01. Research

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Preface

How to design a building capable of accomodating programmatic changes? That was the question I started this research with. There is no straightforward answer to this question, as there probably never is in architecture. Though, providing a clear and unambiguous answer was not goal of this research. It should however, provide a series of insights, or considerations: a guide in the search for an architecture that is more resilient in terms of accomodating changing uses.

Each of the projects that is investigated into, is a case on its own. In the analytical drawings of these cases, the individual qualities of these buildings are manifested. The process of producing these drawings was a gratifying venture, which brought me a lot of knowledge as well as plenty of time to contemplate on the subject.

I am grateful for being able to conduct this research within the Explorelab gradutation studio and I would especially like to thank Lidwine Spoormans for her input and efforts guiding me through this process.

Introduction

Society is changing at an increasingly fast rate: ideas are replaced by others and new possibilities continuously emerge. This has a significant impact on our built environment, since the way we use our buildings and public spaces now constantly changes. Since the dawn of functionalism in early twentieth century, there has been an the emphasis in architecture on defining function. Despite many critiques, this resulted in a tendency within the architectural discourse of defining the use of a building in a strict programme. This defined programme is however an illusion. In contemporary society the 'use' of a building is not something which is definitive, but instead organic. Demands of users and owners of rapidly change, causing a programme to lose relevance over time. A building defined by its programme will then lose its raison d'etre. As a result of this, a large part of the building stock tends to be demolished nowadays, after its use has becomes obsolete. Meaning that buildings, essentially have become consumer goods: discarded after their one-time use. This practice is not by any means sustainable, as it is a waste of resources

and capital. Moreover, these continuous acts of building and demolishing also negatively impact the development of a consistent urban form.

Taking this into account it is we take as a starting point that buildings should be capable of accommodating changes in use. To accomplish this, their architecture has to be adaptable over time by providing a certain degree of flexibility. There have been several architectural experimentations in this field which are mostly categorized under the structuralist movement. Within these experiments a distinction can be made between (A): projects which take the changeable as a starting point, or (B): those which take the permanent as a point of departure. Of the former (A), most notable is the Japanese Metabolism in which the idea of organic growth is central. Flexibility is provided by allowing the possibility for future expansion. In the period 1960-1975 several buildings based on this principle were realised. Now, more than half a century later, reality has taught us that this concept of organic growth was practically unworkable and therefore the metabolism has generally been abandoned. Departing from the permanent (B) instead is the open building concept, developed by John Habraken, which is based on the principles of structure and infill. The structure is permanent and constructed in such a way that it provides the possibility its contents, or infill to change over time. This idea is could be related to Corbusier's Dom-ino concept, in which the open structure permits a large degree of freedom in programmatic layout. In the early 1930s already, Corbusier designed Plan Obus, which features a large residential building which consisted of an open concrete structure that was to be filled in by future inhabitants. Similarly to the open building concept the project focuses on the residential typology and allowing future users to appropriate and customize their habitat.

This study too, will take the permanent as a starting point, the focus however is on supporting programmatic changes, departing from the observation that in contemporary society the use of a building has become an erratic notion. The aim is an architecture which is capable of accommodating extensive programmatic changes. In doing so, it should be able to remain effective for a significant period of time, by answering the need for adaptability, formed by a constantly changing society. The building has to allow, to a certain degree, freedom for the user to appropriate and make changes, while preserving its architectural integrity. The latter is important in relation to the development of a consistent urban form.

Conforming to the idea of the city as a collective work, as Rossi (1966) describes in The architecture of the city, adaptations made within the urban fabric should be carried out with a degree of responsibility, as the city is a fundamental element to the transmission of a culture. Continuous acts of building and demolishing as a result of a fixation on programme and the functioning of architecture, are counterproductive to this transmission and should therefore be avoided. The current trend towards adaptive reuse, demonstrates the continuity of the city form and the concept of the collective city are increasingly appreciated. Re-using existing structures is however not a new tendency, but an established practice, being carried out for a substantial amount of time. It is in fact an essential and integral aspect of architecture, which most historic city centres account for.

Present the numerous examples of adaptive reuse, is the promise that buildings can exist for an extended period of time independent of their function. This reinforces the idea that it is possible to accommodate changing uses, departing from a permanent structure. There are ample examples of buildings which have undergone many transformations during their lifetime, whilst sustaining their architectural quality and integrity. By studying these examples the goal of this research is to gather a set of characteristics which can be used in developing such an architecture.

This lead to the following hypothesis: There are essential characteristics to be found in re-purposed or re-purposable buildings, which contribute to the ability of a building to remain effective over time. Assuming that these characteristics are present within these examples of transformative architecture, deriving them could help in constructing a framework which forms a starting point in producing an architecture which is capable of accommodating changes. By accommodating programmatic changes it should be able to remain effective for an extensive period of time. The following research question therefore is formulated:

What essential characteristics contribute to the ability of a building to remain effective over time?

Effective
adjective
/ ɪˈfek.tɪv /

1. adequate to accomplish a purpose; producing the intended or expected result
2. actually in operation or in force; functioning
3. producing a deep or vivid impression; striking
4. prepared and available for service, especially military service

There is already a substantial amount of research conducted into what aspects contribute to success of a building's ability to accommodate programmatic changes. There are some studies which take the permanent as a departure point, such as *Frame and Generic space* written by Bernard Leupen. Leupen (2006), focuses on the space in which adaptations can occur (generic space) as well as on the building elements which encompass this space (frame). The frame is thought of from a technical perspective. It is constituted from the principle of the shearing layers (Brand, 1994), which takes into account the lifespan of specific building elements. Leupen uses these physical elements to define the frame. In this approach the impact of architectural articulation of the building is however deemphasized, which Leupen mentions in his reflection. A study which does focus on the architectural aspect is Vital Architecture: Tools for Durability by Bas Kegge and Ruurd Roorda. In this research a large number of cases is evaluated and for each project the key component is highlighted that is fundamental to the success of a structure to accommodate changing uses. The subject is investigated in a broad sense.

The goal of this research to complement this existing basis of knowledge by an in depth analysis of the architectural aspect of the transformable building, in relation to the technical aspects. To determine what features of a building need to be investigated and consequently determine the set of drawings needed in order to do this a number of 'search areas' is defined. These have to cover the technical as well as the architectural. The technical or *tangible* conditions are based on the notions of *frame* and *generic space* (Leupen, 2006). These constitute the open space and the building elements surrounding it. Besides these there are the architectural conditions or *representational* which are investigated into. These are the elements which are critical to the architectural expression of a building. It is strongly related to the third aspect: the *narrative*. A building can be the physical manifestation of a certain narrative; it can be meaningful to the ones familiar with this narrative. A building and a narrative are distinct entities however, but there are elements which, like symbols, allude to this narrative. These are the representational elements mentioned before. The narrative is a seperate concept, a mental construct existing in a group of people.

METHODOLOGY

A number of relevant architectural projects will be thoroughly analyzed. Through analytical drawings the cases will be dissected, making explicit the characteristics that are essential to their ability to host a diverse set of programmes and to be reinterpreted over time. There is a great number of buildings which have undergone multiple transformations during their lifetime. To be able to conduct an in-depth analysis the number of cases is limited to four. The cases are carefully selected, in order to represent a wide variety of relevant projects. The goal is to explore and define the underlying aspects which led to their existance. A small number of well executed case studies is sufficient for this (Small, 2009).

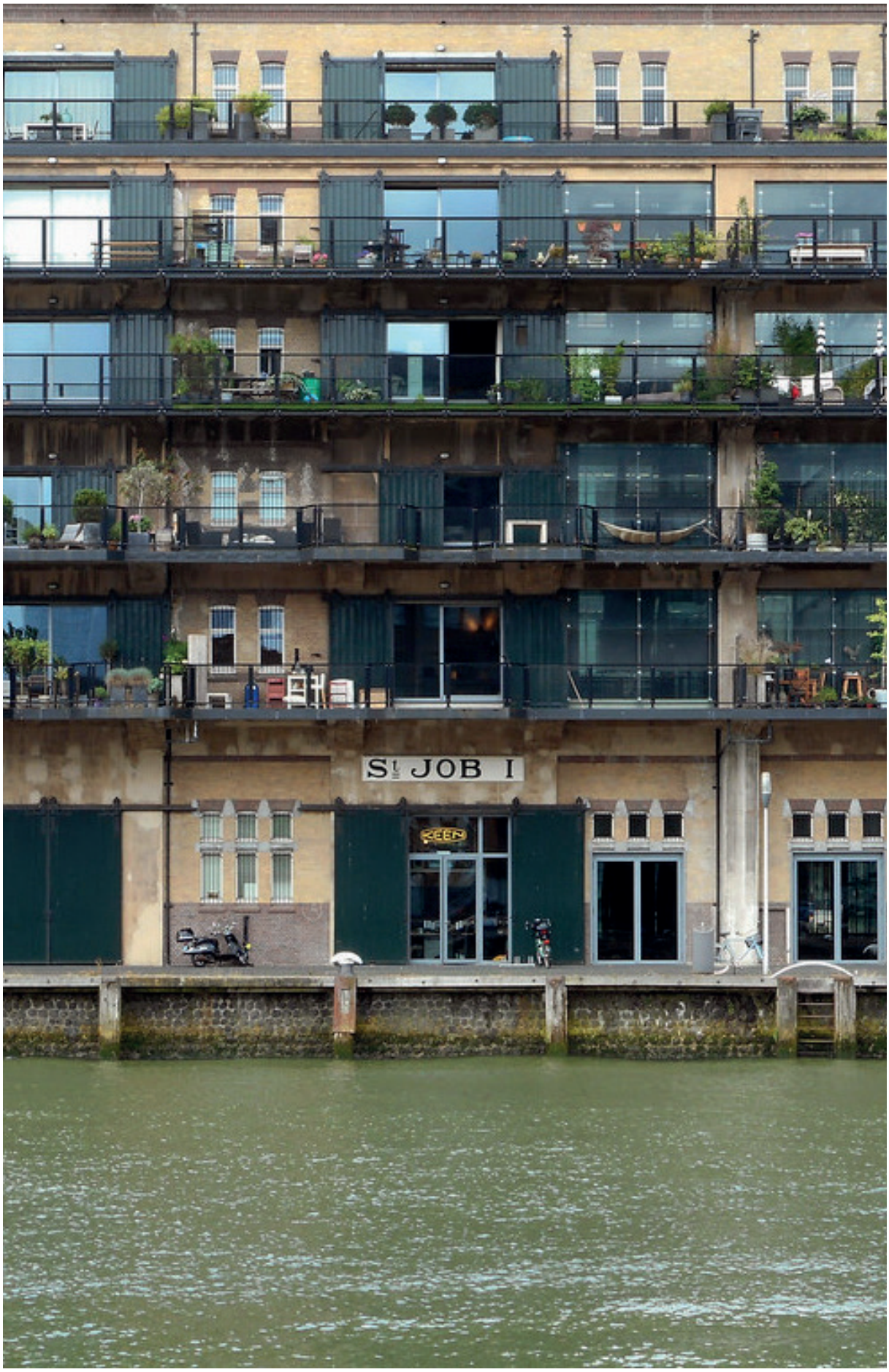
The intended product of the research is a solid foundation providing decent input to develop an architectural project which succeeds in accomodating changing uses while conserving its identity. The results shall be used in the process both as guidelines which the project should conform to and as a starting point in a line of thought about the meaning of a lasting or *persistent* architecture.

RIGHT: BALCONIES ON THE EAST FACADE

St. Jobsveem

ROTTERDAM

The St. Jobsveem is a warehouse located on the quays of the equally named St. Jobshaven on the north bank of the Nieuwe Maas in Rotterdam. In 1910 the city council offered a site for the construction of a new warehouse to the firm: N.V. Blaauwhoedenveem. Architect Jeronimus Kanters was commissioned to design this warehouse and an adjoining grain silo. Until 1966 the building has been used by its original owner as a warehouse, containerization however, made infrastructures for packed goods redundant. In 1978 the land lease contract expired and the building was sold to the city. In 1986 the grain silo was demolished to make way for a power sub-station. In 2003 development started on a the conversion of the warehouse into a complex of houses and workspaces. The complex was designed by Mei Architecten and Wessel de Jonge Architecten supervised the conservation of the existing structure, which was by then protected by the monumental status. The project was completed in late 2007 and encompassed the conversion of the entire warehouse into a residential apartments and office space.


S! JOB I

SITUATION

On the 3rd of february, 1912 the first stone was layed of what for its time was a very modern warehouse and silo complex. In 1913 N.V. Blaauwhoudenveem took the building in operation. The building was used to store goods and grains coming from ships in the adjacent harbour. For this purpose the eastern facade featured a series of movable cranes and grain elevators. Alongside both sides of the building traintracks allowed access to freight trains which could transport the cargo to the hinterland. The warehouse maintained this function until the late 1960s, when the introduction of the container rendered the archetypical warehouse redundant. Up to then, operations had only been interrupted briefly during the First and Second World War. During the former, the Dutch army used the warehouse as a storage depot for provisions. In 1966 N.V. Blaauwhoedenveem closed down its warehousing divisions and operations at St. Jobsveem were ceased. The building was sold to the city in 1978 and activities at the site would slowly decline over the following decades.

Already from the late 1970s onwards, plans were prepared to revitalize the port area, which would be converted into a residential district. During the 1980s a growing appreciation of industrial heritage led to the insight that the existing harbour infrastructures were vital to the identity and character of the area. As a result of this, the original buildings, including the Jobsveem were classified as state monuments, preserving them from being demolished. When in the late 1990s the development of the area eventually was initiated by the city counsil, a competition was held among architects and developers for the conversion of the Jobsveem into a mixed-use urban block. The winning proposal was never realised however, due to the challenging economic situation at that time. In 2003 another competition scheme, designed by Robert Winkel, was developed by contracter and real-estate developer BAM, resulting in a much more feasible design. In 2005 this scheme would eventually be realized, construction was finished in 2007. The project included a thorough renovation of the existing warehouse structure. Additionally, significant changes needed to be made to make the building suitable for residential use. Currently, St. Jobsveem accomodates 99 apartments and 10 penthouses. Furthermore, the plinth holds 2000 m2 of commercial workspaces (Groenendijk & Citroen, 2008).

ARCHITECT

JAN JERONIMUS KANTERS

TYPOLOGY

WAREHOUSE

COMPLETED

1912

FUNCTIONS

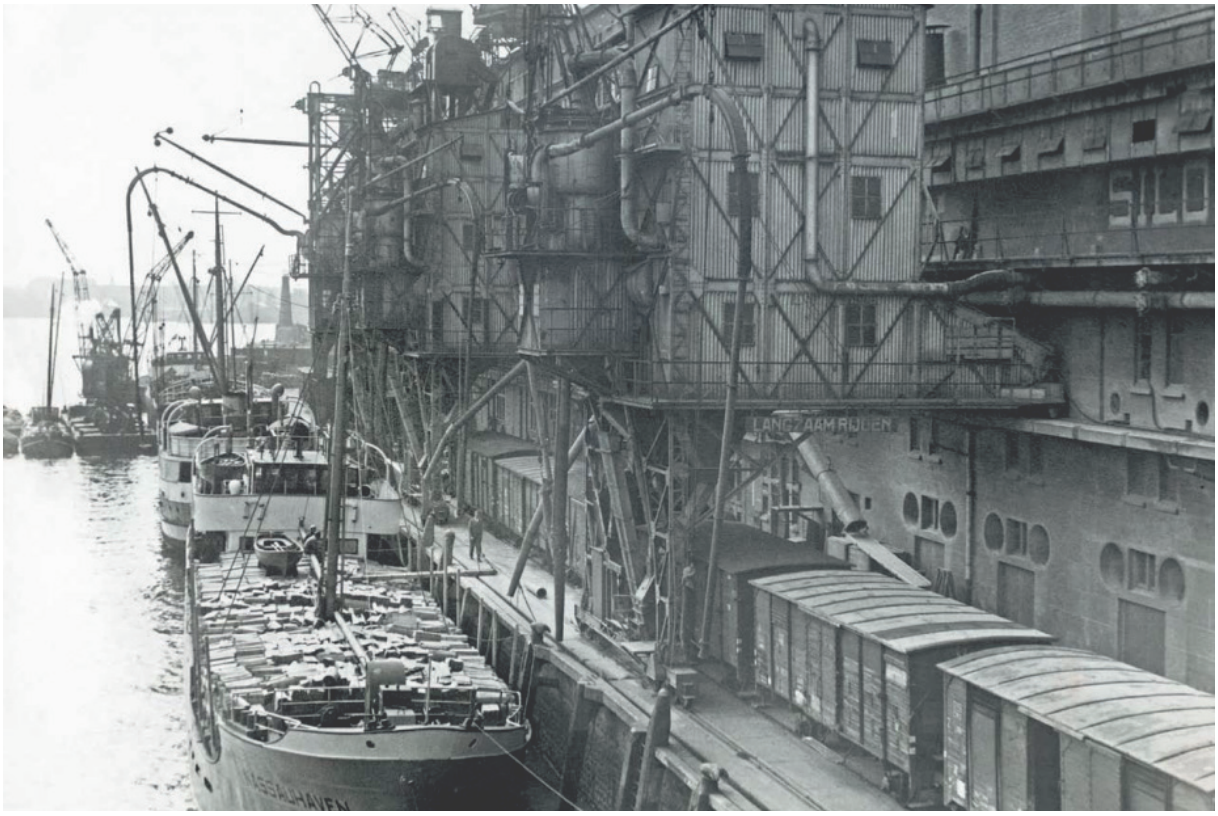
WAREHOUSE

ARMY DEPOT (WORLD WAR II)

NIGHTCLUB (TEMPORARY)

