2.1

2

Structural timber in 15th- and 16th-century town houses in 's-Hertogenbosch: Recent research on supporting structures

Maarten W. Enderman[1]

Key words
Carpentry / Building trends / Timber frame / Dovetail joists / Representative supporting structures

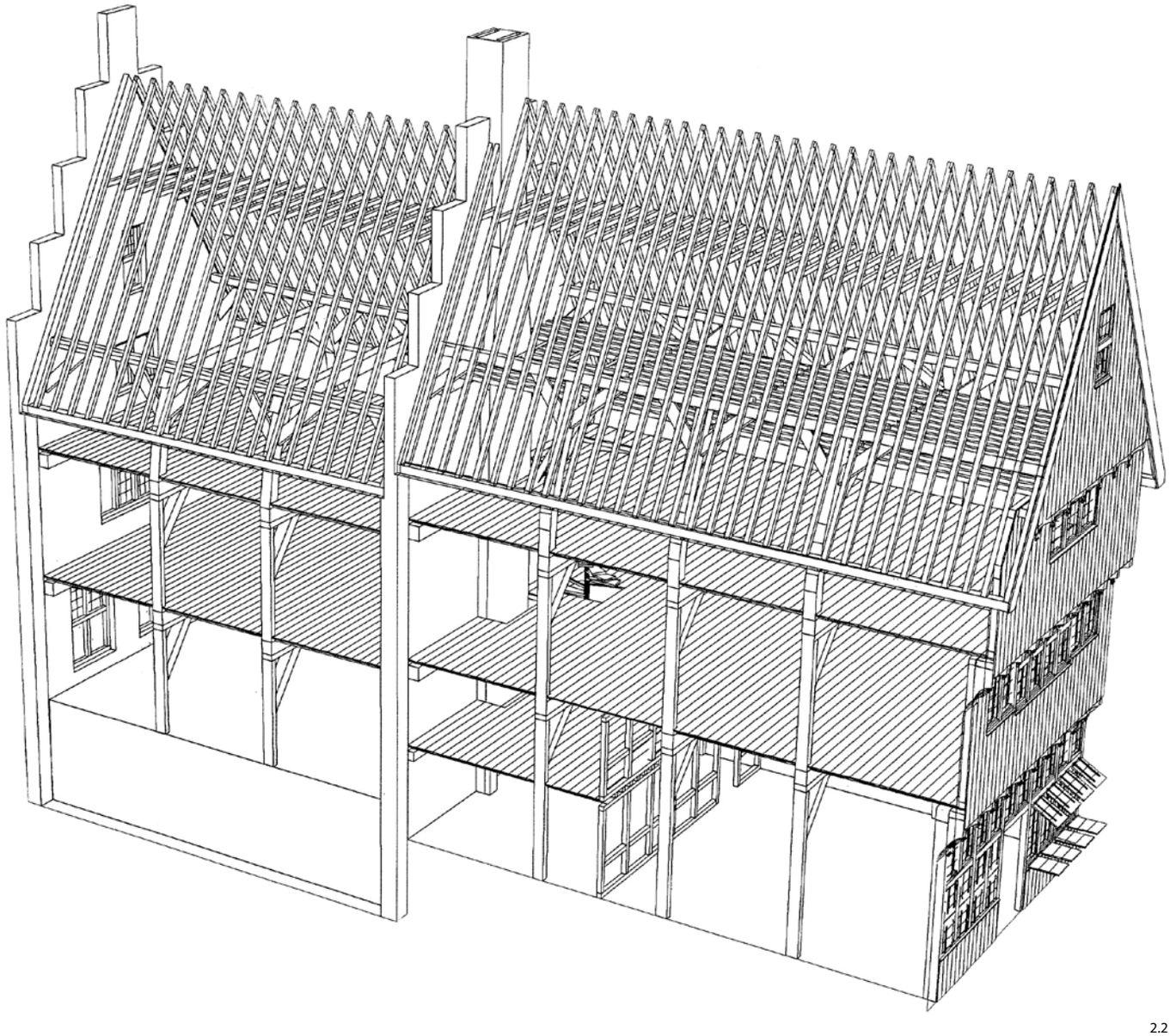
Introduction

The municipality of 's-Hertogenbosch has employed a building historian since 1975 to research the history of structures scheduled for alteration or demolition. In most cases, such research focuses on domestic properties in the historic town centre. After a series of publications during the 1980s and 1990s and a doctoral thesis by van Drunen in 2001 (van Drunen, 1990; van Drunen, 2006; Boekwijt, 1999), research on the 15th- and 16th- century houses typical of 's-Hertogenbosch appeared to have run its course. By then it had been established that this type of building, built at right angles to the street, usually included a ground floor, an upper floor and a gabled roof, and divided into a front part directly attached to a rear part over a cellar (fig. 2.1 and 2.2). To the rear of the front part, and separated from it by a brick or timber-framed partition wall, there was a partial floor below which the 'inside hearth' was located, actually a room used for cooking and other domestic activities. The supporting structure consisted of compound floors (crossbeams supporting smaller joists) forming part of a lightweight oak timber frame that did not support the side walls. Like the stairs, the fireplaces were usually located against the wall separating the front and rear parts of the house.

Recent research in the past five years has revealed that the existing interpretation of these houses needed to be adjusted on several points, and that this type of house is more diverse. This raises new questions about previous structural

[1] Building historian, Municipality of 's-Hertogenbosch, Archeologie en Monumenten, Unit Bouwhistorie
m.enderman@s-hertogenbosch.nl

Fig. 2.1. The house 'Het Fransche Kabinet' (Kerkstraat 73-75) a few years before the wooden facade from c. 1472 was demolished in 1878. Image: courtesy of the City Archive of 's-Hertogenbosch.



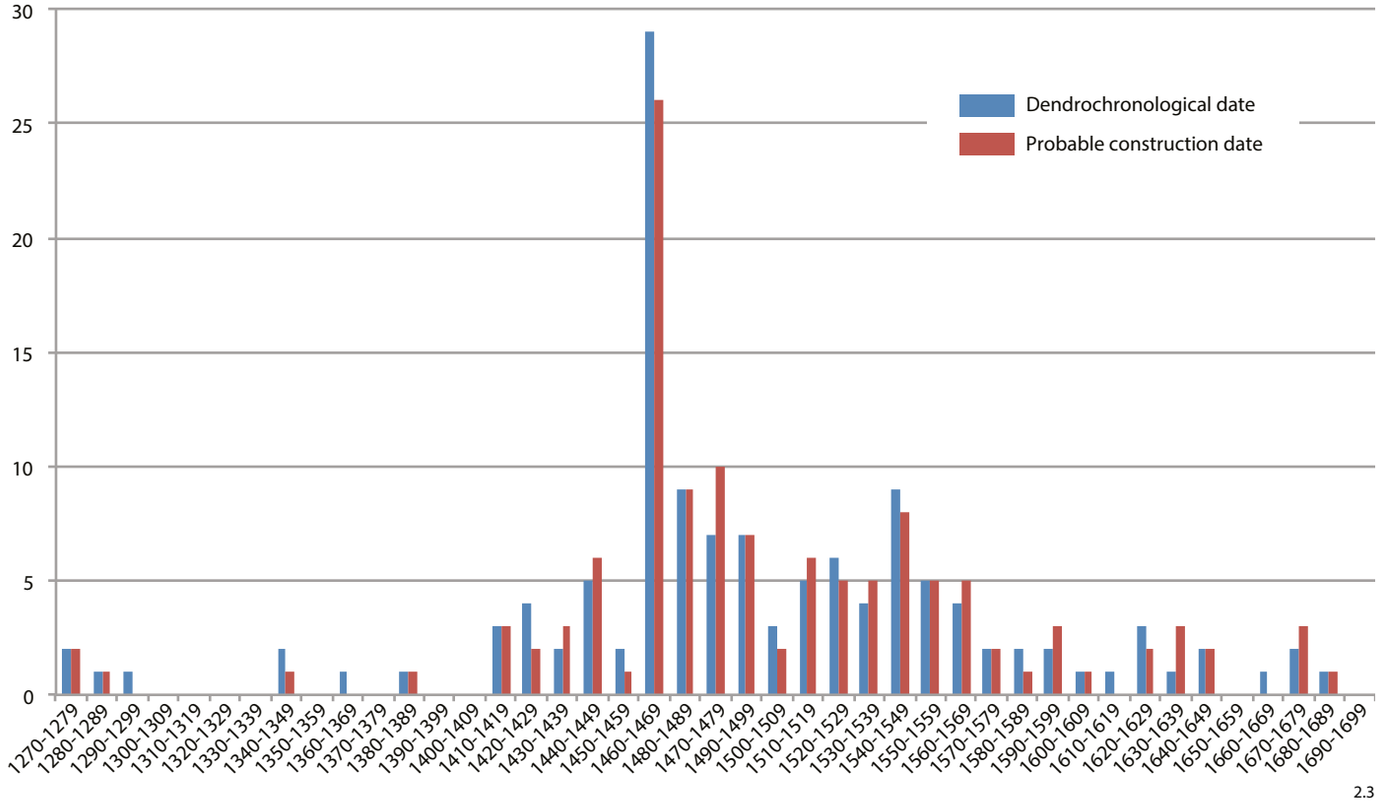
2.2

Fig. 2.2. A typical example of 15th- and 16th-century houses found in 's-Hertogenbosch. Image: Municipality of 's-Hertogenbosch SO/BAM

