

Critical Review of Street Connectivity Between Tejgaon Industrial Area and Adjacent Hatirjheel Development

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ABSTRACT

Tejgaon's development process was initiated in the 1950s by the Department of Public Works (PWD) as an industrial zone and it was also indicated in the first master plan of Dhaka (1959). In 1968, Tejgaon was designed as light industrial area by the Dhaka Improvement Trust (DIT). After Liberation war in 1971 Tejgaon became the most sought after place for industrial activity for not only its being on the outskirts of the than city center but also for the rising demand for the growing population of Dhaka. Several residential areas were developed beyond Tejgaon industrial areas (TIA) resulting in the rapid transformation of land use at this point into a mixed use development changing the physical characteristics of TIA. Responding to this transformation, the Government of Bangladesh has decided to develop Tejgaon industrial area as commercial cum residential hub. At the same time low lying areas i.e. Hatirjheel area on the south of TIA was developed to connect the northern residential areas (beyond TIA) with the older urban core. TIA thus came in between Hatirjheel development and Northern residential areas as such requiring rethinking of the street connectivity in the area. Transformation of TIA and the development of Hatirjheel provides an opportunity to rethink about the connectivity of road network. This study critically reviews the street connectivity between TIA and the adjacent new Hatirjheel development. It is identified that the new Hatirjheel development did not take note of the older TIA road network thus creating problem of urban mobility and integration. This study aims at identifying the street connectivity by quantitative and qualitative method using tools like Depthmapx10 to understand the new dynamics and suggest measures for better urban mobility.

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1. Introduction

Connectivity between spaces through street is an important factor for any area to get better access of vehicle and city people. When a new development takes place adjacent to an older area it needs to take into consideration the traffic dynamics of the area. Low lying areas i.e. Hatirjheel area on the south of Tejgaon industrial area (TIA) was developed recently to connect the northern residential areas (beyond TIA) with the older urban core. Though Hatirjheel is a new development adjacent to TIA, ironically there are no street connectivity between these spaces. The pattern of transformation this industrial area indicates a transition from intensive industrial development to an increasing commercial establishment, followed by a subsequent mixed-use development (Khan *et al.*, 2005). Development and planning of Tejgaon was started during 1950s by Public Works Department

(PWD) as an industrial area (RAJUK, 1995). The first ever Master Plan of Dhaka (1959) also proposed an industrial district in Tejgaon. Industrial development in such a central location of the prime city of the then East Bengal resulted in a number of appalling impacts on the area itself and its surroundings (Oakil & Sharmeen, 2007). Under the circumstances, Tejgaon was designed by the then DIT (Dhaka Improvement Trust) as a light industrial area in 1968. After the liberation in 1971, with the rapid growth of Dhaka City, the city experienced a massive rate of transformation of existing developments (Khan *et al.*, 2005). Development of several residential areas beyond TIA and the transformation within created disputes over land use due to capacity mismatch for the ever-increasing population in terms of growing demand for goods. In turn, it has attracted a wider variety of non-industrial uses such as residential, retail, office, etc (RAJUK, 2004). Taking note of these transformations, the Government had decided

to develop TIA as an industrial-cum-commercial and residential area. The plan was approved by the cabinet on September 8, 2015 and executed by the PWD. In the new declaration for TIA there were no provision of planning or design regarding the integration of the adjacent areas of TIA including the new Hatirjheel development project that was coming up at that time. Independent transformation of TIA and adjacent new Hatirjheel development has caused a chaotic situation. Hatirjheel link road connects circle-1 of Gulshan residential area with Kawran Bazar and runs along the southern boundary of TIA. Surprisingly, there were no designed connectivity with TIA creating a chaotic situation and the problem of urban mobility and integration. To assess this situation this study critically reviews the street connectivity between TIA and the adjacent new Hatirjheel development.

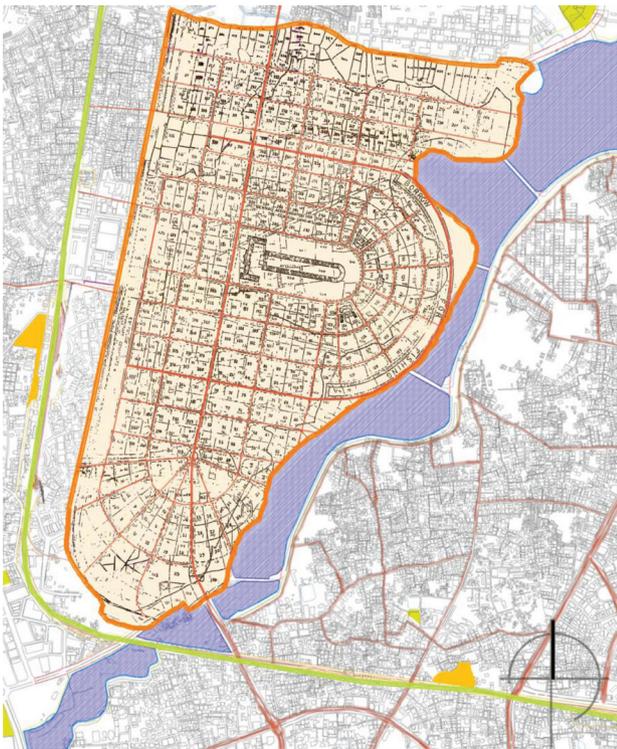


Figure 1: Proposed revised scheme of light industrial development and industrial works area at Tejgaon, Dacca in 1994 master plan. (Source: Ministry of Public Works and Urban development, Government of Bangladesh.)

