The Study of Urban Perimeter Block and Its Performance on Passive Solar Urban Design

Case Study: Old Oak, Park Royal Opportunity Area, London

K14DTS Design Thesis

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Contents

Abstract

Perimeter block has been one common and important typology in urban design and planning studies and implementation. Having been developed through various research and studies, perimeter block can still be optimized as an urban typology.

Research and studies in passive solar urban design has various focus including solar radiation, daylgihting, thermal comfort and wind. The thesis will focus on solar radiation performance of perimeter block and find the optimized criterias and approaches to be implemented in gaining more density. Perimeter block still can gain higher density without sacrificing the functional and design aspect as well as its performance. The thesis study on the configuration of the building in term of which part can be built higher without blocking other part's solar access.

Design criteria and aspect are implemented in an urban design of Old Oak site in London with the objective to gain high density, compact and transit oriented urban design.

introduction

1.1 Urban Block

As one of important elements composing urban fabric, urban block will have great contribution in shaping the character of a city. Urban block will also become one significant factor determining the quality of a city. Hence it is clear that the study and enhancement on urban blocks will help creating better places for people to live in.

The importance of urban block has been studied by various scholars. In the urban morphology study, Conzen (1960) describes block plan as one of three elements of a town plan besides streets and plots. He further define block plan as an area occupied by building and is defined by the line of the building's wall.

In the more recent discourses, Urban block is further described as an area defined by the grid or street and also defined as a group of independent building plots rather than an architectural form. The shape and size of the block will vary according to the street configuration, topography, orientation, and the nature of plot subdivision. (Panerai et al. ,2004; Llewelyn-Davies, 2000)

According to Schenk (2012), Building blocks has been one of the oldest forms in the city as early as first millennium BC when Chinese cities regularized grouped of single-story courtyard house surrounded by planned orthogonal street grid.

In the implementation, building block has many variations which can vary from rows of buildings, perimeter block, or group of standalone buildings. Each of this different variation has their own character which relates to the approaches during certain development era of architecture and urban design.

The perimeter block has been one common form in modern and contemporary urban design. This type of block has a strong character which help defining the public realm by its strong perimeter where the building lines are lined with the block edges at all its sides. With its buildings at the edges, this perimeter block is also defining private places in the internal courtyard of the block. The internal part of the block could become a shared space for the whole blocks, semi private spaces accessible for services, or merely become closed private backyard for each plots.

The perimeter block has evolved throughout urban design and planning history. Tarbatt (2012) noted that the perimeter block typology has been developed from the ancient times with many examples from 5th and 6th century BC of Greek colonies as well as in Roman towns. The perimeter block has also been a common typology found in the medieval cities.

Once it became a less favourable typology especially during the modernism era of architecture and urban design but eventually the perimeter block typology keeps becoming popular solution and keeps developing through studies and exploration in contemporary architecture and urban design enhancing its functional aspect and spatial quality. As different functions and more complex factors now affect urban design approaches, the perimeter block also become more complex but still come with its strong character of defined spaces at the perimeter and courtyard.

It can also be observed that perimeter block typology has potential to support medium and higher density development while still maintain its advantage of public-private defining character and enliven the streets and public realms with its frontages. However, it still open up to discussion on how high the density could be accomodated by perimeter block while not sacrificing the functional and spatial quality aspect. This potential is important because high density living is considered as necessary solution in some urban contexts to tackle the limited land problems or to provide more balance of density and open spaces in an urban area.

In recent developments, when urban design approaches have started to take sustainability aspects into one of main consideration, the traditional perimeter block was also subjected to further studies to optimize its design with its effect on the block's performance. Apart from technology-related active design method, many of the studies put more emphasis on passive method like passive solar urban design on daylighting and heating as well as passive design method related to wind flow which also relate closely to the comfort aspect of urban living.

For example, in the context of European cities, especially in the subtropics and temperate climate area, the perimeter block will face a challenge to balance their need to get good orientation and good building energy performance. How the block is oriented will also determine how solar and wind could affect the comfort of the area and its surrounding.

Many of the studies have brought in guidelines and rule of thumb related to urban blocks' performance which have been applied in many urban developments. Apart from the guidelines, there are more detail and focus studies on urban block's performance in daylighting, solar radiation and wind flow performance by using computer simulation software as well as physical models.

In relation to good urban block's performance, the studies suggest main design criterias like height and width of the buildings, distance between buildings as well as building's orientation. The most common basic guide are the east-west alignment to have more south facing facade and the building's height-to-distance proportion to allow for enough solar radiation and daylighting.

The more contemporary studies involve parametric urban design which put all the determining factors into computation to get results of urban block envelope or form guidelines which sometimes translated into ideal dynamic and angular shapes.

However, there should be proper considerations in applying the studies and guidelines to put them into the urban context. For example, east-west alignment option does not always available due to an existing urban fabric or topography condition. Furthermore, applying all blocks in uniform east-west orientation will result in a rigid urban fabric with lesser dynamism and vitality. On the other hand, putting the ideal and dynamic shapes do not always fit into certain urban design context.

The thesis will look at the potential of the perimeter block typology in enhancing the quality of medium to high density urban living by optimizing the perimeter block's design criterias. The thesis will study the criteria and aspect of perimeter block in term of daylighting, solar potential and wind performance in the context of an existing urban site in the UK as the context. An urban site in Old Oak, part of the Park Royal Opportunity Area in London, with an urban regeneration development opportunity has been picked as the case study. The urban design process of this case study will be a research-led design with emphasis on the perimeter block performance.

1.2 Case Study - Old Oak, London

Old Oak site is located within Park Royal Opportunity Area at the west part of London. Park Royal, extends to a 700ha area, is Europe's largest industrial estate and the principal industrial area in West London (GLA, 2011). The area spans accross a few boroughs of Brent, Ealing, Hammersmith & Fulham, and abuts Kensington and Chelsea.

Park Royal currently accommodates around 2000 business with about 40,000 people employed. Estimation shows that the total opportunity area could accommodate 425,000 sqm of commercial and industrial as well as 3,500 residential units. It is also targeting to add up to 14,000 new jobs and 1,500 new homes.

According to the GLA (2011), Park Royal is crucial to London's economy successes. The site has advantages of being in between Central London and the Heathrow airport and also has access to transport links to the A406 North Circular and the A40 Western Avenue which lead to the national motorway network like M1, M4 and M25. It also has access to three London Underground lines (Bakerloo, Central and Piccailly) and various mainline and overground services.

Park Royal area maintain its competitive advantages also because of its access to a local labour supply, and relatively affordable rents, as well as the advantage of having wide areas for the industry and companies to expand without moving to other business and industrial park.

Old Oak is one of the six wards in Park Royal Opportunity Area. Old Oak wards together with Harlesden, Stonebridge and College Park are within the England 20% most deprived wards in term of social and employment deprivation. (GLA, 2011)

GLA (2013) estimated that the development at Old Oak can generate population up to 40,000 people. GLA (2013) also mentions the potential for Old Oak regeneration to provide up to 19,000 new homes and 90,000 jobs.

The Old Oak site will be developed as the addition to the four gateways to the Park Royal area which act as neighbourhood centre. With its proximity to the White City and Kensal Canalside Opportunity Area, the Old Oak site has potential to enhance the connectivity and regeneration of the surrounding especially with the plan to set the Old Oak Common interchange station.

The government has determined the Old Oak as the place for the new station Old Oak Common as interchange for the new proposed High Speed Rail 2 which will connect London to Birmingham and beyond to Leeds. The High Speed Rail line will also be connected to the HS1 going to Europe. The new proposed Crossrail, which currently start constructions, goes connecting the East and West of London will also have the station at the Old Oak Common.

The high connectivity potential of the Old Oak site due to the proposed HS2 and Crossrail would make the Old Oak reachable within 10 minutes from Central London or Heathrow, 40 minutes from Brimingham and around 2 hours from Paris and further possibilities to connect to European cities.

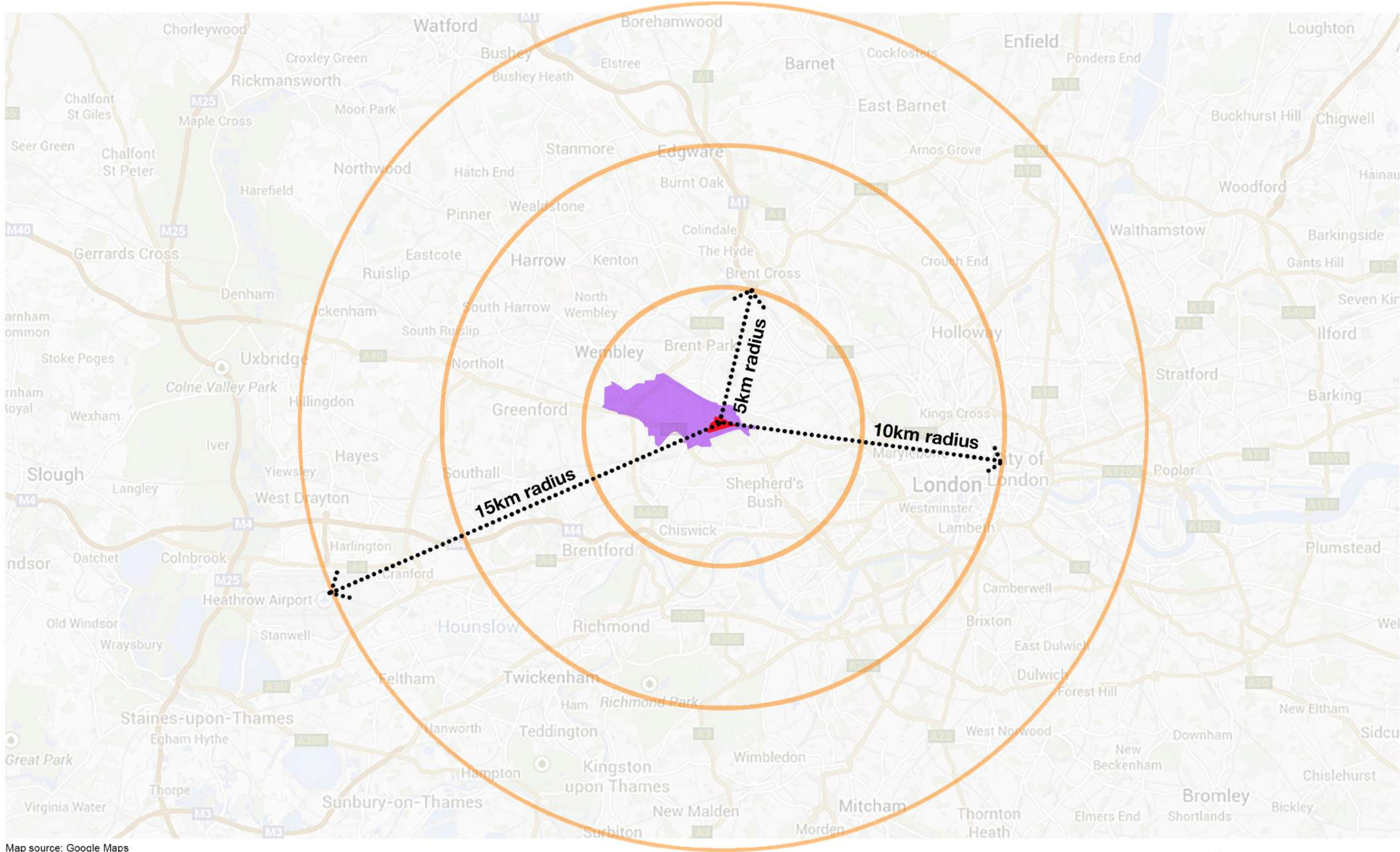
This plan to set Old Oak Common also open the opportunity to connect with Kensal Rise CTRL. The existing Willesden Junction which accommodate the London Overground and London Underground is also prominent point within 600 meter distance north of the Old Oak Common and the case study site.

The thesis will study the Old Oak with an area of 17 hectares that sits adjacent to the new transportation hub. The case study site sits at the north of the proposed station and the south of the Grand Canal Union water canal.

With the site's high connectivity potential, Old Oak will be able to be developed into higher density with mixed land use which in the end will support the regeneration of the whole Old Oak and surrounding area within the Park Royal Opportunity Area.

The regeneration project at the Old Oak site will be approached from the opportunity of mixed use urban blocks with emphasis on optimizing the perimeter block typology potential to support an urban area with optimized density and also towards the more sustainable approaches like transit oriented, compact and walkable city.

site context - park royal opportunity area & old oak site



Map source: Google Maps

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Old Oak site

Park Royal Opportunity Area

Figure 1.1 (Opposite page)

Site context diagram showing the location of Old Oak site within the bigger area of Park Royal Opporunity Area in relation to the central area of London, Heathrow airport and other areas focal point like Wembley Stadium. The other advantages of the site is also its proximity to the surrounding main strategic roads and main motorways as well as railways connections. *(Image source: Author. Map source: Google Maps)*

Map source: Google Earth

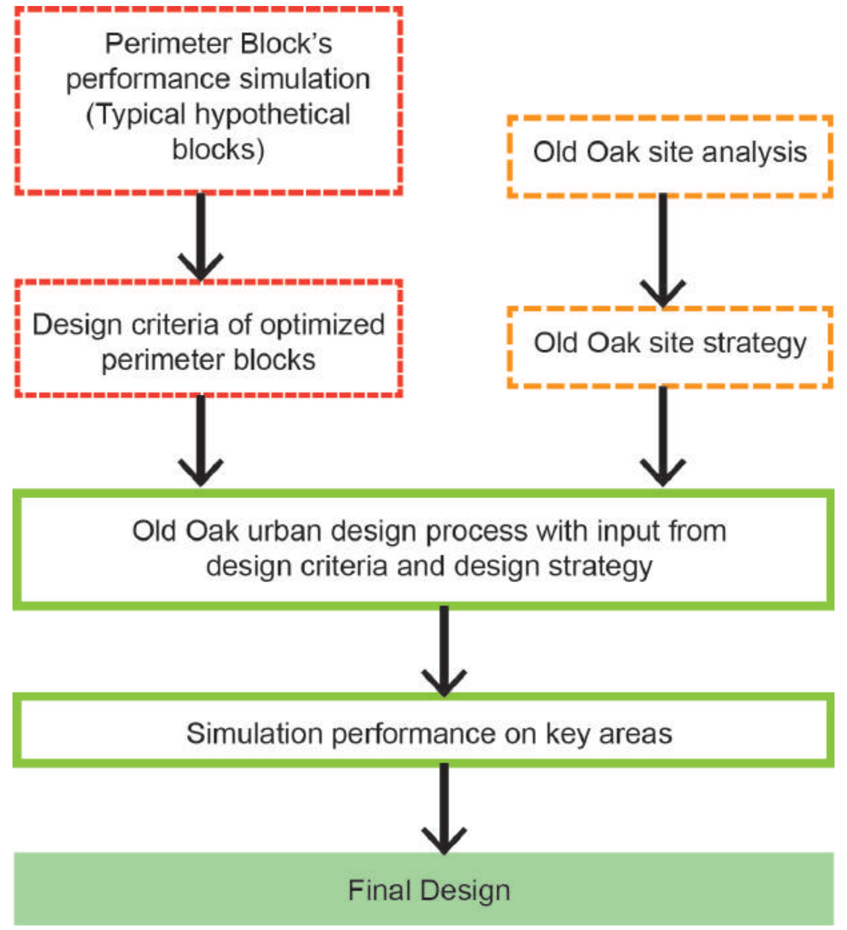
Old Oak site

Figure 1.2 (Opposite page)

Diagram showing the location intervention area for the purpose of thesis study. The area under study is as big as 17 hectares and currently being part of train depot and temporary assembly factory for the train tunnel concrete case. advantages of the site is also its proximity to the surrounding main strategic roads and main motorways as well as railways connections. *(Image source: Author. Map source: Google Maps)*

Figure 1.3 (Right)

Flow Diagram explains the thesis framework and workflow of thesis research and design process. *(Image source: Author)*



1.3 The Thesis Framework

With the advantage and potential of the site to be developed with higher density area promoting good design towards the more sustainable approach, the thesis will prepare design strategy emphasizing on the optimization of perimeter block as urban element composing the Old Oak site.

The thesis will study the design criteria and aspect of perimeter block to explore the optimized solution in performance of an urban block. The study will be conducted with computer software simulation on different possible value of of perimeter block which will include the parameter of height, distance, and orientation.

From the simulations on models of hypothetical block, the criteria and aspect will be derived and implemented on to the Old Oak site area. With further evaluation within the context of the site, along with broader urban design strategy, the urban block will be refined more to obtain the final design for the site context.

With these research-led design approaches, the thesis will demostrate that the perimeter block typology is still open to chance to be optimized in order to give contribution in an urban development which aiming more urban livability as well as towards a better sustainability approach.

literature review

2.1 Perimeter Block and Its Important Aspects

Perimeter block has been one common typology in urban form. Having been refined and improved through the time, perimeter block still bring its character and advantage of defining strong public front and private back area. Perimeter block has become a typical solution in urban design and planning.

Kropf (2006) even mentions perimeter block as one of the defining orthodoxies of current urban design wisdom for the past 30 years and has even been institutionalised in many official guidance. He further mentions that perimeter block has proved its stance against the extreme Modernist urbanism, cul de sac sprawl, and some more typical urban threats. However, implicitly Kropf also mention that perimeter block typology should not be just treated as quick solution and that perimeter block can be studied further more.

It is clearly shown from studies that many evidences have proved that perimeter block typology has many advantages so that it has become one strong typology in urban design. In certain urban context, perimeter block will have potential to be a better solution compared to other block typology.

Earlier in *Nothing Gained By Overcrowding*, Unwin (1912) argues that perimeter development proved to be more cost effective compared to the bye-law housing rows. He explains with his calculations comparing both typology that with the same number of housings, the perimeter development layout could give more spaces that could be used for better functions like garden or places for activities instead of having too many area allocated for streets in the bye-law housing row's layout.

In later studies, Martin (1972) and Martin and March (1972) also compares the perimeter block typology, which they mentions as court form, with other forms of pavillion 'free standing building' and rows of buildings. They argue that court forms could provide more spaces in the courtyard that could be used for other functions and activities and that the court forms come with traffic-free courts connection. Martin also shows that the same density of pavillion form can be achieved by the court form with more open spaces.

The perimeter block, with its public front, will help to enliven the public realms. Continuous active frontages could give more livable streets compared to blank facades, back areas or far setback created by other typology. This public front will activate the street and encourage interactions. This is supported by the argument from Gehl (2010) that life between buildings can generate more interaction provided the quality of the spaces is good and condusive. Public front could also provide 'eyes on the street' that can help creating safer feeling for people doing their activities (Jacobs, 1961).

The clear distinctions between public front and private back will give opportunity to use the back or internal court of perimeter block with more privacy or other activities that needs to be screened off from the public although in certain condition semi-public access can be provided. (Bentley, 1985; Llewelyn-Davies, 2000; Lewis, 2005).

Nevertheless, it is also clear that perimeter block typology is not free from limitation that could lead to become its disadvantages. This can be traced back from the early and initial development of perimeter urban block.

In the early medieval towns, urban blocks were formed by rows of gable houses on deep and narrow lots at all side facing the streets. The inner side of the block which eventually the back of each lots become a private area for each houses. Back-to-back arrangement of the rows made this private area accessible only by the respective building in the lots (Schenk, 2012). In the meantime, the Baroque city block were formed by multi-storeys buildings with the eaves that parallel to the street and creating a perimeter and a courtyard in the middle (Schenk, 2012).

This perimeter development with back-to-back lots provide private areas accessible only by each lots. Without proper maintenance or regulation, because this back areas are private, many turned into a rather untidy or even unhealthy spaces. Conzen (1978) in Whitehand (1981) depicts the British's morphologies during the industrial era where double-terrace back-to-back houses grouped about inner courtyard that led to unhealthy condition which brought cholera epidemics.

Disadvantages also apparent in early Berlin's and Barcelona's perimeter block where the inner courtyard turned to be rather unhealthy and unsafe without proper sanitary and access. This, however, was led more by the inadequate block dimension and proportion because of the high density of the block.

Panerai et. al., (2004) also describes similar situation happened in Paris with the Haussmanian blocks where some of the inner courtyard became a left over spaces and merely act as back area and tend to have less ideal conditions especially because most of the new blocks set by Haussman were used by the rich who tend to let the back area taken for granted.

The building height within the perimeter block initially depends only on the grid or street network and planning which in the end come either with deep and narrow lots or wider and more spacious lots. This will determine how wide the space could be gained for the back-to back lots or how big a common internal courtyard could be created. With taller buildings, due to higher density, the back-to back distance is not wide enough, often the internal of the block become too narrow and cannot get proper and healthy area due to lack of daylight and good air ventilation. In certain development, the narrow internal area could even become a socially unhealthy spaces which in the end also turn to be unsafe places.

For the UK context, Tarbatt (2012) summarizes that in relation to privacy in residential area, local authorities have set a standard separation distance between rear windows of 22 meter has become a common approach for the case of back-to-back plot. Tarbatt also mentions that other guidances, including the *London Housing Design Guide*, also acknowledge 18 meter to 21 meter separation distance as useful conventional guide. *The Essex Design Guide*, the older yet still an influential guide, suggests 25 meter as an acceptable back-to-back distance.

The proportion of inner courtyard will eventually relate to the block size. The block size of medieval towns or some blocks in the core of modern city could have smaller size because of the dominant of walking as transportation mode. On the other hand, the block size in more sub-urban area or in some of city with modernism planning, which rely more on vehicle as mode of transportation, will have longer frontage or bigger block size.

Block size that can promote walking, cycling and creating places for people to interact should be taken into consideration. To support this, permeability of the urban area should be enhanced which can be achieved by short blocks. Jacobs (1961) argues that vitality can be brought to the city by good permeability with short urban blocks, mixing use and variety of function.

As rule of thumb, Llewelyn-Davies (2000) suggest that block size of 80 to 90 meter is suitable for common urban condition while the smaller block size of 60 to 80 meter could be applied in the city centre area.

In broader point of view, the perimeter block should be observed in relation to other adjacent blocks accross the streets, no matter what the adjacent block's type is. Perimeter block's advantage of activating the public realm can truly happen only if the relation to the next streets and blocks is well considered.

As stated by Kropf (2006), the urban blocks are the results of connecting streets. Thus, the perimeter blocks only arises when streets are well connected and defined by the buildings. It is also further strengthen by Panerai et. al., (2004) who assert that because blocks are not architectureal form but group of buildings in lots, they only have proper meaning when there is dialectical relationships with the road network.

In order to form a good relationships with the adjacent public realms, design concern will relate back to the importance of the size of the block as well as the functions allocated within the block. This will also concern with the privacy and accessibility and be determined by, for example, the location of the opening and access to the block.

The distance between buildings will define the spatial quality of the street and the surrounding space related to the feeling of enclosure. This will determine whether the place has been strongly defined and comfortably enjoyable or become terribly unsafe place and unattractive space.

Llewelyn-Davies (2000) suggests that building height-to-street's width ratio between 1:1.5 (minimum) and 1:3 (maximum) is applicable as a guide for normal street. The 1:6 ratio is also acceptable for a square or a very wide street.

To achieve variety and avoid monotonous block, mixing use and function could be encouraged within a perimeter block. The most common practice is putting commercial or civic functions at the lower level and residential at higher level. In certain cases, small industrial functions can also be introduced into the block. Certain public amenities and civic functions could also be integrated which usually take place at the ground floor access.

Different functions could be spread within the block either vertically or horizontally. The courtyard created in the centre could be made accessible separately depending on the mixed function. The courtyard could also be elevated one or more story higher which eventually creating undercroft that could be used as carparks, services area or reserved for bigger space required for functions at the lower floors.

Compared to terrace houses or a point block tower, perimeter block typology has the potential to gain higher density while maintaining good urban places. Further development which can allow perimeter block to have some part of it as taller tower, and eventually create potential for even higher density has started to be explored. However, certain consideration need to be addressed when combining this perimeter block and tower typology in term of access, privacy, circulation, and some more other aspects.

It can be summarized that there are some important aspects of perimeter block need to be taken care of in order to maintain the well ordered function and spatial quality of the block:

- Block size and the proportion of inner courtyard and the thickness of the perimeter slabs.
- Building height and variation of its height which will relate to the targeted density and mixed of functions.
- The allocation of functions which will relate to the accessibility, privacy and comfort
- Interface with the adjacent streets and other blocks which will relate to the proportion of street enclosure, building height to the street's width

The above mentioned aspects mostly concerned with qualitative aspect of spatial quality in urban spaces and will act as input in urban design stategy and decision processes.

For further steps, the thesis will bring these important aspects as the basis to focus the study on how the perimeter block will perform towards the sustainability approach in order to obtain better performance typology providing high density living without sacrificing functional and spatial aspects.

2.2 Perimeter Block in Sustainability Context

There are various aspects in the sustainable urban design approaches that will relate to each other which are economic, social, and environmental sustainability (Jones, 2008). The thesis' research is focusing on the environmental sustainability aspect in studying design criteria for a good perimeter block. The economic and social aspect will still be considered in the design strategy and processes.

In more detail, related to environmental aspect, there are main interrelated factors such as daylighting, solar heat gain, wind and thermal comfort.

Important approach in sustainability is the application of passive design which is the design optimization by utilizing the natural context such as building orientation, natural daylighting and prevailing wind direction before utilizing additional active devices such as artificial lighting or mechanical ventilation.

The ultimate purpose of urban design is providing comfort for people. In term of passive urban design approach in the context of London, this will mean optimizing the design aspect which will include:

- **Daylighting:** Optimizing natural daylighting relative to each activities and purposes including providing shades when necessary.
- **Solar Radiation:** Maintain heat gain during winter and avoiding excessive solar heat gain during the summer. Solar radiation also relates to the availability of solar energy that can be harvested.
- **Wind Flow:** Optimizing wind flow in between the buildings to provide comfort. For example, to remove excessive heat during summer or to tackle the urban heat island effect.
- **Thermal Comfort:** Achieving or maintaining comfortable temperature and humidity at inhabited places.

For London context, which situated at 52^0 latitude north of the equator, the orientation to the south is the basic requirement in order to obtain optimum passive solar design result. This means that the buildings should be elongated or aligned with the east-west axis. By doing this, more building facade area will face the south and could gain solar radiation as well as more daylight when needed especially during the cold season or winter when the sun is low on the sky.

However, this south facing preferences will not be always available especially for the perimeter block typolgy where some part of the block would be facing the north. Hypothetically, this condition could be further solved on architectural and building technical level instead of urban desin level. Reorienting the block may need to be tested to study the best orientation that could manage this contradiction.

In an urban block setting, the access to daylight is important especially for the habitable spaces as it will help reducing dependancy on the artificial lighting. Unlike the solar radiation, daylighting aspect is relatively less complicated in practice. This is because daylighting can be obtained both from direct and indirect sunlight as long as it reach the minimum required Lux level for certain function and activities. Dekay et. al., (2014) mention that an average level of 250 lux for indoor is a moderate level of ambient lighting for required Task Lighting for activities like drawing or reading.

The requirement can also use Daylight Factor which mention the ratio of internal to external light level. For the UK context, CIBSE produces lighting guide that mention daylight factor of 5% as suitable since the interior is adequately lit and artificial lighting is not required although glare might occur.

On the other hand, solar radiation access will need direct sunlight to reach the spaces in certain required amount. Thus, with a certain angle of direct sunlight, for example the low angle of winter sunlight, certain space should not be blocked by any obstruction. In the context of urban block, this angle will determine the distance and height of the buildings that stand adjacent to each other. Further to that, for perimter block typology, this will also determine the spacing between the block edges which eventually will results in the size of the inner courtyard.

A few common guides on passive solar design are providing rule of thumb. LLewelyn-Davies (2000) notes that the building-street enclosure ratio, as mentioned in the previous sub chapter, should also be checked against the access to daylight for the spaces and internal part of the building. South facing facade is still become the common suggestion to achieve more solar advantages in this region's context.

In the meantime, Building Research Establishment (2011) states in their guide that an average daylight factor of 5% is adequate for the UK context. The requirement that direct sunlight should enter to one of habitable room for part of a day is also stipulated by the interim London Housing Design Guide (2010).

Another method, the Daylight Spacing Angles determines the availability and access to daylight by mentioning certain angle of obstruction which will construct the daylight envelope (DeKay et al., 2014). For London context, the buildings will need medium spacing angle of 31^0 which eventually will give guide for the minimum distance between buildings.

Knowles (1999) proposes the Solar Envelope as a method to determine how buildings can be set up within certain enveloped parameter to allow access to daylight for other surrounding buildings or places.

Different study by Ng (2010) brought the Unobstructed Vision Area (UVA) as a design tool to provide adequate daylight availability and achieve required daylight factor for a building in relation to other buildings.

It should be noted that the mentioned methods using cut off angle like Daylight and Solar Envelope as well as UVA will be greatly dependent on the surrounding context and should be guided with consistent application of urban design guidelines. Once the surrounding context changes, for example because of new other buildings stand up, the cutting off angle would be affected.

Other than daylight and solar parameter, block's orientation and form will also affect how the wind flow interacts within and surrounding the block.

Within Urban Canopy Layer (UCL), depicted by Oke (1987) as area closer to the earth's surface under building's roof as opposed to Urban Boundary Layer within 100m to 3000m above the earth's surface, the wind flow direction and velocity will be affected by the form of the buildings, as well as pattern of streets and open spaces (Oke, 1987; Erell et. al., 2011). They further mention that canopy air flow may have characters of being calm at the bottom of deep spaces, strong velocity along the path with the same direction of the wind and eddies occur accross the street perpendicular to winds.

Translating this into urban block's design, the deep canyon aligned with the wind direction will create fast wind flow at the higher layer and vortex at the bottom which could create uncomfortable situation at pedestrian level. Hence, deep canyon should be modified to avoid the unwanted situation. The longer the canyon the faster the wind which eventually create a wind tunnel effect.

However, comfortable wind flow needs to be allowed into the urban quarter by not blocking them with buildings perpendicular to the wind. On the other hand, blocks that are built creating deep canyon perpendicular to the wind will also create vortex that could trap dust and pollution and lead to other uncomfortable condition.

Oke (1987) also indicates that taller buildings could generate wind flow towards its base which can affect the comfort and safety at the pedestrian level. However, he further proposes some solution to divert the wind by placing canopy at the base or by building the taller building on top of protruding podium (Refer to figure 2.1).

2.3 Public Transit Oriented Precedent

It appears that most of the results and guides from the studies above are done based on the simplified and generic condition on building and urban blocks. The models being studied have not been modified to test further exploration to avoid some contradictions.

Subsequently, there are recent studies that have explored other configuration and form of building and blocks that could add contributions to the theory and guides discussed above.

Okeil (2010) has demonstrated that the adjusted perimeter block by cutting solar profiles can allow for better potential of passive design approaches on wind and solar energy. He proposes typical L-block form which is lowered at both of its end. Two of this L-blocks are combined creating full perimeter block. Okeil claims that the height variation could give access to solar advantages.

Okeil's approach in cutting down the building height is interesting in term of finding the block form and layout. However, the module tested may again put limitation on the density. It may also become too generic and lead to another typical repetitive model.

Littlefair (1998), Morello, et. al. (2009) and Morrisey, et. al. (2011) have also conducted studies which shows the importance of passive solar design as well as utilizing the wind to help reducing unwanted heat and creating more comfortable urban places. Morello further shows their finding that a 45 degree rotation of block is good for solar radiation but not good for daylighting.

These findings can be explored further to know, for instance, whether the 45 degree rotation could also bring benefit for the case of the thesis' London site.

Arguably, it could be deduced that there is still open discussion on how to obtain better performance on perimeter urban blocks by combining the functional-spatial quality aspects together with the environmental sustainability aspect as the basis for the thesis' study.

The thesis will focus the research on the solar radiation performance of the perimeter block. The study will be emphasized on looking the possibilities to obtain solar radiation which can be utilized for heating in cold season and also solar energy. Variation of layout and building configuration within the perimeter block will be explored to find good solar gain.

Another important aspect for the thesis' research is incorporating the potential of the site to become a development that promotes compact urban living and towards a more sustainable design approach by taking advantage of integrating the adjacent interchange of HS2 and Crossrail as well as the proximity to other hub like Willesden Junction.

Public transit oriented development will promote less dependancy to private cars. Other than that, the approach to get to the optimum density is a good effort to cope with the limited land resources.

