

# Politecnico di Milano



Scuola di Architettura e Società

Master of Science in Architecture

## **Sandhurst Road Rail Yard Urban Transformation**

**Regeneration of Mumbai Rail yard.  
A new center reintegrating different  
parts of the city. An architectural and  
urban design on Sandhurst Road rail  
yard transformation.**

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**AY:** 2012/2013

Dedicated to my Grandmother and Grandfather

## Acknowledgment

The adventure of understanding cities and its urban texture began in young age and that leads to the explorations of the cities. After completing my graduation Thesis on Rejuvenating the Urban Void in my town and traveled around the parts of India, I look for the pursuit of further understanding of my city Mumbai. This leads to the series of unexplored territories and leads me to the most challenging and exiting journey of my life at Politecnico di Milano Architecture Program and this reflect the culmination of Graduation Thesis.

I take this opportunity to deeply acknowledge the contributions of the many whose support and encouragement has helped me to develop and define this thesis. I thank all who have helped me and contributed to the research and analysis of the thesis and helped me in difficult times and periods of this work.

First and foremost, I wish to sincerely express my gratitude to my mentor, Prof. Cassandra Cozza for her constant guidance and support. Encouragement is the key for the success and I would like to thank my mentor for understanding and guiding throughout the process of this thesis. I would also like to thank Prof. Andrea Oldani for his specific comments during my presentations. I also received professional mentoring during my internship at DAP studio, Milano, which contributed me in my design thoughts and discussions and helped me gain new perspectives. I like to mention Apostrophe Architecture, Mumbai, for the contribution in thesis material.

Special thanks to my parents who contributed tremendously in motivating me with their understanding in several occasions. The success to this thesis work is dedicated to my father, for his endless patience and wisdom and to my mother, for her encouragement. I would like to mention my brothers Sahas and Saurabh and my sister Samiksha who encouraged me during my entire thesis period and specially I pass my love to my sweet niece Nytika and my loving nephew Shaurya.

I am truly grateful to all my friends and take immense pleasure in thanking those who have helped me realize this work and for all the invaluable good times spent. I would like to thank Shantanu, for helping, encouraging and contributing in difficult times. I take this moment to thank Maicheal and Hema, for always being there when I needed. Last but not least, I would like to thank Priyanka and Snigdha, for the initiation of this work and the discussion over countless number of Italian coffee.

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**Part 1**  
**Introduction**

Fig 01  
Aerial view of Mumbai  
Source: Mumbaicorner



## 1.1 Thesis Abstract:

This thesis is an Architecture and Urban design proposal for the regeneration of Mumbai's railway network of Sandhurst road rail yard complex.

Mumbai is the financial capital of India and an alpha city owing to its increased corporate presence in the global economic network. The Population of Mumbai Metropolitan Region is expected to increase from 21.0 million in 2005 to 34.0 million in 2030 (CTBUH 2009)

Mumbai is transforming rapidly and restructuring its urban texture in the process. Due to the rapid urbanization of the city, the railway network is acting as a void for the city and it is dividing it into parts.

The thesis analyzed the part of the railway network and aims to propose an architectural and urban design solution to connect the parts of the city and to design the voids for further development and with the high design quality and livability.

The main background of the thesis analyzed the city development from the historical time to the present condition and frames a Master-Plan for the development of the part of the city, which once played a pivotal role in transforming the city to its present state, but now remains as a void and hindering in the development of the city further.

The main problem deals with the existing condition of under-utilized railway storage lands in the city of Mumbai and its strategic location in the city (as railway network is called a Lifeline of the city). The problem of non integration of railway land of the city with the rest, which has enormous potential for development but remain isolated from the city.

The architectural and urban design proposal is based on these challenges of connecting the existing urban fabric with the site and creating a much needed open public space.

**"Reintegrating: to integrate again into an entity/ restore to unity"**  
(Merriam Webster, 2013)

**The project focuses on the global as well as local level by analyzing the city with morphology and creating a new built fabric by connecting with the existing urban fabric. The project also strengthen the railway infrastructure of the city by giving new identity to the site and create new program for the interchange areas.**

## Tesi Abstract:

Questa tesi è una proposta di progetto architettonico e urbano per la rigenerazione dell'area ferroviaria di Mumbai chiamata complesso di Sandhurst road rail yard.

Mumbai è la capitale finanziaria dell'India ed è una città alfa a causa della sua forte presenza nella rete economica globale. È previsto che la popolazione della Mumbai Metropolitan Region aumenti da 21 milioni, dato del 2005, a 34 milioni nel 2030 (CTBUH 2009).

Mumbai si sta trasformando rapidamente rigenerando il suo tessuto urbano in questo processo. A causa della rapida urbanizzazione della città, la rete ferroviaria si presenta come un vuoto che divide la città in parti.

La tesi si concentra su una parte della rete ferroviaria e mira a proporre un progetto architettonico e urbano per ricollegare parti della città e per progettare i vuoti come spazi pubblici di alta qualità e vivibilità.

La tesi si basa su un'analisi dello sviluppo storico della città fino alla condizione attuale e propone un Master-plan per lo sviluppo di una parte di città, che ha avuto un ruolo fondamentale nello sviluppo la città, ma che ora rimane come un vuoto che ostacola il collegamento tra le parti e l'ulteriore sviluppo della città.

Il principale problema affrontato è quello dell'attuale condizione di sotto-utilizzo delle aree ferroviarie nella città di Mumbai e la posizione strategica dell'area per la città (infatti in città la rete ferroviaria è chiamata Lifeline). Poi c'è il problema della non integrazione dell'area ferroviaria con la città, ma che ha un enorme potenziale di sviluppo, anche se adesso è isolata dalla città.

La proposta di progetto architettonico e urbano si basa su queste proposte di collegare il tessuto urbano esistente con il sito e di creazione uno spazio pubblico aperto del quale c'è molto bisogno.

**"Reintegrare: integrare nuovamente in un'entità/ il ripristino di unità"**  
(Merriam Webster, 2013)

**Il progetto si concentra sia sul livello globale che su quello locale, attraverso l'analisi della città con la sua specifica morfologia e la creazione di un nuovo tessuto che crea un forte collegamento con il tessuto urbano esistente. Il progetto, inoltre, rafforza le infrastrutture ferroviarie della città, dando nuova identità al sito e proponendo un nuovo programma per le aree di interscambio.**



## 1.2 Existing Situation

According to McKinsey (2010) by the year 2025, nearly 2.5 billion Asians will live in cities accounting for almost 54% of the world's urban population (see Fig. 02). India and China alone will account for more than 62% of Asia's urban population. The number of mega-cities with population more than 10 million is expected to double in 20 years.

The world is experiencing intense urbanization by the hand of extensive yet uneven processes of growth and expansion. More than half of humanity now lives in cities (Urban Age, 2007) Indian cities have been following a continuous trajectory of population growth from the start of the twentieth century (see Fig. 33).

The shift to cities is both the product and a catalyst of economic growth.

This growth in Indian cities leads to tremendous pressure in the existing cities. The cities are becoming a magnet of prosperity and connection to the world.

Mumbai has seen tremendous growth in urban population in the past 2 decades. The city is transformed from a city to a mega-city and is rapidly expanding to be no.2 city in terms of population with 30 million inhabitants.

## Population Growth in World Cities

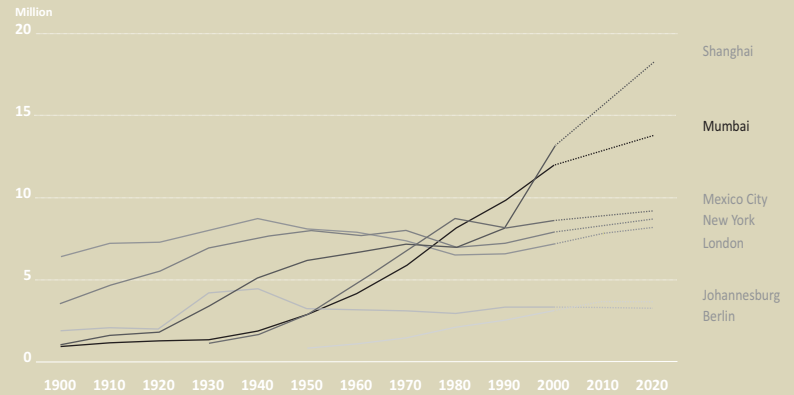


Fig 02  
Graph indicating  
growth of cities

Source:  
Urban Age, 2007

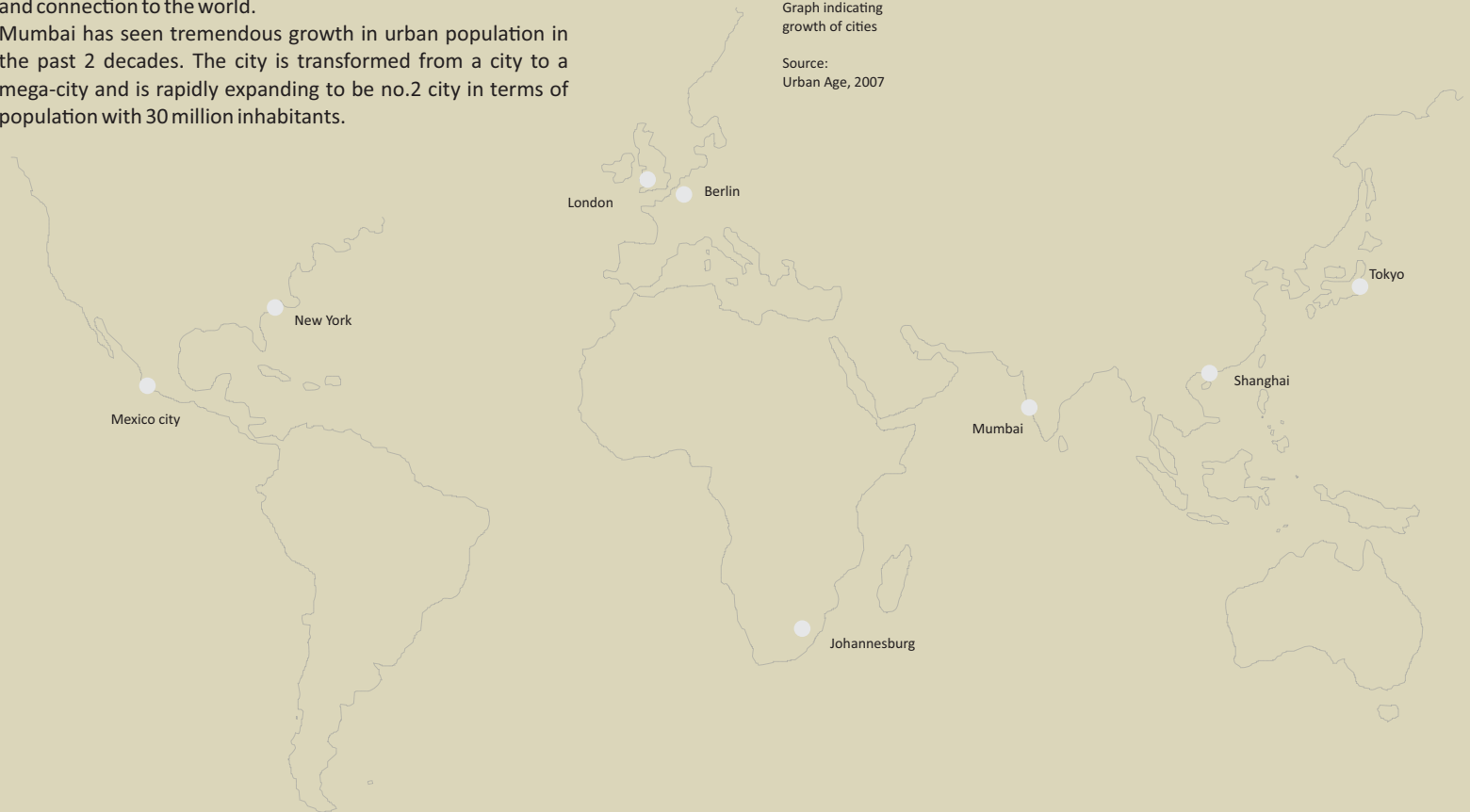


Fig 03  
Relation of Mumbai in  
world context  
Source:  
Urban Age, 2007

### 1.3 Problems and Potentials

#### Problems

Due to rapid urbanization in India and shifting of rural based economy to service based economy, there is an unprecedented migration towards the cities. Mumbai has seen dramatic urban influx in the recent history.

Due to the opportunities in the cities, they act as a magnet thereby attracting people.

The city of Mumbai started transforming in a major way by proposing satellite towns but the problems of poor infrastructure, healthcare, housing persists. The city has undertaken massive projects to restructure its centralities but it is still not effective. The main issue of the city development is its locked land. The city was developed due to the port trading activity, which contributes little to the present day service based economy. Due to this shift in economical activity, large part of Mumbai land used for the port activity or its related activity now act as void in the city and hindering the development of the city.

#### Potentials

Due to the location of the city, it has tremendous potential to become world class city. The city infrastructure, specially the railways have a large part of land staying idle, because it is no more in use of the activity it once used for.



Fig 04  
Commuters waiting at  
the station for taking  
the train  
Source: google

#### **1.4 Statement of purpose**

As Mumbai expands, its open spaces are shrinking. The city's shrinking physical open spaces are the most visible manifestation as they directly and adversely affect our very quality of life. (Open Mumbai, 2011)

The main driver behind the growth and development of Mumbai has been public transportation, at the moment well served by the suburban trains and the city bus system. The Railway system is used by millions daily for commuting but still the point of exchange remain problematic. The city has 51 stations, covering 155 acres, yet crowds, congestion and chaos prevails at the hubs that links the trains. Also due to the shift towards service based economy, the city's railyards are no longer in function it used to be.

The thesis identifies the problems of the situation with its local as well as global scale for providing an architecture and urban design solution to the existing situation.

## **Part 2**

### **Analysis of the City**

**This part aims to analyze the city from its historical background to the development after independence.**

**Developed as a port city, it played a predominant role in shaping the urban texture of the city and as it is shifting from the port based activity to service based activity, it is transforming itself thereby changing its urban texture.**

**The analysis discuss key issues of history, transportation, city structure, its development, morphology and urban activities. The analysis focus on the different scale from the city region to the change in urban texture due to urban transformation.**





Fig05  
Satellite View of  
Mumbai



## 2.1 Timeline of important events in Mumbai's Transformation

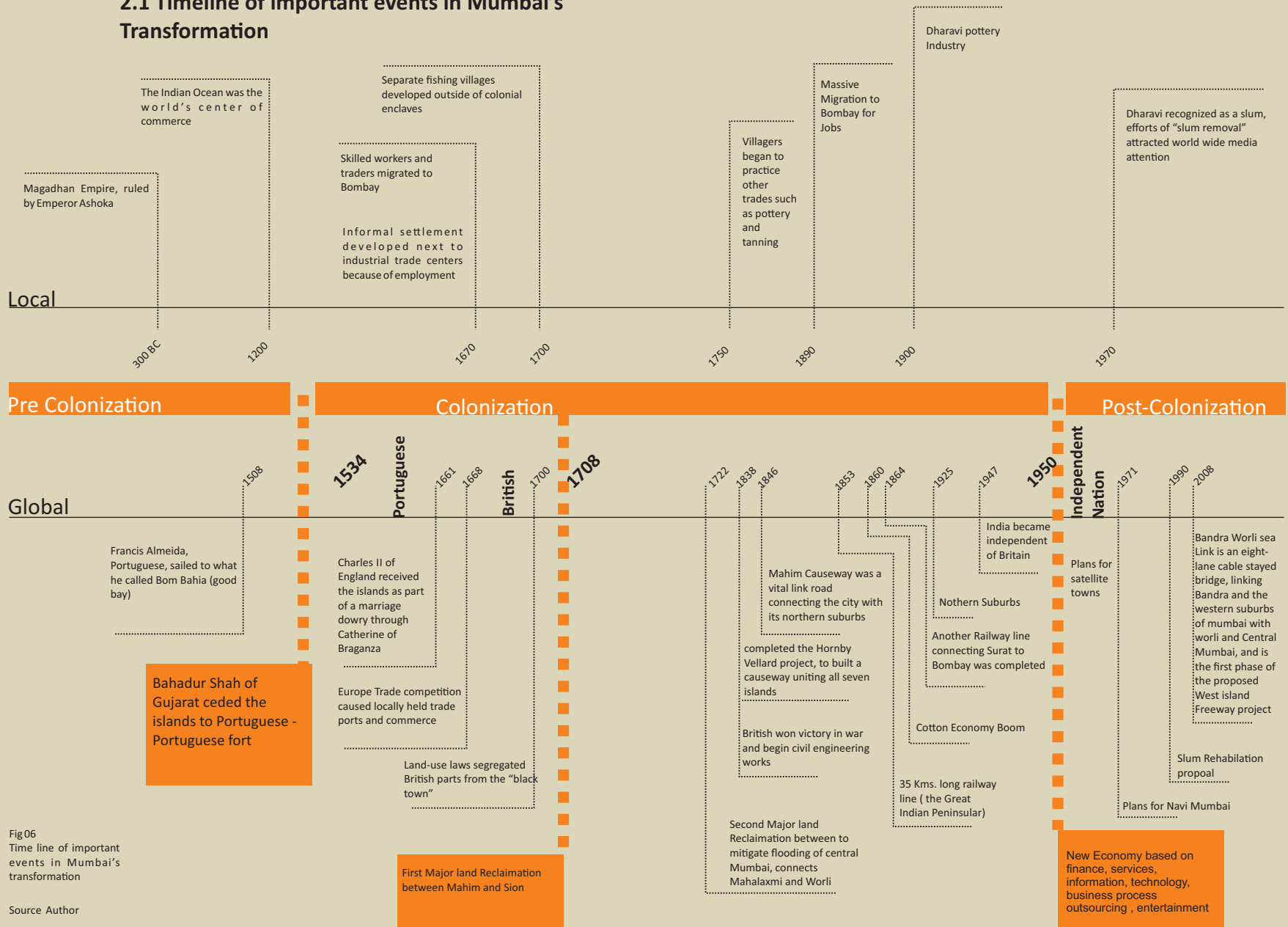


Fig06  
Time line of important events in Mumbai's transformation

Source Author

## 2.2 Historical Transformation

### 2.2.1 Pre Colonial Phase

Mumbai has been growing for five hundred years, even though it was built on what initially looked like very weak foundations. At first there were just seven islands separated by swamps: the land was dangerous and unhealthy.