RESIDENTIAL

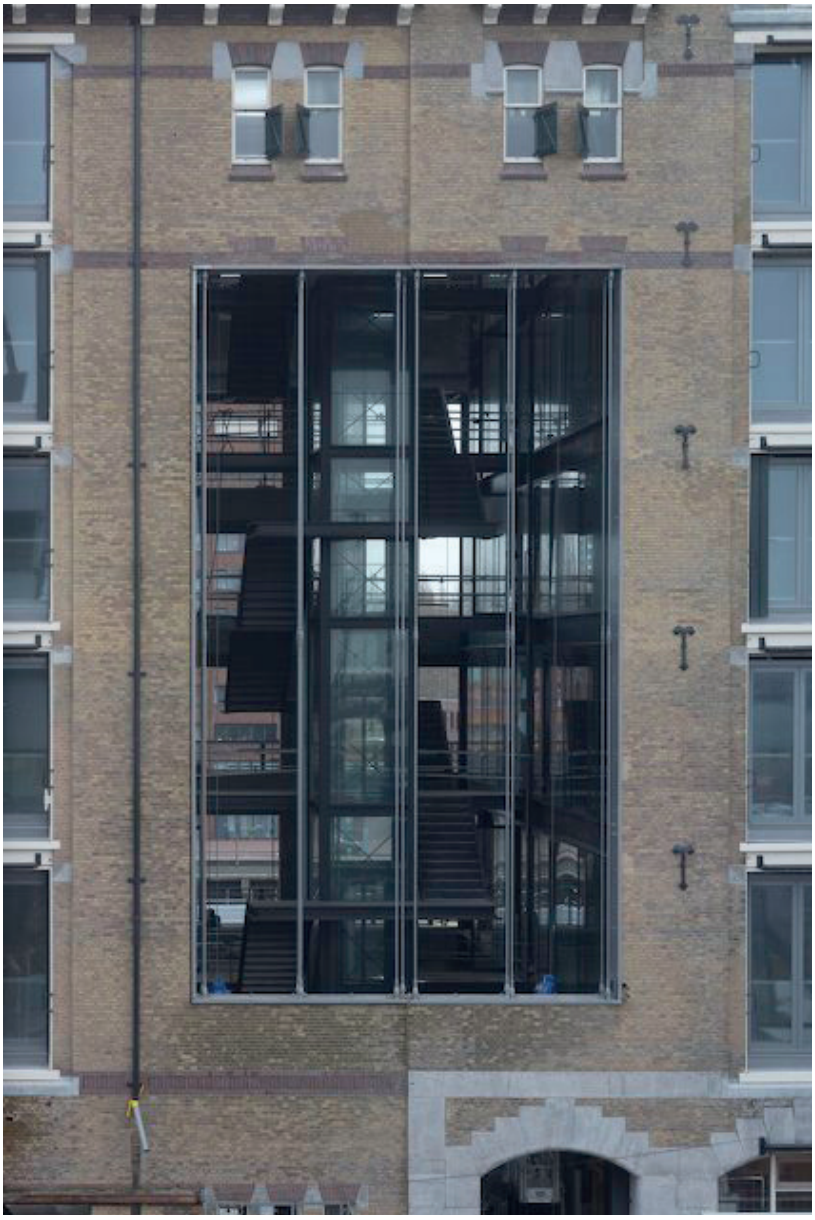
TRACKS LEADING TO ST. JOBSVEEM



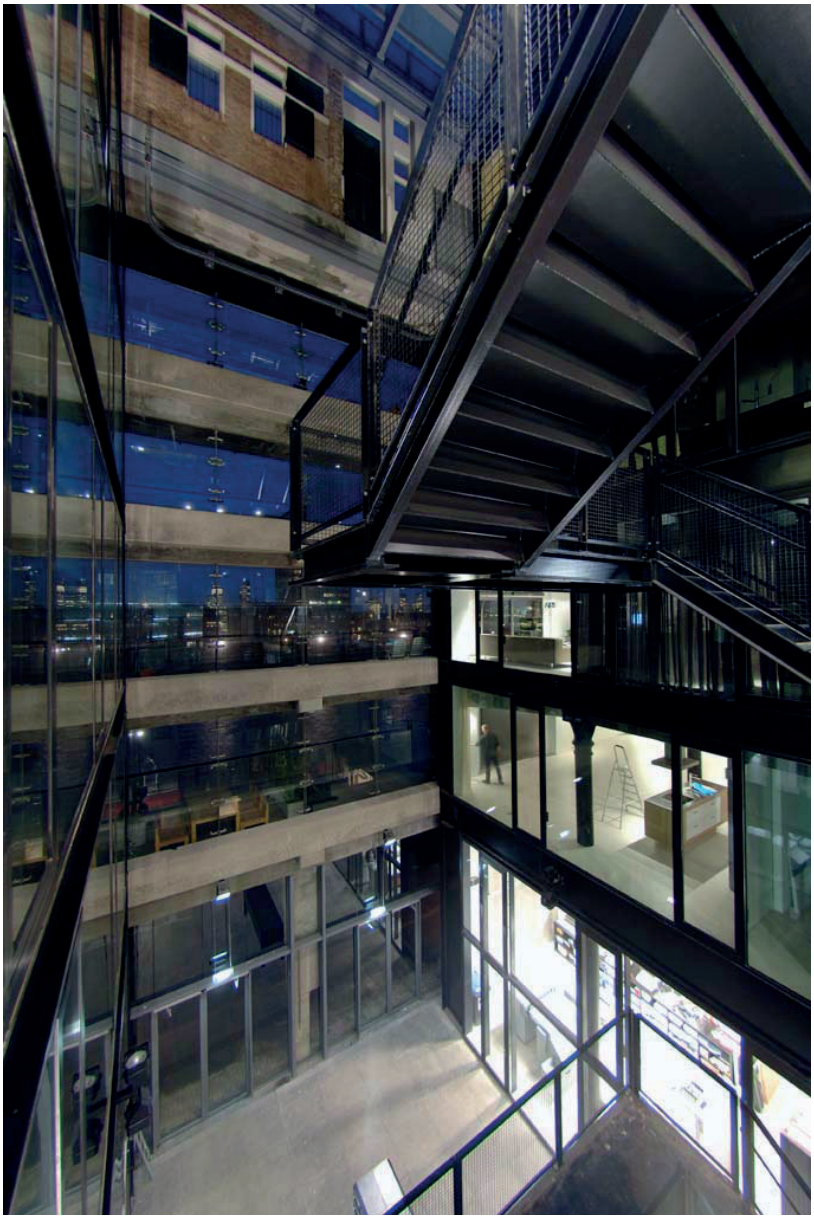
GRAIN ELEVATORS AND CRANES (REAR) ON THE EAST SIDE OF THE BUILDING

BALCONIES ON THE QUAY SIDE

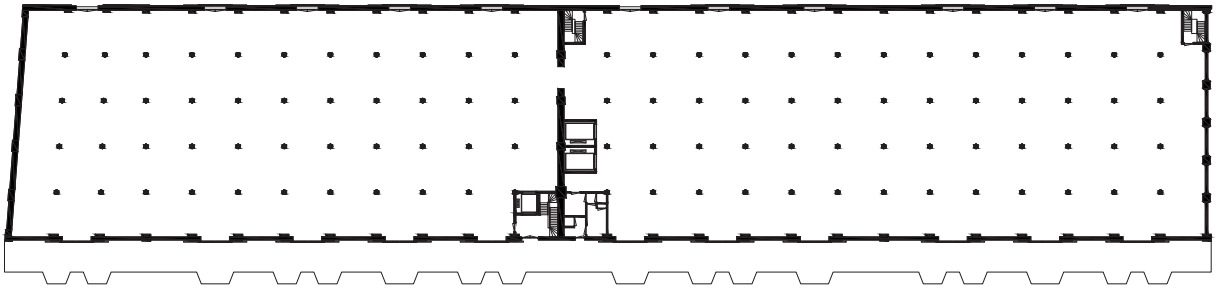
THE ORIGINAL STRUCTURE OF THE WAREHOUSE PRESENT IN ONE OF THE NEW APARTMENTS



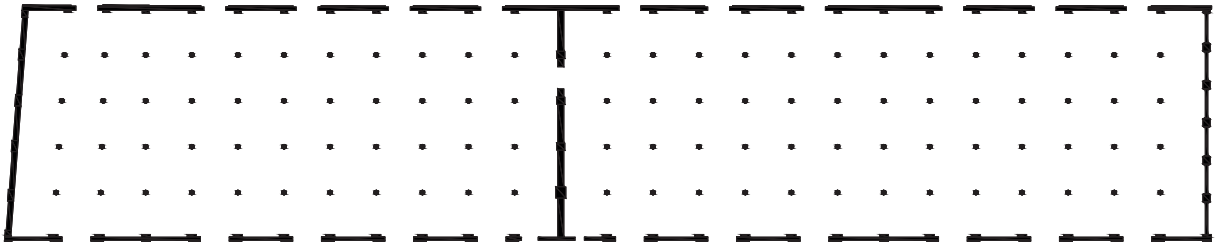
EXTERIOR VIEW OF AN ATRIUM



THE CONCRETE STRUCTURE OF THE ORIGINAL FACADE VISIBLE FROM WITHIN AN ATRIUM



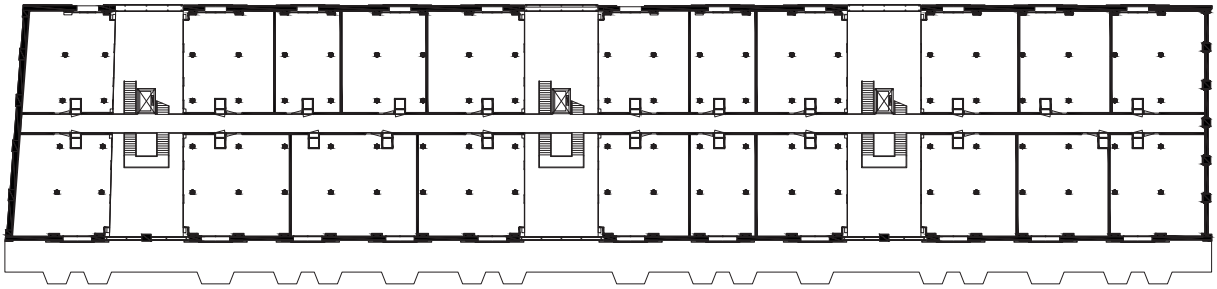
1. PLAN (+1)



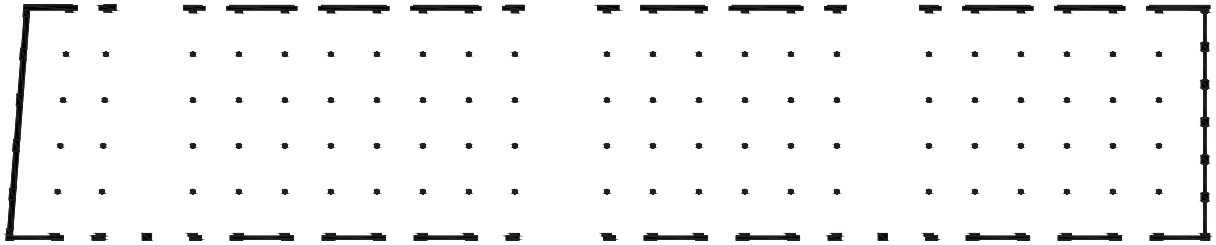
2. STRUCTURAL ELEMENTS

3. OPEN SPACE

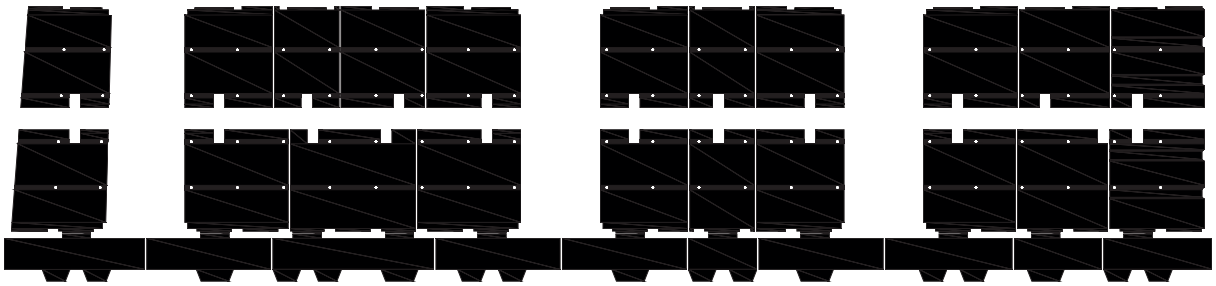
The building is based on a grid of roughly 5 x 5 meters. On the southern end of the building, the grid deviates and widens towards the quay side, so the south facade is placed at an angle. Originally, the floor plans were completely open, apart from the cores and a number of small spaces for services (1). A firewall divided the warehouse into two halfs: St. Job I and St. Job II. The former was an Entrepôt or transshipment warehouse. Here, imported goods were stored until further notice about their subsequent destination. No import duties had to be paid as long as the goods stayed within the warehouse. The upper floors have a gallery on the quay side, allowing for horizontal distribution of goods as well as for the cranes to place the goods coming from the ships. Parts of the balconies protrude to allow for crane access. All four facades of the building are loadbearing. Together with cast-iron columns, placed on the grid, they make up the buildings structure. These elements form the framework within which the adaptions for the conversion have taken place (2). The open space inbetween this framework,



4. FLOOR PLAN (+1)



5. STRUCTURAL ELEMENTS

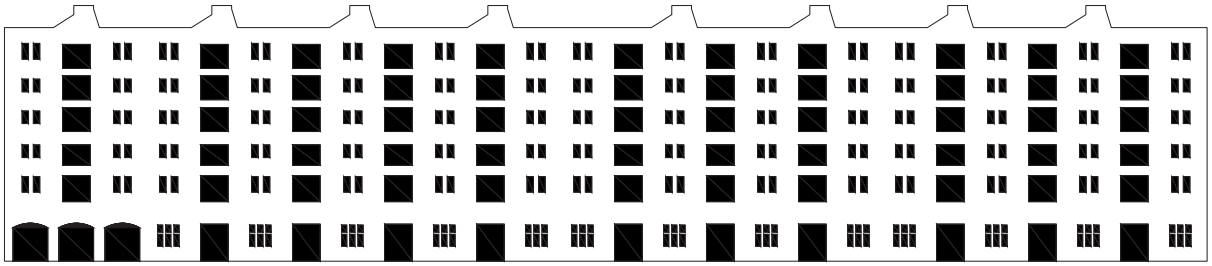


6. OPEN SPACE

originally was maximized to optimize the storage capacity (3). For the conversion to the residential programme, the open space needed to be divided into several apartments. Twelve of them are located in alternating arrangements on each floor (4). To facailitate the transformation, an important aspect to take into consideration was daylight entry. The width of the building is roughly 25 meters, therefore the openings in the facade would not allow for sufficient daylight to make a residential programme feasible. For this reason and to allow for vertical circulation, three atria are created. These atria cut-through the entire building. From the ground floor up to the roof, they span from the northern to the southern facade. A glazed roof allows for light to enter these spaces. The apartments which flank these cores on both sides, now receive daylight from two instead of just one side. The staircases located in the atria also provide access to a central corridor from which the appartments can be accessed (6). To allow for these transformations only minor changes to the framework were needed, especially for the atria (5).

1913

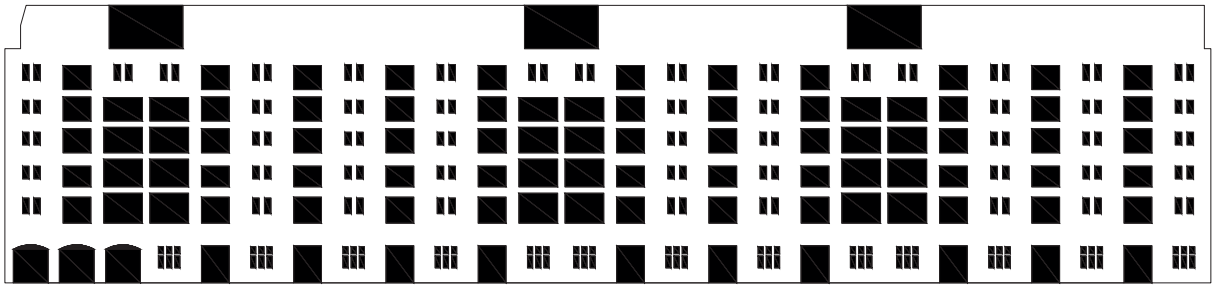
7. EAST ELEVATION



8. EAST ELEVATION OPENINGS

2007

9. EAST ELEVATION



10. EAST ELEVATION OPENINGS

11. EAST ELEVATION TRANSFORMATION

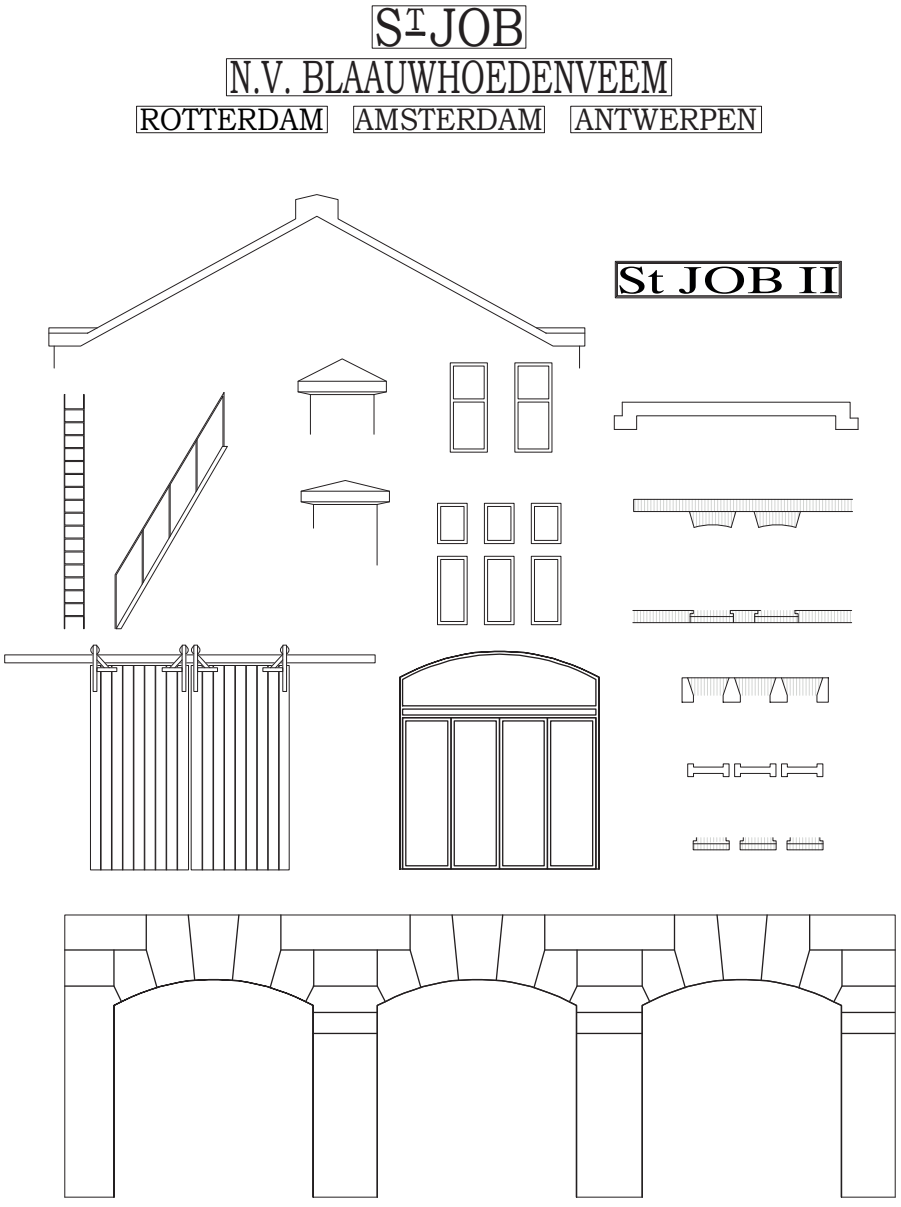
While the interior has changed significantly, the facades have undergone only minor changes. This has to do with the fact that the facades are loadbearing, making adaptations both challenging and costly. The nature of the facades generates a certain resistance which opposes change. Whereas the interior offers an abundance of possibilities to be altered, due to the structure which could easily be adjusted. As a result of this, the expression of the facade, in which the identity of the building is embedded, is preserved. The east facade which faces the water, clearly demonstrates how the image of the building was preserved after the repurposing (7, 10). The major intervention was the creation of openings for the three new atria (8,10). These were created within the concrete framework, which structures the facade. Originally this concrete skeleton was infilled with patches of brickwork, which have been taken out (11). Another adaptation was the addition of a full storey on top of the former roof. This altered the building's roof profile (8,10). Noteworthy however is the south facade which already featured a gable, despite the absence of a roof. This gable now aligns with the new roof seemingly predestined.

12. EAST ELEVATION

13. EAST ELEVATION

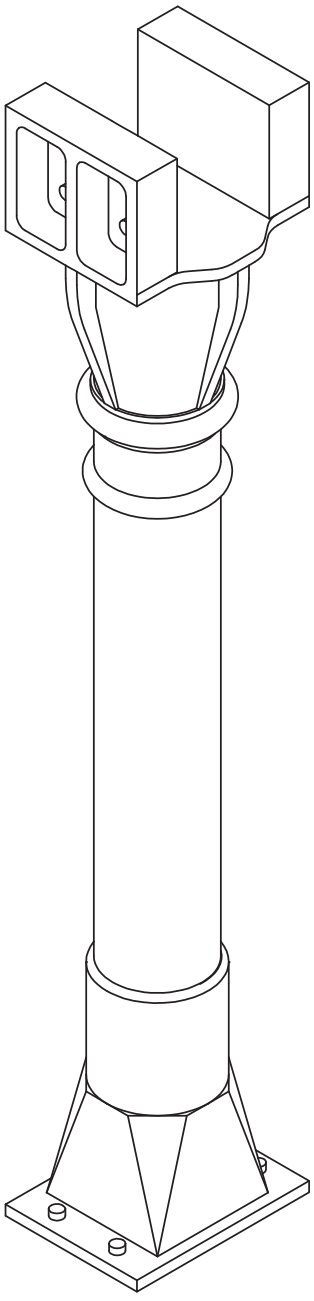
14. SOUTH ELEVATION

The nature of the building is embedded in the precence of elements in the facade which convey the heritage but moreover; the identity of the architecture. Important pieces are the wooden hinged sliding doors. These originally closed the entrances to the storage space, but now serve as shutters for the glass sliding doors of the apartments. Whereas in the past these wooden doors would mostly remain closed to secure the stored goods, they now are operated by the individual tenants. This results in organic configurations of open and closed. It becomes an expression of a change in function,



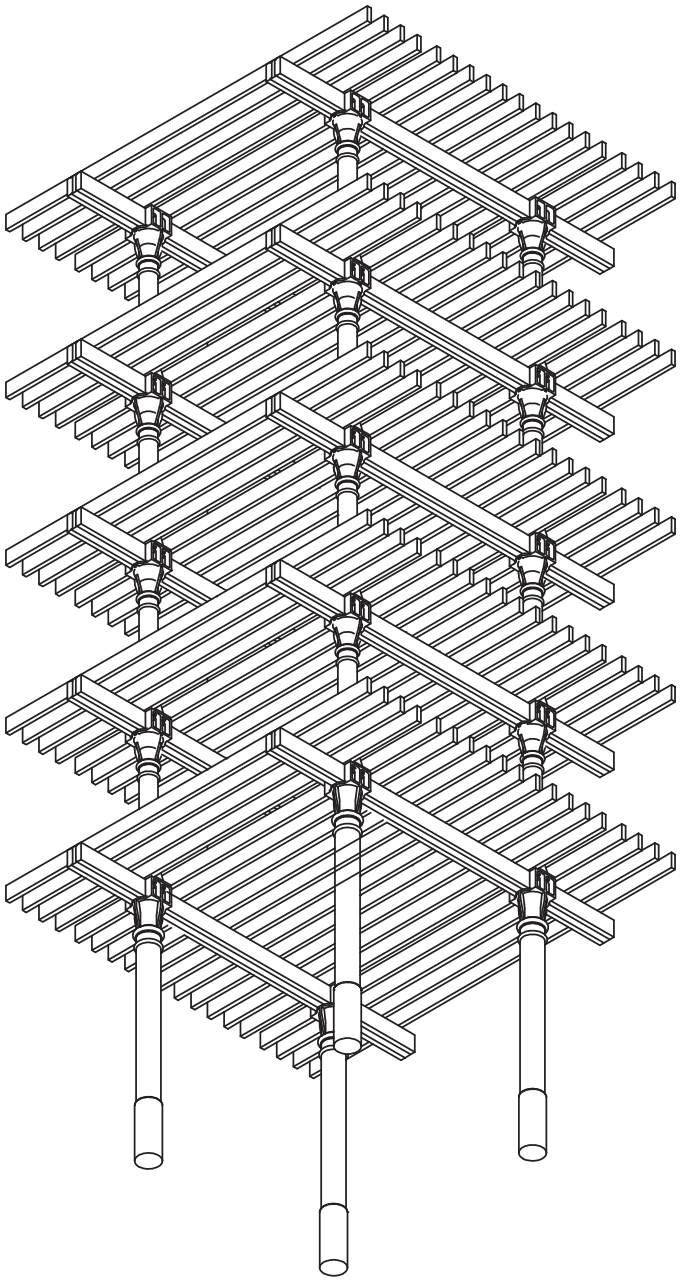
15. ARCHITECTURAL ELEMENTS

while maintaining a clear reference to the original identity. Furthermore, details such as the fire escape stairs, have been retained. Or the original window frames (12, 13) Many of these elements are unique and building-specific; making it recognizable as a seperable entity. These elements go beyond the pieces which are elemental to the warehouse type. Decorative additions make a building stand out from related buildings. Take for example the concrete on the facade which was finished with a layer of ribbed plaster yellowish in colour that makes is look like stone. As well as the characteristic masonry (15).



16. COLUMN

The interior volume of the warehouse is broken down to a scale suitable for the residential programme. These modifications were possible mainly because of the structure of the building. The cast-iron columns are bolted on top of each other, as a result they were suited to be demounted, allowing space for the new atria. Another significant aspect is the floor construction which consist of wooden beams supporting a wooden deck. A material which does not demand an enormous effort to be adapted. To create the atria the floors have simply been cut with a machine saw over the full length



17. STRUCTURAL SYSTEM

of the building. The bearing structure consists of a combination of materials and techniques. The choice for these specific materials - although it was not conscious - was critical to the suitability of the structure for transformation. The flexibility of the internal structure; the floors and columns, provided maximal freedom. Whereas the external facades, which are massive and load-bearing, created a solid framework within which changes could take place, whilst the expression of the building is preserved along with its identity. Maintaining this is critical to the success of the transformation.

THE ORIGINAL STRUCTURE OF THE WAREHOUSE

DETAIL OF THE CAST IRON COLUMNS AND WOODEN FLOORING

CREATION OF AN ATRIUM DURING CONSTRUCTION

COLUMNS REMOVED TO MAKE PLACE FOR AN ATRIUM

RIGHT: ATRIUM OF BUILDING B

Brooklyn Army Terminal

NEW YORK

The Brooklyn Army Terminal is a large complex of warehouses located on the Brooklyn waterfront. The building was commissioned by the US Army during the First World War. Despite being constructed in only one year, the complex was completed in 1919: one year after the conclusion of the war. For this reason the total capacity of the terminal would not be used the decades after completion. During the development of the terminal it was taken into account however that the structure, after the world war, would be used as a civil facility (Stern, 2001). Therefore, parts of the complex were leased out to several parties, exploiting a wide variety of activities. The United States Army eventually stopped using the terminal in 1967. The New York City government eventually purchased the complex and since then the Brooklyn Army Terminal has undergone a series of renovations, making it suitable for accomodating manufacturing businesses. Currently the complex is nearly finished and is home to a diverse set of over one hundred individual tenants. And a large number of additional services.


BROOKLYN ARMY TERMINAL

SITUATION

The terminal was designed by Cass Gilbert, well-known for the Woolworth Building. While most of Gilbert's works could best be described as eclective and feature abundant decorative elements, the Army Terminal is completely devoid of any decorations. The utilitarian architecture had great appeal to modernists such as Le Corbusier, who even included a picture of the terminal in his 1925 ''Vers une architecture". The Army terminal was the largest concrete building at its time. Construction however, took only a year (Irish & Gilbert, 1999). Upon completion, the Brooklyn Army Terminal consisted of two warehouses, three piers and an administrative building, all connected by a number of bridges, allowing passage of goods underneath. A 35 ha. train storage yard with a total capacity for 2,200 cars was located on the site surrounding the complex. The facility was designed to transfer goods from rail to ship and vice-versa. The 300 meter long warehouse buildings had a total storage capacity of roughly 450,000 tons of goods and had an outgoing freight capacity of 1,400 tons per hour. To enable transit of these immense numbers of goods, the facility was organized with maximum efficiency in mind. The centerpiece was the vast atrium of building B. A large number of cantilevered balconies allowed overhead cranes to distribute freight over each of the floors. A system of 96 freight elevators - by far the largest at its time - facilitated further distribution of goods throughout the warehouses. Eventually the goods would be transferred towards the piers over bridges and a number of subterranean connections the connecting bridges. At its peak, during World War II, a total of 33,366,000 tons of freight and 3.5 million soldiers embarked from the terminal. By then the Army Terminal employed 20,000 workers and served as the headquarters for the New York Port of Embarkation (Christen & Flanders, 2001).

