CHAPTER 1

INTRODUCTION

1.1 Background and Problem Statement

From the beginning of mankind, transportation, especially land transportation has been a main aspect in human lives. Communication and trade would not have been possible without it. For this purpose, thousands kilometers of road have been built over the world. Indonesia, with total land area of 1.904.569 kms and population of 255.461.700 peoples, has 38.569,82 km length of national road [1].

Started from the pavements built on Crete during the Minoian period (2600 – 1150 B.C.) mankind continuously develop the construction of road. The famous ancient road construction was built by the Romans. It should be noted that these pavements were remarkably well designed. From those early days of the Roman Empire to the interstate highway system in the United States, roadway networks as well as roadway construction have been developed. The materials used for roadway construction have progressed with time. In its development, pavements can be broadly classified into two types, flexible and rigid pavement. From 38.569,82 km length of national road in Indonesia, most are flexible pavement construction. The basic flexible pavement structure is shown in Figure 1.1.

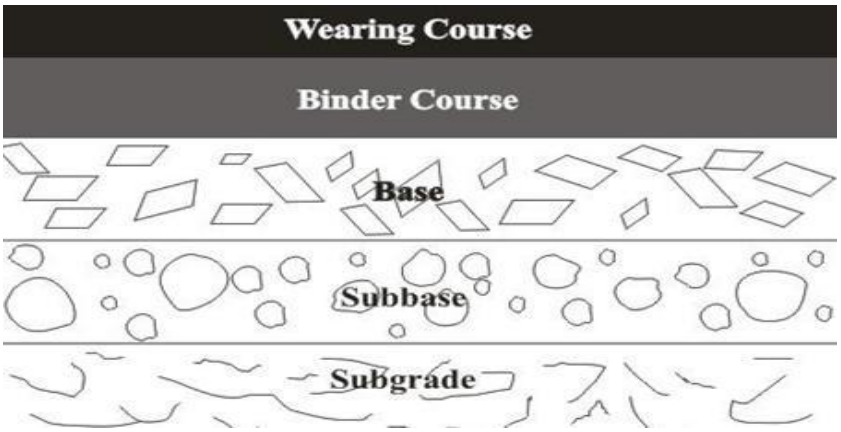

Figure 1.1: Basic flexible pavement structure

In most asphalt pavements, the stiffness in each layer or lift is greater than that in the layer below and less than that in the layer above. This could be understood from the load distribution (Figure 1.2) where the stress at the surface layer is higher than that of the layer below. Surface layer has to withstand the maximum stress and bear the changing conditions of the environment. Therefore, this surface layer usually consists of the 'best' and most costly materials. Also, this layer is always 'bound', that is, mixed with a 'binder', in this case asphalt cement or bitumen binder, to prevent raveling materials under traffic, as well as to provide a dense surface to prevent ingress of water, unless it is an open graded friction course. Therefore, the surface layer has two major components, bitumen binder and aggregates.

The performance of asphalt pavements is mainly governed by the properties of the bitumen, because bitumen is the continuous matrix and only deformable component [2]. At high temperatures (40 to 60^0C), bitumen exhibits a viscoelastic behaviour. Pavement made of bitumen may show distress when exposed to high temperatures. At elevated temperatures, permanent deformation or rutting occurs and leads to channels in the direction of travel. This is attributed to the viscous flow of the bitumen matrix in paving mixtures, which retains strains induced by traffic. On the other hand, bitumen will brittle in low temperature and pavement cracking will occur. Therefore, pavement

performance is strongly associated with the rheological properties of bitumen, which can be improved by its modification.

