

ABSTRACT

Title of Document:

+ SPACE:

Appropriation Urban Infrastructure

Sofia Weller, Master of Architecture, 2015

Directed By:

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Architecture, Planning and Preservation

This thesis explores and proposes urban design schemes for three underutilized and partially abandoned industrial and transportation properties that are presently voids and that are divisive to the urban fabric of Copenhagen's central city. The sites of the voids are located along the rail line that currently and historically serve Copenhagen's Central Train Station. These are Banegardspladsen and the two Boulevard Line's voids. The goal of this thesis is to propose an urban design scheme that follows a feasibility study that states the opportunities and limitations set by Copenhagen's municipality, the community, as well as the property owners. The scheme proposes the interlinking of the physical aspect of a living city with its culture, not only to serve the locals but to welcome visitor by providing Copenhagen with a desired central gathering space as well as a place for arrival to the city. The urban intervention becomes a celebration of History, an exhibition of the transportation culture of the city and provides a series of public spaces that encourage spontaneous events threaded by a string of pedestrian and bike paths.

+ SPACE

APPROPRIATION OF URBAN INFRASTRUCTURE

By

Sofia Weller

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01_OVERVIEW

This thesis explores and proposes urban design schemes for three underutilized and partially abandoned industrial and transportation properties that are presently dividing voids and are divisive to the urban fabric of Copenhagen's central city. The sites of the voids are located along the rail line that currently and historically serve Copenhagen's Central Train Station. These are Banegardspladsen and the two Boulevard Line's voids. The goal of this thesis is to propose an urban design scheme that follows a feasibility study that states the opportunities and limitations set by Copenhagen's municipality, the community, as well as the property owners. The scheme proposes the interlinking of the physical aspect of a living city with its culture, not only to serve the locals but to welcome visitor by providing Copenhagen with a desired central gathering space as well as a place for arrival to the city. The urban intervention becomes a celebration of History, an exhibition of the transportation culture of the city and provides a series of public spaces that encourage spontaneous events threaded by a string of pedestrian and bike paths.

Technological advances are constantly altering our urban fabric. Transportation infrastructures is especially vulnerable to these technological changes and constantly must adapt, or they become overlooked and abandoned, consequently creating negative spaces in the urban form. Recently, large infrastructural revitalizations in many cities around the world

have provided opportunity for these industrial landscapes, railways, rail yards, highways and docklands to be made available to serve a combination of private development and public use. This thesis will examine a series of precedent studies to draw lessons and apply them in the proposal for Copenhagen's site.

Banegardspladsen and the boulevard line, three urban voids in the city center of Copenhagen act as scars left behind by transportation infrastructure that is no longer in use. On the other side of the Central Train Station, lies a rail yard that divides the city from its waterfront. This ruptures left by transportation infrastructure present themselves as a great opportunities for the reintegration with a renewed city fabric.



Figure 1.01 Banegardspladsen Today

02_ CONTEXT: Copenhagen

HISTORY

Copenhagen: Merchants Harbor

The capital city of Denmark, Copenhagen, was founded in the 10th century as a small Viking fishing village protected by a castle. The convenient location for both the Baltic-North Sea and European-Scandinavian medieval trading routes allowed Copenhagen to grow and become a successful and major trading center.

King Christian IV is known to have been an enterprising and inventive Monarch, recognized as a great builder and the most prominent architect of the city. When Christian IV was crowned king in 1596, Copenhagen had become rich and powerful and during King Christian IV's reign great projects such as the Round Tower, the Old Stock Exchange, The Old Citadel and Rosenborg Castle were constructed.

The construction of the Lakes of Copenhagen (Sankt Jørgens Lake, Peblinge Lake and Sortedams Lake) was also a project commissioned by King Christian IV with the intention of having water close to the city to be utilized for watermills and to increase military protection for the

city. These lakes were formed from what was originally a long stream outside the city walls. Today they are used primarily as a recreational area and a biking and running route.

In 1797, The Liberty Memorial was erected outside the ramparts of Copenhagen to commemorate the abolishment of adscription. Adscription had been introduced in Denmark in 1733. It bound farmers and workers to the estates where they were born and prevented them from leaving the properties without the permission of the landowners. The monument was also built to honor King Christian VII who was responsible for the abolishment of adscription. Today, the Liberty Memorial is located in front of Banegårdspladsen, one of the sites this thesis will explore.



Figure 3.01 The Liberty Memorial, Banegårdspladsen + the Central Train Station

GROWTH

Physical Evolution + Fortification Wall

The city of Copenhagen grew on the main land of Zealand adjacent to the island of Amager. By the end of the 15th century, Copenhagen had a population of around 5,000.¹ In 1535, Copenhagen had grown to become a fortress-city. Subsequently, King Christian IV (1588-1648) transformed Copenhagen's defensive system into a typical Renaissance pattern (1606 and 1624). This protected the existing medieval city as well as a new development to the north. The island of Amager was developed with a fortified center in 1617 to strengthen Copenhagen's harbor defenses.



Figure 4.02 Copenhagen 1535



Figure 2.03 Copenhagen 1650

¹ Morris, A. E. J. *History of Urban Form Before the Industrial Revolution*. 3rd ed. Hoboken: Taylor and Francis, 2013.

About one third of the development north of the medieval city center was burned during the fire of 1728. Twenty eight percent of the city was destroyed, including 1,660² houses and five churches in the course of four days. Re-development was done in a Renaissance pattern with regulated streets surrounding one of Copenhagen's most important squares, Amalienborg Slotspads. By the late 17th century the population of Copenhagen had grown to around 60,000 people.

Historically the fortification wall created a barrier between the city center and the no-build zone immediately outside the ramparts. Once the city was allowed to build beyond its fortification, during the 19th century, a series of residential districts were built outside the old ramparts: Vesterbro, Inner Norrebro and Inner Osterbro.

During the 1840s the military was pressured to dismantle the ring of fortifications in the inner city. This led to the military selling the land to Copenhagen Municipality. When the state gave up protecting Copenhagen behind ramparts and moats, the architect and town planner Ferdinand Meldahl, proposed the creation of the Park Belt. Meldahl was a Danish architect and one of the leading proponents of historicism in Denmark and served as a member of the Municipal Council of Copenhagen Municipality for 27 years. In this time he was

² "Copenhagen Fire, 1728." Museum of London -. Accessed November 20, 2014. <http://archive.museumoflondon.org.uk/Londons-Burning/themes/1437/1443>.

able to significantly influence the city's growth. When the fortification wall of Copenhagen was demolished in 1876, Meldahl with his vision of creating a row of parks "applied all his energy to getting the huge green fortification terrain out of the hands of the Ministry of War, which wanted to see the land used for building,³". Dismantling the fortifications and moving the capital area's defenses further out from the city also allowed the city to expand, opening up the development of many of the other city districts of today's Copenhagen.

³ Stensgaard, Pernille, and Anne Prytz Schaldemose. *Copenhagen-- People and Places*. Copenhagen: Gyldendal, 2005.



Figure 2.04 Copenhagen 1535

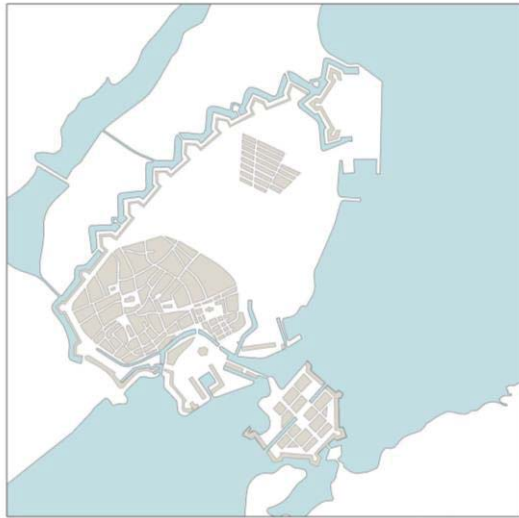


Figure 2.05 Copenhagen 1650



Figure 2.06 Copenhagen 1850

Egnsplan

In more recent years, the Finger Plan, “Egnsplan” of 1947 was developed by Steen Eiler Rasmussen for the Danish Town Planning Institute. The urban plan provides a strategy for development of Greater Copenhagen by addressing ten main concerns facing



Copenhagen during the 1940's:

1. Industrialization
2. Migration
3. Mobility
4. Health
5. Energy
6. Nature Preservation
7. Food
8. Waste
9. Drinking Water
10. Global War

Figure 2.7 Copenhagen 5 finger Urban Plan

The design is based on five corridors of urban development along existing or planned suburban areas, which are then connected to the city center by train. The *palm* is placed over the dense city center from which the fingers radiate. Between each of the five fingers, the plan designated *green wedges* for farmland and recreational use.

The evolution of Egnsplán

Highway construction during the 1960s encouraged the development of lower density single family housing in areas poorly served by public transportation, this “threatened the integrity of some of the Green Wedges.”⁴ Today, growth and suburban sprawl have pushed the length of the fingers beyond their limits. Ørestad New Town is the newest linear development that has been added to Copenhagen’s urban fabric. The new town is being built over a 30 year period, beginning in the 1990s.



Figure 2.08 Copenhagen 7 finger Urban Plan



Figure 2.9 Copenhagen's new development finger plan

⁴ Fullerton, Brian, and R. D. Knowles. *Scandinavia*. London: P. Chapman Pub., 1991.