In 1964 the United States Army considered closing the terminal as part of an operation to downsize unnecessary military installations. Despite efforts to save the base from closing, the facility was definitely closed in 1967. In 1981 the terminal was then bought by the New York City government. Since then the building is being renovated in phases and leased out to light manufacturing, warehousing and back-office businesses. In 2017 the renovation of the terminal was 92% complete. The complex now accomodates 100 companies employing 3,800 workers (Kaysen, 2018).

ARCHITECT

CASS GILBERT

TYPOLOGY

WAREHOUSE

COMPLETED

1919

FUNCTIONS

ARMY FREIGHT TERMINAL

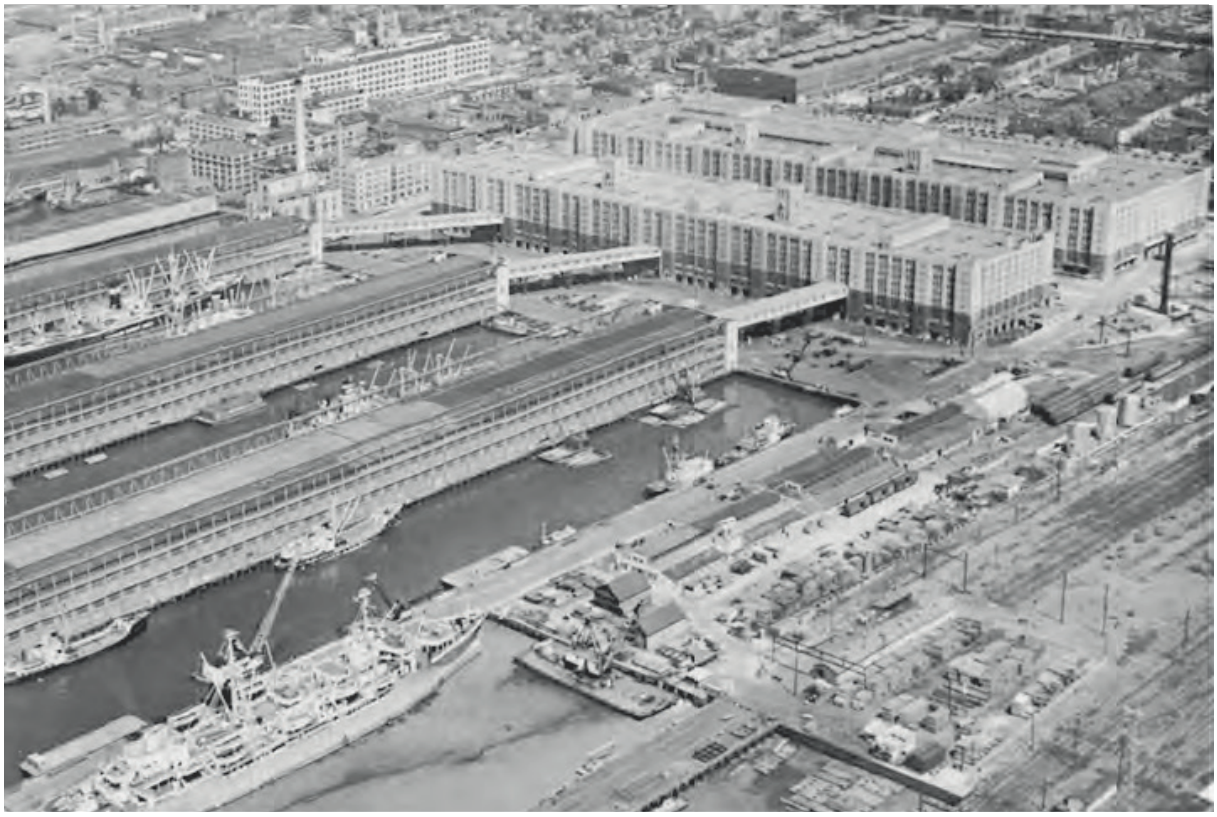
COMMERCIAL FREIGHT DOCK

MILITARY PRISON

MILITARAY SUPPLY BASE / EMBARKATION TERMINAL

MAIL DISTRIBUTION FACILITY

MULTI-TENTANT BUILDING / MANUFACTURING HUB



THE TERMINAL DURING THE INTERBELLUM

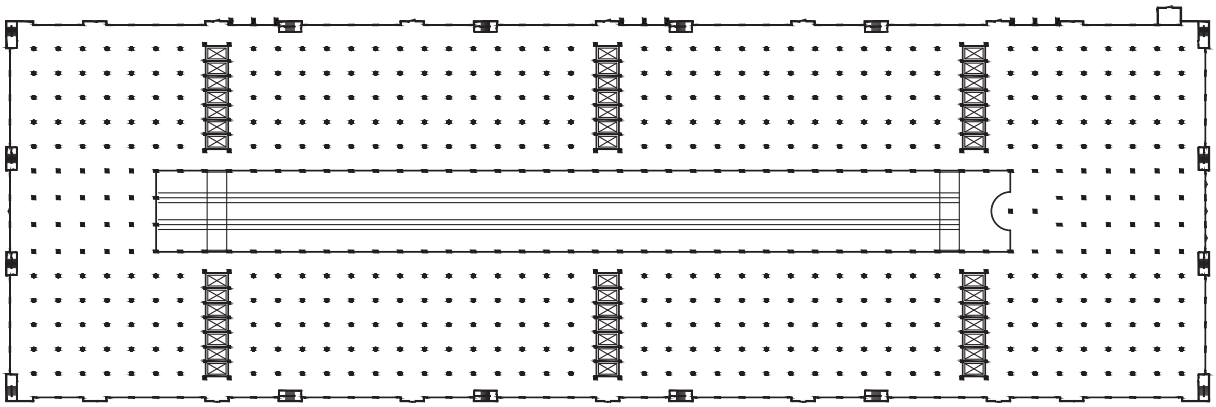
ATRIUM OF BUILDING B

ATRIUM OF BUILDING B

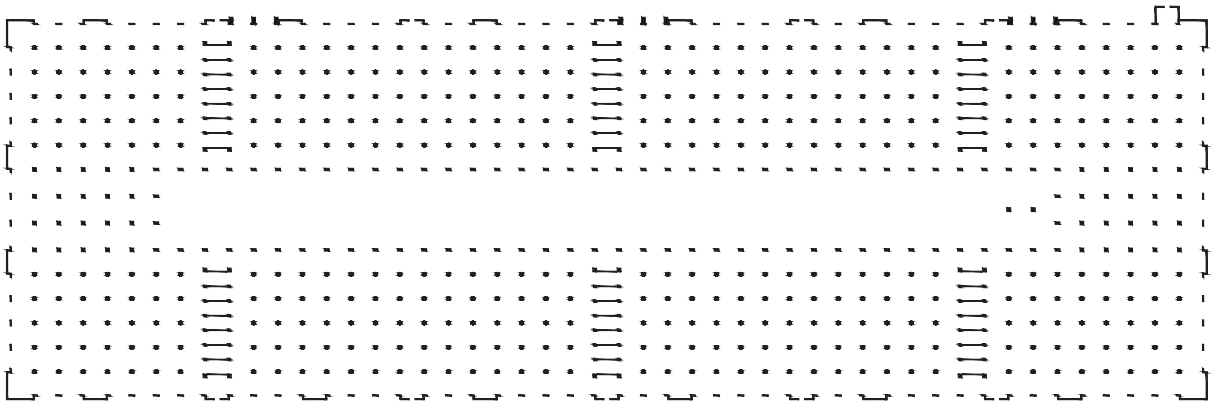
CAFE LOOKING INTO THE RENOVATED ATRIUM

PAINTING STUDIO LOCATED IN BUILDING B

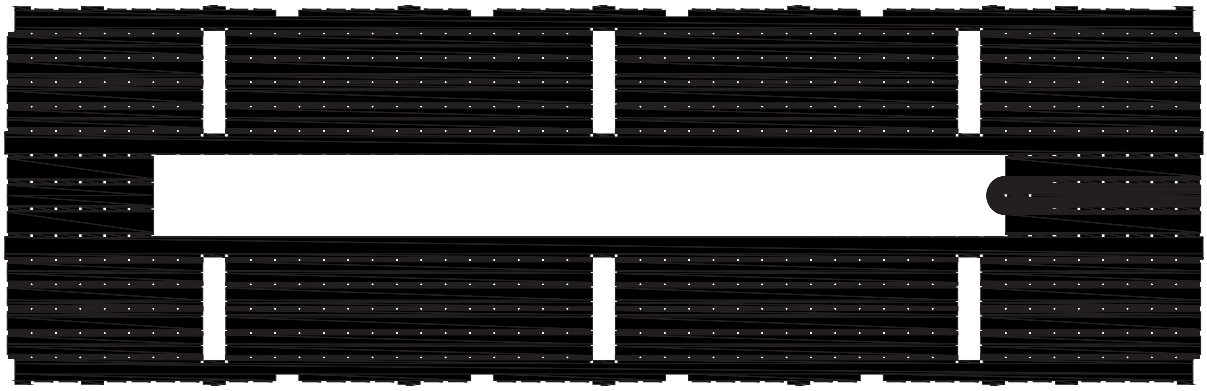
DAY CARE IN THE ARMY TERMINAL



1. PLAN (GF)

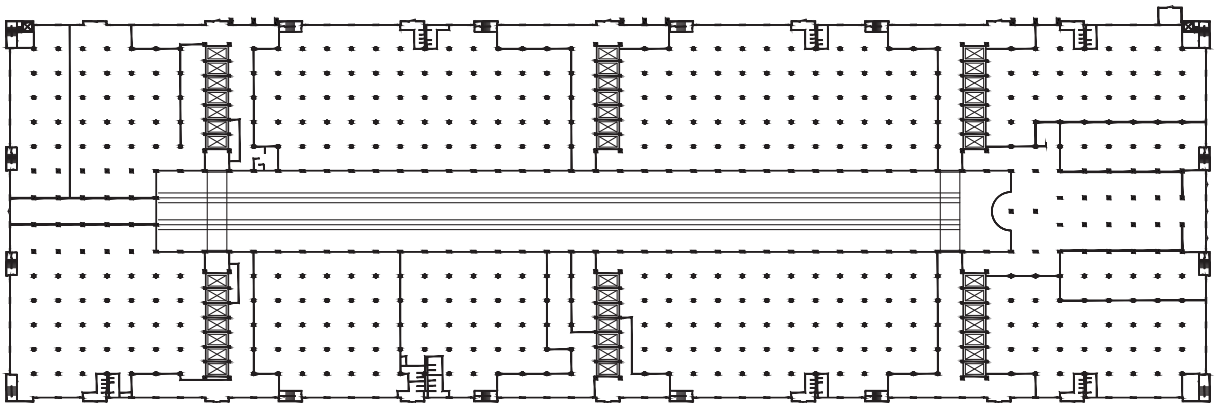


2. STRUCTURAL ELEMENTS

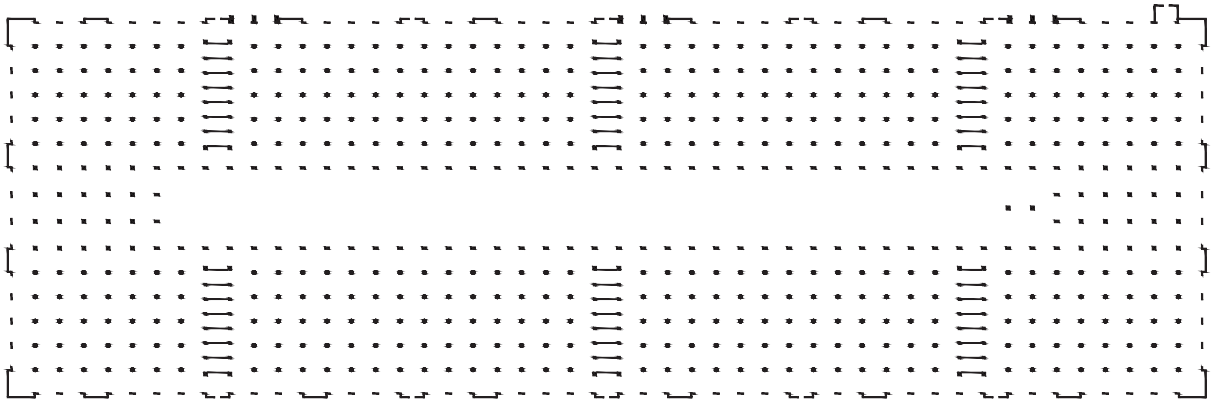


3. OPEN SPACE

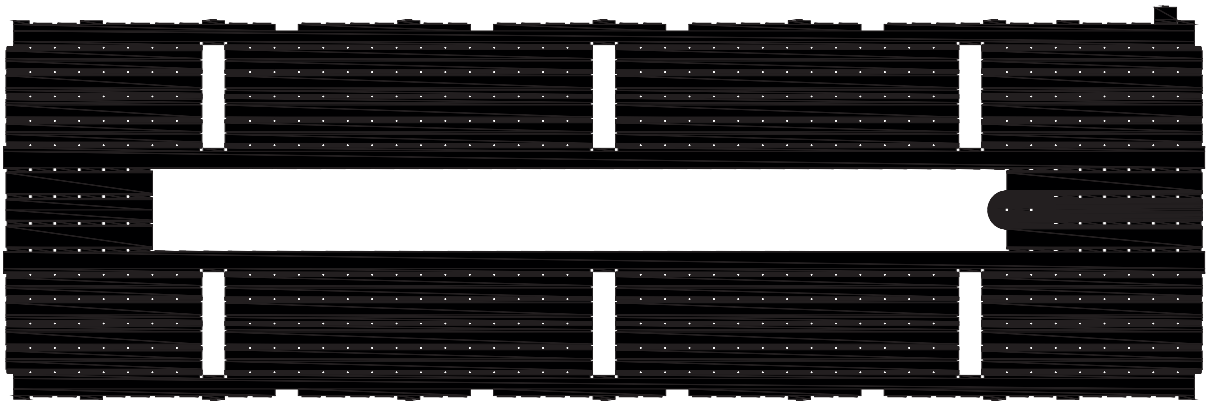
Buildings A and B are constructed on a rational grid of 20 x 20 feet. Each of the consists of 8 floors. A basement is located underneath building A, which is accesible on the quay side due to the terrain sloping down towards the water. The structure consists of concrete floor slabs and columns which are cast in situ, the facades are cast in concrete as well and are loadbearing (2). The B building is centered around an atrium, which accomodates rail tracks, allowing for goods to be transported into the building, then hoisted on the protruding balconies (1). During the usage as a warehouse the entire space was open,



4. FLOOR PLAN (GF)



5. STRUCTURAL ELEMENTS

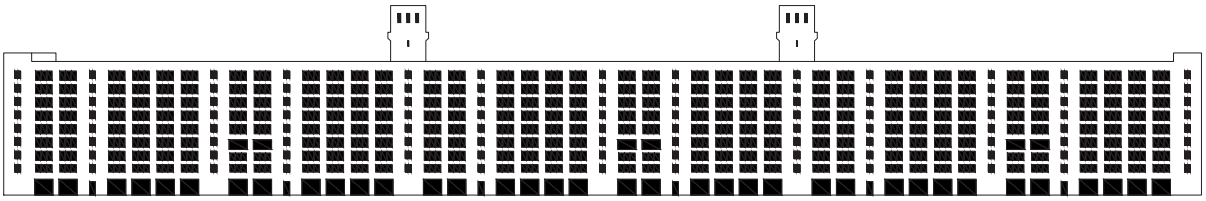


6. OPEN SPACE

the only divisions were the cores housing the 96(!) freight elevators (3). The conversion to a multitenant industrial facility required the open space to be divided into seperate units (4). The New York city counsil chose for a flexible approach, where tenants can make an inquiry for a specific amount of floor area. The rentable units range from 4,500 to 39,000 square feet, but can also be assembled to increase rentable space on floor plates ranging up to 200,000 square feet. The existing structure lends itself perfectly for this, as the grid and the amount of cores allow for a vast amount of possible configurations (5,6).

1919

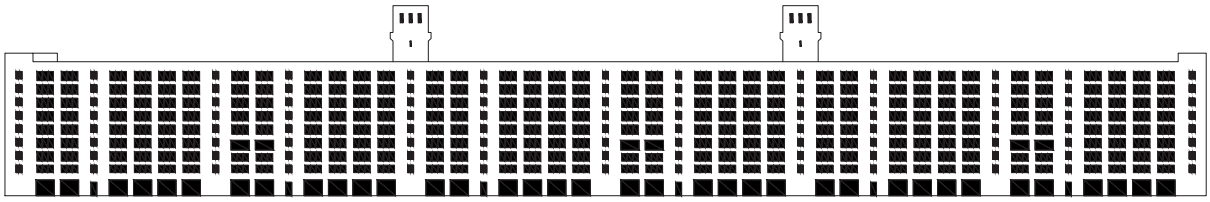
7. SOUTH FACADE



8. SOUTH FACADE OPENINGS

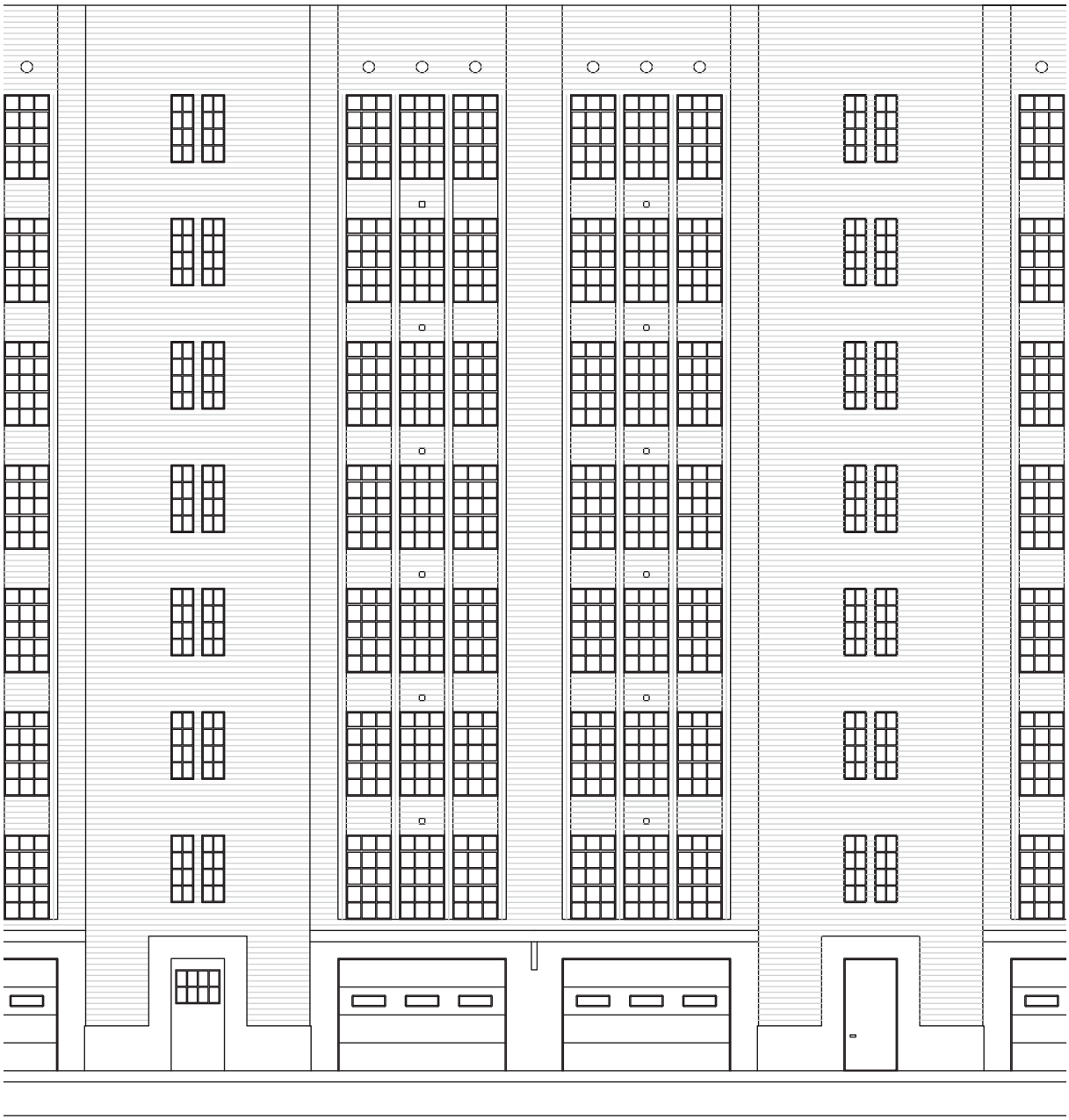
2020

9. SOUTH FACADE



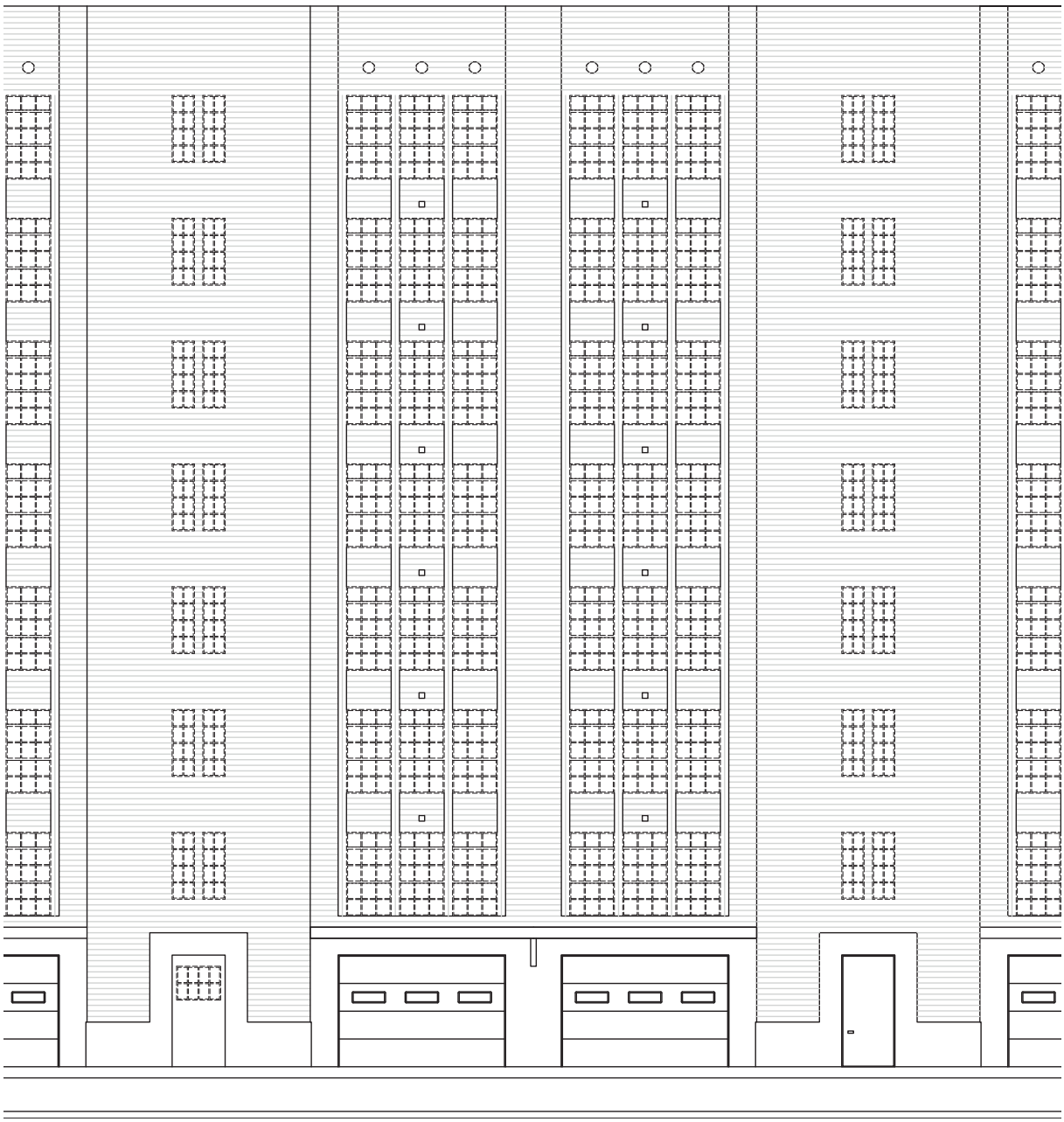
10. SOUTH FACADE OPENINGS

The facades of the terminal follow the rational layout of the interior. The composition however is precisely designed and as a result the complete ensemble forms a harmonious arrangement. The facades are articulated vertically by buttresses, which serve a functional purpose: on the inside stairwells are located which protrude from the outer wall, to not obstruct the distribution of goods in the interior space. Only one out of two buttresses however, contains a stairwell, which suggests that for Gilbert the composition and aesthetics informed the design just as much as did the function. Another peculiarity is the resemblance between the facade composition of the Army Terminal and one of Gilbert's earlier designs: a warehouse for Austin, Nichols & Co. built 9 years before, in 1909. Despite the difference in scale and programme, the facade of this building is very similar to that of the Brooklyn



