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ANALISIS TIMBUNAN RINGAN MORTAR BUSA MENGGUNAKAN MESIN KONVERSI ENERGI PADA PROYEK FLY OVER

Bilhan Gamaliel[1]

[1)]Department of Mechanical Engineering, Faculty of Engineering, Krisnadwipayana University
Email : bilhan.gamaliel.h@unkris.ac.id

ABSTRACT

The relatively high population growth rate as a result of the development in South Tangerang City has caused traffic jams during rush hour at the Gaplek intersection. This congestion can be minimized by constructing a Martadinata flyover without disturbing the existing transportation movements. Heap construction is often faced with several problems, including stability and reduction problems due to the weight of the pile load, due to vehicle traffic loads, and due to being above soft soil layers. This study aims to obtain the magnitude of the carrying capacity of the subgrade under light weight foam mortar, to obtain the amount of stability and reduction of light weight foam mortar to soft soil behavior. Comparative research to get a comparison between manual calculation and finite element calculation method plaxis 8.2 software. The results of the bearing capacity of the soil under lightweight foam mortar at a soil depth of 1.5 meters and 10 meters, the soil bearing capacity is 366,481 kN/m2 and 376,295 kN/m2. The stability results of the lightweight foam mortar pile above the soft soil layer due to the weight of the pile load of 3.52 and 12.53 due to vehicle traffic loads of 3.05 and 9.54 have met the minimum safety factor requirements for road class 1 of 1.4. The results of the reduction of light weight foam mortar are above the soft soil layer due to the weight of the embankment load of 11.91 mm year and 12.61 mm/year, due to vehicle traffic loads of 15.25 mm/year and 20.06 mm/year. meet the criteria for road embankment reduction of 20mm/year. So it can be concluded that the foam mortar stockpile at the Martadinata Pamulang Tengerang Selatan flyover has met the requirements in the technical planning guidelines for lightweight foam mortar pile on soft soil.
Keywordss: flyover, embankment, foam mortar, stability, settlement, conversion energy machine

INTRODUCTION

The relatively high rate of population growth as a result of development in South Tangerang City creates its own problems in terms of providing services needed by the community in the infrastructure sector at Simpang Gaplek, which experiences traffic jams during morning and evening rush hours until evening.

This requires improvements in transportation facilities and infrastructure services, both roads and bridges, so that this congestion can be minimized by constructing the Martadinata flyover at Simpang Gaplek without disrupting existing transportation movements.

The construction of the Martadinata flyover was used as the object of analysis for the Final Project at Simpang Gaplek Jalan Raya Martadinata, Pamulang, South Tangerang. It is necessary to pay attention to the embankment construction on the Martadinata flyover in relation to the condition of the subgrade, aimed at obtaining a soil structure that has adequate bearing strength, both subgrade and road pavement base foundations.

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Embankment construction is often faced with several problems, including problems of stability and settlement due to the own weight of the road embankment, due to the load of vehicle traffic, and due to being on top of soft soil layers in subgrade conditions with low bearing capacity.

Problems in embankment construction can be overcome by using lightweight foamed embankment mortar or also known as "high grade soil" which was developed using an energy conversion machine as a technological innovation because it has several advantages and optimal use. The lightweight foam mortar material is a mixture of sand, cement, water and foam (foam agent).

The important thing in using lightweight foam mortar material as a road embankment material is that it has the characteristics of a light bulk with a fairly high strength as a subgrade, and the compressive strength can be designed according to wishes so that it is expected to reduce the occurrence of stability and settlement problems.

Based on the description explained above, the construction of embankments using light foam mortar materials on the Martadinata flyover requires research to determine the amount of soil bearing capacity, stability and settlement that occurs, so the author took the title: "Analysis of Light Foam Mortar Embankments on the Martadinata Pamulang Flyover South Tangerang".

METHODS

3.1 General Description

In processing the data, the author conducted research at Simpang Gaplek Jalan Martadinata, Pamulang, South Tangerang. Preparation is a series before starting data collection and processing. In the preparation stage, things are arranged that must be done with the aim of making the final project writing time and work more effective. This preparation stage includes activities including:

1. Site survey to get an overview of the project,
2. Determine data needs,
3. Literature study of previous research,
4. Making a proposal for the preparation of the Final Project.

3.2 Research Location

research location for the construction of the Martadinata flyover at Simpang Gaplek Jalan Martadinata, Pamulang, South Tangerang.

3.3 Types of Research Data

Writing a Final Assignment requires data that is used as a writing reference. The types of data used are:

General data is data obtained from the Martadinata Flyover construction project at Simpang Gaplek Jalan Martadinata, Pamulang, South Tangerang, namely machine drilling data, planning drawing data, laboratory data.

Secondary data is data obtained from literature related to this research and data originating from several related agencies, namely the Public Works Department of Highways, PUPR Road and Bridge Research and Development Center, Contractors and Consultants, both planners and supervisors.

3.4 Data Analysis Plan

In carrying out this research, there is a data analysis plan to determine the bearing capacity of the subgrade, stability and settlement of the pile of lightweight foam mortar material. The formula used in this data analysis is

1. Analysis of basic soil data
2. Analysis of embankment geometry data and traffic loads
3. Data analysis of lightweight foam mortar materials
4. Calculation of embankments manually and software using the finite element method using the plaxis 8.2 application
5. Discussion regarding bearing capacity, stability and settlement of embankments

RESULTS AND DISCUSSION

4.1 Soil Data

The soil data used in this final project is machine drill data (bore log) obtained from taking soil investigation test samples at 4 (four) points at the Gaplek Flyover Interchange, Martadinata. The coordinate location points for soil investigations can be seen in Table 4.1. as follows :

Table 4.1. Soil Investigation Coordinates

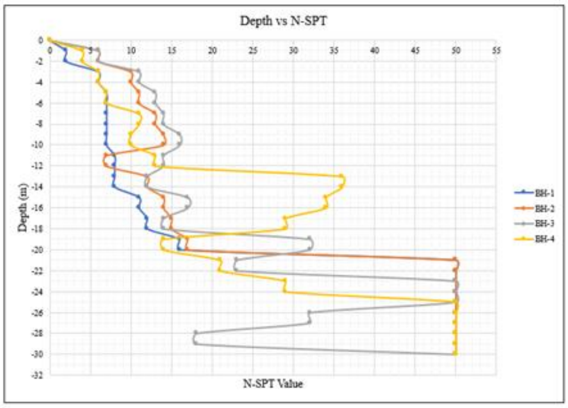
Titik Bor	X	Y	Lokasi
BH-1	0693567	09298153	STA 0+500
BH-2	0693534	09298132	STA 0+500L
BH-3	0693562	09298150	STA 0+475R
BH-4	0693562	09298082	STA 0+450L

Source: PT. Maratama Soil Laboratory

Based on the coordinate points of the soil investigation, the soil data available on the Martadinata flyover is BH-1, BH-2, BH-3, BH-4. then the next step is to combine the N-SPT results from the 4 (four) soil investigation location points.

The combined N-SPT results from the 4 (four) soil investigation location points can also be seen in the form of a graph of the relationship between N-SPT values and depth in **Figure 4.1.**

Figure 4.1. Graph of the Relationship between N-SPT Value and Depth



Source: Analysis Results

4.2 Load Data

The Martadinata Flyover is a primary road network that connects the National Activity Center (PKN) and the Regional Activity Center (PKW) so that the loads that are taken into account include: road pavement load (pavement), traffic load (qLL), and loads due to the weight of the embankment. lightweight foam mortar.

1. Road Pavement Load

Road pavement loads can be seen in Table. 4.2. as follows :

Table. 4.2 Pavement Loads

Jenis Beban	Tebal Perkerasan (cm)	Berat Volume (kN/m²)
Perkerasan Lentur/Aspal	5	1.2
Perkerasan Lantai Beton	25	6
Aksesoris Barrier	-	7,84
Total Beban Perkerasan Jalan (*pavement*)		15,04

Source: Analysis Results

2. Traffic Load

The traffic load on the Martadinata flyover is 15 kN/m².

