タンザニア連合共和国
中波ラジオ放送網拡充計画
基本設計調査

建築事情資料集

昭和62年2月

国際協力事業団

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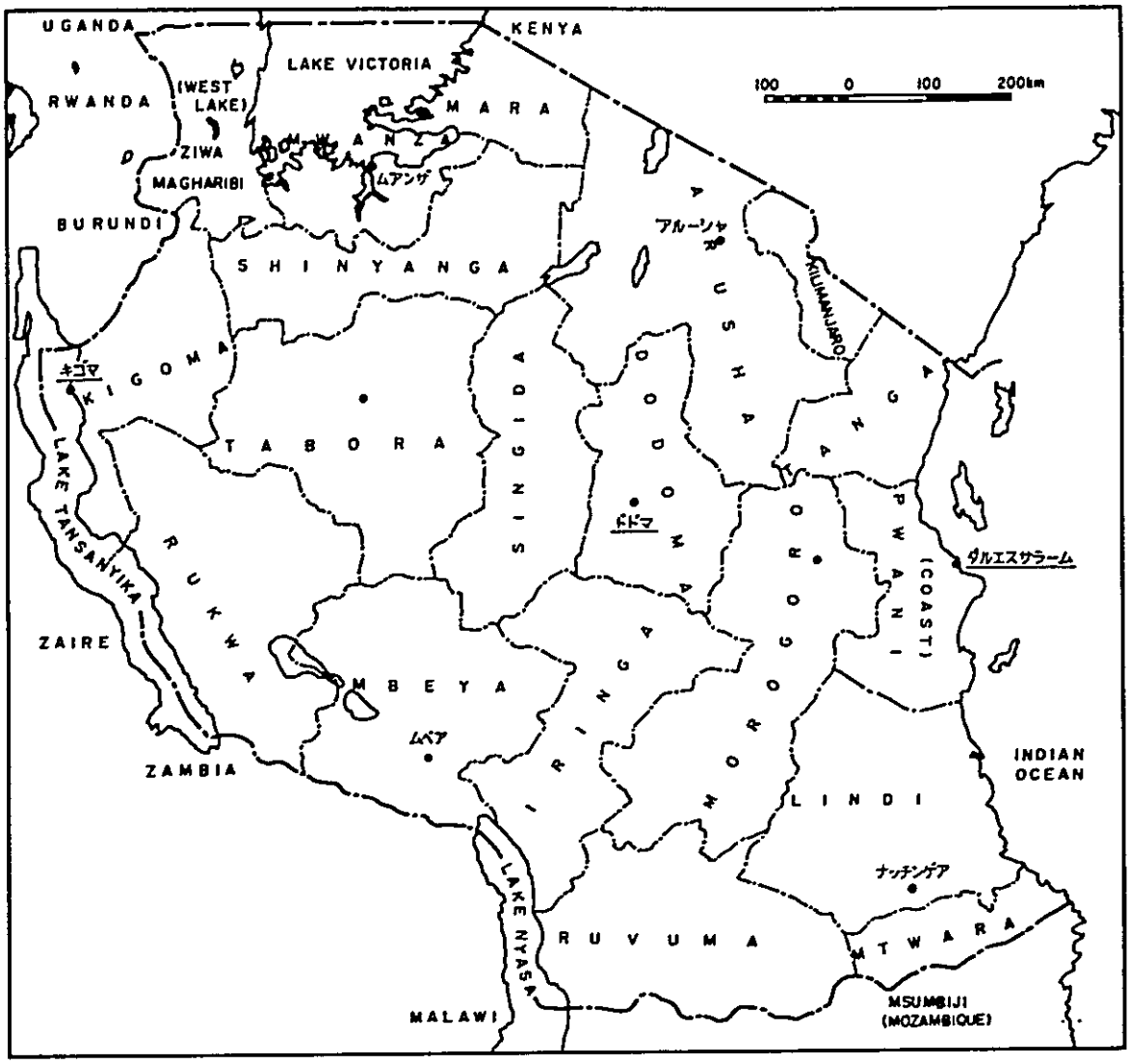
国 際 協 力 事 業 団


UGANDA
KENYA
LAKE VICTORIA
RWANDA
(WEST LAKE)
MARA
ZIWA MAGHARIBI
MWANZA
ムアンザ
BURUNDI
SHINYANGA
アルーシャ
KILIMANJARO
キゴマ
KIGOMA
TABORA
SINGIDA
DODOMA
ドドマ
MANYARA
LAKE TANGANYIKA
RUKWA
ZAIRE
MBEYA
ムベア
ZAMBIA
IRINGA
MOROGORO
PWANI (COAST)
ダルエスサラーム
INDIAN OCEAN
LINDI
ナッチンゲア
LAKE NYASA
RUVUMA
MTWARA
MALAWI
MSUMBIJI (MOZAMBIQUE)
100 0 100 200km

タンザニア連合共和国

目　次

1．自　然　条　件

1－1　気　象　条　件

タンザニアは、インド洋に面する海岸地帯（東経40°）から、タンガニーカ湖東岸（東経30°）までの幅 1,000ｋｍ、北はビクトリア湖南岸（南緯 1°）から南はニアサ湖北岸（南緯15°）までの 1,200ｋｍにおよぶ約94万 5千ｋ㎡（日本の約 2.5倍）の広大な国土を持ち、国土の大部分が海抜1,000m強のサバンナ高原地帯となっている。

首都ダルエスサラームを含む東部海岸地帯は、熱帯性気候で高温多湿である。中央高地は、気温・湿度共海岸地帯より低く、年間を通して昼夜の気温の変化が激しく、20℃前後の気温差の日が多い。また湿度においても昼夜の差が大きく、早朝80%前後のものが日中には45%前後に下がる。タンガニーカ湖やルクワ湖に面する西部高地の湖水地帯もまた高温湿潤であり、山岳地帯は一般に気候が良好である。

表1－1　各地の気温　　(℃)

都市名	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	年間平均
ダルエスサラーム	27.3	27.6	27.6	26.7	25.5	24.3	23.3	23.8	24.2	25.3	26.4	27.4	25.78
ドドマ	23.7	23.6	23.5	23.1	22.0	20.5	19.9	20.5	22.1	23.5	24.8	24.4	22.63
キゴマ	23.2	23.4	23.5	23.4	23.7	22.9	22.7	23.7	24.6	24.6	23.2	22.9	23.48
ナッチンゲア	25.5	25.2	25.2	24.5	23.3	22.3	22.2	23.1	24.2	22.3	26.3	26.3	24.20

[タンザニア気象庁]

表１－２　　中央高地の都市・ドドマの気温（1932-80）　　(℃)