People Oriented City Center

“The process of pushing back cars and reclaiming streets and squares for pedestrians was done incrementally. In the city proper people have had time to change their patterns of driving and parking into patterns of bicycling and using public transportation. Furthermore, the gradual pace of the transformation has given Danes the opportunity to figure out what role attractive public spaces can play in today’s society. The transformation of Copenhagen can be seen as an extensive pedestrianization scheme, but it could just as well be seen as a scheme for taming traffic, not only in the city center, but in a major part of the city.”

Jan Gahl + Lars Gemzøe

Over the past 50 years, Copenhagen has been making drastic changes to the city fabric in order to provide public spaces. “The City Architect of Copenhagen has described the architectural concept underlying the design of the public spaces in the core of the city as - ‘pearls on a string’. The individual squares along the city’s main streets have their own design and are connected by changing the material quality and character of the street surfaces of the streets between them.⁵” Today there are a total of 18 public squares in the medieval city center.

⁵ Gehl, Jan, and Lars E. *New City Spaces*. 3rd ed. Copenhagen: Danish Architectural Press, 2003.

Copenhagen strived to control traffic and reclaim streets to create quality spaces for public use. Stroget and Staedet are two of the major pedestrian streets in the city center of Copenhagen. Stroget has a width of 10-12 meters and can handle about 145 pedestrians per minute.⁶ Straedet, is 8-11 meters wide and used to carry heavy traffic and public buses, but in 1989 it was “experimentally reclassified as a pedestrian priority street, meaning a street where pedestrians and bicycles have priority, but where cars may enter at low speed. The experiment worked well, and in 1992, the street was repaved and the sidewalks eliminated as in the rest of the pedestrian system.⁶” Over a period of four decades, many of the streets and squares in the inner city were gradually transformed into wholly or partially pedestrian spaces.

The center of Copenhagen has a medieval street pattern and within it lay eighteen squares which have been stripped of parking spaces and returned to the public for recreational activities. About one million square feet once devoted to motorized traffic has been pedestrianized, “...the surfaces of streets and squares have been replaced with fine stone materials, and street lighting and furniture have been refined as well.⁶” This thesis proposes that Banegardspladsen becomes part of the pedestrian street and square network of Copenhagen.

⁶ Gehl, Jan, and Lars Gemzøe. *New City Spaces*. Copenhagen: Danish Architectural, 2003. Print.

COPENHAGEN'S **rail**LINE

*Existing rail*LINE

Contrasting the efforts of the past 50 years, the train yard which was originally introduced at the edge of the medieval center in 1911, now is a scar in the city fabric. As the train tracks pass the Vesterbro district of Copenhagen, they act as a divider between the city and the waterfront. The train tracks then reappear after going underground through the Central Train station where they emerge through a series of voids in the city's surface in Banegardspladsen and along the boulevard line. The rail line continues underground while following the contour where the fortification wall used to be located. The lines reappear on the surface of the city once they enter the Osterbro district, past the Ostre Anlaeg Park. Similar to the Vesterbro district, the rail line acts as a divider between the city and the waterfront to the east of the Osterbro district.

New Metro City Circle Line

In 2018 Copenhagen's Central station will be connected to the metro line. It will cover 15.5 km, adding 17 additional stations around the city center. It has been predicted that by adding the additional metro line, the bus system within the city center will be replaced. The land excavated to create the tunnels for the metro line is being reused to expand Nordhavnen. Because of the additional metro lines coming into the central train station, there are plans to either add four additional tracks on a bridge over the existing train lines, or to locate them in a subterranean tunnel.



Figure 2.12 Transportation systems of the city center of Copenhagen with the new City Circle Line

03_SITE

This thesis will focus on three specific areas of Copenhagen, the voids located in Banegårdspladsen and the Boulevard Line, north-east of the central train station. The initial need in the 1900's to have ventilation voids for steam engine trains has been rendered obsolete with today's new technologies. The three voids left today in Copenhagen's city fabric celebrate layers of history of the city and allow the visibility of transportation movement through the subsurface of the city. The zoning opportunities and implications these voids can have on the entire development of Copenhagen enhances the importance of a major infrastructural transformation.



Figure 3.01 Aerial view of Copenhagen highlighting sites of intervention.

The transformation of these voids has been considered and questioned by the city of Copenhagen in the past. A task force comprised by DSB, Denmark's railway company has studied the possibilities of building on top of these sites at the North Port and the Central Station. Congruent with my decision of focusing on these specific sites, the City of Copenhagen also identified them as areas with potential for development, affirming the reality and importance of this thesis exploration.

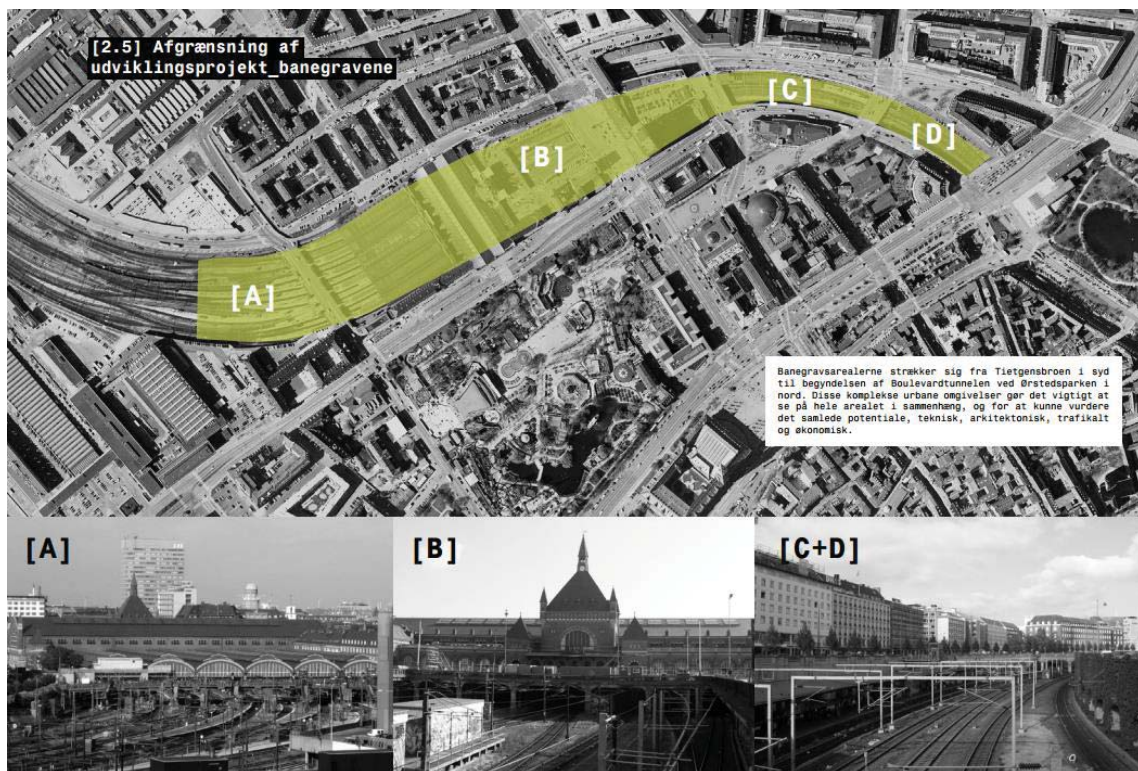


Figure 3.02 Sites Identified by Copenhagen for development and explored on this thesis.

