wide). The measurements of the gateways and interval towers largely correspond. Despite these and some other similarities many differences occur. In this paper, I will discuss some of them and the possible explanation for these differences.

Comparing the structures of the forts, the first striking difference is the variety of design and building techniques of the ramparts (fig. 2). The various types of ramparts in the research area can be categorized into three groups: ramparts with timber corduroy as foundation for a rampart body of sods, with a timber framework to keep the sods together, type A; ramparts with a rampart body like type A behind a timber front revetment, type B; ramparts with a timber revetment both at the front and rear side, filled up in between with sand and clay, a box rampart, type C (fig. 8)<sup>51</sup>.

The ramparts within these types have been built in a different way. The foundations varied substantially. For instance, the box rampart: of

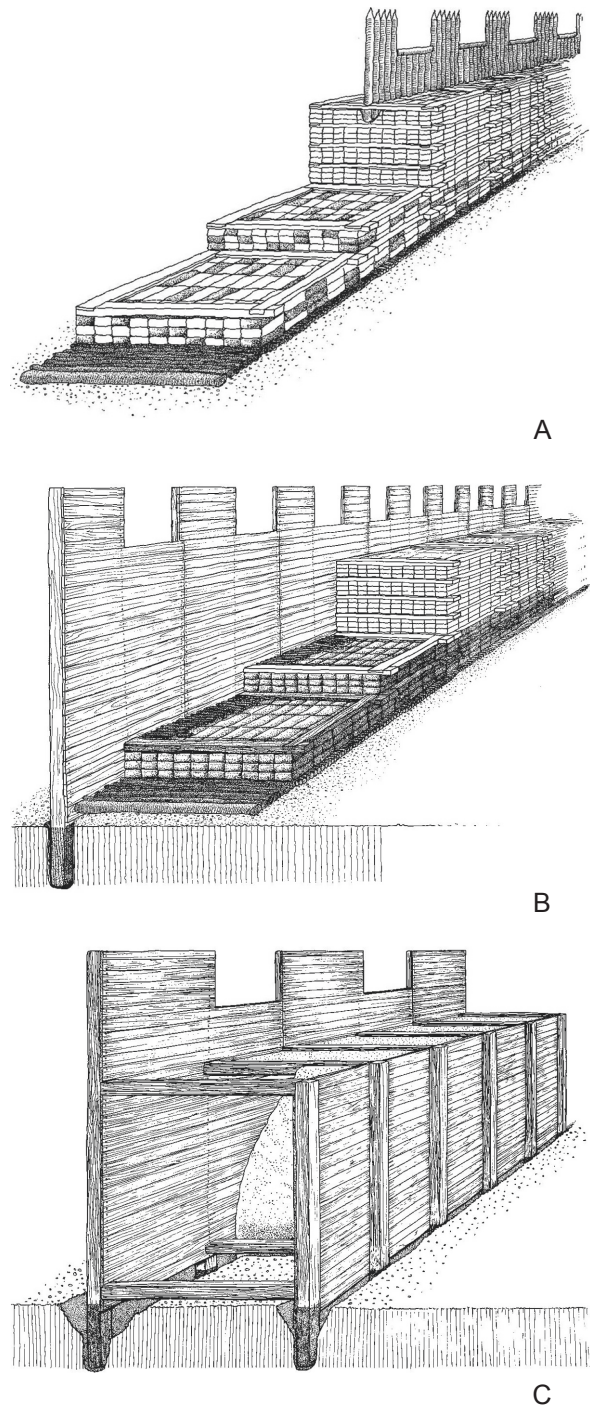
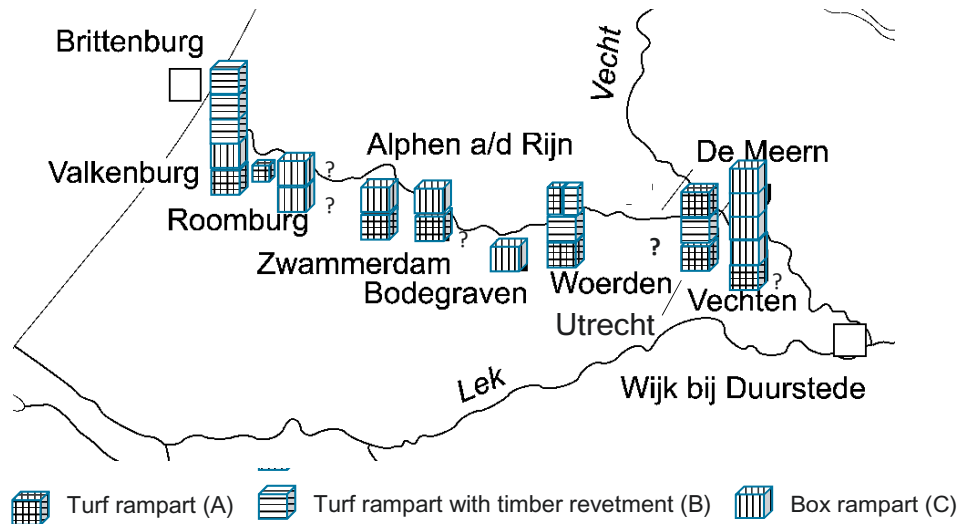