Therefore this research paper aims to critically review street connectivity by quantitative and qualitative method between central urban place Tejgaon and new urban place Hatirjheel to the changing land use perspective of Tejgaon industrial area.

2. Methodology

2.1. Study Area Selection and Preparation of Base Map

Selected study area is “Tejgaon industrial area” and “Hatirjheel” to assess street connectivity. The study area map and base map is collected or prepared with the help of secondary sources materials and field survey. Development of several residential areas beyond TIA and the transformation within created disputes over land use due to capacity mismatch for the ever-increasing population in terms of growing demand for goods. In turn, it has attracted a wider variety of non-industrial uses such as residential, retail, office, etc (RAJUK, 2004). Taking note of these transformations, the Government had decided to develop TIA as an industrial-cum-commercial and residential area. The plan was approved by the cabinet on September 8, 2015 and executed by the PWD (The Daily Star, 2019). At the same time Hatirjheel development was taken up to connect the northern residential districts. It is identified that the new Hatirjheel development did not take note of the older TIA road network thus creating problem of urban mobility and integration. The 500 acres of TIA with around 430 plots and Hatirjheel Lake development area are the areas of this study.

2.2. Objectives of Study

Hatirjheel development projects intend to act as a corridor between densely developed old part of city and TIA and the northern residential areas. The notion of this project is to improve connectivity between major urban districts as well as acting as retention pond to mitigate the flash flood prone densely populated part of the area besides improving the environment. TIA is in between Hatirjheel development and Northern residential areas as such requiring rethinking of the street connectivity in the area. Transformation of TIA and the development of Hatirjeel provides an opportunity to rethink about the connectivity of road network. This study critically reviews the street connectivity between TIA and the adjacent new Hatirjheel development with the following objectives.

To study possible street connectivity of TIA and Hatirjheel development.

To critically analyze and recommend integration of two areas and improve urban mobility.

2.3. Data Collection

The required data was collected from primary and secondary source. Primary data is collected from field survey and photographs. Secondary data is collected from different Journals, articles, conference papers, software and websites. UCL Depthmapx10 software is used as a tool to measure street connectivity of Tejgaon industrial area through Space Syntax method.

3. Literature Review

Historically Dhaka's urban life and living was interwoven with the system of rivers, canals, lakes and ponds scattered and crisscrossing the city (Mowla, 2012). Streets are connected with those water bodies which creates accessibilities for urban people and this connectivity is the hallmark of communities in this deltaic land. Streets and roads are the vital aspect of a city providing the needed vibrancy to the urban realm. In the oriental cities, the streets are fundamentally social spaces (Mowla & Mozumder, 2017) providing needed vibrancy to an urban area. Large growth in urban population lead to increase in transport trips and therefore spread of the urban area give rise to the expansion of road network, sometimes causing disruptions if not properly addressed (Mowla & Khaleda, 1999).

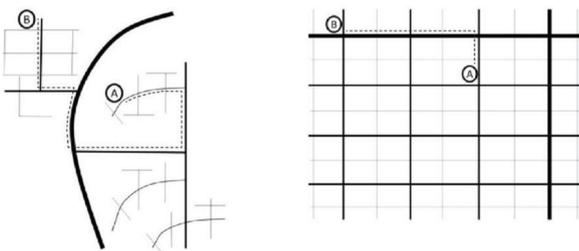


Figure 3: Street network system.

(Source: UTHA street connectivity guide, 2017.)

City streets provide the role of linking us to our employment, to our neighbor's, to our friends, and to our locations. To insure desire mobility, safety and security street connectivity is of much importance for any urban place. High levels of street connectivity actually do a better job of achieving many of the goals that many of our communities share like economic vitality, infrastructure efficiency, health, and how we travel. Higher street connectivity between TIA and Hatirjheel project will create better urban mobility

is the focus of this study. The survey shows that the disconnected street network, increase walking distance and encroachment lessen the connectivity between this two areas.

Street connectivity is a simple idea – providing a network of public streets whose intersections point allow for easy movement around it. However, such simple idea is more difficult to define. These two networks are different in many respects. The network on the left has fewer junctions than the one on the right, and less than the grid pattern. It has bigger, less defined blocks. There are fewer places to access the main road. It takes a longer route to get from Point A to Point B. On the other hand right side street network is well connected and creates so many nodes which insure better mobility (“UTHA street connectivity guide”, 2017). This idea would form the core concept to establish better street connectivity and mobility between two study areas.

In the instance below, the downtown Salt Lake City grid has a greater amount of connection due to its continuous 4-way junctions, while the east Salt Lake City grid has mostly 3-way junctions and cul-de-sacs. Downtown Salt Lake City has more links and nodes. For this reason its street connectivity is better than East Salt Lake street grid. Which is shown in Figure 4 - (“UTHA street connectivity guide”, 2017).



Figure 4: Street connectivity and grid of (a) downtown Salt Lake City and (b) East salt lake city. (c) The relative level of connection. (Source: UTHA street connectivity guide, 2017.)

3.1. Connectivity Index

The comparative connectivity level is evaluated by the connectivity index, also known as the link-node proportion. The connectivity index is the proportion of the connections in the region to the nodes in the same region.

It shows how effective the intersections are—the foundations of a well-connected network are intersections that connect to a number of connections.

This quality is measured by the connectivity index (“UTHA street connectivity guide”, 2017).