considerations. As part of this continuing research effort, a survey was launched to catalogue existing supporting structures and their properties. The dendrochronological dating of 134 houses enables us not only to describe structural details as phenomena *per se*, but also to place them within a chronological context and to reveal practices in construction largely unexplored until now.

Dendrochronology and building trends

Between 1991 and June 2014 a total of 1058 timber samples were collected from 192 buildings in the historic town centre of 's-Hertogenbosch. Of these, 659 samples yielded a result, allowing single or multiple dates to be attributed to 169 houses.[1] For 35 cases, only a *terminus post quem* could be established. In



2.3

the remaining 134 results, two years were added to arrive at the probable construction date of the house, taking into account the time spent to transport and process the timber (de Vries, 1994: 26) (fig. 2.3).

The dating of these houses provides an indication of building activities in the town between 1400 and 1600. The timber analysis yields little reliable information for the first two centuries after the town was granted its charter sometime around 1190. For instance, only two buildings yielded dates in the last quarter of the 13th century that can be attributed with any certainty to initial construction or a major conversion.[2] What little timber that was dated to the 14th century had been reused later, and in only a few cases may have been part of the original house itself. The lack of 14th-century timber is remarkable, as the town prospered during this time, increasing its area more than 13-fold. Further, historical building research regularly finds masonry from this period, showing that the number of brick-built houses in the town must already have been considerable at the time.

The lack of 14th-century timber may in part be explained as the result of two major fires, first in 1419 and again in 1463 (fig. 2.4). The survey dates might lead one to conclude that the impact of the second fire far exceeded that of the first. However, the extent of the fires appears to have been similar. The larger number of newly built houses after 1463 was in fact the result of municipal policy. Almost immediately after the second fire, regulations were introduced to promote reconstruction. In addition, house owners were given ten years to replace thatch with hard roofing materials (Vink, 2013: 21-23). To facilitate this process, grants were provided to alleviate the cost of slate or tiles. Surviving accounts

Fig. 2.3. Frequencies of dendrochronologically dated houses by decade up to 1700, showing the timber's dendrochronological date in green, and in red the probable construction time of the houses two years later.

2.4

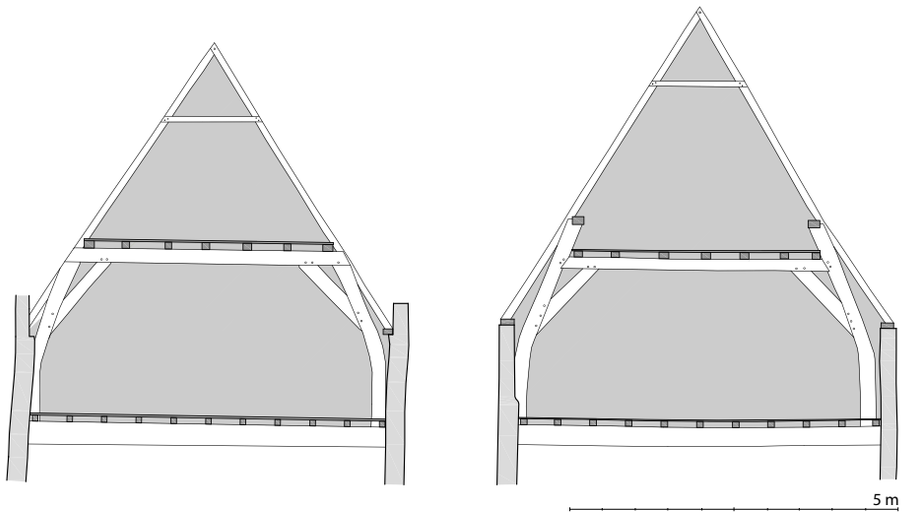
Fig. 2.4. A 1545 map of 's-Hertogenbosch by Jacob van Deventer, with the areas affected by the great fires of 1419 and 1463 superimposed in colour. Map: Albert I Royal Library, Brussels, adapted by the author

of the time show that at 85% the more expensive but also more representative slate was by far the more popular option (van Oosten, 2014: 189; de Vries, 1994: 80). Although roof tiles are almost twice as heavy as slate, this difference seems to have had no impact on the type, size and construction method of the roof.

In addition to the number of successfully dated houses, other factors exist to indicate the scope and rate of reconstruction work. For example, many of the houses built shortly after 1463 used timber that had been felled some ten years before or even earlier. This is remarkable as construction timber was generally used within a few years of felling. This means that a supply of timber must have been available to cope with the sudden demand.[3]

The exceptional demand for timber is also revealed by the fact that some samples indicate origins from as far as Normandy while most wood typically comes from the more local surrounding regions. It would also have taken a considerable number of carpenters to process all of the timber. The lack of sufficient skilled labour within the town itself, attracting reinforcements from the Lower Rhine and Meuse regions, may be deduced from the introduction of a hitherto unknown type of roof construction using link-beam trusses (fig. 2.5).[4]

It is doubtful whether the town's authorities actually managed to achieve their aims within ten years. As the grant system came to an end in 1474, house construction reached a turning point. Even so, the dendrochronological dates show that new houses were still being built in the area devastated by the fire. However, this was followed by economic recession and, in 1492, a new war with the Duchy of Guelders that resulted in a low point in the first decade of the 16th century. At the same time, as revealed by five hearth counts held between 1464 and 1526 for taxation purposes, the town's population almost doubled (van Oosten, 2014: 307). It is possible that many of the so-called rooming houses were built during this period, a type of rented accommodation for the poor in alleys and back streets. Today these houses have practically disappeared in 's-Hertogenbosch. On the other hand, still existing larger houses may have been used differently, a possibility that cannot be verified from the surviving building structure.



The subsequent increase in house production, a trend beginning in the second decade of the 16th century and continuing for the next 50 years or so, could be construed as a response to a recovering economy and improved political stability. Following the ransacking of ecclesiastical buildings in 1566 that ushered in the Eighty Years' War, social unrest and religious upheaval in the town meant that the population waxed and waned, reaching its nadir at the start of the 17th century (Kuijer, 2000: 544-545). Such change appears to be echoed in the number of houses built, although it should be noted that dendrochronological analysis of 17th-century houses (built at the time with softwood instead of oak) remains limited. In addition, the 17th-century houses are often straightforward to date on the basis of decorative elements. The frequent occurrence of such distinguishing features indicates that much house reconstruction and alteration work took place, in particular after the siege of the town in 1629. Of course, the grant system introduced to promote the replacement of timber facades with brick structures may also have played a role.

Timber from nearby and from far afield

The reference chronologies used for the dendrochronological dating of the structures give an indication of the provenance of the oak timber used in the 15th, 16th and 17th centuries.[5] Generally speaking, we can distinguish three regions in modern Germany, three in the Netherlands, one in Belgium, and one in France.

Based on the proportions in which the various regions supplied the timber over a succession of 25-year intervals, the general impression is one of the growth and decline of timber trade flows (fig. 2.6). None of the regions shows a constant market share throughout the period. With regard to the timber imported from north-west Germany, the market decrease towards the end of the 15th century and the increase in the second half of the 16th century are borne out by historical research (Vink, 1993: 136; Weststrate, 2008: 144, 209). From

Fig. 2.5. A cap-beam truss (left) and a link-beam truss (right) used in the same house at Hinthamerstraat 119. Drawing: G. Korenberg

the 17th century onwards, most of the structural oak came from this region. The earlier decline in its use may have been compensated by using timber from further upriver in Germany or from the eastern part of the Netherlands.