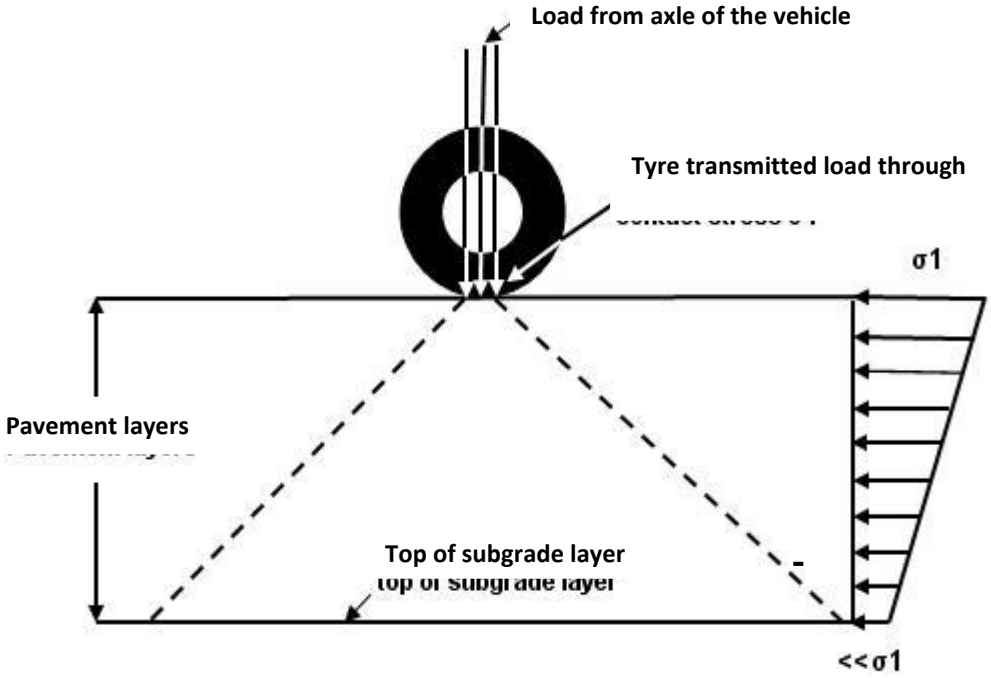

Figure 1.2: Load distributions on flexible pavement

Bitumen is exposed to a wide range of load and weather conditions; however, it does not have good engineering properties, because it is soft in a hot environment and brittle in a cold weather. To prevent the occurrence of pavement distress, it is important to reinforced bitumen to improve its mechanical properties. Modified bitumen with additives to strengthen the mechanical properties of the bitumen has been practiced in many forms for over 150 years but there is a renewed interest. This resurgence in interest can primarily be attributed to the following factors [3, 4].

(1) The increase demand on HMA pavements. Traffic volume, and traffic loads, as well as tyre pressures have increased significantly in recent years causing premature rutting of HMA pavements.

(2) The new binder specifications recommended by Strategic Highway Research Program (SHRP) in March 1993 requires the bitumen binder to meet the stiffness requirements at high as well as low pavement service temperatures. Most base bitumen does not meet these requirements in the regions with extreme climatic conditions and, therefore, modification is needed.

(3) The environmental and economic pressure to dispose of some waste materials and industrial by products as additive in HMA.

(4) Public agencies willingness to pay a higher first cost for pavements with a longer service life or which will reduce the risk of premature distress (failure).

1.2 The Objective of the Research

From the above descriptions it is obvious that bitumen should be modified in order to improve its rheological properties or in order to withstand to use in the several of different temperatures. For that purpose, this research has the following objective:

a. To investigate the feasibility of using bitumen with feldspar,

b. To formulate the mix between bitumen with feldspar that will result in a new binder with better physical and mechanical properties.

c. To evaluate the use of bitumen with feldspar as a binder in hot mix asphalt (HMA).

1.3 Scope of the Study

To accomplish those objectives, this study started with a literature review of the information pertaining to the relationship of bitumen characteristics on some different temperatures conditions, and characteristics of the present modified bitumen, and also tests which have to be conducted to the modified bitumen. Based on the results of the

literature review, a research design was developed involving preliminary research to find the appropriate modifier, in this study was bitumen with feldspar, as well as an extensive laboratory testing and experiments. Bitumen with feldspar was then used as a binder of SMA. Various mix samples of SMA-14, the type of HMA used in this research, using bitumen with feldspar binder were prepared. Some tests on SMA-14 mixture to evaluate its performance were conducted by using Marshall Stability test. Data obtained from the test were analyzed and conclusions and recommendations were made.