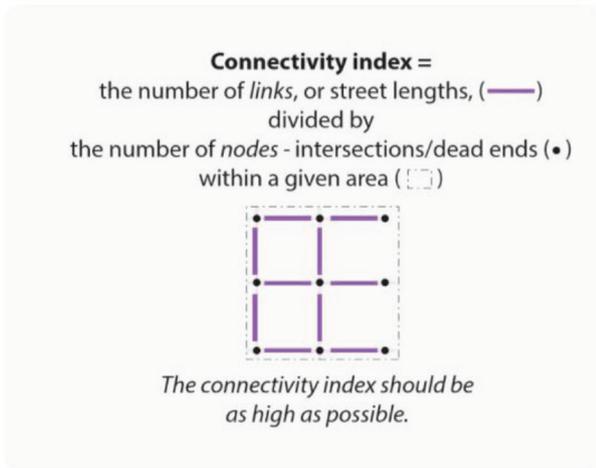


Figure 5: Connectivity index calculation.
 (Source: UTHA street connectivity guide, 2017.)

3.2. Street Connectivity, Land Use and A Case Study

Liverpool is located in the North West of England and is the core city of the ‘Merseyside’ conurbation which encompasses five metropolitan boroughs: Liverpool, Sefton, Wirral, St Helens, and Knowsley (Hussein, 2015). Figure 6 shows street connectivity and node point of Liverpool Albert dock development along Mersey River near Liverpool City Centre. Provision of accessible streets was one of the major goal in the regeneration and development of water front area of Liverpool through creating nodes, integrated link roads beyond the project boundary and widening of roads to take care of new traffic. Those roads are properly connected with the waterfront road. TIA similarly is transforming from an industrial area to commercial mixed use adjacent to Hatirjheel development. The TIA has a similar context and therefore demands similar coordination measures.

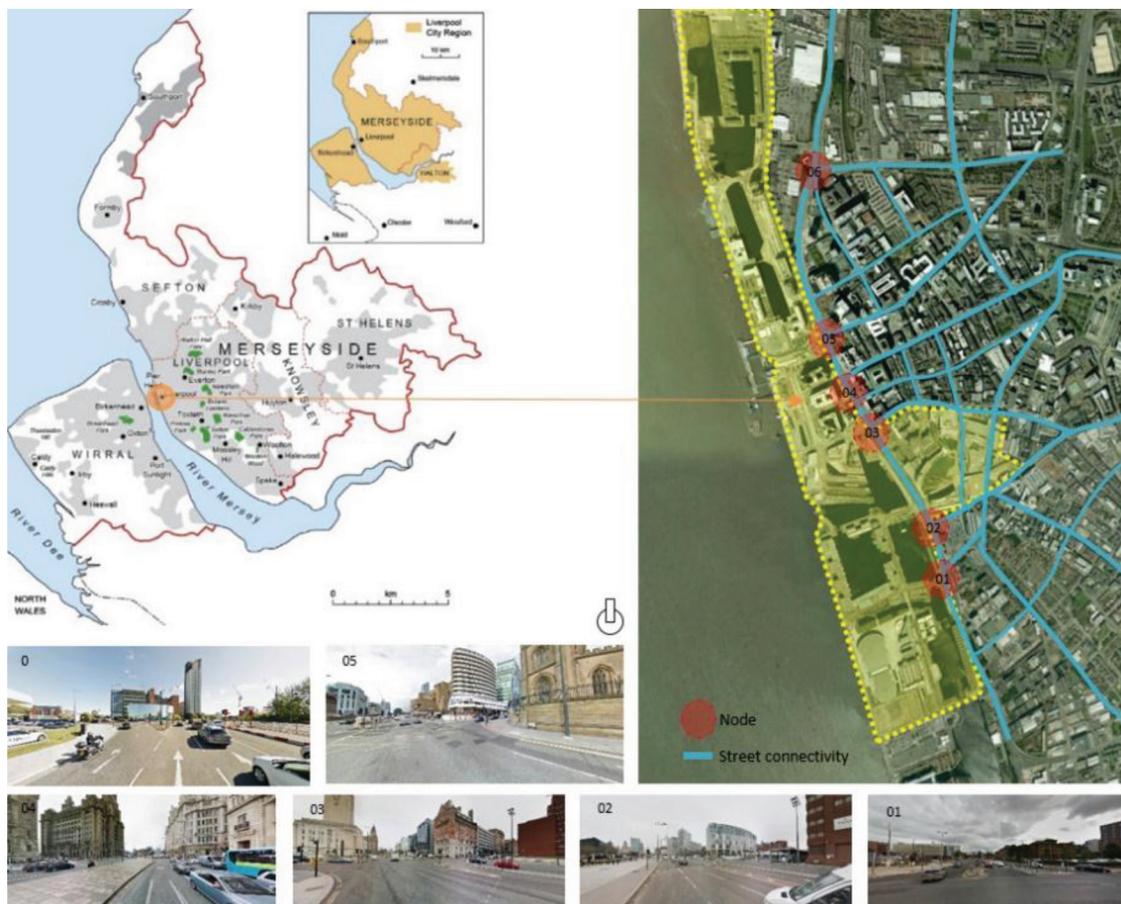


Figure 6: Liverpool street connectivity with waterfront development.
 (Source: Hussein, 2015.)