Fig. 8 Three types of ramparts in the forts in the research area: A turf rampart; B turf rampart with front revetment; C box rampart.

the one in Vechten two trenches were visible with postholes and sometimes with timber remains still inside. The same technique was applied in Zwammerdam and possibly also in Leiden-Roomburg. In Bodegraven the rampart was built with beams and posts with mortice-and-tenon joints at the front and rear side. Heavy posts were



**Fig. 9** Distribution of rampart types A (turf), B (turf and front revetment) and C (box rampart) in the forts in the research area.

found in postholes at the rampart's front side and the rear side, belonging to the second phase of the fort in Alphen aan den Rijn. The second rampart in Valkenburg showed a front revetment with heavy oak beams and posts with the mortice-and-tenon technique. At the rear side the posts were put either in postholes or in a trench<sup>52</sup>.

These ramparts display varying building techniques within a short period of only 100 years and in a small area. In **fig. 9** the distribution of the various types is demonstrated. It is striking that the type of rampart seems randomly chosen. There is no logical sequence of ramparts to discover. It's also remarkable that in the first 30 years of Roman presence at Valkenburg the ramparts were often rebuilt and always in a different way.

What could be the reason behind the diversity of ramparts? One might think of environmental conditions: perhaps the close position of the forts to the river caused problems with water and all those experiments were necessary in order to find the right rampart. But why wasn't only one type of rampart the best defence and why didn't the soldiers stick to that type for the whole of the area? Even after the Batavian Revolt, when all forts were rebuilt, there were still several types of rampart construction in use. The differences between the three landscape regions (see above), the river area, the peat area and the coastal area, could have influenced the choice for a certain type of rampart.

Another possible reason is the availability of wood. Did the builders need more timber for one type of rampart than for another? This is not plausible: when calculating the necessary amount of wood per type, similar quantities are needed. The types of trees, however, do differ (**tab. 1**).

However, there seems no logic as regards the use of timber, geographically nor chronologically.

Besides ramparts other parts of the defences, like angle towers and gates, show differences in plan or foundation methods. Also foundations and walls of buildings inside the defences of the forts show varying building techniques. On one hand, in buildings like the barracks, headquarters and granaries, timber uprights in foundation trenches occur. On the other hand, we see uprights in individual postholes or into sleeper beams, which were let into the ground: the mortice-and-tenon joint. These jointing techniques have predecessors in the Iron Age and further back in time<sup>53</sup>. The foundation of posts in postholes and the raised floors of the Roman *horrea* are known from Iron Age granaries. These often had smaller dimensions but also raised floors. Another difference between buildings in forts is pointed out by the remains of wattle-and-daub walls. Most such walls show a vertical pattern although sometimes a horizontal way of wattle appears<sup>54</sup>. Horizontal wattling was also applied to walls of Iron Age and Roman farmhouses.

Comparing the forts in the Rhine delta with timber forts abroad, further eastward in Germania Inferior, in Germania Superior and Raetia and – to the west – in Britannia, a very similar picture appears. The variety of rampart types is not only limited to the West-Netherlands research area. Also abroad there are places in which in each new building phase different types succeed each other. That also applies to other parts of the defences and to the internal buildings of the forts.



