



Traffic study and flyover design for Burij Al-Sahwa roundabout using Building Information Modelling (BIM).

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Due to the increase in the attraction of human activities and the increase in the rapid population growth into the urban region, which in turn leads to the growth of vehicle ownership, increase the daily trips and use which results in traffic congestion in the major roundabouts of the city. The aim of this project is analyzing the current situation of traffic in Burj Al-Sahwa roundabout using Building Information Modelling (BIM). Where, BIM software can conduct simulations and analysis to enhance the design for, cost-effective, energy-efficient, sustainable and practicable products as well as faster and more effective. In this project, traffic congestion in Burj Al-Sahwa roundabout, has been collected by using traditional through manual spot counting of vehicles, to evaluate roundabout performance.

The outcome of this project found that there is increasing in the traffic in the peak hour between 7 Am to 8 Am on Nizwa road. In that case, the suitable solutions to manage the traffic flow are the design of the flyover and design Signals in roundabout under the flyover.

Introduction

Omani transportation system is one of the most important in all sultanate's physical infrastructure where it is developed in 1970 which including two modern ports, an expanding road network, two international airports to facilitate international service, intraregional and domestic. It was developed in 1992 with 20000 km of graveled roads and 6000 km of paved roads. Unlike in 1970, there was a 10 km long paved road with limited air and coastal traffic.

The transportation system in Oman includes all places with high population density and easy access to most international destinations. The highway is consisting of four-lanes along the Gulf of Oman from Muscat to UAE. In addition, the main airport has scheduled flights to all parts of the world. The port of the Sultanate is considered one of the best harbors for ships in the eastern part of the Arabian Peninsula.

With the major infrastructures in the place by the mid of 1980s, there was a change in the constructions and the maintenances and develop the existing transportation networks. Till to 1984, the road maintenance process was a marginal budget reflected from the ministry of transportation. However, from 1984 the maintenance process of the paved roads become as important, with begun the programs of bituminous surfaces treatments. in the 1990s the focusing was on the upgrade of the presents highways infrastructures and maintaining the paved roads, in the same time the government continued to allocate a substantial's equipment to improve plan for Muscat City, where the severe traffic issues are being addressed by establishing of the interchanges and expansions for some highway by two-lane systems.

Muscat Governorate is the location of the roundabout which is named by Burj Al Sahwa roundabout, where it's known as an active place with huge traffic.



Literature review

Traffic congestion according to (Revenio and Almalinda, 2015) is considered a major challenge to most countries. This study aims at identifying the causes and effects of traffic congestion as well as finding possible solutions to solve this problem in Muscat city, Sultanate of Oman. The results revealed that there are several factors for traffic jams such as increasing population and no discipline in using right lanes while driving. Finally, they said, there are some proposed solutions to reduce the problems of traffic jams, which are the construction of more flyover and the elimination of roundabout.

According to (Ramana, et al 2018) says that in the Sultanate of Oman, the modernization of economic development and the development of infrastructure over the last four decades brought structural changes in people's lifestyles and vehicular growth. Where the Royal Oman Police (ROP) indicated that the annual rate of registration of cars in the country is up to 8.8%. Therefore, increased vehicle ownership is the main cause of traffic congestion. In addition, the methodology used to solve this problem is to collect the data from ROP and collect the number of vehicles' during the peak and non-peak hours on the selected roads.

The traffic congestion has become increasing due to the increasing population and the number of vehicles in the Urban which be a serious concern of traffic managers. Where, (Mututantri, et al, 2015) studies the traffic congestion in Rajagiriya town. Therefore, the data of vehicular flows were evaluated manually in the peak hour. As the result shown in the below chart there is an increase in the traffic in the peak hour between 5 Pm to 7:30 Pm. in that case, they considered to design of the flyover. Also, design roundabout under the flyover which is a suitable solution to manage the traffic flow.

