

More than a node

The dynamic between public transportation and urban development of
The Hague from 1840s to 1940s



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Abstract

Until 1840, The Hague was a relatively small city. However, by 1920 its population had grown to 350,000—five times larger than in 1840—marking its transformation into a modern city. This significant growth coincided with major transportation developments, the construction of two main train stations in 1843 and 1871, and the inauguration of the first horse-drawn tram line in 1864. This thesis investigates whether and how these transportation advancements influenced the rapid expansion of the city.

A mapping analysis was conducted to trace urban changes from 1843 to 1940, spanning the opening of the Hollands Spoor station to the stagnation brought by World War II. This analysis reveals key developments: the disappearance of canals, the extension of the tram line to Scheveningen, significant northwestward expansion, the emergence of industrial zones around Hollands Spoor, and the spatial limitations created by the railway line. Chapter 5 further explores the relationship between these transformations and the transportation system.

The study shows that trains and trams had differing impacts. The railway acted as a physical barrier, slowing development in areas behind the station, while the tram system facilitated uneven urban growth, particularly toward the northwest. This was largely due to the high cost of public transport, which initially served only the upper class. As a result, affluent areas remained relatively stable, while working-class populations settled near the industrial zones surrounding the stations.

These outcomes reflect multiple historical and geographical factors. The rise of industrial zones was influenced by the Second Industrial Revolution, while the choice to locate stations in peat areas also shaped urban development. While results may differ in other geographic contexts, this thesis stresses the importance of considering multiple factors, economic, social, and environmental, when planning transportation infrastructure.

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1. Introduction

1.1 Research purpose

The Hague was a small-sized city with less than 70.000 people until 1840, when the population grew by no more than 30.000 in the past fifty years. Nevertheless, it had a rapid expansion and grew into a modern city with a population of 350.000 in 1920. This considerable transition could be discovered in the words of historians. The American historian Motley described The Hague in 1853 as “The Hague is mild, stagnant, elegant, drowsy, tranquil, clean, umbrageous little capital smothered in foliage, buried in an ancient forest, with the downs thrown up by the North Sea surging all round it, and the ocean rolling beyond.” However, only half a century later, another American was amazed by the elegant suburbs, the trams, and the growth in general: “During the last fifty years, The Hague has grown far beyond the ratio of most Dutch cities.” (Stokvis, P. R. D., 1987) Intriguingly, the two main stations in The Hague were built in 1843 and 1871, which matches the initial time of the rapid urban expansion of The Hague. However, the merger of these two stations never happened, and it has had a great influence on this area. Therefore, this research aims to discover the influence of the public transport system on the making of modern The Hague, and the research questions are established as follows:

How do public transport systems influence the urban expansion of The Hague in the era of railroad dominance?

With the following sub-questions:

- Do railway systems encourage or stop the development of adjacent areas, and how do stations encourage or block expansion?
- Do public transportation systems encourage people to move between different districts, therefore promote the interaction between classes?

1.2 Methodology

Background knowledge is first discussed, including the condition of The Hague in the 17th century, before the emergence of the first train station. The history of trains and trams is also explored, for a better understanding of the public transport system development in The Hague, and to define the research area.

Mapping analysis

The research methodology mainly focuses on mapping analysis. Through comparisons between a series of chosen historical maps, several major changes after the emergence of the transportation system through time are expected to be defined. Further relevant literature research and archival materials will be explored after defining the significant changes.

The mapping analysis focused on the evolution of the area during different periods, highlighting key features such as train and tram lines, waterways and built areas including stations, landmarks, and housing developments.

A detailed exploration of the major transitions, relevant built-up areas and their economic and social conditions is conducted after the mapping analysis, to reveal the interplay between train and tram infrastructure and the urban environment. This is done by analyzing literature and historical photographs of the city.

Chosen research period

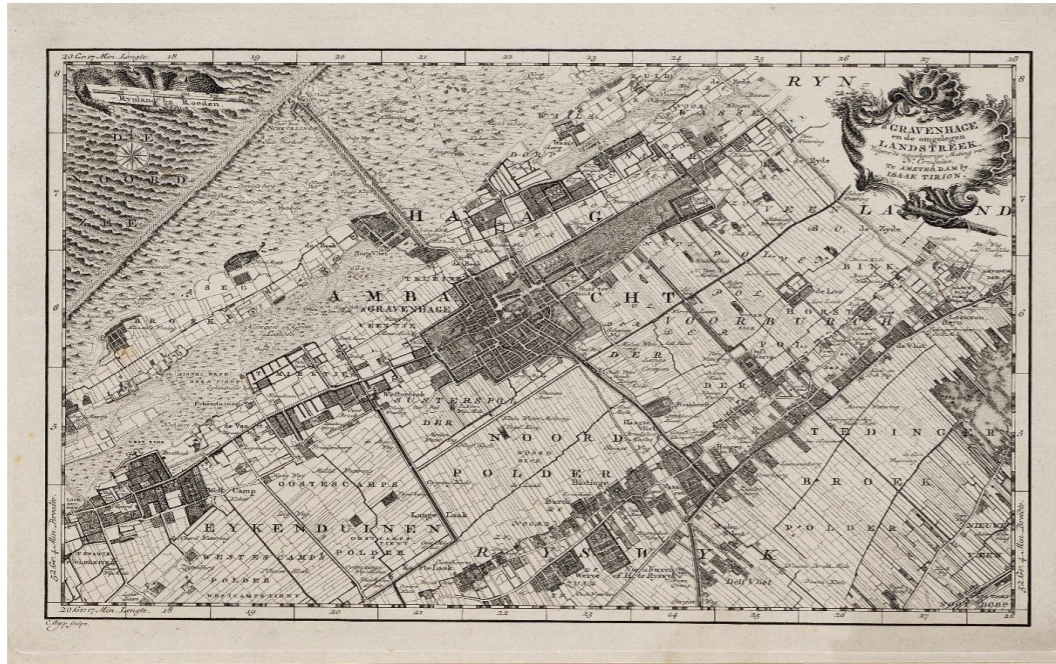
The chosen period is from 1843 to 1940. The former marks the inauguration of The Hague Hollands Spoor station, while the latter signifies the stagnation caused by World War II, providing a rich timeline for understanding the city's transformation.

2. The Hague before the railway

Before the arrival of the train, much of The Hague's urban development revolved around the canals. In this 1757 map (Fig. 5.), several elements that define The Hague's characters can be seen.

Fig. 2-1

The map of The Hague and the surrounding areas (1757)



Developments only occurred inside the canals

The urban development of The Hague in this period remained confined within the surrounding canals (singels) completed in around 1617. Although the city experienced significant population growth in the beginning of 18th century, for example, the population surged from 42,000 in 1815 to 70,000 in 1850, there was no noticeable expansion of the city.

The reason for this might be that most industries at that time were related to the BuitenHof and the government, therefore, the predominant economic and social centers were located around BuitenHof, which attracted people to gather there. Even within the canals, there remained a considerable amount of space, and there was no notable residential expansion beyond the canals. (Stal, K., 1998)

Settlements on the beach ridges and higher sands

The development of towns and settlements is closely related to the terrain, with communities growing in response to the landscape. The Hague has a typical dune landscape, with raised dunes surrounded by peat. The peat is wet and unsuitable for building roads and houses, therefore, people settled along the long, narrow dunes, constructing infrastructures and houses on the dry, sandy land.

Canal systems are the main transportation

Due to the transportation of goods, The Hague opened several canals and docks during the 15th and 16th centuries. These canals and docks were used to transport products such as timber, sand, peat, vegetables, and meat. The canals also acquired names corresponding to the products they carried, such as Bierkade.

As for passengers, transport by barge was reasonably comfortable compared to transport by road and did not make much difference in speed. The roads were mostly bumpy sand roads, which turned into a mud road in unpleasant weather. The mode of transport changed little since the arrival of the barge in the 17th century and the wagon in the 18th century. It was only with the arrival of the train that major changes occurred. (Havelaar, K., 2017)

3. History of tram and train

3.1 Train history

Fig. 3-1

Map of 1870 showing the location of the stations (mark in orange)



Station Hollands Spoor:

The arrival of the first steam train in December 1843, in The Hague, attracted a lot of attention. This is an extension of the first railway line in the Netherlands, connecting The Hague with Haarlem and Amsterdam.

Since railways have to be built with a gentle curve, stations were usually built on the edge or outside the built-up areas. At that time, the surrounding area was still far outside the city on the territory of Rijswijk. The site is at a distance from the built-up area, but it is close to Rijswijkseweg and the Trekvljet. The station was connected to the city center by the extension of Wagenstraat. A bridge was built on the Trekvljet, which would always be open and only closed when the train was approaching. (Havelaar, K., 2017).

The original station building was built in 1843 and was replaced in 1891 by a new building in the Neo-Renaissance style designed by architect Dirk Margadant, which is still in use today.

