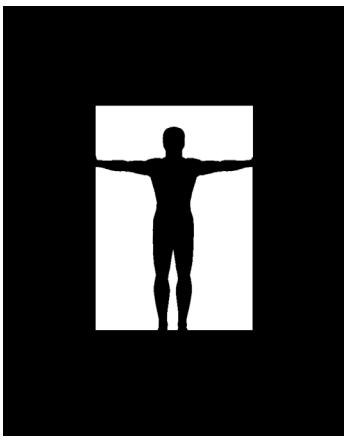

A Benevolent Future

Towards a strategic spatial framework fostering social resilience - The case of Dharavi, Mumbai

Rajat Dinesh Uchil

TU Delft, Faculty of Architecture, Department of Urbanism
EMU – European Post-master in Urbanism 2016-2018

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EUROPEAN POST-MASTER IN URBANISM EMU
strategies and design for cities and territories

TU Delft

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Coming from an education system of the *Guru (teacher) and shishya (student)* has kept me humble to my learnings as a student. It is often recognised that the *shishya* carries on the teachings of the *guru or gurus* in his/ her life and his/ practice. I hope that I can carry on the learnings from that, what I gained from EMU-TU Delft in the same manner. The support,and guidance of my beloved EMU professors and TU Delft faculty has been immensely instrumental in the *production of the self* (myself). It is this self that hopes to carry on the learnings towards research outlooks and perhaps a future Ph.D.

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Preface

While the aim of the graduation project 'A Benevolent Future' is to develop a strategic spatial framework contributing towards social resilience - through the case of Dharavi, Mumbai, the thesis also understands the correlation between space, social solidarity and social resilience. It explores a theoretical association between these three aspects and recognises the potential of design-research and research-by-design as a method to research and explore the capacity of space in time towards fostering social solidarity.

Having spent a considerable part of my life in Mumbai, brought me close to its social (people) and physical (urban form) aspect of the city. A city with maximum exigencies, where the pressures are on every aspect of life: social, physical, economical, and political. At times it is difficult to see and recognise the aspects in their parts and in their whole. It seems chaotic, almost difficult to comprehend from within. Yes, one may say that an urbanist should be balanced and find a way to negotiate within these blurred or unrecognisable aspects, to build reason within complexity, and that is where being a spatial determinist helps.

In numerous occasions I have seen and encountered the resilience of the people of Mumbai, encountered in the various backgrounds of Mumbai. Whether it be the floods of 2005 that brought the infrastructure (railways and roadways) to a halt or the attack on Mumbai by terrorist organisations, Mumbai kept its spirit up and, sprung back to life. In this background, Mumbai being a man-made archipelago faces barriers: social and spatial and struggles in the creation of space for people. Space, that has the capacity to form and foster social relations, is a powerful 'machine' to foster resilience. As Bill Hillier quotes 'Space is the machine' that can maintain and form social relations. How *then* does an urbanist tackle the question of fostering social resilience through space? Through the case of Dharavi, Mumbai, this thesis delves into the exploration, and understanding of the capacity of space to enhance social solidarity that is a determinant in fostering social resilience,

"Nothing in life is to be feared, it is only to be understood. Now is the time to understand more, so that we may fear less." Marie Curie. as quoted in Our Precarious Habitat (1973) by Melvin A. Benarde, p. v

Glossary:

- DRA/ DDA: Dharavi Redevelopment Authority
- MCGM: Municipal Corporation of Greater Mumbai
- MMRDA: Mumbai Metropolitan Regional Development Authority
- MSRDC: Maharashtra State Road Development Corporation
- MRVC :Mumbai Railways Vikas Corporation
- Nagar Co-operatives: Local Housing association, usually unrecognised by law.
- OSM: Open Street Map
- PMAY: Pradhan Mantri Awas Yojana (Prime ministers housing scheme)
- SPARC - Society for the promotion of Area Resource Centre
- SRA: Slum Rehabilitation Authority

In Mumbai, a highway divides the "formal city" and the "informal city."
PC: Yue Zhang, January 2016

PART 1 **Introduction:**

Understanding Social Resilience | Problem field | Problem statement,Research Question + Hypothesis | Theoretical Framework | Methodological Framework | Limitations and Scope | Societal and Scientific Relevance |

The Absorbers: Disaster And Vulnerability In Mumbai. Source: https://theleapblog.org

Introduction

The thesis explores the social potential of space i.e. the social logic of space to enhance resilience of a society. Through a sound theoretical and methodological framework it determines the capacity of space to enhance social cohesion. As social resilience is defined as the capacity of society to cope, adapt or transform societal relations towards external stress, space that is a 'construction' and a function of the structure of society hosts the ability in fostering societal robustness against external perturbations (Alan H. Kwok, 2016; Raffestein 2012;Hillier,1984). Through the case of Dharavi, Mumbai this thesis determines the spatial capacity in time to enhance social solidarity against external stresses (man-made and natural).

Location: Mumbai, India. Source: googleearth

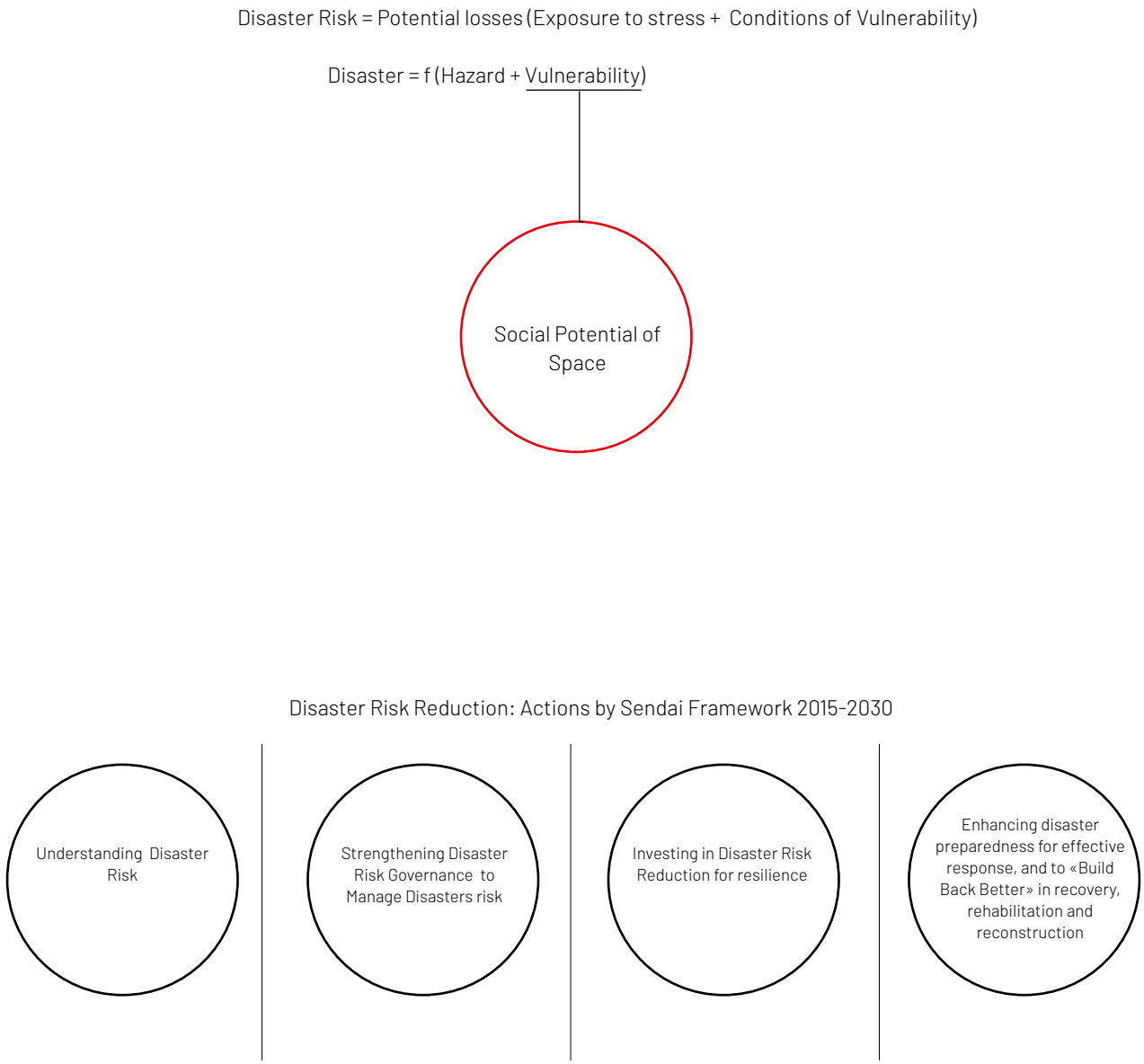


FIG. 1.1 Priorities for Action: Source: Sendai Framework for disaster risk reduction 2015-2030, Drawn by : author

1 – Understanding Social Resilience

Literature review

1.1 – **Understanding disasters and disaster risk reduction as resilience:**

Disaster: according to UNISDR 2009, disaster is defined as a combination of exposure to hazard and conditions of vulnerability that are present for a community or society to cope with that event. A disaster may cause loss of life, injury, disease and negative impacts on human physical, social well-being, along with destruction of assets, loss of services and environmental degradation. (UNISDR, 2009).

Disaster Risk: is defined as the potential loses in lives, assets and services that could occur in the face of a hazard based on the exposure and vulnerability of a community or society to that event. (UNISDR, 2009)

Disaster Risk Reduction: The Sendai Framework for disaster risk reduction 2015-2030 sets important priorities for actions at local, state, national levels for the substantial reduction in potential disaster related outcomes caused by natural and man-made hazards (UNISDR, 2015). The priorities for action are:

- Understanding disaster risk
- Strengthening disaster risk governance to manage disaster risks
- Investing in disaster risk reduction for resilience
- Enhancing disaster preparedness for effective response and to 'build back better' in recovery, rehabilitation and reconstruction.

As disaster is a socially-constructed phenomenon the processes involved in the environment are socially configured that involves multiple sectors, and actors with varied outcomes (Alan H. Kwok, 2016). Usually, activities associated with social disaster recovery focus on achieving desired levels of social well-being and health, quality of life, sense of place and belonging and civic engagement.

While exposure to hazards is an important facet to deal with, through the case of Dharavi, Mumbai , the thesis focuses on the vulnerability of a community, to external stresses (natural or man made) and delves into the the social potential of space (social logic of space) to enhance and foster social solidarity in the face of disasters.

	Coping capacities	Adaptive capacities	Transformative capacities
Response to risk	ex-post	ex-ante	ex-ante
Temporal scope	short-term	long-term	long-term
Degree of change	low, status quo	medium, incremental change	high, radical change
Outcome	restoration of present level of well-being	security of future well-being	enhancement of present and future well-being

FIG. 1.1 Capacities of Social Resilience: Adapted from 'What is Social Resilience? Lessons learned ways forward'. (Markus Keck 2012).

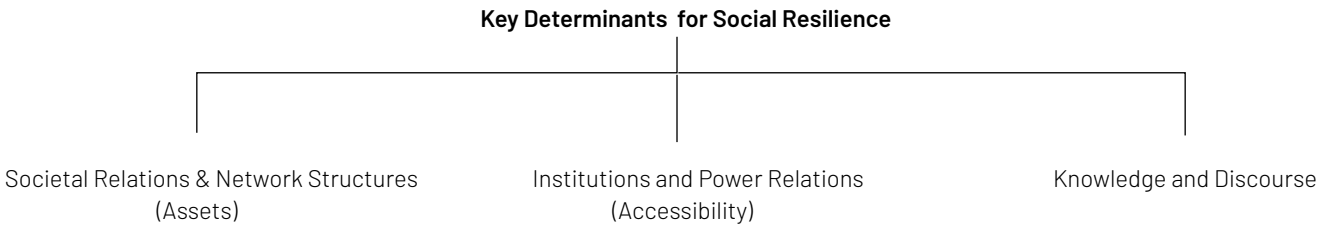


FIG. 1.2 Key Determinants to Social Resilience: Adapted from What is Social Resilience? Lessons learned ways forward. (Markus Keck 2012). Drawn by author

FIG. 1.3 Source: Supporting components of social resilience linkages to other community features, characteristics, and processes. Community resilience domains adapted from Cutter et al. [39,40]. As shown in What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand- (Alan H. Kwok.2016)

1.2 – **Understanding social resilience and vulnerability:**

Social Resilience can be defined as "the capacity of people and communities to deal with external stresses and shocks" (Alan H. Kwok, 2016). It acknowledges the roles played by power, politics and participation in the context of increasing uncertainty and surprise (Marcus Keck, 2013). These shocks and stresses due to uncertainty and surprise, could be from natural and man-made hazards. In the study 'What is Social Resilience? Lessons learned and ways forward' the authors define the notion of social resilience as one in which learning, and adaptation is involved (Marcus Keck, 2013),

- *Coping Capacities:* refers as 're-active' and 'absorptive' and measures the capacity of people to cope with and overcome immediate threats with the means of resources that are directly available. It is the restoration of the present level of well- being after a critical event.
- *Adaptive Capacities:* refers to the 'pro-active' or 'preventive' measures and mechanisms employed by people based on the learnings of past experiences and anticipation of future risks and adjustments of their livelihoods accordingly. It is the incremental change that are taken up by people to secure their present status of well-being in the anticipation of future risks.
- *Transformative Capacities:* refers to people's ability to access assets and assistance from the wider socio-political arena to improve their individual welfare as well as societal robustness to future crises.

Here, the thesis delves into the capacity space to determine these capacities through the understanding of 'the social logic of space'.

The key determinants for Social Resilience:
Social Vulnerability: is the exposure of groups of people or individuals to stress because of the impacts of environmental change, Here stress can encompass disruption to livelihoods and forced adaptation to the changing physical environment. (Adger, 2000).

- *Societal relations and network structures:* defines assets that can enable the capacity of societies to cope with external stress, such as human capital, natural capital, economic capital, physical capital and primarily social capital.
- *Institutions and Power relations:* defines accessibility, they are the rules and norms that are both the structure and are structured by social relations.
- *Knowledge and Discourse on risk perception.*

Here, the key to fostering social resilience is 'entitlement' in political, social, economic, physical and spatial aspects. Entitlement refers to the extent to which individuals, communities or societies are able to access assets or resources that defines their ability to cope with, adapt and transform their individual welfare to achieve societal robustness to future stress. (W. Neil Adger, 1999)

As such, through the case of Dharavi this thesis understands and deals with the spatial aspect of entitlement,in terms of spatial accessibility towards fostering social resilience.

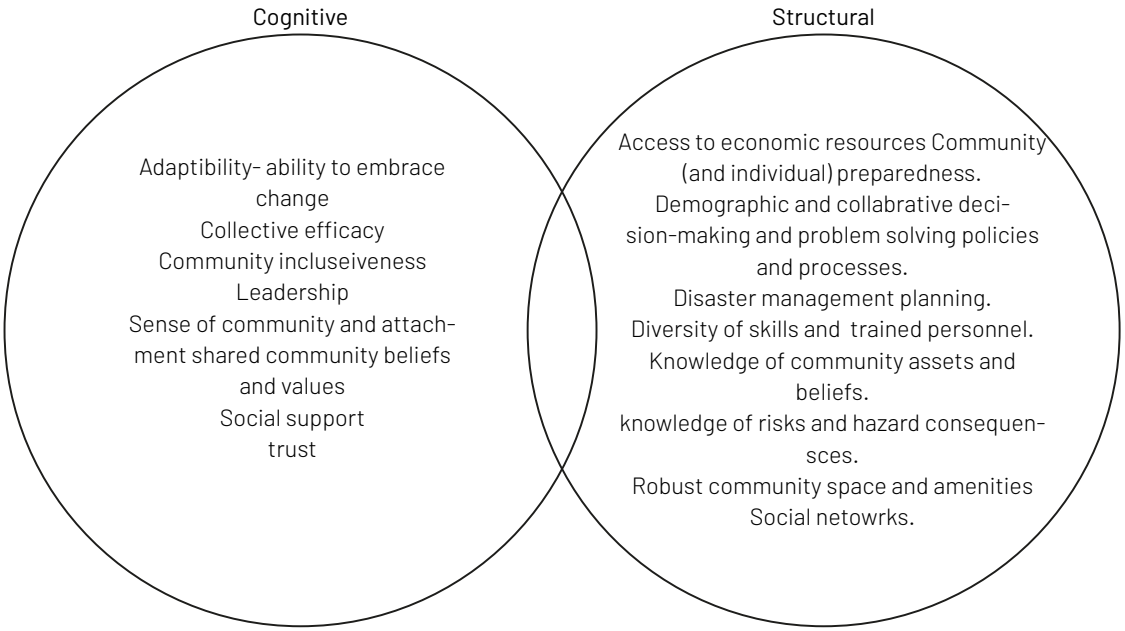


FIG. 1.4 Core attributes of social resilience of communities and accompanying resilience-enhancing actions: Source Alan H Kwok. 2016 Drawn: by Author,

Level of impact on social resilience		Social Resilience Indicators		
	High	Community participation Education Exchange information Learning Shared information Social support Sense of community Trust	Community participation Exchange information Shared information Social support Sense of community Trust	Community participation Exchange information Learning Shared information Social support Sense of community Trust
	Medium	Demographic information	Coordination	Community efficacy
	Low	Improvisation – inventiveness Coping style Leadership	Coping style Leadership	Improvisation – inventiveness Coping style Leadership
		Pre-Disaster	Response	Recovery

FIG. 1.5 Temporal Social Resilience Indicators: Adapted from A temporal framework of social resilience indicators of communities to flood, case studies: Wagga wagga and Kempsey, NSW, Australia, p. 253, by Khalili et al. [57]. as shown in What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand- (Alan H. Kwok.2016)

Multidimensionality of Social Resilience:
Since the concept of social resilience is both a process and an outcome, it is multidimensional, and it has structural and cognitive qualities, and spans both spatial and temporal scales. (Alan H. Kwok, 2016),

Structural and cognitive dimensions of social resilience in disasters: are the dimensions of social resilience that include features such as educational attainment, transportation access, physical infrastructure, communication capacity, food provisioning capacity, health care capacity. To summarise, features associated with well-being of individuals and society.

Temporal dimensions of social resilience in disasters: correspond with mitigation, preparedness, response and recovery phases of a disaster. Briefly, the ability of a community to 'bounce back', adapt or transform to secure well-being in the face of disasters.

Attributes of Social Resilience:
Research on social aspects of resilience highlights six attributes that enhance or contribute to social resilience in the face of natural or man-made hazards and disturbances (Kirsten Maclean, 2014), they are summarised as follows:

- *Knowledge, Skills and learning:* is the capacity of an individual or group to respond to local needs and issues such as water management, governance, skill development.
- *Community Networks:* is heavily dependent on social capital and works with social processes and activities that support peoples and group in a place.
- *People-place connections:* is the interdependencies between human and environment and is connected to concepts such as social-ecological systems, integrated management approaches and sustainable livelihood development.
- *Community infrastructure:* includes diverse services such as healthcare, sanitation, solid waste-management, transport, food markets, recreation facilities, schools etc and other amenities that aid societal robustness.
- *Diverse and innovative economy*: acknowledges changing demands of consumers and new employment opportunities.
- *Engaged governance:* involves collaborative governance models that engage with people and communities affected by issues such as flood risk.

In conclusion social resilience is related to societal governance structures, human capital, economic resilience, the built and natural environment. Thus, the capacity of communities and societies to cope, adapt and transform to external stress is based on a foundation of key determinants such as societal relations, institutions and power relations, knowledge and discourses along with its attributes.

Although, governance plays an important role, the thesis limits its scope to the understanding of the social potential of space (the social logic of space) in the context of Dharavi to maintain and enhance societal relations towards fostering social resilience.

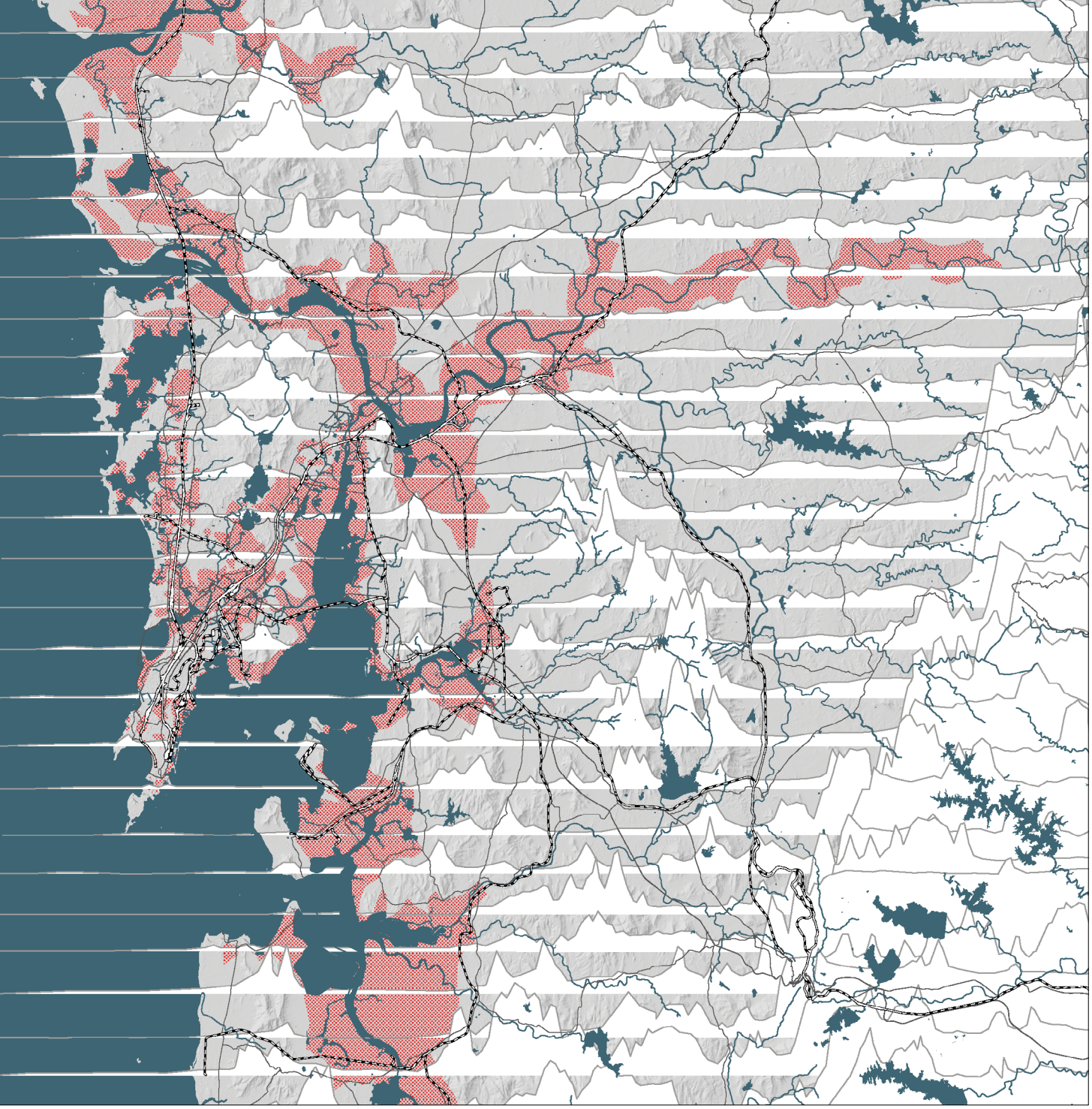


FIG. 1.6 Mumbai Metropolitan Region Flood Risk Map : Data source: Open Street Maps, WRI, Gupta 2007, Surging seas risk zone map. Drawn by : Author

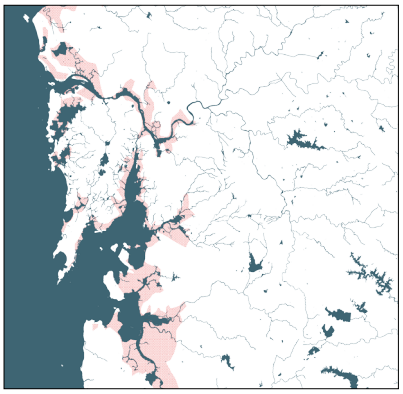


FIG. 1.9 2m Sea Level Rise Risk

2 – Problem Field:

In order for Mumbai to foster social resilience against disturbances such as natural and man-made hazards whether it be floods or fires or acts of ethnic violence, it has to deal with the aspects of exposure and vulnerability. Pressures and barriers that determine vulnerability of society to a hazard (man-made or natural), while disturbances that highlights exposure of that society to a hazard. Here, the aim is to understand the vulnerability of society to risks (man-made and natural).

2.1 – **Mumbai's geographical isolation**

Disturbance floods and flood risk:

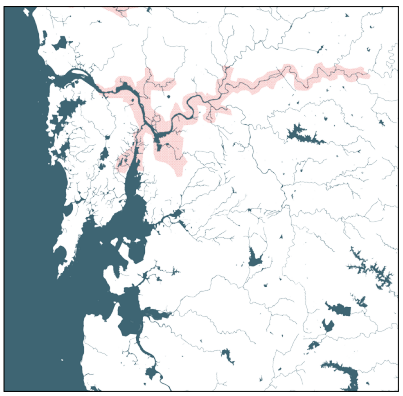


FIG. 1.8 Inland Flooding Risk

The population of the Greater Region of Mumbai is around 12 million with an average density of 24,000 people/ square km (Nijman,2010). The Greater Mumbai region is bound by the Arabian sea to the west , Thane creek to the east, and Ulhas river to the north. It is a man-made peninsula that was reclaimed from an estuary to an archipelago. The size of the peninsula is on an average 10km from West to East and 50km from North to South. This archipelago faces risks from natural hazards such as floods.

Sea level rise: The study by Climate Central highlights areas that could be affected by climate change with a predicted sea level rise of 2m. (Central, 2018)

Inland flooding: The World Resource Institute predicts that with current socio-economic trends and severe climate change the expected annual urban damage 2030 could be around $551.1 M affecting almost 77000 people. (WRI, 2018)

Pluvial Flooding: The floods of 2005, that was caused by an extreme weather event of 950 mm of rainfall in mere 24hr had a major impact on the city. Flooding, happened mainly in the reclaimed areas of Mumbai, the low-lying areas and along major infrastructure networks, such as the railway network. There were also landslides caused due to the heavy rainfall. (Gupta,2007)

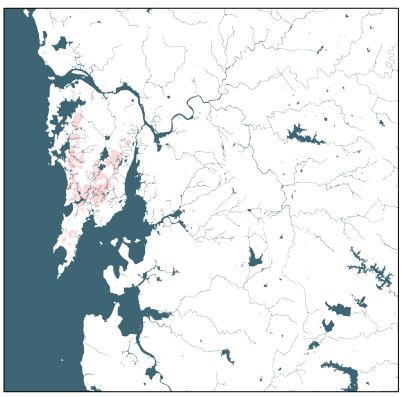


FIG. 1.7 Pluvial Flooding Risk

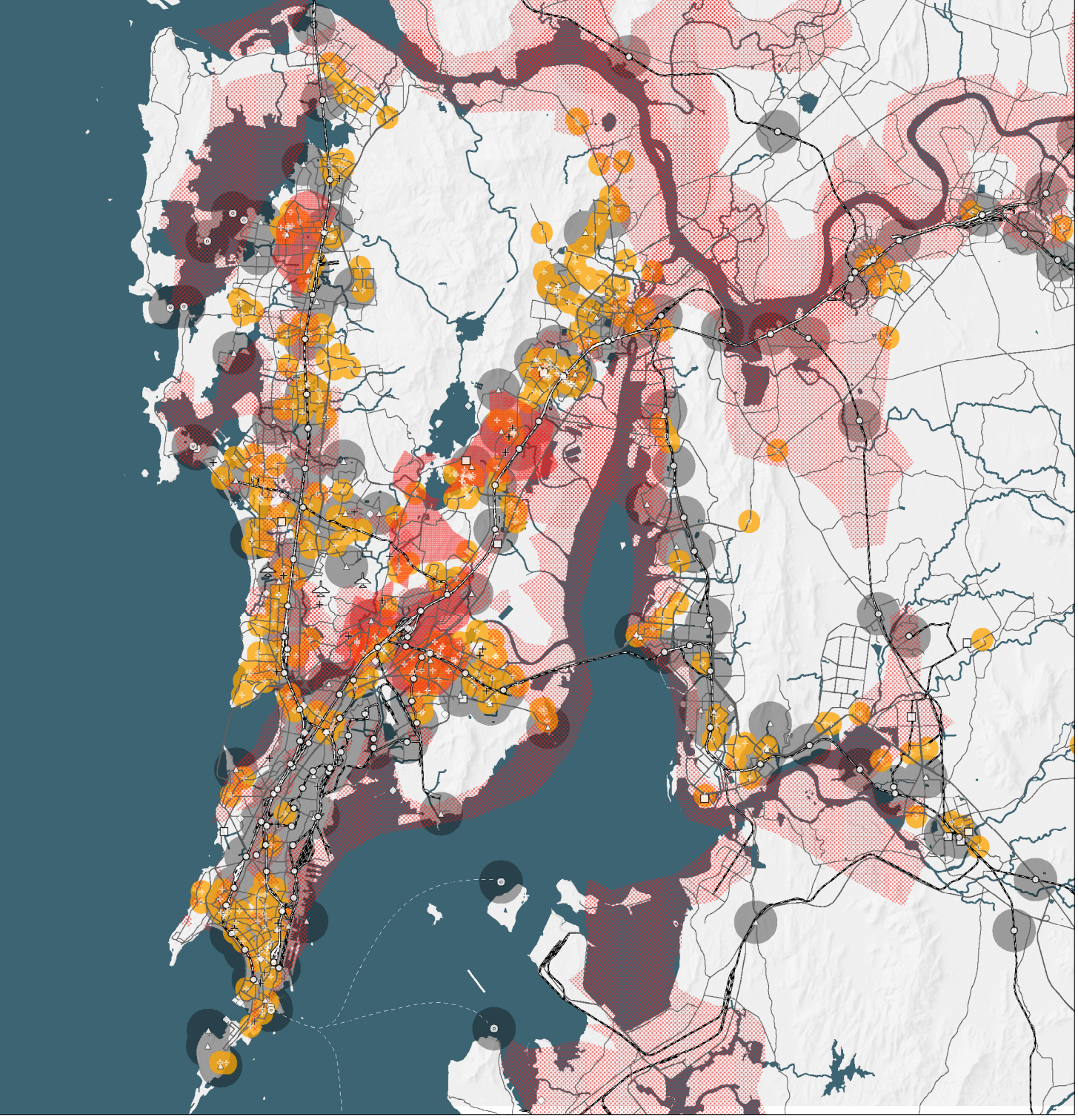
Through the reading (FIG.1.6), it can be interpreted that the geographical isolation of the man-made archipelago, Mumbai, due to the Western Ghats (mountain ranges) to the east and the Arabian Sea to the west makes it vulnerable to external stresses whether it be floods or man-made hazards. The flood risk zones coincide with critical infrastructures such as the railway network and the highway networks that facilitate the functioning of the territory of Greater Metropolitan Region of Mumbai and as such the accessibility to necessary resources during hazard events. Accessibility to social, economic and physical resources that is an attribute towards fostering social resilience.

Heavy rain in Mumbai, School shut & Train services affected :Newspoint TV.
Source: https://www.youtube.com

A man removes water from his house in Bombay (Courtesy: Reuters),
Source: https://www.moneycontrol.com

On A Day Of Heavy Rain, How Strangers In Mumbai Opened Their Hearts And Homes To Help One Another ,
Source: https://www.huffingtonpost.in

Volunteers helping people cross the flooded road,-
Source: http://luckshmimirgh.blogspot.nl


Critical Technical Infrastructure
1000 m buffer Bus Station
1000 m buffer Ferry point
1000 m buffer train station
Airport
Power plants
Communication/ Post
1Water Plants
500 m buffer Social Infrastructure: school, hospital, police
Flood risk zones
Major roadways
Railways
0 2.5 5 7.5 10 km

2.2 – **Mumbai's Crisis**

The 2005 Floods of Mumbai, an extreme weather event of 950mm rainfall in 24hrs had unprecedented results leading to direct economic damages estimated at two billion USD and 500 fatalities. Besides this there were substantial indirect economic losses too (Stéphane Hallegatte, 2010). Although,pluvial flooding was a localised phenomenon the effects of it transcended scales and boundaries. For eg. The railway system came to a halt, electricity and communication systems were shut-off in many parts of the city. Around 40000 commercial establishments were damaged. Most arterial roads and highways were also affected by water logging.

Post the 2005 floods a state disaster management cell was established that created tools to cope with disasters. It is a post- disaster, response and recovery mechanism that indicates social infrastructure and critical infrastructure. At present, Mumbai lacks a strategic spatial framework to deal with disaster related events such as natural and man-made hazards.

While Mumbai came to a standstill in 2005, it was the acts of benevolence by certain groups of people and communities that kept up 'spirit of Mumbai [1]' and helped it from falling into chaos (Times T. E., 2017). Although, a state disaster management cell has been setup to address the issues related to natural hazards and disaster management, the geographical isolation of Mumbai, and the failure of critical infrastructures asserts that besides the improvement of these systems and the necessity to deal with exposure to external stresses , there should be investment in developing the capacity of space to enhance societal robustness against external stresses whether it be natural or man-made.

FIG. 2.1 Greater Mumbai Region Risk Map- Critical Social and Technical infrastructure :
Data source: Open Street Maps, WRI, Gupta 2007, Surging seas risk zone map , Drawn by : Author

[1] 'The Spirit of Mumbai' is its resilience, how people take everything on their chin and then get on with life. The Bomb blasts of 1992, 26/11 Terror attacks, 2005 massive floods, almost everything which encompasses the idea of resilience of the city. 'Is the spirit of Mumbai an overrated concept, just good for media consumption? https://www.quora.com/Cities-and-Towns-in-India-Is-the-spirit-of-Mumbai-an-overrated-concept-just-goodfor-media-consumption.

Slum, implanted in an urban interstice,
Source: http://la-story.over-blog.com

The Most Expensive Home In The World,
Source:http://theredpillnetwork.tumblr.com

Bombay riots 1992: Scars remain, victims still plead for justice
Source: http://indianexpress.com

People carry a wounded to hospital in Dharavi, during the 93 Mumbai riots. Express Photo by Neeraj Priyadarshi. Source:http://indianexpress.com

2.3 – **Mumbai's Spatial Fragmentation**

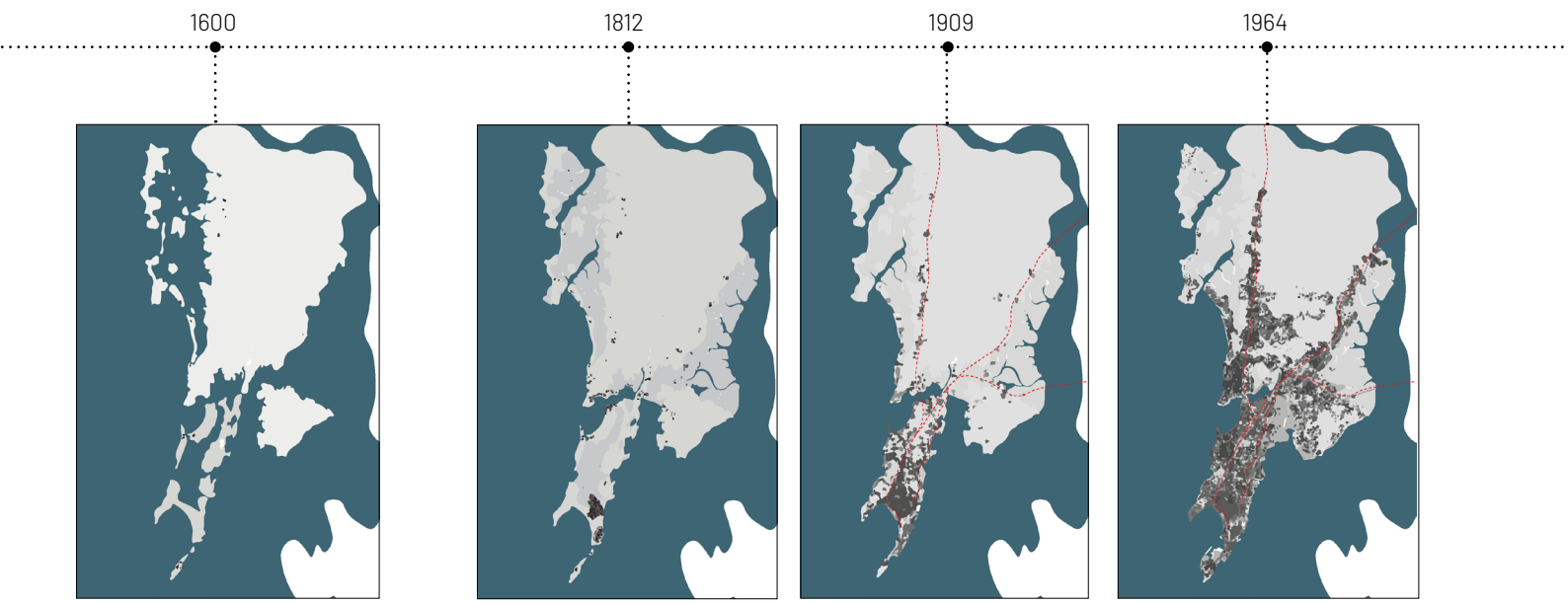
Although certain communities and volunteers did come together to help each other at the time of the crisis such as the floods. In the past Mumbai has experienced communal violences that tore it apart. The 1992-93 riots between Hindu's amd Muslims that was triggered by the demolition of the Babri Masjid Mosque by Hindu activist groups, was one such incident. The riots claimed 900 lives and almost 2032 people were injured (Express, 2018)

Besides this, the percentage of people living in slums or informal settlements in Mumbai is estimated to be around 42% (Zhang, 2016) that take up 12% of its geographical area (Balachandran, 2016) . Slums or informal settelments such as Dharavi represent a spatiality rich and diverse in economic and cultural pattern (Nijman,2010). As argued by Jan Nijman in 'A Study of space in Mumbai slums' cities in less-developed worlds usually have a history of spatial fragmentation in terms of planned and unplanned areas: slums, illegal settlements. As such slums are neglected because modern planning is unable to comprehend strategeis for the same. (Nijman, 2010) Dharavi and its vicinity is no exception as it was an informal settlement that grew organically with immigration from various parts of India. At present Mumbai is a city with two cities, a duality one that is mdoern and planned the other that is undesirable , unintended and formed arganically: the slums . A study by the Centre for Policy Research, New Delhi conlcuded that in India, there is a correlation between spatial patterns (residential) and segregation, segregation on the basis of caste and ethnicity, economic profiles as well as accessibility to resources (Sidhwani, 2015)

As space and segregation have a strong correlation in Mumbai, through the case of Dharavi this thesis aims at developing a strategic spatial framework towards spatial integration. Integration, that can help in fostering societal relations in the wake of external stresses.

Hawkers in Mumbai:
Source: Dinodia, https://chaurahha.wordpress.com

Mumbai suburban train delayed
https://www.hindustantimes.com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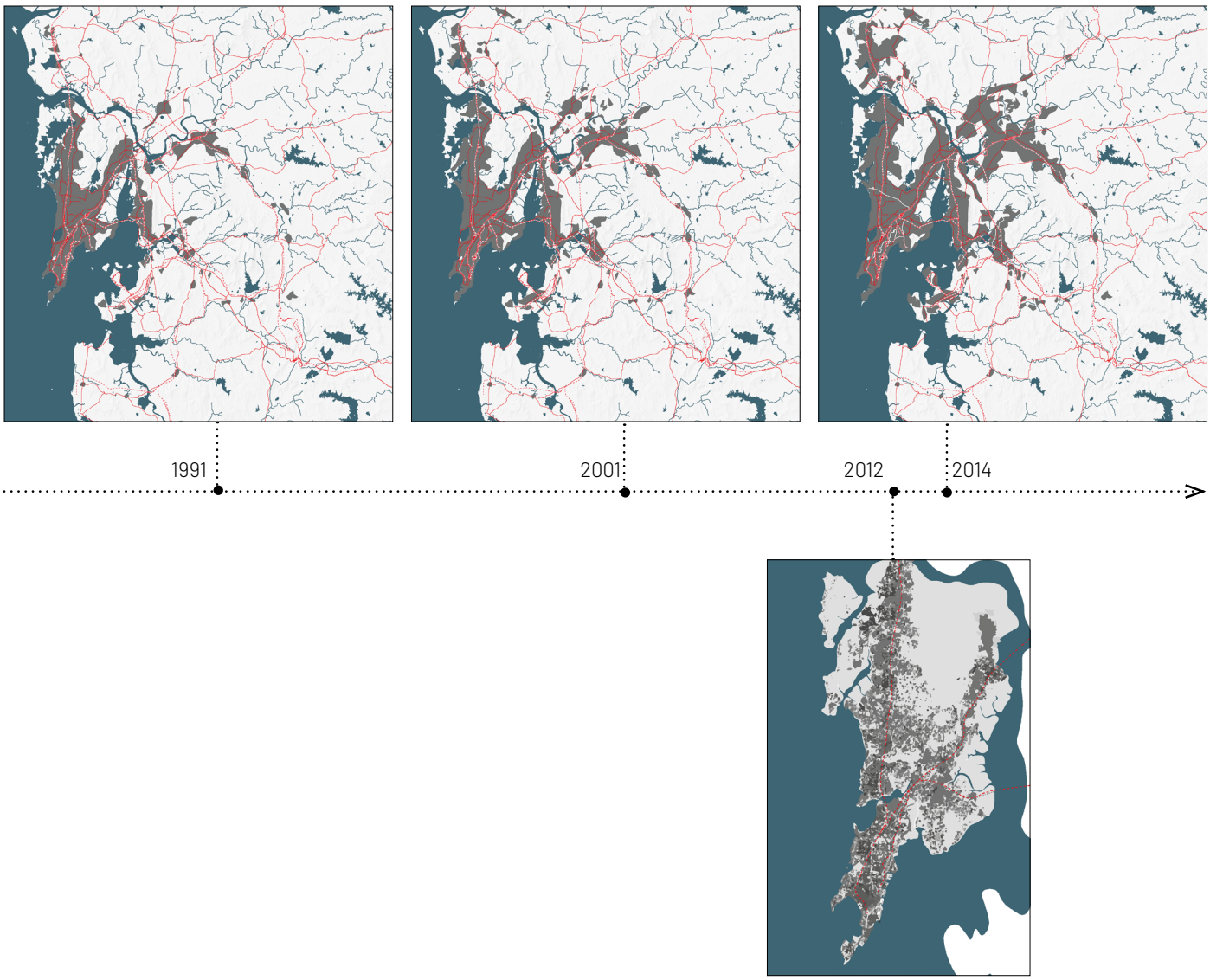

FIG. 2.2 Mumbai's Evolution to Desakota Conurbation
Source: atlasofurbanexpansion, old maps , Drawn by: author

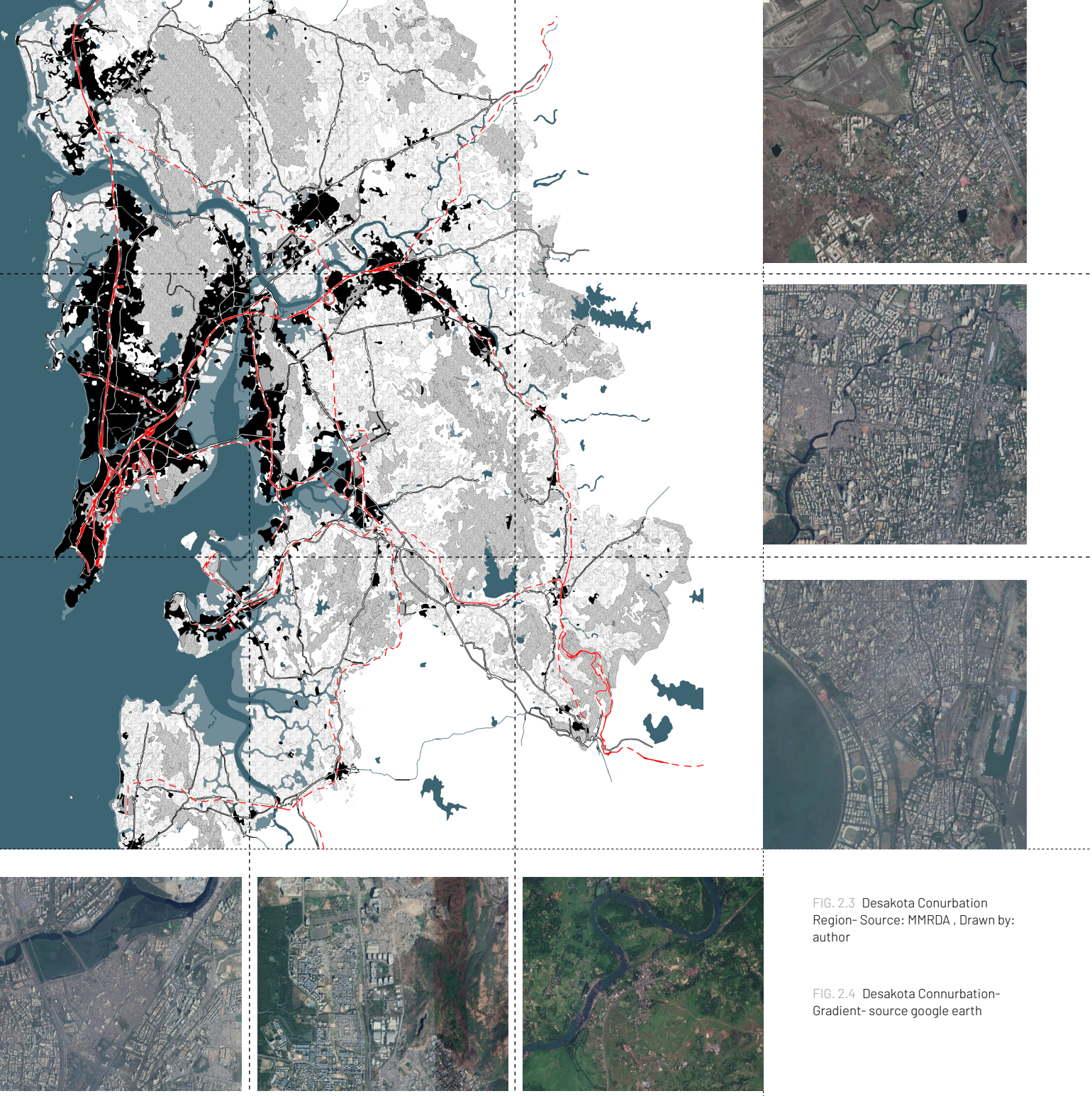

FIG. 2.3 Desakota Conurbation Region- Source: MMRDA , Drawn by: author

FIG. 2.4 Desakota Connurbation- Gradient- source google earth

2.4 – **Mumbai's Vulnerability**

The reading of the growth of Mumbai (fig.2.2) highlights that the functional territory was primarily structured by the railway infrastructure post the 1900's. Apart from the highways, the dependence on this critical infrastructure is evident for the functioning of the *Desakota Connurbation.*

Desakota Concept: The term *Desakota* was first introduced by T G. McGee in 1991 that encompassed the region in between village and town. These regions are linked to major urban centres by cheap transport axes where much of the commercial agricultural and non-agricultural economic activities take place (McGee, 1991). It encompasses more than a 'peri-urban' phenomenon i.e closely linked with rural and urban livelihoods, communication, transport and economic systems. (Marcus Moench, 2008).

