Intercity Bus Terminal: Solution to Traffic Congestion in Kathmandu

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Abstract— **Rapid urbanization has caused highest concentration in the capital instigating traffic congestion, which is the current most serious issue in the Kathmandu valley. The need of innovative traffic management strategies in the city area and high-quality transit service has aroused the demand of an intercity bus terminal. This study examines the current and future urban scenario, addressing the future demands to provide a functional design solution. This research outlines an approach to strengthen the volume of traffic by proposing a bus terminal that limits the intercity functions outside the ring road. This ultimately contributes to the feasibility for transit-oriented development module. It focuses more on the information regarding the choice of site that has been the most determining solution to the addressed problem. The study also deals with calculations for determination of capacity of the proposed terminal. The study may create awareness among professionals about possibility of alternative solution to the congestion issue.**

Keywords— **Urbanization, Traffic Congestion, Intercity Bus Terminal, Transit Oriented Development.**

I. INTRODUCTION

Traffic congestion can be deemed as a major issue in the Kathmandu city, the multitude are facing nowadays. Rapid population growth, urban sprawl, and increasing motorization in Kathmandu valley are creating complexity of traffic congestion, poor public transportation system, pedestrian and vehicular conflict, increased road accidents and air pollution. The daily commute for the passengers is affected largely due to inimical situations of morbid road conditions, notorious traffic jam and unhygienic environment.

According to the preliminary results of the National Population Census 2011, the population growth rate of the whole Kathmandu Valley was 4.32%. Kathmandu being the center of administration, industrial, commercial, social, and economic activities. It is the most densely populated region in Nepal and its population has been increasing rapidly during the past two decades. It is considered to be the engine of growth because the planned urban development of the city directly links to overall economic development of the nation.

The rapidly unplanned urbanization of the Kathmandu Valley caused by the informal process of settlement development in the past has brought several physical, social, and environmental problems in the Kathmandu Valley. Since, Nepal is a landlocked country 90% of its trades are dependent on road transportation. And out of the various problems caused by urbanization one of the prevailing problem includes increase in uncontrollable traffic. (JICA)

The number of motor vehicles in the country has reached 3.08 million as per records maintained by the Department of Transport Management (DoTM) by the end of Nepali month of Baisakh, 2075 BS. Among them, more than 1.17 million vehicles were registered in Bagmati zone alone that includes 48,242 registered bus and trucks. (Poudel, 2019) The traffic police in Kathmandu have been managing the traffic in the city with utmost professionalism but it is clearly evident that this management is not possible only through traffic division. The degree of traffic saturation today has exceeded the road infrastructure designed decades ago and the technology and methods are also outdated. Moreover, out of the four major routes to enter the Kathmandu valley, Gongabu Bus Park, the only bus terminal in the city is over burdened by regulating the entire intercity transport

The government has been acting on this issue by conducting action plans such as road-widening projects, construction of alternative routes like outer ring road, mass transport (Yuba Raj Bhusal, National Planning Commission Secretariat, November, 2012) and flyovers. Although these measures have proven to be very effective, there are still some stretches that can never be expanded in a saturated metropolis. Consequently, this begs the question whether such solutions can actually reduce the volume of traffic entering the city. It is of prime importance that the approach of traffic management in the city to be taken seriously. Hence, increasing recognition of the need for high quality transit service has aroused the demand of a bus terminal controlling the intercity functions, where certain volume of traffic is handled outside the outskirts of the crowded city area before entering the valley itself.

This research qualifies the need of a terminal in the corridors of the city which has not been researched until now. The data collection through various means considering the strategic plans of Nepal and the capacity of the terminal impacting the overall traffic of the city has been further analyzed in this research.

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II. METHODOLOGY

Since the method of research was descriptive in nature, the initial phase of the research was directed through comprehensive literature review using various secondary source of data. Because the logic of research is deductive, it was based on facts obtained from observations to draw conclusions, accompanied by data collection from various primary sources such as interviews from experts. Firstly, the interview with experts from Metropolitan traffic division of Kathmandu resulted in identification of major areas causing traffic congestion and various possible sites feasible for the terminal. Secondly, the data of 20 year strategic plan of Nepal obtained through interview from Kathmandu Valley Development authority experts reinforced the site feasibility analysis. Hence, various observations based on context and the study were analytic for site feasibility analysis.