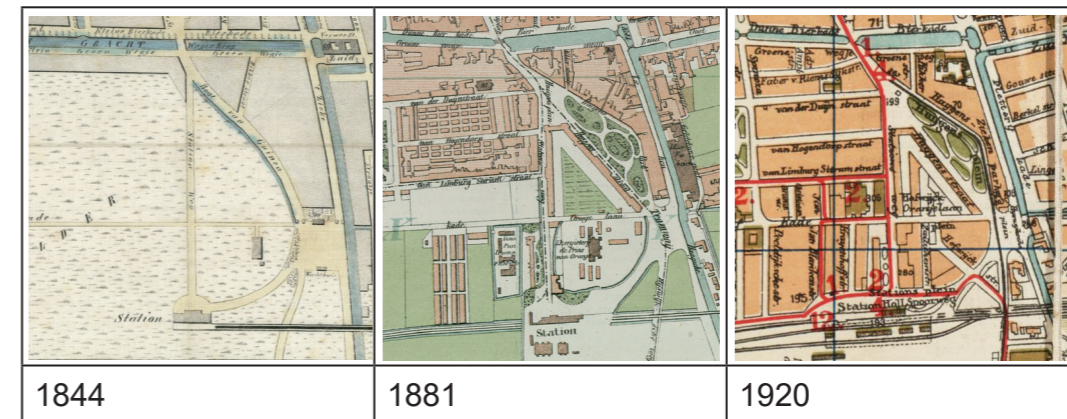


Fig. 3-2, 3-3, 3-4
The transition of the surrounding area

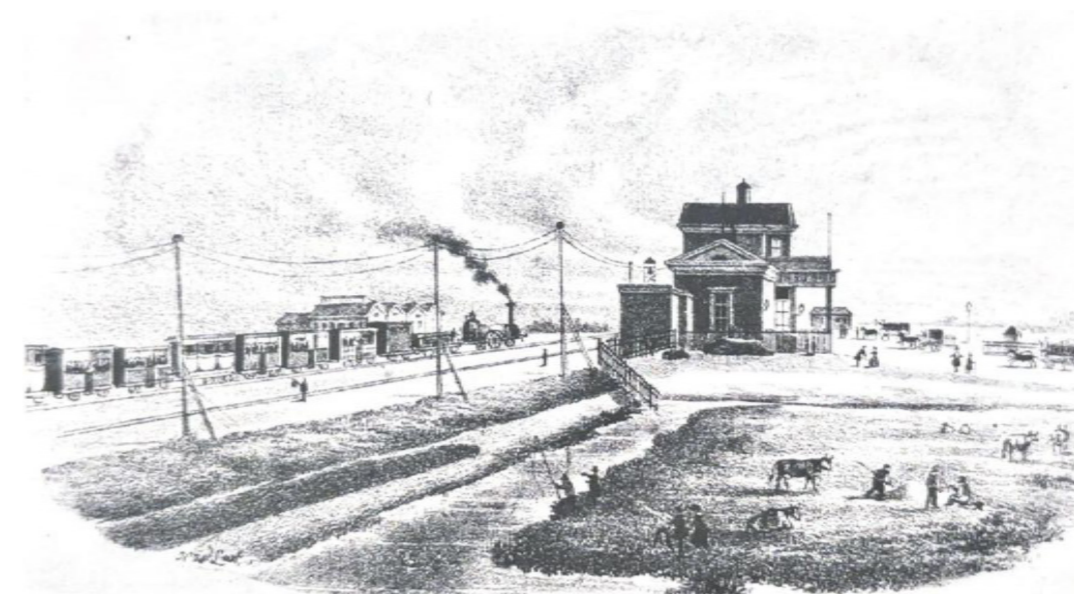


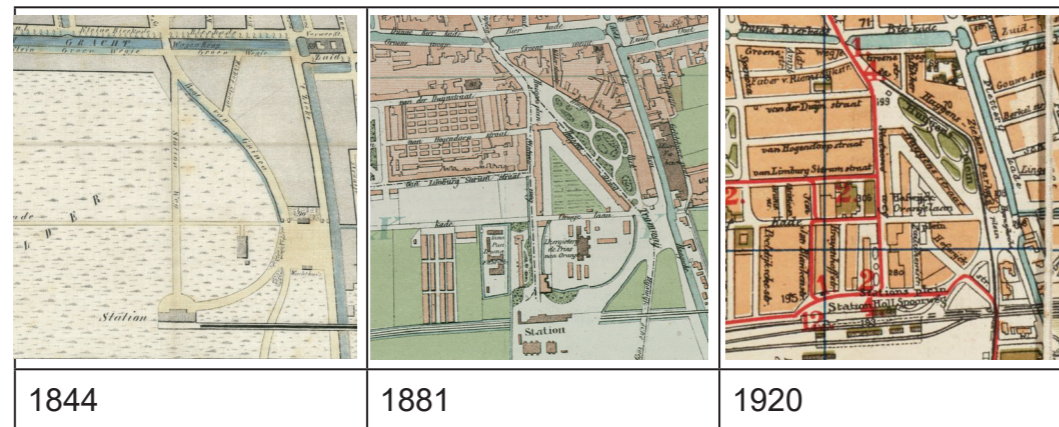
Fig. 3-5
The first station of The Hague in rural area

Station Staatsspoor:

The station Staatsspoor opened in 1870, it was named as Rihijnspoor at that time. The station is operated by a different company from Station Hollands Spoor, and the site was chosen to be close to the city center, but had the possibility to connect the train line to Schveningen.

In 1871, a railway connection between these two station sites was opened. The single-track link is the first cooperation between the rival NRS and HSM. This track was not originally used for passenger transportation, but only for cargo transportation and equipment exchange. On 26 May 1896, the connecting track opened for regular passenger service. However the service was discontinued in 1909 due to the lack of passengers. It was not until 1975 that these two stations were permanently connected, but never merged.

Fig. 3-2, 3-3, 3-4
The transition of the surrounding area



3.2 A comparison of two station site

Site	Den Haag Hollands Spoor (HS)	Den Haag Centraal
Former name	-	Den Haag Rijnspoor Den Haag Staatsspoor
Opened Time	1843	1870
Initial operating companies	Hollandsche IJzeren Spoorweg-Maatschappij (HIJSM or HSM)	Nederlandsche Rhijnspoorweg-Maatschappij (NRS) : 1870-1890 Staatsspoorwegen (SS): 1890-
Connected to	Amsterdam and Rotterdam	Gouda and Utrecht
Distance to city center	1.5km to Binnenhof	1km to Binnenhof
Rebuild	1891	1973 opened, 1976 completed

3.3 Tram history

In 1864, the inauguration of the first horse-drawn tram line opened, which ran from de Plaats to the Badhuis in Scheveningen. Just two years later, in 1866, the first intercity horse tram line in the Netherlands connected The Hague and Delft. This line started from Huygensplein, near the Holland Spoor station, and later adopted steam tram technology in 1887, further modernizing the transport system.

By 1879, The Hague introduced its first steam tram line, which operated between Rhijnspoor and the Badhuis in Scheveningen. This line was operated by NRS, which was the company that built the Station Rhijnspoor, therefore this line was built to replace the unimplemented train line. In 1890, the first electric tram was operated between Plein and Scheveningen. Multiple tram lines were developed after this and laid the foundation of the public transport system.



Fig. 3-6
The first day of tram operation at Gevers Deynootplein

4. Changes in surrounding areas

4.1 The chosen of historical maps

This chapter attempts to interpret and organize the impact of the train and tram systems on the entire city structure through maps. A series of maps is chosen for the mapping.

The dashed line shows the range of the surrounding canals and gives an impression of the scale of different maps. Maps in different periods have a significant different in the range they covered, therefore there will be three different range chosen for the mapping analysis.

For map of 1844 and 1858, a range that is slightly bigger than the surrounding canals are chosen. For map of 1870 and 1890, the range is a bit broader. Lastly for map of 1904, 1920, 1940, the range cover Scheveningen and Laak to show the rapid expansion in these periods.

