

DAFTAR PUSTAKA

- Anbu, P., Kang, C.-H., & Jae-Seong So, Y.-J. a. (2016). Formations of calcium carbonate minerals by bacteria and its multiple applications. *a SpringerOpen Journal*, V, 1-26.
- Antoni. (2019). Biosementasi Tanah Pasir Dengan Cangkang Telur Ayam (*Gallus domesticus*). *SKRIPSI*, 1-52.
- Aswin, L., Muhammad, D. A., & Lestari, A. S. (2019). Studi Eksperimental Kemampuan Biosementasi Bakteri Lokal pada Tanah Pasir Lepas. *Jurnal Teknik Sipil*, 26, 129-137.
- Awais, M., Pervez, A., Yaqub, A., & Shah, M. (2010). Production Of Antimicrobial Metabolies by *Bacillus Subtilis* Immobilized in Polyacrylamide Gel. *Pakistan J. Zool*, III, 265-275.
- Bowles, J. (1991). *Sifat-Sifat Fisis Tanah dan Geoteknis Tanah (Mekanika Tanah)*. Jakarta: PT. Erlangga.
- BSN. (2008). Cara Uji Analisis Ukuran Butir Tanah. *SNI 3423:2008*, 4.
- BSN. (2008). Cara Uji Penentuan Kadar Air Untuk Tanah dan Batuan di Laboratorium. *SNI 1965:2008*, 7-10.
- Chen, F. H. (1975). *Foundations On Expansive Soils*. Amsterdam-New York: American Elsevier Publishing Company, INC.
- Darwis, H. (2017). *Dasar-Dasar Teknik Perbaikan Tanah*. Yogyakarta: Pustaka AQ, Nyutran MG II.
- Das, B. M. (1995). *Mekanika Tanah Jilid 1 (Prinsip-prinsip Rekayasa Geoteknis)*. Jakarta: Erlangga.
- Das, B. M. (2002). *Soil Mechanics Laboratory Manual*. New York: Oxford University Press.

- Gunarso, Nuprayogi, R., & Pardoyo, B. (2017). Stabilisasi Tanah Lempung Ekspansif Dengan Campuran Larutan NaOH 7,5%. *Jurnal Karya Teknik Sipil*, VI, 238-245.
- Hardiyatmo. (2017). *Tanah Ekspansif Permasalahan dan Penanganan*. Yogyakarta: Gadjah Mada University Press.
- Hardiyatmo, H. C. (2002). *Mekanika Tanah I-Edisi Ketiga*. Yogyakarta: Gadjah Mada University Press.
- Hasriana, Samang, L., Djide, M., & Harianto, T. (2018). A Study on Clay Soil Improvement With Bacillus Subtilis Bacteria As The Road Subbase Layer. *International Journal of Geomate*, 15, 114-120.
- Hussein, Z. (2019). Improvement Properties of Self-Healing Concrete by Using Bacteria. *IOP Publishing International Conference*, 1-10.
- Indriani, A. M., & Utomo, G. (2023). Pengaruh Microbially Induced Calcite Precipitation (MICP) terhadap Perilaku Kuat Geser Tanah Terkontaminasi Batu Bara. *Journal of Civil Engineering and Vocational Education*, 10, 53-60.
- IS, 2720. Part XL. (1977). Determination of Free Swell Index of Soils. *Bureau of Indian Standard*.
- Jamal, H. (2019, Oktober 01). *AASHTO Soil Classification System - AASHTO Chart*. Retrieved from aboutcivil: <https://www.aboutcivil.org/aashto-soil-classification-system>
- Lynda, A. (2013). Karakteristik Kuat Geser Tanah Dengan Stabilisasi Biogrouting Bakteri Bacillus Subtilis. *Tugas Akhir Jurusan Sipil Fakultas Teknik Universitas Hasanuddin*, 1-112.
- M, D., Jumaeri, & Triastuti. (2019). Pemanfaatan Bentonite Teraktivasi Asam Sulfat sebagai Adsorben Anion Fosfat dalam Air. *Indonesian Journal of Chemical Science*, 1-8.

- Maulana, G., & Hamdhan, I. N. (2016). Stabilisasi Tanah Lempung Ekspansif Menggunakan Campuran Renolith dan Kapur. *Jurnal Online Institute Teknologi Nasional*, 4, 11.
- Mujah, D., Shahin, M., & Cheng, L. (2016). State-of-Art Review of Biocementation by Microbially Induced Calcite Precipitation (MICP) for Soil Stabilization. *Geomicrobiology Journal*, 1-14.
- Nasution, M. S., Purwana, Y. M., & Setiawan, B. (2017). Penurunan Permeabilitas dan Peningkatan Kuat Geser Tanah Lanau Menggunakan Pengaruh Mikrobakteri *Bacillus Subtilis* dan *Pseudomonas SP.* *e-Jurnal Matriks Teknik Sipil*, 1-8.
- Nugroho, U. (2008). Stabilisasi Tanah Gambut Rawapening Dengan Menggunakan Campuran Portland Cement dan Gypsum Sintesis ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) Ditinjau dari Nilai California Bearing Ratio (CBR). *Jurnal Teknik Sipil dan Perencanaan*, 161-170.
- Skempton, A. W. (1953). *The Colloidal "Activity" of Clays*. Switzerland: 3rd International Conference on Soil Mechanics and Foundation Engineering.
- Snethen, D. R., Jhonson, L. D., & Patrick, D. M. (1977). *An Evaluation Of Expedient Methodology For Identification Of Potentially Expansive Soils*. Washington D. C.: Departement Of Transportation-USA.
- Sukandarrumidi. (2009). *Bahan Galian Industri*. Yogyakarta: Gadjah Mada University Press.
- Suriani, & Muis, A. (2016). Prospek *Bacillus Subtillis* Sebagai Agen Pengendalian Hayati Patogen Tular Tanah Pada Tanaman Jagung. *J. Litbang Pert*, 37-45.
- Wesley, L. (2012). *Mekanika Tanah untuk Tanah Endapan dan Residu*. Yogyakarta: ANDI Yogyakarta.
- Winterkorn, H. F. (1991). *Soil Stabilization And Grouting*. USA: Springer Science+Business Media New York.

Yudhyantoro, Y., Prayoga, A., & Maimunah. (2022, December). Analisis Perubahan Volume Pada Timbunan Tanah Lempung Berdasarkan Nilai Batas Susut (SNI 3422:2008). *Tameh: Journal Of Civil Engineering*, XI, 118.

TEST RESULTS OF GRAIN-SIZE ANALYSIS

(Sieve-Mechanical and Hydrometer Methods)

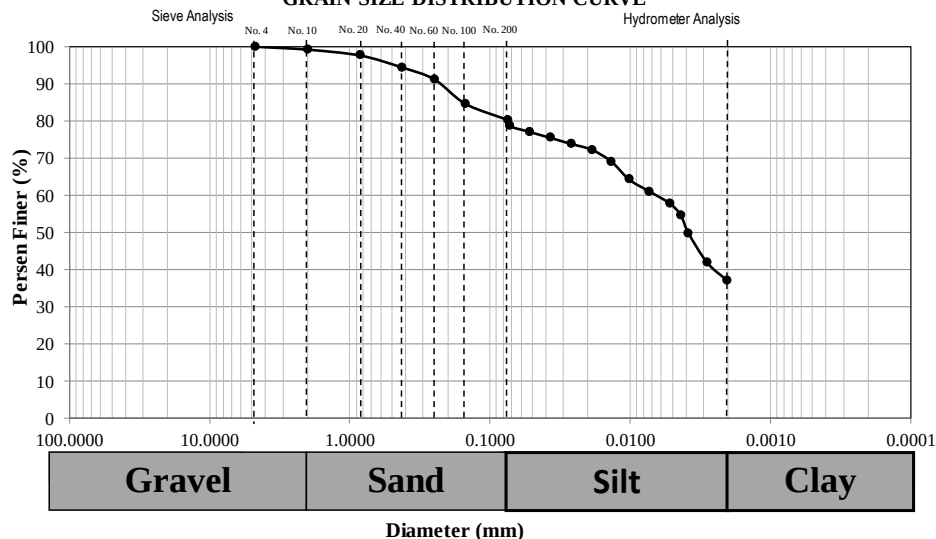
PROJECT : PENELITIAN TUGAS AKHIR
 LOCATION : LABORATORIUM MEKANIKA TANAH FT-UH
 SAMPLING DEPTH : -
 TESTING METHOD : ASTM D6913-17, ASTM D7928-17, ASTM D2487
 LABORATORY : HASANUDDIN UNIVERSITY
 TESTED BY : ANDI AMMAR JULTIAR ALAM
 DATE : 22-02-2023



Jenis Tanah : **Tanah Lanau Plastisitas Rendah**

Dry specimen mass : 500 gr						Hydrometer Sample : 50.0 gr							
Specific Gravity, Gs : 2.66						Temperature, T : 28.0 °C							
Washing : YES NO													
Sieve Analysis						Hydrometer Analysis							
Sieve No.	Diameter (mm)	Retained Mass (gr)	Cumulative Retained Mass (gr)	Percent of Cumulative Retained (%)	Percent Finer (%)	Time (minutes)	R	Rcp = R+Ft-Fz	% Finer = ((a x Rcp)/Ws)x1.00% %Finer Sieve Analysis	RcL= R + Fm	L (cm)	A	D=A\ L\ t (mm)
4	4.75	0	0	0	100	0.25	46.00	49.15	78.62	47.00	8.60	0.0124	0.07273
10	2	4	4	0.8	99.2	0.5	45.00	48.15	77.02	46.00	8.80	0.0124	0.05202
20	0.84	8	12	2.4	97.6	1	44.00	47.15	75.42	45.00	8.90	0.0124	0.03699
40	0.425	16	28	5.6	94.4	2	43.00	46.15	73.82	44.00	9.10	0.0124	0.02645
60	0.25	16	44	8.8	91.2	4	42.00	45.15	72.22	43.00	9.20	0.0124	0.01881
100	0.15	33	77	15.4	84.6	8	40.00	43.15	69.03	41.00	9.60	0.0124	0.01358
200	0.075	22	99	19.8	80.2	15	37.00	40.15	64.23	38.00	10.10	0.0124	0.01018
Pan	-	401	500	100	0	30	35.00	38.15	61.03	36.00	10.40	0.0124	0.00730
						60	33.00	36.15	57.83	34.00	10.70	0.0124	0.00524
						90	31.00	34.15	54.63	32.00	11.10	0.0124	0.00435
						120	28.00	31.15	49.83	29.00	11.50	0.0124	0.00384
						240	23.00	26.15	41.83	24.00	12.40	0.0124	0.00282
						480	20.00	23.15	37.03	21.00	12.90	0.0124	0.00203
Water Density varies with temperature, g _{Wet T}						= 0.99624							
K = (1000 x Gs x g _{Wet T})/(10 x Ws(Gs -1))						= 2.0331							
Kt = f(Gs,T)						= 0.0124							
Temperatur Correction (Ft) = -4.85 + 0.25 T)						= 2.15							
Zero Correction (Fz)						= -1.0							
Meniscus correction (Fm)						= 1							
Gs Correction						= 1.00							

GRAIN SIZE DISTRIBUTION CURVE



Gravel **0.80 %**
 Sand **19.00 %**
 Silt **43.17 %**
 Clay **37.03 %**

TEST RESULTS OF GRAIN-SIZE ANALYSIS

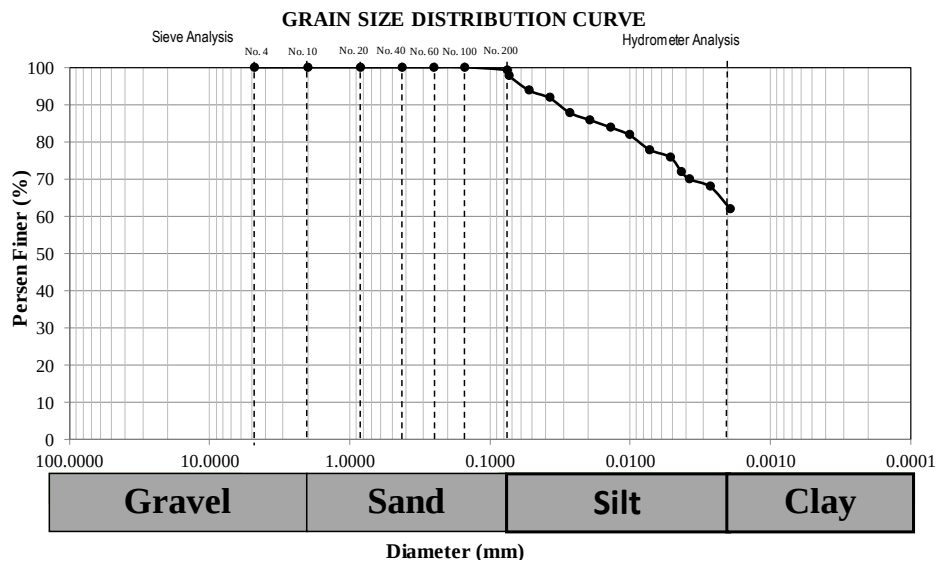
(Sieve-Mechanical and Hydrometer Methods)

PROJECT : PENELITIAN TUGAS AKHIR
 LOCATION : LABORATORIUM MEKANIKA TANAH FT-UH
 SAMPLING DEPTH : -
 TESTING METHOD : ASTM D6913-17, ASTM D7928-17, ASTM D2487
 LABORATORY : HASANUDDIN UNIVERSITY
 TESTED BY : ANDI AMMAR JULTIAR ALAM
 DATE : 27-02-2023



Jenis Tanah : Tanah Lempung Ekspansif

Dry specimen mass : 500 gr						Hydrometer Sample : 50.0 gr							
Specific Gravity, Gs : 2.64						Temperature, T: 28.0 °C							
Washing : YES NO													
Sieve Analysis						Hydrometer Analysis							
Sieve No.	Diameter (mm)	Retained Mass (gr)	Cumulative Retained Mass (gr)	Percent of Cumulative Retained (%)	Percent Finer (%)	Time (minutes)	R	Rcp = R+Ft-Fz	% Finer = ((a x Rcp)/Ws)x100% %Fine Sieve Analysis	RcL= R + Fm	L (cm)	A	D=A\ L/t (mm)
4	4.75	0	0	0	100	0.25	46.00	49.15	97.73	47.00	8.60	0.0124	0.07273
10	2	0	0	0	100	0.5	44.00	47.15	93.76	45.00	8.90	0.0124	0.05232
20	0.84	0	0	0	100	1	43.00	46.15	91.77	44.00	9.10	0.0124	0.03741
40	0.425	0	0	0	100	2	41.00	44.15	87.79	42.00	9.40	0.0124	0.02688
60	0.25	0	0	0	100	4	40.00	43.15	85.80	41.00	9.60	0.0124	0.01921
100	0.15	0	0	0	100	8	39.00	42.15	83.81	40.00	9.70	0.0124	0.01365
200	0.075	4	4	0.8	99.2	15	38.00	41.15	81.82	39.00	9.90	0.0124	0.01007
0	60	496	500	100	0	30	36.00	39.15	77.85	37.00	10.20	0.0124	0.00723
						60	35.00	38.15	75.86	36.00	10.40	0.0124	0.00516
						90	33.00	36.15	71.88	34.00	10.70	0.0124	0.00428
						120	32.00	35.15	69.89	33.00	10.90	0.0124	0.00374
						240	31.00	34.15	67.91	32.00	11.10	0.0124	0.00267
						480	28.00	31.15	61.94	29.00	11.50	0.0124	0.00192
Water Density varies with temperature, g _{Wet T}						= 0.99624							
K = (1000 x Gs x g _{wet T})/(10 x Ws(Gs - 1))						= 2.0331							
Kt = f(Gs,T)						= 0.0124							
Temperatur Correction (Ft) = -4.85 + 0.25 T)						= 2.15							
Zero Correction (Fz)						= -1.0							
Meniscus correction (Fm)						= 1							
Gs Correction						= 1.00							



TEST RESULTS OF GRAIN-SIZE ANALYSIS

(Sieve-Mechanical and Hydrometer Methods)

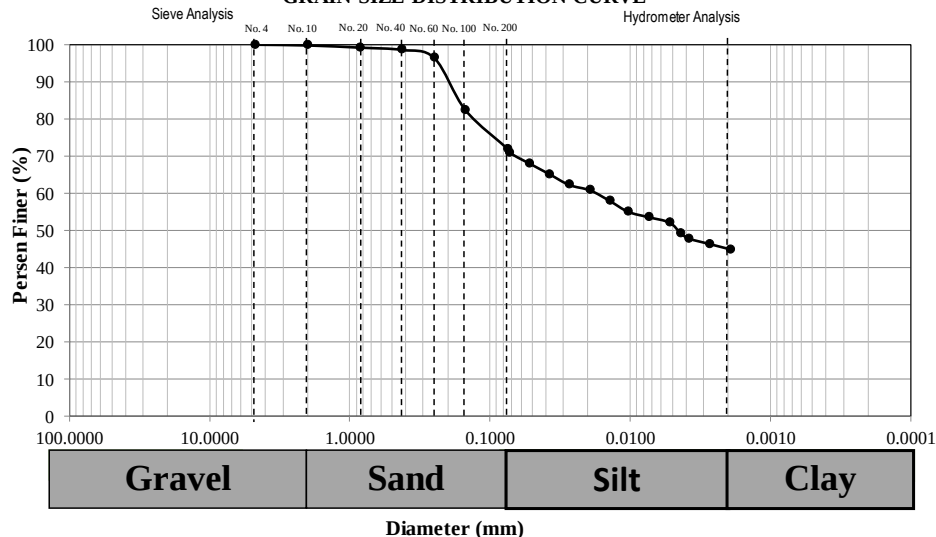
PROJECT : PENELITIAN TUGAS AKHIR
 LOCATION : LABORATORIUM MEKANIKA TANAH FT-UH
 SAMPLING DEPTH : -
 TESTING METHOD : ASTM D6913-17, ASTM D7928-17, ASTM D2487
 LABORATORY : HASANUDDIN UNIVERSITY
 TESTED BY : ANDI AMMAR JULTIAR ALAM
 DATE : 27-02-2023



Jenis Tanah : 70% Tanah Lempung Ekspansif
 - 30% Tanah Lanau PR

Dry specimen mass : 500 gr						Hydrometer Sample : 50.0 gr							
Specific Gravity, Gs : 2.64						Temperature, T : 28.0 °C							
Washing : YES NO													
Sieve Analysis						Hydrometer Analysis							
Sieve No.	Diameter (mm)	Retained Mass (gr)	Cumulative Retained Mass (gr)	Percent of Cumulative Retained (%)	Percent Finer (%)	Time (minutes)	R	Rcp = R+Ft-Fz	% Finer = (G x Rcp) / Ws x 100% % Finer Sieve Analysis	RcL = R + Fm	L (cm)	A	D=A/Lt (mm)
4	4.75	0	0	0	100	0.25	46.00	49.15	70.93	47.00	8.60	0.0124	0.07273
10	2	1	1	0.2	99.8	0.5	44.00	47.15	68.05	45.00	8.90	0.0124	0.05232
20	0.84	3	4	0.8	99.2	1	42.00	45.15	65.16	43.00	9.20	0.0124	0.03761
40	0.425	3	7	1.4	98.6	2	40.00	43.15	62.28	41.00	9.60	0.0124	0.02717
60	0.25	11	18	3.6	96.4	4	39.00	42.15	60.83	40.00	9.70	0.0124	0.01931
100	0.15	70	88	17.6	82.4	8	37.00	40.15	57.95	38.00	10.10	0.0124	0.01393
200	0.075	52	140	28	72	15	35.00	38.15	55.06	36.00	10.40	0.0124	0.01033
Pan	-	360	500	100	0	30	34.00	37.15	53.62	35.00	10.60	0.0124	0.00737
						60	33.00	36.15	52.17	34.00	10.70	0.0124	0.00524
						90	31.00	34.15	49.29	32.00	11.10	0.0124	0.00435
						120	30.00	33.15	47.84	31.00	11.20	0.0124	0.00379
						240	29.00	32.15	46.40	30.00	11.40	0.0124	0.00270
						480	28.00	31.15	44.96	29.00	11.50	0.0124	0.00192
Water Density varies with temperature, g _{Wet T}						= 0.99624							
K = (1000 x Gs x g _{Wet T}) / (10 x Ws(Gs -1))						= 2.0331							
Kt = f(Gs,T)						= 0.0124							
Temperatur Correction (Ft) = -4.85 + 0.25 T)						= 2.15							
Zero Correction (Fz)						= -1.0							
Meniscus correction (Fm)						= 1							
Gs Correction						= 1.00							

GRAIN SIZE DISTRIBUTION CURVE



Gravel 0.20 %
 Sand 27.80 %
 Silt 27.04 %
 Clay 44.96 %

TEST RESULTS OF GRAIN-SIZE ANALYSIS

(Sieve-Mechanical and Hydrometer Methods)

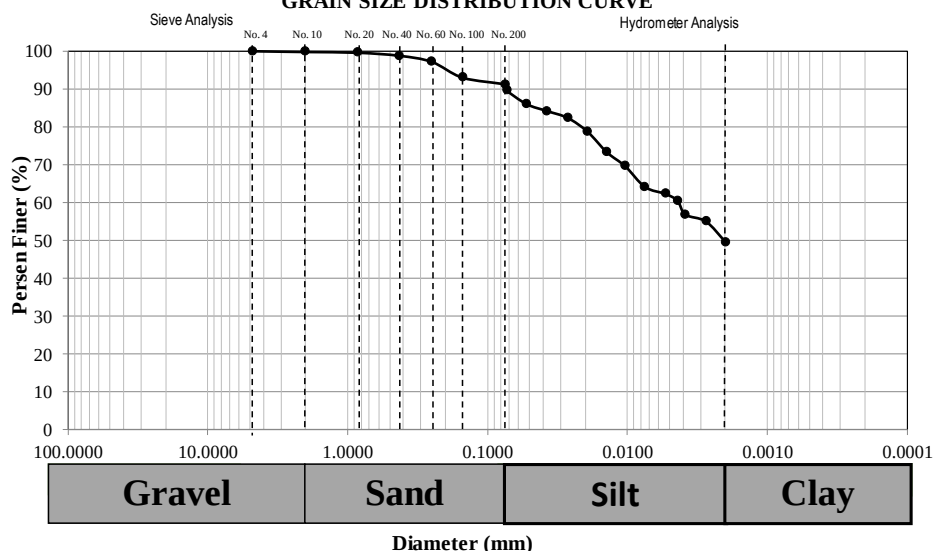
PROJECT : PENELITIAN TUGAS AKHIR
 LOCATION : LABORATORIUM MEKANIKA TANAH FT-UH
 SAMPLING DEPTH : -
 TESTING METHOD : ASTM D6913-17, ASTM D7928-17, ASTM D2487
 LABORATORY : HASANUDDIN UNIVERSITY
 TESTED BY : ANDI AMMAR JULTIAR ALAM
 DATE : 27-02-2023



Jenis Tana : 50% Tanah Lempung Ekspansif -
 50% Tanah Lanau PR

Dry specimen mass : 500 gr						Hydrometer Sample : 50.0 gr							
Specific Gravity, Gs : 2.649380441						Temperature, T : 28.0 °C							
Washing : YES NO													
Sieve Analysis						Hydrometer Analysis							
Sieve No.	Diameter (mm)	Retained Mass (gr)	Cumulative Retained Mass (gr)	Percent of Cumulative Retained (%)	Percent Finer (%)	Time (minutes)	R	Rcp =R+Ft-Fz	% Finer = (a x Rcp)/Ws x 100% %Finer Sieve Analysis	RcL= R + Fm	L (cm)	A	D=A\!L x (mm)
4	4.75	0	0	0	100	0.25	46.00	49.15	89.66	47.00	8.60	0.0124	0.07273
10	2	1	1	0.2	99.8	0.5	44.00	47.15	86.01	45.00	8.90	0.0124	0.05232
20	0.84	1	2	0.4	99.6	1	43.00	46.15	84.19	44.00	9.10	0.0124	0.03741
40	0.425	4	6	1.2	98.8	2	42.00	45.15	82.37	43.00	9.20	0.0124	0.02660
60	0.25	8	14	2.8	97.2	4	40.00	43.15	78.72	41.00	9.60	0.0124	0.01921
100	0.15	21	35	7	93	8	37.00	40.15	73.24	38.00	10.10	0.0124	0.01393
200	0.075	9	44	8.8	91.2	15	35.00	38.15	69.60	36.00	10.40	0.0124	0.01033
Pan	-	456	500	100	0	30	32.00	35.15	64.12	33.00	10.90	0.0124	0.00747
						60	31.00	34.15	62.30	32.00	11.10	0.0124	0.00533
						90	30.00	33.15	60.47	31.00	11.20	0.0124	0.00437
						120	28.00	31.15	56.83	29.00	11.50	0.0124	0.00384
						240	27.00	30.15	55.00	28.00	11.70	0.0124	0.00274
						480	24.00	27.15	49.53	25.00	12.20	0.0124	0.00198
Water Density varies with temperature, g _{Wet T}						= 0.99624							
K = (1000 x Gs x g _{wet T})/(10 x Ws(Gs -1))						= 2.0331							
Kt = f(Gs,T)						= 0.0124							
Temperatur Correction (Ft) = -4.85 + 0.25 T)						= 2.15							
Zero Correction (Fz)						= -1.0							
Meniscus correction (Fm)						= 1							
Gs Correction						= 1.00							

