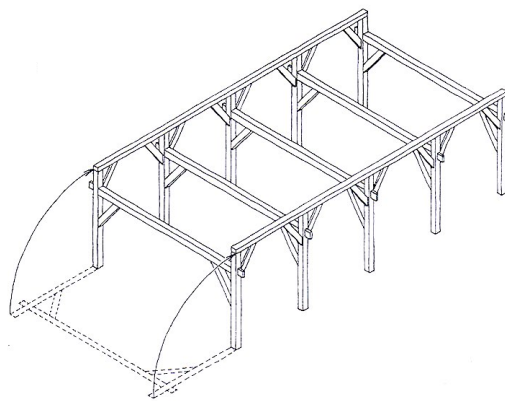


The decline of timber construction practices in North-Holland, The Netherlands



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Abstract

In our contemporary quest to live and build more sustainably, the lessons that one can learn from the understanding of vernacular architecture, as well as the use of (engineered) timber in construction are often praised. Like in many other European countries throughout history, timber once was the most important construction material in the Netherlands. Especially in the north western part of the Netherlands (modern day North-Holland), timber buildings thrived. However, building practices and material use changed and traditions were lost. This thesis offers a concise overview of the role of timber as a construction material in our building practices in both Amsterdam and the rural landscape of North-Holland during the period between the roughly stated years of 1450 and 2000. Through the analysis of case studies, aided by a literature review, it is shown how different large historical events and subsequent societal and administrative changes in the researched period contributed to changing construction practices and material use.

Introduction

In our contemporary quest to live and build more sustainably, and to rekindle our relationship to the natural world of which we are apart, some abide to the believe that research into vernacular buildings and techniques can be of great value (Creang et al., 2010). From one's own personal experience at the Faculty of Architecture and the Built Environment at the TU Delft, vernacular architecture certainly presents itself as an occasionally discussed and/or referenced subject matter, but often when looking at other geographical regions and cultures than those of the Netherlands (Southeast-Asian, Middle-Eastern and African among others). Given the direct relationship of vernacular architecture to its context in every sense of the word (*Vernacular Architecture*, n.d.), researching the vernacular architecture of one's own region can therefore be regarded as a sensible endeavor if indeed the lessons learnt are to be applied in one's own region.

Similarly linked to the aforementioned pursuit of sustainability, the reappearance of so called bio-based materials in the construction industry, and wood in particular, can be seen as an auspicious phenomenon in the context of the extremely polluting construction industry (Ramage et al., 2017), which is in need of drastic change. Like in many other European countries throughout history however, timber once was the most important construction material in the Netherlands (Lintsen et al., 2018, p. 311). Especially in the north western part of the Netherlands (modern day North-Holland), timber buildings thrived, partially due to their low weight in the context of the relatively low bearing capacity of the subsoil, which is of largely peaty nature as evidently visible in figure 1 (van Tussenbroek, 2017, p. 50). The questions then arise how it is that timber was actually used in North-Holland's building practices, and how it came to be

that these practices were lost throughout history. With what is written before in mind, this thesis sets out to give a concise overview of the role of timber as a construction material in common building practices in both Amsterdam and the rural landscape of what is now called North-Holland during the period 1450 - 2000. Conscious of the enormity of this time scale, a very meticulous description of the gradual evolution of our building practices will not be feasible. What will be attainable however, is the treatment of different case studies of both urban and rural dwellings throughout the aforementioned period. These case studies are chosen to be adequately representative of their temporal context with the aim of providing an informative historical overview of the ways in which the Dutch, and the people from Noord-Holland specifically, have used timber as a construction material in their dwellings.

The thesis builds upon the strong foundations of the detailed research into the construction history of the Netherlands by Gabri van Tussenbroek, Ronald Stenvert, Gerard Berends and others. It is not only the exact construction history which is treated in this paper however, as in every chapter, a conscious effort is made to include some concise but necessary historical context to the case studies. This is done from the believe that the placement of a certain practice or method into its historical context allows for it to be understood and learnt from. Pivotal moments such as the two great city fires in Amsterdam in 1421 and 1452 and much later, the aftermath of the Second World War can for instance partially be ascribed to certain changes in construction methods and material use. In the later chapters however, this historical context is described in much more detail, as it is better documented and more readily available.

Methodology & structure

As stated in the introduction, the thesis revolves around the treatment of different case studies of both urban and rural dwellings throughout the researched periods. These case studies are chosen to be adequately representative of their temporal context and are often made up of specific built, and sometimes still standing, examples. In chapter 1.2 however, a more generally described historical typology of a farmhouse is used as no specific example could be found. Primarily, sectional drawings or (reconstructive) open perspective drawings of the buildings are used as main media for the analyses. For most of the case studies from Amsterdam, the municipal archive was used to find sectional drawings which often illustrate the materials used in the buildings' constructions aptly. Additionally, most of the treated topics are researched through a literary review, using books available at the faculty library of Architecture and the Built Environment at the TU Delft, the main library at the TU Delft and the Royal Library (KB) in Den Haag, with the additional use of scientific papers and imagery available online.

Due to the varied nature of available literature concerning the different time-periods throughout this thesis, some chapters are more technical, whereas in other chapters, it is the historical context which is treated more extensively. Chapter 1 revolves around the roughly demarcated period from 1450 till 1600, in which the timber-framed townhouses of Amsterdam and the long aisled farmhouses in the surrounding rural areas were common. The second chapter treats the rather extensive period from 1600 till 1940, during which in Amsterdam, timber was commonly used in conjunction with brick for most constructions. In the rural areas, de Stolpboerderij appeared, of which its structure remained mostly timber-framed. Finally, the third chapter, starting roughly after WWII, illustrates the revolutionary nature of the change in building practices and materials as largely directed by the state in both the city and the rural areas. In the conclusion, the main findings will be summarized and a clear overview of the role of timber as a construction material in the building practices on North-Holland will be given.

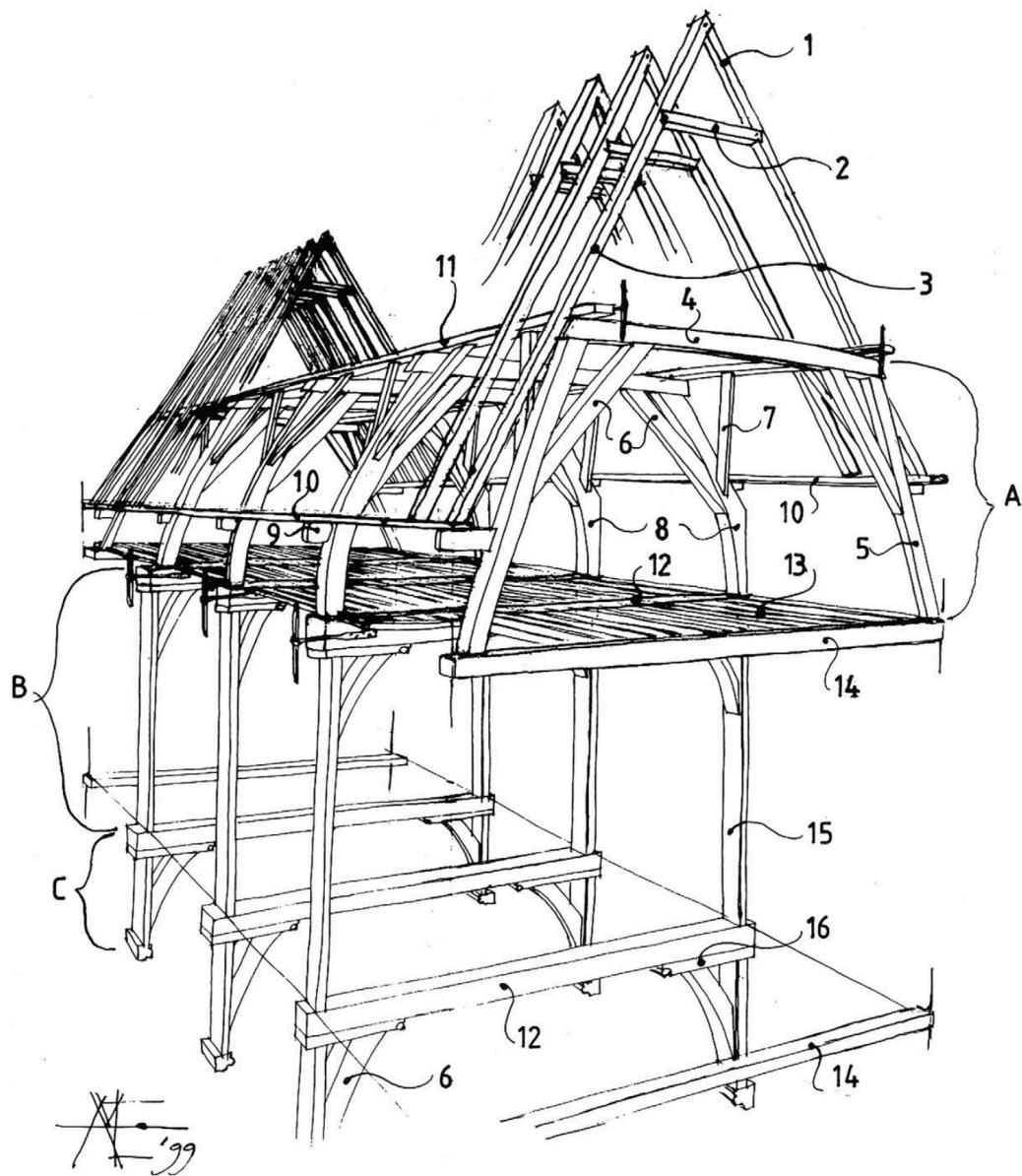


Fig. 2. Late Medieval timber-framed house (drawing Albert van Engelenhoven/Municipality of Dordrecht 1999) (van Tussenbroek, 2017).