	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	平均
最高気温	35.3	36.0	34.4	33.6	32.9	32.2	31.1	34.1	33.8	36.1	36.0	36.4	36.4
最低気温	15.0	12.6	14.6	13.8	10.3	8.5	7.6	9.0	10.2	11.3	14.4	12.2	7.6
月平均最高気温	29.2	29.1	29.1	28.6	28.0	27.2	26.6	27.3	29.2	30.6	31.6	30.3	28.9
月平均最低気温	18.3	18.1	18.0	17.7	16.1	13.9	13.2	13.8	15.0	16.5	18.0	18.6	16.4
高低差	10.9	11.0	11.1	10.9	11.9	13.3	13.4	13.5	14.2	14.1	13.6	11.7	12.5

［タンザニア気象庁］

表１－３　　月平均最高・最低気温表　（ドドマ）

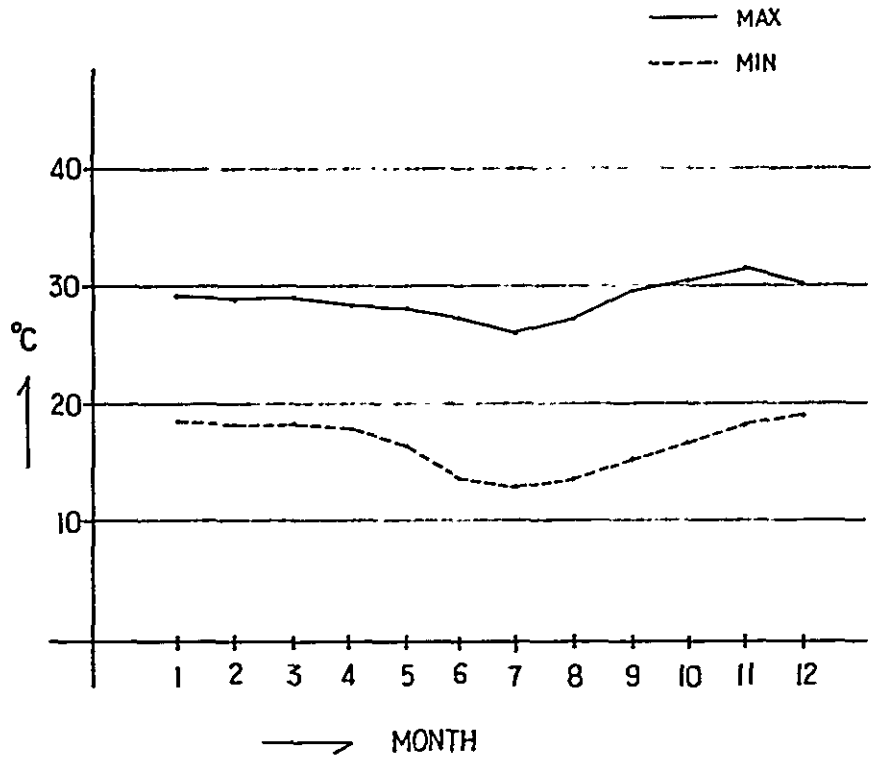


表１－４　　湖水地帯の都市・キゴマの気温（1934-80）　　(℃)

	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	平均
最高気温	31.7	33.2	33.1	33.2	31.8	31.6	31.4	32.7	34.9	36.8	33.7	32.6	36.8
最低気温	15.3	15.6	15.6	13.3	15.0	13.4	13.2	14.5	14.8	15.6	11.2	15.0	11.2
月平均最高気温	26.9	27.2	27.5	27.4	28.3	28.2	28.3	29.1	29.6	29.0	26.8	26.4	27.9
月平均最低気温	19.5	19.6	19.5	19.4	19.2	17.7	17.2	18.4	19.7	20.3	19.6	19.4	19.1
高低差	7.4	7.6	8.0	8.0	9.1	10.5	11.1	10.7	9.9	8.7	7.2	7.0	8.8

［タンザニア気象庁］

表１－５　　月平均最高・最低気温表　（キゴマ）

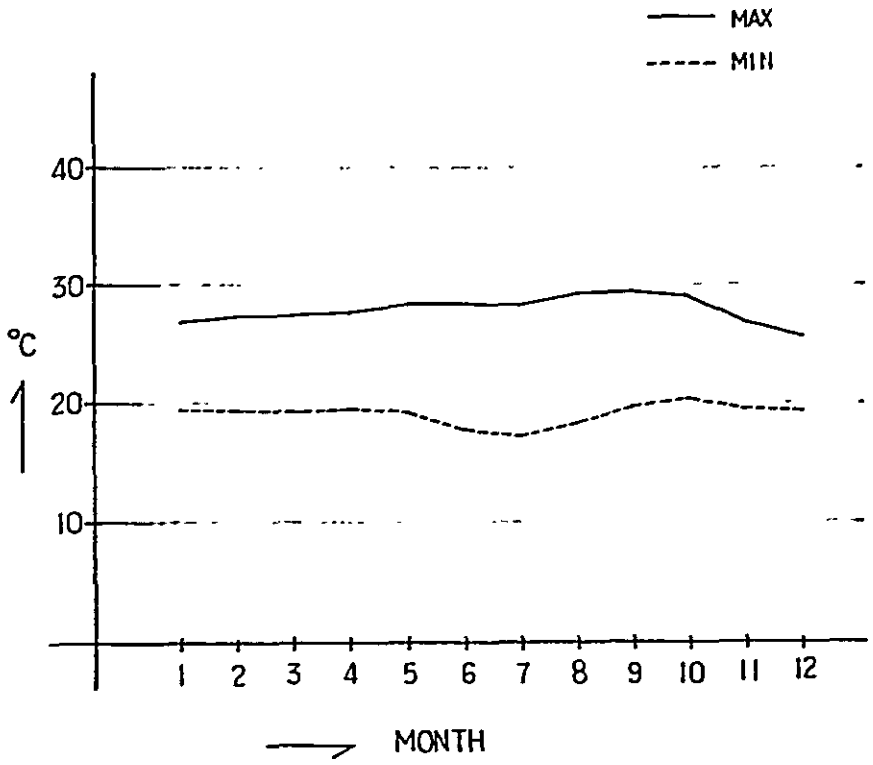
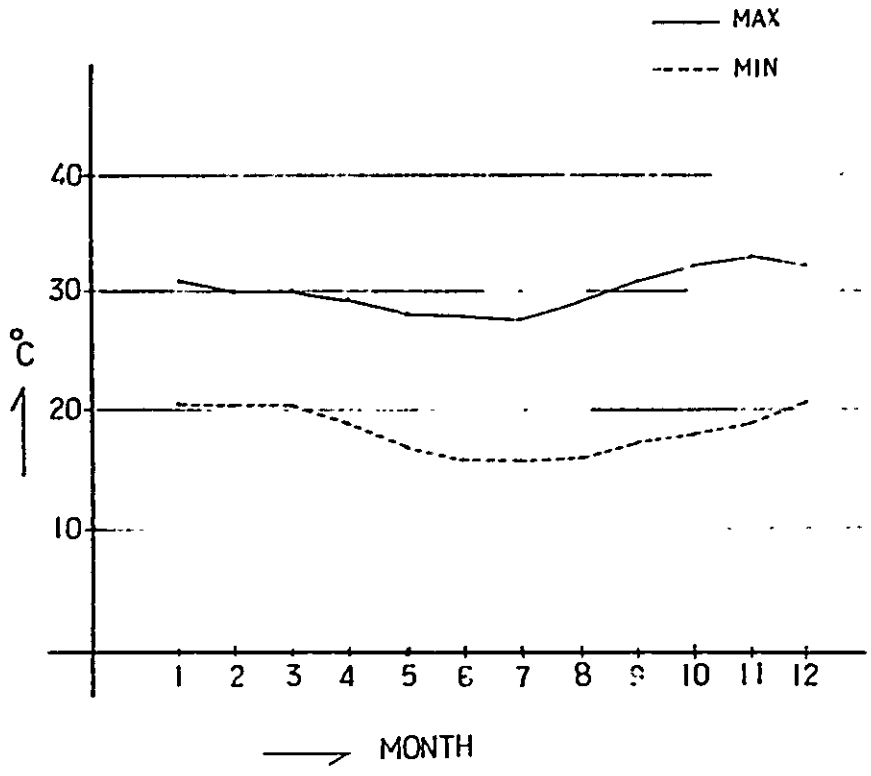