The increasing use of German timber in the 16th century more or less coincides with decreasing use of timber from Brabant, the eastern Netherlands and eastern Belgium. The latter, transported via the Meuse River, accounts on average for some 12% throughout the 15th century, making the contribution during the first quarter of the 16th century, more than triple of this percentage, stand out all the more. This would appear to be correlated with a proportional decline in the use of timber from Brabant. Although it is impossible to be certain, we cannot rule out the possibility that hostilities between Brabant and Guelders were the cause of this.

The large proportion of timber from Brabant used during the 15th and 16th centuries may be linked to freedom from timber tax granted in 1356 (Spierings, 1984: 39). It remains unclear what may have caused the peaks occurring during the last quarter of the 15th and the second quarter of the 16th century. These were perhaps a reaction to insufficient supplies from other sources. It is still unknown to what extent cost may have played a role in favouring some timber sources over others, or indeed with regard to other fluctuations in timber supplies. The gradual decrease of structural timber from Brabant relative to German timber in the second half of the 16th century, and its near disappearance in the 17th century, may probably be attributed to the hostilities that affected the region at the time.

Until the 17th century, timber brought in from the eastern Netherlands accounts on average for about 14% of the total volume, with a peak during the reconstruction period following the second great fire. This may be associated with the relatively short transport distance and the sudden increase in demand. The slight decrease in the 50 years that followed may well be attributable to the continuing hostilities with Guelders.

Timber frame or not?

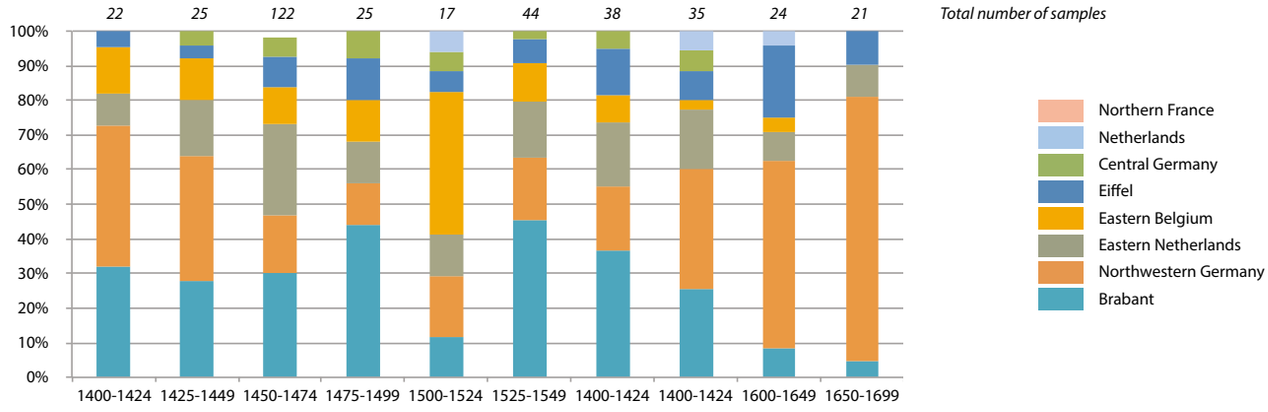
The houses of 's-Hertogenbosch show a succession of two main types of supporting structure. Up to the second quarter of the 17th century we find only compound floor structures consisting of heavy crossbeams supporting smaller joists. The youngest example of this type dates shortly after 1694. With the introduction of pine from southern Norway and Sweden around 1640, the first floor structures using a single size of beam start to appear. These put the town considerably behind the towns of Holland (van Tussenbroek, 2012: 21; Weve, 2013: 211).[6] The fact that 's-Hertogenbosch spent much of the Eighty Years' War under Spanish rule will certainly have contributed to this.

Until the 17th century, the floors covering the beams were made from oak planks from 20 to more than 50 cm wide with half-lap joints. So far only a single softwood floor has been found with a type of joint that may point to a date of 1464.[7] From the 17th to the 19th century, floors seem exclusively made of pine planks joined by loose tongues. These planks measure no more than 35 cm wide.

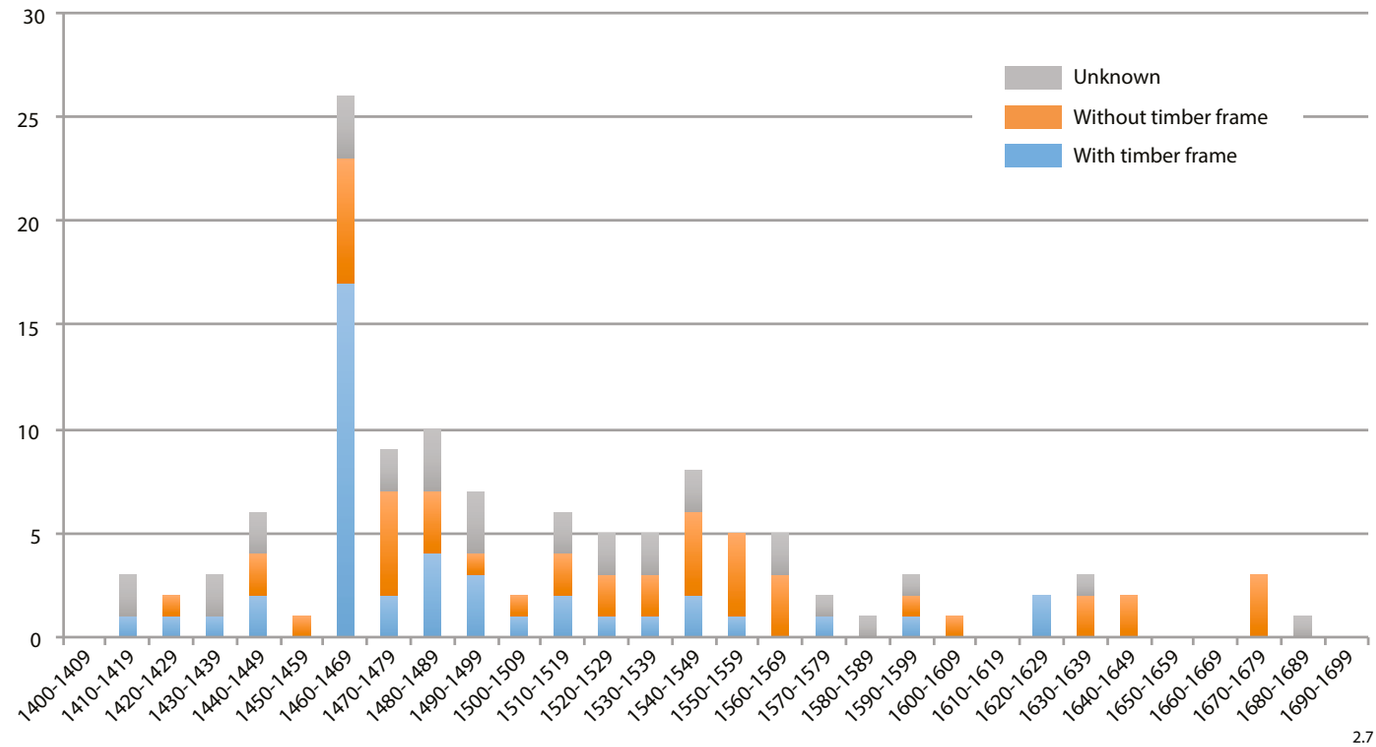
Fig. 2.6. Proportional representation of the regions of origin for samples of 15th- to 17th-century oak timbers (the 15th- and 16th-century samples are shown in 25-year intervals; as only 6 samples were collected from the first quarter of the 17th century and 8 from the last, these samples are shown in 50-year intervals).

Fig. 2.7. Use of timber frames in houses dated between 1400 and 1700.

In many cases, compound floor structures formed part of a timber frame (fig. 2.2 and 2.7). For the houses in 's-Hertogenbosch, this involved a structure consisting of wall posts with braces and corbel pieces, in which the flat-faced wall posts did not support the outer walls. This construction method remained in common use until the first half of the 17th century. The lack of sufficient dated samples leaves it unclear whether the system gradually gave way to compound floor structures without a timber frame, nor do we know whether a shift occurred from a full timber frame to the use of timber frames for upper floors only, as appears to have been the case in the western Netherlands (Meischke, 1997: 35-37; Weve, 2013: 203; Glaudemans, 2003: 30).



