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Analysis of the Calculation of Rigid Pavement Thickness on Jalan Guyangan - Simpang Empat Candi

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A B S T R A C T

There are several factors that need to be considered in road development planning, such as soil structure, traffic conditions, rainfall, and drainage networks. These things need to be considered because they affect the quality of the road. The road guyangan – simpang empat candi is the main road with a flexible pavement structure. The structure is deemed not suitable for a load of passing vehicles. In terms of these conditions, it is necessary to change the pavement structure to the rigid pavement. The rigid pavement itself is an arrangement of road pavement structures which on the top layer uses cement concrete plates. This study aims to plan the thickness of the rigid pavement, the characteristics of the concrete, and the required budget. The method used to plan is by using the 2017 revised road pavement design manual method. The calculation results obtained concrete with quality class III with 28 days of compressive strength of 350 kg / cm2, the thickness of concrete slab 305 mm with details of the cost of Rp. 12,746,095,600.00 (Twelve billion seven hundred forty-six million ninety-five thousand six hundred rupiahs).

INTRODUCTION

Roads are a means of land transportation that covers all aspects including complementary building facilities and equipment, both above and below ground level [1]. Apart from being a medium for road transportation it also functions to advance the tourism and education sectors [2][3]. As a means of connecting between regions, roads also have an important role, namely as a means of transportation for the economy[4]. Therefore, it is

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necessary to have proper and careful planning for either the construction of the old road or the new road [5].

The Guyangan - Simpang Empat Candi road section has a length of 7,730 km which was previously a regional road turned into a provincial road and according to its function the road is a collector road. This is in accordance with the decision issued by the Governor of East Java number: 188/128 / KPTS / 013/2016 dated 12 February 2016 [6]. From the results of the survey that was carried out on these roads, there were many locations that were damaged, ranging from minor to severe damage[7]. The damage was caused by several factors including the unstable soil structure because it was in a rice field area with the characteristics of the soft soil [8], the absence of an adequate drainage network, the construction of the pavement layer does not meet the standards and the passing vehicles exceed the required double pressure so that congestion and even accidents often occur [9].

Judging from the road pavement construction used, namely flexible pavement, of course it is not in accordance with the conditions and traffic loads that pass so it is necessary to change the pavement construction that supports the soil structure on the road[10]. In accordance with field conditions for Jalan Guyangan - Simpang Empat Candi Section, the East Java Provincial Government plans to change the road structure using rigid pavement (Rigid Pavement). [11].

Several similar studies have been carried out before, including research conducted by Andika F. Lukman, Dessy Triana, and Meassa M. Sari, entitled "Rancangan Tebal Perkerasan kaku Jalan Lingkar Selatan Kota Cilegon,". From this research, it is concluded that to analyze the thickness of the pavement, supporting data is needed in the form of direct (primary) data, which is data obtained from field surveys and indirect (secondary) data is data obtained from government agencies, contractors and consultants. [12] Similar research was also carried out by Ida Hadijah and Dian Nafi Surya Putra, with the title "Analisa kerusakan perkerasan jalan ditinjau dari daya dukung tanah dan volume lalu lintas," the required load and carrying capacity of the soil (subgrade) is not good (for the CBR value of subgrade should not be less than 6%)[13].

Referring to the problems that have occurred as well as several studies that have been carried out, research will be carried out on the thickness of the pavement and the type of concrete quality required during the design life and how much is the cost required on Guyangan - Simpang Empat Candi road.

Rigid Pavement

According to the Ministry of PUPR, "Perencanaan Perkerasan Jalan Beton semen," explains that rigid pavement is a structure consisting of cement concrete plates that are

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continuous (not continuous) without or with reinforcement, or continuous with reinforcement, located above the sub-base layer or subgrade, without or with paved surface coating [14].