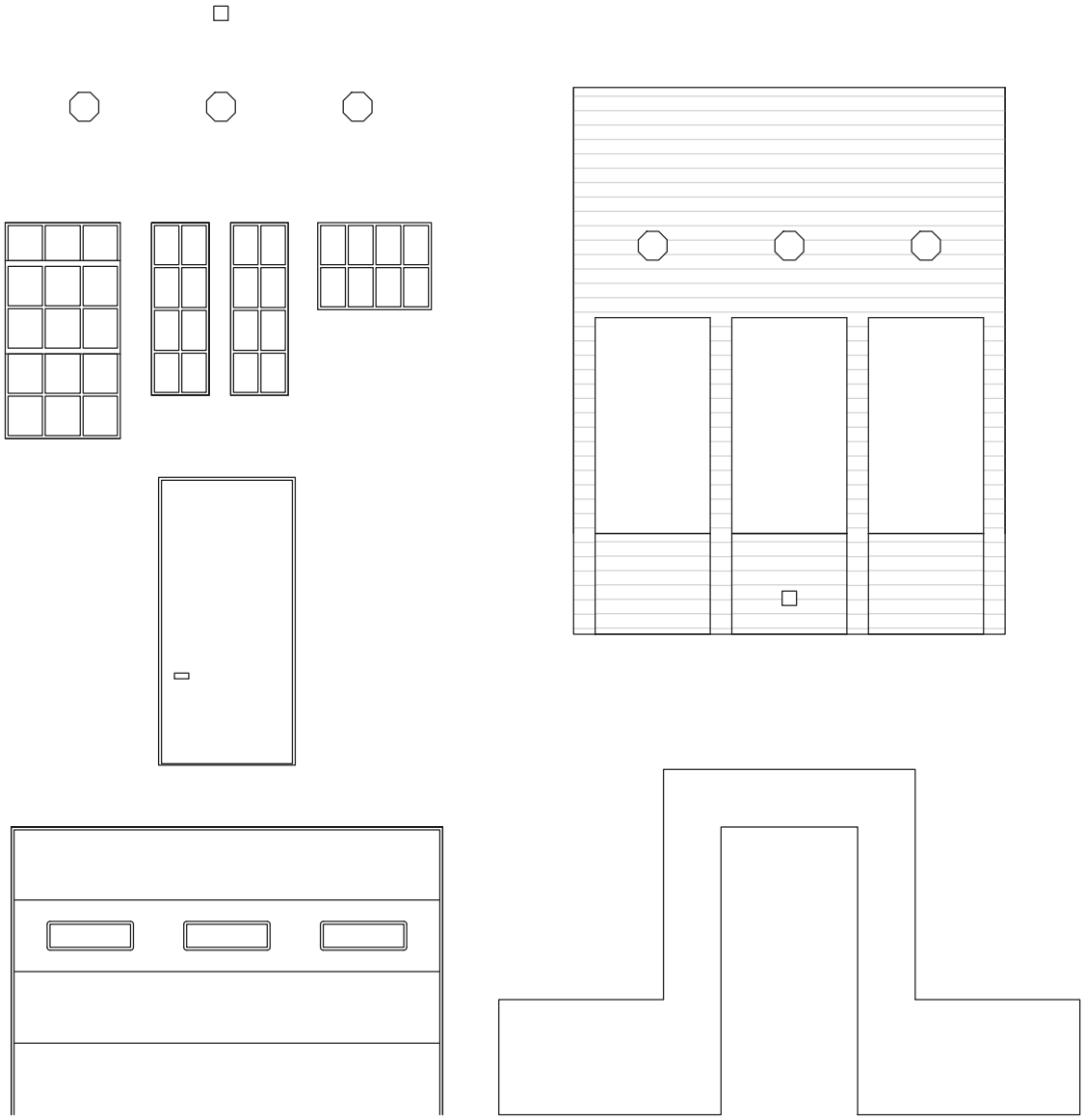
11. SOUTH FACADE

Army Terminal. Gilbert chose to reuse the design. Both buildings were constructed in concrete and share the exact same facade composition: the placing of the windows in pairs of three with a slight setback from the facade as well as the cast-iron windows, characterized by their many subdivisions (11). The buttresses are found on the Austin, Nichols & Co. warehouse as well. In both buildings the buttresses on the corners are risen slightly above the facade, creating the allusion of a fortress almost. These features characterize the building, despite the absence of 'ornament' in a explicit and obvious sense, the appearance of the building is stylized to a high degree. This is not remarkable when taking into consideration the other works of Gilbert, characterized by the eclectic and explicit architectural style, common to the early twentieth century New York. All of these buildings feature facades with



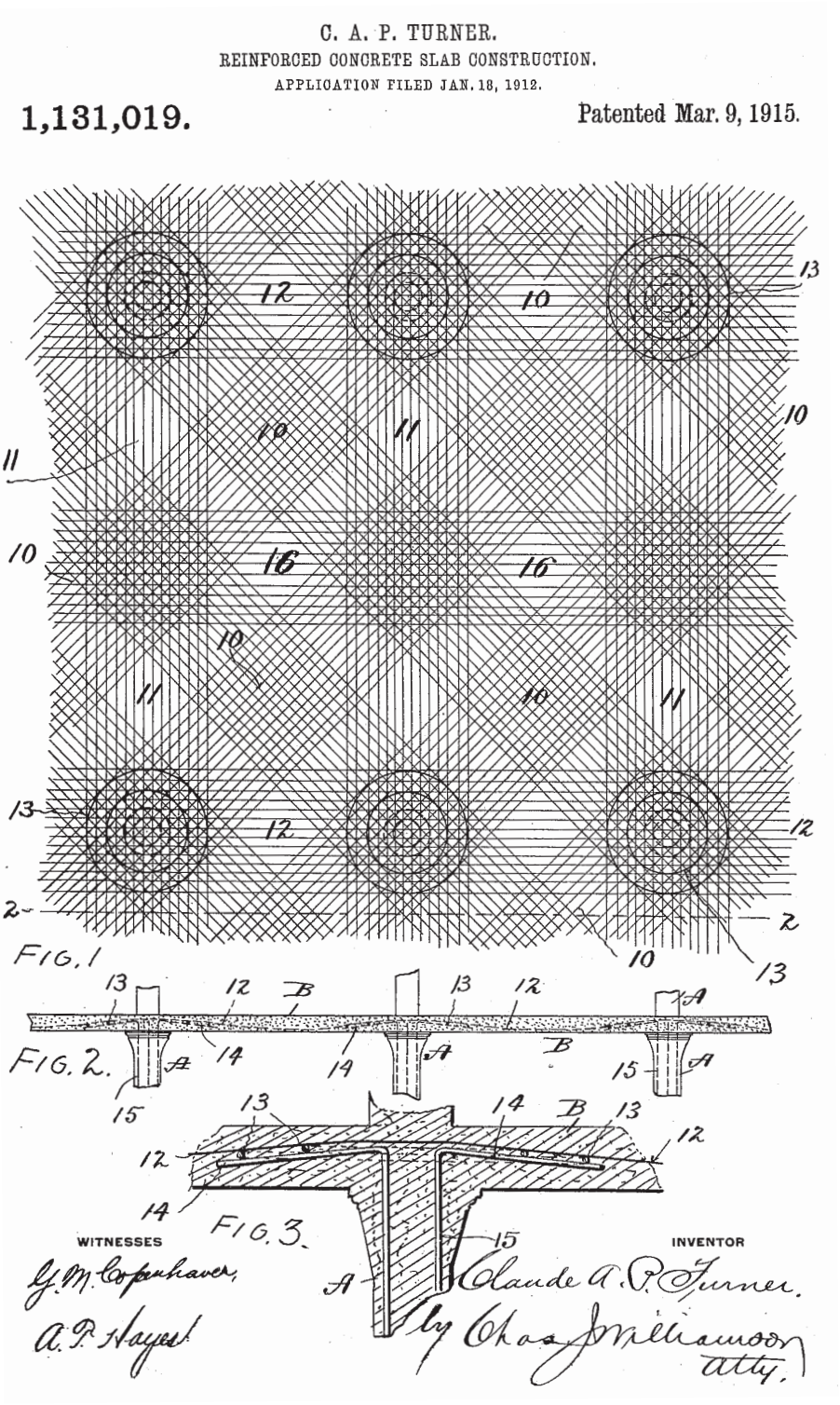
12. SOUTH FACADE

elaborate compositions and ornamentation. The Army Terminal might differ greatly in appearance from these buildings, it shares the care that is put in the facade composition. Since the facade is completely cast in concrete and therefore inherently of a permanent nature, its unique appearance is guaranteed to prevail. And despite the absence of decorative elements, pieces such as the windows, are unique and contribute to identity of the building (12). During renovations, these elements have been carefully preserved or reconstructed, which has greatly helped in preserving the original identity. For the recent conversion into a multi-tenant building, the building's indoor climate needed to be improved. Therefore the original, century-old steel windows have been replaced by new sets of windows. By maintaining the exact same layout of partitions, the image of the facade, and thus the identity of the



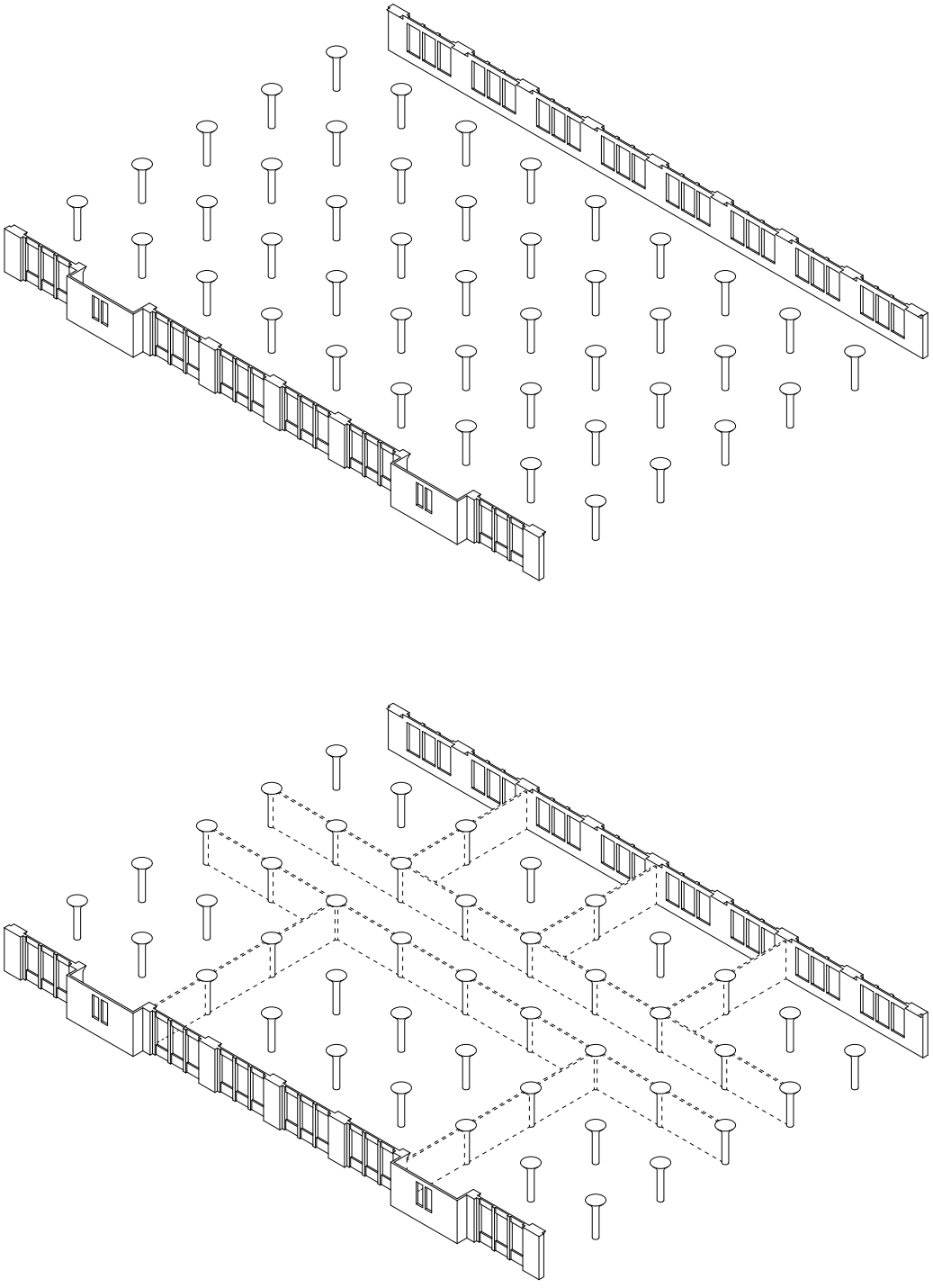
13. ARCHITECTURAL ELEMENTS

building - existing in the collective memory of its many previous users and inhabitants of Brooklyn - has been preserved. This example furthermore demonstrates the importance of carrying out a renovation with a large degree of precision. As the overall identily of the building to a large degree is embedded in just minor details. The new function adds another layer to the already rich history of this edifice, while the expression of the complex is perpetuated. Despite the absence of an overly expressive facade, the composition and the vastness of the building, along with the distinct facade details (13), uphold the identity and rich history of the building. The robustness of the concrete structure was determinent in this too. The replacement of the windows could was a small effort, since the removal and placement onto the simple concrete structure did not require any adaptations to be made to the stucture.



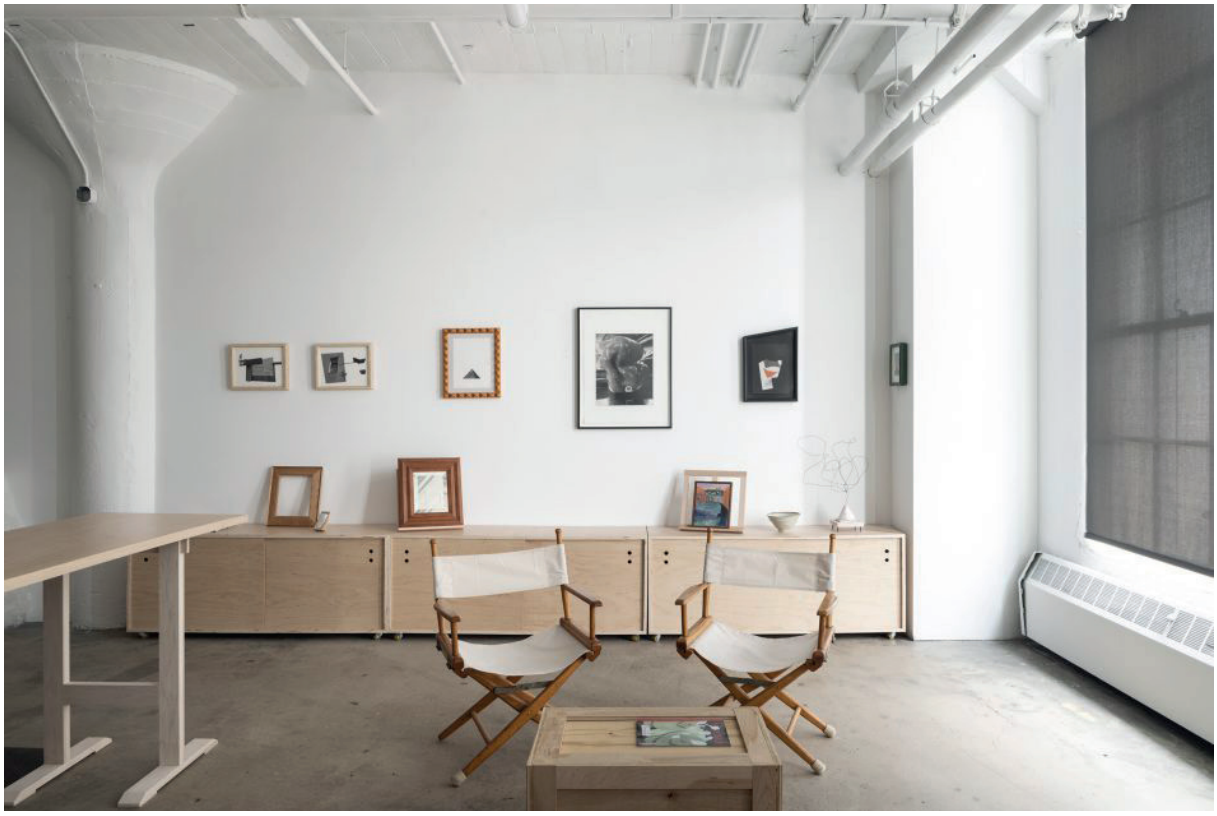
14. PATENT FOR THE REINFORCED CONCRETE STRUCTURE BY C.A.P. TURNER

While the exterior concrete facade of the Army Termnial is a bearer of its identity, the concrete columns in the interior, contribute to the recognizability of the building as well. The construction of the building is unique and was technologically advanced. It was developed in 1909, by C.A.P. Turner, an engineer which worked with Cass Gilbert on the Brooklyn Army Terminal, as well as on the Austin, Nichols & Co. warehouse. The system uses four-way flat-plate slabs and mushroom columns. The slab is reinforced around the columns with capitals shaped as inverted cones. The characteristic shape of the columns is



14. INFILLING THE COLUMN STRUCTURE

recognizeble throughout the interior and is still visible nowadays. The absence of beams and joists minimized the amount of formwork needed which accelerated construction and reduced labor costs. In addition it allows for maximum ceiling heights and mechanical and electrical installation to be fitted and reffitted easily. The latter made the structure very suitable for reuse, as technical requirements tend to change oftenly as they are subject to legal requirements.



COMPARTIMENTALIZATION OF THE OPEN STRUCTURE

NEWLY FITTED INSTALLATIONS IN THE BARE CONCRETE STRUCTURE

NEWLY FITTED INSTALLATIONS IN THE BARE CONCRETE STRUCTURE

LARGE CORES OFFERING SPACE FOR SERVICES TO BE FITTED

RIGHT: ORIGNAL INTERIOR

‘t Karregat

EINDHOVEN

‘t Karregat was a multifunctional community centre designed by Frank van Klingeren. The project was part of the development of a new city district: Hertzenbroeken. The city counsil took an experimental approach for this city expansion, as many of the post-war residential estates, were experienced as dull and monotonous. As much as a building ‘t Karregat was a social experiment, conforming to the idealistic mindset of the 1970s. By combining a variety of district amenities in a single open space, the community centre was envisioned to contribute to social relations within the neighbourhood. The building is controversial and has both been applauded and criticized over the years. Initially the experimental project was a huge success, but as time passed the social ideals from which the building developed faded, as did the initial praise. The original concept faded as the open landscape under the distinctive roof structure cluttered with partition walls. The community centre suffered from degeneration. In 2010 renovation of the complex started, which is currntly being finished.

SITUATION

During the development of the Hertzenbroeken district the city counsil of Eindhoven wanted to develop certain amenities, that would serve the community and simultanously revive the notion of the neighbourhood. A project developer was contacted to realize a community centre in the heart of the new city expansion. During initial talks between the council and the developer ideas arose of combining various programmes, both commercial and social within a single building. It was hoped that by integrating them, the individual amenities and functions would be brought out of isolation. Enabling contact between groups of residents that would normally not take place. This would initiate communal activities and the development of a neighbourhood feeling. The concept of the building was radical but not unusual. More of these so called multifunctional accomodations have been realized in the Netherlands during that particular time period. Frank van Klingeren was an architect that had experience with designing similar buildings. Two notions recur in Van Klingeren's work: *hinder en ontklontering* translating as nuisance and de-clumping. In his opinion nuisance led to frictions between users, that required mutual understanding and agreements to be forged. This would encourage social relations. De-clumping, meant the integration of groups that were divided by the way society was organized. Van Klingeren wanted to create a centre that was a combination of 'maximum openness as well as maximum flexibility' To accomplish this 't Karregat was designed as a single open space, or landscape, covered by an intricate roof construction. Several functions, including a elementary school, library, supermarket and doctors office, were accomodated underneath one roof. Interior divisions were limited as much as possible, to guarantee spontanuous encounters among the users.