2.6



2.7

The contemporaneous occurrence of houses with and without timber frames begs the question of why the method was used or not. It is generally assumed that the use of timber frames as found in 's-Hertogenbosch is dictated by the floor span and the need to take up lateral forces. The load-bearing capacities of the brick side walls, which were thinner than their 14th-century counterparts, also played a role.

To gain insight into the use of timber frames, a comparative study was made of 29 of the 34 houses dating from the third quarter of the 15th century. In all but two cases, these houses consist of a ground floor and an upper floor, and 65% are either detached or semi-detached. Where houses feature a full timber frame, this situation even applies to 10 out of 11 cases. The average width of the houses is over 6 m, whereas in the nine houses with only an upper-floor timber frame and in the nine without any timber frame at all, the average span is less than 5 m. The use of a full timber frame would therefore appear to be related to both the floor span and the need for stability. Two houses with full timber frames stand out because the structure features in only one half of the building. In the house at Korenbrugstraat 16 (1465d ± 4) (fig. 2.8), this is the front part of the house, in which the upper floor and the attic may have been used for storage purposes. In the house at Vughterstraat 46 (1461d), the timber frame is limited to the rear part, which was certainly intended for domestic use.

Of the 11 surveyed houses with full timber frames, eight were built against or between existing side walls, mostly 14th century walls 45 or 60 cm thick. The newly added facade is often of comparable thickness, although sometimes no more than 24 cm (the length of a single brick) across. In the nine narrower houses with upper-floor timber frames, less than half use older walls onto which a new storey was built with the thickness of a single brick's length. In these cases the timber frame appears to have been used to add stability to the lighter, free-standing brick walls. Newly built houses with timber frames on the upper floor also feature single-brick walls on the ground floor, and all are semi-detached. Perhaps it was thought that the adjacent structure would provide sufficient stability. This aspect also appears to play a role in houses without any timber frame at all, which in other respects do not differ greatly from the houses with only upper floor timber frames. Just over half of the houses without a timber frame were built against existing side walls, and in most cases are semi-detached. The reasons for using a timber frame in some cases and not in others remain unclear. It may well be that the choice depended on several factors, which in addition to the opportunity of using existing side walls or erecting shared side walls may have included the experience and traditions of the builders as well as the financial situation of the principal.

Two of the houses, which only have frames on the upper storey, share the curious phenomenon of having wall posts and braces on only one side of the house.[8] This situation is all the more remarkable because the side where the timber frame is missing also happens to be the side with a free-standing side wall. An explanation for this has yet to be found. However, it does rather undermine the theory that the timber frame also helped to stabilise the side walls (Janse, 1964: 305).

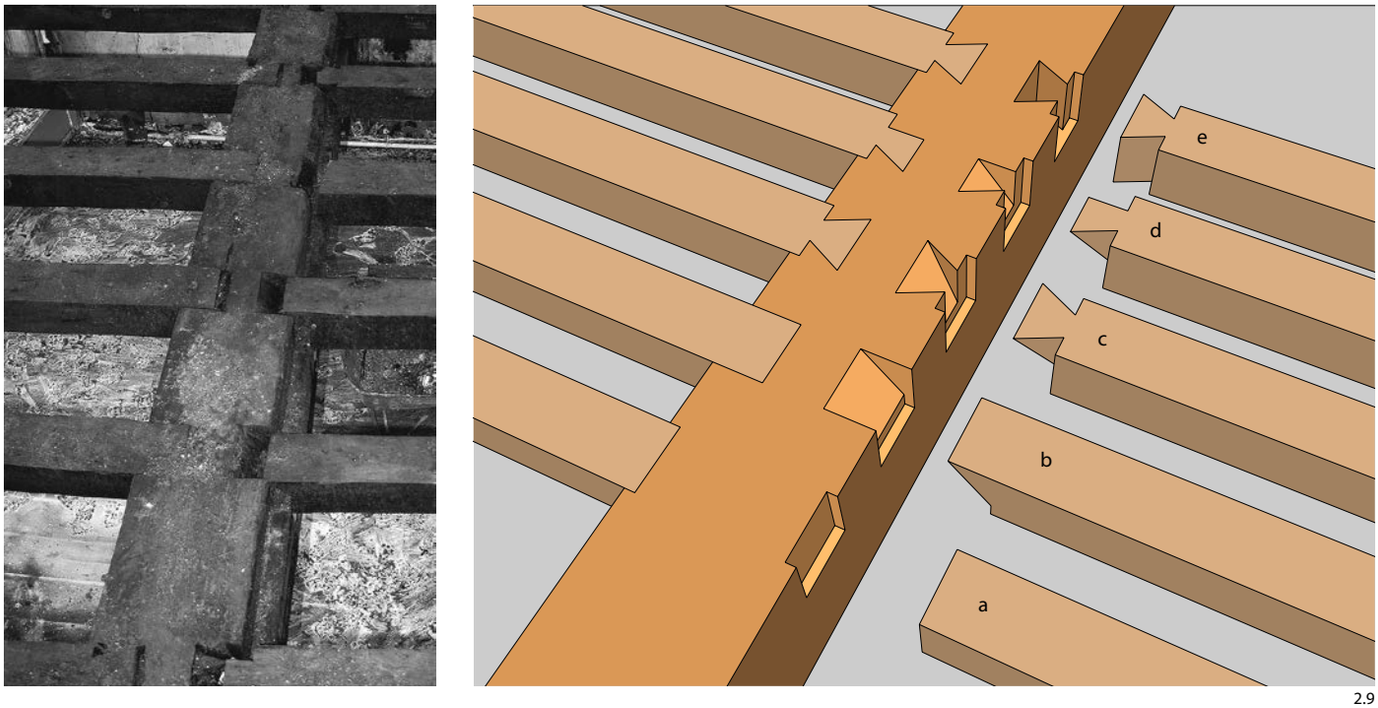
2.8

As with the full timber frame, upper-storey frames may occur in only part of the house, and may be missing below some of the crossbeams. In the house at Vughterstraat 48 (1465d ± 6) for example, the front part of the house features an upper-storey timber frame, whereas the room looking out on the street does not. Evidently the remaining two frames and the wall separating the front and rear parts of the house were considered sufficient to provide stability.

Tension joists between crossbeams[9]

Regarding the joints between the crossbeams and the lighter joists, we can distinguish between floor structures in which the joists have been laid on top of the crossbeams, and floors in which they have been let into the beams using a notched joint. Both types may be found within the same house, and even within the same floor structure.[10] Where the use of slightly curved timber has made the crossbeams irregular in shape, a combination of top-laid and notched joints may occur, with partial notches cut into the crossbeam and the end of the joist cut to a lip to fit the notch. In this way the curvature of the crossbeam timber could be corrected to create a horizontal floor surface.

Fig. 2.8. The house 'De Drie Kroonen' at Korenbrugstraat 16 (1465d ± 4) with only a timber frame in the front part of the house, in which the upper floor and the attic may have been used for storage purposes.



