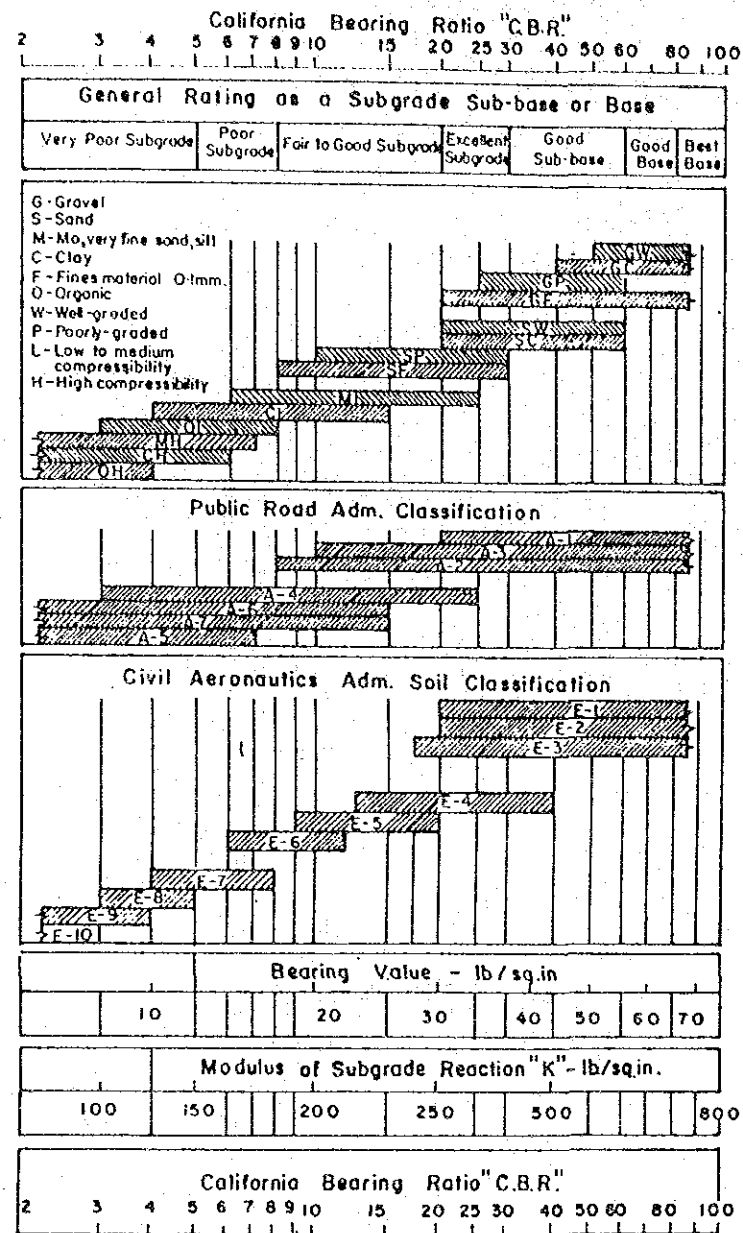


Fig. II-1 CBR and Soil Classification



Source: Laterite Soil Engineering by M.D. Gidigasu

2.2 試験結果の解析

試験結果を表 II-2 に示す。結果より以下のようなことが言えよう。

2.2.1 路床としての土の評価

各試料の分類は AASHTO M 45-73 に従って行った。AASHTO M 57-64 の路床、材料としての土の評価によると A-1, A-3, A-2-4 および A-2-5 は路床材料として良または中程度の土となっている。この分類によると G-2, Z-7 および V-9 地点を除くほとんどの試料は路床材料として不適である。

しかし、表 II-3 の統一分類法による土の分類によればほとんどの試料は GM と GC に分類され、路床だけでなく下層路盤としても良い材料とされている。

以上のように当ラテライトは相反する性格を持っているが、表 II-2 に示すように水浸 CBR 値 (4~11) を考慮すると雨期における路床材料としては不良または普通と判断される。

また、上記の事は雨期に土質調査を行ったので上の解析の相関性は締め固め試験結果からも照合することが出来る。従って、もし道路改良工事を乾期に行うならば路床の施工は良い条件下で行うことが期待出来る。

2.2.2 問題となるラテライト土

問題となるラテライト土は次の通りである。

- A. 最近、火山活動した後風化した土
- B. 年平均降雨量が1,500 mmで絶え間のない湿潤気候の土
- C. 自然密度が $0.320 \text{ g/cm}^3 - 1.121 \text{ g/cm}^3$ の土
- D. 砕けやすくぼろぼろになりやすい土

本プロジェクト対象地域は1,500 mm以上雨が降る多雨地地域であるが、雨期におけるほとんどの土の自然密度は 1.121 g/cm^3 以上である。また、本プロジェクト対象地域においては、火山活動もなく、砕けやすくぼろぼろになりやすい土はない。

以上より、本プロジェクト地域のラテライト土は、問題となるラテライト土の分類には属しないと判断される。

2.2.3 土質試験結果

土質試験の要約は表II-1に、試験結果は、Test Result (1)~(9)に示す通りである。

2.3 現場試験

2.3.1 現場試験の目的

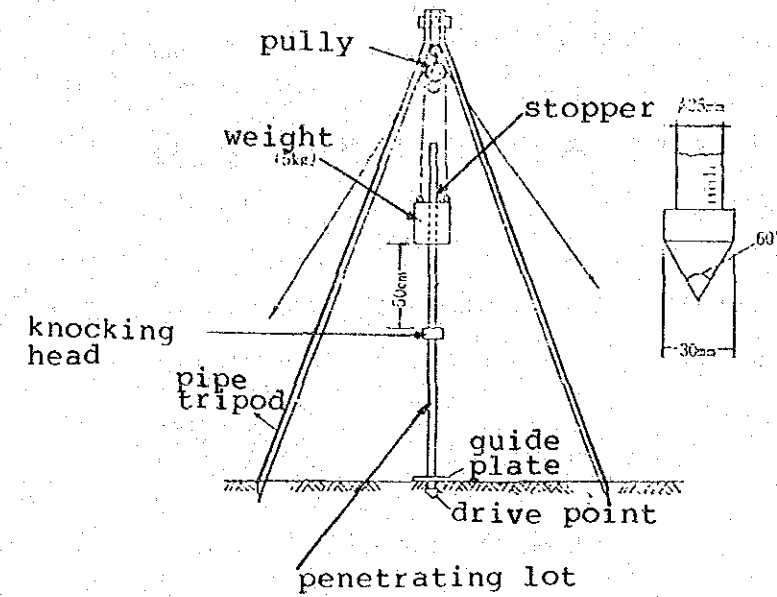
現場CBR試験、ベンケルマンビームを使用した路面たわみ試験および土研式貫入試験等の現場試験は現道のラテライト土質を十分に理解することを目的として行った。

2.3.2 試験方法

現場CBR試験は、ラテライト土の車道上でTOYOTA 6 tonトラックの後部と現場CBR試験器を備えつけて行った。またこの位置の土の自然含水量を知るため試料を採集しこれをMPWの試験所で分析を行った。結果を図示すると、貫入深さと荷重の関係がわかり、2.5 mm貫入における荷重を標準荷重とした。

路面のたわみ試験はベンケルマンビームと土を満載したトラックを使用して行った。まず最初にトラック通過中の最大のたわみ地点の目盛りを記録し、トラック通過後、最終目盛りを記録した。これらの目盛りの差がたわみとなる。試験は2回行ってたわみ量を決めた。

支持力試験は下図に示す日本の建設省土木研究所で開発された特別の貫入試験器具を使用して行った。



試験は車道と路肩上で行い、ハンマーの打撃回数と貫入深さを記録することにより、支持層（表層）ラテライトの厚さがほぼ20cmであることが判明した。

2.3.3 現場試験の結果

現場試験結果の要約を表II-4に示し、詳細な試験結果はTest Result (10)~(12)に示す。

2.4 土取り場および採石場

2.4.1 砂利質ラテライトの土取り場

砂利質ラテライトの採掘場を現道路に沿って調査した。分布状況についてはGWG-II-2に示す通りであり、調査結果を要約すると以下の通りである。

- バンガ～セントポール河
良い砂利質ラテライトが道路に沿って5km以内に分布している。
- セントポール河～ゾロゾロ
この区間道路沿いは殆んど粘土質ラテライトが多く分布し、砂利質ラテライトの分布は非常に少ない。
- ゾロゾロ近辺
良い材料が町の近辺5km以内にとろどころ分布している。
- コニア～ロファ河
この区間の道路沿いは殆んど粘土質ラテライトであるが、ロファ河附近にはとろどころ砂利質ラテライトが分布する。

- ロファ河～ポインジャマ
ところどころ砂利質ラテライトが分布しているが比較的少ない。
- ポインジャマ～コラフン
道路沿いは不良であるが本線から分岐したフィーダー道路の5 Km以内に良い砂利質ラテライトが分布している。
- コラフン～メンディコマ
ほとんど不良であるが、メンディコマ近辺に砂利質ラテライトがところどころ分布している。しかし、固結状ラテライトのような粗悪な土を含んでいるところもある。

2.4.2 採石場

採石場の位置はDWG-Ⅱ-2に示す通りであり、また概況および埋蔵量等については以下の通りである。

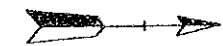
- ベレファナイ地区（ABC地点）
これらの採石場はベレファナイの北部に位置しポインジャマに向かって現道の右側の約1 Km入った地点にある。A地点は埋蔵量が一番多く、BとC地点はほぼ同じである。表土層の厚さも薄く頂上に雑草が生えている外、特に問題はない。
A地点の埋蔵量は約480万 m^3 （長さ400 m、巾150 m、高さ80 m）と見積られる。また、BおよびC地点の埋蔵量は約86.4万 m^3 （長さ180 m、巾80 m、高さ60 m）と見積られる。
- バンウェイ地区（D地点）
この地点はバンウェイの現道路の両側に位置している。このサイトは表層土が厚く覆っているのでコスト高になるため、他の採石場を考慮する必要がある。
埋蔵量は約540万 m^3 （長さ450 m、巾150 m、高さ80 m）と見積られる。
- ノロゾロ地区（E地点）
この地点はノロゾロからポインジャマへ向って1.5 Kmのところ、現道の右側のLPMCのココア園の後方に位置している。少し表層土に覆れているが本プロジェクト道路においては好位置にある。埋蔵量は約1億 m^3 （長さ1.0 Km、巾500 m、高さ200 m）と見積られる。
- テナブ（F地点）
この地点はポインジャマに向って現道の左側約500 mのところにある。ほとんど採取されておらず、露出したままの状態である。埋蔵量は約1億 m^3 （長さ2 Km、巾500 m、高さ100 m）と見積られる。

- ポインジャマ地区 (G地点)
この地点は、現道の左側にあり、ポインジャマより手前7 Kmの地点から取付道路を1 Km行った所にある。この場所には2つの山があり、以前ここに小さな砕石プラントが操業していた。1978年まで可動し、砕石をポインジャマへ供給していた。
埋蔵量は約180万 m^3 (両山とも長さ300 m, 巾100 m, 高さ30 m)と見積られる。
- ジョニータウン地区 (H地点)
この地点はジョニータウン1 Km手前に位置し現道右側約20 mのところから採掘可能なところである。ここは均質な岩が露出しており、G地点 (ポインジャマ) とI地点 (フホヤ) との中間にあり経済的に供給できるであろう。
埋蔵量は約7,500万 m^3 (長さ1.5 Km, 巾500 m, 高さ100 m)と見積られる。
- フホヤ地区 (I地点)
この地点はフホヤよりメンディコマに向って2 Km行った右側に位置し、完全な頂上を持つ山となっていて均質な岩石を観察することが出来る。この採石場はメンディコマあるいはコラフン方向に経済的に搬出するのに適合しているといえよう。
また、この位置からはシエラ・レオーネ国との国境 (メンディコマ) まで搬出可能である。
埋蔵量は約3,000万 m^3 (長さ1 Km, 巾200 m, 高さ150 m)と見積られる。
- メンディコマ地区 (J地点)
この地点はメンディコマの南側に位置し、現道の左側20 mのところから採掘可能である。均質な岩が露出しているが、この地点が本プロジェクトの末端にあることから、現地ではスベアサイトとして考えることが出来る。
埋蔵量は約2,000万 m^3 (長さ1 Km, 巾400 m, 高さ50 m)と見積られる。

2.4.3 岩石標本の比重

岩石の比重をMPWの試験所で測定した結果を示すと下表の通りである。

SAMPLE	SPECIFIC GRAVITY
A, B + C	2.61
D	2.63
E	2.64
J & G	2.69
H	2.64
I	2.64
J	2.62
Average	2.64



DATE OF SAMPLING	SAMPLING POINTS
July 10, '79	G-1
11	G-2, G-3
12	G-4, G-11
14	Z-8, Z-10
16	Z-1, Z-7
20	V-6, V-9
21	V-1, V-8

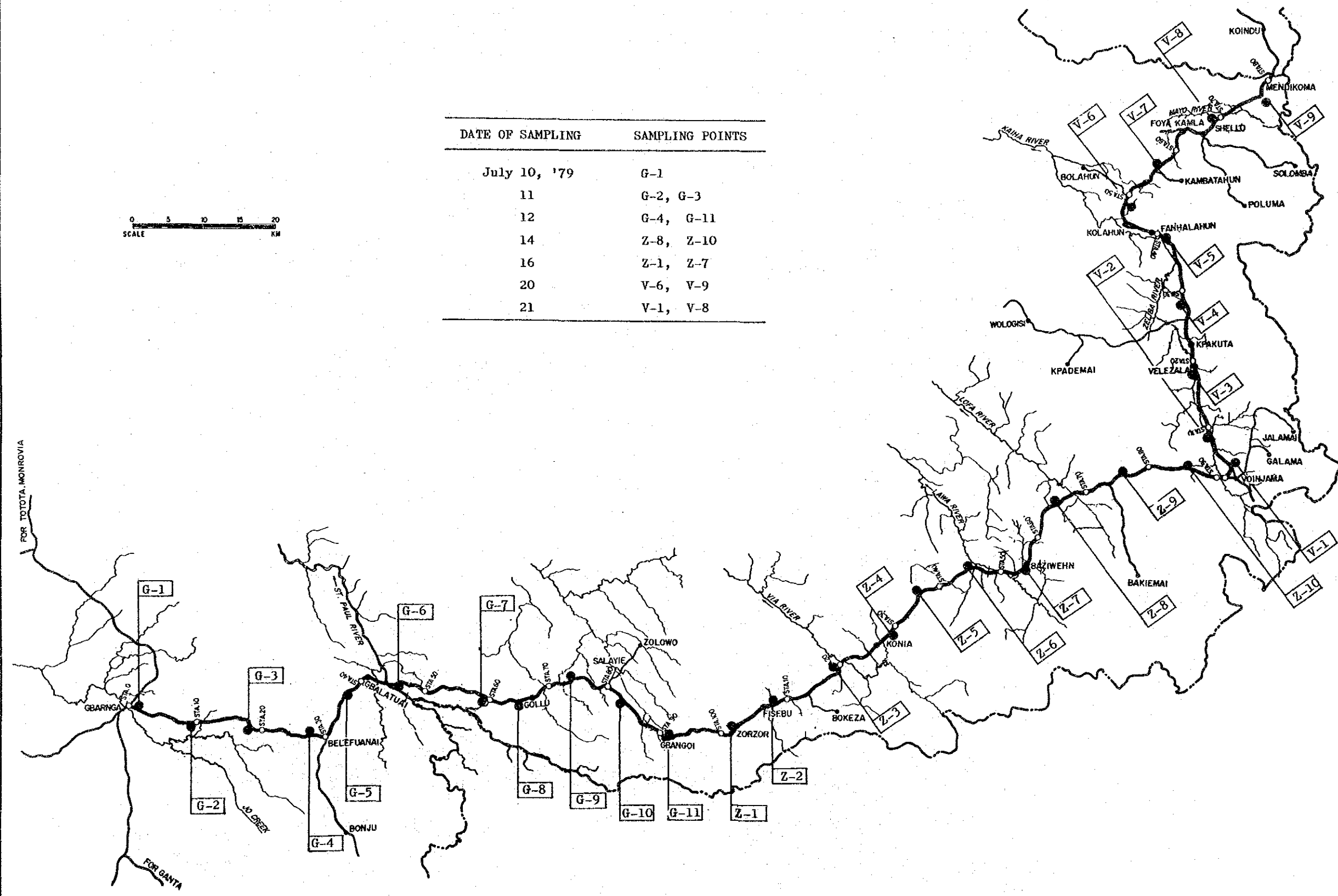
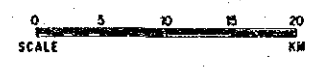


Table II-1 Discription about Soil Sample (1)

SAMPLE	DISTANCE & INTERVAL	RIGHT OR LEFT FOR MENDIKOMA	DEPTH FROM CUT SLOPE TOP	DEPTH FROM ROAD SURFACE	DESCRIPTIONS ABOUT SAMPLES
G-1	10m from Gbarnga Junction G.S	LEFT	0.5m (no slope section)	0 - 0.2m 0.2m - 0.6m	Lateritic material including fine gravel (ϕ 0.5 - 2.0cm). Red clay with a little iron oxides and mica. Red plastic clay, hard milky red clay with silt, gravel (ϕ 2.0cm) and mold in bottom layer.
G-2	9km from G-1	RIGHT	1.0m	0 - 0.2m 0.2m - 0.6m 0.6m - 1.0m	Dark brown wet surface soil with mold. Dark brown gravelly clay with mold. Dark brown gravelly silt with weathered rock.
G-3	9km from G-2	RIGHT	1.0m	0 - 0.5m	Moist brown medium to fine sand, some clay and silt, little medium to fine gravel, (ϕ 0.5mm - 2.0mm), trace of decomposed rock fragments.
G-3'	near by G-3	RIGHT	0 m	1.0m HIGHT	Existing quarry site for selected laterite, mixture from gravel (0.5 - 2.0cm) and clay.
G-4	9km from G-3	LEFT	0.5m	0 - 0.2m 0.2m - 1.0m	Red and hard lateritic material. Wet tanish brown clayey silt and fine to coarse sand with mold.
G-5	9km from G-4	RIGHT	0.5m (embankment section)	0 - 0.5m	Moist light brown fine to coarse sand & clay and silt, trace of medium to fine gravel with mica, and mold.
G-6	9km from G-5	RIGHT	1.0m	0 - 0.5m	Moist tanish brown clay & silt, some fine to medium sand, little fine to medium gravel (ϕ 5.0cm).
G-7	9km from G-6	RIGHT	1.5m	0 - 0.5m	Moist tanish brown fine to coarse sand, some medium to fine gravel & silt & clay gravel (ϕ 10.0cm) in bottom of side ditch.
G-8	9km from G-7	RIGHT	2.0m	0 - 0.5m	Moist tanish brown fine to coarse sand, some silty clay & medium to fine gravel, trace of decomposed rock fragments.
G-9	9km from G-8	LEFT	4.0m	0 - 0.5m	Light brown silty clay with scoria (ϕ 1mm - 3mm) gravel (ϕ 12cm) with mold in bottom of side ditch.
G-10	9km from G-9	RIGHT	1.0m	0 - 0.5m	Moist light brown medium sandy clay and silt some gravel (ϕ 10cm - 1cm) on cut slope.
G-11	9km from G-10	LEFT	2.0m	0 - 0.5m	Moist tan and brown fine to medium sand, some clay & silt fine gravel from weathered rock.
Z-1	800m from Zorzor G.S	LEFT	2.0m	0 - 0.5m	Moist tanish brown fine to coarse sand & clay & silt, little fine to medium gravel from weathered rock.
Z-2	9.3km from Z-1	LEFT	3.5m	0 - 0.8m	Moist red plastic clay, yellow harden silt, medium to coarse sand (ϕ 0.5 - 2mm).
Z-3	9.3km from Z-2	LEFT	0.5m	0 - 0.5m	Moist greyish brown fine to medium sand, little silt with mold.

Table II-1 Discription about Soil Sample (2)

SAMPLE	DISTANCE & INTERVAL	RIGHT OR LEFT FOR MENDIKOMA	DEPTH FROM CUT SLOPE TOP	DEPTH FROM ROAD SURFACE	DESCRIPTIONS ABOUT SAMPLES
Z-4	9.3km from Z-3	RIGHT	3.0m	0 - 0.5m	Moist grey & brown fine to medium sand & clay & silt, trace of fine gravel.
Z-5	9.3km from Z-4	LEFT	0.5m	0 - 0.5m	Moist tan & brown medium to fine sand & silt & clay, trace of mold and scoria.
Z-6	9.3km from Z-5	LEFT	0.6m	0 - 0.3m 0.3m - 0.6m	Red plastic clay with fine sand and gravel. Moist tanish brown medium to coarse sand & silty clay, much medium to fine gravel, trace of mold and milky siet.
Z-7	9.3km from Z-6	RIGHT	0.8m	0 - 0.4m 0.4m - 0.8m	Moist reddish brown clay with fine gravel from weathered rock. Light yellow silt with sand and fine gravel from weathered rock.
Z-8	9.3km from Z-7	LEFT	1.5m	0 - 0.5m	Wet reddish brown medium to fine sand, some silt & clay, trace or roots & mica.
Z-9	9.3km from Z-8	LEFT	1.0m	0 - 0.3m 0.3m - 0.5m	Moist dark grey sandy clay. Moist reddish brown silt & clay and medium to find sand, trace of fine gravel and roots, light milky silt in bottom layer.
Z-10	9.3km from Z-9	LEFT	2.0m	0 - 0.5m	Moist tanish brown clay & silt, some fine to coarse sand, trace of fine gravel & roots, milky red clay and yellow silt.
V-1	4.6km from Voinjama G.S	RIGHT	0 m	0 m	Existing quarry for selected laterite, wet dark brown fine to coarse gravel, some medium to coarse sand & silt & clay, trace of mold & roots.
V-2	8.6km from V-1	LEFT	1.0m	0 - 0.2m 0.2m - 1.0m	Dark grayish brown surface soil. Moist light milkyish gray sandy clay, trace of roots and silt.
V-3	8.6km from V-2	LEFT	3.0m	0 - 0.5m	Moist dark red clay and fine to medium sand, trace of mica.
V-4	8.6km from V-3	LEFT	0.5m	0 - 0.5m	Moist red plastic clay with fine gravel (ϕ 0.5-1.0cm) trace of barden silt and milky coarse gravel (ϕ 5cm).
V-5	8.6km from V-4	RIGHT	2.0m	0 - 0.5m	Moist reddish brown medium to fine sand, some clayey silt, milkyish white clay, trace of roots and harden sand.
V-6	8.6km from V-5	RIGHT	0 m	0 m	Existing quarry for selected laterite. Moist tanish brown fine to medium gravel, some silty clay & fine to medium sand, trace of milky clay.
V-7	8.6km from V-6	LEFT	2.0m	0 - 0.5m	Wet reddish brown silt & clay and medium to fine sand, trace of roots, trace of sandstone and mica.
V-8	8.6km from V-7	LEFT	1.2m	0 - 0.3m	Moist red and brown medium to fine sand, some clay and silt, little decomposed rock fragments, trace of fine to medium gravel, trace of roots and siltstone.
V-9	8.6km from V-8	RIGHT	0 m	0 m	Moist dark red fine to medium gravel (ϕ 1.0 - 3.0cm) some coarse to fine sand and silt, plastic red clay under 0.5m depth. Existing quarry for good lateritic material.

Table II-2 Summary of Soil Laboratory Test

LOCATION	SECTION	SAMPLE NO.	SAMPLE DEPTH (m)	GRAVEL %	SAND %	SILT & CLAY %	MAX DIAMETER (mm)	TYPE OF GRADING	LIQUID LIMIT LL (%)	PLASTIC LIMIT PL (%)	PLASTIC INDEX PI	SOIL CLASSIFICATION	NATURAL MOISTURE CONTENT w_n (%)	WET DENSITY t (g/cm ³)	DRY DENSITY d (g/cm ³)	TEST (AASHTO) CONDITION T 180	OPTIMUM MOISTURE CONTENT omc (%)	MAXIMUM DRY DENSITY d_{max} (g/cm ³)	TEST FOR SUBGRADE MATERIAL (%)	TEST FOR BASE MATERIAL %	DESIGN CBR																
																						GRADATION					CONSISTENCY			NATURAL STATE			COMPACTION			CBR TEST	
GBANGA-ZORZOR	I	G-1	0.5	-	-	-	-	-	43.7	35.8	7.9	A-5	24.3	1,778	1.4	-	-	-	-	-	-																
		G-2	1.0	65.1	19.8	15.1	25.4	C	-	-	-	A-1-b	13.9	1,825	1.6	-	-	-	9.1	-	-																
		G-3	1.0	26.8	35.8	37.4	25.4	(E)	49.3	33.4	15.9	A-7	19.0	2,129	1.8	-	-	-	-	-	8																
		G-4	0.5	4.6	37.5	57.9	9.5	F	26.8	24.2	2.6	A-4	19.5	2,015	1.7	-	-	-	8.1	-	-																
		G-5	0.5	18.5	39.9	41.6	19.1	(F)	54.0	22.8	31.2	A-7	22.3	1,915	1.6	-	-	-	-	-	-																
	II	G-6	1.0	37.3	23.6	39.1	19.1	(E)	36.4	23.6	12.8	A-6	25.1	1,884	1.5	C	13.8	1.92	19.0	-	-																
		G-7	1.5	38.1	34.6	27.3	19.1	(E~F)	37.8	22.3	15.5	A-2-6	13.2	2,050	1.8	-	-	-	-	-	-																
		G-8	2.0	34.9	38.9	26.2	25.4	(E~F)	42.2	18.1	24.1	A-2-7	13.3	1,897	1.7	-	-	-	20.7	-	-																
		G-9	4.0	1.1	59.9	39.0	4.76	(F)	35.6	21.8	13.8	A-6	27.7	1,836	1.4	-	-	-	-	-	8																
		G-10	1.0	1.4	59.9	38.7	4.76	(F)	32.5	20.8	11.7	A-6	20.5	1,859	1.5	-	-	-	6.6	-	-																
		G-11	2.0	22.5	45.7	31.2	19.1	D	37.5	26.9	10.6	A-2-6	24.8	1,694	1.4	-	-	-	-	-	-																
ZORZOR-VOINJAMA	III	Z-1	2.0	24.6	32.2	43.2	19.1	(F)	51.1	34.5	16.6	A-7	22.7	1,983	1.6	-	-	-	17.4	-	-																
		Z-2	3.5	19.2	36.8	44.0	12.7	(F)	46.4	27.1	19.3	A-7	20.2	2,000	1.7	-	-	-	-	-	-																
		Z-3	0.5	3.4	60.3	36.3	9.5	(E~F)	26.8	16.4	10.4	A-4	12.9	2,019	1.8	C	10.6	2.00	15.7	-	-																
		Z-4	3.0	17.0	36.8	46.2	12.7	(F)	-	-	-	A-7	20.8	2,015	1.7	-	-	-	-	-	7																
		Z-5	0.5	8.4	41.4	50.2	4.76	(F)	47.1	31.0	16.1	A-7	21.6	2,004	1.7	-	-	-	6.6	-	-																
		Z-6	0.6	21.6	44.0	34.4	25.4	(F)	56.6	31.3	25.3	A-2-7	16.7	2,017	1.7	-	-	-	-	-	-																
		Z-7	0.8	13.1	32.2	54.7	25.4	(F)	37.2	27.0	10.2	A-2-4	21.9	2,006	1.7	-	-	-	8.3	-	-																
		Z-8	1.5	4.9	73.3	21.9	9.5	F	55.4	30.8	24.6	A-2-7	26.7	1,848	1.5	-	-	-	-	-	-																
VOINJAMA-MENDEKOMA	IV	Z-9	1.0	16.5	35.1	48.4	19.1	(F)	38.4	24.1	14.3	A-6	17.8	2,057	1.8	-	-	-	8.3	-	-																
		Z-10	2.0	-	-	-	-	-	-	-	-	-	21.9	1,955	1.6	-	-	-	6.6	-	-																
		V-1	0	57.0	19.6	23.4	25.4	D	52.8	23.5	29.3	A-2-7	14.9	2,095	1.8	-	-	-	-	-	-																
		V-2	1.0	0.4	58.1	41.5	4.76	(F)	3.8	21.9	16.9	A-6	17.5	1,933	1.7	C	14.0	1.86	5.8	-	-																
		V-3	3.0	-	-	-	-	-	-	-	-	-	26.1	1,752	1.4	-	-	-	-	-	4																
		V-4	0.5	16.3	40.9	42.9	9.5	F	42.4	28.2	14.2	A-7	20.0	1,891	1.6	-	-	-	-	-	-																
		V-5	2.0	2.9	67.7	29.4	9.5	F	38.6	22.0	16.6	A-2-6	24.2	1,926	1.6	-	-	-	6.6	-	-																
	V-6	0	41.9	28.2	29.9	19.1	D	56.2	29.2	27.0	A-2-7	17.7	2,014	1.7	-	-	-	-	-	-																	
	V-7	2.0	2.4	34.5	63.1	4.76	(F)	51.6	44.5	7.1	A-5	33.5	1,848	1.4	-	-	-	4.6	-	-																	
	V	V-8	1.2	13.0	55.3	31.7	19.1	F	38.9	25.5	13.4	A-2-6	16.1	2,103	1.8	-	-	-	13.2	-	-																
V-9	0	52.1	16.6	31.5	25.4	(D)	36.8	27.7	10.1	A-2-4	22.6	2,211	1.8	-	-	-	-	-	-	11																	
V-9'	0.5	-	-	-	-	-	-	-	-	-	-	35.2	1,870	1.4	-	-	-	-	-	-																	
		G-3 & V-9	-	47.5	25.4	27.1	19.1	(D)	42.1	29.7	12.4	A-2-7	-	-	-	-	16.2	1.89	-	63/49																	

Table II-3 Extended Unified Soil Classifications System to laterite soils

CLASSIFICATIONS TO BE MADE ON ALL SOIL MATERIALS						Soundness classification to be made on aggregates if desired			
LESS THAN 50% PASSING THE # 200 SIEVE	ROCK	Gravel or rock greater than 8 inches		Boulder	Large crushed or weathered rock fragments				
		Gravel or rock between 3 inches and 8 inches		Cobble	Medium sized crushed or weathered rock fragments				
	GRAVEL	Gravel or rock smaller than 3" in which the majority of the material retained on the # 200 sieve is also retained on the # 4 sieve	CLEAN	≤ 5% Passing # 200	$\frac{C_u}{C_c} \leq 5$	GW	Well graded gravels with very few fines	Perform the California Coarse Durability Test on the natural, or as used, grading of the 3/4" to #4 fraction of the material. Add symbol: $D_c > 35$ use symbol (1) $20 \leq D_c \leq 35$ use symbol (2) $D_c < 20$ use symbol (3) i.e., GCL (2)	
				6 - 12% Passing # 200	$\frac{C_u}{C_c} \leq 5$	GP	Poorly graded gravels with very few fines		
			DIRTY	6 - 12% Passing # 200	$\frac{C_u}{C_c} \leq 5$	GW/---	Well graded gravels with silt or clay fines		Classify minus # 40 material as for clay and silt below. Add the appropriate symbol in the location indicated by dashes; i.e., GW/CL or GCI
				6 - 12% Passing # 200	$\frac{C_u}{C_c} \leq 5$	GP/---	Poorly graded gravels with silt or clay fines		
			EXCESS FINES	> 12% Passing # 200		GM---	Gravel - sand - silt mixtures of variable plasticity		
				> 12% Passing # 200		GC---	Gravel - sand - clay mixtures of variable plasticity		
	SAND	Majority of the material retained on the # 200 sieve passes the # 4 sieve	CLEAN	≤ 5% Passing # 200	$\frac{C_u}{C_c} \leq 5$	SW	Well graded sands with very few fines	Perform the California Fines Durability Test on the natural, or as used, grading of the minus # 4 material. Add symbol: $D_f > 35$ use symbol (1) $20 \leq D_f \leq 35$ use symbol (2) $D_f < 20$ use symbol (3)	
				6 - 12% Passing # 200	$\frac{C_u}{C_c} \leq 5$	SP	Poorly graded sands with very few fines		
DIRTY			6 - 12% Passing # 200	$\frac{C_u}{C_c} \leq 5$	SW/--	Well graded sands with clay or silt fines	Classify minus # 40 material as for clay and silt below. Add the appropriate symbol in the location indicated by dashes; i.e., SP/ML or SMH		
			6 - 12% Passing # 200	$\frac{C_u}{C_c} \leq 5$	SP/--	Poorly graded sands with clay or silt fines			
EXCESS FINES			> 12% Passing # 200		SM---	Clayey - silty sands of variable plasticity			
			> 12% Passing # 200		SC---	Very sandy clays and clayey sands of variable plasticity			
50% OR MORE PASSING THE # 200 SIEVE	CLAY AND SILT	Non - Plastic	Atterberg limits unobtainable		SF	Very fine sands, sandy - silts, silts			
		LL of minus # 40 material < 35	Atterberg limits plot above 'A' line or in hatched area		CL	Inorganic clayey silts, clays of low plasticity			
			Atterberg limits plot below 'A' line or in hatched area		ML	Inorganic silts, and rock flour of low compressibility			
		LL of minus # 40 material 35 to 50	Atterberg limits plot above 'A' line		OL	Organic silts and clays			
			Atterberg limits plot below 'A' line		CI	Inorganic clays of moderate plasticity			
		LL of minus # 40 material > 50	Atterberg limits plot above 'A' line		MI	Inorganic silty clays, moderately compressible silts			
			Atterberg limits plot below 'A' line		OI	Organic clays and clays			
		Atterberg limits plot above 'A' line		CH	Inorganic clays of high plasticity				
		Atterberg limits plot below 'A' line		MH	Highly compressible silts, micaceous or diatomaceous soils				
		Atterberg limits plot below 'A' line		OH	Organic clays and clays				
		Decaying organic soils usually brown or black possibly with strong odor		P	Fibrous organic soils with very high compressibility and moisture content				
				T					

* $C_u = \frac{D_{60}}{D_{10}}$, $C_c = \frac{(D_{40})^2}{D_{60}D_{10}}$, the term D_{10} , etc., means the diameter of the particle corresponding to the 10% passing point on the plot of grain size versus percent passing

** California State Highway Department, Materials Division, Sacramento, California, Test Procedure 229

D_c = Coarse durability for gravels.
 D_f = Fine durability for sands.
 C_c = Coefficient of curvature.
 C_u = Coefficient of uniformity.