Some urban developments as precedents and case studies have been picked:

- Broadgate area, London
- King's Cross area, London
- Birmingham's New Street

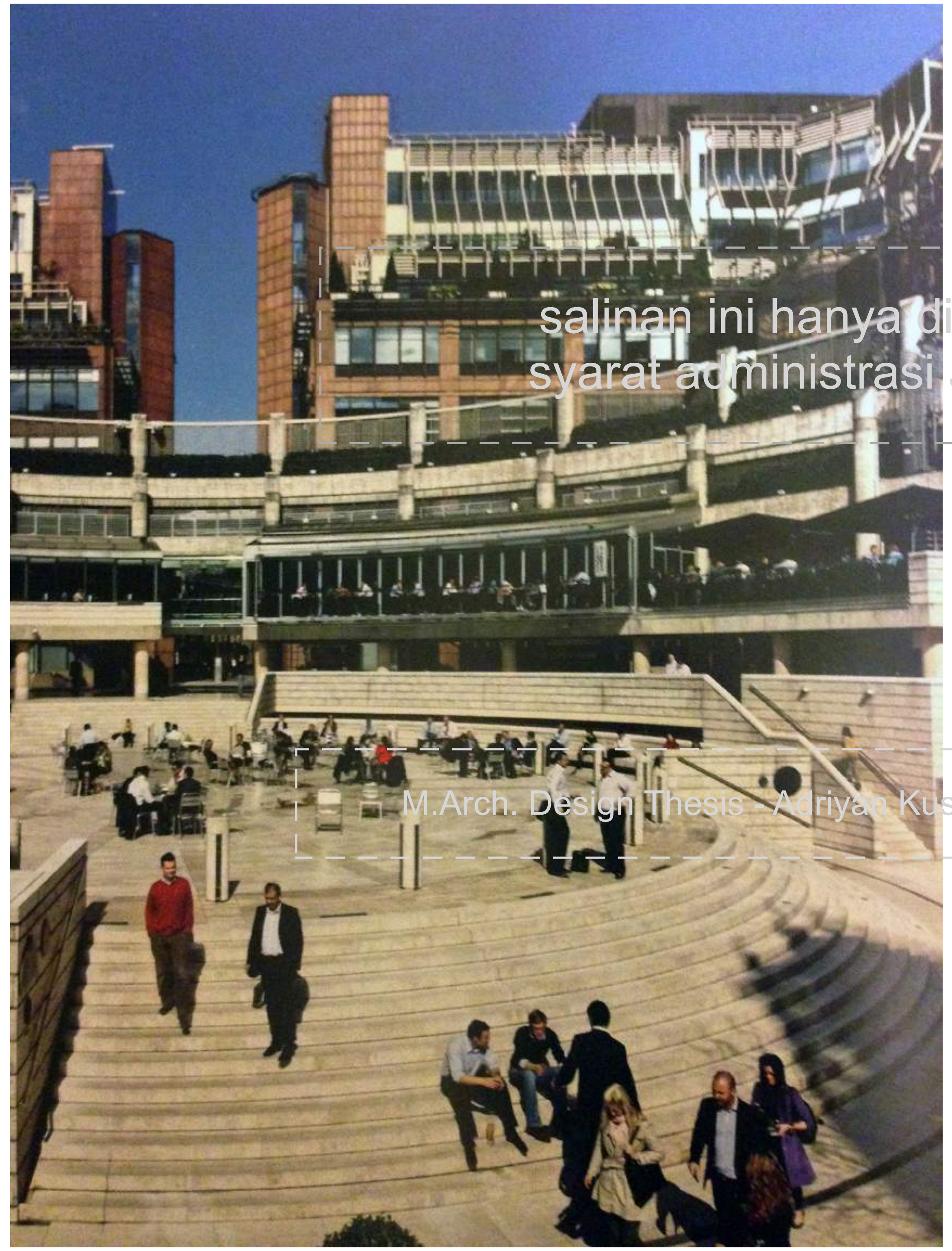


Figure 2.1 Central plaza of Broadgate development enliven the activities during different time and season. *(Image source: Firley, 2013)*

2.3.1 Broadgate, London

With an area of 11.7 hectares, this development has been transforming a site of former train station and adjacent operational station into a major financial district. The development was run between 1985 to 1991 (Firley, 2013).

The approaches that has been taken in the development of Broadgate can be summarized as follow:

- (+) Decommissioning of unused railways provides an area which are filled with plots arranged to close the edges maintaining good perimeter definition towards the adjacent site.
- (+) Providing plazas and courtyards within the block as public places to activate the block. For example, the plaza could be an snow playing field during winter and be a volley beach court during the summer.
- (+) The connectivity of the site is enhanced by managing the movement and separating the access of pedestrian and vehicles which eventually creating better urban places. Including enhancing the connection to the adjacent operational Liverpool Street Station.
- (+) Intensification with higher density development while still maintain the spatial quality and good public realms

2.3.2 King's Cross, London

King's Cross area has been developed since the industrial era in London with the railways as one of major transportation mode. Being a major transportation node, the surrounding area of King's Cross has been developed with domination of commercial and residential areas accomodating high density development.

The character of the development of King Cross can be summarized as follow:

- (-) Bigger blocks create some portion of passive and inactive frontages which could turn to become unsafe places.
- (+) Connectivity to public transport, especially trains and railways, create seamless flow within the station itself for the people that can change from the local city train to the international train line.
- (-) However, the ground connection with the surrounding is not currently well defined and provide weak legibility and orientation.

2.3.3 Birmingham's New Street

New Street in Birmingham is a 400 meter pedestrianized path connecting major points surrounding the city centre. The path connects major shopping centre, The Bullring, on one end to other places like the Victoria Hall or the Library. The New Street path is considered as one of successful regeneration development within Birmingham's city centre commercial area.

- (+) Become one major path with commercial activities as well as providing public spaces for peoples while connecting the city's urban fabric.
- (+) Integration of retails activities along the path as well as mixed use function provide better and more lively area.
- (-) Connection to the adjacent New Street Train Station is provided through pedestrianized path to the station entrance. However the connection is not well integrated, has weak legibility and poor orientation.

question and method

3.1 Thesis' objective and aims

The thesis will analyse the approaches and design of urban perimeter block typology in a high density intervention in complex city area. It will also discuss the approaches and criteria of perimeter block towards achieving more sustainable urban blocks with focus on the passive solar urban design approches and emphasizing on the solar heat gain or solar radiation received by the block.

The approaches and criterias of better perimeter block's performance will be put together with design strategy from the site analysis to get the optimum design solution for the Old Oak site.

The thesis comes with hypothesis that the perimeter block typology has potential to achieve higher density despite its limitation of block size. Variation in building height and layout as well as the whole block configuration will be studied to explore the better potential of passive solar urban design on perimeter block.

The literature study has exposed some common guides for example that south facing building is important or within a block the buildings on the south side should not be taller to avoid blocking the building at the north side. The thesis will come into this current discussion to contribute more study on the block's orientation and how they are arranged in wider urban context.

3.2 Method

Quantitative method by computer simulation measuring the solar radiation performance of the blocks as well as the space created. Different layout and character of perimeter block will be simulated based on the parameter and criteria set up for the thesis.

Four models are prepared to compare the test criteria based on the rule of thumb and the hypothesis context. Building height of 5 to 8 stories will represent the common block with medium to high density.

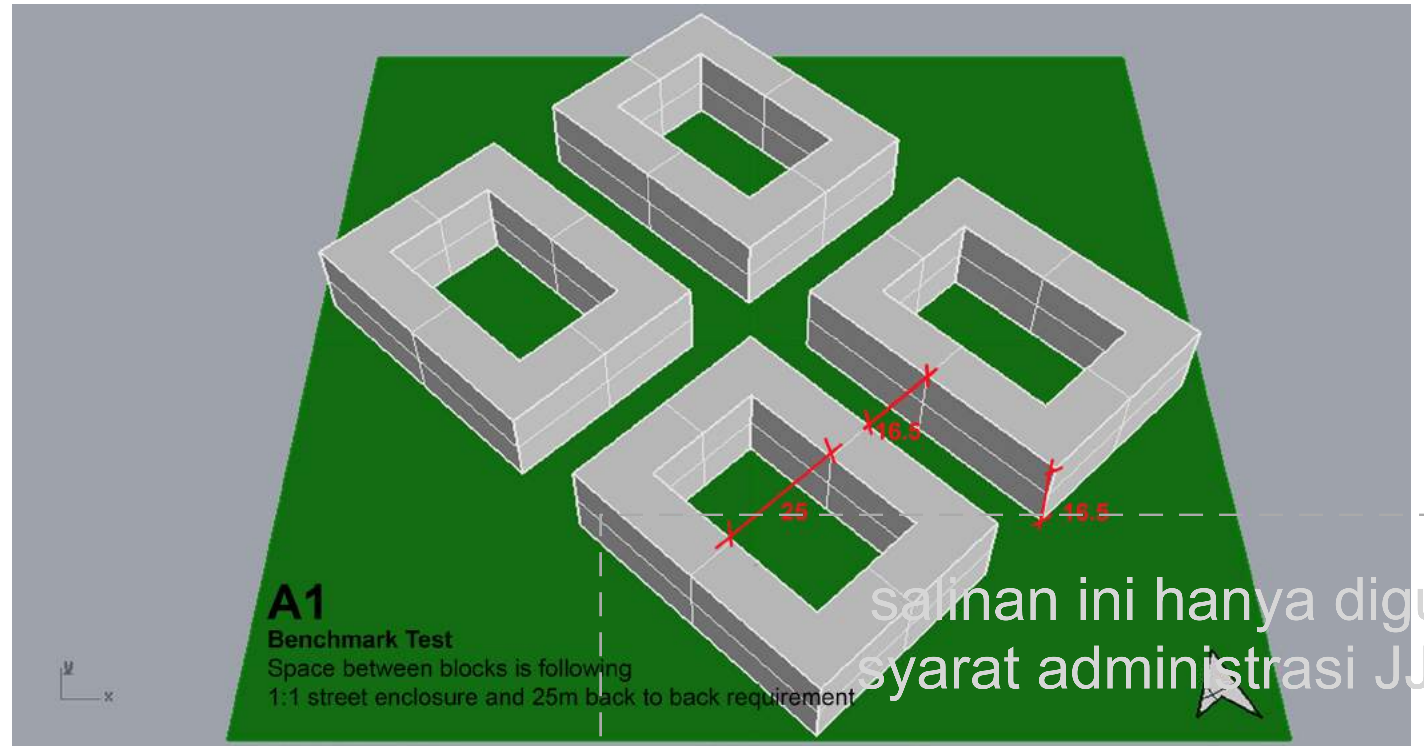
Each model will also be tested on typical orientations which are north-south alignment, east west alignment and 45 degree orientation to simulate the arbitrary orientation in the real urban context. The parameters of the test modules are described in figure 3.1 to 3.4.

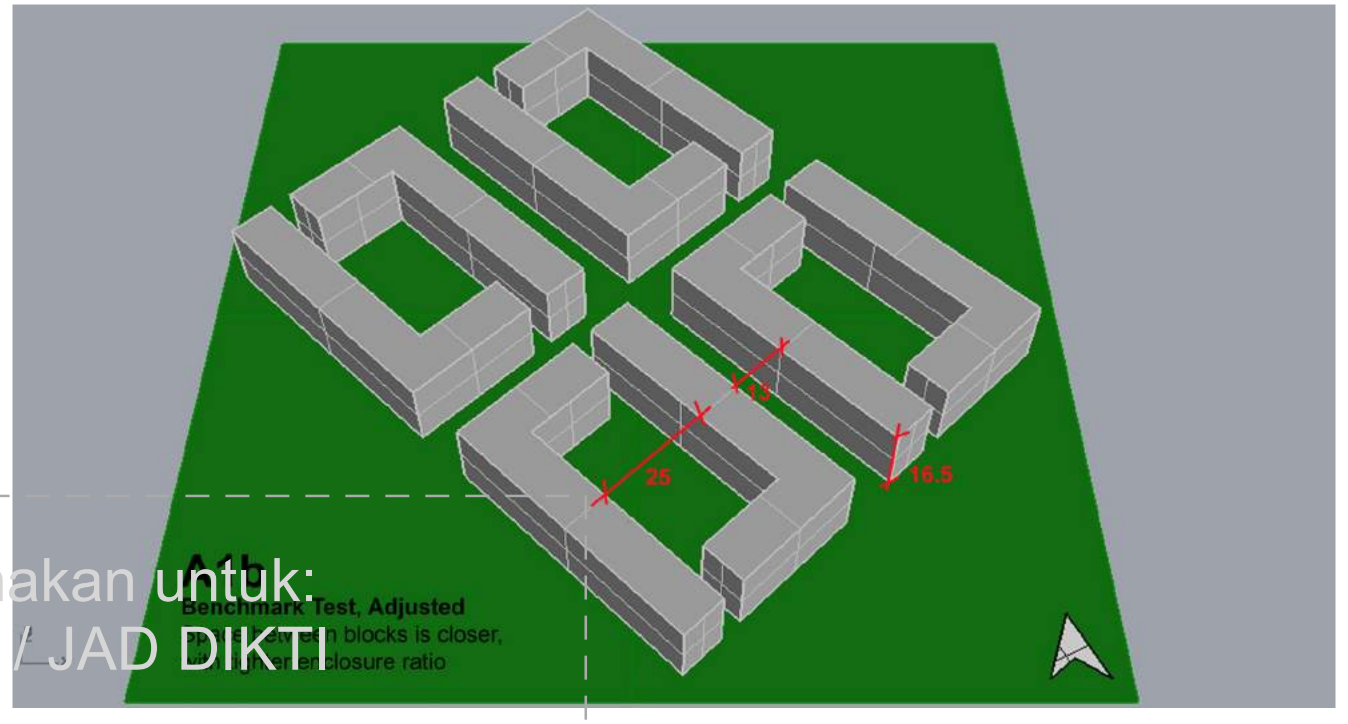
Module A1 and A1b are the benchmark modules as they are following the guide and previous study. The building height is uniform without variation within the block. The distance between the block on A1b is tighter to test the real urban situation where density is aimed while still within proportional enclosure. It also follow the suggested 31 degree cut of angle for solar access.

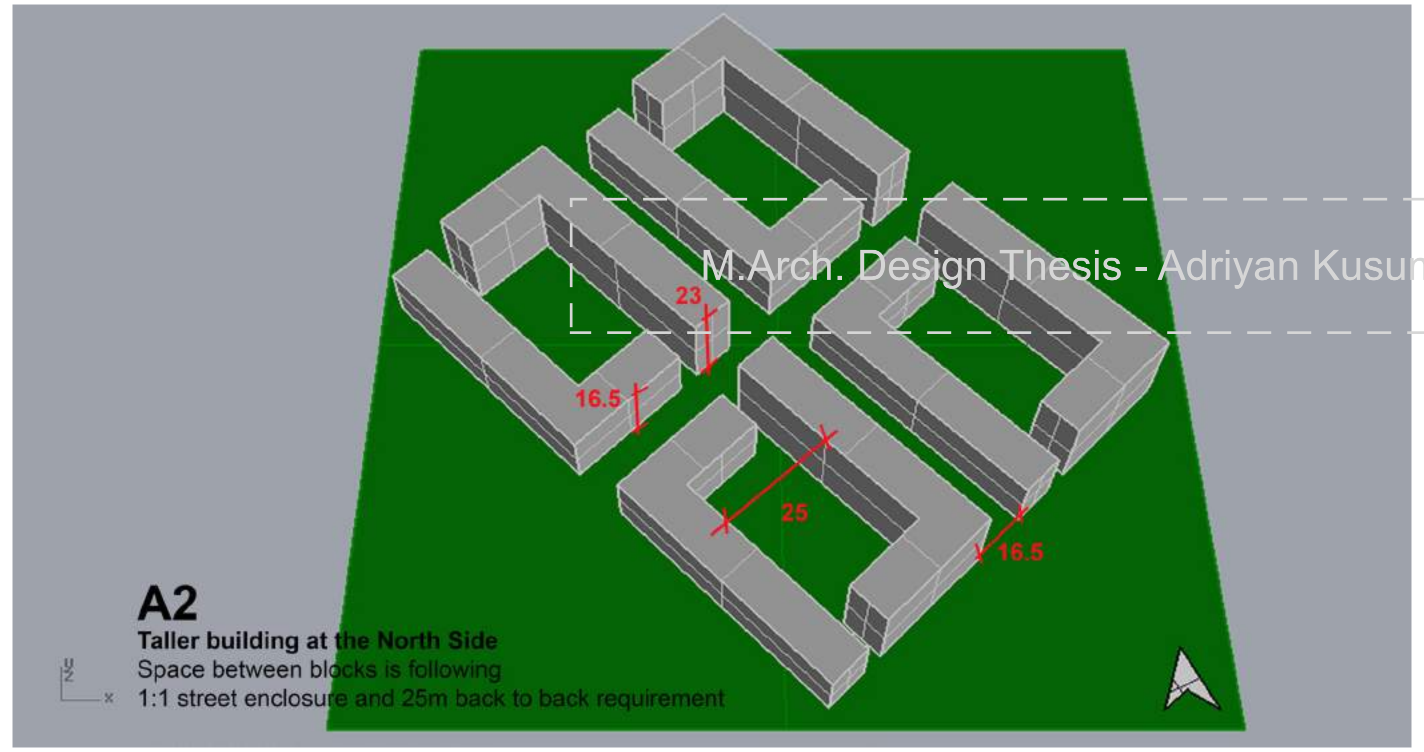
Module A2 and A3 are the study module to test the hypothesis to achieve higher density by adding more floors. Module A2 will compare the results of common guidance that south side block is suggested to be lower to avoid blocking north block. It then will be compared to A3 as the hypothesis that south block should be taller.

Solar heat gain will be simulated with radiation map measuring the insolation. The cumulative insolation for the whole year method will be used to get the complete picture of the performance of the places.

The software DIVA for Rhino will be used for this radiation map simulation purpose. Compared to other current simulation software, DIVA can provide faster simulation process but still come with sufficient accurate result for the purpose of this thesis. DIVA for Rhino analysis uses method which uses GenCumulativeSky modules with pre-processed continuous cumulative sky radiance distribution throughout discretized sky vault (Robinson and Stone, 2004)







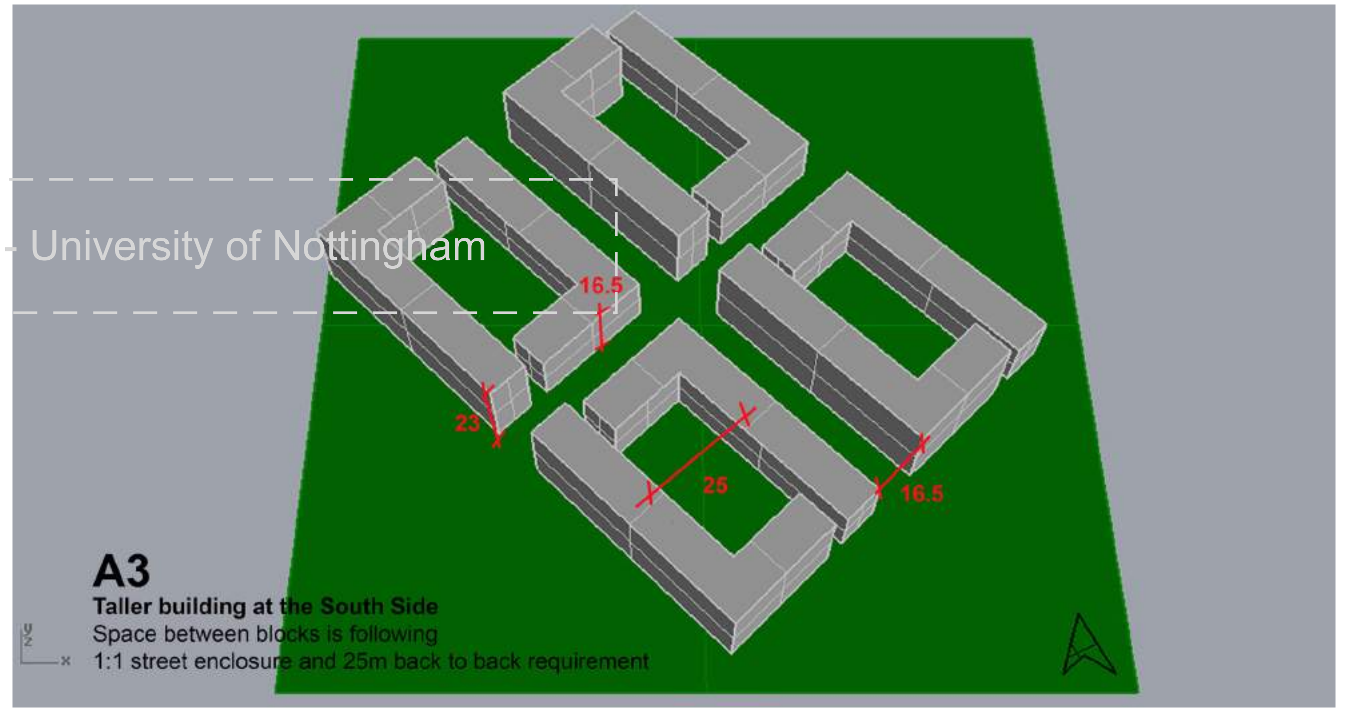


Figure 3.1 to 3.4 (Opposite page) Radiation Module Test

The four test module with their parameters to be compared during the analysis. *(Image source: Author)*

data collection & analysis

4.1 Simulation Results and Analysis

Simulation conducted on the four modules provide results as shown in false colour images which can quickly show the radiation distribution on each of tested blocks and orientations. Comparison can be done by evaluating each of the colour of block surfaces.

To obtain more comparable radiation measure, another round of test is done on all the fours with grid based radiation simulation which using specified nodes on the surfaces. The grid based simulation will provide mean value of each radiation on the surfaces.

The mean values are then translated into table and graph which will give quick insight on the results as shown in table 4.1 and figure 4.1.

Simulation results shown in the radiation map images depict the condition where taller building exist in the block, the radiation received is higher shown with more orange and red colour.

This effect is true according to the the fact that the taller building will add more surfaces receiving the solar radiation. This will bring the question whether this simply adding the building surfaces will be useful for the user.

In fact, taller building add more surfaces which add more chance

Radiation Value on Perimeter Block's Layout and Configuration

Test Module	Description	Mean Radiation		
		East-West	North-South	45degree
A1	Benchmark	560.28	570.74	516.47
A1b	Benchmark, Adjusted	522.56	572.03	518.29
A2	Taller North Block	589.98	594.08	554.72
A3	Taller South Block	608.03	601.84	563.29

Table 4.1 Mean value of solar radiation on each module for each orientation simulation.

