APPENDIX IV 地質及び材料

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IV – 1. GEOLOGIC LOG OF DRILL HOLE AND SKETCH OF TEST ADIT

	Name of Hole or Adit	Location	Length of Hole or Adit (m)	Sheet	Remarks
Core boring	DH-203	Julumito dam site	14.0	1	Left bank
	DH-204	Julumito dam site	14.0	2	Right bank
	DDH-1	Dike No. 1 site	20.0	3	
	DDH-2	Dike No. 2 site	23.0	4 - 5	
	DH-2	Headrace tunnel site	43.0	6 - 8	
	DH-3	Headrace tunnel site	35.0	9 - 10	
	DH-4	Powerhouse site	20.0	11	
	DH-1	Underground powerhouse site	160.0	12 - 18	Alternative plan (Plan B)
	DH-5	Quarry site	60.0	19 - 21	
Test adit	A-1	Julumito dam site	50.0	22	Left bank
	A-2	Julumito dam site	12.85	22	Left bank
	A-3	Julumito dam site	28.05	22	Right bank
	A-4	Julumito dam site	28.30	22	Right bank
	A-5	Julumito dam site	25.00	22	Left bank
	A-6	Julumito dam site	50.00	22	Right bank

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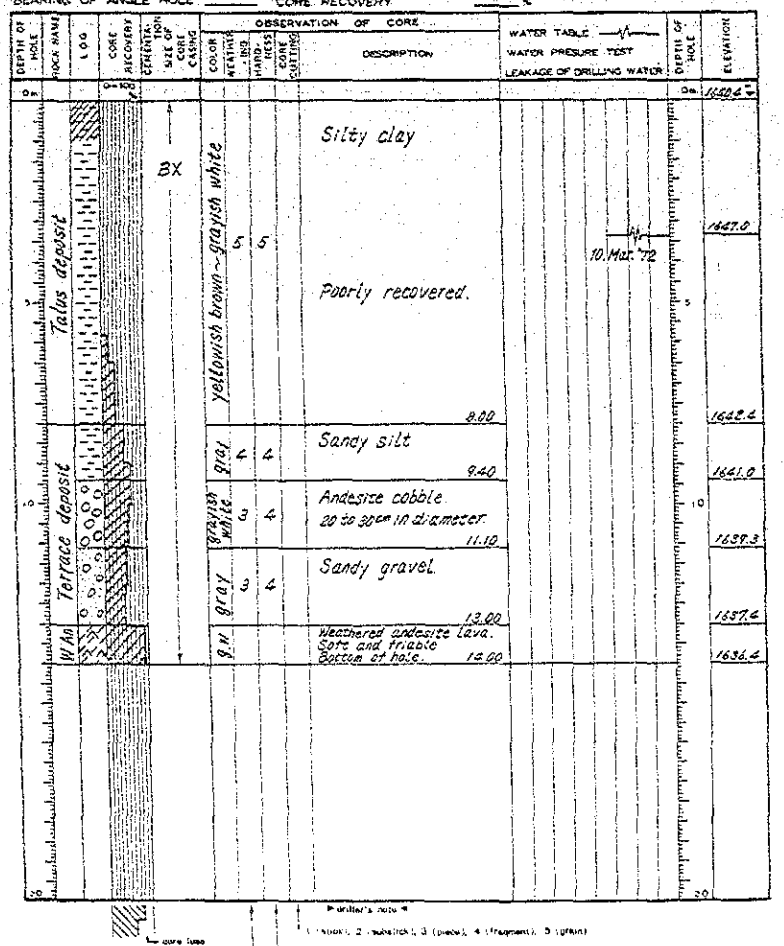
Sheet 1.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-203 (SHEET 1 OF 1)

LOCATION	Julumito Dam	DEPTH OF HOLE	14.00 m	COMMENCED	14-Oct-'70
ELEVATION	1650.37 m	DEPTH OF OVERBURDEN	m	COMPLETED	18-Oct-'70
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		



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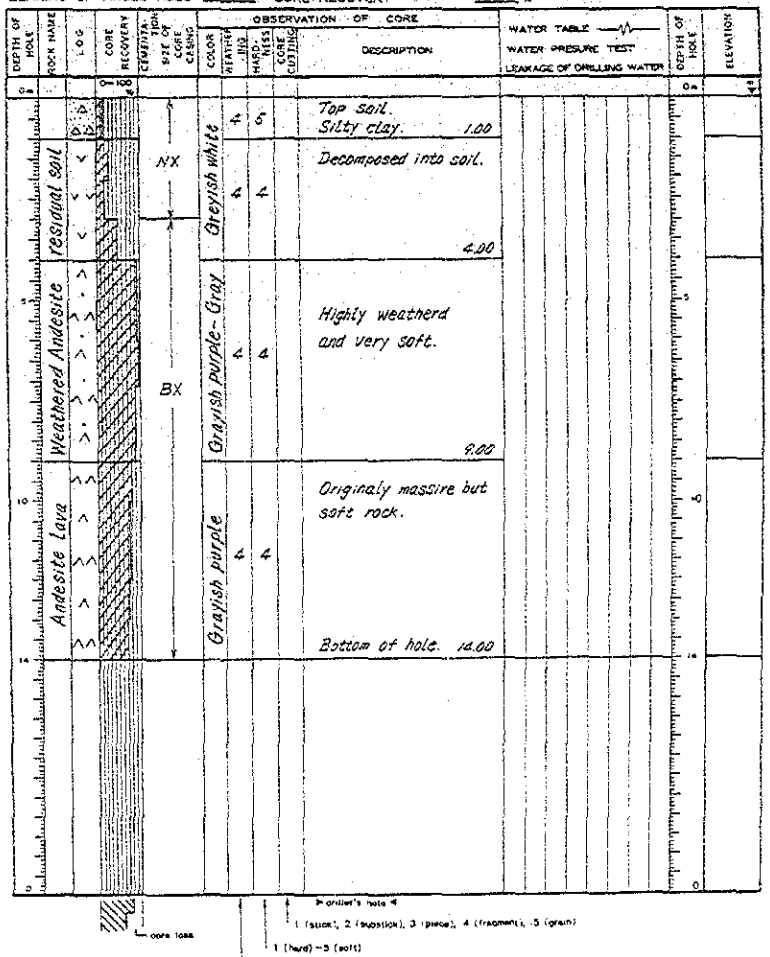
Sheet 2.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-204 (SHEET 1 OF 1)

LOCATION	Julumito Dam	DEPTH OF HOLE	14.00 m	COMMENCED	19-Oct-'70
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	21-Oct-'70
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		



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Sheet 3.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DDH-1 (SHEET 1 OF 1)

LOCATION	Dike NO1 Site	DEPTH OF HOLE	20.00 m	COMMENCED	31-Mar-'71
ELEVATION	1715.116 m	DEPTH OF OVERBURDEN	m	COMPLETED	7-Apr-'71
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
0			0–100 %									0	1715.1
	Silty clay					yellowish white	5	5		Silty clay ~ clay. Secondary deposits of Volcanic ash. 3.00			1712.1
	Sand					grayish white	4	5		Alluvial deposits. Sandy silt ~ Silty sand. 5.00		5	1710.1
	Silty sand						5	5		Poorly recovered. 10.00		10	1705.1
	Sand					grayish purple	5	5		Medium grained sand. 13.00			1702.1
	Silty sand					grayish white	5	5		Poorly recovered. 16.00		15	1699.1
										former surface soil 16.30			1698.8
	Volcanic ash					yellowish brown	5	5		Soft. Impervious deposits. Bottom of hole 20.00		20	1695.1

core loss

* driller's note *
1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (gram)
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

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Sheet 4.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DDH-2 (SHEET 1 OF 2)

LOCATION	Dike NO.2 Site	DEPTH OF HOLE	23.00 m	COMMENCED	16-Apr-'71
ELEVATION	1716.484 m	DEPTH OF OVERBURDEN	m	COMPLETED	26-Apr-'71
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
0			0–100 %									0	1716.5
	Volcanic ash					brown	5	5		Completely altered into clay mineral, with roots. 1.0			1715.5
						light brown ~ yellowish brown	4	5		very soft. Rock forming minerals alter into clay to silty clay. 11.0		5 10	1700.5
						brownish white	4	4		Silty clay. moderately compact.		15	
												20	1696.5

core loss

* driller's note *
1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (gram)
1 (hard) ~ 5 (soft)
1 (fresh) ~ 5 (decomposed)

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Sheet 5.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DDH-2 (SHEET 2 OF 2)

LOCATION	Dike NO. 2 Site	DEPTH OF HOLE	m	COMMENCED	– –
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	– –
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0–100 %)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
20m											20m	1696.5 m
	Volcanic Ash				milky white	4	5		Soft and clay.			
23									Bottom of hole. 23.00		23	1693.5
0											0	
0											0	

core loss

driller's note: 1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain); 1 (hard) – 5 (soft); 1 (fresh) – 5 (decomposed)

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Sheet 6.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-2 (SHEET 1 OF 3)

LOCATION	Headrace tunnel	DEPTH OF HOLE	43.00 m	COMMENCED	23-Oct-'70
ELEVATION	1,733.970 m	DEPTH OF OVERBURDEN	m	COMPLETED	27-Oct-'70
COORDINATE	X=767760 Y=1045850	LENGTH OF ROCK DRILLING	5.80 m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0–100 %)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
0m											0m	1734.0 m
									No core.			
5									5.00		5	1729.0
	Volcanic ash				light brown	4	4	5	Fine grained volcanic ash deposits. Containing much moisture as nearly 60%.			
10									12.70		10	1721.27
					light brownish white	4	5	5	Silty clay softer than upper layer. Homogeneous deposits.			
20											20	714.0

core loss

driller's note: 1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain); 1 (hard) – 5 (soft); 1 (fresh) – 5 (decomposed)

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Sheet 7.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-2 (SHEET 2 OF 3)

LOCATION	Headrace tunnel	DEPTH OF HOLE	m	COMMENCED	— —
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	— —
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
20m			0—100 %									20m	1714.0
	Volcanic ash					Light brownish white		4	5 5	Silt to clay nearly homogeneous deposits. Highly moisture contents and impermeable in situ. Not well consolidated and soft, friable and weak.			
										37.80			1696.77
	Andesite lava					Bluish grey	3	3	2 1	Some what soft due to weathering.			
										39.00			1695.0
40						Pale blue	2	2	1	Fresh and hard in general		40	1694.0

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

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Sheet 8.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-2 (SHEET 3 OF 3)

LOCATION	Headrace tunnel	DEPTH OF HOLE	m	COMMENCED	— —
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	— —
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
40m			0—100 %									40m	1694.0
	Andesite lava					Pale blue	2	2	1	Pale blue to bluish grey. Porphyritic structure. Mostly fresh and hard.			
										Bottom of hole 43.0		43	1691.0

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

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Sheet 9.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-3 (SHEET 1 OF 2)

LOCATION	Headrace tunnel	DEPTH OF HOLE	35.0 m	COMMENCED	– –
ELEVATION	1708.079 m	DEPTH OF OVERBURDEN	6.0 m	COMPLETED	– –
COORDINATE	X-767865 Y-1045165	LENGTH OF ROCK DRILLING	29.0 m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
0m			0–100 %									0m	1708.1
5	Volcanic ash					Light brownish white	4	4	5	Homogeneous deposits. silty clay, soft and weak.		5	
										5.70			
							4	4	5	White 6.00			1702.1
10	Andesite lava									Massive, dense and hard 30~50cm long in cleft interval. Good for materials of rockfill.		10	
						bluish gray	2	2	2 / 1				
15												15	
20												20	1688.1

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

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Sheet 10.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-3 (SHEET 2 OF 2)

LOCATION	Headrace tunnel	DEPTH OF HOLE	m	COMMENCED	– –
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	– –
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
20m			0–100 %									20m	1685.7
25	Andesite lava					bluish gray	2	2	2 / 1	Very suitable for rock materials of rockfill. Remarkable columner joints. (0.8 to 2.0m apart) are observed at this horizon of outcrops.		25	
										28.80			1679.2
30						greenish gray	3	3	2	Slightly weathered and soft.		30	
										31.50			1676.5
						bluish gray	2	2	2 / 1	Existing porphyritic textures and remarkable feldsper phenocrysts.			
35										Bottom of hole. 35.00		35	1673.079
40												40	

