Effect of Double Decker Flyover Construction on Urban Fabric of Ashok Rajpath, Patna, India

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Abstract

Rapid urbanization and increase in number of vehicles has led to diminishing vehicular spaces on the street. This has led to construction of flyovers, which has dominated the streets. They reduce the "Sky-View" factor and has a put a serious threat to "Enclosure" widely used in Urban Design concepts. It has reduced the openness for the pedestrians and severely obstructed the views. This paper examines the effect of fly-over on the "Urban Fabric of an ancient street "Ashok Rajpath" of Patna, India.

Keywords: Sky-view factor; Urban fabric; Fly-over; Enclosure ratio; Street

1 Introduction

According to 2019, Pedestrians, bikers, and users of motorised two-wheelers account for more than 58% of all road mortality casualties in Patna (MoRTH, 2020). The three groups can be known for vulnerable to utilising road and are prone to accidental damage. When compared to no flyover, the existence of a flyover raises the relative risk by 15% (Goela, Jain & Tiwari, 2017).

Flyovers are major road structures that are generally erected on crossings to take away continuous influx, mainly in non-urban areas. To alleviate Karachi's transportation issues, the city government built approximately fifty flyovers at major city crossings. However, in most cases, thorough end long planning have been implemented, resulting in half fulfilment of the city's removal of traffic-allied problems (Zubair, 2019).

According to a recent survey in Bangalore, traffic congestion is the most pressing public problem, followed by poor road conditions "No 1 reason..., followed closely by poor traffic management and lack of proper (sic) infrastructure like flyovers" (TOI Survey, 2008) for the issue. Widening of road, grade-separated crossings (often known as flyovers), restricted access motorways, integrate lights, and traffic management strategies in urban areas were among the former set of improvements (Tiwari, 2002). Using flyovers can save a lot of time and energy by avoiding congestion and minimising negative environmental impacts like smog and traffic jams. Even though its primary function is to make roads safer, flyovers also improve the city's visual appeal. People using the flyover will have a bird's-eye view of the city below.

While there are certainly some drawbacks to using flyovers, these are mostly the result of poor construction of buildings, improper planning, etc.

2 Research Methodology

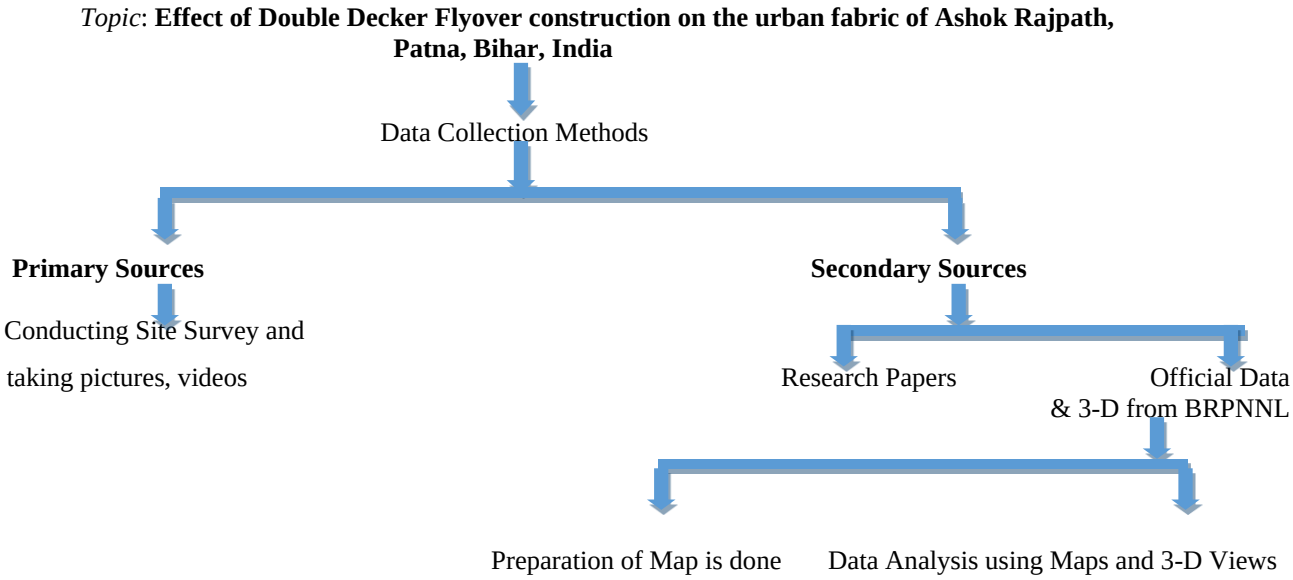

Fig. 1: Research Methodology Flowchart

3 Effect Of flyover on the Urban Fabric

Urban expansion and use of transport are intertwined because transportation networks assist create the urban layout while also promoting the city's economic, cultural, and social development. Similar to how a city's characteristics influence its architecture (Anwar, HONG & Afia Zubair, 2020).