GRAIN SIZE DISTRIBUTION CURVE



Gravel 0.20 %
 Sand 8.60 %
 Silt 41.67 %
 Clay 49.53 %

ATTERBERG LIMITS TEST												
PROJECT	: PENELITIAN TUGAS AKHIR											
LOCATION	: LABORATORIUM MEKANIKA TANAH FT-UH											
QUARRY	: -											
TYPE OF SOIL	: TANAH LANAU PLASTISITAS RENDAH											
TESTING METHOD	: ASTM D4318-10, ASTM D4943-08, ASTM D2487										TESTED BY : ANDI AMMAR JULTIAR.A	
LABORATORY	: HASANUDDIN UNIVERSITY										DATE : 27-02-2023	
Sample No.	:	1										
Depth of Sample	:	-										
	Unit	Plastic Limit		Liquid Limit								Shrinkage Limit
Test Number	-	1	2	1	2	3	4					1
Number of Blows, N	-	-	-	15	21	25	31					-
Container No. or Can No.	-	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	F1
Weight of Wet Soil+Can, W1	gram	16.34	14.99	29.75	21.76	31.93	31.91	29.93	27.08	36.99	31.17	65.55
Weight of Dry Soil+Can, W2	gram	14.78	13.83	22.66	17.23	26.32	26.63	22.87	20.88	30.16	26.22	46.36
Weight of Water, Ww=W1-W2	gram	1.56	1.16	7.09	4.53	5.61	5.28	7.06	6.20	6.83	4.95	19.19
Weight of Can, W3	gram	11.26	11.19	8.78	8.06	14.62	15.77	8.05	7.99	15.49	15.54	10.35
Weight of Dry Soil, Ws=W2-W3	gram	3.52	2.64	13.88	9.17	11.70	10.86	14.82	12.89	14.67	10.68	36.01
Water Content, w=Ww/Ws*100%	%	44.3	43.9	51.1	49.4	47.9	48.6	47.6	48.1	46.6	46.3	53.29
Average of Water Content, w	%	44.13		50.24	48.28	47.87	46.45		53.29			
Weight of Can+Hg, W1	gram											500
Weight of Shrink dish	gram											35.12
Weight of displaced Hg + Shrink dish	gram											347
Hg content	gr/cm ³											13.6
Volume of Wet Soil	cm ³											36.00
Volume of Dry Soil	cm ³											22.93
Shrinkage Limit	%											17
Average Shrinkage Limit	%											17

Chart for Liquid Limit Determination

Number of Blows, N

Chart for the Unified Soil Classification System

Liquid Limit, wL (%)

Atterberg Limits		Value
Plastic Limit, ωp (%)		44
Liquid Limit, ωL (%)		48
Plastic Index, Ip=ωL-ωp		3
Shrinkage Limit, ωL (%)		17

USCS Classification : ML

▲ : Sample Position in the Chart

ATTERBERG LIMITS TEST													
PROJECT		: SOIL INVESTIGATION REPORT											
LOCATION		: LABORATORIUM MEKANIKA TANAH FT-UH											
QUARRY		: -											
TYPE OF SOIL		: BENTONITE											
TESTING METHOD		: ASTM D4318-10, ASTM D4943-08, ASTM D2487										TESTED BY	: ANDI AMMAR JULTIAR.A
LABORATORY		: HASANUDDIN UNIVERSITY										DATE	: 28-02-2023

Sample No.	:	Sampel 70% Bentonite - 30 % Tanah Asli										
Depth of Sample	:	11.50-12.00 m										

	Unit	Plastic Limit		Liquid Limit								Shrinkage Limit
Test Number	-	1	2	1	2	3	4	5	6	7	8	1
Number of Blows, N	-	-	-	19	24	27	29					-
Container No. or Can No.	-	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	F1
Weight of Wet Soil+Can, W1	gram	12.69	12.57	39.66	37.99	35.55	34.61	39.20	35.76	34.64	32.43	52.37
Weight of Dry Soil+Can, W2	gram	12.15	12.00	17.87	17.41	17.69	17.31	19.41	18.24	18.21	17.56	26.49
Weight of Water, Ww=W1-W2	gram	0.54	0.57	21.79	20.58	17.86	17.30	19.79	17.52	16.43	14.87	25.88
Weight of Can, W3	gram	11.38	11.19	9.70	9.72	9.70	9.67	9.64	9.68	9.70	9.76	10.29
Weight of Dry Soil, Ws=W2-W3	gram	0.77	0.81	8.17	7.69	7.99	7.64	9.77	8.56	8.51	7.80	16.2
Water Content, w=Ww/Ws*100%	%	70.1	70.4	266.7	267.6	223.5	226.4	202.6	204.7	193.1	190.6	159.75
Average of Water Content, w	%	70.25	70.4	267.16	267.6	224.98	226.4	203.62	204.7	191.85	190.6	159.75
Weight of Can+Hg, W1	gram	X										426
Weight of Shrink dish	gram											35
Weight of displaced Hg + Shrink dish	gram											131
Hg content	gr/cm ³											13.6
Volume of Wet Soil	cm ³											30.57
Volume of Dry Soil	cm ³											7.06
Shrinkage Limit	%											15
Average Shrinkage Limit	%											15

Chart for Liquid Limit Determination

Chart for the Unified Soil Classification System

Atterberg Limits		Value
Plastic Limit, ω_p (%)		70
Liquid Limit, ω_L (%)		218
Plastic Index, $I_p = \omega_L - \omega_p$		148
Shrinkage Limit, ω_L (%)		15

USCS Classification : CH

▲ : Sample Position in the Chart

ATTERBERG LIMITS TEST												
PROJECT	: SOIL INVESTIGATION REPORT											
LOCATION	: LABORATORIUM MEKANIKA TANAH FT-UH											
QUARRY	: -											
TYPE OF SOIL	: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LAMAU PR											
TESTING METHOD	: ASTM D4318-10, ASTM D4943-08, ASTM D2487										TESTED BY	: ANDI AMMAR JULTIAR.A
LABORATORY	: HASANUDDIN UNIVERSITY										DATE	: 28-02-2023
Sample No.	:	3										
Depth of Sample	:	-										
	Unit	Plastic Limit		Liquid Limit								Shrinkage Limit
Test Number	-	1	2	1	2	3	4					1
Number of Blows, N	-	-	-	15	20	23	29					-
Container No. or Can No.	-	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	F1
Weight of Wet Soil+Can, W1	gram	15.23	14.70	22.01	21.34	20.97	20.79	27.13	19.30	28.99	25.48	54.29
Weight of Dry Soil+Can, W2	gram	13.84	13.59	13.42	13.15	13.22	13.06	15.66	12.67	20.92	16.15	28.91
Weight of Water, Ww=W1-W2	gram	1.39	1.11	8.59	8.19	7.75	7.73	11.47	6.63	8.07	9.33	25.38
Weight of Can, W3	gram	11.25	11.27	8.20	7.90	8.20	8.00	8.10	8.30	15.40	9.80	9.93
Weight of Dry Soil, Ws=W2-W3	gram	2.59	2.32	5.22	5.25	5.02	5.06	7.56	4.37	5.52	6.35	18.98
Water Content, w=Ww/Ws*100%	%	53.7	47.8	164.6	156.0	154.4	152.8	151.7	151.7	146.2	146.9	133.72
Average of Water Content, w	%	50.76		160.28		153.57		151.72		146.56		133.72
Weight of Can+Hg, W1	gram											469
Weight of Shrink dish	gram											35.11
Weight of displaced Hg + Shrink dish	gram											205
Hg content	gr/cm ³											13.6
Volume of Wet Soil	cm ³											33.76
Volume of Dry Soil	cm ³											12.49
Shrinkage Limit	%											22
Average Shrinkage Limit	%											22

Chart for Liquid Limit Determination

Atterberg Limits		Value
Plastic Limit, ω_p (%)		51
Liquid Limit, ω_L (%)		150
Plastic Index, $I_p = \omega_L - \omega_p$		99
Shrinkage Limit, ω_L (%)		22

Chart for the Unified Soil Classification System

USCS Classification : CH

▲ : Sample Position in the Chart

ATTERBERG LIMITS TEST													
PROJECT		: SOIL INVESTIGATION REPORT											
LOCATION		: LABORATORIUM MEKANIKA TANAH FT-UH											
QUARRY		: -											
TYPE OF SOIL		: 50% TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR											
TESTING METHOD		: ASTM D4318-10, ASTM D4943-08, ASTM D2487										TESTED BY	: ANDI AMMAR JULITARA
LABORATORY		: HASANUDDIN UNIVERSITY										DATE	: 28-02-2023

Sample No.	:	4										
Depth of Sample	:	-										

	Unit	Plastic Limit		Liquid Limit								Shrinkage Limit
Test Number	-	1	2	1	2	3	4	5	6	7	8	9
Number of Blows, N	-	-	-	13	20	26	30					
Container No. or Can No.	-	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2	F1
Weight of Wet Soil+Can, W1	gram	17.51	15.08	28.75	27.96	18.09	16.71	26.01	21.59	29.56	26.44	52.98
Weight of Dry Soil+Can, W2	gram	16.49	14.43	20.92	20.36	12.42	12.27	16.88	15.20	22.04	20.37	29.50
Weight of Water, Ww=W1-W2	gram	1.02	0.65	7.83	7.60	5.67	4.44	9.13	6.39	7.52	6.07	23.48
Weight of Can, W3	gram	14.13	12.86	15.17	15.11	8.11	8.61	9.31	9.89	15.72	15.38	10.33
Weight of Dry Soil, Ws=W2-W3	gram	2.36	1.57	5.75	5.25	4.31	3.66	7.57	5.31	6.32	4.99	19.17
Water Content, w=Ww/Ws*100%	%	43.2	41.4	136.2	144.8	131.6	121.3	120.6	120.3	119.0	121.6	122.48
Average of Water Content, w	%	42.31		140.47		126.43		120.47		120.32		122.48
Weight of Can+Hg, W1	gram	X										446
Weight of Shrink dish	gram											35.11
Weight of displaced Hg + Shrink dish	gram											226
Hg content	gr/cm ³											13.6
Volume of Wet Soil	cm ³											32.03
Volume of Dry Soil	cm ³											14.04
Shrinkage Limit	%											29
Average Shrinkage Limit	%											29

Chart for Liquid Limit Determination

Water Content, ω (%)

Number of Blows, N

Chart for the Unified Soil Classification System

Plasticity Index, I_p (%)

Liquid Limit, ω_L (%)

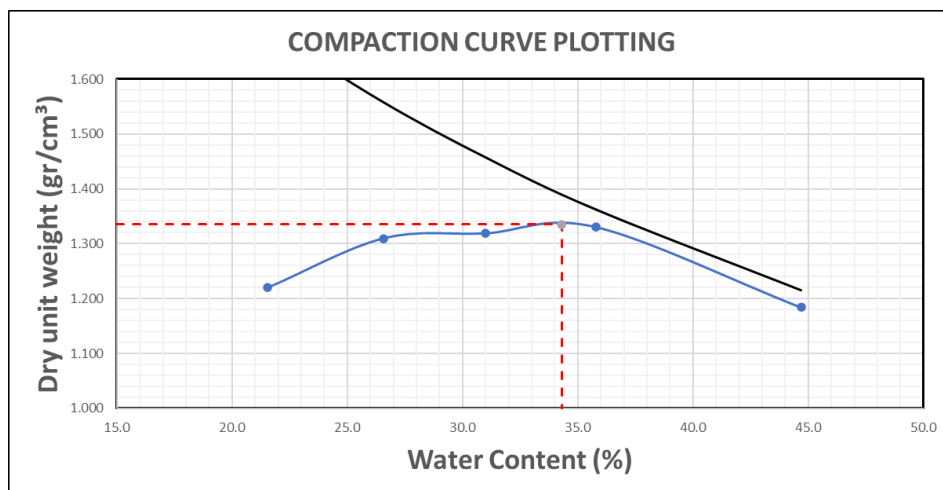
USCS Classification : CH

▲ : Sample Position in the Chart

Atterberg Limits	Value
Plastic Limit, ω_p (%)	42
Liquid Limit, ω_L (%)	123
Plastic Index, $I_p = \omega_L - \omega_p$	80
Shrinkage Limit, ω_L (%)	29

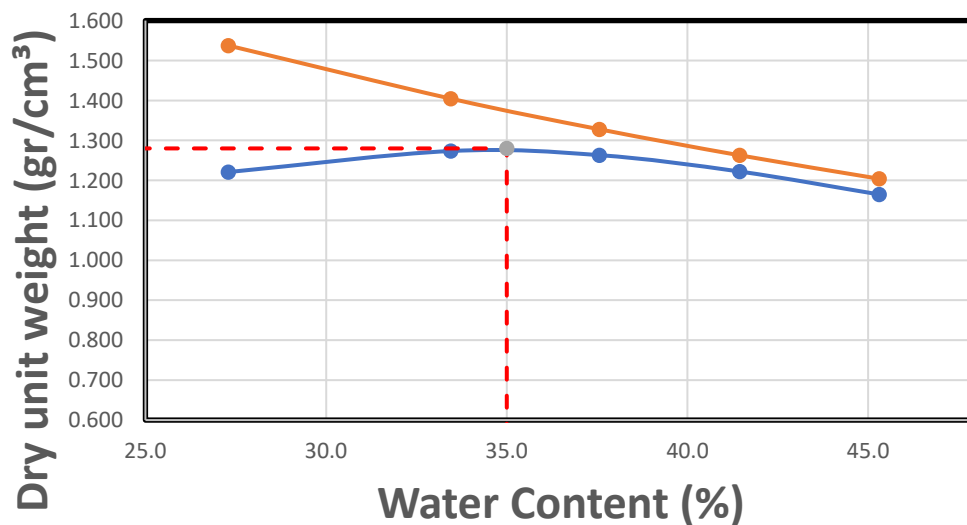
Lampiran 2. Data Pengujian Sifat Mekanis Tanah

STANDARD COMPACTION TEST RESULTS											
PROJECT	: PENELITIAN TUGAS AKHIR										
LOCATION	: LABORATORIUM MEKANIKA TANAH FT-UH										
QUARRY	: -										
SAMPLE / SAMPLE NO.	: TANAH LANAU PLASTISITAS RENDAH										
TESTING METHOD	: ASTM D 698-12, SNI 1742:2008			TESTED BY	: ANDI AMMAR JULTIAR						
LABORATORY	: HASANUDDIN UNIVERSITY			DATE	: 21-03-2023						
Weight of soil	gram	2000	2000	2000	2000	2000					
Initial water content	%	5.1	5.1	5.1	5.1	5.1					
Water addition	ml	300	400	500	600	700					
Molding water content	%	20.8	26.1	31.3	36.6	41.9					
Wet Density											
Mold No.	-	1	2	3	4	5					
Weight of Mold	gram	3528	3528	3528	3528	3528					
Weight of wet soil + mold	gram	4979	5151	5219	5296	5205					
Weight of wet soil, W _{wet}	gram	1451	1623	1691	1768	1677					
Volume of Mold	cm ³	979	979	979	979	979					
Wet unit weight	gr/cm ³	1.482	1.658	1.728	1.806	1.713					
Water Content											
Container No.	-	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B
Weight of wet soil + container	gram	21.88	19.67	18.89	19.62	19.97	21.14	22.97	19.53	42.42	36.80
Weight of dry soil + container	gram	18.63	16.84	15.71	16.27	16.09	16.98	17.85	15.34	32.42	28.28
Weight of water	gram	3.25	2.83	3.18	3.35	3.88	4.16	5.12	4.19	10	8.52
Weight of container	gram	3.59	3.65	3.72	3.70	3.56	3.57	3.58	3.61	9.85	9.38
Weight of dry soil	gram	15.04	13.19	11.99	12.57	12.53	13.41	14.27	11.73	22.57	18.9
Water Content	%	21.6	21.5	26.5	26.7	31.0	31.0	35.9	35.7	44.3	45.1
Avg. water content	%	21.5	26.6	31.0	35.8	44.7					
Dry Density											
Weight of dry soil											
$W_{dry} = \frac{W_{wet}}{1 + \left(\frac{W}{100}\right)}$	gram	1193.92	1282.13	1290.90	1301.92	1159.01					
Dry unit weight											
$\gamma_{dry} = \frac{W_{dry}}{V_{mould}}$	gr/cm ³	1.220	1.310	1.319	1.330	1.184					
gzav = gw/(w+(1/Gs))	gr/cm ³	1.69	1.56	1.46	1.36	1.22					

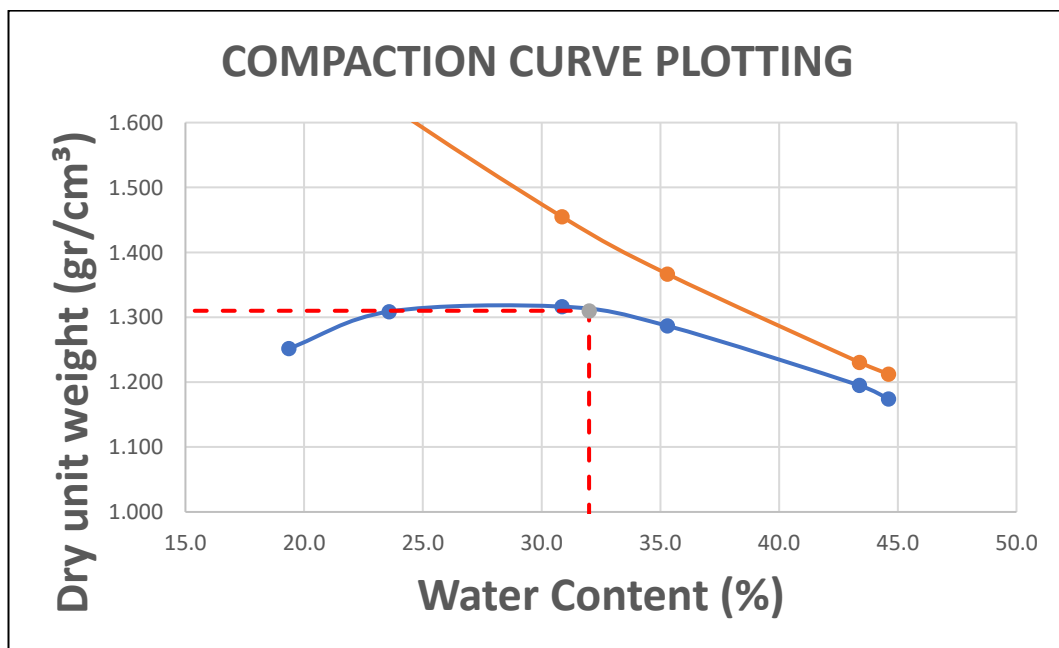


STANDARD COMPACTION TEST RESULTS												
PROJECT		: SOIL INVESTIGATION REPORT										
LOCATION		: LABORATORIUM MEKANIKA TANAH FT-UH										
QUARRY		: -										
SAMPLE / SAMPLE NO.		: TANAH LEMPUNG EKSPANSIF										
TESTING METHOD		: ASTM D 698-12e2, SNI 1742:2008						TESTED BY		ANDI AMMAR JULTIAR A		
LABORATORY		: HASANUDDIN UNIVERSITY						DATE		: 23-03-2023		
Weight of soil	gram	2000	2000	2000	2000	2000						
Initial water content	%	6.0	6.0	6.0	6.0	6.0						
Water addition	ml	400	500	600	700	800						
Molding water content	%	27.2	32.5	37.8	43.1	48.4						
Wet Density												
Mold No.	-	1	2	3	4	4						
Weight of Mold	gram	3528	3528	3528	3528	3528						
Weight of wet soil + mold	gram	5077	5222	5260	5251	5215						
Weight of wet soil, W_{wet}	gram	1549	1694	1732	1723	1687						
Volume of Mold	cm ³	997	997	997	997	997						
Wet unit weight	gr/cm ³	1.554	1.700	1.738	1.729	1.693						
Water Content												
Container No.	-	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	
Weight of wet soil + container	gram	28.76	25.57	20.51	32.32	21.47	24.93	28.50	32.07	28.50	32.07	
Weight of dry soil + container	gram	24.33	21.8	16.74	25.57	17.13	19.57	22.52	25.05	22.12	24.62	
Weight of water	gram	4.43	3.77	3.77	6.75	4.34	5.36	5.98	7.02	6.38	7.45	
Weight of container	gram	8.11	7.98	5.45	5.43	5.46	5.44	8.13	8.07	8.13	8.07	
Weight of dry soil	gram	16.22	13.82	11.29	20.14	11.67	14.13	14.39	16.98	13.99	16.55	
Water Content	%	27.3	27.3	33.4	33.5	37.2	37.9	41.6	41.3	45.6	45.0	
Avg. water content	%	27.3		33.5		37.6		41.4		45.3		
Dry Density												
Weight of dry soil	gram	1216.85	1269.35	1259.07	1218.10	1160.97						
$W_{dry} = \frac{W_{wet}}{1 + \left(\frac{W}{100}\right)}$												
Dry unit weight	gr/cm ³	1.221	1.274	1.263	1.222	1.165						
$\gamma_{dry} = \frac{W_{dry}}{V_{mould}}$												
gzav = gw/(w+(1/Gs))	gr/cm ³	1.54	1.40	1.33	1.26	1.20						

