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Correlation study of asphalt modulus with asphalt immersion time using of lightweight deflectometer laboratory

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Abstract. During The rainy season, the pavement is submerged by water, which affects the performance, durability, and ability to accept the load on the asphalt. Lightweight deflectometer (LWD) developed for evaluation of surface stiffness can be used to estimate the degree of compaction and produce modulus of elasticity. This research using the laboratory version of the LWD to find the correlation between the modulus of elasticity of asphalt on the variation in the Immersion time. From each immersion time, the highest Elasticity modulus value was decreased when it moved from 6,25% because that value is an optimum condition for asphalt samples.

1. Introduction

During the rainy season, road pavement is submerged by water, which affects the performance of asphalt pavement, especially the problems of durability, durability, and the ability to take the burden. The existence of water, decreased capacity of the sidewalk below it so that the portion of the pavement decreases. As per Road Maintenance Manual Number: 03/MN/B/1983 road damage are grouped into; (1) cracking, (2) Distortion, (3) Surface Defects, (4) Wear and tear, (5) bleeding, (6) Reduction in the former utility planting. In general, the damage that occurs is a combination of various types of damage as a result of multiple interrelated factor [1].

The density, deflection, and elasticity of each subgrade, base layer to asphalt mix layer are essential parameters for designing a road construction. Conventional tests carried out for evaluation and monitoring of roads without cover are, such as Dynamic Cone Penetrometer (DCP), CBR, Plate Bearing Test. One tool for testing and analyzing deflection and elasticity in soil, foundation layers, and asphalt mixture layers is LWD (Light-Weight Deflectometer). Ali Ebrahimi and Tuncer B.E. using tools LWD to analyze deflection and resilient modulus of subgrade covered by a variety of surface materials, namely recycled material from asphalt and which stabilized with conventional natural aggregates [2]. Ch. Nageshwar Rao et al, use LWD to test the elasticity of laterite soils whose surface is 30 cm deep. The flexibility of laterite soils based on the tool LWD is between 25 MPa to 40 MPa [3].

The important thing in the management of a road pavement system is the ability to determine the current condition of a road network and predict its future conditions. Predict pavement conditions correctly; it was used the assessment method for identification. This system is a tool for appraisal personnel in assessing pavement damage. The pavement condition evaluation system or method consists of Dirgolaksono Mochtar method and Bina Marga method. This method often used to evaluate road



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pavement conditions. However, at this time, the commonly used LWD (Light Weight Deflectometer) tool to determine the amount of deflection that occurs in the pavement of the road.

2. Methods

This research was conducted at the Eco Material Research Laboratory Department of Civil Engineering, Faculty of Engineering, Hasanuddin University, Gowa, South Sulawesi and Alusan Laboratories, Ministry of PUPR, Bandung, West Java (Central Road and Bridge). The time of the study conducted in July 2019 to October 2019.

The method of data analysis using laboratory LWD tools, in principle the same as analyzing data using field LWD tools, namely computerized systems. Based on Bousinesq elastic, the relationship between pressure and displacement applied in the soil for the case of rigid or flexible bases located in a semi-elastic space will derive as in the equation (1) [4].

$$E = ((1 - \nu^2) \times \sigma_0 \times a) / d_0 \times f \quad (1)$$

mean:

- E = modulus of elasticity (MPa)
- d₀ = measured decrease (mm)
- ν = Rasio Poisson
- σ₀ = applied voltage (MPa)
- a = plate radius (mm)
- f = form factor depends on the voltage distribution

2.1. The deflection testing procedure

The deflection testing procedure using the LWD tool is based on the deflection test method using Light Weight Deflectometer Pd-03-2016-B, SE Menteri PUPR No/19/SE/M/2016 [5]:

- Put the Light Weight Deflectometer on the test point. The inclination of the coating surface, which can test with LWD is a maximum of 4% or granular layers it is recommended to use a thin layer of sand at the test point. It is to get a uniform contact surface between the loading plate and the coating surface.
- Check the loading plate position and the geophone sensor once again.
- Lift the load at a certain height until it reaches the desired stress level and then drops it, causing an impact load on the loading plate.
- Test at this point a minimum of 2 times. If the differences in testing results 1 and 2 are greater than 3%, record this difference in the report. A third test is needed if this happens.
- For testing on the granular layer, also note the amount of field water content.