The later part of research was based on the evaluation and on-site visits, which includes consideration of traffic count data obtained from the Naghdhunga check port for capacity analysis of the terminal. Moreover, the data obtained from Department of transportation management and urban planning were used to conduct the route analysis. Likewise, site visits for nationalcase studyin Gongabu Bus Park, to observethe existing situation and other international case studies using secondary sourceswere conductedfor case study analysis.Qualitative and quantitative analysis were adopted for further interpretations and findings, moving further towards the design development process.

III. RESULTS

A. Current and future urban trends

According to the traffic data, more than 50% of the vehicles of Nepal ply in the Bagmati zone, with the highest concentration in the capital. (Investment Board Nepal,Government of Nepal, 2017)Around 1.17 million vehicles are operating in the Kathmandu Valley and approximately 100,000 vehicles are added every year. (Poudel, 2019) The Metropolitan Traffic Police Division has in total of 1,346 traffic police personnel, one traffic bearing the burden of 900 vehicles every day. If this rate continues Kathmandu valley will not be able to hold the future traffic demand, resulting traffic congestion to be rampant in upcoming years. Unplanned rapid urbanization is a major cause on the development of Kathmandu valley instigating the traffic congestion issue. Three-quarter of inside the Ring road has over 200person/ ha population density and outside the ring road reached 80person/ha. Spill-out of population to outside ring road started around 1980s, spread pattern of urbanization is seen just out of the fringe in the Ring road and along the feeder roads. Also, high population growth can be seen outside the Ring road, especially in the north east. (Khokhali, 31st october 2017)
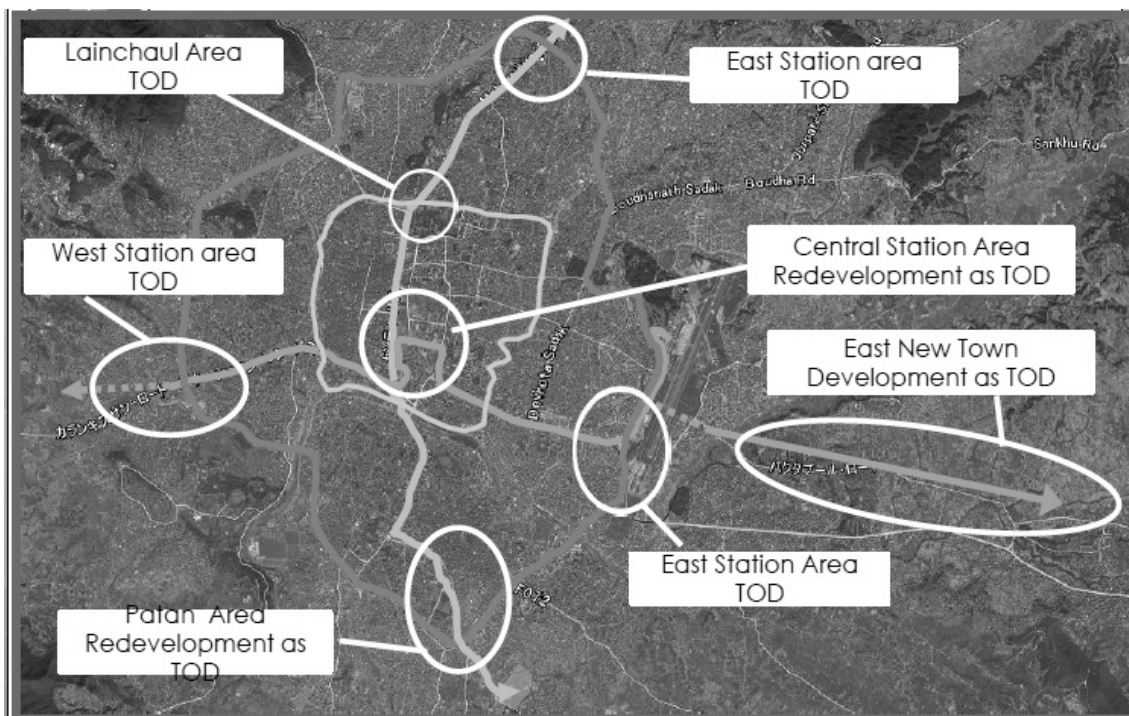

