PERFORMANCE EVALUATION OF MOHAKHALI FLYOVER BY USING VISSIM SIMULATION SOFTWARE

M. S. Mamun*, S. Mohammad, M. A. Haque & M. Y. A. Riyad

Department of Civil Engineering, Ahsanullah University of Science & Technology, Dhaka, Bangladesh
**Corresponding Author: smamun93@hotmail.com*

ABSTRACT
Mohakhali rail crossing intersection is one of the most congested places within Dhaka city. In order to alleviate traffic congestion at this area, Mohakhali flyover was constructed and opened to traffic in 2004. But, unfortunately, it is observed that traffic congestion still exists at Mohakhali flyover and its surrounding areas. In this research, the performance of Mohakhali flyover is evaluated. The whole analysis is performed in VISSIM simulation software. First, existing condition (with flyover) is simulated to obtain the density, flow, speed and delay. The performance measures are then obtained for the network without flyover using the same traffic load. From the result comparison it is found that with the flyover the flow and speed at major links has increased, although the improvements are not significant. In order to increase the capacity of the intersection, it is proposed to extend the flyover by constructing additional links to and from the Gulshan Mohakhali connecting road. The extended version of the flyover is also simulated in VISSIM. Remarkable improvements are noticed. At every major link flow and speed has increased and delay has decreased significantly.

Keywords: Flyover; interchange; simulation software; traffic congestion; VISSIM

INTRODUCTION
The congested situation prevails all the day in most of the streets and intersections in Dhaka city. A recent study reveals that the average speed at Mirpur road (a major arterial road) is 15 to 17 kilometer per hour during peak period (Monayem, 2001). Many government and public transport agencies are trying to solve these problems by drafting policies, undertaking projects and implementing programs. The Dhaka Integrated Transport Studies (DITS, 1994), Strategic Transport Plan (STP, 2005) and Dhaka Urban Transport Network Development Study (DHUTS, 2009) are the major transport related studies conducted to alleviate traffic congestion in Dhaka city. Among many recommendations from those studies, building flyover and interchanges at major intersections gained major attention from Bangladesh government and policymakers. As a consequence, Mohakhali flyover was built to reduce the congestion at Jahangir gate, Mohakhali, Gulshan and Banani area.

The construction of flyover started in December 2001 and opened to traffic in November 2004. The flyover was expected to ease the traffic congestion at Mohakhali railway crossing. Before the construction of Mohakhali flyover, the total area at Mohakhali, Gulshan and Jahangir gate were full of traffic jam because of the Mohakhali intersection and the rail crossing. After the construction of Mohakhali flyover, the situation has been improved but which is not enough to reduce the congestion at those areas. In this research, attempt has been taken to evaluate the performance of Mohakhali flyover and make recommendations to increase the performance. Average delay and speed of the vehicles at the study area for two scenarios are compared: one with the flyover and the other without the flyover. The network is built in VISSIM simulation software and simulated to get the performance measures for both the scenarios. Moreover, the flyover is proposed to be connected to Gulshan-Mohakhali link road to reduce the congestion and increase the effectiveness of the flyover, which is also modelled and tested in VISSIM.

TRAFFIC SIMULATION
Traffic simulation is "Microscopic simulation", also called micro simulation, which means each entity (car, train, and person) that is to be simulated is simulated individually. The widely used micro

simulation software packages are VISSIM, TSIS-CORSIM, TransModeler, PARAMICS, AIMSUN, INTEGRATION, etc.

Simulation software is frequently used to simulate freeways, surface networks, intersections, roundabouts, public transport, etc. Prevedouros and Wang (1998) simulated a large integrated (street and freeway) network to compare three state-of-the-art software programs (INTEGRATION, CORSIM and WATSim). Mystkowski and Khan (2000) examined queue length as measure of effectiveness at signalized intersection by using CORSIM, TRANSYT-7F, and SIGNAL94, PASSER II-90 and SYNCHRO3. Kim and Benekohal (2005) compared control delays obtained from CORSIM simulation to the Highway Capacity Manual (HCM, 2000). Rilett et al. (2000) compared low-fidelity TRANSIMS and high-fidelity CORSIM highway models with ITS data.