表１－６　　南部の街・ナッチンゲアの気温（1951-70）　　(℃)

	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	平均
最高気温	37.4	35.0	35.3	32.6	33.0	34.0	31.5	36.0	36.0	36.3	38.5	38.5	38.5
最低気温	13.6	14.5	10.3	13.7	11.6	9.0	7.7	10.8	11.5	12.9	13.5	12.1	7.7
月平均最高気温	30.5	30.0	30.0	29.3	28.6	28.2	28.1	29.5	30.8	32.1	33.0	32.1	30.2
月平均最低気温	20.5	20.4	20.4	19.7	17.9	16.4	16.2	16.8	17.5	18.4	19.5	20.4	18.7
高低差	10.0	9.6	9.6	9.6	10.7	11.8	11.9	12.9	13.3	13.7	13.5	11.7	11.5

［タンザニア気象庁］

表１－７　　月平均最高・最低気温表　（ナッチンゲア）



３月下旬から５月中旬が大雨期、１１月末から１２月初旬が小雨期、それ以外が乾期となっている。降雨量は海岸地帯が最も多く、次いで湖水地帯が多く、中央高地は少ない。

表１－８　各地の湿度　(%)

都市＼月		1	2	3	4	5	6	7	8	9	10	11	12	年間平均
ダルエスサラーム		72	78	81	82	81	79	78	75	76	76	79	79	78
ドドマ	7:00	91	93	93	93	90	88	86	87	86	84	84	88	89
	10:00	81	82	82	81	76	73	73	72	69	67	68	76	75
	14:00	51	53	53	53	47	42	41	39	36	34	36	45	44
キゴマ	7:00	88	88	90	90	88	83	76	70	70	77	86	90	83
	10:00	84	83	83	84	79	74	68	61	60	67	81	84	76
	14:00	74	73	72	73	64	55	50	51	56	62	73	74	65
ナッチンゲア	10:00	83	86	86	86	81	79	73	73	69	68	69	77	77
	14:00	63	66	69	67	57	49	44	40	42	42	45	53	53

