

# De-Coding Urbanity

Learning from and for Old Delhi || Preserving Cultural Urban Codes

by

**Kanika Kaushal**

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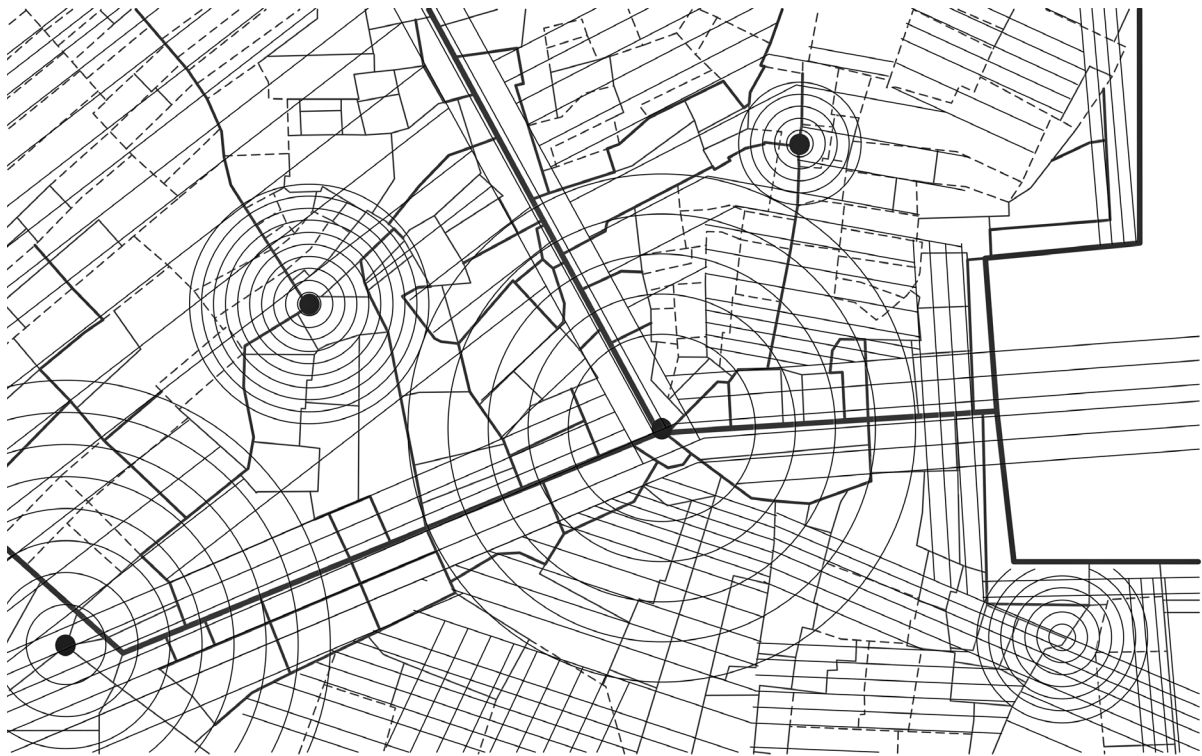


## AUTHOR'S DECLARATION

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I hereby declare that I am the sole author of this thesis.

This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.  
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[ FIGURE 0.1 ] Urban Growth and Density Blueprint  
Diagram showing Domain Range of Urban Attractors (Nodes) forming streets  
and generating varying densities in Urban Form to produce an Adaptive Morphological Output

## ABSTRACT

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THE WALLED CITY OF OLD DELHI serves as the heart of metropolitan Delhi. The city is a complex amalgamation of Mughal, Colonial and post Colonial architecture. This overlap has resulted in a rich urban fabric and networked cultural urbanism. This provides the city its personality traits, which can be defined as its urbanity. The thesis aims to decode the microcosm of this urbanity, which can be understood as the result of a morphogenesis that is generated by boundary conditions, a densely packed fabric and urban attractors and connectors.

This investigation attempts to extract the spatial and cultural codes of Old Delhi using parametric tools to analyze the changing sets of relationships that govern its architectural growth and development. These codes serve as parameters that define the shape of the city's fabric. The first act in this process is the Database Step—this critical part is simply the recording and translation of the informal types of settlements—into architectural and urban maps and drawings so that they can be analyzed. The recording of acts, processes and their resultant architectures and the urban fabric that they constitute are considered to be invisible as they are not 'legitimated' by formal civic processes but rather are embodied in the lives, activities and culture of a community and embodied in the urban fabric that surrounds them.

This narrative description is then supported by the extraction and development of parametric urban codes through Grasshopper scripts and manual design iterations representing a series of algorithmic morphological conditions. These codes can generate typologies and exhibit the relationship between the communal and larger infrastructure to give the user a material sense of the cultural world.

The preservation of historic centers and its embedded urbanism is an important question of urban design. The planning department and organizations pay primary attention to the heritage sites instead of understanding and preserving its embedded spatial codes. Hence, the goal of this thesis is to address the need for a planning model that illustrates the framework of the residential settlements of historic cities that are undergoing rapid transformation or are under process for redevelopment to architects, planners and organizations involved in urban development. This model provides sets of rules and values that anticipate design solutions that can act as a paradigmatic model for Old Delhi and other historic cities thereby facilitating the preservation of its cultural and architectural urbanity.

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Dedicated to my parents  
*Thank you*

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All satellite images: Google Maps 2015, Google Earth Images 2015

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# HISTORIC TO CONTEMPORARY OLD DELHI

The Walled City of Old Delhi 'Shahjahanabad' - a living historic city  
Contemporary Old Delhi and the challenges of Global Urbanization



Systems, notably cities, grow and develop and, in general, evolve. An immediate practical consequence of the evolutionary point of view is that architectural designs should have rules for evolution built into them if their growth is to be healthy rather than cancerous.

Gordon Pask, 1969<sup>1</sup>

The history of urbanism can be comprehended through diagrammatic patterns, codes and conventions. Urban patterns most often play out various constraints related to the interface between technological and cultural conventions. As described, the city is the result of the association of multiple systems, which negotiate each other; in other words, the city is inherently a product of parametric processes. Continuing to explore the paradox of planning versus evolution through “the notion of complexity,” which shows that sophisticated forms and patterns may emerge spontaneously from a miasma of interactions,” raises questions about how to embed emergent, evolutionary spatial properties in design processes.<sup>2</sup>

It seems that the potential to create complex orders inherent in computational design systems can be correlated with the patterns of evolutionary urbanism.

<sup>1</sup> Pask, “The architectural relevance of cybernetics” 78

<sup>2</sup> P. Ball (2009) *Shapes* (London:Oxford), 17

*'Delhi! The name sums up the pomp and power of bygone days.'*

Count Hans von Koenigsmarck, 1910

DELHI has been a prominent capital for North Indian empires. It is surrounded by three major geomorphological components: the Himalayas and their flanking ranges to the east and west, the Peninsula of South India and, between these two, the flat expanse of the Indo-Gangetic Plains.<sup>1</sup> The latter was the primary geomorphological region for the premodern Indian empires because of the presence of rivers Ganges and Jamuna, a sub-tropical climate and fertile and productive alluvium soil. The area is said to have been inhabited in the second millennium BC and urban development continued until 1750 AD.

The mughal emperor Shahjahan planned Old Delhi or Shahjahanabad in 1639 when he transferred his capital from Agra to Delhi. It holds the status of the seventh city of Delhi. Ustad Hamid and Ustad Ahmed Lahori, were the principal architects of Shahjahan, associated with the designing and construction of Shahjahanabad, Red fort and Jama Masjid.<sup>2</sup> Cities before Old Delhi were either abandoned or have transformed drastically. On the other hand, inspite of multiple ruling dynasties of Marathas, Mauryans, Guptas, Mughals and the negligence of British, Old Delhi has been able to retain it's authenticity and cultural identity even today. It still carries the germ cell of it's urban system that acts as the architectural seed for the city's physical form and thus holds significance in the cultural identity of Delhi.

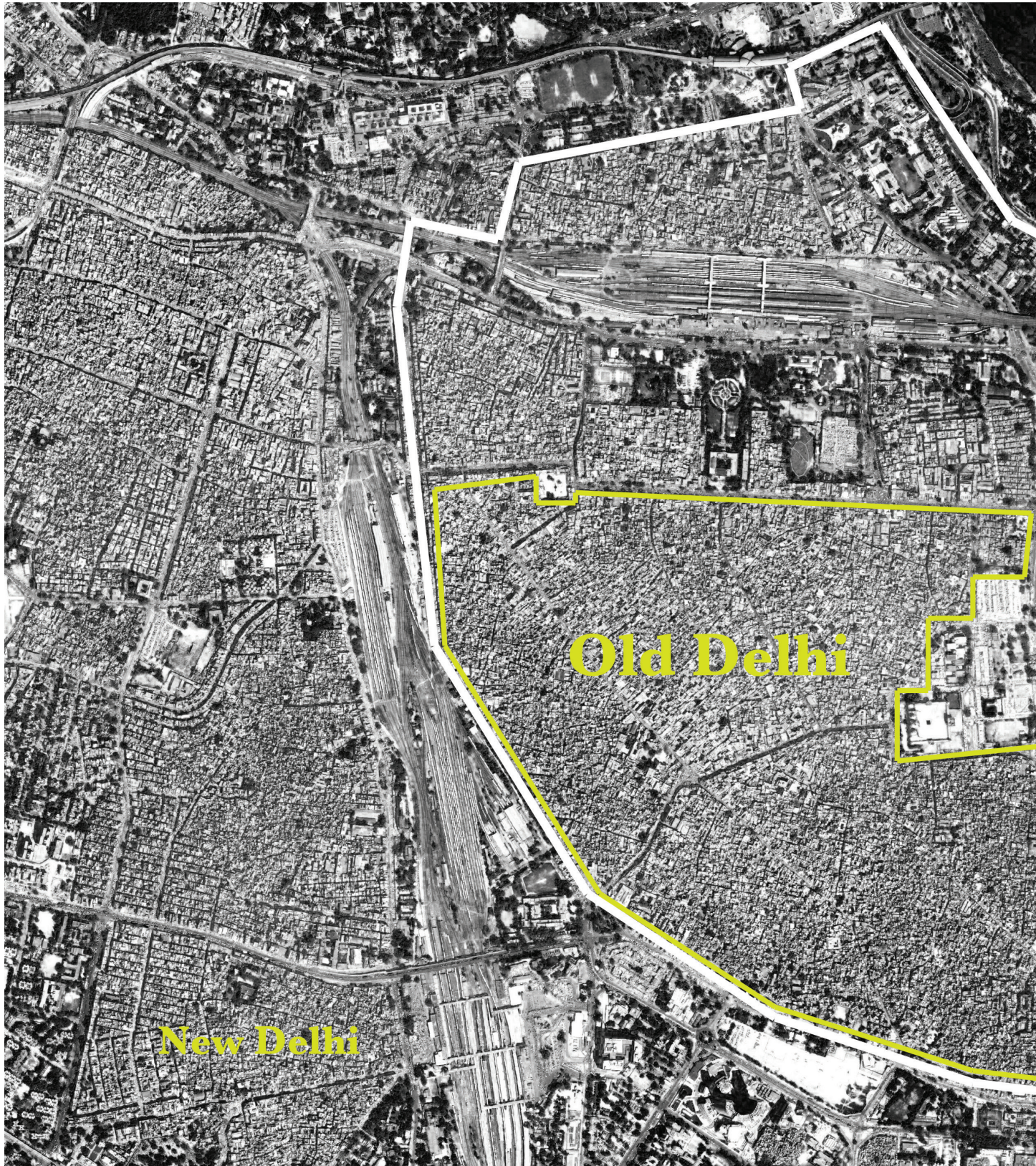
Unfortunately, this urban precinct is continuously deteriorating due to numerous complex reasons. Conservation measures taken up in the past by organizations like INTACH (Indian National Trust for Art and Cultural Heritage) and Aga Khan Trust have primarily focused on the architectural heritage within the city. Initiatives to document the built heritage of Old Delhi have been undertaken, to submit to UNESCO, on behalf of the Government of the National Capital Territory of Delhi. This was done to nominate Old Delhi and colonial New Delhi as a World Heritage City, unfortunately the inventory was not submitted due to reasons unknown.

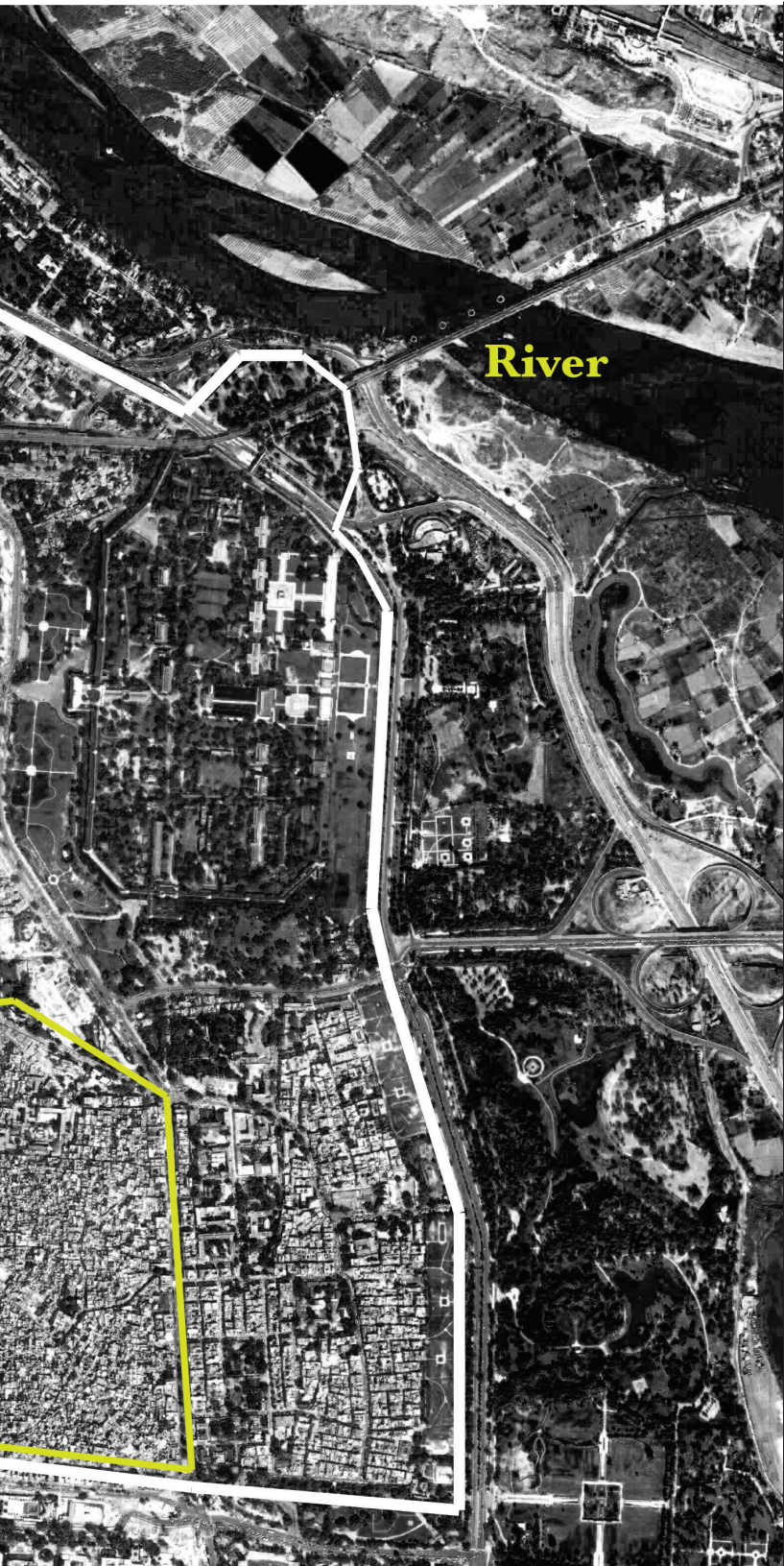
So as to conserve this historic city, it is equally important to look at the embodied philosophy of the city's urban design and planning principles that together generate a specific morphology, which carries the spatial and cultural codes of the urban fabric. The quality of the city's fabric to be able to retain it's urban form with minor changes expresses it's evolutionary and adaptive nature irrespective of the numerous pressures that the city has gone through.

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<sup>1</sup> O.H.K. Spate and A.T.A. Learmonth, *India and Pakistan: A Regional Geography* (London: Methuen and Co., 1967), pp. 176-7

<sup>2</sup> Blake, Stephen, *Shahjahanabad : The Sovereign City in Mughal India 1639-1739* ( Cambridge University Press 1991), pp.1-2





Old Delhi, India

### Legend

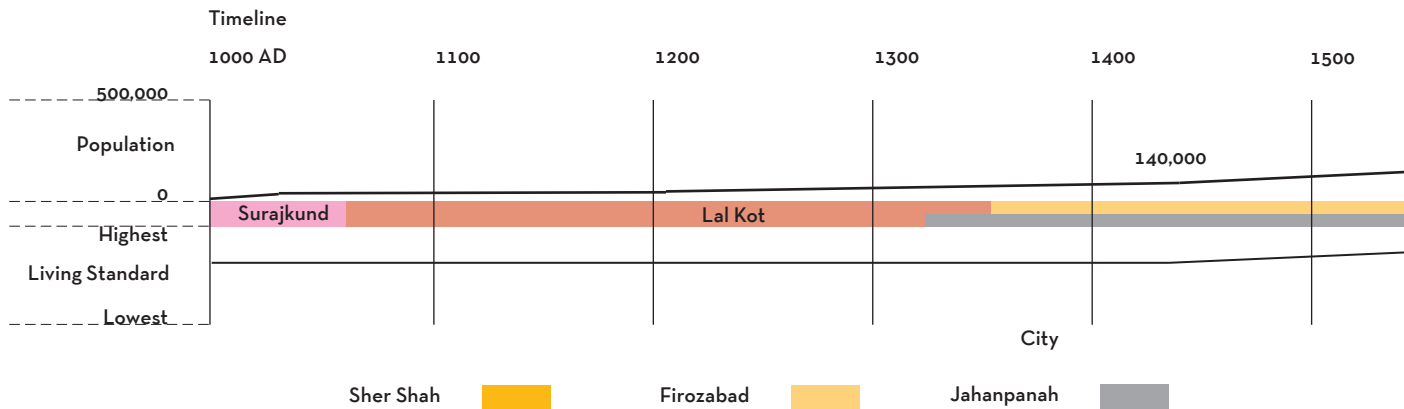
— City Wall / Boundary (AREA : 6 Sq.Kms. approx.)

— Residential Settlements under redevelopment



[ FIGURE 1.1 ] Project Site

## CONTEMPORARY OLD DELHI AND THE CHALLENGES OF GLOBAL URBANIZATION



The painful neglect of the walled cities in the urban policies of developing nations has been noted for some time (Steinberg 1996; Naidu 1994; Mohan 1992), albeit with very little impact. The core of historic cities like the walled imperial cities in developing countries are typically regarded by city planners in the same manner as slum settlements - as 'blight' and 'anachronisms and obstructions to modernization' (Lingawi 1988: 36). In his study of Islamic heritage and development of old Middle Eastern cities, Lingawi notes (1989 :36) that heritage is perceived as inherently incompatible with modern development for a number of reasons: 'The narrow streets are not accessible to automobiles, there are no modern sewer systems, modern appliances do not fit easily into the traditional structures, and so forth'<sup>1</sup>.

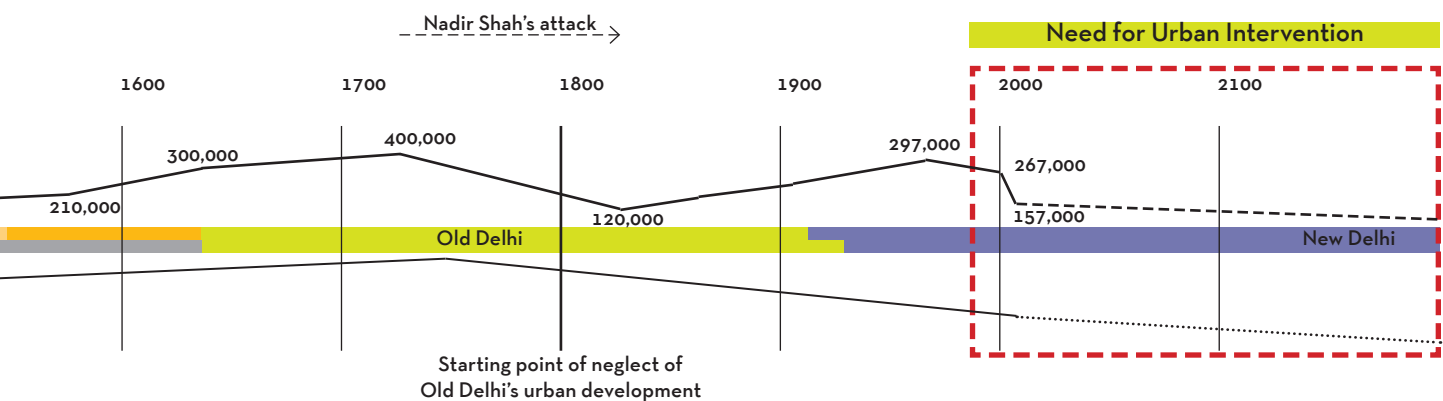
For a number of decades, the imperial cities in India have been in a state of neglect and stagnation. The cities experience myriad problems from significantly high levels of air pollution, poor hygiene, very low percentage of green or open spaces, traffic congestion and an extremely high population density. As a result, this state of the old cities poses real development problems and a huge challenge in the development of policies. It thus becomes extremely crucial to understand what are the various urban elements within the city that constitute an identity, which help in realizing the socio-cultural environment. Lingawi (1988: 37) writes 'The key is to realize the role and the actual vitality of the traditional Muslim city', the elements that made for the vibrant older traditional Muslim city thus were excavated and celebrated in the formal planning of the city.<sup>2</sup>

The walled cities in India contribute to not just the urban heritage and cultural diversity but also form an important part of India's urban development economically. The UNESCO (2010) acknowledges the particular vulnerability of old Indian cities to the problem of socio-spatial exclusion or "ghettoization" as well as "museumisation"<sup>3</sup>. Old Delhi today witnesses a serious problem of ghettoisation that is widening the gap between the residents of the walled city and those living in New Delhi and is one of the major challenges for sustainable urbanization.

<sup>1</sup> Narayan, Yamini , Religion, Heritage and the Sustainable City: Hinduism and Urbanisation in Jaipur (Routledge 2015) pp.54

<sup>2,3</sup> Narayan, Yamini , Religion, Heritage and the Sustainable City: Hinduism and Urbanisation in Jaipur (Routledge 2015) pp.55





[ FIGURE 1.2 ] Cities of Delhi - Timeline

For a person visiting Old Delhi today, the city would be nothing more than a maze of narrow lanes, a mess of congested streets and an extremely intense commercial activity zone. The area today has centuries old mansions and architectural built heritage, which is tangled in billboards and electric cables. The occupants of the city are living with serious problems of traffic movement, lack of sanitation, everyday deteriorating infrastructure as well as encroachments and unauthorized construction.

Old Delhi at present houses approximately one hundred and fifty thousand people. The demographics show a constant decline in the number of residents living in the city in the last decade. This is primarily because of chaos produced due to excessive commercialization, parking crisis and lack of open public spaces in the city. The bazaars within the city that were initially limited to the primary and secondary streets are now spreading like a plague into the fabric. This rise in wholesale trade and industrial activity has seriously affected the quality of life of the residents. The low-income group from rural areas across India, who aspire to work in New Delhi, are now living in Old Delhi as a cheaper option, further increasing the pressure on the walled city. The pressure has led to decay and deterioration of the physical form as well as loss of harmony for the residents.

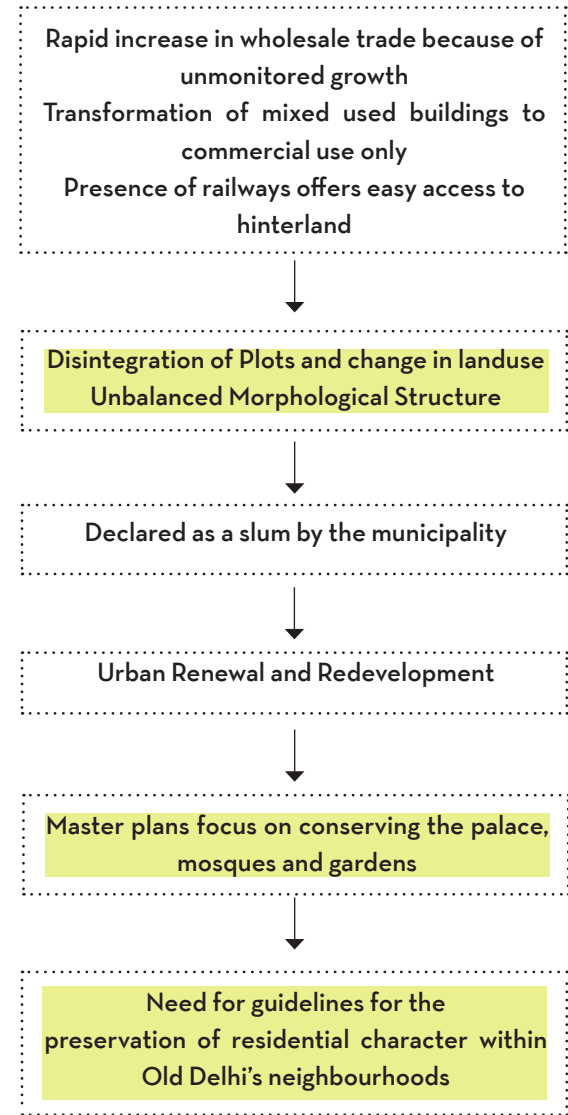
Another dominant factor affecting the urban form is the disintegration of Havelis/Mansions into smaller units that are occupied by different families. The city has an existing population density of 1500 persons per hectare. The Master Plan of Delhi 2001 designated the city as a 'Special Area' with new planning code for making residential hub from deviating retails trade area with a re-densification program based on the available community facilities, this however could not be implemented.

Over time, the places in the walled city that cannot be modernized easily are ignored and thus continue to decline. Old Delhi's condition has deteriorated to an extent that the Delhi Urban Art Commission has declared it 'a slum' as per Delhi Master Plan, which has necessitated the need for Urban Renewal and redevelopment plans for the city.





PRESENT DAY CHALLENGES - OLD DELHI



There is a need to evaluate the preexisting conditions of the historic urban environment and to preserve genetic codes of the fabric, which would help embed conservation in the urban planning process.

[ FIGURE 1.3 ] Matia Mahal Street  
(South of Royal Mosque)  
Source: www.telegraph.co.uk

## REDEVELOPMENT STRATEGIES FOR SHAHJAHANABAD (WALLED CITY) <sup>1</sup>

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The next Master Plan of Delhi 2021 once again aims to revive the city's lost glory. The following guidelines have been extracted from the Zonal Development Plan Zone "A" Walled City, laid out by the Delhi Development Authority, Ministry of Urban Development that focus on conserving the special fabric.

Special efforts are required to conserve the heritage value of the Special Area **while retaining the residential character. Also, redevelopment of government owned and privately owned katras (neighbourhoods) needs to be taken up on priority.** It is suggested that permission of activities in use premises and building control regulations shall be in accordance with the following guidelines.

1. The area surrendered for public facilities/ heritage conservation to be used as tradable FAR.
2. Subject to preparation and approval of an Integrated Redevelopment Scheme, higher FAR and other development controls can be considered subject to requirement of heritage controls, parking, accessibility of emergency vehicles and basic services.
3. The street pattern in residential areas to be restructured to provide better linkages to the metro stations. Road widening considering movement of fire fighting vehicle and other disaster management criteria.

### DEVELOPMENT OF CHOWKS (INTERSECTIONS) IN WALLED CITY

There are many prominent Chowks (cross junctions of roads) within the walled city. These Chowks, are one of the most prominent characteristic of the Walled City Area, and should be dealt with special attention at the time of preparation of Urban Design guidelines.

### REDEVELOPMENT OF KATRAS AND EVACUEE PROPERTIES

As per Zonal Development Plan, there are about 3,500 evacuee properties/ Katras, which are being managed/ controlled by the Slum Department under section III of Slum Area (Improvement Clearance Act of 1956). In-situ redevelopment approach shall be followed. This approach is well suited to conserve the existing social fabric, avoiding undue displacement of vulnerable sections of the society.

### DEVELOPMENT CONTROL REGULATIONS

#### Residential Redevelopment Areas

1. Redevelopment Schemes to take advantage of incentivized FAR shall be permitted on a minimum area of 3000 sqm.
2. Amalgamation/ reconstitution of plots shall be allowed under the purview of Master Plan of Delhi- 2021
3. In Walled City, as per the existing Development Control regulations, the height is restricted to 15m. However in view of utilizing the given incentivized FAR, it is proposed in this report to allow height upto 18 m.

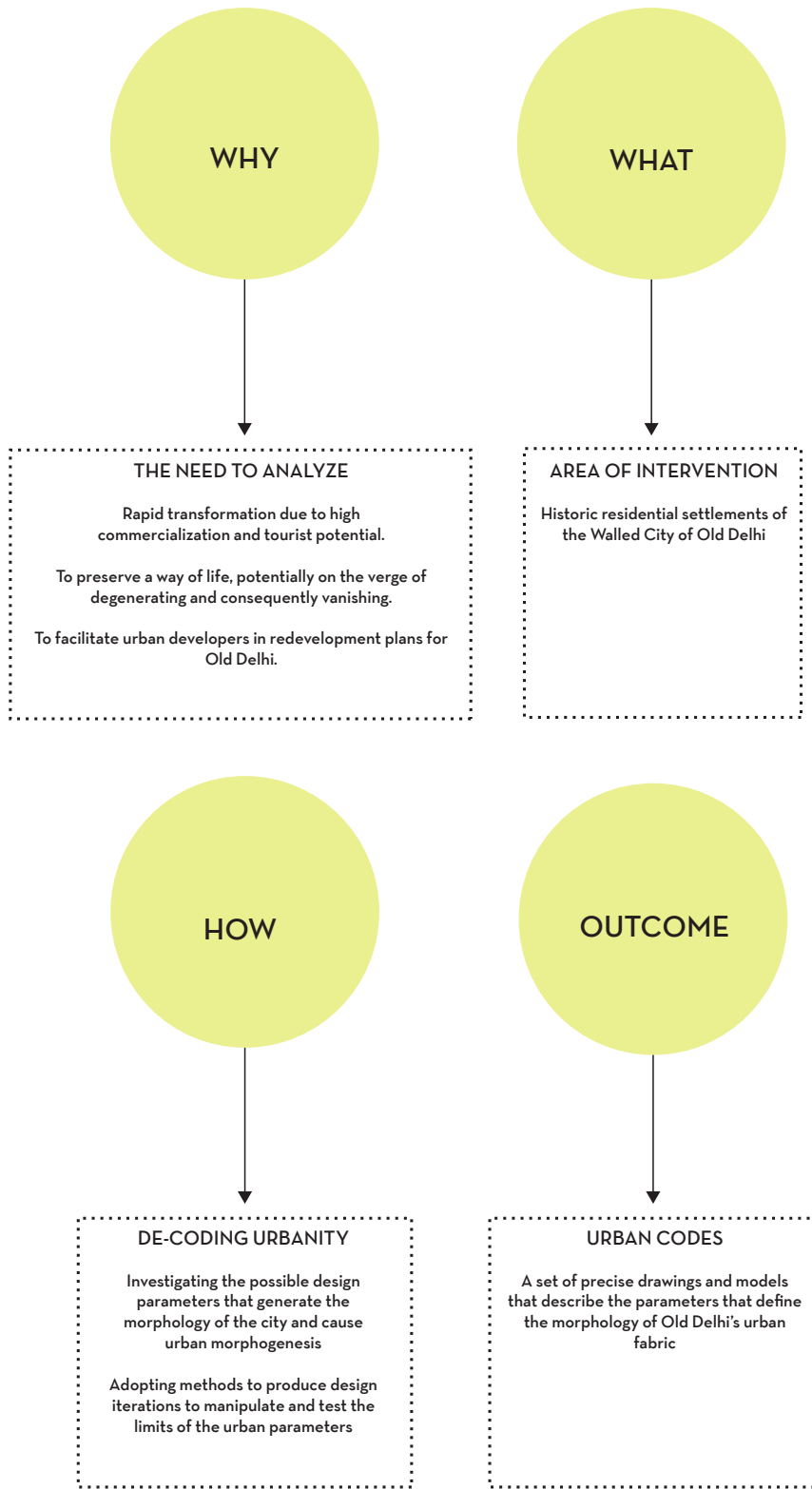
#### Public and Semi Public

1. Existing layout shall be retained.
2. Reconstruction using incentivized FAR and concept of Accommodation Reservation shall be allowed.
3. Renovation and up gradation of basic services shall be carried out.

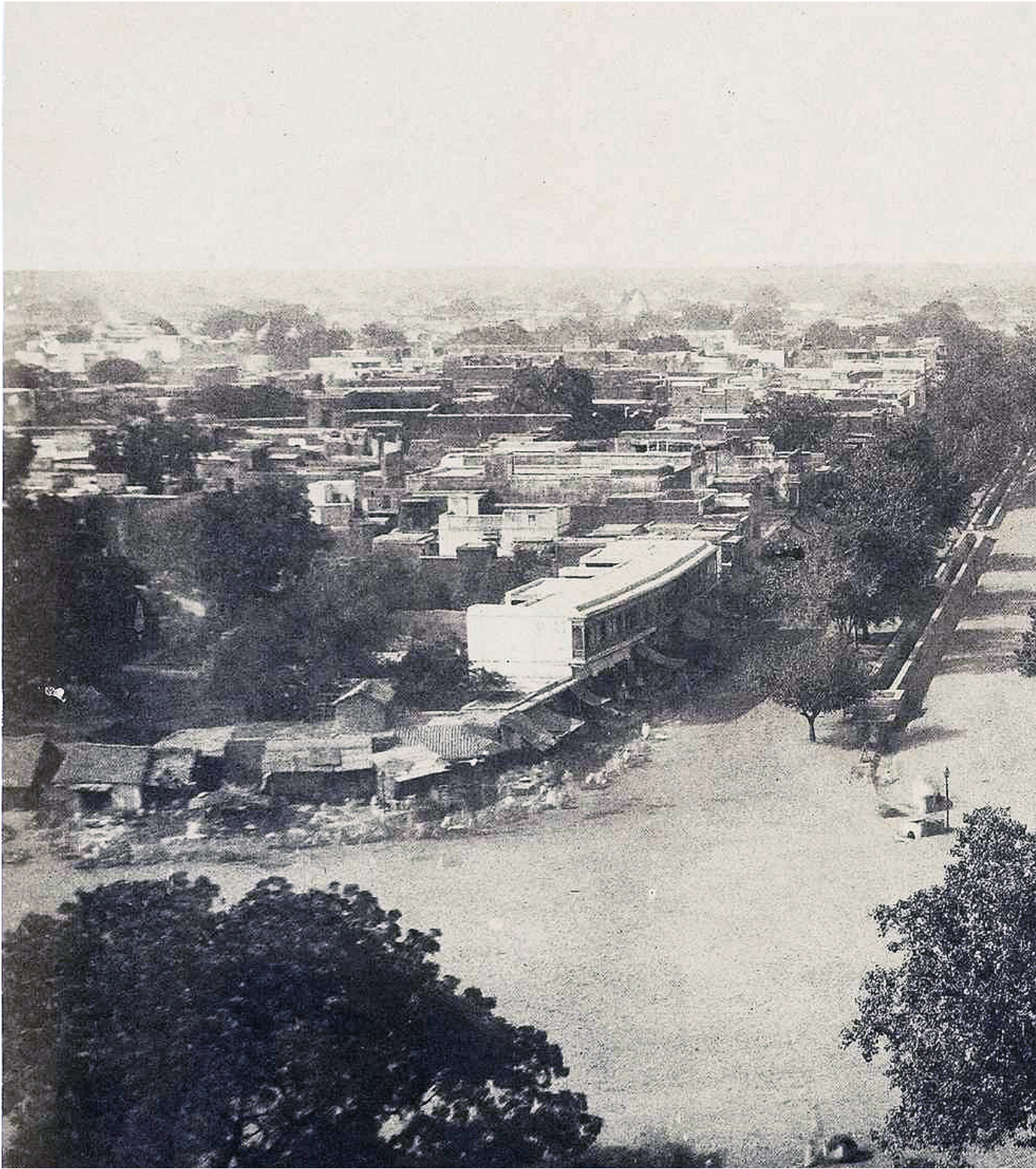
This research and design experimentation thus focusses on the preservation of the residential character of Old Delhi by focussing on the redevelopment of 'katras' as it coincides with one of the most important targets of the government so as to conserve the existing fabric.

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<sup>1</sup> Zonal Development Plan For Zone-A - Walled City (Part A&C) Authenticated On Behalf Of The Government Of India Vide Letter No.k.12011/3/Zone-A Walled City (Part A&C)/2010-Dd.ib Dated 1.6.2010



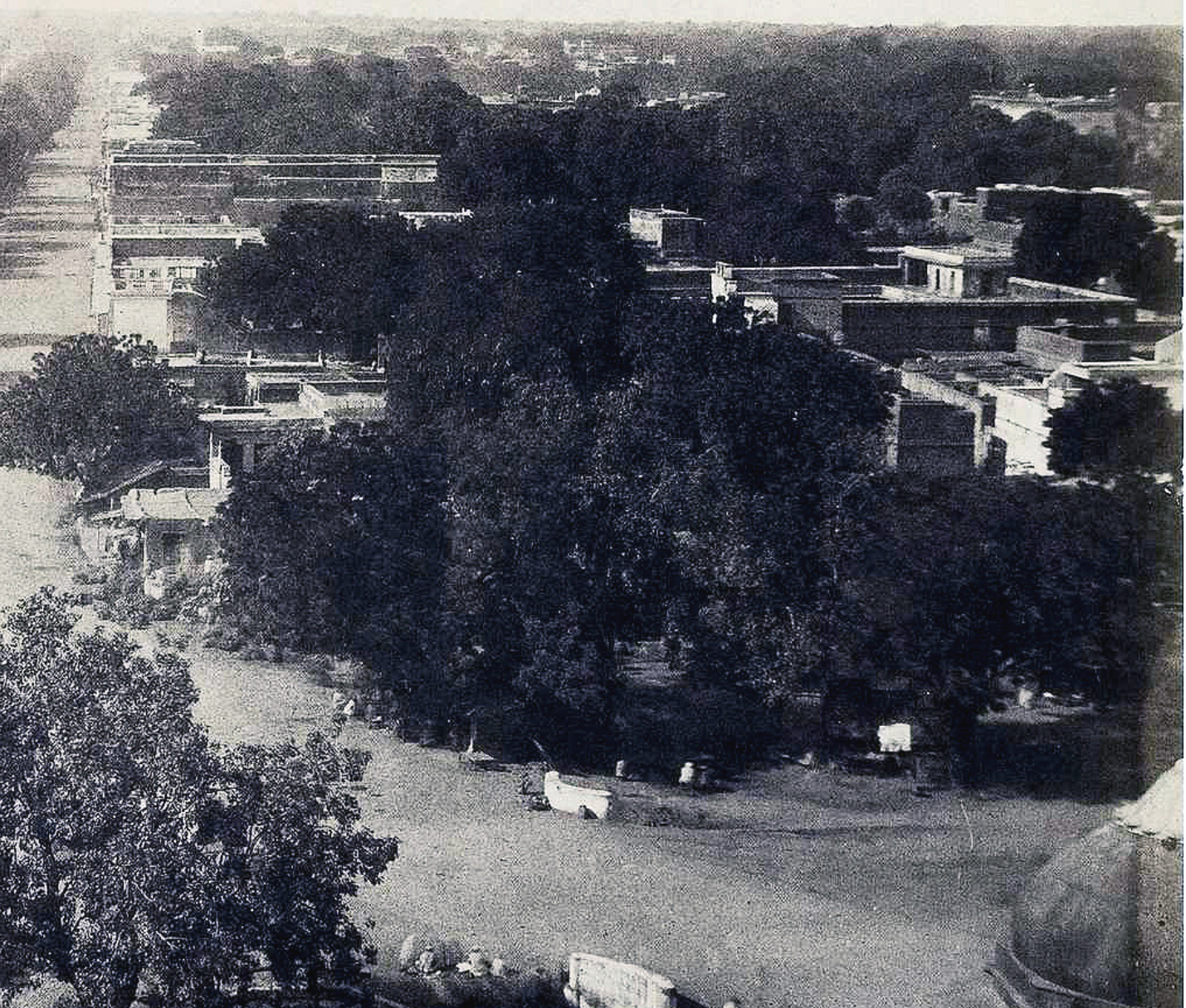
[ FIGURE 1.4 ]  
Thesis Machine

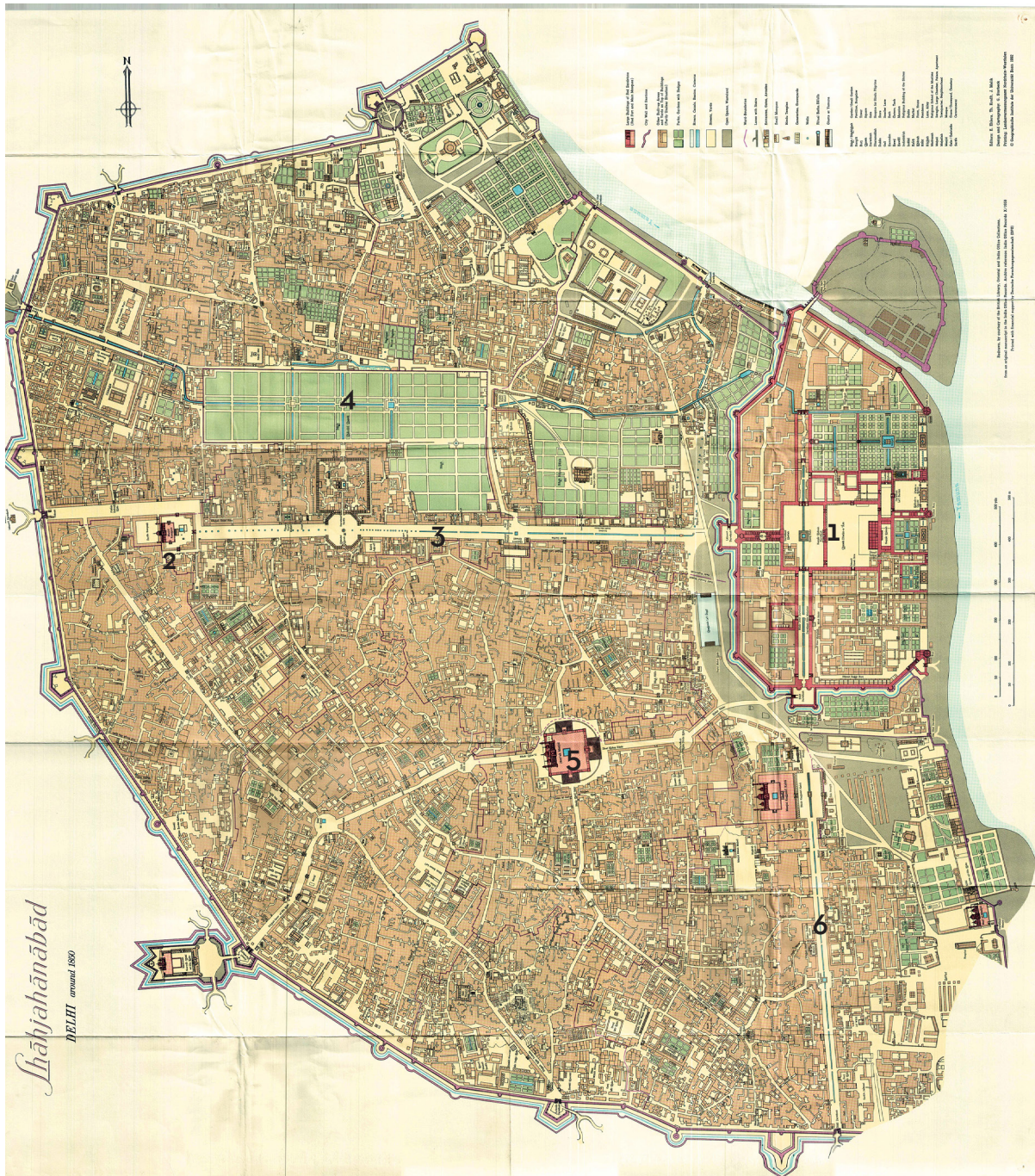


# HISTORICAL BACKGROUND

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**Old Delhi as an evolutionary-adaptive city  
Historical Urban Development of Old Delhi**





 NORTH

[FIGURE 2.1] Old Delhi 'Shahjahanabad' - Delhi Around 1850

Source : Map of Shahjanabad dated 1850 (redrawn from an original manuscript by E. Ehlers and T. Kraft)



## OLD DELHI AS AN EVOLUTIONARY-ADAPTIVE CITY

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Today, Old Delhi might have reduced to disorderly aggregations of dwellings and inadequate infrastructure and serious congestion in almost all quarters, a result of the lapse of effective local government for centuries, however the city that was a planned entity with both Hindu and Islamic influences still holds its traditional character to a great extent. Persian influence is predominant in both planning and architecture. Many of the great men of State were from Iran and thus influenced the design and build of palaces, mosques, tombs and gardens. The propensity of the Mughal dynasty for grandeur is very clearly seen in Shahjahanabad, which exemplifies a grand conceptualization of urban space, is today being upheld as the apogee of town planning in medieval India.<sup>1</sup>

On 19<sup>th</sup> April 1648, Mughal emperor Shahjahan entered his Palace 'Red Fort' which was the first focal point (Fig. 2.1 - 1) of the city. Other focal points were slowly added. The Fatehpuri Masjid (Empress' Mosque - 2) was constructed in 1650 and was located west of the Palace. The street connecting the Palace to the Fatehpuri Mosque called 'Chandnichowk' (3) became the third element in the city, eventually connecting to the Lahore Gate. This became a ceremonial street with shops and houses of the nobles on both sides. This was followed by planning of the Royal Gardens (4) by the emperor's daughter Princess Jahanara. The gardens were 54 acres in area and were located north of Chandnichowk Street. The fifth feature was the Royal Mosque 'Jama Masjid' (5) constructed southwest of the palace, was the main congregational mosque of the city. The mosque was intentionally planned on a rocky outcrop, almost 9m above ground so as to orient the occupants of the city. The sixth feature is the Faiz Bazaar that was established along the street connecting the Delhi gate of the Palace and the Delhi Gate of the city walls. The six urban elements along with the streets connecting the eleven city gates formed the fundamental urban system. These followed a formal layout with a very strong social hierarchy.

Mansions, local mosques and streets developed around these focal points. These were organic and informal. The nobles and the people working directly under the emperor enjoyed proximity to the palace and generally centered the smaller neighbourhoods. These in a way symbolized the emperor's city in miniature in the form of a large quarter that included a mansion, mosque, madrasah, bath, and houses for dependants.

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<sup>1</sup> Lopez, Annabel, Shahjahanabad : Inventory of Built Heriatge - I, INTACH Delhi Chapter, pp. ii, 2013



[FIGURE 2.2] View of the city from the 'Red Fort' - Looking south- west 1823  
Source : British Library, New Delhi

The remaining areas within the neighbourhoods were filled with merchants, artists, laborers who were unattached to any of the great households. They lived in caste/craft quarters in the middle of the area.<sup>2</sup> Thus, the structure of society in the imperial residence, replicated on a smaller scale in the mansions of princes and great amirs, set the pattern for the city as a whole.<sup>3</sup>

The city's vibrancy and vigor encountered its first wound in the year 1739 when a Persian traveller Nadir Shah entered the city. He ordered general slaughter of the citizens and also took away the entire wealth that the Mughals had accumulated in India. This was followed by another attack by Ahmed Shah in 1757 who took away whatever wealth the city had accumulated post Nadir Shah's attack. In 1857, the British carried out a deliberate act of unnecessary vandalism by pulling down the harem apartments of the Royal Palace without preserving any record of the splendid structures. The period until the 19th century, thus, went under the physical, social, cultural and spiritual reconstruction of the community.

At the starting of the 19th century, Old Delhi came under the British Rule. The British had imperial and commercial interests in the city and concentrated on political and military advantages. Although, the social and cultural aspects of the city were not interfered with, the British obliterated a large part of the city areas. All buildings within a radius of four hundred forty-eight yards from the Royal palace were demolished. The city's royal gardens were cleared to incorporate the railways to enhance trade and commerce. Thus, the British brought new parameters that Old Delhi grew and evolved with.

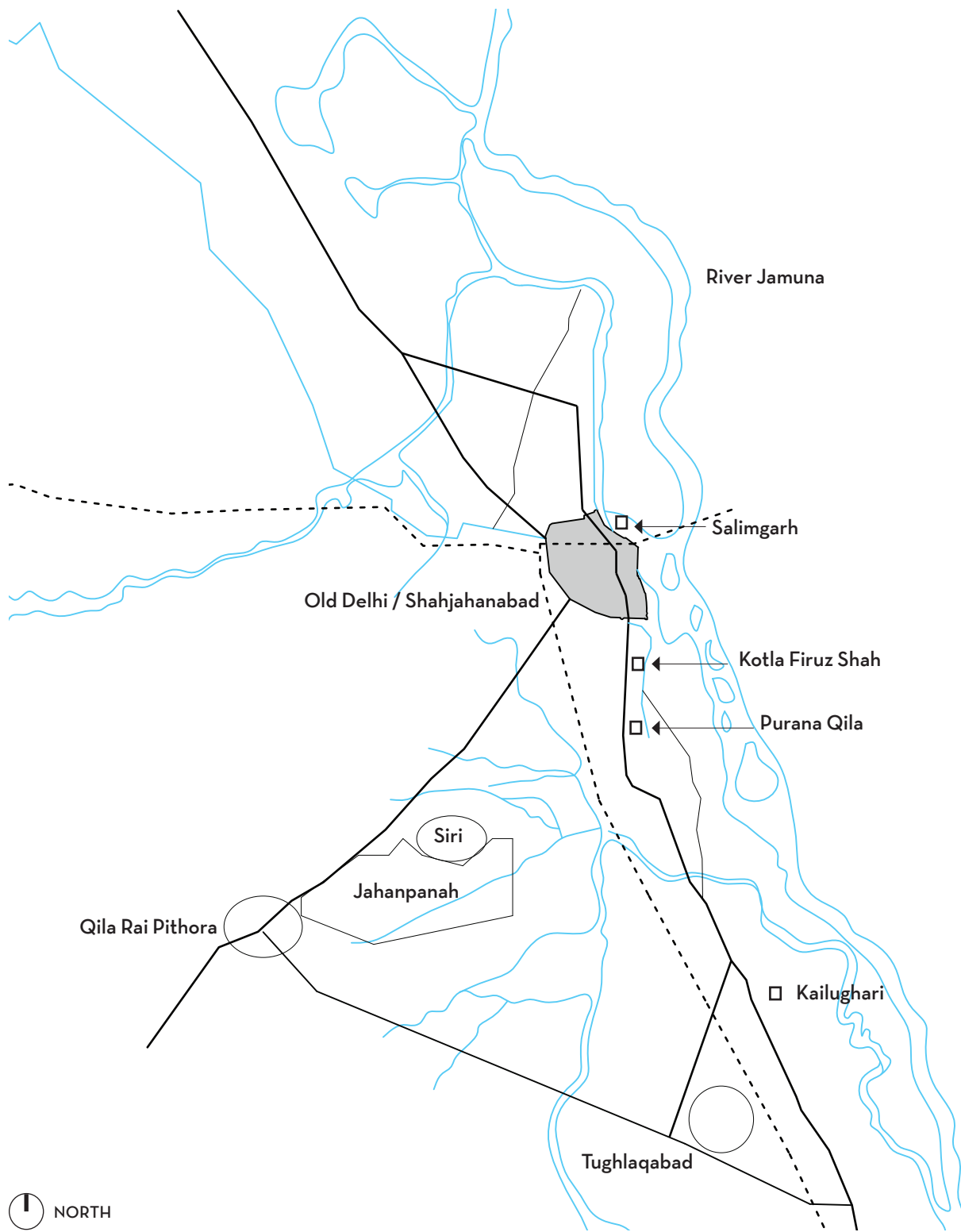
In 1911, a major political shift happened when the British moved the capital from Calcutta to Delhi that gave rise to the planning and development of New Delhi by Sir Edward Lutyens. Even though the principal axis by which New Delhi was designed kept Jama Masjid (Royal Mosque of Old Delhi) as its focal point, Old Delhi was no longer the area of interest for the British and the city started facing extreme neglect. In 1947, the partition between India and Pakistan forced many Muslims living in Old Delhi to move across borders.

Post independence the city has suffered due to extreme immigration from different parts of India. The urban fabric that we see today is a model that has responded to multiple physical, social, cultural and political pressures and continues to bear the brunt of the government's mistakes and negligence even today.

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<sup>2</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp.70-71

<sup>3</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp.83



[FIGURE 2.3] CITIES OF DELHI

## HISTORICAL URBAN DEVELOPMENT OF OLD DELHI

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Over a period of more than 1000 years, Delhi has remained a favourable place for many rulers as it occupied a strategic position in Upper India with the rich unbroken floodplain and the two great river systems. The first city was built around the 8th century A.D. by the Tomar Rajputs and was called Dilli. This was then followed by the Tughluq Dynasty, Mughals and finally the British.

DYNASTY	CITIES OF DELHI	DATE
Tomar Rajput	Lal Kot	1052 A.D.
Chauhan Rajput	Qila Rai Pithora	1180 A.D.
Khalji Turks	Siri	1303
Tughlaq Turks	Tughlaqabad	1321
Tughlaq Turks	Jahanapanah	1325
Tughlaq Turks	Firuzabad	1354
Mughals	Din Panah	1533
Sur Afghans	Shergah	1540
Mughals	Shahjahanabad	1639
British	New Delhi	1911

The walled city of Delhi popularly known as Shahjahanabad was built in 17<sup>th</sup> century for a population of 60000 covering an area of about 5.69 Sq.Km. The city was developed in typical Mughal style, densely built with organic street pattern. Old Delhi was a premodern Indian city with features that characterized medieval European cities, like trade, merchant associations, political autonomy, they were not just princely camps or form less, ready to dissolve at a moment.<sup>1</sup> Today, it is the cultural, industrial and economic heart of Delhi.

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<sup>1</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp. xiv



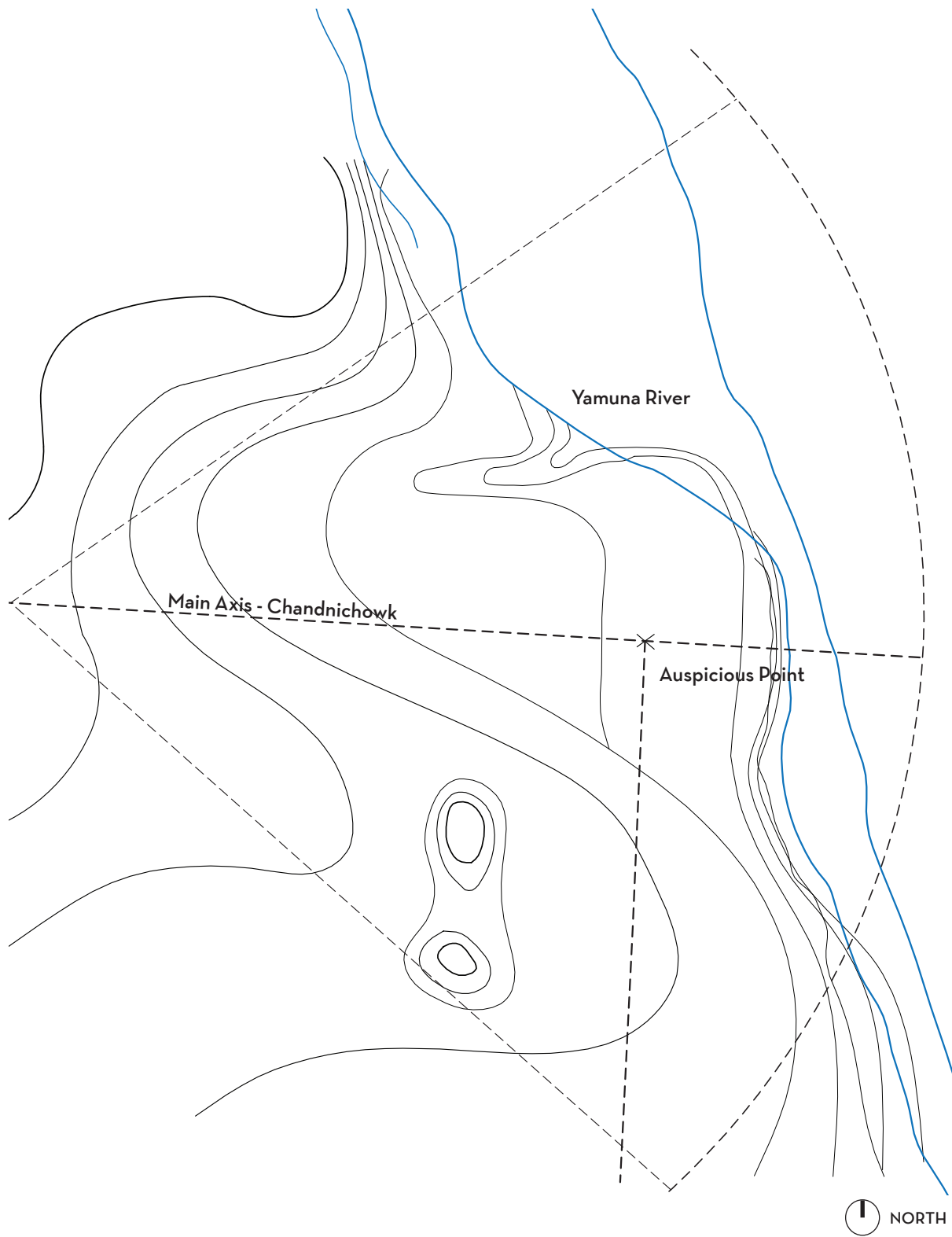


[FIGURE 2.4] Plan Of 'Dehli' 1812  
 ( Now The Walled City Of Old Delhi )

Engineer Coprs, 13th December, 1812



Source : National Archives of India, New Delhi  
 Copy Right Vests In The National Archives Of India,  
 Government of India



[FIGURE 2.5] HINDU PLANNING IDEALS - SETTLEMENT GEOMETRY 1639



## ORIGINAL SITE 1639

### Planning of Old Delhi :

The city was planned according to Hindu planning principles of Shilpa Shastra\* from Vastushastra\*\*. The site was placed on a high land as in the Shastra (Text of the Hindu religion) and was 'Kamukha' or bow shaped, for this ensured its prosperity. The arm of the archer was Chandni Chowk which was the primary ceremonial pathway.

Yamuna river was considered to be the string. The junction of the two main axes is the most auspicious point in the whole site and was therefore the location of the royal palace or the Red Fort.



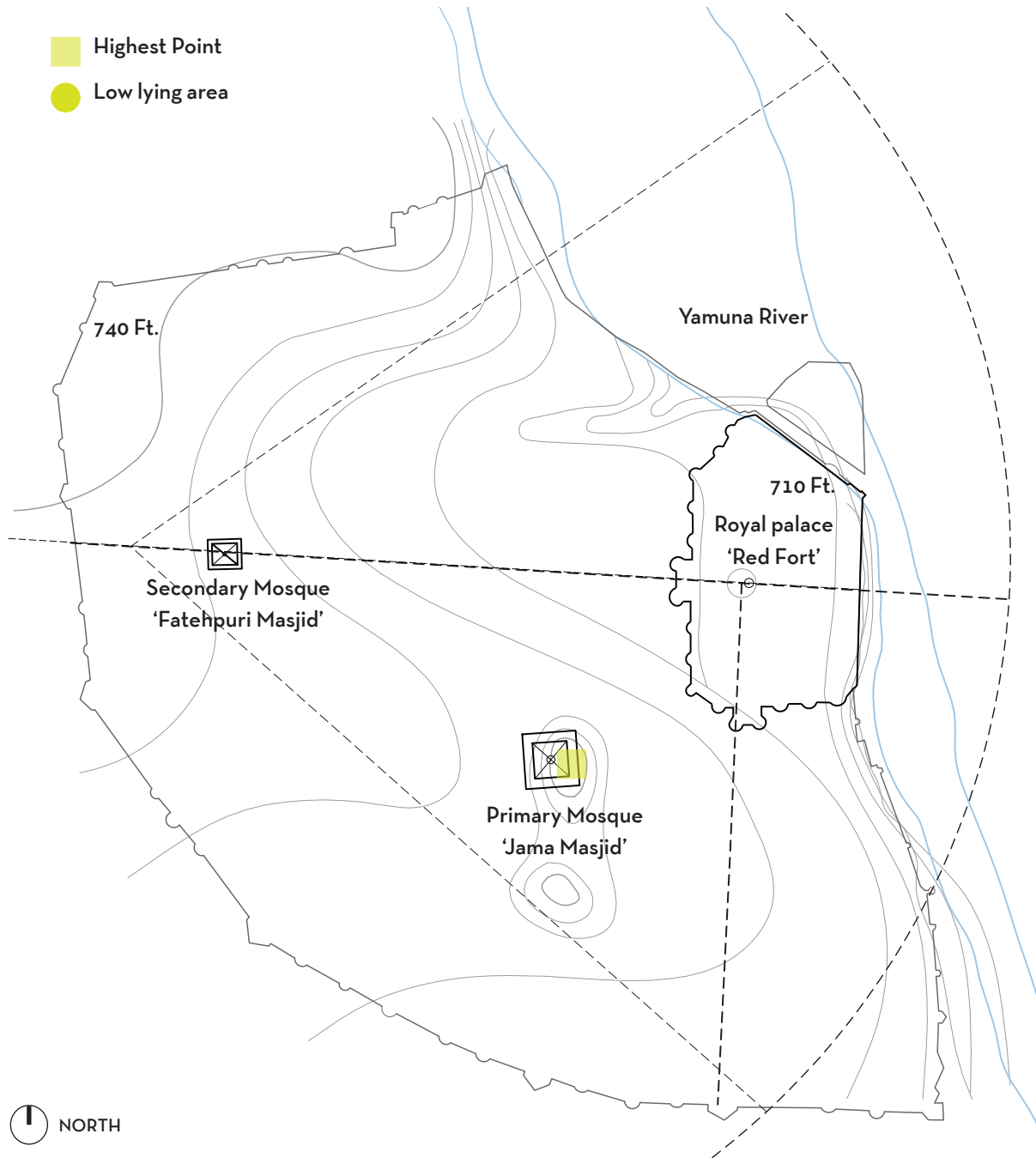
[FIGURE 2.6] View of the royal palace 'Red Fort' from river Jamuna - Looking west 1823

Source : British Library, New Delhi

\*Shilpa Shastra is an ancient umbrella term for numerous Hindu texts that describe arts, crafts, and their design rules, principles and standards.

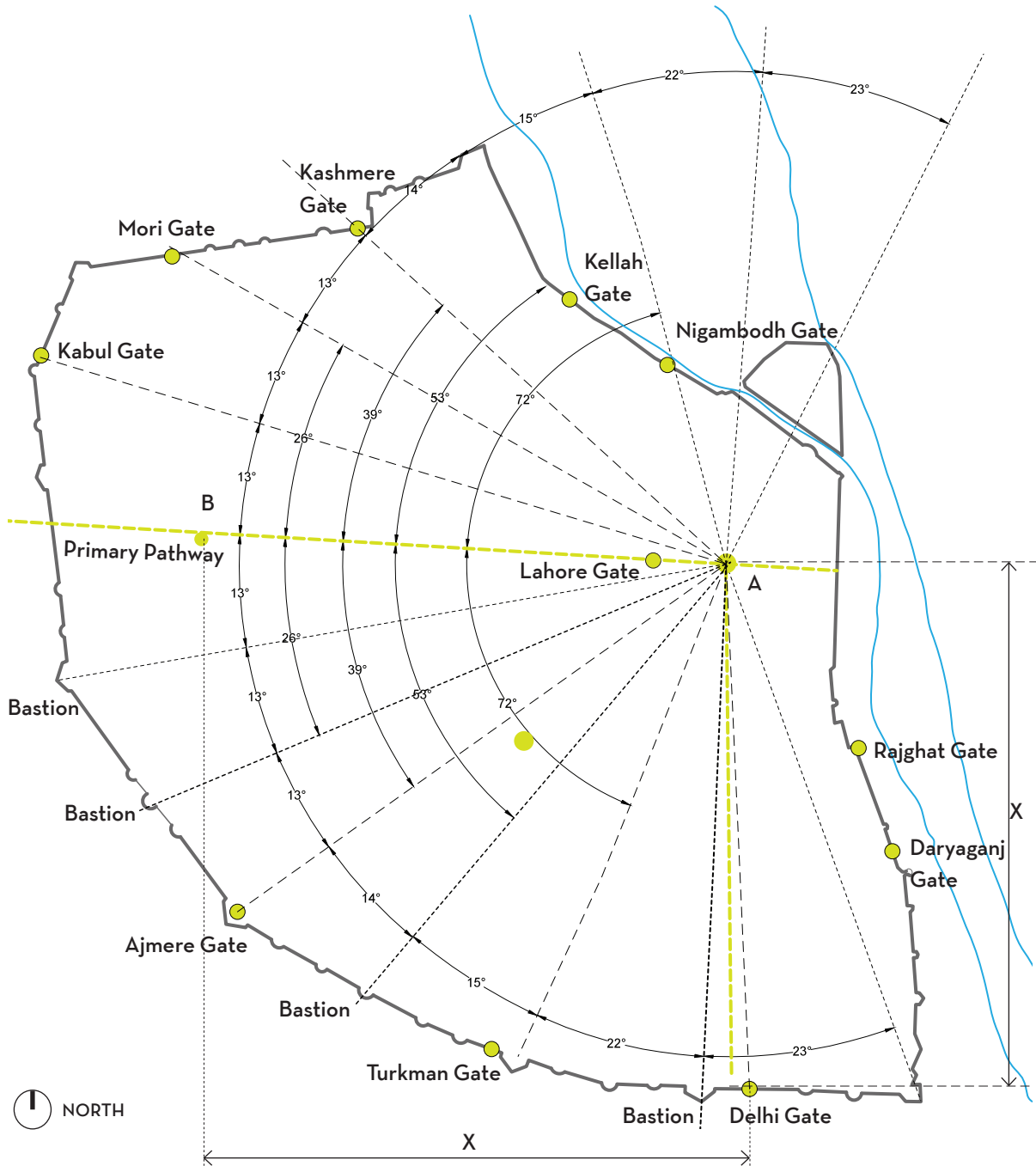
\*\*Vastu Shastra is a traditional Hindu system of architecture

[FIGURE 2.7] SITE CHARACTERISTICS



Old Delhi was built next to Yamuna river and north of the old cities. The natural presence of water was a very important factor in the location of the settlement. Canals and extensive water system was built by Mughal Emperor Shahjahan. Canals ran on the city's outskirts to water the gardens and orchards outside the city. They were then directed into the city through the Kabul gate where it split into two branches - one of them ran through the main street - Chandnichowk and the other ran through the gardens before entering the palace.

[FIGURE 2.8] SETTING OUT PLAN FOR URBAN ELEMENTS  
 QUANTITATIVE ANALYSIS - MEASUREMENTS, ANGLES, PROPORTIONS



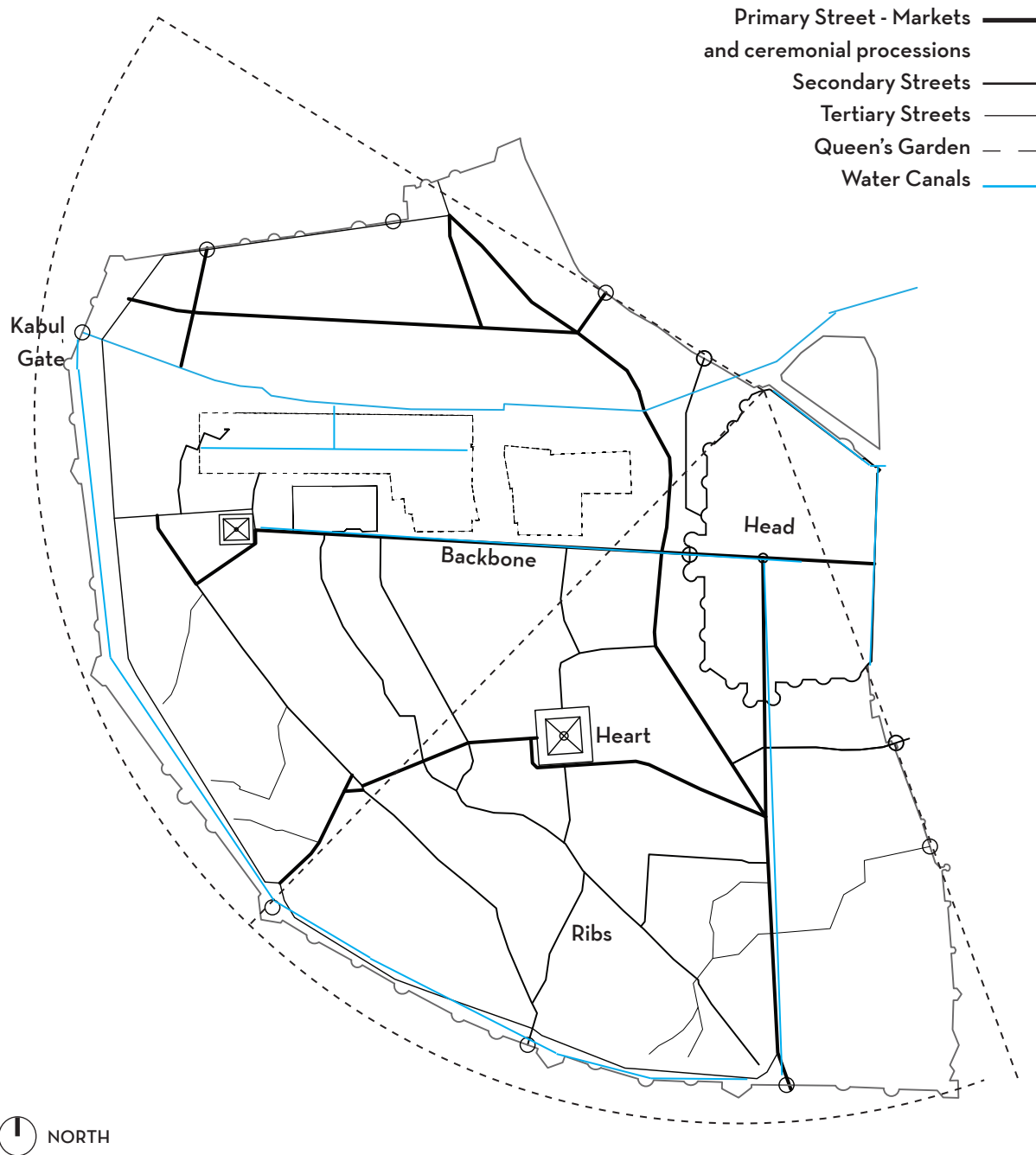
The primary pathway is considered as the reference axis to set out the city gates and bastions. Intervals of 13 degrees is dominant near the axis, followed by 14 - 15 - 22 - 23 degrees as we move towards the river to the northeast and southeast. Taking Centre of circle as the centre of the Red Fort point 'A', and radius as 'X', the location of the Secondary Mosque is obtained on the primary axis point 'B'.





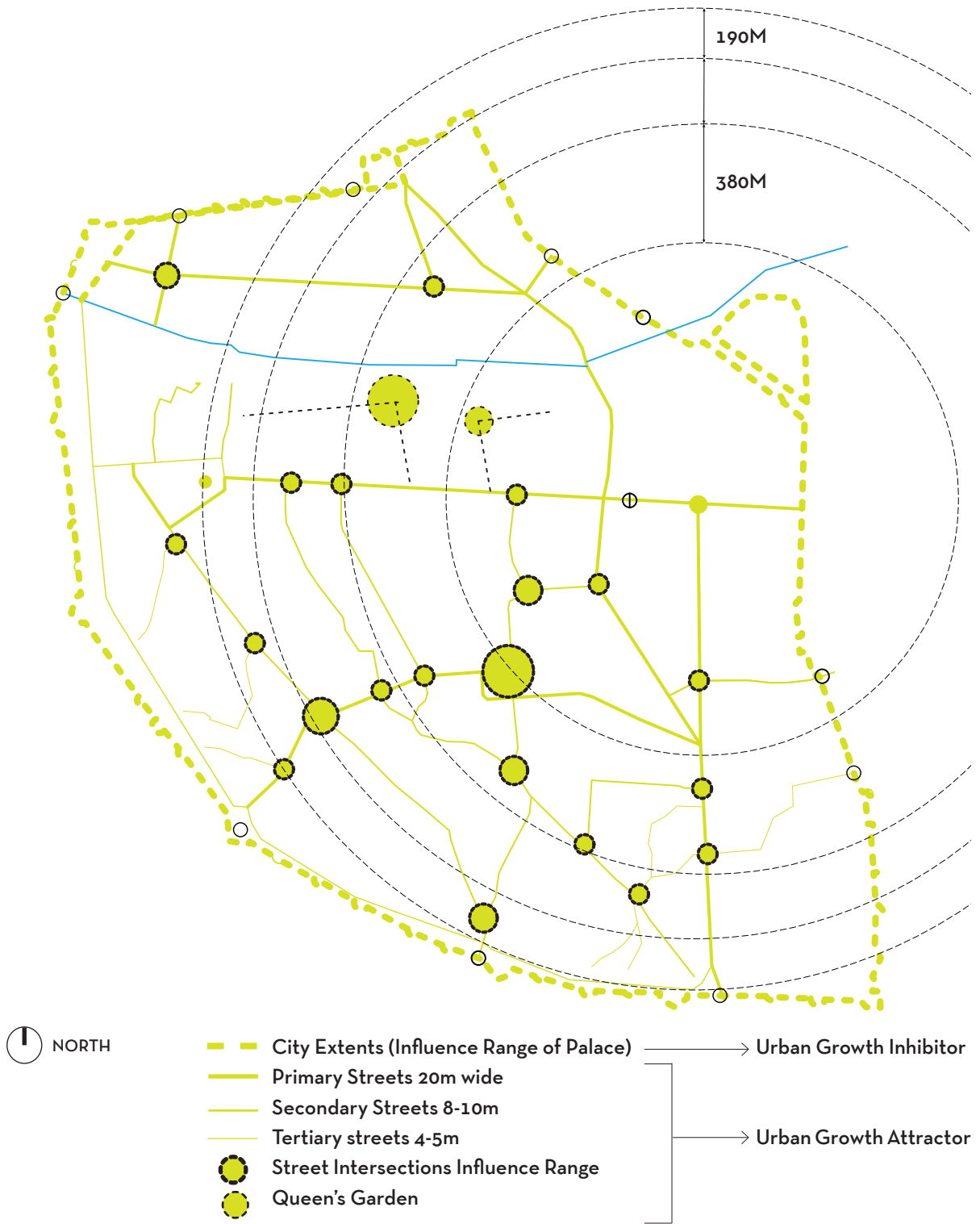
[Figure 2.9] Kashmere Gate , Delhi 1895 - Source : British Library, New Delhi

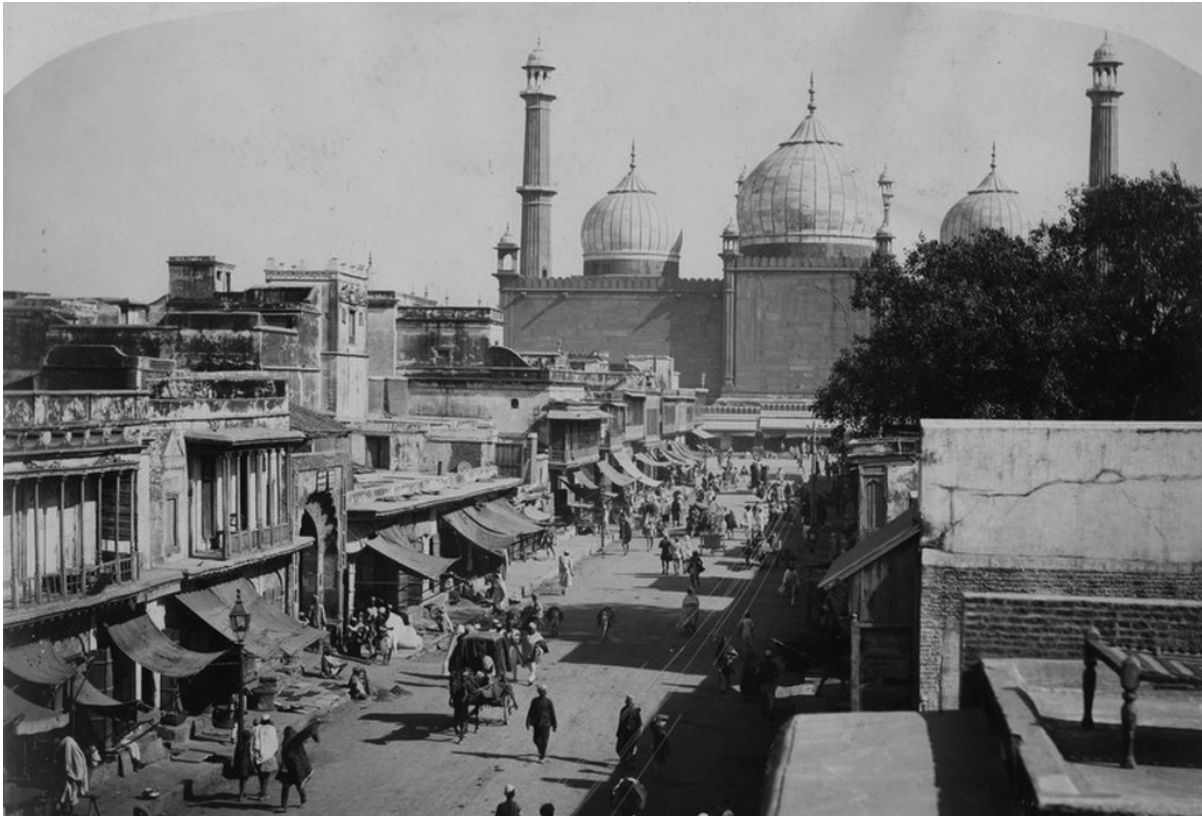
[FIGURE 2.10] ISLAMIC PLANNING IDEALS - SETTLEMENT GEOMETRY 1639



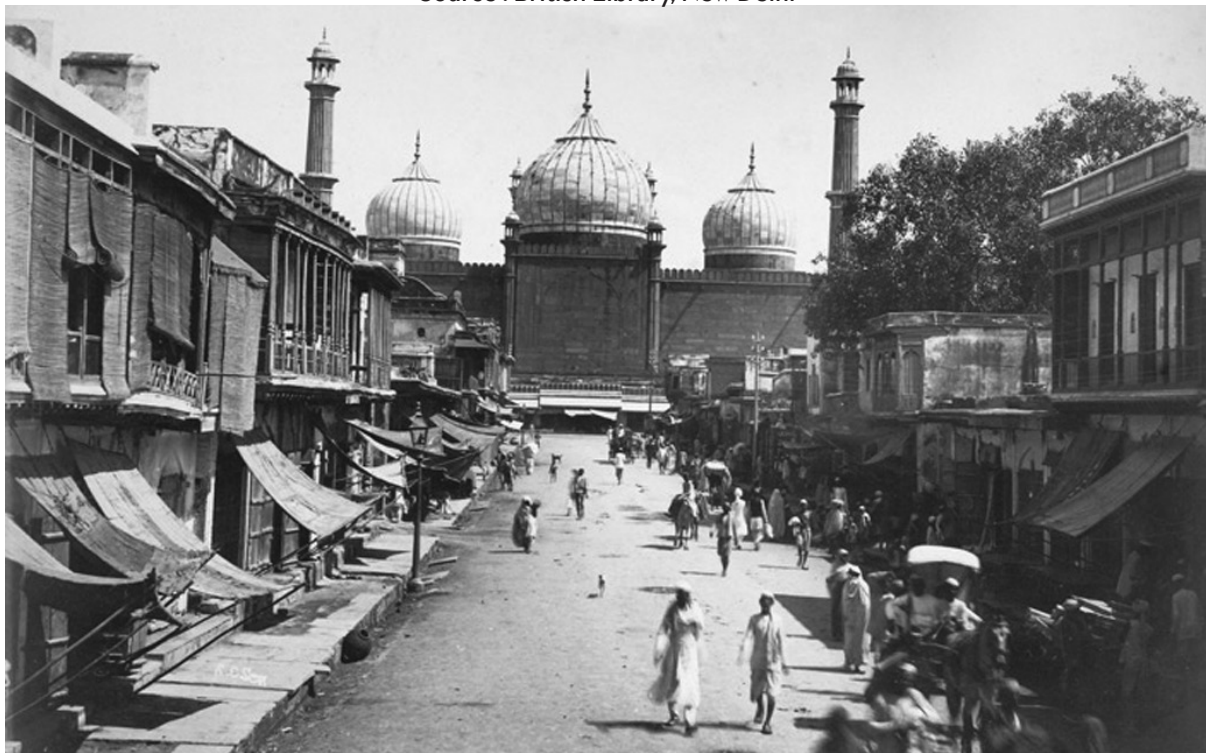
Shaped as a semi-elliptical city, Old Delhi's urban design was an amalgamated model of Persian, Islamic and Vedic principles. Its architects Ustad Hamid and Ustad Ahmed made this with Islamic cosmology, man macrocosm analogies; Spine - Chandni Chowk, Ribs streets, Head fort, Heart Jama Masjid, Organs Sarai, Wall skin. Old Delhi was planned on man macrocosm analogies (Dettmann, 1969). This planning principle has been represented in Islamic texts such as Rasail Ikhwan al Safa.

[FIGURE 2.11] BEHAVIOURAL NATURE OF URBAN ELEMENTS

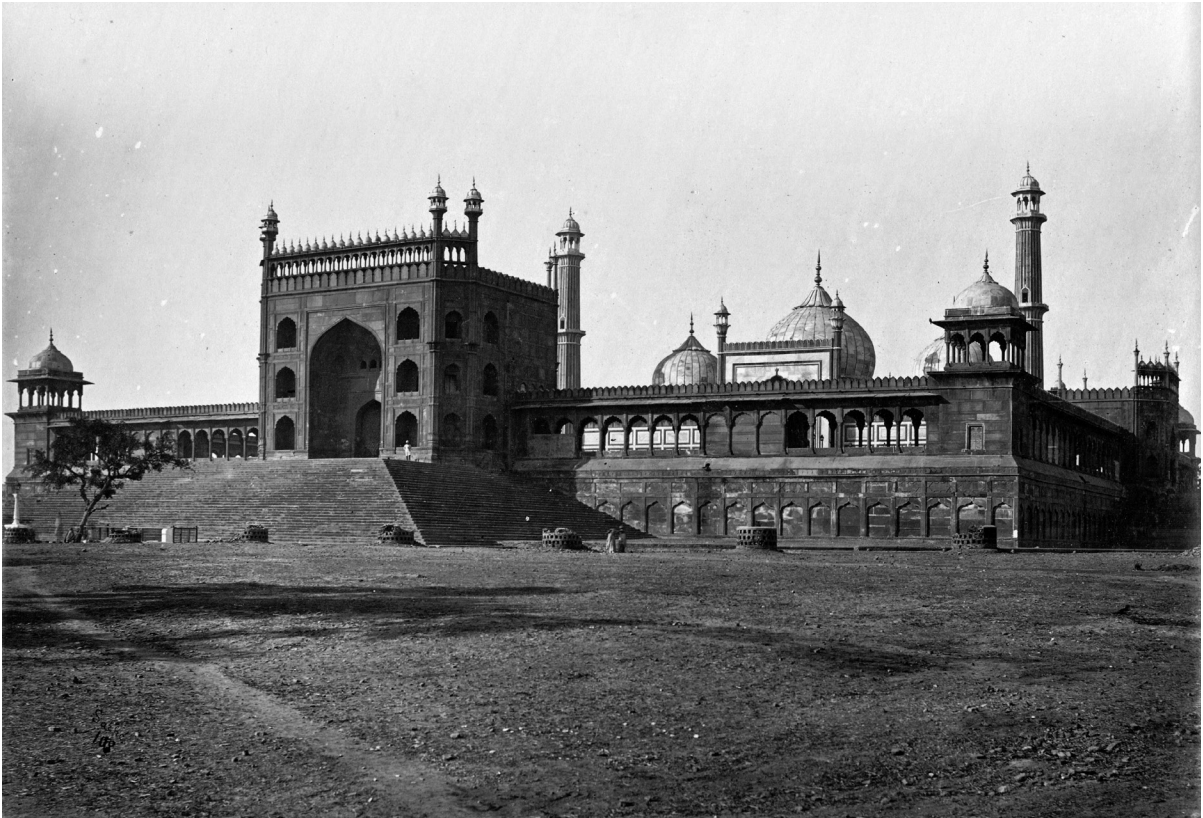




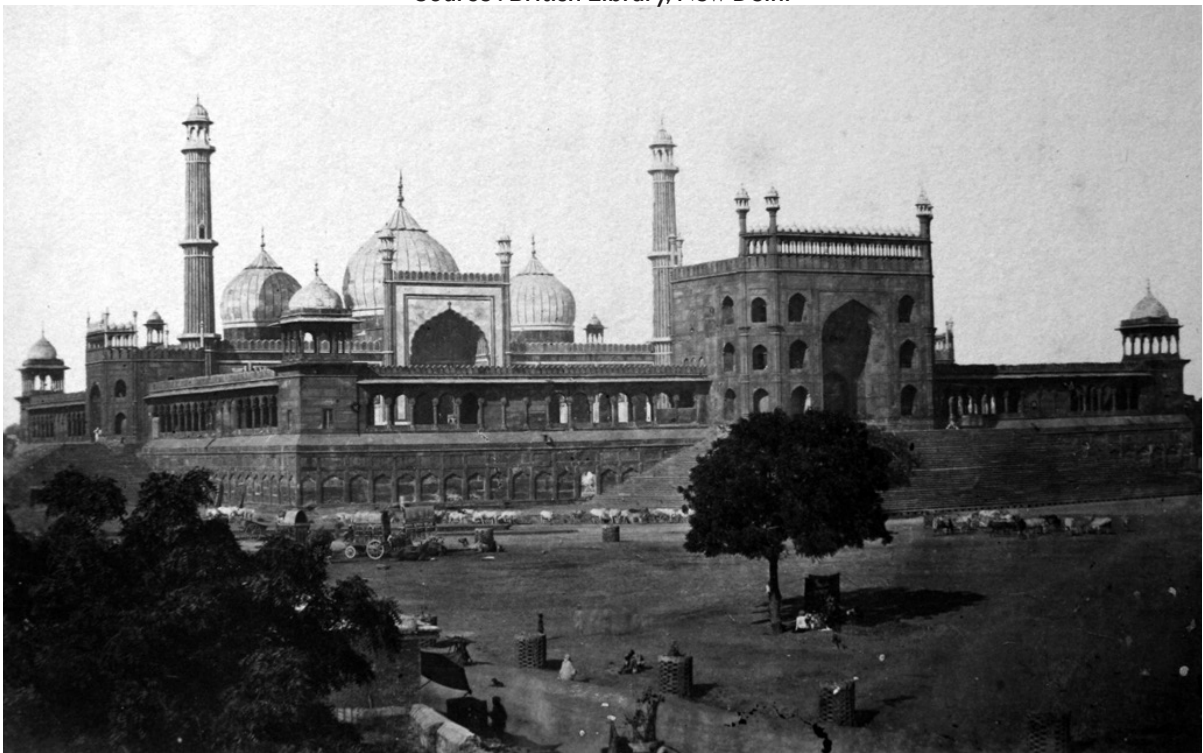
[FIGURE 2.12] Rear view of royal mosque 'Jama Masjid' - Looking east 1857  
Source : British Library, New Delhi







[FIGURE 2.13] Front view of royal mosque 'Jama Masjid' - Looking west 1875  
Source : British Library, New Delhi

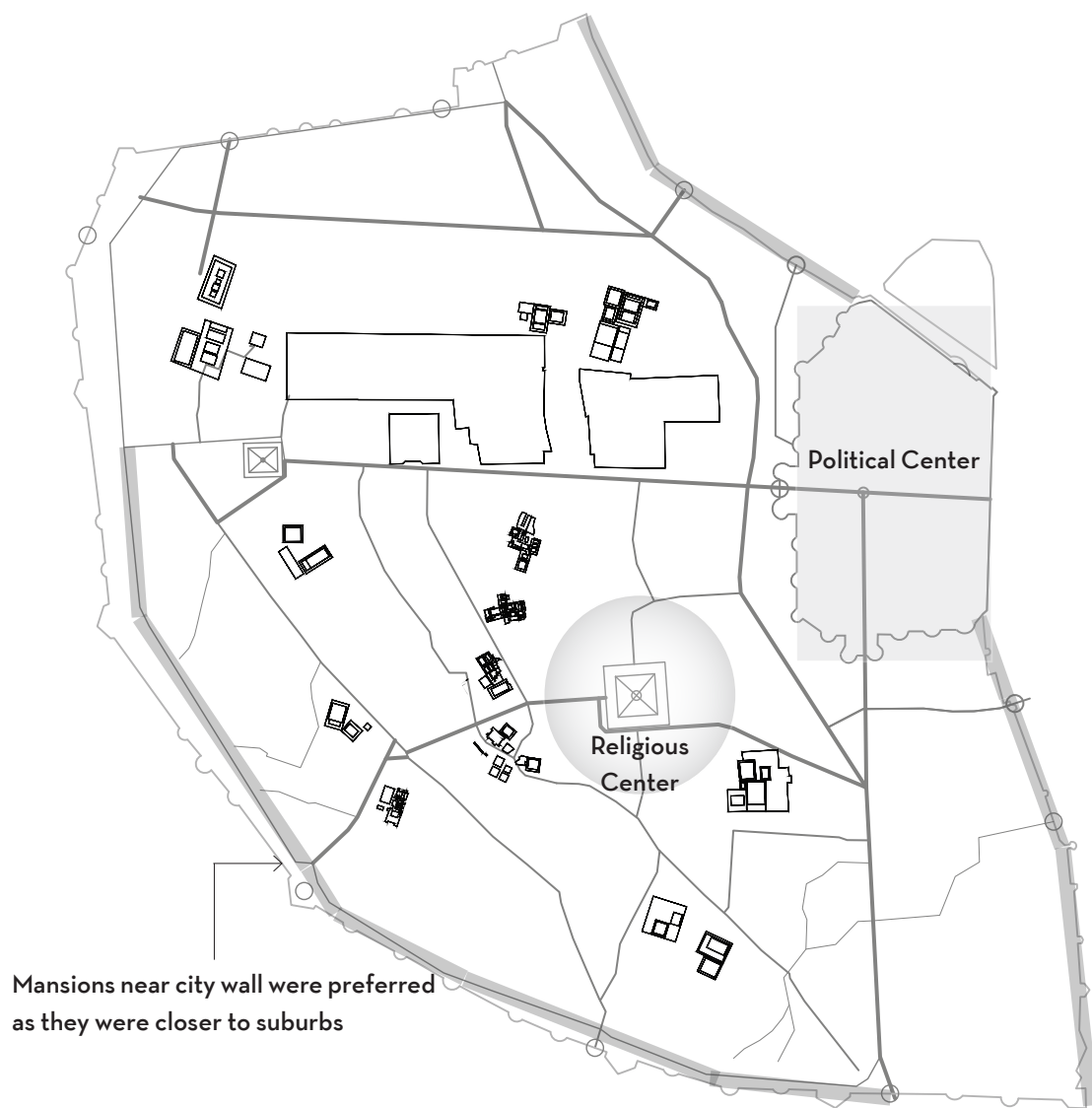






[FIGURE 2.14] JAMA MASJID - REAR VIEW - TODAY - Source : Priyush INTACH

[FIGURE 2.15] OLD DELHI CITYSCAPE : MANSIONS 1649

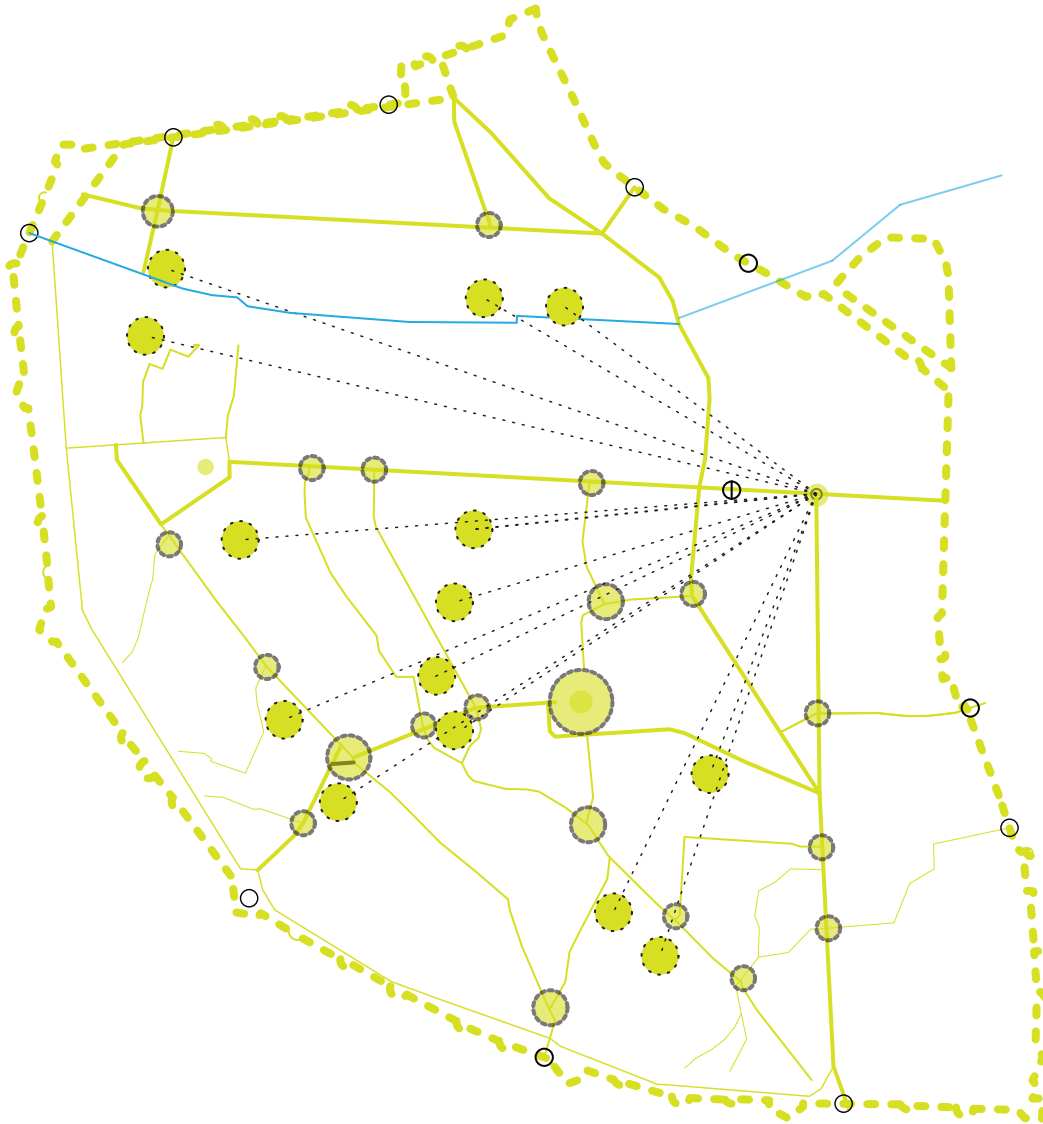


⊕ NORTH

The mansions of the older princes and amirs who were considered as the members of the imperial household were constructed all over the city after the model of the palace-fortress. These mansions dominated their sectors of the city just as the palace dominated the urban area as a whole. They were grouped in three areas: along the river near the palace, about the Jama Masjid and on the periphery of the walled city near the main gates.