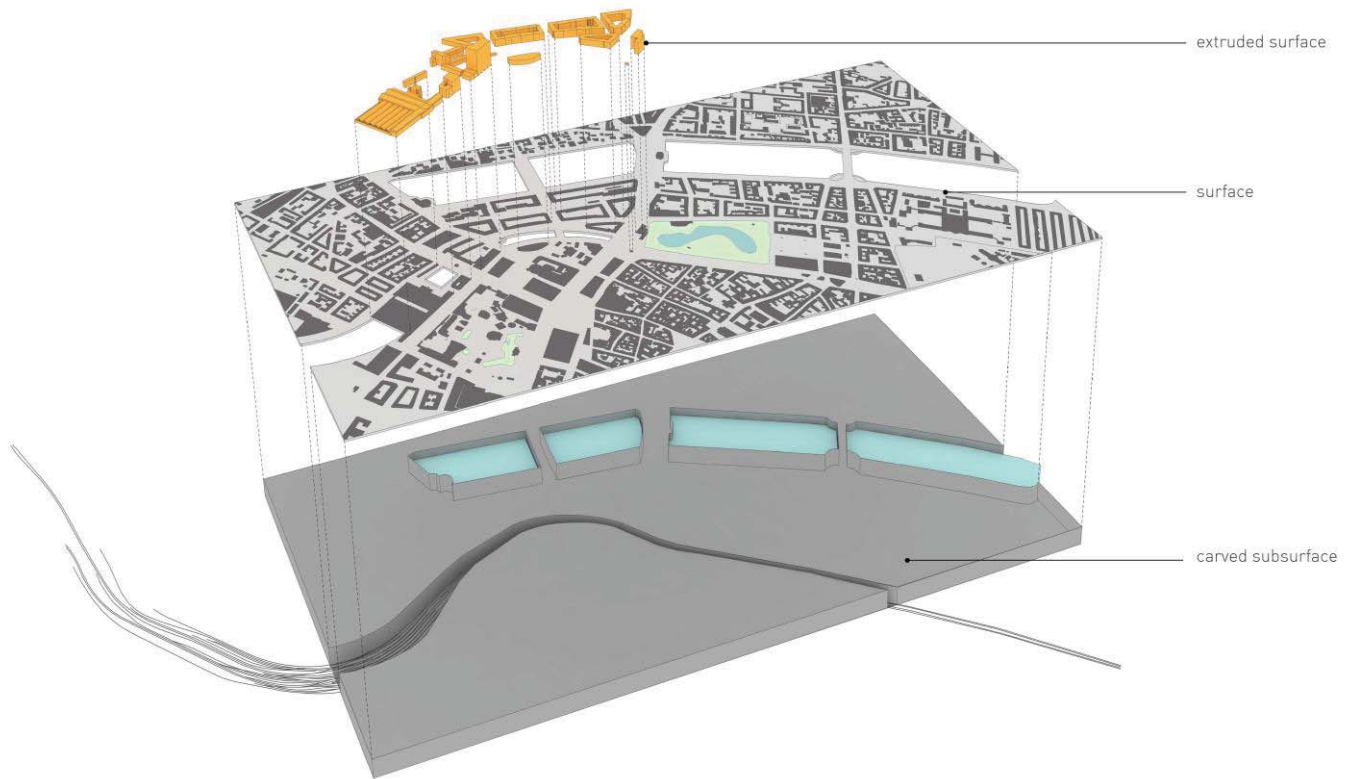


Figure 3.03 Diagram showing multiple layers of the site

Feasibility Study

Given the fact that the site has one of the largest development opportunities with such a central location in Copenhagen, a taskforce formed by Copenhagen's municipality, DSB and Railnet Denmark (the sites owners), as well as the neighborhood community, created a guideline of how to develop the area explored in this thesis. The opportunities, potentials and limitations were defined in order to provide a base line for future development for the site and at the urban

level. The unique location of the sites makes it essential to relate to the spaces and activities the city needs for this site. The feasibility study was done in a process that focused first on the economical and construction issues.

The study makes it clear that it is critical to address the highly trafficked streets around the site and to address one of the city's busiest transportation hubs, especially because the introduction of the Metro City Ring will cause a radical new change in the traffic pattern in the immediate area around the railway's voids. It also states that the proposal should include social and functional considerations, keeping in mind the opportunities and consequences for the city as a whole.

The need for a well-organized and attractive arrival space for Copenhagen via the central train station is described as having a strong impact on how Copenhagen is perceived by tourists and other visitors in the city. The development could help with the city's functionality by providing new services, better conditions for public transportation as well as for pedestrians and cyclists.

Among the programs proposed for Banegardspladsen are a visitor center and bicycle parking. The development of the site has the potential to become a new landmark for the city of Copenhagen (due to

it's central location). This thesis will take all the guidelines and structural restrictions into consideration in designing a proposal.

[5] Areaer

Potentielle byggefeltet for hver af de 4 banegvarealer.

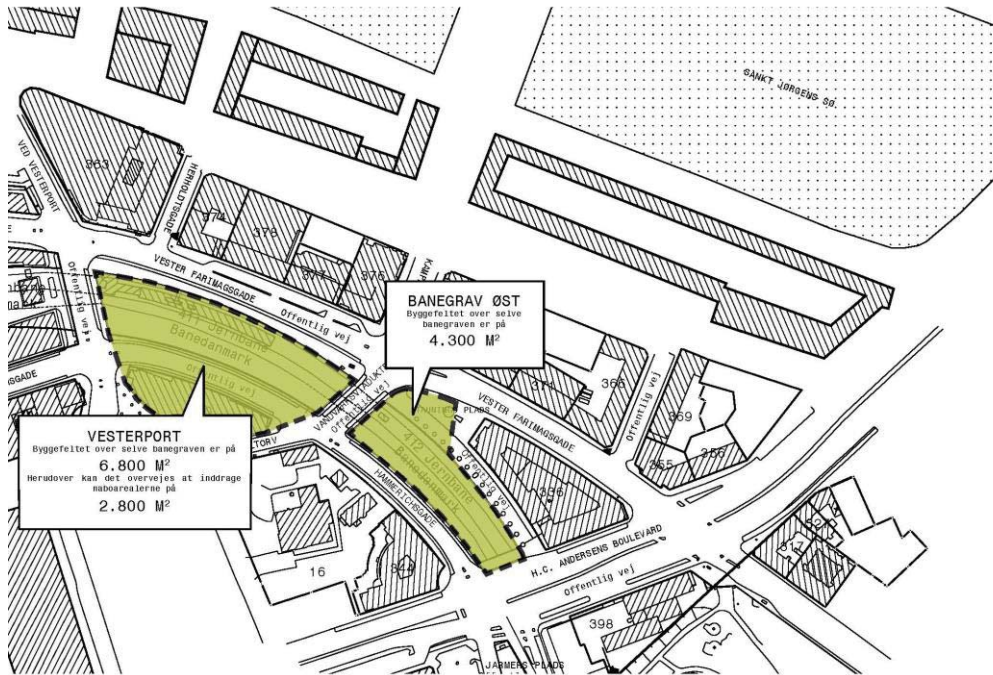
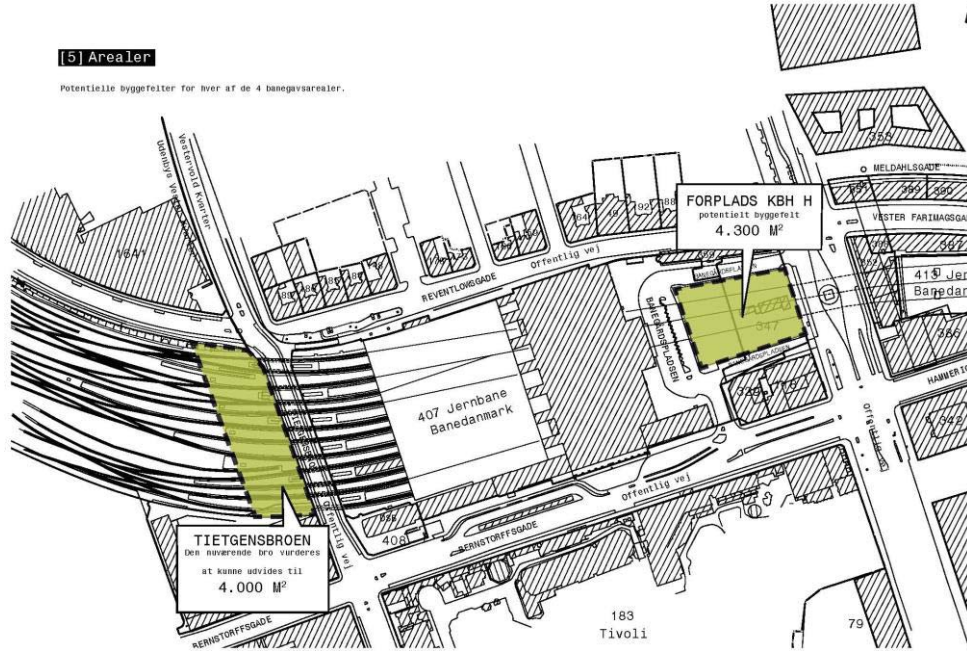


Figure 3.03 + Figure 3.04 Diagrams from Copenhagen's task force identifying selected sites

[8.3] Økonomi for de enkelte banegrave

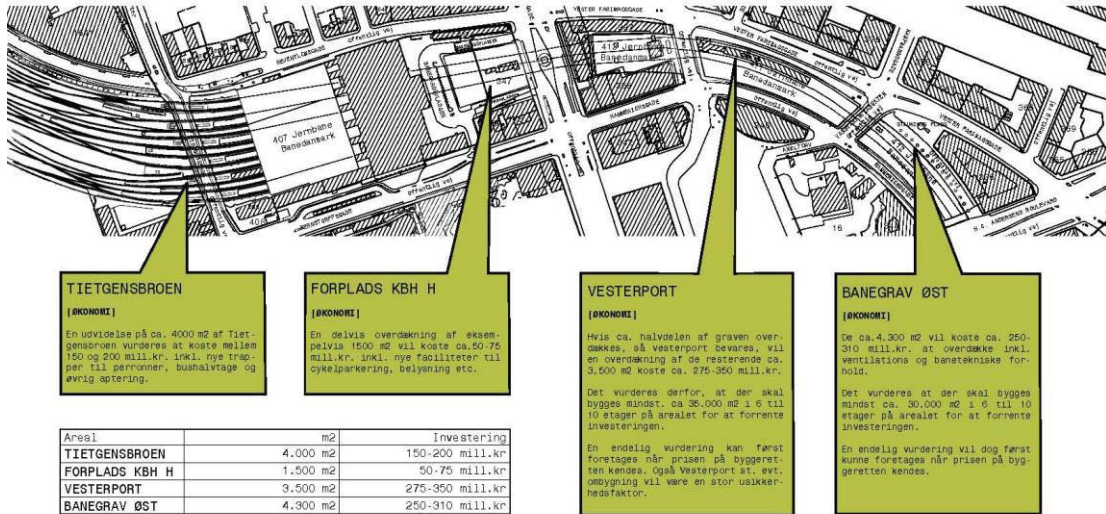


Figure 3.05 Diagrams form Copenhagen's task force identifying projected cost of development.

