Dense Neighborhoods in the Livable City:
A Typomorphological Study of Copenhagen

Ian Crozier | Master of Urban Planning Class of 2017 | University of Washington

Fall 2016

Aknowledgements

This report is the product of four months of study as a guest researcher at the Copenhagen campus of Aalborg University generously funded by the Valle Scholarship and Scandinavian Exchange Program. The author is deeply grateful to the Valle Program and Aalborg University for the opportunity to have conducted this research in such an interesting and inspiring city. The author would like to thank Dayna Cole at the Valle Program, Branden Born, Al Levine, Nancy Rottle, Rachel Berney and the office of International Programs and Exchanges at the University of Washington, and Andrés Felipe Valderrama Pineda and Trine Hertz of Aalborg at the University for their invaluable assistance in making this research possible.

The author would also like to thank the many people who shared their knowledge and expertise about housing, history, urban renewal and public life in Copenhagen including but not limited to Rikke Lequick Larsen, Lars Gemzoe, Toke Christensen, Lars Engberg, Peter Munthe-Kaas, Henriette Steiner, Jacob Norvig, Marie Juul Bauman, Jesper Langebæk, Poul Sverrild, Morten Skou Nicolaisen, Claus Bech-Danielsen.

Finally the author would like to thank the staff and students of Aalborg University and the people of Copenhagen for their kindness and for building such a beautiful city.

Table of Contents

Introduction

This report seeks to investigate the nature of dense neighborhoods in Copenhagen, a city that is regarded as one of the most "livable" worldwide. Livability is a loosely defined concept and is often used as a buzzword in journalism and marketing materials. It is, however, generally considered to be a desirable thing and in the past two decades has become attached to the international reputation of Copenhagen.

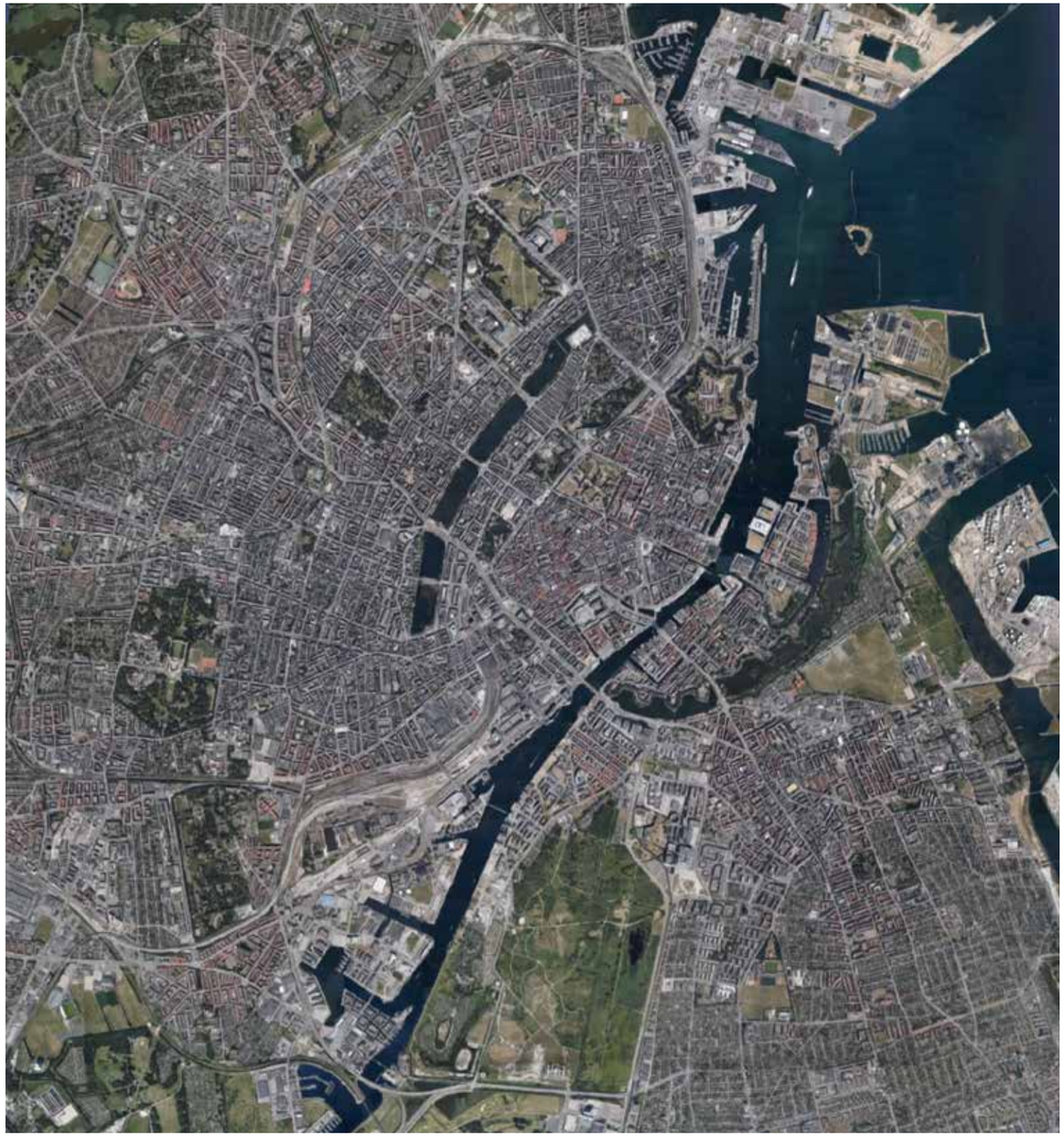
Apart from being considered a "livable" city, Copenhagen is also a dense city, at least by North American standards. 600,000 people live with its 86.4 square kilometers (33.4 sq mi). Seattle's population which is similar in size occupies 217.2 square kilometers (83.87 sq mi). Despite this much greater territorial spread it is Seattle that boasts the taller buildings 46 of which are over 100 meters tall (328 ft) as of 2016, compared to Copenhagen where the tallest building rises to 88 meters.

The cognitive dissonance caused by these two facts prompted the initial curiosity behind this report. What does population density look like in a city without skyscrapers? Copenhagen's reputation for livability makes the question even more compelling. What is the form of dense neighborhoods in the livable city?

I've attempted to answer this question through an approach to studying the urban form called typomorphology. This approach is discussed in the following section. Briefly: by studying the form and history of Copenhagen I have developed a typology of buildings that characterize the most common kinds of dense neighborhoods in the city.

This approach started with a survey of the city at large, visiting different distinctive neighborhoods and districts to get a feel for their character and structure. This was followed by research into their history to discover the relationship of each to other neighborhoods and districts and how each fit within the story of Copenhagen. The information collected was then synthesized into twelve neighborhood profiles which are found in the first section of the report.

The second part of the study involved selecting four study areas from the sites previously visited and profiled. These study areas are the sites that represent the most widespread forms of urban living in Copenhagen. While in the first part I profiled several areas that are interesting because they are unique, in the second part I am interested in the most common areas only. In each study area a single block has been selected for data collection about its physical characteristics and the way it is used by residents. This data along with historical information about the development of the study area and the city overall were then used to develop a description of the principal building type of which the neighborhood of the study area is composed.



Literature Review

Density

Measuring the population of a specific area can provide us with the population density, or the population per unit of measurement as if it were evenly spread. At the city level this is usually measured in population per square kilometer or square mile. This is relatively straightforward to look up online or to compute for oneself. Comparing population densities between cities however can be misleading because the density depends upon how the boundary of the measurement area is drawn. Density tends to decrease the with distance from the urban center, so the more suburbs or rural land that are included, the lower the density will be. This leads the peculiar situation in which the population density of the New York City metropolitan area (pop: 23.7 million13,300 sq mi) is officially lower than that of the famously sprawling Los Angeles metropolitan area (pop: 12.8 million/4,800 sq mi). Fortunately, since Seattle and Copenhagen have similar municipal populations, we can more easily compare the two. The fact that Seattle is 2.5 more territory than Copenhagen means that there must be some fundamental difference in how that population is arranged.

Density in smaller areas is measured in a number of different ways, but generally dwelling units (DU) are used in place of population figures. As the scale gets smaller density measurement tends to increase because less non-residential land is included. In this report three different ways of measuring density are used: the city-level scale of residents/km^2 in the introduction and in two neighborhood profile where other figures are not available; used gross neighborhood density, a measure of DU per hectare in a defined area regardless of nonresidential land use types (parks and streets included) for most of the neighborhood profiles; and block density, which measures DU per hectare of the block excluding adjacent rights-of-way is used for the study blocks.[1]

Population density and sustainability

Generally it is argued that urban populations consume fewer resources in terms of electricity, fuel, and water than suburban population due to the efficiency of sharing infrastructure between more individuals and by the reduction in travel distances. The relationship between population density and sustainability is not always critically examined. In general it has been shown that residents of more densely populated areas have lower CO_2 emissions[2]. Residents of densely populated areas are also more likely to travel by in a way other than automobile.[3] By understanding what the best densely populated places are like, we can work to build dense, sustainable cities that are livable, attractive, and politically feasible.

Typomorphology

Typomorphology is the study of urban form (morphology) derived from detailed studies of typical spaces and structures in the built landscape. According to AV Moudon, the "built landscape" includes both open and built spaces, which are linked by the element of the parcel or lot. Typomorphology seeks to chart the shaping of cities through the conception, production, use and modification of the physical components of the city in the context of fluid relationships between producers and inhabitants.[4]

The Italian school of typomorphology was initially developed by Saverio Muratori, who devoted his work to studying the form of traditional cities. The form and structure of the built landscape derived from the buildings and spaces surrounding them, which could be classified as types which summarized the essential essence of their nature. Muratori's follower Giacomo Caniggia developed a process for studying what he called "built objects" at four scales: the building, the group of buildings (neighborhood, district or quarter), the city, and the region. Objects at each of these levels are composed are related to each other and to objects of other scales. Caniggia focused on objects at the scale of the building, and defined typical objects through their lineage, creation and functions throughout their existence.[5]

Muratori and Caniggia's typological school of thought were developed and adapted by their successors, who tended to view the traditional city less canonically and were more willing to use traditional forms as inspiration for new designs.[6] Aldo Rossi developed his theory of urban artifacts in *The Architecture of the City,* in which he uses the concept of type to distinguish elements which give the city its structure. According to Rossi a type is a piece of the city which is permanent and complex, which provides a logical concept that is "a constant that manifests itself with a character of necessity". They developed gradually and according to both "needs and aspirations to beauty". Also "a particular type was associated with a form and a way of life, although its specific shape varied widely from society to society." Past types do not give an exact model for design, but within them there is present a an ordering principle or rule which informs their design.[7]

Rossi developed an argument against using function as a way of understanding the purpose and structure of cities in favor of types. Cities are given their structure by long-lasting elements which support multiple and changing functions over time. This applies to monuments and singular buildings as well as to dwellings and neighborhoods. Function can be used as one of many ways of assessing types, but it cannot be the primary source for the classification of urban elements.[8]

Study Areas and Dwellings

Rossi encourages the use of residential districts as study areas when studying the form of the city. His study area "can be defined as a concept that takes in a series of spatial and social factors which act as determining influences on the inhabitants of a sufficiently circumscribed" area. The study area is delimited by a zone of continuity in the urban landscape, its social content, and function.[9]

Finally, Rossi approaches the individual dwelling as a unit of study. As the oldest and most fundamental building type it is instantly identifiable, yet amorphous and ever-changing. The form that it takes at a particular place and time in a city are "closely bound up with the urban form, and the house, which materially represents a people's way of life, the precise manifestation of a culture, is modified very slowly". Whatever form these residences take, they constitute the "urban substratum, the material out of which the city was molded."[10] In order to understand the form of the city it is necessary to understand the essence of the residential districts and individual homes from which it is built.

1 Forsyth, Ann. Measuring Density: Working Definitions for Residential Density and Building Intensity. Minneapolis, MN: Design Center for American Urban Landscape, 2003.
2 Glaeser, Edward L., and Matthew E. Kahn. "The greenness of cities: carbon dioxide emissions and urban development." Journal of urban economics 67.3 (2010): 404-418.
3 Ewing, Reid, and Robert Cervero. "Travel and the built environment: a synthesis." Transportation Research Record: Journal of the Transportation Research Board 1780 (2001): 87-114.
4 Moudon, Anne Vernez. "Getting to know the built landscape: typomorphology." Ordering space: types in architecture and design (1994): 290-291.
5 Moudon 1994, 292
6 Moudon 1994, 293-294
7 Rossi, Aldo, and Peter Eisenman. The architecture of the city. Cambridge, MA: MIT press, 1982. Print. 40, 41
8 Rossi, 1982. 41
9 Rossi, 1982. 64
10 Rossi, 1982. 70, 71

Methodology

Research Design

The initial development of the typology was formed by the researcher's experience passing through different quarters of the city. The researcher recorded impressions of the characters of different neighborhoods and the reasons that brought the researcher to pass through each place.

Places with a distinct feel were noted, and a basic attempt to organize these differences was undertaken by answering simple questions. Is this place new or old? Does it feel lively or dull? Are the elements harmonious or disharmonious? Is it like other places that also feel new or old? Am I here for the fun of it or because of obligation? Does this place feel like many other places I've been to in the city?

The researcher then identified neighborhoods worth further investigating and undertook historical research. The researcher sought a general understanding of the development of the city from its birth to the present day, and to identify key events and periods that were most influential on its current form. The researcher conducted background research in places identified as being worth investigating in an attempt to discover which places represented typical places and which represented unique cases.

Once places deemed typical of significant portions of the city are identified the researcher visits each area and seeks to identify a specific block in each for data collection. Study blocks should not be exceptional; they should contain the key elements that characterize their neighborhood.

The researcher collected data from each study block. Data collected includes spatial data related to urban design measures: buildings, blocks, parcels, streets, and open space; and contextual data about the performance of the places: rents, tenure, parking, traffic, energy use. The book Built for Change: Neighborhood Architecture in San Francisco by Anne Vernez Moudon served as a guidebook for documenting morphological data about housing.

The researcher conducted further investigation into the history of residential architecture, construction and urban planning in Denmark. Technological, legal, economic, social, and architectural changes that influenced housing construction methods and styles were recorded. Urban planning policies that have subsequently affected the form and social context of neighborhoods, such as urban renewal programs.

The entire list of sources may be found in the bibliography. These sources include books, websites, interviews, lectures, journal articles, marketing materials and guided tours.

These data were synthesized with study block spatial data to develop the multifamily housing typology. This typology describes the morphological traits of these typical buildings - the way their form many times multiplied creates the character of the neighborhood itself.

Study Neighborhoods

After studying the historical development of the city, four study neighborhoods were selected which represent the most important periods of this development. From each study area a single block was chosen to for measurement and analysis. The study blocks were measured in many ways in order to develop an understanding of how typical buildings interact at the block level and the kinds of environments they tend to be located in. Measurements of study blocks include:

Block

Size, shape, location,

Parcels

Number, sizes, shapes, patterns, change over time

Built Area

Building count, age, coverage, layout, access

Open Space

Quantity, quality, layout, access, type

Streets

Dimensions, division of space, materials, traffic, parking

Streetwall

Facade elements, height to street width ratio, number of entrances, window patterns

Uses

Uses on site, residential tenure, unit cost

Block density

Block

Block area estimated using Google Earth Pro. A polygon was placed over the study block including all the area the edge of surrounding right of ways. The size of the polygon is recorded in square meters and hectares.

Block dimensions were estimated using Google earth. Dimensions were recorded in meters.

The distance of the block from the "city center" was measured using Google Earth Pro. The "city center" was defined as the Caritas well in Gammeltorv in Indre By. This fountain was erected in 1608 on a site that had been used as a market and center of government for hundreds of years prior. Gammeltorv ("old square") is the oldest square in Copenhagen.[1]

Parcels

Data on parcels was gathered from the Municipality of Copenhagen's interactive map page Københavnerkortet found at http://kbhkort.kk.dk/ and Offentlige Informationsserver, a publicly available database of information relating to properties in Denmark found at https://www.ois.dk/.

Built Area

Buildings are counted and layout was analyzed using the city's interactive map page Københavnerkortet (http://kbhkort.kk.dk/). Building age was found on Offentlige Informationsserver (OIS) (https://www.ois.dk/). Coverage was calculated using Adobe Photoshop by comparing the quantity of pixels in aerial photos or plans contained by the block as a whole

1 "Copenhagen's First Town Hall." Københavns Første Rådhuse | Københavns Rådhus | Historier Om København | Udforsk. Accessed December 08, 2016. http://www.kbharkiv.dk/udforsk/historier-om-kobenhavn/kobenhavns-radhus/kobenhavns-forste-radhuse.
In Danish.

and by the area containing only the buildings.

Open space

Open space data was recorded from direct observation and use of Google Earth Pro. To estimate the area of courtyard space a polygon was created in Google Earth over the area occupied by the courtyard. Data is recorded in square meters.

Streetscape

Measures of street width in meters and division between different traffic types (general purpose, bike lane, sidewalk, parking lane, bus lane) come from measurement using pacing and personal observation. Historical information about street uses was sought when relevant.

Two counts of pedestrians, cyclists, and motor vehicles occurred on the busiest street adjacent to each study area. One count occurred in the morning before 9 AM, and one count during the afternoon before 4 PM for each study area. This counts took place in September and October, however the overall weather other later studies was significantly colder than for earlier ones, reducing the validity of the data. Results from these counts can be found in the appendix.

Parking data was collected by direct observation and counting, as well as by analysis of aerial photography with Google Earth.

Streetwall

Data on building facade length is gathered by direct observation, recorded with photographs, and measurement based on pacing.

Physical data about buildings is gathered through measurement by pacing, and personal observation and photography. Building facade length, number of stories, number of bays, number and type of entrances, window shape and size, building facade type and color are recorded. Supplemental data is also recorded and corroborated using Google Maps.

Building age data was found at Offentlige Informationsserver (https://www.ois.dk/).

Access points were recorded during on site observation and recorded as stairwell entries, courtyard entries, ground-level only entries, or basement entries.

The presence and type of ground-level businesses was recorded through personal observation.

Uses

Non-residential uses are determined based on observation and data from Offentlige Informationsserver (OIS) (https://www.ois.dk/)

Density

The quantity of dwelling units (DU) for each building is collected from OIS and then combined to find the total quantity of DU for the block. The unit density calculation is made by dividing the block size in hectares by the number of dwelling units.

Unit value / Tenure

Data on sale prices for apartments was gathered from multiple real estate websites including: https://home.dk/, http://www.nybolig.dk/, and http://www.danbolig.dk/. Data for rental values was found on http://www.lejebolig.dk/ and http://www.boligportal.dk/. Data on unit tenure was found on Offentlige Informationsserver (https://www.ois.dk/). Data for social housing rents was found at https://www.kab-bolig.dk/.

Interviews

Several interviews were conducted to develop a better understanding of the personal experience of residents of different building types. Interview questions may be found in the appendix. Responses were used to corroborate other data, learn about different areas of the city, and gain a better perspective about the human experience of living in different building types.

Interviewees:
Male, 20-30 years old, Danish
Industrial Era flats - Co-op
10/25/16

Male and female couple, 20-30 years old, both Danish
Welfare Era block of flats - Co-op
11/30/16

Female, 20-30 years old, Danish
Welfare Era block of flats - Private rental
12/1/16

Male, 30-40 years old, Danish
Welfare Era block of flats - Co-op
12/7/16

Male, 40-50 years old, Immigrant
Livability Era apartment - Private rental
12/8/16

Male, 40-50 years old, Immigrant
Welfare Era apartment - Social housing
12/10/16

Female, 20-30 years old, Immigrant
Unknown Type - Sublet
12/11/16

Neighborhood Profiles

This document begins with a series of neighborhood profiles, describing distinctive residential areas of the city. Each of these neighborhoods is characterized by the predominance of a particular kind of residential or mixed-use building. Four neighborhoods identified as best representing large areas of the city were then identified for further study.

Nyhavn

Nyhavn ("new harbor") is a neighborhood in Copenhagen centered on a canal lined with brightly colored buildings, lively waterfront restaurants and bars, historic boats and ships along the quays, and many tourists. It is also perhaps the most photographed place in Copenhagen and it's image has become a widely recognized icon of the city.

The combination of factors that have lead to this place becoming so attractive for photographers and tourists is probably in itself worthy of in-depth study. One reason its image functions so well as a symbol for Copenhagen may lie in the way this assemblage of buildings, public space, people, and water represent each of the key elements that define Copenhagen. And, so it may offer the best entry into understanding the city itself.

The buildings serve as the backdrop. What are they like? They stand tightly packed in a row, with similar dimensions, window design and roofing materials. However, their facade treatments vary brilliantly and the floors of each appear to be of different heights and configurations. They are narrow - generally less than 12 meters (40 feet) wide with a few as narrow as 5 meters (16 feet) meaning the eye, or pedestrian, does not have to travel to find a new element to add to the tableau.

This row of townhouses dates mostly to the late 17th century and early 18th, in the decades following the excavation of the canal and the renaissance expansion of the old city. They were merchant houses, and likely each housed a large family, with servants, perhaps tenants, and ground floor shops and businesses. They each have access to narrow courtyards, hemmed in by wings and back buildings with passageways leading to yet more narrow courtyards and buildings. They combine with adjacent structures to make a seemingly endless number of formations of open and built space with overlapping layers of ownership and privacy contained within a membrane of a lively public face.

Nyhavn was spared the fires that ravaged the large parts of the city in the 18th century consequently it is one of very few areas that preserves some of the Baroque era built environment of Copenhagen. In addition to these older buildings, gradual replacement of older stock has produced a range of building ages, however most are confined to the narrow lot dimensions dating from when the block was first platted around 1680. The oldest townhouses tend to be two or three stories tall, have half-timbered walls and originally were divided into rooms with partitioned perpendicularly to the street as was common across the city before the fire of 1728. All

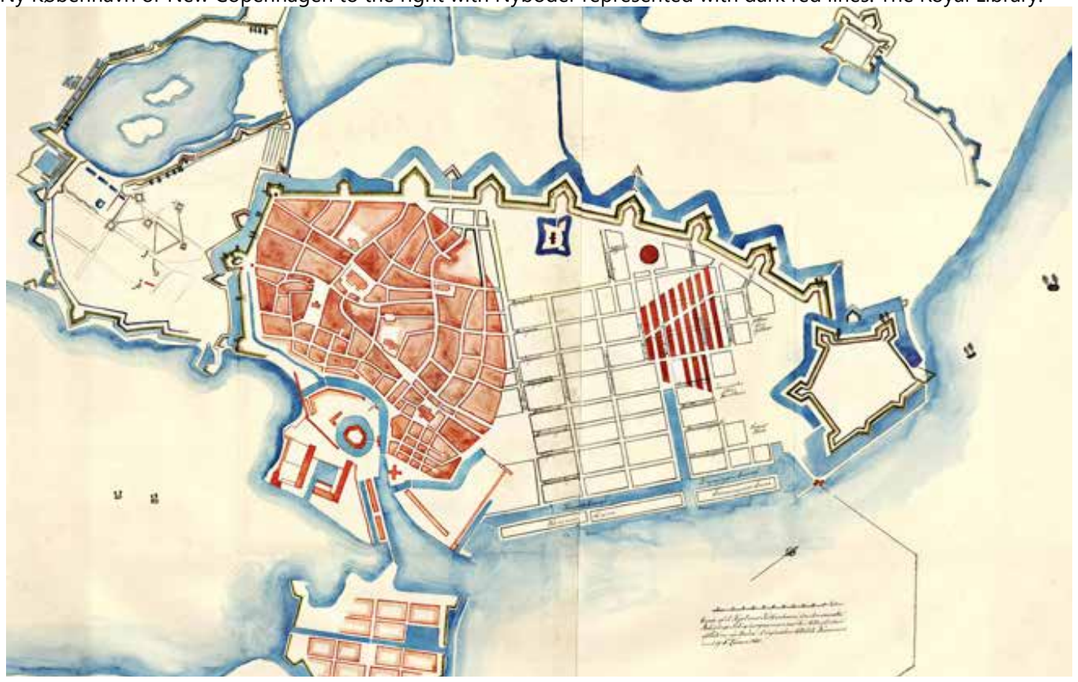
the townhouses on Nyhavn feature non-residential uses on the lower floors.