A thousand years ago the islands were part of the Magadhan empire. Later they belonged to the Silhara family and in 1343 they became part of the lands of the Sultan of Gujarat. (British Library, 2012)

In 1534, the Portuguese captured the islands and established a trading center (or 'factory') there. The Portuguese called the place Bom Bahia, meaning 'the good bay', which the English pronounced Bombay.

Although the archipelago which developed into the modern city of Mumbai was inhabited whenever history chanced on it. The islands lay outside of the sweep of history and beyond the marches of armies for millennia. Stone age implements have been found at several sites in these islands. Later, around the third century BC, the coastal regions, and presumably the islands, were part of the Magadhan empire ruled by the emperor Ashok. The empire ebbed, leaving behind some Buddhist monks and the deep-sea fishermen called Kolis, whose stone goddess, Mumbadevi, gave her name to the modern metropolis. (City data, 2008)

Between the 9th and 13th centuries, the Indian ocean, and especially the Arabian Sea, was the world's center of commerce. Deep sea crafts made of wood tied together with ropes transported merchandise between Aden, Calicut, Cambay and cities on the West coast of Africa. Marco Polo, Ibn Batuta and other travelers passed by without ever making a landfall in these islands.

Bombay changed hands many times. The islands belonged to the Silhara dynasty till the middle of the 13th century. The oldest structures in the archipelago; the caves at Elephanta, and part of the Walkeshwar temple complex probably date from this time. Modern sources identify a 13th century Raja Bhimdev who had his capital in Mahikawati; present-day Mahim, and Prabhadevi. Presumably the first merchants and agriculturists settled in Mumbai at this time.



Fig07  
Islands of Mumbai  
region before  
reclamation

Source: Author

In 1343 the island of Salsette, and eventually the whole archipelago, passed to the Sultan of Gujarat. The mosque in Mahim dates from this period.

### 2.2.2 Colonial Phase

**Portuguese Colony:** Portuguese captured the Islands in 1534 from Sultan of Gujarat.

The islands were leased to several Portuguese officers during their regime. The Portuguese built several fortifications around the city like the Bombay Castle, Castella de Aguada (Bandra Fort), and Madh Fort. (see Fig. 08)

In 1534, the Portuguese captured the islands and established a trading centre (or 'factory') there. The Portuguese called the place Bom Bahia, meaning 'the good bay', which the English pronounced Bombay.

This trading place slowly grew, with local people trading products such as silk, muslin, chintz, onyx, rice, cotton and tobacco. By 1626, there was a great warehouse, a friary, a fort and a ship building yard. There were also new houses for the general population, and mansions for the wealthy.

In 1661 Bombay was given to the British Empire, as part of dowry from Portuguese.

Fig 08  
Portuguese settlement  
in Bombay showing  
Bombay Castle and  
Fort Area

Source: Various



Home of fisherfolk where a group of Buddhist monks established an outpost late during the *Magadhan Empire*.

The Chalukyas (A. D. 550–750) built the magnificent cave temples on *Elephanta Island* in Mumbai Harbor

The Hindu *Silhara dynasty* ruled the region around present-day Mumbai between 810 and 1240.

The *Walkeshwar Temple* and the *Banganga Tank* were built during the reign of Chittaraja, a king of this dynasty

Part of the Sultanate of Gujarat in 1343. Established base in Mahim, one of the 7 islands of Mumbai.

From Top to Bottom

Fig 09, 10, 11, 12  
Occupation of Mumbai  
during various timeline

Source: Author

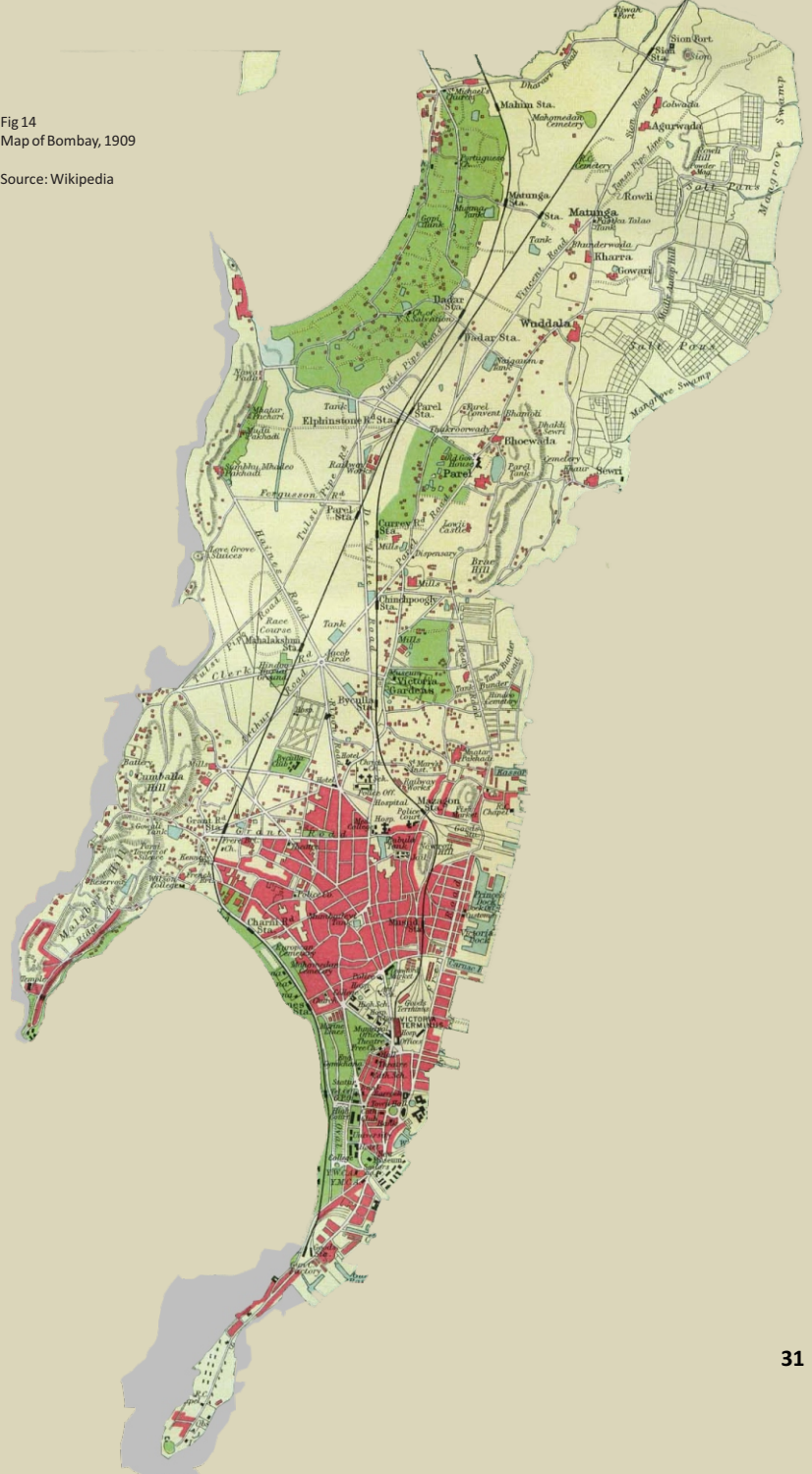
Portuguese captured the Islands in 1534 from Sultan of Gujarat.





Fig 13  
Ships in Bombay  
Harbour, 1731  
Source: Wikipedia

Fig 14  
Map of Bombay, 1909  
Source: Wikipedia



### British Colony

The first Englishmen to visit Mumbai were raiders. In October 1626, whilst at war with Portugal, English sailors heard that the Portuguese had "got into a hole called Bombay" to repair their ships.

They attacked Bombay, but the ships had already left. The English burned down buildings, and destroyed two new Portuguese ships "not yet from the stocks".

In May 1662, King Charles II of England married Catherine of Braganza, whose family offered a large dowry (a gift made by the father of the bride to the groom). Part of this gift was the Portuguese territory of Bombay. However, Charles II did not want the trouble of ruling these islands and in 1668 persuaded the East India Company to rent them for just 10 pounds of gold a year.

As Bombay was a deep water port, large vessels were able to dock there. Bombay needed a fort and a garrison of soldiers to protect it from Dutch fleets and Indian pirates.

(British Library, 2013)

Recognizing the potential of Mumbai and its harbor, the East India Company set about strengthening the settlement's defenses and soon shifted its administrative headquarters to Mumbai from Surat, in Gujarat. Mumbai's second governor, Gerald Aungier (d. 1677), laid the foundations for the city's future growth.

From Left to Right

Fig 15, 16, 17  
Diagrammatic  
representation of  
British colonial  
expansion  
1661 - 1845 indicating  
reclamations of 7  
islands

Source: Author

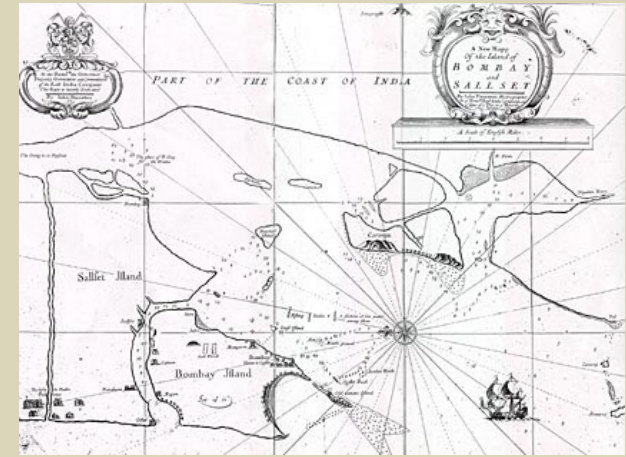


Fig 21  
Map of Bombay and  
Sallet Island

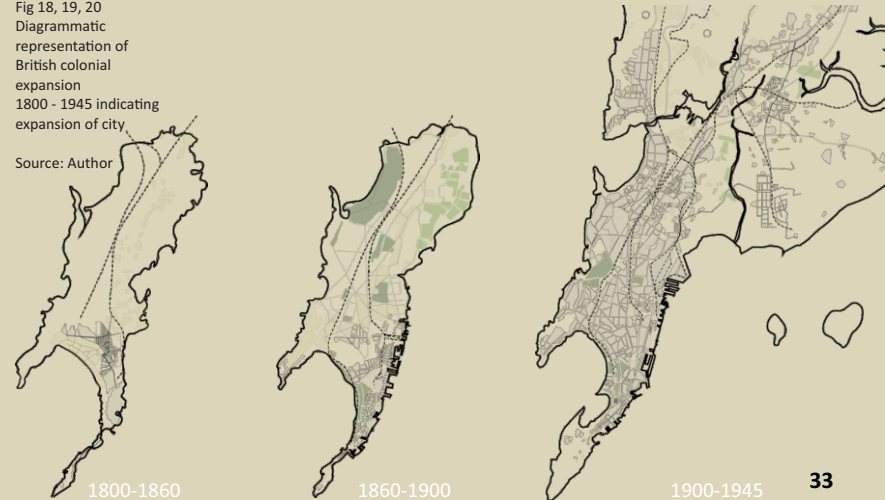
Source: Wikipedia

**Economy and Expansion:** In 1857, the first spinning and weaving mill was established in Mumbai, creating a cotton textile industry that was given a great boost by the American Civil War (1861–65), which cut off supplies of cotton to Britain. The opening of the Suez Canal in 1869 was another stimulus to Mumbai's growth, further enhancing its position as a major trade, commercial, and industrial center.

From Left to Right

Fig 18, 19, 20  
Diagrammatic  
representation of  
British colonial  
expansion  
1800 - 1945 indicating  
expansion of city

Source: Author





## Reclamation Project

In the early 1800s, much engineering work was carried out in Bombay. The very end of the seventeenth century saw the beginning of the construction of seawalls, breakwaters, and reclamation projects that eventually connected the original seven islands (Mahim, Worli, Mazagaon, Old Woman's Island, Colaba, and Mumbai Island) into a single Mumbai Island.

Clockwise from Left

Fig 22, 23, 24, 25  
Diagram indicating the process of Land Reclamation

Source: Author



### Reclamation (1708- 1960):

**1708**

First major reclamation of Causeway between Mahim and Sion

**1772**

Second major reclamation connecting Mahalaxmi and Worli

**1803**

Mumbai connected to Salsette island by a causeway from Sion.

**1838**

Colaba island joined with Bombay by Colaba Causeway

**1845**

Mahim and Bandra connected to Mumbai

**1914**

Extension of the Docklands

**1960**

New Backbay Reclamation

### The Great Breach:

the remnants of a massive stone causeway across the Flats on the island of Bombay between Dongri and Malabar hills

### Pydhonie and Umarchhadi:

The Great Breach extended to Umarchhadi, the creek separating Bombay from Mazagaon. the two islands linked by a shallow creek at the site of Pydhonie.

### The Hornby Vellard:

Major reclamation was due to the closure of the Great Breach north of Cumballa Hill in 1784 by the building of a sea-wall called the Hornby Vellard. The wall allowed reclamation of the Flats and supplied about 400 acres of land for the extension of the crowded inner city.

### Colaba and Old Woman's Island:

The Colaba Causeway was completed in 1838, and used Old Woman's island as a stepping stone to Colaba.

### The First Backbay Reclamation Scheme:

The first Backbay Reclamation Company was formed during the boom years of the early 1860's, with the stated purpose of reclaiming the whole of Backbay, from the tip of Malabar Hill to the end of Colaba.

### The Dockyards:

The Elphinstone Land and Press Company was formed in 1858 to reclaim 250 acres of land from Apollo Bunder to Mazagaon, and a further 100 acres at Bori Bunder, to be given to the GIP Railways for building a the Victoria Terminus.

### Early Twentieth Century:

Between 1914 and 1918 it completed building a dry dock and used the excavated earth to create the 22 acre Ballard Estate.

### Late Twentieth Century:

The third Backbay reclamation scheme was put into effect and yielded the small acreage on which the high-rises of Nariman Point and Cuffe Parade are planted. The Naval Dockyards were reclaimed on the east, and smaller works were continued further north.

(TIFR, 2007)

### 2.2.3 Post Colonial Phase

Mumbai's size and economic power are reflected in its role in India's modern political history. The city was an important center in India's struggle for independence from British colonial rule. The Indian National Congress, which led the nation's fight for freedom, was founded there in 1885. Mohandas Karamchand Gandhi (1869–1948), the Mahatma, spiritual leader of the independence movement, launched his "Quit India" campaign against the British in Mumbai in 1942. Linguistic tensions between Mumbai's Marathi and Gujarati speakers resulted in violence in the city in the late 1950s. This led eventually to the separation of Gujarati-speaking areas from Mumbai state and the creation of Maharashtra State (1960).

During the early 1990s, communal violence between Hindus and Muslims in Mumbai again shattered the myth of a tolerant, cosmopolitan city. Rioting led to the deaths of several hundred people (mostly Muslims) and culminated in the bombing (with numerous fatalities) of several buildings in March 1993. The Shiv Sena, a right-wing Maharashtra-based Hindu political party led by Bal Thackeray, was widely blamed for instigating Hindu violence against Muslims in the city. Subsequently elected to office, the Shiv Sena party in 1996 changed Mumbai's name to "Mumbai," the Marathi name for the city.

In the twenty first century Mumbai is heading towards world class city. Mumbai is developing at unprecedented rate and transforming itself. Massive construction projects are emerging all around the main Mumbai region. Upgradation of existing infrastructure, developing new highways, Freeway projects, Sea link project rapidly changing the urban pattern of the city.

Clockwise from Left

- Fig 26  
Marine Drive looking  
towards Nariman Point
- Fig 27  
New Western freeway,  
Bandra Worli sea link
- Fig 28  
Gateway of India



#### **2.2.4 Present Phase**

In the twenty first century Mumbai is heading towards world class city. Mumbai is developing at unprecedented rate and transforming itself. Massive construction projects are emerging all around the main Mumbai region. Up-gradation of existing infrastructure, developing new highways, Freeway projects, Sea link project rapidly changing the urban pattern of the city.

Due to the Economic liberalization in 1991, the city of Mumbai slowly transformed from industrial based economy to the service based economy.

The period from 1991 to 2005 showed a sharp increase in the commercial growth and an associated expansion of the city infrastructure. The nature of the economy also underwent a core change from manufacturing to a service based industry.

Foreign investments and corporations increased in Mumbai in this period following the emergence of a largely free market economy.

This period also saw an increased immigration from other parts of the country into suburban Mumbai and Navi Mumbai.



## 2.3 Geography

Mumbai consists of two distinct regions: Mumbai City district and Mumbai Suburban district, which form two separate revenue districts of Maharashtra. The city district region is also commonly referred to as the Island City or South Mumbai.

The total area of Mumbai is 603.4 km<sup>2</sup> (233 sq mi), of this, the island city spans 67.79 km<sup>2</sup> (26 sq mi), while the suburban district spans 370 km<sup>2</sup> (143 sq mi), together accounting for 437.71 km<sup>2</sup> (169 sq mi) under the administration of Brihanmumbai Municipal Corporation (BMC). The remaining area belongs to Defence, Mumbai Port Trust, Atomic Energy Commission and Borivali National Park, which are out of the jurisdiction of the BMC.

(MCGM, 2012)

Mumbai lies at the mouth of the Ulhas River on the western coast of India, in the coastal region known as the Konkan. It sits on Salsette Island, partially shared with the Thane district. Mumbai is bounded by the Arabian Sea to the west. Many parts of the city lie just above sea level, with elevations ranging from 10 m (33 ft) to 15 m (49 ft); the city has an average elevation of 14 m (46 ft).

Northern Mumbai (Salsette) is hilly, and the highest point in the city is 450 m (1,476 ft) at Salsette in the Powai–Kanheri ranges. Sanjay Gandhi National Park (Borivali National Park) is located partly in the Mumbai suburban district, and partly in the Thane district, and it extends over an area of 103.09 km<sup>2</sup> (39.80 sq mi). Apart from the Bhatsa Dam, there are six major lakes that supply water to the city: Vihar, Lower Vaitarna, Upper Vaitarna, Tulsi, Tansa and Powai. Tulsi Lake and Vihar Lake are located in Borivili National Park, within the city's limits. The supply from Powai lake, also within the city limits, is used only for agricultural and industrial purposes. Three small rivers, the Dahisar River, Poinisar (or Poisar) and Ohiwara (or Oshiwara) originate within the park, while the polluted Mithi River originates from Tulsi Lake and gathers water overflowing from Vihar and Powai Lakes. The coastline of the city is indented with numerous creeks and bays, stretching from Thane creek on the eastern to Madh Marve on the western front. The eastern coast of Salsette Island is covered with large mangrove swamps, rich in biodiversity, while the western coast is mostly sandy and rocky.