Fig. 4-1
Map of 1844
Fig. 4-2
Map of 1858

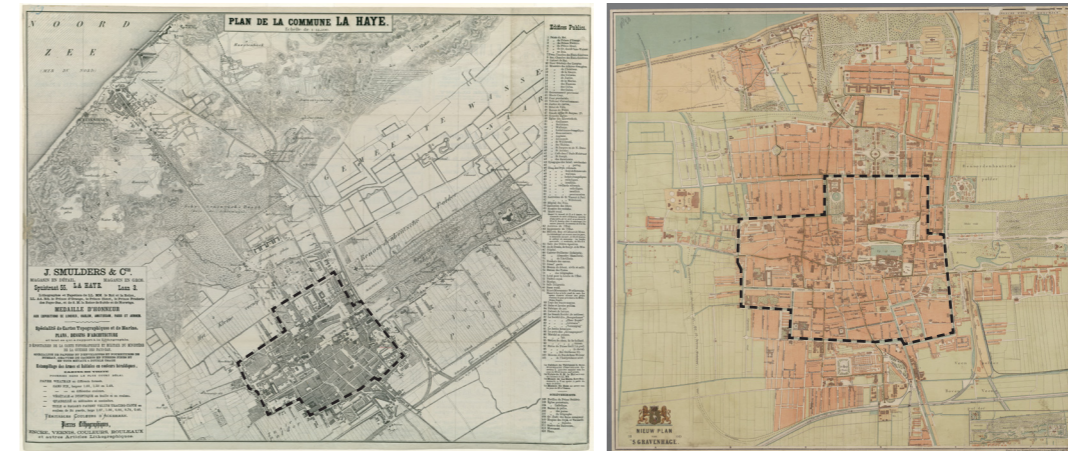
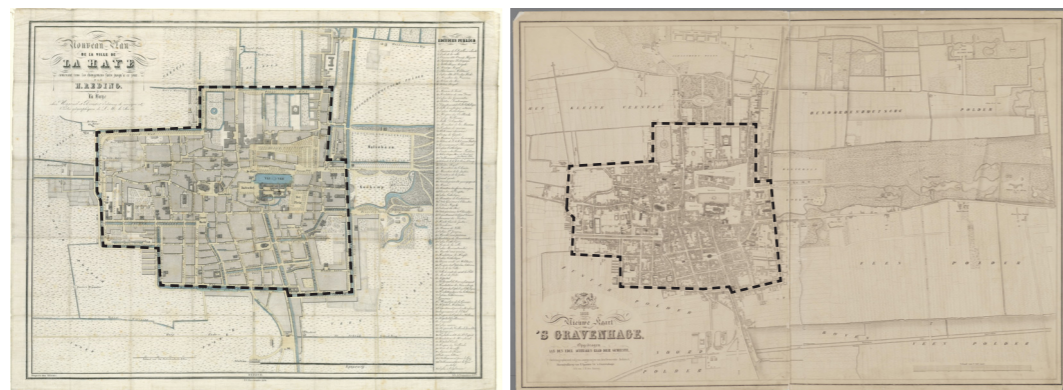


Fig. 4-3
Map of 1870
Fig. 4-4
Map of 1890

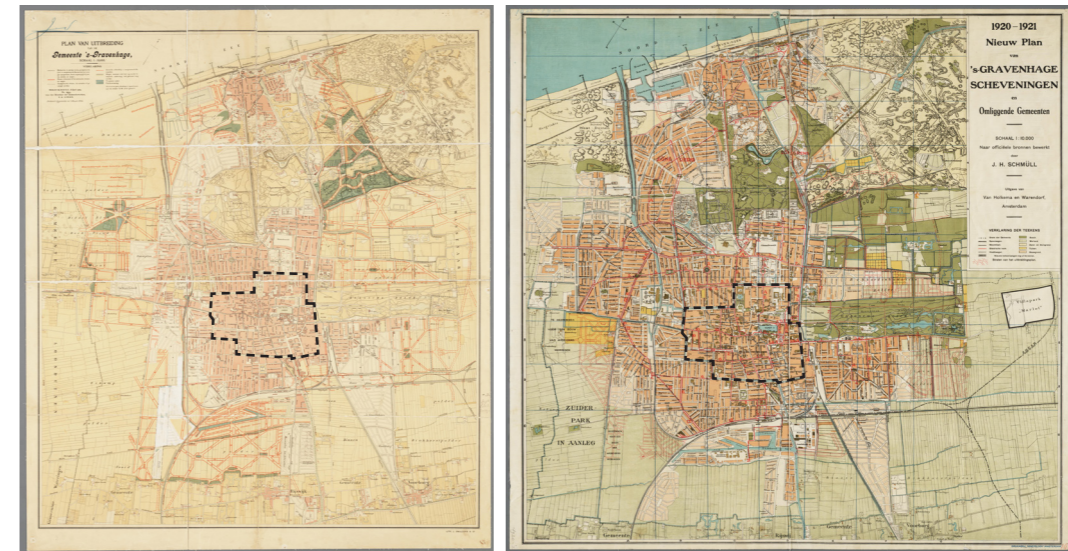


Fig. 4-5
Map of 1904
Fig. 4-6
Map of 1920

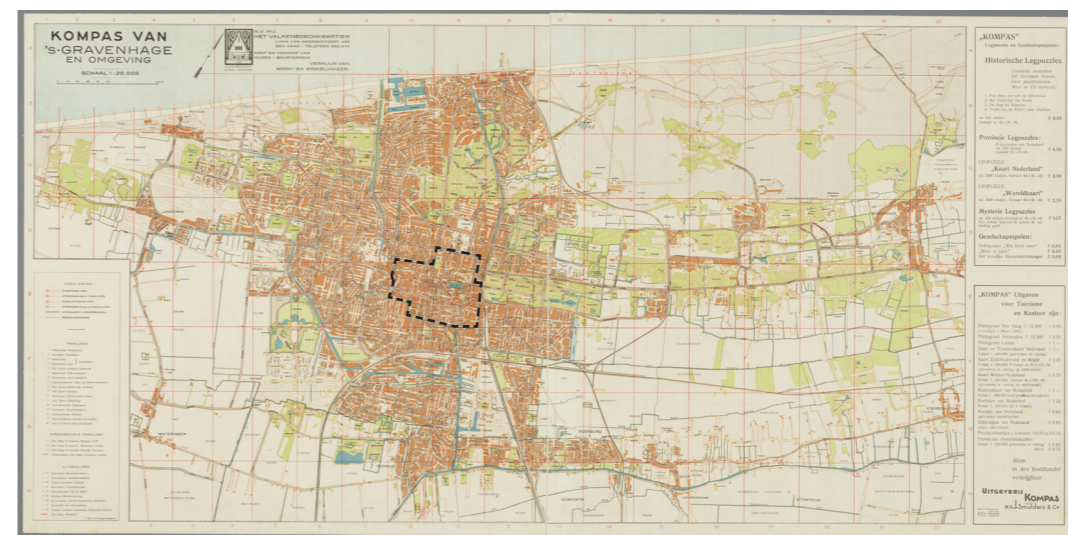


Fig. 4-7
Map of 1940

4.1 Mapping analysis from 1844-1940

The black dashed lines represent the train tracks, the blue dashed lines indicate the tram routes, and the light blue represents canals and water bodies. The orange color denotes the built-up area, while the station buildings are highlighted in red.

The new station was opened in 1843, and from the 1844 map, it can be seen that the railway tracks had not yet extended to Delft. In the changes from 1843 to 1858, it is evident that the city had not expanded to the south but instead began the development of Willemspark (1857-1861) in the northern, sandy area. As for the canals within the city, it is also notable that Fluwelen Burgwal and Heeren Gracht were filled in. There were also some developments in front of the HS station, but away from the city center.

The significant changes from 1858 to 1870 were marked by the opening of the Staatsspoor station in 1870. However, there were no major changes near the station, and it had not yet impacted the area. While growth was slow, by 1890, the area behind the station, Bezuidenhout, began to show gradual development, but at a pace slower than other parts of the city center.