The physiognomies of built-up places, also the characteristics of cities are related with urban fabric, which is different from urban density, land use, and transportation infrastructure. There are differences in the spatial distributions of urban density as a result of new constructions and redevelopments, and new facilities for transportation impacts accessibility and land use. Transport infrastructure is critical to the study of urban form because it separates and unites urban territory into well-defined city segments and allows humans to perform tasks that connect the social, economic, and environmental systems to population growth and urbanization increase.

In architectural sense, flyovers affect the view of street and façade of buildings thus affecting the urban fabric of area. The skyline of an area totally changes giving flyover a static object as a monumental scale and food carts, vehicles as dynamic objects as human scale.

4 Upcoming Flyover in Ashok Rajpath, Patna

On Ashok Rajpath, a 2.2 km-long double-decker flyover has to be built (TOI, 2021). The flyover runs from Kargil Chowk, which is near to Gandhi Maidan to Patna Science College. Rajya Pul Nirman Nigam Pvt. Ltd. Vehicles will be moved at three levels after this project is completed: Tier 2, tier 1and the add-grade level, which is the existing road. There will be no change in grade level. All four lanes of tier 1 and tier 2 will conclude at Patna Science College with three exits for the PMCH via its multi-level parking. The double-decker flyover would be connected to the Loknayak Ganga Path by the Krishna Ghat (Ganga Expressway) (Wikipedia, 2022).

Table 1: Details of Ashok Rajpath 2-Lane Double Decker Flyover

Name of Project	**Construction of Elevated Corridor from Kargil Chowk, Gandhi Maidan to Science College via PMCH, Ashok Raj Path, Patna, Bihar (2-Lane Double Decker)**				
District/Head	Patna				
Description of Project	(i) Type of Structure-RCC/PSC / Steel Composite, (ii) Length of elevated corridor-2.2 km, Length of Tier-1 is 1.5 km and Tier-2 is 2.2 km (iii) Carriage way-2 x 2-lane Double Decker (Tier-1 two lanes + Tier-2 two lane)				
Administrative Approval	Rs.422.00 Crore {RCD, Lt No.-5566 (S) dated-24.09.2020}				
Agreement Amount	Rs.324.0049 Crore (Agreement no.-16/2021-22).				
Date of Start	15.01.2022				
Schedule Date of Completion	14.01.2025				
Contractor	Gawar Construction Limited, DSS- 378, Sector: 16-17, Hisar 125 005 (Haryana)				
Physical Progress					Remarks
Foundation	Sub-Structure	Super-Structure	Approach	Expenditure (Rs. in Cr.)	Work in Progress
20%	15%	15%	-	5.40	