In the article 'Vulnerability, Disasters and Poverty in Desakota Systems' published in 'Re-imagining the Rural-Urban Continuum' (Mark Pelling, 2008) the authors highlight 9 key criterion's that act as these pressures :

1. Increased transport connectivity.
2. Expansions of the local labour market and wage labour.
3. Active Information exchange.
4. Mixed household incomes.
5. Decline in local informal institutions and collective action.
6. Modernization of production and processing technology.
7. Commodification of the local economy.
8. Changing land and resource rights and administration.
9. Engagement with the global/ external economy.

As Mumbai is a Desakota Connurbation (fig.2.3) the pressures shaping vulnerabilities to disaster, in hazard related events is relevant and specific. As many communities within the city, for e.g. urban informal settlements (slums) such as Dharavi have affiliations with both the urban and rural life, migration becomes a daily, weekly, and seasonal aspect. These communities have social, cultural and economic ties in both the urban and rural parts (Nijman,2010). As such spatial entitlement in this particular contexts becomes a blurry concept to deal with . The case of Dharavi, explores the development of spatial entitlement via spatial accessibility and although rudimentary, looks at the aspect of land ownership towards entitlement.

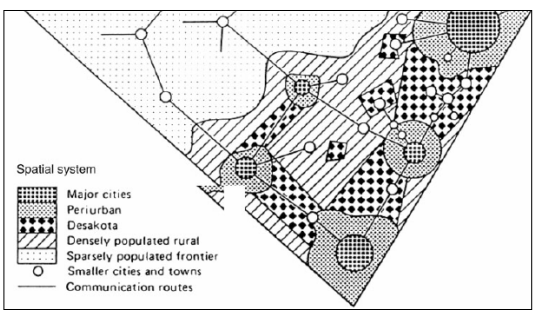

FIG. 2.5 Desakota- Source: TG Mc Gee 1991

Heavy rain floods Mumbai; disrupt rail, road traffic, Source: Shashank Parade/PTI Photo http://www.rediff.com/

3 – Problem Statement, Research Question + Hypothesis

World Global Risks report 2018 considers extreme weather events and natural hazards as a major disturbance towards risk perception (WEF, 2018) . At present, Mumbai as well as other cities are at risk from natural and man-made hazards (floods, fires, ethnic violence etc.). Although, Mumbai did witness acts of benevolence by its people during the times of crisis such as the floods, the past and present situation of Mumbai's spatial and social fragmentation underlines threats towards external stresses . Besides this, the geographical isolation of Mumbai, a man-made archipelago with a population of over 22 million (Review, 2018) makes the accessibility to resources that could maintain and foster resilience even more difficult. Hence, the reliance on social solidarity as a means towards fostering social resilience (societal robustness) is key to safeguarding the future of Mumbai and its people. Although, resilience is not a final state but a process, it is the system's ability to maintain its integrity and to return to its original state, a state of equilibrium, normality, when it is confronted with a disruption or hazard" (Holling,1973).

Through the case of Dharavi - Mumbai, a historic, unplanned settlement located in the heart of Mumbai that faces challenges and highlights potentials in the formation and maintenance of social solidarity, the thesis aims at developing a strategic spatial framework towards fostering social resilience under the purview of the 'social logic of space'.

Main Research Question:

How can the understanding of social logic of space contribute to a strategic spatial framework towards fostering social resilience?

Sub research questions:

- What are the spatial constraints that hinder the formation and maintenance of social solidarity in time to move towards social resilience?
- What are the design principles and strategies to do so?

Aim and Objective of the thesis:

To develop a strategic spatial framework contributing to social resilience through the understanding of the social logic of space, the case of Dharavi, Mumbai .

Hypothesis:

The capacity of space to be adapted or transformed to enhance social solidarity is directly proportional to the resilience of society towards external perturbations and disturbances such as man-made and natural hazards.

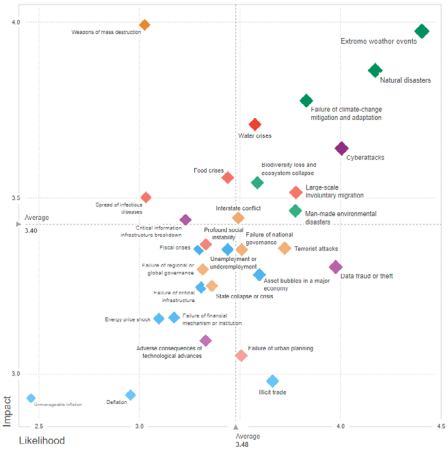

FIG. 3.1 The Global Risks Landscape 2018 - source: WEF 2018

4 – Theoretical Framework

Space, Society and Social Resilience

Space and Society dichotomy?

While social resilience primarily is the 'capacity of an individual, people, community or society to deal with external stresses and disturbances such as man-made and natural disasters' (Alan H. Kwok, 2016). The dichotomy exists between the relationship of 'society' and 'space' and the capacity of space to be transformed to enhance social resilience. In his seminal work 'Space, Territory and Territoriality', Claudé Raffestein argues that the usual misconception is that 'space' is considered 'the first material offered for human activity' that is constituted of both 'nature' and 'space' and all factors characterising it. It is both the 'original prison' and the 'derived prison' as 'societies' maintain 'relations' with 'space' and 'nature', that they constantly transform into territories given the constraints of culture (Raffestein, 2012). He argues that 'space' as a concept is not absolute and permanent. It is, in the affirmation of Einstein a 'construction' or an 'invention' that permits society to act in both material and immaterial realities. Thus, forming relations or an ensemble of relations between actors (society) and the material and/or immaterial reality, that is multiple, varied and changing based on the potentialities of this reality.

4.1 – **The Social Logic of Space:**

In his pioneering work 'The Social Logic of Space', Bill Hillier argues that the construction of material realities of man whether it be a cup, a bridge, or a building has a logic, and so far as they have a purpose, these material realities such as buildings are not just objects but transformation of space through objects or materials. As long as they are first of practical i.e. both functional and meaningful use they are primarily social use. The ordering of this space at an architectural and urban scale defines social relationships that have been formed over time. In addition, there is a social logic that precedes and determines the spatial configurations that orders societal relations. (Bill Hillier, 1984).

He further cogently argues that the ordering of space in and through buildings is the ordering of relations between people, i.e. it is a system of spatial relations between individuals, groups and societies. It is a process and an order that can be described in its 'genotype' of the pattern and the 'syntax' or the semiotics that facilitates them.

"In short, space is a function of the forms of social solidarity i.e. in turn a product of the structure of society"
(Bill Hillier, 1984)

By referring to the argument put forth by sociologist Durkheim, the author, Bill Hillier, distinguishes between two fundamental principles of social solidarity or cohesion: 'organic solidarity' based on interdependence through differences, such as those resulting from the division of labour; and 'mechanical solidarity' based on

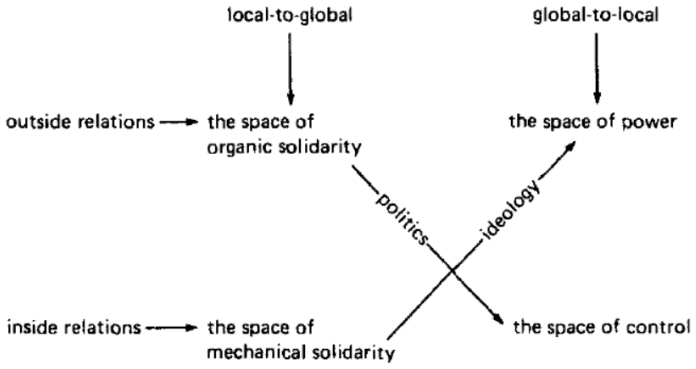

FIG. 4.1 Social Dynamics and Social Potential of Space: Source: The Social Logic of Space, Bill Hillier, 1984

integration through similarities of belief and group structure. These solidarities can further be described through spatial variables such that 'organic solidarity' prefers an integrated and dense space and 'mechanical solidarity' prefers a segregated and dispersed space. The description of these principles of social solidarity through the simplest spatial structure of 'the elementary cell' is argued as the 'social theory of space'. This 'elementary cell' that has an 'outside' and an 'inside' consisting of a boundary, has a sociological reference that determines spatial and social relations between the inhabitants, and between inhabitants and others. The growth of this cell whether by aggregation or by subdivision determines the formation of a settlement or a building respectively. While one is an elaboration of the sociology of the outside the other one is an elaboration of the sociology of the inside. The exterior (outside) has less control as settlement spaces, and tends to grow by accumulating boundaries; while building interiors (inside) are controlled and are more deterministic. The 'inside' defines a more ideological space, that is to say a fixed system of categories and relations continually re-affirmed by use, while the 'outside' defines a political space, that which constructs a more fluid system of encounters and avoidances which is constantly re-negotiated by use. To summarise, the exterior space is the one in which society is produced, such that new relations are generated and the interiors is that in which it is reproduced. The former has a high degree of indeterminacy and the latter is more structured. (Hillier, 1984)

The author, Bill Hillier, argues that another dimension i.e. the *local-to-global* and the *global-to-local* phenomenon further adds complexity to the relation of society with spatial form, that also determines the principles of social solidarity . This duality, of the interior: a space of ideology and the exterior: a space of transactional politics is only the case insofar as the system is considered as a *local-to-global phenomenon*, i.e. insofar as society constructs a global pattern from the inter-relations of the basic units (the cell). Insofar as society is also a global-to-local phenomenon, one set of spaces is produced whose purpose is to define an ideological landscape through its exterior and another set whose purpose is to produce and control a global politics through its interior. This distinction is followed by a second duality i.e. *more the system is run from a global-to-local logic the more the reverse logic prevails over the local-to-global logic (*Hillier,1984). Here, the distinctions between exterior and interior space becomes the distinction between power and control. Fundamental to the global-to-local system is the existence of inequalities, realised in the internal and external relations of buildings. Urban form aptly describes this duality. Villages, towns, and urban areas classically comprise of two dissimilar spatial components: the space of the street system, which is the theatre of everyday life and transactions, and the space of major public buildings and functions. The former creates a dense system, in which public space is defined by the buildings and their entrances and the latter a sparse system, in which space surrounds buildings with few entrances. The more the *global-to-local* phenomenon prevails, the more the town will be of the latter type while more the *local-to-global* phenomenon prevails it will be of the prior type.

In short, it is evident that basic social dynamics is articulated by the social potential of space, and space is a function of the forms of social solidarity, which is in turn the product of the structure of society. As such space has a social logic just as society has a spatial logic. (Hillier, 1984)

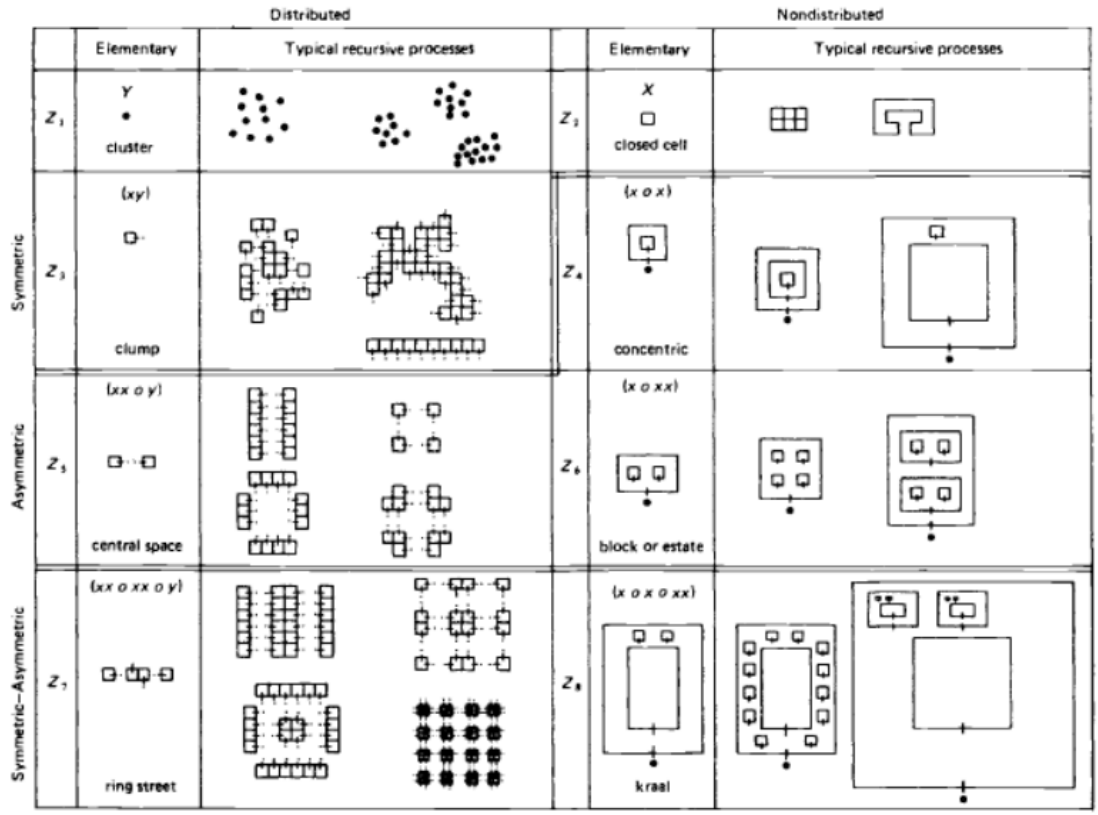

FIG. 4.2 Society and Logic of Space, spatial relations:
Source, The social logic of space: Bill Hillier, 1984

Society and the logic of space, spatial relations:
As previously argued human societies are spatial phenomenon, but they do not merely exist in space. Societies produce different spatial forms based on two fundamental ways: first, how space arranges people and locates them in relation to each other, that describes a greater or lesser degree of aggregation, separation generated by patterns of movement and encounter. Second, societies arrange space itself through the use of buildings, boundaries, paths, edges, markers, zones, such that it gathers a definite pattern (Hillier, 1984). To summarise, the arrangement of society in space determines the way in which it works and reproduces itself. The description of this arrangement forms the notion of a discrete system, where society is a discrete system transcending space such that global forms arise from individual behaviour or a local rule, i.e the local-to-global phenomenon. This description of society and its spatial arrangement forms principles of its knowability i.e. its syntax or the logic of space. The reduction of these relationships to the elementary structure through an ideographic language indicates how they are related to each other and how they may be combined to form more complex structures. The (fig 4.2) describes the typical recursive process that is generated by the elementary cell in distributed and non-distributed relations that are governed by plural or singular subjects as well as symmetric and asymmetric dimensions that realises the difference between relations of these subjects. These descriptions or spatial patterns, highlight the social dynamics articulated by the social potential of space. As such, the author concludes that

> "The more descriptions are symmetric the more will be a tendency to the integration of social categories (such as categories of inhabitant and stranger), while conversely the more they are asymmetric then the more there will be a tendency to the segregation of social categories. While the more descriptions are distributed then the more there will be a tendency towards the diffusion of spatial control, while non distributedness will indicate a tendency towards a unitary, subordinate control." (Hillier, 1984)

Thus space, spatial patterns together have a dialectic relationship with society where all social processes are realised in space.

Spatial Configurations:
In the latter publication by Bill HIllier 'Space is the machine', the author puts forth the concept of 'spatial configuration'. Spatial configuration describes the relation of space taking in account other relations to it. Meaning, urban form or buildings operate socially in two distinct ways: "they constitute the social organisation of everyday life as the spatial configurations of space in which we live and move, and represent social organisation as physical configurations of forms and elements that we see" (Hillier, 2007).

It is further argued that local physical changes in spatial systems have global configurational effects, i.e. the local-to-global spatial laws or phenomenon are linked to the evolution of urban form. Furthermore, space can be described in terms of two 'generic functions' of human use: occupation and movement; *Occupied space* is the static space where movement is localised within the occupied space, for e.g. a public square, on the other hand the *space of movement* is shaped by movement between or from in and out of *occupied space* (Hillier, 2007). Thus the 'generic function' is the first restriction between the field of possibility and architectural actuality. The second restriction is then the cultural or programmatic requirement

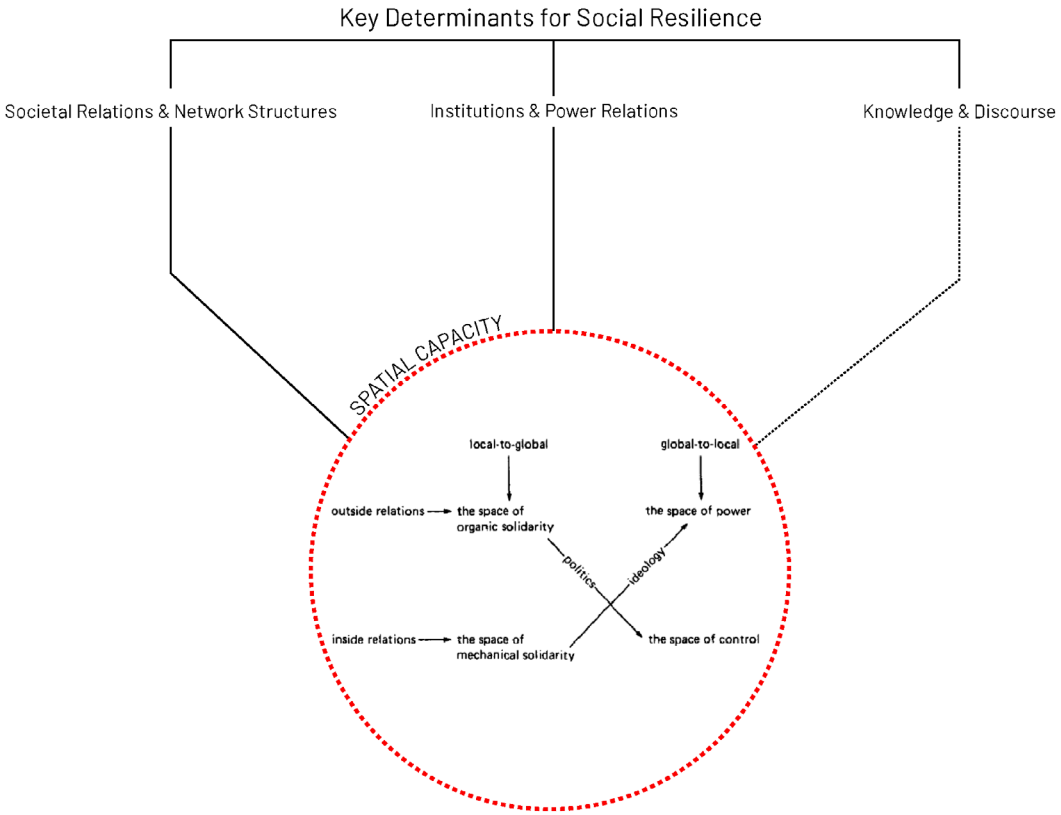

FIG. 4.3 Linking Spatial capacity and Social Resilience: The social logic of space: Bill Hillier, 1984

of that urban form. As such occupied space determines the functional restraint on space which is related to the through-movement potential of that space. Thus, the knowledge of generic function and its spatial implication is influenced by human functioning in space.

Linking Social Resilience and the Social Logic of Space

Towards a theory: fostering social resilience through space

"As space is a function of the forms of social solidarity i.e. in turn a product of the structure of society" (Hillier, 1984) it can be argued that space that is a 'construction' or action permits society to act in both material and immaterial realities. What then, is the capacity of space to foster social resilience? The key determinants that enable society to foster social resilience (i.e. the capacity of society to cope with external stress) such as societal relations, institutions and power relations play a vital role.

The capacity of space towards fostering social resilience clearly lies in the act of transformation, adaptation or change by society to enhance societal relations towards social solidarity, i.e. to say, the capacity of space to adapt or transform can be defined by the description of the principles of social solidarity (which are *the space of organic solidarity and the space of mechanical solidarity*) through the simplest spatial structure of the 'elementary cell'. The distinction between the 'outside' and 'inside' relations of this cell i.e. the exterior space in which society is produced, such that new relations are generated and the interiors in which it is reproduced based on the spatial laws of *local-to-global* and *global-to-local phenomenon* together determines the 'space of power' and the 'space of control' i.e. the ideological domain of space and the political domain of space respectively. The restriction on these spatial relations towards fostering social resilience by the 'elementary cell' is based on two 'generic functions' of human use of space that is, *occupation and movement*. This is the 'spatial configuration' or the relations of societal systems with space, or relations of space with society. Meaning, the operation of urban form or buildings towards fostering social resilience is embedded socially in two distinct ways: the social organisation of space as spatial configurations in which we live and move and the representation of these forms and elements in the way we see it. It can thus be inferred that the operations applied towards enhancing, or developing spatial relations based on movement and occupied space forms the elementary capacity of space to foster social resilience.

This theoretical framework helps in further defining the analysis. Through a methodology of design- research and research-by-design that further contributes to principles of design, which are established and tested, finally boiling down to the capacity of space to foster social resilience. The case of Dharavi forms an ideal test bed for these principles, as an informal settlement located in the heart of Mumbai that faces pressures of redevelopment, and since it also highlights social, and economic challenges and potentials.

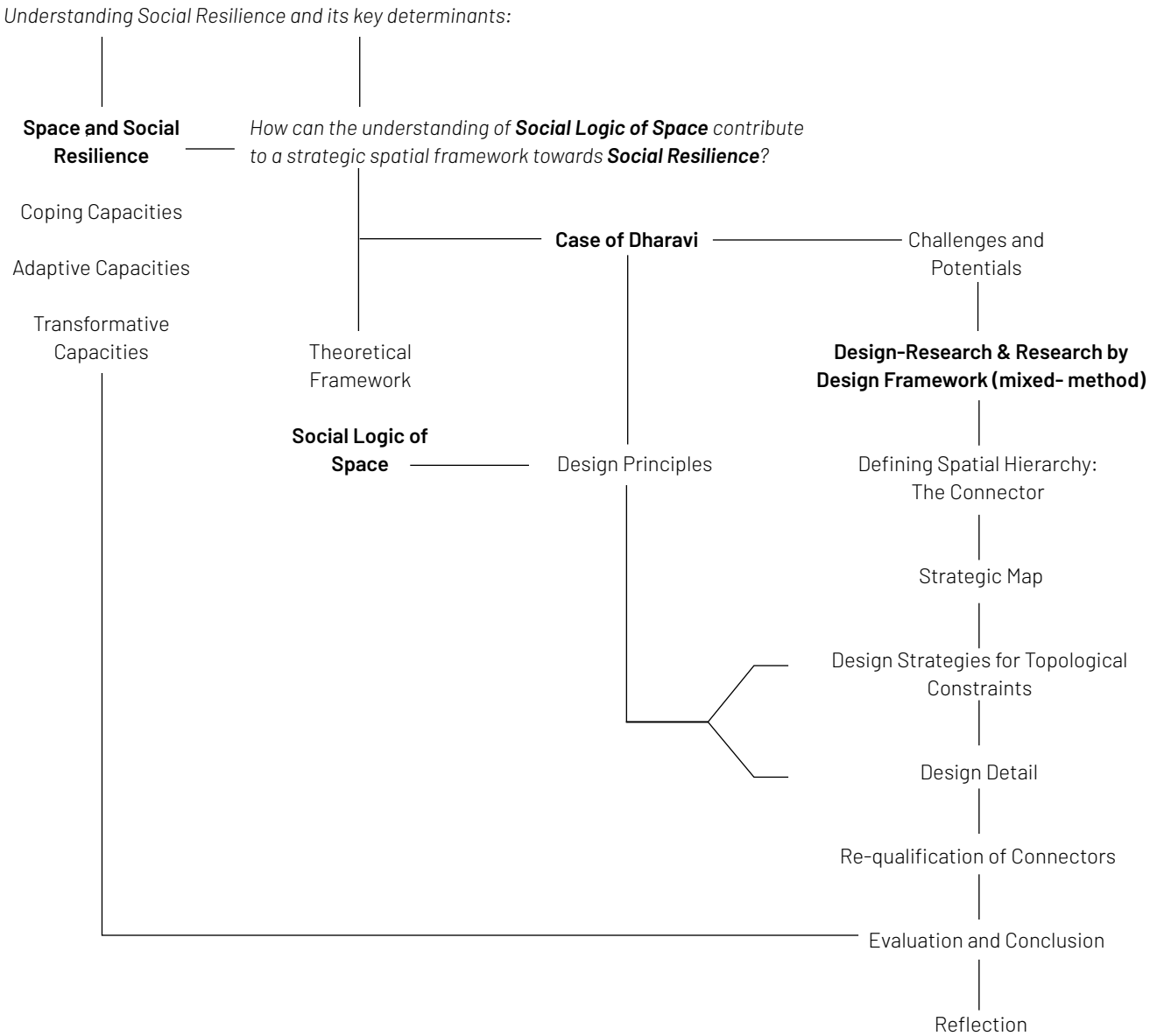

FIG. 4.4 Methodological Framework

5 – Methodological Framework:

The thesis focuses on spatial strategies to be derived towards fostering social resilience with the specific case of a vulnerable settlement, Dharavi, in the heart of Mumbai.

While social resilience highlights the capacity of people i.e. the coping, adaptive and transformative capacities of society to achieve resilience, the literature review does not provide a spatial understanding to achieve the same. Hence, the thesis explores the use of a theoretical framework supported by the *'Social Logic of Space'* as a means to foster social resilience, through the spatial principles of social solidarity. Furthermore, the case of Dharavi highlights challenges and potentials faced by the settlement located in the heart of Mumbai to achieve social resilience. The theoretical framework provides and describes principles of design that are considered as the basis for fostering social solidarity through space and time. In addition, the thesis explores a mixed method (design research & research-by-design) to analyse the spatial potentials: spatial hierarchy for Dharavi to achieve social solidarity within the larger context of the territory. The design strategies primarily focuses on alleviating topological constraints that Dharavi encounters under different spatial conditions. The principles derived for adaptive and transformative capacities of space to achieve social resilience for Dharavi are tested through a Design Detail. From the learnings gained ,the strategies are then applied to the new and re-qualified 'connectors' of Dharavi as a means to achieve re-qualification of spaces that define inside and outside relations of Dharavi, to produce a future scenario / vision, that will guide various stakeholders towards the formation of better integration. The proposed design of Dharavi is further evaluated through a Local Angular Integration analysis i.e. an analysis to comprehend the extent to which the aim of achieving social solidarity (enhancing social encounters or integration) is realised. Finally, the conclusions are further reflected back into the theoretical framework.

6 – Limitations and Scope:

Although, the thesis begins and confronts floods and flood risk as a pressure it does not completely address the issues related to exposure to the hazard since it would need a larger time-frame, further understanding and a theoretical framework that encompasses socio-ecological processes. Instead the thesis focuses on a particular theoretical framework, i.e. *'the social logic of space'* to address the constraints encountered towards fostering social solidarity. As social solidarity, is based on the local-to-global and global-to-local spatial law of urban configurations, scale has a particular association in the reading and understanding of the context and determining the relationship of the space of power and space of control,as there is yet a lack of knowledge on the relationship between social resilience, scale and place, the thesis limits the scope to the context of Dharavi and its relationship to the surrounding territory, The thesis primarily delves into the capacity of space, that is, the constraints on topological relations that Dharavi must overcome towards enabling social cohesion.

7 – Societal and Scientific Relevance:

World Global Risks report 2018 considers extreme weather events and natural hazards as a major disaster towards risk perception (WEF, 2018) . Today, vast urbanised regions face similar issues to confront with, such as natural and man-made hazards, whether it is floods, flood risk, fires, ethnic riots and conflicts. While disaster relief mechanisms are constantly being developed, by state and local authorities, present insights and various scenarios developed on the consequences of environmental hazards do give an understanding of the spatial, economic, environmental and social consequences of disasters. As a socially-constructed phenomenon disaster recovery of the environment is a socially configured process and hence disaster planning as well as urban planning processes should consider the relationship between society and space and the capacity of space to enhance societal relations against various disturbances. The question of societal robustness is useful not only in the case of disasters but also to achieve greater public life, security, safety, and integration within societies as a whole through spatial accessibility. It encompasses a larger domain of equity and accessibility as such the idea of 'the commons'.

The aspect of space, being the epicentre for the production of societal relations is vast yet specific when seen under the purview of the context, here Dharavi. The aim to develop a strategic spatial framework towards fostering social resilience with the concentration on the development of a sound theoretical and a methodological framework is relevant in the application to contexts faced with similar pressures and disturbances (man-made and natural). Although, further research on adoption of spatial planning strategies is yet needed, especially in the cases that lack institutional capacities, changing land and resource rights and administration. In such cases the reliance on space and social capital is of primary importance. As this thesis is a first and could be said elementary attempt in understanding the spatial domain of social resilience, it does get the ball rolling in the direction of research outlooks towards the relationship between social resilience and the spatial capacity to foster it. This thesis opens a discussion and a plethora of questions on the capacity of society to foster social resilience not only in the scientific but also in the societal realm.

Dharavi Shelters, Mumbai, Source http://www.allindiatravelinfo.com

PART 2: The Case of Dharavi, Mumbai

Dharavi's Description | Spatial Hierarchy | Design Strategy |

Dharavi Location

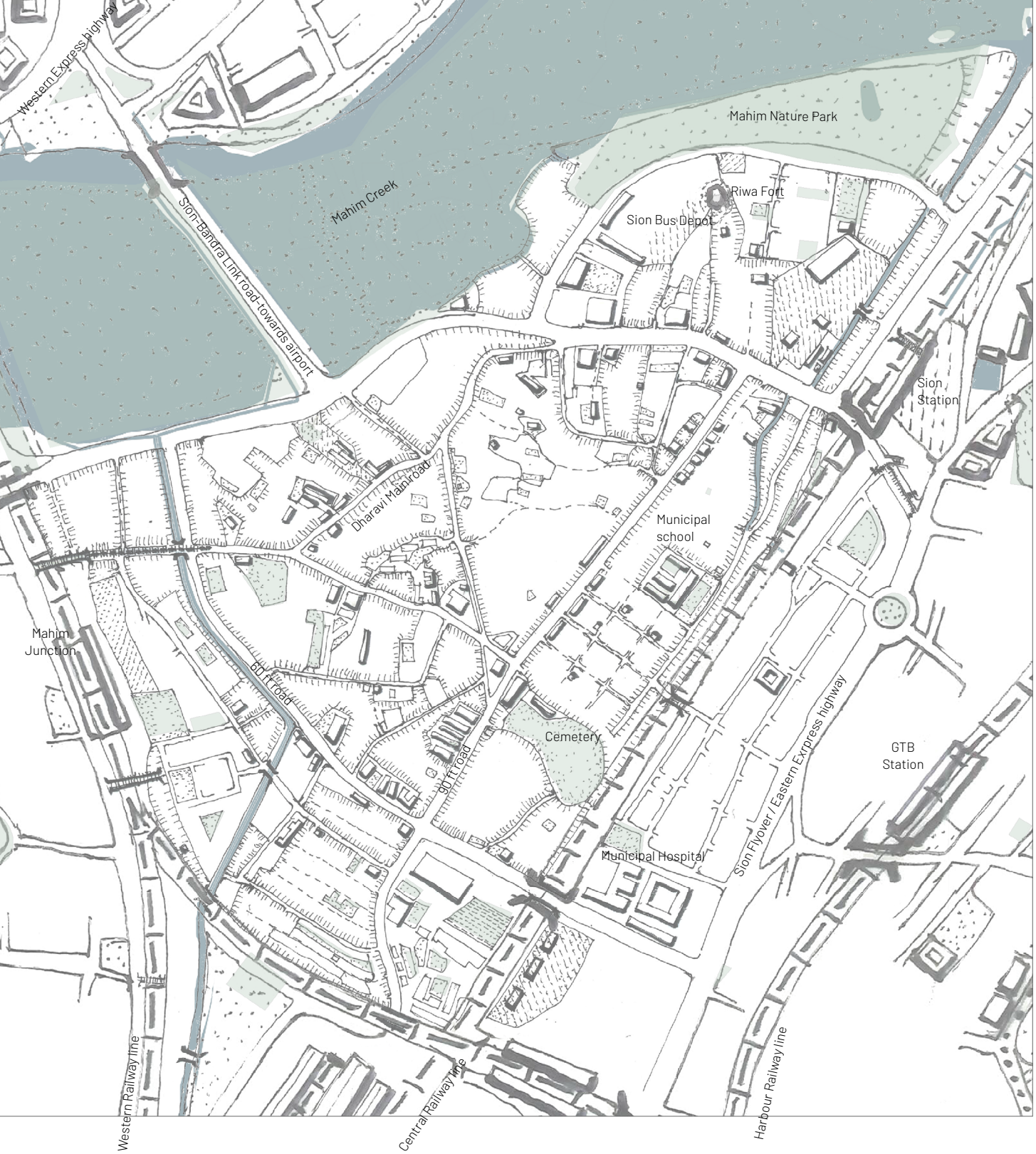

FIG. 7.1 Dharavi : An introduction

8 – Dharavi's Description

Introduction:

Slums or informal settlements such as Dharavi represent a spatiality that is both cultural and economical (Nijman,2010). These slums lack accessibility to amenities such as health infrastructure, water and sanitation, community infrastructure, public spaces, educational facilities that are important attributes to be dealt with for the development of social resilience.

Prior to 1900's, Mumbai was confined to the area below the Mahim creek, known as the ' Island city'. Dharavi, in the early 19th century, was then an area inhabited by fishermen, the *Kolis* and was one of the *Koliwadas* (fishing community). In the late 19th century settlers from different parts of India who carried their trades, professions, customs, and traditions settled in Dharavi: in working, industrial clusters. Dharavi was then the urban fringe. Migrants such as the Muslim tanners from Tamil Nadu, *Kumbhars* or potters from Gujarat first settled over here. Dharavi became an area that combined work and living. Post Independence, as rural-urban migration increased it became an ideal location for immigrants , as it was located close to the Island City. In 1970's growing concerns of health led to larger polluting industries being relocated away from the central location of Mumbai. Due to the city's expansion to the north and north-east, Dharavi which spans 535 acres and has a population density of nearly 869,565 people per square mile (Aneerudha Paul, 2010) is now strategically located on geographically and economically valuable land between two railway infrastructures: the Western Railway line and the Central Railway line that connects the Island city of Mumbai with the districts in Mumbai and the larger Metropolitan Region of Mumbai. To the North it shares an edge with the Mahim creek. It is adjacent to the new Bandra-Kurla complex, a Special Economic Zone (across the Mahim creek) and is 8km away from the airport. Dharavi is bound by the railway infrastructure on two sides and the Mahim creek on the third. At present, Dharavi a densely inhabited, historic, unplanned settlement, houses an estimated 67 communities (Nijman, 2010) with immigrants from TamilNadu, other parts of Maharashtra, Gujarat, Karnataka, Kerala and Uttar Pradesh.

FIG. 8.1 Dharavi Location, Source: google earth

Dharavi, constructed on land reclaimed by its inhabitants is located at the mouth of the Mithi river and is vulnerable due to exposure to pluvial flooding and sea level rise. Apart from this in 2013 Dharavi was also engulfed by fire causing damage as 8 godowns were burnt, causing heavy loss of economic goods, this also affected nearby people. (Express, The Indian Express, 2013). Although, Dharavi did not have as much loss of human life as the rest of Mumbai in the 1992-93 riots it did see acts of violence. Also, since on economically valuable land it faces redevelopment pressures that neglect community aspects of living. Here, Dharavi forms an ideal case for the description of social, economic, and development pressures along with potentials and challenges in spatial configurations or topological constraints that it must overcome in order to move towards social resilience.

Source: https://flickr.com

Source: https://www.domusweb.it

Source: REDHARAVI / UDRI,Urbz

Source: REDHARAVI / UDRI,Urbz

Source: REDHARAVI / UDRI,Urbz

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Source:REDHARAVI / UDRI,Urbz

Source: https://flickr.com

Source: REDHARAVI / UDRI,Urbz

Source: REDHARAVI / UDRI,Urbz

FIG. 8.2 Dharavi: Nolli Map, Data Source: sP+a & URBZ, REDHARAVI, OSM, Drawn by author

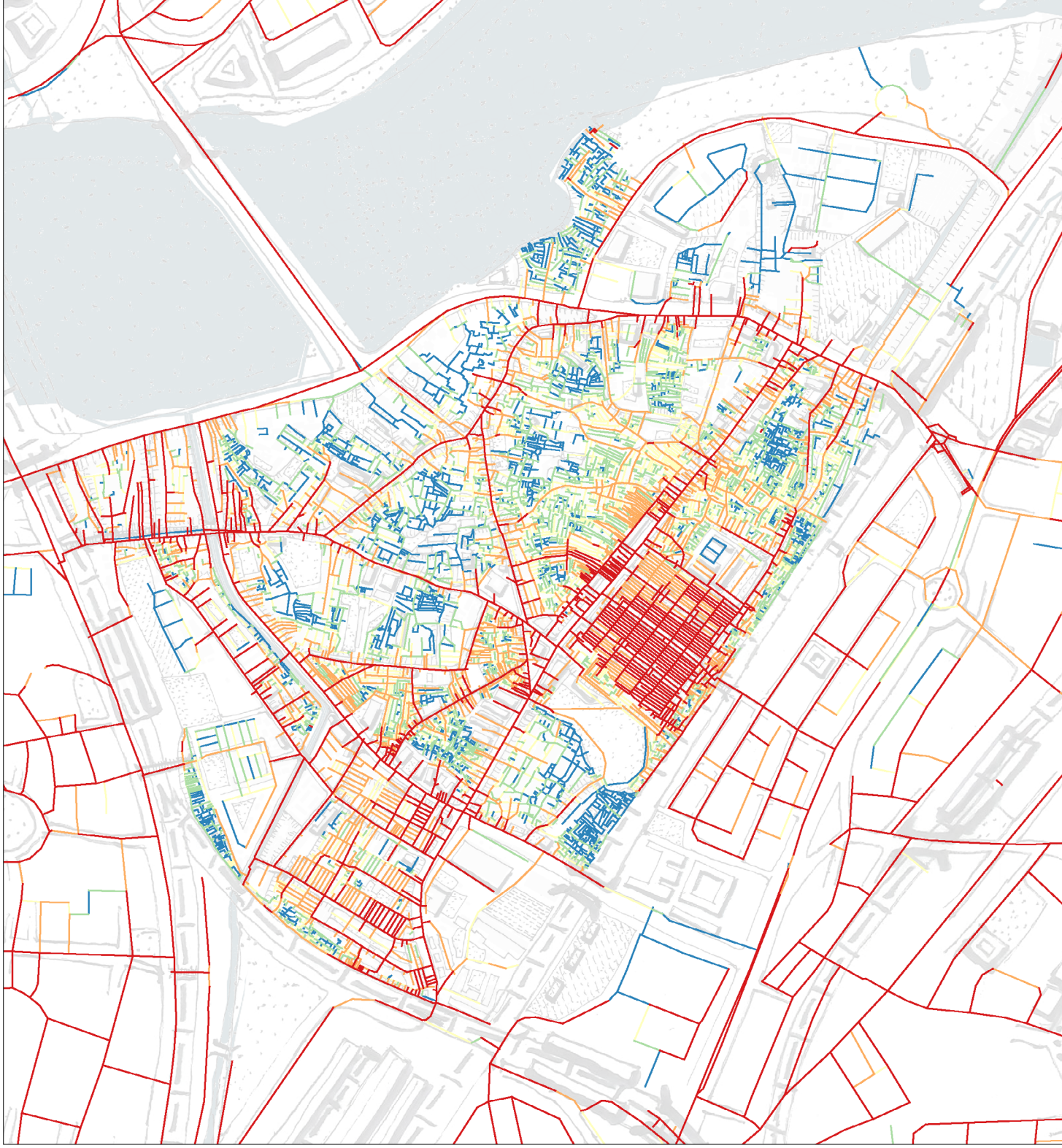


FIG. 8.3 Dharavi: Local Segment Angular Integration_500m radius: , Data Source: sP+a & URBZ, REDHARAVI,OSM. Drawn by author

8.1 – **Dharavi's Inside Relations**

The spatial patterns of Dharavi (fig:8.2)are the result of the organic growth, constructed by its inhabitants. It is a function of cultural origins that was carried by the various immigrants who came to Dharavi through the years. The clustering of industries, residential, work, commercial and public life has together formed today's Dharavi. The main arteries i.e. the 60ft road and 90ft road connect of Dharavi from within, with the rest of Mumbai. The arteries are wide and cut through Dharavi providing external access to commercial and industrial activities. The arteries are aligned with shops, kiosks, retail , restaurants, food sellers, hawkers, taxis, cars, transport trucks. The spaces carry heavy vehicular traffic such as buses, cars, bikes, trucks. Besides, this Dharavi Main Road runs through the heart that hosts similar activities but at a smaller and more intimate scale. These spaces together form the spaces where public life unfolds and are defined by the buildings and entrances adjacent to them. The spaces define the 'outside relation' of Dharavi, where people are constantly moving, many of whom are not from Dharavi itself. Here the stranger or visitor does not realise the presence of life on the 'backside' of this highly active space. It is the space where a 'visitor' is no more a 'stranger'. This space reveals high-integration where the chances for social encounter are high, that is to say a political space which constructs a fluid system of encounters and avoidances, constantly re-negotiated by use. The inside areas or the 'backside' of Dharavi reveals a completely different profile. These areas are partly residential (work-living), the streets are narrower and do not allow for much traffic: vehicular and people movement. It is an intimate scale with slow activities carried in it such as storage of goods, pottery work, drying of food articles, smaller courtyards. The narrow streets means more shade, and less noise. But here, social control of the spaces is evident, the visitor or outsider is easily recognised while behaviours are more routine and coded. Moving into the inner core of Dharavi reveals a distinction in behaviour, exterior from interior, accessible spaces from inaccessible spaces and from public to private.

When The Local Segment Angular Integration of Dharavi (fig:8.3). i.e the measurement of how close each segment is to all others in terms of the sum of angular changes that are made on each route is read along with the Nolli map (fig.8.2) , reveals the gradient of this social life. The red lines indicate the space along which the chances for social encounter: public life, outside relations, accessibility is highest within a local walking radius of 500m, as such integrated spaces, but lacks open space. It also corresponds to spatial configurations with highest local functional diversity such as commercial shops, retail outlets, and the location of public amenities: schools, kindergartens. The blue lines indicates spaces with least chance of social encounter: private life, interior and inaccessible areas as such segregated spaces. Here, certain spaces remain sealed from public life such as open grounds, redundant spaces and the inner areas of Dharavi.

Further, analysis of the relationship of these spaces of integration and segregation within the spatial configurations of Dharavi, highlights spatial potentials and challenges that Dharavi can take advantage of and in turn enhance social life.