According to (Fanning, et al 2015) studies the implementation BIM on infrastructure: Comparison of Two Bridge Construction Projects. This research provides the benefits of using building information modeling (BIM). Throughout the life cycles of infrastructure projects, the BIM software can minimize waste, increase sustainability and significantly increase efficiencies. In addition, the finding that the use of BIM software reducing requests for information, facilitate otherwise infeasible complex projects and has the potential to realize cost savings during follow-on projects.

In recent years, (BIM) has been used extensively in the construction industry and architecture where all countries of the world have tried to adopt building information model systems which are serving as a bridge between different disciplines such as civil engineering, architectural, mechanical, etc. furthermore, the benefits of the (BIM) the system are that it saves time and labor and reduces errors in the early design phase of the project. (Bryde 2013)

Study Area

One of the main arteries of the city is Burj Al-Sahwa roundabout. Burj Al-Sahwa roundabout is located at crossroads Connects to the most prominent Omani states such as Sohar, Salalah, Nizwa, Ministry Defense Building, Muscat, and Muttrah. The location of the roundabout is a strategic location in the city, where it is just a few minutes away from Muscat International Airport, Seeb Air Base and most of the governmental and private establishments in the Sultanate. In addition to the Burj, there are famous tourist areas, large commercial centers and many hotels in different categories: This causes increased traffic congestion in the area. This study will reveal some possible solutions to reduce traffic congestion to in Burj Al-Sahwa roundabout.



Figure 1. Proposed study Area in Buirj Al-Sahwa roundabout.

Objective

- The evolution of the traffic volume in the selected area (Brij AL-Sahwah roundabout).
- To Design a bridge/flyover on Burj Al-Sahwa roundabout using BIM software to avoid traffic.

Methodology

Design of Bridges requires a multidimensional study including topographic survey, alignment study, environmental and economic studies, collection of traffic data and analysis to calculate future traffic.

Traffic Volume

The collection of traffic data is important in the planning and development of the road. So in this study, the direct manual method was used to collect data and obtain traffic volume.

BIM software

BIM is a new technology emerging through the world, in Architecture, Engineering and Construction (AEC) industries. There is several benefit of Building information model (BIM) used for the following purpose; A 3D view can easily be created. Also, the use of BM can be more effective processes, design better, conduct simulation quickly, and Better production quality. It also provides the users of the project consistent and accurate data as well as a virtual view to model the building (Azhar, et al 2014).