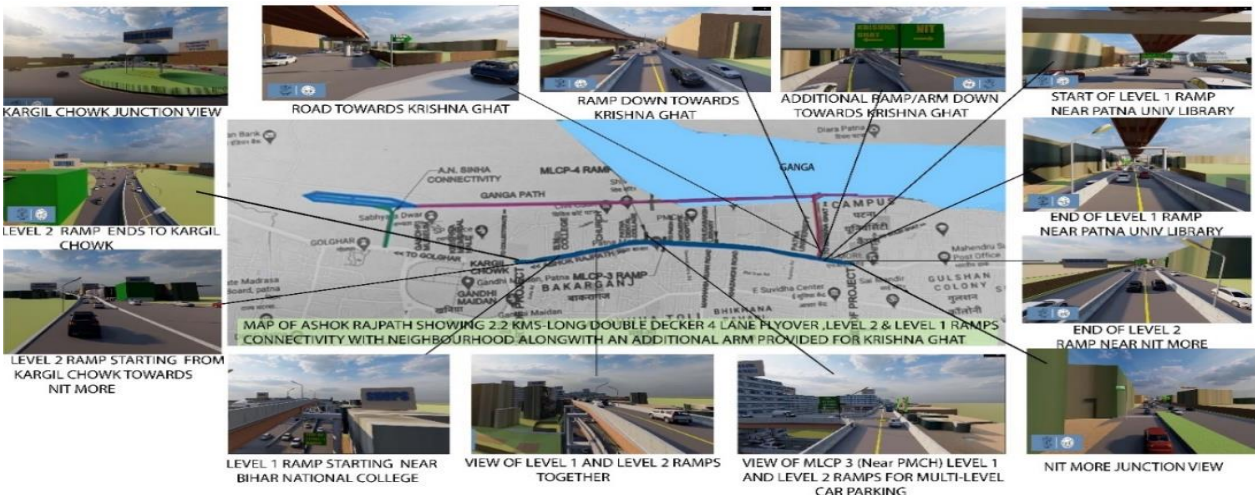

Fig. 2: Map of Double decker flyover on Ashok Rajpath alongwith detailed views

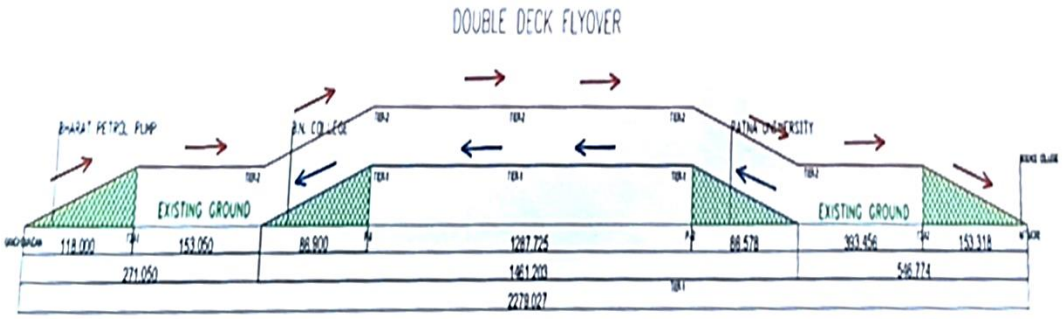

Fig. 3: Sectional Elevation of Double decker flyover on Ashok Rajpath

5 Sky-view Factor and Flyover

The sky view factor (SVF) is the ratio of a point's viewable sky area to the overall sky area. It establishes the link between the observable sky region and the surrounding covered areas, like built

structures, big trees etc. (Miao, et al., 2020). The SVF, as a key criterion in urban climate analysis and urban planning practices is used worldwide (Miao, et al., 2020).

The planning of structures and canyons in urban streets on both edges of a roadway is a critical issue influencing urban micro - climatic and air pollution (Ali-Toudert & Mayer, 2006). The ratio of building heights (H) to street canyon width (W), often known, as the aspect ratio, and the sky view factor (SVF), are two indices that can be used to identify the geometric properties of urban street surfaces.(Arnfield & John, 2003), (Unger, 2009). The aspect ratio illustrates the concentration of built structures in comparison to their heights (Unger, 2009). The SVF is a more favorable parameter than the aspect ratio since it better captures the complicated urban environment (G.T. & Watson, 1984). It denotes the ratio of sky to regions where buildings or plants are blocking it (Matzarakis & Algeciras, 2015), (An, et al., 2013), (Tzu-PingLin, Kang-TingTsai, Ruey-LungHwang & Andreas Matzarakis, August 2012), (SantosNouri, PedroCosta & Matzarakisb, December 2017). Oke (1981) proposed the concept of SVF to evaluate the impact of urban heat islands in urban settings (Oke, 1981; Watson & G., 1987). It is now utilized as a geometric notion to offer the fraction of the observable area of the sky inside the street canyons, which dimensionless values provide an explanation. (Oke, 1981; Xiaodong, et al., 2019). It is stated as a value between 0 and 1, with 0 signifying a completely closed region and 1 representing an open area (Oke, 2015; Scarano & Mancini, 2017). Increasing the elevation of structures along open spaces blocks the sky and reduces the SVF, whereas lowering the elevation increases the SVF (Bourbia & Boucheriba, 2010; Adeb Qaid, Hasanuddin Bin Lamit, Dilshan Remaz Ossen & Mohd Hisyam Rasidi, 2018). SVF influences the surface heat balance, micro-scale airflow, air pollution, and microclimate of the urban environment, to name a few (Venhari, Martin Tenpierik & Taleghani, 2019). It has been widely used in urban climate research, such as renewable energy utilization (Compagnon, 2004), outdoor thermal comfort and urban heat island studies (Unger, 2009; Liang Chen, et al., 2010; Hämmerle, Gál, Unger & Matzarakis,2009), Biometeorology of humans (F. Lindberg & C. S. B. Grimmond, 2010), (Andreas Matzarakis, Frank Rutz, & Helmut Mayer , 2007) and urban planning practices (F.Bourbia & F.Boucheriba, 2010), (Eliasson, 2000), (Ruihan Weia, Dexuan Song, Nyuk HienWong, & Miguel Martin, 2016).