Source: Laterite Soil Engineering by M.D. Gidigasu

Test Result (1)

GRADATION ANALYSIS (ANALYSE GRANULOMÉTRIQUE)			FOR REPORTING (POUR LE RAPPORT)
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	G - 4	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	(m - m)	TESTED BY (ESSAI PAR)	

PARTICLE SIZE & WEIGHT PERCENTAGE OF PARTICLES UNDER THE SIZE
(DIMENSION DES PARTICULES ET POURCENTAGE DE POIDS DES PARTICULES DE DIMENSION INFÉRIEURE AUX PRÉCÉDENTES)

SPECIFIC GRAVITY
(POIDS SPÉCIFIQUE) G_s

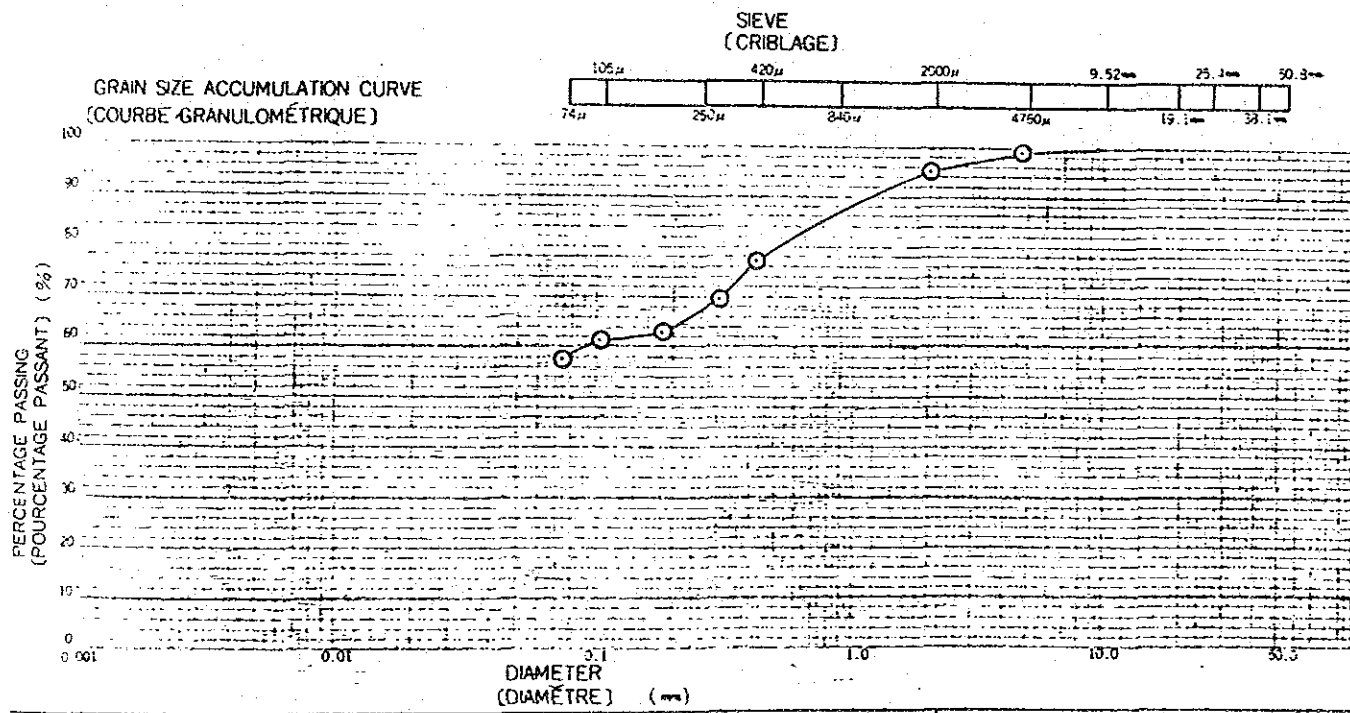
SIEVE (CRIBLAGE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)	50-8	38-1	25-4	19-1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
	TOTAL PASSING (%) (TOTAL PASSANT)	38.1	25.4	19.1	12.7				0.62	0.30	0.18		
HYDROMETER (ARÉOMÈTRE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)					100	99.4	95.4	77.1	69.9	63.0	61.5	57.9
	TOTAL PASSING (%) (TOTAL PASSANT)												

GRADATION ANALYSIS (ANALYSE GRANULOMÉTRIQUE)			FOR REPORTING (POUR LE RAPPORT)
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	G - 8	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	(m - m)	TESTED BY (ESSAI PAR)	

PARTICLE SIZE & WEIGHT PERCENTAGE OF PARTICLES UNDER THE SIZE
(DIMENSION DES PARTICULES ET POURCENTAGE DE POIDS DES PARTICULES DE DIMENSION INFÉRIEURE AUX PRÉCÉDENTES)

SPECIFIC GRAVITY
(POIDS SPÉCIFIQUE) G_s

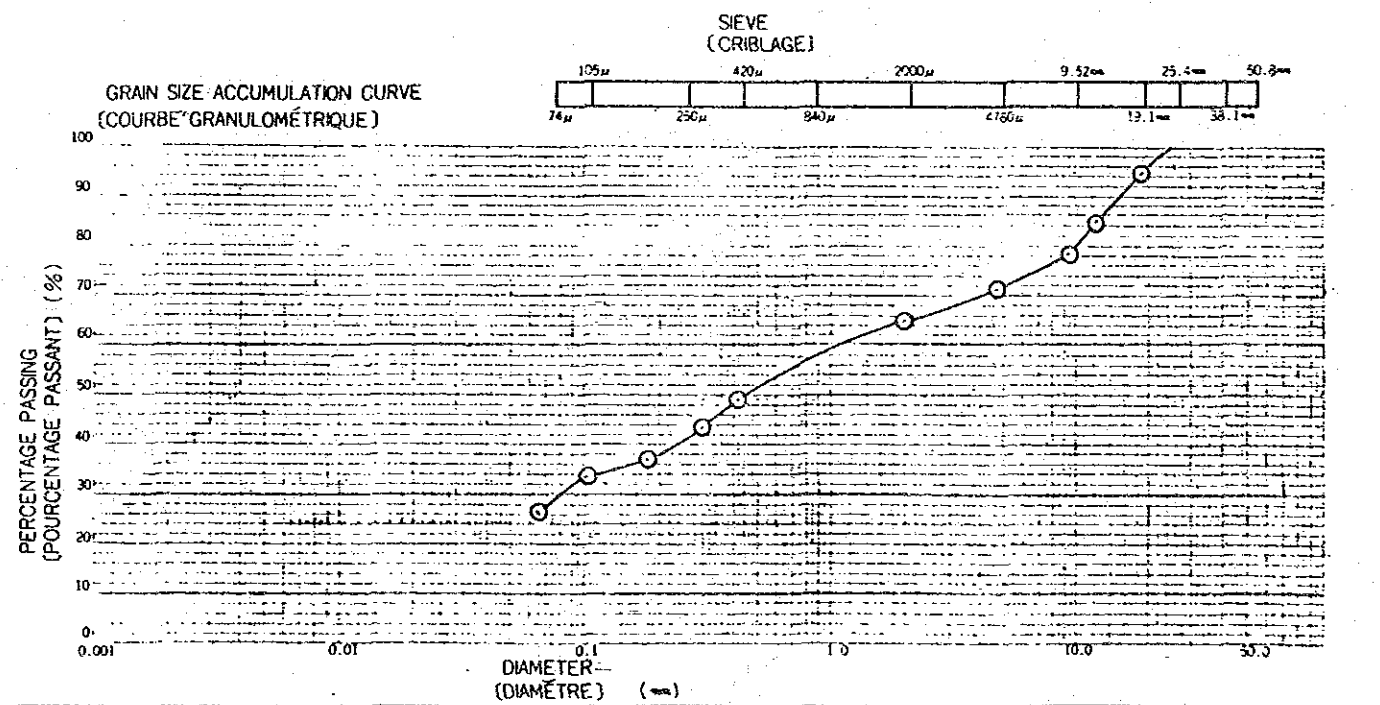
SIEVE (CRIBLAGE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)	50-8	38-1	25-4	19-1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
	TOTAL PASSING (%) (TOTAL PASSANT)	38.1	25.4	19.1	12.7				0.42	0.30	0.18		
HYDROMETER (ARÉOMÈTRE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)					100	96.2	84.4	78.2	71.2	65.1	49.3	43.9
	TOTAL PASSING (%) (TOTAL PASSANT)											36.7	33.9
													26.2



CLAY (ARGILE)	SILT (SLT)	SAND (SABLE)	GRAVEL (GRAVIER)
0.001	0.005	0.074	2.0

* COLLOID
(COLLOÏDE)

PROPORTION (PROPORTION)	4.76mm <	0.6 %	MAXIMUM DIAMETER (DIAMÈTRE MAXIMUM)	9.5 mm
	4.76 ~ 2.00mm	4.0 %	60% DIAMETER (DIAMÈTRE 60%)	0.091 mm
	2.00 ~ 0.42mm	18.3 %	30% DIAMETER (DIAMÈTRE 30%)	mm
	0.42 ~ 0.074mm	19.2 %	10% DIAMETER (DIAMÈTRE 10%)	mm
	0.074 ~ 0.005mm	57.9 %	COEFFICIENT OF UNIFORMITY (COEFFICIENT D'UNIFORMITÉ)	
	0.005mm >		COEFFICIENT OF CURVATURE (COEFFICIENT DE COURBURE)	



CLAY (ARGILE)	SILT (SLT)	SAND (SABLE)	GRAVEL (GRAVIER)
0.001	0.005	0.074	2.0

* COLLOID
(COLLOÏDE)

PROPORTION (PROPORTION)	4.76mm <	28.8 %	MAXIMUM DIAMETER (DIAMÈTRE MAXIMUM)	25.4 mm
	4.76 ~ 2.00mm	6.1 %	60% DIAMETER (DIAMÈTRE 60%)	11.0 mm
	2.00 ~ 0.42mm	15.8 %	30% DIAMETER (DIAMÈTRE 30%)	0.08 mm
	0.42 ~ 0.074mm	23.1 %	10% DIAMETER (DIAMÈTRE 10%)	mm
	0.074 ~ 0.005mm	26.2 %	COEFFICIENT OF UNIFORMITY (COEFFICIENT D'UNIFORMITÉ)	
	0.005mm >		COEFFICIENT OF CURVATURE (COEFFICIENT DE COURBURE)	

Test Result (2)

GRADATION ANALYSIS (ANALYSE GRANULOMÉTRIQUE)		FOR REPORTING (POUR LE RAPPORT)	
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	Z-7	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	(m - m)	TESTED BY (ESSAI PAR)	

PARTICLE SIZE & WEIGHT PERCENTAGE OF PARTICLES UNDER THE SIZE
(DIMENSION DES PARTICULES ET POURCENTAGE DE POIDS DES PARTICULES DE DIMENSION INFÉRIEURE AUX PRÉCÉDENTES)

SPECIFIC GRAVITY
(POIDS SPÉCIFIQUE) G_s

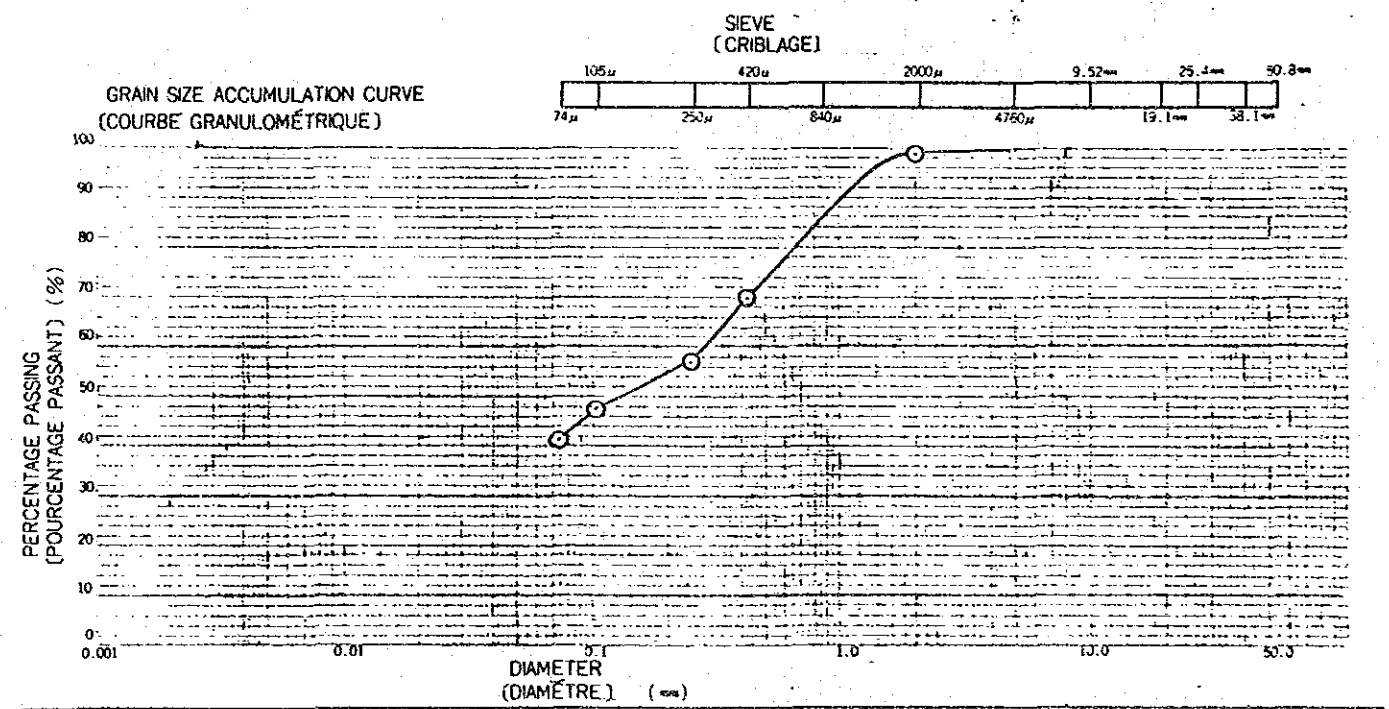
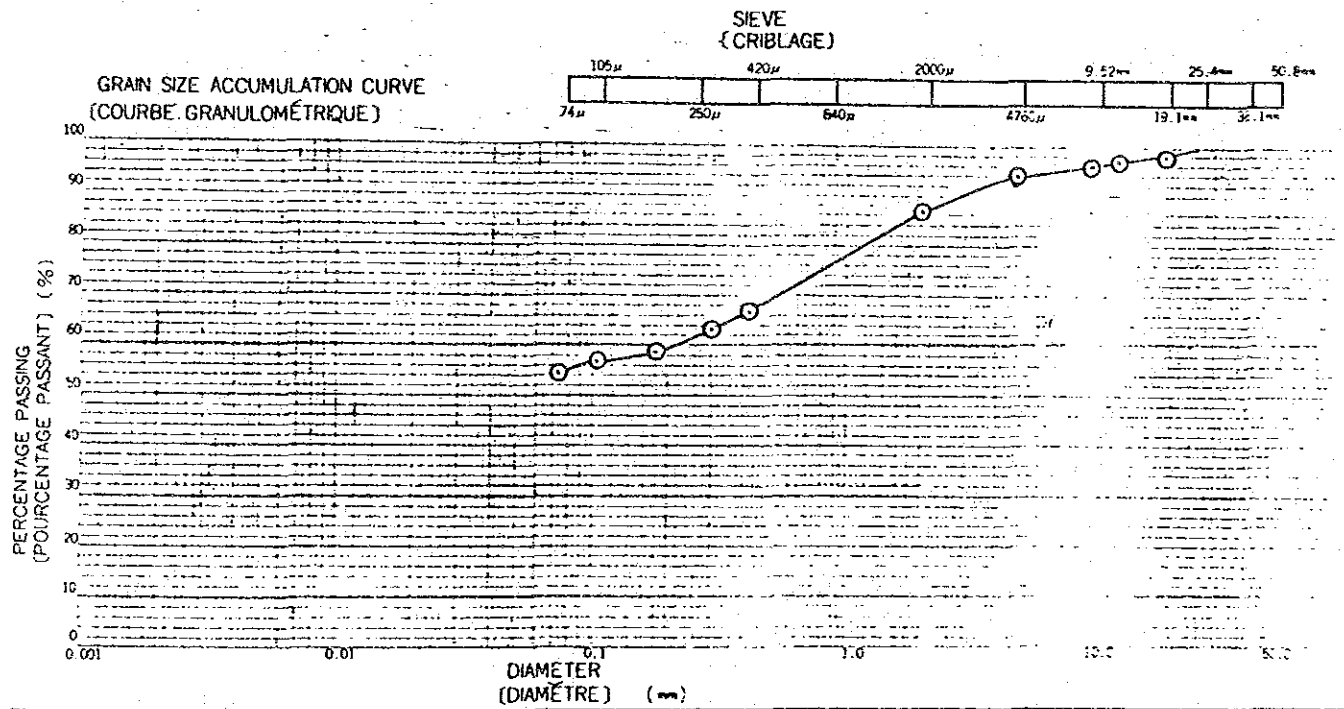
SIEVE (CRIBLAGE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)	50-8	38-7	25-4	19-1	9-52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
	TOTAL PASSING (%) (TOTAL PASSANT)	38.7	25.4	19.1	12.7	96.9	94.3	86.9	66.7	63.5	58.8	57.4	54.7
HYDROMETER (ARÉOMÈTRE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)												
	TOTAL PASSING (%) (TOTAL PASSANT)												

GRADATION ANALYSIS (ANALYSE GRANULOMÉTRIQUE)		FOR REPORTING (POUR LE RAPPORT)	
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	V-2	DATE (DATE)	
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	(m - m)	TESTED BY (ESSAI PAR)	

PARTICLE SIZE & WEIGHT PERCENTAGE OF PARTICLES UNDER THE SIZE
(DIMENSION DES PARTICULES ET POURCENTAGE DE POIDS DES PARTICULES DE DIMENSION INFÉRIEURE AUX PRÉCÉDENTES)

SPECIFIC GRAVITY
(POIDS SPÉCIFIQUE) G_s

SIEVE (CRIBLAGE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)	50-8	38-7	25-4	19-1	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
	TOTAL PASSING (%) (TOTAL PASSANT)	38.7	25.4	19.1	12.7		100	99.6		76.0	57.2	47.9	41.5
HYDROMETER (ARÉOMÈTRE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)												
	TOTAL PASSING (%) (TOTAL PASSANT)												



CLAY (ARGILE)	SILT (SILT)	SAND (SABLE)	GRAVEL (GRAVIER)
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CLAY (ARGILE)	SILT (SILT)	SAND (SABLE)	GRAVEL (GRAVIER)
---------------	-------------	--------------	------------------

* COLLOID
(COLLOÏDE)

* COLLOID
(COLLOÏDE)

PROPORTION (PROPORTION)	4.76mm <	%	MAXIMUM DIAMETER (DIAMÈTRE MAXIMUM)	mm
	4.76 ~ 2.00mm	5.7	60% DIAMETER (DIAMÈTRE 60%)	25.4
	2.00 ~ 0.42mm	7.4	30% DIAMETER (DIAMÈTRE 30%)	0.22
	0.42 ~ 0.074mm	20.2	10% DIAMETER (DIAMÈTRE 10%)	
	0.074 ~ 0.005mm	12.0	COEFFICIENT OF UNIFORMITY (COEFFICIENT D'UNIFORMITÉ)	
	0.005mm >	54.7	COEFFICIENT OF CURVATURE (COEFFICIENT DE COURBURE)	

PROPORTION (PROPORTION)	4.76mm <	%	MAXIMUM DIAMETER (DIAMÈTRE MAXIMUM)	mm
	4.76 ~ 2.00mm	0	60% DIAMETER (DIAMÈTRE 60%)	4.76
	2.00 ~ 0.42mm	0.4	30% DIAMETER (DIAMÈTRE 30%)	0.29
	0.42 ~ 0.074mm	28.6	10% DIAMETER (DIAMÈTRE 10%)	
	0.074 ~ 0.005mm	28.5	COEFFICIENT OF UNIFORMITY (COEFFICIENT D'UNIFORMITÉ)	
	0.005mm >	41.5	COEFFICIENT OF CURVATURE (COEFFICIENT DE COURBURE)	

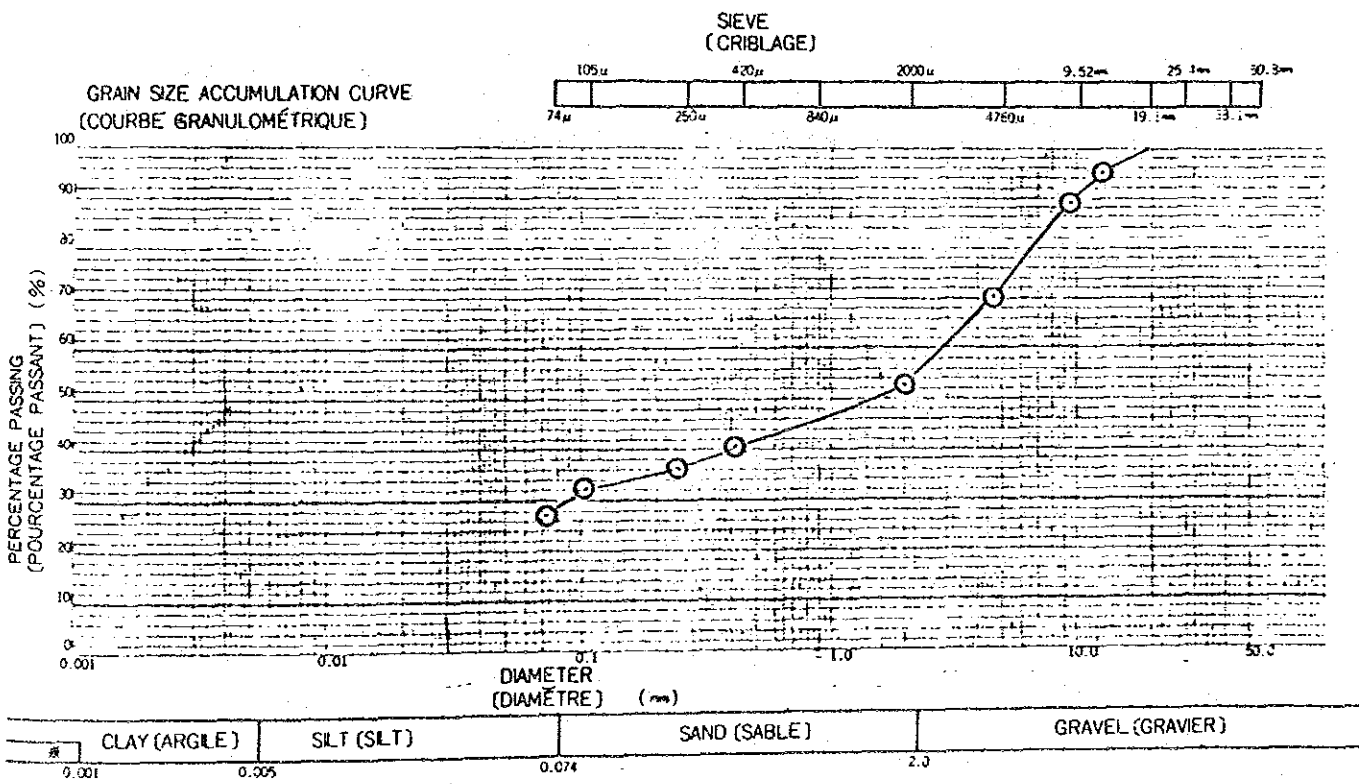
Test Result (3)

GRADATION ANALYSIS (ANALYSE GRANULOMÉTRIQUE)		FOR REPORTING (POUR LE RAPPORT)	
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	G-3 & V-9	DATE (DATE)	
SAMPLE NO & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	(m ~ m)	TESTED BY (ESSAI PAR)	

PARTICLE SIZE & WEIGHT PERCENTAGE OF PARTICLES UNDER THE SIZE
(DIMENSION DES PARTICULES ET POURCENTAGE DE POIDS DES PARTICULES DE DIMENSION INFÉRIEURE AUX PRÉCÉDENTES)

SPECIFIC GRAVITY
(POIDS SPÉCIFIQUE) G_s

SIEVE (CRIBLAGE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)	50-8	38-1	25-4 19.1	19-1 12.7	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
TOTAL PASSING (%) (TOTAL PASSANT)				100	95.0	87.3	70.4	52.5	-	40.5	36.3	32.1	27.1
HYDROMETER (LABOROMÉTRIE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)												
TOTAL PASSING (%) (TOTAL PASSANT)													



* COLLOID
(COLLOÏDE)

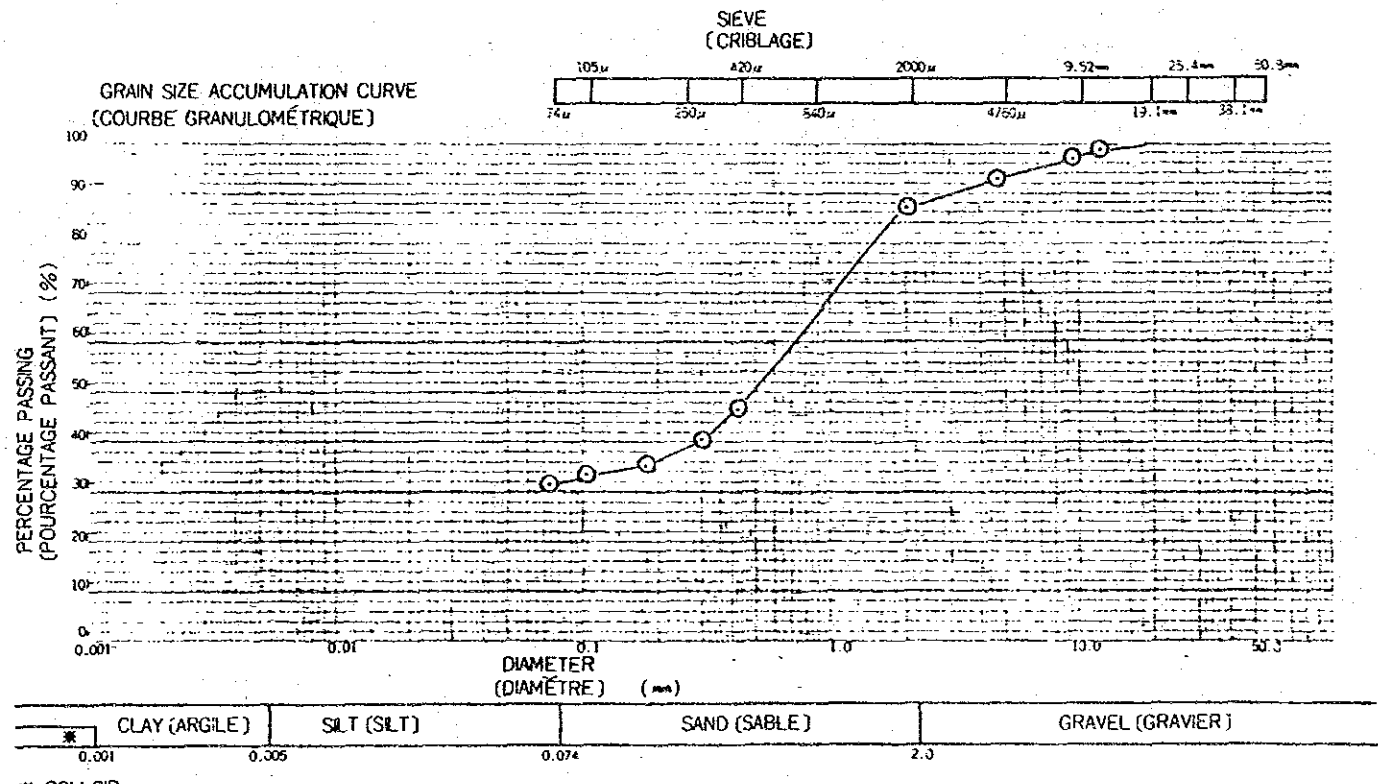
PROPORTION (PROPORTION)	4.76mm <	29.6 %	MAXIMUM DIAMETER (DIAMÈTRE MAXIMUM)	19.1 mm
	4.76-2.00mm	17.9 %	60% DIAMETER (DIAMÈTRE 60%)	2.9 mm
	2.00-0.42mm	12.0 %	30% DIAMETER (DIAMÈTRE 30%)	0.09 mm
	0.42-0.074mm	13.4 %	10% DIAMETER (DIAMÈTRE 10%)	mm
	0.074-0.005mm	27.1 %	COEFFICIENT OF UNIFORMITY (COEFFICIENT D'UNIFORMITÉ)	
	0.005mm >		COEFFICIENT OF CURVATURE (COEFFICIENT DE COURBURE)	