3. Loads Due to the Weight of Light Foam Mortar Filling.

Loads due to the weight of lightweight foam mortar can be seen in the table. 4.3. as follows :

Table. 4.3 Foam Mortar Backfill Load

Lokasi	Tinggi Timbunan (m)	Tinggi Perkerasan (m)	Total Tinggi Timbunan (m)	Beban Timbunan (kN/m²)	Berat Timbunan Dan Beban Lalu Lintas (kN/m²)
	Htimb	Hperkerasan	Htotal	q timb	q rata-rata
STA 0+300	0,5	0,36	0,86	5,16	35,2
STA 0+325	1	0,36	1,36	8,16	38,2
STA 0+350	2	0,36	2,36	14,16	44,2
STA 0+375	4	0,36	4,36	26,16	56,2
STA 0+400	5	0,36	5,36	32,16	62,2
STA 0+425	7	0,36	7,36	44,16	74,2
STA 0+450	7,5	0,36	7,86	47,16	77,2

Source: Analysis Results

4.3 Stockpile Data

In this final project, embankment data analysis will be carried out consisting of the physical material of lightweight foam mortar embankments, embankment geometry data and embankment dimensions at stationing points on the Martadinata flyover. The Martadinata Flyover has a total flyover length of 400 meters from station point STA 0+300 to STA 0+700 consisting of two sides of embankment which have a length of 150 meters. The embankment location points that will be reviewed are only on the Parung – Bogor side from station point STA 0+300 to STA 0+450. The embankment length, embankment width and embankment height use the following planning data, namely:

a. Embankment width = 17.5 meters

b. Heap height = 7.86 meters

c. Length of embankment = 150 meters

d. Longitudinal slope of embankment
= 5%

e. Transverse embankment slope
= 3%

Stockpile data can be seen in Table. 4.4. as follows :

Table. 4.4. Heap Data STA 0+300 Up to STA 0+450

Lokasi	Tinggi Timbunan (m)	LebarTimbunan (m)	Panjang Timbunan (m)
STA 0+300	0,86	17,5	25
STA 0+325	1,36	17,5	25
STA 0+350	2,36	17,5	25
STA 0+375	4,36	17,5	25
STA 0+400	5,36	17,5	25
STA 0+425	7,36	17,5	25
STA 0+450	7,86	17,5	0

Source: Analysis Results

Data on the filling of lightweight foam mortar material and the geometry of the lightweight foam mortar filling. The physical properties of foam mortar light embankment material can be seen in Table 4.5. below as follows:

Table. 4.5. Physical Properties of Foam Mortar Light Fill Material

Parameter Properties	Timbunan Ringan Mortar Busa		Unit
Soil unit weight above phreatic level	γ_{unsat}	6	kN/m³
Soil unit blow phreatic level	γ_{sat}	6	kN/m³
Poisson's ratio	v	0.15	-
Young's modulus (constant)	E_{ref}	892600	kN/m²

Source: Analysis Results

4.4 Heap Crisis Height

Calculation of the critical height of the embankment is carried out to determine the initial value of embankment stability. The calculation of the critical height of the embankment at the location point STA 0+300 to STA 0+450 on the Martadinata flyover was carried out on soft clay and silty clay.

$H_c = \frac{4C_u}{\gamma}$

$H_c = \frac{4 \times 20}{6}$

H_c = 13,33 m,

$H_c > H$ = 13,33 m > 7,86 m

The critical embankment height is greater than the design embankment height so it meets the requirements. If the height of the embankment exceeds the critical height, then part of the embankment must be dismantled.

4.5 Calculation of Carrying Capacity

The bearing capacity of the subgrade is needed to determine the ability of the subgrade under light embankment of foam mortar to accept the working load. Calculation of the soil bearing capacity at location points STA 0+300 to STA 0+450 on the Martadinata flyover was carried out on soft soil with the soil layers being examined being the soft clay layer and the silty clay layer under the embankment with a depth of 1.5 meters and 10 meters being considered.

$q_{ult} = cN_c + \gamma D_f N_q + 0{,}5 B_w N_\gamma$
q_{ult} = (40,50 x 7,73) + (19,03 x 1,5 x 1,81)
+ (0,5 x 17,5 x 0,20)
q_{ult} = 313,065 + 51,666 + 1,75
q_{ult} = 366,481 kPa
q_{ult} = 366,481 kN/m²

Table. 4.6 Amount of Ultimate Bearing Capacity Value for Each Layer of Soil Depth

Jenis Tanah	Kedalaman (m)	$q_{ultimit}$ (kN/m²)
Lempung lunak	1,5	366,481
Lempung lanau	10	376,295

Source: Analysis Results

The safety factor for soil bearing capacity to meet safety requirements, it is recommended that the safety factor against collapse due to maximum load be = 3. A safety factor of 3 is very important to overcome the uncertainty of basic soil conditions.
Depth = 1.5 meters
$Q_{izin} = {q_{ult}}/{FK}$
$Q_{izin} = {366{,}481}/{3}$
Q_{izin} = 122,16 kN/m²

Table. 4.7 Amount of Permit Carrying Capacity Value for Each Layer of Soil Depth

Jenis Tanah	Kedalaman (m)	q_{izin} (kN/m²)
Lempung lunak	1,5	122,16
Lempung lanau	10	125,43

Source: Analysis Results

4.6 Calculation of Embankment Settlement
4.6.1Instant Drop

The instantaneous settlement calculation is carried out using the embankment settlement approach at each point at the base of the embankment with the soil depth being considered in the soft clay and silt layers, because the embankment is located on the original soil surface, then $\mu_0 = 1$,

Find the net stress from the weight of the embankment:

q_n = q – (D_f x γsat)
= 35,2 – (0 x 9,81)
= 35,2 kN/m²
μ_1 = H/B
= $\frac{1{,}5}{17{,}5}$
= 0,03

so, the value μ_1 = 0.04 is obtained from the correction factor curve for the foundation

depth Df.
So, the instantaneous decrease can be calculated as follows:

$$S_i = \mu_1 \text{ x } \frac{qn \text{ x } B}{E}$$

$$S_i = 0{,}040 \text{ x } \frac{35{,}2 \text{ x } 17{,}5}{3000}$$

$$S_i = 0{,}040 \text{ x } 0{,}205$$

$$S_i = 0{,}0082 \text{ m}$$

Table. 4.8 Results of instantaneous decrease due to foam mortar embankment load and traffic load at embankment height H= 0.86 m

Kedalaman	γ_{sat}	q	E	L	B	Df	q_n	μ_1	S_i
(m)	(kN/m³)	(kN/m²)	(kN/m²)	(m)	(m)	(m)	(kN/m²)		(m)
0,5	9,81	35,2	3000	150	17,5	0	35,2	0,04	0,0082
1,5	9,81	35,2	3000	150	17,5	0	35,2	0,08	0,0164
2,5	17,65	35,2	6720	150	17,5	0	35,2	0,11	0,0101
3,5	17,65	35,2	6720	150	17,5	0	35,2	0,15	0,0138
4,5	17,65	35,2	6720	150	17,5	0	35,2	0,19	0,0174
5,5	17,65	35,2	6720	150	17,5	0	35,2	0,21	0,0193
6,5	17,65	35,2	6720	150	17,5	0	35,2	0,26	0,0238
7,5	17,65	35,2	6720	150	17,5	0	35,2	0,31	0,0284
8,5	17,65	35,2	6720	150	17,5	0	35,2	0,36	0,0330
9,5	17,65	35,2	6720	150	17,5	0	35,2	0,38	0,0348
								S_i	0,2052

Source: Analysis Results

So the instantaneous decrease due to embankment load and traffic load at an embankment height of 0.86 m is 0.2052 m

4.6.2Consolidation Decline

Before calculating subgrade subsidence, first calculate the stresses that occur in the soil. The stresses calculated are overburden stress (Po'), which is the effective vertical soil stress, stress distribution (ΔP), which is the stress due to the load acting on the ground, and pre-consolidation stress (Pc'), which is the stress that has occurred on the ground in the past.

1. Calculation of overburden stress

Overburden stress calculations are reviewed at each depth at 1 m intervals. Calculation of stress for a depth of 1 m with an embankment height of 0.86 m.

Overburden stress (Po'):

$$Po' = \gamma' \text{ x z}$$
$$= (\gamma_{sat} - \gamma_w) \text{ x z}$$
$$= (9{,}81 - 5{,}41) \text{ x } 0{,}5$$
$$= 4{,}40 \text{ x } 0{,}5$$
$$Po' = 2{,}20 \text{ kN/m}^2$$

Table. 4.9 Overburden Stress Calculation Results for embankment height H = 0.86 m

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Kedalaman	z	H	γ_{sat}	γ_w	γ'	Po'
(m)	(m)	(m)	(kN/m³)	(kN/m³)	(kN/m³)	(kN/m²)
1	0,5	0,86	9,81	5,41	4,40	2,20
2	1,5	0,86	9,81	5,41	4,40	6,59
3	2,5	0,86	17,65	6,17	11,48	28,71
4	3,5	0,86	17,65	6,17	11,48	40,19
5	4,5	0,86	17,65	6,17	11,48	51,68
6	5,5	0,86	17,65	6,17	11,48	63,16
7	6,5	0,86	17,65	6,17	11,48	74,64
8	7,5	0,86	17,65	6,17	11,48	86,13
9	8,5	0,86	17,65	6,17	11,48	97,61
10	9,5	0,86	17,65	6,17	11,48	109,09

Source: Analysis Results

So the overburden stress at the 0.5 m depth point in the soil is 2.20 kN/m2.