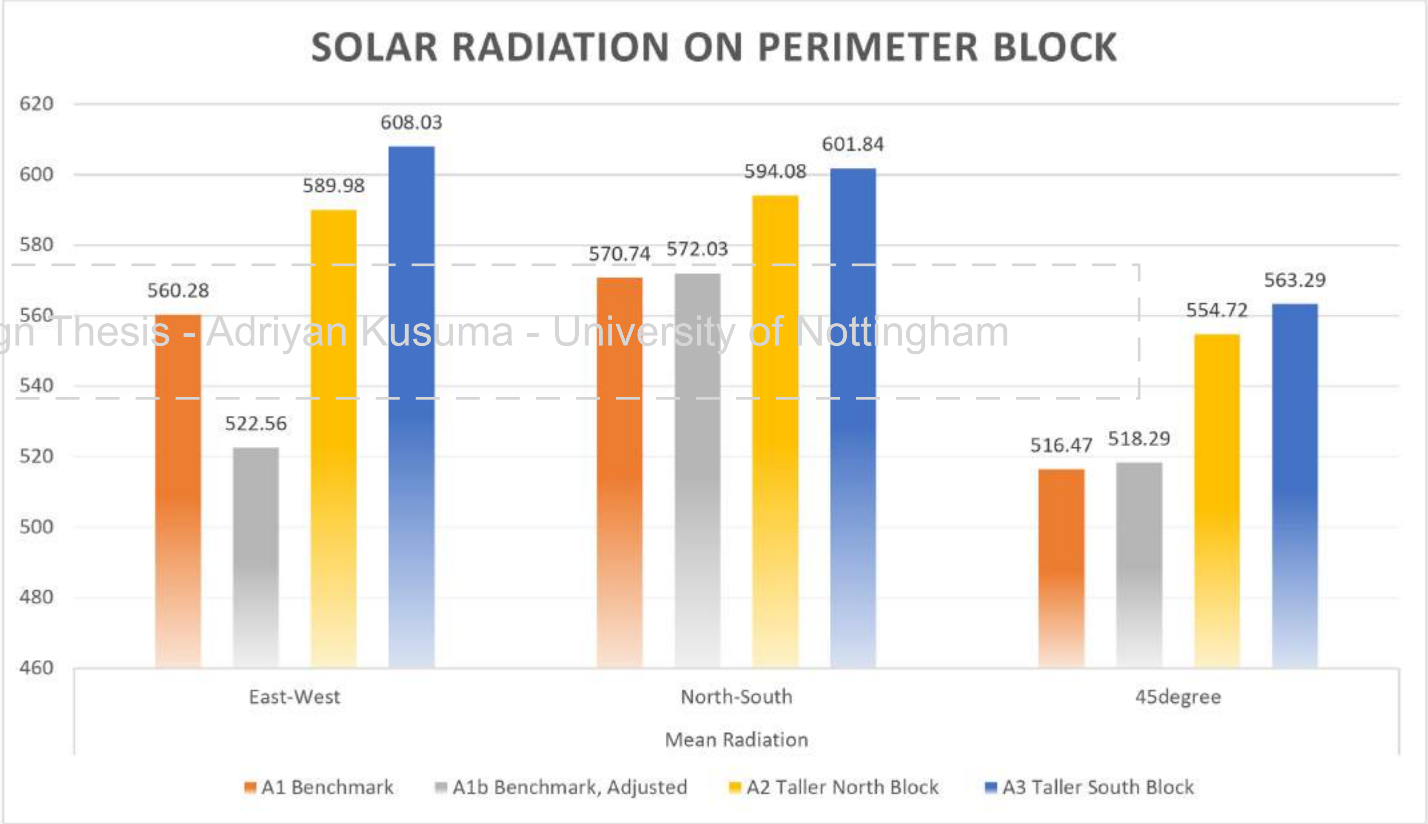


Figure 4.1 Mean value of solar radiation compared to each module and orientation

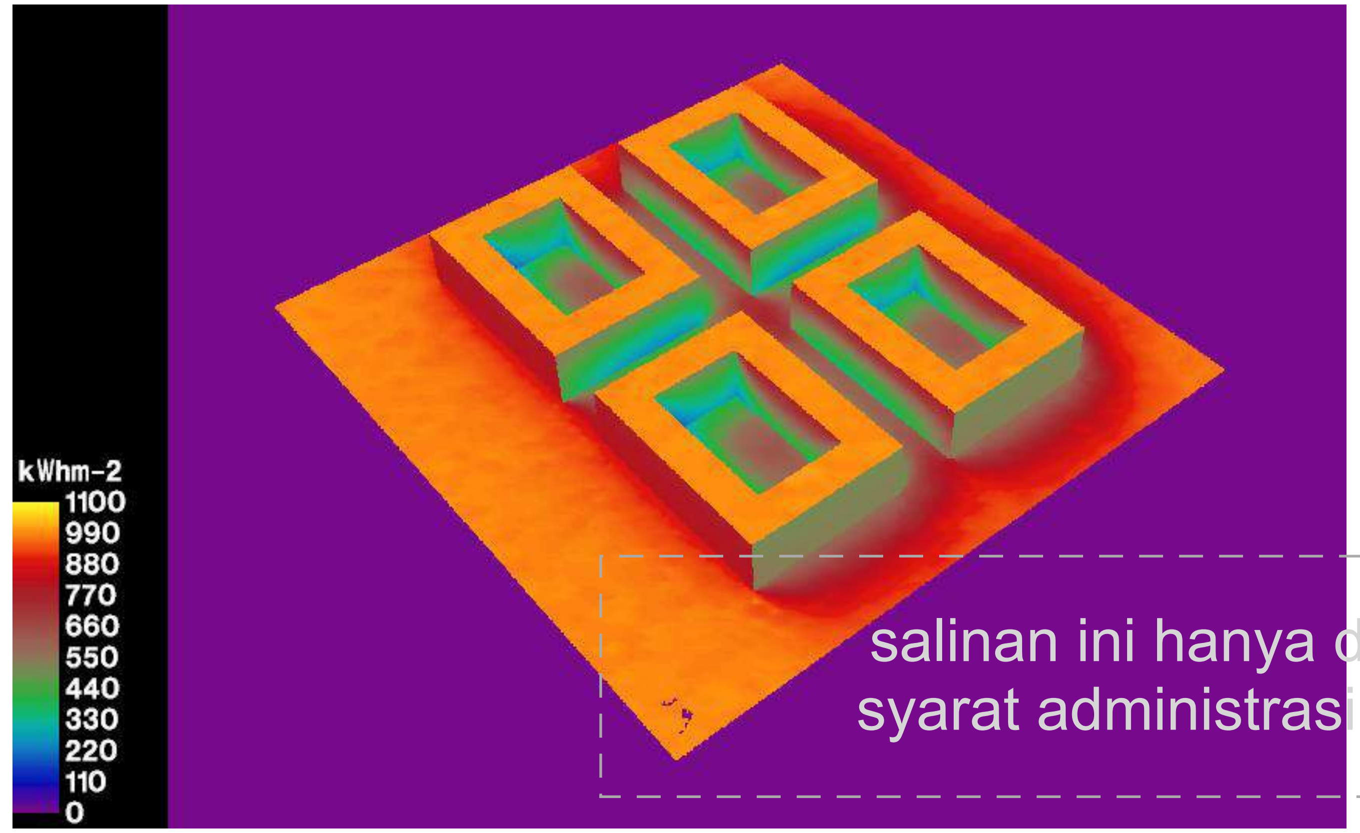


Figure 4.2 Solar radiation map on module A1 in east-west alignment

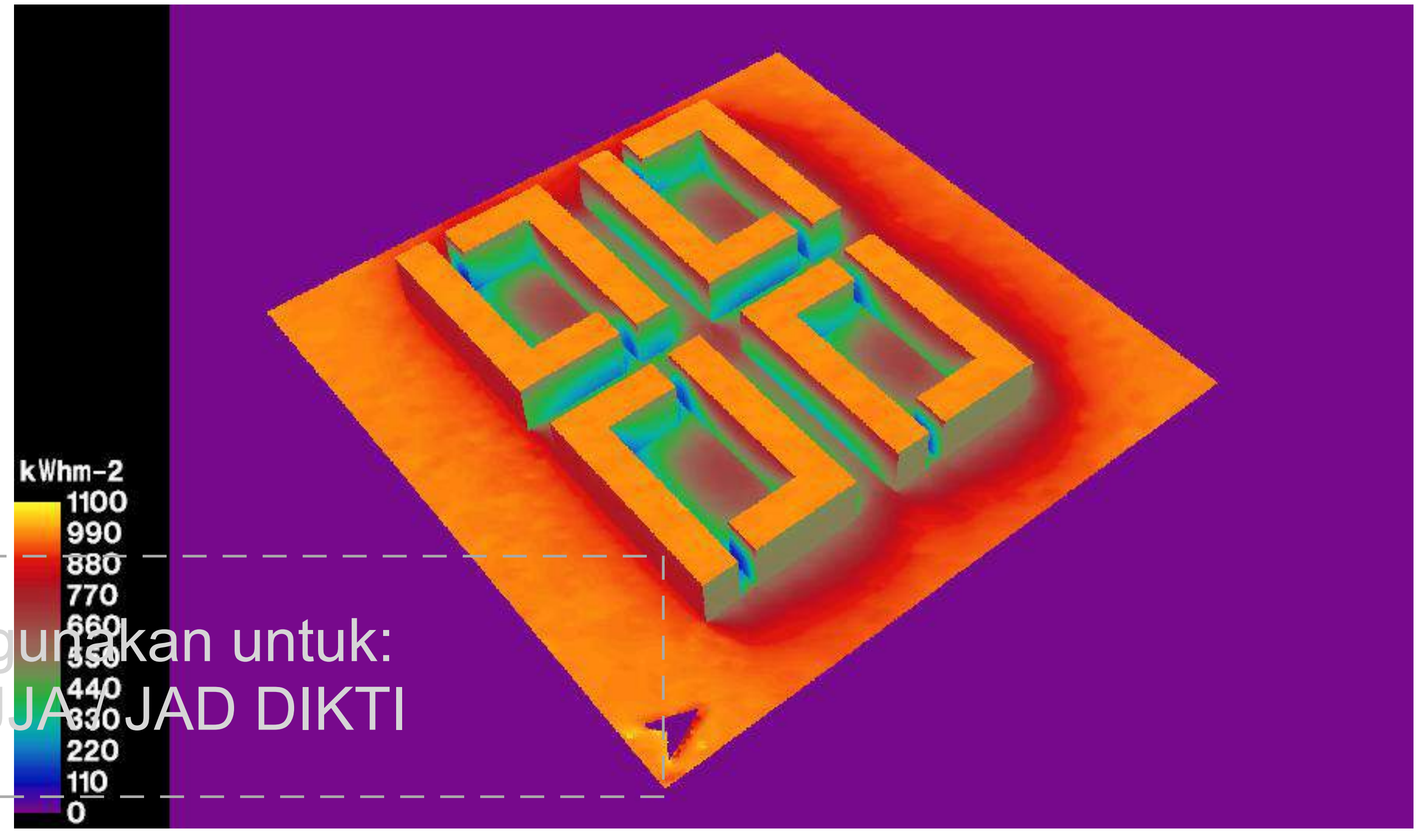


Figure 4.3 Solar radiation map on module A1b in east-west alignment

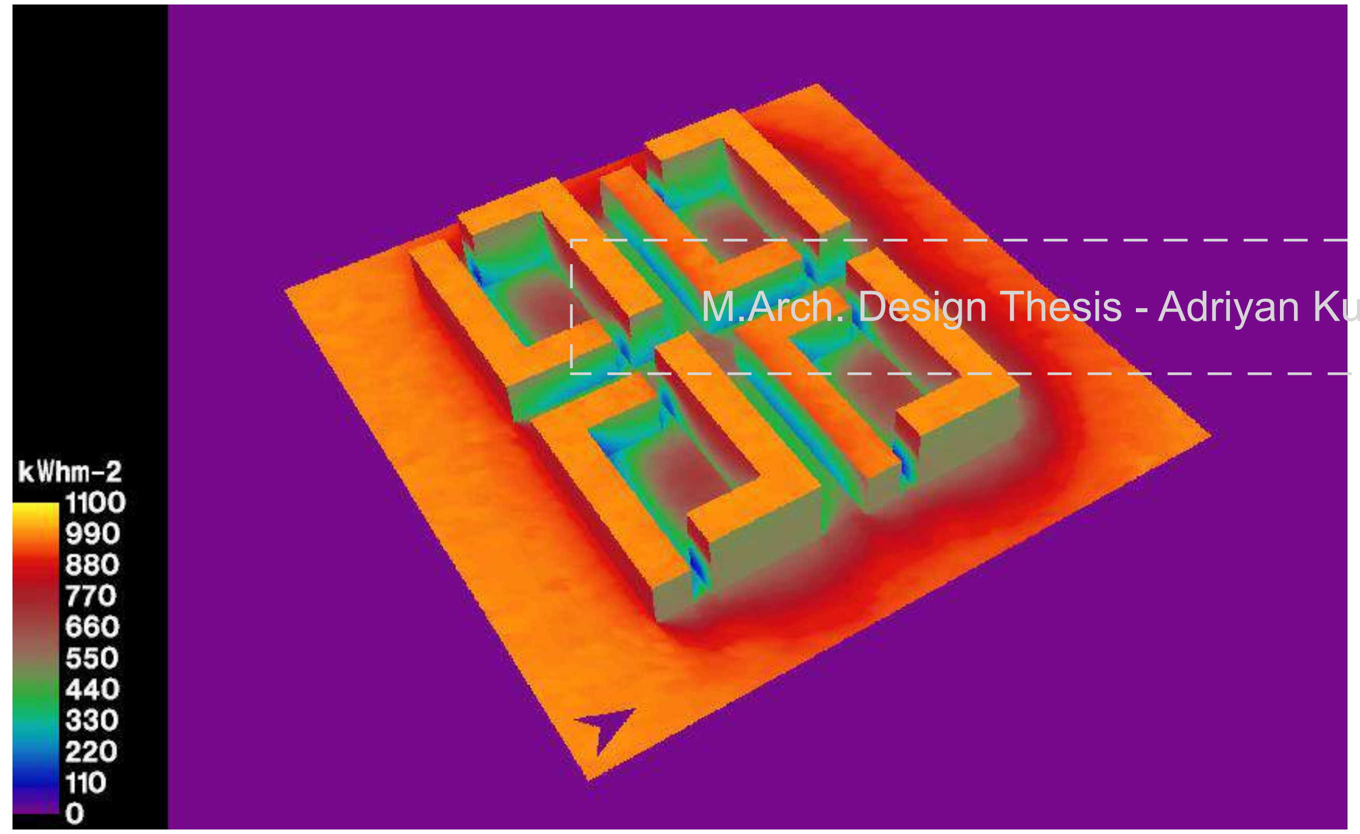


Figure 4.4 Solar radiation map on module A2 in east-west alignment

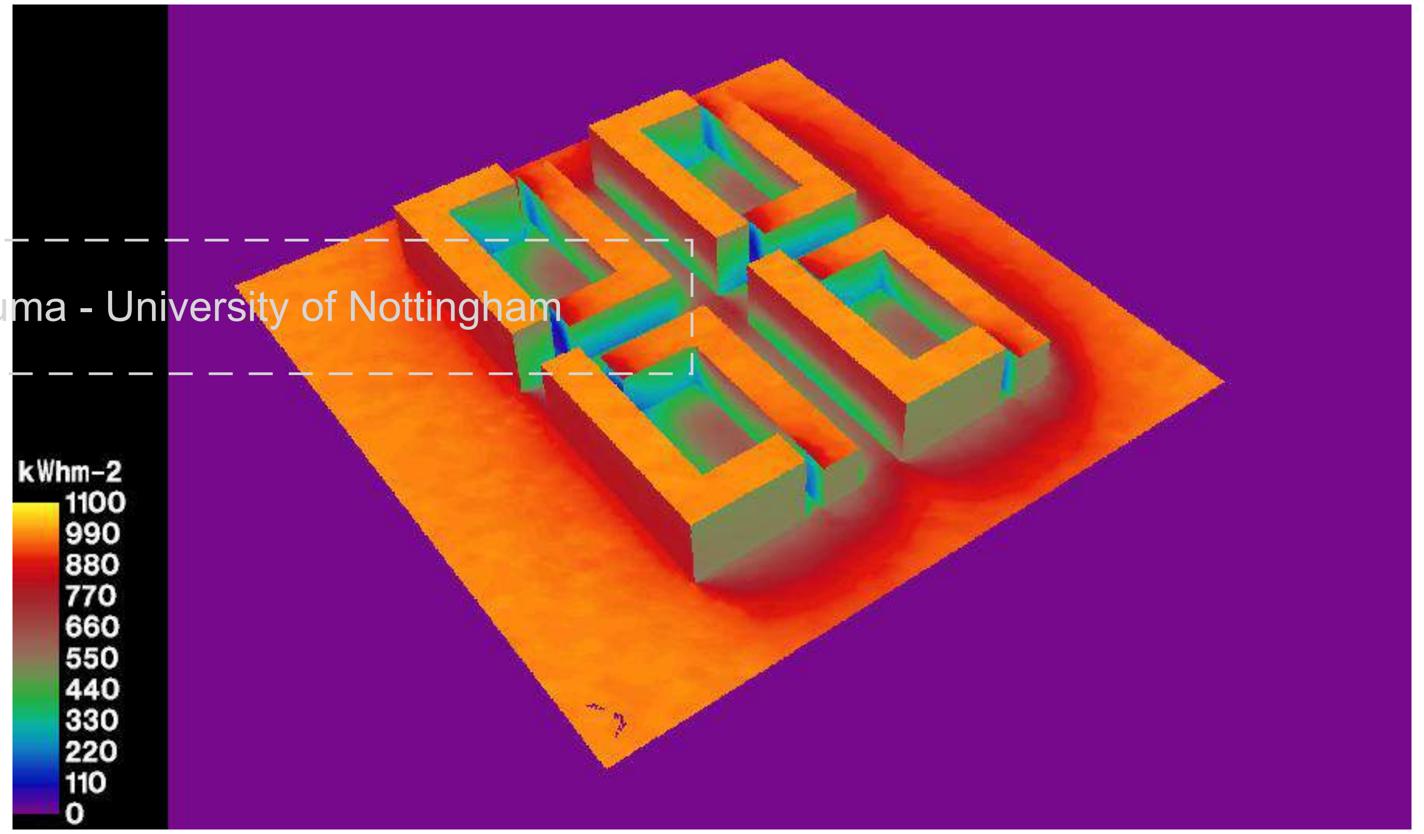


Figure 4.5 Solar radiation map on module A3 in east-west alignment

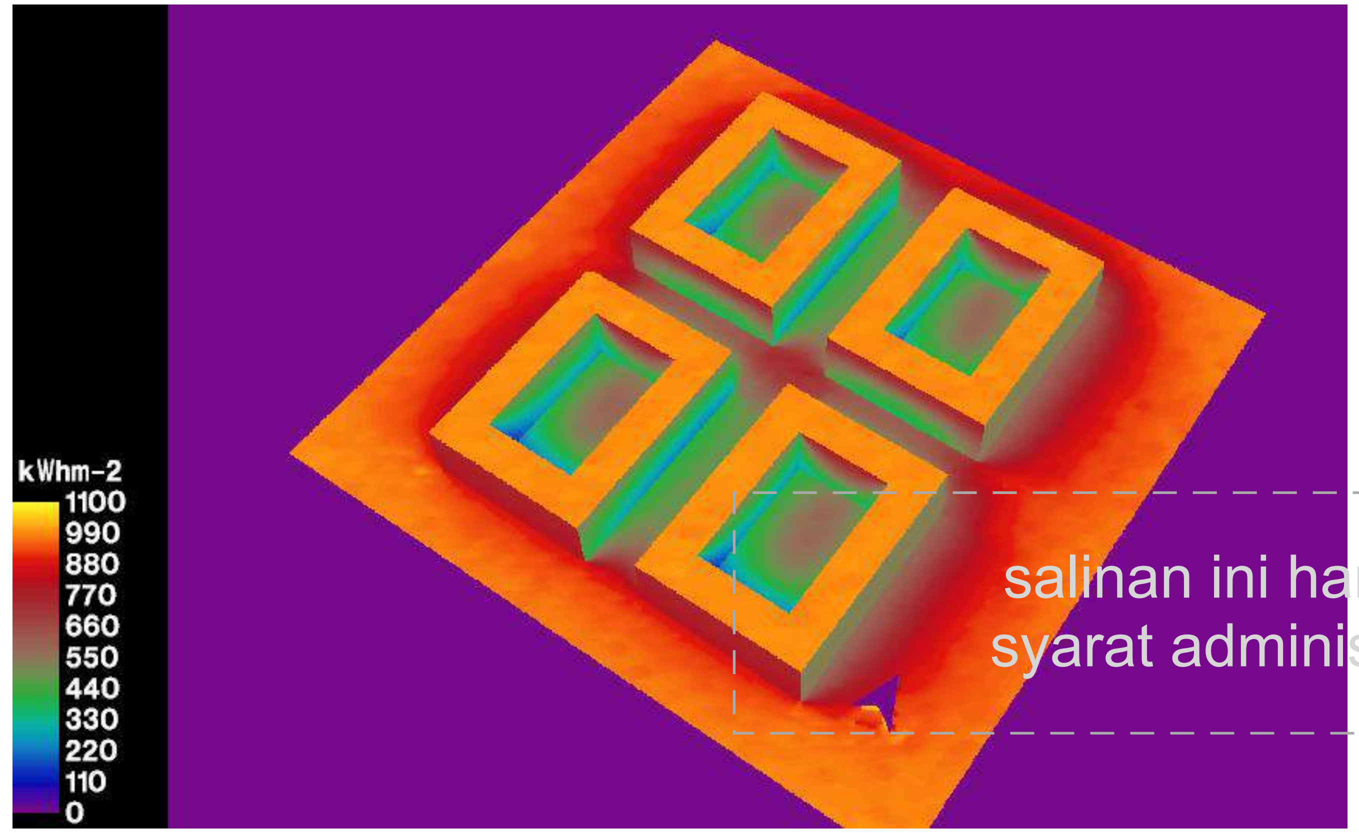


Figure 4.6 Solar radiation map on module A1 in north-south alignment

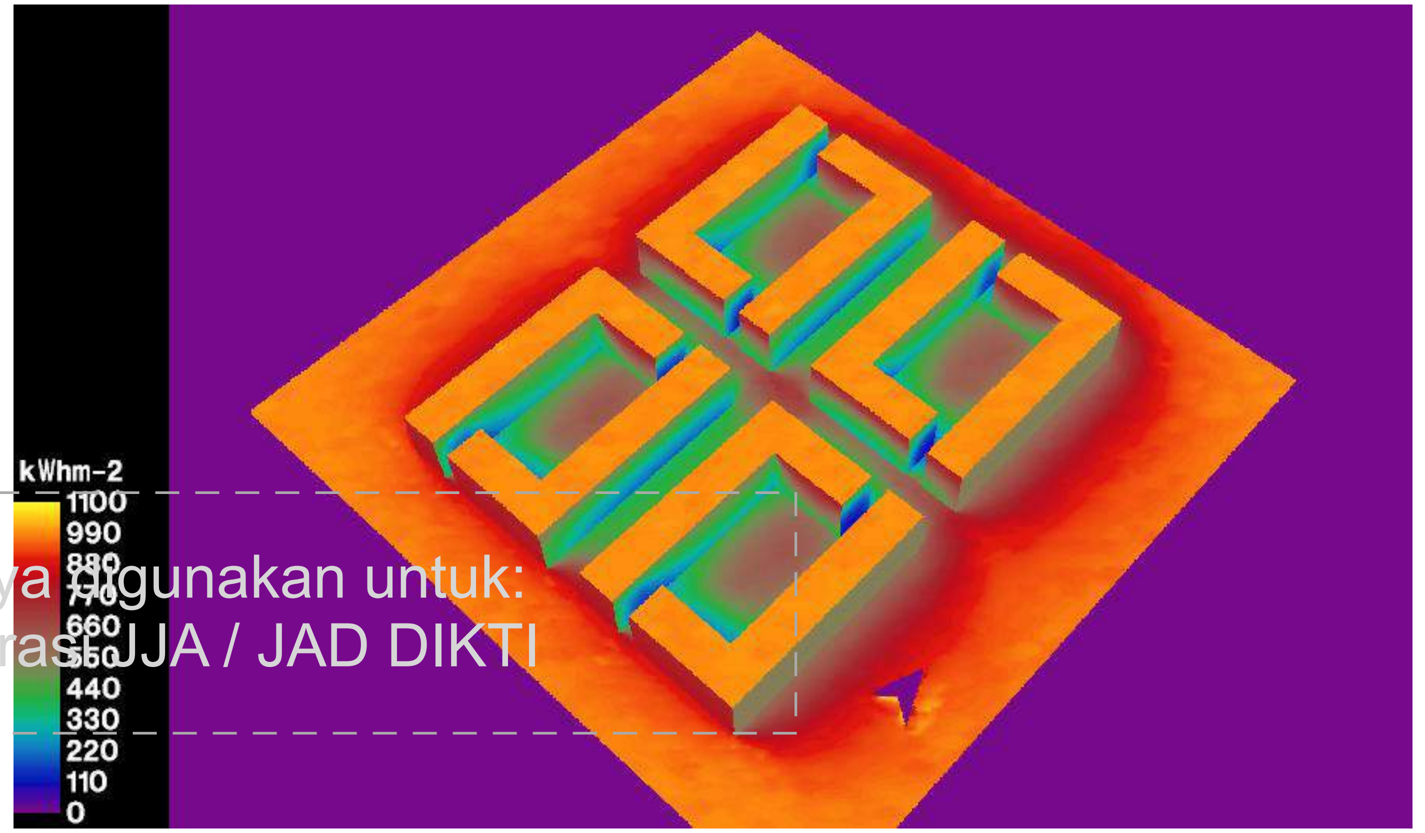


Figure 4.7 Solar radiation map on module A1b in north-south alignment

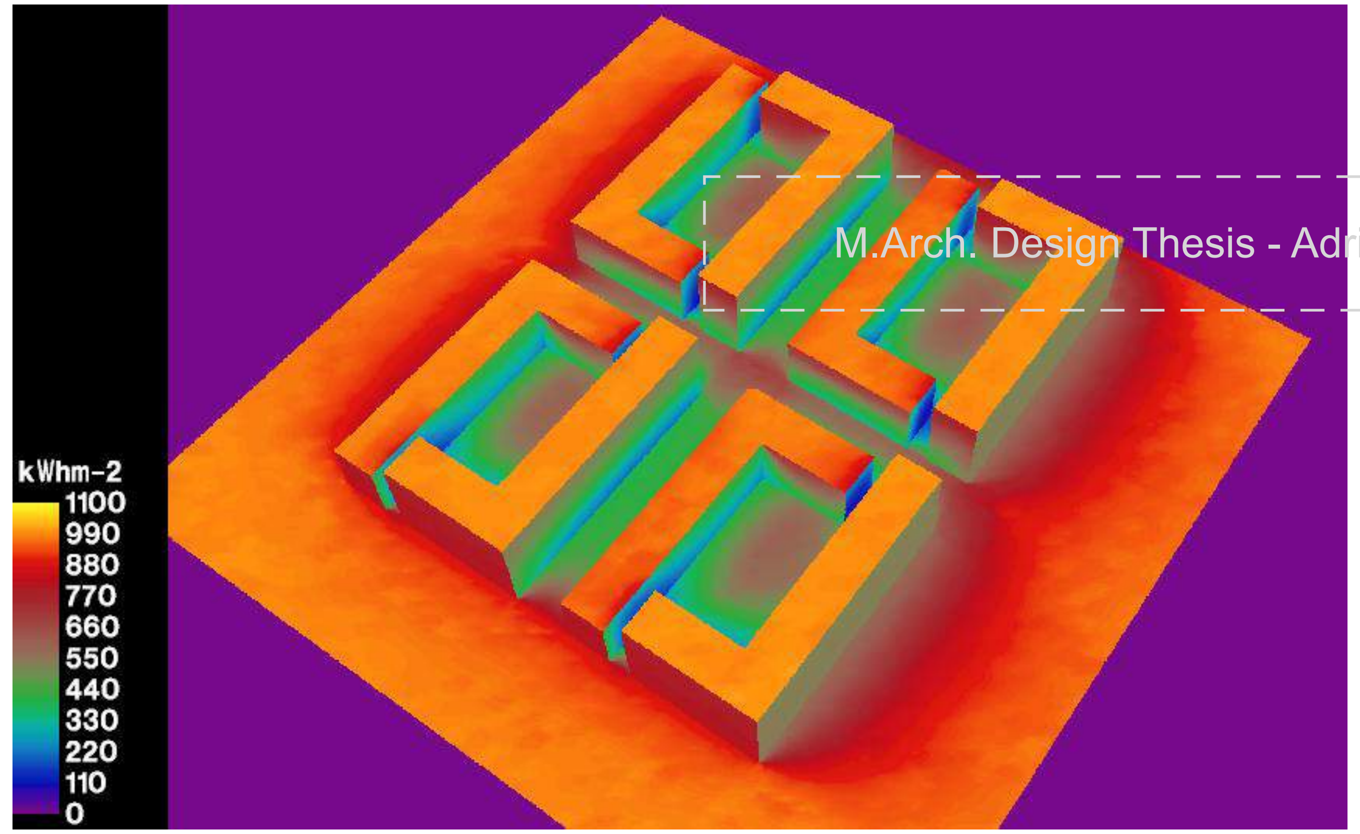


Figure 4.8 Solar radiation map on module A2 in north-south alignment

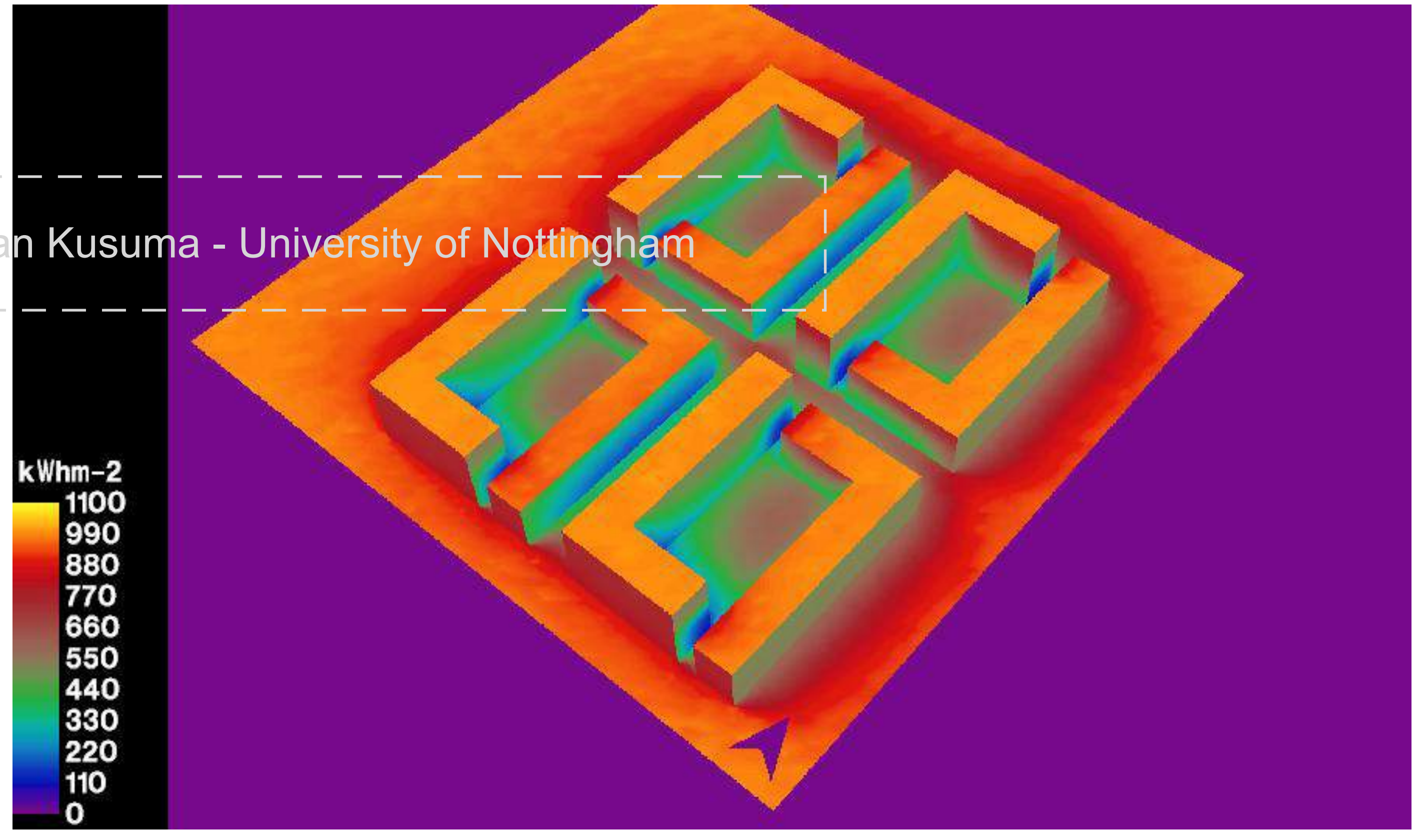


Figure 4.9 Solar radiation map on module A3 in north-south alignment

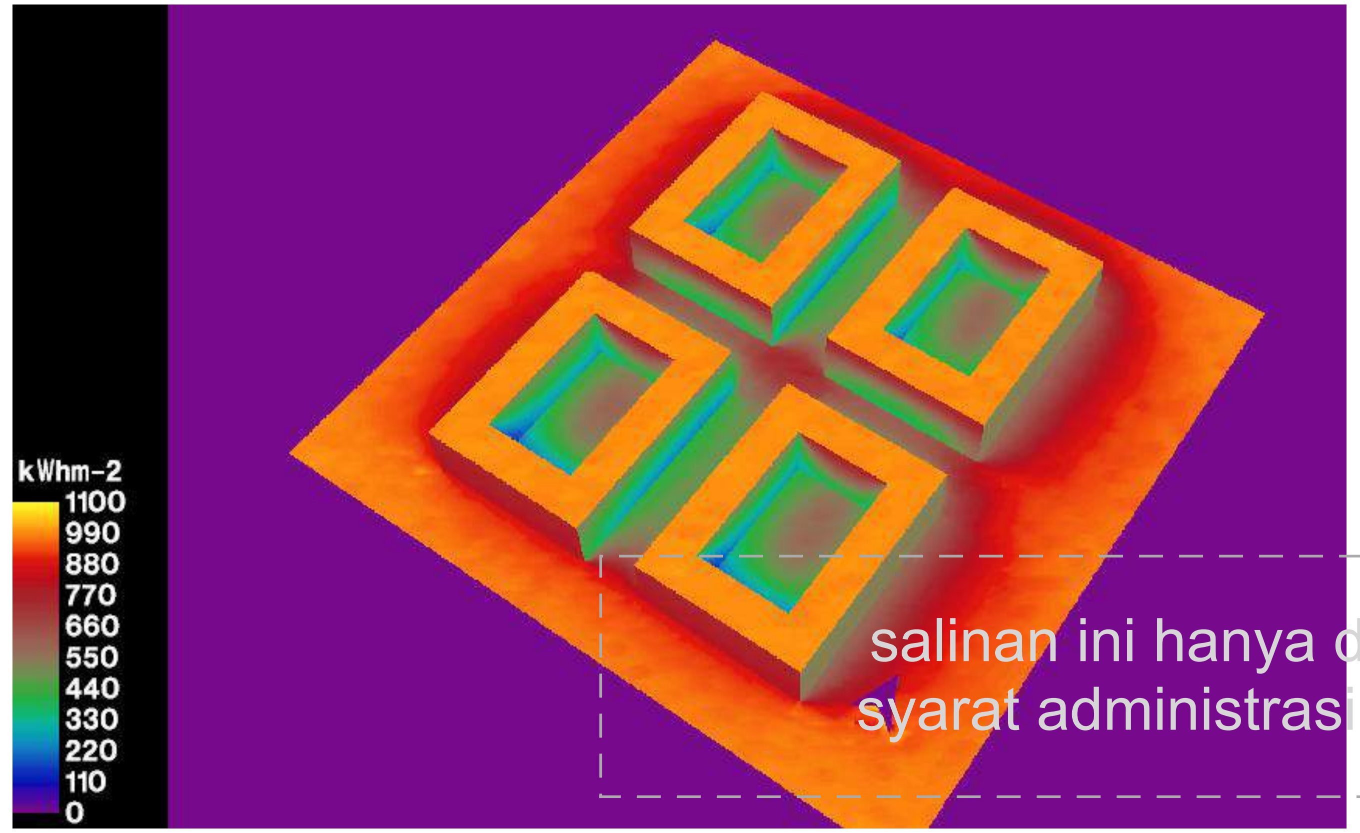


Figure 4.10 Solar radiation map on module A1 in 45 degree orientation

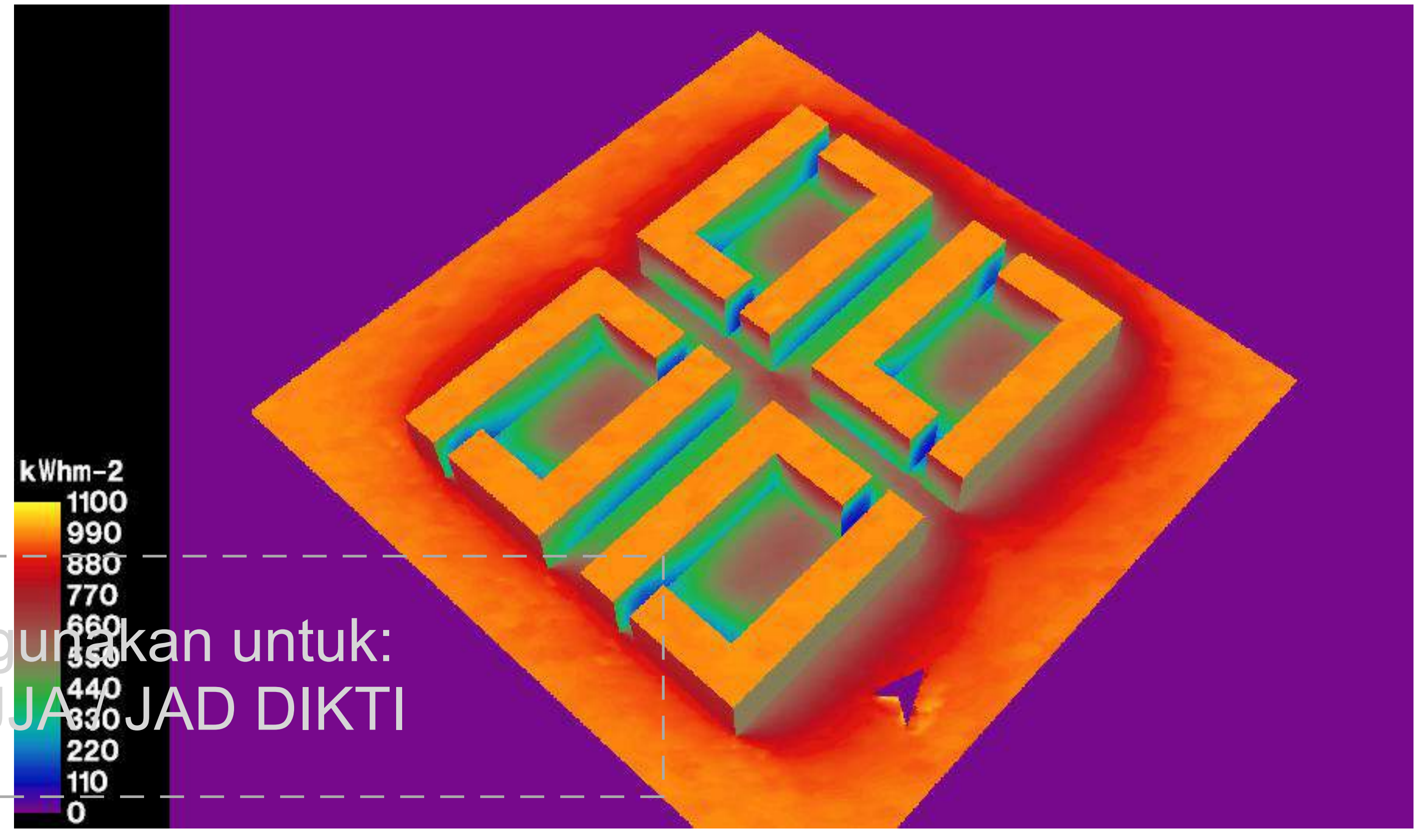


Figure 4.11 Solar radiation map on module A1b in 45 degree orientation

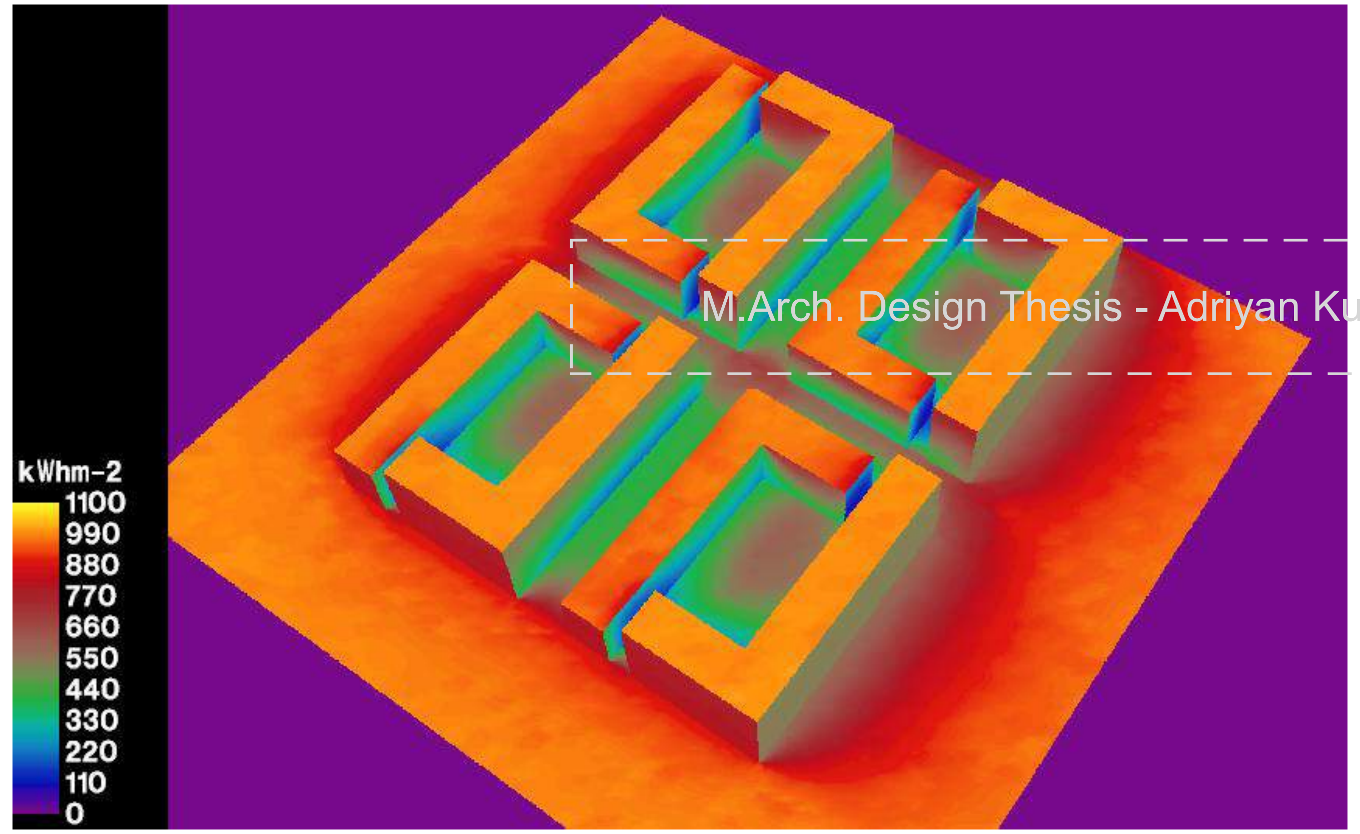


Figure 4.12 Solar radiation map on module A2 in 45 degree orientation

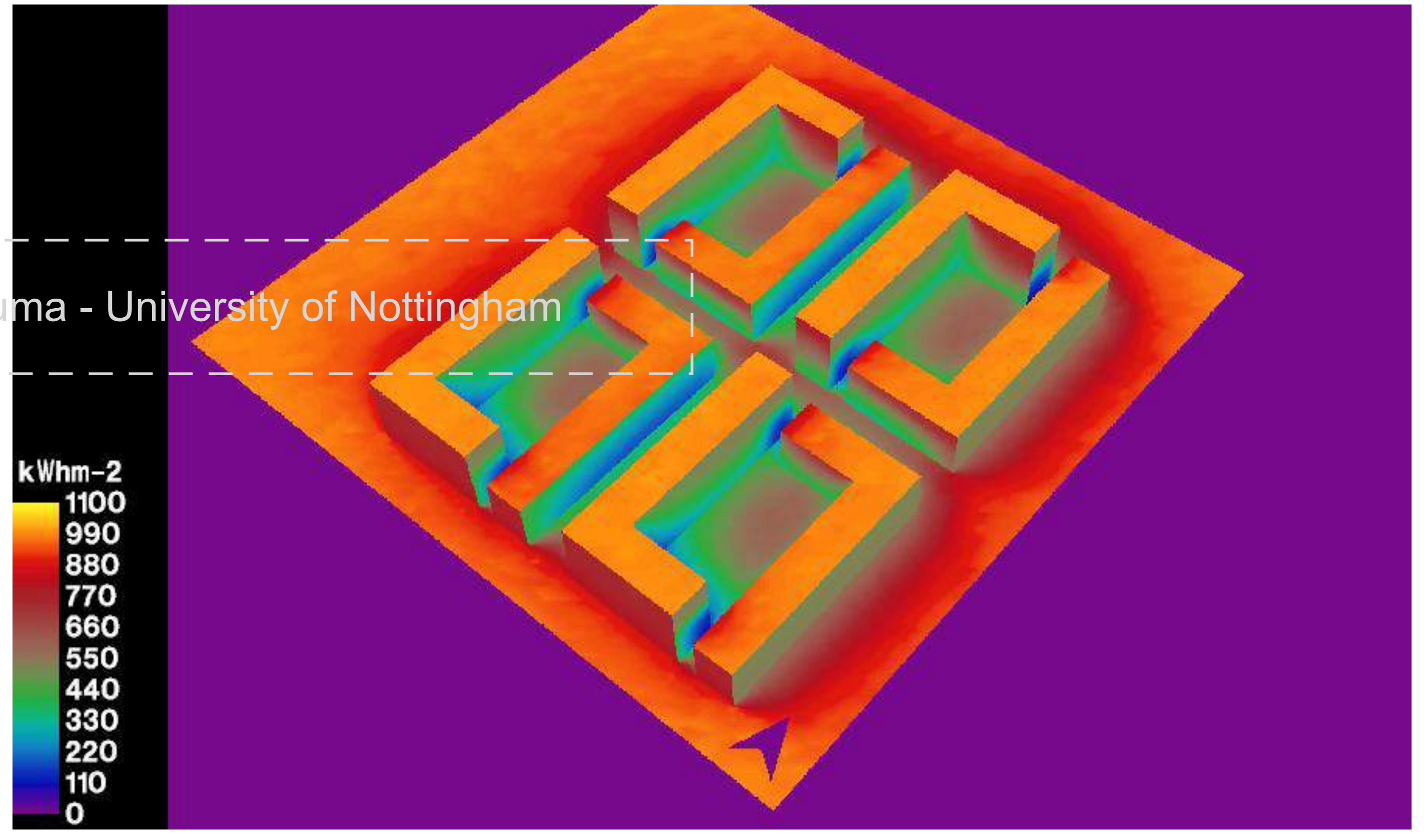


Figure 4.13 Solar radiation map on module A3 in 45 degree orientation

to receive solar radiation and has potential to turn them into environmental friendly solar power through solar panel or also photovoltaic panels. The potential to gain solar power through PV panel is shown with more surfaces receive more than 800 kWh/m2 annual cummulative radiation.