Fig 29  
Mumbai: Geography  
with Mumbai  
metropolitan region

Source: Wikipedia,  
2012

## 2.4 Administration

Cities are not always able to incorporate newly developed land into the administrative boundaries drawn around the original cores. Hence their local governments may lack control on suburban and peri-urban growth, generating problems of metropolitan governance. Also, the varying relation between political boundaries and urbanised areas results in different cities appearing to assume more dissimilar urbanisation patterns than they actually do. Boundary-sensitive differences may appear when comparing patterns of land consumption; ratios between built and green areas; local shares of national populations, etc.

The capital of the State of Maharashtra, Mumbai is a city of 12 million. Known as Greater Mumbai, it covers an area of 438 sq. km with an extremely high population density (27,348 people per sq. km). Furthermore, the Mumbai Metropolitan Region of 18 million residents is the world's fifth most populous metropolitan region. Mumbai is India's entertainment and financial capital, yet also the city with the largest slums. It contributes 40 per cent of national income tax and 60 per cent of customs duty. In purchasing power parity (PPP), Mumbai is estimated to have a US\$143 billion economy. Per capita income is US\$12,070. Traffic congestion, loss of wetlands, and flooding as well as the critical housing issues and slums are key challenges facing Mumbai. Some projections state that Mumbai could overtake Tokyo as the world's largest city by 2050. (Urban Age, 2007)

The Mumbai Metropolitan Region includes the metropolis of Mumbai along with its satellite towns and has developed over a period of 35 years. The first and second municipal expansions of the city were made when the demand for space increased with the accelerated growth of population.

The Mumbai Metropolitan Region (MMR) consists of the following divisions,

1. Mumbai city, covering parts of the city limits of island city until Sion, Mahim and King's circle;
2. Mumbai Suburban, covering parts of Greater Mumbai and Navi Mumbai which extends until Mulund in the central line, Vasai in the west and Mankhurd in the east;
3. Thane, originally the northeastern parts of Greater Mumbai extends from Thane creek upto Ulhas river;
4. Raigad district, a major industrial and housing center.

Mumbai is divided into 21 wards distributed amongst 6 zones. The administration in the different constituents of the districts (called "Tehsils") is handled by the municipality corporations. Mumbai and the suburban regions are governed by the Brihanmumbai Municipal council, the district of Thane is governed by the Thane Municipality council, Navi-Mumbai by the Navi-Mumbai Municipality corporation.

Fig 30  
Mumbai Metropolitan  
Region

Source: Author,  
MMRDA





## 2.5 Urban Texture

### 2.5.1 Density

The ability of Indian cities to accommodate such high numbers of people in relatively confined areas albeit many are living in substandard conditions provides a significant point of comparison in the current debate on urban sustainability and the impact of a city's footprint on energy consumption and climate change.

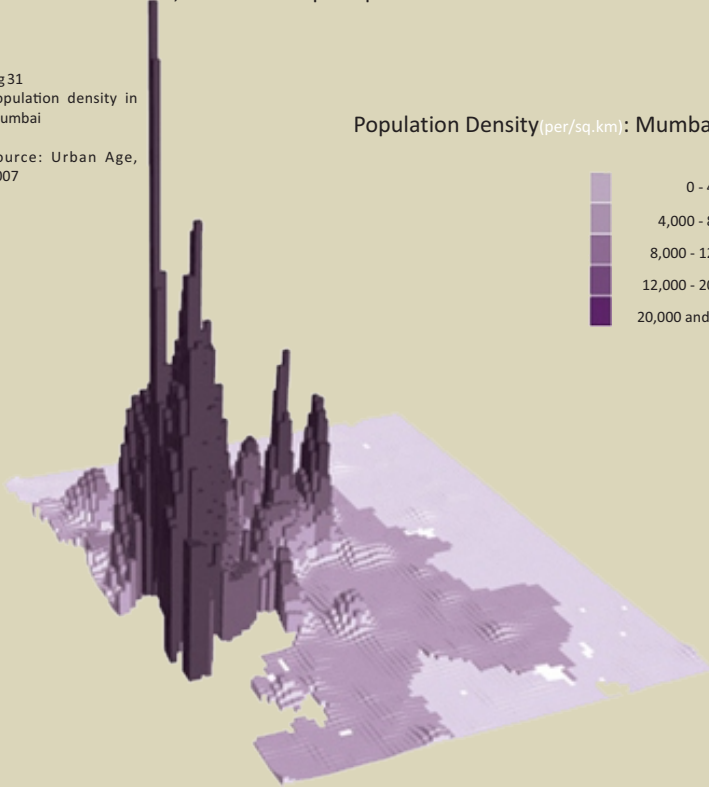
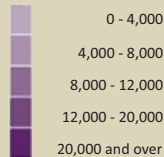
Mumbai (one of the densest cities in the world) constitutes a category on its own. The territorial constraints of this island city have created unusually high urban densities. Within the city limits, the average density surpasses the mark of 27,000 people per sq. km, a figure that rises to well above 50,000 people per sq. km (if one only takes the built-up area into account), a level higher than even the highest density peaks in New York City's borough of Manhattan.

Furthermore, it is not rare for the densest neighbourhoods of Mumbai, such as Dharavi, to accommodate as many as 100,000 residents per sq. km.

Fig 31  
Population density in Mumbai

Source: Urban Age, 2007

Population Density (per/sq.km): Mumbai



▲ **MUMBAI'S** densest area (as shown by the tallest peak at right) is in Kamathipura (above), with 121,312 people per square kilometer. Many low-rise buildings there are now being replaced by tall towers with larger footprints.

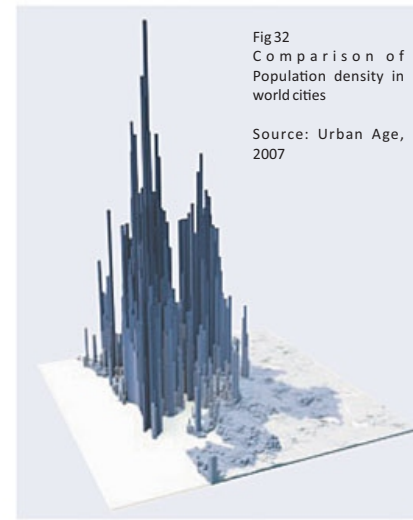
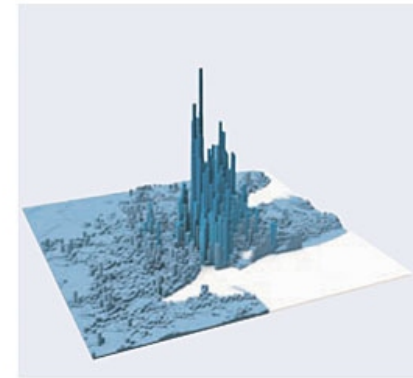


Fig 32  
Comparison of Population density in world cities

Source: Urban Age, 2007



▲ **NEW YORK CITY'S** peak density is found on Manhattan's Upper East Side, with 58,530 people per square kilometer. It's also home to some of the most expensive real estate in the city.



▲ **ISTANBUL'S** Gungoren neighborhood is the city's densest, with 77,267 people per square kilometer. The working-class area has blocks of six- and seven-story apartment buildings, with few green spaces.

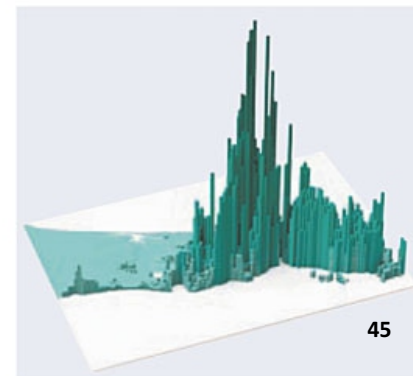
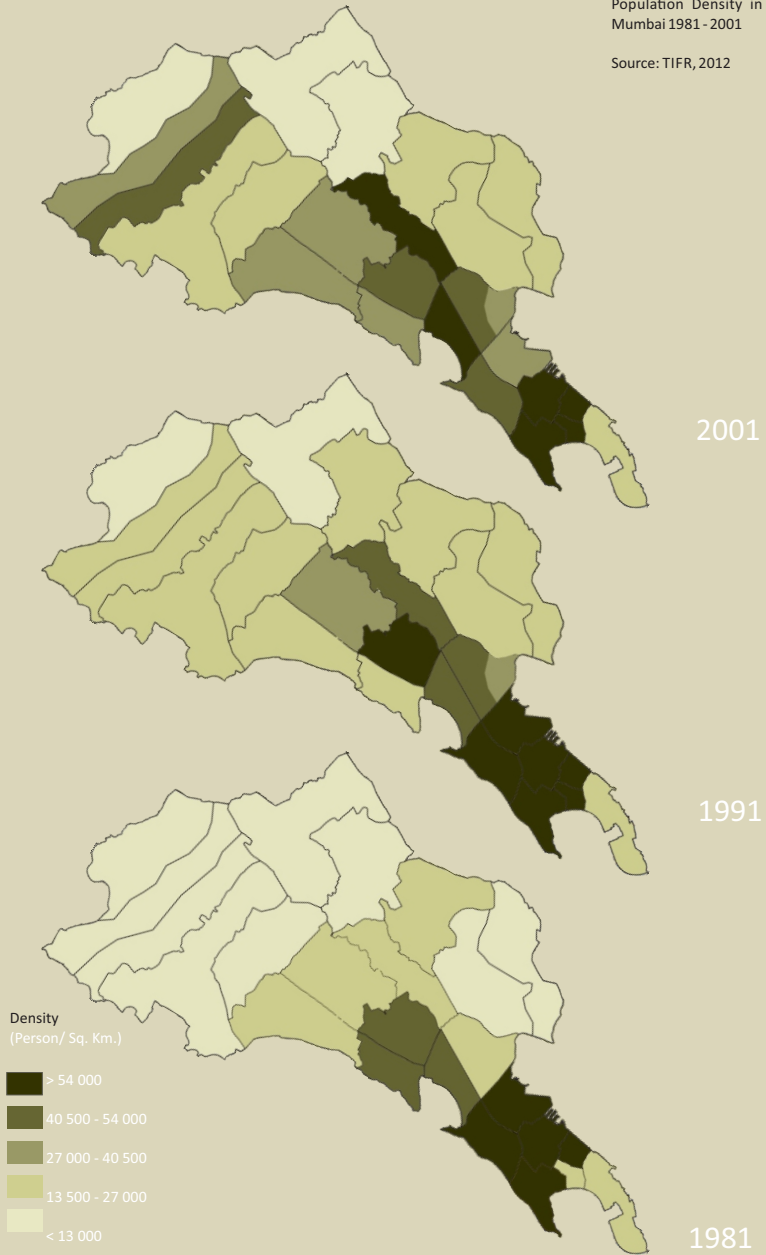


Fig 34  
Population Density in  
Mumbai 1981-2001  
Source: TIFR, 2012



The density map of Mumbai Municipal Corporation shows quite clearly how the population pressure has shifted over the last two decades (1981–2001) from the southern Mumbai toward western and central Mumbai, signifying the decay of the core.

# Evolution of Urbanization in India 1872 - 2001

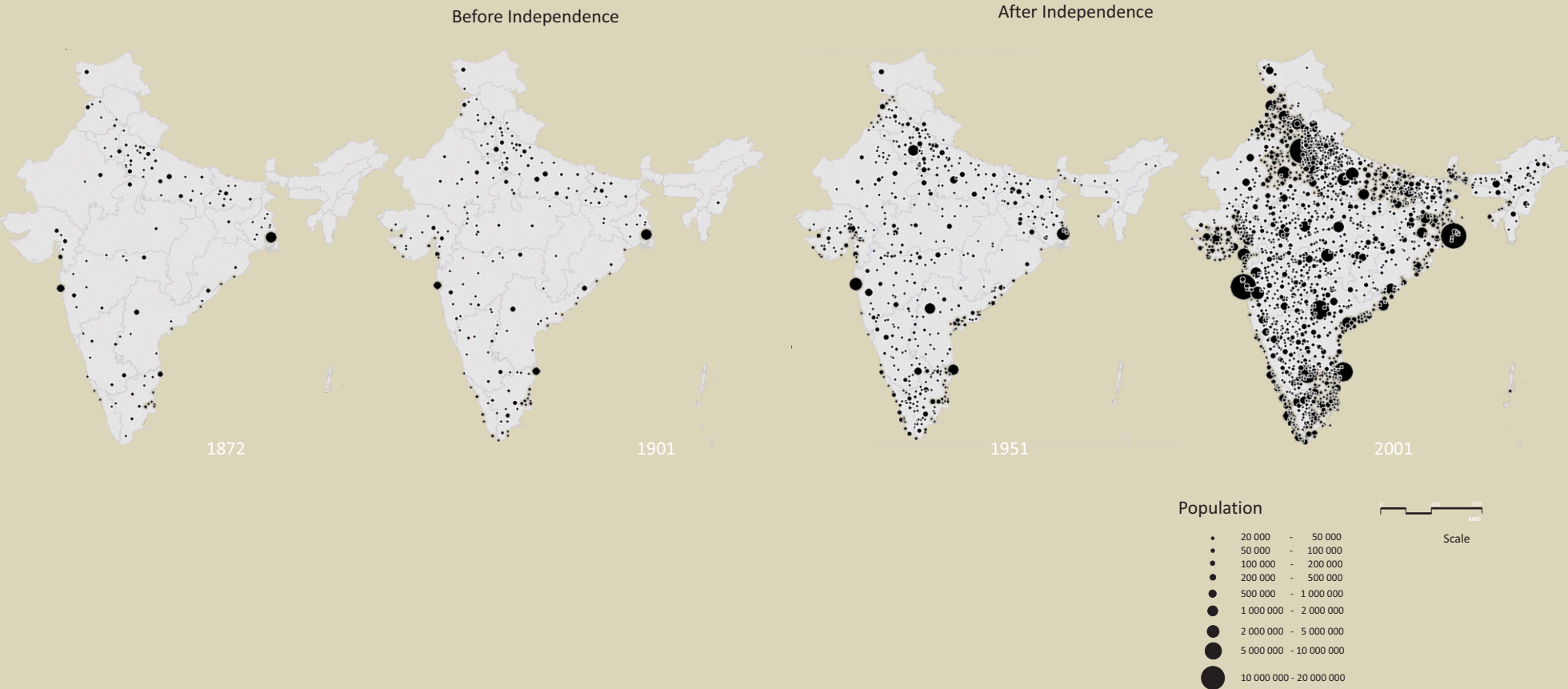


Fig 33  
Rate of Urban  
migration in India.

Source: Geopolis.eu,  
2012

### 2.5.2 Urban Morphology

Cities all over the world need to respond to the demographic and economic pressures that are causing rapid urban growth. The design of city streets, buildings and spaces – their spatial DNA – plays an important role in securing the livability and flexibility of urban environments that are undergoing intense processes of change. One of the central objectives of the Urban Age project is to produce research that helps to better understand the varying capacity of different street grids and block layouts to accommodate change in a resilient way.

The 'figure-ground' (Colin Rowe, Collage City) image presented here are useful tools to visualize the micro-scale of urban neighborhoods and understand how buildings and their surroundings succeed or fail in making a continuous and integrated urban whole. They provide a street-level portrayal of the built forms and arrangements of volumes that shape everyday social life in the city. The 'figure-ground' map of Mumbai representing buildings in black and transport network spaces in white and green open spaces in green.

Fig 36  
Morphology of  
Mumbai

Source: Author

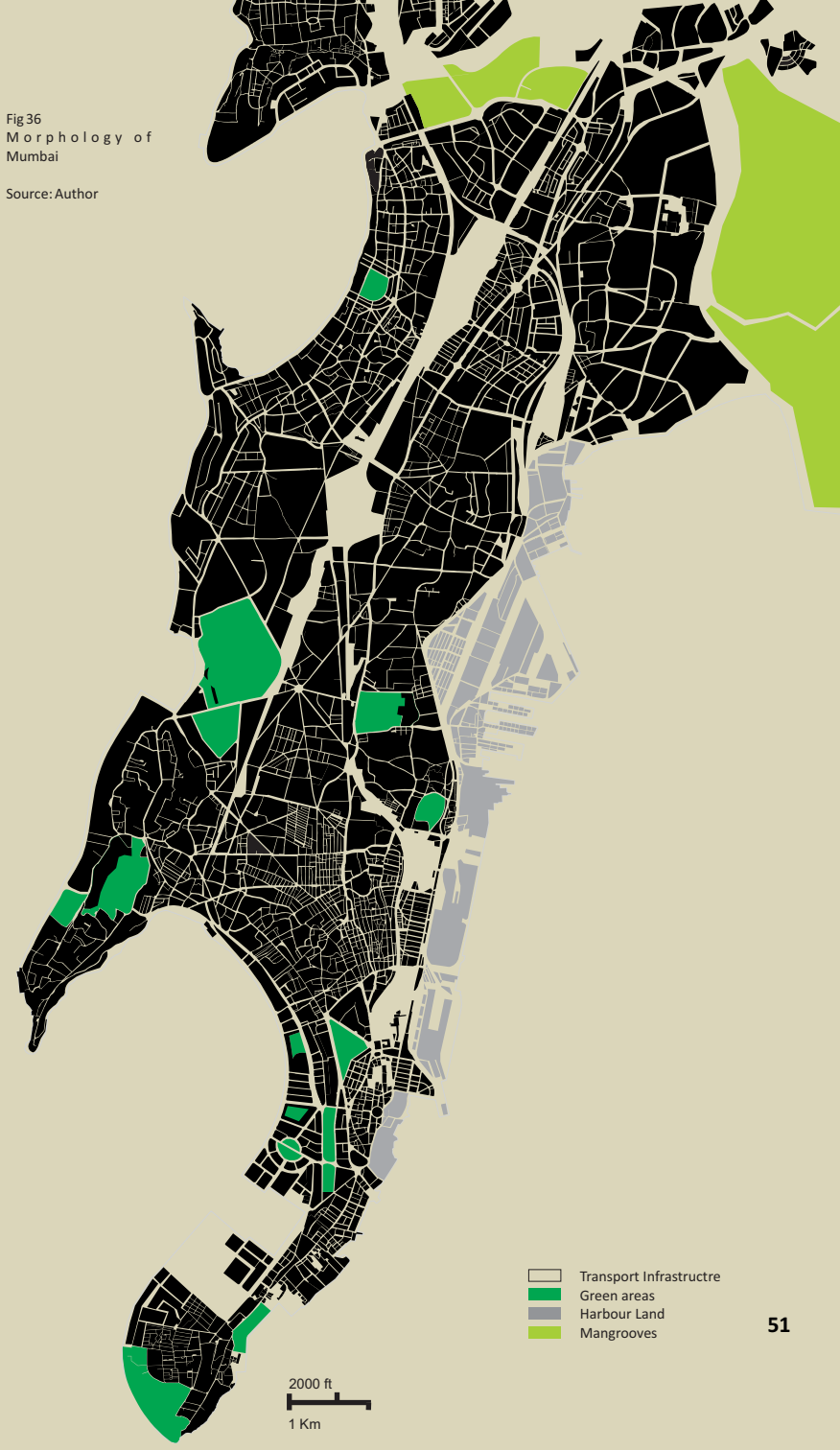


Fig 35  
Morphology of part  
of Bhuleshwar area  
in Mumbai

Source: Author





The spatial structure of the Indian cities reveals an intense and compact arrangement of buildings and structures, containing and compressing the open 'white' spaces that constitute the public realm of the city. The central area of Buleshwar Market in Mumbai (See Fig. 35) shows how dense urban blocks are arranged efficiently along main streets and side alleyways. The Bhuleshwar area shown indicate the intricate texture slowly transforming into new texture.

