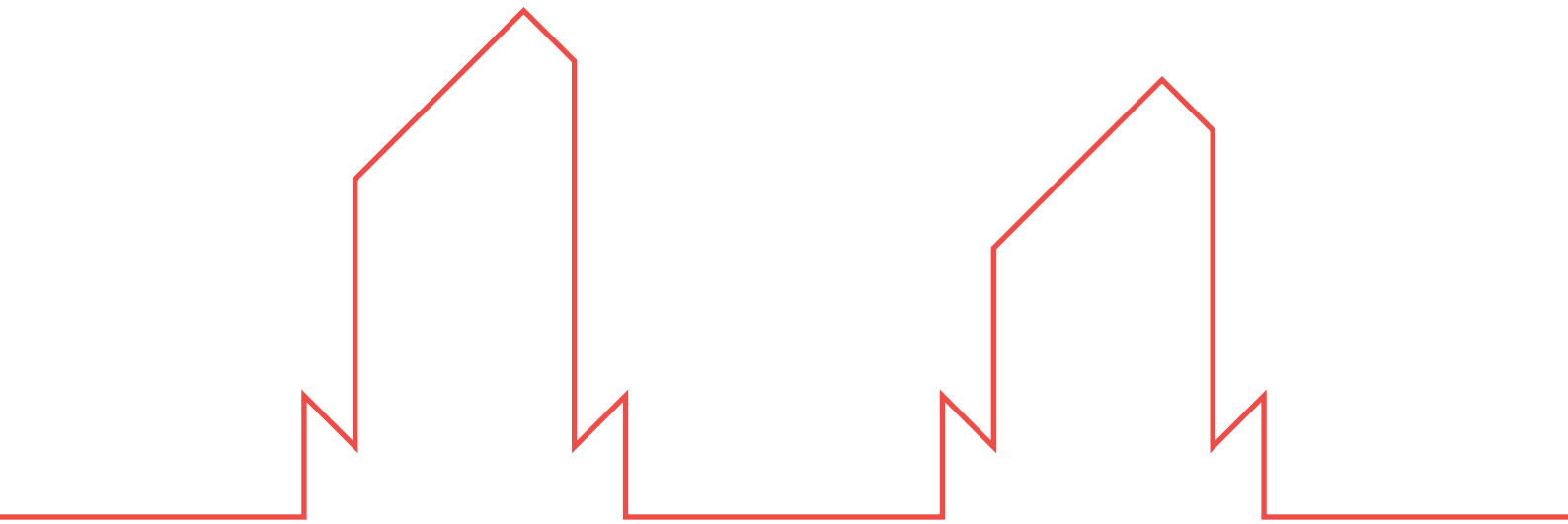
HYPERDENSE
DESIGN



Hyperdense design

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Introduction

In contemporary discussion around the problems facing our cites sustainability and the need for housing are key issues. Density is seen increasingly as a solution to these ills and with them we see advocacy for even more radical solutions such as hyperdensity. But these advocacies for density are often criticized by pointing to the failures of many mass housing programs, yet such discussions rarely go into the details of said failures and more importantly do not delve into if and how it could be done in a way to avoid these failures. Therefore, this project aims to find a site where ideas can be experimented with, look into the theory surrounding hyper density both positive and negative, analyse the site to gain insight into how it how it relates to these ideas and its own specific challenges, derive design principles based of these analyse and theories, refine these principles into a design that uses the principles of hyperdensity to solve problems of the site and thereafter reflect upon how lessons learned form this project can used in future projects engaging with hyperdenisty.

Hyperdenstiy definition

Hyperdensity in this project is defined as places with an abnormally high urban density, the density of people living in an area, such as Singapore and Hong Kong, contrasted Highly dense urban areas as for example in New York and medium density as seen in the typical European town centre.

Introductionto the site

Refshaleøen is a former shipyard area located on the eastern coast of Copenhagen. Like many harbour facilities I Copenhagen the majority of site is an artificial extension on an existing outcropping of coastline and like many former industrial areas it has transition to service oriented businesses, yet it still has many spaces that are neglected or underutilized. This makes it ideal for experimenting with new forms and designs, but this still requires and understanding of the specifics of the site. Therefore, this section of the report explores the history and planning around the site.

History of the site

The peninsula Refhaleøen has been used for a variety of undocumented functions thought-out it's history, notably a block house was built in the 1624 to supplement Copenhagen defences. In the 1860-70s reclamation was used to expand the area of the half island so Burmeister & Wain could establish a shipyard (Wikipedia A).

The early years were somewhat eventful with a strike in 1871, the transition to a public limited company and the beginning of construction of steam locomotives. Despite this the company still saw steady growth with contracts from the national railway and navy in the 1930's. This was disrupted by the second world war with sabotage limiting production, though they recovered afterwards. Problems began in the 1970's with increasing competition on the international market and the oil crisis, which had dire consequences for the company. Under new leadership they saw a brief recovery in 1976-1978, despite this, the company went bankrupt in 1980. It ultimately did not recovery from this Despite of having continuous production and sophistication of ship building techniques, they were unable to recover, closing down in1996 (Wikipedia B).

This has left much of the peninsula disused and empty, therefore Refshaleøens Ejendomsselskab was established for the redevelopment of the peninsula. This has included many temporary functions such as hosting the 2014 European (Wikipedia C) song contest and more permanent function such as Reffen in 2018, northern Europe's largest street food market (Wikipedia A).

This history shows an evolution typical of many places in Denmark of industrial areas in cites being transformed into more service oriented urban areas. Refshaleøen's transition towards cultural and commercial functions, has however been broadlys unplanned as exploration of the local plan in the next section shows.

Local plan text

The local plan can be split into 2 portions: the 1990 plan and 2015 addendum. The addendum mostly focuses on the east of the peninsula leaving the old plan still relevant for the west. While brief the old plan makes it clear that its goal is to allow for the expansion of existing shipbuilding industry, while giving provisions and changes to allow for service and recreational businesses.

To accommodate this shipbuilding has been permitted in the east of the peninsula, expanding on existing businesses, some of this area has also been permitted to be used for recreational purposes. This coincides with the area usage for a variety of festivals over the years, the shipbuilding in contrast has not returned.

Most of the west of the plan's territory has been designated for service industries and provisions have been made to allow for the construction of a pedestrian promenade along most of its harbour's edges. There is also a provision to build a tunnel from this area connecting to Gittervej in Nordhavn. While service business has set up shop and the promenade has been built, the tunnel was never constructed, but notably has not been overturned in the addendum.

The addendum begins by giving a brief overview of important buildings in the area in the context of the area's history emphasizing the site's shipbuilding heritage and placing it in the transition from an industrial to a knowledge-based economy. As part of their planning the municipality has described the wishes of the 2 major landowners in the area: Refshaleøens Ejendomsselskab and By & Havn. Their stated wishes parallel many similar plans for former industrial areas in Copenhagen.

They want some of the site to be used for recreational and cultural purposes and they want to be allowed to have temporary uses that are regulated by time limited rental contracts. The addendum addresses these wishes by allowing for the usage of old buildings to be used for recreational and low impact commercial spaces. A single grocery shop of maximum size 500m² has also been permitted to be built. It also designates several areas, as events spaces as well as a bathing zone and allows them to be used for temporary recreational services. It does however not give any permissions outside of this for temporary usage, but also doesn't explicitly restrict them either.

They also express a desire to build more housing, particularly in the form of house boats. This is covered by allowing housing to be created in connection with businesses but requiring them be phased out if the business functions are removed and by permitting 50 houseboats to be parked/built in along certain harbours, with minimal requirements for their appearance, illustrated in figure 0. There are however restrictions for the placement of housing due to smell discomforts from the sewage treatment plants, based on an analysis done by the municipality, as shown in figure 0, this can however change with improvements to the plant.

Some other wish that they expressed was to expand urban agriculture and be the first CO2-neutral city district, by 2020. While area has been designated for a solar panel power plant, as show in figure 0, there are no other provisions to mitigate or reduce CO2 emissions and has thus not reached its goal. Urban agriculture is also underserved with no areas designated for it and no explicit permissions for its use. The addendum also requires a certain amount of cycle parking per housing/business.

The original plan is one that tries to balance reusing buildings form new purposes and allowing for the return and expansion of shipbuilding. This with the advantage of hindsight has only been partially successful, shipbuilding did not return, but service business did sporadically pop up and several major events were held there.

This success is likely what prompted the addendum, expanding upon these aspects of the old plan and adding new ones. While like the old plan not all of them have been realized, this is not surprising as the plan itself states this area is not the focus of development in Copenhagen.

Seen in this light this area has great potential. Not only in realizing the wishes of the municipality and landowners, but also for those stakeholders whose needs are not accounted for, such as residents and business owners. (Københavns kommune 2015)

Theory

Introduction

This section explores some of the literature surrounding the theories of hyper density. It looks at those with a more positive outlook both historical and contemporary, those with a more negative outlook both those in response to positive theories and those that look at less explored avenues as well as looking at some that a boarder look at the theory and a look outside the European perspective.

Le Corbusier

One of the most famous advocates for high rises is Le Corbusier, whose ideas were most notably outlined in his book Vers Une Architecture, Towards a New Architecture, published in 1923. In it he outlines how industrialization has changed not only how we build, but also how we live. How it has caused a division between worked and free time, how the brilliant tools of industrialisation have improved production, but have not been used to improve our dwellings and lives. He talks about how this change has happened at a pace unmatched by previous eras and that it requires radical change to meet it. (Le Corbusier 1970)

While the book offers much in terms of speculation and inspiration, it lacks elaboration on design specifies to achieve these ideals. Le Corbusier did however also publish a smaller almanac giving his "five points for architecture". Translated by Malcolm Millais (Millais 2015) they are as follows:

1. Buildings should be raised up on columns – *pilotis*.
2. There should be no internal load-bearing walls allowing a planning freedom – *plan libre*
3. External walls should be non-load-bearing – *façade libre*
4. Windows should be in long strips – *fenetre en longeur*
5. The roof should be flat and used as a garden – *toit jardin*

The Sustainable Tall Building: A Design Primer

Advocacy for High Rises is not merely relegated to the past. It has seen a recent resurgence particularly as it relates to sustainability. Philip Oldfield's book "The Sustainable Tall Building: A Design Primer" gives a comprehensive look at this subject. In it he argues that while tall buildings have great potential to be sustainable most of them are currently not living up to that potential. He points to that individually many tall buildings are not as sustainable their lower density counterparts. He puts forth several reasons for this overheating and lacking natural ventilation, but most prominently he points to embodied energy from construction often overlooked in standards for sustainability.