1. Timber constructions from 1450 - 1600

As has been pointed out in the introduction, timber used to be the most used construction material in the Netherlands, and specifically in North-Holland, where vast woodlands once were abundant and the peaty subsoil demanded buildings that were of low mass (van Tussenbroek, 2017, p. 50). This chapter explores two case studies that are representative for common construction practices and materials in both Amsterdam and the surrounding rural landscape of North-Holland during the period of 1450 - 1600.

1.1 Timber-framed townhouses in Amsterdam

Around the year 1450, Amsterdam had grown from a small settlement with one church in 1300 to a relatively substantial city. The houses were originally built with half-timbered walls and loam floors (Meischke et al., 1995) but these somewhat primitive settlements gradually made way for timber-framed multi-story houses with timber gable walls during the course of the fifteenth and sixteenth century (Amsterdam Cultuur-Historische Vereniging, n.d.-b). These houses were predominantly constructed using imported oak from Germany which was shipped over the Rhine river (Stenvert & Tussenbroek, 2007, p. 72). Even-though devastating city-fires in the years 1421 and 1452 brought about laws that would result in fines for those who continued building their houses with timber facades, this type of townhouse remained the norm as Amsterdam's citizens were hard to convince. Thus, Amsterdam remained a mostly wooden city until at least 1521, the year from when building with brick was gradually implemented. (van Tussenbroek, 2017, p. 54). As not much detailed information on specific timber houses from before this year can be found, this chapter showcases an example from a timber-framed townhouse which was built in 1529, amidst the aforementioned transition to more brick. The house in question is located at Begijnhof 34 in Amsterdam and is one of the two timber-framed townhouses with timber facades which is still standing (alongside Zeedijk 1) (Amsterdam Monumentenstad, Database Van De Amsterdamse Grachtengordel, 2020). After its conception in 1529, the house at Begijnhof 34 has undergone (known) restorations in 1888, 1953 and 1979. It was previously believed that the house dated to just after the large city fire of 1452,

but dendrochronological research pointed towards the actual construction year of 1529 (Van Tussenbroek, 2010). The house can be described as a so-called 'Zaalhuis', meaning that it is characterized by a large central space and a timber-framed structure and facades. As described above, this type of house remained dominant in the city till the later half of the 16th century (Amsterdam Monumentenstad, Database Van De Amsterdamse Grachtengordel, 2020).

As van Tussenbroek (2017, p. 46) states, the most important element of nearly all Dutch timber-framed town houses is the repetition of cross frames¹. These cross frames, (titled 'B' in figure 2) are made up of two posts² and a beam³, connected with mortise and tenon joints⁴ and often reinforced with braces⁵ and sole plates⁶ (visible in figure 3). This principle of cross frames that carry the floors and roof also applies to the example of Begijnhof 34 (figure 4), as can be seen in figure 5. Trusses⁷, that show a great resemblance to the cross frames mentioned above, but are slightly less wide, are placed on top of the cross frames to support the roof. The posts of these trusses, also called principals⁸, are made of oak that has grown in a curved shape so that these elements can be placed closer to the side walls (Stenvert et al., 2007, p. 158). These trusses are connected by longitudinal beams on which the rafters⁹ (titled '1' in figure 2) are placed.

In the drawing of the timber frame by Henk Zantkuijkl, the structure appears to be floating. This is due to the fact that the ground floor walls were actually constructed out of brick as it proofed more suitable with the humid subsoil. As I. R. Meischke (1969) proposes, this house can be described as a supported timber-framed house. Alongside these supported timber-framed houses, self-supporting timber-framed houses, which lacked the brick ground-floor walls were also commonly found in Amsterdam. Thin brick side walls, anchored to the timber structure, are also used in Begijnhof 34 in order to provide horizontal stability. (Glaudemans & Smit, n.d.). The nature of these side walls show how the transition to the use of more brick in Amsterdam was already unfolding during the construction of Begijnhof 34. Before this transition, most side walls would have been constructed using timber wind braces¹⁰, rails¹¹ and siding¹² between the cross frames (figure 6).



Fig. 3. Part of beam brace and decorated sole plate of Begijnhof 34 (Schoonenberg, n.d.).



Fig. 4. Begijnhof 34, Amsterdam. Dated to 1529 (Amsterdam Cultuur-Historische Vereniging, 1903).

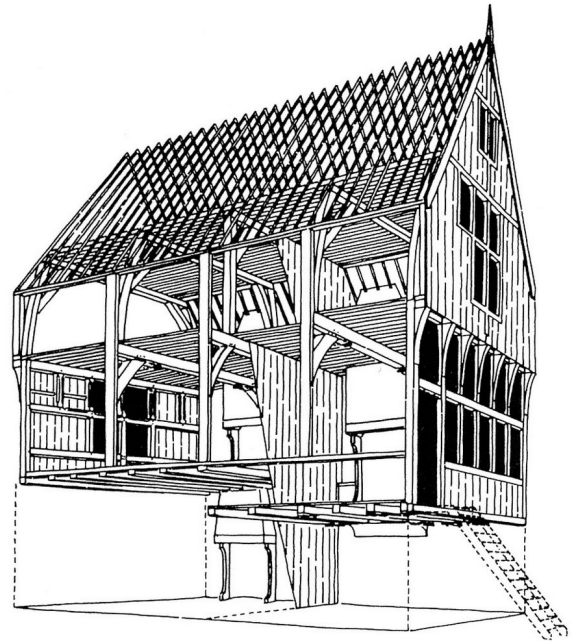


Fig. 5. Reconstruction of the timber frame by Henk Zantkuijl (Amsterdam Monumentenstad, Database Van De Amsterdamse Grachtengordel, 2020).

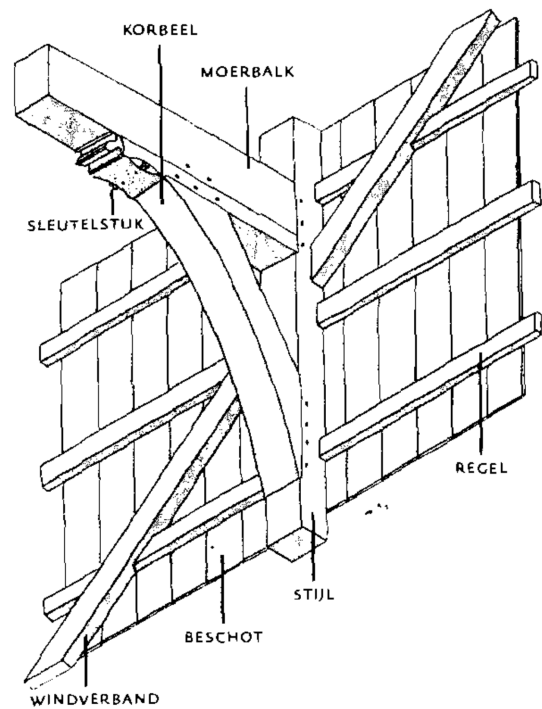


Fig. 6. Reconstruction of a part of the timber frame at Warmoesstraat 96 by Ronald Glaudemans (Glaudemans & Smit, n.d.).