The inner buildings in the Nyhavn blocks tend to be newer than those fronting onto the street. When the blocks of this area of Copenhagen were laid out they were intended to relieve the overcrowding of the medieval city, so they were platted large with ample space for gardens at the center. As further population growth lead to new housing shortages in the late 18th and early 19th centuries these inner areas were haphazardly filled in with housing, creating a complicated patchwork of open and built space with many buildings separated from the street by more than one courtyard. When the city began slum-clearance efforts in the 1940's nearby blocks with a similar history to Nyhavn were the first to be razed due the negative perception of these areas with old buildings and poor internal access.

The elements that characterize Nyhavn: multiple households of different classes under a single roof, public frontage and semi-private courtyards, dense combinations of buildings creating complex block patterns, the overlapping of residential space with commercial space, and periodic government efforts to address overcrowding all defined urban housing in the 17th and 18th centuries and are woven through the structure of the city in many of the forms that urban housing has taken on since then. By placing these themes in such a well-known and picturesque context, Nyhavn provides us with a useful starting place to begin our analysis.

Nyboder

Above: Nyboder. Photo by from Wikimedia Commons. Below: Plan of Copenhagen mid-1600's. Old city to the left, Ny København or New Copenhagen to the right with Nyboder represented with dark red lines. The Royal Library.



To the north of Nyhavn is located a neighborhood with a remarkably different appearance but which dates from a similar era. Nyboder consists of rows of houses arranged in arranged in a regular street grid of rectangular blocks. They are one and two stories tall, with regular rows of windows and doors, and are all painted the same shade of yellow with green trim. Each house has access to a small back yard, where gardens and privies were located.

These rows were constructed as housing for the personnel of the Danish navy beginning in the 1630's and were expanded and rebuilt periodically until 1795. The newer sections have two stories and dormers, while the original houses had only one, but the overall form of these buildings changed remarkably little over the 160-year period from which its buildings date.

The regularity and uniformity of the neighborhood reflects the growing power and consolidation of the Danish state in this period. This consolidation culminated in the elevation of the Danish king to the status of an absolute monarch in 1660. Kings during this period were highly active in developing the infrastructure of the state and transforming Copenhagen into an instrument for the projection of transcontinental power. They built fortresses, ports, palaces, a hospital and university and increased the size of Copenhagen by more than half by reclaiming land from Copenhagen's shallow harbor and platting a new district. These were top-down state-driven projects, and they employed a formal spatial approach which contrasted sharply with the disorder of the older parts of the city.

One of the main expressions of the expansion in state power was the growth of the Danish navy, which was amongst the most powerful in northern Europe in this period. The personnel of this navy needed homes, so the state built Nyboder, or "new booths".

Today 319 of the row houses remain containing 605 dwelling units (DU) in an area of 6.31 hectares. This gives the neighborhood a density of about 96 DU per hectare (38.8 DU per acre). However, the neighborhood's population of about 2000 means that the household size of 3.3 in Nyboder is significantly above the city average of 1.9 .[1]

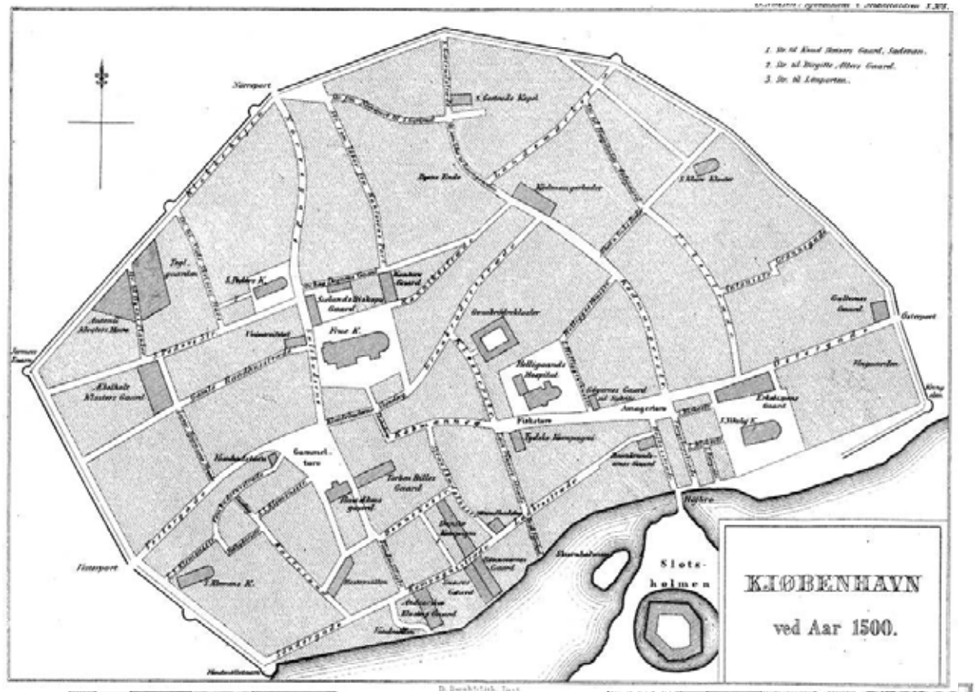
Following the annihilation of the Danish navy by the British during the Napoleonic wars, Denmark's naval power declined, and the need to maintain a large military population in Copenhagen abated. About half of the neighborhood was demolished in the mid-19th century. The remaining houses continue to be inhabited, and are owned and managed by the Danish Defense Forces. Nyboder is now a well-known feature of old Copenhagen, and despite the age of the houses they are highly sought-after.

Nyboder stands out as the first instance of a large scale government intervention in the development of housing in Copenhagen. The development of the neighborhood was planned and sponsored by the state, and its repetitive form and rigid organization foreshadowed the character of the future state-led housing projects in the 20th century.

1 Anderson, Esben. "Re: How Many Houses in Nyboder?" E-mail message to author. October 10, 2016. Response to a question by the Chief of Administration of Nyboder Museum.

Strædet

Above: Kompagnistræde. Photo by the author.



Below: Map of Copenhagen circa 1500. Public Domain.

Strædet is the name of one of the principal pedestrian streets in Indre By, the historic core of Copenhagen. It is a narrow street which with gentle bends works its way north-easterly from City Hall to one of the oldest squares in the city called Amagertorv.

This area was within the original city walls erected in the 14th century and much of the street and block layout is traceable from the 16th century. Unlike later additions, the streets curve throughout their course and the blocks tend to be of irregular size, though generally smaller than in other neighborhoods. Although this is the original area of settlement in Copenhagen, the buildings mostly date from 1795, the year a great fire devastated most of this part of the city.

After the fire much of the city was promptly rebuilt based on both the old housing designs of Nikolaj Eigtved and plans produced by the new court architect, CF Harsdoff. The widespread use of these generic plans by different builders resulted in a visual continuity over much of the old town. The adaptation of these designs to the sinuous street and parcel boundaries from previous centuries created a complex environment in which every block face relates to the neighborhood but no two look exactly alike.

The neighborhood around Strædet is characterized by mixed use buildings of three and four stories that form a continuous streetwall on both sides. They are stuccoed painted a range of colors though these tend to be more restrained than in Nyhavn. There are restaurants and shops on the ground and basement floors and residences and offices in the floors above. The romantic appearance of the street makes it popular with tourists and couples.

Each street-fronting building has access to a courtyard, which itself provides access to wings or backbuildings. Some of these inner buildings date from the time of reconstruction after the fire, while others were added in subsequent decades as the population of the city increased. Until 1852 no building was allowed outside the city's Renaissance era fortifications, meaning that as the population rose from 60,000 to 150,000 between 1700 and 1850, density rose in parallel. In the three square kilometers within the walls population density reached 50,000 residents per km^2 (129,500 per mi^2) in 1850.[1]

After the walls came down the inner city saw relatively little change in its building stock, mostly coming through the gradual renovation or replacement of older buildings. Many of the buildings in this neighborhood are now protected on the Danish Agency for Culture list of heritage buildings. In 1992 Strædet was added to Copenhagen's network of pedestrian streets. Although delivery trucks and other vehicles are allowed to enter the street is primarily designed for pedestrian use. It runs parallel to Copenhagen's original pedestrian street, Strøget, which was pedestrianized in 1962.[2]

This neighborhood is representative of a significant portion of the old town of Indre By, and was selected as one of the study areas for further analysis.

1 Hiort, Esbjørn. Housing in Denmark since 1930. Copenhagen: J. Gjellerup Forlag, 1952. Print.

2 Gehl, Jan, and Lars Gemzøe. Public Spaces, Public Life: Copenhagen 1996. Copenhagen: Danish Architectural Press and the Royal Danish Academy of Fine Arts, School of Architecture, 1996.

Above: Kartoffelrækkerne. Photo by the author.

Kartoffelrækkerne

Just outside the line of the old ramparts is located the Kartoffelrækkerne district. Kartoffelrækkerne consists of 21 rows of two story brick houses lined up back to back. Each house has a small front and back yard, and the middle part of many of the narrow streets have been converted to public spaces so that cars cannot pass through.

This neighborhood arises from the intense population pressure in the old city at the middle of the 19th century, when the population density per square kilometer approached 50,000. Without a sewer system or river to remove human waste the sanitary conditions in the city were extremely favorable towards the outbreak of disease. In 1853 a cholera outbreak occurred which killed about 4,800 which greatly increased concern amongst the ruling classes about how to improve living conditions in the city.[1]

Two outcomes of the conversation that followed were a final push to decommission the city ramparts; and the creation of Arbejdernes Byggeforening, or the "Workers Housing Association" by a group of doctors and architects to construct new sanitary and dignified housing for the working class.[2] Arbejdernes Byggeforening began to develop new terraced housing estates outside the ramparts which were then raffled off to dues-paying members of the association. Construction began on the largest and best known of Arbejdernes Byggeforening's projects in 1873 which is colloquially known as Kartoffelrækkerne, or "Potato Rows".

Each Kartoffelrækkerne house was originally occupied by three families, meaning one family on each 42 m^2 floor, and a block density of 198 DU/hectare or 80 DU/acre.[3] The backyards originally held a privy for each house, while the front yard was intended to encourage the residents to tend their own gardens. The houses were built with gas lighting and running water integrated into the design, which was unusual at that time.[4]

Rowhouses like Kartoffelrækkerne are unusual in Copenhagen. They were partly inspired by the row housing of Great Britain ("terraced housing") and the early social reform doctrines that began to be developed at that time. Although Kartoffelrækkerne resembles Nyboder in plan, each row includes several house designs providing some visual variety. Furthermore, as the houses have become privately owned individual owners have further modified their exteriors.

Although Arbejdernes Byggeforening constructed several other developments of similar row-houses for workers around Copenhagen, this model of housing was not widely replicated.[5] In the 20th century social housing organizations became increasingly important in the creation of modern housing in Copenhagen during the industrial and welfare state eras.

At present, the Kartoffelrækkerne houses are privately owned and occupied by one family each, bringing the density down to about 79 DU/hectare (32 DU/acre). Kartoffelrækkerne was one of the first neighborhoods that gentrified in the in the 1970's and 80's and today claims high selling prices as part of a hip, left-leaning creative neighborhood.[6]

---

1 "Efterhistorien." Cholera in Denmark in 1853. Denmark Science and Medicine Library, 2002. Web.
2 Sverrild, Poul. "Keynote Masterclass." Housing, Modernism and Cultural Heritage. Proc. of Inventorisation of Modern Heritage: Urbanisation and Landscape, Edinburgh College of Art, Edinburgh., 2014.
3 "Interview with Henriette Steiner." Personal interview. 19 Sept. 2016.
4 Storm, Lars. "Rækkernes historie." KARTOFFELRÆKKERNE - Rækkernes historie. Accessed December 19, 2016. http://kartoffelraekkerne.dk/?R%E6kkernes_historie.
5 Arbejdernes Byggeforening ultimately created about 1,500 terraced houses in Copenhagen from 1872-1930
6 "Interview with Henriette Steiner." Personal interview. 19 Sept. 2016.

Vesterbro

Above: Istedgade. Photo by the author.

Below: Map of Copenhagen circa 1900. Public Domain.

Istedgade runs south-west from the Central Copenhagen Train Station through the heart of Vesterbro, just outside the old city walls. It once carried streetcars through this neighborhood of large blocks and straight streets lined with buildings of consistent scale and appearance, mostly five stories tall and constructed in the late 19th century. There are many ground-level shops and ample sidewalks as well as swiftly flowing vehicle traffic.

Vesterbro grew up around the old highway Vesterbrogade which ran from the country to the western gate of the city. The cobblestones, or brosten, of this street leant their name to the neighborhood itself, which together with Nørrebro, Østerbro and Amagerbro are known as the brokvarter.[1] When the building restrictions outside the city walls were lifted these neighborhoods quickly grew up around the old arterials leading to the center. When the industrial revolution accelerated in Denmark in the late 18th century people from the countryside flocked to cities for work and economic opportunity. The brokvarter neighborhoods accommodated much of the resulting growth in Copenhagen as the city population rose from 150,000 to 450,000 in forty years.[2]

Construction in the brokvarter was aided by a new innovation: the creation of the first building credit association in Denmark. Institutions like these allowed the construction of housing as a profitable enterprise. Speculative construction could proceed without the need for individual landowners to finance their own projects. As a result, buildings became more standardized, with firms being able to copy exact models repeatedly to make a profit. This lead to greater efficiency in production, but also began a trend towards the disassociation of those who planned and those lived in multi-family housing. It also started a trend towards speicalization as gradually residential buildings became less like other buildings, and the residents of each building became more like one another.

Areas like Istedgade remained very crowded well into the mid-20th century when the city hit is population peak. The aging housing stock lacked modern amenities such as indoor toilets, showers or central heating and the buildings were becoming badly degraded. With the development of rail and automobile travel, wealthy and middle class families were able to move further from the city, leaving the inner neighborhoods increasingly populated by those with nowhere else to go.

In the late 20th century the City began implementing urban renewal programs in this Vesterbro, aimed at improving living conditions and increasing the economic vitality of the neighborhood. Many of the low-quality courtyard buildings were demolished and the city paid for the landscaping of most of the courtyards around Istedgade, which were combined to be used by all residents of the block. City funds for building renovations were targeted towards installing central heating and the creation of private bathrooms for each flat.[3] The City also the encouraged the development of co-ops and provided funds for building restoration. In the aughts streets like Istedgade and Sønder Blvd one block south became hip destinations for young Danes. These streets have seen a proliferation of trendy restaurants, bars and shops, and housing prices in the area have skyrocketed.

Ultimately the displacement of much of the existing low-income population of Vesterbro led to a political backlash and prompted the city to re-examine its approach to urban renewal in low-income neighborhoods.[4]

---

1 Interview with Henriette Steiner 9/19/16

2 Hiort, Esbjørn. Housing in Denmark since 1930. Copenhagen: J. Gjellerup Forlag, 1952. Print. p. 6

3 "Interview Marie Juul Baumann, Municipality of Copenhagen, Urban Renewal Department." Personal interview. 13 Oct. 2016.

4 Larsen, Rikke L. "Lecture on Municipal Urban Renewal, Urban Nature and Climate Adaptation." Design Workshop with Kobenhavn University Students - University of Washington Gehl Studio Study Abroad. Osramhuset Nørrebro, Copenhagen. 14 Sept. 2016.

Sydhavn

Above: Kongens Enghave. Photo by the author.

Southwest of Vesterbro railroad tracks and industrial land occupy large areas of land creating barriers to movement. Two large parks occupy a significant portion of what is left. In the spaces between these elements the neighborhood of *Sydhavn* ("South Harbor") is located.

Sydhavn is a working-class neighborhood, composed exclusively of large blocks of flats constructed in the early 20th century. These brick buildings are 5 and 6 stories high and present continuous, unadorned facades to the street. They were designed to provide sanitary, dignified living conditions for the working class and to relieve overcrowding in tenements in areas like Vesterbro. Landscaped areas are spread throughout the neighborhood in open areas between buildings and the street and in building courtyards, some of which are open on one side. These courtyards are large open spaces designed to be amenities for residents, and do not have any backbuildings or economic uses. The scale of this neighborhood is noticeably different from Vesterbro, with wider streets, more open areas, and entire block-faces occupied by a single building.

Sydhavn developed adjacent to industrial land along the city's central harbor and railroad network. That area was the city's industrial heart until the 1960's and 70's and areas like Sydhavn housed its labor force. Today the former-industrial brown-field sites near Sydhavn are being developed with corporate offices and high-end apartments. Meanwhile, Vesterbro to the north-east has become increasingly gentrified and unaffordable, putting the residents of Sydhavn in an uncomfortable situation. They want investment in their neighborhood and apartments, but fear losing the affordable rents they still enjoy.

Neighborhoods like Sydhavn appeared throughout Copenhagen starting in the 1910's. At that time the government began to be more actively involved in the housing sector, updating regulations and making financing more readily available, and increasingly becoming involved in the planning of large-scale projects. Prominent architects became involved in the movement away from the flashy facades and rustic interiors of the late 19th century towards the priority of amenities for residents and efficiency of construction. These changes influenced development patterns of the way the outer sections of the brokvarter neighborhoods as well as the next ring of perimeter neighborhoods such as Nordvest, Vanløse, Valby, and this study area from 1920-1940.[1] Buildings of this type are described as Welfare Era Blocks of Flats in the typology section of this report.

Sydhavn has a gross neighborhood density of about 178 DU per hectare (72 DU per acre).

1 Hiort, Esbjørn. Housing in Denmark since 1930. Copenhagen: J. Gjellerup Forlag, 1952. Print.

Above: Bellahoj I. Photo by the author.

Bellahoj

Bellahoj is housing project consisting of two clusters of residential towers on 2.6 hectares (6.5 acres) located on the western periphery of Copenhagen. These buildings represent an unusual building type in Denmark: the "towers in the park" conceived and promoted by the modernist architect and urban planner, Le Corbusier. They were also influenced by similar designs for public housing that later became popular in Sweden.[1]

The Bellahoj towers stand between 9 and 13 stories tall and are surrounded by landscaped open space including playgrounds and gardens. They also have a large space at the front of the project devoted to surface parking lots. These building were constructed from 1951-1958 as social housing, winners of a design competition to explore innovative building styles for Danish public housing. Each story has two units, which are accessed via central core with stairs and an elevator. The location of the towers on the most significant hill in Copenhagen provides them with expansive views of the city.

The Bellahoj towers are a departure from the typical style of Danish multi-family housing which usually consists of long, narrow buildings accessed by stairs; to this day they remain among the tallest buildings in the city. They represent a continuation of the trend in government-planned social housing flats toward large scale, rationalist site plans, with weakening relationships to streets and traditional block structures. However, the location of the towers in an idyllic setting, with well designed traditional parks, a nearby pond, and the majestic view of the city gives this development a better connection with its surroundings than many contemporary projects.

The towers continue to serve as social housing and on a walk through their ample greens one can see children and families playing, calling out in many languages. The buildings, like many constructed of concrete in this era, have had maintenance issues including problems with mold, leaks, and rotting window and door-frames.[2] Not counting adjacent parkland, the gross neighborhood density within the development is 127 DU per hectare (51 DU per acre).

1 Hiort, Esbjørn. Housing in Denmark since 1930. Copenhagen: J. Gjellerup Forlag, 1952. Print.

2 Larsen, Jacob N. "From Slum Clearance and Housing Renewal to Networking and Area-based Approaches: On the Origins of Contemporary Danish Urban Development Programmes." On the Origins of Urban Development Programmes in Nine European Countries. Ed. Helle Nørgaard. Antwerp: Garant, 2003. 46-58. Print.

Christiania

Christiania is one of Copenhagen's most famous neighborhoods. It is an autonomous community within Copenhagen in a former military base on the south-eastern side of the city harbor. The former barracks and ramparts were occupied by counter-culture youth and activists in 1971, and in the decades since a remarkable autonomous community has developed. Cars are prohibited, city authorities do not enter, and cannabis is more or less freely sold.

Much of the building stock in Christiania is made up of former military buildings, some dating from the late renaissance when the defensive ramparts were first constructed. These have been liberally converted and adapted by artists and builders, both residents and visitors to the community. They serve as residences but also concert and meeting halls, studios, workshops, and bars and restaurants. The leafy walking paths between homes and common areas give a strong feeling of an enclosed, protected, unique place, while the lively plaza on the southern end is popular with outsiders and tourists for its relaxed atmosphere and food, music, booze and bud.

The occupation and community-driven development of Christiania marks a clear rejection of the trends of increasing centralization of decision making, spatial scale, mass-production and government intervention in both multi-family housing and the rapidly expanding suburban tracts of single-family houses in the 1960's and 70's. In Christiania no two buildings are alike, things are made by hand, simple technology rules, capitalism and governments are viewed warily and decisions are made at the lowest level possible. Only the most important matters elevated to the community as a whole for a consensus-based decision.[1]

With a population of 850 occupying about 34 hectares (84 acres) Christiania has a population density of only 25 per hectare (10 per acre).[2] Property is not bought or sold, but when a new space opens up the community decides who to invite. This process, relying on social rather than financial capital, is similar to the many housing co-operatives in more conventional parts of the city where rent and buy-in costs are affordable, but openings can be hard to come by.

1 Hellström, Maria. Steal This Place. PhD diss., Swedish University of Agricultural Sciences, 2006.

2 Note: in this case this measurement is of people per hectare, not dwelling units, which is more common at this scale. Source:

Avedøre Stationsby

Nine and a half kilometers (six miles) from the center of the center of the once walled city of Copenhagen, a new walled city, Avedøre Stationsby (Avedore Station City), was erected during the peak of modernist planning and government investment in social housing in the 1970's. This development covers 53 hectares (131 acres), about 30% less area than the original walled city of Copenhagen. It consists of two story row houses made of concrete cubes arranged in 90 degree angles around partial courtyards and parking areas, surrounded by a continuous wall of four story apartments.

One road passes through the "city" from the north at "Ropemaker's Gate" and the east where there is a large gap in the apartment wall. The development is arranged around this road, with public institutions located along it and dead-end streets branching out mostly north and south. These form a grid with walking paths that mostly run east and west. Pedestrian bridges also extend over the main road, which is sunken in the central portion of the development. The development is located adjacent to an S-train station with fast, frequent service to central Copenhagen.

Avedore Stationsby epitomizes the climax of several important trends in housing in Copenhagen: the "finger plan" and the planning of suburban new towns along commuter rail lines; the move towards ever larger, more distant, and more self-contained developments; massive investment by the government in social housing; and the attempt to use rational methods in city planning, architecture, and construction to achieve optimal outcomes in living standards. Its distinctive form points to another nascent trend: an attempt to recreate some element of past urban forms. In this case that form is the walled city, which described Copenhagen in some form until 1867. The project also represents a thoughtful attempt to protect pedestrians from automobiles by providing a well-connected pedestrian network largely independent of vehicular routes.

Avedore Stationsby contains 2,600 units, giving it a gross neighborhood density of 49 units per hectare (121 units per acre). The planned area includes a significant amount of open green space both outside the "wall" and within, as well as a large area dedicated to surface parking, both reducing the density. There are also child care centers, laundromats, a church, a secondary school, an elementary school, a library, a grocery store and a convenience store within the development and several shops and restaurants are located immediately to the east.