To balance this, he looks at high rise sustainability on the urban scale. He talks about how it is on the urban scale that we see sustainability density take hold. Because of this some advocate for large-scale mid-rise housing, like Paris, due to them being a more traditional formulation of human scale design. Philip Oldfield however advocates for hyperdensity due to the advantages it gives, such as for allowing the strategic placement of sites adapting it for the local environment and making it easier to preserve historic parts of cities. It also has the advantages of promoting public transport and walkability as well as helping to maximize open space. He does however warn that these advantages can only be obtained if it is integrated into the local context and mobilities.

He also discusses evolution of building envelopes as it relates to tall building sustainability. Pointing out that many are what he calls fourth generation envelopes, hermetically sealed environment heavily reliant on machinal ventilation and not very sustainable. Instead, he advocates for fifth generation envelopes, which focus on reducing primary energy consumption as much as possible, use techniques such as double skin facades to allow for natural ventilation for more of the year.

He also explores the community in high rises. He points out how many studies of them have been flawed focusing on the most problematic cases and not taking sociopolitical factors into account when measuring satisfaction. He does however also point out that there are some common problems such as lack of community spaces higher up in buildings, monotonous floor layouts and lacking maintenance, but that these flaws are solvable and have been addressed in several buildings already.

He also explores mixed use and vertical programming in tall buildings. He says that as density is increasing there is evermore need to find space to place functions and thus vertical programming is seeing more attention. This is in part fuelled by increasing land prices making low rise building unviable in many cities around the world. Everything from education to vertical farming are being experimented with. The lack of public space around buildings is common issue, but as he points out this need not be the case. Many newer buildings experiment with using the building itself as a means of creating public space, some internally and others shaping a void from the building generating a public space. Yet there are factors that need to be considered. It is important to design them in ways that avoid monotony, and it may be prudent to allow these public spaces to be operated by municipal governments to avoid the increasing privatisation and restrictions of public space that we have been seeing in recent years.

He also explores the topic of embodied carbon in tall buildings, embodied carbon being the sum of the greenhouse gasses generated by the construction of a building as well as those from the creation and transportation of materials. It is therefore important to reduce this as much as possible. In tall buildings he points to 3 major opportunities to reduce this: firstly, to use life cycle analysis to identify areas where emissions can be reduced, secondly to minimize the amount of materials needed for construction and thirdly use innovations in structural engineering to further reduce the amount of material needed for construction. (Oldfield 2019)

Subconclusion

As we can see there is support for high rises in both past and present. Though the forms advocated for may be different and they disagree on many a point, there are still some common threads, the need for functions to be integrated vertically through the building, the need for versatility to adapt for unforeseen circumstances and the need to address the needs of residents in ways that are relevant to their lives. These ideals however are not unchallenged and in the next section we will explore criticisms of tall buildings.

While some criticisms of tall buildings can easily be dismissed due to lack of depth and clear bias, not all are so easily dismissed. In this section these more pointed and specific criticisms will be explored.

A critical appraisal of the design, construction and influence of the Unité d'Habitation

One of these more in-depth criticisms is by Malcolm Millais criticising Le Corbusier's Unité d'Habitation and subsequently those inspired by it. This criticism focuses mainly on the technical and conceptual failings of the design. From the technical perspective he points to flaws with the heating system, sound insolation and fire protection system. From the conceptual perspective he points out that the industrial mass production was never achieved and that it took five times longer than originally estimated, making the design features that pushed in this direction more of an ideological principle. He also points out that light regulating balconies while conceptually functional were rendered useless by the orientation of the building. While as Malcolm Millais says Unité d'Habitation has proven to be an inspiration to many architects, he also points out that only a few of the originals were built and many of the ones directly inspired by Le Corbusier were eventual torn down. He does however point to condominiums as a more successful version of high rises. (Millais 2015)

Alice Coleman Utopia on Trial

Among the references Malcolm Millais uses is that of Alice Coleman's Utopia on Trial. A book documenting a study of the amount of social breakdown and divergence in 1980's high rise buildings with a focus on social housing. The study shows an increase in vandalism, litter and crime around high rise housing particularly lower income and social housing. Alice Coleman then claims that this is primarily due to design features and that other explanations are secondary. On this basis she suggests several recommendations to avoid these effects. In general, she recommends that no new flats should be constructed, that modernist layouts should be walked away from and that existing high rises should improve according to her specific recommendations.

The recommendations for new high rises, focus on minimizing obstruction so the surroundings are observed by neighbours and reduce unwanted behaviour, along with reducing access form outside of blocks, as well as shaping streets in a more traditional manner.

For existing high-rises, she recommends using similar processes to hers to analyse the flaws in these buildings and then use the appropriate of her recommended changes. These focus on reducing the size of these buildings, the size of hallways, the number of entrances, the amount of "confused space" replaced by semi-public and new constructions, as well as splitting commercial functions away from residential functions and changing the streetscape to a more traditional style.

She also talks about the origins of the failings of these Utopian ideals of the High Rises. Instead of planners, developers and designers, who she claims are merely following the natural evolution of trial and error, she puts the blame on the Department of Environment (DoE). She claims that civil servant's ignoring of the facts and heavy-handed interventionism in the planning process, has been disastrous. She instead advocates for a more of hands-off approach and for individuals to be responsible for the quality of their own housing. (Coleman 1985)

Mass Housing: Modern Architecture and State Power

Another avenue of criticism is how mass housing, which often takes the form of high rises, is used by states as a political tool. In the book "Mass Housing: Modern Architecture and State Power" by author Miles Glendinning he explores these ideas. He talks about how rhetorically mass housing programs are often framed politically as solutions to social needs, such as homelessness, but often benefit supporters of the political group that initiate the program more. The programs studied are highly diverse, varying in scale and support, some centralized others decentralized as well as the spatial expression varying greatly dependant on the aim of the program. He also points out that they are most often rooted in the specific political processes of the local area, further diversifying the results. He however does recognize the limitations of this work with it's focus on breadth over depth and on programs that have a combination of state support and modernist architecture. While he does state that the study does not show how mass housing programs will develop in the future and how successful they will be, he is concerned by authoritarian developmentalism still ongoing across the world. (Glendinning 2020)

Alice Coleman Utopia on Trial

While together these texts do show grim prospects for the viability of hyperdense designs, they do bare many of the methodological flaws mentioned elsewhere in this section, such as focusing on worst case scenarios. They can however not fully be dismissed. While their conclusions may be overblown the facts underlying them are not and coincide with many of the issues stated by the other texts. Particularly issues with quality and political misuse must be addressed if for no other reason than to negate negative perception surrounding such projects.

High rise living in Asian cites

The book High rise living in Asian cites edited by Belind Yuen and Anthony G. O. Yeh, collects the work of several contributors to explore the complexities of High rise living in Asian cites. The work mainly focuses on the case of Hong Kong and Singapore, which due to their histories, topologies and policies have become the densest cites in the world and among the highest. This makes them ideal for studying high rise development and countering the stigma of them being "vertical slums". Importantly it distinguishes between building density, how of a given areas are occupied by buildings, and urban density, how many people live in a given area. With building density often resulting in negative consequences associated with high densities, which tall buildings allow to be achieved without (Yuen, Yeh 2011).

Satisfaction of residents

One of the studies is on the satisfaction of residents of tall buildings in Singapore and Hong Kong. In general, the study found that participants were satisfied with high rise living and saw it as an acceptable way of living. It also showed that participants preferred living on higher floors, in contrast to studies of western cities, and that higher people live the more willing they are to live even higher. The study also shows 6 main concerns of living tall buildings by participants, Fire risk, life breakdown, neighbors, crime in lifts, accidental falling off the building and the lack of neighborhoods facilities.

They conclude this study by stating that the study shows that the resident's preference for living higher up, supports the theory contextual understanding of tallness, that people's perception of tallness is based in their experiences and thus can change with new experiences. They also address the condense of residents, by stating that these issues are not fundamental and can be overcome with better design, planning and management (Yuen, Yeh 2011).

Microclimatic implications

One of the literature reviews looks at the literature surrounding the environmental implication tightly packed high rise building and high urban densities in Hong Kong. They state that Hong Kong, by necessity is a highly dense city on only a small proportion of its land. They state that the density combined with the mixed-use nature of many of these areas safer, more efficient and economically viable, in the process helping preserve wood land, due less land usage.

They however also point to the environmental issues with life in tall buildings. In Hong Kong many of these buildings have issues with poor ventilation and lighting. Leading to large usage of lighting and air conditioning, which exacerbate the problem by heating the outside air they take in. This is furthered by air pollution from motor vehicles and decrees air flow between buildings due to tall buildings creating a wall effect against wind. These issues with air are also a problem due to air borne diseases.

They however also point out that due to political pressure the Hong Kong government has taken action to improve air quality, such as stricter regulation on motor vehicles. More interestingly they have also new guidelines for ventilation based on research, proving the wall effect. The guidelines recommend building buildings parrel to wind direction, increase space between buildings, create breezeways and modify building podiums to improve natural ventilation.

They also look at issues with daylight citing a study that analyzed the quality of daylight in tall housing developments in Hong Kong. Showing that the quality varied significantly, with several factors being a specific problem, such as external obstruction from other buildings, furniture arrangements decreasing light levels and too few windows. It also showed issues with privacy from buildings being too close to each other. One solution that the study found effective was increasing the height of rooms.

They also discuss research surrounding satisfaction open spaces. Showing that often that physical qualities over social ones are the main concerns about open spaces for residents living in high density areas. Notably the microclimate and faculties are often big concerns. They also sook at noise pollution being a problem in dense areas. They site a study showing that this is due to the facade effect, the facade of tall building reflecting more sound downward due to their size. They suggest mitigating this by changing facade to defuse rather than reflect sound waves (Yuen, Yeh 2011).

Liveability in tall buildings

This chapter reviews the literature surrounding liveability in tall residential buildings. They contrast how high rises are viewed with caution in the west how even with increasing height high rise in Singapore and Hong Kong show increasing satisfaction. They talk about how residents' satisfaction is often multidimensional and that the whole package received in relation to rent, can easily skew results.

They point out some common concerns, such as how children can be a nuisance in these spaces, due to noise and vandalism. Which ties in with another concern the lessening of parent-child contact, which in turn decreases child autonomy. These can be mitigated by making spaces less opaque and more permissible for community interaction, making spaces feel safer and more communicative. This also helps mitigate concerns surrounding crime, particularly in elevators. They also noted concerns surrounding fire and safety.

They also investigate the attractive aspects of high rise living. When properly designed and planned it offers a more effective use of space thereby more open space. High rises also offer spectacular views, greater privacy and quietness. Together these factors have helped increase its popularity in recent times.