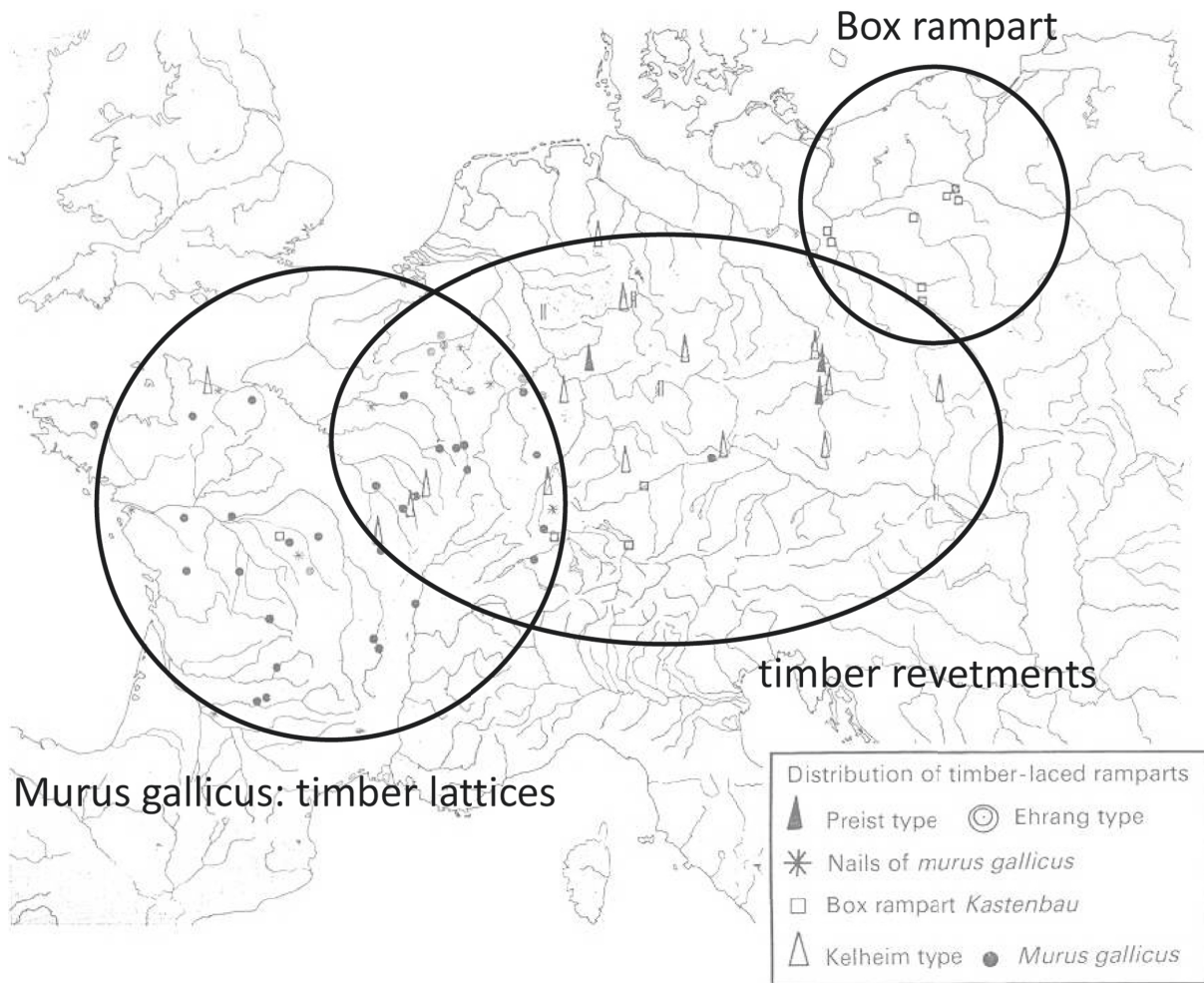


Fig. 10 Distribution of ramparts in continental Europe between 100 and 20 BC.

## 8. Conclusions: all about building traditions

In my opinion each kind of rampart indicates a different occupation within the forts. Assuming that in the pre-Flavian period the auxiliaries were led by their own regional leaders<sup>55</sup> and that the auxiliaries built their own forts at the time<sup>56</sup>, every new garrison with its own commander built or adapted the forts according to their own practices. The same applies to the ramparts. In the following decades the auxiliaries subsequently developed into mixed troops, not descending from one certain tribe, but replenished by soldiers from various different backgrounds<sup>57</sup>. The question about how decisions were made during the building process is an interesting discussion, but too comprehensive to go into detail here<sup>58</sup>.

Apparently, the rules about 'how to build a fort' weren't very strict. There was a certain freedom in building the forts, shown for instance by the enormous diversity of fort plans<sup>59</sup>. I think that

this freedom also relates to the way of building, to both style and technique. The diversity of building techniques must above all be due to the differences in ethnicity of the soldiers and therefore the differences in building traditions<sup>60</sup>. If auxiliary troops could build according to their own tradition within certain limits, where did the knowledge come from?