1.2 De Langhuisboerderij, rural farmhouses in North-Holland

After previously going back and forth between small reclamations and breaches from the North sea and South sea (Zuiderzee), different areas of North-Holland throughout the sixteenth century were subject to large scale land reclamation using dikes and polder mills (Provincie Noord-Holland Archeologie - Collectiesite, n.d.). During the subsequent centuries, more and more areas in North-Holland were reclaimed, which were largely brought into cultivation for agriculture. Despite the fact that the province is well known for its pyramid-shaped Stolpboerderij, it is universally agreed on that this type was preceded by a much lower and elongated farmhouse, also known as the Langhuisboerderij (van Olst, 1991). Even after the introduction of the well-known Stolp types, the aforementioned elongated farmhouse did survive, albeit slightly evolved and with the addition of a square building volume for the storage of hay (Hooihuis). This type is mostly seen in Waterland, just north of Amsterdam, and is often referred to as the Hooihuisboerderij as seen in figure 7. The Langhuisboerderij shows many similarities with the widely distributed (from the north coast of Poland to the Dutch coast) aisled hall house or Low German house (Halle(n)huisboerderij) as they both showcase the combination of a living area for the farmer's family and stables, divided by a wall, underneath one long roof. The fact remains however that not a single farmhouse exactly abides to a description of a certain type. The description of these types often came into existence centuries after the construction of the farmhouses,

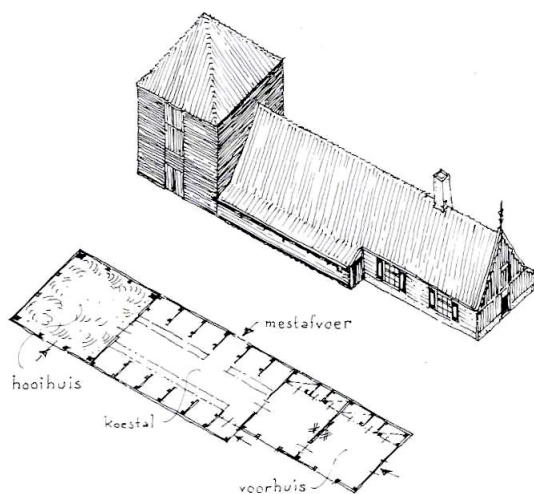


Fig. 7. Isometric projection and ground-floor plan (Hooihuisboerderij, n.d.).

and although useful for the illustration of certain historical developments, they should perhaps not always be treated as narrowly as sometimes described. When stepping away from the technicalities of what exactly entails each type of these elongated farmhouses however, what remains is the fact that most are constructed in a relatively similar manner. Archeological evidence suggests that both single-aisled and three-aisled variants of these long farmhouses were built (Rijksdienst voor het Cultureel Erfgoed, 2015). In case of a three-aisled farmhouse, the smaller side aisles were often used for livestock as for many farms in North-Holland, animal husbandry made up an important part of the operations (Rijksdienst voor het Cultureel Erfgoed, 2015). The oak which was often used in the construction largely came from Germany as most of the local forests had already been cut down (Borghaerts, 2021). Similar to the construction of the town houses of Amsterdam as shown in chapter 1.1, the construction of these farmhouses largely relied on a rhythmic repetition of timber cross frames, placed on brick footings¹³, with trusses on top to carry the roof (figure 8). Due to the elongated nature of the rafters however, the sidewalls end up rather low. These walls, which often performed no real structural task, were often clad with horizontal timber siding like shown in a much more recent example in figure 9. Later on, these walls were often constructed using brick (Figure 10), which was already common in the eastern part of the country.

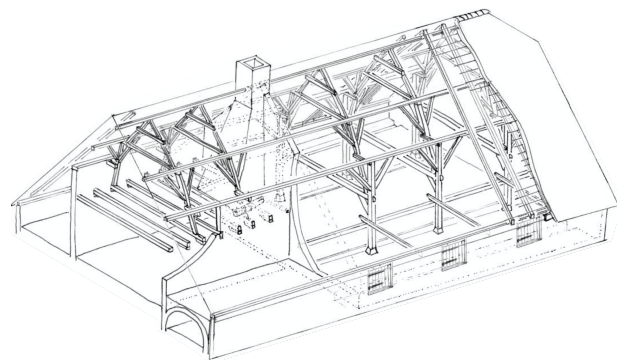


Fig. 8. Timber-framed construction of an aisled hall house (Rijksdienst voor het Cultureel Erfgoed, 2015).



Fig. 9. More recent Langhuisboerderij in Middelie (Unknown & Zuiderzeemuseum, n.d.).



Fig. 10. More recent Langhuisboerderij on Ameland (Uilkema, K. & Zuiderzeemuseum, n.d.).

2. The gradual decline of timber in constructions from 1600 - 1940

Conscious of the fact that the historical time-period from approximately 1600 till 1940 is rather long and full of extremely important historical events, it is chosen as a period in which the development and evolution of both construction materials used and common practices applied can be characterized by its *gradual* (\neq revolutionary) nature (when compared to today's standards). Following a period in which timber used to be the most important building material in large parts of North-Holland, the use of brick became more prevalent from the end of the sixteenth century and the start of the seventeenth century onwards. In slight contrast to the gradual decline of self-supporting timber frames in Amsterdam, the timber building tradition in the rural areas, although different in form, did survive for longer (Van Tussenbroek, 2017, p. 59). This chapter explores case studies that are representative for the ever-changing commonly used construction practices and materials in both Amsterdam and the surrounding rural landscape of North-Holland during the period of 1600 - 1940. Due to the extensive nature of this period, the case-studies are chosen as to illustrate a gradual evolution rather than a fixed state.

2.1 Mixed timber-brick houses of Amsterdam

Whilst other cities in the Netherlands such as Utrecht and Nijmegen are known for their early renouncement of self-supporting timber frames (from the start of the fifteenth century) and the implementation of stone and brick in its buildings, this process started a couple centuries later in Amsterdam (Van Tussenbroek, 2017, p. 51). During the so-called 'Golden Age' from 1580 to 1672 (a contested term due to its dependency on the then prevalent slave trade amongst others), the Netherlands, and particularly Amsterdam, experienced a large prosperity quite unknown in those days and the city's staple market became one of the most important centers of world trade (Lintsen et al., 2018, p. 29). Largely owing to this economic dynamism, Amsterdam attracted many, its population grew rapidly, and so did the city itself (Wikipedia-bijdragers 2, 2023). This large expansion, in conjunction with the implemented laws that prohibited the construction of timber facades as mentioned in chapter 1, resulted in a large part of the townhouses in what is now commonly known as the 'Canal belt', being constructed in a rather consistent manner (when regarding its load bearing structure). In this manner, a material distinction between horizontal and vertical construction elements can be seen. Whilst relatively light timber elements are still

used to span horizontally to disperse loads to the vertical load bearing construction, long lasting and fireproof brick walls now take up this function as vertical load bearing construction, instead of the preceding timber posts of the cross frames. As Van Tussenbroek (2017, p. 59) and Borghaerts (2021) state however, the use of German oak has now mostly made place for imported Norwegian and Swedish pine, which was fast-growing and lighter in weight. Furthermore, the use of iron nails and other connecting agents slowly grows from the end of the sixteenth century onwards (Stenvert et al., 2007, p. 149). Another difference with the timber-framed townhouses is the smaller distance between the beams. This way, the timber floor spans directly between the beams without the use of joist beams¹⁴. Figure 11 shows a section of an unknown townhouse in Amsterdam that clearly illustrates this principle. What also becomes clear in this drawing by Cornelis Danckerts is the fact that the roof structure, with its use of timber trusses, is relatively similar to the one of Begijnhof 34.

After the construction of the Canal belt, which lasted till the start of the eighteenth century, the physical growth of Amsterdam largely stopped (Wikipedia-bijdragers 2, 2023). It was only after 1877, with the expected population boom and the expansion plan by Jan Kalff, that many houses were constructed again. Figure 12 shows a section drawing from 1883 of a townhouse on the corner of Droogbak. When looking carefully, many differences between both section drawings in figures 11 and 12 can be deduced, of which the incorporation of 'modern' toilets and a connection to the sewer are perhaps most notable. Despite the fact that these (drawings of) houses are separated by more than two-hundred years, the materials used in different load bearing elements (walls, floors, roof) remain largely the same. Apart from the steel I-beams and brick arches used in the first floor in figure 12, the walls are still constructed using brick and the roof and floor structures are still made out of timber. This is representative for almost all housing construction in Amsterdam during these centuries (Lintsen, 1993). The section in figure 13 however, with a comparatively small jump forward in time, illustrates the fact that from the 1920's onwards, (reinforced) concrete starts to make an appearance as a construction material, albeit only to construct smaller elements such as balconies and/or lintels with. Looking at this gradual evolution of the materials used for the load bearing elements in Amsterdam's houses, the reasoning behind the treatment of such a long period in this chapter is demonstrated.

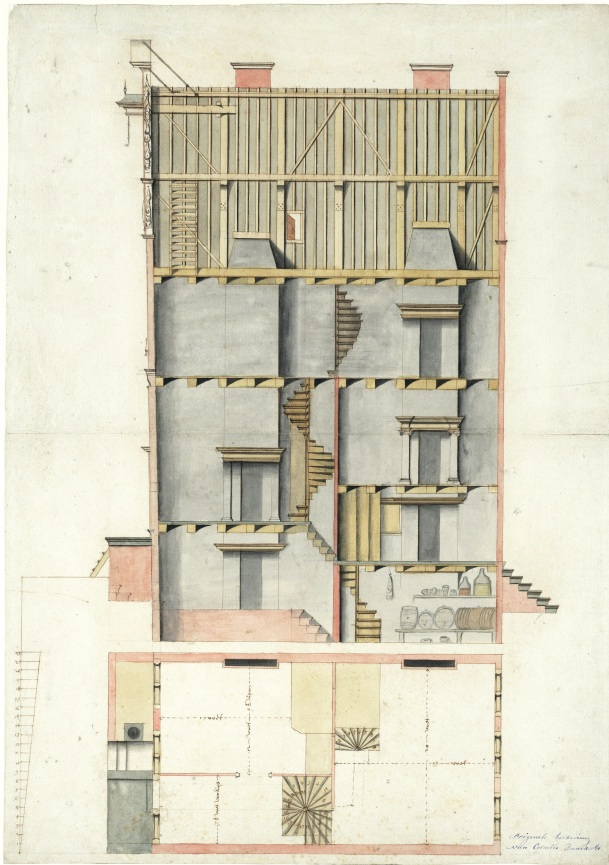


Fig. 11. Section and ground-floor plan by Cornelis Danckerts of unknown house in Amsterdam (no scale) (Danckerts & Stadsarchief Amsterdam, 1678).