Source: REDHARAVI / UDRI,Urbz

Source: REDHARAVI / UDRI,Urbz

Source: REDHARAVI / UDRI,Urbz

Source: REDHARAVI / UDRI,Urbz

Recycling, Source: REDHARAVI / UDRI,UrBz

Recycling Source: REDHARAVI / UDRI,UrBz

Pottery, Source: REDHARAVI / UDRI,UrBz

Embroidery, Source: REDHARAVI / UDRI,UrBz

Retail: Source: REDHARAVI / UDRI,UrBz

Local Business: Source: REDHARAVI / UDRI,UrBz

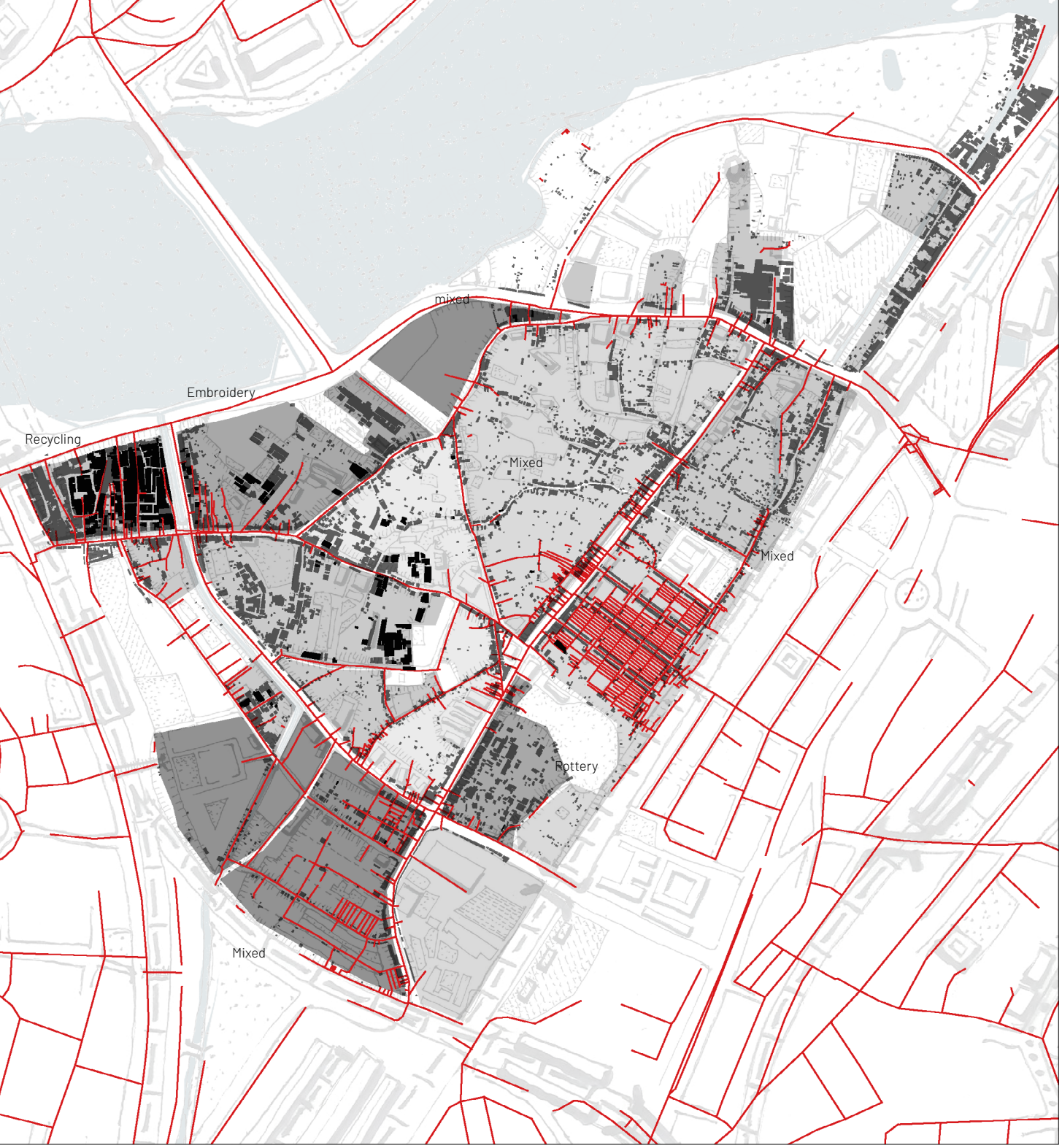


FIG. 8.4 Economic Structure and clustering in Dharavi with industries black and commercial activities grey. The tone of light greys below indicates intensity of production. Data Source: REDHARAVI, sP+a & URBZ, OSM , Drawn by author

0 250 500 750 1000 m

8.1.1 – **Economic Structure and Clusters**

Dharavi is highly entrepreneurial and has been since the settlers reclaimed land to form guilds of varying professions. With people migrating from different parts of the country to seek job during the colonial era, Dharavi formed an ideal location for settlers that helped Mumbai grow to what it is today (Aneerudha Paul,2010). The nature of work varies from leather tanning, pottery, textile, mixed industries such as food processing, recycling and so on. A publication by REDHARAVI estimates a daily turnover of 500 million (Aneerudha Paul,2010) and a high employment rate of nearly 80% (Nijman, 2014). The report by REDHARAVI also highlights a diverse socio-economic profile that generates high employability, where every third house seems to have a sort of economic activity within. There are almost 1700 enterprises in Dharavi that depend on its location . For e.g. the recycling industry relies heavily on the connections the place has to offer with the rest of Mumbai. The so called nature of this 'informal settlement' relies heavily on the relationship with the 'formal city' of Mumbai (Nijman,2010).

Dharavi's economic activities (different industries) is carried out in clusters, whether it be pottery, recycling, leather work and mixed industries such as food processing, embroidery etc. The high economic and industrial activities of Dharavi are mainly carried out in areas that are more exclusive, especially the highly polluted industries, for e.g. the north-west cluster is an industrial cluster with recycling activities (fig.8.4) another example is the pottery industry located in south-east corner, but this is relatively small in size and scale of production. The areas with high industrial activities usually have wider streets, allowing for trucks to bring in goods and services. These areas are also intimate allowing for fewer people/ visitors to pass through them unless there is a business activity. As such these areas are polluted and segregated. The other small scale work-living spaces such as embroidery, food processing are carried out in intimate spaces allowing for less through-movement, less visitors and social encounters to occur: interior, segregated spaces. The areas that do provide higher through-movement, although in the backside of Dharavi are lined with local economic activities on the ground floor such as salons, restaurants, retail etc. with the work-living space on the upper floors. The areas with highest economic activity are located on the exteriors of Dharavi where there is high through-movement, high diversity of spatial functions, and where visitors are not identified as strangers. These spaces for eg. along 60ft road, 90 ft road as explained before are lined with kiosks, public amenities, taxis, and as such have high diversity in occupied space. These spaces are highlighted by the red lines, that represent high local integration.

The location of Dharavi and the presence of a diverse and innovative economy, ranging from small scale to large scale activity described by varied spatial relations does highlight high reliance on people - place connections for economic sustenance and the spatial relations that the settlement has formed: ranging from private to public, integrated to segregated, and accessible to inaccessible. Although faced with issues such as pollution, and segregated spaces; people-place connections in Dharavi proves to be another important attribute for fostering social resilience, but some of the issues needs to be ameliorated towards enhancing social life.

Tamil residents of Mumbai's Dharavi slum celebrate Pongal. Source: /www.hindustantimes.com

Local event, at a temple. Source: Google street images

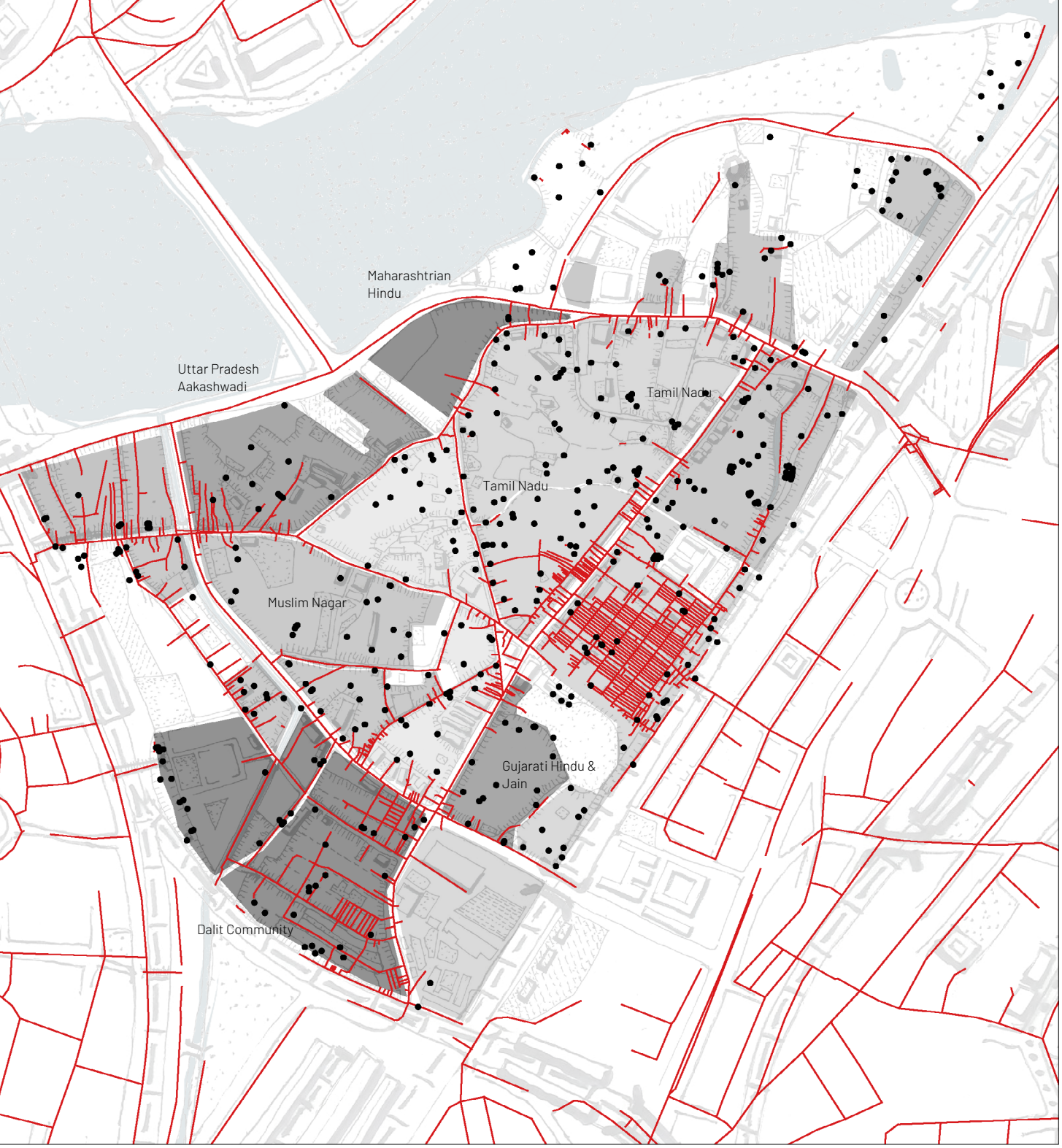


FIG. 8.5 Religious points & Social Structure of Dharavi, Data Source: sP+a & URBZ, REDHARAVI,OSM Drawn by author

8.1.2 – **Social Structure and clusters**

Apart from being a highly diverse and innovative economy Dharavi also relies on social networks and structures for its sustenance. As a society Dharavi is divided or organised on the basis of ethnic groups. Ethnic groups that tend to cluster based on occupation, religious background and places of migration. As described by Jan Nijman in 'Study of slums in Mumbai' there are estimated 67 communities that live in Dharavi. With immigrants from various states of India: Tamil Nadu (Muslims from Tirunvelli district), other areas of Maharashtra, Gujarat, Kerala and Uttar Pradesh. Apart from this there are 27 temples, 11 mosques, 6 churches (Nijman,2010). The spatial pattern and relations formed by these clusters are a function of cultural origins based on economic and social profile together. fig.....

The location of temples and religious structures along the spaces of high integration represents a society that invests in spaces of territorial control (fig.8.5)ǁ. As understood from a global-to-local phenomenon , they are the spaces whose purpose is to define an ideological and political landscape through its exterior: space of power. The streets running along these religious spaces have high integration, i.e the space where ceremonies, marriages, and rituals take place of the society.

In the arguments put forth by Jan Nijman in 'Study of Mumbai Slums' through the case of Dharavi he argues that slums or informal settlements in India do not follow the western logic of segregation i.e they are neither *enclaves, ghettos or exclusionary enclaves* but they are areas with high social control. That is, the communities within slums are 'gated communities', meaning the territories are marked and traffic is controlled with limited number of entrances. The high ethnic concentration and segregation is a result due to competition for space. As such, this determines high social control on spaces (Nijman,2010). While clustering seems viable and an important act in the competition of limited space, it does have negative consequences too. The clustering of Dharavi's Dalit group into a closed community is predominantly because of the social stigma attached with the caste based hierarchy in India. According to a research done by Kaiwan Munshi "Caste plays a role at every stage of an Indian's economic life; in school, university, the labour, market, and into old age. The influence of caste extends beyond private economic activity into the public sphere, where caste politics determines access to public resources" (Munshi, 2016). This argument can also be said to be true for other acts of segregation seen in society based on religion and ethnicity. The map .....indicates that areas within most of the clusters within are isolated and lack integration.

While the diverse set of activities does show limited social cohesion on the highly integrated edges of these clusters, the stress of economic and social activity or the space for social encounters to occur on limited space is a challenge Dharavi faces in its goal towards fostering social resilience. Apart from this the presence of temples as symbols for territorial occupation, by various ethnic groups is evident at the edges of these clusters. Although, they are social spaces they are also symbols of power and control representing the ideological and political landscape. The past riots of 1992-1993 that took place between ethnic groups raises another idealogical and spatial question towards formation of community bonds, and social solidarity between the various communities in Dharavi, and thus a challenge and need for existing social ties to be enhanced and new social ties to be fostered through space.

Dharavi Cluster & SRA ,Source: https://indianexpress.com,

A recipe for vertical slum, Source: http://theperfectslum.blogspot.com

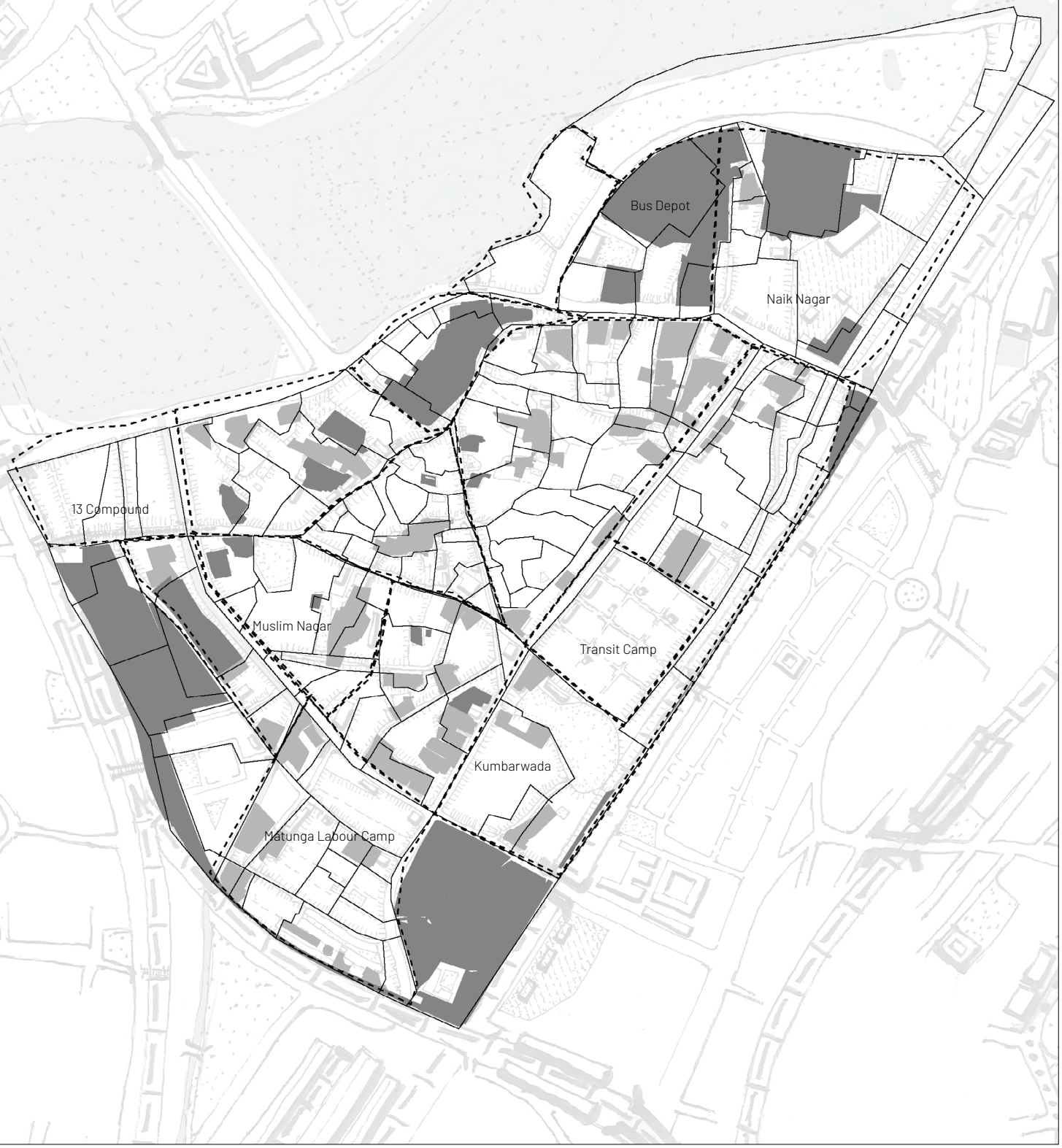
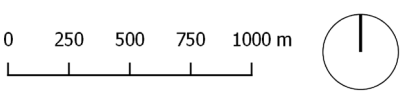


FIG. 8.6 Governance Structure Dharavi, Dark grey- private ownership, light grey -SRA (Slum Rehabilitation Association schemes). solid black line- Nagar Co-operative boundaries, black dotted line Sector boundaries by DRA. Data Source: REDHARAVI, sP+a & URBZ, OSM, Drawn by: author



8.1.3 – **Dharavi Governance Structure and Stakeholders**

Pressures and Problems towards Dharavi's Redevelopment

On account of its location in the heart of the city, Dharavi has high geographical value. It is a highly contested and valued space (Benita, 2014). Although it is an informal settlement with poor sanitation and health facilities, it does not imply that the only way moving ahead would mean complete erasure of the social and economic fabric that is evident within Dharavi. Author Jan Nijman argues that while the informal urban areas within India present a problem to traditional urban planning strategies, they form an underlying part of India's urban structure. He further states that the so-called "slum-dwellers identity is a communal identity and is place-based" (Nijman,2015). Post neo- liberalisation of India's economy (1980's) India's redevelopment schemes have primarily evolved from a state-sponsored scheme to a market driven scheme, adding further stress on this highly valuable land. Dharavi has gone through various redevelopment schemes. Offlate the state has appointed Dharavi Redevelopment Authority (DRA) for the improvement of the informal settlement. The scheme suggested would provide a high FSI of 4.0 for rehabilitation of eligible slum dwellers (Times, 2016).

The past redevelopment schemes have proven ineffective. In a recent study done by the MMRDA (Mumbai Metropolitan Regional Development Authority) on similar situations of redevelopment schemes around, it was found that poor ventilation, lighting conditions , maintenance and sanitation facilities in these redevelopment projects had led to high rate of persons infected with TB. One in 10 households had a member suffering from TB (Shantha, 2018). Since, Dharavi is a reclaimed land, also considered a 'No-man's land' 76% of the land belongs to the MCGM (Municipal Corporation of Greater Mumbai) and as such land ownership rights are not with the inhabitants.

This is another challenge Dharavi must overcome. Since, social resilience refers to people's ability to access assets and assistance from the wider socio-political arena to improve their individual welfare as well as societal robustness to future crisis, the future for Dharavi in fostering social resilience is related to the accessibility and entitlement of land to the communities as well the possible alteration of spatial configurations needed between the redevelopment schemes and Dharavi's communities.

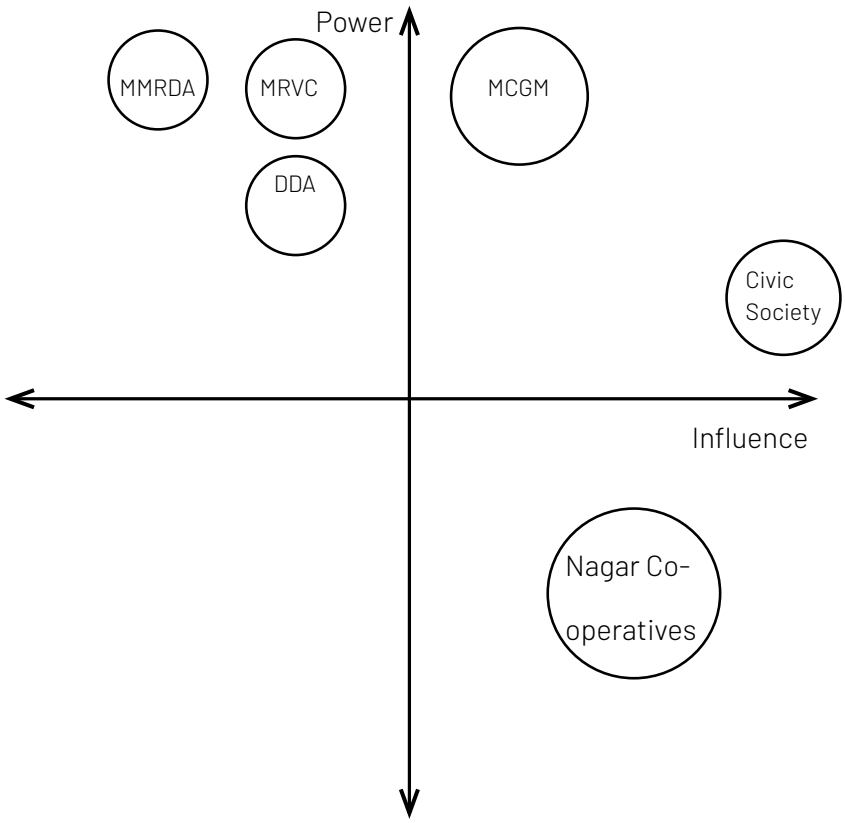


FIG. 8.7 Power And influence, Drawn by Author

Dharavi Stakeholders and their responsibilities:

Public:

- Nagar Co-operatives: Representative of inhabitants
- MCGM: Land ownership -76%
- DRA: Responsible for redevelopment of Dharavi's infrastructure
- Slum Rehabilitation Association: Responsible for resettlement of inhabitants
- Railway Authority / Central Railways of India

Private Enterprises

Civic:

- SPARC (Society for the promotion of Area resource centre) ,: NGO working on housing and infrastructure issues for the urban poor.
- Urbz: Self building initiatives within Dharavi, the Tool house- a strategy that looks at housing based on self-building and on the relevant economic activity within the household

FIG. 8.8 Cluster 1

FIG. 8.9 Cluster 2

FIG. 8.10 Cluster 3

FIG. 8.11 Cluster 4

FIG. 8.12 Cluster 5

FIG. 8.13 Cluster 6

FIG. 8.14 Cluster 7

FIG. 8.15 Cluster 8

FIG. 8.16 Cluster 9

8.2 – **Dharavi's socio-economic clusters**

Spatial relations: synthesis

As argued, Dharavi is organised into clusters based on of socio-economic profiles of various communities. Here, economic activities are often closely related to ethnic identities and thus form a highly localised milieux of cultural identities. For e.g. the leather tanners are Muslims from Tamil Nadu, potters hail from Gujarat etc. The variety of clusters, highlights a variety of spatial patterns that encompass the spatial logic of each cluster, i.e. to say the social logic of each cluster too. Each cluster highlights a different spatial relationship,and as such a different spatial configuration. The Local Segment Angular Integration (fig:8.2) along with the Nolli Map (fig 8.3) analysis reveals that there is certainly a gradient of spaces for social encounters, accessibility, public to private relationships maintained by each cluster. The differences have a strong correspondence with the various socio-economic clusters. Larger industrial clusters with high economic activity have a high local integration from within and towards the outside (Fig:8.8). While It is seen that some clusters tend to be integrated from within, others lack integration from within, but have integration towards the outside (8.14, 8.15, 8.9,8.13). Especially the clusters where the dependency of economic and social activity is towards the outside.

The relationship to the private developments, SRA scheme redevelopments (Fig. 8.13 , 8.16) also reveals a deformation or *spatial barrier* in the spatial logic of the settlement from within. These spatial relations are at times non-distributed, distributed, asymmetric-symmetric within the local-to global spatial laws of symmetric distributed and asymmetric distributed relations. As such undermining the social solidarity of Dharavi. These are the topological constraints (ie the constraints on through-movement and spatial relations of occupied space). These spatial barriers are also observed in the case of certain occupied space: public amenities such as schools, minor hospitals, sports facilities, etc. that have the potential for their convex spaces (open space) to be incorporated into the fabric (fig.8.11 & 8.14). Apart from this the gradient reveals a spatial relationship of clusters to the various edges, such as the edge towards the waterfront, edge towards the railway line front, edge towards canals and pipelines. It is observed that the spatial relations with the various edges towards infrastructures: water, railways tend to have a negative effect where the spaces towards the edge become segregated, inaccessible and at times are asymmetric, distributed (Fig. 8.5 ,8.9). This poses an opportunity and a challenge for transformation, adaptation in spatial relations to the edges, spatial barriers, and constraints. Hence, the potential to form better outside relations with the spatial fabric of the settlement.

Thus, it can be summarised that Dharavi maintains an existing spatial relationship based on the gradient of through-movement and its relation to occupied space. That is Dharavi's *local-to-global* logic of space. This reading provides a potential social logic of space that Dharavi can aspire towards. By overcoming barriers, constraints, and creating new spatial relations Dharavi can certainly move towards creating spaces for social encounter to occur .fostering societal integration.

High integration

Medium integration

low integration

Data source: REDHARAVI, OSM,
Drawn by: author,

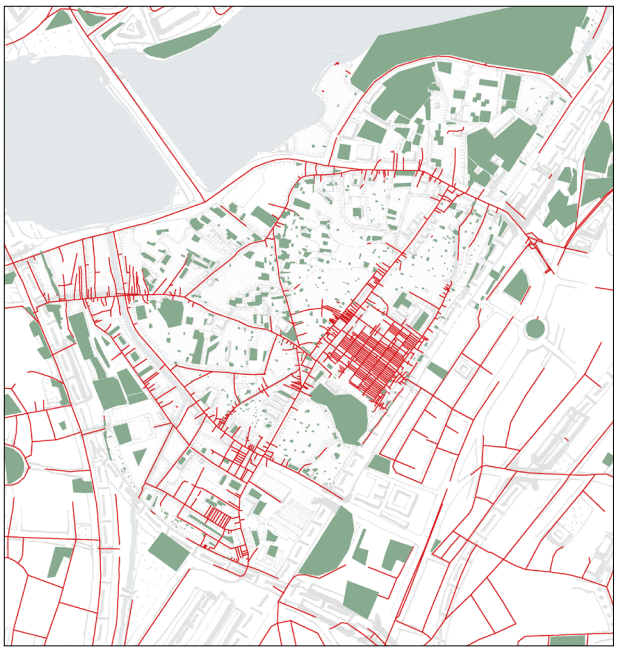


FIG. 8.17 Social hotspots : attraction distance: Open Spaces: 250m_ Natural Breaks

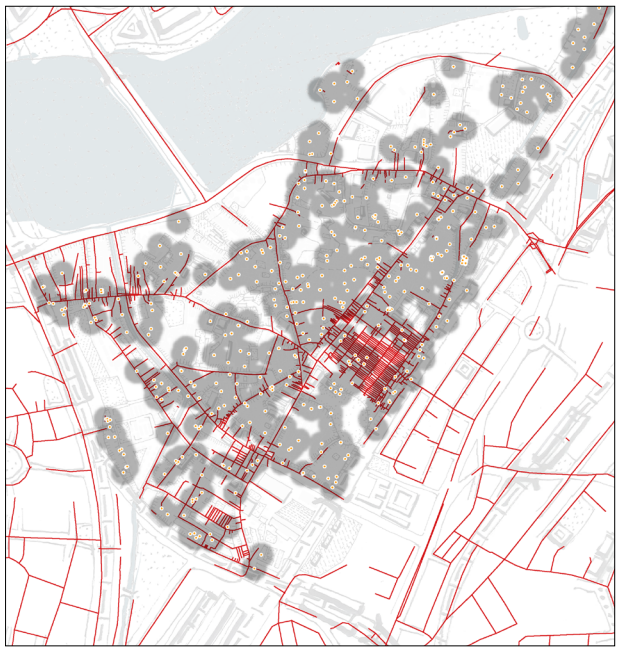


FIG. 8.18 Social hotspots :Attraction Distance: Temples: 250m_ Natural Breaks

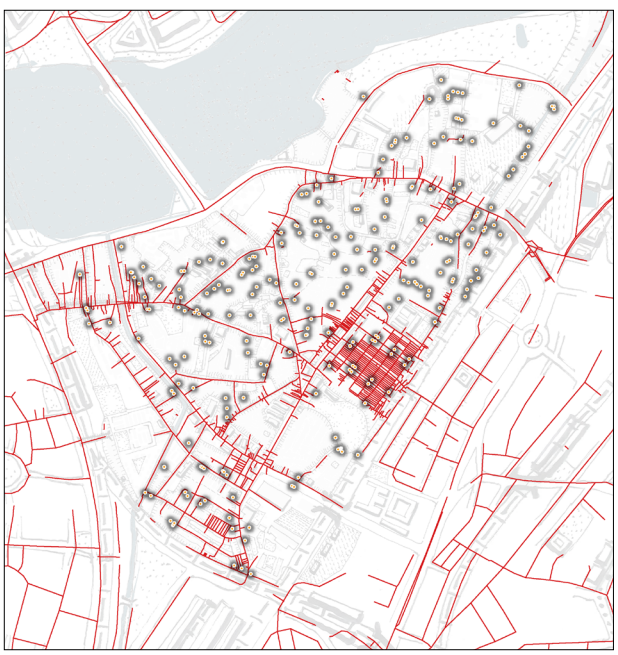


FIG. 8.19 Social hotspots: Attraction Distance: Toilets: 50m_ Natural Breaks

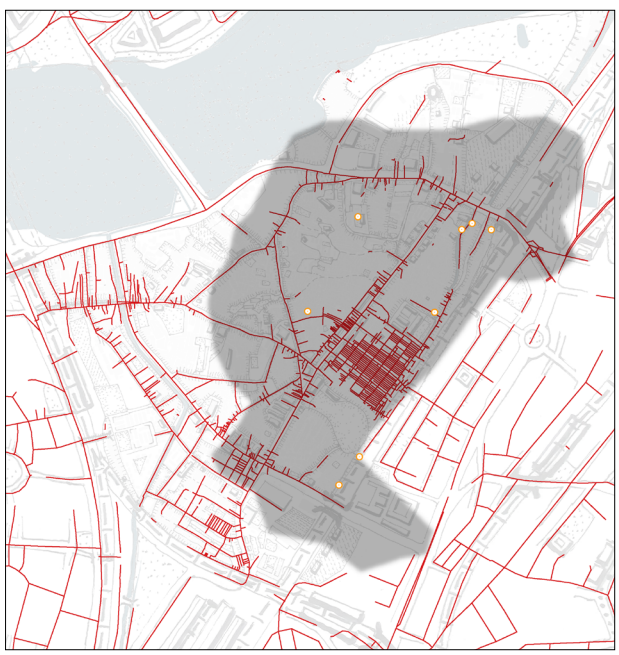


FIG. 8.20 Social Hotspots: Attraction Distance: Mandals/Community Centres: 1500m_ Natural Breaks

Dharavi's, accessiblity to Social, Health, Education Transportation, and Governance Facilities:

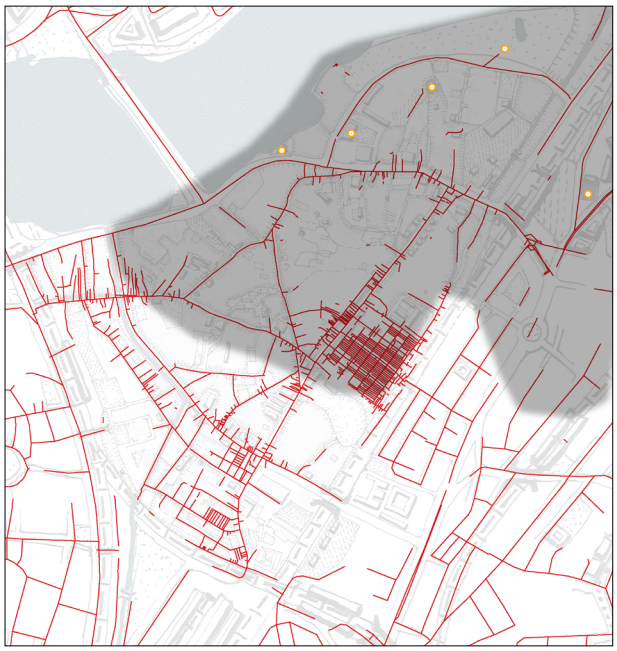


FIG. 8.21 Social Hotspot: Attraction Distance: Recreation parks and Fort, Landmarks: 1500m_ Natural Breaks

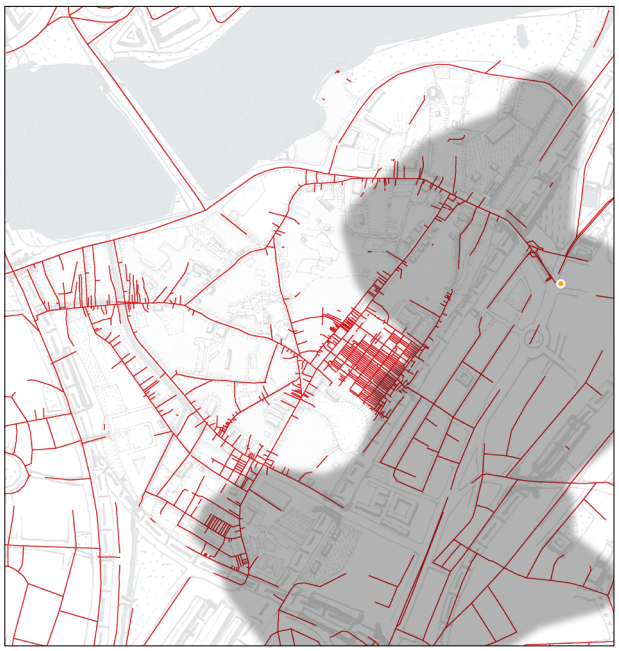


FIG. 8.22 Social hotspot: Attraction Distance: Municipal Markets: 1500m_ Natural Breaks

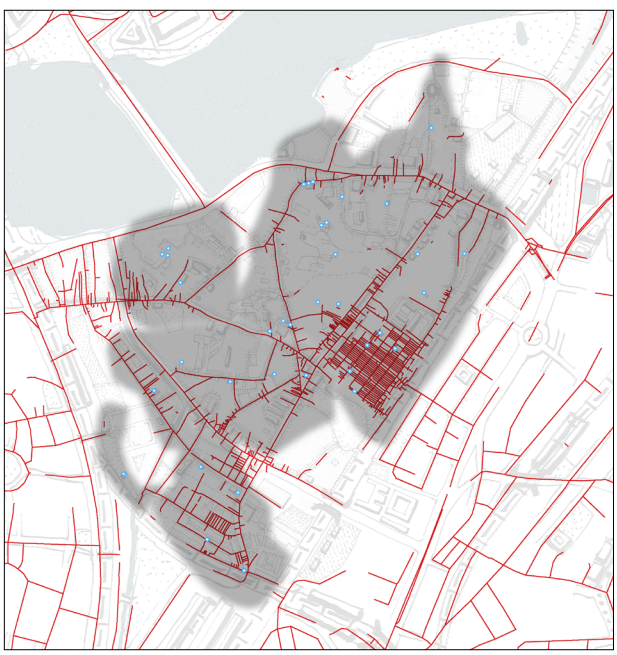


FIG. 8.23 Educational Hotspot: Balwadi/ kindergarten: 1500m_ Natural Breaks

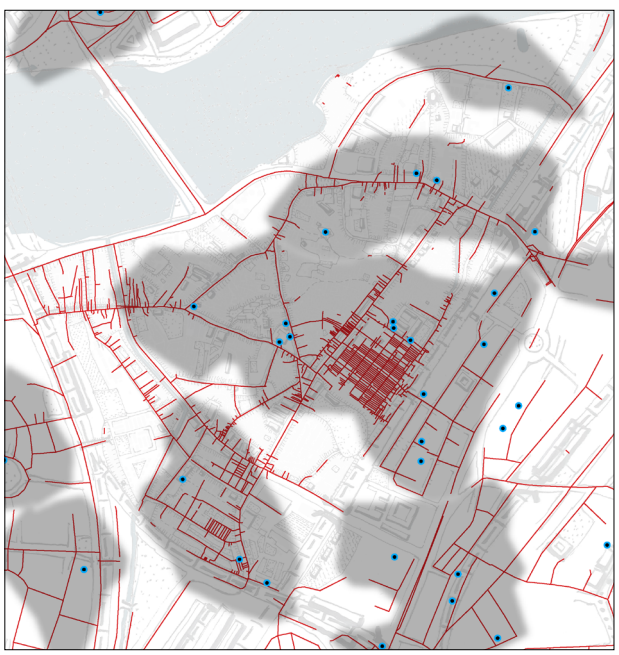


FIG. 8.24 Educational Hotspot:Primary/ secondary Schools: 1500m_ Natural Breaks

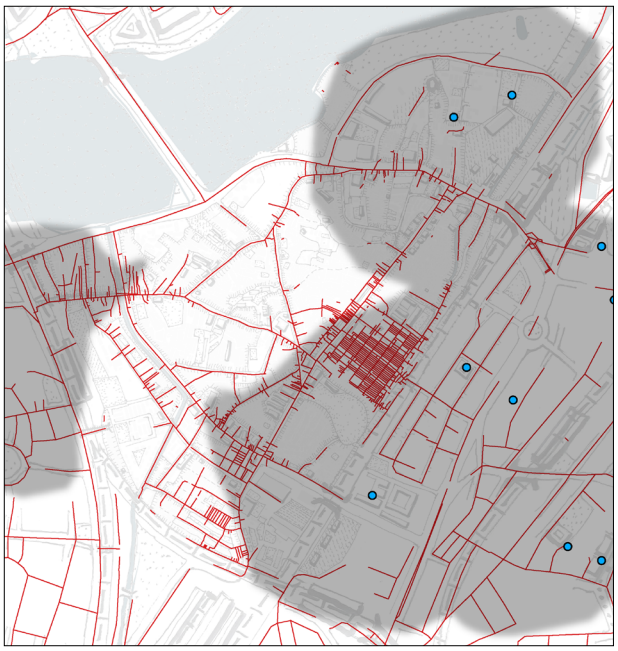


FIG. 8.25 Educational hotspots : Colleges: attraction distance:_1500m

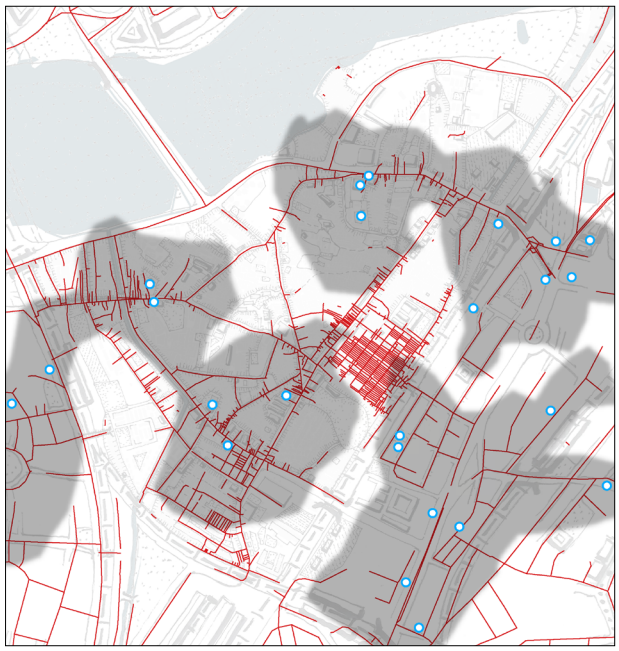


FIG. 8.26 Health and education hotspots: Minor hospitals _Attraction Distance: 1500m

FIG. 8.27 Governance hotspots :Fire-station: attraction distance:_3000m

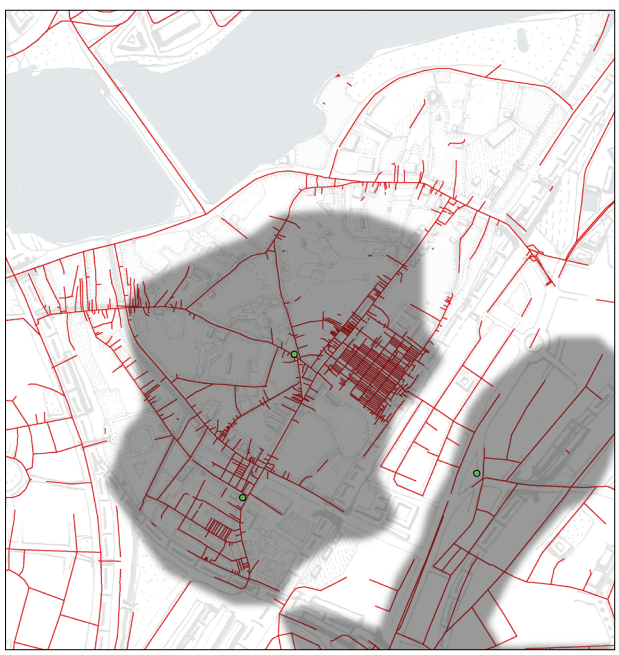


FIG. 8.28 Governance hotspots :Police Station: attraction distance:_3000m

Dharavi's, accessiblity to Social, Health, Education Transportation, and Governance Facilities:

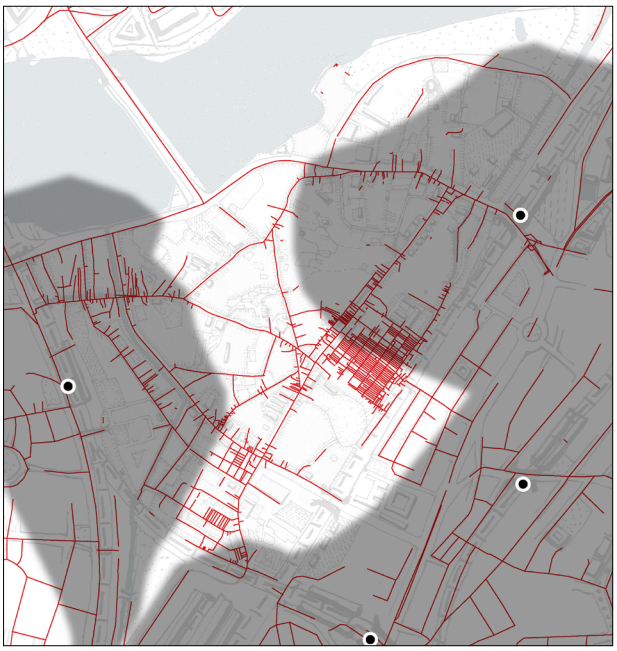


FIG. 8.29 Transportation accessibility: Railway station: attraction distance:_1500m

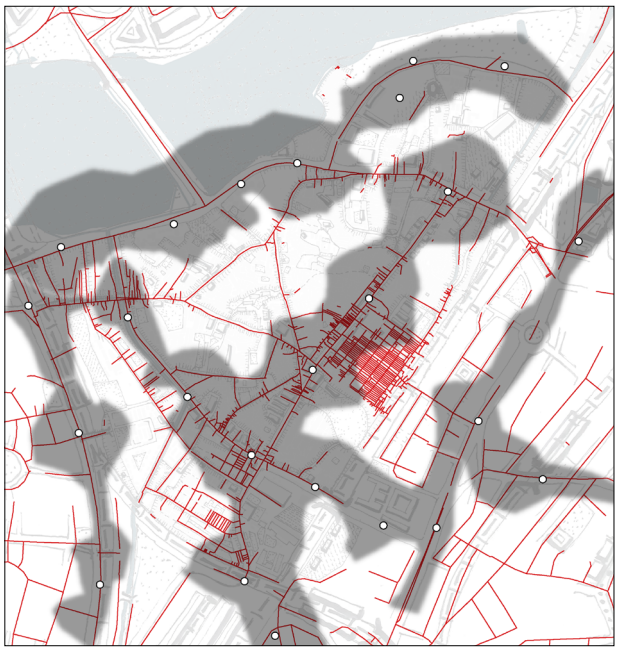


FIG. 8.30 Transportation accessibility station: attraction distance:_1500m

Data source: REDHARAVI, OSM,
Drawn by: author,

8.3 – **Dharavi's accessibility to services**

The study on Dharavi's accessibility to services highlights certain inadequacies and potentials in the existing spatial configurations.

Social Hotspots:
(Fig 8.17,8.18,8.19,8.20,8.21, 8.22) primarily highlights that local social hotspots : community toilets are located away from integration, i.e in the backsides, this is primarily because of safety, and privacy concerns of the communities. Other local social hotspots : temples are integrated and form the global-to-local spaces, as spaces of power formed by the community. These communities also have their own intimate spaces of recreation and work, such as courtyards, inner alleys. Social hotspots that have a larger reach, such as heritage, parks, sports centres, tend to be not integrated Spaces such as local community centres also are not integrated and are few in number. Markets, that seem to cater to a few are located away from Dharavi's core.

Health and Education Hotspots:
(Fig 8.23,8.24,8.25,8.26) Hotspots such as schools, kindergartens that should cater to the local as well as neighbouring areas are not integrated. While schools tend to locate along the main arteries , the kindergartens are present inside communities. Larger education facilities such as colleges are integrated but distant from the reach of Dharavi's core.

Health centres such as minor hospitals, clinics are quite integrated, since they cater to needs of inhabitants and visitors, but located to the outside.

Governance Facilities
(Fig 8.27,8.28) One peculiar reading is the location of a police station in the heart of Dharavi. The spatial configuration and location of the police station in the heart does point towards the states role of power. It has a higher reach on areas that are not integrated and reveals the deficiency of certain spaces to foster a sense of security and safety via the space of control. Emergency facilities such as fire-stations are located away from the core of Dharavi and cater to only a portion of Dharavi.

Transport Facilities:
(Fig 8.29,8.308) The transport facilities though adequate seem to point out to deficiencies in reachability. While Sion station to the west is integrated towards Dharavi,Mahim junction is not so. The paths for movement towards it is unclear as such the inner core of Dharavi is not accessible to the station areas.

To summarise, while some facilities are integrated some are clearly not. It is not necessary that all occupied spaces need to be integrated. For Dharavi to foster social resilience some facilities and hotspots or occupied spaces need to be made accessible through movement and adaptation or transformation of spatial configurations. Occupied spaces such as stations, schools, colleges, community centres that hold the potential to be truly public spaces should be integrated. They play a vital role in being the space for politics and power to work in cohesion, and thus a move towards greater social solidarity.

FIG. 8.31 Dharavi Segregation: Areas in red highlight segregated spaces

8.4 – **Synthesis: Dharavi's Social logic of Space**

A study of the spatial patterns of Dharavi clearly reveals a social logic of the settlement, i.e a social logic of the space. The historical evolution of Dharavi (fig.....) highlights that Dharavi an informal, and organically developed settlement by its inhabitants forms a *local-to-global phenomenon*, i.e. the growth of the 'elementary cell' or unit was by the process of aggregation of the cell, forming the settlement seen today. The exterior spaces, i.e mainly the streets defines 'outside relations', that is to say a political space which constructs a fluid system of encounters and avoidances, constantly re-negotiated by use. This space is where new relations are generated. The spatial reading highlights that Dharavi follows the principle of social solidarity based on interdependence through differences i.e the principle of 'organic solidarity' along its arteries, this is seen towards the integrated areas i.e the public space, or outside relation of Dharavi. While the inside relations are based on integration through similarities of belief and group structure i.e to say 'mechanical solidarity.'

Apart from this the redevelopment and private development schemes, together neglect the spatial configurations determined by the *local-to global* spatial laws formed by the historic settlement. It determines space of power exerted by the 'state' through housing schemes, as the local-to-global spatial laws are broken. The 'state' exerts power through the space, by the alteration of the spatial configuration through the use of various laws, acts, zoning policies. They behave like *enclaves*, which are "areas of spatial concentrations of a particular population group, self-defined by ethnicity or religion or otherwise, and tend to congregate as a means of protecting and enhancing their social, political and cultural development" (Nijman, 2010), leading to *spatial barriers* that constrain the fostering of social encounters , social solidarity and integration as a whole.

