IMPACT OF THE NEW TRAFFIC CIRCULATION PLAN FOR NABLUS CITY NETWORK ON QUALITY OF LIFE

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Summary: Because of recent Israeli military invasions to the City of Nablus, many parts of the city's infrastructure were destroyed including roadways and traffic control devices. There are efforts to rebuild the damaged parts of the city network and its elements such as pavements, sidewalks, islands, traffic signs, and signals.

In the midst of these reconstruction activities, the Municipality of Nablus has opened new roads and set up a new traffic circulation plan for the downtown area. In addition, a major Commercial Development Center is currently under construction in city center and the first phase is scheduled to be open in the near future. The city did not fully evaluate the traffic operations impact of these new changes.

A simulation-based evaluation of the existing traffic conditions for the study area of the city (before changes) was evaluated using CORSIM traffic micro-simulation model. The model was calibrated versus field conditions. Major problem locations within the study network were identified.

In the proposed new traffic circulation plans, some of the problem spots and key locations were changed by redesigning intersections, creating new intersections, and changing traffic directions.

The impact of the new development project and traffic plan on quality of life in terms of travel time, delay, and environmental conditions was evaluated and compared with existing traffic conditions. Results showed that the new traffic plan will mitigate the adverse impacts of the additional traffic on most locations of the network. Palestine Street would be experiencing a considerable increase in delay because it will act as a primary exit from the downtown area. A traffic management plan for this street is recommended to mitigate adverse impacts of the new development.

Key Words: Traffic Circulation, Traffic Operations, Downtown Traffic, Evaluation of Traffic Systems, Sustainable Traffic Systems

NABLUS CITY - GENERAL TRAFFIC CONDITIONS

Nablus City is one of the major cities in the West Bank. It is located in the northern part of the West Bank. The city connects between the northern and southern governorates of the country. It is also a major commercial and education center in the area. An-Najah National University (NNU), which is the largest university in the West Bank, is located in Nablus City. This nature created a busy network in both vehicles and pedestrians.

One of the key features of the city is its topography. It lies on two high mountains. The Old City and the central business district (CBD) are located in the center between the two mountains. The topography of city creates a linear network. Major city streets cross through the CBD area. The roadway network in downtown Nablus City is shown in Figure 1.

The city is serviced by several public transportation routes, most of which are radial routes stationed in the CBD area. The available urban public transportation services are buses and shared taxis; the later one is widely used. In addition, there are many taxi-offices located in the city center.

The CBD area suffers from a high demand and a limited supply of parking. Most available parking is on-street. Because of all these conditions, the CBD area is normally crowded and a few options for rerouting are available.

Several studies evaluated traffic conditions in the CBD area during the last 7 years. These studies were conducted by NNU staff, fifth-year students, and local and international consulting firms. However, few of studies' recommendations were adopted because of the limited fund and space required for major developments especially in the CBD area.

Despite the above conditions, the Municipality of Nablus City, which is in charge of urban traffic management, is considered one of the most progressive municipalities in the West Bank. Since the establishment of the Palestinian National Authority in 1994, the city adopted several major improvements for the transportation systems. Some of the key improvements are signalization of major intersections, constructing a new arterial road extending through the CBD area, and continuous improvements and organization of the urban public transport services and stations. However, due to the needs of massive improvements after several decades of negligence during the Israeli occupations, many improvements are still needed.

ISRAELI MILITARY INVASIONS - IMPACT ON THE TRANSPORTATION SYSTEM

Because of recent Israeli military invasions to Nablus City, many parts of the city's infrastructure were destroyed. The destroyed parts of the transportation system include pavement surfaces, excavated roadways, sidewalks, signs, signals, and islands. In addition, there are roadway closures with concrete blocks and earth piles especially at city's entrances.

Many cities of the West Bank including Nablus City are experiencing major efforts to rebuild the damaged parts of the city network and its elements. Most of these efforts are funded by international donors. In Nablus City, these efforts are concentrated in the downtown area, which suffered from major damages. The entire downtown area was like a construction zone during the period of September 2003 and January 2004. The nature of these projects was rehabilitation.

Figure 1: Downtown Nablus City Roadway Network up to October 2003

MAJOR DEVELOPMENT WITHIN THE STUDY AREA

In the midst of these reconstruction activities, the Municipality of Nablus has redesigned the main road of Faisal Street at its western end, which is the main entrance to the downtown area from the east side. The new design includes geometric channelization of major movements, eliminating Al-Kindy Street, and providing smoother transition of traffic onto Haifa Street via a signalized intersection and an acceleration lane. These changes are shown in Figure 2.