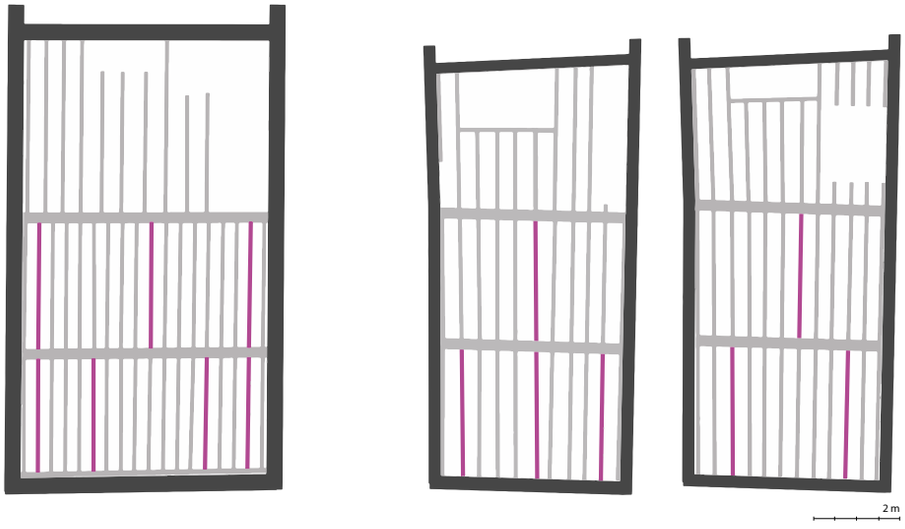
2.9

Fig. 2.9. Detail of the first floor structure in the front part of the house at Vughterstraat 122-124 (1566d ± 6) and drawing of notched joists with: a) no lip; b) recessed lip; c) dovetail lip; d) half dovetail lip; e) full dovetail. Image: courtesy of the Municipality of 's-Hertogenbosch SO/BAM; drawing: author

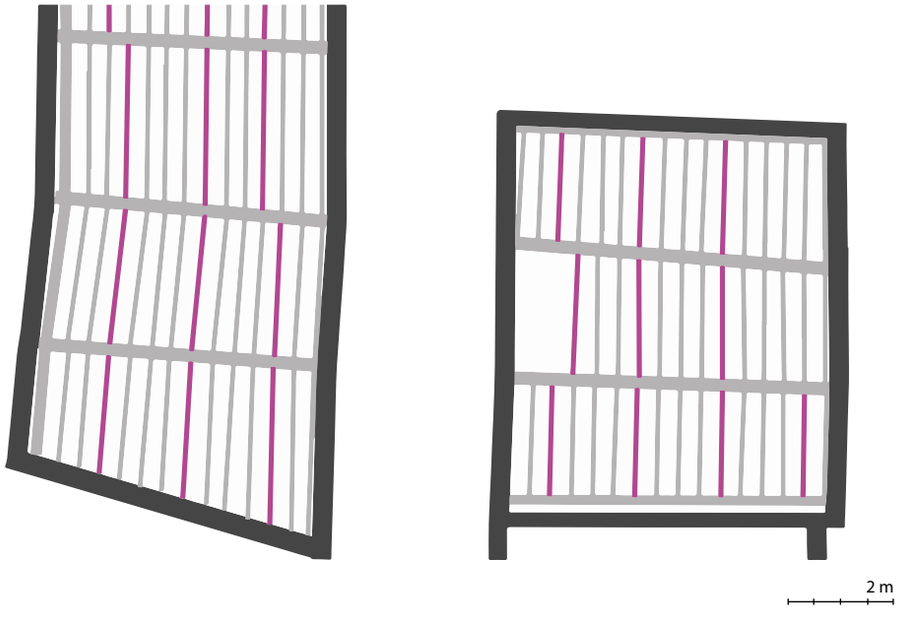
The simplest solution was to lay the joist ends on top of the crossbeam, where they were secured with a wooden peg. This method appears to have been abandoned after 1600. Notched joist joints can be sub-divided into those with and those without a lip (fig. 2.9a and 2.9b). The lip provided a surface through which the joist could be fastened to the crossbeam, which was partially cut away to receive the lip. After 1600 the lip dropped from use, a development that would appear to have started during the second half of the 16th century. From then on, the only means of supporting the joists consisted of a 1 to 2 cm deep notch cut into the side of the crossbeam.

In several cases where notched joists were used, some of the beams were given dovetail ends to create tension joints between two crossbeams or between a crossbeam and an end wall (fig. 9c, 9d and 9e). The limited research covering this phenomenon shows that dovetails were used only on oak joists, and that with a single exception the use of this type of joint was limited to compound floor structures that did not form part of a timber frame.[11] This type of joint was used from the 15th century to the end of the 17th century, but appears to have been most common in the 16th century.

Dovetailed joists were laid in two different patterns, either continuous or staggered. The latter pattern appears to have been more popular in the middle of the 16th century (fig. 2.10). The staggered pattern is limited to two sections of joists behind the front or rear wall of the house. In most houses in which it was used, the wall involved was brick-built. This supports the idea that the pattern may be related to this fact, which is remarkable in view of the many timber facades that at one point existed in the town. It might indicate that during the first half of the 16th century the popularity of timber front and rear facades gradually faded in favour of brick-built facades (Kolman, 1989: 85).



2.10



2.11

When laid in a continuous pattern, the tension joints always cover more than two sections, which is probably to do with the load-bearing capacity of the floor (fig. 2.11). Over the course of the 17th century the dovetail joints gave way to iron strip anchors laid across the crossbeam and fixed to the joists.

Evidence in the supporting construction indicating an original wooden facade has not as yet been found. Joists have sometimes been re-used with mortises for braces to support the jetty. Another way to construct the jetty was with brackets, which were penned in the storefront beam. This was very likely the solution at Kerkstraat 73 (fig. 2.1). The choice of one or the other was due to the layout of the storefront below (Schaars, 2014).

Fig. 2.10. Dovetailed joists (purple) laid in a staggered pattern in the upper floor of the house at Kerkstraat 71 (left, 1549d ± 6), and in the upper floor and attic floor of the house at Hinthamerstraat 138 (centre and right, 1546d).

Fig. 2.11. Dovetailed joists (purple) laid in a continuous pattern in the attic floor of the front part of the house at Vughterstraat 122-124 (left, 1566d ± 6), and in the attic floor of the rear part of the house at Kruisstraat 12-14 (right, second half of the 15th century).

Timber cosmetics

A striking phenomenon in the compound floor structures found in 's-Hertogenbosch is the use of differently processed timbers for the joists. Some of the joists are squared trunks, while others are made of sawn timbers. The former type was also used for the roof rafters. The impression gained is that this relatively thin timber of about 15 cm thick was especially grown for its length over a period of 30 to 50 years.[12] The timbers are easily recognised by their rounded edges and often a slightly undulating shape, unlike the sawn timbers, which are straight and have sharply defined edges.

The two types of joists were not mixed in the same floor section, although adjacent sections may contain different types of joists. The option of using either type of joist was available throughout the 15th and 16th century and appears to be unrelated to the structural function of the floor. In contrast, the type of joint used to connect the joists to the crossbeam does appear to be significant.

The examples show that the choice of joist type was dictated by the status of the house and the rooms within. It will not come as a surprise that squared trunks were considered inferior to sawn timbers. The presence of squared joists throughout a floor, in both the front and rear parts of a house, has so far only been confirmed in the houses at Putgang 6-8 (1553d ± 6) and Vughterstraat 155 (1469d ± 6). The first is known to have had only a single level, and this is probably true for the latter as well. Squared trunk joists do not appear to have been used in the first floor structures in the rear part of houses. For attic floors, the entire structure may use squared trunks, as in the house at Lepelstraat 45 (1429d), or their use may be limited to the front part of the house, as at Hinthamerstaat 119 (1468d).

A possible example of a transition from squared trunks to sawn timbers was found in the first and second floor structures of the front part of the house at Hinthamerstraat 184 (1438d) where the joists consisted of thicker, squared trunks that had been quartered. The joists of the first-floor structure had been tailed into the crossbeams. The only other house in which tailed-in squared trunks have been found is at Kerkstraat 71 (1552d ± 2). In most cases, the shape of the timbers meant that they were simply laid on top of the crossbeam.

In the front part of the houses at Kerkstraat 71 and Vughterstraat 46 (1461d), the upper floor structures contain a combination of sawn and squared joists. In both houses the floor consists of three sections, the frontmost two of which use sawn timbers, while the rearmost section contains squared timbers (fig. 2.12). The difference stems from the sub-division of this part of the house into a front room and a separate back room (the 'inside hearth'). Unfortunately, it cannot be said that houses that do not show a similar use of different timbers did not feature an inside hearth. The absence of an inside hearth is confirmed for the house at Hinthamerstraat 184 and the houses at Hooge Steenweg 19 (1463d ± 6) and 21 (second half of the 15th century). However, the house at Hinthamerstraat 119, with its uniform upper floor structure, did originally feature a sub-divided front part. The reason for the partition may have been the presence of a partial floor over the inside hearth.