It is also revealed that there is a duality in the urban form of Dharavi i.e the space of the street system, which is the theatre of everyday life and transactions forms the *local-to-global spatial law* while the space of major public buildings and functions: schools, hospitals, colleges, sports areas tend to neglect the local-to-global phenomenon. These spaces host the potential for alteration in their spatial configuration such that they form a better relationship with the street. Instead of forming a relationship to the inside a better relationship to the outside. As these institutions spatially represent the space of power, it seems ideal for the occupied space to respond to the outside, as such forming the *global-to-local* spatial law. In addition, the space between the public buildings and the street, i.e the space which surrounds the public building can form greater convex spaces (open space) for public life to unfold. While,The former creates a dense system, in which public space is defined by the buildings and their entrances, the latter a sparse system, in which space surrounds buildings with few entrances.

In the 'Study of Mumbai Slums' Jan Nijman points out in the case of Dharavi (similar in other slums too) local cultural milieu is a form of social capital (Nijman,2010). By referring to the arguments put forth by Bordieu in the paper, Nijman states that "social capital is formed in the context of 'durable networks' and provides the members of society with the backing of collectively owned capital, a credential that

entitles them to credit in various senses of the word" (Nijman,2010). It is also noted that smaller firms often have ties with bigger firms within particular industries in Dharavi, (ibid.) as such ethnic ties, kinship ties and economic interdependence is seen as strong point through the lens of social resilience in Dharavi.

In the map (8.31) the areas highlighted in red represent areas that lack integration with the rest of Dharavi and its neighbours . While clustering seems viable and as such an important act in the competition for limited space, it does have negative consequences, seen in segregation of social and ethnic groups into 'gated communities' . Apart from this the presence of temples as spaces of power highlight a relationship towards further spatial segregation, by various ethnic groups. It is also evident that some of these clusters lack access to social, health, public and educational infrastructure thus forming areas with minimum capacity for social encounters to occur. From the reading it is seen that areas that lack integration within Dharavi have a global-to-local spatial law such as a police station that forms the space of power in governing the whole locality. Again, attributes such as safety, and security that are necessary and form potentials to build societal robustness. This provides an opportunity for the spatial configurations of Dharavi to adapt or transform in order to create better social ties and networks within Dharavi.

Dharavi combines a whole range of functions ranging from economic, industrial, living, retail, wholesale, public amenities, places of worship, and civic organisations. Dharavi is an industrious and economic society where the relationship to land, location, proximity to individuals, communities is intertwined in the social, economic and spatial life of its inhabitants, all forming a clear description for enabling greater social solidarity towards fostering social resilience. While western cities tend to segregate the different realms of life, Dharavi seems spatially and functionally integrated (residential, work, religious and public life) but into 'gated communities' (Nijman,2010).

As from the previous descriptions and analysis it is evident that social solidarity which is a mix and balance of mechanical solidarity and organic solidarity needs to be augmented, especially in the case of Dharavi more towards moving from mechanical solidarity to organic solidarity. It is through various design operations to the existing spatial configurations that these relations can be codified or altered, that which responds to the inside and the outside relations of Dharavi can entail greater social solidarity from within and towards the rest of Mumbai. As space and power relations are closely interlinked with the global-to-local and local-to-global phenomenon, i.e. also a function of spatial configurations, the operations designed can produce better social relations, fostering social solidarity. As argued by Bill Hillier in 'Space is the Machine'

> "The effects of spatial configuration are not on individuals, but on collections of individuals and how they interrelate through space. All that is proposed, in effect, is that a pattern of space in a complex can affect the pattern of co-presence and co-awareness of collections of people who inhabit and visit that complex" (Hillier, 2007)

Here Dharavi can be understood as a complex that needs to build better 'inside' and 'outside' relations. The question then becomes how can Dharavi do *so*? What are the potential spatial relations it must respond to, in order to enable social solidarity and as such societal robustness through space? Is there a relationship between space

of movement, occupied space, and power relations, that is to say is it hierarchical? Does spatial diversity i.e function and form of occupied space have a relationship with these hierarchies or the through-movement capacity? Can a gradient of accessibility determine these relations?

To comprehend its potential for spatial relationships to be formed, altered or to be maintained with respect to the larger territory, Dharavi must be described in terms of spatial hierarchy i.e the relationship of its occupied space to the space of movement within the territory, ranging from the local scale to the scale of the territory. To recognise this potential a historical reading of occupied space along with the change in the space of movement is further used as a method of analysis, (design-research).

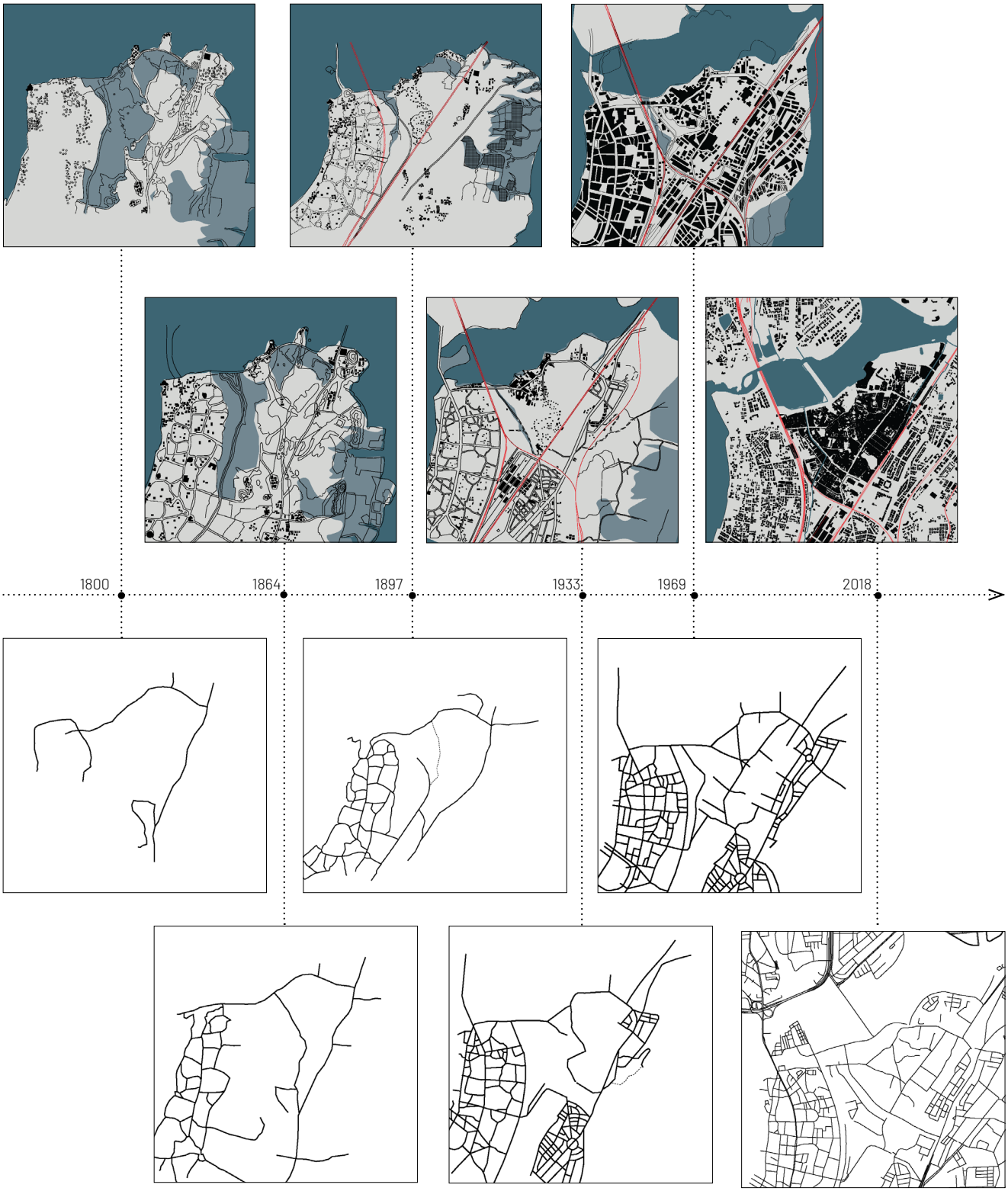


FIG. 8.32 Top: Historical Transformation of Dharavi, Bottom: Topological changes of Dharavi

8.5 – **Historical Transformation of Dharavi:**

Through the historical evolution of Dharavi, it becomes evident that Dharavi has remained spatially segregated with its neighbouring context, i.e the space of movement between Dharavi and its neighbours have remained restricted. Although,it did developed few connections within, the railway infrastructure to the west and east as well as the Mithi river to the north have been a *spatial barriers* or *edge* respectively for it to build spatial relations with its neighbouring context. The evolution also highlights the formation, alteration of topological relations of occupied space in time. The reading or analysis highlights that while Dharavi formed topological relations with the larger context of Mumbai region post 1969, through various road infrastructures, mainly because of economic reasons (the advent of motorised transportation), it remained spatially segregated from its neighbouring context. This is an opportunity as well as a constraint that can be overcome to ameliorate Dharavi's spatial relations with its neighbouring areas.

To comprehend what the spatial repercussions of these changes in the space of movement have been on the present state of occupied space in Dharavi, it is essential that it is described as a relationship between occupied space and the through-movement potential. That is to say a description of the present urban form and function, and its spatial relationship to the gradient of through-movement (angular choice appendix 2).

This spatial configuration, in terms of the relationship between through-movement and occupied space is further described by the use of a strategic design framework 'the connector'. Dharavi must be described in terms of *spatial hierarchy* i.e the relationship of its occupied space to the space of movement, ranging from the local scale to the scale of the region.

Source: REDHARAVI, OSM
Drawn by : author

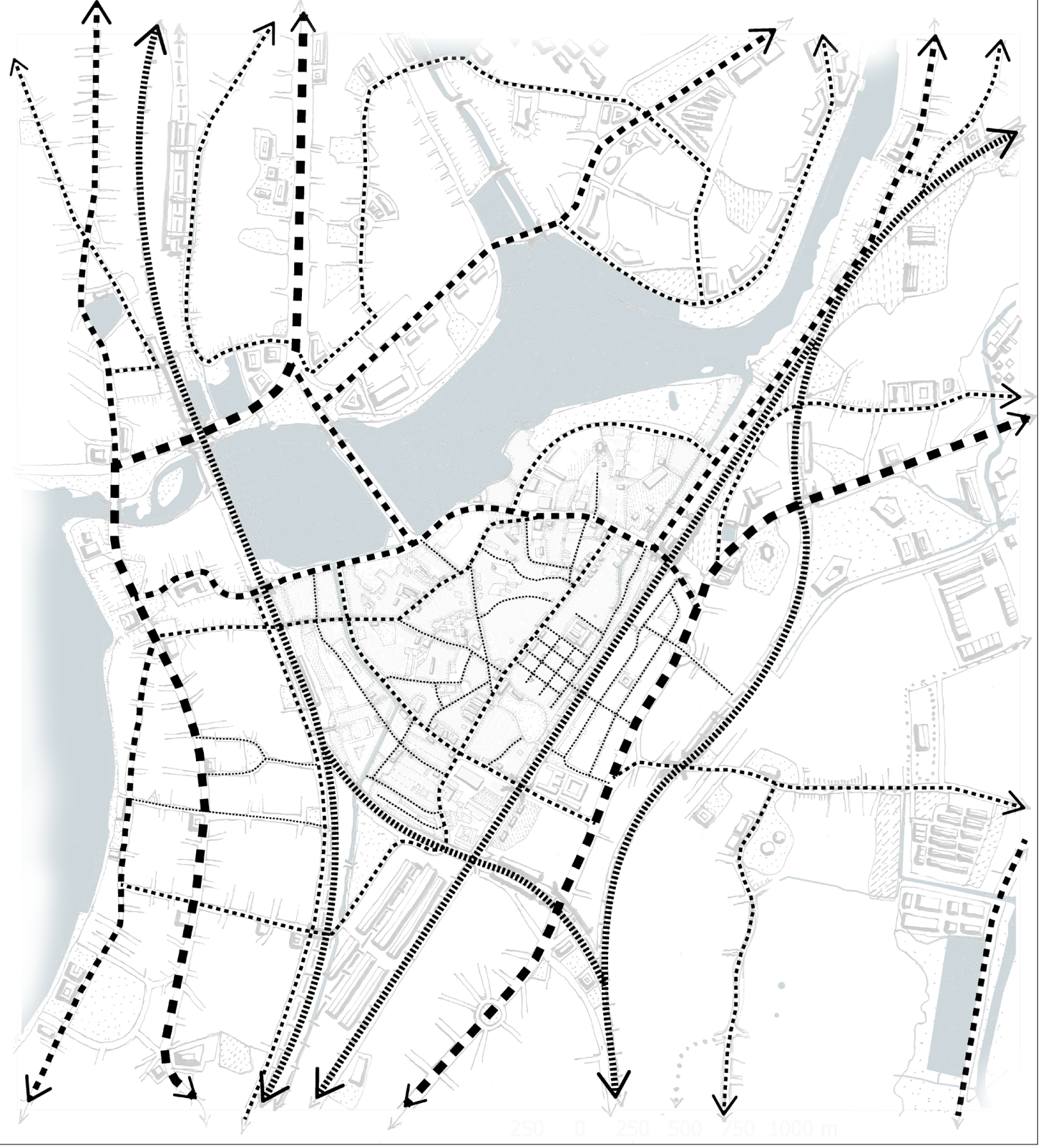


FIG. 8.33 Defining spatial Hierarchy: The connector

9 – Spatial Hierarchy

The Connector:

While Dharavi needs to form inside and outside spatial relations it must also be sensitive to the opportunities provided by the various relations it forms with the larger context of Mumbai.

In order to understand the potential for Dharavi to foster better social ties with the region, the connector, a design framework is introduced. It primarily defines spatial hierarchy. In an EMU workshop conducted in Bucharest I was first introduced to the concept of the 'connector' (Forgaci, 2017). Although the workshop was on 'connectivity and interconnectedness in urban river corridors' the concept of spatial connectivity and accessibility helped in uncovering the potential spatial relationships that Dharavi can form with the region of Mumbai in order to move towards social cohesion. Through the design-research exercise of reading the territory under the lens of Dharavi as the space of movement I define 'the connector' as a strategic research and design instrument in selecting and referring to some elements of the infrastructure that builds relations with Dharavi. It is a method of interpretation that can help in redefining spatial configurations, and accessibility based on the through-movement potential of different infrastructures, such as the train, road and the river edge. Spatial hierarchy helps in defining the potential relationship an occupied space can transform or adapt to in relationship to the existing or potential through-movement capacity. Through the historical reading of the territory and the analysis of through-movement (appendix.2) 'the connector', also a strategic design tool defines potentials for spatial re-qualification based on spatial hierarchy, accessibility, and reconfiguration that Dharavi can aspire to, in order to move towards social solidarity with the region.

This determination of spatial hierarchy is essential to comprehend the local-to-global phenomenon or the global-to-local phenomenon of occupied space within Dharavi, and defines spatial contiguity as well as the spatial relations determined by these configurations that is whether symmetric, asymmetric, distributed and non-distributed. The description through spatial hierarchy defines spatial diversity: function and form, spatial redundancy, spatial barriers and edges. As the relationship between space of movement and occupied space determines the local-to-global and global-to-local phenomenon, as well as issues of accessibility, the connector can further define the different gradients of 'inside' and 'outside' relations that Dharavi can aspire to, as spaces of control and spaces of power. That is to say a spatial hierarchy that can define the two principles of solidarity (mechanic and organic) through gradients. 'The connector' also defines scales of design that encompass the spatial relationship with respect to it.

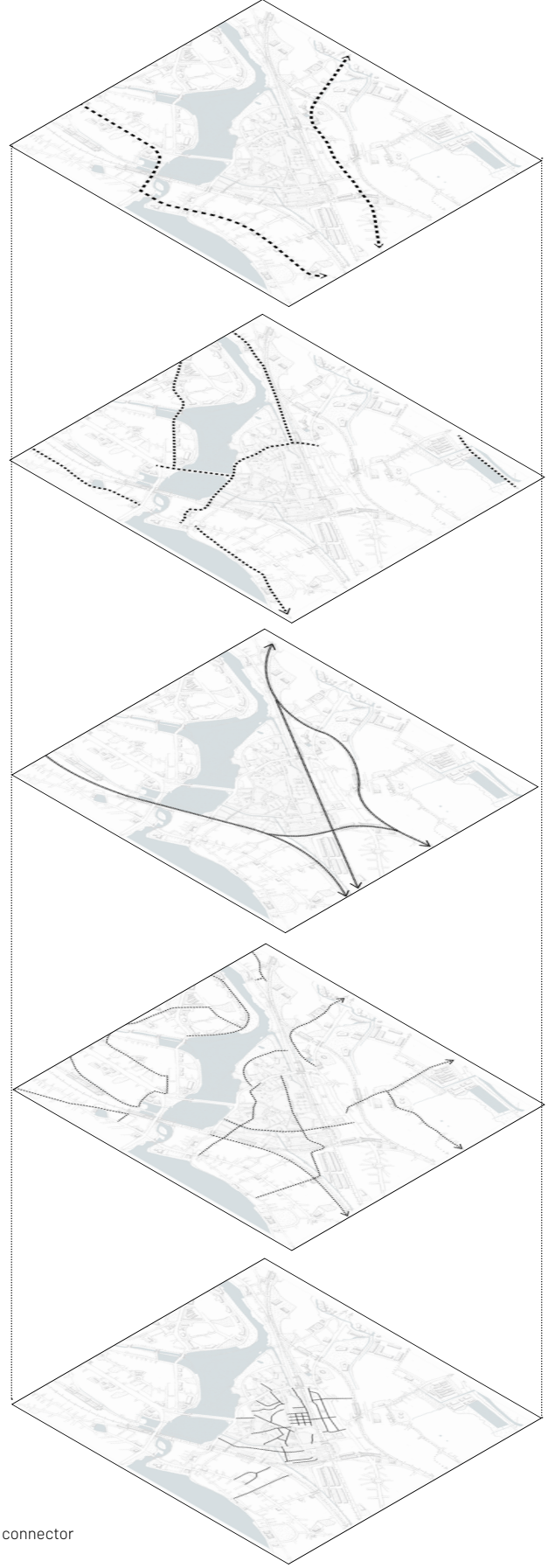


FIG. 9.1 Defining spatial hierarchy: The connector

From this interpretation and description, the connectors are classified into families based on their through-movement potential, spatial hierarchy and the spatial relations of occupied space. These connectors are:

- *1. Extra Regional Connector*
-
- *2. Regional Connector*
-
- *3. Railway Connector*
-
- *4. District Connector*
-
- *5. Neighbourhood Connector*

The connectors are further explained spatially through the process of design-research

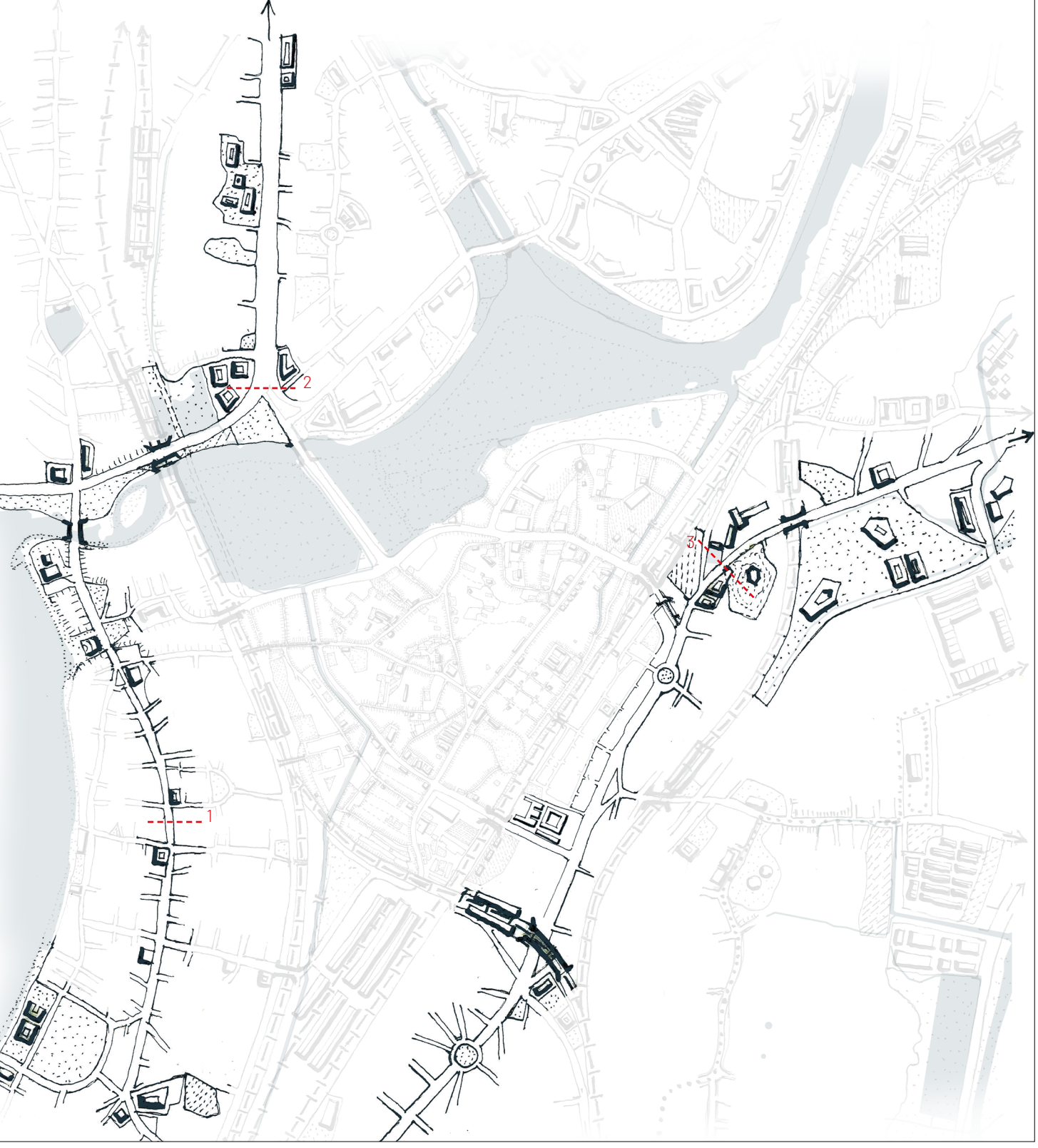
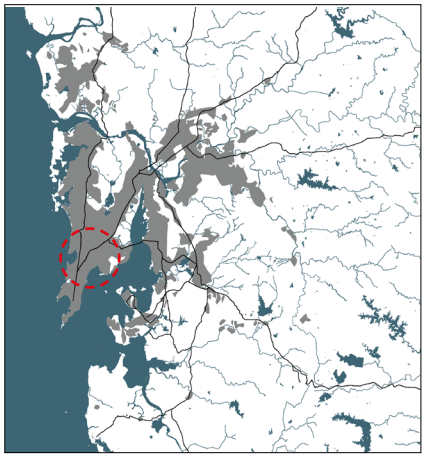


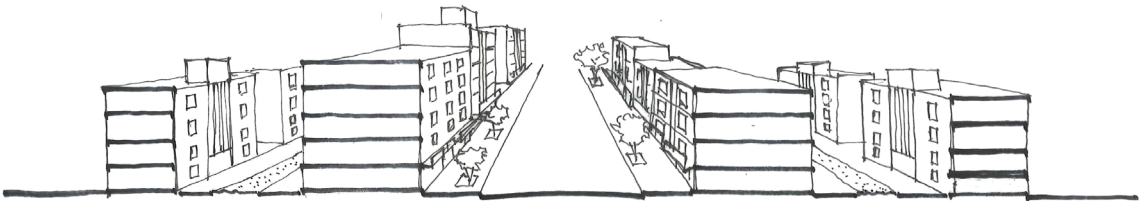
FIG. 9.2 Topological Synthesis: Extra Regional Connector. Drawn by: author

9.1 – **The Extra Regional Connector**

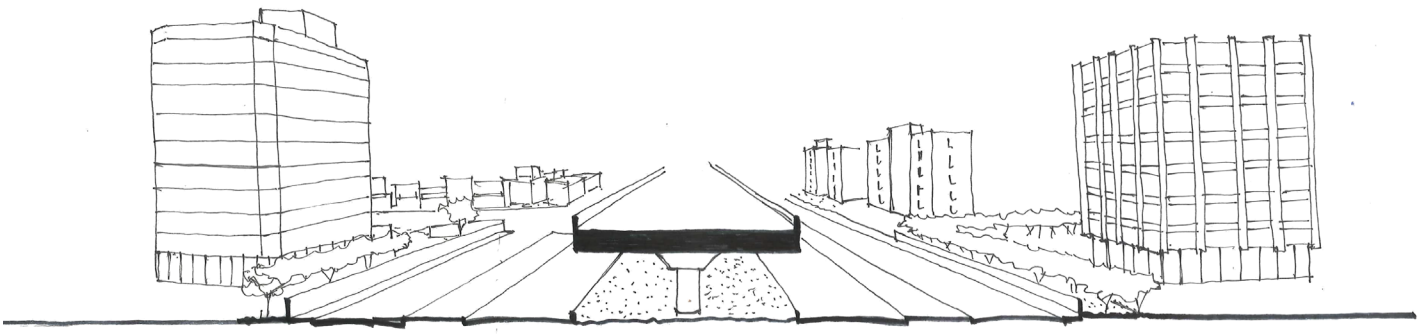
The Extra Regional Connector connects the historical core of Mumbai and the Greater Metropolitan Region of Mumbai. Spatially connecting the historical core with the suburbs, villages, airport, sea port, and the Desakota conurbation. It is the connector or road infrastructure with the highest through-movement potential i.e. Angular Choice value. It describes a diverse set of spatial relationships (functional and occupied). Within the neighbouring context of Dharavi, it forms spatial relations, with the occupied space of public institutions, parks, and water fronts. Within the Greater Region of Mumbai it runs parallel to the railway line. The through-movement of this infrastructure facilitates the movement of goods, services as well as people from the peripheries to the city and vice-versa. Its spatial relationship to the larger context highlights spatial diversity and relations with occupied space: the airport, high court and so on. These occupied space in relation to the space of movement have high levels of diversity: functionally as well as with respect to the number of people traversing and visiting these spaces. It is the space where there are no 'strangers'. These spaces host the potential for public life to unfold.

Although, Dharavi is not directly related to it, as no occupied space within Dharavi is in direct relationship (adjacent) with the space of movement of this connector, and such the spatial configurations of Dharavi are not influenced by this connector it does determine potentials and relations for larger public life to unfold as the last gradient of the outside relation of Dharavi and the relationship that not only Dharavi but the rest of Mumbai can take advantage of for social solidarity to be fostered.

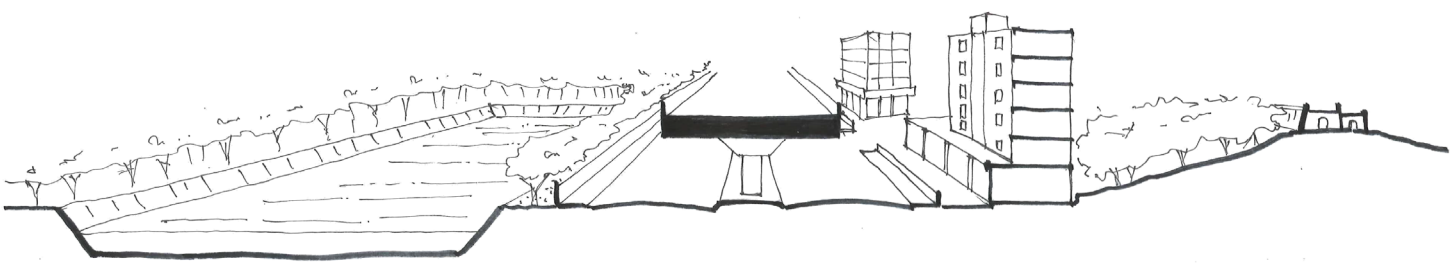




Section 1- Extra Regional Connector: Spatial relations between mixed fabric; residential above and commerce at street level



Section 2- Extra Regional Connector:- Relationships between public institutions; magistrate court to the left and public governance institute (MHADA) to the right



Section 3- Extra Regional Connector:- Relationships between historical elements, the fort and the historical water tanks of Mumbai

Description: Spatial Relations

The extra regional connector highlights the space for highest co-presence and co-awareness to exist within the Greater Region of Mumbai. The hindrances for these qualities to be formed by space are the edges and spatial barriers formed by the infrastructures of the elevated highways. As such the occupied space hosts the potential to respond to high level of through-movement and greater diversity of individuals. Although it describes relationships throughout the region, this connector is separated from the ground at many locations as it is a highway and a flyover. While the spatial configuration: form, and entrances does form a spatial relation i.e. occupied spaces respond to the space of movement (section 1), thus an 'outside relation' .The occupied space along elevated highways, neglects the through- movement potential of the space and forms inside relations (section 2 &3). As such the potential for heritage areas to become public spaces is neglected. Similarly, public institutions such as courts and governance institutes also have a negative response. The global-to-local spatial law, as the space of power is undermined by the spatial configurations represented by non-distributed relations.

FIG. 9.3 Topological Synthesis: Sections_Extra Regional Connector:

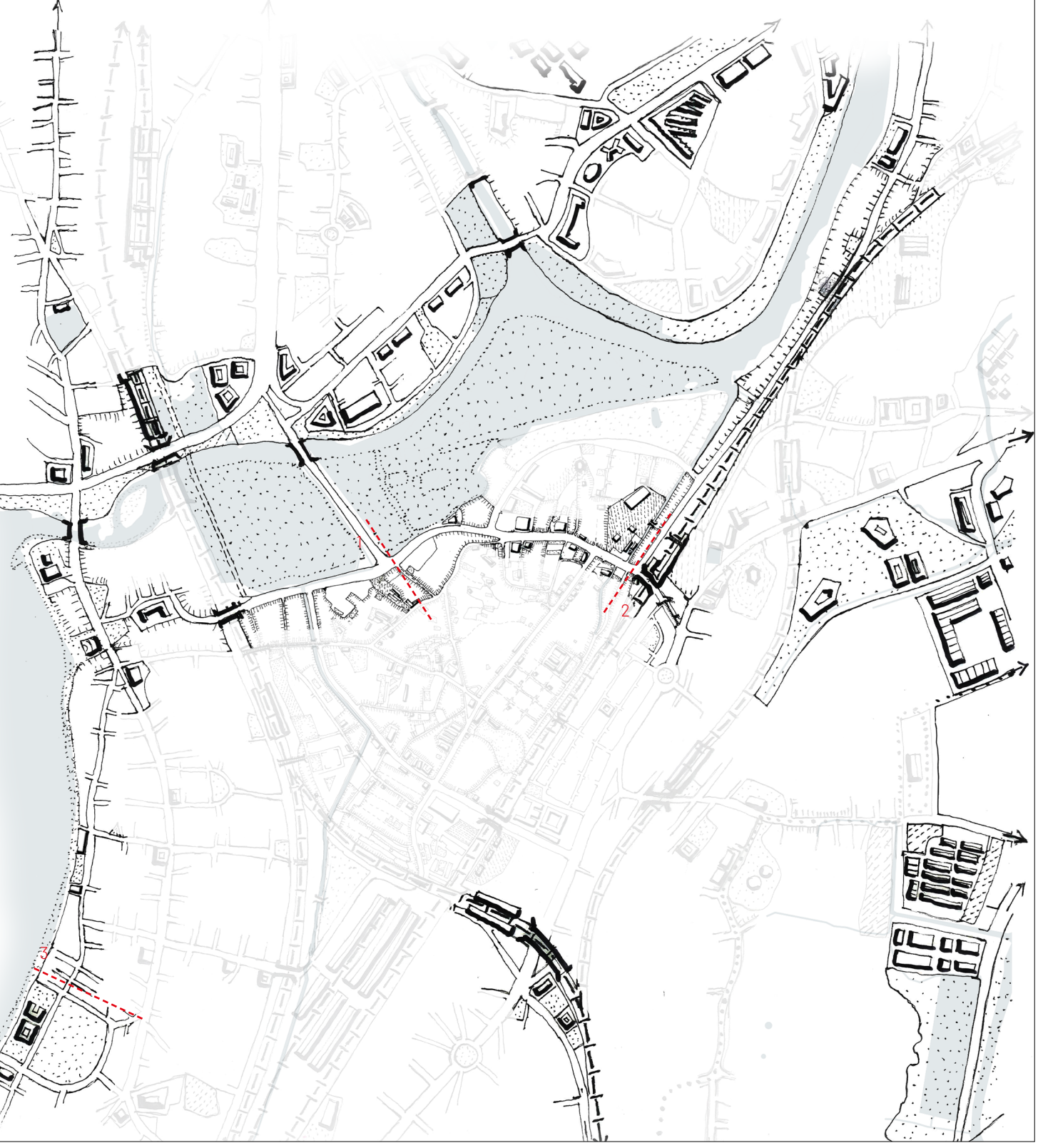


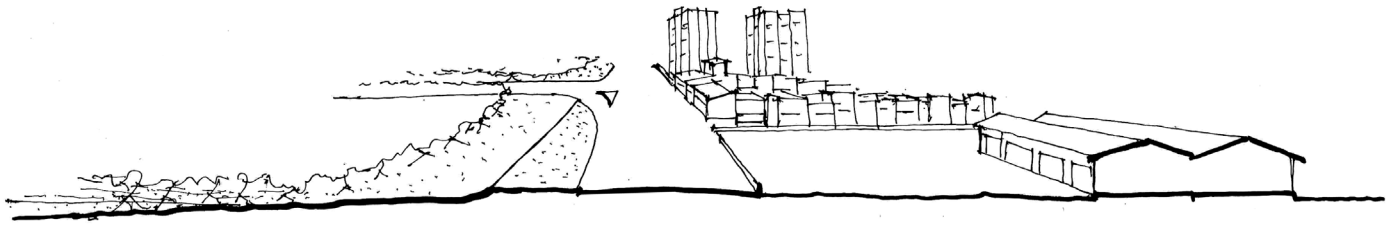
FIG. 9.4 Topological Synthesis: Regional Connector. Drawn by: author

9.2 – **The Regional Connector**

The Regional Connector runs close and parallel to the river and water front of Mumbai and describes relations within the Greater Region of Mumbai. It is the connector that describes spatial relations as Mumbai grew northwards. Its through-movement potential is less than that of the Extra regional connector, and as such it describes spatial relations with occupied space and the space of movement (particular to the through-movement capacity, angular choice) such as educational institutes (University of Mumbai), hospitals, the redundant Eastern waterfront of Mumbai, the neglected edge of the river and the occupied land around it, business parks and Special Economic Zones of Mumbai, cultural spaces and open public grounds as well as neighbouring informal settlements.

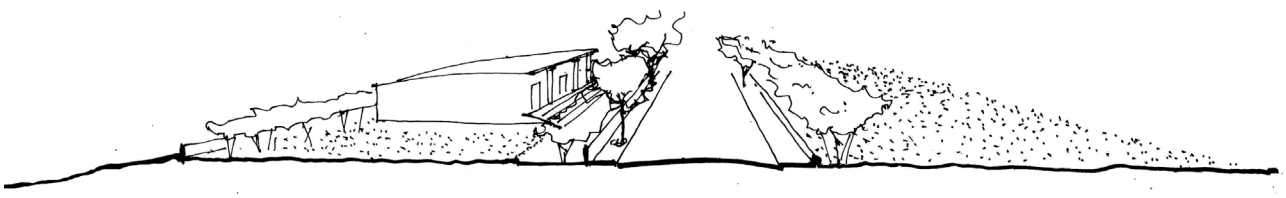
Its spatial relationship within the context of Dharavi highlights spatial diversity and relations with occupied space: redundant spaces, the Mithi river edge and Dharavi's outside: the space for commercial, economic activity, retail etc. It also describes spatial relations with spatial barriers such as the various private housing, SRA schemes, public buildings such as the sports complex.

As the connector with highest through-movement in Dharavi, the occupied space in relation to the space of movement has high levels of diversity: functionally as well as with respect to the number of people traversing and visiting these spaces. It is the space with highest public life to unfold in the exterior of Dharavi. These spaces host the potential for public life to unfold that can become the first public interface and space of Dharavi, thus capable of higher diversity.



Section 1- Regional Connector: Spatial relations between Mithi river front and redundant spaces, private or state housing schemes and Dharavi's clusters exterior.

Section 2- Regional Connector: spatial relationships between redundant spaces and Dharavi's clusters 'outside relations'



Section 3 - Regional Connector: spatial relationships between cultural centre and public grounds

Description: Spatial Relations

The regional connector highlights the space for highest co-presence and co-awareness to exist at the exterior of Dharavi. The hindrances for social encounters to occur lies in the spatial relationship to the edge of the Mithi river. The spatial relationship determined by the private housing schemes and SRA schemes are also barriers for social encounters to occur. The potential of the connector also lies in the potential spatial reconfiguration of redundant spaces, and the exterior relations of Dharavi's clusters (Section 1, 2) . As such the occupied space: river front, redundant spaces hosts the potential to develop spatial relations with respect to the level of through-movement. While Dharavi's clusters do determine outside relations based on the local-to-global phenomenon, the occupied space or urban form of the private schemes can determine or enhance spatial relations with the space of movement (section 1). As such the potential for the regional connector to enhance, adapt, transform spatial relations towards social solidarity lies in design operations towards the improving accessibility to and along the edge of the river; reconfiguration of state or private housing schemes, and public buildings from non-distributed, asymmetric relations to distributed relations.

FIG. 9.5 Topological Synthesis: Sections_Regional Connector. Drawn by: author

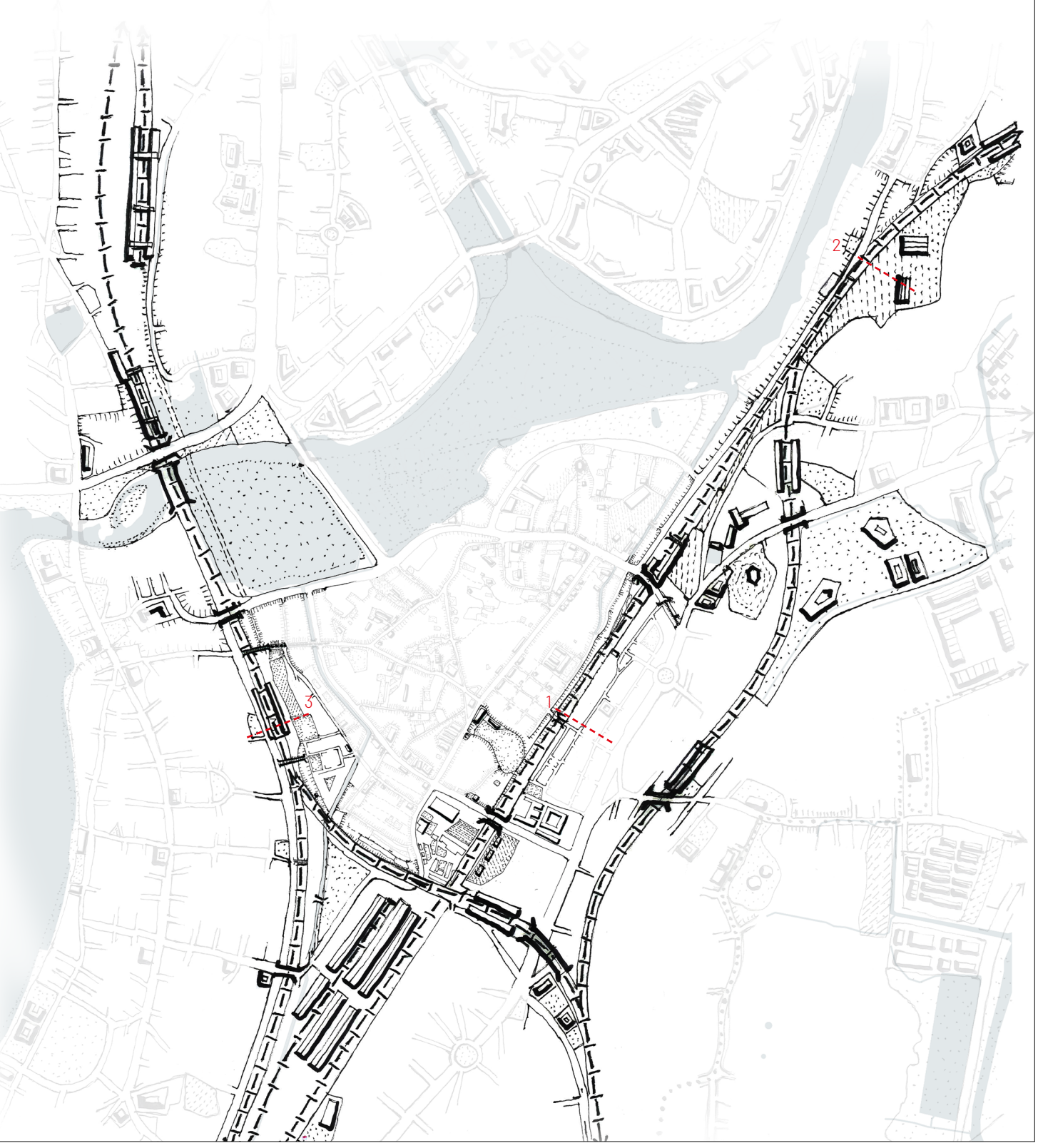
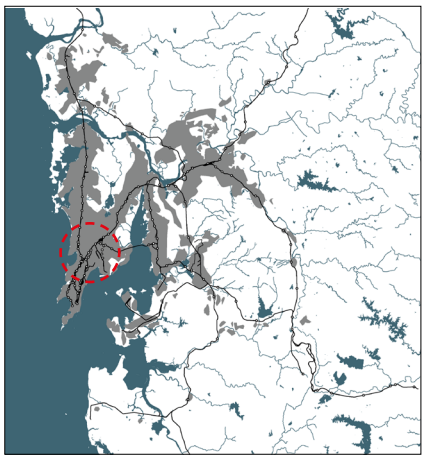
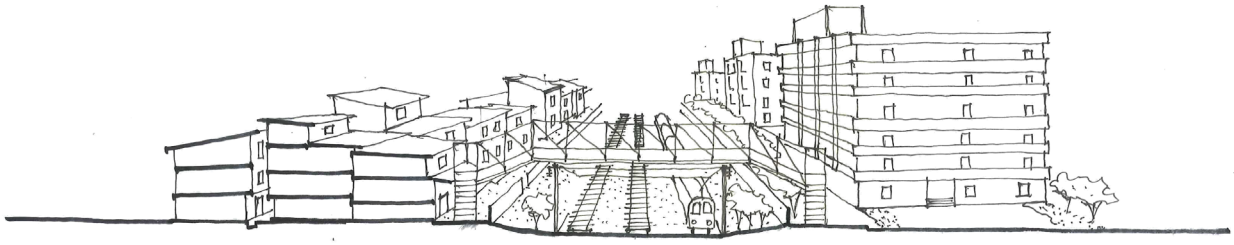


FIG. 9.6 Topological Synthesis: The Railway Connector. Drawn by: author

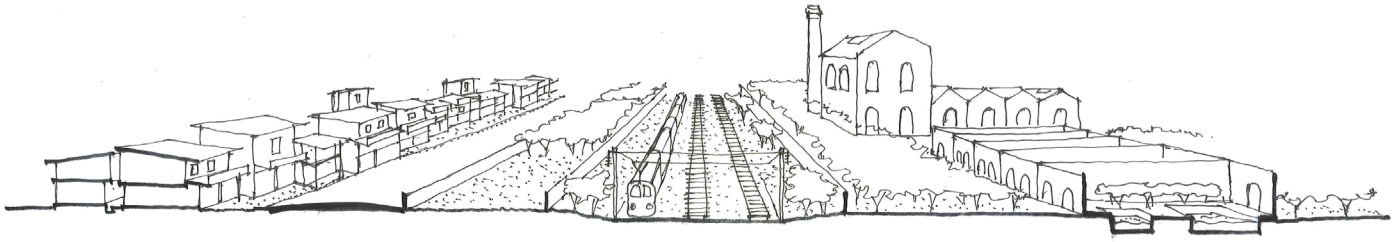
9.3 – **The Railway Connector**

Although the railway infrastructure is not a physical space of movement it does hold the capacity for spatial relations across and through it. At present, the railway infrastructure is a critical infrastructure i.e. vulnerable to pluvial flooding since it is constructed in the low-lying areas. The railway connector has the potential to foster spatial relations across its barrier as well as within the territory. As it passes through the territory it shares a potential spatial relation with diverse occupied spaces: redundant mill lands, railway lands, graveyards, educational centres, historical water storage tanks for Mumbai, informal settlements, housing schemes, public institutions.

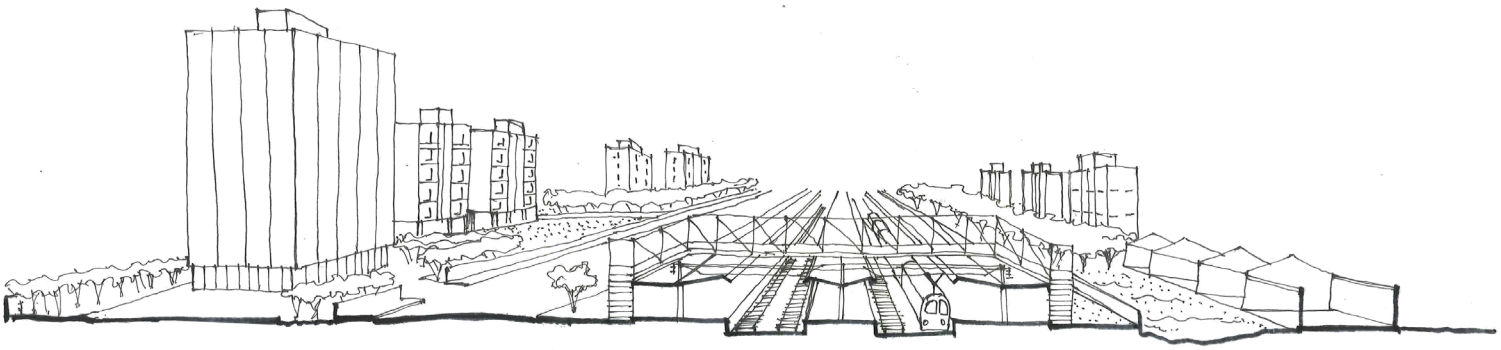




Section 1- The Railway Connector: Potential for spatial relations between Dharavi Slum and educational centre, residential spaces across



Section 2- The Railway Connector: Potential for spatial relations between slum and redundant spaces,(abandoned mill lands). while the regional connector runs parallel along the railway infrastructure.