Avedore Stationsby is one of the last large-scale multi-family suburban social housing projects in greater Copenhagen. With the oil-shocks and financial stagnation of the 1970's and 80's the ability of the government to finance such projects declined; at the same time there was a growing cultural rejection of such projects with such a single-minded pursuit of standard of living improvements.[1]

1 Sverrild, Poul. Periurban Phase and Sphere. PhD diss., University of Aalborg, 2016. Aalborg, DK: Aalborg University Press, 2016.

Above: Squatters in Norrebro. Source unconfirmed.

Below: Superkilen Park. Photo by the author.

Outer Nørrebro

Like its twin Vesterbro, Nørrebro is one of the *brokvarter*, a dense neighborhood largely built up during the late-19th century in the height of the industrial revolution. Also like Vesterbro, Nørrebro was targeted by the city in the mid and late 20th century due to crime, derelict and degraded buildings, and the flight of the middle-class. Nørrebro was the city's first urban renewal district and as such was the recipient of a major investment in slum-clearance and redevelopment in the 1970's and 80's.

These programs sought to demolish older tenement buildings, especially courtyard buildings which tended to be of poorer quality and lacked direct access to the street. They were replaced with lower density blocks of flats owned by social housing providers. These buildings tend to be much larger than those they replaced meaning they could dominate entire block-faces with their long, unadorned facades and overall distant, institutional character. They also had far fewer units than in the razed tenements and were more expensive, exacerbating a growing housing shortage.[1] [2]

This process of demolition and redevelopment saw a growing backlash in the 1980's, both by typical neighborhood residents and a group of disaffected youth who, in the absence of affordable housing, took to squatting in many of the condemned buildings. Attempts by the city to evict the squatters lead to a series of clashes between these youth, who came to be known as the BZ, and the city throughout the 80's, 90's and aughts over urban renewal programs, including several large scale riots and street clashes with police.[3] Later urban renewal programs abandoned this approach in favor of investments in existing building stock, in addition to investments in public areas and community organizations.[4]

Nørrebro today remains a gritty neighborhood. Many buildings are covered in graffiti, vehicle burnings are a regular occurrence, and residents speak of gang activity in some of the social housing projects. A large immigrant population has made the district its home, changing the ethnic makeup of the district and at times resulting in tension with ethnic Danes. At the same time, gentrification in the inner sections of the neighborhood has already displaced some of the lower income population.

The neighborhood around Superkilen park epitomizes the district, with the award-winning park, large community center with a wealth of inventive programs, and a public library all within a block of each other. The park lies at the junction of two major bike routes and is two blocks south of an S-train elevated light rail line and is surrounded by a mix of 19th century flats and 1970's social housing. The park incorporates objects and outdoor furniture from many different countries, in an attempt to reflect and embrace the national diversity of the people that make use of the park. It is popular with local residents and tourists alike.

The population in the 4.1 km^2 of Nørrebro is 79,700 making it the most populated district in the city and geographically the smallest, with a density of 19,440 per km^2 (50,350 per sq mi), which lies somewhere between the densities of Manhattan and Brooklyn, New York. This neighborhood was selected as one of the study areas for further data collection and analysis.

1 In Denmark social housing organizations are non-profits and receive subsidies from the government. Rents are not tied to income and can be unaffordable for the very poor, while low-quality private sector housing can be cheaper.

2 Larsen, Jacob N. 2003. 46-58.

3 Mouritsen, Lone, and Caroline Osborne. *The Rough Guide to Copenhagen*. London: Rough Guides, 2010. 102.

4 Interview Marie Juul Baumann, Municipality of Copenhagen, Urban Renewal Department 10/13/16

Above: 8TALLET by BIG. Photo by the author.
Below: Central Oretad as seen in Google maps.

Ørestad

Ørestad is a neighborhood in Copenhagen that has been developed since 1995 on the southern edge of the city. The site was once an artillery practice range on land reclaimed from the city's central harbor. It was cleaned of unexploded munitions and is now owned by the Ørestad Development Corporation, a majority stake of which is held by the city. Ørestad is located five kilometers from the city center but has easy access through the M1 Metro line, which was planned in conjunction with the development of the area. It is characterized by distinctive modern buildings by major architecture firms such as the famous 8-House by BIG and Bella Sky hotel by 3XN.

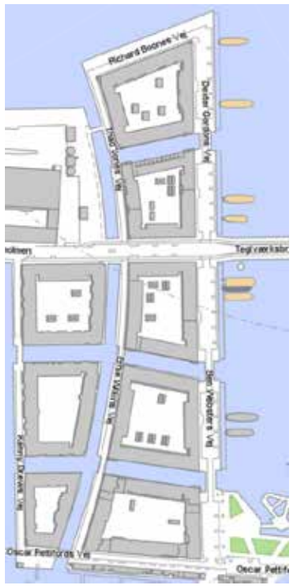
The neighborhood has ample green space and includes pedestrian pathways, however the inward-focused, coarse-grained pattern of development has been criticized for preventing the growth of lively pedestrian environments in the area. The neighborhood has a mix of building types, with the residential heart of 8-12 story apartments located around Byparken, a park of 7.82 hectares. These buildings surround enclosed or partially enclosed courtyards and lack ground-level retail uses. The presence of Denmark's largest shopping mall, which is inward oriented, and Scandinavia's largest convention center bring many short-term visitors to the area but have not so far helped build neighborhood life outside these destinations.[1]

Ørestad was developed as part of a partnership between the city and private developers, partly with the purpose of financing the new metro system. It was the first such collaboration for private sector housing in the city's recent history.[2] As such it represented a movement away from the city's past investment in social housing in favor of the housing and amenities for higher-income earners along with quality of life infrastructure improvements such as the metro line and Byparken. This trend has continued, with Copenhagen becoming celebrated for its sustainability, livability and avantgarde architecture, while the city becomes increasingly popular among high-income earners. Ørestad is one of several new neighborhoods developed by the city and private partners creating new areas of high-income housing.

Ørestad as a whole is planned to accommodate 20,000 residents and 60,000 jobs by 2025. At present the residential area around Byparken, where construction has mostly been completed, has 2,146 dwelling units in a 25.6 hectare area, giving it a neighborhood density of 84 DU/hectare (34 DU/acre).

1 Majoor, Stan. "Urban Megaprojects in Crisis? Ørestad Copenhagen Revisited." European Planning Studies 23, no. 12 (2015): 2497-515. doi:10.1080/09654313.2015.1014780.
2 Majoor, 2015.

Sluseholmen. Photos by the author. Map from KbhKort.kk.dk



Sluseholmen

Located in the former industrial sites adjacent to Sydhavn, Sluseholmen represents the second generation of the city's public-private development partnerships. In an attempt to learn from mistakes attributed to the Ørestad project, Sluseholmen was designed with the walkable fabric of the older parts of the city in mind. It also integrates the harbor, which had undergone major successful cleanup efforts, into the design, with a grid of canals over lapping with a grid of low-traffic, pedestrian friendly streets. Most waterfront edges in the project are designed for residents and visitors to interact with the water, through step down decks called "ghats" and floating docks for swimmers, numerous berths for boats and house-boats, and a floating swimming platform located just north of the neighborhood.

Each Sluseholmen block is occupied by a single building which wraps around the block. The courtyards in the middle of each block are accessible to the public through gaps in the first story, and these are landscaped with playgrounds, seating areas, gardens and covered bicycle parking areas. Ground floor units on the courtyard have porches and upper units have balconies which look out on the shared space. Underneath each courtyard is a parking lot for residents.

The facades of these large continuous buildings are broken up to sections pertaining to each stairwell section of the building. These sections were assigned to a total of 25 architectural firms to develop facade designs within certain parameters. In this way the project seeks to recreate the variety and complexity of historic sections of the city built over time by multiple actors.

Sluseholmen has won several design and planning awards, and is often described as an model for sustainable development. It has been criticized however for the seeming failure to create the lively pedestrian atmosphere it was designed for.[1] It is also a high-end private development of condos and rental apartments, meaning the district lacks economic diversity.

Construction of Sluseholmen was completed in 2007 just before the financial crash of the Great Recession which halted development of other nearby brownfield areas and left the new development somewhat isolated. Recent years have seen a resumption of construction to the south of Sluseholmen and on Tegholmen, connected to Sluseholmen by a drawbridge which opened in 2011.

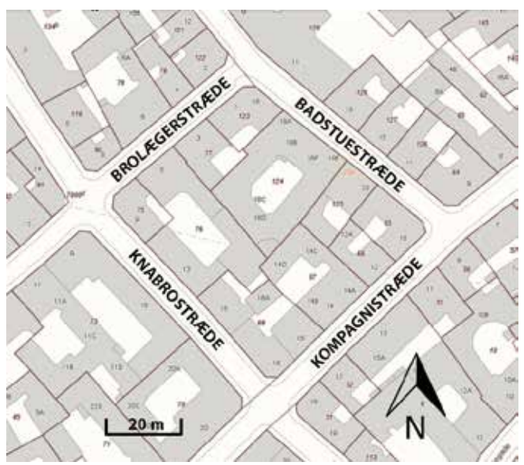
The population density of Sluseholmen plus the nearby Metropolis building is 152 DU per hectare (62 DU per acre). This neighborhood was selected as one of the study areas for further data collection and analysis.

1 O'Sullivan, Feargus. "Copenhagen Needs More Jane Jacobs, Says Jan Gehl." CityLab. August 15, 2016. Accessed December 09, 2016. http://www.citylab.com/design/2016/08/copenhagen-needs-more-jane-jacobs-says-jan-gehl/495854/.

Study Areas & Typology

The second half of this report consists of detailed measurements from four study areas and a building typology. The study areas were selected from the profiled neighborhoods and districts of the previous section. The four areas which seemed to best represent a general fabric of the city were selected. Data from study areas was used in the development of a typology of the principal building types for each study area. These types are presented following their respective study areas.

Cadaster maps from **1761** [above left] **1807** (same as **1861**) [above right] and **2016** [below]. City of Copenhagen.



Study Area: Indre By

Block

The study block forms an irregular quadrangle with a total surface area of about 3,700 m^2 (0.91 acres). It's sides are 50 m , 70 m, 60 m, and 66 m (164 ft, 230 ft, 197 ft and 217 ft) along its NW, SW, SE, NE sides for a total perimeter of 246 meters (807 ft). There are 14 street-fronting buildings on the block, 5 interior buildings, and 8 courtyards.

The study block is located 200 m (656 ft) from the city center.

Parcels

The cadastral layout of the study block has changed relatively little since the development of the existing building stock at the end of the 18th century. A cadastral map from 1761 map shows parcels of highly irregular size and shape, all of which however include street frontage and a back area for a courtyard and backbuildings or wings. As of 1761 there were two gaps in the streetwall along Knabrostræde and a total of 14 parcels.

The cadastral map from 1807, thirteen years after the fire of 1794, shows a modest transformation of the block, with most of the building footprints slightly altered and several minor changes to parcel boundaries. The cadaster maps show no change in the study block from 1807 to 1861, with a total of 13 parcels present. Since 1861 several parcels have been combined, dropping the total parcel count down to 10. The two instances of parcel combination (on the SW side of the block) have occurred around shared courtyards, suggesting it is more advantageous to consolidate parcels where buildings which make use of common entrances and open space.

Parcels range in size from 168 m^2 to 771m^2. The median size is 228 m^2 and the mean size is 368 m^2.

Built Area

There are 19 buildings on this block. These buildings are three and four stories tall with peaked roofs and cover 81% of the surface area of the block. The Floor to Area Ratio (FAR) is 2.83 assuming an average of 3.5 stories.

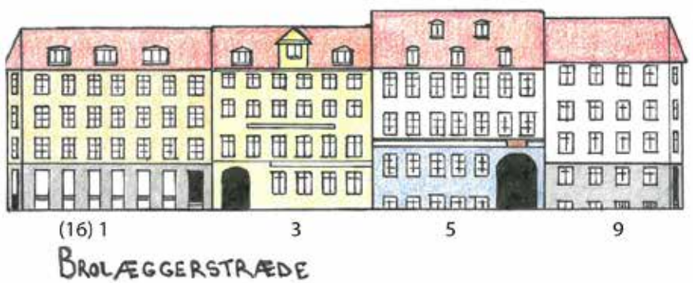
These buildings were built between 1770 and 1799. More than half were built in the late 1790s after the Great Fire of 1795. Buildings like those on the study block are usually described as being of the "Neo-classical" architectural style. 18 Badstuestræde demonstrates the "Empire" style, with similar elements as the others but more elaborate ornamentation. This building is also larger and more ornate than others on this block. It is also the only building to fully enclose a courtyard.

All represent some permutation of the "Golden Era Apartment House" type described in the following section.

Open Space

There are seven courtyards in the study block, which take up 19% of the surface area of the block. They are generally narrow and range in width from less than 3 m (10 ft) to about 8 m (26 ft). They range in area from about 40m^2 (430 ft^2) to about 220m^2 (2,368 ft^2) with an average size of about 100m^2 (1,076 ft^2).

Each courtyard is accessed through a street-fronting building. In turn, each courtyard provides access to at least one back building or wing.



Historically, these courtyards were used for light industry, livestock storage, privies, and garbage heaps.[1] The privies would be emptied periodically and the contents taken to be used as fertilizer on Amager Island.[2] Today they tend to be used for automobile and bicycle parking, waste collection, utilities and as outdoor seating areas. They tend to be paved with asphalt or cobblestones.

Streets and Transport

The study block for this neighborhood is located between Brolæggerstræde (NW), Knabrostræde (SW), Kompagnistræde (SE) and Badstuestræde (NE) streets. These streets all have rights of way of about 8 m (26 ft). Brolæggerstræde, Knabrostræde and Badstuestræde are paved with asphalt and have sidewalks on either side of about 1.5 m (5 ft) in width. Kompagnistræde is paved with cobblestones and concrete blocks and has no raised sidewalks, although changes in paving material indicate a vehicular travel-way of about 4 m (13 ft). Kompagnistræde is the busiest street in terms of traffic and number of businesses. It is part of the Strædet pedestrian-priority street, meaning there are no physical barriers to cars entering but they are prohibited from driving more than one block along the street.

Automobile and bicycle parking occupies one side of Brolæggerstræde, Knabrostræde and Badstuestræde, providing space for about 15 vehicles.[3] The parking space per unit ratio is 0.22 spaces per unit, however the residential units are also competing for parking with the many businesses on this block. Hourly parking costs about $4.50 and resident passes are available for $105 per year.[4]

Traffic counts conducted during morning rush hour and midday on Kompagnistræd observed about 660 passersby per hour, with similar total levels of traffic on both occasions. The bicycle mode share fell from 72% in the morning to 38% at midday. The walking mode share rose from 23% in the morning to 57% at midday. Vehicle traffic represented a smaller portion of the traffic, with a 11% mode share in the morning and 7% mode share in the afternoon.

The nearest bus stop is 260 meters away from the southern corner of the study block. It is served by five different bus lines for nearly constant service during the day.

Streetwall

Buildings are continuous around the entire perimeter of the block. They are all between 3.5 and 4.5 stories tall (half a story meaning the cellar floor is half exposed), ranging from about 12 to 15 meters in height at the ridgeline (39 to 49 ft). With streets 8 m wide the ratio of building height to street width is 0.57.

The buildings all have stucco facade treatments covering their entire facades. Most of the ground floor facades are differentiated from upper story facades by a different paint color, and ground floor facades on several of the buildings have joint lines rendered in imitation of ashlar masonry. There is generally limited ornamentation on the building facades. Most buildings feature at least one horizontal element that runs between two stories, usually rendered in stucco with a slight

1 Steiner, Henriette. The Emergence of a Modern City: Golden Age Copenhagen 1800-1850. Surrey: Ashgate, 2014. Print.

2 Amager still has the nickname "Shit Island"

3 Note: only half of the street parking has been assigned to this block under the assumption that adjacent blocks will have equal parking demand.

4 31 DKK and 740 DKK as of 2016. Hourly evening parking costs 11 DKK ($1.57) and overnight parking costs 3 DKK ($0.43) per hour.

indentation. Some of these elements feature a different material, an ornamental pattern, or a historical plaque. Some buildings have window ornamentation, especially around second story and corner windows. All the windows on the block are six-pane and oblong and are present in two standardized sizes. Building frontage length falls within a range from 7.5 to 21 m (24.5 to 69 ft) with a median length of 11.75 m (38.5 ft).

All street-fronting buildings feature at least one entrance per side or on the corner, with the exception of Knabrostræde 11, which is accessed from the courtyard. Many of the buildings, including all the buildings on Kompagnistræde, have cellar and/or ground floor entrances to businesses. Most of the buildings on the block also feature large arched courtyard entrances. These usually provide access both to the courtyard and back buildings as well as one or more stairwells in the front building. There are a total of 21 entrances on the block, with a mean distance between entrances of 10.4 m (34 ft).

There are 15 street-fronting businesses on the study block. These include restaurants, salons, and shops. All the restaurants are located on Kompagnistræde, a busy walking street.

Uses and Density

This block accommodates residential and commercial uses. There are 68 dwelling units and 48 units not used for dwellings, many of which are used for commercial businesses. The cost of retrofitting units to provide bathrooms in old buildings without indoor toilet facilities may be a cause for units not to be used as residences.

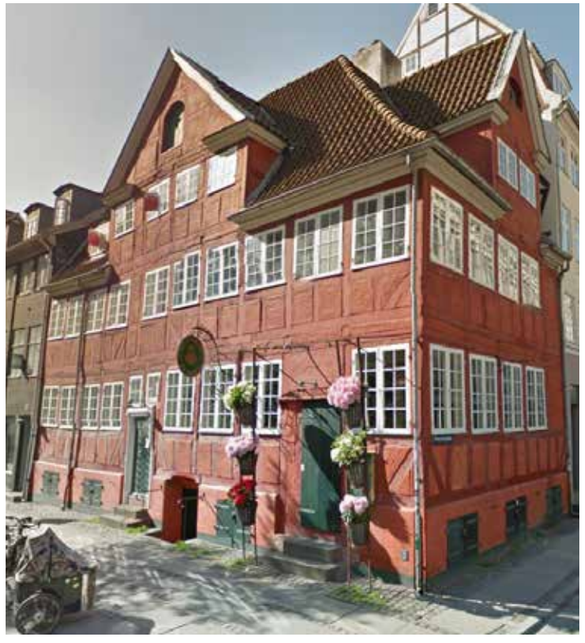
The current average household size in Copenhagen is 1.9 letting us estimate a population of 129 on the study block. The residential density of the block is 184 dwelling units (DU) per hectare (74 DU per acre). Historically all 115 units would have been occupied at least part time as residences, raising the block's density to 310 per hectare (125 DU/acre).

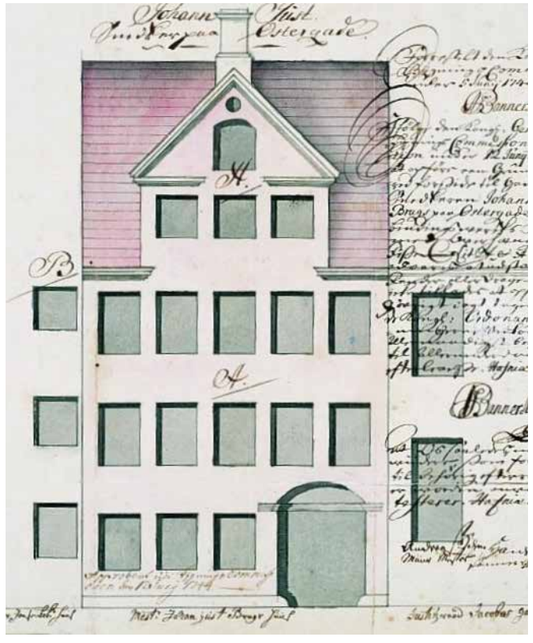
Household size was also higher in the past. We can get an idea of the population density of these buildings during the early 19th century by looking at a somewhat typical case, that of Soren Kierkegaard's house. According to Henriette Steiner, Kierkegaard's family's house was built at some point between 1795 and 1808 and "[t]he house is typical of the early period of reconstruction after the fire in Copenhagen." It housed ten families totaling 42 individuals at the time when Soren became the head of household in 1844.[5] If we take the average household size (4.2) in this apartment house as normal for the period, we can estimate a study block population of 483 around 1844, nearly four times our guess for the present population.

Buildings and flats on this block are all privately held. Three flats are currently for sale on the study block. Their asking prices are $700,000 (at Badstuestræde 16), $825,000 (at Badstuestræde 18D) and $1.6 million (at 14 Kompagnistræde). Respectively these units are 97 m^2 (1,044 ft2), 136 m^2 (1,463 ft^2) and 179 m^2 (1927 ft^2) in size, giving valuations of $7,220/$m^2$ ($670/$ft^2$), $6,066/$m^2$ ($564/$ft^2$) and $8,940/$m^2$ ($830/$ft^2$).

5 Steiner, 2014. 72.

Above: Golden Era Apartment House from 1798. Photo by the author. Below Left: Half-Timber townhouse from 1700. Screenshot from Google Maps. Below Right: Townhouse design by Cornelius Kreiger circa 1720. Wikimedia Commons.





Type: Golden Era Apartment House

The Golden Era Apartment House is the first building type described in this report. It was widely constructed in Copenhagen during and immediately prior to the city's cultural "Golden Age" which ran from about 1800-1850.[1] It was a mixed-use building type which served most of the residential, commercial and light industrial needs of the city. A great number of these buildings have been preserved and they continue to serve residential and commercial uses in the heart of Copenhagen.

Development of the type

The roots of the Golden Era Apartment House come from the lineage of medieval, renaissance, and baroque vernacular architecture in Denmark. It represents the transition from an pre-industrial extended family model to a multi-family model for urban housing.

The direct antecedents for the type lie at the beginning of the 18th century when the city was characterized by two story half-timber structures. There was still open land in the city used for gardens and small farms and the population of Copenhagen was only about 50,000 at this time. Most of these structures were destroyed in the Great Fire of 1728.

The new model for townhouses after the fire was based on designs by the court architect, Cornelius Krieger. This design mandated masonry walls for at least the facade to improve fire safety. It also introduced a partition between front and back rooms and dormer gables, based on the Dutch townhouse design. These plans were made freely available to buildings, promoting architectural advances and stylistic consistency in the city. One of his designs is pictured right.[2]

Plans released by subsequent court architects Nicolai Eigtved and CF Harsdoff did away with the dormer gable and introduced the Neo-Classical style to Danish vernacular architecture. These plans provided standard models for reconstruction after the Great Fire of 1795 and British bombardment of 1807 again decimated the building stock of the city. Also influential were new fire-safety regulations setting a minimum size of courtyards and prohibiting right-angle corners on buildings at intersections to allow better mobility for fire engines. This rule lead to the distinctive rounded and chamfered corners that are seen throughout Copenhagen in buildings built up until the 1920's.[3]

The term "Apartment house" is used for this type because it reflects the transitional nature of this structure between modern multi-family "apartment" building of individual units and the earlier model of a manor house or merchant's townhouse, with multiple families living under one roof related by ties of employment, vassalage, or extended family. The Danish words borgerhus ("citizen's house"), byhus ("townhouse") roughly describe the merchant's houses of the previous period, while lejekaserne ("rental barracks"), bebyggelsen ("settlement") roughly translate to the American use of the word tenement. The combination of these ideas is probably the best way to think about this type.

Individual Form

The typical Golden Era apartment house is about 10 meters wide, between 8 and 12 meters deep

1 In Danish national history this period of painting, music and literature considered to have been especially productive and creative. For more see *The Emergence of a Modern City: Golden Age Copenhagen 1800-1850* by Henriette Steiner

2 Fisker, Kay. "The History of Domestic Architecture in Denmark." In The Architecture of Denmark, 21-37. Aarhus: Aarhus University, 1949. E-Book. 22.