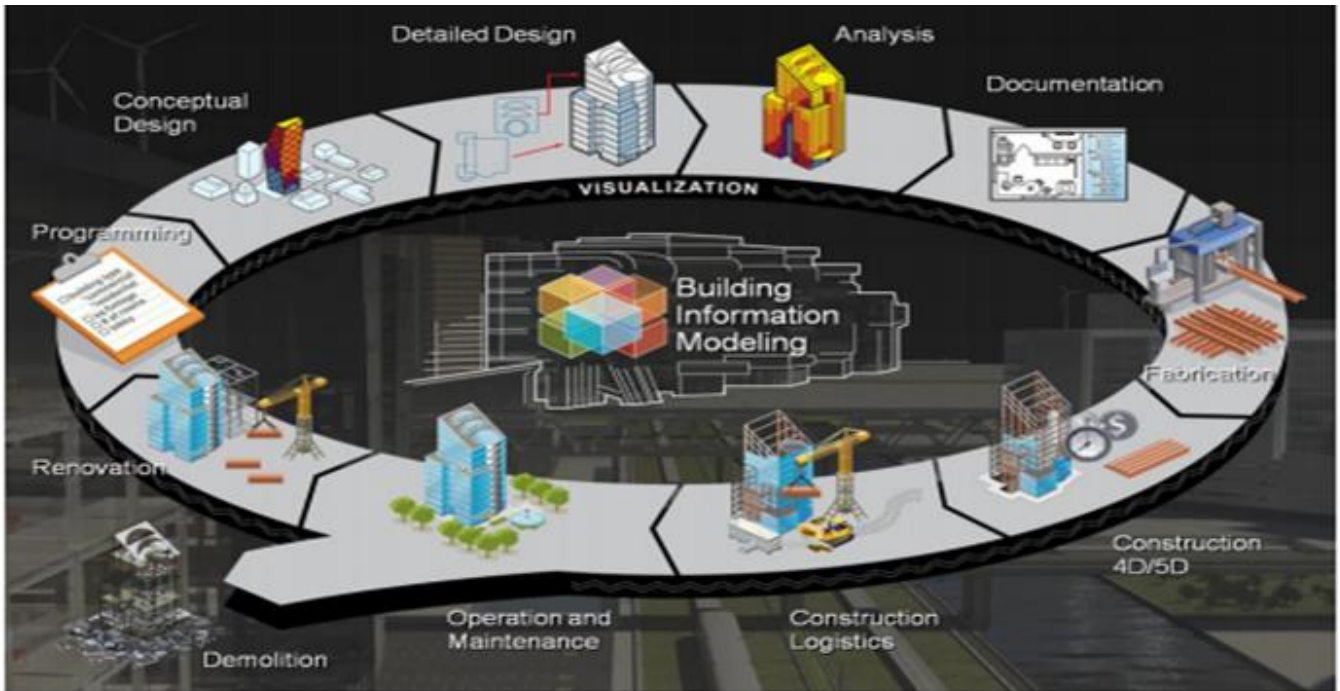


Figure 2. Show application of BIM software.

5.0 Results

Nizwa road

	Time		
Day	07:00 - 08:00 AM	13:00 - 14:00 PM	18:00 - 19:00 PM
Sunday	1931	403	1507
Monday	1506	215	1711
Tuesday	1348	281	1859
Wednesday	1616	168	1604
Thursday	1253	132	1219
Friday	147	86	151
Saturday	94	105	829
Total traffic/week.	7895	1390	8880

Table 1. Show the traffic data in Nizwa road.

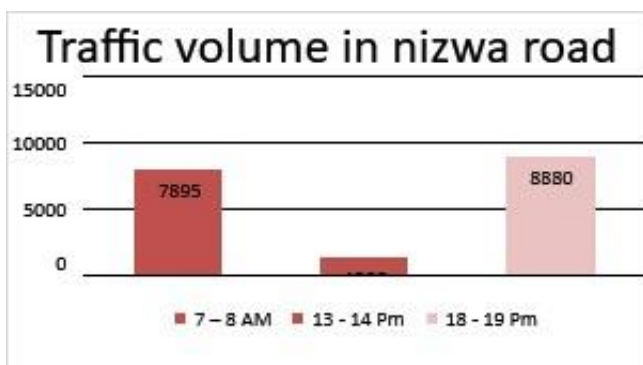


Figure 3. Show the diagram of traffic volume in Nizwa road.



Muscat road

Day	Time		
	07:00 - 08:00 AM	13:00 - 14:00 PM	18:00 - 19:00 PM
Sunday	643	2097	448
Monday	562	1954	561
Tuesday	437	1675	372
Wednesday	802	1732	625
Thursday	755	1512	305
Friday	325	193	116
Saturday	222	173	96
Total Traffic/week	3746	9334	2523

Table 2. Show the traffic data in Muscat road.

