

**Review Article**

Management of Al-Khaldiyah Road (Al Khobar, KSA) in Order to Optimize Safety and Improve Sight View

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Abstract: Al Khaldiyah is a regional road situated in west-south of Al Khobar (KSA), precisely in the area of Half Moon Bay. It is characterized by four lines – which become six lines in some places – in both directions extending over about 10 km length. The road extends between the bridge near the Air Force Base and Half Moon Bay Road. Many accidents have been observed in this road notably over the last two years. Many injuries and deaths were recorded; some of the victims were PMU students. Consequently, management of the road to eliminate or reduce accidents to a large extent becomes imperative. The main goals of this paper are to propose sustainable solutions for the purpose optimizing safety and improving the sight view of the road by designing some appropriate junctions including bridge and tunnel in the critical locations. The solution retained for the purpose of this project consisted on the prevision of three different junctions in this case: tunnel, tunnel/roundabout and bridge.

Keywords: Management, Al Khaldiyah Road, Al-Khobar, Traffic, Safety, Improvement

1. Introduction

The Kingdom of Saudi Arabia has a network of internal roads sophisticated and modern and has a total road length of about 160 thousand kilometers of which about 47 thousand kilometers are paved roads linking major centers [1]. In Saudi Arabia the motor vehicle is the main means of transportation. However, between 1971 and 1997; 564 762 people died or were injured in road traffic accidents, a figure equivalent to 3.5% of the total population in Saudi Arabia [2], [3], [4] and [5]. They reported that during this period 66 914 people have died on the roads in Saudi Arabia due to road accidents, amounting to one person killed and four injured every hour [6], [7] and [8].

The main goal of this project is the management of Al-Khaldiyah road in order to optimize its safety and improve its sight view. The project is mainly concerned by the proposition of sustainable solutions for the purpose of optimizing the safety use of this important road and also improving its sight view. This includes: i) the design of some appropriate junctions in order to increase convenience,

comfort and safety while at the same time enhancing the efficient movement of all road users, and ii) The minimization of traffic conflicts locations at these junctions. A good design should aim at minimizing the severity of potential accidents at these points.

2. Description of Al-Khaldiyah Road

Al-Khaldiyah road, nicknamed in the past as the abundant road, is situated in the eastern region of the Kingdom of Saudi Arabia. Al-Khaldiyah is a regional road situated in west-south of Al-Khobar, precisely in the area of Half Moon Bay. The road is considered as subdivision road linking the cities of Al-Khobar, Dhahran and Dammam, along a distance or a length of about 9.8 kilometers and an actual width of 19.6 m. However the allowable design width of the road is around 60.0 m. Al-Khaldiyah is an important and a vital road in the Half Moon Bay. It provides direct access to many local beaches and notably to PMU University. It is used daily and extensively

ridden by PMU university staff and students, and by workers in nearby projects.

Al-Khaldiyah road was constructed almost about 30 years ago and has been expanded in 2005 to become a large four-lane road without median island and lighting. Geographically, the road is important since it connects the road of the Gulf Cooperation Council and Half Moon Bay. It is bordered from the south-east by Al-Azizia, from the north-east by Abu Hadriyah and from the north-west by Raas Al-Ghar. Moreover, it is limited from the west by the sea and from the east by the city of Dhahran (and the Air Base). The distance between the roundabout (douar) Al-Azizia to the intersection Al-Khaldiyah/ Half-moon road is about 22.7 km.

The road is characterized by four lines (which become six lines in some places) in both directions extending over about 9.8 km length. The actual width of the road is 19.8 meters at a rate of 3.65 meters per line for a total of four lines (two lines for each direction). The lines of both directions are separated by a space of 60 cm or by concrete barriers of 40 cm width each [9] and [10]. The road, which is almost straight, extends between the bridge of the Air force base and Half Moon Bay road (Figures 1 and 2). The length of the exchanger or the crossover situated currently in the middle of Al-Khaldiyah road is approximately 2.4 km from the beginning to its end.