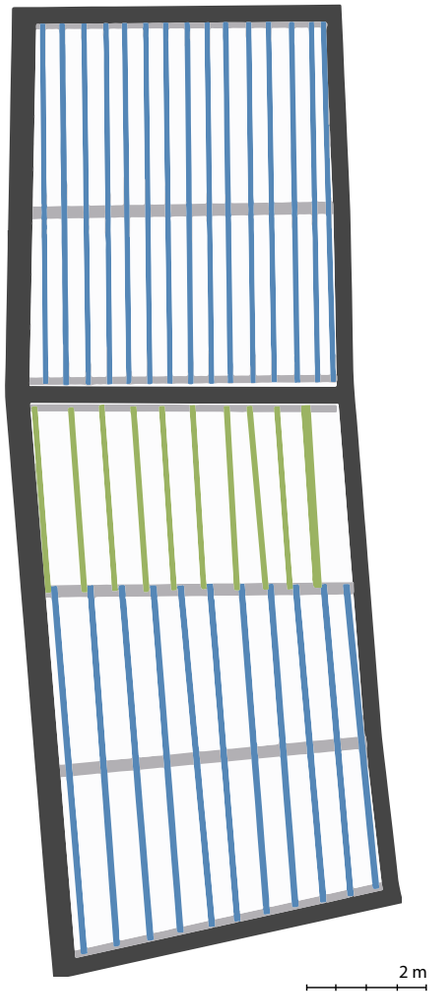
2.12

Despite the similarity in the type of timber used, the front parts of the houses at Kerkstraat 71 and Vughterstraat 46 differ regarding the method of construction and number of joists. The Vughterstraat house has equal numbers of each type of joist laid onto the crossbeams, whereas the Kerkstraat house has tailed-in joists, 18 above the front room and 13 above the inside hearth. A similar difference in numbers is however found between the front and rear parts of the house at Vughterstraat 46, the former having 11 joists, and the latter 15 (fig. 2.13). Sometimes the numbers differ only slightly, as at Kolperstraat 30 (1463d), with 12 squared joists laid onto the crossbeams in the front part of the house, and 13 tailed into the crossbeams of the rear part.

Where the same types of joists were used, different numbers expressed the distinction between the various rooms. This is evident in the house at Hinthamerstraat 184, where the attic floor contains only 11 joists above the front part of the house, whereas the rear part of the house has 14. Looking at the first floor structure of the house at Vughterstraat 48 (1465d ± 6), the different numbers of joists enabled the original presence of a front room to be deduced, its ceiling containing 12 joists as opposed to the ten joists in the space behind it. A similar setup was found in the attic floor structure of Hinthamerstraat 163 (1543d), in which the front room ceiling contained 14 tailed-in joists, whereas the sections behind it contained 12 laid-on joists.

We can deduce from the various examples found in the town that sawn timber carried more status than squared timber, as did higher numbers of joists. In addition to the number of joists, their size would also appear to play a role. In some cases the joists are even laid flat to make them appear bigger. Larger sizes of timber would have been more expensive, which would have made a high crossbeam with tailed-in joists convey more status than a lightweight crossbeam with laid-on joists. This distinction is even made within the supporting structure of one part of the house. For example, at Hinthamerstraat 111 the part of the joisting above the former retail space on the street shows a crossbeam with

Fig. 2.12. View of the upper floor structure in the front part of the house at Kerkstraat 71 (1552d ± 2), looking towards the front. The section over the inside hearth contains fewer joists, and these are made of squared trunks. Image: courtesy of the Municipality of 's-Hertogenbosch SO/BAM



2.13

Fig. 2.13. The upper floor structure of Vughterstraat 46 (1461d), showing the squared joists in green and the sawn joists in blue. Note the difference in numbers of joists in the front and rear parts of the house.

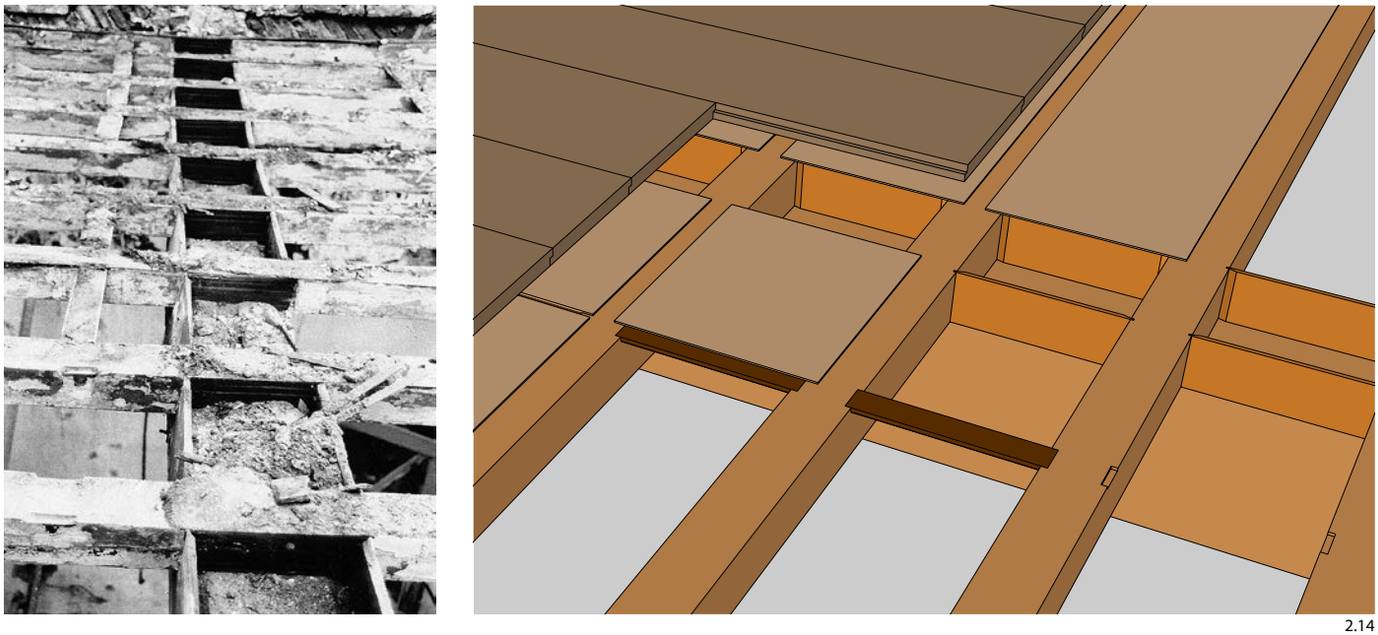
tailed-in joists, while behind, in the domestic 'inside hearth' area, the joists rest on a lower crossbeam. The status of a higher crossbeam with tailed-in joists sheds new light on the use of filler boards to close the gaps between laid-on joists above the crossbeam. These small oak panels, which are placed in sawn grooves in the joists, make the joist look as if they are tailed-in, thereby suggesting the presence of a higher and more expensive crossbeam (fig. 2.14).[13] It is striking that in this context the timber frame does not appear to form any part of this 'language of wood'. This can be deduced from the absence of any such structure in the first floor front room at Vughterstraat 48 and in the rear part of the house at Korenbrugstraat 16.

It should be noted that filler boards were often combined with a veneer-cut oak ceiling panelling between the joists to hide the floor planks. This was surely the ultimate demonstration of conspicuous consumption of wood. Its use is often restricted to the room in the rear part of the house, as at Lepelstraat 45 and Orthenstraat 336 (1465d ± 6 d). In more extreme cases the front part of the house was treated in the same way, as at Hinthamerstraat 119 and Hooge Steenweg 21. Interestingly, in many cases the length of the panels, that in width are no more than the space between two or three joists, does not cover the entire space between two crossbeams, so ornamental panel slats were used to conceal the joints (van Drunen, 1995) (fig. 2.14). This would seem to indicate that the wood used for the panelling was available in limited lengths only.