The location of the taller building also affect the amount of the radiation received. This is clearly demonstrated by the results of module A2 and A3. Both of them gain higher mean value compared to the block with uniform building height.

Further to that, when the taller building is located on the north side, the amount of radiation is lower compared to when the taller building located on the south side. This condition itself does not follow the common rule of thumb and guide that suggest to have taller building on the north side instead of on the south side in order to avoid blocking if there is taller buildings on that south side.

It can be analyzed further that infact the taller north side of block A will conceal the access to solar radiation to the next adjacent block, namely block B. It could be worse if the next adjacent block has lower south side block which mean it will be totally blocked by the block A. The condition can even be more difficult if especially the distance between the block, which usually the street, follow the enclosure ratio which sometimes goes tighter from the recommended ratio.

In the condition where south side is taller, the same block still can cope with the concealment of solar access by maintaining wider courtyard distance which will more likely to follow minimum back-to-back distance, for example 25 meter. This will give chance for the north side block to still receive enough radiation. And if no necessary to become taller, this noth side should not be taller as it will affect the next adjacent block.

This situation support the earlier hypothesis that the consideration to have taller building on north or south side should take wider urban scope consideration. The hypothesis to have the building taller on the south side, to achieve higher density without compromising the comfort within the block, was supported by the simulation results.

It is apparently correct because developers often have more control for their own block and do not always have full control on the next adjacent block and street enclosures. The developers could manage to add density by for example adding floors on the south side and keep following the minimum distance which usually still within the acceptable distance especially to receive daylight and solar radiation while eventually do not necessarily become a hindrance for the other blocks.

Simulation results also shows that changing the orientation from east-west alignment to the north-south alignment does not give significant effect. Although it is true that with east-west alignment, it is the advantage of the block to gain more radiation with its south facing facade and avoid the excessive heat during the hot season.

Rotating the orientation toward 45 degree does not give more advantages compared to other orientation alignment. This could be analyzed that at north- south and 45 degree the solar radiation does not fall perpendicular on the surface.

The analysis on this simulation results has offered certain insight on how to better layout and configure the block within an urban setting. The finding that placing taller building on the south side gives more advantage can be brought and tested on the urban site context to be further analyzed and studied.

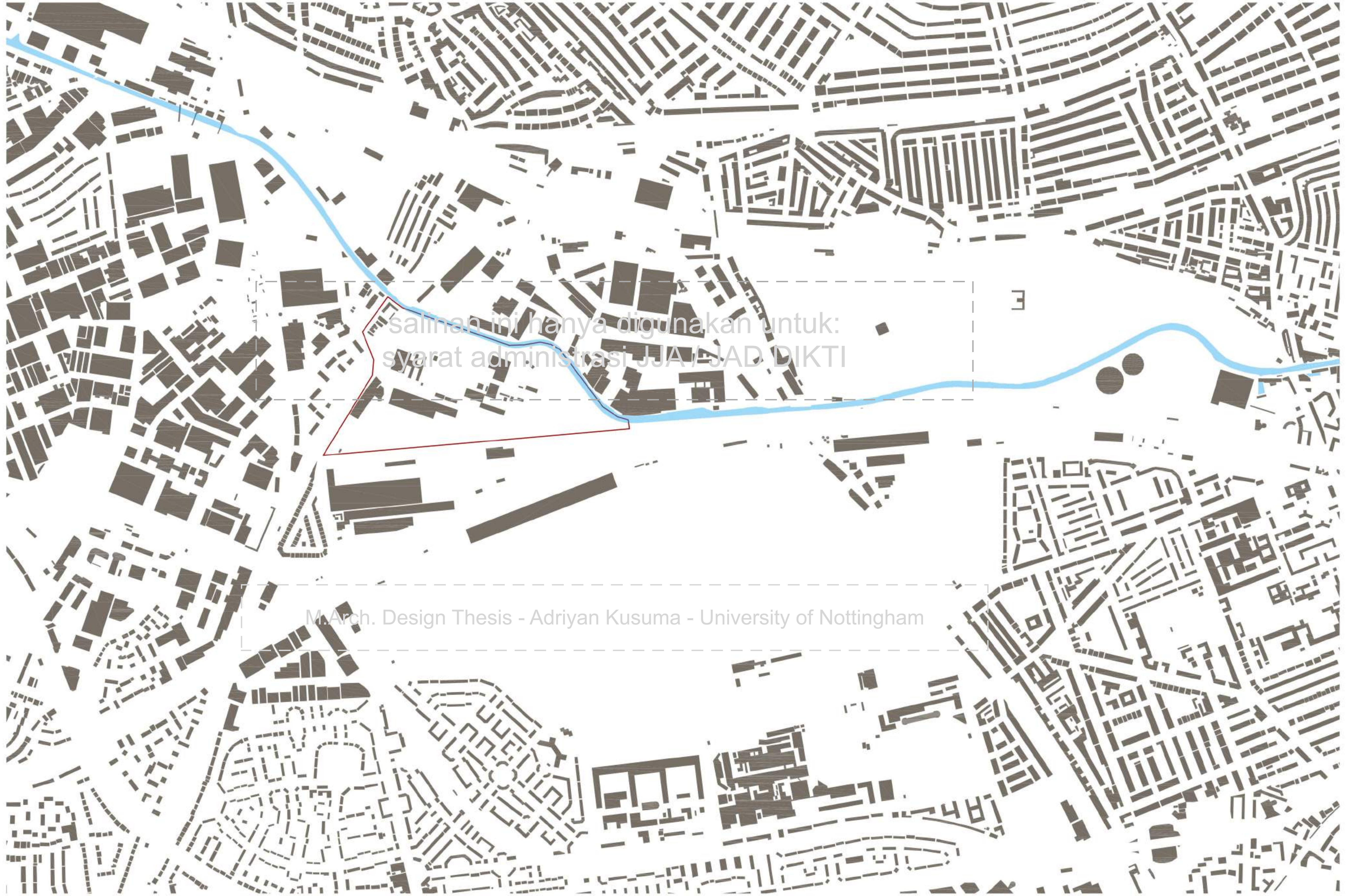


FIGURE GROUND DIAGRAM
1:10000

Figure 4.14 (Opposite page) **Figure Ground Diagram**

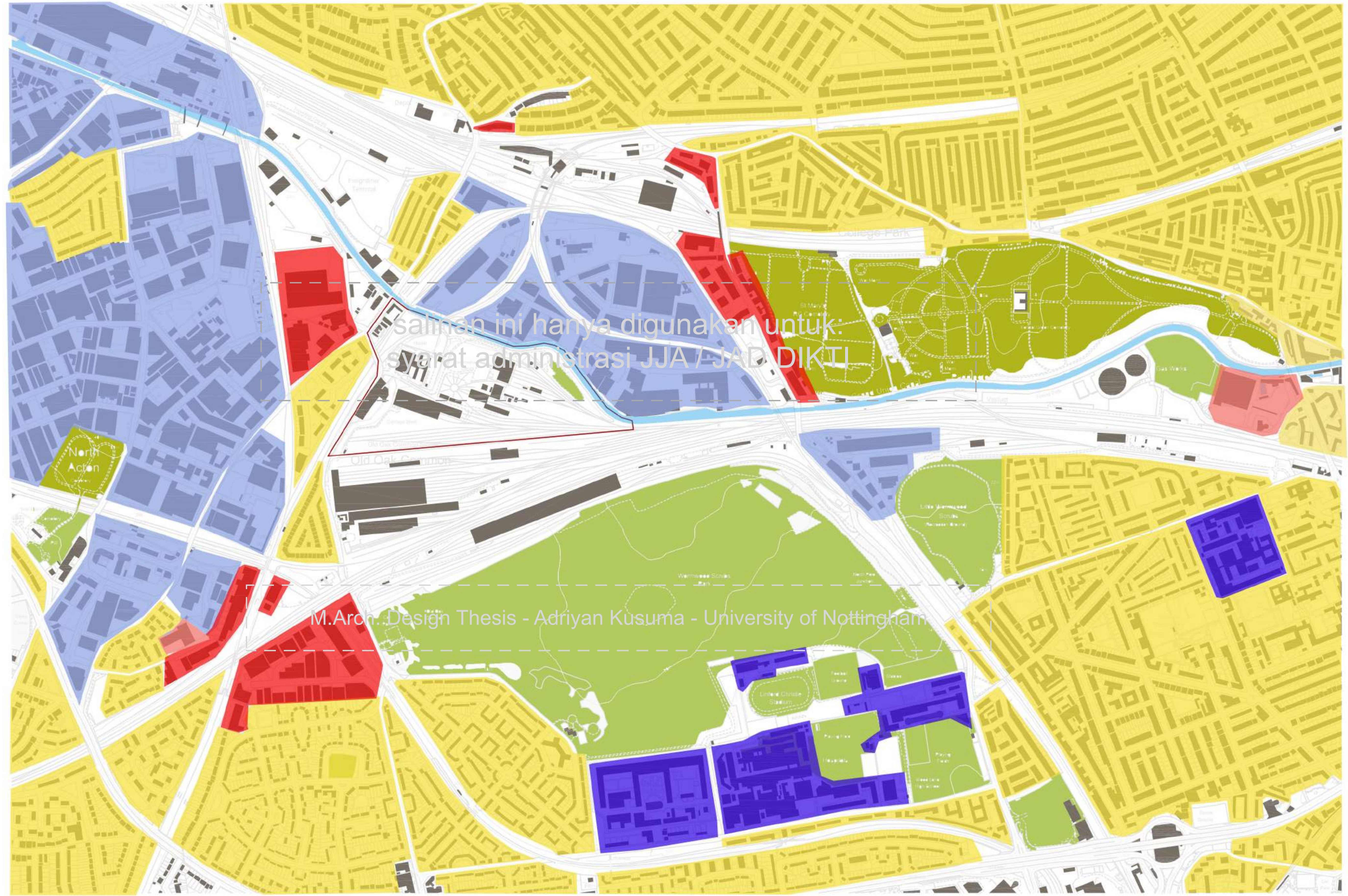
The figure ground diagram shows the morphology around the sites. Residential areas with fine grain are dominating the area surrounding the site in the radius of 500m or more.

Some industrial sites with their big blocks are dominating along the canal as the allocated industrial site within the Park Royal Opportunity area site.

The diagram also shows that there exist quite big undefined area and spaces. This is due to the nature of the current land use of Old Oak site and its surrounding which is dominated by industrial uses and transportations especially railways. This condition creates fragmentation of urban areas.

4.2 Old Oak Site Analysis

Further to the initial analysis and background described in the introduction chapter, Old Oak site urban design strategy will also be based on detail analysis as shown in the following diagrams.



LAND USE DIAGRAM
1:10000

Figure 4.15 (Opposite page) **Land Use Diagram (Ground Floor)**

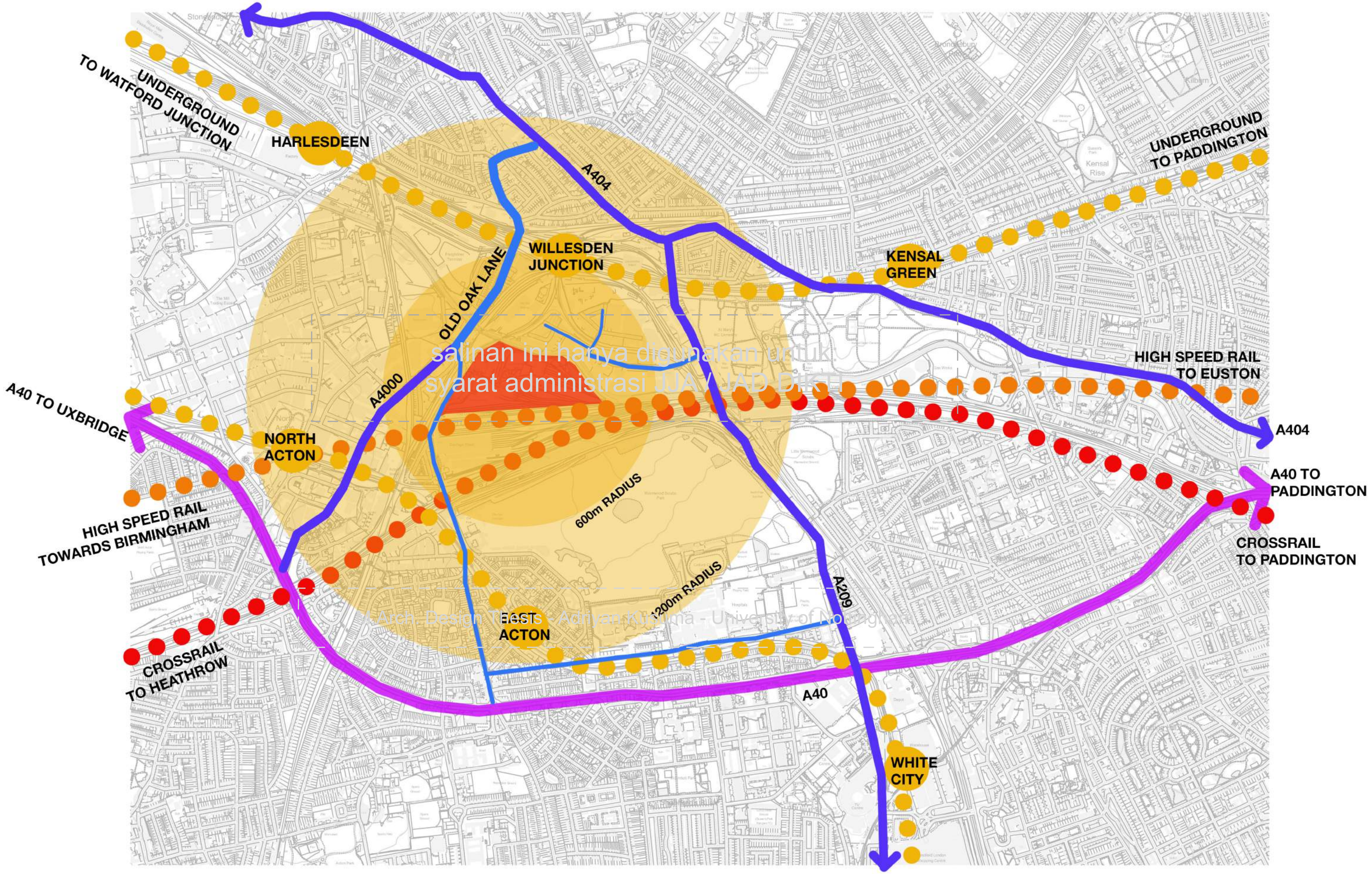
The land use diagram further depicts the condition of urban fabric and its function within and surround the Old Oak site.

As it is clearly shown that residential use dominates the vat area within 500m or more than 1km radius. Industrial uses are still dominating the closest part from the site. Old Oak site itself still falls in the Strategic Industrial Land (SIL) and Preferred Industrial Land.

Certain other facilities and uses like retails and schools or other public facilities are spread all over the area creating fragmented and discrete urban area.

However, there are major green and open spaces adjacent next to the site which is Worm Scrub Green on the South and Kensal Cemetery and Kensal Park towards the East which later could have potential as good destination public space that could be connected to and from the Old Oak regeneration.

It is also apparent that Grand Canal Union that goes passing by the site will give opportunity to integrate te site with the water canal and to toher places currently connected by the canal.



TRANSPORTATION NETWORK
1:15000

Figure 4.16 (Opposite page) **Transportation Network Diagram**

The Old Oak site is strategically within close distance to some strategic road leading to the main road and highways.

The plan to establish the High Speed Rail 2 line and building the station, Old Oak Common, within the site will enhance the connectivity of the site. Crossrail lines which is under construction will also have station stop at the Old Oak Common.

Railways connections, either underground (tube) and overground line connected to Willesdeen Junction which is within 600m northward from the site.

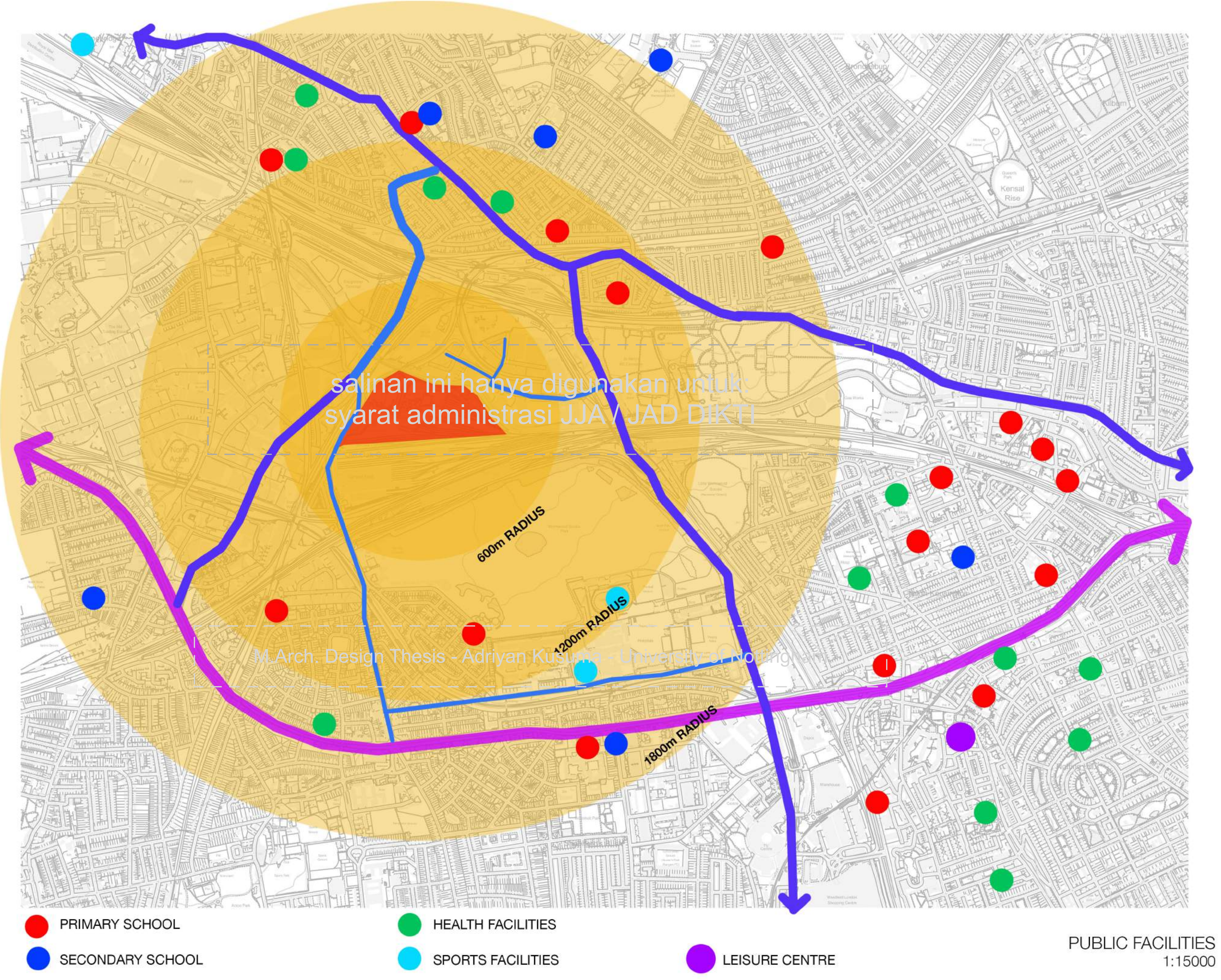


Figure 4.17 (Opposite page) **Public Facilities Diagram**

The site is mainly lack of easy and close access to public facilities. More civic and public facilities are located within 500m to 1km from the site. This is due to the situation that currently the site functions as railways depot and also industrial zone.

The regeneration of Old Oak should then provide more facilities within the site or provide proper access and linkages to the outside facilities.

Figure 4.18 (Opposite page - Above) and 4.19 (Opposite page - Below) **Existing Site Condition**

The site is currently occupied by railways track and railways depot which left the site barely empty and vacant. The railways depot is planned to be relocated to left the Old Oak site having its regeneration development.

There are currently one block of residential in the zone which is now defunctioned to give ways to the development of the Crossrail tunnel.

Long brown building on the left shown in the figure 4.18 is currently the temporary factory building part of concrete tunnel for Crossrail development. In the meantime, the building shown on the right side of figure 4.18 is currently depot for overground railways which is now still functioning. This line of railways depot and its track cut the access from the Old Oak site to the ***Wormwood Scrubs*** park , a big but underutilized open park. The park is only accessible from the residential area at the south of the park.

Figure 4.19, taken from the water canal toward the south facing the site, is clearly shows the temporary Crossrail concrete tunnel factory.

Water canal divide the site from the big area of industial use which now is currently occupied by car industry and storage as well as freight and delivery.

Part of London skyline towards the east of the site can still be seen from within the site. This could create a potential view for higher point within the Old Oak site.

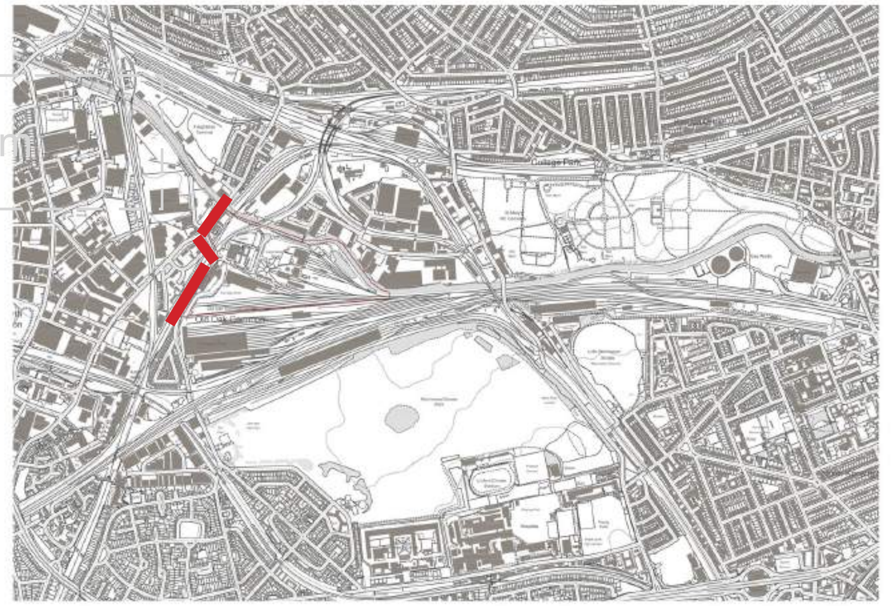


Figure 4.20 - 4.25 (Opposite page) and 4.26 - 4.29 (Following page)

Existing Surrounding Site Condition

The figures on the left are showing the condition of Old Oak Common Lane which is situated directly on the west boundary of the Old Oak site.

Because of there is not many buildings and activity, the road become rather quite. Eventhough there is pedestrian way provided as well as bus lane and bus stops, the quality of the road and access do not encourage people to use it.

The road is still considered as local main road which only capable of allowing current traffic. Double decker bus can not go pass through this road as there is elevated railways crossing the road which limit the accessibility of the site and its surrounding.

To support the regeneration of Old Oak site as it will be a high density development with national and international rail connection, this Old Oak Common Lane should be made wider and more accessible.

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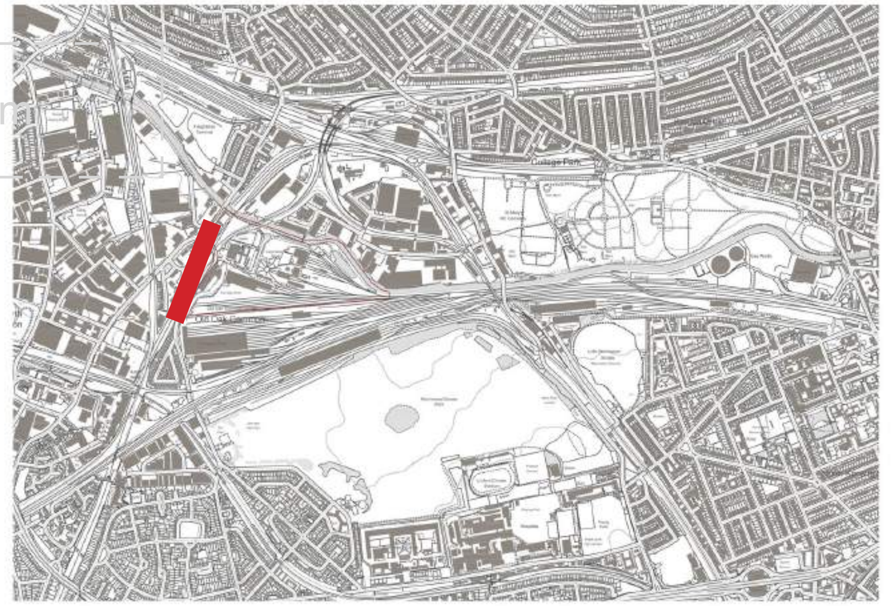

Figure 4.26 - 4.29 (Opposite page) **Existing Surrounding Site Condition**

Typical problem in the Park Royal area including the area surrounding the Old Oak site is that the high dependence on the private car. This is partly caused by slow and unreliable some of the bus routes, unattractive public realms, walking and cycling routes.

There should be improvement for feeder access from Old Oak Common to the rest of surrounding area for example with bus services with bus interchange integrated into the site.






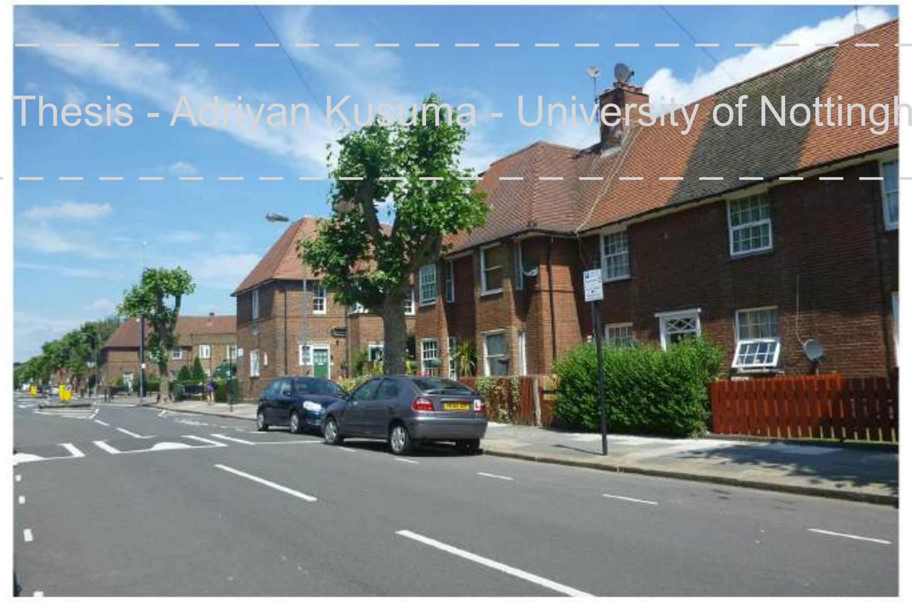
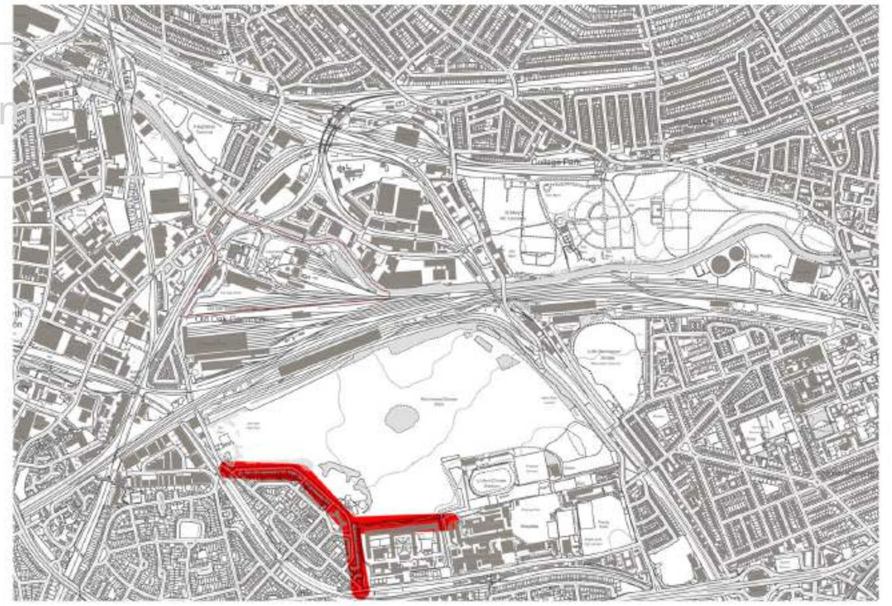

Figure 4.30 to 4.35 (Opposite page) **Surrounding Residential Area**

The figures show the residential area south of the Wormwood Scrubs park. This residential area is dominated by small flats, and semi detached houses. The neighbourhood has been matured and well kept with controlled access.

The Old Oak site will also be providing residential areas and should be made well connected to other surrounding including the Wormwood Scrubs park and this neighbourhood which also come with some civic and public facilities. Together with the facilities that is going to be provided by the regeneration of Old Oak site, these amenities will complement each other and create a more connected urban fabric.

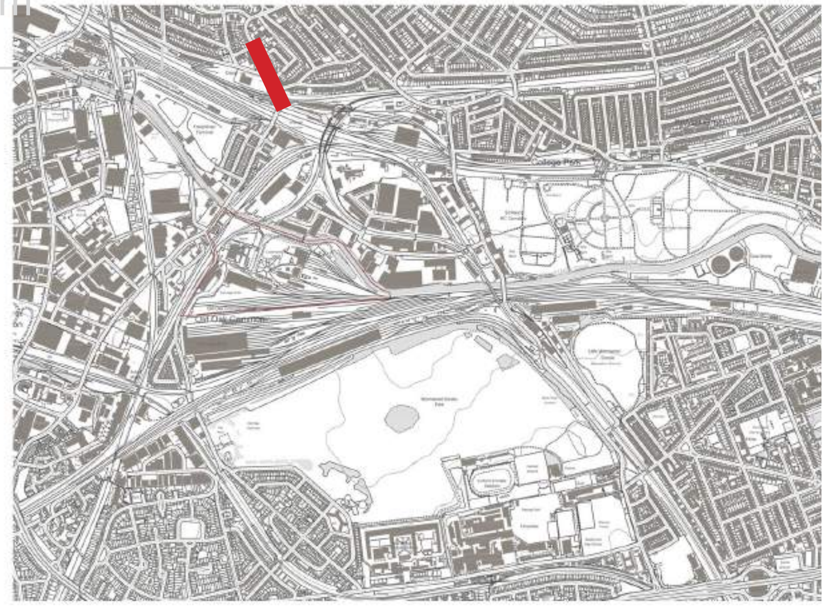

Figure 4.36 to 4.41 (Opposite page) **Surrounding Residential Area**

The is another matured community and residential area far north of the site. This residential area is situated near the Willesdeen Junction and close to the connecting road to Old Oak Common and Old Oak Common Lane.