They point to Singapore as a prime example of these aspects, with its increasing density since 1953. This rapid increase was often uneven and had many of the flaws stated above. In response to this Singapore housing was changed to mitigate these flaws. The "new towns" created in response where designed and planed as total living environments, ensuring high quality of both indoor and outdoor living environments. They point out that not content with ensuring that new public housing was of better quality Singapore's government has all made programs to improve existing buildings and districts. This continual improvement to ensure equity has improved public perception in Singapore of tall buildings.

They conclude by talking about while many cities debate over whether or not to build high rises, Singapore and cities like it have achieved great success, due to their focus on good design and planning (Yuen, Yeh 2011).

Community in tall buildings

This chapter discusses the problems and potentials surrounding community in tall buildings. They point to how in the west high rises are often blamed for social unrest, while the evidence indicates that instead it is socioeconomic factors to blame. They do however point out that many western studies do show a connection, but that these studies suffer from 2 different forms of selectivity bias, income by being almost solely focused on lower income residents and life cycle by focusing mainly on single young residents. Therefore, focusing on worst case scenarios, they point to how studies in Asian cities can be a counter to this.

They discuss how the appearance of community does not mean that they serve them in reality. Using Europe and the US as examples city centres are often being built at the expense of outlining areas or as purely recreational space not serving those who live there. They contrast this with Singapore whose design and planning focus on the day to day needs of residents and thus serves their interest first. They point to a study showing as a result of these policies public space is used more intensely, due to their purposive design and fewer social activities take place in people's homes than their western counterparts and are instead done in external spaces.

They are however not uncritical of Singapore's policies. They point out this and other welfare policies weaken social ties, due to them being less necessary to get needed resources, making them instead reliant on the state. The social networks are thereby predominantly family oriented and connections outside of it are usually work related. This means that despite on paper public areas giving opportunities for interaction and the diversity cultures and income in many areas creating inter-penetrating networks Singapore remains segregated. They posit that opportunity alone does not incentivize social ties and without a practical need for these ties they weaken, as can be seen in Singapore and many other cities.

They conclude by stating that despite there being less incentive to do so many people still desire community. Thus, community becomes more symbolic and spaces to do so more functional. They say that tall buildings are in some ways ideal for this creating more functional spaces, that can symbolise communities (Yuen, Yeh 2011).

Design and planning strategies for high rises

A chapter in the book attempts to derive and discuss planning and design strategies for high rises based on the available research. They discuss that in Hong Kong and Singapore land use is organized vertically instead of horizontally, which allow for a more mixed-use organization. Often these are arranged with a residential building on top, sometimes with a community space inside, on top of a podium, blocking noise and dust. The podium contains a combination of community, retail and public transport facilities, with the basement often containing carparks and subway facilities.

They discuss that while tall buildings save energy on heating due to their mass, they also use a lot of energy on air conditioning. Therefore, building envelopes must be designed well. Factors important to this include insolation, ventilation and heat from daylight.

The distance between buildings is another consideration, impacting both airflow and daylight. They recommend maximizing the distance between buildings to ensure good airflow, while minimizing the wind tunnel effect and giving more sunlight. They also recommend staggering the height of building to further increase sunlight penetration and optimizing orientation for airflow.

Another consideration they discuss is open spaces. While important to wellbeing, both socially and microclimatically, they can be difficult to come by in dense areas. Therefore, they put forth using the areas on top of podiums, rooftops and sky gardens, green areas on a floor in the building, as is often done in Hong Kong.

A suggestion they make that Hong Kong is weak in is balconies. They point out how they not only offer residents more living space, but also reduce noise, act as a buffer against heat gain and give a space to dry clothing.

They conclude by reiterating that tall building can reduce environmental impact by minimizing the use of natural land, more efficiently using building materials and the amount of energy used for transportation, but also reiterates that tall building also often has negative impact on the quality of life by insufficient amount of services and poor microclimate. They reiterate the 5 design and plan solutions to optimize these qualities. They are energy-efficient envelope designs, environmentally considered building placement, elevate open spaces, balconies and vertical organization of multiuse tall buildings (Yuen, Yeh 2011).

Vertical green spaces

A chapter in the book explores ecological promotion in high rise housing environments. They point to the importance of green public space for people's quality of life and how in highly dense cities there is often unequal access to them. One example of this is Singapore which historically put them secondary to alleviating the housing crisis but has implemented ambitious goals to remedy this. These fall into 3 main strategies: building more green spaces and gardens, tending to existing natural greenery and bringing more nature into urban areas.

They say that this has yielded a diversity of green spaces. In the vertical dimension we see both roof gardens and sky parks, mid floor parks build into tall buildings. They also tend to be highly accessible by foot and have intentionally avoided fences or other obstacles that hinder accessibility. This diversity also helps addressing the needs and wants of different user groups with different interests. These green spaces also provide environmental benefits, such as reducing the heat island effect and providing cleaner air.

They state that these strategies are readily seen in the "new towns" being built, embracing and integrating local ecology and history instead of the old demolish and replace strategy. They have also proven to be cost effective especially in the long run.

In their concluding remarks they talk about green space are not only a tool to create spaces for community but improve sustainability by reducing the heat island effect and improving energy performance of buildings, making it important not to neglect these spaces (Yuen, Yeh 2011).

Closing remarks

In the conclusion to the book the authors say that Hong Kong and Singapore are by no means the only cities which experience rapid urbanization, many Asia cities are growing at a rapid rate and with them concerns about quality of life and environmental impact. High rises are seen as a solution to these problems, therefore making it more important to have a nuanced perspective on the advantages and disadvantages of this typology.

They talk on how technology is fundamental to tall buildings and are in some ways celebration of these technologies. In the short term they have a big environmental impact, but in the long term they are better than their alternatives. They therefore advocate for institutional changes to encourage better built tall buildings.

They state that equity between residents of different Socio-economic background systems of improving tall buildings should be implemented in places with high rises. These amenities are important to the quality of life in tall buildings both public and private, outdoors and indoors. Common spaces are one such amenities each appealing to different groups, thus a diversity of spaces is needed. In this context access to greenery is highly important making vertical greenery, such as green roofs, a useful tool in placemaking. These results disprove a lot of the claims made by western literature on the flaws and anxieties of tall buildings, but their research is not alone in focusing on a specific subset of society and therefore more research is needed.

They remind us that while high rises have their positive aspects history has shown that they can quickly degenerate into places of low quality of life and antisocial behaviour without the needed physical and social maintenance. Therefore, the implications of this typology should aim to satisfy residents and maintain and improve quality. They say that this is not the last word on this subject and more cross disciplinary research is needed.

They conclude by pointing out that despite what dooms sayers have said tall build have proliferated but we must remember that they are neither the problem or the solution to our modern problems only a new form with its strengths and weakness (Yuen, Yeh 2011).

Conclusion

This exploration of the theory surrounding hyperdensity has shown several advantages and potential issues with the design and planning of such spaces. One key takeaway is the distinction building density and urban density, showing that one way to avoid the negative aspects of tall buildings is by building taller instead of broader.

As many of the texts show sustainability is a key factor in both the viability and usefulness of tall buildings. Embodied energy particularly is an clear issue, while efficiencies of scale may reduce this somewhat improving structural designs and other methods of reducing material usage should still be implemented where applicable. The design of building envelope is also a critical factor in making tall buildings more sustainable. At the urban scale is where we can see the biggest impact on sustainability from hyperdensity. Specifically places where mobilities are integrated show the best results. At this scale we can also see the benefit form potential space savings allowing for more historical preservation and open/green spaces. These spaces don't need to be only at ground level, they can be placed vertically as seen with sky and roof gardens. These functions are however not the only ones need to ensure a good quality of life, the more mundane function such as commercial and community facilities are also important. These as the texts show can also be arranged vertically, it is however important to avoid monotony in such arrangements.

The texts also point to potential issues. Safety, both against physical issues with buildings and other people was key concern, it is therefore important that a project not only insures a buildings physically safe, but also feels safe, for example by insuring neighbourhood visibility to reduce antisocial behaviour. Maintenance and improvement also plays a vital role in making a place feel safe and in ensure a good quality of life, unfortunately this is often overlooked, it is therefore necessary to make institutions and systems to ensure maintenance and improvement. If not then we see the social issue often reported about, while overstated it is nevertheless important to avoid these outcomes. Inflexible design can easily contribute to these outcomes, therefore more adaptable design can help overcome unforeseen circumstances.

As shown a holistic approach can help mitigate many of these issues and bring out their best qualities. Such an approach however cannot overcome its use as a political tool, as such it is important to interrogate and hold to account such projects to ensure that they achieve their stated goals. Together these texts show that when done right hyperdensity can yield tremendous results, but care must be given less it turn into a fare more unsavoury result.

Accessibility analysis

After visiting the site for the second time I observed that the site had issue with accessibility along the path often used by pedestrians. On this basis the site was analysed for its accessibility along these major thoroughfares sorting them into 3 categories and marking the public transportation stops. The first category being those decent pathways which bear some features that make them more accessible to people with mobility issues such as seating or decent paving. The second being mediocre are those that are lacking features that make them accessible but are still technical useable for people with mobility issues. The third being poor, are those that present an active hindrance for accessibility. As the map and the example pictures show much of the site lacks accessibility, particularly towards the north of the site. Especially along the route to Reffen the bridge acts as a major hindrance for accessibility. The design should therefore seek to alleviate these problems.