While comparing the city morphology with different cities in the world (See Fig. 37,38,39,40) illustrates the compact density of Mumbai.

Mexico City



Berlin



Johnnesburg



From Top to Bottom

Fig 37,38,39,40  
Morphology of  
different cities  
compared to Mumbai

Source: Urban Age,  
2007

Mumbai



## 2.6 Transport Infrastructure

The transport systems of the city reflect the specific geographical, historical and political conditions that have shaped their development. Infrastructure development for mass transit, whether metro, trains or buses as well as for private vehicles has had an enormous impact on the patterns of urban growth with long-lasting effects on land use, densities and the residential distribution of different social groups. Urban rail outranks all other forms of travel in terms of its capacity to move vast numbers of passengers throughout a metropolitan region, and its footprint requires relatively small amounts of urban land.

The 300 km long, Mumbai's suburban rail system is the most extensive on the subcontinent. Transporting more than 6 million passengers each day, it is also one of the busiest rail systems worldwide

Fig 41  
Mumbai structure  
Source: Author





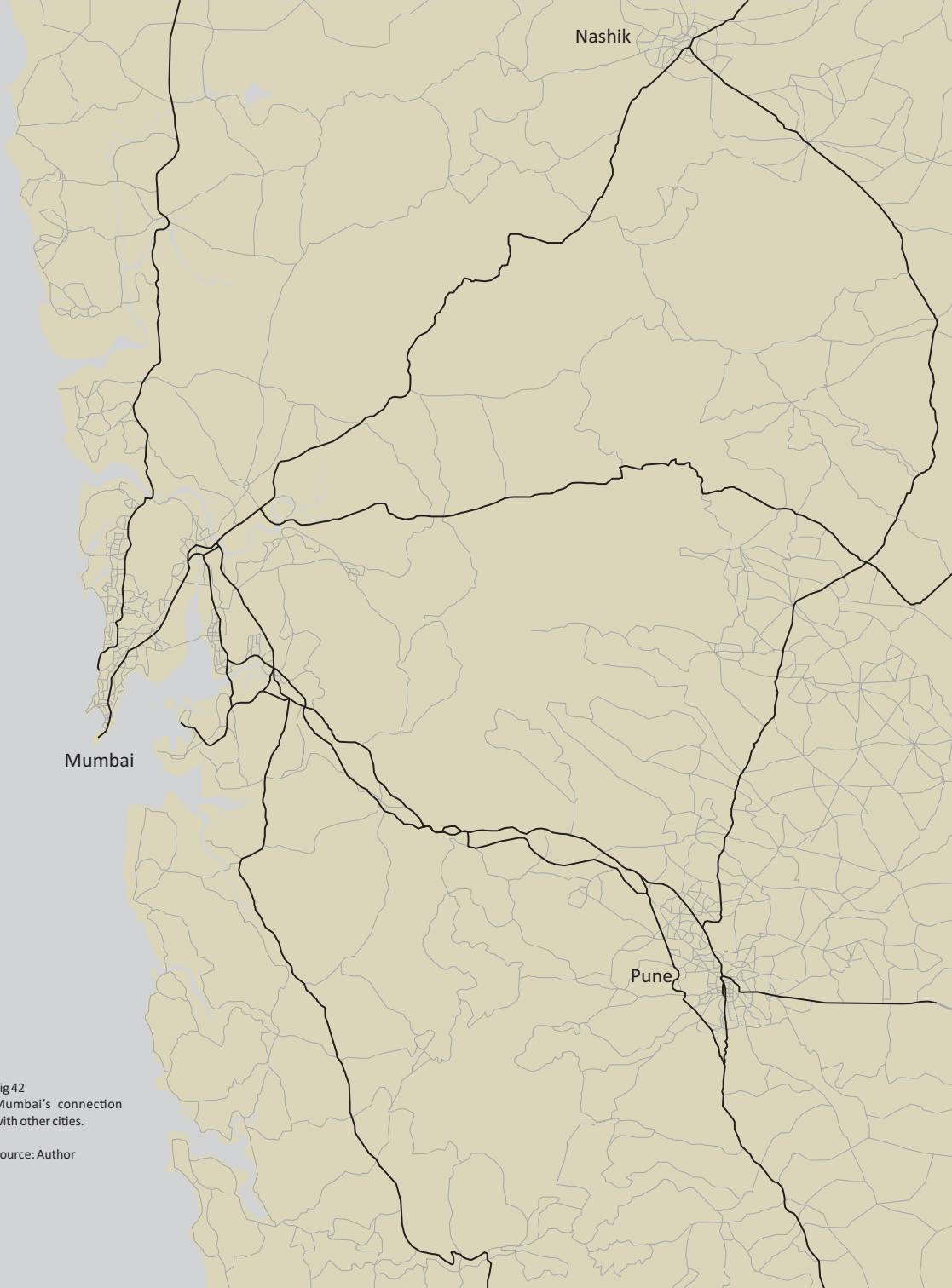


Fig 42  
Mumbai's connection  
with other cities.

Source: Author

**2.6.1 Mumbai Metropolitan Region Physical connection**  
 The city is very well connected with the country by railway and roadways.  
 Due to the geographical spread of the population and location of business areas, the rail network is the principal mode of mass transport in Mumbai.

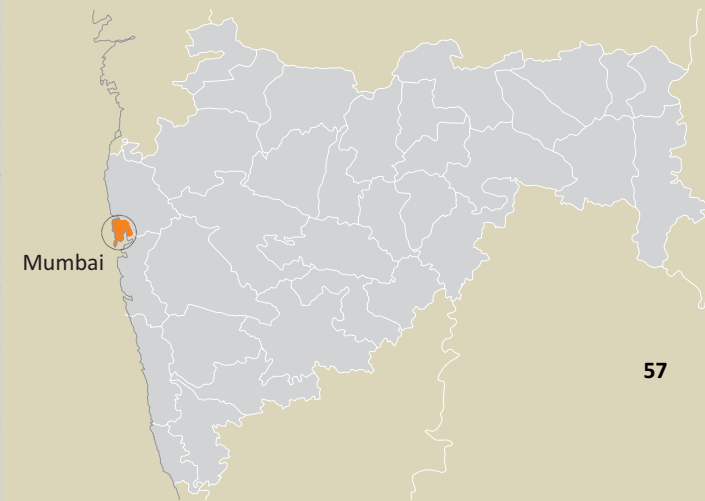


Fig 43  
Mumbai location in the  
state of Maharashtra

Source: Author

**2.6.2 Railway Network**

Due to the geographical spread of the population and location of business areas, the rail network is the principal mode of mass transport in Mumbai.

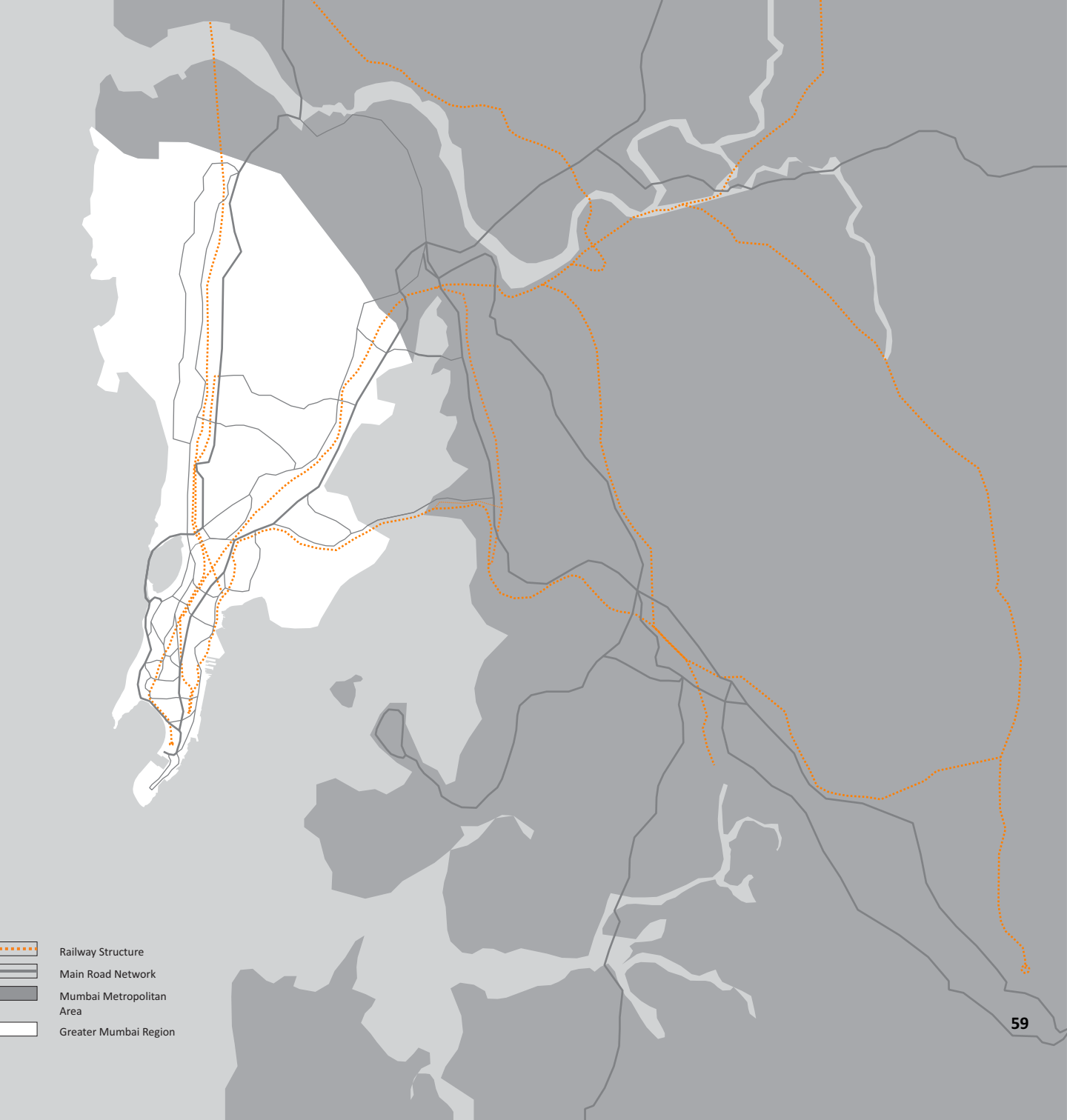






Fig43  
M u m b a i ' s  
I n f r a s t r u c t u r e  
N e t w o r k .

Source: Author

-  Railway Structure
-  Main Road Network
-  Mumbai Metropolitan Area
-  Greater Mumbai Region

Mumbai has around 9% of its surface area under railway line and railway related activities.

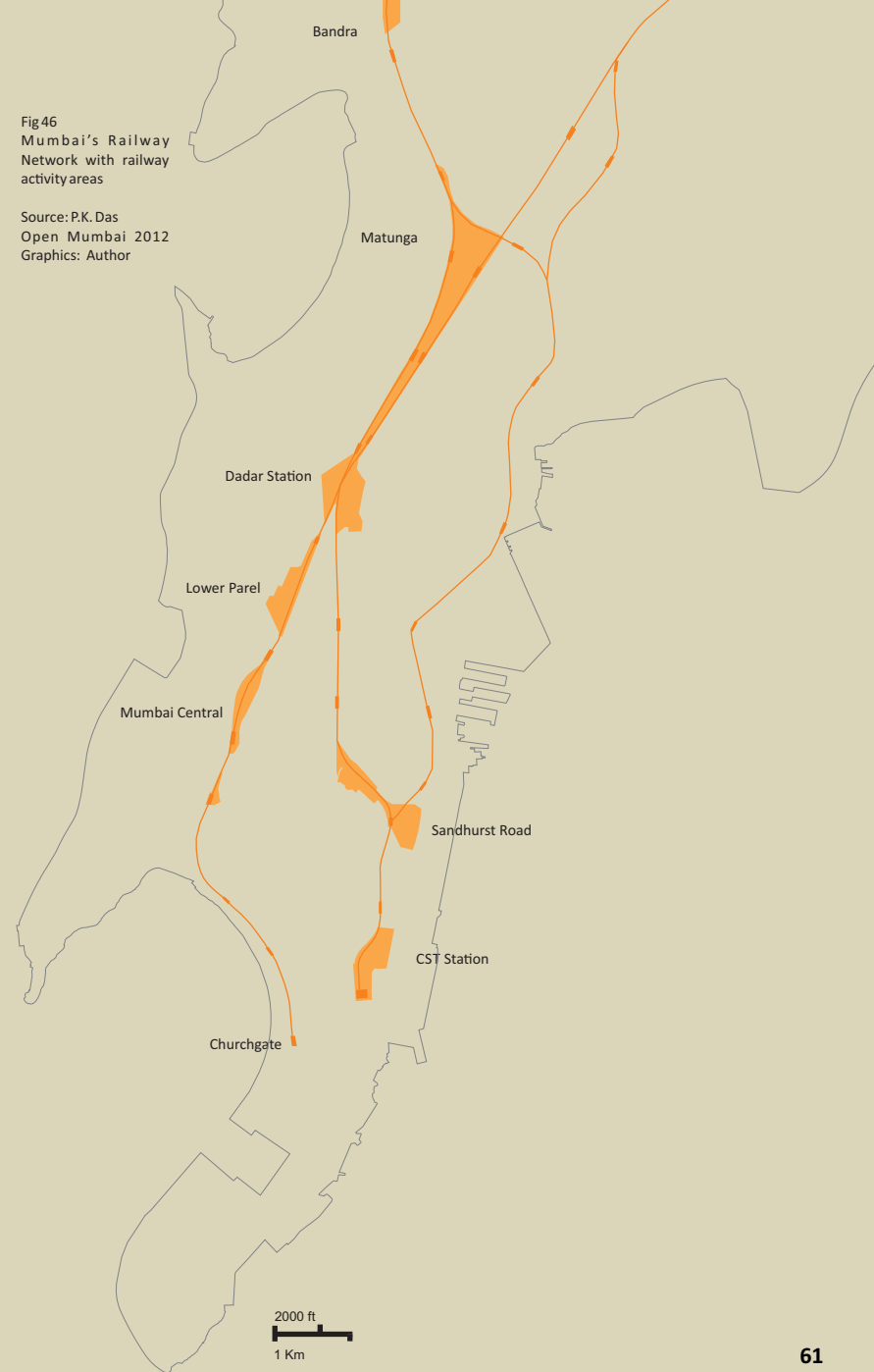
Around 6 million people travel/use the railway system daily. The connectivity with the city and the railways is disconnected and poor connectivity considering that 40% of people use it in one form or other.

These spaces could be utilize for Public purposes and can be transformed for connectivity with the city and creating a much needed public spaces for the city.

The Railway system comprises of 55 stations and covers 155 acres of space with 300 kms. long suburban lines.

Fig 46  
Mumbai's Railway Network with railway activity areas

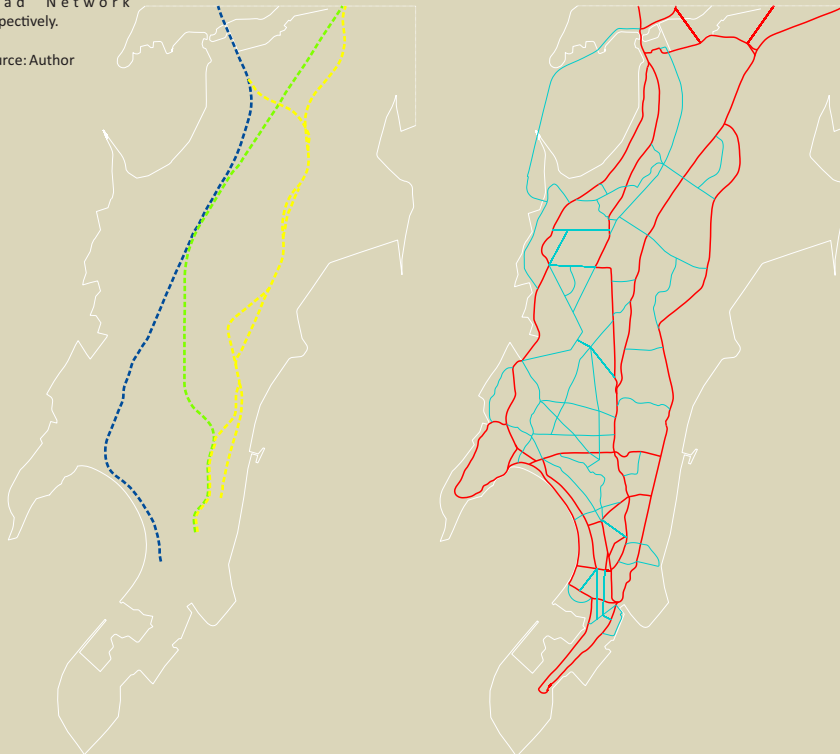
Source: P.K. Das  
Open Mumbai 2012  
Graphics: Author



From Left to Right

Fig 44, 45  
Mumbai's Rail and Road Network respectively.

Source: Author



### 2.6.3 Mumbai Sub-urban railway

The Mumbai Suburban Railway is a suburban rail system serving the Mumbai Metropolitan Region. It is operated by Indian Railways' two zonal Western Railways (WR) and Central Railways (CR). The system carries more than 7.24 million commuters daily. It has the highest passenger density of any urban railway system in the world. The trains plying on its routes are commonly referred to as local trains or simply as locals by Mumbaikars.

Spread over 465 km, the suburban railway services are run by electric multiple units (EMUs). 191 rakes (train sets) of 9-car, 12-car & 15-car composition are utilized to run 2342 train services, carrying 6.94 million passengers per day. If annual ridership (2.64 billion) is taken into account, the Suburban rail would be the second busiest rapid transit system in the world.