Simulation software is also used with signal controlling system. Adaptive signal control systems proposed by Perrin et al. (2001) was connected to Federal Highway's CORSIM model. Park et al. (2000) presented a stochastic signal optimization method based on a genetic algorithm (GA-SOM) that interfaces with the CORSIM microscopic simulation program.

Many researchers used simulation software in access management, operation of roundabouts, operation of public transport, etc. Yang and Zhou (2004) proposed Right turn plus U-turn at median openings as an alternative to direct left turn for access management, which was tested in CORSIM. Trueblood and Dale (2003) simulated roundabouts with VISSIM. Vandebona and Richardson (1985) developed TRAMS (Transit Route Animation and Modeling by Simulation) for simulating light rail transit operations. Chien et al. (2000) developed a CORSIM-based microscopic simulation model, which provides transit planners and operators with the ability to simulate bus operations on transit routes.

Simulation software is now a widely used tool in the field of transportation engineering. The advantage of using simulation is that it offers the users the opportunity to evaluate alternative strategies which could be very helpful in the field of transportation engineering. In this research the strength of VISSIM simulation software is used to evaluate the performance of Mohakhali flyover.

STUDY AREA AND DATA COLLECTION

Mohakhali flyover is located at Mohakhali connecting Bir Uttam Ziaur Rahman Sarak and New Airport raod. The portion of the network used in this study is shown in Figure 1. The network consists of two intersections (Rail crossing intersection and Gulshan-Mohakhlai link road intersection) which are controlled manually by the traffic police very poorly. The passengers and travellers need to wait for a long time at the signals.

For this study, data was collected during 9:30 to 10:30 am on Sunday (16th and 23rd June, 2013) and during 5:00 to 6:00 pm on Thursday (20th and 27th June, 2013). Traffic volume was counted for four consecutive 15-minutes at four data collection points and converted to Passenger Car Unit (PCU/hr). A sample data is provided in Table 1.

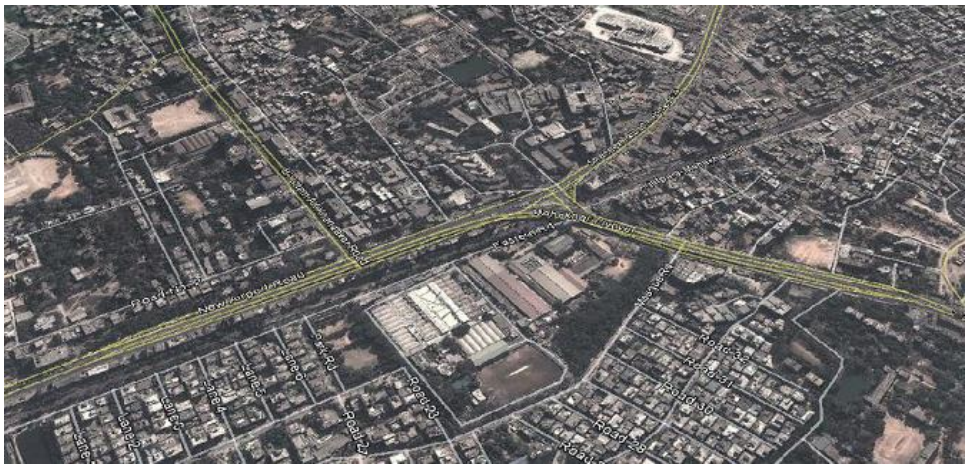

Fig. 1: Satellite View of the Network

Table 1: Traffic Flow at Different Locations

Locations	VPH	PCU/Hr
Banani Shoinik Club to Mohakhali	4156	3665
Mohakhali ICDDRB to Mohakhali	1440	1596
BAF Shaheen College to Mohakhali	3256	2705
Gulshan wireless more to Mohakhali	1468	1308