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

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Sheet 11.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-4 (SHEET 1 OF 1)

LOCATION	Powerhouse Site	DEPTH OF HOLE	20 m	COMMENCED	– –
ELEVATION	1585.660 m	DEPTH OF OVERBURDEN	14.70 m	COMPLETED	– –
COORDINATE	X-767830 Y-1044560	LENGTH OF ROCK DRILLING	5.30 m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CONTINUATION	SIZE OF CORE CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
0m			0–100 %									0m	1585.7
	Talus deposit					Light brown	4	4		Consisting of rubble debris of dacitic andesite and dacitic tuff breccia, 3 to 20cm in size. Brown sandy silt fills up the space of rubble and debris as matrix. 6.00		5	
						Light grayish blue	4	4		Big blocks of tuff breccia. 8.30			
						Light brown	4	4		9.50			1576.2
10	Gravel					Light brown	4	4		Consisting of sand and pebbly gravel in general and boulder gravel in part. 14.70		10	1571.0
	Tuff breccia					grayish green	3	3	3	Slightly weathered. Somewhat soft and friable.		5	
20						pale green	2	3	2	Almost hard and fresh. Bottom of hole 20.00		20	1565.7

core loss

* driller's note *
1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)
1 (hard) – 5 (soft)
1 (fresh) – 5 (decomposed)

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Sheet 12.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-1 (SHEET 1 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	– –
ELEVATION	1728.620 m	DEPTH OF OVERBURDEN	m	COMPLETED	– –
COORDINATE	X-767830 Y-1046370	LENGTH OF ROCK DRILLING	127.00 m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CONTINUATION	SIZE OF CORE CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
20m			0–100 %									20m	1708.6
	Volcanic ash					milky white	5		4 5	Silty clay, soft and loose. 25.45		5	1703.2
	Weathered andesite					brownish white	5 4	4	4 3	Rock appears massive but very soft and most of rock forming minerals are highly altered to clay minerals due to complete weathering. Boundary is very clear but weathered. 33.00		30	1695.6
	Andesite lava					bluish gray	2	2	2 1	Porphyritic structure is slightly recognized. Rock is homogeneous and is endowed with good quality for material of Rock fill. Especially fresh parts, are seemed to be usable for concrete aggregate		5	
40												40	1688.6

core loss

* driller's note *
1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)
1 (hard) – 5 (soft)
1 (fresh) – 5 (decomposed)

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Sheet 13.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 1 (SHEET 2 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0-100 %)	CEMENTATION	SIZE OF CORE CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
40m												40m	1688.6
	Andesite lava					bluish gray	2	2	2 ~ 1	Massive, dense and hard. 44.00			1684.6
5						brownish gray	3	3	2 ~ 3	Many irregular stained cracks indicate the marks of groundwater passage. Somewhat weathered and friable. 53.00		5	1675.6
50						bluish gray	2	2	2 ~ 1	Generally fresh and hard. Sustaining open cracks.		50	
60												60	1668.6

core loss

driller's note: 1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain); 1 (hard) ~ 5 (soft); 1 (fresh) ~ 5 (decomposed)

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Sheet 14.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 1 (SHEET 3 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0-100 %)	CEMENTATION	SIZE OF CORE CASING	COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
50m												50m	1668.6
	Andesite lava					bluish gray	2	2	2 ~ 1	Fresh and hard in general. Sustaining many irregular cracks with stained surface. Many cracks indicate the marks of groundwater passage. 70.0		5	1658.6
70						gray	2	3	2	Agglomeratic andesite. 71.0		70	1657.6
	Andesite lava					bluish gray	2	2	1 ~ 2	Hard, dense and few cracks; good for rock material.		5	
80												80	1648.6

core loss

driller's note: 1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain); 1 (hard) ~ 5 (soft); 1 (fresh) ~ 5 (decomposed)

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Sheet 15.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 1 (SHEET 4 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	— —
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	— —
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
80m			0–100 %									80m	1728.6
5	Andesite lava					bluish gray	1	2	3	Hard and dense with many irregular cracks. Lithologically, it differs from the layer below than 91.0 m		5	
							2						
										89.0			1639.6
90						grayish purple	2	3	1	Core is soft and easily parted by hands from remarkable flow structure		90	
							3		2	91.0			1637.6
	Weathered andesite lava					purplish white	3	4	2	Massive but friable due to string weathering			
							4			95.0		5	1633.6
	Andesite lava					purplish white	3	3	4				
										97.5			1631.1
100						purplish white	3	3	3				
							2		4			10.0	1628.6

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

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Sheet 16.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 1 (SHEET 5 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	— —
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	— —
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY	CEMENTATION	SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
100m			0–100 %									100m	1628.6
5	Andesite lava					grayish purple	2	2	1	Hard, dense and few cracks. Containing automorphic quartz and biotite. it assumed to be plagioclase-liparite. in petrography.		5	
									2				
110												110	
										115.0			1613.6
						purplish white	4	4	3	Weathered and soft			
									4				
										118.5			1610.1
120	Tuff						4	4	5			12.0	1608.6

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

OVERSEAS TECHNICAL COOPERATION AGENCY, JAPAN

Sheet 17.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 1 (SHEET 6 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0~100 %)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
120m											120m	1608.6 m
	Tuff				purplish white	4	4	5	In cluding automorphic biotite. Alterd into clay minerals and soft.			1605.6
5	Andesite lava				light grayish purple	3 ~ 4	3 ~ 4	4	Highly weathered and altered into clay minerals in part, because of being former ground surface of lava flow. Not usable as materials of rockfill. Sustaining many cracks. 5~20cm apart.		5	1597.5
150	Andesite lava				reddish purple	2	3 ~ 2	3	Platy jointing. Hard in general but including friable portions. Questionable for use of materials of rockfill.		5	1590.6
160	Andesite				light gray	3	3 ~ 4	4	Weatherd and friable		140	1588.6

core loss

driller's note

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
TOKYO, JAPAN

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Sheet 18.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 1 (SHEET 7 OF 7)

LOCATION	Underground P.H.	DEPTH OF HOLE	160.00 m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0~100 %)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
140m											140m	1588.6 m
	Andesite lava				reddish purple	2	3 ~ 4	4	Including phenocrysts of feldsper, biotite and quartz. The rock is similar to plagioclase-liparite 143.0			1585.6
5	Sandy tuff				milky gray	4	4	4	Highly altered into clay minerals. Very soft. 146.0		5	1582.6
150	Silty tuff				light gray ~ white	4	4	4 ~ 2	Massive but soft, easily broken by hands. 155.0		150	1573.6
5						4	4	2	Tuff breccia. 154.5		5	1573.1
	Sandy tuff				milky white	4	4	2 ~ 3	Soft, and altered into clay.			1571.1
160	Tuff breccia				bluish gray	4	4	1 ~ 2	Massive but friable in part. Including block and lapilli. Bottom of hole 160.0		160	1568.6

core loss

driller's note

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

ELECTRIC POWER DEVELOPMENT CO., LTD.
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Sheet 19.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-5 (SHEET 1 OF 3)

LOCATION	Qaurry Site	DEPTH OF HOLE	60.00 m	COMMENCED	2-Mar-'71
ELEVATION	1745.160 m	DEPTH OF OVERBURDEN	m	COMPLETED	12-Mar-'71
COORDINATE	X-767000 Y-1045700	LENGTH OF ROCK DRILLING	21.00 m	DRILLED BY	
ANGLE FROM HORIZONTAL	90°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0–100 %)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
0m											0m	1745.2 m
	Top soil				black	4	5	5	Poor recoverly. Silty clay. 1.5			1743.7
	Weathered ash				light brown	4	5	5	Altered into soil. 5.0			1740.2
5	Volcanic ash					4	5	5	Silty clay. 6.4		5	1738.8
10					pale brown	4	5	5	Tuffaceous clay. Soft. 15.0		10	
15					light brown~whitish brown	4	5	5	Massive silty clay. Soft.		15	1730.2
20											20	1725.2

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) – 5 (soft)

1 (fresh) – 5 (decomposed)

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Sheet 20.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH-5 (SHEET 2 OF 3)

LOCATION	Qaurry Site	DEPTH OF HOLE	m	COMMENCED	– –
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	– –
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0–100 %)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
20m											20m	1725.2 m
	Volcanic ash				whitish brown	4	5	5	Clayey and soft. 23.0			1722.2
						5	5	5	Blackish brown, including carbonaceous material. 23.5			1721.7
5					whitish brown	5	5	5	Silty clay. Very soft. 29.0		5	1716.2
30					milky white	5	5	5	clay. 32.0		30	1713.2
5					brownish white	5	5	4	Silty clay. 39.0		5	1706.2
40					b.w				former residual soil of andesite lava.		40	1705.2

core loss

▶ driller's note ◀

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) – 5 (soft)

1 (fresh) – 5 (decomposed)

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Sheet 21.

GEOLOGIC LOG OF DRILL HOLE

JULUMITO PROJECT. HOLE NO. DH - 5 (SHEET 3 OF 3)

LOCATION	Qaurry Site	DEPTH OF HOLE	m	COMMENCED	- -
ELEVATION	m	DEPTH OF OVERBURDEN	m	COMPLETED	- -
COORDINATE		LENGTH OF ROCK DRILLING	m	DRILLED BY	
ANGLE FROM HORIZONTAL	°	TOTAL LENGTH OF CORE	m	LOGGED BY	
BEARING OF ANGLE HOLE		CORE RECOVERY	%		

DEPTH OF HOLE	ROCK NAME	LOG	CORE RECOVERY (0~100%)	CEMENTATION SIZE OF CORE CASING	OBSERVATION OF CORE: COLOR	WEATHERING	HARDNESS	CORE CUTTING	DESCRIPTION	WATER TABLE / WATER PRESURE TEST / LEAKAGE OF DRILLING WATER	DEPTH OF HOLE	ELEVATION
40 m											40 m	1705.2 m
	Residual soil of andesite				yellowish white	4	4	4	Decomposed into sandy silt. 45.0		5	1700.2
50	Weathered anesite				grayish white	4	4	4	Rock appears massive, but can be easily crushed. 51.0		50	1694.2
5	Andesite Lava				grayish white ~ pale purplish white	3	4 ~ 3	3	Containing remarkable phenocrysts of biotite. Rock resembles rhyolite. Soft and easily broken by hammer blow. Not suitable for material of rockfill but usable for filter material.		5	
60									Bottom of hole. 60.0		60	1785.2

core loss

driller's note

1 (stick), 2 (substick), 3 (piece), 4 (fragment), 5 (grain)

1 (hard) ~ 5 (soft)

1 (fresh) ~ 5 (decomposed)