3 Fisker, 1949. 23.

Typical Golden Era Apartment House courtyard. Photo by the author.

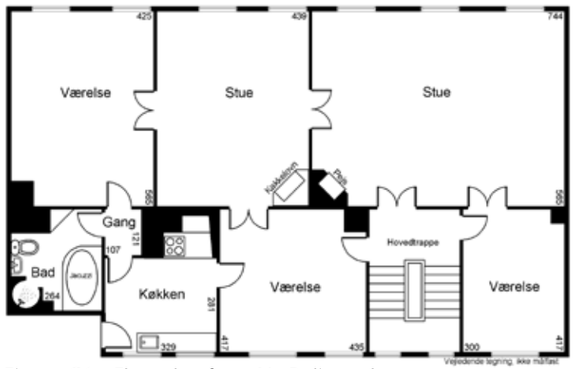


Figure G1 - Floorplan from Ny Bolig real estate.

Figure G2 - Floorplan from Danbolig real estate.

Courtyard building of half timber construction. Photo by the author.

and between three and five stories tall with a peaked roof, attic and a basement. It fronts directly onto a narrow street, with no setback and a building height to street width ratio between 2:1 and 1:1. It usually has one stairwell which leads to the dwelling units, of which there could be as few as one per level, though two units per level is more common. The ground floor is usually elevated half a story above the street, allowing windows to the basement to be placed directly at the ground line.

The typical apartment house had a courtyard which was shared with at least one other adjacent building. The courtyard was bounded by wings or mews (stables or former stables with rooms above) protruding from side of the front structure and/or a "backbuilding" constructed opposite the main building on the other side of the courtyard. This pattern produced many L and U-shaped buildings, which could combine with other buildings to enclose the small courtyards. Less often a building fully encloses its own courtyard in an O-shape. Golden Era buildings were usually built on lots and streets that had changed little in shape since the middle ages, meaning that right angles are rare in these structures.

Combination of form

This building-courtyard-building arrangement with 3-8 m (10-26 ft) wide courtyards functioned best at a depth of about 35 m (115 ft) from the street, meaning a block of no more than 70 m (230 ft) in both dimensions. In larger blocks, the rhythm between form and void becomes chaotic, with large buildings and their wings completely isolated from the street. 20th century slum clearance efforts in Indre By focused on these larger blocks.

It is exceedingly rare for buildings of this era to have publicly accessible open space. The only such cases in the old city of Copenhagen occur around churches. All other open space is made up by public squares, street right-of-way, or courtyards. With narrow streets and high building coverage, districts made of Golden Era apartment houses create spaces with very well-defined streetscapes that act as corridors and social spaces.

Floor plan

Figure G1 is a contemporary plan for a flat from the second floor of a typical midblock Golden Era apartment house (14 Kompagnistræde on the study block). The main rooms (*stue*) look out onto the street while the kitchen (*køkken*) and bedrooms (*værelse*) face the courtyard, an organizational pattern which held for apartments in Copenhagen until the 1930's. The bathroom has likely been added during building renovation. It is possible that this unit represents two combined units because there is more than one access point from the stairwell. It has an area of 179 m^2 (1926 ft^2).

Figure G2 shows smaller floor plan from the 1st floor of a corner apartment house (Badstuestræde 16 on the study block). The bathroom (*bad*) and kitchen have windows to the small courtyard, while the living and bedrooms look out onto the street. The unit has an area of 97m^2 (1044 ft^2), and probably has not been combined with any other units as there is only one access point to the stairwell.

Construction and appearance

Brick with stucco is the dominant construction material for buildings of this type. Half-timber construction is common for rear walls and in backbuildings and wings. Wood beams support floors and peaked roofs. Roofs consist of red terracotta tiles.

Some later apartment houses feature stucco styling on the ground floor in imitatation of ashlar masonry. This is representative of the "Empire" style inspired by imperial Paris during the early 19th century. Other modest ornamentation sometimes consists of horizontal bands marking off the separation between floors and ornamentation around corner windows.

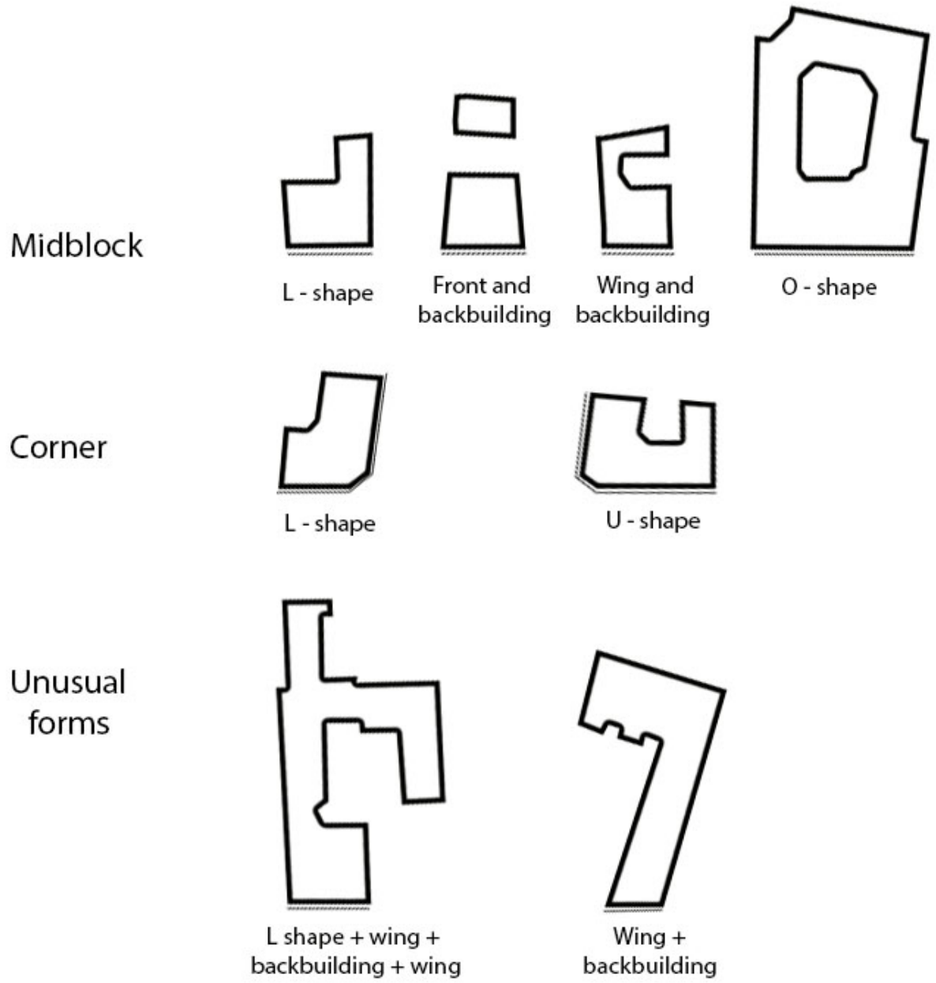


Figure G3 - Typical footprints for Golden Era apartment houses and relation to street. Image by the Author.

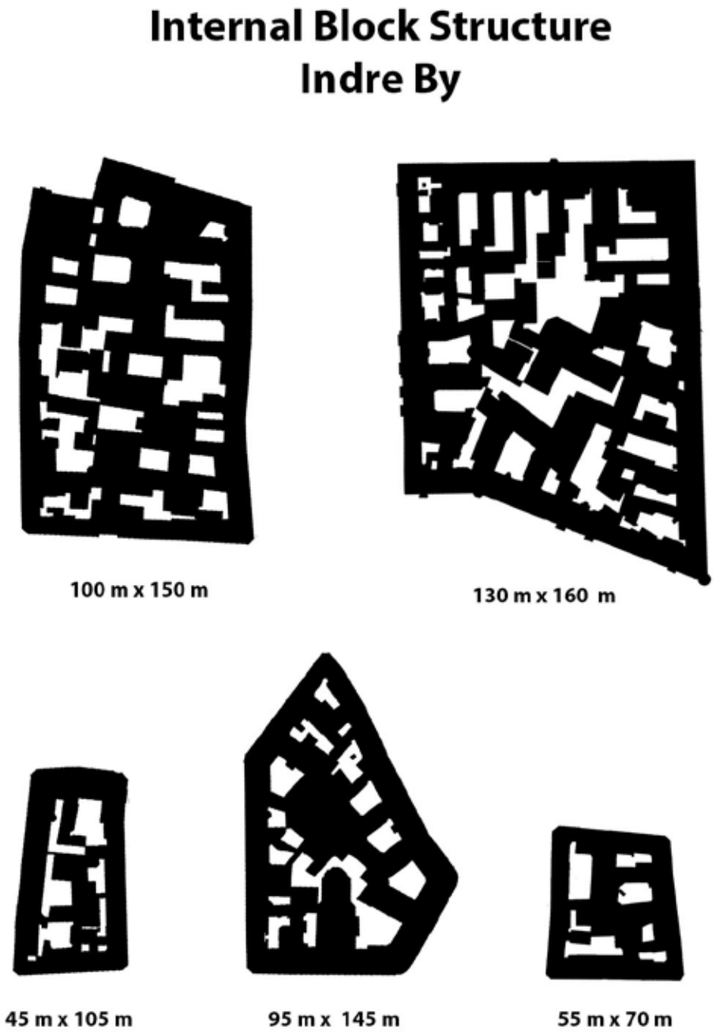


Figure G4 - Figure-ground of individual blocks in Indre By. Internal strucuture breaks down at widths greater than 70 m. Image by the author.

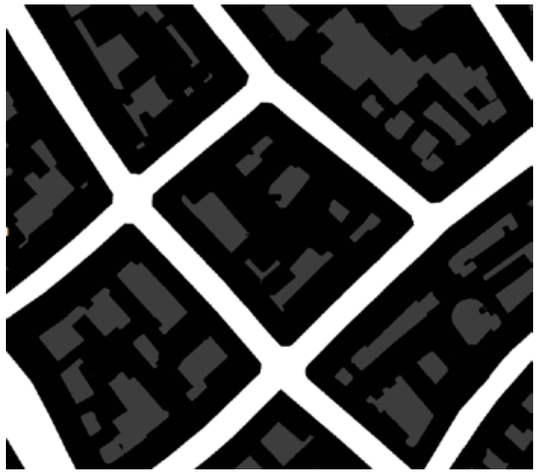


Figure G5: Public Realm - areas in white are accessible to the public

Indre By courtyard in late 19th century. Copenhagen Municipal Archives.

Construction of these buildings were usually financed by wealthy bourgeois families. This family would occupy most comfortable part of the house and then could rent out the other floors to tenants or use them to house employees of the family. The building served as a manifestation of the wealth of the family and represented its stake in the city.

Function

These buildings served a variety of uses, but the most common one was housing. Usually all the floors above the ground floor were used as residences. Shops, workshops and pubs might be located either on the ground floor or in the basement and often fulfilled residential uses simultaneously. The most expensive habitations were on the 1st floor (counting in the European style with the "1st floor" being above the ground floor) and were known as the belètage. The upper floors housed those of more modest means, with the attics usually reserved for servants.

The vertical arrangement of the apartments of varying quality yet sharing walls and stairs mirrors the vertical arrangement of social classes at this time, which operated in separate but overlapping worlds. The bourgeois families occupied the most visible and comfortable level of the building, with petty bourgeois, widows and widowers, and peripheral classes above and below, and the poorer classes nearly out of sight above, below, or behind the main sections of the building.[4]

Courtyards were used for privies, light industrial work, and to corral animals. According to one estimate there were nearly 3,000 horses, 1,500 cows, 800 pigs and several dozen sheep present in the city in 1838. Industrial operations taking place in courtyards might include tanneries or blacksmiths. Backbuildings and wings generally housed servants or lower income tenants.[5]

Adaptations

As the density of the population increased within the city the form of the house came to function ever more as a purely multi-family dwelling.

Golden Age apartments have been adapted from their original state to modern standards. This has mostly been undertaken by private property owners and with government funding. Significantly, much of the exterior built fabric remains little changed from the 19th century. Few courtyard building demolitions have occurred many blocks remain entirely intact from the early 19th century. Modifications to the interiors of buildings have mostly involved the addition of toilets and bathing facilities and the combination of small apartments. Courtyards are now used for automobile and bicycle parking, utilities and waste disposal, and open space. However, most courtyards associated with this building type are quite small allowing little natural light and putting a premium on space for utilitarian purposes.

Variations

This basic building type is highly adaptable for different uses. It was and continues to be well suited for use as offices or institutional buildings. It's basic form can also be modified for educational uses, as can be been at the old campus of Copenhagen University.

Over the course of the 18th century this building type became larger, more ornamented and more standardized. When given room to expand it evolved into the Industrial Era Flats, the next building type to be discussed.

4 Steiner, 2014. 33.
5 Steiner, 2014. 76.

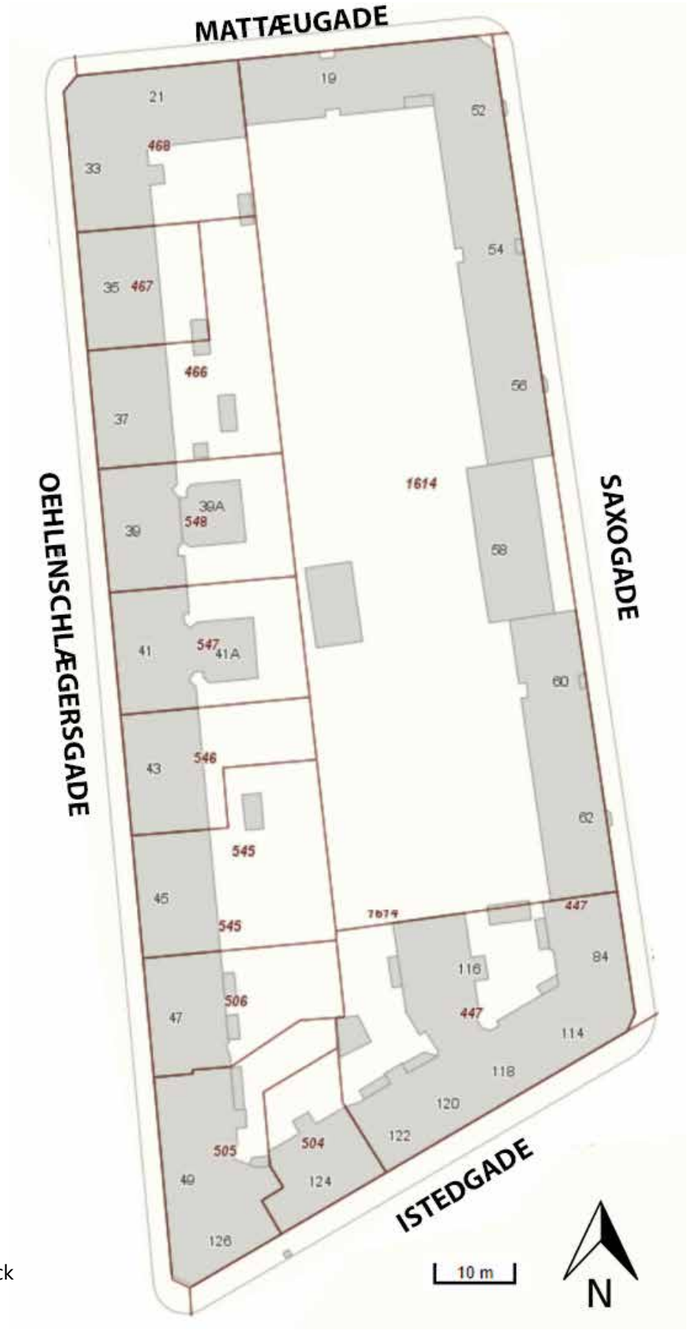


Figure V1: Study block cadastre.

Study Area: Vesterbro

Study block

The study block is located in the Vesterbro neighborhood, 1.7 km from the city center. It forms an irregular quadrangle with an area of approximately 8,760 m^2. It's sides are 56, 68, 162, and 125 meters long on N, S, W, E sides respectively, for a total perimeter length of 412 meters. There are 14 buildings on the block surrounding one courtyard.

Parcels

There are twelve parcels on the study block. They range in size from 225 m^2 to 4,011 m^2, with a median size of 412 m^2.

All the parcels on this block include street frontage and a rear area for a courtyard and backbuildings or wings. Although the street-fronting sections of the parcels are mostly uniform in width, in the courtyard areas some parcels are much wider than others.

A historic map from 1879 indicates that the block was originally divided into two parcels, each facing one of the long sides of the block. This division is maintained in the current cadaster, with the west-side parcel broken up into smaller units but the east-side parcel mostly intact (or reassembled).

Built Area

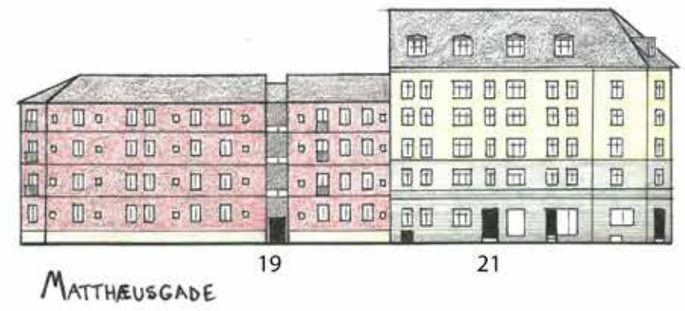
There are fourteen buildings on the study block. Of these, eleven were constructed between 1883 and 1885, which are located along Oehlenschlægersgade and Istedgade. Three buildings (or three segments of a single building) were constructed in 1982 as social housing along Saxogade, replacing a number of older buildings of the same type as to those on Oehlenschlægersgade.

The building coverage for the block is 48%. This represents a significant decline from the 85% seen in aerial photography from 1945. At that time eight apartment blocks were present on the east side of the block in the area now occupied by the social housing buildings and their associated courtyard. There were also several courtyard several backbuildings in the west side of the block which have since been demolished. The block has a FAR of 2.27.

The older buildings on the block are consistent in scale and style, and it is possible they were constructed by a single firm. They are all five stories tall with basements and dormers, with the exception of the south-west corner building, which is six stories tall. They range in frontage lengths from 16 to 36 meters, and have ornate decoration in the Italianate style around the windows, especially on the middle floors, and have painted stucco facades. These buildings are iterations of the "Industrial Era apartment" type which proliferated in this and similar neighborhoods from the 1860's to the 1910's and is detailed in detailed in the next section.

The social housing buildings are shorter than the others but are significantly longer. They could be considered one continuous building, but are being here treated as three separate buildings due to variations in height. They have a continuous, unadorned brick facade and are clearly the work of a mechanized production and construction processes. These buildings are a late form of the "welfare state apartment" type which is described later in this report.

Open space



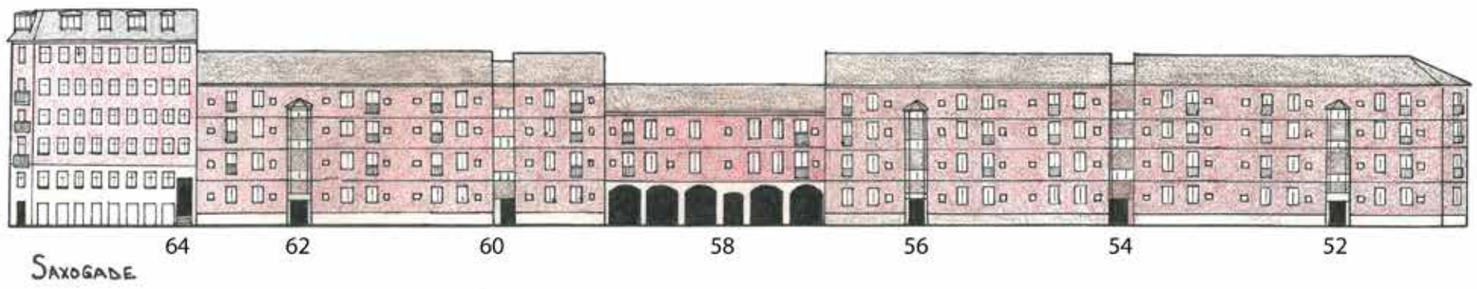


Figure V2: Study block elevation. Drawings by the author.

Figure V3: Present and historic building footprints on the study block. Image by the author.

The central area of the block forms a single courtyard of with dimensions of about 125 m x 40 m (410 x 130 ft) with an area of 4,500m² or 52% of the surface of the block. Other open space on the block is negligible.

There are eight buildings with entrances that access the courtyard directly from the street. One of these (Saxogade 58) includes vehicle access for service vehicles. Other buildings likely have direct access to the courtyard via kitchen stairwells.

This courtyard was renovated in 1980 with funds from the City as part of an urban renewal program. This required a vote in favor by at least ⅔ of the residents and property owners of the block. The courtyard contains a playground, trees and lawns, covered bike parking and seating areas. As required by the City it is maintained by a commission which all property owners on the block contribute based on the floor area of their building. The courtyard is accessible to all properties on the block.

Streets and Transport

The study block is located between Matthæusgade, Oehlenschlægersgade, Istedgade and Saxogade streets on its N, E, S and W sides. A streetcar route formerly ran along Istedgade, which has an 18 m (59 ft) right of way, with 4 m (13 ft) sidewalks on both sides.

The other three streets all have rights of way of about 12 m (39 ft), with 2.5 m (8 ft)sidewalks on both sides. Istedgade is unusual among arterial streets in Copenhagen in that it lacks complete bike lanes.

Non-roadway space is occupied by wide sidewalks, parking and partial bike lanes, with a small amount of cafe seating in the sidewalks. Sidewalks are paved with cobblestones and concrete blocks, while roadways, parking areas and bike lanes are paved with asphalt. The smaller streets accommodate one lane of traffic with automobile and bicycle parking on both sides of the street. Sidewalk bulb-outs shorten crossing distances in some of the intersections.

There are 12 street-level businesses on the study block. These are located on the ground-floor of Industrial Era buildings and tend to be located on the corners and along the busiest street, Istedgade. Several businesses are also located mid-block on Oehlenschlægersgade. These include two pubs, a hair salon, a bicycle shop, a bakery, a convenience store, a hardware store and other shops.

There is no on-site parking on the study block. There is parallel street parking along all four streets surrounding the study block, for a total capacity of about 50 spaces, or 0.24 spaces per unit. Street parking costs $1.57 hourly during the day and $105 for a yearly pass for residents.[1]

Traffic count conducted during morning rush hour and midday on Istedgade observed about 1200 passersby per hour, with similar total levels of traffic at both times. The bicycle mode share fell from 59% in the morning to 30% at midday. The walking mode share rose from 18.5% in the morning to 30% at midday. Vehicle traffic rose from a 18% mode share in the morning to a 40% mode share in the afternoon.

Bus lines 10 and 14 travel along Istedgade with a stop on Istedgade adjacent to the study block. These buses have combined 6 minute headways during the day. Construction is underway on a new metro line which will have a stop 250 meters from the south-west corner of the study block. Construction is hoped to be completed by 2019.

Streetwall

Building frontage is continuous along the entire length of the block, meaning the inner spaces of the block are fully enclosed. The Industrial Era buildings on the block are most five stories tall,

1 11 DKK hourly and 740 DKK yearly as of 2016

Istedgade 114. Photo by the author.

with the exception of Istedgade 116-122 at six stories, and are about 15-16 m tall (49-52 ft) at the ridgeline with partially above ground cellars and attic dormers. The Welfare Era housing block has four stories without dormers or cellar windows. This gives a building height to street width ratio range from 1.2 on Istedgade to 0.8 where there are Industrial Era buildings on the other streets.