［タンザニア気象庁］

表１－９　月平均湿度表　（ドドマ）

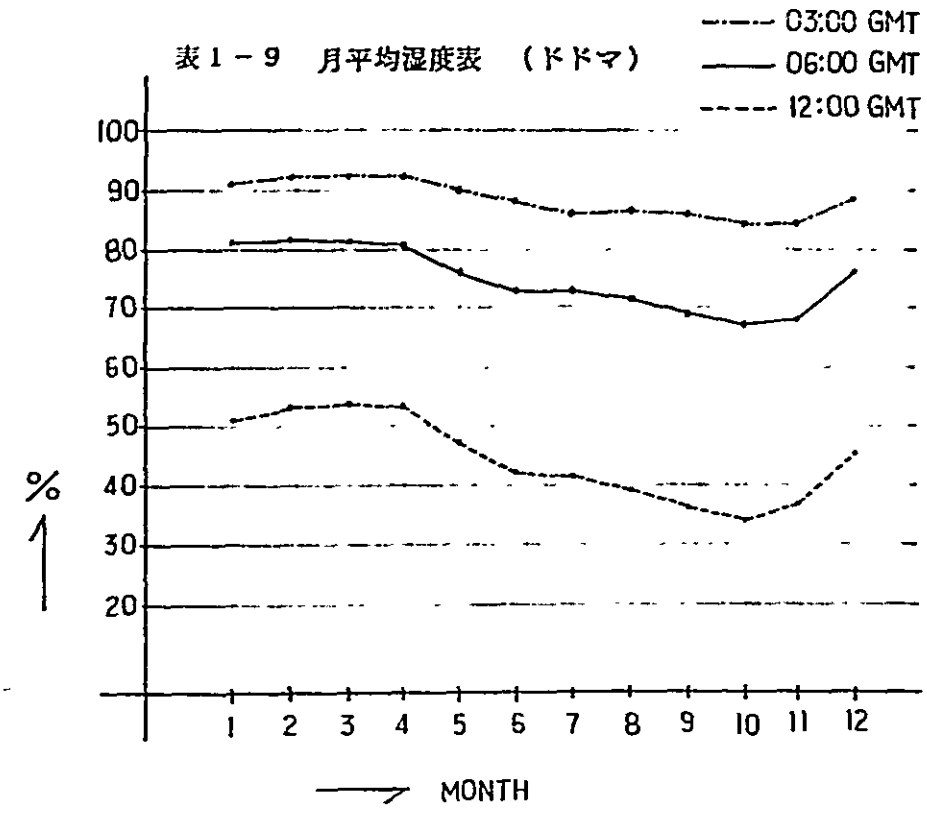


表１－１０　月平均湿度表　（キゴマ）

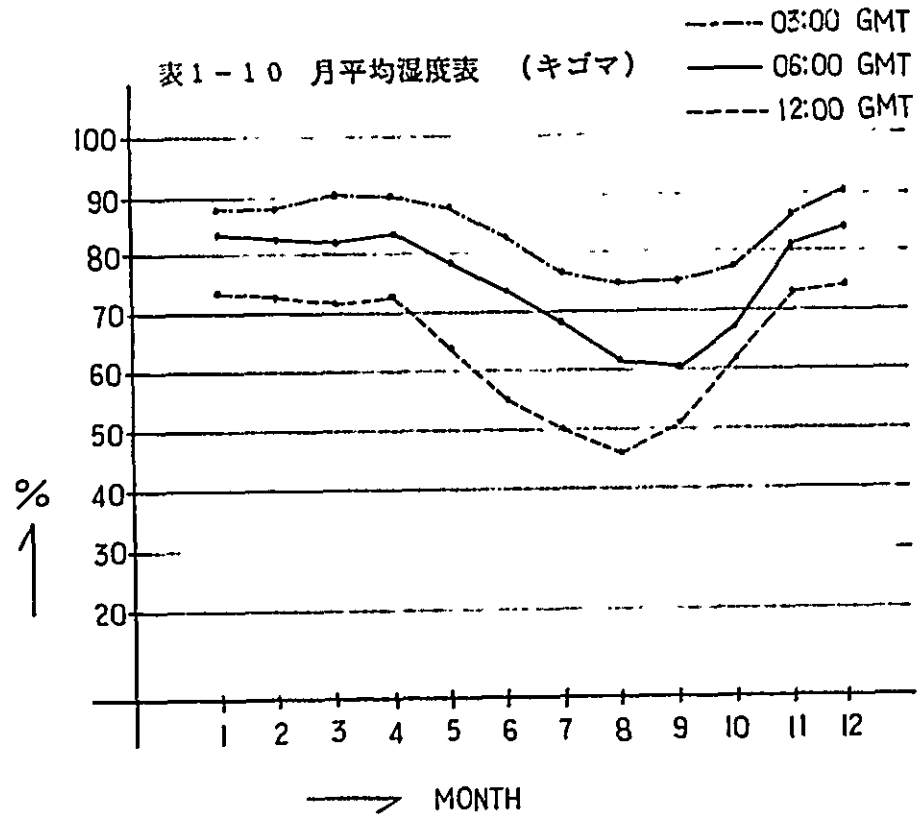


表１－１１　各地の降雨量　　(mm)

都市名	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	年間雨量
ダルエスサラーム	58	68	128	264	219	33	21	24	8	48	68	83	1022
ドドマ	139	111	118	53	4	1	0	0	1	3	21	107	558
キゴマ	130	118	146	166	54	6	3	2	17	53	133	147	975
ナッチンゲア	196	168	196	151	29	4	4	1	4	6	66	125	950

［タンザニア気象庁］

表１－１２　各地の降雨日数　　(日)

都市名	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	計
ドドマ	11	10	9	6	1	0	0	0	0	0	2	8	47
キゴマ	13	11	14	16	7	0	0	1	3	7	16	16	105
ナッチンゲア	12	11	15	13	1	1	1	0	1	1	6	11	73

［タンザニア気象庁］

東部海岸地帯は、インド洋からの南東貿易風の影響を受け、雨期には北風が、乾期には南風が多い。南部においては、熱帯性低気圧の発生による季節風の影響を受けることがある。しかし、年間を通して全般に風は穏やかであり、内陸部では無風の日が多く、特に雨期は月の½が無風状態である。

表1－13　各　地　の　風　速　　(knots)

都市＼月		1	2	3	4	5	6	7	8	9	10	11	12	年間平均
ドドマ	10:00	6	6	7	8	9	9	10	12	13	13	11	8	9
	14:00	5	5	6	7	8	8	8	10	10	11	9	6	8
キゴマ	10:00	5	4	5	6	7	9	9	9	8	7	8	6	7
	14:00	8	9	8	9	8	10	11	13	12	10	9	8	10
ナッチンゲア	10:00	6	4	3	5	6	6	7	6	6	6	6	7	6
	14:00	5	5	4	5	7	7	7	8	7	7	6	6	6

[タンザニア気象庁]

霧や、もや、霞の発生は少なく、雨期でも月に 2～3 回程度であり、全般に大気中の見通しは良好である。

表1－14　各地の平均日射時間　　(時間／日)

都市名	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	年平均
ドドマ	7.6	8.5	7.4	7.3	9.0	9.6	9.4	9.8	9.9	9.8	9.8	8.0	8.8
キゴマ	5.7	6.2	6.0	6.1	7.6	9.3	9.6	9.5	7.9	7.3	5.9	5.3	7.2

[タンザニア気象庁]

表1－15　各地の全天日射量月平均日量　　MJ／m²(=23.3645cal／m²)

都市名	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	年平均
ドドマ	20.77	20.65	20.55	19.62	19.06	19.95	19.83	20.99	21.96	22.49	22.48	20.99	20.79

[タンザニア気象庁]