The nuisance envisioned by Van Klingeren proved to be counterproductive. During the 1980s several adaptations were made to the building. This was a result of the problematic acoustics and indoor climate. Another aspect was the social programme that was under pressure as a result of a shifting societal paradigma, produced by changing economic prospects. The original architectural concept slowly faded, as internal divisions were erected. After years of decay, a revitalization was carried out in 2010. The original concept however, was not brought back. (van den Bergen & Vollaard, 2001)

ARCHITECT

FRANK VAN KLINGEREN

TYPOLOGY

MULTIFUNCTIONAL ACCOMODATION

COMPLETED

1973

FUNCTIONS

PRIMARY SCHOOL

LIBRARY

SUPERMARKET

COMMUNITY CENTER

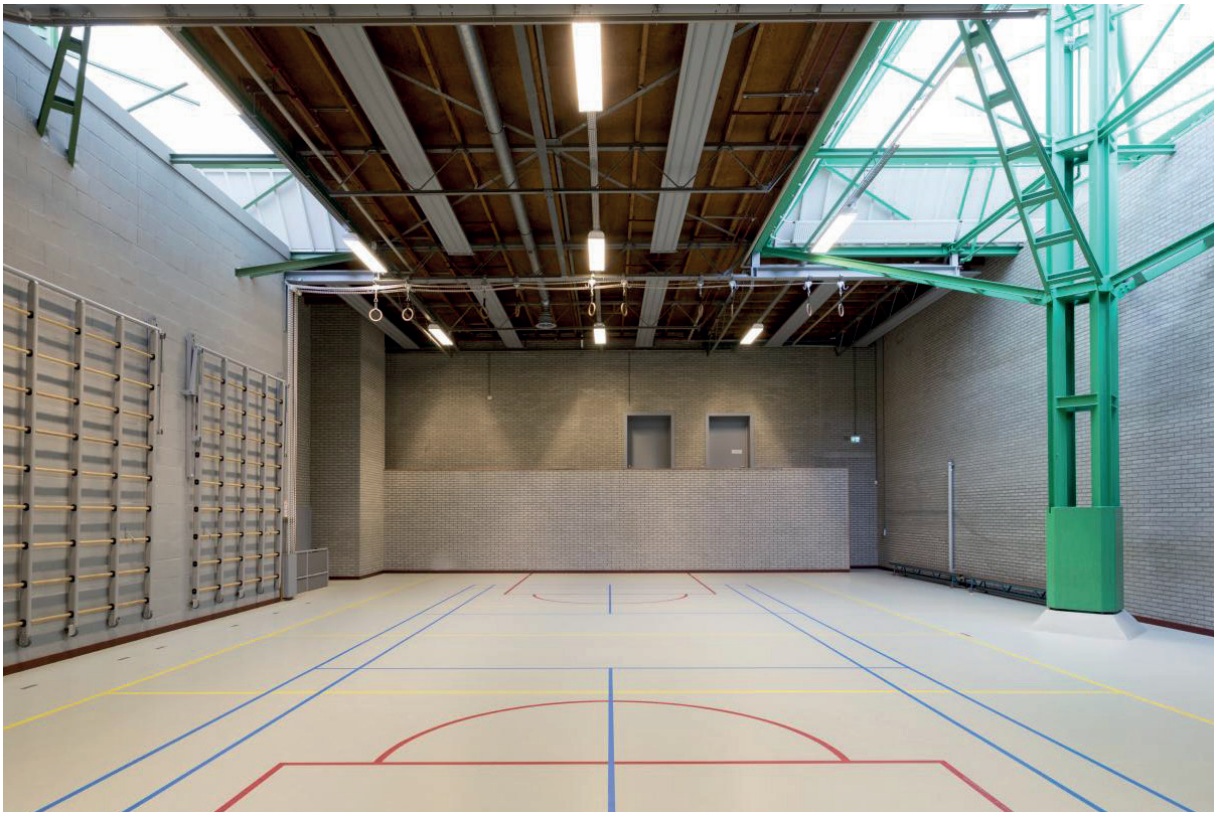
DOCTOR'S OFFICE

EXTERIOR VIEW SHORTLY AFTER COMPLETION

ORIGINAL INTERIOR OF ‘DE KUIL’, THE CENTRAL SPACE OF THE BUILDING

ART EXHIBITION IN THE CENTRAL SPACE, BEFORE RENOVATION

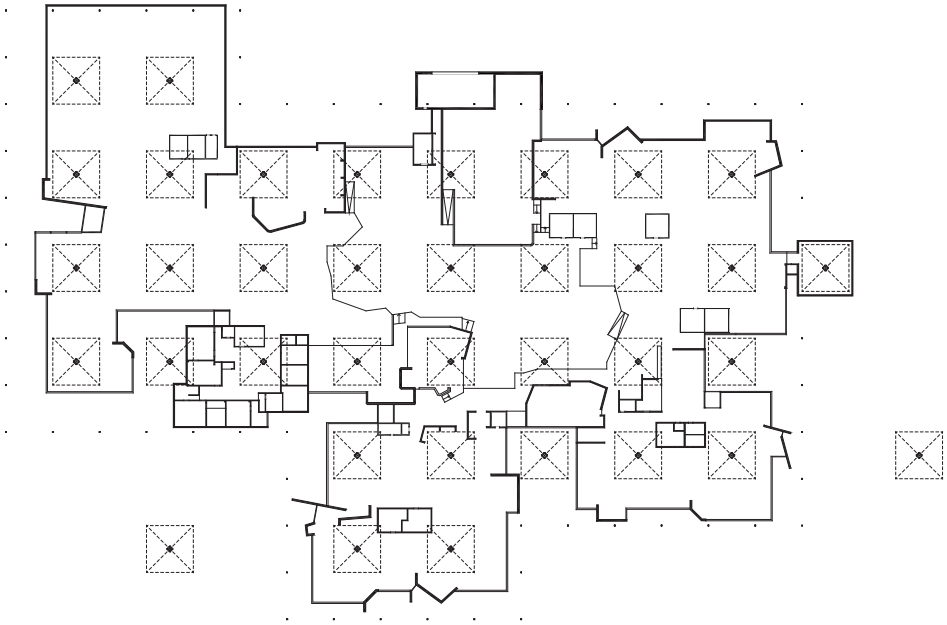
SUPERMARKET BEFORE RENOVATION



NEW SPORTS FACILITY

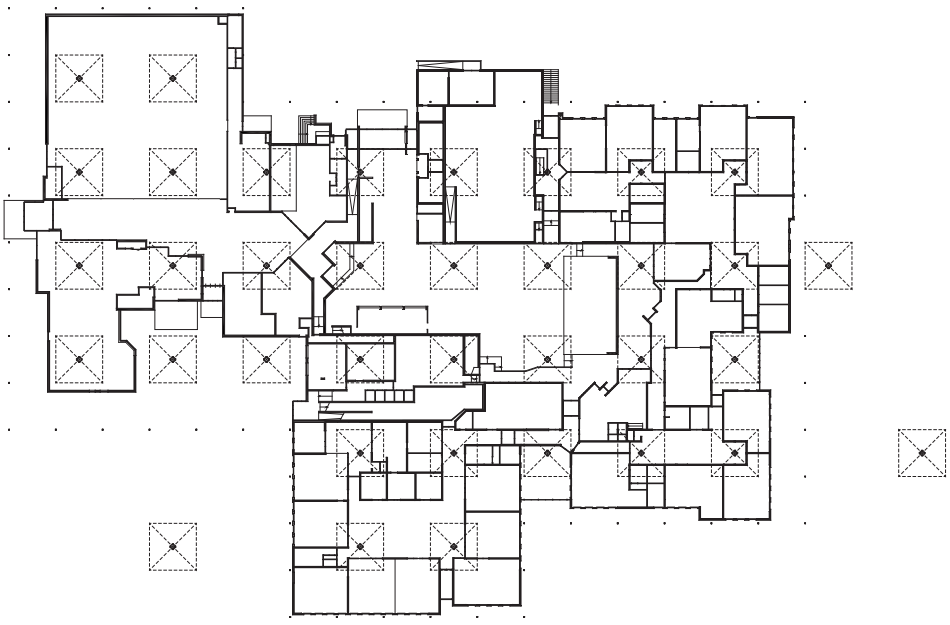
GATHERING IN THE NEWLY RENOVATED PRIMARY SCHOOL

1973



1. PLAN (GF)

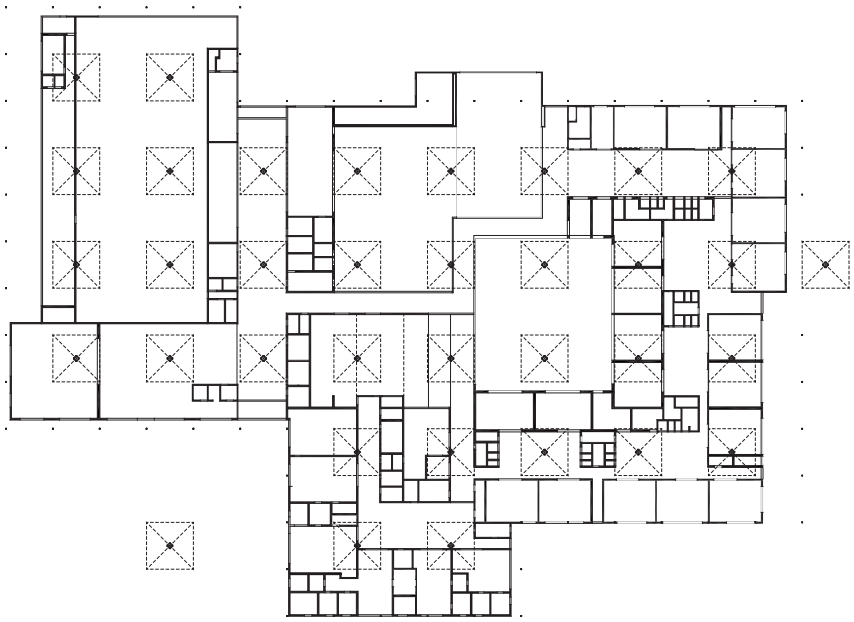
2010



2. PLAN (GF)

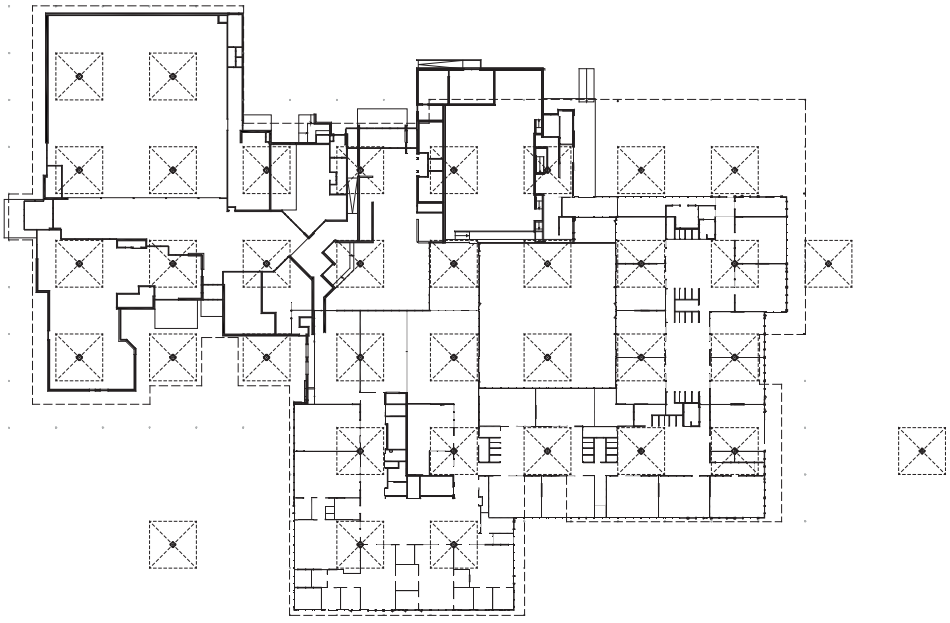
Originally the building had an open plan. Apart from a small number of auxilary spaces, which were enclosed by walls, the amount of dividing elements was minimal (1). As a result, the diverse programme was located within one large space. In the philosophy of Van Klingeren this would lead to a certain friction between users that could lead to spontanoeus encounters to take place, maximizing social relations. In the first years after completion this approach seemed to work. As time passed however, the friction between users led to the opposite of what Van Klingeren had envisioned. During the years, many of the uses were to be separated from the others. This was mainly a result

2010 (PLAN)



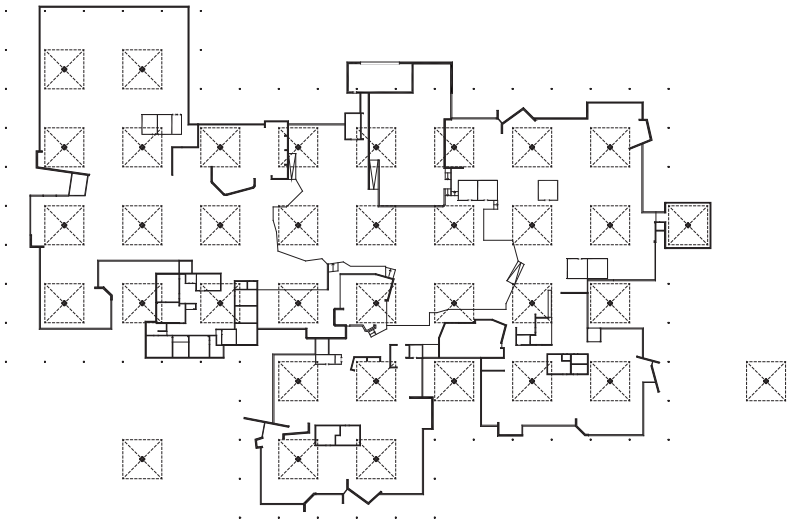
3. PLAN (GF)

2019

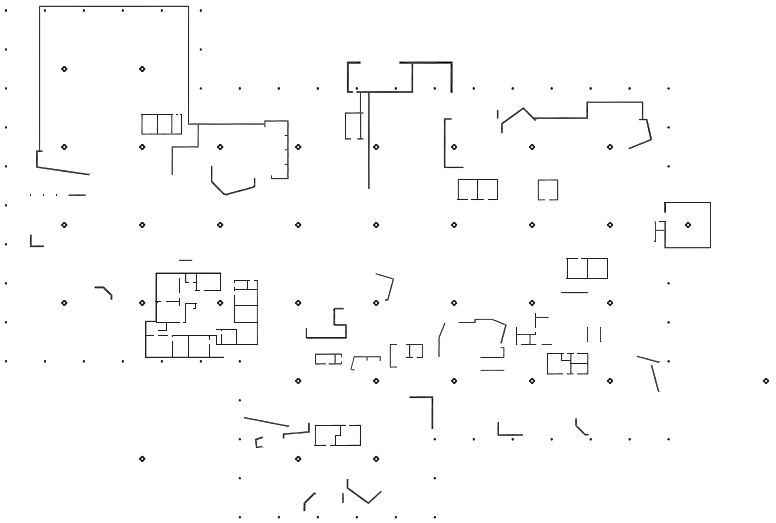


4. PLAN (GF)

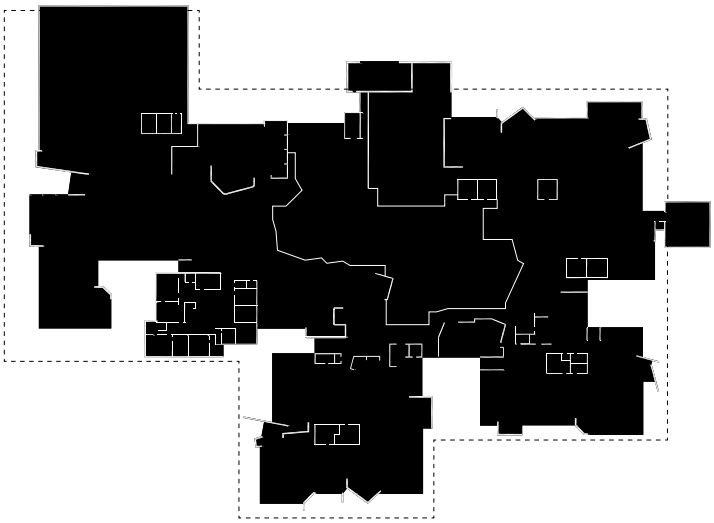
of the acoustics. Especially the elementary school produced high levels of noise, which made certain activities impossible. Dividing walls were erected, ultimately resulting in a chaotic plan, almost maze-like, lacking any kind of ratio (2). In 2010 a renovation was planned to restore the building. The original concept would not be restored however, as in the new design the programmes maintain separated (3). Currently the renovation is only partly carried out. One half of the building was finished in 2016. Work on the other half, housing the supermarket, is currently being carried out. After the 2016 renovation the building has been in a ambiguous state between the new and old (4).



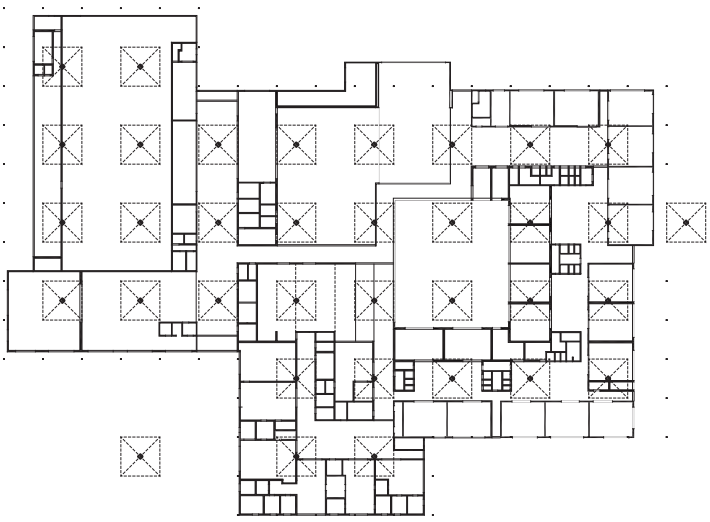
5. PLAN (GF)