2. Calculation of stress distribution
   The stress distribution calculation is reviewed at each depth with an interval of 1 m.

q0 lead = H x γmortar
= 0.86 x 6
= 5.16 kN/m2
Voltage distribution (ΔP):
ΔP = I x q0 timb
= 0.25 x 5.16
= 1.29 kN/m2
There is an increase in effective stress in the stress distribution
2ΔP = 2 x 1.29
= 2.58 kN/m2

Table. 4.10. Stress Distribution Calculation Results for embankment height H = 0.86 m

Kedalaman	z	x	y	n	m	I	q_0 timb	$2\Delta P$
m	m	m	m	m	m		kN/m²	kN/m²
1	0,5	8,75	150	17,5	300,0	0,25	5,16	2.58
2	1,5	8,75	150	5,8	100,0	0,25	5,16	2.58
3	2,5	8,75	150	3,5	60,0	0,247	5,16	2.55
4	3,5	8,75	150	2,5	42,9	0,245	5,16	2.53
5	4,5	8,75	150	1,9	33,3	0,24	5,16	2.48
6	5,5	8,75	150	1,6	27,3	0,231	5,16	2.38
7	6,5	8,75	150	1,3	23,1	0,215	5,16	2.22
8	7,5	8,75	150	1,2	20,0	0,214	5,16	2.21
9	8,5	8,75	150	1,0	17,6	0,205	5,16	2.12
10	9,5	8,75	150	0,9	15,8	0,195	5,16	2.01

Source: Analysis Results

So, the stress distribution ΔP at the 0.5 m depth point in the soil is 2.58 kN/m2.

3. Preconsolidation Stress Calculation
   In general, soft soil layers in Indonesia can be considered as slightly overconsolidated (OC) soil, so that pre-consolidation stress calculations are used. Preconsolidation stress calculations were reviewed at each depth at 1 m intervals.

Pc' = Po' + P fluktuasi

= 2,20 + 8

Pc' = 10,20 kN/m^2

$P1'$ = $Po' + \Delta P$

= 2,20 + 2,58

$P1'$ = 4,78 kN/m^2

OCR = $\frac{Pc'}{P1'}$

= $\frac{10{,}20}{4{,}78}$

OCR = 2.13 > 1, then it is overconsolidated (OC)

In two conditions, if P1' < Pc' = 4.78 < 10.20, then the calculation of overconsolidated (OC) clay uses equation (2.15).

Δe = C_r x $\log \frac{P1'}{Po'}$ = C_r x $\log \frac{Po' + \Delta P}{Po'}$

= 0,041 x $\log \frac{4{,}78}{2{,}20}$

Δe = 0,□

4. Decrease Due to Total Consolidation

The calculation of the decrease due to total consolidation is as follows:

Sc = $\frac{\Delta e}{1 + eo}$ x H

= $\frac{0{,}013827}{1 + 1{,}608}$ x 0,86

Sc = 0,004559 m

So, the magnitude of the pre-consolidation settlement at the soil depth point considered at 0.5 m is 0.004559 m

The results of calculating the decrease due to consolidation can be seen in Table 4.11. as follows:

Table. 4.11. Calculation Results of Decrease Due to Consolidation (H = 0.86)

z	Po'	ΔP	Pc'	$P1'$	Cc	Cr	e_0	Δe	Sc
m	kN/m^2	kN/m^2	kN/m^2	kN/m^2					m
0,5	2,20	2,58	10,20	4,78	0,638	0,041	1,608	0,013827	0,004559
1,5	6,59	2,58	14,59	9,17	0,638	0,041	1,608	0,005880	0,001939
2,5	28,71	2,55	36,71	31,26	0,346	0,040	1,496	0,001478	0,000509
3,5	40,19	2,53	48,19	42,72	0,346	0,040	1,496	0,001060	0,000365
4,5	51,68	2,48	59,68	54,15	0,346	0,040	1,496	0,000813	0,000280
5,5	63,16	2,38	71,16	65,54	0,346	0,040	1,496	0,000644	0,000222
6,5	74,64	2,22	82,64	76,86	0,346	0,040	1,496	0,000509	0,000175
7,5	86,13	2,21	94,13	88,33	0,346	0,040	1,496	0,000440	0,000152
8,5	97,61	2,12	105,61	99,72	0,346	0,040	1,496	0,000372	0,000128
9,5	109,09	2,01	117,09	111,10	0,346	0,040	1,496	0,000318	0,000109
								Sc	0,008439

Source: Analysis Results

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4.7 Consolidation Speed

The calculation of settlement over time is predicted using Terzaghi's one-dimensional consolidation theory, so the time factor for consolidation speed can be calculated.

H_t = 17 m

C_v = 6,43

C_v = 5,01

h = $h_1 + h_2$

h = 1,5 + 8,5

$\sum h$ = 10 m

$\sum \sqrt{C_v}$ = $\sqrt{6,43} + \sqrt{5,01}$

$\sum \left(\frac{h}{\sqrt{C_v}}\right)$ = $(0,591 + 3,79)$

= 4,389

C_v = $\sum H_t / \sum \left(\frac{h}{\sqrt{C_v}}\right)$

= $(10)^2/(4,389)^2$

= 5,191

then the time factor uses the following calculation:

$$T_v = \frac{C_v \times t}{{H_t}^2}$$

$$t_{50} = \frac{0,197 \times 17^2}{5,191} = 10,97 \text{ year}$$

$$t_{90} = \frac{0,848 \times 17^2}{5,191} = 47,22 \text{ year}$$

$$T_v = (\pi/4) \times U(50\%)$$

= 50,13%

$$T_v = -0,933 \times \log\big(1 - U(90\%)\big) - 0,085\ ; U(90\%)$$

= 89,97%

4.8 Calculation Analysis Results

1. Calculation of the decrease in foam mortar embankment due to the weight of the embankment:

The stot (Sc) that occurs is 0.625 m, so:

$S_t(50\%)$ = $U(50\%) \times S_c$ = 50,13% x 0,625
= 0,313 m

$S_t(90\%)$ = $U(90\%) \times S_c$ = 89,97% x 0,625
= 0,562 m

The results of all calculations for the reduction to the height of the lightweight foam mortar embankment can be seen in Table 4.12. as follows:

Table. 4.12 Calculation Results of Settlement Due to Embankment Loads

Tinggi Timbunan	Stot	50%	90%	Sisa Tinggi Timbunan
m	m	m	m	m
0,86	0,039	0,019	0,035	0,821
1,36	0,067	0,033	0,060	1,293
2,36	0,132	0,066	0,118	2,228
4,36	0,288	0,144	0,259	4,072
5,36	0,377	0,189	0,339	4,983
7,36	0,573	0,287	0,516	6,787
7,86	0,625	0,313	0,562	7,235

Source: Analysis Results

If we refer to the decline criteria, the amount of decline that occurred during the construction period on road class 1 of the Martadinata flyover embankment (>90%) was 0.562 over 47.22 years, amounting to:

$\frac{562}{47,22}$ = 11.91 mm/year < 20 mm/year

Fulfills the requirements of kimpraswil guidelines (Pt T-10-2002-B,2000) for embankment reduction criteria. Thus, the total subsidence that occurs still meets the criteria for subsidence on soft soil.

2. Calculation of decrease in foam mortar embankment due to traffic load:
The stot (Sc) that occurs is 0.800 m, so:

S_t (50%) = U(50%) x S_c = 50,13% x 0,800
= 0,401 m

S_t (90%) = U(90%) x S_c =89,97% x 0,800
= 0,720 m

The results of all calculations for the reduction to the height of the lightweight foam mortar embankment can be seen in Table 4.13. as follows:

Table. 4.13 Calculation Results of Reduction Due to Traffic Load

Tinggi Timbunan	Stot	50%	90%	Sisa Tinggi Timbunan
m	m	m	m	m
0,86	0,214	0,107	0,192	0,646
1,36	0,242	0,121	0,217	1,118
2,36	0,307	0,154	0,276	2,053
4,36	0,463	0,232	0,417	3,897
5,36	0,552	0,277	0,497	4,808
7,36	0,748	0,375	0,673	6,612
7,86	0,800	0,401	0,720	7,060

Source: Analysis Results

If referring to the settlement criteria, the magnitude of the decline that occurred during the construction period on road class 1 of the Martadinata flyover embankment (>90%) was 0.720 over 47.22 years, amounting to:

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$\frac{720}{47,22}$ = 15.25 mm/year < 20 mm/year

Fulfills the requirements of kimpraswil guidelines (Pt T-10-2002-B,2000) for embankment reduction criteria. Thus, the total subsidence that occurs still meets the criteria for subsidence on soft soil.