In conducting rigid pavement analysis, there are several parameters that must be considered, including:

1) Design Life

The design life is the amount of time in years, which is calculated from the time the road was opened to the time that major repairs or reconstruction were needed [15]. Meanwhile, the design life for rigid pavement is planned for 40 years [16], as shown in Table 1 below:

Table 1. Design life of road pavement

Type Pavement	Pavement Element	Design Life (year)
	Asphalt layer and grained layer.	20
	Road foundations	
Flexible	All pavements for areas that are not	
Pavement	overlay is possible, such as:	
	urban, underpass, bridge, road	40
	tunnel.	
	Cement Treated Based (CTB)	
Rigid	Top foundation layer, base foundation layer, layer	
Pavement	cement concrete, and road foundations.	
The Road	All elements (including the road foundation)	Minimum 10
Without Cover		

Source: Manual Desain Perkerasan Jalan Revisi (2017)

2) Traffic Growth

Traffic growth is the increase in the volume of traffic every year according to the plan age or to the stage where road capacity is achieved [14]. Traffic growth during the plan life is calculated using the cumulative growth factor [16]:

$$\boldsymbol{R = \frac{(1+0{,}01i)^{UR}-1}{0{,}01i}}$$

In Eq:

R : Cumulative traffic growth multiplier factor.

i : Annual traffic growth rate (%).

UR : Design Life (year).

3) Traffic on the planned lane

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The planned lane is one of the traffic lanes from the road that accommodates the largest vehicle traffic (trucks and buses), the traffic load on the planned lane is expressed in the cumulative standard axle load (ESA) taking into account the direction distribution factor (DA) and lane distribution factor (DL)[17]. The Guyangan - Simpang Empat Candi road. is a two-way street, with a general direction distribution factor (DA) of 0.50 while the lane distribution factor (DL) is 80 as can be seen in Table 2.

Table 2. Lane distribution factors (DL)

Number of Lanes per direction	Commercial vehicles on the design line (% of commercial vehicle population)
1	100
2	80
3	60
4	50

Sumber : Manual Desain Perkerasan Jalan Revisi (2017)

4) Cumulative standard axle load

The cumulative standard axle load is the cumulative sum of the design traffic axle loads on the design lane over the design life, using the following equation:

$$(\mathbf{ESA_{TH-1}}) = \left(\Sigma \mathbf{LHR_{JK} x\ VDF_{JK}}\right) \mathbf{x\ DA\ x\ DL\ x\ R\ x\ 365}$$ [16]

In Eq :

(ESA_{TH-1}) : Cumulative load over the design life.

LHR_{JK} : Average daily traffic per vehicle type (per day).

VDF_{JK} : Load Equivalent Factor (Vehicle Damage Factor) for each type of vehicle.

DA : Directional distribution factor.

DL : Lane distribution factor.

R : Multiplier factor for cumulative traffic growth

365 : The number of days during the year

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Table 3. The heaviest vehicle axle group values.

Type Vehicle	Name Vehicle	Axis Group	The cargo carried
5B	Big Bus	2	
6A	Truck 2 Axis	2	general cargo (earth, sand, iron, cement)
6B	Truck 3 Axis - Light	2	general cargo (earth, sand, iron, cement)
7A	Truck 3 Axis - Medium	2	general cargo (earth, sand, iron, cement)
7B	Truck 4 Axis - Trailer	4	
7C	Truck 5 Axis - Trailer	5	

Sumber : Manual Desain Perkerasan Jalan Revisi (2017)

5) Desain perkerasan kaku (rigid pavement)

According to PBI, (1971) concrete for construction is divided into quality and class as in **Table 4** below: [18]

Table 4. Class and quality of concrete

Class	concrete quality	σ'_{bk} (kg/cm2)	σ'_{bm} dg.s=46 (kg/cm2)	Purpose	Supervision of	
					aggregate quality	compressive strength
I	B0	-	-	non-struktur	Light	without
II	B1	-	-	structure	moderate	without
	K 125	125	200	structure	strict	continuous
	K 175	175	250	structure	strict	continuous
	K 225	225	300	structure	strict	continuous
III	K>225	> 225	> 300	structure	strict	continuous

Sumber : PBI, (1971)

The thickness of the concrete slab pavement can be determined based on the axle group of the vehicle with the heaviest traffic load, as in **Table 5** below: [16]

Table 5. Design of rigid pavements with heavy traffic loads

Pavement structure	R1	R2	R3	R4	R5
Heavy vehicle axle group *(overloaded)(10E6)*	<4.3	<8.6	<25.8	3	<86
Dowels and concrete shoulders	YA				
PAVEMENT STRUCTURES (mm)					
Concrete slab thickness	265	275	285	295	305
LMC foundation layer	100				
Drainage layer (can drain well)	150				

Sumber : Manual Desain Perkerasan Jalan Revisi (2017)

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6) Analysis of construction costs

Construction cost analysis is a method of calculating the unit price of construction work, which is described in the multiplication of the index for building materials, work wages, and work equipment with the price of building materials, work wage standards, rental prices for work equipment to complete construction work per unit [19].