GRADATION ANALYSIS (ANALYSE GRANULOMÉTRIQUE)		FOR REPORTING (POUR LE RAPPORT)	
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)	V-8	DATE (DATE)	
SAMPLE NO & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)	(m ~ m)	TESTED BY (ESSAI PAR)	

PARTICLE SIZE & WEIGHT PERCENTAGE OF PARTICLES UNDER THE SIZE
(DIMENSION DES PARTICULES ET POURCENTAGE DE POIDS DES PARTICULES DE DIMENSION INFÉRIEURE AUX PRÉCÉDENTES)

SPECIFIC GRAVITY
(POIDS SPÉCIFIQUE) G_s

SIEVE (CRIBLAGE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)	50-8	38-1	25-4 19.1	19-1 12.7	9.52	4.76	2.00	0.84	0.42	0.25	0.105	0.074
TOTAL PASSING (%) (TOTAL PASSANT)				100	98.8	97.1	93.4	87.0	46.6	40.5	35.5	33.9	31.7
HYDROMETER (LABOROMÉTRIE)	GRAIN SIZE (mm) (GRANULOMÉTRIE)												
TOTAL PASSING (%) (TOTAL PASSANT)													



* COLLOID
(COLLOÏDE)

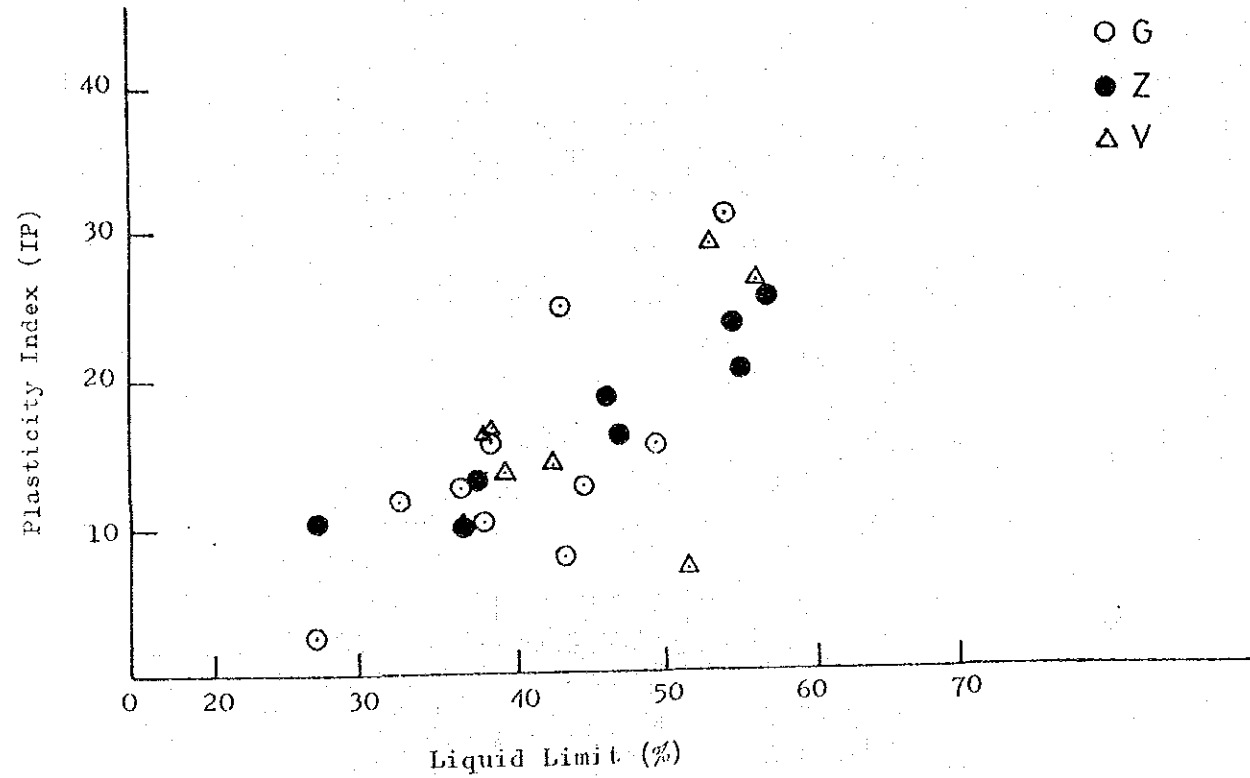
PROPORTION (PROPORTION)	4.76mm <	6.6 %	MAXIMUM DIAMETER (DIAMÈTRE MAXIMUM)	19.1 mm
	4.76-2.00mm	6.4 %	60% DIAMETER (DIAMÈTRE 60%)	0.73 mm
	2.00-0.42mm	40.4 %	30% DIAMETER (DIAMÈTRE 30%)	mm
	0.42-0.074mm	14.9 %	10% DIAMETER (DIAMÈTRE 10%)	mm
	0.074-0.005mm	31.7 %	COEFFICIENT OF UNIFORMITY (COEFFICIENT D'UNIFORMITÉ)	
	0.005mm >		COEFFICIENT OF CURVATURE (COEFFICIENT DE COURBURE)	

Test Result (4)

The correlation of Liquid Limit (W_L) and Plasticity Index (I_p) is given below.

I_p of the most of samples is over than 6 ranging 10 to 25, which is required for subbase course materials in AASHTO M 147-65.

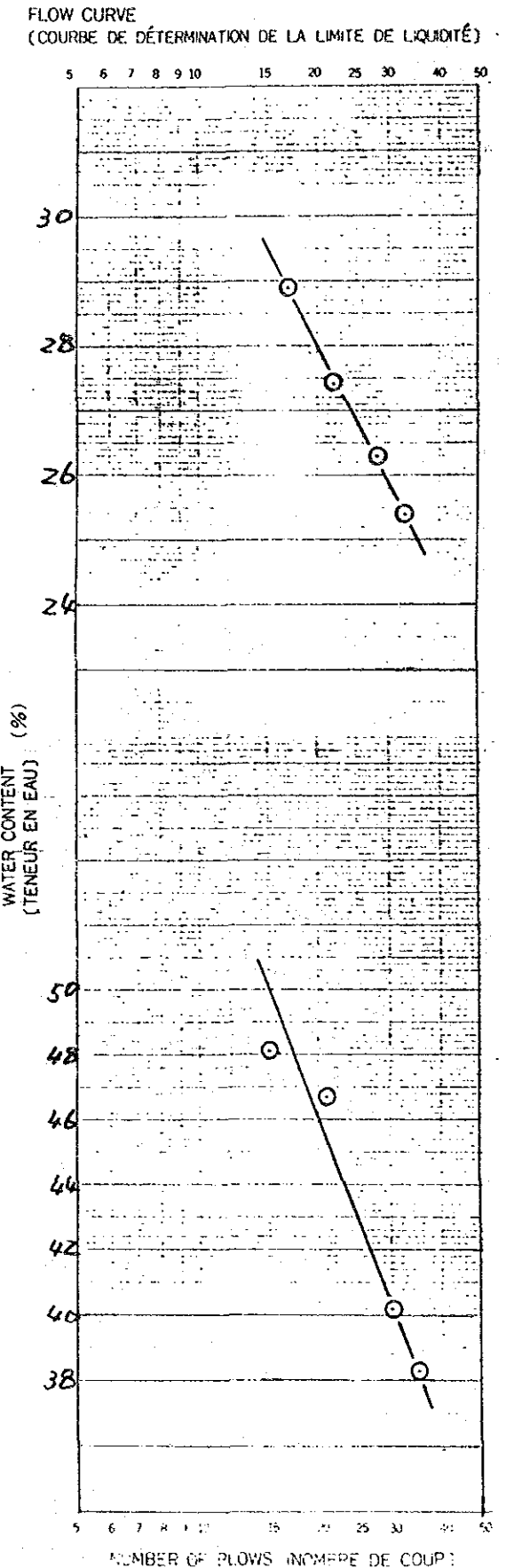
Six (6) results from all test results are picked up and shown hereunder



LIQUID LIMIT & PLASTIC LIMIT TEST (ESSAI DE LIMITE DE LIQUIDITÉ ET DE LIMITE DE PLASTICITÉ)			FOR REPORTING (POUR LE RAPPORT)
NAME OF SURVEY & LOCALITY (DÉNOMINATION DE L'ENQUÊTE ET LOCALITÉ)			
DATE (DATE)		TESTED BY (ESSAI PAR)	

SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)		No G-4 (m - m)		
LIQUID LIMIT TEST (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT TEST (LIMITE DE PLASTICITÉ)		
TEST. NO. (N° DE L'ESSAI)	NO. OF BLOWS (NOMBRE DE COUP)	WATER CONTENT (TENEUR EN EAU)	TEST. NO. (N° DE L'ESSAI)	WATER CONTENT (TENEUR EN EAU)
1	33	25.4 %	1	23.7 %
2	28	26.3 %	2	24.6 %
3	22	27.4 %	3	%
4	17	28.9 %		
5		%		
6		%	MEAN VALUE (VALEUR MOYENNE) 24.2	
LIQUID LIMIT (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT (LIMITE DE PLASTICITÉ)	PLASTICITY INDEX (INDICE DE PLASTICITÉ)	
w_L 26.8 %		w_p 24.2 %	I_p 2.6	

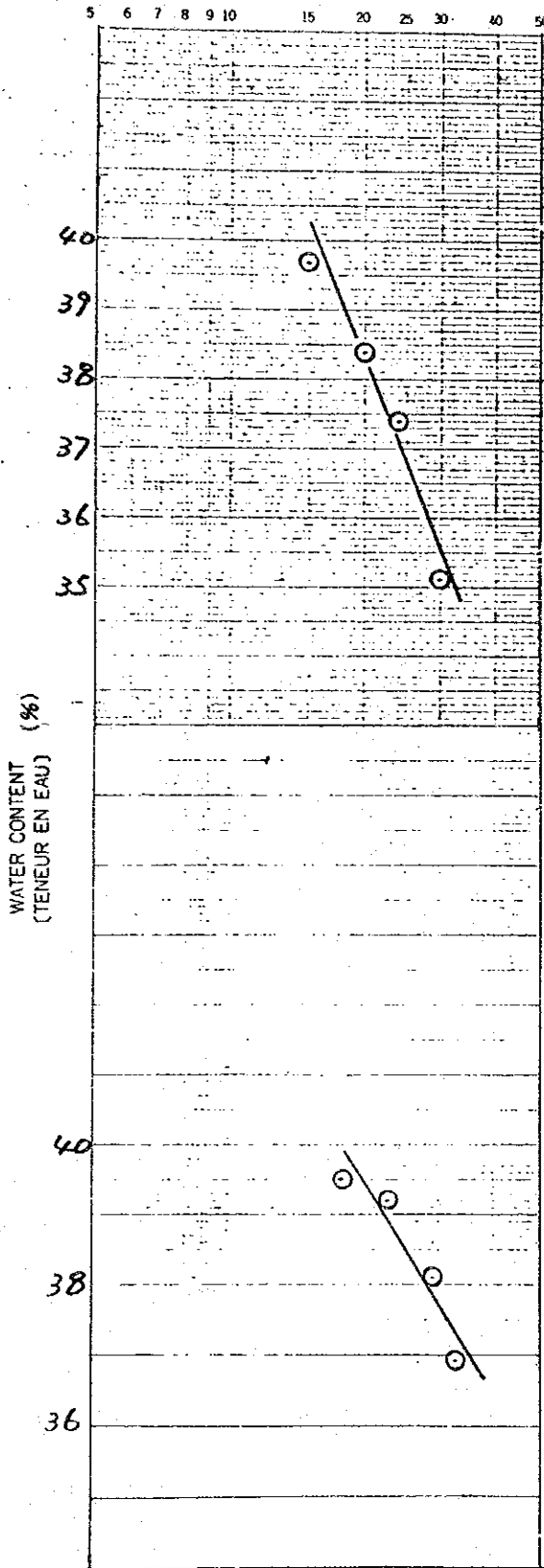
SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)		No G-8 (m - m)		
LIQUID LIMIT TEST (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT TEST (LIMITE DE PLASTICITÉ)		
TEST. NO. (N° DE L'ESSAI)	NO. OF BLOWS (NOMBRE DE COUP)	WATER CONTENT (TENEUR EN EAU)	TEST. NO. (N° DE L'ESSAI)	WATER CONTENT (TENEUR EN EAU)
1	35	38.3 %	1	18.2 %
2	30	40.2 %	2	18.0 %
3	21	46.7 %	3	%
4	15	48.1 %		
5		%		
6		%	MEAN VALUE (VALEUR MOYENNE) 18.1	
LIQUID LIMIT (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT (LIMITE DE PLASTICITÉ)	PLASTICITY INDEX (INDICE DE PLASTICITÉ)	
w_L 43.0 %		w_p 18.1 %	I_p 24.9	



LIQUID LIMIT & PLASTIC LIMIT TEST (ESSAI DE LIMITE DE LIQUIDITE ET DE LIMITE DE PLASTICITE)		FOR REPORTING (POUR LE RAPPORT)
NAME OF SURVEY & LOCALITY (DENOMINATION DE L'ENQUETE ET LOCALITE)		
DATE (DATE)	TESTED BY (ESSAI PAR)	

SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)		No Z-7 (m - m)			
LIQUID LIMIT TEST (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT TEST (LIMITE DE PLASTICITÉ)			
TEST NO. (N° DE L'ESSAI)	NO. OF BLOWS (NOMBRE DE COUP)	WATER CONTENT (TENEUR EN EAU)	TEST NO. (N° DE L'ESSAI)	WATER CONTENT (TENEUR EN EAU)	
1	30	35.1 %	1	26.7 %	
2	24	32.4 %	2	27.3 %	
3	20	38.4 %	3	%	
4	15	39.7 %			
5		%			
6		%	MEAN VALUE (VALEUR MOYENNE)	27.0	
LIQUID LIMIT (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT (LIMITE DE PLASTICITÉ)		PLASTICITY INDEX (INDICE DE PLASTICITÉ)	
w _L	36.8 %	w _p	27.0 %	I _p	9.8

FLOW CURVE
(COURBE DE DÉTERMINATION DE LA LIMITE DE LIQUIDITÉ)



SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)		No V-2 (m - m)			
LIQUID LIMIT TEST (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT TEST (LIMITE DE PLASTICITÉ)			
TEST NO. (N° DE L'ESSAI)	NO. OF BLOWS (NOMBRE DE COUP)	WATER CONTENT (TENEUR EN EAU)	TEST NO. (N° DE L'ESSAI)	WATER CONTENT (TENEUR EN EAU)	
1	33	36.9 %	1	20.8 %	
2	29	38.1 %	2	22.9 %	
3	23	38.2 %	3	%	
4	18	39.5 %			
5		%			
6		%	MEAN VALUE (VALEUR MOYENNE)	21.9	
LIQUID LIMIT (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT (LIMITE DE PLASTICITÉ)		PLASTICITY INDEX (INDICE DE PLASTICITÉ)	
w _L	38.5 %	w _p	21.9 %	I _p	16.6

WATER CONTENT (TENEUR EN EAU) (%)

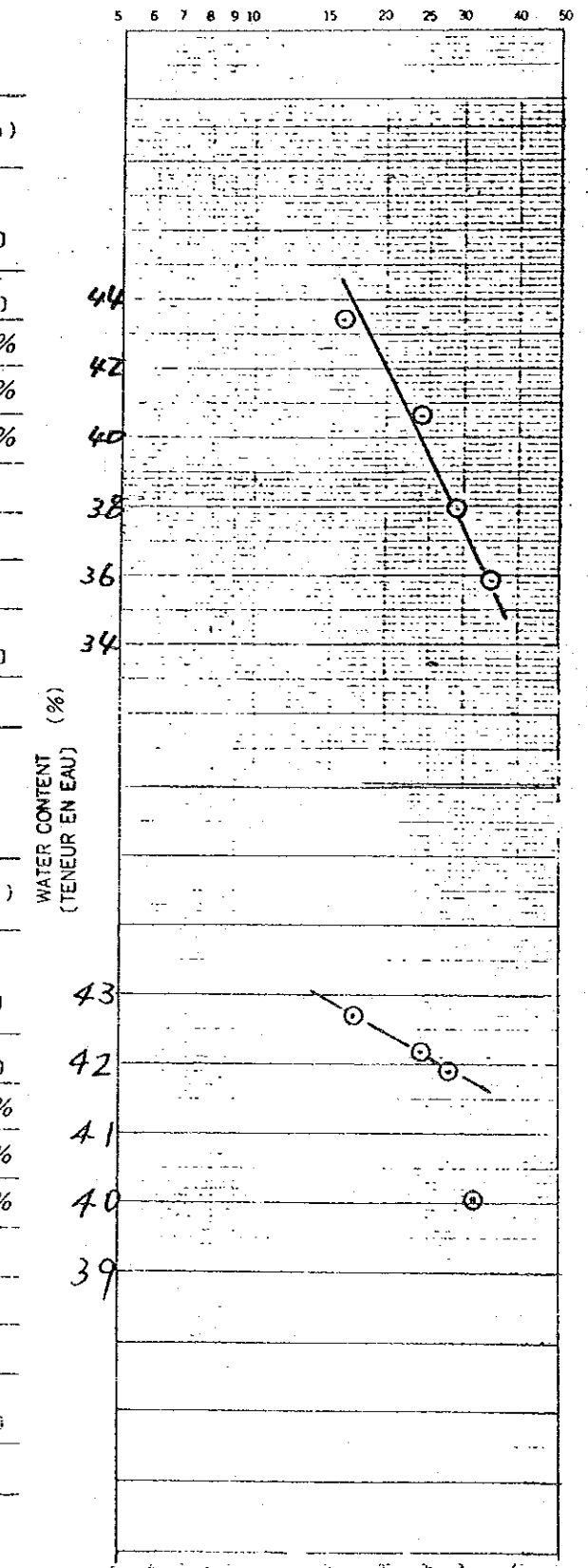
40
38
36

NUMBER OF BLOWS (NOMBRE DE COUP)

LIQUID LIMIT & PLASTIC LIMIT TEST (ESSAI DE LIMITE DE LIQUIDITE ET DE LIMITE DE PLASTICITE)		FOR REPORTING (POUR LE RAPPORT)
NAME OF SURVEY & LOCALITY (DENOMINATION DE L'ENQUETE ET LOCALITE)		
DATE (DATE)	TESTED BY (ESSAI PAR)	

SAMPLE NO. & DEPTH (N° DE L'ÉCHANTILLON ET PROFONDEUR)		No V-8 (m - m)			
LIQUID LIMIT TEST (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT TEST (LIMITE DE PLASTICITÉ)			
TEST NO. (N° DE L'ESSAI)	NO. OF BLOWS (NOMBRE DE COUP)	WATER CONTENT (TENEUR EN EAU)	TEST NO. (N° DE L'ESSAI)	WATER CONTENT (TENEUR EN EAU)	
1	35	35.8 %	1	25.3 %	
2	29	37.9 %	2	25.6 %	
3	24	40.6 %	3	%	
4	16	43.4 %			
5		%			
6		%	MEAN VALUE (VALEUR MOYENNE)	25.5	
LIQUID LIMIT (LIMITE DE LIQUIDITÉ)		PLASTIC LIMIT (LIMITE DE PLASTICITÉ)		PLASTICITY INDEX (INDICE DE PLASTICITÉ)	
w _L	39.4 %	w _p	25.5 %	I _p	13.9

FLOW CURVE
(COURBE DE DÉTERMINATION DE LA LIMITE DE LIQUIDITÉ)



WATER CONTENT (TENEUR EN EAU) (%)

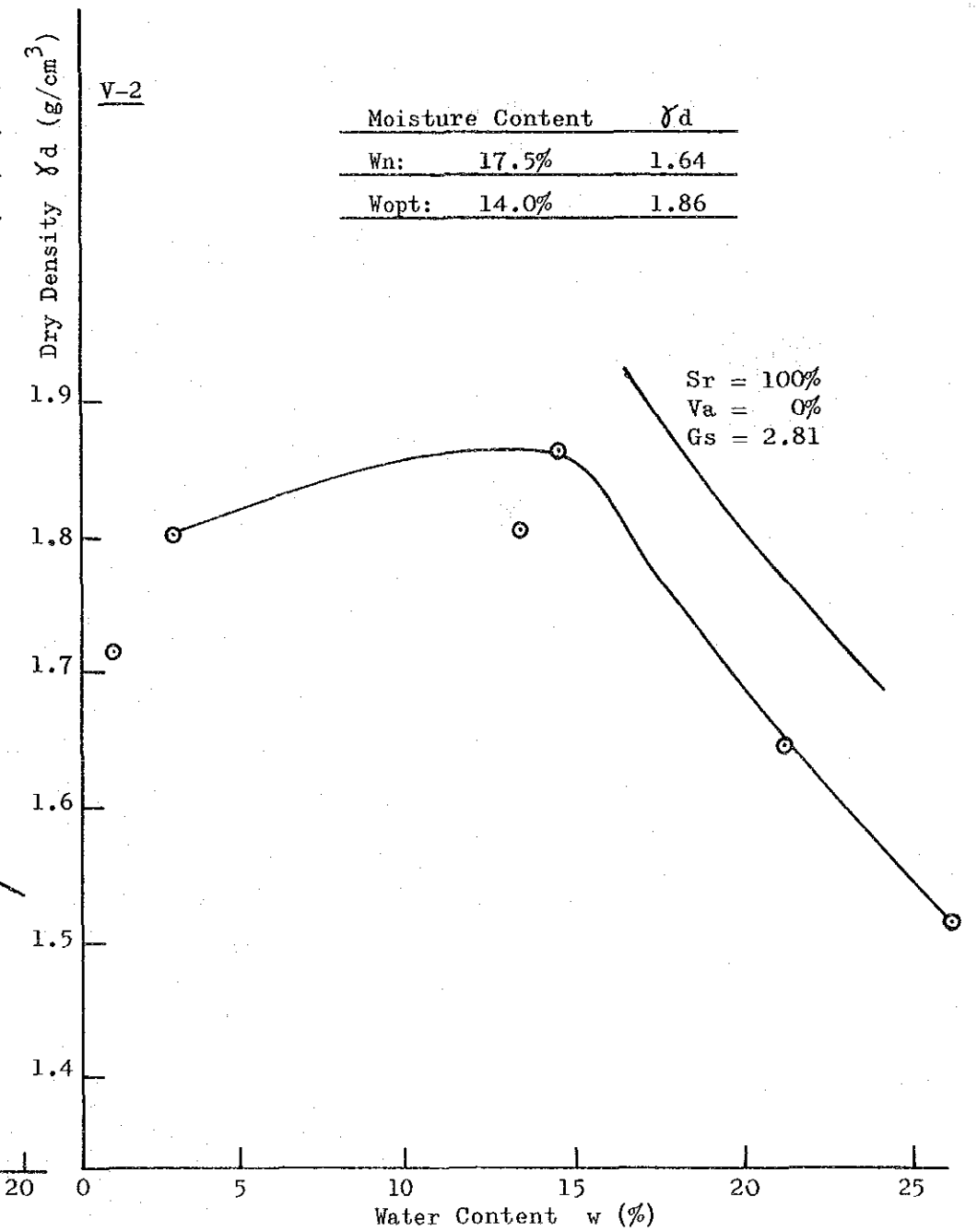
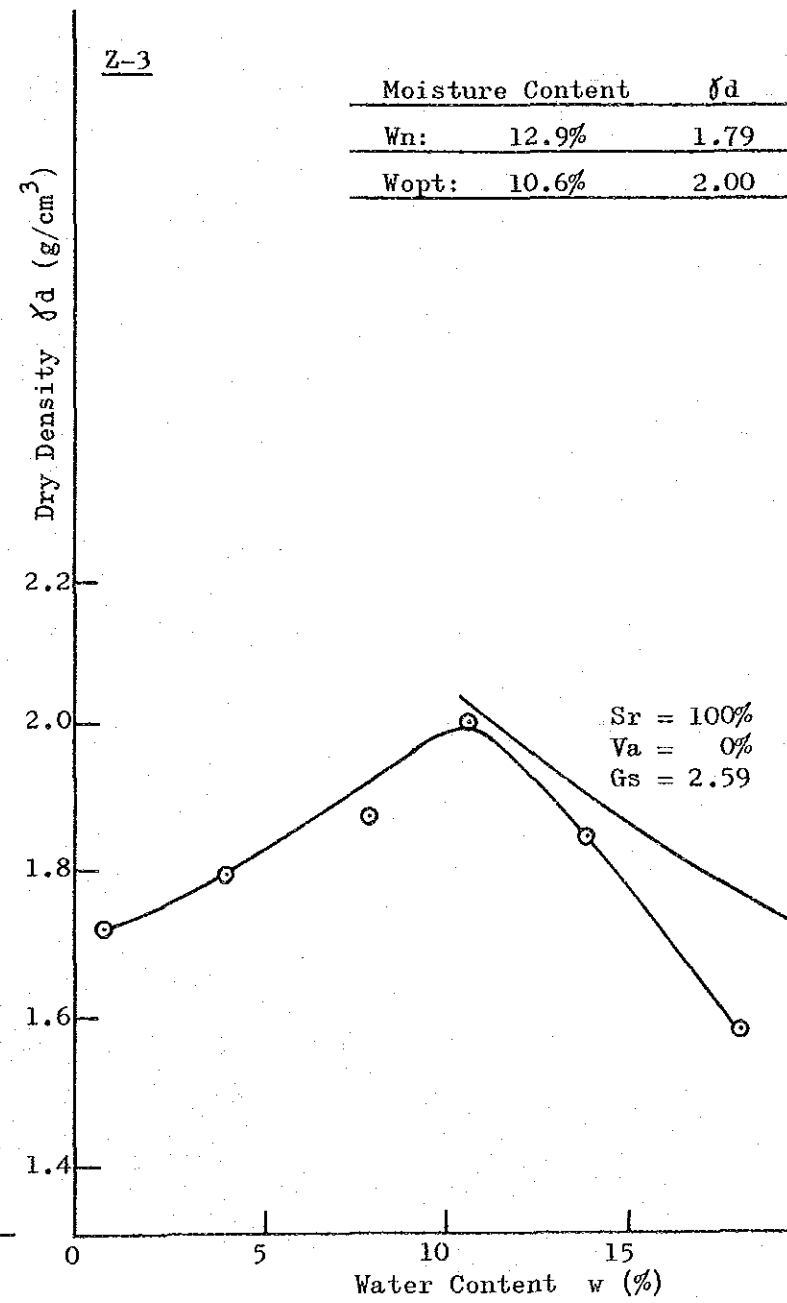
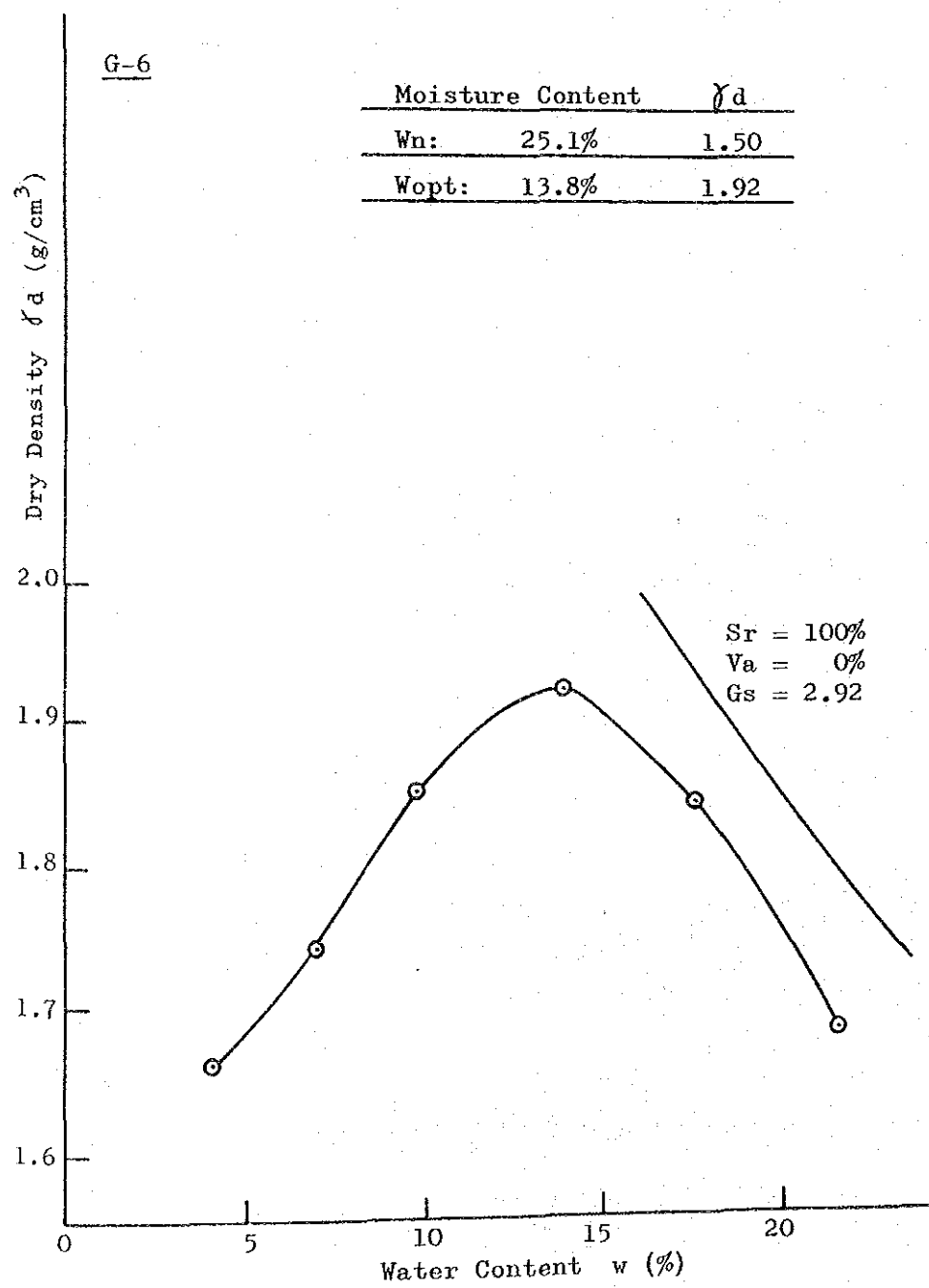
44
42
40
38
36
34

NUMBER OF BLOWS (NOMBRE DE COUP)

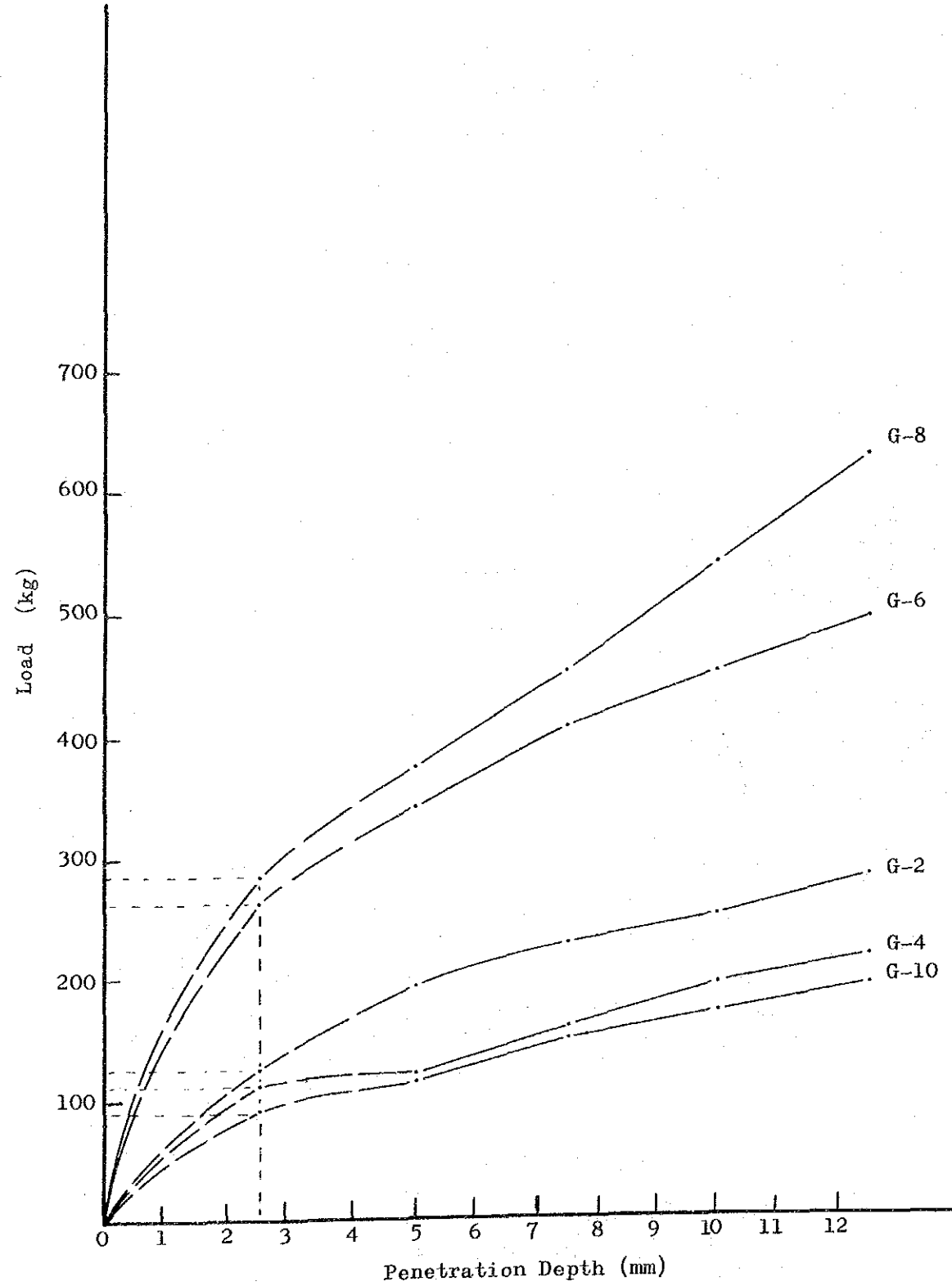
Test Result (6) Compaction Test

The following three (3) samples were tested as the typical sample of each stretch;

G-6 for Gbarnga-Zorzor, Z-3 for Zorzor-Voinjama, V-2 for Voinjama-Mendikoma.