1－2　地勢・地質

1-2-1 地　　勢

面積　　945,100 ㎢

緯度　　南緯　1°　～　15°

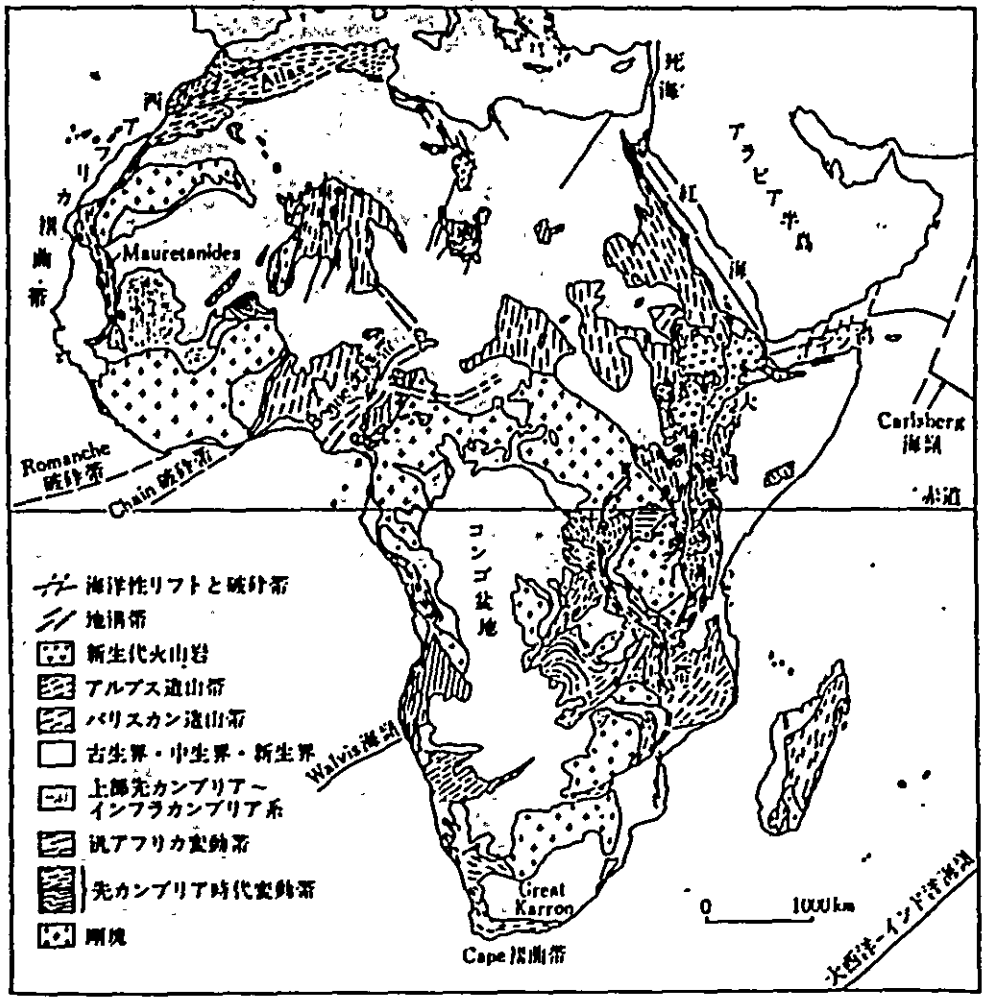
経度　　東経　29.5°～　40°

タンザニアはアフリカ大陸の東部にあり、ほとんど全土にわたってゆるやかに起伏する海抜1,000m前後のサバンナ高原地帯からなっている。国土の中央部を大地溝帯が南北に走っており、これに沿って北部のアフリカ最高峰キリマンジャロ山(5,895m)、メルー山(4,545m)、ハナング山（3,418m）、南部のキペンゲレ山地（最高峰 2,959m)などの高山がある。キリマンジャロ山の南にはマサイステップが広がり、東部は湿の多い低い沿岸平野部へと、西部と南西部は熱帯サバンナの丘陵地帯を経てタンガニーカ湖（最大水深1,435m、水面標高 772m)、マラウィ湖へと落込む形になっている。

1-2-2 地　　質

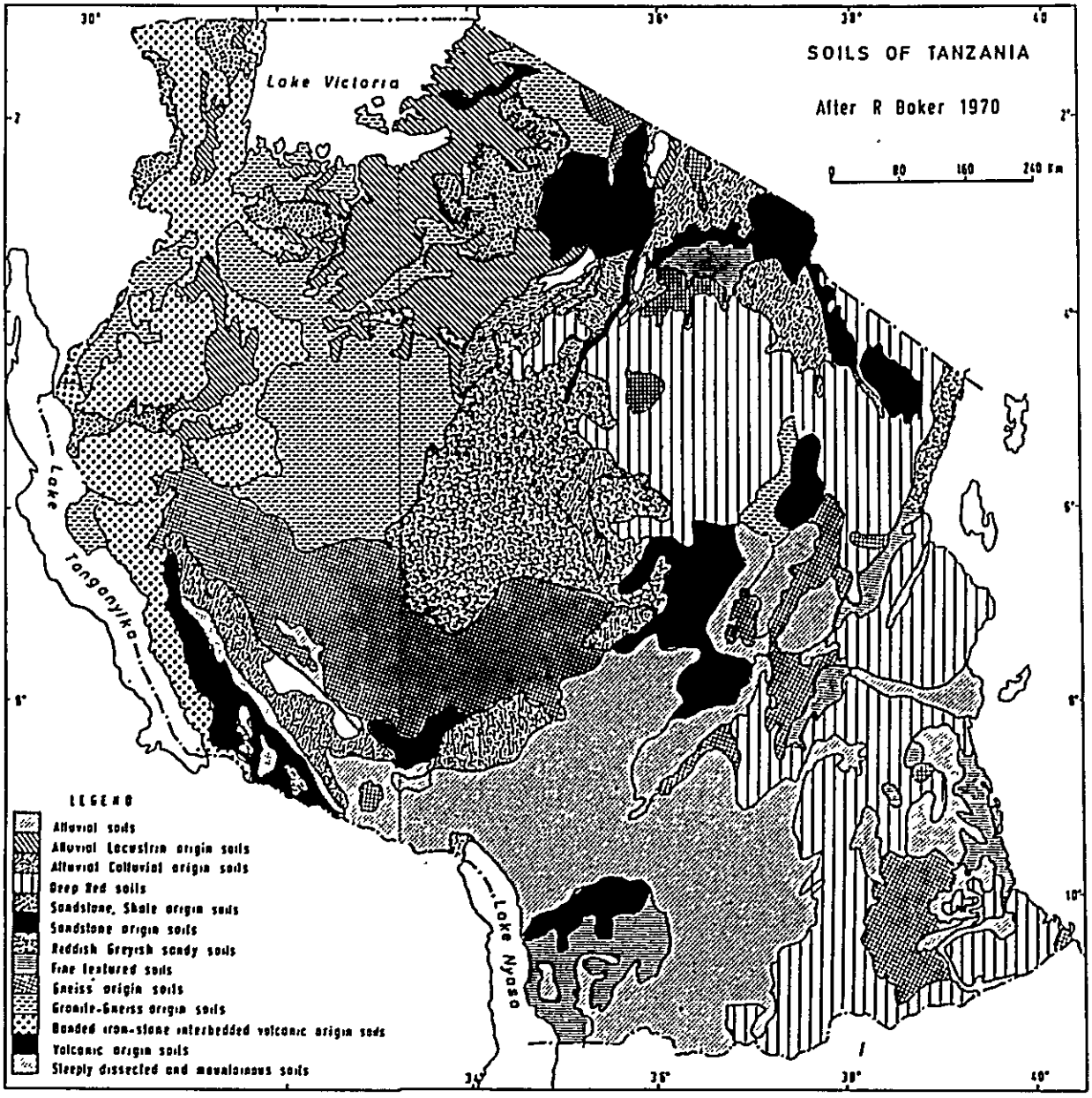
アフリカ大陸は、北部のアトラス山脈を除けば大部分は古い地質時代から褶曲を受けなかった高原状の卓状地であり、古期の結晶質岩石を基底とし、その上を各地質時代の陸成岩石が覆っている古い単調な大陸である。この大陸の特徴は海岸平野が狭く、大陸内部が大きな内陸盆地とそれをとりまく高原台地から成っていることである。

タンザニアの地質構造は、国土の中央を南北に走っている大地溝帯（東部大地溝帯）によって分けられており、タンガニーカ湖などの湖をつくっているリフトバリー（西部大地溝帯）との間は、先カンブリア剛塊と呼ばれる台地からなり、海岸地帯との間は、古生・中生・新生界の地殻となっている。