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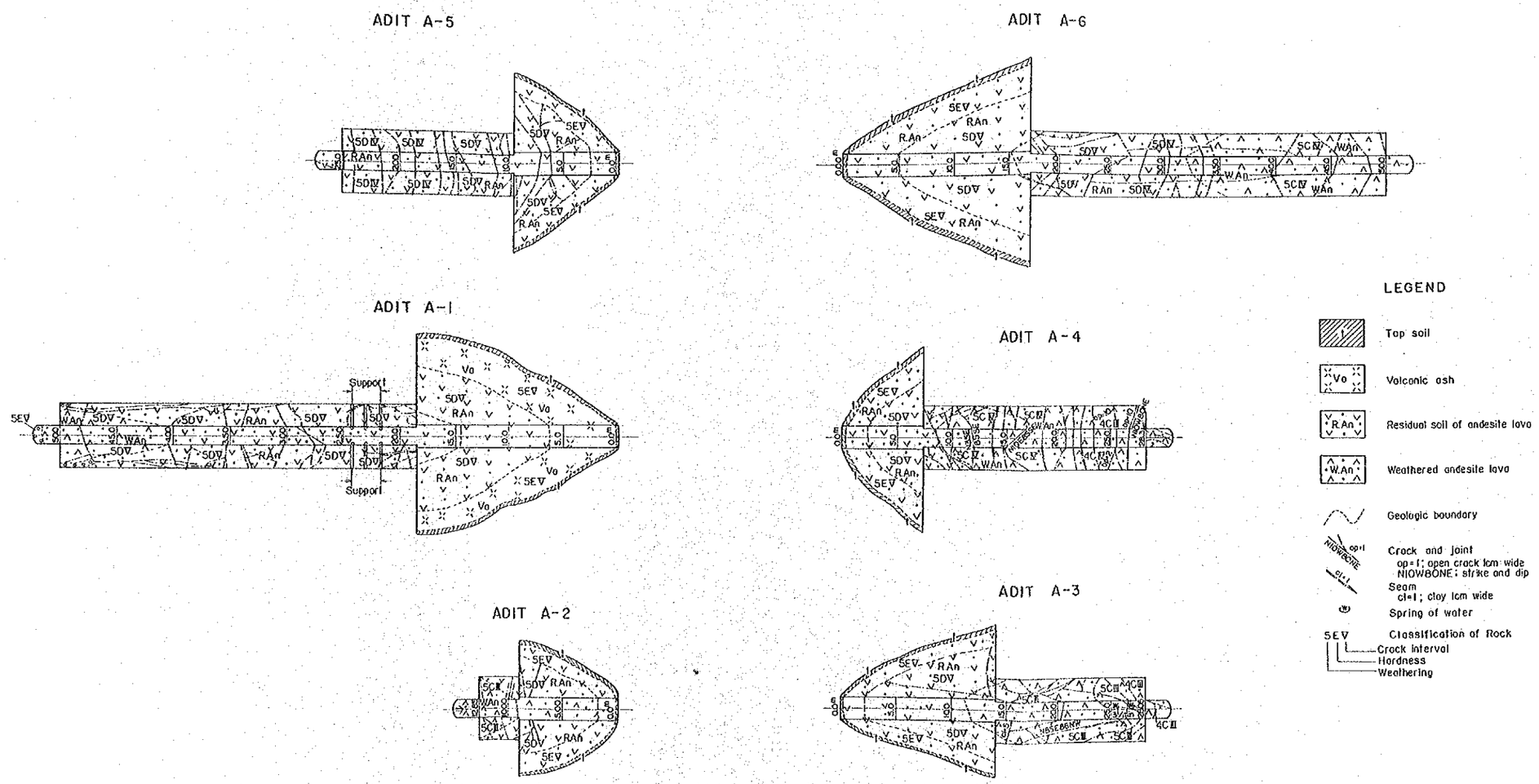
SKETCH OF TEST ADIT AT DAM SITE

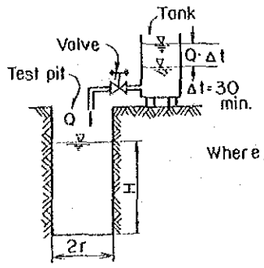


CLASSIFICATION OF ROCK CHARACTER IN FIELD

	WEATHERING		HARDNESS		CRACK INTERVAL
S	The rock forming minerals and grains are completely deteriorated and discolored, and rock is remarkably weathered and loosened	E	The rock can be easily excavated with a hammer tip and easily broken with fingers and can be scratched by fingernail.	V	Cracks and joints are spaced less than 5cm apart
4	Almost rock forming minerals and grains excluding quartz are slightly softend and altered. Somewhere, unweathered parts are remained as block or gravel in weathered parts	D	The rock is easily broken by blow of hammer. Sometimes snapped off by hands or can be whittled with a knife.	IV	Cracks and joints are spaced 5 to 20cm apart
3	The rock forming minerals and grains are slightly softend and altered. Most of cracks, sometimes rock itself are stained by limonite etc. and some cracks are filled by clay materials.	C	The rock is broken by blow of hammer into small pieces to fragment with some amount of rock dust and powder.	III	Cracks and joints are spaced 20 to 40cm apart
2	The rock forming minerals and grains are partially sustained with slight weathering and deterioration. Some of cracks are slightly stained but locked clayey materials.	B	The rock is broken by strong blow of hammer into pieces to fragments with some amount of rock powder.	II	Cracks and joints are spaced 40 to 100cm apart
1	The rock is very fresh, and the rock forming minerals and graines are neither weathered nor deteriorated.	A	The rock is broken by strong blow of hammer into sharp edged pieces or fragments with sharp fractures.	I	Cracks and joints are spaced more than 100cm apart

IV-2 FIELD PERMEABILITY TEST

Field Permeability Test (Sheet 1 of 3)



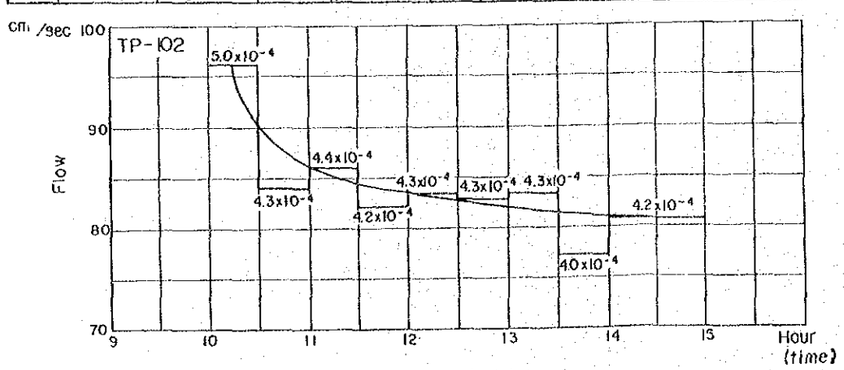
Computation for percolation rate

$$K = \frac{Q}{2\pi H^3}\left[H \cdot \mathrm{Loge}\left\{\frac{H}{r}+\sqrt{1+\left(\frac{H}{r}\right)^2}\right\}-\sqrt{r^2+H^2}+r\right]$$

Where, K = Coefficient of permeability (cm/sec)
H = Effective he (constant = 170cm)
Y = Radius of pit (constant = 50cm)
Q = Flow into pit (cm3/sec)

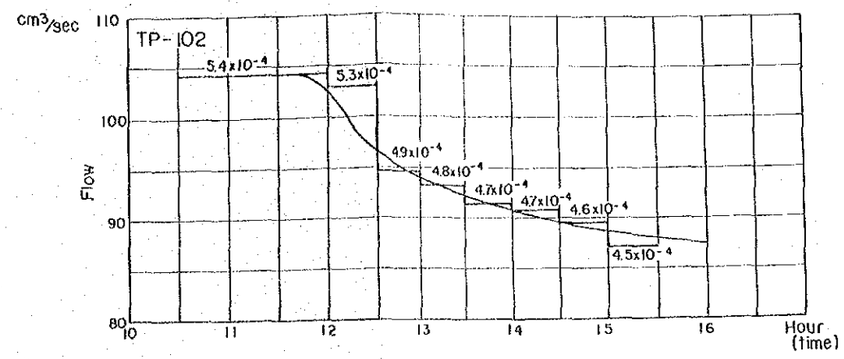
Locality : TP-102. Depth 3m, Date Oct. 5, '70

Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)
10:00				13:00	149.1	82.83	4.3×10^{-4}
30	173.0	96.11	5.0×10^{-4}	30	150.2	83.44	4.3×10^{-4}
11:00	151.3	84.06	4.3×10^{-4}	14:00	139.2	77.33	4.0×10^{-4}
30	154.7	85.94	4.4×10^{-4}	30	145.5	80.83	4.2×10^{-4}
12:00	148.0	82.22	4.2×10^{-4}	15:00	145.5	80.83	4.2×10^{-4}
30	150.2	83.44	4.3×10^{-4}				



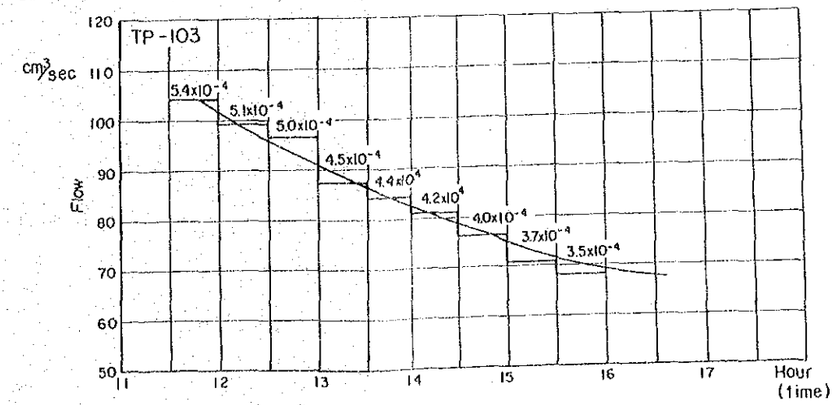
Locality : TP-102. Depth 3m, Date Sept. 30, '70

Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)
10:30				13:30	168.0	93.33	4.8×10^{-4}
11:00	188.0	104.44	5.4×10^{-4}	14:00	164.7	91.50	4.7×10^{-4}
30	188.0	104.44	5.4×10^{-4}	30	163.6	90.88	4.7×10^{-4}
12:00	188.0	104.44	5.4×10^{-4}	15:00	161.4	89.66	4.6×10^{-4}
30	185.5	103.05	5.3×10^{-4}	30	156.9	87.16	4.5×10^{-4}
13:00	170.5	94.72	4.9×10^{-4}				



Locality : TP-103. Depth 3m, Date Oct. 2, '70

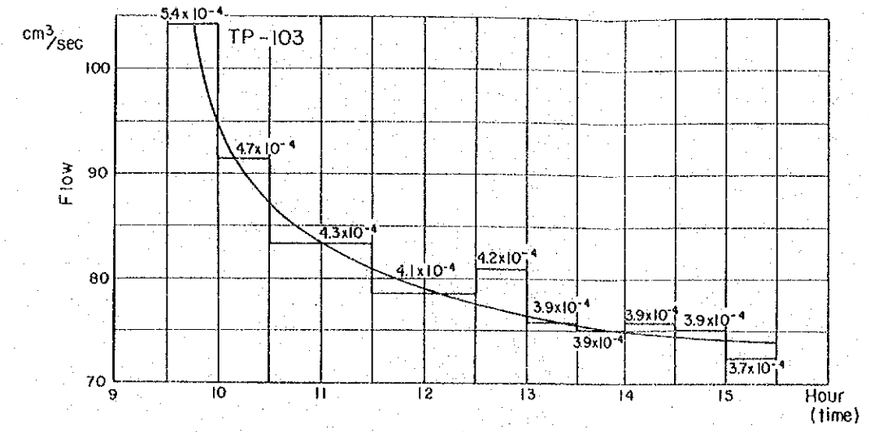
Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)
11:30				14:00	152.5	84.72	4.4×10^{-4}
12:00	188.0	104.44	5.4×10^{-4}	30	146.0	81.11	4.2×10^{-4}
30	179.0	99.44	5.1×10^{-4}	15:00	138.0	76.66	4.0×10^{-4}
13:00	174.2	96.77	5.0×10^{-4}	30	128.0	71.11	3.7×10^{-4}
30	156.9	87.16	4.5×10^{-4}	16:00	123.0	68.33	3.5×10^{-4}