<sup>1</sup> Blake, Stephen, *Shahjahanabad : The Sovereign City in Mughal India 1639-1739* ( Cambridge University Press 1991), pp. 49 - 51

[FIGURE 2.16] MANSIONS AS URBAN GROWTH ATTRACTORS



Mansions were like small towns where the woman of the nobles resided and public markets were also seen. These then attracted the mansions of lower-ranking amirs and so on<sup>1</sup>. Thus, mansions can be analysed as Second Order Urban Growth Attractors ( after the Palace and the Mosques) that generated a bottom-up typology with houses, servant quarters, bazaars which allowed the area to populate.

 Street Intersections

 Mansions for nobles





[FIGURE 2.17] ROYAL PALACE - RED FORT FACADE

Source : British Library, New Delhi

[FIGURE 2.18] OLD DELHI CITYSCAPE 1750



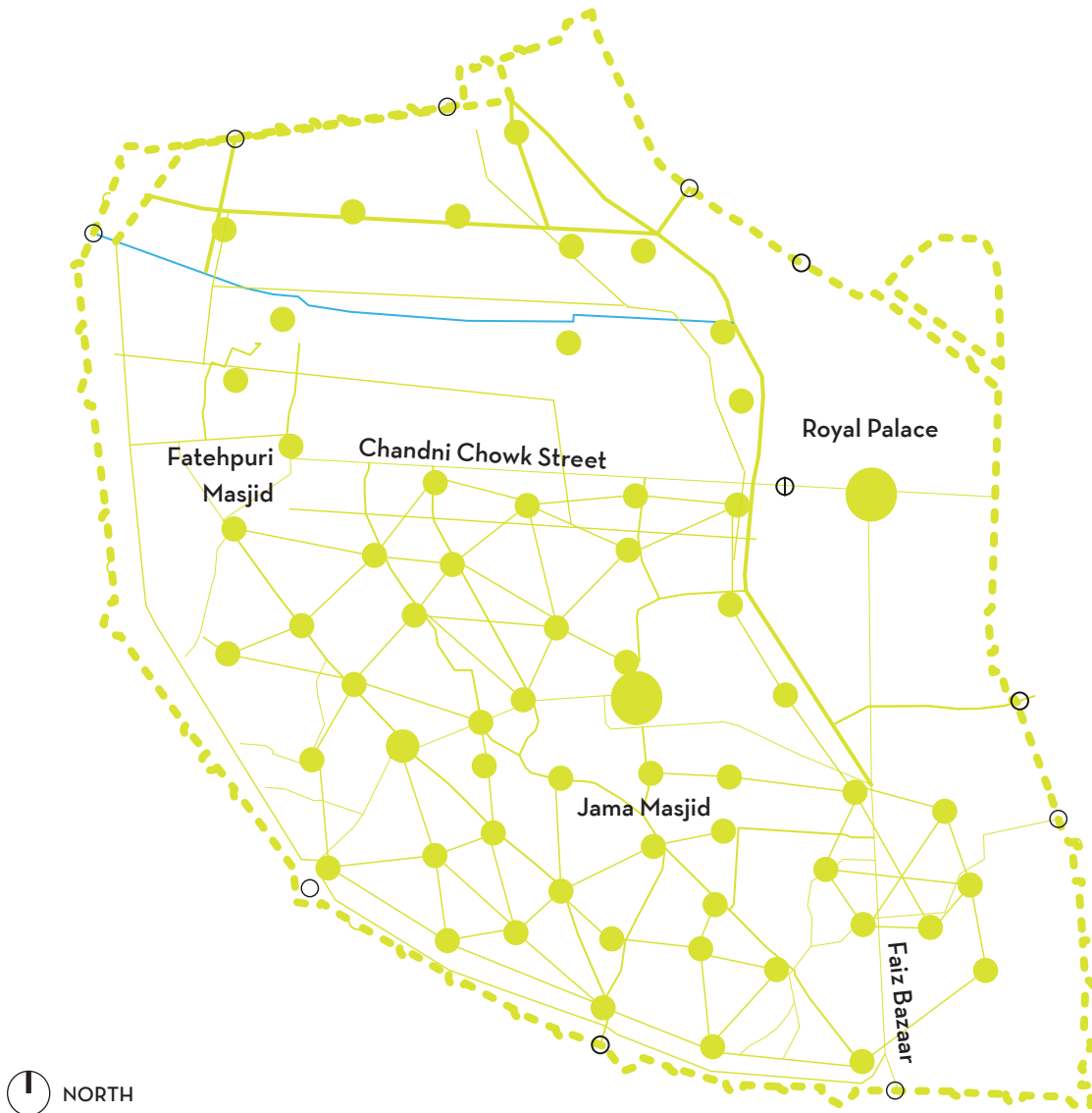
By 1750, the city had reached the peak of its urban development. A traveller named Francois Bernier who lived in the city from 1659 to 1663 judged it to be about the size of Paris, which during the late 17th century had a population of about 500,000 persons<sup>1</sup>.

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<sup>1</sup> Bernier, Travels, The Ascendancy of France -1648-88, Cambridge University Press, 1961, pp. 282



[FIGURE 2.19] OLD DELHI : URBAN MESH GENERATING TERRITORIES



Urban field where the fabric is generated is developed through multiple Urban Growth Attractors that occur at city, neighbourhood and local level. The fundamental elements of the city - palace, royal mosques streets, street intersections form the territories for growth.

- First Order Urban Growth Attractors
- Second Order Urban Growth Attractors
- Connectors





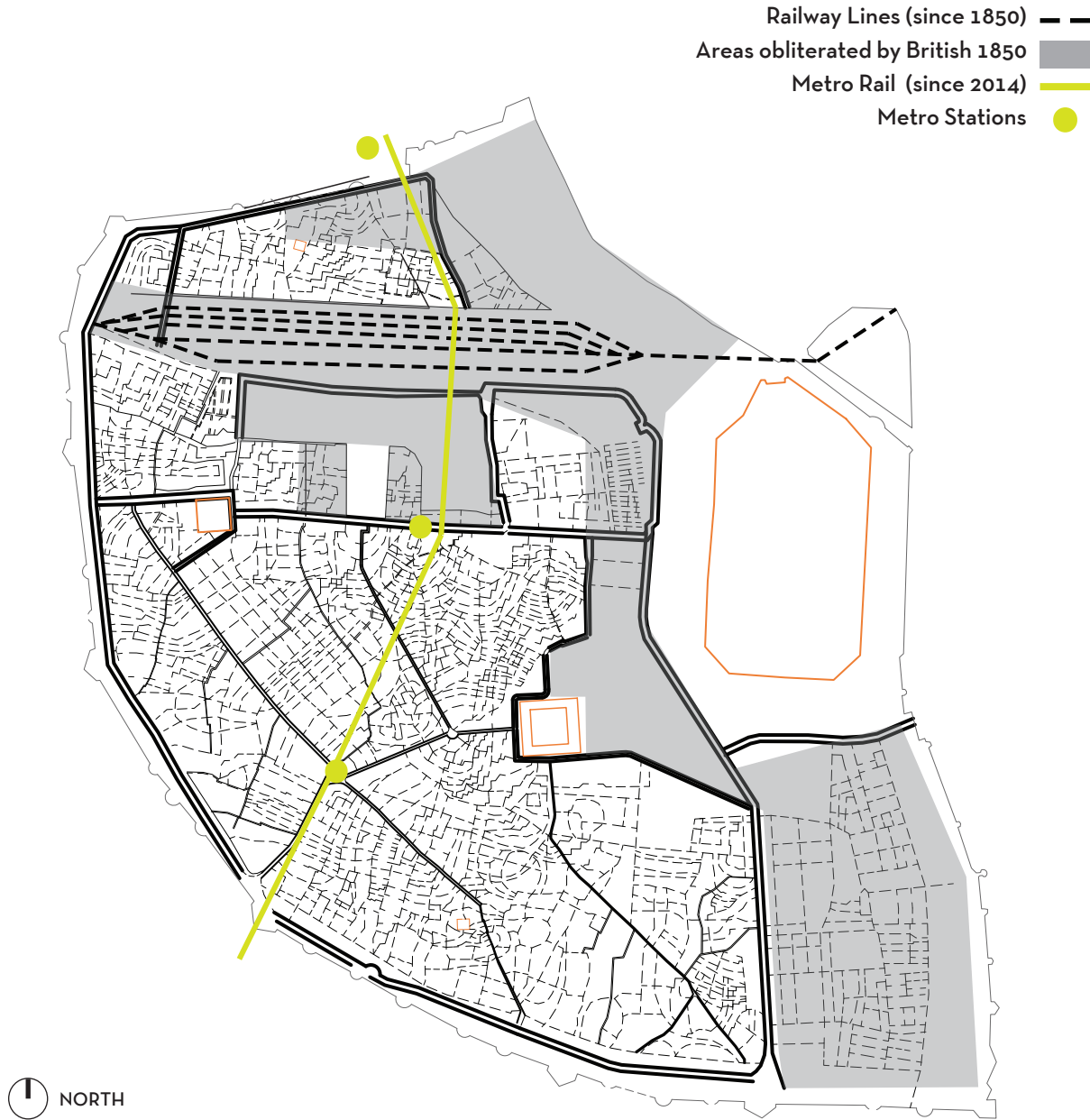
[FIGURE 2.20] Chandni Chowk Street C. 1814 - Source: Roli Books





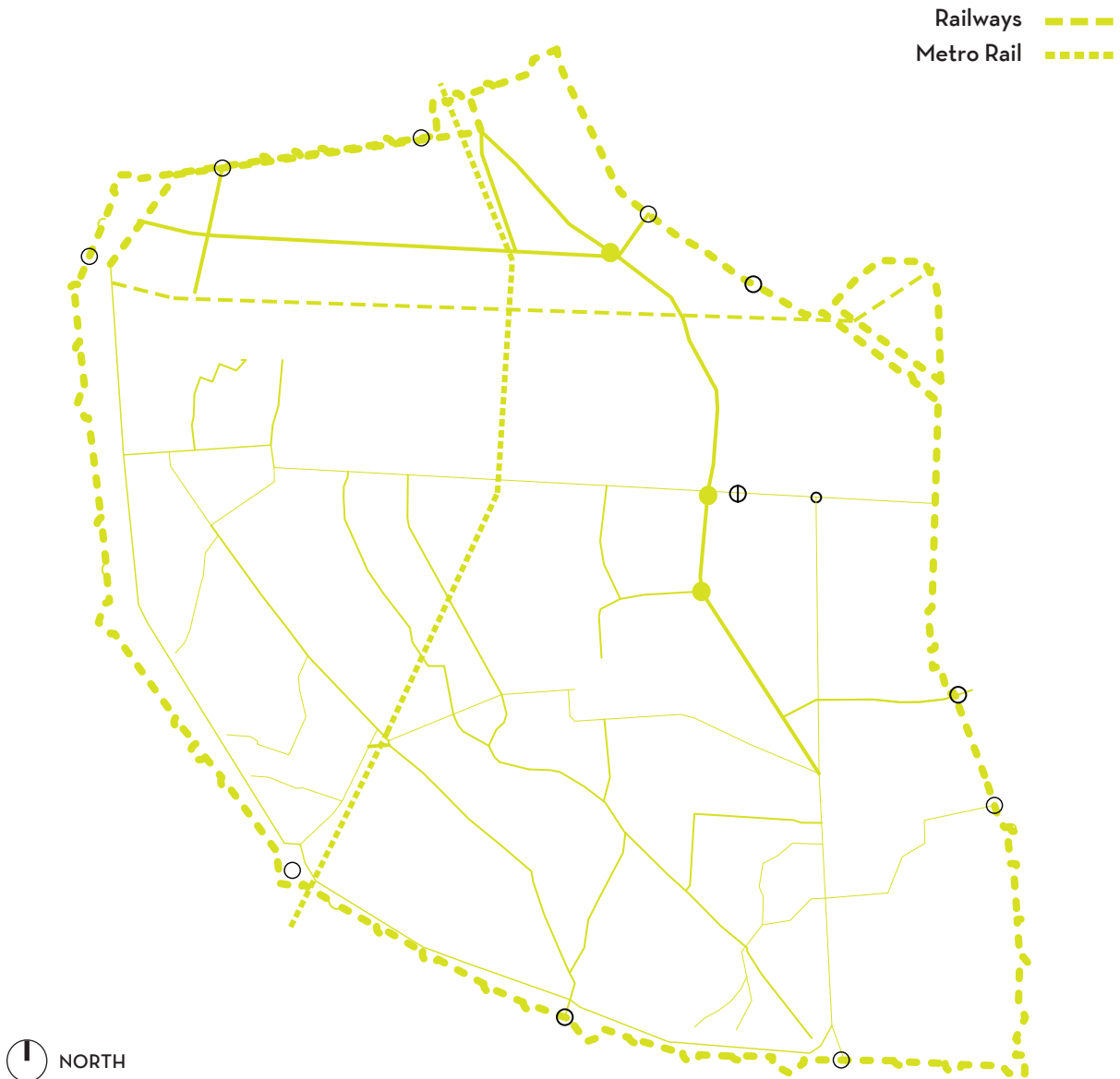
[Figure 2.21] Chandni Chowk Street Today - Source :Rayaprolu.wordpress.com

[FIGURE 2.22] OLD DELHI CITYSCAPE 2015



The city's dynamism and its adaptive quality can be seen in 1800s when the British introduced railway lines in the North of the city cutting through the Queen's garden. New streets were built around the railways mostly to connect to highways that facilitated trade and commerce. Areas near Jama Masjid and north and south of Red Fort were completely obliterated. These urban spaces show a very different planning grid in contrast to the organic self-organized patterns in the rest of the city.

[FIGURE 2.23] NETWORK SYSTEM 2015



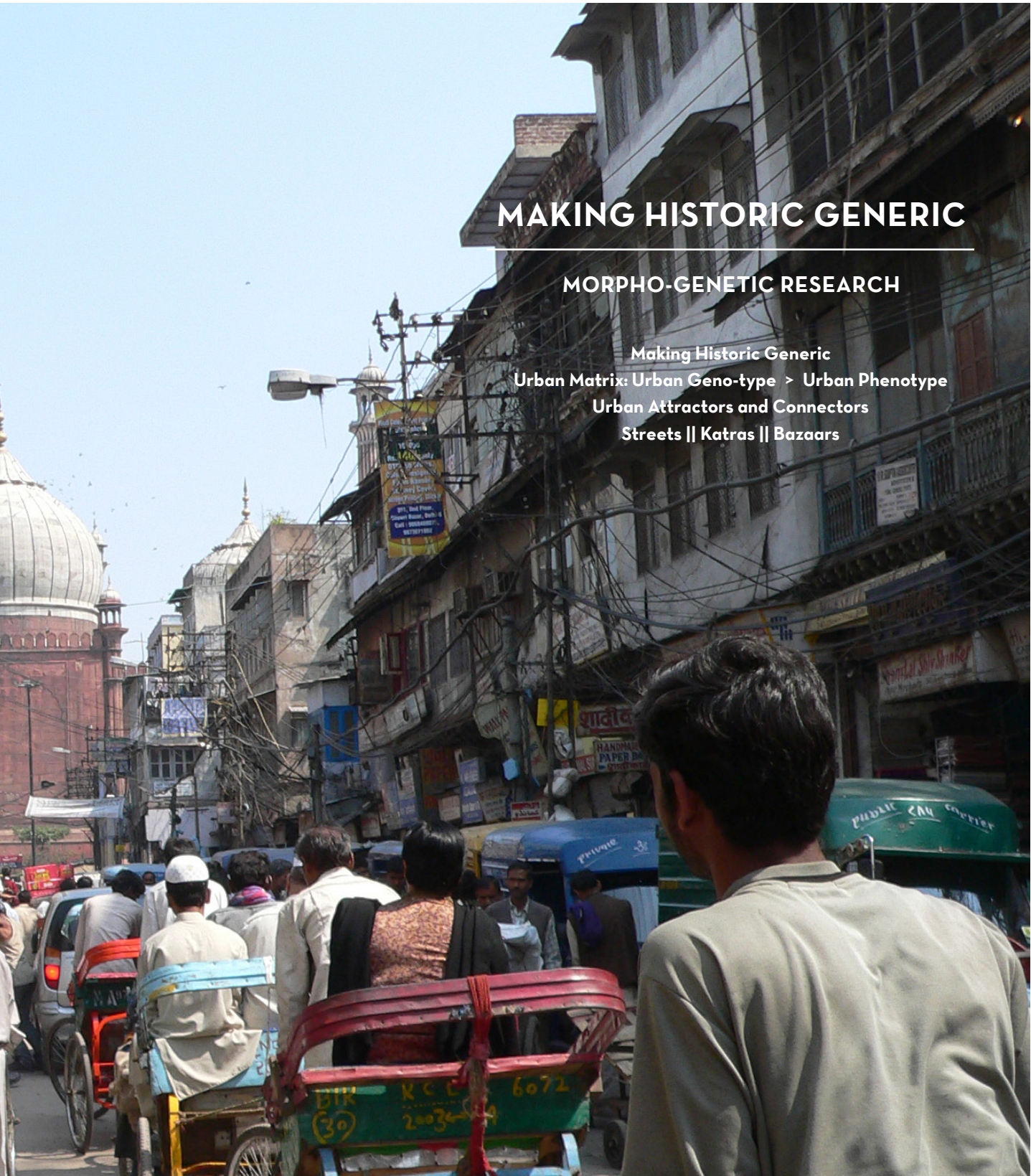
Railways and Metro Lines act as Urban Growth Inhibitors as they limit the fabric beyond a certain point. In 1901, British moved their capital to New Delhi. From this point, Old Delhi saw complete neglect and continues to be ignored even today. The city today is an industrial hub. So as to restrict vehicular traffic, in 2014 the government started a metro line through the city. The city however still faces extreme congestion and a deteriorating quality of life as a result of commercialization and unauthorized construction and encroachments.





*Historical analysis of the city provided a critical view of the city's urban design and planning principles. The following chapter shall focus on extracting the most significant urban elements that when put together translate into Old Delhi's architecture.*

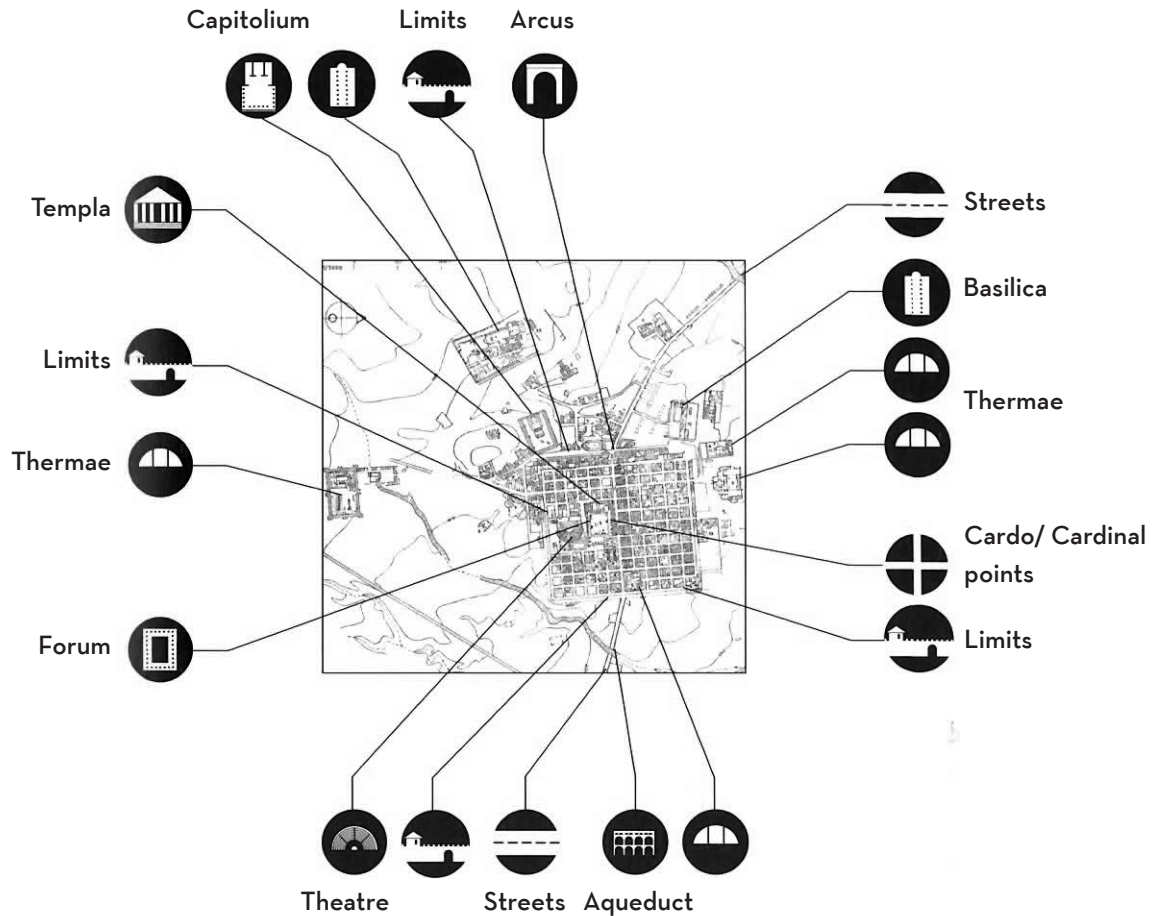




# MAKING HISTORIC GENERIC

## MORPHO-GENETIC RESEARCH

Making Historic Generic  
Urban Matrix: Urban Geno-type > Urban Phenotype  
Urban Attractors and Connectors  
Streets || Katras || Bazaars



The “ suitcase ‘, a sort of toolbox , lists the available items shown by pictograms and divided into 5 categories: buildings (eg basilica , capitolium , templa ) , monuments ( arcus , colomna ) planning ( centuratio , forum) infrastructure ( limits viae ) , trade / services.

[ FIGURE 3.1 ] Roman Operating System  
Excerpt from book Mutations, Rem Koolhaas , ACTAR dream Arc 2001

## MAKING HISTORIC GENERIC

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*'The city follows a series of general principles which are determined socially, culturally, politically and, in most cases, are manifested through clear architectural and urban examples. The city is the relationship between currents constantly changing which are superimposed on a generic model. You will have the ability to manufacture according to your city's topographical, climatic or local cultural situation.*

*Once rules are known, it will be easy to build a city, despite its apparent complexity.'*

*Rem Koolhaas, in Mutations, ACTAR dream Arc 2001*

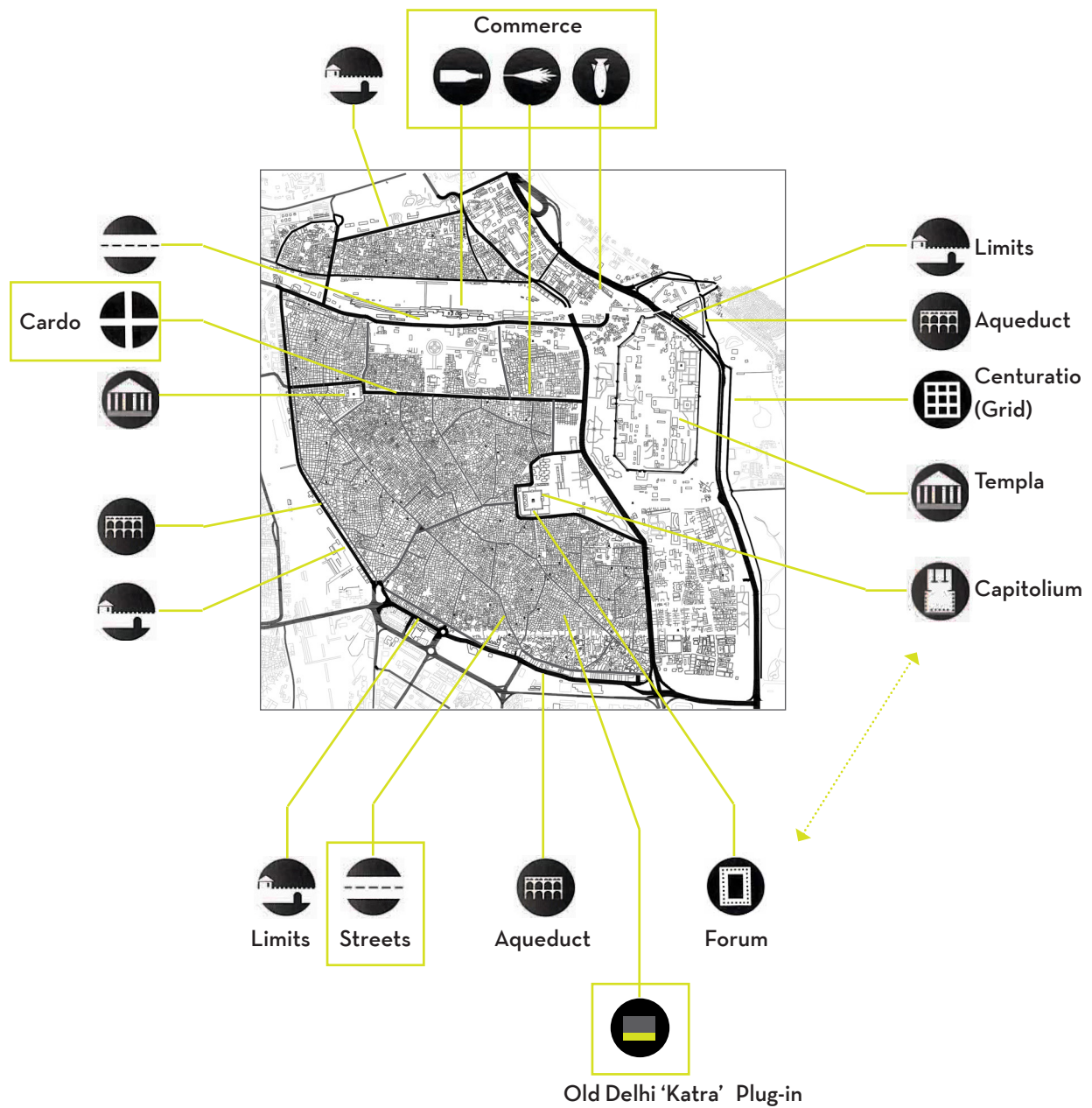
While reading a paper on 'The Generic City' as well as the book 'Mutations' by Rem Koolhaas, the question of making historic generic came into existence. Rem Koolhaas talks about the city as a program rather than a series of buildings. He explains this through the Roman Operating System by discussing how the Roman cities were planned and created. The argument was that the Roman cities were "100% generic" - thus having common principles that made them all the same - but equally, they were "100% specific" as they reacted and adapted to the local environment, topographical, site specific situations as well as diverse cultures which spread across the empire<sup>1</sup>. This made the Roman city a successful tool. The city was the object through which Rome expressed their authority and through which trade was maximized.

This concept of looking at a city through programmatic parts can also be seen in Old Delhi. The walled city was set up as a program rather than a series of buildings. Similar to Roman cities, Old Delhi was also built like an intricate game of chess: set pieces (being the key buildings) organized in such a way onto a *centuriatio* (or grid) and confined by *limites* (or edge systems of walls). Thus, when the task of redevelopment of Old Delhi arose, it became important to ask if we could take the historic ideas and adapt them to our time. Is there a way of redeveloping Old Delhi that demonstrates the critical urban elements, which when placed together following a set of logic, make the city functional and sustainable ?

The research thus began by firstly identifying the key urban elements from an urban matrix, that affect the spatial quality of Old Delhi's fabric and secondly by analyzing how they are interconnected to form a unified whole. The urban elements are investigated as Urban Attractors, connectors and inhibitors that act together at different scales.

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<sup>1</sup> [www.urbanmedic.blogspot.ca](http://www.urbanmedic.blogspot.ca)



[ FIGURE 3.2 ] Old Delhi Operating System  
 Understanding programmatic parts of Old Delhi through the Roman Operating System

## URBAN MATRIX: URBAN GENOTYPE > URBAN PHENOTYPE

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### *Thesis Question*

*'How can the historic city of Old Delhi be analyzed to extract a Generic Genetic Code that allows the city to grow and evolve with the changing urban scenario yet demonstrate its culture through its distinctive morphology?'*

Looking at Old Delhi's historical development, it is evident that the patrimonial-bureaucratic emperor dominated the social, economic and cultural life of the city and this influenced its built form as well. From the macro-perspective, the city was the kingdom in miniature. The royal palace, was the most important neighbourhood and directed the life of the city. Red Fort was a 'city within a city' of about ten thousand, with its hierarchical organization of horizontal space using courtyards and screened walls to create a separation between the spaces for public ritual and those for domestic privacy.<sup>1</sup> The residential complex of the great men ordered the urban system. The mansions directed the affairs of the sectors and thus dominated economy. These architectural elements form a part of the city's global grid as they defined the city's composition and extents, thus creating a top-down system that can be called as the city's URBAN GENOTYPE. Any urban element that forms a part of the genotype is static in nature. Their permanent presence formulates the fundamental growth rules and attractor points, that then create the territories within which fabric is generated.

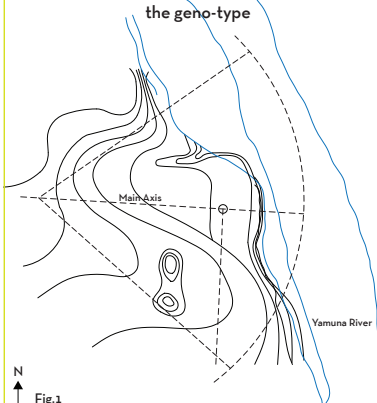
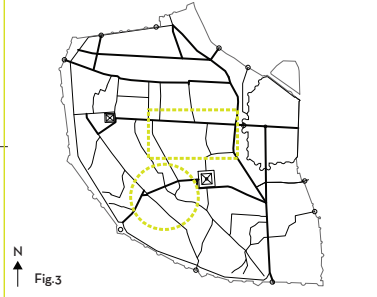

From the micro-perspective, the structuring principles of both the house and the city were based on progressive differentiation of 'interior niches' from 'exterior spaces', the notion of 'interior' and 'exterior' being relative values within a large spatial spectrum which ranged from the small private room to the complete urban structure. The urban fabric consisted of countless centers that allowed multiple individual forms to merge into a lively and highly differentiated unity. The numerous mosques and markets that were segregated in accordance to the socioeconomic differentiation constituted the main public core complex. The residential houses on the other hand were shielded from public life. They were inward oriented and were designed to preserve the aura of the family sphere and protect against visual intrusion. The residential settlements were thus intra-urban quarters, intermingled with shops and homes with enclosed courtyards. It was at this scale that the design of rules governed the urban form even more than the rules at the global scale. The morphological product that resulted can thus be called as the URBAN PHENOTYPE of the city. This system of genotype and phenotype has been explained in the Urban Matrix in Fig. 3.3.

The adaptive quality of the fabric can be connected to these rules or the morph-genetic parameters. The city exhibits a control of the rules but not of the final morphological product. The same rules however also set the limits of growth and the kind of built environment that an Islamic city can prosper in. They act as a genetic code that needs to be decoded and preserved. The following analysis thus focusses on understanding the city in a more generic manner and demonstrates the key components that carry the genetic code.

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<sup>1</sup> Hastings, James.M. "Shāhjahānābād/Old Delhi: Tradition and Colonial Change by Eckart Ehlers; Thomas Krafft." Rev. of Shāhjahānābād/Old Delhi: Tradition and Colonial Change, Eckart Ehlers; Thomas Krafft. *The Sixteenth Century Journal* Vol.36, No.2 (Summer, 2005), pp. 592

# URBAN MATRIX

Urban Layers	Urban Elements	Operative Diagram
What is the urban field system ?	What is the urban geno-type ?	Graphic Sampling representing the geno-type
<b>1. Site Environment</b>		
Climate	Hot and Humid (Sub-Tropical)	 <p>Fig.1</p>
Local Building Material	Delhi quartz, Sandstone, Marble	
Orientation	Global Co-ordinate System North-South Grid, East-West Grid	
Topography	South West and North West areas almost on one level (740ft.) North and North-East lower (710ft.)	
Soil Conditions	Extremely rich and fertile alluvium soil	
Surroundings	Yamuna river	
<b>2. Points</b>	Royal Mosques (First Order Attractor) Secondary Mosques (Second Order attractors)  Royal Palace (First Order Attractor)  Royal Mansions (Second Order attractors)	
<b>3. Boundary</b>	City Wall Queen's Garden Green Buffer around Palace	
<b>4. Networks</b>	Path System - Streets  Nodes - Intersections	 <p>Fig.3</p>
<b>5. Parcels</b>	Residential Buildings (Houses) Commercial Buildings (Shops - Markets) Blind Alleys Public Spaces	 <p>Fig.5</p> <p>100m</p>
<b>6. Infrastructure</b>	Railway Lines through the Queens's Garden Metro Line passing through the residential fabric connecting the Delhi Gate to Chandnich-owk (Main Commercial Axis)	

URBAN GENOTYPE — A  
GLOBAL GRID ( TOP-DOWN SYSTEM)



Urban Morpho-genetic Parameters	Morphological Product	Quantitative Determinant
<p>What is the variable shaping factors associated with the geno-type?</p> <p>Hindu Planning Principles of Shilpashastra from Vastushastra Fig.1                      Located on the high land                      Bow shaped planning- Khamukh to ensure prosperity                      River - as the string of the bow                      The main commercial street as the arm of the archer.</p>	<p>What is the urban pheno-type produced by the systematic variation of the urban parameter?</p> <p>Sun-dried/baked bricks</p> <p>Site Location                      Site Extents</p> <p>Primary Streets - Chandnichowk street and Faiz Bazaar Street</p>	<p>What is the measurable information representing the variation of the Urban Parameter ?</p> <p>Location of Royal Palace ( Point Co-ordinates)                      Maximum Distance between Palace &amp; Mosque</p>
<p>INDO-ISLAMIC CITY                      Urban Design of the city to be based on the Hindu Planning Principles of Shilpashastra from Vastushastra.                      Bow-shape planning                      Palace to be located at the meeting point of the two axis Fig.2</p>	<p>Location of Royal Palace</p> <p>Primary Streets - Chandnichowk street and Faiz Bazaar Street</p>	<p>Average distance between Mansions / Mosques                      (No.of mansions /100 Sq.M.)                      Average area of each ward (Sq.M.)</p>
<p>Land available as per topographic constraints                      Projected Population                      Location of City Gates and Bastions Fig.2</p>	<p>City Profile/Shape</p>	<p>City Area (Sq.M)</p>
<p><b>Path System - Streets Fig. 3</b>                      Orientation, Connection to Primary streets                      Narrow streets to facilitate face to face pedestrian interaction</p> <p><b>Nodes - Intersections</b></p>	<p>Development of Local Streets (Secondary and Tertiary Streets)</p> <p>Polymorphous Centres (Zones of Maximum Interaction)</p>	<p><b>Length and Width of Street</b>                      No. of Branches                      Maximum distance of a local street to a primary street (Meters)</p> <p><b>Entwined Urban Growth Rings Patterns</b>                      No. of streets leading to one node</p>
<p>Climatic Control - Tight architectural envelope with protected interior spaces</p> <p>Privacy, Social and Religious Interaction -                      Secluded private family space                      Interior Disposition - Independent Rooms to allow for sub-divisions in the house as the family size increases.                      Each room can be used for multiple purposes and allow for short term shifts of seasonal nature.                      Architectural richness to be displayed within the walls as an element enhancing the idea of the sacred interior space of the home. Exteriorizing was considered inappropriate.</p> <p>Urban Fabric - Prophet's saying "should stick together like the bricks of a wall" Faith of tawhid "oneness"</p> <p>Absence of monumental public spaces to prevent social disintegration</p>	<p>Prototype for Vernacular Architecture - Self-Contained Courtyard Typology (Climate- Shade, Wind, Privacy, Social gatherings, open green space)</p> <p>Private Houses ---- Cluster of Houses - Development of Neighbourhoods / Mohallas</p> <p>Polyvalent Use of Space-                      Each house is made up of individual cellular units.                      No distinction between living room, bedrooms and dining rooms.</p> <p>Building Height - Exclusive Ground Floors, 2 storeys, 3 storeys</p> <p>Agglutination of individual houses to integrated urban entities</p>	<p><b>Courtyard Proportion Rules</b> - Courtyard length varies from 3 to 6m.                      Depth shall not exceed 3m.(Practical limitation of beam length, to be transported through narrow lanes and a comfortable distance between occupants of the courtyard)</p> <p>Symmetrical Layout - at the local level                      Random at the Global Level</p> <p><b>Building Height</b> - Each floor height varies from 4m to 5m, therefore building height ranges from 4m to 12m.</p> <p><b>Solid vs Void %</b>                      Built Up (Sq.M.)                      Ground Coverage (Sq.M.)</p>
<p>Defence - Connect Delhi to Merrut and Punjab to call army troops whenever necessary, Close to the Royal Palace, Passing through available open space, Connecting the main commercial hubs and passing approximately through the center of the city (Raised Metro line)</p>		



## CRITICAL PROGRAMMATIC PARTS OF OLD DELHI

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The scope of research focusses on the following three elements that work together to demonstrate the Genetic Code of the city's fabric. Old Delhi's typo-morphology<sup>1</sup> can be analyzed at three scales of interaction.

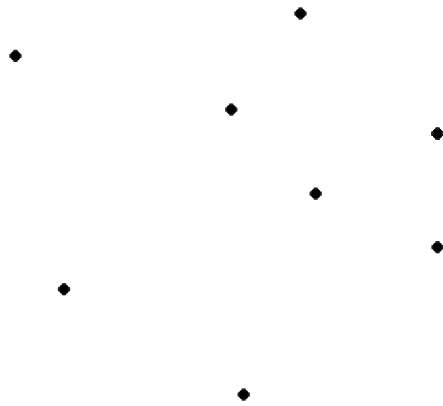
- |  |   |                                 |
|--|---|---------------------------------|
| 1. Street Network (Infrastructure)           | → |                                 |
| Primary Commercial Street                    |   | City Scale                      |
| Secondary Streets                            |   |                                 |
| Tertiary Street 'Kuchah' -- By-Lane          |   | Neighbourhood Scale             |
| Local Street 'Gali' -- Narrow Alleyway       |   | Local Scale                     |
| 2. Urban Block Typology -- 'Katra' (Parcels) | → | Neighbourhood Scale             |
| 3. Bazaar Typology -- (Commerce)             | → | City Scale, Neighbourhood Scale |

All the above elements work through the local to the city scale and contribute to the complex spatial system of the city. The three elements will be studied to produce a generic-genetic algorithm by building relationships that would help in filtering through the seeming chaos of the existing fabric and identify key parameters that create this kind of morphology.

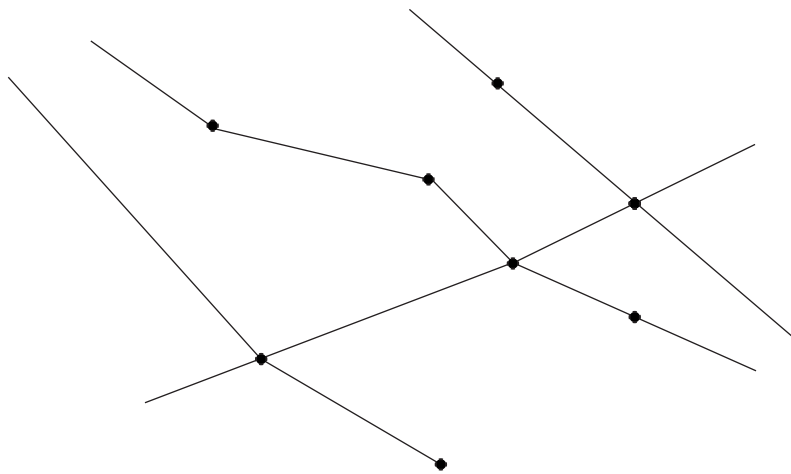
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<sup>1</sup> Coined by the Italian architect, Aymonino, the element of the 'typo-morphological' approach, deemed significant in an urban analysis is the urban tissue/ morphological region; an organic whole, whose form, in turn, is studied at three distinct levels of resolution:

- a. At the level of the city (or a part thereof) and the composition of urban blocks within it. (Macro)
- b. At the level of the urban block and the composition of built form within it. (Meso)
- c. At the level of the built form and adjoining open spaces. (Micro)

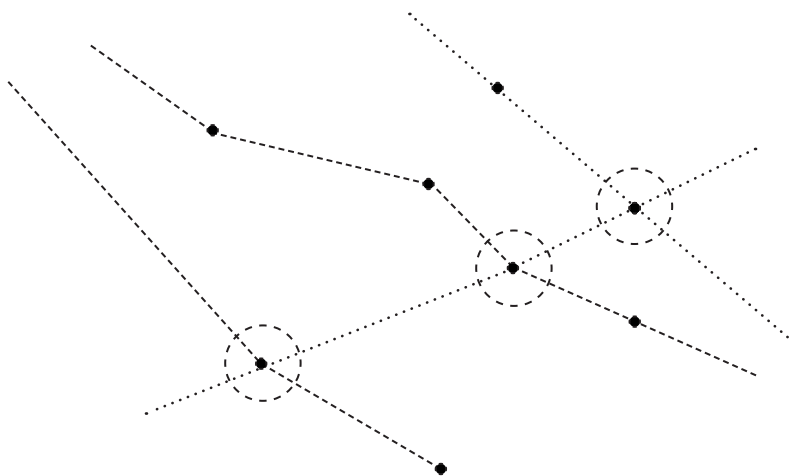


[ FIGURE 3.4 ] Vertices representing the different Point Attractors of the city



[ FIGURE 3.5 ]

Point Attractors connect with each other through line segments that represent linear attractors as streets



[ FIGURE 3.6 ]

Street intersections represent fixed or variable point attractors based on what streets they connect to.  
 Point Attractors located on primary streets (15 to 25 m wide) are Fixed Point Attractors

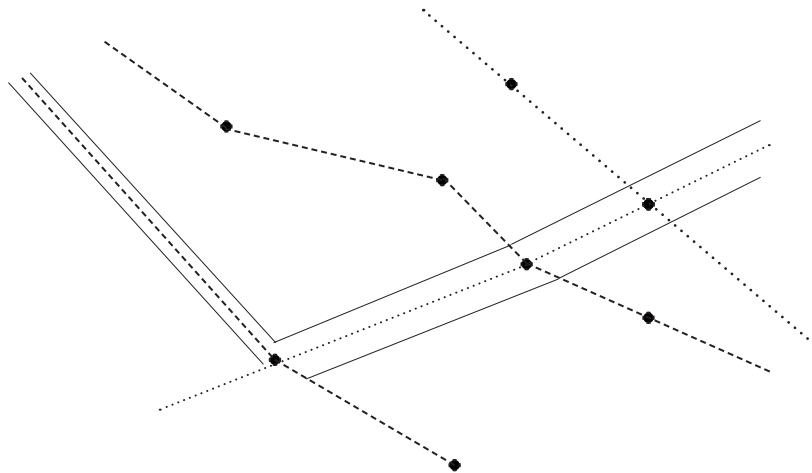
## CRITICAL PARTS AS URBAN ATTRACTORS AND CONNECTORS

---

Old Delhi as a city is an evolving system in which the urban tissue has fractal properties. This property is a result of the following Urban Growth Attractors that generate geometrical networks working at multiple scales.

A. POINT ATTRACTORS : Urban elements within the city towards which a given urban system tends to grow and evolve. They can be of two types:

1. Fixed Point Attractors : These are elements that remain fixed under any transformation. They are responsible for constructing the city on a global scale. For example the Royal Buildings and the primary street intersections.
2. Variable Point Attractors : These are elements that are flexible and can change location with time and transformation. For example mansions, secondary and tertiary street intersections.



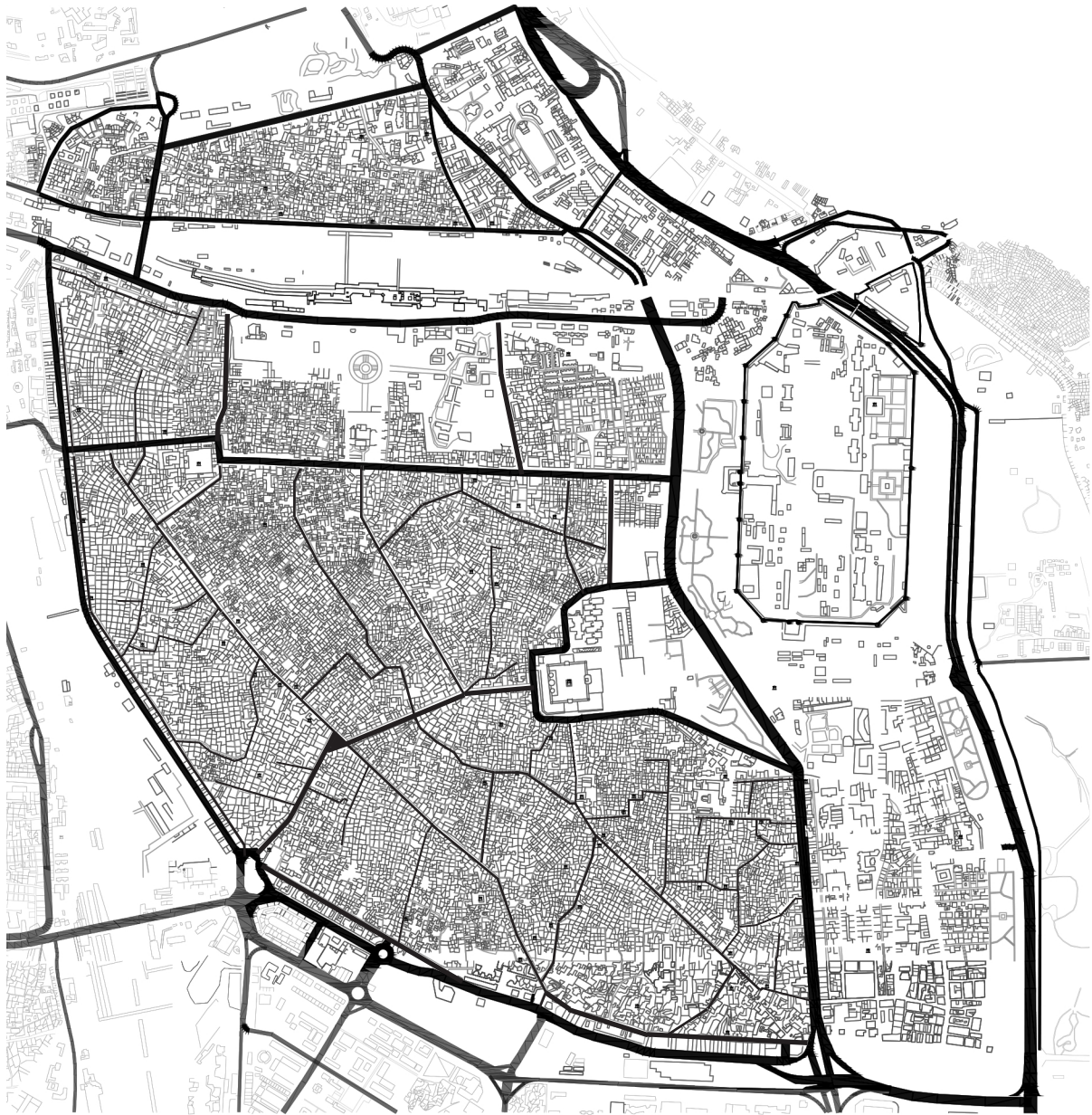
[ FIGURE 3.7 ]

Emergence of land use patterns along primary and secondary streets - Bazaars or Markets

B. LINE ATTRACTORS : Urban elements that function as connectors and generate a specific land use pattern on the Global Scale. They are of two types:

1. Line Attractors: These are the line segments within the fabric that connect the point attractors. Their location is thus dependent upon both the fixed and variable point attractors. For example primary, secondary and tertiary streets.
2. Bazaar Attractors: These are the line segments that generate commercial growth along both sides. For example primary and secondary streets. The scale of the building depends on which segment it generates from.

C. INVISIBLE CULTURAL ATTRACTORS: A pervasive cultural set up that attracts individuals to become a part of an existing urban block. For example - urban blocks where people of the same caste or craft live together.



0 m 500 m

[ FIGURE 3.8 ] Urban Network - Connections

## PART 1 : STREET NETWORK

---

### MODELLING DECISION - MAKING PROCESSES TO GENERATE ACTIVE NETWORKED TOPOLOGY

Urban Street Network of Old Delhi consists of both planned as well as random occupations<sup>1</sup>. The planned occupation can be seen at the city scale with the formal street layout and location of the fundamental Islamic institutions on a grand axial path. On the other hand, the neighbourhood and local scale exhibits random organic occupations that carry the seed of an emergent and evolutionary urban space. This occurs within an Urban Field condition that imparts a specific spatial and cultural quality thereby generating a morphological logic of the city on the whole.

As per the contemporary notion of space a 'Field' can be defined as: the spacialization of multi-scale latent information flows crossing a pre-existent place. The city is thus perceived as an ecosystem where the interaction of dynamic and decentralized forces draws its increasing complexity<sup>2</sup>. It is only once the model for the city's decision making processes is built that the neighbourhoods and the buildings can be generated. The street network forms this model.

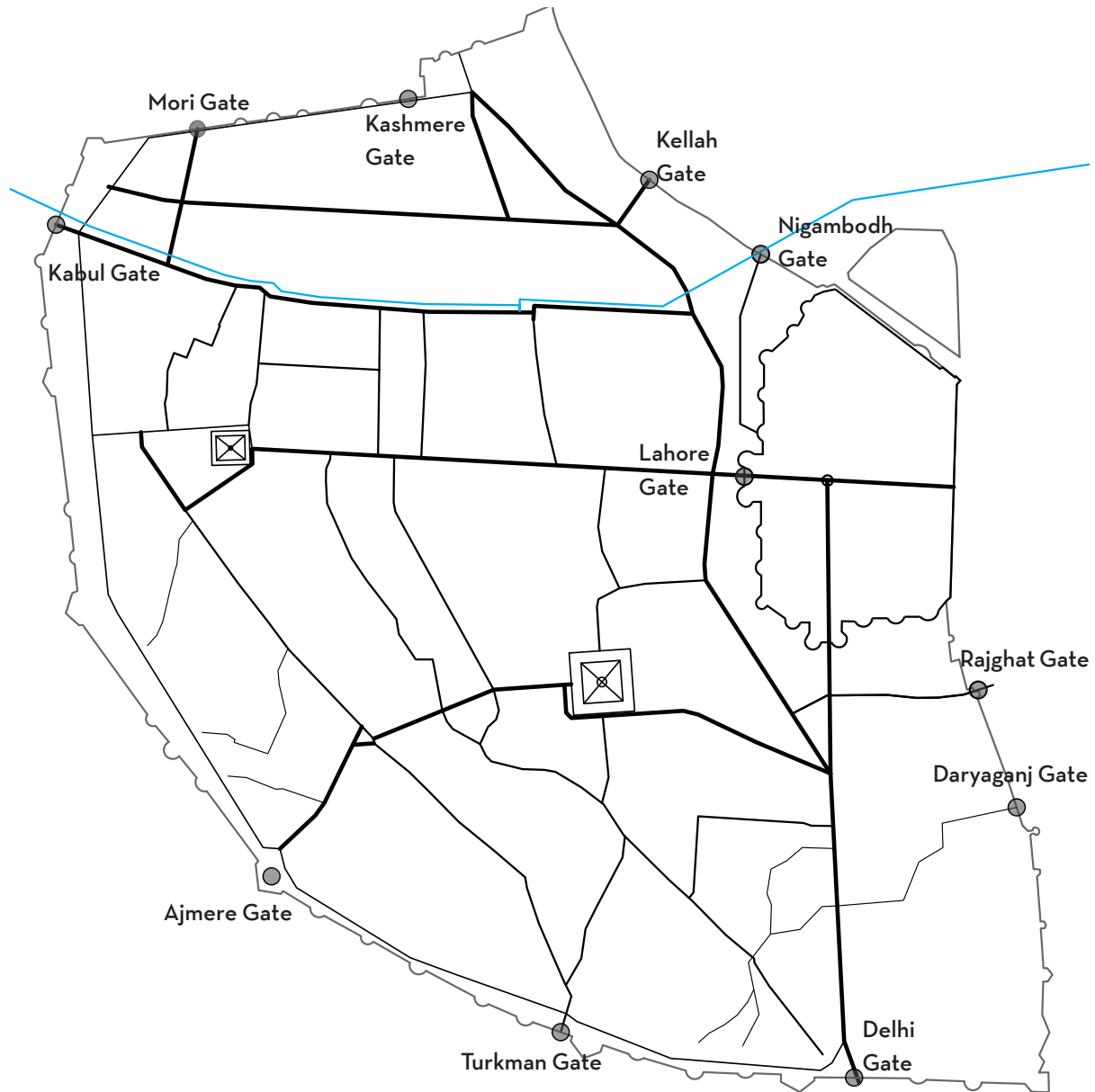
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<sup>1</sup>Otto, F.: 2011, *Occupying and connecting: thoughts on territories and spheres of influence with particular reference to human settlement*, Edition Axel Menges, Stuttgart.

<sup>2</sup>Schumacher P.: 2008, *Parametric-ism - A New Global Style for Architecture and Urban Design*, in N. Leach (ed.), *AD Architectural Design - Digital Cities*, 79 (4), 14-23.

CITY SCALE : FORMAL GEOMETRIC STREET PATTERNS [ IDEAL LAYER ]

[ FIGURE 3.9 ]



Functional Classification of Streets

Primary Streets connecting to City Gates - Commercial 

Secondary Streets - Commercial + Residential 

Tertiary Streets - Residential 

Gates 

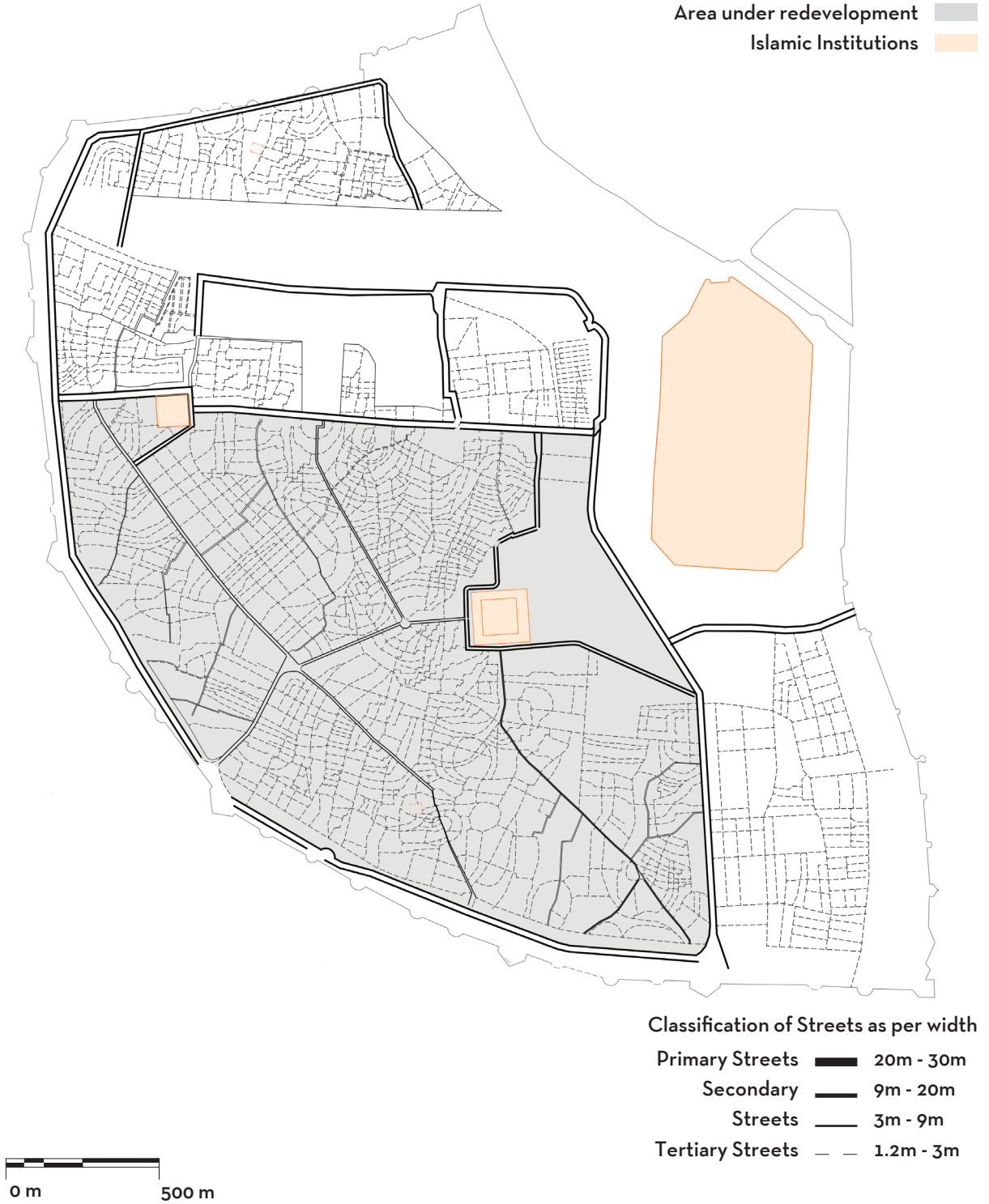
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NEIGHBOURHOOD AND LOCAL SCALE : INFORMAL STREET PATTERNS  
[ MATHEMATICAL AND PROPORTIONAL LAYER ]

[ FIGURE 3.10 ]





[ FIGURE 3.11 ] Katra Naugarah, Old Delhi

## PART 2 : 'KATRA'

---

A Katra can be defined as a *micro-level urban block typology within the fabric*, that is composed of both residential and commercial activities, accessed from a street through a single doorway. The term Katras and Mohallas, generally used interchangeably, refer to quarters that represented the major form of residential organization in Old Delhi.

### HISTORY

These spatial precincts were classified and differentiated based on caste or craft and were headed by chiefs of caste councils. Neighbours were "people of the mohallah" - persons who occupied an adjacent or who attended the mosque of the mohallah<sup>1</sup> and one of the first duties of a city magistrate was to see that the urban area was divided into mohallas.<sup>2</sup> According to a survey conducted by Bharat Sevak Samaj, there are 999 katras in the walled city. Katras were surrounded by high walls and contained houses, shops. The katras that were located adjacent to the primary commercial streets also contained wells for water, rest houses for travelers. Further elaborate katras belonging to princes of the royal family and noblemen were also seen, with open public spaces, madrassahs (Schools) and mansions for elephants called 'Khil Khanah'.

*The above can be deduced from the following description of an Islamic city in the Near East, given by Lebon. He writes, "Close by (Friday mosques) was the most significant suq or bazaar, in which trades and crafts were segregated and in which some merchants, especially those dealing in cloth, were accommodated in specially built halls. Here also, were khans for the use of visiting traders, and perhaps also Madrassahs (schools) where young men were taught Islamic theology and law. Away from the Suq, the built up area was essentially residential (apart from smaller mosques and baths) and was composed generally of two-storeyed houses, surrounding interior courtyards, entered from the street through a single doorway. From the upper floor, a screened balcony protruded."*<sup>3</sup>

### PROCESS OF DEVELOPMENT OF A KATRA - A NARRATIVE DESCRIPTION

1. Every Katra has a single entry and exit point from a major spine, that is entered through a strong doorway.
2. The first street into the katra is wide enough for pedestrian movement. This branches into a local street of lesser width that leads to an exclusive residential courtyard space. The precautionary cul-de-sac type of housing is reminiscent of the katra typology.
3. Houses were mostly of courtyard typology and two to three storeys high.

Katras are micro-communities that are largely self reliant in the sense that each one formed a virtually autonomous social unit, embracing a representative cross section of society and establishing, controlling and maintaining the basic shared facilities.

The analysis of the urban fabric thus focusses on understanding a 'boundary condition' where one or multiple katras 'couple' together that would be bordered by streets of varying widths. The following page explains the procedural growth within katras.

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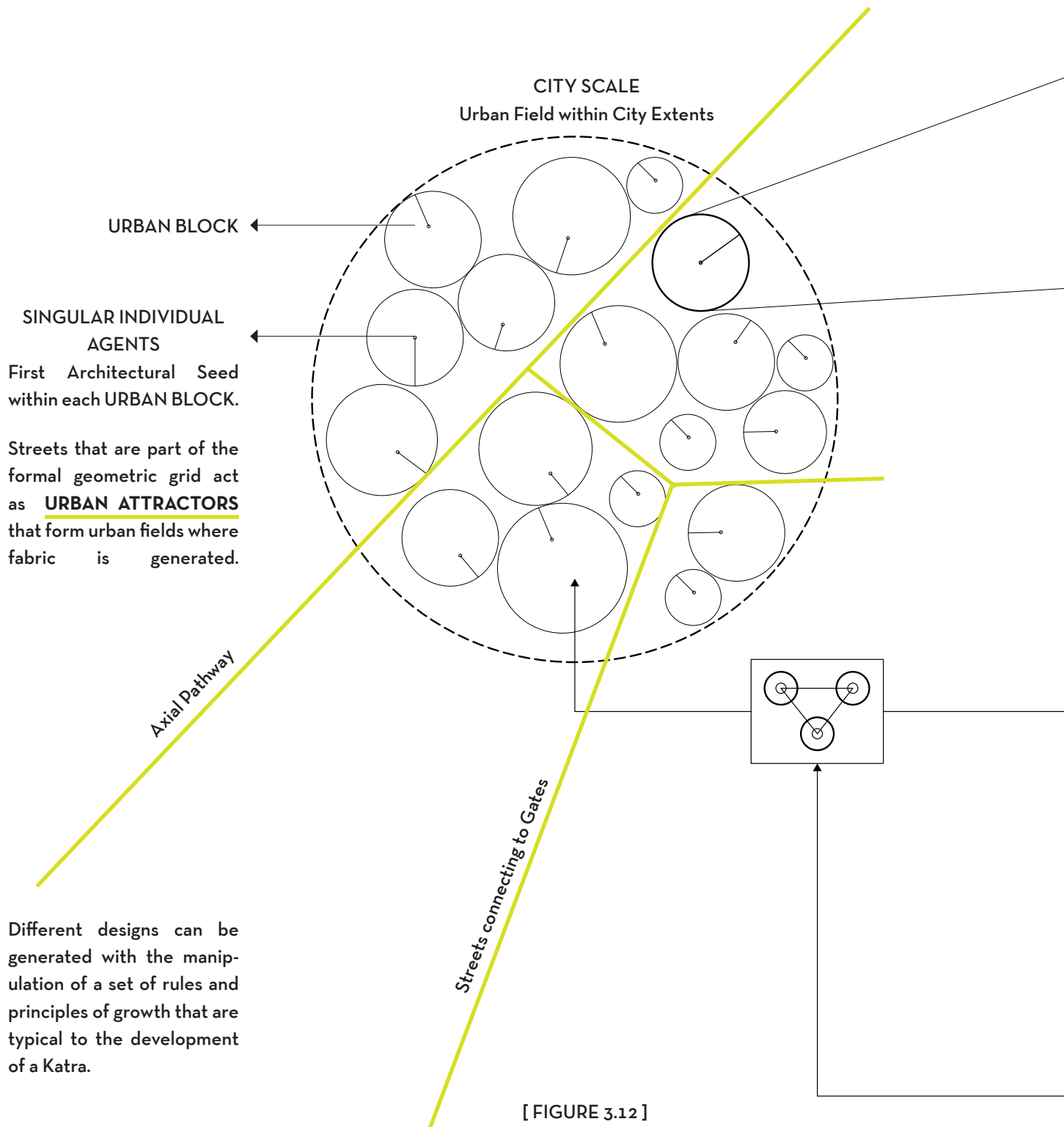
<sup>1</sup> Charles Hamilton, trans., *The Hedaya or Guide : A Commentary on the Mussulman Laws*, 2nd end (London : W.H. Allen and Co., 1870) pp.689

<sup>2</sup> Abu al-Fazl, *A'in*, 1 pp. 284

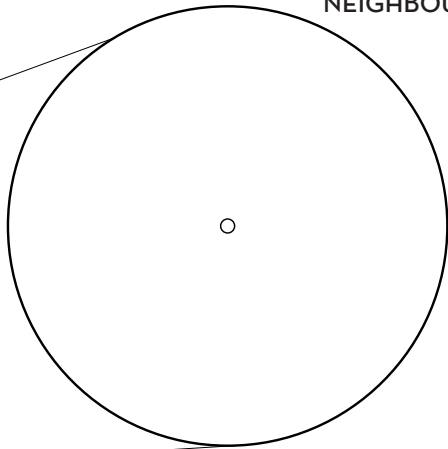
<sup>3</sup> Apte, Vaman Shivaram, *Sanskrit-English Dictionary - Part I* (Prashad Prakashan Puna, 1957)

# MAPPING PERVASIVE LOGIC

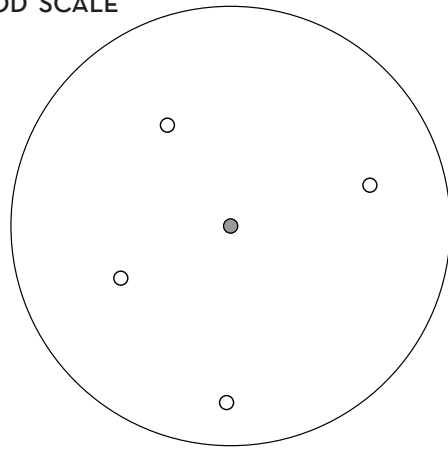
## PROCEDURAL GROWTH IN URBAN BLOCKS 'KATRAS' - ABSTRACT



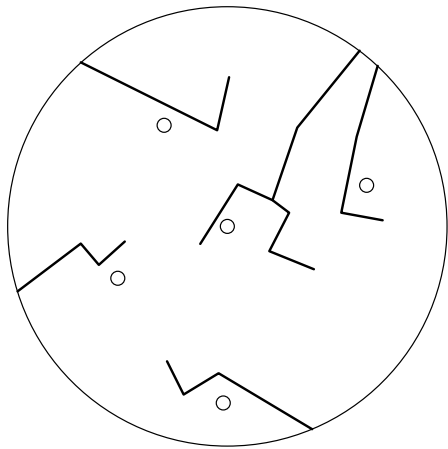
NEIGHBOURHOOD SCALE



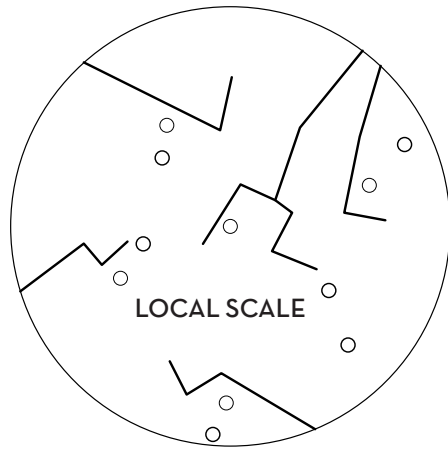
Boundary with a Mansion as the second order Urban Attractor



Urban Attractor invites more individuals  
This occurs all over the city

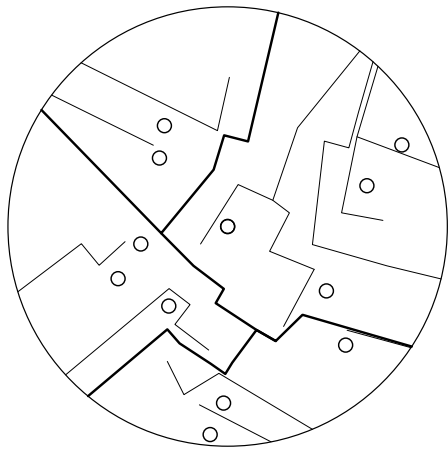


Streets with cul de sac are formed to create individual access.

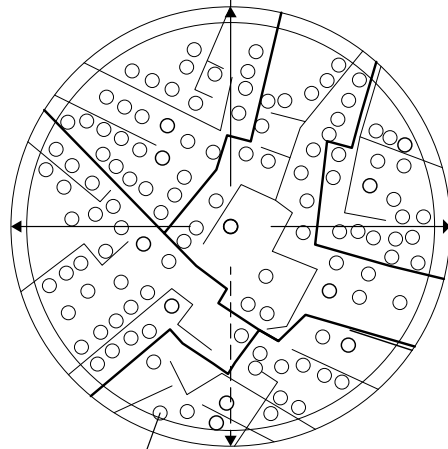


LOCAL SCALE

Urban Form is added incrementally through decisions and is path dependent



Micro-level segregation within the fabric to generate an Urban Block Typology

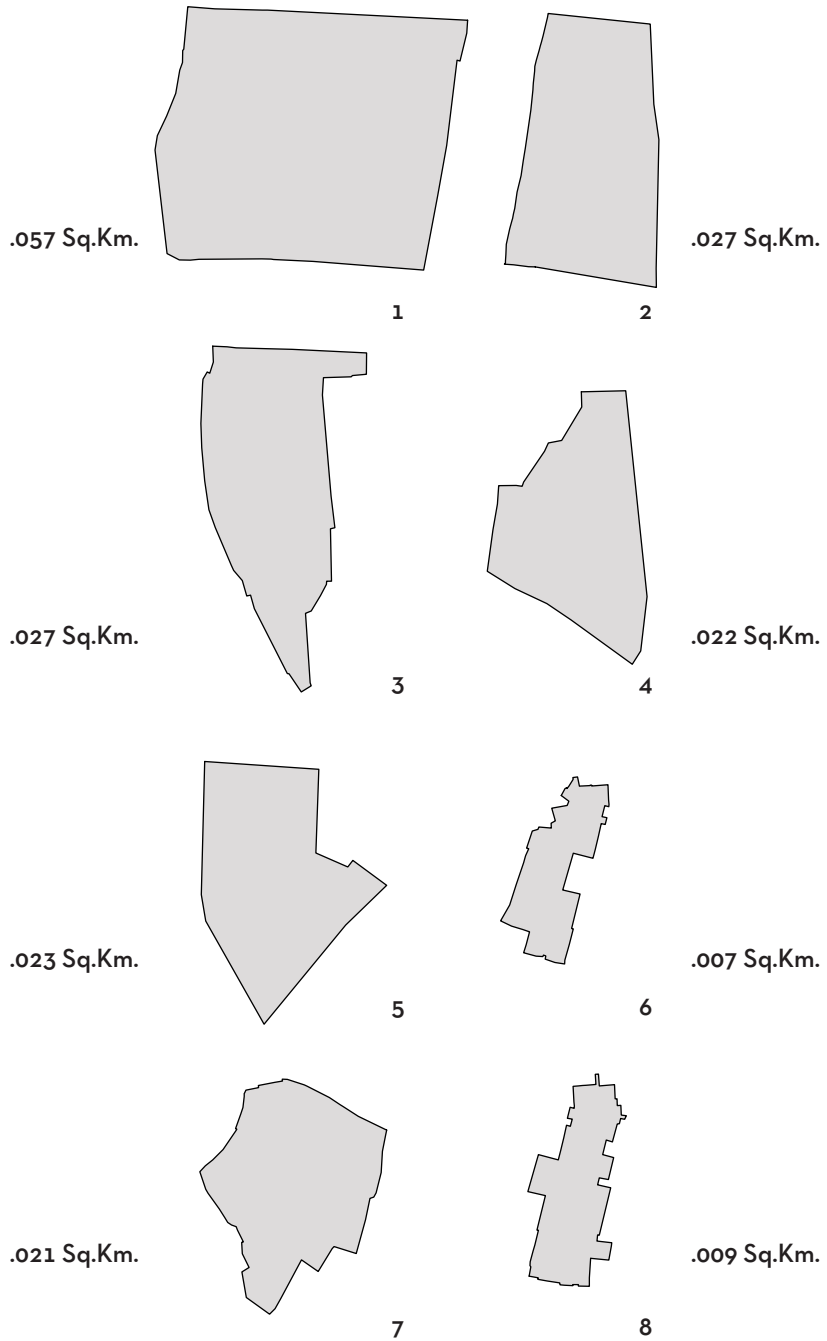


Bottom Up generation of Morphology

MAPPING PERVASIVE LOGIC  
PROCEDURAL GROWTH IN EXISTING KATRAS



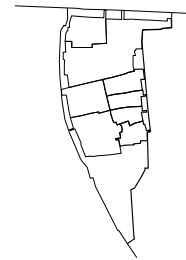
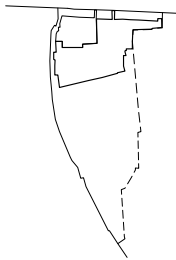
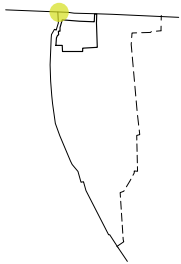
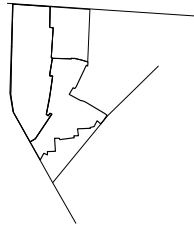
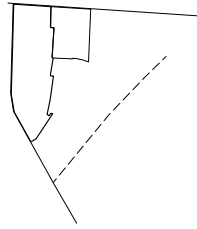
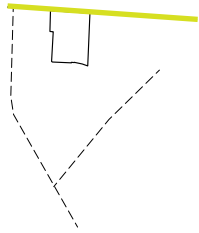
[ FIGURE 3.13 ] OLD DELHI - Location of neighbourhood boundary samples



[ FIGURE 3.14 ] SAMPLES OF 'KATRAS' IN OLD DELHI

# KATRA - PROCESS OF DEVELOPMENT

## URBAN GROWTH ATTRACTORS

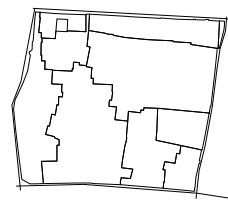
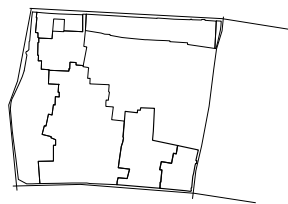
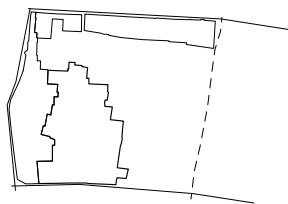
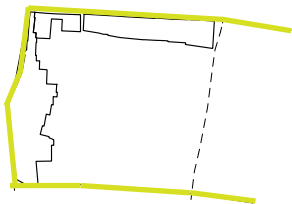
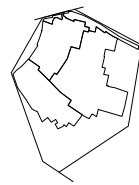
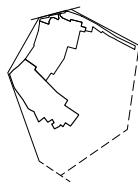
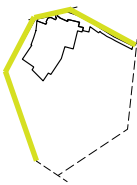


- Linear Attractor
- Point Attractor
- - - Growth Inhibitor

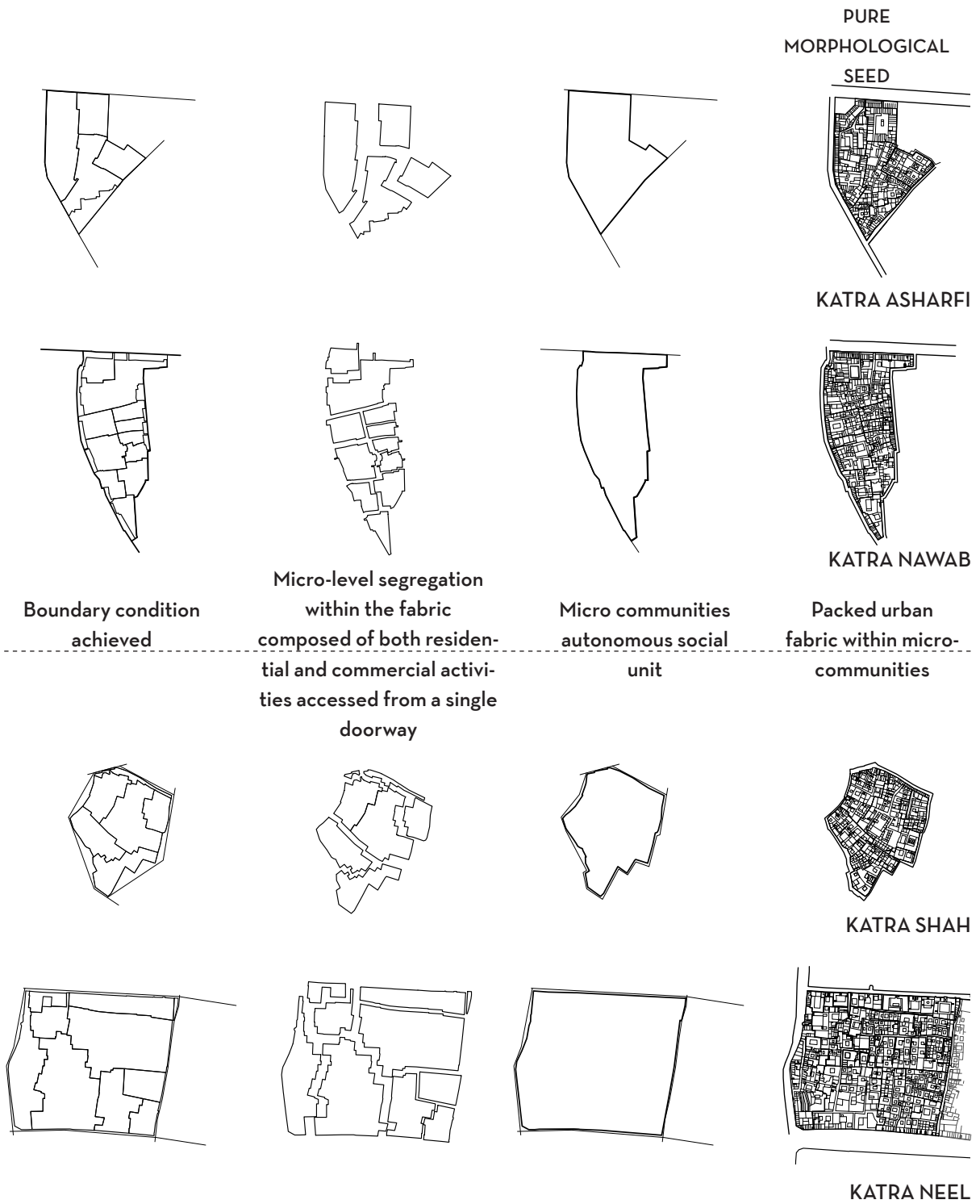
New streets develop  
Peripheral Urban  
Growth

Morphological  
Urban Blocks  
create Urban Infill

Urban Infill  
proceeds  
street development







[ FIGURE 3.15 ]



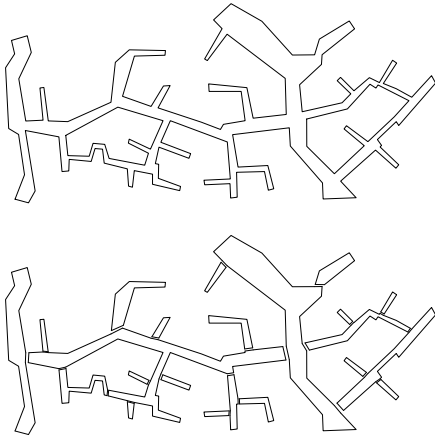
[ FIG. 3.16 ] Gateways to Courtyard houses



[ FIG. 3.17 ] Early Mughal Street Facade - 'Otlas'

1. GATEWAYS:

Gates were located at the entry point of the katra. They were controlled by the inhabitants of the katra and thus formed an important means of maintaining their autonomy.



[ FIG. 3.18 ]

1850 - 2015 Continuum of Space

Gates were controlled from one side by the inhabitants and thus were removed by the government to penetrate into the fabric. Removal of gates creates a continuous sequence in which the adjacent elements are not perceptibly different programmatically. Public spaces increased dramatically.

1650 - 1850 Socio-Cultural Structure of Society

Traditional physical organization with a different quality. These gates were meant for security and distinguished the urban blocks belonging to various groups within the city. The private areas were accessed through one or multiple gates which then led to a dead end street. Fig. 3.18

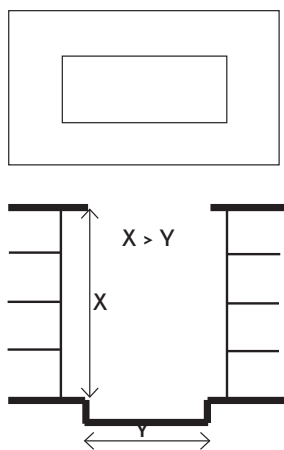


[ FIG. 3.19 ]

2. OTLAS:

Otlas act as an extension to a shop or a house, present along a street. It is generally used by children and elderly as a social space to meet and chat. These act as semi-private threshold spaces within the residential quarters of Old Delhi. The gradation from public to semi-public and eventually private is still evident in most of the neighbourhoods.

Fig. 3.19



[ FIG. 3.20 ]

3. RESIDENTIAL BUILT FORM:

Due to the social form existing in the city, most of the houses were occupied by joint families and thus were large and introvert in nature. The houses were built with a high plinth and were accessed through series of steps. *The height of the plinth increased as the width of the access lane narrowed down.*

All houses were entered through arched openings and doors with metal and wood detailing, that led into a courtyard where all the domestic activities of the house took place. Terraces of each of the houses generated a public space for children and women specially.

Fig. 3.20



[ FIG. 3.21 ] Meena Bazaar near Jama Masjid (Royal Mosque), Old Delhi



[ FIG. 3.22 ] Market Street in Katra Neel



[ FIG. 3.23 ] Kinaari Bazaar, Old Delhi

## PART 3 : BAZAAR

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Bazaars or markets were streets lined on both sides with merchants and artisans and were distributed at central, regional and local scales.

A. At the central scale, bazaars developed along the two primary streets that were wide and straight and thus acted as processional routes.

### 1. CHANDNI CHOWK BAZAAR : 1560 shops and porticos<sup>1</sup>

The first primary street was the east-west street called Chandi Chowk that connected the Lahore gate to the city wall. It was 1.4 km in length and was built as the central axis of the city with a canal flowing through its centre. The street accommodated houses of great nobles, guest-houses for travelers and centers for trade and commerce. The royal palace was visible from any point on the street.

*'The shops that lined the sides of the bazaar occupied small rooms under arcades. Thin partitions separated the shops, and at the back of each one a door led to a small warehouse where surplus goods were stored. Above the warehouse lived the merchant, his family and servants.<sup>2</sup> In these shops could be found spicy kabobs, beautifully scented flowers and astrologers. Rubies, emeralds and pearls were there ; glass huqqas and eyeglasses from China and a variety of sweets. Scattered here and there were coffeehouses where amirs gathered to listen to poetry, engage in light conversation, and watch the passing scene.'*

### 2. FAIZ BAZAAR

The second primary street was the north-south street called Faiz Bazaar that connected Delhi gate of the royal palace to the city wall's Delhi gate. It was about 1.2km in length.

*'Here dancing girls, physicians (who , according to Dargah Quli Khan, passed off bags of dirt as medicine), story-tellers, and astrologers plied their trades; here also were shops that dispensed cloth, medicine, hot food, weapons, birds, fruits, flowers, wild animals, and sugarcane.'<sup>3</sup>*

B. At the regional scale, commercial activity developed along secondary streets that connected the Ajmere gate with the Jama Masjid and Turkman gate and Lahore gate.

The intersections of the above streets produced landmarks and points from where bazaars grew along the streets.

C. At the local scale, although bazaar typology was not that significant, however it did form a part of the residential quarters within the fabric. Each 'Katra' comprised of a few shops that were located near the entrance gate of the enclosed space.

The city did not exhibit any communal spaces except the spacious courtyard of Jama Masjid. The character of the city was introvert and thus the Mughal capital did not provide for social units. Social planning was not of prime importance.<sup>4</sup>

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<sup>1</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp. xiv

<sup>2</sup> Bernier, Travels, pp. 245-6

<sup>3</sup> Dargah Quli Khan, "Risalah-i- Salar Jung." fols. 86b-8a

<sup>4</sup> Lizuka, Kiyo, The Shahjahan's Concept of Town Planning in Delhi, pp. 31



*The following chapter is a photographic essay that exhibits the present day on-site condition of the three critical elements 'streets, katras and bazaars' and analyzes their transformation over time.*





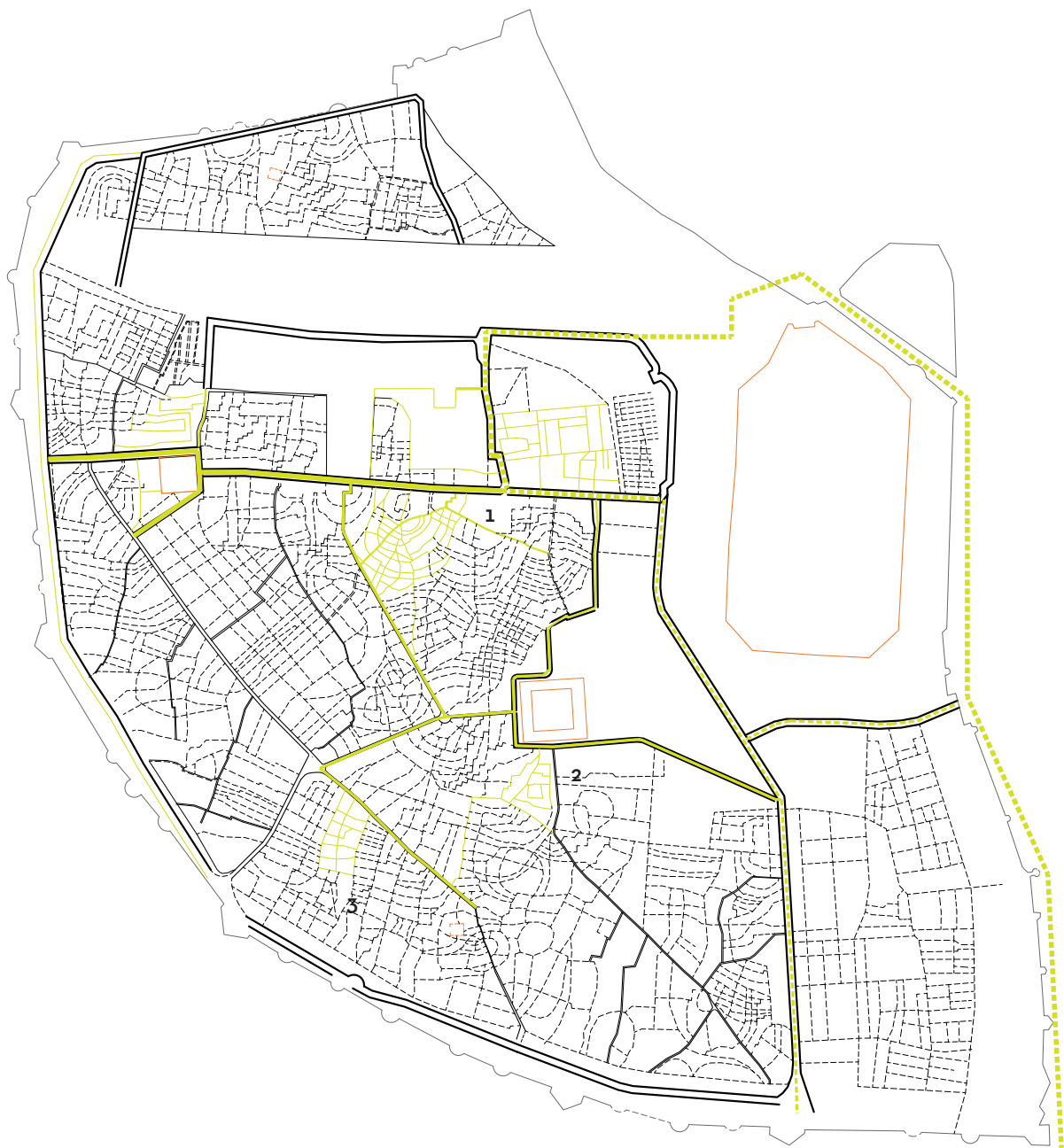
# MAPPING FOR CHANGE

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## SITE VISIT 2015

'Maliwara Street' - Nai Sarak, Chandnichowk Street  
'Katra Babu Roshan Lal' - Lal Darwaza, Sita Ram Bazaar Street  
'Kucha Pati Ram' - Sita Ram Bazaar Street, Chawri Bazaar Street





- Primary Street
- Secondary Street
- Tertiary Street
- Tertiary Street
- Areas documented

[ FIG. 4.1 ] Key Plan showing areas documented



### Site Visit 2015

*'A city is as much a personality as a human being... There are cities whose histories are always an expression of violence. There are others which are renowned for their breadth of mind, others for their industry, yet others for their skill and craftsmanship and so on, until you begin to see in the mind's eye a picture of the... inner life of the city long before you visit it...'*

*Philip Paneth*

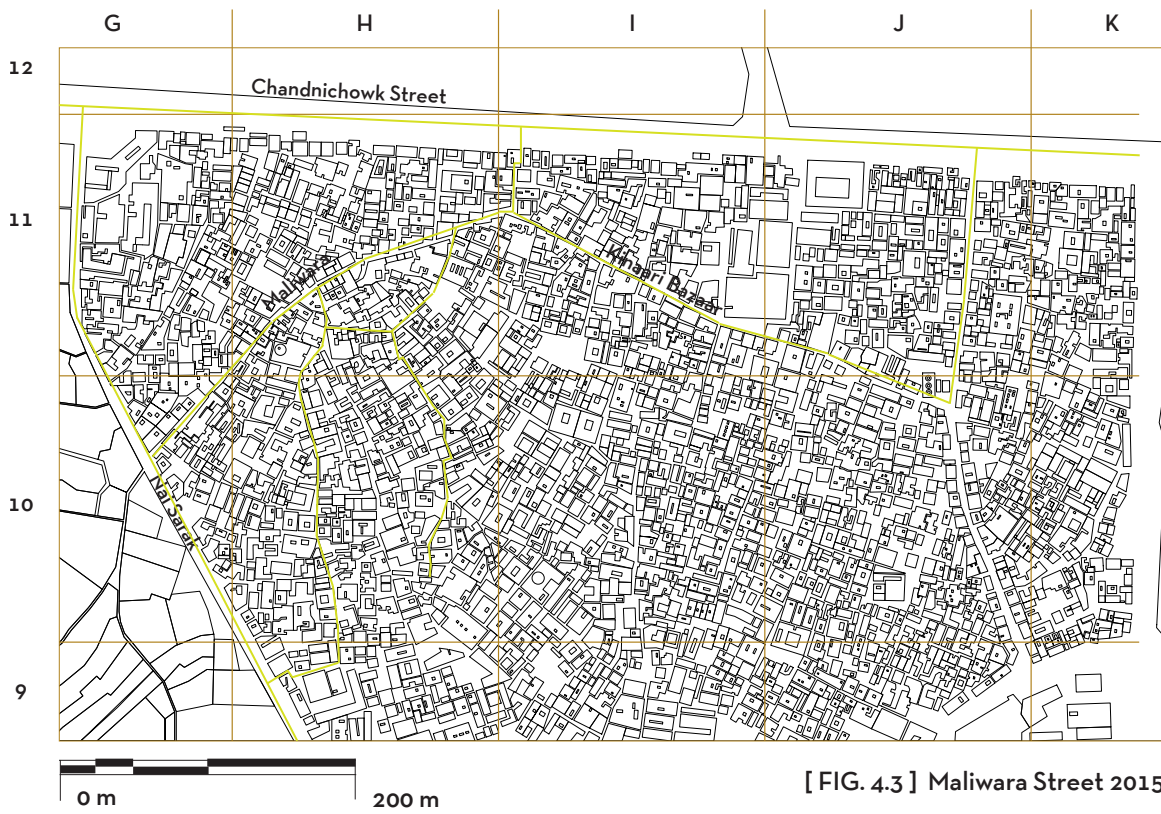
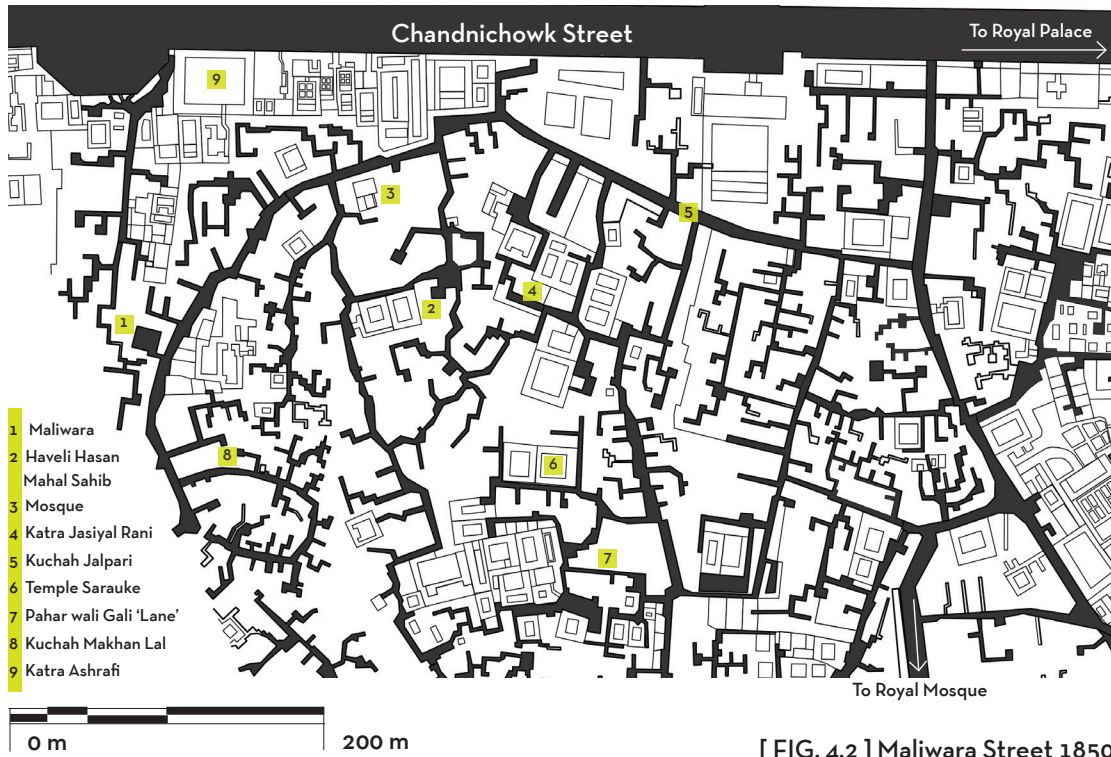
Old Delhi is a historic city carrying the potential to link its past with the present and propagate. The street patterns, way of life and the city's skyline define its character. The city's urban structure is based on a fundamental fractal system, which allows the city to work on multiple scales. The different parts of the city are linked together in a hierarchy that leads to the creation of nodes (intersections), connections (streets) and interactions. Each urban scale performs a specific function.

