

KEY WORDS:

Gating, Gurgaon, Street Pattern, Fragmentation, Continuity.

Impact of Gating on Neighbourhood Street Pattern in Gurgaon

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Tekton

Volume 4, Issue 1, March 2017

pp. 54 - 65

ABSTRACT

Gurgaon's residential sectors are developing and showcasing the different approaches adopted for their development. The city neighbourhoods are moving towards the concept of 'Gating'. Due to high pressure on land, growing population and increasing land prices in the city, the choice to go high rise is unavoidable. Gating is used for security reasons, but in many cases the developers are using this as a concept as a selling point of their product. Gated developments enforce full control on their street network. The paper brings out the difference in the changing street pattern on account of gating. The main objective is to understand the impact of gating on the neighbourhood street pattern by using metric and geometric parameters for street network. For this three different sectors of Gurgaon depicting different growth patterns have been selected and compared on several parameters and tested using a few tests. The results show that the connectivity is poor in Sector 49 which is full of high-rise gated complexes.



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Introduction

Cities have been developing rapidly. According to UNFP, as of 2008, more than half of the world's population, appx. 3.3 billion people are living in towns and cities. Accommodating a growing population in the cities is a challenge for the development agencies. Cities are expanding in terms of their population sizes and the spatial dynamics are also changing accordingly. The expansions are visible, as the cities stretch beyond their boundaries; most prominent signs of growth are the vertical expansion seen in terms of high rise residential and commercial towers. Cities in India are expanding at a high rate notably after liberalization in 1990s. Over the past decade and half, cities have changed very rapidly swelling beyond their capacities. Gurgaon in the state of Haryana, in close proximity of the national capital, Delhi and a part of the National Capital Region (NCR), is one such city that epitomizes post liberalization urban growth scenario. The low rise residential developments are being replaced by high rise developments especially during the last decade and half. Gurgaon has been referred to as an icon of India's growth and development at various platforms internationally (Mehtani, 2012). As of 2013, Many Fortune 500 companies are operating in Gurgaon, including American Express, General Electric, Motorola, Dell, Microsoft, IBM, and Google (Rajgopalan and Tabarrok, n.d.).

During the decade of 2001-2011 the city has witnessed a growth in population by 73.14%, rising to more than 1.5 million, mainly due to migration. This is highest of all the 22 districts of the state and more than four times the state average. Its proximity to the affluent southern part of Delhi and its airport has always been an edge over other cities of Haryana. The



Figure 1: Location of Gurgaon district in the NCR region
(Source: Mehtani, 2012)

population density of 1204 persons per sq. km. is also very high. This is second highest in the state after Faridabad district as per the Statistical Abstract of Haryana, 2013-14.

According to the Regional Plan 2021 for NCR, area constituted by the Haryana Sub-Region is 13,428 sq. km. Out of this the Gurgaon region itself is 1,254 sq.km. with a population of over 1.5 million. (Sub-Regional Plan for Haryana Sub-Region of NCR-2021 and Census of India, 2011). In early 1990s, it used to be a small town that has established the initial pattern and signs of growth with the contribution of private developers. National highway 8 divides the city in two distinctly identifiable parts. The north of the national highway was developed first and is called old Gurgaon and the southern part is called New Gurgaon.

The political and economic atmosphere in the city was conducive due to growing trends that encouraged investment from private developers. The neighbourhood development in the form of sectors in the city of Gurgaon



Figure 2: Location of private high rise apartments and co-operative group housing societies in Gurgaon (blue dots-CGHS, red and green dots – private condominiums).

is ever changing since the inception of regulatory body Haryana Urban Development Authority or HUDA.

Gated Developments and Gated Communities

Discussion about gated communities in sociological literature and gated developments in planning and architecture literature brings out the following definitions and typologies about them. According to Basak Tanulku (2013), Gated Communities (GC) usually refer to “residential complexes, which are closed to outsiders through different mechanism such as walls, gates and fences and are protected against potential dangers through security guards and closed circuit television (CCTV) cameras”.

Evan Mckenzie (2003) terms them as ‘Common Interest Development’ or CID. He further clarifies that CIDs are “planned communities of single family homes, housing cooperatives and condominiums”. Thus closed condominiums are also included within the larger ambit of gated communities or Gated Development. Sonia

Roitman (2007) further defines GCs as “closed urban residential schemes voluntarily dwelled by homogeneous social group where public space has been privatized restricting access through implementation of security devices”.