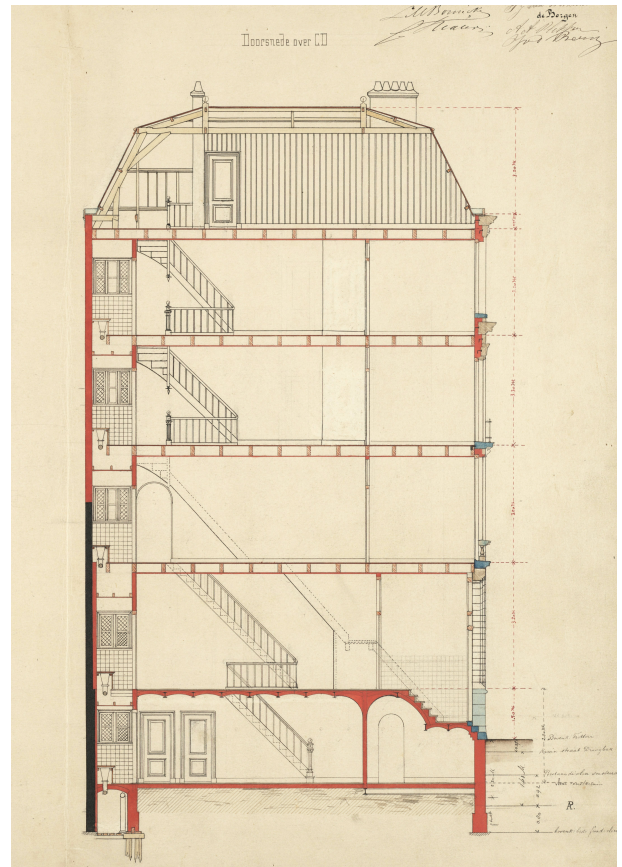


Fig. 12. Section by Adriaan Cyriacus Bleijs of house on the corner of Droogbak, Amsterdam (no scale) (Bleijs & Stadsarchief Amsterdam, 1883).

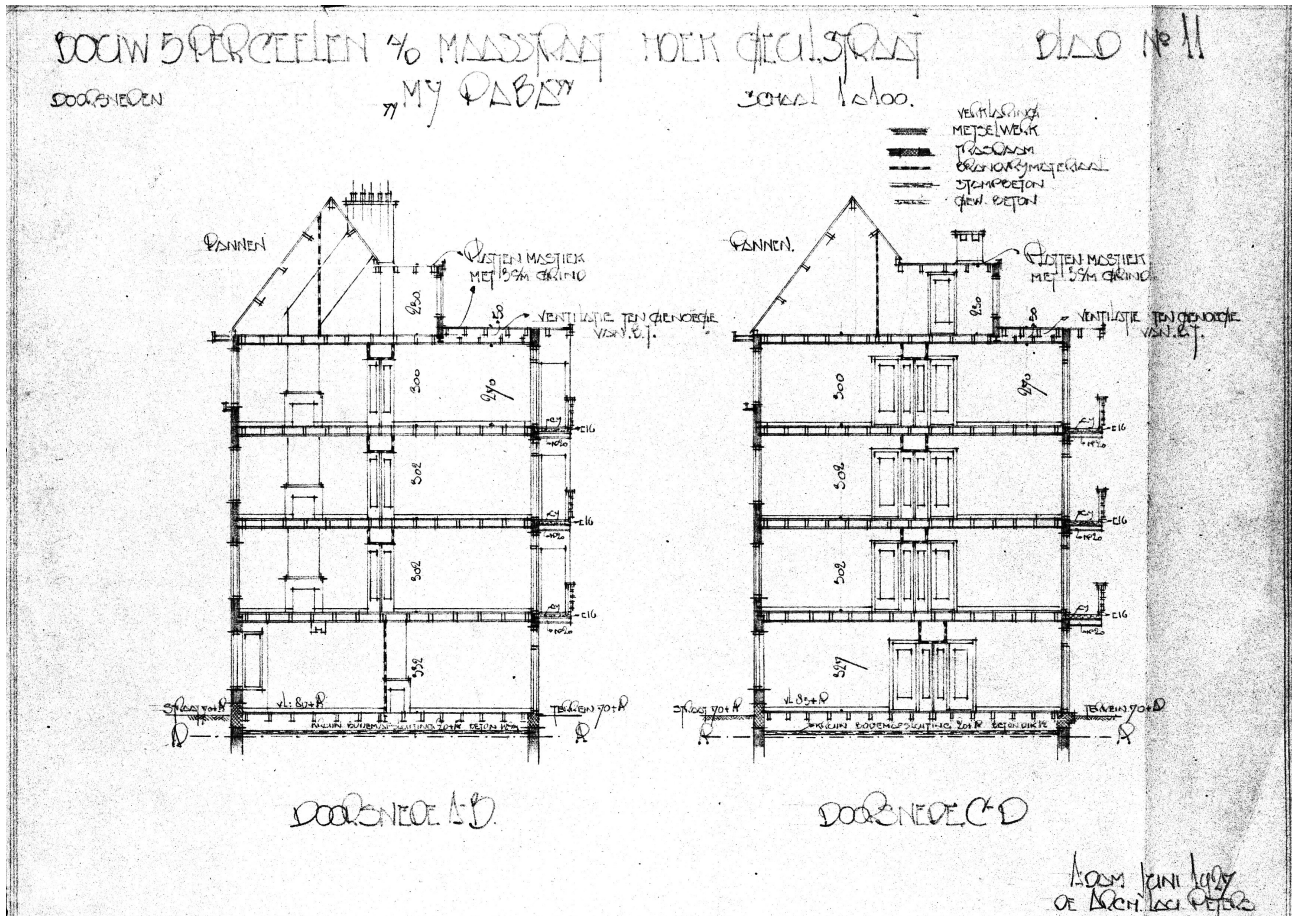


Fig. 13. Sections by Baanders architects of houses on the Maasstraat (no scale) (Architectenbureau Baanders & Stadsarchief Amsterdam, 1927).

2.2 De stolpboerderij, rural farmhouses in North-Holland

The previous chapter illustrates the gradual decline of timber-framed townhouses and the start of the long lasting tradition of timber-brick townhouses. In the rural areas however, the material-use in the construction of farmhouses was less susceptible to change. Where the application of timber frames largely came to a halt during the seventeenth century in Amsterdam, the introduction of the Stolpboerderij in rural North-Holland ‘simply’ ushered in a new kind of timber frame (van Tussenbroek, 2017). Often believed to have been ‘imported’ from Friesland, the Stolpboerderij started appearing in the landscape of North-Holland towards the end of the sixteenth and the beginning of the seventeenth century. Like the previously discussed Langhuisboerderij, the Stolpboerderij was still mostly geared towards animal husbandry. This typical pyramid-shaped farmhouse is however different, given that it houses all its functions in a very efficient manner under one big, largely symmetric, roof. The central square space, ‘de tasruimte’ (as seen in the isometric drawing in figure 15), was used to store hay. The lower surrounding spaces were used as stables and living areas for the farmers. Apart from the so often praised spatial efficiency, the prevalence of the Stolpboerderij might also be attributed to the smart way in which it dealt with the low bearing capacity of the subsoil (van Olst, 1991). It is the square timber frame (figures 14 and 17) that confines the building’s central space, consisting of four cross frames with shared posts, which supports the majority of the roof. Subsequently, it is this timber construction which asks for a strong foundation, whereas the low walls on the end of the roof often need very little to no foundation (van Olst, 1991).

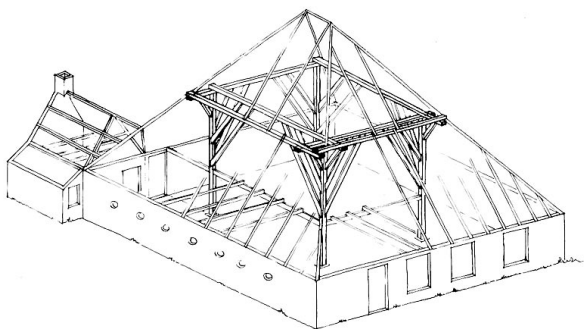


Fig. 14 Isometric projection of the common timber frame (Constructie Van Een Stolpboerderij, n.d.).

Like the timber used for the townhouses of Amsterdam, the main material used for the timber frame often came down to imported Scandinavian pine (Borghaerts, 2021). Conversely to the townhouses however, the timber used in the Stolpboerderij practically constitutes the whole load bearing construction and the minimal use of brick was often restricted to footings (figure 17) and sometimes side walls. Logically, this type of farm has known many sub-variants, with some having additional small building volumes (or tails) protruding from the square base. Towards the end of the nineteenth and the start of the twentieth century however, the many regional (and national) styles started disappearing, partially due to changes in farming practices, but also thanks to the housing act implemented in 1901 and the introduction of more modern materials. In this process, the large roles of the skilled carpenters and builders were constrained and partially taken over by architects (Lamberts et al., 2007).

