IMPROVEMENT OF SUBSTATIONS AND DISTRIBUTION NETWORK, PHASE 3, JICA PROJECT.

SOIL INVESTIGATION (File 2 / 2 : Field & laboratory tests)

III. PHISICAL & MECHANICAL TESTS (for 50 points)

- New substation construction site & branch point line 110 kV at Gasogi (7 points) : Sip1 , Sip2, Sip3, Sip4, Sip5, Sip6 & Sip7
- 15 kV Distribution line Gasogi substation - Nyagasambu (15 points) : Sip1 , Sip2, Sip3, Sip4, Sip5, Sip6, Sip7 Sip9, Sip10, Sip11, Sip12, Sip13, Sip15, Sip16 & Sip17 .
- 15 kV Distribution line Gasogi substation - Masaka hospital (15 points) : Sip1 , Sip3, Sip4, Sip5, Sip6, Sip8, Sip9, Sip10, Sip12, Sip13, Sip15 , Sip16, Sip17, Sip18 & Sip19.
- Reconstruction of transmission 110 kV line Jabana - Birembo (13 points) : Sip176 , Sip177, Sip178, Sip180, Sip181, Sip182, Sip184, Sip186, Sip187, Sip189, Sip190, Sip195, Sip196 .

1 INTRODUCTION

1.1 Context

For the improvement of substation and distribution network Phase 3 of the Power Line Gasogi – Ndera , Gasogi-Nyagasambu and reconstruction of 110Kv transmission line Jabana-Birembo, PITRAD IBAMBA LTD assigned to the RINCENT BTP RWANDA's Laboratory to carry out the laboratory tests on materials of the foundation soil.

The order consisted of the following tests:

a) In-situ tests :
- Collecting samples for laboratory tests carried out from 22 to 25 July 2017 under the supervision of the client. Digging trial pits were done by the client.

b) Laboratory tests
- 51 Atterberg limits,
- 51 Natural Moisture content,
- 51 Sieve analysis,
- 51 Specific gravity,
- 51 Shear tests,
- 51 Modified proctor,
- 36 Unconfined compressive strength.

2 TEST OBJECTIFS

The objective of this investigation was to find out the nature and the geotechnical characteristics of the soil, for the foundation design purpose.

This study is a component of stage 2 (G2 mission) according to the French standard, NF P 94-500, defining the geotechnical missions.

The results of the investigation shall allow to:

- Define the lithology of the soil,
- Determine the geotechnical characteristics of the soil.

2.1 Standard references

The tests listed in the introduction have been performed in accordance with the following standards or their equivalent:

- Standard NF P 94-050 : Moisture content,
- Standard NF P 94-053 : Specific gravity,
- Standard NF P 94-056 : Sieve Analysis ,
- Standard NF P 94-051 : Atterberg limits,
- Standard NF P 94-202 : Sampling,
- Standard NF P 94-093 : Modified Proctor,
- Standard NF P 94-071-2: Direct Shear Box,
- Standard AASHTO T 134 :Unconfined compressive strength,
- USCS: Unified Soil Classification System.

3 TEST RESULTS

All the test results are given on separate papers and are as well described in the following tables:

- *Identification and mechanical tests results*

New substation construction site

Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings								ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS
			0.08	0.315	2	4	8	10	20	40	LL	PL	PI	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)	
S1	Sand stone	2.00-3.50m	40	43.21	51.6	55.5	75.67	80.4	94.71	100	38.93	NP		1.95	14.68	1.68	14.5	0.26	23.99	GM
S2	Weathered sand stone	3.70-4.00m	58.9	77.98	93.3	94.8	97.94	98.6	100	100	38.05	NP		1.95	15.10	1.94	17.7	0.14	26.57	GM
S3	Soft reddish lateritic gravels	3.50-4.00m	33.3	42.92	51.7	63	75.69	79.1	85.99	100	37.06	22.28	**14.8**	1.94	13.80	1.93	14.6	0.14	26.34	GC
S4	Silt and Sand stone in weathering process	3.50-4.00m	31.1	59.63	82.1	85.1	87.58	88.7	90.8	100	38.42	23.24	**15.2**	2.01	12.80	1.94	18	0.10	27.25	GC
S5	Silty weathered sand stone	3.50-4.00m	50.9	81.75	91.2	96.2	99.01	100	100	100	39.46	21.36	**18.1**	1.88	14.40	1.84	16	0.37	19.80	CI
S6	Brownish sandy silt	3.50-4.00m	61.3	84	93.5	97.3	99.36	99.8	100	100	41.50	22.66	**18.8**	1.82	16.98	1.71	18	0.26	20.30	CI
S7	Brownish lateritic gravels	3.50-4.00m	43.3	52.91	58.6	66.2	79.22	81.4	90.19	100	38.17	22.17	**16.0**	1.96	14.69	1.93	18.3	0.25	23.75	SM

Distribution line Gasogi-Nyagasambu

Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings								ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS
			0.08	0.315	2	4	8	10	20	40	LL	PL	PI	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)	
AP1	Brownish sandy silt	3.70-4.00m	61.1	78.52	91.6	94.6	97.03	98	100	100	40.40	unmeasurable		1.89	12.35	1.64	16.3	0.31	23.03	GM
AP2	Reddish sandy silt	1.00-2.00m	41.8	53.88	63.9	76	87.37	89	97.33	100	38.21	21.39	**16.8**	1.92	13.40	1.72	14.6	0.28	25.41	SM
AP3	Brownish grayish silty schist	3.60-4.00m	77.1	83.63	87	90.6	94.22	95.4	100	100	42.65	unmeasurable		1.83	14.20	1.63	17.2	0.21	29.68	ML
AP4	Reddish silt	3.60-4.00m	72.7	88.47	95.3	96.5	98.16	98.6	100	100	47.00	25.98	**21.0**	1.9	14.20	1.64	20	0.31	26.57	CI
AP5	Reddish Lateritic gravels	1.00-2.00m	55.3	60.61	67.1	73.5	84.34	88.6	98.5	100	38.09	20.64	**17.5**	2.02	13.80	1.65	15	0.18	29.03	CI
AP6	Reddish Lateritic gravels	3.60-4.00m	32.8	34.13	36	38.8	50.43	56	84.45	100	39.29	23.55	**15.7**	2	11.20	1.82	14.2	0.06	38.48	GC
AP7	Reddish Lateritic gravels	3.60-4.00m	27.1	30.48	33.2	39.2	53.41	59.7	77.43	100	40.09	24.65	**15.4**	2.03	10.00	1.84	14.3	0.14	24.23	GC
AP9	Reddish Lateritic gravels	1.50-2.00m	55.3	60.61	67.1	73.5	84.34	88.6	98.5	100	37.87	20.21	**17.7**	1.9	14.20	1.78	15.0	0.25	29.90	CI
AP10	Reddish schist	3.00-3.50m	64.8	76.4	84.4	87.6	92.01	93.3	97.08	100	38.08	18.97	**19.1**	1.94	13.20	1.61	15	0.17	24.90	CI
AP11	Lateritict gravels	3.50-4.00m	35	35.94	46.9	56.9	70.52	74.8	95.7	100	42.97	27.23	**15.7**	1.67	22.22	1.93	18	0.21	24.94	GC
AP12	Lateritict gravels	3.60-4.00m	22.7	25.27	30.3	40	63.64	70.9	88.79	100	37.16	22.41	**14.7**	2	10.40	1.81	13.2	0.01	39.18	GC
AP13	Reddish silt	3.60-4.00m	80.8	86.64	91.5	93.5	96.33	96.9	98.52	100	46.35	25.37	**21.0**	1.77	16.40	1.62	13.3	0.30	25.64	CI
AP15	Brownish lateritic gravels	3.60-4.00m	33.3	36.92	45.8	57.1	74.46	80.5	90.43	100	36.44	20.09	**16.3**	2.01	12.40	1.78	13.3	0.12	30.54	CI
AP16	Lateritict gravels	3.40-4.00m	35	35.49	47	57	70.45	74.9	95.43	100	42.77	27.56	**15.2**	1.73	20.60	1.93	18	0.25	23.75	GC
AP17	Blackish clay	0.50-1.00m	82.7	93.28	96.9	97.1	97.3	97.4	100	100	45.42	25.32	**20.1**	1.78	19.68	1.76	19	0.20	26.57	MI

Distribution line Gasogi-Masaka

Location	Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings								ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS
				0.08	0.315	2	4	8	10	20	40	LL	PL	PI	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)	
GASOGI-MASAKA	AP1	Brownish sandy silt	3.80-4.00m	63.2	85.65	92.3	94.9	97.96	98.5	100	100	40.18	21.60	**18.6**	1.83	17.20	1.90	20.7	0.28	23.51	CI
	AP3	schist	3.75-4.00m	93.2	94.7	98.3	99.1	99.69	99.8	100	100	32.59	NP		1.68	22.40	1.70	20.6	0.09	30.54	SM
	AP4	Latertic gravels	3.50-4.00m	36.5	44.87	61.8	68.4	73.07	74.6	78.8	100	39.32	22.91	**16.4**	2.02	12.40	1.98	16.3	0.10	26.10	GC
	AP5	Schist gravels	3.70-4.00m	31.2	72.34	98.1	98.9	100	100	100	100	37.14	NP		2.03	10.62	1.72	14	0.04	27.02	GM
	AP6	Brownish silt	3.60-4.00m	37.3	50.77	64.4	72.6	82.55	85.5	91.99	100	39.03	23.87	**15.2**	2.02	11.36	1.90	18	0.14	25.41	GM
	AP8	Gravelly Schist	3.80-4.00m	17.1	50.75	87.6	94.5	95.57	95.8	100	100	unmeasurable			2.06	10.40	1.63	18.3	0.04	25.70	GM
	AP9	Brownish gravely silt	3.70-4.00m	43.1	51.24	75.4	95.9	100	100	100	100	40.00	23.54	**16.5**	1.94	15.20	1.88	17.3	0.20	23.75	GC
	AP10	Brownish silt	3.70-4.00m	81.9	90.52	97.9	99.5	100	100	100	100	44.30	24.43	**19.9**	1.82	18.40	1.87	22.3	0.38	21.31	CI
	AP12	Brownish silt	3.50-4.00m	87.4	93.67	99.5	99.9	100	100	100	100	45.74	23.87	**21.9**	1.75	21.63	1.78	20	0.44	21.31	CI
	AP13	Reddish silt	3.60-4.00m	86.8	94.6	99.5	100	100	100	100	100	44.10	23.37	**20.7**	1.73	20.00	1.70	21	0.45	20.30	CI
	AP15	Brownish silt	3.80-4.00m	87	93.33	99.5	100	100	100	100	100	44.91	24.21	**20.7**	1.78	18.00	1.61	14.9	0.41	26.10	CI
	AP16	Brownish silt	3.40-4.00m	71.4	77.37	89.6	96.6	99.54	99.5	100	100	42.45	23.30	**19.2**	1.77	20.40	1.69	20.3	0.39	22.29	CI
	AP17	Blackish clayey sand	2.50-3.50m	40.8	58.2	92.2	98.6	99.82	99.8	100	100	37.88	22.18	**15.7**	1.87	15.65	1.63	13.5	0.19	31.59	CI
	AP18	Blackish sandy clay	3.00-3.50m	57.5	76.14	99.8	100	100	100	100	100	40.38	23.98	**16.4**	1.84	15.20	1.73	15	0.21	26.79	CI
	AP19	Reddish silt	3.80-4.00m	84.4	92.91	99.6	99.7	99.89	100	100	100	43.32	24.35	**19.0**	1.7	19.40	1.70	21	0.48	19.29	CI

Transmission line Jabana-Biremo

Location	Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings								ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS
				0.08	0.315	2	4	8	10	20	40	LL	PL	LL	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)	
JABANA-BIREMBO	**176**	Blackish clay	0.50-1.00	80.9	95.49	99.6	99.7	99.79	99.8	100	100	42.05	22.77	**19.3**	1.83	17.32	1.71	19.7	0.48	22.05	CI
	177	Blackish clay	0.50-1.00	81.5	94.03	96.2	96.7	97.21	97.6	99.96	100	43.24	22.59	**20.7**	1.81	18.98	1.80	15.7	0.41	19.03	CI
	178	Grayish clay	1.50-2.00	51.3	66.71	91.2	98.3	100	100	100	100	38.07	NP		1.69	22.00	1.62	17.4	0.10	26.79	ML
	180	Brownish silty sand	3.70-4.00	52.1	62.69	88.1	98.4	99.58	99.8	100	100	42.09	24.75	**17.3**	1.87	14.36	1.80	16	0.20	24.23	MI
	181	Brownish Yellowish silt	3.40-4.00	75.4	88.65	99.4	100	100	100	100	100	43.99	22.87	**21.1**	1.94	15.20	1.68	16	0.31	23.75	CI
	182	Yellowish Brownish silt	3.80-4.00	80.1	89.28	99.5	99.8	100	100	100	100	45.17	23.69	**21.5**	1.79	16.87	1.86	20.7	0.38	23.03	CI
	184	Brownish Yellowish silt	3.50-4.00	75.6	86.24	98.5	99.2	99.67	100	100	100	39.97	20.86	**19.1**	1.79	19.00	1.82	21.5	0.35	22.54	CI
	186	Orange,Yellowish lateritic gravels	3.70-4.00	34.6	39.53	51	60.5	74.06	80.3	92.3	100	43.33	26.95	**16.4**	1.93	15.88	1.90	18.4	0.23	26.57	GC
	187	Reddish silt	3.60-4.00	73.7	80.1	95.2	99.4	99.8	100	100	100	44.01	24.39	**19.6**	1.87	16.54	1.72	19	0.39	20.56	CI
	189	Grayish sandy clay	3.50-4.00	46.4	71.79	99.7	100	100	100	100	100	39.21	22.00	**17.2**	1.97	14.40	1.80	16	0.37	22.29	SC
	190	Clayey sand	3.00-3.50	48.1	60.65	83.2	97.4	98.55	98.9	99.15	100	39.57	21.36	**18.2**	1.88	17.01	2.01	16.0	0.22	25.64	SC
	195	Grayish sandy clay	3.60-4.00	47.5	53.03	81.1	97.6	99.73	100	100	100	40.34	23.83	**16.5**	1.91	16.40	1.97	16.6	0.18	27.70	SC
	196	Reddish silty sand	3.70-400	56.4	61.86	74.7	87.8	97.47	100	100	100	41.73	21.47	**20.26**	1.89	16.21	1.89	18.8	0.30	25.41	CI

- *Unconfined compressive strength results*

After the identification of the materials, we proceeded with their stabilization by the adjunction of 3% of cement CEMIV/B-[P] 42.5N HIMA.

The prepared specimens underwent a 7 day curing period, and 4 hours of soaking, then the unconfined compressive strength test was performed on them.

New substation construction site

N°	Location	Origin	Visual identification	Depth	MODIFIED PROCTOR TEST		% OF CEMENT	COMPACTION		Strenght in MPa at 7 days of curing +4 hours of soaking	Observation
					MDD (T/m³)	OMC (%)		MDD (T/m³)	W (%)		
1	NEW SUB STATION GASOGI	S1	Sand stone	2.00-3.50m	1.95	14.68	3	1.94	12.41	1.76	
								1.93	13.87		
								1.93	13.10		
2		S2	Weathered sand stone	3.70-4.00m	1.95	15.10	3	1.90	14.34	1.78	
								1.92	14.19		
								1.92	14.05		
3		S3	Soft reddish lateritic gravels	3.50-4.00m	1.94	13.80	3	1.94	11.27	1.79	
								1.93	13.08		
								1.93	11.58		
4		S4	Silt and Sand stone in weathering process	3.50-4.00m	2.01	12.80	3	2.03	9.23	2.11	
								2.01	10.01		
								2.04	10.98		
5		S5	Silty weathered sand stone	3.50-4.00m	1.88	14.40	3	1.87	13.09	1.67	
								1.86	14.25		
								1.89	12.39		
6		S6	Brownish sandy silt	3.50-4.00m	1.82	16.98	3	1.83	15.96	1.71	
								1.85	14.15		
								1.83	14.72		

Distribution line Gasogi-Nyagasambu

Origin	Location	Visual identification	Depth	MODIFIED PROCTOR TEST		% OF CEMENT	COMPACTION		Strenght in MPa at 7 days of curing +4hours of soaking	Observation
				MDD (T/m³)	OPM (%)		MDD (T/m³)	W (%)		
AP1	GASOGI-NYAGASAMBU	Brownish sandy	3.70-4.00m	1.89	12.35	3	1.90	11.25	1.65	
							1.89	10.37		
							1.88	11.47		
AP2		Reddish sandy silt	1.00-2.00m	1.92	13.40	3	1.94	10.48	1.70	
							1.92	10.11		
							1.94	10.91		
AP3		Brownish grayish silt schist	3.60-4.00m	1.83	14.20	3	1.83	13.54	1.59	
							1.83	12.96		
							1.84	12.82		
AP4		Reddish silt	3.60-4.00m	1.90	14.20	3	1.88	13.44	1.80	
							1.88	13.64		
							1.89	13.73		
AP5		Reddish Lateritic Gravels	1.00-2.00m	2.02	13.80	3	2.02	11.89	2.08	
							2.02	11.07		
							2.01	12.14		
AP6		Reddish Lateritic Gravels	3.60-4.00m	2.00	11.20	3	2.01	10.82	2.03	
							2.03	9.30		
							2.02	10.92		
AP7		Reddish Lateritic Gravels	3.60-4.00m	2.03	10.00	3	2.04	9.82	2.09	
							2.04	8.63		
							2.03	9.84		
AP9		Reddish Lateritic Gravels	1.50-2.00m	1.90	14.20	3	1.93	12.31	1.70	
							1.91	12.75		
							1.93	12.28		
AP10		Reddish schist	3.00-3.50m	1.94	13.20	3	1.94	12.63	1.51	
							1.92	11.20		
							1.94	11.34		
AP11		Yellow reddish schist compact	3.50-4.00m	1.67	22.22	3	1.67	21.21	1.48	
							1.69	19.52		
							1.68	20.37		
AP12		Lateritict gravels	3.60-4.00m	2.00	10.40	3	2.00	9.04	2.07	
							2.01	9.41		
							2.03	10.05		
AP13		Reddish silt	3.60-4.00m	1.77	16.40	3	2.04	16.02	1.65	
							1.77	17.28		
							1.75	16.23		
AP15		Brownish lateritic gravels	3.60-4.00m	2.01	12.40	3	2.00	10.60	2.08	
							2.00	11.85		
							1.98	12.00		
AP16		whitish silty schist	3.40-4.00m	1.73	20.60	3	1.71	19.99	1.65	
							1.72	19.09		
							1.74	17.57		
AP17		Blackish clay	0.50-1.00m	1.78	19.68	3	1.77	19.99	1.66	
							1.78	19.09		
							1.80	17.57		

Distribution line Gasogi-Masaka

N°	Location	Origin	Visual identification	Depth	MODIFIED PROCTOR TEST		% OF CEMENT	COMPACTION		Strenght in MPa at 7 days of curing +4 hours of soaking	Observation
					MDD (T/m^3)	OMC (%)		MDD (T/m^3)	W (%)		
1	GASOGI-MASAKA	AP1	Brownish Sandy Silt	3.80-4.00m	1.83	17.20	3	1.85	16.36	2.00	
								1.85	16.65		
								1.84	16.30		
2		AP3	schist	3.75-4.00m	1.68	22.40	3	1.90	21.43	1.70	
								1.92	23.94		
								1.92	22.76		
3		AP4	Latertic gravels	3.75-4.00m	2.02	12.40	3	2.04	11.19	2.19	
								2.04	11.53		
								2.03	11.44		
4		AP5	schist gravels	3.75-4.00m	2.03	10.62	3	2.05	9.23	2.18	
								2.05	10.01		
								2.04	10.98		
5		AP6	Brownish Silt	3.75-4.00m	2.02	11.36	3	2.03	10.27	2.14	
								2.04	10.15		
								2.04	10.26		
6		AP8	Schist Gravels	3.75-4.00m	2.06	10.40	3	2.08	9.41	2.20	
								2.08	9.89		
								2.08	9.61		
7		AP9	Brownish gravely silt	3.75-4.00m	1.94	15.20	3	1.96	14.30	1.97	
								1.96	13.09		
								1.97	12.72		
8		AP10	Brownish Silt	3.75-4.00m	1.82	18.40	3	1.85	16.47	1.76	
								1.84	16.18		
								1.87	16.19		
9		AP12	Brownish Silt	3.75-4.00m	1.15	21.63	3	1.77	20.24	1.65	
								1.77	19.86		
								1.78	19.33		
10		AP13	Reddish Silt	3.75-4.00m	1.73	20.00	3	1.77	19.80	1.62	
								1.75	19.12		
								1.74	17.24		
11		AP15	Brownish Silt	3.75-4.00m	1.78	18.00	3	1.80	15.59	1.69	
								1.79	19.12		
								1.79	16.26		
12		AP16	Brownish Silt	3.75-4.00m	1.77	20.40	3	1.79	18.46	1.59	
								1.79	18.19		
								1.79	18.71		
13		AP17	Blackish Clavey Sand	3.75-4.00m	1.87	15.65	3	1.88	14.26	1.74	
								1.89	14.19		
								1.88	13.95		
14		AP18	Blackish sandy clay	3.75-4.00m	1.84	15.20	3	1.86	14.63	1.70	
								1.86	14.18		
								1.85	14.80		
15		AP19	Reddish Silt	3.75-4.00m	1.70	19.40	3	1.74	18.71	1.56	
								1.76	17.66		
								1.76	17.82		

Legend:

LL	: Liquid Limit
PP	: Plastic Limit
PI	: Plasticity Index
MDD	: Optimum ~~moisture content~~ Dray Density
OMC	: Optimum moisture content
γ	: Specific weight of solid grains
W(N)	: Natural Moisture content
Cuu	: Cohesion
Ψ	: Angle of internal friction
CI	: Clay of intermediate plasticity
MI	: Silt of intermediate plasticity
GM	: Silty gravels poorly graded
GC	: Clayey gravels poorly graded
SM	: Silty sands poorly graded
SC	: Clayey sands poorly graded
ML	: Silt of low plasticity
USCS	: Unified Soil Classification System
AP	: Angle Point (Soil investigation Point)

4 CONCLUSION

According to the laboratory test results, the geotechnical classification reveals that we have in most cases:

- Silty gravels and sandy clay of low and intermediate plasticity,and sometimes weathered rock (schists),
- They are in general semi cohesive.

We recommend our client to make an interpretation of these results based on the project specifications.

Please do not hesitate to contact the Rincent BTP Rwanda for any useful information.