These definitions demonstrate that gated developments cover vast range of spatial developments. These include from single family residential units within gates and boundary walls to the high rise gated condominiums. Gurgaon has abundance of such developments as can be seen in **figure 2**. Hence its can be argued that such large scale developments are going to impact the overall urban environment comprising of streets, open and green spaces, urban blocks etc.

Typologies of Gated Development

Grant and Mittlesteadt (2004) tabulate and cite the three broad typologies of gated communities based on the seminal works of Blakely and Snyder.

Life style -These highlight the common amenities and facilities specifically catering to the leisure class and are found in the form of luxury/retirement/resort type development having golf course, gymnasium, lush greenery and other life style enhancing facilities. The private gated condominiums of Sector 49 in Gurgaon are examples of such types of development.

Prestige -These developments showcase the image, need for privacy and the everlasting desire to control exclusive rights to use few shared facilities and amenities. The cooperatives group housings in Sector 56 in Gurgaon are examples of such category, where the gates and boundary walls are to exert control over the

property and amenities/streets access etc.

Security Zones -These developments reflect the fear in the mind of occupiers. The alleys /

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streets are gated and walled off by retrofitting which makes them feel secure and private by controlling access (Grant & Mittelsteadt, 2004). Sector 4 in Gurgaon is completely low rise and has gates retrofitted in the alleys and streets. This sector is a typical example of security zones where gates, not part of original design, were put in place later.

Other than the above some authors characterize gated Community (GC) or Gated Development (GD) as a phenomenon which the cities are witnessing. Qiang Dou (2008), while studying the morphological characteristics of pre-reform and post- reform Beijing, discussed that the morphological variation in the GC are due to influence from the west where the design firms bring in this new idea, simultaneously he does not desist from saying that the society is also passing through a transition phase. Research conducted in context closed condominium (one of the typology of GC) of Portugal by Cruz & Pinho (2009) indicates that these developments promote exclusive and fragmented urban residential typology. Abe-Kudo (2007) with respect to Japanese urban development argues that the high rise condominiums are a kind of gated developments while drawing a parallel



Figure 3: Location of Sectors (Selected areas for study).
Source: Author

between the American gated communities and the high rise developments found in Tokyo (J. Abe-kudo, 2007).

Gating as Morphological Outcome of City Neighbourhood

This paper is an attempt to understand the city of Gurgaon, which has been gradually developed with the help of a master plan over a period of time and has different planning and development strategies that have manifested in its urban development in the form of Gating. The planned growth of the city took place after the inception of Haryana Urban Development Authority - HUDA in 1977 (Mehtani, 2012). Nearly 38 years of planned development is not uniform. Gurgaon is a city that represents dynamism of growth. Being part of the National Capital Region (NCR) this is a city in Haryana that has excelled compared to the rest. There are some other valid reasons for the morphological development of an area such as, master plan regulations, FAR, demand and market forces, historical reasons etc.



Figure 4: Low rise plotted housing in Sector 4, Gurgaon

Case Study Areas

In order to best understand the morphology of the city developed over a period, it is best to understand and compare the morphology of different sectors, as identified above, with distinct urban form developed at different times. The neighbourhood sector nos 4, 56 and 49 have been identified for the matter of comparison between the different typologies as mentioned above.

The locations of the three sectors are shown in **figure 3**. Sector 4 lies on the northern part of the city where as Sector 56 and 49 lie closeby on the southern or new part of Gurgaon.

Study Area 1: Sector 4

This was one of the earliest developed sectors of the city. It was developed during 1975-1978 (Mehtani, 2012). The residential sector comprises of plotted development with plot sizes ranging from 150 sq.m. to 500 sq.m. (**Figure 4**). This sector has 4 schools and a commercial center on a 18m wide road, easily accessible from all sides. The sector has other amenities also like gymkhana club, temples, offices etc. Sector development is a typical prototype of orthogonal street network system as can be seen in **figure 5a**. The orthogonal street pattern with variety

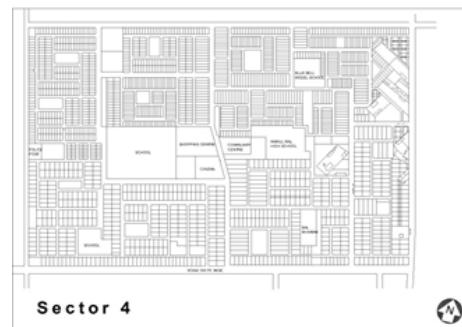


Figure 5a: Plan of Sector 4 (Source: Author)