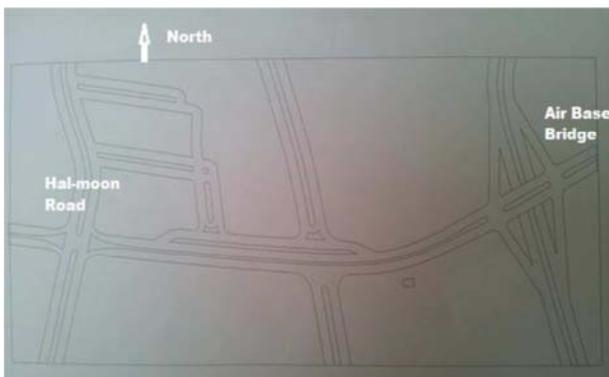


Figure 1. Plane (top) view of the actual Al-Khaldiyah Road.



Figure 2. Picture of the actual Al-Khaldiyah road.

3. Management of the Road

This section covers the geometrical design of the different solutions proposed concerning the management of the road.

Moreover, a comparative study between these solutions is included in order to select the more appropriate design based on the specificity of the road. Then, a detailed description of the different junctions proposed in the final design (i.e. the retained design) is introduced.

As mentioned previously, the road is about 10 km long. Since the allowable design width of the road is around 60.0 m, it is suggested to construct a road with three lines in each direction in addition to two service roads of two lines each. The service roads will be located at both sides of the main road. Furthermore, it was decided to divide the main road into three different equal segments. Every two consecutive segments will be connected to each other by a junction, leading to a total of three junctions (including the junction of the road at the intersection with the Half-moon road). Many types of junctions were suggested, and the combination of these junctions resulted in three different propositions (three different geometrical designs). These alternatives are summarized as follows:

1. Alternative #1 (Figure 3): the road will be composed by a tunnel and two roundabouts junctions. The tunnel junction will be located at 3.3 km away from the air base bridge (noted junction A). The two roundabout will be distanced by 3.3 km away from each other and from the proposed tunnel. One of the roundabout is suggested to be at the intersection between Al-Khaldiyah and Half-moon roads (noted junction C).
2. Alternative #2 (Figure 4): in this proposition, a bridge is suggested at the junction C (i.e. in the intersection between Al-Khaldiyah and Half-moon roads). However, for the junctions A and B, and similarly to proposition #1, a tunnel and roundabout are retained. The distances between the different junctions are similar are those adopted in alternative #1.
3. Alternative #3 (Figure 5): the third proposition consisted on a tunnel at junction A, a bridge at junction C and a tunnel/roundabout at junction B. The locations or the positions of these different junctions, on the road, are kept alike alternatives #1 & #2.

In order to select the final geometrical design of the managed road, a comparative study was performed. The Comparative study helps to understand the different aspects of the road, in short and long term. The first idea was to manage al-Khaldiyah road in the form to be an expressway in the near future. Accordingly, some problems could be encountered with the first and second propositions. It is believed that, these two solutions can cause traffic jam. In order to avoid this important problem the roundabout of junction C is replaced by a bridge, while, the simple roundabout of junction B is replaced by a tunnel/roundabout. Furthermore, from an esthetic point of view, a tunnel is suggested in junction A instead of a bridge. It is believed that, the bridge will mask the sight view of the opposite sides of the road. Many constructions will be implanted all along al-Khaldiyah road from both sides (e.g., PMU complex house, residential and commercial building, etc.).



Figure 3. Geometrical design of Alternatives #1.

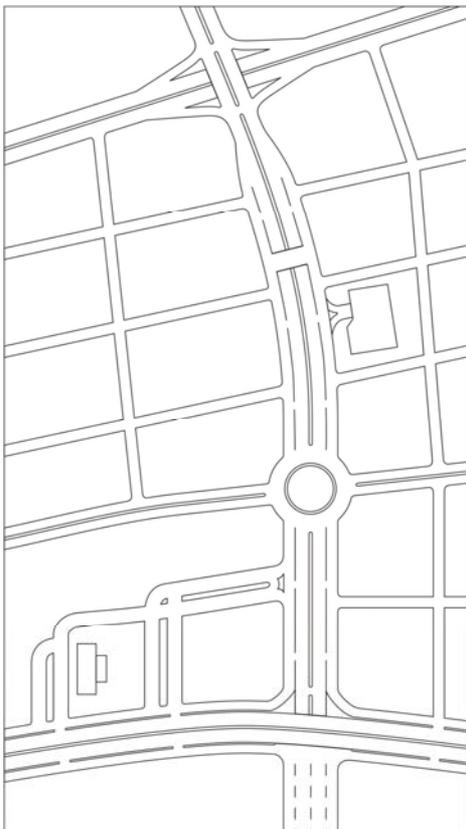


Figure 4. Geometrical design of Alternatives #2.