Laboratory Technician
IRADUKUNDA Jérémie

RINCENT BTP RWANDA * P.O Box 4973 KIGALI - RWANDA * QUALITY EVALUATION LABORATORY

Managing Director
Eng. Alain RUBAYIZA

5 ANNEX 1: TEST SHEETS FOR IDENTIFICATION AND MECHANICAL TEST

SEE ON THE FOLLOWING PAGE

RINCENT BTP RWANDA

OVERVIEW OF THE GEOTECHNICAL TESTS RESULTS

Location	Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings								ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS	Observation
				0.08	0.315	2	4	8	10	20	40	LL	PL	PI	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)		
NEW SUBSTATION CONSTRUCTION	S1	Sand stone	2.00-3.50m	40	43.21	51.6	55.5	75.7	80.4	94.7	100	38.93	NP		1.95	14.68	1.68	14.5	0.26	23.99	GM	
	S2	Weathered sand stone	3.70-4.00m	58.9	77.98	93.3	94.8	97.9	98.6	100	100	38.05	NP		1.95	15.10	1.94	17.7	0.14	26.57	GM	
	S3	Soft reddish lateritic gravels	3.50-4.00m	33.3	42.92	51.7	63	75.7	79.1	86	100	37.06	22.28	14.8	1.94	13.80	1.93	14.6	0.14	26.34	GC	
	S4	Silt and Sand stone in weathering process	3.50-4.00m	31.1	59.63	82.1	85.1	87.6	88.7	90.8	100	38.42	23.24	15.2	2.01	12.80	1.94	18	0.10	27.25	GC	
	S5	Silty weathered sand stone	3.50-4.00m	50.9	81.75	91.2	96.2	99	100	100	100	39.46	21.36	18.1	1.88	14.40	1.84	16	0.37	19.80	CI	
	S6	Brownish sandy silt	3.50-4.00m	61.3	84	93.5	97.3	99.4	99.8	100	100	41.50	22.66	18.8	1.82	16.98	1.71	18	0.26	20.30	CI	
	S7	Brownish lateritic gravels	3.50-4.00m	43.3	52.91	58.6	66.2	79.2	81.4	90.2	100	38.17	22.17	16.0	1.96	14.69	1.93	18.3	0.25	23.75	SC	

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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	S1(NEW SUB -STATION-GASOGI)
re of sample	Weathered sand stone	Depth	2.00-3.50
extraction date	7/23/2017	Testing Date	7/24/2017

Modified proctor according to NF P 94-093 — a 55 — 1.95

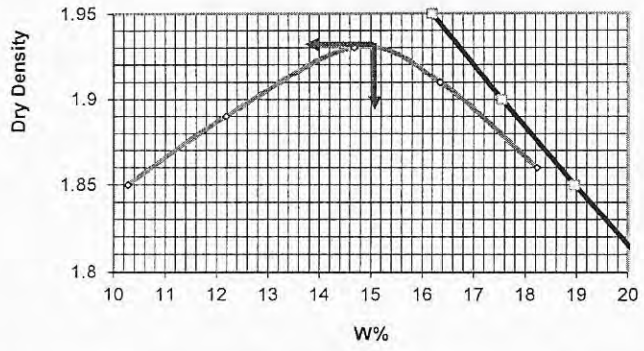
Blows number		5*56	5*56	5*56	5*56	5*56
$W_{\%}$		10.28	12.19	14.68	16.35	18.24
gd		1.85	1.89	1.93	1.91	1.86
SATURATION CURVE						
gd		1.95	1.9	1.85	1.8	1.75
w		16.19	17.54	18.966	20.47	22.06

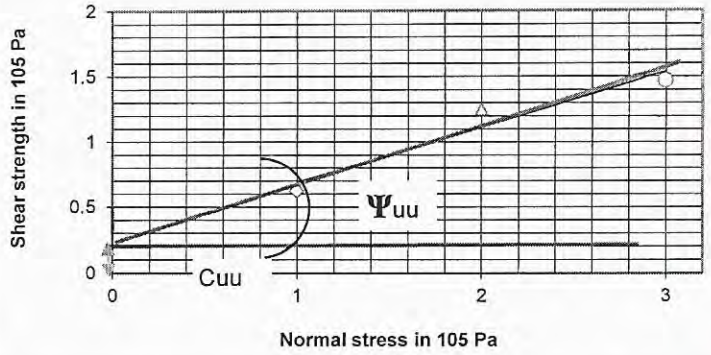
OMC 14.68

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.62	1.25	1.47
γs	2.85		

Cuu(105Pa) 0.26 — Ψ° 23.03 — γh(T/m3) 1.68 — W(n)% 14.52





SIEVE ANALYSIS according to NF P 94-056

909.60

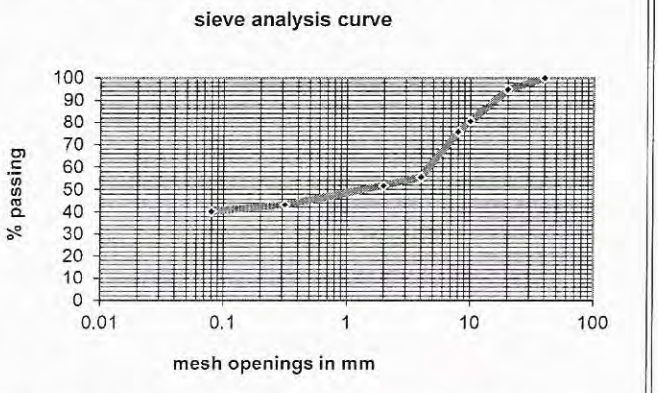
Dia	0.08	0.315	2	4	8	10	20	40
%	40.03	43.21	51.63	55.54	75.671	80.41	94.71	100
Cumul	545.5	516.6	440	404.4	221.30	178.2	48.1	0

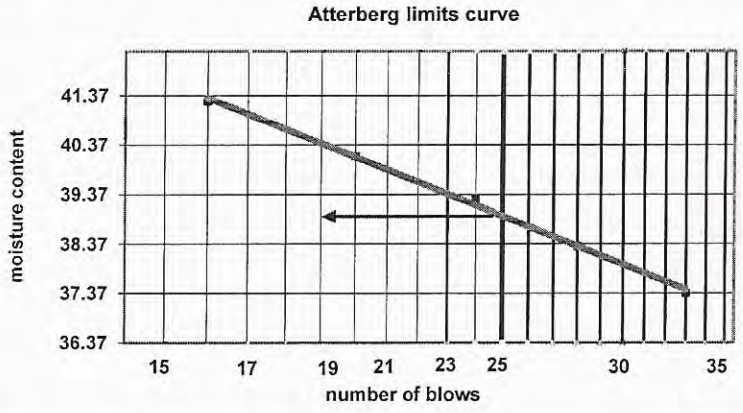
LIQUID LIMITS "LL"

N		33	28	24	20	16
	36.37	1.519	1.447	1.380	1.301	1.204
W	42.25	37.37	38.32	39.28	40.14	41.25

PL: NP

RESULT: LL 38.93 — PL ##### — PI #####





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	S2(NEW SUB -STATION-GASOGI)
re of sample	Weathered sand stone	Depth	3.70-4.00m
extraction date	7/22/2017	Testing Date	7/24/2017

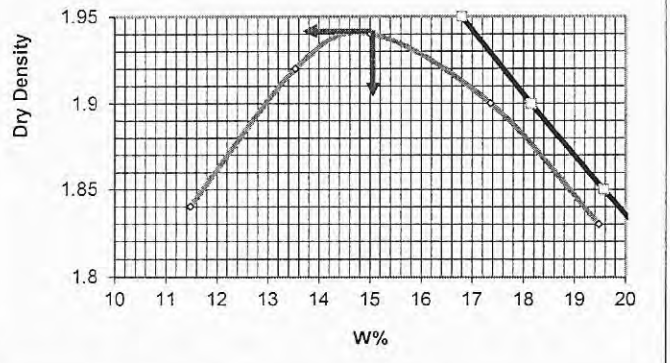
Modified proctor according to NF P 94-093 — a 55 — 1.95 — OMC 15.10

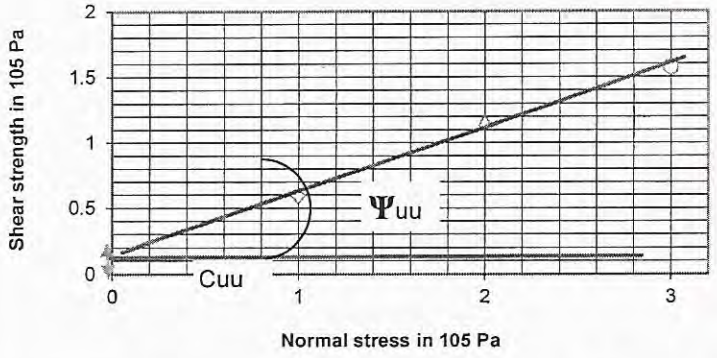
Blows number		5*56	5*56	5*56	5*56	5*56
$W_{\%}$		11.48	13.54	15.01	17.36	19.48
gd		1.84	1.92	1.94	1.90	1.83
SATURATION CURVE						
gd		1.95	1.9	1.85	1.8	1.75
w		16.8	18.15	19.57	21.07	22.66

Shear test according to NF P 94-071

Shear test	1	2	3
Normal stress in 10^5 Pa			
Shear strength in 10^5 Pa	0.59	1.17	1.57
ys	2.9		

Cuu(105Pa)	0.13		
Ψ°	26.10		
γh(T/m3)	1.68	W(n)%	16.2





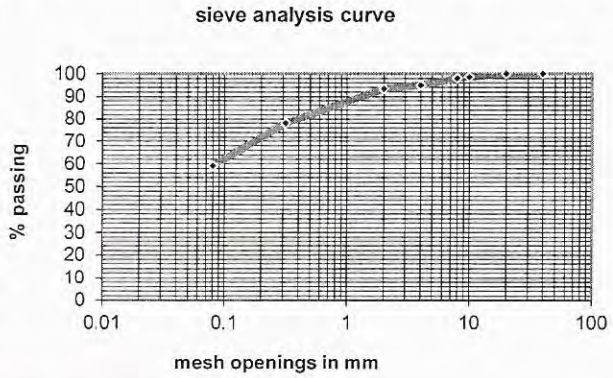
SIEVE ANALYSIS according to NF P 94-056

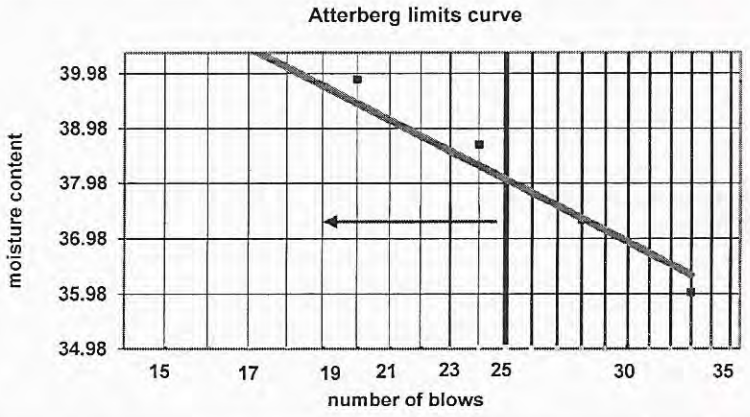
901.00								
Dia	0.08	0.315	2	4	8	10	20	40
%	58.93	77.98	93.25	94.76	97.94	98.56	100	100
Cumul	370	198.36	60.8	47.2	18.60	13	0	0

LIQUID LIMITS "LL"

N		33	28	24	20	16
	35.00	1.519	1.447	1.380	1.301	1.204
W	41.36	36.00	37.31	38.69	39.87	40.36

PL	RESULT	
NP	LL	38.05
	PL	#DIV/0
	PI	#DIV/0





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	S3(NEW SUB -STATION- GASOGI)
re of sample	Soft reddish lateritic gravels	Depth	3.50-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

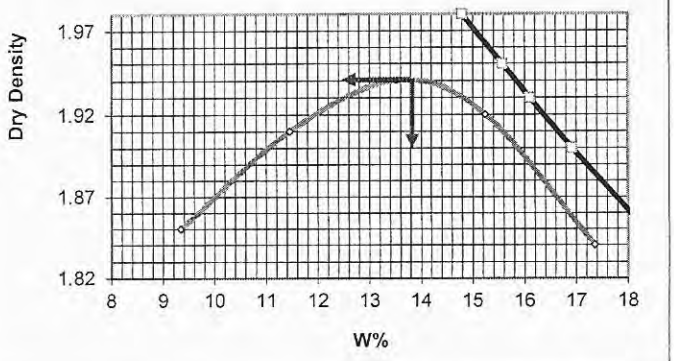
Modified proctor according to NF P 94-093 — a 55 — 1.94 — OMC — 13.80

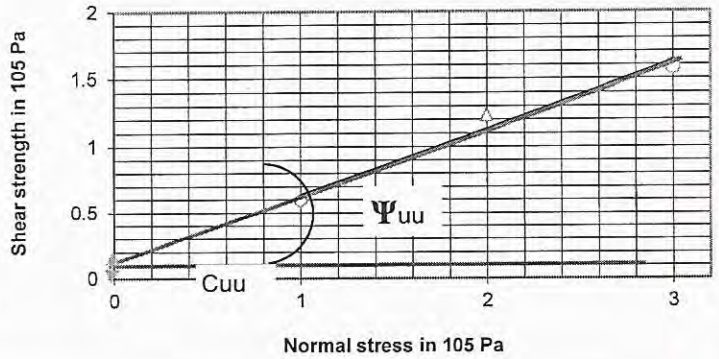
Blows number		5*56	5*56	5*56	5*56	5*56
$W_{\%}$		9.34	11.46	13.52	15.25	17.36
gd		1.85	1.91	1.94	1.92	1.84
SATURATION CURVE						
gd		1.98	1.95	1.93	1.9	1.85
w		14.79	15.57	16.099	16.92	18.34

Shear test according to NF P 94-071

Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.59	1.23	1.58
γs	2.8		

Cuu(105Pa)	0.14		
Ψ°	26.34		
γh(T/m3)	1.93	W(n)%	14.56





SIEVE ANALYSIS according to NF P 94-056

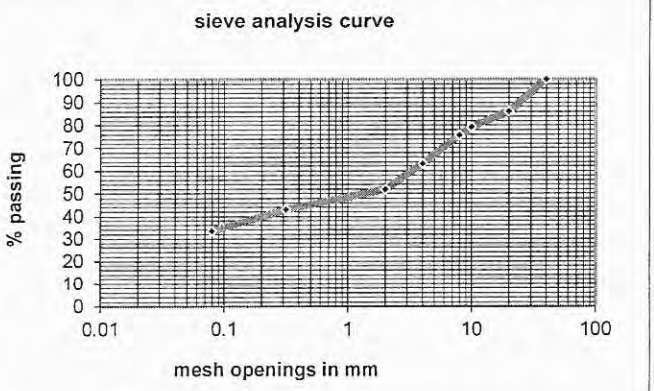
912.50

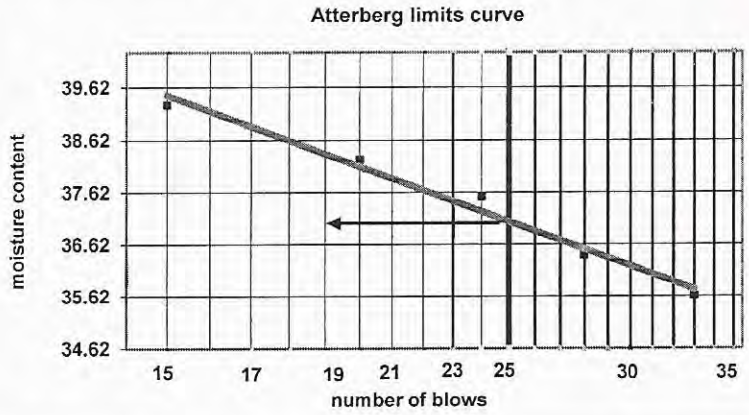
Dia	0.08	0.315	2	4	8	10	20	40
%	33.28	42.92	51.72	63.05	75.69	79.09	85.99	100
Cumul	608.8	520.9	440.6	337.2	221.80	190.8	127.8	0

LIQUID LIMITS "LL"

N		33	28	24	20	15
	34.62	1.519	1.447	1.380	1.301	1.176
W	40.29	35.62	36.41	37.54	38.25	39.29

PL		RESULT	
22.25	LL	37.06	
22.14	PL	22.28	
22.45	PI	14.78	





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	S4(NEW SUB -STATION- GASOGI)
re of sample	Sand stone in weathering process	Depth	3.50-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 2.01

Blows number		5*56	5*56	5*56	5*56	5*56
$W_{\%}$		8.36	10.25	12.36	14.25	16.58
gd		1.87	1.96	2.01	1.98	1.89

OMC 12.80

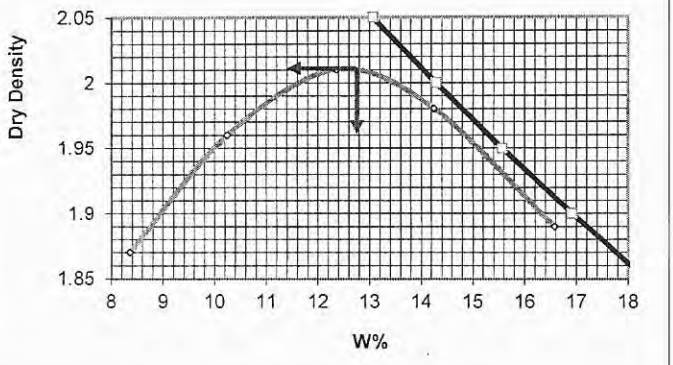
SATURATION CURVE

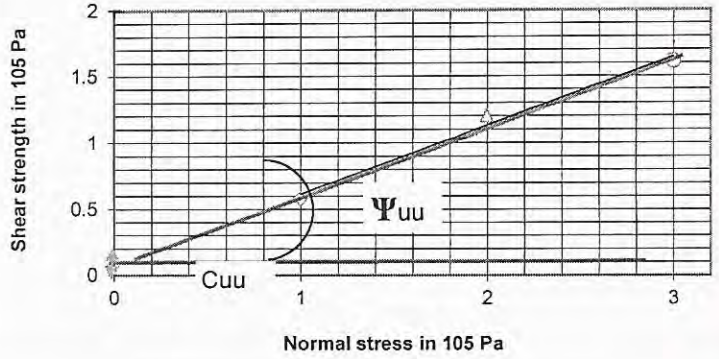
gd		2.05	2	1.95	1.9	1.85
w		13.07	14.29	15.568	16.92	18.34

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.58	1.2	1.61
γs	2.8		

Cuu(105Pa)	0.10		
Ψ°	27.25		
γh(T/m3)	1.94	W(n)%	17.69





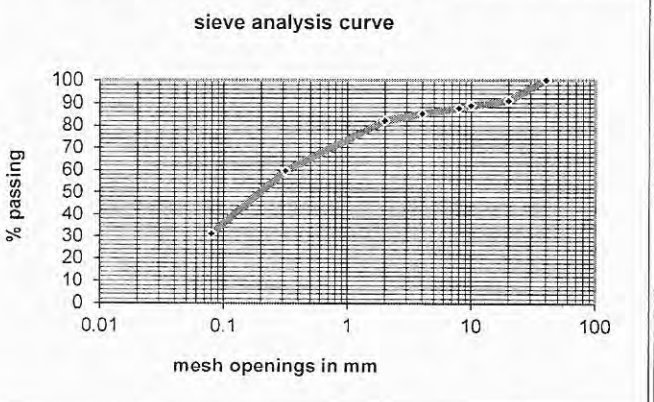
SIEVE ANALYSIS according to NF P 94-056

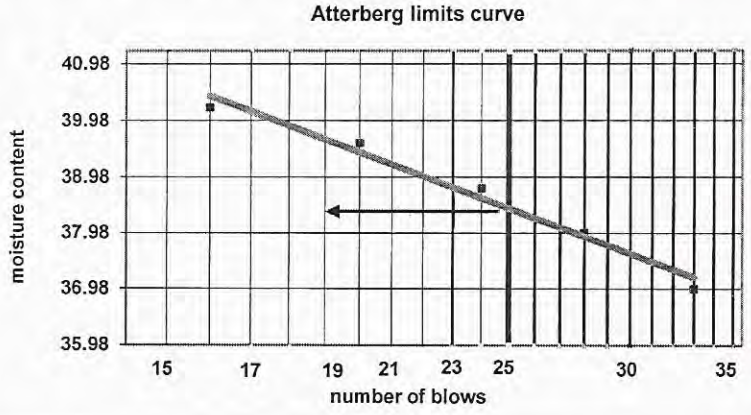
#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	31.08	59.63	82.08	85.05	87.58	88.66	90.8	100
Cumul	860.9	504.3	223.9	186.7	155.20	141.6	114.9	0

LIQUID LIMITS "LL"

N		33	28	24	20	16
	35.98	1.519	1.447	1.380	1.301	1.204
W	41.21	36.98	37.98	38.78	39.58	40.21

PL	RESULT	
22.69	LL	38.42
23.58	PL	23.24
23.46	PI	15.18





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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QUALITY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	S4(NEW SUB -STATION- GASOGI)
re of sample	soft sand stone	Depth	3.50-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

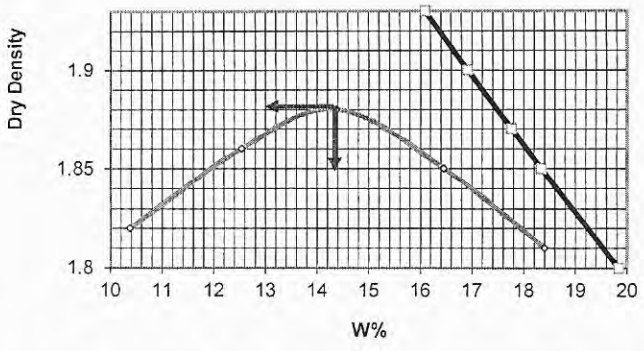
Modified proctor according to NF P 94-093 — a 55 — 1.88

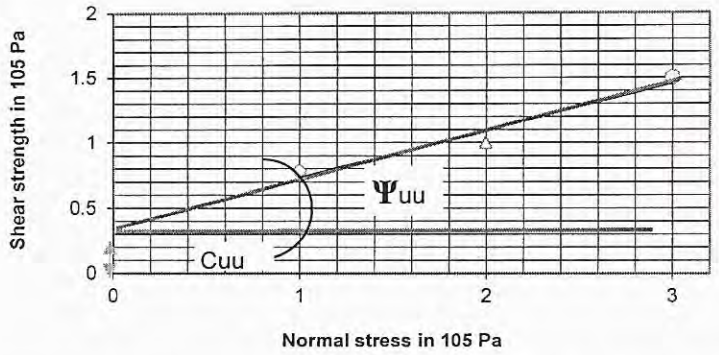
Blows number		5*56	5*56	5*56	5*56	5*56	OMC	14.40
$W_{\%}$		10.38	12.54	14.38	16.46	18.41		
gd		1.82	1.86	1.88	1.85	1.81		
SATURATION CURVE								
gd		1.93	1.9	1.87	1.85	1.8		
w		16.1	16.92	17.762	18.34	19.84		