Section 3- The Railway Connector:: Potential for relationships between commercial centres and redundant spaces,(railway lands), while the district connector runs parallel to railway infrastructure.

Description: Spatial Relations

As a space with high through-movement potential it has the capacity to become a regional park along the spine of Greater Region of Mumbai. As it passes through It has the potential to build relations with the neighbouring districts as well as redundant spaces for eg. the abandoned mill lands, occupied railway lands, public institutions, educational centres, graveyards, the historical water storage tanks of Mumbai, neighbouring informal settlements, water fronts.

The spatial relations between Dharavi's settlement on one side and the residential, educational centre (public building) on the other is obstructed by the railway infrastructure. While Dharavi's clusters tend to negotiate the space in front by its entrances, the educational and residential spaces neglect the railway front, as an inaccessible, spatial barrier. This forms a spatial relation that is distributed and symmetrical on one side and asymmetric, non-distributed on the other (section 1).

Similarly, The space of the mills on one side and informal settlements(distributed and asymmetric) is disturbed by the railway infrastructure (section 2). The spatial relation between commercial centres on one side and redundant spaces on the other are also hindered by the infrastructure. Sections 2 and 3 are not directly related to the edge of Dharavi but form potentials for change in the larger scale.

FIG. 9.7 Topological Synthesis: Sections _Railway Connector. Drawn by: author

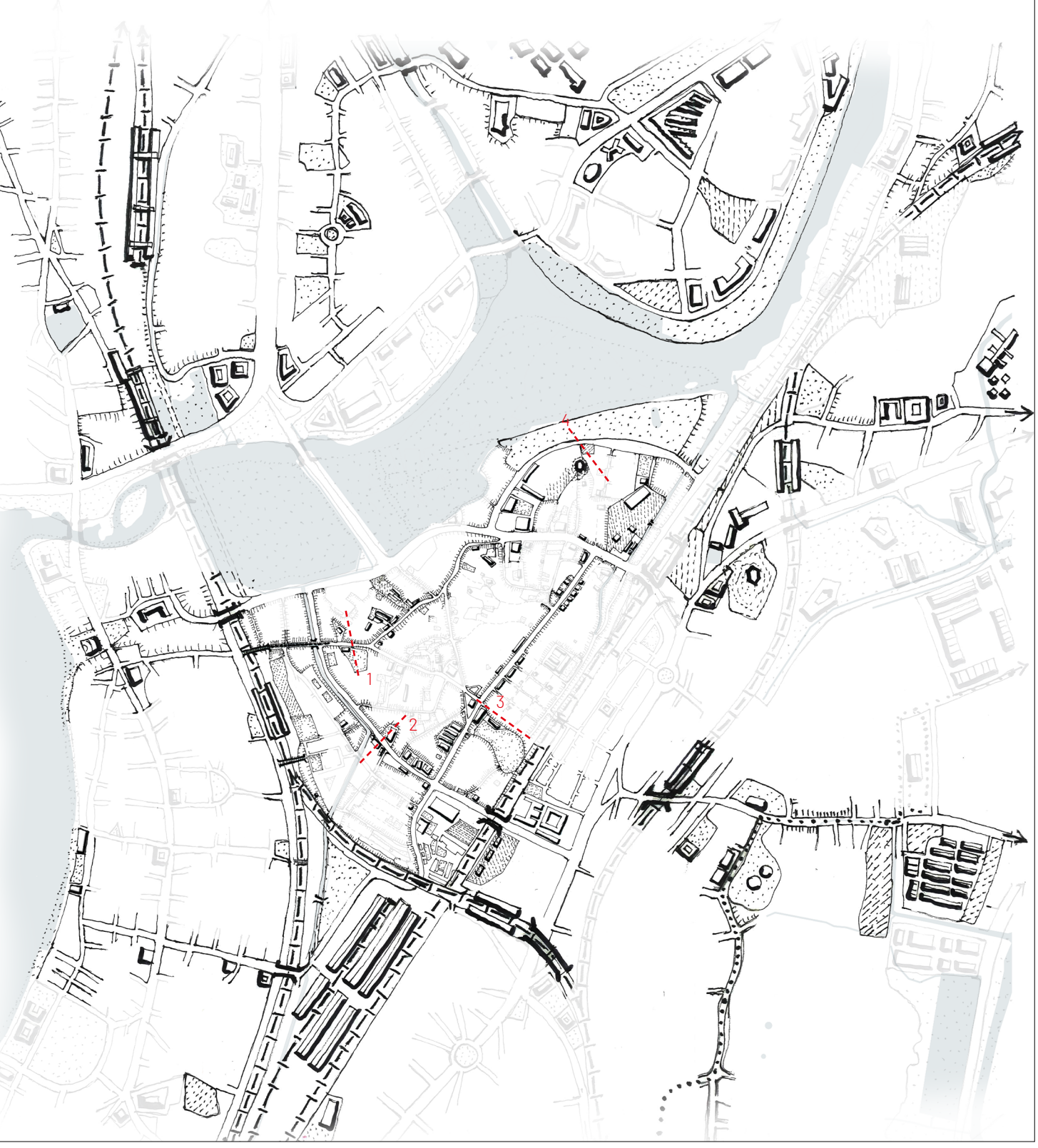
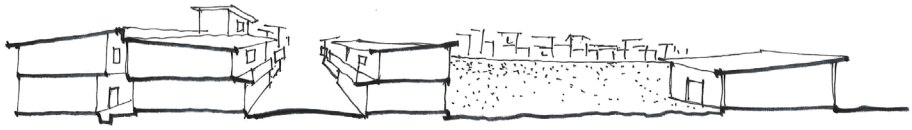


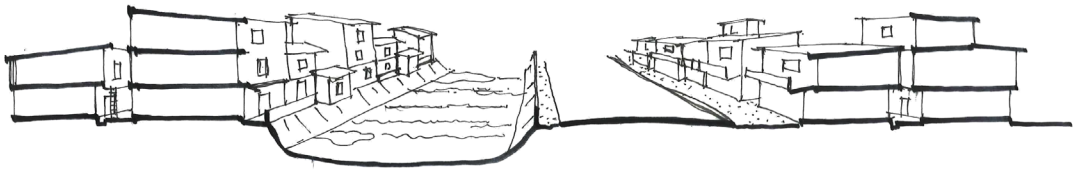
FIG. 9.8 Topological Synthesis: District Connector. Drawn by: author

9.4 – **The District Connector**

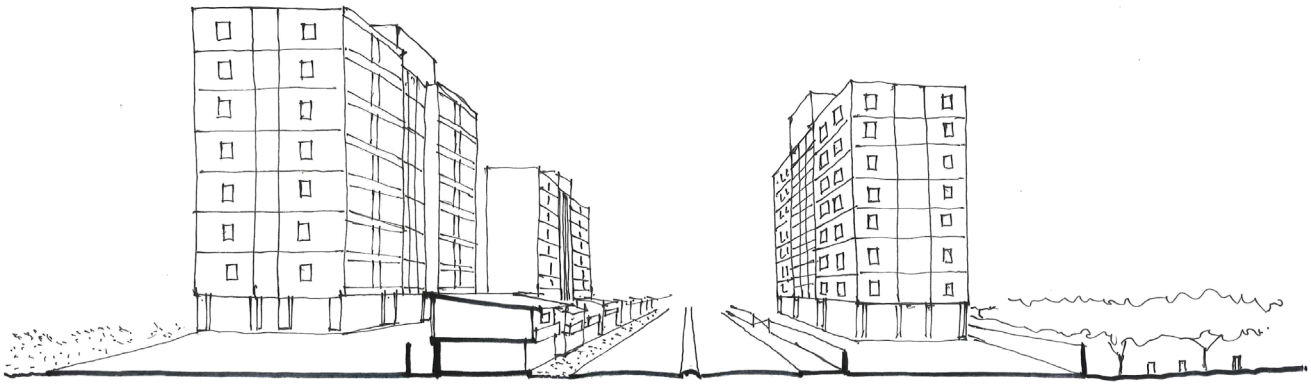
The District Connector describes and connects spaces across infrastructural barriers such as the train and the extra regional connector. The connector describes and forms spatial relations with the railway station nodes as it passes along it. Historically, the district connector is the one that formed the first spatial relation by enabling accessibility to Dharavi, along which Dharavi grew. As compared to the Regional connector the District connector has lower through-movement potential and as such it describes a set of spatial relations with occupied spaces: religious spaces, minor hospitals, public amenities, the waterfront, nature parks, sports facilities, schools, and colleges. In terms of spatial hierarchy i.e. relationship between to the space of movement and occupied space, this connector describes a lower order of diversity compared to the Regional Connector. It describes spatial relations of Dharavi's clusters to the exterior and as such the outside relations of Dharavi. The connector, narrates diversity in terms of local functions and also with respect to the number of people traversing and visiting these spaces. It describes a relation where social encounters are established between districts.



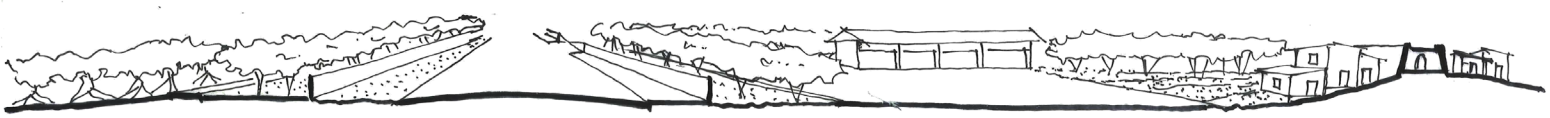
Section 1- The District Connector: Relationship between Dharavi and the internal open space with community centre



Section 2- The District Connector: Relationship between Dharavi and the neglected water canal



Section 3- The District Connector: Enclosed blocks and redundant spaces behind



Section 4- The District Connector: enclosed nature parks, redundant spaces (Dharavi Bus Depot) and the informal edge of the Heritage fort

Description: Spatial Relations

The District Connector highlights the space for co-presence and co-awareness to exist with the exterior of Dharavi's clusters based on the space of movement. The hindrances for social encounters or topological constraints that this connector describes is by the inaccessible edges of water canals (section 2), enclosed public spaces (Section 1) , spatial barriers: private and state housing schemes, redundant spaces (Section 3) and inaccessible Mithi river water front, nature park, enclosed heritage area (Section 4).

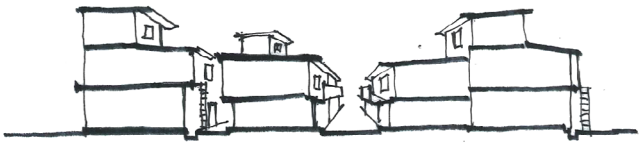
The potential of the connector as a space to foster societal relations, social encounters, social solidarity lies in the spatial reconfiguration of redundant spaces, and the exterior relations of Dharavi's clusters with the canal, heritage areas, the river front , and the spatial relations formed by the housing schemes. As such the occupied space: river front, redundant spaces hosts the potential to develop spatial relations with respect to the level of through-movement. While Dharavi's clusters do determine outside relations based on the local-to-global phenomenon the occupied space or urban form of the private schemes can determine or enhance spatial relations with the space of movement. As such the potential for the district connector to enhance, adapt, transform spatial relations towards social solidarity lies in design operations improving accessibility along and to the river / canal edge, redundant or enclosed spaces; reconfiguration of state or private housing schemes, improving accessibility and reconfiguration of internal open spaces and community centres together as well as making the heritage area accessible to visitors. The spatial relations encompassing social solidarity can be seen as a distortion in the local-to global spatial laws of Dharavi, as asymmetric and non distributed spatial patterns of private, social housing schemes and public facilities are located with respect to the symmetric and distributed relations of Dharavi's clusters with the connector.

FIG. 9.9 Topological Synthesis: District Connector.
Drawn by: author

FIG. 9.10 Topological Synthesis: Neighbourhood Connector:

9.5 – **The Neighbourhood Connector**

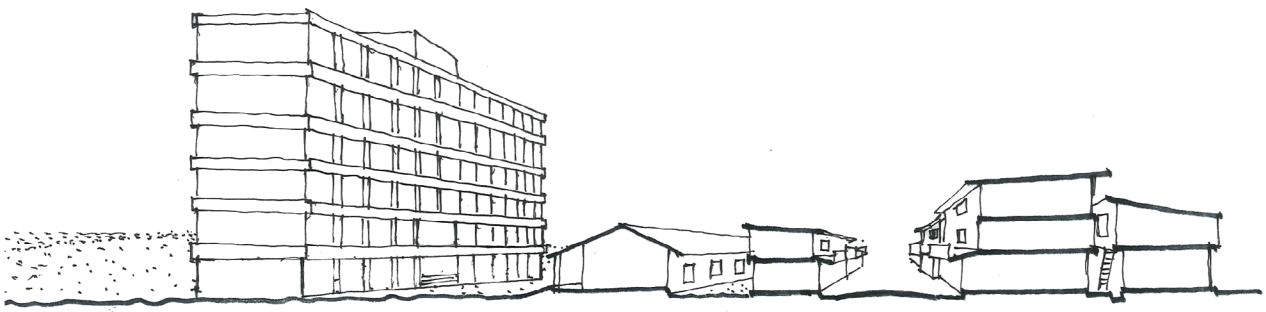
The Neighbourhood Connector describes and connects spaces within Dharavi. it describes the space of movement with the least through-movement potential apart from the inner most spaces of clusters. In terms of spatial hierarchy i.e. relationship between to the space of movement and occupied space, this connector describes a lower order of diversity compared to the District connector. It describes spatial relations of Dharavi's various clusters with each other . The connector, narrates diversity in terms of local functions and also with respect to the number of people traversing and visiting these spaces. These people are usually people from the locality or cluster itself. Its accessibility is low compared to that of the District connector. Its the space where social encounters are established between clusters, and forms the space for local life to unfold, where the streets become the space for celebration of local festivals, ceremonies. Neighbourhood connector is the one that. It has the lowest through-movement potential and hence the least diversity in production of spatial relations as well as social encounter.



Section 1- The Neighbourhood Connector: spatial relations between clusters of Dharavi with commercial below and mixed-use: residential with work spaces above.

Section 2- The Neighbourhood Connector: spatial relations between different clusters of Dharavi with the temple as a social space

Section 3- The Neighbourhood Connector: Relationship between SRA schemes and cluster of Dharavi.



Section 4- The Neighbourhood Connector: Relationship between an educational institute / school with the adjacent cluster.

Description: Spatial Relations

The Neighbourhood connector highlights the space for co-presence and co-awareness that exist between communities, between the exterior of Dharavi's clusters based on the space of movement. As a visitor may still be considered a stranger in these spaces, it fosters spatial relationships within the community and towards neighbouring communities, relations between the community around community spaces such as toilets, temples, community halls, kindergartens, as asymmetric distributed relations, these are the spaces of control where the community ascertains a level of control in the landscape (Section 2) . Apart from that the areas lined with mixed spaces: commercial / retail below and work-living spaces above form symmetrical relations through the elementary cell (Section 1). While some spaces (Section 3) highlight that there is conflict between the relationship non-distributed, symmetric and non- distributed, symmetric relations between SRA schemes and Dharavi's clusters. (Section 4) The relationship between the school and Dharavi's clusters is a distributed asymmetric relation.

The hindrances for social encounters or topological constraints that this connector describes is by tight, narrow spaces (scale) with less through-movement capacity, for community life to unfold. It also describes that there is a distortion in the local-to-global spatial laws that Dharavi's cluster follows. The school as a public space, that should exert spatial control neglects the relationship with the cluster an as such open spaces inside become less used .

FIG. 9.11 Topological Synthesis: Sections _ Neighbourhood Connector:

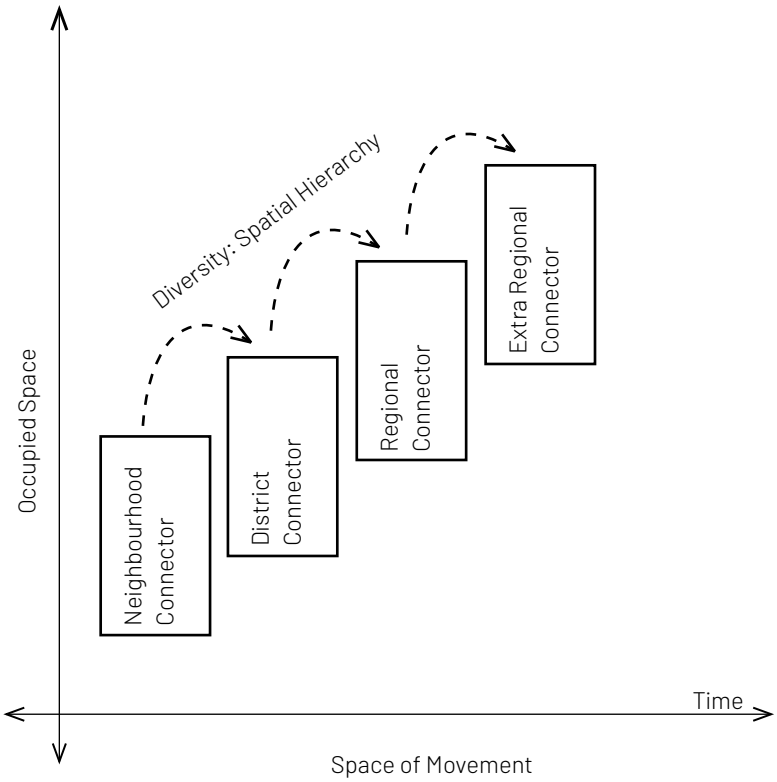


FIG. 9.12 Conclusion: Spatial Hierarchy and Space of Movement:

9.6 – **Conclusions**

The historical reading of the connectors along with the present relation of occupied space and the space of movement highlights an alteration in spatial hierarchy. As space for movement was created, the relations the occupied space had changed. Through time, certain spatial relations were formed with the larger context, that in turn have higher accessibility and diversity (function and form). While some connectors highlight potentials for alteration, adaptation, transformation of spatial configurations by the change of spatial relationship of the elementary cell with the space of movement, at present the integration of Dharavi indicates that it lacks neighbourhood connectors, and hence leading to spatial segregation, where the interiors become less accessible, leading to less social encounters occur and low quality of public life and space. The Railway although a spatial barrier is also a potential to be valorised (vulnerable infrastructure), apart from this the Mithi-river hosts the potential to become an accessible space along public with life to unfold. These infrastructures together have the potential to become accessible as spaces for greater social-solidarity between various communities.

As from the previous descriptions and analysis it is evident that social solidarity which is a mix and balance of mechanical solidarity and organic solidarity needs to be augmented, especially in the case of Dharavi, more towards organic solidarity. It is through the use of neighbourhood connectors and various design operations to the existing spatial configurations that these relations can be codified or altered. The neighbourhood connectors which responds to the inside and the outside relations of Dharavi can entail greater social solidarity from within and towards the rest of Mumbai. As the space of control and space of power relations are closely interlinked with the global-to-local and local-to-global phenomenon, i.e. also a function of spatial configurations, appropriate design principles and strategies are devised to enhance social solidarity in Dharavi's complex.

The spatial hierarchy described by these connectors explains spatial patterns in the local-to-global and global-to-local spatial laws in the context of Dharavi and its neighbours, as well as the inside and outside spatial relations of the *occupied space* with the *space of movement*. It highlights a relationship between the space of movement, occupied space and the space of power, space of control, i.e to say the accessibility of space determines these principles of social solidarity. The present landscape of 'prestige buildings' whether it be of any function of occupied space (commercial, educational, residential,) follows a global-to-local spatial phenomenon in a context determined by local-to-global spatial phenomenon. i.e. the *local-to-global* and the *global-to-local* phenomenon further adds complexity to the relation of society with spatial form, that also determines the principles of social solidarity. This duality, of the interior: a space of ideology and the exterior: a space of transactional politics is only the case insofar as the system is considered as a *local-to-global phenomenon*, i.e. insofar as society constructs a global pattern from the inter-relations of the basic units (the elementary cell). The issue lies in the relationship of these spaces with Dharavi in the interiors and the exteriors that conflict with the enhancement of societal integration.

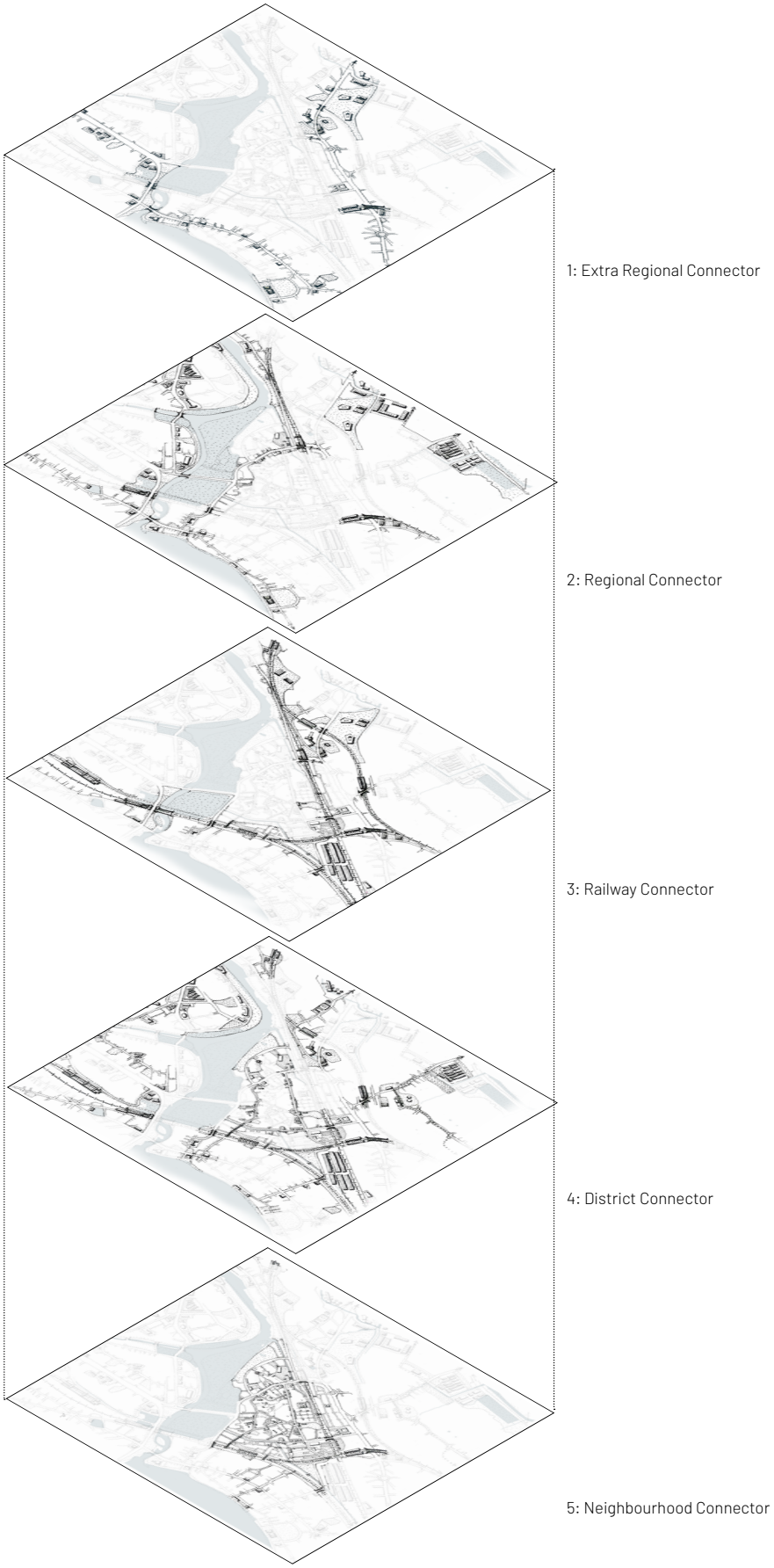


FIG. 9.13 Conclusion: Spatial Hierarchy

Thus, The existing connectors host potential for spatial re-qualification of Dharavi's inside and outside relation, also the need for spaces to be accessible with new relationships to be formed in the interiors and exteriors of Dharavi, based on the capacity of the s*pace of movement* (through-movement) and *occupied space*. This forms the principles of design that are further explained.

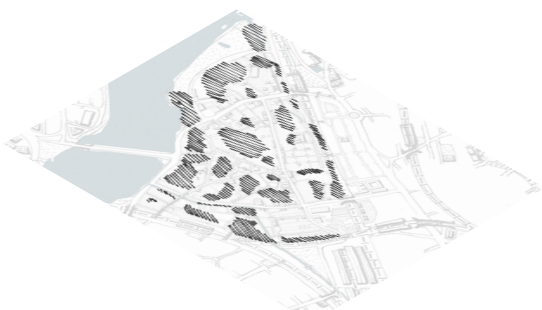
FIG. 9.14 Dharavi's Strategic Map for Spatial Reconfiguration.

10 – Design Strategy

1: Potential Connectors

2:Spatial Barriers

3:Re-qualification of Existing Connectors



4:Segregated Areas

As discussed before Dharavi needs to deal with spatial segregation to ameliorate its societal differences towards societal robustness.

1. Potential Connectors:
From the reading of Dharavi and its context and the initial understanding on segregation it is evident that Dharavi needs different types of connectors.

- 1. The connector that will form spatial configurations within Dharavi's clusters- New neighbourhood connector
- 2. The connector that will help Dharavi form better connections with its neighbours.
- 3. The train as a potential connector,
- 4. And the river front that will address the issue of the edge, and form the collective front for Dharavi, it is considered a park as well as a flood protection dike, that can help alleviate the issue of sea level rise in the future.

2. Spatial barriers:
In the context of Dharavi spatial barriers are defined as those spaces that do not allow for through movement, as well as lack the potential for social encounters, for eg, The SRA schemes, private developments, and infrastructural barriers such as the railway network and the Extra Regional connector. I

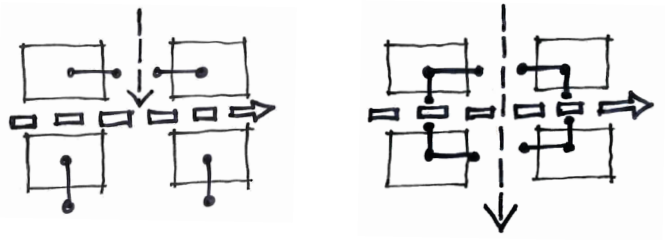
3. Re-qualification of Existing connectors:
The existing connectors prove essential in spatial re-qualification and reconfiguration of existing negative spatial relations.

4. Segregated areas:
Finally, the aim of the connectors is to address the issue of fostering relations with areas that are spatially segregated certain areas within Dharavi The map to the left indicates the potential connectors that Dharavi must form in order to improve social encounters.

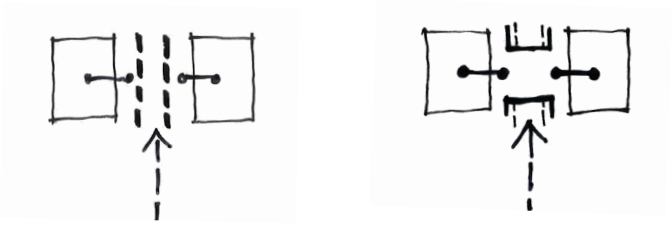
Adaptation &Transformation : The existing spatial relation is maintained and a new relation is formed with the space of movement

Adaptation : The existing spatial relationship is enhanced with the space of movement

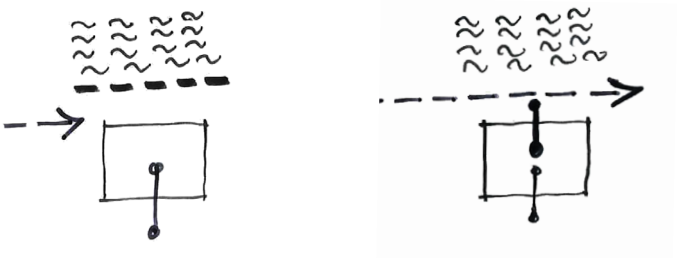
Transformation: the spatial relationship is changed as the space for movement is created.



Adaptation and Transformation: the existing spatial relationship is maintained and enhanced while a new spatial relationship is created with the higher order space of movement, that was previously a spatial barrier



Adaptation: the existing spatial relationship is enhanced across an inaccessible edge with the space of movement



Transformation : a new spatial relationship is created to the edge along with the space of movement

10.1 – **Design Principles:**

The capacity of space towards fostering social resilience clearly lies in the act of transformation, adaptation or change by society to enhance societal relations towards social solidarity, i.e. to say, the capacity of space to adapt or transform can be defined by the description of the principles of social solidarity (which are *the space of organic solidarity and the space of mechanical solidarity*) through the simplest spatial structure of the 'elementary cell' and its relationship to the *space of movement*. The restriction on spatial relations towards fostering social resilience by the 'elementary cell' is based on two 'generic functions' of human use of space that is, *occupation and movement*. It can thus be inferred that the operations applied towards enhancing, or developing spatial relations based on movement and occupied space forms the elementary capacity of space (elementary cell) to foster social resilience.

Adaptive capacity and Transformative capacity of societal relations through space:

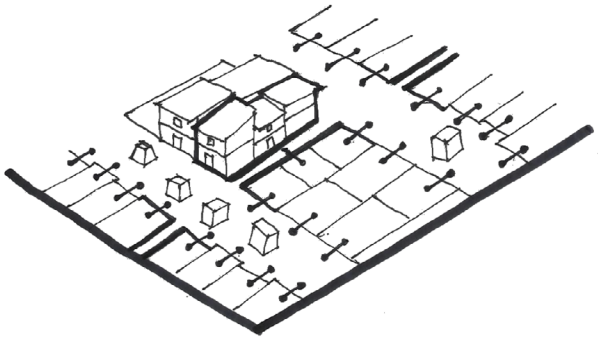
As social resilience defines coping, adaptive and transformative capacities of human beings through time respectively, space is the 'construction' for fostering and enabling these capacities through time in order to deal with external perturbations. The limitations in defining social relations through space in terms of time is a complex phenomenon and can be argued through the description of space in terms of 'long and short models', i.e where space is governed by rules such that social relationships and statuses are generated by space. A ritual is a 'spatial long model' as spatial configurations generate a determined system of spatial relations and movement that are governed by societal rules. On the other hand a party is a 'spatial short model', since its purpose is to generate new spatial relationships by reshuffling the space of movement and occupied space, hence reshuffling must be done by using a 'spatial short model' (Hillier,2007). The design principles adopted here aim to produce symmetric, asymmetric, symmetric - asymmetric and distributed spatial relations that represent higher chances for social encounter and as such greater Integration within different spatial configurations. The principles determine the space of power and space of control according to the spatial configuration and the urban form. Based on the various spatial configurations the connector describes i.e the relationship of the occupied space (elementary cell) with the space of movement the principles illustrated indicate whether a spatial relation is either altered or created in the presence of a spatial 'long model or short model'.

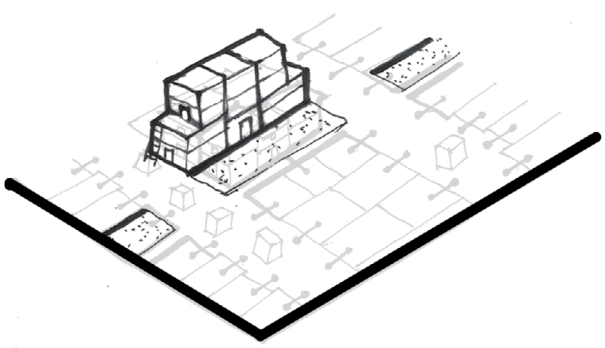
The creation of a new spatial relationship signifies transformation since the rules applied are towards reshuffling of a spatial relationship and hence a 'spatial short model', on the other hand a change where existing relations are maintained and enhanced through enhancing the relationship of the elementary cell with the space of movement is adaptation since spaces governed by societal rules are maintained in a 'spatial long model.'

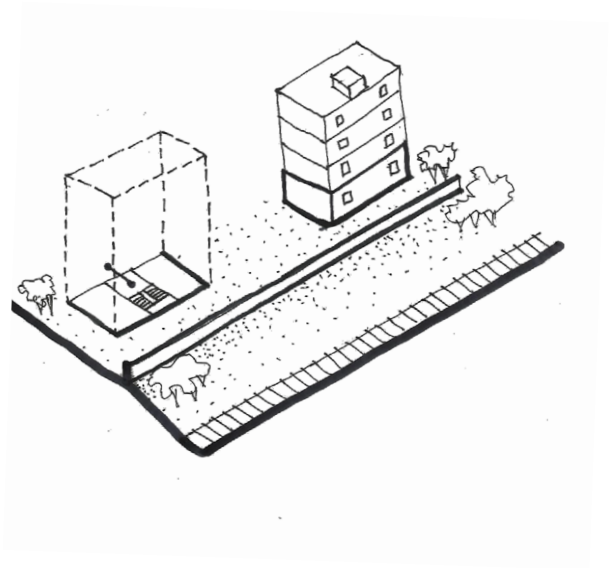
These principles are further tested through strategies applied to different spatial constraints and situations.

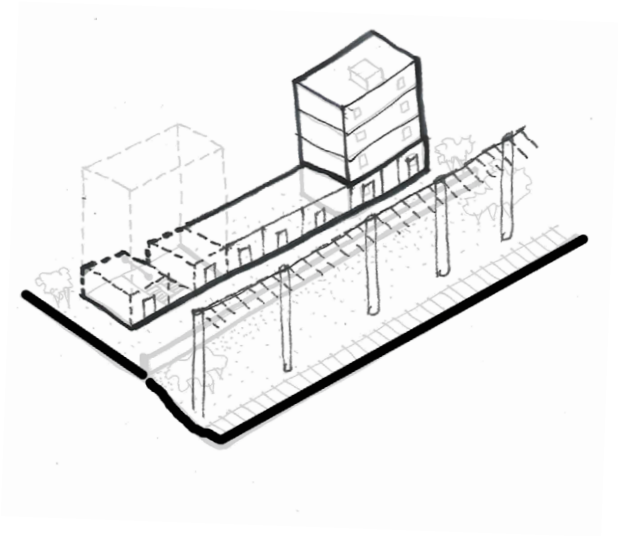
FIG. 10.1 Design Principles: Adaptation and Transformation

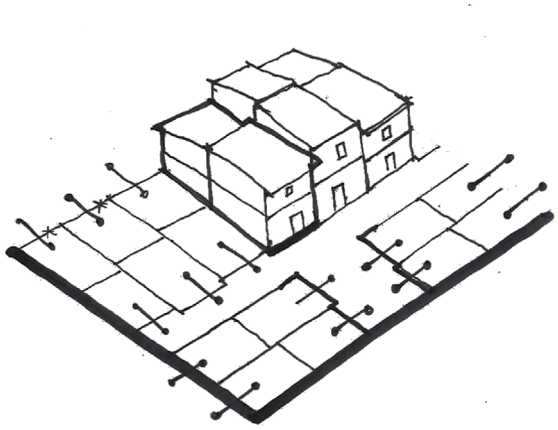
Existing *Proposed*

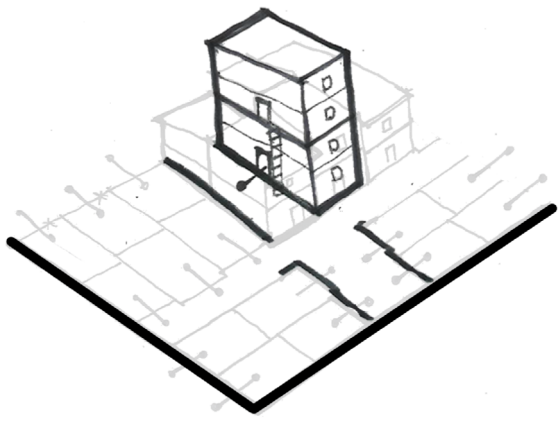












Application of Design Principles: Strategies addressing topological constraints between space of movement and occupied space

1. Adaptation:

Existing: for eg, the brick kilns or pottery area in Dharavi have a relationship to the open space ahead, the space in front is the working space, where pots and clay artefacts are made. As the space for movement is constrained by the width of the street between buildings,it is a constraint for public life, social encounters to take place and is a barrier for integration.

Proposed: The width of the street is increased by re-housing the inhabitants on neighbouring buildings, while entrances and relationship to the street is maintained. The space below could also become a retail space as a through-movement potential is increased

2. Transformation and Adaptation:

Existing: The railway infrastructure is an inaccessible space and barrier for formation of spatial relations across and through it. As such the built form maintains an asymmetric and non-distributed relation with the potential space of movement.

Proposed: As the flood prone, vulnerable railway infrastructure is elevated new relationships are formed below while the existing relationships are maintained. Spaces for smaller businesses , commercial and retail activity is opened up. The existing relation of accessibility to the built form is maintained while new relations are proposed towards the railway corridor changing the asymmetric and distributed relation with the space of movement, the railway space It becomes the space of control that can be appropriated by use

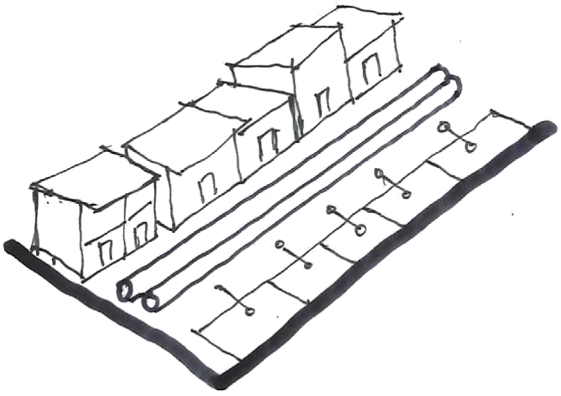
3.Transformation:

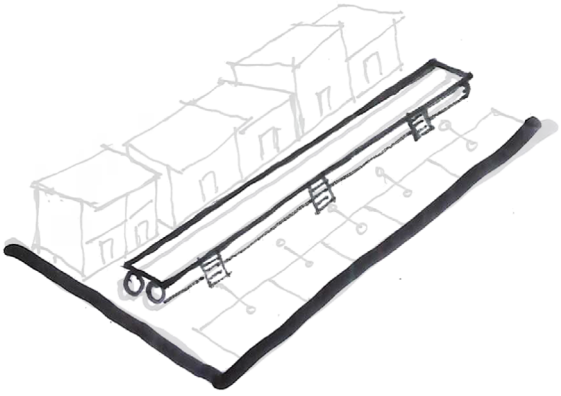
Existing: the built form and its entrances are a barrier for potential through-movement. Although, the built form has a symmetric and distributed relation with the space of movement.

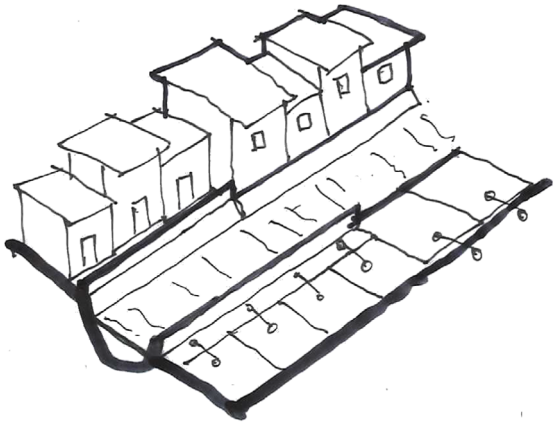
Proposed: as a barrier for potential movement, the spatial configuration is altered and new entrances are proposed. The affected built form is re-housed over neighbouring blocks. The potential re-configured built form can become commercial node or a space for neighboured activity, eg: kindergarten, art-centre to be established. Thus opening up space as a node or junction. It forms the space of control that is appropriated by use

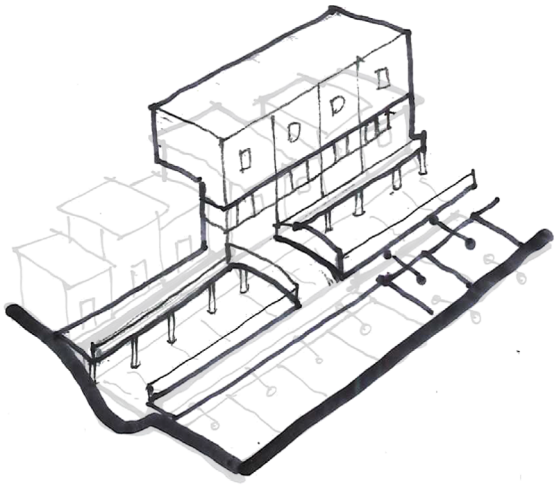
FIG. 10.2 Application of Design Principles:

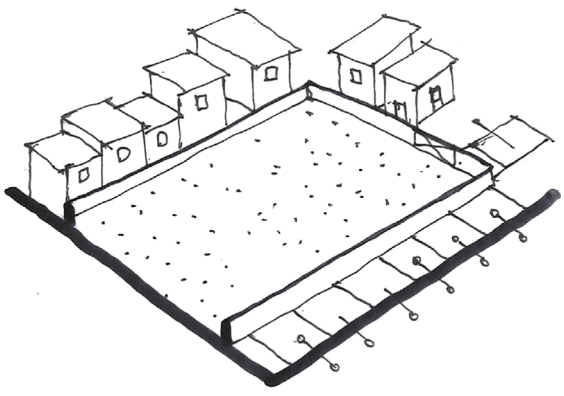
Existing *Proposed*

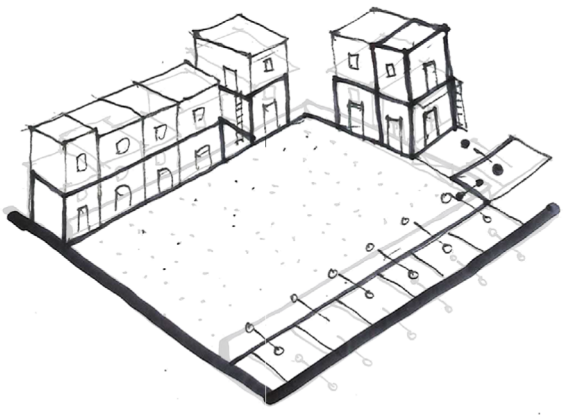












Application of Design Principles: Strategies addressing topological constraints between space of movement and occupied space

4. Adaptation:

Existing: although the existing relations are asymmetric and distributed, the pipeline is between two clusters and hinders the formation of relations across as an inaccessible edge.

Proposed: the pipeline is made accessible as the space of movement while existing spatial relations are maintained. The spatial strategy would entail further control of the area by inhabitants

5. Transformation and Adaptation:

Existing: the water canal is an inaccessible edge that maintains a spatial relationship with a mix of symmetric and asymmetric ,distributed spatial relations with Dharavi's clusters.

Proposed: the edge is made accessible while existing spatial relations are maintained and new distributed symmetric spatial relations are created. This opens the opportunity for retail, commercial activity. As well as it forms the space of control by inhabitants, thus adding safety and security to the space.

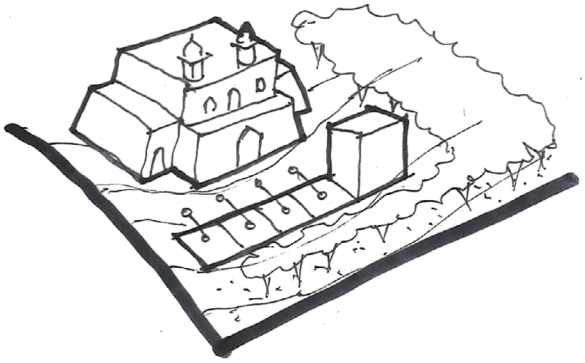
6. Transformation:

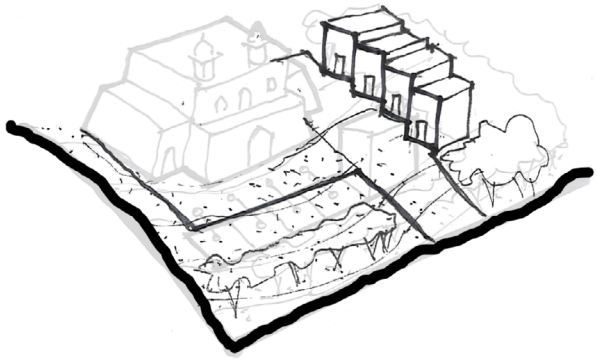
Existing: an enclosed, redundant open space is a barrier between the symmetric-asymmetric and distributed spatial relations with the space of movement.

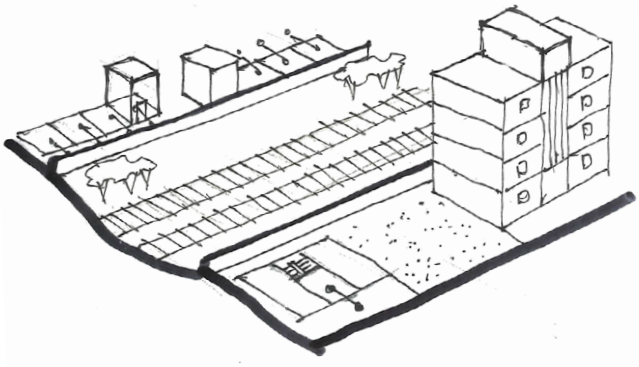
Proposed: the space of movement opens the enclosed space leading tolspatial reconfiguration between occupied space and space of movement, as such spatial relations would change to the open space, thus forming the community space or plaza for activities, festivities, and public life to unfold. It would also mean new distributed and asymmetric spatial relations are made thus forming the space of control.