Old Delhi, being a medieval city, was predominantly pedestrian. Over a period of time, the city saw incremental additions onto its fractal structure. The urban morphology that we see today is the result of the street network which was laid when the city was planned initially in 1639 and the transportation system that was later introduced within the city, slowly over the last 375 years. This has led to the process of Urban Morphogenesis, which can be investigated by analyzing the transformation of street networks and the built environment within the city.

The layout of streets in the palace-fortress guides the street plan in the city at large. The city has beautiful narrow, almost intricately 'carved' in streets that are woven with the memories of the past. The chaotic looking yet rule-based street network system forms the backbone of the city's urban design. It is responsible for controlling climate, acoustics as well as the level of privacy and social order. The streets and squares offer a platform for endless opportunities and activities to all its users. It might appear chaotic and confusing while walking through the city however there is a definite, vast and complex communication system for people, goods and ideas. The street network is the city's skeleton over which the urban fabric grows. The physical form within the fabric influences the efficiency of the communication system.

Over the last 200 years, the city has undergone rapid transformation primarily because of the unprecedented commercial growth and increase in the number of migrant population from different parts of India. The aim of the site visit was to verify and document street patterns and a typical residential neighbourhood in Old Delhi that carry the unique qualities of the fabric. Emphasis was laid on mapping the change that the city has gone through since 1857 and analyzing the responsible parameters. The following areas were documented:

1. Maliwara Street, Nai Sarak, Chandnichowk Street
2. Katra Babu Roshan Lal, Lal Darwaza, Sita Ram Bazaar Street, Chawri Bazaar Street
3. Kucha Pati Ram, Sita Ram Bazaar Street, Chawri Bazaar Street



## MALIWARA STREET

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Maliwara - 'gardener's quarter' is one of the oldest Mohallas (spatial sub-division) to be urbanized in north-east of Old Delhi because of its proximity to the primary street 'Chandnichowk' as well as the Royal Palace. As a result, the area saw early growth around the already urbanized cores.

1850

The area originated in the period of Maratha control (1783 - 1803), as indicated by the Marathi suffix 'wara'. It was one of the few exclusive areas that consisted of people belonging to a single profession. The area was known for its gardens and manufacturing establishments. The street was lined with numerous multiple gateways that led to specific 'katras' - neighbourhoods, 'kuchas' - by-lanes and mansions. There was always a single point that served both as an entrance and an exit. Every spatial division was thus a sealed homogeneous entity. By-lanes were narrower and were generally famous for a specific commodity or a particular group of professionals. The width of the street varied from 4m to 6.5m. The width further increased to 8m in front of entrance arched gateways. The streets were laid asymmetrically. This was probably because it had been built at different times by different individuals, but also for making ingress more difficult for invading troops. A local mosque/temple or a school was located at street junctions or 'chowks'. These generally acted as a locality landmark. Shops on the lower level and residences on the upper storeys dominated the street facade. The residences showcased extensive balconies on the first storey with intricate geometric patterns.

2015

Today, the primary street 'Chandnichowk' connects to Maliwara Street through 'Nai Sarak' that acts as a secondary street. Thus, the area can be reached through a series of streets laid out in a hierarchical manner. Maliwara now consists of many different neighborhoods and is known for shops that sell beautiful clothing fabric and jewelry. The Maliwara street continues and connects with Kinaari Bazaar at a tri-junction in the east. The greater the distance to the core of the mohallah, the broader and more representative (but also increasingly socially anonymous) are the lines of communication, which may be categorized as "primary, secondary and tertiary streets". (Fonseca, 1971). The street width ranges from 2.9m at the entrance to 4m at the tri-junction. A number of local streets branch from Maliwara Street. These are very narrow, ranging between 1.2m to 1.5m in width, few of these have dead ends that act as gathering spaces for social interaction. Apart from the local streets, Maliwara street also showcases multiple threshold spaces that mark the entrance of the Mohallas which is generally through an arched gateway. This symbolized the point of transition from a semi-public to a private space.

Since 1857, the area has transformed structurally with regard to street widths, street connections, location of gateways, encroachments and building heights. The entrance gates to Mohallas have been destroyed at a number of places, which has led to restricted private spaces and increased public spaces thereby facilitating the rise in commercial typologies. From an approximate eight hundred houses, the area today witnesses only eight residential properties (Source: Mr. Gupta - one of the few residents). There has also been a change in the land parcel footprint, primarily because of the evolution of street networks. Multiple connections between local streets over the years has generated new complex growth patterns. This has led to urban casualties in the form of urban landfills and voids. A comparison between the urban field condition in 1857 and in 2015 has been made so as to understand how the transformation of streets and their unique features define both the urban field and the urban fabric within the city. (Fig. 4.3)



[ FIG. 4.4 ] Entrance to Maliwara Street from Nai Sarak 2015

# Urban Portrait

## Maliwara Street

'Street Skeleton' of Maliwara was studied to investigate how the latter parametrically, dictates the spatial and cultural codes of the urban field and hence the morphology. Both quantitative and qualitative determinants were taken into consideration that would be responsible in shaping the morphology.

Quantitative Determinants	Qualitative Determinants
Street Width	Privacy level
Primary Street 21 m	
Secondary Street 9 m	Threshold spaces
Tertiary Street 3 m to 4 m	
Local Street 1.2 m to 1.5 m	Location of commercial typology
Nature of street	Location of residential typology
Primary Street Straight	
Secondary Street Curved	Location of arched entrance gateways
Tertiary Street Curved	
Local Street Curved	
No. of branches per street	Street Facades
Branch Depth	Use of materials
Skyline	Balconies
Primary Street 3 - 4 Storeys	Screens
Secondary Street 3 - 4 Storeys	Raised entrance platforms
Tertiary Street 2 - 3 Storeys	
Local Street 2 - 3 Storeys	Type of Transportation
Building Height	Vehicular
Lower storeys 3.7 m	Pedestrian
Upper Storeys 4 m	
Sound levels	View
Primary Street 81 dB	
Secondary Street 81 dB	Inter-connected Terraces
Tertiary Street 70 dB	
Local Street 55 dB	
Climatic Control	
Population Density	
Number of streets leading to one node	



[ FIG. 4.5 ] Secondary street 'Nai Sarak' leading to Maliwaara Street -  
All secondary streets gradually bend and generate visual interest



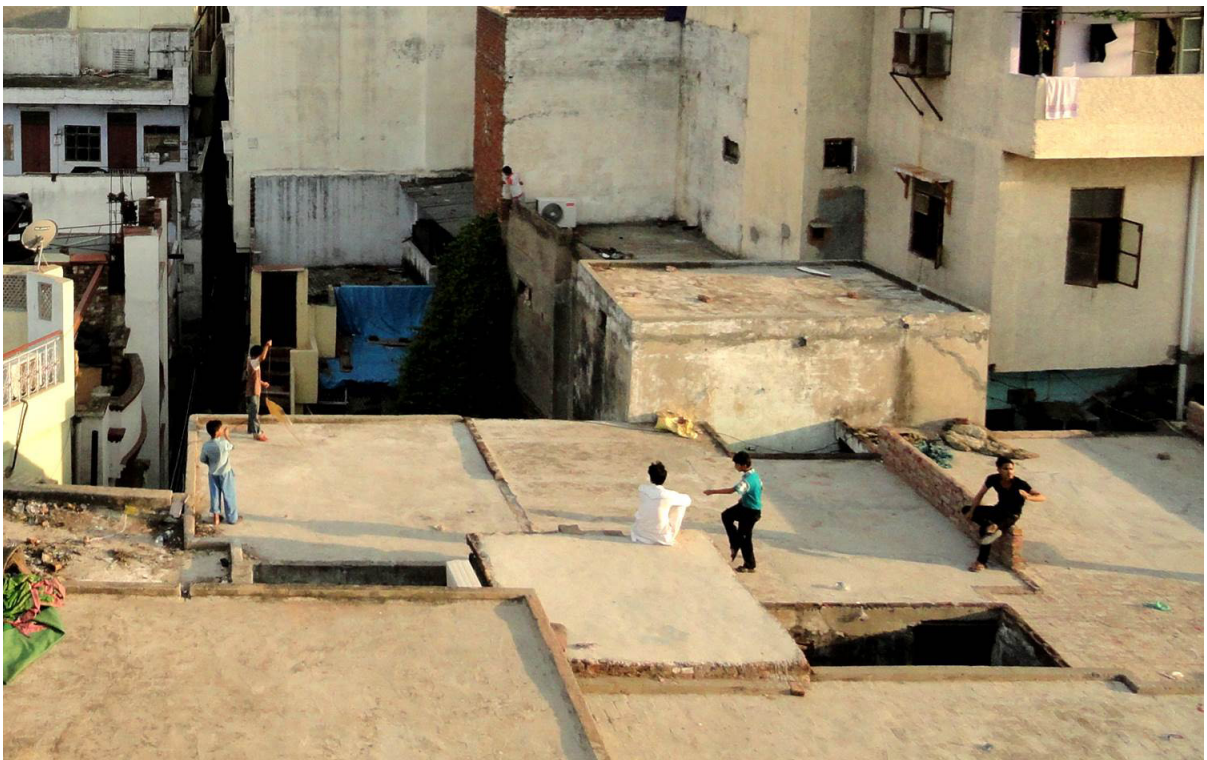


[ FIG. 4.6 ] Private mohallas with entrance gateways - The transition of public to private space forms a crucial aspect of the neighbourhood's structural module.



As the city's planning was based on a patrimonial - bureaucratic system there were no exclusive public spaces for the residents to socialize or interact within the city. Gardens were designed and maintained exclusively for the royals. This lack of social spaces however didn't lower the interaction among the residents. Intersections, threshold spaces, gateways, mosques and bazaars became the places for social opportunities. These acted not just as transfer points or commercial trade centers but as meeting points for the community. The city also saw layering of activities within the same space as a result of lack of social spaces. Courtyards with rooms were used as schools during the day within each community, instead of building one large scale unit. These rooms were then used as gathering spaces for meetings during the evenings and night. The same groups of courtyards were used as larger administrative units where elections could be carried out.

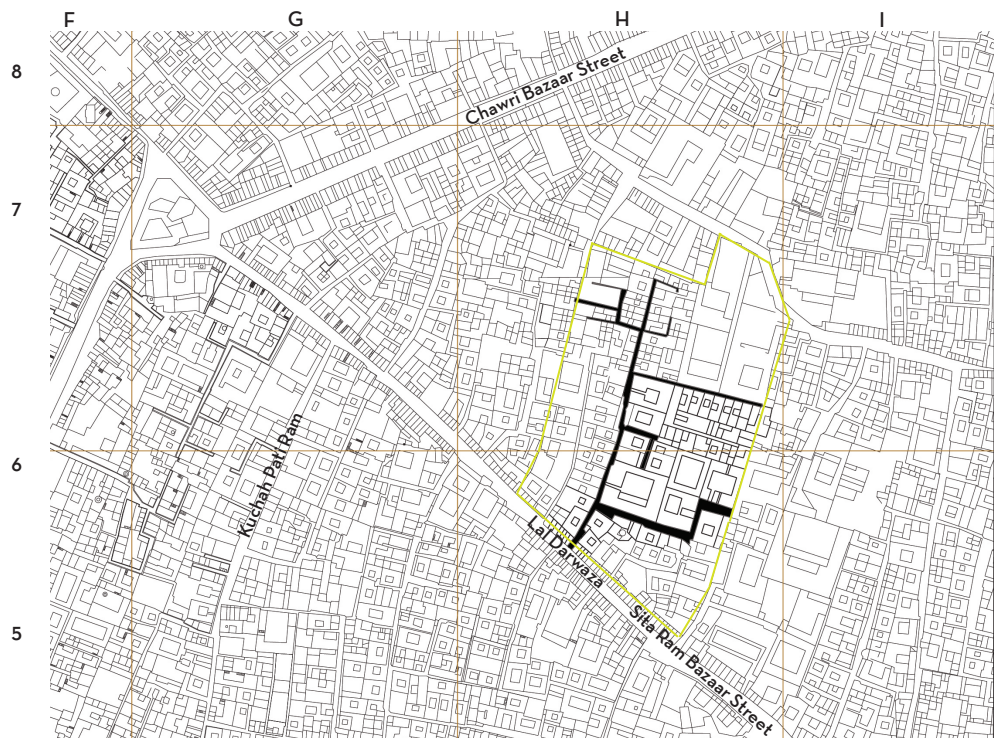
[ FIG. 4.7 ] Streets as extension of public space



[ FIG. 4.8 ] Series of connected terraces act as a new realm of public space



[ FIG. 4.9 ] Lal Darwaza, Katra Babu Roshan Lal 1850



[ FIG. 4.10 ] Lal Darwaza, Katra Babu Roshan Lal 2015

## KATRA BABU ROSHAN LAL, LAL DARWAZA

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The social structure of the imperial residence The Red Fort was replicated on a smaller scale in the mansions of princes and great amirs and this set the pattern for the city as a whole. These acted as the central institutions of Old Delhi that typified and distinguished the sovereign city.

Indian cities have been divided into quarters from earliest times. According to the *Silpasastras*, Sanskrit texts on architecture and city planning, the cities of Hindu India were composed of residential subdivisions called *gramas* or *padas*. Inhabited by people of the same caste, craft, profession, or tribe, these quarters were arranged in a pattern that depended on the size and function of the city.<sup>1</sup> In the cities of Mughal India the quarter or mohallah was the major form of residential organization.

The spatial division within the city can be seen in its center-defined identifiable quarters 'Mohallas'. These act like a microcosm to establish the city's local identity as each of these 'Mohallas' is based on specific public service, market, combinations of special functions or a group of individuals belonging to the same profession. Thus, socio-economic conditions very strongly dictate the physical structure of the walled city. This generates a way of life within the urban fabric which has a character of its own.

The Mohallas can be studied like a system of self contained urban units, integrated with open spaces. These are then repeated all over the city in different yet defined scales, which makes it possible to control city growth both quantitatively and qualitatively. Another interesting quality of these units is their walkable distance from the nearest major intersection, mosque or temple.

1850

The Lal Darwaza, as the name suggests, is a red coloured doorway to a small mohalla. The gateway has a large square frame with a recessed segmented arch opening. (Fig.) As depicted in the 1857 map, Lal Darwaza was the entry way to a Mohalla belonging to Babu Roshan Lal and Raja Sohan Lal who belonged to the elitist community. The neighborhood consisted of Babu Roshan Lal's mansion near the entrance, followed by shops on both sides of the street. This street then extended into two zones. The zone on the right led to private spaces that were exclusively meant for Raja Sohan Lal's guests. This area was further connected to the private courtyard complex through multiple arched gateways. The other zone was more public. It catered to larger public gatherings and was called 'Hatah Sohan Lal' - Fig. 4.9

2015

Lal Darwaza today witnesses a large percentage of commercial typology within the neighbourhood. Street layout is mostly the same with extensions at certain spaces however widths of streets have reduced due to encroachments. The areas that were open until late 1800s are now completely built. New streets were developed within these spaces to cater to the new houses. As it has been an inconsistent but continuous incremental growth, plots are of varying sizes. It would be fair to assume that the bigger plots were claimed or bought prior to the smaller ones.

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<sup>1</sup> Dutt, Town Planning, pp. 142-3



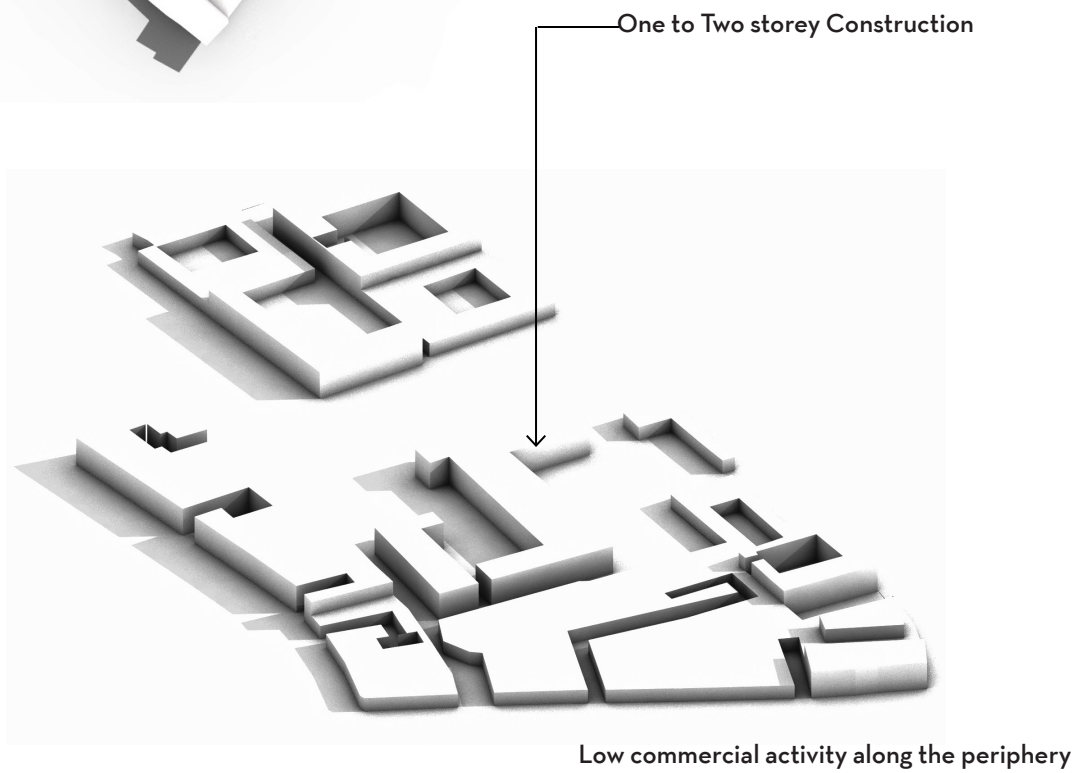
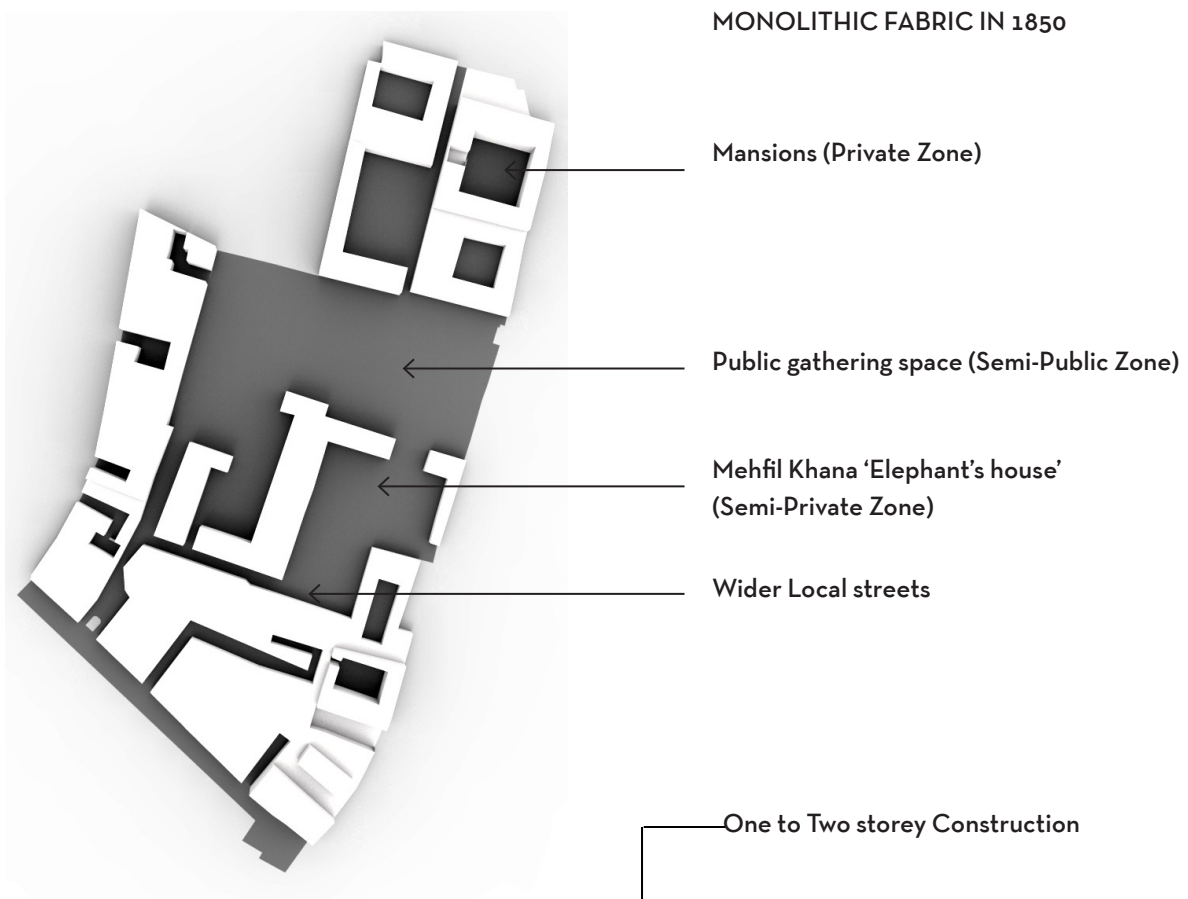
[ FIG. 4.11 ] Entrance gateway - Lal Darwaza (VIEW-A)  
(Lal - Red , Darwaza - Door)

# Urban Portrait 2015

Lal Darwaza, Katra Babu Roshan Lal

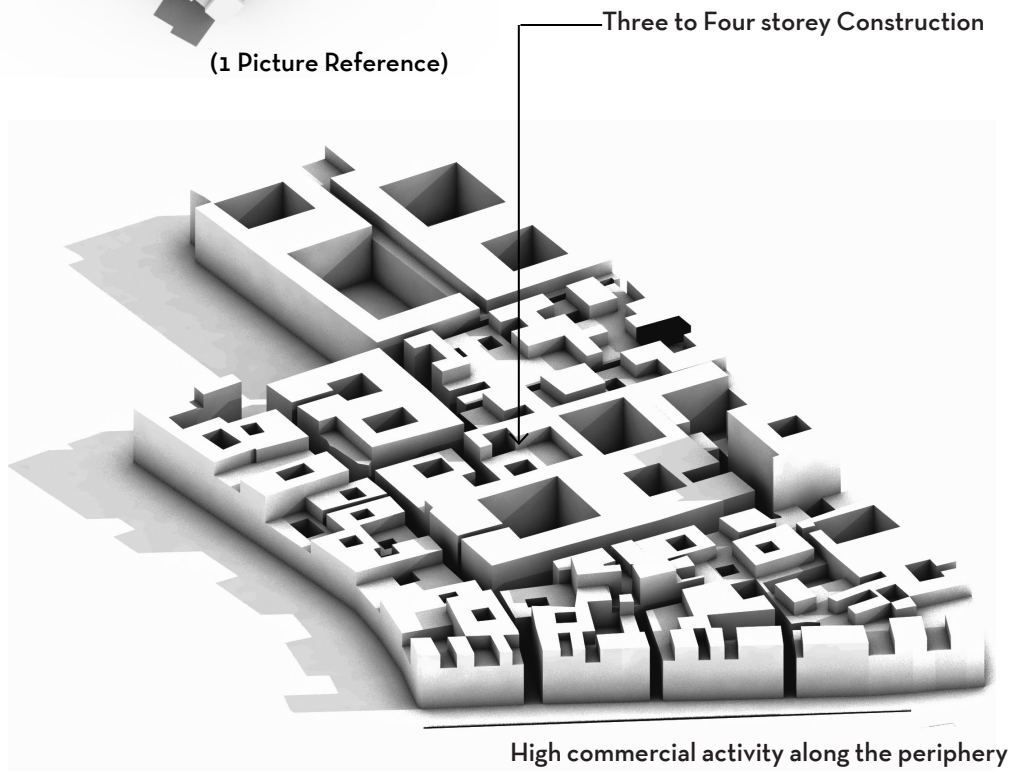
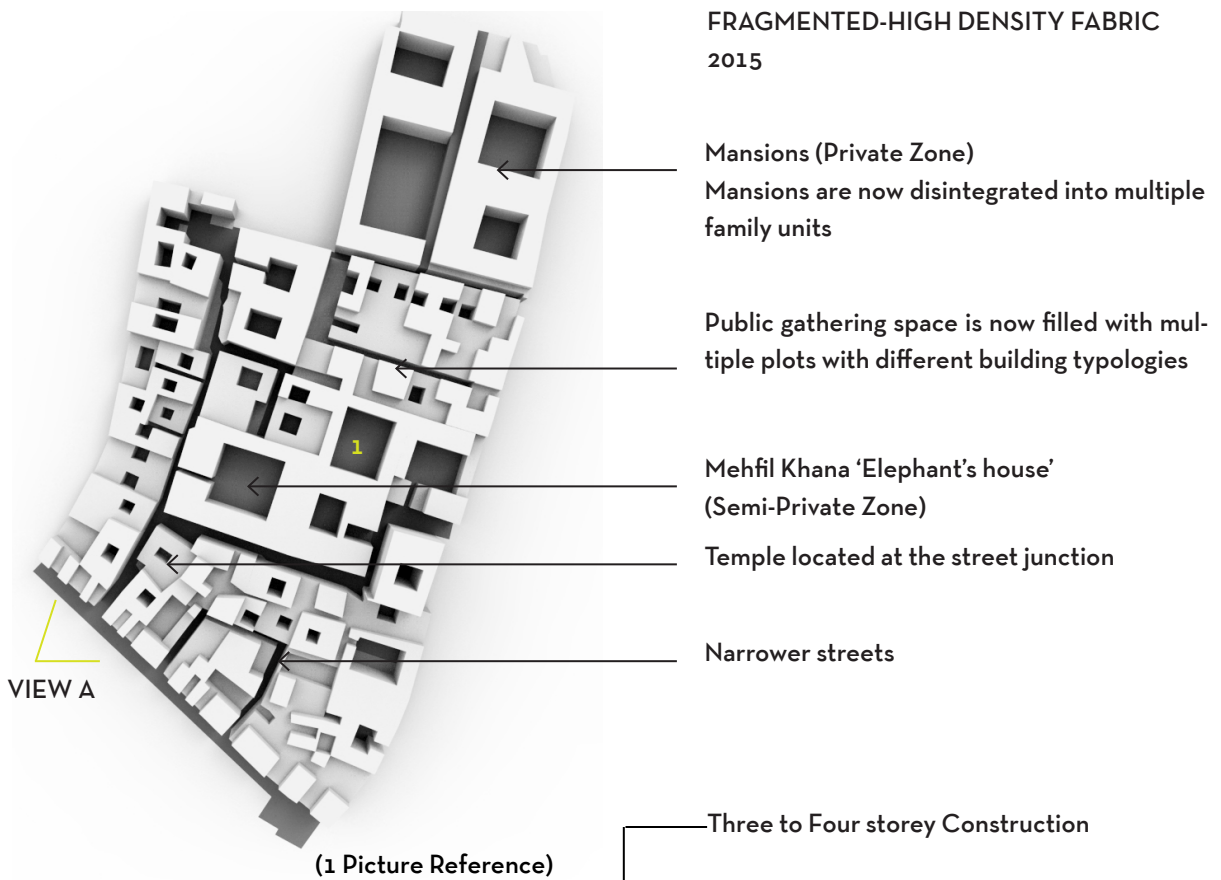
Based on the current scenario, the following quantitative and qualitative determinants were documented that are the variable shaping factors associated with the urban structure.

Quantitative Determinants	Qualitative Determinants
Street Width	Privacy level
Primary Street 11 m	A very strong transition from a highly public street to a very private courtyard space
Secondary Street 8 m	Threshold spaces
Tertiary Street 3 m to 4 m	Multiple threshold spaces were located near arched gateways that marked the entrance of the neighbourhood
Local Street 1.5 m to 3 m	Location of commercial typology
Nature of street	All buildings except the courtyard building are commercial
Primary Street Straight	Location of residential typology
Secondary Street Curved	Residential Courtyard Building
Tertiary Street Curved	Location of arched entrance gateways
Local Street Straight	Connection between secondary and tertiary street and entrance to the residential courtyard
No. of branches per street	Street Facades
Branch Depth	Use of materials
Skyline	Balconies
Primary Street 3 - 4 Storeys	Screens
Secondary Street 3 - 4 Storeys	Raised entrance platforms
Tertiary Street 2 - 3 Storeys	Type of Transportation
Local Street 2 - 3 Storeys	Vehicular (Two Wheelers)
Building Height	Pedestrian
Lower storeys 3.7 m	View
Upper Storeys 4 m	Inter-connected Terraces
Sound levels	
Primary Street 81 dB	
Secondary Street 81 dB	
Tertiary Street 70 dB	
Local Street 60 dB	
Climatic Control	
Population Density	
Number of streets leading to one node	



[ FIG. 4.12 ] Volumetric Study - Lal Darwaza, Katra Babu Roshan Lal 1850





[ FIG. 4.13 ] Volumetric Study - Lal Darwaza, Katra Babu Roshan Lal 2015

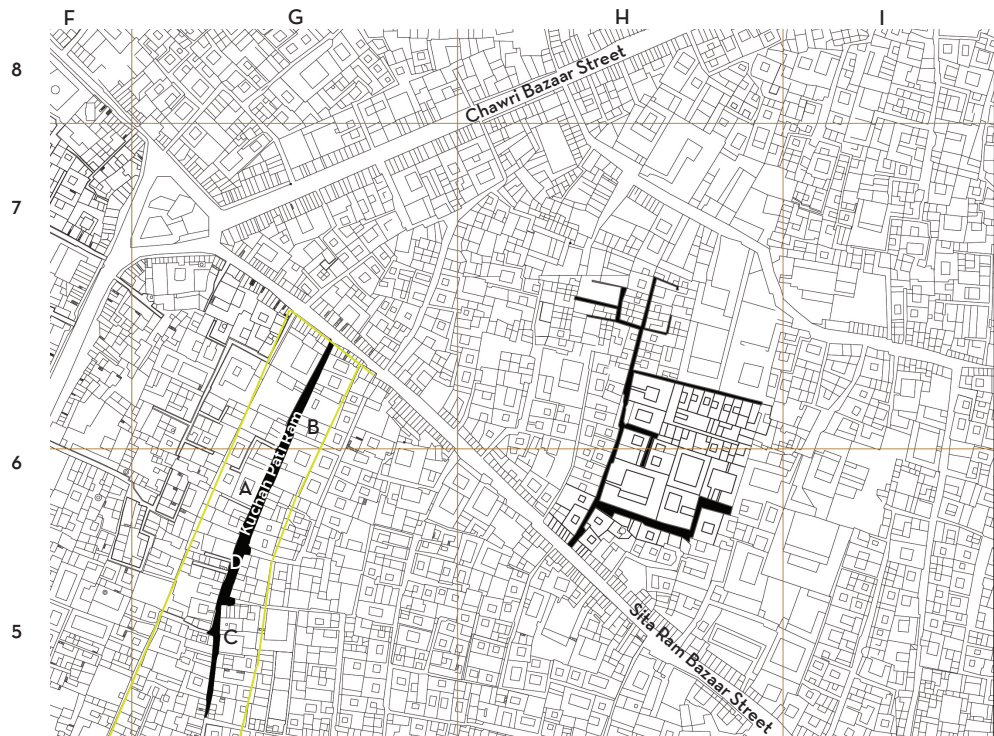




[ FIG. 4.14 ] View 1 - Katra Interior - Central courtyard space. Each room around the courtyard caters to one family, approximately 80 people live here together.



[ FIG. 4.15 ] Kuchah Pati Ram 1850



[ FIG. 4.16 ] Kuchah Pati Ram 2015

## 'KUCHA PATI RAM' - SITA RAM BAZAAR STREET, CHAWRI BAZAAR STREET

By-lane



Secondary Street



Primary Street

Kuchah Pati Ram is one of the by-lanes (kuchah stands for a bylane) emerging from Sita Ram Bazaar Street, located in south-west of Old Delhi. The by-lane connects to the Ajmere Gate and thus is an important infra-structural element of the city.

1850

Kuchah Pati Ram houses one of the densest collections of fine havelis in the walled city. Residences here ranged from houses of the nobility to the residences of courtesans, where gatherings and performances of dance and music were arranged for the elite of the city<sup>1</sup>. Almost all mansions are built with 'Lakhori brick' and are characterized by rooms around a central courtyard. Some have multiple courtyards as well, for example 'Ram Kutiya', a large residence belonging to one of the prominent nobles of Old Delhi. Diversity in the built structure is seen through the facades that range in color and style. Apart from the mansions, the area also has a number of Hindu temples.

2015

Kuchah Pati Ram today is one of the few areas in Old Delhi that is still majorly residential. The high number of mansions 'Havelis' in the area has helped preserve this quality. Some of the land owners maintain their structures as they hold high heritage and commercial value, others have given them on rent. This however has affected the condition of the mansions as they are not maintained by the tenants. Some of the tenants have sub-divided their own space to further lease it out to make additional income. The rooms at the lower level have been converted into shops by the tenants. These factors have deteriorated the quality of the fabric on the whole.

Three classes of population exist in the area-service class (daily wage workers), professional class (clerks, engineers) and business class (traders). High population density with low infrastructure has resulted in a low standard of living for the residents.

The older generations still remember the long lost days of glory, when the Kucha was very different from what we see today. The large havelis had large courtyards in which the family assembled for important functions. Marriages were held there, the womenfolk performed their daily chores, drying fruits, pickles, washing etc. The 'Otlā' in front of the houses were the 'transition zones connecting the street, which was the public zone to the private zone inside the havelis. Old men sat on otlas, cracking jokes and engaged in arguments<sup>2</sup>. In course of time, many mansions have been demolished to make way for modern interventions. The character of the area is thus changing everyday.

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<sup>1</sup> INTACH Delhi Chapter, Shahjahanabad Inventory Of Built Heritage - II, Pp.251

<sup>2</sup> Sunder Rajeev, Sharat, A Study On Community Profile Of Kucha Pati Ram, Shahjahanabad



[ FIG. 4.17 ] Most of the houses have a high plinth that is approached from either sides or from the front.

# Urban Portrait 2015

Kuchah Pati Ram, Sita Ram Bazaar

Based on the current scenario, the following quantitative and qualitative determinants were documented that are the variable shaping factors associated with the urban structure.

Quantitative Determinants	Qualitative Determinants
Street Width	Privacy level
Primary Street 11 m	A very strong transition from a highly public street to a very private courtyard space
Secondary Street 8 m	Threshold spaces
Tertiary Street 3 m to 4 m	Multiple threshold spaces were located near arched gateways that marked the entrance of the neighbourhood
Local Street 1.5 m to 3 m	Location of commercial typology
Nature of street	Commercial is restricted to lower levels on the Sita Ram Bazaar street
Primary Street Straight	Industrial godowns are now replacing shops
Secondary Street Curved	Location of residential typology
Tertiary Street Curved	75% of the area is still residential
Local Street Straight	Location of arched entrance gateways
No. of branches per street	Connection between secondary and tertiary street and entrance to the residential courtyard
Branch Depth	Street Facades
Skyline	Use of materials
Primary Street 3 - 4 Storeys	Balconies
Secondary Street 3 - 4 Storeys	Screens
Tertiary Street 2 - 3 Storeys	Raised entrance platforms
Local Street 2 - 3 Storeys	Type of Transportation
Building Height	Vehicular (Two, Three and Four wheelers)
Lower storeys 3.7 m	Pedestrian
Upper Storeys 4 m	View
Sound levels	Inter-connected Terraces
Primary Street 81 dB	
Secondary Street 81 dB	
Tertiary Street 60 dB	
Local Street 55 dB	
Climatic Control	
Population Density	
Number of streets leading to one node	



[ FIG. 4.18 ] Dead end streets that were earlier used for social gatherings and marriages are now used for parking.





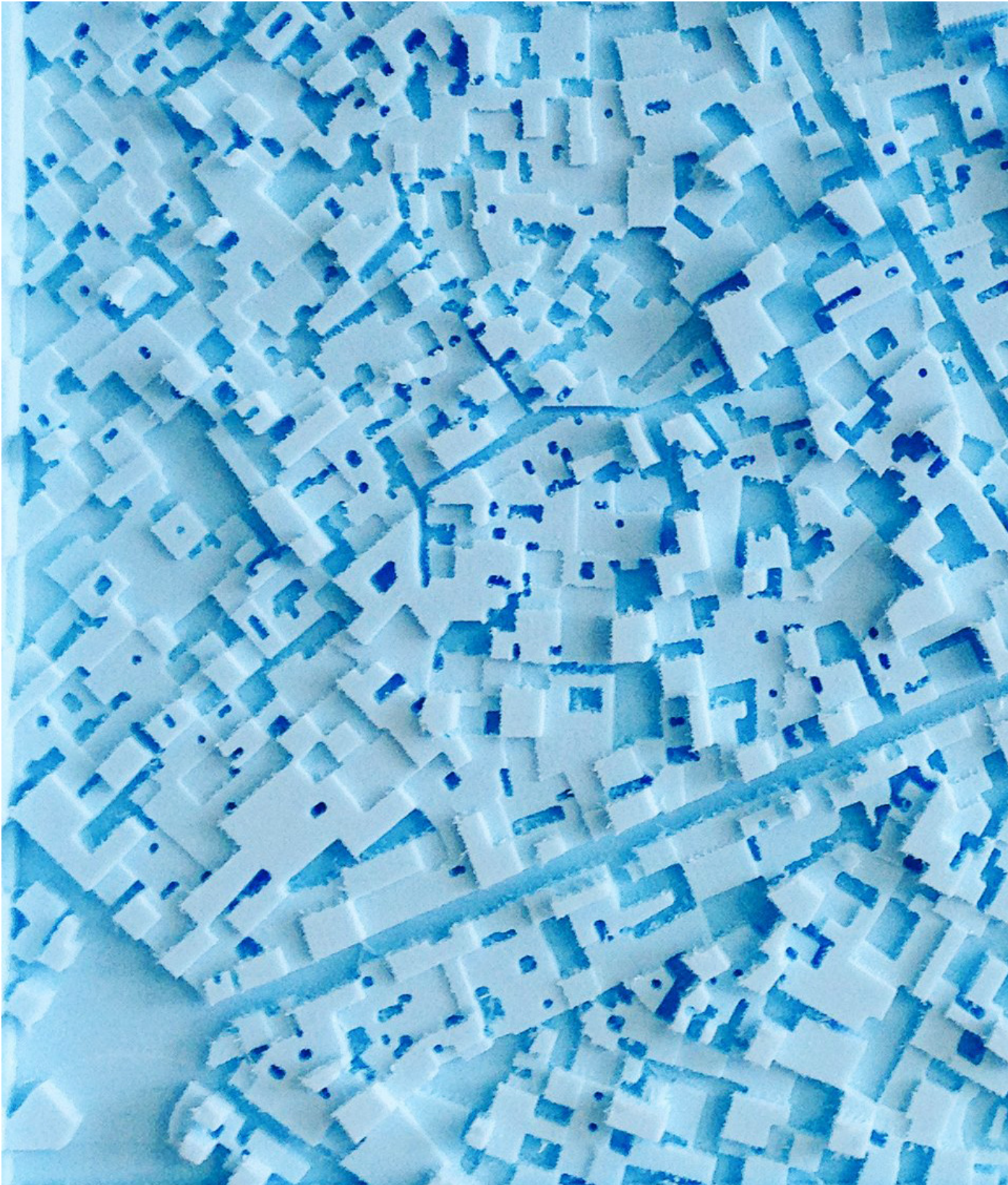
[ FIG. 4.19 ] An old mansion now being used as a Residents Welfare Association office



[ FIG. 4.20 ] Shops on the lower levels are now being used as godowns which is drastically changing Old Delhi



*The following chapter analyzes the street network and katra typology thus documented in further detail by investigating their spatial characteristics and establishing relationships among them.*





# URBAN ELEMENTS

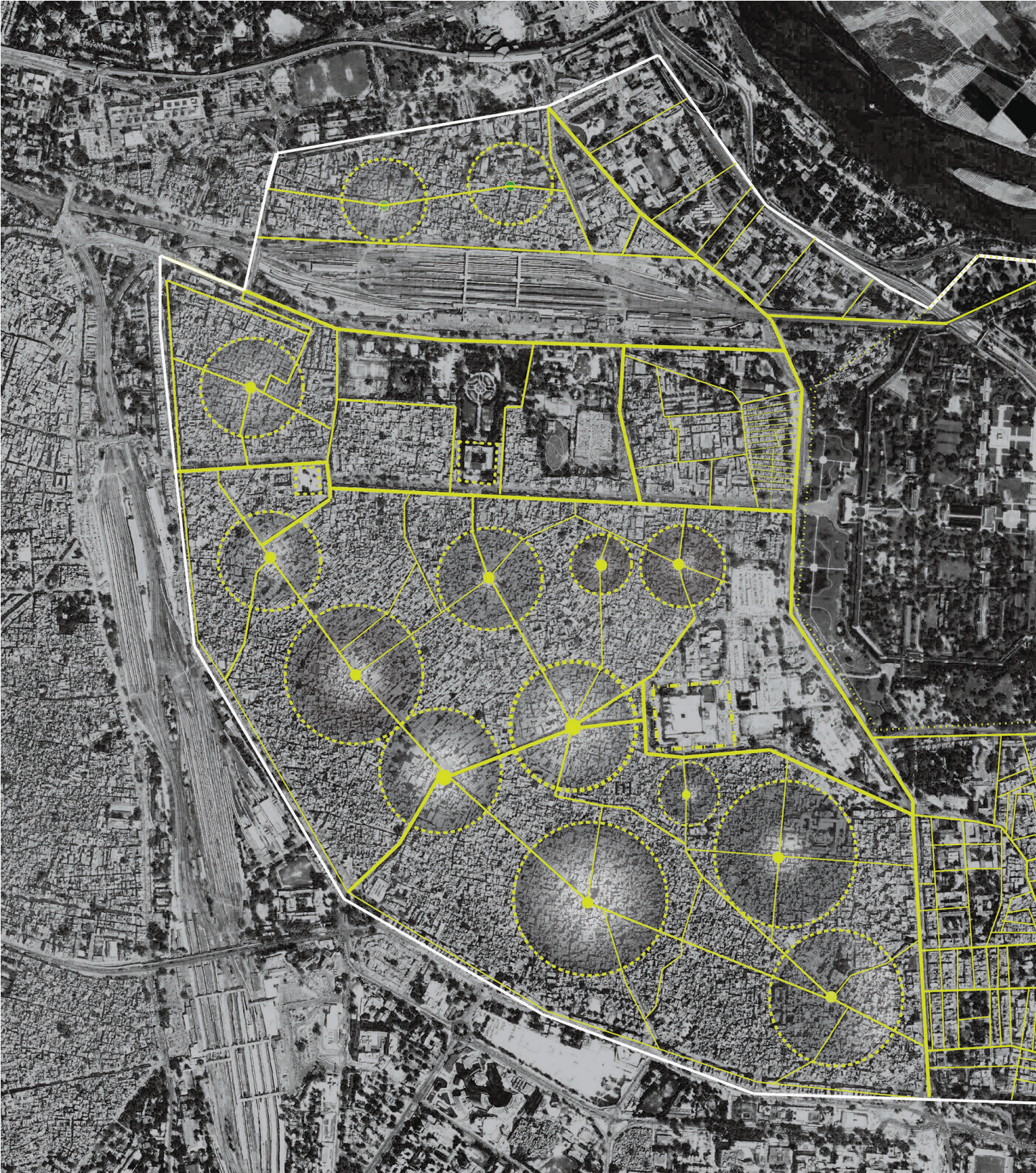
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## CHARACTERISTICS AND RELATIONSHIPS

- Street Network Patterns
- Abstraction of Urban Growth Patterns and Density blueprints
- Entwined Urban Growth Rings
- Catalogue of Urban Effects

Katra - Neighbourhood Structure in Old Delhi








STREET NETWORK PATTERNS





Old Delhi, India

**Legend**

- 
 Royal Palace  
 Fixed Point Attractor  
 First Order
- 
 Royal Mosque  
 Fixed Point Attractor  
 First Order
- 
 Mosque  
 Fixed Point Attractor  
 Second Order
- 
 City Wall / Boundary  
 Line Attractor  
 First Order
- 
 Street Network  
 Line Attractor  
 Second Order
- 
 Density Circles  
 (Increase in density from the  
 center to the periphery)
- 
 Nodes  
 Fixed + Variable Point Attractors  
 First + Second Order



[FIGURE 5.1]

‘Old Delhi exhibits a spatial order that is derived from socio-economic patterns and technological capabilities of the times. The morphology of old settlements represents an organically knit built form with narrow winding streets on a pedestrian scale, a high degree of functional mix and an introverted social structure which is reflected in inward looking residential clusters. The fabric and the texture of the city exhibits a closely knit framework of residences, work places and trade centers.

These elements are then affected by their location, movement pattern and how well they are inter-related. Thus, spatially all commerce and trade centers run along the city’s main arteries. The arteries give out branches in the form of inner narrow streets where the residential structures dominate. These are introvert in nature and they draw sustenance from the streets, defining what zone is private and public.’

*Rory Fonseca  
 Urban Rehabilitation in India  
 Ward 9 of the Walled City of Old Delhi  
 University of Berkeley, 1968*

The walled city of Old Delhi can be thus understood as an urban field where a number of urban attractors work together to generate relationships that influence the city’s morphology. These attractors will be analyzed on the basis of their location, their position in the social organization and the kind of patterns they generate.



[FIGURE 5.2] View from Royal Mosque 'Jama Masjid' Looking South



OLD DELHI as a city can be characterized by its connective geometry. The distribution and location of urban elements at various scales and the connections within the fabric define the city. These elements acting as Urban Attractors work at different scales to generate interactive networks. These networks of distinctive character have the ability to interact with each other, which allows the walled city to exist as a living-dynamic city. Old Delhi like many other medieval cities is the most fractal on the smaller scales up to 1 km, whereas 19th century cities work better on larger scales<sup>1</sup>. Like most of the pre-modernist cities, Old Delhi too works on all scales which makes it a Fractal City.

The following urban components work together at city, neighbourhood and local scale:

1. **NODES:** The city's structure is linked at all scales in an hierarchical organization. This is primarily done through a system of nodes with a large number of connections between them. Each node acts as an attractor and provides a certain character to the field it lies in.
2. **PATHS:** The nodes are connected by paths in multiple ways, either directly or indirectly which makes urban life possible. The occupants of Old Delhi thus experience freedom of movement and interaction as they are able to move from one point to many other points of the city. So as to ensure this movement and exchange of information, it is important to ensure diversity among nodes in close proximity. Old Delhi exhibits this pattern very prominently. A shop catalyzes paths among residences, whereas residences in turn catalyze flow in front of the shop.<sup>1</sup>
3. **HIERARCHY OF CONNECTIONS:** Old Delhi exhibits a balance of small and large scale connections. Paths at lower scales are narrow which are essentially pedestrian friendly as they limit the speed of vehicles. Large scale connections generate a strong global transportation network. The problem that Old Delhi faces today is how to convert a pedestrian city into a car city. With time, modifications in the transport system led to changes in the urban system. The policies laid by the government cater to large scales and do not work at lower scales. Emphasis on making the larger scale stronger generates an unbalanced urban structure. In order to generate a living city, it is important to formulate a sophisticated connective structure.

All the above components work together and generate a specific morphology for Old Delhi.

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<sup>1</sup> Salingaros, Nikos.A, Connecting the Fractal City, PRINCIPLES OF URBAN STRUCTURE, Techne Press, Amsterdam, Holland, 2005



*Two sample site studies are conducted to understand the relationship of Old Delhi's urban attractors at the city, neighbourhood and local scale. Both samples investigate the breakdown of urban territories into land parcels, which further sub-divide into plots, on which building develop. A relationship between the size of these plots with the distance of the plot from the street intersection (urban attractor) has been formulated, which generates varying density offsets. Thus each urban attractor is studied for its influence range.*

*Each sample is then represented in the form of an abstract density blueprint.*

*Sample 2 is further analysed to exhibit the growth dynamics of the city by investigating the transformation of streets network.*

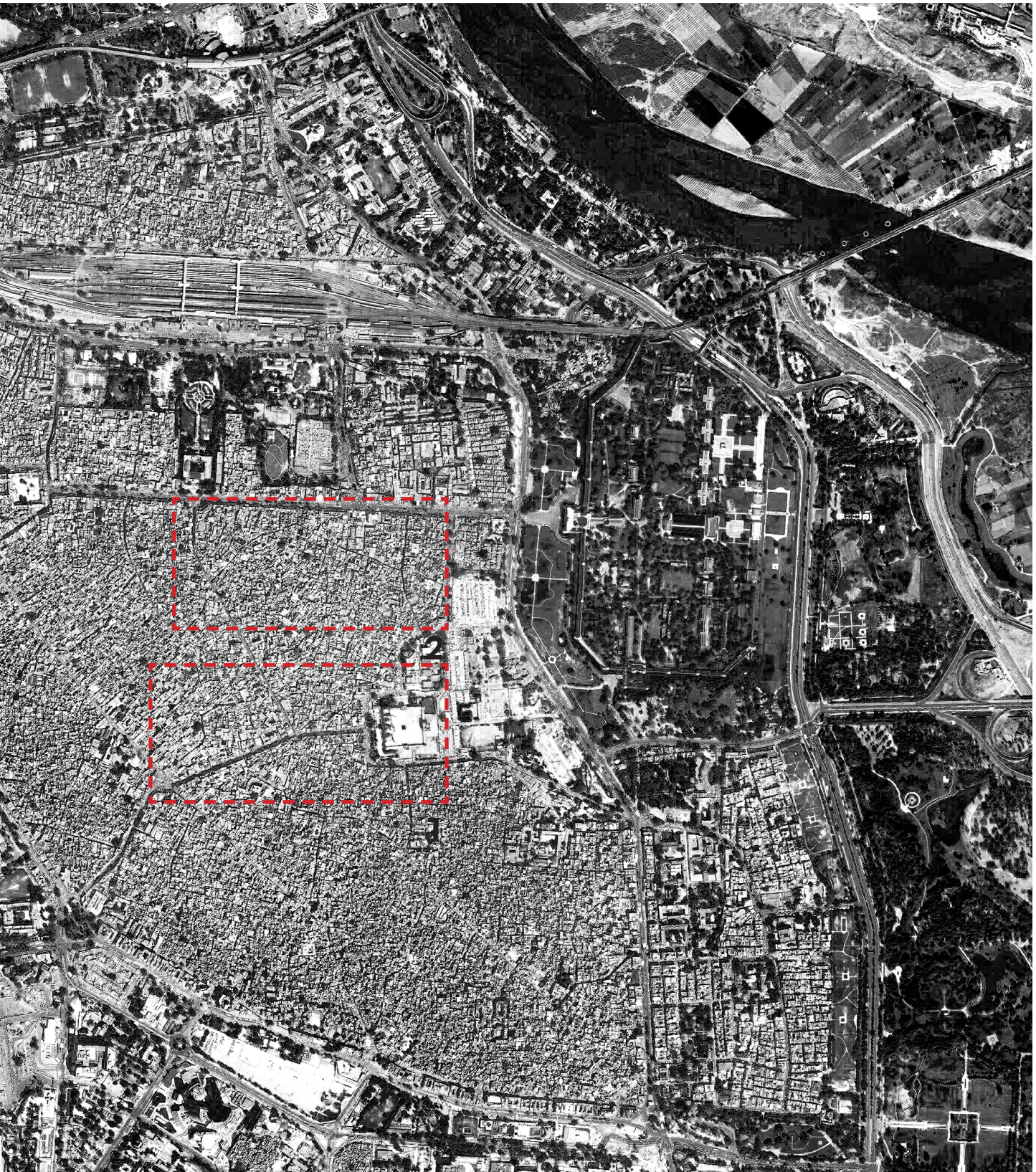
**Site Study: Sample 1**  
Area Near Royal Mosque And Chawri Bazaar  
Street Intersections

**Site Study: Sample 2**  
Area Next To Chandnichowk Street And  
Maliwara Street

Old Delhi Satellite Image  
Source: Gis Imagery

[FIGURE 5.3] location of study samples





## PARCELIZATION



[FIGURE 5.4.1]

## SUB-PARCELS BLOCKS



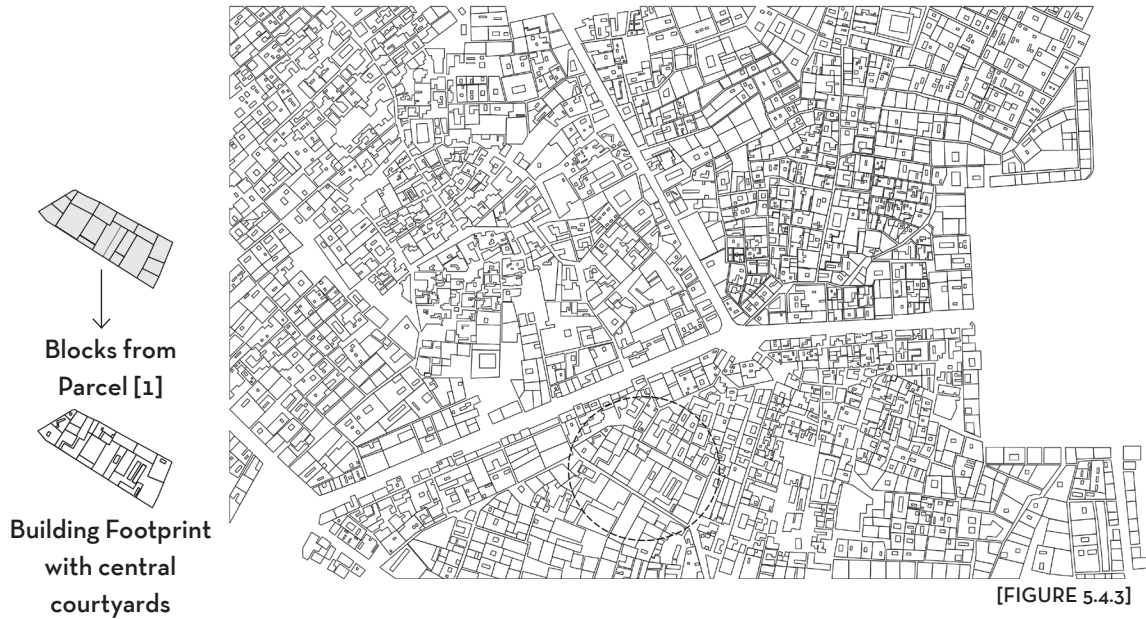
[FIGURE 5.4.2]



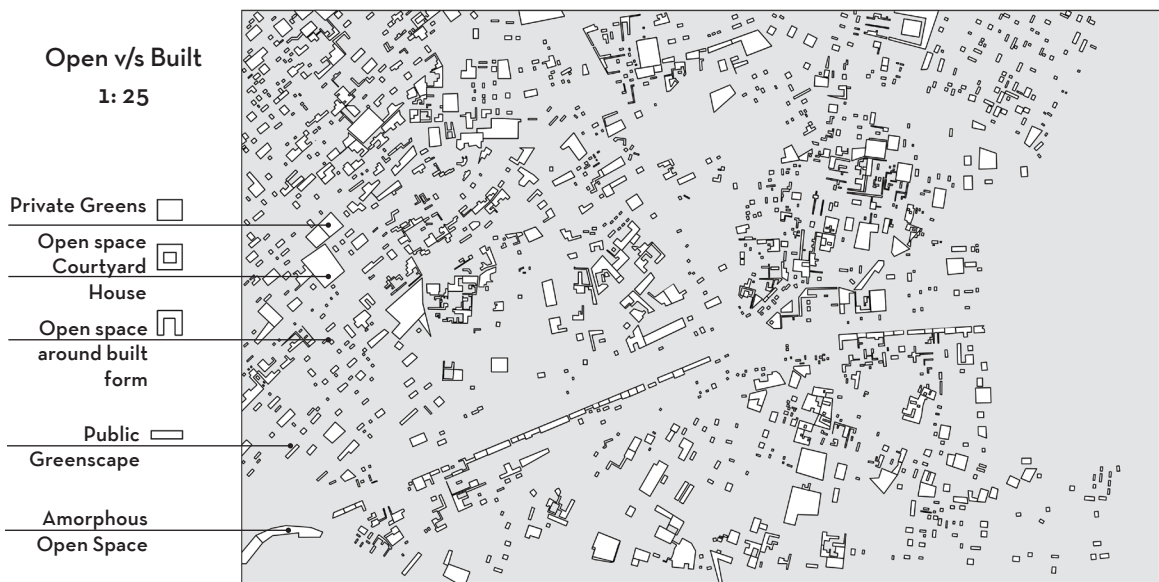
# SITE STUDY: SAMPLE 1

[FIGURE 5.4] AREA NEAR ROYAL MOSQUE AND CHAWRI BAZAAR STREET INTERSECTIONS

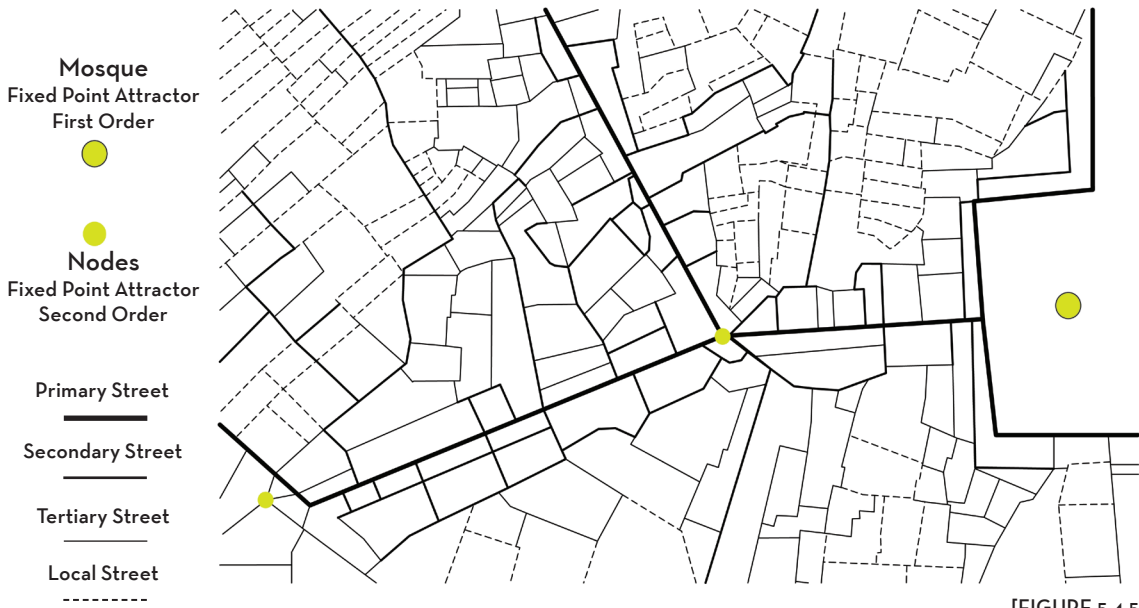
## BUILDING FOOTPRINT



## OPEN SPACES



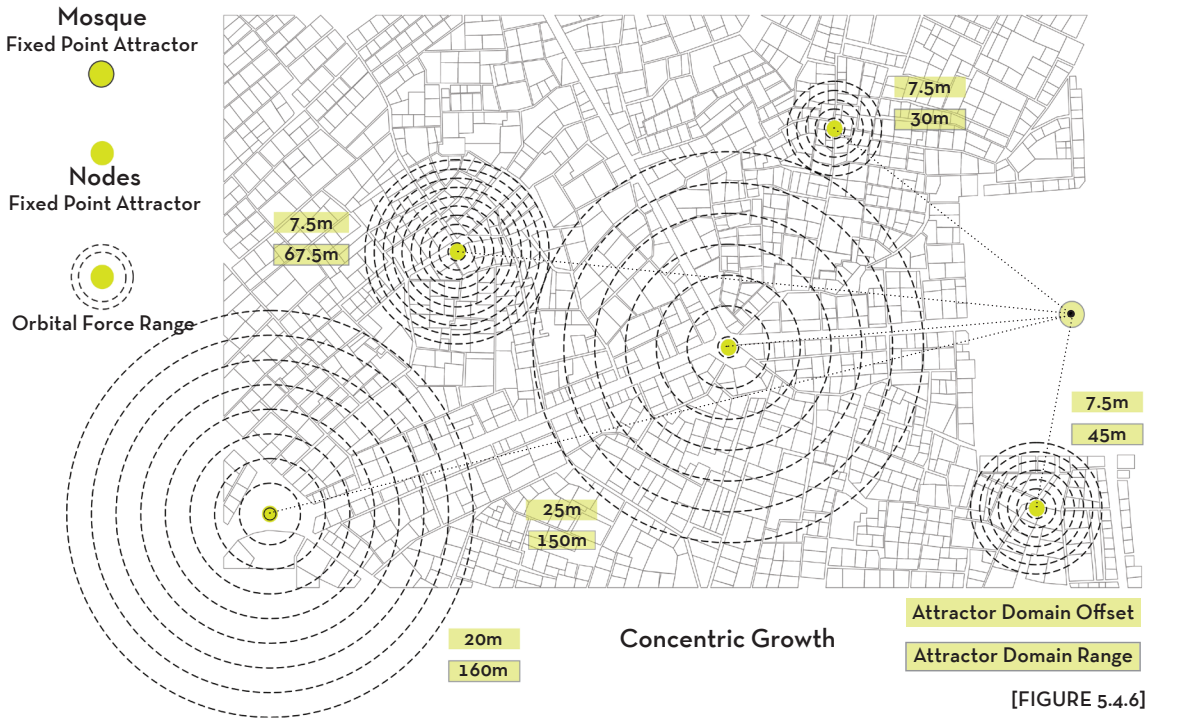
## STREET NETWORK



[FIGURE 5.4.5]

## URBAN GROWTH AROUND INTERSECTIONS/ NODES

(Point Attractors with varying influence range generating different density patterns)



[FIGURE 5.4.6]





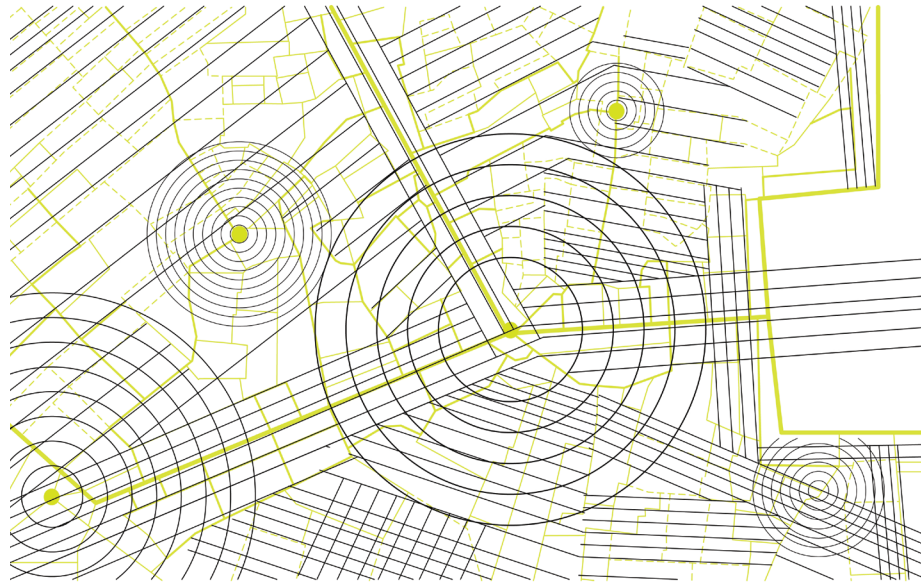
**URBAN GROWTH AROUND STREETS**  
 (Linear Attractors)



Change in Density vs Distance from Node

[FIGURE 5.4.7]

**URBAN GROWTH AND DENSITY BLUEPRINT**  
 (Formulation of Streets and Nodes through Connective Geometry)



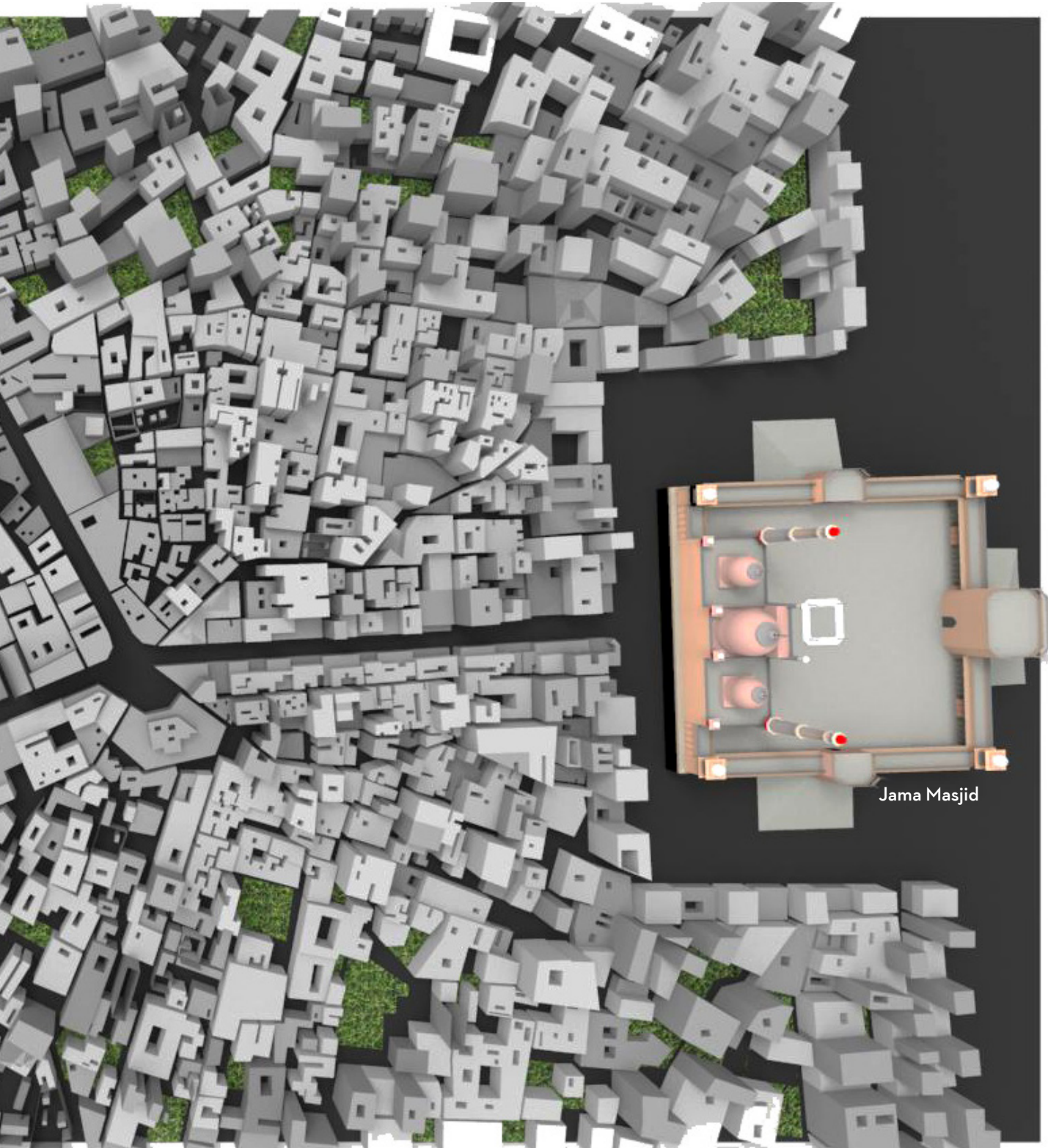
Each attractor generates a specific density pattern within a certain range. Multiple attractors interact with each other to generate a connective responsive network.

[FIGURE 5.4.8]





[FIGURE 5.4.9] Site Sample 1 : Present day urban fabric 2015

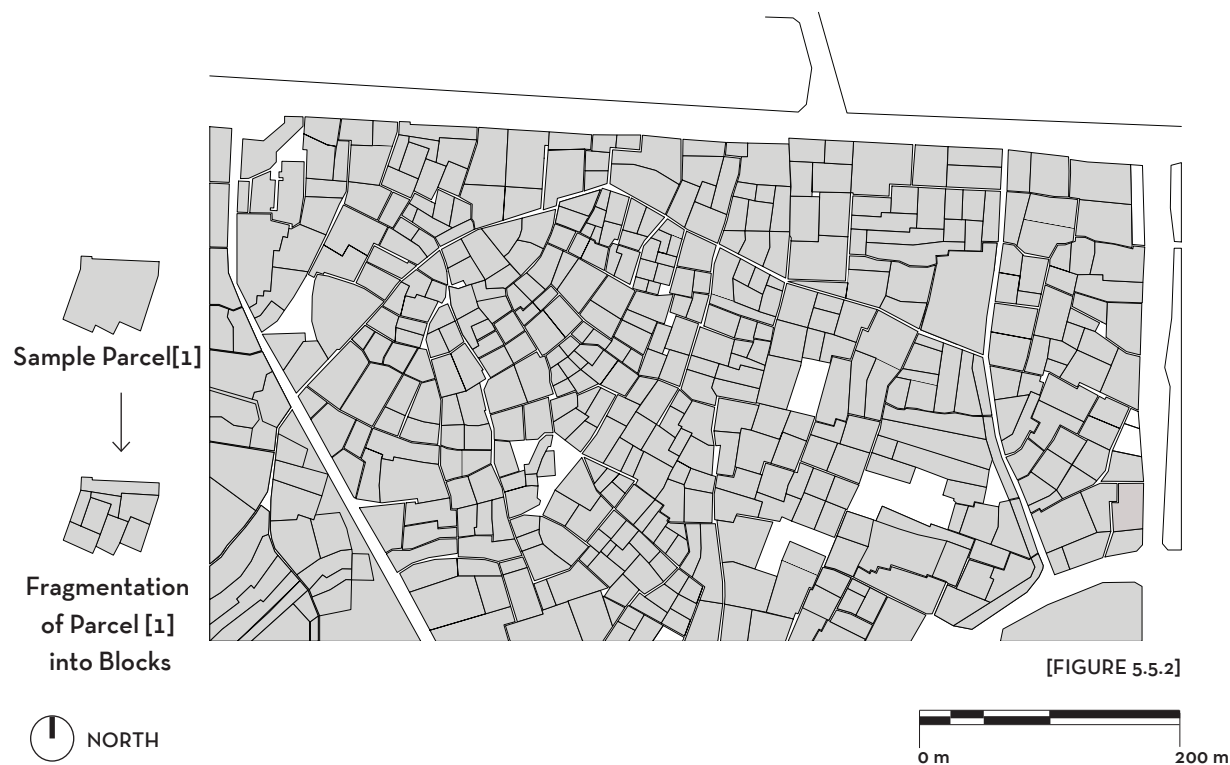


## PARCELIZATION



[FIGURE 5.5.1]

## SUB-PARCELS BLOCKS



[FIGURE 5.5.2]

SITE STUDY: SAMPLE 2

[FIGURE 5.5] Area Between Chandnichowk Street And Nai Sarak Street

BUILDING FOOTPRINT



[FIGURE 5.5.3]

OPEN SPACES



[FIGURE 5.5.4]



## STREET NETWORK



[FIGURE 5.5.5]

## URBAN GROWTH AROUND INTERSECTIONS/ NODES

(Point Attractors with varying influence range generating different density patterns)



Attractor Domain Offset (m)

Concentric Growth

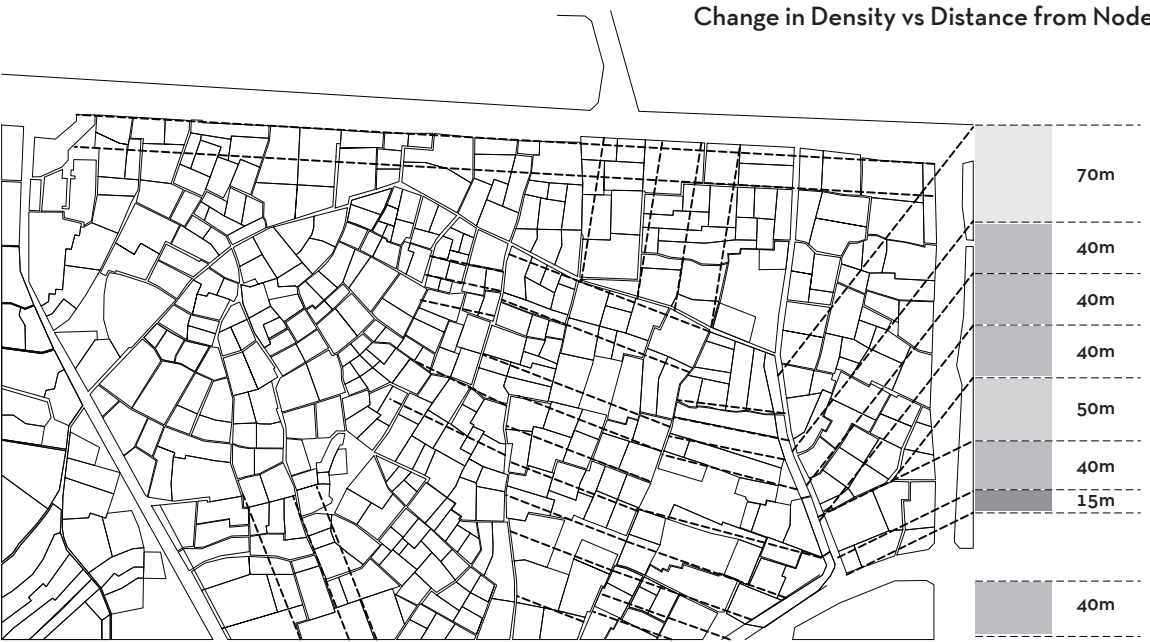
[FIGURE 5.5.6]

Attractor Domain Range (m)



**URBAN GROWTH AROUND STREETS**

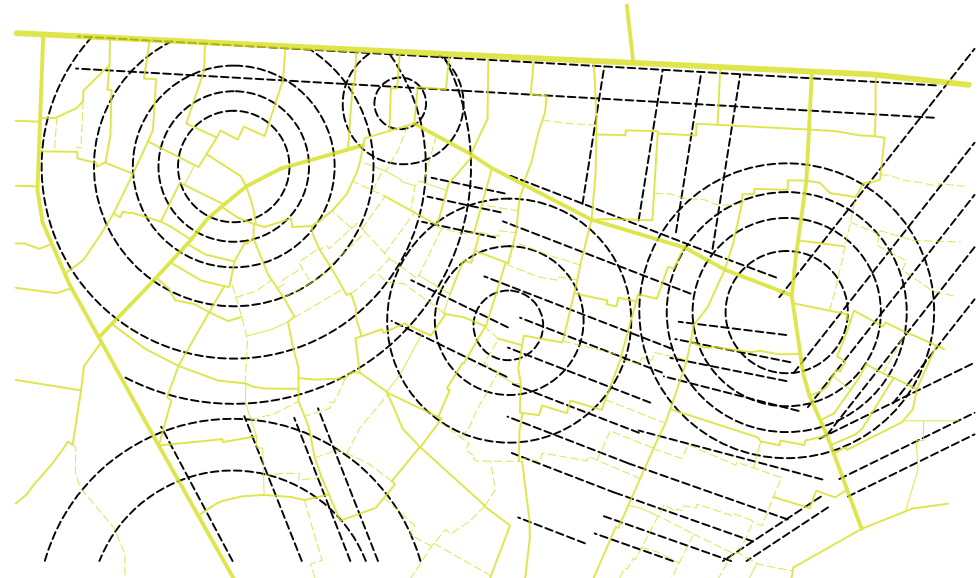
( Linear Attractors )



[FIGURE 5.5.7]

**URBAN GROWTH AND DENSITY BLUEPRINT**

( Formulation of Streets and Nodes through Connective Geometry )



[FIGURE 5.5.8]

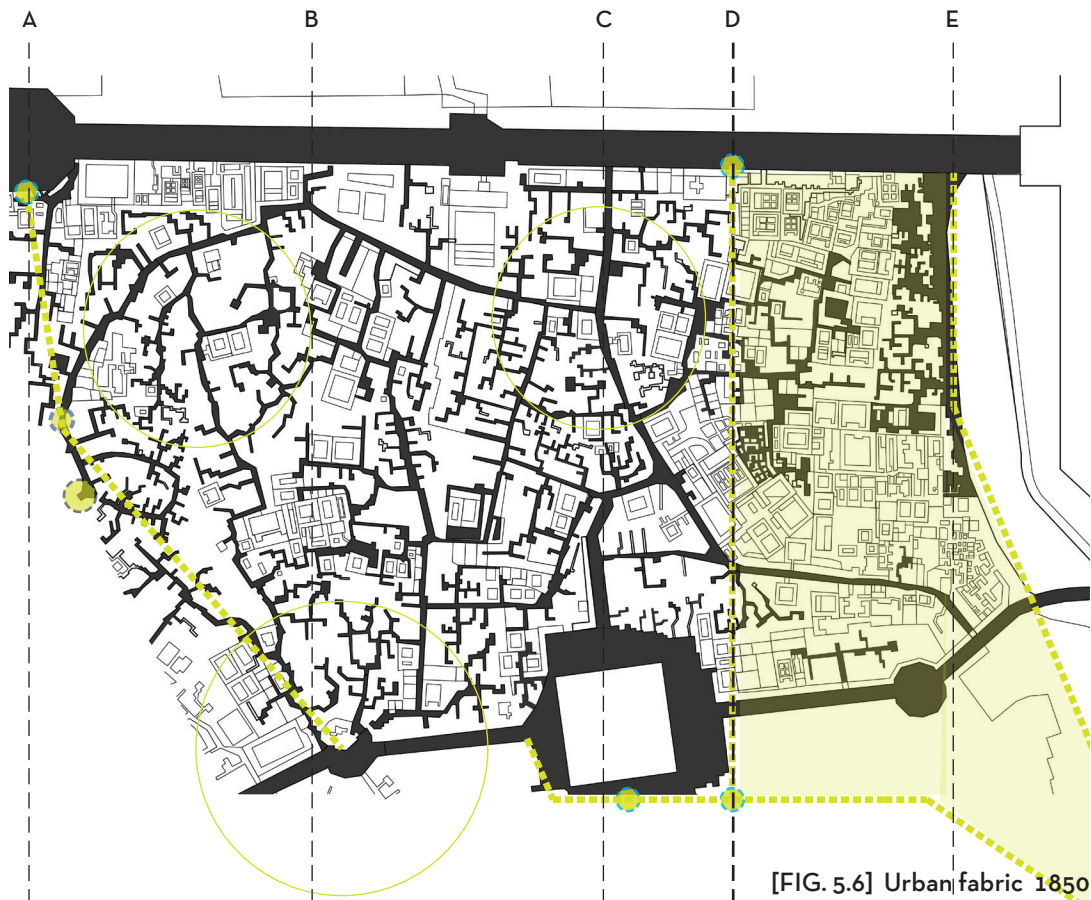






[FIGURE 5.5.9] Site Sample 2 : Present day urban fabric 2015





[FIG. 5.6] Urban fabric 1850

Code of the field generates the Code of the fabric



New Street - D

Street Lines

[FIG. 5.7] Urban fabric 2015

- Area obliterated by British - New Fabric
- Urban Growth Orbitals
- New Street

- Non-Existent Intersections
- New Intersections

STUDY SAMPLE 2  
GROWTH DYNAMICS

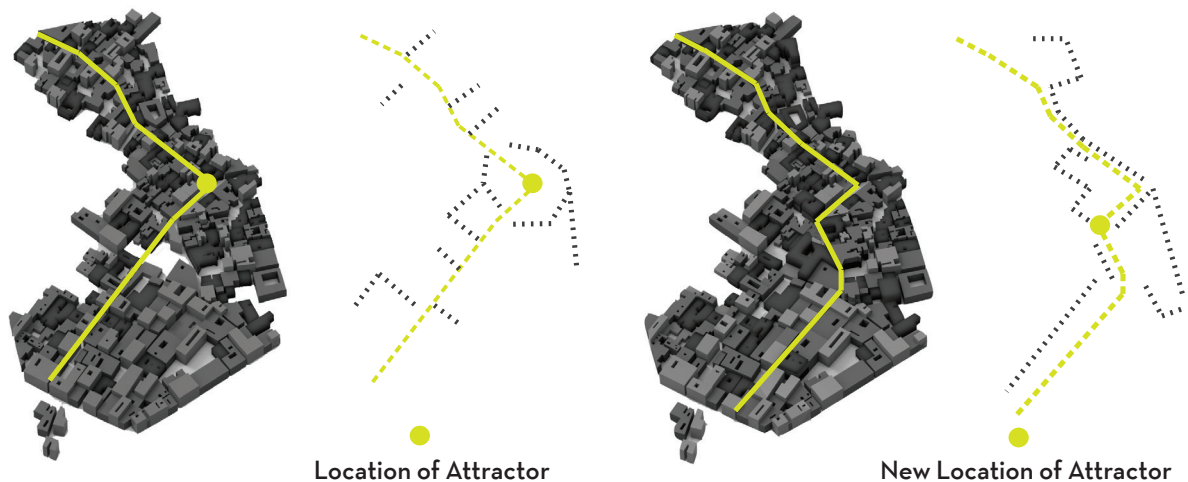
Until 1739, Old Delhi exhibited the patron-client system centered on the palace-fortress and the mansions of princes and great amirs<sup>1</sup>. From 1739-1857, the city witnessed a decline of this system because of major upheaval in the form of Nadir Shah's attack. During this period, a number of amirs were killed affecting the city's society and culture significantly. The houses of amirs that were left vacant were then converted to residential quarters.

Under the British rule, new principles emerged. As the British were interested in trade and commerce, the city saw the expansion of the economy that threw up a new group of merchants. Centered on schools, courts, religious institutions, and political organizations, these new associations replaced the old patron-client structures and spawned a new middle class of lawyers, teachers, brokers, merchants, bankers, religious specialists, and administrators.<sup>2</sup> Most of the population in Old Delhi resided in mohallas formed on caste/craft rather than on patron-client principles. This led to development of micro-communities all over the city. Thus, socio-cultural changes affected residential patterns.

Over time, as the city grew, migrants came into the city increasing the density manifolds. This resulted in disintegration of land parcels and division of plots by introduction of new streets and connections between the traditional street network. Thus, when the Urban Field got crowded, the growth dynamics changed from one where growth takes place from a central core and outwards to one where the field is successively filled uniformly over the whole field.

MOVEMENT OF URBAN ATTRACTORS WITHIN THE FABRIC

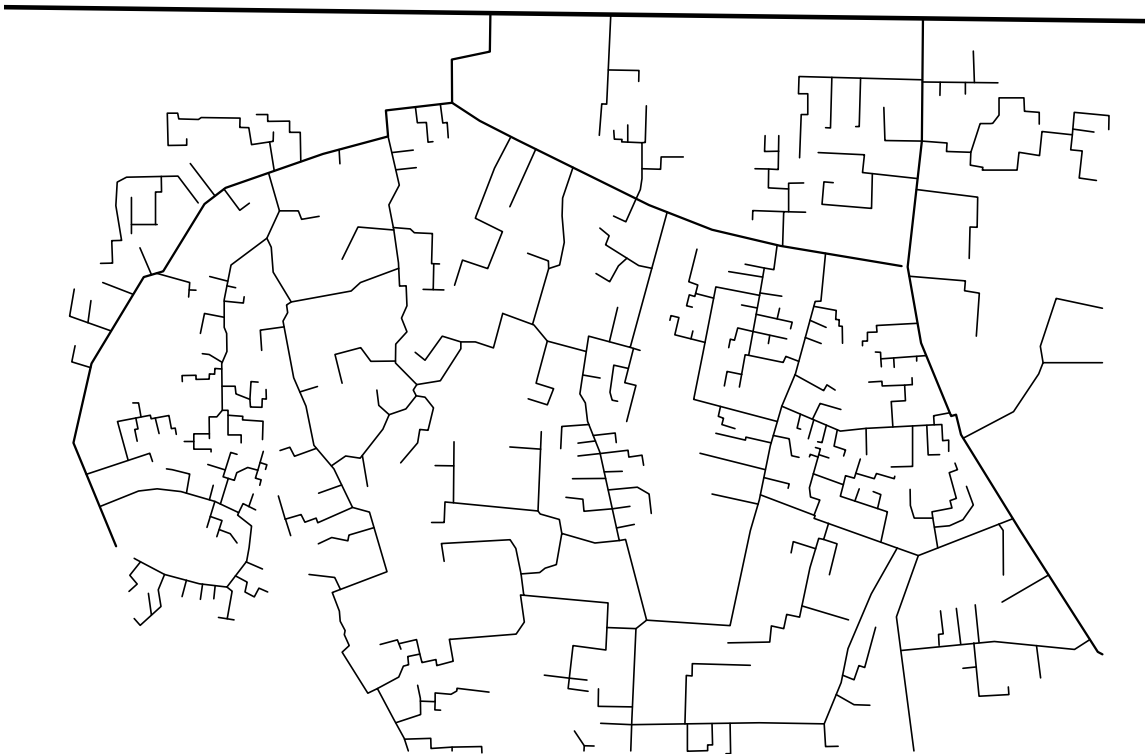
The growth patterns and height development of buildings evolves with the introduction of a new curve (street D). The curve thus behaves as an urban attractor capable of generating and manipulating fabric.