Fig. 1. Possible regions of transit-oriented development
Source: (Khokhali, 31st october 2017)

According to 20 years strategic plan of Nepal, the Outer Ring Road Development Project (ORRDP) by Kathmandu Valley Development Authority (KVDA) is on the process to build an important 72- km long Outer Ring Road that will form a half circle around all three districts of the valley. The Road will pass through various areas on the outskirts of Kathmandu (35.08 km), Lalitpur (15.80 km) and Bhaktapur (21.05 km). It will pass through Chobhar, Gamcha, Satungal, Naikap-PuranoBhanjhang, Sitapaila, Nagarjun, Nepaltar, Gongabu, Tokhagaun, Chapali, Kapan, Jagdol, Sandol and Thalidachi in Kathmandu district. (Khokhali, 31st october 2017)

The project is expected to ease traffic hassles in the Valley and facilitate the movement of people living in suburban areas. From figurJe-1, we can see that KVDA (Kathmandu Valley Development Authority) has identified the east and the west station area as a possible area for transit-oriented development in the future.

After the construction of the outer ring road, there will be changes in the urban fabric of the city, need of transit-oriented development will be seen and the demand of an intercity bus terminal will also be felt in the near future.

*B. Route analysis*The design of the Public Transport network is based upon a three-tier hierarchy of public transport routes as illustrated in the figure-2 below, in which the vehicle type and size is designed appropriate for the passenger demand and compatible with the roadway width and alignment on the route. The primary route, which includes; the Ring road surrounding Kathmandu valley, highway, and the arterial road (which is the high demand corridor serving high capacity vehicles) serves 12m bus or articulated with more than 100,000 passenger/ day. Secondary routes, which

includes major feeder roads, urban arterials, special road and connector roads, is operated in mixed traffic with 9-10m bus with 50,000-100,000 passengers/day. Similarly, tertiary road includes narrow urban roads and has comparatively low volume operating small vehicles, tempo, micro and mini bus up to 25 seats.(Kathmandu Sustainable Urban Transport Study 44058), june 2010)

However, thisthree-tier route hierarchy of public transport has not determined particular routes allocated for specificfunction. The vehicles are moving haphazardly unrestrained by any government rules rather many overlapping routes are fixed by public transport operators (Samitties). This is seen as one of the primary causes that undermines the proper execution of traffic management. By limiting the intercity function to primary route only, and intra city function to the core city areas through secondary and tertiary routes only, smooth maneuvering of vehicles can be achieved ultimately making the traffic more tractable.

C. Existing terminals

Four public transport terminals are located within the City Centre of Kathmandu which has been categorized as intercity and intra city terminals. Old Bus Park which is the main Bus terminal for Kathmandu; used by all three of the service types, namely City Services within the Ring Road, Valley services and Long-Distance services. The other three bus terminals serving intra city functions are Bhaktapur Bus Park, serving routes to Bhaktapur and neighboring towns. And the NAC terminal, located on Kantipath Road, provides services for Tempos, microbuses and minibuses. Ratna Park Terminal is also an on-street facility, north of the Tundikhel, serving tempos, microbuses and minibuses.
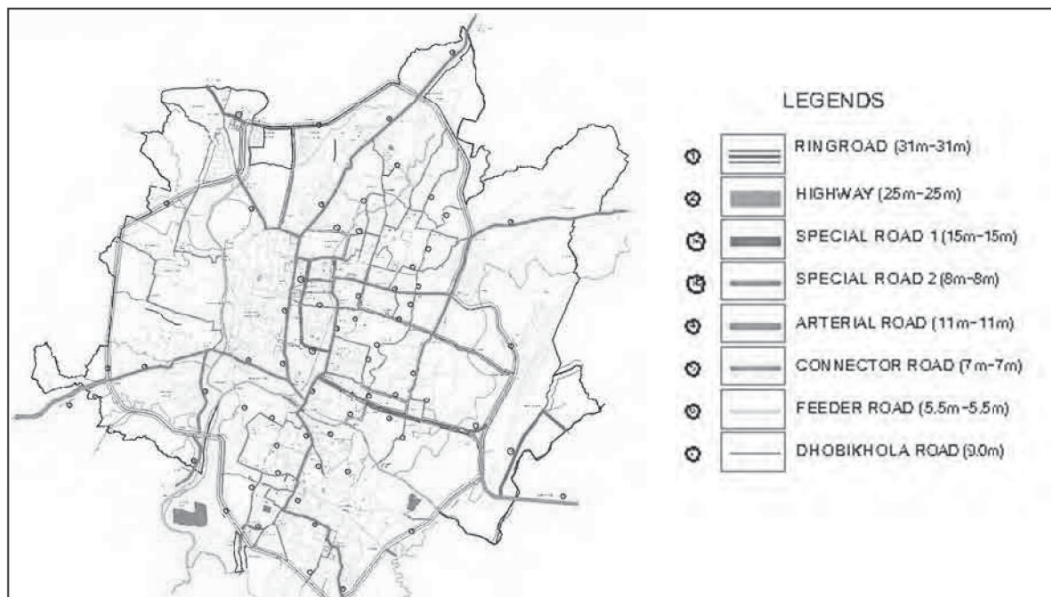