The size of the budget can be seen from the planned design drawings as well as the price of basic benefits that have been set by the government both the unit price of wages, materials and equipment, so that for each region it will vary according to the provisions set by the local government, in general the unit price basic (HSD) can be formulated as follows:

HS. Basic = HS. Material + HS. Wage + HS. Equipment [20]

*HS is Unite Price

To analyze the construction cost budget, both materials and equipment must comply with general specifications, namely the procedures and rules for the implementation of construction work both roads and bridges so that the quality of work can be controlled [21], Meanwhile, to determine or calculate the amount of each work volume required design drawings that have been defined in the planning .

RESEARCH METHODS

To analyze the thickness of rigid pavement, the author uses the 2017 Revised Road Pavement Design Manual method, with observational data obtained from the results of traffic surveys (LHR) which aims to determine the level of traffic density, both light vehicles to heavy vehicles so that the pavement thickness and concrete quality values can be determined. Used [11][22].

Meanwhile, to analyze the amount of construction costs used by the author refers to the Indonesian National Standard (SNI 7394: 2008) with supporting data obtained from project implementation documents in the form of design drawings, road maps (location) and existing road data, all of which data is taken. in order to get the volume of work which will then be stated in the basic unit price (HSD) [23] [24][20] [25].

Deskripsi dan Teknis Penelitian

In this study, the description and technical research that the author conducted can be explained as follows:

1) Population and Sample.

The population in this study is located on the guyangan-intersection of four temples road which consists of several research objects, including: the type of road pavement, the

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carrying capacity of the soil and the average daily traffic (LHR), from the object of this research several samples can be taken to be carried out [26].

2) Sampling technique.

In this study, sampling was carried out sequentially, firstly by testing the bearing capacity of the subgrade by conducting a DCP test to obtain the CBR value of the foundation layer on the concrete slab, secondly conducting a traffic survey to determine how much axle load was passing on the road so that it could be the applicable pavement type and thickness are determined.

3) Definition of Operating Variables.

The variable definition applied in this study uses the dependent variable where to get the type and thickness of rigid pavement, the variable used is the axle load of the type of vehicle that crosses the four temples to determine the thickness and characteristics. concrete used during the design life.

4) Analysis tools

- Stopwatch is used to measure each alternate time period when the vehicle passes.
- Hand counter is used to count the number of vehicles passing the road according to the type of vehicle.
- Dynamic Cone Penetrometer (DCP) / CBR is used to determine the state of the subgrade (soil bearing capacity).
- The meter is used as a measuring tool in conducting research to determine the exact dimensions / geometry of the road sections, either the length or width of the road.
- Digital cameras are used as equipment to take image subjects (photos) for documentation in research.
- Work format or research form
- Writing tools to record research results

5. Data Analysis Technique.

To obtain data in accordance with the problem under study to be discussed, the researchers used data collection techniques as follows:

a. Literature study

Studying and seeking information about rigid pavement thickness planning theory either directly or indirectly.

b. Data collection analysis

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Data collection is in the form of data taken directly from the field (primary data) and data that is not taken directly from the field but data that already exists, both from contractors, consultants and from government agencies (secondary data).[27]

c. Analysis data processing

Primary data is in the form of average daily traffic survey data (LHR) and CBR data value to determine the nature of the soil bearing capacity and HSD Base Unit Price data as reference data for determining the Cost Budget Plan (RAB). Meanwhile, secondary data is only used as supporting data in research which is to strengthen and complement existing data in the field [27].

d. Result

For pavement structure thickness planning and concrete quality, it starts with determining the design life period, calculating the average daily traffic (LHR), determining the axle load value based on the axle group of each vehicle during the design life so that the pavement layer thickness and concrete quality can be found. which is planned, from the calculation results in the form of either data or images [16] it will be known how much the budget will be required [28].