3. Results and discussion

3.1. The relationship of modulus of elasticity and asphalt level at the soaking time

From the table below, we found that Immersion Time, the highest Modulus of Elasticity, was obtained at the asphalt content of 6.25%. The modulus of elasticity decreases as it moves away from the 6.25% level. Because at 6.25% asphalt content is an optimum condition for asphalt samples.

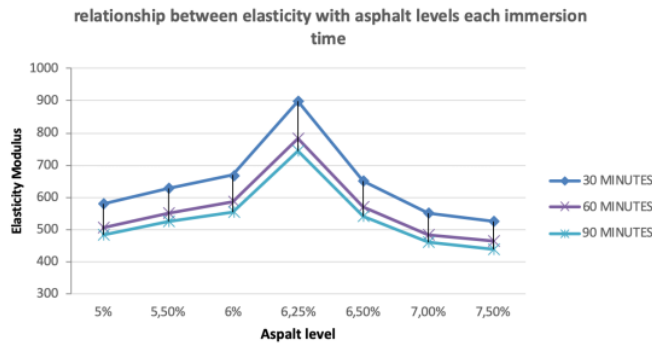


Figure 1. Graph of modulus of elasticity relationship with asphalt levels at each immersion time.

3.2. Relationship of modulus of elasticity and soaking time per asphalt content

From the graph of the relationship of modulus of elasticity with Soaking Time at each asphalt level, it found that at each level of asphalt with variations of Immersion Obtained the highest modulus of elasticity at 6.25%. It happens because at 6.25% is the optimum asphalt content condition so that it has a modulus of elasticity that is better than the others.

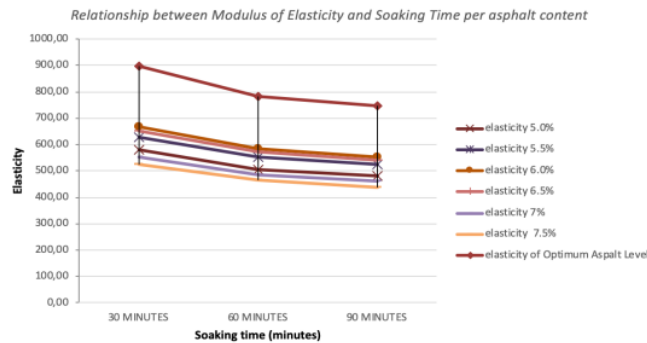


Figure 2. Graph of relationship of modulus of elasticity and soaking time per bitumen level.

3.3. Discussions

Optimum Asphalt Level is an oil asphalt level based on Marshall specific test wherein the variation of asphalt level used is following the adequate asphalt level (SNI 06-2489-1991 asphalt mixture testing method with the Marshall method) [5]. Obtained optimum asphalt or effective asphalt from content variation is 6.25%. When asphalt level 6.25% is a sufficient asphalt level from the total variation of asphalt content wherewith the duration of immersion variation in asphalt content, get asphalt content 6.25 % and immersion 30 minutes the highest number so the longer the immersion time, the lower the strength of the asphalt.

One factor that influences the level of durability of asphalt mixes is the cavity in the mixture (VIM). A small VIM value will make the layer waterproof of the air does not enter the mixture, so the durability value is good, but the asphalt mixture that has been aging will result in more significant cavities in the mixture due to oxidation. The number of cavities in the water mixture, consequently when done immersion water, it will quickly enter and fill cavities in the mixture so that the durability of the mixture decreases. So the longer the immersion has carried out, the lower the durability will be [1].

4. Conclusion

From the results of research LWD testing on AC-WC Asphalt pavement samples and discussion, some conclusions obtained. Based on the result were obtained. *First*, the relationship of modulus of elasticity with Soaking Time at each level of asphalt, it was found that at each level of asphalt with the variation of Immersion given produced the highest modulus of elasticity at 6.25%. It happens because at 6.25% is the optimum asphalt content condition so that it has a modulus of elasticity that is better than the others. *Second*, the highest Modulus of Elasticity value from each immersion time was obtained at asphalt content of 6.25%. Modulus of elasticity decreases when it moves away from 6.25%. this is because at 6.25% asphalt content is an optimum condition for asphalt samples.

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