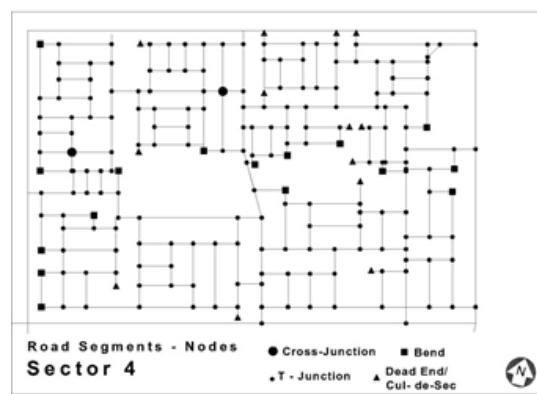


Figure 5b: Roads and nodes of Sector 4, Gurgaon (Source: Author).

of junctions can be seen in **figure 5b**, showing a greater number of T-junctions.

Study Area 2- Sector 56

This sector was developed in the year 2000 (Mehtani, 2012). The residential sector comprises of plotted development by HUDA and 83 group housings on plots ranging from half acre to over 15 acres. The plotting for group housing has been done by HUDA itself. A drain flows through the sector that divides it in two parts diagonally. A 30m wide road running east – west also passes through the center of the sector. The group housing is spread all over and majority of them



Figure 6: Images of co-operative group housing in Sector 56, Gurgaon

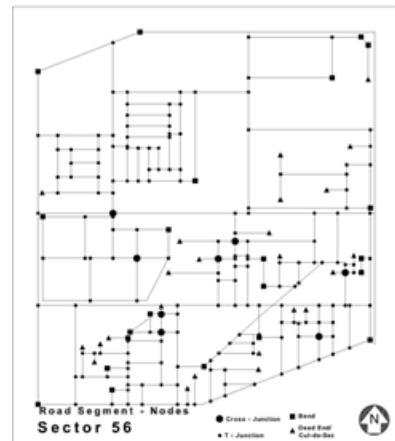


Figure 7b: Roads and nodes of Sector 56, Gurgaon
(Source: Author)



Figure 7a: Plan of Sector 56, Gurgaon (Source: Author)

located on northern part of the sector (**Figure 6**). The sector has 8 schools. The commercial center is located in the center and is surrounded by roads on all the four sides. The plotted Sector development is a typical prototype of orthogonal street network system as can be seen in figure 7a. The orthogonal street pattern with variety of junctions can be seen in **figure 7b**. This sector also has more numbers of T-junctions.

Study Area 3: Sector 49

This sector comprises of mixed development and was developed during the years 1995-2000



Figure 8: High-rise group housings in Sector 49, Gurgaon

(Mehtani, 2012). The sector is a development initiative of private developers, as such all the respective development is gated and guarded. The sector has 5 high- rise group housing schemes namely, Nile, Vatika, Parkview, Sispal Vihar, and Orchid Petals. The representative images of the group housing by private developers can be seen in **figure 8**. Besides this there is a low- rise row housing and plotted development on individual plots. The plan of the sector can be referred in **Figure 9a**. The fragmented street pattern with variety of junctions can be seen in **figure 9b**.



Figure 9a: Plan of Sector 49, Gurgaon (Source: Author)

Figure 9b: Roads and nodes of Sector 49, Gurgaon (Source: Author)

Methodology of the Study

In order to study the impact of the gated development on urban blocks and streets, the pattern of block composition was studied in detail. The study of street patterns comprises overall configuration and geometric features like number of axial lines, length of axial lines, curvature degree, streets intersections typology and numbers. Whereas the blocks are studied with respect to their sizes and location etc. Specific information is generated regarding the numbers and sizes of a block in case of urban blocks based on Omer and Zafir-Reuven (2015). These parameters will be discussed for all the three sectors selected based on initial decision taken on their morphological differences.

Factors such as curvature, fragmentation, spatial connections to the city, continuity and differentiation are analysed with respect to the street patterns in the 3 selected sectors. Omer

and Zafir-Reuven (2015) mention and describe them as follows:

Curvature: A street may not be straight all the time. A curvilinear street will have more axial lines. Axial lines are defined as the longest straight lines with respect to line of visibility and movement that passes through any street or open space. Thus curvature can be defined as a “ratio between number of streets and the number of axial lines”. Omer Zafir-Reuven cite Montello and indicates that the movement options having possible implication on environment perception. A longer and curved street is likely to have more number of axial lines whereas straight line will have one axial line, however long it may be. Orthogonal street patterns are expected to have low curvature ratio value whereas the curved streets are likely to have high curvature ratio value.