Due to the geographical spread of the population and location of business areas, the rail network is the principal mode of mass transport in Mumbai.

#### History

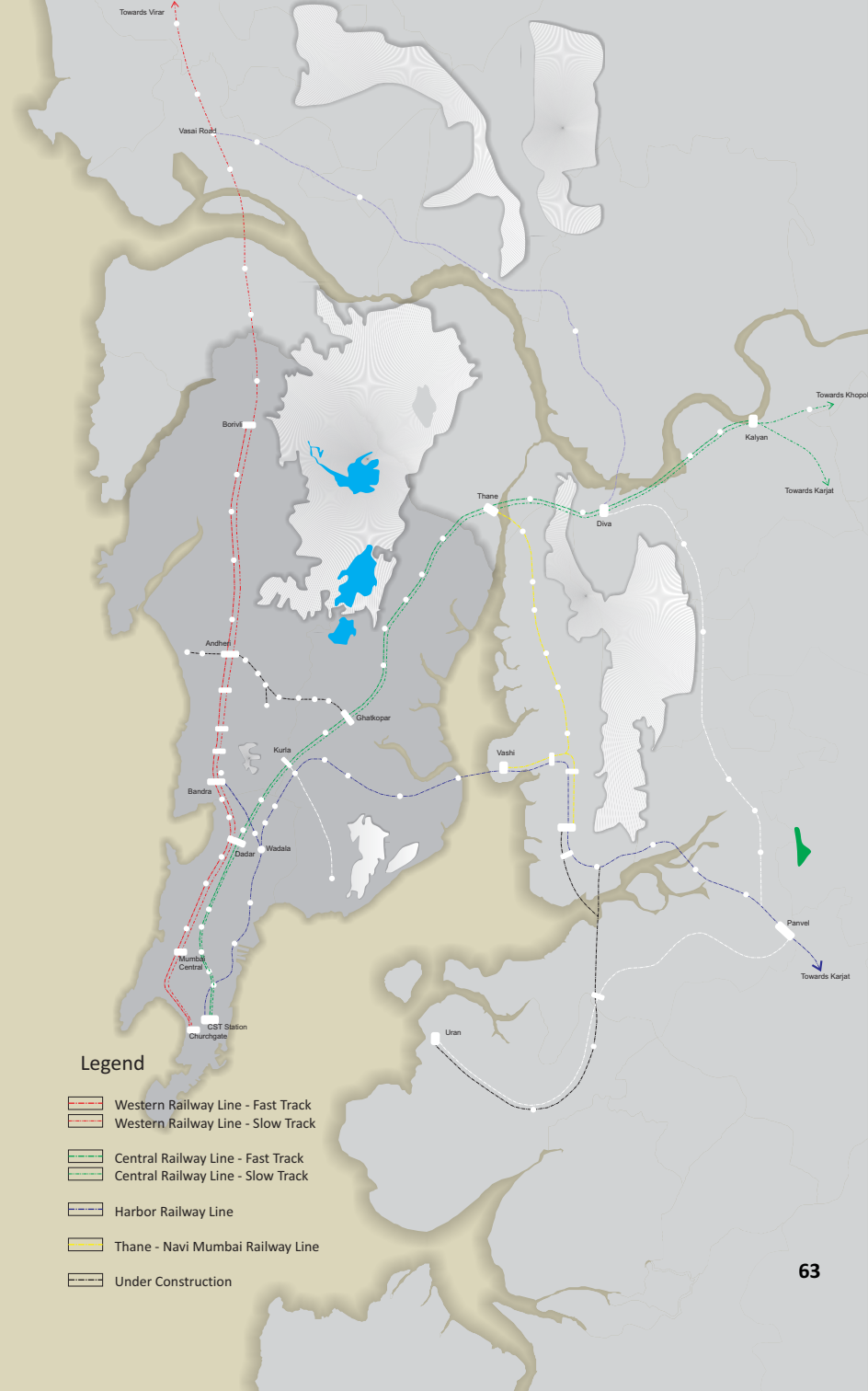
The Mumbai Suburban Railway, as well as the Indian Railways, are an offshoot of the first railway to be built by the British in India, and is also the oldest railway system in Asia. The first train ran between Bori Bunder (now Chhatrapati Shivaji Terminus) and Thane, a distance of 34 km, on 16 April 1853.

#### Subdivision of Sub-urban railway system

The Railway system is divided into 3 main lines called central, Western and Harbor. The Trans Harbor line connects Navi-Mumbai to Thane.

#### Future Expansion

The city is upgrading of existing infrastructure of railways and creating a dedicated corridor for long distance and freight. A metro system and a monorail system are under construction in Mumbai to ease the traveling conditions on the suburban network.



Opposite

Fig 47  
Mumbai's Sub-urban  
Railway Network



## 2.7 Open Spaces in Mumbai

As Mumbai expands, its open spaces are shrinking. The city's shrinking physical open spaces are the most visible manifestation as they directly and adversely affect our very quality of life (Open Mumbai, 2011).

Mumbai needs new program to sustainable development and also to expand its public spaces. Due to increase in development projects, Mumbai needs to rethink its existing unused infrastructure spaces and incorporate them in the city structure.

These unutilized spaces needs to be regenerated and integrated into city structure to generate much needed public spaces. The city has 3 major types unlocked spaces

1. Mill Lands: Due to the strike in mill lands in twentieth century the mills in Mumbai were shut down and since then never been resumed. These mills were booming at the time of American Civil War and made Mumbai richer. Lot of proposals and new constructions have been implemented in various mill lands which is changing the very fabric of the city, but open spaces for the city is given least priority in the development plan.

2. The Railway network: Railways are the lifeline of Mumbai as it connects far satellite towns to the city center and used by millions daily, but the hubs connecting them are chaotic and congested. the areas around the railway system, which was once used for transportation and storage of cotton; to be exported to England, remains vacant and unused. These spaces have huge potential to become the public spaces; as a large number of urban population depends on them.

3. Docklands: Due to the shift in economy from industrial to service based and recent shifting of major dock to JNPT (opposite Victoria dock, in Raigad district) the docklands remain a landlock area of 600 acres. The docks can create much needed open spaces in the city by opening to the waterfront and further develop the area more sustainably.

Opposite

Fig 48  
Mumbai's Open Spaces  
Map

Source: P.K. Das, Open  
Space Mumbai 2012







Fig 49  
View of Girgaon  
Chowpatty on occasion  
of Ganesh Visarjan

Source:  
Urban Age, 2007

## **Part 3**

### **Analysis of Site**

**This part attempts to analyze the site from its historical background to the existing situation.**

**Developed predominantly for the purpose of storage of goods and transfer of goods, it played a predominant role in shaping the urban texture of the city.**

**The analysis discuss key issues of site location, its context, transportation, morphology, its development and landuse The analysis focus on the different scale from the city region to the change in urban texture due to urban transformation.**

### 3.0 Site Analysis

#### 3.1 Location of Site

The Sandhurst road Railyard is named after Lord Sandhurst, the Governor of Bombay between 1895 and 1900, the station was built in 1910 using funds from the Bombay City Improvement Trust. The Sandhurst Road railway station (upper level servicing the Harbour Line) was built in 1921. Mumbai is divided into administrative wards for the administration of the region. The Site is located in the B ward of Administrative district of Mumbai



Fig 50  
Administrative wards  
of Mumbai

Source: MCGM





Fig 51  
Satellite image of  
Mumbai in context of  
Site

Source: Google Maps



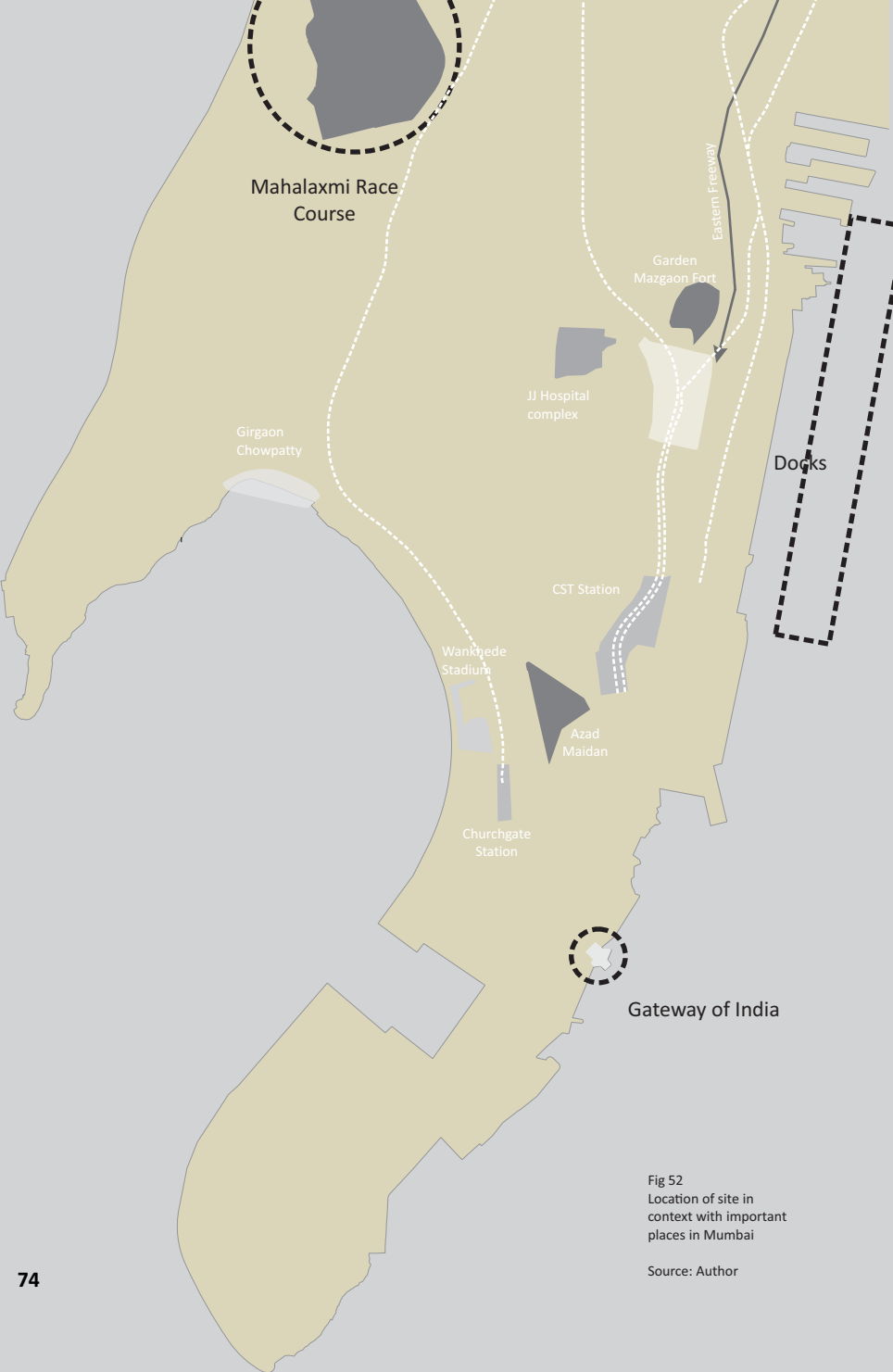


Fig 52  
Location of site in  
context with important  
places in Mumbai

Source: Author

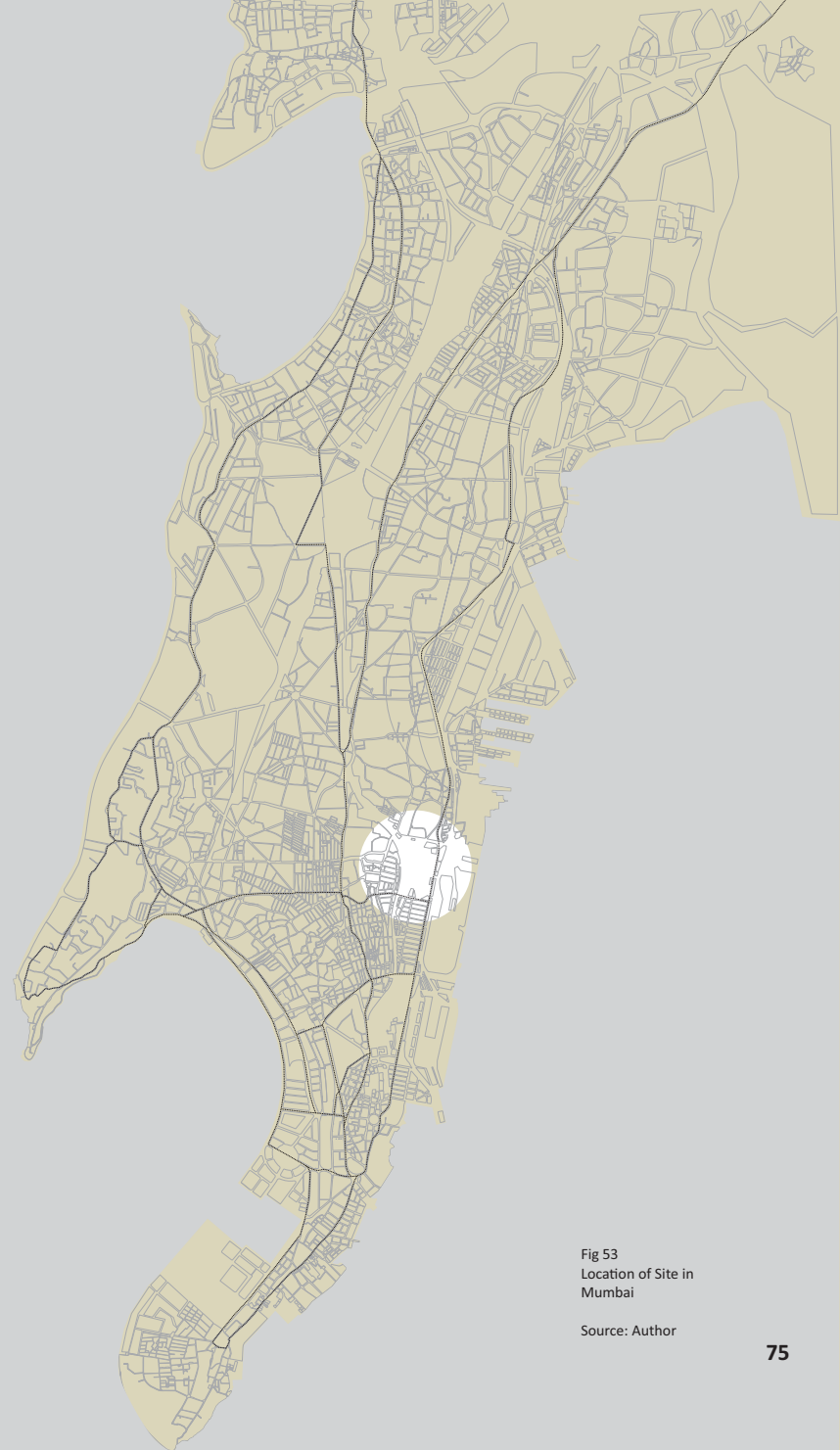


Fig 53  
Location of Site in  
Mumbai

Source: Author

### 3.2 History

Mumbai has been growing for five hundred years, even though it was built on what initially looked like very weak foundations.

The site was developed as a part of a reclamation project to create a new hub for storage and transportation of goods to Europe as well to other parts of the country. Due to the American Civil War, cotton was produced in different parts of the country and then transported in freight to the Wadi-Bunder for docking and shipping to UK.

After the end of civil war, the site (wadi-bunder) continues to remain active and expanded to the present form. But then series of events took place in Mumbai which transformed the economy driven by industry to service based economy leads to massive underutilization of such places. These events further accentuated by the mill strike which completely and painfully annihilated the industrial production.

Meanwhile, due to series of political decisions after independence leads to shifting of docks to new terminus (JNPT) on the other side of island of Mumbai, created a void in the spaces dependent on freight storage and transportation.



Fig 54  
view of Wadi Bunder in  
1925

Source: IRFCA

### 3.3 Existing Site condition

The Sandhurst road Rail yard; formerly called Wadi Bunder is a complex consist of underutilized freight and weighing stations and repair yards for the trains of the Central Railway network. some of these structures are historically important sheds.

#### 3.3.1 Railway network

The site has 2 stations for Central railway and for the Harbor railway. The harbor rail station is at the upper level and is at the same level as the city on the west side of the site. The west side of site is disconnected with the west side of city by the railway system.

#### 3.3.2 Road Network

The eastern freeway is on the east side of site culminating at the end of the site junction of SVP road.

P D'mello road is the main road connecting east side of the site to the city in the north and SVP road connecting south side of site to the west part of site.

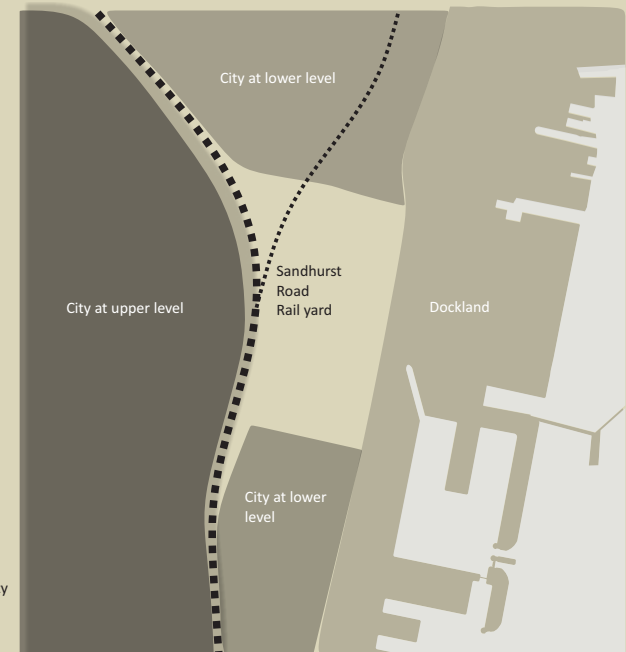


Fig 55  
Graphical  
representation of city  
topography

Source: Author

### 3.4 Climate Condition

The Climate of Mumbai is a tropical wet and dry climate. Mumbai's climate can be best described as moderate temperatures with high level of humidity. Due to higher humidity level, it is required to have a ventilation.