Locality : TP-103. Depth 3m, Date Oct. 3, '70

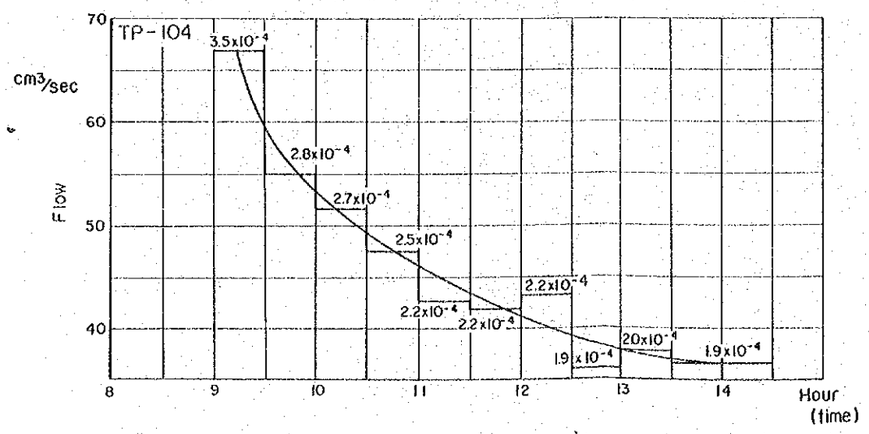
Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(l/30min)	Flow Q(cm3/sec)	Coefficient of permeability (K)
9:30				13:00	146.0	81.11	4.2×10^{-4}
10:00	188.0	104.44	5.4×10^{-4}	30	136.7	75.94	3.9×10^{-4}
30	164.7	91.50	4.7×10^{-4}	14:00	135.5	75.27	3.9×10^{-4}
11:00	150.2	83.44	4.3×10^{-4}	30	136.7	75.94	3.9×10^{-4}
30	150.2	83.44	4.3×10^{-4}	15:00	135.5	75.27	3.9×10^{-4}
12:00	141.7	78.72	4.1×10^{-4}	30	130.5	72.50	3.7×10^{-4}
30	141.7	78.72	4.1×10^{-4}				

Field Permeability Test (Sheet 2 of 3)



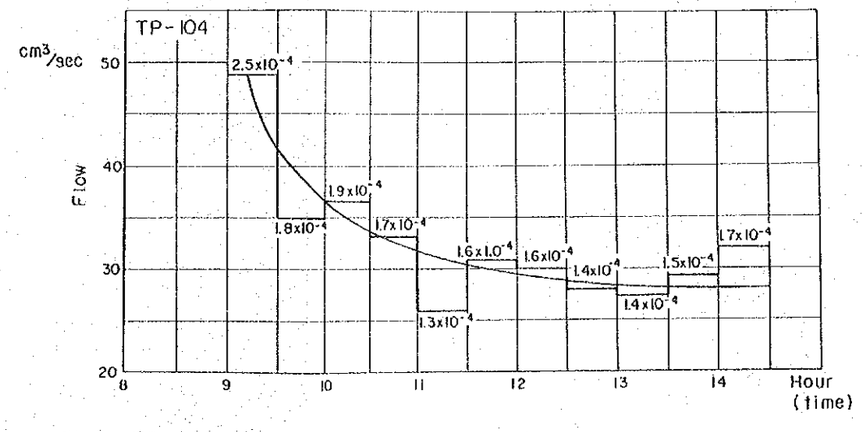
Locality : TP-104 Depth 3m Date Oct. 1, '70

Hour	Flow Q·Δt(1/30min)	Q(cm³/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(1/30min)	Q(cm³/sec)	Coefficient of permeability (K)
9:00				12:00	75.5	41.94	2.2×10^{-4}
30	120.5	66.94	3.5×10^{-4}	30	78.0	43.33	2.2×10^{-4}
10:00	99.0	55.00	2.8×10^{-4}	13:00	65.0	36.11	1.9×10^{-4}
30	93.0	51.66	2.7×10^{-4}	30	68.0	37.78	2.0×10^{-4}
11:00	85.5	47.50	2.5×10^{-4}	14:00	66.0	36.67	1.9×10^{-4}
30	76.8	42.67	2.2×10^{-4}	30	66.0	36.67	1.9×10^{-4}



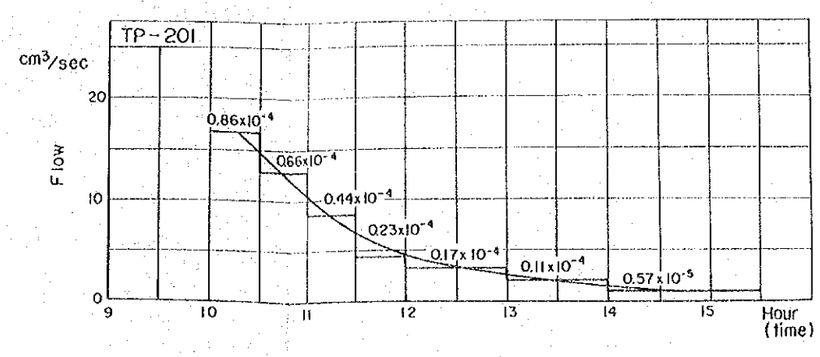
Locality : TP-104 Depth 3m, Date Oct. 6, '70

Hour	Flow Q·Δt(1/30min)	Q(cm³/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(1/30min)	Q(cm³/sec)	Coefficient of permeability (K)
9:00				12:00	55.5	30.83	1.6×10^{-4}
30	88.0	48.89	2.5×10^{-4}	30	54.3	30.17	1.6×10^{-4}
10:00	63.0	35.00	1.8×10^{-4}	13:00	50.5	28.06	1.4×10^{-4}
30	66.0	36.67	1.9×10^{-4}	30	49.3	27.39	1.4×10^{-4}
11:00	60.0	33.33	1.7×10^{-4}	14:00	53.0	29.44	1.5×10^{-4}
30	46.8	26.00	1.3×10^{-4}	30	58.0	32.22	1.7×10^{-4}



Locality : TP-201 Depth 3m, Date Sept. 13, '70

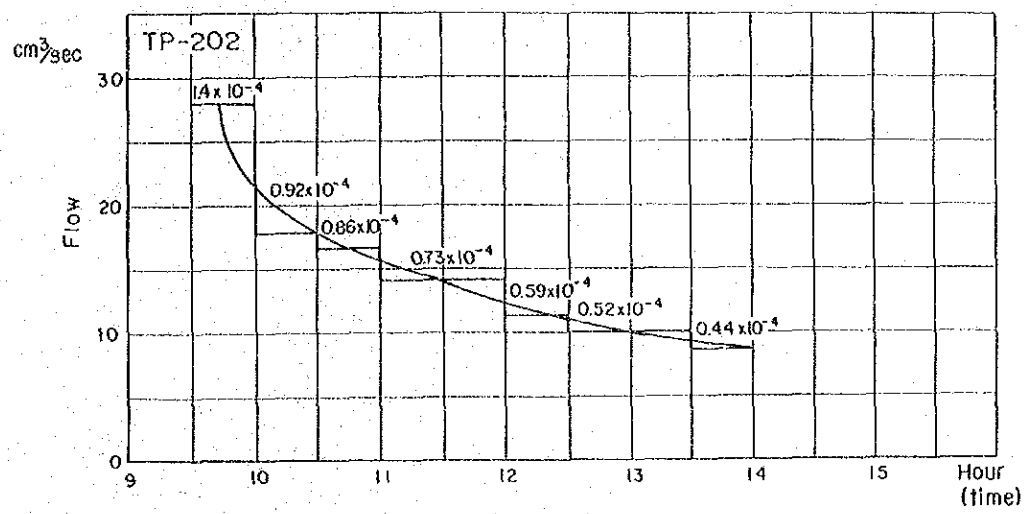
Hour	Flow Q·Δt(1/30min)	Q(cm³/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(1/30min)	Q(cm³/sec)	Coefficient of permeability (K)
10:00				13:00	6.0	3.33	0.17×10^{-4}
30	30.0	16.67	0.86×10^{-4}	30	4.0	2.22	0.11×10^{-4}
11:00	23.0	12.78	0.66×10^{-4}	14:00	4.0	2.22	0.11×10^{-4}
30	15.5	8.61	0.44×10^{-4}	30	2.0	1.11	0.57×10^{-5}
12:00	8.0	4.44	0.23×10^{-4}	15:00	2.0	1.11	0.57×10^{-5}
30	6.0	3.33	0.17×10^{-4}	30	2.0	1.11	0.57×10^{-5}



Field Permeability Test (Sheet 3 of 3)

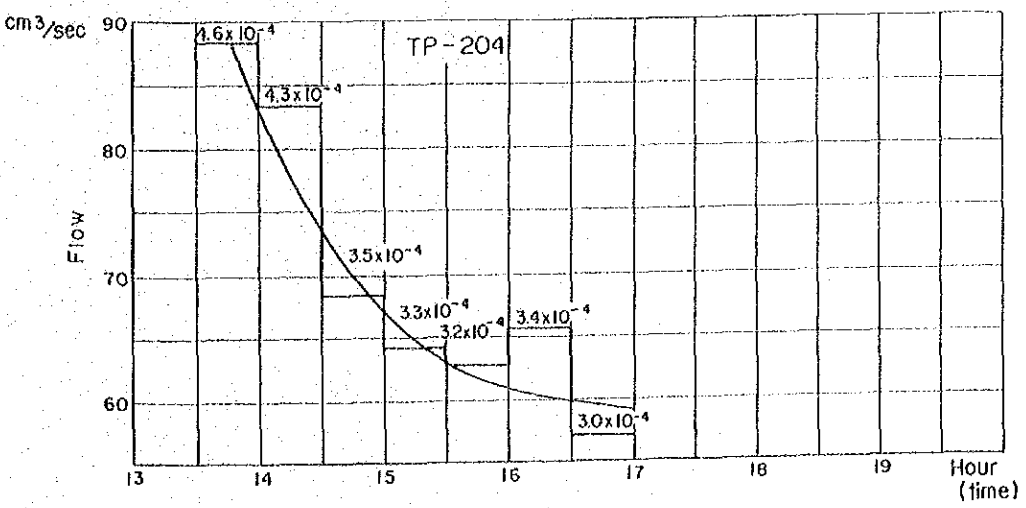
Locality : TP - 202. Depth 3m, Date Aug. 28,'70

Hour	Flow Q·Δt(l/30min)	Flow Q(cm³/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(l/30min)	Flow Q(cm³/sec)	Coefficient of permeability (K)
9:30				12:00	25.5	14.17	0.73×10^{-4}
10:00	50.5	28.06	1.4×10^{-4}	30	20.5	11.39	0.59×10^{-4}
30	32.0	17.78	0.92×10^{-4}	13:00	18.0	10.00	0.52×10^{-4}
11:00	30.0	16.67	0.86×10^{-4}	30	18.0	10.00	0.52×10^{-4}
30	25.5	14.17	0.73×10^{-4}	14:00	15.5	8.61	0.44×10^{-4}



Locality : TP-204. Depth 3m, Date Aug. 23,'70

Hour	Flow Q·Δt(l/30min)	Flow Q(cm³/sec)	Coefficient of permeability (K)	Hour	Flow Q·Δt(l/30min)	Flow Q(cm³/sec)	Coefficient of permeability (K)
13:30				15:30	115.5	64.17	3.3×10^{-4}
14:00	159.2	88.44	4.6×10^{-4}	16:00	113.0	62.78	3.2×10^{-4}
30	150.2	83.44	4.3×10^{-4}	30	118.0	65.56	3.4×10^{-4}
15:00	123.0	68.33	3.5×10^{-4}	17:00	103.0	57.22	3.0×10^{-4}



IV-3 PETROGRAPHIC DESCRIPTION

Petrographic description and photomicrograph of thin section of rock (plate 1 of 5)

Locality;
Drill hole DH-1
at 65 m deep

Specimen number in laboratory test;
No. 2

Rock name;
Andesite
(Plagioclase-liparite)

(crossed nicols, X76)

Petrographic description;

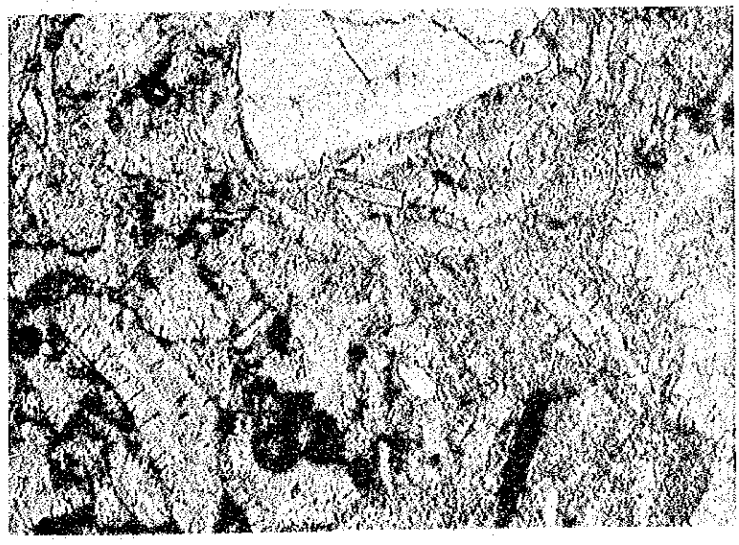
The phenocrysts are mostly composed of idiomorphic-hypidiomorphic plagioclase (oligoclase). It is twined but is not zoned. A little amount of euhedral quartz is present. Brown biotite is seen.