RESULTS AND DISCUSSIONS

Pavement Thickness Determination

To determine the thickness of the pavement on the guyangan-intersection of four temples road, calculations are carried out with the following description:

a. Design Life

The design life is in accordance with the Revised Road Pavement Design Manual method (2017) for the type of rigid pavement for 40 years (**Table 1.).**

b. Daily Traffic Calculations

Daily traffic calculations are carried out on all vehicles for 7 days with time intensity, namely morning between 02.00-10.00 WIB, afternoon between 10.00-15.00 WIB, afternoon between 15.00-21.00 WIB, and evening between 21.00-01.00 WIB. then in one day thenumber

of vehicles is accumulated as presented in **Table 6.** below:

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Table 6. Number of Vehicles by Vehicle Type

No.	Type	Name	Day							Amount
	Vehicle	Vehicle	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	LHR/day
1	1	Motorcycle	8567	8563	8534	8541	8496	8542	8425	**8524**
2	2,3	Sedan, Jeep, Wagon	2540	2451	2356	2472	2358	2356	2451	**2426**
3	4	Pick up, delivery car	1456	1523	1456	1453	1358	1398	1423	**1438**
4	5A	Small Bus	100	98	102	110	80	95	101	**98**
5	5B	Big Bus	425	475	462	456	400	410	454	**440**
6	6A	Truck 2 Axis	4426	4102	4235	4300	4258	4302	4251	**4267**
7	6B	Truck 3 Axis - Light	4856	3542	3563	3500	3521	3500	3242	**3674**
8	7A	Truck 3 Axis - Medium	3564	2614	2471	2750	2435	2684	2124	**2663**
9	7B	Truck 4 Axis - Trailer	1756	1564	1689	1845	1541	1796	1345	**1648**
10	7C	Truck 5 Axis - Trailer	1542	1548	1565	1623	1536	1574	1423	**1544**
	Amount		**29232**	**26480**	**26433**	**27050**	**25983**	**26657**	**25239**	
	LHR/12 Hour		**2436,00**	**2206,67**	**2202,75**	**2254,17**	**2165,25**	**2221,42**	**2103,25**	
	Average/Day					**2227,07**				
	Average//100%					**22,27**				
	Average//tahun					**6,10**				

Source: Calculation results

As the data in Table 6 above is obtained from the results of the survey, where every passing vehicle is recorded and recorded every day according to the type and name of the vehicle then from the total amount of data on the average per day so that it is known how much daily average traffic passes on the road.

c. Traffic growth

The annual traffic growth, with the exponential method can be calculated from the value of LHRT, LHRo and design age (n) with the formula:

LHRT = LHRo (1 + i) n

Where:

LHRT = LHR at the end of the design life

LHRo = LHR at the beginning of the design life

(n) = design age (years),

i = growth rate.

By referring to the results of the previous year's traffic survey with the results of the current survey, the growth value (i) can be seen as shown in the following calculation table:

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Table 7. Data on Traffic Analysis Results

No.	Type Vehicle	Name Vehicle		EMP	LHR 2018		LHR 2019	
					Vehicle	smp	Vehicle	smp
1	1	Motorcycle	LV	1	6582	6582	8524	8524
2	2,3	Sedan, Jeep, Wagon	LV	1	1546	1546	2426	2426
3	4	Pick up, delivery car	LV	1	1045	1045	1438	1438
4	5A	Small Bus	LV	1	85	85	98	98
5	5B	Big Bus	HV	1,3	425	552,5	440	572
6	6A	Truck 2 Axis	HV	1,3	3245	4218,5	4267	5547,1
7	6B	Truck 3 Axis - Light	HV	1,3	2895	3763,5	3674	4776,2
8	7A	Truck 3 Axis - Medium	HV	1,3	2498	3247,4	2663	3461,9
9	7B	Truck 4 Axis - Trailer	HV	1,3	1023	1329,9	1648	2142,4
10	7C	Truck 5 Axis - Trailer	HV	1,3	986	1281,8	1544	2007,2
		Amount Vehicle			**LHRo =**	**23651,6**	**LHRT =**	**30992,8**
		Traffic growth rate (i%)						**3,10%**

Source: Calculation results

From the calculations in **Table 7**, the value of the traffic growth rate is 3.10%

d. Cumulative Growth Factor (R)