Banetekniske konsekvenser og konstruktion i de enkelte banegrave

I det følgende gives en kort overordnet beskrivelse af de banetekniske konsekvenser i de uopgede områder.

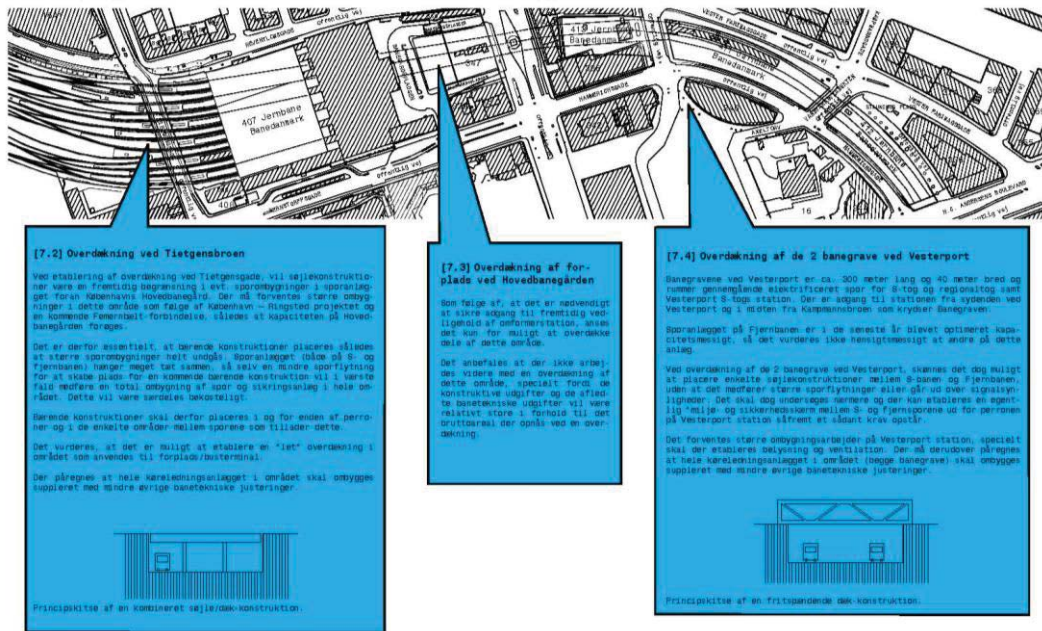


Figure 3.06 Diagrams form Copenhagen's task force's structural analysis for the sites.

Alternative Proposals in the Feasibility Document

"Mulighed for gennembrudt bygningsstruktur der tilpasser sig den eksisterende bebyggelse, men markerer sig imod H C Andersens Boulevard"



Overordnet beskrivelse af de 4 banegravsområder

"Ved at udvide Tietgensbroen mod syd, over de eksisterende perroner og baneterrænet, er det muligt at skabe en central forbindelse i byen, der kan rumme en fremtidig busterminale"

"Det unikke byrum foran Kbh H tænkes ikke bebygget. Dog er en delvis lukning af banegravens en mulighed, så pladsens potentiale bedre kan udnyttes"

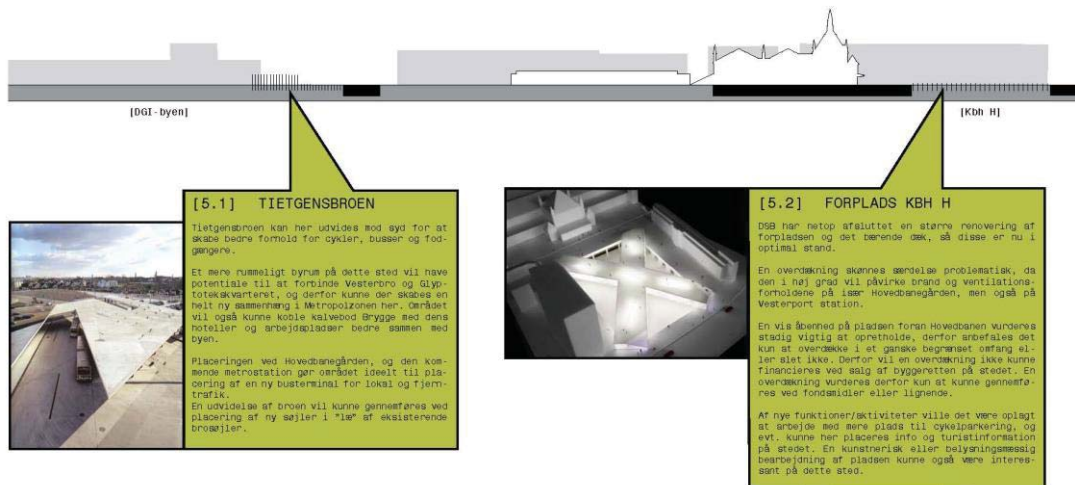


Figure 3.06 + Figure 3.07 Alternative Proposals by Copenhagen's Task Force.

BANEGARDSPLADSEN + THE BOULEVARD railLINE

Existing Conditions

Overlooking the city's railway system, Banegårdspladsen is currently an underutilized space at the city's largest transportation hub. Surrounded by historical structures such as the Central Train Station by Heinrich Wenck (1911), The Liberty Memorial (1779), SAS Royal Hotel by Arne Jacobsen (1956), City Hall by Martin Nyrop (1905) and tourist attractions such as Tivoli, this site has become a great opportunity for the development of a public



Figure 3.09, Figure 3.10 + Figure 3.11 Current Site Conditions

space.

Commonly referred to as the world's most expensive hole, the 47,700sqft void was initially built in 1911 to vent the exhaust steam from the steam engines before they entered the station.

More than 3,500 bicycles park alongside Central Station every day. Almost 8.8 million train tickets are sold yearly and about 2,000 employees work at the Grand Central Station. Today, the Central Station, the main transportation hub, lacks sufficient bike parking and an outdoor gathering space to accommodate the vast number of users.

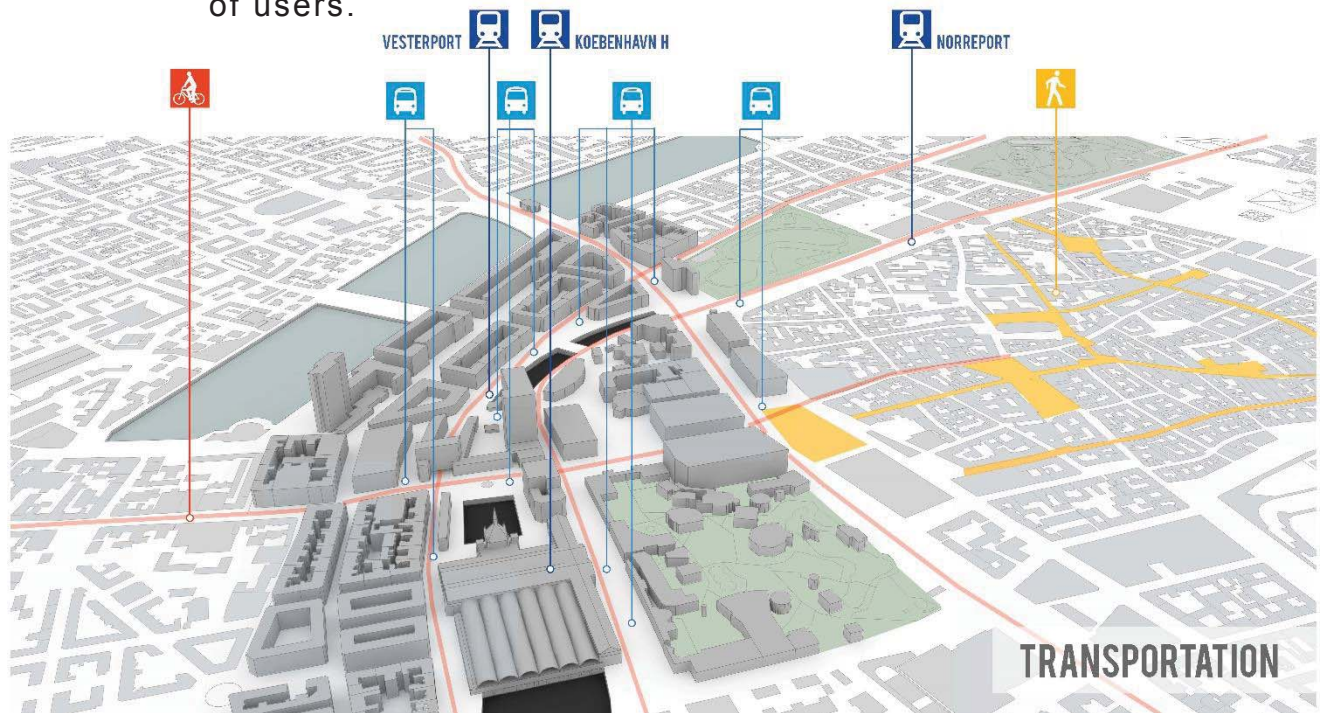


Figure 3.12 Transportation Diagram

04 OPPORTUNITIES FOR INTERVENTION

To understand the opportunities for development on the sites, I began to examine the surrounding public spaces found along the main pedestrian street in the historic center of Copenhagen. The study revealed that extending the pedestrian connection towards the central train station would allow Banegårdspladsen to become an important node and addition to the thread of spaces currently existing in the city.