NETWORK DEVELOPMENT AND SIMULATION

The network is built by using link, lane, connector, signal, etc. First, background is set and scale is adjusted. Then gradually links are added. Links are then connected by link connectors. The entire network is presented in Figure 2. Total road width is divided into number of lanes. Simulation parameters, speed profiles, vehicle type characteristics, traffic composition are adjusted according to modeling needs. Entering traffic volumes, routing decision, speed changes, conflict area, etc. are inputted/set according to data obtained from field survey. Although, at Mohakhali, traffics are controlled manually by traffic police, signal timings are set arbitrarily that provides the best traffic operations in the network.

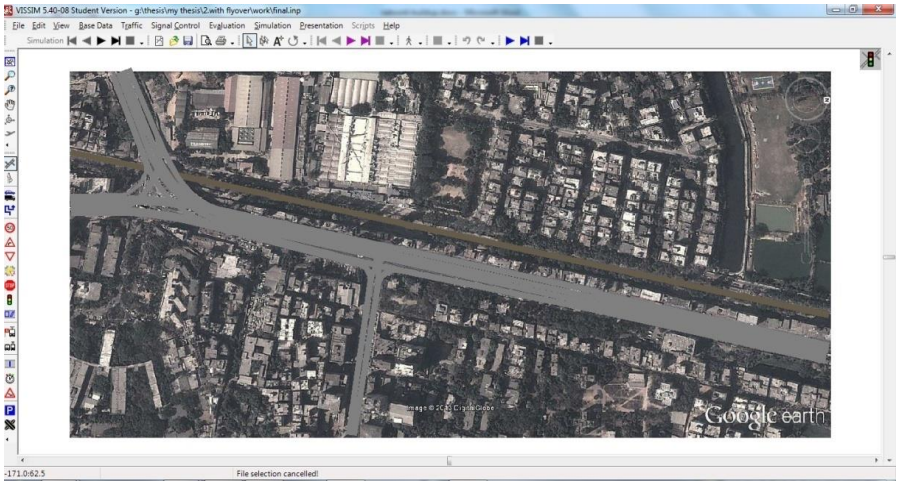

Fig. 2: Screen Shot of the Entire Network in VISSIM

Present Condition Simulation (with flyover)

In order to get the current performance of the flyover, the calibrated network is simulated in VISSIM (Figure 3). Performance measures (density, flow, speed and delay) obtained from the simulation runs are provided in the result section.

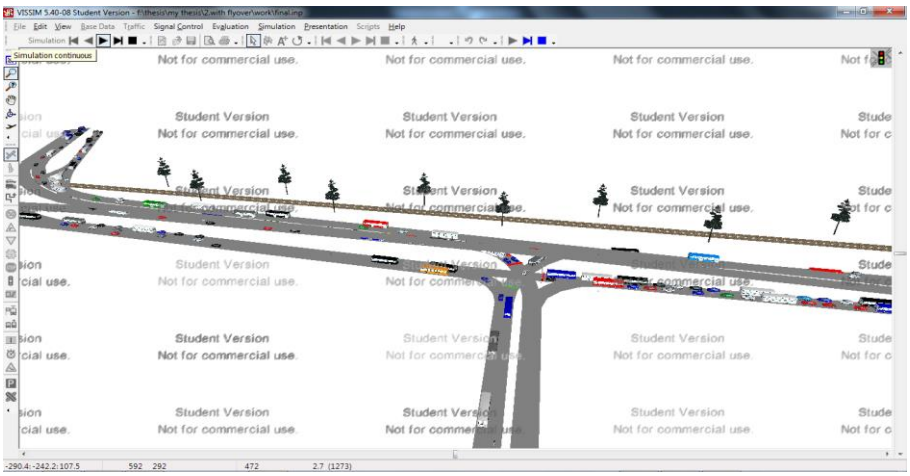

Fig. 3: Present Condition Simulation

Previous Condition Simulation (without flyover)

In order to get the performance of the previous condition, the same network is simulated in VISSIM without the flyover (Figure 4). Performance measures (density, flow, speed and delay) obtained from the simulation runs are provided in the result section.