アフリカ大陸の地質構造. *International Tectonic Map of Africa* (1968) および *Geological World Atlas*, Unesco (1975) から総合, 簡略化

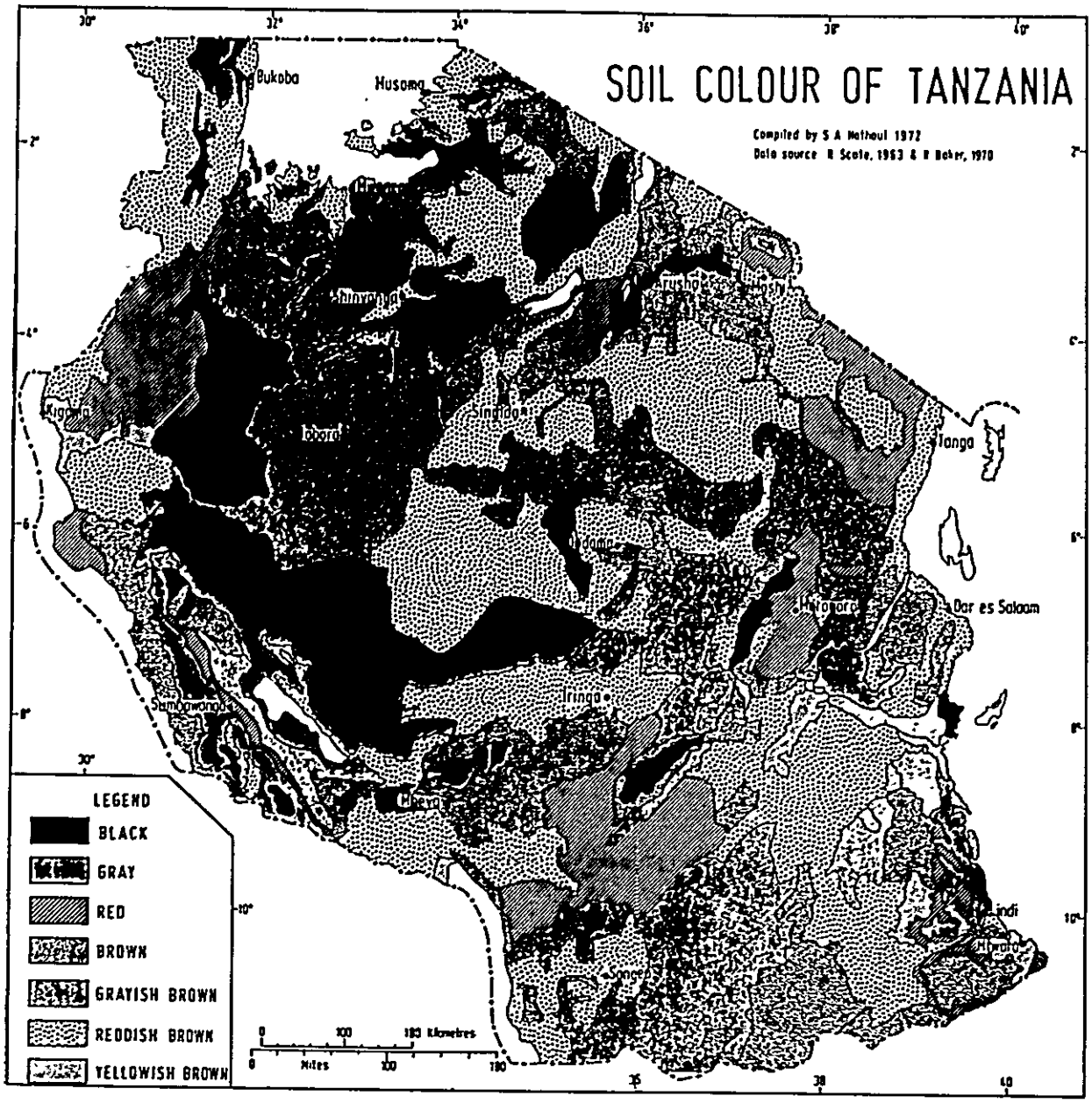
図1－1　アフリカ大陸の地質構造



["SOIL ATLAS OF TANZANIA" S.A. HATHOUT]

図1－2　タンザニアの土壌分布図

地表面の土壌は、熱帯性赤色土と呼ばれるレンガ色や茶褐色のものが広く分布している。西部の一部に Black cotton Soils と呼ばれる膨張性の土層が見られる。



["SOIL ATLAS OF TANZANIA" S.A. HATHOUT]

図1－3　表土の色分布図

1－3災　　害

1-3-1 地　　震

アフリカ大陸は古い大陸であり、世界の主な地震帯からは大きくはずれているが、1920年から1970年の間に東アフリカで 4回の大きな地震が記録されている。いずれもマグニチュード７前後のものであるが、震源地が浅かった為、広範囲に及んでいない。これらの地震は 100万年より古くない比較的新しいリフトバリーと呼ばれる地溝帯の地殻変動に起因するものと見られている。従って震源地は東西の大地溝帯周辺地域及びタンガニーカ湖周辺地域に多い。