4.9 Embankment Stability Calculation

A stockpile is considered to be at the point of failure if the safety factor, FK = 1, and is in a stable condition if the FK owned is greater than one (FK>1) or in other words has more strength (reserve strength).

1. Calculation of embankment stability due to the weight of the embankment load.

a = 0,5 m
h = 0,5 m
H = 7,86 m
W_{mortar} = 177,12 kN
W_w = 18,63 kN
γ_w = 5,41 kN/m^3
S_{tot} = 0,625 m
B_w = 17,5 m
L = 150 m
O_{REG} = 0 kN/m^2
$W_{w\ timbunan}$ = 1/2 x a x H x γ_w
= 1/2 x 0,5 x 7,86 x 5,41
= 10,633 kN/m

$$FK = \frac{WMortar\ busa + Ww + OREG}{\frac{1}{2}\gamma w\ .Bw\ .(h + Stot)}$$

$$= \frac{177{,}12 + 18{,}63 + 0}{\frac{1}{2} x\ 5{,}41\ x\ 17{,}5\ (0{,}5 + 0{,}625)}$$

= 3,52 > 1,4

Meet the requirements of construction and building guidelines (Pd-T-11-2005, 2005) embankment stability safety factors. In this way, the stability of the embankment due to the weight of the embankment load still meets the safety factor of having greater strength (reserve strength).

2. Calculation of embankment stability due to traffic loads.

a = 0,5 m
h = 0,5 m
H = 7,86 m
W_{mortar} = 177,12 kN
W_w = 18,63 kN
γ_w = 5,41 kN/m^3
S_{tot} = 0,800 m
B_w = 17,5 m
L = 150 m
O_{REG} = 0 kN/m^2
$W_{w\ timbunan}$ = 1/2 x a x H x γ_w
= 1/2 x 0,5 x 7,86 x 5,41
= 10,633 kN/m

$$FK = \frac{WMortar\ busa + Ww + OREG}{\frac{1}{2}\gamma w\ .Bw\ .(h + Stot)}$$

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$$= \frac{177{,}12 + 18{,}63 + 0}{\frac{1}{2} \times 5{,}41 \times 17{,}5\ (0{,}5 + 0{,}800)}$$

$$= 3{,}05 > 1{,}4$$

Meet the requirements of construction and building guidelines (Pd-T-11-2005, 2005) table 2.9 embankment stability safety factors. In this way, the stability of the embankment due to traffic loads still meets the safety factor of having more strength (reserve strength).

4.10 Embankment Modeling Using Plaxis Software

Embankment modeling uses soil data by obtaining cross sections of soil layers from SPT and laboratory investigations, so that the soil parameters of each layer can be determined to determine the amount of settlement, stability and safety factors for lightweight foam mortar embankments using the Plaxis 8.2 program

Basic soil material parameters can be seen in Table 4.14. as follows :

Table 4.14. Basic Soil Material Parameters

Properties	Lapisan	Lempung	Lempung Lanauan	Lempung Kepasiran	Unit
Kedalaman	-	1.5	10	17	m
Material Model	Model	*Mohr-Coloumb*	*Mohr-Coloumb*	*Mohr-Coloumb*	-
Type of behaviour	Type	*UnDrained*	*UnDrained*	*UnDrained*	-
Soil unit weight above phreatic level	γ_{dry}	7,52	10,52	10,84	kN/m³
Soil unit blow phreatic level	γ_{sat}	9,81	17,65	18,63	kN/m³
Permeability in horizontal	K_x	0,00000001	0,00000001	0,00000001	m/day
Permeability in vertical direction	K_y	0,00000001	0,00000001	0,00000001	m/day
Young's modulus (constant)	E_{ref}	3000	6720	11400	kN/m²
Poisson's ratio	v	0,3	0,3	0,3	-
Cohession (constant)	c_{ref}	88,36	83,75	65,61	kN/m²
Friction angle	φ	20,092	21,017	37,027	°
Dilatancy angle	ψ	0	0	0	°

Source: Analysis Results

Foam mortar material parameters can be seen in Table 4.15. as follows :

Table. 4.15 Foam Mortar Backfill Material Parameters

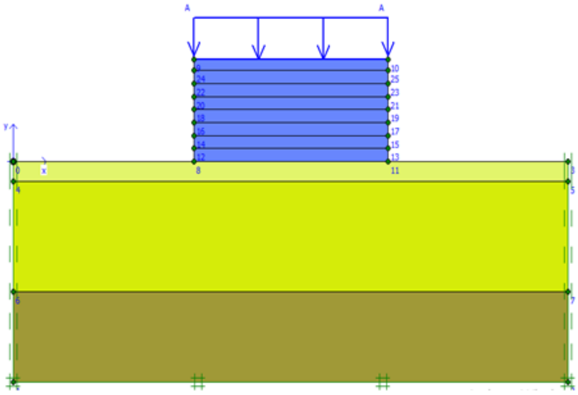
Parameter Properties		Timbunan Ringan Mortar Busa	Unit
Material Model	Model	*Linear Elastic*	-
Type of behaviour	Type	*Non-Porous*	-
Soil unit weight above phreatic level	γ_{unsat}	6	kN/m³
Soil unit blow phreatic level	γ_{sat}	6	kN/m³
Poisson's ratio	v	0.15	-
Young's modulus (constant)	E_{ref}	892600	kN/m²
Cohession (constant)	c	-	kN/m²
Friction angle	φ	-	°

Source: Analysis Results

4.11 Calculation Stage Using Plaxis Software

4.11.1. Input Stage

Create a geometry model of the embankment using the Geometry Line toolbar or by inputting coordinates by typing the point on geometry line at the bottom of the window. so that a model is formed as in Figure 4.2. below as follows:



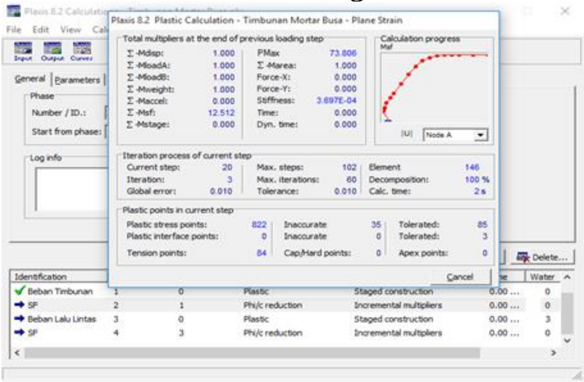
Source: Embankment Analysis With Plaxis 8.2

Figure 4.2. Foam Mortar Light Fill Model

4.11.2. Plaxis Calculations 8.2

1. Calculation Stage Consequences of Embankment Weight

Calculation Process Reviewed Due to Embankment Weight. Below, the calculation process is reviewed due to the weight of the embankment in Figure 4.3. below as follows

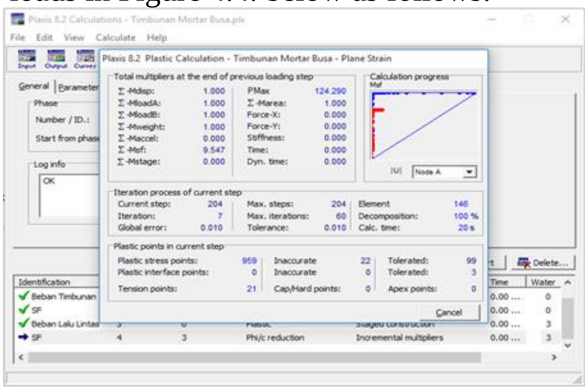


Source: Embankment Analysis With Plaxis 8.2

Figure 4.3. Calculation Process Reviewed Due to Embankment Weight

2. Traffic Load Calculation Stage

Calculation Process Reviewed Due to Traffic Loads The following calculation process is reviewed due to traffic loads in Figure 4.4. below as follows:



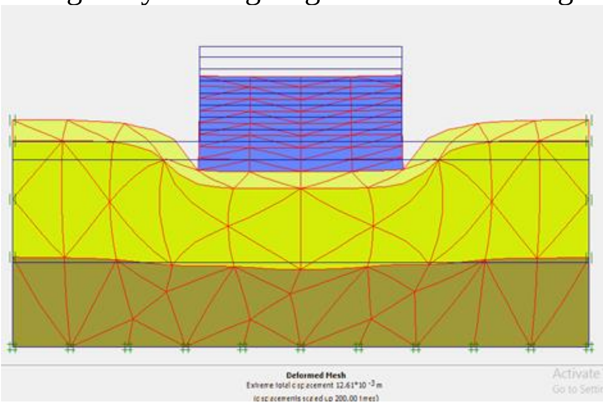
Source: Embankment Analysis With Plaxis 8.2