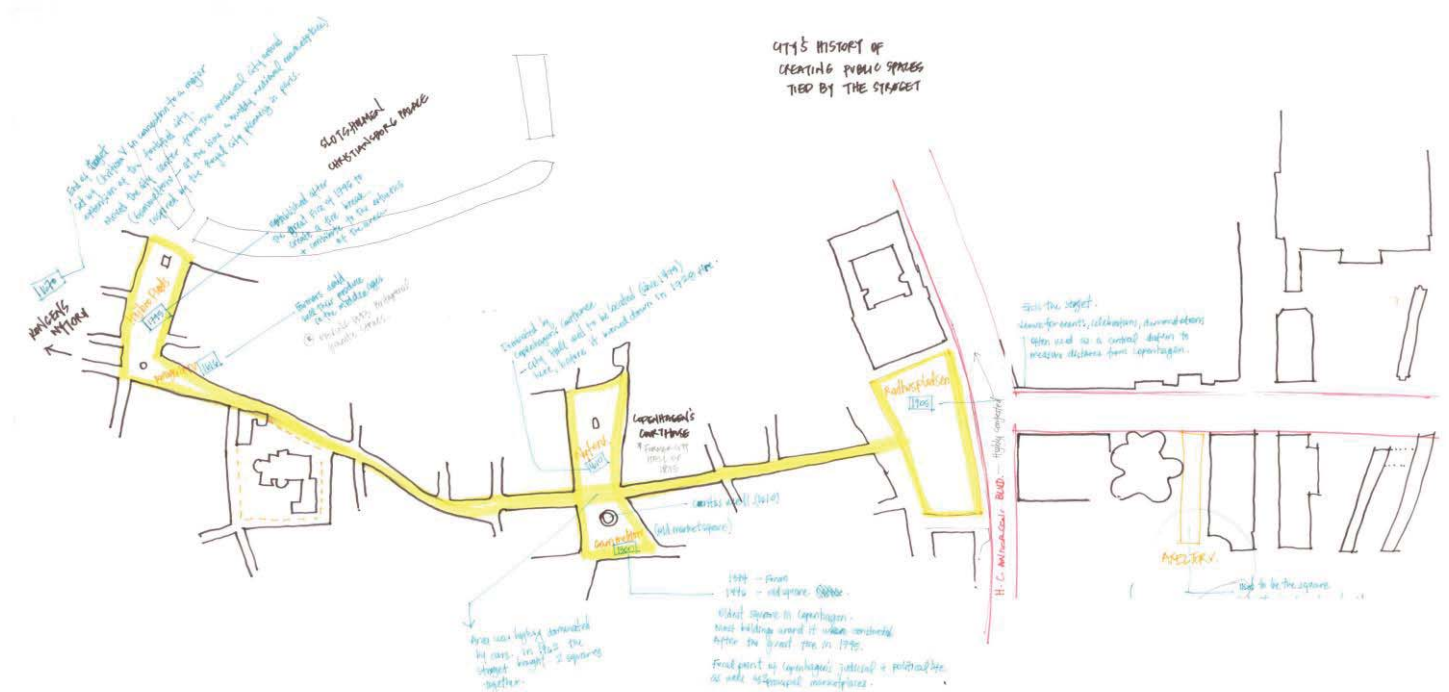


Figure 4.01 Study of adjacent public spaces

In addition, it was important to examine the major connections to the site from the adjacent neighborhoods to better understand where the key moments of connection needed to occur.



Figure 4.02 Diagram of potential connections to adjacent public spaces

An alternative connection to consider is the green link to the parks established after the fortification wall was removed. To establish a connection to these parks, and make them accessible for the train users to enjoy these amenities, is one of the goals of this proposal.

05_DESIGN APPROACH

The design examines major opportunities and constraints of the site and develops a strategy to mitigate the issues and provide Copenhagen with community spaces that are integrated with the urban fabric.

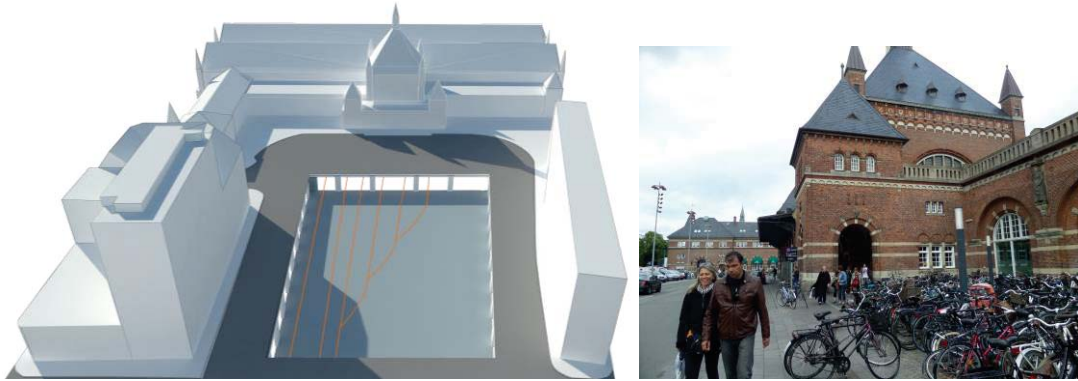


Figure 5.01 + Figure 5.02 Current site conditions

The Banegardspladsen void is currently surrounded by highly congested vehicular streets. Once you exit the station, instead of having the opportunity to linger in a plaza you are only a few feet away from the taxi pick up area and parking. The lack of space in front of the station leads to a sidewalk overcrowded with parked bicycles.

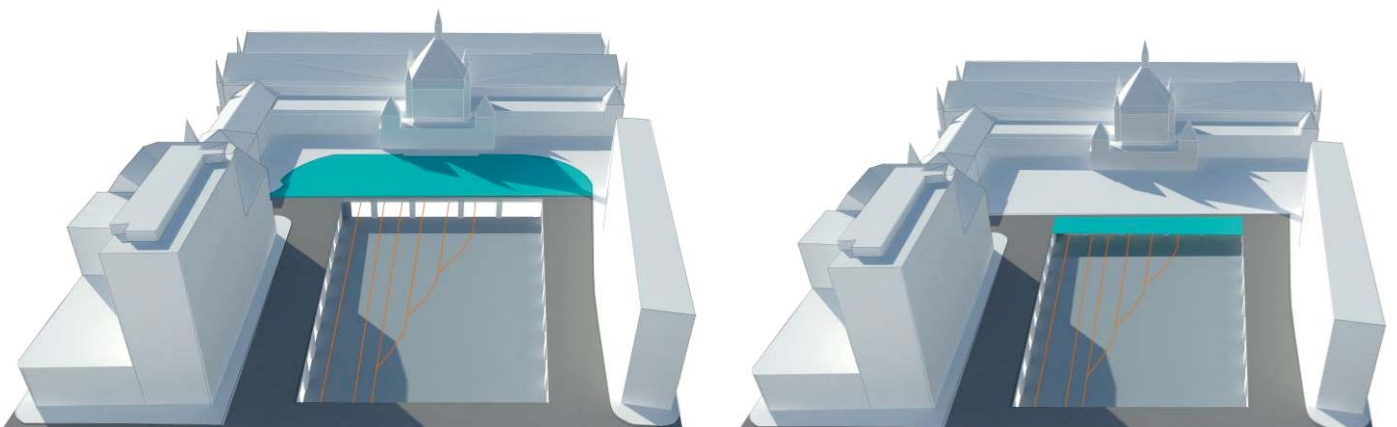


Figure 5.03 + Figure 5.04 Design proposal diagrams

By extending the forecourt of the Central train station, and adding a street over the void, the experience of exiting and entering the station changes. Not only is there more space to park bicycles, but there is an area of stasis in which people can wait, meet and gather.

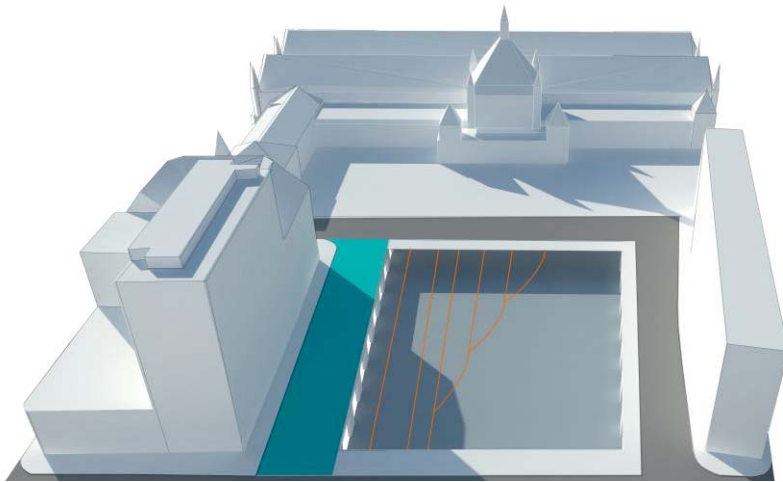


Figure 5.05 Design Proposal Diagram

By pedestrianizing one of the streets around the station, the vehicular circulation around the station is reduced and pedestrian access is increased. The pedestrianization of streets has been historically successful in the city of Copenhagen. Gehl and Gemzoe explain in their book *Public Spaces Public Places* that “Whereas city centers in many other places in the world have deteriorated over the years- becoming noisy, heavily trafficked places that are rather unpleasant and at times frightening to be in- Copenhagen has followed a different path. The city center has improved year by year, becoming more and more used and appreciated.” While this might be true for the medieval

space of the city, the Metropolitan zone has been neglected. The same principles that have been applied to the medieval city center can carry over a few blocks south west to continue the same character that Copenhagen has successfully established.