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.78	1	1.50
γs	2.8		

Cuu(105Pa)	0.37		
Ψ°	19.80		
γh(T/m3)	1.84	W(n)%	16.25





SIEVE ANALYSIS according to NF P 94-056

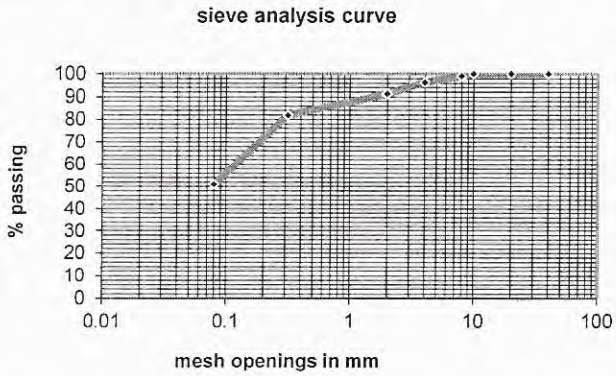
746.90

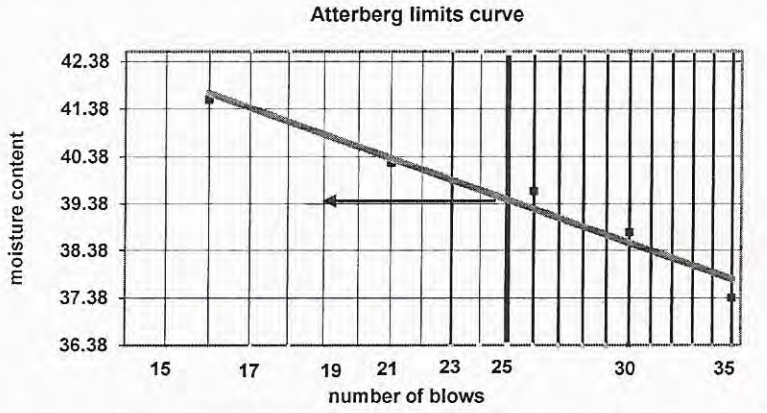
Dia	0.08	0.315	2	4	8	10	20	40
%	50.9	81.75	91.23	96.17	99.01	100	100	100
Cumul	366.7	136.3	65.5	28.6	7.40	0	0	0

LIQUID LIMITS "LL"

N		35	30	26	21	16
	36.38	1.544	1.477	1.415	1.322	1.204
W	42.58	37.38	38.78	39.65	40.25	41.58

PL		RESULT	
21.36	LL	39.46	
21.14	PL	21.36	
21.58	PI	18.10	





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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QUALITY ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	S/(NEW SUB -STATION- GASOGI)
re of sample	Brownish sandy silt	Depth	3.50-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 1.82

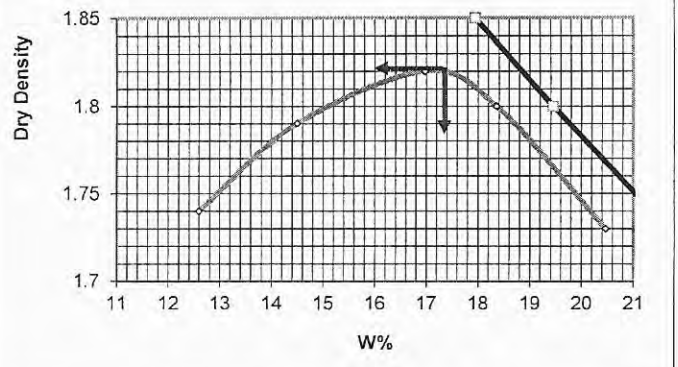
Blows number		5*56	5*56	5*56	5*56	5*56
$W_{\%}$		12.6	14.5	16.98	18.36	20.47
gd		1.74	1.79	1.82	1.80	1.73
SATURATION CURVE						
gd		1.85	1.8	1.75	1.7	1.65
w		17.95	19.45	21.042	22.72	24.5

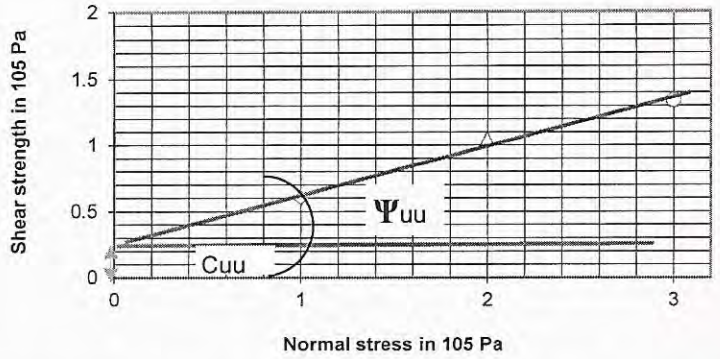
OMC 16.98

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.6	1.05	1.34
ys	2.77		

Cuu(105Pa)	0.26			
Ψ°	20.30			
γh(T/m3)	1.71	W(n)%	18.3	





SIEVE ANALYSIS according to NF P 94-056

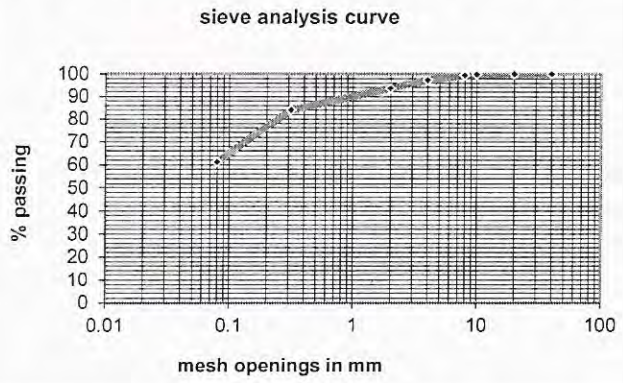
879.00

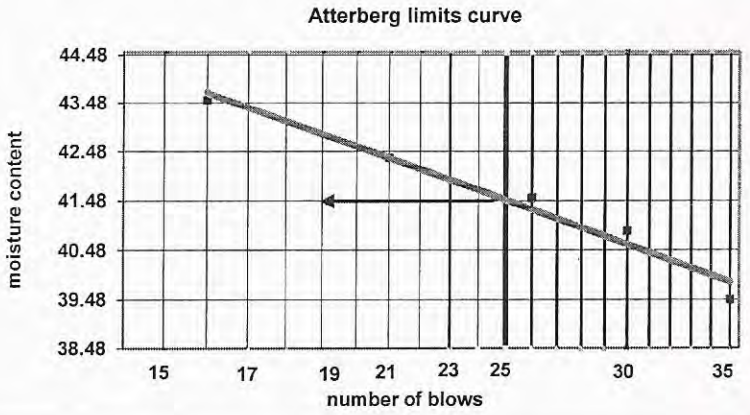
Dia	0.08	0.315	2	4	8	10	20	40
%	61.26	84.00	93.52	97.27	99.36	99.77	100	100
Cumul	340.5	140.6	57	24	5.60	2	0	0

LIQUID LIMITS "LL"

N		35	30	26	21	16
	38.48	1.544	1.477	1.415	1.322	1.204
W	44.54	39.48	40.87	41.54	42.36	43.54

PL		RESULT	
22.36	LL	41.50	
23.47	PL	22.66	
22.14	PI	18.84	





DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LAB MANAGER	

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RINCENT BTP RWANDA

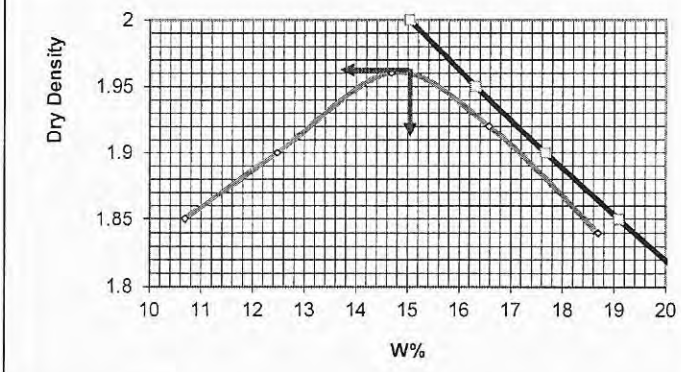
IDENTIFICATION OF THE MATERIALS

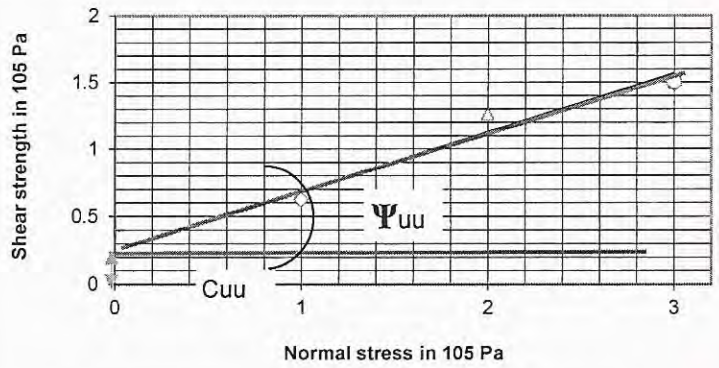
CLIENT	PITRAD	Origin	S7(NEW SUB -STATION- GASOGI)
re of sample		Depth	3.50-4.00m
extraction date	7/23/2017	Testing Date	7/25/2017

Modified proctor according to NF P 94-093 — a 55 — 1.96 — **Shear test according to NF P 94-071**

Blows number		5*56	5*56	5*56	5*56	5*56	OMC	14.69
W%		10.69	12.48	14.69	16.58	18.69	Normal stress in 10^5 Pa	1	2	3
gd		1.85	1.9	1.96	1.92	1.84				
SATURATION CURVE							Shear strength in 10^5 Pa	0.62	1.26	1.50
gd		2	1.95	1.9	1.85	1.8				
w		15.03	16.32	17.667	19.09	20.59	γs	2.86		

Shear test — Cuu(105Pa): **0.25** — Ψ°: 23.75 — γh(T/m3): 1.93 — W(n)%: 18.32





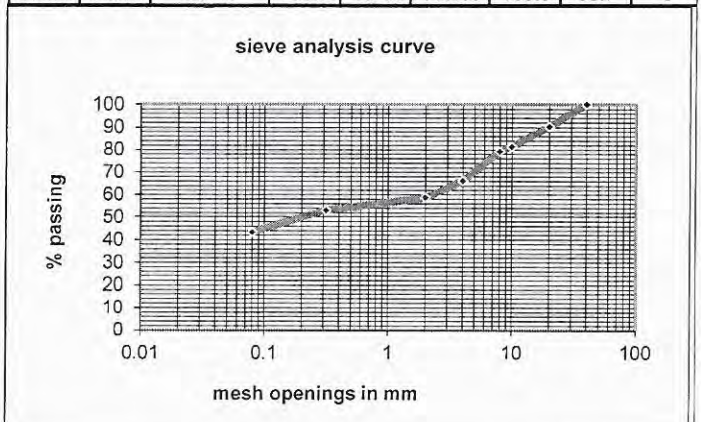
SIEVE ANALYSIS according to NF P 94-056

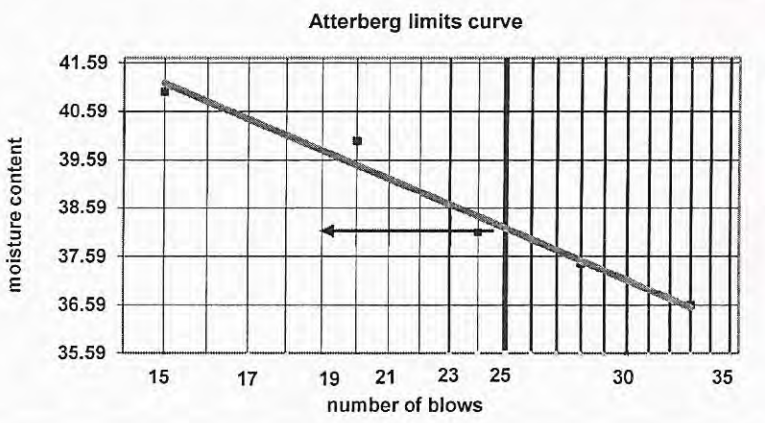
567.90								
Dia	0.08	0.315	2	4	8	10	20	40
%	43.32	52.91	58.58	66.16	79.22	81.41	90.19	100
Cumul	321.9	267.4	235.2	192.2	118.00	105.6	55.7	0

LIQUID LIMITS "LL"

N		33	28	24	20	15
	35.59	1.519	1.447	1.380	1.301	1.176
W	41.99	36.59	37.45	38.08	39.98	40.99

PL		RESULT	
22.36	LL	38.17
22.56	PL	22.17
21.58	PI	16.00





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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RINCENT BTP RWANDA

OVERVIEW OF THE GEOTECHNICAL TESTS RESULTS

LOCATION	Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings								ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS	Observation
				0.08	0.315	2	4	8	10	20	40	LL	PL	PI	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)		
GASOGI-NYAGASAMBU	AP1	Brownish sandy silt	3.70-4.00m	61.1	78.52	91.6	94.6	97	98	100	100	40.40	unmeasurable		1.89	12.35	1.64	16.3	0.31	23.03	GM	
	AP2	Reddish sandy silt	1.00-2.00m	41.8	53.88	63.9	76	87.4	89	97.3	100	38.21	21.39	**16.8**	1.92	13.40	1.72	14.6	0.28	25.41	SM	
	AP3	Brownish grayish silty schist	3.60-4.00m	77.1	83.63	87	90.6	94.2	95.4	100	100	42.65	unmeasurable		1.83	14.20	1.63	17.2	0.21	29.68	ML	
	AP4	Reddish silt	3.60-4.00m	72.7	88.47	95.3	96.5	98.2	98.6	100	100	47.00	25.98	**21.0**	1.9	14.20	1.64	20	0.31	26.57	CI	
	AP5	Reddish Lateritic gravels	1.00-2.00m	55.3	60.61	67.1	73.5	84.3	88.6	98.5	100	38.09	20.64	**17.5**	2.02	13.80	1.65	15	0.18	29.03	CI	
	AP6	Reddish Lateritic gravels	3.60-4.00m	32.8	34.13	36	38.8	50.4	56	84.4	100	39.29	23.55	**15.7**	2	11.20	1.82	14.2	0.06	38.48	GC	
	AP7	Reddish Lateritic gravels	3.60-4.00m	27.1	30.48	33.2	39.2	53.4	59.7	77.4	100	40.09	24.65	**15.4**	2.03	10.00	1.84	14.3	0.14	24.23	GC	
	AP9	Reddish Lateritic gravels	1.50-2.00m	55.3	60.61	67.1	73.5	84.3	88.6	98.5	100	37.87	20.21	**17.7**	1.9	14.20	1.78	15.0	0.25	29.90	CI	
	AP10	Reddish schist	3.00-3.50m	64.8	76.4	84.4	87.6	92	93.3	97.1	100	38.08	18.97	**19.1**	1.94	13.20	1.61	15	0.17	24.90	CI	
	AP11	Lateritict gravels	3.50-4.00m	35	35.94	46.9	56.9	70.5	74.8	95.7	100	42.97	27.23	**15.7**	1.67	22.22	1.93	18	0.21	24.94	GC	
	AP12	Lateritict gravels	3.60-4.00m	22.7	25.27	30.3	40	63.6	70.9	88.8	100	37.16	22.41	**14.7**	2	10.40	1.81	13.2	0.01	39.18	GC	
	AP13	Reddish silt	3.60-4.00m	80.8	86.64	91.5	93.5	96.3	96.9	98.5	100	46.35	25.37	**21.0**	1.77	16.40	1.62	13.3	0.30	25.64	CI	
	AP15	Brownish lateritic gravels	3.60-4.00m	33.3	36.92	45.8	57.1	74.5	80.5	90.4	100	36.44	20.09	**16.3**	2.01	12.40	1.78	13.3	0.12	30.54	CI	
	AP16	Lateritict gravels	3.40-4.00m	35	35.49	47	57	70.4	74.9	95.4	100	42.77	27.56	**15.2**	1.73	20.60	1.93	18	0.25	23.75	GC	
	AP17	Blackish clay	0.50-1.00m	82.7	93.28	96.9	97.1	97.3	97.4	100	100	45.42	25.32	**20.1**	1.78	19.68	1.76	19	0.20	26.57	MI	

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A15-143

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP1(GASOGI-NYAGASAMBU)
re of sample	Brownish sandy silt	Depth	3.70-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

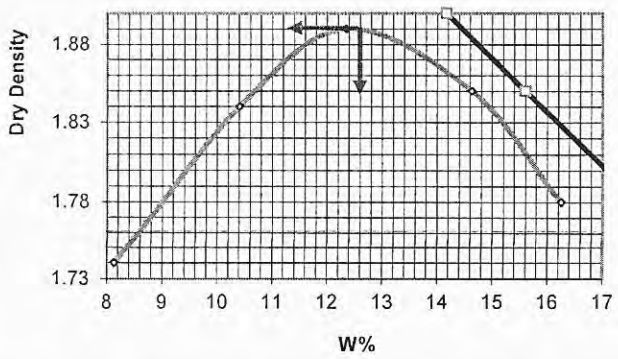
Modified proctor according to NF P 94-093 — a 55 — 1.89

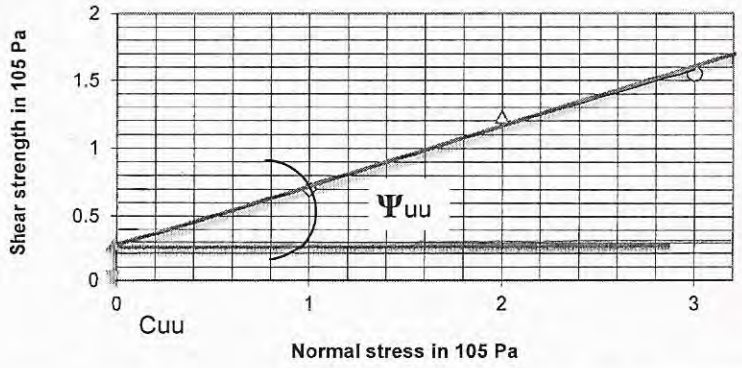
Blows number	5*56	5*56	5*56	5*56	5*56	WOPM	12.80
W%	8.14	10.41	12.35	14.63	16.25		
gd	1.74	1.84	1.89	1.85	1.78		
SATURATION CURVE							
gd	2	1.95	1.9	1.85	1.8		
w	11.54	12.82	14.17	15.59	17.09		

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.7	1.23	1.55
γs	2.6		

Cuu(105Pa)	**0.31**		
Ψ°	23.03		
γh(T/m3)	1.64	W(n)%	**16.25**





SIEVE ANALYSIS according to NF P 94-056

934.80

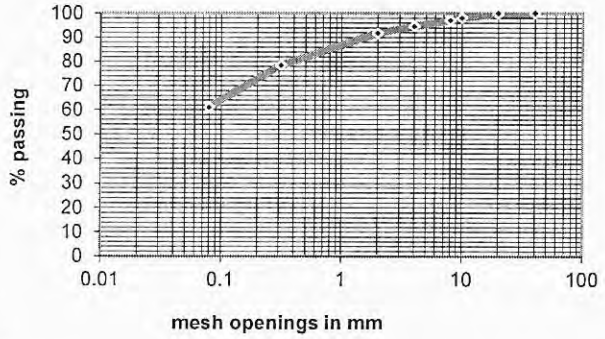
Dia	0.08	0.315	2	4	8	10	20	40
%	61.05	78.519	91.65	94.59	97.03	98	100	100
Cumulati ve	364.1	200.8	78.1	50.6	27.8	18.7	0	0

LIQUID LIMITS "LL"

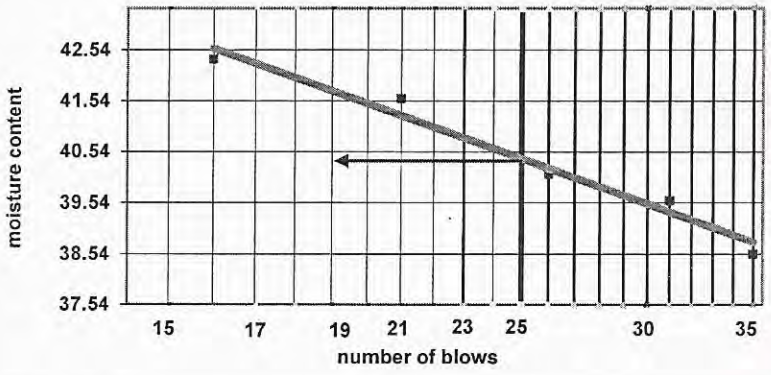
N		35	31	26	21	16
	37.54	1.544	1.491	1.415	1.322	1.204
W	43.36	38.54	39.58	40.10	41.58	42.36

PL	RESULT	
22	LL	40.40
21.5	PL	22.40
23.5	PI	18.00

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LABORATORY MANAGER	
05-08-2017			

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RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP2(GASOGI-NYAGASAMBU)
re of sample	Reddish sandy silt	Depth	1.00-2.00 m
extraction date	4/29/2015	Testing Date	4/30/2015

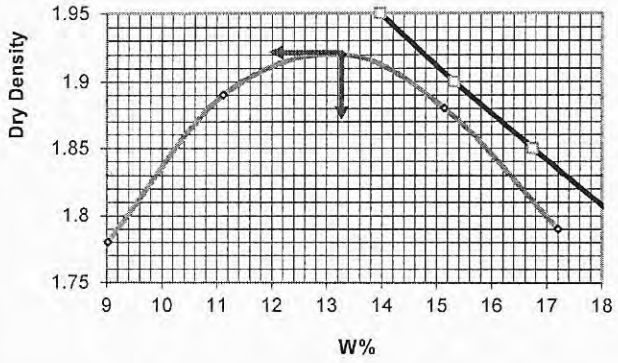
Modified proctor according to NF P 94-093 — a 55 — 1.92

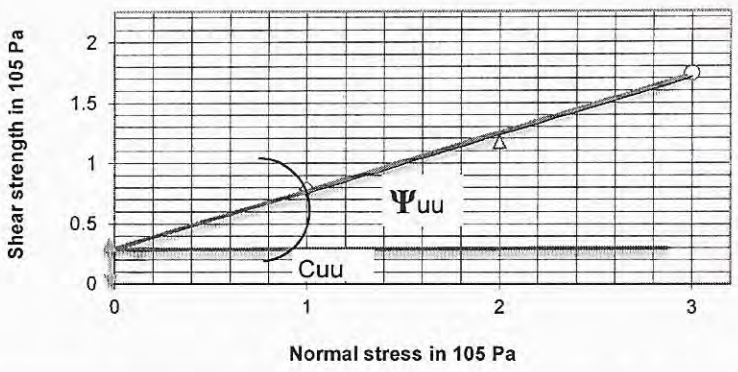
Blows number	5*56	5*56	5*56	5*56	5*56	WOPM	13.40
W%	9.02	11.12	13.28	15.14	17.21		
gd	1.78	1.89	1.92	1.88	1.79		
SATURATION CURVE							
gd	2	1.95	1.9	1.85	1.8		
w	12.69	13.97	15.32	16.74	18.24		

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.79	1.17	1.74
γs	2.68		

Cuu(105Pa)	0.28		
Ψ°	25.41		
γh(T/m3)	1.72	W(n)%	14.58





SIEVE ANALYSIS according to NF P 94-056

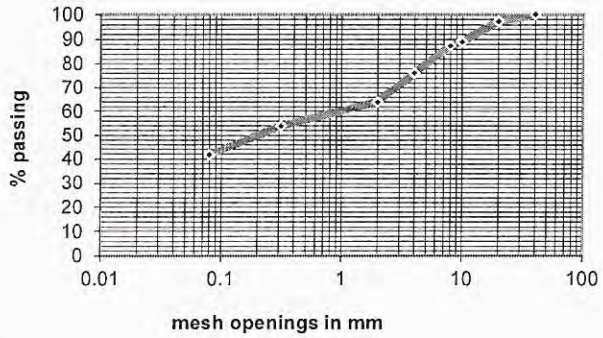
654.60								
Dia	0.08	0.315	2	4	8	10	20	40
%	41.75	53.88	63.89	76.05	87.37	88.99	97.33	100
Cumulati ve	381.3	301.9	236.4	156.8	82.7	72.1	17.5	0

