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ROAD IMPROVEMENT USING RIGID PAVEMENT ON THE TARAKAN CITY ROAD

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Abstract:

The Tarakan City Road is part of the transportation system as a service for infrastructure facilities for the impact of population growth. In order to meet these needs, new pavement planning is needed to serve the traffic needs in the future. Rigid pavement is an arrangement of pavement construction in which a concrete slab is used as the top layer, which is located on the foundation or directly above the subgrade (Bina Marga, 2003). The concept of the design of rigid pavement (cement concrete) using the Bina Marga method is planned for the configuration of the axle load which results in the greatest stress on the slab. The concept of pavement planning using the AASHTO method is that the thickness of the planned plate will increase according to the increase in equivalent traffic during the design life and vice versa, the thickness of the slab will decrease with the reduction of the equivalent traffic volume. Similarly, in the PCA method, the calculation obtained is almost the same as the Bina Marga method, but in determining the LHR of the vehicle, it only calculates the axle load of the truck. Planning of Pavement Concrete Plate Thickness using the Bina Marga, AASHTO, and PCA methods obtained respectively 30 cm, 32 cm, and 29 cm, there is a difference of 1-2 cm, this is due to differences in the basic concepts of each method.

Keywords: Rigid pavement, equivalent load, AASHTO, Bina Marga, PCA.

INTRODUCTION

The road is one of the land transportation infrastructures that have an important role for economic growth, socio-culture, tourism area development, and defense and security to support national development as stated in Law no. 13 of 1980 and in government regulation no. 26 of 1985 (Utamy S. Saputri; Paikun; Fitri Sondang, 2019).

Indonesia is currently experiencing rapid population growth, causing an increase in human activities and needs, resulting in increased human movement, the need for transportation facilities and the growth of traffic flow has increased, causing congestion and road congestion (Aminsyah .M, 2010). This is because the available infrastructure is not able to serve the traffic flow. For this reason, efforts need to be made so that transportation needs can be met properly (Susanto & Nono, 2018).

Indonesia as a developing country faces many obstacles and obstacles in implementing development programs. Barriers and difficulties are caused, among others, by the inadequate condition of infrastructure, especially in the transportation sector. The rapid increase in the socio-economic standard of living has resulted in an increase in mobility which in turn has also increased the number of motorized vehicles (Hermanto, 2016). With the increase in the number of motorized vehicles, it means that the number of repetitions which is a burden on the road pavement also increases. Generally, the damage to a road pavement is not solely caused by

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heavy loads. From the evaluation results of several road pavement planning experts, it is said that the damage to the pavement is caused by the high frequency of repetition of the load (Pengajar, Teknik, Politeknik, Semarang, & Jalan, 2015).

Transportation is one of the supporting facilities in the development of a country, especially the Tarakan area which is developing and has great potential with natural resources. In this case transportation facilities and infrastructure is one of the main factors. For this reason, it is necessary to build an adequate road network in order to be able to provide optimal services in accordance with the required capacity.

In addition to road geometric planning, road pavement is part of road planning that must be planned effectively and efficiently. Rigid pavement construction is a pavement that generally uses a mixture of cement concrete as the surface layer and granular material as the layer underneath. Construction of this pavement layer will protect the road from water damage and traffic loads (Abdjan, Paransa, Lintong, & Monintja, 2013).

Currently, concrete roads are relatively widely used on roads in big cities and in areas with high traffic density. The relatively large vehicle load and the increasingly congested traffic flow are the main reasons for choosing a concrete road (rigid pavement). What's more, its structure is stronger, durable, and maintenance-free (Hardiyatmo & Terpaku, 2016). Concrete roads are a very effective solution for use on Tarakan City roads, due to traffic density and relatively large vehicle loads. From the results of the road inventory carried out, it can be seen that the existing road conditions on the Tarakan City road are categorized as moderate to heavily damaged roads. This can be seen from the amount of peeling asphalt so that the road tends to be potholes. The total length of the planned pavement is 4.96 KM.

Calculation of pavement, in general, includes the thickness and width of the pavement. Calculation of pavement layer thickness can be divided into the rigid pavement and flexible pavement. The thickness of the pavement layer can be calculated in various ways (Tajung, Raya, & Makmur, 2019), including the Bina Marga Method, Indonesia; AASHTO Method, United States of America; PCA Method, Canada; and others.

Because of the many existing methods, the researchers tried to make a comparison of the calculation of the thickness of the pavement layer on the Tarakan City road using three methods, namely the Bina Marga Method (2003), the AASHTO Method (1993), and the PCA Method for road improvement in Tarakan City.