The previous characteristics of Faisal Street were a three-lane, one-way westbound where its western end connects to Haifa Street via a short street of three lanes (Al-Kindy Street) that did not exceed 30 meters. Westbound Faisal Street has the highest peak-hour traffic volume in the city with approximately 1780 vehicles/hour. Approximately 90 percent of this traffic continues onto Al-Kindy Street. Additional peak-hour traffic of approximately 200 vehicles/hour flows onto Al-Kindy Street from the Al-Hijaz Street eastbound, as illustrated in Figure 1. Traffic flowing onto the short segment of Al-Kindy Street from the two sources had to conduct lane changes and to weave. This created a remarkable delay that spilled back onto westbound Faisal Street, which was already congested.

In addition, a major Nablus Commercial Development Center (NCDC) is currently under construction in city center and is scheduled to be open in the near future. The NCDC is a multi-storey structure that will consist of a public parking garage, shared-taxi stations, shops, and offices. The NCDC is located next to the city circle (Martyrs Square), as shown in Figure 2.

The NCDC will consist of two basements and eight floors. The two basements are planned to supply 180 spaces for all urban shared-taxi services, fast food shops, and police offices. Three floors are planned to provide a public parking garage of 220 spaces. The remaining five floors are planned to provide shops and offices (Municipality of Nablus, 2000). The project is planned in two stages. The first stage, which is scheduled to be open in few months, includes the shared-taxi basements, a parking garage of two-floors with 180 spaces, and a shopping area of 9420 square meters. Entrance/exit of NCDC traffic will be regulated at an access driveway on the north side. Entrance/exit of the shared-taxis at the NCDC will be regulated at an access driveway on the south side.

Because of previous knowledge and experience with the city network and because of these developments, the Municipality of Nablus set up a new traffic circulation plan for the downtown area to meet access and circulation requirements of the new NCDC. The new traffic circulation plan is shown in Figure 2.

STUDY OBJECTIVE

The Municipality of Nablus implemented improvements to the city roadway network, constructed Nablus Commercial Development Center (NCDC) in the critical downtown area, and set up a new traffic circulation plan. However, the traffic impact of these changes and the NCDC were not evaluated. The objective of this study is to evaluate the impact of these developments on the city roadway network and on quality of life in terms of travel time, delay, fuel emissions, and fuel consumptions.

Figure 2: New Roadway Network and Traffic Circulation in Downtown Nablus City

EXISTING TRAFFIC AND ENVIRONMENTAL CONDITIONS

The existing traffic is based on conditions up to September 2003, prior to changes to the roadway network. Traffic volume counts were conducted at all major streets and intersections within the study area between the period of late 2002 and early 2003 (Alomari, 2003). Daily traffic volume counts showed that the peak-hour volume was at 2:00 – 3:00 PM. The analysis of existing conditions was based on the PM peak-hour.

Existing traffic conditions were simulated using CORSIM computer program. CORSIM is a microscopic stochastic simulation model of urban and freeway traffic, which is supported by the Federal Highway Administration (FHWA, 1999).

The summary of traffic and environmental results for the study network and major corridors are shown in Table 1.

Table 1: Existing Traffic and Environmental Conditions in Nablus CBD

Traffic Impact on Study Area Network and Corridors			
Network Segment	**Vehicle-Trips**	**Average Delay (sec/veh-trip)**	**Average Speed (km/hr)**
CBD Network	3221	369.6	12.1
Faisal Street (WB)	5401	17.7	16.9
Faisal Street (EB)	5428	15.0	19.5
Sufian Street	2537	51.8	4.7
Gharnata-Palestine Streets	3544	25.0	10.9
Martyrs Square – Al Qawareen Street	1619	54.0	1.8
Environmental Impact on CBD Network			
Fuel Consumption (km/liter)	**HC Emission (gm/km)**	**CO Emission (gm/km)**	**NO Emission (gm/km)**
2.48	0.09	6.94	0.34

The above results show that the segments of Sufian Street and Martyrs Square/Al-Qawareen Street are congested with an average delay of 52 and 54 seconds/vehicle, respectively. The average travel speeds for these two segments were consequently low.

NEW TRAFFIC

The NCDC project is expected to be open in 2004. Because of the closures of cities and bad economic conditions due to the current political conditions in the West Bank, traffic growth was assumed negligible. Studies have shown negative traffic growth at certain places within the study area (Al-Haaj, 2003). Therefore, the 2002/2003 traffic volume was assumed to remain stable.

All urban shared-taxi services will be relocated in the NCDC. There are 18 major service lines for the city with 650 vehicles/hour PM peak-hour traffic volume (Abweh et al, 2002). All these services will be stationed at the NCDC. Therefore, traffic volume generated by each shared-taxi line was rerouted from its original station/line to the new station at the NCDC. The ingress-egress routes are established by the Municipality of Nablus.

The NCDC project will generate new traffic when it opens. The first phase of the NCDC project consists of 9420 m^2 (101,000 ft^2). Based on the Institute of Transportation Engineers Trip Generation book (ITE 1998), the PM peak-hour trip generation rate for shopping centers is 3.74 trips per 1000 ft^2. However, these are rates were developed based on conditions in the USA. It is expected that these rates are higher than rates for Palestinian conditions. Therefore, it was necessary to establish local trip generation rates.