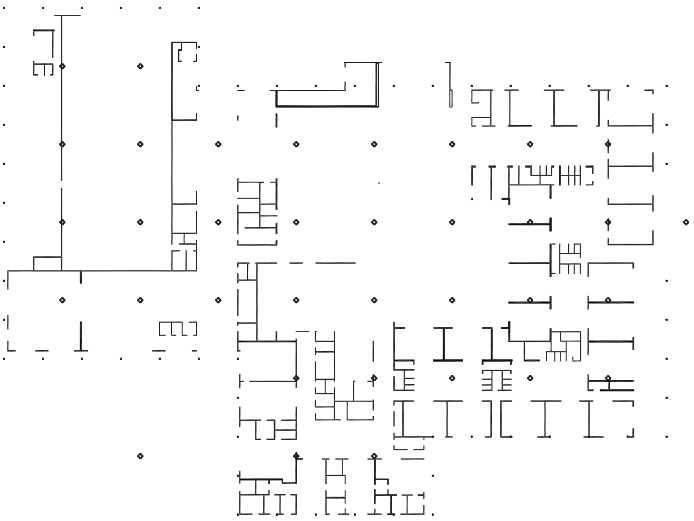
6. STRUCTURAL ELEMENTS



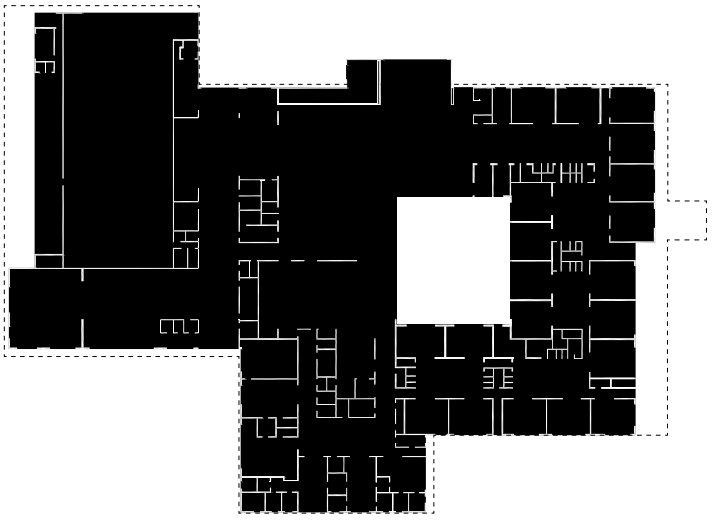
7. OPEN SPACE



8. PLAN (GF)

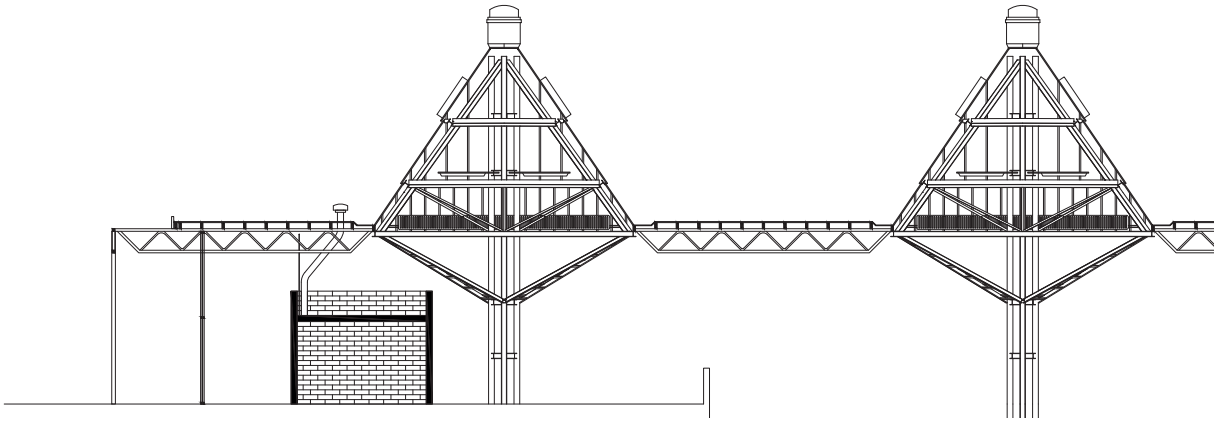


9. STRUCTURAL ELEMENTS



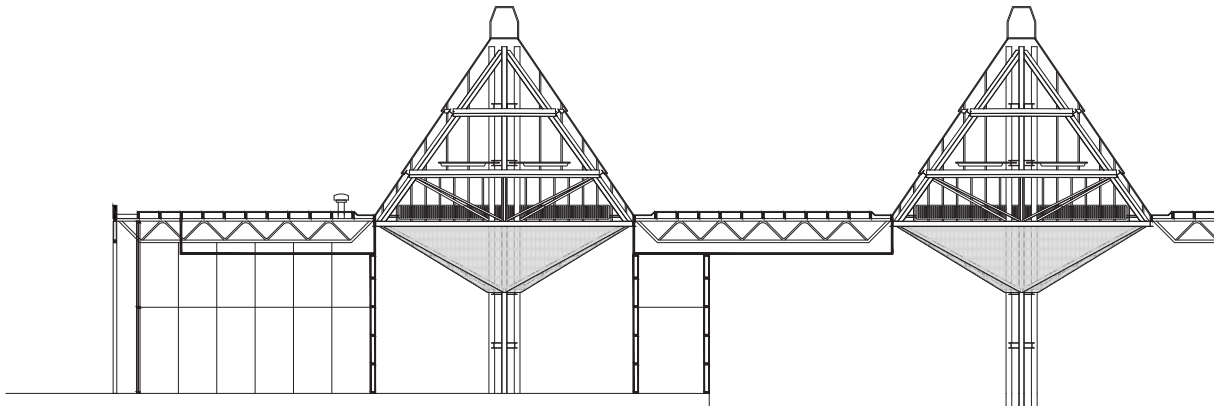
10. OPEN SPACE

1973



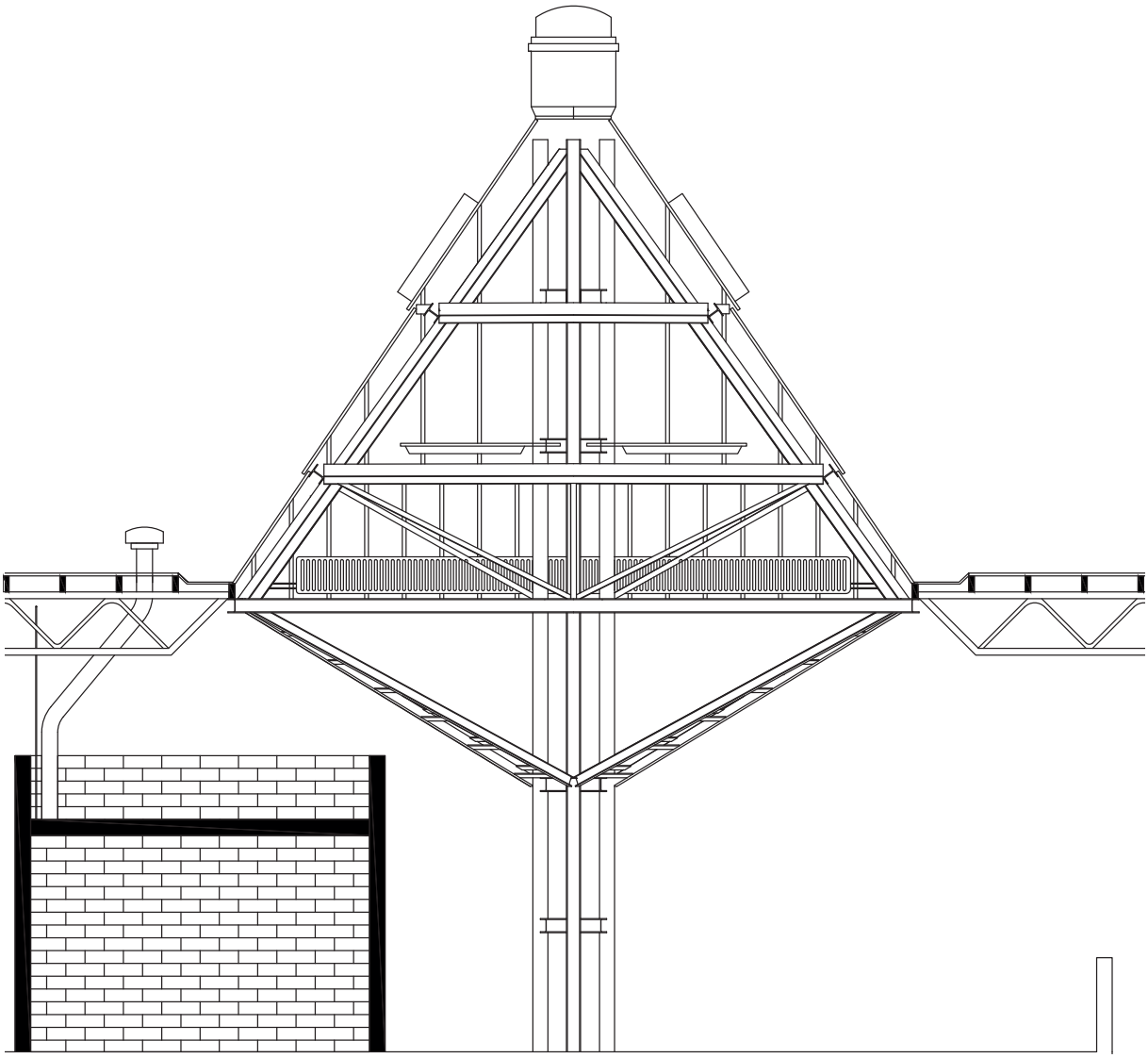
11. SECTION

2010



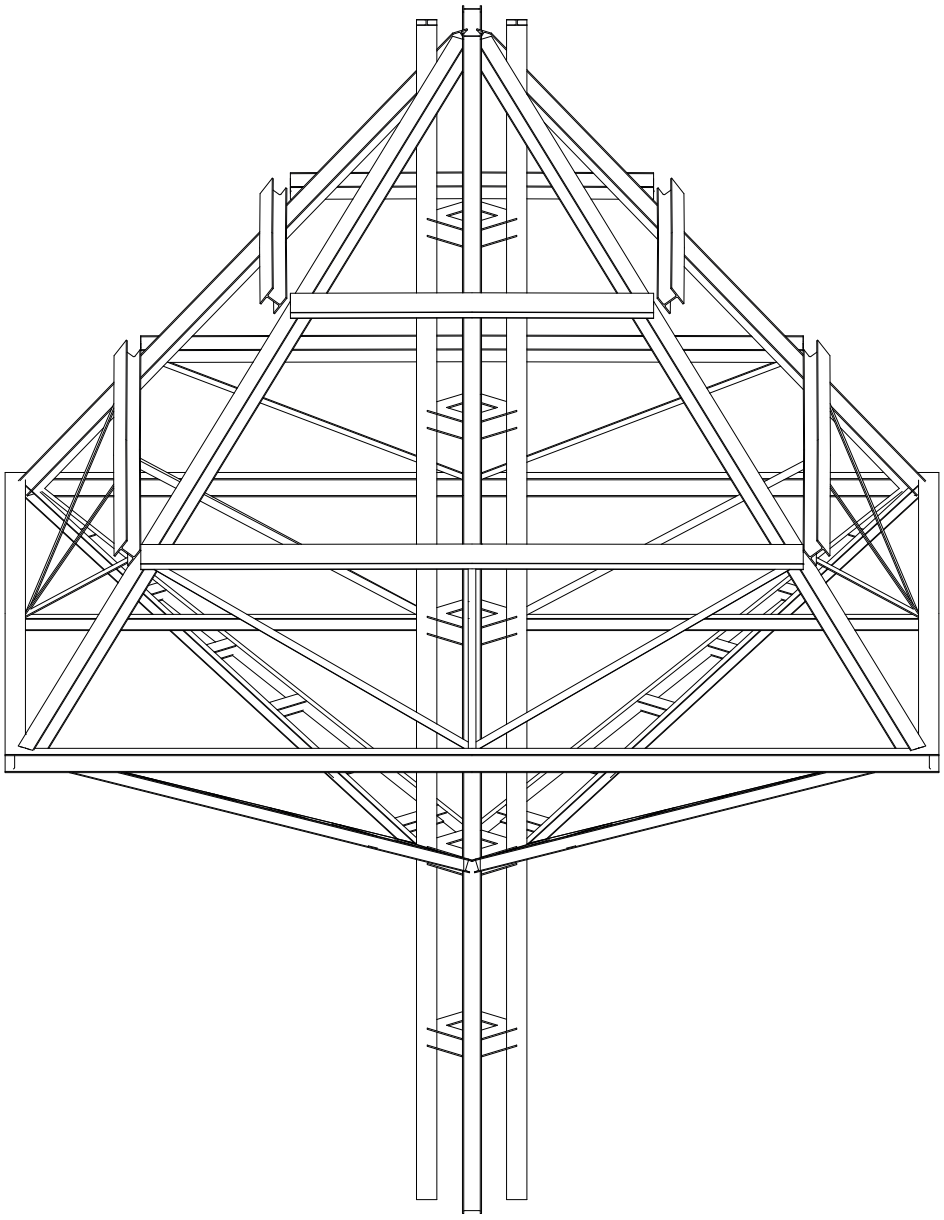
12. SECTION

A distinctive feature of the building is its ‘lack’ of a facade. The outer shell of the building is no more than exactly that: a shell. The building is practically a roof over a multitude of small pavilion-like structures. Originally the interior stood in open connection with the surrounding public space. ‘t Karregat was seen as a extension of the surrounding park. The facades of ‘t Karregat as well as the interior walls were envisioned by Van Klingeren to be adapted independent of the roof structure. The building would be able to be expanded or altered while the roof could be maintained (11). This concept was taken very serious, every aspect is designed with adaptability in mind. The water drainage and ventilation channels for example, existed of flexible tubes, connected to fixed points in the roof. Installations such as the heating are located in the roof structure to free the ground floor from



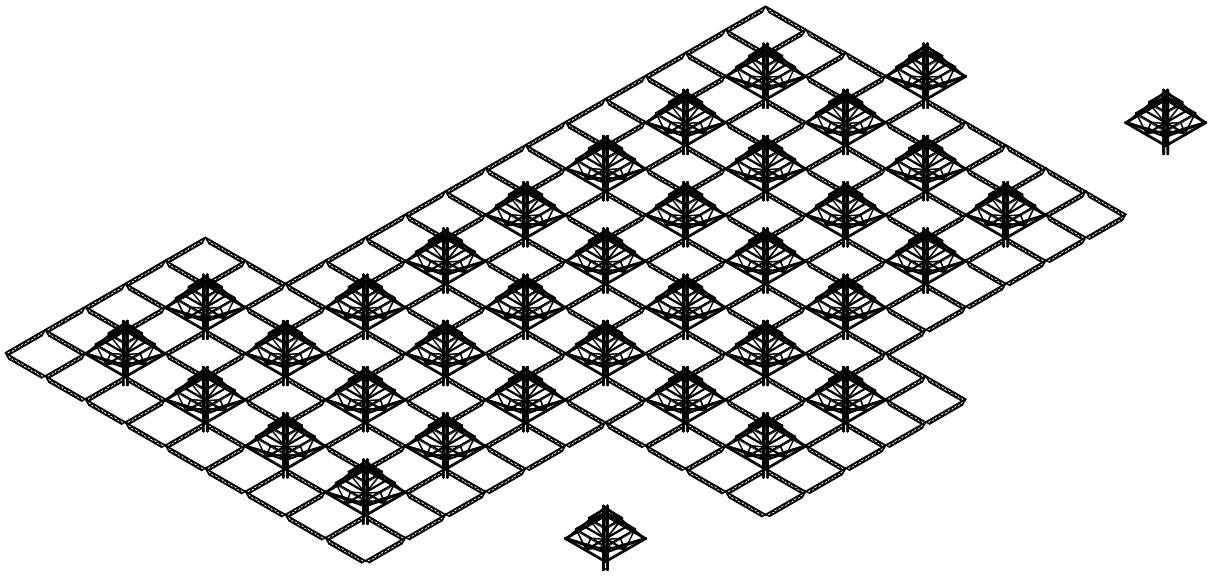
13. SECTION DETAIL

any elements obstructing future alterations (13). Although the adaptations made to the building over time did not exactly correspond to Van Klingeren's vision. The structure has proved to be able to accomodate significant changes. In the new situation the walls and facades extend completely to the roof in order seperate the interior spaces (12). This has eliminated open nature of the original building, but programmatically was necessary to maintain a functional building. The building was not able to 'contain' its programme, instead the programme has overruled the original architecture. As a result of this the identity of the building is partially lost. However, the distinctive roof structure upholds athe original identity of the building, reminding users of long forgotten social ideals.



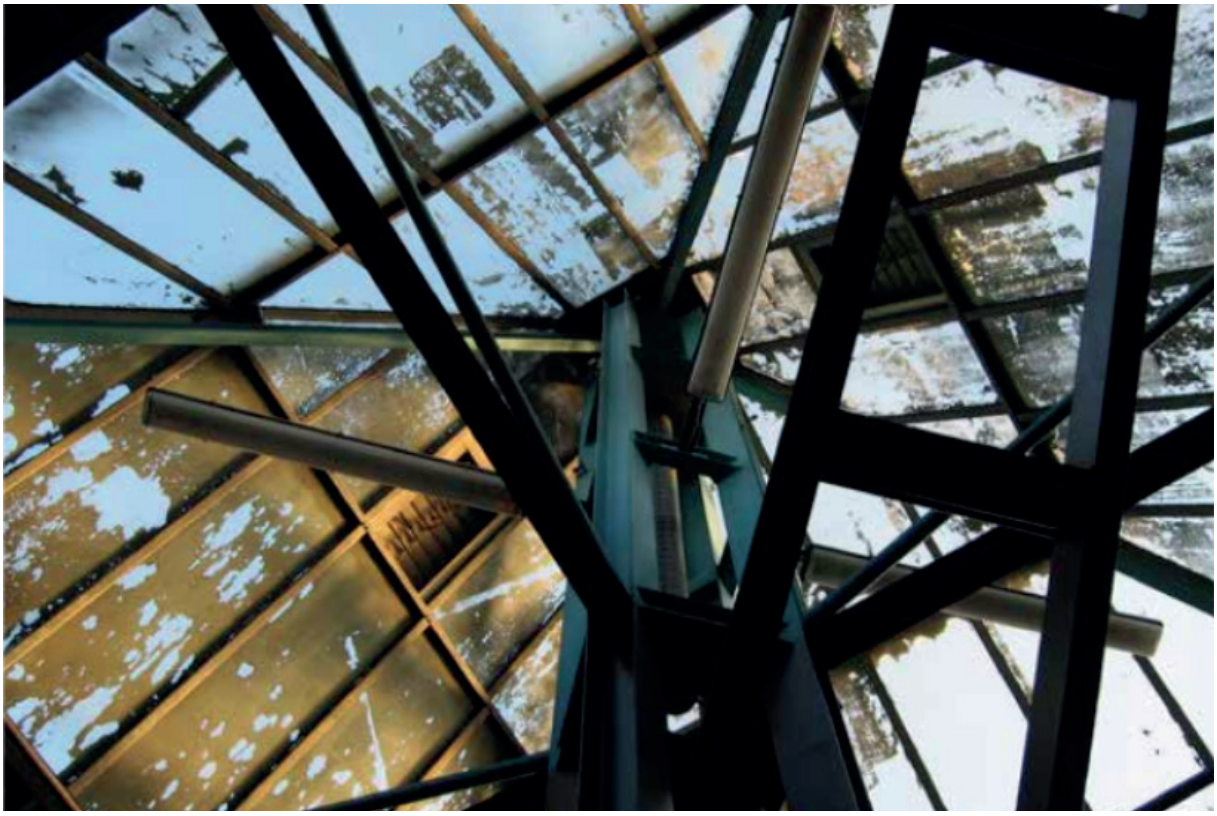
14. COLUMN

The column is both the critical element in the construction, as well as it is crucial in upholding the building's identity. The umbrella-shaped columns are placed on a 14,40 x 14,40 meters grid. The individual columns measure 7,20 x 7,20 meters, steel trusses span the distance inbetween. Van Klingeren designed the structure in this particular manner for a number of reasons. The first being the desire to minimize the amount of columns obstructing the activities on the ground floor level. By doing this, the flexibility as well as the openness of the building were maximized. A second reason was daylight access. The pyramid-shaped roofs of the columns are clad with transparent panels. This allowed daylight to enter, which was critical since the building measures 120 meter in width. Then lastly the structure was designed to be modular. It is expandable in each direction. Van Klingeren envisioned it to grow over



15. STRUCTURE

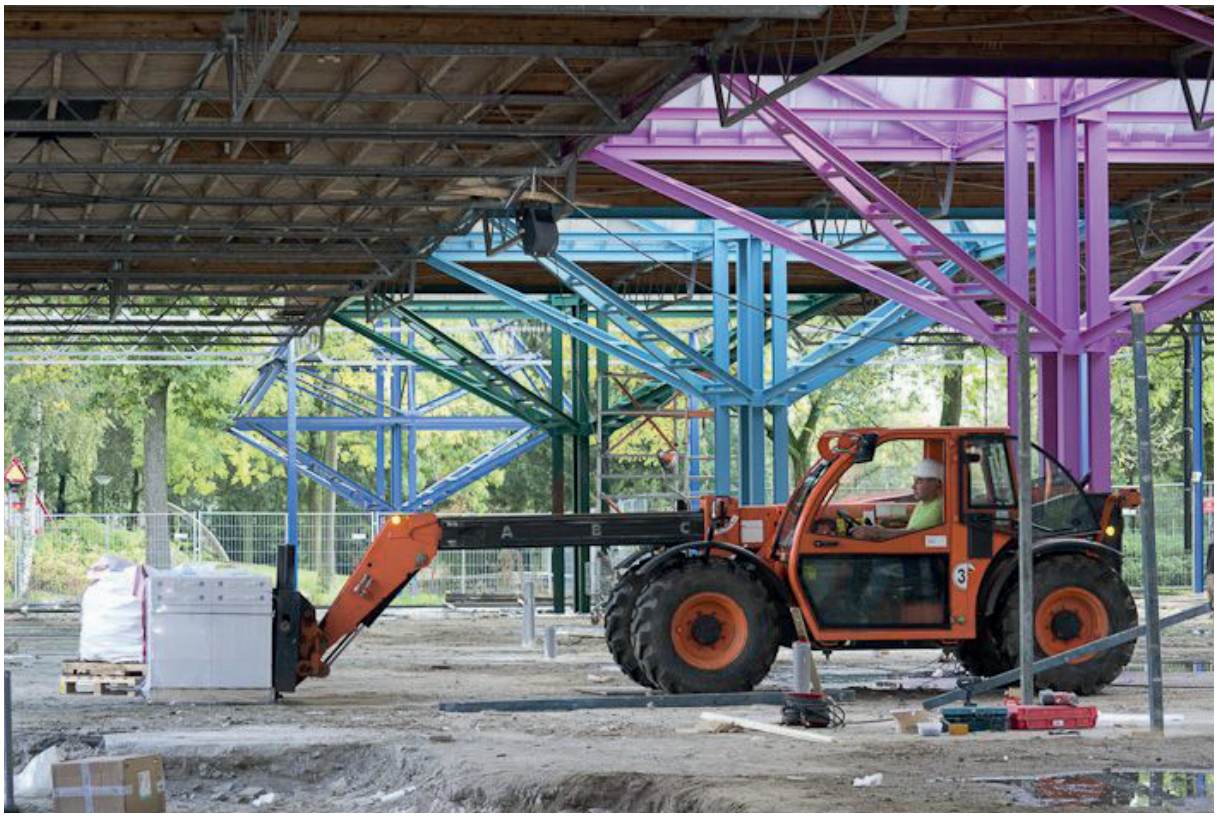
the years, he even anticipated the umbrella-like columns to pop up all over the city of Eindhoven. This ambition never was realized however. The building was not expanded even. However, ‘t Karregat has changed drastically over time, while the structure was never adapted. In this sense the scheme has proved to be very successful. The roof structure has succeeded in providing flexibility, a totally new building has developed underneath it over time, whilst the structure has remained and with the structure the original ideas and identity of the architecture. Although the concept and social agenda behind this building have faded, its identity has not. This is all the result of just one building element: the column.



ROOFLIGHT BEFORE THE RENOVATION WAS CARRIED OUT

RENOVATED COLUMN

ROOF STRUCTURE STANDING CLEAR DURING RENOVATION WORKS



ROOF STRUCTURE STANDING CLEAR DURING RENOVATION WORKS

RIGHT: ORIGINAL BUILDING BETWEEN SPORTSFIELDS

Nederlandsch Sportpark

DEN HAAG

This unnamed, brick building, realized in 1896, was part of a large sports complex that hosted a variety of indoor and outdoor sports such as athletics, cycling and equestrian sports. The sports facility was developed by N.V. Sportterrein Den Haag along a newly constructed avenue on the edge of the city. In 1901, only five years after its realization the complex was abandoned already. The building from then on, was used by a wide variety of owners each introducing a specific programme. During the years a series of extensions was constructed on the rear side of the building to accomodate the variety of activities being deployed. The original building however, was not altered significantly. It consisted of a representational front behind which the former gym was located. The hall accomodating the gym features an innovative roof construction in reinforced concrete, rare at the time of construction. As a result of the historic importance, as well as the fact that it is an early example of the application of reinforced concrete in the Netherlands. The building has recently been renovated and is now being used as a supermarket.

SITUATION

The building consists of large hall and a representational front, both erected in brick. The architecture is an example of the *overgangsarchitectuur* which marked the transition from revivalism to the modern architectural styles in the Netherlands. A period which is characterized by the abundant use of ornamentation. The arched roof structure of the hall was revolutionary in the late nineteenth century. It is one of the first examples of a such a construction in the netherlands. The reinforced concrete ribs span a distance of 20 meters. Creating an open space with a generous height of 11,50 meters. The original appearance of the building has been preserved, both on the exterior as in the interior. The entrance building for example, still features a mosaic floor and a cast iron stairwell.

After the building lost its original function in 1901 it would be used by a great variety of users. The representational front building, combined with the large hall behind, proved to be able to suit a diverse group of users. The free standing building, which had until then been serving as a gym, would first be used as a riding school. For this purpose a stable and coach house were added on the rear end. Subsequently it was used as a horse dealership. Of which the placard above the main entrance still remind. In 1925 a car dealership by the name of Englebert moved into the building after a number of adaptions had been made to the interior configuration. The firm would use the location as its headquarters for many decades. After which it eventually was sold to a rubber wholesale. In 1991the building was renovated to once againg be used as a gym. In 2016 it was then sold to dutch supermarket chain Hoogvliet, which significantly changed and revitalized the building interior. (Monumentenzorg Den Haag, n.d.)