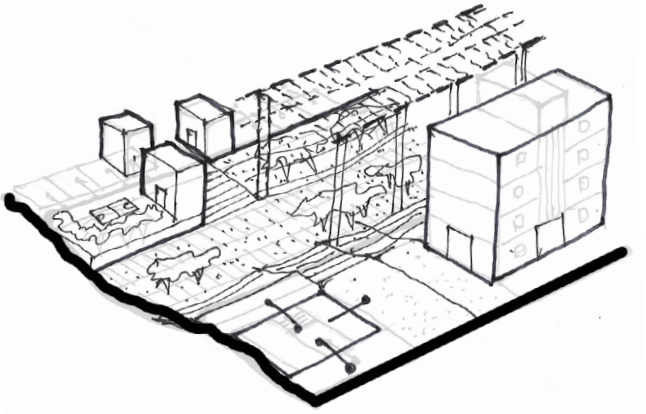
FIG. 10.3 Application of Design Principles:

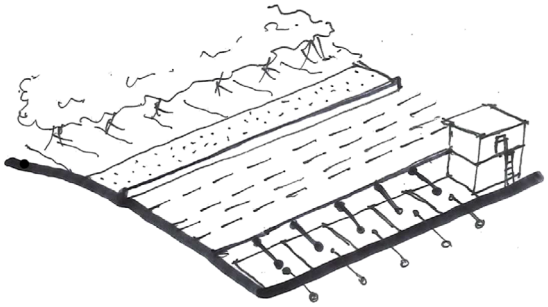
Existing *Proposed*

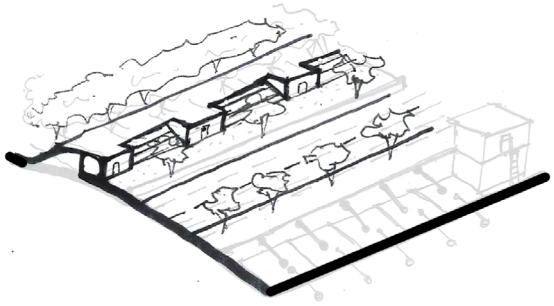












Application of Design Principles: Strategies addressing topological constraints between space of movement and occupied space

7. Transformation:

Existing: The Riwa fort, an existing heritage site in Dharavi is a fort that maintains spatial relations with the inhabitants of Dharavi's clusters. But it is inaccessible to visitors. The spatial relation is distributed and asymmetric, as such it forms the space of control, hence appropriated by inhabitants of Dharavi.

Proposed: By rehousing the block in its vicinity and transforming the spatial relation between the fort and the cluster the strategy entails that the fort is opened as a public space, although control is yet maintained by the inhabitants, it transforms from an inside to an outside relation, making occupied space accessible to visitors.

8. Transformation and Adaptation:

Existing: The railway infrastructure is an inaccessible space and barrier for formation of spatial relations across and through it. As such the built form maintains an asymmetric and non-distributed relation with the potential space of movement

Proposed: As the flood prone, vulnerable railway infrastructure is elevated new relationships are formed below while the existing relationships are maintained. As a junction of two connectors,the existing relation of accessibility to the built form is maintained while new spatial relations are proposed towards the railway corridor changing the asymmetric and distributed relation with the space of movement, the railway space becomes the space of control that can be appropriated for public use. The railway connector hosts the potential to become a park that is controlled and appropriated for public use and occupation. As such a potential for occupied space to form public buildings: schools, kindergartens, education institutes, that can vary in spatial hierarchy, and thus host the potential for diverse occupied , since the space of movement has the highest through-movement potential.

9. Transformation:

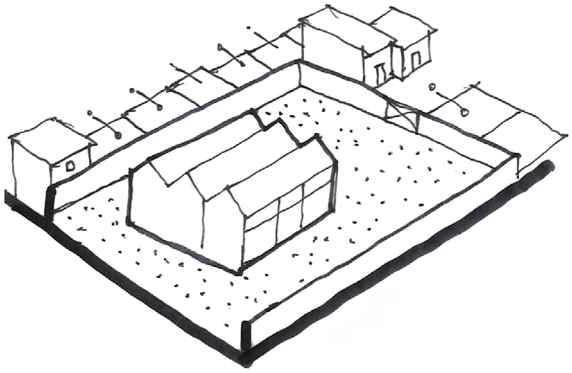
Existing: The river front is an edge and is a potential space of movement, but the edge is neglected and is inaccessible. The spatial relation of Dharavi's cluster to the outside is symmetric and distributed but it is also the space that lacks control. Here, Dharavi is also is at risk from sea-level rise.

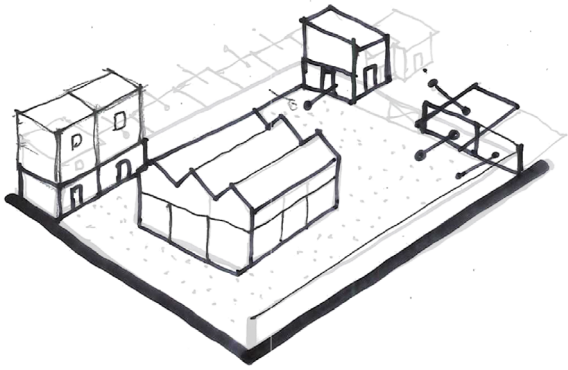
Proposed: The edge is made accessible by the use of a raised dyke, hence certain spaces below form asymmetric and distributed relations with Dharavi's exteriors, thus forming a space of control. The area above the dyke becomes the public space for slow movement and recreational activities, developing better spatial relations with Dharavi's outside as space of encounter. The transformation would entail enhancement of public activities such as space for festivities, as well as slowing down of vehicular traffic.

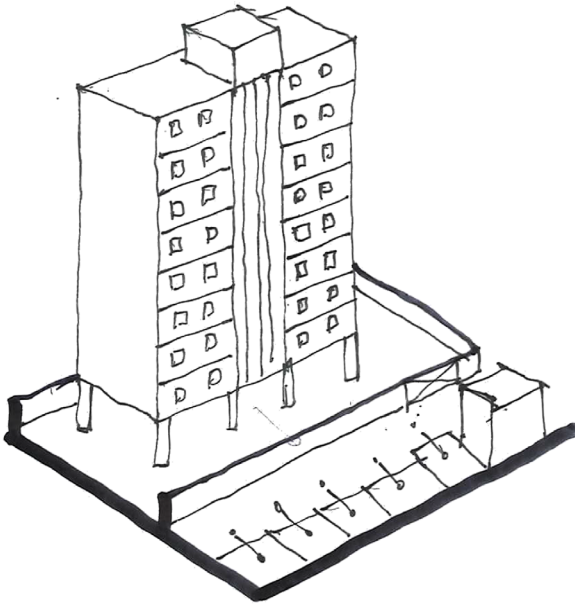
FIG. 10.4 Application of Design Principles:

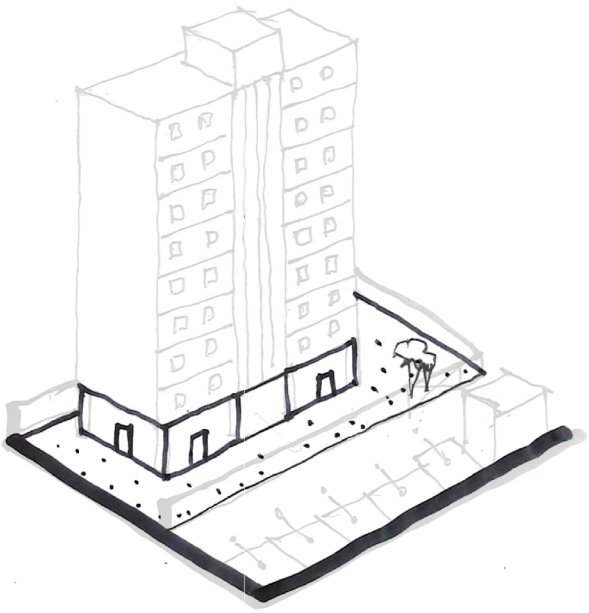
Existing

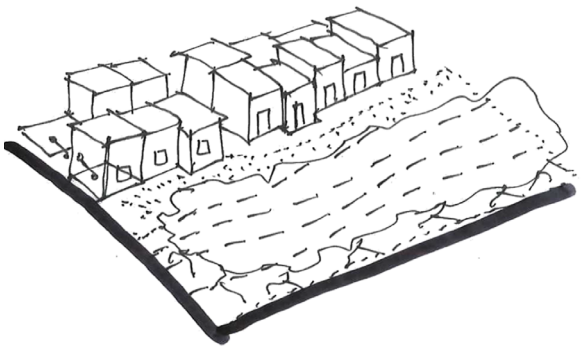
Proposed

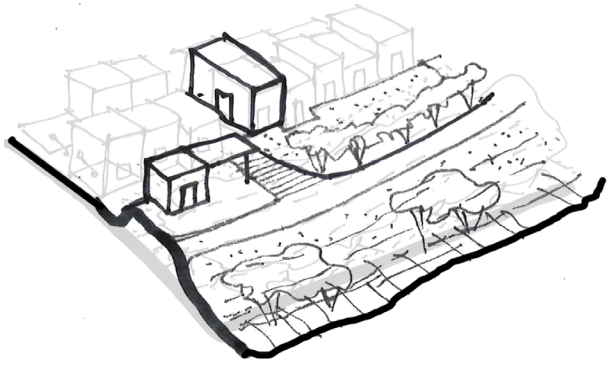












Application of Design Principles: Strategies addressing topological constraints between space of movement and occupied space

10. Transformation:

Existing: an enclosed, redundant space, with an abandoned building is a barrier between the symmetric-asymmetric and distributed spatial relations within the cluster.

Proposed: the space of movement opens the enclosed space and the built form would entail spatial reconfiguration between occupied space and space of movement, as such spatial relations would change the occupied space as the space of power. The potential built form can host functions: cultural institute, library, museum. It would also mean a new distributed and asymmetric spatial relation forming the space of power within Dharavi's cluster.

11. Adaptation:

Existing: The SRA and Private housing schemes are a spatial barrier. i.e to say the spatial relation with the space of movement and Dharavi's clusters is asymmetric and non-distributed. The housing scheme is determined as space of power when it should determine a space of control.

Proposed: By the addition of space (commercial, retail) in the stilt area the boundary is opened up and convex space is added to the street. Thus forming the space of control as well as adding space for public life to unfold, as such increased integration with the neighbouring cluster.

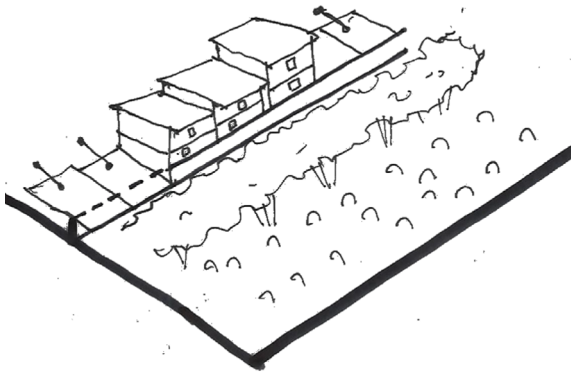
12. Adaptation and Transformation:

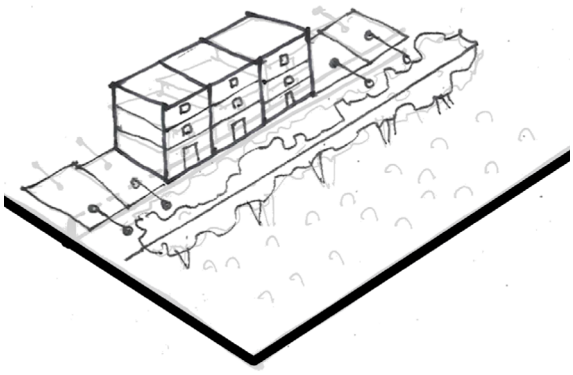
Existing: The river front is a living edge and is a potential space of movement, but the edge is neglected and is inaccessible. The spatial relation of Dharavi's cluster to the outside is symmetric-asymmetric and distributed is a space that lacks control. Here, Dharavi's cluster is also at risk from sea-level rise.

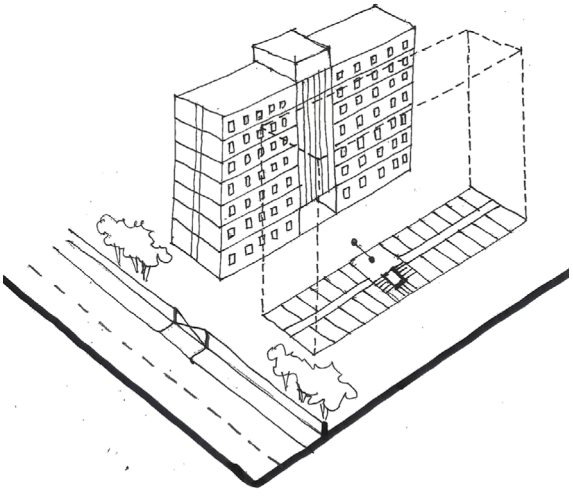
Proposed: The edge is made accessible by the use of a raised dyke, as such the new space of movement entails spatial reconfiguration of the clusters spatial relationship with the new space of movement. As a junction of two connectors, the space entails higher diversity, that forms the outside relation of Dharavi's cluster, as such forming a space of control based on the local-to-global spatial law, but also the addition of new occupied space determines the space of power. The new occupied space can host spatial functions: ecology centre, education centre or a cultural hub.

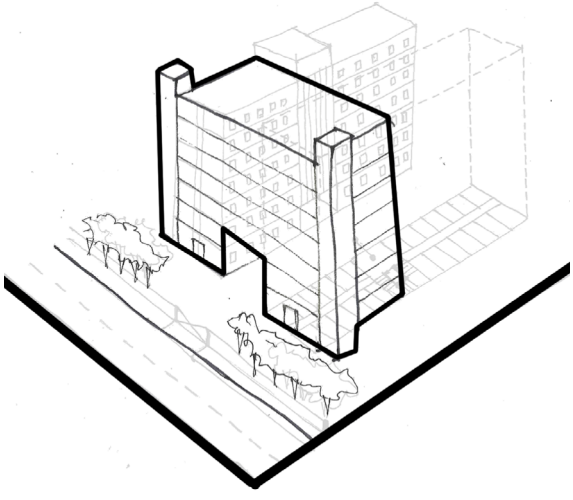
FIG. 10.5 Application of Design Principles:

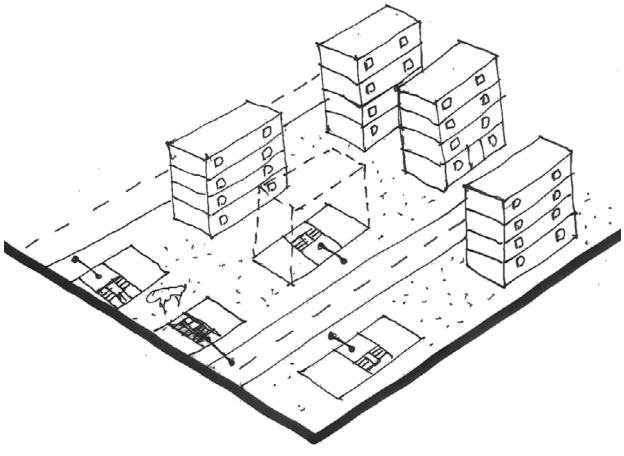
Existing *Proposed*

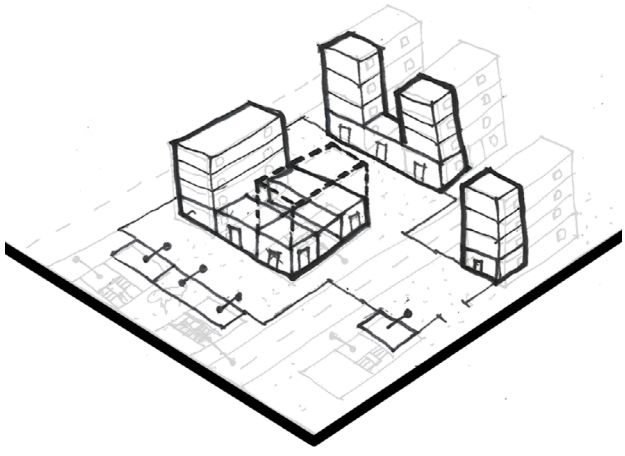












Application of Design Principles: Strategies addressing topological constraints between space of movement and occupied space

13. Transformation and Adaptation:

Existing: in the local-to-global spatial system of Dharavi, the cemetery is a space of power. The spatial relation that Dharavi's cluster maintains with it is asymmetric and distributed. As such it is inaccessible and closed. While this space holds the potential to become an accessible open space, since Dharavi lacks open space.

Proposed: A new space of movement that entails the opening of the edge and as such spatial reconfiguration of occupied space to the new space of movement. This would mean certain functions would be added in the ground floor adding safety and control, while the area around cemetery becomes accessible and safe, with symmetric-asymmetric spatial relations, as existing relations will be maintained within Dharavi's cluster.

14. Transformation and Adaptation:

Existing: The SRA and Private housing schemes are a spatial barrier. i.e to say the spatial relation with the space of movement is symmetric-asymmetric and distributed. The housing scheme is determined as space of power when it should determine a space of control.

Proposed: By the reconfiguration of the built form (commercial, retail) along the edge of the street (the space of movement) the boundary is opened up and convex space is added to the street. Thus forming the space of control as well as adding space for public life to unfold, as such increased integration with the neighbouring cluster as entrances are added to the street as well as safety (eyes on the street). In this case existing spatial relations are maintained in the inside while new relations are formed to the outside

15. Adaptation and Transformation:

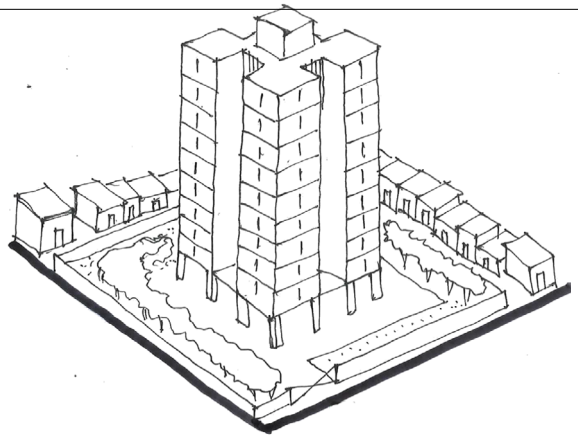
Existing: The existing spatial relations of the housing cluster adjacent to Dharavi to which a new space of movement (neighbourhood connector) is proposed , is symmetric-asymmetric and distributed

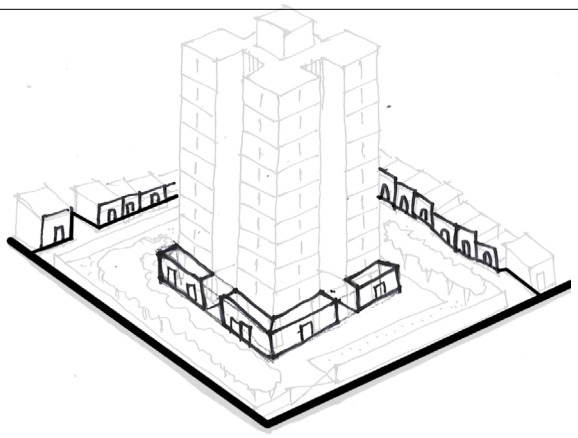
Proposed: As a new space of movement is formed , spatial reconfiguration is proposed, such that it forms a junction or node for occupied space . This would mean a public building that has few entrances and is the new space of power: school, educational institute. As such spaces around form a symmetric- asymmetric relation with the space of movement. The reconfigured built form maintains existing and adds new spatial relations.

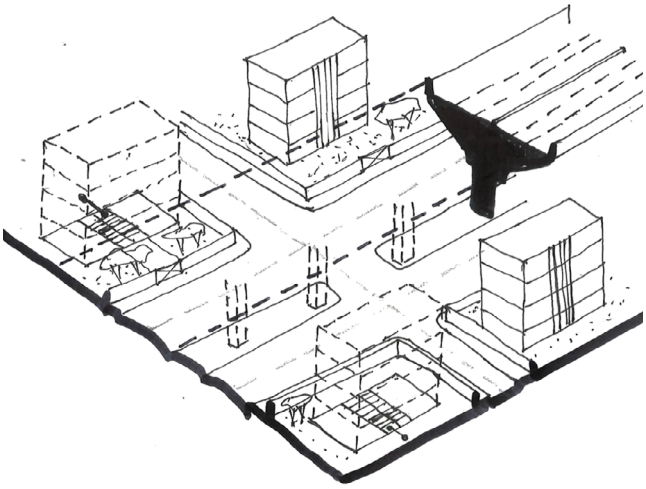
FIG. 10.6 Application of Design Principles:

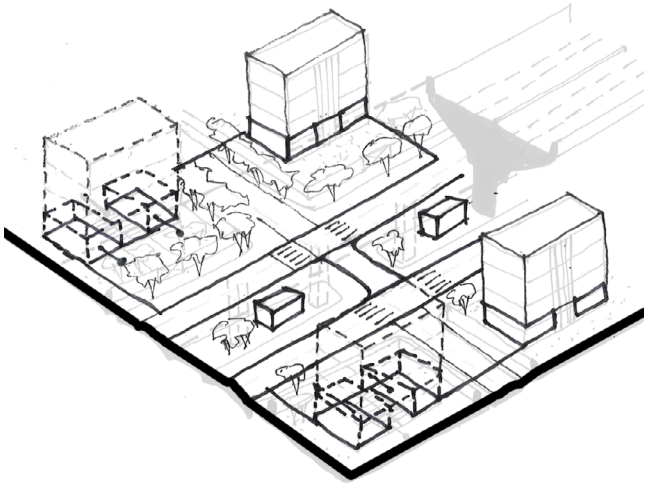
Existing

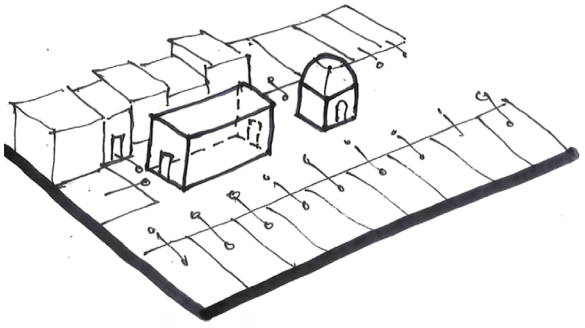
Proposed

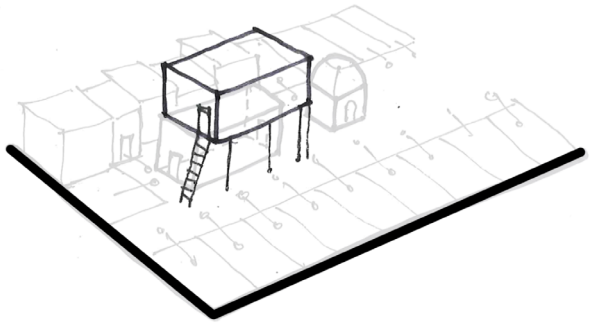












Application of Design Principles: Strategies addressing topological constraints between space of movement and occupied space

16. Adaptation:

Existing: The existing spatial relationship of a private scheme with Dharavi's neighbouring cluster is symmetric- asymmetric and distributed, and as such segregated and diffused control of space.

Proposed: A new space of movement that passes through the private scheme entails that spatial configuration is altered, the edge is opened and made accessible while the space of control is diffused to a larger extent, as such new entrances and spaces are proposed in the ground floor that enhance control on the open space as well as increase integration. The occupied space can be programmed to host functions: health centres, commercial, small business.

17. Transformation

Existing: Although Dharavi does not have a direct relation with the extra regional connector, it does host the potential for better spatial relations across, as the 'last' outside relation for Dharavi while defining the gradient of inside -outside relations. The spatial repercussion of the highway infrastructure is observed as a state determined space of power exerted on the spaces of control below. As such the spatial relations of built form is asymmetric, and non-distributed to the space of movement.

Proposed: By reconfiguration of the built form (commercial, retail) along the space of movement (the space of movement) the boundary is opened up and convex space is added to the space below. Thus enhancing the space of control as well as adding space for public life to unfold, as such increased integration across the infrastructural barrier. This would further entail the slowing down of traffic movement in the lower part and built reconfiguration to symmetric, distributed spatial relations. Thus opening the street front at the node to host functions such as colleges, schools, minor hospitals, commercial and retail activity

18. Adaptation

Existing: The existing spatial relations of Dharavi's cluster with social hotspots such as toilets and temples is asymmetric-symmetric and distributed, with temples and toilets being in the local-to-global reading spaces of power: community public buildings.
Proposed: the space of movement can define an addition of occupied space such that the addition would entail a further diffused control of the landscape and enhancement of spatial relations, This occupied space can host functions such as a multifunctional neighbourhood cultural hub.: Kindergarten, local community centre, health clinic,

FIG. 10.7 Application of Design Principles:

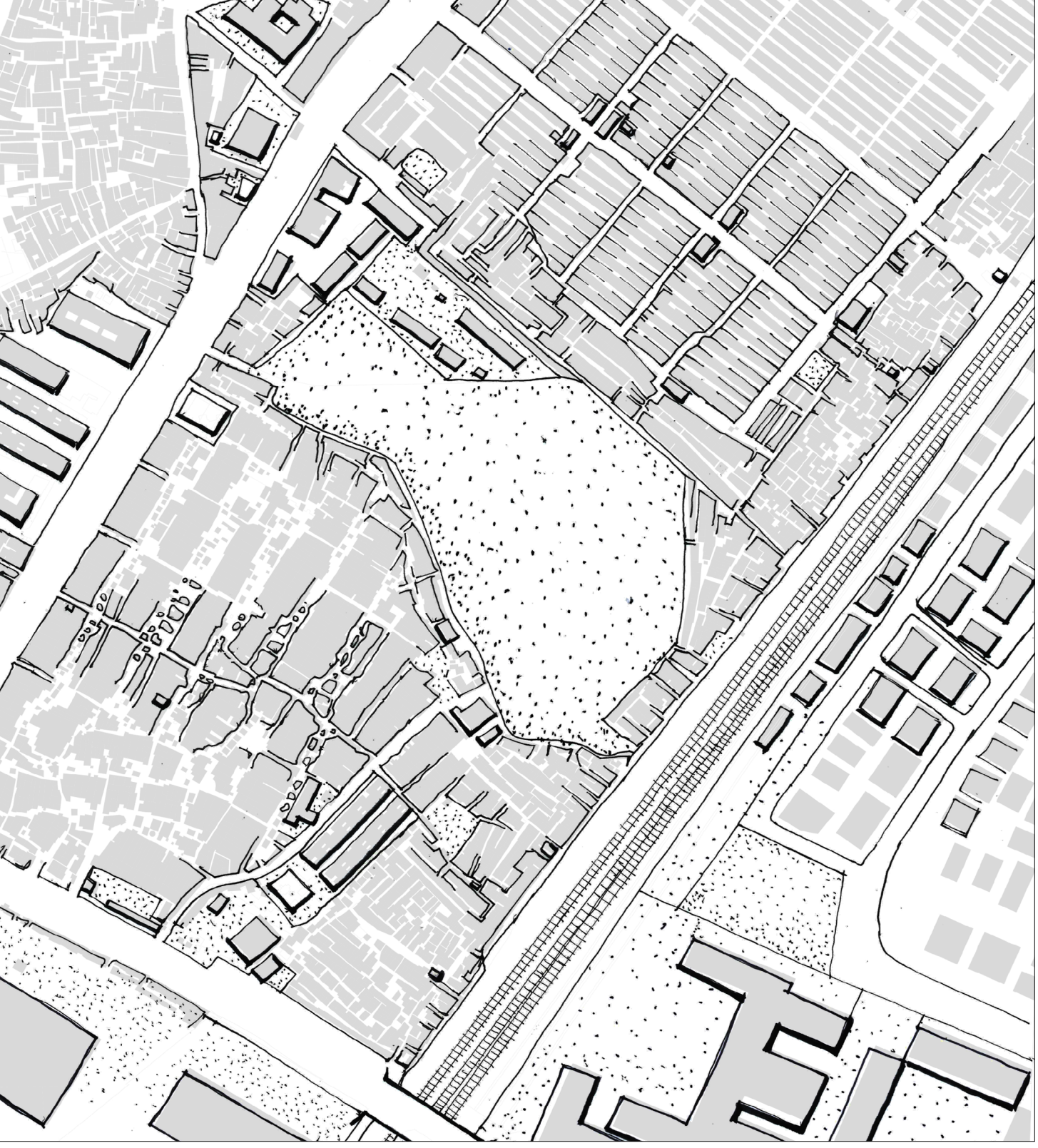
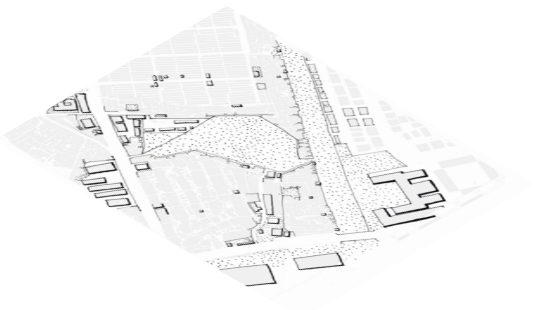


FIG. 10.8 Design Detail : Existing situation :Proposed situation :Kumbarwada / potters cluster and its neighbourhood. Drawn by: author

10.2 – **Design Detail**

Application of Design Principles : Kumbarwada / Potters Cluster

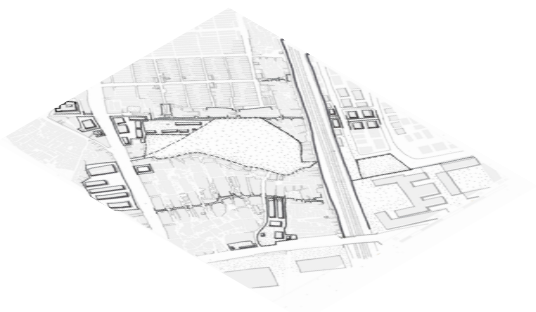
The potters cluster, (Appendix .3) is the cluster that depends on the space ahead of the house for its economic sustenance. Apart from this the they belong from the same ethnic community. As analysed before, the insides of this community are spatially segregated, hence the strategy envisions the opening up of this cluster in a sensitive manner.



1: Existing and Potential social attractors

1. Social attractors:

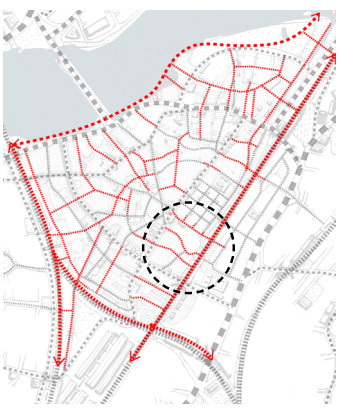
Through spatial reconfiguration the strategy imagines the valorisation of social attractor nodes as spaces that can be made accessible for greater societal value



2: Existing Spatial Barriers

2. Spatial Barriers:

It imagines the overcoming of spatial barriers as hindrances in generating societal relations via accessibility of space.



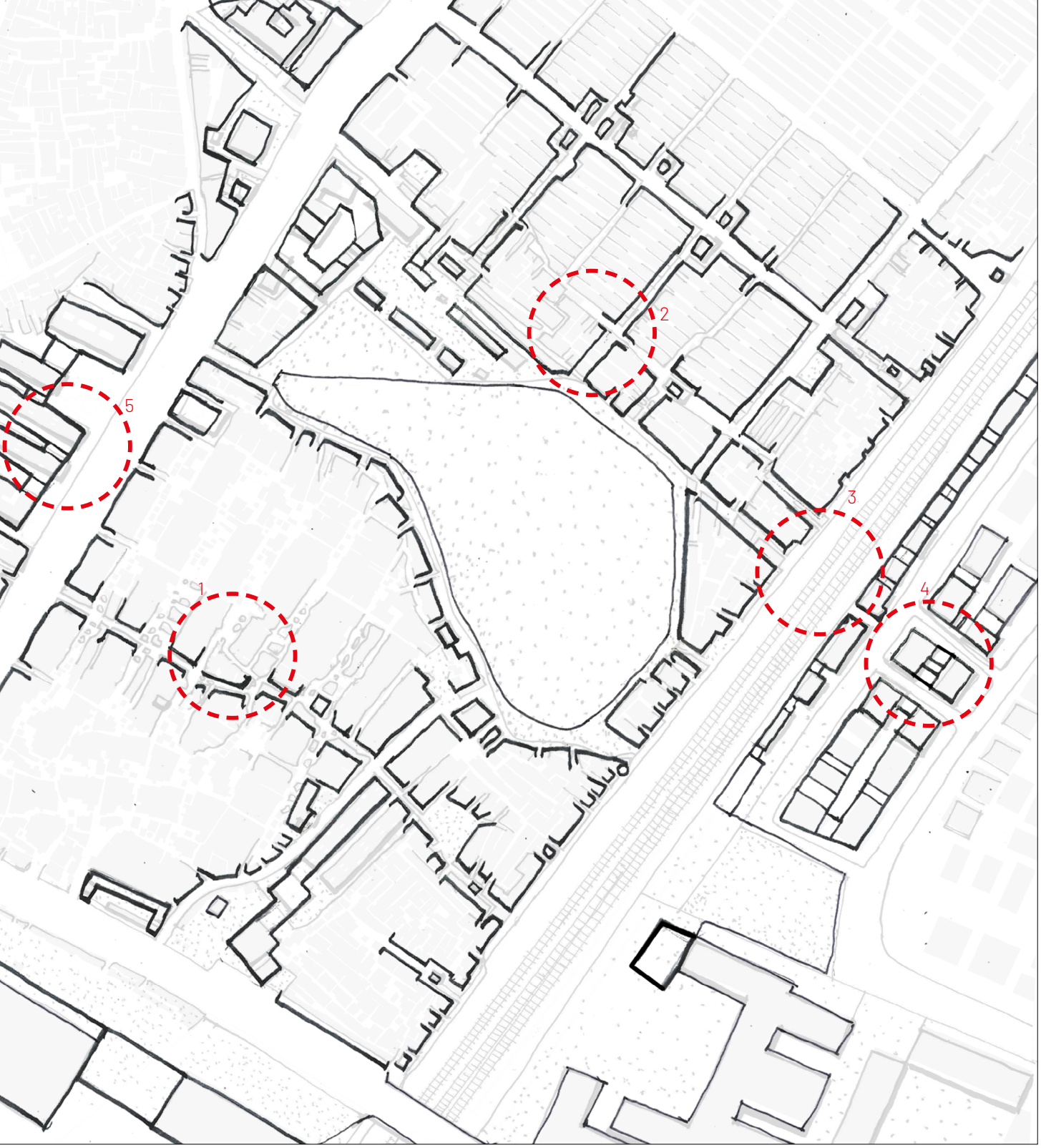
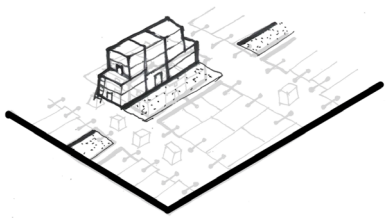
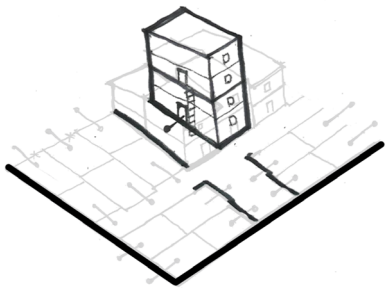


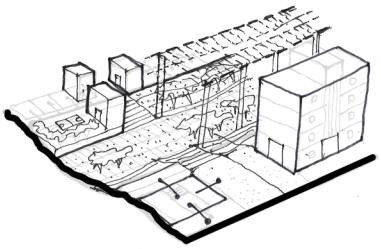
FIG. 10.9 Design Detail : Proposed situation :Kumbarwada / potters cluster and its neighbourhood. Drawn by: author



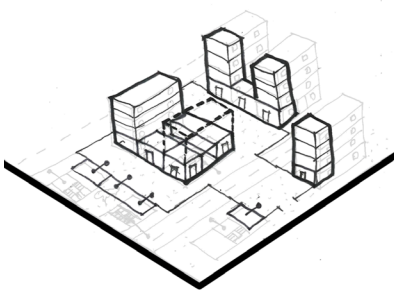
1. The width of the street is increased by re-housing the inhabitants on neighbouring buildings, while entrances and relationship to the street is maintained. The space below could also become a retail space as a through-movement potential is increased



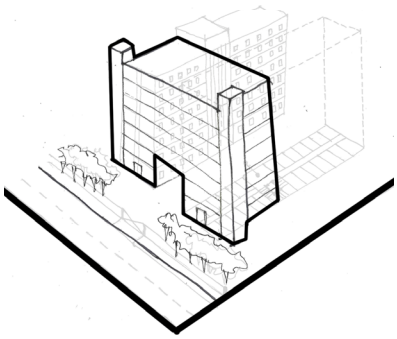
2. as a barrier for potential movement, the spatial configuration is altered and new entrances are proposed. The affected built form is re-housed over neighbouring blocks. The potential re-configured built form can become commercial node or a space for neighboured activity, eg: kindergarten, art-centre to be established. Thus opening up space as a node or junction. It forms the space of control that is appropriated by use



3. As a new space of movement is formed by the elevation of the railways, spatial reconfiguration is proposed, such that it forms a junction or node for occupied space . This would mean a public building that has few entrances and is the new space of power: school, educational institute. As such spaces around form a symmetric-asymmetric relation with the space of movement. The reconfigured built form maintains existing and adds new spatial relations.

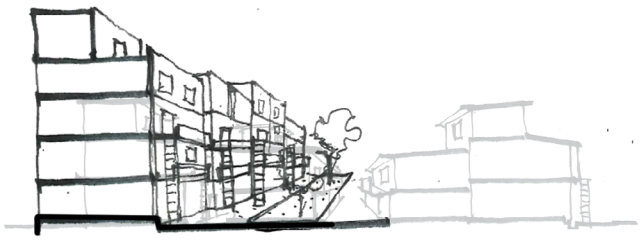


4. As a new space of movement is formed , spatial reconfiguration is proposed, such that it forms a junction or node for occupied space . This would mean a public building that has few entrances and is the new space of power: school, educational institute. As such spaces around form a symmetric- asymmetric relation with the space of movement. The reconfigured built form maintains existing and adds new spatial relations.

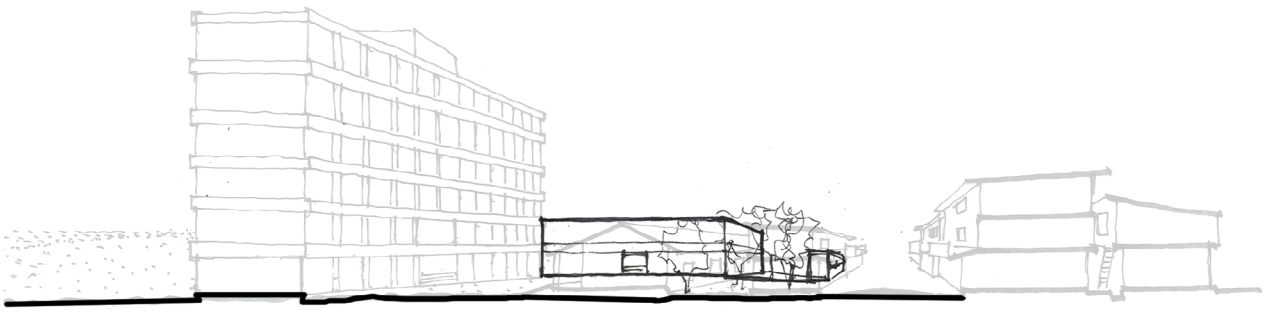


5. By the reconfiguration of the built form (commercial, retail) along the edge of the street (the space of movement) the boundary is opened up and convex space is added to the street. Thus forming the space of control as well as adding space for public life to unfold, as such increased integration with the neighbouring cluster as entrances are added to the street as well as safety (eyes on the street). In this case existing spatial relations are maintained in the inside while new relations are formed to the outside

Re-qualified Neighbourhood Connector: The spatial relation between SRA schemes and cluster edge is reconfigured allowing for commercial activity to take place in certain areas, while spaces are added between adjacent SRA blocks.This could host mixed neighbourhood functions: housing, kindergartens. The streets become shared space for social activity, childrens play area, communal processions.



Re-qualified Neighbourhood Connector: The spatial relations between spatially constrained cluster edges is ameliorated by rehousing previous households above the neighbouring ones, thus altering scale and adding social value to the street for street life to unfold. Ground floor areas host the potential for commercial , retail, neighbourhood activities to happen.



Re-qualified Neighbourhood Connector: The spatial reconfiguration of the public institution (school) is altered with a single entrance from the street adding higher control, as such the public institution becomes a space of power controling social activties in its vicinity.

10.3 – **Re-qualified Neighbourhood Connectors**

The concept of re-qualification entails slowing down of vehicular traffic on streets, that are shared spaces. Simultaneously, reconfiguration of occupied space asymmetric and non-distributed relations towards symmetric relations, and enhancing symmetric, distributed relations by the addition of open spaces ahead. By using the ground floor or stilt areas for commercial and retail activities in the case of SRA, and private schemes. The street becomes the space for public life to unfold, encouraging social encounters and urban form is altered such that entrances of buildings are towards the streets. Hence, higher control on street activities as spaces are appropriated by neighbouring communities for use, this action adds safety and security in the inside areas of Dharavi's environment. As urban form is altered to build spatial contiguity, the scale of the space is also altered too. The addition of previously enclosed open spaces and new open spaces in the environment would allow for community activities such as festivities, children play areas, green spaces to be brought to the public front. Public institutions such as schools are reasserted as spaces of power with minimum entrances, surrounded by large open spaces.

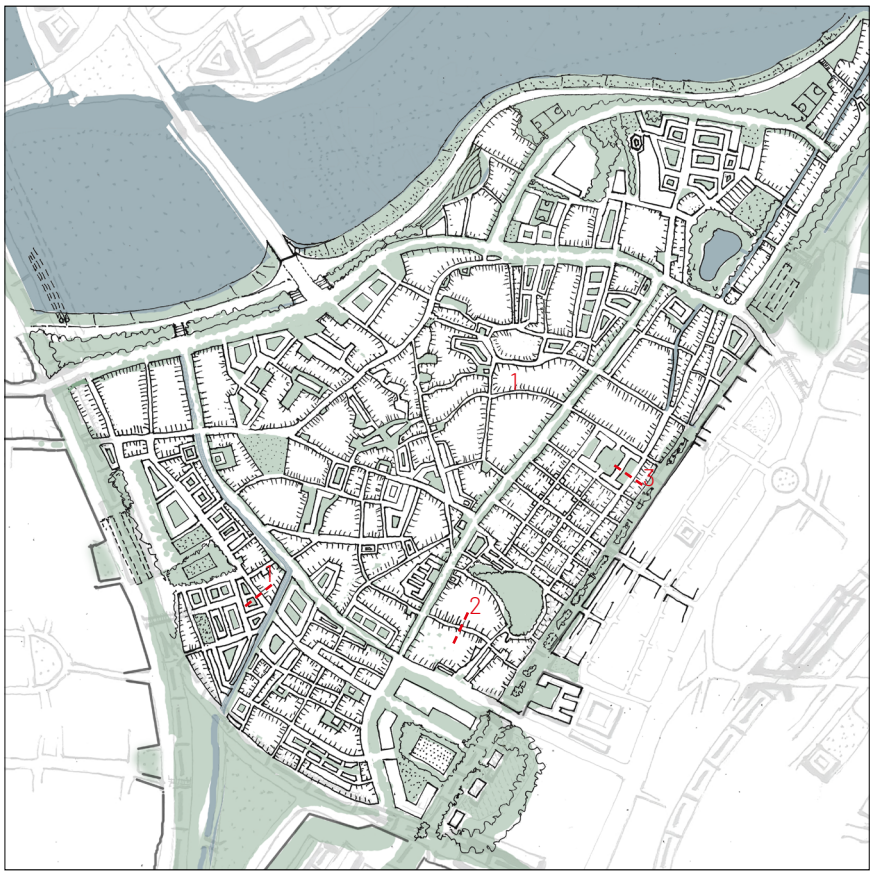
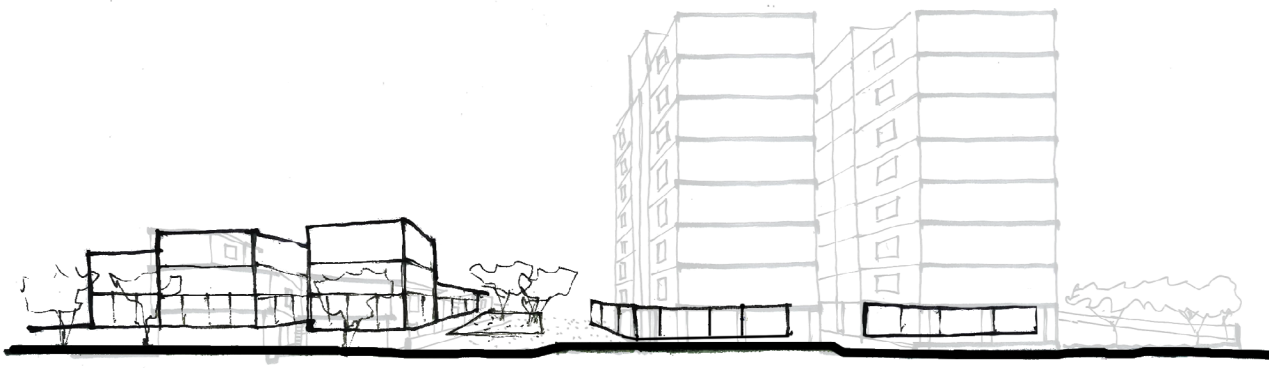


FIG. 10.10 Re-qualified Neighbourhood Connectors. Drawn by: author

New Neighbourhood Connector: The area around religious spaces increased to accomodate open space and spatial configurations around are altered to ensure diffused control of the space.



New Neighbourhood Connector: The spatial relation between SRA schemes and cluster edge is enhanced allowing for movement across previously closed edges through appropriation of ground rights. This space carries the potential to host mixed ,neighbourhood functions: housing, kindergartens. community centres, civic space .

New Neighbourhood Connector: The relation between private properties and clusters are reconfigured as new space of movement is created along the canal front adding safety to the previously ignored edge.