These are also seen as the microphenocrysts. The groundmass consists of glass and the spherules. Among the latter, the well-shaped and distorted ones are present and show the intergrowth of quartz-feldspathic mineral and glass as like as the micrographic texture. The accessory minerals are magnetite and zircon. The specimen is fresh.

Locality;
Drill hole DH-1
at 83 m deep.

Specimen number in laboratory test;
No. 3

Rock name;
Andesite
(Plagioclase-liparite)



(open nicols, X76)

Petrographic description;

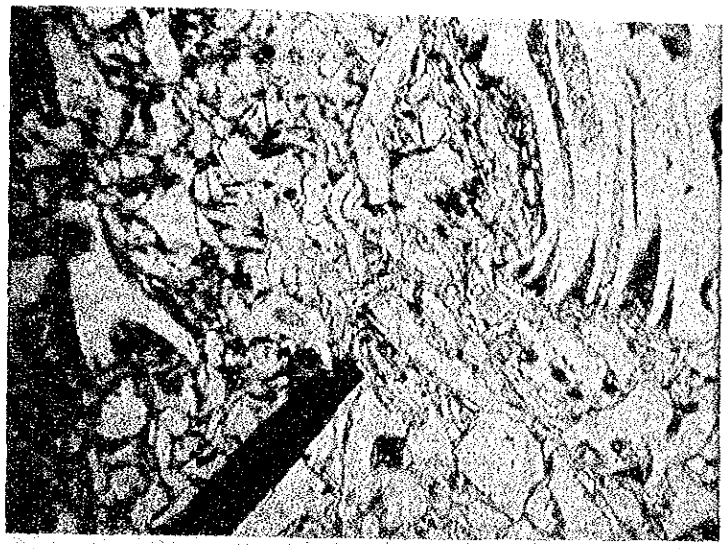
This specimen is completely the same to the specimen taken at the depth of No. DH1-3 in composition and texture. However, it is somewhat weathered and fine streaks or veins of 0.02 to 0.03 mm wide consisting of amorphous hydroxide of iron and amorphous silica are seen. A small xenolith (0.2 to 0.3 mm) of altered andesite is recognized.

Petrographic description and photomicrograph of thin section of rock (plate 2 of 5)

Locality;
Drill hole DH-1
at 98 m deep.

Specimen number in laboratory test;
No. 4

Rock name;
Andesite
(Plagioclase-liparite)



(open nicols, X76)

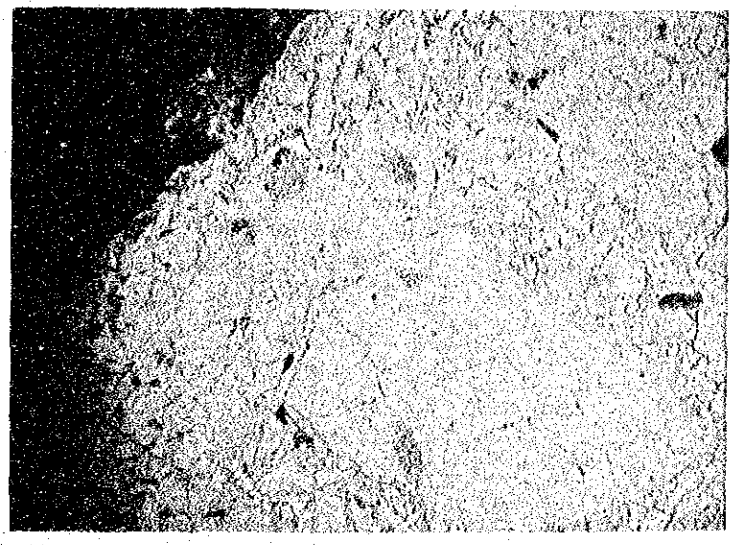
Petrographic description;

The phenocrysts are mostly composed of plagioclase (oligoclase). It is twined but is not zoned. Quartz, brown biotite and magnetite are present. These are seen also as the microphenocrysts. The groundmass is composed of glass of which texture is fluidal and partly shows pumice structure. Accessory mineral is zircon. Small xenoliths of siltstone and altered andesite are seen. The specimen is fresh.

Locality;
Drill hole DH-1
at 135 m deep.

Specimen number in laboratory test;
No. 6

Rock name;
Andesite
(Plagioclase-liparite)



(open nicols, X76)

Petrographic description;

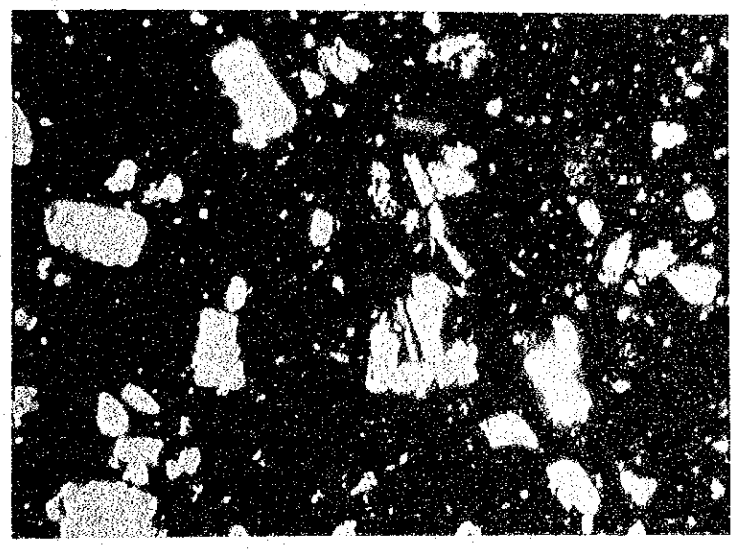
The phenocrysts are mostly plagioclase (oligoclase). It is fresh and it twined. Zonal structure is not seen. Brown biotite is present, but quartz is scarce. Except plagioclase and biotite little amounts of augite, hypersthene, quartz, hornblende and magnetite are present as the microphenocrysts. The groundmass is glass of which texture is fluidal and partly shows pumice-like structure. Accessory mineral is zircon. Fine veins of quartz and magnetite are developed with the amorphous silica aureole of 0.02 to 0.05 mm wide. There are small xenoliths of altered andesite, dacite, chalcedony-like material and spherule.

Petrographic description and photomicrograph of thin section of rock (plate 3 of 5)

Locality;
Drill hole, DH-1.
at 150 m deep.

Specimen number in laboratory test;
No. 7

Rock name;
Liparitic tuff ?



(crossed nicols, X76)

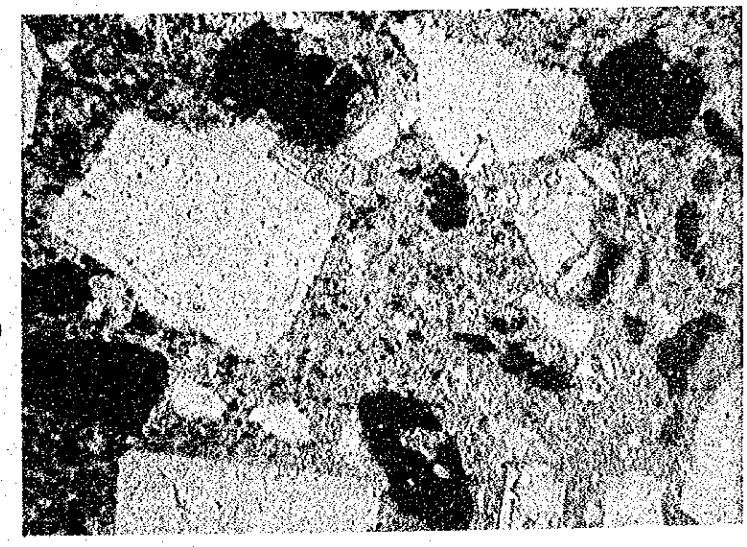
Petrographic description;

This is composed of the minerals such as plagioclase, quartz, biotite, magnetite, etc. and the matrix consisting of glass and fine dusty materials. Plagioclase (oligoclase) and less amount of quartz are xenomorphic and subangular. Almost all of the biotite is slightly altered. There is no reliable evidence of tuff, but no evidence of lava.

Locality;
Drill hole, DH-1
at 158 m deep.

Specimen number in laboratory test;
No. 8

Rock name;
Tuff breccia.
(Hornblend-andesite)



(open nicols, X76)

Petrographic description;

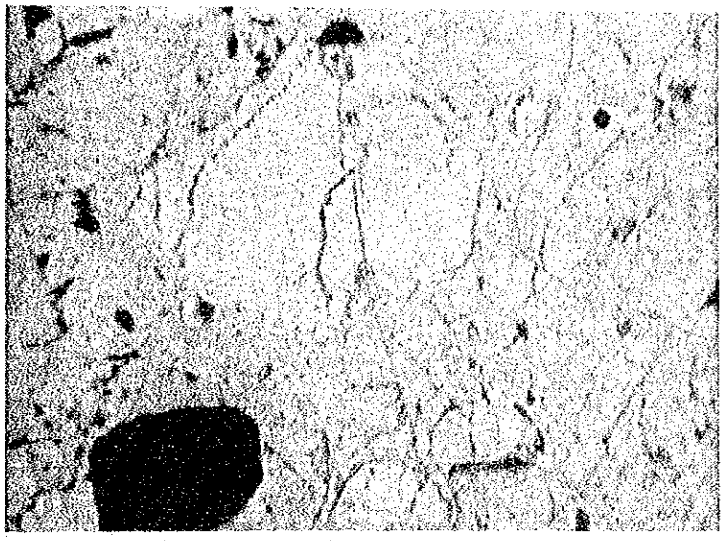
The phenocrysts consist of idiomorphic plagioclase (oligoclase) and hornblende. Plagioclase is fresh and is twined in various laws. Most of the grains are not zoned but some are weakly zoned. Hornblende is brownish green and prismatic. Except these phenocrysts, biotite, magnetite, quartz and hypersthene are present. The composition of the microphenocrysts is the same to the phenocrysts. The groundmass is composed mainly of glass and very fine amplibole, pyroxene, magnetite, etc. Accessory mineral is zircon.

Petrographic description and photomicrograph of thin section of rock (plate 4 of 5)

Locality;
Powerhouse site
(rigit bank of Rio Cauca)

Specimen number in laboratory test;
No. 18

Rock name;
Andesite
(Plagioclase-liparite)



(open nicols, X76)

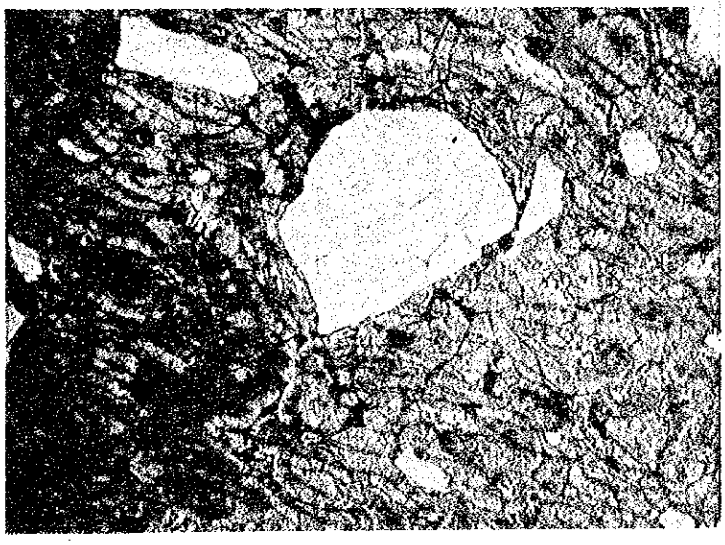
Petrographic description;

The phenocrysts consist mainly of plagioclase (oligoclase). It is fresh and is twined in various laws. Brown biotite, quartz and magnetite are seen. The microphenocrysts are the same composition. The groundmass is completely glass and partly shows pearlitic texture. Accessory is zircon.

