



**HIGHER TECHNICAL INSTITUTE  
CIVIL ENGINEERING DEPARTMENT**

*Mix Design Methods of Bituminous Mixtures*

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Project Report

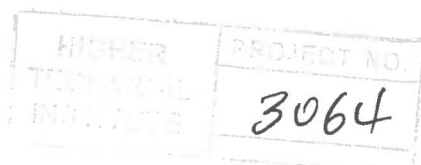
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## SUMMARY

### Mix Design Methods of Bituminous Mixtures

Bitumen is a very widely used civil engineering material, the properties of which still remain a mystery to many of the large number of people involved in its various applications, the most important being construction and maintenance of roads. In practice, the use of bitumen has remained a craft rather than a technology.

Engineers responsible for the design of works using bitumen, have a professional responsibility to get adequate understanding of its physical properties.

In this Project Report the following subjects relating to bituminous mixtures are discussed to some extent.

- Understanding what is meant by bituminous mixtures
- A brief description of the properties of bituminous materials
- Mechanisms of how surfacings deteriorate
- Asphalt mix design principles
- Different kinds of mix design methods

Special attention is given to the Marshall Method of Mix Design, being the most popular and widely used method today.

## **INTRODUCTION**

In the Middle East there are extensive crude oil deposits and for thousands of years there have been corresponding surface seepage of natural bitumen. The ancient inhabitants of these parts discovered quickly and appreciated the excellent waterproofing, adhesive and preservative properties of the material placed in front of them. For over 5000 years bitumen in one form or another has been used as a waterproofing and bonding agent. The earliest recorded use was by the Sumerians around 3800 B.C. At Mohenjo Daro in the Indus valley there is a particularly well-preserved water tank, which dates back to around 3000 B.C. In the walls of this tank not only are the stone blocks bonded with a natural bitumen but there is also a vertical bituminous core in the center of the wall. This technique is also used today in the design of dams.

Bituminous mixtures is a term used to describe mixtures of different materials which have at least one characteristic component: bitumen. Bituminous mixtures consist of: **coarse aggregates**, **fine aggregates** and **filler**. By **coarse aggregate** is generally meant the material retained on the 3,25 mm BS sieve, although some specifications refer to stone as that material retained on the 2,36 mm sieve. This stone can be rock, slag or gravel. The **fine aggregate** is that which passes the 3,25 mm or 2,36 mm sieve and is retained on the 75  $\mu$ m sieve. It is usually composed of angular, natural sand particles, but can also consist of crushed rock or slag. The **filler** is the dust ingredient, all of which passes the 75  $\mu$ m sieve. It is most usually composed of crushed limestone dust, but may also be quartz, lime, cement or pulverized fuel ash.

Fillers can play a number of roles in surfacing mixtures, of which the following are the most important:

1. They are a part of the mineral aggregate and they fill the interstices and provide the contact points between larger aggregate particles and thereby strengthen the mixture.

2. When a filler is mixed with a binder, it forms a high consistency binder or matrix, which binds larger aggregate particles together. Thus it transforms the original binder into one which closely resembles a higher penetration-grade bitumen or a more viscous tar.
3. The water-sensitivity of a bituminous mixture can be considerably influenced by the type and concentration of filler used.

There is confusion in differentiating between binding agents produced from coal (coal tars, pitches, etc) and those produced from crude oil. Another confusion arises from the difference in meaning of the word "asphalt" in Europe and North America. In Europe it always means a mixture of bitumen and mineral aggregate, e.g. rolled asphalt, mastic asphalt, gussasphalt etc. However in North America "asphalt" means bitumen.