3.3. Street Connectivity, Land Use and TIA

For growing numbers of people in urban centers, there is a major challenge to adjust infrastructure and transportation standards for urban mobility and to find environmental protection and social inclusion solutions. Consistent transport delays in large cities resulting from inefficient use of the transport system, harm to urban mobility, which damages people and the environment. Dhaka's movement is more difficult due to various factors and difficulties. During the day time, Dhaka City become a problem for traffic, due to diversified land users, poor pedestrian infrastructure, poor public transport and the growing number of private passenger cars. It is projected that in 2030 more than 20 million people will live in Dhaka if unhindered growth rates continue (Barua *et al.*, 2013). A number of variables affect the growth pattern of an area in particular. Changes in one or more of the variables will alter the trend of growth in this region easily. The main responsibility for influencing regional trends for growth are key variables including land use infrastructural changes, Traffic and transportation changes, changes in ownership patterns, changes in structural type and heightening, land price changes etc. (Das *et al.*, 2015).

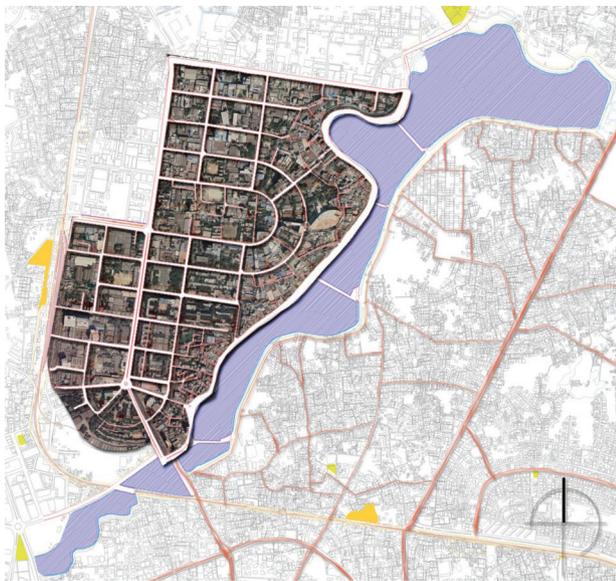


Figure 7: Street connectivity of Tejgaon industrial area and South eastern with Hatirjheel development.
(Source: Google earth, AutoCAD and Photoshop.)

Tejgaon is losing its former characteristics with various transformations leading to mixed use pattern

on area originally designed as an industrial area. The area is constantly faced with the growing demand for transformation into a center of mixed use. In the last two decades, most industrial uses have turned into commercial ones (Oakil & Sharmeen, 2007). With the establishment of RAJUK (formerly known as DIT) in 1987, mismatch of usage patterns have increased. Since Tejgaon is neighboring Dhaka's central region, there have been a considerable increase in commercial activity in this region. More commercial use emerged and heavy industries moved as a result of RAJUK's planning policies. It has triggered transformation of this district into an economic zone of Dhaka city.

Besides development of residential districts on TIA's north, the new Hatirjheel Development next to Tejgaon's industrial area on the south has a further impact on its physical character and urban mobility. The construction of peripheral roads, junctions and walkways along the banks of the Hatirjheel Region could overcome congestion and avoid further disturbance in the local area. The Hatirjheel development being the newer one did not take note of the possible street connection point with TIA resulting in spontaneous haphazard connectivity being coming up. Integration and accessibility between these two areas is therefore painful and problematic.

4. Analysis of the Case Study Area

Axial and segment map analysis shows the structure of the street network. Highly integrated areas are the dark red and orange shades in the figure below, and the green, blue axes are the less integrated areas in the spatial structure. The movement potential diminishes from red to blue (red > orange > yellow > green > blue > indigo) for both axial and segment analysis. Figure shows the campus ' global integration and connectivity. Red segments are the most integrated parts according to these figures, and this means that street accessibility for pedestrians is more than other segments. Light blue segments, on the other hand, are the most segregated parts and this means they are not integrated into the entire street network of campus.

From Literature review and case study it is clear that street connectivity is a vital factor for any area for its sustainability especially when two development areas are placed side by side. There must have clear street connectivity for better urban mobility and

pedestrian access. Better street connectivity create physical and visual connection between spaces and connect or integrate activities properly. “Connectivity index, Space syntax” are the tools to assess better street connectivity, this analysis and the findings from literature review besides field survey helps to consolidate this study about the street connectivity between TIA and Hatirjheel development.

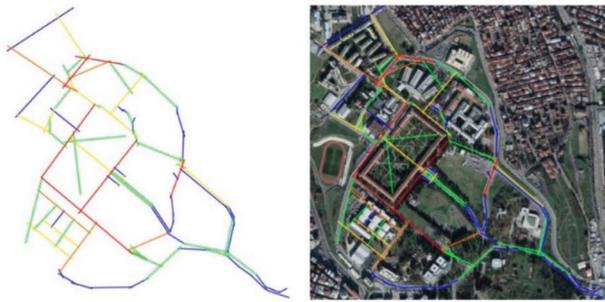


Figure 8: Global connectivity of axial map
(Source: Öztürk et al., 2018.)

5. Result and Discussion

5.1. Present State of the Study Area

A number of important institutions like Ahsanullah University of Science & Technology, Textile University, Polytechnic institute, institutes of Glass and Ceramic

are established in this area. Many government institutions like DLRS, BSTI, BITAC and banks are found here. Most of the lands are under private ownership and group property. Government also leases the land to different organizations for longer time period. Growth of industrial and commercial land use in Tejgaon industrial area and land use pattern are shown in Figure-9 & 10.