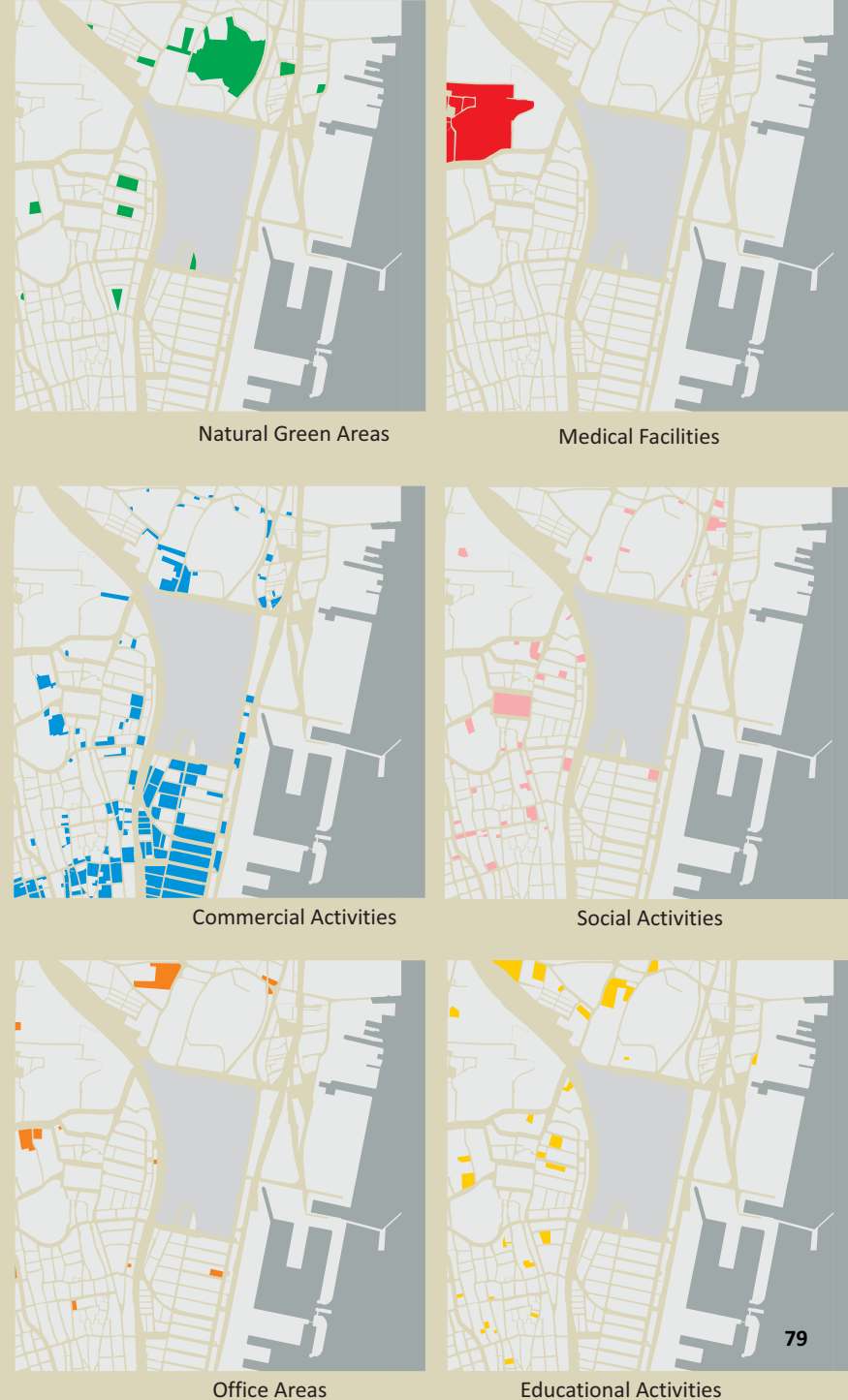
### 3.5 Landuse

Part of the site is situated on the reclaimed land and it is lower than the city in the west side. The land is predominantly used for the railway workshop and car shed. Most fo the sheds are unutilized and remain vacant. There are some storage buildings and existing maintenance yards for railway related activities.

The site surrounding clearly indicates the shift in programs in various zones.

The west side has mostly housing, while the east side contains docklands. The north side has residential as well as historical fort, while the north-west side has a big hospital complex. (JJ Hospital complex)

The south side is mainly dedicated to commercial activity related to docks and storage.

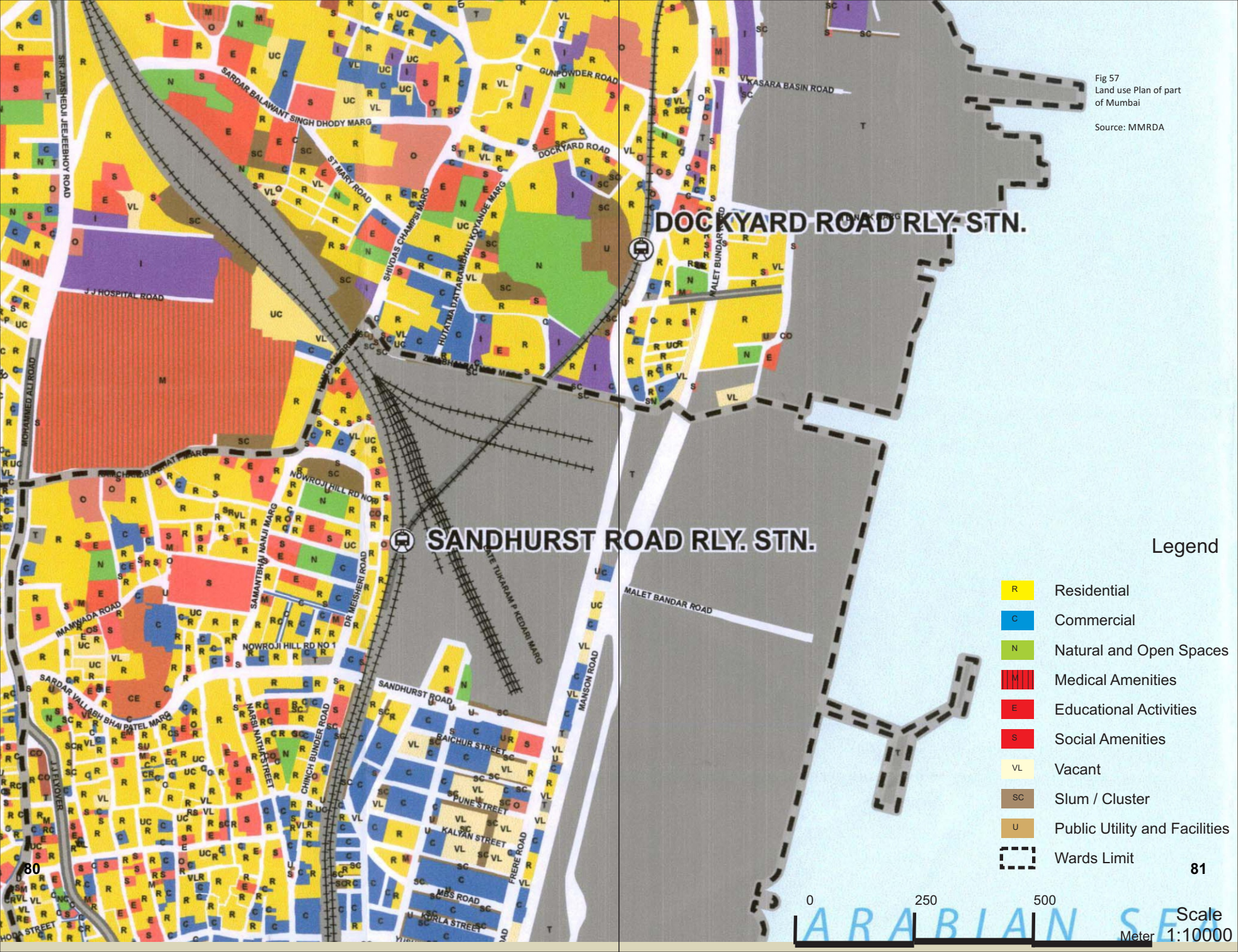


Opposite

Fig.56  
site context indicating  
various landuse pattern



Fig 57  
Land use Plan of part  
of Mumbai  
Source: MMRDA



Legend

- Residential
- Commercial
- Natural and Open Spaces
- Medical Amenities
- Educational Activities
- Social Amenities
- Vacant
- Slum / Cluster
- Public Utility and Facilities
- Wards Limit

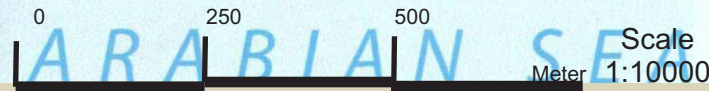






Fig 58  
Satellite image of Site

Source: Google earth



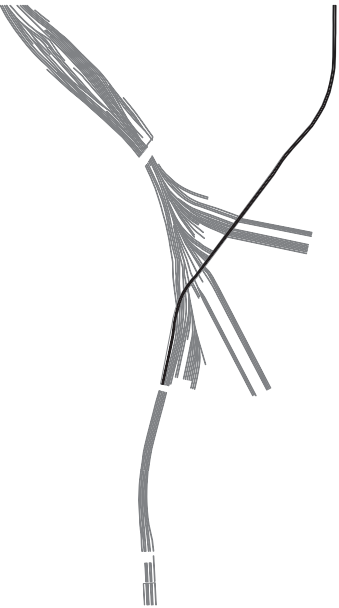




Fig 59  
Urban Morphology of  
Site. 1:5000

Source: Author





Clockwise from Left

Fig 60  
Railway Network

Fig 61  
Road Network

Fig 62  
Urban Morphology

Opposite

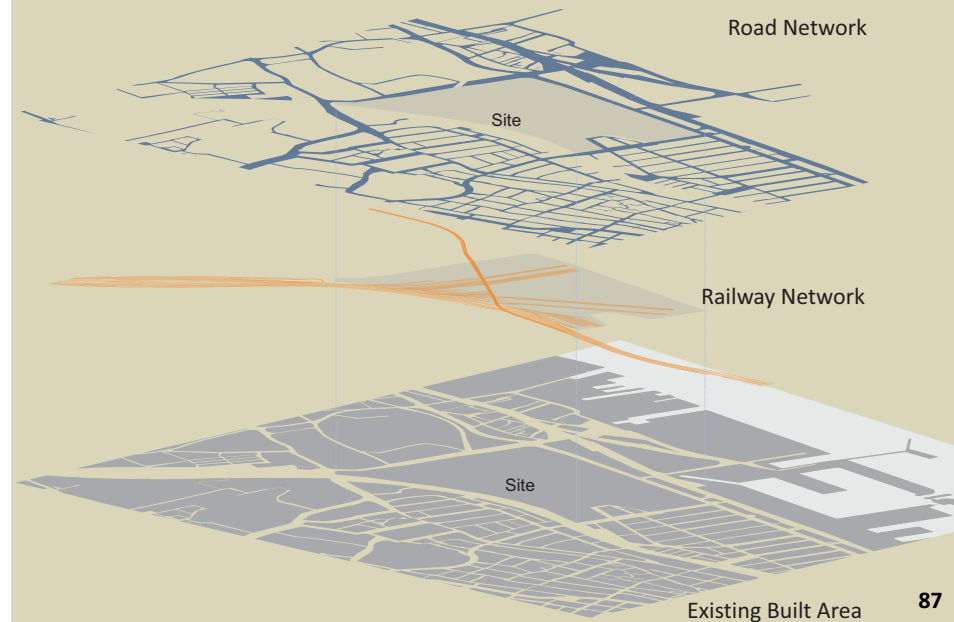
Fig 63  
Axonometric exploded  
view of site layers

### 3.6 Site Characters

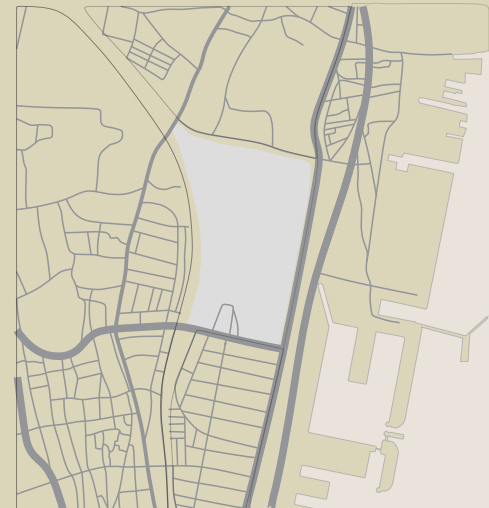
various character of site create an unique challenge for the development of Masterplan.

Site consists of 2 existing railway stations, one above. These stations are poorly connected with the part of the city; albeit used by millions daily.

The potential of site creates an unique opportunity for new public spaces as it is loosely connected with the existing part of city but strongly connected with existing railway stations and bus network. the site has a potential to open up the much needed public spaces in the city and strengthen the existing open spaces by connecting the part of the city together. The site can also extends itself towards the docks by a public axis.







From Top to Bottom

Fig 64  
Site topography

Fig 65  
Main roads along the  
site

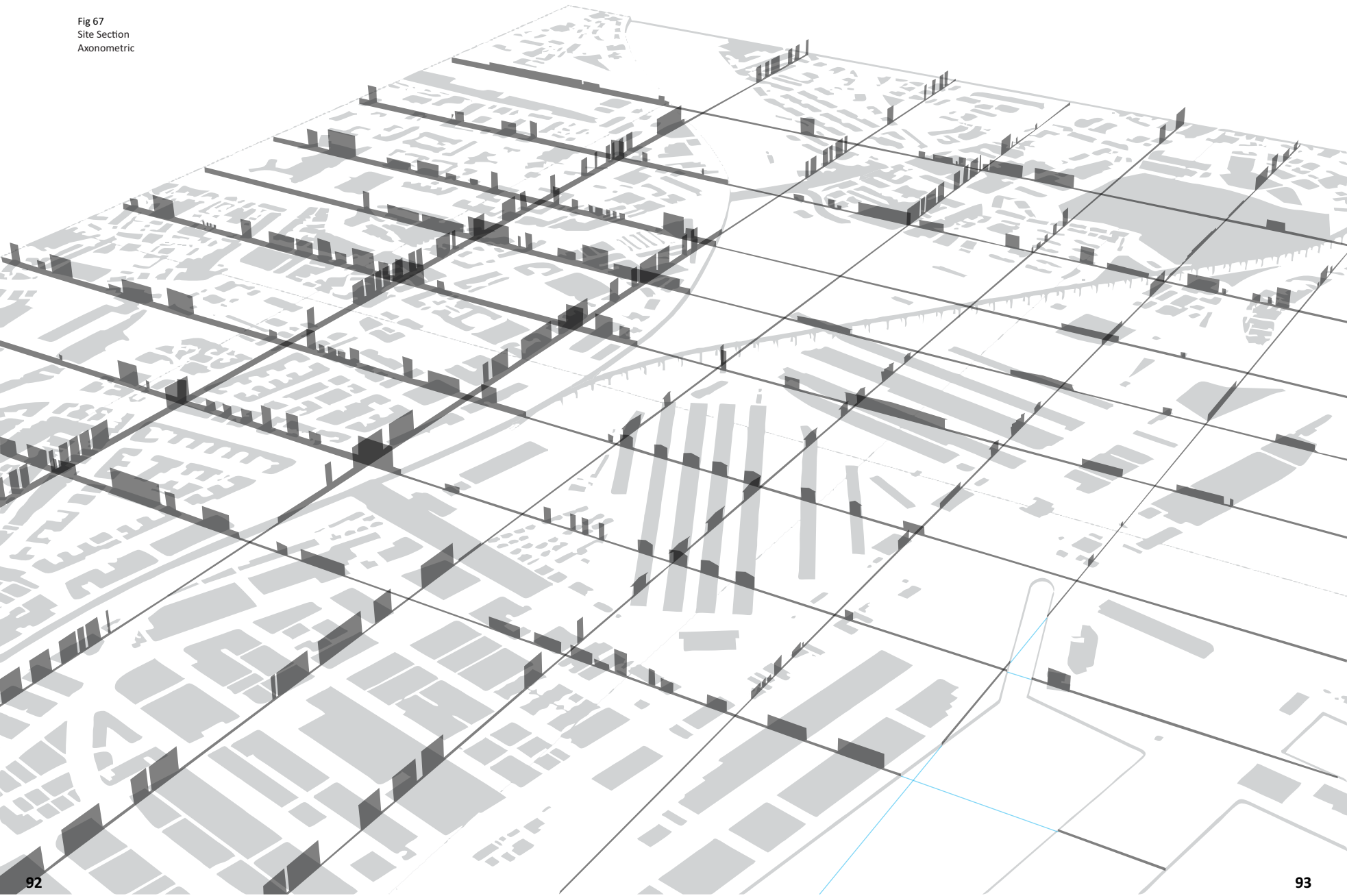
Fig 66  
Transportation  
network

### 3.7 Site Sections

The site sections explain the topography of the site and its relation to the context. The sections also indicate the density of the city and the site condition. The sections 8-13 clearly indicate the dis-connection of the site with respect to its surrounding.



Fig 67  
Site Section  
Axonometric





From Left to Right

### 3.8 Site Images

Fig 68, 69  
Sandhurst road  
Railway station  
central and harbor  
lines respectively

The site photographs illustrates the present condition of site and its context. Most part of site is un-utilized and used as a dumping place for railway activities. The part of workshop is being utilized for maintenance of the car. The rest of the space is mostly used as a car-shed and remain as a void in the city.



From Left to Right

Fig 70, 71  
Sandhurst road  
Railway yard sheds



From Left to Right

Fig 72, 73  
Sandhurst road  
Railway yard storage  
spaces (historically  
important)



Left

Fig 74  
Existing Railway  
workshop

Right

Fig 75  
Railway sheds



## **Part 4**

### **Concept and Program**

**This part explains the initial approach taken for the development of the Masterplan.**

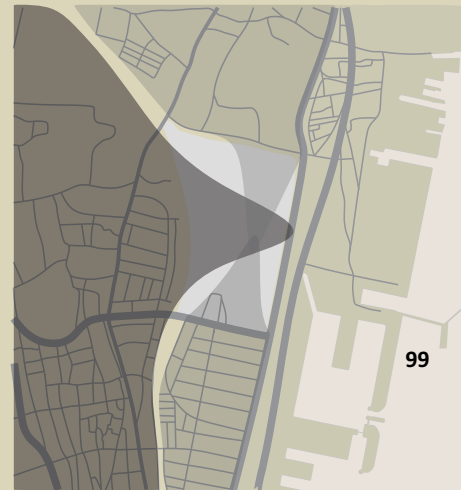
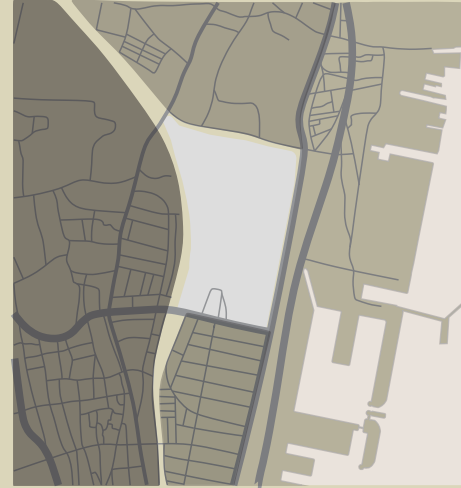
**After analyzing the context of the site, the concept interpret the areas of site to be preserved while others to be demolished in order to create a new Masterplan.**

## 4.0 Concept

### 4.1 The Integration of Fabric

Due to the difference in level between the city structure, the idea is to stretch the city fabric towards the site to integrate the city with the site. The site then transforms with the context by creating a connection between the existing fabric and the new program.