LIQUID LIMITS "LL"

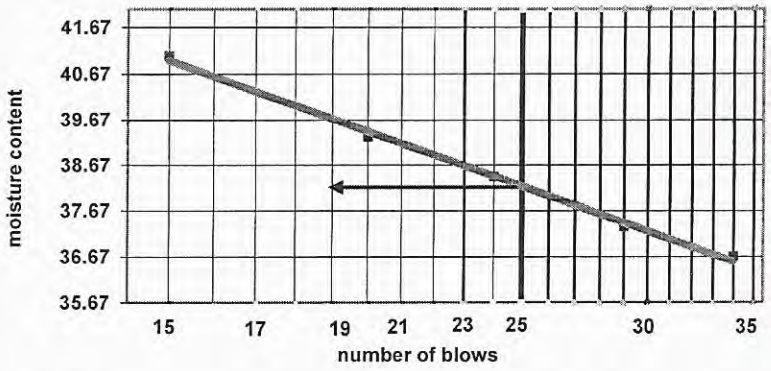
N		34	29	24	20	15
	35.67	1.531	1.462	1.380	1.301	1.176
W	42.06	36.67	37.32	38.42	39.29	41.06

PL	RESULT	
21	LL	38.21
21.12	PL	21.39
22	PI	16.82

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LABORATORY MANAGER	

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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP3(GASOGI-NYAGASAMBU)
re of sample	Brownish grayish silty schist	Depth	3.60-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 1.83

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	9.02	11.52	13.91	15.5	17.72
gd	1.74	1.8	1.83	1.81	1.76
SATURATION CURVE					
gd	1.84	1.83	1.76	1.78	1.73
w	15.89	16.18	18.36	17.72	19.34

WOPM 14.20

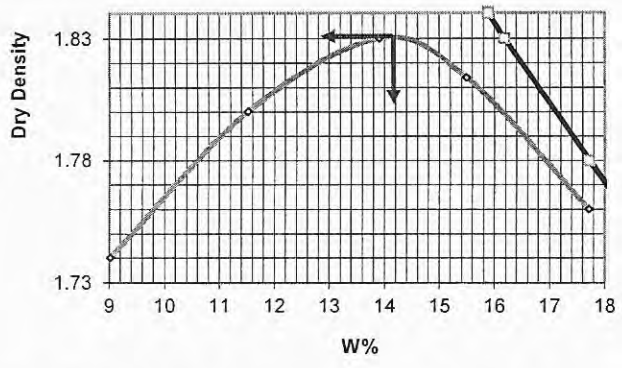
Shear test according to NF P 94-071

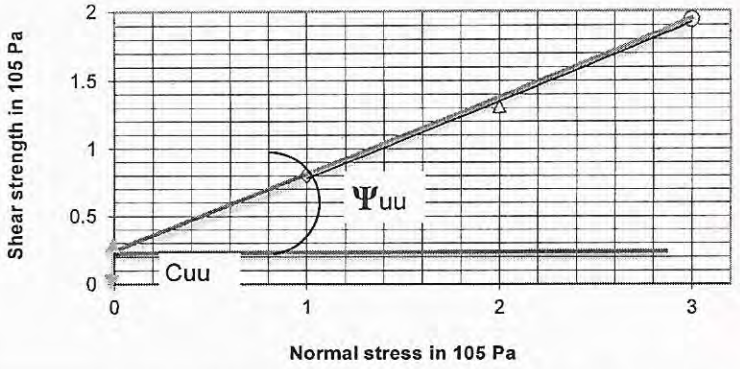
Shear test	1	2	3
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.8	1.31	1.94
ys	2.6		

Cuu(105Pa) **0.21**

Ψ° 29.68

γh(T/m3) 1.63 W(n)% **17.23**





SIEVE ANALYSIS according to NF P 94-056

#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	77.09	83.631	86.96	90.59	94.22	95.43	100	100
Cumulati ve	233.3	166.7	132.8	95.8	58.9	46.5	0	0

LIQUID LIMITS "LL"

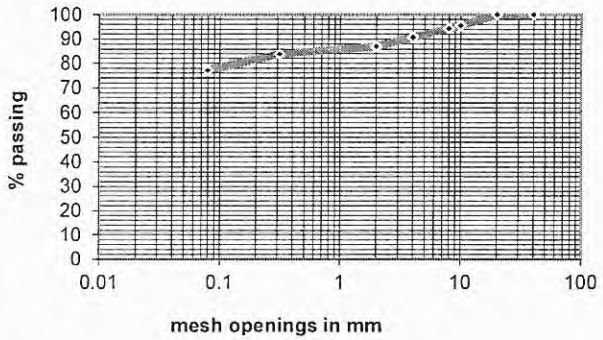
N		34	29	24	20	15
	39.53	1.531	1.462	1.380	1.301	1.176
W	46.16	40.53	42.18	43.22	43.87	45.16

PL: No PL

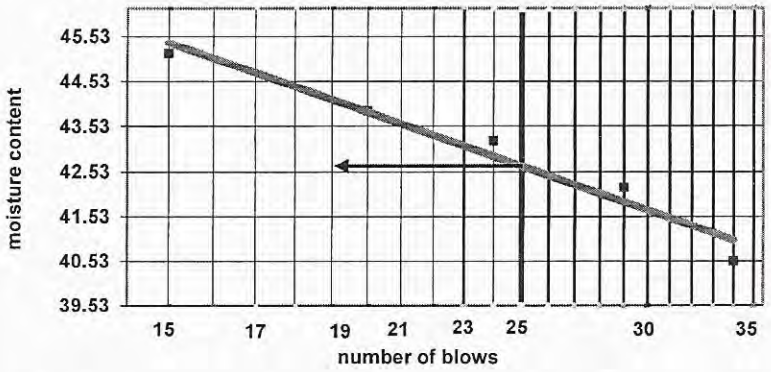
RESULT

LL	42.65
PL	#DIV/0
PI	#DIV/0

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LABORATORY MANAGER	
05-08-2017			

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RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP4(GASOGI-NYAGASAMBU)
re of sample	Reddish silt	Depth	3.60-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 1.9

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	10.02	12.12	14.21	16.21	18.23
gd	1.77	1.87	1.9	1.87	1.76
SATURATION CURVE					
gd	1.92	1.85	1.8	1.82	1.75
w	15.32	17.29	18.79	18.18	20.38

WOPM 14.20

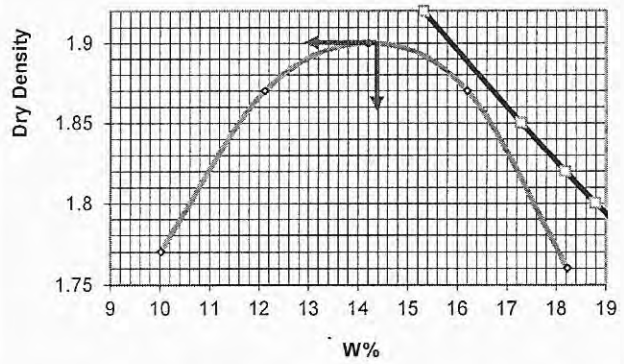
Shear test according to NF P 94-071

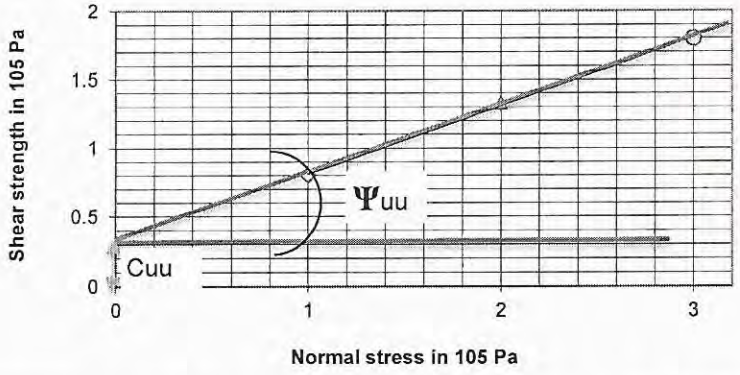
Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.8	1.33	1.80
γs	2.72		

Cuu(105Pa) **0.31**

Ψ° 26.57

γh(T/m3) 1.64 W(n)% **20.1**





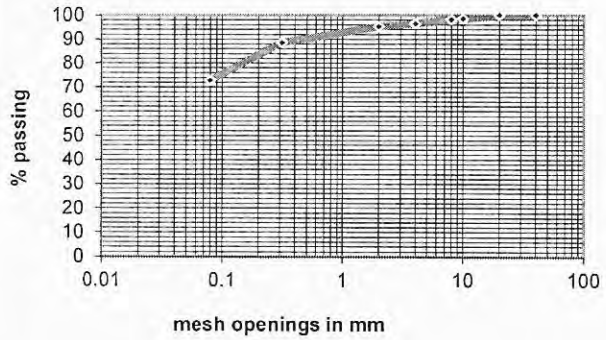
SIEVE ANALYSIS according to NF P 94-056

#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	72.74	88.474	95.26	96.49	98.16	98.57	100	100
Cumulati ve	322.1	136.2	56	41.5	21.7	16.9	0	0

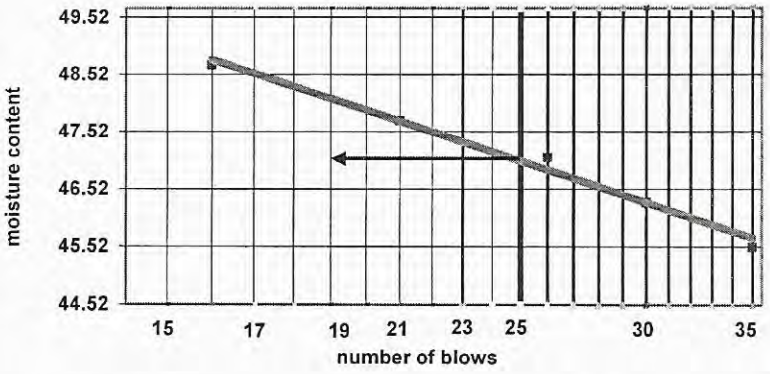
LIQUID LIMITS "LL"

N		35	30	26	21	16	PL	RESULT	
	44.52	1.544	1.477	1.415	1.322	1.204	25.86	PL	25.98
W	49.68	45.52	46.29	47.07	47.71	48.68	26	PI	21.02

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LABORATORY MANAGER	

RINCENT BTP RWANDA
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LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP5(GASOGI-NYAGASAMBU)
re of sample	Reddish Lateritic gravels	Depth	1.00-2.00 m
extraction date	7/23/2015	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 2.02

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	9.28	11.24	13.58	15.45	17.21
gd	1.87	1.95	2.02	1.97	1.89

WOPM 13.80

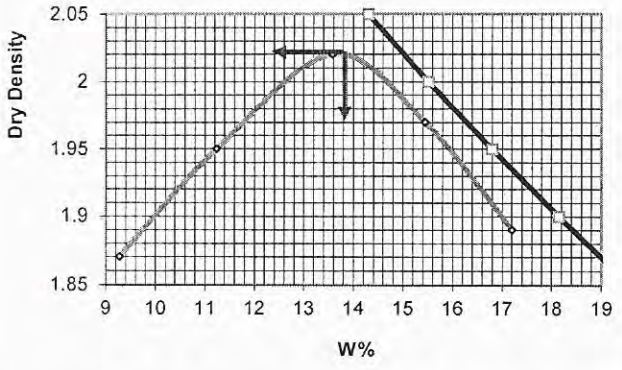
SATURATION CURVE

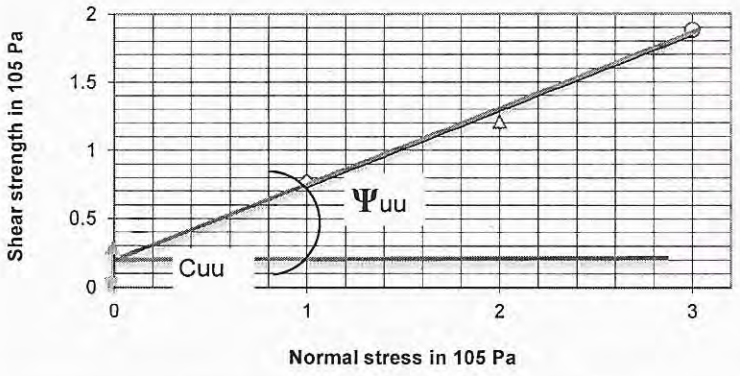
gd	2.05	2	1.95	1.9	1.85
w	14.3	15.52	16.8	18.15	19.57

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.77	1.21	1.88
ys	2.9		

Cuu(105Pa)	**0.18**		
Ψ°	29.03		
γh(T/m3)	1.65	W(n)%	**15.33**





SIEVE ANALYSIS according to NF P 94-056

833.80

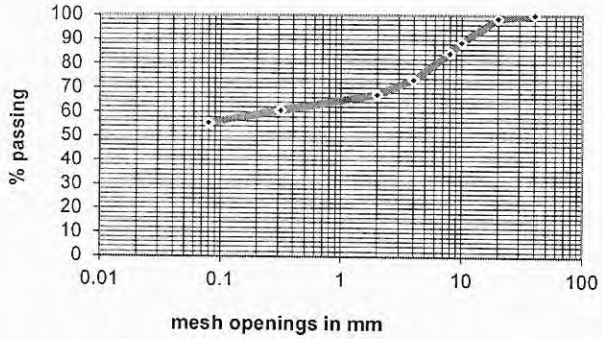
Dia	0.08	0.315	2	4	8	10	20	40
%	55.33	60.614	67.13	73.47	84.34	88.59	98.5	100
Cumulati ve	372.5	328.4	274.1	221.2	130.6	95.1	12.5	0

LIQUID LIMITS "LL"

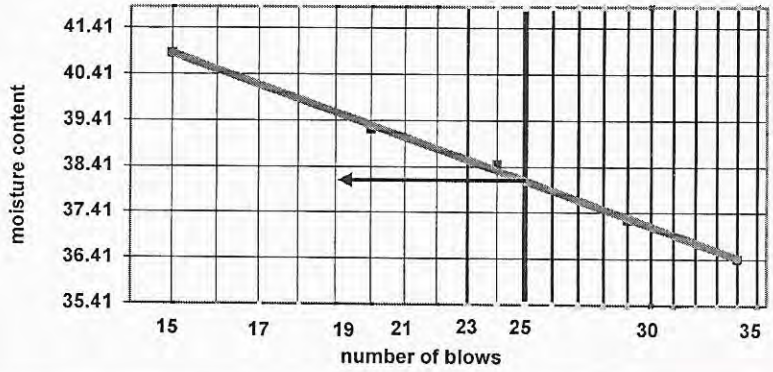
N		34	29	24	20	15
	35.41	1.531	1.462	1.380	1.301	1.176
W	41.87	36.41	37.25	38.45	39.21	40.87

PL	RESULT	
21	LL	38.09
20.63	PL	20.64
20.54	PI	17.45

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
04-08-2017	LAB TECHNICIAN	LABORATORY MANAGER	

RINCENT BTP RWANDA
P.O Box 4973 KIGALI - RWANDA

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP6(GASOGI-NYAGASAMBU)
re of sample	Reddish Lateritic gravels	Depth	3.60-4.00m
extraction date	7/23/2017	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 2.00

Blows number	5*56	5*56	5*56	5*56	5*56	WOPM	11.20
$W_{\%}$	6.02	8.99	10.94	12.06	14.34		
gd	1.91	1.98	2	1.99	1.92		

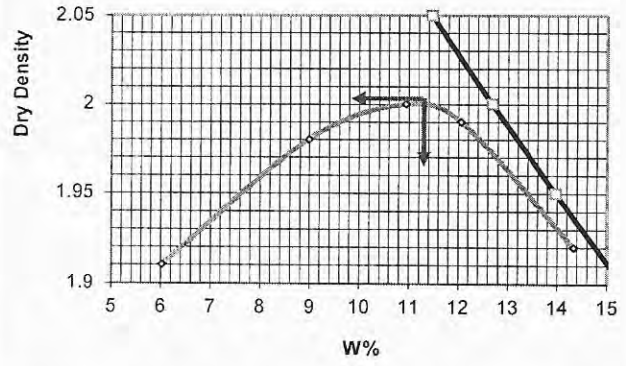
SATURATION CURVE

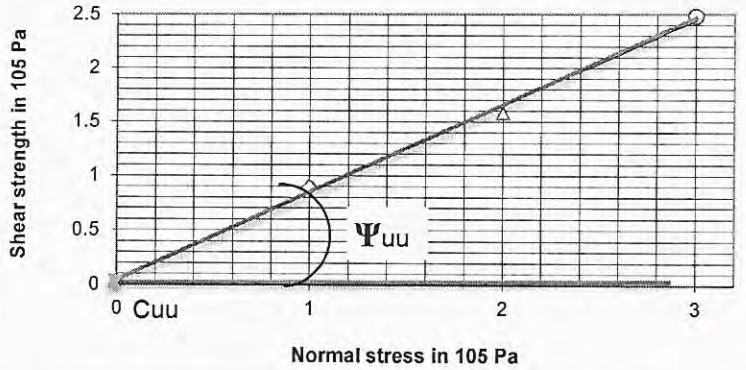
gd	2.05	2	1.95	1.9	1.85
w	11.47	12.69	13.97	15.32	16.74

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.89	1.58	2.48
ys	2.68		

Cuu(105Pa)	**0.06**		
Ψ°	38.48		
γh(T/m3)	1.82	W(n)%	**14.23**





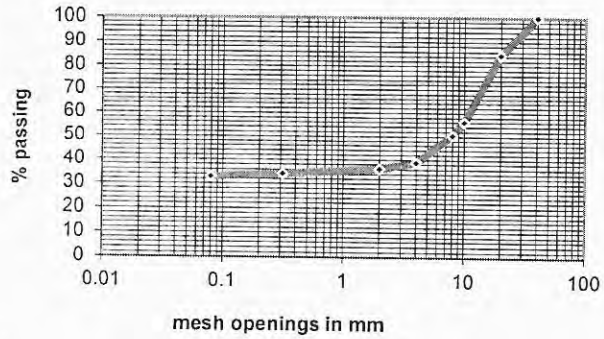
SIEVE ANALYSIS according to NF P 94-056

#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	32.81	34.132	36.04	38.82	50.43	56.05	84.45	100
Cumulati ve	737.4	722.9	702	671.5	544	482.4	170.7	0

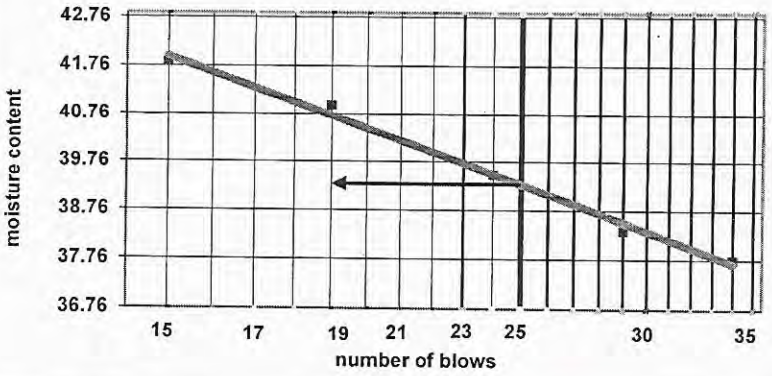
LIQUID LIMITS "LL"

N		34	29	24	19	15	PL	RESULT	
	36.76	1.531	1.462	1.380	1.279	1.176	23.21	PL	23.55
W	42.84	37.76	38.34	39.49	40.94	41.84	23.97	PI	15.73

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LABORATORY MANAGER	

RINCENT BTP RWANDA P.O Box 4973 KIGALI - RWANDA

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP7(GASOGI-NYAGASAMBU)
re of sample	Reddish Lateritic gravels	Depth	3.60-4.00m
extraction date	7/23/2017	Testing Date	7/24/2017

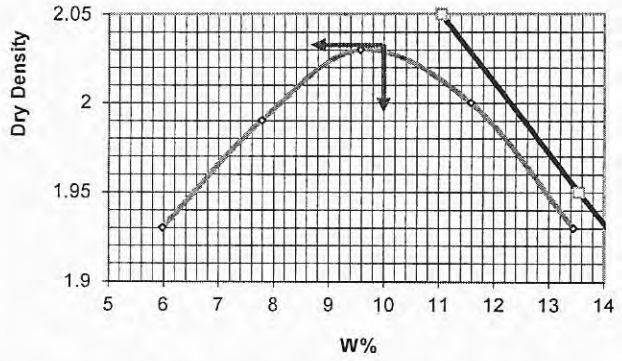
Modified proctor according to NF P 94-093 — a 55 — 2.03

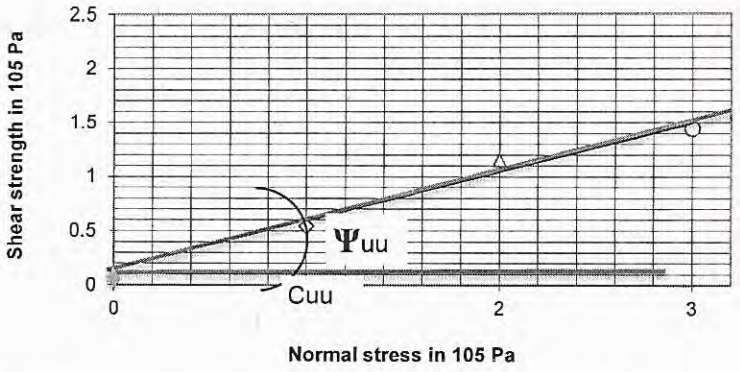
Blows number	5*56	5*56	5*56	5*56	5*56	WOPM	10.00
$W_{\%}$	5.98	7.78	9.58	11.58	13.45		
gd	1.93	1.99	2.03	2.00	1.93		
SATURATION CURVE							
gd	2.05	1.95	1.93	1.88	1.83		
w	11.04	13.55	14.08	15.46	16.91		

Shear test according to NF P 94-071

Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.54	1.15	1.44
γs	2.65		

Cuu(105Pa)	**0.14**		
Ψ°	24.23		
γh(T/m3)	1.84	W(n)%	**14.3**





SIEVE ANALYSIS according to NF P 94-056

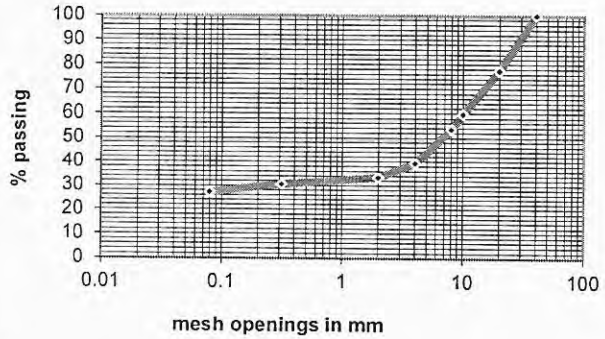
563.60

Dia	0.08	0.315	2	4	8	10	20	40
%	27.09	30.483	33.2	39.19	53.41	59.65	77.43	100
Cumulati ve	410.9	391.8	376.5	342.7	262.6	227.4	127.2	0