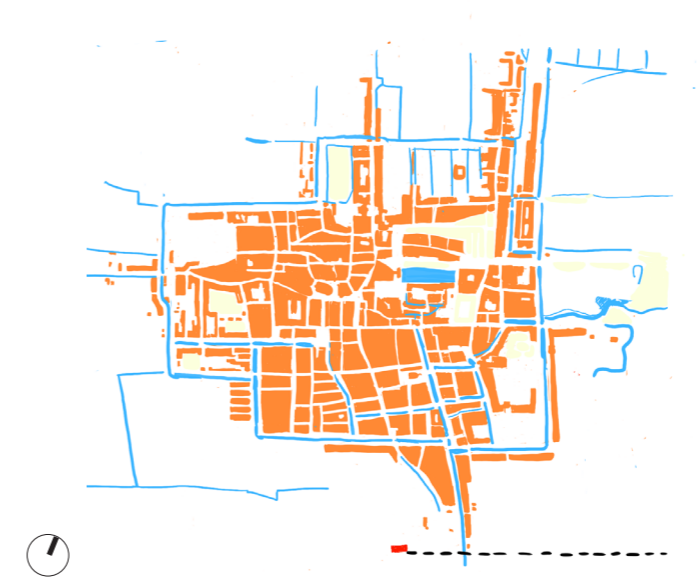


Fig. 4-8

Map of 1844

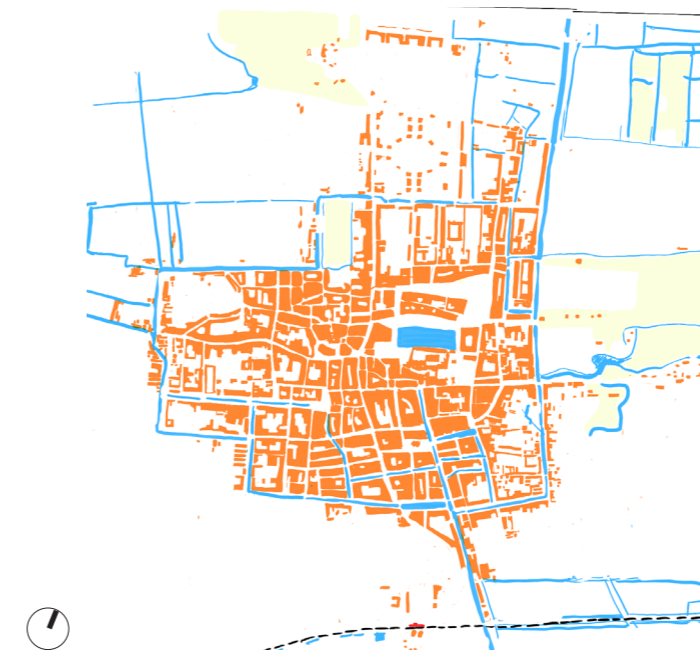
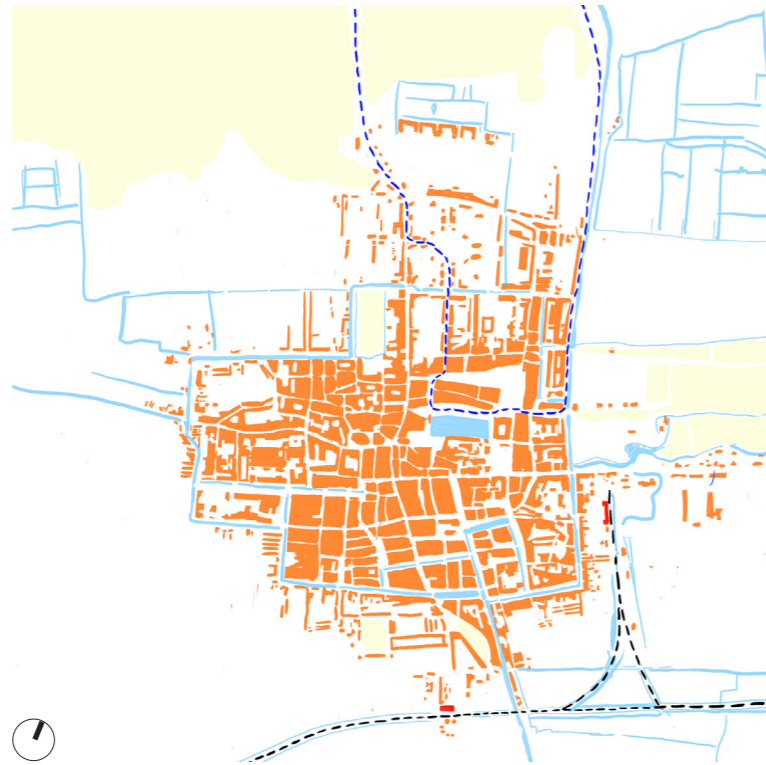


Fig. 4-9

Map of 1858

Fig. 4-10

Map of 1870

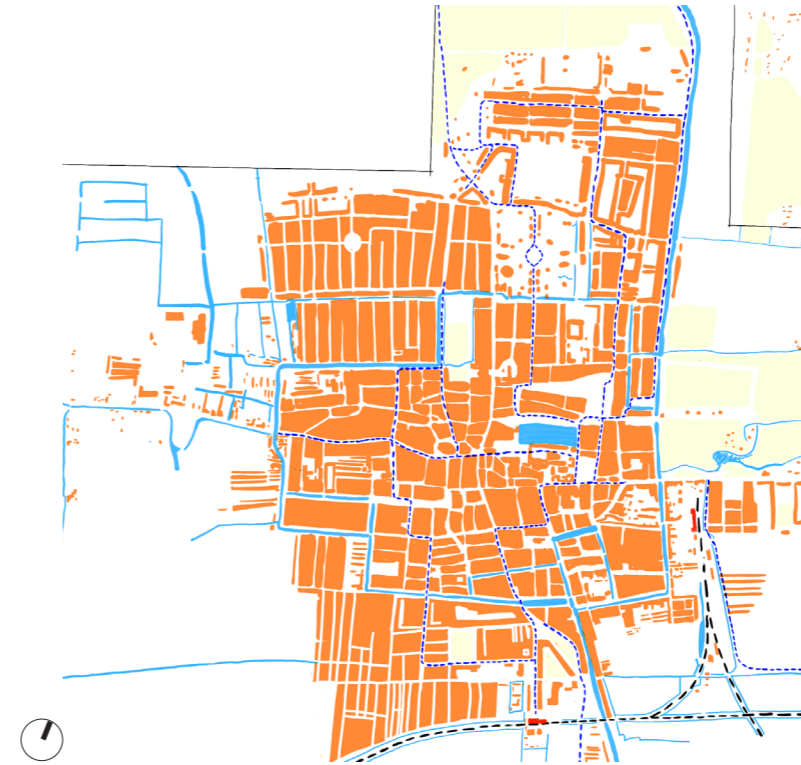


In terms of urban development, maps from 1890 clearly show that the city expanded beyond the canals. On the southeast side, the development of the Stationsbuurt began in 1861, and Schilderswijk gradually developed starting in 1875. On the northwest side, the Zeeheldenkwartier was built between 1870 and 1890, and the Archipelbuurt was developed from 1869 to 1889. On the other side of the railway tracks, along the tramline to Delft (now Rijswiksweg), scattered residential developments also began to emerge.

Another significant breakthrough during this period was the introduction of the first horse-drawn tram in 1864. The tram line extended along the canal to Scheveningen, providing a faster means of transport from the city center to Scheveningen, replacing the slower waterway transport. It is important to note that the primary focus of this tram route was to extend to Scheveningen, rather than to serve the growing population on the south

Fig. 4-11

Map of 1890



side of the city center. Furthermore, the tram routes within the city had not yet intersected with the railway lines at this time, suggesting that the service primarily catered to the wealthier classes around the BinnenHof area.

By 1890, several tram lines originating from the Holland Spoor station began to appear, winding through the city center. Some of these lines also extended into the newly developed residential areas.

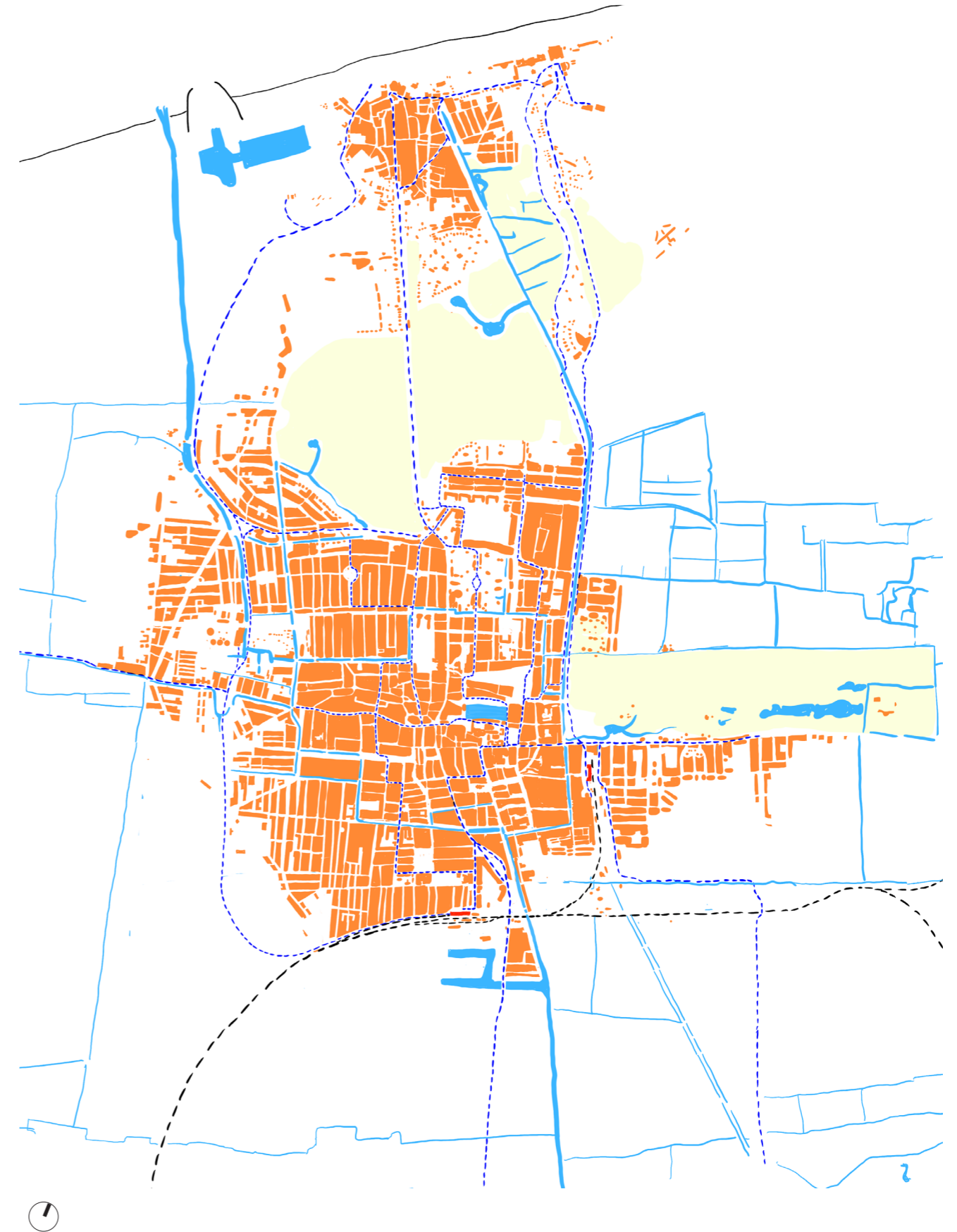
In terms of the canals, Schedeldoekshaven, Ammuntiehaven, Paviljoensgracht were all filled in by 1870. By 1890, Lutherse Burgwal, parts of Spui, and Prinsengracht were also gradually filled in. Among these, only Heerengracht had a tram line passing through, while the others were retained as roads.