Furthermore, the SVF is buildings which obstructs the sky around a street may significantly restrict how much sun radiation reaches canyons, therefore they should be included in an urban solar radiation model. (Ali-Toudert & Mayer, February 2006), (J.A.R., Tablada, & Matzarakis, 2003), (Corripio, 2003), (Christine Ketterer & Andreas Matzarakis, 2014), (Herrmann & Andreas, 2012), (T.Nguyen & Joshua, 2012), (Qaid A & Ossen D, 2003). It might be integrated in studies on enhancing the thermal setting in an urban region using remote sensing (Yang, Man, Massimo, & Janet, 2015).

Areas having lower SVF values cool more quickly at night and get warmer gradually within the day, owing to shadowing from buildings and trees (Loyde, Lucila, & Andreas, 2015), (Robert D. Brown & Terry J. Gillespie, 1990), (M.Scarano & J.A. Sobrino, 2015). As a result, deep roadway canyons with narrow widths and tall buildings may limit thermal exchange (M.Scarano & F.Mancini, 2017).

Urban climate change studies and urban planning have recently focused heavily on how thermal comfort levels vary across various urban SVF values, particularly in light of climate change and population growth. (Ruihan Weia, Dexuan Song, Nyuk HienWong, & Miguel Martin, 2016), (Kim & Yun, 2019), (Xiaojiang Li, Carlo Ratti, & Ian Seiferling, 2018), (Yun Kyu Yi & Hyoungsub Kim, 2017).

6 Enclosure and Flyover

The relationship between building height and floor area, as well as their relationship to the surrounding landscape, structures, and roadways. In addition, it includes the solar direction, site coverage, and building envelope. Dimension and mass affect the amenity of streets, spaces, and other buildings by creating a sense of openness or enclosure. Enclosure: height to distance ratio h/d = 1:1 (full enclosure) = 1:2 (minimal enclosure) = 1:3 (threshold of enclosure) = 1:4 (loss of enclosure).

Table 2: Explanation of different types of Enclosure Ratio

Enclosure Ratio	Explanation
1:1	Enclosure 1:1 is when one tends to see details of building more than façade.
1:2	Enclosure 1:2 is when the object perceived in relationship with surrounding.
1:3	Enclosure 1:3 is when all perceived together with details.
1:4	Enclosure 1:4 is when an object seen as an edge.
1:6	Enclosure 1:6 is when the backdrop of building more than its façade.

Enclosure can be seen on Ashok Rajpath on different locations through the following pictures.

Fig. 4: Loss of Enclosure (1:4) happens on Ashok Rajpath after coming of the flyover

7 Results & Discussion

This paper explains the effect on urban fabric of an area with the coming of double-decker flyover between Kargil Chowk and NIT More. Thus, by connecting it to Krishna Ghat will help keep traffic moving without interruptions. Hence, it will reduce the travelling time for two and four wheeler vehicles.

In addition, by coming of Double decker flyover, the skyline of the street will change, thus affecting buildings front facade and increase in their height. This will induce a total change in the street canyons, as perceived from the bird's eye view. Usually with the increase in the height of buildings around street canyons, the sunrays from the sky gets blocked, that leads to a reduction in the SVF.As sky is less visible and solar access is limited and this will affect the lives of people, animals and plants. The study of enclosure is also done along the Ashok Rajpath, as the coming of double decker flyover will thus affect the enclosure ratio, hence loss of enclosure will be seen at several points along the street.

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