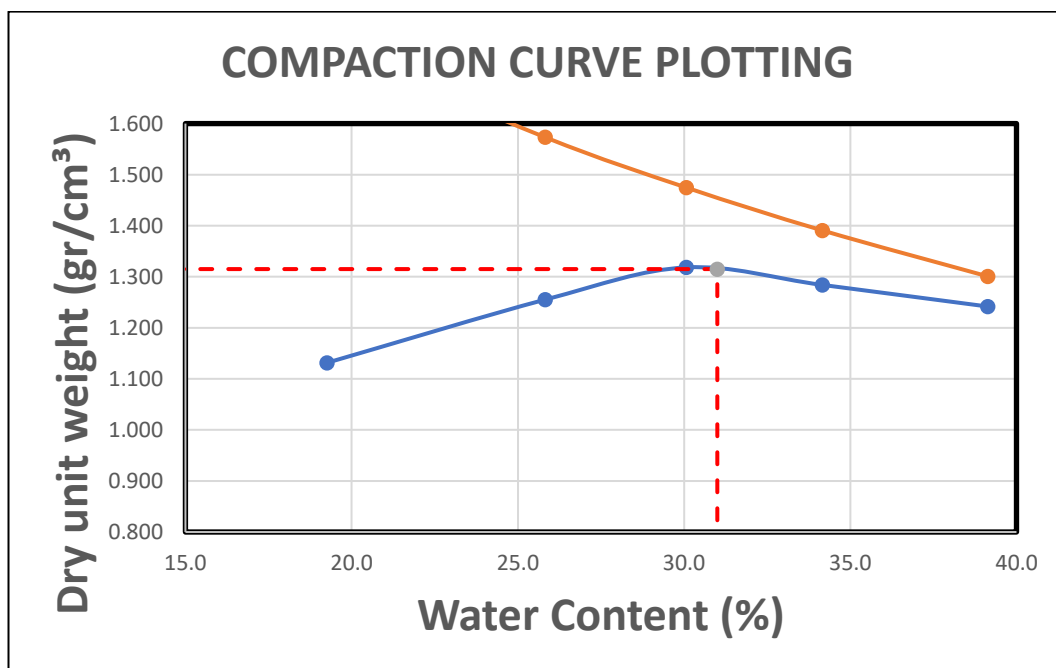
COMPACTION CURVE PLOTTING



STANDARD COMPACTION TEST RESULTS													
PROJECT	: PENELITIAN TUGAS AKHIR												
LOCATION	: LABORATORIUM MEKANIKA TANAH FT-UH												
QUARRY	: -												
SAMPLE / SAMPLE NO.	: 70 % TANAH LEMPUNG EKSPANSIF - 30 % TANAH LANAU PR												
TESTING METHOD	: ASTM D 698-12, SNI 1742:2008										TESTED BY	: ANDI AMMAR	
LABORATORY	: HASANUDDIN UNIVERSITY										DATE	: 23-03-2023	
Weight of soil	gram	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Initial water content	%	8.54	8.54	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Water addition	ml	200	300	400	500	600	700	800	900	1000	1100	1200	1300
Molding water content	%	19.4	24.8	30.3	35.7	41.1	46.5	51.9	57.3	62.7	68.1	73.5	78.9
Wet Density													
Mold No.	-	1	2	3	4	5	6	7	8	9	10	11	12
Weight of Mold	gram	3524	3524	3524	3524	3524	3524	3524	3524	3524	3524	3524	3524
Weight of wet soil + mold	gram	4987.1	5108	5211	5229	5202	5187	5163	5139	5115	5091	5067	5043
Weight of wet soil, W_{wet}	gram	1463.1	1584	1687	1705	1678	1663	1640	1616	1593	1569	1545	1521
Volume of Mold	cm ³	979	979	979	979	979	979	979	979	979	979	979	979
Wet unit weight	gr/cm ³	1.494	1.617	1.723	1.741	1.713	1.698	1.674	1.650	1.626	1.602	1.578	1.554
Water Content													
Container No.	-	1	2	1	2	1A	1B	2A	2B	3A	3B	3A	3B
Weight of wet soil + container	gram	46.8	44.3	45.1	55.1	53.70	56.50	71.10	44.60	52.80	49.60	35.08	44.45
Weight of dry soil + container	gram	40.87	38.58	38.08	46.23	43.01	45.21	54.87	35.22	39.34	35.74	26.81	31.94
Weight of water	gram	5.93	5.72	7.02	8.87	10.69	11.29	16.23	9.38	13.46	13.86	8.27	12.51
Weight of container	gram	9.6	9.6	8.58	8.28	8.45	8.53	8.48	8.87	8.39	3.71	8.39	3.71
Weight of dry soil	gram	31.27	28.98	29.5	37.95	34.56	36.68	46.39	26.35	30.95	32.03	18.42	28.23
Water Content	%	19.0	19.7	23.8	23.4	30.9	30.8	35.0	35.6	43.5	43.3	44.9	44.3
Avg. water content	%	19.4	23.6	30.9	35.3	43.4	44.6	45.8	46.5	47.2	47.9	48.6	49.3
Dry Density													
Weight of dry soil	gram	1225.88	1281.71	1289.21	1260.24	1170.31	1150.02	1130.73	1111.44	1092.15	1072.86	1053.57	1034.28
Dry unit weight	gr/cm ³	1.252	1.309	1.316	1.287	1.195	1.174	1.182	1.153	1.160	1.131	1.138	1.109
$g_{zav} = gw/(w+(1/G_s))$	gr/cm ³	1.75	1.63	1.45	1.37	1.23	1.21	1.09	1.07	1.05	1.03	1.01	0.99

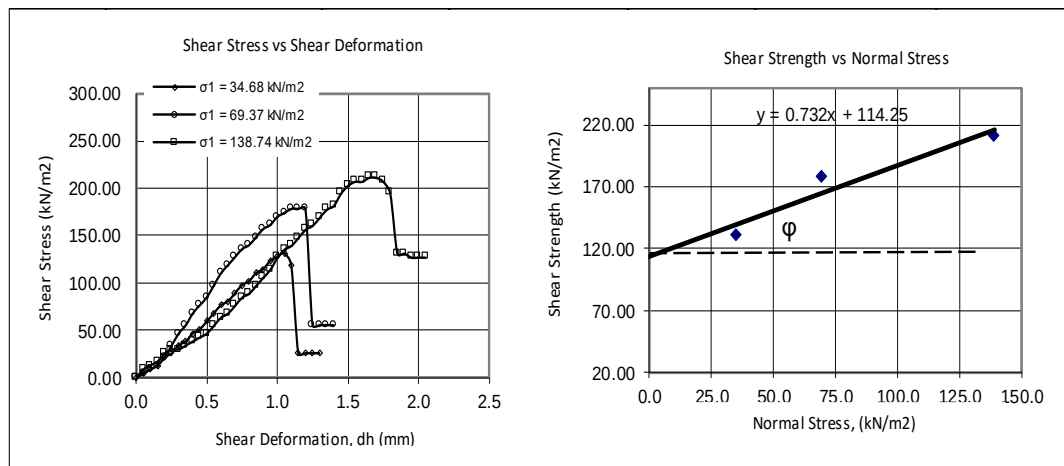


STANDARD COMPACTION TEST RESULTS												
PROJECT	: PENELITIAN TUGAS AKHIR											
LOCATION	: LABORATORIUM MEKANIKA TANAH FT-UH											
QUARRY	: -											
SAMPLE / SAMPLE NO.	: 50 % TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR											
TESTING METHOD	: ASTM D 698-12, SNI 1742:2008						TESTED BY	: ANDI AMMAR JULTIAR				
LABORATORY	: HASANUDDIN UNIVERSITY						DATE	: 23-03-2023				
Weight of soil	gram	2000	2000	2000	2000	2000						
Initial water content	%	8.9	8.9	8.9	8.9	8.9						
Water addition	ml	200	300	400	500	600						
Molding water content	%	19.8	25.2	30.7	36.1	41.6						
Wet Density												
Mold No.	-	1	2	3	4	5						
Weight of Mold	gram	3528	3528	3528	3528	3528						
Weight of wet soil + mold	gram	4873	5102	5237	5245	5250						
Weight of wet soil, W_{wet}	gram	1345	1574	1709	1717	1722						
Volume of Mold	cm ³	997	997	997	997	997						
Wet unit weight	gr/cm ³	1.349	1.579	1.715	1.723	1.728						
Water Content												
Container No.	-	1A	1B	2A	2B	3A	3B	4A	4B	5A	5B	
Weight of wet soil + container	gram	32.6	35	20.19	18.68	17.21	17.27	16.02	18.88	22.40	29.27	
Weight of dry soil + container	gram	29.5	32.2	16.92	15.51	14.05	14.11	12.92	14.93	17.23	21.89	
Weight of water	gram	3.10	2.80	3.27	3.17	3.16	3.16	3.1	3.95	5.17	7.38	
Weight of container	gram	15.50	15.10	3.72	3.71	3.56	3.58	3.61	3.65	3.58	3.62	
Weight of dry soil	gram	14.00	17.10	13.20	11.8	10.49	10.53	9.31	11.28	13.65	18.27	
Water Content	%	22.1	16.4	24.8	26.9	30.1	30.0	33.3	35.0	37.9	40.4	
Avg. water content	%	19.3		25.8		30.1		34.2		39.1		
Dry Density												
Weight of dry soil												
$W_{dry} = \frac{W_{wet}}{1 + \left(\frac{W}{100}\right)}$	gram	1127.80		1251.01		1313.94		1279.84		1237.65		
Dry unit weight												
$\gamma_{dry} = \frac{W_{dry}}{V_{mould}}$	gr/cm ³	1.131		1.255		1.318		1.284		1.242		
$g_{zav} = gw/(w+(1/Gs))$	gr/cm ³	1.75		1.57		1.47		1.39		1.30		



Lampiran 3. Data Pengujian Sifat Mekanis (*Direct Shear Test*) Tanpa Bakteri

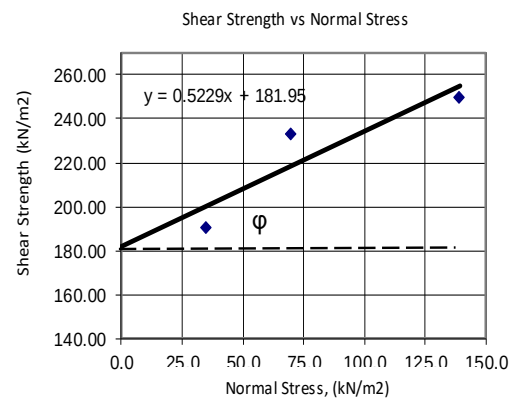
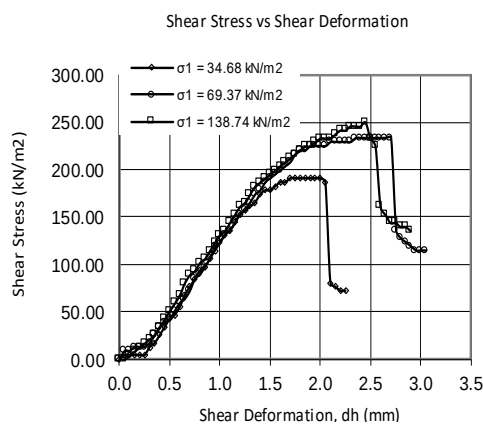
DIRECT SHEAR TEST RESULTS (UU)						
PROJECT		: PENELITIAN TUGAS AKHIR				
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				
SAMPLE		: TANAH LANAU PR				
QUARRY		: -				
TESTING METHOD		: ASTM D 3080-72		TESTED BY : ANDI AMMAR JULTIAR ALAM		
LABORATORY		: HASANUDDIN UNIVERSITY		DATE : 15/05/2023		
Sample Size :		Proving Ring Calibration		= 1.22		kg/div
Diameter Sample	= 0.06	m	Displacement Rate		=	kg/div
Height of Sample	= 0.02	m	c		= 114.25	kN/m ²
Area of Sample	= 0.00283	m ²	φ		= 36.20	°
Test No.	TA01		TA02		TA04	
Normal Load	P1 = 10.00	kg	P1 = 20.00	kg	P1 = 40.00	kg
Normal Stress	σ1 = 34.68	kN/m ²	σ1 = 69.37	kN/m ²	σ1 = 138.74	kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	1.220	4.231	1.220	4.231	2.440	8.463
0.10	2.440	8.463	2.440	8.463	3.660	12.694
0.15	3.660	12.694	3.660	12.694	4.880	16.926
0.20	6.100	21.157	6.100	21.157	7.320	25.389
0.25	7.320	25.389	9.760	33.852	8.540	29.620
0.30	9.760	33.852	13.420	46.546	8.540	29.620
0.35	10.980	38.083	15.860	55.009	9.760	33.852
0.40	13.420	46.546	19.520	67.703	10.980	38.083
0.45	14.640	50.777	21.960	76.166	12.200	42.314
0.50	17.080	59.240	24.400	84.629	13.420	46.546
0.55	19.520	67.703	28.060	97.323	15.860	55.009
0.60	21.960	76.166	31.720	110.017	18.300	63.472
0.65	23.180	80.397	34.160	118.480	19.520	67.703
0.70	25.620	88.860	36.600	126.943	21.960	76.166
0.75	28.060	97.323	39.040	135.406	24.400	84.629
0.80	29.280	101.555	40.260	139.637	25.620	88.860
0.85	31.720	110.017	42.700	148.100	28.060	97.323
0.90	32.940	114.249	45.140	156.563	30.500	105.786
0.95	35.380	122.712	46.360	160.795	32.940	114.249
1.00	36.600	126.943	48.800	169.258	36.600	126.943
1.05	37.820	131.175	50.020	173.489	39.040	135.406
1.10	34.160	118.480	51.240	177.720	40.260	139.637
1.15	7.320	25.389	51.240	177.720	42.700	148.100
1.20	7.320	25.389	51.240	177.720	45.140	156.563
1.25	7.320	25.389	15.860	55.009	46.360	160.795
1.30	7.320	25.389	15.860	55.009	48.800	169.258
1.35	0.000		15.860	55.009	51.240	177.720
1.40	0.000		15.860	55.009	52.460	181.952
1.45	0.000		0.000		56.120	194.646
1.50	0.000		0.000		58.560	203.109
1.55	0.000		0.000		59.780	207.341
1.60	0.000		0.000		59.780	207.341
1.65	0.000		0.000		61.000	211.572
1.70	0.000		0.000		61.000	211.572
1.75	0.000		0.000		59.780	207.341
1.80	0.000		0.000		56.120	194.646
1.85	0.000		0.000		37.820	131.175
1.90	0.000		0.000		37.820	131.175
1.95	0.000		0.000		36.600	126.943
2.00	0.000		0.000		36.600	126.943
2.05	0.000		0.000		36.600	126.943



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	131.17	1.790
69,37	177.72	1.834
138,74	211.57	1.878

DIRECT SHEAR TEST RESULTS (UU)							
PROJECT		: PENELITIAN TUGAS AKHIR					
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA					
SAMPLE		: TANAH LEMPUNG EKSPANSIF					
QUARRY		: -					
TESTING METHOD		: ASTM D 3080-72		TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY		DATE		: 15/05/2023	
Sample Size :			Proving Ring Calibration		=	1.22 kg/div	
Diameter Sample		=	0.06 m	Displacement Rate		= kg/div	
Height of Sample		=	0.02 m	c	=	181.95 kN/m ²	
Area of Sample		=	0.00283 m ²	φ	=	27.60 °	
Test No.	BE01		BE04		BE03		
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg	
Normal Stress	σ1 =	34.68 kN/m ²	σ1 =	69.37 kN/m ²	σ1 =	138.74 kN/m ²	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	
	0.00	0.000	0.000	0.000	0.000	0.000	
	0.05	1.220	4.231	2.440	8.463	0.000	0.000
	0.10	1.220	4.231	2.440	8.463	1.220	4.231
	0.15	1.220	4.231	3.660	12.694	2.440	8.463
	0.20	1.220	4.231	3.660	12.694	3.660	12.694
	0.25	1.220	4.231	3.660	12.694	4.880	16.926
	0.30	3.660	12.694	4.880	16.926	6.100	21.157
	0.35	4.880	16.926	7.320	25.389	7.320	25.389
	0.40	7.320	25.389	9.760	33.852	9.760	33.852
	0.45	9.760	33.852	10.980	38.083	12.200	42.314
	0.50	12.200	42.314	12.200	42.314	14.640	50.777
	0.55	13.420	46.546	14.640	50.777	17.080	59.240
	0.60	15.860	55.009	17.080	59.240	19.520	67.703
	0.65	19.520	67.703	18.300	63.472	23.180	80.397
	0.70	21.960	76.166	20.740	71.934	25.620	88.860
	0.75	24.400	84.629	24.400	84.629	26.840	93.092
	0.80	26.840	93.092	25.620	88.860	29.280	101.555
	0.85	28.060	97.323	28.060	97.323	30.500	105.786
	0.90	30.500	105.786	30.500	105.786	32.940	114.249
	0.95	32.940	114.249	34.160	118.480	35.380	122.712
	1.00	35.380	122.712	35.380	122.712	37.820	131.175
	1.05	37.820	131.175	37.820	131.175	39.040	135.406
	1.10	39.040	135.406	39.040	135.406	41.480	143.869
	1.15	41.480	143.869	41.480	143.869	43.920	152.332
	1.20	43.920	152.332	43.920	152.332	46.360	160.795
	1.25	45.140	156.563	45.140	156.563	47.580	165.026
	1.30	46.360	160.795	47.580	165.026	50.020	173.489
	1.35	47.580	165.026	50.020	173.489	52.460	181.952
	1.40	50.020	173.489	51.240	177.720	53.680	186.183
	1.45	51.240	177.720	53.680	186.183	54.900	190.415
	1.50	51.240	177.720	54.900	190.415	56.120	194.646
1.55	52.460	181.952	56.120	194.646	57.340	198.878	
1.60	53.680	186.183	57.340	198.878	58.560	203.109	
1.65	53.680	186.183	58.560	203.109	59.780	207.341	
1.70	54.900	190.415	59.780	207.341	61.000	211.572	
1.75	54.900	190.415	62.220	215.803	62.220	215.803	
1.80	54.900	190.415	63.440	220.035	63.440	220.035	
1.85	54.900	190.415	63.440	220.035	64.660	224.266	
1.90	54.900	190.415	64.660	224.266	64.660	224.266	
1.95	54.900	190.415	64.660	224.266	65.880	228.498	
2.00	54.900	190.415	64.660	224.266	67.100	232.729	
2.05	53.680	186.183	64.660	224.266	67.100	232.729	

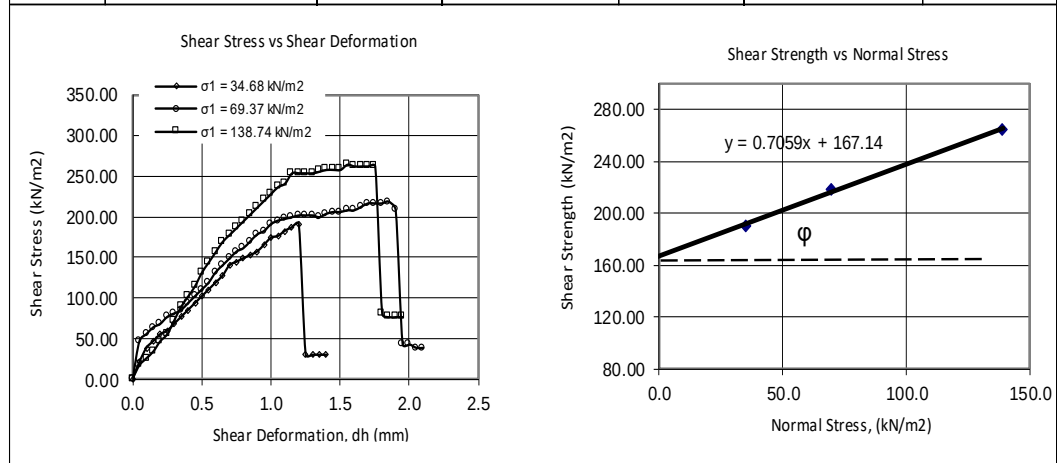
Test No.	BE01		BE04		BE03	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	σ_1 =	34.68 kN/m ²	σ_1 =	69.37 kN/m ²	σ_1 =	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	23.180	80.397	65.880	228.498	67.100	232.729
2.15	21.960	76.166	65.880	228.498	68.320	236.961
2.20	20.740	71.934	65.880	228.498	69.540	241.192
2.25	20.740	71.934	65.880	228.498	69.540	241.192
2.30	0.000		65.880	228.498	70.760	245.423
2.35	0.000		67.100	232.729	70.760	245.423
2.40	0.000		67.100	232.729	70.760	245.423
2.45	0.000		67.100	232.729	71.980	249.655
2.50	0.000		67.100	232.729	67.100	232.729
2.55	0.000		67.100	232.729	64.660	224.266
2.60	0.000		67.100	232.729	46.360	160.795
2.65	0.000		67.100	232.729	43.920	152.332
2.70	0.000		67.100	232.729	41.480	143.869
2.75	0.000		39.040	135.406	41.480	143.869
2.80	0.000		36.600	126.943	40.260	139.637
2.85	0.000		35.380	122.712	40.260	139.637
2.90	0.000		34.160	118.480	39.040	135.406
2.95	0.000		32.940	114.249	0.000	
3.00	0.000		32.940	114.249	0.000	
3.05	0.000		32.940	114.249	0.000	
3.10	0.000		0.000		0.000	
3.15	0.000		0.000		0.000	
3.20	0.000		0.000		0.000	
3.25	0.000		0.000		0.000	



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	190.41	1.842
69,37	232.73	1.923
138,74	249.65	1.930

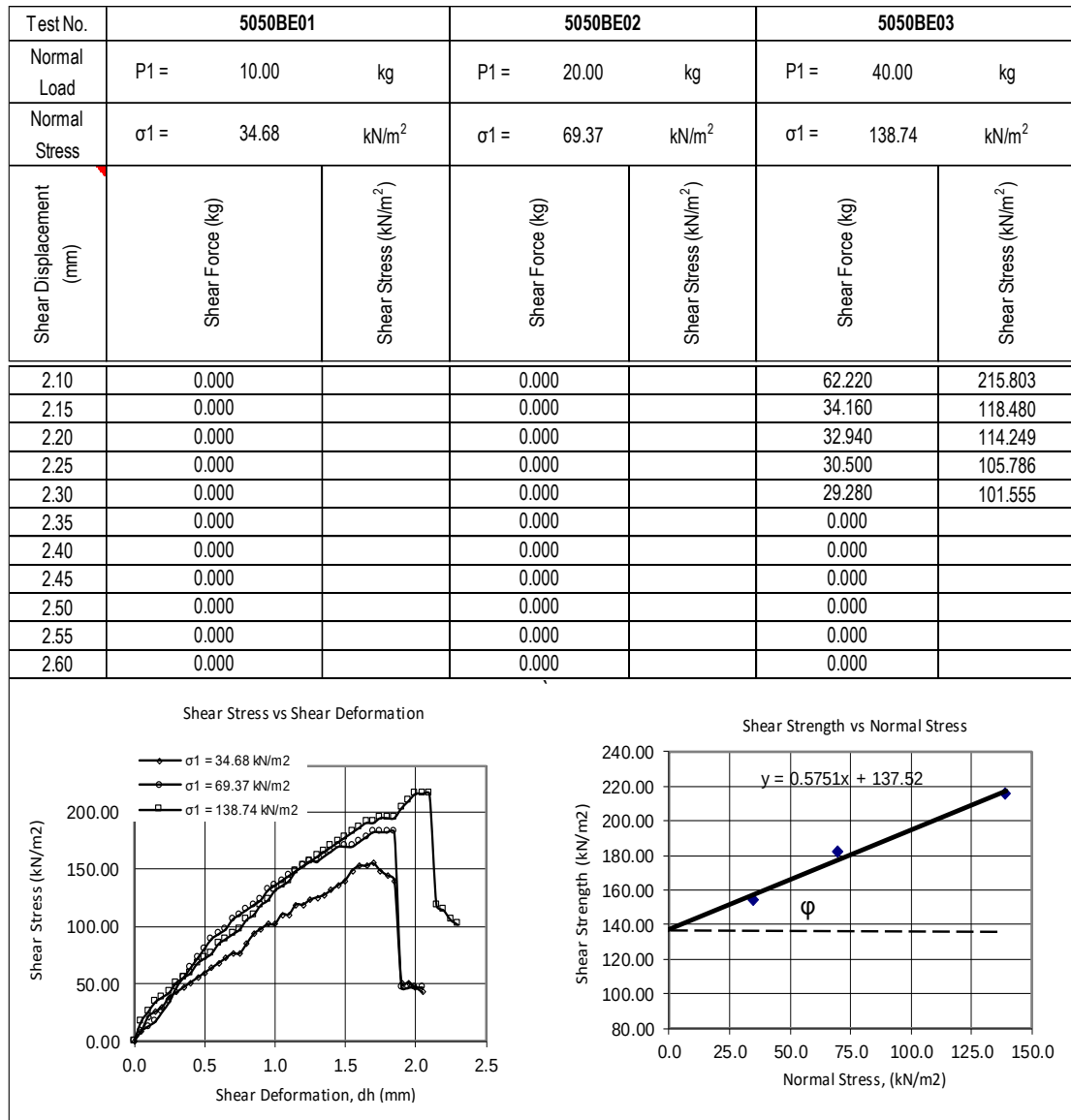
DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR							
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
SAMPLE		: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LANAU PR							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 15/05/2023	
Sample Size :				Proving Ring Calibration		=		1.22 kg/div	
Diameter Sample		=	0.06	m	Displacement Rate		=	kg/div	
Height of Sample		=	0.02	m	c		=	167.14 kN/m ²	
Area of Sample		=	0.00283	m ²	φ		=	35.22 °	
Test No.	7030BE01			7030BE02			7030BE03		
Normal Load	P1 =	10.00	kg	P1 =	20.00	kg	P1 =	40.00	kg
Normal Stress	σ1 =	34.68	kN/m ²	σ1 =	69.37	kN/m ²	σ1 =	138.74	kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)	
	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.05	6.100	21.157	13.420	46.546	4.880	16.926		
	0.10	10.980	38.083	15.860	55.009	7.320	25.389		
	0.15	13.420	46.546	18.300	63.472	9.760	33.852		
	0.20	15.860	55.009	19.520	67.703	13.420	46.546		
	0.25	17.080	59.240	21.960	76.166	15.860	55.009		
	0.30	19.520	67.703	23.180	80.397	20.740	71.934		
	0.35	21.960	76.166	24.400	84.629	25.620	88.860		
	0.40	24.400	84.629	26.840	93.092	29.280	101.555		
	0.45	26.840	93.092	29.280	101.555	32.940	114.249		
	0.50	29.280	101.555	31.720	110.017	37.820	131.175		
	0.55	31.720	110.017	34.160	118.480	41.480	143.869		
	0.60	34.160	118.480	37.820	131.175	45.140	156.563		
	0.65	36.600	126.943	40.260	139.637	48.800	169.258		
	0.70	40.260	139.637	42.700	148.100	51.240	177.720		
	0.75	41.480	143.869	45.140	156.563	53.680	186.183		
	0.80	42.700	148.100	46.360	160.795	56.120	194.646		
	0.85	43.920	152.332	48.800	169.258	58.560	203.109		
	0.90	45.140	156.563	51.240	177.720	61.000	211.572		
	0.95	47.580	165.026	52.460	181.952	63.440	220.035		
	1.00	50.020	173.489	54.900	190.415	65.880	228.498		
	1.05	50.630	175.605	56.120	194.646	68.320	236.961		
	1.10	52.460	181.952	56.730	196.762	69.540	241.192		
	1.15	53.680	186.183	57.340	198.878	73.200	253.886		
	1.20	54.900	190.415	57.950	200.993	73.200	253.886		
	1.25	8.540	29.620	57.950	200.993	73.200	253.886		
	1.30	8.540	29.620	57.950	200.993	73.200	253.886		
	1.35	8.540	29.620	57.340	198.878	73.810	256.002		
	1.40	8.540	29.620	58.560	203.109	74.420	258.118		
	1.45	0.000		59.170	205.225	74.420	258.118		
	1.50	0.000		59.170	205.225	74.420	258.118		
1.55	0.000		59.780	207.341	76.250	264.465			
1.60	0.000		59.780	207.341	75.640	262.349			
1.65	0.000		61.000	211.572	75.640	262.349			
1.70	0.000		62.220	215.803	75.640	262.349			
1.75	0.000		62.220	215.803	75.640	262.349			
1.80	0.000		62.220	215.803	23.180	80.397			
1.85	0.000		62.830	217.919	21.960	76.166			
1.90	0.000		59.780	207.341	21.960	76.166			
1.95	0.000		12.200	42.314	21.960	76.166			
2.00	0.000		12.200	42.314	0.000				
2.05	0.000		10.980	38.083	0.000				