[FIG. 5.8] Change in fabric due to movement of attractors

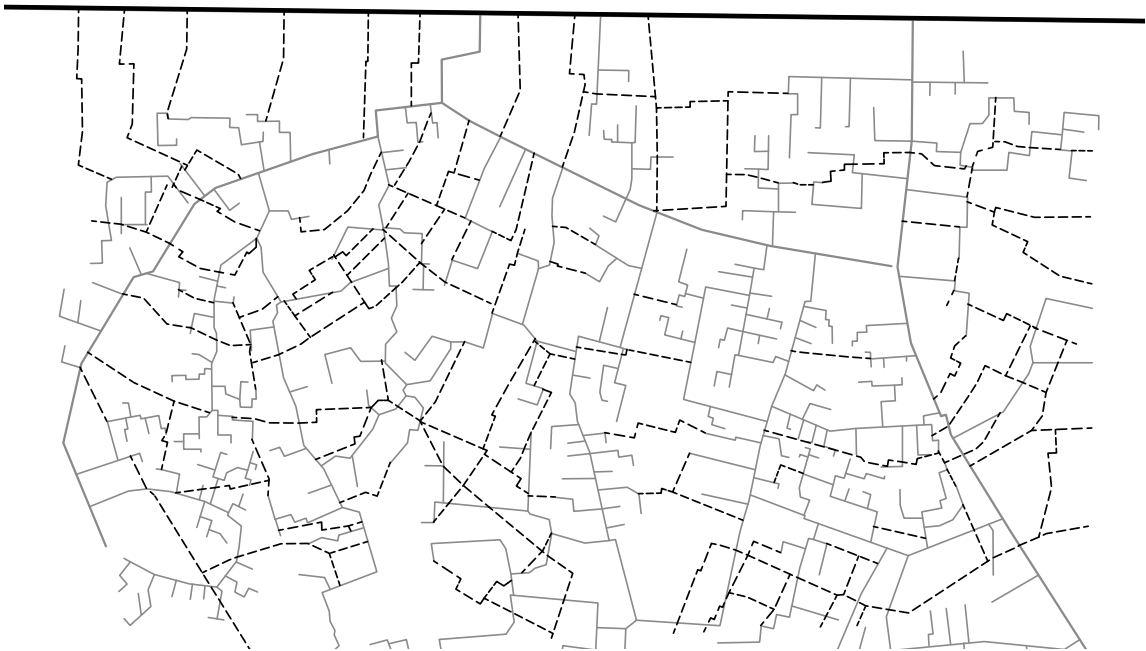
<sup>1</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp. 177

<sup>2</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp. 178



1850

[FIG. 5.9] Traditional Street Network



1851-2014

----- [FIG. 5.10] New Streets connecting the traditional street network



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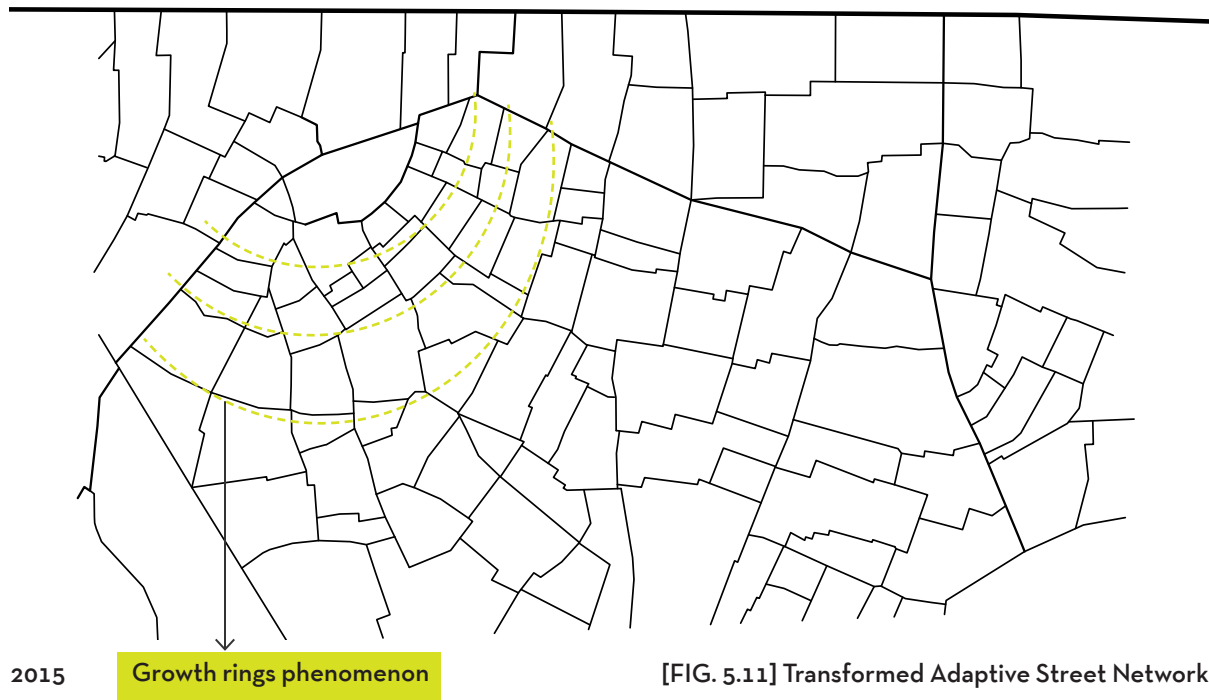
STUDY SAMPLE 2  
URBAN PERMEABILITY

---

The traditional fabric exhibits streets seep into the fabric until they reach near another line or point attractor. The streets were laid at almost regular intervals with the same branching logic through out the city. The property of the final branch or the local street to be a dead end street was crucial. As the population grew, the growth logic was modified with the introduction of streets mostly at the tertiary and local level, increasing the number of branches at the secondary level. As more connections grew between the secondary streets, the fabric became more permeable. This altered the structure. Spaces that were earlier private or semi-public became public. This further led to the development of shops in the interior of the residential settlements, thereby changing the character of the place drastically.

Old Delhi today witnesses a system that gradually varied its functionality by varying its urban skeleton making it a highly adaptive urban fabric. However, in order to preserve the vernacular quality of Old Delhi, it is extremely crucial to know the limits of this adaptation. Old Delhi exhibits a spatial order that is derived from socio-economic patterns and technological capabilities of the times. The morphology of old settlements represents an organically knit built form with narrow winding streets on a pedestrian scale, a high degree of functional mix and an introverted social structure which is reflected in inward looking residential clusters. <sup>1</sup> This morphology can only be sustained if the embedded growth logic is preserved.

Secondary streets give rise to new tertiary connections that generate a continuous and almost concentric growth generating a highly permeable network with many short links, numerous intersections, and minimal dead-ends.



---

<sup>1</sup> Fonseca, Rory, Urban Rehabilitation in India - Ward 9 of the Walled City of Old Delhi, University of Berkeley, 1968



*The density growth rings analyzed in the above two samples exist all over the city. These have been termed as the 'Entwined Urban Growth Rings' as they intersect and overlap with each other.*

*The influence range of these growth rings has been divided into three categories - High, Medium and Low influence range on the basis of the radius of each ring.*

ENTWINED URBAN GROWTH RINGS : CHARACTERISTICS [FIGURE 5.12]



Urban Growth Rings  
High + Medium + Low  
Influence Range



Urban Growth Rings - High influence range  
0.14 Sq.km. to 0.1 Sq.km  
Primary Streets  
Primary Street Intersections  
First Order attractors - Mosque

GROWTH RING COMBINATIONS

As the city grew, continuous and concentric patterns of streets started developing not just at the architectural scale but on a city scale. These streets formulated 'Growth Rings' of three types based on the point attractor they were formed around. They can be categorized as urban growth rings of :

1. High Influence Range
2. Medium Influence Range
3. Low Influence range

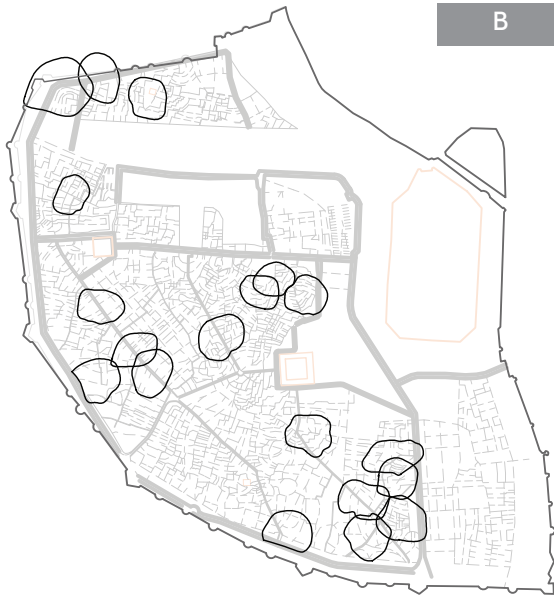
All the rings interact with each other to generate varying patterns which further affect the morphology of the city.

It is these rings that act as the boundaries for ka-tras or mohallas.



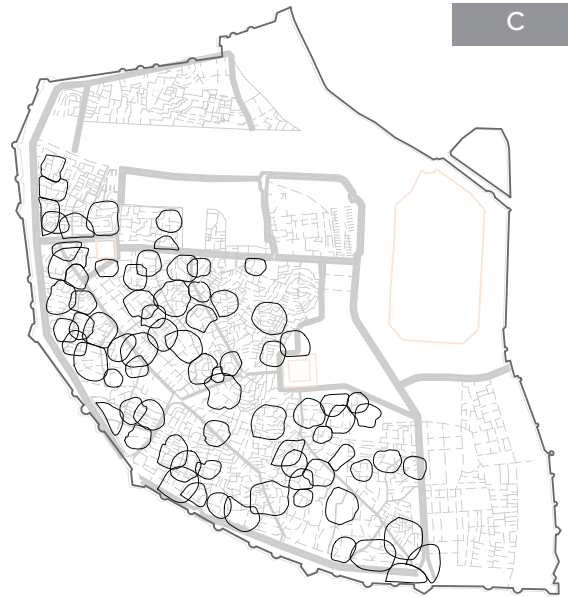
Urban Growth Rings - High + Medium influence range  
Primary + Secondary Streets  
Primary + Secondary Street Intersections  
First + Second order attractors - Mosques, Mansions





B

Urban Growth Rings - Medium influence range  
 0.05 Sq.km. to 0.03 Sq.km  
 Primary + Secondary Streets  
 Secondary Street Intersections  
 Second order attractors - Mosques, Mansions



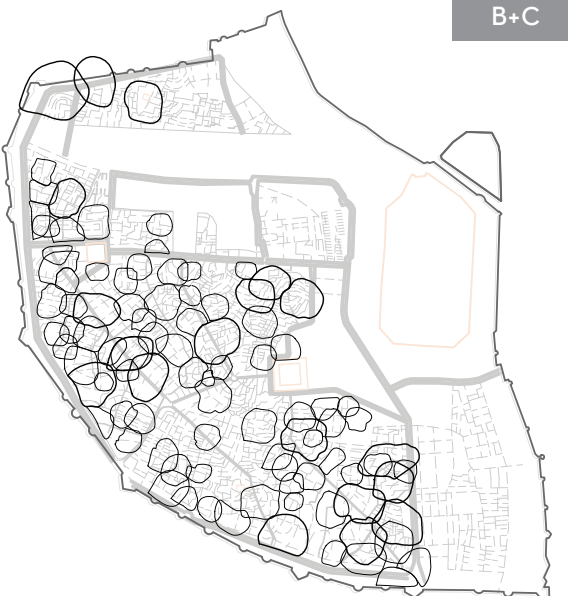
C

Urban Growth Rings - Low influence range  
 0.01 Sq.km. to 0.007 Sq.km  
 Tertiary/Local Streets  
 Local Street Intersections within neighbourhoods  
 Third order attractors - Mosques, Temples,  
 Schools, Markets



A+C

Urban Growth Rings - High + Low influence range  
 Primary + Tertiary Streets  
 Primary + Tertiary Street Intersections  
 First + Third order attractors - Mosques



B+C

Urban Growth Rings - Medium + Low influence range  
 Secondary + Tertiary Streets  
 Secondary + Tertiary Street Intersections  
 Second + Third order attractors - Mosques

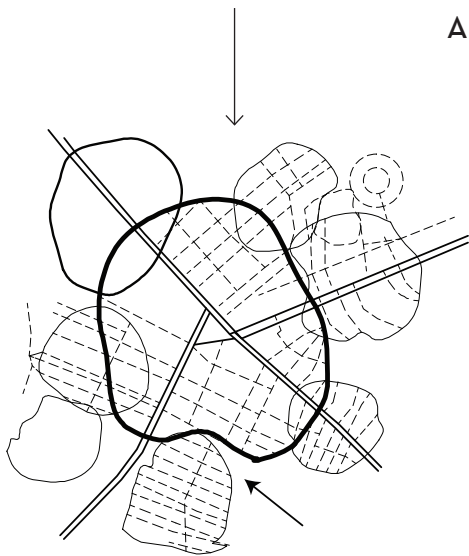
EXISTING URBAN PATTERN SAMPLES EXHIBITING GROWTH RING BEHAVIOUR

[FIGURE 5.13]

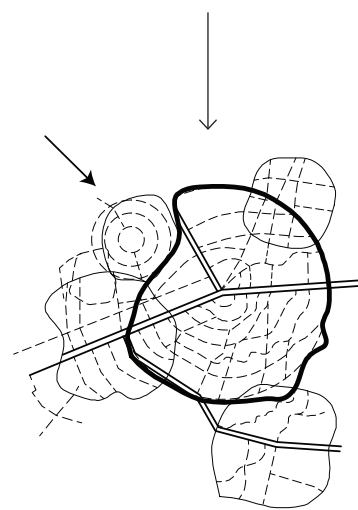


A

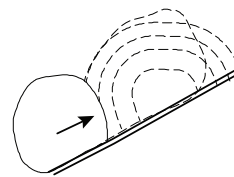
B



A high influence range urban attractor accommodates its boundary with respect to the low influence range urban attractor



Previously existing urban attractor impacts a newly generated urban attractor irrespective of the influence range



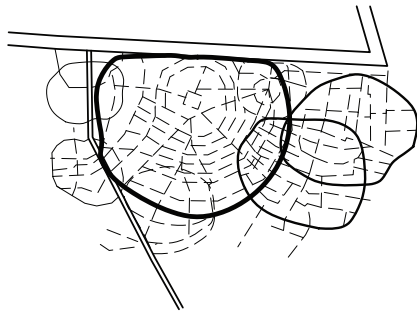
The boundary of High Influence Range growth ring behaves as the central axis for the Medium and Low influence range urban growth rings. Street intersections are located on the rings. The urban fabric generates within the street patterns produced by an urban attractor within an influence range.



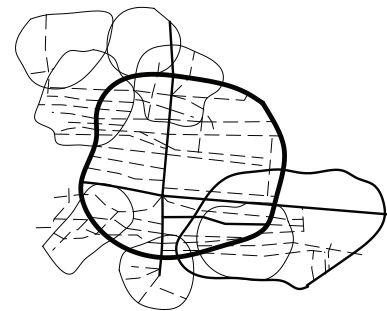
C



D



E







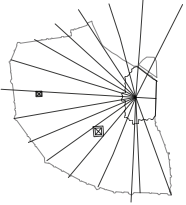






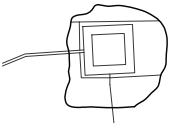




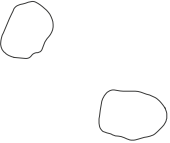


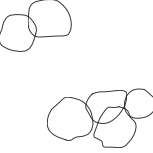
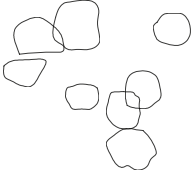


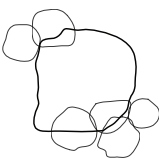
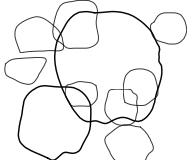



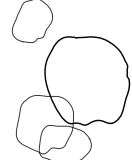


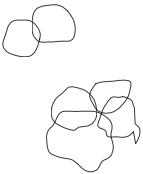
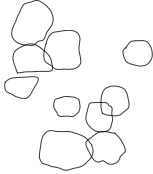


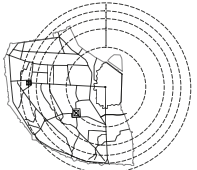


F

Interaction of Urban Growth rings with one and another to generate patterns of varying density.

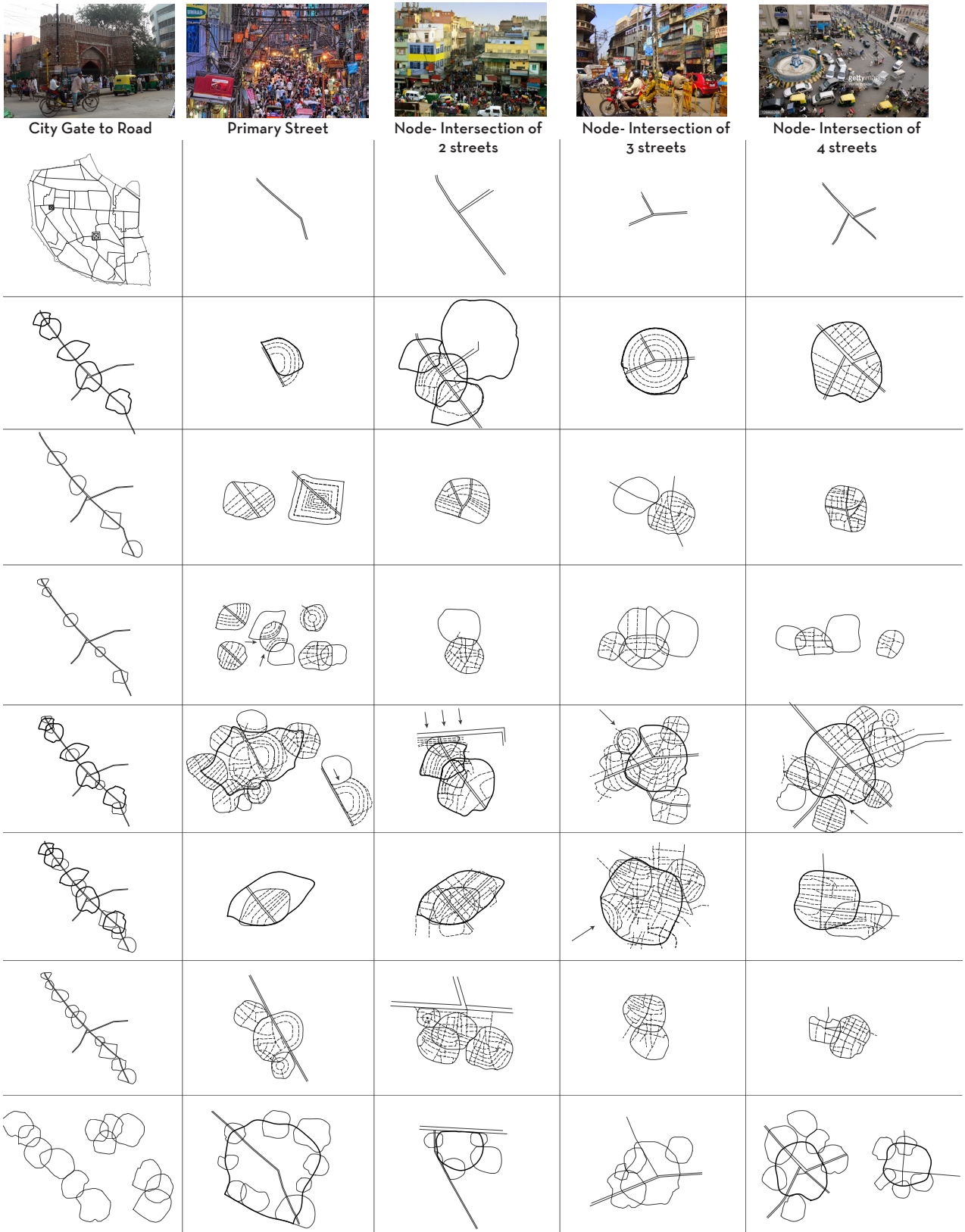


*An urban attractor thus exhibits an urban growth ring carrying a particular influence range. This has been catalogued further, to show the behaviour of each attractor independently as well as when it reacts with another existing urban attractor to generate myriad growth patterns.*

# CATALOGUE OF URBAN EFFECTS : GENERATION OF PATTERNS BY URBAN ATTRACTORS

Type of Urban Attractor				
Influence Range of Urban Attractor	City Gates	Royal Palace	Primary Mosque	Secondary Mosque
<b>Primary Streets and First Order Attractors</b>  6.1 Sq.K.m City Range				
<b>Second Order Attractors</b>  .14 Sq.K.m to .10 Sq.K.m High Influence Range				
<b>Local Neighbourhood Attractors</b>  .05 Sq.K.m to .03 Sq.K.m Medium Influence Range				
 .01 Sq.K.m to .007 Sq.K.m Low Influence Range				
 High and Low Range				
 High and Medium Range				
 Medium and Low Range				
 Ring Interaction				

THROUGH INTERACTION OF URBAN GROWTH RINGS [FIGURE 5.14]





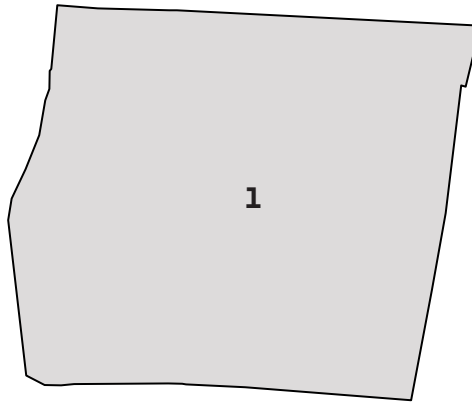


*The street network in Old Delhi thus can be seen as series of connections between different attractors that generate urban growth territories. These territories are boundary conditions that are surrounded with both point and linear attractors. The quantitative determinants of these attractors as discussed before, affect the territorial organization within each boundary condition. This has been explained further by exhibiting the relationship of the streets and street intersections with the urban system of a neighbourhood or 'katra'. Together all these urban elements create a system of multi-agents that inform the decision making process to generate the city's urban form.*

KATRA - NEIGHBOURHOOD STRUCTURE IN OLD DELHI  
MORPHOLOGICAL STUDY OF MICRO-COMMUNITIES WITHIN A NEIGHBOURHOOD

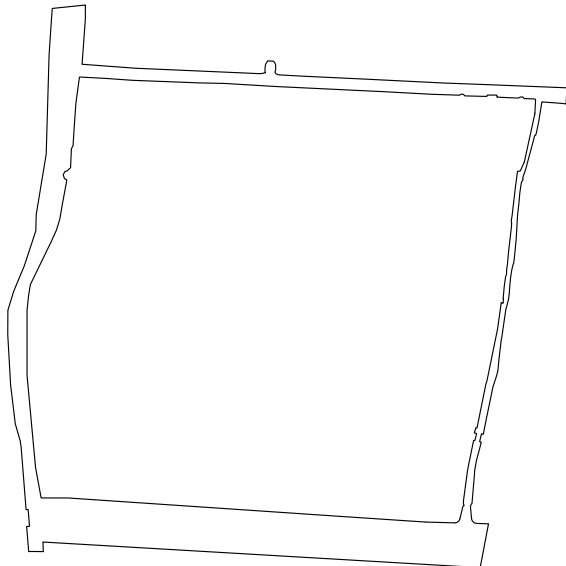


[FIGURE 5.15] Location Map

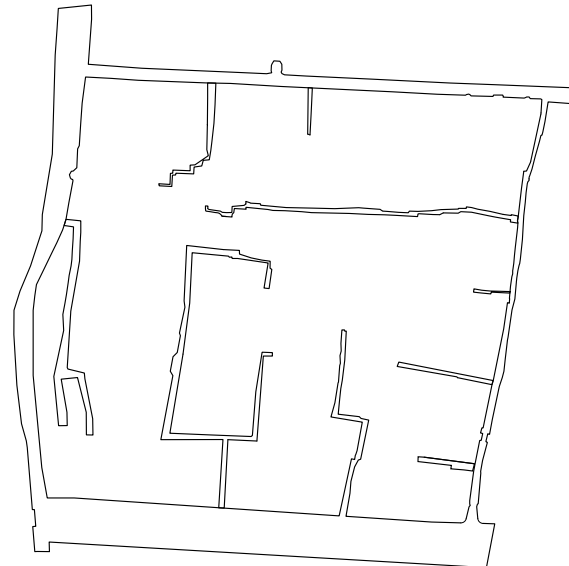


Neighbourhood Sample - Katra Neel  
Area : .057 Sq.Km.

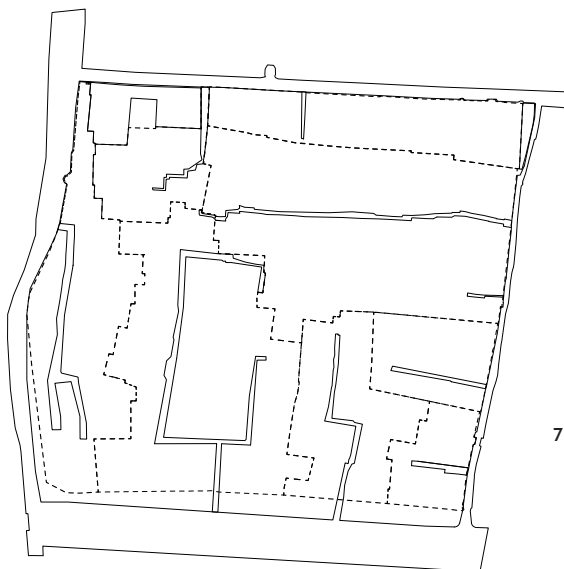
Katra Neel can be analyzed as a micro-level base element within Old Delhi's fabric, that is composed of both residential and commercial activities, accessed from a local street through a single doorway. These spatial precincts were classified and differentiated based on caste or craft.



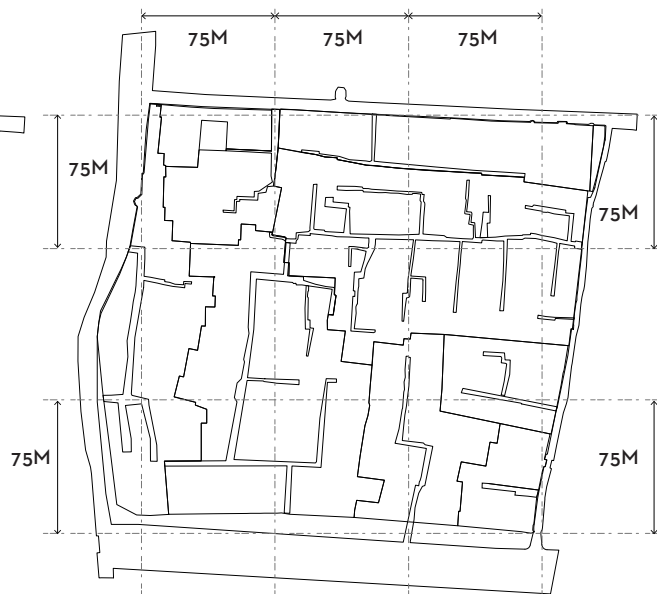
**1** Boundary condition for spatial unit and social organization



**2** Configuration of dead-end streets

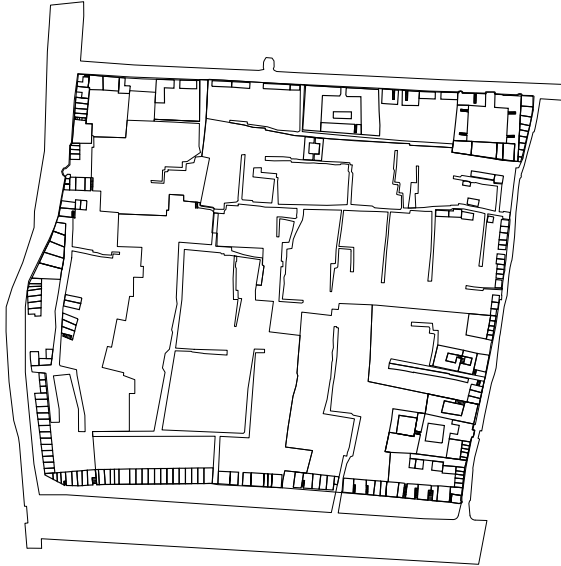


**3** Each street caters to a specific socially homogeneous quarter (same caste or craft)



**4** Street network development based on spatial and cultural logics





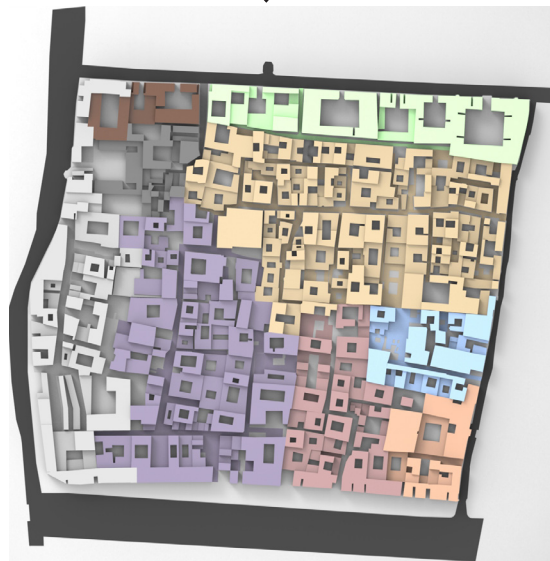
5 Bazaars or markets occupied the periphery of the micro-communities



6 Territorial configuration generates social homogeneity

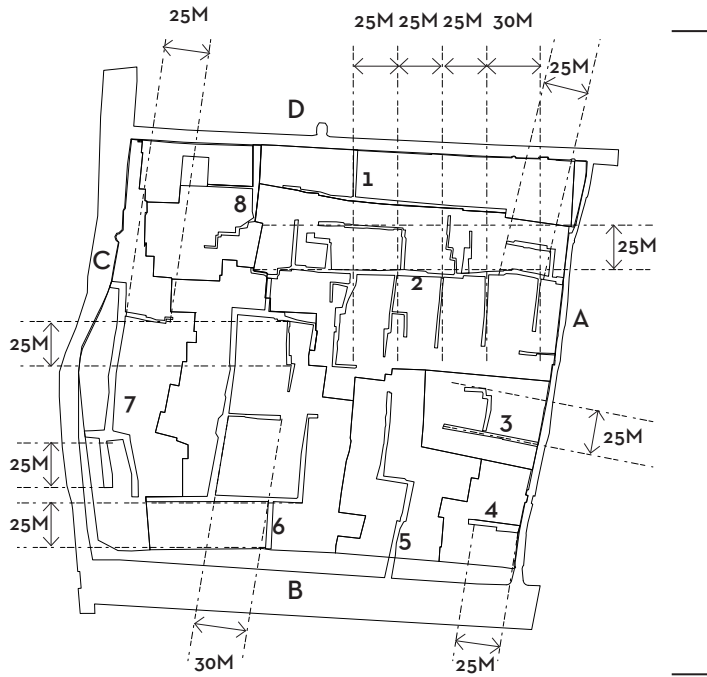


KATRA NEEL 1850



KATRA NEEL 2015

Each color describes a different community.



[FIGURE 5.17]

Legend:

Name Of Surrounding Street

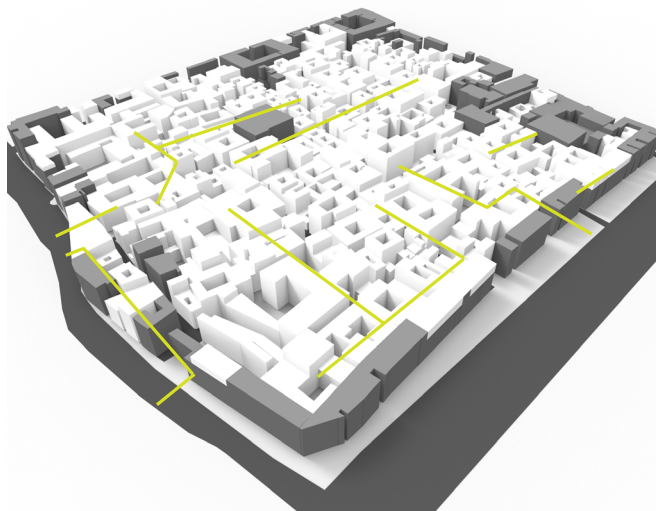
- A Krishna Gali
- B Chandnichowk Road
- C Church Mission Road
- D Tulsli Ram Seth Marg

Katra Streets:

- 1 Kinaari Bazaar
- 2 Ghanteshwar Gali
- 3 Kuchah\* Ghasi Ram
- 4 Kuchah\* Ghasi Ram
- 5 Kuchah\* Ghasi Ram
- 6 Kuchah\* Ghasi Ram
- 7 Kuchah\* Ghasi Ram
- 8 Kuchah\* Ghasi Ram

\* Gali Refers To A Narrow Street

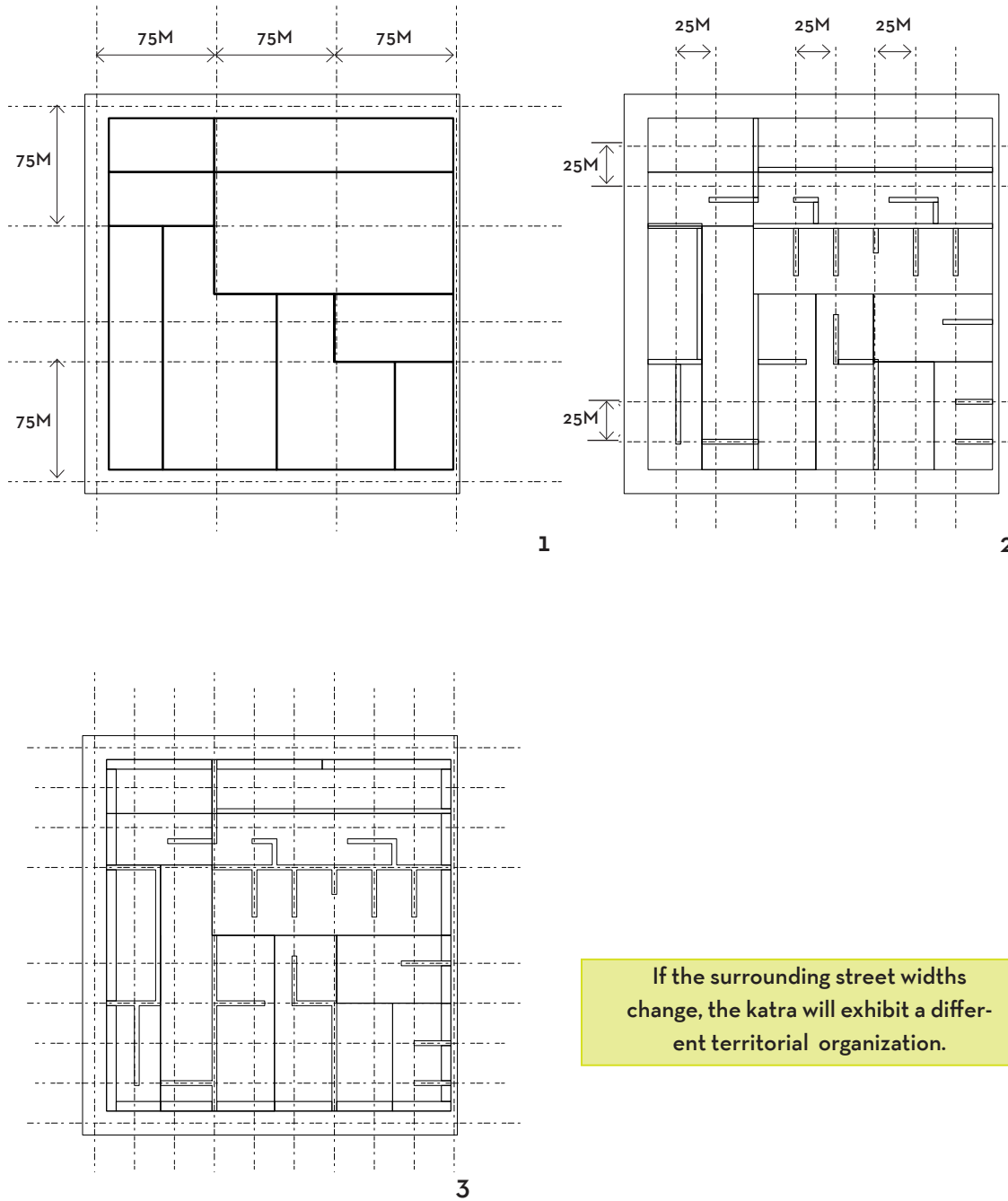
\*\*Kuchah Refers To By-Lane



- STREET LINES
- COMMERCIAL
- RESIDENTIAL

[FIGURE 5.18] EXISTING KATRA NEEL MODEL

ABSTRACTION OF URBAN BLOCK TYPOLOGY WITH GRID BASED STREET PATTERN



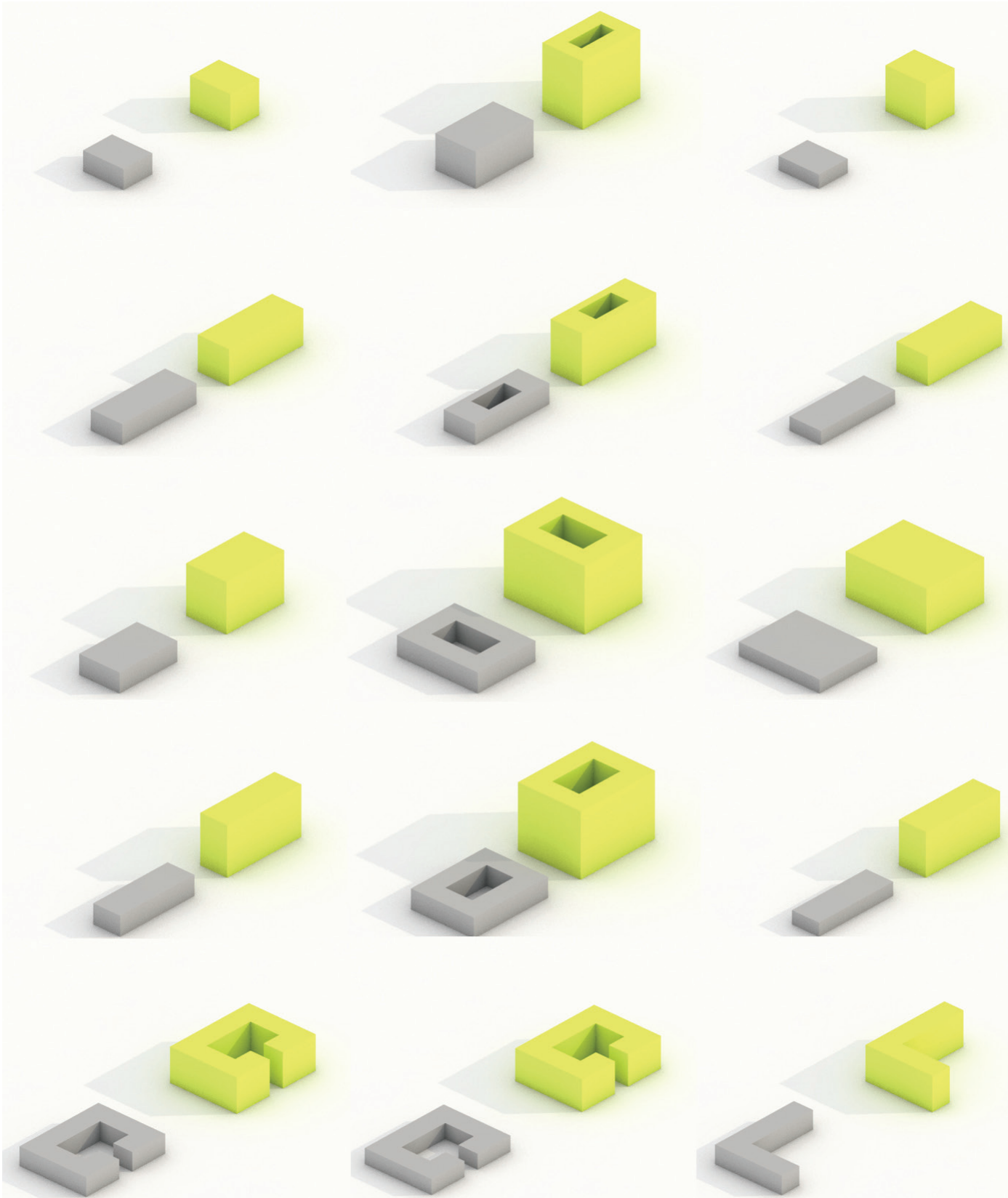
[FIGURE 5.19] ABSTRACTED MODEL

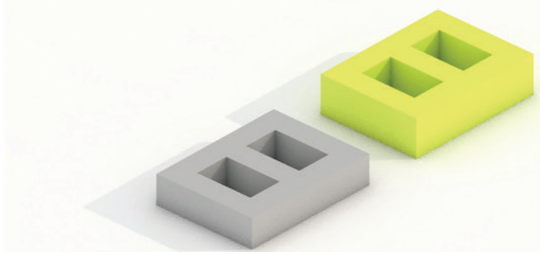
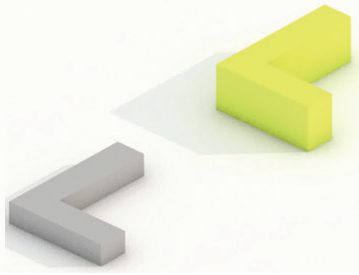
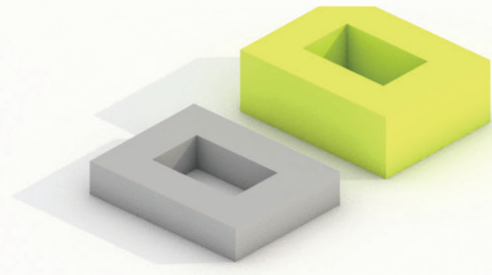
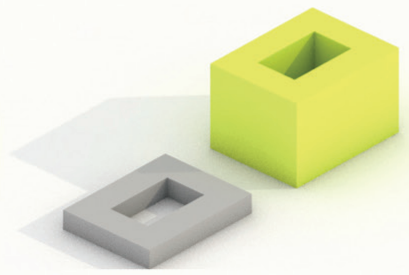
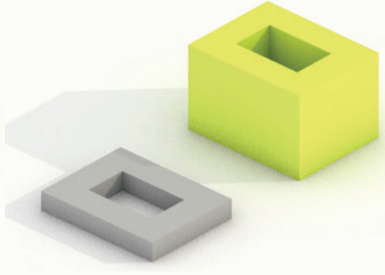
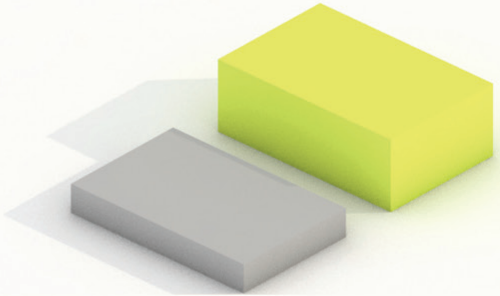
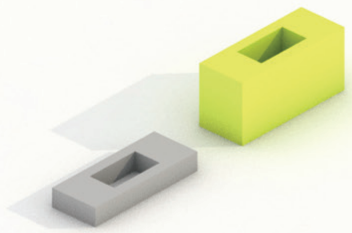
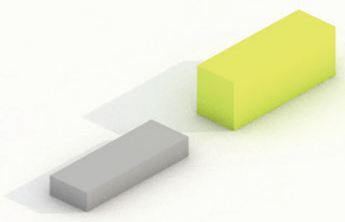
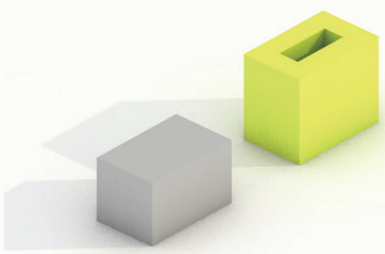
If the surrounding street widths change, the katra will exhibit a different territorial organization.





*Street Network of Old Delhi and Katra Urban Block typology are studied with respect to their formal and spatial qualities to extract rules that have the ability to evaluate the fabric on the morphological criteria.*



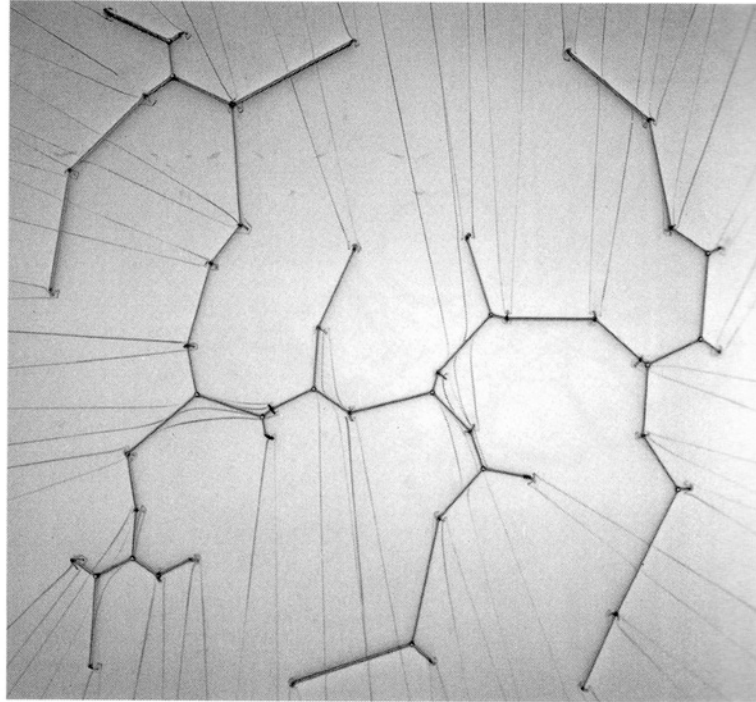


# URBAN FORM AND MORPHOLOGY CODES FOR OLD DELHI

Urban Design Guidelines for Old Delhi [ Manual Codes ]

- Urban Rules at City Scale
- Urban Rules at Neighbourhood Scale
- Urban Rules at Local Scale





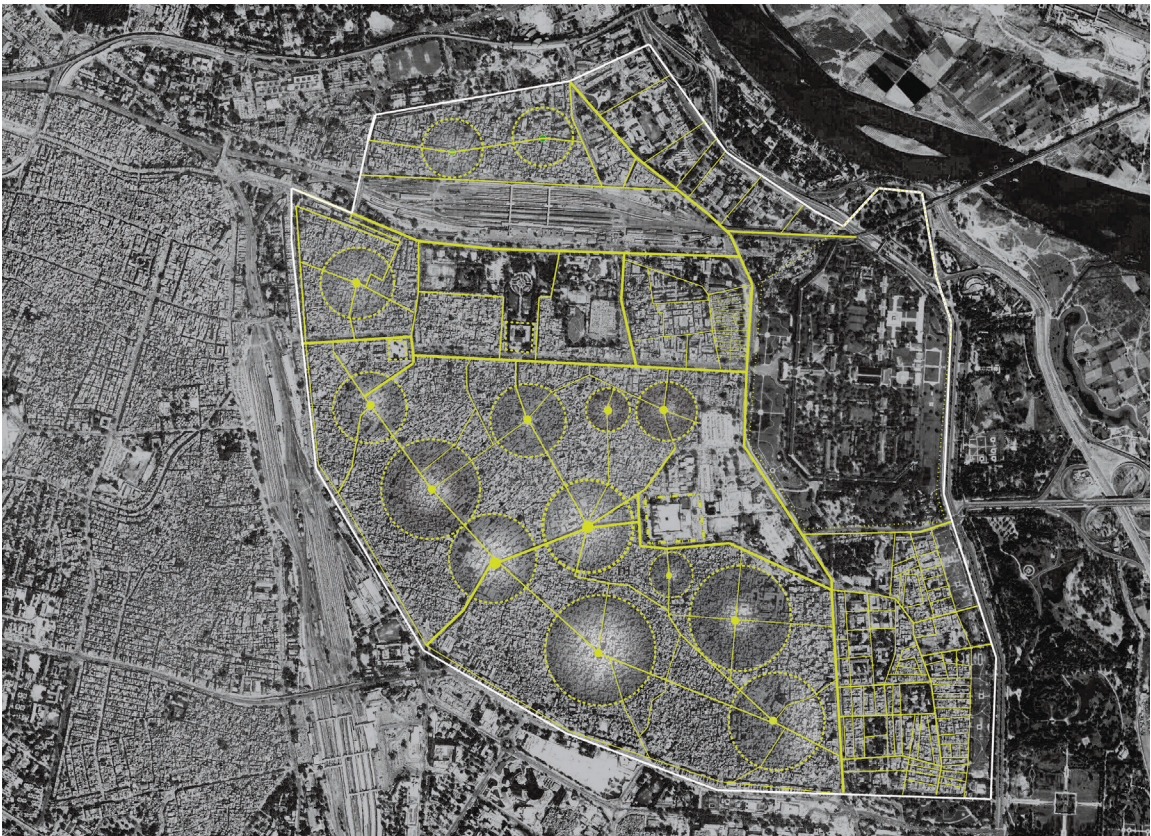
**[FIGURE 6.1] The Minimal Path System**

**At every junction the three arms connect at an angle of 120 degrees  
Path Systems in general, Occupying and Connecting**

*“ The present work on the history, origins, function and changes in housing estates and their connection may be seen as the beginning of a new way of looking at town planning as a field. Knowledge of the self-perpetuating processes of natural occupation of points, lines, areas and spaces would have to be a fundamental requirement of any town planning. It is quite clear that few planners are familiar with them. Planning means applying knowledge. Architecture and planned towns come into being by arranging familiar things. Researching the processes of occupying and connecting in nature and technology requires a fresh start, with observations, experiments and the development of explanatory models.*

*Nets, paths, connection, nodes and occupied areas run all through our natural and technical environment, creating and influencing it. Knowledge about connecting and occupying is thus one key to understand historical and modern contexts.”*

**Frei Otto, Occupying and Connecting  
Thoughts on Territories and Spheres of Influence with Particular reference to Human  
Settlement 2009**



[FIGURE 6.2] Reference image - Street Network GIS Map

## CITY SCALE

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### *Setting Out Rules*

*The following rules will be significant in case an Old Delhi replica has to be developed on a different site.*

#### 1. SITE:

The walled city will be located next to a river.

#### 2. TOPOGRAPHY

The slope of the site will always be towards the river. All land parcels will follow the topography.

#### 3. LOCATION OF ISLAMIC INSTITUTIONS

The royal palace will always be the closest to the river with the longer side facing the river.

The royal mosque will occupy the highest point on site. It will face west.

#### 4. STREETS

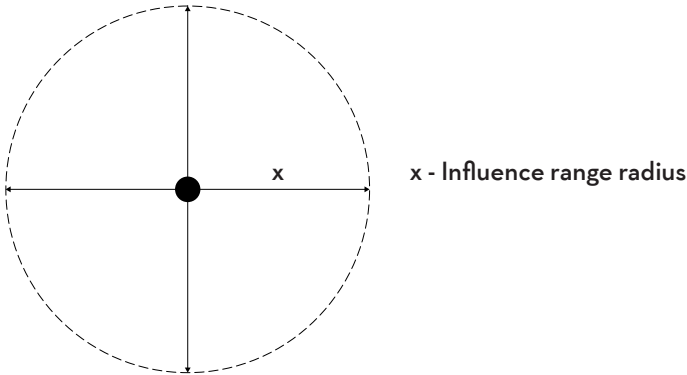
The two main primary streets will start from the palace and will be perpendicular to both sides of the palace

The ratio of the length of the street to the width of the street is 1500:30 (meters)

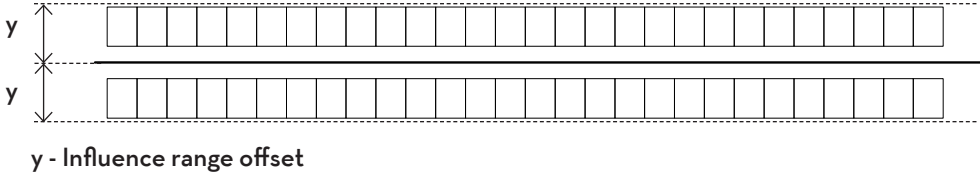
a. The origin point (Urban Attractor : from where the growth starts) can have 4 or less than 4 streets originating from itself and not more. These 4 streets are the ones connecting to city wall, gates or palace (any fixed point attractor).

b. The sub- branches from these 4 streets are almost perpendicular to the parent street and not at acute angles. And there will never be a case when one point will have more than one street originating from a secondary or a tertiary street. A primary street can have a point from where 4 or less streets originate however when it comes to other streets of lower rank (secondary, tertiary, local) these would never carry a point that allows multiple streets to originate.

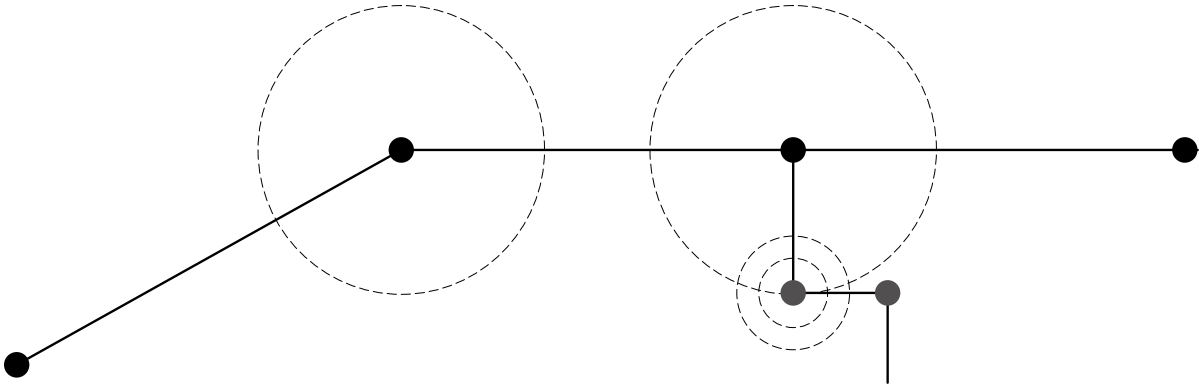
c. No local street can originate from primary/secondary.



Point Urban Attractor within an Urban Field with an influence range



Linear Urban Attractor within an Urban Field determining Urban Form

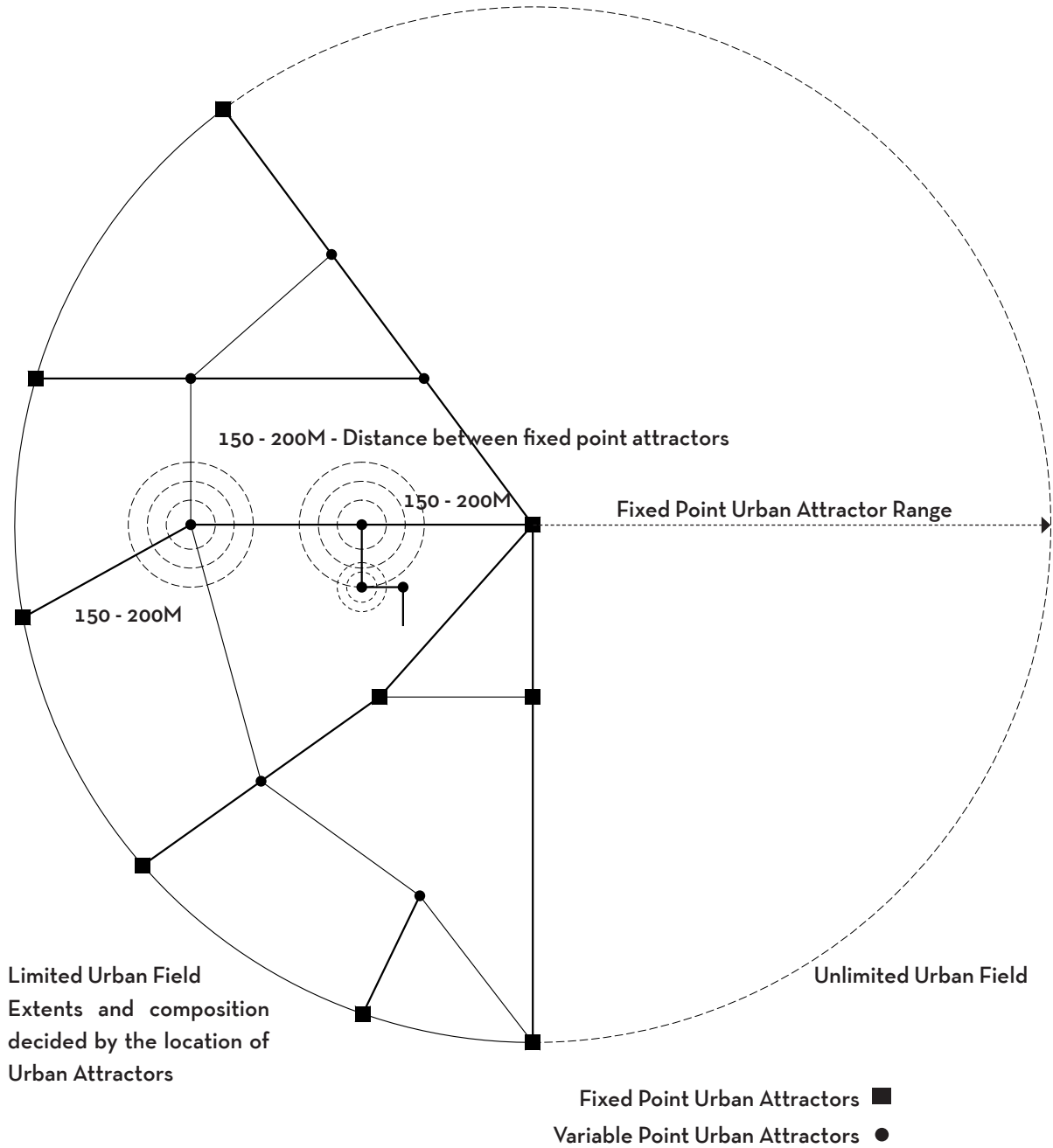


Point and Linear Urban Attractors within an Urban Field

[ FIGURE 6.3 ] Behavioral Patterns and Influence Range of Urban Attractors



*Different urban field conditions are formed by the way the Urban Attractors are placed within the urban system. The fixed urban attractors decide the composition of the city and its extents at the city scale. The variable urban attractors carry the dynamic quality of the fabric. Based on where they are located, varying growth patterns can be observed at the neighbourhood and local scale.*



[ FIGURE 6.4 ] Generation of Urban Framework through Urban Attractors



*There is a change in density as we move away from the origin point (Street intersection). The distance between streets that are near the intersection will be higher and as we move away, the street offsets reduce in size. This would generate bigger plots near intersection with lower density and smaller plots away from intersection with higher density.*

*This logic has been explained in the following spread through a street network logic table that demonstrates the relationship of different streets with each other with reference to their widths, branching system and the start and end point of each street.*

# Relationship Between Primary, Secondary, Tertiary And Local Street

Width (m)	Street	Symbolic Representation	First Branch	Second Branch
30				
15				
12				
9				
6				
4.5				
3				
2.4				
1.2				

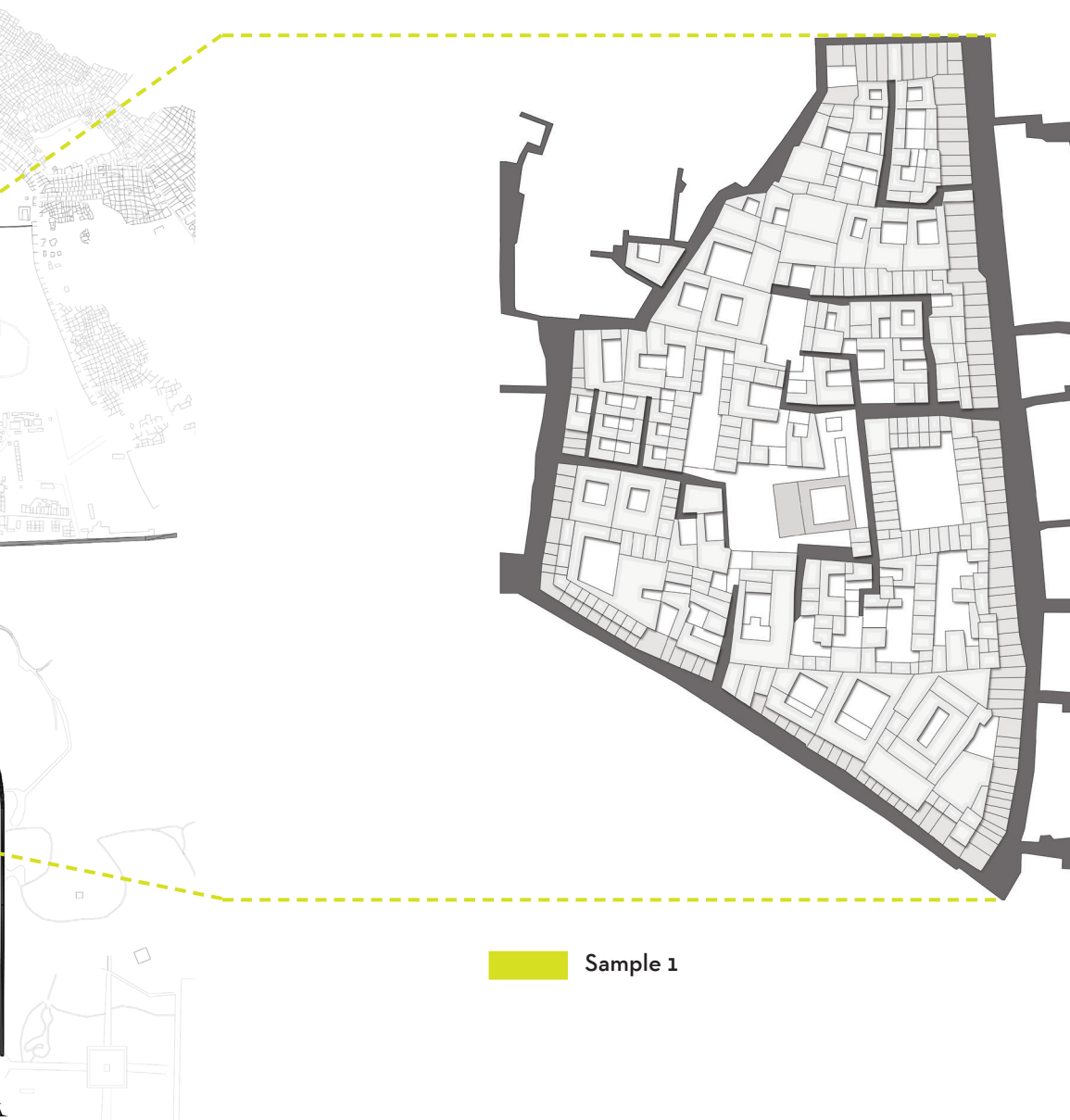


# URBAN RULES AT NEIGHBOURHOOD SCALE



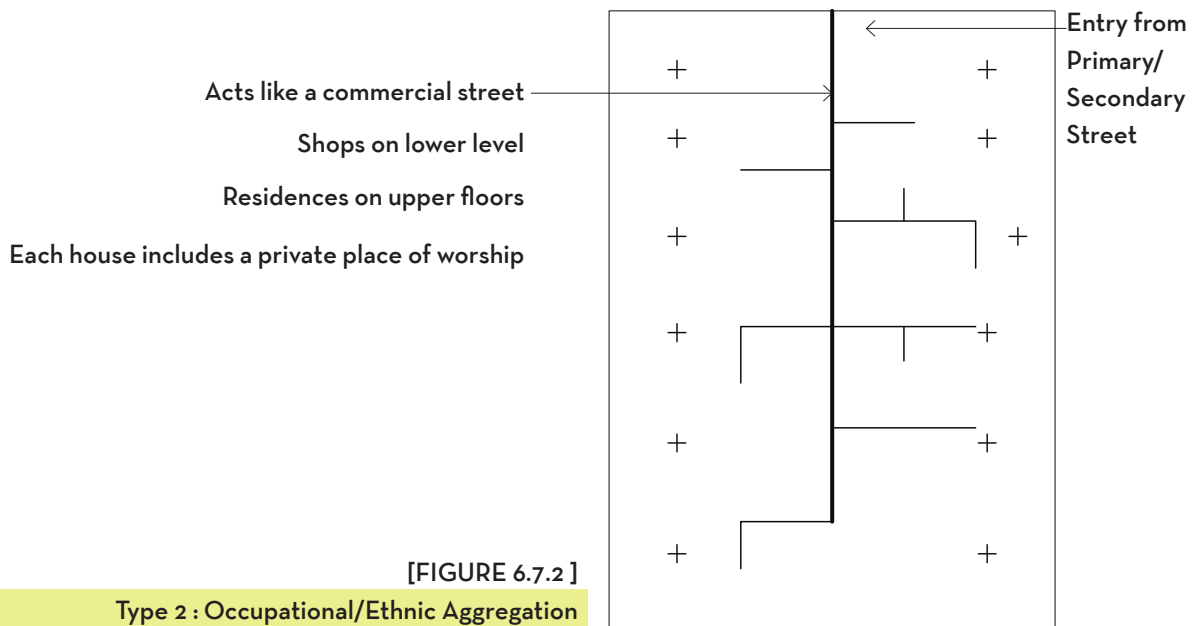
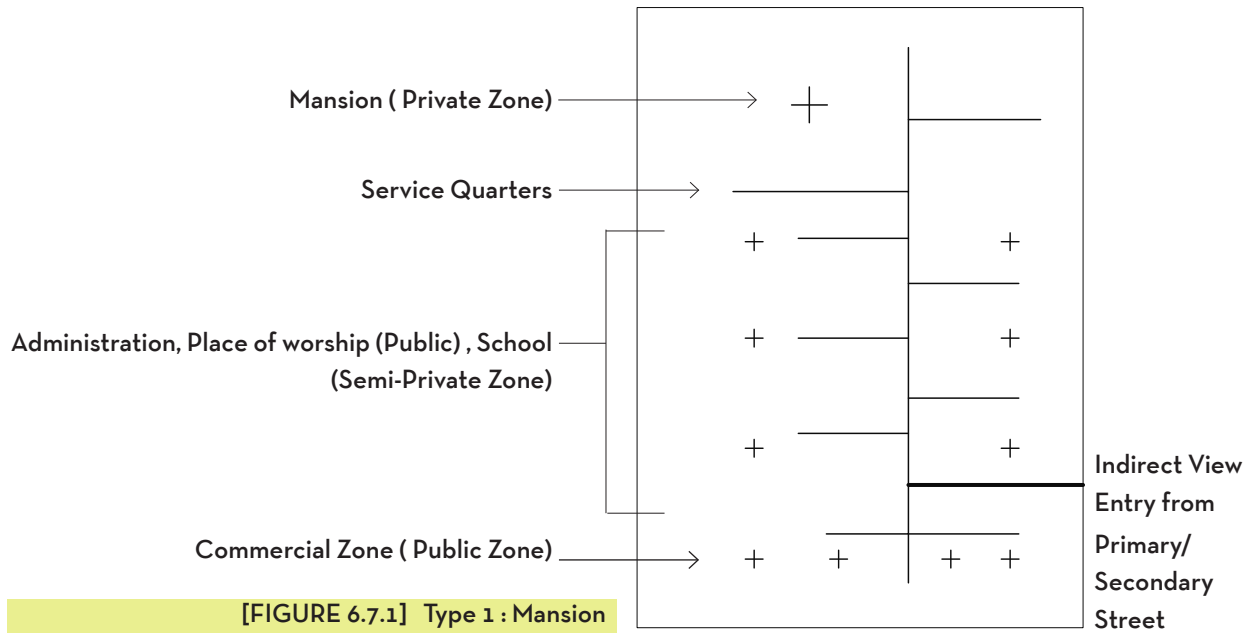
Urban territories are generated when the street network logic is applied as per rules and parameters at the city scale. These territories are 'kstras'. A sample katra is analysed to extract rules at the neighbourhood level.

The first step is finding the type of katra.

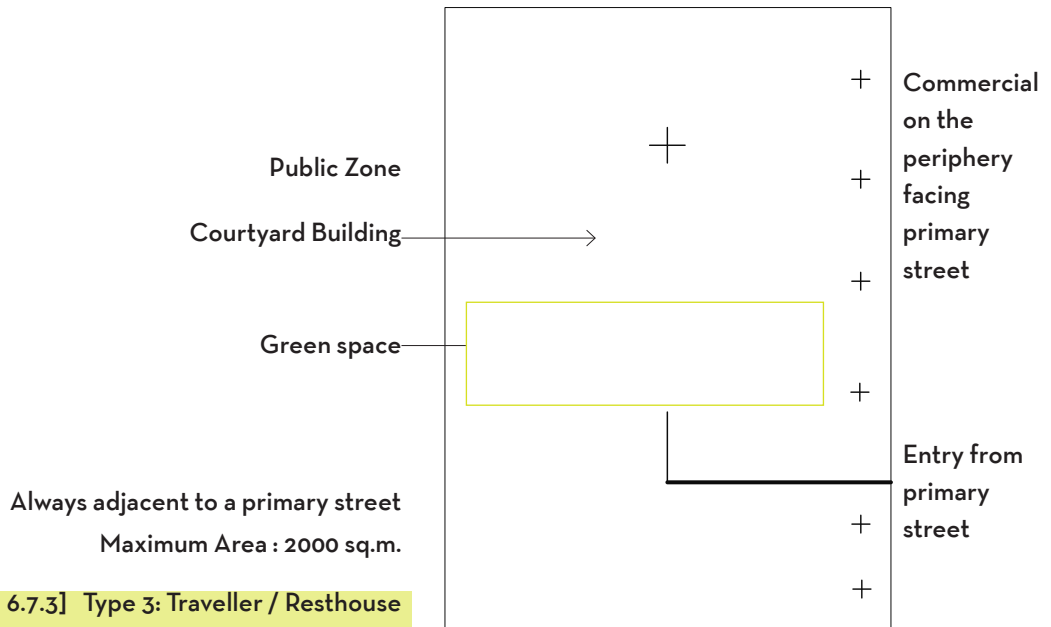


## TYPES OF 'KATRA' / NEIGHBOURHOODS

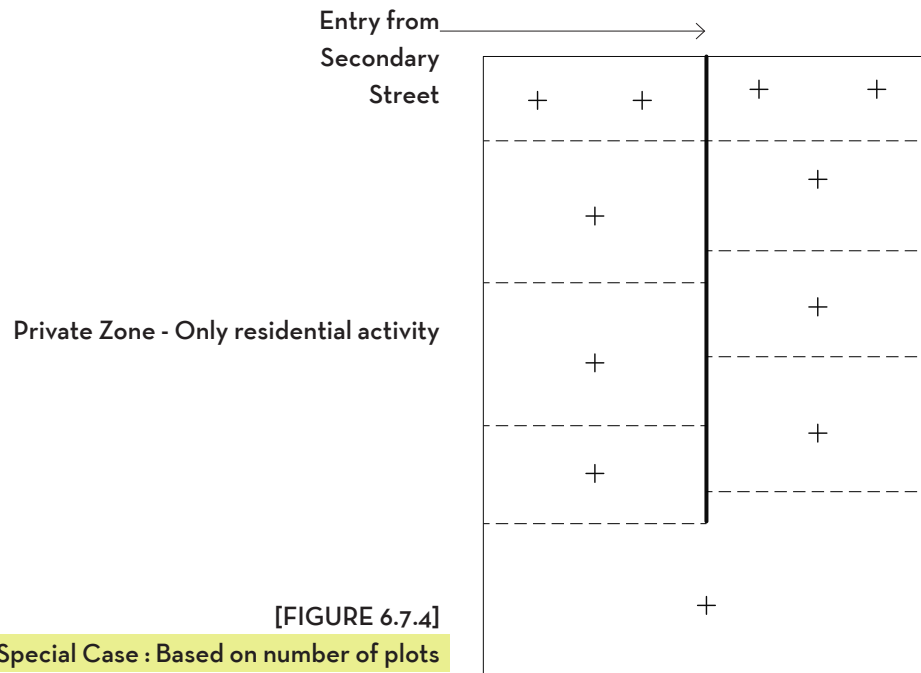
Classification Based On Internal Arrangement And Proportion Of Buildings, Street Layout And Landuse







[FIGURE 6.7.3] Type 3: Traveller / Resthouse



[FIGURE 6.7.4]  
Special Case : Based on number of plots

Main street (dead-end) inside katra connecting to an exterior primary or secondary street ———

Local streets ———

Building / Plot +



[ FIGURE 6.8 ] Territorial Organization within a boundary

## 'KATRA' OR THE NEIGHBOURHOOD QUARTER

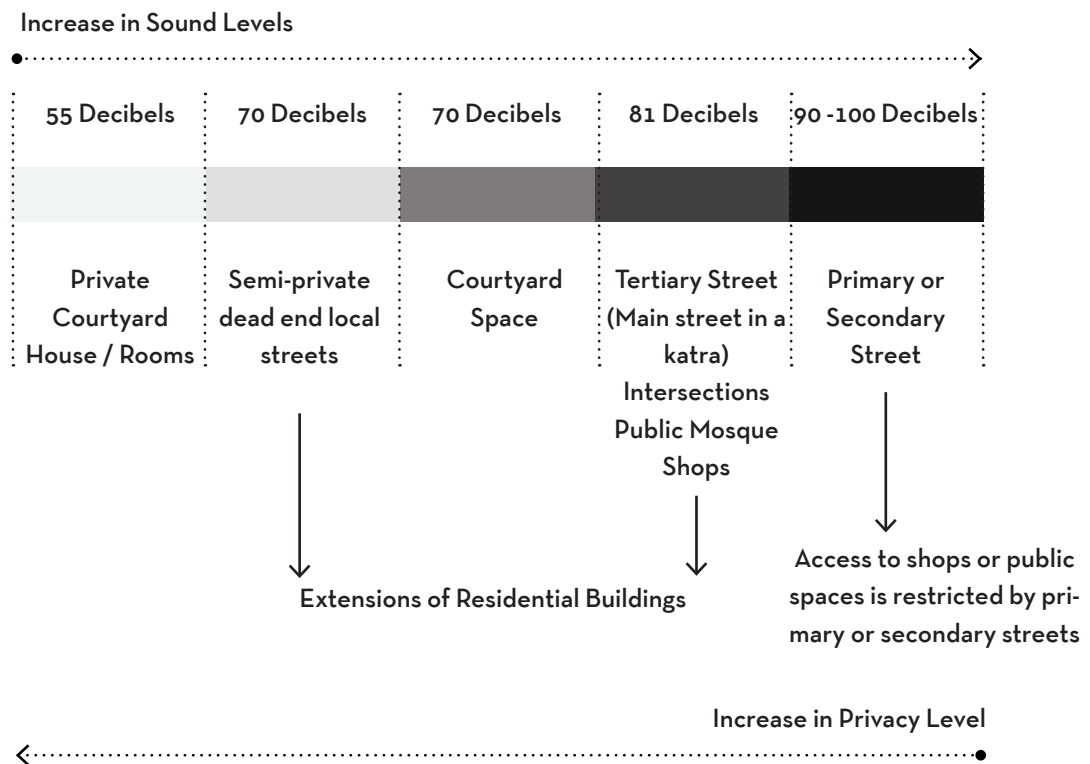
**MICRO-COMMUNITY:** Each katra can have one or more communities of occupants belonging to a particular caste or practicing a specific craft.

**MAIN ENTRANCE :** Every Katra is accessed by a arched doorway. The main door of a house will never be directly opposite to the door of the house across the street. A minimum of 1m deviation is required.

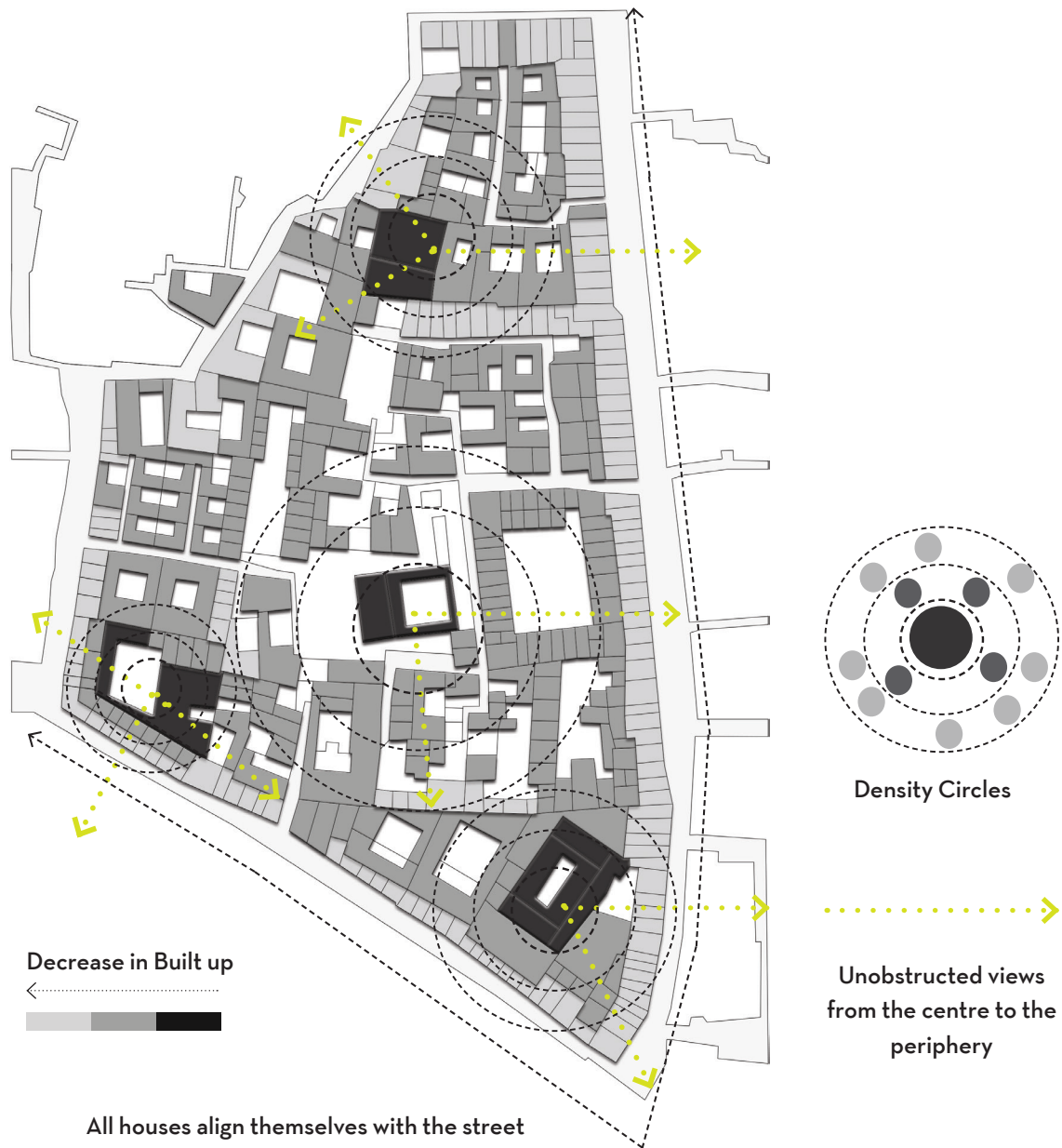
**STREET NETWORK:** Each micro-community within a katra is accessed by a dead-end street. This street has narrow sub-branches that lead to private courtyard houses. The tertiary street (4.5m-6m) is the main street within the katra from which narrower streets (1.2m-3m) branch out. (Refer to Fig. for Street Network Logic)

Secondary street is at 90 degrees to Primary street but bends (curves) as it goes deeper into the fabric. (160-170 degrees). This makes the streets look curved and enhances privacy levels.

**PROGRAM:** More public activities and buildings (shops) are located closer to the entrance of the katra and street intersections. As we move into the katra, the privacy level increases.



[ FIGURE 6.9] Quantitative and Qualitative Determinants within a neighbourhood



[ FIGURE 6.10 ] Quantitative and Qualitative Determinants for local buildings

## URBAN RULES AT LOCAL SCALE

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*The fabric consists of multiple building types. Based on the way these are arranged within a given boundary, a specific katra type is generated. The building types are analyzed volumetrically to achieve their growth limits.*

The following are the key rules that should be followed to maintain the traditional quality at the local scale:

1. **BUILDING FOOTPRINT:** If width of courtyard house is X then depth will not be more than 3X or less than X.
  - a. Multiples of 3m for both width and depth will be taken - due to practical limitation of beam length which have to be carried through narrow streets. The shorter side generally faces the street. (except the bigger courtyard houses which are on primary streets, their longer side faces the street)
  - b. **OPEN VS BUILT RATIO:** The open space (interior courtyard area) is always 25% of the total building foot print.

**LINEAR BUILDING BLOCKS:** (Bazaars + Storage spaces)

There are linear building blocks along primary and secondary streets that are 6m to 7m in width. The courtyard houses and solid building blocks start behind this commercial strip.

**BUILDING HEIGHT:** The height of the buildings varies from 2.7m > 3m > 4m > 7m > 10m > 13m. This would be distributed as per the Volumetric Code (discussed later in this chapter) however clusters of houses with same height will be generated to achieve patches of continuous running terraces. The height of houses will be distributed in a way that the bigger houses will be higher than the surrounding smaller houses. This would be primarily to offer an unobstructed view to the family of the bigger house.

**BALCONIES :** Upper floors to have a private balcony with jaali patterns to allow partial visibility.



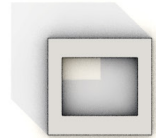
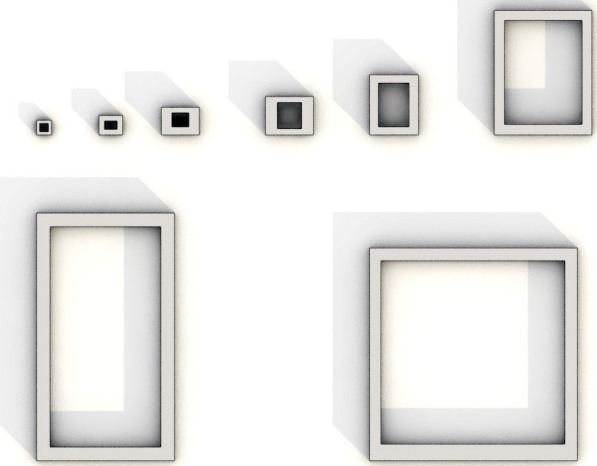


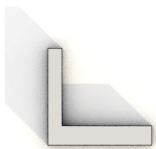



**WINDOWS :** All windows to open into the corridor so as to keep the house introvert.

**MAIN ENTRANCE :** The entrance axis can be bent so as to avoid direct view into the house.

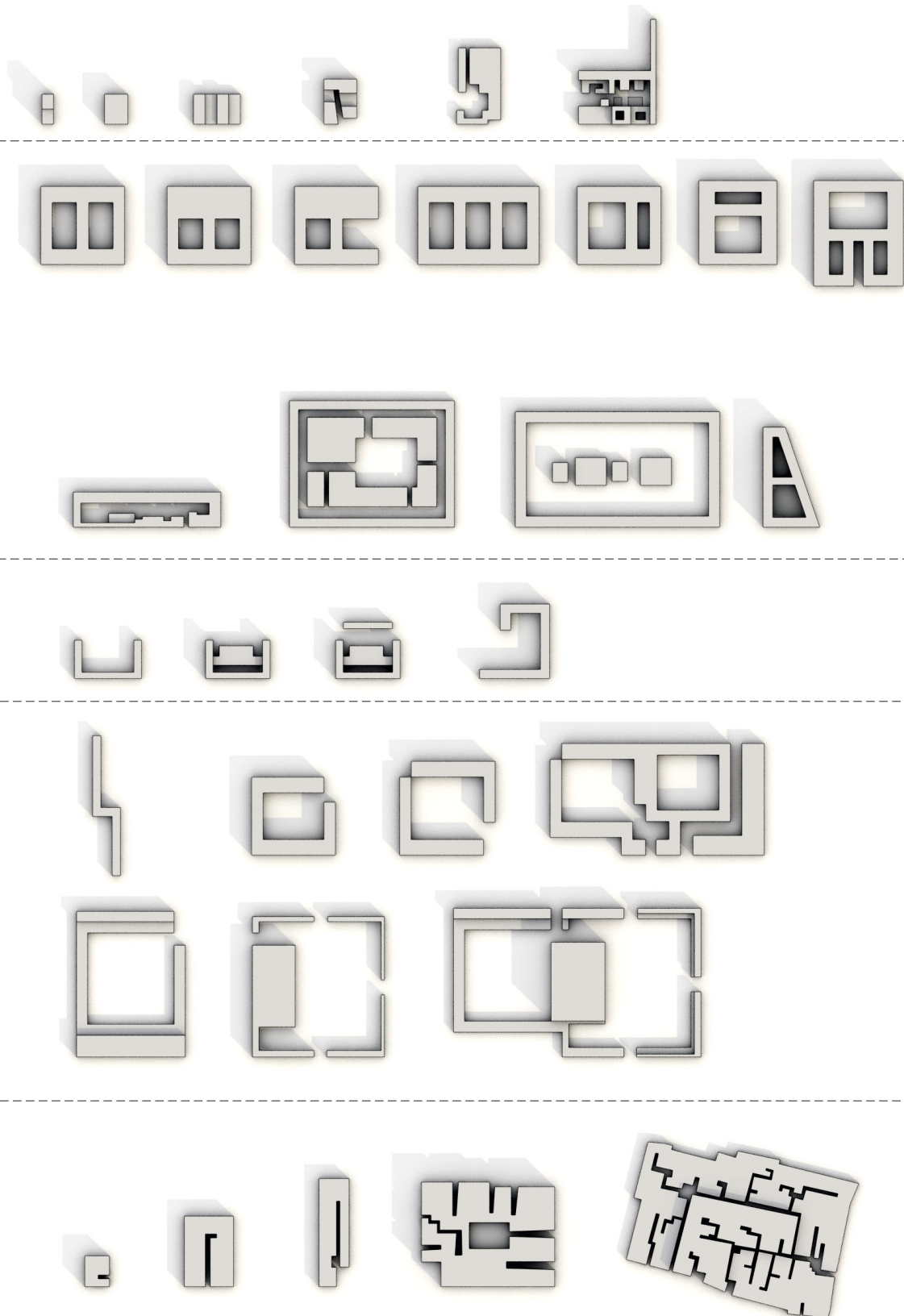
**ORIENTATION:** All houses will orient themselves to the roads they are adjacent to. These roads are oriented according to the topography.

*A detailed analysis of the different building types has been discussed to exhibit their transformation over time that allows for spatial diversity within the fabric.*

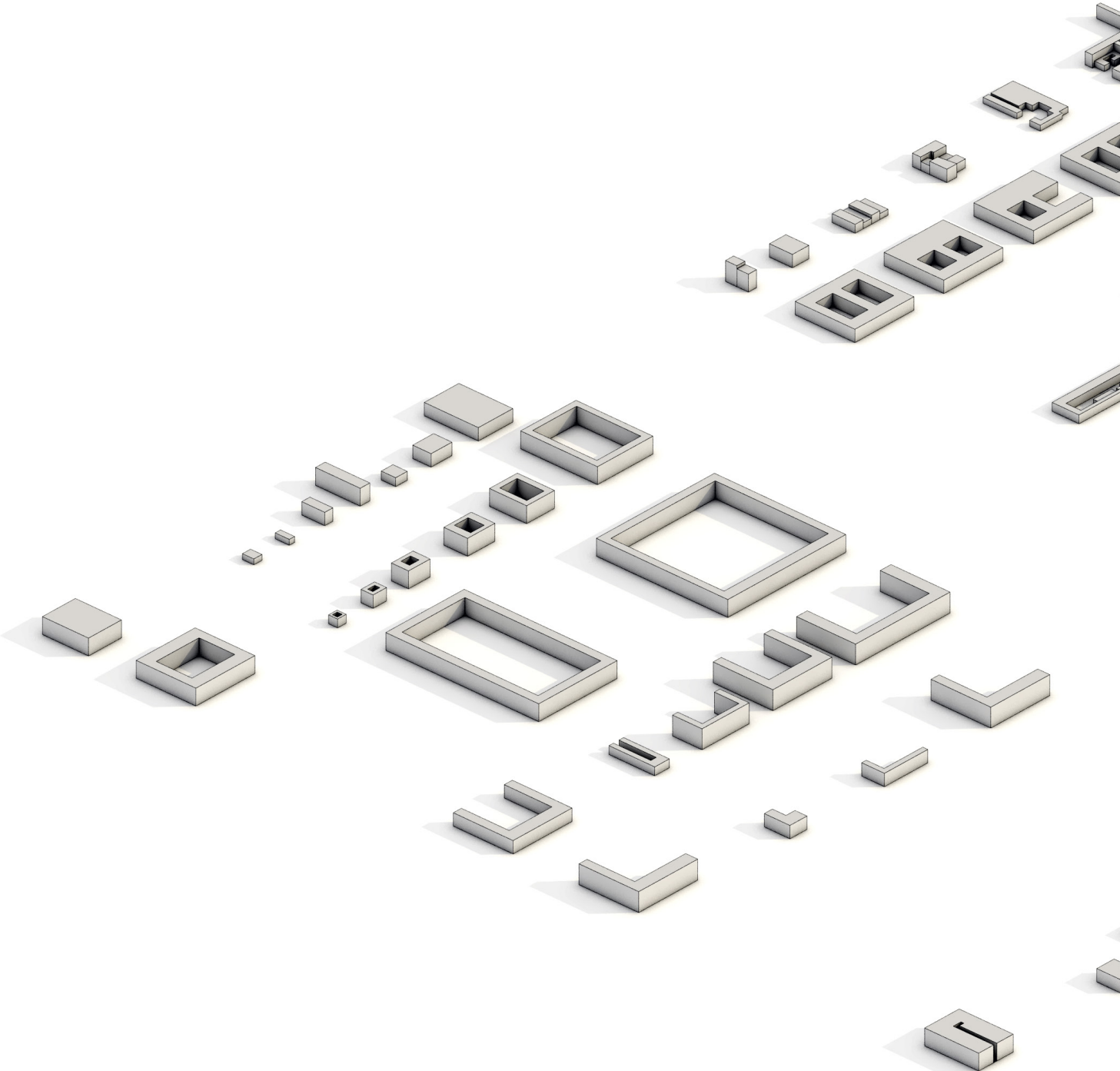
MAPPING BUILDING TYPES AND SCALES - PLAN

	TYPE	SCALE
TYPE		<p>(9x7)m</p> 
COURTYARD BLOCK		
U-COURT		
SIDE-COURT + LINEAR		
FABRIC FILLERS		

COMBINATION OF TYPES

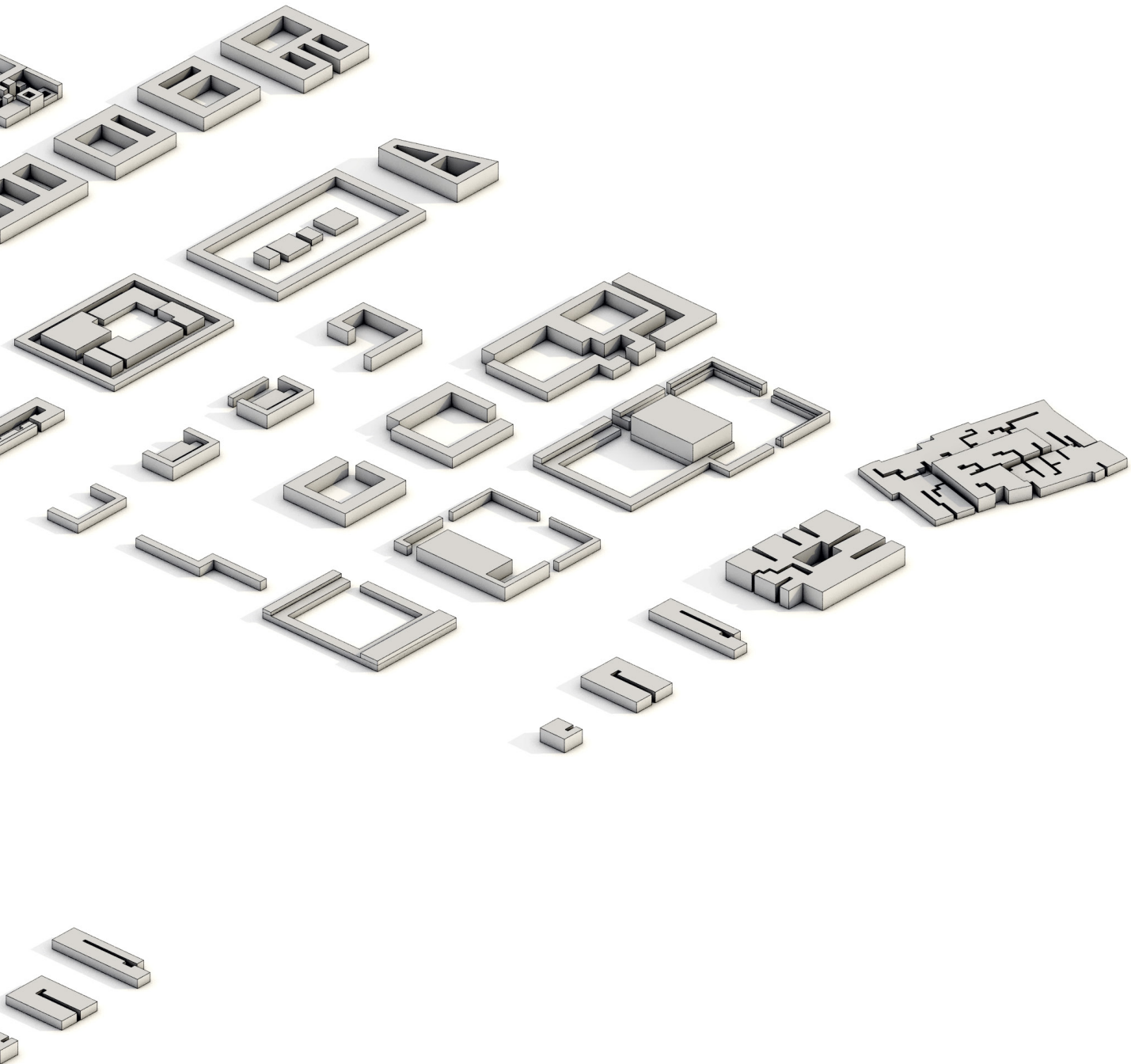


MAPPING BUILDING TYPES AND SCALES - ISOMETRIC VIEW



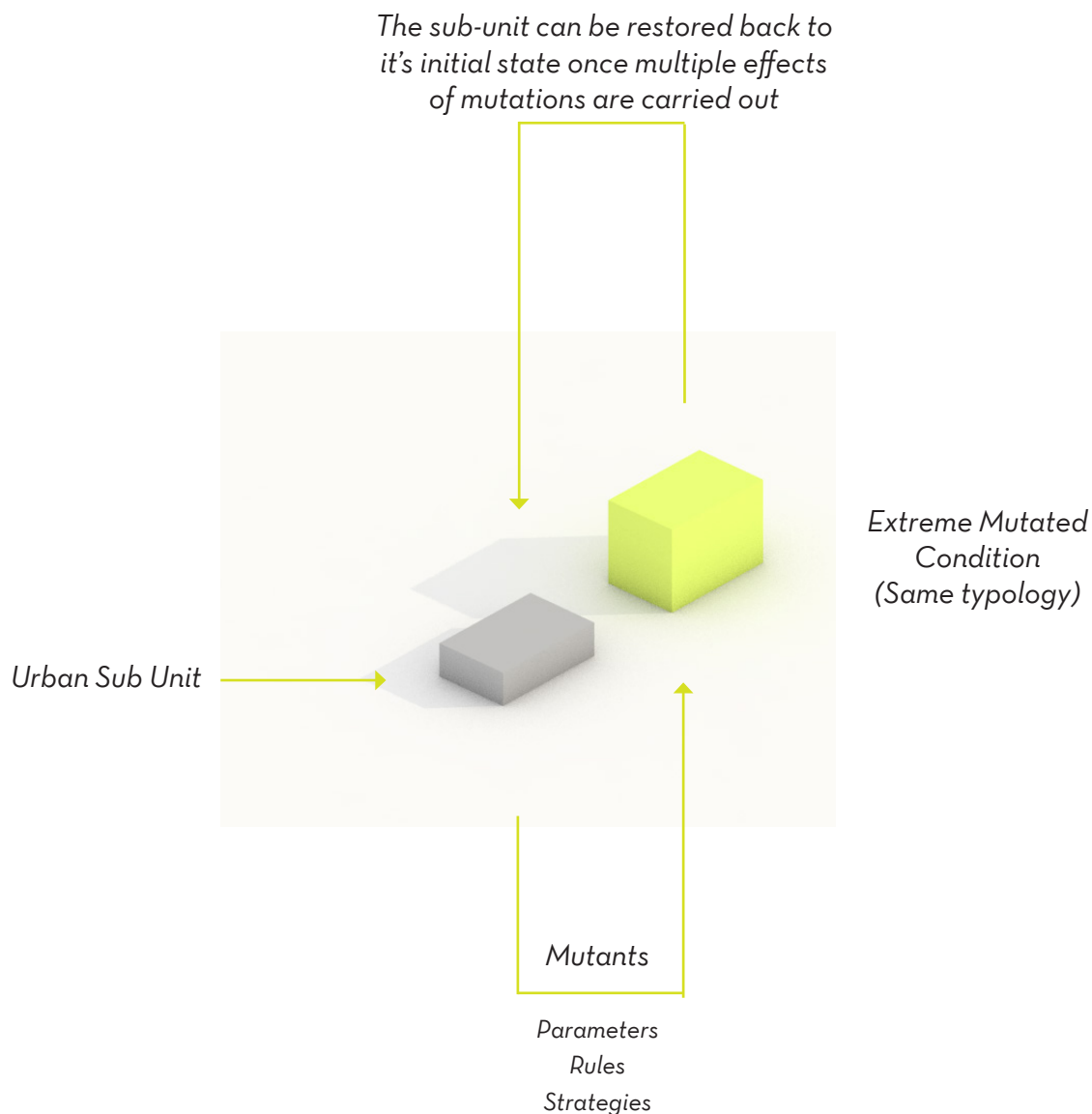


[FIGURE 6.12]

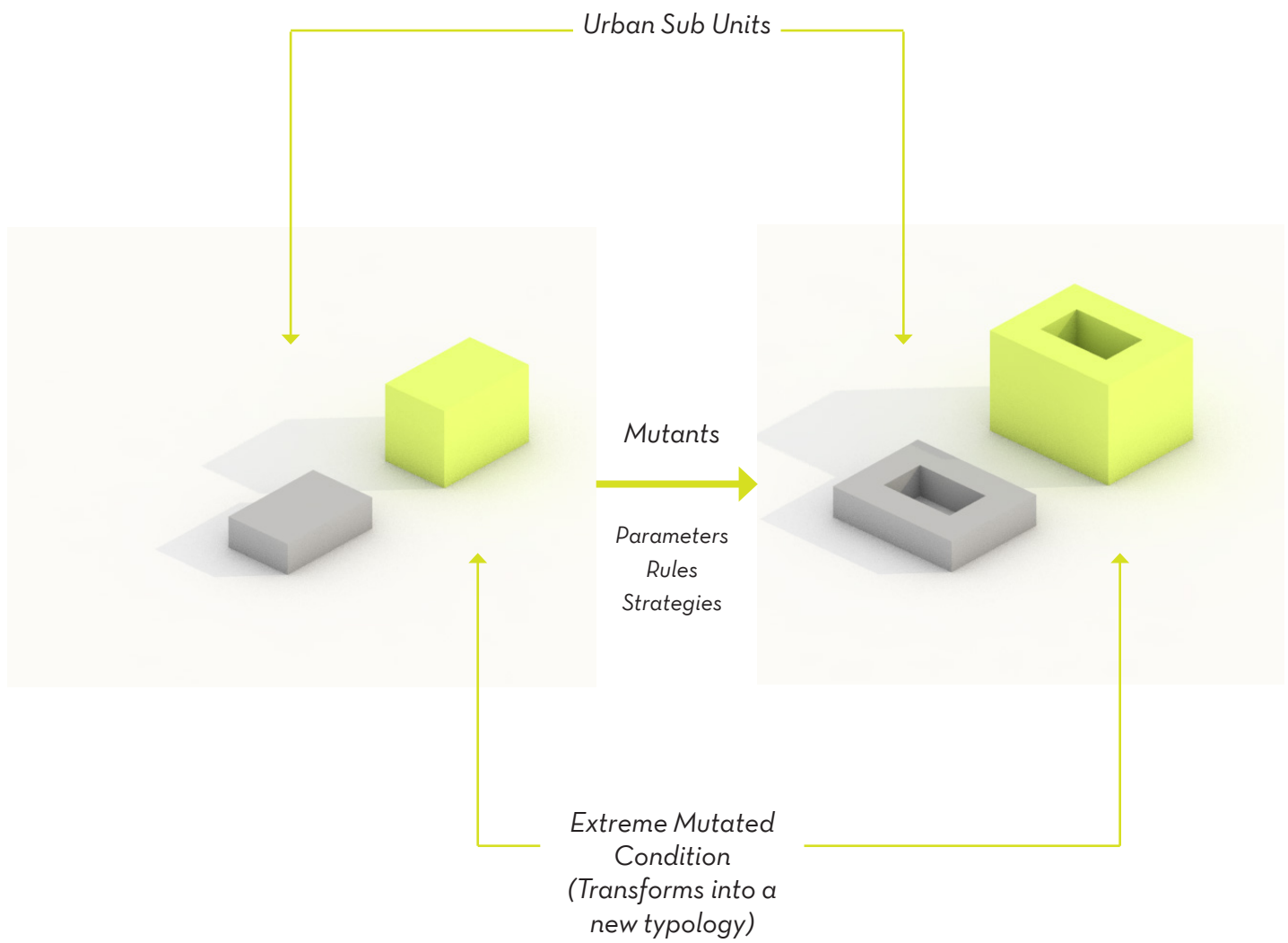


## URBAN MUTATION IN DIFFERENT BUILDING TYPES

Each building type is studied as an urban sub-unit whose form can alter over time to generate a mutated condition. These however, transform in accordance to rules/parameters/strategies so as to achieve a definite minimum and maximum mutated condition. Till the time the transformation happens within this morphological band, the spatial quality shall be preserved, thereby conserving Old Delhi's urban fabric.