The diversity of rampart types of the Roman forts shows, in my opinion, a link with ramparts of Late Iron Age fortifications, the *oppida*, and possibly also with walled enclosures in other regions of the time<sup>61</sup>. As the distribution map (fig. 10) of the different types of ramparts in the late Iron Age shows, the concentrations of rampart types are evident. These concentrations represent different cultural traditions that must reflect the traditions in the Roman fort building.

The various rampart constructions from the late Iron Age seem to have been decisive for the specific rampart constructions in the Roman

Fort with information on wood	Date	Type of rampart	Wood species
Utrecht 1	c 47	A	fraxinus/alnus (corduroy)
Woerden 2	c 50	B	fraxinus/alnus/quercus
Bodegraven	c 45/50?	C	ulmus/alnus/quercus/ salix (beams); alnus/quercus/ salix (posts)
Alphen aan den Rijn 1	c 41	A	fraxinus/alnus ulmus/corylus a (corduroy)
Valkenburg 1	c 40	A	Populus (corduroy)/ulmus (framework)
Valkenburg 2	c 47	C	Ulmus (beams), ulmus (posts)
Valkenburg 3	c 50/60?	B	Quercus (beams revetment)
Alphen aan den Rijn 2	c 70	C	Alnus, ulmus, fraxinus (posts)
Valkenburg 4	c 70	B	Ulmus (corduroy), revetment?
Valkenburg 5	c 100	B	Quercus (beams revetment)

Tab. 1 Use of wood in ramparts in the research area.

forts in the Rhine delta. The knowledge of how to build a rampart was combined with Roman elements like the units of measurement (Roman foot) and the use of Roman building equipment and instruments like the *groma*. It seems that the forts, the soldiers, their recruitment area and their building tradition are related. On the one hand one could point out Gaul as a recruitment area with the *murus gallicus*, leaving traces in the forts in Utrecht and Valkenburg (phase 1 and perhaps 3) and probably in the earliest forts in Woerden, Alphen aan den Rijn and Valkenburg-Marktvelde.

On the other hand, Germany, the Czech Republic and Slovakia and box ramparts up north in the direction of Poland could be seen as recruitment areas. Around the middle of the first century BC the grandparents of current auxiliaries migrated from Central Europe towards the Rhine and Danube. The auxiliaries had inherited their culture traditions, including the building traditions. Examples are Elbgermanen and Przeworsk culture people<sup>62</sup>. In that area vertical ramparts were built.

Maybe the Batavians with their former homelands from this region, where the Chatti lived, are part of this cluster. Possible traces of these recruits with their building traditions can be found in the forts in Vechten, Bodegraven and in second phases in Alphen aan den Rijn and Valkenburg.

It is interesting to study how those traditions are related to the wood procuring process and to wood supply, and to look at the consequences of the changes in the wood procuring process and those in the wood supply. In order to answer these questions the next step should be an even closer look at the constructions of the military buildings of the forts, the wood species and the changes over time. Then it might be possible to find out whether the alternation of the available wood spectrum influenced the forts' construction, the building style and technique, as applied by the auxiliaries.

Soldiers from many different regions built their forts with wood from the local environment, on the one hand according to a larger programme, but on the other hand according to what they were used to and the building traditions of their ancestors.

#### Footnotes

\* This article is the result of close cooperation with P. van Rijn. I would like to thank her for the fruitful and enthusiastic discussions we had. Unfortunately, she was not able to finish her contribution to this article. I would also like to thank M. K. Dütting for her valuable comments on earlier versions of this article and S. Anderson for correcting the English.

<sup>1</sup> Willems 1986, 329–356; Bechert/Willems 1995, 65, 77–8.