Figure 5. Geometrical design of Alternative #3.

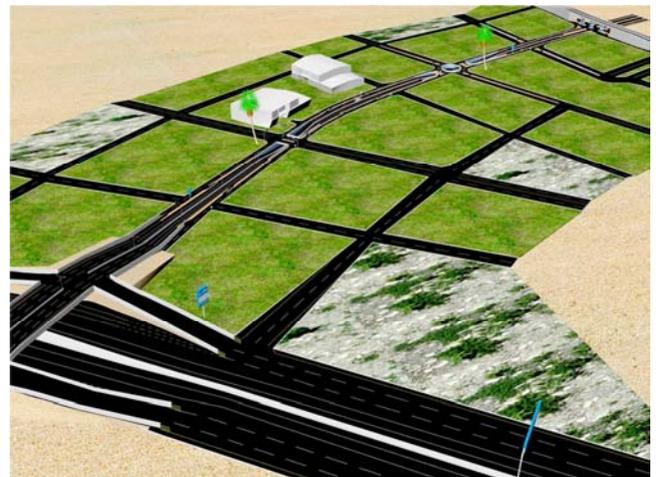


Figure 6. Overall view of the managed road (retained alternative).

The retained solution should be sustainable for many generations. The managed road is designed to locate 3 lines in each direction. In addition a service road in each side of the road is planned. The service road will be a two line road. In the retained solution (the final design), Al-Khaldiyah road (10 km long), is divided into three equidistance segments connected to each other by different junctions (Figure 6), as follows:

- a) The tunnel section is located at 3.3 km away from the air base bridge. It has an average height of 5.5 m and it is surrounded by a retaining wall of 6.5 m height maximum. The slope of the road in the tunnel is about is 6% (Figure 7).

- b) The tunnel/roundabout junction (junction B) is about 6.6 km away from Air Base Bridge and 3.3 km away for the tunnel junction. Similarly, it has a height of 5.5 m and surrounded by a retaining wall of 6.5 m height. The slope of the road in the section is about 6% (Figure 8).
- c) The bridge is located at the intersection between Al-Khaldiyah and Half-moon roads. It is composed of four freeways, where two freeways are used as U-turn (Figure 9).

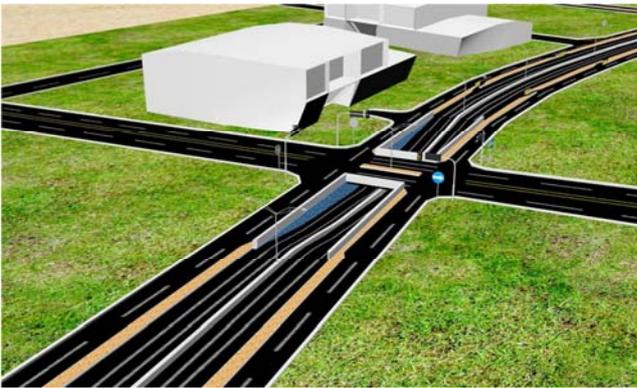


Figure 7. View of the tunnel (junction A).



Figure 8. View of the tunnel/roundabout (junction B).



Figure 9. View of the bridge (junction C).

4. Conclusion

The objectives of this investigation were to propose sustainable solutions for the purpose of optimizing the safety use of Al-Khaldiyah road and also improving its sight view. Three different solutions were proposed in order to manage the road of Al-Khaldiyah. A comparative study were carried out in order to optimize the management of the road in respect to the movement efficiency of all road users, the minimization of traffic conflicts, comfort and safety of the road, and also the improvement of its sight view. The solution retained for the purpose of this project consisted on the prevision of three different junctions in this case: tunnel, tunnel/roundabout and bridge. They are situated at equidistance from each other at 3.3 km from the air base bridge. The new bridge will connect Al-Khaldiyah and Half-moon roads.

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