Test Result (7)
CBR Test for Gbarnga-Zorzor Stretch

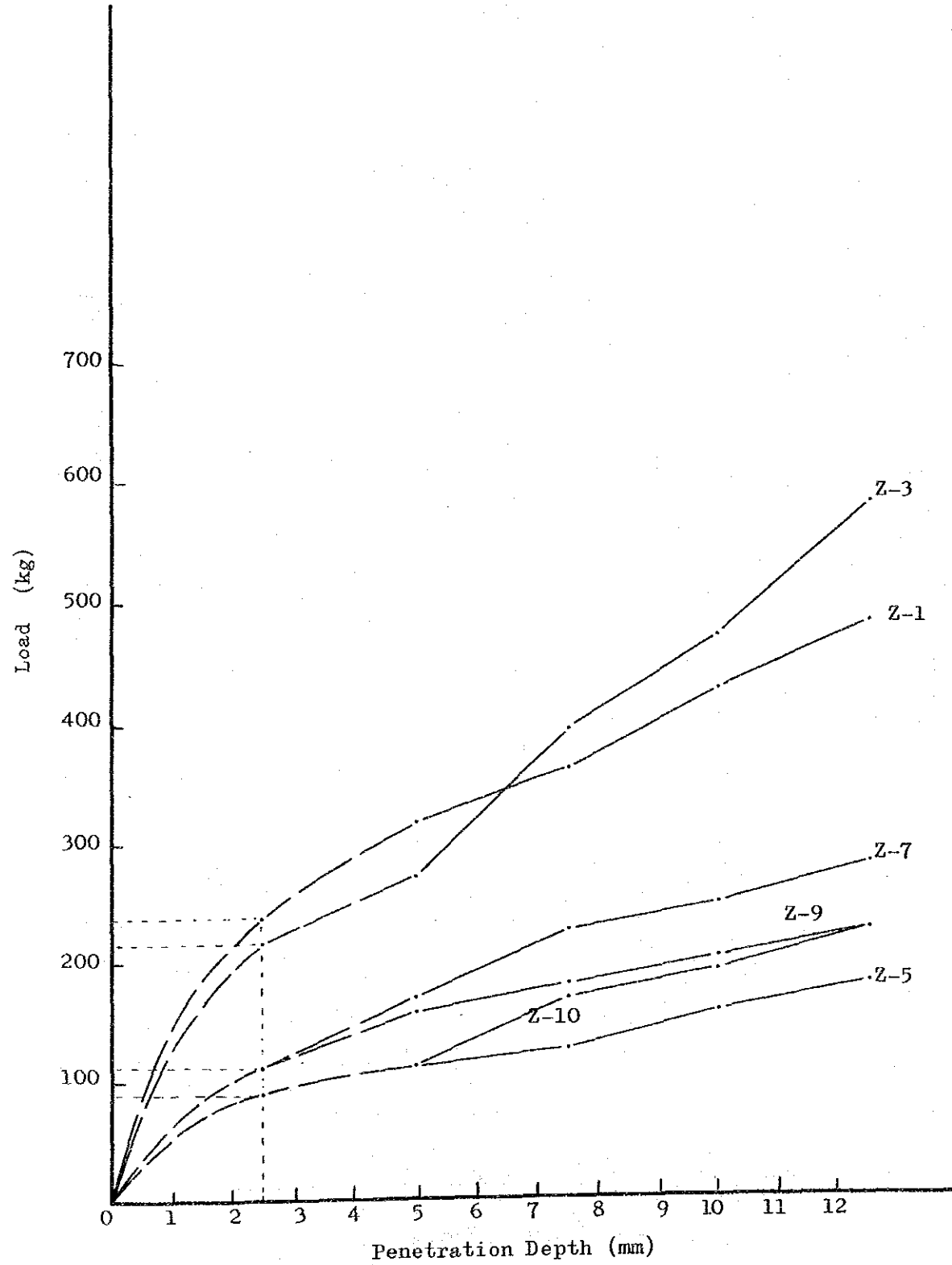


$$\text{CBR} = \frac{\text{Actual Load}}{\text{Standard Load}} \times 100\%$$

G-2	$\text{CBR}_{2.5} = \frac{124.7}{1370} \times 100 = 9.1\% \quad *$
	$\text{CBR}_{5.0} = \frac{192.8}{2030} \times 100 = 9.5\%$
G-4	$\text{CBR}_{2.5} = \frac{111.1}{1370} \times 100 = 8.1\%$
	$\text{CBR}_{5.0} = \frac{120.0}{2030} \times 100 = 5.9\%$
G-6	$\text{CBR}_{2.5} = \frac{260.8}{1370} \times 100 = 19.0\%$
	$\text{CBR}_{5.0} = \frac{340.2}{2030} \times 100 = 16.8\%$
G-8	$\text{CBR}_{2.5} = \frac{283.5}{1370} \times 100 = 20.7\%$
	$\text{CBR}_{5.0} = \frac{374.2}{2030} \times 100 = 18.4\%$
G-10	$\text{CBR}_{2.5} = \frac{90.7}{1370} \times 100 = 6.6\%$
	$\text{CBR}_{5.0} = \frac{113.4}{2030} \times 100 = 5.6\%$

Note: $\text{CBR}_{2.5}$ is value at 0.1 in(2.5) penetration,
 and $\text{CBR}_{5.0}$ is value at 0.2 in(5.0) penetration.
 The CBR is generally selected at 0.1 in(2.5) penetration.

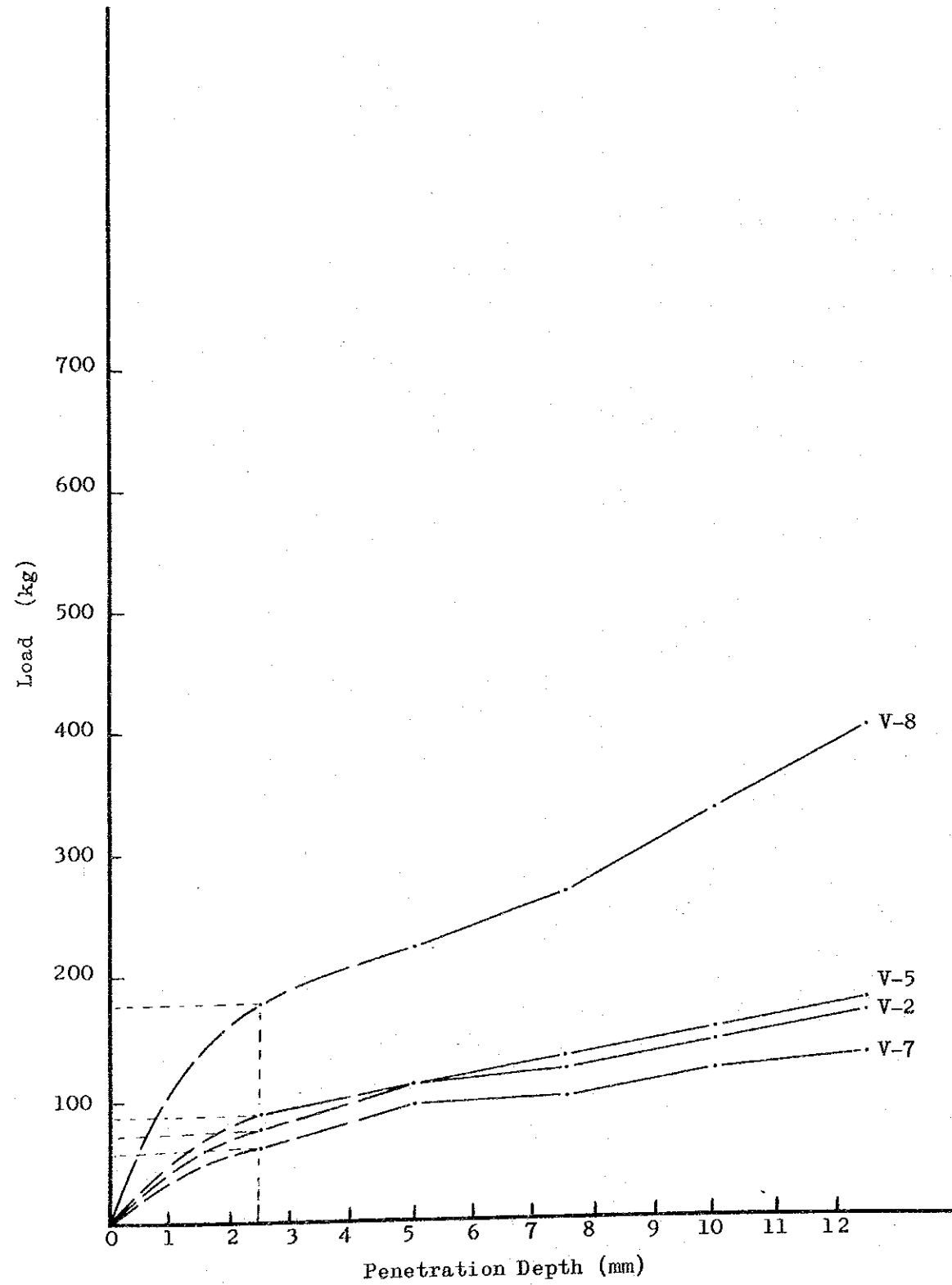
Test Result (8)
CBR Test for Zorzor-Voinjama Stretch



$$\text{CBR} = \frac{\text{Actual Load}}{\text{Standard Load}} \times 100\%$$

Z-1	$\text{CBR}_{2.5} = \frac{238.1}{1370} \times 100 = 17.4 \%$
	$\text{CBR}_{5.0} = \frac{317.5}{2030} \times 100 = 15.6 \%$
Z-3	$\text{CBR}_{2.5} = \frac{215.5}{1370} \times 100 = 15.7 \%$
	$\text{CBR}_{5.0} = \frac{272.7}{2030} \times 100 = 13.4 \%$
Z-5	$\text{CBR}_{2.5} = \frac{90.7}{1370} \times 100 = 6.6 \%$
	$\text{CBR}_{5.0} = \frac{113.4}{2030} \times 100 = 5.6 \%$
Z-7	$\text{CBR}_{2.5} = \frac{113.4}{1370} \times 100 = 8.3 \%$ *
	$\text{CBR}_{5.0} = \frac{170.1}{2030} \times 100 = 8.4 \%$
Z-9	$\text{CBR}_{2.5} = \frac{113.4}{1370} \times 100 = 8.3 \%$
	$\text{CBR}_{5.0} = \frac{158.8}{2030} \times 100 = 7.8 \%$
Z-10	$\text{CBR}_{2.5} = \frac{90.7}{1370} \times 100 = 6.6 \%$
	$\text{CBR}_{5.0} = \frac{130}{2030} \times 100 = 6.4 \%$

Test Result (9)
CBR Test for Voinjama-Mendikoma Stretch



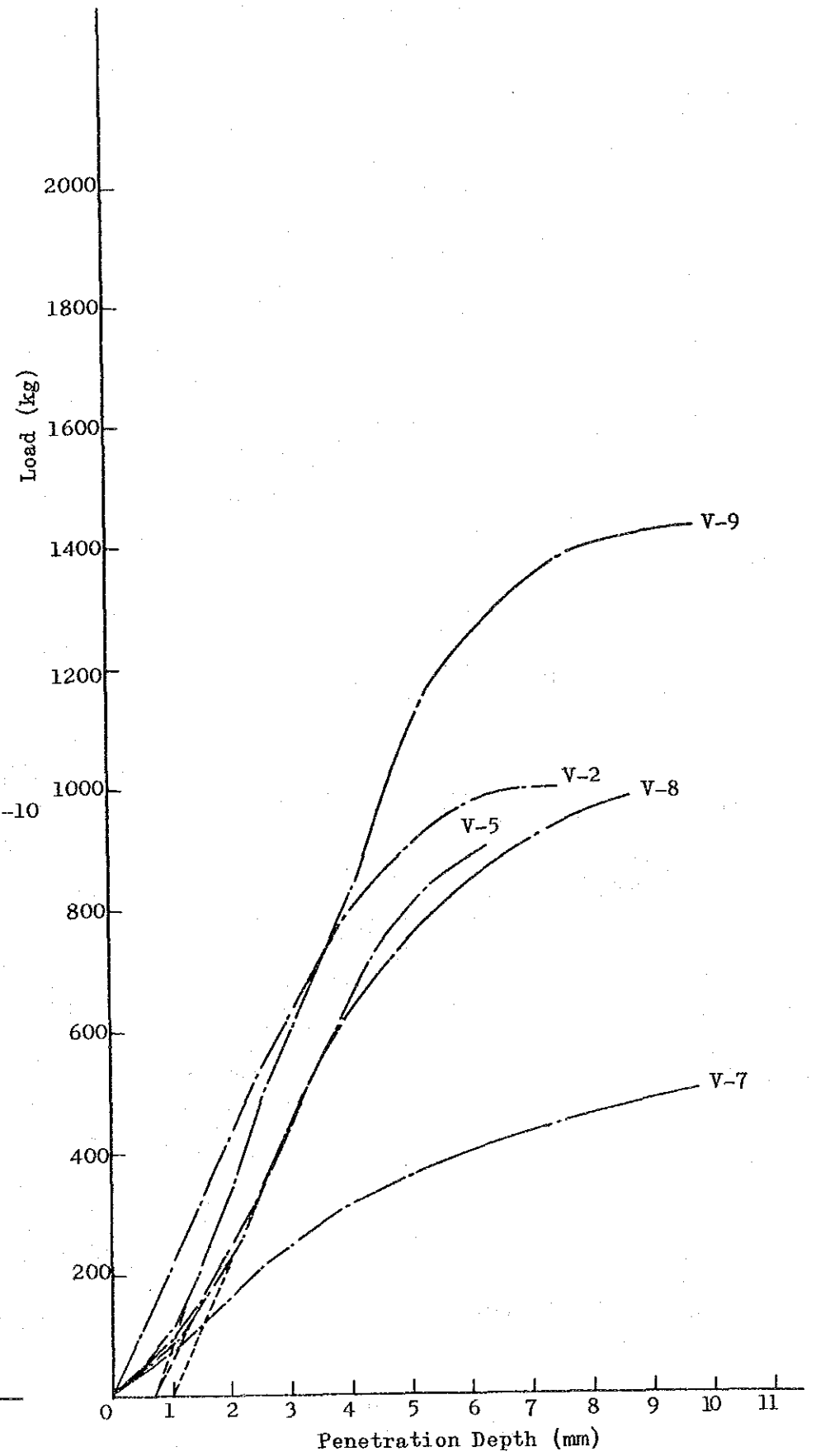
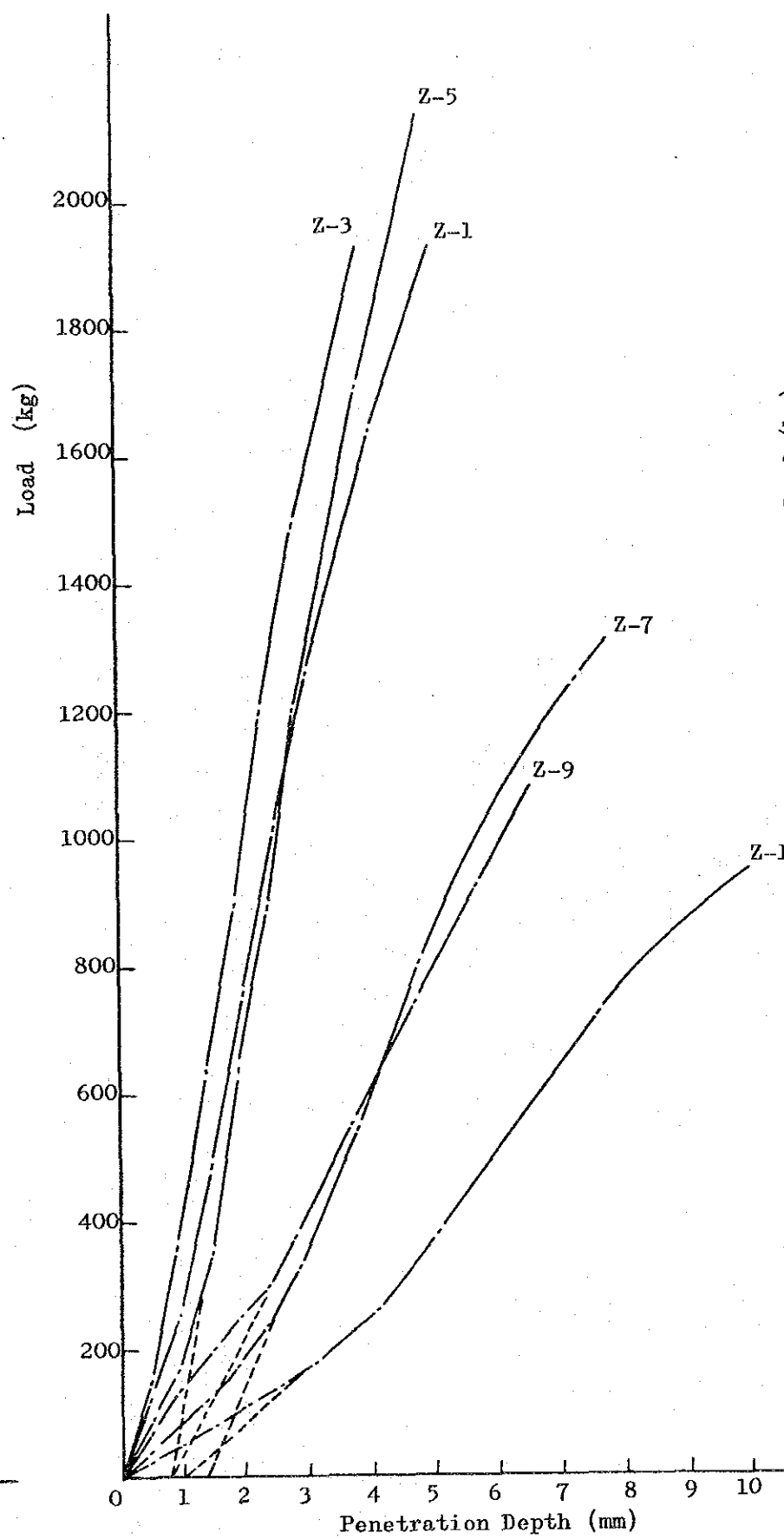
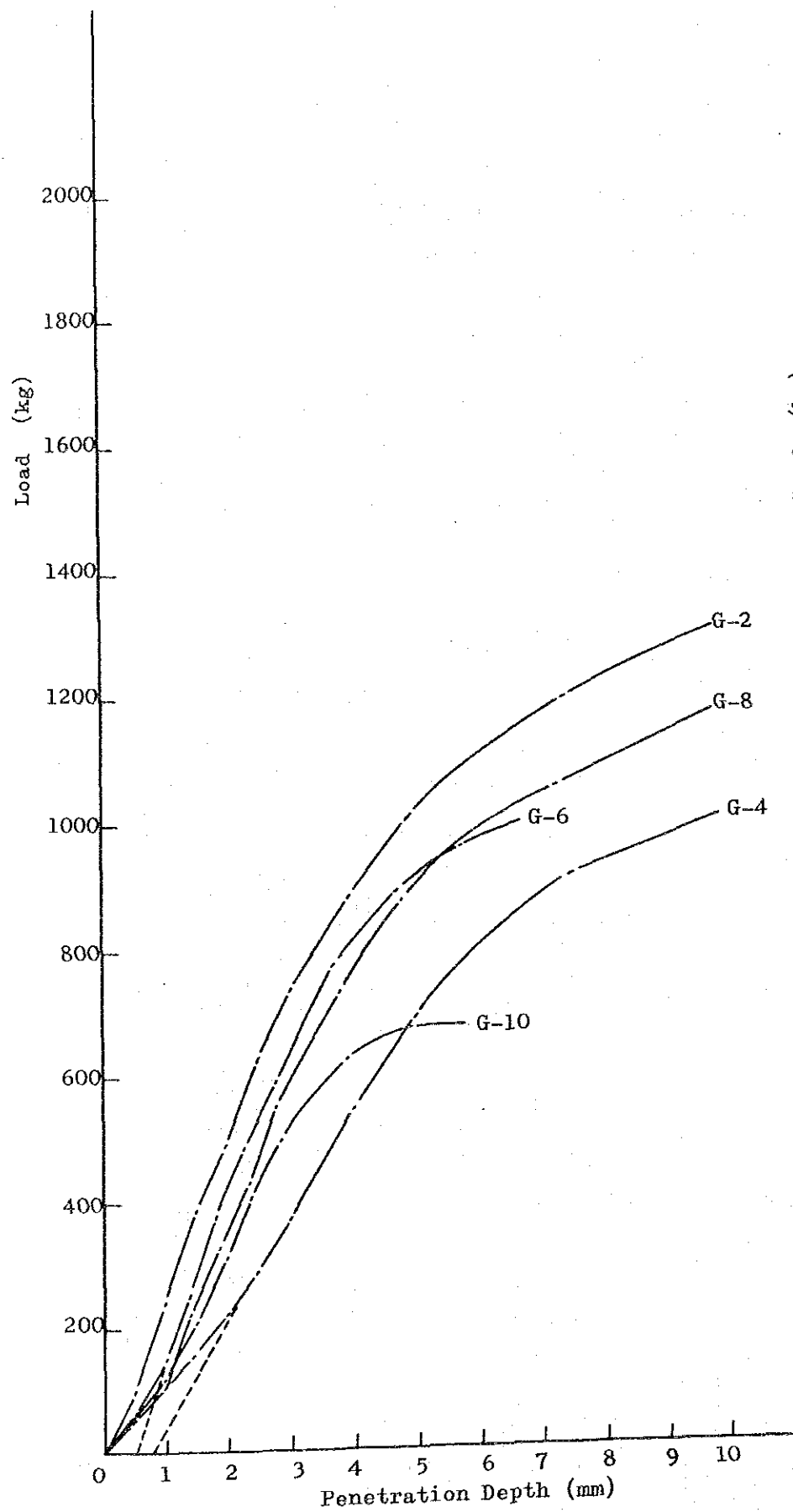
$$\text{CBR} = \frac{\text{Actual Load}}{\text{Standard Load}} \times 100\%$$

V-2	$\text{CBR}_{2.5} = \frac{79.4}{1370} \times 100 = 5.8 \%$
	$\text{CBR}_{5.0} = \frac{113.4}{2030} \times 100 = 5.6 \%$
V-5	$\text{CBR}_{2.5} = \frac{90.7}{1370} \times 100 = 6.6 \%$
	$\text{CBR}_{5.0} = \frac{113.4}{2030} \times 100 = 5.6 \%$
V-7	$\text{CBR}_{2.5} = \frac{63.5}{1370} \times 100 = 4.6 \%$
	$\text{CBR}_{5.0} = \frac{79.4}{2030} \times 100 = 3.9 \%$
V-8	$\text{CBR}_{2.5} = \frac{181.4}{1370} \times 100 = 13.2 \%$
	$\text{CBR}_{5.0} = \frac{226.8}{2030} \times 100 = 11.2 \%$

Table II-4 Summary of Road Surface Test

TEST ITEMS		LOCATION																															
		Gbarnga-Zorzor					Zorzor-Voinjama						Voinjama-Mendekoma																				
Sample Point		G-2	G-4	G-6	G-8	G-10	Z-1	Z-3	Z-5	Z-7	Z-9	Z-10	V-2	V-5	V-7	V-8	V-9																
Sample Depth (m)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0																
C.B.R. Test	Natural Moisture Content (%)	10.7	15.0	10.6	6.1	8.9	8.9	3.3	6.2	11.1	10.1	9.4	8.0	8.3	18.0	8.4	11.8																
	Field C.B.R. (%)	46.4	30.7	46.7	42.4	38.0	74.6	94.9	108.0	42.3	34.3	16.1	38.9	39.4	15.4	35.8	49.6																
Benkelman Bean Test	Initial Dial Reading (mm)	2.3	2.5	2.2	2.0	1.0	1.4	0.7	0.2	3.1	2.5	2.4	2.3	1.7	0.8	2.2	2.5	3.7	2.5	1.1	1.7	0.6	1.0	3.5	3.6	2.4	4.2	3.8	4.3	3.8	3.4	2.6	2.3
	Final Dial Reading (mm)	0.6	0.9	1.2	1.0	0.7	1.4	0.7	0.2	2.6	1.8	2.4	2.0	1.3	0.8	1.5	2.4	2.2	1.0	0.6	0.7	0.2	1.0	3.1	2.7	2.4	4.2	1.6	2.3	2.2	2.1	1.8	1.7
	Total Rebound Deflection (mm)	0.7	1.6	1.0	1.0	0.3	0	0	0	0.5	1.4	0	0.3	0.2	0	0.7	0.1	1.5	1.5	0.5	1.0	0.4	0.1	0.4	0.9	0	0	2.2	2.0	1.6	1.4	0.8	0.6
Sounding Test	N-Value per 10 CM Depth from Surface	Carriage Way		150	104	58	58	75	167	125	98	136	125	-	250	208	139	91	127	91													
	Shoulder	36	25	17	29	30	12	23	125	29	28	-	-	-	-	-	-	-	78	45													

Test Result (10)
Field CBR Test



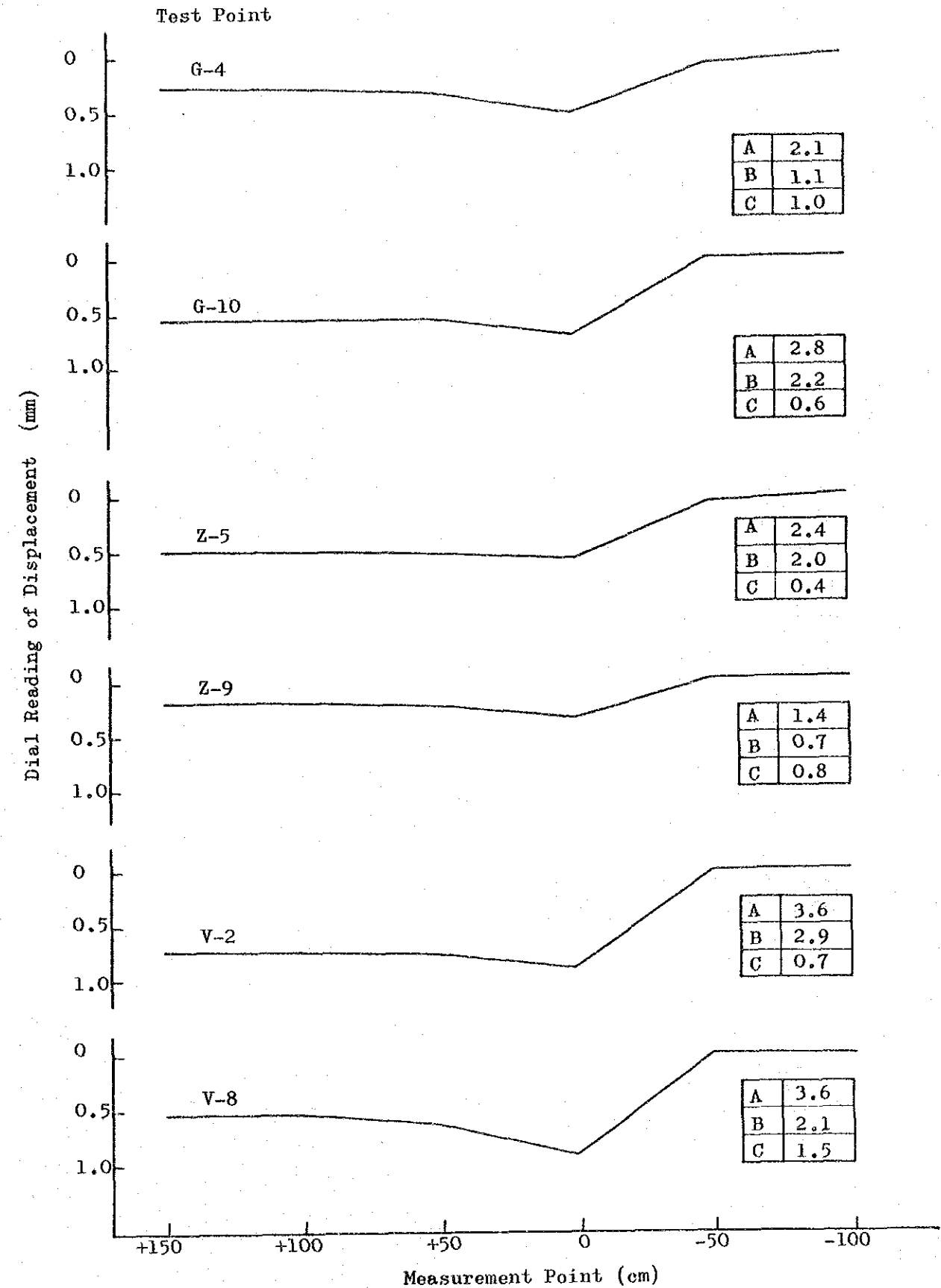
Test Result (11)

Benkelman Beam Test

The 6.0 ton TOYOTA truck fully loaded with laterite soil which was checked to be 5.2 ton per wheel and 6.0 kg/cm² air pressure of tire was used as the test load.