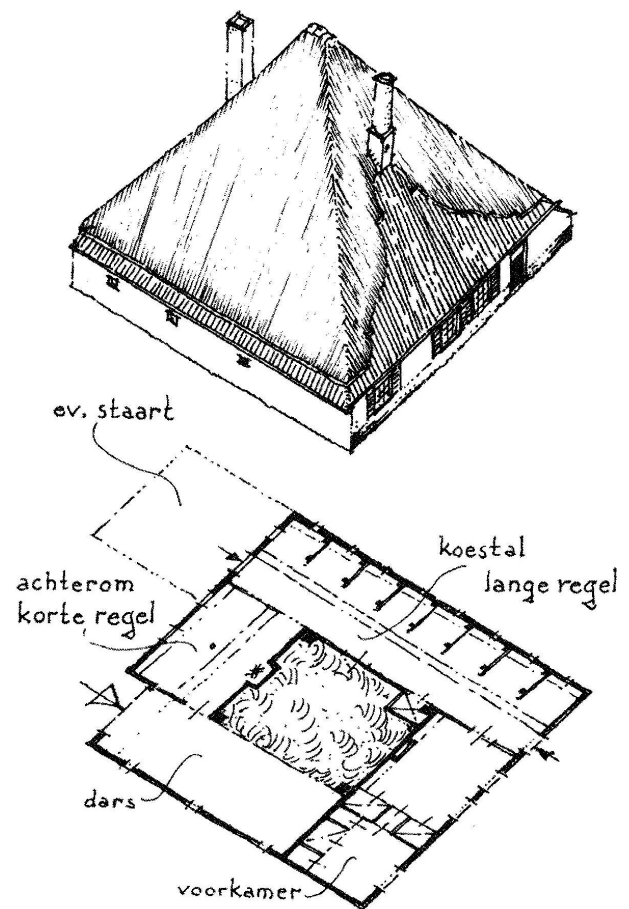


Fig. 15. Isometric projection and ground-floor plan (Noord-Hollandse normaalstolp, n.d.).



Fig. 16. Stolpboerderij and windmill in North-Holland (Pons et al., 1975).



Fig. 17. Remaining central timber frame and brick footings of an unknown Stolpboerderij (Dukker, 1986).

3. Post-WWII developments and new practices from 1940 - 2000

Whilst we concluded just before the start of the second world war in the previous chapter, this chapter illustrates the grave effects of the second world war and the subsequent societal and administrative changes in the country on its building practice. After WWII had come to an end in the Netherlands, two large enemies of a different nature still remained. These were both the housing shortage (Van Hoogstraten & De Vries, 2013, p. 19), and the unstable food production. Whereas a response to the housing shortage can be seen in the execution of the previously created Algemeen Uitbreidingsplan (General Enlargement plan) of Amsterdam, a physical manifestation of a dreaded possible future food shortage can be recognized in the construction of the Wederopbouwboerderijen (Reconstruction farms) in the rural areas. As Elpers (209, p. 9) states, more than nine thousand farms were destroyed in the Netherlands throughout WWII. This enormous destruction of dutch farms, in combination with the pursuit for more food security and a higher productivity through upscaling and mechanization, as pioneered by Sicco Mansholt (Mansholtcampus, 2021), led to a complete revolution in dutch farming, which is reflected in the construction and materialization of postwar farms. Through case studies of both urban and rural manifestations of postwar reconstruction in North-Holland, this chapter illustrates how construction practices and material use changed in a somewhat revolutionary fashion during the postwar reconstructions.

3.1 Postwar urban expansions

Even-though Amsterdam had seen relatively little wartime destruction of its building stock when compared to other cities, the housing shortage was immense and a large task was at hands. Helped by the fact that the Ministry of Public Housing and Reconstruction assumed responsibility for housing construction, the number of newly constructed dwellings per year nationally rose from 50,000 in the early 1950s to more than 150,000 twenty years later (Lintsen et al., 2018, p. 303). Many of these postwar neighborhoods are characterized by the aspiration to let in more light water and air into the neighborhoods through the emphasis on green and blue structures, reacting to the often overpopulated and dense neighborhoods of the pre-existing city (Wikipedia-bijdragers 3, 2023). This zeitgeist did not lead to a singular solution however, as different architectural interpretations with a similar goal in mind were realized. A well known and universally criticized example is the expansion of the Bijlmermeer, characterized by its modernist high rise dwellings amidst ample green space.

Another interesting example however, is the slightly older and lower Frankendaal neighborhood in Watergraafsmeer. This neighborhood consists of 792 duplex houses; consisting of two apartments stacked on top of each other that were to be combined when the housing shortage was over (Zijlstra, 2002). The way in which they were constructed is exemplary for the then prevalent industrialization of the construction process. The introduction of mass production and prefabrication was expected to lead to a cost-, work- and time reduction in the construction process (De Wederopbouw: Architectuur En Stedenbouw, n.d.). The 'new' construction-materials, being concrete and steel, which had previously mostly been used for small elements such as balconies and lintels (see chapter 2.1), now took up an important role in construction. The term 'system construction'¹⁵ is often associated with the dutch post-war reconstruction as more than 400.000 of dwellings constructed between 1950 en 1979 have been built using on of the many mass-produced systems (De Wederopbouw: Architectuur En Stedenbouw, n.d.). The section in figure 20 clearly illustrates this revolution in construction methods. In a substantial part of the Frankendaal neighborhood, the Dotremont-Ten Bosch was used; a system which is characterized by its use of notched concrete columns and beams as its main constructive elements as seen in figure 19 (Zijlstra, 2002). The use of timber was now quickly reduced to the fabrication of window frames and floor planks. Partially owing to the strong national coordination, dwellings were built at a rate previously unknown. Combined with the aforementioned revolution in construction practices and the creation of large infrastructural works, this led to an enormous increase in the yearly use of concrete and steel (figure 18) (Lintsen et al., 2018, p. 310).

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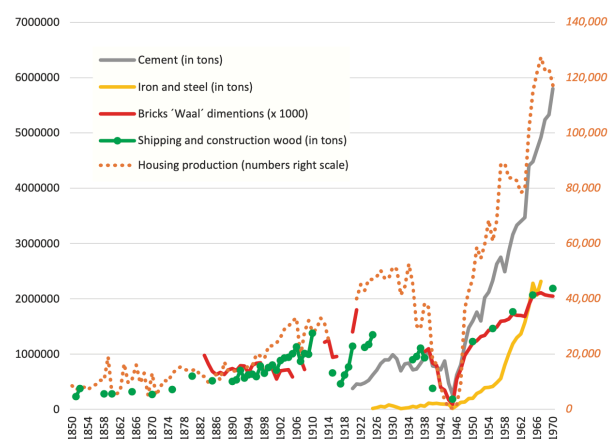


Fig. 18. Utilization of construction materials and housing production in the Netherlands, 1850–1970 (Lintsen et al., 2018, p. 311).

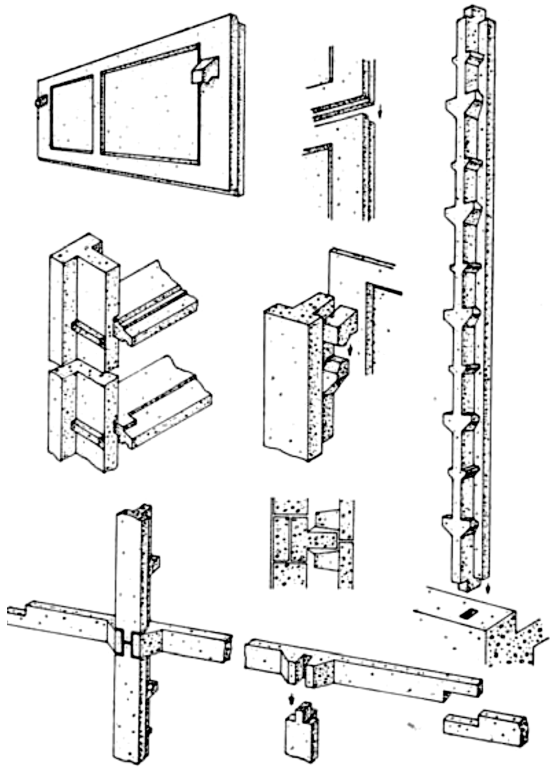


Fig. 19. Schematic drawings of the systemized construction elements as applied in the Frankendaal duplex houses (Kwantes, 1952).