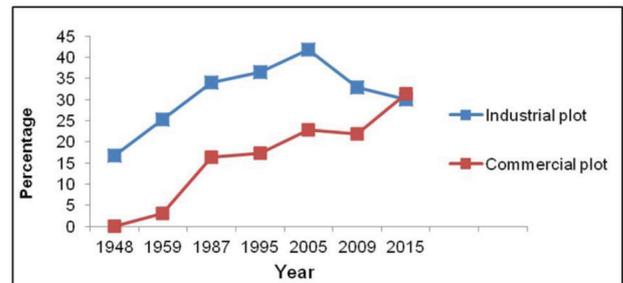


Figure 9: Growth of industrial and commercial land use in TIA.
(Source: Das et al., 2016.)

Land use category	Number of plots	Total occupied floor area (in acres)
Commercial	147	152
Industrial	141	209
Institutional	61	64
Residential	61	61
Service Category	20	14
Total	430	500

Figure 10: land use pattern of TIA.
(Source: Das et al., 2016.)

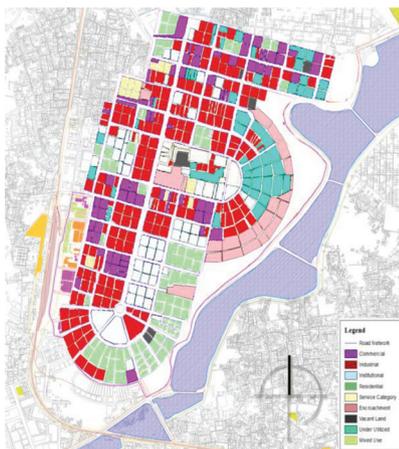


Figure 11: Land use map of TIA in 2005.
(Source: Khan et al., 2005.)

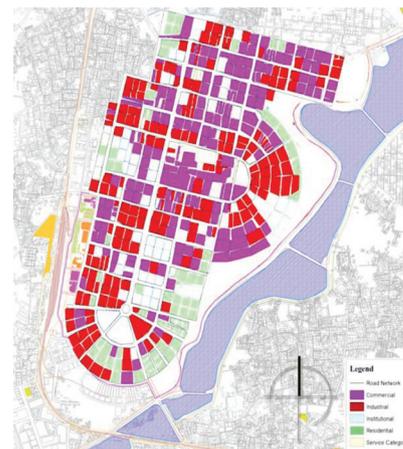


Figure 12: Land use map of TIA in 2015.
(Source: Das et al., 2016.)

Analysis shows that significant changes of commercial and industrial land use have occurred between the 2005 and 2015 years in this area. Industrial land usage was

a big part of total land uses in 2005 (64.6 per cent). However, in 2015, there was a major shift in land use in the Tejgaon industrial area. Currently, commercial and

industrial uses of land form a large part of the region and contribute roughly both equally. By the period of 2015, most of the existed industrial and institutional land uses in 2005 have been converted into commercial land uses. A clear indication of this continuing trend of shift of industrial land uses to mainly commercial, residential and other uses for the last few decades is also exhibited in the study of Khan *et al.* (2005).

Figure 11 and Figure 12 exhibit the land use pattern of Tejgaon industrial area in the year of 2005 and 2015

subsequently and hence a provide a basis for the analysis of the land use change in this area within 2005 to 2015 year period. Most of the residential land uses within the area is located adjacent to the Hatirjheel Lake along Hatirjheel-Gulshan link road (Das *et al.*, 2016). From recent survey it is found that in the periphery of Tejgaon industrial area there were so many unplanned encroachment which interrupted the street linkage between TIA and Hatirjheel. Maximum Street are not connected because of those development.