RESEARCH METHOD

Traffic data is the main data needed for road planning because the capacity of the road to be planned depends on the composition of traffic that will use the road on a planned road segment. The amount of traffic volume is needed to determine the number of lane widths in one road lane in determining geometric characteristics, while the type of vehicle is needed to determine the load class or MST (heaviest axle load) which has a direct effect on pavement construction planning (Rahman, Nurhakim, Riswan, Noure, & Joetra, 2017).

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The data collection used is secondary data collection. Secondary data collection was obtained from planning consultants and related agencies, literature studies, and established regulations (Ruas, Haekesak, & Kecamatan, 1997).

In this study, three pavement methods were used to determine the rigid pavement thickness. The three rigid pavement planning methods are Highways Method (2003), AASHTO (1993), and PCA. The steps taken in this planning are to collect some of the data needed to plan the thickness of the pavement on the road (Sunarjono, 2006).

RESULTS AND DISCUSSION

In planning a highway pavement, good knowledge is needed in planning it, both in terms of filling materials for each layer of pavement and also the process of working on the highway pavement structure (Munggarani & Wibowo, 2017). Everyone can plan a highway pavement with the assumptions as desired, but the pavement design does not necessarily provide the results desired by the planners both in terms of the ability of the pavement to withstand vehicle loads and pavement resistance from damage (failure) (Setiawan & Pradani, 2013). Road pavement is a mixture of road layer filling material with a binder as an adhesive between the particles of the material to form a solid layer to support the load on the pavement (Imron et al., 2021).

Rigid pavement according to the Bina Marga method includes several very important elements, including determining the CBR assessment of the subgrade first, estimating the distribution of commercial vehicle axes and the type/axle load, determining or selecting the type of subbase, determining the effective CBR, selecting using concrete shoulders or not, determines the factor of safety for the FKB load (Widodo & Hakim, 2014).

There is a rigid pavement plan that requires accuracy in data collection and in determining parameters in accordance with applicable regulations. The data are obtained from the results of field tests which are then developed in the laboratory (Anugerah, 2019). The results of the CBR survey data were obtained from the results of the DCP and CBR tests which were correlated from the sondir test taken from the soil investigation report along the Tarakan road section. The rigid pavement design parameter according to AASHTO (1993), is related to the problem of the Resilient Modulus (MR) of the design subgrade = 4000 psi, which is obtained from the CBR value of the subgrade = 3.1% (Pengisi et al., n.d.). And other parameters can be seen directly in the rigid pavement calculation formula below. In the calculation of ESAL 18-kip rigid pavement method AASHTO (1993) has accommodated the tridem axis (3 axes) (Saleh, Sofyan M, 2009).

Rigid pavement according to the PCA method includes the following parameters which are very important and must first be known including the type of connection and the road shoulder, the flexural strength of concrete (MR) at the age of 28 days, the value of the constant (k) subgrade or a combination of subgrade and subbase, safety factor load (LSF), axle load distribution and repetitions that occur. Then proceed with Fatik analysis (to control “fatik”

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cracks) and erosion analysis (to control erosion of foundations, road shoulders, and pipes) (Thamrin & Madya, 2018).

CONCLUSION

In the design of rigid pavements using the Bina Marga method (2003), the thickness of the road pavement concrete slab is obtained, namely: The thickness of rigid pavement is 30 cm, adjusted to the calculation of the pavement thickness of Bina Marga (2003). Lean concrete is 15 cm thick, and base A is 15 cm thick.

With the AASHTO method (1993) the thickness of the road pavement concrete slab is obtained, namely: 32 cm rigid pavement thickness, adjusted for the AASHTO (1993) pavement thickness calculation. Lean concrete is 15 cm thick, and base A is 15 cm thick.

With the PCA method, the thickness of the road pavement concrete slab can be obtained, namely: The thickness of the rigid pavement is 29 cm, adjusted to the calculation of the thickness of the PCA pavement. The thickness of the subbase is 15 cm.

In the Bina Marga method, the thickness of the rigid pavement or the thickness of the cement-concrete pavement obtains the thinnest thickness which results in the total fatigue damage and/or erosion of 100%. The AASHTO method of rigid pavement thickness is obtained from calculations with the control value of W18 (axle load) must be greater than the CESA (Cummulative Equivalent Standard Axle) value. The AASHTO pavement design method found that the thickness of the pavement slab will increase according to the equivalent traffic growth during the design life, otherwise, the thickness of the slab will decrease with the reduction of the equivalent traffic volume. Similarly, in the PCA method, the calculation obtained is almost the same as the Bina Marga method, but in determining the vehicle LHR, it only calculates the axle load of the truck. So it was found that the Bina Marga method is a more efficient and economical method to be used in road pavement planning because the calculations made are in accordance with or close to Indonesian regional conditions.

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