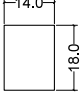


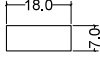

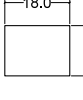


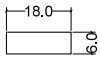
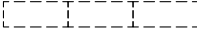
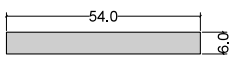

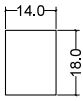

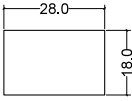


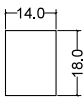
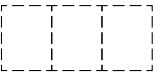
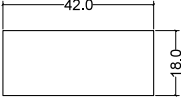
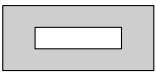

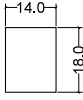
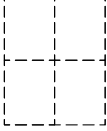
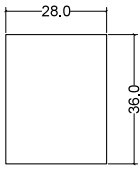
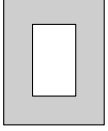


[FIGURE 6.13] Urban Mutation in one unit



[FIGURE 6.14] Urban Mutation between two units

URBAN MUTATION [FIGURE 6.15]

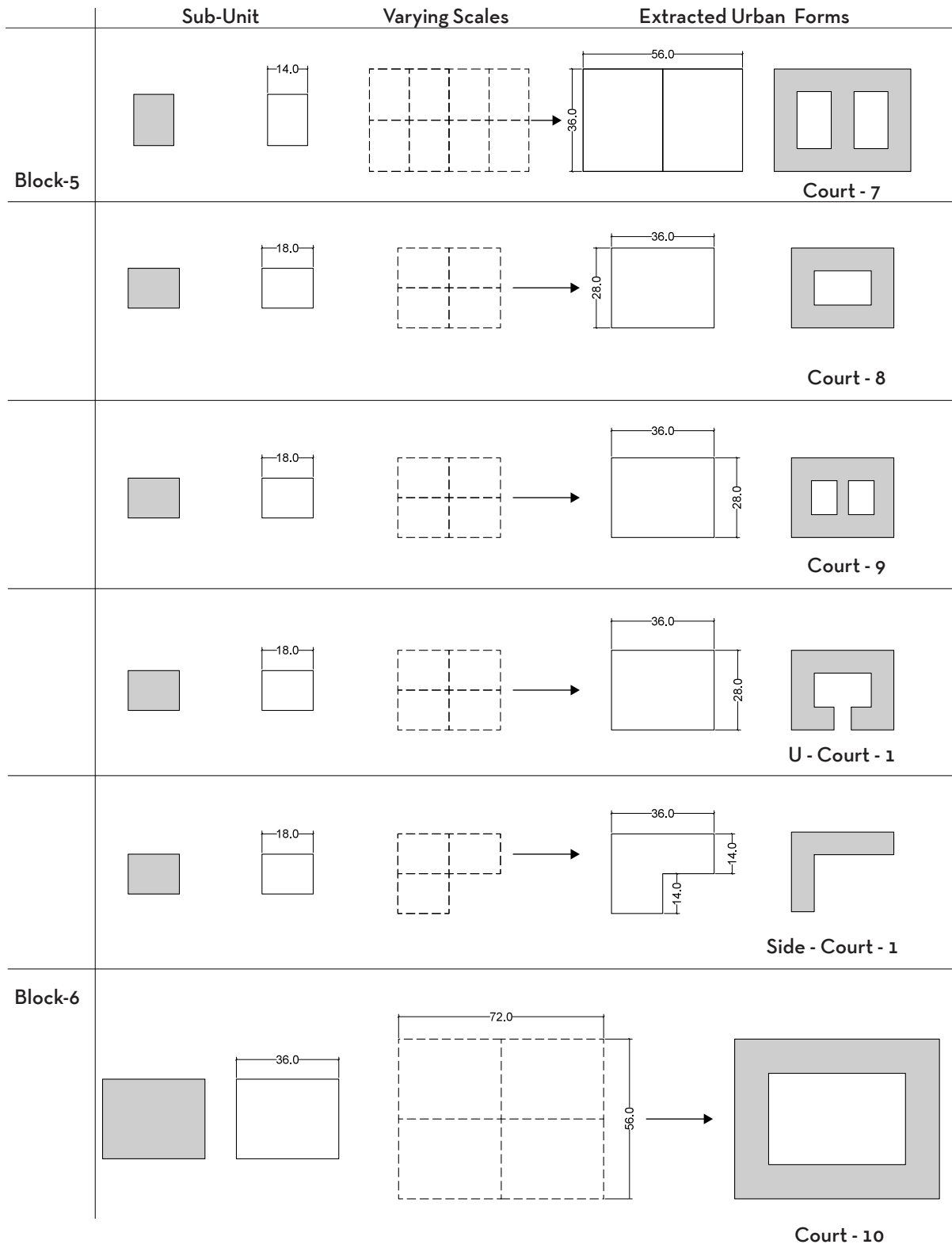
	Sub-Unit	Varying Scales	Extracted Urban Forms
Block-1	 	 → 	 <b>Court - 1</b>
Block-1	 	 → 	 <b>Court - 2</b>
Block-2	 	 → 	 <b>Court - 3</b>
Block-3	 	 → 	 <b>Court - 3</b>
Block-4	 	 → 	<b>Linear - 1</b>
Block-5	 	 → 	 <b>Court - 4</b>
	 	 → 	 <b>Court - 5</b>
	 	 → 	 <b>Court - 6</b>

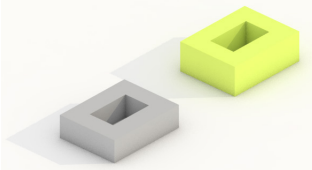
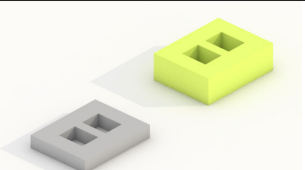
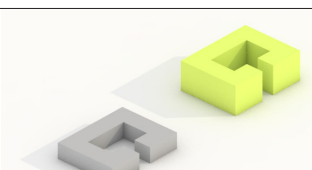
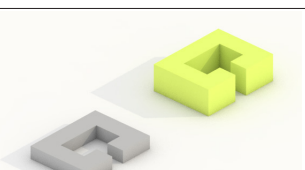

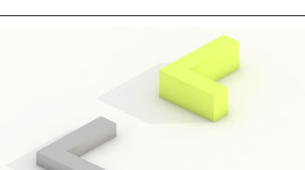
HOUSING

COMMERCIAL / MIXED

Min. Max.		Min. Max.		Min. Max.		Min. Max.	
A : 4m to 7m		Court - 1 : 7m to 13m		A : 2.7m to 8.7m		Court - 1 : 8.7m to 11.7m	
B : 4m to 7m		Court - 2 : 4m to 10m		B : 2.7m to 5.7m		Court - 2 : 2.7m to 8.7m	
C : 4m to 10m		Court - 3 : 4m to 13m		C : 2.7m to 8.7m		Court - 3 : 2.7m to 11.7m	
C : 4m to 10m		Court - 3 : 4m to 13m		C : 2.7m to 8.7m		Court - 3 : 2.7m to 11.7m	
—		—				—	
						Linear - 1 : 2.7m to 7m	
				—		—	
D : 4m to 13m		Court - 4 : 7m to 13m		—		—	
—				—		—	
		Court - 5 : 7m to 13m		—		—	
—				—		—	
		Court - 6 : 7m to 13m		—		—	

URBAN MUTATION



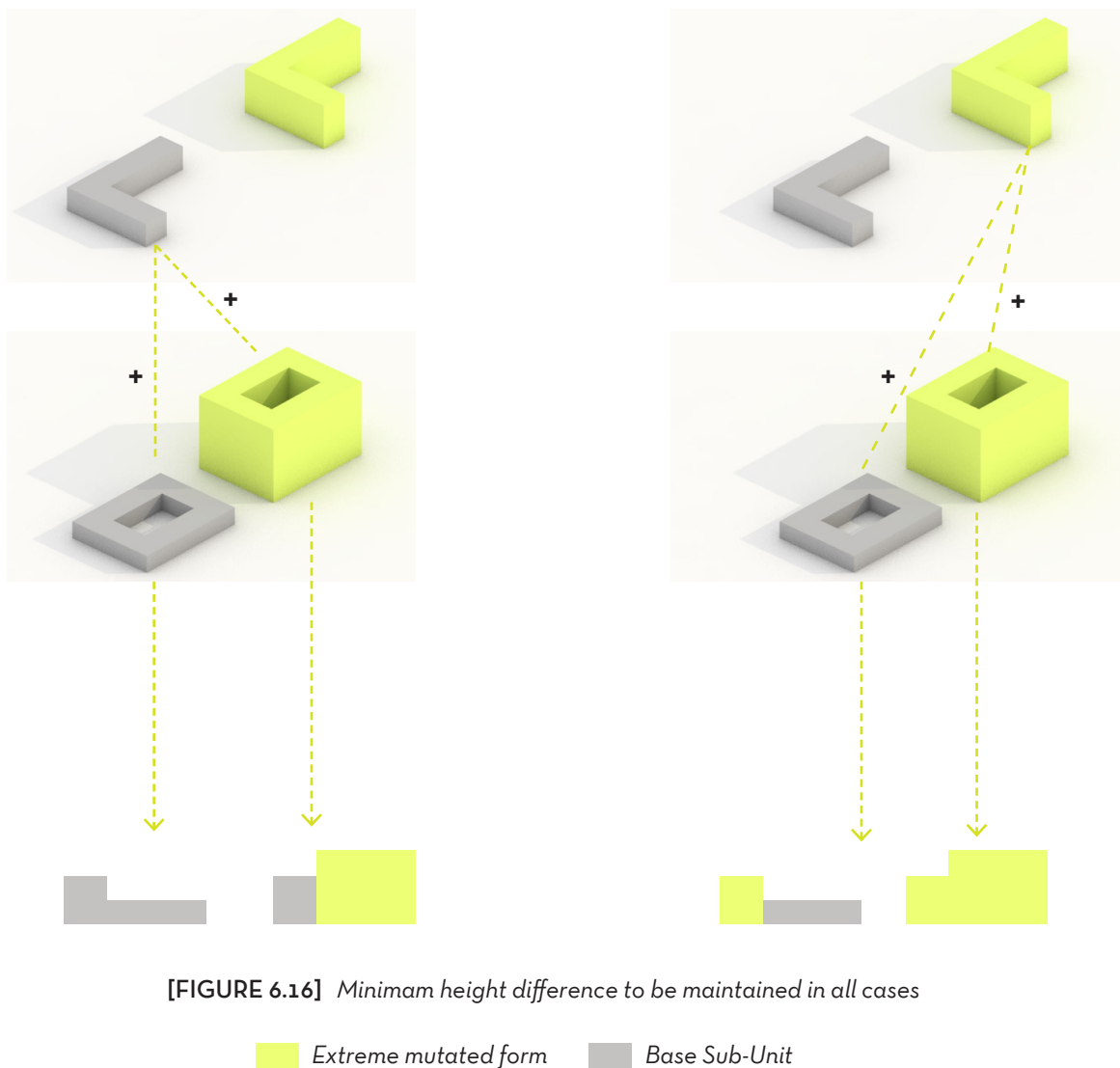
HOUSING				COMMERCIAL / MIXED			
Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
—				—		—	
		Court - 7 : 10m to 13m					
—				—		—	
		Court - 8 : 10m to 13m					
—				—			
		Court - 9 : 7m to 13m			Court - 9 : 5.7m to 11.7m		
—				—			
		UCourt - 1 : 7m to 13m			UCourt - 1 : 5.7m to 11.7m		
—				—			
		LCourt - 1 : 7m to 13m			LCourt - 1 : 5.7m to 11.7m		
—				—		—	
		Court - 10 : 4m to 13m					





## INTERACTION OF URBAN MUTATIONS BETWEEN TWO DIFFERENT TYPOLOGIES

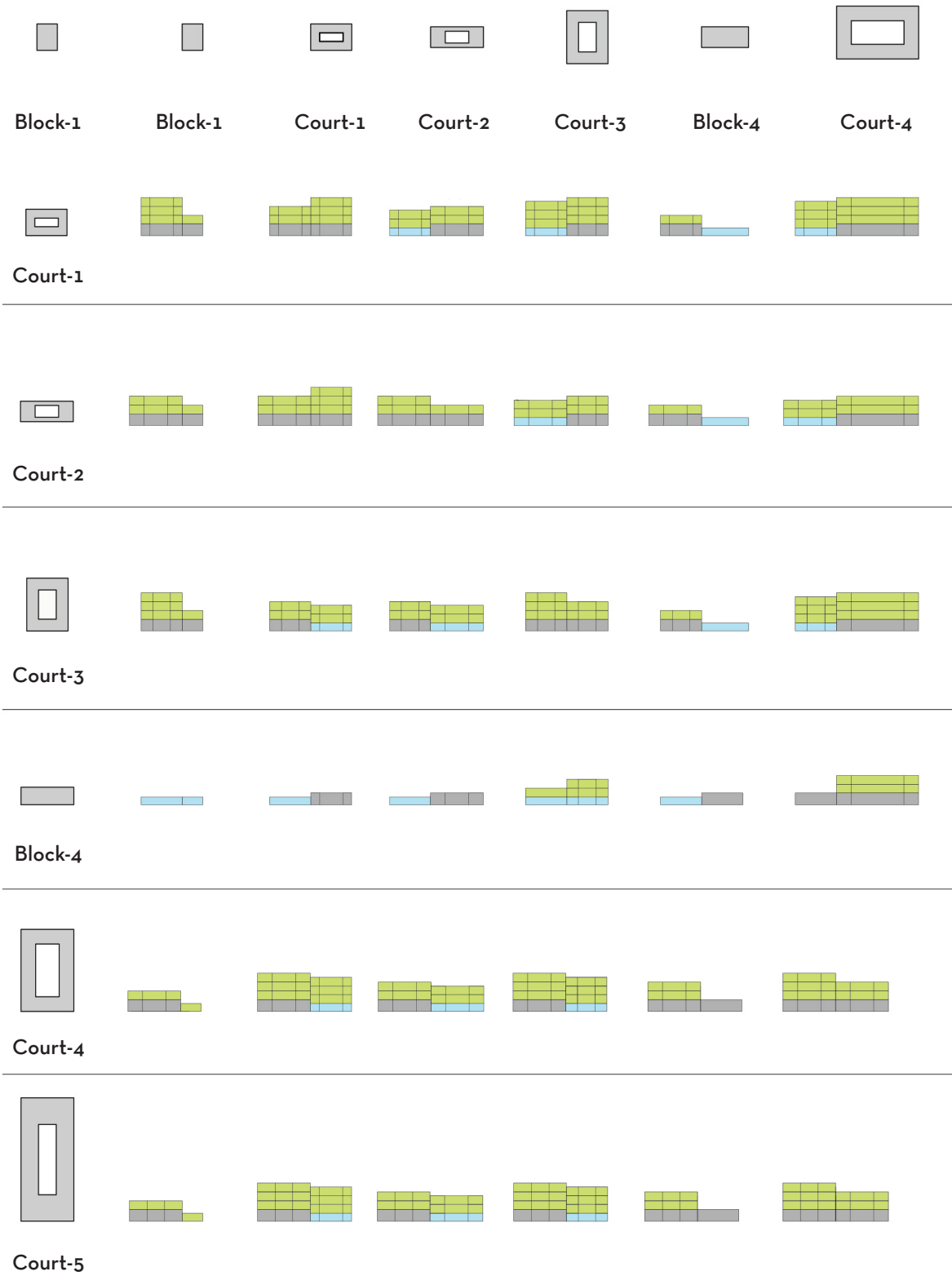
Once the sub-units are allowed to mutate, the different sub-units then interact with each other. This interaction is regulated by maintaining a minimum height difference between the two units at any given point of time. The maximum and minimum height of each unit is also maintained as per the set urban mutation minimum and maximum limits.



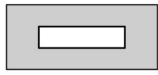
[FIGURE 6.16] Minimum height difference to be maintained in all cases

ELASTIC BAND OF VOLUMETRIC CODE [FIGURE 6.17]

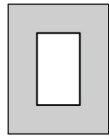
Contextual Stacking - Minimum Height Difference Between Building Types



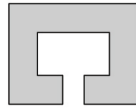
2.7 meters    3 meters    4 meters



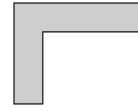
Court-5



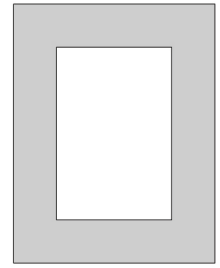
Court-6



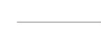
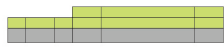
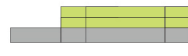
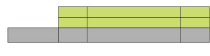
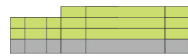
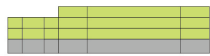
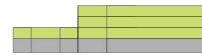
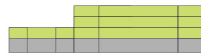
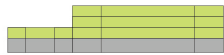
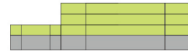
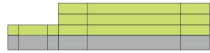
U-Court - 1



Side Court- 1

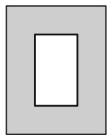


Court-10

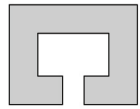
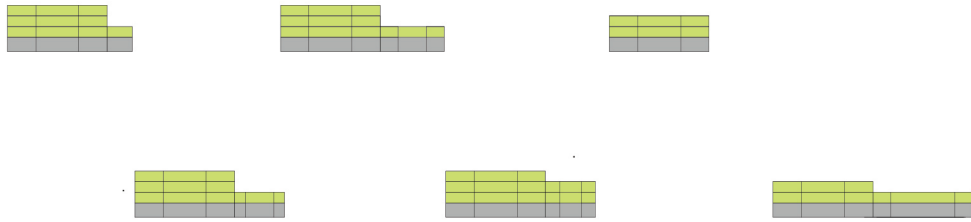


# ELASTIC BAND OF VOLUMETRIC CODE

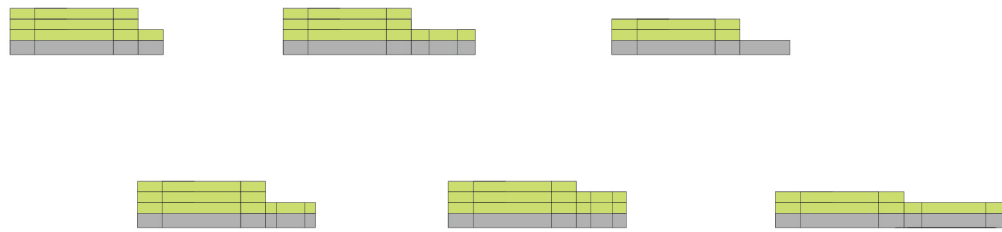
Contextual Stacking - Minimum Height Difference Between Building Types



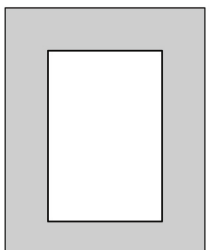
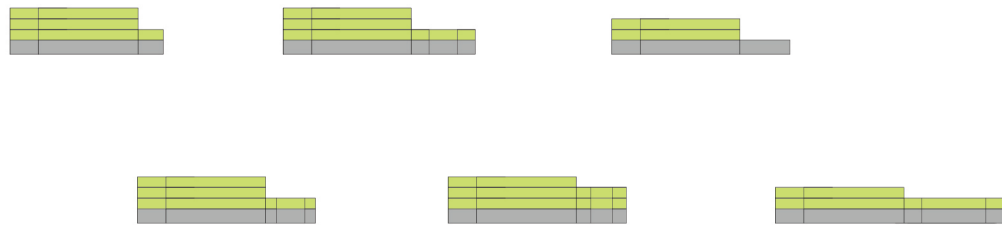
Court-6



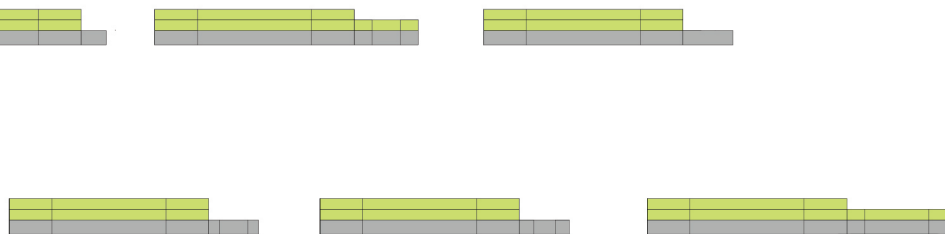
U-Court - 1



Side Court- 1



Court-10





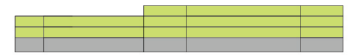
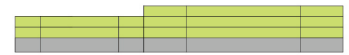
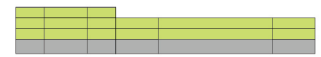
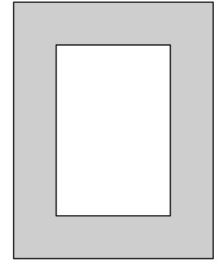
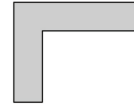
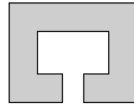
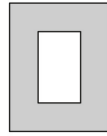
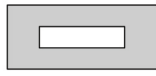
2.7 meters

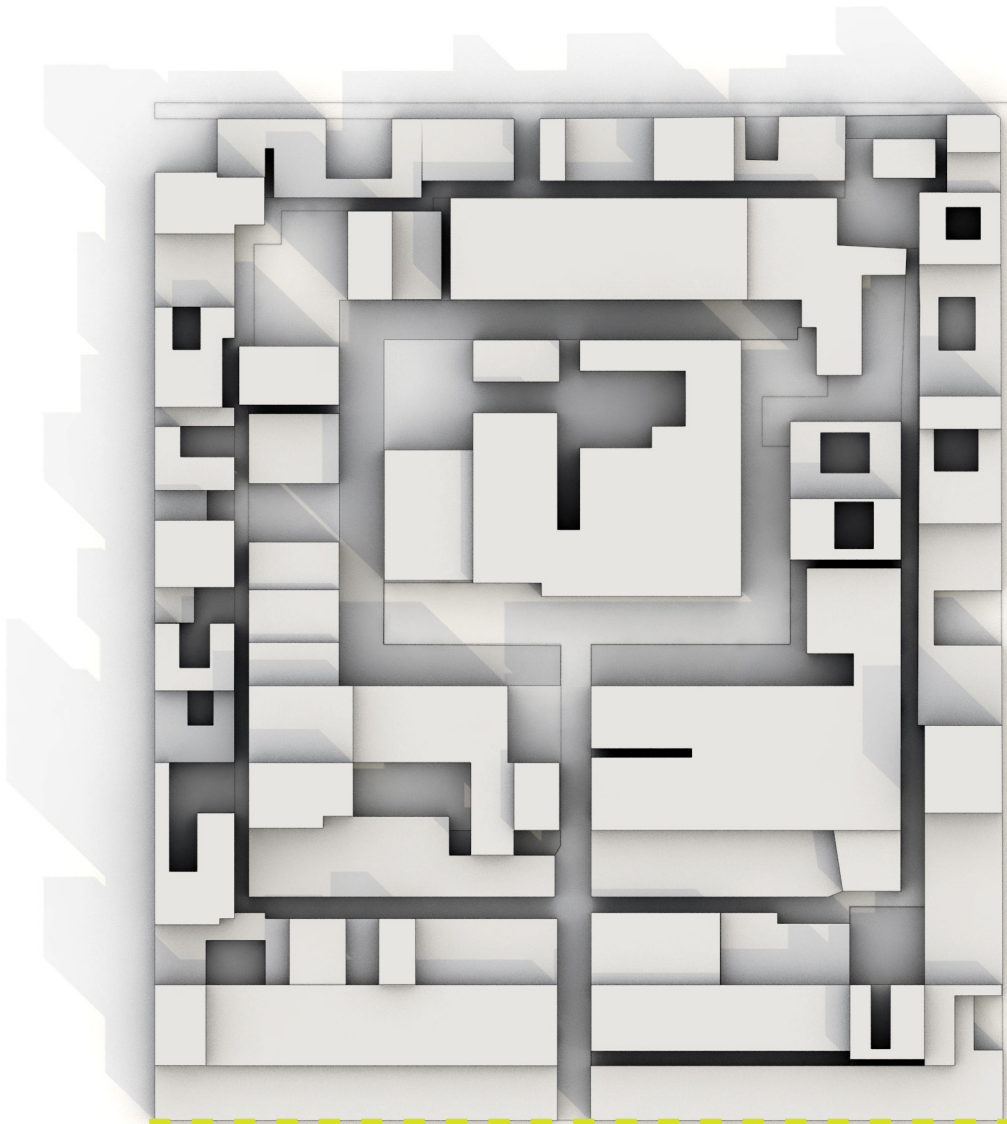


3 meters



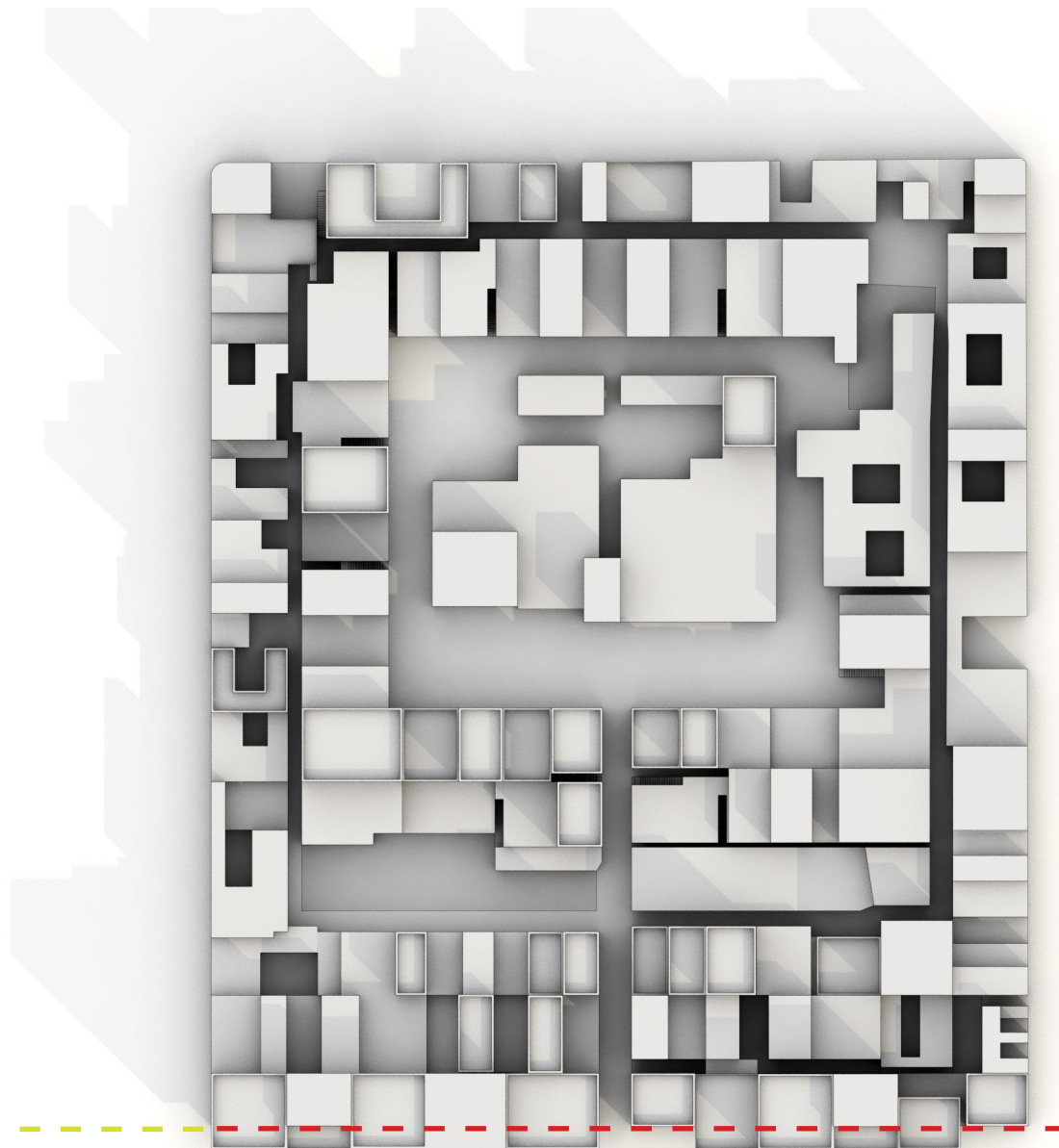
4 meters





This block has multiple courtyard block offset one into the other and incorporates more building types.

[Figure 6.18] Layout Of A Mega Courtyard Block - Old Delhi 1850

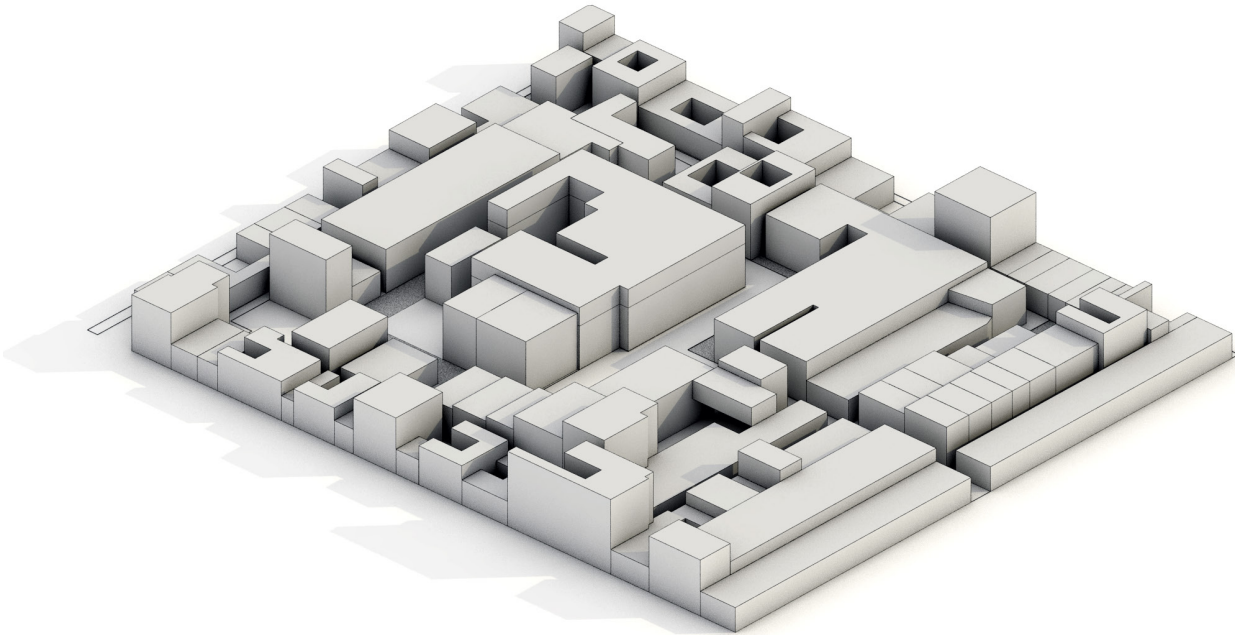


Facade transformation by additions and multiple plot divisions.

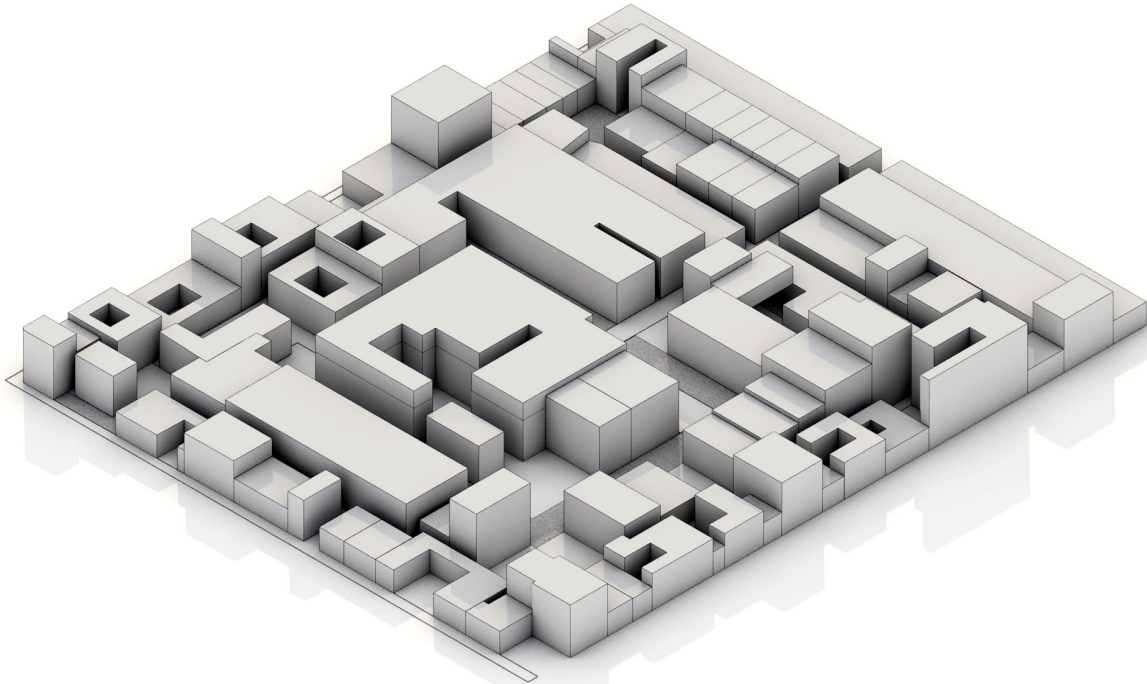
The courtyard block today has disintegrated into finer dense fabric that is the result of unrestrained urban development.

[Figure 6.19] Courtyard Block Today 2015  
Architectural Interventions Over Time

COURTYARD BLOCK 1850



[Figure 6.20.1] South-West Isometric View 1850

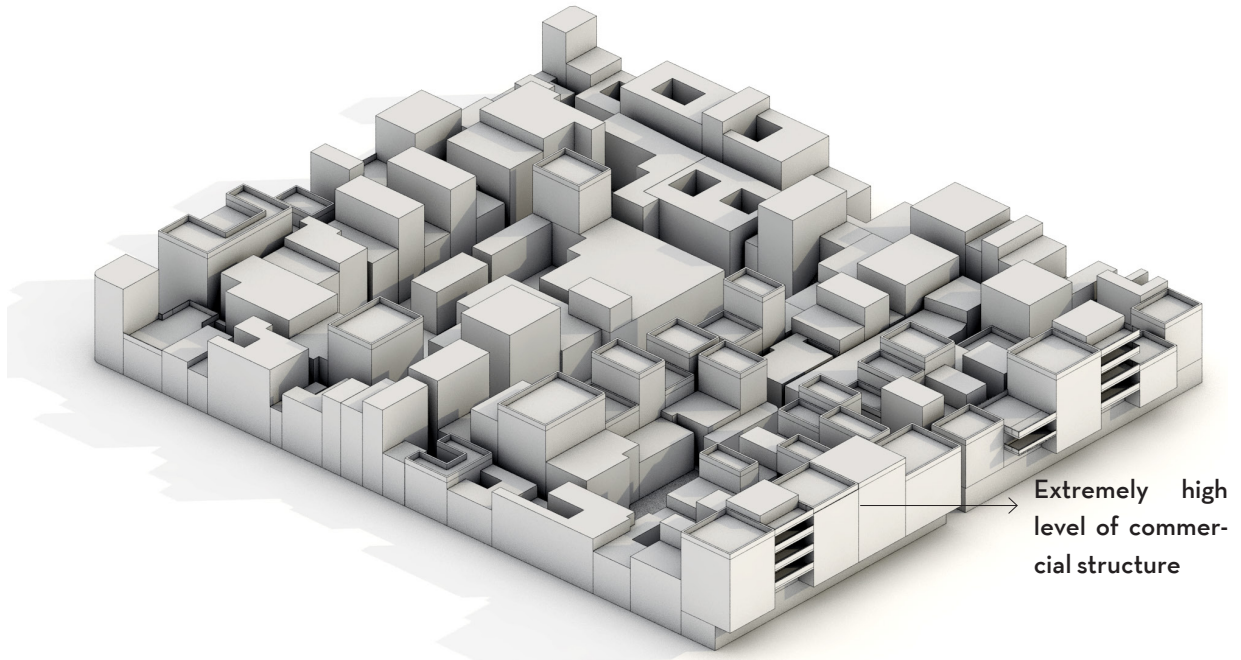


[Figure 6.20.2] North-West Isometric View 1850

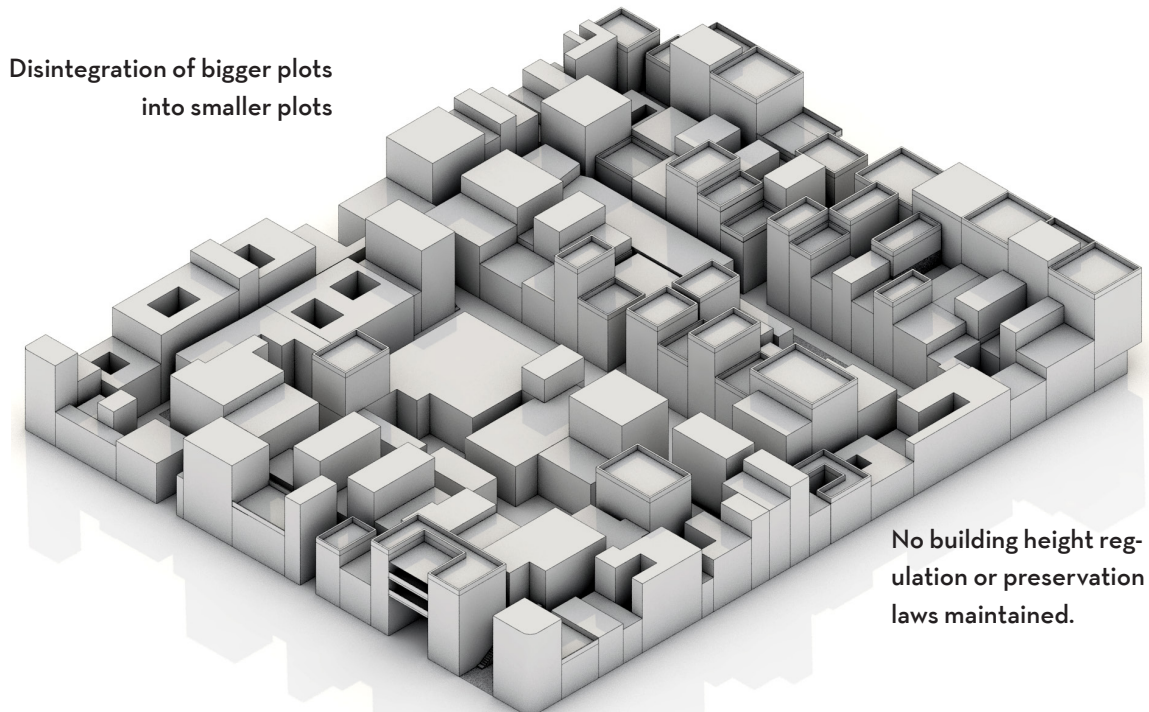
*Urban Mutation within permissible limits*



COURTYARD BLOCK TODAY 2015



[Figure 6.21.1] South-West Isometric View 2015

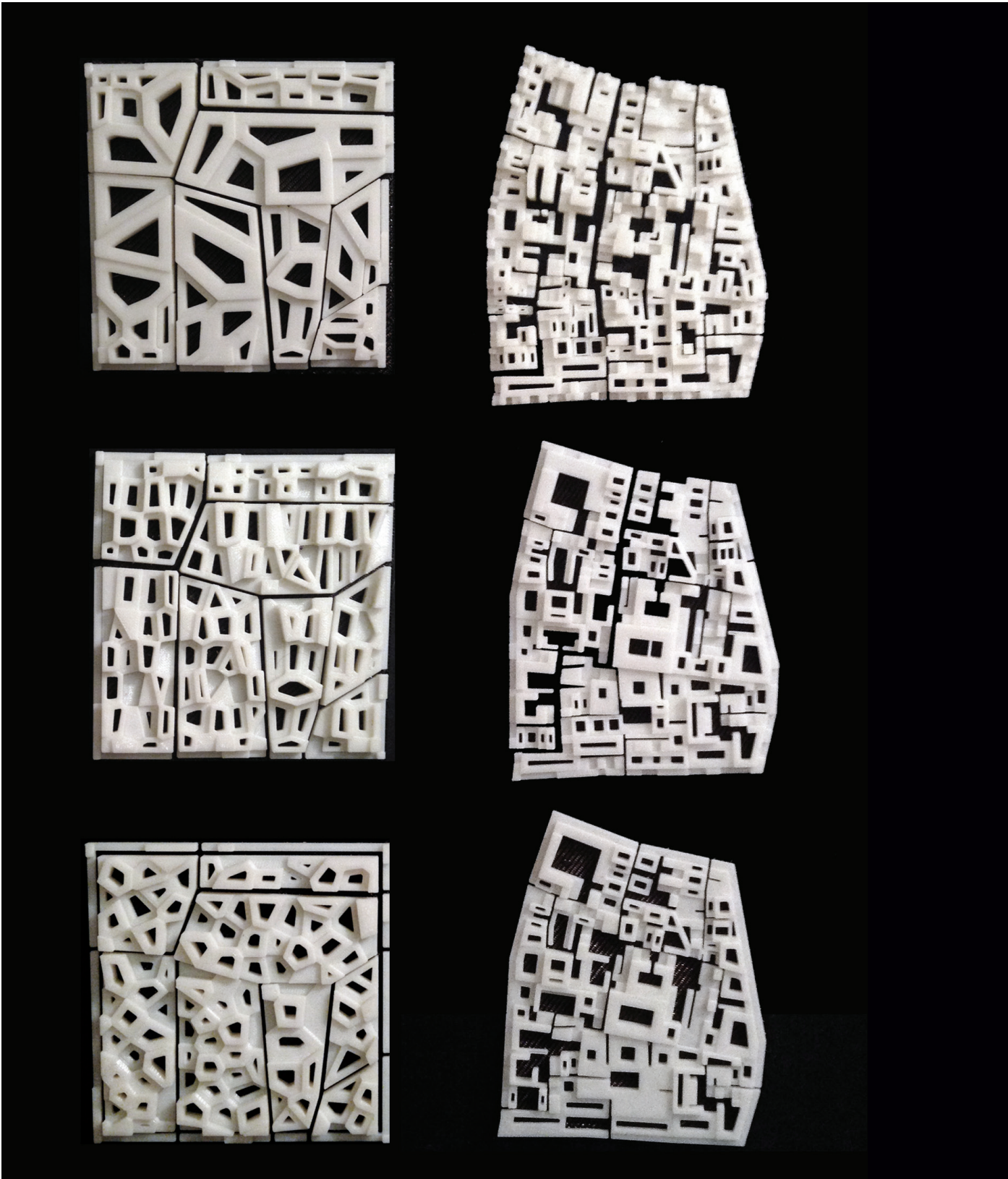


[Figure 6.21.2] North-West Isometric View 2015

*Urban Mutation beyond permissible limits*



*Urban Codes formulated at the city, neighbourhood and local scale are now used to generate automated and manual design iterations that demonstrate varying urban scenarios and expose the stages when an urban structure fails to exhibit the spatial quality of Old Delhi's fabric.*



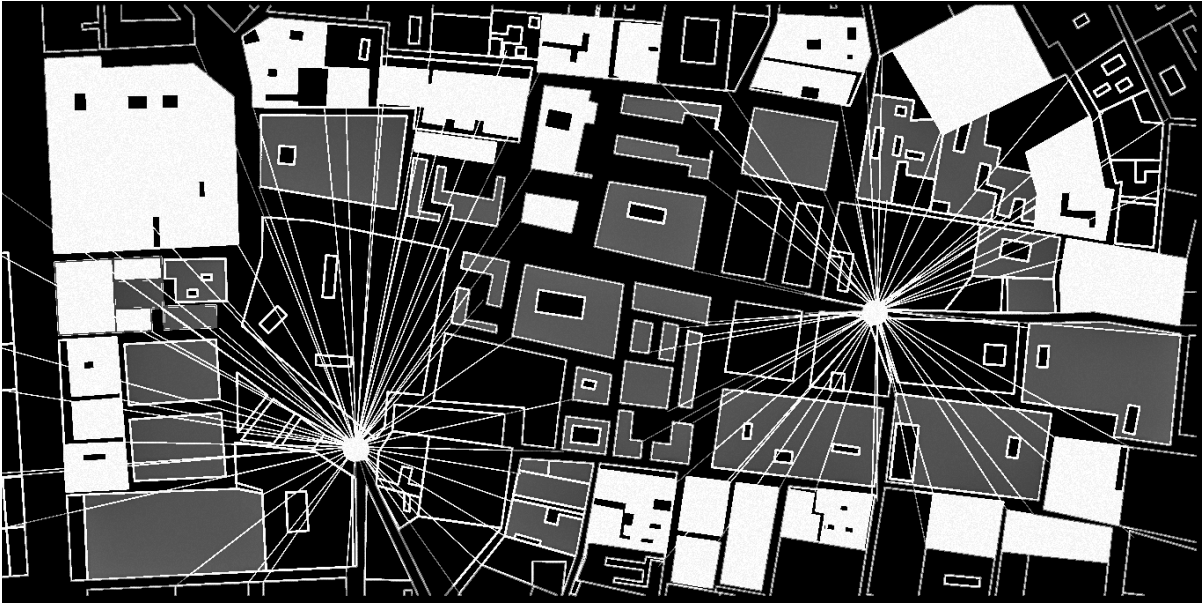
# TRANSLATING URBAN PARAMETERS

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Automated Procedural Modelling through Grasshopper

Manual Procedural Modelling





[FIGURE 7.1] Urban Attractors generating varying densities

*“The more contemporary architects operating within the new morphogenetic paradigm can be seen more as the controllers of processes, who facilitate the emergence of bottom-up form-finding processes that generate structural formations. The difference, then, lies in the emphasis on form-finding over form-making, on bottom-up over top-down processes, and on formation rather than form. Indeed the term ‘form’ should be relegated to a subsidiary position to the term ‘formation’. Meanwhile, ‘formation’ must be recognised as being linked to the terms ‘information’ and ‘performance’. When architecture is ‘informed’ by performative considerations it becomes less a consideration of form in and of itself, and more a discourse of material formations. In other words, ‘form’ must be ‘informed’ by considerations of ‘performative’ principles to subscribe to a logic of material ‘formation.’”*

Neil Leach, *Digital - Morphogenesis* 2008





## TRANS-CODING OF URBAN PARAMETERS THROUGH GRASSHOPPER

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*After analyzing Old Delhi's fabric and its dependency on mathematical relationships, it is evident that the city was planned keeping numbers and proportions in mind. The relationships between the quantitative determinants of the urban elements were quite specific so as to generate a typical traditional character for the Mughal city. As Grasshopper is parametric, it acts as a potential generative tool that can help build and depict these relationships through a system that allows interactive play with alternatives. It also offers unprecedented control over the individual components that can be edited or manipulated until the desired result is achieved.*

The trans-coding through Grasshopper will be done by scripting techniques that employ the set of Urban Growth rules through the following stages:

1. Development of primary street patterns from a fixed attractor point within a boundary
2. Development of secondary, tertiary and local street patterns for the following cases -
  - Street Network diagrams through a two street intersection and its associated branching organizations
  - Street Network diagrams through a three street intersection and its associated branching organizations
  - Street Network diagrams through a four street intersection and its associated branching organizations
3. Development of street patterns and micro-communities within a 'katra' boundary
4. Urban infill - Filling the urbanization typology (katra) with courtyard houses

The process of trans-coding through Grasshopper begins with a point of growth acting as an Urban Attractor. This point acts as the origin for one to four primary streets which then branch out further to generate secondary, tertiary and local streets. This street network gives rise to various territories within the city boundary inside which the buildings are generated and multiple morphing transformations are analysed.

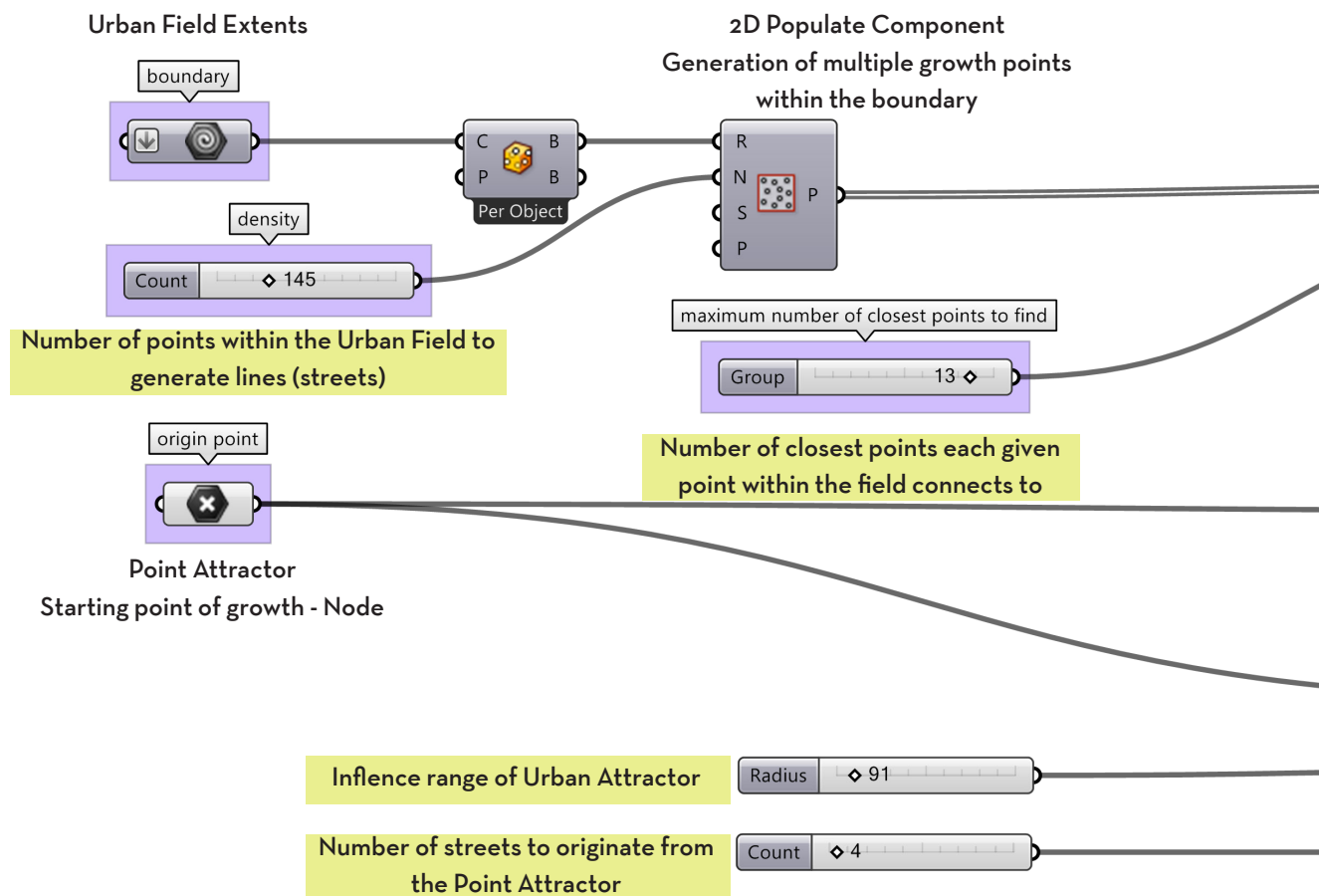
## SCRIPTING STREET NETWORK (ORGANIC)

### Generating The Urban Genotype Through Point Attractors

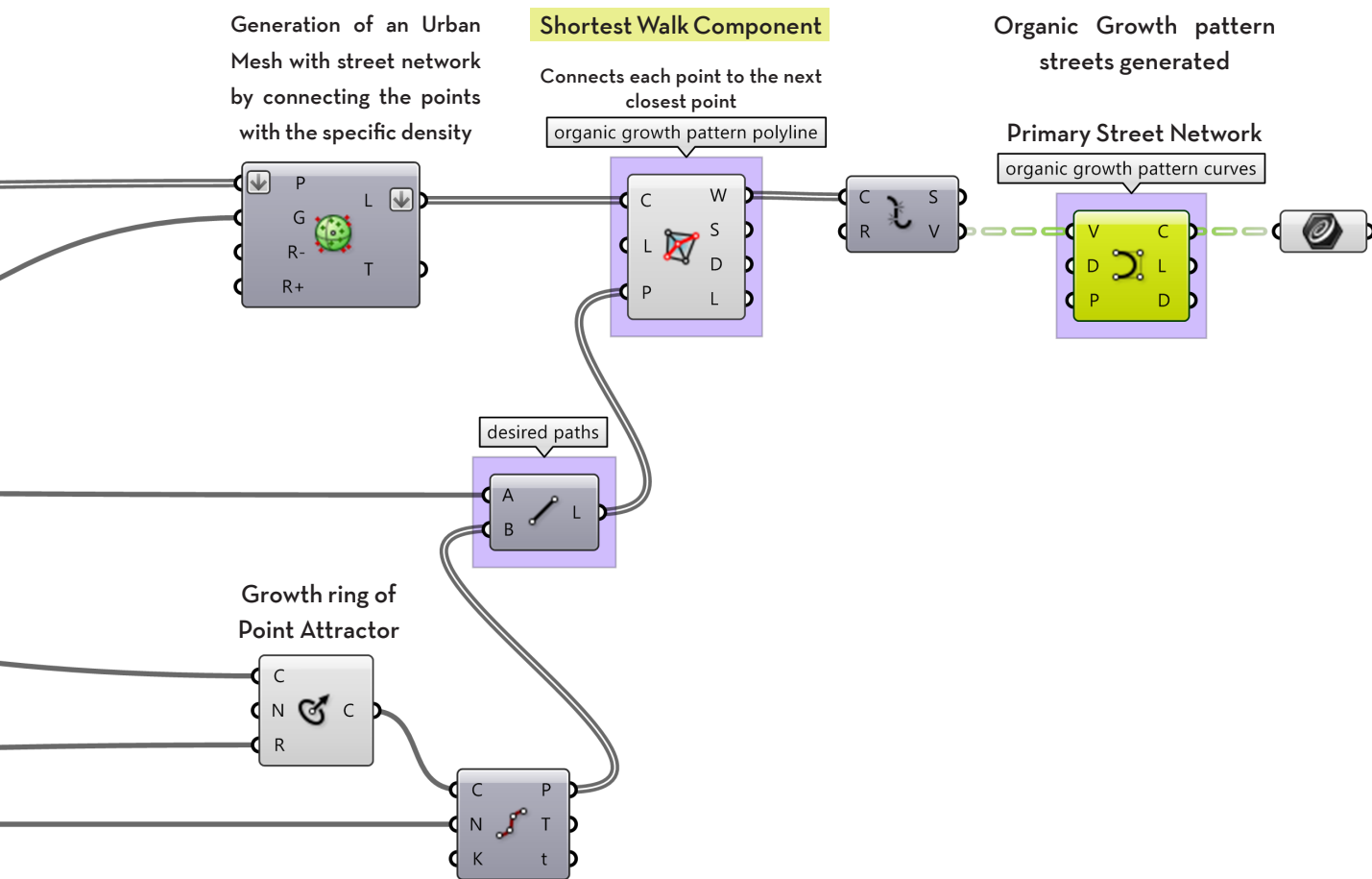
Techniques of scripting through Grasshopper are used to fill the city with fixed points that generate 'organic' street patterns responsive to human occupation and those that develop their own adaptive behaviour.

The points are intelligent enough to connect to the closest points in order to generate the required density. All the points together form a complex urban mesh that exhibits the possible connections between the points (nodes) within the urban field.

The points of growth have a specific influence range radii, the density of which can be manipulated.



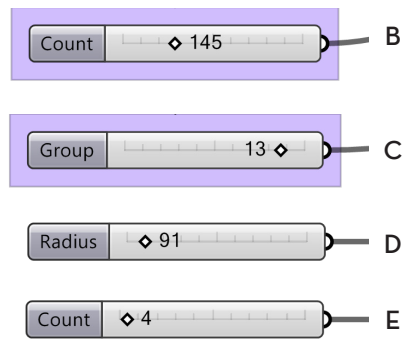
### Varying Key Quantitative Determinants



[FIGURE 7.2] Grasshopper Script - 1  
Generation of an organic street growth pattern within a given boundary from a node  
(Fixed or Variable Point Attractor)

NOTE : All parameters are set so as to achieve an output that expresses Old Delhi's urban logic to the closest.

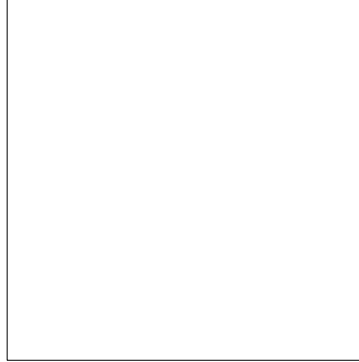
[FIGURE 7.3] SCRIPT SETTINGS



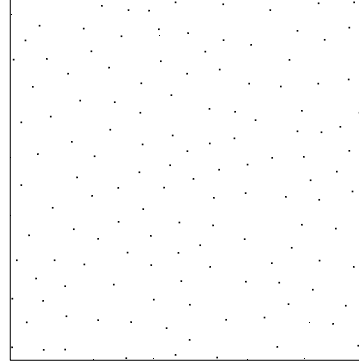
## PRIMARY STREET NETWORK DIAGRAMS (ORGANIC)

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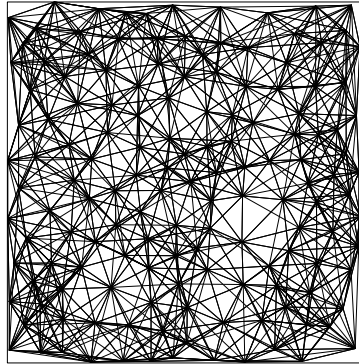
Generated Through Grasshoper Script - 1



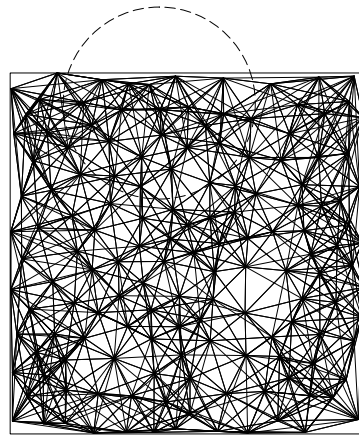
A. Urban Field  
City Boundary



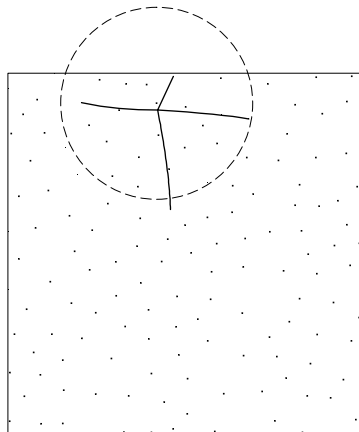
B. Points of growth populated  
as per set density



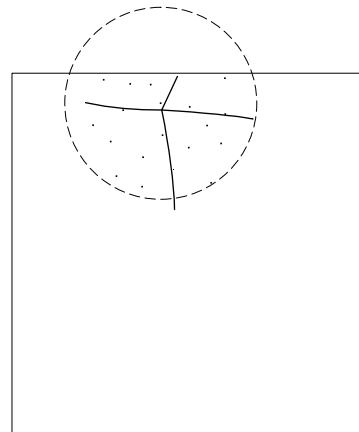
C. Each point connects to 13  
closest points to generate a



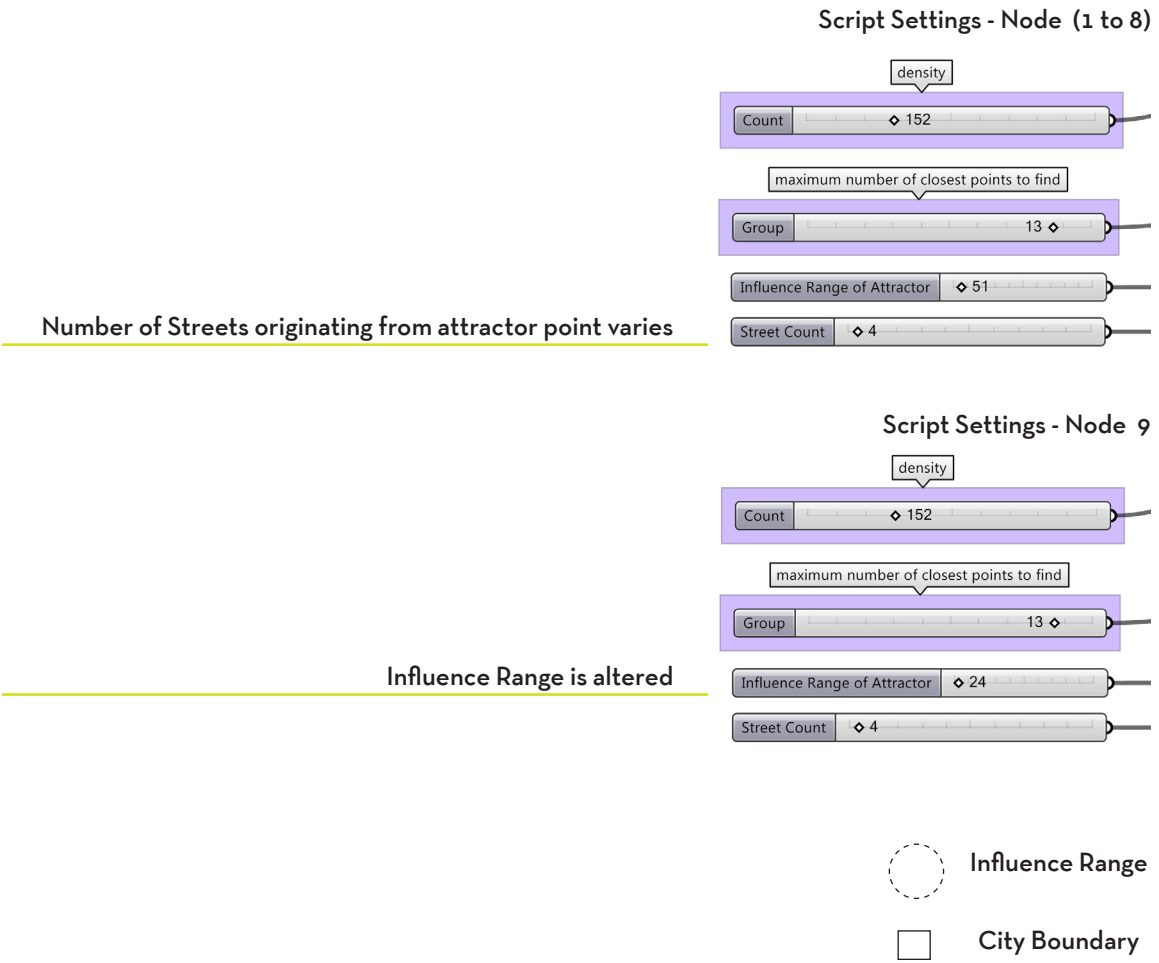
D. Positioning a point attractor with a  
specific influence range radius



E. Assigning the number of streets to  
originate from the growth point



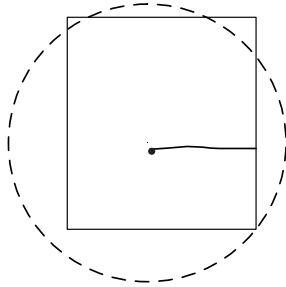
F. Generation of a 4 streets intersec-  
tion by a fixed point attractor



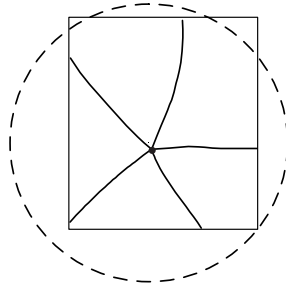
[FIGURE 7.4] Script Settings for varying Nodes

# VARYING PRIMARY STREET INTERSECTION DIAGRAMS (ORGANIC)

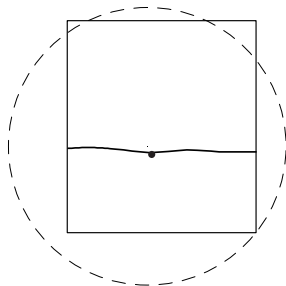
Generated Through Grasshoper Script - 1



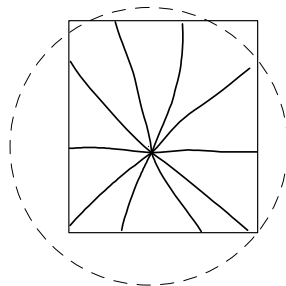
Node 1 One street growth



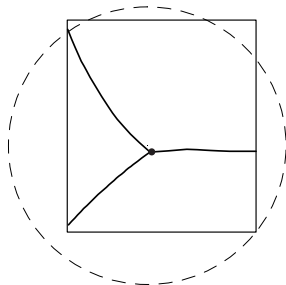
Node 5 Five streets intersection



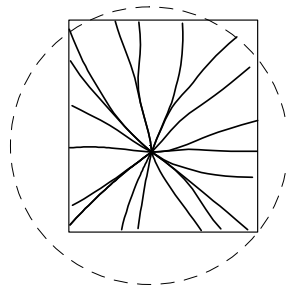
Node 2 Two streets intersection



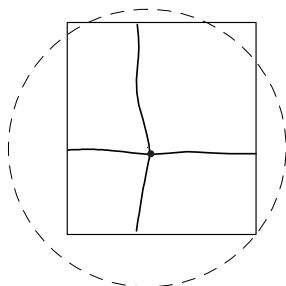
Node 6 Ten streets intersection



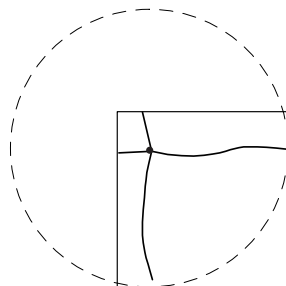
Node 3 Three streets intersection



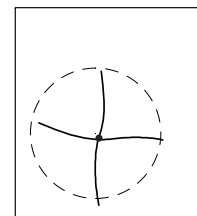
Node 7 Twenty streets intersection



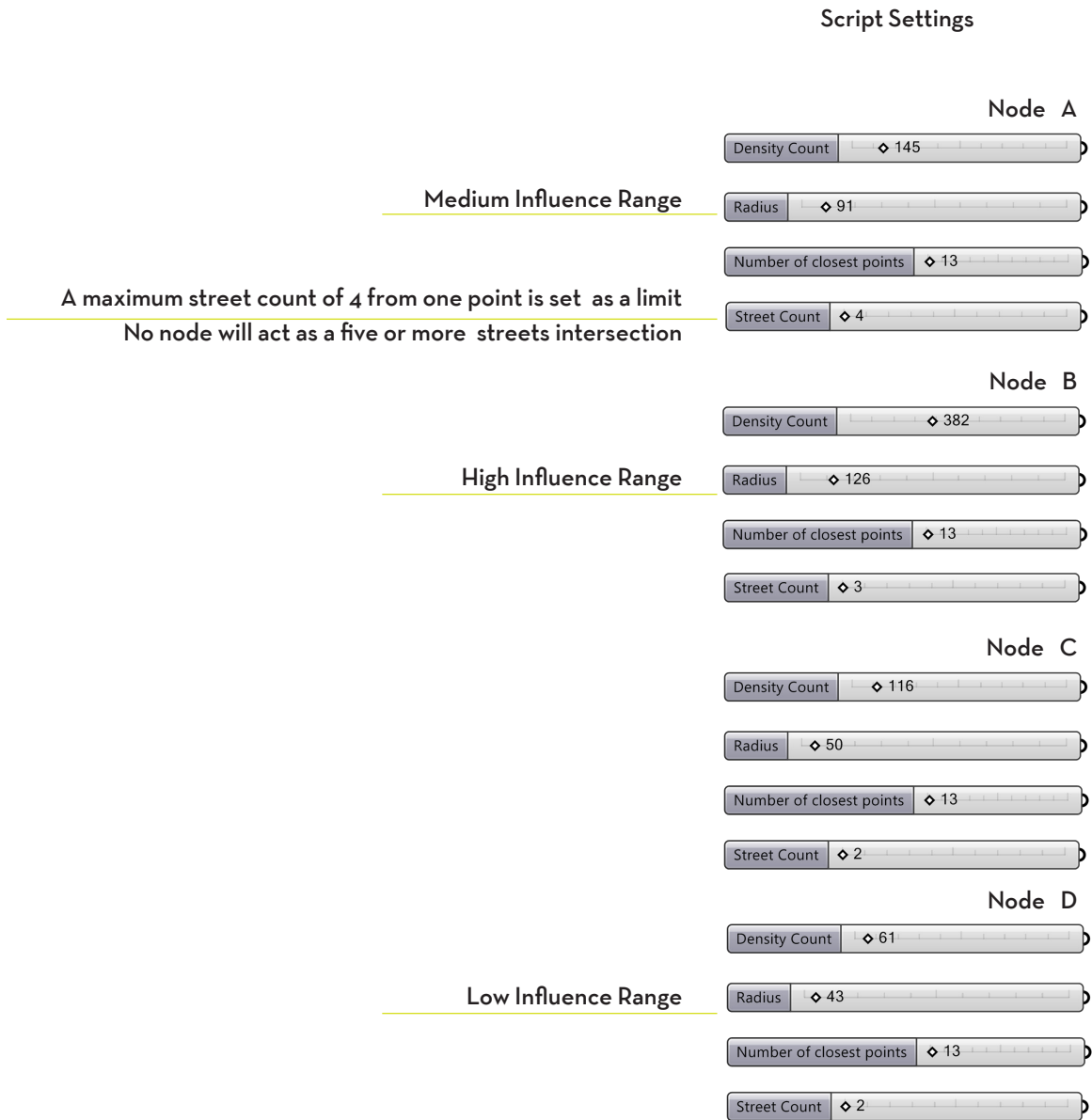
Node 4 Four streets intersection



Node 8 Pattern generated when boundary is changed



9. Pattern generated when influence range of attractor is changed

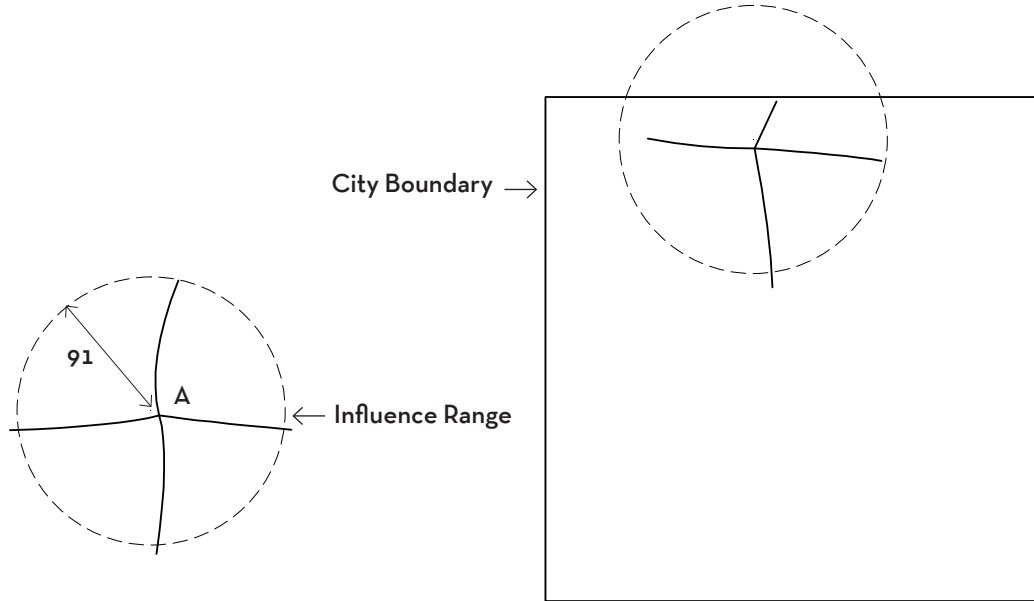


[FIGURE 7.5] Varying parameters for Script - 1 to generate four different conditions



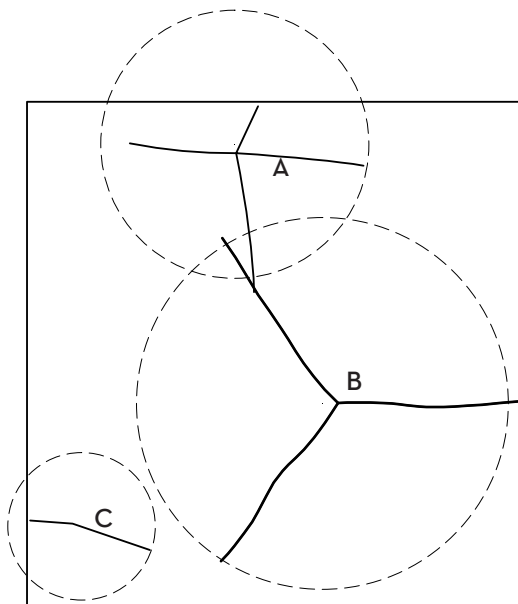
## INTERSECTION OF PRIMARY STREETS

Generated Through Grasshoper Script - 1

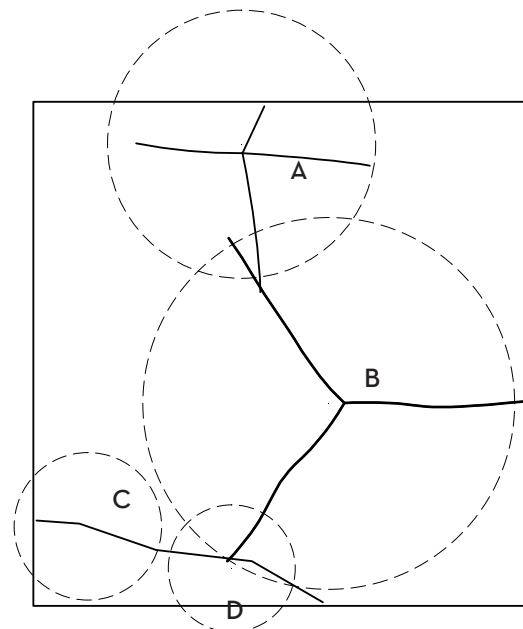


Street Pattern from Point A  
Influence Range Radius : 91m

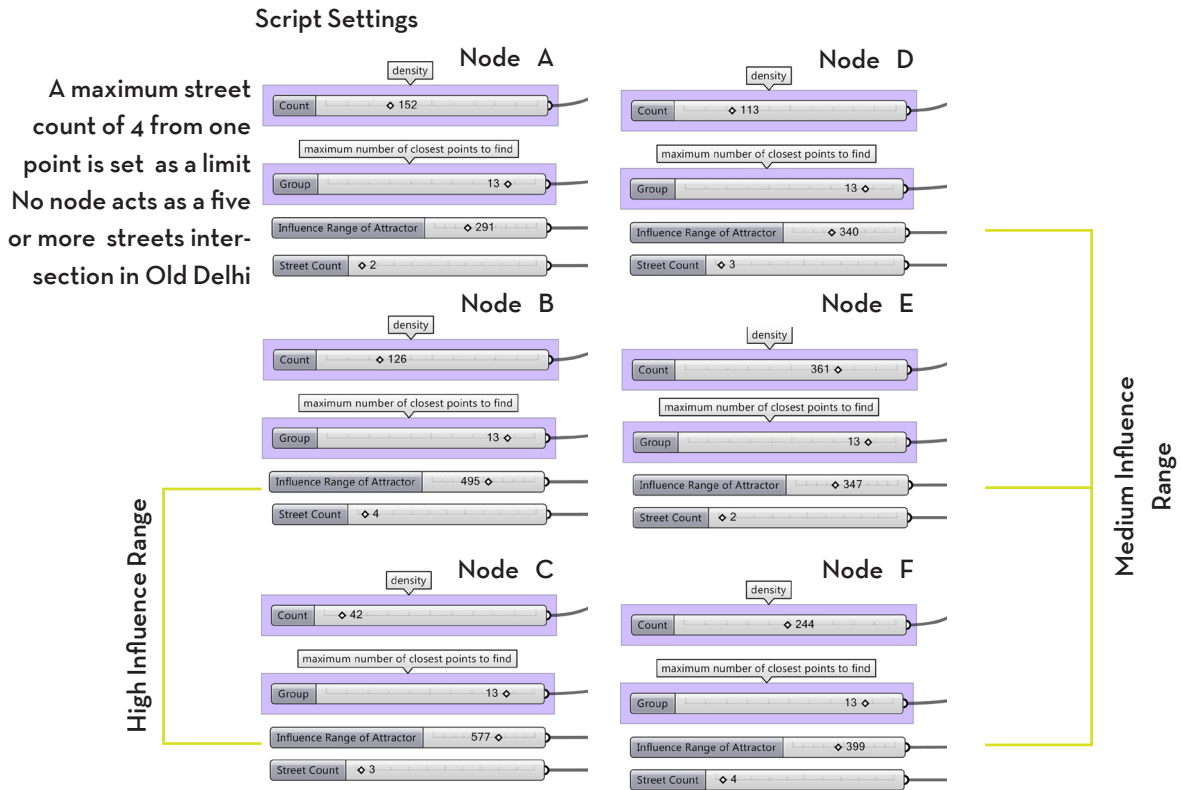
Point A placed inside a (city) boundary behaves as a primary street intersection. No street development takes place outside the city boundary.