This eventually creates the site as a part of city rather than part in the city and establish a continuous flow of connection between existing and new. This approach extends the existing program of the city into the site by extending the existing functions and creating a new function along with it by creating relations.



Opposite

Fig 77  
Concept study of  
extending the city  
fabric.

- Road Network
- City at +5 Mt. Level
- City at +0 Mt. Level
- Dock/ Harbor Land

## 4.2 City axis

The concept evolves from connecting the city with the site through existing axis created by the city texture. The concept identifies main axis and connects the parts of the city through Public spaces and green spaces

Fig 78  
Existing city structure  
lines

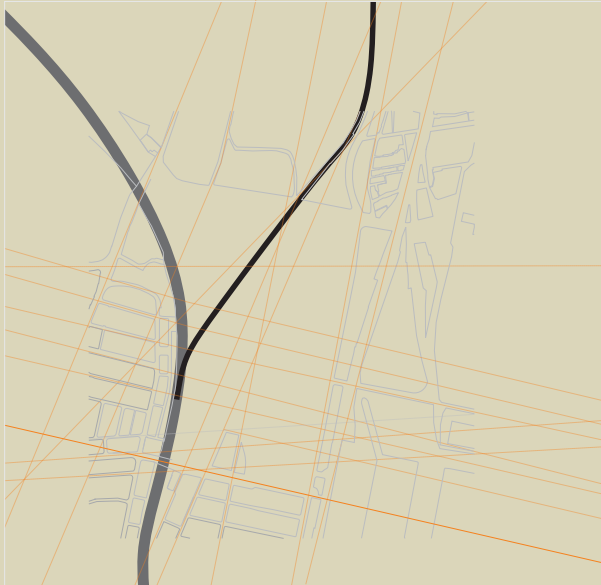
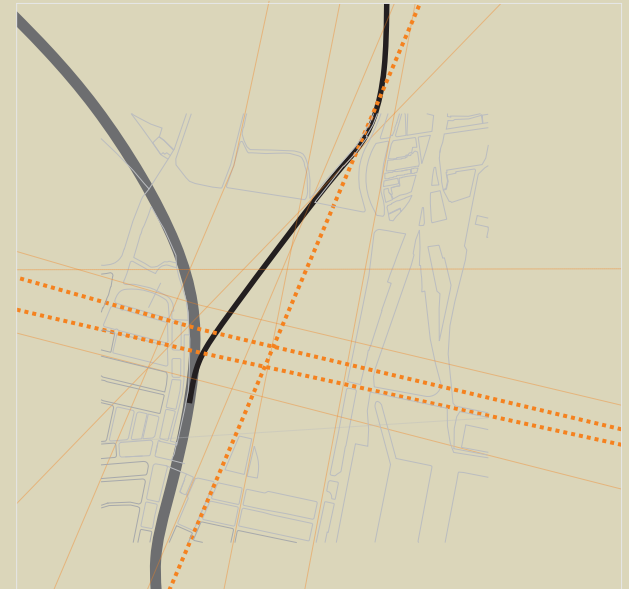


Fig 79  
Important connecting  
lines to the site from  
the city structure



### 4.3 Preservation

The site consists of storage areas which are of historical importance (see fig. 80). The main gate for the site also built as a monument which needs to be preserved for the relevance of site and its importance in shaping the city. The concept carefully analyzed the buildings that needs to be preserved along with its importance and incorporate new program to the structures, thereby utilizing the existing infrastructure. Relevant preservation technique should be used to preserve the structure and use it for the function relevant to the context. The design proposal for the existing important storage sheds was to reintegrate the space into the existing functional context, by proposing a market, relevant to the city and to the site context.

Fig 80  
Historically important  
buildings on site

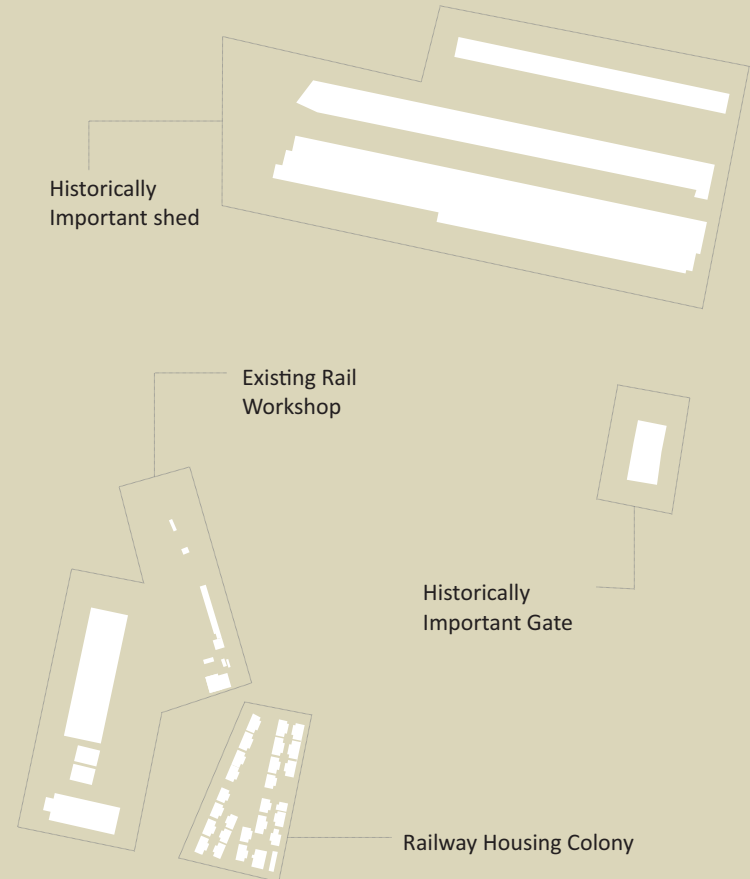




Fig 81  
Demolition of existing  
structures

#### 4.4 Demolition

The site consists of many dilapidated sheds and structures which are no longer in use (see Fig 81). The concept carefully analyzed the buildings that needs to be demolished and incorporate new program.

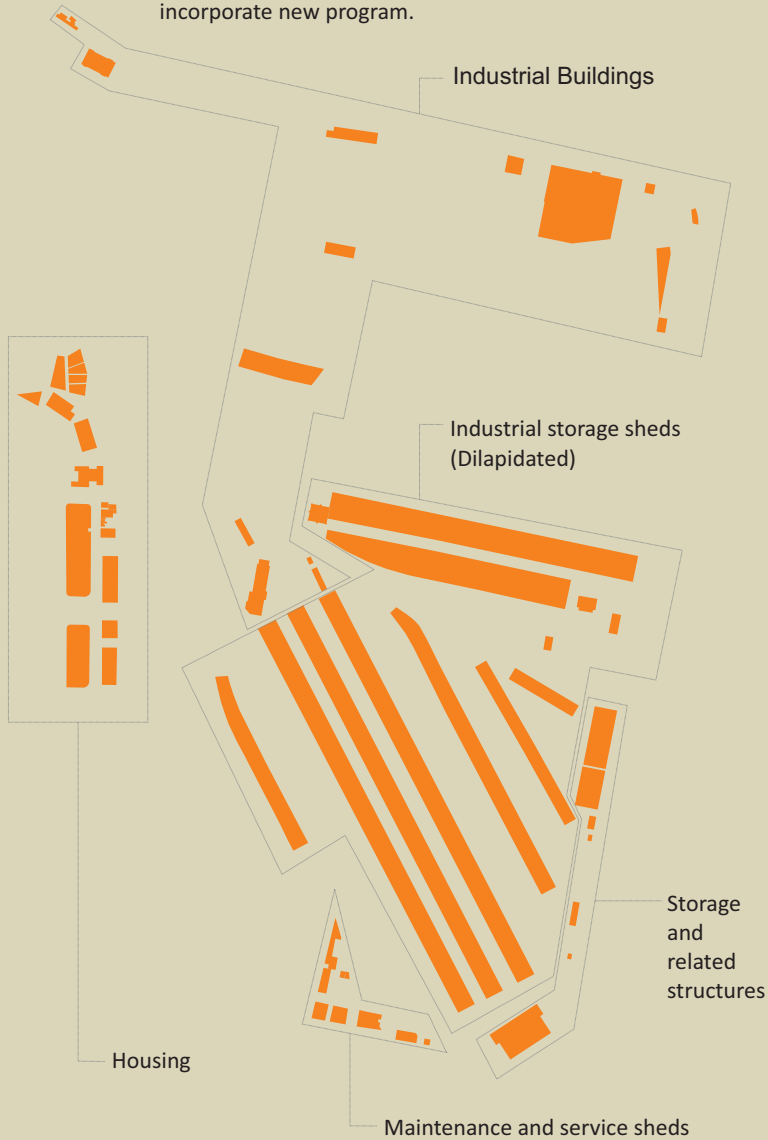
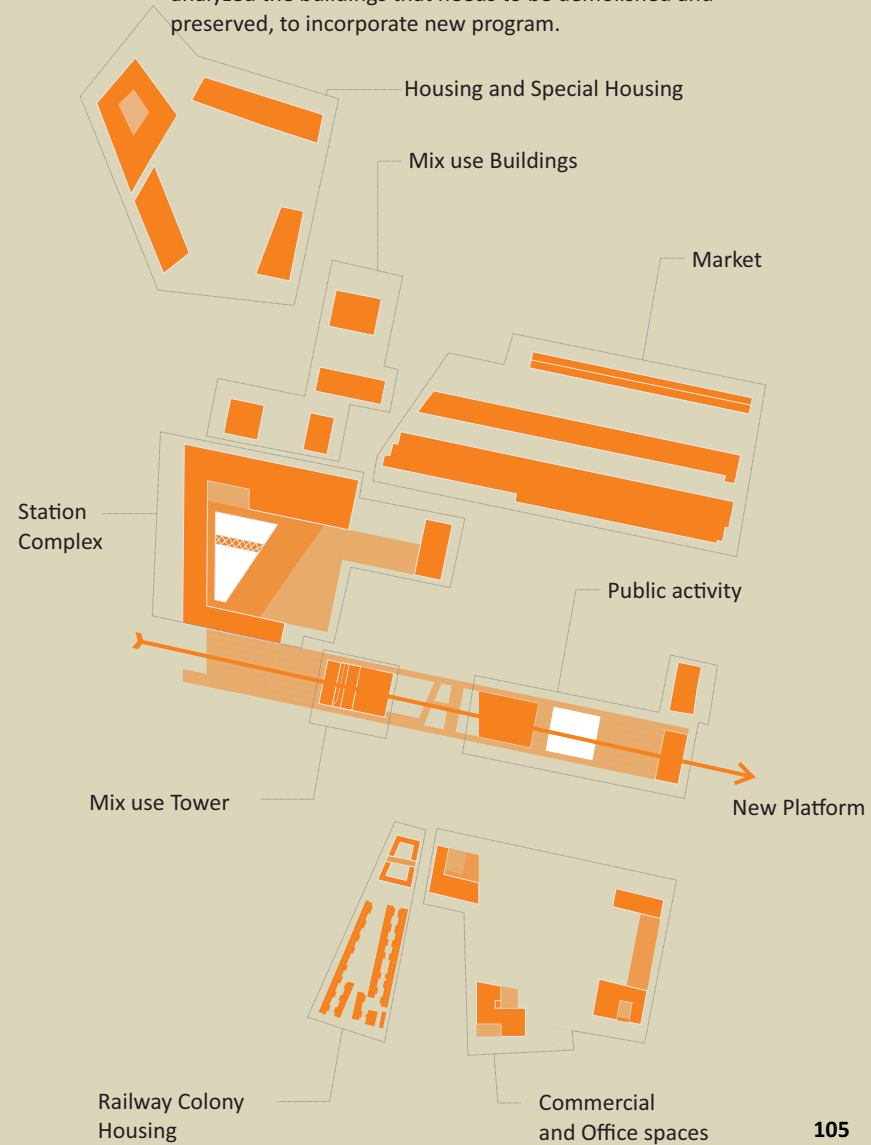


Fig 82  
New Proposed  
structures

#### 4.5 Addition

The dilapidated sheds and structures are demolished and new structures are added (see Fig 82). The concept carefully analyzed the buildings that needs to be demolished and preserved, to incorporate new program.





Platform

### 4.6 Program

The Fig 83 illustrates the diagrammatic process of creating a new master plan for the site with relation to the concept.



Green Spaces



Road Network

Fig 83  
Diagrammatic concept  
of program with  
relation to context

The Program uses the existing spaces and infrastructure elements to create a unique identity for the site as well as for the city.

The Market redefines the historical importance of the Market and its importance in the Indian cities.

The program carefully analyze the existing city and its transformation for the past 400 years and to look forward in the 21st century.

The new development and new infrastructure projects influence the program of the site by considering the Freeway project and the allocation of Dock lands for development.

Program also consider the future development of the area and create a heterogeneous environment. Program reintegrate the texture of the city and create a continuous city grid for connecting the existing part of the city.

The porous programming leads in creating much needed public spaces. The existing Railway infrastructures are incorporated in the program and strengthen it. The Railway station consider not just a transition space but a program area for connecting the void to the city structure.

**Public Open Areas :**

Market, parks, squares, Landscaped areas	<b>35%</b>
Parking/ Interchange Area	<b>5%</b>
Special Housing (Hospital)	<b>4%</b>
New Housing	<b>20%</b>
Offices	<b>10%</b>
Entertainment areas: Restaurant, Cinema, etc	<b>5%</b>
Street shopping/ Open shopping areas	<b>1%</b>
New Railway Station area	<b>10%</b>
Existing Railway Yard	<b>2%</b>
Existing storage godowns	<b>8%</b>

Fig 84  
Schematic diagram  
linking different  
program with existing  
context

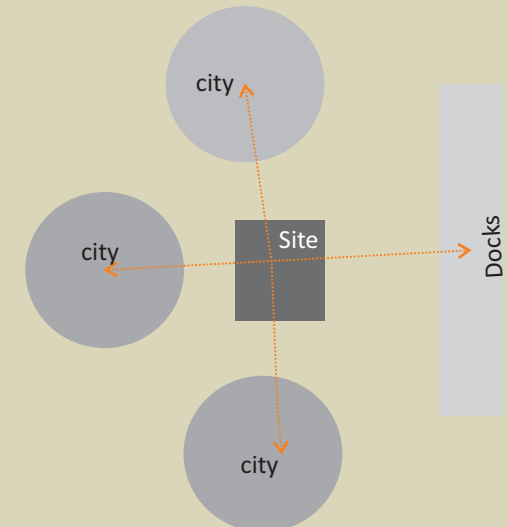
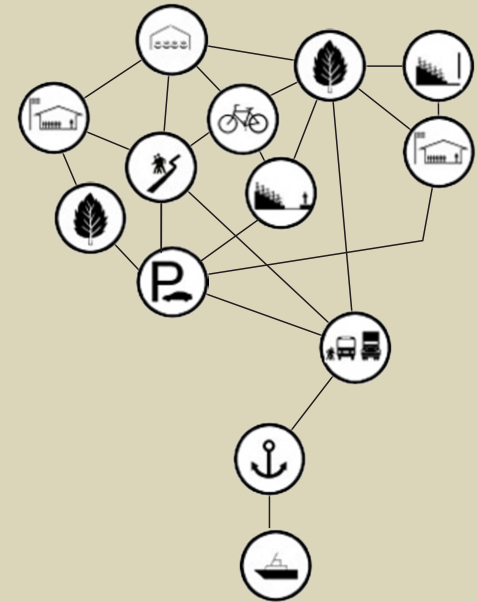


Fig 85  
diagrammatic  
representation of Site  
in context

## **Part 5**

### **Case Studies**

**This part studies some of the projects around the world concerning the Urban morphology and Voids.**



## 5.0 Case Studies

The case studies involves an understanding of creating a new place or understanding the existing context by referring to the new built spaces

### 5.1 Gasometer, Vienna, Austria

Gasometer, Renovated to 615 Apartments.

Arch: Jean Nouvel, Coop Himmelb(l)au, Manfred Wehdorn, & Wilhelm Holzbauer

In 1896 Viennese authorities constructed a large-scale gas and electric utility, which became Europe's largest gas plant. After nearly a century long run the plant was decommissioned, and left behind were four massive gasometers.

These incredible structures were cast off, but a recent revitalization project led by Jean Nouvel, Coop Himmelb(l)au, Manfred Wehdorn, and Wilhelm Holzbauer have transformed these four tanks into spectacular and thriving communities.