- <sup>2</sup> Van Rijn 2011; Kooistra et al. 2013; Van Dinter et al. 2014.
- <sup>3</sup> The research (Oogst van Malta programme) was funded by the Netherlands Organization for Scientific Research. The project team consists of, besides the author, C. Cavallo (University of Amsterdam), M. van Dinter (ADC Archeoprojecten), M. K. Dütting (at that time Hazenberg Archeologie Leiden), M. Erdrich (at that time Radboud University Nijmegen), E. P. Graafstal (City of Utrecht), L. I. Kooistra (Biax Consult), M. Polak (Radboud University Nijmegen) and P. van Rijn (Biax Consult).
- <sup>4</sup> Bechert/Willems 1995; Van Dinter 2013, 12.3.
- <sup>5</sup> Kemmers 2006, 61–62, 65; Niemeijer 2013, 71; Polak/Kooistra 2013, 393.
- <sup>6</sup> The fort at Trajanusplein is dated between AD 10–20 (Bechert/Willems 1995, 66–67), and must have functioned as an operation base or as a providing camp during the campaigns of Germanicus in Germania between AD 14 and 16. Some later, smaller camps appeared in the neighbourhood of Trajanusplein and Kops Plateau (Willems et al. 2005, 55–73; Willems/Van Enckevort 2009).
- <sup>7</sup> The first signs of a military presence at Vechten are dated to the beginning of first century (Polak/Wynia 1991; Zandstra/Polak 2012), doubted by some scholars, like De Weerd (2003, 190) who suggests the 2nd decade for the founding of Vechten, as part of Germanicus' expeditions.
- <sup>8</sup> Willems 1986a; Polak/Kooistra 2013, 426.
- <sup>9</sup> Velsen is dated circa AD 15/16 (Morel 1988; Bosman 1997; Bechert/Willems 1995, 9; Bosman/De Weerd 2004).
- <sup>10</sup> Coins, pottery and historic sources point out that the fort at Valkenburg (ZH) was founded circa AD 40 (De Weerd 1977, 271; De Weerd 2003, 191). Although there were many very well preserved timber remains of the five building phases, no dendrochronological data are available. All wood samples taken at the excavations in the Second World War were used as fuel during the Hunger Winter of 1944 (De Hingh/Vos 2005, 113).
- <sup>11</sup> Tacitus, *Annales* 11,19.
- <sup>12</sup> Polak/Kloosterman/Niemeijer 2004, 54; 61; 250. The date is based on dendrochronological research and coins (Kemmers 2004, Kemmers 2006b).
- <sup>13</sup> At De Meern no dendrochronological data are available. Coins indicate a date in circa AD 41 (Kemmers 2006c).
- <sup>14</sup> The same goes for Woerden. Coins show a date around 45 (Kemmers 2008, 269–288).
- <sup>15</sup> Duiven and Herwen/De Bijlaard (Bechert/Willems 1995, 65, 77–78; Willems 1986b, 295).
- <sup>16</sup> Barrett 1989; Winterling 2005.
- <sup>17</sup> Polak/van Doesburg/van Kempen 2004, 249–250; Polak 2009, 949.
- <sup>18</sup> The basis for this date consists of finds, especially terra sigillata, and burning layers (Utrecht: Ozinga et al. 1989, 41; Zwammerdam, Haalebos 1977, 47–55). The dating evidence of Leiden-Roomburg consists of pottery (Brandenburgh/De Bruin 2016; Polak/van Doesburg/van Kempen 2004).
- <sup>19</sup> Niemeijer 2014, 93–100; Van Diepen, in prep.
- <sup>20</sup> Chorus, in prep. a.
- <sup>21</sup> Niemeijer 2004, 24–37; Van der Kooij et al. 2005, 283–284, 291; Van der Kooij/Sprey/Postma 2014; Polak/Niemeijer/Van der Linden 2012, mention the possibility of the presence of Roman troops in Bodegraven around AD 50, based on research by J. K. Haalebos on terra sigillata (Haalebos 1980).
- <sup>22</sup> Willems 1986, 329–356; Bechert/Willems 1995, 65, 77–80.
- <sup>23</sup> Bechert/Willems 1995, 27, but re-use of some forts until the early fifth century is mentioned. The date of abandonment is being analysed by Heeren, in prep.
- <sup>24</sup> See S. Lange in this volume for wood research on roads, watchtowers, river quays, and also (among others) Lange 2007, 102–113; Lange 2010, 181–190.
- <sup>25</sup> Van Rijn 2011, 31.
- <sup>26</sup> Polak/van Doesburg/van Kempen 2004, Chorus, in prep. a.
- <sup>27</sup> Van Rijn 2011, 32.
- <sup>28</sup> Van Rijn 2011, 33. See for a detailed palaeogeographical map and description of the research area: Van Dinter 2013; Kooistra et al. 2013; Van Dinter 2014.
- <sup>29</sup> Kooistra et al. 2013, 11.
- <sup>30</sup> Kooistra et al. 2013, 11.
- <sup>31</sup> Van Rijn 2011, 33; Kooistra et al. 2013, 11.
- <sup>32</sup> See also Dütting/Van Rijn in this volume.
- <sup>33</sup> Van Rijn 2011, 33.
- <sup>34</sup> Kooistra et al. 2013, 12.
- <sup>35</sup> Van Rijn 2011, 38.
- <sup>36</sup> Kooistra et al. 2013, 12.
- <sup>37</sup> Van Rijn 2011, 35; Kooistra et al., 2013, 12. Van Rijn also states: "Research into the numbers and pattern of year rings has demonstrated that part of the construction wood came from woodland that had been harvested for wood before. Wood with several hundreds of year rings also occurs, and some of it has been investigated dendrochronologically. This has revealed that these oaks have come from natural woodland located in what is now the western part of the Netherlands (Visser 2009; Visser/Jansma 2009)".
- <sup>38</sup> Van Rijn 2011, 35.
- <sup>39</sup> Kooistra et al. 2013, 18–19.
- <sup>40</sup> Kooistra et al. 2013, 7.
- <sup>41</sup> Van Dinter et al. 2014, 16.
- <sup>42</sup> Kooistra et al. 2013, 7. These questions were also asked about the data of food, collected during several excavations in the same research area. Kooistra et al. 2013; Van Dinter et al. 2014.
- <sup>43</sup> See Van Dinter et al. 2014 for the results of these calculations.
- <sup>44</sup> Kooistra et al. 2013, 7.
- <sup>45</sup> Van Dinter et al. 2014, 20–21.
- <sup>46</sup> Van Dinter et al. 2014, 31–32.
- <sup>47</sup> Van Dinter et al. 2014, 32.
- <sup>48</sup> Van Dinter 2013.
- <sup>49</sup> The only exception is the fort at Vechten (near Utrecht), Chorus, in prep. a.