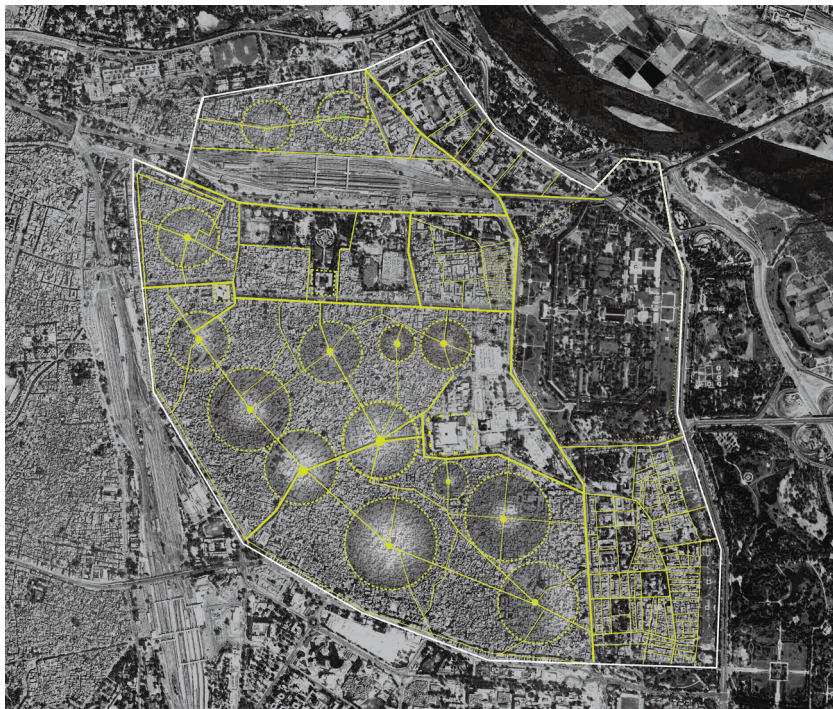
Fixing the location of point attractors after a former point has settled in the neighbourhood  
Organic Street Patterns from multiple point attractors with varying influence range radii



Rules specified that determine how attractors locate with respect to one another to generate the city's Urban Genotype that carries the primary urban elements



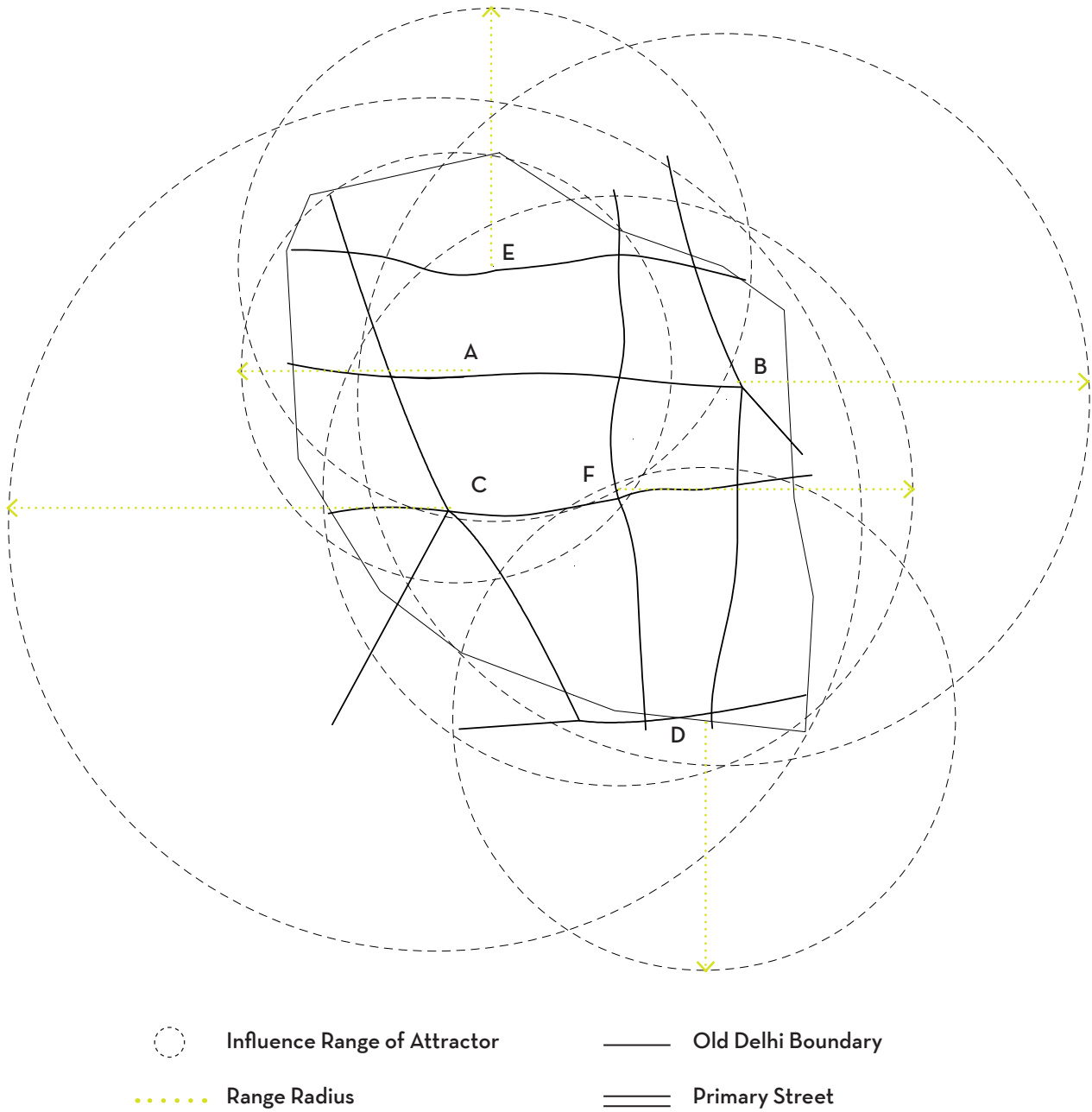
[FIGURE 7.6.1] Generation of primary street network in Old Delhi using GH Script -1



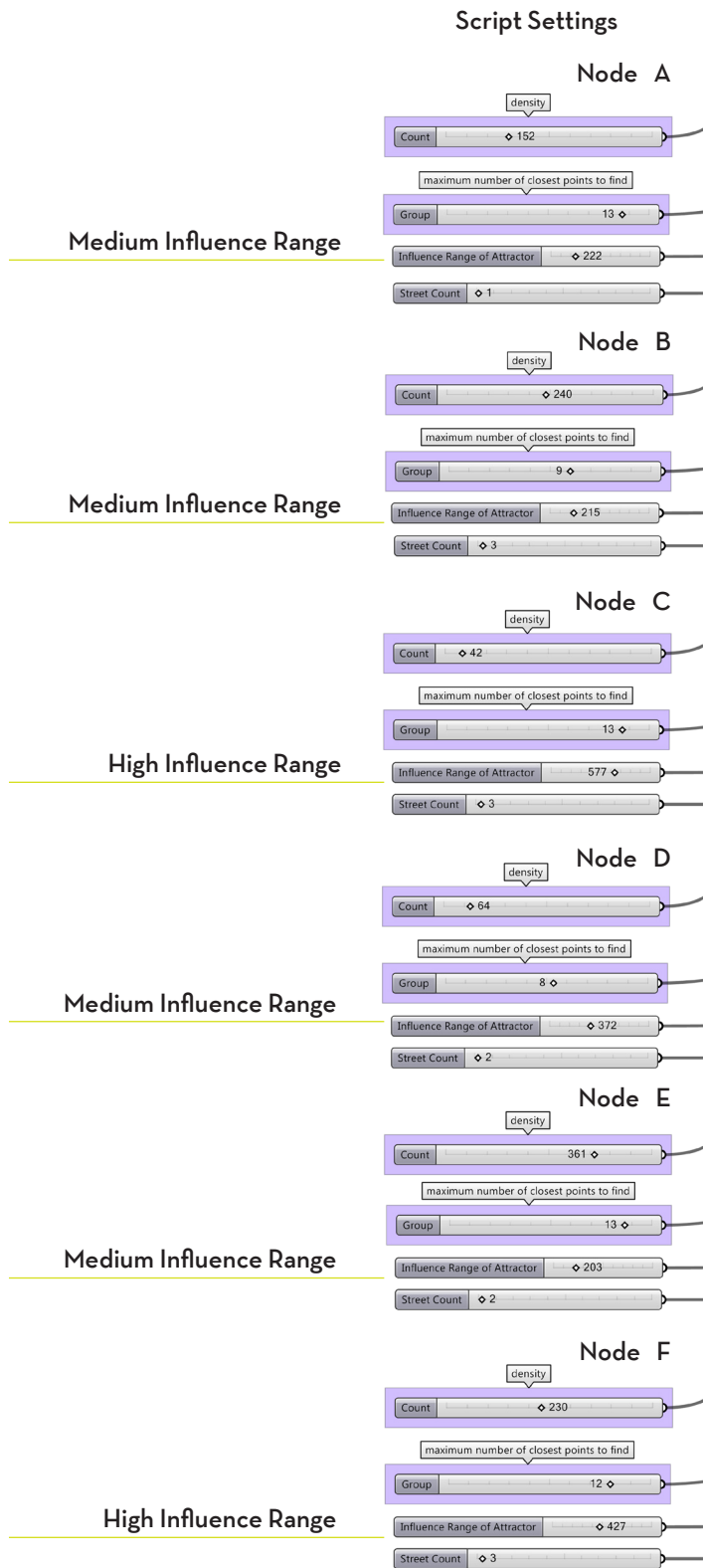
Old Delhi - Reference Image GIS Mapping

# EXISTING PRIMARY STREET NETWORK DIAGRAM - OLD DELHI

Generated Through Grasshoper Script - 1



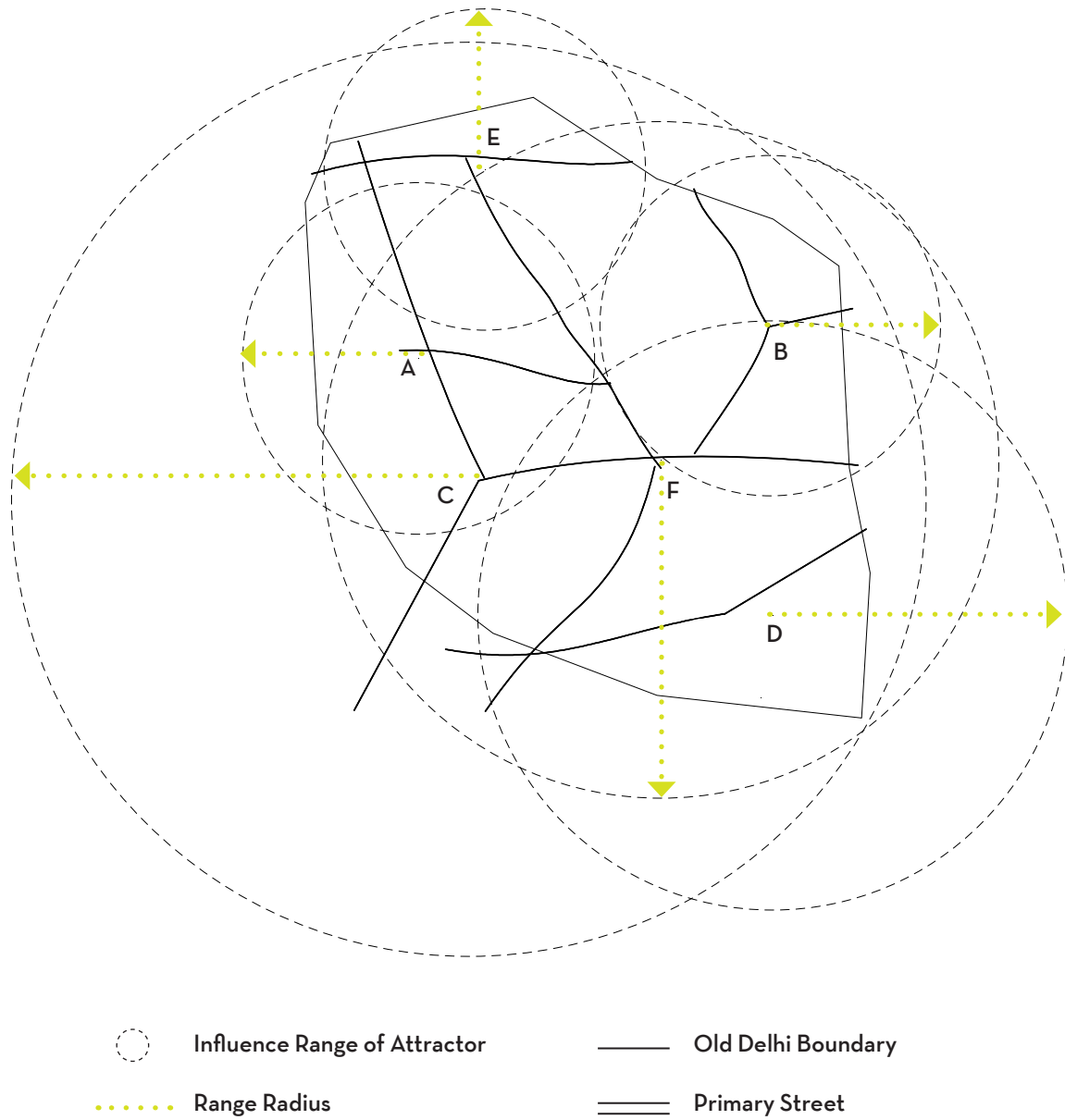
[FIGURE 7.6] Locating urban attractors as per existing fabric conditions



[FIGURE 7.7.1] Generation of new primary street network in Old Delhi using GH Script -1

# ALTERED PRIMARY STREET NETWORK DIAGRAM - OLD DELHI

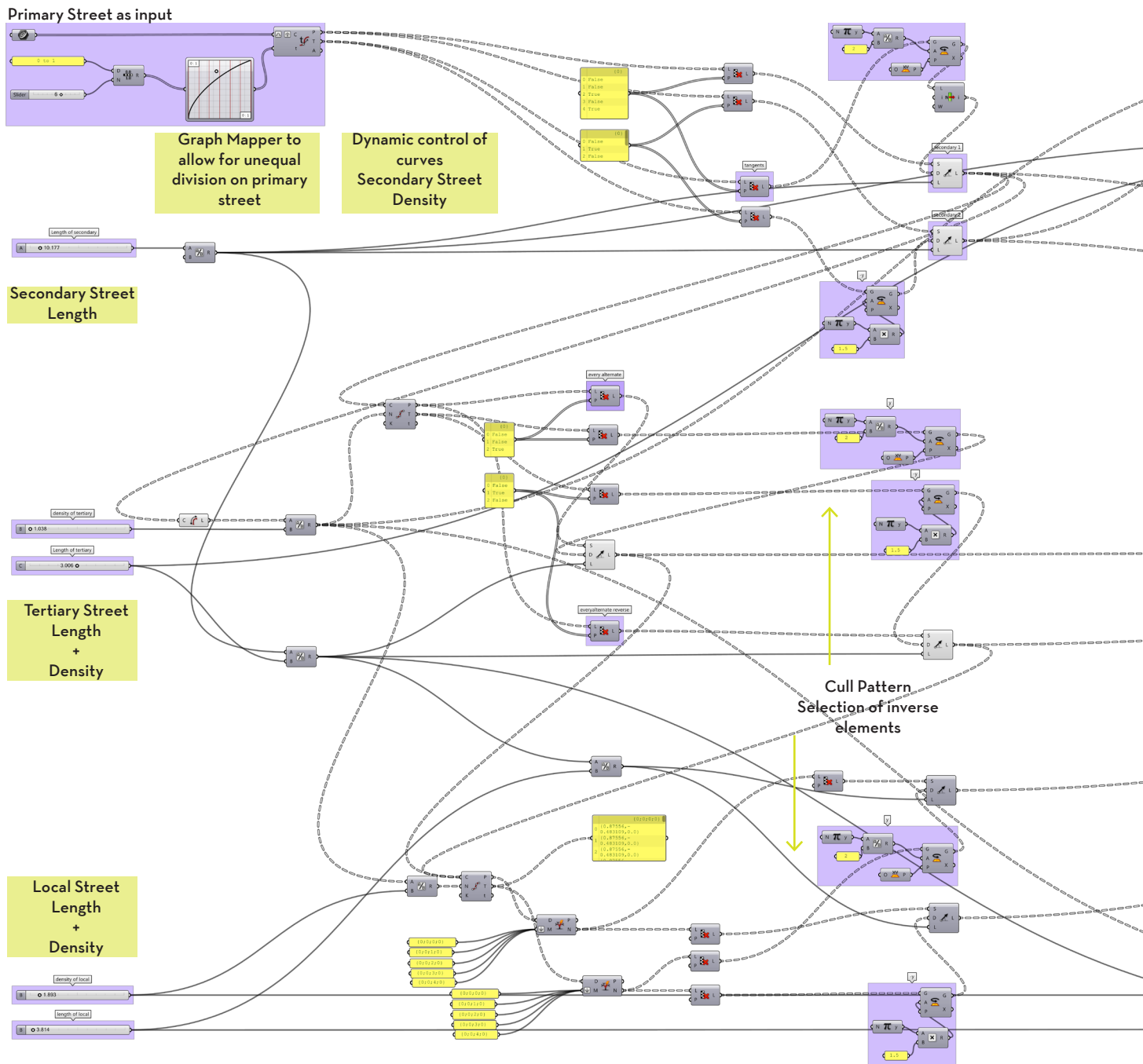
Generated Through Grasshoper Script - 1



[FIGURE 7.7] New street patterns generated by manipulating attractors within the same field

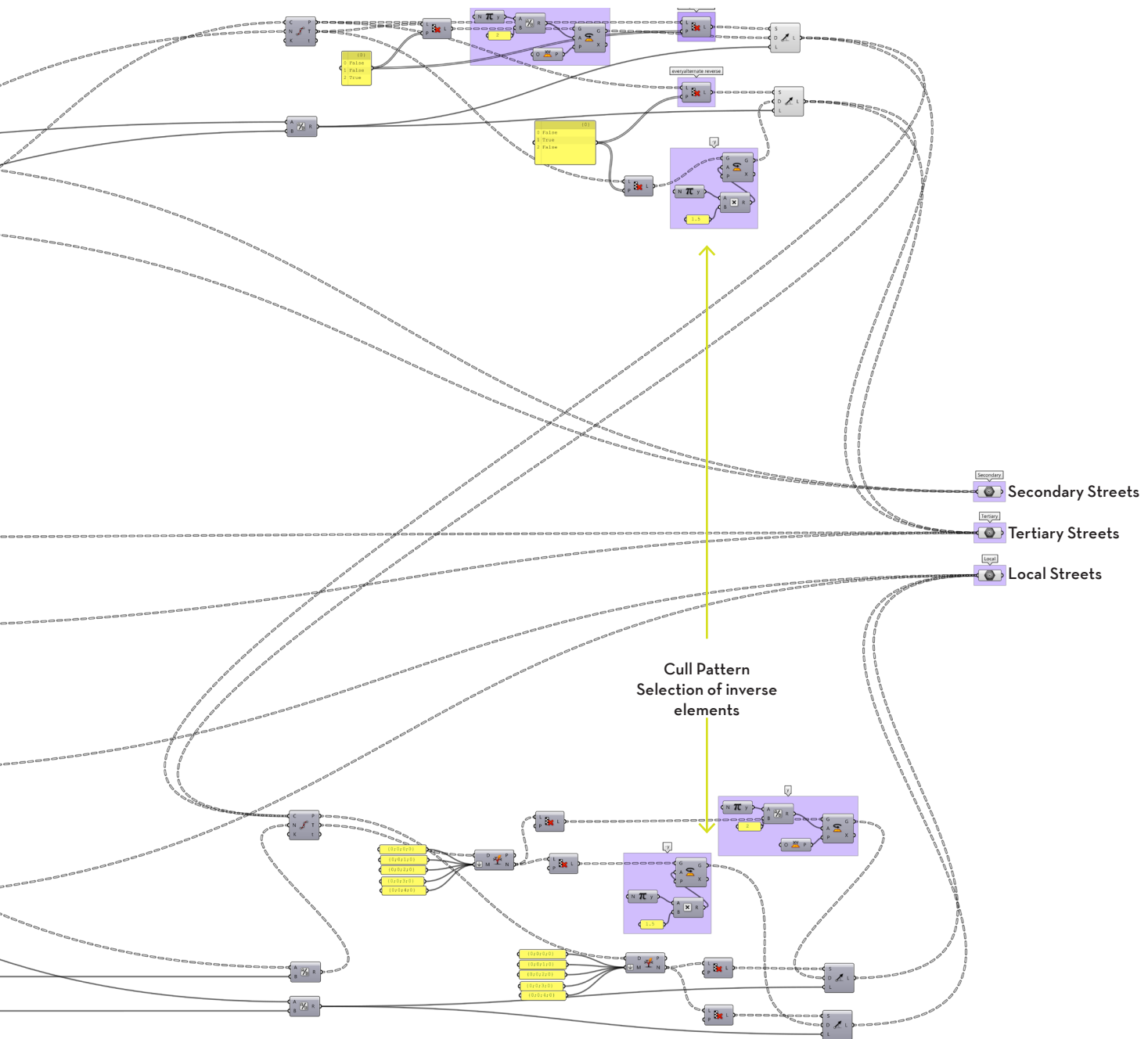
# SCRIPTING STREET NETWORK (ORTHO)

## Generating Secondary, Tertiary And Local Streets from Primary Streets



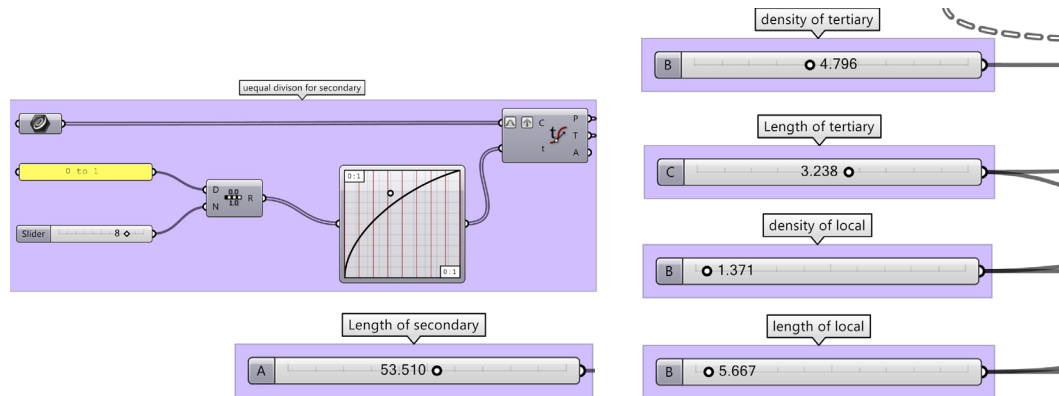
Length and density of all streets are relative, thus changing parameter for any street affects growth pattern of all other streets.

[FIGURE 7.8] Grasshopper Script - 2  
Generation of ortho street patterns from a primary street (Linear Attractor)

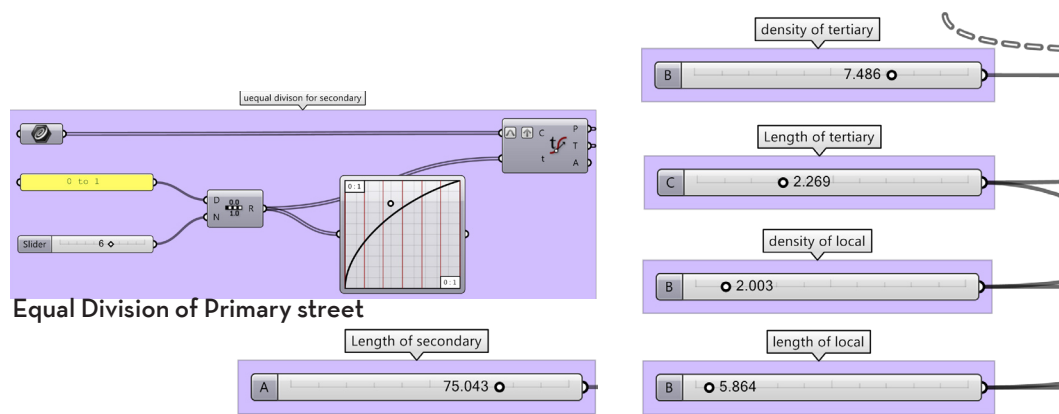


The primary street is divided into parts. From these parts, secondary streets grow which are about half the length of the primary street in the positive perpendicular direction from alternate points and negative perpendicular direction from the other alternate points. The tertiary streets follow the same logic in relation to the secondary and so do the local streets. The density and length of each street is kept as a variable and can be manipulated to generate a highly dynamic urban network.

### Settings for Output 1

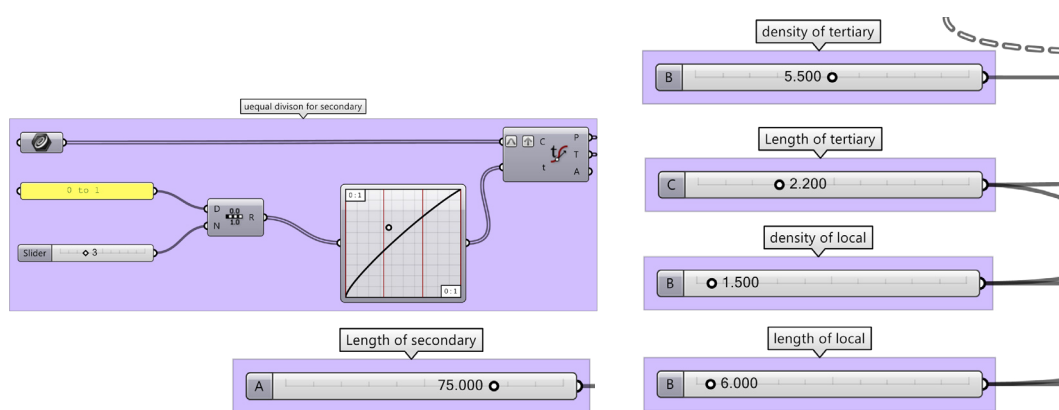


### Settings for Output 2



Equal Division of Primary street

### Settings for Output 3



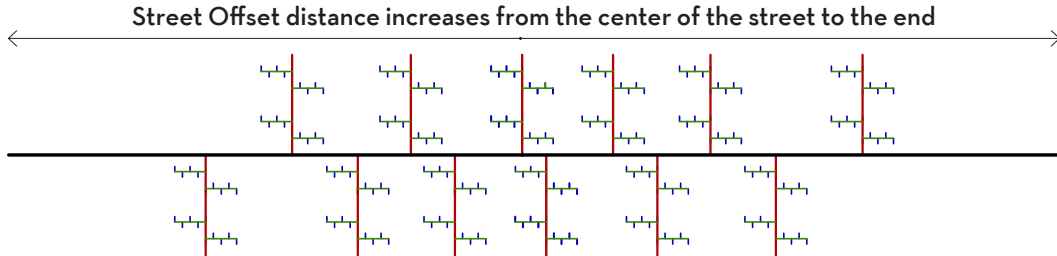
[FIGURE 7.9.1] Modification of Quantitative Determinants (length and density) in GH Script -2 to generate different street patterns



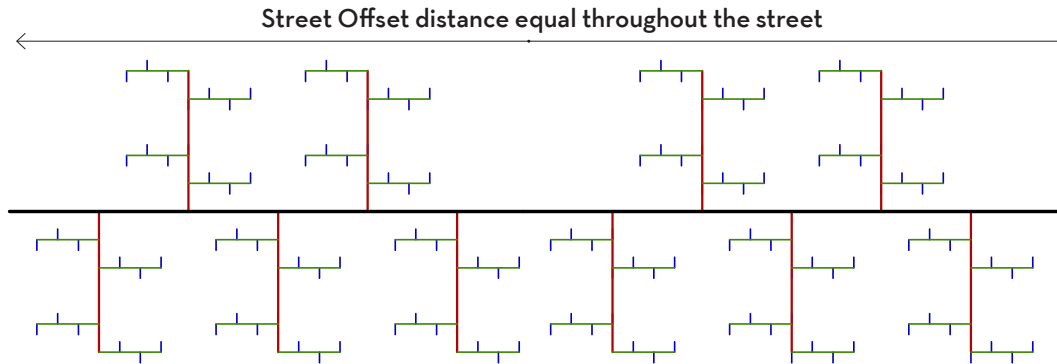
# SCRIPTING STREET NETWORK - PRIMARY STREET

Street Network diagrams along a primary street and it's associated branching organizations

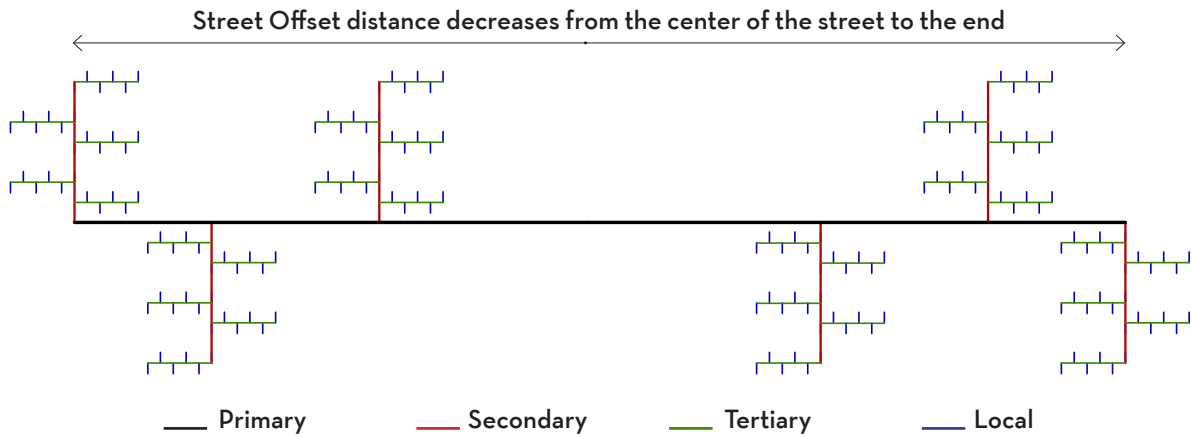
## Output 1 Old Delhi fabric



## Output 2

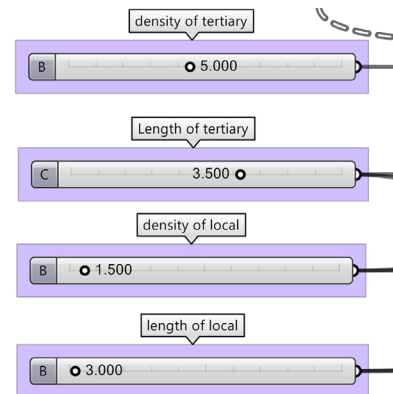
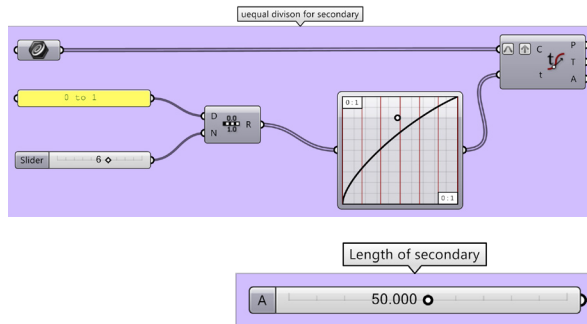


## Output 3

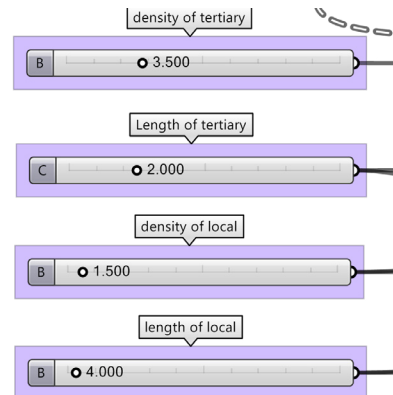
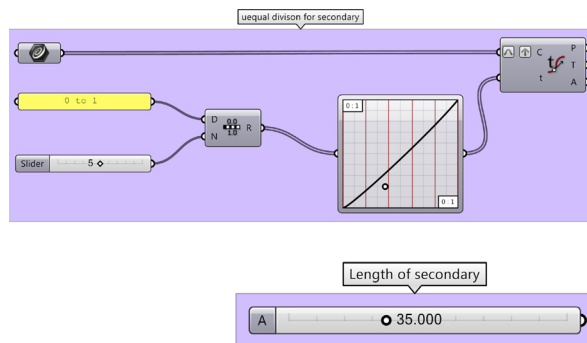


[FIGURE 7.9] Generation of street patterns of varying densities using GH Script -2

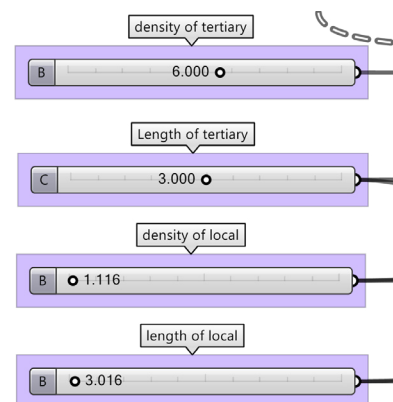
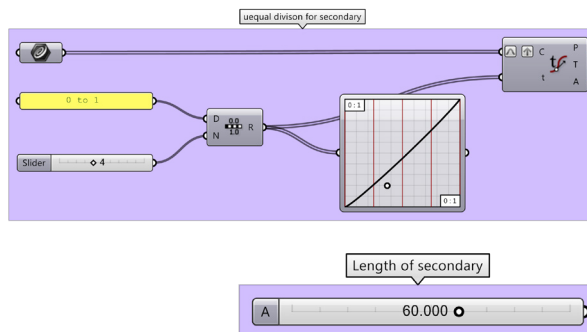
### Settings for Output 1



### Settings for Output 2



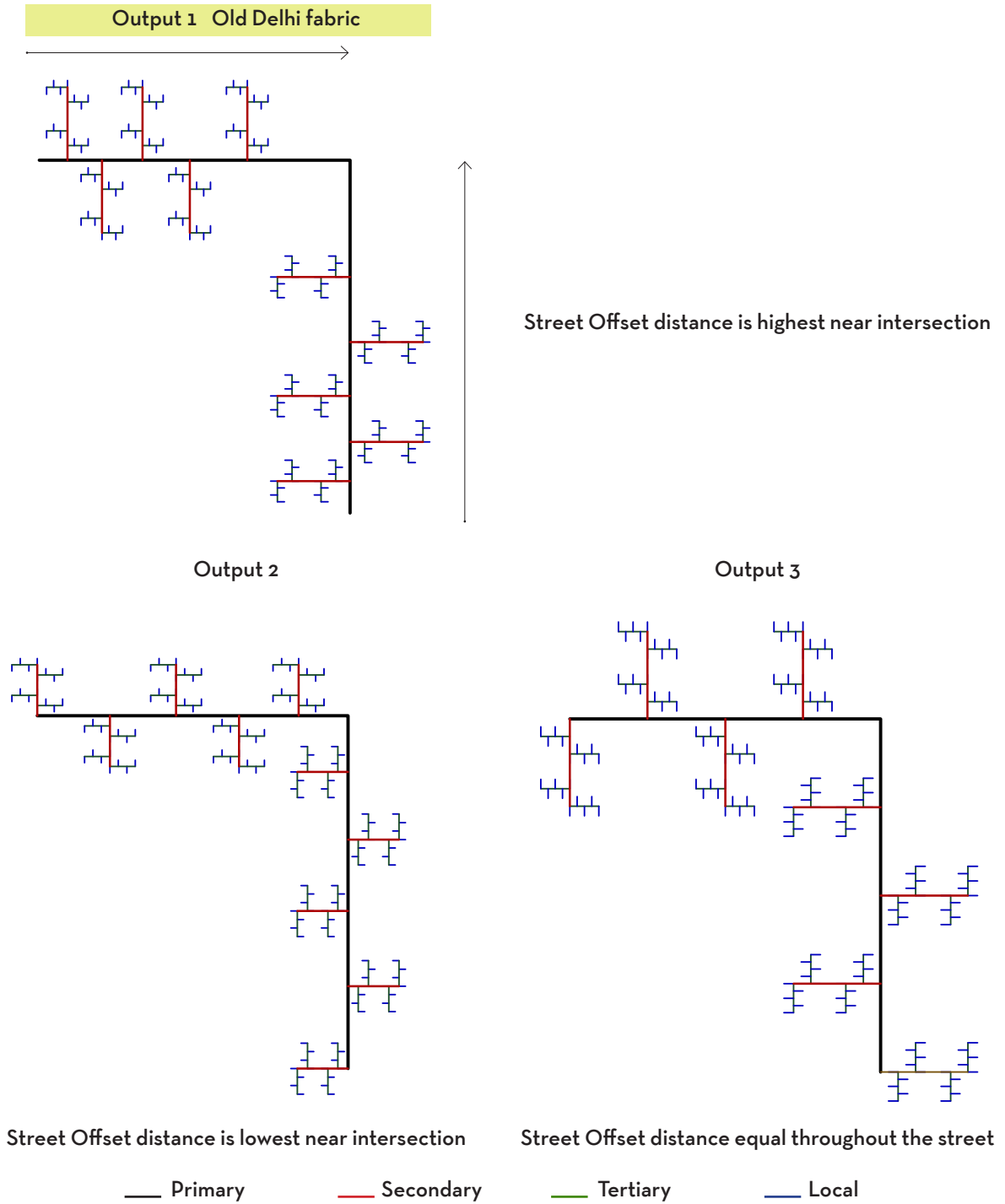
### Settings for Output 3



[FIGURE 7.10.1] Modification of Quantitative Determinants ( length and density) in GH Script -2 to generate different street patterns

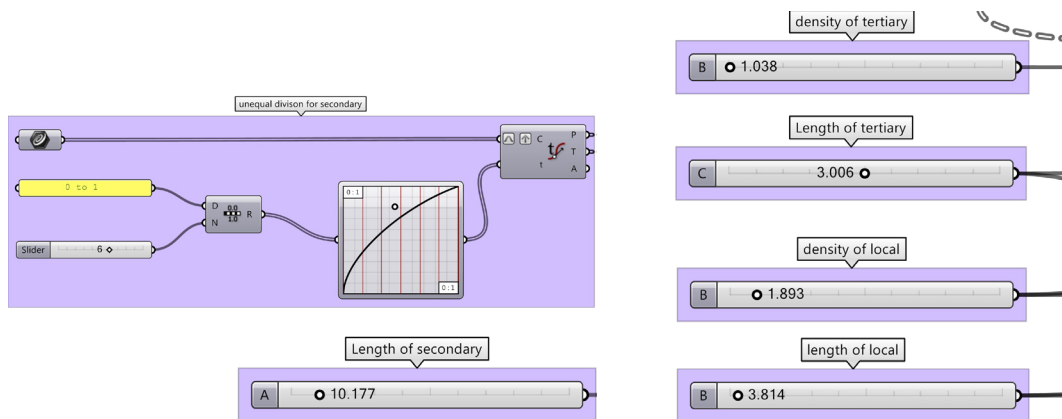
## SCRIPTING STREET NETWORK - 2 PRIMARY STREETS

Street Network diagrams through a two street intersection and its associated branching organizations

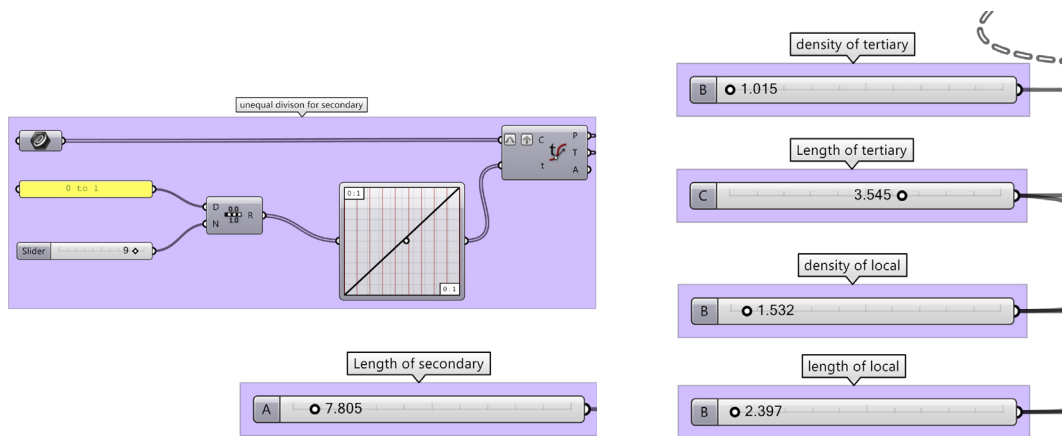


[FIGURE 7.10] Generation of street patterns of varying densities using GH Script -2

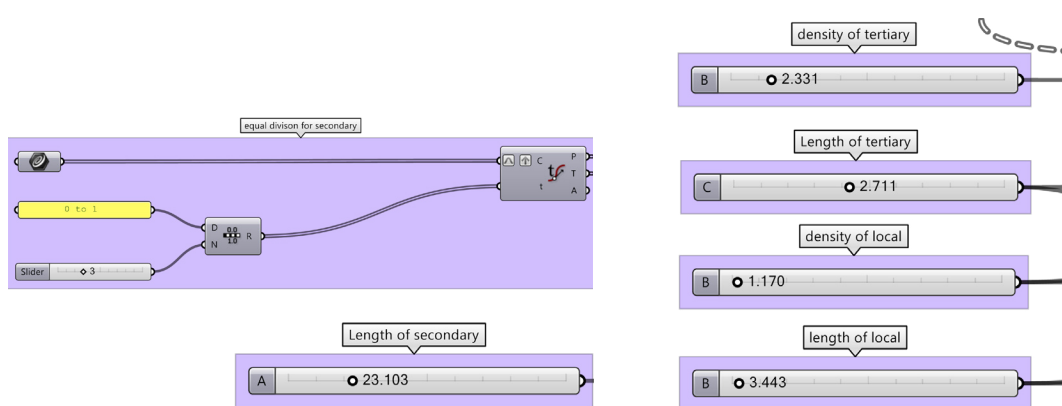
### Settings for Output 1



### Settings for Output 2



### Settings for Output 3

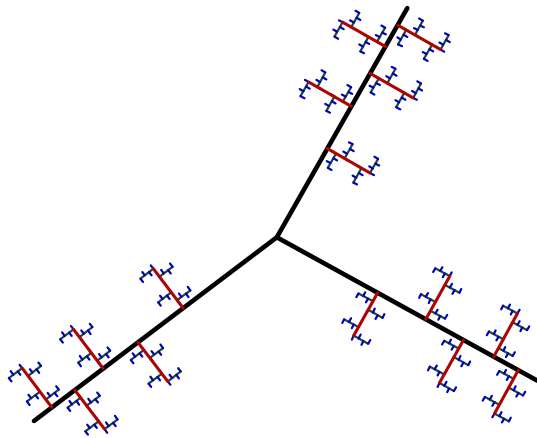


[FIGURE 7.11.1] Modification of Quantitative Determinants ( length and density) in GH Script -2 to generate different street patterns

## SCRIPTING STREET NETWORK - 3 PRIMARY STREETS

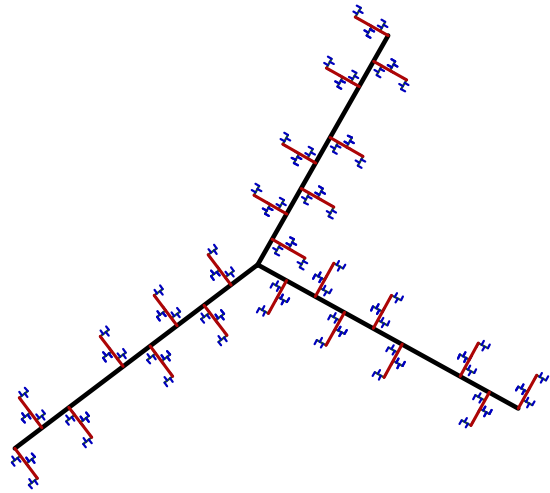
Street Network diagrams through a three street intersection and it's associated branching organizations

Output 1 Old Delhi fabric



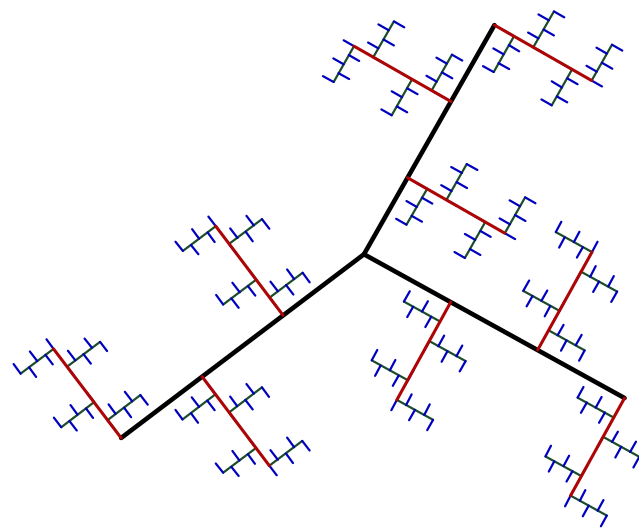
Street Offset distance is highest near intersection

Output 2



Street Offset distance is lowest near intersection

Output 3



Street Offset distance equal throughout all streets

— Primary

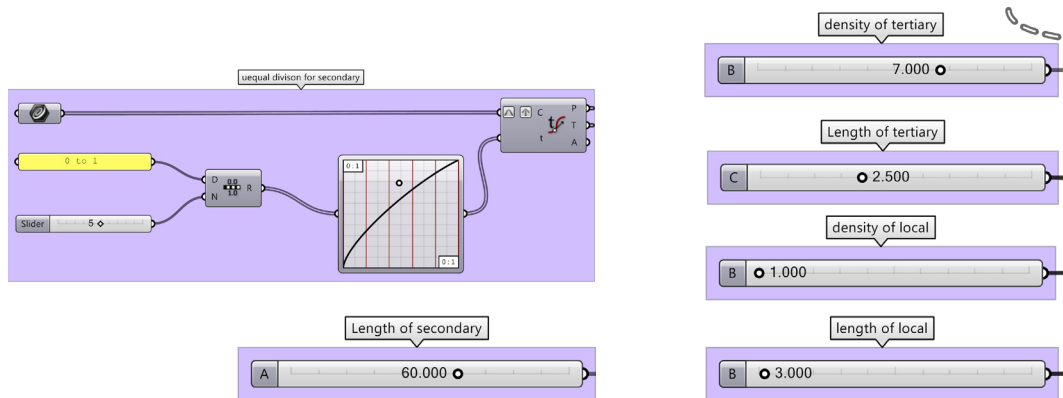
— Secondary

— Tertiary

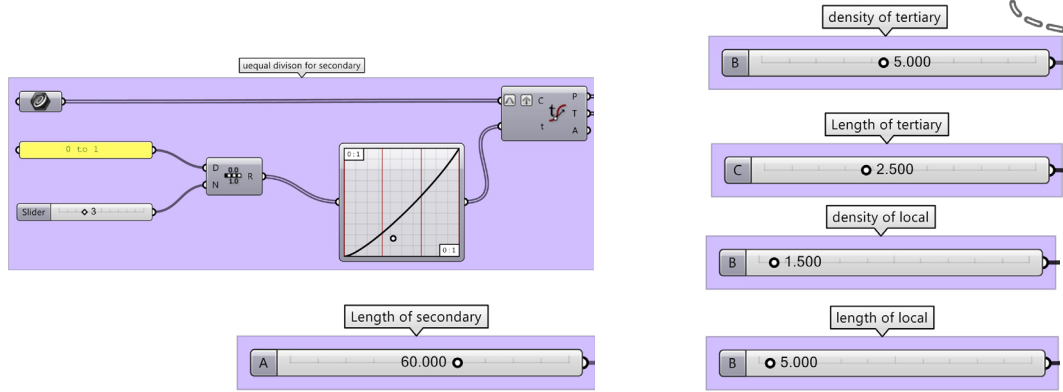
— Local

[FIGURE 7.11] Generation of street patterns of varying densities using GH Script -2

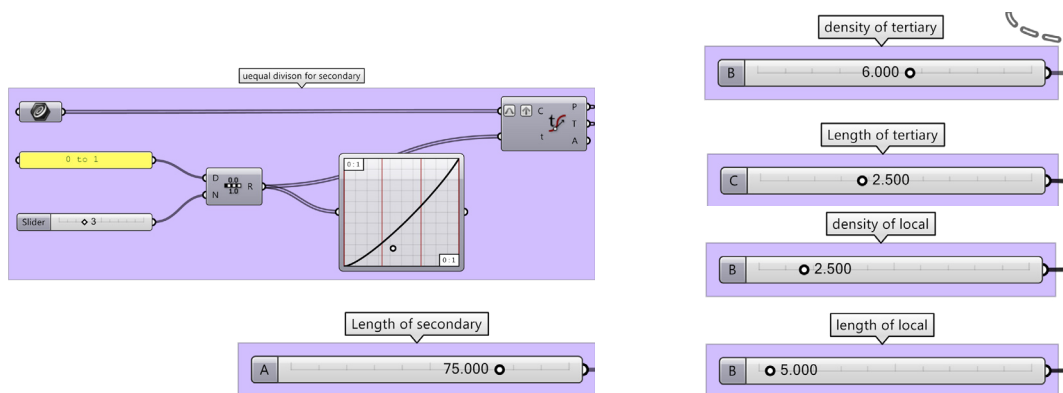
### Settings for Output 1



### Settings for Output 2



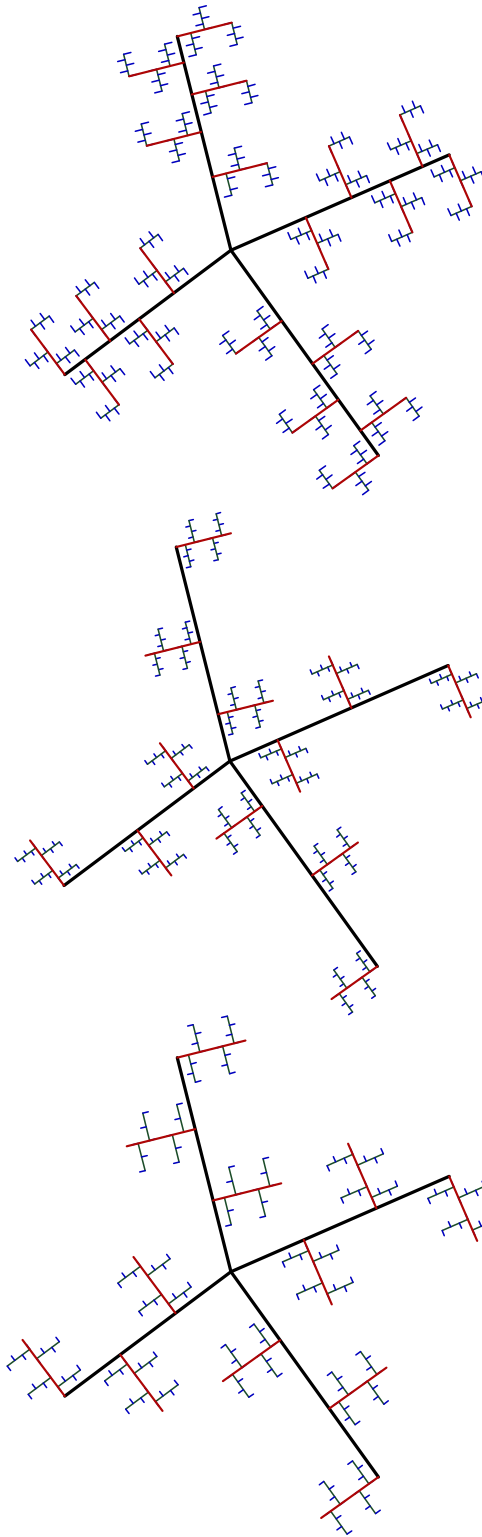
### Settings for Output 3



[FIGURE 7.12.1] Modification of Quantitative Determinants ( length and density) in GH Script -2 to generate different street patterns

## SCRIPTING STREET NETWORK - 4 PRIMARY STREETS

Street Network diagrams through a four street intersection and it's associated branching organizations



Output 1 Old Delhi fabric

Street Offset distance is highest near intersection

Output 2

Street Offset distance is lowest near intersection

Output 3

Street Offset distance equal throughout all streets

Primary — Tertiary —  
Secondary — Local —

[FIGURE 7.12] Generation of street patterns of varying densities using GH Script -2





## SCRIPTING NEIGHBOURHOODS - 'KATRA'

---

### Urban Infill : A case of micro-communities within a 'katra' boundary

*The primary street patterns give rise to territories that are closed boundary conditions within which secondary, tertiary and local streets develop. Each dead-end street inside the boundary, caters to a land parcel. The parcel is then filled with buildings that together give rise to the urban fabric.*

Urban Fabric is generated by varying the arrangement of buildings (buildings are depicted as points) inside the boundary. Two types of point arrangement is considered :

FAMILY A Points arranged parallel to parcel boundary

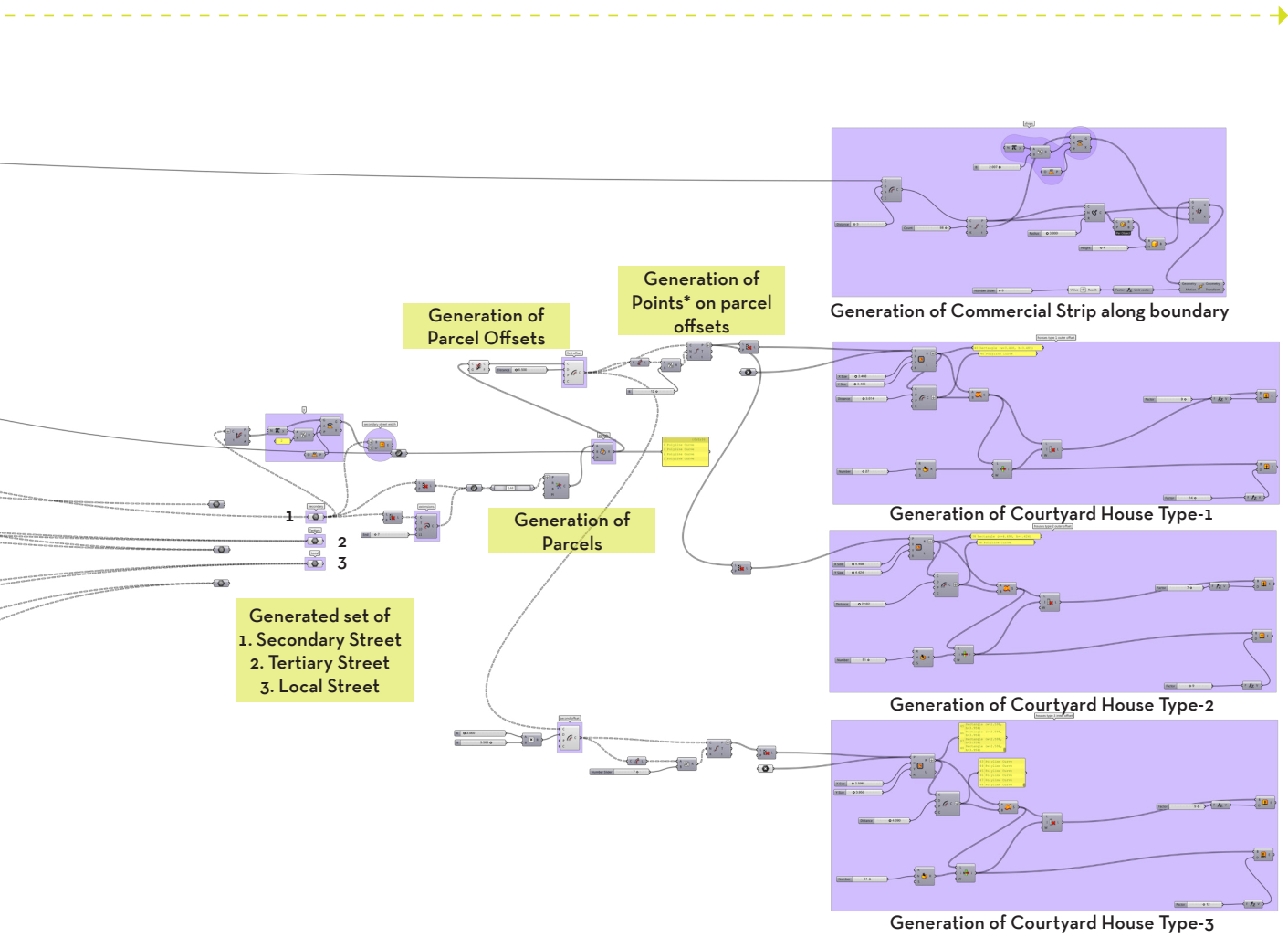
FAMILY B Points arranged in a rectangular array, parallel to the secondary street

The territorial organization and density within each boundary are manipulated by varying the following parameters to generate multiple design iterations -

1. Number of secondary streets inside the boundary (each secondary street caters to one land parcel)
2. Open vs built ratio for courtyard houses
3. Proportion of building plot size
4. Height of buildings
5. Footprint and height of shops on the periphery of the boundary



AUTOMATED RULE INFERENCE  
3D MODEL



\* Each point corresponds to the location of a courtyard house

\*\* Each parameter has been assigned with suitable magnitudes and constraints and all outputs are relative.

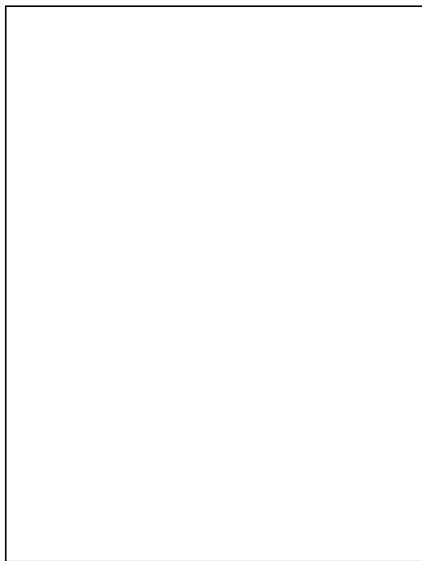
## SCRIPTING NEIGHBOURHOODS - 'KATRA'

Diagrams showing procedural growth logic of urban fabric in neighbourhoods

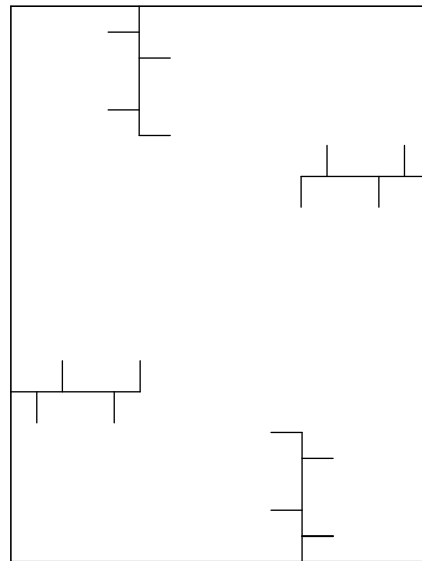
[FIGURE 7.14] Outputs from Grasshopper Script - 3.1

Generation of buildings within a neighbourhood boundary by variation of multiple points

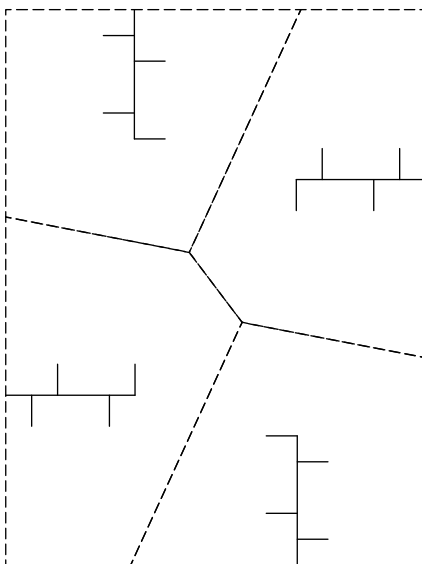
FAMILY 'A' - CASE 1 : Points arranged parallel to parcel boundary



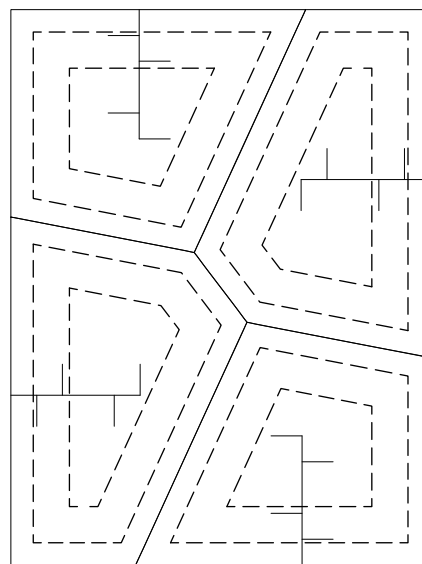
A. Closed Neighbourhood Boundary



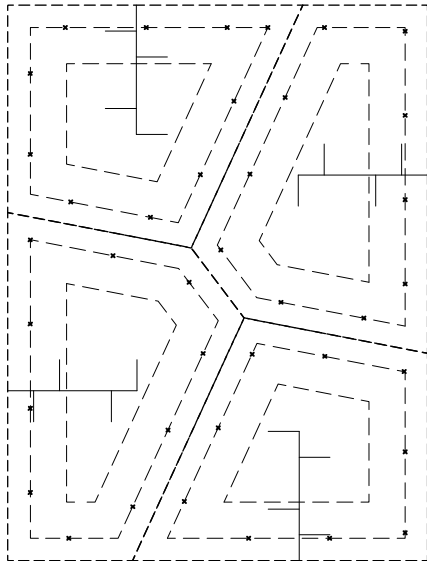
B. Generation of secondary streets within boundary as per rules



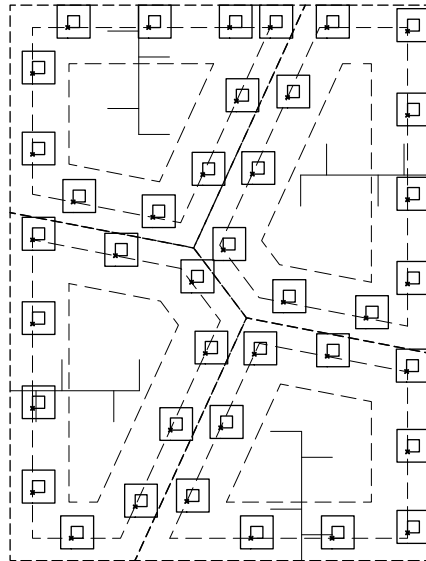
C. Secondary streets generate sub-divisions called Parcels



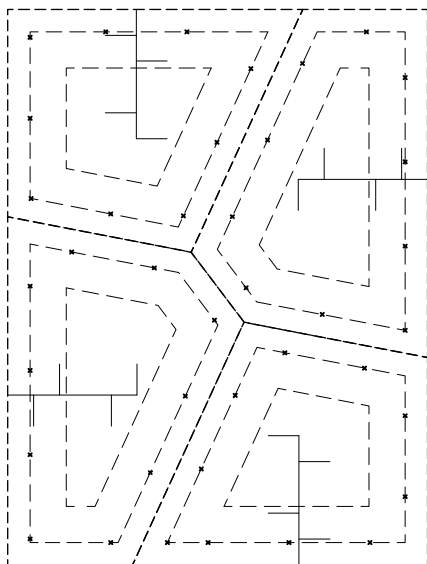
D. Parcel Offsets are generated as per required density



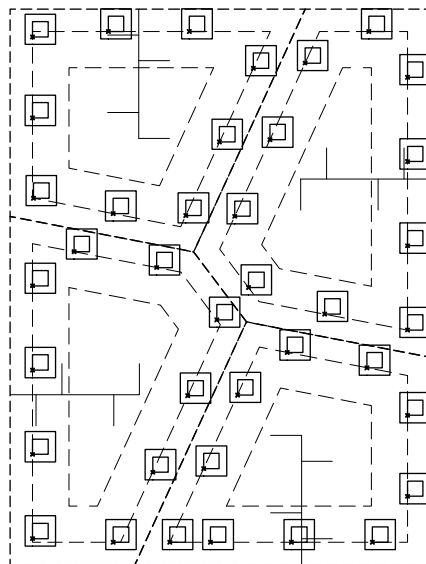
**E. Generation of points on parcel offset-1 as per required density**



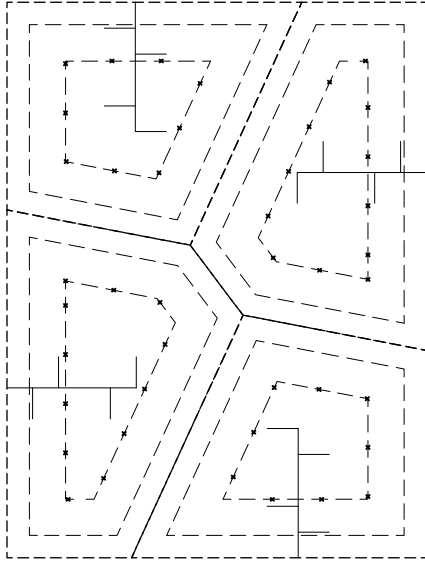
**F. Each point corresponds to a courtyard house-1 (open vs built and height vary)**



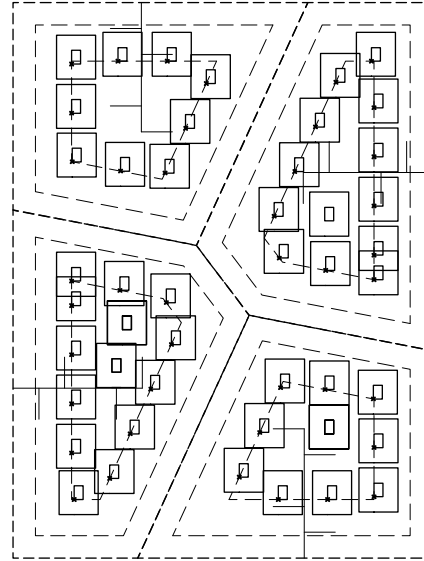
**G. Generation of more points on parcel offset-1 as per required density**



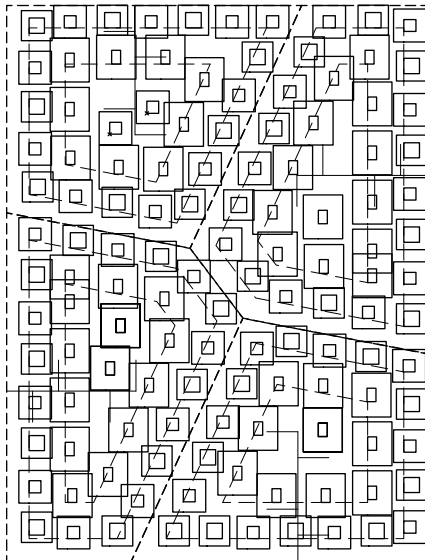
**H. Each point corresponds to a courtyard house-2 (open vs built and height vary)**



I. Generation of points on parcel offset-2 as per required density



J. Each point corresponds to a courtyard house-3 (open vs built and height vary)



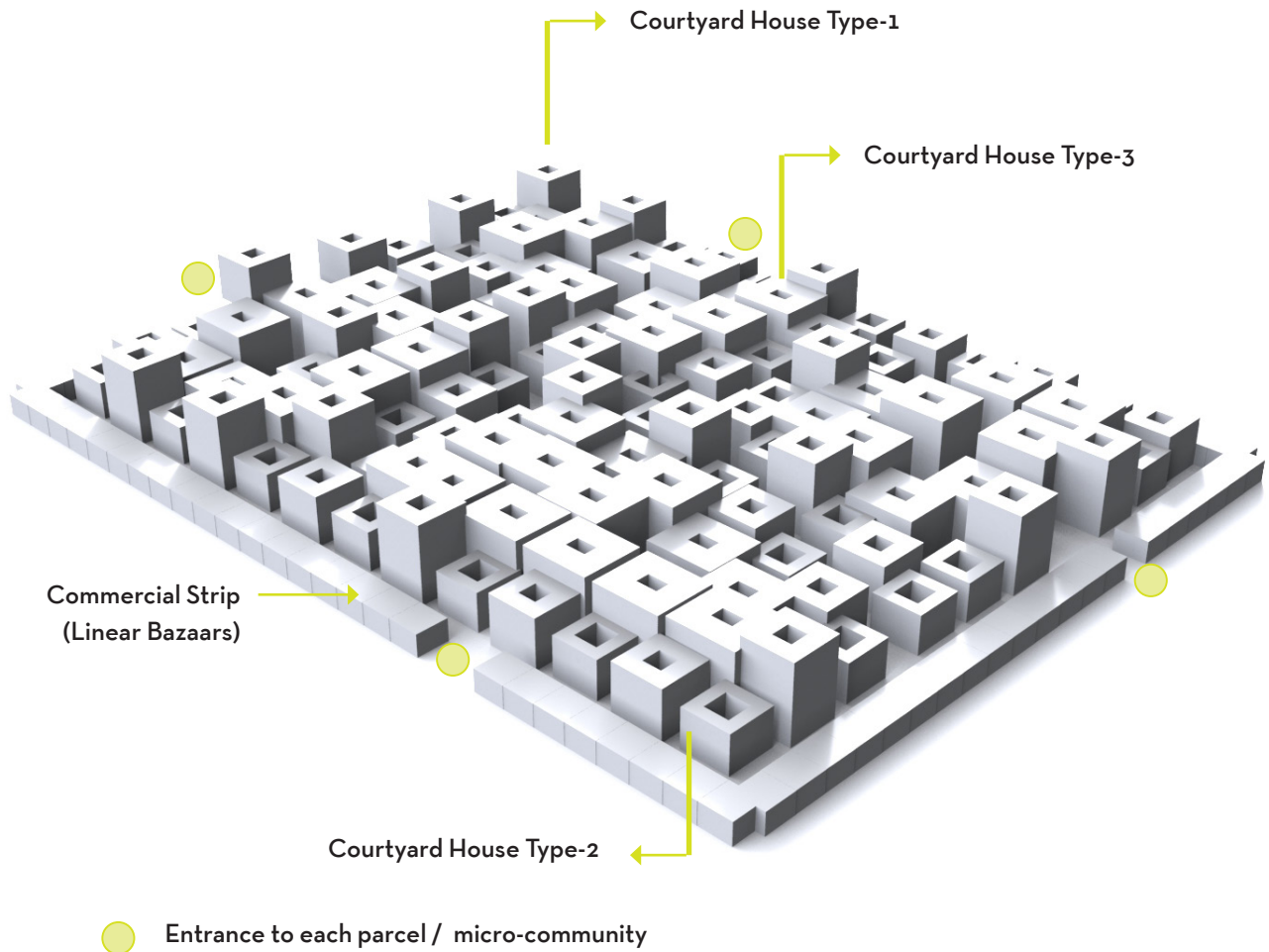
K. Urban Fabric generated

#### Varying Parameters:

1. Number of Secondary streets : 4
2. Number of parcels : 4
3. Number of parcel offsets : 2
4. Arrangement of points within parcel boundary : Parallel to Parcel boundary
5. Distance between parcel offsets
6. Open vs Built Ratio and height of courtyard buildings
7. Shops around boundary : Width and height of commercial strip (check present vs ideal scenario)

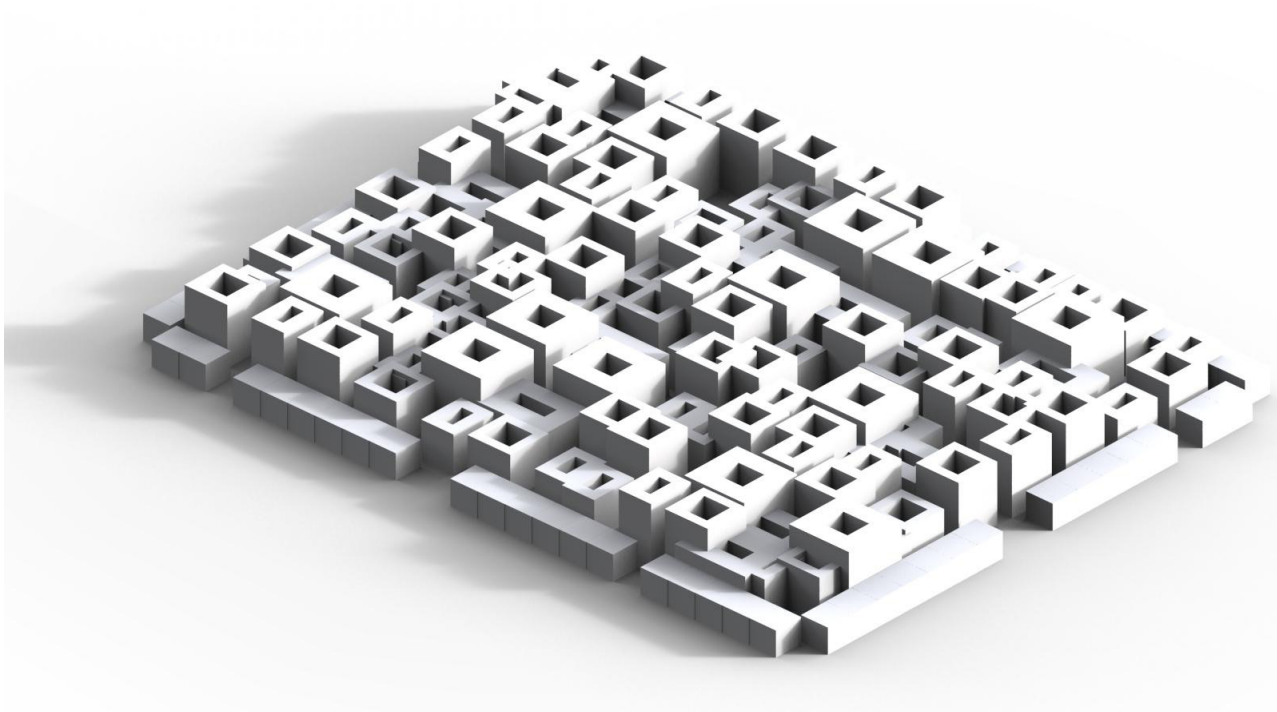
## CASE 1

### Courtyard Houses Aligned To Parcel Boundaries

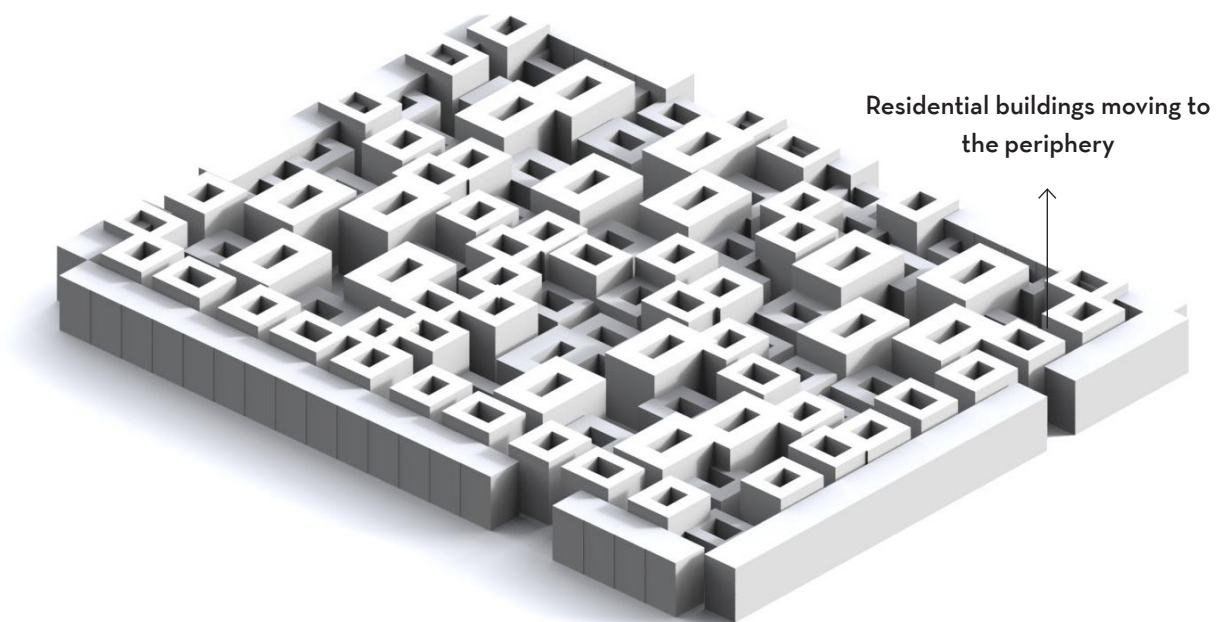


[FIGURE 7.14.1] Iteration - 1 : Output from Grasshopper Script - 3.1

CASE 1 : VARYING DENSITIES AND INTERNAL ARRANGEMENT

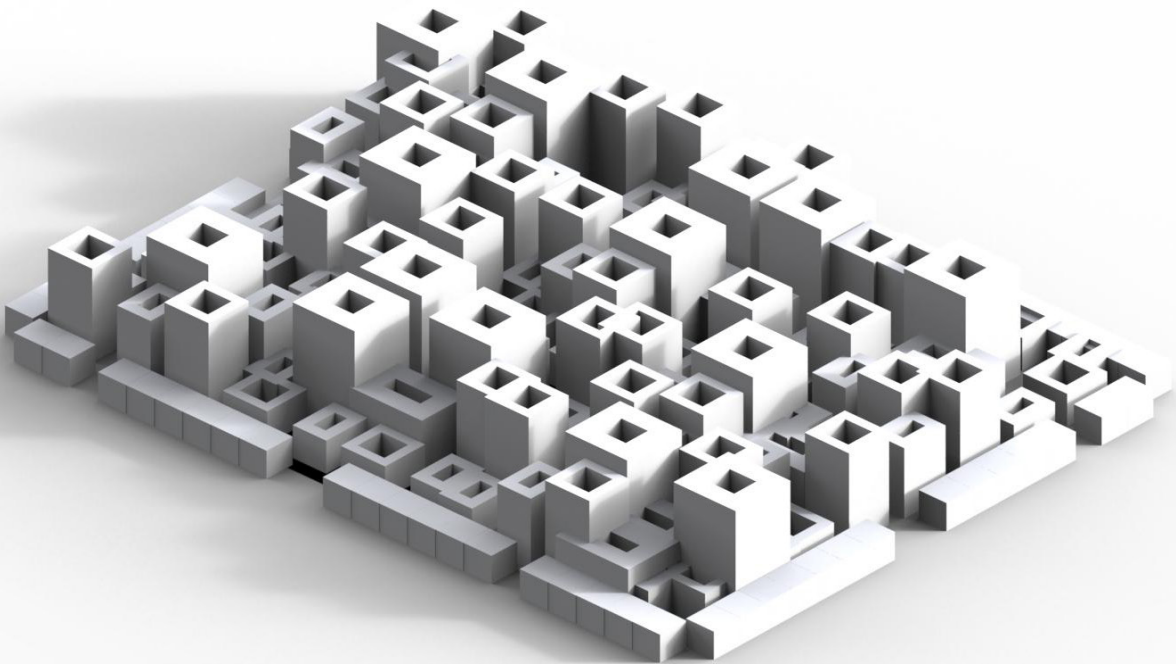


[FIGURE 7.15.2] Iteration - 2  
Number of Parcels : 4 2.5FAR



[FIGURE 7.15.3] Iteration - 3  
Number of Parcels : 4 High level of commercial Activity  
Change in size of courtyard blocks





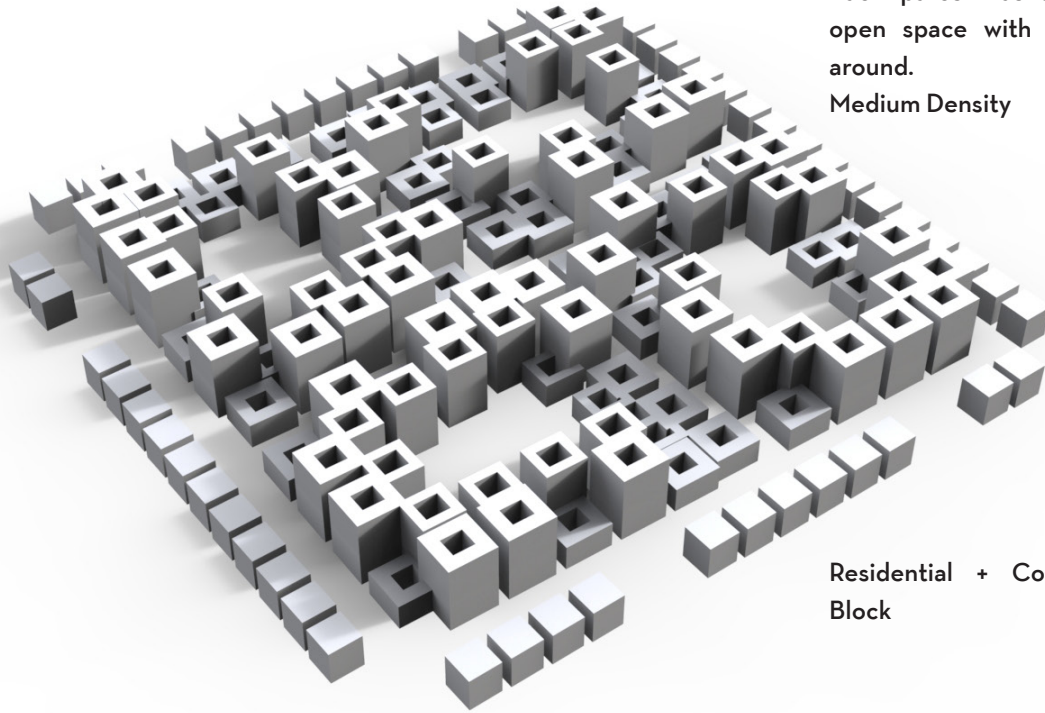
[FIGURE 7.15.4] Iteration - 4  
Number of Parcels : 4 - 4FAR

## CASE 2 : VARYING DENSITIES AND INTERNAL ARRANGEMENT

### Central Open Space

[FIGURE 7.14.5] Iteration - 5

Number of Parcels : 4

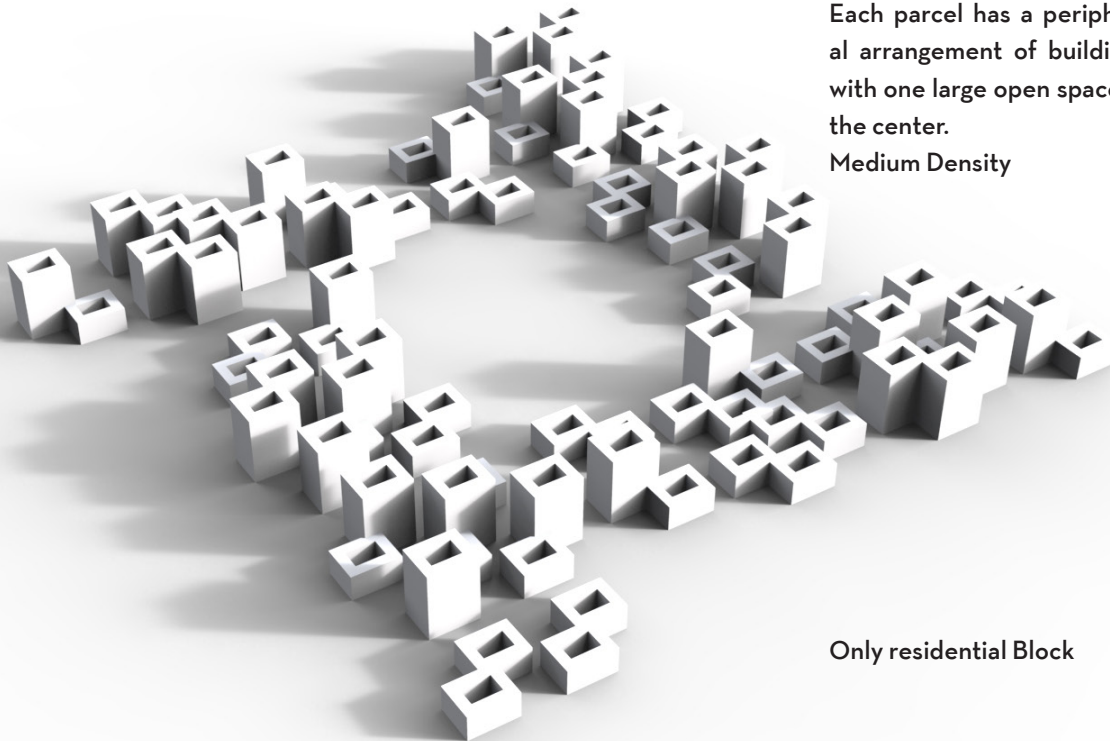


Each parcel has a central open space with buildings around.  
Medium Density

Residential + Commercial Block

[FIGURE 7.14.6] Iteration - 6

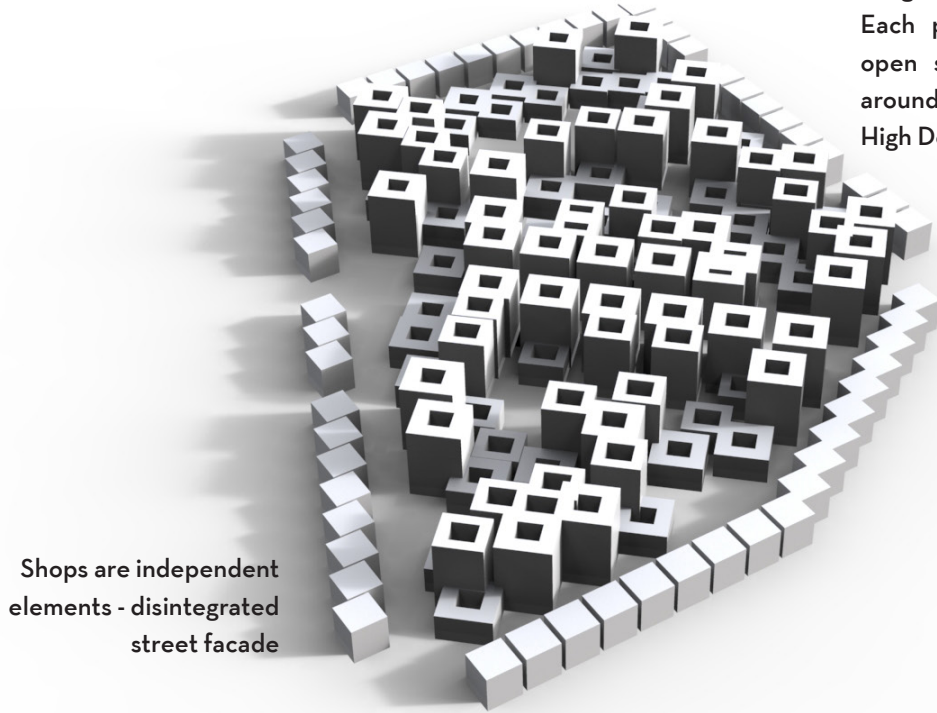
Number of Parcels : 4



Each parcel has a peripheral arrangement of buildings with one large open space in the center.  
Medium Density

Only residential Block

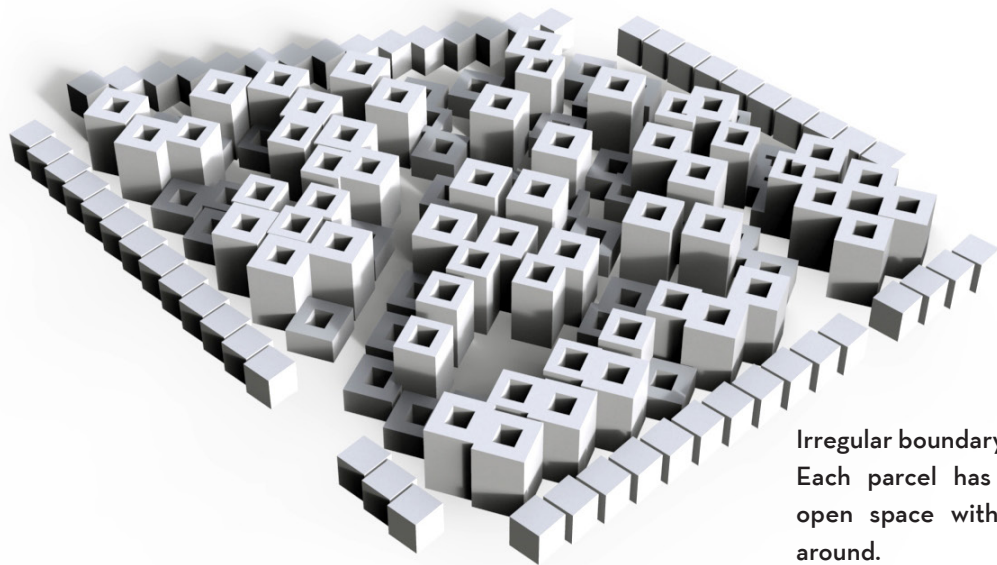
[FIGURE 7.14.7] Iteration - 7  
Number of Parcels : 5



Irregular boundary  
Each parcel has a central  
open space with buildings  
around.  
High Density

Shops are independent  
elements - disintegrated  
street facade

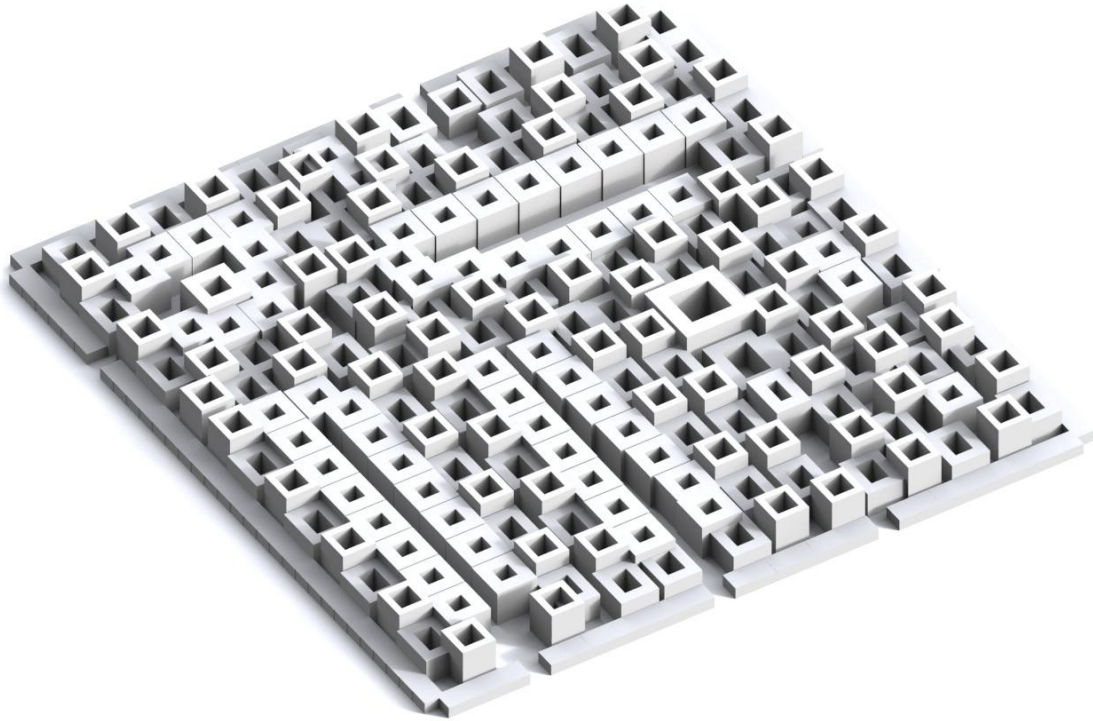
[FIGURE 7.14.8] Iteration - 8  
Number of Parcels : 5



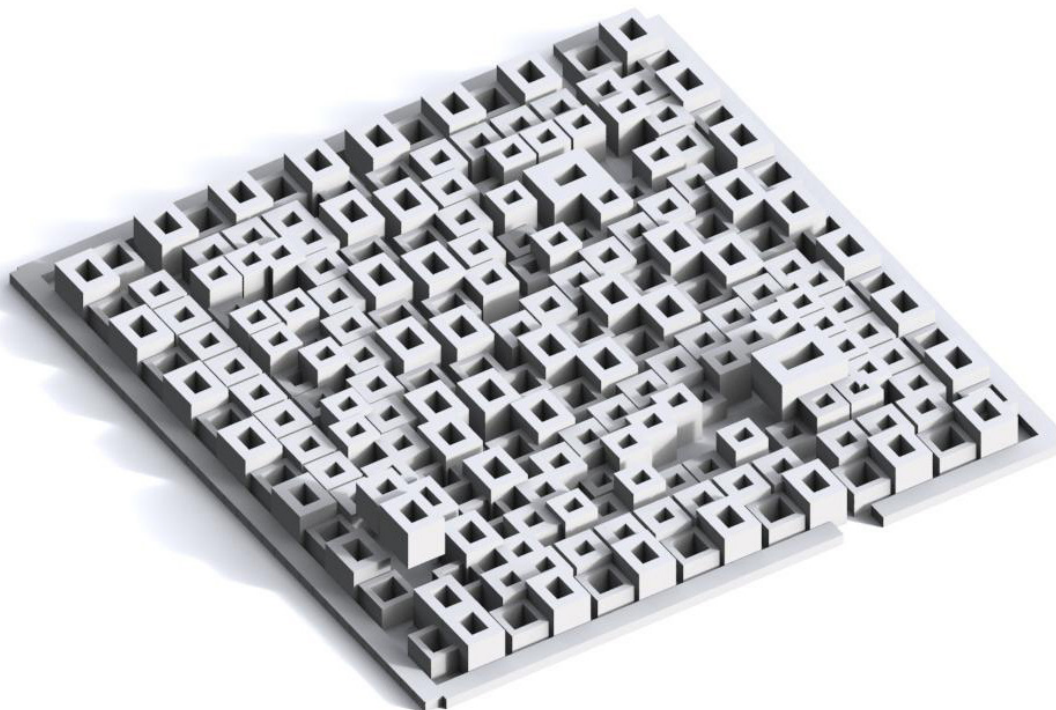
Irregular boundary  
Each parcel has a central  
open space with buildings  
around.  
High Density

### CASE 3 : VARYING DENSITIES AND INTERNAL ARRANGEMENT

Closely Packed Fabric With Different Scales Of Courtyard Houses And Dead End Streets

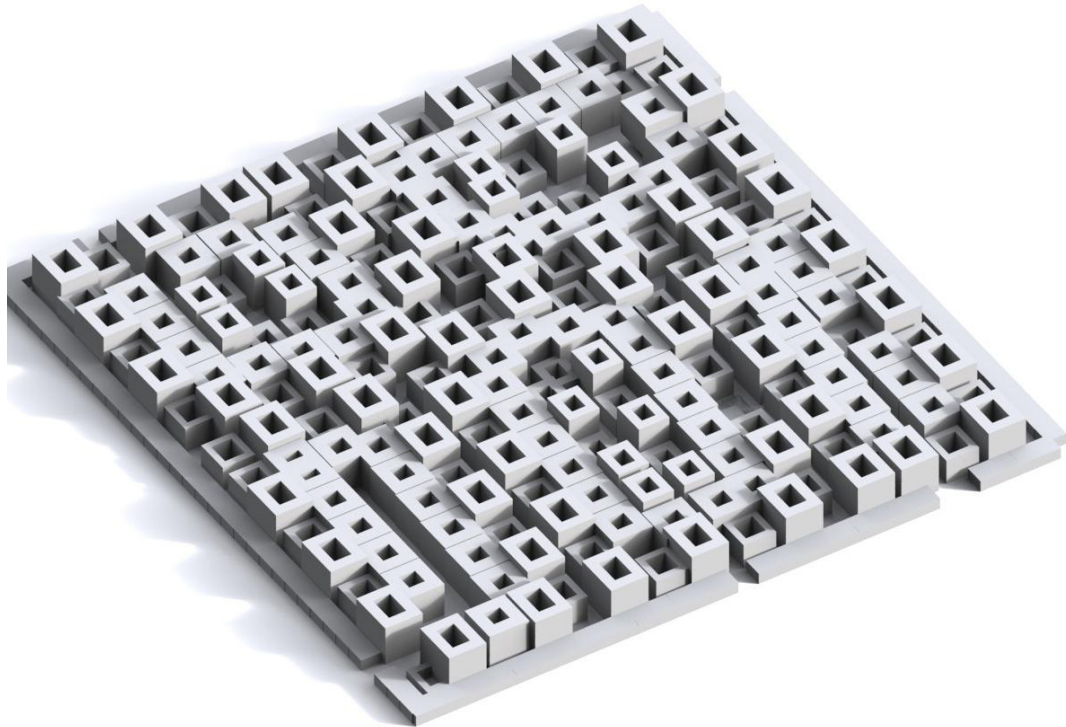


[FIGURE 7.14.9] Iteration - 9  
Number of Parcels : 5 FAR 2.5

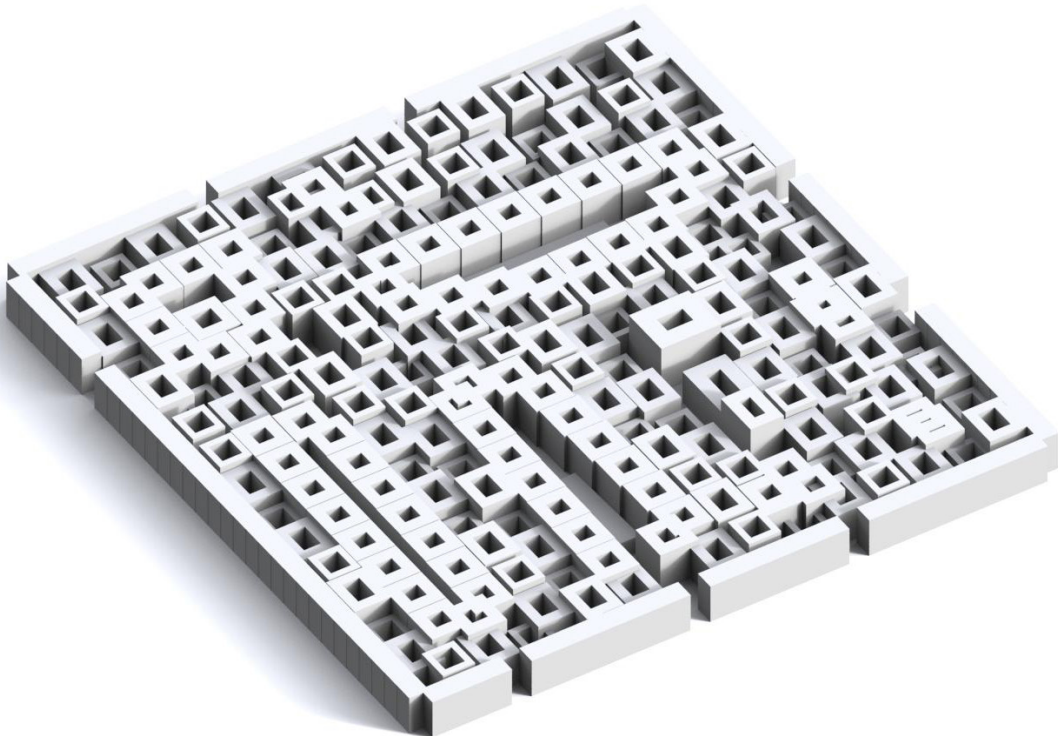


[FIGURE 7.14.10] Iteration - 12  
Number of Parcels : 3 FAR 2.5

Parcel division varies  
Optimum Density



[FIGURE 7.14.11] Iteration - 10  
Number of Parcels : 5 FAR 3



[FIGURE 7.14.12] Iteration - 11  
Number of Parcels : 5 - FAR 2.5 + Higher commercial activity

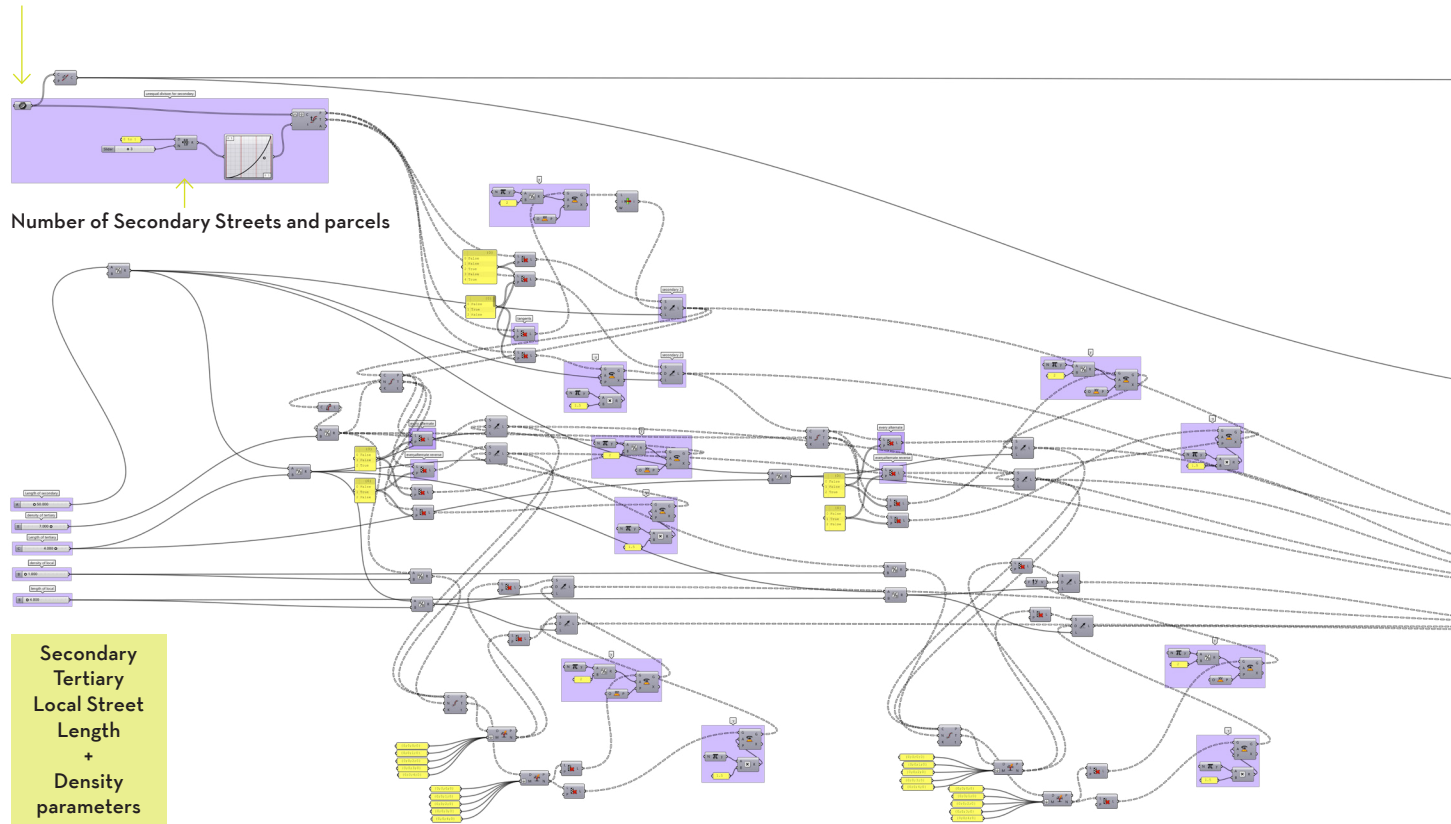
Parcel division maintained  
Density varies

# PROCEDURAL MODELLING OF A NEIGHBOURHOOD 'KATRA'

FAMILY 'B' Points arranged in a rectangular array AND/OR  
Organic Fabric [Voronoi]

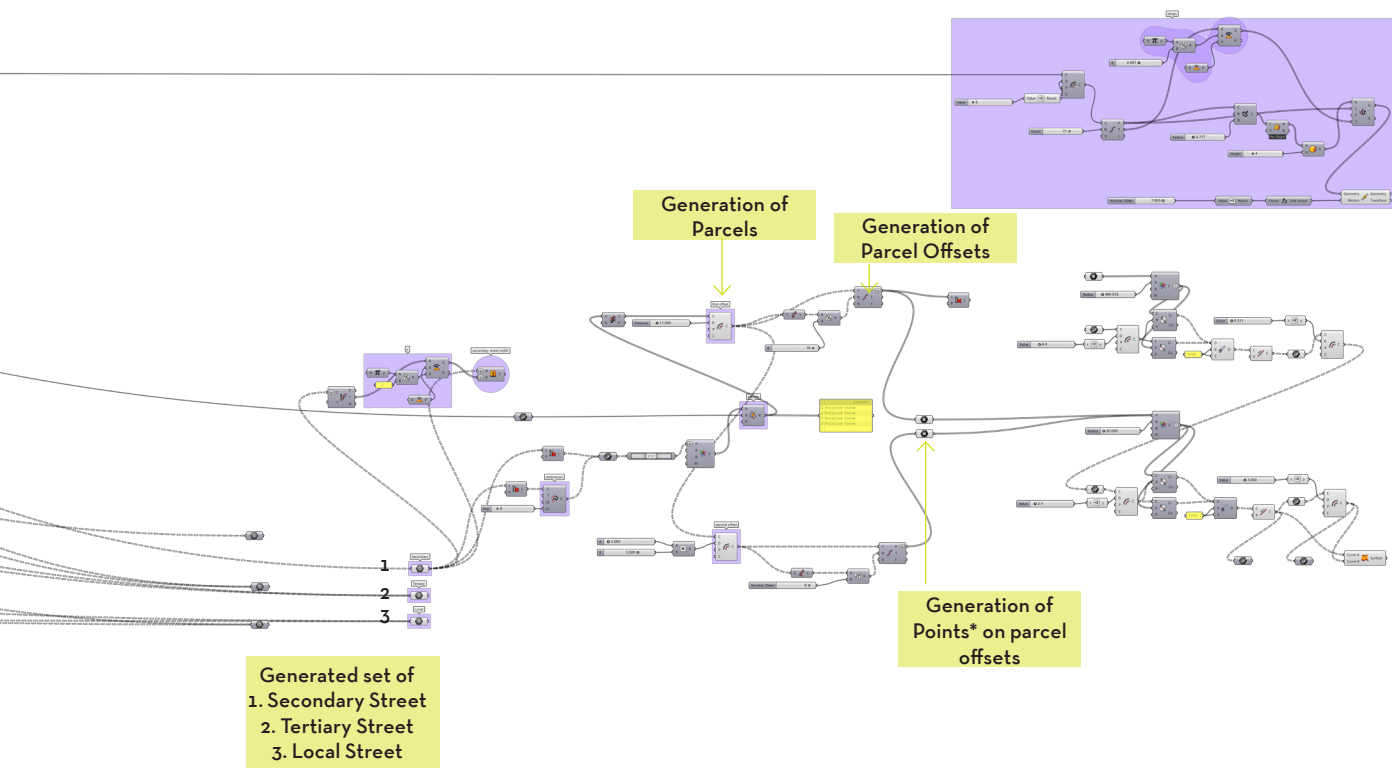
MANUALLY DESIGNED SET OF URBAN RULES  
2D DATASET

Group of Primary Streets as input to generate a closed boundary



[FIGURE 7.15] Grasshopper Script - 3.2  
Generation of buildings within a neighbourhood boundary

AUTOMATED RULE INFERENCE  
3D MODEL



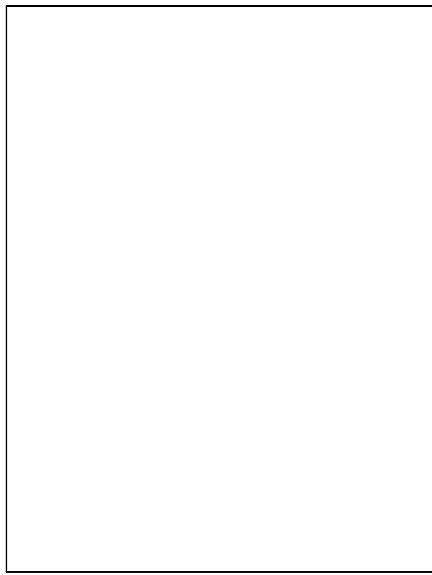
\* Each point corresponds to the location of a courtyard house

\*\* Each parameter has been assigned with suitable magnitudes and constraints and all outputs are relative.