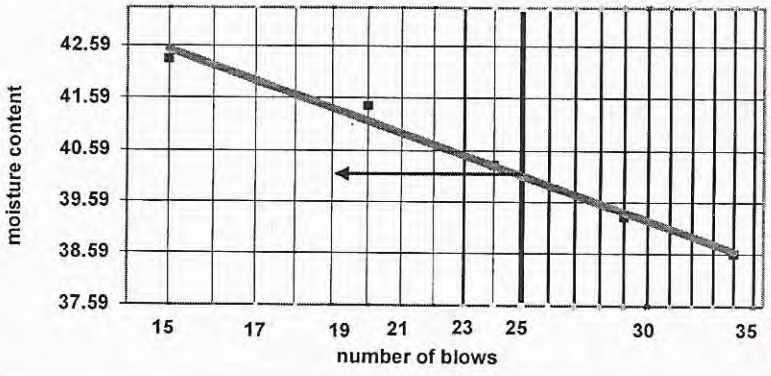
LIQUID LIMITS "LL"

N		34	29	24	20	15	PL	RESULT	
	37.59	1.531	1.462	1.380	1.301	1.176	24.44	LL	40.09
W	43.33	38.59	39.29	40.30	41.45	42.33	24.6	PL	24.65
								PI	15.44

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
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05-08-2017			

RINCENT BTP RWANDA
P.O Box 4973 KIGALI - RWANDA

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP9(GASOGI-NYAGASAMBU)
re of sample	Reddish Lateritic gravels	Depth	1.50-2.00m
extraction date	4/29/2015	Testing Date	4/30/2015

Modified proctor according to NF P 94-093 — a 55 — 1.9

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	9.02	12.24	14.22	16.14	18.25
gd	1.76	1.87	1.9	1.86	1.77
SATURATION CURVE					
gd	1.92	1.89	1.84	1.79	1.74
w	15.32	16.15	17.58	19.1	20.71

WOPM 14.20

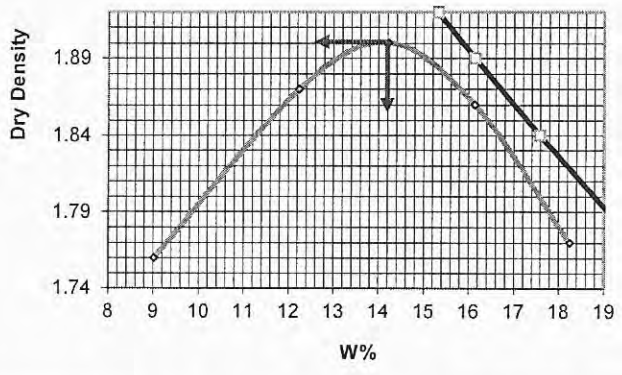
Shear test according to NF P 94-071

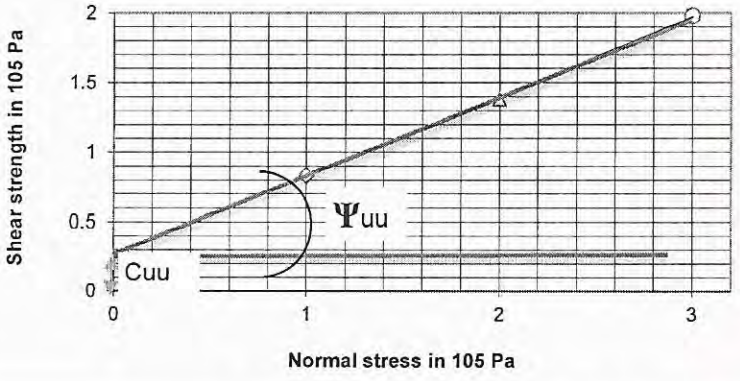
Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.83	1.38	1.98
γs	2.72		

Cuu(105Pa) **0.25**

Ψ° 29.90

γh(T/m3) 1.78 W(n)% **15.02**





SIEVE ANALYSIS according to NF P 94-056

833.80

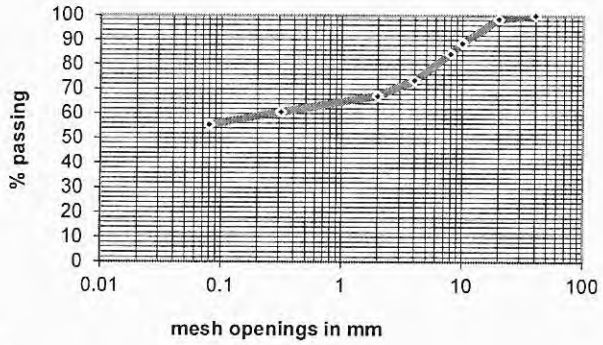
Dia	0.08	0.315	2	4	8	10	20	40
%	55.33	60.614	67.13	73.47	84.34	88.59	98.5	100
Cumulative	372.5	328.4	274.1	221.2	130.6	95.1	12.5	0

LIQUID LIMITS "LL"

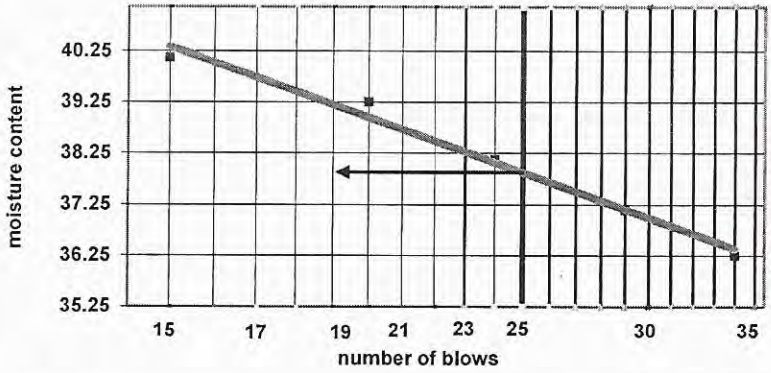
N		34	29	24	20	15
	35.25	1.531	1.462	1.380	1.301	1.176
W	41.12	36.25	37.14	38.12	39.25	40.12

PL	RESULT	
20	LL	37.87
20.23	PL	20.21
20.41	PI	17.65

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
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RINCENT BTP RWANDA
P.O Box 4973 KIGALI - RWANDA
QUALITY ENGINEERING LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP10(GASOGI-NYAGASAMBU)
re of sample	Reddish schist	Depth	3.00-3.50m
extraction date	4/29/2015	Testing Date	4/30/2015

Modified proctor according to NF P 94-093 — a 55 — 1.94

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	12.15	14.78	16.98	18.65	20.45
gd	1.66	1.75	1.77	1.74	1.68
SATURATION CURVE					
gd	1.8	1.75	1.7	1.65	1.6
w	17.82	19.41	21.09	22.87	24.76

WOPM 13.20

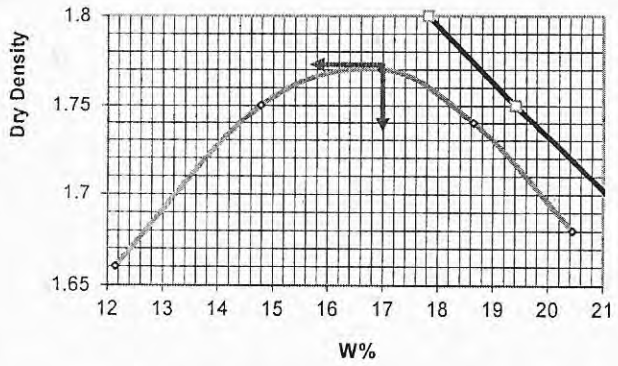
Shear test according to NF P 94-071

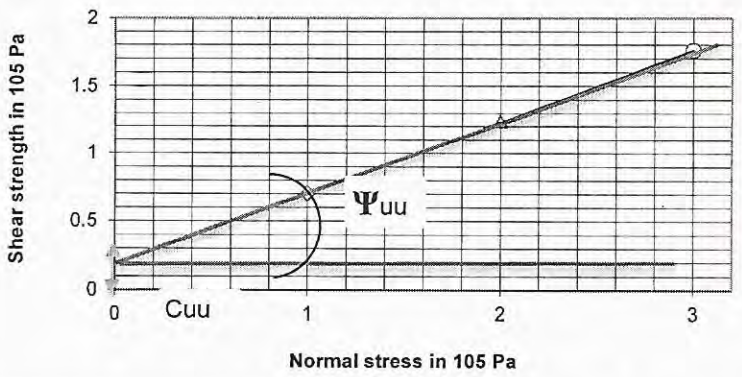
Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.7	1.24	1.76
γs	2.65		

Cuu(105Pa) **0.17**

Ψ° 27.92

γh(T/m3) 1.61 W(n)% 14.9





SIEVE ANALYSIS according to NF P 94-056

#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	64.85	76.398	84.41	87.59	92.01	93.28	97.08	100
Cumulative	353.9	237.6	156.9	124.9	80.4	67.6	29.4	0

LIQUID LIMITS "LL"

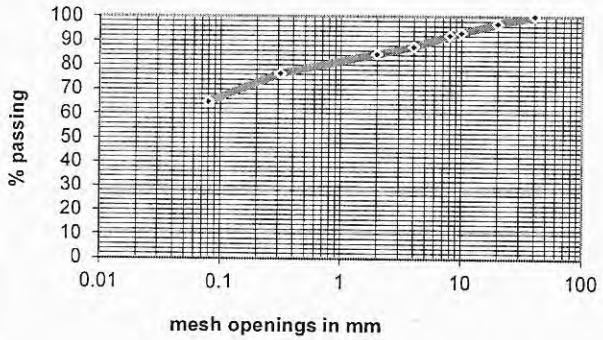
N		34	29	24	20	15
	35.67	1.531	1.462	1.380	1.301	1.176
W	41.06	36.67	37.32	38.42	39.29	40.06

PL 18.96 | 18.8 | 19

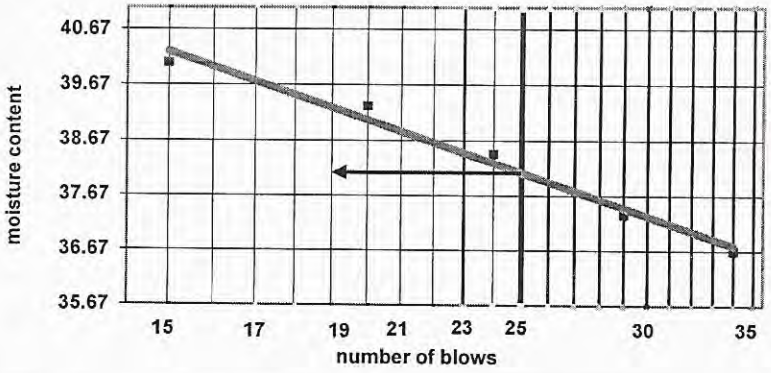
RESULT

LL	38.08
PL	18.97
PI	19.10

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LABORATORY MANAGER	
05-08-2017			

RINCENT BTP RWANDA
P.O Box 4973 KIGALI - RWANDA
QUALITY ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP11 (GASOGI-NYAGASAMBU)
e of sample	Yellowish Reddish schist compact	Depth	3.50-4.00
extraction date	7/23/2017	Testing Date	7/25/2017

Modified proctor according to NF P 94-093 — a 55 — 1.67

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	18.97	20.14	22.22	23.38	26.58
gd	1.57	1.62	1.67	1.66	1.58
SATURATION CURVE					
gd	1.7	1.65	1.6	1.55	1.5
w	22.59	24.37	26.268	28.28	30.43

OMC 22.22

Shear test according to NF P 94-071

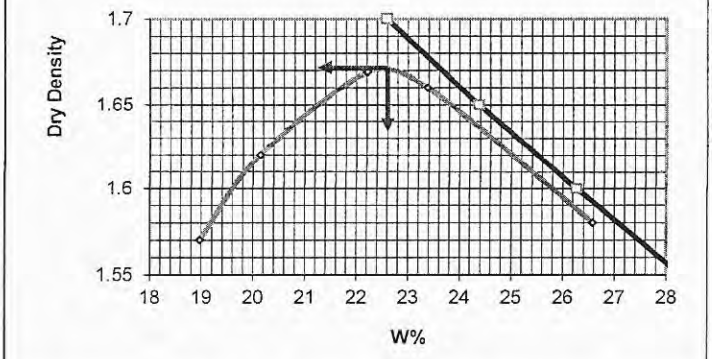
Shear test

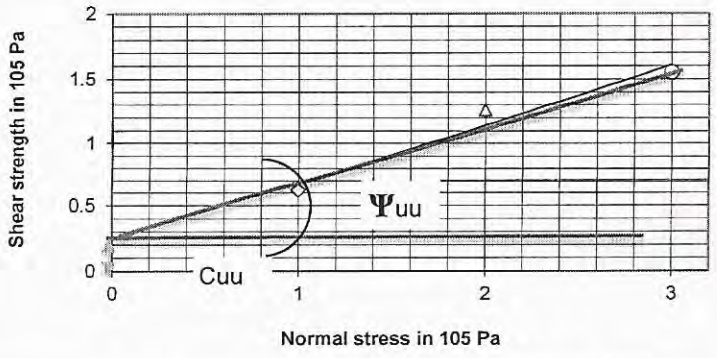
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.62	1.26	1.55
ys	2.76		

Cuu(105Pa) 0.21

Ψ° 24.94

γh(T/m3) 1.93 W(n)% 18.32





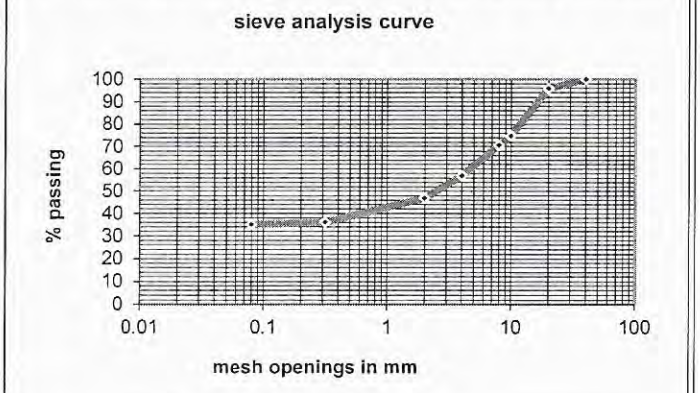
SIEVE ANALYSIS according to NF P 94-056

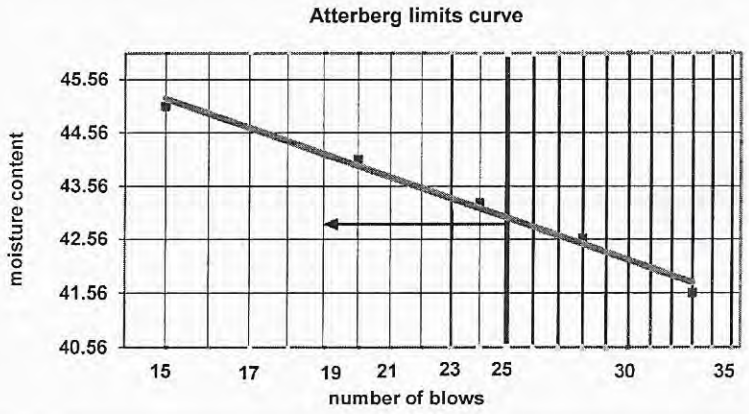
#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	34.98	35.94	46.86	56.9	70.52	74.78	95.7	100
Cumul	716.3	705.7	585.4	474.8	324.80	277.8	47.4	0

LIQUID LIMITS "LL"

N		33	28	24	20	15
	40.56	1.519	1.447	1.380	1.301	1.176
W	46.05	41.56	42.58	43.25	44.06	45.05

PL		RESULT	
28.41	LL	42.97
25.56	PL	27.23
27.72	PI	15.74





DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LAB MANAGER	

RINCENT BTP RWANDA
P.O Box 4973 KIGALI - RWANDA
QUALITY ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP12(GASOGI-NYAGASAMBU)
re of sample	Lateritictgravels with quartz pebbes	Depth	3.60-4.00m
extraction date	7/26/2017	Testing Date	7/26/2017

Modified proctor according to NF P 94-093 — a 55 — 2

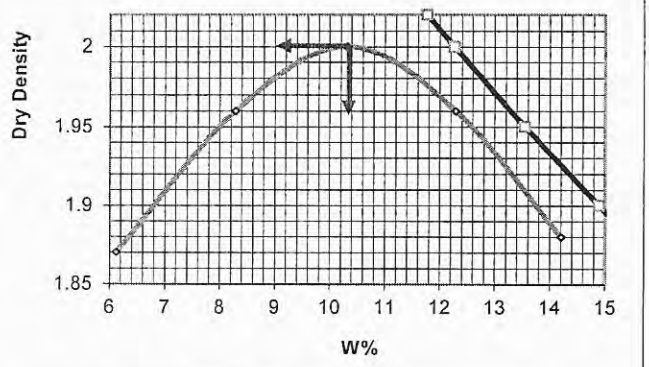
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	6.12	8.29	10.32	12.29	14.21
gd	1.87	1.96	2	1.96	1.88
SATURATION CURVE					
gd	2.02	2	1.95	1.9	1.85
w	11.77	12.26	13.55	14.9	16.32

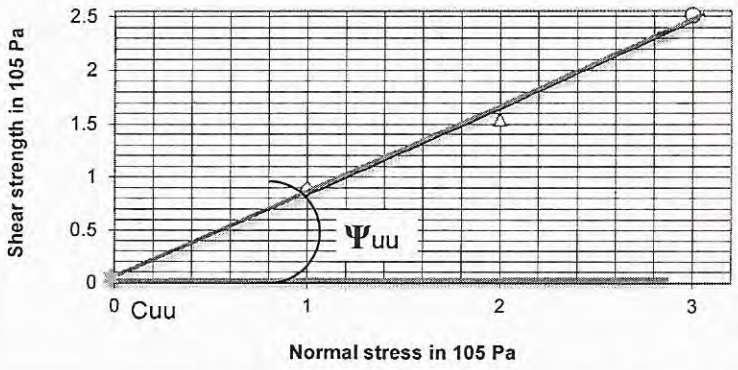
WOPM 10.40

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.88	1.54	2.51
γs	2.65		

Cuu(105Pa)	0.01		
Ψ°	39.18		
γh(T/m3)	1.81	W(n)%	13.24





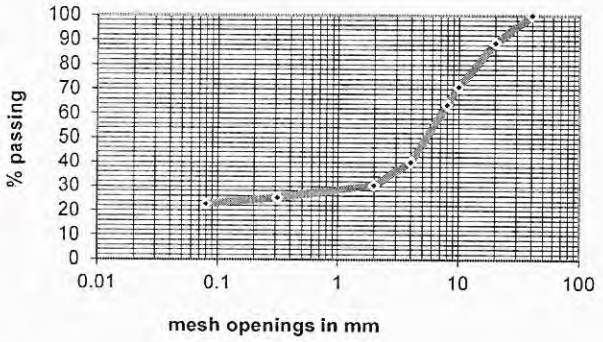
SIEVE ANALYSIS according to NF P 94-056

#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	22.69	25.274	30.32	39.95	63.64	70.93	88.79	100
Cumulati ve	875.8	846.5	789.3	680.2	411.9	329.3	127	0

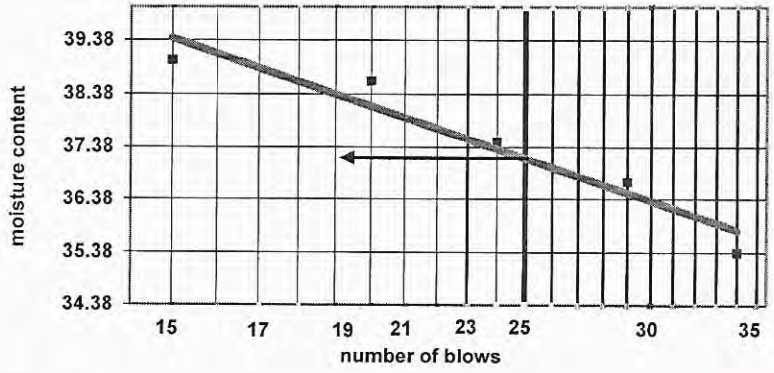
LIQUID LIMITS "LL"

N		34	29	24	20	15	PL	RESULT	
	34.38	1.531	1.462	1.380	1.301	1.176	22.62	LL	37.16
W	40.01	35.38	36.71	37.47	38.62	39.01	21.93	PL	22.41
								PI	14.75

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LABORATORY MANAGER	

RINCENT BTP RWANDA
P O Box 4973 KIGALI - RWANDA

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP13(GASOGI-NYAGASAMBU)
re of sample	Reddish silt	Depth	3.60-4.00 m
extraction date	7/23/2017	Testing Date	7/27/2017

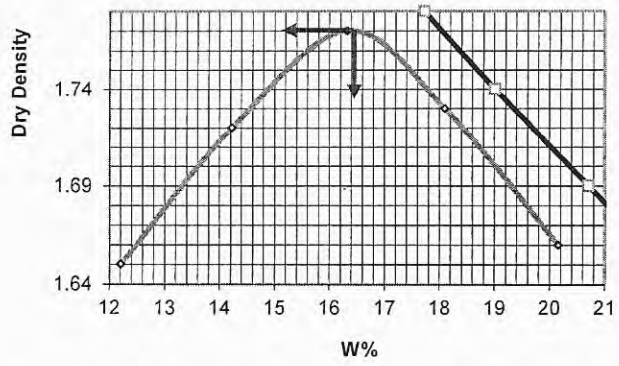
Modified proctor according to NF P 94-093 — a 55 — 1.77

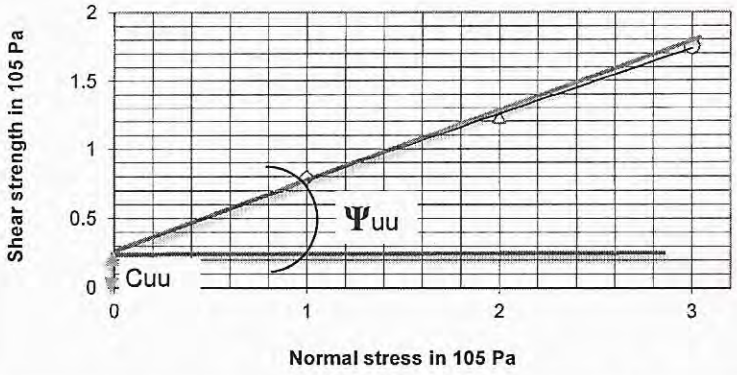
Blows number	5*56	5*56	5*56	5*56	5*56	WOPM	16.40
W%	12.21	14.23	16.32	18.1	20.16		
gd	1.65	1.72	1.77	1.73	1.66		
SATURATION CURVE							
gd	1.78	1.74	1.69	1.67	1.64		
w	17.72	19.01	20.71	21.42	22.51		