Figure 4.4. Calculation Process Reviewed Due to Traffic Load

4.11.3. Plaxis Output 8.2

1. Gravity Loading Stage

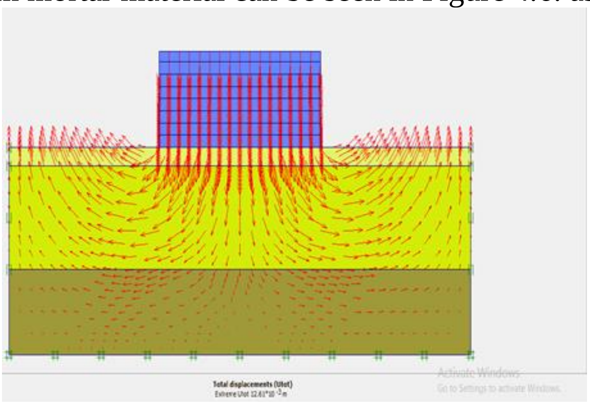
At this stage, the results show that the weight of the embankment with lightweight foam mortar material, in the lower structure of the road body, has decreased by 12.61 mm or 1.261 cm. The output results of the gravity loading stage can be seen in Figure 4.5. as follows :



Source: Embankment Analysis With Plaxis 8.2

Figure 4.5. Embankments Deformed Due to Gravity Loading

At this stage, the soil receives the weight of the lightweight material filled with foam mortar. The direction of movement and settlement due to the weight of the embankment load from the lightweight foam mortar material can be seen in Figure 4.6. as follows :

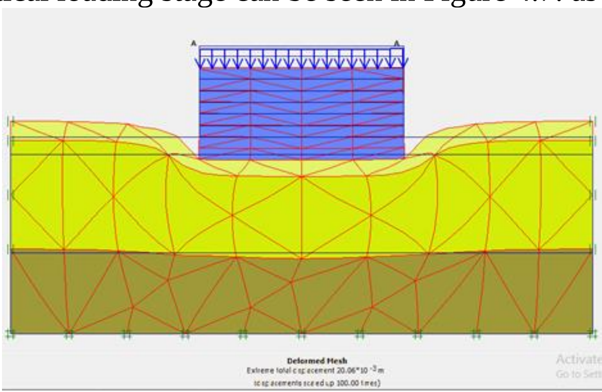


Source: Embankment Analysis With Plaxis 8.2

Figure 4.6. Direction of Ground Movement and Settlement Due to Gravity Loading

2. Vertical Loading Stage

At this stage, the soil receives the load of the road pavement structure which is modeled as a uniform load (tractions). The soil experienced deformation of 20.06 mm or 2.006 cm. The output results of the vertical loading stage can be seen in Figure 4.7. as follows :



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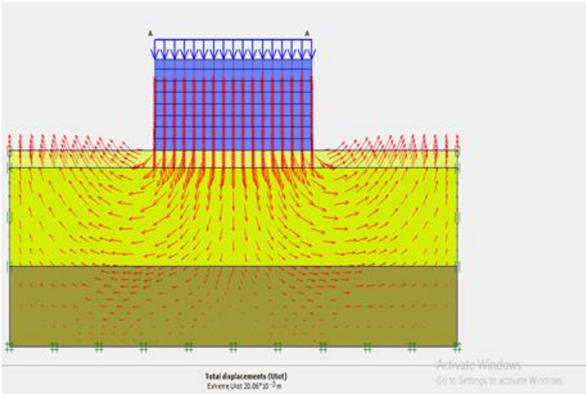
Source: Embankment Analysis With Plaxis 8.2

Figure 4.7. Embankments Deformed Due to Vertical Loading

At this stage, the soil receives the load of the road pavement structure and road traffic which are modeled as uniform loads (tractions). The direction of movement and settlement due to the load of the road pavement structure and road traffic can be seen in Figure 4.8. as follows :

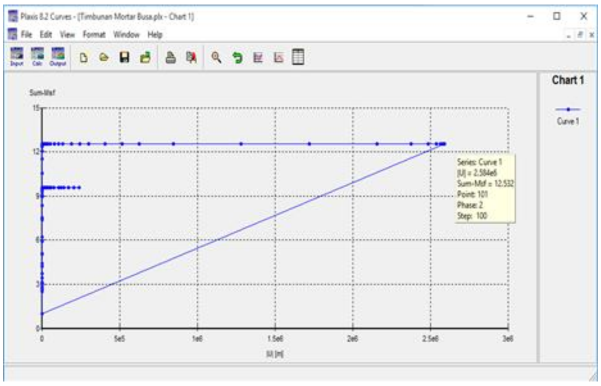


Source: Embankment Analysis With Plaxis 8.2

Figure 4.8. Direction of Ground Movement and Settlement Due to Vertical Loading

4.11.4. Plaxis Curves 8.2

1. Gravity Loading Stage

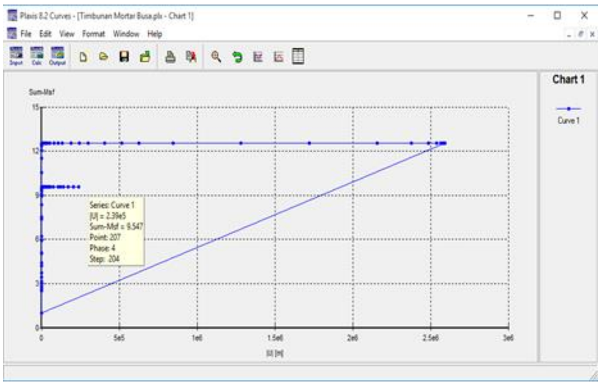


Source: Embankment Analysis With Plaxis 8.2

Figure 4.9. Safety Figures Due to Gravity Loading

From Figure 4.9. It can be seen that the SF due to gravity loading is 12.532. This figure is greater than the minimum SF for class 1 road collapse, which is 1.4. So it can be concluded that the embankment meets the required minimum safety factors.

2. Vertical Loading Stage



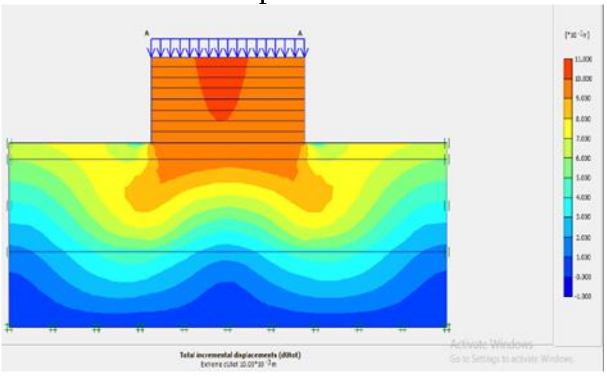
Source: Embankment Analysis With Plaxis 8.2

Figure 4.10. Safety Figures Due to Vertical Loading

From Figure 4.10. It can be seen that the SF due to vertical loading is 9.547. This figure is greater than the minimum SF for class 1 road collapse, which is 1.4. So it can be concluded that the embankment meets the required minimum safety factors.

3. Derivation Field

Knowing the area of landslides that occurred at the study location can be seen in the SF Vertical Loading output by selecting the Total Incremental Displacement toolbar as in Figure 4.11. The treatment carried out must cut the part below the landslide area



Source: Embankment Analysis With Plaxis 8.2

Figure 4.11. Total Incremental Displacement

CONCLUSIONS AND SUGGESTION

Conclusion

Based on the results of the analysis of the light embankment of foam mortar on the Martadinata Pamulang Flyover, South Tangerang, with manual calculations and using the plaxis 8.2 program, the following conclusions are drawn:

1. Based on the calculation results, the bearing capacity of the soil under the pile of lightweight foam mortar material to accept the load acting at a soil depth of 1.5 meters, the ultimate soil bearing capacity is 336.481 kN/m2 and the permitted bearing capacity is 122.16 kN/m2. At a soil depth of 10 meters, the ultimate soil bearing capacity is 376.295 kN/m2 and the permitted bearing capacity is 125.43 kN/m2.
2. Based on the results of manual stability calculations that occur in light embankments of foam mortar above the soft soil layer due to an embankment load of 3.52, a traffic load of 3.05 and the results of a plaxis calculation of 8.2 due to an embankment load of 12.53, a traffic load of 9, 54 has met the requirements for a class 1 road safety factor of 1.4. So it can be concluded that the embankment meets the required minimum safety factors.

Meanwhile, the settlement that occurred in light embankments of foam mortar was above the soft soil layer due to embankment loads of 11.91 mm/year, traffic loads of 15.25 mm/year and the results of plaxis calculations due to embankment loads of 12.61 mm/year, The traffic load of 20.06 mm/year meets the requirements for the reduction criteria of 20 mm/year in the Kimpraswil guidelines (Pt T-10-2002-B, 2002).