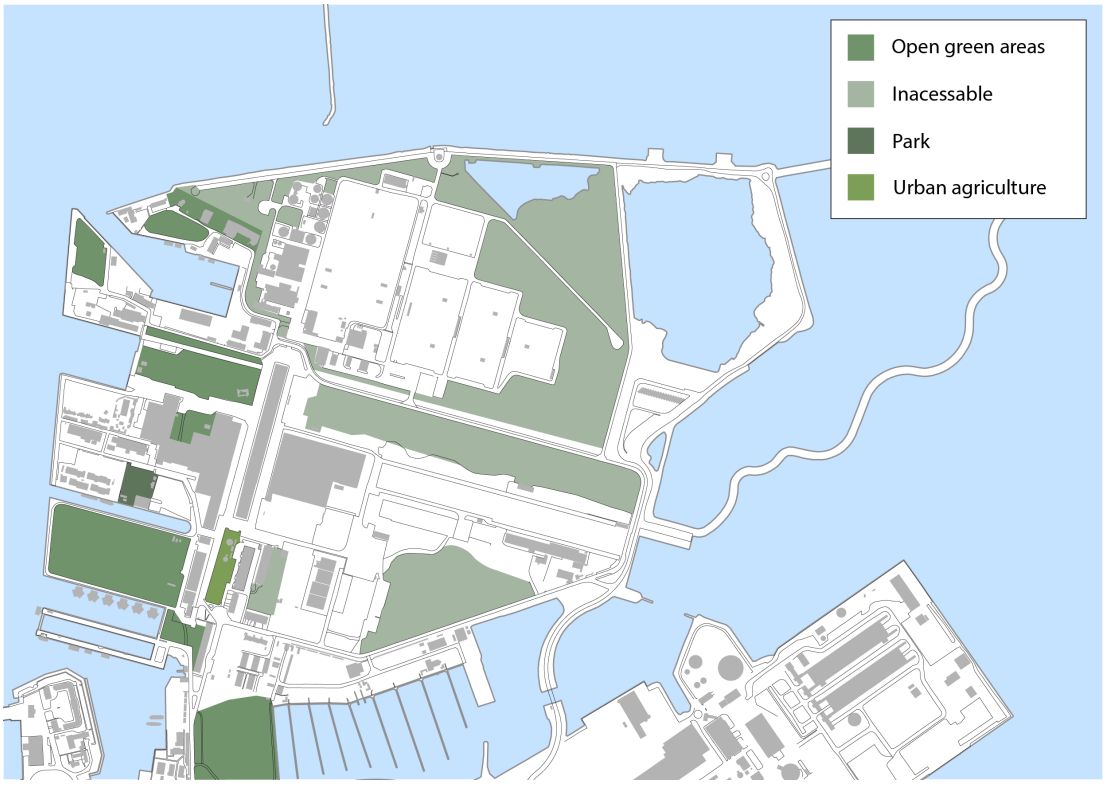
Greenspace analysis

The greenspace analysis is made to get a better understanding of the greenspaces of the peninsula and how they relate to the site.

It shows that on the north side of the peninsula and especially near and on the site, there are a lot of open green spaces. These are largely poorly maintained grass fields, some of which are occasionally used as event spaces. vThe largest green areas are those that are inaccessible either because of physical barriers or by their hostility to use. While the space surrounding the sewage treatment plant is impractical to use for other purposes the remaining green spaces could be reconfigured for other uses.

This leaves 2 other spaces of note: the park and urban agriculture. The park is close to the site and right next to the CPH village student housing. It is a repurposed open green space with some added outdoor furniture to make it more useable. The urban agriculture area is in contrast a space of production that produces foodstuffs for high end restaurants and other similar businesses, both in the city and the peninsula itself. While it does not serve a recreational purpose it does still give some aesthetic pleasantries for those walking near it.

Together this analysis shows that while underutilized the green space has a lot of potential for transformation. Particularly the site with its vicinity to both resident and tourist function and thoroughfares should be at least partially utilized in this manner.



Housing analysis

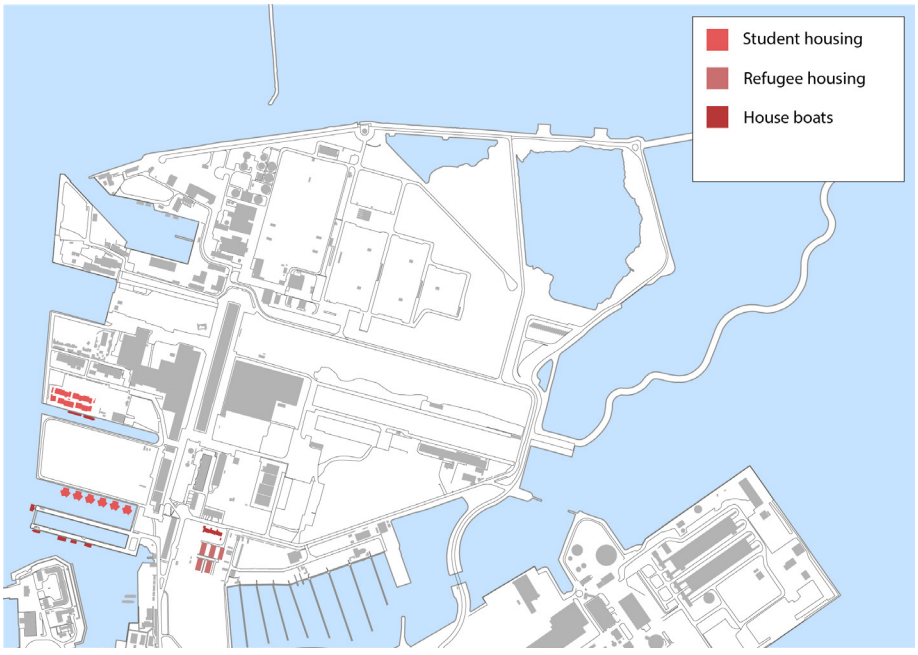
To get an idea of who lives in Refshaleøen I analysed the housing of the area. This housing can be split into 4 categories: student housing, houseboats, social housing and single houses. Student housing is by far the most common with 2 dormitories. CPH village Refshaleøen is the largest being container apartments with space for 164 students at 5405kr of monthly rent . The Urban riggers are a less conventional design being floating platforms with several container apartments stacked in a hexagonal pattern on top of them. These house around 72 students with rent at 7,250kr a month .

The houseboats, as mentioned in the local plan are permitted along the sides of some of the harbours. They tend to be fairly expensive with the ones listed ranging form 3.500.000 - 4.250.000kr and building new ones also tends to be expensive, putting them out of range to most buyers.

The 3 single houses while odd for this area still fall into the same demographic as the houseboats, albeit slightly cheaper at 243.472.000kr .

The social housing is owned and operated by Beskæftigelses- og Integrationsforvaltningen and appears to be pavilion dwellings for mainly Ukrainian refugees . There appears to be no long-term plan for these buildings, which may be relevant for the project.

Together this analysis shows that there are 3 types of residents: students, refugees and homeowners. They appear to be built with little regard as to how they relate to each other or the rest of the site. This helps strengthen that as with the local plan there is no consistent idea of what to do with Refshaleøen or how to integrate its diverse functions.



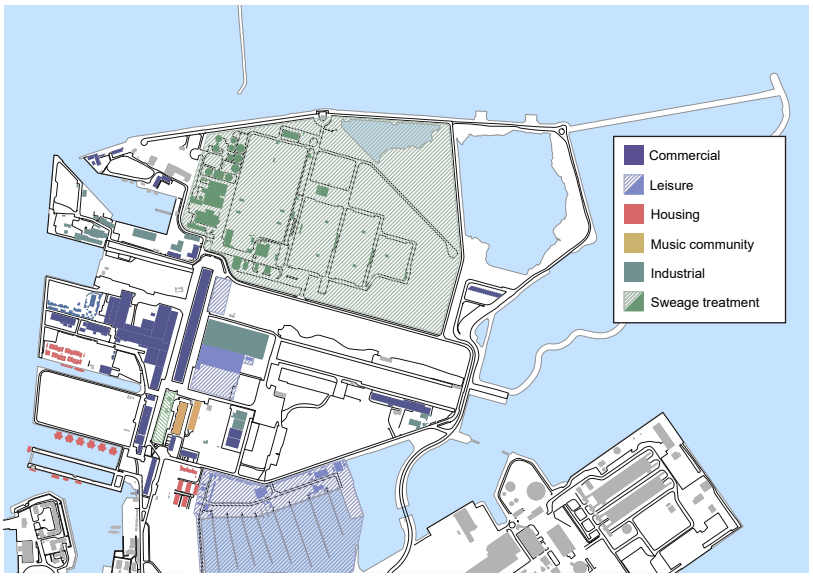
Function analysis

To gain a better understanding of the site the functions of the site were mapped. This showed that much of the north site is cordoned off by a sewage treatment facility. There is no plan for replacing this facility, so it is assumed that it cannot be utilized for redevelopment. The remaining functions are mostly concentrated in the western part of the site, with the remaining east being occasionally used as an event space for some weeks in the year, but otherwise unutilised.

The residential units are mostly concentrated in the southwest of the peninsular, surrounded by commercial spaces mainly consisting of main tourist oriented or other high-end businesses. There are still some industrial businesses dotted around the peninsula, mostly older and working at a smaller scale.

There are also some more specific functions worth mentioning. Reffen, a street food market and one of the most popular attractions on the peninsula open only during summer months. The urban agriculture business as mentioned elsewhere services several businesses with high end foodstuffs both in and out of the peninsula. Around and in the iconic shipyard halls several commercial sports facilities have been established. In the south the long-established Marina still sees business and will likely continue for the foreseeable future. The old changing rooms that have been turned into a music community with practice rooms, showing that the area is becoming more important in Copenhagen's cultural scene.

While the site has many well-established functions, there are many patches that remain unutilised and are prime for redevelopment. There is also a notable absence of functions oriented towards residents, notably the lack a of supermarket and any functional equivalent to it given its specific mentioning in the local plan. To further narrow the site of intervention the environmental analysis was made.



Smell discomfort analysis

As part of the background for the local plan an analysis of smell discomforts from the sewage treatment plant was made, showing that most of the peninsula is unsuited for residential uses, but that the west and southwest of the peninsula has low enough values for residential purposes. This is one of the reasons that the site in the southwest was chosen and it also further emphasized the need for good ventilation (Københavns kommune 2015).