ARCHITECT

J. MUTTERS

TYPOLOGY

SPORTS ACCOMODATION

COMPLETED

1896

FUNCTIONS

SPORTS FACILITY

RIDING SCHOOL

HORSE DEALERSHIP

CAR DEALERSHIP

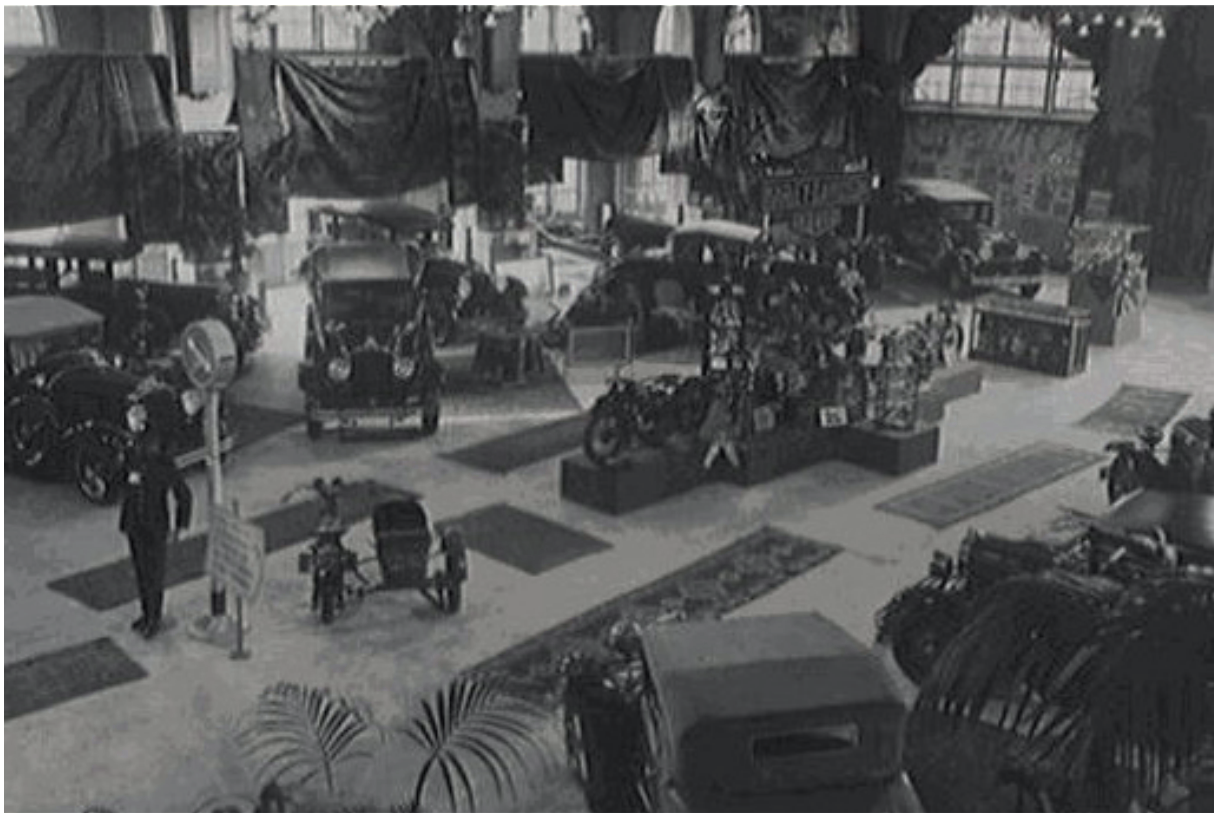
WHOLESALE

GYM

SUPERMARKET

THE BUILDING RECENTLY AFTER COMPLETION

SIGN ABOVE THE ENTRANCE



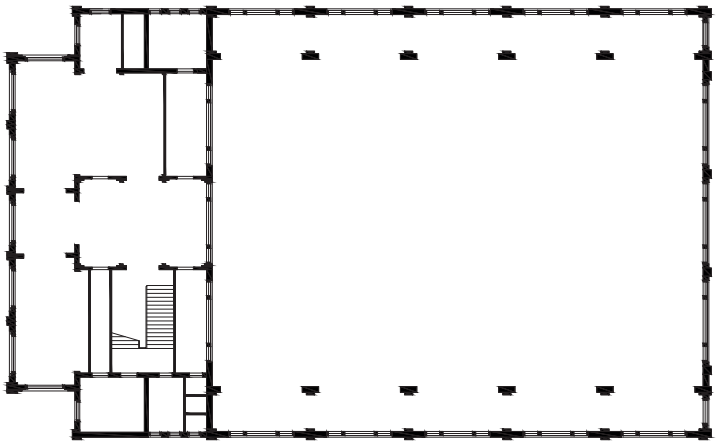
THE MAIN SPACE BEING USED AS A CAR DEALERSHIP

FRONT FACADE DURING THE PERIOD THE BUILDING WAS USED BY A PRODUCER OF RUBBER HOSES

PEOPLE WORKING OUT IN THE MAIN SPACE

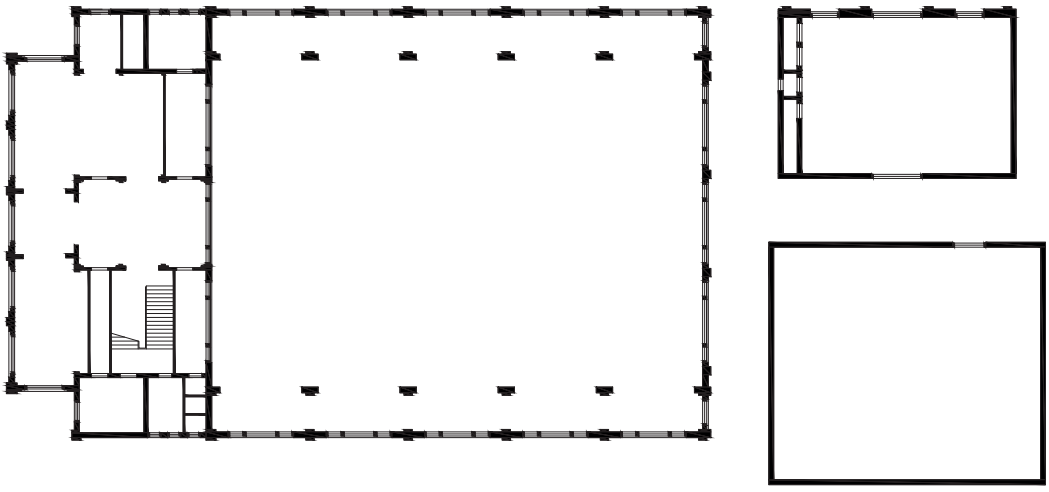
THE BUILDING IS CURRENTLY USED AS SUPERMARKET

1896



1. PLAN (GF)

1910

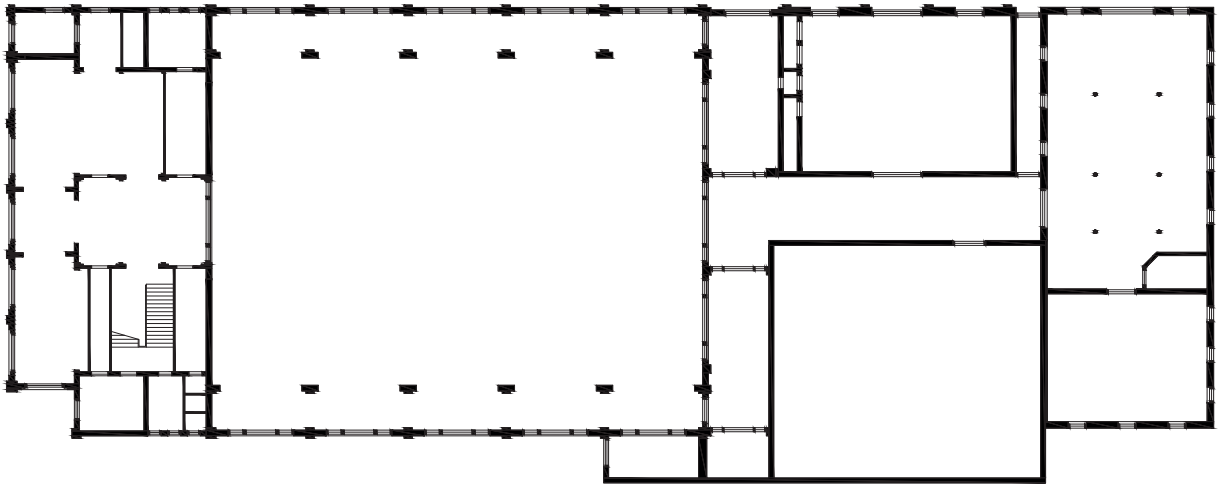


2. PLAN (GF)

As an ensembel the building can be clearly divided in a representational front and a functional rear part. The two-story front building facing the street housed several auxillary functions, such as the entrance lobby, a bar and a space for small gatherings. The central hall allowed for a variety of programmes to be accomodated, due to its height and its arched roof structure which eliminated the use of columns (1,5,6,7). The combination of the large hall, of industrial proportions, in addition to a representative front, proved to be usable to a diverse set of users. Since the central hall provided a large amount of space and thus, flexibility it did not need to be altered to accomodate the variety of uses. However, over time, a series of extensions was added behind the building, to allow the allocation of additional functions and services (2,3,4). The building was realized on the city border, along a newly planned lane. The terrain on the rear side accomodated a sports track, onto which the building could eventually be expanded. The additional spaces on this side grew organically until the floor area eventually was doubled.

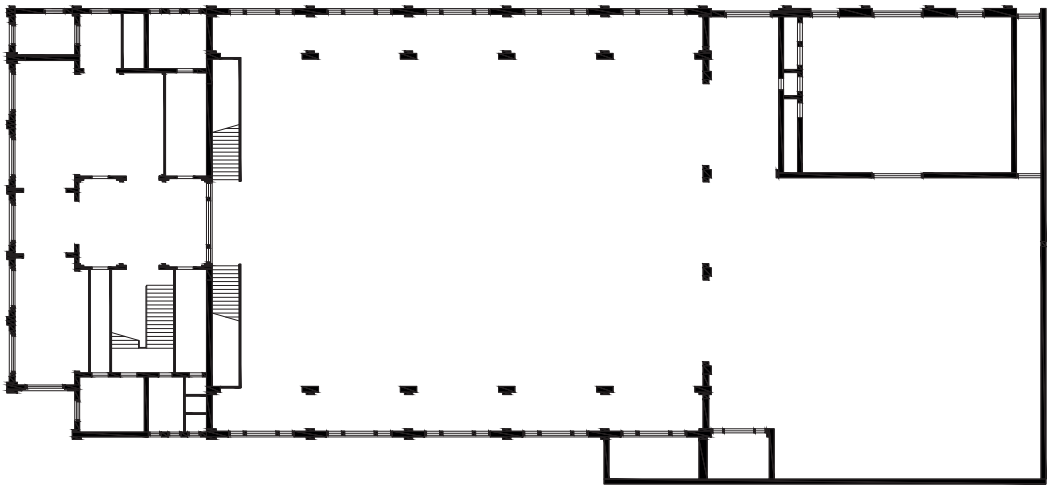
Each of the users made alterations to these back

1925



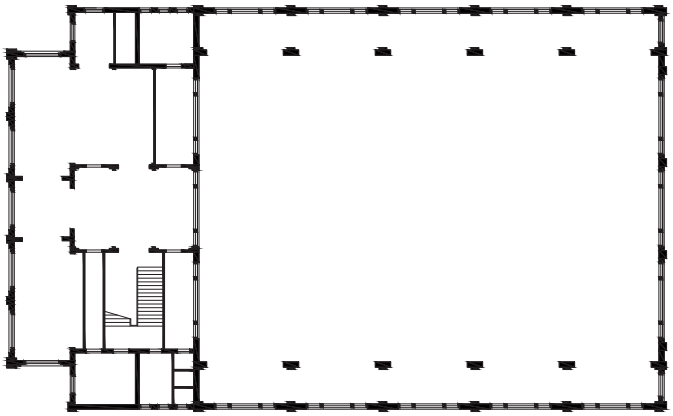
3. PLAN (GF)

2020

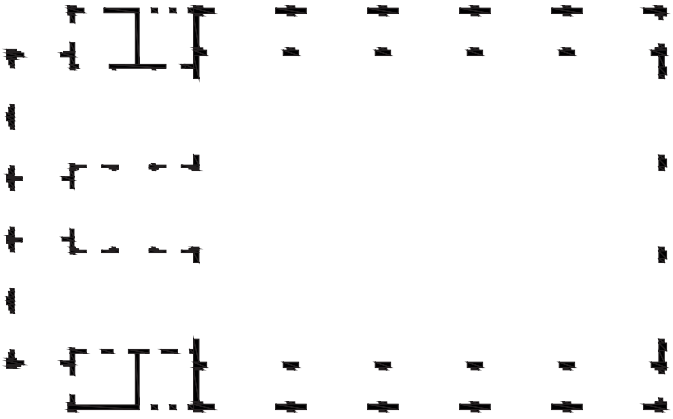


4. PLAN (GF)

buildings as well as to the entrance building on the front. The central hall hosted the core programmes. Subsequently it was used as; sports facility, riding school, horse dealership, car dealership, wholesale, gym and currently as a supermarket. The auxilary spaces on the rear side accomodated; a coachhouse and stables (2), storage space, a mechanical workshop, back-offices and warehousing space (3). Currently it houses part of the super market and its storage space (4). While the expansions on the back are of an informal nature, a collage of different architectural styles and forms, the front of the building still shows the original architectural style. While some internal alterations have taken place, the original structure and expression have not been touched. From the street the symmetry of the ensemble is still clearly visible. The large hall has not been adapted as well. Only recently a set of stairs was placed near the entry doors, other than that no changes have been made to it in over hundred years of time. It has been and still remains an open space capable of hosting a variety of uses (8,9,10).

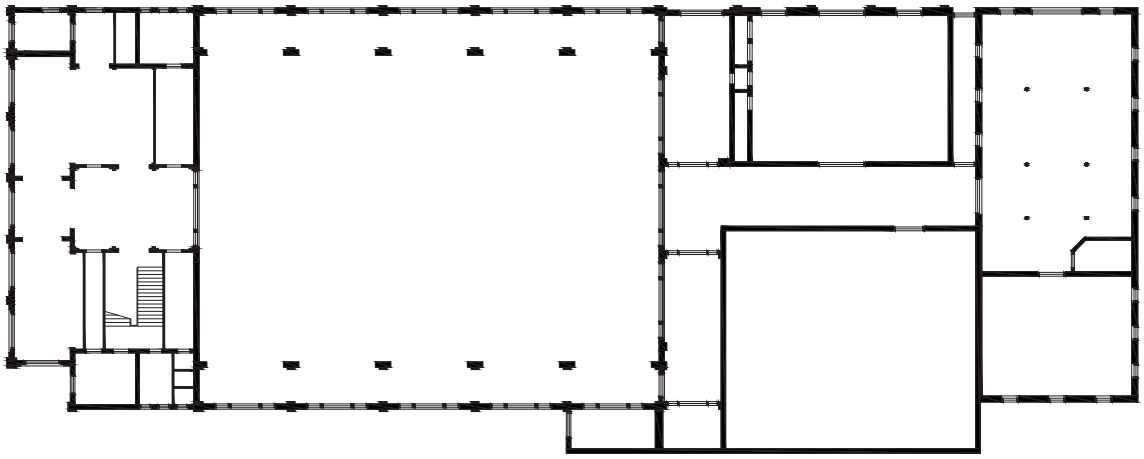


5. FLOOR PLAN (GF)

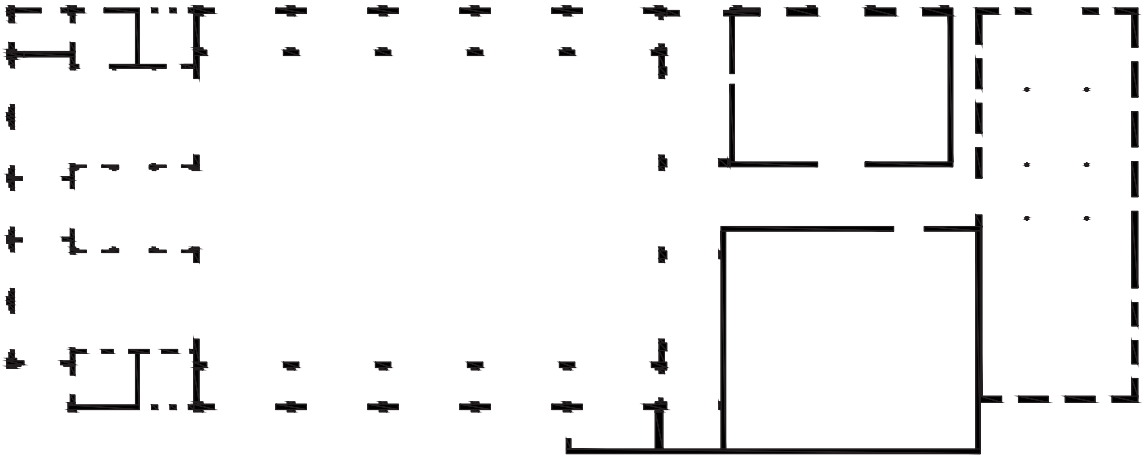


6. STRUCTURAL ELEMENTS

7. OPEN SPACE



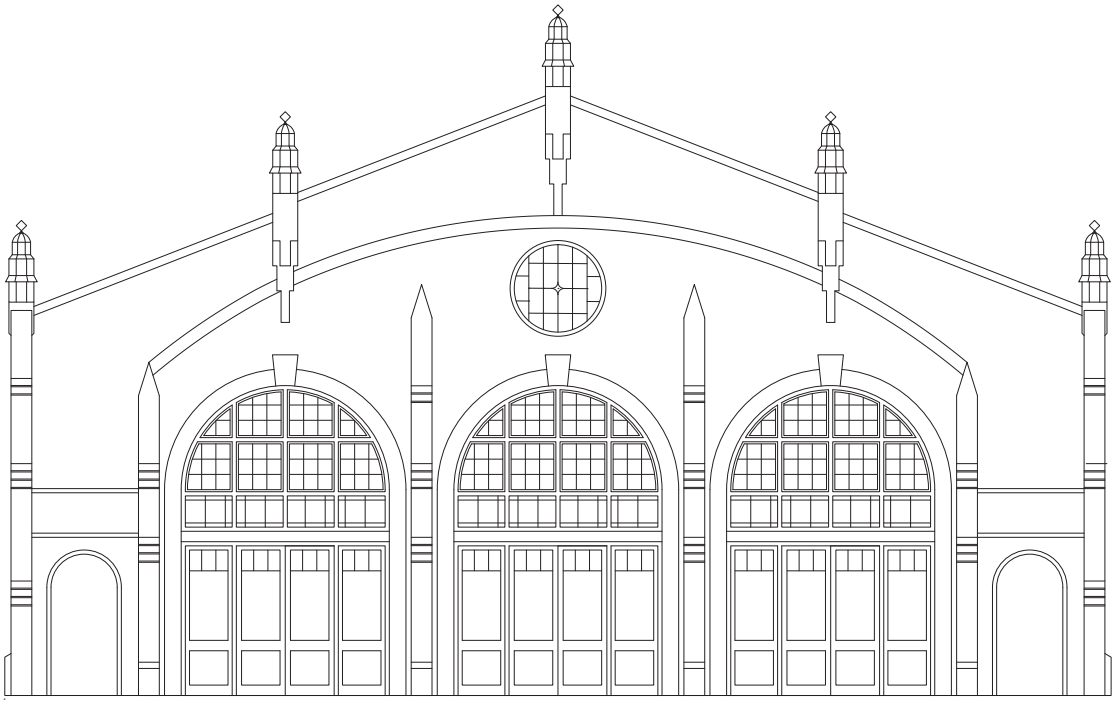
8. FLOOR PLAN (GF)



9. STRUCTURAL ELEMENTS

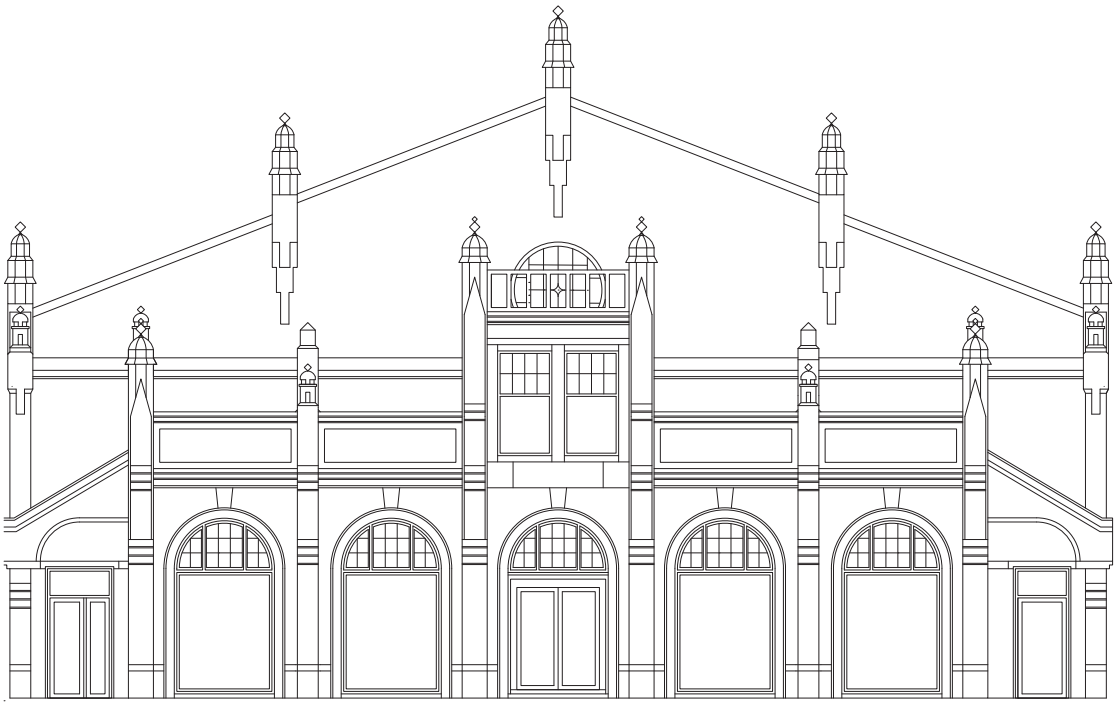
10. OPEN SPACE

11. FRONT FACADE

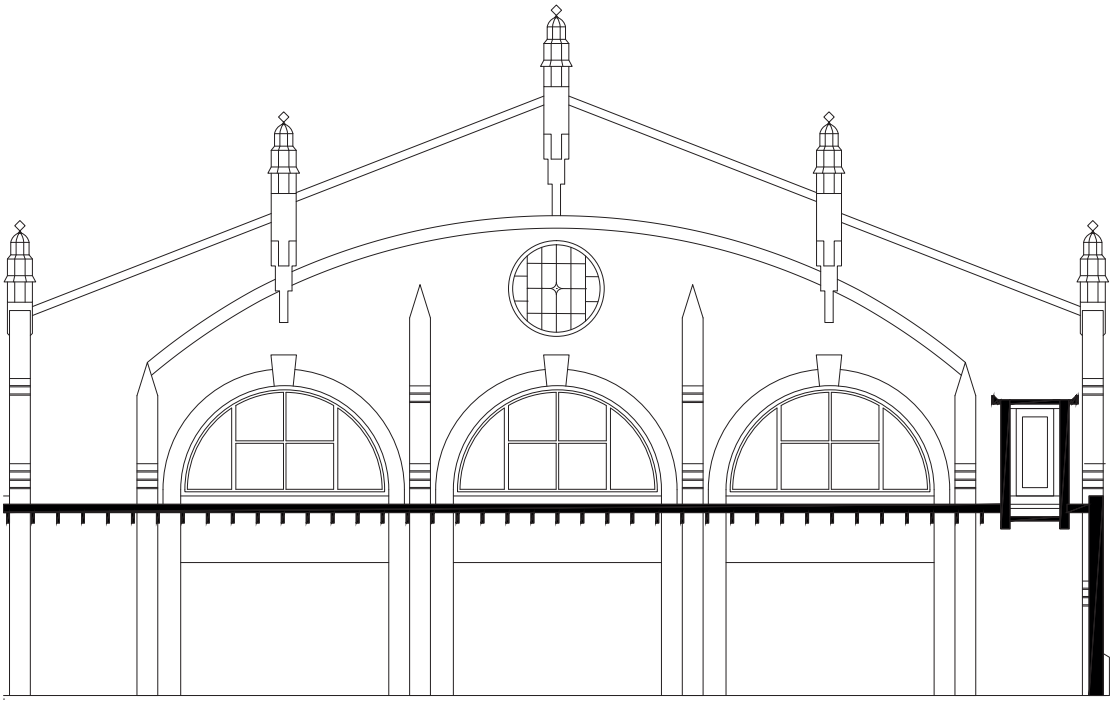


12.REAR FACADE

Originally the building stood free in an open area on the city edge. As a result of this, each of the four facades was carfully articulated and featured abundant decoration. The building clearly has a front and rear though (11,12), which is the result of the organazation of its programme, as well as its location along the Theresiastraat, a newly projected avenue at the time of construction. The architecture is hard to classify as related to a certain building type or use. Typologically it features elements of an industrial workshop as well as those typical to a riding school. The entrance building however is of a