Locality;
3-6-1 Julumito bridge
(Crossed Rio Cauca)

Specimen number in laboratory test;
No. 19

Rock name;
Andesite.
(Plagioclase-liparite)



(open nicols, X76)

Petrographic description;

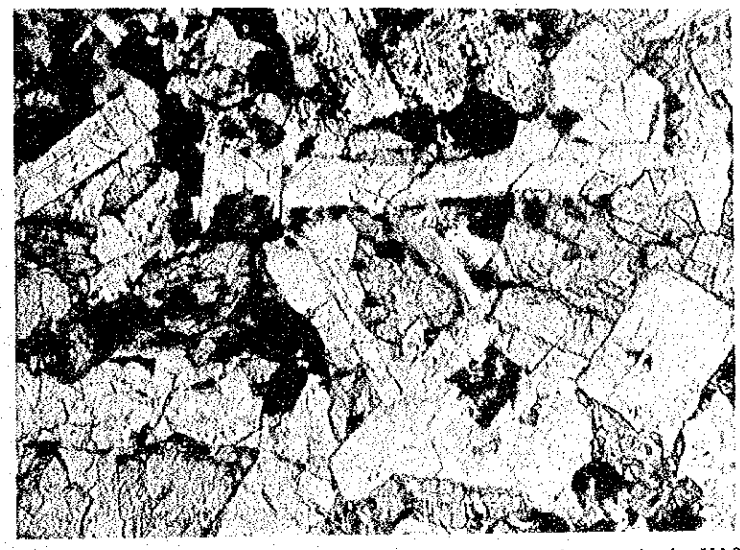
The phenocrysts consist of plagioclase, biotite and quartz. Plagioclase is fresh and twined in albite, Carlsbad and other laws. Biotite is brown. Quartz is less. The microphenocrysts are the same composition. The groundmass is composed of variously distorted spherules of radial aggregate of quartz-feldspathic mineral and glass. Fine veins of limonite-hydroxides of iron are seen. Small xenotiths of altered andesite are present.

Petrographic description and photomicrograph of thin section of rock (plate 5 of 5)

Locality;
La Titella

Specimen number in laboratory test;
No. 20

Rock name;
Meta dolerite.



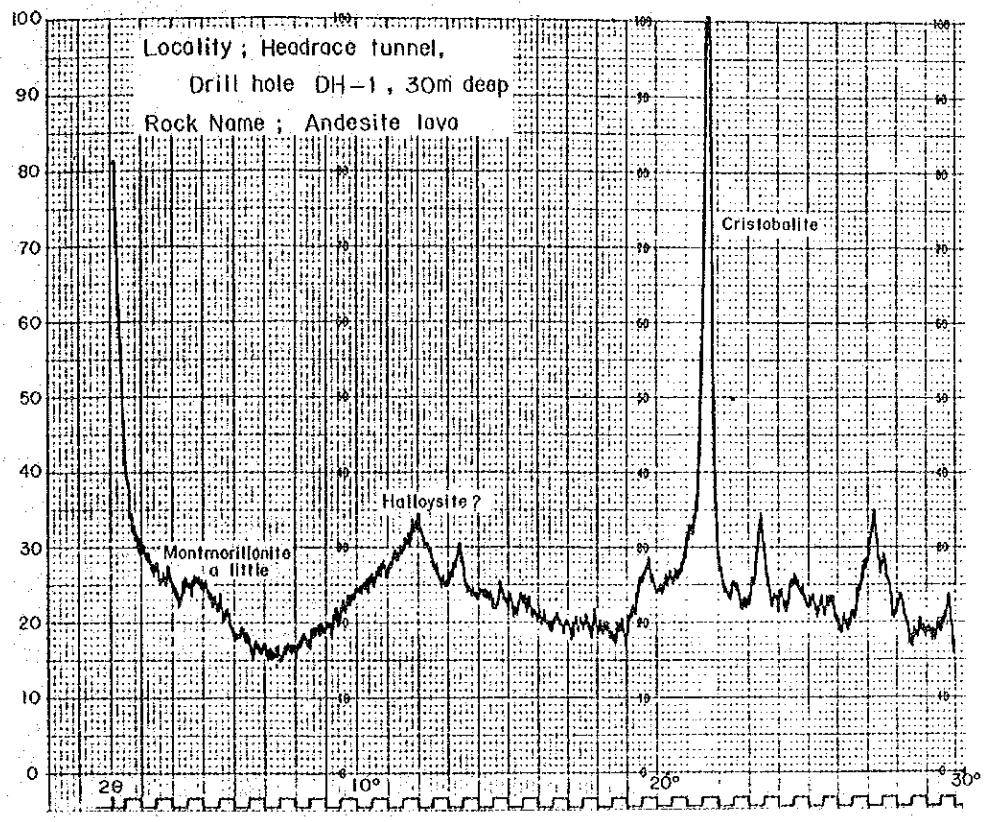
(open nicols, X186)

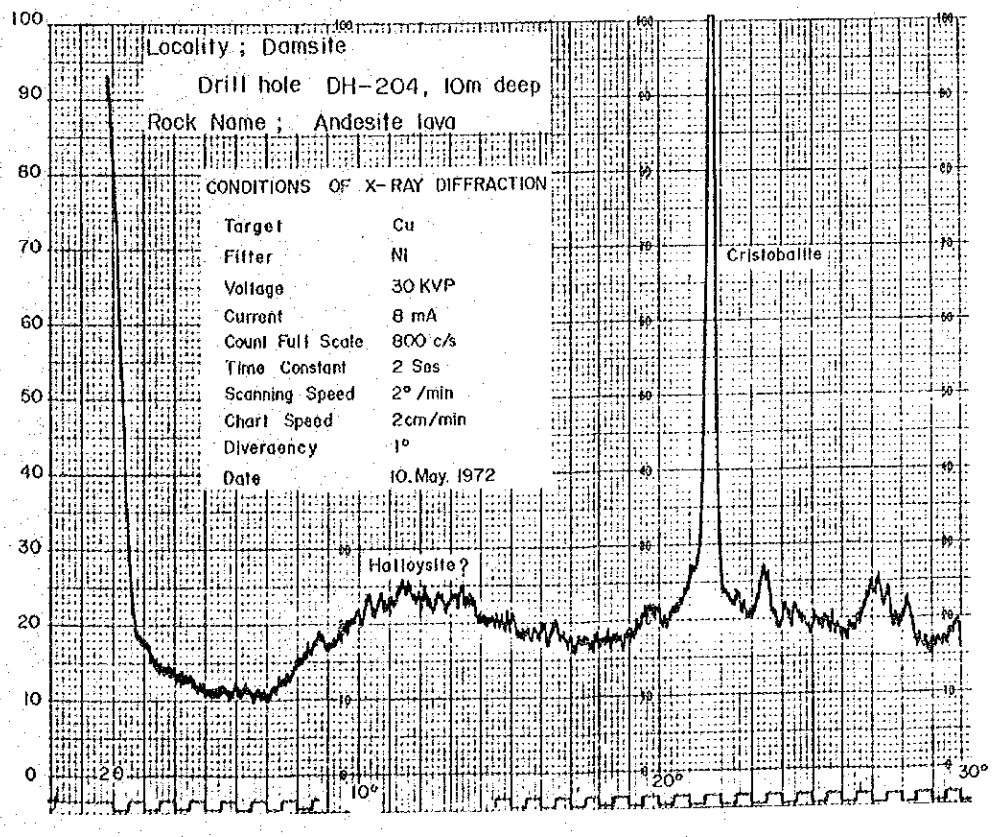
Petrographic description;

The primary minerals: Plagioclase, augite and ilmenite. The diabasic-doleritic texture is well preserved, but a few thin crack cemented by the crushed minerals such as augite and leucoxene is seen. Plagioclase (andesine) is fairly fresh and is twined in albite and Carlsbad laws. Zonal structure is not met. Fine streaks of chlorite are commonly developed in plagioclase, Augite is plentiful and rather fresh. It is not colored. The altered minerals: chlorite, leucoxene and calcite. Ilmenite with the rim of leucoxene is abundant. Chlorite is found mainly as an intergranular cement and sometimes as a pseudomorph of augite. Calcite is less.

IV-4 X-RAY DIFFRACTION ANALYSIS

X-RAY DIFFRACTION ANALYSIS





IV-5 SOIL MATERIAL

IV-5-1 ORIGINAL DATA OF SOIL TEST

IV-5-2 TABLE OF SOIL TEST

IV-5-3 GRADATION ANALYSIS

IV-5-4 DIRECT SHEARING TEST

IV-5-5 TRIAXIAL SHEARING TEST

IV-5-1 ORIGINAL DATA OF SOIL TEST

o THESE SOIL TEST WEAR CONDUCTED BY UNIVERSIDAD DEL CAUCA RESPONDING TO THE REQUEST OF CEDELCA

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 2

Popayán, octubre 26 de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP. 101 Profundidad 3.00 m

Descripción de la muestra Suelo fino amarillo ambar

Humedad natural 49.13% Clasificación U.S.C.E. No plastice

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	100	99.22	94.49	89.02	83.03		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	N.P.	N.P.	N.P.	-	2.69

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Promedio Segundos
	1.51	1.30	1.16	1.91

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.037	0.0096	0.015	1.42×10^{-4}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO: C.R. (Qc)	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.5	0.48		
	2	25	1.0	0.91	0.1	40°
	3	25	1.5	1.29		

OBSERVACIONES

1) Corte directo sobre muestra inalterada.

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 5

Fecha. Sept. 30/70

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

LOCALIZACION DE LA MUESTRA TP - 101 Alterado

DESCRIPCION DE LA MUESTRA Suelo fino color pardo claro

PENETRACION EN EL SITIO HUMEDAD NATURAL 83.1% DENSIDAD NATURAL CLASIFICACION U. S. C. E. MH.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Específ. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION Densidad HARVARD gr/cm³	Humedad %	C. B. R.
No. 10 99.99		LL. 61.0	2.69	2.06				1.20	42.0	
No. 40 99.00		LP. 45.4								
No. 200 92.16		IP. 15.6								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No.6

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

Fecha. Sept. 30/70

LOCALIZACION DE LA MUESTRA TP - 102 Alterada

DESCRIPCION DE LA MUESTRA Suelo fino color habano

PENETRACION EN EL SITIO HUMEDAD NATURAL 55.0% DENSIDAD NATURAL CLASIFICACION U. S. C. E. MH.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Especif. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION HARVARD Densidad gr/cm³	Humedad %	C. B. R.
No. 10 99.37		LL. 60.0	2.72	3.25				1.25	38.0	
No. 40 97.96		LP. 41.0								
No. 200 89.17		IP. 19.0								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

Número 6

Popayán, 7 de noviembre de 1.970

ESPECIALIDAD EN VIAS

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP. 102 Parafinada Profundidad 3.00 m

Descripción de la muestra Suelo fino color carmelita

Humedad natural 57.2% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100	100	99.81	97.65	94.85	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	61.0%	47.5%	13.5	-	2.60

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			1.19
	W óptima %			45.0

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) t_{90} Segundos
	e inicial	e final		
	1.55	1.36	1.17	117 promed.
	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.025	0.0341	0.0098	3.3×10^{-4}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	13.53	0.1139	8.54	9.64	1.40

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1	1.0 (0.98)	4.90	0.020		
	2	3.0 (2.96)	10.71	0.045	0.10	40°
	3	5.0 (4.94)	22.63	0.058		

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.5	0.36		
	2	25	1.0	0.83	0.00	40°
	3	25	1.5	1.19		

OBSERVACIONES

1) Compresión inconfinada sobre muestras Harvard.