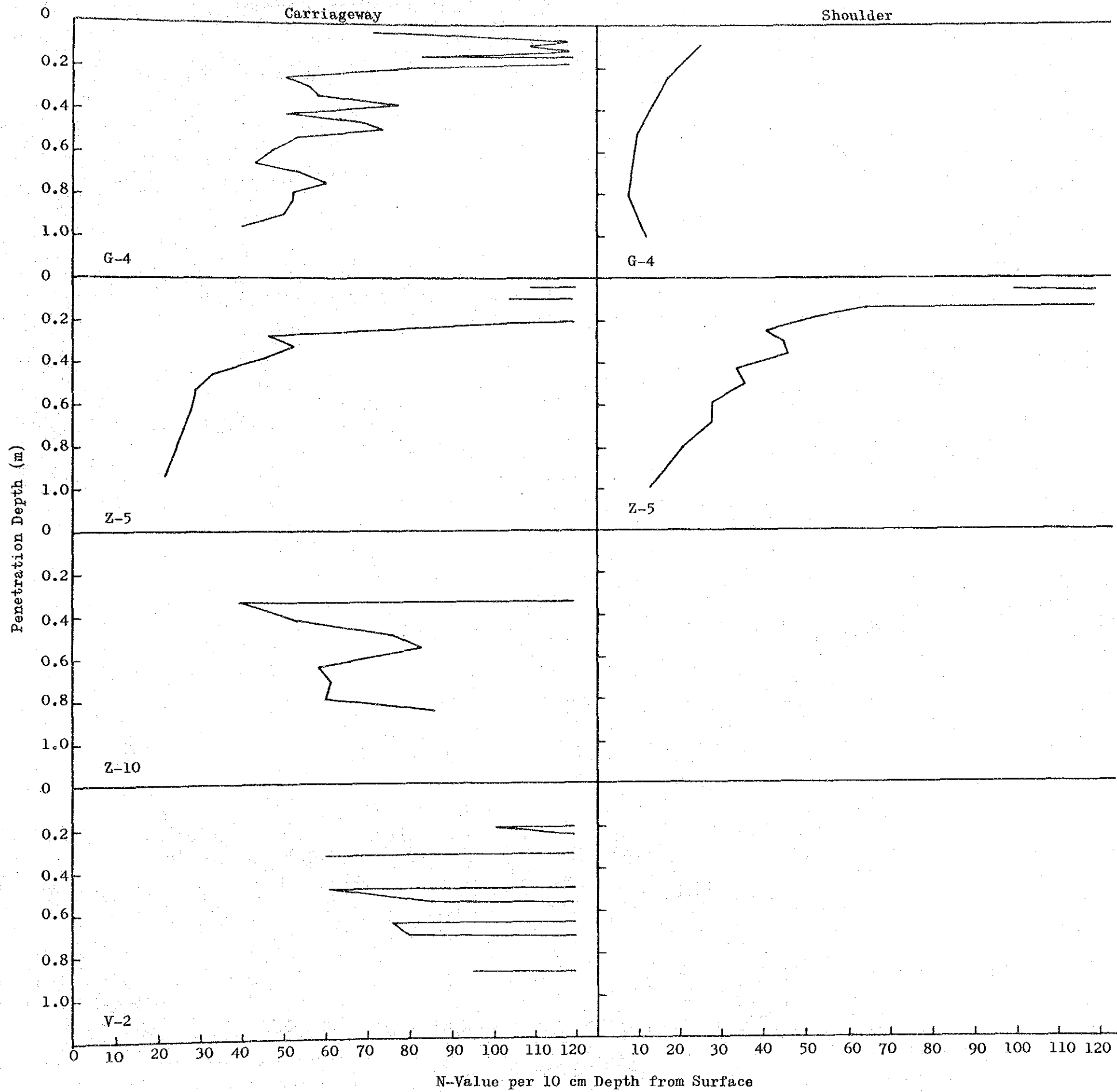
The deflection test were tried at two points in one test point. Only six (6) test result are drawn in the following graphs.

- A : Max deflection
 = Initial Dial Reading x 2
- B : Final deflection
 = Final Dial Reading x 2
- C : Total Rebound Deflection
 = A - B

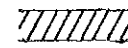


Test Result (12)

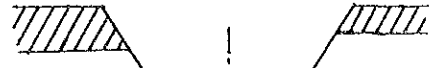
Sounding Test



Typical Section

 Gravelly Laterite

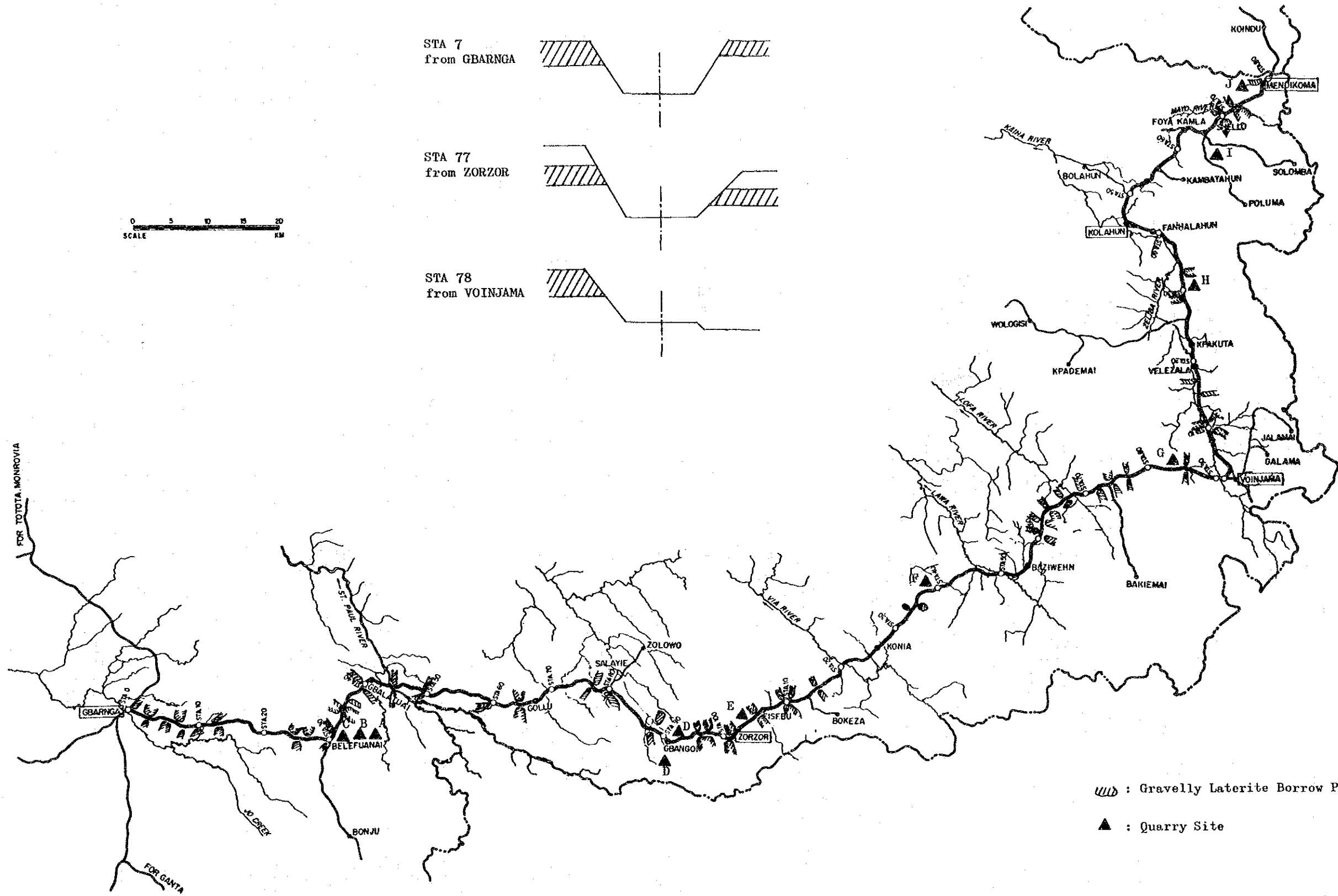
STA 7
 from GBARNGA





STA 77
 from ZORZOR



STA 78
 from VOINJAMA



 : Gravelly Laterite Borrow Pit
 : Quarry Site

Ⅲ. 排水構造物の水文解析

III 排水構造物の水文解析

3.1 解析方法

本プロジェクト地域の水文解析の方法を選定するためにいろいろな方法を比較検討し、次のような方法を用いた。

100年、50年、25年、10年確立の降雨強度は次式を用いて計算した。

$$100\text{年確立 } ht_{100} = 33 t^{0.4}$$

$$50\text{年確立 } ht_{50} = 22 t^{0.54}$$

$$25\text{年確立 } ht_{25} = 19 t^{0.6}$$

$$10\text{年確立 } ht_{10} = 17 t^{0.58}$$

ここに、 ht = 降雨強度 (mm/時間)

t = 設計降雨時間

$$t = (t' + 1)^{-0.2} t' \text{ (時間)}$$

t' = 降雨継続時間 (時間)

この式は、Fig. III-1 に示すような本プロジェクト地域の月別の降雨記録とガンタ〜タピタ地域の記録を比較して決定した。

排水構造物の規模を決定するために、橋梁に対しては100年確立の降雨強度を、ボックスカルバートとパイプカルバート等の計算にはそれぞれ50年と25年確立の降雨強度を用い、水路および河川の流出量を算定し、この計画を行った。10年確立の降雨強度は参考値として示したものである。

流出量は以下の算定式にしたがって算出した。

$$Q = \frac{0.28 ht \times C \times A \times f}{t} \quad (m^3/sec)$$

ここに、 Q = 流出量 (m³/sec)

C = 流出係数 (0.5)

A = 流域面積 (Km²)

f = ハイドログラフの形状係数 (0.6)

しかし、セント・ポール河、ウィリー河、ローワ河およびロフア河のような大河川についてはデッケン式を用いて算出した。

$$Q = C \cdot \sqrt[4]{A^3} \quad (m^3/sec)$$

ここに, $C =$ 高地における流出係数 (3.46)

$A =$ 流域面積 (Km^2)

一方, 現在の許容排水容量については Manning 式を用いて算出した。

$$Q = V \cdot A = \frac{1}{n} \cdot R^{\frac{2}{3}} \cdot I^{\frac{1}{2}} \cdot A$$

ここに, $Q =$ 排水構造物の容量 (m^3/sec)

$V =$ 平均流速 (m/sec)

$A =$ 断面積 (m^2)

$R =$ 径 深 (m)

$n =$ 粗度係数

$I =$ 水面勾配 (%)

3.2 既設構造物の水文解析

既設の橋梁, ボックスカルバートおよびパイプカルバートの水文解析は排水容量と予想される流量とを比較検討した。

3.2.1 集水面積

各河川の集水面積はリベリア国土鉱山省から入手した 1:250,000 の地形図と水理地図を基に算出したが, セント・ポール川の集水面積はギニア国から得た 1:200,000 の地形図と合せて算出した。

解析結果を DWG-III-1 に示す。

3.2.2 既設構造物の水文解析

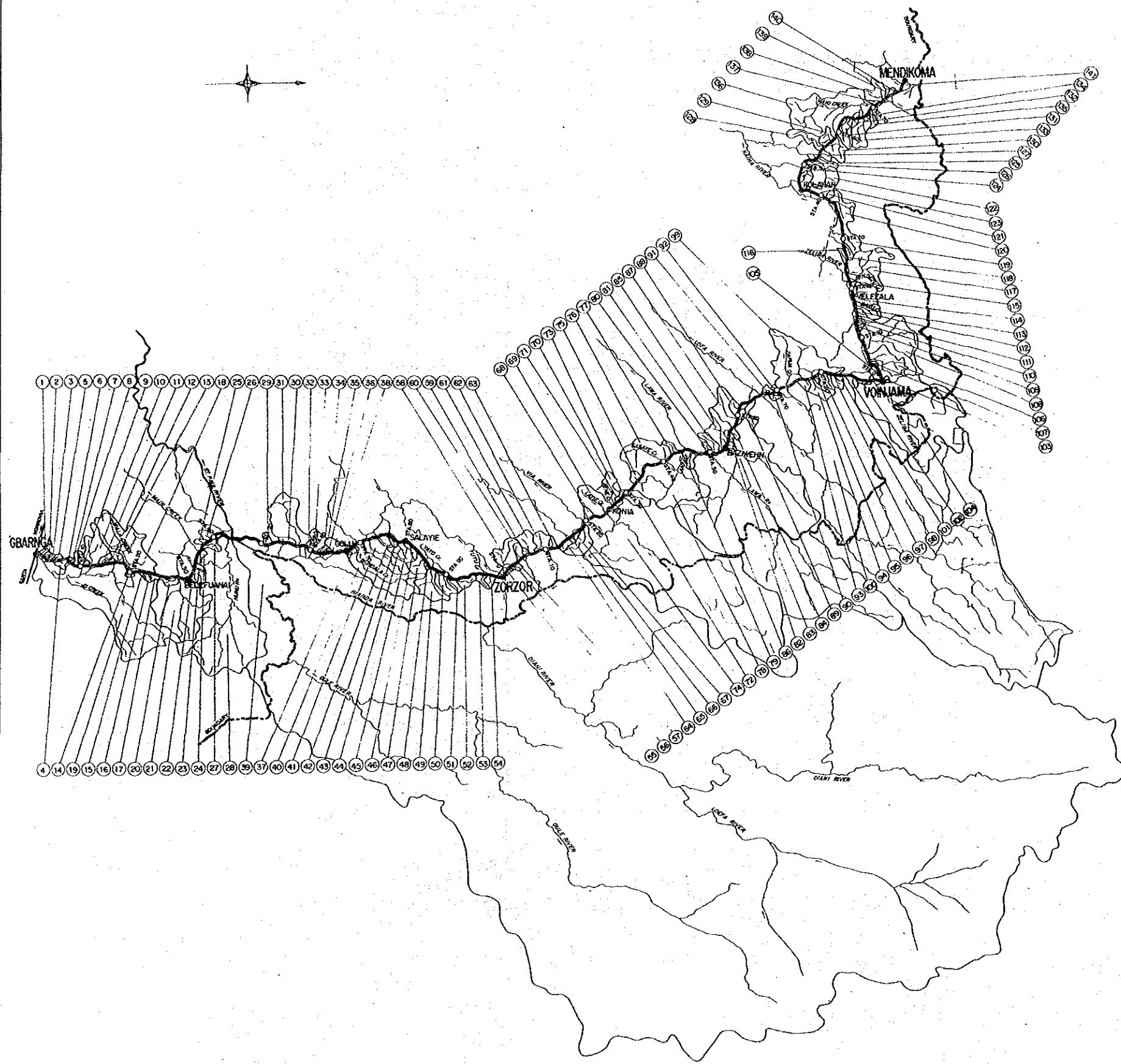
1) 橋梁カ所

本プロジェクト道路に架かるすべての橋梁は, 100年確立降雨強度による検討の結果, Table III-1 に計算結果を示すようにオーバーフローするものはないと考えられる。

2) ボックスおよびパイプカルバートカ所

ボックスおよびパイプカルバート等の排水構造物も同様に解析した結果, 現調査段階では排水容量が不足しているカ所はボックスカルバート部では1カ所, パイプカルバート部では2カ所あることが判明した。

位置, 流出量および排水容量等については表 III-2 ~ III-4 に示す通りである。



Catchment Basin No.	Catchment Area (Km ²)	Discharge Q (m ³ /s)				Remarks	Catchment Basin No.	Catchment Area (Km ²)	Discharge Q (m ³ /s)				Remarks
		Q ₁₀	Q ₂₅	Q ₅₀	Q ₁₀₀				Q ₁₀	Q ₂₅	Q ₅₀	Q ₁₀₀	
1	2.6	3.3	3.6	4.4	7.7	73	12.2	17.4	19.3	22.0	35.5		
2	0.6	1.4	1.5	1.9	3.5	74	591.5				415.0	Via River	
3	0.9	2.1	2.3	2.9	5.2	75	3.6	6.3	7.0	8.5	14.0		
4	2.5	4.9	5.4	6.6	11.2	76	34.0	33.5	37.7	42.8	60.7		
5	2.2	4.0	4.4	5.4	9.0	77	3.7	5.6	6.2	7.4	11.7		
6	1.2	2.7	3.0	3.8	6.7	78	126.3	53.0	90.1	97.2	124.1	Loko River	
7	1.0	2.4	2.6	3.2	5.8	79	3.9	5.9	6.5	7.8	12.3		
8	2.6	4.2	4.7	5.6	9.0	80	1.5	3.5	3.9	4.8	8.1		
9	3.0	4.9	5.4	6.4	10.4	81	6.7	7.8	8.8	10.1	15.0		
10	20.0	21.0	23.5	26.8	38.7	82	2.4	4.6	5.0	6.1	10.2		
11	2.8	4.6	5.0	6.0	9.7	83	1.5	3.4	3.6	4.5	8.0		
12	1.5	3.4	3.6	4.5	8.0	84	1.8	3.3	3.6	4.4	7.4		
13	3.7	7.3	8.0	9.8	16.6	85	25.7	17.1	24.9	27.7	38.1		
14	1.0	2.6	2.8	3.5	6.5	86	726.2				484.0	Loko River	
15	1.2	2.7	2.9	3.6	6.4	87	12.0	12.2	13.7	16.0	22.3		
16	1.3	2.6	2.8	3.4	5.8	88	4.3	7.0	7.7	9.2	14.9		
17	2.2	4.9	5.3	6.6	11.8	89	26.3	20.5	23.2	25.6	34.4	Loko River	
18	60.7	45.7	52.0	57.3	76.4	90	2.7	5.3	5.9	7.1	12.2		
19	316.3	133.2	154.0	160.4	187.5	91	4.9	3.3	3.7	9.7	15.5		
20	3.8	6.2	6.8	6.9	13.2	92	1.1	2.6	2.8	3.5	6.4		
21	79.0	6.43	72.8	80.7	109.5	93	3.0	5.3	5.8	7.1	11.7		
22	6.2	9.8	10.9	13.0	20.8	94	10.0	11.7	13.1	15.1	22.4		
23	2.0	3.7	4.0	4.9	8.2	95	1.3	2.7	3.0	3.7	6.4		
24	2.5	4.4	4.9	5.9	9.7	96	6.0	8.6	9.5	11.2	17.5		
25	2.5	4.1	4.5	5.4	8.7	97	3.0	4.6	5.0	6.0	9.5		
26	3.8	6.2	6.8	8.2	13.2	98	1.3	2.6	2.8	3.4	5.9		
27	14.3	15.5	17.4	19.9	29.0	99	94.6	46.6	72.0	78.2	101.1		
28	215.0	122.7	140.7	150.5	188.0	100	610.6				829.7	Loko River	
29	2.5	4.6	5.0	6.1	10.3	101	4.2	6.8	7.5	9.0	14.6	Zobe River	
30	2.2	6.0	6.4	8.2	15.3	102	2.1	4.1	4.6	6.3	9.5		
31	45.0	40.9	46.2	51.8	72.2	103	1.1	2.6	2.8	3.5	6.4		
32	1.1	2.3	2.5	3.1	5.3	104	193.1	116.8	133.8	144.0	182.5	Zobe River	
33	11.0	15.7	17.4	20.5	32.0	105	0.8	2.1	2.3	2.8	5.2		
34	1.5	2.9	3.3	4.0	6.8	106	27.8	24.8	28.8	32.4	45.7	Zobe River	
35	0.8	2.2	2.3	3.0	5.6	107	1.3	2.9	3.1	3.9	7.0		
36	0.6	1.7	1.8	2.4	4.5	108	67.0	50.5	57.4	63.2	84.3		
37	1.2	2.9	3.3	4.0	6.8	109	0.9	2.2	2.4	3.1	5.6		
38	9.5	10.2	13.5	15.7	28.8	110	0.7	1.9	2.0	2.6	4.9		
39	8758.5				3132.6	111	0.8	2.4	2.6	3.3	6.3		
40	53.0	38.6	44.0	48.1	63.7	112	2.0	3.7	4.0	4.9	8.2		
41	23.0	20.9	23.6	26.5	36.9	113	6.0	7.6	8.5	9.9	15.1		
42	3.8	7.0	7.7	9.3	15.6	114	15.0	17.9	20.0	23.1	34.4		
43	1.8	4.0	4.4	5.4	9.6	115	1.5	3.5	3.9	4.8	8.7		
44	10.0	13.5	14.9	17.5	26.9	116	3.7	5.3	5.9	6.9	10.8		
45	1.0	2.7	2.9	3.7	7.0	117	43.7	34.9	39.5	43.7	54.1	Zobe River	
46	2.2	3.9	4.3	5.2	8.6	118	2.4	2.0	2.2	2.5	3.3		
47	8.0	12.1	13.4	15.9	25.2	119	11.0	14.0	15.7	18.2	27.6		
48	1.2	2.5	2.7	3.3	5.7	120	14.0	17.6	19.7	22.7	33.8		
49	15.0	17.6	19.7	22.6	33.6	121	2.6	4.8	5.2	6.4	10.7		
50	11.0	13.7	15.3	17.7	26.7	122	22.0	22.4	25.2	28.5	40.9		
51	3.3	5.4	5.9	7.1	11.5	123	7.0	10.6	11.7	13.9	22.1		
52	3.3	7.9	8.8	10.4	16.4	124	2.1	4.5	5.0	6.1	10.8		
53	4.0	6.2	6.9	8.2	13.1	125	3.1	4.3	5.0	5.9	9.3		
54	3.2	5.6	6.2	7.5	12.5	126	4.5	6.4	7.1	8.3	13.0		
55	1.3	3.9	4.2	5.4	10.3	127	3.4	6.0	6.6	8.0	13.2		
56	1.0	2.1	2.3	2.8	4.8	128	8.0	7.7	8.6	9.8	13.7		
57	0.8	1.8	1.9	2.4	4.3	129	5.0	8.1	9.0	10.7	17.4		
58	21.1	17.0	19.2	23.3	35.5	130	23.0	17.3	19.7	21.7	28.9		
59	4.4	6.8	7.5	9.0	14.4	131	11.0	12.9	14.4	16.6	24.7		
60	1.5	3.0	3.3	4.0	6.8	132	1.3	2.9	3.1	3.9	7.0		
61	8.0	10.8	12.0	14.0	21.5	133	11.0	12.9	14.4	16.6	24.7		
62	9.0	12.8	14.2	16.8	26.2	134	0.6	1.3	1.5	1.6	3.2		
63	2.3	4.0	4.5	5.4	9.0	135	2.2	3.3	3.7	4.4	6.9		
64	2.6	4.6	5.1	6.1	10.1	136	140.1	70.2	80.5	85.5	104.0	Koyo River	
65	0.6	1.4	1.5	1.9	3.5	137	1.3	2.3	2.5	3.1	5.1		
66	1.1	3.0	3.2	4.1	7.7	138	8.0	10.8	12.0	14.0	21.5		
67	16.0	16.8	18.8	21.5	30.9	139	2.3	4.2	4.6	5.6	9.4		
68	3.3	5.4	5.9	7.1	11.5	140	0.8	2.0	2.2	2.7	5.0		
69	24.0	25.2	28.2	32.2	46.4	141	1.5	3.1	3.3	4.2	7.6		
70	16.0	17.4	19.5	22.3	32.5								
71	1.0	2.7	2.9	3.7	7.0								
72	10.5	13.4	14.9	17.5	26.3								

SCALE 1:500,000
 0 5 10 15 20 KILOMETERS

Fig. III-1 (1963-1972) Monthly Rainfall Record

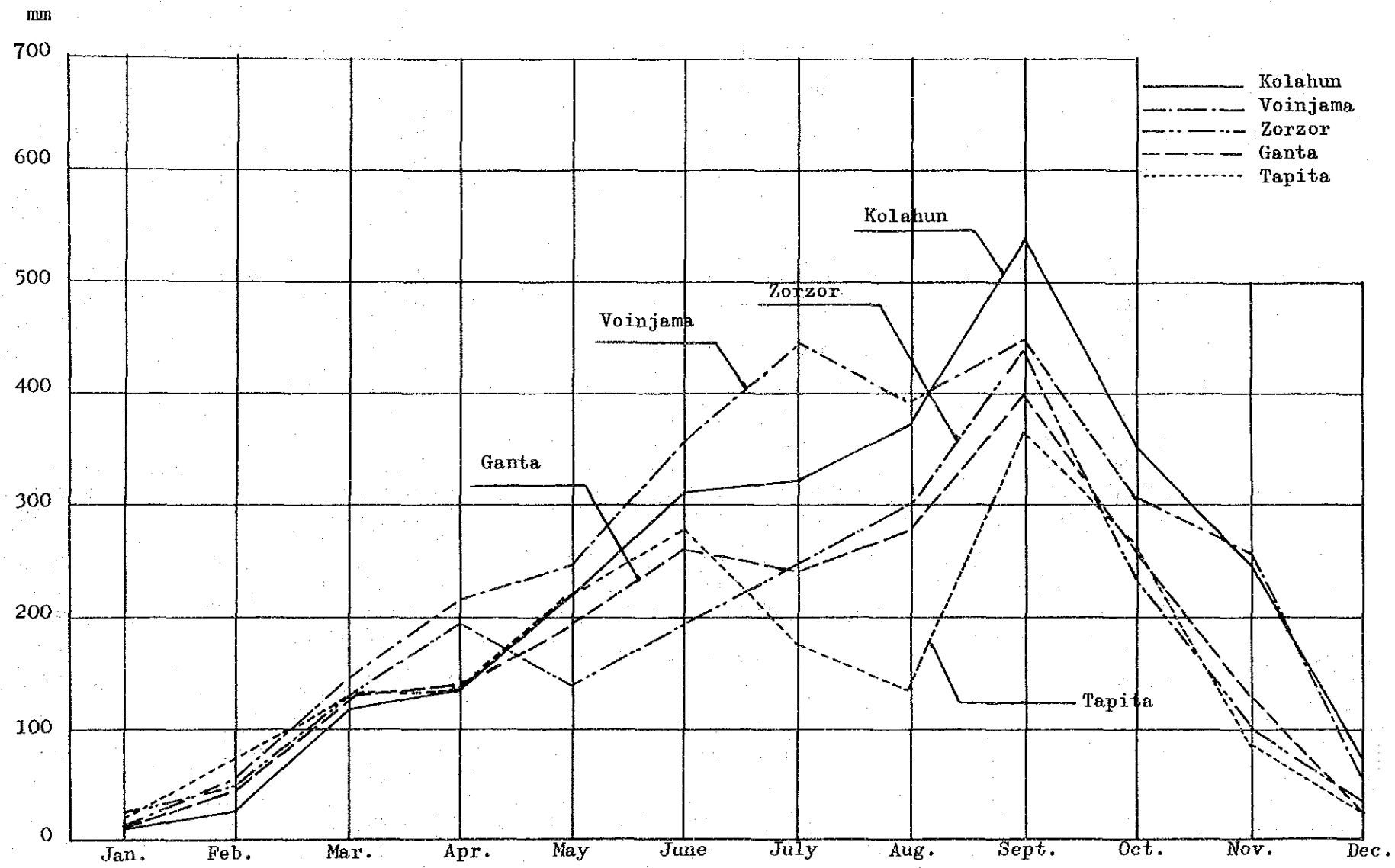


Table III-1 Bridge Inventory and Hydrological Study

Bridge No.	Accum. (mile)	Dist. (km)	River Name	Br. Length (m)	Span Composition (m)	Effective Width (m)	Type of Br.	Condition	Capacity (m ³ /s)	Discharge (m ³ /s)	Catching Basin No.	Remarks
GBARNGA	0	0										See Hydrograph
1	17.9	28.7	Mem Creek	15.15	14.75	6.90	Steel Girder	Good	123.2	109.5	21	
2	26.7	42.9	Noom River	18.20	17.80	7.50	Concrete T-Beam	"	197.9	188.0	28	- do -
3	27.6	44.4	St. Paul River	123.45	14.80+12.20 +15.25+49.60	7.40	Concrete T-Beam (5) Steel Truss (1)	"	3543.2	3132.6	39	- do -
4	37.7	60.6		9.85	9.45	7.40	Concrete Slab	"	59.9	32.0	33	
5	39.8	64.0	Leya River	9.85	9.45	7.40	"	"	59.9	28.8	38	
6	43.4	69.2		18.60	18.20	7.43	Concrete T-Beam	"	224.4	63.7	40	
7	44.6	71.8		15.60	15.20	7.43	"	"	124.2	36.9	41	
8	48.3	77.7	Sepayea River	15.60	15.20	7.45	"	"	172.8	26.9	44	- do -
9	54.6	87.9		9.60	9.20	7.40	Concrete Slab	"	34.0	33.6	49	
10	55.1	88.7		9.95	9.55	7.25	"	"	48.9	26.7	50	
11	63.2	101.7		10.25	9.85	7.45	"	"	63.2	12.5	54	
ZORZOR	0	0										
1	0.5	0.8		16.30	15.90	7.70	Concrete T-Beam	Good	119.1	35.5	58	
2	11.5	18.6	Weaher River	10.50	10.00	7.45	Concrete Slab	"	65.0	30.9	67	
3	12.5	20.1	Via River	47.60	10.10+18.15 +18.15	"	" (1) Concrete T-Beam (2)	"	1240.2	415.0	74	- do -
4	14.1	22.7		9.50	9.10	"	Concrete Slab	"	71.3	11.5	68	
5	15.3	24.6	Layie Creek	15.70	15.30	"	Concrete T-Beam	"	95.1	46.4	69	
6	17.0	27.3	Bene Creek	10.40	10.00	"	Concrete Slab	"	64.0	32.5	70	
7	17.9	28.8		16.50	16.10	"	Concrete T-Beam	"	112.0	35.5	73	
8	25.7	41.4	Gabaryca River	31.25	15.30+15.15	7.40	"	"	460.6	60.7	76	
9	28.6	46.0	Lueah River	49.95	24.65+24.50	"	Concrete Box girder	"	1011.4	124.1	78	
10	30.8	49.5	Lawa River	68.40	14.80+19.20 +18.00+14.80	"	Concrete T-Beam	"	1175.3	484.0	86	- do -
11	33.1	53.3	Zear River	49.10	17.40+18.30 +12.20	"	"	"	983.2	38.1	85	
12	42.3	68.0	Lofa River	93.20	30.40+30.75 +30.85	7.45	Concrete Box girder	"	2939.3	879.7	100	- do -
13	45.3	72.9		31.45	12.10+18.55	7.40	Concrete T-Beam	"	769.1	101.1	99	
14	56.5	90.9	Zeliba River	37.60	18.30+18.50	"	"	"	484.9	182.5	104	
VOINJAMA	0	0										
1	4.8	7.7		15.75		7.45	Concrete T-Beam	Good	105.4	84.3	108	- do -
2	23.6	38.0		18.90	18.90	"	"	"	163.3	33.8	120	
3	26.8	43.2		12.60		"	"	"	82.6	40.9	122	- do -
4	43.6	70.1	Maiyo River	43.85	12.75+18.45 +12.65	"	"	"	244.7	104.0	136	- do -

Table III-2 Discharge Calculation (1)