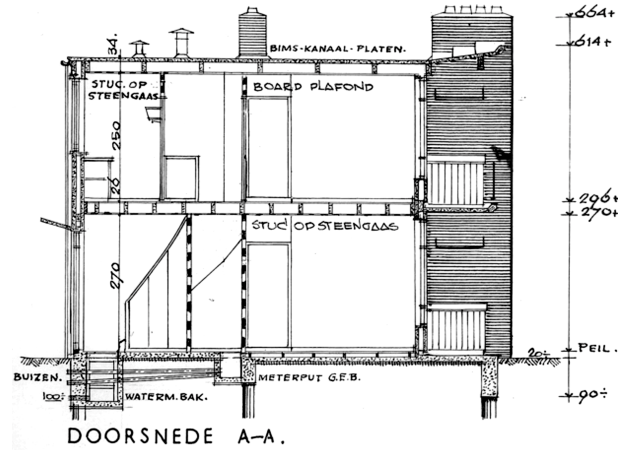


Fig. 20. Section by Merkelbach and Elling of Frankendaal duplex house (no scale) (NAi archive MELK, NM 8-002, 1949).



Fig. 21. A street in the Frankendaal neighborhood after its completion (Eesteren C., *Forum*, 1952).

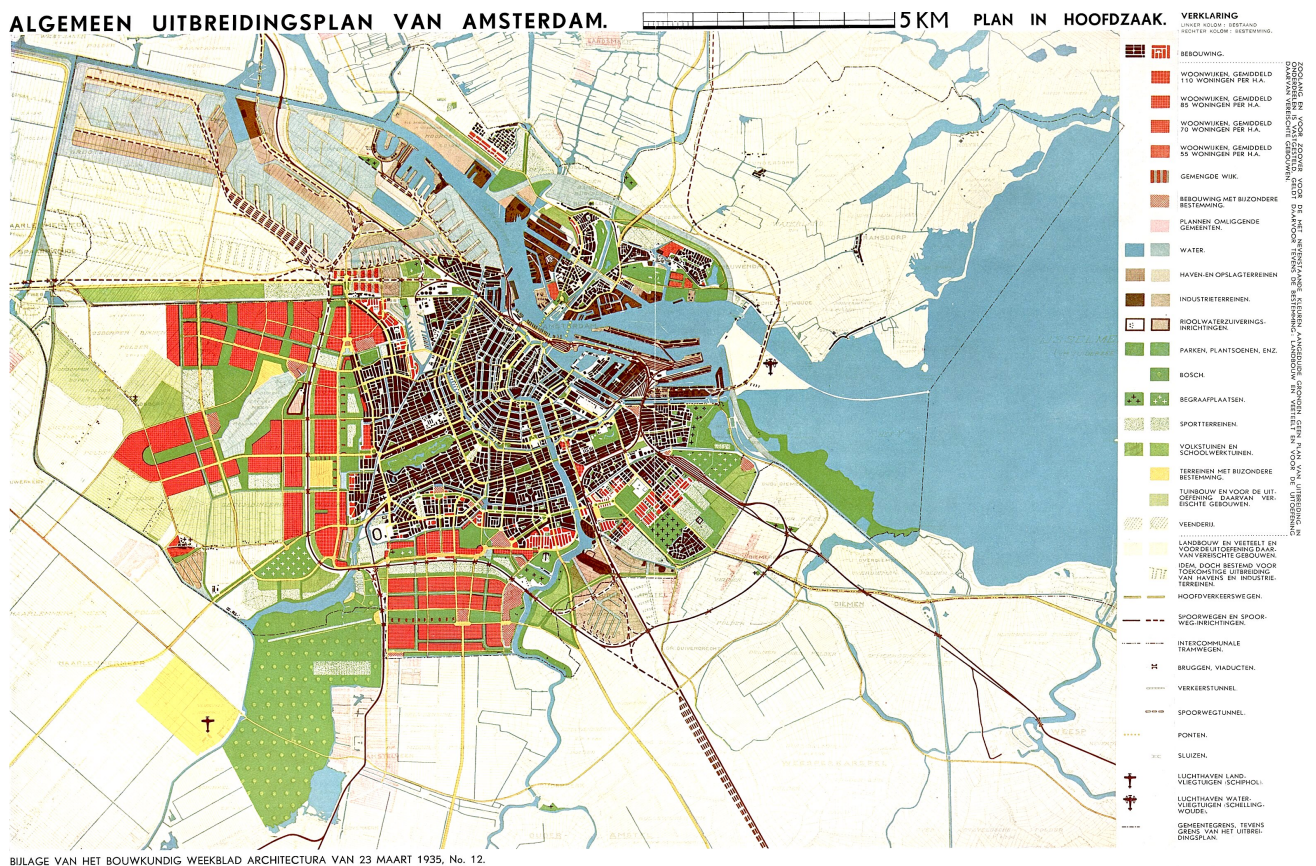


Fig. 22. Enlargement plan of Amsterdam, new neighborhoods in red (Eesteren & Stadsarchief Amsterdam, 1935).

3.2 Postwar farmhouses in North-Holland

The aforementioned sum total of over nine thousand dutch farms that were completely destroyed during the second world war, combined with the pursuit of more food security and a higher productivity, illustrates the then prevalent need to rebuild quickly and efficiently. Even-though rural North-Holland experienced less destruction than other provinces, with 311 destroyed and 193 heavily damaged farms (Lamberts et al., 2007), multiple typical examples of postwar farmhouses can be found in the area. The government backed BWB (Bureau Wederopbouw Boerderijen), established in 1940, was largely responsible for the reconstructions and thus greatly influenced the way in which many postwar farms were built. The process of land consolidation (Mansholtcampus, 2021) as pioneered by Mansholt however shouldn't be forgotten. This process not only led to a higher productivity, but also resulted in increasingly larger farms and a starkly different landscape, as many historical landscapes and irrigation systems were remodeled to adhere to this new way of farming .

Partially owing to the generally more conservative nature of the rural population however, the Delft's School, with its dedication to traditional architectural elements and material use, was popular at first. Still, towards the end of the 1940's, it was concluded by the BWB that due to the shortages in skilled laborers, traditional materials and monetary means, standardization and prefabrication were unavoidable (Lamberts et al., 2007). And thus, similarly to many of the postwar neighborhoods in Amsterdam, the rise of system-constructions and an industrialized building sector became prevalent throughout the country. An increasing proportion of these farms were constructed using precast concrete elements (Lintsen et al., 2018, p. 310). The concrete element gained popularity thanks to its durability, its strength, its relatively fireproof nature and its suitability for a high hygienic standard (Lamberts et al., 2007). Figure 23 illustrates this aptly. Whilst the architects of the Delft's School tried (and often succeeded) to refer and adhere to the many stylistic and organizational elements of the different historical regional farmhouses, the new functionalist farmhouses from the 1950's were often made up of different mono-functional building volumes and similarly constructed farms could be found throughout the whole country. Figure 24 shows an example of one of these 'split up' farmhouses, where the house, staples and the tasruimte (hay storage) are all divided into different building volumes. The farmhouses that arose in the Noord-oostpolder, although not in North-Holland, are rather illustrative for the move to more standardized construction in the 1950's.

Due to the fact that experiments with standardized farm construction were already made in this area before WWII (Elpers, 2019), it proved suitable to continue this trend by building standardized barns using 'shock concrete'¹⁶ and, laminated timber trusses (Figure 25). But the move towards standardization also settled in North-Holland. On the island of Texel for instance, 44 farms were rebuilt by the BWB after multiple weeks of heavy fighting in the spring of 1945. Despite working with brick and red tiles for the facades and roof respectively in order to hold on to some form of regionality (figure 28), the farms were constructed using shock concrete stable walls and windows and laminated timber trusses (Eelman, 2021). The laminated timber trusses were produced by Nemaho (a Dutch firm from Doetinchem) and, thanks to their high load bearing capacity, could span relatively far and wide, especially when compared to its predecessor; the timber cross frame. This allowed for ample open space to store the increasingly large agricultural machines.

Somewhat reminiscent of the way in which the timber frame survived much longer in rural North-Holland than in Amsterdam, it seems that even after WWII, or maybe actually because of it (Elpers, 2019), the appreciation for traditional and regional farmhouse construction remained in most provinces. Where the aforementioned revolution in urban construction practices and materials in Amsterdam commenced immediately after the war, rural North-Holland needed more time before being swayed by the believed benefits of upscaling, mechanization and standardization. Interestingly however, and regardless of the fact that these new farming methods are now believed to be rather unsustainable, the introduction of laminated timber trusses can be seen as an even bigger leap, concerning the fact that the use of engineered timber is now regarded by many as an important ingredient in our contemporary aim to built more sustainably (Ramage et al., 2017).

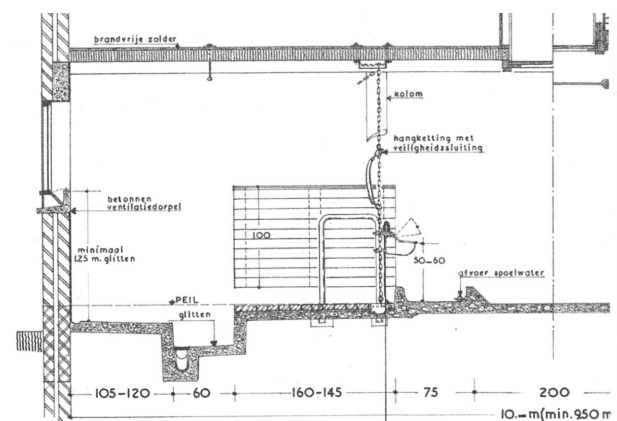


Fig. 23. Standardized section by the BWB (no scale) (Elpers, 2019).