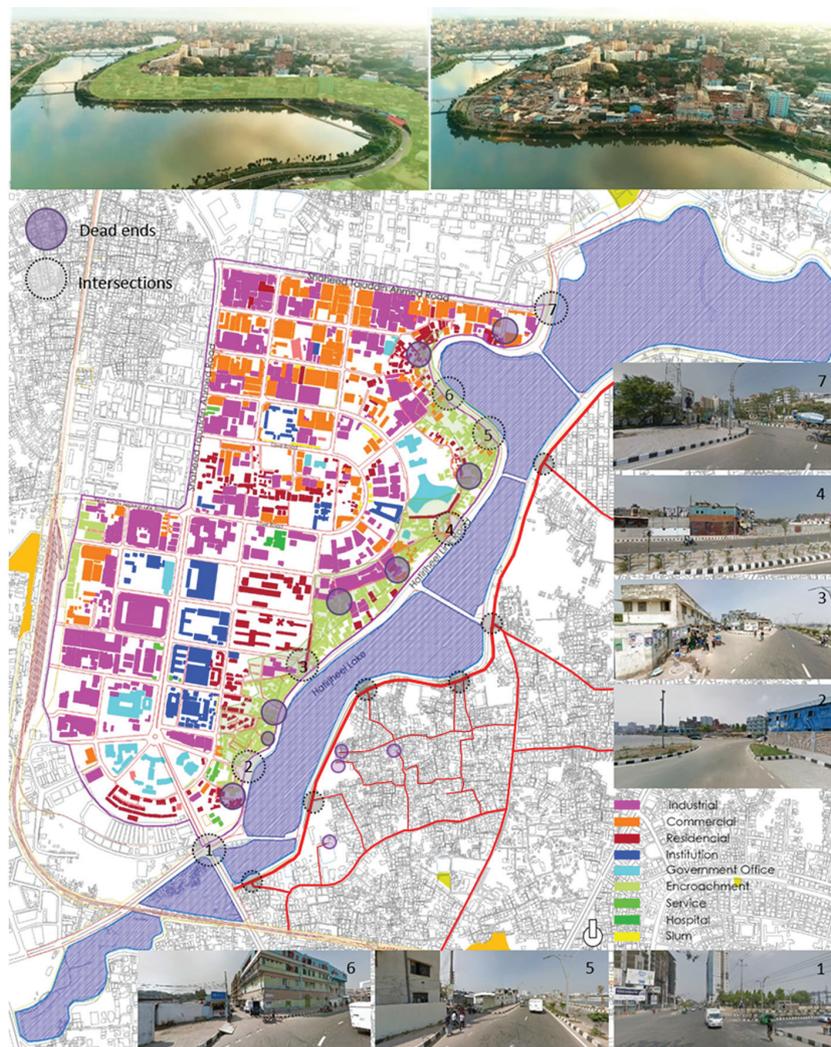


Figure 13: Existing land use of Tejgaon industrial area in 2019 with encroached area and street connectivity between TIA and Hatirjheel link road. (Source: Site survey, Autocad and Photoshop.)

The Figure 13 shows only seven street from Tejgaon industrial area to Hatirjheel link road are closer. But the connected street condition is very poor and most of them do not have adequate width and have

obstructions. In Figure 13 intersection point 2 to 6 are such streets which are connected with Hatirjheel link road but not providing with adequate mobility infrastructure between TIA and Hatirjheel. Intersection

point 1 and 7 are better but not smoothly blended that's why maximum vehicular and pedestrian traffic use this two way to move from Tejgaon to Hatirjheel link road. Also there were so many dead end in Tejgaon industrial area which are not connected as was not conceived at a planning stage of the Hatirjheel development. Because of the independent development of these two adjacent Tejgaon and Hatirjheel are not well connected or integrated. Some of the 60 feet wide proposed road are converted into 20 feet wide roads due to adjacent encroachments. Had the Hatirjheel been developed considering the traffic and transportation dynamics of its northern and southern older settlements, the blending would have been smooth. There are a fewer street connectivity with the settlement in the south-eastern side of Hatirjheel. Only three major street are properly connected with Hatirjheel link road and other Secondary and tertiary road have formed dead ends which could have been connected to uniformly distribute the traffic load to all nodes. As the traffic and transportation network of northern (TIA) and southern settlements, Street are not properly aligned and turn frequently without forming a connection with another street, there is a rise in unnecessary circuitous movement. The bridges across the Hatirjheel Lake are also not properly placed giving rise to frequent

interruptions and unnecessary circuitous movement. Hatirjeel project can thus be said to be a failed urban design project as it is not properly integrated with both its northern and southern neighbors.

The street was intended to be 200 meters long, according to the layout, but these new plots occupied nearly 130 meters of it. In Figure 14 it is seen that newly created plot 136/1 and 133/1 has fully occupied Kunipara street. There is no existence of street what so ever because of this land use, failure of which can be attributed to the insensitiveness of RAJUK. Plot 171/1 cover maximum street area. That's why existing Kunipara Street is now only 15-20 feet and not connected with Hatirjheel link road. Like Kunipara Street there were many streets which are not connected because of these newly created plots not considering the adjacent development or keeping provision of future extension. All those streets formed dead end because of encroachments (Figure 14). In Figure 14(f) it is seen that 1994 master plan of Dacca proposed Kunipara Street to be of 60 feet width. Like Kunipara all the street of Tejgaon, marked in Figure 14 as dead end, were actually planned as 60 feet in 1994 master plan of Dacca. All those road is now encroached by newly created plot and due to inefficient management of planning authority.

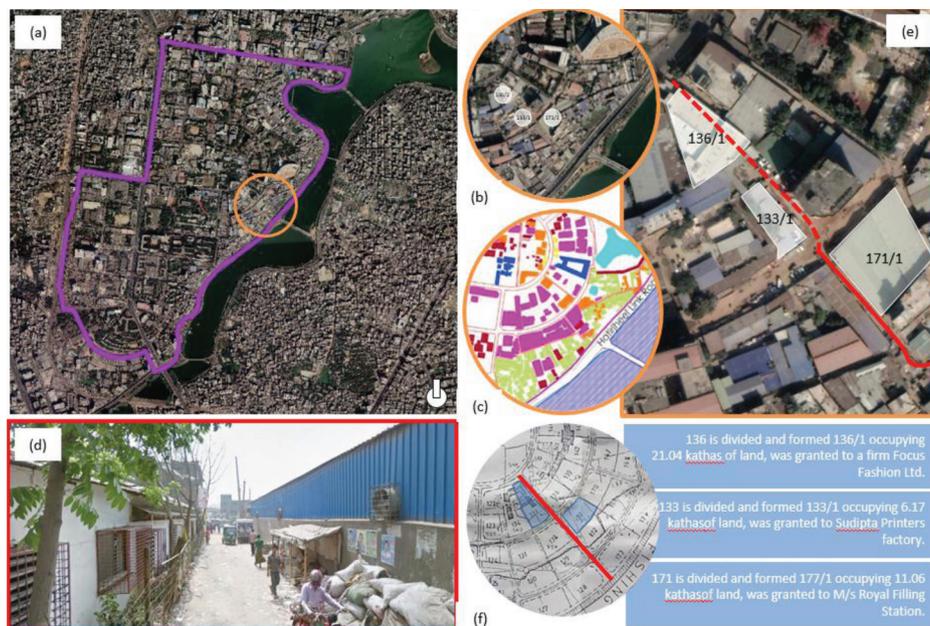


Figure 14: (a) Satellite view of Tejgaon industrial area. (b),(c), (d) & (e) Existing land use condition of South Kunipara street. (f) proposed 60 ft wide Kunipara Street and its adjacent allotted plots in 1994 master plan of Dacca.