世界地震分布図（$M \geqq 4.0$，深さ100km以下，1964～1982年）

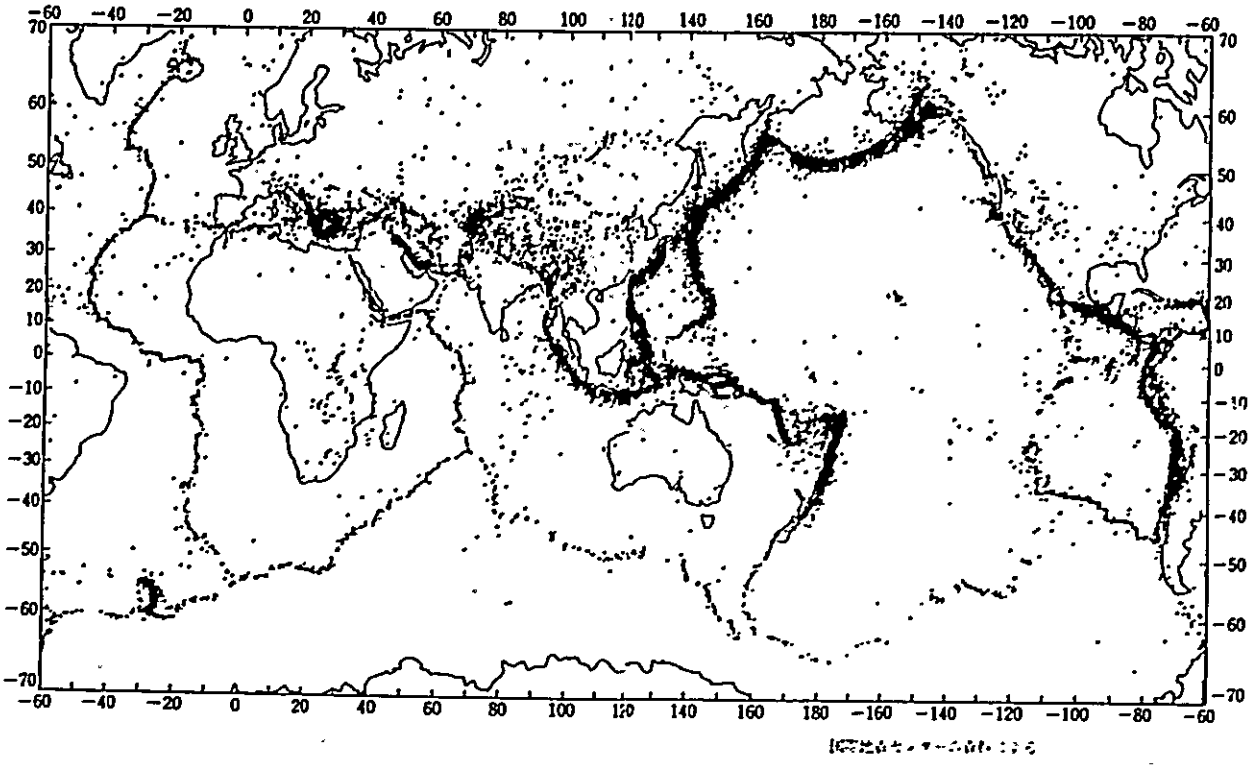
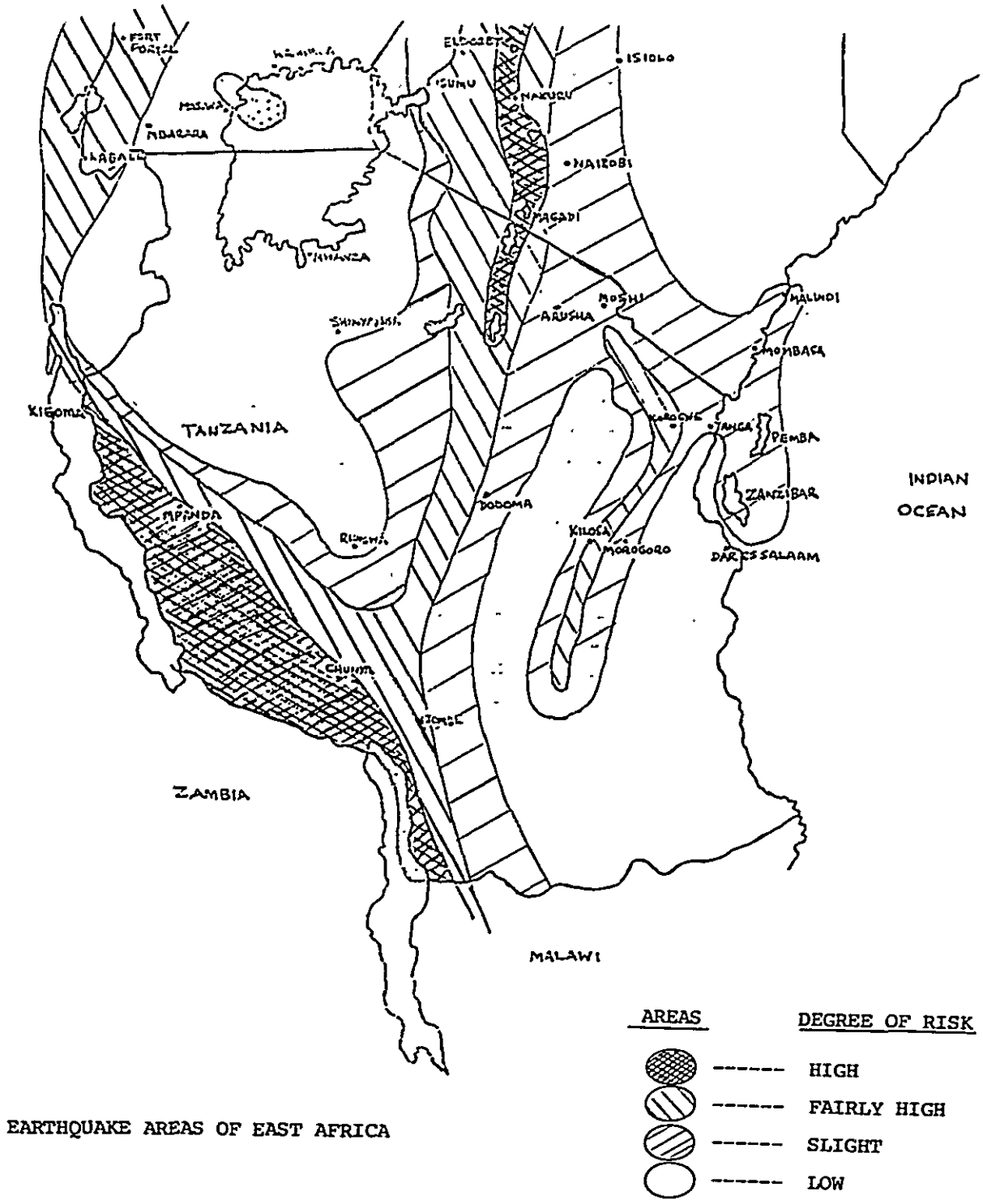


図1－4　世界地震分布図



EARTHQUAKE AREAS OF EAST AFRICA

[EARTHQUAKE INSURANCE IN EAST AFRICA 1970]