Cordon counts were conducted around two similar shopping centers in Nablus City. The PM peak-hour trip generation rate was approximately 3.00 trips/1000 ft^2 (3.22 trips/100 m^2) (Abweh et al, 2002).

The Institute of Transportation Engineers Trip Generation Handbook (ITE, 1998) established pass-by percentages for similar size shopping centers. The percentages ranged between 20 and 60 percent. Considering the location of the NCDC in the heart of the downtown area, the pass-by trips was estimated at 50 percent.

Based on these results, the estimated PM peak-hour primary trips to be generated by the NCDC was 151 vehicles/hour with 48/52 percent entrance/exit split.

New traffic of the rerouted shared-taxis and NCDC trips was distributed and assigned to the study area network based on travel option by the new traffic circulation plan, existing traffic distribution percentages, and traffic assignment modeling developed for Nablus City (Douleh, 2000).

ANALYSIS OF NEW TRAFFIC AND ENVIRONMENTAL CONDITIONS

The new traffic conditions of rerouted shared-taxis, trips generated by the NCDC, changes to the roadway network, and the new traffic circulation plan were simulated using CORSIM computer program. The summary of traffic and environmental impacts of the new traffic conditions is shown in Table 2.

Table 2: Summary of Traffic and Environmental Impacts of New Traffic Conditions

Traffic Impact on Study Area Network and Corridors			
Network Segment	**Vehicle-Trips**	**Average Delay (sec/veh-trip)**	**Average Speed (km/hr)**
CBD Network	4525	175.8	13.0
Faisal Street (WB)	5799	13.9	19.5
Faisal Street (EB)	8481	15.1	16.3
Sufian Street	2910	17.3	13.9
Gharnata/Palestine Streets	3898	54.5	5.1
Martyrs Square / Al-Qawareen Street	2669	8.3	13.8
Environmental Impact on CBD Network			
Fuel Consumption (km/liter)	**HC Emission (gm/km)**	**CO Emission (gm/km)**	**NO Emission (gm/km)**
3.61	0.09	6.43	0.33

The simulation results presented in Table 2 show that there is a clear overall improvement for the downtown network. Vehicle-trips increased by 40 percent, the overall average delay decreased by 52 percent, and the average trip speed increased by 7 percent. The environmental conditions of fuel consumption and emissions have consequently improved. Despite the increase in traffic volume, traffic conditions improved because of the new design at the end of the westbound Faisal Street and the new circulation plan.

Traffic conditions for the majority of network segments have also improved especially Martyrs Square/Al-Qawareen Street with a decrease in average delay from 54 to 8.3 (85%) seconds/veh-trip. This is primarily due to the new circulation around this area. However, traffic conditions for the segments of Gharnata/Palestine Streets and eastbound Faisal Street would be experiencing an increase in delay and a decrease in the average vehicular speed.

Although the number of lanes on eastbound Faisal Street has increased from 2 to 3 lanes, the average delay has slightly increased because all traffic generated by the NCDC and portion of the rerouted shared-taxis will be using this link. The average speed on this link would decrease from 13 to 12.1 km/hour (7%). It can be stated that these changes are minor considering the improvements in other parts of the network.

The segment of Gharnata/Palestine would be experiencing a significant increase in average delay from 25 to 54.5 seconds/vehicle (118%) and a decrease in the average speed by 17 percent. This is because the new circulation plan necessitates using Palestine Street as a major exit from the downtown area to the southwestern neighborhoods of the city.

CONCLUSIONS

Based on simulation results, it is clear that the new geometric design and traffic circulation plan will improve traffic and environmental conditions in downtown Nablus City. Therefore, quality of life in the study area will improve.

The new Nablus Commercial Development Center (NCDC) will house all shared-taxi services in the city and will also generate additional traffic volume. This project is located in the heart of the downtown area. Therefore, it is anticipated to have a major impact on traffic conditions in the downtown Nablus City. However, results showed that most of the adverse impacts of the project traffic were mitigated by the improvements made to the key streets and the new circulation plan.

The new circulation plan dictates using Palestine Street as the major exit for downtown traffic and shared-taxis from the downtown area to the southwestern neighborhoods of the city. As a result, congestion along this street is expected to increase. Therefore, a traffic management study for this street should be conducted. This study should consider redesigning signalization along this street and increasing the number of lanes by managing on-street parking on both sides of the street.

The NCDC will provide a sizable parking space for the downtown area. Although parking was not part of this study; however, it is expected that the first and the second phases of the project will improve parking deficiencies in the downtown area.

This research shows the necessity of conducting a comprehensive study when major developments are constructed and when a new traffic circulation plan is implemented to mitigate potential adverse impacts.

The impact of the first phase of the NCDC was studied in this research. The second phase of the project will provide shopping and office areas that is more than twice the area of the first phase. Therefore, major additional traffic will be generated. It is recommended that a comprehensive study be conducted before the second phase is operational.

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