

CHAPTER I

INTRODUCTION

A. Background

Roads are transportation links between one city and another, not only as a link for economic and other social activities. Stable road conditions will facilitate the mobility of residents in carrying out economic activities and social activities (Priana, 2018). Indonesia has problems related to roads which often experience damage before the design achieved. The damage that occurs will definitely affect the safety and comfort of road users. Damage to roads can come from various factors, such as water, temperature fluctuations, weather conditions, variations in air temperature, type of pavement construction material, inadequate subgrade stability, less than optimal compaction process on the subgrade layer, and heavy vehicles that exceed capacity and increasing vehicle volume continues to increase (Yudaningrum & Ikhwanudin, 2017).

The structure of road pavement has a role in supporting and leveling the load generated by traffic, with the aim of preventing significant damage or failure in existing road construction. In Indonesia, the types of road surface layers currently available consist of Asphalt Concrete and Hot Rolled Sheet (Sukirman, 2016). Asphalt Concrete itself is divided into three components, namely Wearing Course, Binder Course, and Base Course. In this research, researchers used Wearing Course as a surface layer. This surface layer is an important part of road pavement because it directly interacts with traffic loads. To ensure long-lasting performance of these road surface layers, it is necessary to design the mixture according to the desired road function.

Innovation and developments in the field of nanotechnology in various applied fields are increasingly widespread, one of which is in the field of civil engineering (Rao et al., 2015). The presence of nano materials has been used to improve the performance of asphalt (Bhargava et al. 2016). It is important to note that the application of these nanomaterials enhances the development of nanotechnology, besides that nanomaterials have unique characteristics due to their

small scale size, large surface area and high functional density (Teizer et al., 2012). The development of nanotechnology in civil engineering practice is illustrated in this proposal to improve the function of nanotechnology in the field of road pavement, especially to increase the strength and durability of asphalt mixtures. This research is very important because it produces an asphalt mixture product which is mixed with nano carbon powder material from coconut waste and then has properties that can make the asphalt stronger and increase its durability which will be tested in the Marshall test and its durability value will also be reviewed by searching Retained Marshall Stability

B. Problem Identification

Based on the background above, several problems can be raised as follows.

1. How is the effect utilization Carbon Nano Powder viewed from Marshall Characteristic aspect of Asphalt Concrete Wearing Course ?
2. How is the effect utilization of Carbon Nano Powder viewed from Durability aspect of Asphalt Concrete Wearing Course?

C. Purpose of Research

The objectives that will be achieved in this study are as follows.

1. Analyzing the Marshall Characteristic of Asphalt Mixture utilization Carbon Nano Powder with variation 0 ppm, 200 ppm, 1000 ppm and 2000 ppm
2. Analyzing the Durability of Asphalt Mixture utilization Carbon Nano Powder 0 ppm, 200 ppm, 1000 ppm and 2000 ppm

D. Research Benefits

The benefits that will be obtained from this research are as follows.

1. Providing an understanding of the Marshall Test value, Durability carbon nano powder asphalt mixture
2. Contributing for research references for road pavement application

E. Problem Limitation

The limitations of the problem in this study are as follows.

1. Planned mix asphalt concrete wearing course
2. The physical properties of aggregate and asphalt tested refer to Bina Marga Specification 2018 Division 6
3. The asphalt used is 60/70 PT Pertamina, Cilacap, Central Java
4. The aggregate used comes from PT Selo Progo Sakti Klaten
5. This study used aggregate heating temperature of 200°C and compaction temperature of 140-160°C
6. Asphalt content using variations of 4%, 5%, 6%, 7%, 8%
7. Carbon Nano Powder using variations of 0 ppm, 200 ppm, 1000 ppm and 2000 ppm
8. Value testing using the Marshall Test

G. Originally of Research

This study entitled "**Marshall and Durability Analysis of Asphalt Concrete Wearing Course Utilize Carbon Nano Powder**" is an original research and has never been done by researchers before. Research examining Asphalt Concrete Wearing Course and the use of palm oil waste on road pavements has been carried out including (Aljbouri & Albayati, 2023), (Taherkhani et al., 2017), (Eisa et al., 2022)

H. Similarities and Differences With Previous Research

Here are some similar studies on Asphalt Concrete Wearing Course and nanomaterials conducted previously as in Table 1.1

Table 1.1 Comparison of related studies with previous studies

Researchers	Equation	Difference	Purpose
(Aljbouri & Albayati, 2023) “Investigating the effect of nanomaterials on the Marshall	Using nanomaterials and also analyzing Marshall Properties And Durability	The previously research used nano silica, nano carbonate calcium, nano clay and nano platelets	Research aims to investigate the effect of four nanomaterial types on the Marshall

properties and durability of warm mix asphalt”		but the author use carbon nano powder for the nanomaterial	properties and durability of warm mix asphalt (WMA)
(Taherkhani et al., 2017) “Comparative Study of the Effects of Nanosilica and Zyco-Soil Nanomaterials on the Properties of Asphalt Concrete”	Using Nano Materials and Analyzing Properties of Asphalt Concrete	The previously research used Nanosilica and Zyco-Soil Nanomaterials but the author use carbon nano powder for the nano material. The previously research analyzing Marshall test, indirect tensile strength test, resilient modulus, dynamic creebs, and also comparison of cost and environmental effect. Meanwhile, the author only analyzes Marshall properties and durability.	Research aims to compare their effects on some engineering properties of a typical asphalt concrete, the environmental impact, and the cost. The 60/70 penetration-grade asphalt cement was modified by adding different percentages of nanosilica (1, 3, and 5%, by the weight) and zyco-soil (0.1, 0.3, and 0.5%) content and evaluated using experiments

(Eisa et al., 2022) “Mechanical properties of asphalt concrete modified with carbon nanotubes (CNTs)”	Using Nano Materials and Analyzing Properties of Asphalt Concrete	The previously research used carbon nanotubes for the nanomaterials ,whereas the author use carbon nano powder for the nanomaterial.The previously research analyzing Marshall Properties,ITS,low temperature cracking test,dynamic and stability rut depth and cost analysis	Research aims to analyze mechanical properties of Asphalt Concrete modified with carbon nanotubes
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