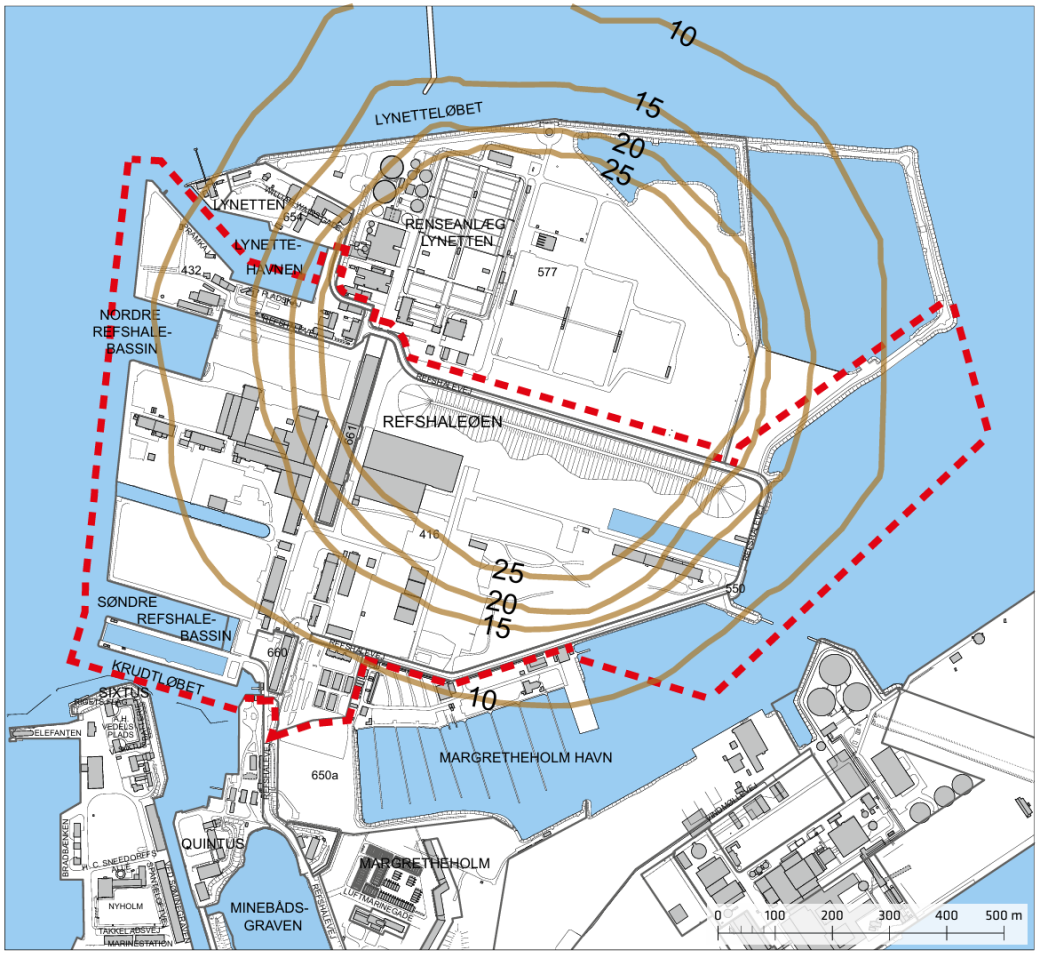


Illustration 1

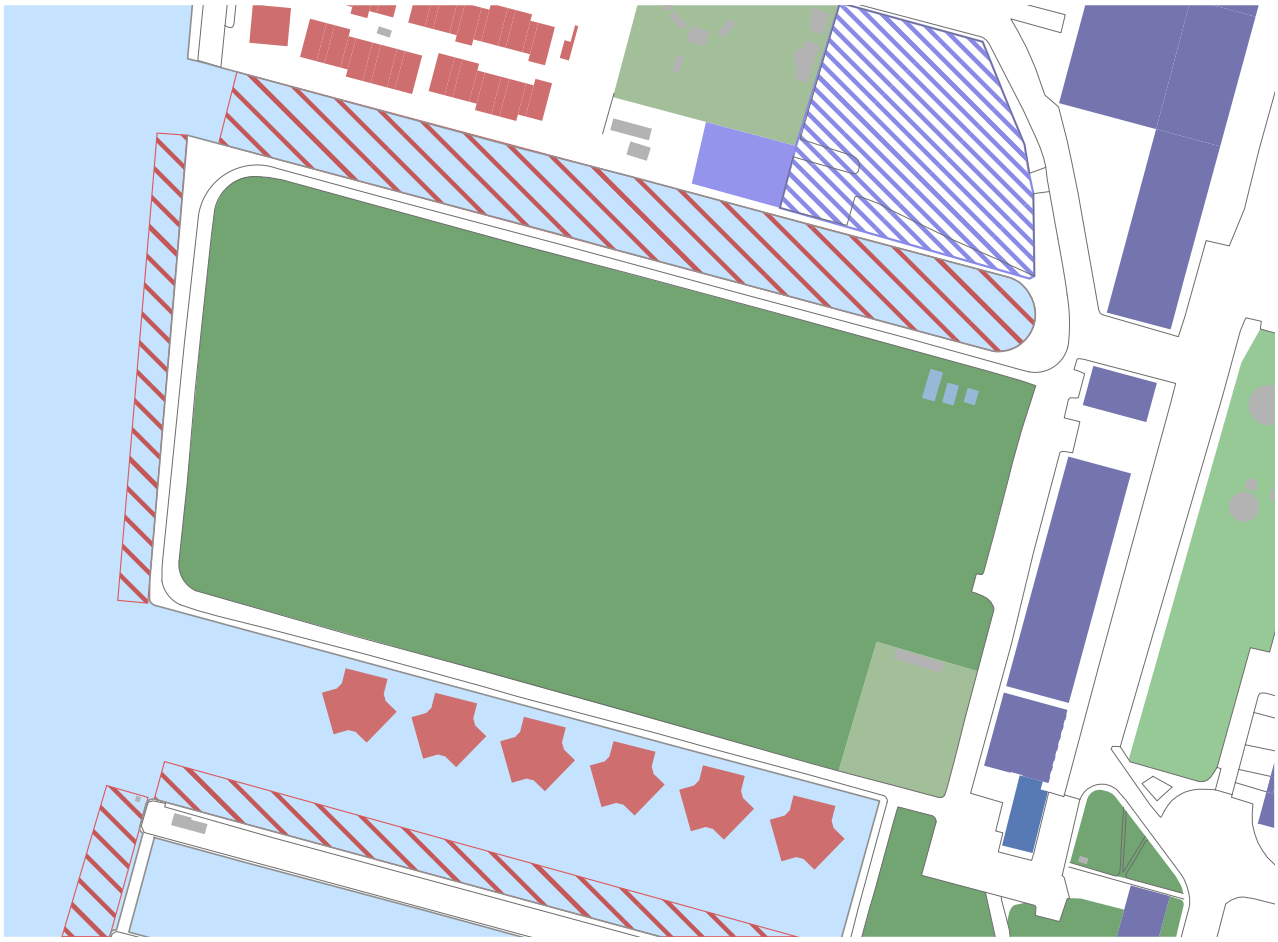
Zoomed in function analysis

With the site narrowed the need for a more zoomed in look at the functionalities was necessary. While largely echoing the function analysis there are several nuances that reveal themselves.

Firstly, while still overwhelmingly oriented towards tourist and high-end products, there is a kiosk that sells some regular items, but at a premium that may not be affordable for the students living nearby.

Secondly while still largely empty in the southeastern corner of the field there is a seating area attached to the kiosk allowing for seating by customers and in the northeastern corner there are demonstration houses for a modular house concept by Jane Ostermann-Petersen . Thirdly as mentioned in the local plan Areas for houseboats surround the piers, giving potential for increased residential functions.

This further emphasises the need for proper commercial functions oriented towards residents, while showing existing functions that should be preserved.



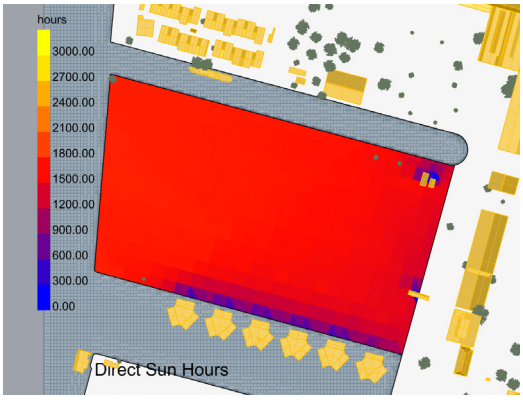
Initial wind and sun analysis

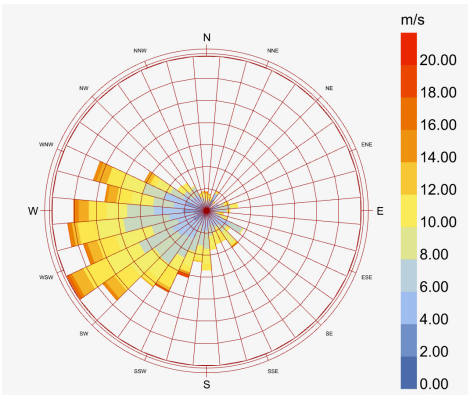
To further gain a better understanding of environmental conditions of the stie an analysis of the wind and sun conditions using the program Rhino was made.

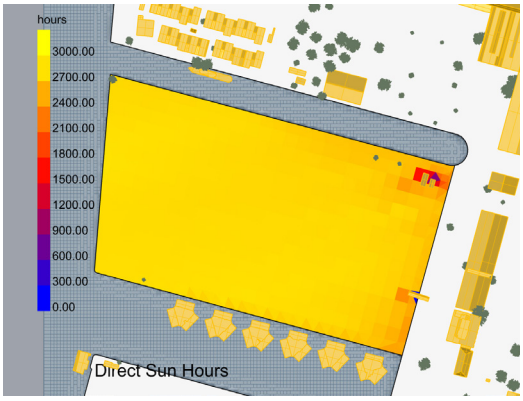
The wind rose analysis measuring the wind speed and direction showed that during the winter months from October to march wind comes mostly from westerly to south-westerly direction. The average windspeed is around 10 to 12 m/s and the highest speeds begin just below 20 m/s. During the summer months, April to September, the wind comes mostly from a westerly direction. With the average ranging from 8 to 10 m/s and a peak at under 16 m/s.

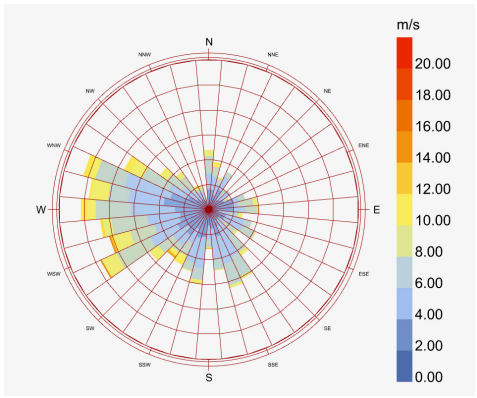
The sunlight hour analysis measuring the amount of time sun shined on a specified area shows broadly what was expected with plenty of sunlight during the summer months and significantly less during the winter months. Shade however shows difference from expectations while the demonstration houses offer light shade as predicted, the urban riggers provide an extended shade during the winter and light during the summer.

Together this analysis that the site overall has excellent sun and wind conditions, allowing of diversity of design solutions. The wind conditions specifically for good natural ventilation, but as the urban riggers show care should be taken to avoid to much shade effecting the surrounding environment.









Conclusion

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Case study Manitoba Hydro

To gain a better understanding of how to practically implement sustainability of tall buildings Manitoba Hydro's office Building in Winnipeg, Canada designed by KPMB Architects was chosen as a case study. Manitoba Hydro is a crown corporation owned by the provincial government and is one of the largest energy providers in Canda. They wanted their new headquarters to be next generation sustainable building while also securing a high quality of life for its employees (archdaily).

To do this they used several design solutions, such as using a doble facade as buffer in winter to heat up air passively and in summer in combination with automated shades as a means to reduce certain wavelengths of light from heating interior spaces. It also helps circulate air through the building allowing for even ventilation during the summer and for fresh air to be circulated in the winter.