- <sup>50</sup> Among others Johnson 1987, 264.
- <sup>51</sup> Chorus 2008; Chorus 2017; Chorus, in prep. a.
- <sup>52</sup> Field drawings and Braat 1939; Van Giffen 1950; Reddé et al. 2006 (Vechten); Van der Kooij et al. 2005; Van der Kooij/Sprey/Postma 2014 (Bodegraven); Haalebos 1977 (Zwammerdam); Haalebos et al. 2000; Polak/van Doesburg/van Kempen 2004 (Alphen aan den Rijn); Polak/Kloosterman/Niemeijer 2004; Brandenburgh/De Bruin 2016 (Leiden-Roomburg); Van Giffen 1948, 1955 (Valkenburg).
- <sup>53</sup> Audouze/Büchschütz 1992, Huijts 1992.
- <sup>54</sup> Glasbergen/Groenman-van Waateringe 1974, 19.
- <sup>55</sup> Among others Alföldy 1968, 111–116.
- <sup>56</sup> Sommer 1984, Campbell 2009, 37; 59–60, Marcu 2011.
- <sup>57</sup> Alföldy 1968; Holder 1980; Haynes 1999; Le Bohec 2005.
- <sup>58</sup> Chorus, in prep. a.
- <sup>59</sup> Johnson 1987, 319.
- <sup>60</sup> See for details Chorus 2008; Chorus 2017.
- <sup>61</sup> Chorus 2008, Chorus 2017.
- <sup>62</sup> M. Erdrich, personal communication.

## Figure and Table Credits

- Fig. 1 After Polak 2009, fig. 1.
- Fig. 2 Polak et al. 2004, Afb. 35.
- Fig. 3 After Kooistra et al. 2013, fig. 3.
- Fig. 4a-b After Kooistra et al. 2013, fig. 4a-b.
- Fig. 5 After Van Rijn 2011, fig. 4, drawing barrack construction by R. Reijnen, Radboud University, after Goodburn 1991.
- Fig. 6a-b After Kooistra et al. 2013, fig. 4c-d.
- Fig. 7 After Johnson 1987, Abb. 19, adapted by Polak et al. 2004b, Afb. 9. Drawings R. Reijnen, Radboud University Nijmegen with author, Chorus in prep. a).
- Fig. 8 Drawings R. Reijnen, Radboud University Nijmegen with author, Chorus in prep. a).
- Fig. 9 Underlying map after Polak 2009, fig. 1.
- Fig. 10 After Audouze and Büchschütz 1992, fig. 50.
- Tab. 1 Author.

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