2) Compresión triaxial sobre muestras Harvard.

3) Corte directo sobre muestra inalterada.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 007

Popayán, Febrero de 1971

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP-102 Profundidad m

Descripción de la muestra Suelo fino - Color amarillo mate

Humedad natural 48.0% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100.00	100.00	98.36	97.90	94.41	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	67.00	60.83	6.17		2.71

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³	1.18		1.20
	W óptima %	43.5		41.5

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) $t_{90\%}$ Segundos
	e inicial	e final		
	1.39	1.25	1.20	112
	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.028	0.0119	0.012	1.4×10^{-7}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	13.38	0.0285	8.55	8.79	1.52

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1	1 (0.980)	10.85	0.02		
	2	3 (2.940)	38.33	0.06	0.25	55°
	3	5 (4.900)	71.15	0.10		

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.50	0.54		
	2	25	1.00	0.93	0.20	36°
	3	25	1.50	1.26		

OBSERVACIONES

1) Corte directo sobre muestra tipo Proctor Standard.
2) Consolidación sobre muestra tipo Proctor Standard.
3) Compresión innonfinada con pasante No. 10 Harvard.
4) Compresión triaxial con pasante No. 10 Harvard.

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 8

Fecha. Sept. 30/70

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

LOCALIZACION DE LA MUESTRA TP - 103 Alterada

DESCRIPCION DE LA MUESTRA Suelo fino color pardo oscuro

PENETRACION EN EL SITIO HUMEDAD NATURAL 76.2% DENSIDAD NATURAL CLASIFICACION U. S. C. E. SM.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L N.P. %	Peso Específ. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION Densidad HARVARD gr/cm³	Humedad %	C. B. R.
No. 10 99.66		LL.		N.P.				N.P.	N.P.	
No. 40 92.07		LP.								
No. 200 79.00		IP.								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 4

Popayán, octubre 28 de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP. 103 Parafinada Profundidad m

Descripción de la muestra Suelos fino color carmelita

Humedad natural 102% Clasificación U. S. C. E. SMu (1)

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	99.93	98.06	88.19	76.51	57.26		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	NP	NP	NP		2.36

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	2.91	2.18	1.03	125 Prom.

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.150	0.0103	0.038	4×10^{-4}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²

COMPRESION TRIAXIAL TIPO: C.R. (Qc)	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1	25	0.5	0.44		
	2	25	1.0	0.74	0.18	30°
	3	25	1.5	1.05		

CORTE DIRECTO TIPO: C.R. (Qc)	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.5	0.44		
	2	25	1.0	0.74	0.18	30°
	3	25	1.5	1.05		

OBSERVACIONES

1) Arenas limosas con muchos finos no plásticos medianamente compresibles, mal drenaje. - SMu -

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 4

Fecha. Sept. 30/70

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

LOCALIZACION DE LA MUESTRA TP - 104 Alterada

DESCRIPCION DE LA MUESTRA Suelo fino color morado claro

PENETRACION EN EL SITIO HUMEDAD NATURAL 67.3% DENSIDAD NATURAL CLASIFICACION U. S. C. E. M.H.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Específ. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION Densidad gr/cm³	Humedad HARVARD %	C. B. R.
No. 10 99.82		LL. 61.0	2.58	2.22				1.22	41.9	
No. 40 98.17		LP. 45.9								
No. 200 91.52		IP. 15.1								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

Número 1

Popayán, 26 octubre de 1.970

ESPECIALIDAD EN VIAS

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP. 104 Parafinada Profundidad 3.00 m

Descripción de la muestra Suelo fino amarillo branco - muchas raices

Humedad natural 66.51% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100	99.98	99.72	97.94	94.26	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	67.0%	52.6%	14.4		2.58

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			1.14
	W óptima %			46.3

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) t_{90} Segundos
	e inicial	e final		
	1.40	1.24	1.21	135

Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
0.025	0.0056	0.0104	4.7×10^{-5}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	20.4	0.05	8.54	9.0	2.26

COMPRESION TRIAXIAL TIPO: C.R. (Qc)	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1	1.0 (0.97)	4.47	0.035		
	2	3.0 (2.98)	8.68	0.020	0.75	22°
	3	5.0 (4.95)	10.75	0.055		

CORTE DIRECTO TIPO: C.R. (Qc)	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25.0	0.5	0.41		
	2	25.0	1.0	0.64	0.12	32°
	3	25.0	1.5	1.00		

OBSERVACIONES

1) Compresión inconfinada sobre muestra Harvard.
2) Compresión triaxial sobre muestra Harvard.
3) Corte directo sobre muestra inalterada.

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 3

Fecha. Sept. 30/70

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

LOCALIZACION DE LA MUESTRA TP - 201 Alterata

DESCRIPCION DE LA MUESTRA Suelo fino color rosado claro

PENETRACION EN EL SITIO HUMEDAD NATURAL 40.8 % DENSIDAD NATURAL CLASIFICACION U. S. C. E. ML.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Específ. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION HARVARD Densidad gr/cm³	Humedad %	C. B. R.
No. 10 99.09		LL. 48.0	2.47	2.92				1.42	26.9	
No. 40 96.70		LP. 30.0								
No. 200 84.25		IP. 10.0								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 8

Popayán, 9 de Noviembre de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroeléctrico JULUMITO - CEDELCA

Referencias de la muestra TP 201 Parafinada Profundidad 3.00 m

Descripción de la muestra Suelo fino rojizo veteado en gris. Entremezelado

Humedad natural 42.5% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	3/8	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	97.85	97.82	97.65	96.24	92.46	85.71	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	58.3	39.9	18.4	-	2.42

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			1.30
	W óptima %			38.1

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) t_{90} Segundos
	1.00	0.88	1.20	110 promd.

Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
0.012	0.0132	0.006	7.9×10^{-5}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	21.85	0.064	8.54	9.12	2.40

COMPRESION TRIAXIAL TIPO: C.R. (Qc)	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1	1.0 (0.99)	10.99	0.012		
	2	3.0 (2.97)	27.79	0.028	0.5	51°
	3	5.0 (4.99)	43.88	0.015		

CORTE DIRECTO TIPO: C.R. (Qc)	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.5	0.37		
	2	25	1.0	0.75	0.08	34°
	3	25	1.5	1.05		

OBSERVACIONES

1) Compresión inconfinada sobre muestras Harvard.
2) Compresión triaxial sobre muestras Harvard.
3) Corte directo sobre muestra inalterada.
4) MH corresponde al pasante del tamiz #40.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número

Popayán, febrero de 1.971

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP-201 Profundidad 3.00 m

Descripción de la muestra Heteregeneo, suelo fino con piedras cuarzosas color caqui

Humedad natural 47.3% Clasificación U. S. C. E. ML

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	100.00	99.11	96.53	91.38	86.42		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	46.30	39.28	7.02		2.53

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³	1.30		1.31
	W óptima %	33.0		32.0

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	e inicial	e final		
	0.9	0.8	1.23	182

CONSOLIDACION	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.01	0.008	0.0053	4.2×10^{-8}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	18.46	0.0641	8.55	9.14	2.02

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos		P. Neutra U kg/cm²	C kg/cm²	ϕa
		$\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²			
	1	1.0 (0.970)	10.86	0.03		
	2	3.0 (2.690)	26.77	0.31	1.0	49°
	3	5.0 (4.960)	67.76	0.04		

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.50	0.62		
	2	25	1.00	1.18	0.22	43°
	3	25	1.50	1.56		

OBSERVACIONES

1) Corte directo sobre muestra Proctor Standard.
2) Consolidación sobre muestra Proctor Standard.
3) Compresión inconfinada con pasante No. 10 Harvard.
4) Compresión triaxial pon pasante No. 10 Tipo Harvard.

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 2

Fecha. Sept. 30/70

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

LOCALIZACION DE LA MUESTRA TP - 202 Alterada

DESCRIPCION DE LA MUESTRA Suelo fino morado claro

PENETRACION EN EL SITIO HUMEDAD NATURAL 40.9% DENSIDAD NATURAL CLASIFICACION U. S. C. E. ML.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Especif. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION Densidad gr/cm³	Humedad HARVARD %	C. B. R.
No. 10 99.44		LL. 47.5	2.45	4.5				1.33	30.3	
No. 40 96.98		LP. 37.4								
No. 200 88.53		IP. 10.1								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 3

Popayán, 27 de octubre de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP 202, Paratinada Profundidad 3.00 m

Descripción de la muestra Suelo heterogeneo amarillo y blanco, fino con piedras

Humedad natural 48.3% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	99.92	99.62	97.25	91.97	87.79		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	50.0%	37.4%	12.6		2.53

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) t90 prom. Segundos
	e inicial	e final		
	1.01	0.83	1.15	179

Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
0.02	0.0066	0.011	6.6×10^{-5}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos		P. Neutra	C	ϕa
		$\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	U kg/cm²	kg/cm²	
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES	Suelo heterogéneo fino con arena y piedras no permitió talla para corte directo. Por su comportamiento complejo no fué remoldeado para otros ensayos.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 007

Popayán, febrero de 1971

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP-202 Profundidad 3.00 m

Descripción de la muestra Suelo fino color rosado oscuro veteado en amarillo

Humedad natural 55.3% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	100	99.86	98.49	96.45	94.56		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	78.75	64.50	14.25		2.37

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³	1.22		1.25
	W óptima %	39.0		44.0

CONSOLIDACION	Relación de vacíos		H mínima para (90%)	(t_{50}) t_{90}
	e inicial	e final	(50%) consolidación	Segundos
	1.05	0.98	1.23	128

Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
0.023	0.0129	0.01122	1.4×10^{-7}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	17.61	0.093	8.54	9.41	1.87

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1	1 (0.945)	8.365	0.055		
	2	3 (2.920)	30.540	0.080	1.5	33°
	3	5 (4.920)	22.190	0.080		

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.50	0.55		
	2	25	1.00	0.97	0.19	39°
	3	25	1.50	1.25		

OBSERVACIONES

1) Corte directo sobre muestra inalterada.
2) Consolidación sobre muestra tipo Proctor Standard.
3) Compresión inconfinada con pasante No. 10 Harvard.
4) Compresión triaxial con pasante No. 10 Harvard.

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 1

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

Fecha. Sept. 30 - 70

LOCALIZACION DE LA MUESTRA TP - 203 Alterada

DESCRIPCION DE LA MUESTRA Suelo tipo pardo oscuro

PENETRACION EN EL SITIO HUMEDAD NATURAL 58.4 % DENSIDAD NATURAL

CLASIFICACION U. S. C. E. SM.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Especif. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION Densidad gr/cm³	Humedad %	C. B. R.
								HARVARD		
No. 10 99.96		LL.	2.66	N.P.				N.P.	N.P.	
No. 40 98.67		LP.								
No. 200 90.47		IP.								
		LC.								

DATOS COMPLEMENTARIOS

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA
UNIVERSIDAD DEL CAUCA
INGENIERIA CIVIL

Número 7
Popayán, noviembre 4 de 1.970

ESPECIALIDAD EN VIAS

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA
Referencias de la muestra TP. 203 Parafinada Profundidad 3.00 m
Descripción de la muestra Suelo fino arenoso amarillo mate
Humedad natural 87.8% Clasificación U. S. C. E. S. Mu

GRANULOMETRIA	Tamiz	3/8	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100	99.88	97.20	76.20	50.23	34.65	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	N.P.	N.P.	N.P.		2.46

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	2.34	1.97	1.13 cm.	99 promed.

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.044	0.0131	0.0132	1.7×10^{-4}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO: C.R. (Qc)	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.5	0.40		
	2	25	1.0	0.81	0	40°
	3	25	1.5	1.16		

OBSERVACIONES

Suelo arenoso con muchos finos no plástico, compresibilidad media, mal drenaje. SMu

UNIVERSIDAD DEL CAUCA

LABORATORIO DE GEOLOGIA - SUELOS Y PAVIMENTOS

REGISTRO No. 7

MOTIVO Y TIPO DEL MUESTREO Proyecto Hidroelectrico JULUMITO - CEDELCA

Fecha. Sept. 30/70

LOCALIZACION DE LA MUESTRA TP-204 Alterada

DESCRIPCION DE LA MUESTRA Suelo fino coror pardo oscuro

PENETRACION EN EL SITIO HUMEDAD NATURAL 107.2*% DENSIDAD NATURAL* CLASIFICACION U. S. C. E. SM.