(Source: Bdnews24.com, 2016; Google earth; Ministry of public works and urban development, Government of Bangladesh.)



Figure 15: Existing Street connectivity analysis between Tejgaon and Hatirjheel link road. (Source: Depthmapx10 and Photoshop.)

5.2. Connectivity Analysis Between Tejgaon and Hatirjheel by Depthmapx10

Before measuring the study area it is downloaded from Google earth then traced in Autocad 2007 software. After tracing the street line of the study area the map is converted into polyline then imported it in Depthmapx10 software. After exporting the map it has been converted into segment map then in axial map. This axial map is used for the street connectivity analysis.

5.2.1. Result

This section has analyzed according to the findings from case study and literature review. Depthmapx10 and Connectivity index tool has applied to generate possible connecting point between TIA and Hatirjheel development. Also this procedure has figured out which TIA's street and node will be vibrant when it will be connected with Hatirjheel link road. In Figure 15 it is seen that the existing street condition and connectivity with depthmapx10 analysis in where dark red and orange shades above are highly integrated areas and the green, blue axes are the less integrated area (case study). Red segments are the most interconnected sections according to these statistics, and this means that road accessibility for pedestrians is more than other segments. Light blue sections, on the other hand, are the most separated parts and this means they are not incorporated into the entire area.

In Tejgaon industrial area it is clearly seen that Shaheed Tajuddin Ahmed road is the most integrated street and on the other side Hatirjheel link road is the less interconnected road. Interconnectivity of street is

gradually lessen from Shaheed Tajuddin Ahmed road to Hatirjheel link road. There no good connectivity of Tejgaon area stret with Hatirjheel link road. All the street of Tejgaon have been marked as blue which are connected with Hatirjheel. Those streets are less interconnected with Hatirjheel link load and street accessibility for pedestrians are less than other segment of the area. Except the nodes of Shaheed Tajuddin Ahmed road all the node of this area is not much vibrant. Square of seven roads is the most vibrant node of this area where the maximum street is connected with proper width.

Figure 16 shows proposed street connectivity and its analysis by Depthmapx10. Street connectivity proposal derived from master plan of Dacca in 1994 and removing unplanned settlement. From this condition street connectivity analysis shows better integration of Tejgaon streets with Hatirjheel link road because of Tejgaon streets proper width and length. Another issue is clear by Depthmapx10 analysis from Figure 15 & 16 the street which cover maximum length and width will be the most integrated section in the area. That's why in both figure Shaheed Tajuddin Ahmed road is the most interconnected street. In Figure 16 the street length, intersection of streets between Tejgaon and Htirjheel link road has been increased which results orange to green in Depthmapx 10 analysis. Hatirjheel link road is not straight that's why it I not the most interconnected street of this area but from Figure 16 it is clear that it is the most vibrant and integrated street for pedestrian movement into the Hatirjheel lake. Connectivity index (section 3.1) method between existing and proposed street will provide the better connectivity result.



Figure 16: Proposed Street connectivity analysis between Tejgaon and Hatirjheel link road. (Source: Depthmapx10 and Photoshop.)

From existing street connecting situation of Tejgaon industrial area in Figure 17 it is clearly seen that there are so many dead ends in the periphery of Tejgaon near Hatirjheel link road. The connectivity index is 1.36 with 188 Link Street, 102 connections

and 36 dead ends. The periphery dead ends expresses how inefficient the intersections between Tejgaon industrial area and Hatirjheel link road. Connectivity index value would be much better if those dead ends were connected to the Hatirjheel road link.

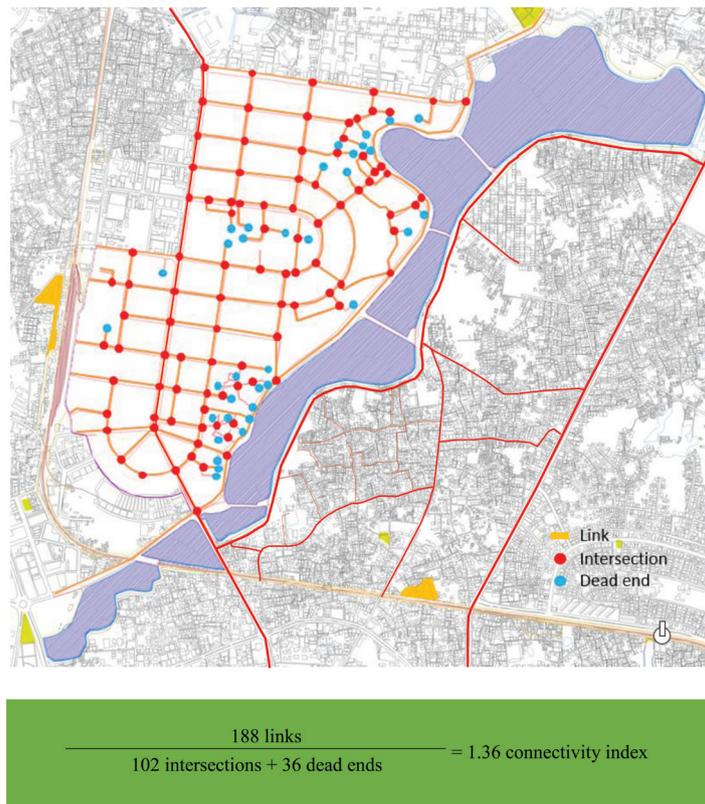


Figure 17: Connectivity index for existing map of TIA. (Source: AutoCAD and Photoshop.)