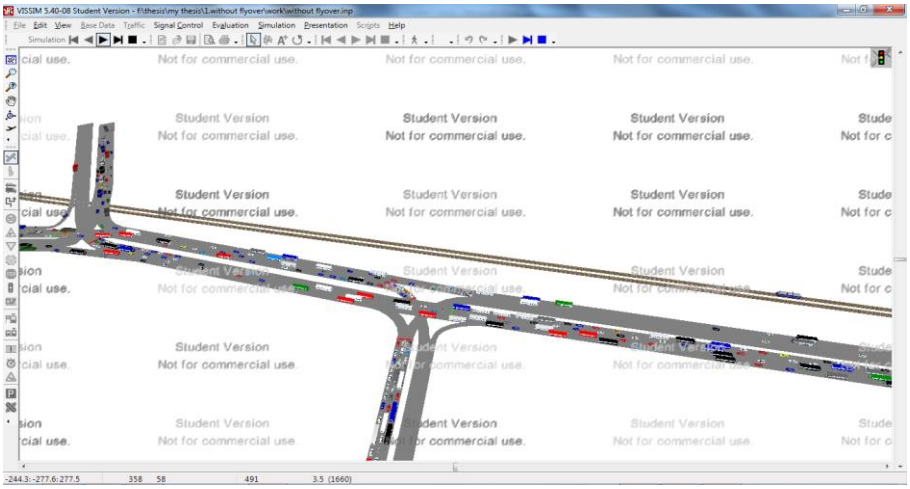

Fig. 4: Previous Condition Simulation

Extension of Mohakhali Flyover

There are two intersections having 3 legs present in Mohakhali. These are the main reasons for congestion in the network. Especially the intersection at the head of the Gulshan Mohakhali connecting road causes the main problem. Therefore, in order to solve the congestion problem in the network it is required to improve the capacity of this intersection. After taking some physical measures (i.e., parking control, vehicle movement control, and pedestrian movement control) additional links can be constructed to/from the flyover. One link can be added from Gulshan wireless to Mohakhali flyover towards Banani, one can be added to the Mohakhali flyover towards Shaheen College from the same position and one can be added from Mohakhali flyover towards Gulshan wireless. The new trumpet interchange created in VISSIM is shown in Figure 5. Three new routes will be generated by the additional construction. Therefore, huge numbers of right-turns will be eliminated at both of the intersection within our study area. Performance measures (density, flow, speed and delay) obtained from the simulation runs are provided in the result section.