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.79	1.23	1.75
γs	2.6		

Cuu(105Pa)	**0.30**		
Ψ°	25.64		
γh(T/m3)	1.62	W(n)%	13.25





SIEVE ANALYSIS according to NF P 94-056

951.00

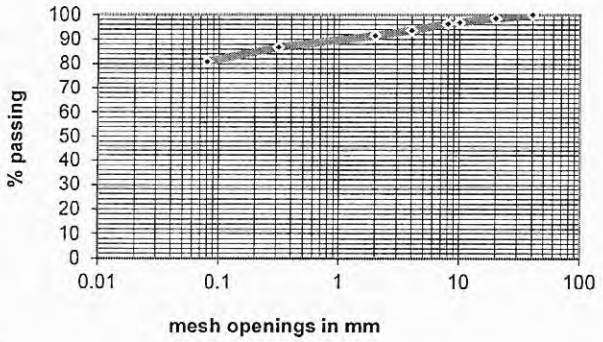
Dia	0.08	0.315	2	4	8	10	20	40
%	80.83	86.635	91.49	93.5	96.33	96.87	98.52	100
Cumulative	182.3	127.1	80.9	61.8	34.9	29.8	14.1	0

LIQUID LIMITS "LL"

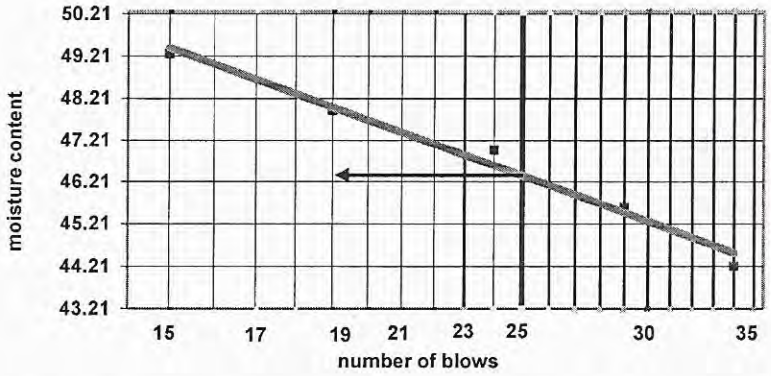
N		34	29	24	19	15
	43.21	1.531	1.462	1.380	1.279	1.176
W	50.26	44.21	45.60	46.98	47.92	49.26

PL		RESULT	
25		LL	46.35
25.87		PL	25.37
25.23		PI	20.99

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LABORATORY MANAGER	
05-08-2017			

RINCENT BTP RWANDA
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QUALITY LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP15(GASOGI-NYAGASAMBU)
re of sample	Brownish lateritic gravels	Depth	3.60-4.00m
extraction date	7/24/2017	Testing Date	7/27/2017

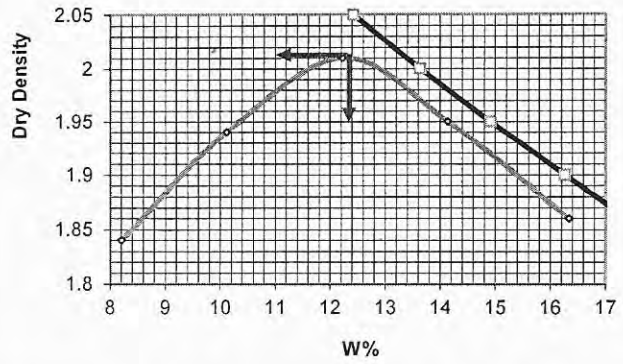
Modified proctor according to NF P 94-093 — a 55 — 2.01 — WOPM 12.40

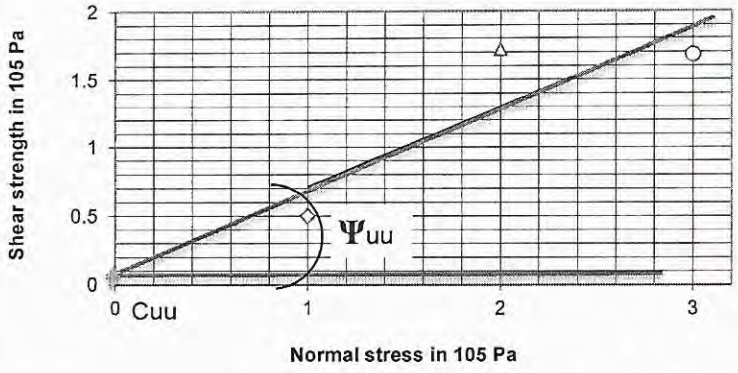
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	8.21	10.12	12.23	14.14	16.34
gd	1.84	1.94	2.01	1.95	1.86
SATURATION CURVE					
gd	2.05	2	1.95	1.9	1.85
w	12.42	13.64	14.92	16.27	17.69

Shear test according to NF P 94-071

Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.5	1.72	1.68
γs	2.75		

Shear test — Cuu(105Pa) **0.12** — Ψ° 30.54 — γh(T/m3) 1.78 — W(n)% 13.25





SIEVE ANALYSIS according to NF P 94-056

873.60

Dia	0.08	0.315	2	4	8	10	20	40
%	33.25	36.916	45.75	57.07	74.46	80.53	90.43	100
Cumulati ve	583.1	551.1	473.9	375	223.1	170.1	83.6	0

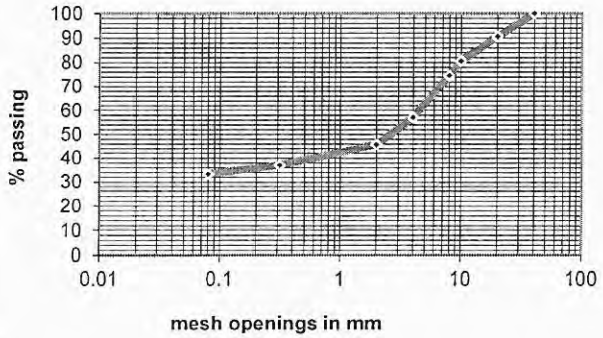
LIQUID LIMITS "LL"

N		33	29	24	20	16
	33.56	1.519	1.462	1.380	1.301	1.204
W	39.28	34.56	35.89	36.98	37.91	38.28

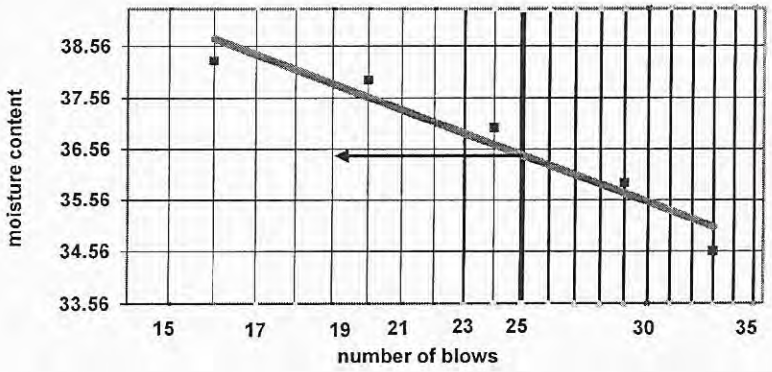
PL 20 — 20.43 — 20.05

RESULT: LL 36.44 — PL 20.09 — PI 16.35

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP16(GASOGI-NYAGASAMBU)
re of sample	Whitish schist	Depth	3.40-4.00m
extraction date	7/24/2017	Testing Date	7/25/2017

Modified proctor according to NF P 94-093 — a 55 — 1.73

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	16.45	18.54	20.34	22.45	24.58
gd	1.62	1.69	1.73	1.70	1.63
SATURATION CURVE					
gd	1.75	1.7	1.65	1.6	1.55
w	21.43	23.11	24.892	26.79	28.8

OMC 20.60

Normal stress in 10^5 Pa

Shear strength in 10^5 Pa

γs 2.8

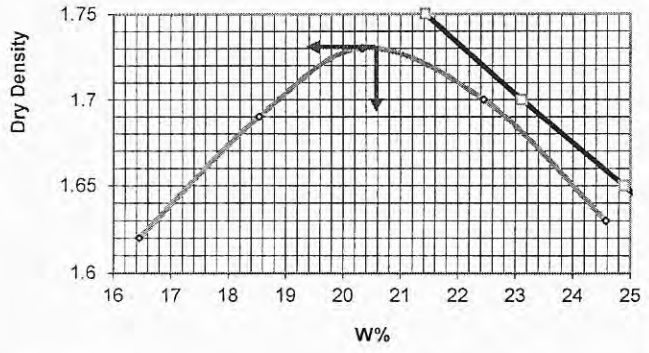
Shear test according to NF P 94-071

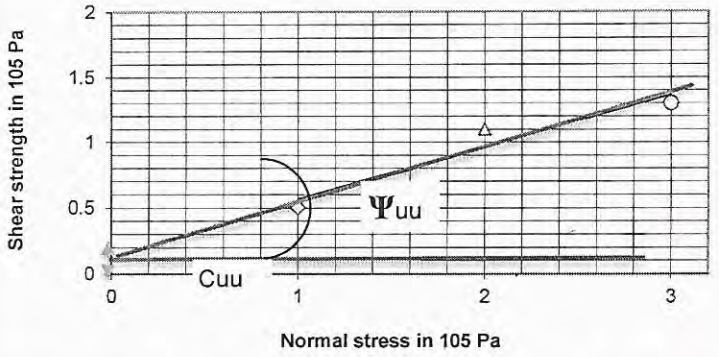
Shear test	1	2	3
	0.5	1.1	1.30

Cuu(105Pa) **0.17**

Ψ° 21.80

γh(T/m3) 1.62 W(n)% 18.32





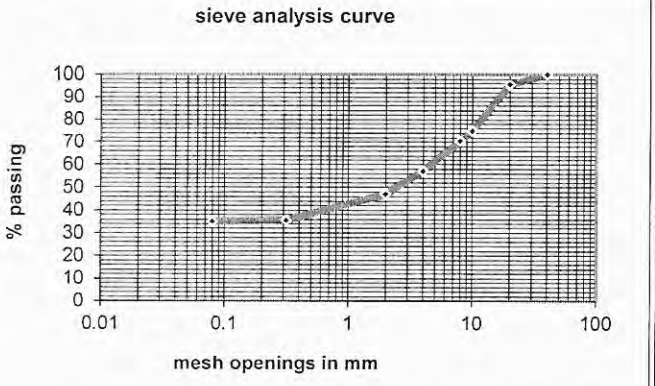
SIEVE ANALYSIS according to NF P 94-056

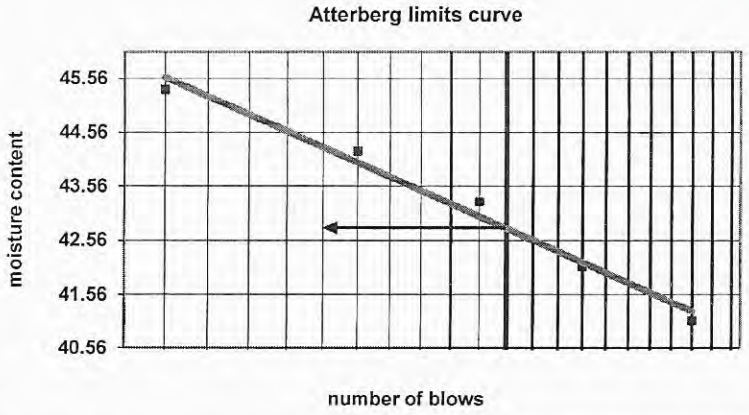
#####								
Dia	0.08	0.315	2	4	8	10	20	40
%	34.96	35.49	47.01	57	70.45	74.87	95.43	100
Cumul	716.5	710.7	583.8	473.7	325.60	276.9	50.4	0

LIQUID LIMITS "LL"

N		33	28	24	20	15
	40.07	1.519	1.447	1.380	1.301	1.176
W	46.35	41.07	42.08	43.27	44.21	45.35

PL		RESULT	
27.41	LL	42.77
27.56	PL	27.56
27.72	PI	15.21





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP17(GASOGI-NYAGASAMBU)
re of sample	Blackish clay	Depth	0.50-1.00m
extraction date	7/24/2017	Testing Date	7/25/2017

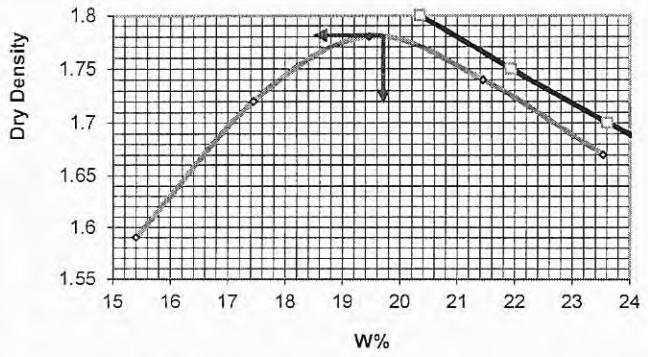
Modified proctor according to NF P 94-093 — a 55 — 1.78

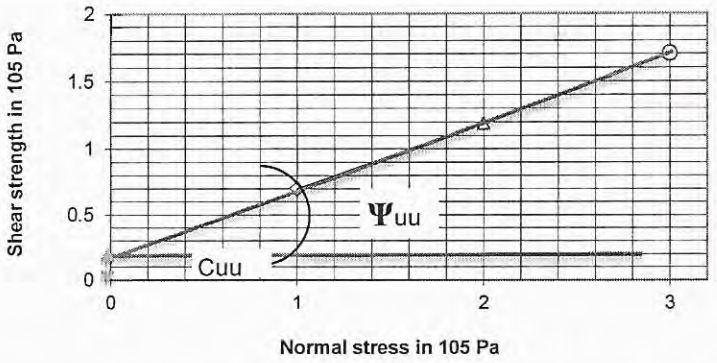
Blows number	5*56	5*56	5*56	5*56	5*56	OMC	19.68
$W_{\%}$	15.4	17.45	19.47	21.45	23.54		
gd	1.59	1.72	1.78	1.74	1.67		
SATURATION CURVE							
gd	1.8	1.75	1.7	1.65	1.6		
w	20.34	21.93	23.612	25.39	27.29		

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.7	1.19	1.70
γs	2.84		

Cuu(105Pa)	0.20		
Ψ°	26.57		
γh(T/m3)	1.76	W(n)%	19.25





SIEVE ANALYSIS according to NF P 94-056

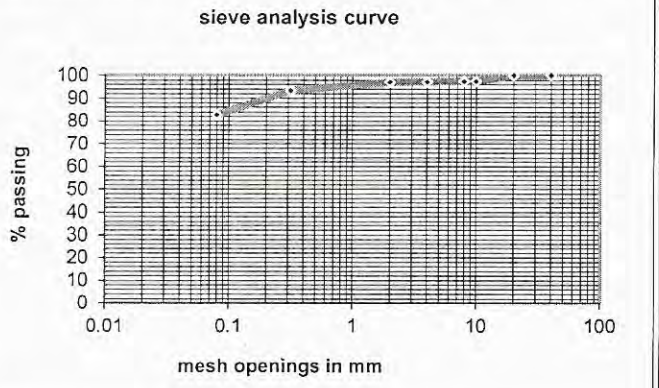
662.60

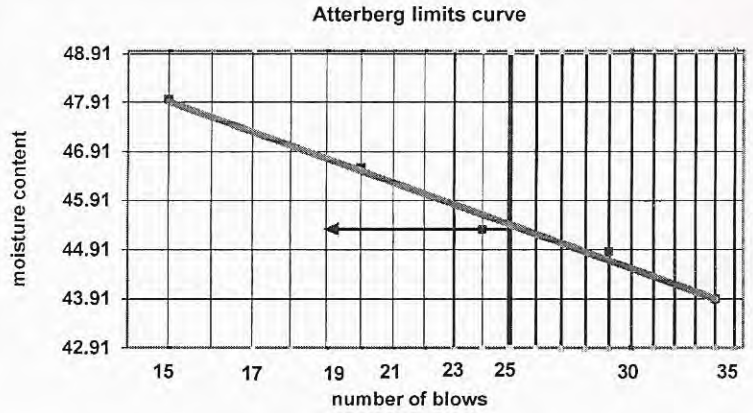
Dia	0.08	0.315	2	4	8	10	20	40
%	82.66	93.28	96.94	97.12	97.30	97.4	100	100
Cumul	114.9	44.5	20.3	19.1	17.90	17.2	0	0

LIQUID LIMITS "LL"

N		34	29	24	20	15
	42.91	1.531	1.462	1.380	1.301	1.176
W	48.97	43.91	44.87	45.32	46.58	47.97

PL		RESULT	
24.69	LL	45.42	
25.48	PL	25.32	
25.80	PI	20.09	





DATE	LABORATORY		REMARKS
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RINCENT BTP RWANDA

OVERVIEW OF THE GEOTECHNICAL TESTS RESULTS

Location	Origin	Visual identification	Depth	SIEVE ANALYSIS % passing in sieves with squared shape openings							ATTERBERG LIMITS			PROCTOR		γh(t/m3)	W(n)%	Shear test		Soil Classification according USCS	Observation
				0.08	0.315	2	4	8	10	20	40	LL	PL	PI	MDD (T/m3)	OMC (%)			Cuu (10^5Pa)	Ψ°(%)		
GASOGI-MASAKA	AP1	Brownish sandy silt	3.80-4.00m	63.2	85.65	92.3	94.9	98	98.5	100	100	40.18	21.60	18.6	1.83	17.20	1.90	20.7	0.28	23.51	CI	
	AP3	schist	3.75-4.00m	93.2	94.7	98.3	99.1	99.7	99.8	100	100	32.59	NP		1.68	22.40	1.70	20.6	0.09	30.54	SM	
	AP4	Lateritic gravels	3.50-4.00m	36.5	44.87	61.8	68.4	73.1	74.6	78.8	100	39.32	22.91	16.4	2.02	12.40	1.98	16.3	0.10	26.10	GC	
	AP5	Schist gravels	3.70-4.00m	31.2	72.34	98.1	98.9	100	100	100	100	37.14	NP		2.03	10.62	1.72	14	0.04	27.02	GM	
	AP6	Brownish silt	3.60-4.00m	37.3	50.77	64.4	72.6	82.5	85.5	92	100	39.03	23.87	15.2	2.02	11.36	1.90	18	0.14	25.41	GM	
	AP8	Gravelly Schist	3.80-4.00m	17.1	50.75	87.6	94.5	95.6	95.8	100	100	unmeasurable			2.06	10.40	1.63	18.3	0.04	25.70	GM	
	AP9	Brownish gravely silt	3.70-4.00m	43.1	51.24	75.4	95.9	100	100	100	100	40.00	23.54	16.5	1.94	15.20	1.88	17.3	0.20	23.75	GC	
	AP10	Brownish silt	3.70-4.00m	81.9	90.52	97.9	99.5	100	100	100	100	44.30	24.43	19.9	1.82	18.40	1.87	22.3	0.38	21.31	CI	
	AP12	Brownish silt	3.50-4.00m	87.4	93.67	99.5	99.9	100	100	100	100	45.74	23.87	21.9	1.75	21.63	1.78	20	0.44	21.31	CI	
	AP13	Reddish silt	3.60-4.00m	86.8	94.6	99.5	100	100	100	100	100	44.10	23.37	20.7	1.73	20.00	1.70	21	0.45	20.30	CI	
	AP15	Brownish silt	3.80-4.00m	87	93.33	99.5	100	100	100	100	100	44.91	24.21	20.7	1.78	18.00	1.61	14.9	0.41	26.10	CI	
	AP16	Brownish silt	3.40-4.00m	71.4	77.37	89.6	96.6	99.5	99.5	100	100	42.45	23.30	19.2	1.77	20.40	1.69	20.3	0.39	22.29	CI	
	AP17	Blackish clayey sand	2.50-3.50m	40.8	58.2	92.2	98.6	99.8	99.8	100	100	37.88	22.18	15.7	1.87	15.65	1.63	13.5	0.19	31.59	CI	
	AP18	Blackish sandy clay	3.00-3.50m	57.5	76.14	99.8	100	100	100	100	100	40.38	23.98	16.4	1.84	15.20	1.73	15	0.21	26.79	CI	
	AP19	Reddish silt	3.80-4.00m	84.4	92.91	99.6	99.7	99.9	100	100	100	43.32	24.35	19.0	1.7	19.40	1.70	21	0.48	19.29	CI	

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A15-159

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP 1(GASOGI-MASAKA)
re of sample	Brownish sandy silt	Depth	3.80-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

Modified proctor according to NF P 94-093

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	12.78	14.9	16.87	18.48	20.51
gd	1.7	1.78	1.83	1.80	1.73
SATURATION CURVE					
gd	1.85	1.8	1.75	1.7	1.65
w	17.69	19.19	20.78	22.46	24.24

MDD 1.83

OMC 17.20

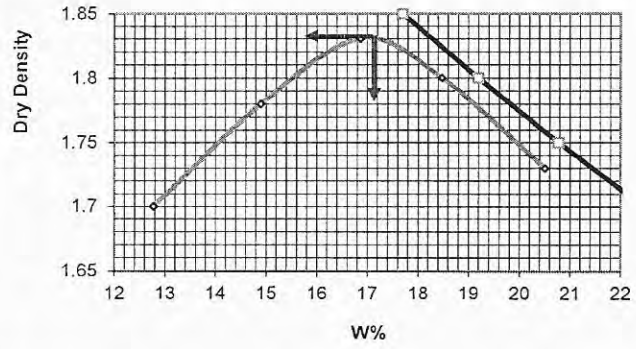
Shear test according to NF P 94-071

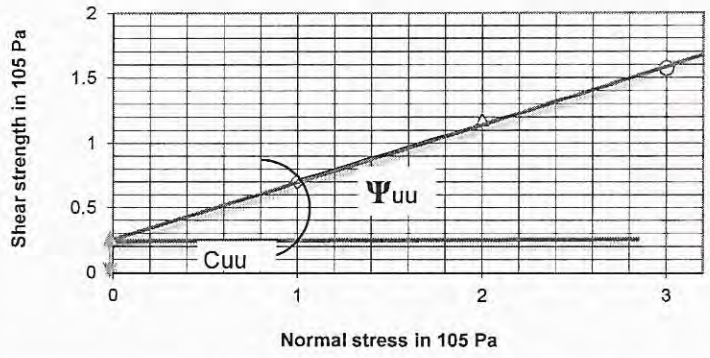
Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.7	1.18	1.57
γs	2.75		