10.4 – **New Neighbourhood Connectors**

As new spaces of movement are formed, existing occupied space is reconfigured towards symmetric-asymmetric and distributed relations. Using ground floor or stilt areas for commercial and retail activities in the case of SRA, and private schemes. As through-movement is allowed along canal fronts, canal fronts are made accessible and safe. The previously enclosed SRA and private enclaves are reconfigured, opening inner private areas to public use, as such new spatial relations are formed while also maintaining the existing one. This could be done by enforcing ground rights on private entities to ensure accessibility. The spatial configuration around religious nodes is reconfigured such that new relations are formed to it and the surrounding space is relieved to add open space and increase entrances to it, as such diffusing the space of control around religious institutes.

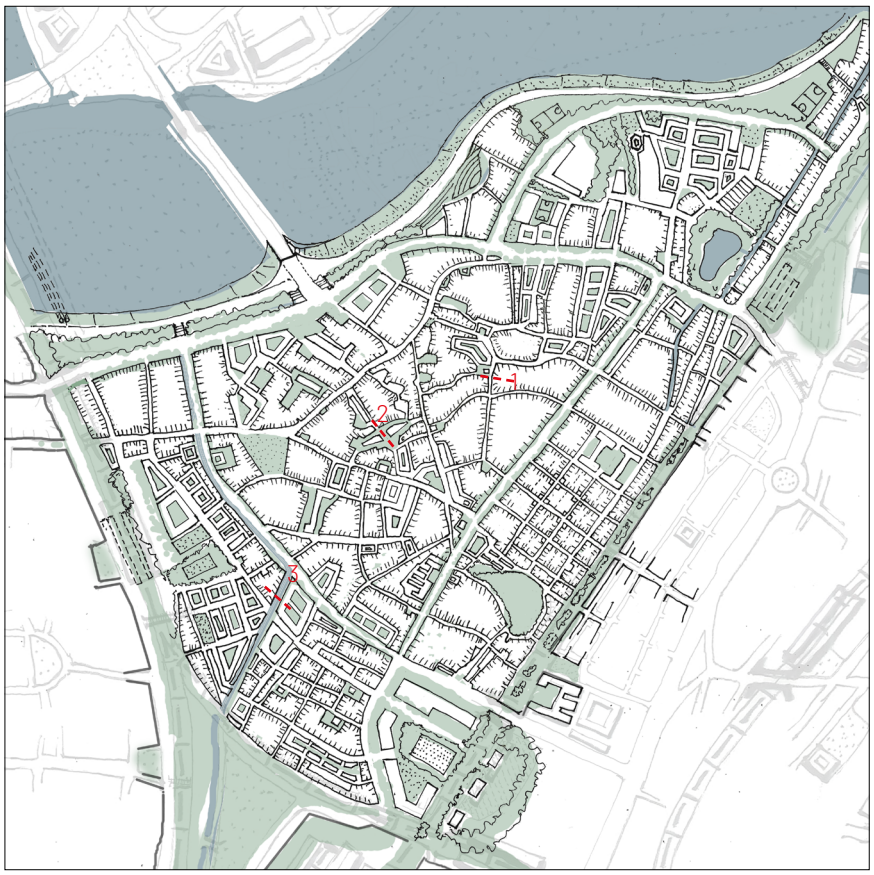
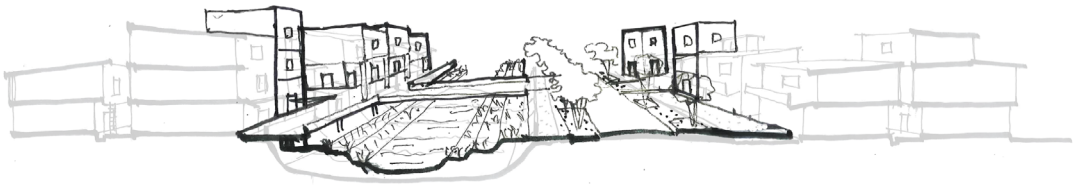
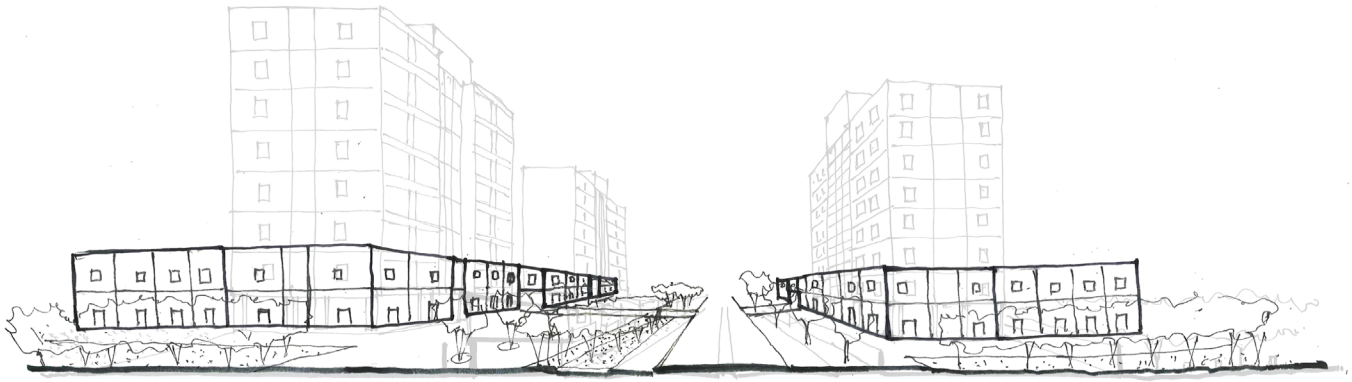


FIG. 10.11 New Neighbourhood Connectors. Drawn by: author

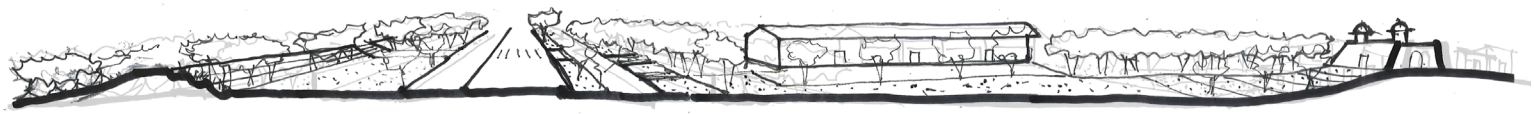
Re-qualified District Connector: The spatial relationship between and cluster edges is enhanced allowing previously closed open inside community spaces to be brought to the outside creating space of higher integration and communal activities, place for festivities to unfold



Re-qualified District Connector: The spatial relationship between cluster and a previously ignored canal edge is enhanced for district activities to unfold allowing, new district nodes at junctions of neighbourhood and district connectors, such as health care centres, minor hospitals, schools. with ground space for commercial activity . This would entail maintenance and cleaning of the revitalised canal edge.



Re-qualified District Connector: : Previously enclosed parks are opened up and higher convex spaces are created, Functions on the street are accommodated in new spaces along the SRA schemes. Adding shared space to the street, with higher capacity for green spaces.



Re-qualified District Connector: The relationship between the Fort, and river front is strengthened: forming a park and educational, exhibition, cultural space. More pedestrian spaces are made available as well as recreational grounds are added to the river-front as an accessible space

10.5 – **Re-qualified District Connectors**

In the case of district connectors, re-qualification entails slowing down of vehicular traffic on streets by reduction of street width for traffic movement and shared space for people and vehicles. Simultaneously, open spaces become accessible, and previously closed community spaces that were the inside spaces become open for the visitors, thus becoming more accessible to host functions related to the district connector: school, health centres, minor hospitals. As previously inaccessible spaces become accessible by spatial reconfiguration towards symmetric, distributed relations, the canal forms a recreation space, this would surely entail socio-ecological processes to be involved in the further process of design. Also previously enclosed private and SRA schemes could re-accommodate adjacent settlements forming a space of higher integration. Areas that were previously inaccessible, heritage and river front are reconfigured and form an integrated open space as new spaces of movement.

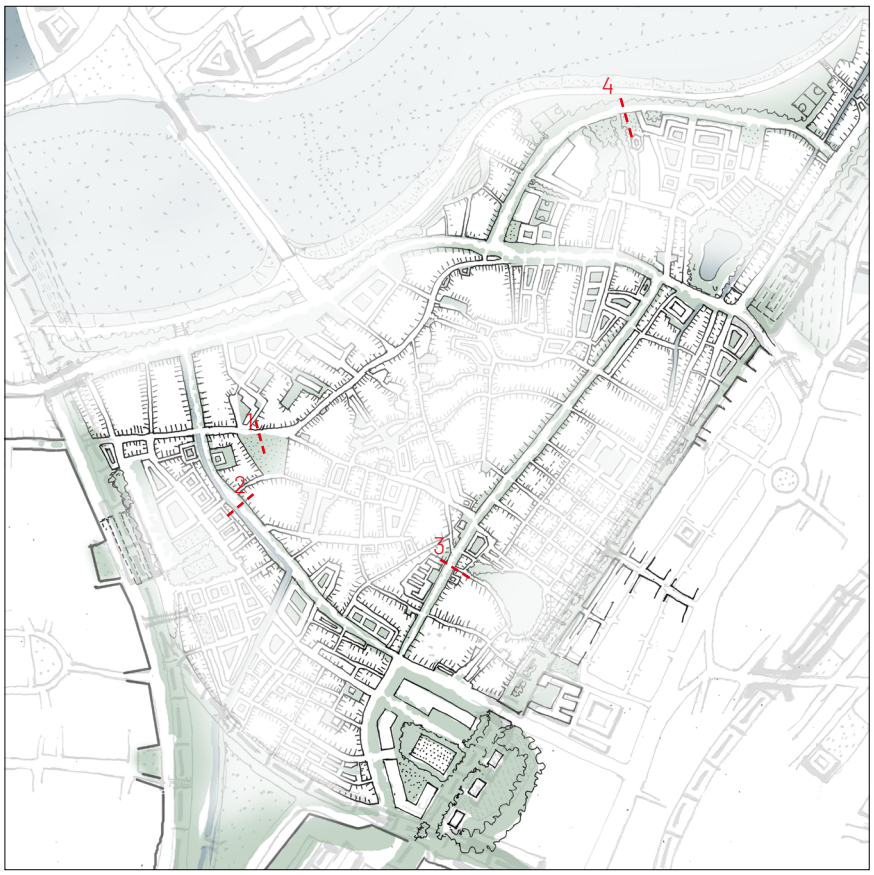
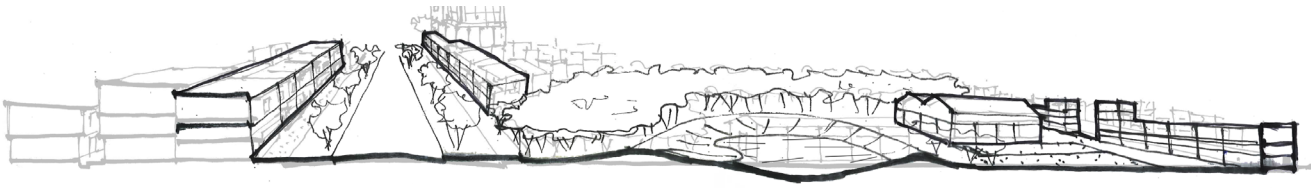
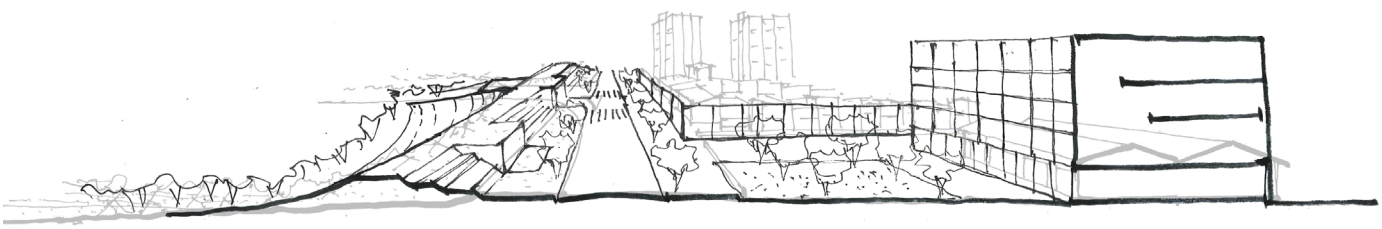


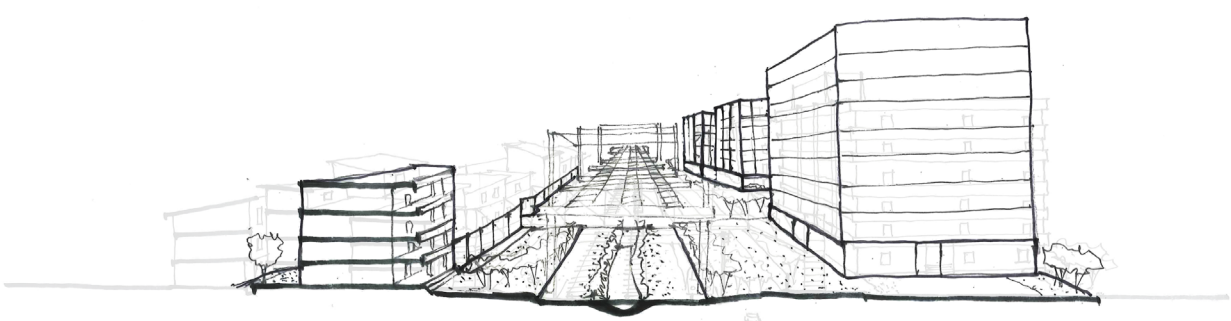
FIG. 10.12 Re-qualified District Connectors. Drawn by: author



Requalified Regional Connector: The Relationship between cluster edges is strengthened by slowing traffic down, opening redundant closed spaces for a park with water storage, and revitalizing the disused building for Regional activities such as a civic centre, cultural centre,



Re-qualified Regional Connector and river edge: The Relationship between Dharavi and the region is strengthened by adding convex spaces facing the river front, Adding occupied space to the space of movement: cultural institutes could valorise this space as a space of power and control.



New Railway Connector: The elevation of a vulnerable railway infrastructure makes the space below to be appropriated by adjacent spaces , adding green and open space value. Existing Public buildings could gain value by vertical expansion as well. Educational, cultural centres could appropriate spaces for activities to unfold.

10.6 – **Re-qualified Regional and Railway Connectors**

In the case of regional connectors, re-qualification entails slowing down of vehicular traffic on streets by reduction of street width for traffic movement as well as addition of space for pedestrian and public life to unfold. Simultaneously, redundant spaces are opened to the public front such as parks and cultural institutes. The space of control is reinforced by reconfigured public institutes as spaces of power. Higher street life entails greater social encounters and hence to ensure spatial contiguity spaces are reconfigured to bring in uniformity in urban form, adding further control to street life. The river front becomes an accessible dyke (protection from sea-level rise). As slow moving corridor as a space of recreational spaces are opened formed along the river and regional connector, integrating Dharavi and the outsides (the region of Mumbai).

The Railway connector hosts the highest potential for diversity, (built form and use) as it runs through the spine of Mumbai. As such space along the previously inaccessible railway infrastructure is made accessible by the elevation of the railways, this would entail that spaces around could appropriate the front as an accessible open space (a park). Spaces of recreation are added to the public realm. Adjacent functions such as schools, hospitals, cultural institutes, mill lands could valorise this space for higher diversity, thus a space of integration.

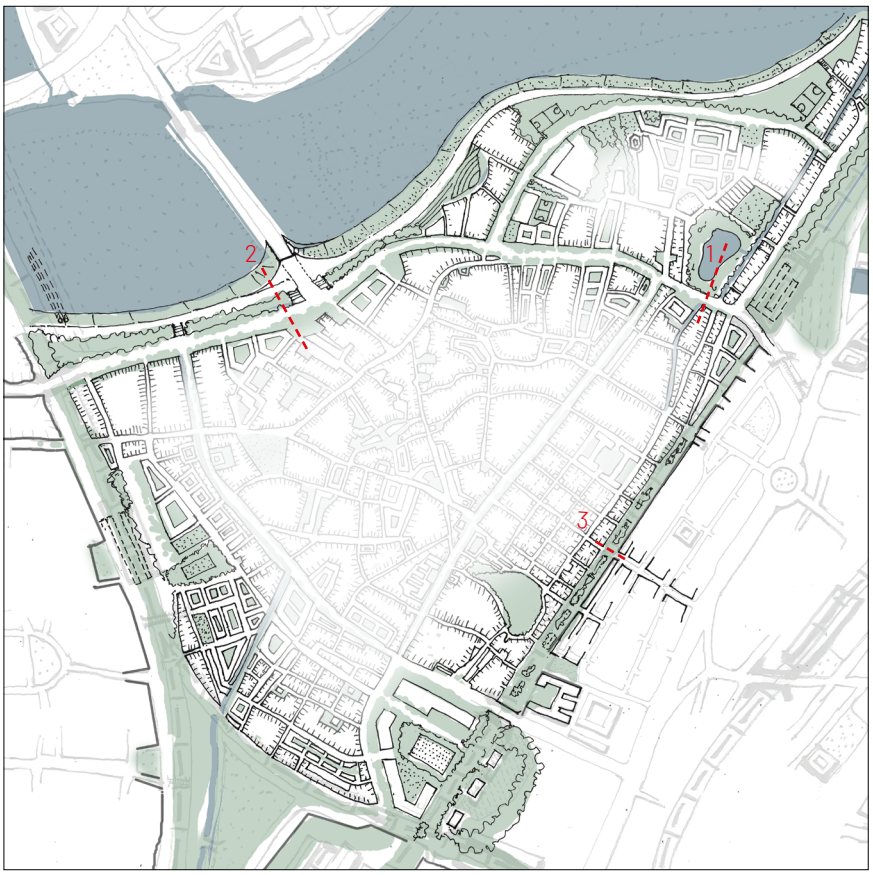
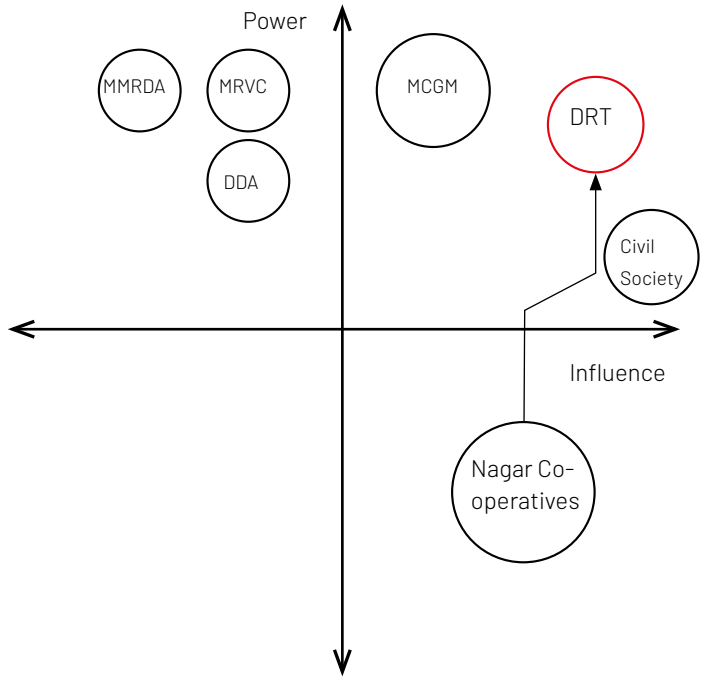
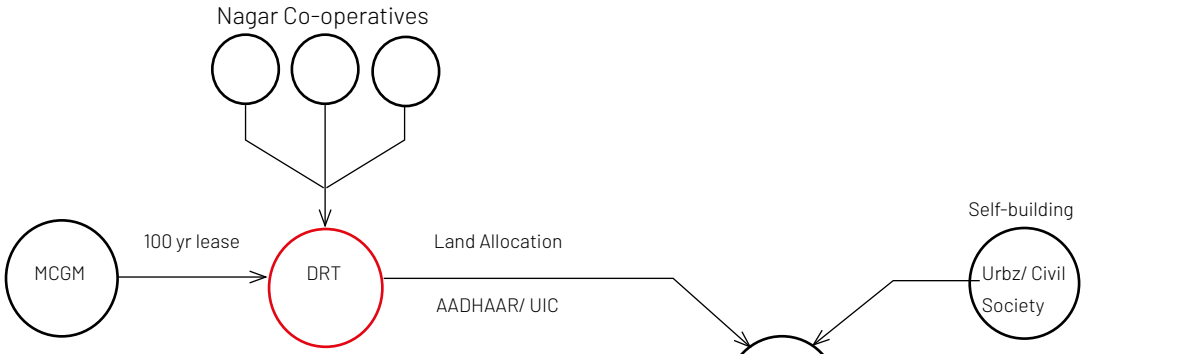


FIG. 10.13 Re-qualified Railway and Regional connector Neighbourhood Connectors. Drawn by: author

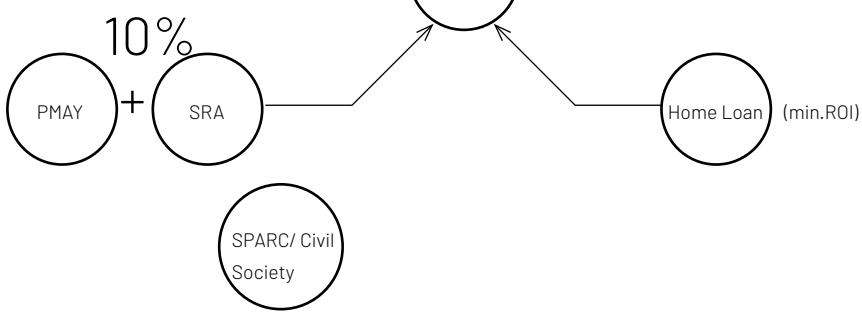
Power & Influence



Land Ownership

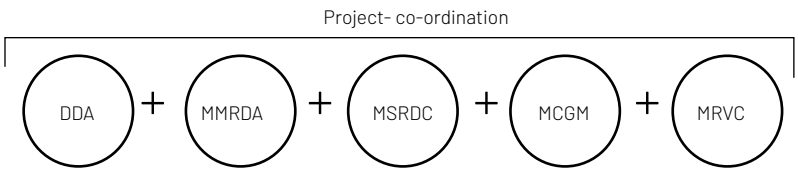


Financial Strategy



Infrastructure

water, & sanitation,
railways
roads
waterfront dyke



10.7 – **Stakeholder and Agencies Strategy**

In order for Dharavi to foster social resilience it must be able to access assets and resources from the wider socio-political arena. This would mean accessibility to institutions and power relations that are both the structure and are structured by social relations. 'Entitlement' is the key to fostering social resilience, Entitlement refers to the extent to which assets and resources are accessible to communities and societies (W. Neil Adger, 1999).

Land Ownership:

The strategy in this case envisions that majority of the land owned by MCGM is leased for a period of 100 years to a new trust (Dharavi Redevelopment Trust) that ensures that land is allocated just and efficiently to Dharavi's inhabitants. The Trust is created by elected representatives from the Nagar co-operatives (Housing Associations). The use of AADHAAR (Unique Identification Code) can ensure that land is leased with adequate legal representation to households.

Financial Strategy:

The financial strategy for redevelopment of households affected by this strategy envisions that 80% of the scheme is sponsored by the individuals of Dharavi. The remaining financial support is gained from joint a scheme between SRA or PMAY (Pradhan Mantri Awas Yojana-Housing for All- Ministry of Housing and Urban Affairs) home-loans from financial institutions that are subsidised with minimum rates of interest. DDA can shoulder the responsibilities for the adequate provisioning of infrastructure such as sewage, water and, waste disposal. NGO's or civil society representatives such as SPARC and Urbz can overlook the implementation of the strategy in phases and voice the opinions of Dharavi's inhabitants.

Strategy for Connectors:

Through the connectors the strategy envisions alteration in streets, the elevation of the railway infrastructure, as well as the river edge as a dyke, all of which are long term strategies. This would require involvement of agencies such as railway authority- MRVC, road and infrastructure development authority- MSRDC, development authority-MMRDA, and the municipality

FIG. 10.14 Stakeholder and Agencies Strategy.
Drawn by: author

रहिमा जनरल स्टोर्स

PART 3 **Evaluation and Conclusions**

Evaluation | Conclusions | Design Reflection

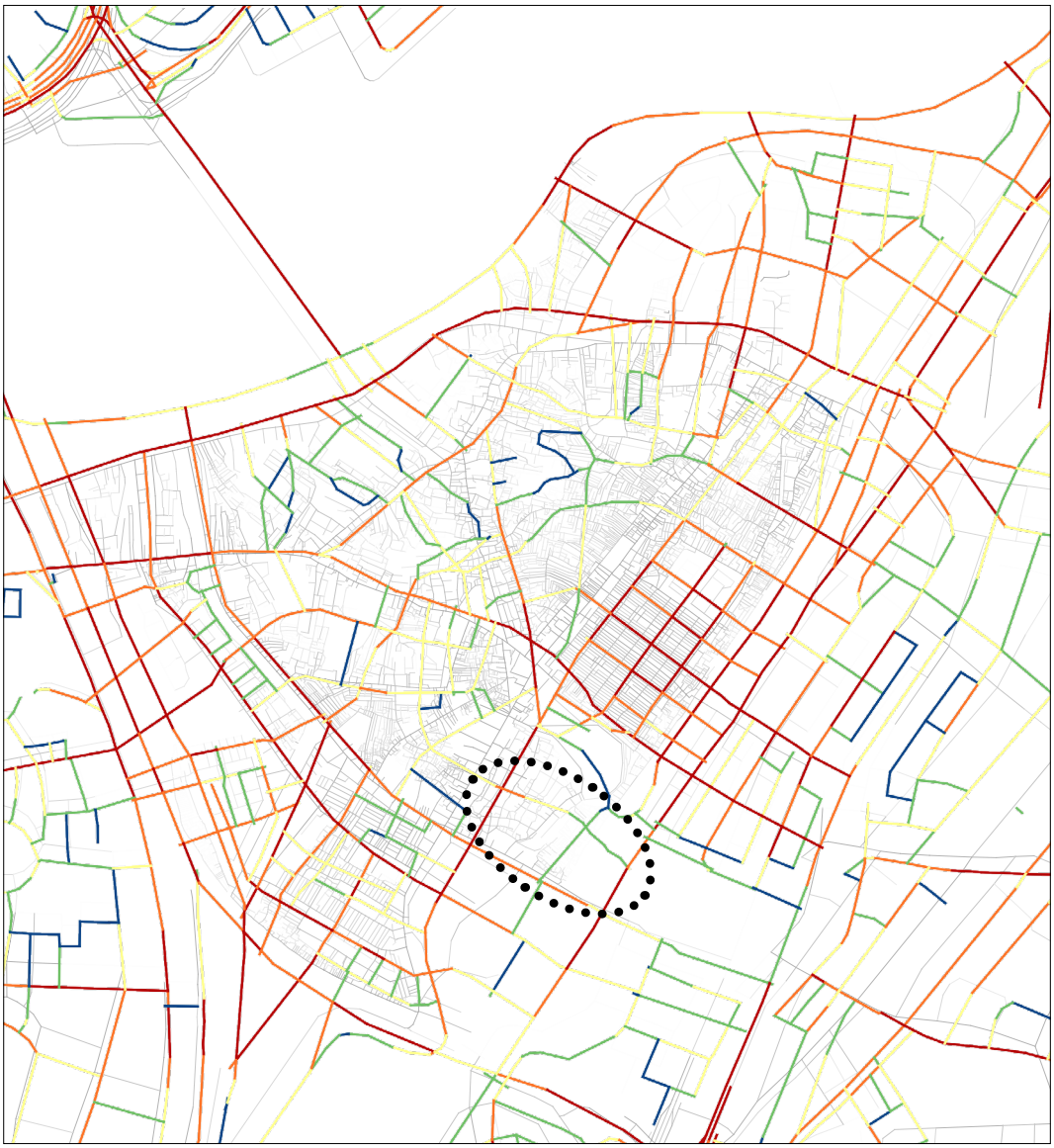


FIG. 10.15 Proposed Design: Dharavi Segment Angular Integration: PST_NAIN_500m_Quantile

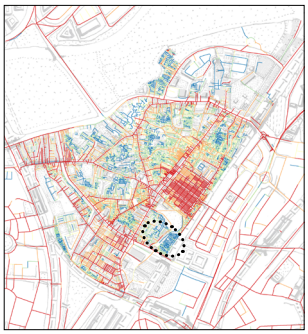


FIG. 10.16 Existing: Dharavi Segment Angular Integration: PST_NAIN_500m_Quantile

High integration

Medium integration

low integration

11 – Evaluation

Although rudimentary, the evaluation is done on the proposed design by carrying out a Local Segment Angular Integration analysis. The map to the left clearly indicates the differences by the addition of the space of movement. What is observed is that the segregated areas get integrated into the new layout. This method of refinement for achieving social solidarity can continue till minimum angular deviations are obtained that co-relates with visibility and comprehension of space, but that would mean breaking apart existing spaces of integration and as such dilution of organic solidarity of Dharavi, which is. not intended,since the aim is to maintain and enhance social solidarity. Besides this the testing of principles through strategies alleviating topological constraints further adds to social solidarity as symmetric, symmetric-asymmetric distributions are formed. The addition of as public spaces, eyes on the street, sense of community, upgraded community infrastructure, revitalised edges, are actions towards fostering societal robustness through space.

Also by shifting the relationship of religious structures of society from a space of power to diffused control would mean greater accessibility and entitlement to spaces surrounding religious institutions, forming a political setting for the inhabitants of Dharavi and its visitors, this could potentially ameliorate the ethnic differences that constrain societal relations between Dharavi's community. The creation of new public institutions in redundant spaces as spaces of power would allow for institutions to become the new spaces of politics and power between Dharavi and the rest of Mumbai, and education would gain a forefront in the upbringing of society. As the connectors determine spatial hierarchy, diversity (function and form) from the capacity of through-movement, re-qualification of spaces would allow for a peaceful and humane environment that is rich and diverse in social use. Spatial accessibility would also entail up-gradation and retrofitting of existing infrastructure such as water and sanitation.

12 – Conclusions

Design and Theoretical conclusions

"As space is a function of the forms of social solidarity i.e. in turn a product of the structure of society" (Hillier, 1984) it can be argued that space that is a 'construction' or action permits society to act in both material and immaterial realities. The initial hypothesis that, it *is* the capacity of space to be adapted or transformed to enhance societal relations and in turn fostering social solidarity against external perturbations and in turn contributing towards social resilience is evident through the mixed-method framework (design -research & research-by-design) of description adopted.

The capacity of space towards fostering social resilience clearly lies in the act of transformation, adaptation or change by society to enhance societal relations towards social solidarity, i.e. to say, the capacity of space to adapt or transform can be defined by the description of the principles of social solidarity (which are, *the space of organic solidarity and the space of mechanical solidarity*) through the simplest spatial structure of the 'elementary cell'. The distinction between the 'outside' and 'inside' relations of this cell i.e. the exterior space in which society is produced, such that new relations are generated and the interiors in which it is reproduced based on the spatial laws of *local-to-global* and *global-to-local phenomenon* together determines the 'space of power' and the 'space of control' i.e the ideological domain of space and the political domain of space respectively. Here, the restriction on these spatial relations towards fostering social resilience by the 'elementary cell' is based on two 'generic functions' of human use of space that is, *occupation (first form and then function) and movement* which together determines *spatial hierarchy.* This is the 'spatial configuration' or the relations of societal systems with space. Meaning, the operation of urban form or buildings towards fostering social solidarity is embedded socially in two distinct ways: the social organisation of space as spatial configurations in which we live and move and the representation of these forms and elements in the way we see it. It can thus be inferred that the operations applied towards enhancing, or developing spatial relations based on movement and occupied space forms the elementary capacity of space to foster social solidarity.

As social resilience defines coping, adaptive and transformative capacities of human beings through time respectively, space is the 'construction' for fostering and enabling these capacities through time, in order to deal with external perturbations. The limitations in defining social relations through space through design operations in terms of time is a complex phenomenon and can be argued through the description of space in terms of 'long and short models', i.e. where space is governed by rules such that social relationships and statuses are generated by space.

Based on the various spatial configurations described i.e. the relationship of the occupied space (elementary cell) with the space of movement the principles illustrated,(fig:12.1)convey whether a spatial relation is either altered or created in the presence of a spatial 'long model or short model'. The creation of a new spatial relationship signifies *transformation* since the rules applied are towards reshuffling

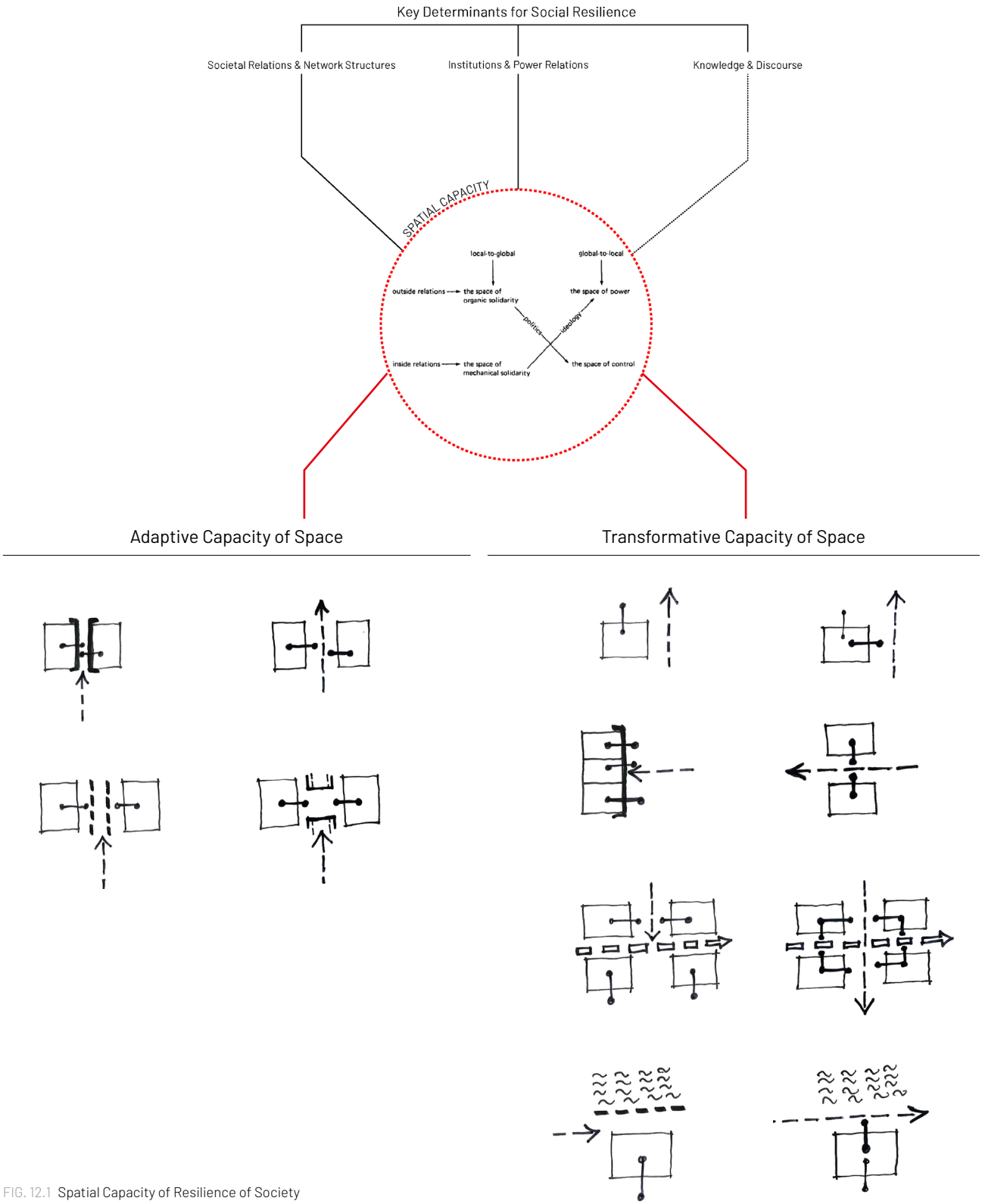


FIG. 12.1 Spatial Capacity of Resilience of Society

of a spatial relationship and hence a 'spatial short model'.On the other hand a change where existing relations are maintained and enhanced through enhancing the relationship of the elementary cell with the space of movement is *adaptation* since the space governed by societal rules are maintained in a 'spatial long model.' As the key to fostering social resilience is 'entitlement' in political, social, economic, physical and spatial aspects, space i.e an 'invention' permits society to act in both material and immaterial realities forming relations or an ensemble of relations between society and the material and/or immaterial realities, that is multiple, varied and changing based on the potentialities of this reality. Hence, the actions on changing relations of the elementary cell with the space of movement determines the capacities to achieve social resilience, that is to say the adaptive and transformative capacity of space to enhance social solidarity and in turn towards social resilience. The design does try to be sensitive to the attributes encompassing social resilience, by retaining and developing a sense of place, enhancing a sense of identity

The arguments put forth through the mixed-method approach, it is understood that the space of power and space of control is related to spatial hierarchy: accessibility, diversity of occupied space, that together encompasses the gradient of social encounters, social life and as such mechanical and organic solidarity of space. The relation of scale with space of power and space of control is another challenge uncovered through the reading of the connectors. Scale in terms of reading at a local level as well as in terms of reading at the level of the territory. The description of spatial hierarchy highlights so. The understanding of the local-to-global and global-to-local reading of 'the connectors' determines the limitations of occupied space to enhance social solidarity which is related in the understanding of spatial configurations in the whole and in parts, i.e. to say it is related to the scale of understanding *local-to-global and global-to-local phenomenon of space*.

The case of Dharavi in relation to Mumbai city highlights this aspect. As Jan Nijman argues in 'the study of Mumbai slums' that 'Mumbai is a city with two cities that which is modern and desirable and the other ,the slums, that is unintended and undesirable' (Nijman, 2010). This duality of society and as such spatial configurations is related to the understanding of local-to-global and global-to-local phenomenon of space.

The limitations of design operations is determined by the reading of these spatial laws, in the case of Dharavi. As such the principles of design although universal (transpatial) will be applicable to other contexts only by the understanding of the local-to-global and global-to-local spatial laws. That is to say, for slums such as Dharavi to enhance social solidarity it must determine spatial relations inside, but it must also determine spatial relations to the outside. The problem is in the gradient of the relations. The limitations on the application of the principles of design is related to the scale of reading and understanding *the local-to-global phenomenon and global to local phenomenon*, i.e in terms of spatial configurations and the relationship of the elementary cell with respect to the space of movement. That also describes the space of power, space of control, inside and outside relations, and the mechanical and organic solidarity of space in symmetric -asymmetric relations, and distributed relations in scale. This understanding truly lies in the description of 'what

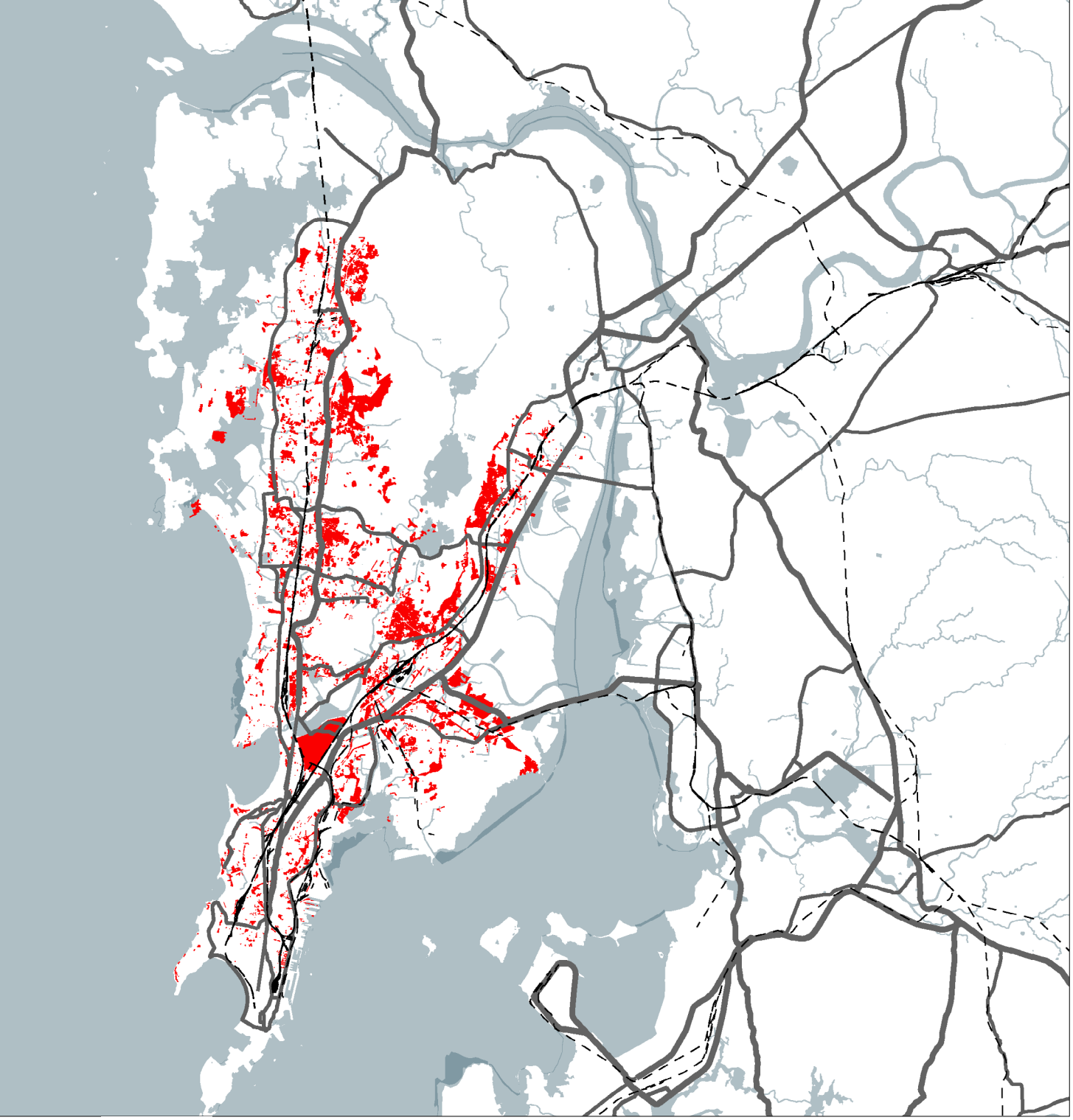


FIG. 12.2 Potential Transpatial application of strategies. Drawn by: author

is to what' . As a spatial determinist, it would mean further understanding the scale of action and implementation of design operations.

From the reading and description of the connectors it is evident that functional as well as spatial diversity or occupation of static space is related to the through movement potential. From the historical reading it is understood that as spatial connectivity/ accessibility increases with time ,occupied space holds the potential for higher diversity, and hence the capacity of forming greater spatial relations through scale whether it be by the use of first, second, third dimension of space. This may be due to restrictions, such as topography. It is also based on the size of available parcel or block or ownership of land and on the metric distances travelled. That is to say spatial hierarchy that can define the two principles of solidarity (mechanic and organic) through gradients. 'The connector' also defines scales of design that encompass the spatial relationship with respect to it.

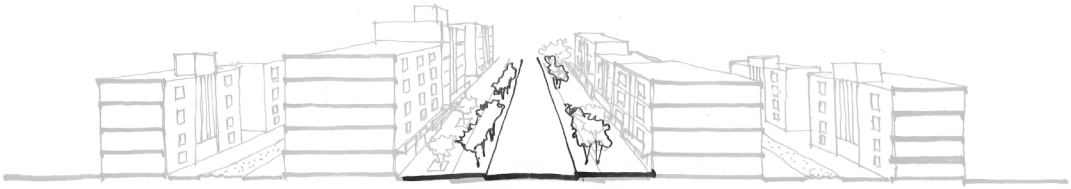
Spatial Hierarchy:
Space is hierarchical i.e the relationships formed are based on the capacity of movement and the relationship it has to the occupied space i.e for eg. a higher order space such as a business park (relationship with the regional connector) will not move down the order to a District Connector. Although there are cases that Spatial Junctions host different spatial capacities for occupations, at the same time it is based on the choice of a desired relation to be fostered, but in many cases the occupied space moves only upwards in spatial order.

Diversity:
As the connector describes different through-movement capacities, with the increase of spatial connectivity, there is a potential for higher social encounters as such higher integration. From this hierarchical order it is evident that the stress on the Greater metropolitan region of Mumbai as a Desakota Connurbation is mainly due to lack of spatial relations that form the space for social encounters and hence social solidarity within and in the periphery. Though this is an assumption based on the reading of integration analysis of the territory.(refer .appendix. 2) .

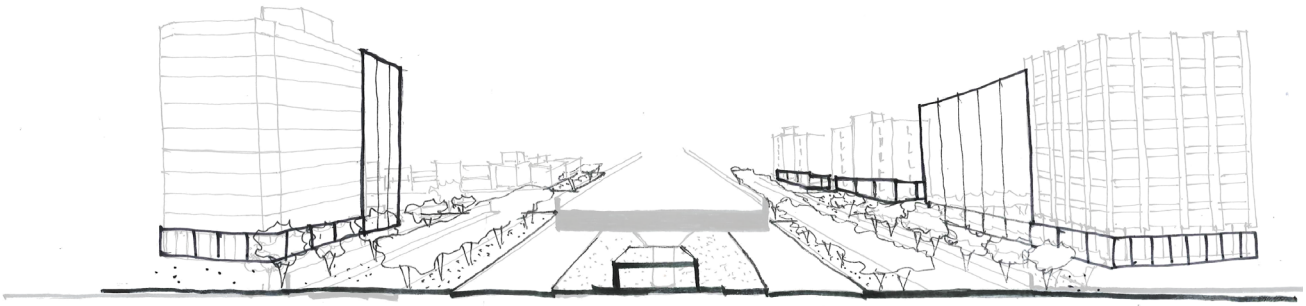
Scales and Multiscalarity:

As there is yet a lack of knowledge on the relationship between social resilience, scale and place. 'Translocality' can be a suitable concept applied to the various scales. It distinguishes between places referring to locations in the physical environment, where confronting communication takes place, 'locales' refer to settings for social interaction that extend beyond space. With the concept of translocality, social resilience can be considered an outcome of plurilocal embeddedness of social actors. (Marcus Keck, 2013). Another approach could be from Network theory,' the strength of weak ties' that describes Social infrastructure as system of strong and weak ties (Granovetter, 1973). '

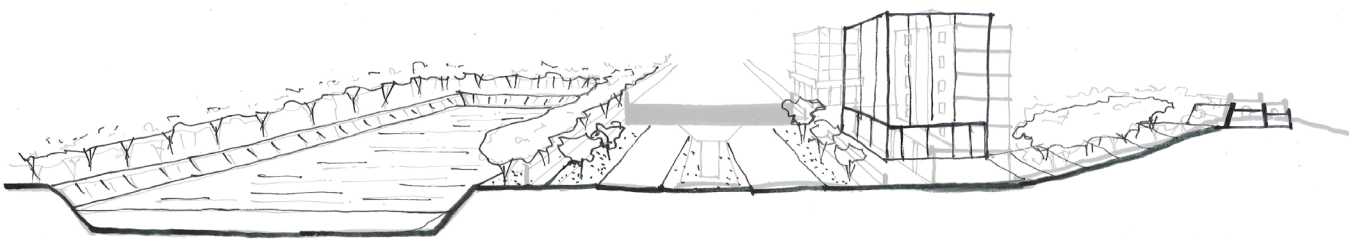
With this in mind the Extra Regional Connector and the Railway Connector have the potential to form spatial ties or relations between spaces and across the region. The strategies or design principles (transpatial principles) could also be used across spatial configurations towards fostering social resilience.