Fig. 1 Kathmandu and Lalitpur road By-Laws Map (source: KVTDC/ KVDA)

The total number of operations starting from Kathmandu City Center was around 12,900. Operations from Ratnapark and N.A.C outnumbered the operations in the Old Bus Park. (Udas, 2012) The area of the Old Bus Park was not sufficient to manage all the buses coming into the city center area. Since the bus parks other than the Old Bus Park are located along roadside of the trunk road in the city center, buses hampered the traffic.

Gongabu Bus Park is the oldest terminal constructed in 1993 A.D. with the help of JAICA, and the only existing bus terminal, regulating the intercity transport services in the western corridor of the valley. This terminal was designed according to the traffic volume dated back in 1990s and is not sufficient to withstand the present growing traffic demand. Since, it is the only terminal operating in one of the corridors of the valley specified for inter-city functions, increasing recognition of the need for high-quality transit service to alleviate these conditions has aroused the demand of an intercity bus terminal in other corridors of the city.

D. Site feasibility analysis

The Kathmandu city is located in the valley with only two international corridors available, namely one is from India to western Kathmandu via Prithivi highway (Naghdhunga route), and the other is from China to Northwestern Kathmandu via Araniko highway. Regarding the later road, it crosses over Himalayan Mountains and landslides hence have limited the trade volume. The third route to approach the city is Sindhuli road, but because of its narrow road width i.e. 4.75m, it is restricted to 8 seater vehicles only (large sized buses and trucks are difficult to pass each other). Dakshinkali to Kathmandu through Hetauda Kulekhani is the fourth route to approach the valley, but its road conditions are limited to private vehicles and freight trucks only (the fast track has only been in policies and not in the implementation phase yet). Hence, the east west highway i.e. the Naghdhunga route is the most viable roadway to enter Kathmandu valley currently and also the main route for the long route buses.

Table-1 shows the traffic volume count of the vehicles inbound and outbound within the Kathmandu valley, taken on 2074/06/01. The major vehicles plying in the valley is through Bhaktapur and then Naghdhunga. (Udas, 2012)

TABLE 1

TRAFFIC VOLUME IN THE FOUR-CHECK POST (SOURCE: TRAFFIC METROPOLITAN OFFICE)

Check post	Vehicle inbound	Vehicle outbound
Naghdhunga	2134	2236
Bhaktapur	6226	7138
Mudkhu	279	290
Pharping	429	623
Total	1048	10284

However, in order to determine the transportation demands and appropriate solutions for an area it is important to have an understanding of the underlying characteristics of travel. According to the origin destination data as shown in Table-2, the top trip origin area was found to be Kalanki with 5.57% of passengers originating from the area whereas Bhaktapur has only 2.42%.