From this 1904 municipal map, it is clear that the city's expansion was halted at the edge of the railway tracks. In the 1890 map, development on both the north and south sides of the singels was relatively balanced. However, by the 1904 map, the city had rapidly expanded to the northwest, with tram routes extending towards Scheveningen. The Duinoord area on the northwest side was completed between 1892 and 1902, while the Regentessekwartier was built from 1885 to 1910. The Bezuidenhout area was expanded after 1895 based on Lindo's expansion plan. (Koopmans, B., 1994)

In terms of the canals, Stille Veerkade, Amsterdamse Veerkade, Spui, Turfmarkt, and Prinsengracht were all closed. From this point onward, the layout of the old canals in the city center became largely like the current layout. Also, by this time, the Laak area's port had already started to take shape.

Fig. 4-12

Map of 1904



The present-day Binckhorst area was incorporated into The Hague in 1907 and began developing into an industrial zone. For a long time, this area was separated from the city center of The Hague by the railway tracks, requiring one to cross the tracks from the city center to reach it. It was also separated from the Laak area by the Trekvliet, thus remaining largely undeveloped area for an extended period.

In terms of urban development, new residential areas began to develop along the tram routes of 1904. These areas, located relatively far from the train stations, relied on tram lines to connect to the city center. Notable developments include the Statenkwartier, built between 1900 and 1915 on the northwest side, and the Volkenboskwartier, constructed between 1903 and 1925. On the other side of the railway tracks, along the tramline to Delft, more residential developments had emerged. In 1906, the port project for the Laak area was initiated. In 1940 expansion in all directions had been developed.

Fig. 4-13

Map of 1920

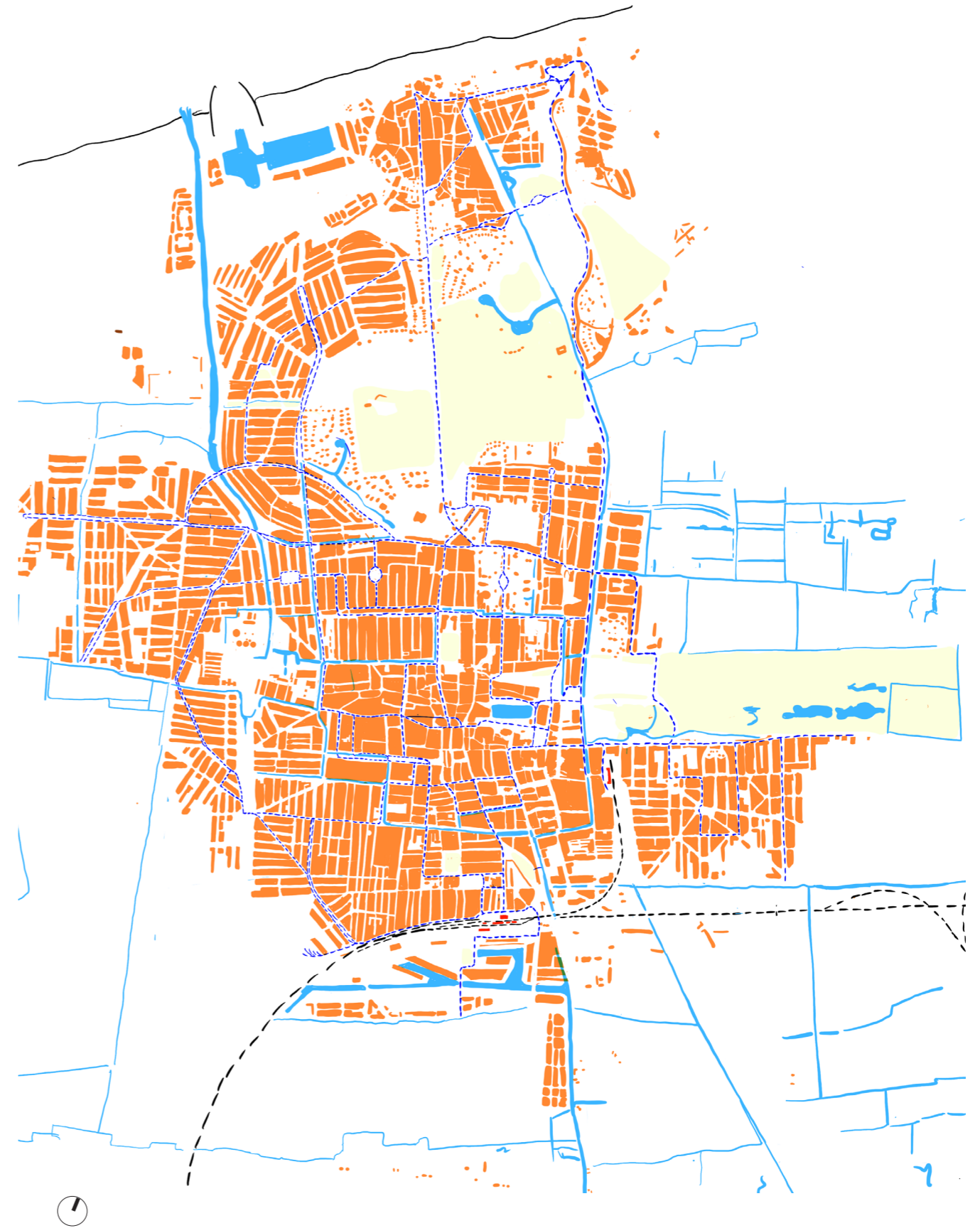
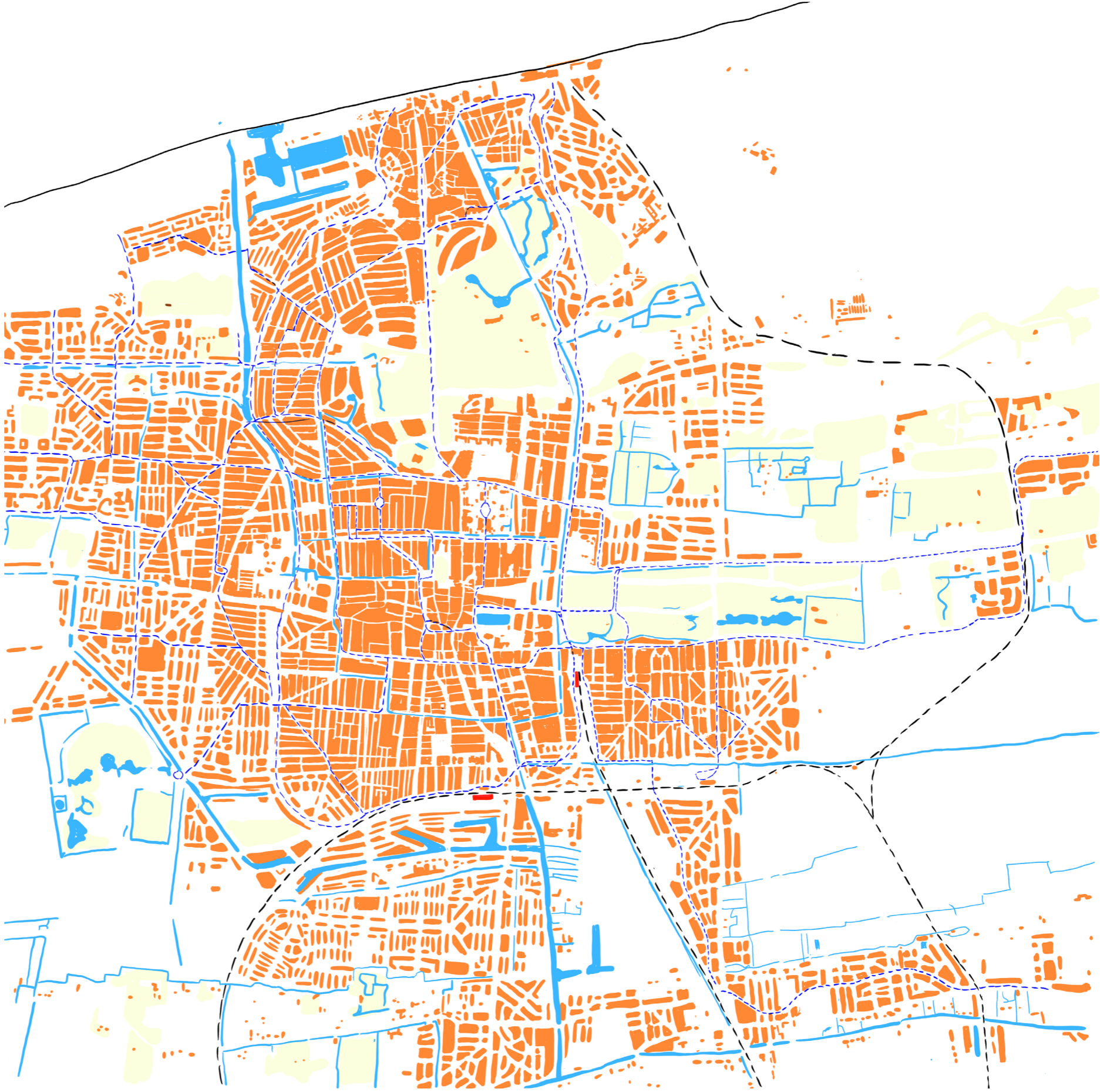


Fig. 4-14

Map of 1940



5. Impacts of train and tram

5.1 Disappearance of the canals

From the previous chapter, in 1860-1900, canals around The Hague disappeared one by one. The reason for the closing canals was a consequence of unpleasant sanitary conditions around the canals; however, part of the reason is also due to the function of the canals being replaced by the train and tram line. In terms of passenger transportation, a network of wagon barges and wagons was popular before the arrival of the train. Intercity passenger transport was traditionally provided by cheap but slow barges, which took 8 hours from The Hague to Amsterdam. From 1815, the wagon took 5 and a half hours to complete the same journey. However, the train was too strong to compete with, which only took 4 hours for the same distance. (Stokvis, P. R. D., 1987) Around 1875, most wagon barges had been discontinued. (Havelaar, K., 2017) After the disappearance of the canals, some of the filled-in areas were made for the wider road for the tram line to pass through.