Cuu(105Pa) 0.28

Ψ° 23.51

γh(T/m3) 1.90 W(n)% 20.69





SIEVE ANALYSIS according to NF P 94-056

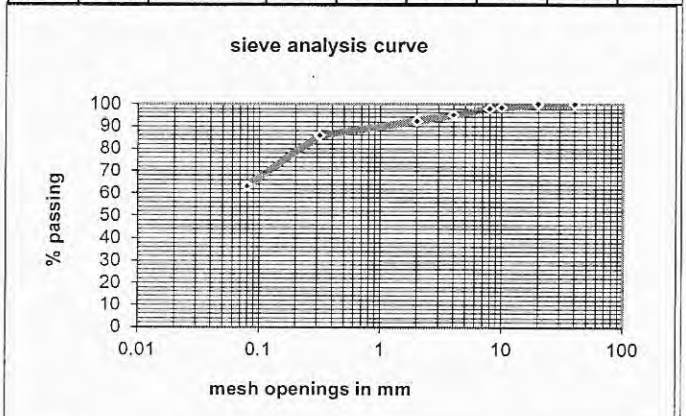
719.10

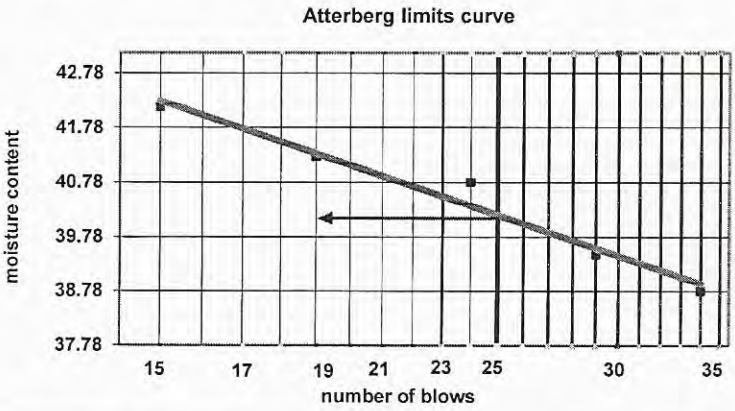
Dia	0.08	0.315	2	4	8	10	20	40
%	63.22	85.65	92.3	94.94	97.96	98.51	100	100
Cumul	264.5	103.2	55.4	36.4	14.70	10.7	0	0

LIQUID LIMITS "LL"

N		34	29	24	19	15
W	43.15	38.78	39.45	40.78	41.25	42.15

PL	22.58	LL	40.18
	21.69	PL	21.60
	20.54	PI	18.58





DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LAB MANAGER	

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RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP 3 (GASOGI-MASAKA)
re of sample	schist	Depth	3.75-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

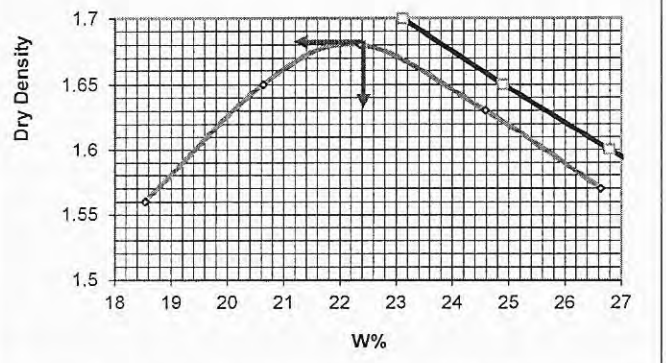
Modified proctor according to NF P 94-093 — MDD: 1.68, OMC: 22.40

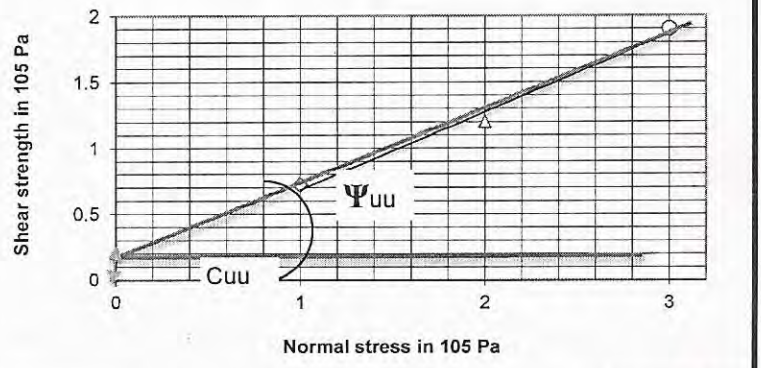
Blows number	5*56	5*56	5*56	5*56	5*56
W%	18.54	20.64	22.36	24.59	26.64
gd	1.56	1.65	1.68	1.63	1.57
SATURATION CURVE					
gd	1.7	1.65	1.6	1.55	1.5
w	23.11	24.89	26.79	28.8	30.95

Shear test according to NF P 94-071

Shear test	1	2	3
Normal stress in 10^5 Pa			
Shear strength in 10^5 Pa	0.72	1.2	1.90
γs	2.8		

Cuu(105Pa)	0.09		
Ψ°	30.54		
γh(T/m3)	1.70	W(n)%	20.64





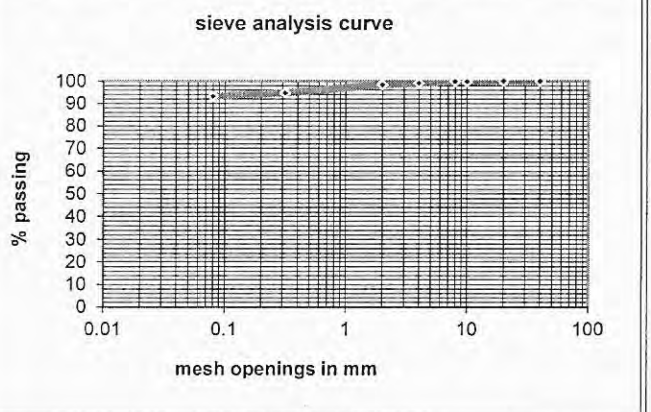
SIEVE ANALYSIS according to NF P 94-056

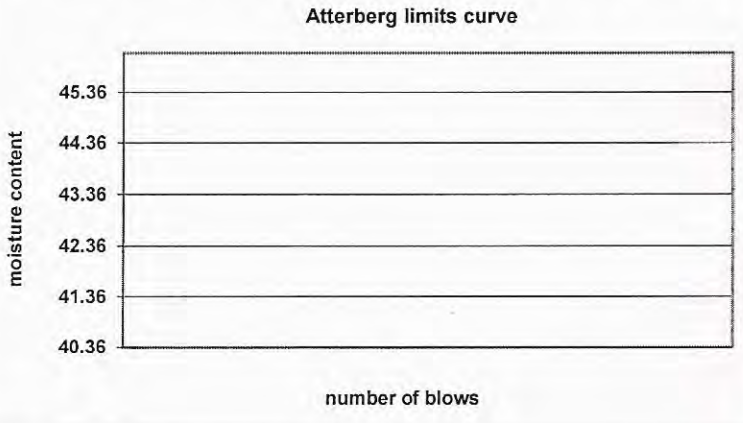
985.80								
Dia	0.08	0.315	2	4	8	10	20	40
%	93.19	94.70	98.35	99.1	99.69	99.77	100	100
Cumul	67.1	52.2	16.3	8.9	3.10	2.3	0	0

LIQUID LIMITS "LL"

N		34	29	24	20	15
W	36.61	30.69	31.25	32.96	34.51	35.61

PL	RESULT	
NP	LL	32.59
	PL	#####
	PI	#####





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

RINCENT BTP RWANDA
P.O Box 4973 KIGALI - RWANDA
QUALITY ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP4(GASOGI-MASAKA)
re of sample	Latertic gravels	Depth	3.50-4.00
extraction date	7/22/2017	Testing Date	7/23/2017

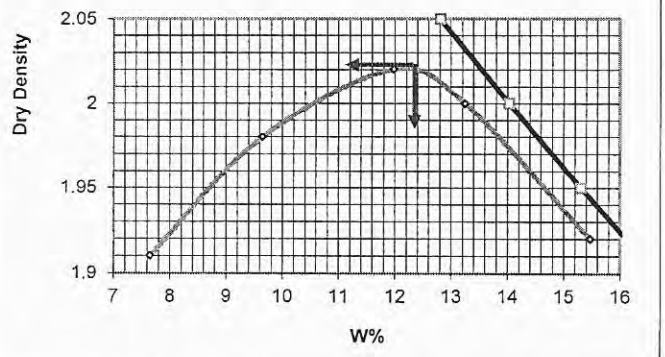
Modified proctor according to NF P 94-093 — MDD 2.02 — OMC 12.40

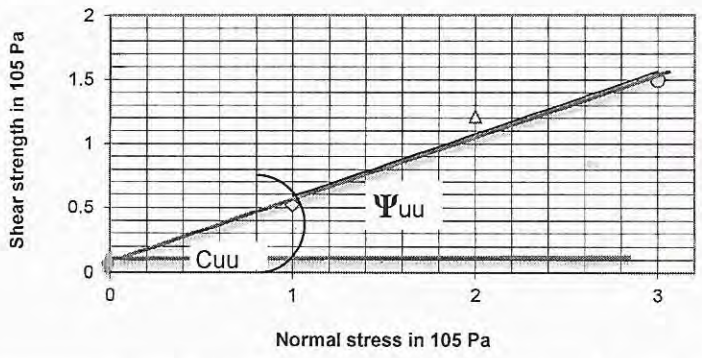
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	7.65	9.65	11.98	13.25	15.47
gd	1.91	1.98	2.02	2.00	1.92
SATURATION CURVE					
gd	2.05	2	1.95	1.9	1.85
w	12.81	14.03	15.311	16.66	18.08

Shear test according to NF P 94-071

Shear test	1	2	3
Normal stress in 10^5 Pa			
Shear strength in 10^5 Pa	0.52	1.21	1.50
γs	2.78		

Cuu(105Pa)	0.10		
Ψ°	26.10		
γh(T/m3)	1.98	W(n)%	16.3





SIEVE ANALYSIS according to NF P 94-056

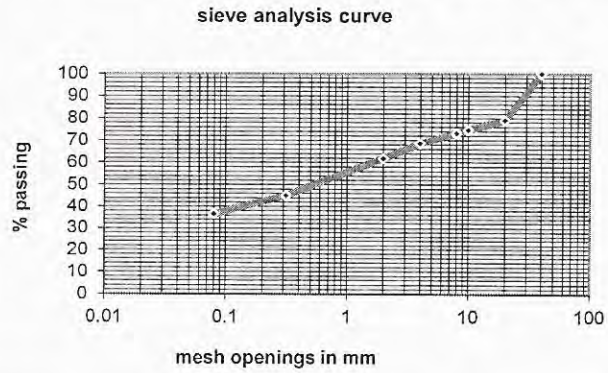
787.10

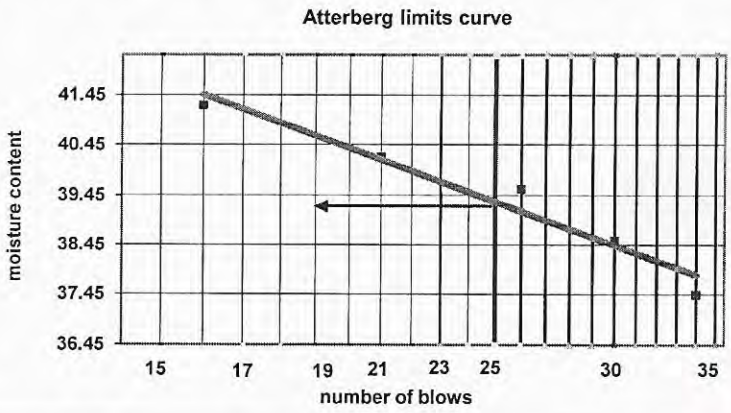
Dia	0.08	0.315	2	4	8	10	20	40
%	36.46	44.87	61.81	68.36	73.07	74.56	78.8	100
Cumul	500.1	433.9	300.6	249	212.00	200.2	166.9	0

LIQUID LIMITS "LL"

N		34	30	26	21	16
	36.45	1.531	1.477	1.415	1.322	1.204
W	42.25	37.45	38.54	39.57	40.21	41.25

PL		RESULT	
22.69	LL	39.32	
23.64	PL	22.91	
22.40	PI	16.41	





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
08-08-2017			

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QUALITY CONTROL & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP5(GASOGI-MASAKA)
re of sample	Schist gravels	Depth	3.70-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

Modified proctor according to NF P 94-093

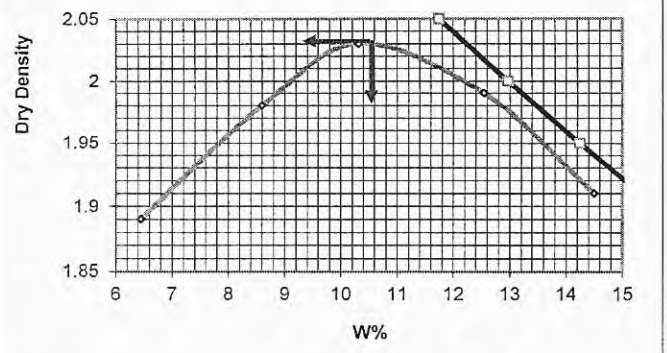
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	6.45	8.6	10.32	12.54	14.5
gd	1.89	1.98	2.03	1.99	1.91
SATURATION CURVE					
gd	2.05	2	1.95	1.9	1.85
w	11.74	12.96	14.245	15.59	17.02

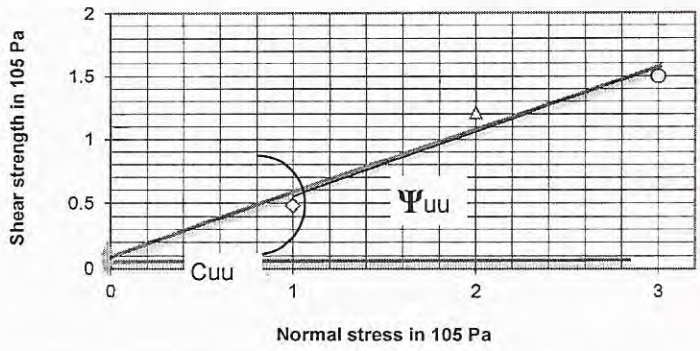
MDD 2.03 — OMC 10.62

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.48	1.21	1.50
γs	2.7		

Cuu(105Pa)	0.04		
Ψ°	27.02		
γh(T/m3)	1.72	W(n)%	14.36





SIEVE ANALYSIS according to NF P 94-056

930.30

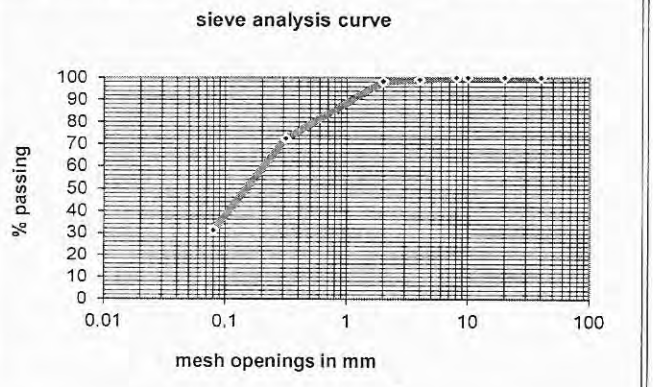
Dia	0.08	0.315	2	4	8	10	20	40
%	31.18	72.34	98.14	98.9	100.00	100	100	100
Cumul	640.2	257.3	17.3	10.2	0.00	0	0	0

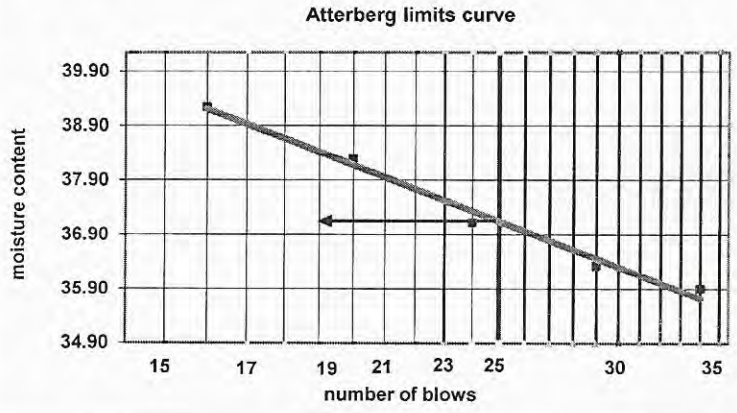
LIQUID LIMITS "LL"

N		34	29	24	20	16
	34.90	1.531	1.462	1.380	1.301	1.204
W	40.25	35.90	36.32	37.12	38.29	39.25

PL: NP

RESULT: LL 37.14 — PL ##### — PI #####





DATE	LABORATORY		REMARKS
05-08-2017	LAB TECHNICIAN	LAB MANAGER	

RINCENT BTP RWANDA
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ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP6(GASOGI-MASAKA)
re of sample	Brownish silt	Depth	3.60-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

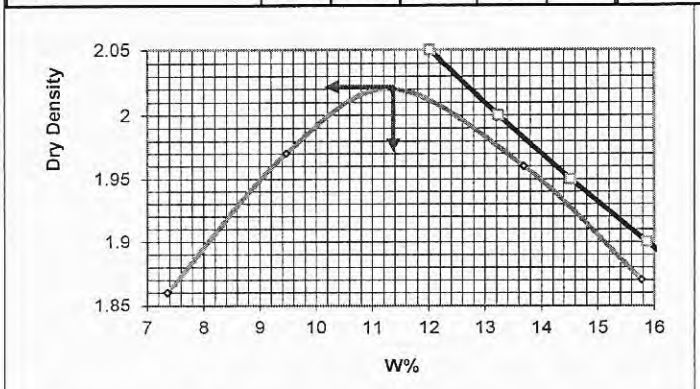
Modified proctor according to NF P 94-093 — MDD 2.02, OMC 11.36

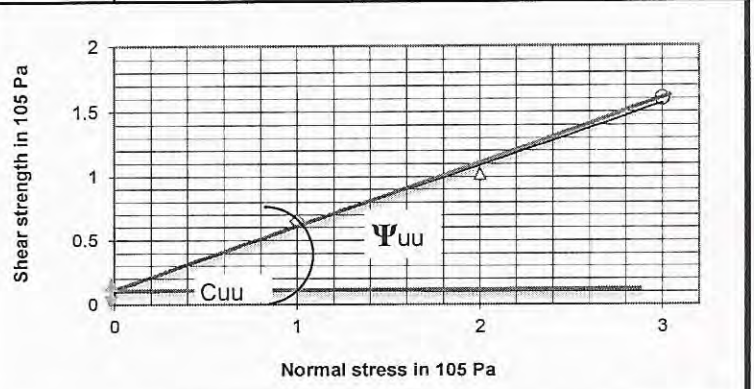
Blows number	5*56	5*56	5*56	5*56	5*56
W%	7.36	9.47	11.36	13.69	15.78
gd	1.86	1.97	2.02	1.96	1.87
SATURATION CURVE					
gd	2.05	2	1.95	1.9	1.85
w	12.02	13.24	14.517	15.87	17.29

Shear test according to NF P 94-071

Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.65	1.02	1.60
γs	2.72		

Cuu(105Pa)	0.14		
Ψ°	25.41		
γh(T/m3)	1.90	W(n)%	18.01





SIEVE ANALYSIS according to NF P 94-056

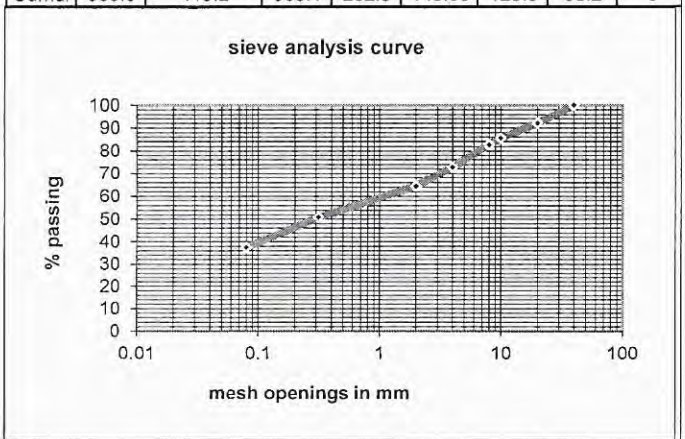
851.50

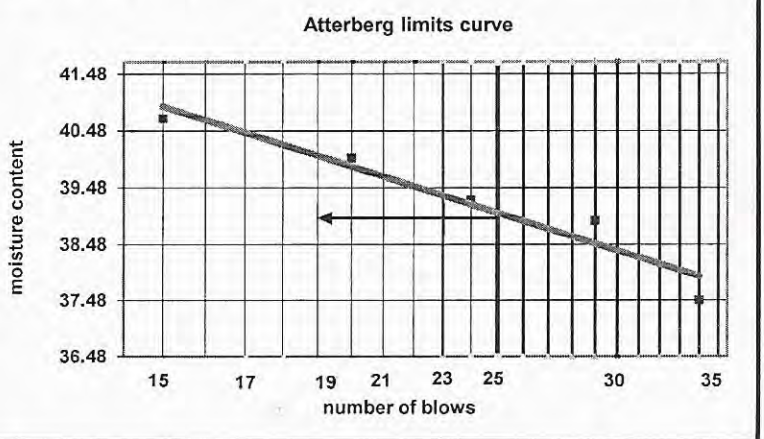
Dia	0.08	0.315	2	4	8	10	20	40
%	37.35	50.77	64.4	72.65	82.55	85.5	91.99	100
Cumul	533.5	419.2	303.1	232.9	148.60	123.5	68.2	0

LIQUID LIMITS "LL"

N		34	29	24	20	15
	36.48	1.531	1.462	1.380	1.301	1.176
W	41.69	37.48	38.90	39.27	40.00	40.69

PL		RESULT	
23.69	LL	39.03	
22.96	PL	23.87	
24.97	PI	15.16	





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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QUALITY ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP8(GASOGI-MASAKA)
re of sample	Schist gravels	Depth	3.80-4.00m
extraction date	7/22/2017	Testing Date	7/29/2017

Modified proctor according to NF P 94-093 — MDD: 2.06

Blows number	5*56	5*56	5*56	5*56	5*56
W%	6.54	8.78	10.3	12.58	14.69
gd	1.94	2.03	2.06	2.02	1.94

SATURATION CURVE

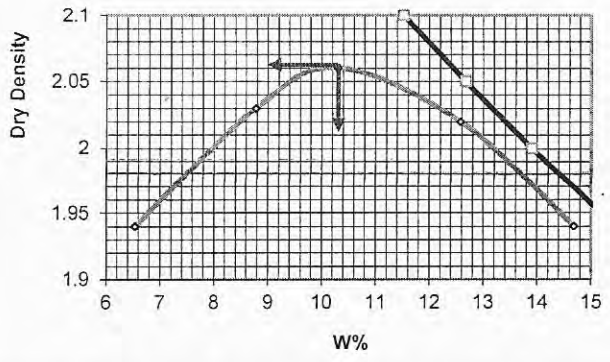
gd	2.1	2.05	2	1.95	1.9
w	11.52	12.68	13.9	15.18	16.53