Frontage length of buildings on this block ranges from 16 to 55 m (52 to 180 ft), with a median length of 16.8 m. The Welfare Era building type has by far the longest frontage lengths on the block. There are 52 entrances from the street level on the study block including cellar entrances, shop entrances, courtyard entrances and stairwell entrances with a mean distance between entrances of 7.9 m (26 ft). Almost all of the Industrial Era buildings have at least two entrances, though they vary in entrance type and placement.

The appearance and interest of the exterior face of the block is enhanced by different styles of windows, doors, facade treatments and exterior ornamentation among the older buildings. Entrances and shop windows add another degree of complexity. The block face along Oehlenschlægersgade exhibits a degree of variation in ornamentation, facade treatment and color within a repeating pattern. The block face along Istedgade has a high density of shops with entrances and windows.

There are 12 street-level businesses on the study block. These are located on the ground-floor of Industrial Era buildings and tend to be located on the corners and along the busiest street, Istedgade. Several businesses are also located mid-block on Oehlenschlægersgade. These include two pubs, a hair salon, a bicycle shop, a bakery, a convenience store, a hardware store and other shops.

Uses and Density

There are 206 dwelling units on the study block, yielding a block density of 235 DU per hectare or 95 DU per acre. The current average household size in Copenhagen is 1.9 lets us estimate a population of 391 residents on the study block.

If the density of units per building in the demolished structures was the same as that of existing industrial era apartments, the block would have had about 295 dwelling units in 1945. This would translate to 337 DU per hectare (136 DU per acre). At that time the houshold size was approximately 4.1, giving us an estimate of 1,209 for the block population, three times the present population.

Seven of the Industrial Era apartment buildings on this block are co-operatively owned. The remaining four are privately owned by a single entity and rented out or are owned as condominiums. The social housing buildings are owned and operated by KAB, the largest social housing provider in Denmark.

In 1920 this neighborhood had the cheapest rents in the city. Today Industrial Era apartment buildings are similar to those on this block have conominium units listed between $360,000 and $870,000, or $5,600/$m^2$ and $8,870/$m^2$. Social housing rents on this block are $900 per month for three room 77m^2 (829 ft^2) and $1200 per month for a four room 110m^2 (1,184 ft^2) unit, or $12 per m^2 and $11 per m^2 monthly respectively. A three room 95 m^2 (1023 ft^2) private rental on a nearby block is renting for $1,725 per month or $18 per m^2. A four room 143 m^2 (1,539 ft^2) penthouse unit nearby is renting for $3,600 monthly or $25/$m^2$.

Above: Industral Era Flats from 1884. Below left: Backbuilding and front building. An additional story and skylights have been added to the backbuilding. Below Right: back side of late Industrial Era Flats. Photos by the author.

Type: Industrial Era Flats

Industrial Era Flats is a building type which describes multi-family housing built in Copenhagen from approximately 1860 to 1910. It was designed from the start to serve as multi-family housing and was built for profit by speculative developers. It had a modular form based on the layout of the Golden Era house, expanded to new dimensions to fill the space outside the old walls.

Development of the type

Industrial Era Flats were widely built after the demarcation line which had prohibited building outside the ramparts was abolished in the 1850's and the ramparts were demolished in the 1860's. The industrial revolution arrived in Denmark at this time and the population of the city rose from 150,000 in 1860 to 450,000 in 1900 as farmers and peasants made their way to the city to look for wages.

Industrial Era Apartments were strongly influenced by buildings laws passed in 1856, which mandated minimum housing standards for the first time. Subsequent laws were passed in 1871, 1875 and 1889 which mandated minimum unit sizes, number of access points, building coverage, street width, building spacing and facade modulation.

These standards required each apartment to be accessible by two staircases, and that site coverage not surpass 75%. A new law enacted in 1871 lowered the coverage requirement to 66.7%. Further legislation four years later mandated the minimum “right-angle distance” between a window and its opposite wall.

Individual Form

The typical Industrial Era Flats building is about five stories tall, with an inhabitable attic and a cellar. It maintains the “Golden Era” organization of a central stairway with apartments on either side and an entrance onto the street, however, these buildings tend to be larger in scale. They typically have a frontage of about 16 m (52 ft) per stairwell, going down to a a minimum of about 12 m (39 ft). They often include more than one stairwell but rarely dominate and entire block face. Industrial Era Flats are 10-12 m (33-39 ft) deep. Roofs can either be peaked or leveled off at the attic level.

Industrial Era apartment buildings were adaptable to specific sites and block shapes, however their forms are more standardized than Golden Era apartment houses. Back and side buildings were often built at the same time as from builings to increase profitability. Front buildings with side buildings would make T or L-shaped buildings, while U- and O-shaped buildings also occur. L’s, T’s, wings and back-buildings were also combined in a wide variety of forms to maximize buildable land.

Industrial Era Flats always had access to a courtyard behind the main unit. As in the old city, these were poorly lit and poorly ventilated utilitarian spaces, used for privies, stables, garbage, light industry, but mostly they were packed with low-quality housing. The backbuildings were cheaply built to very high densities and have been widely disdained in the Danish consiousness. The government began a first round of clearing backbuildings in the 1950's followed by another round in the 70's and 80's.

Over the period when Industrial Era Flats were being constructed several historicist, highly ornamented styles came into and out of vogue however. Sometimes one style dominates an entire block-face, sometimes many different styles are found on the same block. In general all

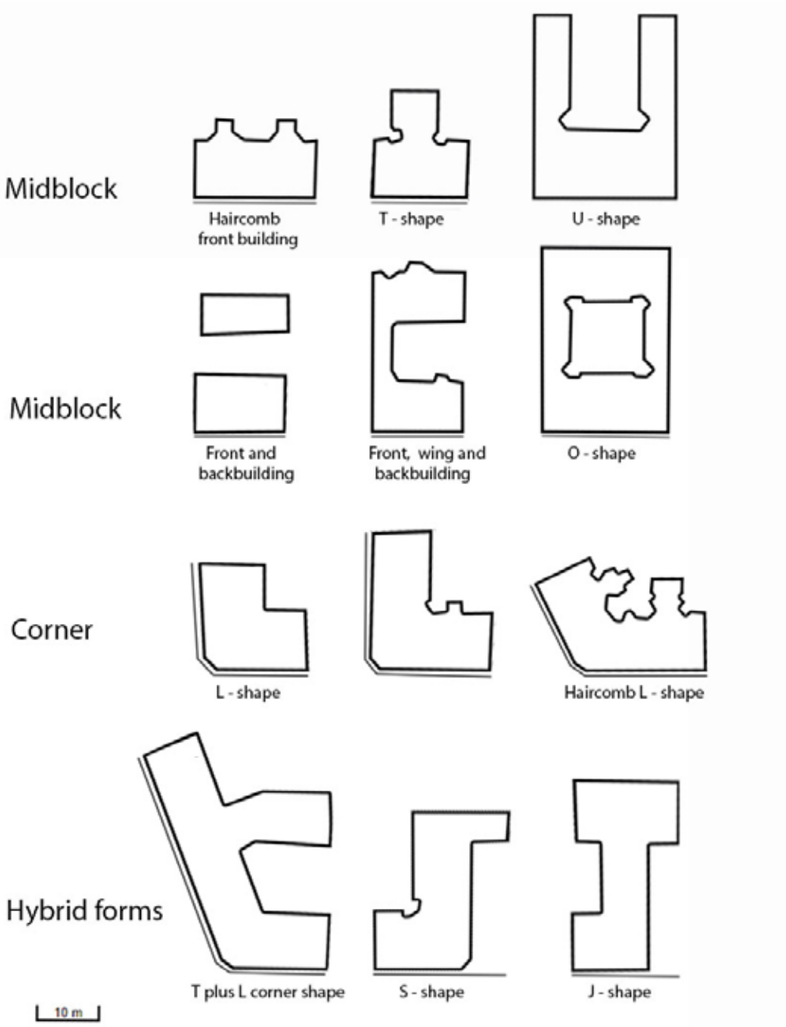


Figure I1 - Common building footprints and relation to street. More than any other type, Industrial Era Flats has a modular form designed to be combined with other buildings of the same type. Image created by the author.

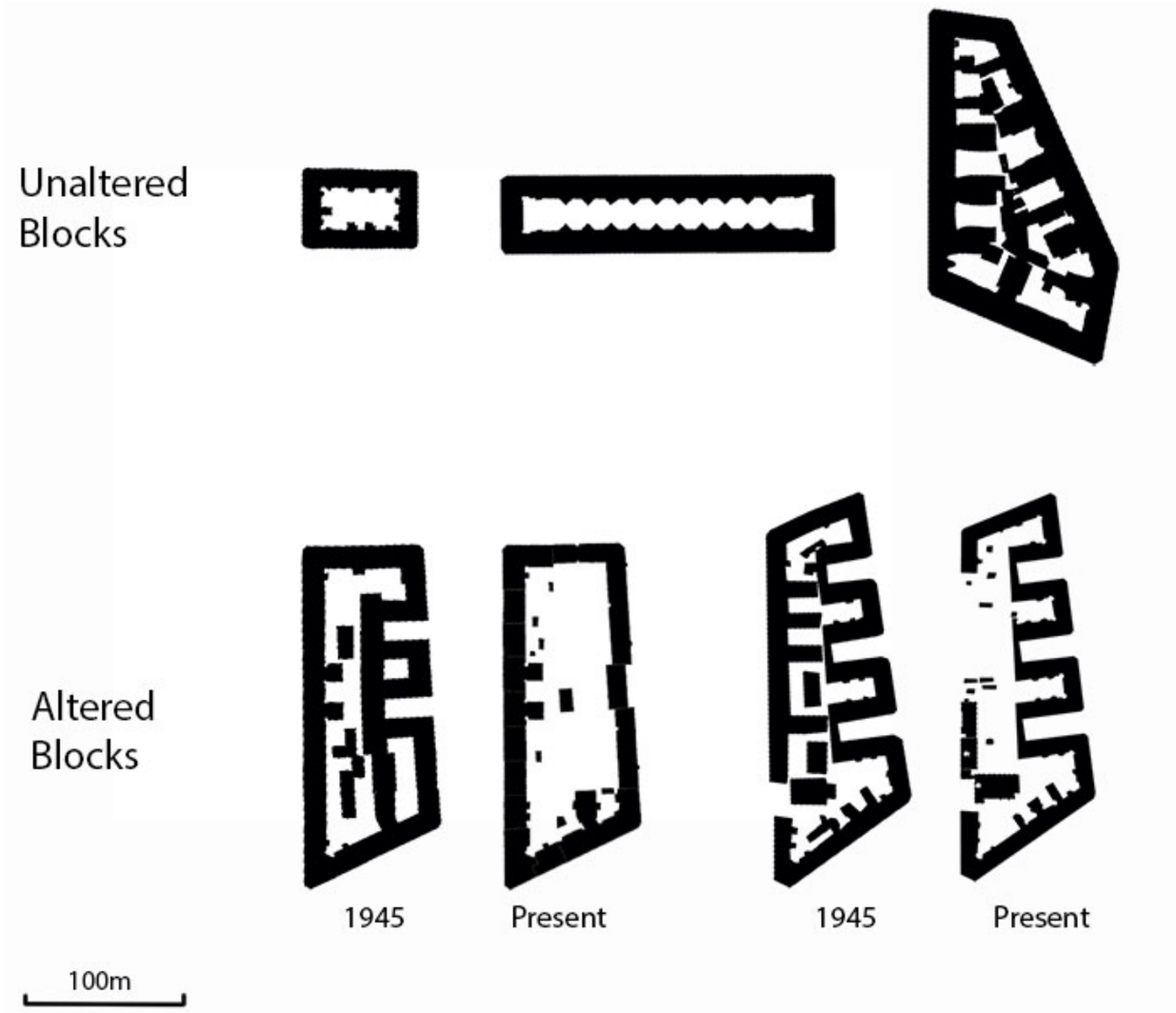


Figure I2 - Internal structure of blocks of Industrial Era Flats. Image created by the author.

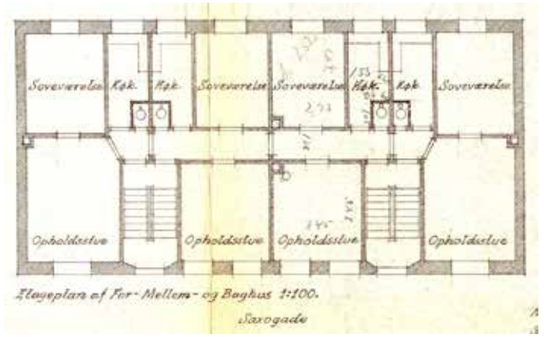


Figure I3 - Floor Plan for four units in a backbuilding from 1874, demolished in 1983. The toilets were added in 1920. Source: Copenhagen Municipal Archives

Typical bathroom in 2 room flat. Photo from nybolig.dk

Streetscape in Inner Norrebro. Photo by the author.

Figre I4 - Seven room, 179 m² unit from 1885. Source www.danbolig.dk

Courtyard Buildings. Photo from Copenhagen Municipal Archives.

these styles were oriented towards the street and followed established patterns for windows and doors, resulting in a street environment that features both complexity and regularity parameters.

Floor Plan

Units were usually arranged perpendicular to the street, with living rooms on the street side and bedrooms and the kitchen on the courtyard side. There was a wide range of different apartment sizes from one room to more than seven. Over the course of this period two room flats became the most common floor plan type.[1]

Legislation from 1802 had incentivized very small units however, as apartments of less than 27m² (290 ft²) paid no "floor-space tax". The minimum exemption for this tax was raised to 31.5 m² (340 ft²)in 1873. Total dwelling size increased after 1889 when the minimum size for any one room was set at 5.91m² (64 ft²). At this time all rooms were also required to have a window.[2]

All Industrial Era Flats were required to have a second stairwell for fire-safety, although a loophole allowed builders to place a communicating door between units of adjacent stairwells instead. When built, the secondary stairwells usually connect the kitchens of each unit directly to the courtyard, without street access. They were used by servants or residents carry coal ash and refuse from the kitchen down to the courtyard, but now provide easy access to renovated courtyards for residents. These are commonly called "kitchen staircase" and are usually located directly behind the main stairwell, although sometimes they are located at the edge of the building. In the 1890's these stairwells increasingly were built to protrude from the back of the building, creating the "hair-comb" pattern. This maximized floorspace at the expense of light and space in the courtyard.

Toilets started to appear indoors in 1897 when the first sewer system was completed. Before this time residents relied on privies located in the courtyard. In one Industrial Era building in Vesterbro 220 residents shared 12 privies, and did not receive indoor toilets until 1920.[3] The floor plan for the backbuilding of this property is pictured right, with four 30 m² units. These were usually placed in very small rooms and as far away as possible from the main rooms of the apartment.[4] It was also common for toilets to be placed in small rooms accessed from the stairwell and shared between several units. Bathing facilities were usually absent except in the most luxurious units, with most residents making use of public bathhouses when possible.[5]

Combined Form

Industrial Era apartment buildings tend to create a street environment characterized by a continuous streetwall, with elaborate but ordered facades. Facades were initially required to be flush with the street and building corners at intersections were still required to be chamfered or rounded. The combination of these two factors with regularity of height and straightness of streets gives districts characterized by this type an geometric appearance.

1 Hiort, Esbjørn. Housing in Denmark since 1930. Copenhagen: J. Gjellerup Forlag, 1952. Print.
2 Hiort, 1952. 10
3
4 Sørensen, S., B. Petersen, N. Kofod, and P. Jacobsen. "Historical Overview of the Copenhagen Sewerage System." Water Practice and Technology 1, no. 1 (2006). doi:10.2166/wpt.2006007.
5 "The Sørensen Family Apartment." Danish Design Review. Accessed December 15, 2016. http://danish-designreview.com/blog/2015/12/4/the-srensen-family.

Faux ashlar styling on lower stories. Photo by the Author.


Late Industrial Era building with faux ashlar styling on lower stories. Photo by the Author.


Renovated courtyard in Vesterbro. Photo from www.danishdesignreview.com

In older parts of town buildings of this type tend to front onto streets of minor streets of 12 m (39 ft) in width, and arterials of 18 m (59 ft). With 12 meter streets the building height to street width ratio was 5:4. The Housing Act of 1889 required all streets to be of 18 meters, lowering the building height to street width ratio to 5:6.6 Industrial Era Flats rarely have setbacks, so these rights-of-way represent most of the public realm in these neighborhoods. They serve as relatively narrow corridors between walls of buildings while the courtyards in the now hollow blocks making up the bulk of the open space.

Building forms on a single block would combine into many different formations, however these blocks tend to be more ordered than blocks made up of Golden Era apartment houses. The blocks tend to be rectangular and between 40 and 70 m wide (141 to 230 ft) and up to 200 meters long.[7] Blocks of less the 45 m (147 ft) in width tended to have dark narrow courtyards due to the height of the buildings. This space was further degraded if there were building extensions for extra units or kitchen stairwells protruding into the courtyard or if the block was oriented east-west and therefore received no sunlight during winder months.

Many of these blocks were substantially altered by slum clearance and urban renewal programs in the latter half of the 20th century. In city-sponsored urban renewal programs courtyards were combined and turned in to shared, landscaped green space.

Construction and Appearance

Construction materials were usually red brick with painted stucco until about 1900. Stucco ornamentation could be quite elaborate, especially on the 2nd and 3rd floors. A common motif for buildings of this type is a stucco facade on the ground floor and sometimes 1st floor with joint lines rendered in imitation of ashlar masonry. After 1900 yellow brick without stucco becomes more popular.[8] Roofs are tiled with slate or made to look as such in the earlier period to about 1900. They are either gabled or flattened off above the attic level. After 1910, gabled red-tile again roofs became popular.

The Housing Act of 1889 allowed bayed windows and balconies on street-fronting faces of buildings for the first time. Bay windows and corner overhangs became popular in the next two decades, but balconies did not become common until the 1930's. Ornamental turrets and other romantic ornamentation can be seen on the most elaborate Industrial Era Flats.

It was common for buildings of this type to be constructed by speculators as a profitable venture. The first building finance company was established in 1851, allowing the construction to be financed by loans as a profitable venture.

Function

Industrial Era apartment buildings were primarily used as a residence. In keeping with the Golden Age model, the Industrial Era apartment buildings were stratified based on socio-economic class. The first and second floors were the most prized, and often feature elaborate ornamentation on their outer features. Ground floor units could be low-rent residential, due to the lack of privacy, or have commercial or productive uses. Basement units are present but tend to be much less prominent than in apartments from the previous era. Very small ground-level windows offer little access to natural light.

6 Hiort, 1952. 11
7 The longest block found so far by the author is 380 meters long in Frederiksberg.
8 Hiort, 1952. 11

Renovated backbuilding with elevator. Photo from www.nybolig.dk

Light industry or stables would often be placed in the courtyards.

Adaptations

Since the mid 20th century, government and private efforts have improved the quality of many of the Industrial Era apartment buildings in Copenhagen. Early efforts to reduce overcrowding and improve living conditions lead to the demolition of courtyard buildings and the installation of private toilets and bathrooms. The opening of courtyard space has allowed improvement of courtyards with landscaping and playgrounds by block committees with city support. Efforts to increase home values have lead to the combination of small units into larger units and installation of balconies. Some buildings have also been equipped with elevators and roof-top decks.

A law passed in 1975 gave the tenants of any building put up for sale the right to purchase it collectively from the seller before it could be offered to any other buyer. This lead to the creation of many co-ops, especially in older buildings, including many Industrial Era apartment buildings. Other apartment buildings continue to be privately held, or exist as condominiums of "freehold flats".

Variations

Industrial Era Flats varied a great deal in size and ornamentation depending on the economic level of the target residents.

Like the Golden Era apartment house, this type of building was suitable for modification as an institutional office or educational building. Its pattern could be repeated infinitely to fill any needed parcel or block size, a practice that became increasingly common for workers housing and ultimately evolved into the "welfare state apartment block" of the 20th century. Further from the city center Industrial Era apartments were more likely to be three or four stories rather than five or six.

As time went on these buildings became increasingly specialized by social class, another trend which lead to the evolution of the "welfare state apartment block" type, which is described in the next section.

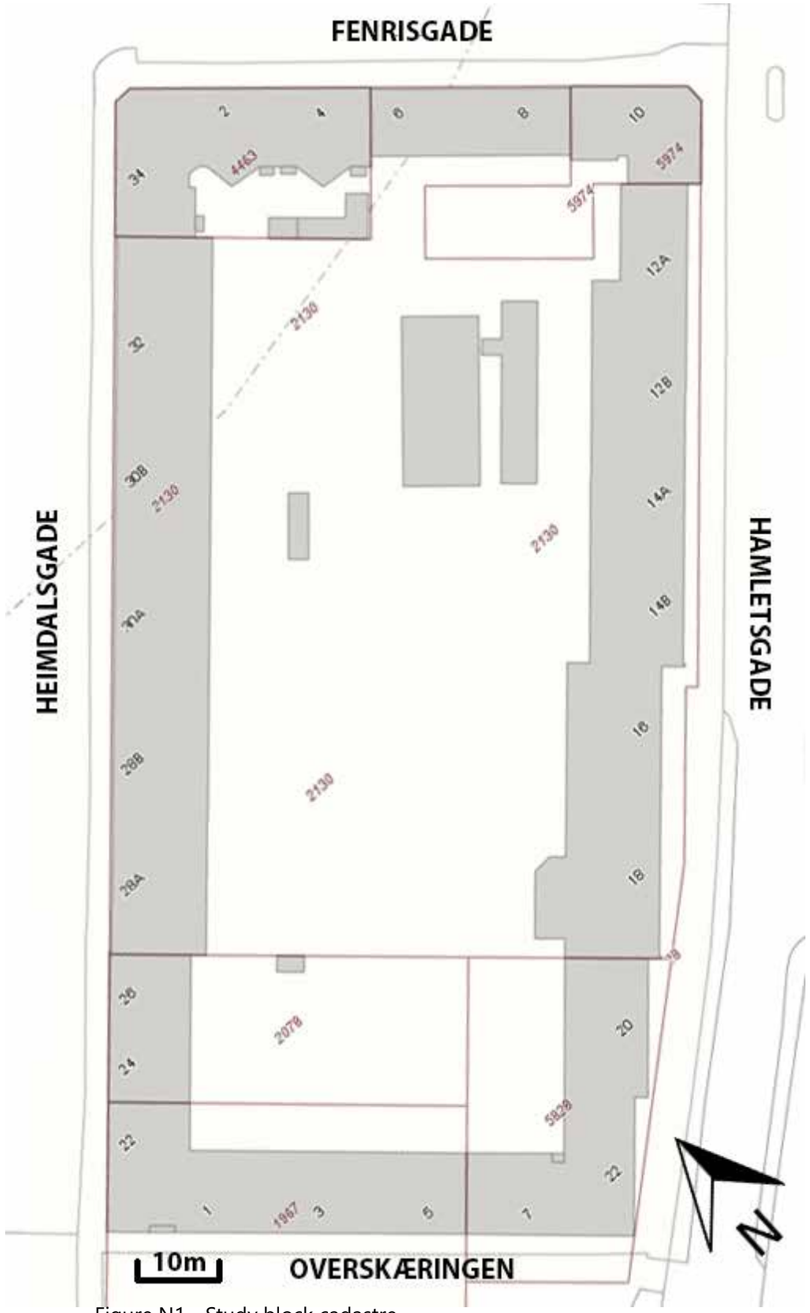


Figure N1 - Study block cadastre.

Study Area: Norrebro

Block

The study block is located in the outer edge of the Nørrebro neighborhood. 3.2 km (2 mi) from the city center. It has an area of approximately 11,173 m^2 or 1.12 hectares (2.76 acres). It is roughly rectangular with side lengths of 147 m , 75 m , 146 m, and 67 m (482 ft, 256 ft, 479 ft and 220 ft) on its SE, NE, NW and SW sides for a total perimeter of 462 m (1516 ft). It contains eight buildings and one courtyard.