	No. of Streets	No. of axial Lines	CURVATURE Streets/Axial Lines	No. of Cul-de-sacs	FRAGMENTATION -Cul de sacs/Streets	No. of Blocks	DIFFERENTIATION -No. of blocks/ No. of Axial Lines	No. of all Junctions (Nodes)	No. of T-Junctions	CONTINUITY (T Junction/ All Junctions)
Sector 4	119	123	0.96	13	0.109	92	0.75	214	183	0.86
Sector 56	119	124	0.96	23	0.193	74	0.59	209	160	0.76
Sector 49	164	173	0.97	59	0.324	106	0.61	292	171	0.59

Table 1: Comparison of various parameters (Source: Author)

Fragmentation: This degree is defined as “ratio of cul- de- sac streets to overall streets within the street network”. Omer Zafrir-Reuven cite Hebbert stating that the modern planned areas have higher number of cul- de- sac ended streets to ensure closed neighbourhoods and hierachal street network. This parameter is examined in case of all three sectors.

Spatial Connection: These are the number of access lines linking the internal street pattern with the rest of the city. In case of Gurgaon’s sectors, it will be shown that there is only limited number of links connecting the neighbourhood’s street pattern with the rest of the city. Citing Song et al., Omer notes that modern neighbourhood areas are introverted and have inward enclosure as their characteristics.

Continuity: This is one of the most important morphological features of a neighbourhood’s

street pattern and is defined as “ratio of Tjunction out of all kinds of junctions available in the street pattern” (Omer and Zafrir-Reuven, 2015).

Differentiation: It is defined as “ratio of number of blocks to the number of axial lines”. It is worthy to note that the sector 49 and sector 56 have a large size blocks as compared to the blocks in sector 4.

Analysis

The impact of the gated development on the street network was analysed by comparing the above parameters for the three sectors, each developed separately under different planning strategies. The sectors 56 and 49 with gated developments show a strong variation with respect to the parameters discussed. Different types of morphological measures were used to describe the properties of street network created within the three sectors. The street pattern

generated due to three different strategies is quite visible. These differences highlight the impact of private gated development on the street. The parameters and values of Sector 56 and 49 are highlighted in the Table 1.

Testing the Street Layouts

Some of the other tests conducted for evaluation of the streets layout of the three different sectors are Route Directness Test, Block Size and Intersection Spacing, Connectivity Index and Distance to Public Street Test (Laven, 2007).

Route Directness Test: This test, citing Hess by Laven (2007), “evaluates the ratio of the distance between two points from ‘as the

There appears a correlation between gated and guarded complexes and increased Route Directness Ratio. We can say that the presence of gated and guarded complexes thus reduces the overall connectivity of the neighbourhood.

bird flies’ measurements, and on the ground measurements, following the street pattern and established pedestrian route.” Good settlement layout with better connectivity should offer a number of route opportunities to a given destination, thus giving a person different choices. Author further mentions that a well-connected settlement should ideally be having “direct route to destination”.

A total of 15 locations were selected in the three sectors and one central point was chosen (tentatively central location of the sectors). From each of the point, direct distance ‘as the bird flies’ was measured to the central location. It was assumed that one can pass through the gated

development. The data was then used to analyse the trends in the three sectors. The mean route directness ratio for Sector 4 is 1.443; Sector 56 is 1.463; and Sector 49 is the highest at 1.650.

There is now an established link between gated guarded development and larger blocks and road segments. This kind of development with large size grain reduces options of better connectivity and further reduces permeability in the neighbourhood.

It was observed that the ratio increases in case of gated development in Sector 49. The ratio is below standard level of 1.5 in both Sector 4 and 56 whereas it crosses the limit in Sector 49 which has private gated and guarded complexes all over. There appears a correlation between gated and guarded complexes and increased Route Directness Ratio. We can say that the presence of gated and guarded complexes thus reduces the overall connectivity of the neighbourhood.

Block Size and Intersection Spacing: This test involves the measurement of neighbourhood blocks. Laven (2007) says that “well connected neighbourhoods are made up of lots of small blocks and intersections”. More number of blocks intuitively gives better route choices and overall permeability. Thus it can be said that the block size and connectivity are intrinsically linked. Average block size in Sector 4 is 10,278.36 sq.m.; in Sector 56, it is 21,552 sq.m.; whereas in Sector 49, it is 18,613.10 sq.m. Laven cites Handy to state that 7 to 11 acres is an ideal block size.