This area is important as it will also be one gateway accessing to the Old Oak Common station later and Old Oak site. However, the current capacity of the road and neighbourhood could become a bottle neck threat as this is one of access to the Old Oak site from the north area.

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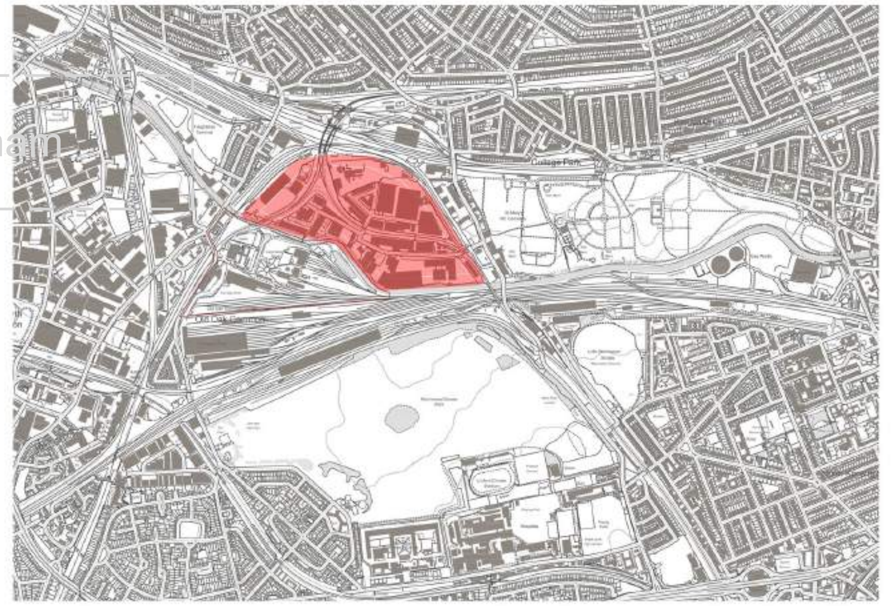


Figure 4.42 to 4.44 (Opposite page) **Surrounding Industrial Area**

The industrial area north of the site and separated by water canal. As there is plan to develop Old Oak, this industrial site is also planned to be relocated into the main industrial area of Park Royal.

Located on the north side of the site, this area could give opportunity to create access especially connecting the road from the west to the east.







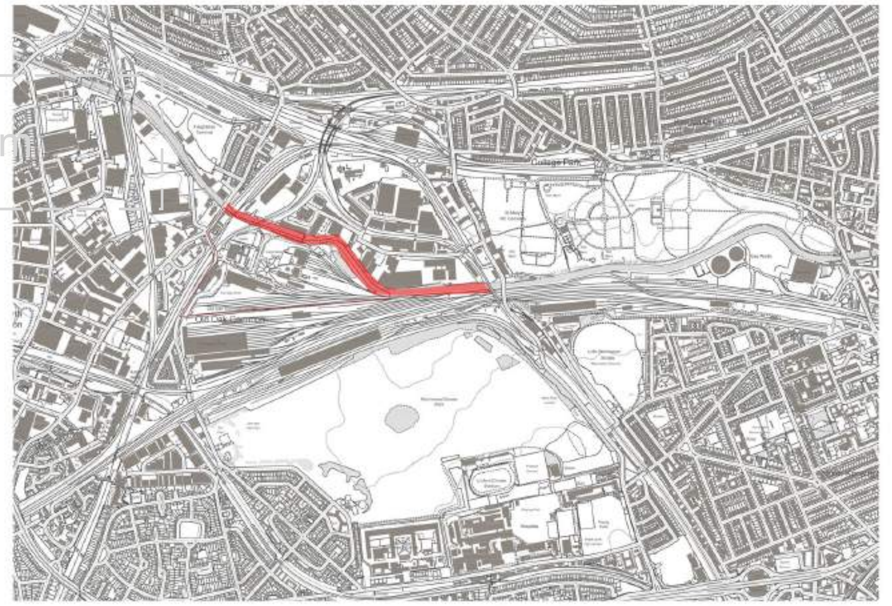


Figure 4.45 to 4.50 (Opposite page) **Water Canal**

The grand union water canal is a path connecting the park royal park and kensal rise by passing through the Old Oak site.

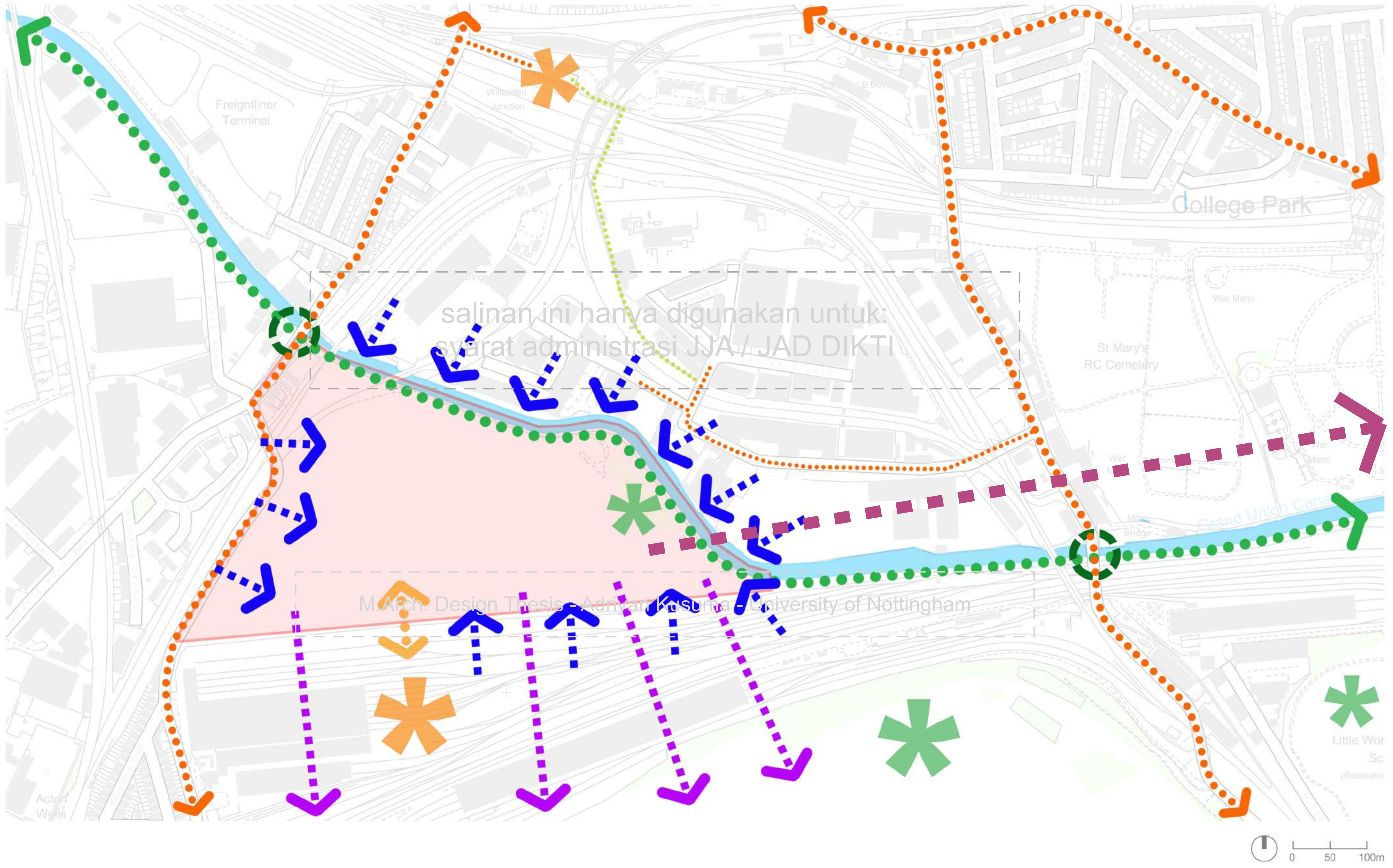
Opportunity to integrate the water canal path into the old oak development will also help alleviating the current condition of canal path which feels unsafe eventhough people are still using it.

Nature reserve and natural habitat in the canal could be supported and complement the effort within the site for example by providing biopond and bioswales system.

This canal is the Paddington arm of the Grand Union Canal that was buiilt in 1801. It used to be used for materials trasportation until the canal trade went into decline in stop the operation in 1960s.

The railways and sidings at and surrounding the Old Oak site has been constructed since the mid 19th century. These railways together with the water canal were prominent to the industry at the time until road transport replaced their significant in the 20th century.

site analysis - strength and opportunity



- Main Green and Open Spaces
- Transport Hub / Stations
- Connection from Road Level to Water Canal's Path
- Main Connection to Old Oak Common Station
- Potentially Good View Inward
- Potentially Good View Outward
- Existing Water Canal Path
- Existing Pedestrian Path to the Willesden Junction Station
- Main Road Access
- Existing Local Road Access Connecting to Functions

Figure 4.51

site analysis - weakness and threat

- Steep Slope / Different Elevation
- Noise
- No Access and Direct Path to Green/Open Spaces
- No Access and Direct Connecting Traffic
- Not a Good View Towards Overground Railways Track
- Overground Railways Track

Figure 4.52

Current Productivity, Jobs and Development

Old Oak has been dominated by industrial area and the crossing of railways either underground or over ground. Some of the railways are dedicated to industrial freight lines which support the industrial area around Hythe Road.

Park Royal is the largest industrial estate in Europe and principal industrial area in the West London (GLA, 2011). Currently, the Park Royal area's industrial has employment uses primarily in three main key industry clusters with potential to provide more growth and jobs:

- Food and Drink processing
- TV and Film production
- Transport and Logistic

This background can be the strong basis to develop the thesis of Old Oak area to be regenerated as a potential mixed use area.

However, the zoning as industrial area and the construction of the railways are the main factors that lead to the condition of the Old Oak site in a rather complicated and land locked with minimum access. This condition will need to be tackled by providing more access and linkages.

Demography

As identified by The West London Sub-Regional Development Framework, there are concentrations of the Black Caribbean community in Harlesden, College Park and Old Oak.

According to the Borough of Hammersmith and Fulham, age structure in the Old Oak is dominated with 19% of children age 0-15 years old while the proportion of people aged 65 and over is 12%.

GLA (2011) also notes that 50% people who are employed within the Park Royal area drive to work. In the meantime, others who live locally maintain a good travel pattern with public transport, walking or cycling.

This character and habbit can be taken into consideration in the future development of the site which could lead to a more sustainable way of living.

Surrounding area is also dominated by the most deprived area in London and most come with less skilled labour.

Accorrding to the report from London Borough of Hammarsmith & Fulham (2009), the employment rates of residents living around the Old Oak Common site are much lower than London and England's employment rate.

There are also a number of communities with more than half of the residents who do not have the basic necessary qualification to be competitive in the labour market. The challenge has become tougher by the poor access to housing and services and the quality of local living environment.

Housings and Facilities

According to the London Plan (2009) the Park Royal Opportunity area has the housing capacity of 1,500. In the meantime, there is also figure from the Planning Framework that the potential capacity should reach 3,500 houses with population of 8,330 and child yield od 1,800.

Housings within the area are still dominated by small flats and detached houses. While the detached houses still remain in uprise price trend, the other necessary housing will need to be supplied.

Central Middlesex Hospital is located in the heart of Park Royal area, within 1.5km radius from the Old Oak site. Harlesden, Shepherd's Bush, Ealing and Portobello are four among few established town centres close to the Old Oak site. White City at the south is providing good shopping area with good public transportation links.

Along with this, Old Oak could also be developed as another local centre with retail and commercial to support the potential of the hub other than providing residential area. The residential area should be supported with facilities like health centres, schools, sport amenities and other public facilities.

Connection to Wormwood Scrubs, Kensal and Park Royal Park as well as the improvement of Old Oak Nature Reserve and Cerebus Garden within the site could enhance the potential to provide open and green public spaces for facilities.

Timeframe and Planning of the Transport Hub

The development of HS2 Phase one is planned to start on 2017 and be completed in 2026. The second phase of HS2 will bring connection further to Manchester and Leeds which is planned to be completed in 2032.

The area North of the proposed station is still currently occupied as Crossrail Depot. However, there is plan to relocate the depot and the land would be available in the 2030.

The station is expected to provide enhancment for North-South access from Willesden Junction and Wormscrub Wood as well as the east-west access that enhance the connectivity from Scrub Lane and Old Oak Common Lane.

The proposed station is planned to be build by 2026 which comprises:

- Eight platform station for Great Western Main Line
- Six platform HS2 station

The station is expected to handle 250,000 passengers a day. It is an equivalent number to Waterloo Station when it still serve Eurostar. A significant number compared to 140,000 passengers per day in King's Cross station (Network Rail, 2011).

Tall Buildings

Currently in the Park Royal area there are a few tall buildings:

- Diageo Hq, 8 storey office in the Western Gateway
- Fairview building, 15 storey residential tower
- Proposed 19-storey student building on Victoria Road in the Southern Gateway

4.3 SWOT Analysis and Design Strategies

SWOT

he Old Oak site analysis can be concluded and summarized into SWOT analysis as described below.

Strength

- The connectivity to major transit rail: High speed rail, underground Crossrail
- Relatively vacant lot, brownfield site (decommissioned depot site) with relatively flat topography

Weakness

- Minimum road access to the site
- Landlocked by railways and road
- Housing demand and demography of deprived area

Opportunity

- Grand union canal connecting to Park Royal and Kensal Site
- View and access to Wormschrub Green as green space on the South
- View of London skyline
- Within 500m to Wilesdeen Junction which connect to more rails (Tube)
- Long term plan for the transport hub completed 2030s, opportunity to consider more advanced design approaches with more sustainability awareness

Threat

- Other over ground railways and infrastructure which could give unsightly view

Design Strategy

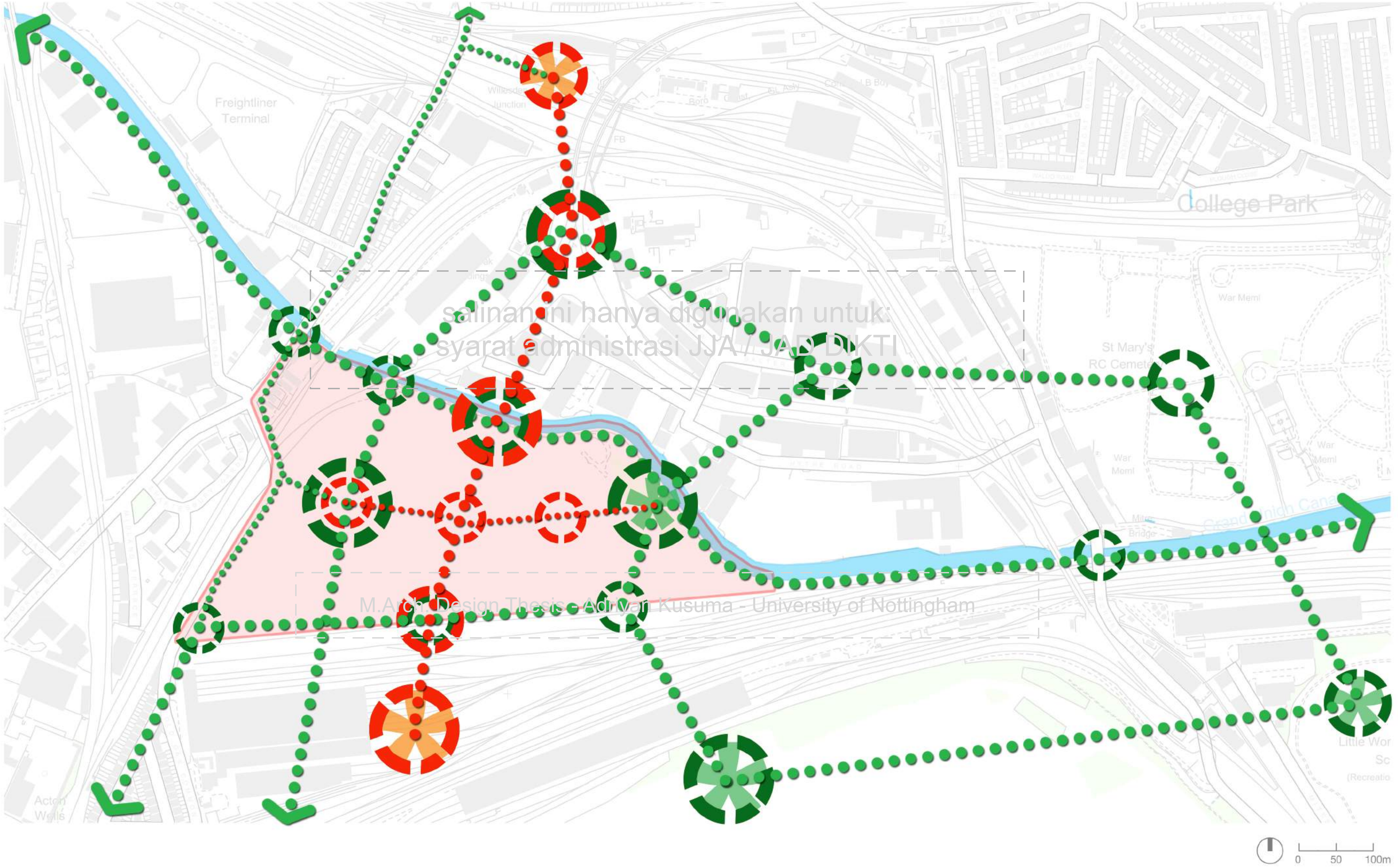
Maintain, improve and use the opportunity:

- Integrate the development with seamless compact city between the neighbourhood and proposed train station
- Alleviating the potential site view towards outside as well as the visibility of the site. This, together with the advance of technology will give chances to provide some taller buildings as landmark for the vicinity.
- Employ design strategy promoting walkable community but still maintain connection with the more busy centre near the station
- The shape of the site give potential to offer central area near the station, radial and gradually subdue towards the edges
- With transit community and the demography in the existing place as well as the prediction of mobile and younger user profile as well as the long term planning, the development will provide a balance of housings: urban and service apartment, student accomodation and hotel in the middle ring. More flat and for family and eldery at the edges ring with the green spine promoting walkability
- Integrate water canal, provide biopond and bioswales system

Minimize the Weakness and Threat:

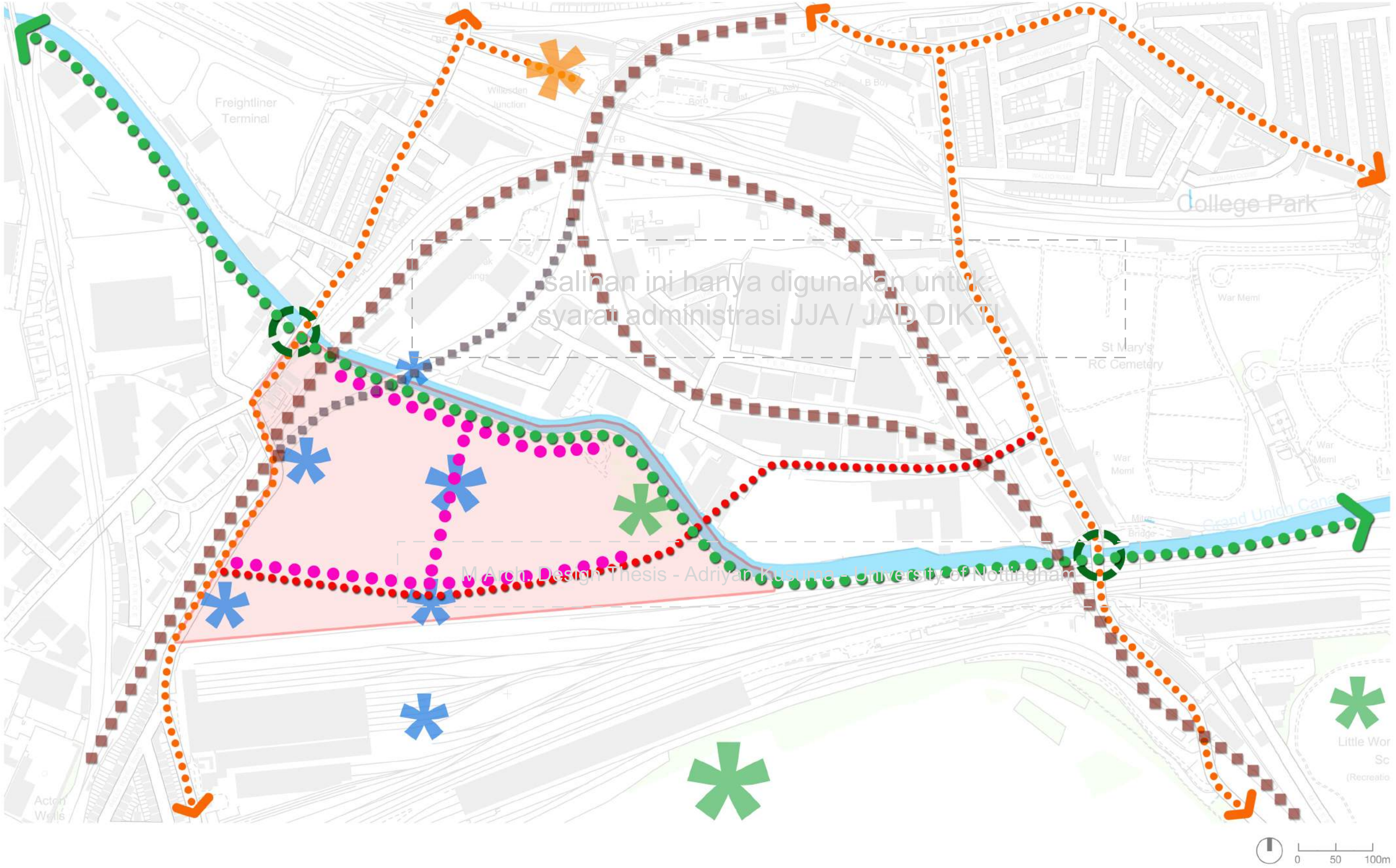
- Promote great boulevard to connect to Willesdeen Junction, pedestrianized with active frontages, spaces for activities to improve the accessibility and invite people to come visiting the city.
- Provide road connection to the north area and to the east side by crossing the canal.

site strategy - activity and green nodes



Existing Green and Open Spaces
Main Transport Hub / Stations
Green & Open Spaces Activity (Parks, Pedestrian Paths)
Main Neighbourhood Functions / Activities
Green Paths (Pedestrian / Bicycle)
Main Active Frontages / Paths

site strategy - traffic access framework and visual nodes



Existing Green and Open Spaces
Potential Visual Landmark
Road Level Access Connection to Canal Path
Existing Railways Track (Overground)
Existing Road to be Enhanced
Proposed New Vehicle Road
Green Paths (Pedestrian / Bicycle)
Main Visual Potential for Active Frontages

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discussion & design implementation

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5.1 Research and Design Strategy Implementation

Result of the research and simulation processes on perimeter urban block will be implemented together with design strategy based on the site analysis.

With the main site's topography and design strategy to have central area as well as development rings towards the edges, the most prominent exposure would be from the south as the building blocks will mostly be able to align with east-west orientation.

The buildings on the south side of the perimeter block will be able to be built taller to obtain more density without sacrificing function and comfort. The 31 degree solar angle can still be used to determine the spacing of building's back to back or the size of the courtyard. The building on the north side of the block will be built by considering the next adjacent block so not to conceal the solar access too much.

Considering the nature of the site and design strategy, there would be still some building align to north-south. There would be also some buildings that are still blocked by the adjacent building because of the aimed density. Within the central area, there are also more taller building and higher density. This will reduce the capability of the building to gain more solar radiation which would be useful during cold season or could be harnessed as solar power. Usually lower part of the building will suffer more of this reducing access to solar radiation. Strategy involved would be by distributing the mixed use function horizontally as well as vertically.

The central area with mostly retail and office commercial function can still bear the lack of radiation because of the nature of their usage timing. Type of retail and commercial places as well as public area with less radiation chance will be more toward the semi active usage which do not require heat and daylight to get active. For example, cafe and restaurant which expecting people to enjoy more sunshine and heat will be located towards the position that are exposed more to the south. The other facilities like retail shops could be in place with less radiation.

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old oak regeneration - masterplan
Note: Masterplan in bigger scale is provided as attachments
0 25 50m


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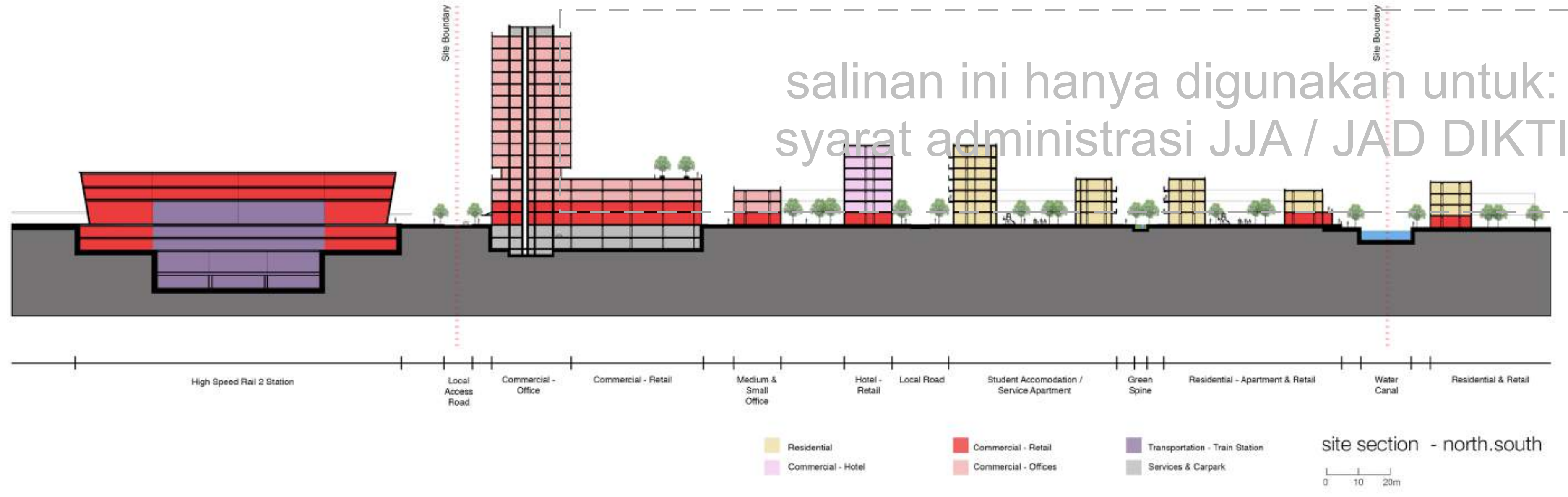
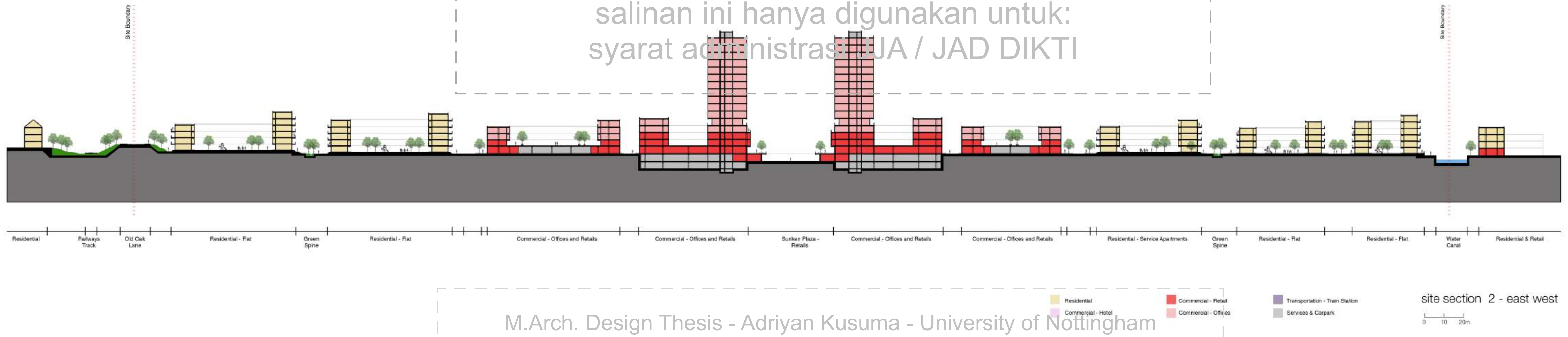
old oak regeneration - masterplan
Note: Masterplan in bigger scale is provided as attachments
0 20m

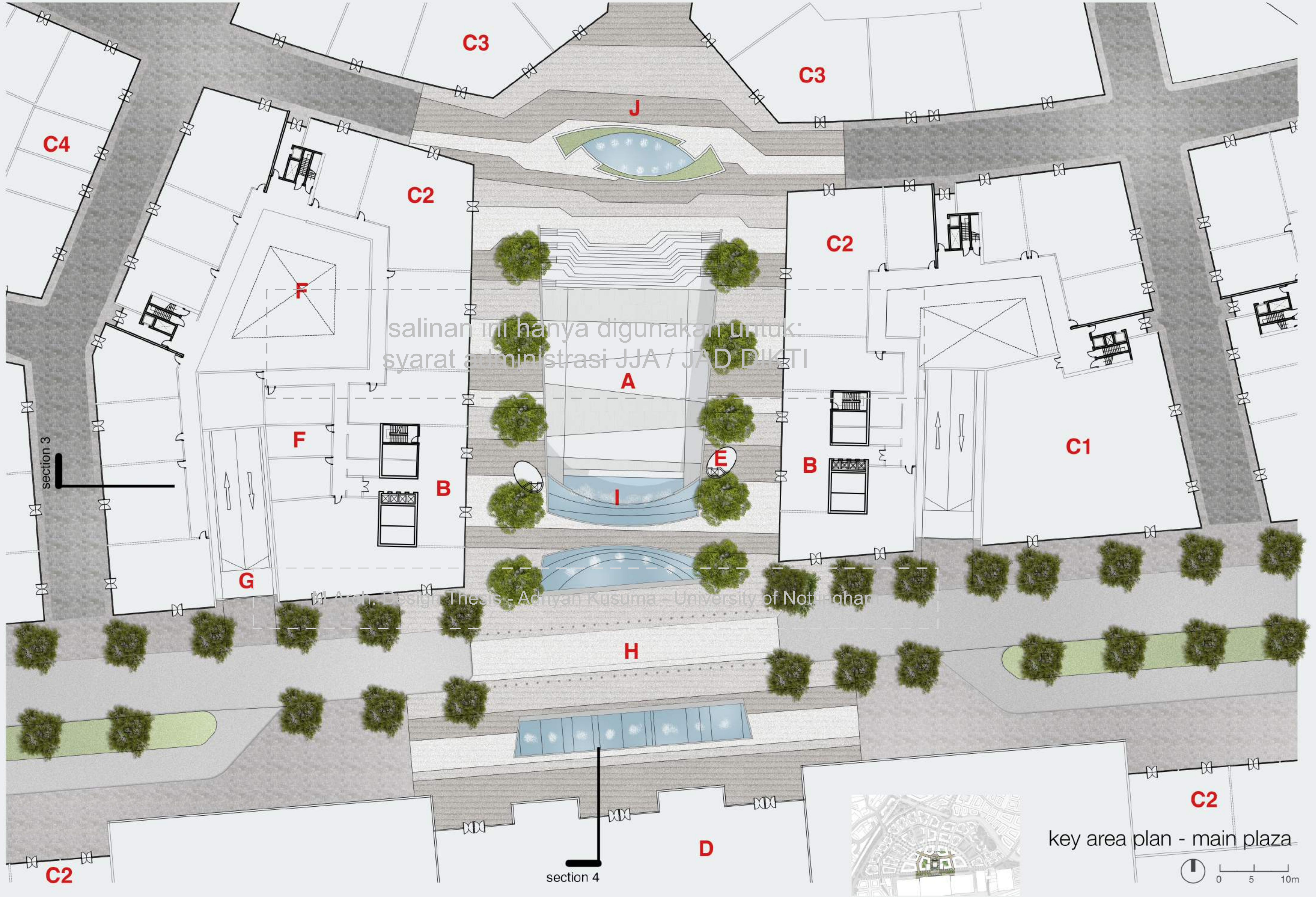
old oak regeneration - masterplan



Note: Masterplan section in bigger scale is provided as attachments

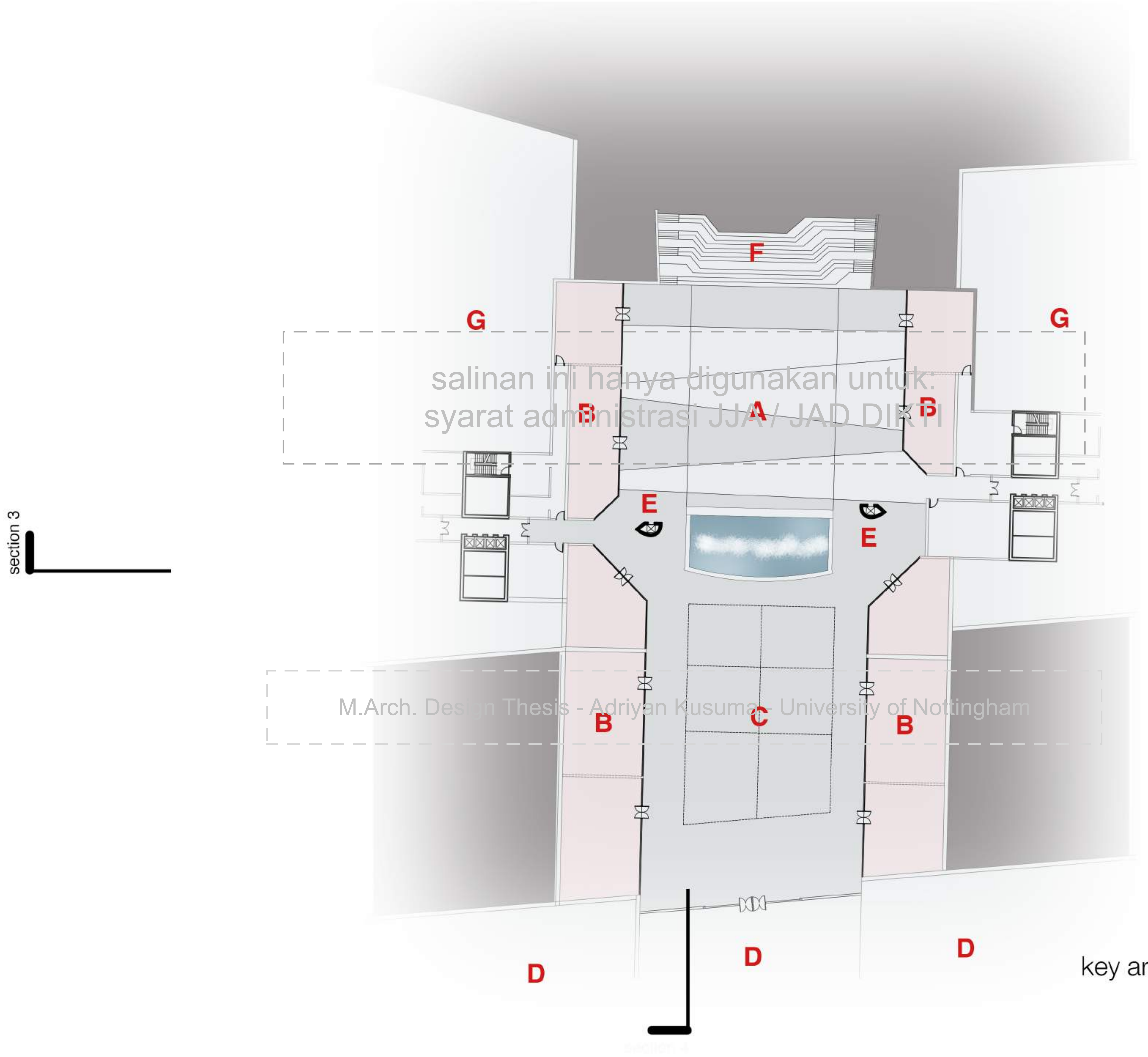


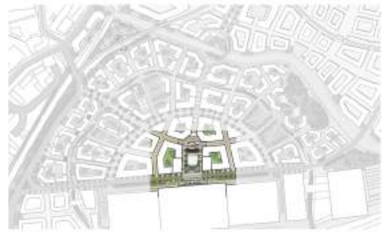
Note: Masterplan section in bigger scale is provided as attachments