No.	Catchment Area (km ²)	Discharge Q (m ³ /sec)	Existing Drainage Structures		Remarks	No.	Catchment Area (km ²)	Discharge Q (m ³ /sec)	Existing Drainage Structures		Remarks
			Dimension (m)	Capacity (m ³ /sec)					Dimension (m)	Capacity (m ³ /sec)	
1	1.6	3.60	P(cor) ϕ 1.00 P(cor) ϕ 1.10	2.9	Out	26	3.8	8.16	C-Bx 3.50 x 3.05	38.9	
2	0.6	1.54	P(cor) ϕ 1.35	2.8		27	14.3	19.93	C-Bx 2-6.5 x 3.05	202.4	
3	0.9	2.30	P(cor) ϕ 1.20	2.2		28	215.0	187.98	Br 7.50 x 18.20	197.9	
4	2.5	6.60	C-Bx 2-3.00 x 1.50	28.0		29	2.5	6.11	C-Bx 3.50 x 3.10	44.1	
5	2.2	5.37	C-Bx 2.90 x 3.00	32.4		30	2.2	6.41	P(cor) ϕ 0.80 4 - ϕ 1.20	9.4	
6	1.2	3.01	P(cor) ϕ 1.25 P(cor) ϕ 1.00	3.6		31	45.0	51.83	P(cor) 2 - ϕ 1.50	7.6	
7	1.0	2.57	P(cor) ϕ 1.40 P(cor) ϕ 1.00	4.4		32	1.1	2.47	P(cor) ϕ 0.90 ϕ 1.60	5.7	
8	2.6	4.66	P(cor) ϕ 1.20	2.2	Out	33	11.0	31.99	Br 7.40 x 9.85	59.9	
9	3.0	6.44	C-Bx 2-2.45 x 1.60	23.3		34	1.5	3.25	P(cor) 2- ϕ 1.00	2.6	
10	20.0	26.82	C-Bx 2-3.50 x 3.50	102.4		35	0.8	2.33	P(cor) ϕ 0.60	0.6	
11	2.8	6.01	C-Bx 3.10 x 2.20	24.1		36	0.6	1.84	P(cor) 2- ϕ 0.85	1.8	
12	1.5	3.62	P(cor) ϕ 1.40	3.1		37	1.5	3.96	C-Bx 3.00 x 2.50	27.1	
13	3.7	9.76	C-Bx 3.10 x 2.20	24.1		38	9.5	28.83	Br 7.40 x 9.85	59.9	
14	1.0	2.82	P(cor) ϕ 1.45 P(cor) ϕ 0.80	4.5		39	8,758.5	3,132.55	Br 7.40 x 123.45	3,543.2	
15	1.2	2.90	P(cor) ϕ 1.05 ϕ 0.70 ϕ 1.40	5.1		40	53.0	63.72	Br 7.43 x 18.60	224.4	
16	1.3	2.81	P(cor) 2- ϕ 0.60 ϕ 1.60	5.8		41	23.0	36.89	Br 7.43 x 15.60	124.2	
17	2.2	5.31	P(cor) ϕ 0.60 ϕ 1.40	3.7	Out	42	3.8	9.28	C-Bx 2-3.10 x 3.00	71.1	
18	60.7	57.27	C-Bx 3.00 x 3.00	33.9	Out	43	1.8	4.35	P(cor) 4- ϕ 1.20	9.0	
19	315.3	187.46	Br 7.25 x 9.85	197.9		44	10.0	26.90	Br 7.45 x 15.60	172.8	
20	3.8	6.80	P(cor) ϕ 0.80	0.8	Out	45	1.0	2.91	P(cor) 3- ϕ 1.40	9.4	
21	79.0	109.54	Br 6.90 x 15.15	123.2		46	2.2	4.28	P(cor) 3- ϕ 1.60	13.7	
22	6.2	12.96	C-Bx 2-3.00 x 3.00	67.8		47	8.0	15.89	C-Bx 2-6.40 x 18.20	193.8	
23	2.0	4.03	P(cor) 2- ϕ 1.40	6.2		48	1.2	2.70	P(cor) 2- ϕ 1.50	7.6	
24	2.5	4.87	P(cor) ϕ 0.60 ϕ 1.50	4.5		49	15.0	33.62	Br 7.40 x 9.60	34.0	
25	2.5	4.48	P(cor) ϕ 1.60	9.1		50	11.0	26.70	Br 7.25 x 9.95	48.9	

TABLE III-3 Discharge Calculation (2)

No.	Catchment Area (km ²)	Discharge Q (m ³ /sec)	Existing Drainage Structures		Remarks	No.	Catchment Area (km ²)	Discharge Q (m ³ /sec)	Existing Drainage Structures		Remarks
			Dimension (m)	Capacity (m ³ /sec)					Dimension (m)	Capacity (m ³ /sec)	
51	3.3	5.92	P(cor) ϕ 0.80	0.8		76	34.0	60.68	Br 7.40 x 31.25	460.6	
52	5.3	10.41	C-Bx 2-6.40 x 3.00	193.8		77	3.7	6.19	P(cor) ϕ 1.40 ϕ 0.60	3.8	Out
53	4.0	6.86	P(cor) ϕ 1.80	6.2		78	126.3	124.14	Br 7.40 x 49.95	1,011.4	
54	3.2	12.46	Br 7.45 x 10.25	63.2		79	3.9	6.52	P(cor) 2- ϕ 1.60	9.1	
55	1.3	4.20	P(cor) 2- ϕ 1.20	4.5		80	1.8	3.90	P(cor) ϕ 1.20 ϕ 1.00	3.5	
56	1.0	2.25	P(cor) 2- ϕ 1.20 ϕ 0.90	3.3		81	6.7	10.10	C-Bx 2-3.00 x 3.00	67.8	
57	0.8	1.93	P(cor) ϕ 0.85 2- ϕ 0.80	2.4		82	2.4	4.98	P(cor) 2- ϕ 1.20	4.5	
58	21.1	35.51	Br 7.70 x 16.30	119.1		83	1.5	3.62	P(cor) 2- ϕ 1.50	7.6	
59	4.4	8.96	C-Bx 3.10 x 3.10	37.1		84	1.8	3.60	P(cor) ϕ 1.60	4.6	
60	1.5	3.25	P(cor) ϕ 0.60 2- ϕ 1.20	5.1		85	25.7	38.08	Br 7.40 x 49.10	983.2	
61	8.0	11.95	P(cor) 2- ϕ 1.60	9.1	Out	86	726.2	484.03	Br 7.40 x 68.40	1,175.3	
62	9.0	14.24	P(cor) 5- ϕ 1.60	22.8		87	12.0	13.73	P(cor) ϕ 1.20 2- ϕ 1.25	6.9	Out
63	2.3	4.48	P(cor) 2- ϕ 1.60	4.5		88	4.3	7.71	P(cor) ϕ 1.20	2.3	Out
64	2.6	5.06	P(cor) 2- ϕ 1.60 2- ϕ 1.20	13.6		89	26.3	23.17	P(cor) 4- ϕ 1.20	9.0	Out
65	0.6	1.54	P(cor) ϕ 0.70 ϕ 1.00	1.9		90	2.7	5.85	P(cor) ϕ 0.80	0.8	Out
66	1.1	3.21	P(cor) 3- ϕ 1.20	6.7		91	4.9	3.68	P(cor) ϕ 1.15	1.8	Out
67	16.0	30.93	Br 7.45 x 10.50	65.0		92	1.1	2.82	P(cor) 2- ϕ 1.40	6.2	
68	3.3	11.45	Br 7.45 x 9.50	71.3		93	3.0	5.84	P(cor) ϕ 1.20 2- ϕ 0.80 ϕ 1.00	4.8	Out
69	24.0	46.40	Br 7.45 x 15.70	95.1		94	10.0	13.11	P(cor) ϕ 0.80 ϕ 1.20	3.0	Out
70	16.0	32.49	Br 7.45 x 10.40	64.0		95	1.3	2.98	P(cor) ϕ 0.90	1.0	Out
71	1.0	2.91	P(cor) ϕ 0.80	0.8	Out	96	6.0	11.20	C-Bx 2-3.00 x 3.00	67.8	
72	10.5	14.94	P(cor) ϕ 1.20	2.2	Out	97	3.0	5.02	P(cor) 2- ϕ 0.90 2- ϕ 1.20	2.1	Out
73	12.2	35.48	Br 7.45 x 16.50	112.0		98	1.3	2.82	5- ϕ 1.60	27.3	
74	591.5	414.99	Br 7.45 x 47.60	1,240.2		99	94.6	101.11	Br 7.40 x 31.45	769.1	
75	3.6	8.48	C-Bx 3.10 x 3.00	35.6		100	1,610.6	879.66	Br 7.45 x 93.20	2,939.3	

TABLE III-4 Discharge Calculation (3)

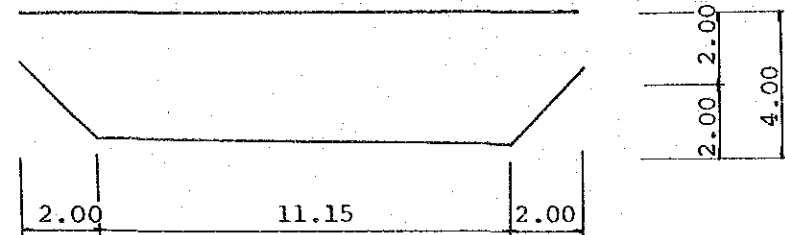
No.	Catchment Area (km ²)	Discharge Q (m ³ /sec)	Existing Drainage Structures		Remarks	No.	Catchment Area (km ²)	Discharge Q (m ³ /sec)	Existing Drainage Structures		Remarks
			Dimension (m)	Capacity (m ³ /sec)					Dimension (m)	Capacity (m ³ /sec)	
101	4.2	7.53	P(cor) 2- ϕ 1.60	9.1		126	4.5	8.31	C-Bx 3.00 x 2.00	20.4	
102	2.1	4.55	P(cor) 2- ϕ 1.50 2- ϕ 1.40	13.9		127	3.4	8.01	C-Bx 3.00 x 3.00	33.9	
103	1.1	2.82	P(cor) 3- ϕ 1.20 ϕ 0.60	7.3		128	8.0	9.75	C-Bx 3.00 x 2.50	27.1	
104	193.1	182.46	Br 7.40 x 37.60	484.9		129	5.0	10.73	C-Bx 3.00 x 3.00	33.9	
105	0.8	2.26	P(cor) 2- ϕ 1.60	9.1		130	23.0	21.70	C-Bx 2-3.00 x 3.00	67.8	
106	27.8	32.35	C-Bx 2-3.00 x 3.00	67.8		131	11.0	16.58	C-Bx 2-2.50 x 2.00	31.2	
107	1.3	3.14	P(cor) 2- ϕ 1.60	9.1		132	1.3	3.14	P(cor) ϕ 1.20	2.2	Out
108	67.0	84.28	Br 7.45 x 15.75	105.4		133	11.0	16.58	C-Bx 2-2.30 x 1.80	24.6	
109	0.9	3.06	C-Bx 3.00 x 3.00	33.9		134	0.6	1.45	P(cor) ϕ 1.50	3.8	
110	0.7	2.04	P(cor) 3- ϕ 1.40	9.1		135	2.2	3.68	P(cor) ϕ 0.80	0.8	Out
111	0.8	2.58	P(cor) 4- ϕ 1.40	12.2		136	140.1	103.95	Br 7.45 x 43.85	244.7	
112	2.0	4.00	P(cor) ϕ 1.40	3.0	Out	137	1.3	2.53	P(cor) ϕ 1.20	2.2	
113	6.0	9.91	C-Bx 2-3.00 x 3.00	67.8		138	8.0	13.98	C-Bx 2-2.40 x 1.80	26.2	
114	15.0	23.07	C-Bx 2-3.00 x 3.00	67.8		139	2.3	4.60	P(cor) 2- ϕ 0.7	1.3	Out
115	1.5	3.85	P(cor) 2- ϕ 1.60 ϕ 1.00	10.5		140	0.8	2.17	P(cor) ϕ 0.75 ϕ 0.60	1.3	
116	3.7	6.91	C-Bx 3.00 x 3.00	33.9		141	1.3	3.33	P(cor) ϕ 1.60	4.6	
117	43.7	43.73	C-Bx 2-3.00 x 3.00	67.8							
118	2.4	2.21	P(cor) ϕ 1.60 ϕ 1.20	6.7							
119	11.0	18.16	C-Bx 2-3.00 x 3.00	67.8							
120	14.0	33.83	Br 7.45 x 18.9	163.3							
121	2.6	5.24	P(cor) 2- ϕ 1.60	9.1							
122	22.0	40.85	Br 7.45 x 12.60	82.6							
123	7.0	13.91	C-Bx 3.00 x 3.00	33.9							
124	2.1	4.96	P(cor) 2- ϕ 1.20 2- ϕ 0.80	6.1							
125	3.1	5.90	C-Bx 3.00 x 3.00	33.9							

Analysis Result (1)

GBARNGA - ZORZOR

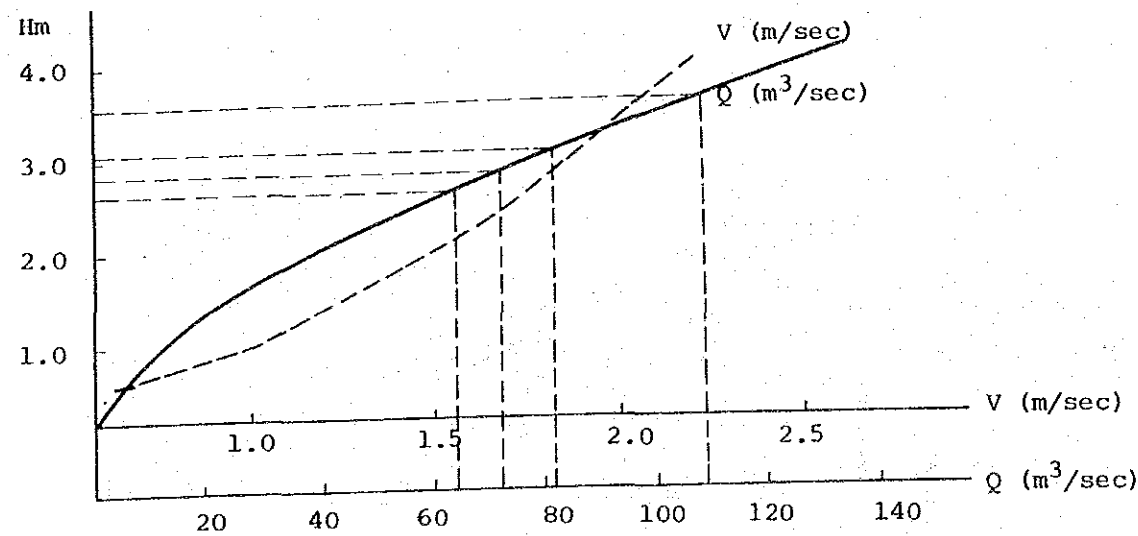
BRIDGE NO.1 (Mem Creek)

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 18.6km



Q=109.54 m³/sec i=0.002
n=0.04

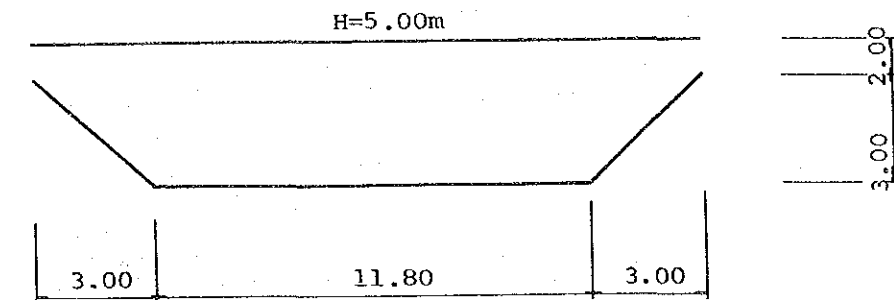
H (m)	A (m ²)	P (m)	R (m)	R ^{2/3}	I ^{1/2}	V (m/sec)	Q (m ³ /sec)
0.50	5.85	12.56	0.462	0.598	0.0447	0.668	3.91
1.00	12.15	13.98	0.869	0.911	"	1.018	12.37
1.50	18.98	15.39	1.233	1.150	"	1.285	24.39
2.00	26.30	16.81	1.565	1.348	"	1.506	39.62
2.50	33.88	17.81	1.902	1.535	"	1.715	58.12
3.00	41.46	18.81	2.204	1.694	"	1.893	78.49
3.50	49.03	19.81	2.475	1.830	"	2.045	100.27
4.00	56.60	20.81	2.720	1.948	"	2.177	123.24



GBARNGA - ZORZOR

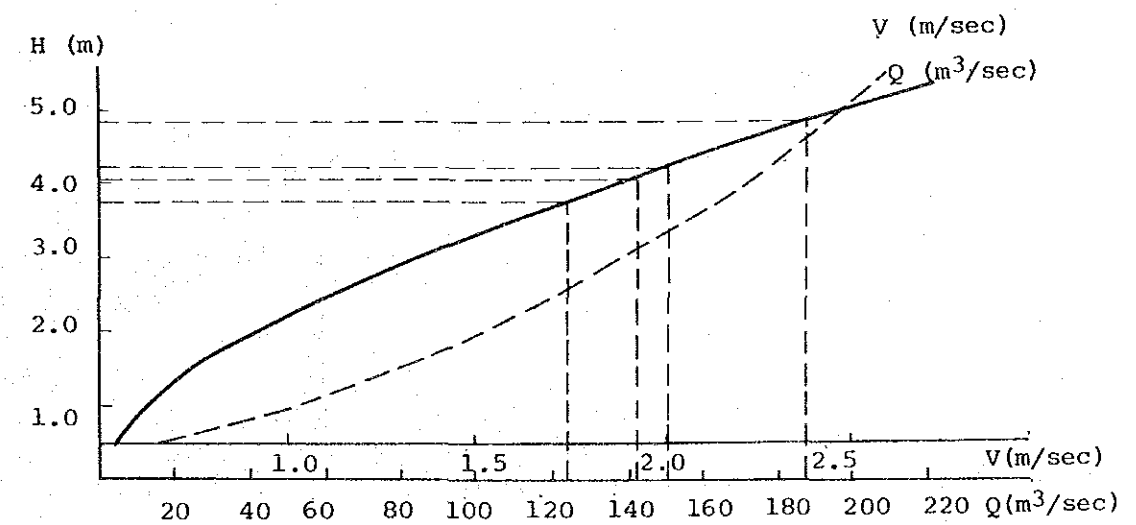
BRIDGE NO.2 (Noorn River)

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 42.9km



Q=1880 m³/sec i=0.002
n=0.04

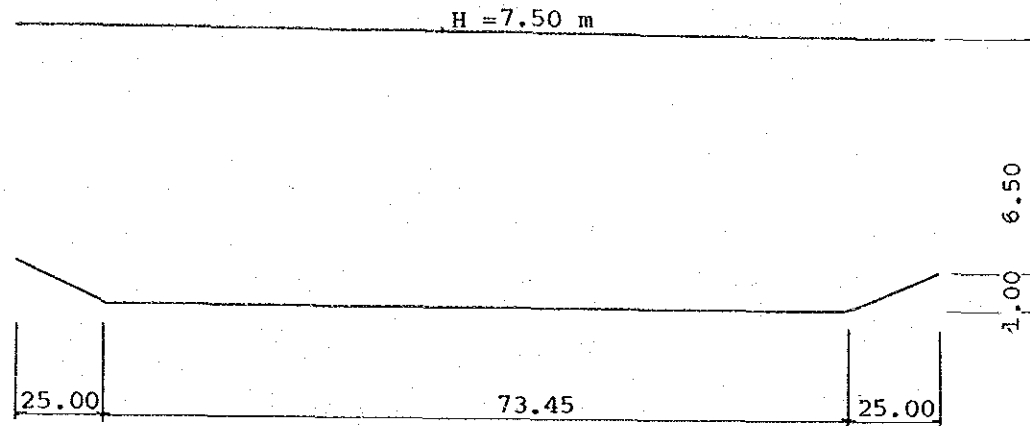
H (m)	A (m ²)	P (m)	R (m)	R ^{2/3}	I ^{1/2}	V (m/sec)	Q (m ³ /sec)
0.50	6.15	13.21	0.466	0.601	0.0447	0.672	4.13
1.00	12.80	14.63	0.875	0.915	"	1.023	13.09
1.50	19.95	16.04	1.244	1.157	"	1.293	25.80
2.00	27.60	17.46	1.581	1.357	"	1.516	41.84
2.50	35.75	18.87	1.895	1.531	"	1.711	61.17
3.00	44.40	20.29	2.188	1.686	"	1.884	83.65
3.50	53.30	21.29	2.504	1.844	"	2.060	109.82
4.00	62.20	22.29	2.790	1.982	"	2.215	137.77
4.50	71.10	23.29	3.053	2.105	"	2.352	167.21
5.00	80.00	24.29	3.294	2.214	"	2.474	197.90
5.50	88.90	25.29	3.515	2.312	"	2.584	229.72



Analysis Result (2)

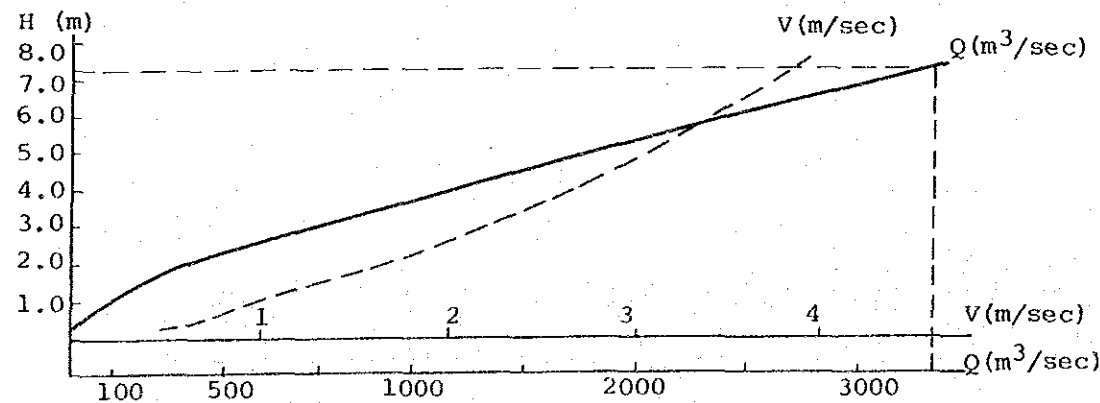
GBARNGA - ZORZOR

BRIDGE NO.3 (St. Paul River)
HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 44.4km



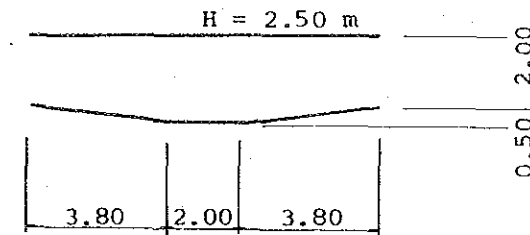
$Q = 3,132.6 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

H (m)	A (m ²)	P (m)	R	$R^{\frac{2}{3}}$	$I^{\frac{1}{2}}$	V (m/sec)	Q (m ³ /sec)
0.50	43.98	98.45	0.447	0.584	0.0447	0.653	28.72
1.00	98.45	123.45	0.797	0.860	"	0.961	94.62
1.50	160.18	124.45	1.287	1.183	"	1.322	211.76
2.00	221.90	125.45	1.769	1.463	"	1.635	362.78
3.00	345.36	127.45	2.710	1.944	"	2.172	750.27
4.00	468.81	129.45	3.622	2.358	"	2.635	1235.34
5.00	592.26	131.45	4.506	2.728	"	3.049	1805.53
6.00	715.71	133.45	5.363	3.064	"	3.424	2450.61
7.00	839.16	135.45	6.195	3.373	"	3.769	3163.07
7.50	900.89	136.45	6.602	3.519	"	3.933	3543.20



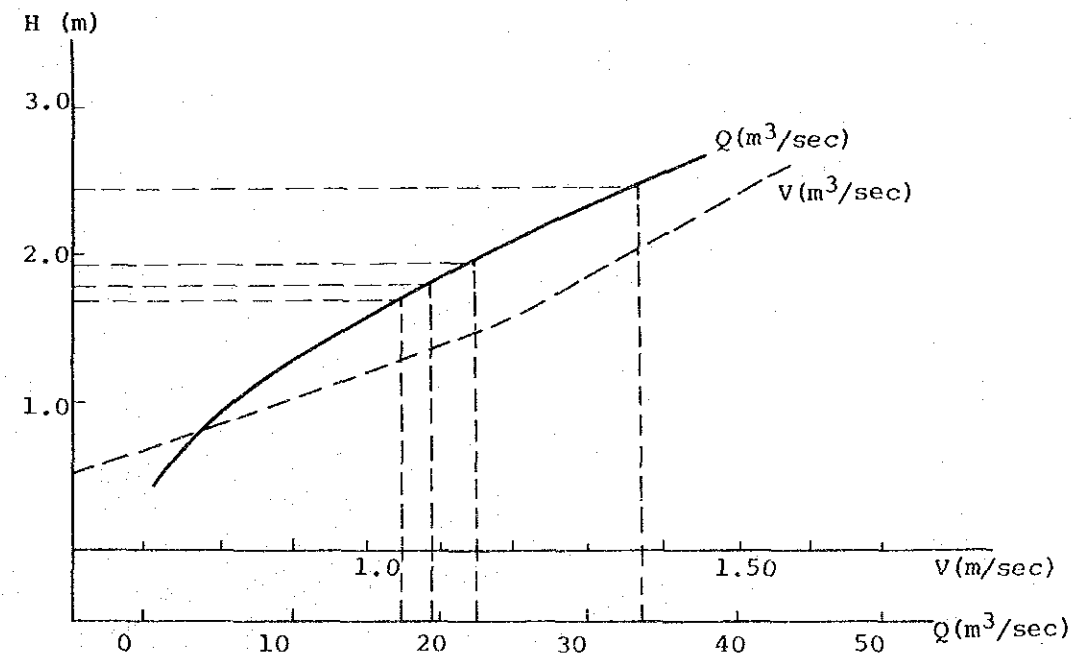
GBARNGA - ZORZOR

BRIDGE NO.9
HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 87.9km



$Q = 33.62 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

H (m)	A (m ²)	P (m)	R	$R^{\frac{2}{3}}$	$I^{\frac{1}{2}}$	V (m/sec)	Q (m ³ /sec)
0.50	2.90	9.666	0.300	0.448	0.0447	0.501	1.45
1.00	7.70	10.666	0.722	0.805	"	0.899	6.92
1.50	12.50	11.666	1.071	1.047	"	1.170	14.62
2.00	17.30	12.666	1.366	1.231	"	1.376	23.80
2.50	22.10	13.666	1.617	1.378	"	1.540	34.03

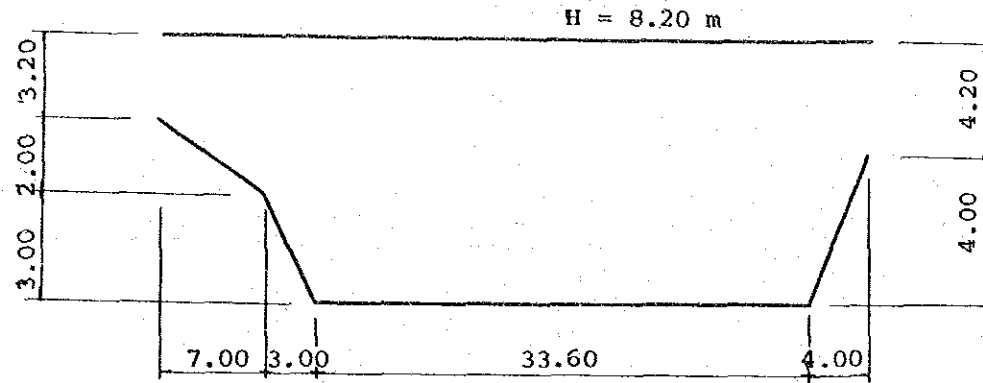


Analysis Result (3)

ZORZOR - VOINJAMA

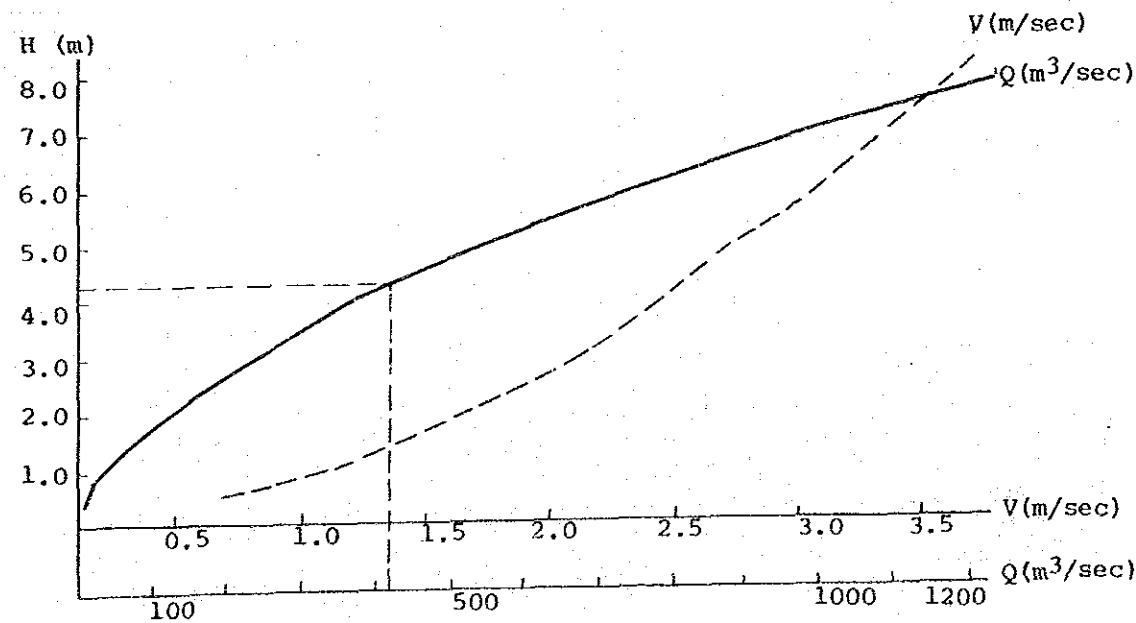
BRIDGE NO.3 (Via River)

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 20.1km



$Q = 415.0 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

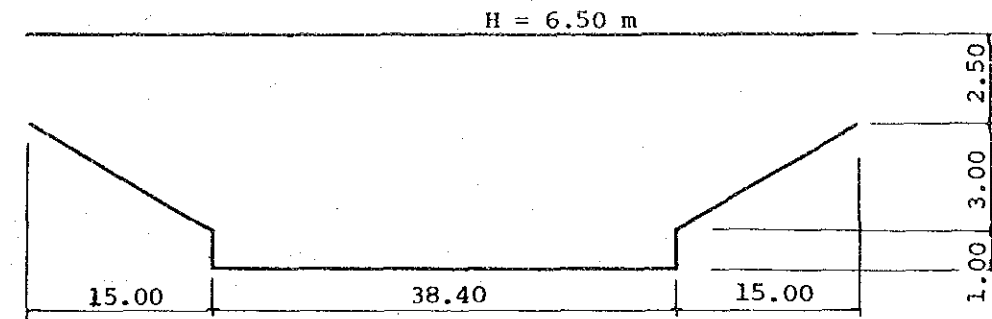
H (m)	A (m ²)	P (m)	R	$R^{\frac{2}{3}}$	$I^{\frac{1}{2}}$	V (m/sec)	Q (m ³ /sec)
1.00	34.60	36.43	0.950	0.966	0.0447	1.080	37.37
1.50	52.65	37.84	1.391	1.246	"	1.393	73.33
2.00	71.20	39.26	1.814	1.487	"	1.662	118.33
3.00	109.80	42.09	2.609	1.895	"	2.118	232.53
4.00	151.65	47.14	3.217	2.179	"	2.435	369.27
5.00	197.50	51.78	3.814	2.441	"	2.728	538.79
6.00	245.10	53.78	4.557	2.749	"	3.072	752.91
7.00	292.70	55.78	5.247	3.020	"	3.375	987.72
8.00	340.30	57.78	5.890	3.261	"	3.645	1240.23