Because there is a difference in the annual growth rate over the total design life (UR) of 40 years, with i1% during the first period (UR1 year) and i2% during the remainder of the following period (UR - UR1), the cumulative traffic growth multiplier can be calculated as formula as follows:

$$R = \frac{(1 + 0{,}01i)^{UR} - 1}{0{,}01i}$$

$$R = \frac{(1 + 0{,}01 \text{ x } 3{,}10)^{40} - 1}{0{,}01 \text{ x } 3{,}10}$$

$$R = 77{,}1338$$

So with the traffic growth (i) of 3.10%, it can be seen that the cumulative growth factor (R) is 77.1338.

e. Traffic on the planned lane

As explained in sub-chapter 2.1.3 above, the direction distribution factor (DA) is generally 0.50 and the lane distribution factor (DL) is 80 (**Table 2.)**

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f. Calculation of the cumulative standard axis load value over the design life

The value of the vehicle axle load during the design life can be determined based on the number of axle groups for each vehicle as the calculation is presented in **Table 8.**

Source: Calculation results

Table 8. Vehicle cumulative axis load

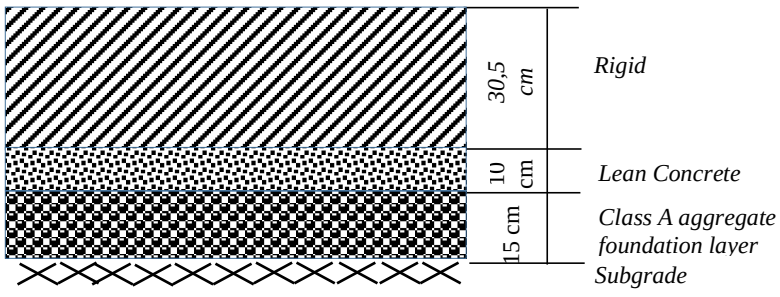
Type Vehicle	Name Vehicle	Axis Group	LHR 2018	Axis Group 2018	DA	DL	R	Group 2019 - 2059
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
5B	Big Bus	2	425	850	0,5	0,8	77,13377301	9,5723E+06
6A	Truck 2 Axis	2	3245	6490	0,5	0,8	77,13377301	7,3087E+07
6B	Truck 3 Axis - Light	2	2895	5790	0,5	0,8	77,13377301	6,5204E+07
7A	Truck 3 Axis - Medium	2	2498	4996	0,5	0,8	77,13377301	5,6263E+07
7B	Truck 4 Axis - Trailer	4	1023	4092	0,5	0,8	77,13377301	4,6082E+07
7C	Truck 5 Axis - Trailer	5	986	4930	0,5	0,8	77,13377301	5,5519E+07
		Cumulative group of axis 2019 - 2059						**3,0573E+08**

Where:

Axis group 2018 = Axis group x LHR 2018

Number of axis groups = Axis groups 2018 x DA x DL x R x 365

From **Table 8.** above the cumulative number of vehicle axle groups during the design life of 3.0573 x 10^8, including in the category R5, the thickness of the concrete slab is 305 mm (**Table 5.)** with overload, it can be categorized as Class III quality concrete which using a concrete quality above K225 (**Table 4**), while for highways with heavy traffic it is recommended to use a 28-day concrete compressive strength of 350 kg / cm^2.