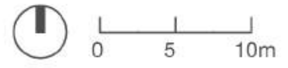
LEGEND

A = Sunken Plaza - activity stage at basement level
B = Office (Hi Rise) Lobby
C1 = Commercial - Anchor tenant
C2 = Commercial - Retails
C3 = Commercial - Food and Beverages
D = Lobby and entrance to the station
E = Lift - Handicap access to basement level
F = Services and Carpark
G = Service access ramp
H = Pedestrian Priority Crossing to Station
I = Water feature
J = Sculpture - Wind breaker



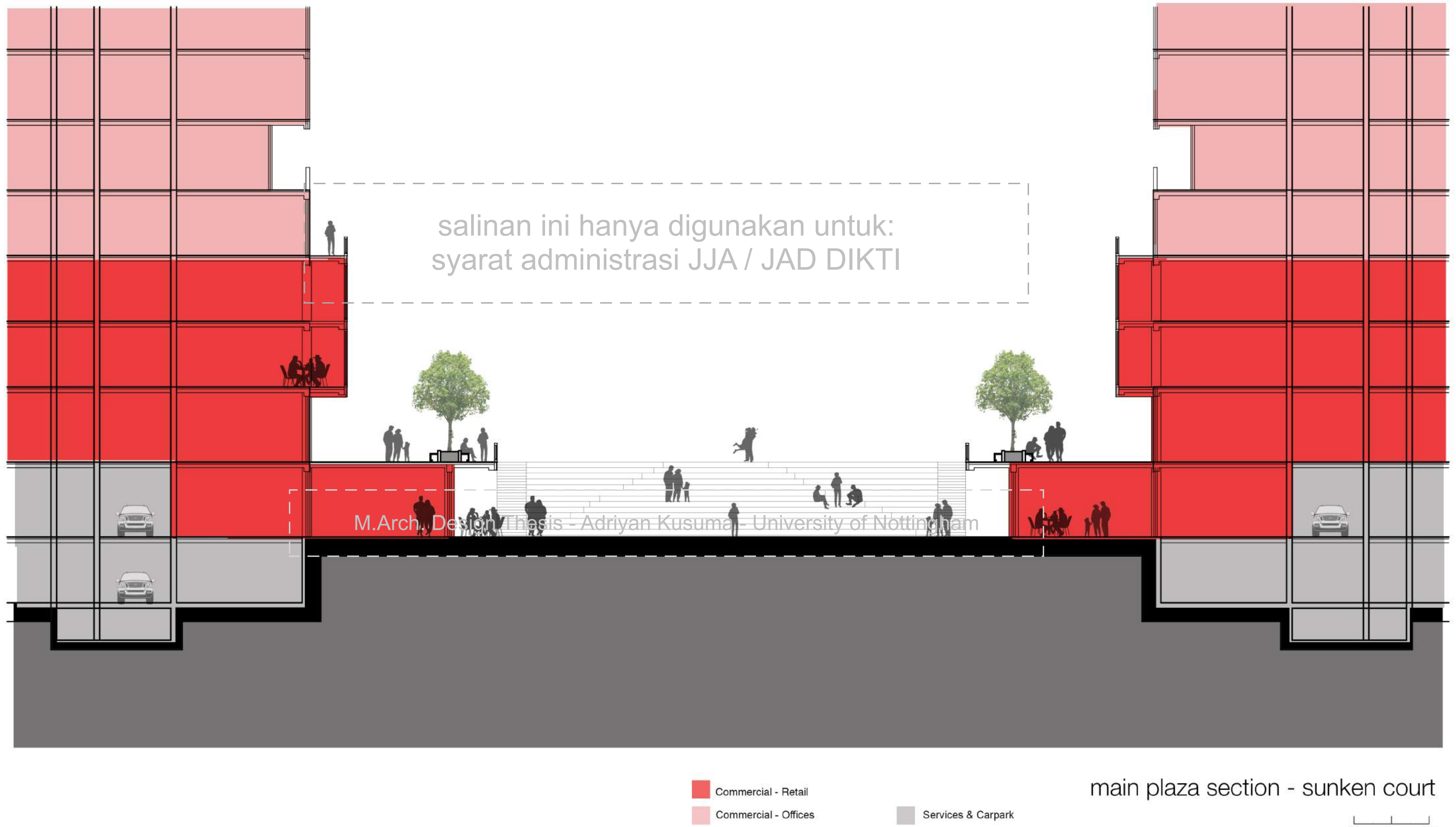


key area plan - main plaza sunken court
undergrund link to station



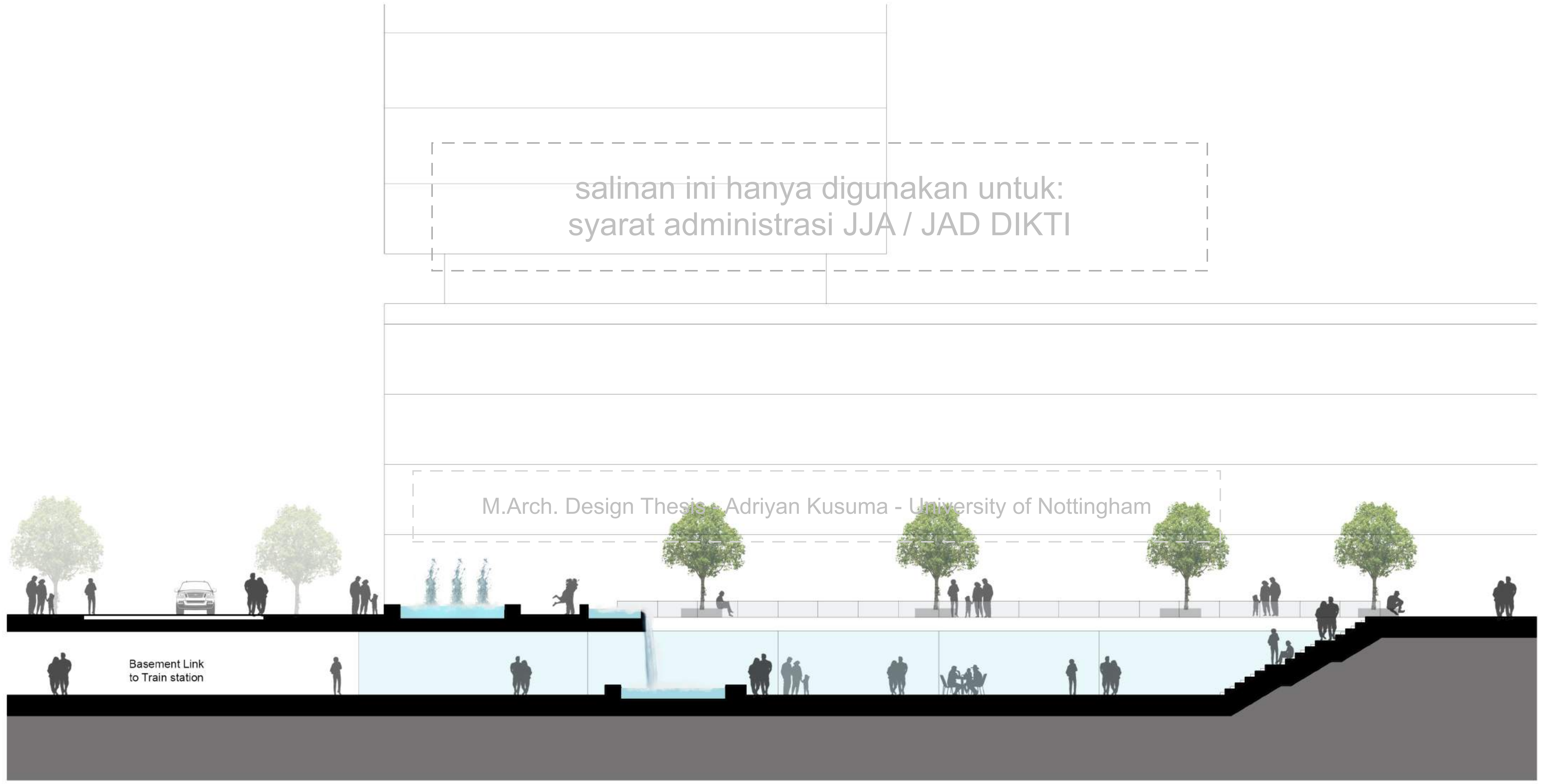
LEGEND

A = Sunken Plaza - activity stage at basement level
B = Retails and Cafes
C = Retail Kiosk Portable
D = Lobby and entrance to the station
E = Lift - Handicap access to Ground level
F = Staircase and Seats to Ground Level



main plaza section - sunken court

0 2 4m



section 4 - sunken plaza

0 2 4m

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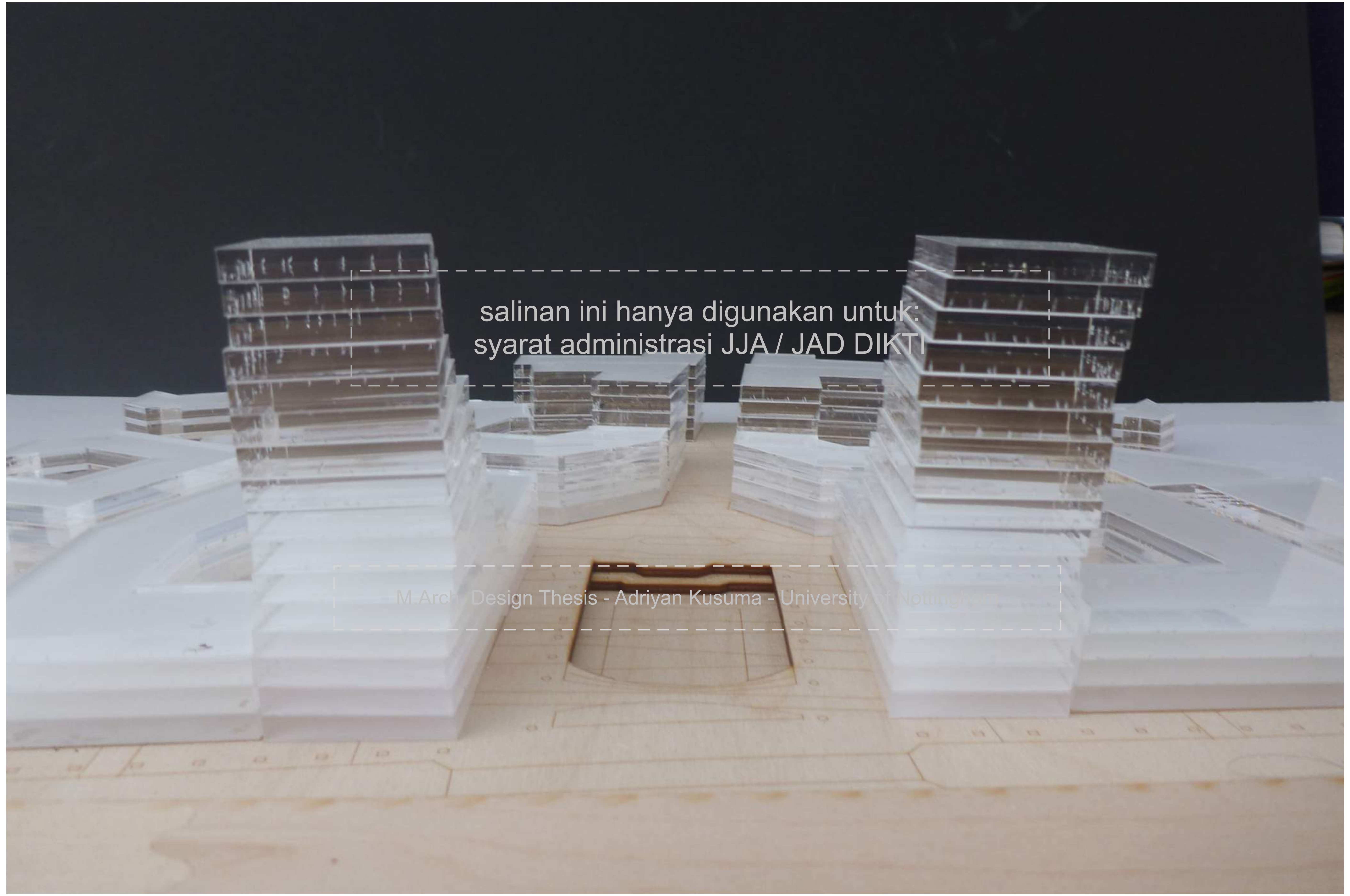
main plaza - south view

main plaza - north view



key area plan - residential and green spine

0 5 10m

LEGEND

A = The Green Spine - Public Pathway with green and bioswales
Pervious pavements, and Accessible for emergency

B = Playground and Park - Shared within for the block

C = Local access road with on street parking, pedestrian priority

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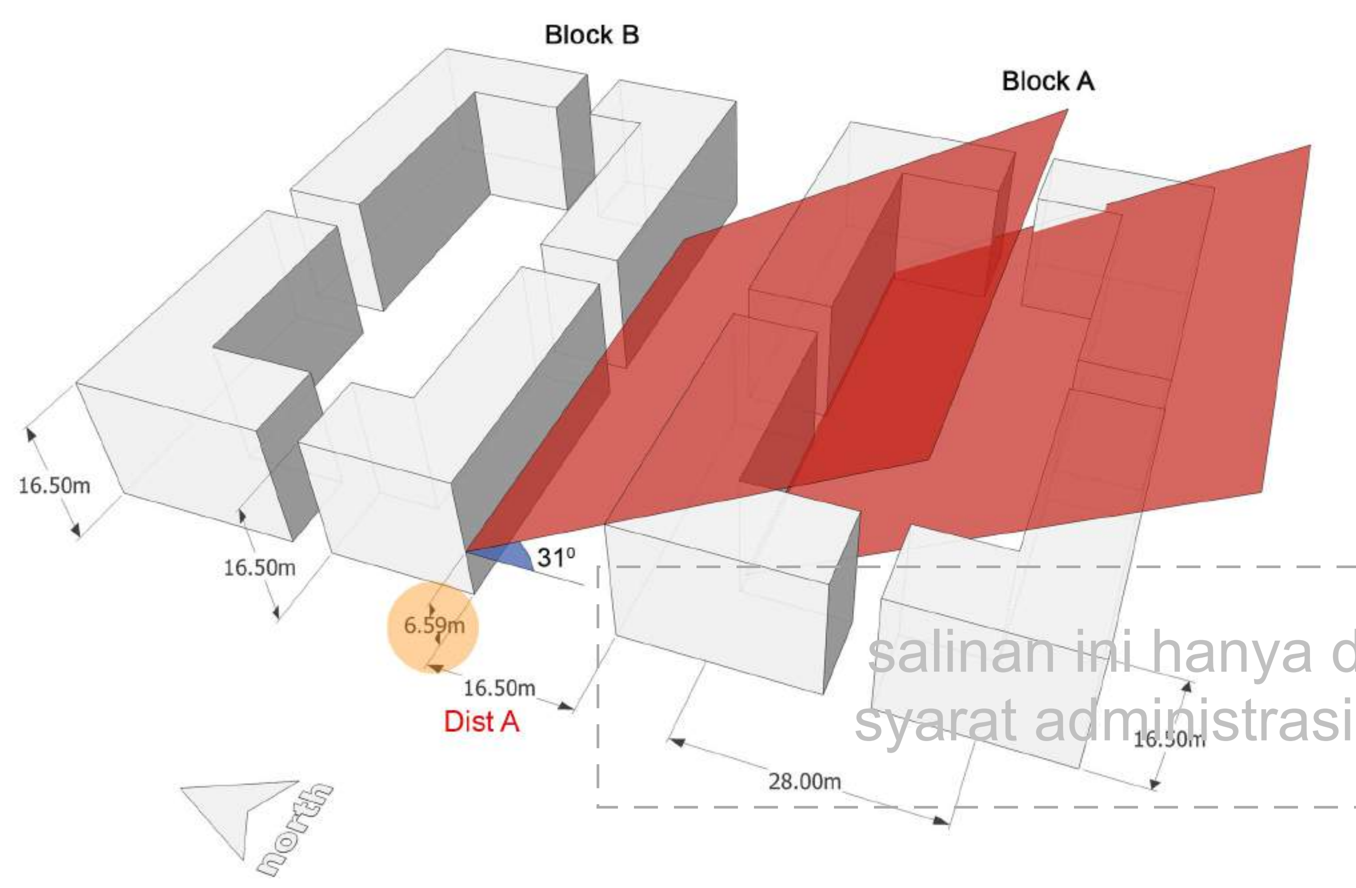
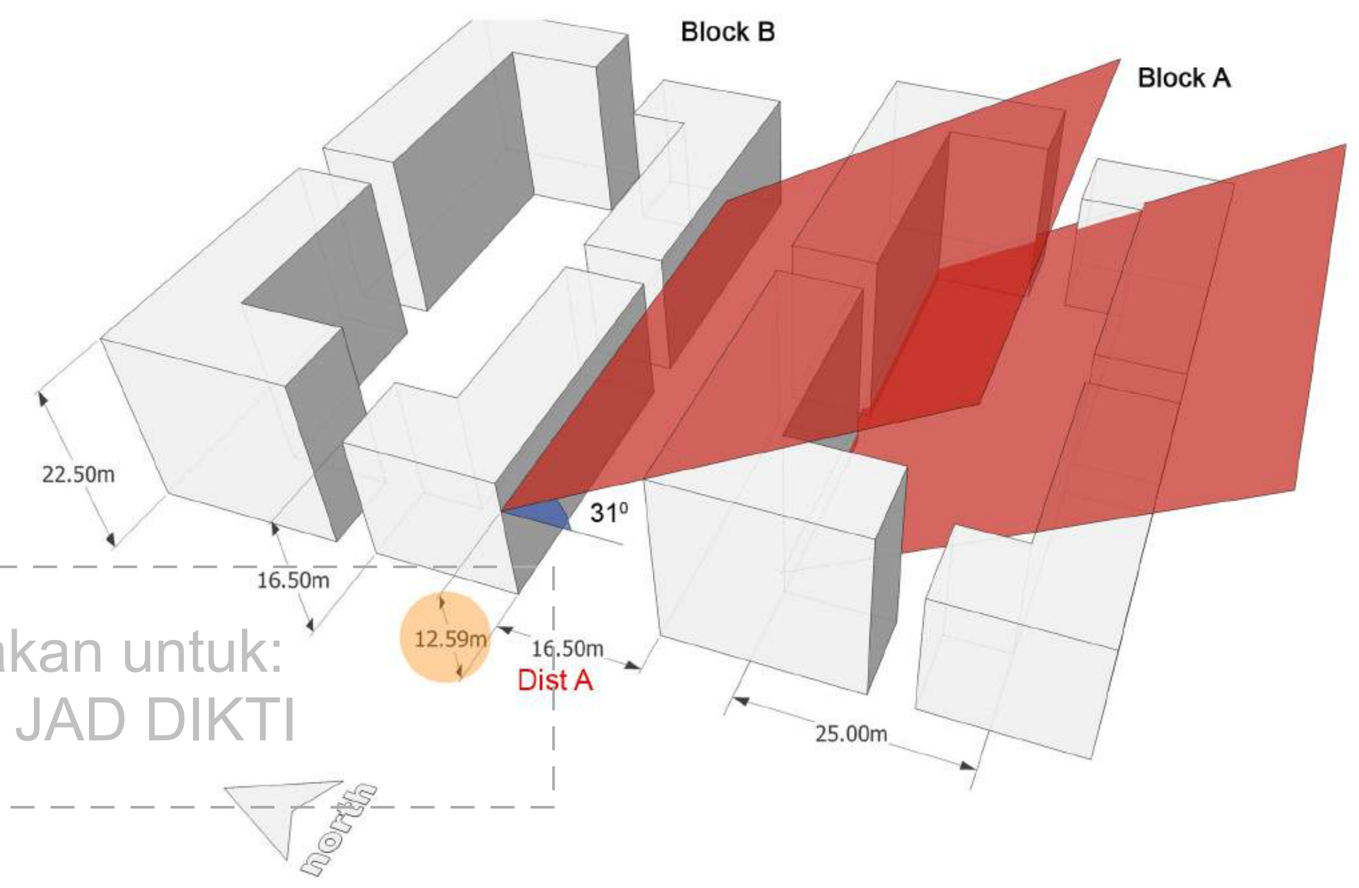
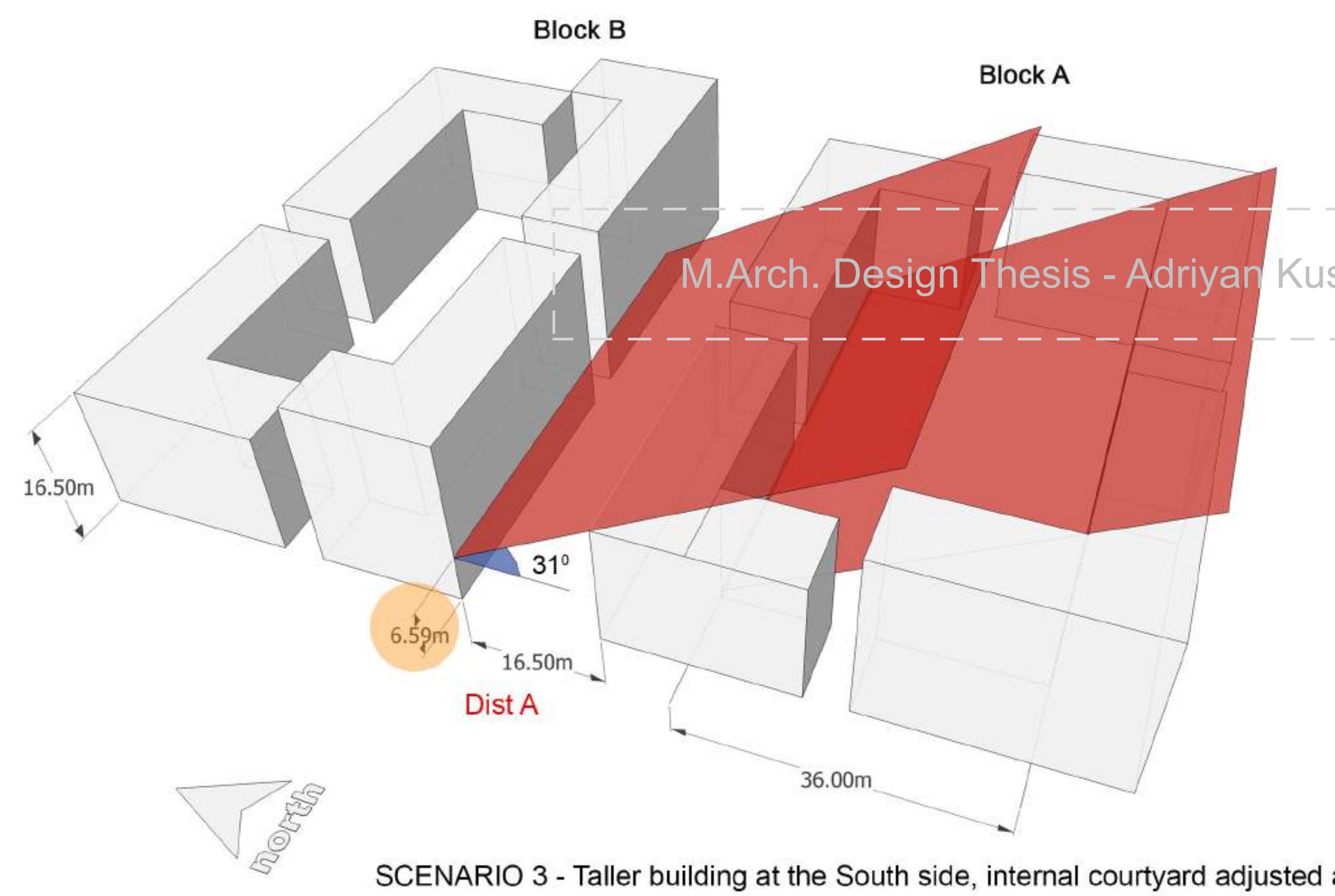
residential - the green spine

SCENARIO 1 - Common Perimeter Block,with the same building height, street enclosure 1:1, internal courtyard follows minimum distance 25m or as per 31 degree cut off angle



SCENARIO 2 - Taller building at the North side, internal courtyard follows minimum distance 25m or as per 31 degree cut off angle





SCENARIO 3 - Taller building at the South side, internal courtyard adjusted as per 31 degree cut off angle

Blocks (Perimeter block) massing idea incorporates the input from research: *Taller massing at the South side of the block could provide more chance to get more solar gain with lesser negative impact on adjacent block.*

As shown in the Scenario 3, the additional 2 floors on the South massing of block A could provide more density. Internal courtyard dimension and back-to-back distance are increased to follow the 31° cut off angle. The additional distance also provides more units on South massing of Block A. In the meantime, adjacent block B especially the street side will not get negative effect (low radiation area remain the same compared to the original scenario 1). However, there are still going to be some area receiving less radiation. This could be solved in the architectural detail level, for example with building facada and materials, or by placing certain function and use which do not really crucial to solar radiation, like shops, banks or post offices.

Scenario 2 has shown that building North side taller will worsen the condition of adjacent block B while density gain is not as many as what is obtained in scenario 3.

perimeter block massing concept

Dwelling Comparison - Block A & Block B (Lower Density - Original Scenario)

	Numbers of Unit per floor						Numbers of Unit per Wing					
	Studio	1br	2br	3br	3br +	Number of stories	Studio	1br	2br	3br	3br +	Total Unit
Block A												
Wing 1		2	2			5	0	10	10	0	0	20
Wing 2	3	2		1		5	15	10	0	5	0	30
Wing 3	2	1			1	5	10	5	0	0	5	20
Wing 4	2	1	4			5	10	5	20	0	0	35
							35	30	30	5	5	**105**
Block B												
Wing 1 (North)	3	3	1	1		4	12	12	4	4	0	32
Wing 2 (South)		2	5	1		4	0	8	20	4	0	32
							12	20	24	8	0	**64**
							47	50	54	13	5	169

Composition (%)	27.81	29.59	31.95	7.69	2.96	100.00
Area Block A & B (hectare)						0.82
Density Block A & B (dwelling per hectare)						**205.22**

Dwelling Comparison - Block A & Block B (Optimized Perimeter Block Scenario)

	Numbers of Unit per floor						Numbers of Unit per Wing					
	Studio	1br	2br	3br	3br +	Number of stories	Studio	1br	2br	3br	3br +	Total Unit
Block A												
Wing 1		2	2			7	0	14	14	0	0	28
Wing 2	3	2		1		6	18	12	0	6	0	36
Wing 3	2	1			1	6	12	6	0	0	6	24
Wing 4	2	1	4			8	16	8	32	0	0	56
							46	40	46	6	6	**144**
Block B												
Wing 1 (North)	3	3	1	1		4	12	12	4	4	0	32
Wing 2 (South)		2	5	1		6	0	12	30	6	0	48
							12	24	34	10	0	**80**
							58	64	80	16	6	224

Composition (%)	25.89	28.57	35.71	7.14	2.68	100.00
Area Block A & B (hectare)						0.82
Density Block A & B (dwelling per hectare)						**272.01**

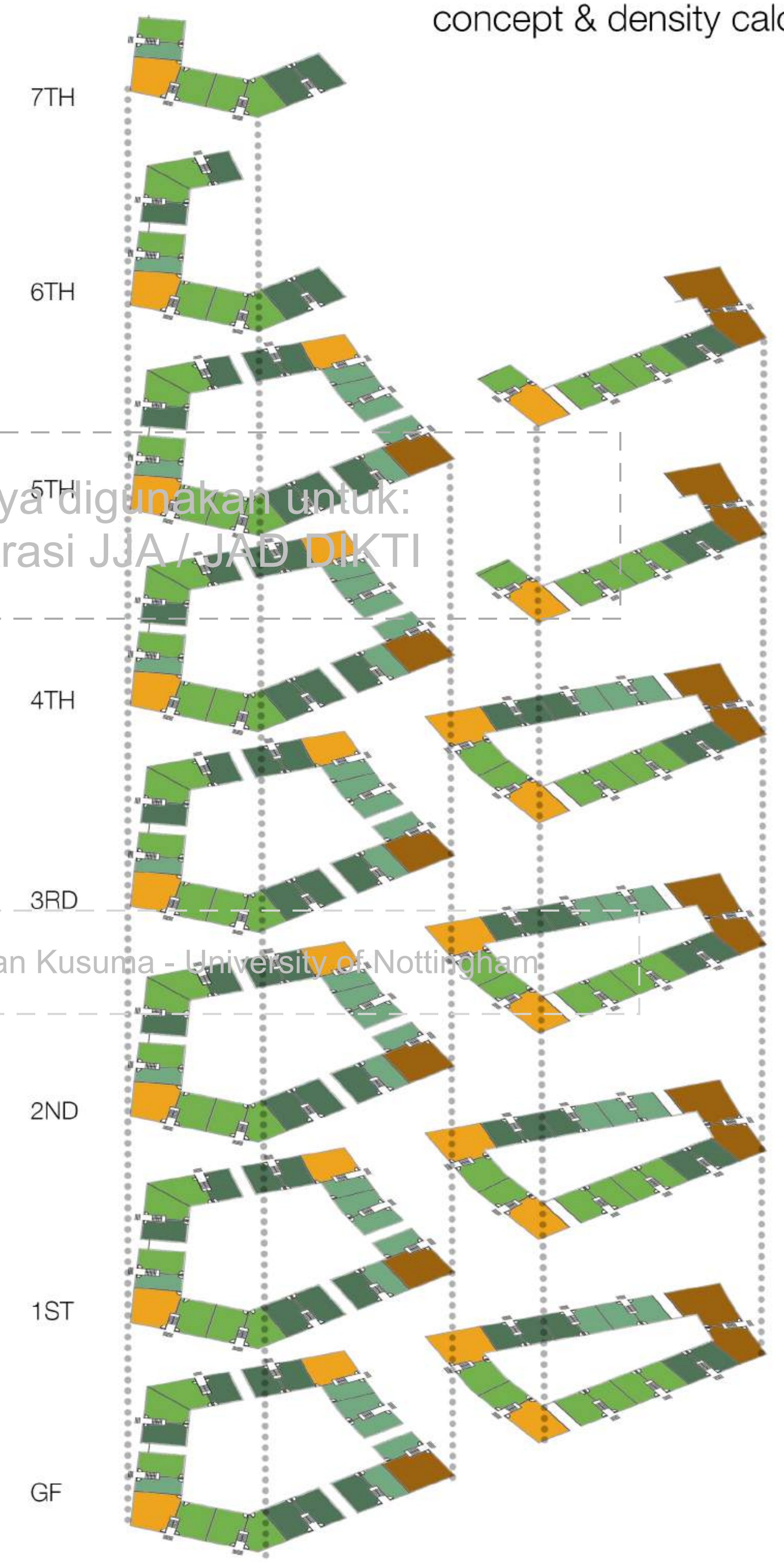
Block A and Block B as shown in the key area are taken as the density calculation sample area.