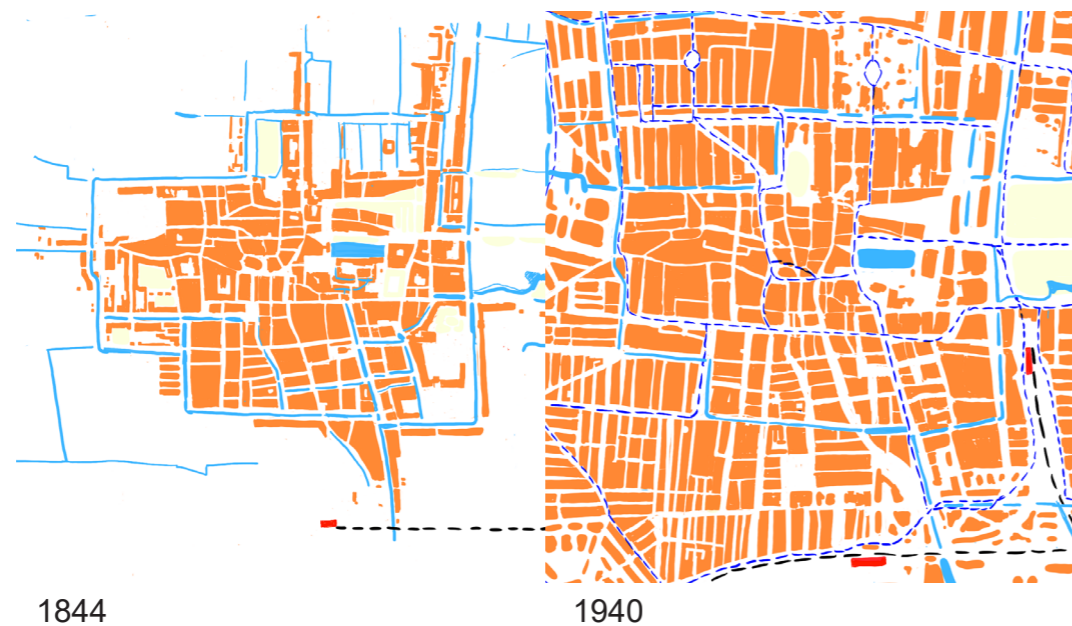


Fig. 5-1
Canals in the city center disappeared

5.2 The thriving of Scheveningen

Scheveningen grew into a fashionable seaside resort and gained international attention around 1900. After the tram connection to the city center was constructed, the large hotels were built at a rapid pace. Train and tram line systems help to bring people to the beach resort and the surrounding residential areas. (Koopmans, B., 1994)



Fig. 5-2
Hague horse tram (1865)

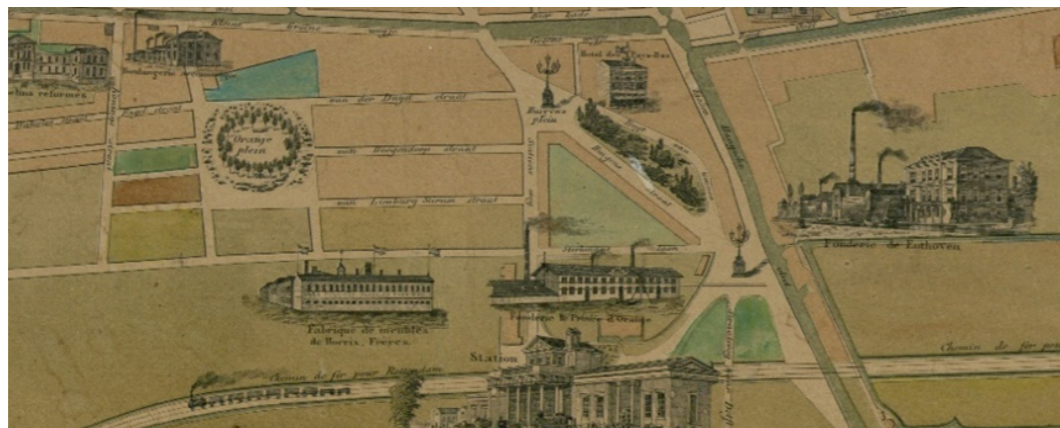
This figure shows the first horse-drawn tram in The Hague, namely the imperial carriage no. 2 of the Dutch Tramway Company (1864-1867, route Kneuterdijk-Stedelijk Badhuis Scheveningen) on its way to Scheveningen along the Scheveningseweg. Left is a view of the Buitenhof and right is a view along the coast from the Keizerstraat near the beach.

5.3 Industrial area and worker housing

For a long time, the front area of the HS station was occupied by two large factories in The Hague. This was rather an odd situation compared to the modern city, in which the area in front of the train station would be considered the core of the city. However, the train was operated by a private company, and the site was chosen to be away from the city center. The two factories were shown in Fig. 5-3, which were De Prins van Oranje and Meubelfabriek Anna Paulowna.

Fig. 5-3

The factories in front of the HS station (1867)



De Prins van Oranje (1840-1897) was an iron foundry established by Albert Sterkman in 1840. It was the second iron factory in The Hague after that of Enthoven & Co. Sterkman's company was located on the Stationsweg, with 575 employees in 1868, and was closed in 1897. The Anna Paulowna (1850-1890) was a furniture factory established on the Hoefkade in 1850 by the Horrix brothers. The Horrix brothers were among the most important furniture manufacturers in the Netherlands in the 19th century. Their furniture factory 'Anna Paulowna' was the largest in the Netherlands and the first to use a steam engine. However, the production of the furniture was still largely manual work. The factory had 266 employees in 1873 and closed in 1890.

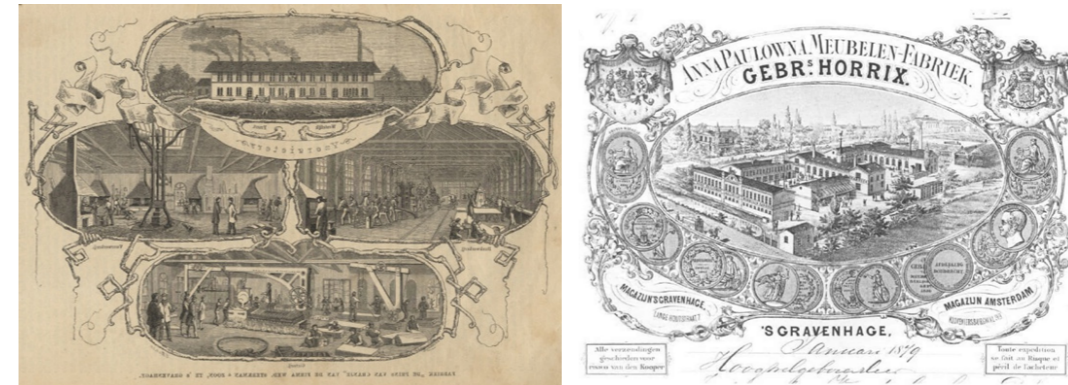


Fig. 5-4

The factory and various interior images of the iron foundry De Prins van Oranje

Fig. 5-5

Lange Houtstraat 7; Anna Paulowna Meubelen-Fabriek van Gebr.'s Horrix



Fig. 5-6

The Rijswijkseplein in 1903. In the front, a dock with a crane was for unloading the cargos from Leiden and Delft. In the background, the chimney of Enthoven metal factory is shown.

Stationsbuurt and Schilderswijk: worker housing

Workers and servants hardly used public transport for commuting since the tram tickets were too expensive for working class before 1904. To save travel costs, workers continued to live as close to the workplace as possible. (Stokvis, P. R. D., 1987) Several worker housings were built near the factories and the station, such as the Rode Dorp (1874) in Stationsbuurt.