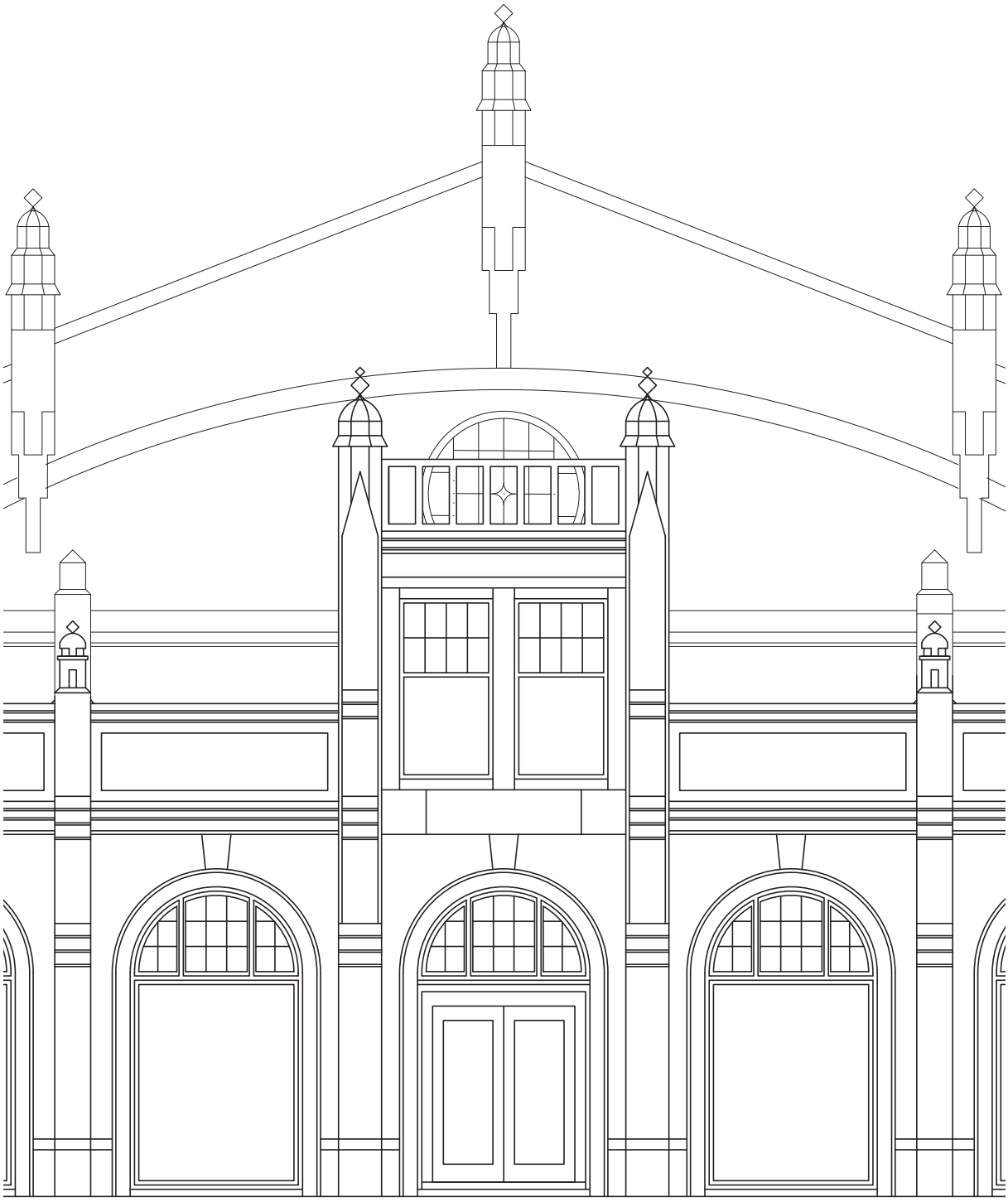


13. FRONT FACADE



14. REAR FACADE

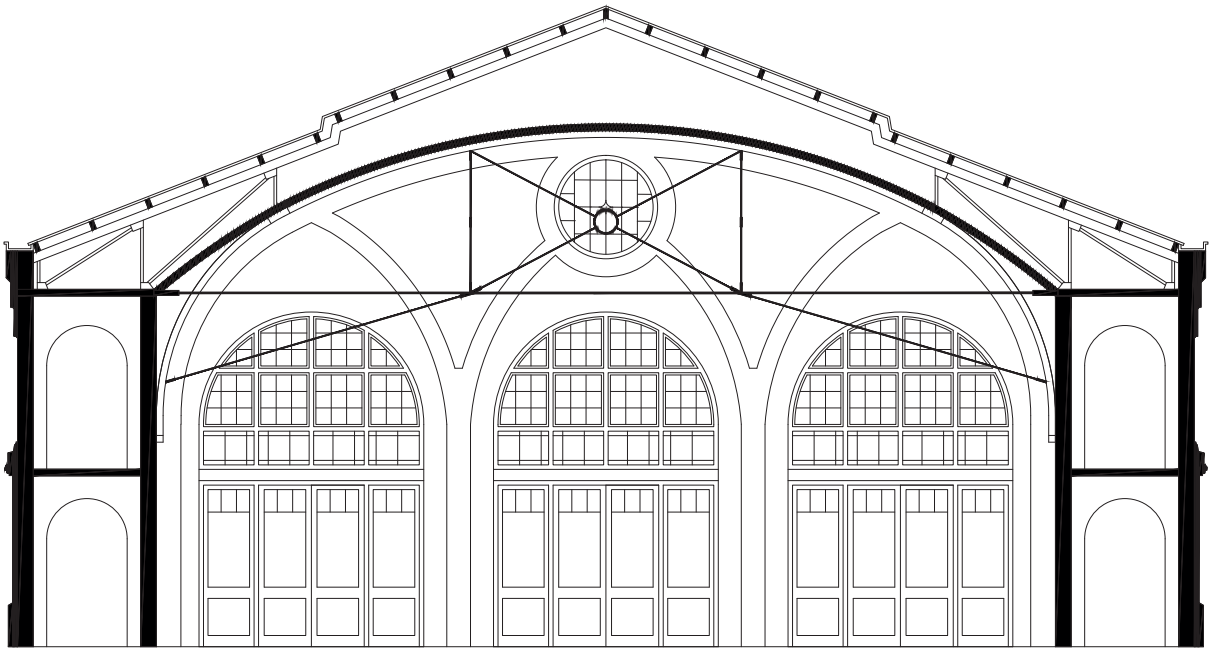
completely different scale and alludes more to what seems a shopfront. The stained glass windows in the central hall combined with its symmetrical layout and the aisles on both sides make for an appearance which much resembles religous architecture. This ambiguity in its appearance allowed the building to suite the wide variety of users that appropriated the structure over time. Additionally it gives the building its unique identity. The building is one of a kind and since it stands free from its context it is recognizable and clearly distinguishable to passersby.



15. FACADE DETAIL

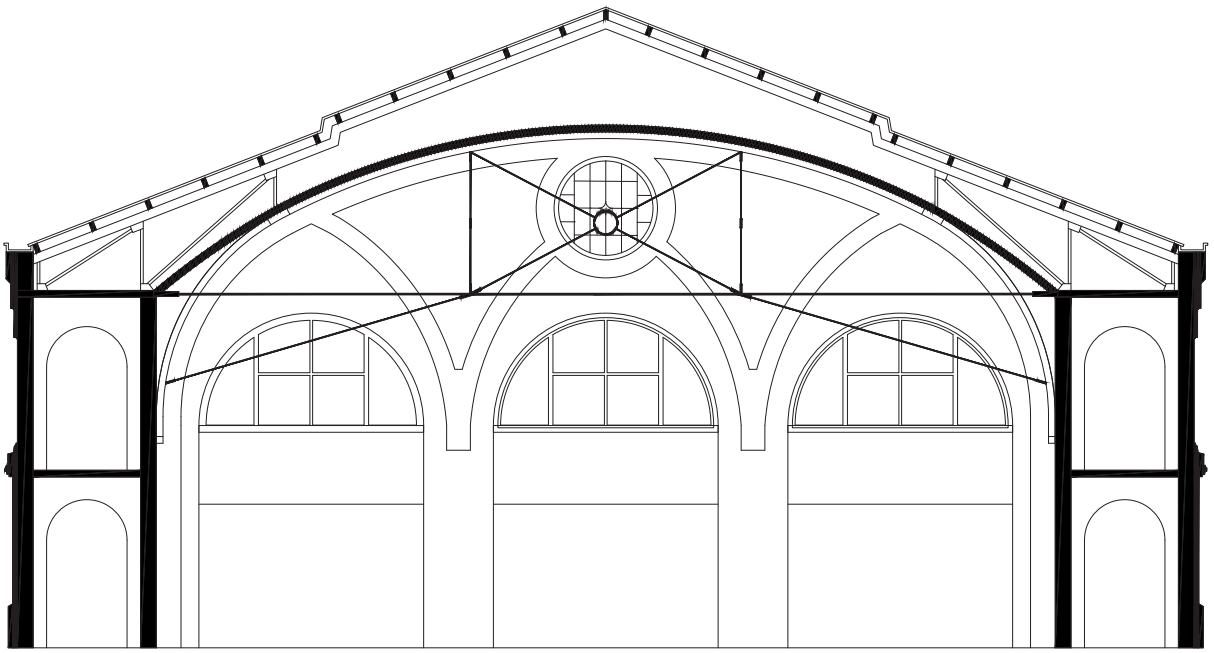
The central hall behind the representational entrance building measures 20 x 30 meters and is spanned by a reinforced concrete structure. At the the building was realized, in the 1890s, this type of roof construction was still experimental. It is one of the first applications of reinforced concrete in such a structure in The Netherlands. The construction method was based on a system invented by Joseph Monier: one of the principal inventors of reinforced concrete. The roof consists of a series of concrete arches. On top of which a wooden roof is assembled. Within the concrete arches an iron mesh is embedded,

1896



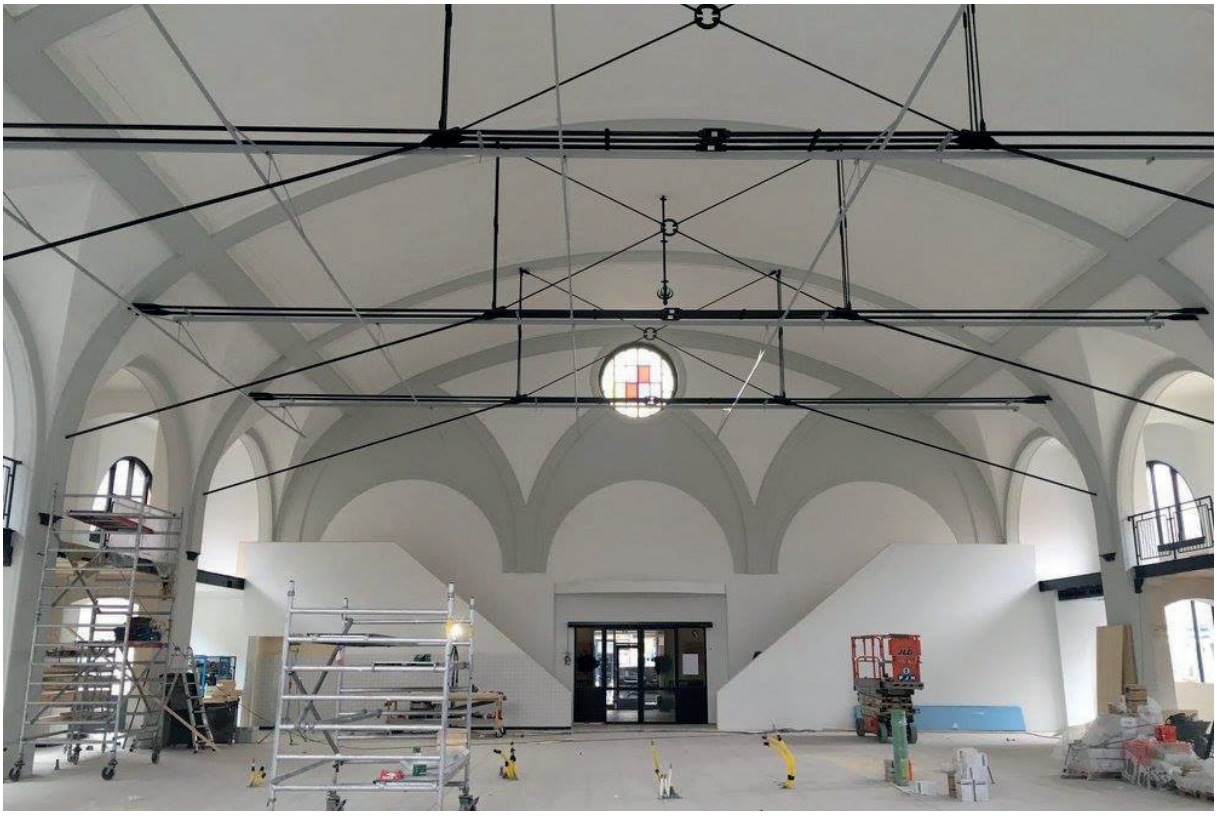
17. SECTION

2007



18. SECTION

which serves as reinforcement. To counter the outward forces of the arched construction, the space is flanked by two aisles. A scheme that resembles the layout of a gothic church. Furthermore a steel tensile structure is placed underneath the roof. This structure contributes to the distinctive appearance of the space. The central space is important to the identity of the building. The layout combined with the circular stained glass windows on both ends make for nearly religious atmosphere. This, in combination with the expressive facades, creates a rather remarkable piece of architecture.



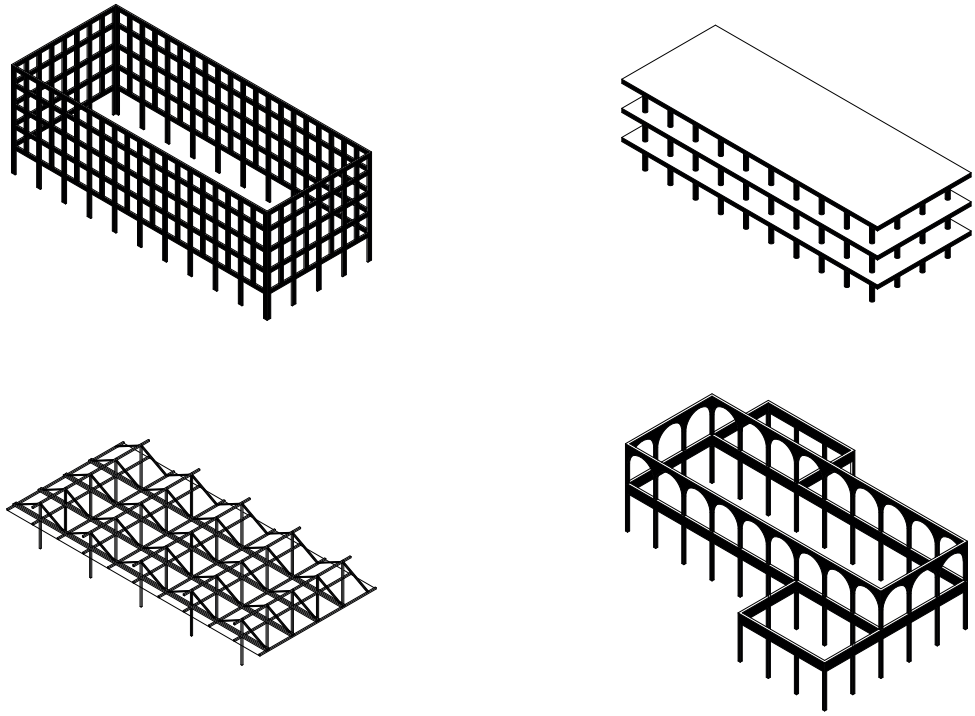
THE CENTRAL HALL DURING RENOVATION

THE ARCHED ROOF STRUCTURE AND STEEL TENSION CABLES

Conclusion

Each of the case studies can be seen as a ‘framework’ in which adaptations are made. While, through time, the use of these buildings changed, this framework remained. The frameworks should not be confused with the load bearing structure of the buildings. Despite being closely related, the research shows that the bearing structure by no means is the exact same thing as the framework. Another important observation is that in each case a different building element can be pointed out as frame.

This allows four independent ‘models’ (p. 101) to be deducted from the individual case studies. These models are abstractions of the element that forms the framework in each of the cases. The models show the wide variety in the composition of the frameworks. However, they do share a common characteristic: which is the articulation of the framework. The models demonstrate that the framework is never merely an open structure or skeleton into which a variety of programmes can be inserted. On the contrary, these frameworks always have embedded within them, the unique architectural expression of



1. FOUR ABSTRACTIONS OF THE 'FRAMEWORKS' IN EACH OF THE FOUR CASE STUDIES

the buildings. Since the framework is permanent, this expression or image will be preserved, which is vital to the ability of a structure to survive. The image a building conveys makes it possible to be associated with a certain narrative: it will have a meaning to the observer. This is critical to its preservation and therefore its lifespan. In case a building loses its raison d'être, as a consequence of it surpassing its financial, technological, or practical lifespan, the only incentive to preserve it, is the a collective appreciation which opposes demolition, whcih in many cases this leads to the allocation of a monumental status.

For an image of a building to speak to a observer and to allow for meaning to develop it first needs to be recognized and identified. Or as Lynch (1960) puts it: "*A workable image requires first the identification of an object, which implies its distinction from other things, its recognition as a separable entity. This is called identity, not in the sense of equality with something else, but with the meaning of individuality or oneness. Second, the image must include the spatial or pattern relation of the object to the observer and to other objects. Finally, this object must have some meaning for the observer, whether practical or emotional. Meaning is also a relation, but quite a different one from spatial or pattern relation.*" To adhere to the above the articulation of the framework is essential. Since the framework is the permanent component of the building, the distinct identity should be present within. Only then the image of a building is guaranteed to survive, along with its narrative and the meaning to its context.

The main focus of this study was to expose the characteristics critical to a building's ability to remain relevant and operational over time. The main question therefore was formulated as: What essential characteristics contribute to the ability of a building to remain effective over time? As suggested, the buildings can be abstracted as frameworks. The main question could therefore be formulated as: which characteristics should the framework possess to remain effective over time? These characteristics are:

1. Technical fitness, the capability to facilitate extensive adaptations.

2. Architectural articulation, which enables a structure to be associated to a collective narrative.

How do these characteristics manifest themselves in the four case studies? Through the analytical drawings the technical properties of the frame, as well as the elements that are key to the architectural expression have been made explicit. A synopsis of essential concepts is given below, to summarize and provide an overview of play a crucial role in developing adaptable and long-lived architecture.

1. Technical Fitness:

Excess space
Starting with the technical fitness, a critical aspect is excess space. In all four case studies the floor to ceiling height is more than average. This leaves space for adaptations to be made. Excess space on floor level is of lesser importance as a building can always be extended horizontally, given that there is enough free space surrounding the object. Altering the floor to ceiling height of especially a multi storey structure after is obviously a much more challenging exercise.

Permeability
Besides an excess in space, the permeability of the structure is important. This should be understood as the extent to which a structure features openings or allows for additional openings to be made in order to connect indiviual spaces, interior and exterior. This includes vertical connections (shafts), an aspect that is sometimes overlooked. For circulation and moreover for technical installation the presence or possibility to for shafts is critical. In the trasformation of the Brooklyn Army Terminal the advantage of this is clearly visible. The crucial factor in this is the question whether an element is part of the bearing structure or not.

Materiality
An aspect closely related to the permeability of a structure is the materiality. The adaptability of specific building elements depends heavily on their materialization. Each material has ofcourse a different degree of adjustability. A reinforced concrete structure will be harder to alter than a timber frame partition wall. The joints are of major importance as well. If the materials are efficiently connected, by making use of 'dry' instead of 'wet' joints, they can be demounted and altered in a later stage offering freedom for change.

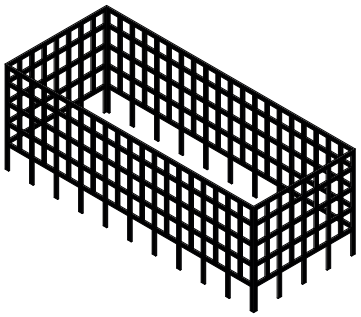
Compartimentalization
The possibility of a structure to be in-filled or compartimentalized is a last factor that is significant in the transformability of the structure. In each of the four cases the open space in the buildings is divided in to several smaller, mostly hosting a programme smaller in scale, or more diversified than the original. This seems to be a regularity in many cases of adaptive reuse, which mostly involve large spaces (industrial workshops, churches, warehouses) being infilled with new, smaller scale, diverse programmes.

2. Architectural articulation:

Seperable entity
For a building to be commemorated its identification is the first act required. This implies its distinction from other things (Lynch, 1960). The way this can be achieved is by the addition of distinct features, which go beyond the common expression of a certain architectural type. Building-specific details and ornamentation create an identity which is unique and therefore recognizable. Allowing the observer associate with the architecture and connect to it.

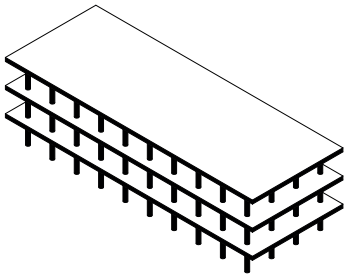
Spatial relation
The spatial relation of a building with its physical context as well is essential for the observer to be able to recognize it as a seperable entity. On the other hand the architectural context surrounding a building can assist the observer in its recognition and moreover in the association of the object to a certain meaning. This phenomena can be illustrated best, by the photographic work of Thomas Struth, whose images of urban scenes clearly demonstrate the meaning embedded in an assemblage of architectural objects.

Pattern relation
The pattern relation allows for the observer to see and relate the building to a broader context. Allusions to a familiar typology contribute to the ability of a building to be recognized and identified by an observer. The works of Bernd and Hilla Becher demonstrate how buildings, while being unique, individual entities, can perceived to an observer as meaningful when put into relation with buildings of the same type.



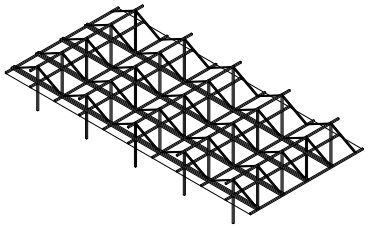
EMPTY SHELL

The facades of the building are are preserved, only a few openings have been adapted to allow for extra daylight access. The interior however has been altered radically. This is mostly a result of the materialization. The facades are load bearing and only allow minor changes, whilst the interior is adaptable due to the demountable columns and wooden flooring.



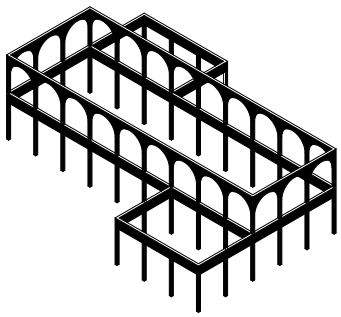
ROBUST SKELETON

This concrete structure is virtually impossible to be demolished due to its mere size and the vast amount of reinforcing. However, due to its rationality and its overcapacity in terms of space, this inflexible structure, paradoxically, offers a large degree of flexibility and freedom in the way it provides a starting point and framework to be filled in.W



CANOPY

With a minimum of columns, the roof structure provides a large degree of freedom for any programme to be hosted underneath. Since the structure is designed with a surplus in ceiling height, pavilion-like structures on the ground floor can be configured independently providing flexibility in use. The canopy provides an identity and common ground.



AGORA

A central hall offers a large open space for a wide variety of uses or programmes to be deployed. The arch construction eliminates the need for columns, which maximizes flexibility. The addition of structures surrounding the central hall makes it possible to accomodate a set of specific and changing programmes.

SEPERABLE ENTITY

SPATIAL RELATION

PATTERN RELATION

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