The primary means of ventilation and air conditioning is the solar chimney. It ventilates the building during most of the year using the stack effect, the tendency for hot air to seek upwards, and during winter this air is instead funnelled downwards using fans so some of the heat can be recaptured.

The atria also play an important role using their water features as a means to air condition incoming air. Most of the year this is done with automated window openings in the façade and during the winter with mechanical units. (paper)

In addition to these the building also uses its thermal mass as an additional moderating element and a closed-loop geothermal system to draw on heat or cold to condition the building. The building has proven successful with almost all of the employees having no complaints about microclimatic comfort after the first months fine tweaking's.

While this building has proven very successful in fulfilling its goals all its features are not compatible with this project. While many features are very innovative, its reliance on automated systems and geothermal energy are not compatible with the issues of maintenance and the context of the project. Its use of the stack effect and double facades can however be inspiration to this project.

Desgin Principles

Combining the analyses and theory a problem formulation was derived, that being:

Can we use the principles of hyper density to design a space that appeals to the needs of its resident's and local commercial interests while also see to the interests of tourist and the greater city?

This was then turn into design principles as follows:

Sustainability

Passive energy

To help reduce the energy consumption while minimizing maintenance of the building usage of passive strategies should be prioritized. Particularly passive solar energy and natural ventilation.

Embodied energy

As one of the largest sources of greenhouse gases from buildings, reducing the embodied energy from construction and used materials is critical for sustainability.

Mobilities

The hyperdense environment should be incorporated into the local mobilities, with focus put on walkability and public transportation.

Community/quality of life

Transparency

Communal and common spaces, such as hallways and parks, should be trans parent so they can be overlooked by neighbours and give a feeling of safety.

Communal space and facilities

To ensure that residents have a good quality of life the design of a hyperdense environment should create communal spaces, to help with social needs and establish facilities, both commercial and public, that deal with the mundane needs of residents.

Open and green spaces

Space for open and green spaces should be insured both outside between buildings and vertically through roof and/or sky gardens, these should have different functions serving interest of different groups.

Maintenance

Physical

Systems and institutions for the physical maintenance of buildings should be built to ensure future financing for and viability of hyperdense environments.

Social

While no design features can ensure community, space should neither the less be reserved to be used for communal functions to make it easier to establish.

Governmental

Efforts should be made to give residents a degree of control over their buildings and environment to prevent government and landlord overreach, minimizing the risks they present to residents.

Planning

Flexibility

The design of hyperdense environments should allow for reconfiguration so that it can adapt to unforeseen situations and opportunities.

Local specifics

The advantages of tall buildings should be used to preserve and utilize as much of the local historic and contemporary context as possible.

Space between and proportionality

Using the space savings of tall buildings space between buildings should be reserved, so that it can be used for communal functions, while helping opti mizing air flow. It also helps ensure that the buildings are proportional to the human scale along with other measures.

Total planning

As the theory around hyperdensity suggests the design and plan of these areas should not be done piece by piece but should instead be designed in totality to ensure that the needs of the residents and locals are met, while still keeping enough flexibility so improvements can be made in the future.

Desgin

Intro

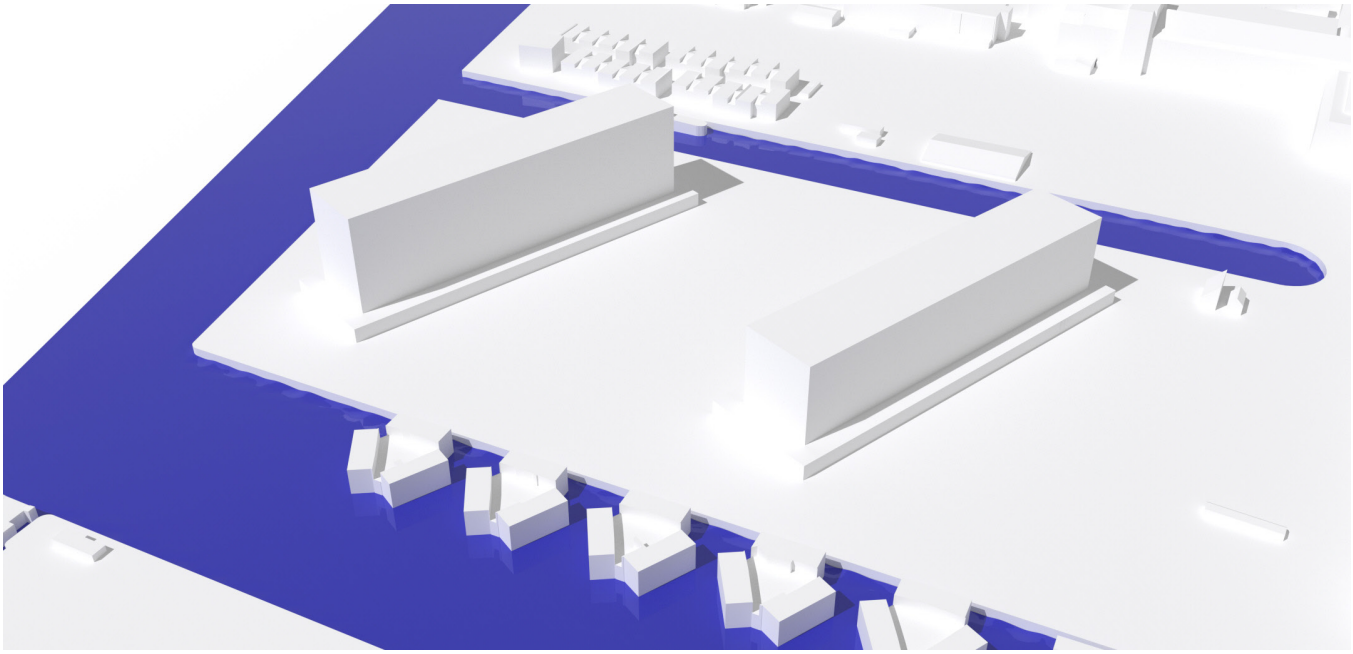
From the design principles, a design was derived aiming not only to create a design that addresses the problem at the heart of the project, but also test the viability of hyperintensity as a solution to our contemporary urban woes. This design focuses on tall buildings, based on the theory showing it being a viable solution to the problems that arise within hyper dense areas. To achieve this, the project looks in to positioning and massing of the buildings, how its function would be programmed vertically throughout the buildings, how open spaces can be arranged to fulfil the needs of its locals, residents and tourists. The project also seeks to understand how this design can be maintained in the long run and how it can fit into the larger context.

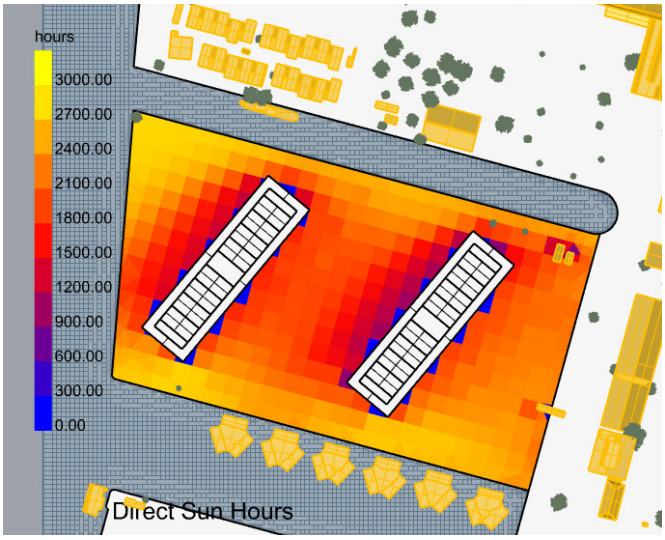
Positioning and massing

The position and massing of the buildings are some of the first elements to be decided upon in the final design. The placement of the buildings is based on the initial analysis of wind in the site, with them turned towards northeast to optimize airflow, also being placed apart from each other to reduce the likelihood of creating a wind tunnel. The distance between the buildings and the reduction in hight of the second building aims to ensure that both buildings receive an adequate amount of sunlight.

A second round of environmental analysis was then executed, as to ensure the placement of the buildings could achieve the stated goals. The analysis of sun light hours, as expected, show that the buildings create a shadow, which reduces received sun light, but the distance between the building is sufficient to mitigate the reduction in sunlight due to said shadowing.

Wind simulations of on the buildings were initiated, yet were unable to be completed in the time frame, due to limitations of available computation, licence restrictions and bugs in programs.

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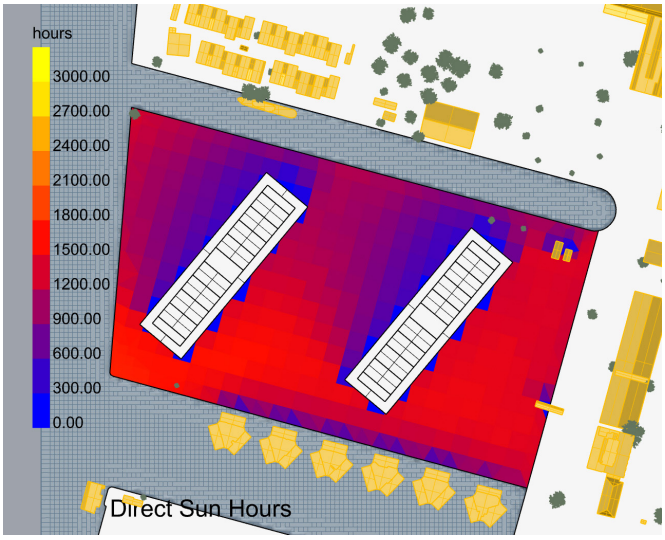
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Vertical programming

As tall buildings are the focus of this design, vertical programming of the functions throughout the buildings is an essential process. This section will explore how the buildings' functions have been laid out in the design.

Green spaces are key to the residents' quality of life, a diversity of the green spaces is particularly important. Therefor diverse green spaces will be incorporated vertically in the buildings. These include a garden roof and green terraces on top of the podium. These provide a space where residents can interact with each other, whilst ensuring that residents can regulate how and when they interact with tourists. The podium terrace also allows for a degree of choice when it comes to weather enabling residents to choose between shade or sun throughout the day. They also should theoretically provide some insolation and shade to the buildings reducing energy consumption.

Communal spaces and functions can also improve residents' quality of life. Communal spaces have therefore been placed on the floor above the podium, ensuring accessibility and connectivity, while also preserving privacy from non-residents.

The direct connection to the podium terrace enhances both spaces, by allowing for interactions between residents who are doing tasks and residents who are using the terrace for recreational purposes. This placement also enhances flexibility by making it easier to reconfigure the spaces, due to material not needing to be lifted up many floors.