Parcels

The study block is composed of six parcels, ranging in size from 400 m^2 (4,300 ft2) to 7,128 m^2 (76,700 ft^2) with a median size of 827 m^2.

They are mostly rectangular with the exception of the parcel containing Fenrisgade 10, which appears as two adjacent rectangles connected at a corner, and the largest parcel of the block, which partially surrounds this smaller irregularly shaped parcel. Each parcel includes street-frontage and space within the courtyard, although they do so in various configurations and the central parcel contains street-frontage on three sides. Each parcel is occupied by at least one separate building.

A historic map from 1931 indicates that the study block and the small adjacent block to the southwest were united at that time.

Buildings

There are eight buildings on the study block. They cover 46% of the surface area of the block. The FAR is 2.32.

These buildings were built in 1913, 1920, 1937, 1949 and 1978. The earliest building (Fenrisgade 2) is in the National Romantic architectural style and the building from 1920 (Fenrisgade 10) is in the Neo-classical style[1]. The mid-century buildings have a functionalist style, and the buildings from 1978 could almost be called Brutalist in style. In this block one can see the transition from the late-stage Industrial Era type in the oldest buildings to the Welfare Era type and the evolution of its form.

They have similar depths in the range of 9-13 m (30-43 ft) and are all five stories high. All have peaked roofs and only Fenrisgade 2 (the oldest building) has dormers above the fifth story.

Aerial photography from 1954 indicates that the middle section of the block, now occupied by the social housing buildings was at that time occupied by non-residential uses.

Open Space

The center of the block is occupied by a single 125 x 42 m (410 x 138 ft) courtyard of about 5,800 m^2 (1.4 acres), which occupies 50% of the surface area of the block. It is subdivided into 3 sections of different sizes, each of which accessible by a different combination of buildings. The largest of

1 Styles called "neo-classical" are present both at the beginning of the 19th century and at the beginning of the 20th in Denmark.

Figure N2: Study block elevation. Drawings by the author.

these sections takes up about ¾ of the courtyard and is landscaped with plants and grass and includes a large playground, outdoor seating areas, and a waste collection area. Beneath the largest section of the courtyard is a parking garage.

The residents can access the courtyard through some of the stairwells of the surrounding buildings or through one of the three large entrances, at Hamletsgade 20, Fenrisgade 6, and Heimdalsgade 22. Ground floor flats all have direct courtyard access, and many have small decks that extend a short distance into the courtyard. Vehicles can access the courtyard and parking garage through the vehicle entrance off Fenrisgade.

About 200 m^2 (2152 ft^2)of open space lies between Hamletsgade 12A and the street. This space is occupied by small grass lawns and surrounded with low chain-link fencing. These lawns do not appear to be used for any purpose, however the residents use the fences to lock bikes.

Streets and Transport

The study block is bounded by the streets Hamletsgade, Fenrisgade, Heimdalsgade , and Overskæringen on its SE, NE, NW and SW sides.

Hamletsgade is the largest street, with a right-of-way of 19 m (62 ft). It has two vehicle travel lanes each 3.5 m wide (11.5 ft), sidewalks 3.75 m (12 ft) wide. There are also 2.25 m (7.5 ft) shoulder that is alternately used for parallel parking or bike lanes.

Fenrisgade is 14 meters wide and has one bidirectional travel lane 5 m (16.5 ft) wide. It has 2 m (6.5 ft) wide sidewalks on both sides with bulb-outs at the intersections and a raised, textured crosswalk where it meets Hamletsgade. There are also shoulders used for parallel parking.

Heimdalsgade is 18 m (59 ft) wide, but has only one bi-directional travel lane 5.5 m (18 ft) wide. It has sidewalks 2.25 (7.5 ft) meters wide and wide shoulders used for diagonal parking on both sides of the street.

Overskæringen is 10 m (33 ft) wide, with one bi-directional travel lane 3 m (10 ft) wide. It has a 1.5 m (5ft) sidewalk on the study block side. There is parallel parking occupying 2.5 m (8 ft) of roadway adjacent to the sidewalk and diagonal parking occupying 3.5 m (11.5 ft) on the opposite side. There are sidewalk bulb-outs and raised, textured crosswalks at the intersections at both ends of the street. This street was likely added at the time of the development of the adjacent apartment blocks and is contained within the parcel of one the block directly to the south-west.

All sidewalks are paved with combinations of cement paving stones, asphalt, and cobblestones.

There is one coffee shop on the corner of Heimdalsgade and Overskæringen.

There is an underground parking garage serving Heimdalsgade 28A, Hamletsgade 12A and Fenrisgade 6 with approximately 100 parking spaces which is accessed via a entrance at Fenrisgade 6. There are 52 street parking spaces on the study block. Together these provide a total parking capacity of 152 or 0.53 spaces per DU. Street parking is free in this part of Copenhagen.

Traffic count conducted during morning rush hour and midday on Hamletsgade observed about 1200 and 600 passersby per hour, respectively. The bicycle mode share fell from 38% in the morning to 28% at midday. The walking mode share rose from 13% in the morning to 20% at midday. Vehicle traffic rose from a 48% mode share in the morning to a 52% mode share in the afternoon.

Bus line 6A travels along Tagensvej with a stop about 200 meters from the western corner of the block. This bus line has 3 minute headways during the day. The blocks to the east of the study block is Nørrebro station S-Train station, which is served by the F line with 5 minute headways at peak hours. Construction is also underway on a new metro line with a stop at Nørrebro station. The line is hoped to open in 2019.

Streetwall

The buildings are continuous along the entire perimeter of the block. The buildings on this block are all five stories tall, with ridgeline heights ranging from 14 to 16 m (46 to 53 ft). Fenrisgade 2, the oldest building, is the only one with dormers. It also has a partially above-ground cellar, as does Fenrisgade 10. The building height to street width ratio ranging from 1.3 and 0.75. Building range from in frontage length from 17 to 91 m (56 - 300 ft) with a median frontage length of 25 m (82 ft).

Flats in each building are reached by stairwells that are accessed from the street. There are also three large courtyard entries, one of which access the underground parking garage. There is a single cellar entrance at Hamletsgade 16. There are 26 stairwell entrances on the study block, with an average distance between entrances of 16.7 m (55 ft). There is a vehicle entrance in Fenrisgade 6.

The buildings on this study block all have red brick facades, with some variation in brick type and bricklaying pattern. There is no differentiation in facade type between ground and upper floors except on Fenrisgade 2, the oldest building on the block, which has a white stucco facade on the ground floor. This building features the most elaborate historicist ornamentation.

Fenrisgade 10 also features from restrained neo-classical ornamentation around the stairwell windows. The facades of Heimdalsgade 22, 24 and Overskæringen 7 have some decoration with yellow bricks making horizontal bands and partially framing windows.

Heimdalsgade 22, 24 and Overskæringen 7 feature exterior balconies. These are made of metal, painted either white or green, and have about 3 m^2 (32 ft^2) of floor space. There is one balcony for each flat.

There is one street-fronting business on the study block, which is a coffee shop and record store. It is located at Heimdalsgade 24, one of the buildings constructed in 1937.

Uses and Density

This block primarily supports residential uses. Apart from the one coffee shop there is also a day-care for residents of the social-housing complex. There are 285 dwelling units (DU) in the study block. With the current household size of 1.9 in Copenhagen, this would give the study block a population of about 542. The block density is 255 DU per hectare or 103 DU/acre.

The largest parcel, which contains Hamletsgade 12A, Fenrisgade 6, and Heimdalsgade 28A is social housing. The two oldest buildings, Fenrisgade 2 and 10, are a private cooperative and a condominium respectively. The buildings on the south-east edge of the block, Heimdalsgade 22, 24 and Overskæringen 7 are private market-rate rental apartments.

There is one unit currently for sale in the condominium on this block. The sale price is $486,750, for an 85 m^2 ground floor flat, which includes a room in the cellar, or $5,469/$m^2$. A one-bedroom 65 m^2 apartment is available for rent in the same building for $1,329 per month, or $20.44/$m^2$ per month. A unit in a nearby building that is similar to Heimdalsgade 24 and 22 has a sale price of $329,250 for 57$m^2$ unit, or $5,776/$m^2$.

Rents in the social housing complex for a two room (one bedroom) flat of 62.7 m^2 (732 ft^2) is $938 per month or $14/$m^2$ per month ($1.28/$ft^2$ per month). Social housing unit sizes range from studios to 5 rooms.

Type: Welfare Era Block

Above and Below: Welfare Era Apartment Blocks. Photos by the author

The Welfare Era apartment block describes a type of building which was built from around 1920 to 1990. It manifests the application of industrial technology and state financing to solve the problem of urban overcrowding. These resources were deployed to mass produce housing based on the layout of the Industrial Era type, but with larger living quarters, open, green courtyards, and non-hierarchical social standards.

Development of the type

This type appeared when the government became involved in the creation of housing after World War I. The war had worsened a housing crisis originally caused by a by the cessation of construction after a financial bubble. Meanwhile the population of the city continued to grow and surpassed 500,000 in the first decade of the century. In response, the newly elected Social Democratic national government began offering government financing to private projects and paying to develop its own projects in the 1920's.

The deployment of government resources meant that housing could be produced on a scale never before possible. Entire blocks, and later entire neighborhoods, could be raised at once. These large projects were married with this ideals of functionalist architecture, which called for the elimination of ornamentation in favor of performance and efficiency.

The Social Democratic government continued to invest in social housing projects through the 1980's. By the 1940's these were built in ever larger projects that shifted in orientation away from the street and block into abstract, rational forms that were located far from the city center in the midst of green lawns in the suburbs. Periodically the government would also invest in slum-clearance efforts in the old districts of the central city, replacing aging buildings from the 18th and 19th century with new, lower-density Welfare Era blocks. These programs reached their height in the 1970's, but with the oil shocks, economic stagnation, and a general backlash against this approach to housing they ceased to be widely produced thereafter.

Individual Form

In general these buildings consist of long buildings composed of flats arranged side-by-side which are accessed by limited entry stairwells. They range from three to six stories tall, but usually lack elevators. Like Industrial Era apartments, they tend to be about 10-12 m deep (33-40 feet) and have about 16 m (52 ft) between stairwells. The building height to street width ratio tends to be about 5:6. They almost universally have peaked roofs without dormers until the 1960's, when flat roofs started to appear.

All Welfare Era apartment blocks were built with associated and dedicated green space. Since these large buildings often enclosed entire blocks, there was no question of dividing up courtyards, and backbuildings were never introduced. When the block structure was abandoned for free-stranding buildings these would be surrounded by lawns and landscaped areas.

Floor Plan

Floor plans of this housing type initially were similar to industrial era apartments, with the living room facing the street and bedrooms and the kitchen facing the street. This started to change in the 1920's,

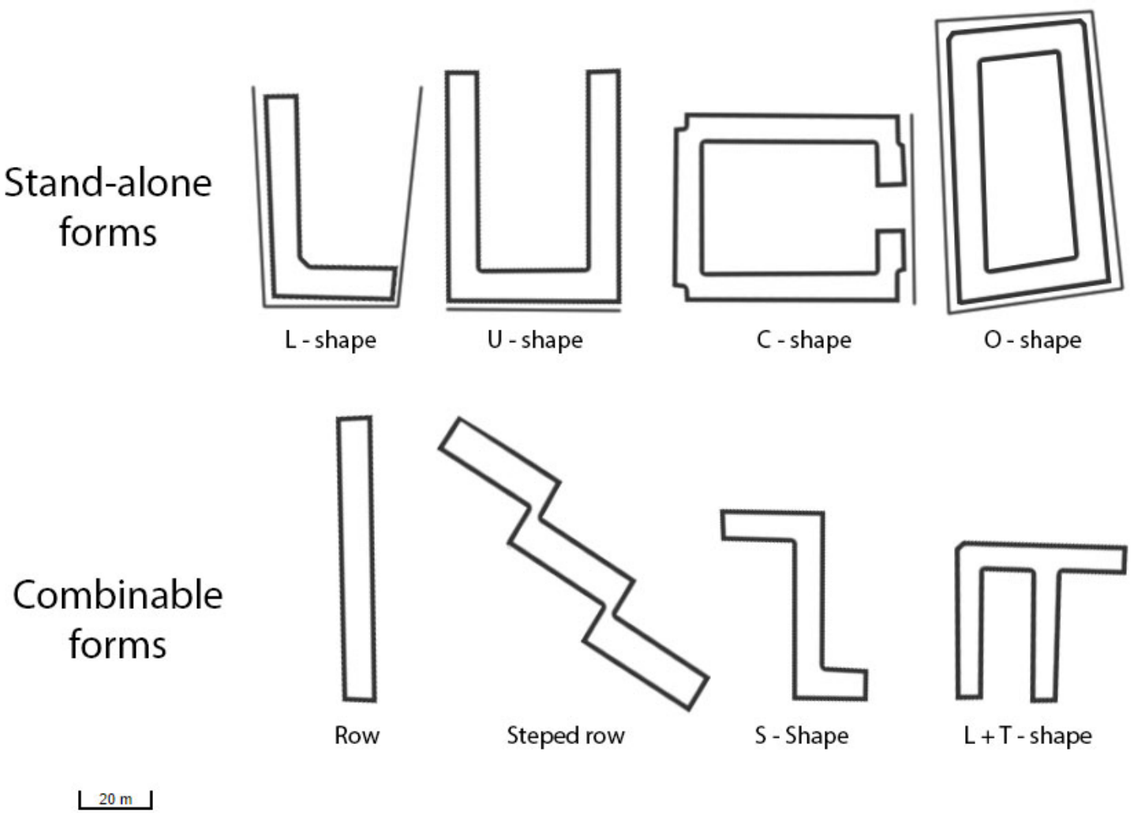


Figure W1: Common building footprints and relation to the street. Image by the author.

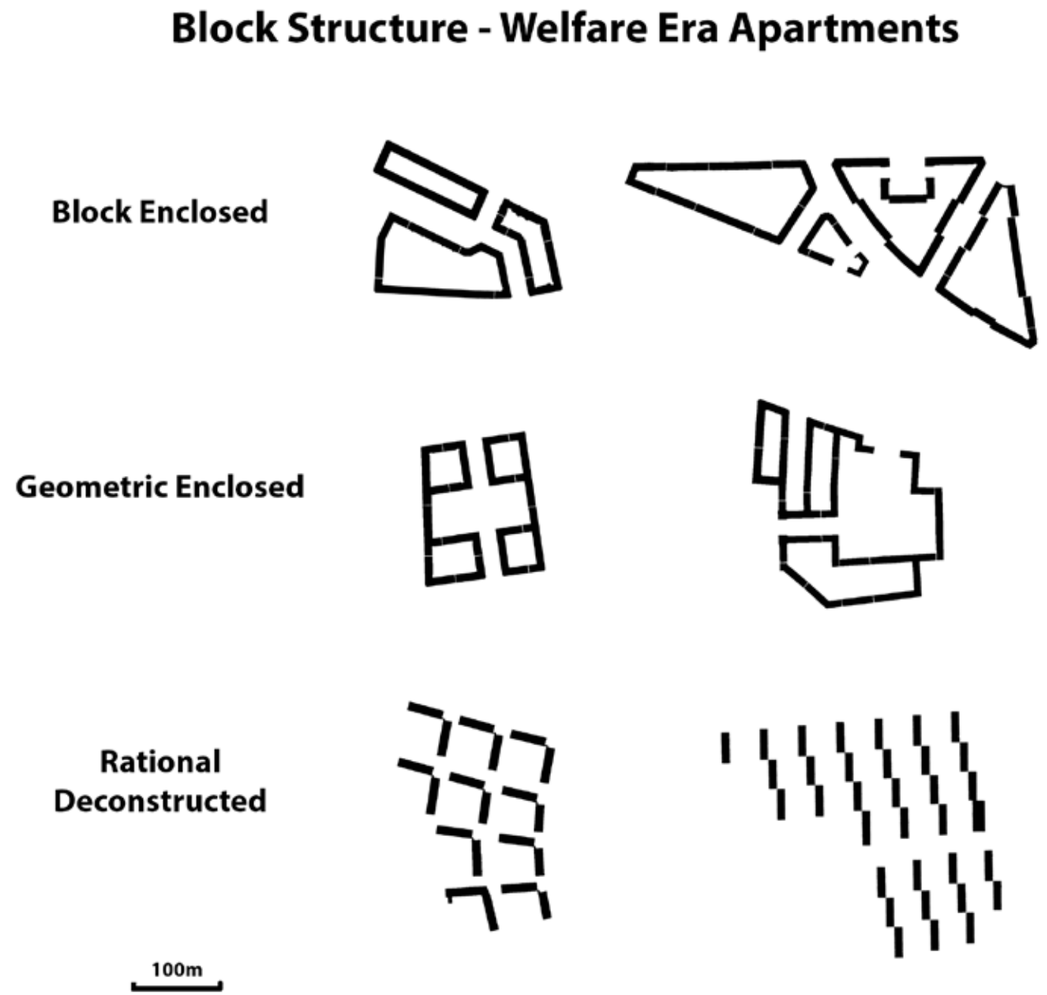


Figure W2: Common block and grouping patterns. Image by the author.

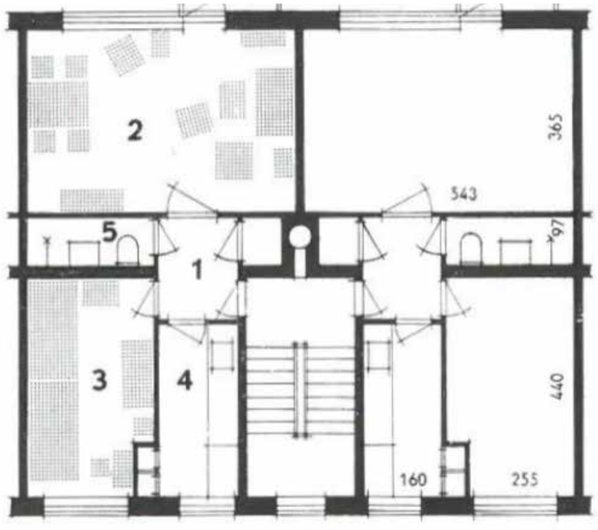


Figure W3 - 2 room plan from 1933. Source: Hiort 1952.

Figure W4 - 3 room plan from 1941. Source: Hiort 1952.

when apartments began to be designed with the living rooms facing the (now larger, landscaped) courtyard. Other designers experimented with orienting flats based on solar radiation, with living rooms located on the south or west sides of the flat. Balconies became more common, initially as a fire-safety measure which allowed architects to eliminate one of the two staircases previously required by law. These came to be a popular amenity, especially as recessed “bay-balconies” which offered greater privacy and protection from the elements.[1] Two-room flats continued to be the most common, and the share of apartments with only two rooms actually increased until 1950.

Pictured are floor plans for a two-room flat constructed in 1933 and a three-room flat constructed in 1941. Both are oriented away from the street (the street would be at the bottom of the image). The later plan also features a recessed “bay-balcony” on one side.

Units size in Welfare Era building projects increased in size over time, so that by the 1970's new units to 110 m^2 (1180 ft^2) with four or five rooms and two bathrooms were common.

Combined Form

The street environment in areas with Welfare Era apartments tend to be characterized by continuous unadorned facades. There is little or no orientation toward the street and the buildings lack a clear center axis. This can have a disorienting or monotonous effect on the street environment. Right-of-ways are usually 18 m (26 ft) meaning there is space for parking or landscaped areas on minor streets where the roadway is narrow.

Large-scale government involvement in housing construction meant that for the first time a single development could cover an entire block. By the 1930’s architects began to deconstruct the traditional block, first by eliminating the southern side, to allow greater solar radiation to the rest of the apartments. Later plans further dismembered the traditional block with L-shaped patterns, “step” patterns of free-standing apartment buildings, parallel rows of buildings, and various other formations of free-standing buildings to take advantage of topography and site exposure.

One combined form that became common in the 60's and 70's were buildings arranged in rows so that two adjacent rows could be constructed by a single crane located in between without relocating the crane. This came to be known as "crane lanes".[2]

Construction and Appearance

Building construction methods changed rapidly during the period of the Welfare Era apartment, in part due to an effort by architects and engineers to modernize construction. This played out in the production of materials and in the increasing use of machines in construction.

Bricks were the most common construction material for buildings of this type until the 1950's when concrete construction became more common. Concrete construction was mandated by

1 Hiort, 1952.
2 Sverrild, Poul. "Interview with the Director of the Suburbs Museum." Interview by author. December 5, 2016.

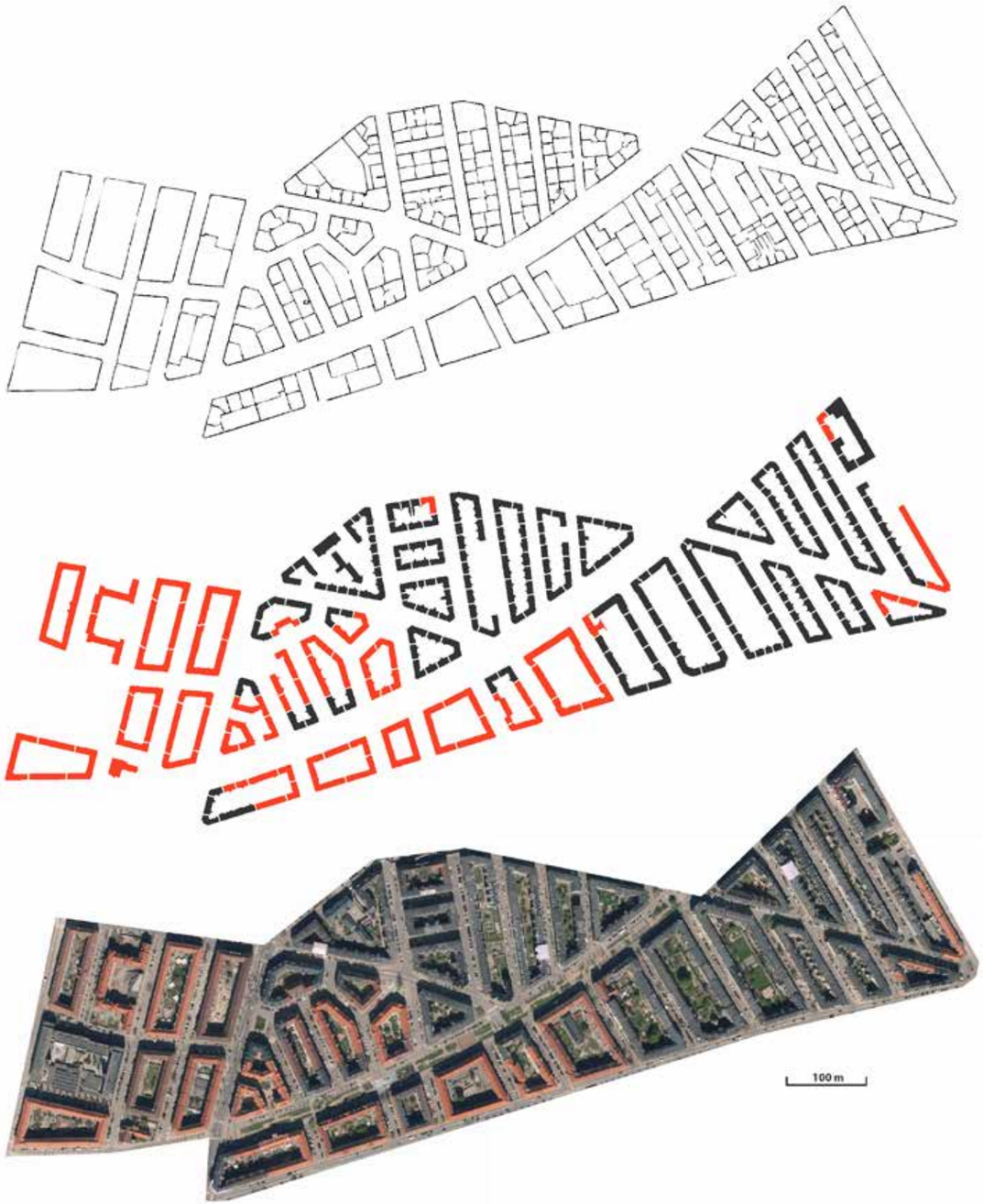


Figure W5 - This diagram shows the parcel boundaries, building outlines, a aerial photo of the southern part of Vesterbro. We can clearly see the differences in pre-WWI and post-WWI patterns in parcel and building size correlated with roof color. Image by the author - aerial photo from Google maps.

government funding rules by the 1960's[3].