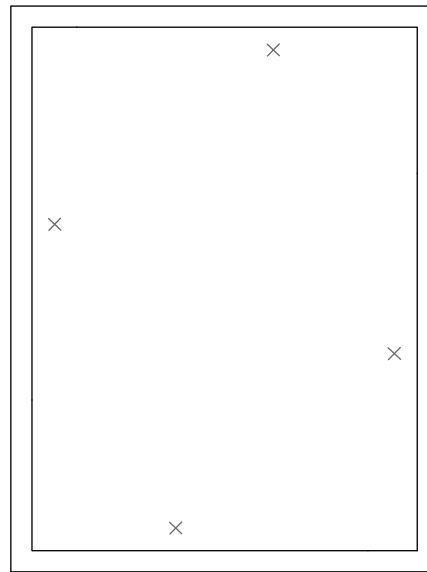
[FIGURE 7.16] Outputs from Grasshopper Script - 3.2

Generation of buildings within a neighbourhood boundary by variation of multiple points

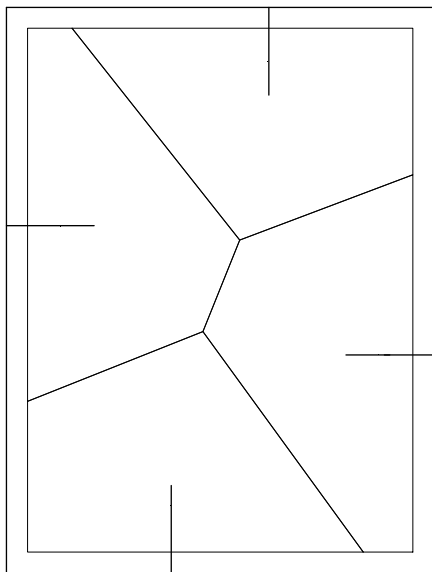
FAMILY 'B' - CASE 1 - Points arranged parallel to parcel boundary AND VORONOI



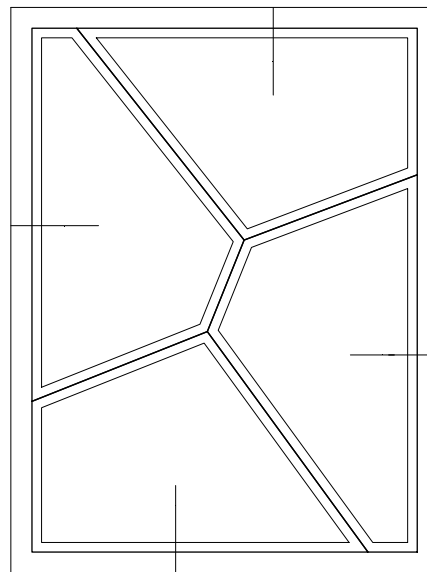
A. Closed Neighbourhood Boundary



B. Locating points to create sub-divisions within boundary and creating offsets to accommodate commercial strip along boundary

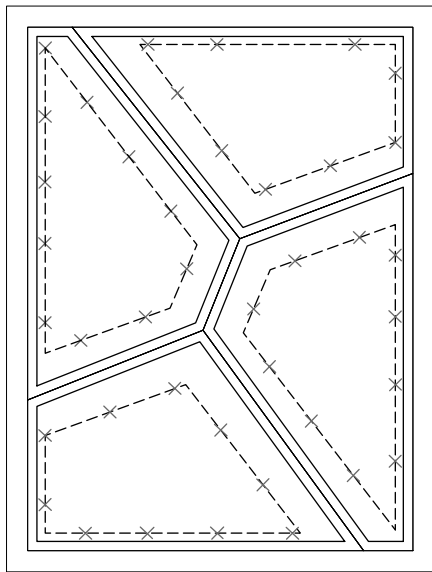


C. Secondary streets generate sub-divisions called Parcels

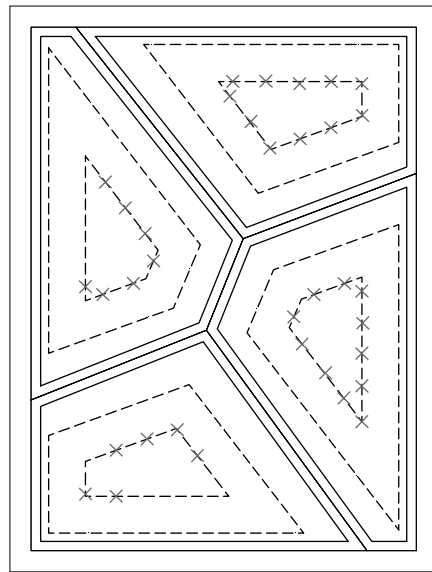


D. Parcel Offsets generated to segregate parcel boundaries

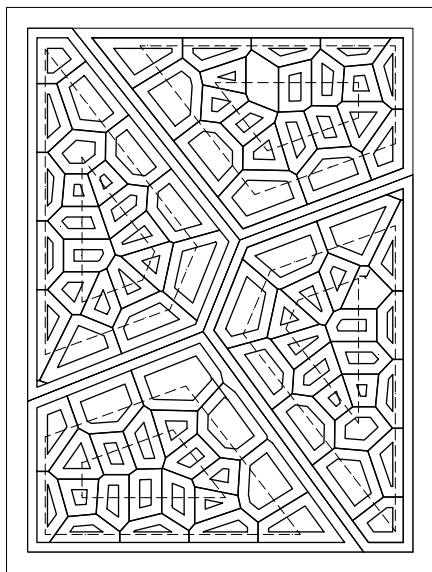




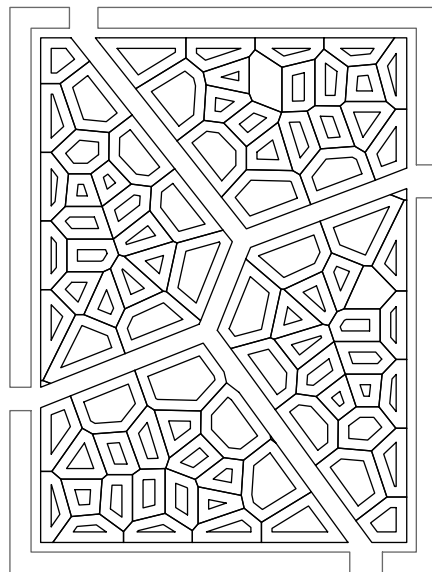
**E. Generation of points on parcel offset-1 as per required density**



**F. Each point corresponds to a courtyard house-1 (open vs built and height vary)**



**G. Generation of more points on parcel offset-1 as per required density**

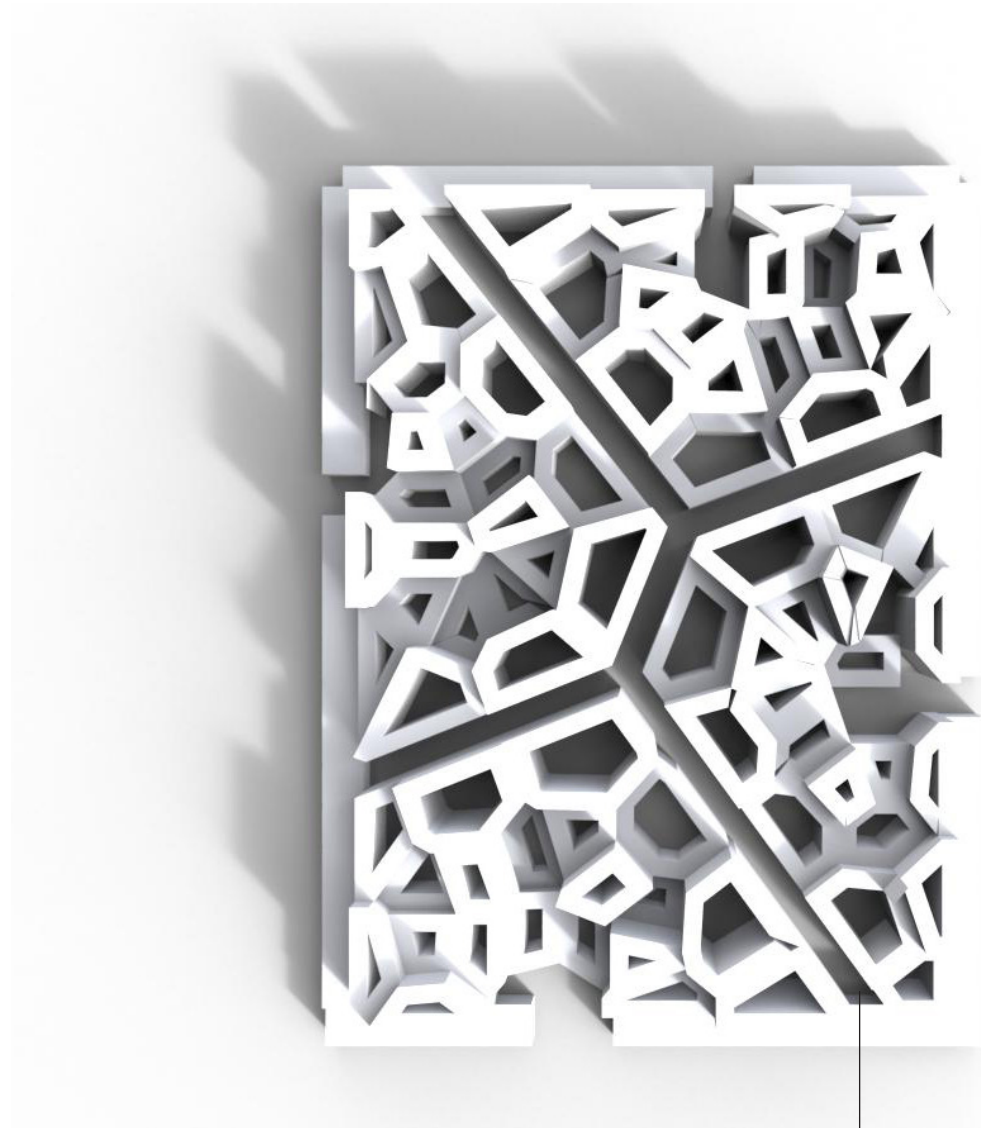


**H. Neighbourhood fabric generated**

DESIGN ITERATIONS:

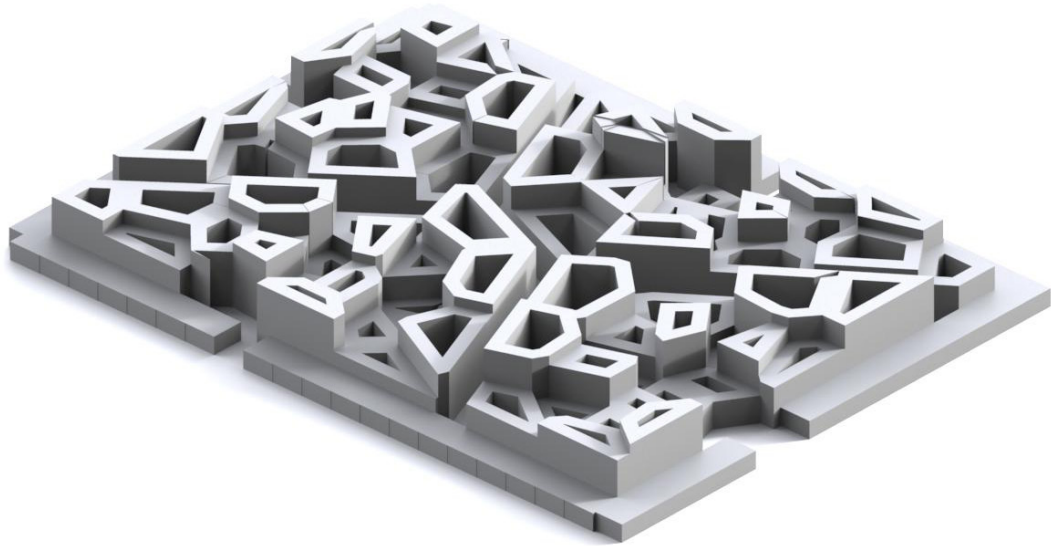
FAMILY 'B'- CASE 1 : Outputs from Grasshopper Script - 3.2

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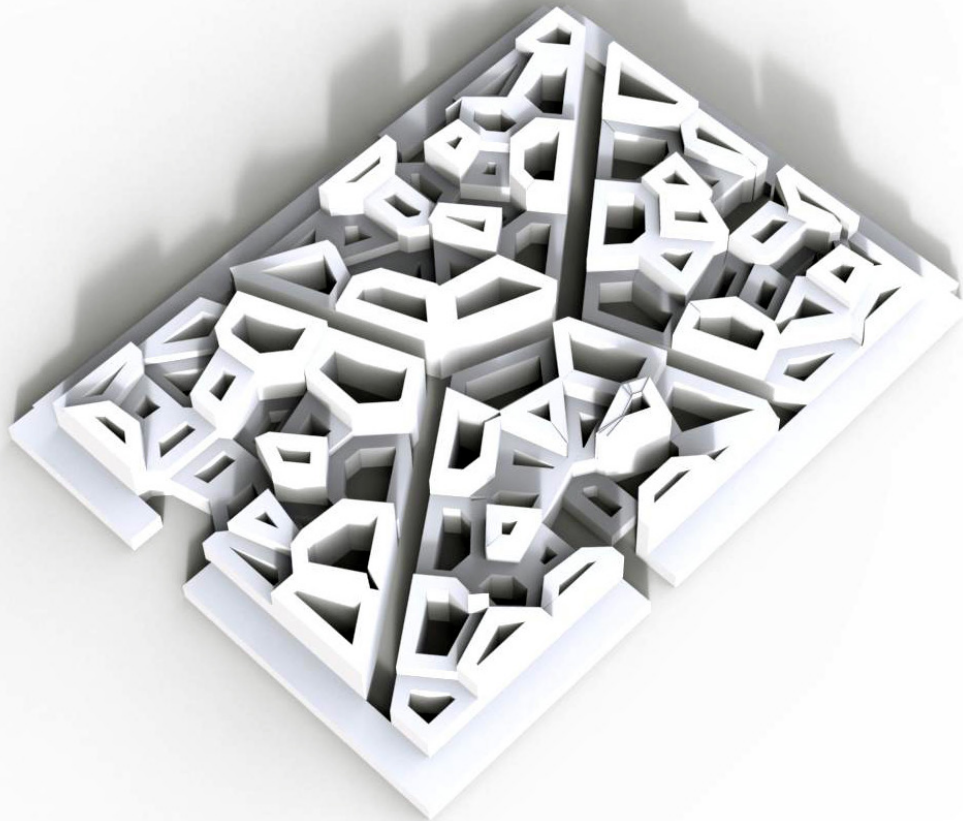
[FIGURE 7.16.1] Iteration - 1

This iteration examines the possibility of streets around each parcel, this however does not represent Old Delhi's neighbourhood structure as it disintegrates the fabric at the local scale.



[FIGURE 7.16.2] Isometric Views

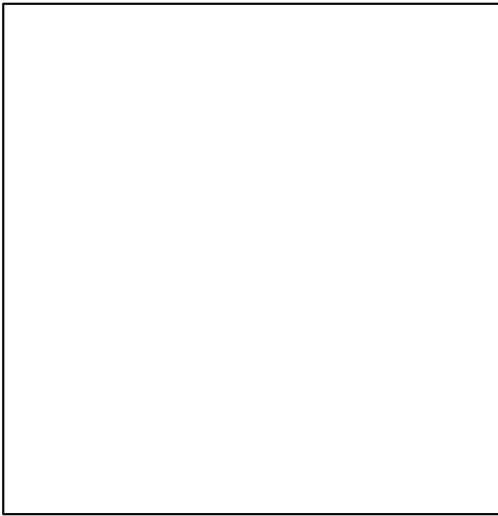
The prevalence of only one building type makes the iteration very rigid inspite of the flexible building forms.



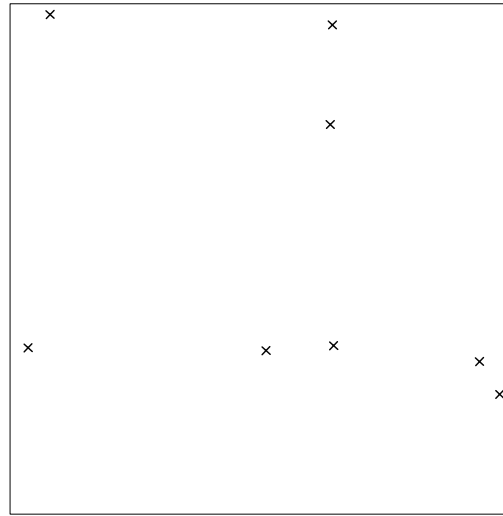
## CASE 2 : VARYING DENSITIES AND INTERNAL ARRANGEMENT

FAMILY 'B' Points arranged in a rectangular array AND VORONOI

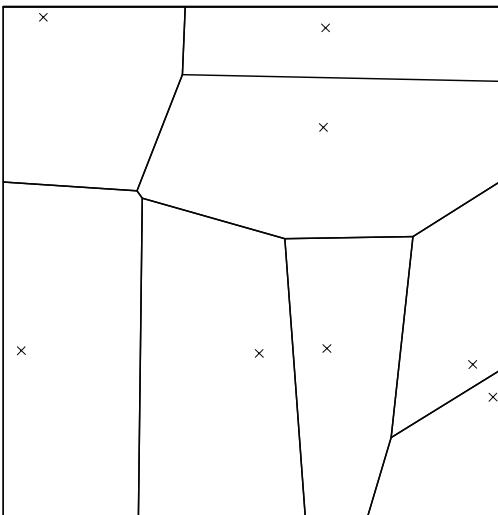
[FIGURE 7.17]



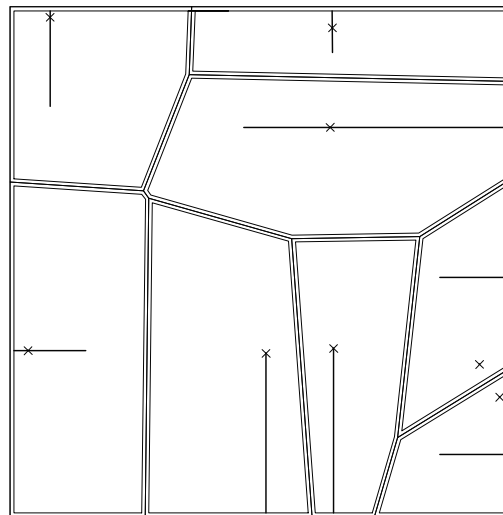
A. Closed Neighbourhood Boundary



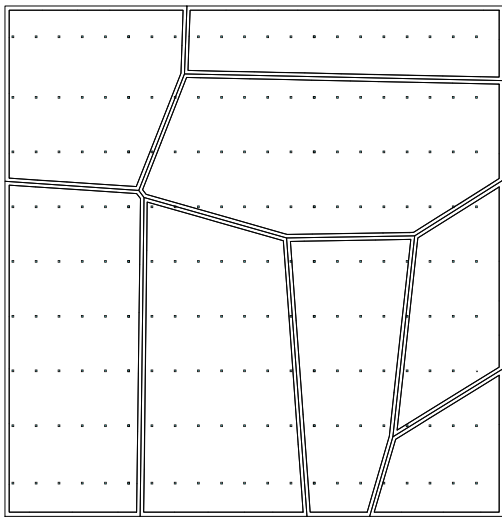
B. Points located to generate parcels



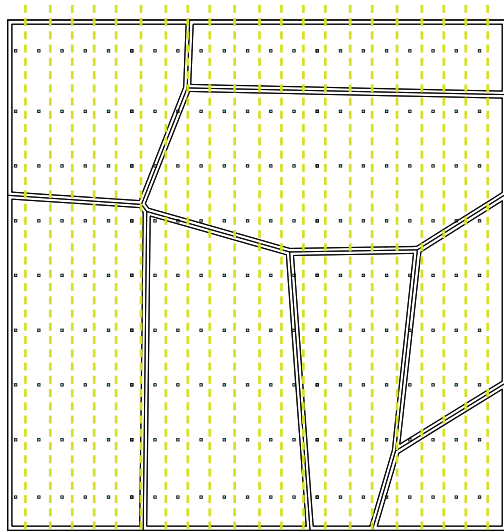
C. Generation of sub-divisions called Parcels



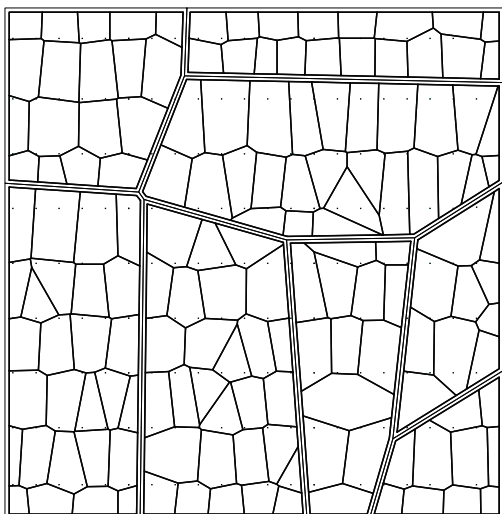
D. Parcel Offsets are generated as per required density



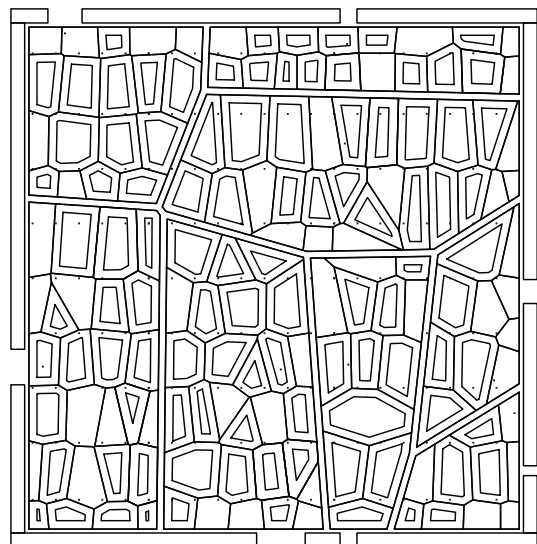
E. Generation of points in parcel as per required density



F. Morphological output depends on how the points are selected - Vertical selection



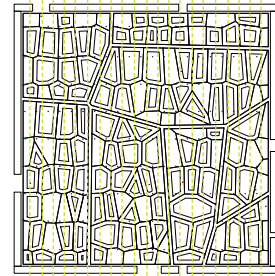
G. Each point corresponds to a plot



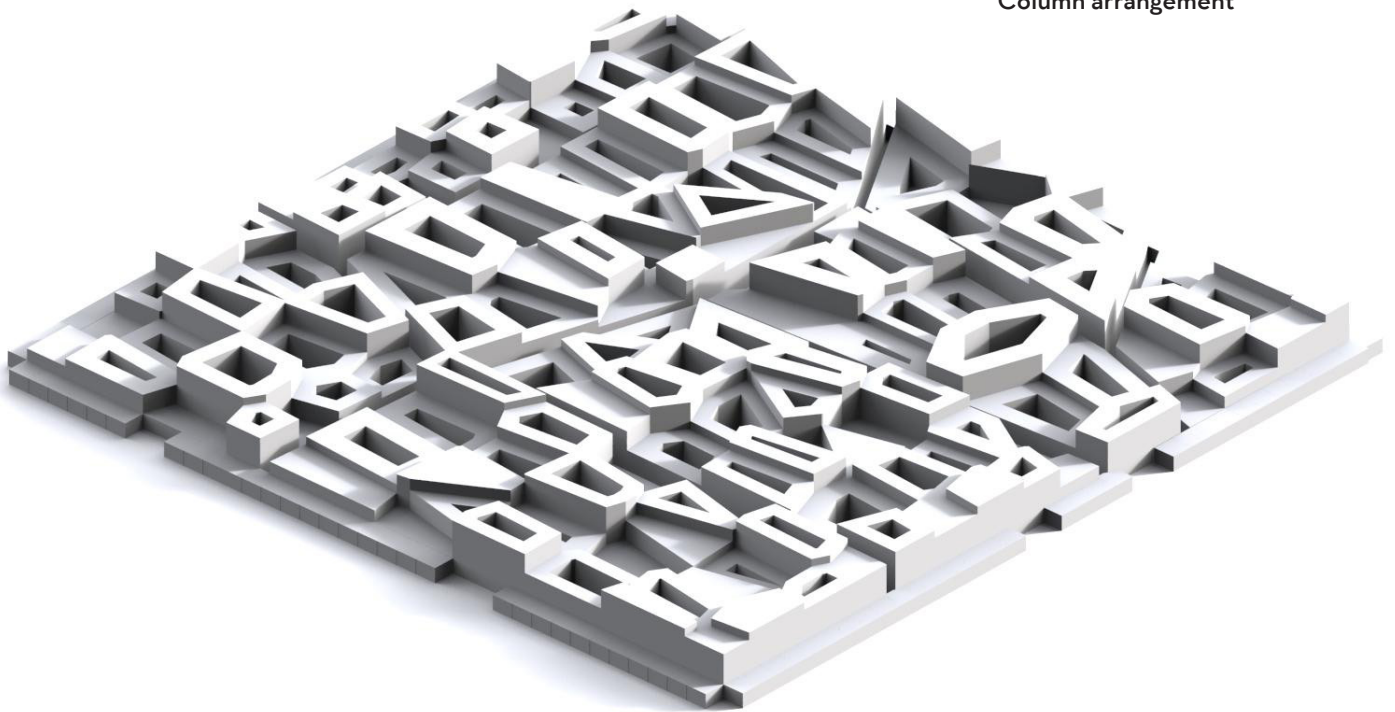
H. Multiple typologies may occur depending upon open vs built ratio (height also varies)

## CASE 2 : VARYING DENSITIES AND INTERNAL ARRANGEMENT

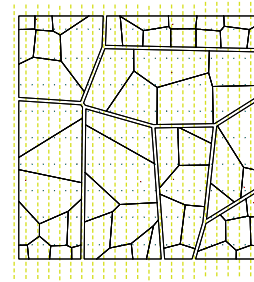
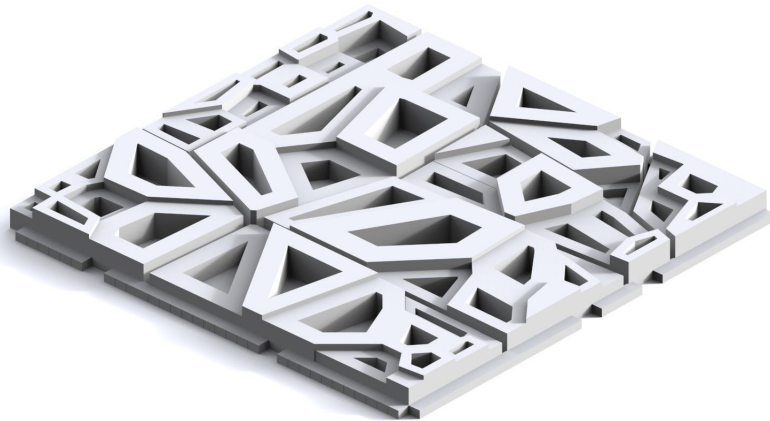
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Vertical selection of points  
Column arrangement

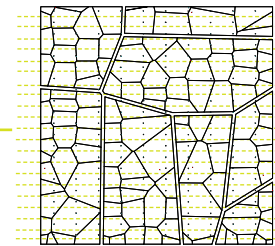


[FIGURE 7.17.1] Iteration -2 : Outputs from GH Script 3.2  
Generation of morphology based on specific density count of points and their column arrangement



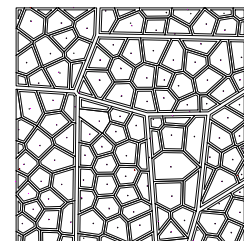
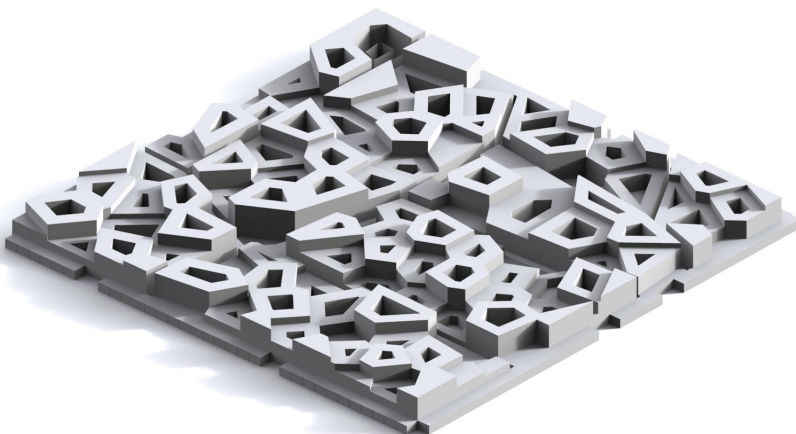
Vertical selection of points  
Column arrangement

[FIGURE 7.17.2] Iteration -3 : Outputs from GH Script 3.2  
Low Density Count of points generate bigger plots



Horizontal selection of points  
Row arrangement

[FIGURE 7.17.3] Iteration -4 : Outputs from GH Script 3.2  
Same group of points generate a different massing when analysed in rows.



Random Selection  
Irregular arrangement

[FIGURE 7.17.4] Iteration -5 : Outputs from GH Script 3.2  
Same group of points generate a different massing when distributed  
randomly.

Parcel division maintained  
Arrangement of points varies





## LIMITATIONS OF DIGITAL EXPERIMENTATION

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Procedural modelling through Grasshopper demonstrates the mathematical qualities of connectivity and land sub-divisions in Old Delhi. These networks form the basis of urban form and the urban system on the whole. Digital modelling also demonstrates the significance of the arrangement of points in the generation of morphology within each sub-division inside a boundary condition. Any change in the location of points and distance between points manipulates the urban form as well.

However, the models do not demonstrate the true quality of Old Delhi's morphology as they are either too regularised (FAMILY A) or they are too organic (FAMILY B). The models also lack the presence of different building types (discussed in Chapter 6), irregularity and monumentality, that is true to Old Delhi. Another limitation of these models is their inability to express incremental growth of urban fabric that is based on cultural urban strategies.

So as to extend the range of design possibilities that Grasshopper and scripting could potentially do and generate models that exhibit the aesthetic qualities of the medieval urban environments, a manual design exercise is carried out that demonstrates the logic of the grasshopper script as well as the complex parametric relations between the urban components of Old Delhi's fabric. Models are generated by a step by step design process. Different iteration patterns are produced on the basis of the relationship between street patterns, plots, parcels and building structure and the urban rules they work around.



## B. PROCEDURAL MODELLING OF A NEIGHBOURHOOD 'KATRA' - MANUAL

*' We begin with that part of the language which defines a town or community. These patterns can never be "designed" or "built" in one fell swoop - but patient piecemeal growth, designed in such a way that every individual act is always helping to create or generate these larger global patterns, will, slowly and surely, over the years, make a community that has these global patterns in it.'*

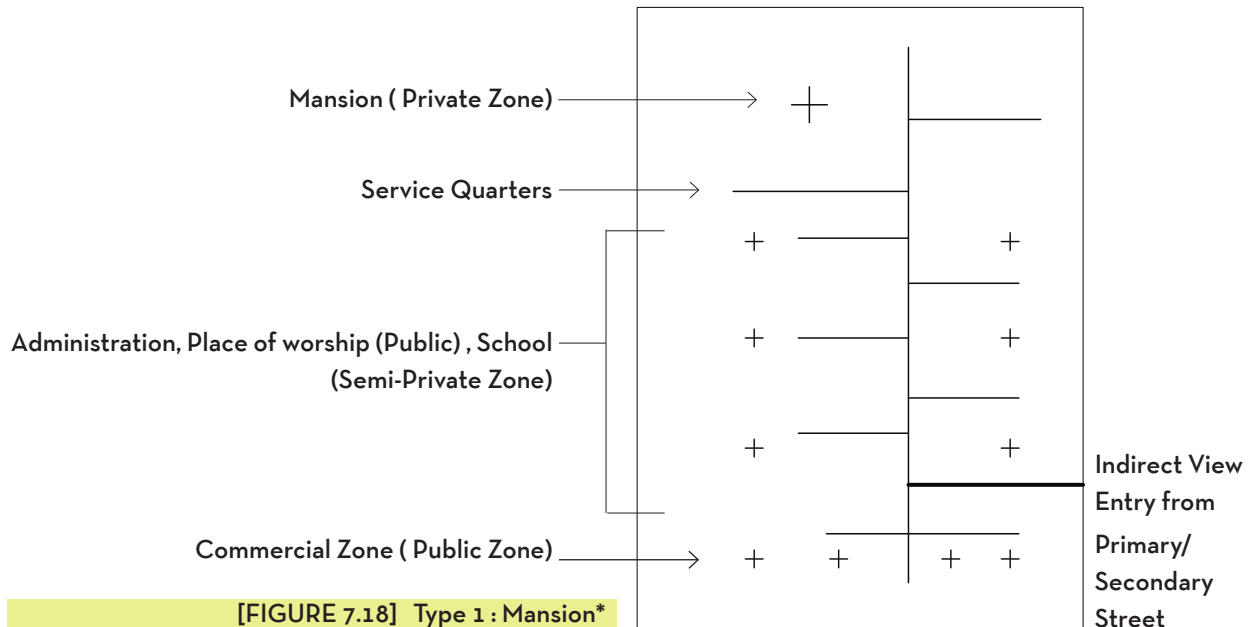
*A Pattern Language, Christopher Alexander*

The following study illustrates the self-organizing quality of Old Delhi's neighbourhoods through a series of steps, which is understood through the notion of placemaking and how this place perception created an identity for the city. With the changing urban scenario, this identity is increasingly not aligning with the changing people's perception of space, which has generated a new urban structure that does not carry forward the identity or the memory of the traditional medieval fabric.

Thus, the study analyzes the key form-shaping parameters (like street pattern, building structure, land use) and manipulates them so as to test the limits of the traditional fabric and demonstrate when and how it the embedded spatial quality is lost.

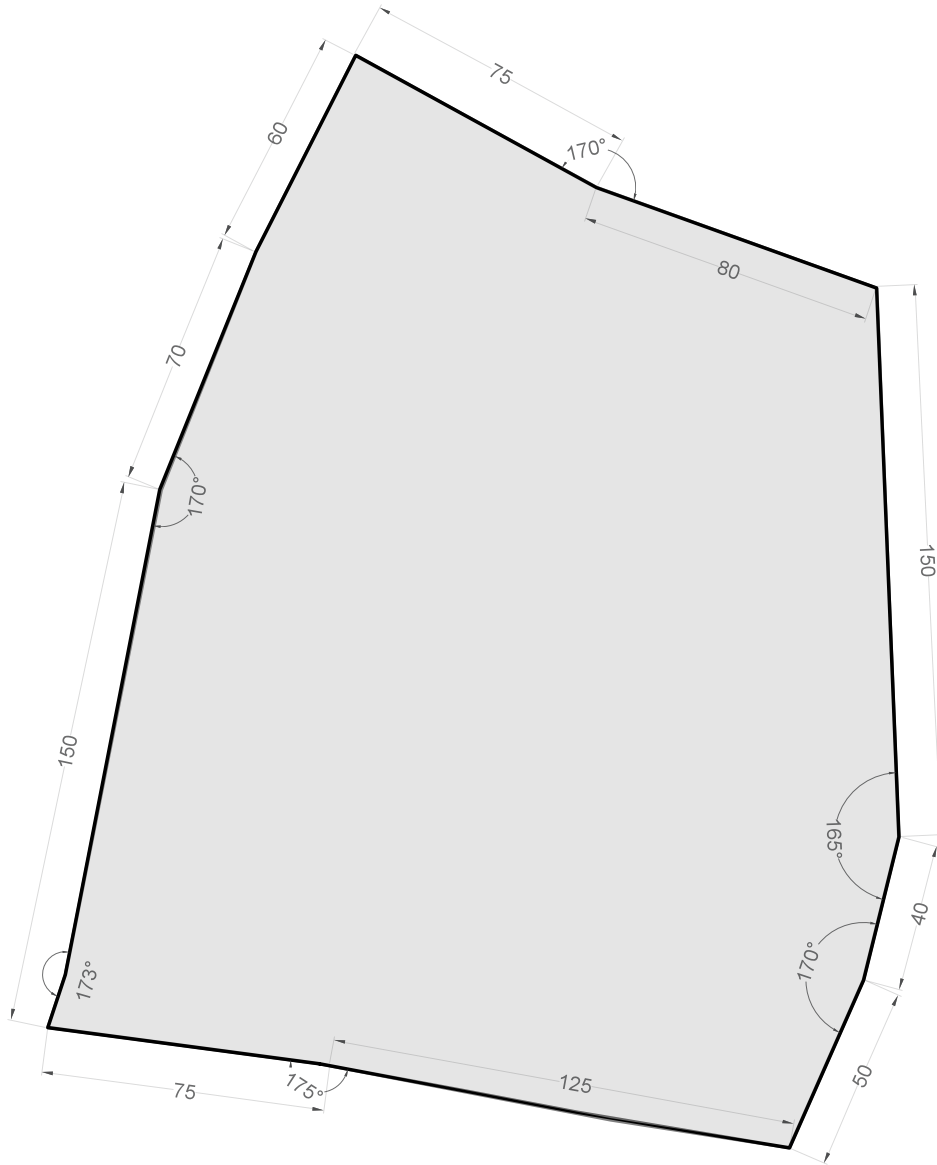
### Step 1 : Establishing The Type Of 'Katra'

A mansion type Katra has been chosen for this design experiment.



[FIGURE 7.18] Type 1 : Mansion\*

STEP 2 : SETTING UP EXTENTS OF THE URBAN SYSTEM 'KATRA'



[FIGURE 7.19 ]

Katra Area : 49,950 sq.m. = 0.049 sq.km. (average area)

Key Shaping Parameters

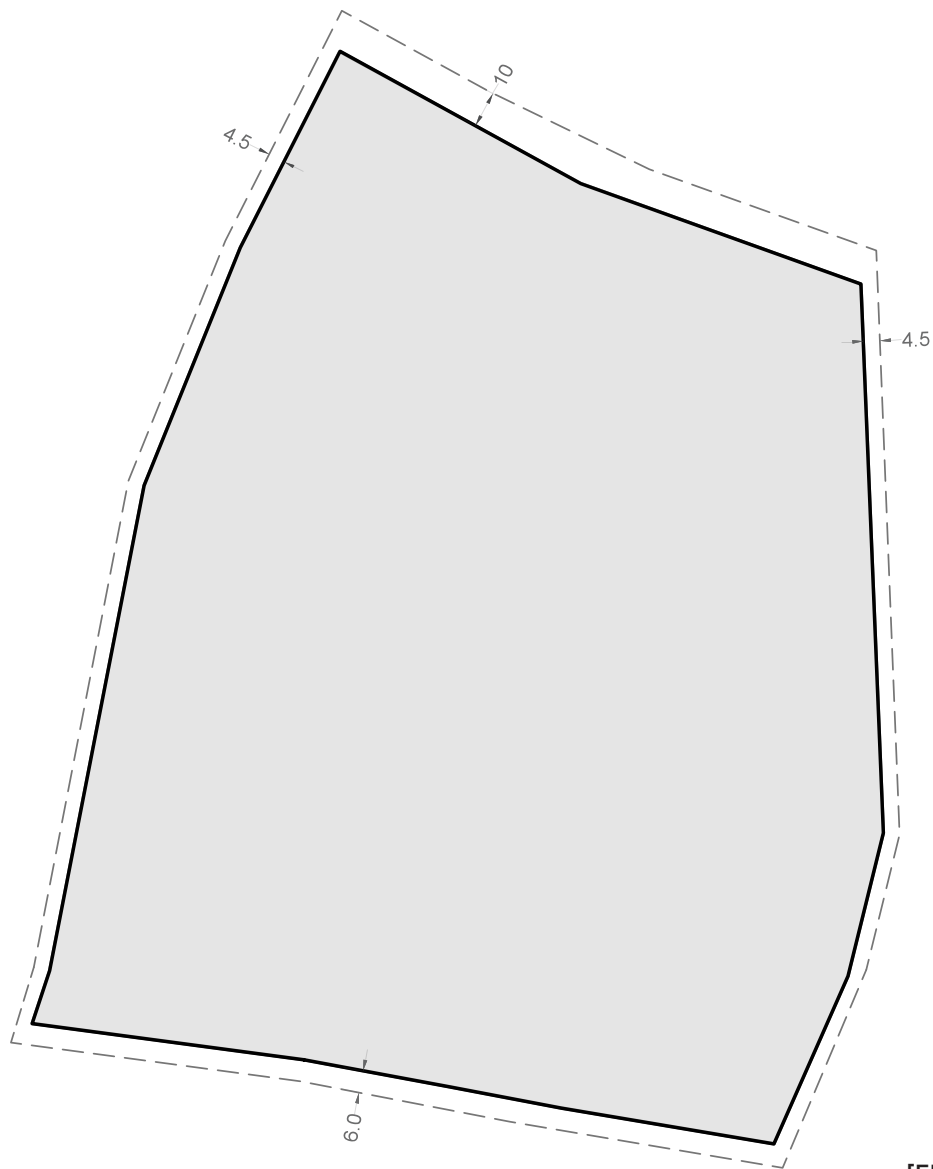
Area of 'Katra'	Length of each side
Number of Katra sides	Lines of sight

Each katra boundary to have atleast 4 or more sides.

No side length to be less than 25m or more than 150m. All dimensions to be multiples of 5 or 10 or 25.

Streets will be represented according to their lines of sight. Angular dimension -  $165 < x < 175$  degrees.

### STEP 3 : BOUNDARY CONDITION



[FIGURE 7.20]

#### Key Shaping Parameters

Width of surrounding streets

Lines of Sight

----- Center Line of surrounding street

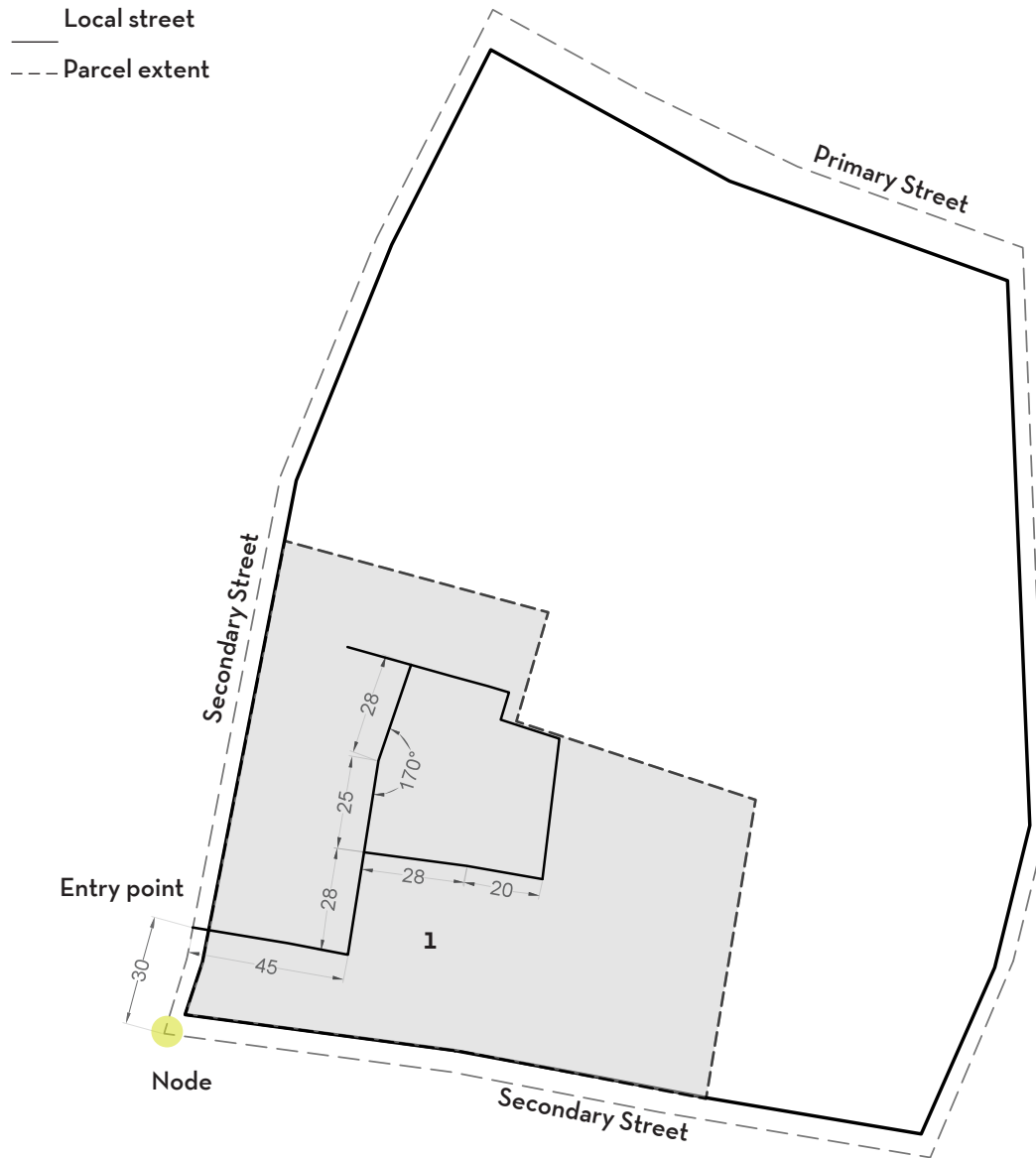
A katra may or may not be surrounded with primary street (15 to 20m wide).

Every katra to be aligned with atleast one secondary street (6 - 9 - 12m wide)

Tertiary streets will be 3 to 4.5 wide.

\*All local streets will be pedestrian streets.

STEP 4 : SUB-DIVISION - LAND PARCEL 1



[FIGURE 7.21 ]

Area of Parcel 1 : 30% of total = 14985 sq.m.

Key Shaping Parameters

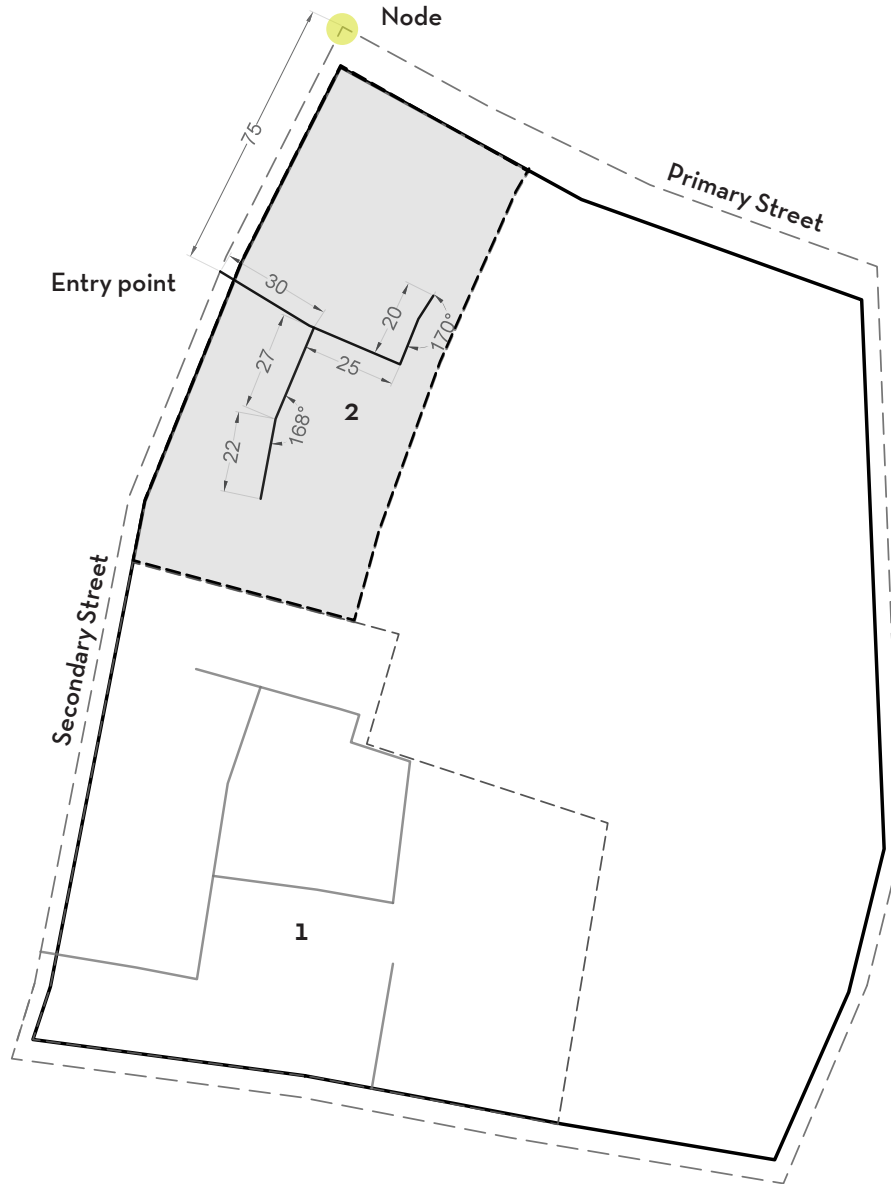
Area and Location of sub-division	Depth, width and sub-branches of local streets
Location of local street on the katra boundary	Lines of Sight - Local streets

The first sub-division within the katra will always arise from a node (away from the primary street to get more privacy). In this particular case, the parcel is adjacent to secondary streets, as a result, the entry point into the parcel will be atleast 25m away from the node and can go maximum upto 50m.

Area of Parcel cannot be more than 35% of the total area. Maximum branches from 1 local street : 3

Width of local streets :  $1.8m < x < 3m$       Length of local streets :  $20 < x < 75m$

STEP 5 : SUB-DIVISION - LAND PARCEL 2



[FIGURE 7.22 ]

Area of Parcel 2 : 17% of total = 8491 sq.m.

Key Shaping Parameters

Area and Location of sub-division	Depth, width and sub-branches of local streets
Location of local street on the katra boundary	Lines of Sight - Local streets $165 < x < 175$ degrees

The second sub-division within the katra will arise from another node. In this particular case, the parcel is adjacent to a primary and a secondary street, as a result, the entry point into the parcel will be atleast 75m away from the node, on the secondary street to avoid heavy traffic. (Chap. 6 Street Network Logic)

Area of Parcel is lower than 35% of the total area. Maximum branches from 1 local street : 3

Width of local streets :  $1.8m < x < 3m$       Length of local streets :  $20 < x < 75m$

STEP 6 : SUB-DIVISION - LAND PARCEL 3



[FIGURE 7.23]

Area of Parcel 3 : 10% of total = 4995 sq.m.

Key Shaping Parameters

Area and Location of sub-division	Depth, width and sub-branches of local streets
Location of local street on the katra boundary	Lines of Sight - Local streets 165<x<175 degrees

The third sub-division occurs around another node. In this case, the parcel is adjacent to secondary streets, as a result, the entry point into the parcel will be atleast 25m away from the node. (Chap. 6 Street Network Logic)

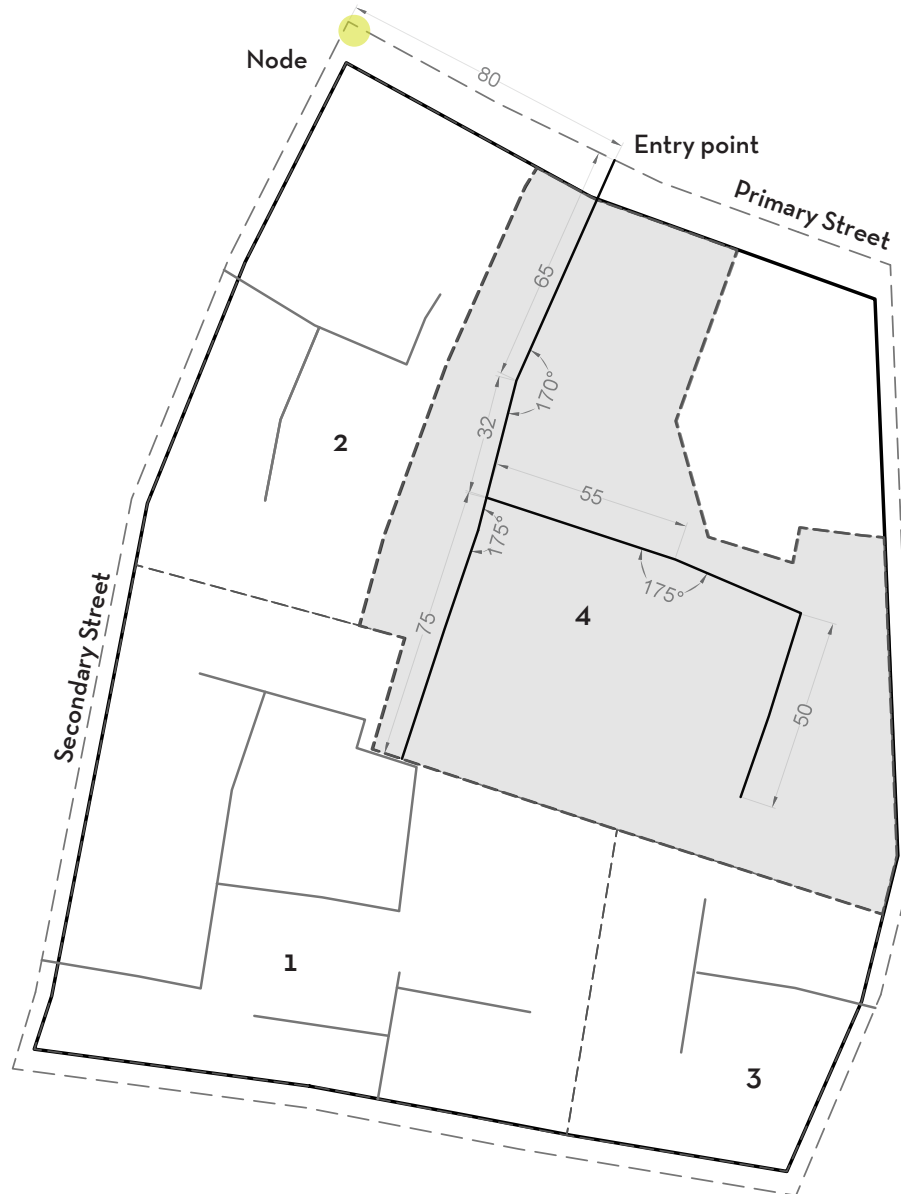
Area of Parcel is lower than 35% of the total area. Maximum branches from 1 local street : 3

Width of local streets : 1.8m<x<3m Length of local streets : 20<x<75m

Incremental growth in Parcel 1 is seen as a part of the urban development.



STEP 7 : SUB-DIVISION - LAND PARCEL 4



[FIGURE 7.24 ]

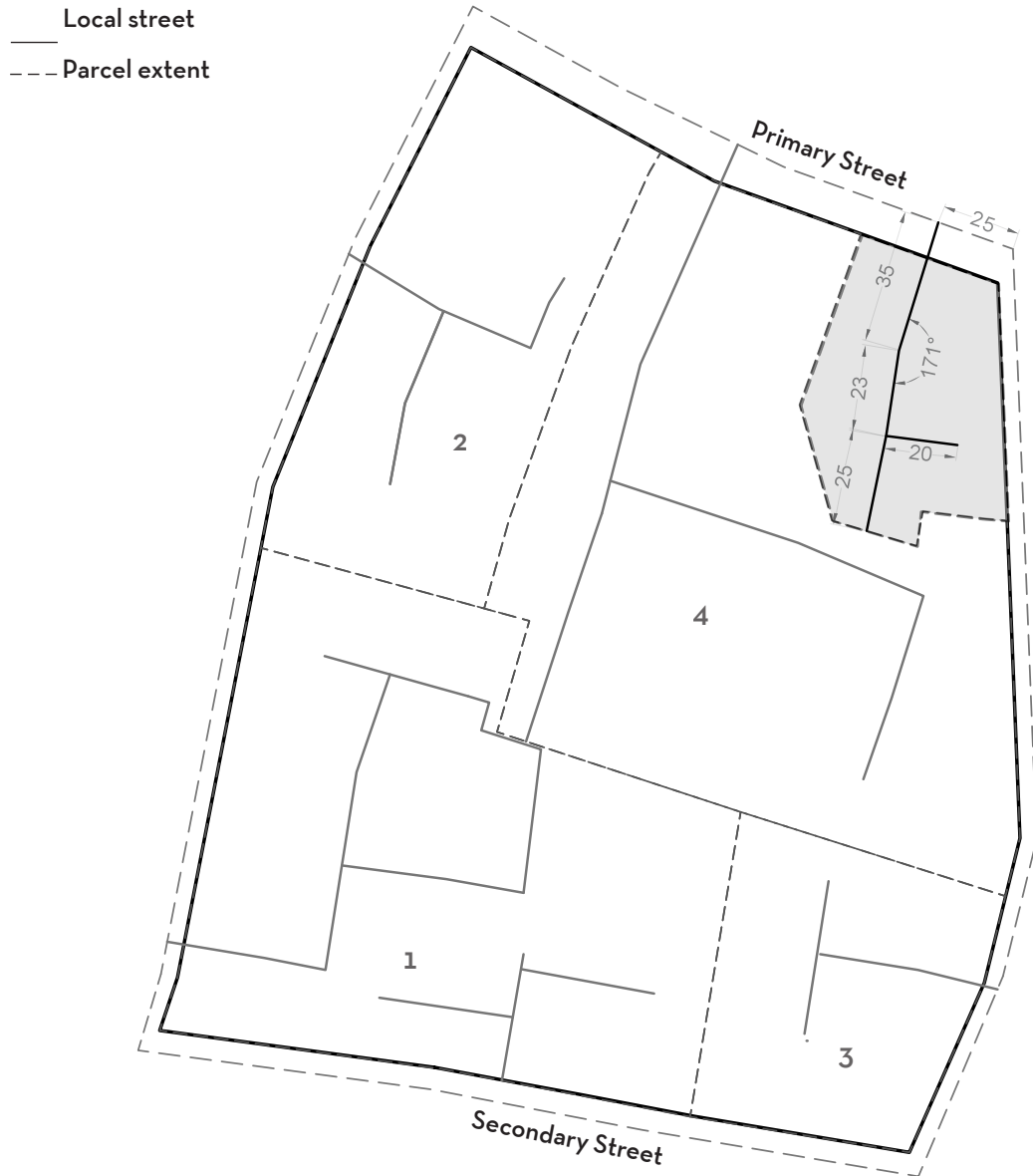
Area of Parcel 4 : 35% of total = 17482 sq.m.

Key Shaping Parameters

Area and Location of sub-division	Depth, width and sub-branches of local streets
Location of local street on the katra boundary	Lines of Sight - Local streets $165 < x < 175$ degrees

The fourth sub-division extends towards the pre-existing parcels and the katra boundary, maintaining the maximum covered area up to 35% of the total area of katra. The parcel is adjacent to a primary and a secondary street, as a result, the entry point into the parcel will be at least 75m away from the node. (Chap. 6 Street Network Logic) Area of Parcel is 35% of the total area. Maximum branches from 1 local street : 3  
 Width of local streets :  $1.8m < x < 3m$       Length of local streets :  $20 < x < 75m$

STEP 8 : SUB-DIVISION - LAND PARCEL 5



[FIGURE 7.25]

Area of Parcel 5 : 8% of total = 3996 sq.m.

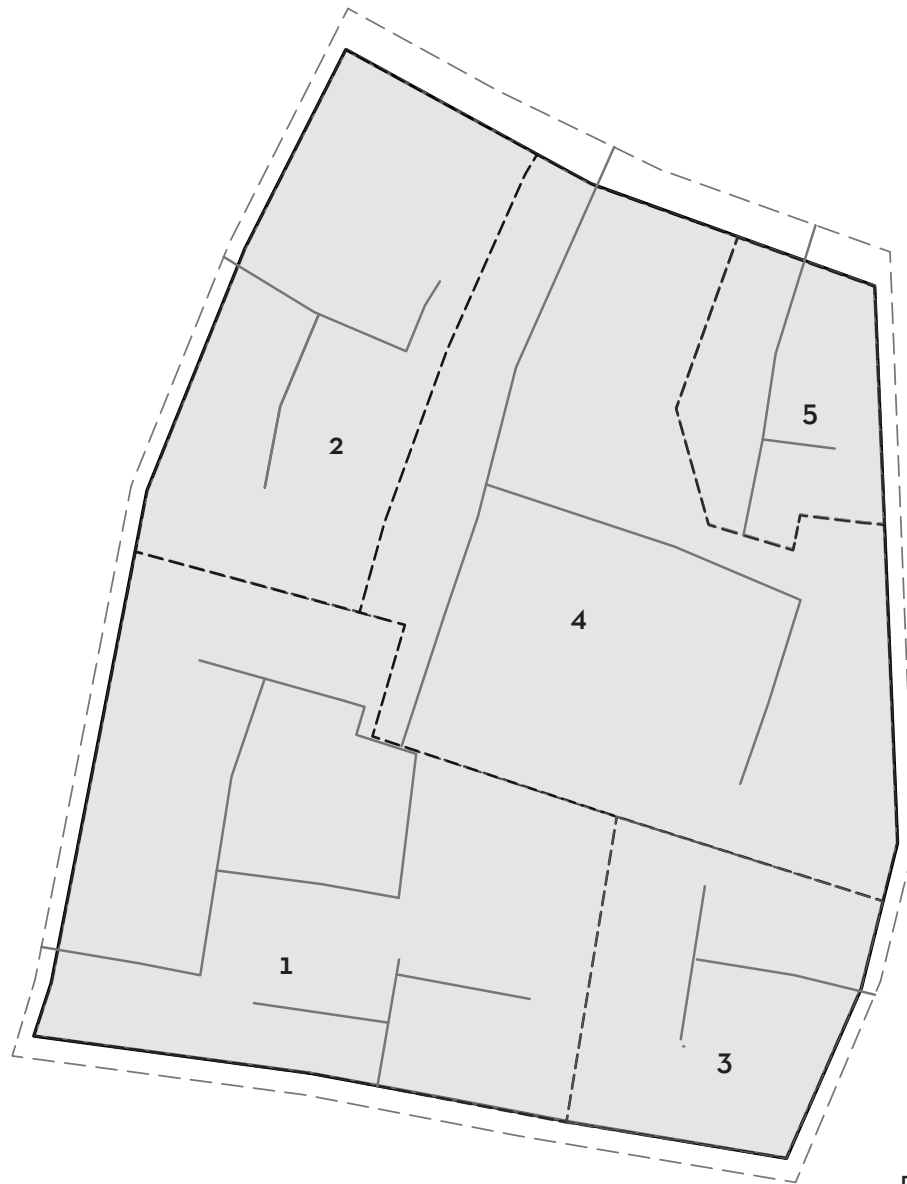
Key Shaping Parameters

Area and Location of sub-division	Depth, width and sub-branches of local streets
Location of local street on the katra boundary	Lines of Sight - Local streets $165 < x < 175$ degrees

The last sub-division fills up the remaining space and extends towards the pre-existing parcels and the katra boundary. The local street connects to the primary street in this particular case as it is considered as a commercial street that extends deep into the parcel with shops on both sides.

Area of Parcel is less than 35% of the total area. Maximum branches from 1 local street : 3

Width of local streets :  $1.8m < x < 3m$       Length of local streets :  $20 < x < 75m$



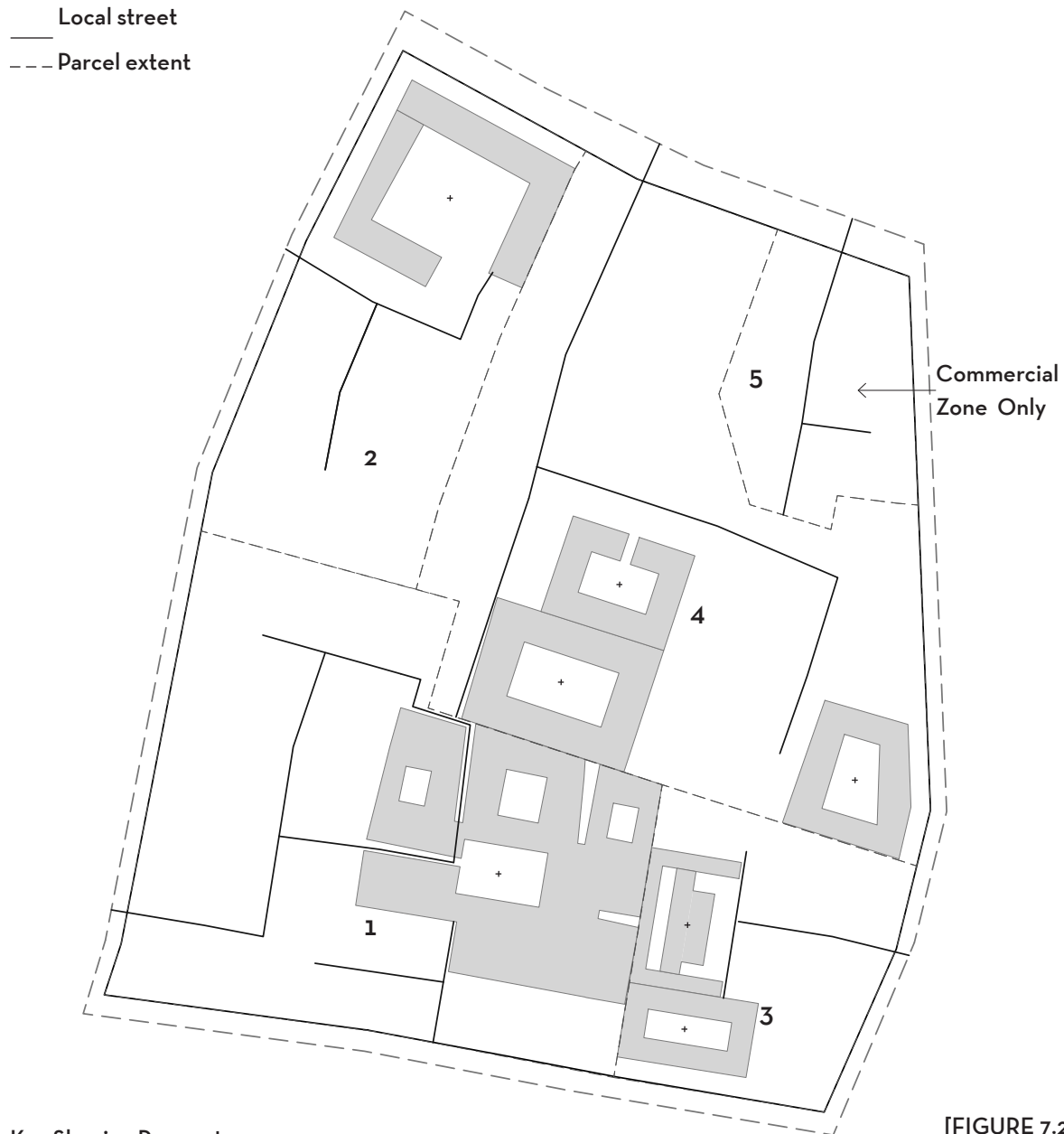
[FIGURE 7.26 ]

**Key Shaping Parameters for subsequent urban development**

**OPEN VS BUILT RATIO + FLOOR AREA RATIO :** The fabric within the katra will be analysed by manipulating the percentage of open space and FAR through 3 cases - 30% open + 1.5 FAR , 25% open + 2.5 FAR and 15 % open + 4 FAR ( open space shall include streets, patio spaces and courtyards)

Incremental growth within all parcels using different building types. The building types are positioned at specific locations within each parcel. These types vary in scales, however each type is based on a basic module which has been repeated a number of times to generate a higher degree of variation (Chap.6 Building Types Catalogue) and thereby visual interest within the fabric.

STEP 9.1 : URBAN INFILL  
POSITIONING MANSIONS IN EACH PARCEL



Key Shaping Parameters

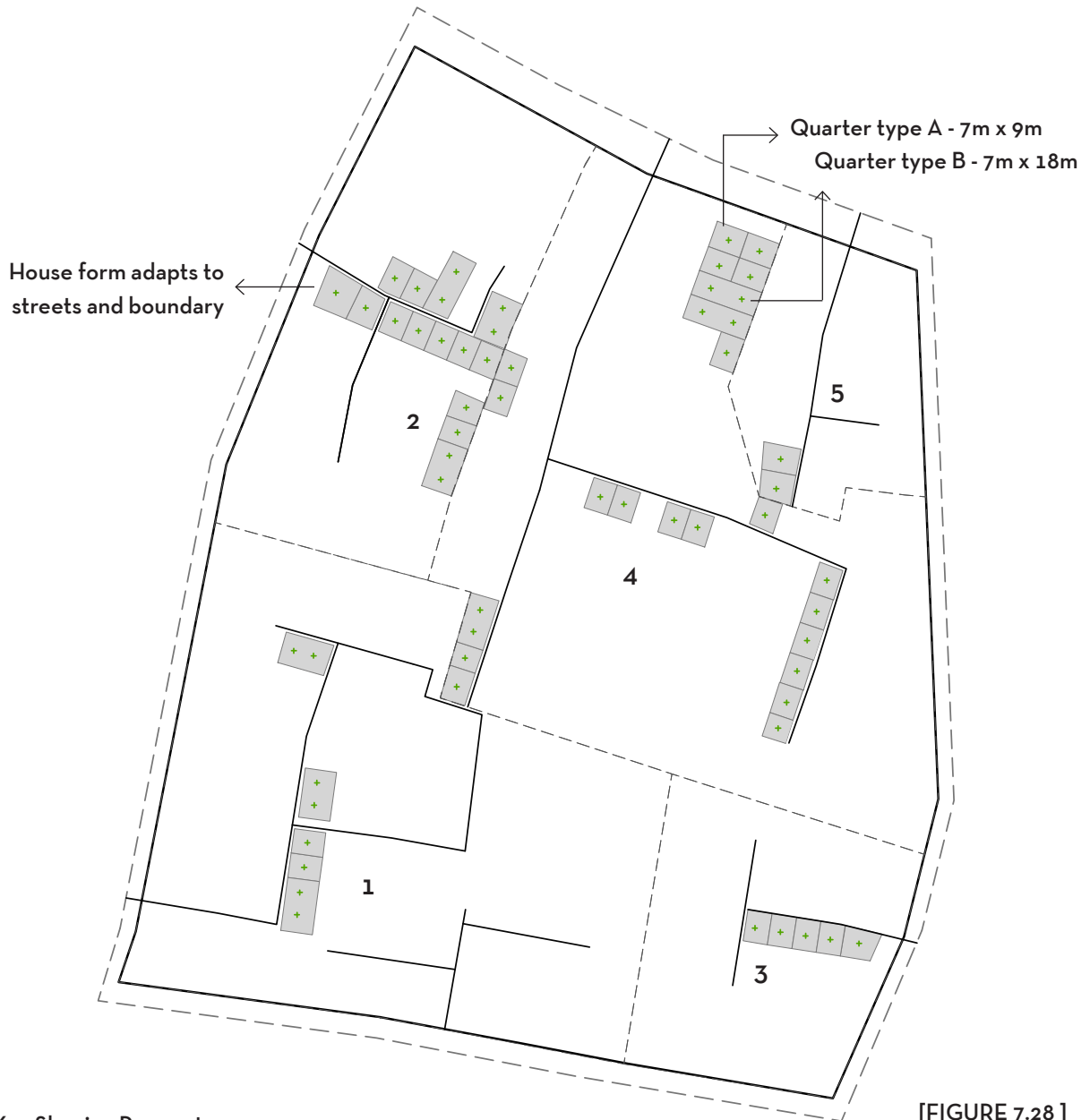
Location, Type and scale of Mansion  
6m Offset from each exterior parcel boundary for commercial activity

Each parcel is a miniature city in itself, where all activities revolve around the mansion. So as to offer maximum variation, each mansion is considered as a different building type, exhibiting multiple scales. All mansions are located at the end of the local street within each parcel to demonstrate a clear transition of public to private space as occupant moves from the entry point of a parcel to a mansion.

Height of mansions shall be 10m or 14m.

[FIGURE 7.27 ]

STEP 9.2 : URBAN INFILL  
POSITIONING QUARTERS SERVING THE MANSIONS



[FIGURE 7.28 ]

Key Shaping Parameters

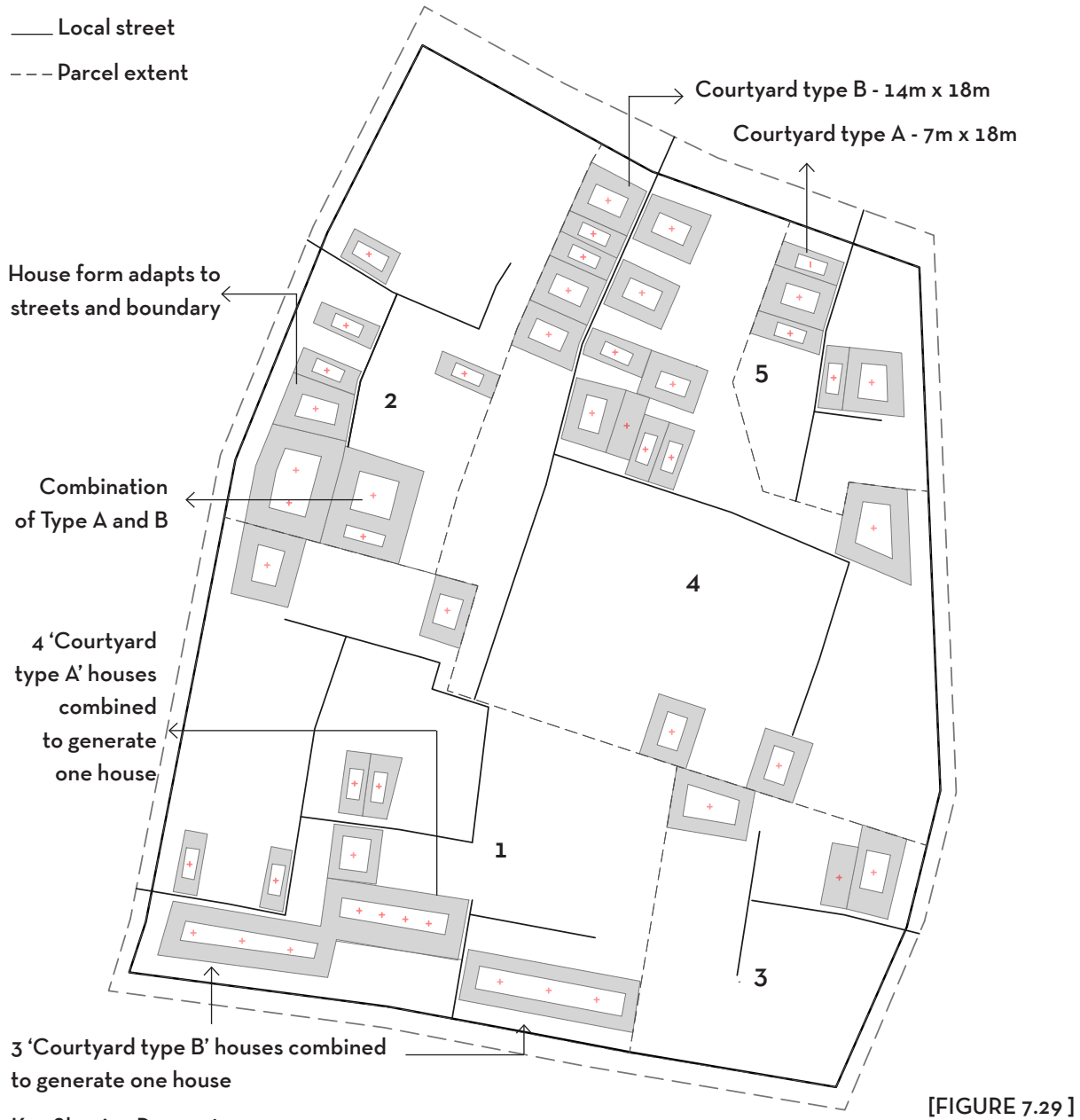
Location, Type and scale of Quarters

Each mansion and its household contained departments that cared for books, clothing, utensils, weapons and the nobles also supported poets, musicians and religious specialists<sup>1</sup>. The quarters were also meant for servants and guards of the mansion. Quarters were 9m x 7m in size (or 9 x 14 or 7 x 18). This was repeated along one side of the local streets within each parcel.

Height of quarters shall be 4m, or 6m or 9m. No two quarters that share a wall shall be of the same height.

<sup>1</sup> Blake, Stephen, Shahjahanabad : The Sovereign City in Mughal India 1639-1739 ( Cambridge University Press 1991), pp. 87

STEP 9.3 : URBAN INFILL  
COURTYARD HOUSES FOR RESIDENTS



[FIGURE 7.29 ]

Key Shaping Parameters

Location and volume of Courtyard Houses	Open vs solid condition of house
---	----------------------------------

The parcels are then filled with courtyard houses that are based on the basic quarter module of 7mx9m. This module is scaled up to generate courtyard houses of size 7mx18m and 14mx18m. The latter are then multiplied to generate more scales and variety within the same building type. The open space within each courtyard is atleast 25% of the total house size. All houses are located on the other side of the local street, opposite to the quarters.

Height of houses shall be 4m, or 6m or 10m or 12m. No two houses that share a wall shall be of the same height.

STEP 9.4 : URBAN INFILL  
COMMERCIAL ZONE



[FIGURE 7.30]

**Key Shaping Parameters**

**Location and width of Linear Commercial strip**

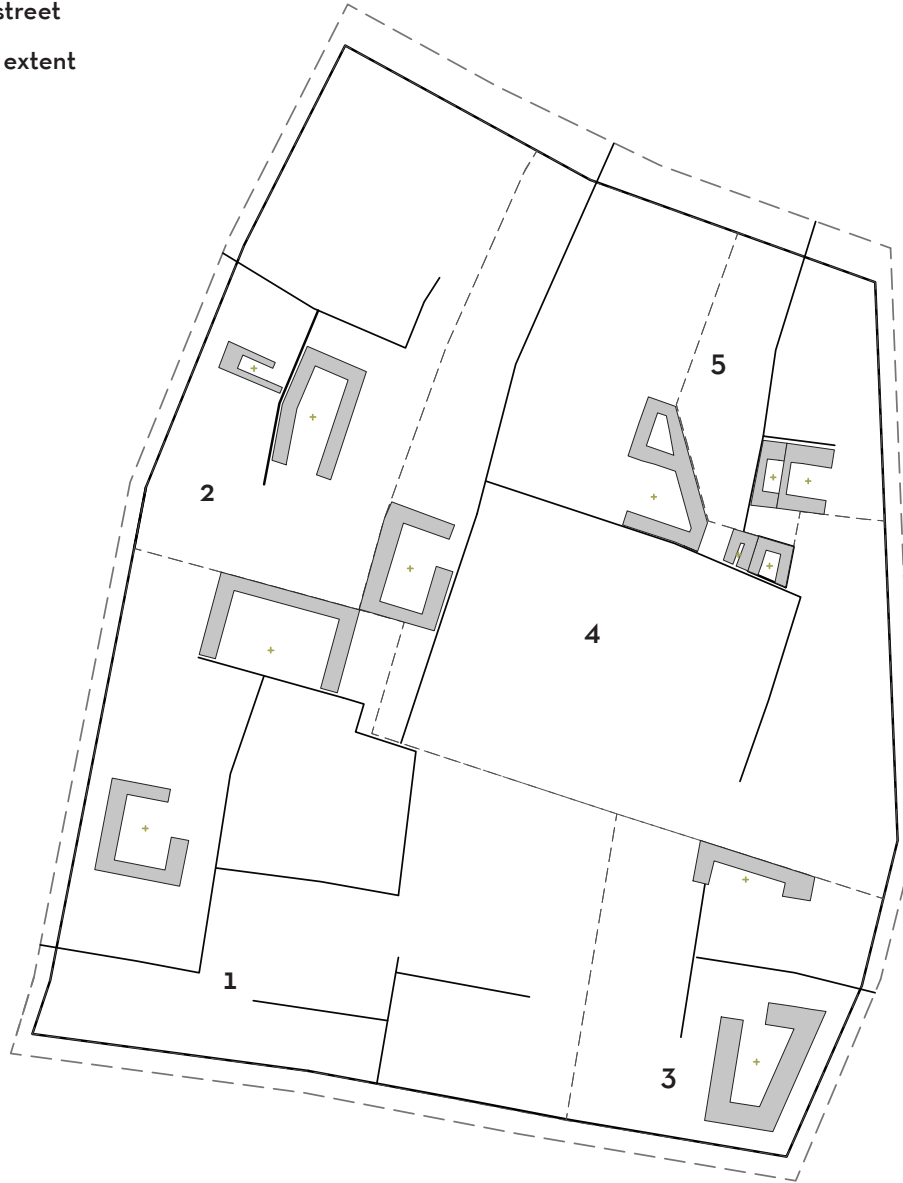
A katra boundary shall have a continuous 6m wide commercial strip running along the periphery. Each parcel has its own shops that are accessed by either the primary street or the secondary street.

Height of shops shall be 4m or 6m and not higher.

Some linear buildings are also introduced within the parcel. (These were used as storage spaces.)

STEP 9.5 : URBAN INFILL  
U-COURT TYPE BUILDINGS

— Local street  
- - - Parcel extent



[FIGURE 7.31 ]

Key Shaping Parameters

Land use and Building program

Scale of building

U-Court buildings formed part of the mansions and houses on the smaller scale. These were used as schools as well.

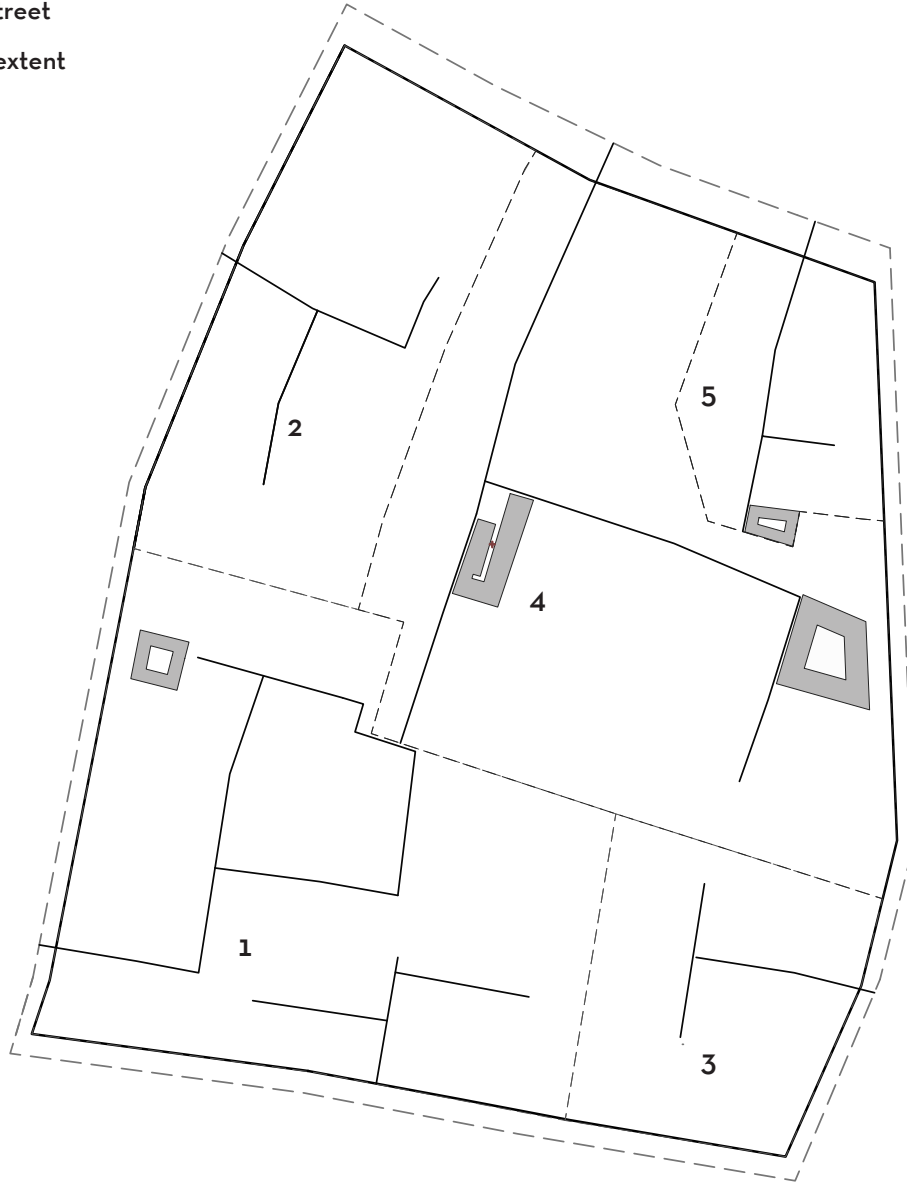
Height of shops shall be 4m or 6m and not higher.