Source: Road Planning Design Drawings

Figure 1. Thickness of Rigid Pavement Design

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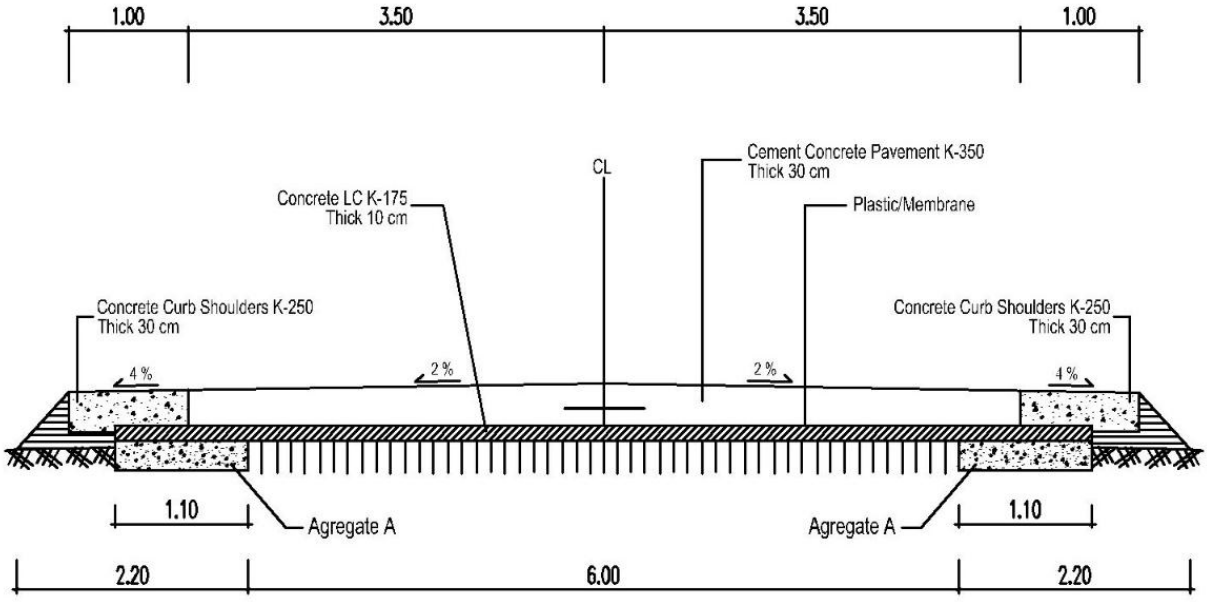
Analysis of the Construction Cost Budget Plan

To analyze the amount of the cost budget, supporting data is needed in the form of: work drawings (designs), the basic unit price of wages, materials and tools and work unit price analysis, then it can be stated in the calculation table of work unit price coefficient analysis, from the results of these calculations will be it is known how much the unit price of each work item is planned.

The size of the cost budget is also influenced by the size of the work volume, while calculating the volume of work can be obtained from the planned design drawing (Shop Drawing), with the following technical data:

- The length of the road is 2600 meters.
- The width of the road is 7 meters.
- Thickness of pavement (Rigid) 30.5 centimeters.
- The left and right shoulders are 1 meter wide, 30.5 centimeters thick.
- Lance Concrete 8.20 meters wide, 10 centimeters thick.

As shown in **Figure 2.** below:



Source: Road Planning Design Drawings

Figure 2. Cross-section

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On Jalan Guyangan - the intersection of four temples, there are two bridges, each of which is a bridge along with a bridge oprit of 2 x 60 meters = 120 meters which is not done using rigid pavement, so the total length of the road is:

P = 2,600 meters - 120 meters

= 2,480 meters

Table 9. Calculation of work volume

No.	Description	Unit	Long (m)	Wide (m)	Depth (m)	Volume (m3)
1	Low quality concrete pavement f'c=14,5 MPa (K175)	m^3	2.480,00	8,20	0,10	2.033,60
2	Medium quality concrete pavement f'c = 21,7 MPa (K250)	m^3	2.480,00	2,00	0,305	1.512,80
3	High quality concrete pavement f'c = 31,2 MPa, (K350)	m^3	2.480,00	7,00	0,305	5.294,80

Source: Calculation results

From the data in **Table 9,** the volume of each work item is obtained from the multiplication result of the length, width and thickness of the concrete which is then used as a reference in calculating the budget planning (RAB).

Table 10. Calculation of the Budget Plan

No.	Description	Unit	Work Volume	Unit Price (Rp.)	Amount Price (Rp.)
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)=(4)x(5)**
1	Low quality concrete pavement f'c=14,5 MPa (K175)	m^3	2.033,60	1.178.983,67	2.397.581.198,08
2	Medium quality concrete pavement f'c = 21,7 MPa (K250)	m^3	1.512,80	1.254.133,44	1.897.253.063,21
3	High quality concrete pavement f'c = 31,2 MPa, (K350)	m^3	5.294,80	1.377.299,49	7.292.525.353,79
A.	Amount				11.587.359.615,08
B.	Value Added Tax (VAT) 10% x (A)				1.158.735.961,51
C.	Sum of Total Price (A) + (B)				12.746.095.576,59
	Rounded off				**12.746,095.600,00**
In number					
Twelve billion seven hundred forty-six million ninety-five thousand six hundred rupiah					

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Source: Calculation results

From the calculation table above, it can be seen that the amount of the cost budget required by adding up the multiplication result between the volume of work and the unit price of each work item plus a Value Added Tax (VAT) of 10%.