Red tile became popular for roofing in the late 1910's and is the most common roofing material for buildings of this type through the 1950's.[4] One outcome of this change is that it is easy to tell which areas of the city were developed before and after WWI from aerial photography.

Building loans from the government allowed construction of large scale housing projects by private developers, social housing associations and co-ops. The Welfare Era type describes developments created by all of these entities, although it's later form is much more strongly associated with social housing associations.

Function

Welfare Era apartments blocks were often 100% residential. Some units would include ground-floor commercial spaces, and large developments would often include child-care and other amenities for the use of the entire complex. Some very large developments include schools, libraries, churches, and shops.

Buildings of this type were usually developed by social housing organizations with a high degree of government involvement. These organizations do not have income restrictions and there is a tradition of a fair degree of economic diversity within social housing projects. Larger, less popular concrete developments located far from the city quickly developed problems with social breakdown, however. The influx of immigrants and refugees into these buildings has further complicated matters.[5]

Unlike Industrial Era and Golden Era building types, Welfare Era blocks were not stratified by class. Generally units on all levels were of the same quality and paid the same rent.

Adaptations

The Welfare Era apartment is relatively recent housing type, and has not needed as extensive modifications as older housing types have. In the period from 1930-1950 94% of new flats had private toilets, however only 66.3% had central heating, 69% had private bathing facilities, and only 60% had hot water. Retrofits have addressed such deficiencies in these and older Welfare Era apartments. Other adaptations include connecting buildings with district heating, adding balconies, energy-saving retrofits, and unit combinations.

Early concrete construction has not aged well. As early as 1985 problems with leaky roofs, crumbling concrete, rotting window and door frames, and cold and damp walls had gotten bad enough to require new government intervention.[6]

3 Sverrild, Poul. December 5, 2016.
4 Hiort, 1952.
5 Sverrild, Poul. "Keynote Masterclass." Housing, Modernism and Cultural Heritage. Proc. of Inventorisation of Modern Heritage: Urbanisation and Landscape, Edinburgh College of Art, Edinburgh., 2014.
6 Larsen, 2003. 48.

Variations on type

Welfare Era apartment type buildings are highly specialized for use as housing, and generally do not fulfill other uses. The Aarhus University campus design by CF Møller and Kay Fisker reflects many of the functionalist developments of the Welfare Era housing type, such as right-angle combinations of buildings, solar orientation, ample landscaped open space and minimal ornamentation applied to educational uses.

One variation on this type is to increase the height beyond six stories, without significantly altering the layout of the building. This requires elevators in every stairwell, as there are no interior corridors linking apartments. Such a layout can be seen at the Dronningegården luxury-apartment complex that was built as part of a slum clearance program in the central city. This form was also used for high-rise blocks in social housing developments in places like Avedøre, Brøndby, and Gladsaxe in the outer suburbs of Copenhagen.

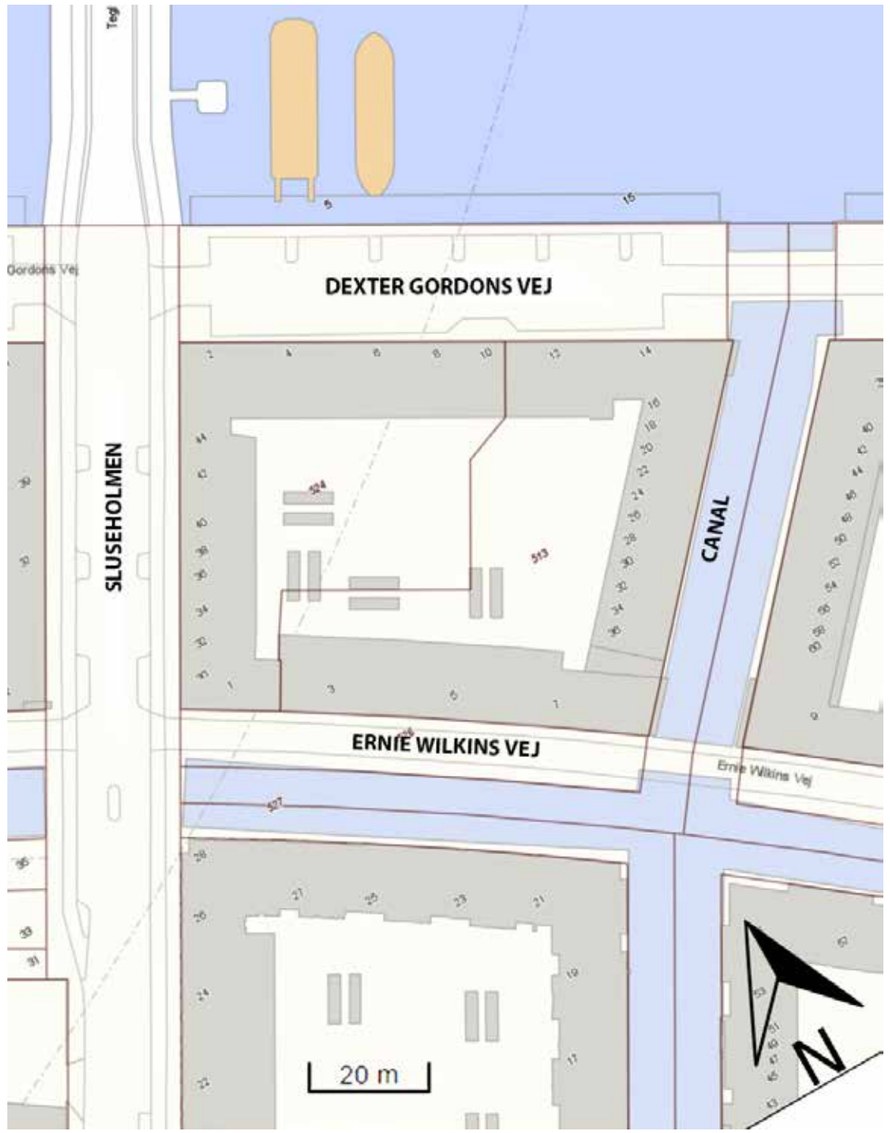


Figure S1 - Study block cadastre.

Study Area: Sluseholmen

Study Block

The study block is located in the Sluseholmen neighborhood, 3.8 km (2.3 mi) from the city center. It is a nearly rectangular quadrangle and has an area of 5,717 m^2 (1.4 acres). It's sides are 95 m , 63 m , 81 m , 61.5 m (312 ft, 206 ft, 267 ft and 225 ft) along its NE, NW, SW and SE for a perimeter of 308 m (1010 ft). It contains a single continuous building and one courtyard.

The block is surrounded by water on three sides, with the SE side of the block directly adjacent to a waterway.

Parcels

There are two parcels on the study block. They form interlocking L-shapes, each occupying about half of the area of the block or 2,850 m^2 (0.7 acres). Each contains building frontage on three sides and approximately half of the courtyard.

Built Area

According to government records the block has two connected buildings on it, one for each parcel. These buildings were all built in 2007 as part of a single master plan and form one apparently continuous edifice. The building coverage is 60% and the FAR is 3.24.

The buildings on this block represent the Livability Era type which is described in the following section.

Open Space

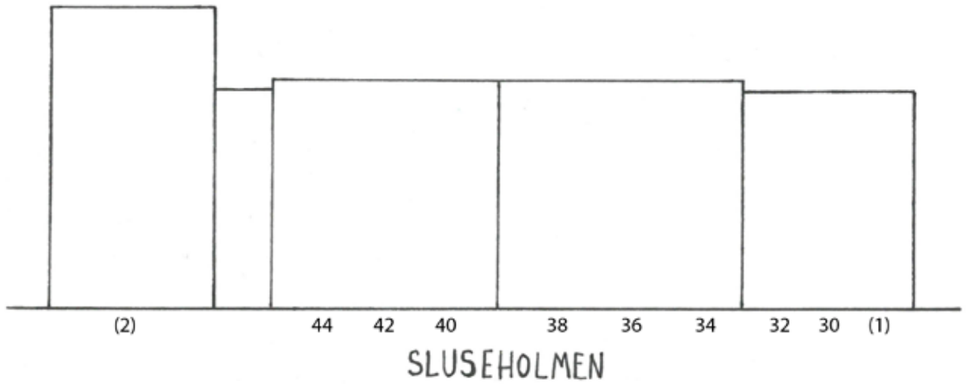
This block contains an approximately 60 x 40 m (197 x 131 ft) courtyard of 2,290 m^2 (0.57 acres), covering 40% of the surface area of the block. The courtyard includes a play structure, shaded seating areas with picnic tables, covered bike storage, landscaped areas with grass lawns, and paved walkways. The courtyard is raised approximately 1.5 m (5 feet) above the street level. Below the courtyard is an underground parking garage with approximately 80 parking spaces. The garage is accessed from a mid block entrance on Ben Websters Vej. The courtyard is accessed via openings in the 1st floor at Ben Websters Vej 14 and Ernie Wilkins Vej 7.

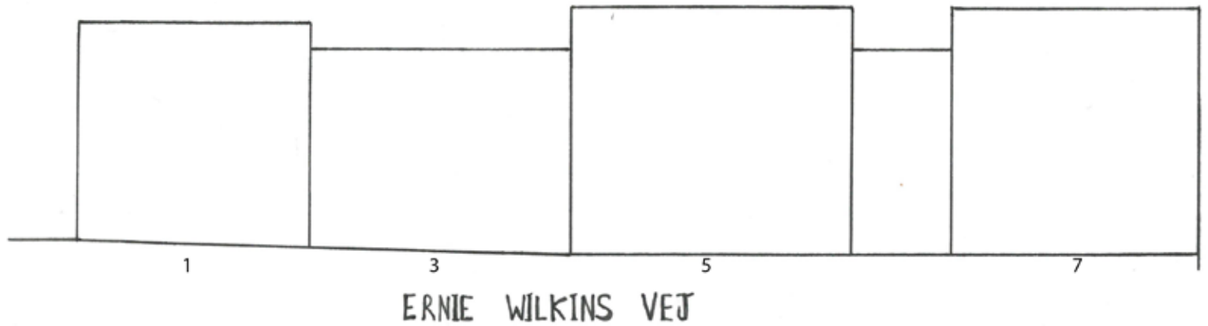
Canals surround the study block on three sides, with one side directly adjacent to the canal, and Ben Websters Vej and Ernie Wilkins Vej separating the study block from canals on those two sides. These two sides have open public areas, including a stair-stepped deck or "ghat" that lead down to the water on the Ben Websters Vej side. Residents are permitted to swim or boat in the canals.

Streets and Transport

The study block is surrounded by Ben Webster Vej, Sluseholmen, and Ernie Wilkins Vej on the NE, NW, and SE sides. On the SW side the block is directly adjacent to a canal, which is spanned by bridges to adjacent blocks.

Ben Webster Vej is 19 m (62 ft) wide. It has general purpose lane for bidirectional travel 8 m (26 ft) wide paved with concrete paving blocks with perpendicular parking on either side of the street totaling 62 parking spaces. A 1.7 m (5.5 ft) wide sidewalk is between the parking from





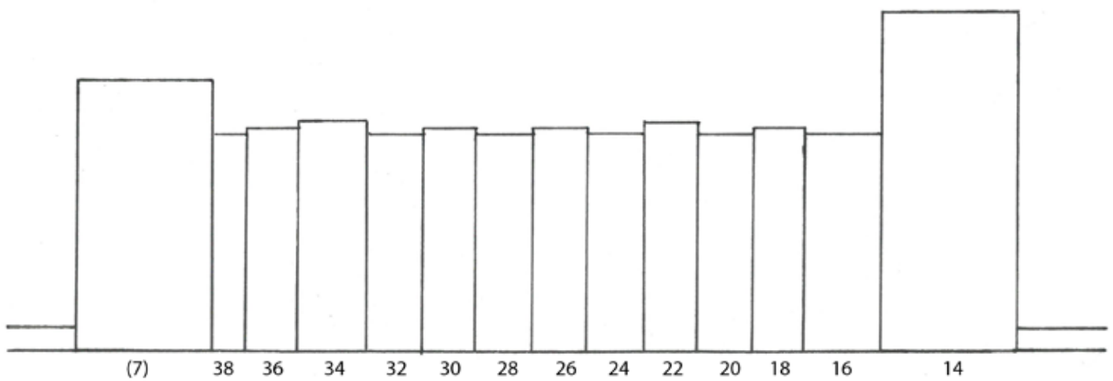


Figure S2 - Study block elevations. Drawings by the author.

Above: "townhouse" units along the canal with floating docks. Below: Sluseholmen street. Photos by the author.

the building. The street spans the canal via a bridge 8 m wide with 1.7 m walking areas on either side demarcated by a low wooden barrier.

Sluseholmen is 22.5 m (74 ft) wide. It has one general purpose lane 3.6 m (12 ft) wide in each direction and parallel parking lanes 2.3 m (7.5 ft) wide on both sides of the street. There are raised bike lanes 2.5m (8 ft) between the parking lane and the sidewalk in each direction. There are 2.9 m (9.5 ft) sidewalks on both sides between the bike lanes and the streetwall. General purpose lanes, parking lanes and bike lanes are paved with asphalt while the sidewalks are paved with concrete paving blocks and cobblestones.

Ernie Wilkins Vej is 9 m (29 ft) wide. It has one general purpose lane for bidirectional travel 6.4 m (21 ft) wide. Bollards in two places mid-block restrict traffic movement by preventing two-way traffic flow; only one car can pass through at a time at low speeds. Sidewalks are not present on this street, however on the canal side there is an open flat area with tables, chairs and trees 2.4 m (8 ft) wide. The travel lane descends 1.5 m (5 ft) from Sluseholmen over the course of 19 m (62 ft), where the travel lane becomes level with the above mentioned flat area. It is paved with concrete paving stones.

A canal 13 m (43 ft) wide separates the study block from an adjacent block. “Ground floor” dwelling units on this side of the building have access to the canal via ladders and small floating docks outside each unit. The streets in this neighborhood are all named after expatriate American jazz musicians who lived in Copenhagen at one time.

There are a total of 156 parking spaces within or adjacent to the study block, for a ratio of 0.9 spaces per unit.

A Traffic count conducted during morning rush hour and midday on Sluseholmen observed about 700 passersby per hour, with slightly more traffic during the morning commute than during the day. The bicycle mode share fell from 21% in the morning to 12 at midday. The walking mode share fell from 20% in the morning to 19% at midday. Vehicle traffic rose from a 59% mode share in the morning to a 69% mode share in the afternoon.

There two bus routes that travel along Sluseholmen, with a stop 25 m (82 ft) from the eastern corner of the study block and combined 6 minute headways during the day. There is also a “harbor bus” ferry stop 100 m (328 ft) from the northern corner of the study block with 40 minute headways during the day.

Streetwall

The buildings are continuous around the entire block, however at two places there are openings in the first story to allow access to the inner courtyard, one opening on Ben Websters Vej and one on Ernie Wilkins Vej, both close to the SE side of the building. These openings are each about 7 m wide There is also one opening on the first story to allow access to the underground parking garage.

Buildings on the study block have between four stories and seven stories, with heights ranging from 23 to 14 m (75 to 46 ft). The building height to street width ratio therefore ranges between 1.3 and 0.82 although the unusual arrangement of streets next to canals renders this measure less meaningful.

The single building of this block is divided into 15 apartment sections and 12 townhouse sections with unique facades. The median facade length of apartment sections is 16 m (52.5 ft) and the median facade length of the townhouses sections is 4 m (13 ft). There are 22 entrances of various

types along the three sides of the block that front streets,

The streetwall displays multiple different facade treatments and window patterns. There is also some variation in building height. These modulations appear to be related to the location of building entries, with particular facade materials and windows for each stairwell section, simulating streets in older neighborhoods in which each stairwell would be for a different building, with a particular appearance. This effect was achieved by hiring different architecture firms to design facades for these simulated buildings. Most of the facades are made of brick, though brick colors vary widely from tan to dark purple. Other facade materials are wood and metal. Although each building entrance section is designed to appear as a distinct unit, they are in fact part of a single building.

The block also supports ground-floor retail uses along Sluseholmen, where there are three businesses: a deli/cafe, a pizza parlor, and a real estate office. Another ground floor space appears to be used as a common space for the building.

Uses

The study block has 170 dwelling units and with the city average household size of 1.9 the block would support 323 residents. The block density is 298 DU per hectare (121 DU per acre). With The gross neighborhood density for the eight Sluseholmen blocks plus the adjacent Metropolis building is 152 DU per hectare (62 DU per acre).

Units on the study block are owned by individuals as part of a condominium. They tend to be at least 100 m^2 with three or four rooms. One units available to rent (by owners) on or near the study block cost $2,100-2,250 per month, or $21-24 per m^2 ($225-242 per ft^2). Others are available to purchase for $650,000-$750,000 or $6,200-$7,500 per m2 ($68,000-81,000 per ft^2).

Above: Havneholmen 64. Photo by the author.

Type: Livability Apartment

Development of the Type

Livability apartments appeared in the Copenhagen beginning in the late 90's and early aughts. They reflect a movement away from functionalist residential projects of the Welfare Era state towards a goal of attracting higher income residents to the city. This is often attributed to lack of funds for the government-sponsored housing projects of the previous decades as well as a cultural reappraisal of the large-scale functionalist architecture and planning behind such projects.

Livability apartments occasionally appear as standalone infill projects, however strict market controls and the existing filled-in housing infrastructure limit the opportunities for such projects. More often these appear as new districts, developed by public-private partnerships and planned in conjunction with the city on brownfield sites or vacant government-owned land. The first such development of this type was Ørestad, with Sluseholmen, Tegloverksted Holm, Enghave Holm, and Nordhavn beginning subsequently. Most of these projects are still in development as of 2016. The development and creation of these new districts has been tightly integrated with city planning of new infrastructure.

Livability apartments are designed to provide the amenities and quality of life desired by middle and upper-class urban residents, with ample landscaped green areas, access to a variety of transportation options including parking for automobiles, common-rooms and nearby shops and entertainment. They emulate the form of traditional multifamily structures and in some cases attempt to hearken back to the appearance of older, especially industrial era, neighborhoods. They represent the continuity of cultural expectations of the built-environment in the midst of social, economic, and technological transformations.

Individual Form

The form of the Livability Apartment varies considerably. They are often between 4 and 9 stories tall, but can rise to 12 or more stories, and almost always has elevators and flat roofs. Like all the building types in this report, the units are usually organized around stairwells (which now include elevator shafts) without internal corridors. This means that units can have natural light on two sides of the flat and that buildings maintain the narrow width of about 10-12 m common to historic multi-family types, although some Livability apartments are as wide as 15 m. Because the units tend to be large, the stairwells tend to be spaced somewhat farther apart than historic types.

Livability Era Apartments tend to be free standing buildings surounded by lawns and landscaped areas.. They often have no direct relationship to the street, with parking strips and multi-use paths providing movility connections for residents.

Floor Plan

Livability Era apartments tend to be oriented towards the courtyard rather than the street, like later Welfare Era flats. Units tend to be large, with floor plans of between 80-120 m^2. Kitchens and bathrooms are significantly larger than in units of preceding building types. Many units are divided between two floors. Balconies are nearly universal.

Building Footprints Livability Era

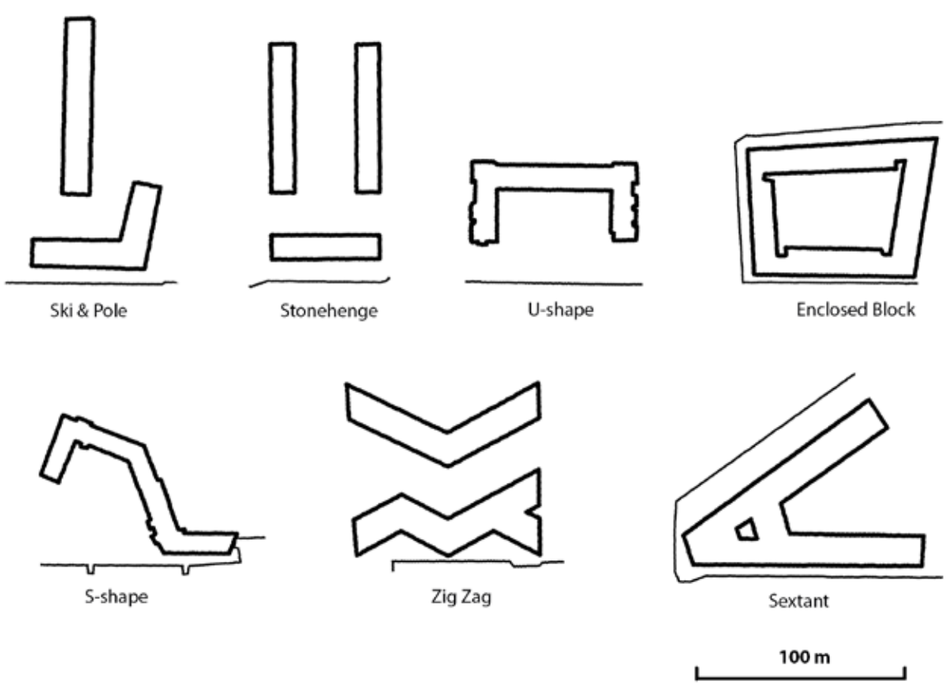


Figure L1 - Common building footprints and relation to street. Image by the author.

Block Structure - Livability Era Apartments

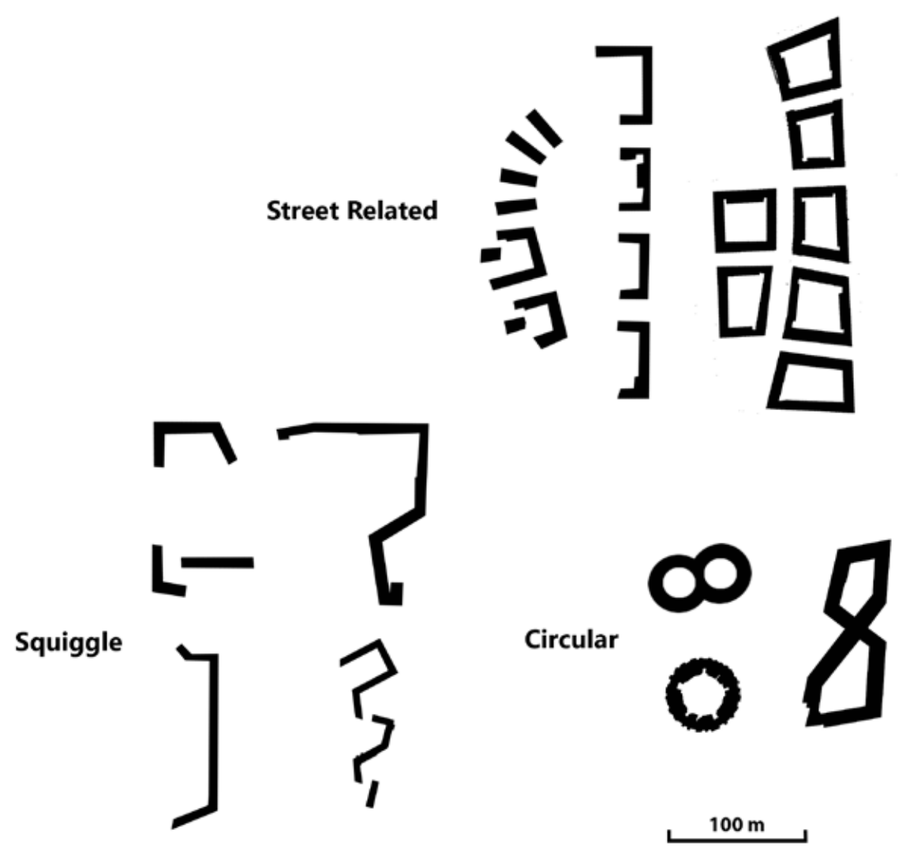


Figure L2 - Common grouping patterns. Image by the author.