Figure 5.06 + Figure 5.07 Design Schemes

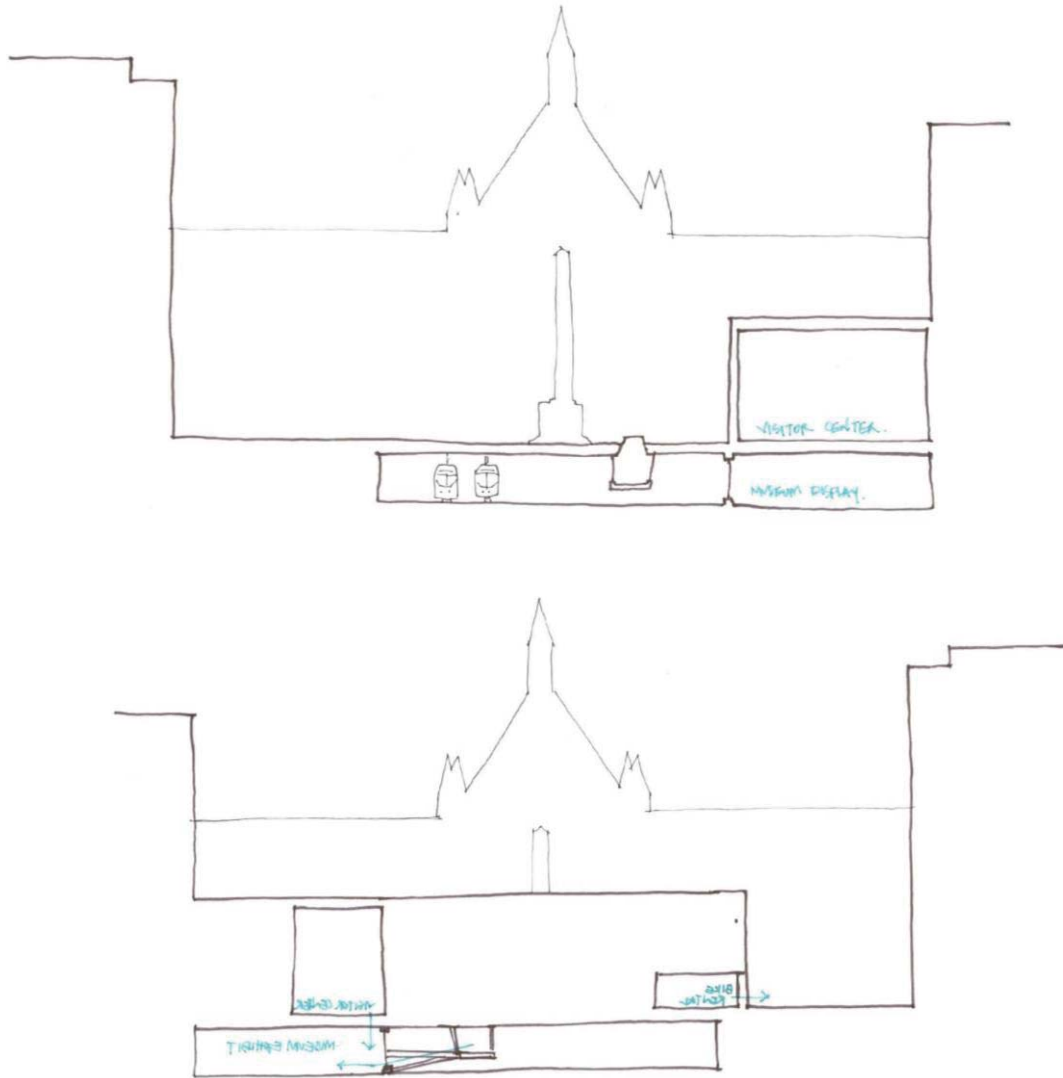


Figure 5.08 + Figure 5.09 Sectional schematic Design

Sectional studies were done to understand the vertical layers of the site and explore the programs that would best work for the site.

The site in which these voids are located is extremely diverse in its urban function. There is transportation as well as cultural and entertainment districts in the city. Tschumi explains in his book *Event-Cities* “The juxtaposition of function, scale and historical time in contemporary culture is not a negative

phenomenon but belongs to the logic of a new urban society.” So with the multiple events occurring in the site, I determined that the programming for this proposal had to serve both visitors and local people. It had to be practical and allow for movement but at the same time create spaces of stasis.

The design proposal includes a series of buildings and a bicycle and pedestrian path that weaves underground and moves you through the voids as you explore the history of trains in Copenhagen and enjoy its transportation culture.

Tschumi explains in his book *Event-Cities* “*Can a new urban strategy encourage a new type of Architecture? Reciprocally, can one invent an architecture capable of generating a new urban lifestyle?*” pg. 41 An interactive, real life/ real time experience that begins to redefine what a museum should be. The visitors are able to have “the Copenhagen experience” and the locals are provided an alternative transportation corridor that allows a dynamic, direct and safe connection through the city.

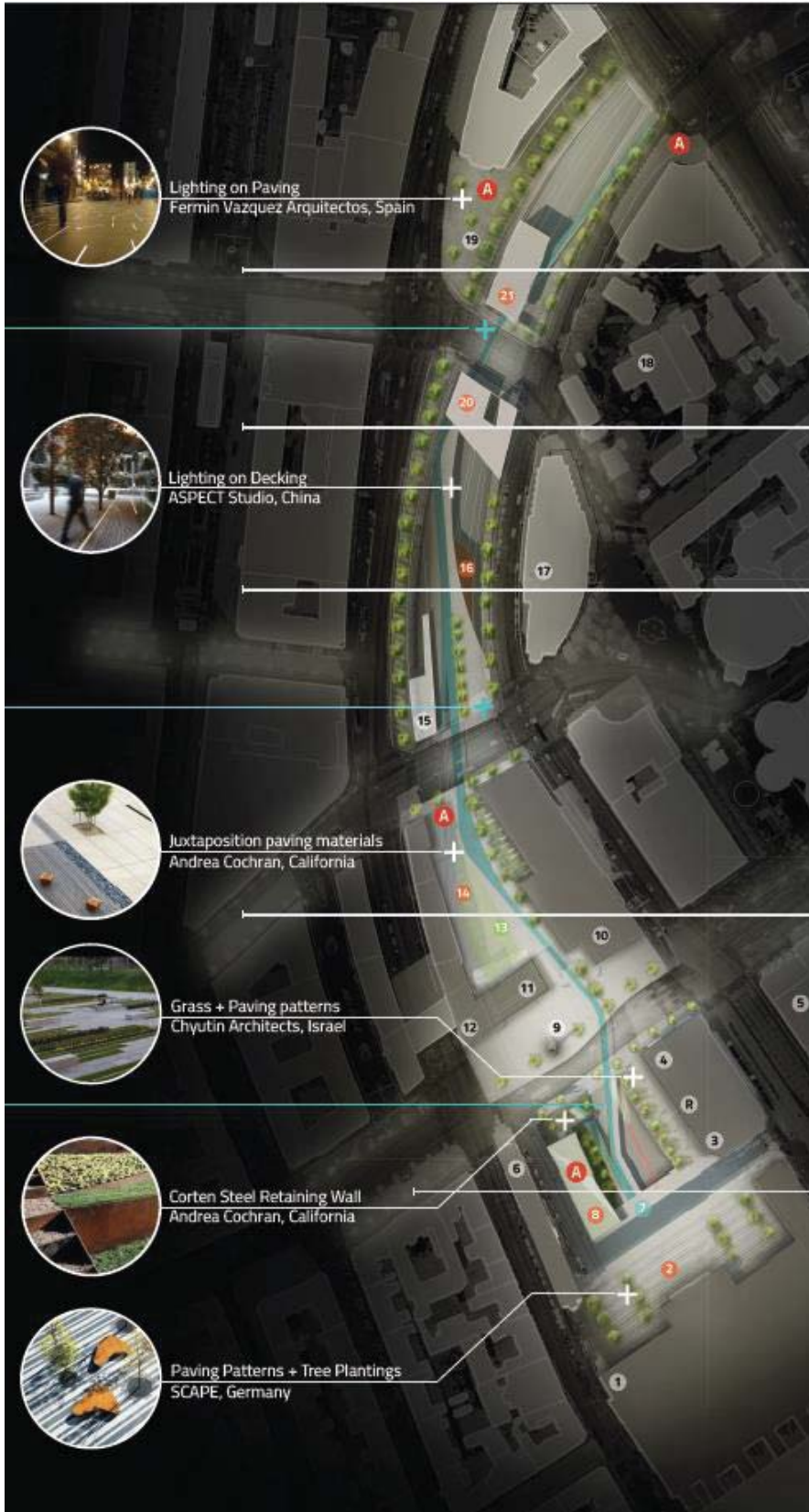


Figure 5.10 Urban Plan of Design Intervention

The proposed museum includes exhibits displaying the history of bicycles and bicycle technology in the city, pedestrian urban changes in the historic city center as well as underground exhibits of the regional and s-train history.