The hallways and stairways have also been placed with similar intentions. The stairways are intended to not facilitate movement, as well as being a space for residents to sit and talk, while ensuring transparency and improving the feeling of safety. The hallways are likewise designed to allow for short interactions, while ensuring transparency, on the paths and across the open atrium. The hallways also facilitate ventilation, as shown in figure 0, using the stack effect to lead the hot air upwards.

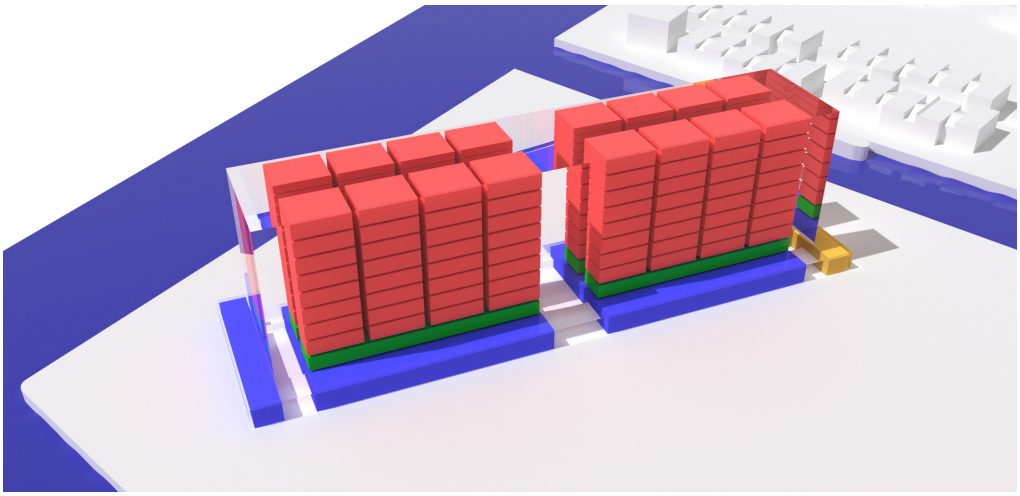
Many of the analyses show there is a prominent lack of functions oriented towards the locals, particularly commercial functions. Therefore, most of the ground level space in the buildings have been reserved for commercial functions oriented towards locals, especially prioritising a supermarket. Some of the space along the southern edge of the pier has been reserved for cafes and similar functions, due to their ideal placement and suitability for such functions. Some space towards the northern end of the buildings has also been reserved for cycle parking, as the placement avoids tourist flows while still having a strong connection to the road network.

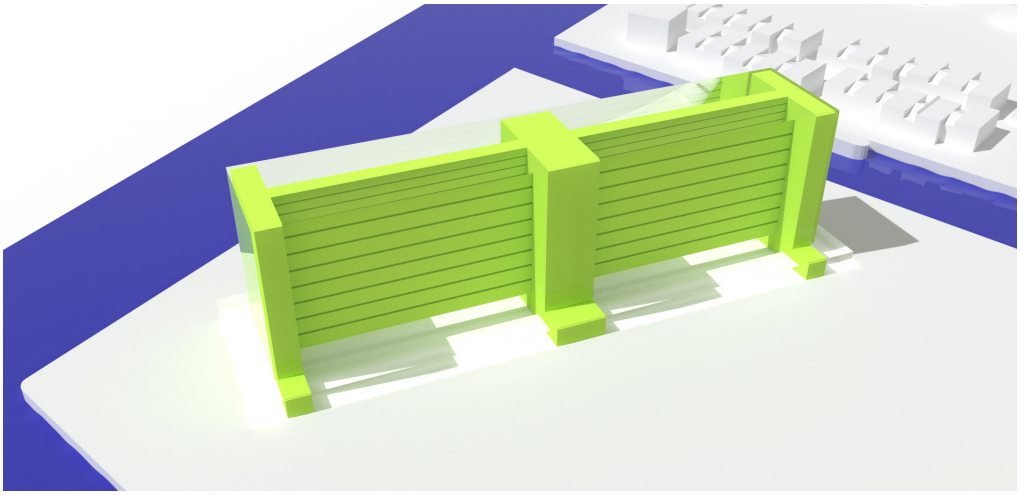
Most of the buildings volume is occupied by residential functions. The other functions have been placed with consideration of how it can affect the residential functions, as shown above.

In addition to providing residents with an open space for themselves, the terrasses also acts as a regulation of sunlight, intending to minimise overheating, thus improving the quality of the micro climate and the energy efficiency of the buildings.

These additional qualities of the spaces, similarly to the sustainability features, unfortunately remain untested due to the aforementioned licensing and computational limitations. Summing up, the vertical programming of functions in the building, have been shown in this section to aid in improving the residents' quality of life by appreciating and considering the needs of residents.

While somewhat detailed the specific layout of internal spaces has not been, due to this being a urban design project and thus totality of the design taking priority. As part of that larger design the space between the buildings is also important and is the focus of the next section.





Open and green spaces

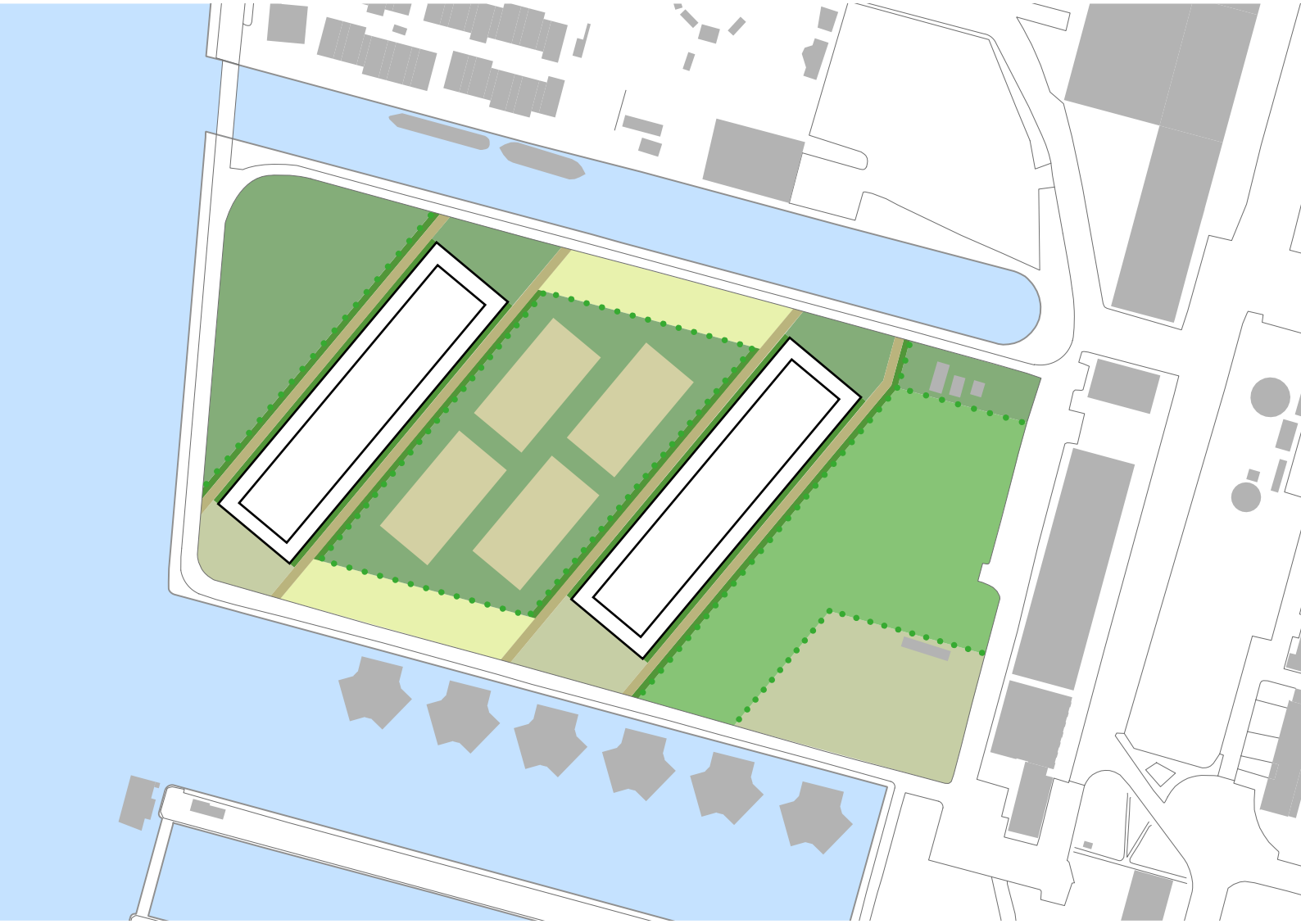
The existing open and green spaces in Refshaleøen are in a poor state. The added green and open spaces in this design, will presumably be greatly used by residents as well as locals and tourists. These new open and green spaces must therefore present a diverse range of functions that can fulfil the needs of the different groups.
One of the largest and most prominent of the functions is the sports field in the centre of the site. The sports field is intended to be multi-purpose, facilitating a variety of sports. It is primarily indented for younger people, but is also appealing for other groups due the multi-functionality. Like the other spaces on the site, the border of the area that the sport field occupies is marked of by rows of trees. These rows of trees create a semi-transparent division between the spaces.

The paths beside the buildings are wide and are likewise also marked by rows of trees. The design is indented to ensure comfort and clearly communicate the purpose of the space. The rows of trees create an experience of human scale, and the greenery provides a sense of comfort. The path is paved with cobblestone, connecting it to Copenhagen's history and visual characteristics, making the area feel like an innate part of the city. The cobblestone also communicates the space as being a pedestrian area.

The pre-existing paths will also be improved and adjusted. These paths will be repaved with tarmac to fulfil the needs of the commercial spaces. To ensure these paths also are supportive of the needs of residents, locals and tourists, they will be coloured red to as to clearly communicate the spaces that are designated as a pedestrian area. The pre-existing bridge will be replaced with a bascule bridge to improve accessibility and also improve conveniency for house boats.

Along these pathways seating areas will be created, intended for customers. Seating areas will be created in front of the two new cafés, as well as an expansion of the original seating areas in the southeast of the site. These areas will be pathed with a light yellow stone to invoking the older buildings on the peninsula.
In the northwest of the site, the green field will be preserved, keeping it as a flexible area that can accommodate a variety of functions, thereby preserving and supplementing the temporary uses that the peninsula is known for. Permanent benches will be placed along the edge of the area improving accessibility.

The existing urban agriculture on the peninsula will be expanded, utilising spaces that are unideal for recreational purposes on the site.
An expansion to the peninsula's urban agriculture has also been brought into the site, filling as space that would otherwise be unideal for recreational purposes. The building examples in the northeast corner of the site has been preserved and given a slightly larger area so that they add new examples or use the space for other functions.