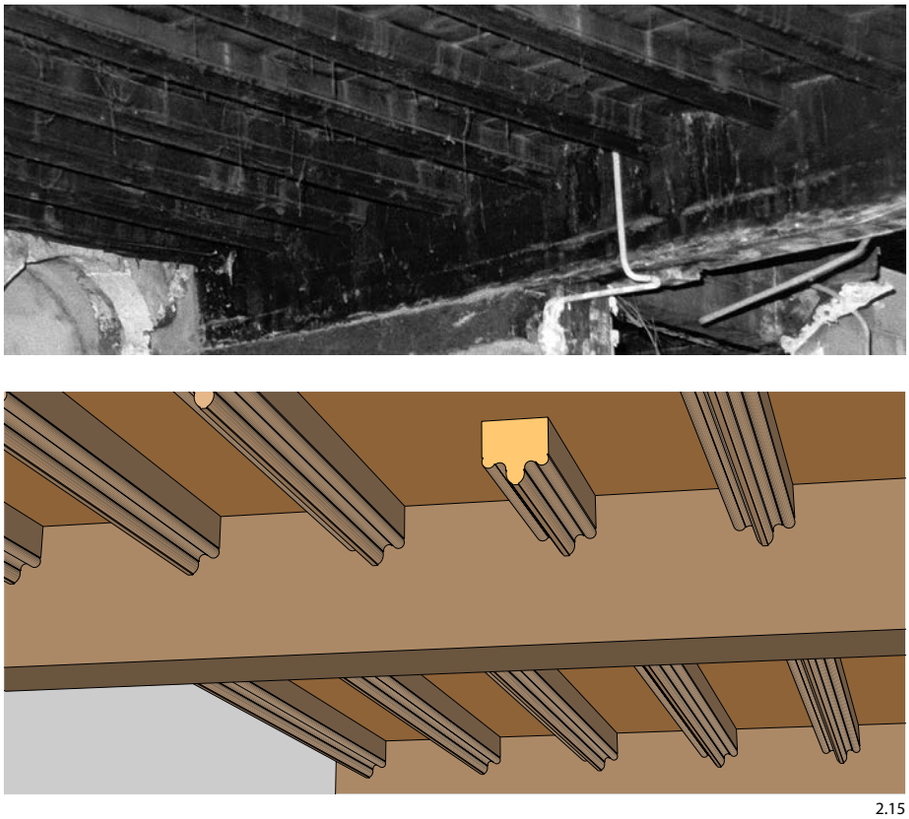
In the houses of 's-Hertogenbosch, the wood used for the late medieval supporting structures, with respect to quantity, size and operation, appear to have been selected with the function and status of each room in mind. Despite the outward differences of grain texture and colour, the wood almost always remained unpainted. Decorative colour finish seems with a few exceptions to have arisen in the late 16th century and it became especially prevalent in the 17th century. This was mainly due to softwood floors being used instead of traditional oak floors.

The main chamber of the house must have been the room to the rear above the cellar. This, more often than not, had the most sawn joists. The status of the space was emphasized by the presence of mural paintings, which were often more opulent than elsewhere in the house. A room on the first floor above the main chamber could also have the same expensive supporting structure and was perhaps as important as the main chamber itself.

If exceptionally a chamber at the first floor in front of the house was present, then it was also a higher status room. For Hinthamerstraat 90 (1516d ± 6), it may have even been the best room in the house, because the supporting structure above it was made with joists elaborated with a fine profile (fig. 2.15). This is the sole example in 's-Hertogenbosch of this kind of processing. Mostly in the front room only, the number of joists in the ceiling differs from the joists above the adjacent space which acted as a passage. At ground level the shop or workspace facing the street may show a similar status, not as high as the room to the rear but higher than the middle room known as the inside hearth. The inside hearth, as a kitchen, can be considered the least representative living space in the house. Often the squared trunk joists in the ceiling above it are darkened by smoke.



2.14

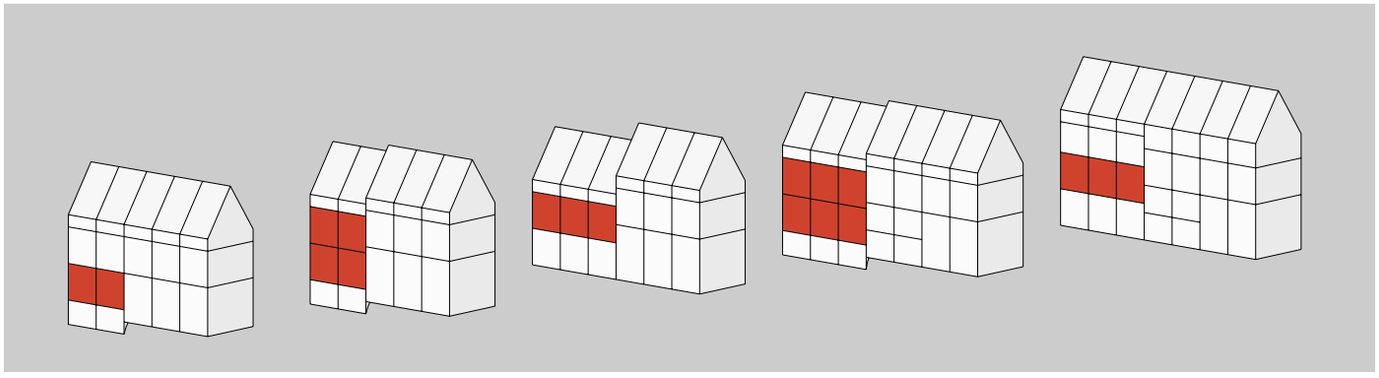


2.15

Fig. 2.14. Detail of the first floor structure in the rear part of the house at Orthenstraat 23-25 (1469d) and drawing of the layout, showing the use of filler boards to close the gaps above the crossbeam between the joists. Over the joists an ornamental ceiling panelling was laid with slats to cover the seams. Image: courtesy of the Municipality of 's-Hertogenbosch SO/BAM; drawing: author

Fig. 2.15. Detail of the rare supporting structure above the formal room facing the street at the first floor of Hinthamerstraat 90, where the ceiling has decorative moulded joists. Image: courtesy of the Municipality of 's-Hertogenbosch SO/BAM; drawing: author

Above the ground floor of the house, either sawn or squared trunk joists can be employed to the full depth of the front part. Sawn joists may indicate the presence of a partial floor over the inside hearth. For squared trunk joists, no wall separated the front room and the inside hearth. This suggests that the entire front part was used as commercial space or a workshop. Whether food was prepared here or elsewhere in a detached kitchen is not known. It



2.16

is striking that in larger houses, the number of representative rooms did not increase (fig. 2.16). This raises the question whether certain houses were built for a more specific profession. In addition, the presence of more rooms of status may be, for example, an indication of occupancy by several members of a family. Historical research on residents and their professions would possibly provide more clarity but this is complicated by the fact that the vast majority of houses in the city were rented.

Conclusion

Dendrochronological research shows that the city fire of 1463 and the subsequent actions of the City Authorities were of major influence on construction activity in 's-Hertogenbosch over a period of ten years. After that time, house building slowly but surely decreased, reaching its lowest point at the end of the 16th century. In the period immediately after the fire, there was both new construction and reconstruction.

It is striking that even in the often originally 14th-century stone houses outside the disaster area the supporting beams were replaced. In two-thirds of the cases, the new supporting structures were part of a timber frame that had no supporting function for the outer walls. Where houses were detached or semi-detached and had a width of more than 6 m, a full timber frame was applied for stability and to reduce the crossbeam length. In houses with an average width of less than 5 m, no timber frame was applied on the ground floor but was sometimes used on the first floor. Explanation for this seems partly to be attributed to the construction of neighbouring buildings but could also have been a financial issue.

Strangely enough, the supporting timber frame was not included in the way in which ceiling joists were differently designed for the purpose of status. This would have been expected within the context of 'the more wood the more status'. One explanation may be that the braces in the construction of supporting timber frames both practically and visually narrowed the rooms. It may also have played a role in the fact that the presence of a wooden frame in the homes of the nobility had fallen out of fashion (Meischke, 2000: 52).

For 's-Hertogenbosch, the late medieval supporting structures provide understanding as to the original use of space in the houses in different ways.

Fig. 2.16. Schematic representation of some 15th-century houses, showing in red the representative chamber(s) in the rear part of the house (left to right: Lepelstraat 45, Vughterstraat 84, Postelstraat 36, Hinthamerstraat 119 and Vughterstraat 43).

The manner in which joists are processed, the number of joists and the connection with the crossbeams make the difference in status visible between the rooms themselves and, possibly by extension, the status of a house in the street. When dovetails were used for the connection of joists with the crossbeams, from the pattern in which the tension joists were applied, it can be deduced whether the house originally had a stone facade or an upper floor or attic which was suitable as a storage space for heavy goods.

As these results show, the final word on the history of timber and supporting structures in late medieval houses in 's-Hertogenbosch has not yet been spoken. Many aspects of their use, for instance regarding upper-floor timber frames, will need to be considered in a broader context, taking urban development into account, if we are to increase our understanding of the various decisions made regarding their application. The urban research initiated by van Drunen forms a good starting point, provided it can be combined with dendrochronological analysis.[14] This also applies to the use of floor structures to convey status. An in-depth survey to map the locations of houses with more or less richly constructed floor structures may be able to provide insight into the distribution of social groups within the town by providing a new basis for research into the history of house owners and occupants. The use of dovetail joints also raises new questions. Their presence in combination with the absence of border joists has not yet been addressed, and this calls for further research into the floor structures of houses with timber facades.