Fig. 5-7

The Rode Dorp

Hofjeswoningen

The Hofjeswoningen (courtyard houses) is a type of housing that consists of small houses in the courtyard and can be divided into three categories: charity courtyards, workers' courtyards, and social housing courtyards. In the middle of the nineteenth century, exploitation courtyards were built for the growing population. This happened especially in the second half of the nineteenth century, when large groups of workers moved to the cities because of the industrial revolution and sought housing there. These courtyards were in inner courtyards and were invisible from the street. At that time, no permit was required for building this type of housing, therefore, this was a low-cost construction methods to make a profit. However, the quality of the housing was ignored since the demand was always higher than the supply.

Fig. 5-8

Courtyards on
Vuurbaakstraat and
Drogersdijk



The map of 1895 shows approximately 9500 courtyard houses in over 700 courtyards. In 1890 and 1900, almost 40000 workers lived in the courtyards, respectively 71 and 56% of the entire working population. (Stokvis, P. R. D.,1987) Within the canal, most courtyards were in the

area around Westeinde and the Spuikwartier, and outside of it in the Stationsbuurt, Schilderswijk, Zeeheldenkwartier and Scheveningen. The construction of courtyards was already considered in the street plans. For example, in the Schilderswijk district, the streets were planned at a distance from each other so that there was enough space for courtyard houses. It was not until the implementation of Building and Housing Regulations in 1901 that the construction of houses in the inner courtyards was completely prohibited. (Koopmans, 2015)

5.4 Intensification of differences between “zand en veen”

Interaction between social classes

The Hague has a long history of having people from different social classes living in different areas. The wealthy preferred to live on the dry sand in the Northwest, and the workers could only stay on the peat land in the Southeast. However, the arrival of the station changed this situation. The railway brought people from different social classes to The Hague, businessmen, teachers, factory workers, and made here a more diverse city.

The division remained due to the trams

The first expansion of the period studied is Willemspark, which is a residential project mainly with individual villas, intended for the wealthy. The following expansion is the Stationsbuurt, which was meant to attract middle- and upper-class residents with the mansions built here. This could also be verified through the construction of Oranjeplein (1863), since the leisure park at that time was meant for the upper class. At this point, the development of the northwest and southeast seemed to be balanced. However, the industrial activity had traditionally been concentrated in the southeast, first near the canals that were connected to the Vliet, and later

around the Holland Spoor Station. The activities that attracted workers were experienced as a nuisance by the wealthy. The damp peat soil, the proximity of workers' courtyards and the concentration of workshops drove the established middle-class away. (Stokvis, P. R. D.,1987)

Fig. 5-9

Map of elevation of The Hague from the construction plan of Duinoord 1896

From this map, the lowest level of the city is clear shown, and indicated the desired place to live is on the north east of the city.

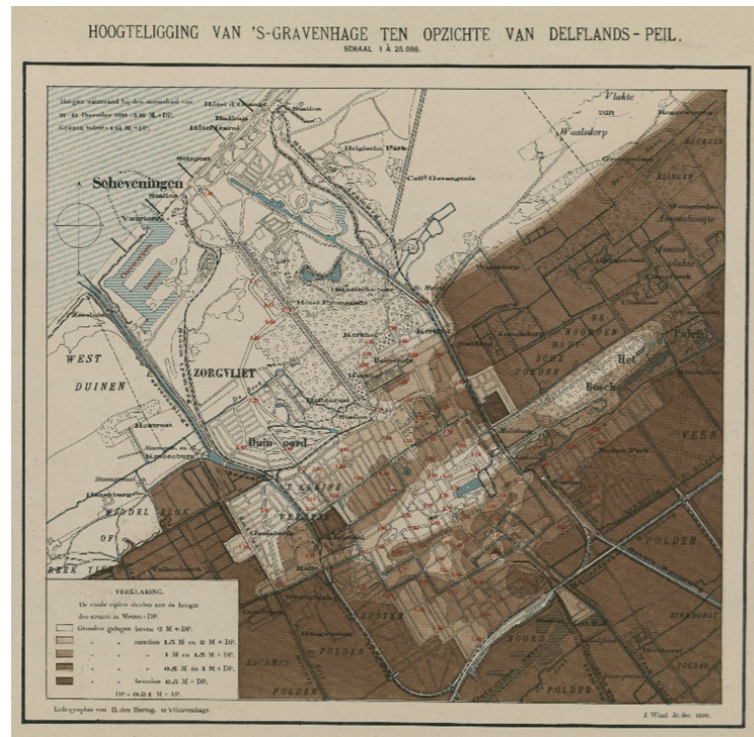
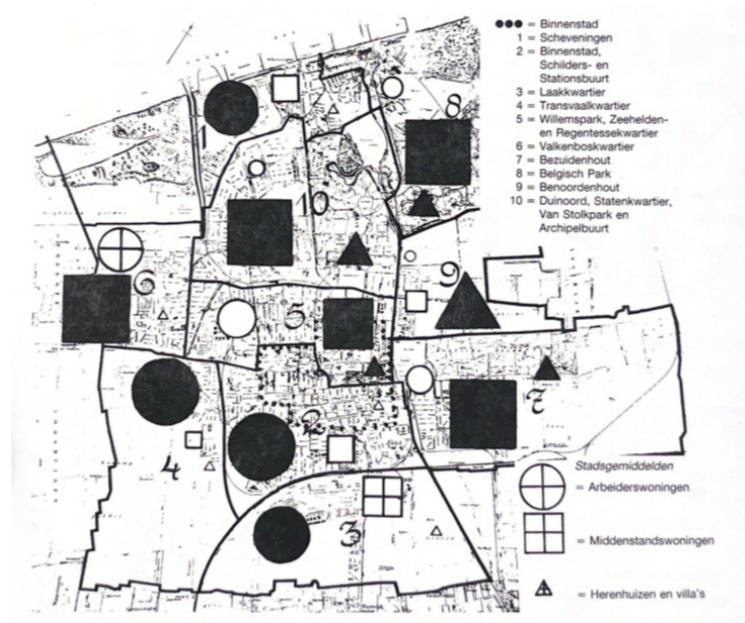


Fig. 5-10

The relative concentration of workers' housing, middle-class housing and mansions of each area



Moreover, citizens who could afford a daily return trip by tram could live further away from the workplace. Therefore, the expansion of the tram network encouraged the emergence of socially homogeneous suburbs after 1890. As shown in Fig. 5-10, mansions and villas were most strongly seen in area 9,10,8,7 and 5. While workers' housings dominated in area 4,2,1 and 3.

