



## The superiorities of concrete roads over asphalt roads

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### Keywords

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Cement

### ABSTRACT

Roads are vital for the human being to travel and reach goods safely, comfortably and economically. Every year, thousands of kilometers of roads are covered with asphalt or concrete. The selection of the pavement type is very important at the project stage. It should be designed in accordance with socio-economic needs. In addition, they are expected to safely distribute the loads acting on them to the subfloor and withstand detrimental environmental effects. Roads are named according to the material used as a binder in their construction, and when bitumen and cement are used as binder materials, respectively, they are called asphalt and concrete roads. Asphalt has been used as the main paving material for years. However, lately, concrete has emerged as a strong competitor to asphalt in road construction. This study reveals the superiorities of concrete roads over asphalt roads by considering them in terms of technical, economic, safety and environmental aspects.

### Introduction

Transportation is the transfer of persons or goods from one location to another for a specific purpose, arising from a specific need [1]. It is desired that an ideal transportation service should be economical, safe, and have features such as comfortable, fast and environmentally friendly at the same time. As a general perception, the level of development of countries is related to the desired level and quality of transportation routes. With the increasing population and increasing industrialization, the importance of road in freight and passenger transportation is increasing day by day and it is known that highway use comes first in terms of both freight and passenger transportation. Due to the increase in heavy vehicle traffic, significant problems may arise in the road structure when all design criteria are not fully taken into account. For this reason, it is possible to create more economical, comfortable and environmentally friendly structures that can serve for many years with the right material selection at the project stage before the construction of the highway [2].

Roads are structures that safely transmit the loads acting on them to the sub-base and can effectively withstand detrimental environmental effects efficiently. A road is categorized according to the material used as binder during its construction. The type of road that uses asphalt as a binder is called asphalt roads (flexible superstructures) and the type that uses cement is called concrete roads (rigid superstructures). The asphalt roads consist of 3 main parts: sub-base, foundation and pavement. The construction of the pavement layer differs on high and low standard roads. It is applied as a single or double-layer surface coating on low standard roads. The concrete roads, on the other hand, is formed by the concrete pavement built on the substructure. If the daily number of commercial vehicles in one direction on a road is more than 5000, it is recommended by many institutions to build a concrete road [3]. This study presented here deals with the superiorities of concrete roads over asphalt roads.

Since the selection of road superstructure is based on some criteria and standards, it has high importance both in construction a new road and repairment the existing roads. Today, with the increase in heavy vehicle traffic, it is necessary that the works should be performed to renew existing road structures in accordance with the request, rather than building a new road [4].

## Advantages of concrete roads compared to asphalt roads

### Concrete roads are more rigid

Concrete roads have significant advantages over asphalt roads. One of them is that concrete roads spread the loads acting on them over a wider area than asphalt roads by acting as a beam. Since the bearing capacity is not dependent on the ground, it can also be built on soils with low bearing capacity. However, since the point load model is valid on asphalt roads, the ground and sub-floor are subjected to much more load and the bearing capacity of asphalt roads depends on the stiffness of the ground as depicted in Figure 1 [5]. Thereby, if there is a low-bearing capacity soil under asphalt roads, the roads could be deformed easily in the direction of load profile. Concrete road application may be more suitable for roads under heavy traffic as it is more durable.

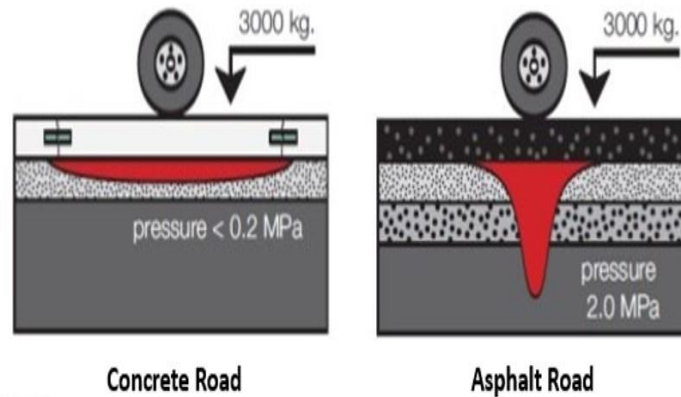


Figure 1. Load distribution of concrete and asphalt roads

### Concrete roads are more economical

Concrete roads are more economical compared to asphalt roads. They need less maintenance in their service life. In a fifty years period, maintenance expenses could be decreased up to 66% with concrete roads. Considering the initial cost, it is seen that concrete roads are generally built at less cost [1]. Also, they could save fuel up to a level of 3.2% and 4.5% for vehicles and loaded trucks respectively. Under heavy traffics, asphalt roads show more deformation. So, the deteriorations on the upper face of the pavement absorb a part of the energy of the vehicle and result in more fuel consumption [6].

### Concrete roads are safer

Concrete roads have a high coefficient of sliding friction which is important for factors of safety, thus providing a shorter stopping distance. Also on rainy days, the decrease in this sliding friction coefficient could be less compared to asphalt roads, providing more driving safety. Since the surface of the concrete roads is smoother, the surface waters flow more easily. Thus, the risk of icing could be minimized in cold weather. Also, the surface smoothness results in less accumulation of water and the deteriorating effect of water the surface of the road in the cold season decreases [7].

While concrete roads are light-colored, asphalt roads are dark-colored. Because of being light-colored, concrete roads reflect the vehicle's light much more compared to the asphalt roads, providing in the enhancement of the night-sight of drivers [8]. Also, it is possible to save on the cost of lighting streets and highways owing to the high light reflectivity of concrete roads. Figure 2 demonstrates the night-sight of concrete and asphalt roads [9].



Figure 2. The night-sight of asphalt and concrete roads

## Concrete roads are more environmentally friendly

Heating bitumen during the construction of asphalt roads causes environmental pollution. However, this is not the case in concrete roads construction. Concrete is a material that can be 100 % recycled. And, the waste materials such as fly ash, ceramic and eggshell wastes could be easily utilized in concrete. With these superiorities, the chance of preventing the pollution of the environment arises. Since the concrete roads require less repair and maintenance, it results in faster traffic flow and consequently less exhaust fumes emission to nature. Thus, the environment would be less polluted [4].

## Conclusion

In the construction of a road, the most profitable and efficient road type should be chosen in line with the needs of countries by choosing the best option suitable for the purpose. Taken into consideration of rigidity, environment, economic, sustainability and safe and rigidity, concrete roads come into view as a good solution. It seems that the majority of countries are convinced with superiorities of concrete roads over asphalt roads, so most of the new projects are being planned as concrete roads. However, today's studies performed on concrete roads should be much more supported and it is important to demonstrate the beneficial of concrete roads to the public.

## Author contributions:

**Muhammed Tanyıldızı:** Conceptualization, Methodology, Validation, Visualization, Writing-Original draft preparation. **Erden Ozan Karaca:** Data curation, Writing-Original draft preparation, Validation.

## Conflicts of interest:

The authors declare no conflicts of interest.

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