TABLE 2:

LIST OF TOP TEN ORIGIN AREAS (SOURCE: PUBLIC TRANSPORT REPORT SURVEY) (Udas, 2012)

S.no	Trip Origin	Percentage
1	Koteshwor	6.54%
2	Kalanki	5.57%
3	Kalimati	5.33%
4	City core area	5.08%
5	Baneshwor	4.36%
6	balaju	3.39%
7	Chabahil	3.39%
8	Bhaktapur	2.42%
9	Patan	2.42%
10	Anamnagar	2.18%
11	Gaushala	2.18%

Furthermore, the Table-3 shows the data for top most transit with 10.81% for Kalanki and 1.35% of passenger passing through transit in Bhaktapur or Balaju area.

TABLE 3

LIST OF MOST USED TRANSITS (SOURCE: PUBLIC TRANSPORT REPORT SURVEY) (Udas, 2012)

S.no	Transit	Percentage
1	City Core Area	29.73%
2	Lagankhel	22.97%
3	Kalimati	13.51%
4	Kalanki	10.81%
5	Koteshwor	5.41%
6	Baneshwor	4.05%
7	Satdobato	4.05%
8	Chabahil	2.70%
9	Lainchaur	1.35%
10	Balaju	1.35%
11	Bhaktapur	1.35%
12	Gwarko	1.35%
13	Jawlakhel	1.35%

Both of these data provides some foundation on travel pattern indicating that the trip origin and transit origin is more in the western corridor than in the eastern corridor. Therefore, these evidences strengthens the hypothesis; introduction of an intercity bus terminal proposed in the Naghdhunga route outside the ring road minimizes the entire load of traffic to some extent liberating the burden on the existing Gongabu bus park.

Moreover, vehicle composition of Naghdhunga shows that 18% of the total traffic composition is of heavy bus and 30% for freight trucks. This indicates that terminal in the Naghdhunga should cater 18% of the long route buses entering the valley, making the traffic much manageable.
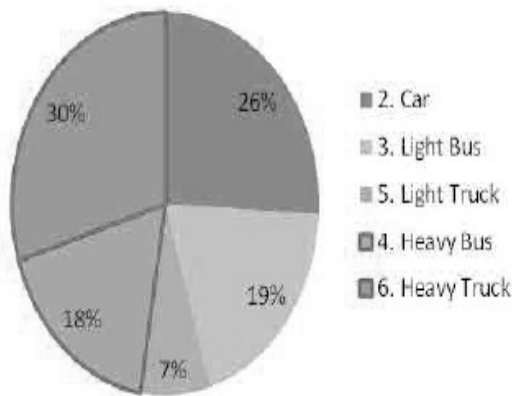
Fig. 1 Traffic composition at Naghdhunga (without motor cycle)
(Source: Preparatory survey for Naghdhunga tunnel construction in Nepal final report)

E. Capacity analysis

The capacity of the new terminal was calculated based on the data obtained from 24 hrs. Survey traffic counting at Naghdhunga, which are as follows: (Source: Preparatory survey for Naghdhunga tunnel construction in Nepal final report)

Average daily flow: 650

Total number of arriving buses from the check port: 640

Total number of departing buses from the check port: 660

F. Population projection

TABLE 4

TRAFFIC COUNTING DATA

	2007	2008	2009	2010	2011	2012	2014
ADT (annual daily traffic) with motor cycle	5,582	6,861	6,479	8,020	9,773	7,899	9,022
ADT (annual daily traffic) without motor cycle	4,891	5,682	5,379	6,280	8,668	6,653	7,0621

(Source: Preparatory survey for Naghdhunga tunnel construction in Nepal final report)

From the above data shown in table-6, the forecast rate of buses in the future in 10 years was calculated considering rate as 0.05% using the following formula:

Increase in no. of buses in the future

Total no. of buses outbound 2028 = No. of buses inbound in 2018 $(1+ 0.05\%)^{10}$

$$= 660 \times (1+0.05\%)^{10}$$

$$= 663$$

Total no. of buses inbounds in 2028 = No. of buses outbound in 2018 $(1+ 0.05\%)^{10}$

$$=640 \times (1+0.05\%)^{10}$$

$$=643.20 =645$$

Calculation of the terminal capacity

After the future projection of vehicles it was estimated that the average daily flow of buses in the terminal is 654. This includes total number of 645 arriving buses and 663 departing buses from the check port.