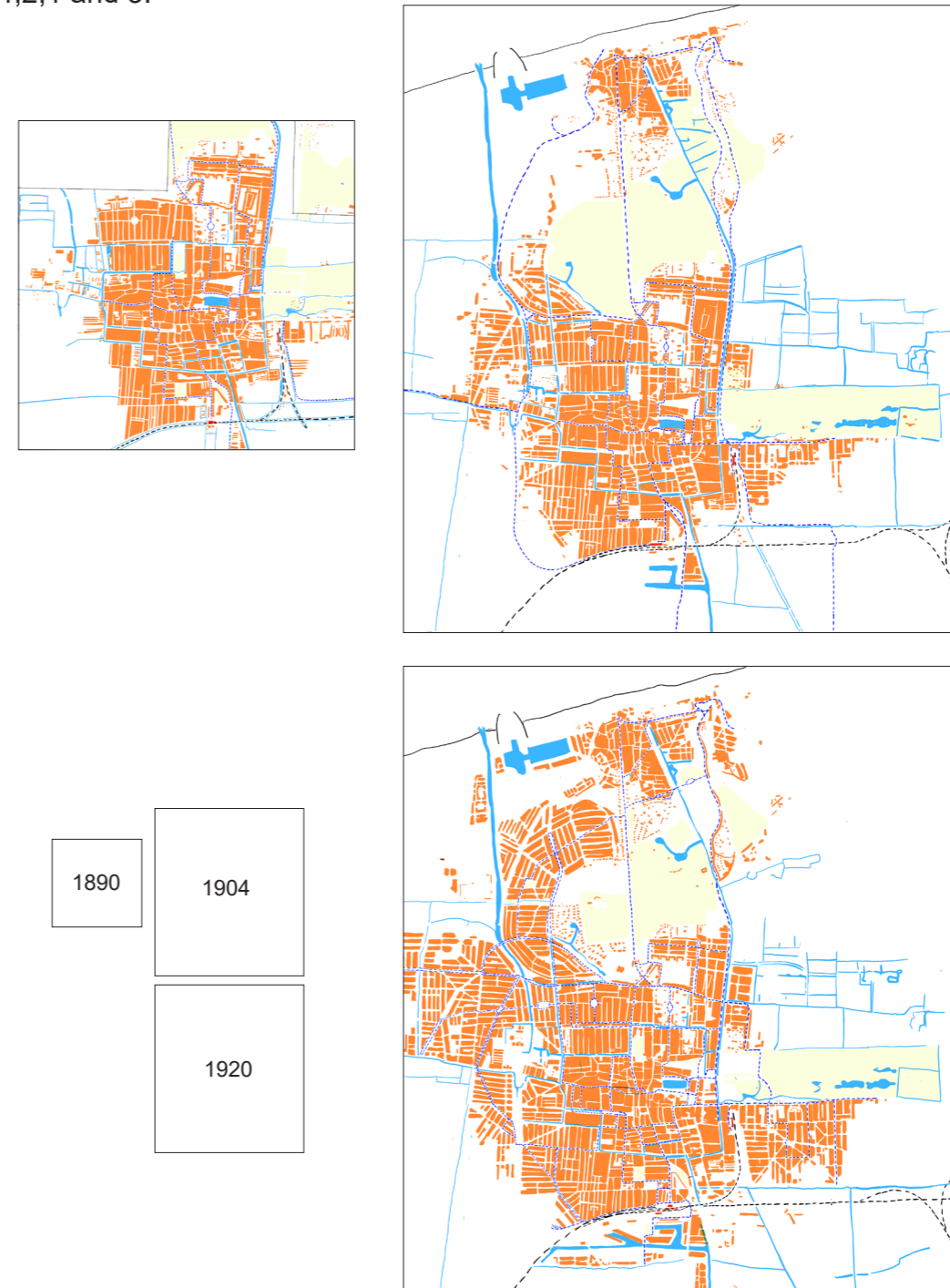


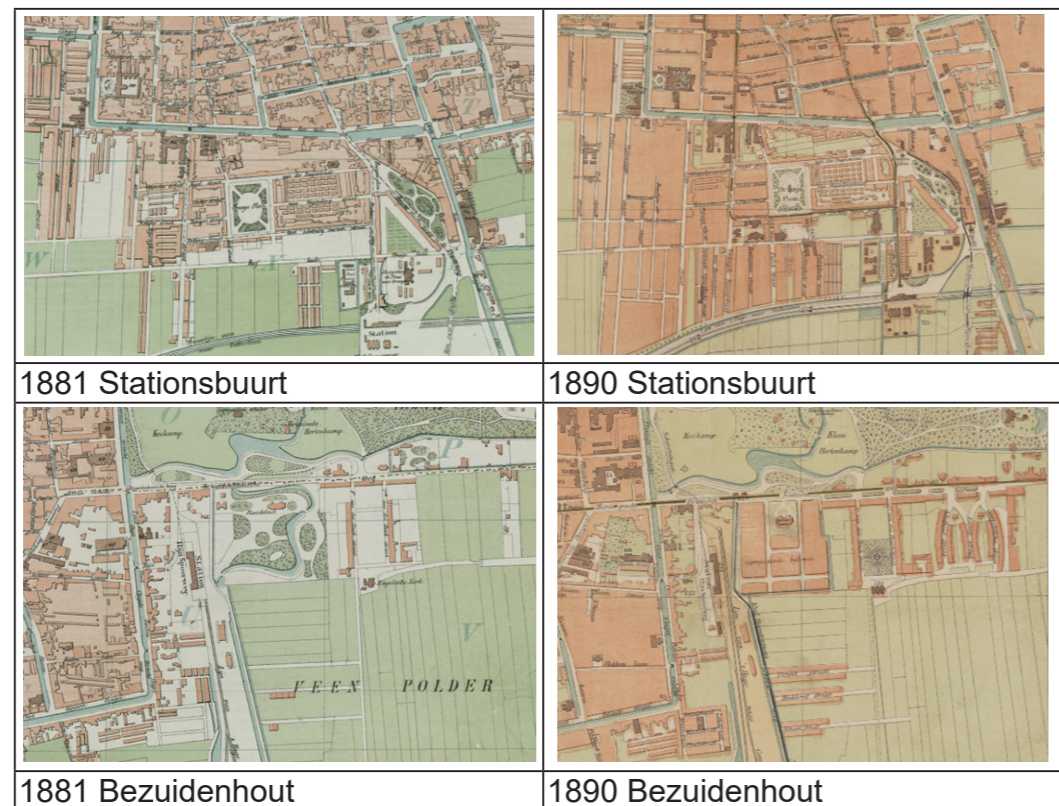
Fig. 5-11

The expansion mostly went northeast with the development of the trams (blue dashed line)

5.5 A barrier of the city expansion

In the comparison of the maps mentioned above, it is clear that the station and railway tracks formed a boundary and barrier to urban development. Compared to other areas in the city center, the areas behind the station developed significantly more slowly, such as Bezuidenhout, located on the side of the Staatsspoor station, far from the city center. This area, distinct from the Laak district, was more suitable for residential purposes.

Fig. 5-12, 5-13
The condition of Schilderswijk, Bezuidenhout in 1881 and 1890



Being close to the Hague Forest and occupying a strategic location bordering the Voorburg area, this region had a significant number of country estates since the 17th century, making it an attractive residential area. This is the reason that it remained a neighborhood of the established middle class and the upper middle class. However, during the period of extensive urban expansion in The Hague, the railway tracks isolated part of this area from the city center, slowing its development compared to other

districts like the Stationsbuurt, which is also peatland-based. It wasn't until 1897 that major expansion plans for Bezuidenhout were made. (Koopmans, B., 1994)

Laakhaven: Industrial area

The blocking situation is more evident in the Laak, which is to the southeast of the HS station. This area was eventually developed into an industrial area for a long period. Laakhaven is an inland harbor of The Hague, which was built in 1898 onwards. Before the construction of this harbor, there was no expansion in this area, even though this area was adjacent to the HS station and not far from the city center, if there were no rail tracks in between.

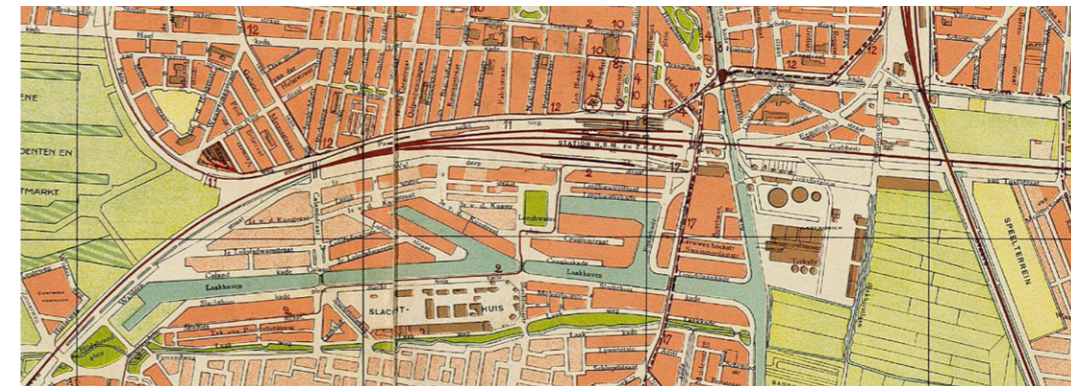


Fig. 5-14
Laak in 1927

Although railway transportation replaced part of the functions of the canals, the waterways remained a significant transportation for goods. In 1889, improvement of the Trekvlief was accomplished, and in 1891 and 1893, the bottlenecks at Leidschendam and Delft were removed, so an improvement of the waterways in The Hague for the growing inland shipping became urgent. In 1898, a start was also made on the construction of the inland harbor, the Laakhaven. (Stokvis, P. R. D., 1987) An expansion to the southeast can be observed in this area after the Laakhaven was built.

6. Conclusion

The thesis aimed to find the relationship between the urban development and the emergence of the public transportations in The Hague, with an assumption of finding a positive relationship between them. However the conclusion is not exactly aligned with the assumption.

To begin with, this thesis delved into the history of the formation of The Hague before the emergence of trains and trams. It is clear that at this point The Hague is a small scale settlement which mostly appeared on the beach ridges and higher sands, and the development is also restricted in the range of surrounding canals.

The following two research questions are answered through the mapping analysis and the following research:

- Do railway systems encourage or stop the development of adjacent areas, and how do stations encourage or block expansion?
- Do public transportation systems encourage people to move between different districts, therefore promoting the interaction between classes?

From a spatial point of view, the trains and trams had distinct impacts on the development of the city. The trains replaced some of the function of the canals due to the shorter transportation time, however, the disappearance of canals was mainly because of the hygiene needs of the citizens. Despite being close to the train stations, districts like Laakhaven and Bezuidenhout, which are located at the back of the station, had a slower development than the other districts. This is a result of the railway line acting as a boundary that is hard to surpass, and because of the factories in the surrounding areas, and the pollution caused by these factories.

On the other hand, the trams had a more positive impact. The trams brought people to the Scheveningen and helped with the thriving of this area. Moreover, the west of The Hague experienced a rapid expansion and had multiple residential development thanks to the wide spread tram systems.

However, from a cultural point of view, even though the arrival of the trams helped to break the restriction of having to live near the workplace and city expansion went beyond the surrounding canals, there was still a downside to this expansion.

It is worth noting that this expansion was highly uneven and did not propel the interaction between different classes. Instead, the public transportation was not for the public in the beginning, since the cost to take the public transportation was too high and as a result, they are only for the middle to upper-class group. This caused the intensification of differences between “zand en veen”, which the traditional area for upper class group remained and the worker class concentrated in the peat area or near the industrial zone surrounded the stations.

This is a result of a combination of historical factors at the time, which are the heavily industrialized use area due to the Second Industrial Revolution, and the geological characteristics of The Hague having the station at the peat area. Even though the result could be significantly different in another area, this thesis shows that it is important to take diverse aspects into consideration when the establishing of the transportation systems .

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