CONCLUSION

From the analysis and calculations in the discussion it can be concluded as follows:

1. From the average daily traffic data obtained and the configuration of the axles based on the type and load of the vehicle including rigid pavement with heavy traffic, it can be categorized as class III quality concrete using concrete qualities above K225, for roads with heavy traffic it is recommended using 28-day concrete compressive strength of 350 kg / cm2, the thickness of the concrete plate is 30.5 centimeters.
2. The amount of the construction cost budget depends on the volume of work planned, in this study the authors only calculate the total budget for concrete work (rigid), from the calculation it requires a cost of Rp. 12,746,095,600.00 (Twelve billion seven hundred forty-six million ninety-five thousand six hundred rupiah).

Suggestion

In the implementation of rigid pavement, the quality of the concrete must be considered carefully. This is so that it is in accordance with the requirements, namely the quality of concrete for 28 days with a compressive strength of 350 kg / cm2 that does not experience damage when the vehicle load is planned. For concrete quality testing it is recommended to be carried out periodically, not having to wait for the age of the concrete for 28 days so that the implementation can be controlled. Meanwhile, budget planning and implementation time must be well planned so that construction is carried out on time and in terms of costs so that it is more efficient.

References

[1] Kepres, “Undang-Undang Republik Indonesia Nomor 38 Tahun 2004 Tentang Jalan,” 2004.

[2] Sistem Transportasi Nasional No. 49 Tahun, “Sistranas No. 49 tahun 2005,” 2005.

[3] L. J. dan A. J. Kepres, “Kepres Undang-Undang Tentang Lalu Lintas dan Angkutan Jalan,” vol. 2, no. 5, p. 255, 2009.

[4] E. Wibisono, “Analisa Dampak Lalu Lintas Jalan Tambak Osowilangun Akibat

https://doi.org/10.30736/cvl.v2i2

ISSN (*Online*) 2503 - 2399
ISSN (*Print*) 2503-2399

Pembangunan Teluk Lamong Surabaya," *UKaRsT*, vol. 4, no. 1, p. 69, 2020, doi: 10.30737/ukarst.v4i1.690.

[5] E. Gardjito, "STUDY PERENCANAAN GEOMETRIK, PERKERASAN JALAN DAN PERENCANAAN ANGGARAN BIAYA PADA JALAN RAYA KALIDAWIR – Ds. NGUBALAN Kec. KALIDAWIR," *UKaRsT*, vol. 1, no. 2, p. 11, 2017, doi: 10.30737/ukarst.v1i2.264.

[6] SK Gubernur Jawa Timur, "Nomor : 188/128/KPTS/013/2016 Tentang Penetapan Ruas-Ruas Jalan Menurut Statusnya sebagai Jalan Provinsi," 2016.

[7] E. Wibisono, "Analisis Kinerja Simpang Bersinyal di Simpang Papar Untuk Perencanaan Jalan Tol Kertosono-Kediri," *UKaRsT*, vol. 3, no. 2, p. 23, 2019, doi: 10.30737/ukarst.v3i2.492.

[8] T. W. Suroso, "Faktor-Faktor Penyebab Kerusakan Dini Pada Perkerasan Jalan," *Puslitbang Jalan dan Jemb.*, vol. 1, pp. 2–3, 2008.

[9] A. S. Baginda Oloan Lubis, "Analisis Penyebab Kerusakan Jalan Serta Desain Ulang Tebal Perkerasan Kaku Dengan Menggunakan Metode Manual Desain Perkerasan Jalan (Studi Kasus : Jalan Jenderal Sudirman, Desa Api-Api, Kec. Bandar Laksamana)," *Apl. Virtual Museum Sej. Istana Siak Sri Indra Pura Sebagai Media Promosi Dan Pelestarian Sej.*, vol. 2003, no. 2018, pp. 256–265, 2016.

[10] B. A. Harsono, S. Winarto, and Y. Cahyo, "PERENCANAAN PENINGKATAN JALAN PADA RUAS JALAN PACITAN-NGADIROJO," *Jurmateks*, vol. 1, no. 2, pp. 291–302, 2018, doi: http://dx.doi.org/10.30737/jurmateks.v1i2.416.

[11] Departemen Pekerjaan Umum, "Highway Capacity Manual Project (HCM)," *Man. Kapasitas Jalan Indones.*, vol. 1, no. I, p. 564, 1997.