Re-qualified Extra Regional Connector: The Relationship between adjacent spaces hosting commercial and residential activity can be enhanced by the use of slower traffic movement adding recreational space .



Re-qualified Extra Regional Connector: The Relationship between adjacent spaces of regional importance such as the High court and spaces below the highway infrastructure can be used as space for landscape, adding green and open space to the environment for recreation.



Re-qualified Extra Regional Connector: The Relationship between adjacent spaces of Heritage value along the regional connector such as the fort and water tank can be enhanced by slower traffic movement below.

13 – Design Reflection

Recommendations towards fostering resilience

Land Management and Value:

While the study began with the focus on the capacity of space to enhance social resilience, it has become evident that land value, connectivity (through-movement potential) can shape relations but if not designed for future scenarios can have spatial effects leading to segregation and greater inequalities. It can also be discerned that there is a strong relationship between high land value or geographical value and high integration value as this is observed in the case of Mumbai where the land value increases towards the southern part of Mumbai (Nijman 2010), as such although integration increases, slums become the first target for redevelopment actions, that usually leads to gentrification. Thus the recommendations is to form new spatial relations in the Desakota Connurbation by the use of Transport Oriented Development (TOD) and giving impetus to other means of transport such bus services, biking paths and bike sharing around station nodes. Since only 4% of Mumbai's population owns personal vehicles such as a car, this option seems feasible. With this benefit, land value that is exorbitantly high will come down. Apart from this the state along with private enterprises should find financial methods to aid self-building or incremental housing initiatives within informal settlements.

Desakota Connurbation and Land Management:

In an interview conducted by an Indian newspaper Hindustan Times with Urbz, an experimental action and research collective specialized in participatory planning and design, based in Dharavi, describing why Mumbai extends far beyond its metropolitan limits . In the interview they describe the circular migration of Mumbai's inhabitants

" Even after two or three generations here, families have extensive relationships back in villages,[...] despite the prevailing belief that rural-urban migration is a one-way street, the younger people [...] are attached to both the city and the village for different reasons. They don't want the village to become the city. The distance is part of what allows both places to retain specific qualities." (Matias & Rahul,2017)

As such within Greater Mumbai Region the government should encourage leasing public land for social housing purposes, instead of selling it to private enterprises.

Planning Instruments:

At present Mumbai uses Landuse Zoning as an instrument for planning, this accompanied by a DCR (Development Control Regulation) stipulates the allowable FSI to construct in various parts of the city. This zoning plan does not recommend form or spatial configuration desired and only recommends FSI with strict setback rules. The recommendation is to add certain points to the zoning plan in the DCR,

FIG. 13.1 Strength of Weak ties. Drawn by: author

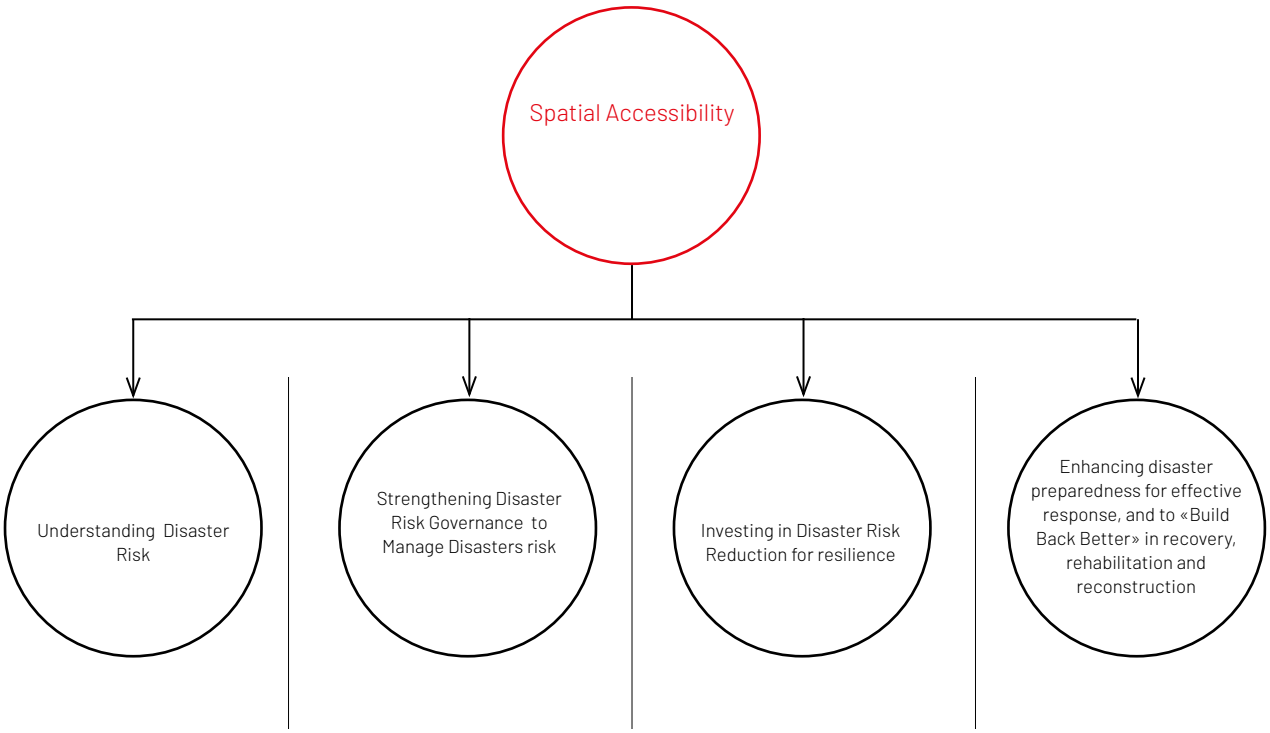


FIG. 13.2 Adoption of Spatial accessibility into the Sendai Disaster Framework

that could valorize the potential of the connectors as well as give actions on types of spatial configurations accompanied by land-use recommendations. This could also be accompanied by laws that establish ground rights for the public. Though strategic planning would be suitable, an instrument such as strategic planning would take a long time to be implemented because of the National and State Planning policies.

Risk Reduction: Floods and flood risk through space:

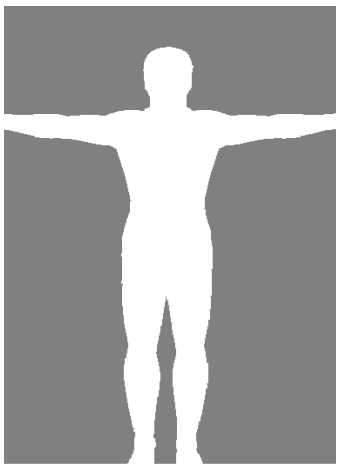
The process of design entails investment in disaster risk reduction towards achieving resilience. The issue of floods and flood risk management should be tackled by appropriate means where the future long term implications are seen. Instead of being a post recovery method for flood risk management, tools and scenarios should be developed that could aid flood adaptation strategies through spatial configurations.

In the thesis the issue of risk from man-made or natural disasters is addressed by focusing on vulnerability through spatial accessibility. In order to improve spatial accessibility, the vulnerable infrastructure of the train network i.e a critical infrastructure for the functioning of the city should be upgraded or retrofitted to accommodate for flooding, this proves as an important action in alleviating the stress on a critical infrastructure, as well as improving the quality of adjacent spaces. The spaces gain the potential for reconfiguration, as well as opening of redundant spaces along the railway infrastructure. The possibility of a park or a park as a regional spine is opened up through this action. Apart from this the re-qualification of convex spaces into the public realm through spatial reconfiguration especially of public amenities such as schools, colleges, hospitals, could prove essential in improving accessibility to open spaces , as safe critical-social infrastructure proves essential at the times of disasters such as floods.

As spatial accessibility is one of the methods to determine social solidarity moving towards social resilience, an important recommendation is that it should be incorporated within the Sendai Disaster Risk Framework as a way to enhance social cohesion towards external stress (natural or man-made),

Robustness of Built environment:

Although spatial accessibility is an important aspect towards fostering social resilience, vulnerability of the built environment is an important aspect to be taken care of especially in communities such as slums, as robustness of the built environment would entail safety and security of personal assets in the time of disasters such as floods, fires, etc. Hence, it is recommended that self-building initiatives be taken up with under the guidance of civic society.



A Brief Reflection of Society

The concept of social solidarity when seen only through the purview of space has the potential to ameliorate societies segregative differences. But there is a limitation, the limitation of space, to be true 'the social logic of space' does not quite describe how society itself can further ameliorate its segregative nature, the concept of 'the commons' does raise further questions on the capacity of society to ameliorate its differences.

As stated before , "space is a function of the forms of social solidarity i.e. in turn a product of the structure of society" (Bill Hillier, 1984) But,space alone is not enough.

For society to become robust, it must understand the value of itself, of its settings around, the value of 'the commons'. The concept of 'a benevolent future' seems rather bleak when seen from the purview of society itself.

14 – Reflection:

It is said that design is a reflective practice, as quoted by Schön "the designer constructs the design world within which he/she sets the dimensions of his/her problem space and invents the moves by which he/she attempts to find solutions." (Visser, 2011), this thesis is not an exception. The creation and adoption of a methodological and theoretical framework to form design principles based on the potential of the connector and the spatial constraints encounter, was tested through the process of design detailing. This design exercise is an attempt at fostering social resilience through the understanding of social logic of space.

While the issue related to flooding and flood risk, that is the exposure of a society to flooding is important, this thesis primarily focused on the creation of social relations and network structures through space to alleviate pressures related to hazards. While the attributes of social resilience do put forth water, sanitation and infrastructure related to health in fostering social resilience as important, the limitations of the framework chosen by me on addressing these issues is evident. Apart from this, the EMU graduation semester is an intense and short semester and limits as well as focuses the research and design within a time frame.

As understood and through the arguments put forth through the design exercise, social resilience is the capacity of people to cope, adapt or transform spatial configurations in order to achieve better societal robustness. That is, it is the spatial capacity that determines how societies adapt or transform social relations in order to achieve social solidarity. The use of a strategic design instrument 'the connector' to select relevant infrastructures that hold the potential to build spatial relationships across scale is surely an attempt in the direction of fostering social resilience through space. While the river is also a potential connector, my understanding in the case of Mumbai and in the context of the Mithi river is different. From the territorial reading it becomes evident that Mumbai was never structured by the river, the river here is a canal formed by extensive land reclamation from an estuary to an archipelago. It is an edge that has been neglected and hence forms a logic of its own except for a few native communities such as the Koli fisher folk who still may have a relationship with the river for economic sustenance. To understand the relationship between these settlements and the river edge would require further data and relevant theoretical frameworks such as Landscape Urbanism and Infrastructure as Landscape as well as the accompaniment of social-ecological principles of design. The edge has also been informally reclaimed by many encroachments that claim a transient, informal ownership of the land, reflecting to other debates on land management. Apart from this, in the present condition while dealing with Indian context, the lack of data at bigger scales becomes a shortcoming. Although there is accessibility to Bhuwan, ISRO satellite data it is yet limited. This is because of the Indian Geospatial Bill, that has limited accessibility to data due to national security reasons.

Further on, under the purview of the theoretical framework adopted by me and under the advice of my guides at the P2 presentation, the choice to adopt a singular theoretical framework, to which I have adhered to, limited my scope but yet made it relevant in an attempt at fostering social resilience through space. Their recommendation was indeed due to the time limitations that the EMU graduation semester poses. Another comment posed by Dr. Stephen Read was the scope of the project that I had set out at P2 was equivalent to a PHD and would take atleast 10 years to accomplish it. I realised that my project at this moment was not only about being faithful to it but about addressing the question to the best of my ability within the time frame of 4 and 1/2 months. Though I would like to take this theoretical framework ahead towards further research and possibility of a PHD

While the railway network that has structured the city of Mumbai is vulnerable due to pluvial flooding it is also the lifeline for Mumbai. Although an extreme scenario, the dependency on the critical railway infrastructure for the sustenance of life in the Desakota Connurbation of Mumbai does create debates on the viability of the elevation of the railway network project. But this action of elevating it also opens the gate to redundant spaces such as the abandoned mill lands that could form a park for the region. Here, The aim to achieve social resilience through time should not be forsaken.

The process of learning by design, research-by-design and design-research has been crucial in developing my thought process. The use of spatial concepts such as 'the connector' by the adoption of space syntax theories did help guide my project and outlook. The process of learning at IUAV did use research-by-design as a powerful tool to explore future scenarios. This indeed did open my outlook on design. Design as a method to create opportunities, and influence other interdisciplinary fields such as engineering, and traffic management to think about the future to achieve sustainability. The connector here becomes a powerful design framework in the manifestation of extreme future scenarios.

Bibliography

- Adger, W. N. (2000). Social and ecological resilience: are they related? Progress in Human Geography 24,3, 347-364.

- Alan H. Kwok, E. E. (2016). What is 'social resilience'? Perspectives of disaster researchers, emergency management practitioners, and policymakers in New Zealand. International Journal of Disaster Risk Reduction, 197-211.

- Aneerudha Paul, S. P. (2010). REDHARAVI. Mumbai: SPARC, KRVIA.

- B Walker, C. H. (2004). Adaptability and Transformability in Social-Ecological Systems. Retrieved from resalliance: http://www.ecologyandsociety.org/vol9/iss2/art5

- Balachandran, M. (2016, June 29). The world's biggest survey of slums is underway in India. Retrieved from qz.com: https://qz.com/717519/the-worlds-biggest-survey-of-slums-is-underway-in-india/

- Benita, F. (2014, April 02). An urbanist's guide to the Mumbai slum of Dharavi. Retrieved from The Guardian: https://www.theguardian.com/cities/2014/apr/01/urbanist-guide-to-dharavi-mumbai

- Hillier, B., & Hanson, J. (1984). The Social Logic of Space. Bath: Press Syndicate of the University of Cambridge.

- Central, C. (2018, 03 26). climatecentral.org. Retrieved from Surgin Seas: Risk Zone Map: https://ss2.climatecentral.org/#9/19.2282/73.0563?show=satellite&projections=0-K14_RCP85-SLR&level=2&unit=meters&pois=hide

- Desk, T. (2017, September 01). Amul celebrates 'spirit of Mumbai' with this beautiful cartoon on deluge. Retrieved from The Indian Express: http://indianexpress.com/article/trending/trending-in-india/mumbai-rains-and-floods-amul-topical-cartoon-reactions-4823891/

- Express, T. I. (2013, Jan 22). The Indian Express. Retrieved from Dharavi turns into fireball as flames engulf slum: http://archive.indianexpress.com/news/dharavi-turns-into-fireball-as-flames-engulf-slum/1063044/

- Express, T. I. (2018, 05 29). Bombay riots 1992: Scars remain, victims still plead for justice. Retrieved from indianexpress.com: http://indianexpress.com/photos/picture-gallery-others/bombay-riots-1992-the-scars-remain-victims-still-plead-for-justice-babri-masjid-demolition-4972254/

- Forgaci, C. (2017, March). The Urban River Corridors of Bucharest- a Design workshop. Bucharest, Romania.

- Granovetter, M. S. (1973). The Strngth of Weak Ties. Amerocian Journal of Sociology, 1360-1380.

- Grant, R., & Nijman, J. (2004,). THE RE-SCALING OF UNEVEN DEVELOPMENT IN GHANA AND INDIA, Vol. 95, No. 5. Tijdschrift voor Economische en Sociale Geografie, 467 –481.

- Gupte, R., Shetty, P., & Mishra, R. (July 2010). TYPOLOGIES AND BEYOND: Slum Settlement Studies in Mumbai. Mumbai: CRIT.

- Habraken, N. (2000). The Structure of the Ordinary: Form and Control in the Built Environment. Cambridge, Massachusetts. London, England: The MIT Press.

- Hillier, B. (2007). Space is the machine: a configurational theory of architecture. London, United Kingdom: Space Syntax, UCL.

- Hillier, B., & Lida, S. (2005). Network and Psychological Effects in Urban Movement. In: Cohn A.G., Mark D.M. (eds) Spatial Information Theory. COSIT 2005. Lecture Notes in Computer Science (pp. 475-490). Berlin, Heidelberg: vol 3693. Springer.

- Holling, C. (1973). Resilience and Stability of Ecological Systems. Annual REview of Ecology and Systematics 4, 1-23.

- Kirsten Maclean, M. C. (2014). Six Attributes of social resilience. Journal of Environmental Planning and Management, 144-156.

- L.H Gunderson, C. H. (2002). Panarchy: Understanding Transformation in Systems of Humans and Nature. Waashington DC: Island Press.

- Marcus Keck, P. S. (2013). What is Social Resileince? Lessons Learned and ways forward. ERDKUNDE, Vol 67, No.1, 5-19.

- Marcus Moench, D. G. (2008). Re-imagining the Rural-Urban Continuum: Part II A: Understanding the role ecosystem services play in the livelihoods of the poor in desakota regions undergoing rapid change. Kathmandu, Nepal: Institute of Soceial and Environmental Transition. Retrieved from Ecosystem Services for Poverty Alleviation: https://www.espa.ac.uk/

- Mark Pelling, D. M. (2008). Reimagining the Rural Urban Continuum: Part II B : Vulnerability, Disasters and Poverty in Desakota Systems. Kathmandu, Nepal: Institute for Social and Environmental Transition- Nepal (ISET-Nepal).

- Matias, & Rahul. (2017, July). Why Mumbai extends far beyond its metropolitan limits. Retrieved from urbz: http://www.urbz.net/index.php/articles/why-mumbai-extends-far-beyond-its-metropolitan-limits

- McGee, T. G. (1991). Emergence of 'Desakota' Regions in Asia: Expanding a Hypothesis. The extended metropolis: Settlement transition in Asia, 3-25.
- McHarg, I. L. (1969). Design with Nature. Philadelphia: Natural History Press.
- Munshi, K. (2016, October). Caste and the Indian Economy. Retrieved from Joint Centre for History and Economics: http://www.histecon.magd.cam.ac.uk/km/Munshi_JEL1.pdf
- Nijman, J. (2010). A STUDY OF SPACE IN MUMBAI'S SLUMS. Tijdschrift voor Economische en Sociale Geografie – Vol. 101, No. 1, 4-17.
- Nijman, J. (2014). India's Urban Future. American Behavioral Scientist , Vol 59, Issue 3, pp. 406 - 423.
- Raffestin, C. (2012). Space, territory, and territoriality. Environment and Planning D: Society and Space, Volume 30, 121-141.
- Review, W. P. (2018, 02 13). Mumbai Population. Retrieved from worldpopulationreview: http://worldpopulationreview.com/world-cities/mumbai-population/
- Shantha, S. (2018, April 10). Mumbai's 'Designed for Death' Buildings Are Incubating TB. Retrieved from thewire: https://thewire.in/health/how-mumbais-designed-for-death-buildings-are-manufacturing-tb-hotspots
- Sidhwani, P. (2015, May 30). Spatial Inequalities in Big Indian Cities. Economic & Political WEEKLY, p. Vol 1. No 22.
- SMoG. (2018, 3). Spatial Morphology Group : PST Documentation. Retrieved from smogchalmers: https://www.smog.chalmers.se/
- sP+a, & URBZ. (n.d.). RECLAIM GROWTH.
- Stéphane Hallegatte, N. R. (2010). OECD Environment Working Papers No. 27: Flood Risks, Climate Change Impacts and Adaptation Benefits in Mumbai. Paris: OECD.
- Times, A. (2016, June 27). Accomodation Times. Retrieved from Shiv Sena Opposes Dharavi Re-Development Project: https://accommodationtimes.com/shiv-sena-opposes-dharavi-re-development-project/
- Times, T. E. (2017, August 30). How Mumbai helped Mumbai during its worst rain. Retrieved from The Economic Times: https://economictimes.indiatimes.com/news/politics-and-nation/how-mumbai-helped-mumbai-during-its-worst-rain/community-kitchens/slideshow/60292620.cms
- UNISDR. (2009). UNISDR Terminology on Disaster Risk Reduction. Geneva: United Nations International Strategy for Disaster Reduction.

- UNISDR. (2015). Sendai Framework for Disaster RIsk Reduction 2015-2030. Sendai, Japan: UNISDR.

- Visser, W. (2011, June 29). Hal: archives ourvertes. Retrieved from CCSD- Le Centre pour la Communication Scientifique Directe: https://hal.inria.fr/inria-00604634/document

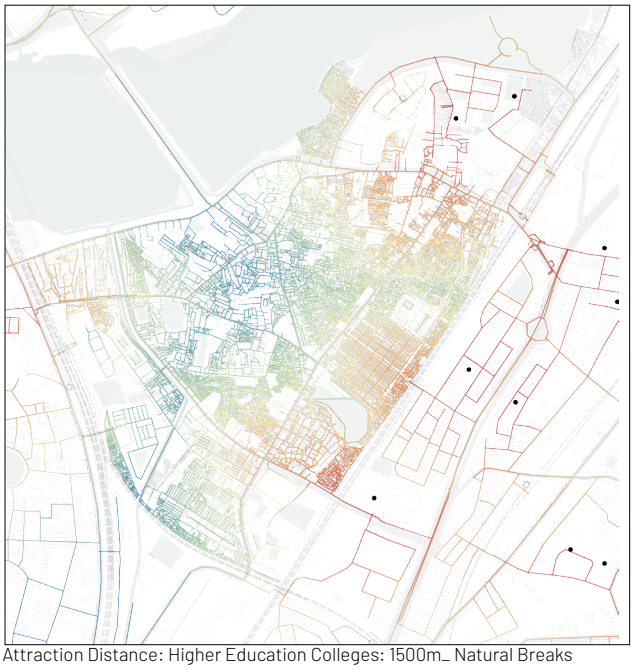
- W. Neil Adger, P. M. (1999). Social Vulnerability and the architecture of entitlements. Mitigation and Adaptation Strategies for Global Change, Volume 4, Issue 3-4, 253- 266.

- WEF, W. E. (2018). The Global Risks Report 2018, 13th Edition. Geneva: World Economic Forum.

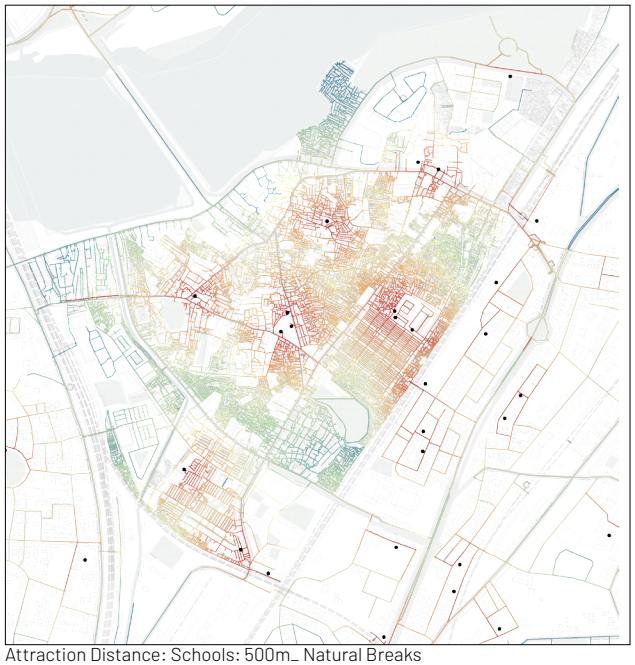
- WRI, W. R. (2018, 03 26). AQUEDUCT: Global Fflood Analyzer. Retrieved from floods.wri.org: http://floods.wri.org/#/city/74/The%20City%20of%20Mumbai,%20India

- Zhang, Y. (2016, March 3). Building a Slum-Free Mumbai. Retrieved from wilsoncenter: https://www.wilsoncenter.org/article/building-slum-free-mumbai

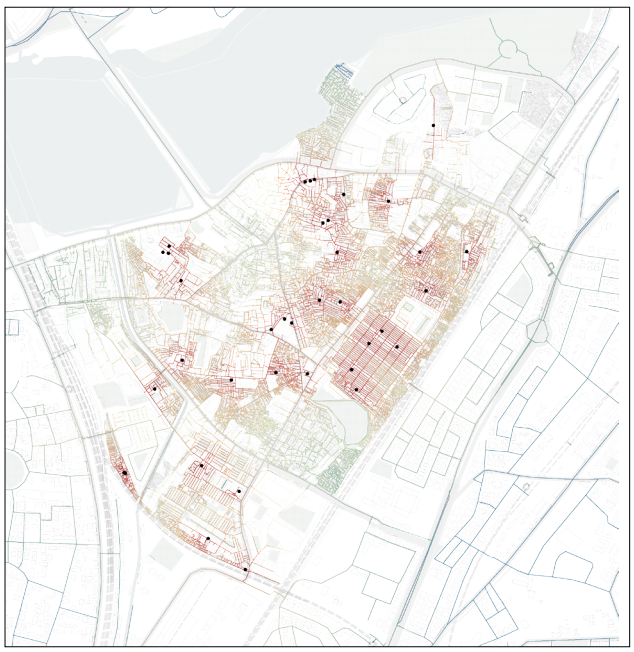
APPENDIX 1



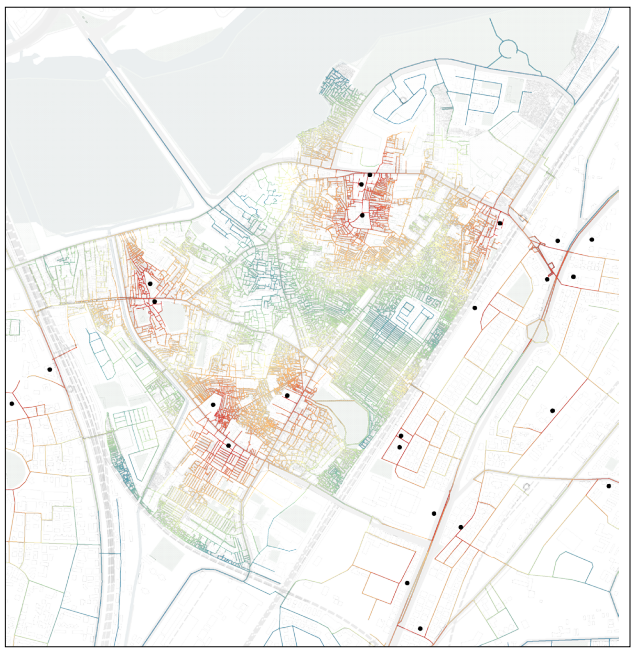
Attraction Distance: Higher Education Colleges: 1500m_ Natural Breaks



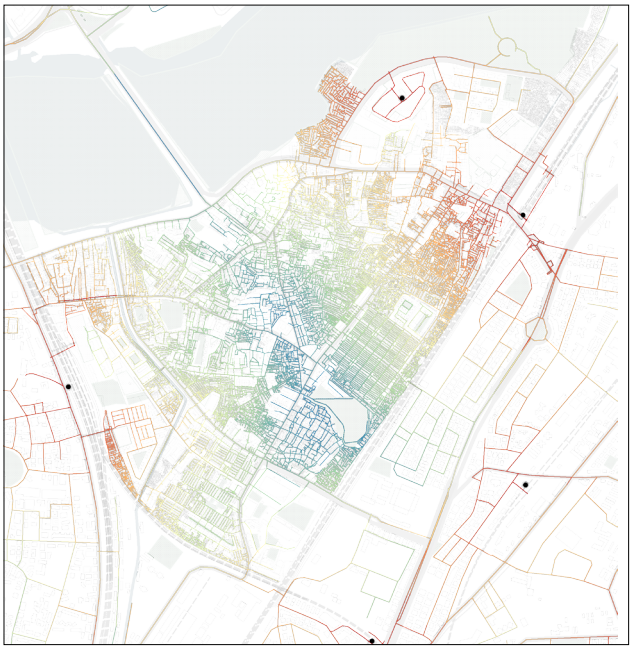
Attraction Distance: Schools: 500m_ Natural Breaks



Attraction Distance: Balwadi/Kindergarten: 1500m_ Natural Breaks

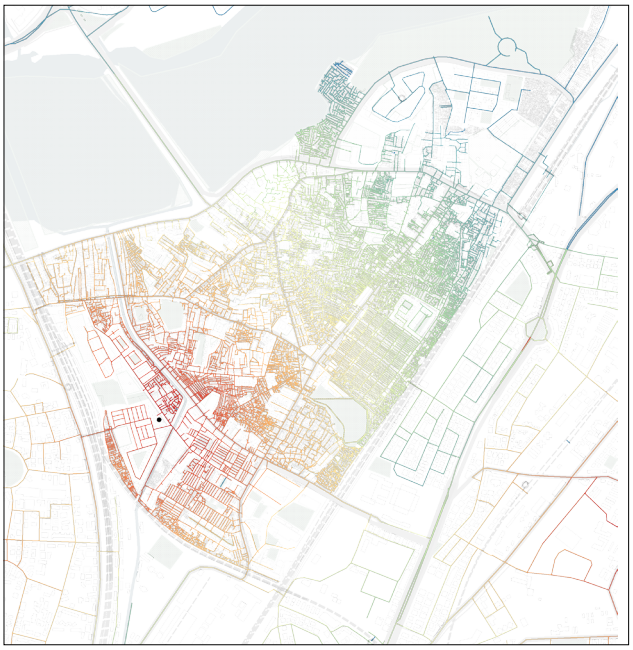


Attraction Distance: Minor Hospitals: 1500m_ Natural Breaks

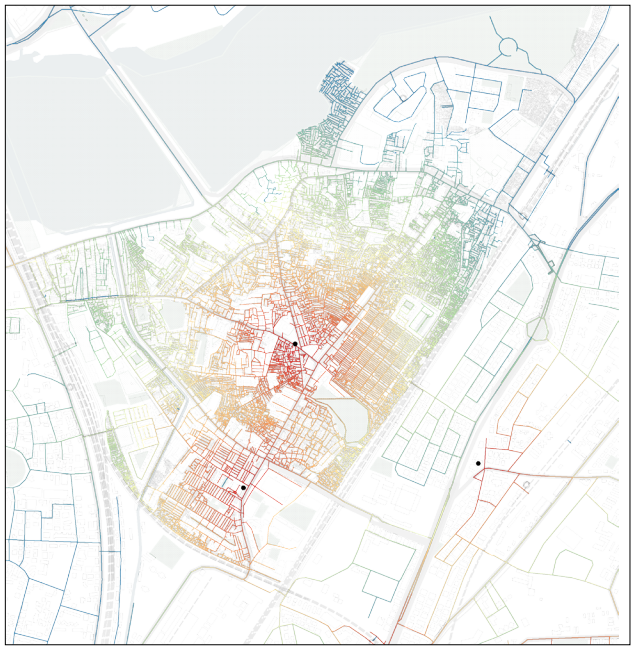


Attraction Distance: Bus and Stations: 1500m_ Natural Breaks

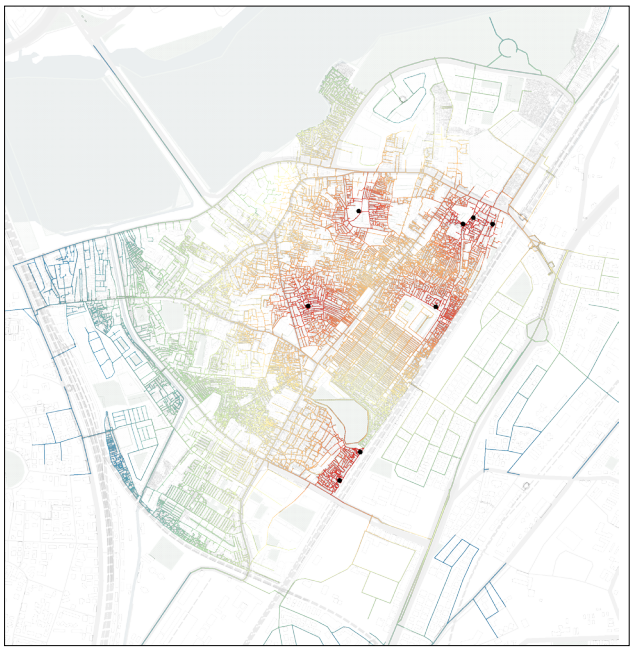
Attraction Distance: Bus Stops: 500m_ Natural Breaks



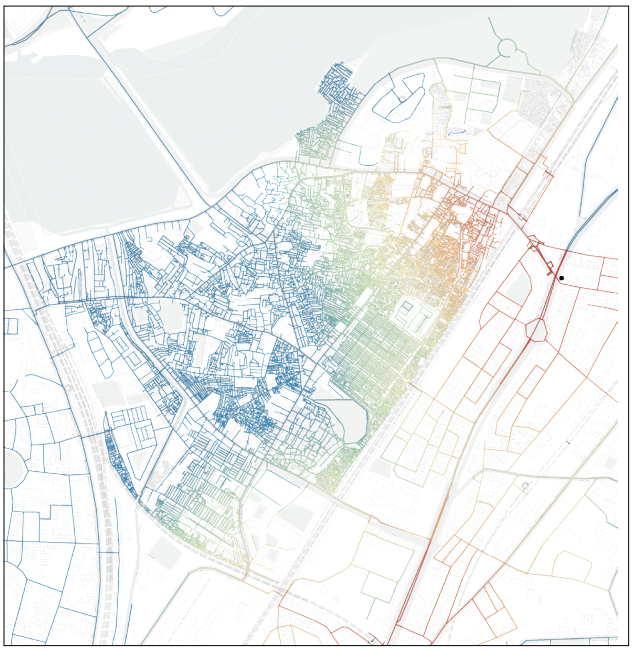
Attraction Distance: Fire Station: 3000m_ Natural Breaks



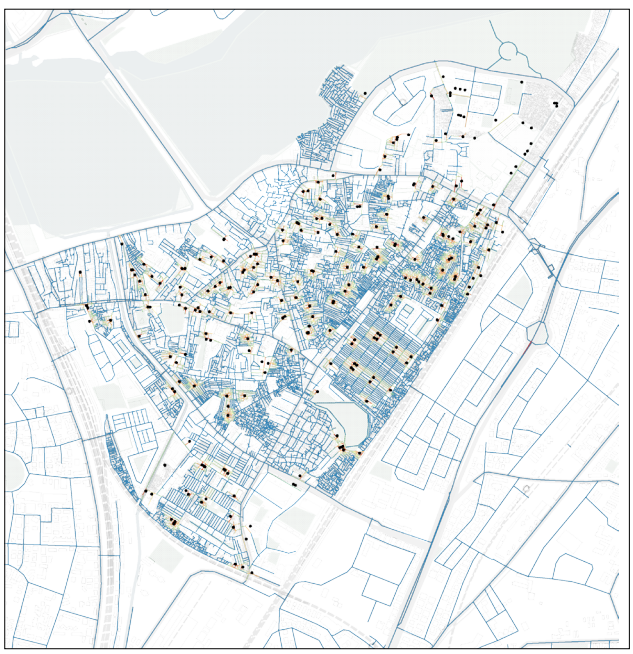
Attraction Distance: Police Station: 1500m_ Natural Breaks



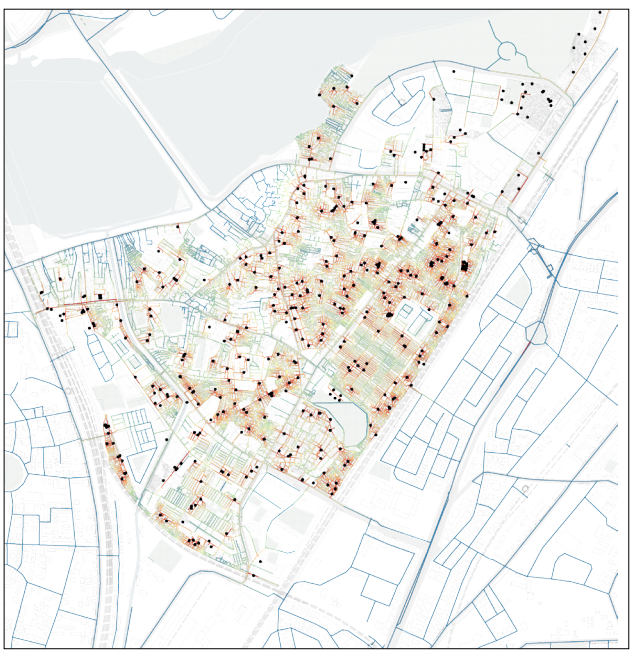
Attraction Distance: Mandals/Community Centres: 1500m_ Natural Breaks



Attraction Distance: Municipal Markets: 1500m_ Natural Breaks



Attraction Distance: Toilets: 50m_ Natural Breaks

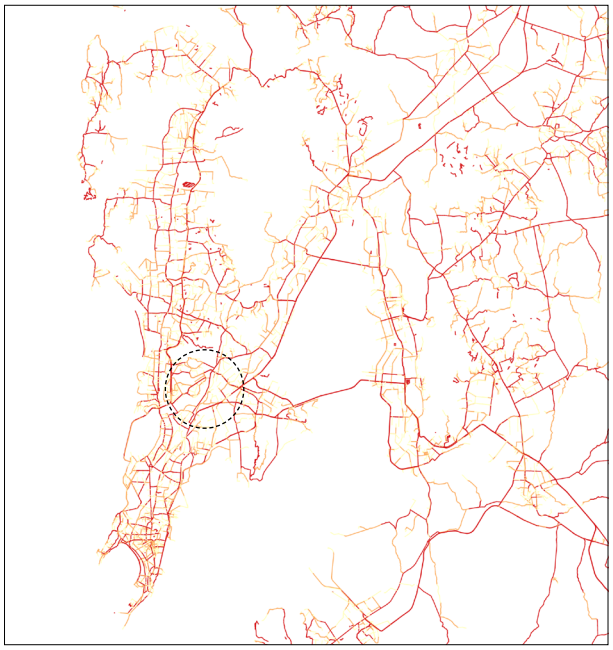


Attraction Distance: Temples: 250m_ Natural Breaks

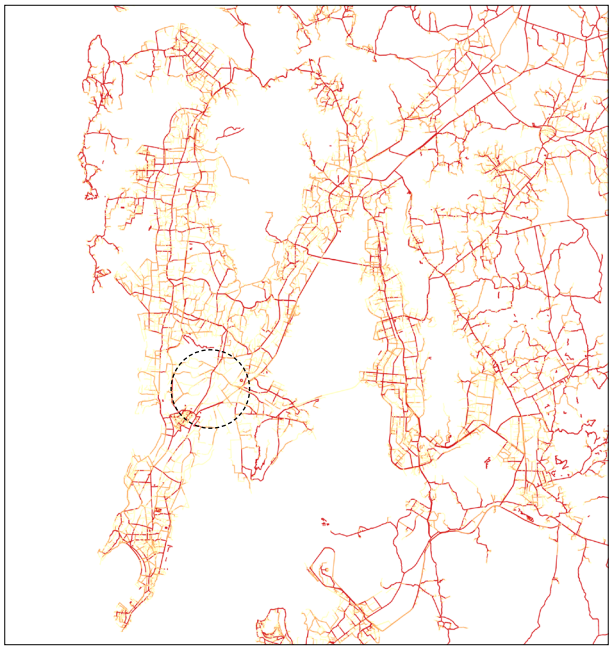
Attraction Distance: Open Spaces: 250m_ Natural Breaks

Data Source: Open Street maps and Drawn by Author

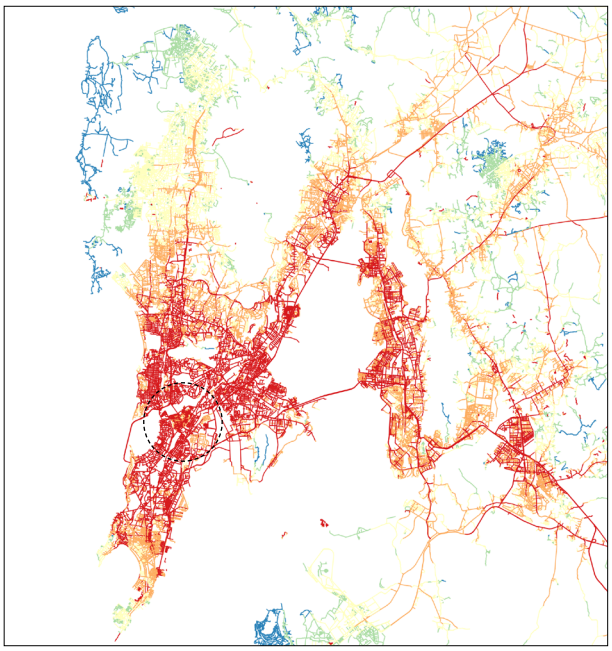
APPENDIX 2:



Angular Choice: 25km_PST_Quantile



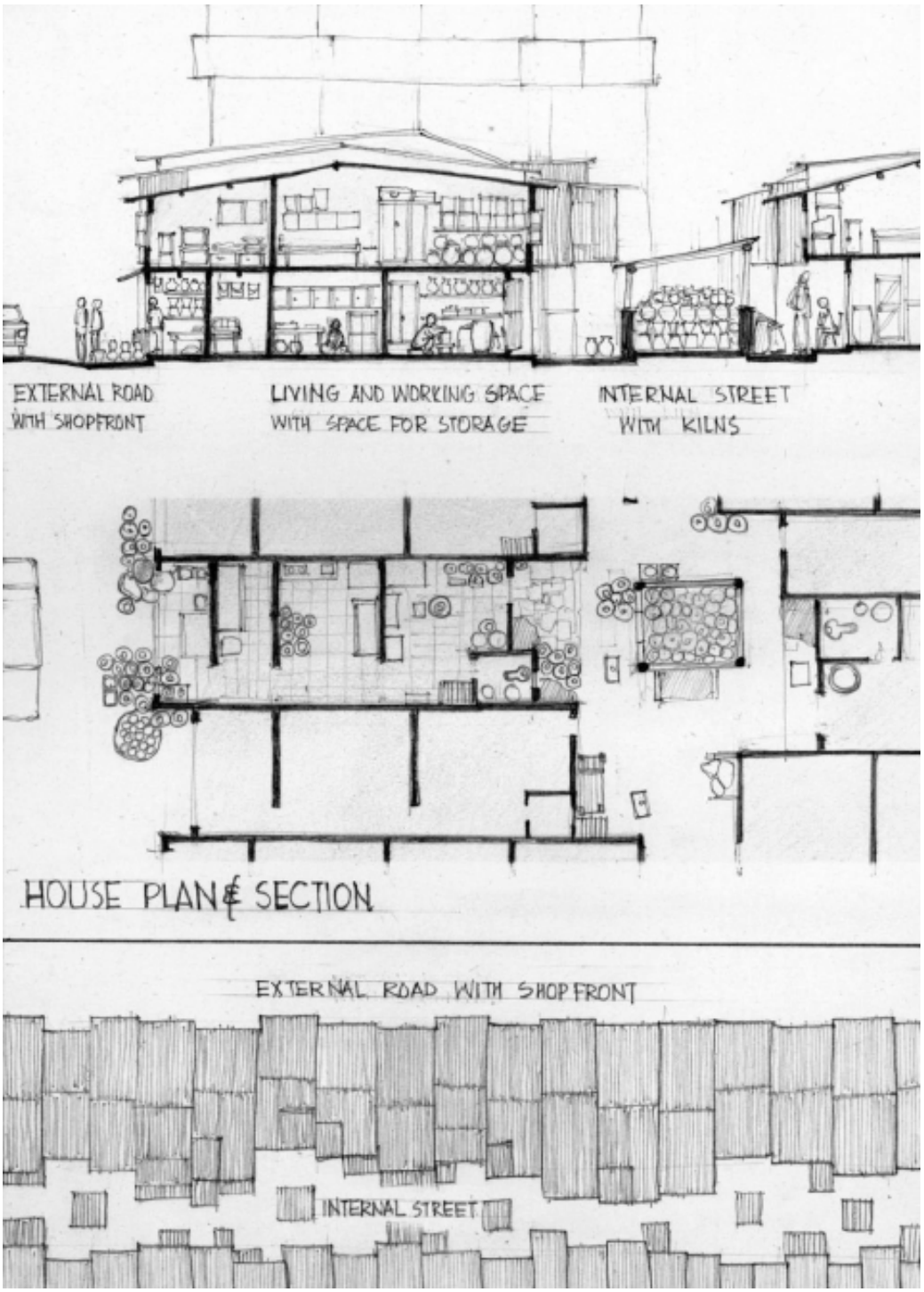
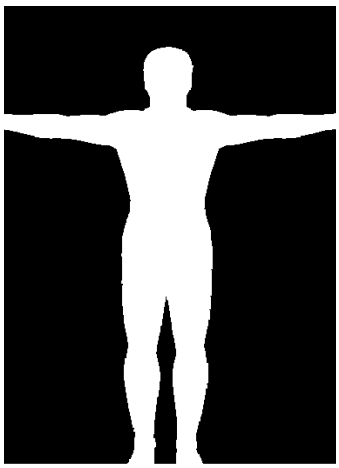
Angular Choice: 5km_Quantile_PST_Quantile



Global Segment Angular Integration_25km_ PST_ quantile

Data Source: Open Street maps and Drawn by Author

APPENDIX 3:



Kumbarwada:typical housing type in (potters cluster). Source: (Gupte, Shetty, & Mishra, July 2010)