Test No.	7030BE01		7030BE02		7030BE03	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	0.000		10.980	38.083	0.000	
2.15	0.000		0.000		0.000	
2.20	0.000		0.000		0.000	
2.25	0.000		0.000		0.000	
2.30	0.000		0.000		0.000	
2.35	0.000		0.000		0.000	



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	190.41	1.760
69,37	217.92	1.811
138,74	264.46	1.841

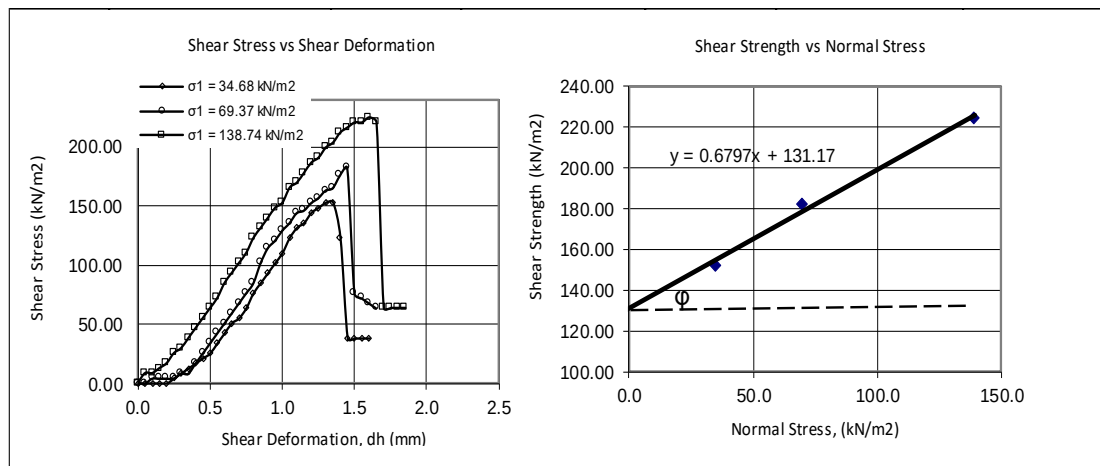
DIRECT SHEAR TEST RESULTS (UU)						
PROJECT		: PENELITIAN TUGAS AKHIR				
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				
SAMPLE		: 50% TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR				
QUARRY		: -				
TESTING METHOD		: ASTM D 3080-72		TESTED BY		: ANDI AMMAR JULTIAR ALAM
LABORATORY		: HASANUDDIN UNIVERSITY		DATE		: 15/05/2023
Sample Size :			Proving Ring Calibration		=	1.22 kg/div
Diameter Sample	=	0.06 m	Displacement Rate		=	kg/div
Height of Sample	=	0.02 m	c		=	137.52 kN/m ²
Area of Sample	=	0.00283 m ²	φ		=	29.91 °
Test No.	5050BE01		5050BE02		5050BE03	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	σ1 =	34.68 kN/m ²	σ1 =	69.37 kN/m ²	σ1 =	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	2.440	8.463	2.440	8.463	4.880	16.926
0.10	6.100	21.157	3.660	12.694	7.320	25.389
0.15	7.320	25.389	4.880	16.926	9.760	33.852
0.20	8.540	29.620	7.320	25.389	10.980	38.083
0.25	10.980	38.083	9.760	33.852	12.200	42.314
0.30	12.200	42.314	13.420	46.546	14.640	50.777
0.35	13.420	46.546	15.860	55.009	15.860	55.009
0.40	14.640	50.777	18.300	63.472	17.080	59.240
0.45	15.860	55.009	20.740	71.934	19.520	67.703
0.50	17.080	59.240	23.180	80.397	20.740	71.934
0.55	18.300	63.472	25.620	88.860	21.960	76.166
0.60	19.520	67.703	26.840	93.092	24.400	84.629
0.65	20.740	71.934	28.060	97.323	25.620	88.860
0.70	21.960	76.166	30.500	105.786	26.840	93.092
0.75	21.960	76.166	31.720	110.017	28.060	97.323
0.80	24.400	84.629	32.940	114.249	30.500	105.786
0.85	26.840	93.092	34.160	118.480	31.720	110.017
0.90	28.060	97.323	35.380	122.712	34.160	118.480
0.95	29.280	101.555	37.820	131.175	35.380	122.712
1.00	29.280	101.555	39.040	135.406	37.820	131.175
1.05	31.720	110.017	40.260	139.637	39.040	135.406
1.10	31.720	110.017	41.480	143.869	40.260	139.637
1.15	34.160	118.480	42.700	148.100	42.700	148.100
1.20	34.160	118.480	43.920	152.332	43.920	152.332
1.25	35.380	122.712	45.140	156.563	45.140	156.563
1.30	35.990	124.827	45.140	156.563	46.360	160.795
1.35	36.600	126.943	46.360	160.795	47.580	165.026
1.40	37.820	131.175	47.580	165.026	48.800	169.258
1.45	39.040	135.406	48.800	169.258	50.020	173.489
1.50	40.260	139.637	48.800	169.258	51.240	177.720
1.55	42.700	148.100	48.800	169.258	52.460	181.952
1.60	43.920	152.332	50.020	173.489	53.680	186.183
1.65	43.920	152.332	51.240	177.720	54.900	190.415
1.70	44.530	154.448	52.460	181.952	54.900	190.415
1.75	42.700	148.100	52.460	181.952	56.120	194.646
1.80	41.480	143.869	52.460	181.952	56.120	194.646
1.85	40.260	139.637	52.460	181.952	56.120	194.646
1.90	14.640	50.777	13.420	46.546	58.560	203.109
1.95	14.640	50.777	13.420	46.546	60.390	209.456
2.00	13.420	46.546	13.420	46.546	62.220	215.803
2.05	12.200	42.314	13.420	46.546	62.220	215.803



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	154.45	1.621
69,37	181.95	1.709
138,74	215.80	1.767

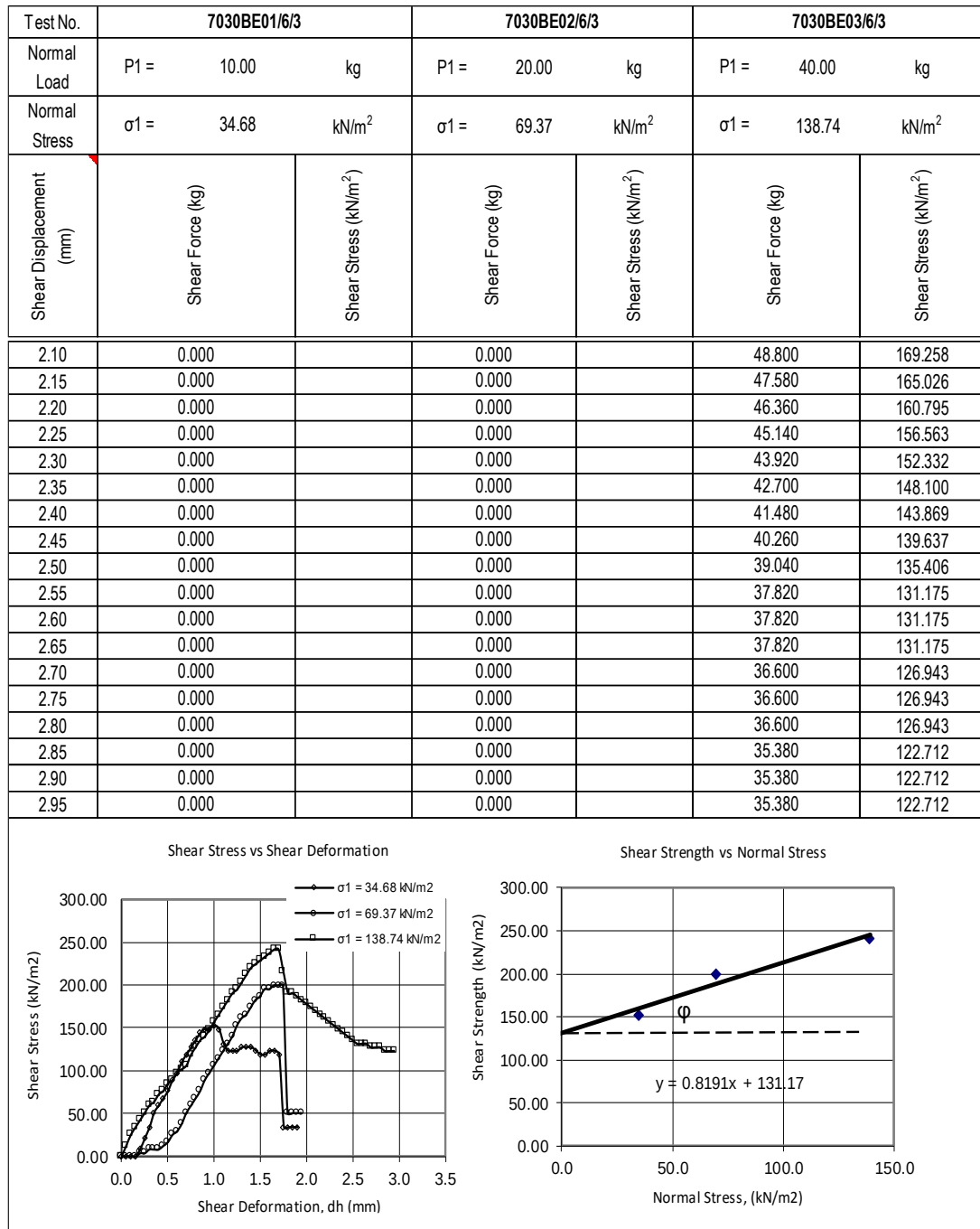
Lampiran 4. Data Pengujian Sifat Mekanis (*Direct Shear Test*) Terstabilisasi Bakteri Bacillus Sp Kultur 3 Hari

DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 6 %			
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
SAMPLE		: TANAH LANAU PR							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 21/06/2023	
Sample Size :				Proving Ring Calibration		=		1.22 kg/div	
Diameter Sample		=	0.06 m	Displacement Rate		=	kg/div		
Height of Sample		=	0.02 m	c		=	131.17 kN/m ²		
Area of Sample		=	0.00283 m ²	φ		=	34.20 °		
Test No.	TA01/6/3			TA02/6/3			TA03/6/3		
Normal Load	P1 =	10.00 kg		P1 =	20.00 kg		P1 =	40.00 kg	
Normal Stress	σ1 =	34.68 kN/m ²		σ1 =	69.37 kN/m ²		σ1 =	138.74 kN/m ²	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)	
0.00	0.000	0.000		0.000	0.000		0.000	0.000	
0.05	0.000	0.000		0.000	0.000		2.440	8.463	
0.10	0.000	0.000		1.220	4.231		2.440	8.463	
0.15	0.000	0.000		1.220	4.231		3.660	12.694	
0.20	0.000	0.000		1.220	4.231		4.880	16.926	
0.25	1.220	4.231		1.220	4.231		7.320	25.389	
0.30	2.440	8.463		2.440	8.463		8.540	29.620	
0.35	3.660	12.694		2.440	8.463		10.980	38.083	
0.40	4.880	16.926		4.880	16.926		13.420	46.546	
0.45	6.100	21.157		7.320	25.389		15.860	55.009	
0.50	7.320	25.389		9.760	33.852		18.300	63.472	
0.55	9.760	33.852		12.200	42.314		20.740	71.934	
0.60	12.200	42.314		14.640	50.777		24.400	84.629	
0.65	14.640	50.777		17.080	59.240		26.840	93.092	
0.70	15.860	55.009		19.520	67.703		29.280	101.555	
0.75	18.300	63.472		21.960	76.166		31.720	110.017	
0.80	21.960	76.166		24.400	84.629		35.380	122.712	
0.85	24.400	84.629		29.280	101.555		37.820	131.175	
0.90	26.840	93.092		32.940	114.249		40.260	139.637	
0.95	29.280	101.555		34.770	120.596		42.700	148.100	
1.00	31.720	110.017		37.210	129.059		43.920	152.332	
1.05	35.380	122.712		39.040	135.406		47.580	165.026	
1.10	37.820	131.175		41.480	143.869		48.800	169.258	
1.15	39.040	135.406		42.090	145.985		51.240	177.720	
1.20	41.480	143.869		43.920	152.332		53.680	186.183	
1.25	42.700	148.100		45.140	156.563		54.900	190.415	
1.30	43.920	152.332		46.970	162.910		57.340	198.878	
1.35	43.920	152.332		47.580	165.026		58.560	203.109	
1.40	35.380	122.712		50.630	175.605		61.000	211.572	
1.45	10.980	38.083		52.460	181.952		62.220	215.803	
1.50	10.980	38.083		21.960	76.166		63.440	220.035	
1.55	10.980	38.083		20.740	71.934		63.440	220.035	
1.60	10.980	38.083		19.520	67.703		64.660	224.266	
1.65	0.000			18.300	63.472		63.440	220.035	
1.70	0.000			0.000			18.300	63.472	
1.75	0.000			0.000			18.300	63.472	
1.80	0.000			0.000			18.300	63.472	
1.85	0.000			0.000			18.300	63.472	



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	152.33	1.679
69,37	181.95	1.695
138,74	224.27	1.782

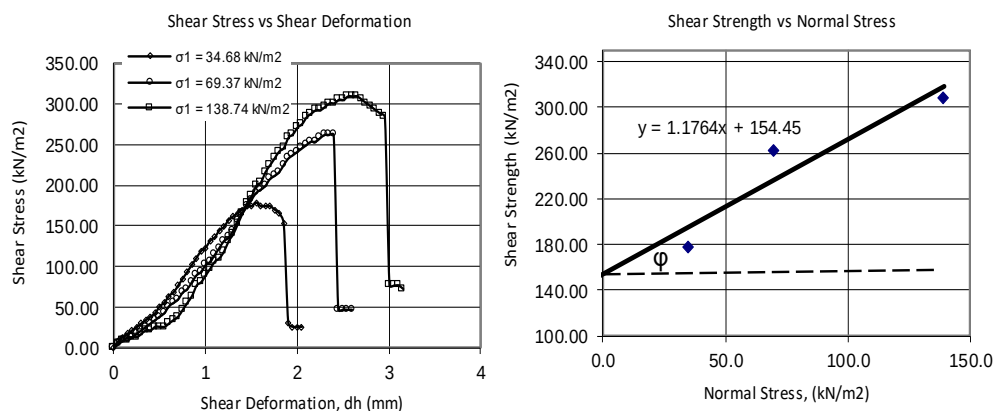
DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 6 %			
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
NO SAMPLE		: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LANAU PR							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 21/06/2023	
Sample Size :						Proving Ring Calibration		= 1.22 kg/div	
Diameter Sample		= 0.06 m					Displacement Rate		= kg/div
Height of Sample		= 0.02 m					c	= 131.17 kN/m ²	
Area of Sample		= 0.00283 m ²					φ	= 39.32 °	
Test No.	7030BE01/6/3			7030BE02/6/3			7030BE03/6/3		
Normal Load	P1 =	10.00	kg	P1 =	20.00	kg	P1 =	40.00	kg
Normal Stress	σ1 =	34.68	kN/m ²	σ1 =	69.37	kN/m ²	σ1 =	138.74	kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
0.05	0.000	0.000	0.000	0.000	0.000	0.000	3.660	12.694	
0.10	0.000	0.000	0.000	0.000	0.000	0.000	7.320	25.389	
0.15	0.000	0.000	0.000	0.000	0.000	0.000	9.760	33.852	
0.20	2.440	8.463	1.220	4.231	12.200	42.314			
0.25	6.100	21.157	1.220	4.231	14.640	50.777			
0.30	9.760	33.852	2.440	8.463	17.080	59.240			
0.35	14.640	50.777	2.440	8.463	18.300	63.472			
0.40	17.080	59.240	2.440	8.463	20.740	71.934			
0.45	19.520	67.703	3.660	12.694	21.960	76.166			
0.50	21.960	76.166	4.880	16.926	24.400	84.629			
0.55	25.620	88.860	7.320	25.389	25.620	88.860			
0.60	28.060	97.323	8.540	29.620	28.060	97.323			
0.65	31.720	110.017	10.980	38.083	29.280	101.555			
0.70	34.160	118.480	14.640	50.777	30.500	105.786			
0.75	36.600	126.943	17.080	59.240	34.160	118.480			
0.80	39.040	135.406	19.520	67.703	36.600	126.943			
0.85	41.480	143.869	21.960	76.166	39.040	135.406			
0.90	42.700	148.100	25.620	88.860	40.260	139.637			
0.95	42.700	148.100	28.060	97.323	42.700	148.100			
1.00	43.920	152.332	30.500	105.786	45.140	156.563			
1.05	42.700	148.100	32.940	114.249	47.580	165.026			
1.10	37.820	131.175	35.380	122.712	50.020	173.489			
1.15	35.380	122.712	37.820	131.175	52.460	181.952			
1.20	35.380	122.712	40.260	139.637	54.900	190.415			
1.25	35.380	122.712	43.920	152.332	56.120	194.646			
1.30	36.600	126.943	46.360	160.795	58.560	203.109			
1.35	36.600	126.943	47.580	165.026	61.000	211.572			
1.40	36.600	126.943	50.020	173.489	63.440	220.035			
1.45	35.380	122.712	52.460	181.952	64.660	224.266			
1.50	34.160	118.480	53.680	186.183	65.880	228.498			
1.55	34.160	118.480	56.120	194.646	67.100	232.729			
1.60	35.380	122.712	56.120	194.646	68.320	236.961			
1.65	35.380	122.712	57.340	198.878	69.540	241.192			
1.70	34.160	118.480	57.340	198.878	69.540	241.192			
1.75	9.760	33.852	57.340	198.878	62.220	215.803			
1.80	9.760	33.852	14.640	50.777	54.900	190.415			
1.85	9.760	33.852	14.640	50.777	54.900	190.415			
1.90	9.760	33.852	14.640	50.777	53.680	186.183			
1.95	0.000		14.640	50.777	52.460	181.952			
2.00	0.000		0.000		51.240	177.720			
2.05	0.000		0.000		50.020	173.489			



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	152.33	1.660
69,37	198.88	1.663
138,74	241.19	1.720

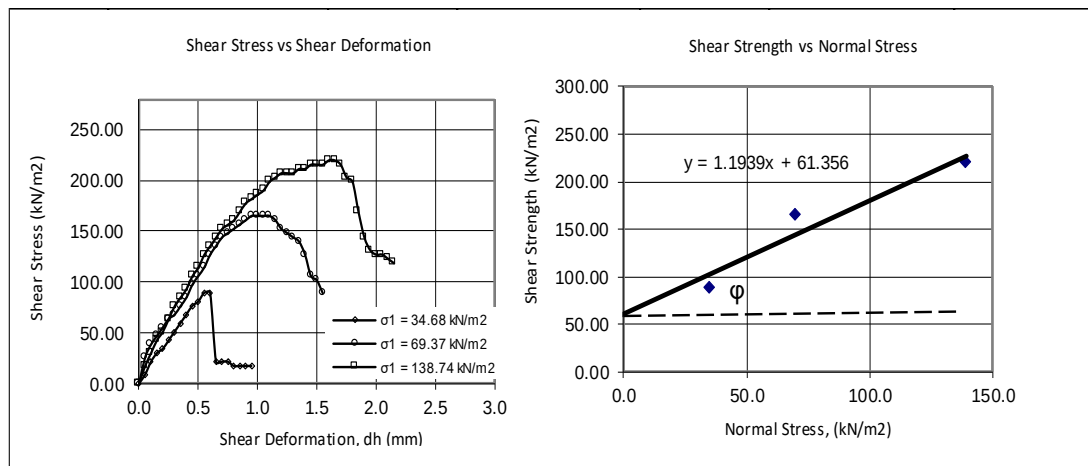
DIRECT SHEAR TEST RESULTS (UU)						
PROJECT		: PENELITIAN TUGAS AKHIR			 Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 6 %	
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				
SAMPLE		: 50% TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR				
QUARRY		: -				
TESTING METHOD		: ASTM D 3080-72			TESTED BY : ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY			DATE : 21/06/2023	
Sample Size :				Proving Ring Calibration = 1.22 kg/div		
Diameter Sample = 0.06 m				Displacement Rate = kg/div		
Height of Sample = 0.02 m				c = 154.45 kN/m ²		
Area of Sample = 0.00283 m ²				φ = 49.63 °		
Test No.	5050BE01/6/3		5050BE02/6/3		5050BE04/6/3	
Normal Load	P1 = 10.00 kg		P1 = 20.00 kg		P1 = 40.00 kg	
Normal Stress	σ1 = 34.68 kN/m ²		σ1 = 69.37 kN/m ²		σ1 = 138.74 kN/m ²	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	2.440	8.463	1.220	4.231	1.220	4.231
0.10	3.660	12.694	2.440	8.463	2.440	8.463
0.15	4.880	16.926	3.660	12.694	2.440	8.463
0.20	6.100	21.157	3.660	12.694	3.660	12.694
0.25	7.320	25.389	4.880	16.926	3.660	12.694
0.30	8.540	29.620	6.100	21.157	4.880	16.926
0.35	9.760	33.852	7.320	25.389	6.100	21.157
0.40	10.980	38.083	8.540	29.620	6.100	21.157
0.45	12.200	42.314	9.760	33.852	7.320	25.389
0.50	14.640	50.777	10.980	38.083	7.320	25.389
0.55	15.860	55.009	12.200	42.314	7.320	25.389
0.60	18.300	63.472	14.640	50.777	8.540	29.620
0.65	19.520	67.703	15.860	55.009	9.760	33.852
0.70	21.960	76.166	17.080	59.240	10.980	38.083
0.75	24.400	84.629	19.520	67.703	13.420	46.546
0.80	26.840	93.092	20.740	71.934	15.860	55.009
0.85	29.280	101.555	23.180	80.397	18.300	63.472
0.90	31.720	110.017	25.620	88.860	21.960	76.166
0.95	34.160	118.480	26.840	93.092	23.180	80.397
1.00	35.380	122.712	29.280	101.555	25.620	88.860
1.05	37.820	131.175	30.500	105.786	28.060	97.323
1.10	39.040	135.406	32.940	114.249	30.500	105.786
1.15	41.480	143.869	35.380	122.712	31.720	110.017
1.20	42.700	148.100	37.820	131.175	34.160	118.480
1.25	45.140	156.563	39.040	135.406	37.820	131.175
1.30	46.360	160.795	41.480	143.869	40.260	139.637
1.35	47.580	165.026	45.140	156.563	43.920	152.332
1.40	48.800	169.258	47.580	165.026	47.580	165.026
1.45	50.020	173.489	50.020	173.489	51.240	177.720
1.50	50.020	173.489	52.460	181.952	53.680	186.183
1.55	51.240	177.720	54.900	190.415	57.340	198.878
1.60	50.020	173.489	56.120	194.646	58.560	203.109
1.65	50.020	173.489	57.340	198.878	62.220	215.803
1.70	50.020	173.489	59.780	207.341	64.660	224.266
1.75	48.800	169.258	61.000	211.572	67.100	232.729
1.80	47.580	165.026	62.220	215.803	69.540	241.192
1.85	43.920	152.332	64.660	224.266	70.760	245.423
1.90	8.540	29.620	67.100	232.729	74.420	258.118
1.95	7.320	25.389	68.320	236.961	75.640	262.349
2.00	7.320	25.389	69.540	241.192	78.080	270.812
2.05	7.320	25.389	70.760	245.423	79.300	275.044