IV. DISCUSSION

The analysis of this research establishes that the proposed intercity bus terminal with capacity 654 should cater 18% of the buses in the Naghdhunga area.Althoughthe traffic count data in major four corridors shows the majority ofvehicles ply in Bhaktapur and Naghdhunga, thetrip origin and transit origin data indicates the site should be located in the western corridor of the Kathmandu valley. Our findings that the only present Gongabu bus park is unable to hold the traffic load anymore,designates a need for introduction of a new bus terminal outside the ring road which would reduce the burden. This approach allows the intercity functions to operate in the premises outside the outer ring road, leaving the intra city functions only to the core area within the ring road, eventually diminishing the vehicular traffic inside the valley. This specifies that the traffic management in different routes is made much more manageable by separation and segregation of the public transportation. It also implies that future research for proper route wise segregation of the roads and their allocated functions needs to be conducted.
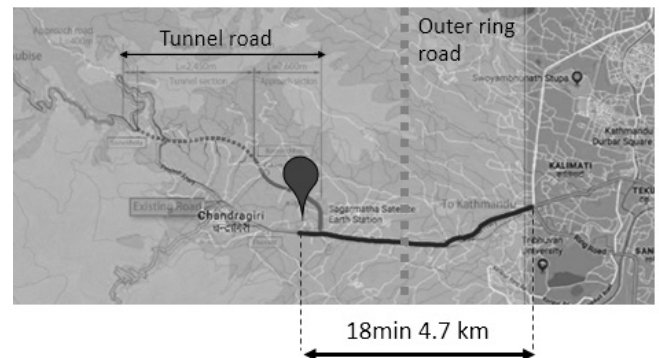

Fig. 1. Proposed site for the intercity bus terminal

The past urban trends suggests that the traffic demand claims for immediate traffic solutions such as introduction of an alternate possible route likeouter ring road. After theconstruction of outer ring road, the current urban fabric

will be changed ultimately suggesting the possibility of Transit Oriented Development (TOD) in the western area. TOD aims to increase the public transport ridership by reducing the use of private cars promoting sustainable urban growth. It typically includes a central transit stop such as a terminal surrounded by high density mixed used area, with low density area spreading out from this centre.The present need and the future TOD demand approves the terminal location for a site feasible in Balambu area.

The proposed site in Balambu lies between Satungal and Gurjudhara which are high density mixed used settlement next to high vision colony, a low density new settlement area. It lies in the transit corridor connecting Naghdhunga route with the proposed outer ring road, serving as main entry point to Kathmandu valley.

The impact of this terminal may not be so apparent to eradicate the traffic congestion issue completely however, significant differences in the traffic management perspective will be felt. This approach serves the main purpose of the research byminimizing thetraffic congestion as much as possible in urban and architectural scale. Various research regarding traffic management has been conducted before at various academic and non-academic levels but only a few research have been introduced based on terminal as one of the solution for the congestion issue.

V. CONCLUSION

In a developing country like Nepal where road transportation is considered major infrastructure of development, rapid urbanization has caused the traffic congestion to emerge as one of the major concern. Despite the hustle of government and traffic division constantly trying to resolve the matter, the problem still persists.

The inundated and uncontrolled traffic growth in haphazard manner and poor traffic management engendered the main purpose of this research; to find a solution to the traffic congestion issue and mitigate its measures to some extent. This research suggests that the on-going solutions may not be the only solution to traffic congestion, but an introduction of a bus terminal can also be one of the solutions to alleviate the problem. The terminal acting as a transportation hub can not only help in segregation of different types of functions related to traffic but also serve to futuristic approach aiding the transit oriented development. This research focuses on considerations of the traffic in various corridors and has provided a suitable location for a proposal of the terminal. The main findings of the study were, the Naghdhunga route being the main route that causes the congestion inside the city.The data and analysis were supportive in selecting and justifying the site along with the capacity analysis to determine the project scale, which served beneficial in the design phase of the project.The focus of design of terminal will be on clear segregation of different types of traffic at peak hours, and designing it as a transportation hub incorporating

the facilities and accommodations, which meets the needs of passengers. Its impact cannot be overlooked considering the significance it can provide in the traffic management point of view. The findings of this research is expected to be helpful for the academic, various other governmental and urban planning fields setting a different perspective for the intended solution.

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