MUESTRA kg. PROFUNDIDAD 3.00 MTs.

DATOS DE LABORATORIO

% Pasa Tamices	Coefic. Uniform.	Límites de Consisten. L %	Peso Especif. G	Compresión Inconfin. kg/cm²	Corte Directo	Coeficiente Consolid.	Compresión Triaxial	COMPACTACION Densidad gr/cm³	Humedad HARVARD %	C. B. R.
No. 10 98.66		LL.	2.58	N.P.				N.P.	N.P.	
No. 40 90.98		LP.								
No. 200 67.84		IP.								
		LC.								

DATOS COMPLEMENTARIOS *ES CONTRADICTORIA LA HUMEDAD NATURAL Y LA GRANULOMETRIA, POR LO TANTO RS POSIBLE CUB LA MUESTRA HAYA SIDO.

Laboratorista

Jefe de Laboratorio

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 5

Popayán, 31 de octubre de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra TP. 204 Parafinada Profundidad 3.00 m

Descripción de la muestra Suelo fino color chocolate

Humedad natural 178.0% Clasificación U. S. C. E. SMu (1)

GRANULOMETRIA	Tamiz	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100	99.98	79.37	59.25	51.54	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	N.P.	N.P.	N.P.		2.59

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) t_{90} Segundos
	e inicial	e final		
	5.19	4.56	1.14	386 Prom.

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k
	0.055	0.0049	0.0089	4.4×10^{-5}

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos		P. Neutra U kg/cm²	C kg/cm²	ϕa
		$\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²			
	1					
	2					
	3					

CORTE DIRECTO TIPO: C.R. (Qc)	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1	25	0.5	0.71		
	2	25	1.0	0.95	0.50	23°
	3	25	1.5	1.13		

OBSERVACIONES

Suelo arena fina con muchos finos no plásticos, medianamente compresible, mal drenaje. - SMu -

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

Número

Popayán, octubre de 1.970

ESPECIALIDAD EN VIAS

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 6 Profundidad 6.00 a 7.00 m

Descripción de la muestra Suelo fino color pardo oscuro

Humedad natural 76.7% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	10	40	100	200			D_{60}/D_{10}
	% Pasa	99.90	99.34	96.82	92.42			

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	66.5%	51.6%	14.9%		

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	25.59	0.043	17.34	18.12	1.63

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES: Ensayos realizados sobre muestras inalteradas tubo shelby.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número

Popayán, octubre de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 6 Profundidad 10 a 11 m

Descripción de la muestra Suelo fino color pardo claro

Humedad natural 58.5% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	40	100	200				D_{60}/D_{10}
	% Pasa	99.13	94.33	90.12				

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	56.5%	44.3%	12.2%		

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%)	(t_{50})
	e inicial	e final	(50%) consolidación	Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	24.52	0.053	17.34	18.31	1.34

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos		P. Neutra	C	ϕa
		$\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	U kg/cm²	kg/cm²	
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES	Ensayos realizados sobre muestras inalteradas tubo shelby.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número

Popayán, octubre de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 6 Profundidad 15 a 16 m

Descripción de la muestra Suelo fino color crema

Humedad natural 42.6% Clasificación U. S. C. E. ML

GRANULOMETRIA	Tamiz	10	40	100	200			D_{60}/D_{10}
	% Pasa	99.86	98.40	92.68	88.15			

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	42.5%	32.8%	9.7%		

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	76.10	0.080	17.34	18.85	4.04

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre muestras inalteradas tubo shelby.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número

Popayán,

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 7 Profundidad 5.00 a 6.00 m

Descripción de la muestra

Humedad natural 58.4% Clasificación U.S.C.E. MH

GRANULOMETRIA	Tamiz	10	40	100	200			D_{60}/D_{10}
	% Pasa	99.95	99.17	94.84	89.81			

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	62%	44.4%	17.6%		

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	e inicial	e final		

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	20.29	0.096	15.61	17.27	1.17

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre muestras inalteradas tubo shelby.

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INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número

Popayán,

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 7 Profundidad 10.00 a 11.00 m

Descripción de la muestra

Humedad natural 47.1% Clasificación U. S. C. E. ML

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	99.94	99.87	99.24	93.30	86.92		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	47.5%	31.5%	16.0%		

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	11.84	0.080	15.61	16.97	0.70

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre muestras inalteradas tubo shelby.

REPUBLICA DE COLOMBIA

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INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número

Popayán,

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 7 Profundidad 16.00 a 17.00 m

Descripción de la muestra

Humedad natural 42.3% Clasificación U.S.C.E. N.P.

GRANULOMETRIA	Tamiz	3/8	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	99.81	99.63	99.17	97.07	85.87	74.24	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
		N.P.			

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	14.65	0.069	15.61	16.77	0.87

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre mustras inaleradas tubo shelby.

REPUBLICA DE COLOMBIA

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ESPECIALIDAD EN VIAS

Número

Popayán, Mayo 5 de 1.971

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra DDH-1 -60 Lbs. de presion Profundidad 20.0 m

Descripción de la muestra Suelo heterogeneo, plástico, con arenas y piedras color gris.

Humedad natural 47.45% Clasificación U.S.C.E. ML y Grava

GRANULOMETRIA	Tamiz	3/4	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	95.74	64.75	55.61	45.83	35.74	34.98	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	38.50	37.97	0.53	-	2.59

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	e inicial	e final		

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	12.96	0.1653	14.99	17.96	0.72

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES		
DENSIDADES	D. Natural 1.88	Densidad Seca 1.28

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ESPECIALIDAD EN VIAS

Número

Popayán, mayo 5 de 1.971

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra DD-H2 80 Lbs. de presión Profundidad 5.00 m

Descripción de la muestra Suelo fino plástico, color carmelita

Humedad natural 69.60 Clasificación U.S.C.E. ML

GRANULOMETRIA	Tamiz	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100.00	99.72	98.73	93.17	81.61	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	63.00	56.28	6.72	-	2.62

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	e inicial	e final		
	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	31.42	0.08	14.99	16.29	1.93

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES		
DENSIDADES	D. Natural	D. Seca
	1.72	1.02

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LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra DD-H2-100 Lbs. de Presión Profundidad 10.00 m

Descripción de la muestra Suelo fino, plástico, amarille mate

Humedad natural 56.9% Clasificación U. S. C. E. ML

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	100.00	99.55	98.13	92.75	84.86		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	58.00	50.61	7.39		2.74

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	46.22	0.1227	14.99	17.09	2.7

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

DENSIDADES: D. Natural 1.78 D. Seca 1.13

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ESPECIALIDAD EN VIAS

Número

Popayán, mayo 5 de 1.971

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA
Referencias de la muestra DD-H2 140 Lbs. de presion Profundidad 20.00 m
Descripción de la muestra Suelo fino, plastico color Caky.

Humedad natural 76.39% Clasificación U. S. C. E. ML

GRANULOMETRIA	Tamiz	3/8	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	100.00	99.97	98.46	87.01	73.92	63.44	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	58.00	56.26	7.74	-	2.66

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	8.03	0.08	14.99	16.29	0.49

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

DENSIDADES	D. Natural	D. Seca
	1.75	1.01

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Número 5
Popayán, noviembre 25 de 1.970

ESPECIALIDAD EN VIAS

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA
Referencias de la muestra POZO DH 2 Profundidad de 5.60 a 6.00 m
Descripción de la muestra

Humedad natural 64.7% Clasificación U.S.C.E. MH

GRANULOMETRIA	Tamiz	10	40	100	200			D_{60}/D_{10}
	% Pasa	99.92	99.15	93.97	89.00			

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	56.0%	40.3%	15.7%		2.58

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³	1.72 Densidad natural		
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	23.81	0.0907	15.28	16.80	1.42

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre muestras inaltradas tubo shelby.

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INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 3

Popayán, noviembre 25 de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 2 Profundidad de 10 a 11 m

Descripción de la muestra

Humedad natural 76.8% Clasificación U. S. C. E. MH

GRANULOMETRIA	Tamiz	10	40	100	200			D_{60}/D_{10}
	% Pasa	99.97	99.40	96.20	94.25			

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	67.0%	52.6%	14.4%		2.43

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³	1.65 Densidad natural		
	W óptima %			

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	e inicial	e final		
	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	12.54	0.1334	15.21	17.55	0.71

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES	Ensayos realizados sobre muestras inalterada tubo shelby.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 2

Popayán, noviembre 25 de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH-2 Profundidad de 15 a 16 m

Descripción de la muestra

Humedad natural 37.0% Clasificación U.S.C.E. ML

GRANULOMETRIA	Tamiz	4	10	40	100	200		D_{60}/D_{10}
	% Pasa	100.00	99.98	96.31	86.00	82.80		

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	35.0%	26.9%	8.1%		2.49

COMPACTACION			PROCTOR	MODIFICADA	HARVARD
	D máxima	gr/cm³	1.89 Densidad natural		
	W óptima	%			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	26.49	0.1654	16.05	19.23	1.38

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre muestras inalteradas tubo shelby.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

Número 4

Popayán, noviembre 25 de 1.970

ESPECIALIDAD EN VIAS

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 2 Profundidad de 20 a 21 m

Descripción de la muestra

Humedad natural 38.1% Clasificación U. S. C. E.

GRANULOMETRIA	Tamiz	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	99.88	99.86	94.34	80.08	74.37	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	32.8	28.8	4.0%		2.50

COMPACTACION			PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³		1.85 Densidad natural		
	W óptima %				

CONSOLIDACION	Relación de vacíos		H mínima para (90%) (50%) consolidación	(t_{50}) Segundos
	e inicial	e final		

CONSOLIDACION	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²
	14.93	0.0587	17.06	18.12	0.82

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	$\phi a'$
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES	Ensayos realizados sobre muestras inalteradas tubo shelby.

REPUBLICA DE COLOMBIA

UNIVERSIDAD DEL CAUCA

INGENIERIA CIVIL

ESPECIALIDAD EN VIAS

Número 1

Popayán, noviembre 25 de 1.970

LABORATORIO DE SUELOS - INFORME

OBRA: Proyecto Hidroelectrico JULUMITO - CEDELCA

Referencias de la muestra POZO DH 203 Profundidad 6.00 a 7.00 m

Descripción de la muestra

Humedad natural 37.4% Clasificación U.S.C.E.

GRANULOMETRIA	Tamiz	3/8	4	10	40	100	200	D_{60}/D_{10}
	% Pasa	97.70	97.31	95.11	81.39	68.58	65.86	

LIMITES	L. Líquido	L. Plástico	Indice de Plasticidad	Límite de Contracción	Gravedad Específica G.
	N.P.	N.P.	N.P.		2.60

COMPACTACION		PROCTOR	MODIFICADA	HARVARD
	D máxima gr/cm³			
	W óptima %			

CONSOLIDACION	Relación de vacíos e inicial	e final	H mínima para (90%) (50%) consolidación	(t_{50}) Segundos

	Coeficiente Compres. a_v	Coeficiente Consol. C_v	Módulo Volm. m_v	Coeficiente de Permeabilidad k

COMPRESION INCONFINADA	Carga kg	Deformación Unitaria	Area cm² Inicial A.	Area cm² corregida	Resistencia kg/cm²

COMPRESION TRIAXIAL TIPO:	No.	Esfuerzos efectivos $\bar{\sigma}_3$ kg/cm²	$\bar{\sigma}_1$ kg/cm²	P. Neutra U kg/cm²	C kg/cm²	ϕa
	1					
	2					
	3					

CORTE DIRECTO TIPO:	No.	Area cm² = A.	P. Normal Pn kg/cm²	Esfzo. Tang. τ kg/cm³	C kg/cm²	ϕ
	1					
	2					
	3					

OBSERVACIONES

Ensayos realizados sobre muestras inalteradas tubo shelby muestra heterogenea arenosa.