Test No.	5050BE01/6/3		5050BE02/6/3		5050BE04/6/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	0.000		71.980	249.655	81.740	283.506
2.15	0.000		73.200	253.886	82.960	287.738
2.20	0.000		73.200	253.886	84.180	291.969
2.25	0.000		74.420	258.118	84.180	291.969
2.30	0.000		75.640	262.349	85.400	296.201
2.35	0.000		75.640	262.349	86.620	300.432
2.40	0.000		75.640	262.349	86.620	300.432
2.45	0.000		13.420	46.546	87.840	304.664
2.50	0.000		13.420	46.546	87.840	304.664
2.55	0.000		13.420	46.546	89.060	308.895
2.60	0.000		13.420	46.546	89.060	308.895
2.65	0.000		0.000		89.060	308.895
2.70	0.000		0.000		87.840	304.664
2.75	0.000		0.000		86.620	300.432
2.80	0.000		0.000		85.400	296.201
2.85	0.000		0.000		84.180	291.969
2.90	0.000		0.000		82.960	287.738
2.95	0.000		0.000		81.740	283.506
3.00	0.000		0.000		21.960	76.166
3.05	0.000		0.000		21.960	76.166
3.10	0.000		0.000		21.960	76.166
3.15	0.000		0.000		20.740	71.934



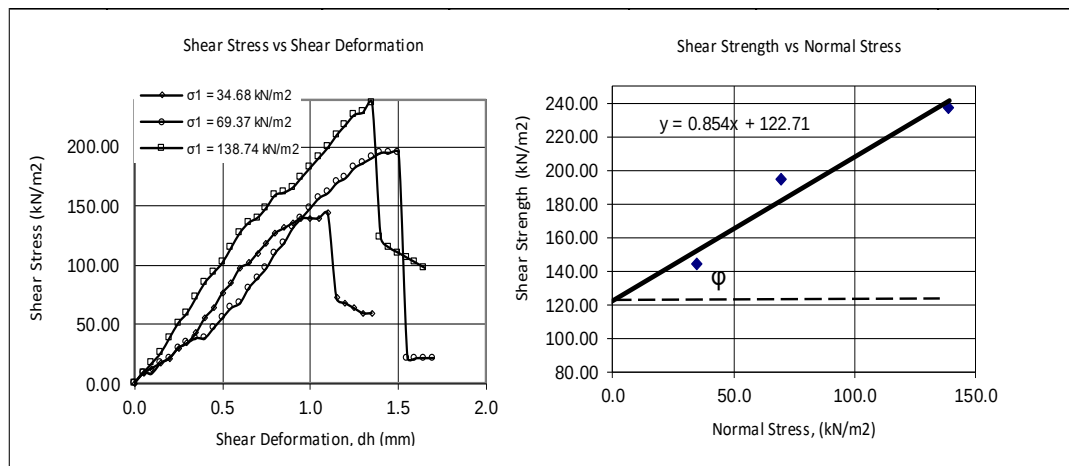
Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	177.72	1.693
69,37	262.35	1.746
138,74	308.90	1.788

DIRECT SHEAR TEST RESULTS (UU)						
PROJECT		: PENELITIAN TUGAS AKHIR			 Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 6 % TESTED BY : ANDI AMMAR JULTIAR ALAM DATE : 21/06/2023	
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				
SAMPLE		: TANAH LEMPUNG EKSPANSIF				
QUARRY		: -				
TESTING METHOD		: ASTM D 3080-72				
LABORATORY		: HASANUDDIN UNIVERSITY				
Sample Size :				Proving Ring Calibration = 1.22 kg/div		
Diameter Sample = 0.06 m				Displacement Rate = kg/div		
Height of Sample = 0.02 m				c = 61.36 kN/m ²		
Area of Sample = 0.00283 m ²				φ = 50.05 °		
Test No.	BE01/6/3		BE02/6/3		BE03/6/3	
Normal Load	P1 = 10.00 kg		P1 = 20.00 kg		P1 = 40.00 kg	
Normal Stress	σ1 = 34.68 kN/m ²		σ1 = 69.37 kN/m ²		σ1 = 138.74 kN/m ²	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	2.440	8.463	7.320	25.389	4.880	16.926
0.10	6.100	21.157	10.980	38.083	8.540	29.620
0.15	8.540	29.620	13.420	46.546	12.200	42.314
0.20	9.760	33.852	15.860	55.009	14.640	50.777
0.25	12.200	42.314	18.300	63.472	18.300	63.472
0.30	14.640	50.777	19.520	67.703	21.960	76.166
0.35	17.080	59.240	21.960	76.166	24.400	84.629
0.40	19.520	67.703	24.400	84.629	26.840	93.092
0.45	21.960	76.166	28.060	97.323	30.500	105.786
0.50	23.180	80.397	30.500	105.786	32.940	114.249
0.55	25.620	88.860	32.940	114.249	36.600	126.943
0.60	25.620	88.860	36.600	126.943	39.040	135.406
0.65	6.100	21.157	39.040	135.406	41.480	143.869
0.70	6.100	21.157	41.480	143.869	43.920	152.332
0.75	6.100	21.157	42.700	148.100	45.140	156.563
0.80	4.880	16.926	43.920	152.332	46.360	160.795
0.85	4.880	16.926	45.140	156.563	48.800	169.258
0.90	4.880	16.926	46.360	160.795	51.240	177.720
0.95	4.880	16.926	47.580	165.026	52.460	181.952
1.00	0.000		47.580	165.026	53.680	186.183
1.05	0.000		47.580	165.026	54.900	190.415
1.10	0.000		47.580	165.026	57.340	198.878
1.15	0.000		46.360	160.795	58.560	203.109
1.20	0.000		43.920	152.332	59.780	207.341
1.25	0.000		42.700	148.100	59.780	207.341
1.30	0.000		41.480	143.869	59.780	207.341
1.35	0.000		40.260	139.637	61.000	211.572
1.40	0.000		36.600	126.943	61.000	211.572
1.45	0.000		30.500	105.786	62.220	215.803
1.50	0.000		29.280	101.555	62.220	215.803
1.55	0.000		25.620	88.860	62.220	215.803
1.60	0.000		0.000		63.440	220.035
1.65	0.000		0.000		63.440	220.035
1.70	0.000		0.000		62.220	215.803
1.75	0.000		0.000		58.560	203.109
1.80	0.000		0.000		57.340	198.878
1.85	0.000		0.000		48.800	169.258
1.90	0.000		0.000		41.480	143.869
1.95	0.000		0.000		37.820	131.175
2.00	0.000		0.000		36.600	126.943
2.05	0.000		0.000		36.600	126.943
2.10	0.000		0.000		35.380	122.712
2.15	0.000		0.000		34.160	118.480



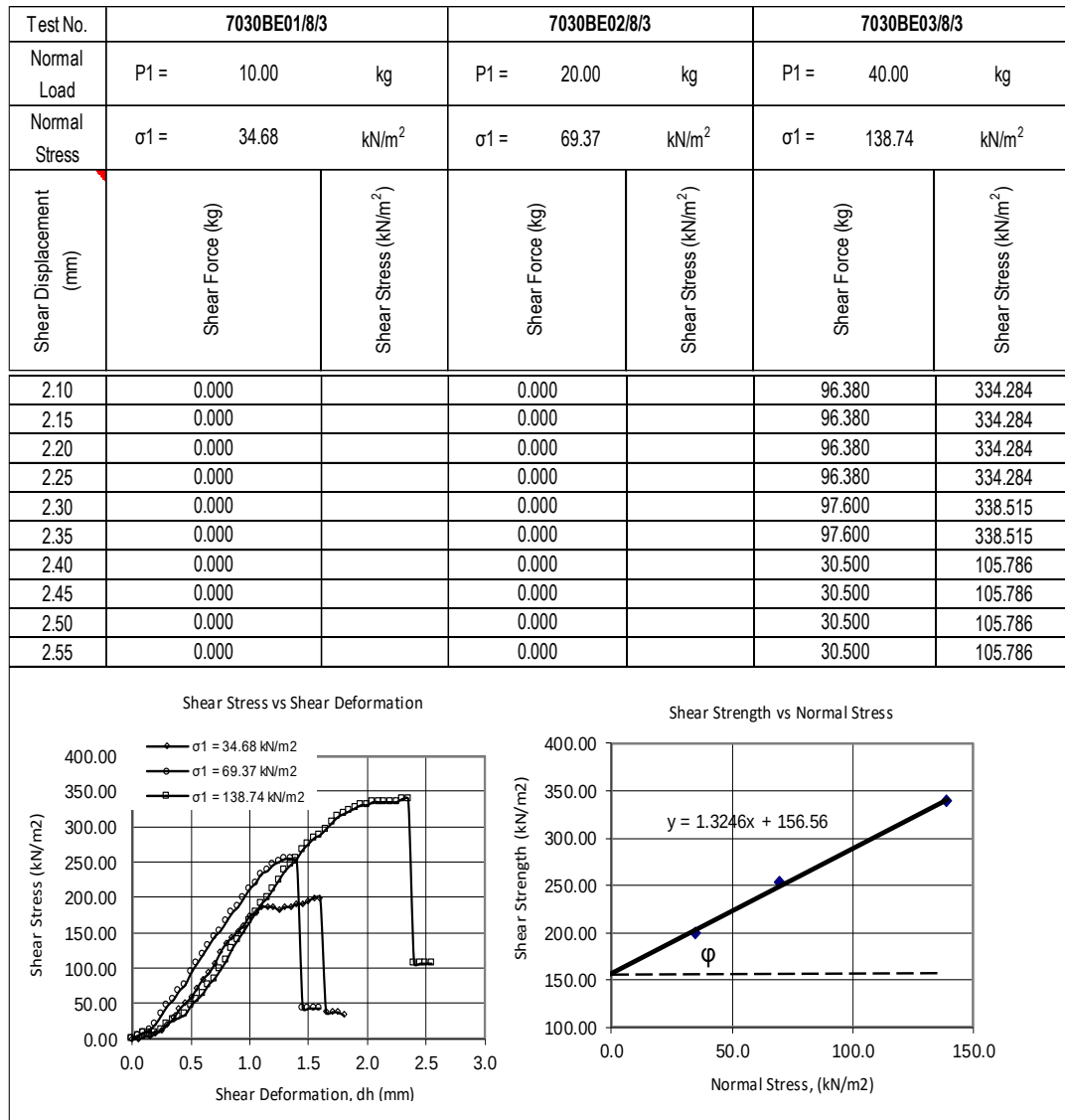
Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	88.86	1.902
69,37	165.03	1.903
138,74	220.03	1.944

DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR							
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				Kultur Bakteri : 3 Hari			
SAMPLE		:TANAH LANAU PR				Pemeraman : 7 Hari			
QUARRY		: -				Bakteri : 8 %			
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 20/07/2023	
Sample Size :				Proving Ring Calibration		=		1.22 kg/div	
Diameter Sample		=	0.06	m	Displacement Rate		=	kg/div	
Height of Sample		=	0.02	m	c		=	122.71 kN/m ²	
Area of Sample		=	0.00283	m ²	φ		=	40.50 °	
Test No.	TA02/8/3			TA01/8/3			TA03/8/3		
Normal Load	P1 =	10.00	kg	P1 =	20.00	kg	P1 =	40.00	kg
Normal Stress	σ1 =	34.68	kN/m ²	σ1 =	69.37	kN/m ²	σ1 =	138.74	kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	
0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
0.05	2.440	8.463	2.440	8.463	2.440	8.463	2.440	8.463	
0.10	3.660	12.694	2.440	8.463	4.880	16.926	4.880	16.926	
0.15	4.880	16.926	4.880	16.926	7.320	25.389	7.320	25.389	
0.20	6.100	21.157	6.100	21.157	10.980	38.083	10.980	38.083	
0.25	8.540	29.620	8.540	29.620	14.640	50.777	14.640	50.777	
0.30	9.760	33.852	9.760	33.852	17.080	59.240	17.080	59.240	
0.35	12.200	42.314	10.980	38.083	20.740	71.934	20.740	71.934	
0.40	15.860	55.009	10.980	38.083	24.400	84.629	24.400	84.629	
0.45	18.300	63.472	13.420	46.546	26.840	93.092	26.840	93.092	
0.50	21.960	76.166	15.860	55.009	29.280	101.555	29.280	101.555	
0.55	24.400	84.629	18.300	63.472	32.940	114.249	32.940	114.249	
0.60	28.060	97.323	19.520	67.703	36.600	126.943	36.600	126.943	
0.65	29.280	101.555	23.180	80.397	39.040	135.406	39.040	135.406	
0.70	31.720	110.017	25.620	88.860	40.260	139.637	40.260	139.637	
0.75	34.160	118.480	28.060	97.323	42.700	148.100	42.700	148.100	
0.80	36.600	126.943	31.720	110.017	45.750	158.679	45.750	158.679	
0.85	37.820	131.175	34.160	118.480	46.360	160.795	46.360	160.795	
0.90	39.040	135.406	37.820	131.175	47.580	165.026	47.580	165.026	
0.95	40.260	139.637	40.260	139.637	50.020	173.489	50.020	173.489	
1.00	40.260	139.637	42.700	148.100	52.460	181.952	52.460	181.952	
1.05	40.260	139.637	45.140	156.563	54.900	190.415	54.900	190.415	
1.10	41.480	143.869	46.360	160.795	57.340	198.878	57.340	198.878	
1.15	20.740	71.934	48.800	169.258	60.390	209.456	60.390	209.456	
1.20	19.520	67.703	50.020	173.489	62.830	217.919	62.830	217.919	
1.25	18.300	63.472	52.460	181.952	65.270	226.382	65.270	226.382	
1.30	17.080	59.240	53.680	186.183	65.880	228.498	65.880	228.498	
1.35	17.080	59.240	54.900	190.415	68.320	236.961	68.320	236.961	
1.40	0.000		56.120	194.646	35.380	122.712	35.380	122.712	
1.45	0.000		56.120	194.646	32.940	114.249	32.940	114.249	
1.50	0.000		56.120	194.646	31.720	110.017	31.720	110.017	
1.55	0.000		6.100	21.157	30.500	105.786	30.500	105.786	
1.60	0.000		6.100	21.157	29.280	101.555	29.280	101.555	
1.65	0.000		6.100	21.157	28.060	97.323	28.060	97.323	
1.70	0.000		6.100	21.157	0.000		0.000		



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	143.87	1.790
69,37	194.65	1.868
138,74	236.96	1.874

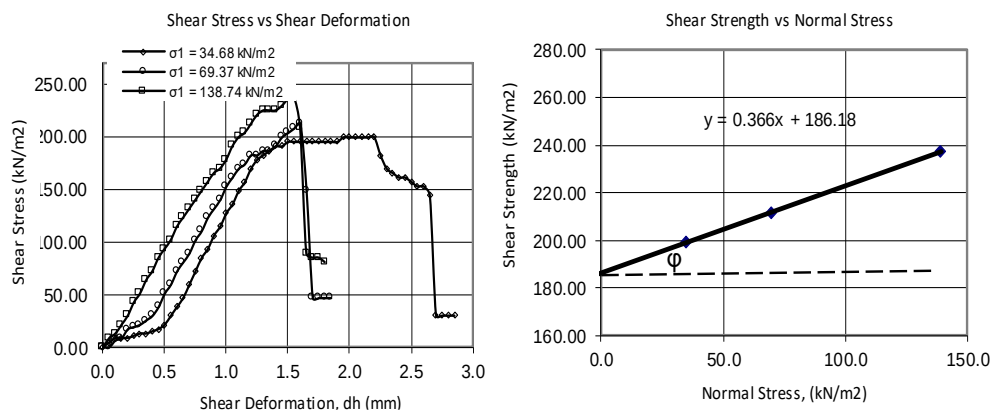
DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 8 %			
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
NO SAMPLE		: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LANAU PR							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 20/07/2023	
Sample Size :					Proving Ring Calibration		= 1.22 kg/div		
Diameter Sample		=	0.06	m	Displacement Rate		=	kg/div	
Height of Sample		=	0.02	m	c		=	156.56	kN/m ²
Area of Sample		=	0.00283	m ²	φ		=	52.95	°
Test No.	7030BE01/8/3				7030BE02/8/3			7030BE03/8/3	
Normal Load	P1 =	10.00	kg		P1 =	20.00	kg		P1 = 40.00 kg
Normal Stress	σ1 =	34.68	kN/m ²		σ1 =	69.37	kN/m ²		σ1 = 138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)	
	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.05	0.000	0.000	1.220	4.231	1.220	4.231		
	0.10	1.220	4.231	2.440	8.463	2.440	8.463		
	0.15	1.220	4.231	3.660	12.694	2.440	8.463		
	0.20	2.440	8.463	6.100	21.157	2.440	8.463		
	0.25	3.660	12.694	9.760	33.852	3.660	12.694		
	0.30	6.100	21.157	13.420	46.546	6.100	21.157		
	0.35	8.540	29.620	15.860	55.009	7.320	25.389		
	0.40	12.200	42.314	19.520	67.703	8.540	29.620		
	0.45	14.640	50.777	21.960	76.166	9.760	33.852		
	0.50	17.080	59.240	26.840	93.092	13.420	46.546		
	0.55	20.740	71.934	30.500	105.786	15.860	55.009		
	0.60	24.400	84.629	34.160	118.480	18.300	63.472		
	0.65	26.840	93.092	37.820	131.175	21.960	76.166		
	0.70	30.500	105.786	41.480	143.869	24.400	84.629		
	0.75	35.380	122.712	43.920	152.332	28.060	97.323		
	0.80	39.040	135.406	47.580	165.026	31.720	110.017		
	0.85	41.480	143.869	51.240	177.720	36.600	126.943		
	0.90	43.920	152.332	53.680	186.183	40.260	139.637		
	0.95	46.360	160.795	57.340	198.878	43.920	152.332		
	1.00	50.020	173.489	61.000	211.572	47.580	165.026		
	1.05	51.240	177.720	63.440	220.035	51.240	177.720		
	1.10	53.680	186.183	67.100	232.729	54.900	190.415		
	1.15	53.680	186.183	68.320	236.961	57.340	198.878		
	1.20	53.680	186.183	70.760	245.423	61.000	211.572		
	1.25	52.460	181.952	71.980	249.655	64.660	224.266		
	1.30	53.680	186.183	73.200	253.886	68.320	236.961		
	1.35	53.680	186.183	73.200	253.886	70.760	245.423		
	1.40	54.900	190.415	71.980	249.655	73.200	253.886		
1.45	54.900	190.415	12.200	42.314	76.860	266.581			
1.50	56.120	194.646	12.200	42.314	79.300	275.044			
1.55	57.340	198.878	12.200	42.314	81.740	283.506			
1.60	57.340	198.878	12.200	42.314	82.960	287.738			
1.65	10.980	38.083	0.000		85.400	296.201			
1.70	10.980	38.083	0.000		87.840	304.664			
1.75	10.980	38.083	0.000		90.280	313.127			
1.80	9.760	33.852	0.000		91.500	317.358			
1.85	0.000		0.000		92.720	321.589			
1.90	0.000		0.000		93.940	325.821			
1.95	0.000		0.000		95.160	330.052			
2.00	0.000		0.000		95.160	330.052			
2.05	0.000		0.000		96.380	334.284			



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	198.88	1.649
69,37	253.89	1.731
138,74	338.52	1.859

DIRECT SHEAR TEST RESULTS (UU)													
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 8 %							
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA											
SAMPLE		: 50% TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR											
QUARRY		: -											
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM					
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 27/07/2023					
Sample Size :			Proving Ring Calibration			= 1.22 kg/div							
Diameter Sample = 0.06 m			Displacement Rate			= kg/div							
Height of Sample = 0.02 m			c			= 186.18 kN/m ²							
Area of Sample = 0.00283 m ²			φ			= 20.10 °							
Test No.		5050BE05/8/3			5050BE06/8/3			5050BE07/8/3					
Normal Load		P1 = 10.00 kg			P1 = 20.00 kg			P1 = 40.00 kg					
Normal Stress		σ1 = 34.68 kN/m ²			σ1 = 69.37 kN/m ²			σ1 = 138.74 kN/m ²					
Shear Displacement (mm)		Shear Force (kg)		Shear Stress (kN/m ²)		Shear Force (kg)		Shear Stress (kN/m ²)		Shear Force (kg)		Shear Stress (kN/m ²)	
0.00		0.000		0.000		0.000		0.000		0.000		0.000	
0.05		1.220		4.231		0.000		0.000		2.440		8.463	
0.10		2.440		8.463		1.830		6.347		3.660		12.694	
0.15		2.440		8.463		2.440		8.463		6.100		21.157	
0.20		2.440		8.463		4.880		16.926		8.540		29.620	
0.25		3.050		10.579		5.490		19.041		12.200		42.314	
0.30		3.660		12.694		6.100		21.157		14.640		50.777	
0.35		3.660		12.694		7.320		25.389		18.300		63.472	
0.40		4.270		14.810		8.540		29.620		20.740		71.934	
0.45		4.880		16.926		10.980		38.083		24.400		84.629	
0.50		6.100		21.157		14.640		50.777		26.840		93.092	
0.55		8.540		29.620		17.080		59.240		29.280		101.555	
0.60		10.980		38.083		20.740		71.934		32.940		114.249	
0.65		13.420		46.546		23.180		80.397		35.380		122.712	
0.70		17.080		59.240		25.620		88.860		37.820		131.175	
0.75		20.740		71.934		29.280		101.555		40.260		139.637	
0.80		24.400		84.629		31.720		110.017		42.700		148.100	
0.85		26.840		93.092		35.380		122.712		45.140		156.563	
0.90		30.500		105.786		37.820		131.175		47.580		165.026	
0.95		32.940		114.249		40.260		139.637		48.800		169.258	
1.00		36.600		126.943		43.920		152.332		51.240		177.720	
1.05		39.040		135.406		46.360		160.795		54.900		190.415	
1.10		42.700		148.100		48.800		169.258		57.340		198.878	
1.15		45.140		156.563		50.020		173.489		58.560		203.109	
1.20		48.800		169.258		52.460		181.952		61.000		211.572	
1.25		51.240		177.720		52.460		181.952		63.440		220.035	
1.30		52.460		181.952		53.680		186.183		64.660		224.266	
1.35		53.680		186.183		53.680		186.183		64.660		224.266	
1.40		54.900		190.415		54.900		190.415		64.660		224.266	
1.45		54.900		190.415		57.340		198.878		65.880		228.498	
1.50		56.120		194.646		58.560		203.109		67.710		234.845	
1.55		56.120		194.646		59.780		207.341		68.320		236.961	
1.60		56.120		194.646		61.000		211.572		59.780		207.341	
1.65		56.120		194.646		42.700		148.100		25.620		88.860	
1.70		56.120		194.646		13.420		46.546		24.400		84.629	
1.75		56.120		194.646		13.420		46.546		24.400		84.629	
1.80		56.120		194.646		13.420		46.546		23.180		80.397	
1.85		56.120		194.646		13.420		46.546		0.000			
1.90		56.120		194.646		0.000				0.000			
1.95		57.340		198.878		0.000				0.000			
2.00		57.340		198.878		0.000				0.000			
2.05		57.340		198.878		0.000				0.000			