Fig 86  
Gasometer, Vienna  
Site Location

- Project Location
- Historical City Core
- Water body

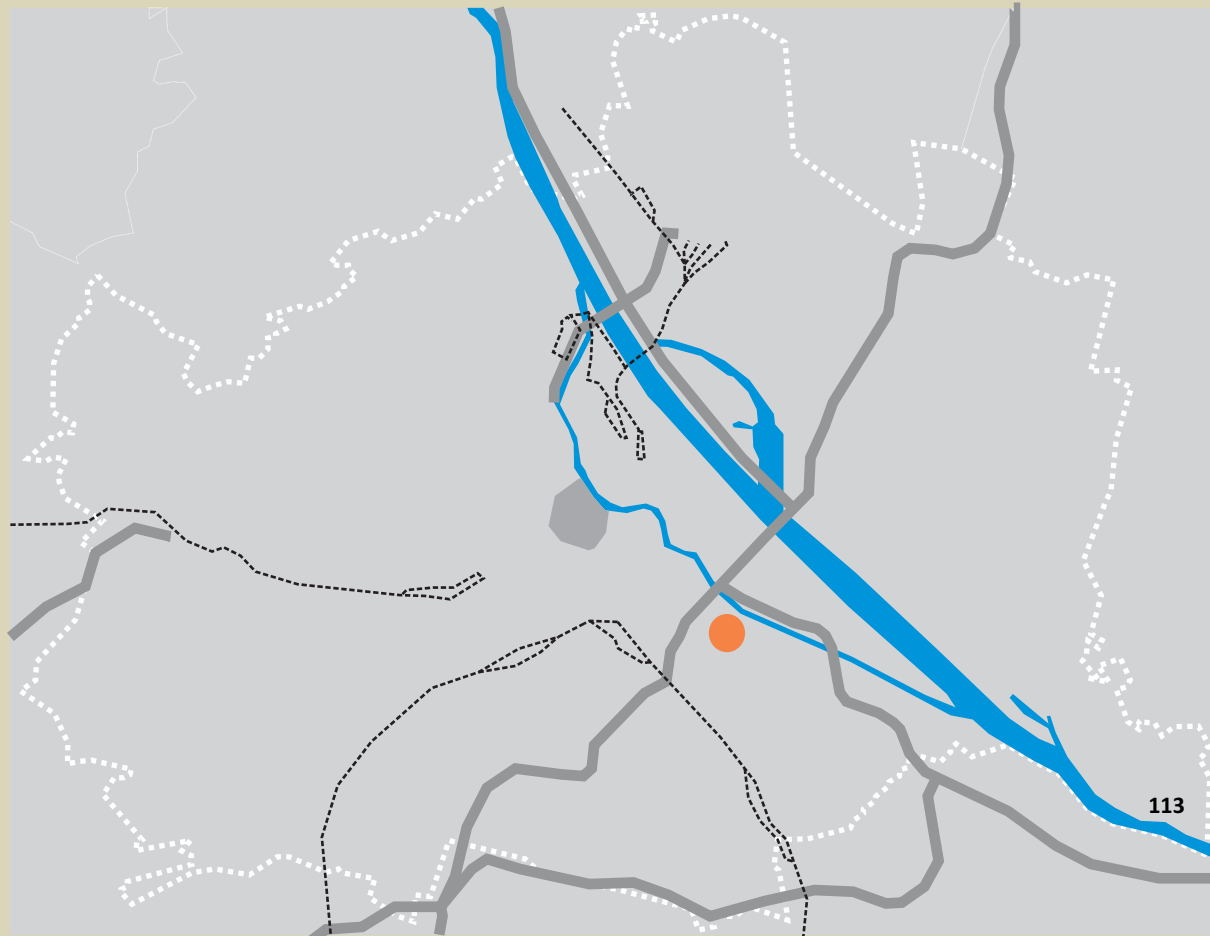


Fig 87  
Gasometer, Vienna  
Aerial view



The gasometers are four gigantic gas tanks enclosed by a brick facade.

Once used for the storage of coal gas, the gasometers were retired in 1984 as the city shifted over to natural gas between 1999 and 2001 the Gasometers were gutted leaving only the brick exterior and parts of the roof. The structures were then renovated into 615 new apartments, a student dormitory, offices, a day care centre, a multiplex, over 70 shops, restaurants, bars and cafes an events hall, and the Vienna National Archive.

Today the gasometers form a unique city center all their own, with a strong sense of community given its abundant housing and diversity of destinations.

Fig 90  
Interior view of  
Gasometer, Vienna  
showing apartments  
facing the central  
courtyard

Fig 88  
View of the Coal Plant



Fig 89  
view of Gasometer  
after refurbishment



## 5.2 Philipphof, Vienna

Memorial for War and Fascism, Sculpture by: Alfred Hrdlicka

The Austrian sculptor Alfred Hrdlicka created a monument in 1991 to commemorate all those killed during the National Socialist regime and World War II.

Separate elements, made of granite from the area of the Mauthausen concentration camp, are arranged on the square where the Philipphof house was situated.

The house was destroyed during an air raid on 12 March 1945 and more than 300 people were buried alive in the debris.

The monument includes the Austrian Declaration of Independence on the Stone of the Republic.



Opposite

Fig 91  
Location of site in  
historical city core,  
Vienna



The Monument Against War and Fascism consists of four thought-provoking statues.

Fig 92  
The Area after the  
WWII bombings



Fig 93  
Area after redesign



### 5.3 Potsdamer Platz: Berlin, Germany Richard Rogers Partnership

This historic 100-hectare site is situated at the heart of reunited Berlin between Alexander Platz and Kurfürstendamm. The brief's objective was to transform one millionsquare metres of urban waste land into a dynamic mixed-use development that would re-establish Potsdamer Platz as a key destination at the centre of the re-united city.

#### Design Concept:

The proposed masterplan places Potsdamer Platz as the focus of the historic radial street pattern, creating four zones of development, each with their own balance of offices, residential, retail and cultural activities.

The built form of the envelope rises from heights at Potsdamer Platz that respect the traditional building typology of the old center, to taller buildings at the back of the site that can take advantage of views across the Tiergarten.

#### Sustainable Development:

The development zones are anchored in a clearly defined public realm, including major green spaces in the form of a series of linear parks that act as an ecological link passing right through the heart of the scheme, from the Landwehr Canal to the Tiergarten and all the way to the banks of the river Spree.

Fig 94  
Historical mapping of  
Potsdamer Platz





Fig 95  
Conceptual idea for  
the Potsdamer Platz

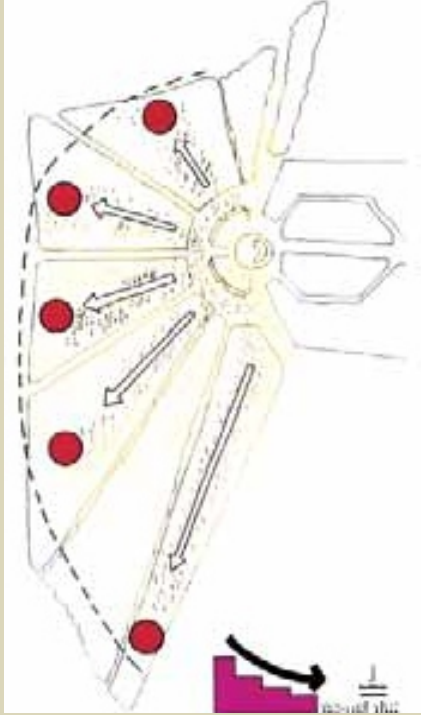
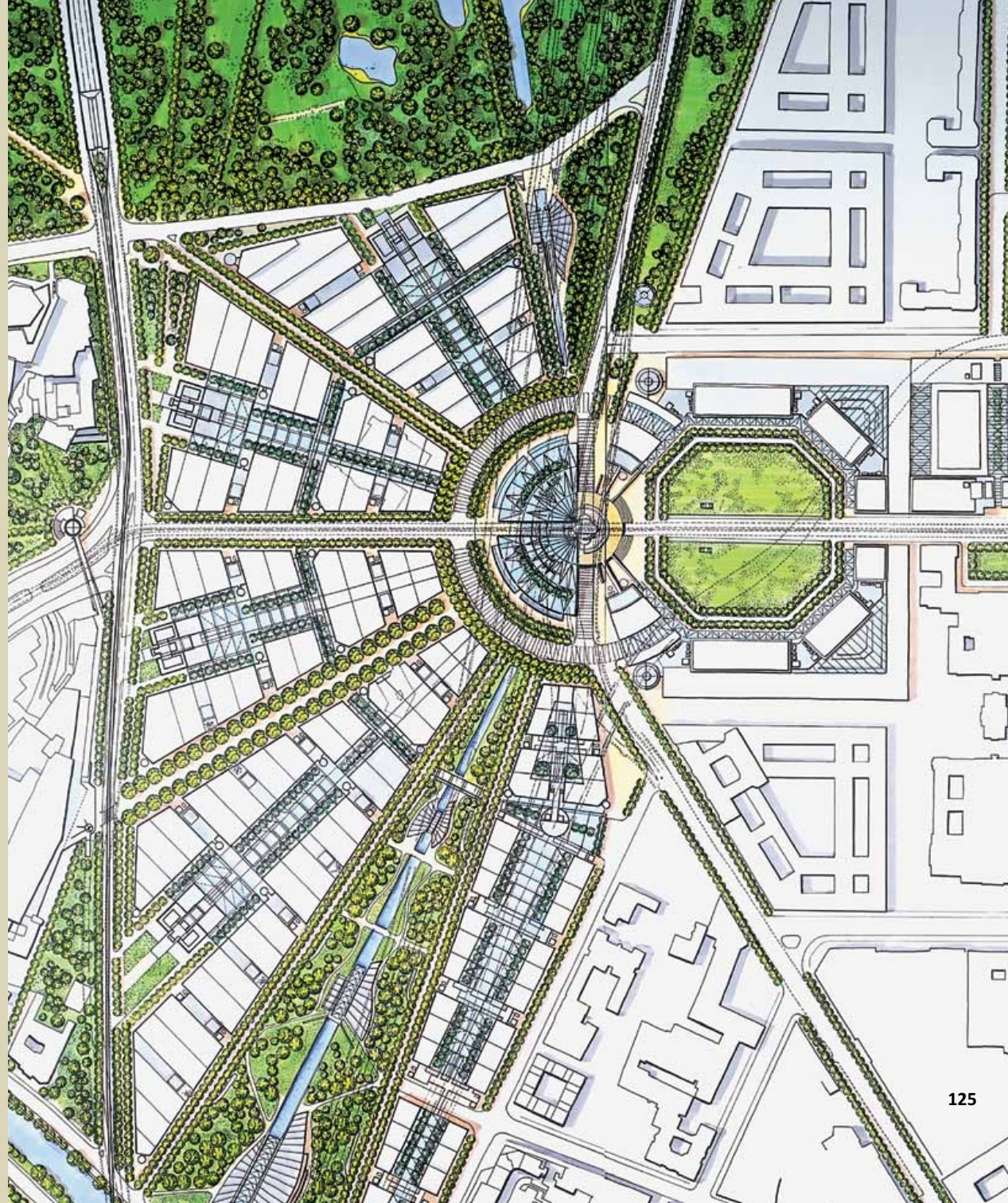


Fig 96  
Masterplan model of  
Potsdamer Platz



Opposite

Fig 97  
Masterplan of  
Potsdamer Platz







From Left to Right

Fig 98  
The most busiest place  
in Europe in 1930's  
Potsdamer Platz

Fig 99  
After WWII the area  
became a void

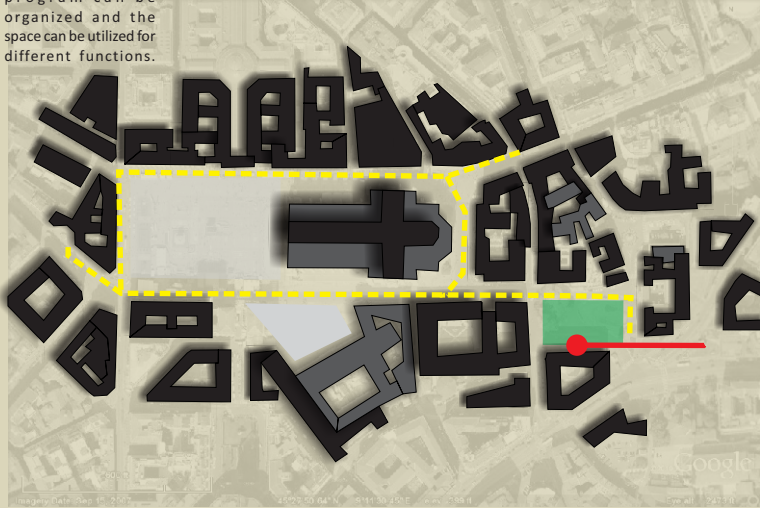
Fig 100, 101, 102  
View of the area After  
redesign.



### 5.4 Morphological Studies of Public Spaces

The Study compares 4 different Squares and spaces and Circulation around it. This study also focus on the utility of different spaces and its texture and circulation.

Fig103  
The Duomo Area creates a large Open Public space where program can be organized and the space can be utilized for different functions.



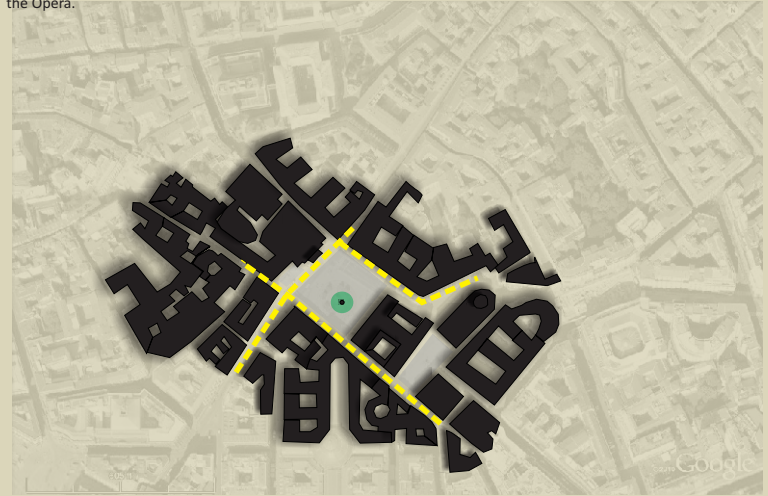
Duomo Area, Milano

Fig 104  
Due to the presence of Architectural elements the place is divided into many small fragments of open areas connected but still segregated, creating many different uses.



Krakow Square, Poland

Fig 105  
The Piazza in front of the Opera serves as a stop point in space and create a foreground for the Opera.



Palazzo Marino, Milano

Fig 106  
The Piazza Del Campo is an interesting space as it is the place where major street converge resulting in the use of space as most effective Public Piazza for celebrations, Protests or just evening leisure or rest a while.



Piazza Del Campo, Siena

## 5.5 Parc André Citroën, Paris

Parc André Citroën is a 14 hectares (35 acres) public park located on the left bank[1] of the river Seine in the XV<sup>e</sup> arrondissement (district) of Paris. The park was built on the site of a former Citroën automobile manufacturing plant,[2] and is named after company founder André Citroën.

### History

In 1915, Citroën built his factory on the banks of the Seine; it operated there until closure in the 1970s. At that time, 24 hectares (59 acres) were thus freed up and included in the capital's "urbanization" policy and gave rise to the Parc André Citroën. It was created at the beginning of the 1990s and was officially opened in 1992. Responsible for its design are the French landscape designers Gilles Clément and Alain Provost, and the architects Patrick Berger, Jean-François Jodry and Jean-Paul Viguier.

### Design

The park is built around a central, rectangular lawn of roughly 273 by 85 meters of size. It is embellished with two greenhouse pavilions (hosting exotic plants and Mediterranean vegetation) at the Eastern, urban end, which are separated by a paved area featuring dancing fountains. The South edge of the lawn is bounded by a monumental canal — the "Jardin des Métamorphoses" — composed of an elevated reflecting pool that reaches through granite guard houses, lined by a suspended walkway. On the North side are two sets of small gardens: the six "Serial Gardens", each with a distinct landscape and architectural design, and a "Garden in Movement" that presents wild grasses selected to respond at different rates to wind velocity. A 630-meter diagonal path cuts through the park, which constantly changes in its nature.

Since 1999, the park has been home to a moored gas balloon. It allows visitors to rise above the Parisian skyline, and is currently operated by the Banque Populaire. The balloon is filled with 6000 cubic meters of helium. It is 32 meters high and has a diameter of 22 meters. It is moored to the ground with a hydroelectrically-activated cable. It can rise to an altitude of 150 meters[3] and has a carrying capacity of 30 adults, or 60 children.[4] The balloon provides a view of the Champ de Mars, the River Seine, Basilica of the Sacré Cœur and the Notre Dame de Paris Cathedral.

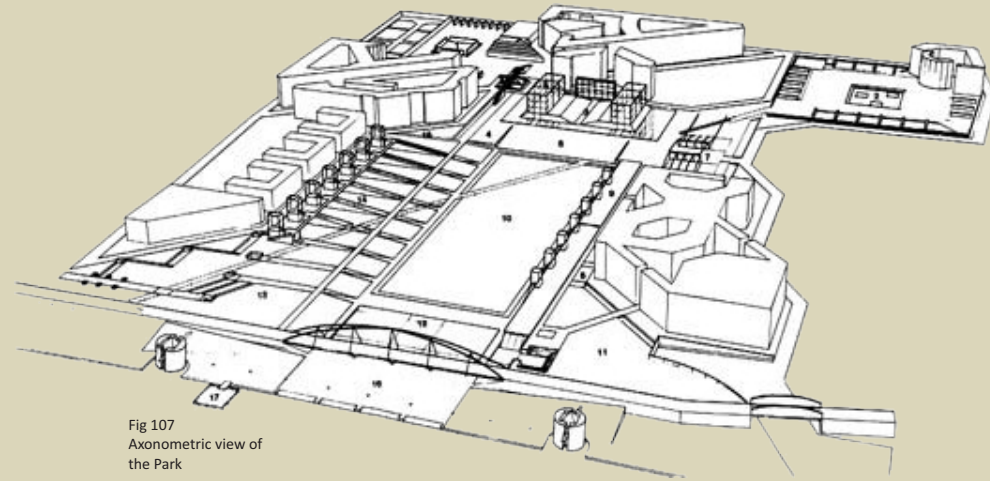


Fig 107  
Axonometric view of  
the Park

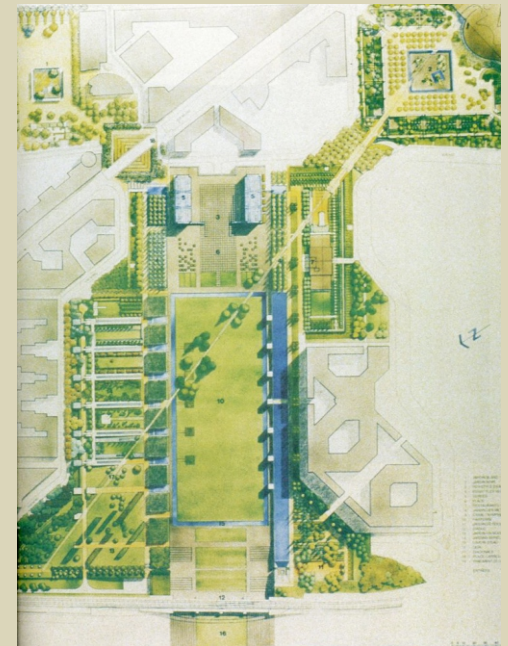


Fig 108  
Master Plan for the  
Citroën Park



Fig 109  
Satellite view of  
Citroen Park



## **Part 6**

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**Part 6**  
**Design Sheets**