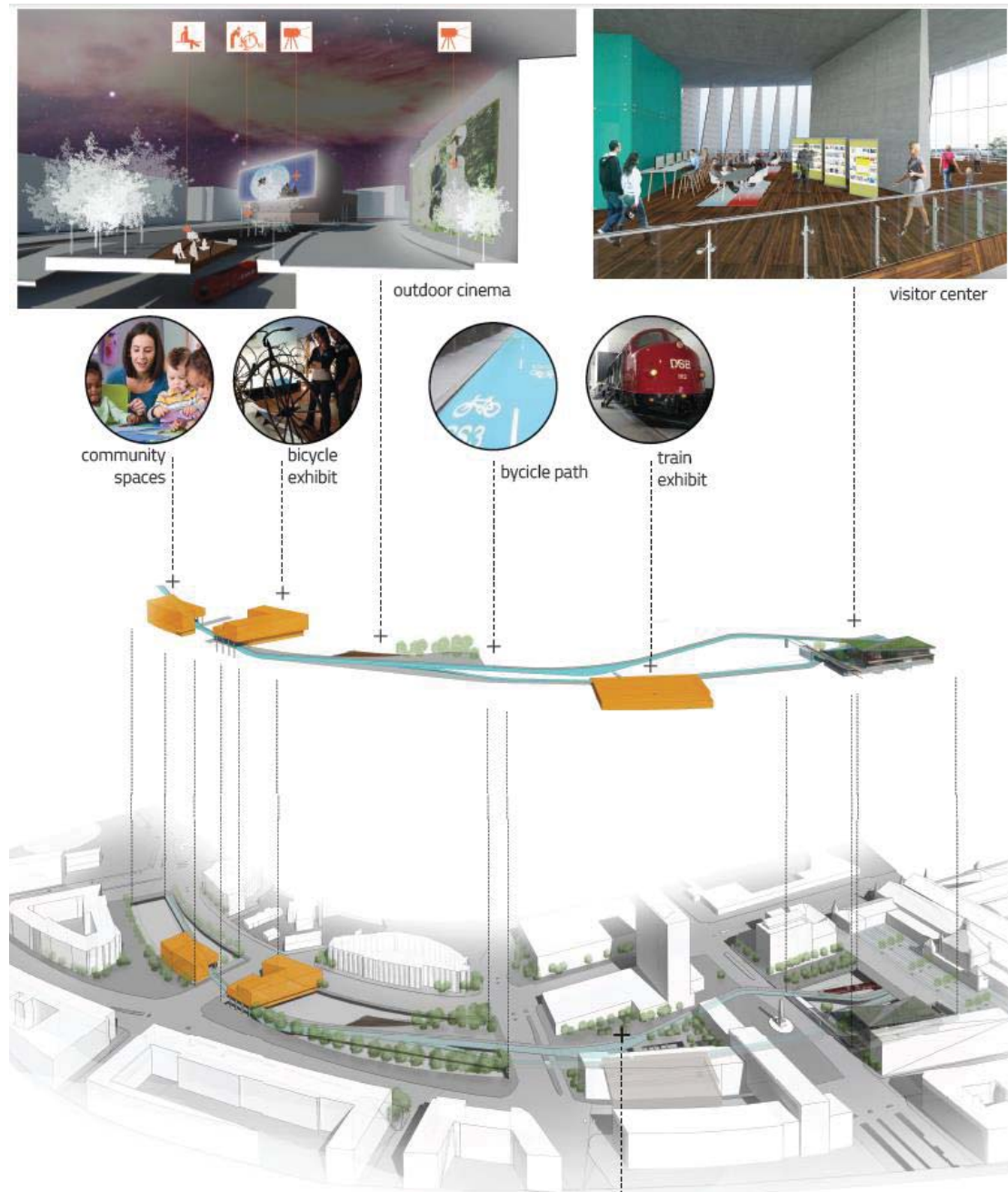


Figure 5.11 Design Intervention

The first building you encounter is the visitor center at Banegardspladsen that in addition has a restaurant on the train track level. The program was established by taking into consideration the analysis of the community, municipality and site owners.

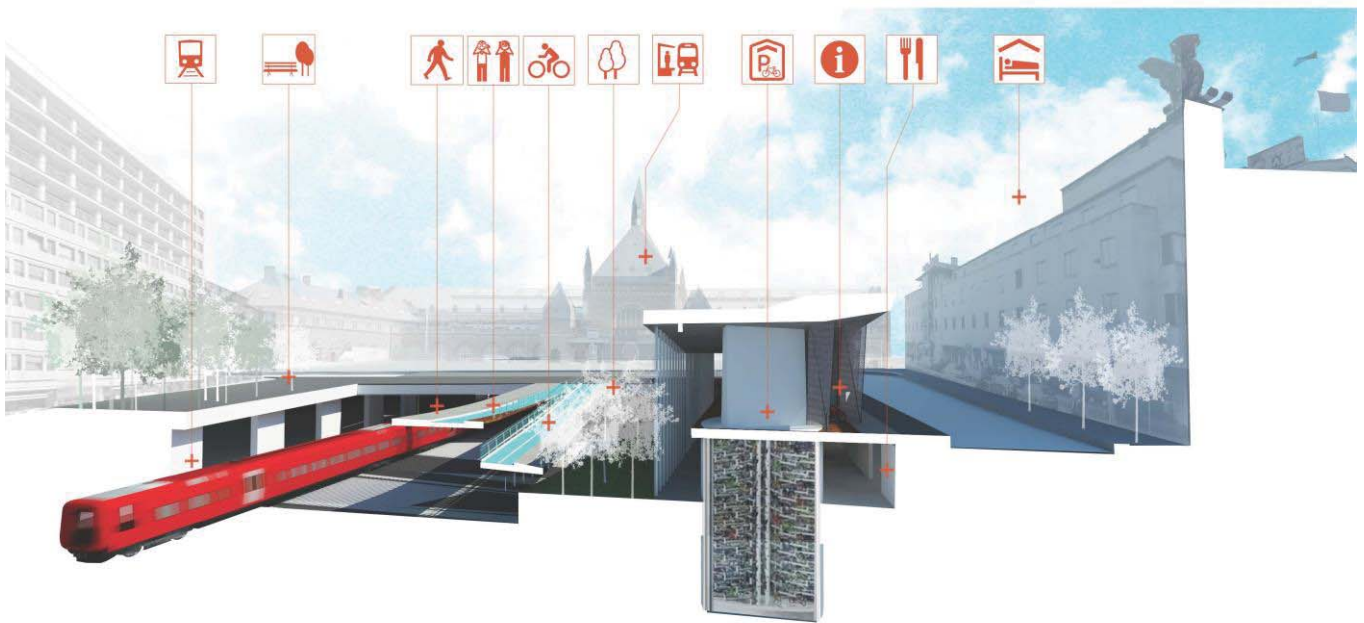


Figure 5.12 Section perspective diagram through Banegardspladsen

At the building's core, there are two eco-cycle parking silos like those currently used in Japan, the most advanced technology for bicycle parking that exists in the world. These silos can each hold 200 bicycles, absorbing 1/3 of the need for bicycle parking that is currently lacking in the Metropolitan

Zone. In addition 6 other silos have been strategically proposed throughout the area to provide a total of 1600 safe and covered bicycle parking spaces.