ZORZOR - VOINJAMA

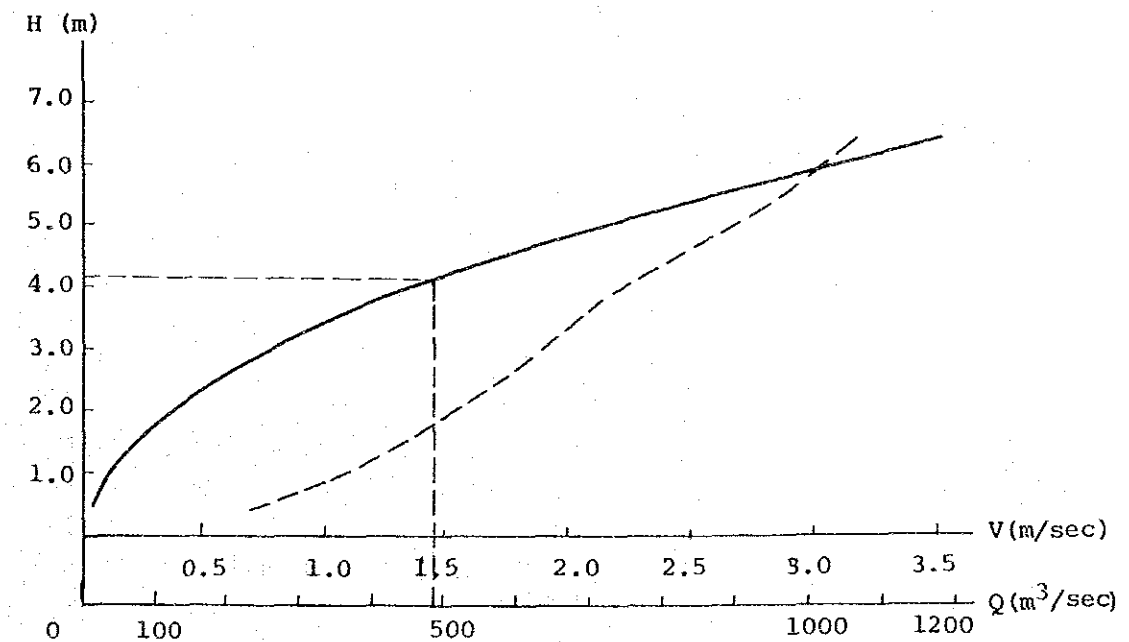
BRIDGE NO.10 (Lawa River)

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 49.5km



$Q = 484.0 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

H (m)	A (m ²)	P (m)	R	$R^{\frac{2}{3}}$	$I^{\frac{1}{2}}$	V (m/sec)	Q (m ³ /sec)
1.00	38.40	40.40	0.950	0.967	0.0447	1.081	41.51
2.00	81.80	50.60	1.617	1.377	"	1.539	125.89
3.00	135.20	60.80	2.224	1.704	"	1.904	257.42
4.00	198.60	70.99	2.798	1.985	"	2.219	440.69
5.00	267.00	72.99	3.658	2.374	"	2.653	708.35
6.00	335.40	74.99	4.473	2.715	"	3.034	1017.60
6.50	369.60	76.99	4.801	2.846	"	3.180	1175.33

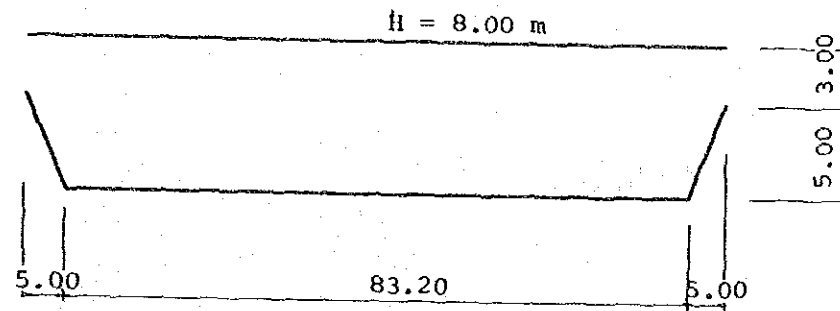


Analysis Result (3)

ZORZOR - VOINJAMA

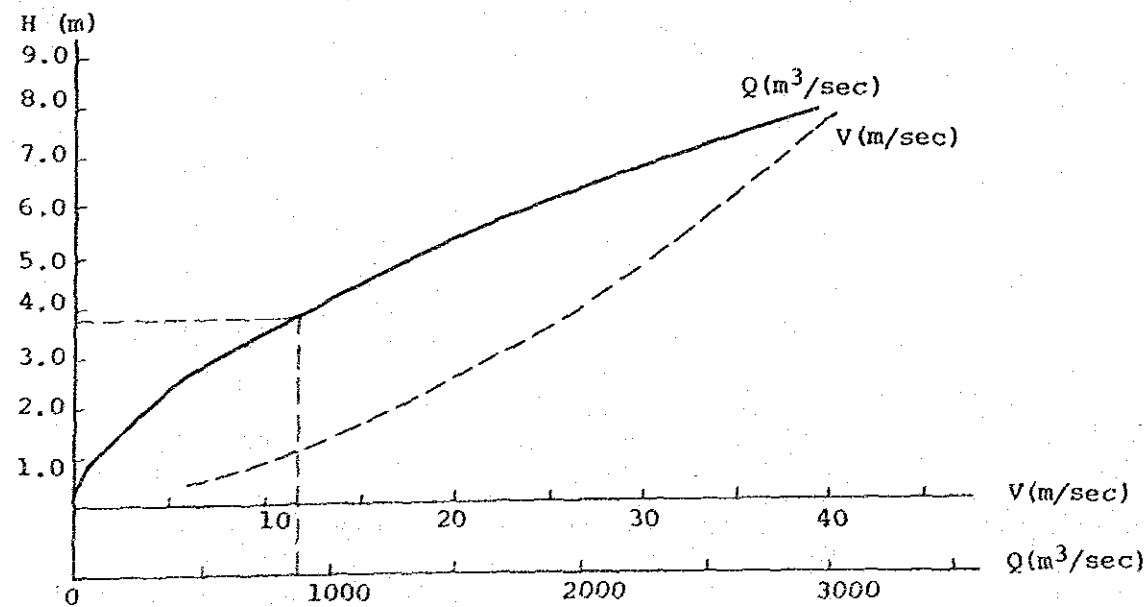
BRIDGE NO.12 (Lofa River)

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 68.0km



$Q = 879.70 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

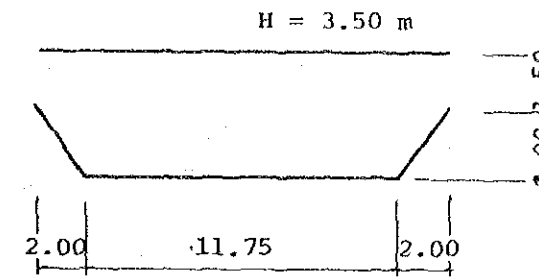
H (m)	A (m ²)	P (m)	R	$R^{\frac{2}{3}}$	$I^{\frac{1}{2}}$	V (m/sec)	Q (m ³ /sec)
1.00	84.20	86.03	0.979	0.986	0.0447	1.102	92.79
2.00	170.40	88.86	1.918	1.544	"	1.725	293.94
3.00	258.60	91.69	2.820	1.996	"	2.231	576.94
4.00	348.80	94.51	3.691	2.388	"	2.669	930.95
5.00	441.00	94.34	4.531	2.738	"	3.060	1349.46
6.00	534.20	99.34	5.377	3.069	"	3.430	1832.31
7.00	627.40	101.34	6.191	3.372	"	3.768	2364.04
8.00	720.60	103.34	6.973	3.650	"	4.079	2939.33



VOINJAMA - MENDIKOMA

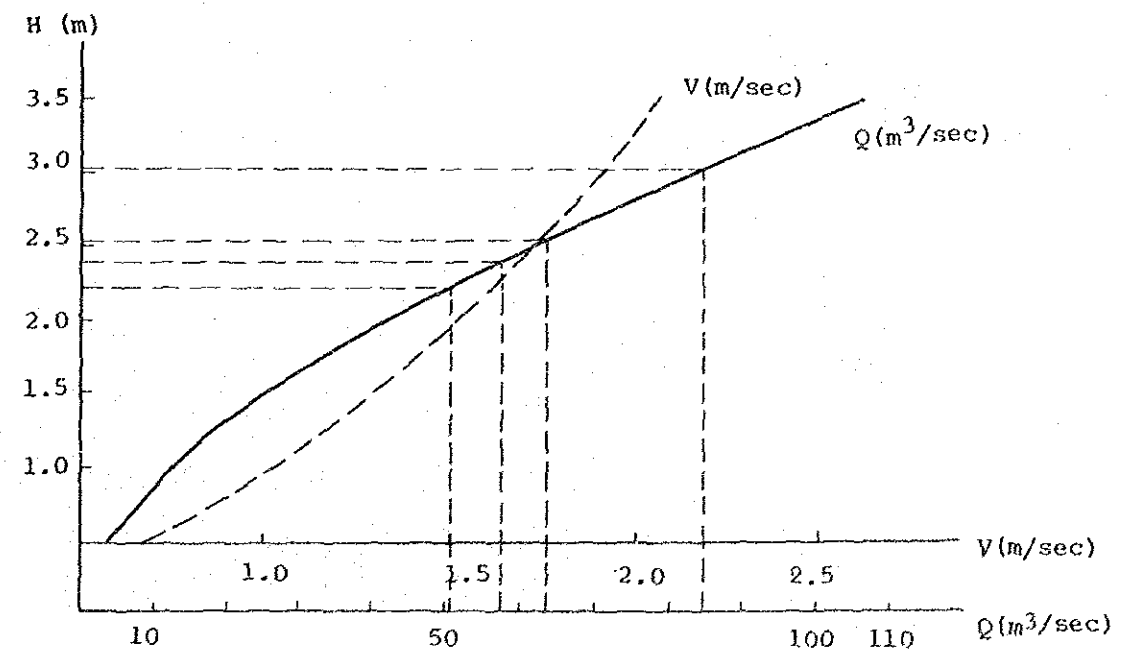
BRIDGE NO.1

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 7.7km



$Q = 84.28 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

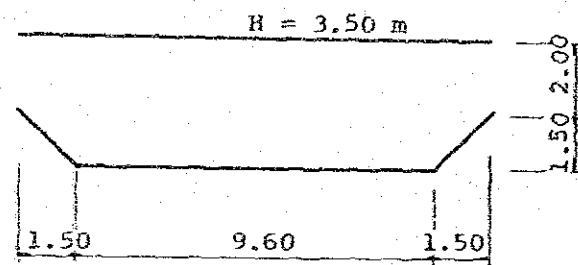
H (m)	A (m ²)	P (m)	R	$R^{\frac{2}{3}}$	$I^{\frac{1}{2}}$	V (m/sec)	Q (m ³ /sec)
0.50	6.13	13.16	0.466	0.601	0.0447	0.672	4.12
1.00	12.75	14.58	0.874	0.914	"	1.021	13.02
1.50	19.88	15.99	1.243	1.156	"	1.292	25.68
2.00	27.50	17.41	1.580	1.356	"	1.515	41.66
2.50	35.38	18.41	1.922	1.546	"	1.727	61.10
3.00	43.25	19.41	2.228	1.706	"	1.906	82.43
3.50	51.13	20.41	2.505	1.845	"	2.062	105.43



VOINJAMA - MENDIKOMA

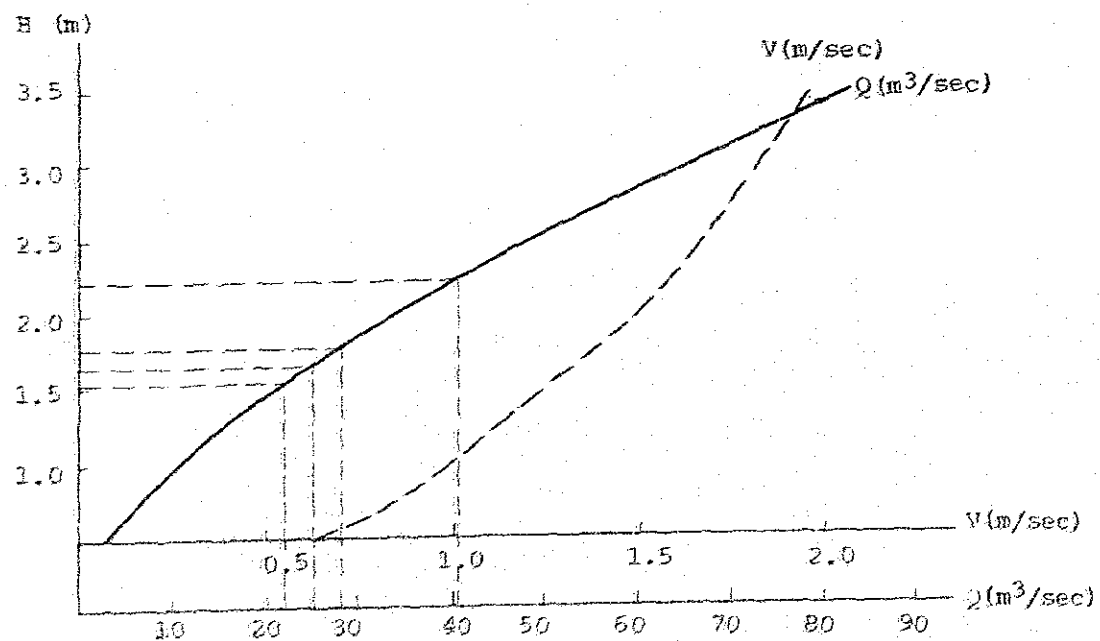
BRIDGE NO.3

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 43.2km



$Q = 40.85 \text{ m}^3/\text{sec}$ $i = 0.002$ $n = 0.04$

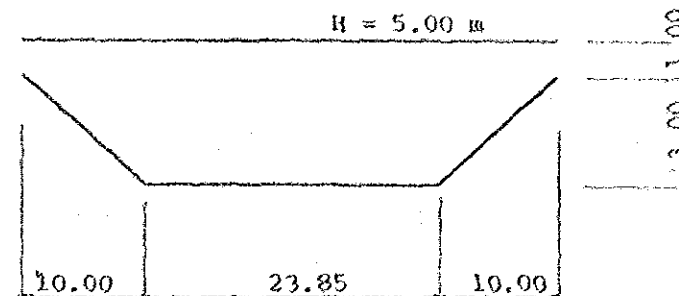
H (m)	A (m ²)	P (m)	R	$R \frac{2}{3}$	$I \frac{1}{2}$	V (m/sec)	Q (m ³ /sec)
0.50	5.05	11.01	0.459	0.595	0.0447	0.665	3.36
1.00	10.60	12.43	0.853	0.899	"	1.005	10.65
1.50	16.65	13.84	1.203	1.131	"	1.264	21.05
2.00	22.95	14.84	1.546	1.337	"	1.494	34.29
2.50	29.25	15.84	1.847	1.505	"	1.682	49.20
3.00	35.55	16.84	2.111	1.646	"	1.839	65.38
3.50	41.85	17.84	2.346	1.766	"	1.974	82.61



VOINJAMA - MENDIKOMA

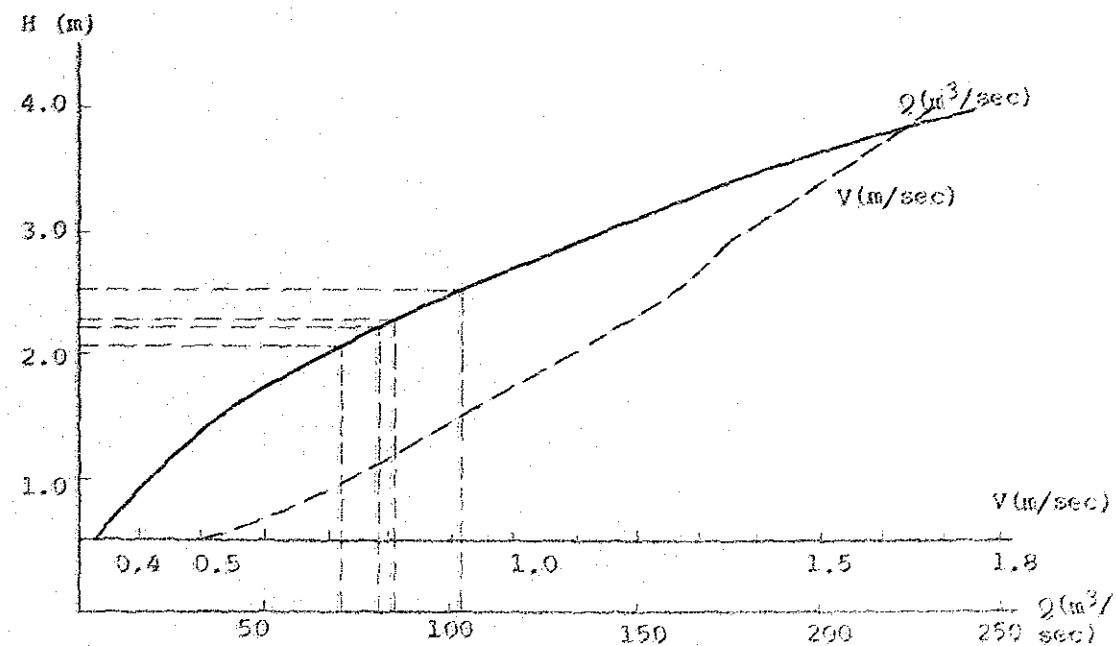
BRIDGE NO.4

HYDRAULIC CROSS-SECTION OF THE CREEK FOR BRIDGE at 70.1km



$Q = 85.53 \text{ m}^3/\text{sec}$ $i = 0.001$ $n = 0.04$

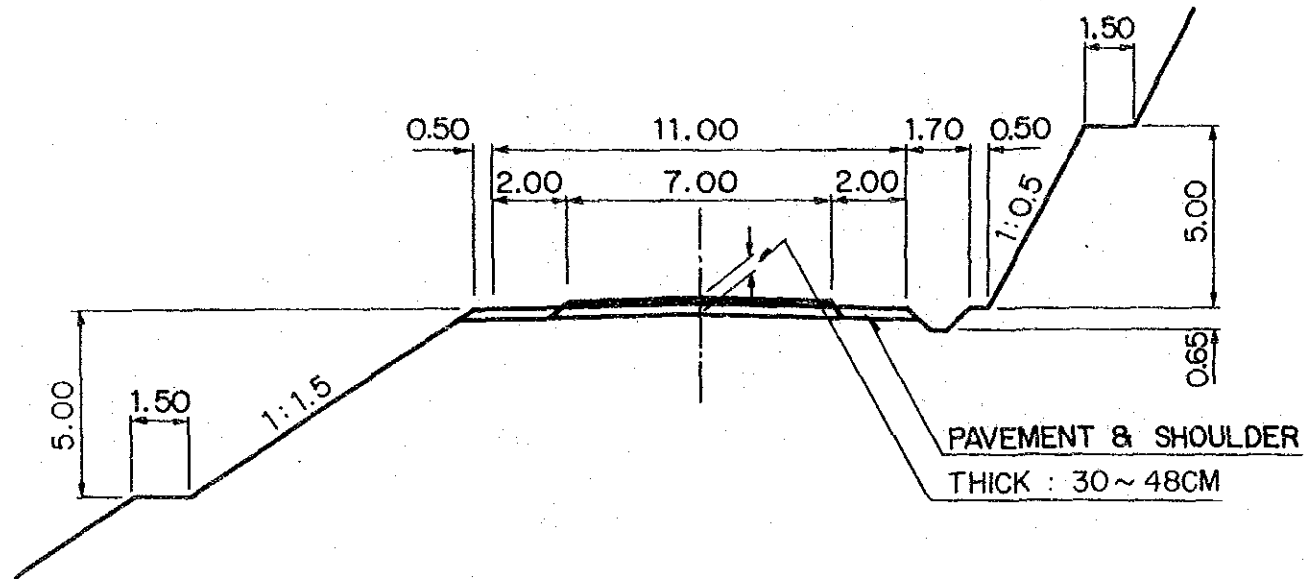
H (m)	A (m ²)	P (m)	R	$R \frac{2}{3}$	$I \frac{1}{2}$	V (m/sec)	Q (m ³ /sec)
0.50	12.76	27.33	0.467	0.602	0.0316	0.476	6.07
1.00	27.18	30.81	0.882	0.920	"	0.727	19.76
1.50	43.28	34.29	1.262	1.168	"	0.923	39.95
2.00	61.03	37.77	1.616	1.377	"	1.088	66.40
2.50	80.46	41.25	1.951	1.561	"	1.233	99.21
3.00	101.55	44.73	2.270	1.727	"	1.364	138.51
4.00	145.40	46.73	3.111	2.131	"	1.683	244.71



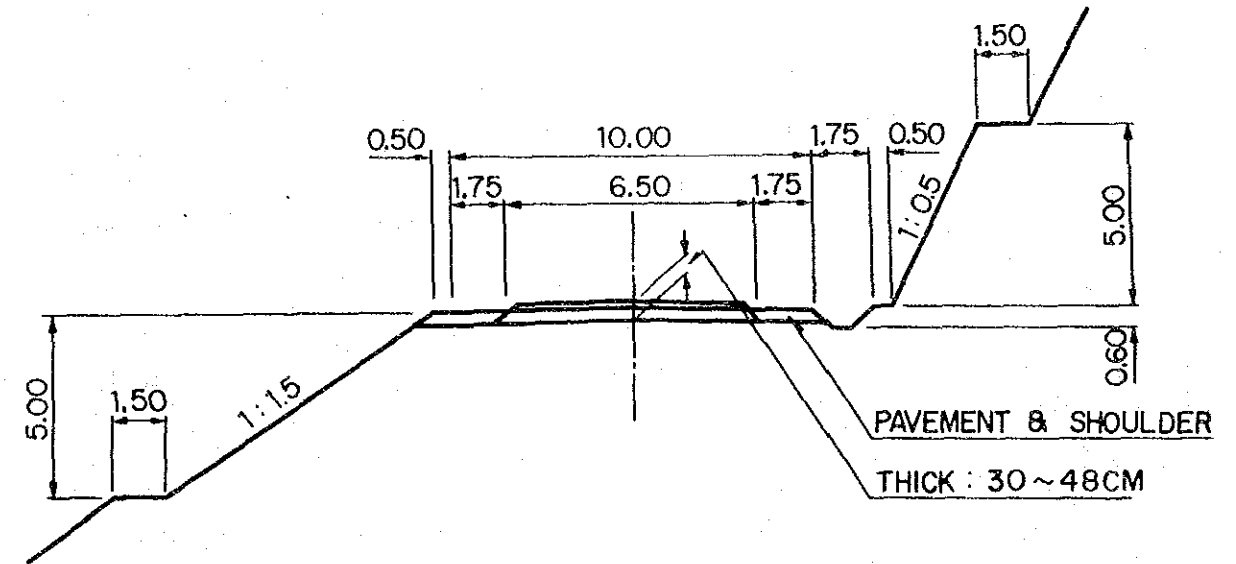
IV. 主要断面、舗装構造および排水構造物

(UNIT : M)

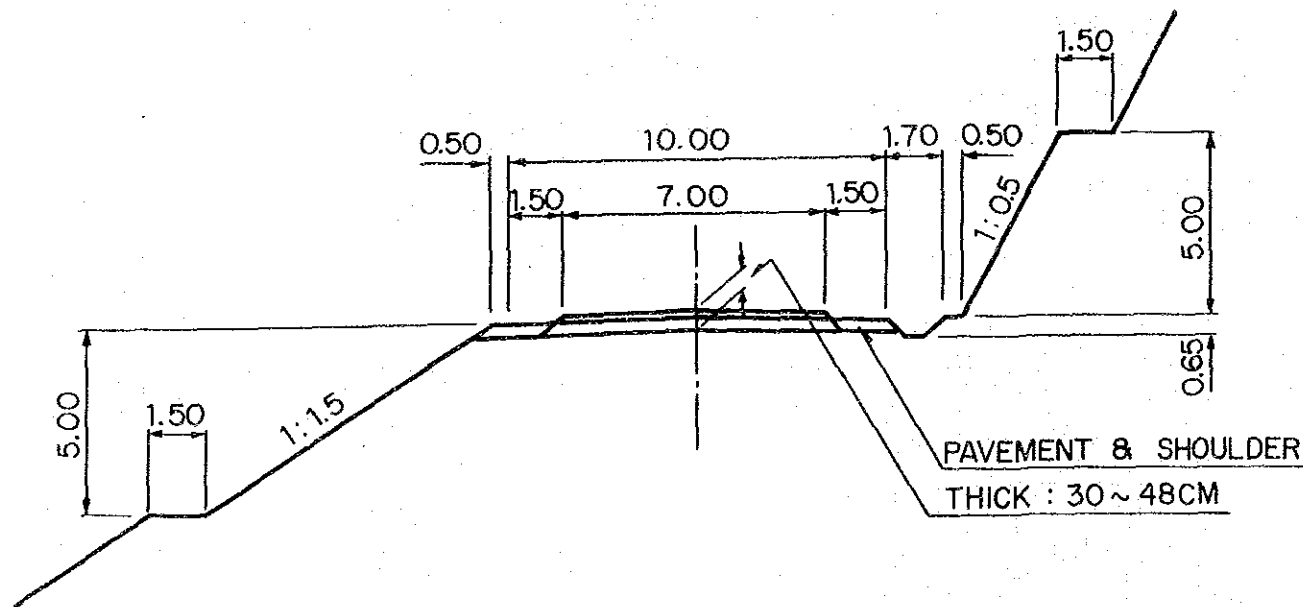
DESIGN SPEED 80km/h (LOFA RIVER-VOINJAMA-SHELLO)



DESIGN SPEED 60km/h (KONIA-LOFA RIVER)



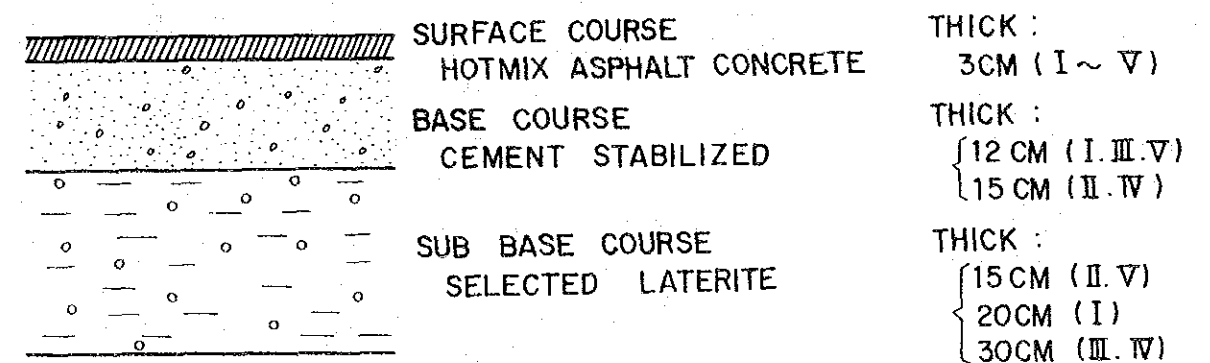
DESIGN SPEED 80 km/h (GBARNGA-KONIA . SHELLO-MENDIKOMA)



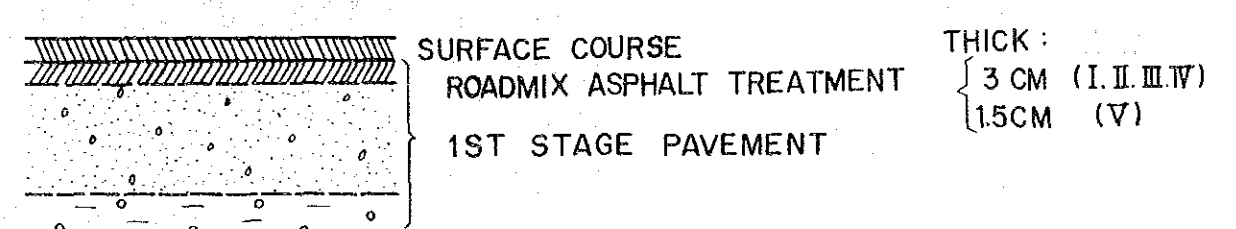
PAVEMENT STRUCTURE

(10 YEARS STAGE-WISE CONSTRUCTION METHOD)

1ST STAGE

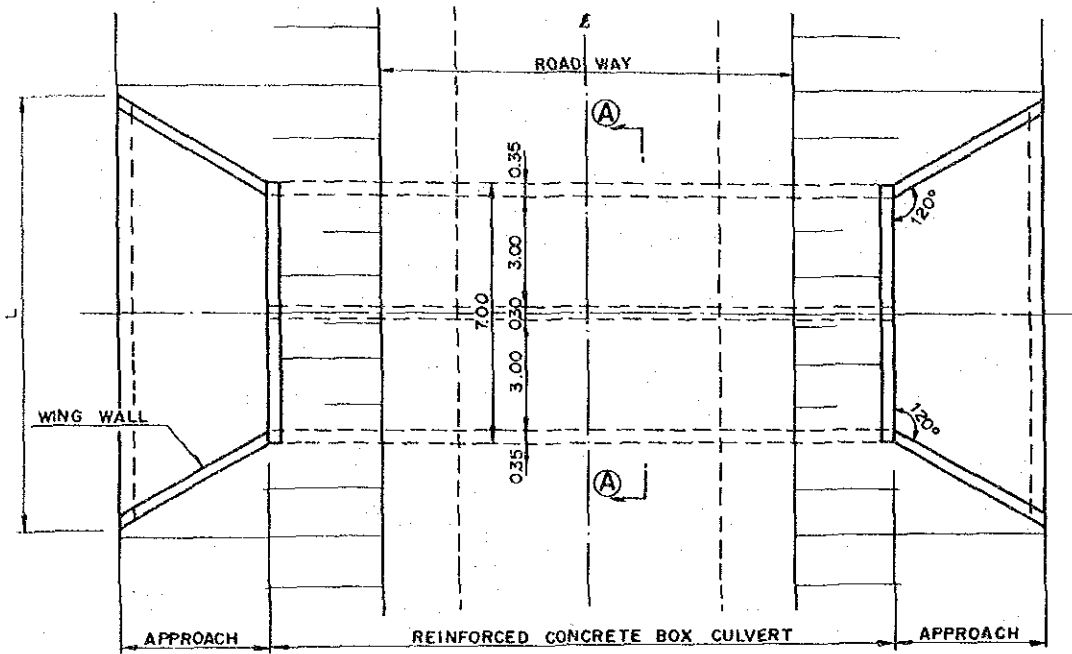


2ND STAGE (AFTER 10 YEARS OVERLAY)