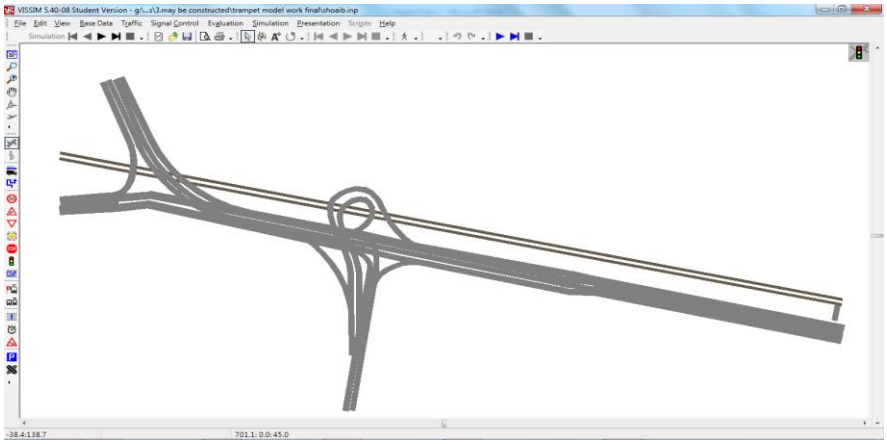

Fig. 5: New Trumpet Interchange

RESULTS

The density, flow and speed of the important links under three conditions are provided in Figures 6 to 8. From the Figures we can observe that density has decreased significantly, and the flow and speed have increased significantly for the extended flyover scenario. The comparisons of average speed and delay

of the whole network are provided in Figure 9. From the figure it can be seen that without flyover average speed of traffic is very low (13.05 km/h) and delay time per vehicle is very high (135.22 sec/veh). After the flyover construction, the average speed increases to 17.73 km/h and delay time per vehicle also decreases to 109.65 sec/veh, although the changes are not significant. Still there exists congestion. With the extension of the flyover, the average speed of traffic has increases remarkably and the delay time per vehicle has become very low. The average speed of the vehicle is now 53.61 km/h and average delay is now 21.86 sec/veh.