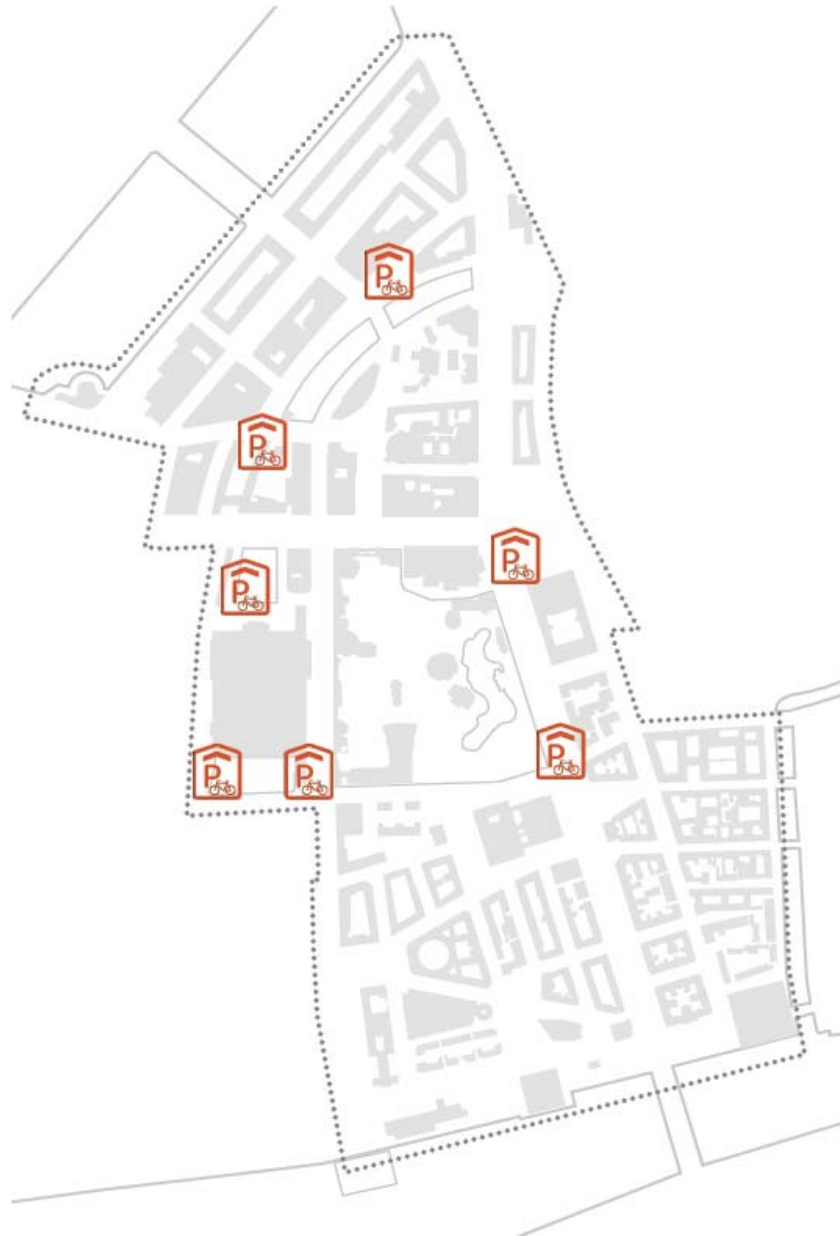


Figure 5.13 Proposal for Eco-cycle Bicycle Parking Locations

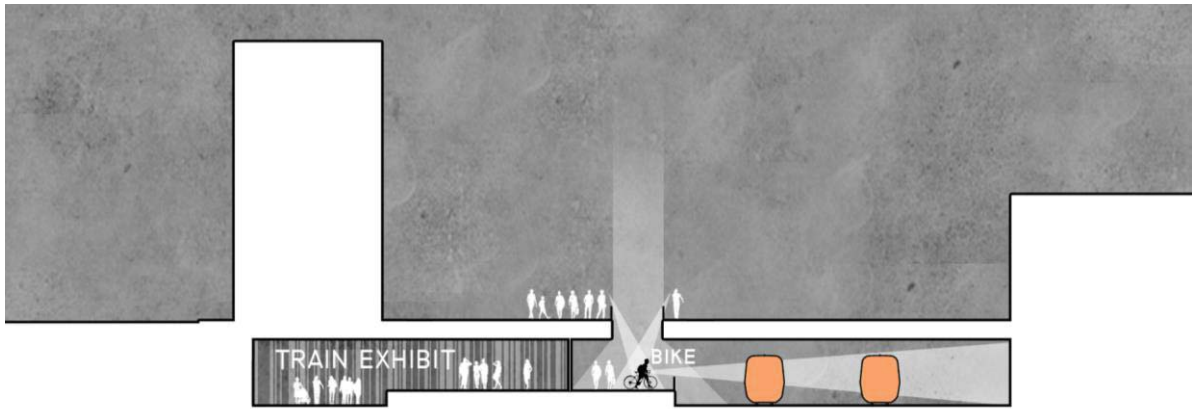


Figure 5.14 Section through underground train history exhibit

While continuing on the pedestrian and bicycle path that leads you underground to the track level, you can experience a historic train exhibit while also viewing the modern trains drive by adjacent to you.

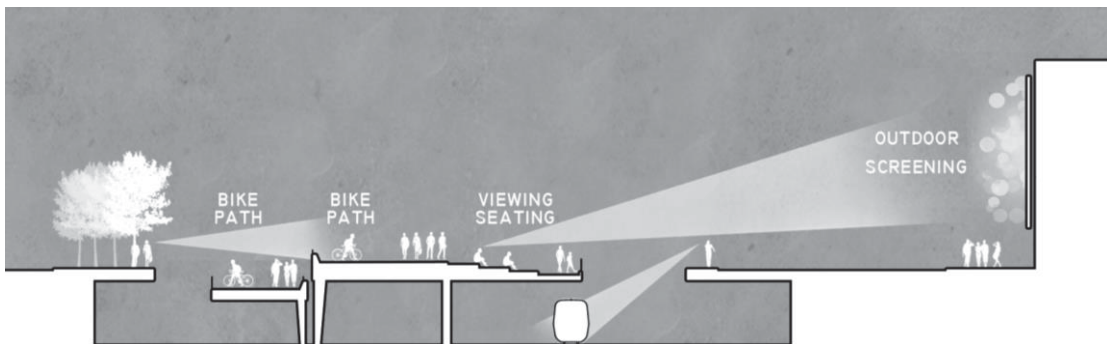


Figure 5.15 Section through outdoor screening and cinema

The intervention also proposes spaces that by being located adjacent to key existing buildings are able to enrich the experience. As an example, outdoor seating space located in front of an existing movie theater allows for the

opportunity of the façade of the movie theater to be used for outdoor screenings.

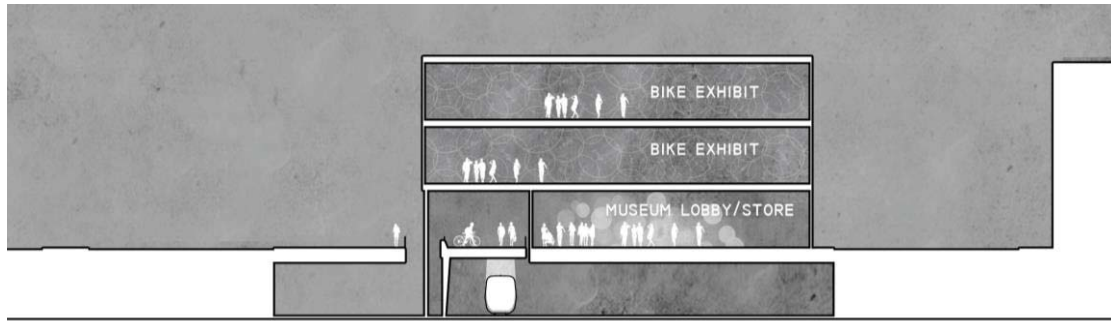


Figure 5.16 Section through proposed museum

At the opposite end of the intervention from the train station there are two buildings. One building is a proposed museum building that exhibits the history of bicycles and their use in the city of Copenhagen as well as providing access to additional exhibits for historic trains at the train track level.

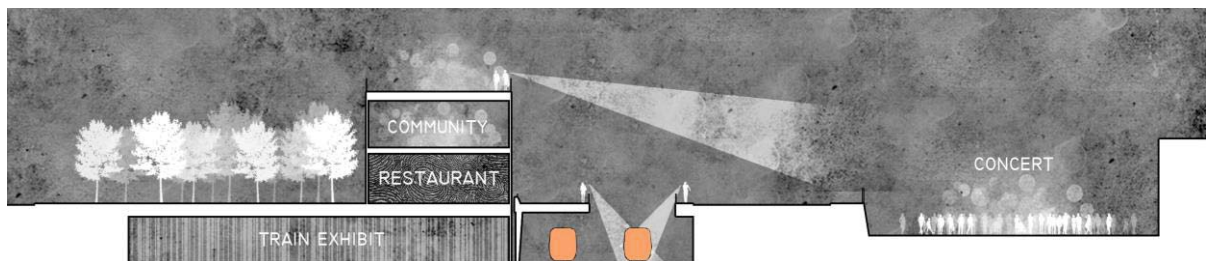


Figure 5.17 Section through community building and adjacent/existing concert venue

The second building program includes community activities such as daycares. Given the fact that there are 20,000 people working in the Metropolitan Zone and no childcare options around the area, it is appropriate to host that type of

program in the intervention. In addition, the building is strategically located adjacent to a concert venue, where the community can take advantage of rooftop access and enjoy the performances next door as an extension of the venue.



Figure 5.18 View of proposed Visitor Center and Banegardspladsen



Figure 5.19 View of proposed Pedestrian and bicycle path



Figure 5.20 Proposed Intervention

06_CONCLUSION

As previously mentioned, technological advances are constantly altering our urban fabric. Infrastructures are especially vulnerable to these changes and must constantly adapt, or they become overlooked and abandoned, creating negative spaces in the urban form are merely used for utilitarian purposes.

How can the three voids in the Metropolitan Zone of Copenhagen contribute to the linking and place making that the district desperately requires? I believe this design proposal creatively accomplishes the creation of connections and public space making in the heart of the city.

This thesis explores the question of how we appropriate and adapt urban infrastructure to enhance public spaces. It focuses on the train voids found in the Metropolitan Zone of Copenhagen, Denmark. By proposing a design that incorporates not only the residents of Copenhagen, but in addition, the visitors to the city, this intervention would have a high impact on the district.

Finally, by making the decisions to cover a minimal area of the voids rather than covering and developing the whole site, one is able to celebrate the history of a scar that informed the urban fabric as it is today. The voids are able to be connected through the multiple layers of the city while still retaining their character.

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