The massing and allocation is incorporating the input from research: building taller at the south side to gain more density. Exception is given to the block A because it is located at the perimeter adjacen to the main road so the west and north side are also taller.

272 dph achievable for the key area is suitable for residential area flats type near the transit hub. (Compare to Llewelyn-Davis (2000) who mention 200-300 dph for the kind of urban area).

Based on site analysis & strategy, the area would have more the single youngs and young small family, hence the housing type of flats with more 1br - 2br units are provided.

residential block A & block B (key area)
concept & density calculation sample area



Note:	Unit Type	Size
	Studio	40m2 - 50m2
	1br	55m2
	2br	65m2
	3br	90m2
	3br +	130m2

figure ground diagram - post intervention

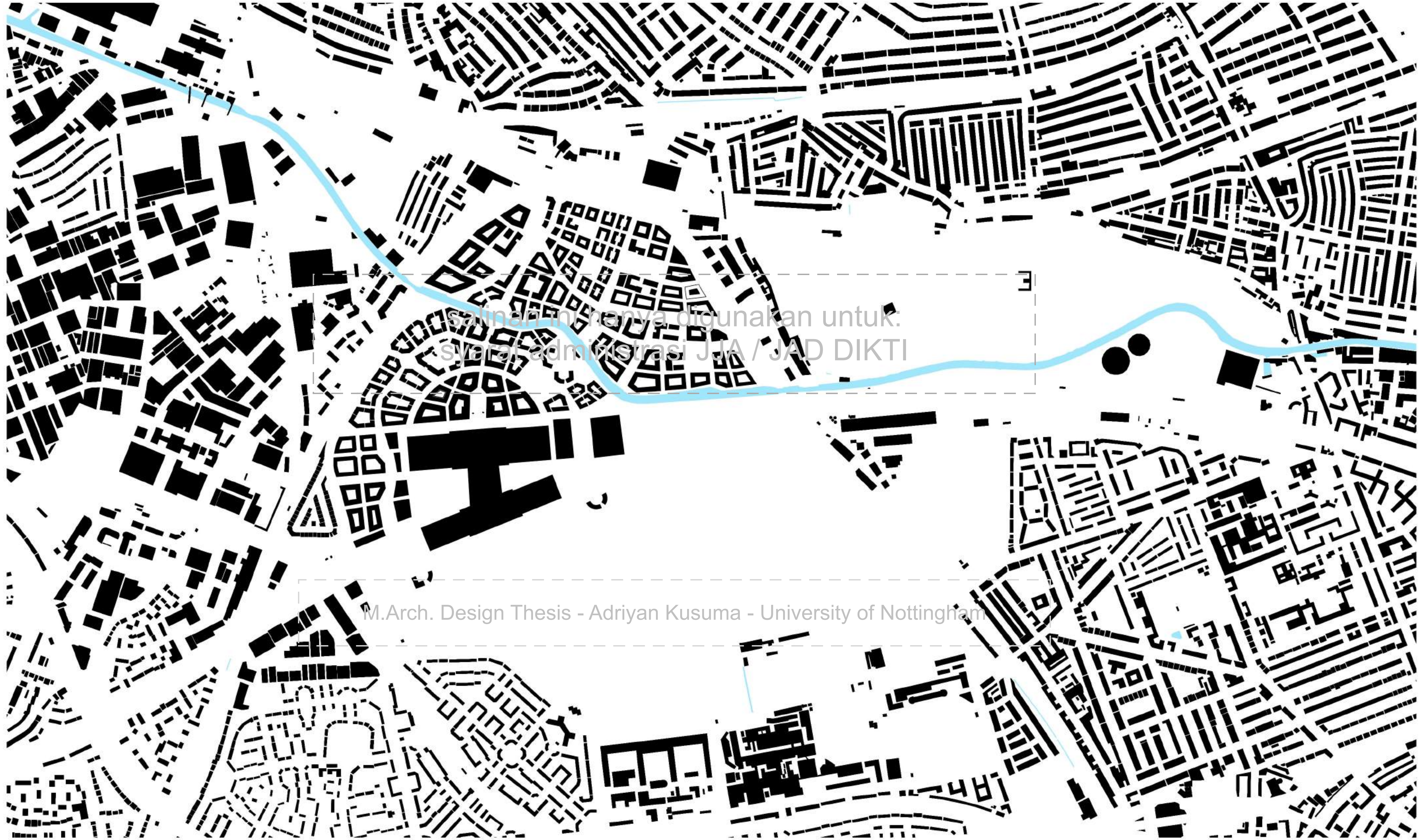
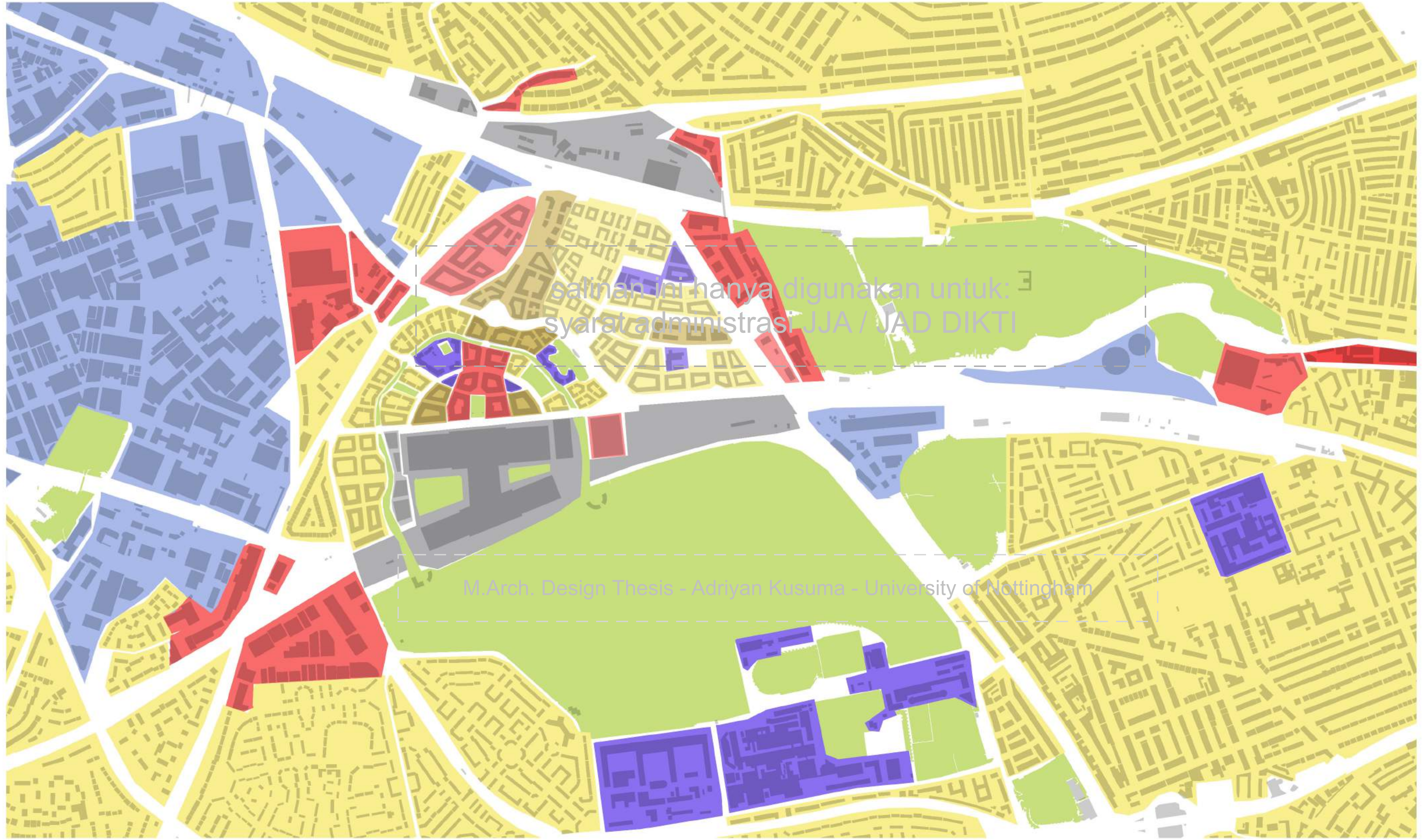


figure ground with the new proposed old oak common shows that the area now has stronger block form and defined spaces.

0 100 200m

land use - post intervention

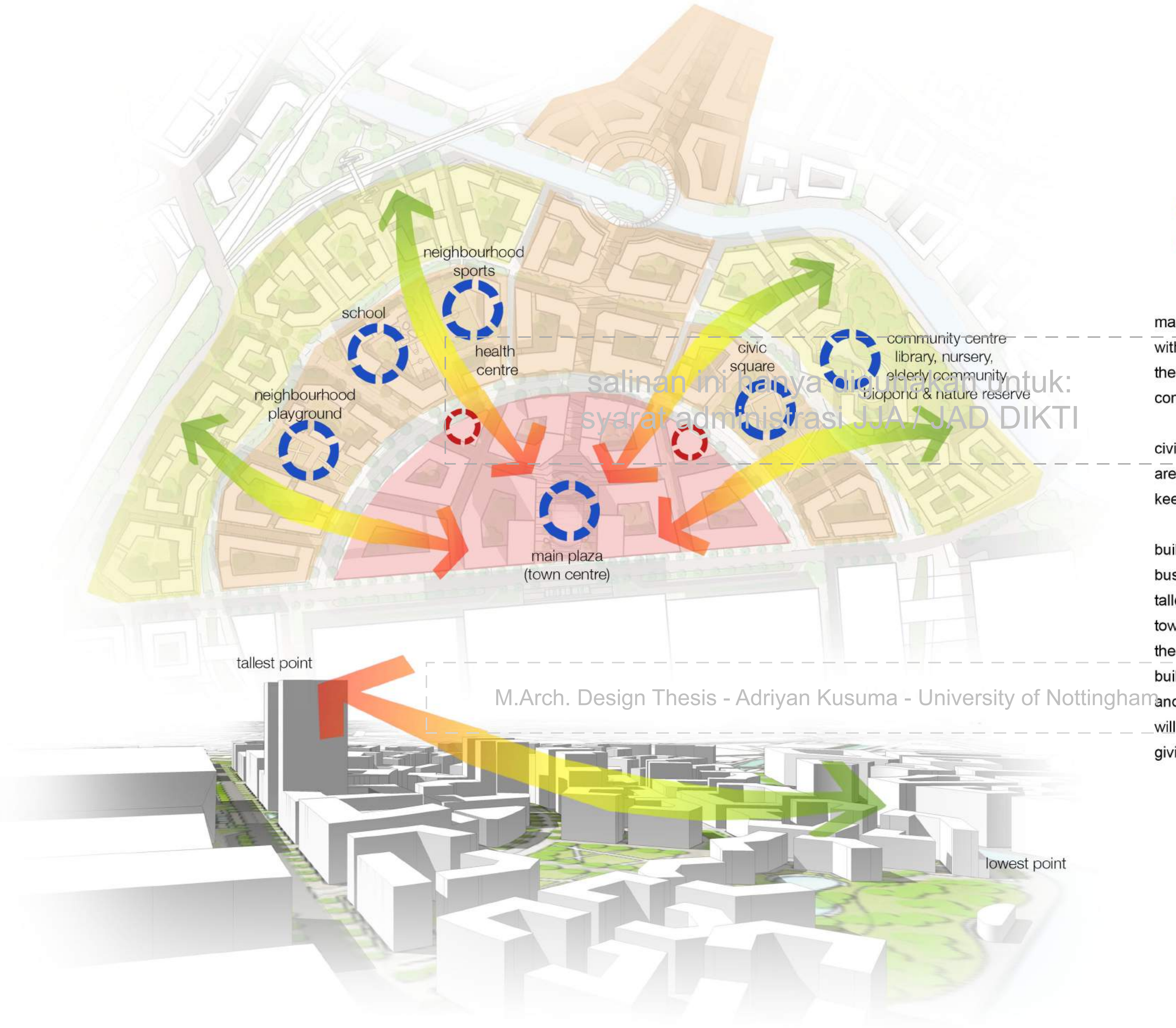


land use with the new proposed old oak common shows more integration into the urban fabric and add more integrated facilities & function.

0 100 200m

- Residential
- Industrial
- Retail and Commercial
- Institutions and Public Facilities
- Green and Open Spaces
- Transportation Facilitites
- Mixed use

masterplan massing concept



massing and zoning take central and radial concept, with the busiest area near the station as the centre and the outer residential ring as the most neighbourhood, community and people oriented.

civic functions are distributed as nodes serving th whole area within walkng distance, promoting walkability and keep good people movement framework.

building massing follows the zoning concept, with the busiest zones come with higher density and usually taller buildings. the building massing will get lower towards the outside with concept of 'taller building at the south side' as per research input. the most outer buildings for example those facing the main roads and watercanal or those next to the open area, however, will take advantage to become taller too. this will help giving definiition to the road and open areas.

masterplan zoning concept

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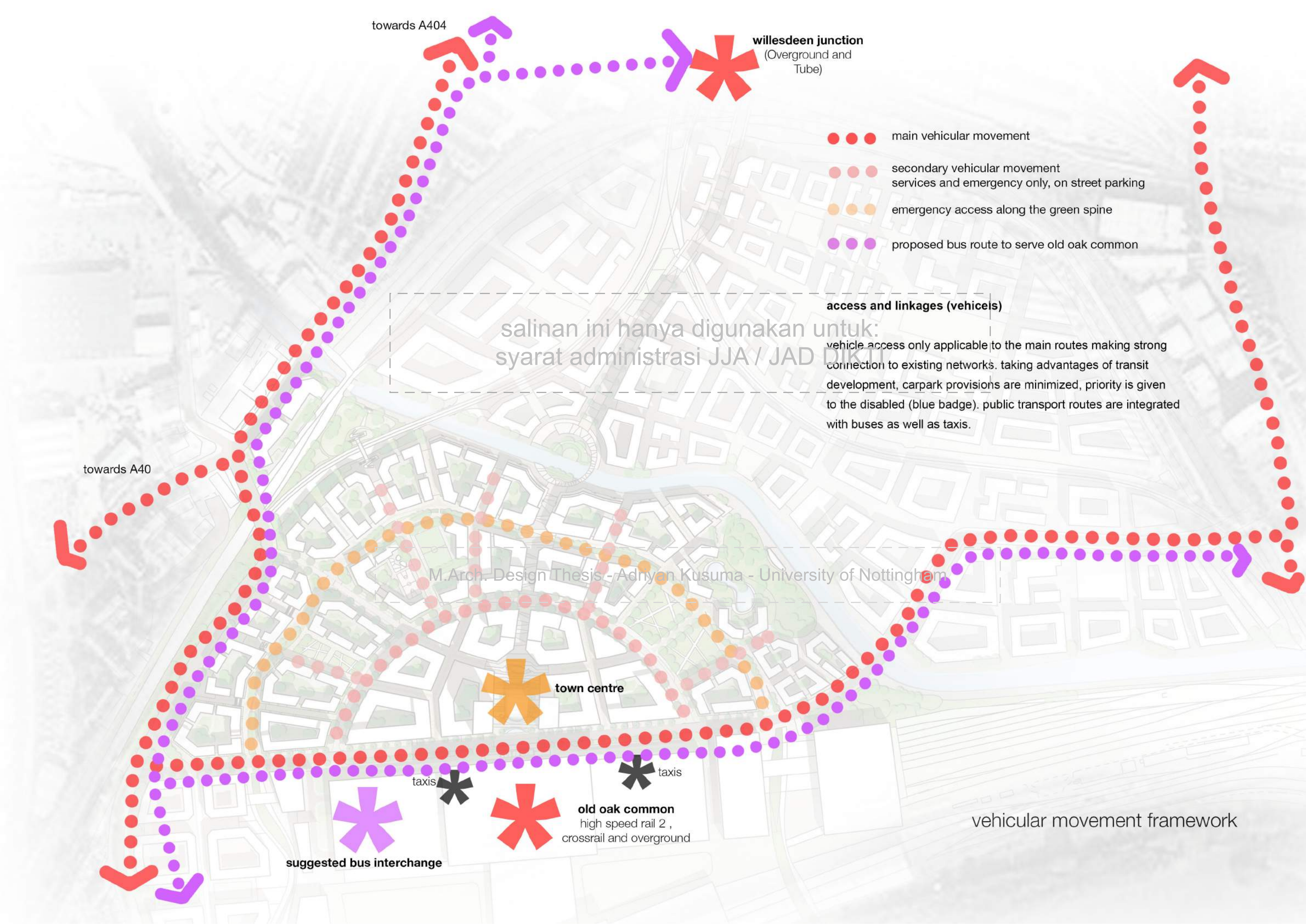
access and linkages

the masterplan promote a compact city which promote walkability and minimize vehicle interventions. the pedestrian path is shared by pedestrian and cyclist.this is to take advantage of transite oriented and the good potential of high connectivity with transport modes.

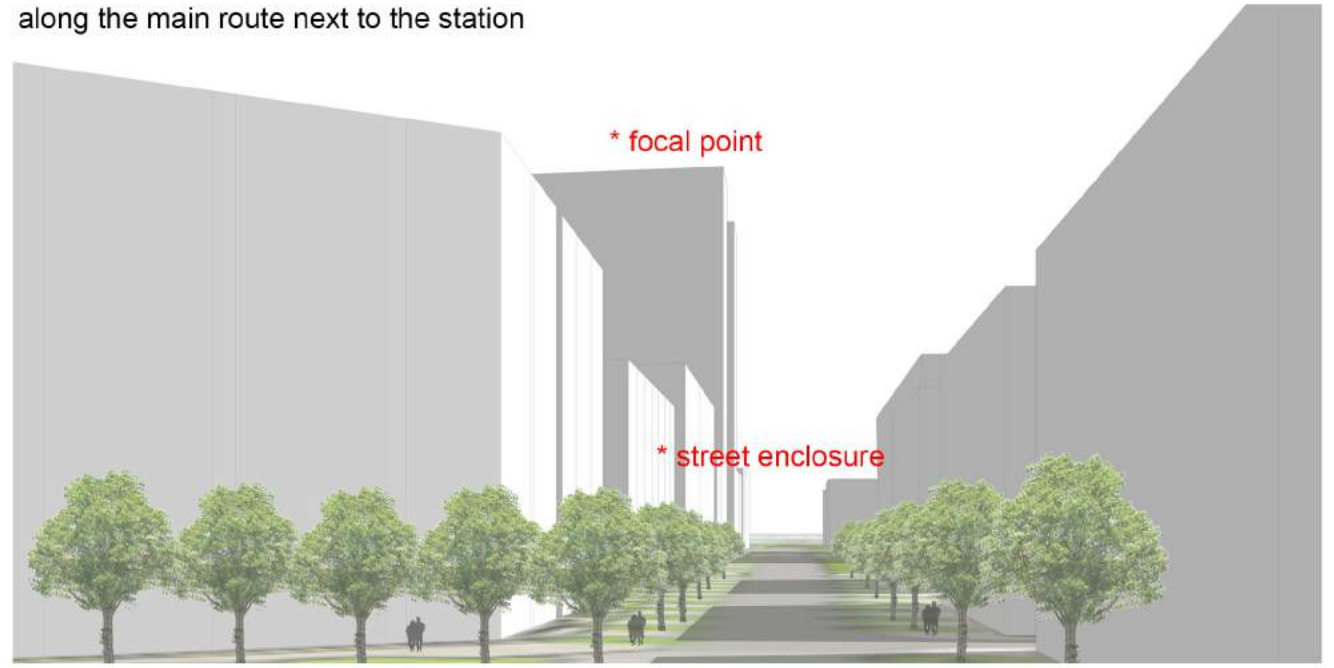
the path will connect and strengthen the access and linkage to other surrounding area including residentials and parks.



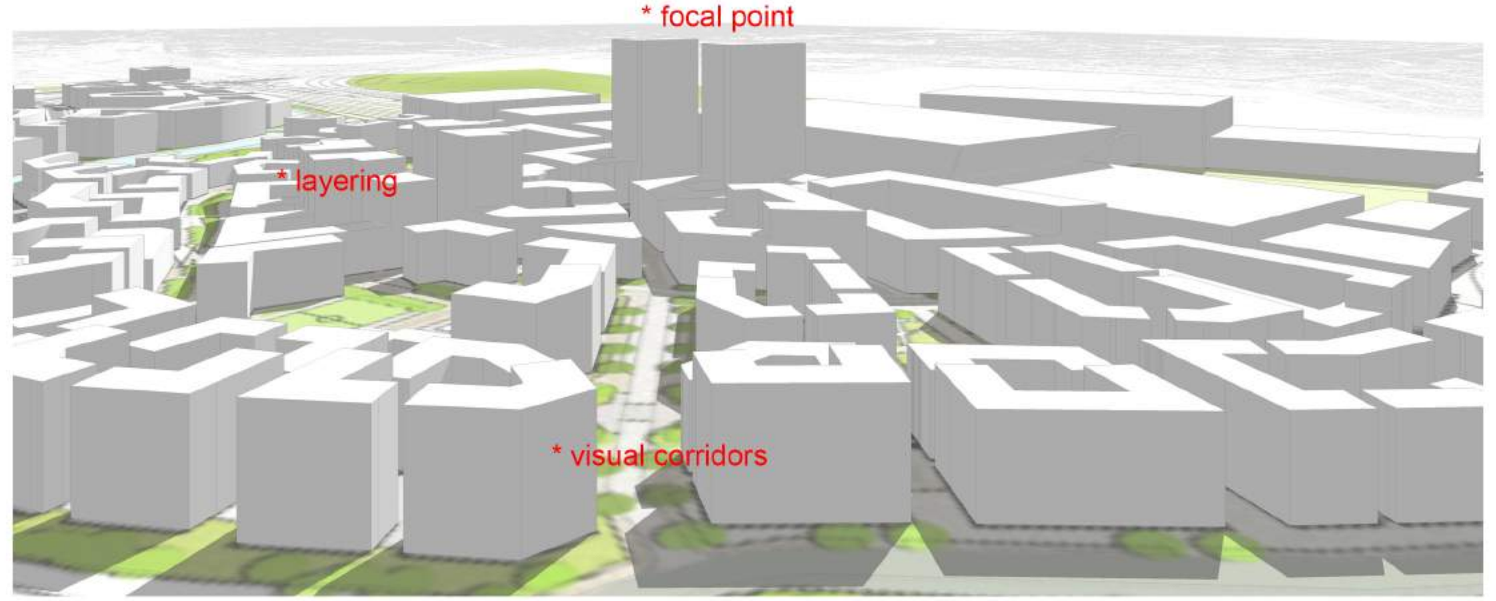
access and linkages (vehicels)

vehicle access only applicable to the main routes making strong connection to existing networks. taking advantages of transit development, carpark provisions are minimized, priority is given to the disabled (blue badge). public transport routes are integrated with buses as well as taxis.

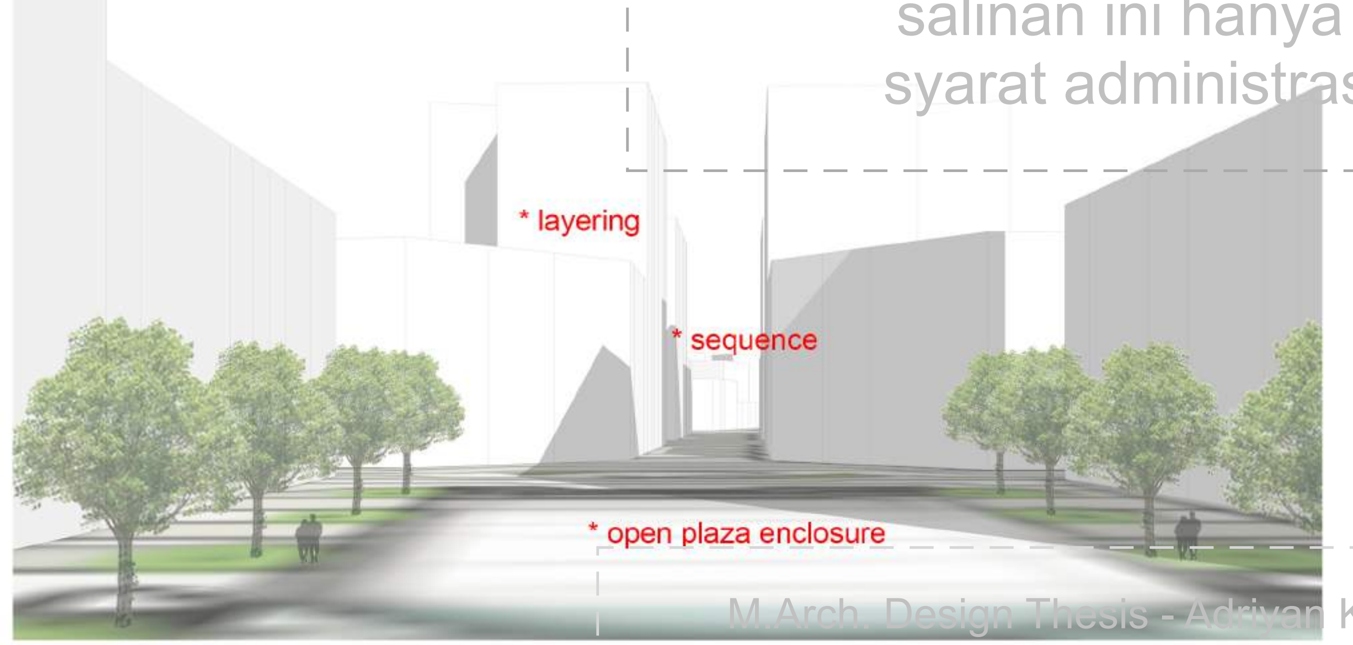
along the main route next to the station



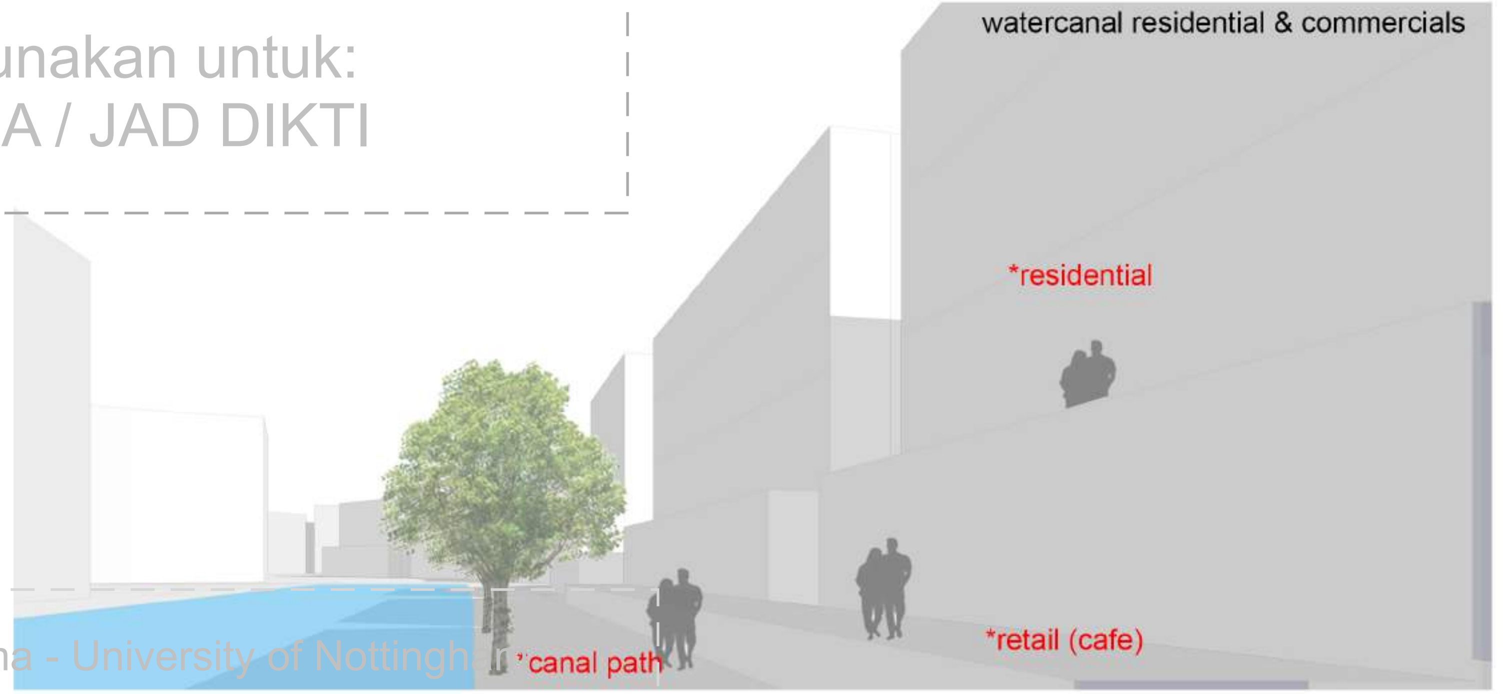
view from the road old oak common lane



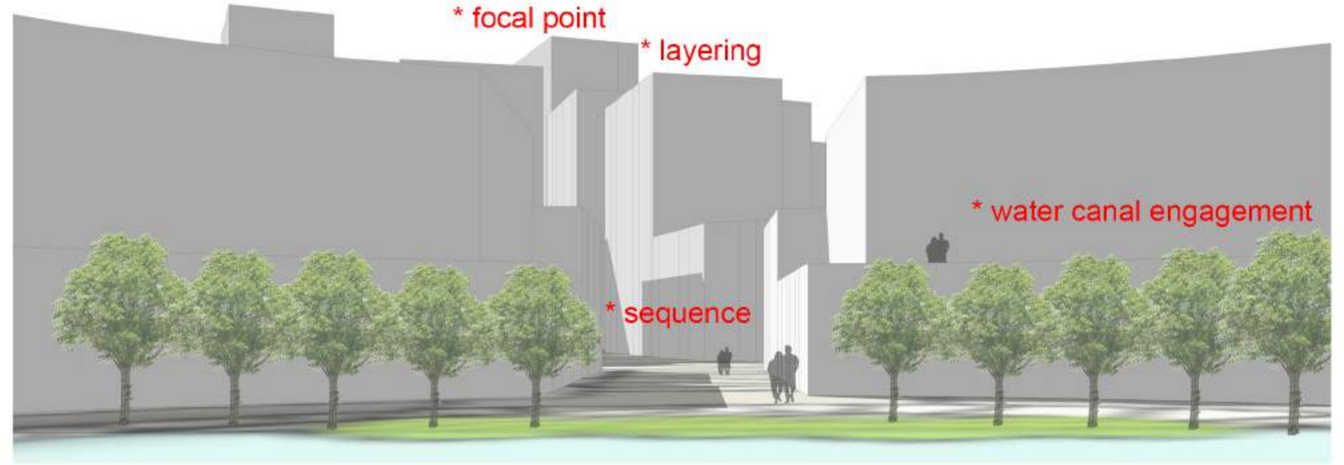
main central plaza looking northwards



watercanal residential & commercials



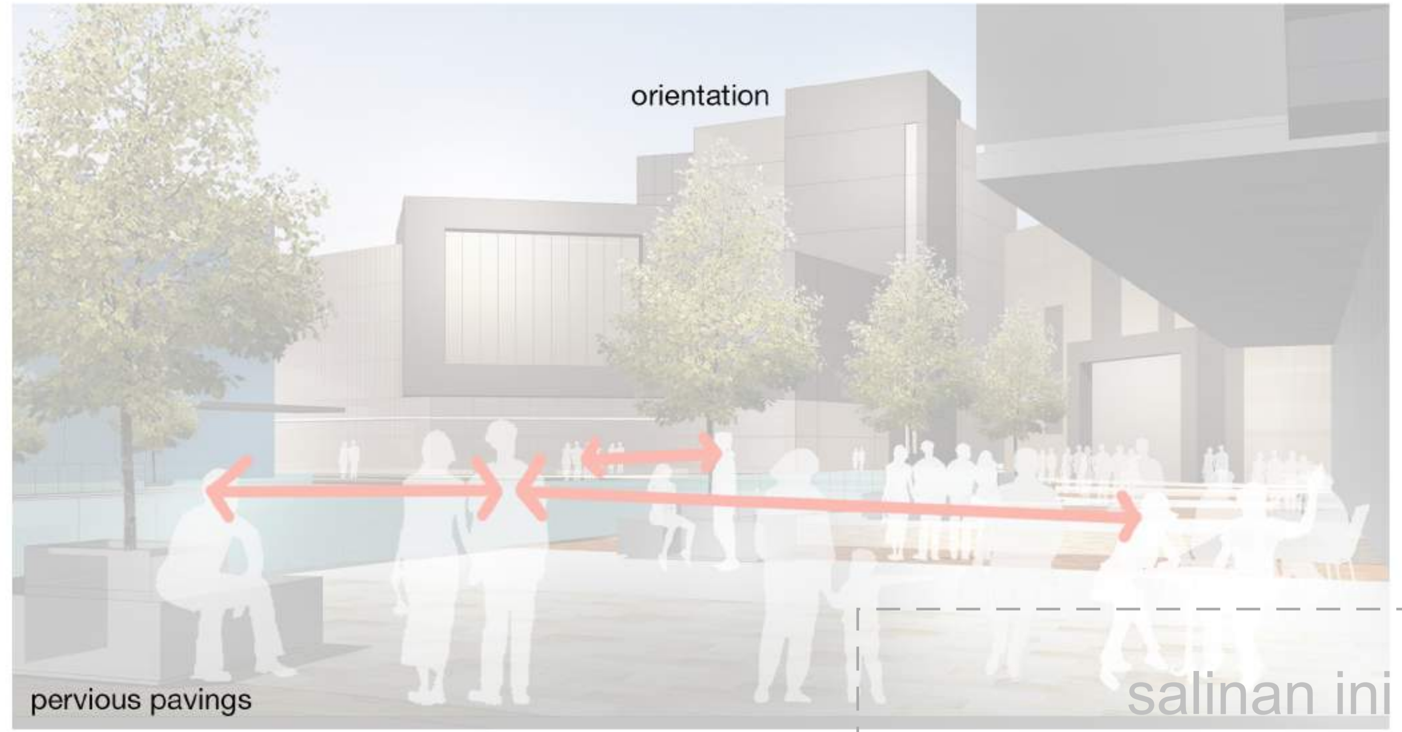
water canal, looking southwards



taking advantages of perimeter block which define the public front and strengthen as wella s activate the public realm, the massings are composed to create more dynamic experience that could be ejoyed especially by walking.