Suggestion

From the results of the research that has been carried out, there are several suggestions for further research, including:

1. There needs to be a comparison between earth filling and light foam mortar filling on the stability and settlement of the Martadinata Pamulang South Tangerang flyover.
2. Analysis using the Plaxis 8.2 program still has weaknesses, to get more accurate results it requires comparison with other methods or programs, such as GEOSLOPE, ROC SCIENCE, Z SOIL, SAGE CRISP, and so on.

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OPTIMIZATION OF SUPRA FIT MOTORCYCLE ENGINE MODIFICATION INTO A MACHINE CONVERTING HEAT ENERGY INTO ELECTRIC ENERGY

Bilhan Gamaliel[1]

[1)]Department of Mechanical Engineering, Faculty of Engineering, Krisnadwipayana University
Email : bilhan.gamaliel.h@unkris.ac.id

ABSTRACT

The relatively high population growth rate as a result of the development in South Tangerang City has caused traffic jams during rush hour at the Gaplek intersection. This congestion can be minimized by constructing a Martadinata flyover without disturbing the existing transportation movements. Heap construction is often faced with several problems, including stability and reduction problems due to the weight of the pile load, due to vehicle traffic loads, and due to being above soft soil layers. This study aims to obtain the magnitude of the carrying capacity of the subgrade under light weight foam mortar, to obtain the amount of stability and reduction of light weight foam mortar to soft soil behavior. Comparative research to get a comparison between manual calculation and finite element calculation method plaxis 8.2 software. The results of the bearing capacity of the soil under lightweight foam mortar at a soil depth of 1.5 meters and 10 meters, the soil bearing capacity is 366,481 kN/m2 and 376,295 kN/m2. The stability results of the lightweight foam mortar pile above the soft soil layer due to the weight of the pile load of 3.52 and 12.53 due to vehicle traffic loads of 3.05 and 9.54 have met the minimum safety factor requirements for road class 1 of 1.4. The results of the reduction of light weight foam mortar are above the soft soil layer due to the weight of the embankment load of 11.91 mm year and 12.61 mm/year, due to vehicle traffic loads of 15.25 mm/year and 20.06 mm/year. meet the criteria for road embankment reduction of 20mm/year. So it can be concluded that the foam mortar stockpile at the Martadinata Pamulang Tengerang Selatan flyover has met the requirements in the technical planning guidelines for lightweight foam mortar pile on soft soil.

Keywords: Flywheel, Pulley, Response Surface Methodology, V-belt, Volt.

INTRODUCTION

Electrical energy is a very vital need in everyday life. Day by day the need for electrical energy is increasing, where the industrial, service, transportation and other sectors are very dependent on this energy. Of course, because demand for electricity increases, fossil fuels in the form of oil, coal and gas, including energy sources in the world, are accelerating their reserves in nature. For this reason, it cannot be denied that accelerating the use of renewable energy is the most urgent reason at this time.

One of the best energy conversion machines is a steam engine because it can convert steam into mechanical energy. The idea of the steam engine dates back to 100 BC. The aim of the steam engine is to produce electrical energy ranging from 10 to 15 voltages which functions to charge the battery, where the battery has the task of supplying electricity to several components such as the mist spray fog maker and a fan which has a voltage of 12 voltages, one of which is The function of this tool is to be used for the mushroom farming process in the cultivation area in order to maintain the room temperature conditions in the place which are always humid. The type of steam engine used is made from a 125 cc supra fit engine which has previously been modified and functions well. However, the electricity produced is not optimal, namely it is still around 7 to 8 voltages, so it is still not possible to charge the battery which has a voltage of around 12 voltages, where the electrical power needed to charge the battery is 10 to 15 voltages. Therefore, the factors that have an influence on the amount of current produced need to be investigated further using an experimental design.

For this reason, the experimental design that will be carried out in this research uses the Response Surface Methodology method. Henceforth we will call Response Surface Methodology RSM. In essence, RSM uses adjustments to linear mathematical models, quadratic polynomial functionals, etc. with several series of experiments designed and verified with models obtained using statistical techniques. If we look at previous research, what differentiates this research is the use of 4 supporting factors, namely pulley, flywheel and v-belt, while the response indicator measured is the current voltage produced. The resulting output is the influence of factors on the response and maximum conditions of steam engine experiments in order to solve problems related to optimizing steam engine design characteristics.

LITERATURE REVIEW

Electricity generation is the conversion of one form of energy into another form of energy where the final form is electrical energy. The form or form of energy above its existence or position is as follows:

1) Fuel contains chemical energy;
2) Then a combustion reaction occurs which produces heat which is then transmitted to the boiler pipe walls, where it is received by the boiler water as heat energy;
3) Then kinetic energy occurs where the steam energy changes as a function of speed pushing the angle of rotation of the turbine shaft;
4) Mechanical energy is a concentration of energy located in the turbine shaft axis;
5) The rotation of the turbine shaft is transmitted to the generator shaft to produce electricity, this is where the final product in the form of electrical energy is produced.

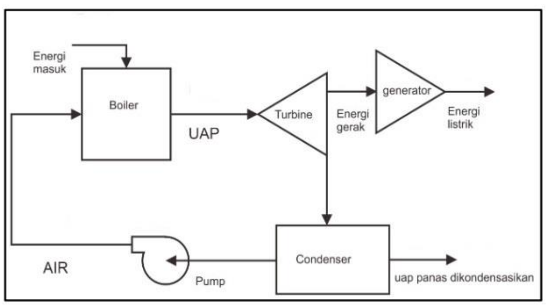

Figure 1. PLTU Cycle Flowchart

The elements of power transmission are several components that are used to transfer energy or power from one component to different components in a mechanical system. Some common elements of power transmission include the following:

1) Flywheel

It is an element that has a disc-like shape which has the function of maintaining the smooth rotation of a machine.

2) V-belt

The V-belt functions as a transmission link which is made of rubber and has a cross-sectional design that is almost similar to the letter "V" which encircles a similar shaped pulley groove.

3) Pulleys

One of the components that plays a role in the machine mechanism is to transmit energy from one axis to another using a belt.

METHOD

The object of this research is a steam engine modified from a supra fit motorbike engine. This research includes:

1) Measure the output current from the alternator using a multimeter;

2) Turning on the steam engine, the steam engine experimental design begins by heating the bolter tube.

This research was carried out in the manufacturing laboratory of the Faculty of Engineering, Krisnadwipayana University because all the equipment and materials needed are located or available in the laboratory.

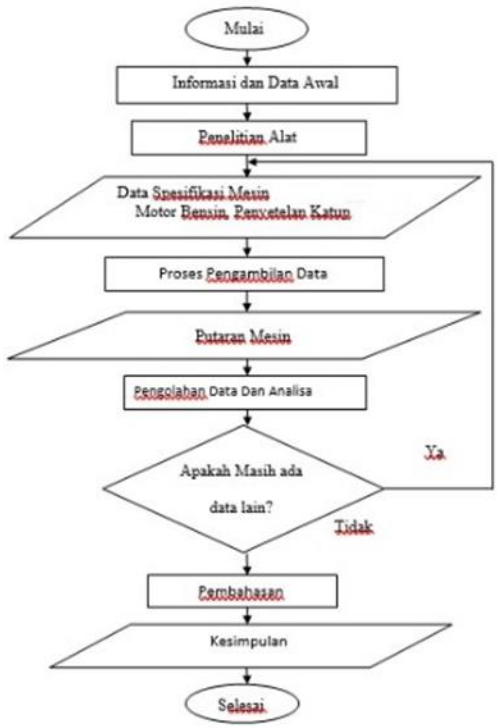

Figure 2. Research Flow Diagram

RESULTS AND DISCUSSION

The data collected in this research came from direct observations in the field. The data obtained is in the form of electrical voltage results. Data collection was carried out from March 20 2023 to March 27 2023 by carrying out 2 to 3 experiments.

Table 1. Experimental Results Data

No.	Diameter *Pulley* (cm)	Diameter *Flywheel* (cm)	Kekencangan *V-beltt* (cm)	Listrik yang di hasilkan (Voltase)
1	15	10	5	6.7
2	45	10	5	8.1
3	15	30	5	11.9
4	45	30	5	13.7
5	15	10	15	4.1
6	45	10	15	6.4
7	15	30	15	8.8
8	45	30	15	10.2
9	15	20	10	7.6
10	45	20	10	9.4
11	30	10	10	5.3
12	30	30	10	10.6
13	30	20	5	9.7
14	30	20	15	7.6
15	30	20	10	8.5
16	30	20	10	8.5
17	30	20	10	8.5
18	30	20	10	8.5
19	30	20	10	8.5
20	30	20	10	8.5

It can be seen in Table 1 that the percentage of experimental results from 3 factors and 3 levels, in each experiment the results were 4.1 to 13.7.