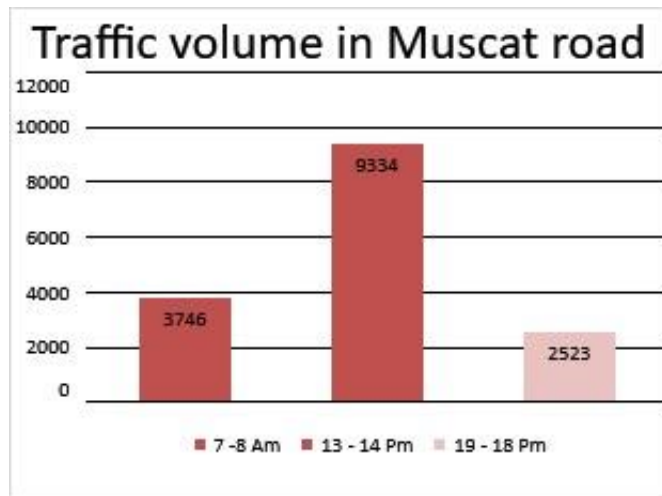


Figure 4. Show the diagram of traffic data in Muscat road

Analysis Data

- Nizwa road

Day	Time		
	07:00 - 08:00 AM	13:00 - 14:00 PM	18:00 - 19:00 PM
Sunday	1931	403	1507

Table 3. Show the traffic data in Nizwa road on Sunday.

- Estimate the 24-hr volume for Sunday using the factors mention in below table:



<i>Hour</i>	<i>Volume</i>	<i>HEF</i>	<i>Hour</i>	<i>Volume</i>	<i>HEF</i>
6:00–7:00 a.m.	294	42.00	6:00–7:00 p.m.	743	16.62
7:00–8:00 a.m.	426	29.00	7:00–8:00 p.m.	706	17.49
8:00–9:00 a.m.	560	22.05	8:00–9:00 p.m.	606	20.38
9:00–10:00 a.m.	657	18.80	9:00–10:00 p.m.	489	25.26
10:00–11:00 a.m.	722	17.10	10:00–11:00 p.m.	396	31.19
11:00–12:00 p.m.	667	18.52	11:00–12:00 a.m.	360	34.31
12:00–1:00 p.m.	660	18.71	12:00–1:00 a.m.	241	51.24
1:00–2:00 p.m.	739	16.71	1:00–2:00 a.m.	150	82.33
2:00–3:00 p.m.	832	14.84	2:00–3:00 a.m.	100	123.50
3:00–4:00 p.m.	836	14.77	3:00–4:00 a.m.	90	137.22
4:00–5:00 p.m.	961	12.85	4:00–5:00 a.m.	86	143.60
5:00–6:00 p.m.	892	13.85	5:00–6:00 a.m.	137	90.14
Total daily volume = 12,350.					

Figure 5. Show Hourly Expansion factor for a Rural Primary Road.

Adjust the 24-hr volume for Sunday to an average volume for the week using factor given in below table:

<i>Day of Week</i>	<i>Volume</i>	<i>DEF</i>
Sunday	7895	9.515
Monday	10,714	7.012
Tuesday	9722	7.727
Wednesday	11,413	6.582
Thursday	10,714	7.012
Friday	13,125	5.724
Saturday	11,539	6.510
Total weekly volume = 75,122.		

Figure 6. Show the Daily expansion factor for a rural primary road.

- To obtain the AADT, using the below table for Monthly expansion factors Since the data collected in October:

Figure 7. Show the Monthly expansion factors for a rural primary road

- **Muscat road**

Day	Time		
	07:00 - 08:00 AM	13:00 - 14:00 PM	18:00 - 19:00 PM
Sunday	643	2097	448

Table 4. Show the traffic data in Muscat road on Sunday.

- Estimate the 24-hr volume for Sunday using the factors mention in table # 6:



- Adjust the 24-hr volume for Sunday to an average volume for the week using factor given in table # 7:
- To obtain the AADT, using table # 9 for Monthly expansion factors Since the data collected in October:

Discussion:

Based on the results obtained, suggest designing a bridge between Muscat road to Nizwa road, in order to reduce the traffic congestion Moreover, this design creates a safe route and represents an important economic return for the region.

Figure 8. Show the design bridge at Burj Al-Sahwa.

Figure 9. Show the design bridge at Burj Al-Sahwa.

Conclusion

- Overall, it can be concluded that more traffic flow during peak hours in Nizwa road observed.
- The design of flyovers can reduce traffic volume.
- The use of BIM can be more effective processes, design better, conduct simulation quickly, and Better production quality.

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