Test No.	5050BE05/8/3		5050BE06/8/3		5050BE07/8/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	57.340	198.878	0.000		0.000	
2.15	57.340	198.878	0.000		0.000	
2.20	57.340	198.878	0.000		0.000	
2.25	52.460	181.952	0.000		0.000	
2.30	48.800	169.258	0.000		0.000	
2.35	47.580	165.026	0.000		0.000	
2.40	46.360	160.795	0.000		0.000	
2.45	46.360	160.795	0.000		0.000	
2.50	45.140	156.563	0.000		0.000	
2.55	43.920	152.332	0.000		0.000	
2.60	43.920	152.332	0.000		0.000	
2.65	41.480	143.869	0.000		0.000	
2.70	8.540	29.620	0.000		0.000	
2.75	8.540	29.620	0.000		0.000	
2.80	8.540	29.620	0.000		0.000	
2.85	8.540	29.620	0.000		0.000	



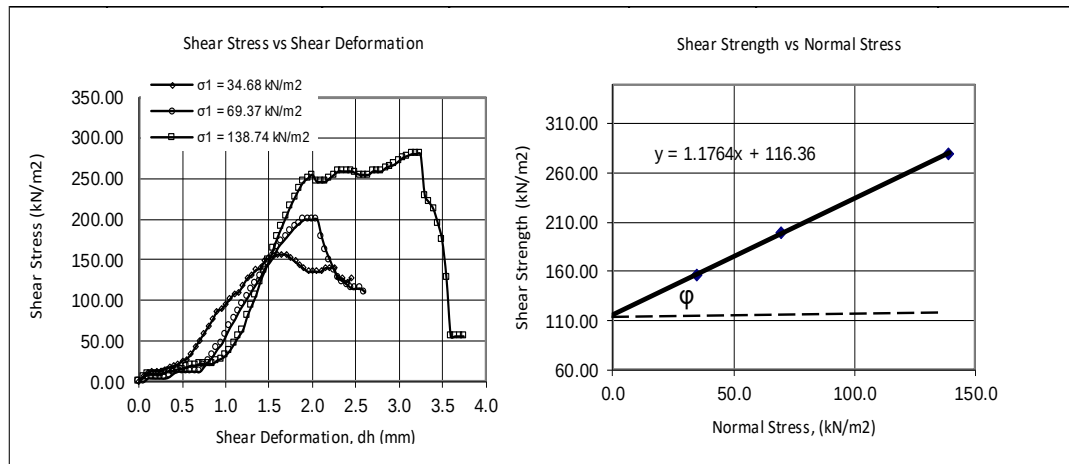
Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	198.88	1.727
69,37	211.57	1.758
138,74	236.96	1.789

PROJECT	: PENELITIAN TUGAS AKHIR	
LOCATION	: FAKULTAS TEKNIK UNHAS GOWA	
SAMPLE	: TANAH LEMPUNG EKSPANSIF	
QUARRY	: -	
TESTING METHOD	: ASTM D 3080-72	
LABORATORY	: HASANUDDIN UNIVERSITY	
		Kultur Bakteri : 3 Hari Pemeraman : 7 Hari Bakteri : 8 %
		TESTED BY : ANDI AMMAR JULTIAR ALAM DATE : 20/07/2023

Sample Size :			Proving Ring Calibration	=	1.22	kg/div
Diameter Sample	=	0.06	m	Displacement Rate	=	kg/div
Height of Sample	=	0.02	m	c	=	116.36 kN/m ²
Area of Sample	=	0.00283	m ²	φ	=	49.63 °

Test No.	BE01/8/3		BE04/8/3		BE03/8/3	
Normal Load	P1 = 10.00 kg		P1 = 20.00 kg		P1 = 40.00 kg	
Normal Stress	$\sigma_1 = 34.68 \text{ kN/m}^2$		$\sigma_1 = 69.37 \text{ kN/m}^2$		$\sigma_1 = 138.74 \text{ kN/m}^2$	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	1.830	6.347	0.000	0.000	1.220	4.231
0.10	3.050	10.579	1.220	4.231	2.440	8.463
0.15	3.660	12.694	1.220	4.231	2.440	8.463
0.20	3.660	12.694	1.220	4.231	2.440	8.463
0.25	3.660	12.694	1.220	4.231	2.440	8.463
0.30	4.270	14.810	1.220	4.231	3.050	10.579
0.35	4.880	16.926	1.830	6.347	3.660	12.694
0.40	5.490	19.041	3.050	10.579	3.660	12.694
0.45	6.100	21.157	3.660	12.694	4.270	14.810
0.50	7.320	25.389	3.660	12.694	4.270	14.810
0.55	7.930	27.504	3.660	12.694	4.880	16.926
0.60	9.760	33.852	3.660	12.694	5.490	19.041
0.65	12.200	42.314	3.660	12.694	5.490	19.041
0.70	14.640	50.777	3.660	12.694	6.100	21.157
0.75	17.080	59.240	5.490	19.041	6.100	21.157
0.80	19.520	67.703	7.320	25.389	6.100	21.157
0.85	21.960	76.166	9.150	31.736	6.100	21.157
0.90	25.010	86.745	11.590	40.199	7.320	25.389
0.95	25.620	88.860	13.420	46.546	7.930	27.504
1.00	27.450	95.207	16.470	57.124	9.150	31.736
1.05	29.280	101.555	19.520	67.703	10.980	38.083
1.10	31.110	107.902	21.960	76.166	13.420	46.546
1.15	31.720	110.017	25.010	86.745	15.860	55.009
1.20	34.160	118.480	27.450	95.207	18.300	63.472
1.25	36.600	126.943	29.890	103.670	23.180	80.397
1.30	37.820	131.175	32.330	112.133	26.840	93.092
1.35	39.650	137.522	34.770	120.596	30.500	105.786
1.40	40.260	139.637	37.210	129.059	35.380	122.712
1.45	42.700	148.100	40.260	139.637	39.040	135.406
1.50	43.920	152.332	42.090	145.985	42.700	148.100
1.55	44.530	154.448	44.530	154.448	46.970	162.910
1.60	45.140	156.563	47.580	165.026	51.240	177.720
1.65	45.140	156.563	49.410	171.373	54.900	190.415
1.70	45.140	156.563	51.240	177.720	58.560	203.109
1.75	43.920	152.332	53.070	184.068	62.220	215.803
1.80	42.700	148.100	54.900	190.415	65.270	226.382
1.85	41.480	143.869	56.120	194.646	68.320	236.961
1.90	40.260	139.637	57.340	198.878	70.760	245.423
1.95	39.040	135.406	57.340	198.878	71.980	249.655
2.00	39.040	135.406	57.340	198.878	73.200	253.886

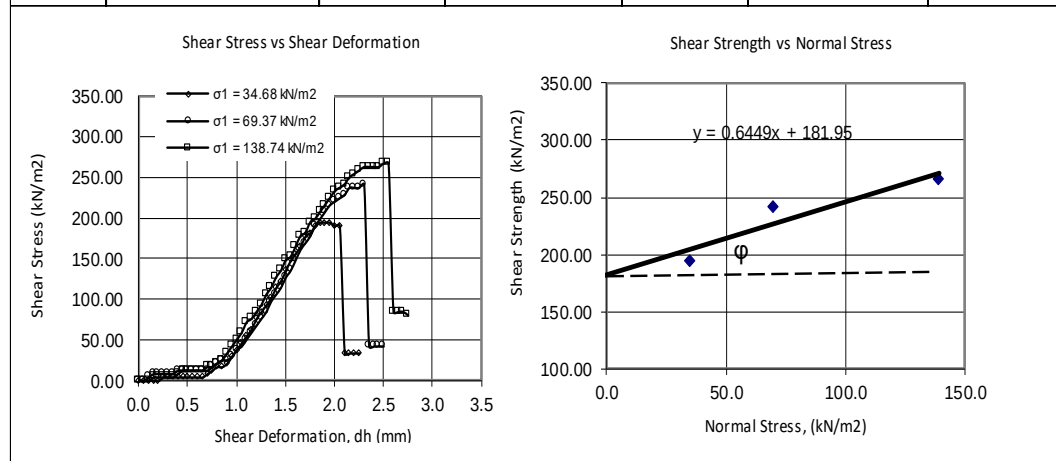
Test No.	BE01/8/3		BE04/8/3		BE03/8/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.05	39.040	135.406	57.340	198.878	70.760	245.423
2.10	39.040	135.406	51.240	177.720	70.760	245.423
2.15	40.260	139.637	46.360	160.795	70.760	245.423
2.20	40.260	139.637	42.700	148.100	71.980	249.655
2.25	40.260	139.637	39.040	135.406	73.200	253.886
2.30	36.600	126.943	36.600	126.943	74.420	258.118
2.35	36.600	126.943	35.380	122.712	74.420	258.118
2.40	35.380	122.712	34.160	118.480	74.420	258.118
2.45	36.600	126.943	32.940	114.249	74.420	258.118
2.50	0.000		32.940	114.249	73.810	256.002
2.55	0.000		32.940	114.249	73.200	253.886
2.60	0.000		31.720	110.017	73.200	253.886
2.65	0.000		0.000		73.200	253.886
2.70	0.000		0.000		74.420	258.118
2.75	0.000		0.000		74.420	258.118
2.80	0.000		0.000		74.420	258.118
2.85	0.000		0.000		75.640	262.349
2.90	0.000		0.000		76.250	264.465
2.95	0.000		0.000		76.860	266.581
3.00	0.000		0.000		78.080	270.812
3.05	0.000		0.000		79.300	275.044
3.10	0.000		0.000		79.910	277.159
3.15	0.000		0.000		80.520	279.275
3.20	0.000		0.000		80.520	279.275
3.25	0.000		0.000		80.520	279.275
3.30	0.000		0.000		65.880	228.498
3.35	0.000		0.000		63.440	220.035
3.40	0.000		0.000		61.000	211.572
3.45	0.000		0.000		56.120	194.646
3.50	0.000		0.000		50.020	173.489
3.55	0.000		0.000		36.600	126.943
3.60	0.000		0.000		15.860	55.009
3.65	0.000		0.000		15.860	55.009
3.70	0.000		0.000		15.860	55.009
3.75	0.000		0.000		15.860	55.009



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	$\gamma_{\text{setelah dibebani}}$ (gr/cm ³)
34,68	156.56	1.805
69,37	198.88	1.833
138,74	279.27	1.878

DIRECT SHEAR TEST RESULTS (UU)										
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 6 %				
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA								
SAMPLE		:TANAH LANAU PR								
QUARRY		: -								
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM		
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 28/06/2023		
Sample Size :					Proving Ring Calibration		= 1.22 kg/div			
Diameter Sample		=	0.06	m	Displacement Rate		=	kg/div		
Height of Sample		=	0.02	m	c		=	181.95 kN/m ²		
Area of Sample		=	0.00283	m ²	φ		=	32.82 °		
Test No.	TA04/6/3				TA05/6/3			TA07/6/3		
Normal Load	P1 =	10.00	kg		P1 =	20.00	kg		P1 =	40.00 kg
Normal Stress	σ1 =	34.68	kN/m ²		σ1 =	69.37	kN/m ²		σ1 =	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		
	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.05	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.10	0.000	0.000	1.220	4.231	0.000	0.000	0.000	0.000	
	0.15	0.000	0.000	2.440	8.463	1.220	4.231	1.220	4.231	
	0.20	0.000	0.000	2.440	8.463	1.220	4.231	1.220	4.231	
	0.25	1.220	4.231	2.440	8.463	1.220	4.231	1.220	4.231	
	0.30	1.220	4.231	2.440	8.463	1.220	4.231	1.220	4.231	
	0.35	1.220	4.231	2.440	8.463	1.220	4.231	1.220	4.231	
	0.40	1.220	4.231	3.660	12.694	2.440	8.463	2.440	8.463	
	0.45	1.220	4.231	3.660	12.694	3.660	12.694	3.660	12.694	
	0.50	1.220	4.231	3.660	12.694	3.660	12.694	3.660	12.694	
	0.55	1.220	4.231	3.660	12.694	3.660	12.694	3.660	12.694	
	0.60	1.220	4.231	3.660	12.694	3.660	12.694	3.660	12.694	
	0.65	1.220	4.231	3.660	12.694	3.660	12.694	3.660	12.694	
	0.70	2.440	8.463	3.660	12.694	4.880	16.926	4.880	16.926	
	0.75	3.660	12.694	4.880	16.926	4.880	16.926	4.880	16.926	
	0.80	4.880	16.926	6.100	21.157	6.100	21.157	6.100	21.157	
	0.85	4.880	16.926	7.320	25.389	7.320	25.389	7.320	25.389	
	0.90	6.100	21.157	7.320	25.389	9.760	33.852	9.760	33.852	
	0.95	8.540	29.620	8.540	29.620	12.200	42.314	12.200	42.314	
	1.00	10.980	38.083	10.980	38.083	14.640	50.777	14.640	50.777	
	1.05	13.420	46.546	12.200	42.314	17.080	59.240	17.080	59.240	
	1.10	15.860	55.009	14.640	50.777	20.740	71.934	20.740	71.934	
	1.15	18.300	63.472	17.080	59.240	21.960	76.166	21.960	76.166	
	1.20	21.960	76.166	19.520	67.703	24.400	84.629	24.400	84.629	
	1.25	24.400	84.629	21.960	76.166	26.840	93.092	26.840	93.092	
	1.30	26.840	93.092	24.400	84.629	30.500	105.786	30.500	105.786	
	1.35	29.280	101.555	28.060	97.323	32.940	114.249	32.940	114.249	
	1.40	32.940	114.249	30.500	105.786	36.600	126.943	36.600	126.943	
	1.45	35.380	122.712	32.940	114.249	39.040	135.406	39.040	135.406	
	1.50	39.040	135.406	36.600	126.943	42.700	148.100	42.700	148.100	
1.55	42.700	148.100	39.040	135.406	43.920	152.332	43.920	152.332		
1.60	45.140	156.563	42.700	148.100	47.580	165.026	47.580	165.026		
1.65	47.580	165.026	46.360	160.795	51.240	177.720	51.240	177.720		
1.70	51.240	177.720	48.800	169.258	52.460	181.952	52.460	181.952		
1.75	52.460	181.952	51.240	177.720	56.120	194.646	56.120	194.646		
1.80	54.900	190.415	54.900	190.415	57.340	198.878	57.340	198.878		
1.85	56.120	194.646	57.340	198.878	59.780	207.341	59.780	207.341		
1.90	56.120	194.646	59.780	207.341	62.220	215.803	62.220	215.803		
1.95	56.120	194.646	62.220	215.803	64.660	224.266	64.660	224.266		
2.00	54.900	190.415	63.440	220.035	67.100	232.729	67.100	232.729		
2.05	54.900	190.415	64.660	224.266	68.320	236.961	68.320	236.961		

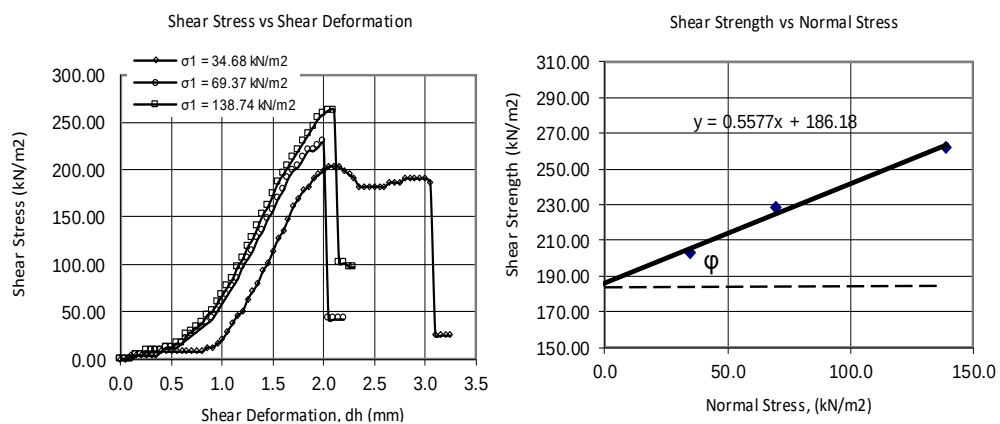
Test No.	TA04/6/3		TA05/6/3		TA07/6/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m^2	$\sigma_1 =$	69.37 kN/m^2	$\sigma_1 =$	138.74 kN/m^2
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m^2)	Shear Force (kg)	Shear Stress (kN/m^2)	Shear Force (kg)	Shear Stress (kN/m^2)
2.10	9.760	33.852	65.880	228.498	69.540	241.192
2.15	9.760	33.852	68.320	236.961	71.980	249.655
2.20	9.760	33.852	68.320	236.961	73.200	253.886
2.25	9.760	33.852	68.320	236.961	74.420	258.118
2.30	0.000		69.540	241.192	75.640	262.349
2.35	0.000		12.200	42.314	75.640	262.349
2.40	0.000		12.200	42.314	75.640	262.349
2.45	0.000		12.200	42.314	75.640	262.349
2.50	0.000		12.200	42.314	76.860	266.581
2.55	0.000		0.000		76.860	266.581
2.60	0.000		0.000		24.400	84.629
2.65	0.000		0.000		24.400	84.629
2.70	0.000		0.000		24.400	84.629
2.75	0.000		0.000		23.180	80.397



Tegangan Normal (kN/m^2)	Tegangan Geser (kN/m^2)	$\gamma_{\text{setelah dibebani}}$ (gr/cm^3)
34,68	194.65	1.658
69,37	241.19	1.662
138,74	266.58	1.740

DIRECT SHEAR TEST RESULTS (UU)							
PROJECT		: PENELITIAN TUGAS AKHIR			 Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 6 %		
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA					
NO SAMPLE		: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LANAU PR					
QUARRY		: -					
TESTING METHOD		: ASTM D 3080-72			TESTED BY : ANDI AMMAR JULTIAR ALAM		
LABORATORY		: HASANUDDIN UNIVERSITY			DATE : 28/06/2023		
Sample Size :			Proving Ring Calibration		= 1.22 kg/div		
Diameter Sample		= 0.06 m	Displacement Rate		= kg/div		
Height of Sample		= 0.02 m	c		= 186.18 kN/m ²		
Area of Sample		= 0.00283 m ²	φ		= 29.15 °		
Test No.	7030BE05/6/3		7030BE06/6/3		7030BE07/6/3		
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg	
Normal Stress	σ1 =	34.68 kN/m ²	σ1 =	69.37 kN/m ²	σ1 =	138.74 kN/m ²	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	
	0.00	0.000	0.000	0.000	0.000	0.000	
	0.05	0.000	0.000	0.000	0.000	0.000	
	0.10	1.220	4.231	0.000	0.000	0.000	
	0.15	1.220	4.231	1.220	4.231	1.220	4.231
	0.20	1.220	4.231	1.220	4.231	1.220	4.231
	0.25	1.220	4.231	1.220	4.231	2.440	8.463
	0.30	1.220	4.231	2.440	8.463	2.440	8.463
	0.35	1.220	4.231	2.440	8.463	2.440	8.463
	0.40	2.440	8.463	2.440	8.463	2.440	8.463
	0.45	2.440	8.463	3.660	12.694	3.660	12.694
	0.50	2.440	8.463	3.660	12.694	3.660	12.694
	0.55	2.440	8.463	3.660	12.694	4.880	16.926
	0.60	2.440	8.463	4.880	16.926	4.880	16.926
	0.65	2.440	8.463	6.100	21.157	7.320	25.389
	0.70	2.440	8.463	7.320	25.389	8.540	29.620
	0.75	2.440	8.463	8.540	29.620	9.760	33.852
	0.80	2.440	8.463	9.760	33.852	10.980	38.083
	0.85	3.660	12.694	10.980	38.083	13.420	46.546
	0.90	3.660	12.694	12.200	42.314	14.640	50.777
	0.95	4.880	16.926	14.640	50.777	17.080	59.240
	1.00	6.100	21.157	17.080	59.240	19.520	67.703
	1.05	8.540	29.620	19.520	67.703	21.960	76.166
	1.10	10.980	38.083	21.960	76.166	24.400	84.629
	1.15	13.420	46.546	24.400	84.629	28.060	97.323
	1.20	14.640	50.777	28.060	97.323	30.500	105.786
	1.25	18.300	63.472	30.500	105.786	34.160	118.480
	1.30	20.740	71.934	32.940	114.249	36.600	126.943
	1.35	23.180	80.397	36.600	126.943	40.260	139.637
	1.40	26.840	93.092	39.040	135.406	43.920	152.332
	1.45	29.280	101.555	42.700	148.100	46.360	160.795
	1.50	32.940	114.249	45.140	156.563	50.020	173.489
1.55	36.600	126.943	48.800	169.258	53.680	186.183	
1.60	39.040	135.406	51.240	177.720	56.120	194.646	
1.65	42.700	148.100	54.900	190.415	58.560	203.109	
1.70	46.360	160.795	57.340	198.878	61.000	211.572	
1.75	48.800	169.258	58.560	203.109	63.440	220.035	
1.80	51.240	177.720	61.000	211.572	65.880	228.498	
1.85	52.460	181.952	63.440	220.035	68.320	236.961	
1.90	54.900	190.415	63.440	220.035	70.760	245.423	
1.95	56.120	194.646	64.660	224.266	73.200	253.886	
2.00	57.340	198.878	65.880	228.498	74.420	258.118	
2.05	58.560	203.109	12.200	42.314	75.640	262.349	

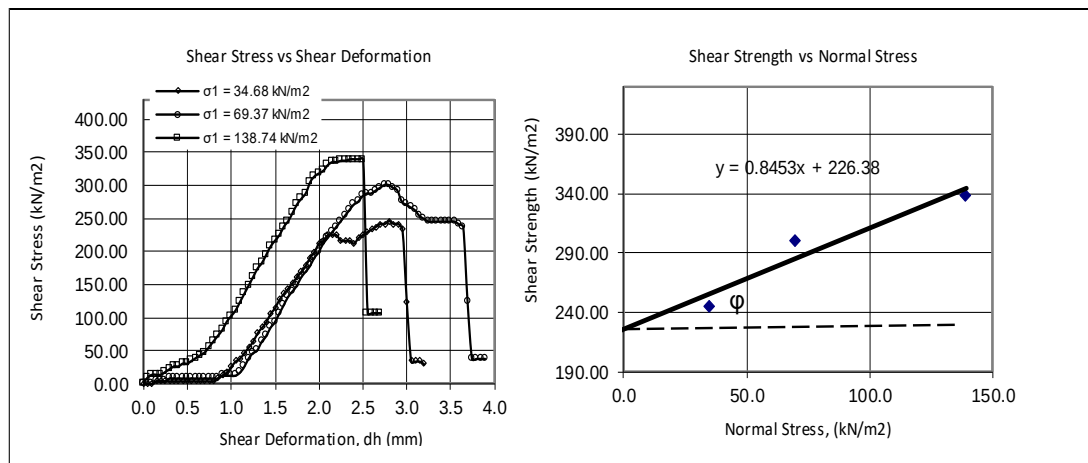
Test No.	7030BE05/6/3		7030BE06/6/3		7030BE07/6/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	58.560	203.109	12.200	42.314	75.640	262.349
2.15	58.560	203.109	12.200	42.314	29.280	101.555
2.20	57.340	198.878	12.200	42.314	29.280	101.555
2.25	56.120	194.646	0.000		28.060	97.323
2.30	54.900	190.415	0.000		28.060	97.323
2.35	52.460	181.952	0.000		0.000	
2.40	52.460	181.952	0.000		0.000	
2.45	52.460	181.952	0.000		0.000	
2.50	52.460	181.952	0.000		0.000	
2.55	52.460	181.952	0.000		0.000	
2.60	52.460	181.952	0.000		0.000	
2.65	53.680	186.183	0.000		0.000	
2.70	53.680	186.183	0.000		0.000	
2.75	53.680	186.183	0.000		0.000	
2.80	54.900	190.415	0.000		0.000	
2.85	54.900	190.415	0.000		0.000	
2.90	54.900	190.415	0.000		0.000	
2.95	54.900	190.415	0.000		0.000	
3.00	54.900	190.415	0.000		0.000	
3.05	53.680	186.183	0.000		0.000	
3.10	7.320	25.389	0.000		0.000	
3.15	7.320	25.389	0.000		0.000	
3.20	7.320	25.389	0.000		0.000	
3.25	7.320	25.389	0.000		0.000	