From the data that has been obtained, data processing is carried out using Minitab 18 software to analyze and build models. The experimental design method chosen was response surface methodology with a central composite design type. There are 3 factors that are input, namely v-belt tightness, flywheel diameter, pulley diameter. The experimental design carried out was 14 times plus the center point 6 times, so the total experiment that was carried out was 20 times.

REGRESSION

Regression is used to fit mathematical models obtained to experimental data. The results are summary statistics on three orders of polynomials: first, second, and third, which translate into pulley diameter, flywheel diameter, and v-belt tightness respectively.

Table 2. Regression

Term	Coef	SE Coef	T-Value	P-Value
Constant	8.4073	0.0868	96.87	0.000
D *Pulley*	0.8700	0.0798	10.90	0.000
D *Flywheel*	2,4600	0,0798	30,81	0,000
K *V-belt*	-1.3000	0.0798	-16.28	0.000

The prediction model for the response to the weight of the burger product is linear. The mathematical model for the thickness response is: Weight = 14.15-0.22C, where C is the temperature (o C). The weight response mathematical model shows that there is a relationship between the weight response and the temperature factor, if the temperature is increased it will cause the weight of the resulting product to decrease. This can be influenced because the lower the temperature used, the more compact the product will be, which can increase the weight of the final product produced.

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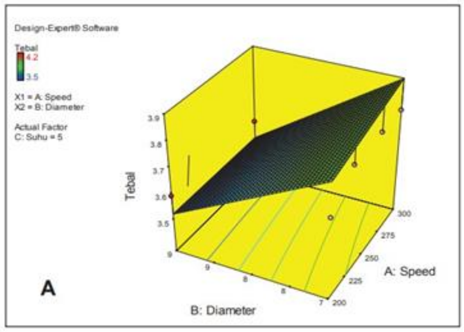


Figure 3. 3D profile of the thickness response

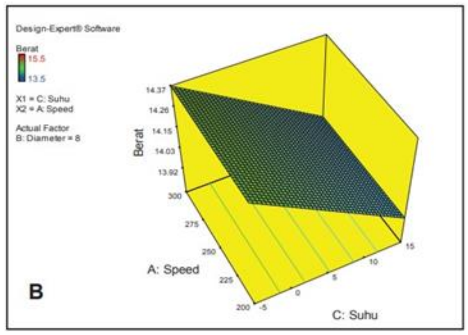


Figure 4. 3D profile of weight response

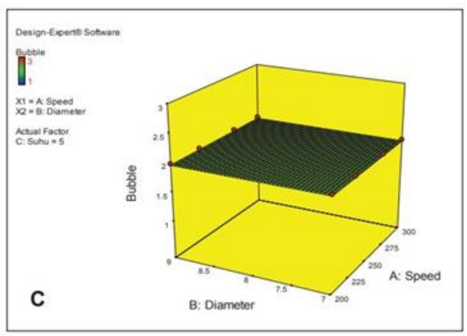
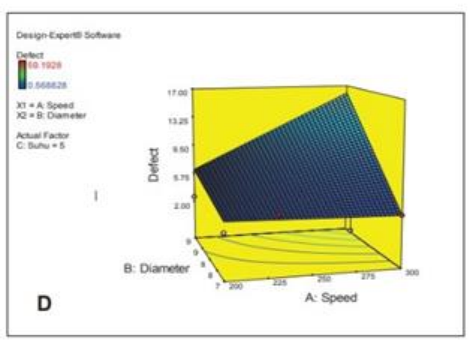


Figure 4. 3D profile of the bubble response



Gambar 5. Profil 3D dari respon defect

Sistem Oscillating Water Column (OWC) merupakan sistem dengan konstruksi yang terdiri dari dua komponen utama, yaitu ruang udara (Air Chamber) dan Turbin Udara Generator (air turbine generator).

Kesemuanya ini direncanakan untuk membangkitkan energi listrik melalui turbin generator yang dapat berputar karena tekanan udara yang disebabkan oleh gerakan naik turunnya gelombang didalam ruang udara tetap. Gerakan naik turunnya air pada kolom osilasi diasumsikan sebagai piston hidraulik.

Piston ini selanjutnya menekan udara yang berfungsi sebagai fluida udara. Udara yang bertekanan tersebut akan menggerakan turbin udara yang selanjutnya menggerakan generator listrik. Proses pengubahan dari energi gerak gelombang kepada energi potensial tekanan udara berlangsung secara isothermis.

Pendekatan ini dipilih karena dalam proses kompresi ini dianggap tidak terjadi peningkatan temperatur yang berarti. Besarnya kompresi tergantung kepada Panjang langkah piston, sedangakan panjang langkah piston dipengaruhi oleh tinggi gelombang (H) dan efisiensi absorsi gelombang pada kolom osilasi.

CONCLUSION

From the results of the regression equation, it can be explained that the constant value of 8.407 has a positive number, which means that if the sum of the pulley diameter, flywheel diameter and v-belt tension is equal to 0, it produces a voltage of 8.407. while the regression coefficient for pulley diameter, flywheel diameter and v-belt tightness increases by one unit for each factor, increasing by 0.870 for pulley, 2.460 for flywheel and -1.300 for v-belt, whereas every decrease in the level of the factor will reduce it. The optimal voltage conditions seen from the response surface and contour plot are at a pulley diameter factor of 45 cm, flywheel diameter of 30 cm, and vbelt tension of 5 cm, producing an electrical voltage of 13.7 volts.

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IMPLEMENTATION OF AN ELECTRO-PNEUMATIC SYSTEM IN A VALVE SAFETY SUPPORT DEVICE THROUGH LINEAR TO ROTATIONAL MOTION

Bilhan Gamaliel[1]

[1)]Department of Mechanical Engineering, Faculty of Engineering, Krisnadwipayana
Email : bilhangamaliel@unkris.ac.id

ABSTRACT

This research aims to develop a tool that can be used in the process of clamping valves on motorbike engine blocks using a pneumatic system as a mechanism for clamping the engine block and as a rack and pinion driver, replacing human hand movements semi-automatically through electropneumatic control. This aims to save time in the clamping process, which usually takes around 90 to 120 minutes manually. By using this valve adjustment tool, clamping time can be cut to 10 to 17.5 minutes. Research methods include design, component manufacturing, assembly, testing, and data collection. The results of the development of a valve control tool with an electro-pneumatic system can also be applied in the learning process of mechanical engineering students in the fluid control laboratory.
Keywords: Electro-pneumatic, Support device, Rotational motion

INTRODUCTION

The increase in the use of motorized vehicles as a means of transportation has resulted in an increase in the number of engine damage we encounter, especially valve leaks in the cylinder head which often occur due to the buildup of scale on the valve seat surface. This situation disrupts the compression process and reduces engine performance. Symptoms that appear include a decrease in engine performance due to suboptimal compression, instability in engine performance which causes sudden shutdown, and wasteful fuel consumption. One of the causes of scale buildup is the entry of oil into the combustion chamber. To overcome this problem, improvements are needed through the valve lapping process.

Based on research conducted by researchers in workshops around Pondok Gede and Kranggan Bekasi, there are still manual (traditional) methods used in the process. This method involves using your hand to turn the valve handle right, left, up and down. However, using both hands in this process makes measurements time consuming and inefficient. However, not all technicians in workshops are able to carry out measurements using this method.

To overcome the manual process of adjusting valves with the aim of preventing leaks and ensuring that the valve is securely attached to its seat, a valve adjustment tool is needed that uses electro-pneumatic technology. This tool converts the linear movement of the cylinder into rotational movement, so it is hoped that it can overcome the instability of hand movements in manual processes which often results in poor valve adjustment accuracy, causing uneven valve surfaces and the potential for leaks. The results of this research can produce valve adjustment tools using electro-pneumatic applications that can be applied in valve adjustment workshops. Apart from that, this tool can also be used as a practical learning tool for mechanical engineering students in understanding electro-pneumatic applications in their practical context.

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METHODS

The aim of this research is to investigate problems related to the application of electro-pneumatic technology that are relevant to the field of mechanical engineering, based on theory and several available references.

Direct observations in the field were carried out to recognize and understand various problems that arise in the operation of valve adjustment workshops in Jakarta.

Testing tools is a crucial step in assessing the success of a study; without this step, the research objectives are not considered achieved. This test is essential to verify the effectiveness of the safety aids in operation. This process involves measuring three valve samples on a motorbike engine block, where the efficiency of the tool is tested by measuring the duration of the measurement time to determine the best performance for the intake and exhaust valves. The criteria for checking to be considered successful is if after the valve is installed there are no leaks, which is tested by dripping gasoline on the valve seat to ensure there are no leaks.