- layering creates good vista with background and foreground, *'hereness-thereness'*
- sequences creates spatial experiences, encourage flow of movement
- focal points creates orientation and landmark
- visual corridors strengthen linkages and wayfinding
- waterfront engagement

massing concept



- neighbourhood scale creates places for interaction
- 'eyes on the street', walkability

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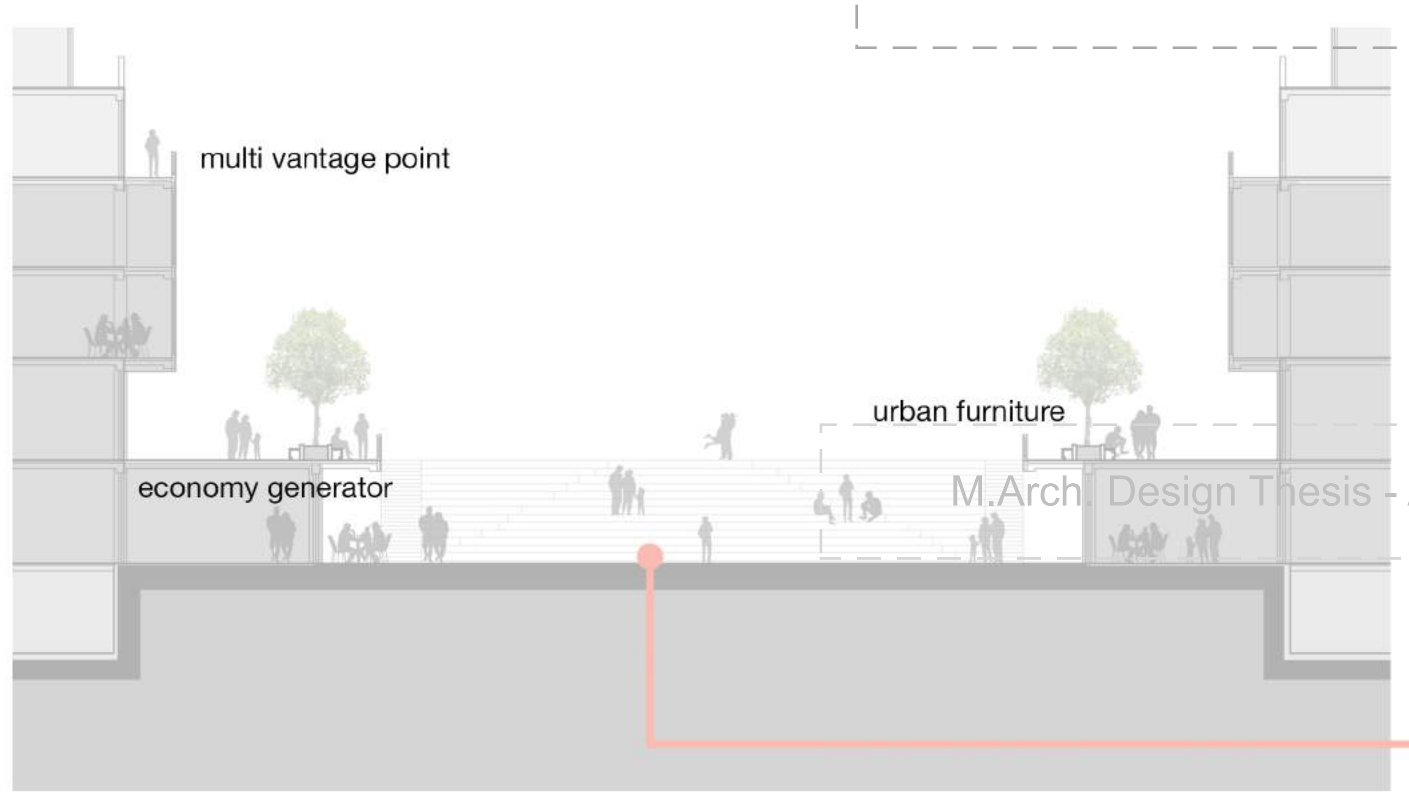

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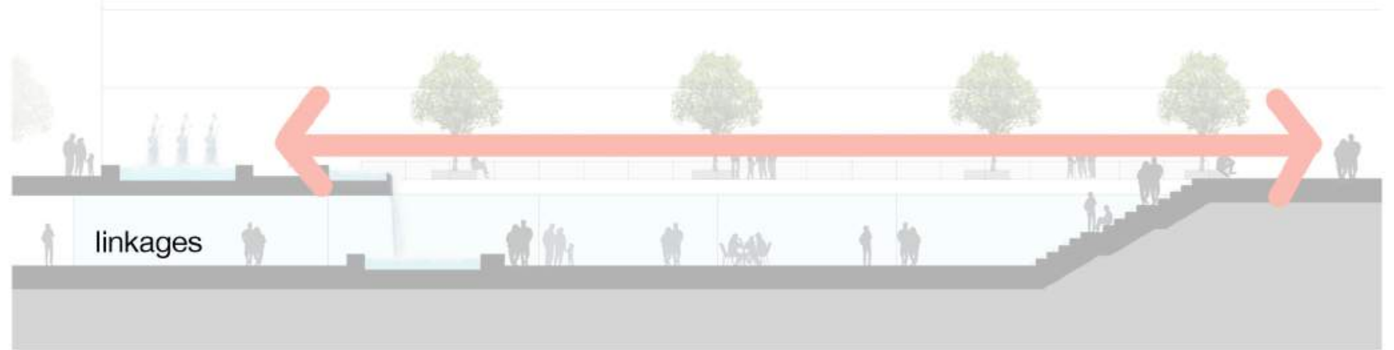
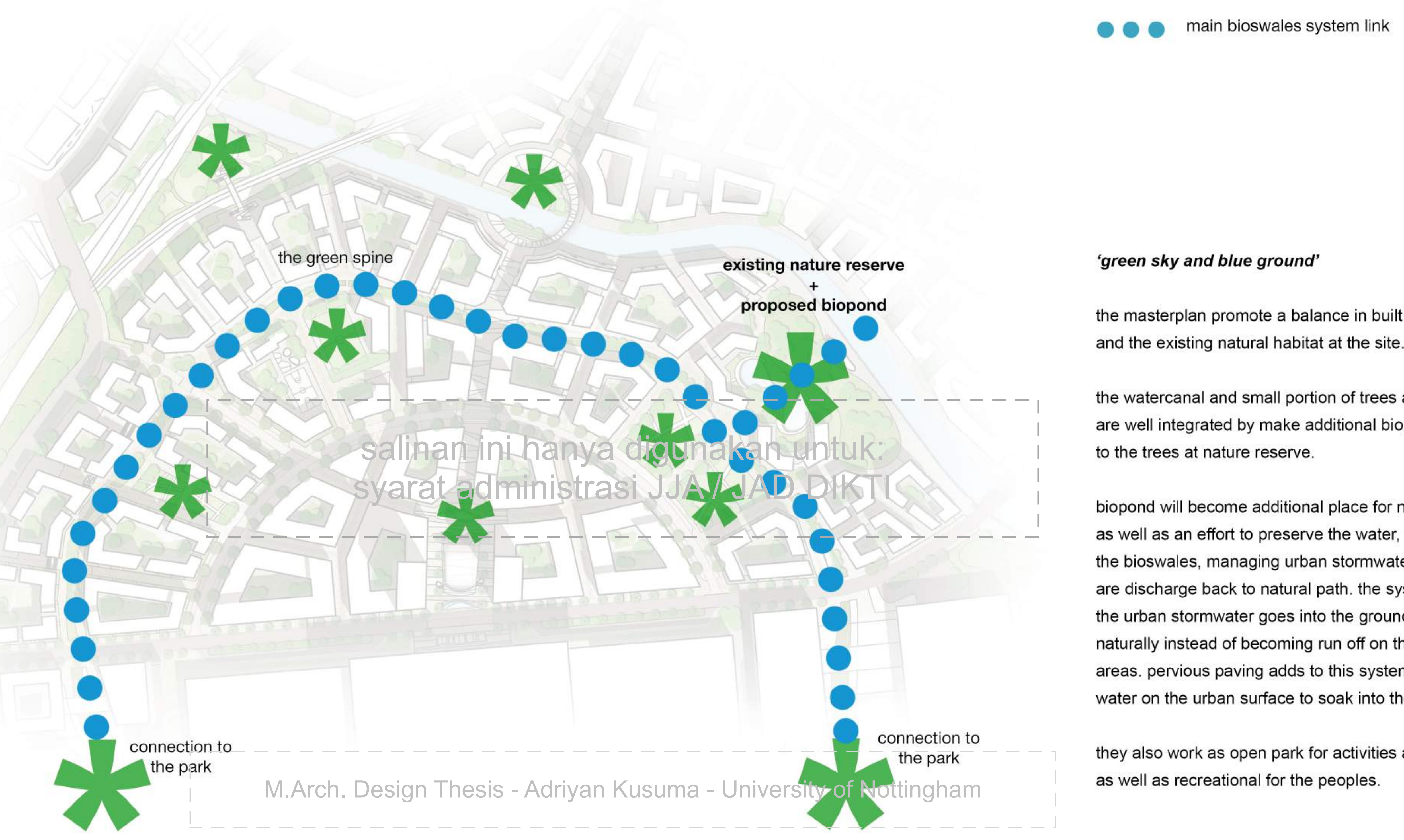
- places for activities at anytime: summer sand beach, winter skating rink, street performing stage
- mixed use and activity, creates urban vitality
- integrated commercial functions in the plaza for self-sustain economically as well as creates jobs
- integrating transit hub with pedestrian and activities flow strengthen access and linkages
- urban furniture (seatings, trees) creates comfort for peoples
- legibility adds strong orientation and wayfinding



public realm concept



the green spine = pedestrian path with as green connector with bioswales

'green sky and blue ground'

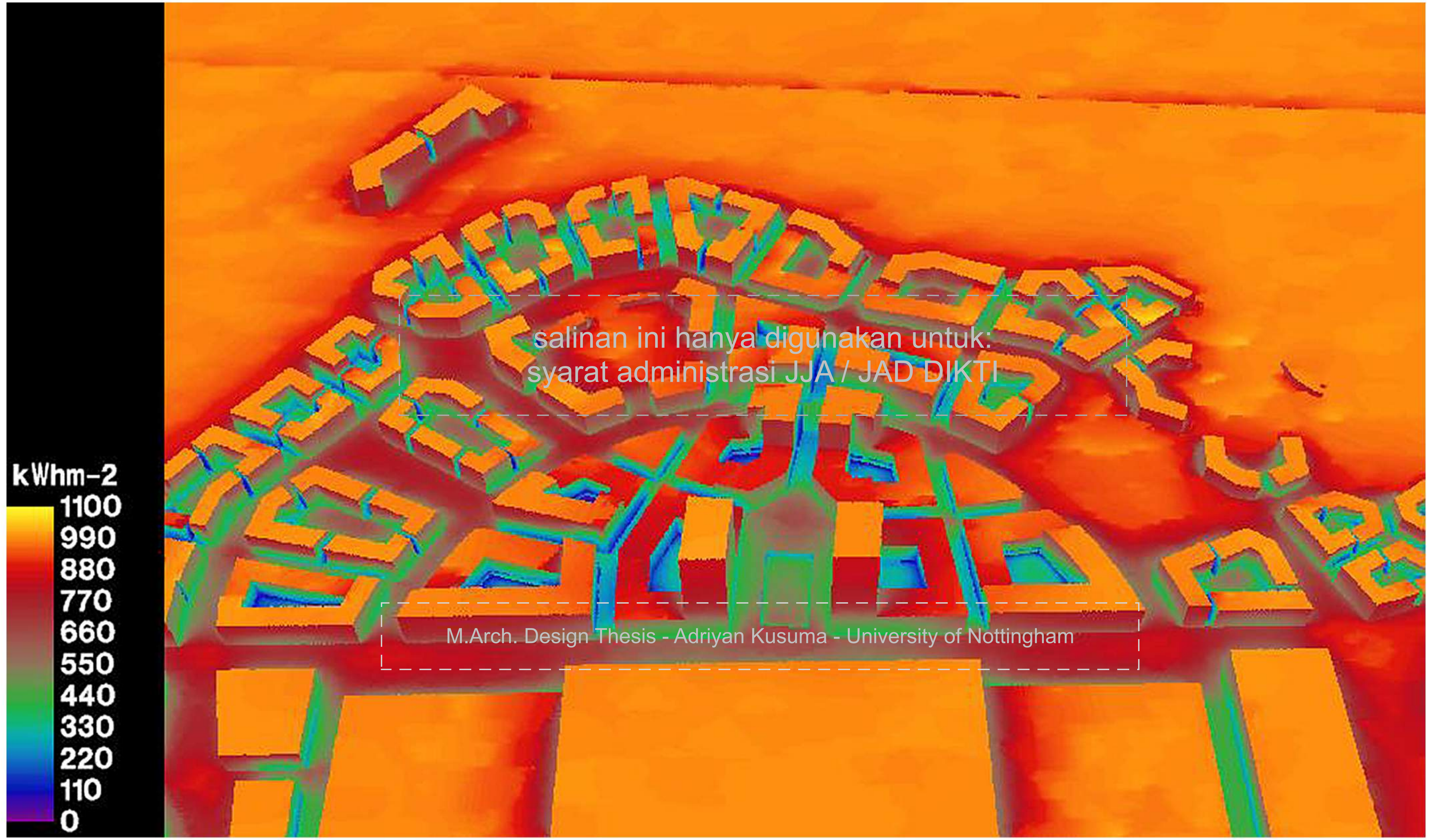
the masterplan promote a balance in built environment and the existing natural habitat at the site.

the watercanal and small portion of trees as nature reserve are well integrated by make additional biopond adjacent to the trees at nature reserve.

biopond will become additional place for natural ecosystem as well as an effort to preserve the water, together with the bioswales, managing urban stormwater before they are discharge back to natural path. the system will let the urban stormwater goes into the ground slowly and naturally instead of becoming run off on the street/urban areas. pervious paving adds to this system managing water on the urban surface to soak into the ground.

they also work as open park for activities and educational as well as recreational for the peoples.

ecological framework



solar radiation map (annual accumulative) shows that most building blocks enconter relatively high insolation. Certain part at the ground or lower stories still experiences lower insolation, this would need more architectural detail solution, for example building material and elements as well as ditribuiton of functions which do not rely much on solar radiation

solar radiation on final site

conclusion

The thesis has started with the study of urban perimeter block and the advantages of this kind of typology. Various study and literature has been compared to explore the aspect of perimeter block as one of the most common typology in urban design.

Perimeter block with its strong character defining the public-private spaces while maintaining its function keeps this form as an interesting subject of study in urban design.

The thesis focus on the performance of perimeter urban block in passive solar design emphasizing in the solar radiation aspect. The functional and design aspect of perimeter block is combined together with this environmental sustainability aspect of passive solar radiation.

One of perimeter block typology advantage is its ability to become more effecient with the same density compared to other urban form. Hence, the perimeter block could also sustain the achievement of medium and high density city.

The thesis comes with hypothesis that the perimeter block could be optimized to gain more density by adding the floors. However, early studies have shown that traditional perimeter block has limitation to become taller and gain more density in order to maintain the size of the inner courtyard to obtain good performance in design and functional aspects. Certain proportion and dimension should be kept in order to have proper enclosure on the adjacent street as well as the inner courtyard itself. Adding more floors could results in darker courtyard which could lead to unhealthy or unsafe conditions. Following studies explain this connected to the solar radiation, daylighting, wind flow as well as thermal condition of the block.

Earlier studies and guide have also come with common notions that south facing is significant for the building in the context of UK. It follows that the building should not blocking the other for their solar access, hence the building at the south side should be lower than the one at the north side. Certain studies have done more exploration on various possibilities of the block's form, layout and configuration.

The study conducted through this thesis has shown that the perimeter block has potential to be optimized in order to gain more density and still maintain its performance. Through solar radiation simulation, it is found that one side of the block still can be built taller.

This study has also found out that in the UK context, building taller building at the south side could be more efficient in achieving better passive solar radiation. Contrary to some of the early guides, the thesis has shown that in term of configuring the perimeter block, the wider aspect of urban area should be taken into account. Instead of just determining the configuration and its effects within the block itself, the adjacent block will also determine the configuration ot the block. In fact, with this consideration of adjacent building accross the street, the possibility to gain more effective layout could be gained.

By making the south side of the block taller, more solar radiation could be gained which could be harnessed as solar power. By maintaining certain back-to-back distance or following the required 31 degree cut off angle, the other side of the block could still gain solar access without being blocked. The distance will usually be the same as the required minimum back-to-back building like 25 meter.

In the meantime, the adjacent block and streets has been configured and has lower flexibility in adjusting the spacing and distance. Without proper consideration, the adjacent block will be blocked from solar access.

The thesis also further study and implemented the finding in design strategy of an urban site at Old Oak, London. With 17 ha area, the regeneration development which connect to the proposed new station which international and national accessibility, the high

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density and compact city approach could be more applicable for the Old Oak area. Further with the site analysis input, the design criteria and aspect of urban perimeter block are implemented to move towards the more sustainable urban design approach.

All in all the research and thesis has shown the study that urban perimeter block could still be enhanced and studied to be applied in high density city with even more efficient in passive solar urban design.

The study was limited only on the solar radiation performance of urban block. Further research studying the perimeter urban block with more aspect like thermal and wind could be really useful for the wider urban design advantages.

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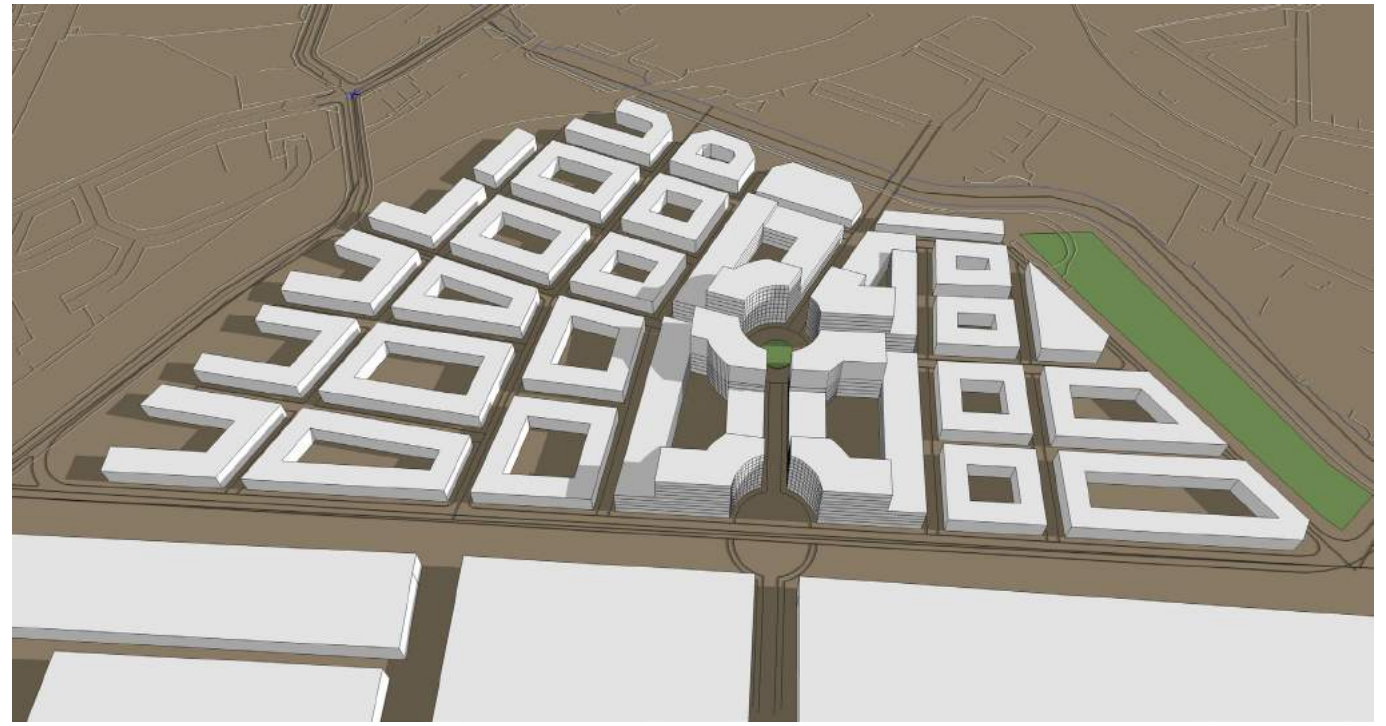
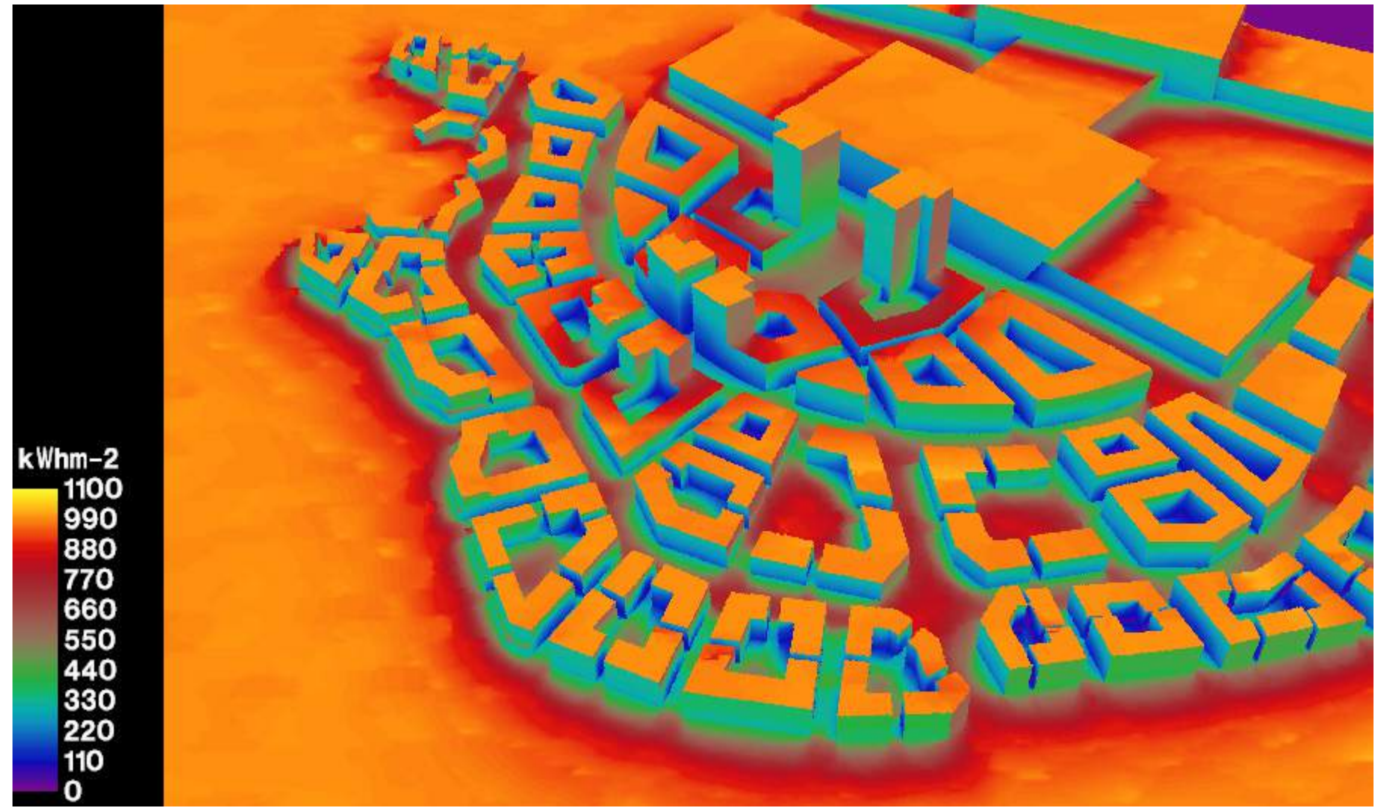
design processes

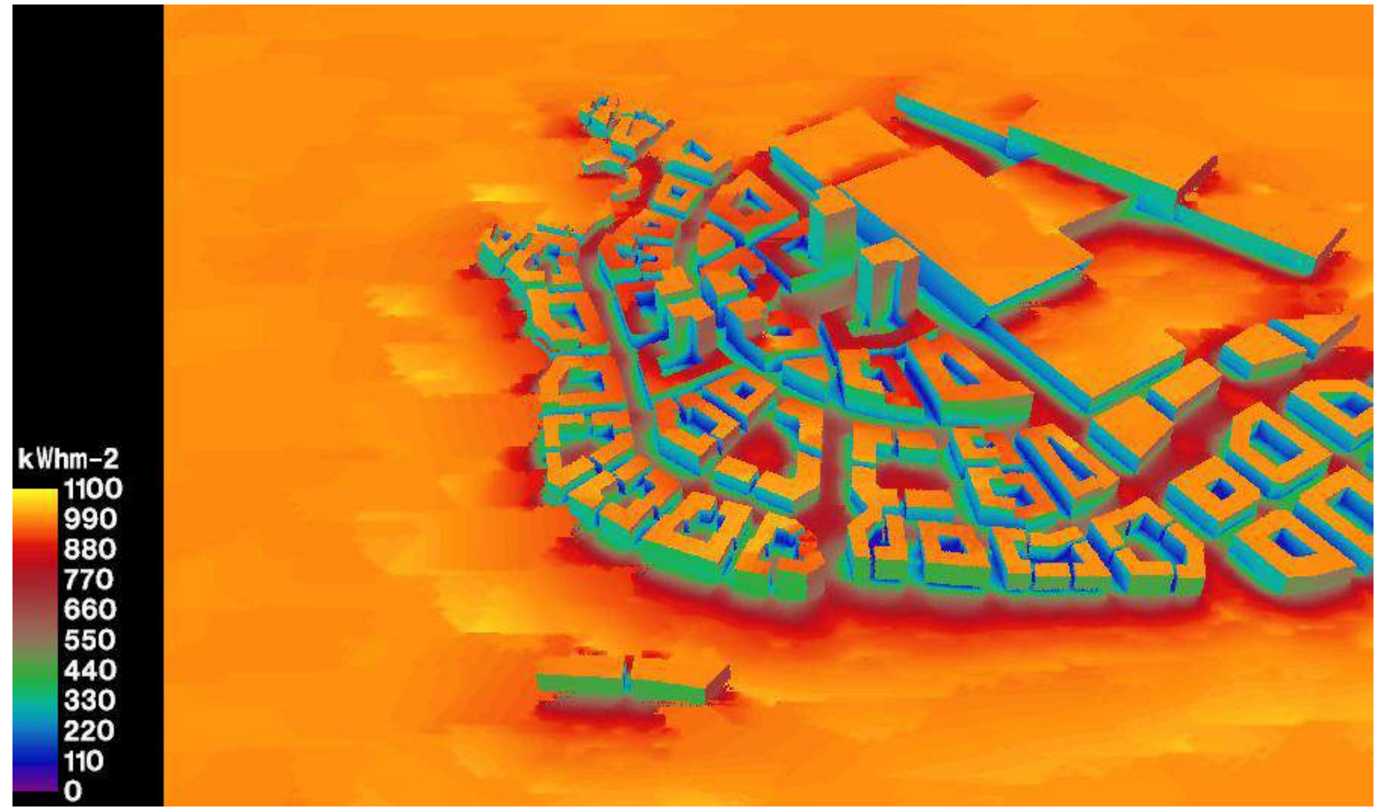
Initial Massing Model

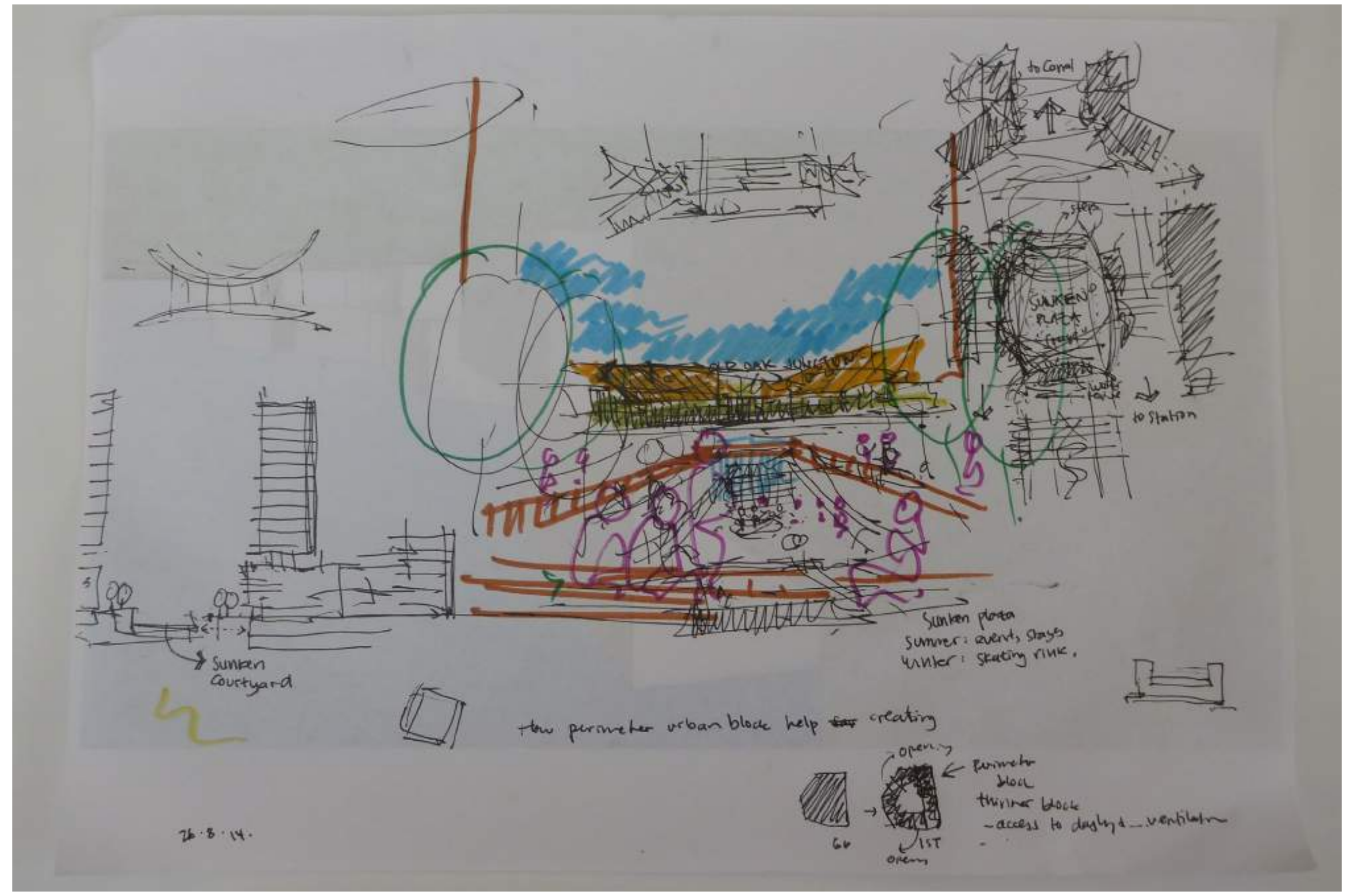


Initial study on density and blocks placement. The grid and placement of the blocks are still too rigid. Further enhancement involving block massing study, zoning hierarchy are done to refine the design



Solar radiation study on block massing comparing before and afte adjustment and input from research. Left top and bottom drawings shows early massing. Right top and bottom show massing after one side of building built higher to create more density. Solar radiation map shows that adding density with additional floors (taller buildings on the south side) manage to create better improvement (more solar radiation, lesser blocking of radiation)




Sunken plaza
Summer: events, stages
Winter: skating rink.
How perimeter urban block help creating
opening
Perimeter block
thinner block
- access to daylight _ ventilation
opening