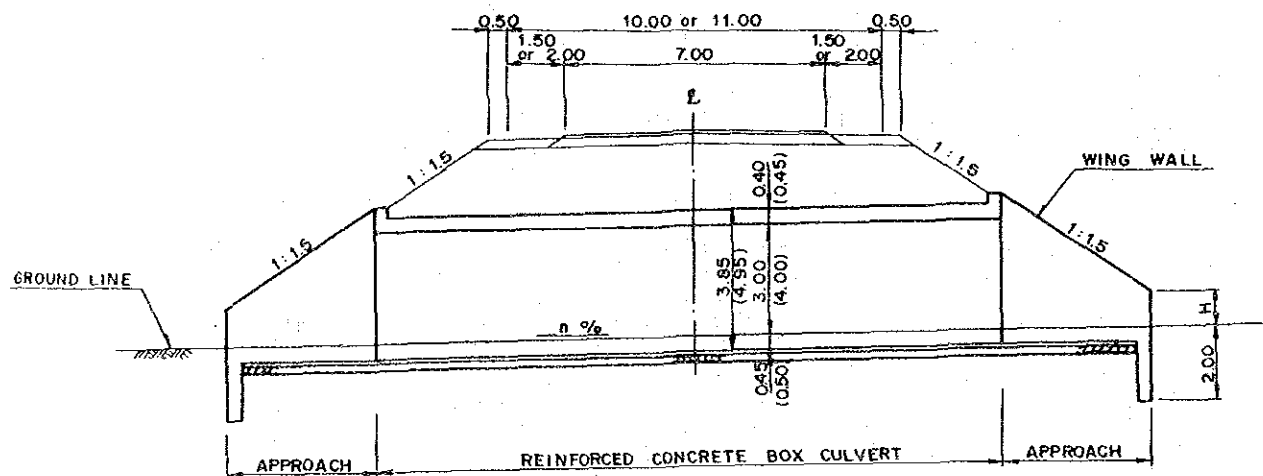


**BOX CULVERT 3.0x3.0-2
(4.0x4.0-2)**

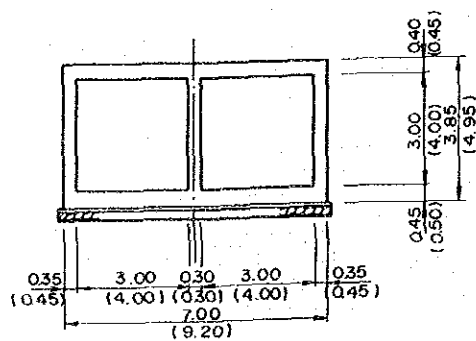
PLAN SCALE A



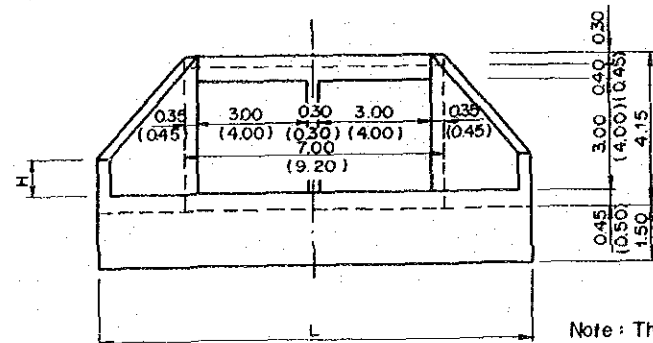
PROFILE SCALE A



CROSS SECTION SCALE A
(A-A)

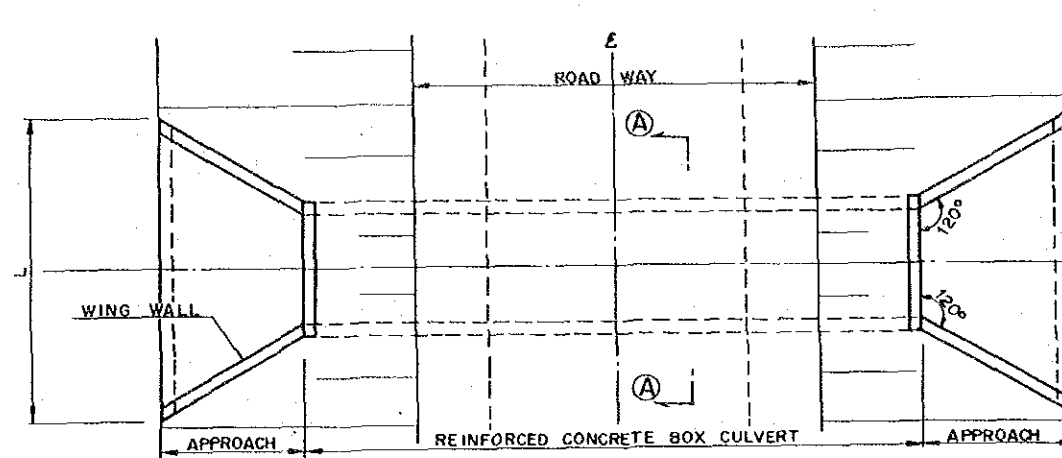


FRONT VIEW SCALE A

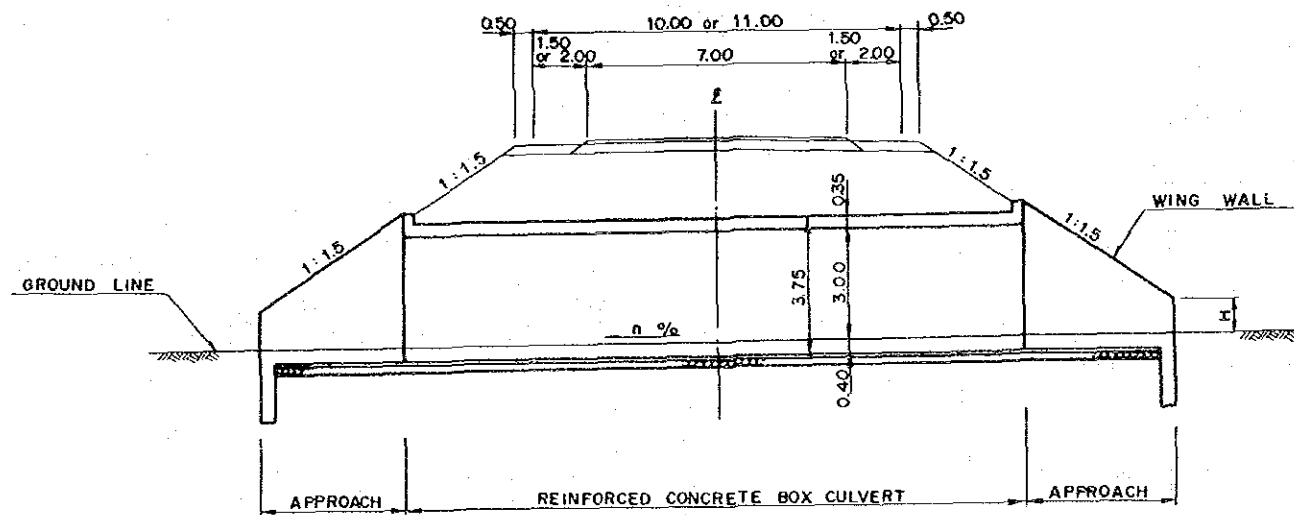


BOX CULVERT 3.0x3.0

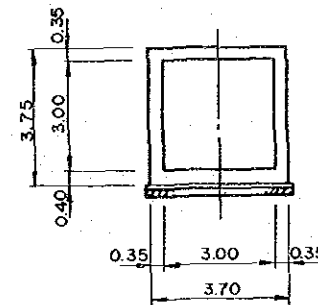
PLAN SCALE A



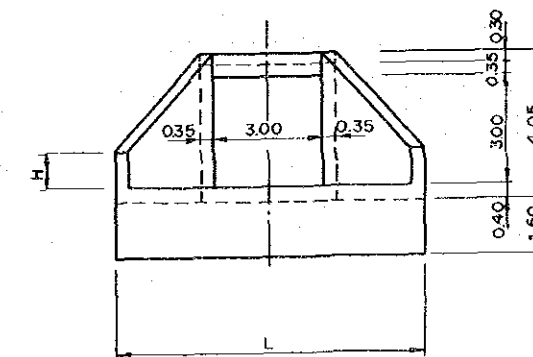
PROFILE SCALE A



CROSS SECTION SCALE
(A-A)



FRONT VIEW SCALE A

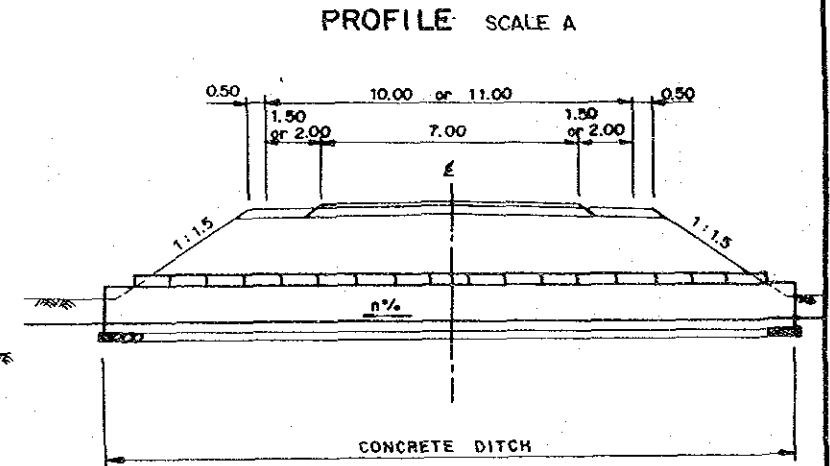
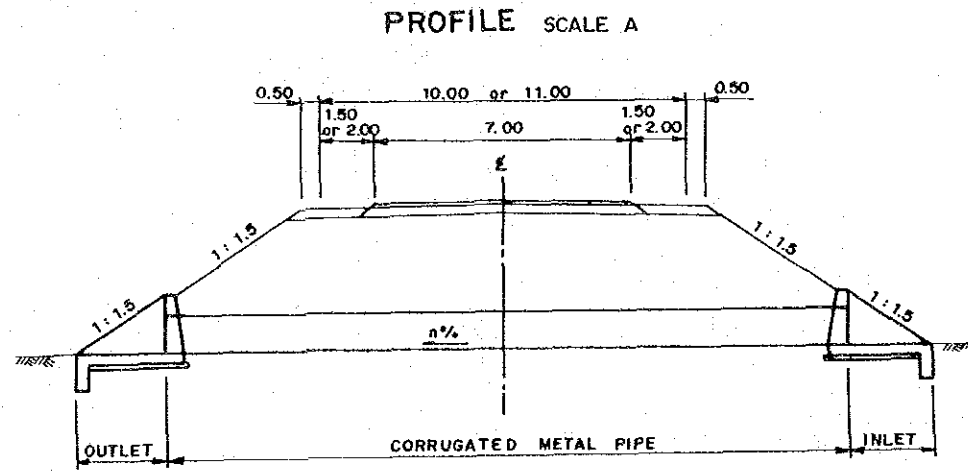
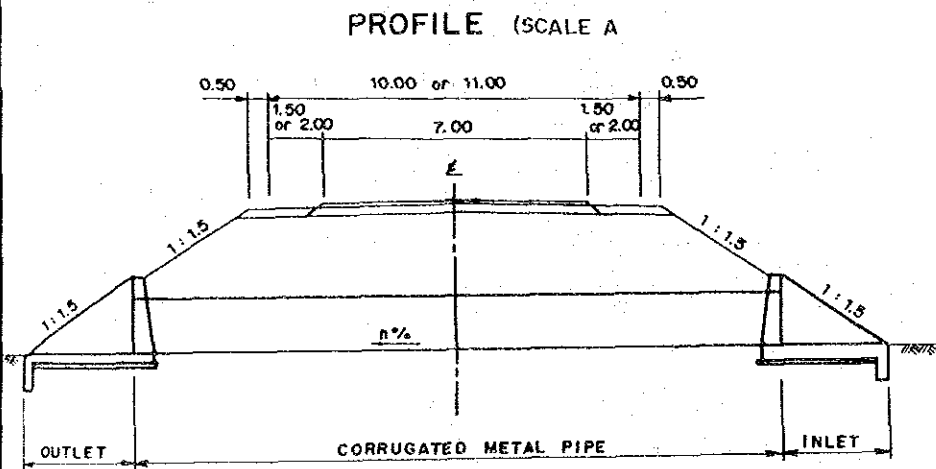
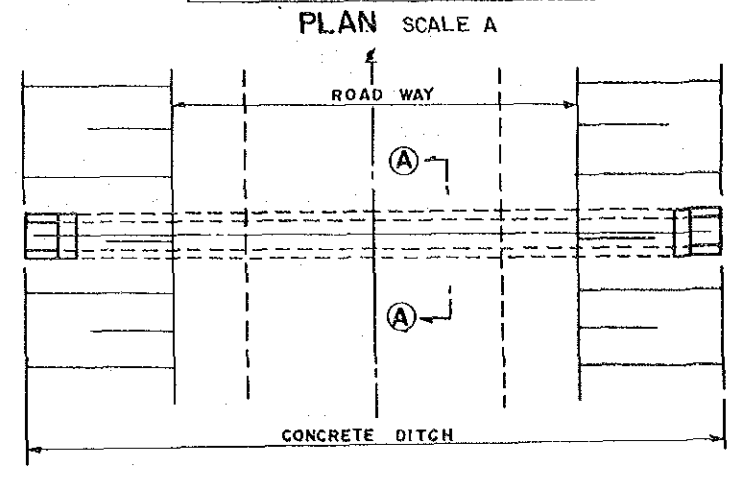
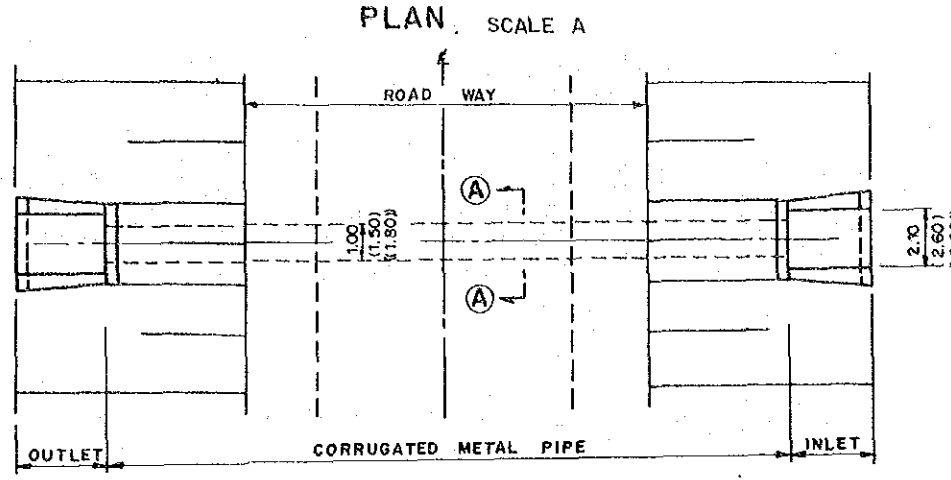
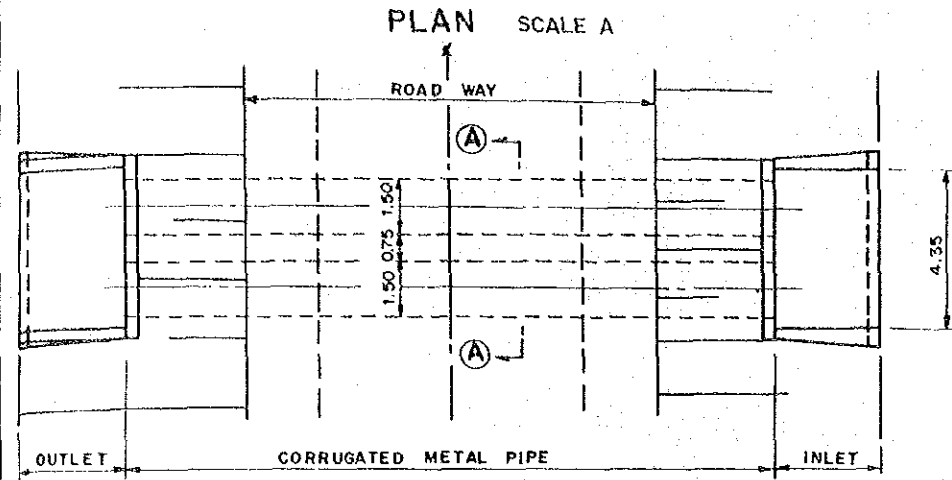


SCALE A 0 1 2 3 (m)

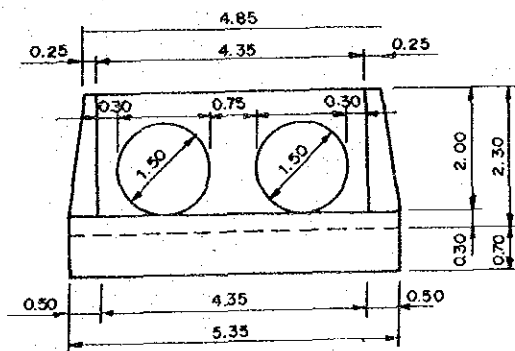
Note: The figures in the parenthesis denote Box Culvert (2-4.00x4.00)

PIPE CULVERT

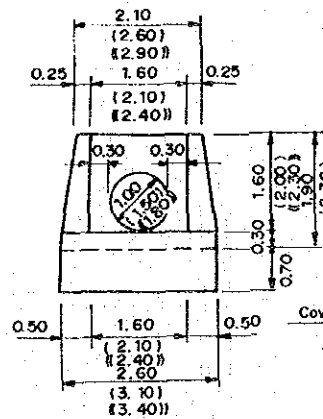
CROSS DITCH



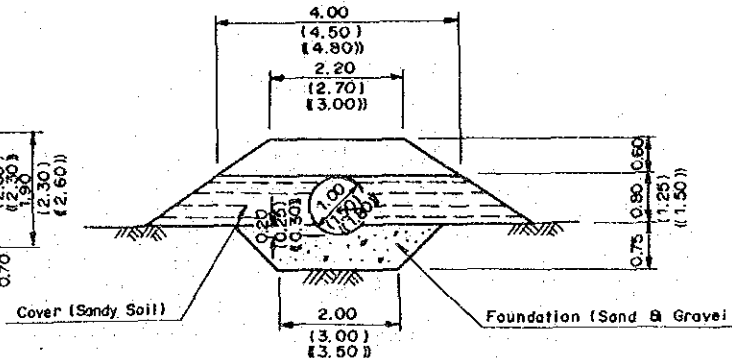
FRONT VIEW SCALE B



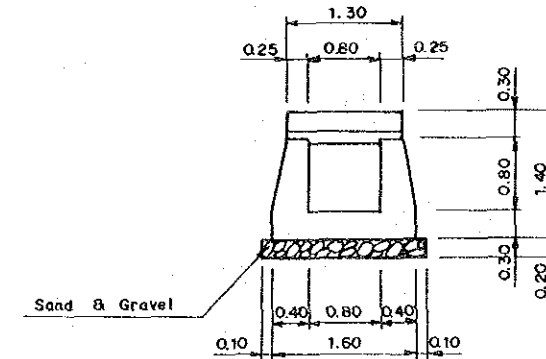
FRONT VIEW SCALE B



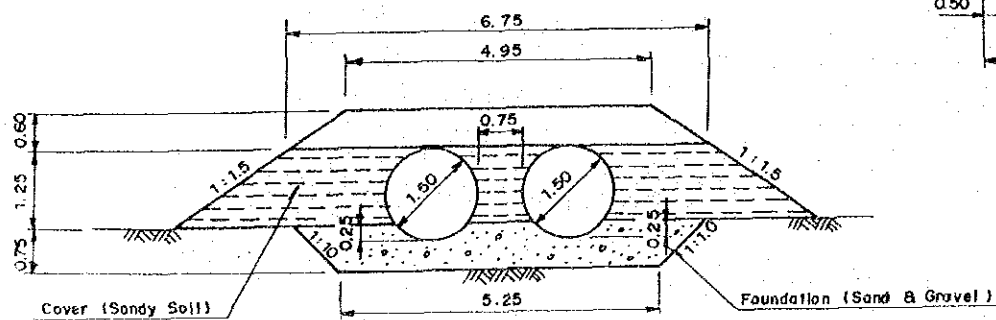
CROSS SECTION SCALE B (A-A)



CROSS SECTION SCALE C (A-A)



CROSS SECTION SCALE B (A-A)



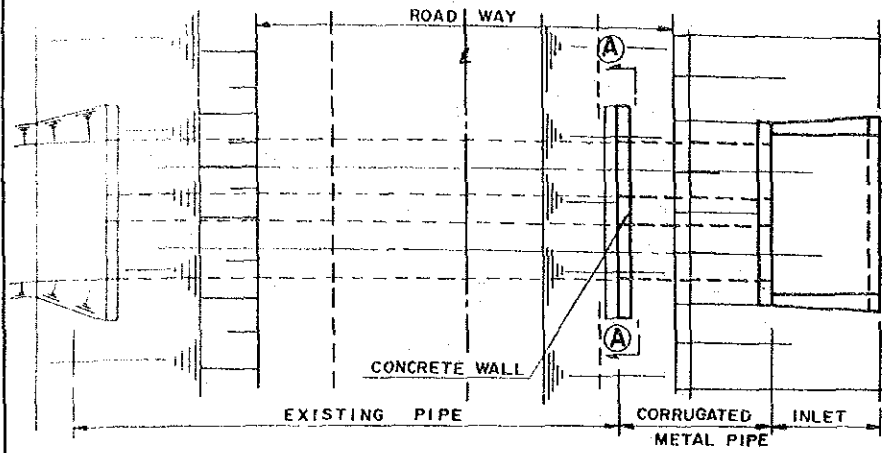
Note: The figures in the parenthesis denote corrugated metal pipe D150 and D180

SCALE A 0 1 2 3 (m)

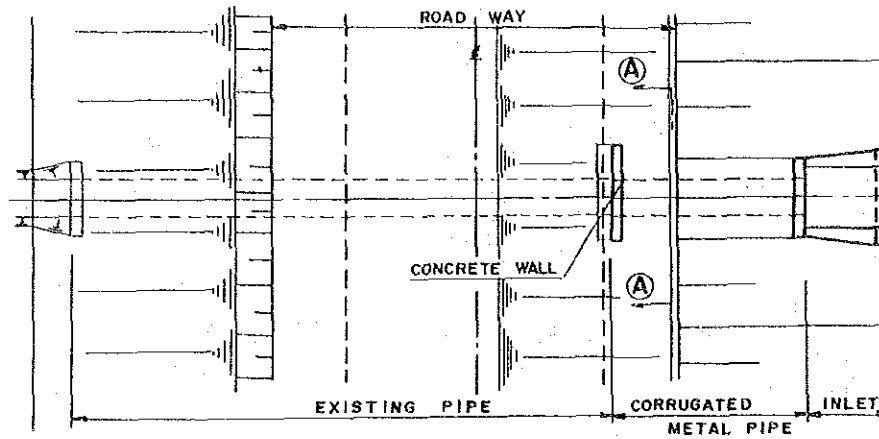
SCALE B 0 1 2 (m)

SCALE C 0 1 2 (m)

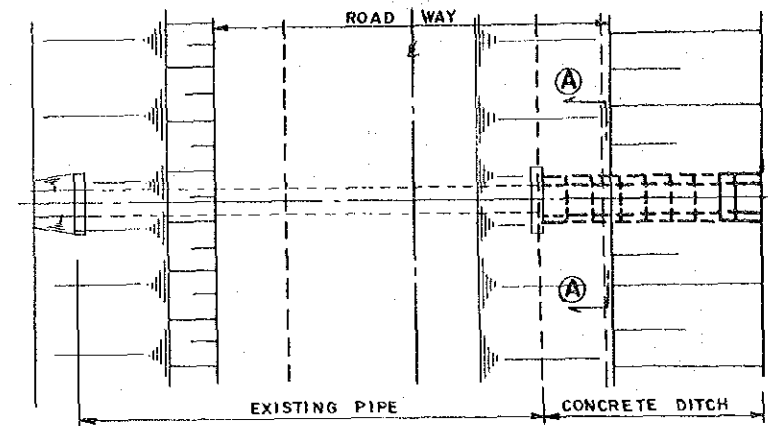
PLAN SCALE A



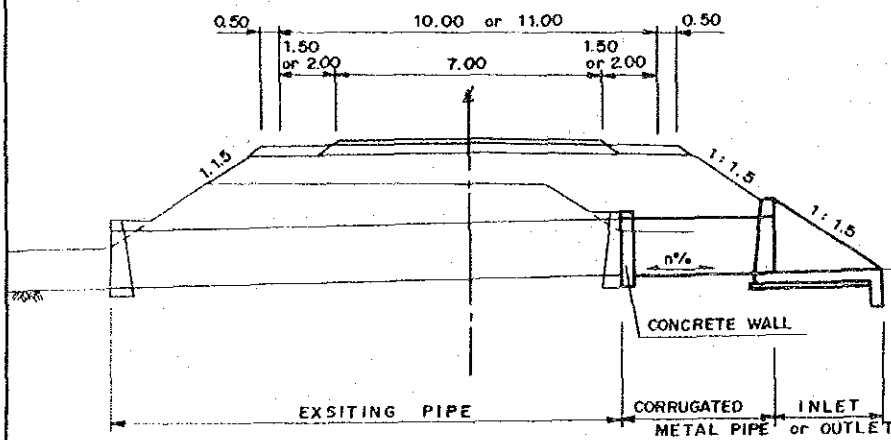
PLAN SCALE A



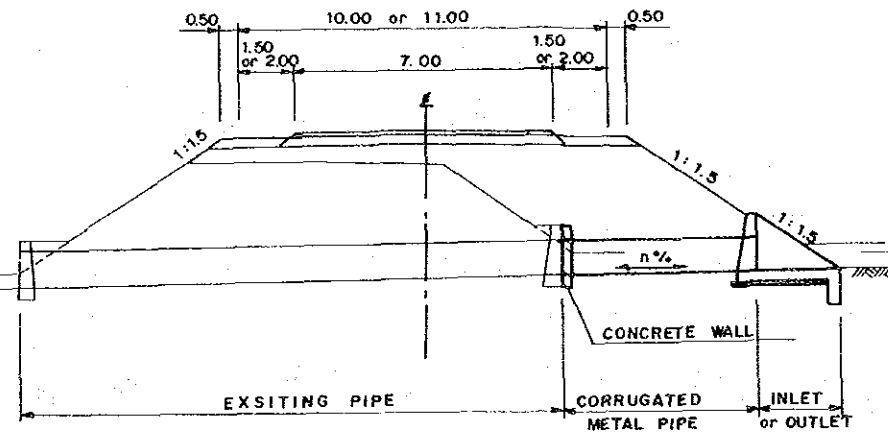
PLAN SCALE A



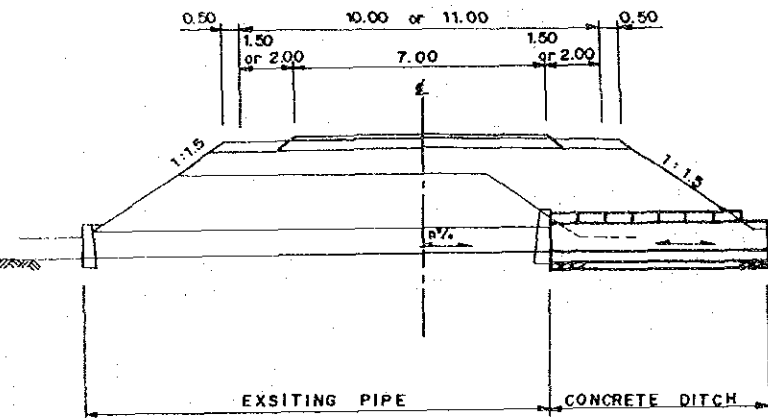
PROFILE SCALE A



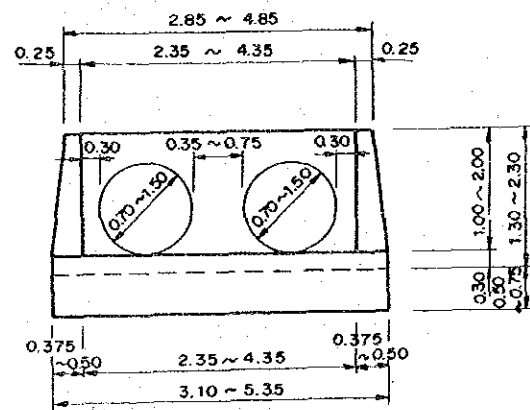
PROFILE SCALE A



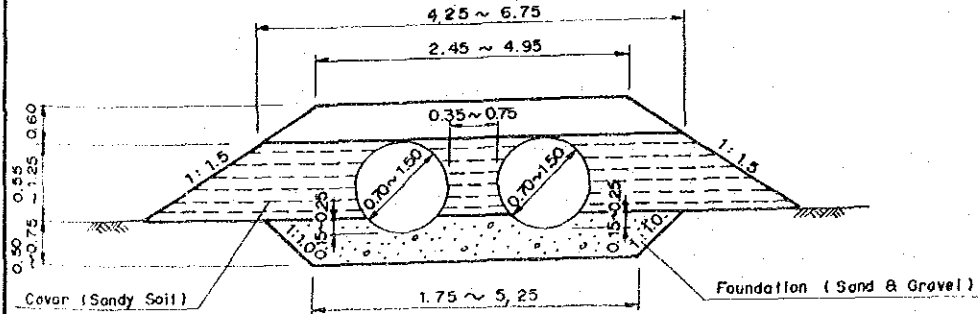
PROFILE SCALE A



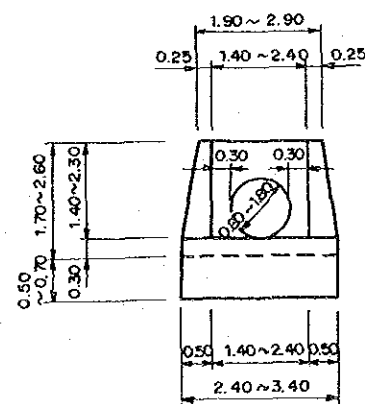
FRONT VIEW SCALE B



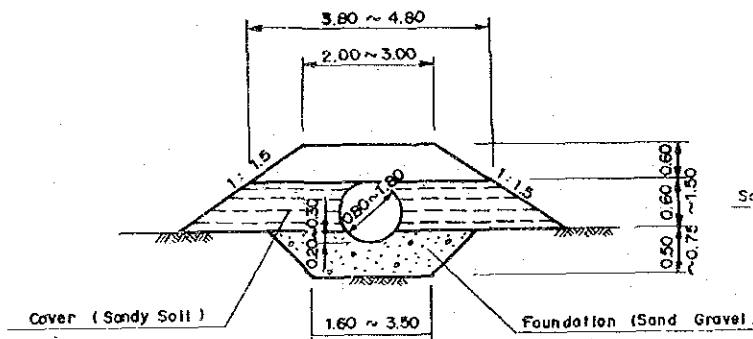
CROSS SECTION SCALE B (A-A)



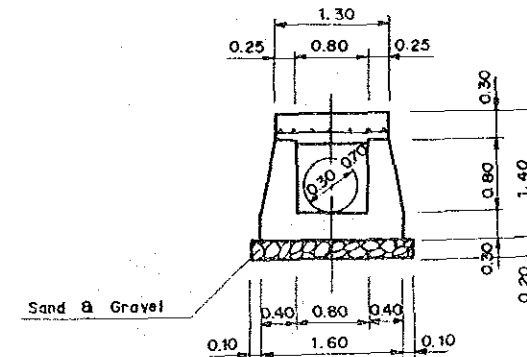
FRONT VIEW SCALE B



CROSS SECTION SCALE B (A-A)

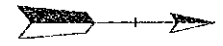


CROSS SECTION SCALE C (A-A)



SCALE A 0 1 2 3 (m)
 SCALE B 0 1 2 (m)
 SCALE C 0 1 2 (m)

V. 概略設計図



□ : DRAWING NUMBER
 () : SECTION LENGTH (80 km/h)
 [] : SECTION LENGTH (60 km/h)