Figure L3 - Floor plan from a three room 86 m2 unit on Teglhomen.
Source: Home.dk Real Estate.

Figure L4 - Floor plan for a three room 124 m2 unit in Sluseholmen.
Source: Danbolig.dk real estate

Combined Form

Livability Era Apartments are usually constructed alone on a large plot. They sometimes mimic grouping patterns of older types in enclosed blocks, U-shapes, and angled rows. Many buildings of this type have a long sinuous form, running parallel to but independently from a nearby street.

The street environment in neighborhoods characterized by Livability Apartments tends to be have a wide-open, somewhat unfocused aspect. Pedestrian pathways are often prioritized and sidewalks and bike-ways are present, however parking also tends to be present at higher levels than for older building types. Green space is also prioritized, with landscaping and interactive outdoor furniture. Buildings are often set back from the street, however, even when buildings to directly abut the street the inward-focus of these buildings reduces the intensity of the street environment.

Canal edges have been utilized in many areas with Livability Era apartments to provide places for passing time, socializing, and exercising. This is possible because of the location of many livability apartments in urban brownfield sites along the harbor and because of heavy involvement in planning and infrastructure development by the city.

Construction and Appearance

Livability apartments are constructed from reinforced concrete and steel, with decorative facades. These facades provide a canvas for a wide range of colors and materials as well as decorative patterns. In some cases, efforts are made to echo past building materials with brick facades, in other cases materials are shown to demonstrate a stark contrast with past building methods. In general there is an attempt to provide visual complexity, especially on large buildings which would otherwise have a monotonous appearance. One method demonstrated at Sluseholmen is to divide each set of flats around a stairwell into an visually distinct unit and to assign a specific aesthetic to that unit so that it appears as a standalone building. In Sluseholmen these “buildings” have been contracted to separate design firms.

Function

Livability Apartments are devoted to residential uses, though some include ground-level retail as well. Common-areas such as fitness rooms and event rooms are often included as amenities for tenants. Due to the low-intensity urban spaces where livability apartments tend to be located, it can be difficult for businesses to attract a critical mass of customers. In Sluseholmen some ground level units were designed to be used either as residences, common-rooms, or businesses, with the hope that as the new neighborhood grows and becomes better established there will be a greater demand for shops.[1]

Reversing the pattern of Industrial and Golden Era flats, the most valuable units in Livability apartments are on the highest floors. This reflects the value given to views of the city, privacy, and

1 Gemzoe, Lars. "Lars Gemzoe’s Copenhagen: Harbor Circle and Allotment Gardens." Lecture, University of Washington Gehl Studio Study Abroad, Copehagen, September 7, 2016.

Photos by the author.

the utility of the elevator in eliminating the time and effort cost of traveling between the street and upper floors. All units in these developments tend to be much more expensive than other housing types. They are sold as condominiums or rented out by private firms.

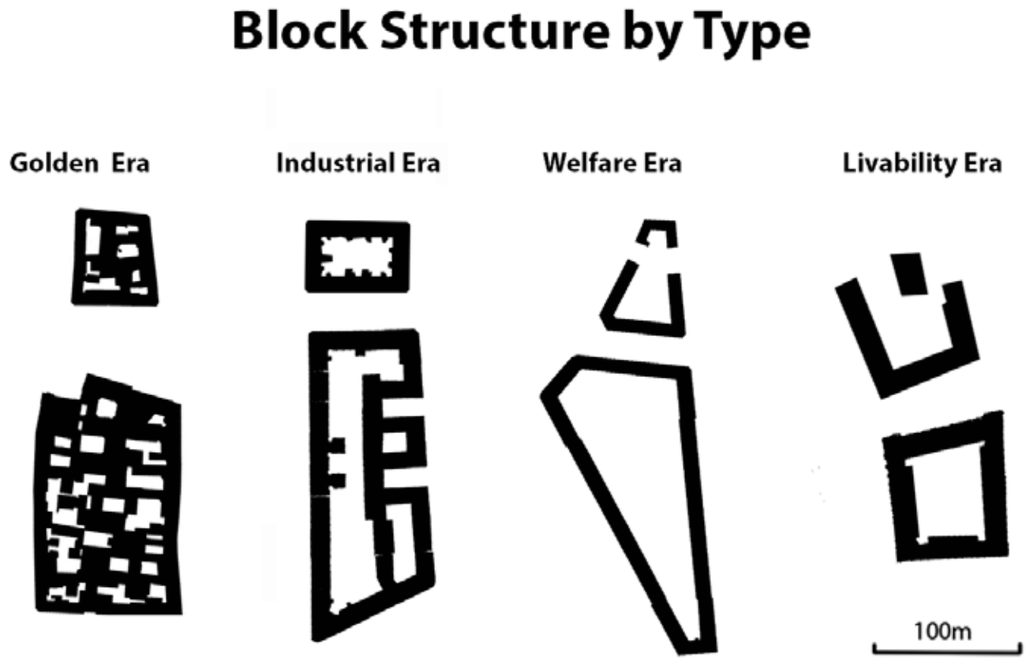
Adaptation

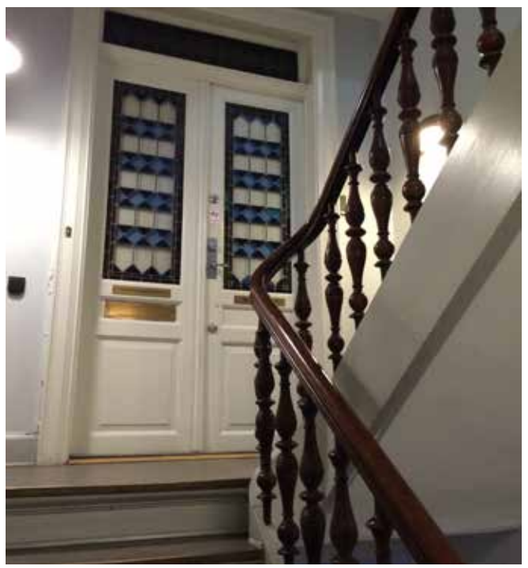
This type is too young to have accumulated many adaptations. Complaints about the coarse grain of development in Ørestad have lead city planners to attempt to design future additions that will be more supportive of neighborhood life. Transit service to Sluseholmen has improved since it was first constructed, with the opening of the Tegholmen bridge.

Variations

A great deal of variation is seen within this type. Big-name architectural firms have used high-end urban apartments as a canvas for experimentation and innovation in housing designs throughout the development of this type. A famous example, 8Tallet in Ørestad, features a sloping ramp that climbs from the ground-floor to the top of the building over the course of its length. This building includes common rooms, co-working spaces, space for shops and educational facilities and is the winner of several architectural prizes.

Conclusions and further research





What are dense neighborhoods like in Copenhagen? What elements comprise these neighborhoods? What are the predominant building types? How do typical buildings shape their form?

This research project was undertaken to answer the above questions. We have learned about the character and history of a range of neighborhoods in Copenhagen. Those neighborhoods that had the most to say about the city as a whole were selected for further analysis, and a fundamental building type of was described for each of these neighborhoods which arises from its history and determines its structure and character.

Despite the differences between these types there is also a clear lineage among them. These related types share features despite the more than 200 year time span and enormous advances in technology they encompass. These include:

- **Stairwell organization:** with two or three units on each floor grouped around a stairwell. This eliminates the need for internal corridors and by provides greater interaction with the street than a single entry point. It also makes possible narrower buildings than are common in Seattle.
- **Narrow buildings:** ranging from about 9 to 12 m (ft) in width in most cases. This increases the feasibility of linear arrangements.
- **Linear arrangements:** especially the encirclement of the block.
- **Natural light from two directions:** with windows both of the street and courtyard sides. This is possible because of the lack of internal corridors and the narrowness of buildings.
- **Courtyards:** creating an area which is clearly removed from the public realm. These are present for most of the building types described, with the exception of the late-stage Welfare Era type. This maximizes the usable land for residents by devoting nearly all the unbuilt land to a semi-private use. Of course, courtyards must be well maintained and somewhat limited in size in order to maintain their usefulness and privacy.
- **Limited Height:** The building types described fall within the range of 3-6 stories tall. Elevators did not become universal in multi-story buildings in Copenhagen until quite recently and even then they did not lead to a dramatic increase in height, with the taller Livability Era apartments only rising to a maximum of about 12 stories. This means that these buildings have a stronger connection with the ground level and the population is distributed more evenly across the city than would occur with high-rise development.
- **Masonry and concrete construction:** Early in the 19th century half-timber construction was abandoned in favor of bricks. Wood beams were used as lateral elements - for floors and roofs, until concrete construction became widespread in the 1950's. The lack of earthquake risk means that even old masonry buildings are safe for habitation. This reduces redevelopment pressure on historic areas, strengthening the connection to historic built fabric.

All of these features have been regulated by the government in some fashion historically and in the present. Some early regulations are discussed in the report, although as time goes on housing legislation becomes more detailed and less accessible to the English-speaking researcher. Generally we can say that regulation merely codifies some version of what society deems acceptable, and that it is therefore one of many factors that goes into the shaping of building traditions.

The above qualities all contrast with the common characteristics of multi-family housing in Seattle

Study Block Quantitative Measures

	Measure	Indre By	Vesterbro	Norrebro	Sluseholmen
Block	Distance from center	0.2	1.7	3.2	3.8
	Block Size m²	3,700	8,760	11,173	5,717
	Building count	19	14	8	2
Parcels	Parcel count	10	12	6	2
	Median parcel size m²	228	412	827	2850
Built Area	Type	Golden Era	Industrial Era*	Welfare Era*	Livability Era
	Median bld age	1796	1884	1943	2007
	Coverage	81%	48%	46%	60%
	Floor Area Ratio (FAR)	2.83	2.27	2.32	3.24
Open Space	Courtyard count	8	1	1	1
	Courtyard size mean m²	100	4500	5800	2290
Streets and Transport	Street width mean m	8	13.5	15.25	15.9
	Parking ratio	0.22	0.24	0.53	0.9
	Parking price per hour	$4.50	$1.57	free	free
	Vehicle mode share	9%	29%	50%	55%
Streetwall	Frontage per entrance m	10.4	7.9	16.7	20
	Median frontage m	11.75	16.8	25	20
	BH : SW	0.57	1.2, 0.8	1.3, 0.75	1.3, 0.8
	Street-level shop count	15	12	1	3
Use and Density	Block Dwelling Units (DU)	68	206	285	170
	Historic DU				
	Block density DU	184	235	255	298
	Historic household size	4.2 (1830)	4.1 (1950)	1.8 (1980)	NA
	Historic pop est	483	1209	513	NA
	Current city household size	1.9	1.9	1.9	1.9
	Current pop est	129	391	542	323
	Pct current pop of historic	26.71%	32.34%	105.65%	NA
	Price per m² rent LOW	-	$11.00	$14.00	$21.00
	Price per m² rent HIGH	-	$25.00	$20.44	$24.00
	Price per m² buy LOW	$6,066.00	$5,600.00	$5,469.00	$6,200.00
	Price per m² buy HIGH	$8,904.00	$8,870.00	$5,776.00	$7,500.00

*Vesterbro and Norrebro both have a mix of Industrial Era and Welfare Era housing. The type indicated is the one that predominates on the study block.

which generally consists of freestanding, thick, double-loaded corridor buildings of highly variable height. Mid-rise multi-family buildings are now constructed of wood and older masonry structures are in need of seismic retrofits due to earthquake risk. These buildings occupy small areas of the city creating pockets of high population density surrounded by large areas of single-family homes.

My interest in the distinct morphologies created by our respective building types and traditions is what prompted this study. The effects that these morphologies have on the quality of public realms is worth researching further.

Study Area Comparisons

Four study areas were chosen in this report because they appeared to embody characteristics that were typical of many other neighborhoods in the city. In each of these areas a single block was chosen for data collection that was representative of the wider neighborhood. A wide range of measures was taken in an attempt to record the essential attributes of each block objectively and for comparison with the other study blocks. These measures included many of standard tools of urban planning and urban design: population density, building coverage, parking ratios, street widths; as well as a few unusual measures: frontage per entrance, historic population estimate, median parcel size.

Because the study collected a wide range of data points it is possible to see how the differences and similarities of the neighborhoods shows up in the numbers. These are all dense, urban neighborhoods, and as such they do have much in common. However each is composed of a different type of buildings, the physical attributes of which give the neighborhood much of its character. Can those attributes be measured in order to understand the why the qualitative differences one perceives when visiting are so clear?

Many of the measures are not helpful for distinguishing between neighborhoods. Some vary little, some move arbitrarily, some provide us with context without revealing anything about the study block itself. Some of the quantitative measures show little difference between the neighborhoods.

There were a few measures that showed important differences between the neighborhoods related to the form of the neighborhoods themselves. Several of these show a clear direction of change: number of parcels, median parcel size, building count, parking ratio and vehicle traffic mode. These measures all move in one direction with building age from Indre By to Sluseholmen. This seems to reflect the centralization of development decision-making and resources into fewer hands over time as well as the rise of automobile ownership.

A few other measures of the form of the neighborhood showed something a little different. Street-level shop count, building coverage, block size, courtyard size - these measures all move in a certain direction in parrallel with building age, until the Sluseholmen study block, where the direction is reversed. Sluseholmen was designed to recreate some of the feel of a historic neighborhood, so it makes sense that this is reflected in the measurements. Clearly, whether intentionally or not they've recreated a few of these aspects.

Are these measurements really getting at the most important differences between these places? Building coverage is a crude measure, and the success street-level shops are dependent on the qualities of a neighborhood at least as much as they help to shape it. The grain size of a place - which shows up in block size and courtyard size, is clearly important, and in this degree Sluseholmen shows real progress. Still, we hardly know anything about a place if we just know that it has small blocks. What are the qualities that these measures are hinting at, and what are they obscuring?

Golden Era

Industrial Era

Welfare Era

Livability Era

10m
SCALE

Further Research

Several dynamics revealed themselves during the course of the research which seemed to have strong effects on the quality of different neighborhoods depending on the type of building that predominated. The effect of these dynamics on the built form of different cities and neighborhoods could provide rich areas for further study.:

1. Centralization/decentralization of planning, design, construction and ownership

The number of decision-makers at each level of the creation and maintenance of residential buildings changes drastically over the range of neighborhoods studied. In the case of the Welfare Era building there was an exceptional degree of centralization. This tended to have the effect of maximizing those values prioritized by the bureaucracy, apartment size, integration with infrastructure, and efficiency of construction.

In the case of the Golden Era townhouse individual building owners made decisions about the design of their buildings, but their decisions were based on a common framework of vernacular design as well as design-plans made available by the court architects. The street and parcel grid were essentially inherited from medieval times, and construction outfits would have been small groups of craftsmen and laborers. The devolution of decision-making authority to more actors and to traditional practices seems to create a more complex built landscape, while centralized planning can provide structure and coherence. The situation in which many actors are making decisions within an overall strong frame work seems to result in the most successful neighborhoods.

2. Orientation outwards/inwards

A marked difference between the 19th century neighborhoods and the 20th-21st century neighborhoods lies in the orientation of their buildings. In the Golden Era and Industrial Era building types the building is clearly oriented towards the street to the public: street-facades are more ornate, living-rooms face the street, while courtyards were cluttered with refuse, human waste, and poorer-quality buildings and plain facades.

Welfare Era buildings take a sharp swing in the opposite direction. Ostentation is abandoned in favor fairness and elevation of human dignity in the form of improved living conditions for all. These buildings turn inwards, focused on modern dwelling quarters and spacious courtyards. Livability Era buildings generally maintain this orientation away from the street, although ostentation in the form of architectural avant-gardism has made a comeback. These buildings are designed for residents to take pleasure in their homes, not to go out into society searching for something.

This shift in orientation is preserved in the built landscape of the neighborhoods composed of these different types. It seems no accident that the most lively nightlife zones are located in neighborhoods composed of elements built to engage with society.

3. Specialization of function and class

There is a strong chronological trend towards increasing specialization in the building types described. The Golden Era type is vertically stratified by class, with servants living in attics and wealthy families on the first floor. Shopkeepers and pub-keepers are operating out of the cellars and light industry or animal husbandry is taking place in the courtyard. The Industrial Era type generally maintains these arrangements, though industry is starting to move to specialized districts and the poor are more often constrained to the crowded back buildings in the courtyard.

Welfare Era buildings by contrast are enormously specialized by function and class. They are made of identical dwelling units with identical prices. They are built to provide the best possible housing and this is nearly the only thing they do. While the Livability type makes concessions to the mixing of uses, they are nearly as specialized as the Welfare Era type especially in terms of socio-economic class, as these buildings rarely contain subsidized units.

4. Purpose of creation

Buildings of each type were created for different purposes, the effects which were expressed in their design and location. Golden Era townhouses were built by wealthy families to establish their stake in the city. The Industrial Era type was built to turn a profit. The Welfare Era type was built to advance society (and sometimes to develop voting constituencies in suburban jurisdictions). The Livability Era type was built both to turn a profit for developers and to strengthen the city financially.

The purposes behind the creation of each other neighborhoods profiled is revealing too. Like the Golden Era bourgeois, the hippies of Christiania sought to establish their stake in the city. Nyboder was built to strengthen the power of the state, while the urban renewal projects in Norrebro were an attempt by the state to change an existing neighborhood for its own good. City planners and citizens should be conscious of the motives behind their planning and building projects as these will likely be permanently expressed in the form of the built environment they create.

Bibliography

Anderson, Esben. "Re: How Many Houses in Nyboder?" E-mail message to author. October 10, 2016. Response to a question by the Chief of Administration of Nyboder Museum.

Baumann, Marie Juul. "Interview with city planner from the Urban Renewal Department." Interview by author. October 13, 2016.

Bosselmann, Peter. Urban Transformation: Understanding City Design and Form. Washington, DC: Island Press, 2008.

"The Sørensen Family Apartment." Danish Design Review. Accessed December 15, 2016. http://danishdesignreview.com/blog/2015/12/4/the-srensen-family.

"Efterhistorien." Cholera in Denmark in 1853. Denmark Science and Medicine Library, 2002. Web.

Fisker, Kay. "The History of Domestic Architecture in Denmark." In The Architecture of Denmark, 21-37. Aarhus: Aarhus University, 1949. E-Book.

Forsyth, Ann. Measuring Density: Working Definitions for Residential Density and Building Intensity. Minneapolis, MN: Design Center for American Urban Landscape, 2003. Hebbert, Michael, and Wolfgang Sonne. "History Builds the Town: on the uses of History in Twentieth Century City Planning." (2006): 3-20.

Geddes, Christian. "Gedde's 1761 Elevated Map of Copenhagen." Map. In Map of the Royal Residence City Copenhagen and Its Surrounding Meadows. 2002. Accessed September 12, 2016. http://www.kbharkiv.dk/udforsk/kobenhavn-1761/copenhagen-1761.

Gehl, Jan, and Lars Gemzøe. Public Spaces, Public Life: Copenhagen 1996. Copenhagen: Danish Architectural Press and the Royal Danish Academy of Fine Arts, School of Architecture, 1996.

Hiort, Esbjørn. Housing in Denmark since 1930. Copenhagen: J. Gjellerup Forlag, 1952. Print.

"Copenhagen's First Town Hall." Københavns Første Rådhuse | Københavns Rådhus | Historier Om København | Udforsk. Accessed December 08, 2016. http://www.kbharkiv.dk/udforsk/historier-om-kobenhavn/kobenhavns-radhus/kobenhavns-forste-radhuse.

Kristensen, Hans. Housing in Denmark. Report. Centre for Housing and Welfare, Realdania Research. 2007.

Langbæk, Jesper. "Interview with city planner from the Urban Renewal Department." Interview by author. October 20, 2016.

Larsen, Jacob N. "From Slum Clearance and Housing Renewal to Networking and Area-based Approaches: On the Origins of Contemporary Danish Urban Development Programmes." On the Origins of Urban Development Programmes in Nine European Countries. Ed. Helle Nørgaard. Antwerp: Garant, 2003. 46-58. Print.

Larsen, Rikke L. "Lecture on Municipal Urban Renewal, Urban Nature and Climate Adaptation." Design Workshop with Kobenhavn University Students - University of Washington Gehl Studio Study Abroad. Osramhuset Nørrebro, Copenhagen. 14 Sept. 2016.

Mathiesen, D., & Markers, S. (2016). KBNHVN: Hello Copenhagen. Kbh.: People's Press.

Majoor, Stan. "Urban Megaprojects in Crisis? Ørestad Copenhagen Revisited." European Planning Studies 23, no. 12 (2015): 2497-515. doi:10.1080/09654313.2015.1014780.

Mouritsen, Lone, and Caroline Osborne. The Rough Guide to Copenhagen. London: Rough Guides, 2010. Print.

Moudon, Anne Vernez. Built for Change: Neighborhood Architecture in San Francisco. Cambridge: MIT, 1986. Print.

Moudon, Anne Vernez. "Getting to know the built landscape: typomorphology." Ordering space: types in architecture and design (1994): 289-311.

O'Sullivan, Feargus. "Copenhagen Needs More Jane Jacobs, Says Jan Gehl." CityLab. August 15, 2016. Accessed December 09, 2016. http://www.citylab.com/design/2016/08/copenhagen-needs-more-jane-jacobs-says-jan-gehl/495854/.

Pineda, A. F. V. & N. Vogel (2014): Transitioning to a Low Carbon Society? The case of personal transportation and urban form in Copenhagen – 1947 to the present. Transfers Spring 2014. (The article can be downloaded from Moodle) (Supplementary reading)

Rossi, Aldo, and Peter Eisenman. The Architecture of the City. Cambridge, MA: MIT press, 1982. Print.

Sørensen, S., B. Petersen, N. Kofod, and P. Jacobsen. "Historical Overview of the Copenhagen Sewerage System." Water Practice and Technology 1, no. 1 (2006). doi:10.2166/wpt.2006007.

Steiner, Henriette. "Interview with the author of The Emergence of a Modern City: Golden Age Copenhagen 1800-1850" Interview by author. September 19, 2016.

Steiner, Henriette. The Emergence of a Modern City: Golden Age Copenhagen 1800-1850. Surrey: Ashgate, 2014. Print.

Sverrild, Poul. "Interview with the Director of the Suburbs Museum." Interview by author. December 5, 2016.

Sverrild, Poul. "Keynote Masterclass." Housing, Modernism and Cultural Heritage. Proc. of Inventorisation of Modern Heritage: Urbanisation and Landscape, Edinburgh College of Art, Edinburgh., 2014.

Sverrild, Poul. Periurban Phase and Sphere. PhD diss., University of Aalborg, 2016. Aalborg, DK: Aalborg University Press, 2016.

Plunz, Richard A. "On the Uses of Air: Perfecting the New York Tenement, 1850–1901," Berlin/New York: Like and Unlike. New York: Rizzoli International Publications, 1993. 159-180. Print.

Worbs, Dietrich. "The Berlin Mietskaserne and Its Reforms." Berlin/New York: Like and Unlike. New York: Rizzoli International Publications, 1993. 145-158. Print.