The remaining space on the north and the south of the pier is reserved for creating small parks for people, who are seeking recreational spaces that are less intense, busy, and noisy. Creating a park on both the north and south of the pier allows for the user to choose if they want a more or less public facing environment.

This section describes how the design will be when it is initially implemented. The next section describes what the design anticipates of needs that could arise in the future as well as from the surrounding context, then how to mitigate these potential needs.

Maintenance and context

The design is not just intended to be a redevelopment of the site itself, but also a catalyst for change the peninsula radiating outwards. As is shown on figure 0, after the development on the site, the immediate surrounding will be the next to see redevelopment. The immediate surrounding of the site consists of commercial functions, the buildings are already in use and therefore the redevelopment will entail minimal construction. The redevelopment should consist of improvements to the spaces in between buildings and should seek improvements of mobilities.

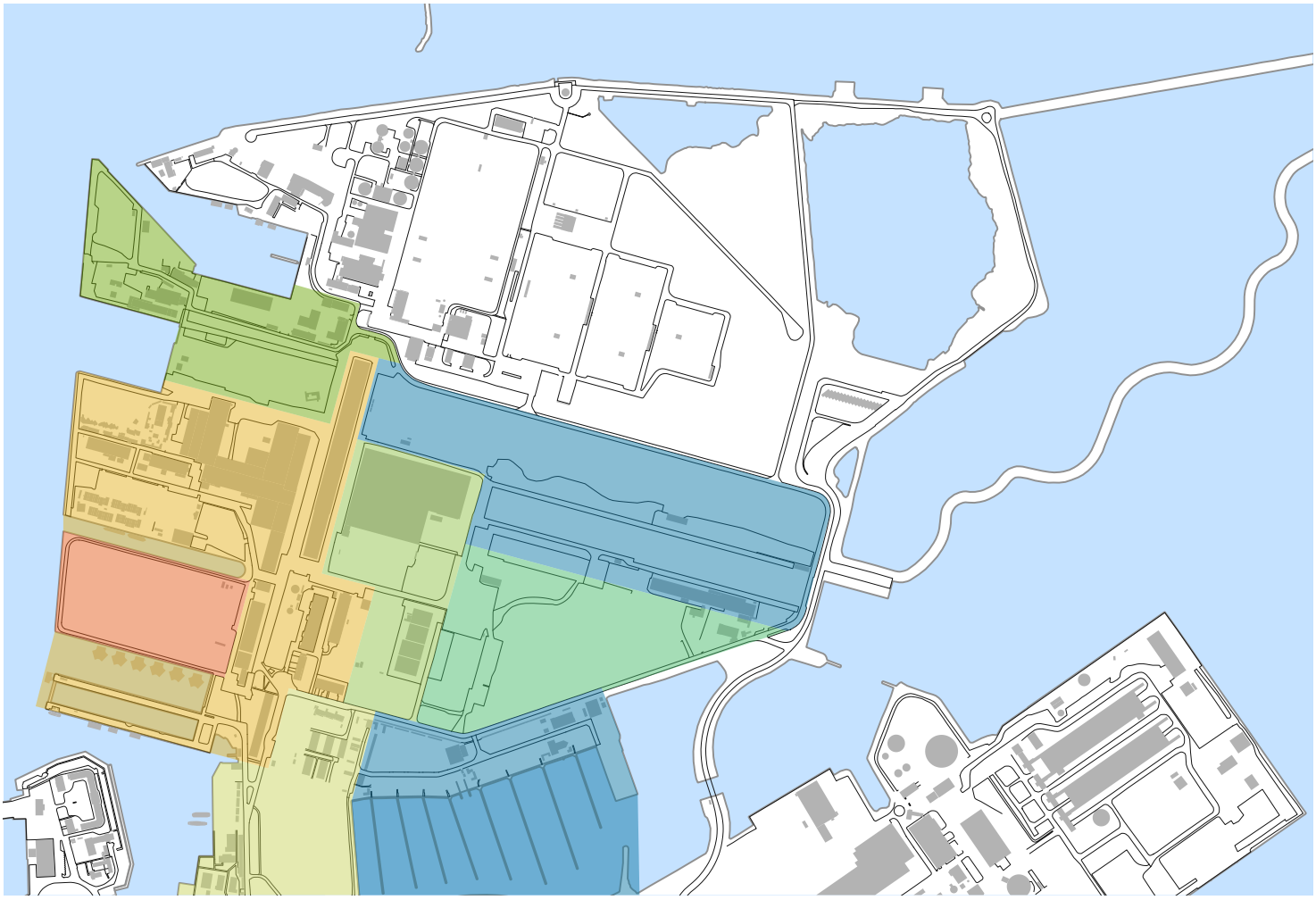
The subsequent waves of redevelopment on the peninsular depend on the pressure from the demands at that time. It is therefore difficult to pinpoint which specific area would be the next to meet redevelopment after the immediate surrounding area of the site, but we can predict that the areas will see more dramatic changes due to their current lack of development.

The areas on the peninsular have differing profiles of functions. The southern area is mainly occupied by residential functions, the central area is mainly occupied by commercial functions, the eastern is predominantly a green space and the northern areas is also mainly occupied by commercial functions. The two preserved areas will see only a small amount of change to their functions as they already fulfil specific niches. Consequentially, this means that the two areas will be last in line for redevelopments, as there is less need for improvements.

Maintenance as the theory suggests is an important part in the viability of hyperdense environments not only but socially and politically. The physical maintenance is predominantly dependent on two factors: original quality and funding. High quality conventional construction and flexible construction reduces the amount of maintenance needed and also ensures that the needed maintenance is easier and less resource heavy. Maintenance is constrained by the availability of funding; a solution to this is a system of democratisation of maintenance funding. In this system funding is secured by setting aside a portion of the monthly rent in a separate account, which is accessed when maintenance is needed. This system is controlled, ensuring that the funding is actually used for maintenance.

The democratic system of maintenance funding is innately connected to the maintenance of the site. These two elements are dependent on each other and thereby continually reinforce each other. This positive loop is upheld by the need for actors to cooperate which reinforces the willingness to cooperate. This “social contract” positive loop is further supported by the design’s communal functions which help residents to be accustomed to interacting and cooperating. In turn the flexibility of the communal functions aids the residents and adapts to their social needs.

Hence, it is important for the social network to be able to withstand external pressure for the democratic maintenance funding to be a sustainable, long-lasting, and independent solution. This solution is self-reinforcing as long as external actors are not able to irreparably disrupt the loop, therefore a degree of resistance to said factors is essential for the internal actors to have. The effectiveness of this is limited due to the small scale of the network. Ensuring the resistance of the network, is dependent on a larger scale, therefore it is beyond the scope of this project.



Conclusion

This design has achieved many of the design principles laid out earlier in this document. It has created and connected communal spaces and facilities, by careful arrangement through vertical space. It has made these spaces feel safe by ensuring transparency between them and throughout the building. The design has addressed the needs of locals, residents, and tourists for green and open spaces, by creating diverse spaces at multiple levels.

The design has addressed the need for sustainability, reducing energy consumption by incorporating passive methods of heating and ventilation. It has also utilised and incorporated itself into the local mobilities network, helping residents to reduce their dependence on carbon intensive transportation. However, it has not modelled the embodied energy, due to the design processes focus on qualitative and functional aspects of the design. Due to unfortunate circumstances, it has also not been simulated and thus not been able to prove the effectiveness of sustainable design solutions.

The project has included a detailed and reflective planning elements of the design. The utilisation of tall buildings allowed for more space to be allocated for recreational functions. The inclusion of a podium has helped to keep it within the human scale. The efficient utilisation of space along with the strategic choices in the vertical programming of the functions in the building, have created greater flexibility and consequentially been able to preserve the limited amount of local specifics. It has also incorporated these functions into a greater context and plan for the peninsula.

The maintenance of the site is also a key aspect of the design. With the physical maintenance ensured by the construction and flexibility of the design as well as the securing of adequate funding. The social maintenance ensured by the adequate supply of communal spaces and facilities along with democratic control helping reinforce the communal network and in turn itself. The risk of political and market overreach has been minimized with the democratic control, however it's effect in this aspect is limited due to scale of the potential network and the scope of the project.

The success' and failures of this design have shed light on the potentials and pitfalls of a hyperdense design, hereafter being able to derive recommendations for methods for future hyperdense designs.

Suggested methodology

The experience gained from this project has shed light the strengths and weakness of hyperdense design. Which has given an opportunity to give recommends for future hyperdense designs, these being:

Quality of life

The arrangement of spaces and functions both internally and externally have been shown to be very important for the residents' quality of life. Ensuring a diversity of these spaces that fulfil residents' and locals' needs should be a priority in any hyperdense project.

Environmental factors

Environmental factors have proven to play a key role not only for the tall buildings themselves but also their surroundings and not only in a negative light, but also shade from sun and shelter from wind. This should be implemented using environmental simulation both before and after placement of such buildings to bring out their best qualities.

Planning

Experience has also shown how hyperdense design should be incorporated into large planning of the area partially to ensure that it is incorporated into the local mobilities and is used strategically so it doesn't negatively impact it's surrounding, but also as tool for preservation of local character and sites.

Maintenance

The theory has proven maintenance to be a critical factor in the longevity of tall buildings, both socially, physically and politically. Therefore, it is recommended that any hyperdense building project create or incorporate systems and institutions to maintain and improve these factors.

Refelction

The processes of this project have resulted in a design that while has achieved many of its goals is still lacking in a few aspects. The sustainable aspect of the design while based of solid principles, does lack a full simulation and calculations to prove it's viability. This in and of itself does not count against hyperdensity and tall buildings as concepts due to technical aspect being one of the most well-trodden and proven in the literature m though as the theory suggest this universal the case and these typologies still need to be design with care to ensure that they are sustainable.

The incorporation of features to sucre a good quality of life and the long-term maintenance of the building have been some of the successful aspects of the design. Particularly the usage of vertical programming to arrange a verity of functions both commercial and communal proved effective at maximizing the usable space and comfort of using them. Creating a system of democracy also proved to be a strong method of achieving maintenance both physically and socially. However, these aspects are limited in their detailing and thus go only so far in proving their viability.

The long-term planning has been one of the aspects that has been least explored in the design, but still demonstrates hyperdense design principles viability as part of larger plans and that their viability is closely tied with these plans.

While together this does show hyperdensity can be a valid approach to dealing with many of our urban woes, it like all approaches that use design and engineering to resolve problems are limited by the paradigm that they lay within. Therefore, hyperdensity or any other design solution to larger issues cannot act alone and must be part of political solution to these larger issues.

Apendix

Reference list

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