From proposed street connecting situation of Tejgaon industrial area in Figure 23 it is clearly seen that there are only a few dead ends and peripheral street connection of Tejgaon and Hatirjheel link road is much better. The connectivity index 1.6 with 170 link street, 100 connections and 4 dead

ends. It is seen from Figures 17 and 18 that the connectivity index is much better in proposed street connectivity for Tejgaon and has grown much better between Tejgaon industrial area and Hatirjheel due to reduced dead ends on the periphery of Tejgaon road connectivity.

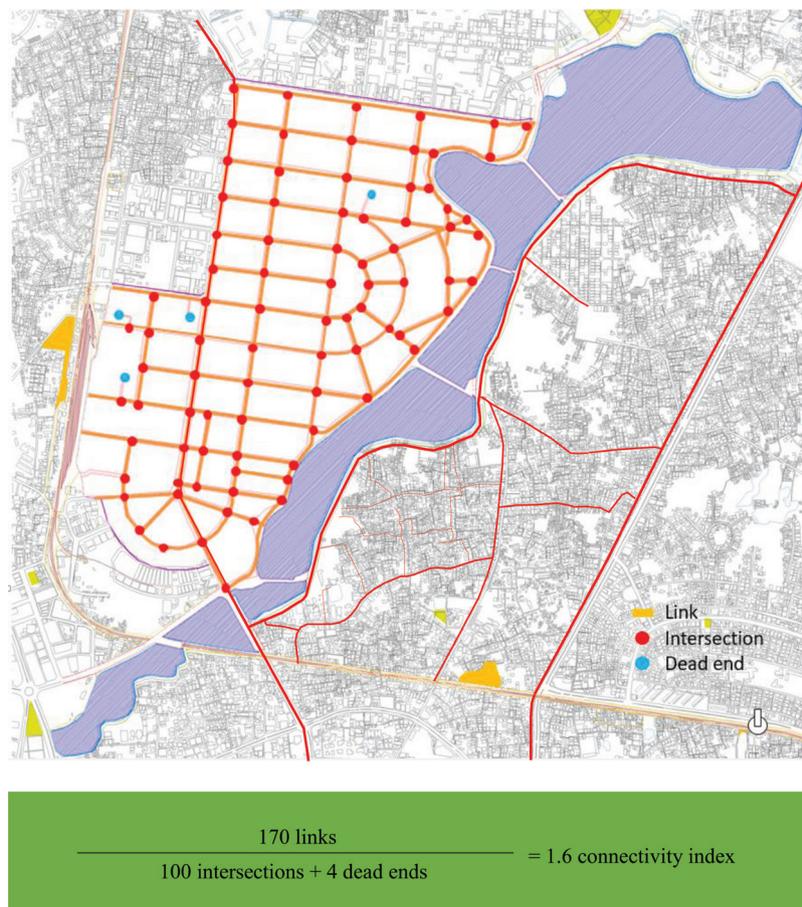


Figure 18: Connectivity index for proposed map of TIA Depthmapx10.
(Source: AutoCAD and Photoshop.)

6. Recommendation

The findings presented in this study confirm that the spatial structure, land use pattern, street width and length, streets links and intersections of urban areas plays a significant role to develop street connectivity. The following are the recommendations based on primary and secondary study, Depthmapx10 and connectivity index analysis:

01. Possible street connecting point between TIA and Hatirjheel development are found.

02. From the entire study according to literature review, case study, field survey, analysis and simulation it is clear that there are so many street of TIA which are not connected because of design and management failures. So, it should focus on this particular areas to readjust the boundary areas of three adjacent developments considering Proper Street and pedestrian connectivity.

03. Hatirjheel link road should be readjusted to blend with the development in either side and the bridges are to be aligned accordingly.

04. Tejgaon's street width and length must be based on Dhaka's first master plan.

05. In order to ensure maximum street connectivity with Hatirjheel, TIA master plan should be revived. Smooth connection of these Tejgaon streets with Hatirjheel will ensure better urban mobility.

06. A pedestrian network integrating the three developments is necessary for the vibrancy of the whole area. That would also ensure accessibility of northern and southern settlements to Hatirjheel urban development.

Conclusion

The aim of this study was to evaluate the street connectivity condition of TIA with Hatirjheel link road after the development of Hatirjheel. The Hatirjheel development between TIA and Eastern area was aimed to integrate those areas and develop an urban area in between. Ironically, Hatirjheel being the newer development could not take note of the mobility dynamics of its adjacent area therefore failed to establish street connectivity between these two areas. The Hatirjheel project did not keep provision of possible connecting point which would develop better street connectivity with TIA and south-eastern zone to ensure better accessibility and the integration of the community people. The study outcome provides clue to possible integration strategy of the study area.

The possible street connectivity between Hatirjheel and adjacent developments has been generated through connectivity index, analysis and result. From study, it is clear that there were quite a number of street in TIA and South-eastern settlement that could be fruitfully blended for sustainable and harmonious development of the whole area and would facilitate efficient urban mobility. The first task is to figure out the possible connecting point in the peripheral road of Hatirjheel with the roads coming out of TIA and South-eastern settlement, which would then crisscross the lake at appropriate points to avoid circuitous movement and bottleneck. In nutshell, the study recommends integration of adjacent areas and improve urban mobility by some surgery at identified points.

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