RESULTS AND DISCUSSION

Research Design Results

In this study, a tool was developed to operate the valve using a pneumatic cylinder which produces a back and forth rotational movement.

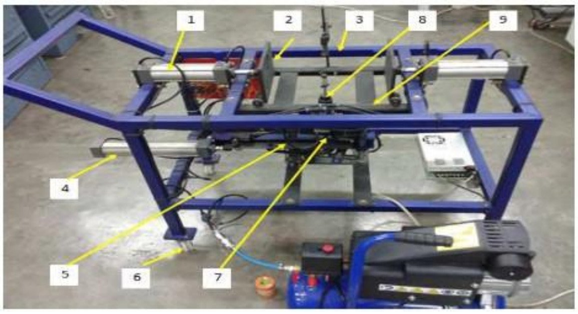

Figure 2 Valve adjustment tool

Information :
1. Double acting cylinders A and B (for gripping the cylinder head)
2. Dampening sponge
3. Framework
4. Double acting cylinder C (to move the rack and pinion)
5. Rack and pinion
6. Wheels
7. Double acting cylinder D (to raise and lower the valve)
8. Valve chuck
9. Launch pad

Work Steps Before Tool Testing

- Connect the hoses from the two double acting cylinders located at the top using a T connector, then this connection is directed to a double type 5/2 solenoid valve. Before making this connection, make sure you have installed a flow control valve. Next, the connection from the double 5/2 solenoid valve must be connected to the compressor, and the cable from the double 5/2 solenoid valve must be connected to a switch.

- Attach pneumatic hoses to the two double acting cylinders at the bottom leading to the flow control valve, then connect them to the two 5/2 double solenoid valves. After that, connect the hose from the 5/2 double solenoid valve to the compressor, and the cable from the 5/2 double solenoid valve is connected to the switch.
- Connect the cable from the limit switch to the switch.
- Connect the cables to the specified locations, then use the cables to connect the relays and switches.
- Connect the (+) and (-) cables on the switch to the power supply

Test result

Trials were carried out by assessing the successful functioning of the equipment and the effectiveness of collecting excellent braking time data, with success criteria including the absence of leaks at the intake and exhaust ports.

Table 1. Valve Seats for Valve on Motorcycle Engine Block 1

Jenis Klep	Pengujian	Waktu Penyekuran	Hasil Penyekuran	Kualitas Hasil Penyekuran
Klep Intake	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Merembes	Baik
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali
Klep Exhaust	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Masih bocor	Belum baik
	6	15 menit	Merembes	Baik
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali

Table 2. Valve Seats Against Valve on Motorcycle Engine Block 2

Jenis Klep	Pengujian	Waktu Penyekuran	Hasil Penyekuran	Kualitas Hasil Penyekuran
Klep Intake	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Merembes	Baik
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali
Klep Exhaust	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Masih Bocor	Belum baik
	5	12,5 menit	Masih bocor	Belum baik
	6	15 menit	Merembes	Baik
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali

Table 3. Valve Seats Against Valve on Motorcycle Engine Block 3

Jenis Klep	Pengujian	Waktu Penyekuran	Hasil Penyekuran	Kualitas Hasil Penyekuran
Klep Intake	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Merembes	Baik
	4	10 menit	Rapat	Baik sekali
	5	12,5 menit	Rapat	Baik sekali
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali
Klep Exhaust	1	2,5 menit	Masih bocor	Belum baik
	2	5 menit	Masih bocor	Belum baik
	3	7,5 menit	Masih bocor	Belum baik
	4	10 menit	Merembes	Baik
	5	12,5 menit	Rapat	Baik sekali
	6	15 menit	Rapat	Baik sekali
	7	17,5 menit	Rapat	Baik sekali
	8	20 menit	Rapat	Baik sekali

Discussion of Research Results

Based on data analysis from the sizing process between valves and valve seats in motorcycle engine blocks for samples 1, 2, and 3 (a total of three motorcycle engine block samples were examined), where each engine block has one intake valve and one exhaust valve, everything has been installed very well. This is proven through a leak test, where if the valve

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and valve seat are tightly installed, this indicates very good alignment, if there is seepage, this indicates good alignment, and if there is still a leak, it indicates poor alignment.

Figure 3. The relationship between staking time and the quality of engine block 1's staking results

Information:
• Pensekuran 1 has not very good quality.
• Pensekuran 2 has good quality.
• Surveying 1 shows very good quality.
• Series 1 is a suction valve.
• Series 2 is an exhaust valve. Based on table 1 and figure 3 from a study of the adjustment of the valve seat and the valve itself in the engine block of motorbike 1, it was found that to obtain very good quality on the intake valve, a adjustment time of 15 minutes was required, whereas to achieve the same quality on the exhaust valve , a survey time of 17.5 minutes is required.

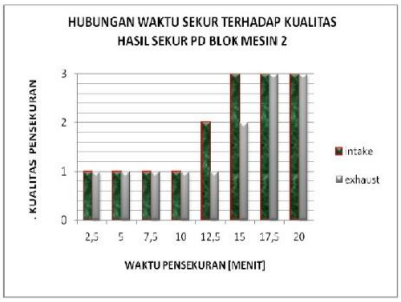

Figure 4. Relationship between mixing time and the quality of engine block 2 skirting results

Details:
• The quality of the first survey was deemed unsatisfactory.
• The quality of the second survey was considered good.
• The quality of the first survey was considered very good.
• The first series is categorized as suction valves.
• The second series is categorized as an exhaust valve.

Based on information from table 2 and figure 4 in research on the seaming process of the valve seat and the valve itself in the engine block of motorbike 1, it was revealed that the suction valve required a seaming time of around 15 minutes to achieve very good quality. Meanwhile, for the exhaust valve to achieve similar quality, it required a tuning time of 17.5 minutes, which coincidentally is the same result as previous research on motorbike engine block 1.

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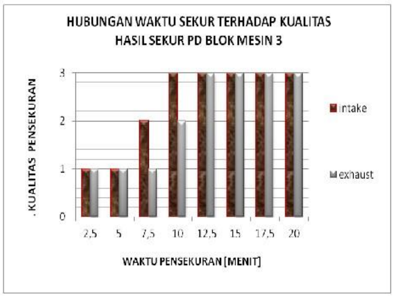

Figure 5. Relationship between staking time and the quality of engine block 3's securing results

Details:
The performance of the first survey did not meet standards.
The performance of the second survey was considered satisfactory.
The performance of the first survey turned out to be very satisfactory.
Series 1 is identified as a suction valve.
Series 2 is identified as an exhaust valve.

Analysis of the data in table 3 and figure 5 in the study of the sequestering process in the seat area and the valve itself on the motorbike engine block 1 shows that to achieve very satisfactory performance on the suction valve, a sequestering time of 10 minutes is required. Likewise, to achieve very satisfactory performance on the exhaust valve, 12.5 minutes of sizing time is required, indicating that this result is different from previous sizing studies on motorcycle engine blocks 1 or 2.

Based on analysis of three test samples of motorbike engine blocks number 1, 2, and 3, it was found that drilling for the suction valve takes a minimum of 10 minutes. Meanwhile, for the exhaust valve, a searing time of 12.5 minutes is required, especially in the test carried out on motorbike engine block number 3. In the case of motorbike engine blocks number 1 and 2, to achieve excellent seaming quality, it is necessary 15 minutes for checking the suction valve seat and 17.5 minutes for checking the exhaust valve seat. Variations in the adjustment time required for each test sample can be explained by differences in the initial condition of the valve seat and valve, which may be influenced by factors such as the year the engine was manufactured, maintenance methods, motorbike use, and the type of fuel used. In particular, exhaust valves require a longer cleaning time compared to intake valves because the presence of exhaust gases from the combustion process tends to accelerate the buildup of dirt.

CONCLUSIONS

The results of this research produce an auxiliary device for securing valves that operates with a linear pneumatic mechanism that is converted to rotational movement. Based on the tests carried out, conclusions can be drawn as follows:

1. The test results show that very good seaming quality is achieved on the valve seat and the valve itself in the number 3 motorbike engine block, requiring a seaming time of 10 minutes for the intake valve and 12.5 minutes for the exhaust valve.
2. Among the three samples tested, only test samples number 1 and 2 gave similar results, namely that a probe time of 15 minutes was required for the suction valve and 17.5 minutes for the exhaust valve.
3. The closing time for the intake valve is shorter than for the exhaust valve because there is a flow of exhaust gas which results in a faster buildup of combustion residue.
4. The difference in closing time between each test sample is caused by the initial condition of the sample which is not identified, including the varying age of use of the motorbike engine.

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