The grain size of any development is highly dependent on the block size and distance

Road Segment Length Analysis			
	Sector 4	Sector 56	Sector 49
Road Segment Length			
More Than 200 m	12	30	19
150-200m	11	31	17
100-150m	49	45	36
Less than 100m	239	201	313
Total	311	307	385

Table 2: Comparison of various parameters (Source: Author)

between the intersections. All blocks sizes were measured and node segments were calculated. Due to different kind of development patterns, no specific limit of distance between intersections was considered. Numbers of road segments more than 200m, between 150-200m, 100-150m, and less than 100 m were calculated. The details are as follows (Table 2 & 3).

A greater number of segments (although within gated and guarded complexes) in Sector 49 proves that this sector is more fragmented, despite of the fact that large land parcels are still undeveloped. Sector 56 has maximum number of road segments over 200 m. This clearly signifies that there is a direct correlation between the block sizes and large road segments. There is now an established link between gated guarded development and larger blocks and road segments. This kind of development with large size grain reduces options of better connectivity and further reduces permeability in the neighbourhood.

Connectivity Index: This test is used by planners to ensure better connectivity. According to Laven (2007), "...a simple measure

Block Area Analysis (in sq.m.)			
	Sector 4	Sector 56	Sector 49
Blocks	92 no.	74 no.	106 no.
Max. Area	96483.1	206062.2	270536.5
Min. Area	1920	1800	550.7
Average	10278.36	21552	18613.1

Table 3: Block sizes (Range) (Source: Author)

of connectivity is the number of street links divided by the number of nodes or link ends... more the links relative to nodes, better is connectivity." The argument in favour of well-connected neighbourhood is that a well-connected street network will have more number of links in comparison to nodes. This would mean that the network will have a lesser number of nodes- whether cul-de-sac or dead ends but more number of cross junctions. Laven says that the range from 1.0 (in case of neighbourhood having more cul-de-sac) to 2.0 in case of perfect grid street layout system is acceptable. Author further cites Ewing to state that 1.4 is the optimum ratio to be achieved.

The streets segments were made for each of the three sectors. And then nodes were identified in terms of cross junctions, cul-de-sac, bends and T-junctions (Figures 5b, 7b, 9b). There was no specific objective behind this except that nodes typology was understood in a better way. All the three sectors have majority of T-junctions. Sector 4 has nearly 58% T-junctions, Sector 56 has 51%, whereas Sector 49 has 44% T-junctions and maximum number of bends at nearly 15% (highest of all three sectors) (Table 4).

Connectivity Index - Segments to Node Ratio			
	Sector 4	Sector 56	Sector 49
Type of Nodes			
Cross Junctions	2	7	22
T- Junctions	183	160	176
Bend	16	18	40
Cul de Sac/Dead End	13	24	59
TOTAL (A)	214	209	297
Number of Road Segments (B)	311	307	385
Segments/Node	1.45	1.46	1.30

Table 4: Connectivity Index- the details of Nodes in three Sectors can be seen in Figures 5b, 7b, 9b. (Source: Author)

Conclusions

The above discussion compares the parameters between the three sectors based on which the conclusion is drawn. Sector 56 and Sector 49 with gated developments show a strong variation with respect to the parameters discussed.

As per the data enumerated in **Table 1**, it can be argued that Sector 49 is highly fragmented and disjointed in terms of street networks. This sector is full of private gated high-rise as well low-rise development. As mentioned earlier, the large sized gated development tend to fragment the urban texture and lead to discontinuity in urban street network. All private developers exert their own control on the street fabric and network. Low values of differentiation means that sector either has low number of blocks or high number of axial lines. Comparatively, Sector 49 has high number of blocks and axial lines. It means that the majority of block sizes is smaller and there is a presence of large chunk

of unified land parcels forming urban blocks. Analyses of geometric properties also reveal that Sector 56 and 49 have large block sizes due to presence of gated high rise group housings (**Table 3**). Large plot sizes lead to large grain size and large numbers of big size road segments (**Table 2**). The connectivity index reveals that the connectivity is poor in Sector 49 which is full of high-rise gated complexes (**Table 4**).

Thus one can conclude that the urban fabric of Sector 49 is fractured, fragmented and more differentiated and least continuous. It is also noteworthy to mention that Sector 49 is full of private gated high/low rise development. Thus, it is concluded that, the urban pattern generated by the private developments at different point of time is discontinuous and does not project as unified urban image of a sector as in the case of Sector 4 and 56 where it occurs to some extent. ■

Acknowledgements:

This paper is a work of ongoing PhD research of the author under the supervision of Prof. (Dr.) Jyoti Pandey Sharma, DCRUST, Murthal.

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