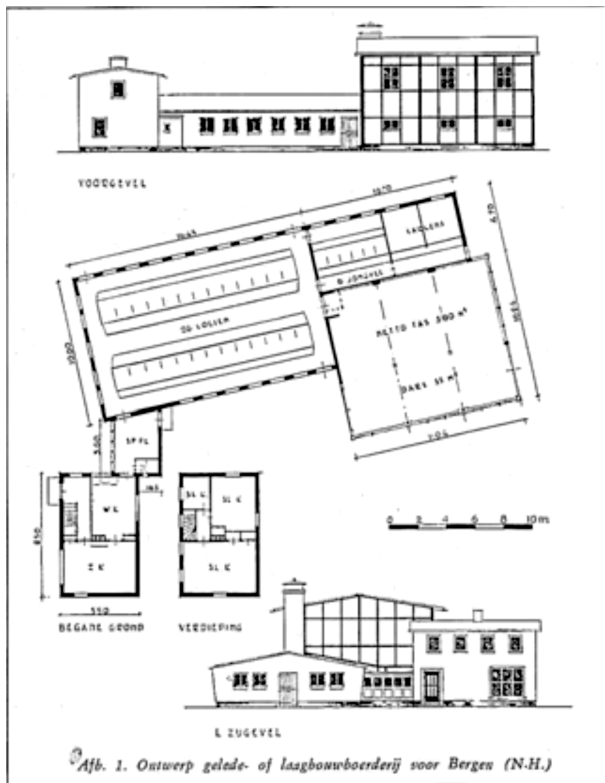


Fig. 24. Design for a farmhouse in Bergen (Lamberts, 2007).

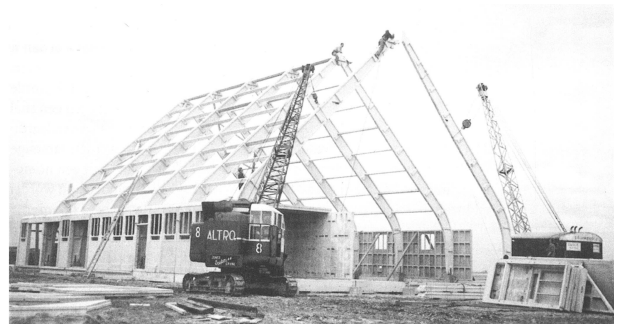


Fig. 25. Constructing a barn in the Noord-oostpolder (Elpers, 2019).

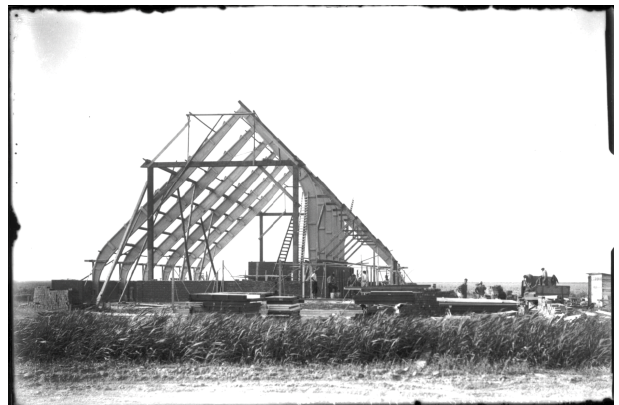


Fig. 26. Laminated timber truss construction on Texel (Eelman, 2021).



Fig. 28. Barn by the BWB on Texel from 1953, next to a house from 1910 that survived the war (Eelman, 2021).

Conclusion

As described in the introduction, this thesis sets out to give a concise overview of the role of timber as a construction material in our building practices in both Amsterdam and the rural landscape of what is now called North-Holland during the period between the roughly stated years of 1450 and 2000. At first glance, it becomes clear that the Netherlands, and North-Holland specifically possess a rich history of timber construction practices. From the completely timber-framed townhouses of Amsterdam to the notable pyramid-shaped Stolpboerderijen of the rural province, all (literally) building upon the same principle of the cross-frame as a staple element in the construction. Sometimes richly adorned by skilled carpenters, but often ‘just’ used for its excellent constructive properties.

Notably, the first substantial change in construction practices and material use in the researched period can be tied to multiple great city fires in Amsterdam at the end of the fifteenth century. Even though change came slow, these events did contribute to the slow disappearance of the timber-framed townhouses and the rise of the mixed timber-brick houses (as expressed in chapter 2.1) of Amsterdam. These timber-brick houses, in some form or another, were built well into the twentieth century. In the rural province however, where great city fires logically posed no threat, the construction of fully timber-framed farmhouses was kept alive and continued evolving for centuries more. The use of fired brick came slowly there, and often to a lesser extent when compared to Amsterdam.

After a long period of rather gradual change in construction practices and material use, the tragedy and aftermath of the second world war could be stated to have unleashed a true revolution in the construction industry (as it became one). This time the change did not confine itself to inside the borders of the cities however. Especially due to the great destruction of the rural country and its farms, combined with a strong new belief in upscaling and mechanization and the prevalent process of land consolidation, construction practices and material use changed drastically throughout the whole country.

It is clear that the large scale introduction of (reinforced) concrete and steel, be it in pre-fabricated system constructions or otherwise, has resulted in the emergence of completely different construction practices. With that, the use of timber often got relegated to smaller elements and the material no longer served an important role in the load bearing structures of dwellings in and outside of the city. This being said, some examples that have been shown in chapter 3.2 did actually rely on the use of engineered timber, hereby surprisingly enough already showing a move towards something that would nowadays be considered as a rather sustainable construction practice. These examples are however not truly representative for the large amount of farmhouses and barns that were constructed in the latter half of the twentieth century. Like figure 18 in chapter 3.1 shows, the leading materials in the construction industry most definitely were steel and concrete.

Lastly, given the fact that this research was partially conducted with our contemporary pursuit of sustainability in our construction practices in mind, it should be pointed out that building with timber cannot always be defined as being sustainable. As wood is a regenerative resource, the actual regeneration of the resource is crucial for its potential sustainability. This meaning that new trees should be planted and that production forestry should be managed in the right ways (Ramage et al., 2017). If this is not the case, building with timber can be accompanied by the destruction of existing forests, and with it crucial ecosystems. What has been reappearing throughout the chapters is the fact that after having cut down their own forests, the Dutch were reliant on imported timber. First from Germany and later from Scandinavia, eastern Europe and even America (Borghaerts, 2021). It is very likely that large amounts of this timber was not produced sustainably by today's standards, and we should therefore be somewhat weary of praise to our vernacular sustainable ways. Nevertheless, with our current knowledge on sustainable forestry management among others, one can still be inspired by the beautiful ways in which the people from North-Holland have used this precious resource to build their dwellings with.



Fig. 29. Image of a carpenter by Jan Luyken (1694). Rijksmuseum, RP-P-1936-458

Glossary

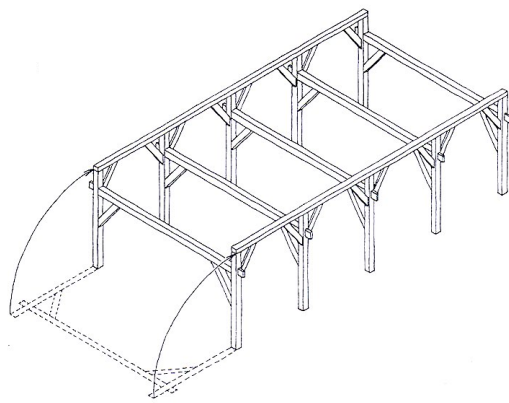
Translation of building terms

English

1. Cross frame
2. Post
3. Beam
4. Mortise and tenon joint
5. Brace
6. Sole plate
7. Truss
8. Principal
9. Rafter
10. Wind brace
11. Rail
12. Siding
13. Footing
14. Joist beam
15. System construction
16. Shock concrete

Dutch

1. Gebint
2. Stijl
3. Moerbalk
4. Pen en gat verbinding
5. Korbeel
6. Sleutelstuk
7. Juk
8. Jukbeen
9. Spoor
10. Windverband
11. Regel
12. Beschot
13. Poer
14. Kinderbalk
15. Systeembouw
16. Schokbeton



Bibliography:

- Amsterdam Cultuur-Historische Vereniging. (n.d.). Houten gevel (1200-1550), Amsterdam | www.amsterdamhv.nl. <https://www.amsterdamhv.nl/wiki/houten-gevel.html>
- Amsterdam Monumentenstad, database van de Amsterdamse grachtengordel. (2020, January). https://www.amsterdam-monumentenstad.nl/database/grachtenboek_tekst.php?id=18
- Amsterdam Monumentenstad, database van de Amsterdamse grachtengordel. (2020b, October). https://www.amsterdam-monumentenstad.nl/database/grachtenboek_objecten.php?id=2223
- Architectenbureau Baanders & Stadsarchief Amsterdam. (1927). Bouw van woonhuizen op 5 percelen aan de Maasstraat. Archief.Amsterdam. <https://archief.amsterdam/beeldbank/detail/c352a89b-235b-52e7-4a4a-7abdf328fce4>
- Berends, G. (1996). Historische houtconstructies in Nederland.
- Bleijjs, A. C. & Stadsarchief Amsterdam. (1883). Ontwerp voor het bouwen van een woonhuis aan het Droogbak hoek Buitenvisscherstraat No 13 te Amsterdam Archief.Amsterdam. <https://archief.amsterdam/beeldbank/detail/1e378009-666a-5f90-5f44-68f3bd426345>
- Borghaerts, P. (2021). Houtstromen. Bossen, binten en boerderijen. Noordboek.
- Creang, E., Ciotoiu, I., Gheorghiu, D., & Nash, G. (2010). Vernacular architecture as a model for contemporary design. Ecology and the Environment. <https://doi.org/10.2495/arc100141>
- Constructie van een stolpboerderij*. (n.d.). oud-castricum.nl. <https://www.oud-castricum.nl/categorie-activiteiten/nieuws/stolpen-geven-geheim-prijs/>
- Danckertsz, C. & Stadsarchief Amsterdam. (1678). Doorsnede en plattegrond van een stoepverdieping. Archief.Amsterdam. <https://archief.amsterdam/beeldbank/detail/225411d1-7644-ad65-459e-9ac921ba4045>
- De wederopbouw: architectuur en stedenbouw. (n.d.). Erfgoedhuis Zuid-Holland. <https://geschiedenisvanzuidholland.nl/verhalen/verhalen/de-wederopbouw-architectuur-en-stedenbouw/>
- Dukker, G.J. (1986). Overzicht restant boerderij. Beeldbank.cultureelerfgoed.nl. <https://beeldbank.cultureelerfgoed.nl/rce-mediabank/detail/ceec3075-6c03-45ff-4240-302a4385750c>
- Dukker, G.J. (1986). Extérieur detail houten vierkant. Beeldbank.cultureelerfgoed.nl. <https://beeldbank.cultureelerfgoed.nl/rce-mediabank/detail/db20394e-fab8-12d8-a55b-b21a7b788758>
- Eelman, W. (2021). De boerderijen van het Bureau Wederopbouw Boerderijen in polder Eierland op Texel. *Tijdschrift Voor Historische Geografie*, 6(3), 267–281. <https://doi.org/10.5117/thg2021.3.003.eelm>
- Eesteren, C.A. & Stadsarchief Amsterdam. (1935). Algemeen Uitbreidingsplan van Amsterdam. Archief.Amsterdam. <https://archief.amsterdam/beeldbank/detail/e62d2005-d01a-b141-04c0-b7b55f4b98fb>
- Elpers, S. (2019). Wederopbouwboerderijen: agrarisch erfgoed in de strijd over traditie en modernisering, 1940-1955. nai010 uitgevers.
- Glaudemans, R., & Smit, J. (n.d.). De houten stad. Het lange leven van het Amsterdamse houtskelet. <https://docplayer.nl/224810339-De-houten-stad-het-lange-leven-van-het-amsterdamse-houtskelet-ronald-glaudemans-en-os-smit.html#>
- Hooihuisboerderij*. (n.d.). www.boerderijstichting.nl. <https://www.boerderijstichting.nl/beeldbank/>
- Janse, H. (1989). Houten kappen in Nederland, 1000-1940. Delftse Universitaire Pers

- Lamberts, B. & Projectteam Wederopbouw van de Rijksdienst voor Archeologie, Cultuurlandschap en Monumenten. (2007). Boerderijen CATEGORIAAL ONDERZOEK WEDEROPBOUW 1940-1965. . <https://www.cultureelerfgoed.nl/publicaties/publicaties/2007/01/01/boerderijen-categoriaal-onderzoek-wederopbouw-1940-1965>
- Lintsen, H. W. (1993). Geschiedenis van de techniek in Nederland. De wording van een moderne samenleving 1800-1890. Deel III. https://www.dbnl.org/tekst/lint011gesc03_01/lint011gesc03_01_0012.php
- Lintsen, H., Veraart, F., Smits, J. P., & Grin, J. (2018). Well-being, Sustainability and Social Development. Springer. <https://doi.org/10.1007/978-3-319-76696-6>
- Mansholtcampus. (2021, April 10). Sicco Mansholt – Met ambitie naar een nieuw voedselsysteem. <https://www.mansholtcampus.nl/campus/mansholt/>
- Meischke, I. R. (1969). Het nederlandse woonhuis van 1300-1800.
- Meischke, R., Zantkuijl, H. J., Raue, W., & Rosenberg, P. T. E. E. (1995). Huizen in Nederland: Amsterdam. Waanders Uitgevers.
- Noord-Hollandse normaalstolp*. (n.d.). www.boerderijenstichting.nl. <https://www.boerderijenstichting.nl/beeldbank>
- Pons, L. J., Van Oosten, & Wageningen University. (1975, March). Soil map of The Netherlands. <https://library.wur.nl/WebQuery/edepot/380562>. <https://library.wur.nl/WebQuery/edepot/380562>
- Provincie Noord-Holland Archeologie - collectiesite. (n.d.). <https://collectie.huisvanhilde.nl/>
- Ramage, M. H., Burridge, H. C., Busse-Wicher, M., Fereday, G., Reynolds, T. M., Shah, D. U., Wu, G., Yu, L., Fleming, P., Densley-Tingley, D., Allwood, J. M., Dupree, P., Linden, P., & Scherman, O. A. (2017). The wood from the trees: The use of timber in construction. *Renewable & Sustainable Energy Reviews*, 68, 333–359. <https://doi.org/10.1016/j.rser.2016.09.107>
- Rijksdienst voor het Cultureel Erfgoed. (2015). Vier eeuwen boeren: Synthese Oogst voor Malta onderzoek: Archeologische sporen van boerderijen en erven 1250-1650. In <https://www.cultureelerfgoed.nl> (No. 49).
- Schoonenberg, W. (n.d.). *Sleutelstuk met peerkraalmotief*. www.amsterdam-monumentenstad.nl. https://www.amsterdam-monumentenstad.nl/database/grachtenboek_objecten.php?id=2223
- Stenvert, R., & Tussenbroek, G. (2007). *Inleiding in de bouwhistorie* (1st ed.). Stichting Bouwhistorie Nederland.
- Uilkema, K. & Zuiderzeemuseum (n.d.). Boerderij. Beeldbank.cultureelerfgoed.nl. <https://beeldbank.cultureelerfgoed.nl/zuiderzeemuseum/detail/dbb13a9e-e051-5b1b-9082-592e4d3ba410>
- Unknown & Zuiderzeemuseum (n.d.). Langhuisstelpboerderij. Beeldbank.cultureelerfgoed.nl. <https://beeldbank.cultureelerfgoed.nl/zuiderzeemuseum/detail/a06121ea-4eda-5087-a95b-9d6a88170c26>
- Van Hoogstraten, D., & De Vries, B. (2013). Monumenten van de wederopbouw Nederland 1940-1965. nai010 uitgevers.
- van der Lugt, P. (2021). Houtbouwmythes ontkracht: het onderscheid tussen fabels en feiten. Amsterdam Institute for Advanced Metropolitan Solutions (AMS).
- van Olst, E.L. (1991). Uilkema, een historisch boerderij-onderzoek. Boerderij-onderzoek in Nederland 1914-1934. Deel 1. https://www.dbnl.org/tekst/olst003uilk02_01/olst003uilk02_01_0012.php#831

van Tussenbroek, G. (2010). De datering van het Houten Huys op het Begijnhof. Nieuwe gegevens over het “oudste” huis van Amsterdam. *Amstelodamum*, 97(4). <https://www.bouwhistorie.nl/wp-content/uploads/2021/08/De-datering-van-het-Houten-Huys-op-het-Begijnhof-Van-Tussenbroek-2010.pdf>

van Tussenbroek, G. (2017). Timber-framed Town Houses in the Northern Netherlands Before 1600. Construction and Geographical Distribution. *Vernacular Architecture*, 48(1), 44–62. <https://doi.org/10.1080/03055477.2017.1375843>

vernacular architecture. (n.d.). Oxford Reference. <https://www.oxfordreference.com/display/10.1093/oi/authority.20110803115517898;jsessionid=A15C875669603DFDB9CC7B913E31CD04>

Wikipedia-bijdragers 1. (2023, March 30). *Hallenhuisboerderij*. Wikipedia. <https://nl.wikipedia.org/wiki/Hallenhuisboerderij>

Wikipedia-bijdragers 2. (2023, March 8). *Geschiedenis van Amsterdam*. Wikipedia. https://nl.wikipedia.org/wiki/Geschiedenis_van_Amsterdam

Wikipedia-bijdragers 3 (2023, March 23). *Algemeen Uitbreidingsplan*. Wikipedia. https://nl.wikipedia.org/wiki/Algemeen_Uitbreidingsplan

Zijlstra, H. (2002). Woonwijk Frankendaal Watergraafsmeer Amsterdam. Bouwtechnisch onderzoek. Delft University of Technology.