Height shall be 4m, or 6m or 10m or 12m. No two buildings that share a wall shall be of the same height.



STEP 9.6 : URBAN INFILL  
ADAPTIVE BUILDINGS

— Local street  
- - - Parcel extent



[FIGURE 7.32 ]

Key Shaping Parameters

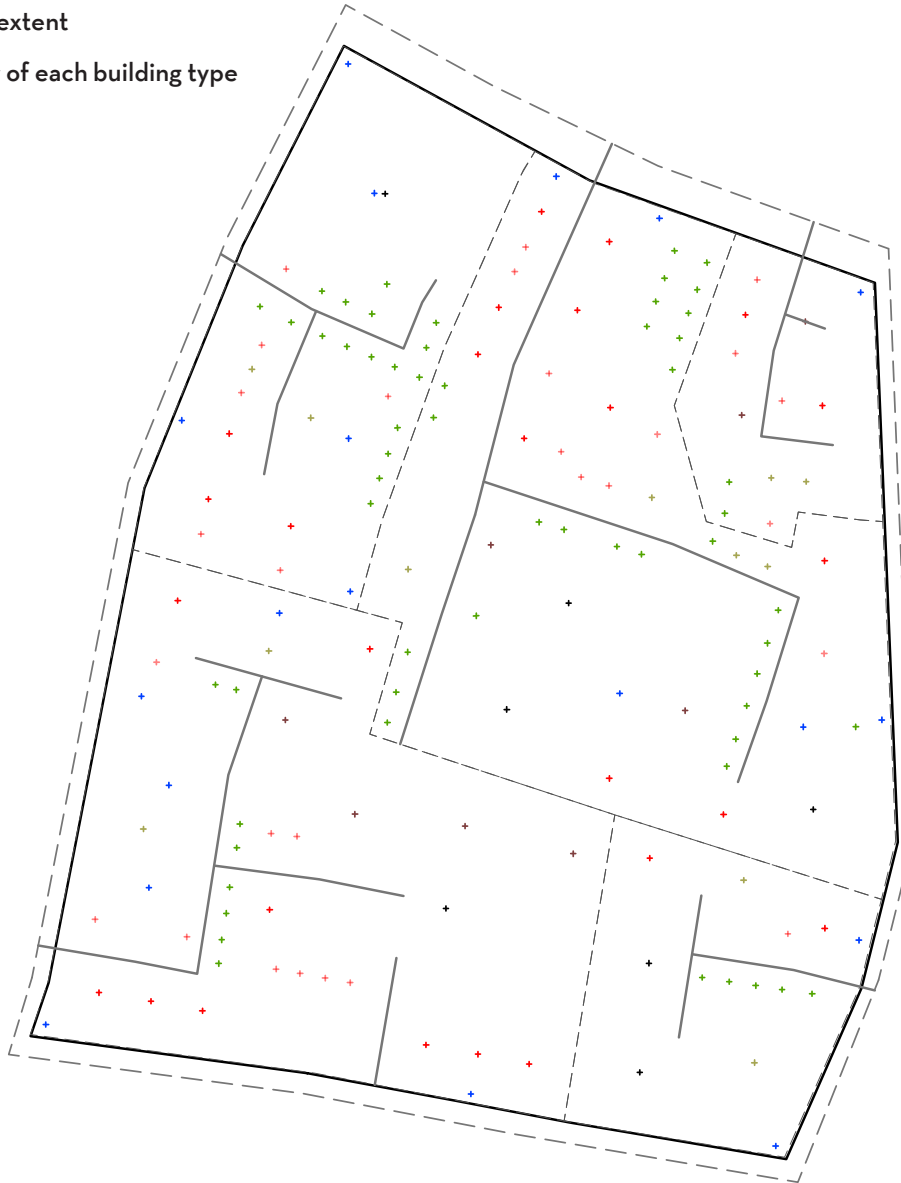
Land use and Building program

Surrounding context

These buildings offer complexity and diversity to the fabric as they help in breaking any monotony that may have been created by the repetition of selected building types.

URBAN INFILL  
DENSITY BLUEPRINT - 1

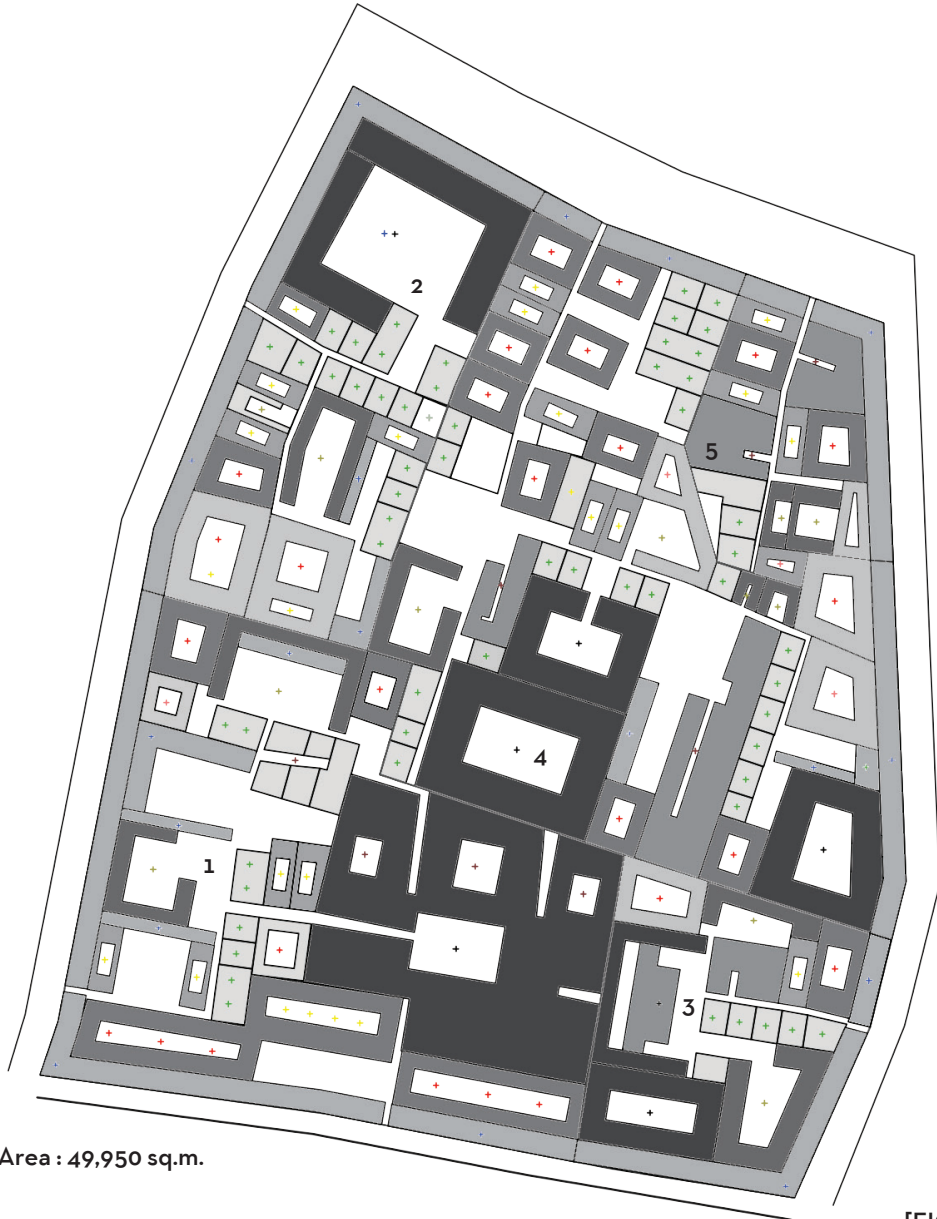
- Local street
- - - Parcel extent
- + Center of each building type



[FIGURE 7.33]

Each point represents the center point of one building. Colors signify the different building types. More the distance between points, bigger the scale of the building.

BASE MAP - 1  
OPEN VS SOLID CONDITION



Total Katra Area : 49,950 sq.m.

[FIGURE 7.34]

Parcel Number	Open Space Private - Courtyards, Patio	Open Space Public - Streets	Total Open Area
1	3455	1500	4955
2	3116	547	3663
3	1253	353	1606
4	2795	3000	5795
5	418	203	621
			16398
			32.8% Open

## URBAN FABRIC - 1

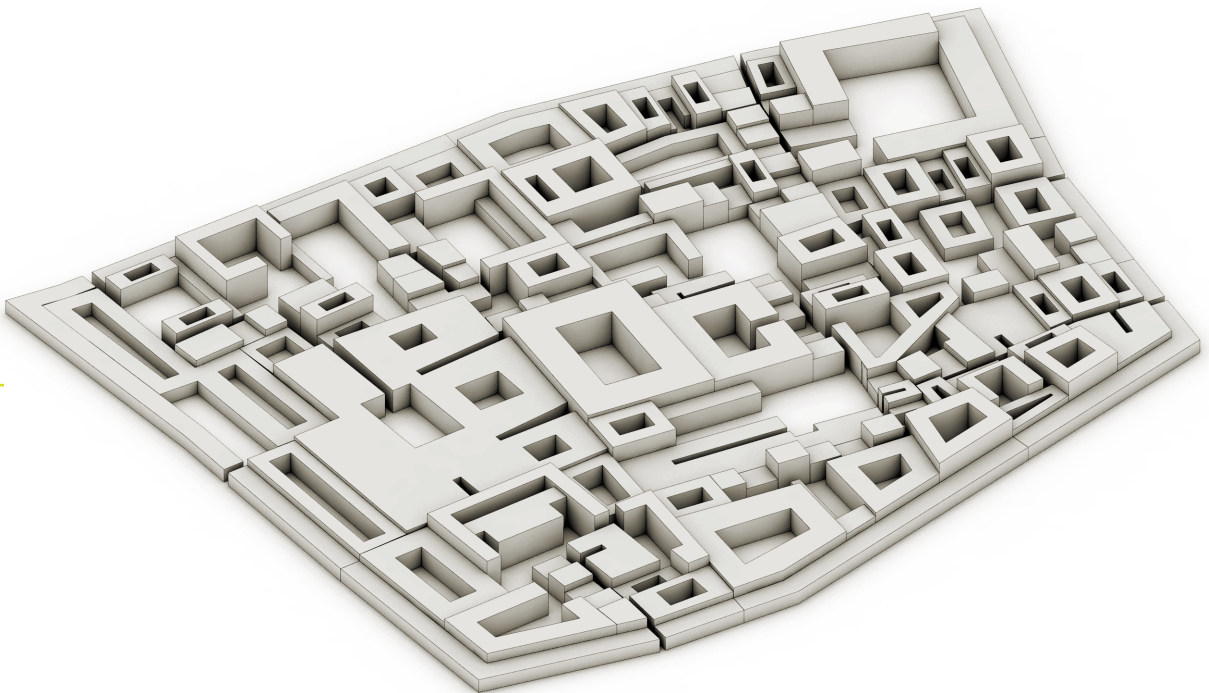
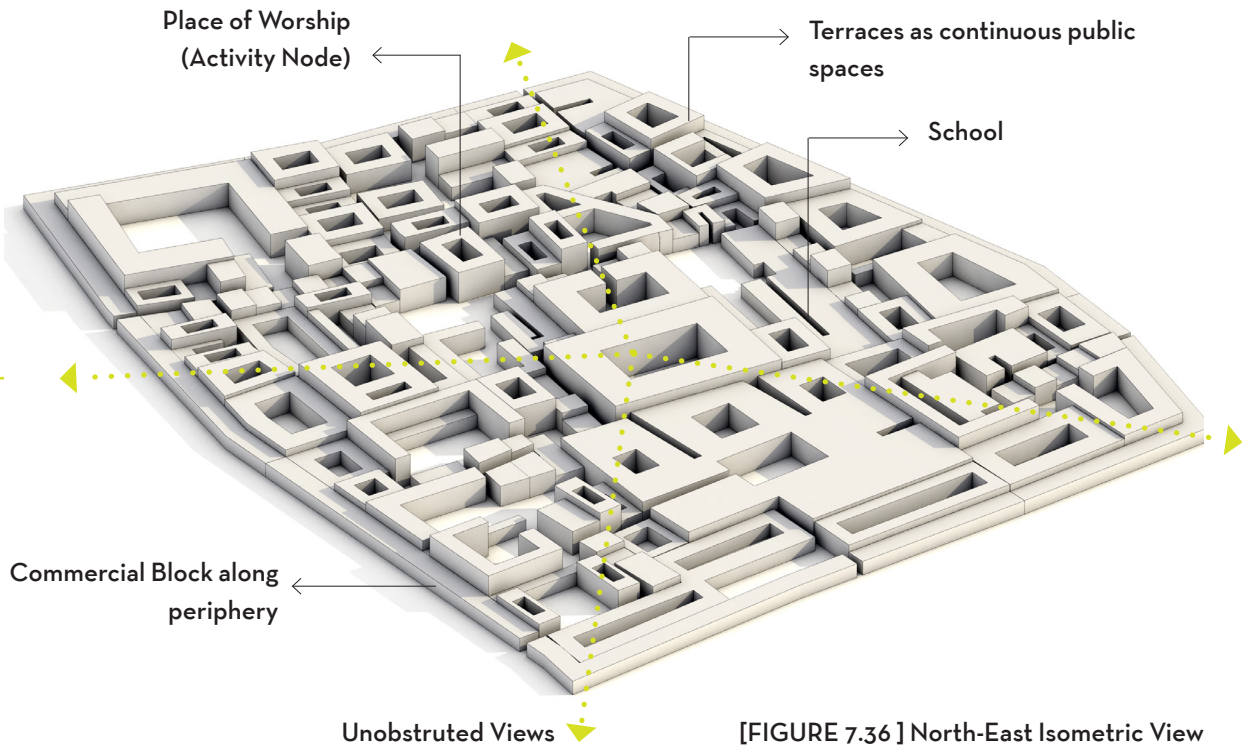
Parcelization based on mansions as second order point attractors



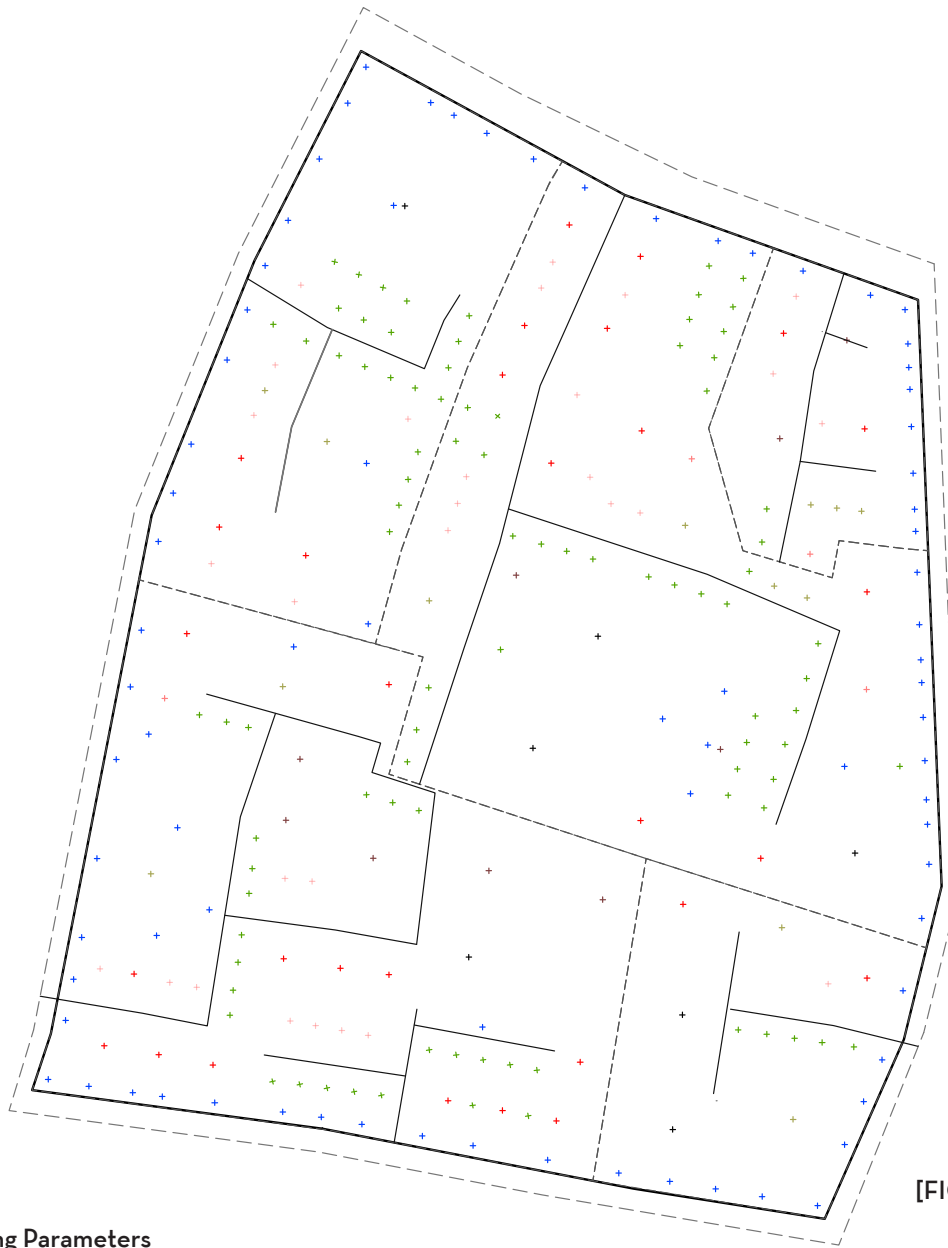
[FIGURE 7.35] Iteration 1

### Key Shaping Parameters

32.8 % open space	FAR 1.5	Minimum plot/block size 7x9m
Presence of Building Types		All building types based on the base module
Maximum building height 10m		Minimum building height 4m
Land Use Pattern		Boundary Condition
Street Widths and Depths		Angle of Views
Commercial Block - Location and Volume		



URBAN INFILL  
DENSITY BLUEPRINT - 2



[FIGURE 7.38]

Key Shaping Parameters

Arrangement, density and type of points

Maximum permissible height 14m

Minimum open area 25 % of total Katra area

Density Blueprint -2 exhibits incremental growth and disintegration of large blocks into smaller fragments. The parcels also demonstrate the addition of new buildings and new floors on existing buildings.

BASE MAP - 2  
OPEN VS SOLID CONDITION

Disintegration of Large scale buildings into medium and small scale buildings



Total Katra Area : 49,950 sq.m.

[FIGURE 7.39]

Parcel Number	Open Space		Total Open Area
	Private - Courtyards, Patio	Public - Streets	
1	2259	1500	3759
2	1725	547	2272
3	1082	353	1435
4	2456	1949	4405
5	233	188	421
			12292
18 % increase in street area from Case 1 (Maximum permissible 20%)			25% Open

## URBAN FABRIC - 2

Parcelization based on mansions as second order point attractors

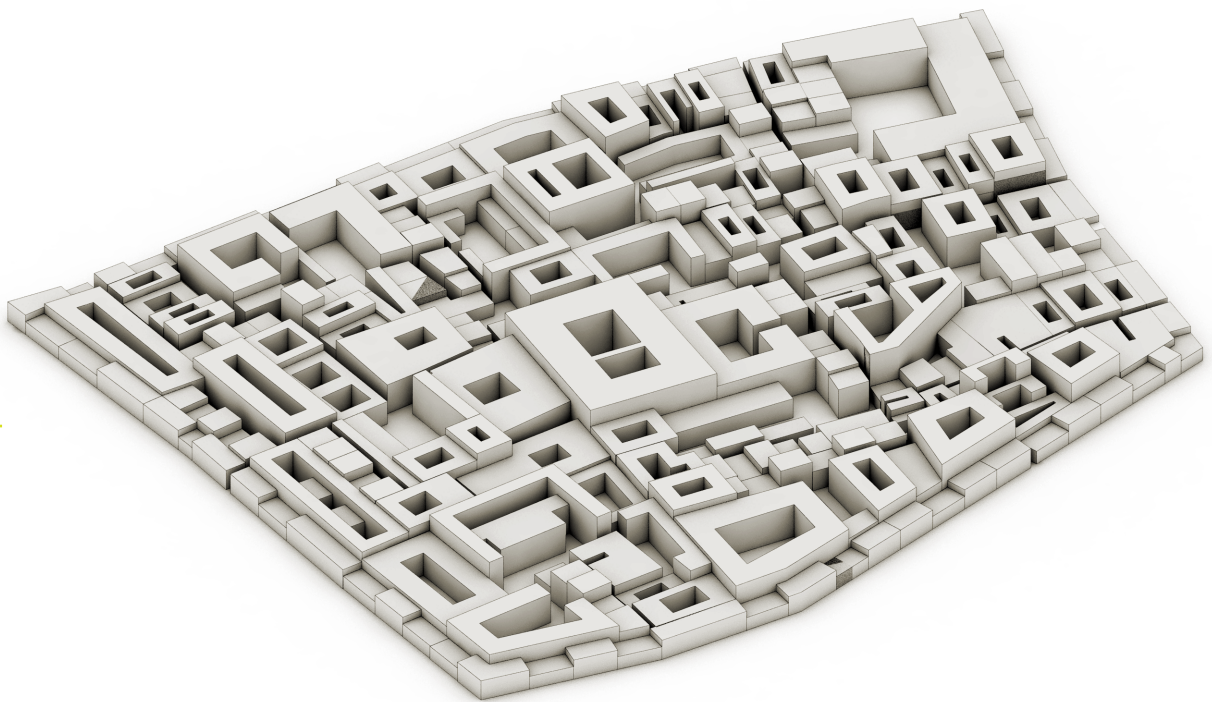
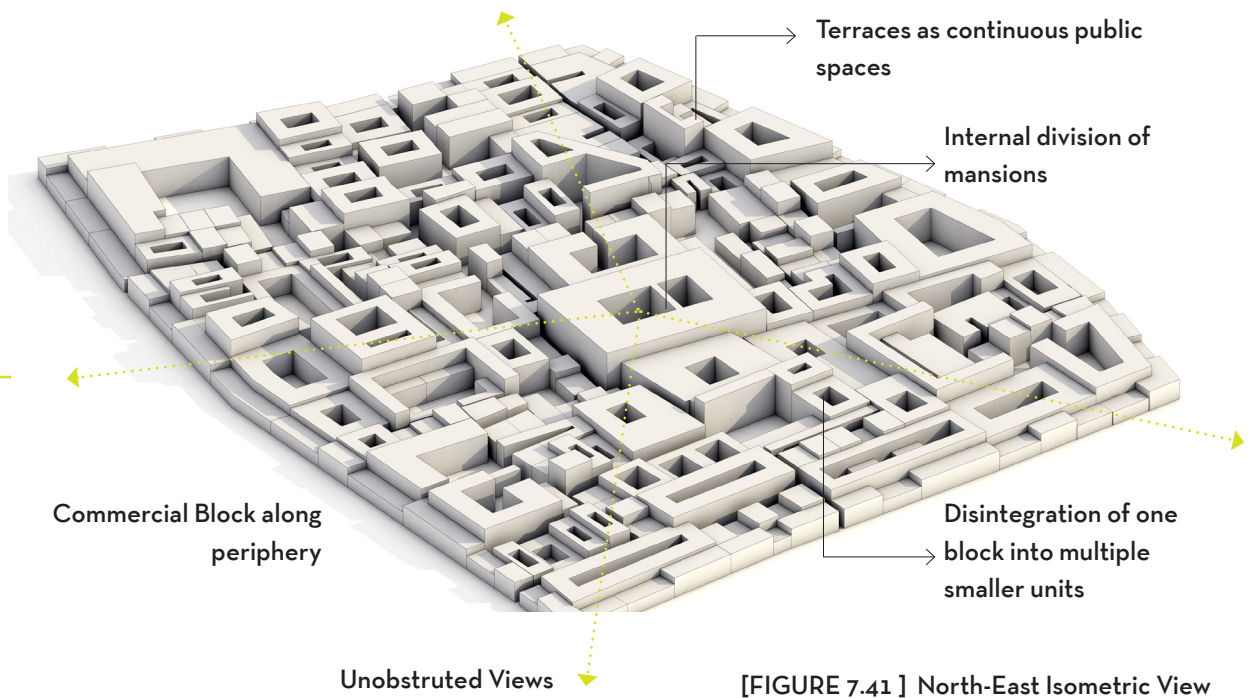


[FIGURE 7.40 Iteration 2 ]

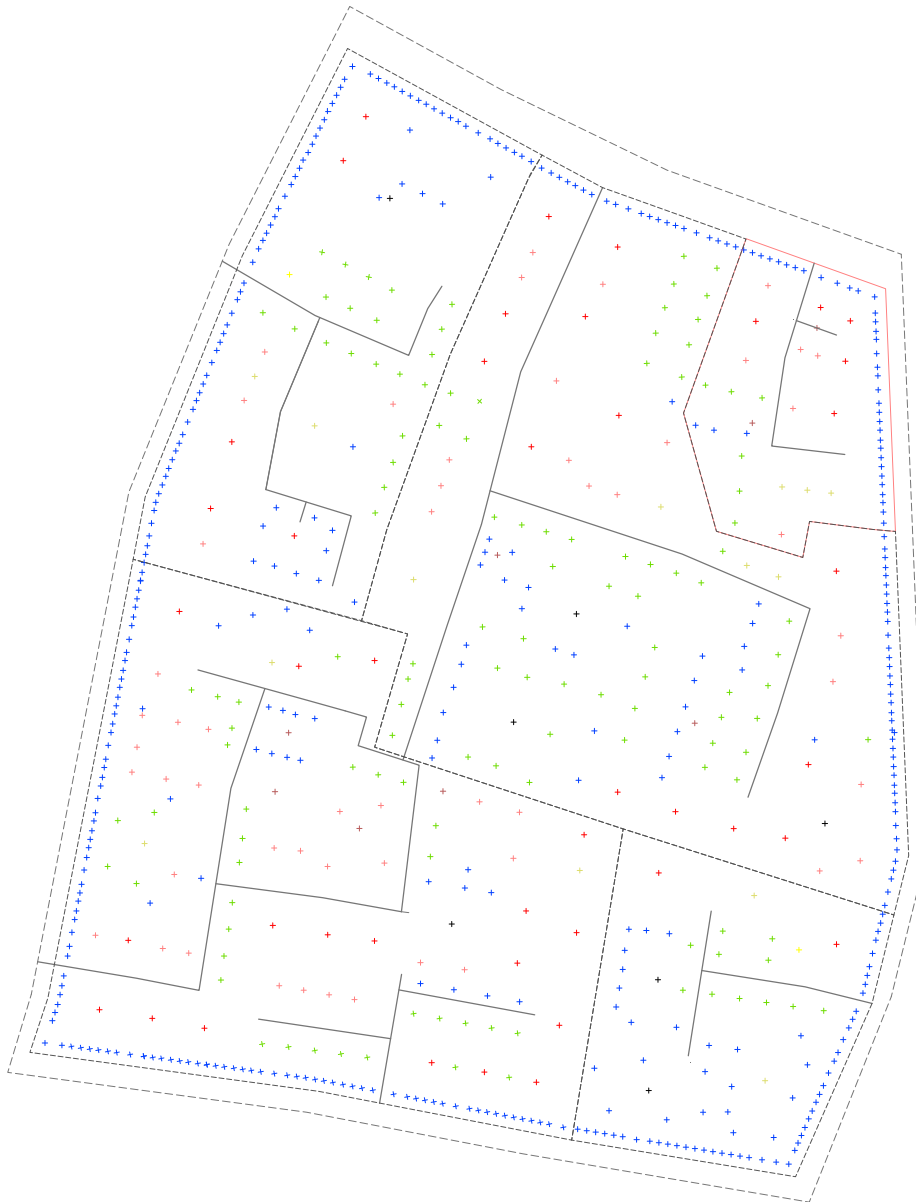
### Key Shaping Parameters

25 % open space FAR 2.5	Minimum plot/block size 7x9m
Presence of Building Types	All building types based on the base module
Maximum building height 14m	Minimum building height 4m
Land Use Pattern	Boundary Condition
Street Widths and Depths	Angle of Views
Commercial Block - Location and Volume	Minimum shop module size 6x12m and maximum height 7m





URBAN INFILL  
DENSITY BLUEPRINT - 3



[FIGURE 7.43]

**Key Shaping Parameters**

Arrangement, density and type of points

Maximum permissible height 18m

Minimum open area 20 % of total Katra area

Density Blueprint - 3 exhibits higher density and further disintegration of blocks into smaller fragments. The open spaces in the form of courtyards are covered with new structures both temporary and permanent. The size of the courtyards reduces to 50% from case 1. Floor area ratio is 3 times than the first urban fabric condition. Street widths are narrower in some parcels, which could be attributed to encroachments.

BASE MAP - 3  
OPEN VS SOLID CONDITION

Disappearance of Large scale buildings



[FIGURE 7.44]

Parcel Number	Open Space		Total Open Area
	Private - Courtyards, Patio	Public - Streets	
1	1691	1205	2896
2	1280	522	2272
3	686	285	971
4	1789	1780	3569
5	154	164	318
			10026
			20% Open

## URBAN FABRIC - 3

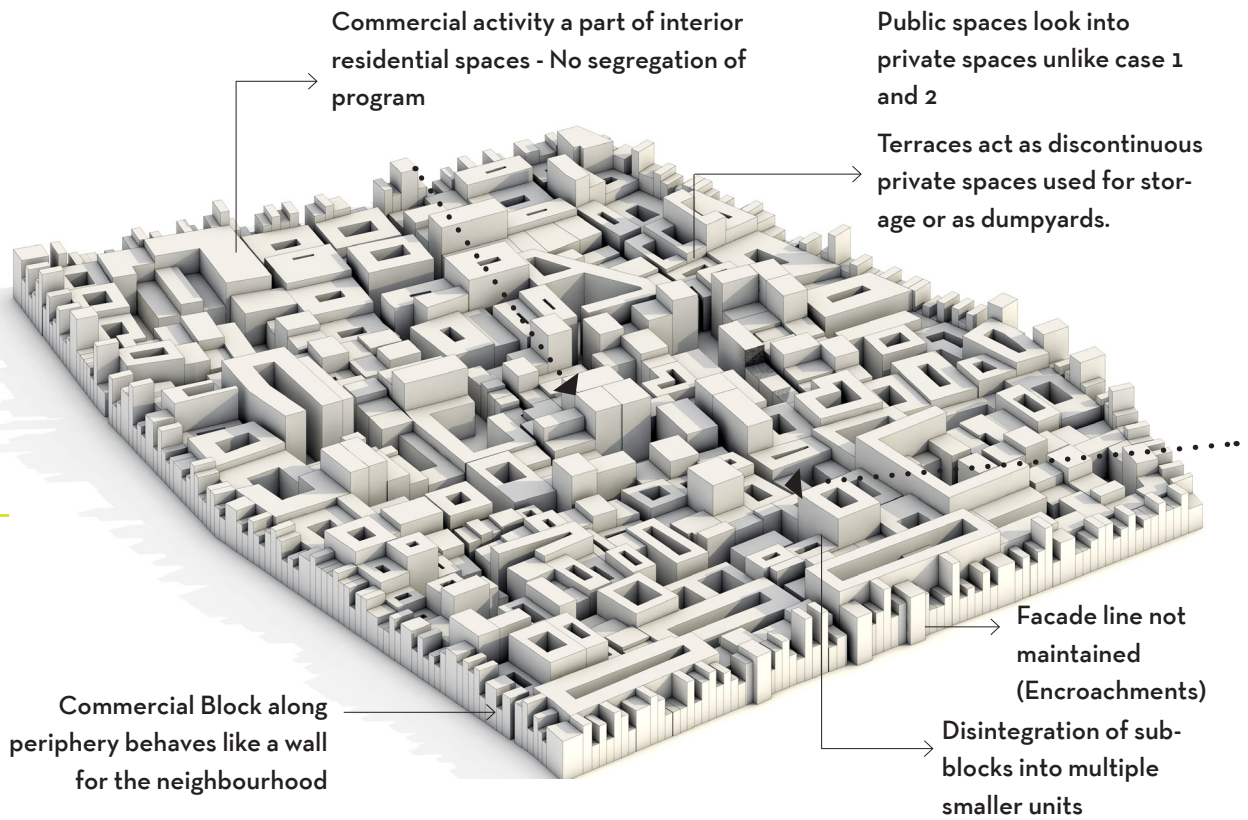
Parcelization based on mansions as second order point attractors



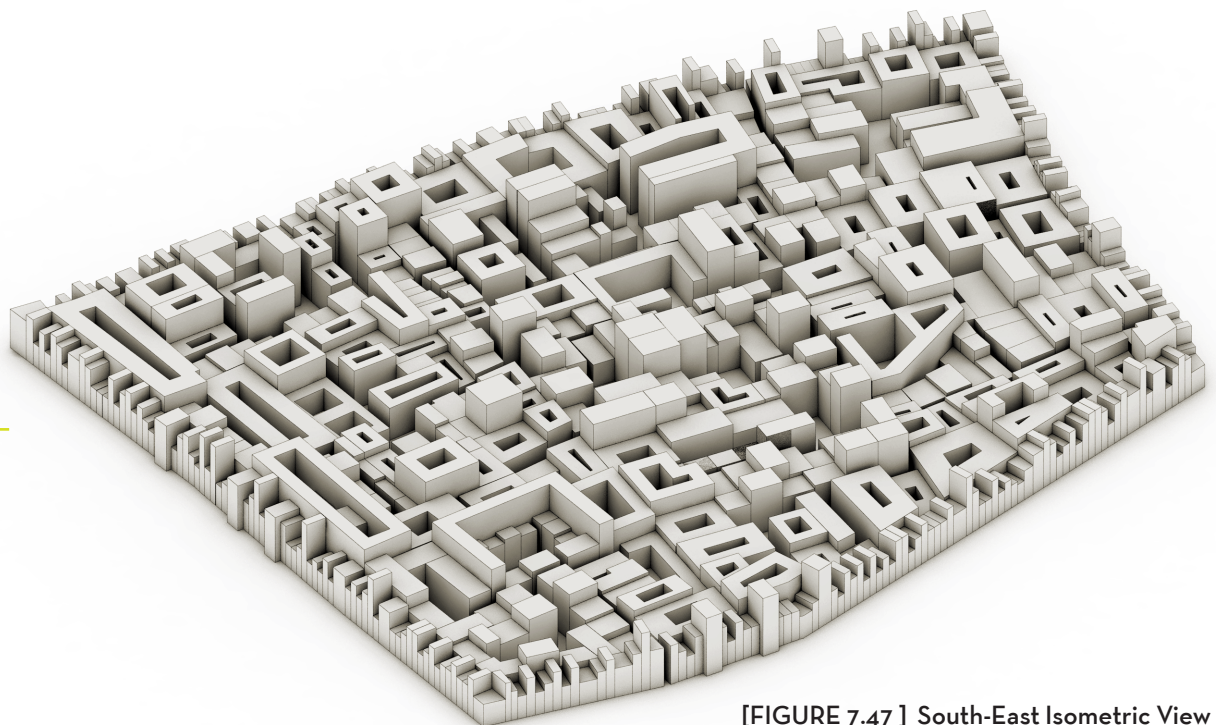
### Key Shaping Parameters

[FIGURE 7.45 Iteration 3 ]

20 % open space	FAR : 4	Minimum plot/block size 3.5x4.5m
Presence of Building Types		All building types may or may not be based on the base module
Maximum building height 18m		Minimum building height 7m
Land Use Pattern		Boundary Condition
Street Widths and Depths		Angle of Views
Commercial Block - Location and Volume		Minimum shop module size 2.4x6m and maximum height 18m



[FIGURE 7.46] North-East Isometric View



[FIGURE 7.47] South-East Isometric View

## URBAN FABRIC - 3

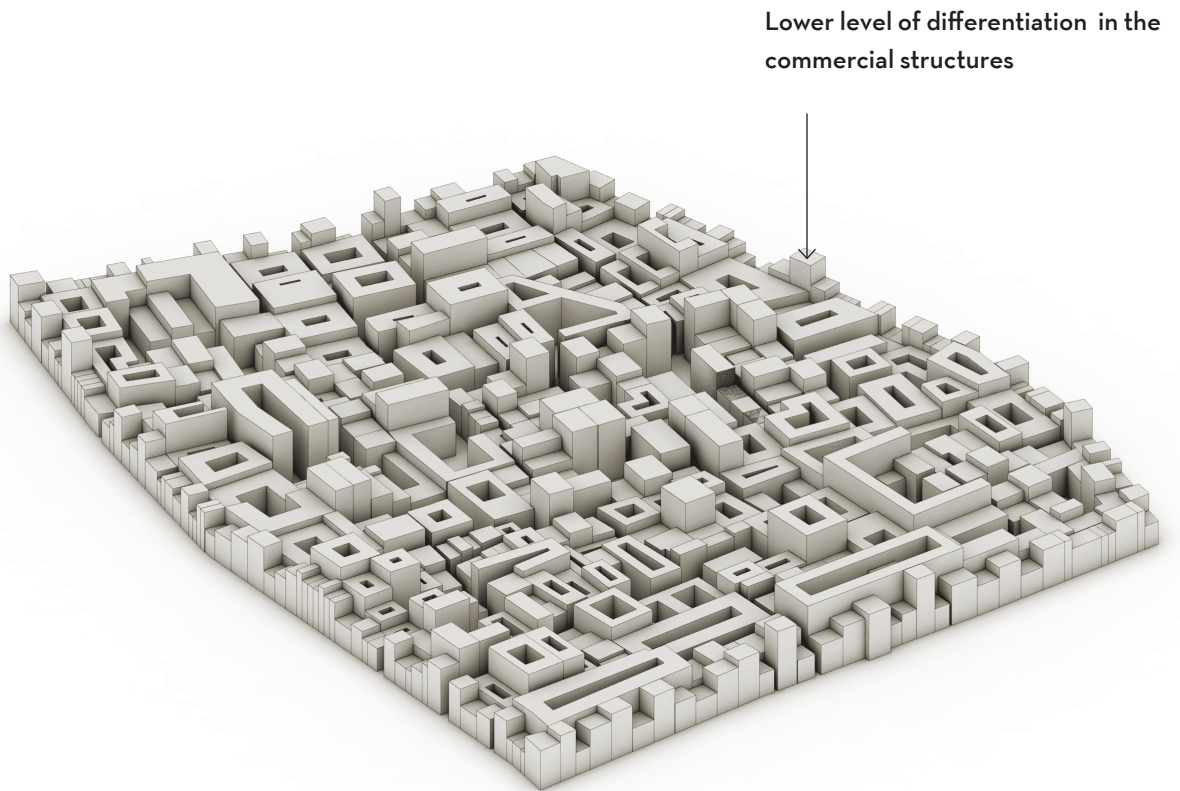
### Case 02 - Low level of Commercial Differentiation



#### Key Shaping Parameters

[FIGURE 7.48 Iteration 4 ]

20 % open space	FAR : 4	Minimum plot/block size 3.5x4.5m
Presence of Building Types		All building types may or may not be based on the base module
Maximum building height 18m		Minimum building height 7m
Land Use Pattern		Boundary Condition
Street Widths and Depths		Angle of Views
Commercial Block - Location and Volume		Minimum shop module size 2.4x6m and maximum height 18m



[FIGURE 749 North-East Isometric View

## URBAN FABRIC - 4

Parcelization based on mansions as second order point attractors

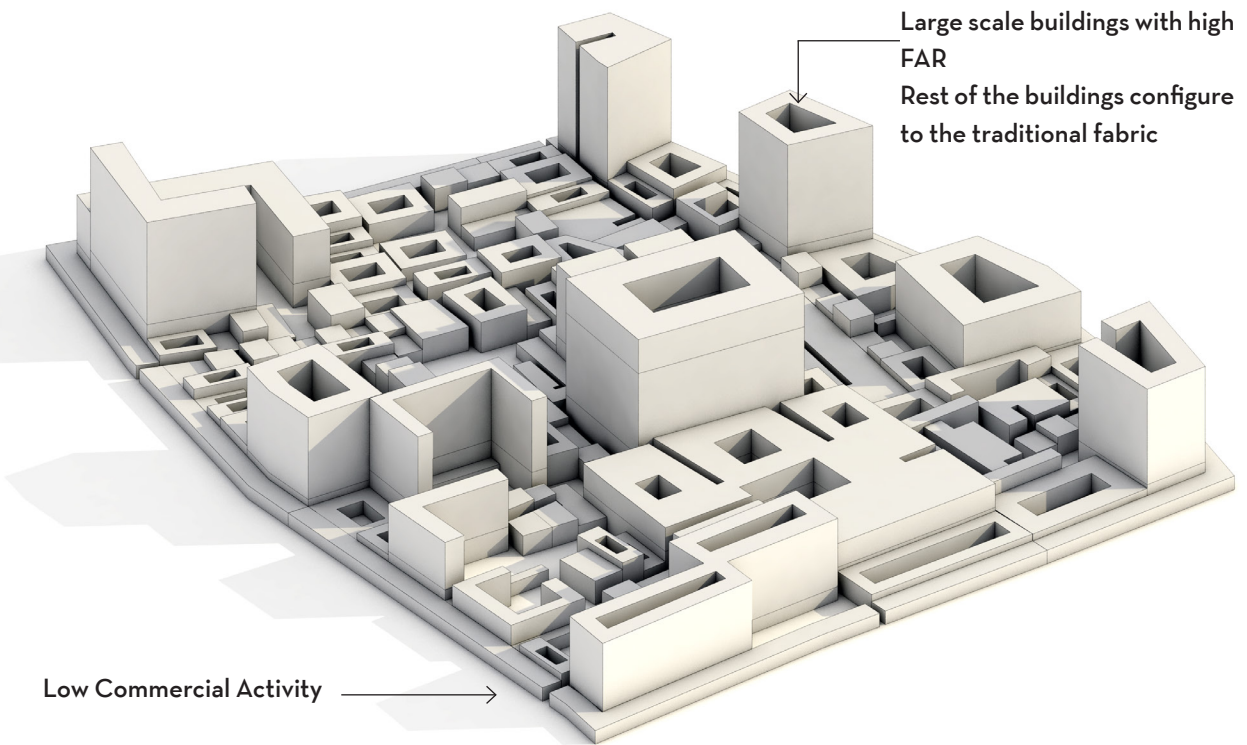


### Key Shaping Parameters

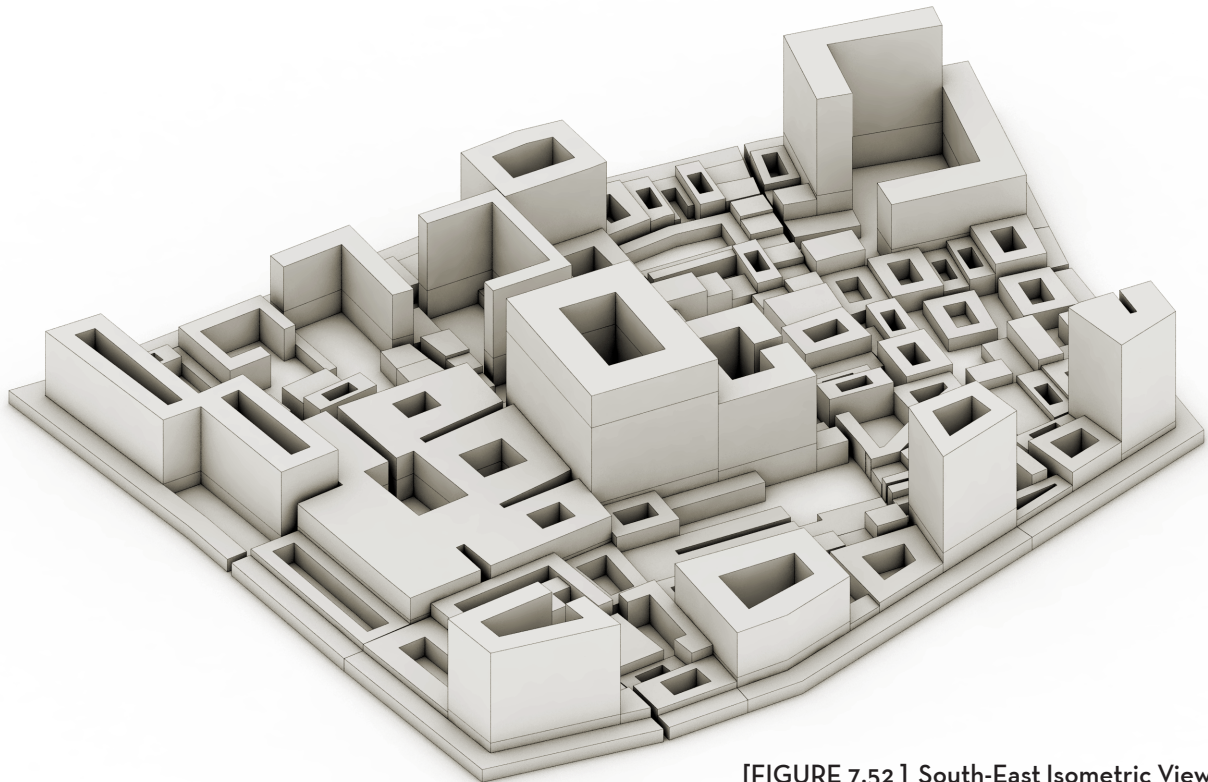
[FIGURE 7.50 Iteration 5 ]

30 % open space	FAR : Mixed	Minimum plot/block size 7x9 m
Presence of Building Types		All building types derived from a base module
Maximum building height 30 m		Minimum building height 4m
Land Use Pattern		Boundary Condition
Street Widths and Depths		Angle of Views
Commercial Block - Location and Volume		Minimum shop module size 6x12m and maximum height 7m





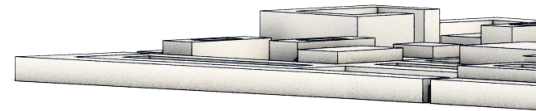
[FIGURE 7.51 ] North-East Isometric View



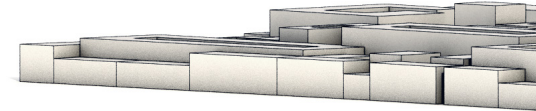
[FIGURE 7.52 ] South-East Isometric View

## PRESERVING URBAN VIEWS

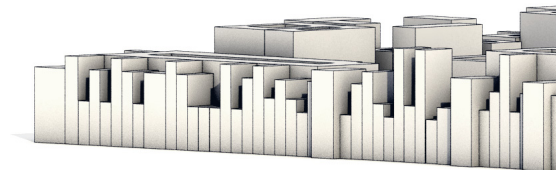
[FIGURE 7.53] Shaping form and matching the urban scale of Old Delhi



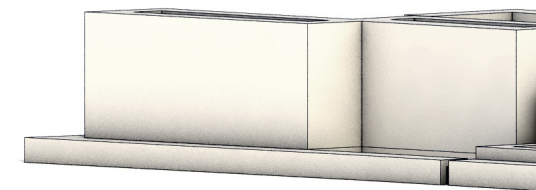
Urban Fabric - 1



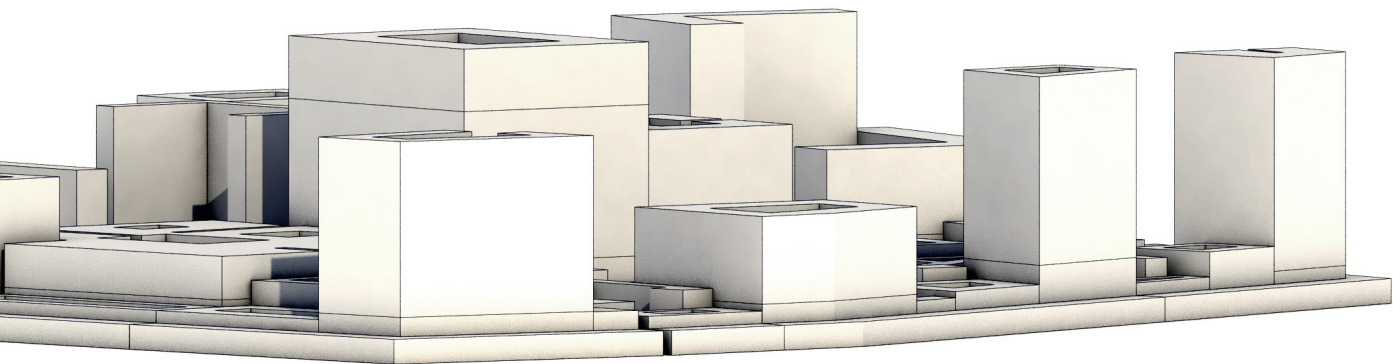
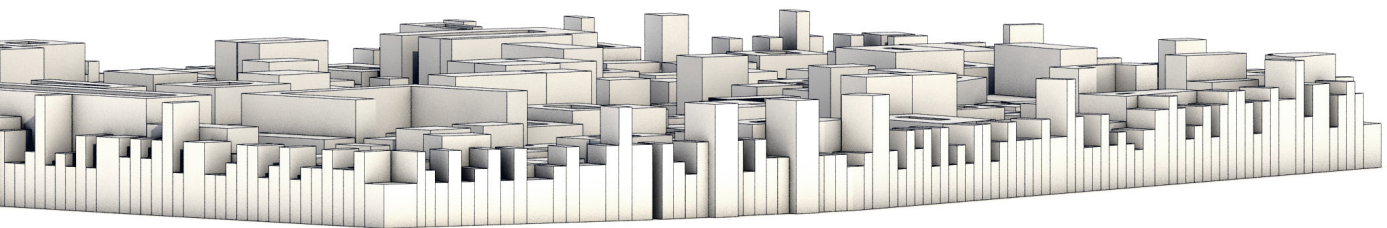
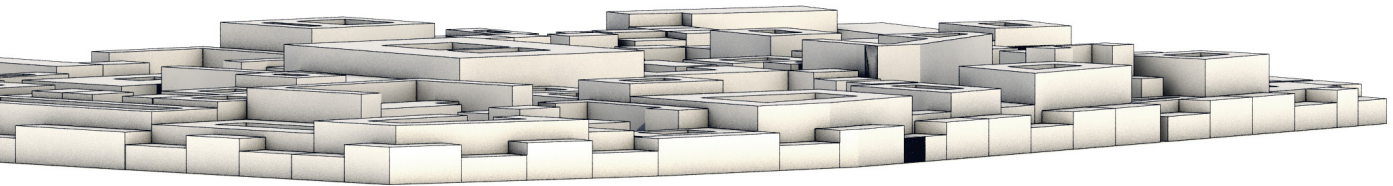
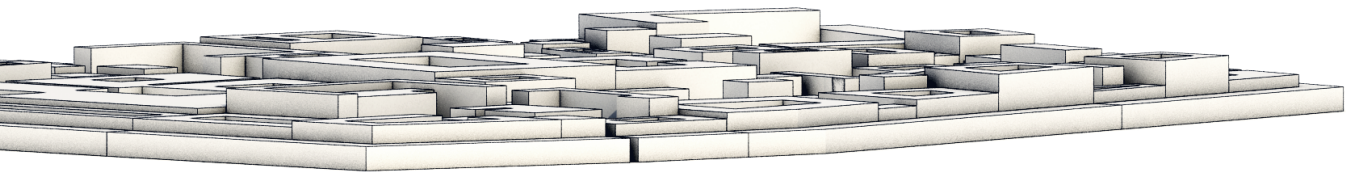
Urban Fabric - 2  
OLD DELHI URBAN FORM



Urban Fabric - 3

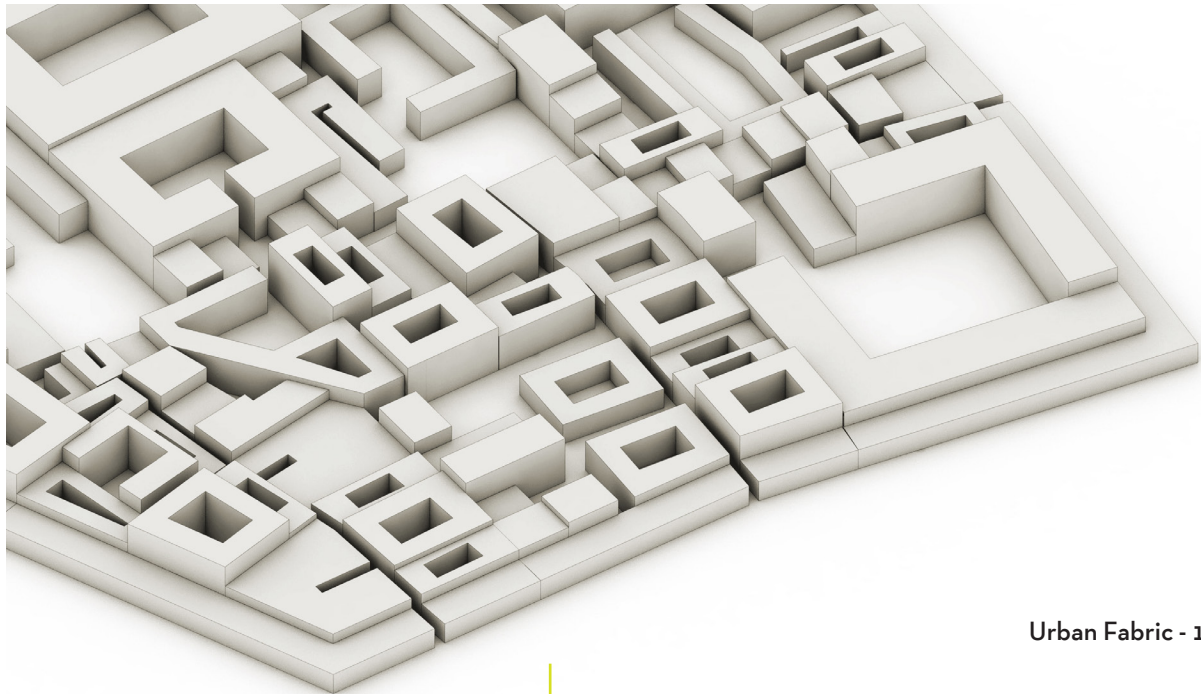


Urban Fabric - 4



## PRESERVING STREET FACADES

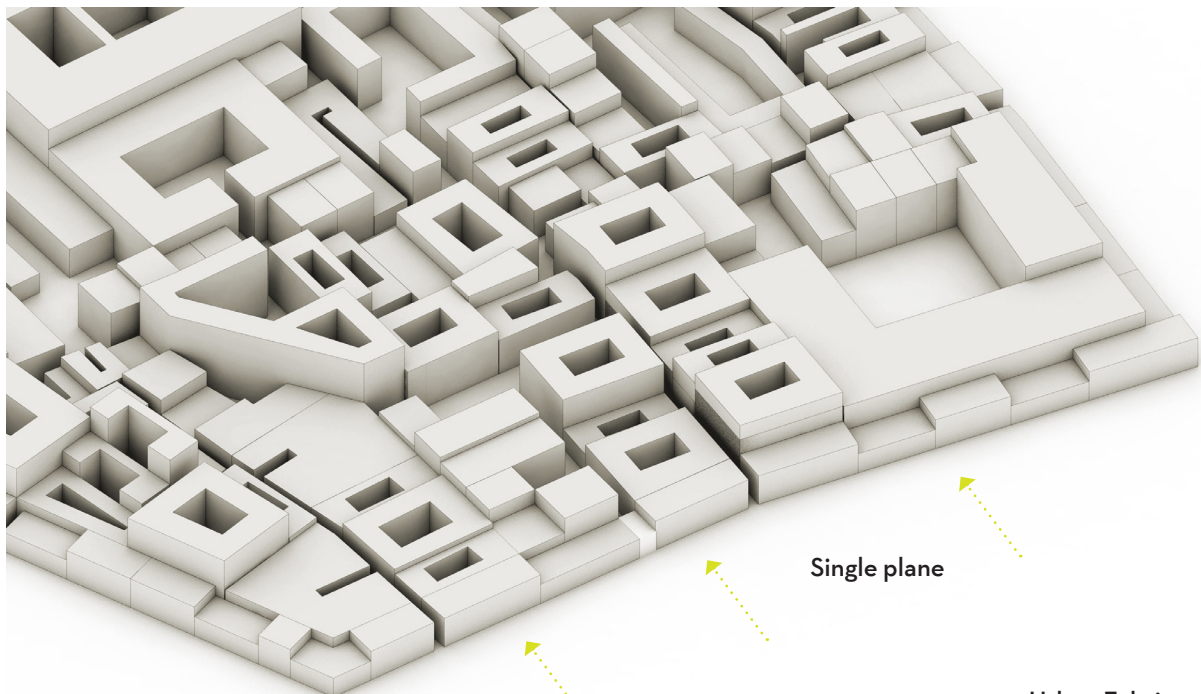
[FIGURE 7.54]



Urban Fabric - 1

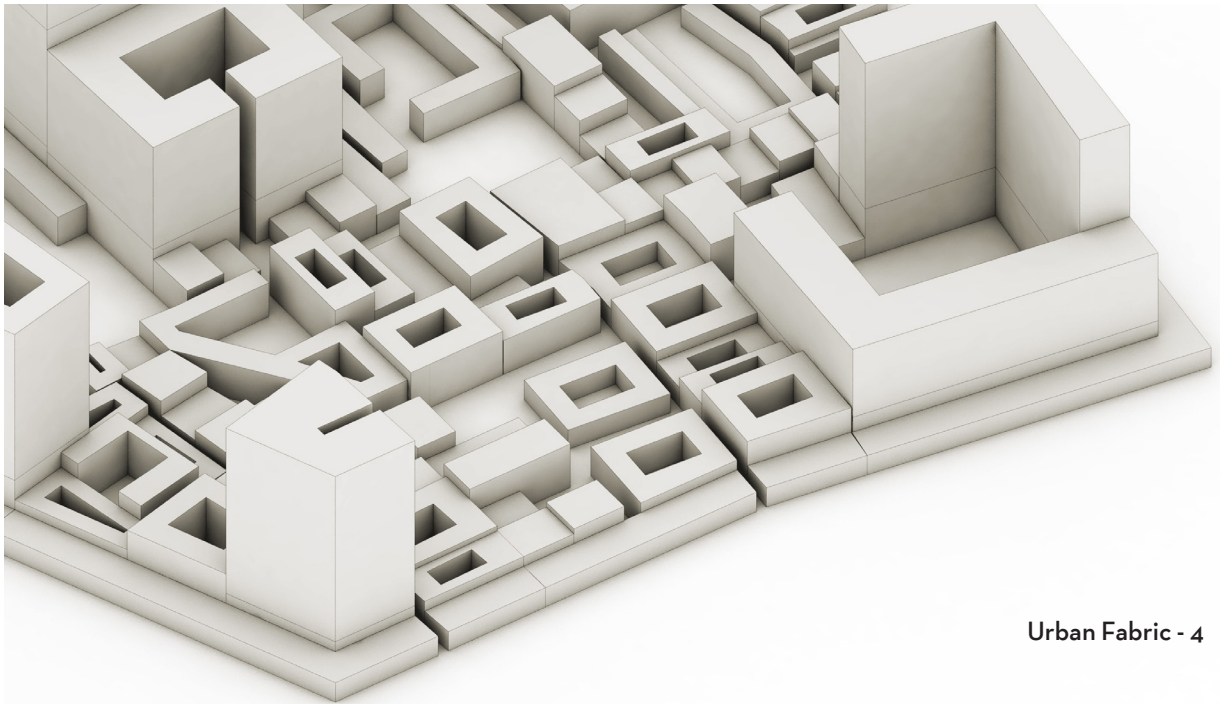


Spatial Quality to be preserved in Old Delhi's fabric



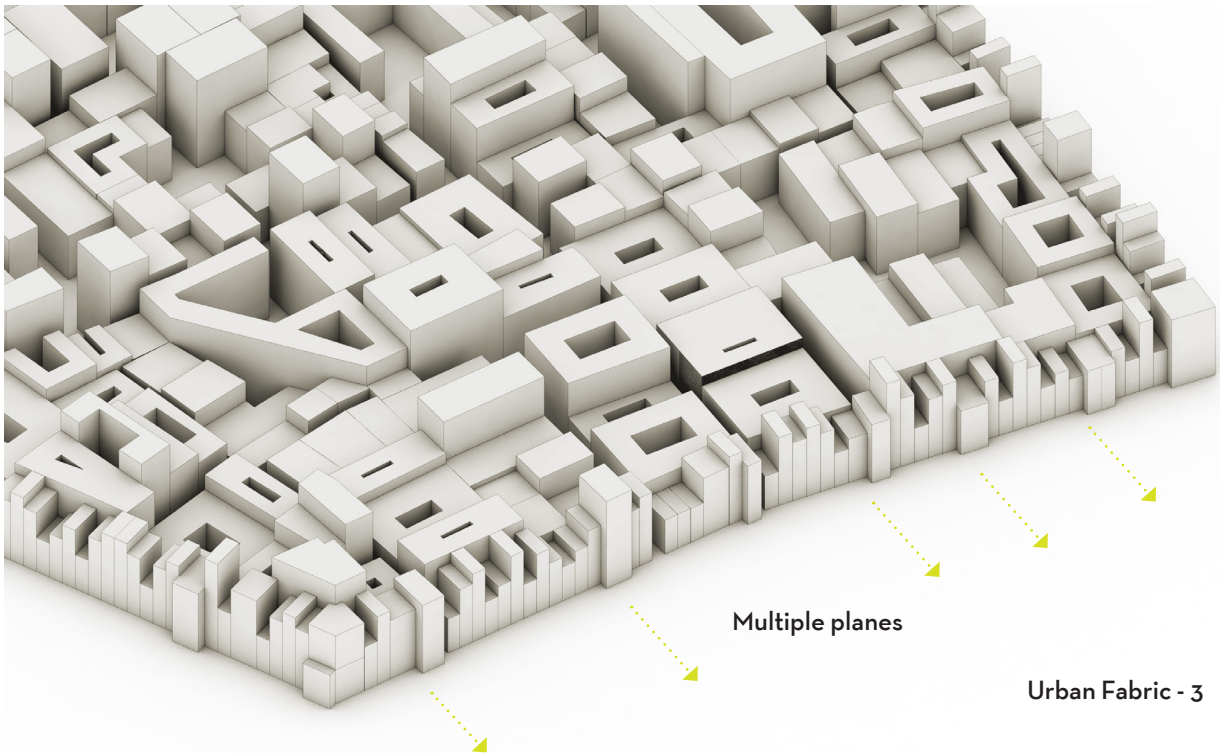
Urban Fabric - 2

Street Facade with varying building heights offer aesthetic value to the city and ensure the continuity of urban character that makes a city desirable. Implementing laws of preservation would help in ensuring dynamic urban change which might not be possible incase of unchecked interventions that would eventually prevent the evolution of the city..



Urban Fabric - 4

Unbalanced real estate development



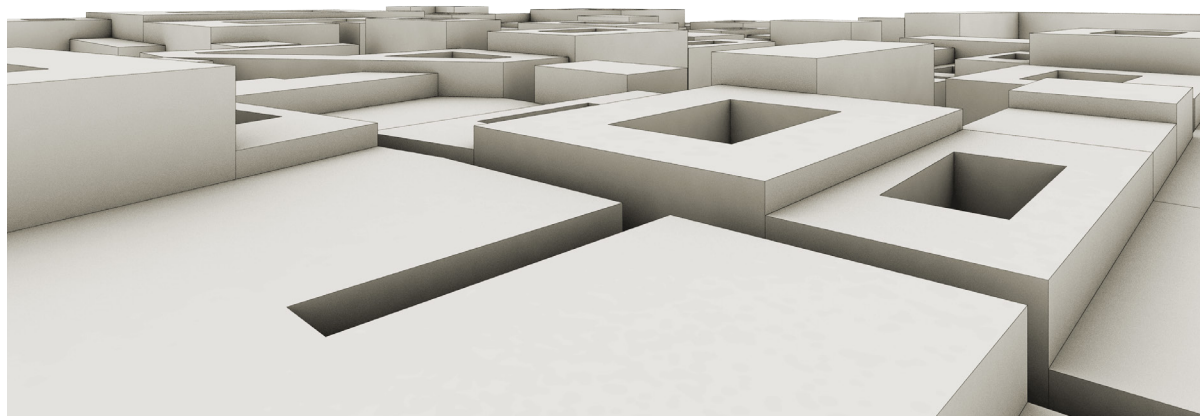
Multiple planes

Urban Fabric - 3

Loss of integrity of overall neighbourhood due to unrestrained development and heavy architectural interventions

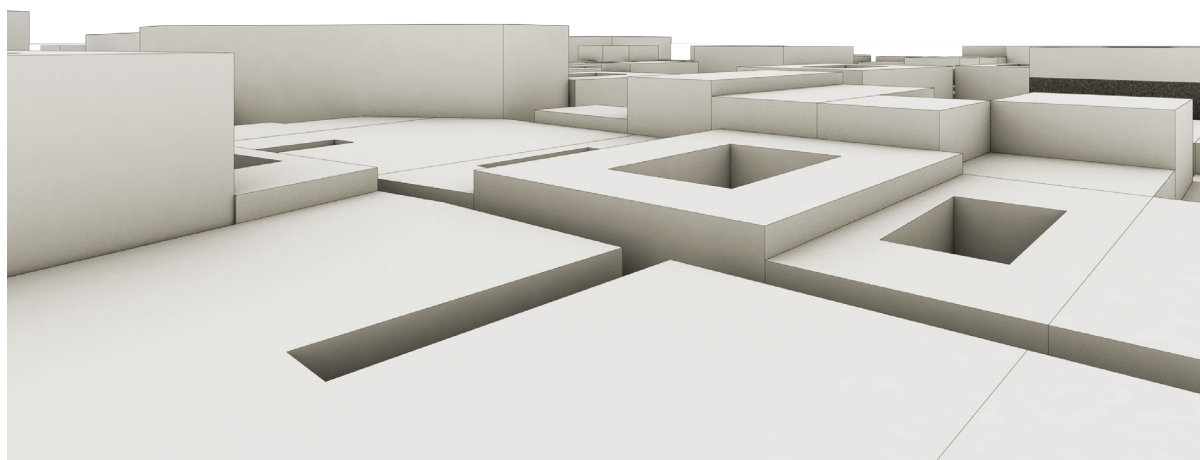
## PRESERVING LOCAL VIEWS

[FIGURE 7.55] Views from Terraces

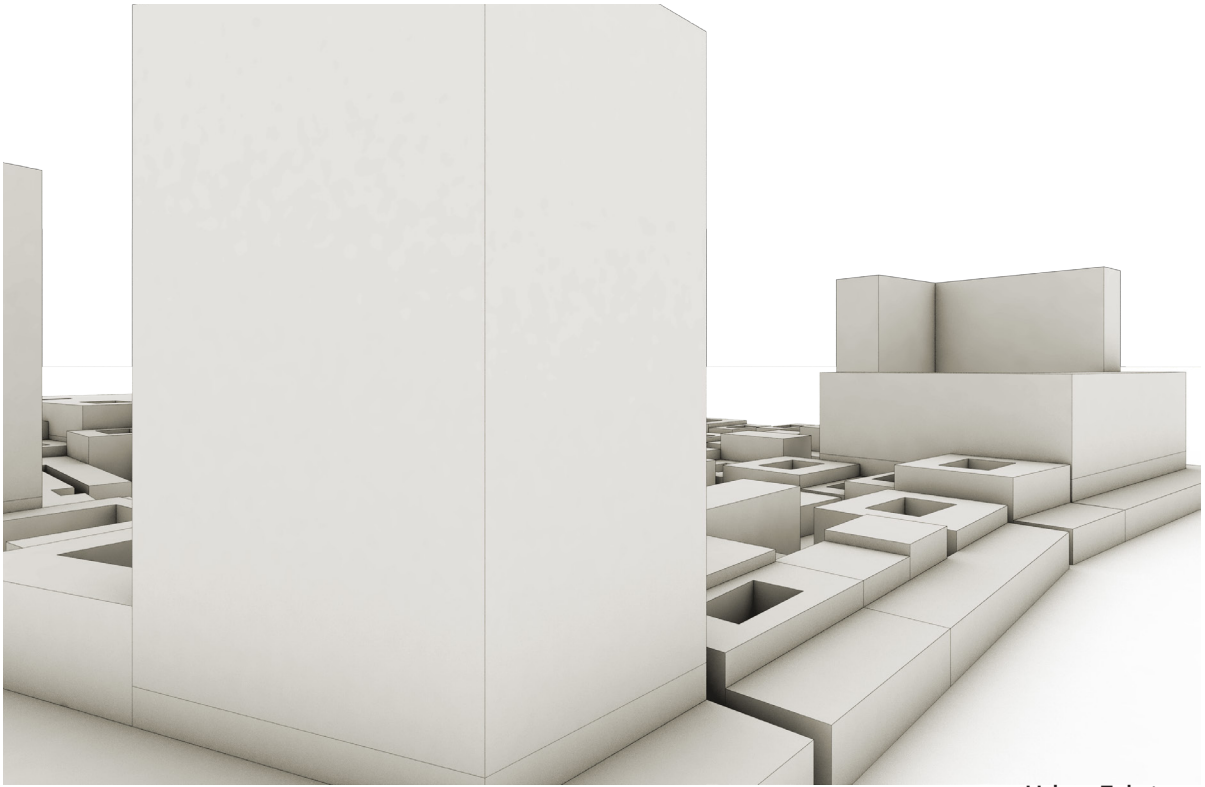


Urban Fabric - 1

Clear lines of sight offer neighbourhood views to the residents thereby maintaining the integrity of the fabric as well as reinforcing cultural values.

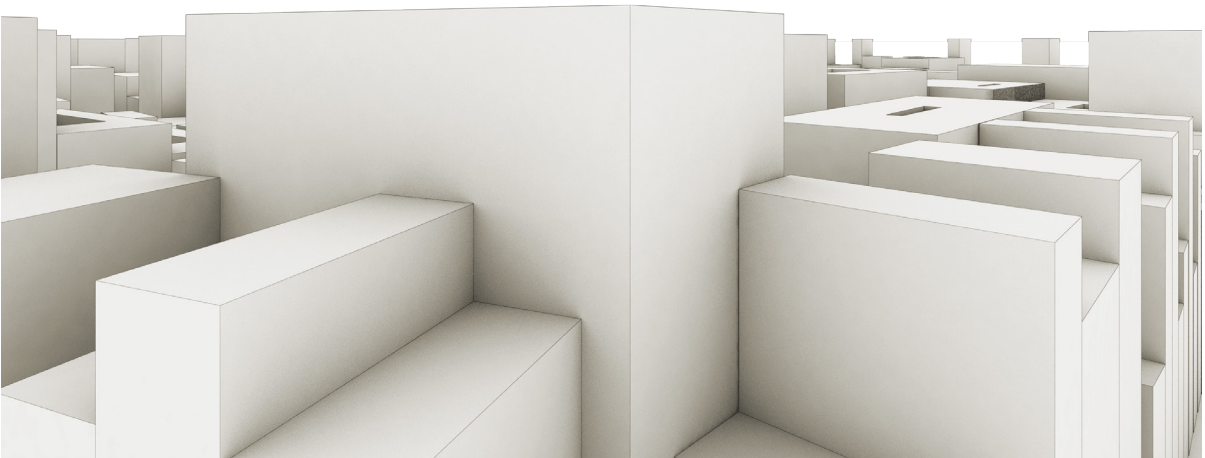


Urban Fabric - 2



Urban Fabric - 4

Unregulated building heights block views thereby cutting the parcels affecting place perception.



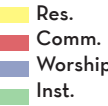
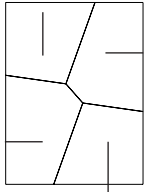


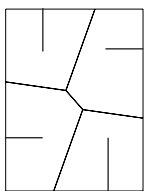


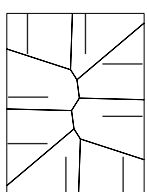


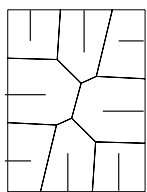


Urban Fabric - 3

[FIGURE 7.56 ] INFERENCES : EVALUATION MATRIX : ANATOMY OF A KATRA BLOCK

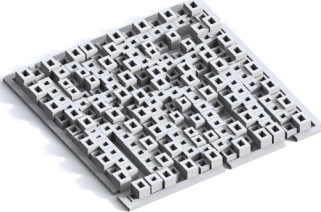
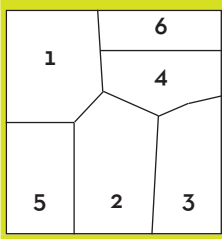
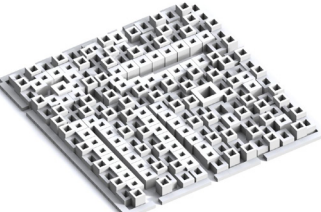
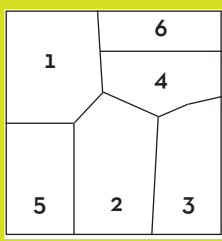
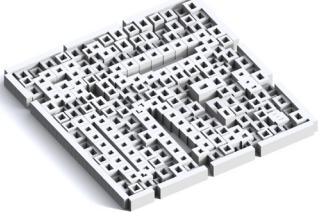
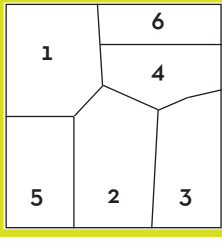
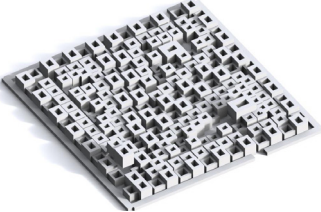
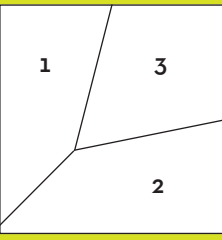
DESIGN ITERATION	KEY URBAN PARAMETERS AND EXPOSING STAGES				
AUTOMATED DESIGNS	KATRA TYPE (INTERNAL ARRANGEMENT)	AREA OF KATRA	LINEAR AND ANGULAR DIMENSIONS OF KATRA BOUNDARY	NUMBER AND AREA OF PARCELS	
		.019 Sq.Kms.	4 sides Linear Dimensions: 120m x 160m Angular Dimensions : 90 Degrees	4 Parcels All parcels approximately one fourth the total area	
		.019 Sq.Kms.	4 sides Linear Dimensions: 120m x 160m Angular Dimensions : 90 Degrees	4 Parcels All parcels approximately one fourth the total area	
		.019 Sq.Kms.	4 sides Linear Dimensions: 120m x 160m Angular Dimensions : 90 Degrees	8 Parcels All parcels approximately one eighth the total area	
	Same number of parcels - different arrangement 	.019 Sq.Kms.	4 sides Linear Dimensions: 120m x 160m Angular Dimensions : 90 Degrees	8 Parcels Central parcels bigger in area than the peripheral parcels	



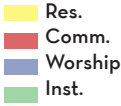
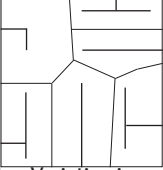


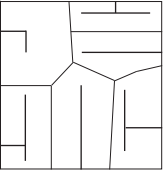


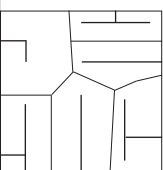


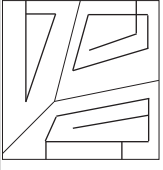


Stage where code exceeds limit / fails

STRUCTURE OF LOCAL STREETS	PROPORTION AND NUMBER OF BUILDING TYPES	% OF OPEN AREA FAR	COURT-YARD SIZE	CONTEXTUAL STACKING AS PER VOLUMETRIC CODE	LANDUSE 	OLD DELHI SPATIAL CODE
 No variation in depth and lines of sight	2 Building Types Block Courtyard 0% large plots 85% medium plots 15% small plots	12% Open FAR : 2.5	10% - 20% of Plot area	Volumetric code violated		
 No variation in depth and lines of sight	2 Building Types Block Courtyard 0% large plots 85% medium plots 15% small plots	23% Open FAR : 4	20%-30% of Plot area	Volumetric code violated		
 All local streets equal in depth No variation in lines of sight.	2 Building Types Block Courtyard 0% large plots 85% medium plots 15% small plots	24% Open FAR : 3.1	15%-40% of Plot area	As per band of volumetric code		
 Street location does not correspond to distance from street intersection	2 Building Types Block Courtyard 0% large plots 85% medium plots 15% small plots	24% Open FAR : 6	15%-40% of Plot area	Volumetric code violated		

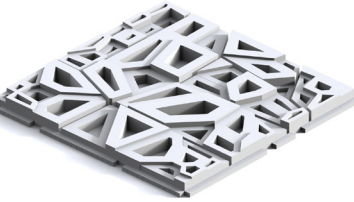
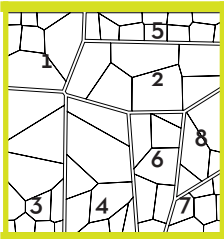
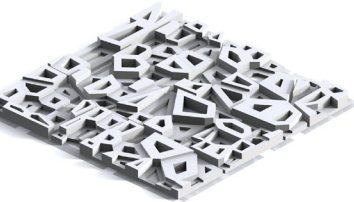
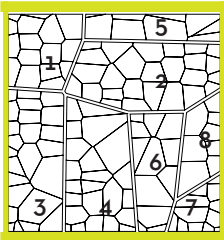

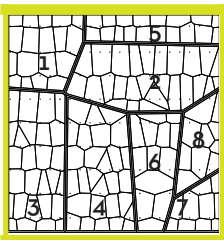

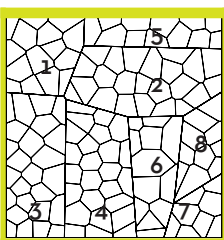
EVALUATION MATRIX : ANATOMY OF A KATRA BLOCK

DESIGN ITERATION	KEY URBAN PARAMETERS AND EXPOSING STAGES				
AUTOMATED DESIGNS	KATRA TYPE (INTERNAL ARRANGEMENT OF BUILDINGS)	AREA OF KATRA	LINEAR AND ANGULAR DIMENSIONS OF KATRA BOUNDARY	NUMBER AND AREA OF PARCELS	
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	6 Parcels Parcels vary in area ranging from high, medium to low.	
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	6 Parcels Parcels vary in area ranging from high, medium to low.	
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	6 Parcels Parcels vary in area ranging from high, medium to low.	
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	3 Parcels No change in Parcel scale.	

Stage where code exceeds limit / fails

	STRUCTURE OF LOCAL STREETS	PROPORTION AND NUMBER OF BUILDING TYPES	% OF OPEN AREA FAR	COURT-YARD SIZE	CONTEXTUAL STACKING AS PER VOLUMETRIC CODE	LANDUSE 	OLD DELHI SPATIAL CODE
	 Variation in street depths, lines of sight only restricted to 90 degrees.	2 Building Types Block Courtyard 46% large plots 28% medium plots 26% small plots	20% Open  FAR : 1.5	20% of Plot area	Volumetric code violated		
	 Variation in street depths, lines of sight only restricted to 90 degrees.	2 Building Types Block Courtyard  0% large plots 83% medium plots 17% small plots	25% Open  FAR : 1.5	25% -30% of Plot area	Volumetric code violated		
	 Variation in street depths, lines of sight only restricted to 90 degrees.	2 Building Types Block Courtyard  0% large plots 93% medium plots 7% small plots	20% Open  FAR : 2	15%- 20% of Plot area	Volumetric code violated		
	 Loop system lines of sight only restricted to 90 degrees and acute angles.	2 Building Types Block Courtyard  2% large plots 95% medium plots 3% small plots	20% Open  FAR : 2	15% -20% of Plot area	As per band of volumetric code		

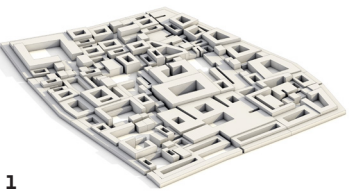
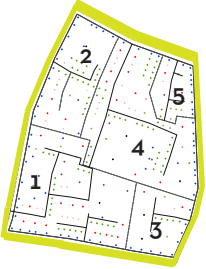
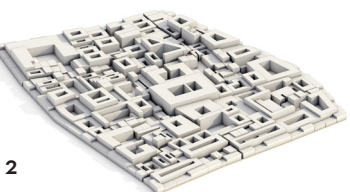
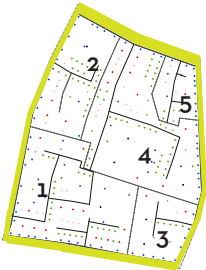
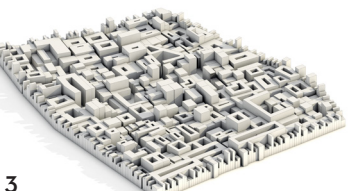
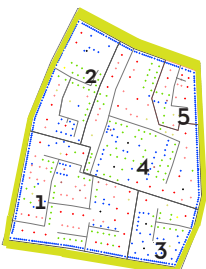
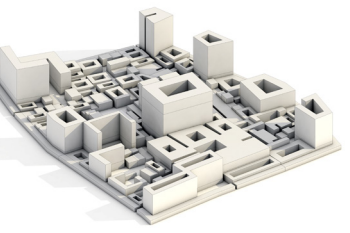

EVALUATION MATRIX : ANATOMY OF A KATRA BLOCK

DESIGN ITERATION	KEY URBAN PARAMETERS AND EXPOSING STAGES			
AUTOMATED DESIGNS	KATRA TYPE (INTERNAL ARRANGEMENT)	AREA OF KATRA	LINEAR AND ANGULAR DIMENSIONS OF KATRA BOUNDARY	NUMBER AND AREA OF PARCELS
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	8 Parcels Parcels vary in area ranging from high, medium to low.
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	8 Parcels Parcels vary in area ranging from high, medium to low.
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	8 Parcels Parcels vary in area ranging from high, medium to low.
		.047 Sq.Kms.	4 sides Linear Dimensions: 215m x 220m Angular Dimensions : 90 Degrees	8 Parcels Parcels vary in area ranging from high, medium to low.

Stage where code exceeds limit / fails

STRUCTURE OF LOCAL STREETS	PROPORTION AND NUMBER OF BUILDING TYPES	% OF OPEN AREA FAR	COURT-YARD SIZE	CONTEXTUAL STACKING AS PER VOLUMETRIC CODE	LANDUSE 	OLD DELHI SPATIAL CODE
 <p>All local streets equal in depth No variation in lines of sight.</p>	<p>2 Building Types Block Courtyard</p> <p>46% large plots 28% medium plots</p>	<p>30% Open  FAR : 1.5</p>	<p>12% to 27% of plot area</p>	<p>As per band of volumetric code</p>		
 <p>All local streets equal in depth No variation in lines of sight.</p>	<p>2 Building Types Block Courtyard</p> <p>0% large plots 83% medium plots 17% small plots</p>	<p>20% Open  FAR : 1.5</p>	<p>15% to 40% of plot area</p>	<p>As per band of volumetric code</p>		
 <p>All local streets equal in depth No variation in lines of sight.</p>	<p>2 Building Types Block Courtyard</p> <p>0% large plots 93% medium plots 7% small plots</p>	<p>26% Open  FAR : 1.5</p>	<p>25% to 30% of plot area</p>	<p>As per band of volumetric code</p>		
 <p>All local streets equal in depth No variation in lines of sight.</p>	<p>2 Building Types Block Courtyard</p> <p>2% large plots 95% medium plots 3% small plots</p>	<p>14% Open  FAR : 1.5</p>	<p>15% to 30% of plot area</p>	<p>As per band of volumetric code</p>		

EVALUATION MATRIX : ANATOMY OF A KATRA BLOCK

DESIGN ITERATION	KEY URBAN PARAMETERS AND EXPOSING STAGES				
MANUAL DESIGNS	KATRA TYPE (INTERNAL ARRANGEMENT OF BUILDINGS)	AREA OF KATRA	LINEAR AND ANGULAR DIMENSIONS OF KATRA BOUNDARY	NUMBER AND AREA OF PARCELS	
<p>1</p> 	 <p>Mansion Type</p>	.05 Sq.Kms.	<p>Lengths : Multiples of 5,10, 25.</p> <p>Angles : All angular dimensions between 165-175 degrees.</p>	<p>Number : 5</p> <p>Maximum area of parcel : 30% of total area</p>	
<p>2</p> 	 <p>Mansion Type</p>	.05 Sq.Kms.	<p>Lengths : Multiples of 5,10, 25.</p> <p>Angles : All angular dimensions between 165-175 degrees.</p>	<p>Number : 5</p> <p>Maximum area of parcel : 30% of total area</p>	
<p>3</p> 	 <p>Mansion Type</p>	.05 Sq.Kms.	<p>Lengths : Multiples of 5,10, 25.</p> <p>Angles : All angular dimensions between 165-175 degrees.</p>	<p>Number : 5</p> <p>Maximum area of parcel : 30% of total area</p>	
<p>4</p> 	 <p>Mansion Type</p>	.05 Sq.Kms.	<p>Lengths : Multiples of 5,10, 25.</p> <p>Angles : All angular dimensions between 165-175 degrees.</p>	<p>Number : 5</p> <p>Maximum area of parcel : 30% of total area</p>	

Stage where code exceeds limit / fails

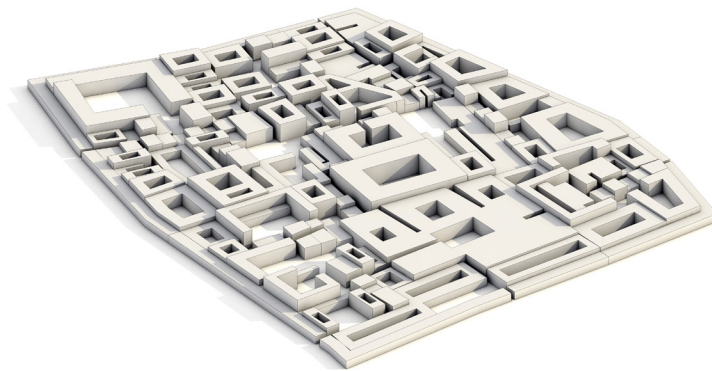
STRUCTURE OF LOCAL STREETS	PROPORTION AND NUMBER OF BUILDING TYPES	% OF OPEN AREA FAR	RELATIVE COURTYARD SIZE	CONTEXTUAL STACKING AS PER VOLUMETRIC CODE	LANDUSE 	OLD DELHI SPATIAL CODE
Depth- multiples of 5,10,25. Width range - 1.5m to 2.4m Angular dimensions -165-175 degrees. Maximum brances-2	6 Building Types Block, Courtyard Side-Court, Linear, U-Court, Fillers  18% large plots 75% medium plots 7% small plots	33% Open  FAR : 1.5	25% of Plot area	As per band of volumetric code		
Depth- multiples of 5,10,25. Width range - 1.2m to 2.4m Angular dimensions -165-175 degrees. Maximum brances-3	6 Building Types Block, Courtyard Side-Court, Linear, U-Court, Fillers  13% large plots 77% medium plots 10% small plots	25% Open  FAR : 2.5	75% of (25% of Plot area)	As per band of volumetric code		
Depth- multiples of 5,10,25. Width range - .9m to 1.8m Angular dimensions -165-175 degrees. Maximum brances-6	6 Building Types Block, Courtyard Side-Court, Linear, U-Court, Fillers  2% large plots 85% medium plots 13% small plots	20% Open  FAR : 4	65% of (25% of Plot area)	Volumetric code violated		
Depth- multiples of 5,10,25. Width range - 1.5m to 2.4m Angular dimensions -165-175 degrees. Maximum brances-2	6 Building Types Block, Courtyard Side-Court, Linear, U-Court, Fillers  18% large plots 75% medium plots 7% small plots	33% Open  FAR : 2.5	25% of Plot area	Volumetric code violated		



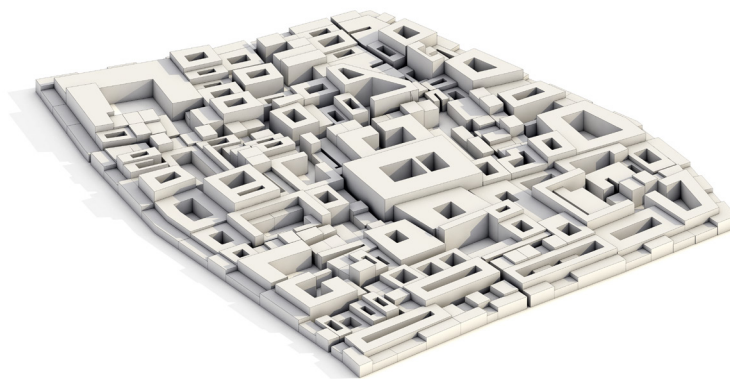


*The inferences from the evaluation matrix highlight the role of the local relationships between the city's physical and social realms that would otherwise appear dormant. Urban mutation is facilitated by this societal control which occurs at various levels within the city and allows for an active and dynamic urban life. Based on the research and experimentation with generative morphologies, the manual iterations number one and two represent Old Delhi's morphology and the urban codes they are generated with, define the minimum (Case 1) and maximum limits (Case 2).*

*Both of these have been further compared to look at the finer details and illustrate the feel of the fabric with the help of rendered views of streets and terraces that provide a glimpse of the local life of Old Delhi residents.*



Case 1 - Lower Limit



Case 2 - Upper Limit

*Both Case 1 and Case 2 demonstrate architectural forms that represent the crystallization of a creative process; the built form is not accidental and superficial but is a carrier of meaning and soul of the city.*

[ FIG. 7.57 ] Case 1



[ FIG. 7.58 ] Case 2





## AFTERTHOUGHTS

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The underlying theme of the study remains the focus on development of spatial and cultural codes as a means to achieve greater urban flexibility with the design of a systematic logic that modulates various conditions in response to local inputs.

*This code works only if the global grid of the city is preserved, the street network follows the mathematical qualities documented, the urban fabric carries the different building types, constructed within the set limits and lastly the involvement of cultural urban strategies in urban development. The end morphological product will depend on the level of sophistication in translating these rules.*

The study was a productive experiment as it identifies the core ingredients that when put together produce the required level of sophistication while generating Old Delhi's urban fabric. Even though the digital experimentation with Grasshopper did not generate models that required a level of subtlety, however it did demonstrate the missing information that is a prerequisite to critically analyze Old Delhi's morphology. The most significant information being the importance of arrangement and proportion of building types. This was the piece of information that was used to initiate the manual design experimentation. Apart from the spatial and formal codes implemented, hidden cultural codes were further incorporated.

These two experiments thus worked together to exhibit the complexity of information within the fabric.

*It is thus through creative exploration, by reviving internal shaping processes and by carefully understanding the evolution of the historic structures, that we can maintain a link to the past. This link is not for the sake of nostalgia rather for re-integrating a human wholeness. The only way to regenerate the city from within is by looking at 'building' not as an object-oriented activity rather a process-oriented one and not imposing abstract schemes.*

This thesis looks at preservation with a different ideology and focusses on generating guidelines that embody the spirit of Old Delhi. These are the architectural, urban design and planning guidelines that are not meant to fossilize the existing urban structure rather aim to prevent an uncontrolled and unchecked development that would eventually lead to heavy architectural interventions. These guidelines would help in renewing the fabric and prevent residents living in Old Delhi for generations to move out. These residents are the real stakeholders of architecture that carry the sharp intellect and their set of cultural beliefs within them. This together would ensure Urban Conservation through *the preservation of historic spatial and cultural codes.*

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## APPENDIX

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### Precedent Analysis

#### 1. Venice

The city of Venice was studied as one of the case studies. Venice has a very high tourist potential, to a level that it is forcing the residents to move out. This current process threatens the traditional fabric of Venice as it slowly might just become a Museum City. Thus similar to Old Delhi, preservation of fabric becomes critical for Venice too.

#### 2. Generic City, Rem Koolhaas

Rem Koolhaas talks about a city without an identity, where nothingness is created. He talks about a city with no boundaries, no walls and endless repetition of fractals. The city grows with time and adapts as per the need of the hour. This was an interesting approach to preservation when it came to Old Delhi as well in spite of Old Delhi being a historic city with its specific urbanity. The study of the generic city helped in understanding that if a city's specific elements were kept constant while the others were allowed to be manipulated, the city still might be able to preserve its character yet grow and adapt with time.

This was the starting point of thinking about a new mode of preservation for Old Delhi.

#### 3. Urban Field Adaptive Urban Fabric / [UTO] Designer(s): Ursula Frick, Thomas Grabner

#### 4. RE-FARMING BEIJING: Parametric Food Urbanism in Peri-Urban China - Organicités studio

Designer(s): Parakesh, Christoph Holz, Johann Watzke

Media x Design Lab, Ecole polytechnique fédérale de Lausanne [EPFL], Switzerland

#### 5. KOKKUGIA, MELBOURNE DOCKLANDS, MELBOURNE, AUSTRALIA, 2008 SWARM URBANISM