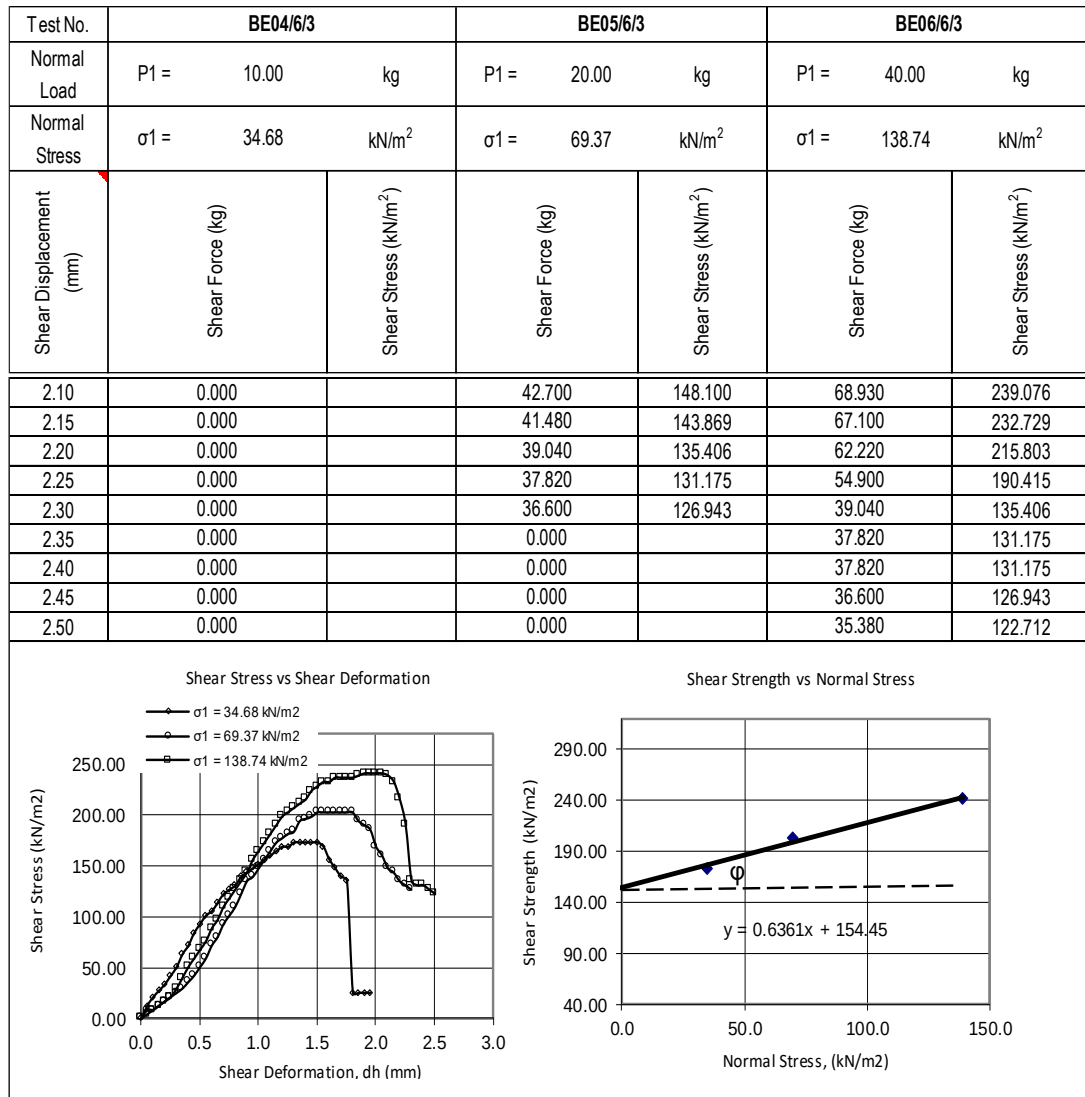
Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	203.11	1.607
69,37	228.50	1.612
138,74	262.35	1.687

DIRECT SHEAR TEST RESULTS (UU)						
PROJECT		: PENELITIAN TUGAS AKHIR			 Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 6 %	
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				
SAMPLE		: 50% TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR				
QUARRY		: -				
TESTING METHOD		: ASTM D 3080-72			TESTED BY : ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY			DATE : 28/06/2023	
Sample Size :			Proving Ring Calibration		= 1.22 kg/div	
Diameter Sample		= 0.06 m	Displacement Rate		= kg/div	
Height of Sample		= 0.02 m	c		= 226.38 kN/m ²	
Area of Sample		= 0.00283 m ²	φ		= 40.21 °	
Test No.	5050BE05/6/3		5050BE06/6/3		5050BE07/6/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	σ1 =	34.68 kN/m ²	σ1 =	69.37 kN/m ²	σ1 =	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
	0.00	0.000	0.000	0.000	0.000	0.000
	0.05	0.000	0.000	0.000	0.000	0.000
	0.10	0.000	0.000	0.000	0.000	0.000
	0.15	1.220	4.231	1.220	4.231	3.660
	0.20	1.220	4.231	1.220	4.231	3.660
	0.25	1.220	4.231	1.220	4.231	4.880
	0.30	1.220	4.231	2.440	8.463	6.100
	0.35	1.220	4.231	2.440	8.463	7.320
	0.40	1.220	4.231	2.440	8.463	7.320
	0.45	1.220	4.231	2.440	8.463	8.540
	0.50	1.220	4.231	2.440	8.463	8.540
	0.55	1.220	4.231	2.440	8.463	9.760
	0.60	1.220	4.231	2.440	8.463	10.980
	0.65	1.220	4.231	2.440	8.463	12.200
	0.70	1.220	4.231	2.440	8.463	13.420
	0.75	1.220	4.231	2.440	8.463	15.860
	0.80	1.220	4.231	2.440	8.463	18.300
	0.85	2.440	8.463	2.440	8.463	20.740
	0.90	3.660	12.694	3.660	12.694	23.180
	0.95	4.880	16.926	3.660	12.694	26.840
	1.00	7.320	25.389	3.660	12.694	29.280
	1.05	9.760	33.852	3.660	12.694	31.720
	1.10	10.980	38.083	4.880	16.926	35.380
	1.15	13.420	46.546	7.320	25.389	39.040
	1.20	15.860	55.009	10.980	38.083	42.700
	1.25	18.300	63.472	13.420	46.546	46.360
	1.30	21.960	76.166	14.640	50.777	50.020
	1.35	24.400	84.629	18.300	63.472	52.460
	1.40	26.840	93.092	20.740	71.934	56.120
	1.45	30.500	105.786	24.400	84.629	59.780
	1.50	32.940	114.249	26.840	93.092	62.220
1.55	36.600	126.943	30.500	105.786	64.660	
1.60	39.040	135.406	34.160	118.480	68.320	
1.65	41.480	143.869	37.820	131.175	70.760	
1.70	43.920	152.332	40.260	139.637	74.420	
1.75	46.360	160.795	42.700	148.100	78.080	
1.80	48.800	169.258	46.360	160.795	80.520	
1.85	51.240	177.720	48.800	169.258	82.960	
1.90	54.900	190.415	51.240	177.720	87.840	
1.95	57.340	198.878	54.900	190.415	90.280	
2.00	61.000	211.572	57.340	198.878	91.500	
2.05	62.220	215.803	61.000	211.572	92.720	

Test No.	5050BE05/6/3		5050BE06/6/3		5050BE07/6/3	
Normal Load	P1 = 10.00 kg		P1 = 20.00 kg		P1 = 40.00 kg	
Normal Stress	$\sigma_1 = 34.68 \text{ kN/m}^2$		$\sigma_1 = 69.37 \text{ kN/m}^2$		$\sigma_1 = 138.74 \text{ kN/m}^2$	
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m^2)	Shear Force (kg)	Shear Stress (kN/m^2)	Shear Force (kg)	Shear Stress (kN/m^2)
2.10	64.660	224.266	63.440	220.035	95.160	330.052
2.15	64.660	224.266	65.880	228.498	96.380	334.284
2.20	64.660	224.266	68.320	236.961	96.380	334.284
2.25	62.220	215.803	70.760	245.423	96.990	336.399
2.30	62.220	215.803	73.200	253.886	96.990	336.399
2.35	62.220	215.803	75.640	262.349	97.600	338.515
2.40	61.000	211.572	78.080	270.812	97.600	338.515
2.45	63.440	220.035	79.300	275.044	97.600	338.515
2.50	64.660	224.266	81.740	283.506	97.600	338.515
2.55	65.880	228.498	82.960	287.738	30.500	105.786
2.60	67.100	232.729	82.960	287.738	30.500	105.786
2.65	68.320	236.961	84.180	291.969	30.500	105.786
2.70	69.540	241.192	85.400	296.201	30.500	105.786
2.75	69.540	241.192	86.620	300.432	0.000	
2.80	70.760	245.423	86.620	300.432	0.000	
2.85	69.540	241.192	85.400	296.201	0.000	
2.90	69.540	241.192	84.180	291.969	0.000	
2.95	67.100	232.729	79.300	275.044	0.000	
3.00	35.380	122.712	78.080	270.812	0.000	
3.05	9.760	33.852	76.860	266.581	0.000	
3.10	9.760	33.852	75.640	262.349	0.000	
3.15	9.760	33.852	73.200	253.886	0.000	
3.20	8.540	29.620	71.980	249.655	0.000	
3.25	0.000		70.760	245.423	0.000	
3.30	0.000		70.760	245.423	0.000	
3.35	0.000		70.760	245.423	0.000	
3.40	0.000		70.760	245.423	0.000	
3.45	0.000		70.760	245.423	0.000	
3.50	0.000		70.760	245.423	0.000	
3.55	0.000		70.760	245.423	0.000	
3.60	0.000		69.540	241.192	0.000	
3.65	0.000		68.320	236.961	0.000	
3.70	0.000		35.380	122.712	0.000	
3.75	0.000		10.980	38.083	0.000	
3.80	0.000		10.980	38.083	0.000	
3.85	0.000		10.980	38.083	0.000	
3.90	0.000		10.980	38.083	0.000	

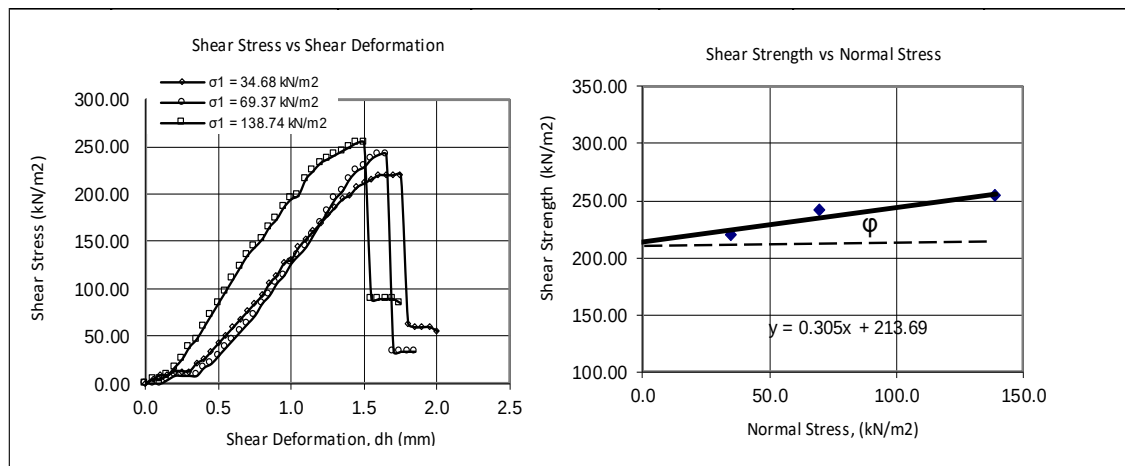


Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	$\gamma_{\text{setelah dibebani}}$ (gr/cm ³)
34,68	245.42	1.721
69,37	300.42	1.755
138,74	338.52	1.919



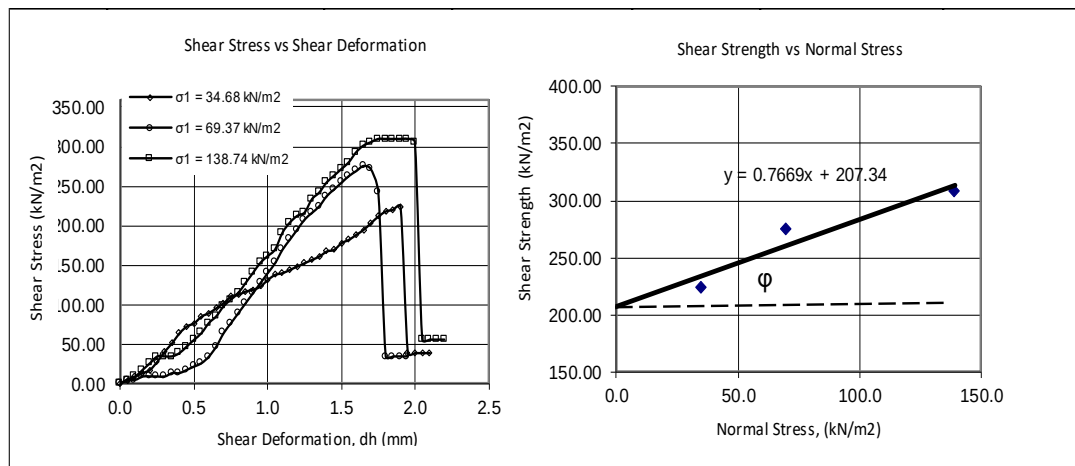
Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	173.49	1.877
69,37	203.11	1.935
138,74	241.19	2.043

DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 8 %			
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
SAMPLE		:TANAH LANAU PR							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 27/07/2023	
Sample Size :			Proving Ring Calibration			= 1.22 kg/div			
Diameter Sample = 0.06 m			Displacement Rate			= kg/div			
Height of Sample = 0.02 m			c			= 213.69 kN/m ²			
Area of Sample = 0.00283 m ²			φ			= 16.96 °			
Test No.	TA06/8/3			TA05/8/3		TA07/8/3			
Normal Load	P1 = 10.00 kg			P1 = 20.00 kg		P1 = 40.00 kg			
Normal Stress	σ1 = 34.68 kN/m ²			σ1 = 69.37 kN/m ²		σ1 = 138.74 kN/m ²			
Shear Displacement (mm)	Shear Force (kg)		Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)		Shear Stress (kN/m ²)	
0.00	0.000		0.000	0.000	0.000	0.000		0.000	
0.05	1.220		4.231	0.000	0.000	1.220		4.231	
0.10	2.440		8.463	0.000	0.000	1.220		4.231	
0.15	2.440		8.463	1.220	4.231	2.440		8.463	
0.20	3.660		12.694	2.440	8.463	4.880		16.926	
0.25	3.660		12.694	2.440	8.463	7.320		25.389	
0.30	3.660		12.694	2.440	8.463	10.980		38.083	
0.35	6.100		21.157	2.440	8.463	13.420		46.546	
0.40	7.320		25.389	4.880	16.926	17.080		59.240	
0.45	9.760		33.852	6.100	21.157	20.740		71.934	
0.50	12.200		42.314	8.540	29.620	24.400		84.629	
0.55	14.640		50.777	10.980	38.083	28.060		97.323	
0.60	17.080		59.240	13.420	46.546	31.720		110.017	
0.65	19.520		67.703	15.860	55.009	35.380		122.712	
0.70	21.960		76.166	18.300	63.472	39.040		135.406	
0.75	24.400		84.629	20.740	71.934	41.480		143.869	
0.80	26.840		93.092	24.400	84.629	43.920		152.332	
0.85	30.500		105.786	26.840	93.092	47.580		165.026	
0.90	32.940		114.249	30.500	105.786	50.020		173.489	
0.95	36.600		126.943	32.940	114.249	53.680		186.183	
1.00	37.820		131.175	36.600	126.943	56.120		194.646	
1.05	41.480		143.869	39.040	135.406	57.340		198.878	
1.10	43.920		152.332	41.480	143.869	62.220		215.803	
1.15	46.360		160.795	45.140	156.563	64.660		224.266	
1.20	48.800		169.258	48.800	169.258	67.100		232.729	
1.25	51.240		177.720	52.460	181.952	68.320		236.961	
1.30	53.680		186.183	56.120	194.646	69.540		241.192	
1.35	56.120		194.646	58.560	203.109	70.760		245.423	
1.40	57.340		198.878	62.220	215.803	71.980		249.655	
1.45	59.780		207.341	64.660	224.266	73.200		253.886	
1.50	61.000		211.572	65.880	228.498	73.200		253.886	
1.55	62.220		215.803	68.320	236.961	25.620			



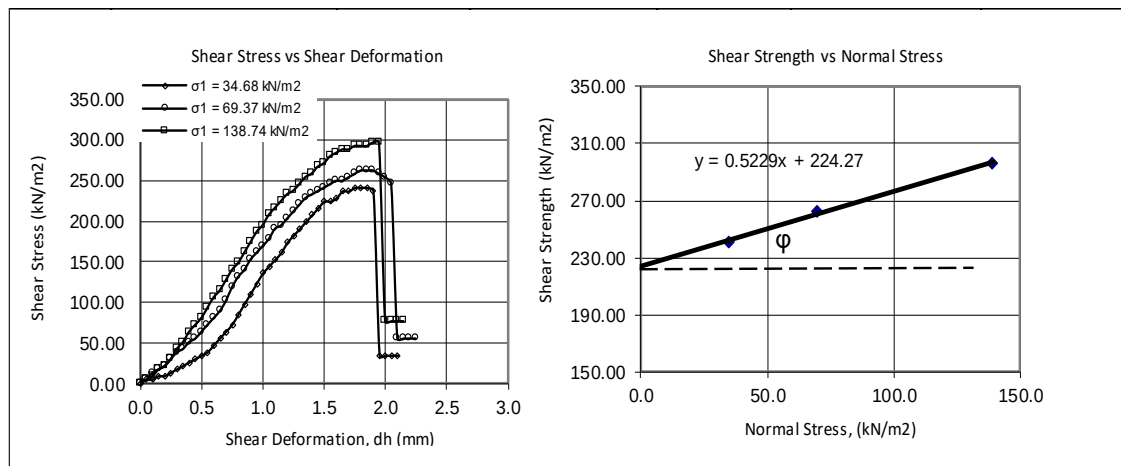
Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	220.03	1.799
69,37	241.19	1.794
138,74	253.89	1.813

DIRECT SHEAR TEST RESULTS (UU)						
PROJECT		: PENELITIAN TUGAS AKHIR		Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 8 % TESTED BY : ANDI AMMAR JULTIAR ALAM DATE : 27/07/2023		
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA				
NO SAMPLE		: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LANAU PR				
QUARRY		: -				
TESTING METHOD		: ASTM D 3080-72				
LABORATORY		: HASANUDDIN UNIVERSITY				
Sample Size :			Proving Ring Calibration		=	1.22 kg/div
Diameter Sample		= 0.06 m	Displacement Rate		=	kg/div
Height of Sample		= 0.02 m	c		=	207.34 kN/m ²
Area of Sample		= 0.00283 m ²	φ		=	37.48 °
Test No.	7030BE07/8/3		7030BE04/8/3		7030BE06/8/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	σ1 =	34.68 kN/m ²	σ1 =	69.37 kN/m ²	σ1 =	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	1.220	4.231	1.220	4.231	1.220	4.231
0.10	2.440	8.463	1.220	4.231	2.440	8.463
0.15	3.660	12.694	2.440	8.463	4.880	16.926
0.20	4.880	16.926	2.440	8.463	7.320	25.389
0.25	7.930	27.504	2.440	8.463	9.760	33.852
0.30	11.590	40.199	2.440	8.463	9.760	33.852
0.35	14.640	50.777	3.660	12.694	9.760	33.852
0.40	18.300	63.472	3.660	12.694	10.980	38.083
0.45	20.740	71.934	4.880	16.926	13.420	46.546
0.50	21.960	76.166	6.100	21.157	15.860	55.009
0.55	24.400	84.629	7.320	25.389	18.300	63.472
0.60	25.620	88.860	9.760	33.852	21.960	76.166
0.65	27.450	95.207	13.420	46.546	24.400	84.629
0.70	29.280	101.555	18.300	63.472	28.060	97.323
0.75	31.720	110.017	21.960	76.166	30.500	105.786
0.80	32.330	112.133	25.620	88.860	32.940	114.249
0.85	33.550	116.365	29.280	101.555	36.600	126.943
0.90	34.160	118.480	32.940	114.249	40.260	139.637
0.95	35.380	122.712	36.600	126.943	43.920	152.332
1.00	37.820	131.175	40.260	139.637	46.360	160.795
1.05	39.650	137.522	43.920	152.332	48.800	169.258
1.10	40.260	139.637	48.800	169.258	54.900	190.415
1.15	41.480	143.869	52.460	181.952	58.560	203.109
1.20	42.700	148.100	56.120	194.646	61.000	211.572
1.25	43.920	152.332	59.780	207.341	62.220	215.803
1.30	45.140	156.563	62.220	215.803	67.100	232.729
1.35	46.360	160.795	64.660	224.266	69.540	241.192
1.40	48.190	167.142	68.320	236.961	73.200	253.886
1.45	48.800	169.258	70.760	245.423	75.640	262.349
1.50	51.240	177.720	73.200	253.886	78.080	270.812
1.55	52.460	181.952	75.640	262.349	80.520	279.275
1.60	54.290	188.299	77.470	268.696	84.180	291.969
1.65	56.120	194.646	79.300	275.044	86.620	300.432
1.70	58.560	203.109	78.080	270.812	87.840	304.664
1.75	61.000	211.572	69.540	241.192	89.060	308.895
1.80	62.830	217.919	9.760	33.852	89.060	308.895
1.85	63.440	220.035	9.760	33.852	89.060	308.895
1.90	64.660	224.266	9.760	33.852	89.060	308.895
1.95	10.980	38.083	9.760	33.852	89.060	308.895
2.00	10.980	38.083	0.000		87.840	304.664
2.05	10.980	38.083	0.000		15.860	55.009
2.10	10.980	38.083	0.000		15.860	55.009
2.15	0.000		0.000		15.860	55.009
2.20	0.000		0.000		15.860	55.009



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	224.27	1.846
69,37	275.04	1.885
138,74	308.90	1.898

DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 8 %			
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
SAMPLE		: 50% TANAH LEMPUNG EKSPANSIF - 50% TANAH LANAU PR							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		:20/07/2023	
Sample Size :					Proving Ring Calibration = 1.22 kg/div				
Diameter Sample = 0.06 m					Displacement Rate = kg/div				
Height of Sample = 0.02 m					c = 224.27 kN/m ²				
Area of Sample = 0.00283 m ²					φ = 27.60 °				
Test No.	5050BE01/8/3			5050BE04/8/3			5050BE03/8/3		
Normal Load	P1 =	10.00	kg	P1 =	20.00	kg	P1 =	40.00	kg
Normal Stress	σ1 =	34.68	kN/m ²	σ1 =	69.37	kN/m ²	σ1 =	138.74	kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)	
	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.05	1.220	4.231	1.220	4.231	1.220	1.220	4.231	4.231
	0.10	1.220	4.231	3.660	12.694	2.440	2.440	8.463	8.463
	0.15	2.440	8.463	4.880	16.926	4.880	4.880	16.926	16.926
	0.20	2.440	8.463	6.100	21.157	6.100	6.100	21.157	21.157
	0.25	3.660	12.694	8.540	29.620	8.540	8.540	29.620	29.620
	0.30	4.880	16.926	10.980	38.083	12.200	12.200	42.314	42.314
	0.35	6.100	21.157	12.200	42.314	14.640	14.640	50.777	50.777
	0.40	7.320	25.389	14.640	50.777	18.300	18.300	63.472	63.472
	0.45	8.540	29.620	15.860	55.009	20.740	20.740	71.934	71.934
	0.50	9.760	33.852	18.300	63.472	23.180	23.180	80.397	80.397
	0.55	10.980	38.083	20.740	71.934	26.840	26.840	93.092	93.092
	0.60	13.420	46.546	23.180	80.397	30.500	30.500	105.786	105.786
	0.65	15.860	55.009	25.620	88.860	32.940	32.940	114.249	114.249
	0.70	18.300	63.472	29.280	101.555	36.600	36.600	126.943	126.943
	0.75	20.740	71.934	34.160	118.480	40.260	40.260	139.637	139.637
	0.80	24.400	84.629	37.820	131.175	42.700	42.700	148.100	148.100
	0.85	28.060	97.323	40.260	139.637	46.360	46.360	160.795	160.795
	0.90	31.720	110.017	43.920	152.332	50.020	50.020	173.489	173.489
	0.95	35.380	122.712	46.360	160.795	53.680	53.680	186.183	186.183
	1.00	39.040	135.406	48.800	169.258	56.120	56.120	194.646	194.646
	1.05	41.480	143.869	51.240	177.720	59.780	59.780	207.341	207.341
	1.10	43.920	152.332	54.900	190.415	62.220	62.220	215.803	215.803
	1.15	46.360	160.795	56.120	194.646	64.660	64.660	224.266	224.266
	1.20	50.020	173.489	58.560	203.109	67.100	67.100	232.729	232.729
	1.25	52.460	181.952	61.000	211.572	68.320	68.320	236.961	236.961
	1.30	54.900	190.415	63.440	220.035	70.760	70.760	245.423	245.423
	1.35	57.340	198.878	65.880	228.498	73.200	73.200	253.886	253.886
	1.40	59.780	207.341	67.100	232.729	74.420	74.420	258.118	258.118
	1.45	62.220	215.803	68.320	236.961	76.860	76.860	266.581	266.581
	1.50	64.660	224.266	69.540	241.192	78.080	78.080	270.812	270.812
	1.55	64.660	224.266	70.760	245.423	80.520	80.520	279.275	279.275
	1.60	65.880	228.498	71.980	249.655	81.740	81.740	283.506	283.506
	1.65	68.320	236.961	71.980	249.655	82.960	82.960	287.738	287.738
	1.70	68.320	236.961	73.200	253.886	82.960	82.960	287.738	287.738
1.75	69.540	241.192	74.420	258.118	84.180	84.180	291.969	291.969	
1.80	69.540	241.192	75.640	262.349	84.180	84.180	291.969	291.969	
1.85	69.540	241.192	75.640	262.349	84.180	84.180	291.969	291.969	
1.90	68.320	236.961	75.640	262.349	85.400	85.400	296.201	296.201	
1.95	9.760	33.852	74.420	258.118	85.400	85.400	296.201	296.201	
2.00	9.760	33.852	73.200	253.886	21.960	21.960	76.166	76.166	
2.05	9.760	33.852	70.760	245.423	21.960	21.960	76.166	76.166	
2.10	9.760	33.852	15.860	55.009	21.960	21.960	76.166	76.166	
2.15	0.000		15.860	55.009	21.960	21.960	76.166	76.166	
2.20	0.000		15.860	55.009	0.000				
2.25	0.000		15.860	55.009	0.000				

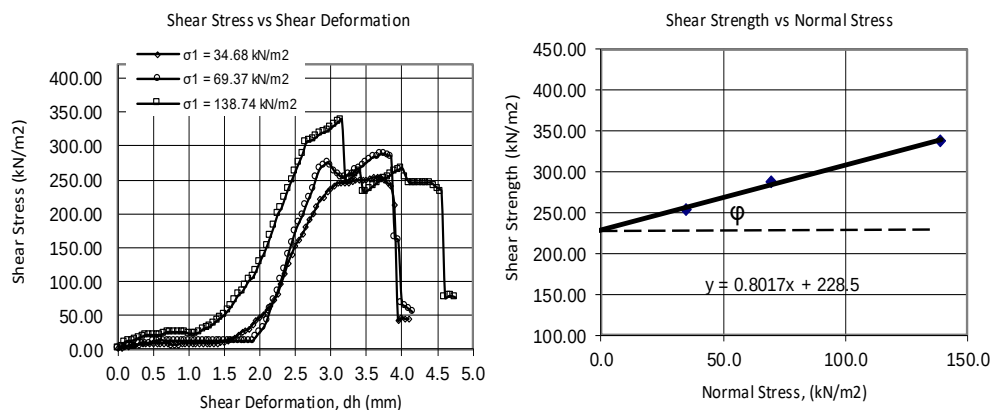


Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	241.19	1.805
69,37	262.35	1.833
138,74	296.20	1.878

DIRECT SHEAR TEST RESULTS (UU)									
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 14 Hari Bakteri : 8 %			
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA							
SAMPLE		: TANAH LEMPUNG EKSPANSIF							
QUARRY		: -							
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM	
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 27/07/2023	
Sample Size :					Proving Ring Calibration		= 1.22 kg/div		
Diameter Sample		=	0.06	m	Displacement Rate		=	kg/div	
Height of Sample		=	0.02	m	c		=	228.50	kN/m ²
Area of Sample		=	0.00283	m ²	φ		=	38.72	°
Test No.	BE05/8/3				BE06/8/3			BE08/8/3	
Normal Load	P1 =	10.00	kg		P1 =	20.00	kg		P1 = 40.00 kg
Normal Stress	σ1 =	34.68	kN/m ²		σ1 =	69.37	kN/m ²		σ1 = 138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)		Shear Force (kg)	Shear Stress (kN/m ²)	
	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
	0.05	0.000	0.000	1.220	4.231	1.220	4.231		
	0.10	1.220	4.231	1.220	4.231	3.050	10.579		
	0.15	1.220	4.231	1.220	4.231	3.660	12.694		
	0.20	1.830	6.347	1.220	4.231	3.660	12.694		
	0.25	1.830	6.347	1.220	4.231	4.270	14.810		
	0.30	1.830	6.347	2.440	8.463	4.880	16.926		
	0.35	2.440	8.463	2.440	8.463	5.490	19.041		
	0.40	2.440	8.463	2.440	8.463	6.100	21.157		
	0.45	2.440	8.463	2.440	8.463	6.100	21.157		
	0.50	2.440	8.463	3.660	12.694	6.100	21.157		
	0.55	2.440	8.463	3.660	12.694	6.100	21.157		
	0.60	2.440	8.463	4.270	14.810	6.100	21.157		
	0.65	2.440	8.463	3.660	12.694	6.710	23.273		
	0.70	2.440	8.463	3.660	12.694	7.320	25.389		
	0.75	1.830	6.347	3.660	12.694	7.320	25.389		
	0.80	1.830	6.347	3.660	12.694	7.320	25.389		
	0.85	1.830	6.347	3.660	12.694	7.320	25.389		
	0.90	2.440	8.463	3.660	12.694	7.320	25.389		
	0.95	2.440	8.463	3.660	12.694	7.320	25.389		
	1.00	2.440	8.463	3.660	12.694	6.710	23.273		
	1.05	2.440	8.463	3.660	12.694	6.710	23.273		
	1.10	2.440	8.463	3.660	12.694	6.710	23.273		
	1.15	2.440	8.463	3.660	12.694	7.320	25.389		
	1.20	2.440	8.463	3.660	12.694	8.540	29.620		
	1.25	2.440	8.463	3.660	12.694	9.150	31.736		
	1.30	2.440	8.463	3.660	12.694	9.760	33.852		
	1.35	2.440	8.463	3.660	12.694	10.980	38.083		
	1.40	2.440	8.463	3.660	12.694	12.200	42.314		
	1.45	3.050	10.579	3.660	12.694	13.420	46.546		
	1.50	3.050	10.579	3.660	12.694	14.640	50.777		
1.55	3.660	12.694	3.660	12.694	16.470	57.124			
1.60	4.270	14.810	3.660	12.694	18.300	63.472			
1.65	4.880	16.926	3.660	12.694	20.740	71.934			
1.70	6.100	21.157	3.660	12.694	23.180	80.397			
1.75	7.320	25.389	3.660	12.694	24.400	84.629			
1.80	7.930	27.504	3.660	12.694	26.840	93.092			
1.85	8.540	29.620	3.660	12.694	29.280	101.555			
1.90	10.370	35.967	3.660	12.694	30.500	105.786			
1.95	12.200	42.314	5.490	19.041	33.550	116.365			
2.00	13.420	46.546	7.320	25.389	37.210	129.059			
2.05	14.640	50.777	9.150	31.736	40.260	139.637			

Test No.	BE05/8/3		BE06/8/3		BE08/8/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	16.470	57.124	12.200	42.314	43.920	152.332
2.15	18.300	63.472	17.080	59.240	48.190	167.142
2.20	20.740	71.934	20.740	71.934	52.460	181.952
2.25	23.180	80.397	24.400	84.629	57.340	198.878
2.30	27.450	95.207	29.280	101.555	59.780	207.341
2.35	31.720	110.017	34.160	118.480	64.050	222.151
2.40	36.600	126.943	40.260	139.637	68.320	236.961
2.45	40.260	139.637	45.140	156.563	71.980	249.655
2.50	43.920	152.332	50.020	173.489	75.640	262.349
2.55	46.360	160.795	53.680	186.183	79.300	275.044
2.60	48.800	169.258	56.730	196.762	82.960	287.738
2.65	51.850	179.836	61.000	211.572	87.840	304.664
2.70	54.900	190.415	64.660	224.266	88.450	306.779
2.75	57.340	198.878	68.320	236.961	89.060	308.895
2.80	60.390	209.456	73.200	253.886	90.280	313.127
2.85	63.440	220.035	76.860	266.581	91.500	317.358
2.90	64.660	224.266	78.080	270.812	92.110	319.474
2.95	67.100	232.729	79.300	275.044	92.720	321.589
3.00	68.320	236.961	78.080	270.812	93.940	325.821
3.05	69.540	241.192	75.640	262.349	95.160	330.052
3.10	70.760	245.423	74.420	258.118	96.380	334.284
3.15	70.760	245.423	73.200	253.886	97.600	338.515
3.20	70.760	245.423	73.200	253.886	71.980	249.655
3.25	70.760	245.423	74.420	258.118	71.980	249.655
3.30	71.370	247.539	74.420	258.118	73.200	253.886
3.35	71.980	249.655	76.250	264.465	74.420	258.118
3.40	71.980	249.655	76.860	266.581	75.640	262.349
3.45	71.980	249.655	78.080	270.812	67.100	232.729
3.50	71.980	249.655	79.300	275.044	67.100	232.729
3.55	72.590	251.771	80.520	279.275	68.320	236.961
3.60	73.200	253.886	81.740	283.506	69.540	241.192
3.65	73.200	253.886	81.740	283.506	70.760	245.423
3.70	73.200	253.886	82.960	287.738	71.980	249.655
3.75	71.980	249.655	82.960	287.738	72.590	251.771
3.80	70.760	245.423	82.350	285.622	73.200	253.886
3.85	69.540	241.192	81.740	283.506	74.420	258.118
3.90	61.000	211.572	47.580	165.026	75.640	262.349
3.95	12.200	42.314	46.360	160.795	76.250	264.465
4.00	13.420	46.546	19.520	67.703	76.860	266.581

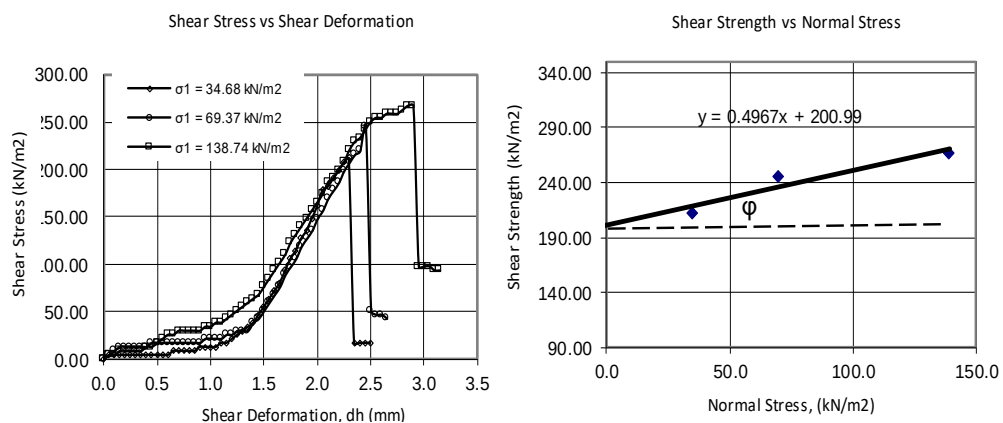
Test No.	BE05/8/3		BE06/8/3		BE08/8/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	σ_1 =	34.68 kN/m ²	σ_1 =	69.37 kN/m ²	σ_1 =	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
4.05	12.810	44.430	18.300	63.472	73.200	253.886
4.10	12.810	44.430	17.080	59.240	70.760	245.423
4.15	0.000		15.860	55.009	70.760	245.423
4.20	0.000		0.000		70.760	245.423
4.25	0.000		0.000		70.760	245.423
4.30	0.000		0.000		70.760	245.423
4.35	0.000		0.000		70.760	245.423
4.40	0.000		0.000		70.760	245.423
4.45	0.000		0.000		69.540	241.192
4.50	0.000		0.000		68.320	236.961
4.55	0.000		0.000		67.100	232.729
4.60	0.000		0.000		21.960	76.166
4.65	0.000		0.000		22.570	78.282
4.70	0.000		0.000		22.570	78.282
4.75	0.000		0.000		21.960	76.166



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	γ setelah dibebani (gr/cm ³)
34,68	253.89	1.856
69,37	287.74	1.886
138,74	338.52	2.018

DIRECT SHEAR TEST RESULTS (UU)												
PROJECT		: PENELITIAN TUGAS AKHIR				Kultur Bakteri : 3 Hari Pemeraman : 28 Hari Bakteri : 6 %						
LOCATION		: FAKULTAS TEKNIK UNHAS GOWA										
SAMPLE		:TANAH LANAU PR										
QUARRY		: -										
TESTING METHOD		: ASTM D 3080-72				TESTED BY		: ANDI AMMAR JULTIAR ALAM				
LABORATORY		: HASANUDDIN UNIVERSITY				DATE		: 12/07/2023				
Sample Size :					Proving Ring Calibration		= 1.22 kg/div					
Diameter Sample		=	0.06	m	Displacement Rate		=	kg/div				
Height of Sample		=	0.02	m	c		=	200.99 kN/m ²				
Area of Sample		=	0.00283	m ²	φ		=	26.41 °				
Test No.	TA08/6/3				TA09/6/3			TA10/6/3				
Normal Load	P1 =	10.00	kg		P1 =	20.00	kg		P1 =	40.00 kg		
Normal Stress	σ1 =	34.68	kN/m ²		σ1 =	69.37	kN/m ²		σ1 =	138.74 kN/m ²		
Shear Displacement (mm)	Shear Force (kg)		Shear Stress (kN/m ²)		Shear Force (kg)		Shear Stress (kN/m ²)		Shear Force (kg)		Shear Stress (kN/m ²)	
0.00	0.000		0.000		0.000		0.000		0.000		0.000	
0.05	1.220		4.231		1.220		4.231		1.220		4.231	
0.10	1.220		4.231		2.440		8.463		1.220		4.231	
0.15	1.220		4.231		3.660		12.694		2.440		8.463	
0.20	1.220		4.231		3.660		12.694		2.440		8.463	
0.25	1.220		4.231		3.660		12.694		2.440		8.463	
0.30	1.220		4.231		3.660		12.694		2.440		8.463	
0.35	1.220		4.231		3.660		12.694		2.440		8.463	
0.40	1.220		4.231		3.660		12.694		3.660		12.694	
0.45	1.220		4.231		4.880		16.926		3.660		12.694	
0.50	1.220		4.231		4.880		16.926		4.880		16.926	
0.55	1.220		4.231		4.880		16.926		6.100		21.157	
0.60	1.220		4.231		4.880		16.926		7.320		25.389	
0.65	2.440		8.463		4.880		16.926		7.320		25.389	
0.70	2.440		8.463		4.880		16.926		8.540		29.620	
0.75	2.440		8.463		4.880		16.926		8.540		29.620	
0.80	2.440		8.463		4.880		16.926		8.540		29.620	
0.85	2.440		8.463		4.880		16.926		8.540		29.620	
0.90	3.660		12.694		4.880		16.926		8.540		29.620	
0.95	3.660		12.694		6.100		21.157		9.760		33.852	
1.00	3.660		12.694		6.100		21.157		9.760		33.852	
1.05	3.660		12.694		6.100		21.157		10.980		38.083	
1.10	4.880		16.926		6.100		21.157		10.980		38.083	
1.15	4.880		16.926		7.320		25.389		12.200		42.314	
1.20	6.100		21.157		7.320		25.389		13.420		46.546	
1.25	7.320		25.389		8.540		29.620		14.640		50.777	
1.30	8.540		29.620		8.540		29.620		15.860		55.009	
1.35	9.760		33.852		8.540		29.620		17.080		59.240	
1.40	10.980		38.083		10.980		38.083		18.300		63.472	
1.45	13.420		46.546		12.200		42.314		19.520		67.703	
1.50	15.860		55.009		14.640		50.777		21.960		76.166	
1.55	18.300		63.472		17.080		59.240		24.400		84.629	
1.60	20.740		71.934		19.520		67.703		26.840		93.092	
1.65	23.180		80.397		21.960		76.166		29.280		101.555	
1.70	26.840		93.092		25.620		88.860		31.720		110.017	
1.75	30.500		105.786		28.060		97.323		35.380		122.712	
1.80	32.940		114.249		30.500		105.786		37.820		131.175	
1.85	36.600		126.943		34.160		118.480		40.260		139.637	
1.90	39.040		135.406		36.600		126.943		42.700		148.100	
1.95	42.700		148.100		39.040		135.406		45.140		156.563	
2.00	46.360		160.795		42.700		148.100		47.580		165.026	
2.05	51.240		177.720		45.140		156.563		50.020		173.489	

Test No.	TA08/6/3		TA09/6/3		TA10/6/3	
Normal Load	P1 =	10.00 kg	P1 =	20.00 kg	P1 =	40.00 kg
Normal Stress	$\sigma_1 =$	34.68 kN/m ²	$\sigma_1 =$	69.37 kN/m ²	$\sigma_1 =$	138.74 kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
2.10	52.460	181.952	48.800	169.258	53.680	186.183
2.15	54.900	190.415	51.240	177.720	54.900	190.415
2.20	57.340	198.878	53.680	186.183	57.340	198.878
2.25	59.780	207.341	57.340	198.878	59.780	207.341
2.30	61.000	211.572	59.780	207.341	63.440	220.035
2.35	4.880	16.926	62.220	215.803	65.880	228.498
2.40	4.880	16.926	63.440	220.035	67.100	232.729
2.45	4.880	16.926	70.760	245.423	69.540	241.192
2.50	4.880	16.926	14.640	50.777	71.980	249.655
2.55	0.000		13.420	46.546	73.200	253.886
2.60	0.000		13.420	46.546	73.200	253.886
2.65	0.000		12.200	42.314	74.420	258.118
2.70	0.000		0.000		74.420	258.118
2.75	0.000		0.000		74.420	258.118
2.80	0.000		0.000		75.640	262.349
2.85	0.000		0.000		76.860	266.581
2.90	0.000		0.000		76.860	266.581
2.95	0.000		0.000		28.060	97.323
3.00	0.000		0.000		28.060	97.323
3.05	0.000		0.000		28.060	97.323
3.10	0.000		0.000		26.840	93.092
3.15	0.000		0.000		26.840	93.092



Tegangan Normal (kN/m ²)	Tegangan Geser (kN/m ²)	$\gamma_{\text{setelah dibebani}}$ (gr/cm ³)
34,68	211.57	1.731
69,37	245.42	1.758
138,74	266.58	1.828

DIRECT SHEAR TEST RESULTS (UU)						
PROJECT	: PENELITIAN TUGAS AKHIR					
LOCATION	: FAKULTAS TEKNIK UNHAS GOWA				Kultur Bakteri	: 3 Hari
NO SAMPLE	: 70% TANAH LEMPUNG EKSPANSIF - 30% TANAH LANAU PR				Pemeraman	: 28 Hari
QUARRY	: -				Bakteri	: 6 %
TESTING METHOD	: ASTM D 3080-72				TESTED BY	: ANDI AMMAR JULTIAR ALAM
LABORATORY	: HASANUDDIN UNIVERSITY			DATE	: 12/07/2023	
Sample Size :		Proving Ring Calibration		=	1.22	kg/div
Diameter Sample	=	0.06	m	Displacement Rate	=	kg/div
Height of Sample	=	0.02	m	c	=	196.76 kN/m ²
Area of Sample	=	0.00283	m ²	φ	=	35.55 °
Test No.	7030BE08/6/3		7030BE11/6/3		7030BE10/6/3	
Normal Load	P1 =	10.00	kg	P1 =	20.00	kg
Normal Stress	σ1 =	34.68	kN/m ²	σ1 =	69.37	kN/m ²
Shear Displacement (mm)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)	Shear Force (kg)	Shear Stress (kN/m ²)
0.00	0.000	0.000	0.000	0.000	0.000	0.000
0.05	0.000	0.000	1.220	4.231	3.660	12.694
0.10	0.000	0.000	1.220	4.231	3.660	12.694
0.15	1.220	4.231	1.220	4.231	4.880	16.926
0.20	1.220	4.231	1.220	4.231	4.880	16.926
0.25	1.220	4.231	2.440	8.463	4.880	16.926
0.30	1.220	4.231	2.440	8.463	6.100	21.157
0.35	1.220	4.231	2.440	8.463	6.100	21.157
0.40	1.220	4.231	2.440	8.463	7.320	25.389
0.45	1.220	4.231	2.440	8.463	8.540	29.620
0.50	1.220	4.231	2.440	8.463	9.760	33.852
0.55	1.220	4.231	2.440	8.463	10.980	38.083
0.60	1.220	4.231	2.440	8.463	12.200	42.314
0.65	2.440	8.463	3.660	12.694	13.420	46.546
0.70	2.440	8.463	3.660	12.694	14.640	50.777
0.75	2.440	8.463	3.660	12.694	15.860	55.009
0.80	2.440	8.463	4.880	16.926	17.080	59.240
0.85	3.660	12.694	4.880	16.926	18.300	63.472
0.90	3.660	12.694	6.100	21.157	19.520	67.703
0.95	4.880	16.926	7.320	25.389	20.740	71.934
1.00	6.100	21.157	8.540	29.620	21.960	76.166
1.05	7.320	25.389	10.980	38.083	24.400	84.629
1.10	8.540	29.620	13.420	46.546	25.620	88.860
1.15	9.760	33.852	15.860	55.009	28.060	97.323
1.20	12.200	42.314	18.300	63.472	30.500	105.786
1.25	13.420	46.546	20.740	71.934	31.720	110.017
1.30	15.860	55.009	24.400	84.629	35.380	122.712
1.35	17.080	59.240	28.060	97.323	37.820	131.175
1.40	19.520	67.703	31.720	110.017	40.260	139.637
1.45	21.960	76.166	35.380	122.712	43.920	152.332
1.50	25.620	88.860	40.260	139.637	46.360	160.795
1.55	28.060	97.323	43.920	152.332	48.800	169.258
1.60	31.720	110.017	47.580	165.026	51.240	177.720
1.65	35.380	122.712	50.020	173.489	53.680	186.183
1.70	36.600	126.943	53.680	186.183	57.340	198.878
1.75	39.040	135.406	57.340	198.878	59.780	207.341
1.80	40.260	139.637	61.000	211.572	62.220	215.803
1.85	42.700	148.100	63.440	220.035	64.660	224.266
1.90	47.580	165.026	65.880	228.498	68.320	236.961
1.95	48.800	169.258	68.320	236.961	69.540	241.192
2.00	51.240	177.720	68.320	236.961	71.980	249.655
2.05	54.900	190.415	70.760	245.423	74.420	258.118