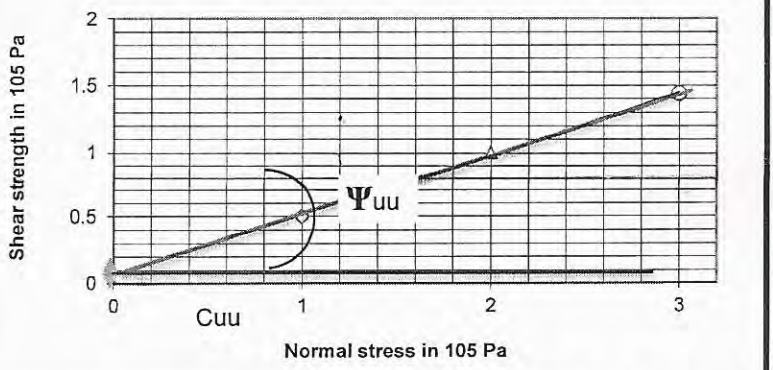
WOPM: 10.40

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.5	1	1.44
γs	2.77		

Cuu(105Pa)	**0.04**		
Ψ°	25.17		
γh(T/m3)	1.63	W(n)%	**18.25**





SIEVE ANALYSIS according to NF P 94-056

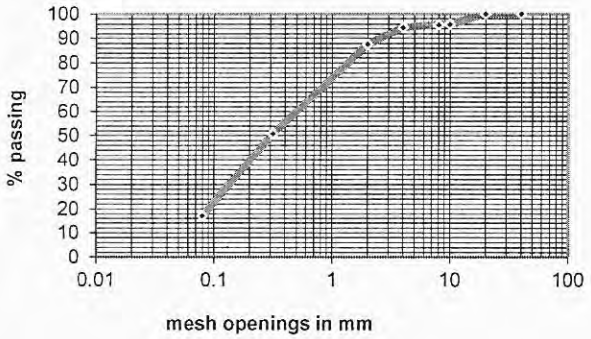
703.90								
Dia	0.08	0.315	2	4	8	10	20	40
%	17.09	50.746	87.58	94.5	95.57	95.78	100	100
Cumulati ve	583.6	346.7	87.4	38.7	31.2	29.7	0	0

LIQUID LIMITS "LL"

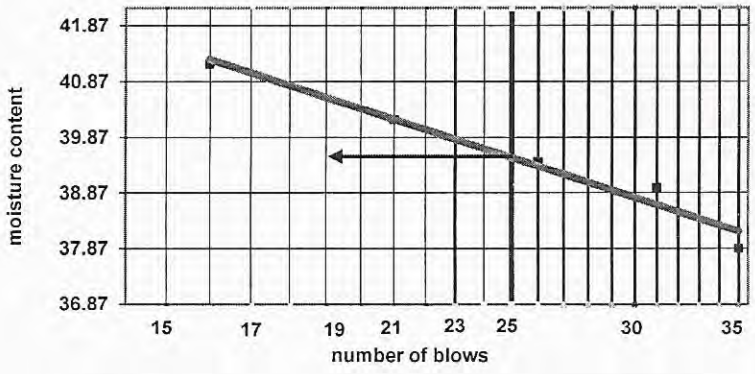
N		35	31	26	21	16
	36.87	1.544	1.491	1.415	1.322	1.204
W	42.19	37.87	38.96	39.43	40.19	41.19

PL	RESULT	
21	LL	39.50
20.58	PL	20.78
20.75	PI	18.73

sieve analysis curve



Atterberg limits curve



DATE	LABORATORY		REMARKS
	OPERATOR	LABORATORY MANAGER	
05-08-2017			

RINCENT BTP RWANDA
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ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP[illegible](GASOGI-MASAKA)
re of sample	Brownish gravely silt	Depth	3.70-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

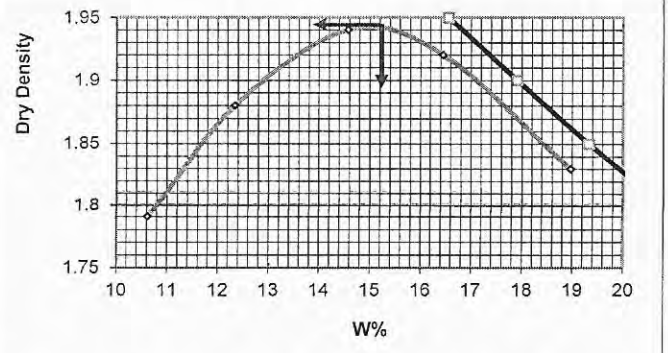
Modified proctor according to NF P 94-093 — MDD: 1.94 — OMC: 15.20

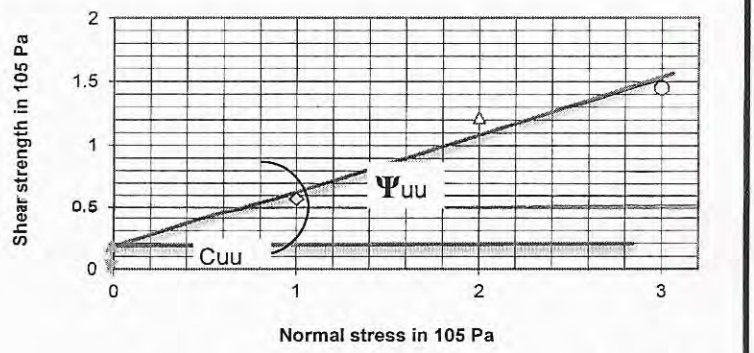
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	10.62	12.34	14.58	16.45	18.97
gd	1.79	1.88	1.94	1.92	1.83
SATURATION CURVE					
gd	1.95	1.9	1.85	1.8	1.75
w	16.56	17.91	19.332	20.83	22.42

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.57	1.22	1.45
γs	2.88		

Cuu(105Pa)	0.20		
Ψ°	23.75		
γh(T/m3)	1.88	W(n)%	17.32





SIEVE ANALYSIS according to NF P 94-056

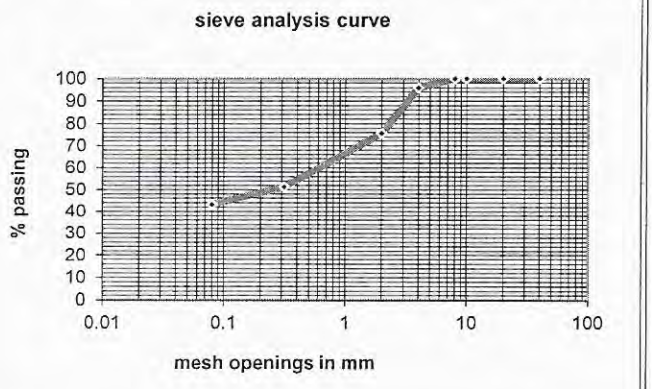
816.50

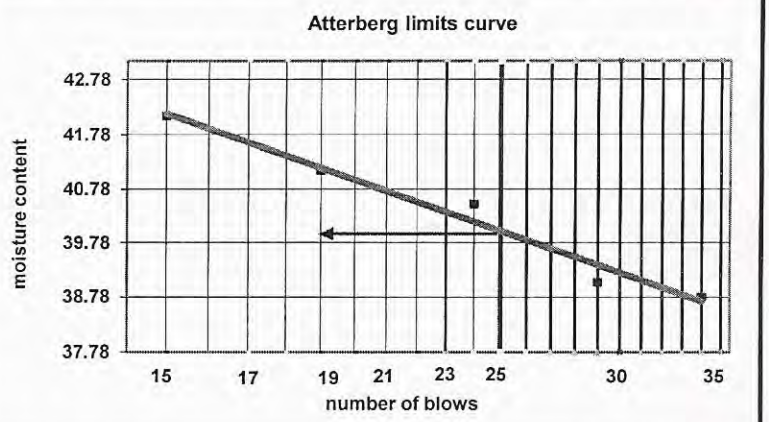
Dia	0.08	0.315	2	4	8	10	20	40
%	43.09	51.24	75.43	95.86	100.00	100	100	100
Cumul	464.7	398.1	200.6	33.8	0.00	0	0	0

LIQUID LIMITS "LL"

N		34	29	24	19	15
	37.78	1.531	1.462	1.380	1.279	1.176
W	43.12	38.78	39.05	40.50	41.12	42.12

PL		RESULT	
23.80	LL	40.00	
24.69	PL	23.54	
22.14	PI	16.46	





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

RINCENT BTP RWANDA P.O. Box 4973 KIGALI - RWANDA ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP10(GASOGI-MASAKA)
re of sample	Brownish silt	Depth	3.70-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

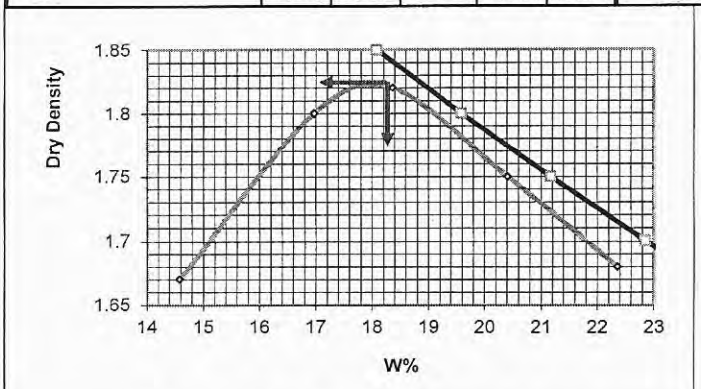
Modified proctor according to NF P 94-093 — MDD: 1.82, OMC: 18.40

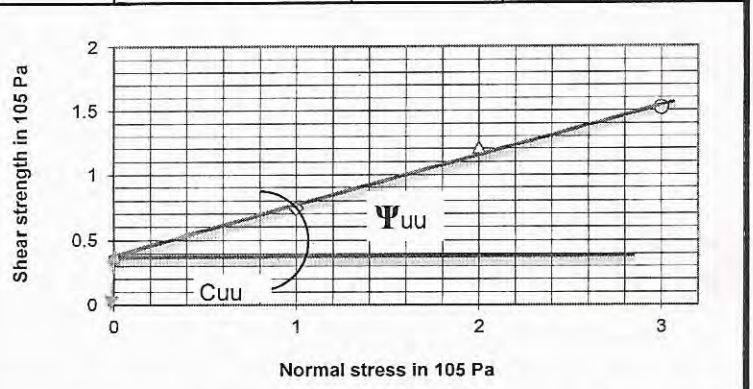
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	14.58	16.97	18.36	20.41	22.36
gd	1.67	1.8	1.82	1.75	1.68
SATURATION CURVE					
gd	1.85	1.8	1.75	1.7	1.65
w	18.08	19.58	21.172	22.85	24.63

Shear test according to NF P 94-071

Shear test			
Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.74	1.21	1.52
γs	2.78		

Cuu(105Pa)	0.38		
Ψ°	21.31		
γh(T/m3)	1.87	W(n)%	22.3





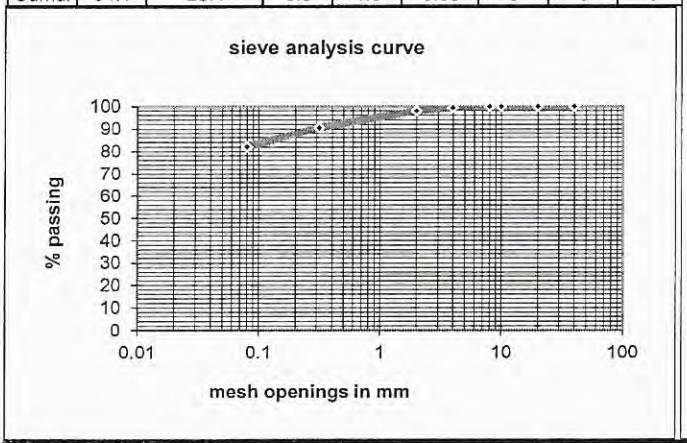
SIEVE ANALYSIS according to NF P 94-056

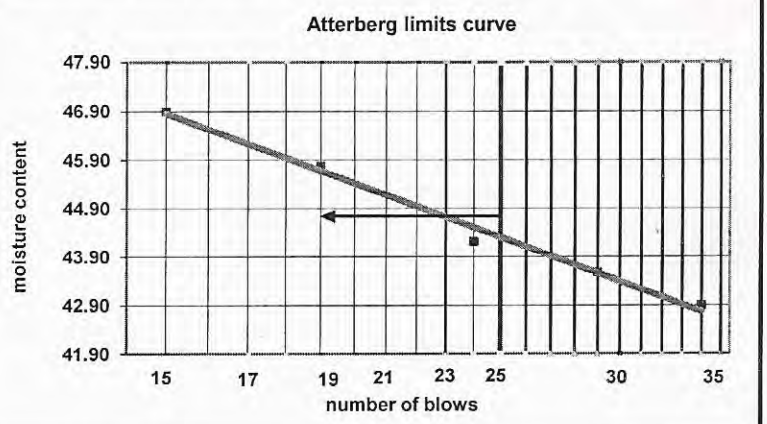
299.50								
Dia	0.08	0.315	2	4	8	10	20	40
%	81.94	90.52	97.9	99.5	100.00	100	100	100
Cumul	54.1	28.4	6.3	1.5	0.00	0	0	0

LIQUID LIMITS "LL"

N		34	29	24	19	15
	41.90	1.531	1.462	1.380	1.279	1.176
W	47.90	42.90	43.58	44.21	45.78	46.90

PL		RESULT	
24.89	LL	44.30	
24.96	PL	24.43	
23.45	PI	19.87	





DATE	LABORATORY		REMARKS
05-09-2017	LAB TECHNICIAN	LAB MANAGER	

RINCENT BTP RWANDA
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QUALITY ENGINEERING & LABORATORY

RINCENT BTP RWANDA

IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP12(GASOGI-MASAKA)
re of sample	Brownish silt	Depth	3.50-4.00
extraction date	7/22/2017	Testing Date	7/24/2017

Modified proctor according to NF P 94-093

Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	17.9	19.47	21.36	23.58	25.69
gd	1.57	1.69	1.75	1.70	1.63

MDD 1.75 — OMC 21.63

SATURATION CURVE

gd	1.8	1.75	1.7	1.65	1.6
w	20.83	22.42	24.101	25.88	27.78

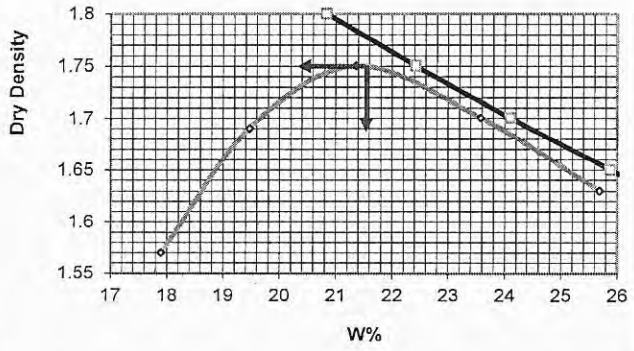
Shear test according to NF P 94-071

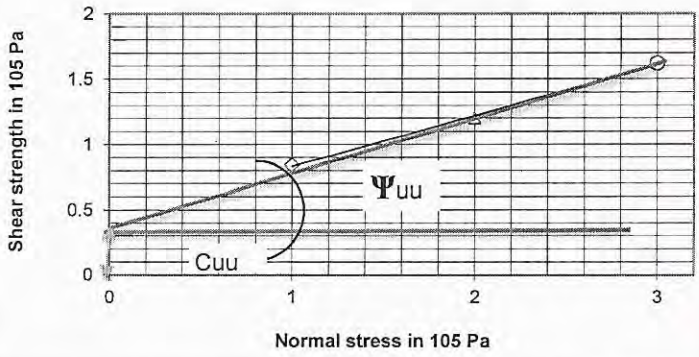
Shear test

Normal stress in 10^5 Pa	1	2	3
Shear strength in 10^5 Pa	0.84	1.2	1.62

γs 2.88

Cuu(105Pa)	0.44		
Ψ°	21.31		
γh(T/m3)	1.78	W(n)%	20.01





SIEVE ANALYSIS according to NF P 94-056

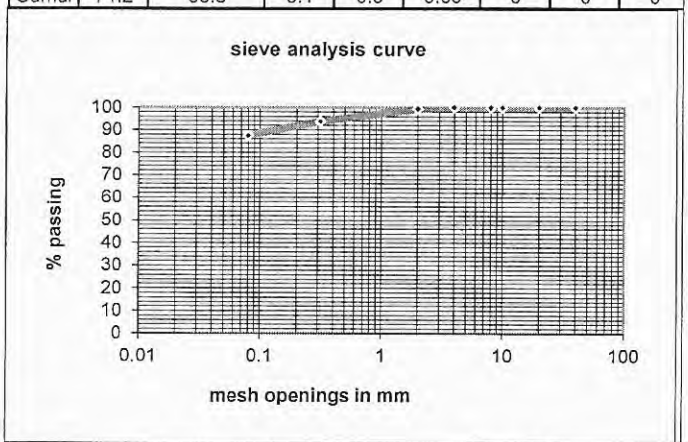
565.50

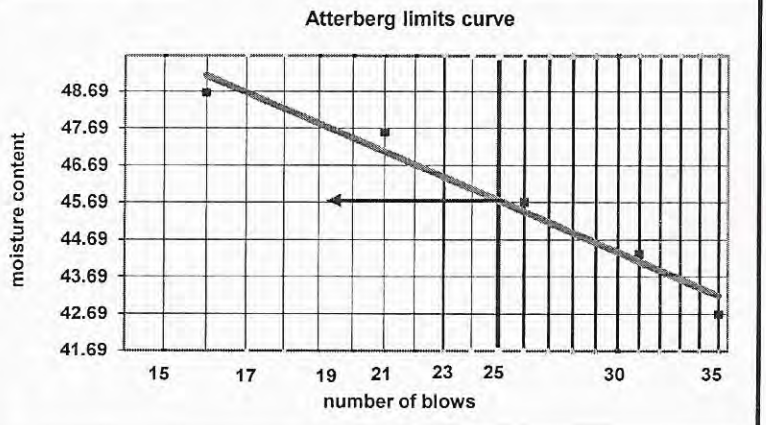
Dia	0.08	0.315	2	4	8	10	20	40
%	87.41	93.67	99.45	99.91	100.00	100	100	100
Cumul	71.2	35.8	3.1	0.5	0.00	0	0	0

LIQUID LIMITS "LL"

N		35	31	26	21	16
	41.69	1.544	1.491	1.415	1.322	1.204
W	49.65	42.69	44.30	45.69	47.58	48.65

PL		RESULT	
23.69	LL	45.74	
22.96	PL	23.87	
24.97	PI	21.86	





DATE	LABORATORY		REMARKS
	LAB TECHNICIAN	LAB MANAGER	
05-08-2017			

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ENGINEERING & LABORATORY

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IDENTIFICATION OF THE MATERIALS

CLIENT	PITRAD	Origin	AP 13 (GASOGI-MASAKA)
re of sample	Reddish silt	Depth	3.60-4.00
extraction date	7/23/2017	Testing Date	7/24/2017

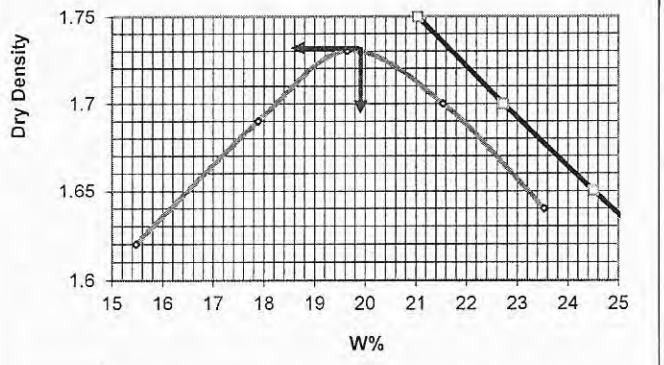
Modified proctor according to NF P 94-093 — MDD: 1.73 — OMC: 20.00

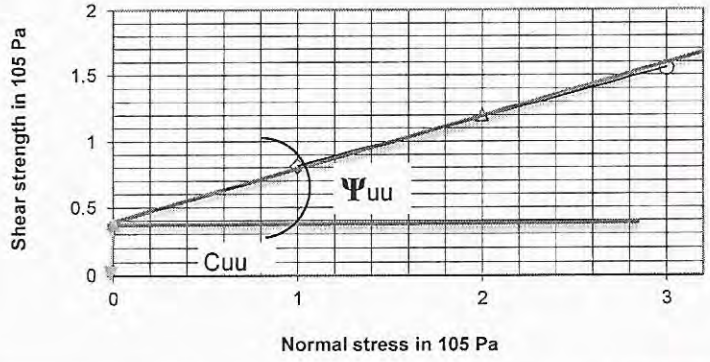
Blows number	5*56	5*56	5*56	5*56	5*56
$W_{\%}$	15.48	17.89	19.65	21.54	23.54
gd	1.62	1.69	1.73	1.70	1.64
SATURATION CURVE					
gd	1.75	1.7	1.65	1.6	1.55
w	21.04	22.72	24.5	26.4	28.42

Shear test according to NF P 94-071

Shear test	1	2	3
Normal stress in 10^5 Pa			
Shear strength in 10^5 Pa	0.81	1.2	1.55
γs	2.77		

Cuu(105Pa)	0.45		
Ψ°	20.30		
γh(T/m3)	1.70	W(n)%	20.64





SIEVE ANALYSIS according to NF P 94-056

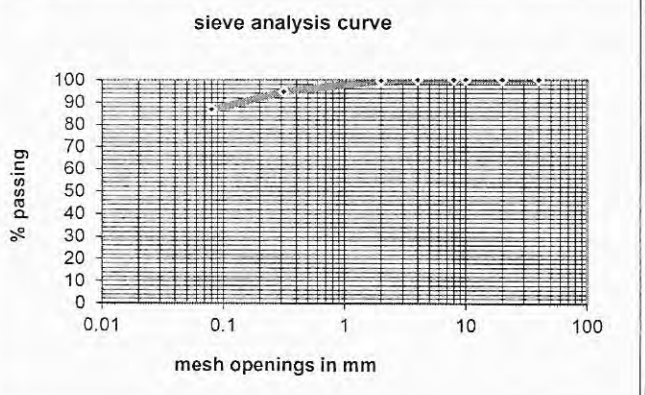
367.00

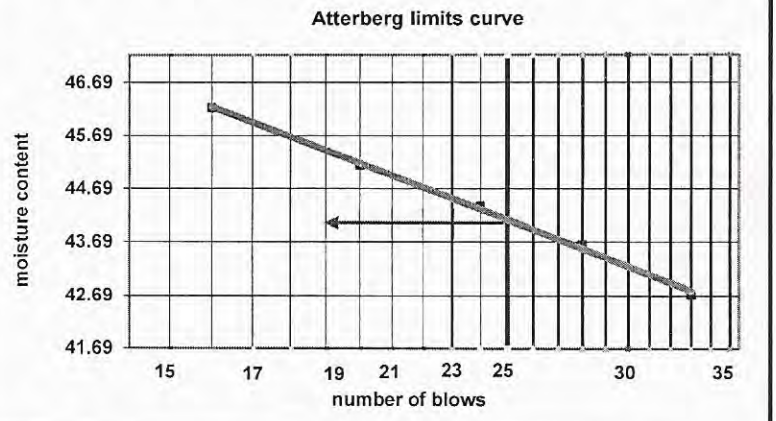
Dia	0.08	0.315	2	4	8	10	20	40
%	86.76	94.60	99.48	100	100	100	100	100
Cumul	48.6	19.8	1.9	0	0.00	0	0	0

LIQUID LIMITS "LL"

N		33	28	24	20	16
	41.69	1.519	1.447	1.380	1.301	1.204
W	47.21	42.69	43.64	44.37	45.13	46.21

PL		RESULT	
23.47	LL	44.10	
23.47	PL	23.37	
23.16	PI	20.74	





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