[12] A. F. Lukman and M. M. S. Triana, Dessy T, "Rancangan Tebal Perkerasan kaku Jalan Lingkar Selatan Kota Cilegon," *CIVTECH*, pp. 1–14, 2003.

[13] D. Hadijah, I, Putra, "Analisa kerusakan perkerasan jalan ditinjau dari daya dukung tanah dan volume lalu lintas (," *Tapak*, vol. 7, no. 1, pp. 64–69, 2017.

[14] [Kementerian PUPR]. Kementerian Pekerjaan Umum dan Perumahan Rakyat, "Perencanaan Perkerasan Jalan Beton Semen," p. 52, 2003.

[15] L. O. Nanang, M. T. Azikin, S. N. Ahmad, and F. R. Rustan, "Analisis Tinjauan Perencanaan Tebal Perkerasan Kaku (Rigid Pavement) Dengan Metode Manual Desain Perkerasan 2017 (MDP 2017)," vol. 8, pp. 71–78, 2020.

[16] Dirjen.Bina.Marga, "Manual Desain Perkekrasan Jalan Revisi 2017 di Lingkungan Direktorat Jenderal Bina Marga," 2017.

ISSN (*Online*) 2503 - 2399
ISSN (*Print*) 2503-2399

[17] F. Andriansyah P, S. Winarto, Y. C. Setianto Poernomo, and A. I. Candra, "Analisa Tebal Perkerasan Lentur Pada Rencana Peningkatan Jalan Ruas Legundi – Pertigaan Bunder," *J. Manaj. Teknol. Tek. Sipil*, vol. 2, no. 2, p. 322, 2019, doi: 10.30737/jurmateks.v2i2.541.

[18] *Peraturan Beton Bertulang indonesia*. 1971.

[19] H. Prasetiyo, Y. C. S. Poernomo, and A. I. Candra, "Studi Perencanaan Perkerasan Lentur Dan Rencana Anggaran Biaya," *Jurmateks*, vol. 3, 2020.

[20] Permen PU, "Analisis Harga Satuan Pekerjaan (AHSP) Bidang Umum," 2016.

[21] Kementrian.PUPR, "Spesifikasi Umum." 2018.

[22] A. Setiawan, "Studi penentuan nilai ekivalensi mobil penumpang (emp) berbagai jenis kendaraan pada ruas jalan utama di kota palu," *J. Rekayasa dan Manaj. Transp.*, vol. I No. 1, pp. 16–26, 2011.

[23] Y. A. M. Christiani C. manubulu, Dantje A.T.Sina, "Analisa Indeks Biaya Untuk Pekerjaan Beton Bertulang dengan menggunakan Metode SNI 7394-2008 dan Lapangan (Studi Kasus pada Proyek Pembangunan Asrama STIKES CHMK Tahap III)," *J. Tek. Sipil, Vol. II. No. 1, April 2013*, vol. II, no. 1, 2013.

[24] B. S. SNI 7394, "Tata cara perhitungan harga satuan pekerjaan beton untuk konstruksi bangunan gedung dan perumahan," 2008.

[25] P. Jalan, K. Di, and F. Anderson, "Perbandingan Estimasi Biaya Antara Metode BOW , Metode SNI , Metode AHSP Pada Proyek Desa Simpang Dolok," pp. 636–646, 2019.

[26] S. Zohri, W. Sutrisno, and A. Priyanto, "Analisis Tebal Perkerasan Kaku Pada Jalan Tol Pasuruan – Probolinggo Berdasarkan Metode Bina Marga (Manual Desain Perkerasan 2017) Dan AASHTO (1993)," vol. l, no. 1993, pp. 33–41, 2018.

[27] S. Ps, M. Warman, and I. Farni, "Perencanaan Perkerasan Kaku (Rigid Pavement) Pada Ruas Jalan ' Batas Kota Padang – Simpang Haru ' Planning Roughness Stiff (Rigid Pavement) on the Road ' Limits of Padang City – Simpang Haru ,'" 2003.

[28] Kementrian.PUPR, "Tentang pedoman Analisis Harga Satuan Pekerjaan Bidang Pekerjaan Umum," 2016, doi: 10.1017/CBO9781107415324.004.

https://doi.org/10.30736/cvl.v2i2