Notes

1 Most samples were analysed by Pressler GmbH, a smaller subset by BAAC B.V., 's-Hertogenbosch, and by Stichting RING, Amersfoort.

2 These are the houses at Markt 79-85 ('De Moriaan', dated 1277d) and at Pensmarkt 16-20 (dated 1287d ± 6).

3 Timber from the 1450s in combination with timber dated to shortly after 1463 was found in seven houses. In Amsterdam the same phenomenon was observed in buildings constructed during the third and fourth expansions of the town (van Tussenbroek, 2012: 29).

4 For a graphical representation of the occurrence of the link-beam truss, see: Boekwijt and van Drunen, 1996: 22.

5 An important part of dendrochronology is to specify the regions of origin of the wood, termed 'dendro-provenancing' (for example Bonde *et al.*, 1997; Jansma and Hanraets, 2004; Eckstein and Wrobel, 2007; Eissing and Dittmar, 2011). For this article only the reference chronologies mentioned in dendrochronological reports have been used without further investigation of whether the areas to which they refer are actually the areas of origin or places of timber trade. Therefore interpretation of wood source regions should be considered indicative and deserves further refinement in the future.

6 In Amsterdam, the earliest dendrochronological date for pine, also from Sweden, is 1603 (felling date). Floor constructions of single beams are in Delft, already known from the 16th century.

7 Upper floor of the house at Vughterstraat 43. The planks were not sampled for dendrochronological research.

8 Houses at Hinthamerstraat 113 (1464d) and Kolperstraat 5 (1466d).

9 For a more exhaustive description of this subject, see Enderman, 2014.

10 This was found in the attic floor structure in the front part of the house at Hinthamerstraat 163 (1543d) and in the upper floor structure of the front part of the house at Hinthamerstraat 111 (1536d ± 6).

11 In the house at Orthtenstraat 23-25 (1464d), this type of joint was found in an attic floor structure forming part of a timber frame.

12 Two-thirds of the dated rafters were grown during this period. The highest number of growth rings in the remaining third is 90.

13 The size of the filler boards is determined by the height and distance between the joists. The panels are approximately 0.5 to 1 cm thick and chamfered at the ends at the back to allow them to slide into the sawn grooves in the joists. It is known that wood was re-used for the boards, such as in the house at Kerkstraat 73 (fig. 1) where sawn drapery panels on the back side were found.

14 van Drunen, 2006: 29-31.

References

Boekwijt H.W. and van Drunen A.H., 1996. Het middeleeuwse tussenbalkjuk opnieuw beschouwd, *in:* Emmens K. *et al.* (ed.), *Monumenten en bouwhistorie*, Jaarboek Monumentenzorg, Zwolle: 19-28.

Boekwijt H.W., 1999. Bouwhistorie en archeologie in 's-Hertogenbosch. Raakpunten in het huizenonderzoek van de Middeleeuwse stad, *in:* Carmiggelt A. *et al.* (ed.), *Rotterdam Papers 10, a contribution to medieval and post-medieval archeology and history of building*, Rotterdam: 37-51.

Bonde N., Tyers I. and Ważny T.,1997. Where does the timber come from? Dendrochronological evidence of the timber trade in Northem Europe, *in:* Sinclair A., Slater E. and Gowlett J. (eds.), *Proceedings of a conference on the application of scientific techniques to the study of archaeology*, Liverpool 1995 (Archaelogical Sciences, Oxbow Monograph 64), Oxford: 201-204.

de Vries D.J., 1994. *Bouwen in de late middeleeuwen*, Utrecht: 512 p.

Eckstein D. and Wrobel S., 2007. Dendrochronological proof of origin of historic timber –retrospect and perspectives, *in:* Haneca K. *et al.* (ed.), *TRACE – Tree Rings in Archaeology, Climatology and Ecology* 5, Proceedings of the Dendrosymposium, 2006, Tervuren: 8-20.

Eissing T. and Dittmar C., 2011. Timber transport and dendro-provenancing in Thuringia and Bavaria, *in:* Fraiture P. *et al.* (ed), *Tree Rings, Art, Archaeology*, Proceedings of a conference at the Royal Institute for Cultural Heritage, Brussels, 10-12 February 2010, Royal Institute for Cultural Heritage (*Scientia Artis* 7): 137-149.

Enderman M.W., 2014. Binten met een staartje, *Nieuwsbrief Stichting Bouwhistorie Nederland* 56: 50-61.

Glaudemans R. and Smit J., 2003. De houten stad, *in:* Gawronski J. *et al.*, *Amsterdam Monumenten & Archeologie* 2, Amsterdam: 25-39.

Janse H., 1964. Constructie, ondersteuning en versiering van balken en houten vloeren tot omstreeks 1650, *Bulletin van de Koninklijke Nederlandse Oudheidkundige Bond (KNOB)* 17-5: 303-328.

Jansma E. and Hanraets E., 2004. Dating Flanders – towards a Flemisch tree-ring chronology of oak, *in:* Jansma E. *et al.* (ed.), *TRACE – Tree Rings in Archaeology, Climatology and Ecology* 2, Proceedings of the Dendrosymposium, 2003, Utrecht: 8-20.

Kolman C.J. 1989. Houten gevels in het Nederlandse stadsbeeld (14de-18de eeuw), *in: "Ten voordele en cieraat van dese stad" Studies over houten huizen in Nederlandse steden* (RV bijdrage 09), Den Haag: 41-93.

Kuijer P.T.J., 2000. *'s-Hertogenbosch, stad in het hertogdom Brabant ca. 1185-1629*, Zwolle: 720 p.

Meischke R. *et al.*, 1997. *Huizen in Nederland, Zeeland en Zuid-Holland*, Zwolle: 448 p.

Meischke R. *et al.*, 2000. *Huizen in Nederland, Utrecht, Noord-Brabant en de oostelijke provincies*, Zwolle: 464 p.

Schaars D., 2014. Voorgevels met overstek en puibalken, *Nieuwsbrief Stichting Bouwhistorie Nederland* 56: 42-49.

Spierings M.H.M., 1984. *Het schepenprotocol van's-Hertogenbosch 1367-1400*, Tilburg: 39 p.

van Drunen A.H., 1990. Die mittelgroßen Backsteinhäuser in's-Hertogenbosch, *Jahrbuch für Hausforschung* 39 (*Hausbau in den Niederlanden*): 187-204.

van Drunen A.H., 1995. Doc blad 7, *in: Rijksdienst Monumentenzorg, Restauratie Vademecum, Vloer op balklaag, hout*, 's-Gravenhage: 4.

van Drunen A.H., 2006. *'s-Hertogenbosch van straet tot stroom*, Zwolle: 516 p.

van Oosten R., 2014. *De stad, het vuil en de beerput*, Groningen: 336 p.

van Tussenbroek G., 2012. *Historisch hout in Amsterdamse monumenten*, Amsterdam: 237 p.

Vink E., 1993. Bosch bouwhout onderweg, *Bulletin van de Koninklijke Nederlandse Oudheidkundige Bond (KNOB)* 92-5: 129-140.

Vink E., 2013. *Keuren, ordonnanties en andere bronnen over de openbare ruimte in's-Hertogenbosch*, report commissioned by the Municipality of 's-Hertogenbosch SO/BAM: 161.

Weststrate J., 2008. *In het kielzog van moderne markten. Handel en scheepvaart op de Rijn, Waal en IJssel ca. 1360-1560*, Hilversum: 336 p.

Weve W., 2013. *Huizen in Delft in de 16de en 17de eeuw*, Zwolle: 263 p.

Summary

In the decade after the town fire of 1463, at the behest of the city authorities the thatch roofs of houses in the town were replaced with hard roofing material. Widespread rebuilding and restoration took place, both inside and outside the disaster area. In the subsequent period to the end of the 16th century, homebuilding gradually but steadily decreased. Depending on the circumstances for building new houses, lightweight timber frames were used. The construction of supporting structures was aligned with a stone rather than a wooden facade and in connection with the use of the different rooms in a house with a more or less standard layout.