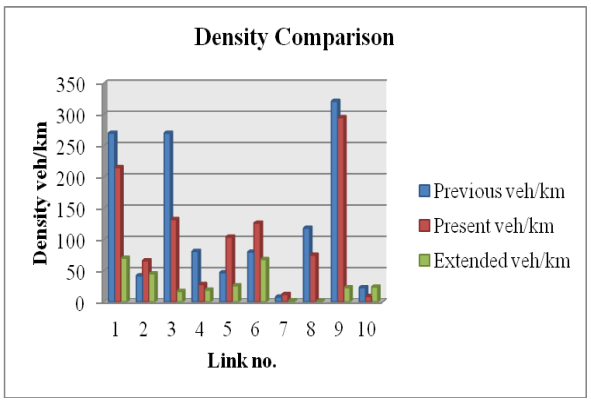

Figure 6: Density Comparison

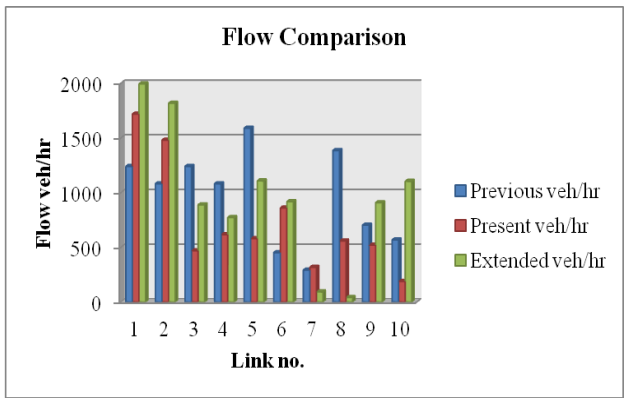

Figure 7: Flow Comparison

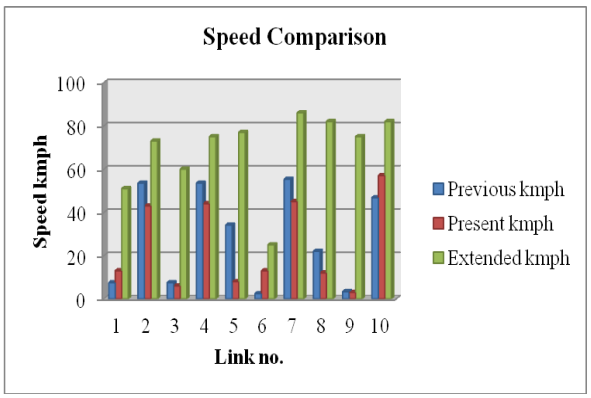

Figure 8: Speed Comparison

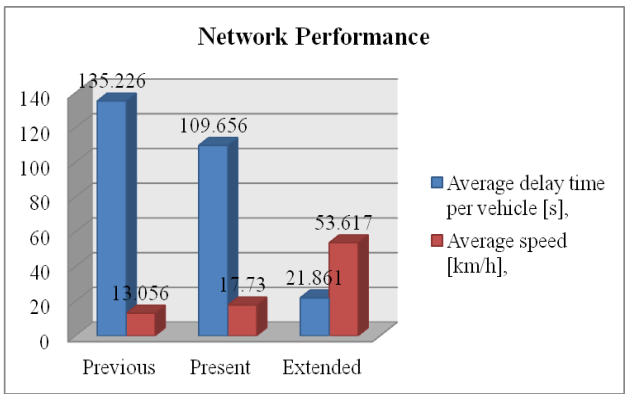

Figure 9: Avg. Speed and Delay of the Whole Network

CONCLUSIONS

The existing flyover is not very effective in reducing traffic congestion at Mohakhali area. And we cannot go back to the previous condition where there was no flyover. Moreover, we have spent Tk 113,52,72,000 for the construction of this flyover. Therefore, at this point we need to do something that can increase the capacity of this area and increase the effectiveness of the flyover. Extension of the flyover is one such solution. If we spend some extra money and construct few additional links as mentioned in this research, the flyover will be converted to interchange and it will be able to handle traffic congestion more efficiently at the study area.

REFERENCES

Chien, SI; Chowdhury, SM; Mouskos, KC and Ding, Y. 2000. Enhancement of CORSIM Model in Simulating Transit Operations. *Journal of Transportation Engineering.*

DITS. 1994. *Dhaka Integrated Transport Study*, Dhaka.

DHUTS. 2010. *Dhaka Urban Transport Study*, Dhaka.

Kim, S and Benehohal, RF. 2005. Comparison of Control Delays from CORSIM and the Highway Capacity Manual for Oversaturated Signalized Intersections. *Journal of Transportation Engineering*, ASCE.

Monayem, MA. 2001. *Evaluation of Traffic Operation Conditions on Two Urban Arterials in Metropolitan Dhaka.* M.Eng. Thesis, Department of Civil Engineering, BUET.
Mystkowski, C and Khan, S. 2000. Estimating Queue Lengths by Using SIGNAL94, SYNCHRO3, TRANSYT-7F, PASSER II-90, and CORSIM. *Transportation Research Record 1683,* 99-117.
Park, B; Pourhail, NM and Sacks, J. 2000. Assessment of Stochastic Signal Optimization Method Using Microsimulation. *Transportation Research Record 1748,* 01-23.
Perin, J; Martin, PT and Hansen, BG. 2001. Connecting SCOOT to CORSIM: Real-Time Signal Optimization Simulation. *The 27th Annual Conference of the IEEE Industrial Electronics Society.*
Prevedouros, PD, and Wang, Y. 1998. "Simulation of Freeway/Arterial Network with CORSIM, INTEGRATION, and WATSim." Proc., 78th Annual Meeting, Transportation Research Board, Washington, D. C.
Rilett, LR; Kim, K and Raney, B. 2000. A Comparison of the Low Fidelity TRANSIMS and High Fidelity CORSIM Highway Simulation Models Using ITS Data. *Transportation Research Record 1739:*1-8.
STP. 2004. *Strategic Transport Plan,* Dhaka.
Trueblood, M and Dale, J. 2003. Simulating Roundabout with VISSIM. *2nd Urban Street Symposium (Anaheim, California).*
Vandebona, U and Richardson, AJ. 1985. TRAMS: Transit Route Animation and Modeling by simulation. *Journal of the Advanced Transportation,* 19(2):153-177.
Yang, XK and Zhou, HG. 2004. CORSIM-based Simulation Approaches to Evaluation of Direct Left Turn Versus Right Turn Plus U-turn from Driveways. *Journal of Transportation Engineering,* ASCE.