図1－5　タンザニア地震分布図

1-3-2　雷

雨季には雷雨の発生が多く見られる。一般的には西部ほど多くなっており、湖水地帯が最も多い地域となっている。

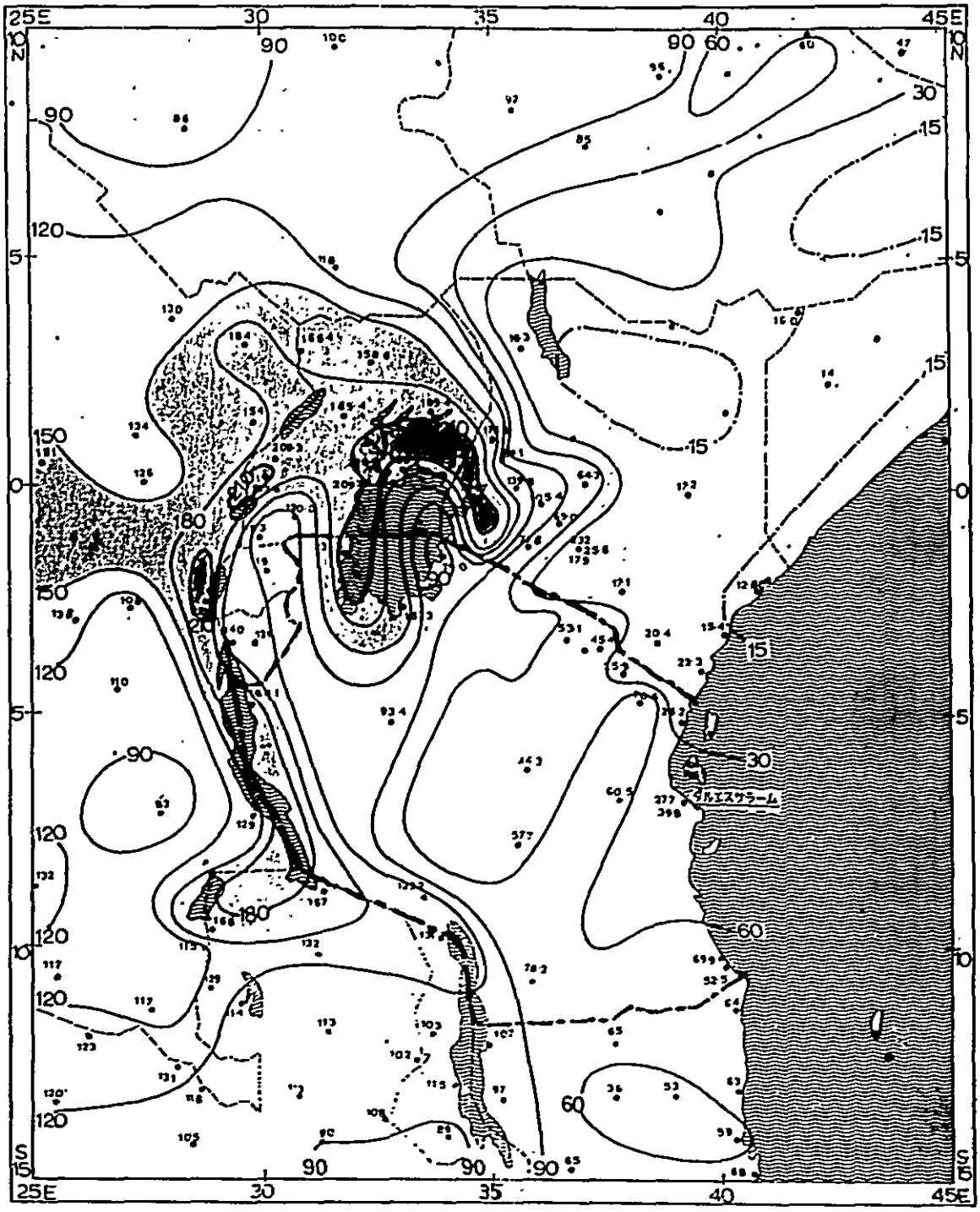
1-3-2　雷

雨季には雷雨の発生が多く見られる。一般的には西部ほど多くなっており、湖水地帯が最も多い地域となっている。

表1－16　月平均雷雨発生日　（日）

都市名	1月	2月	3月	4月	5月	6月	7月	8月	9月	10月	11月	12月	計
ダルエスサラーム	4.6	5.9	12.0	7.6	1.2	0.1	0	0	0	0.3	2.4	5.7	39.8
ドドマ	10.7	10.1	9.8	3.3	0	0	0	0	0	0.4	1.8	8.2	44.3
キゴマ	25.2	22.2	25.0	19.7	12.9	5.7	2.4	2.3	6.8	13.8	23.5	24.9	184.1

［タンザニア気象庁］



ANNUAL MEAN FREQUENCY OF THUNDERSTORM DAYS

[EAST AFRICAN METEOROLOGICAL DEPARTMENT, EAST AFRICAN COMMUNITY]

図1－6　年間雷雨発生日数分布図

1-3-3　その他の災害

洪水や、風害によって建物の被害が発生したという記録は特になく、建築物やその他の構造物に影響が及ぶ災害として特記すべきものはない。しかし、局部的な特殊な状況による災害については、注意を要する。例えば、地形に原因する集中豪雨の浸水や、テルミーク（上昇気流）による竜巻などである。又、昆虫による木の腐食等が報告されている。

2．建　設　事　情

2－1　一般建設事情

首都ダルエスサラームは、植民地時代に西欧側がつくった古い町であり、港を囲む一帯には当時の面影が色濃く残っている。市街地には独立後つくり変えられた町も見られ、ホテルなどの中高層建築物も多く見られる。しかし、現在建設中の大規模建物はごく少なく建設中途で中断しているものも見受けられ、経済の低迷に伴い建設活動は停滞気味のようであり、さらにドドマへの遷都が予定されている為、公共建築の建設も全般的に控えられていると思われる。一方、日本の無償援助による道路建設が進められていたり、港湾工事のプロジェクトが動いていたりして、土木工事の方は、若干の活況を呈している。

国土中央部の都市ドドマにおいては、現在ダルエスサラームからの遷都計画が実施されており、一部省庁の移転が始まり国会もある期間この地で開かれている。遷都計画は、当初1985年に完了する予定であったが、大幅に遅れているようで、郊外に共同住宅などの公共建築物の建設現場と道路工事が見受けられる程度で、本格的な都市建設はこれからのようである。

一方、タンガニーカ湖に面する西端の地方都市キゴマにおいては、人の流出入が少なく新規の設備投資等も特にない地域であるので、小住宅の建設現場がわずかに見られるだけで建設活動は低調である。

タンザニアにおける、建築物の一般的構造は鉄筋コンクリート造の隅柱と架梁で補強したレンガによる壁式構造が主体であり、勾配屋根の場合は、木造小屋組に古い建物では洋瓦で、新しい建物だと波型鉄板で葺いている。ホテル等の中高層建築物においては、本格的な鉄筋コンクリート造の躯体にプレキャストコンクリート板を取り付けたものが多く見られる。

一般的戸建て住宅は、土壁又はレンガによる壁式構造であり、屋根は木造小屋組に波型鉄板を葺いたものが圧倒的に多い。気候が高温多湿であるせいか、ホテルなどの外国人向けの建物を除いて、開口部は防犯のための鉄棚と、防虫網張りのみで建具を使用していない例が多い。窓建具がある場合でも、板ガラスルーバー窓（ジャロジー窓）を使用している例を多く見かける。

2－2 法規・規格等

建設行政の担当省は通信／建設省建設局 (Department of Constr. & Maint. Ministry of Communications & Works)であり、国民建設評議会 (National Construction Council) で行政方針の決定を行っており、技術面での行政はタンザニア工業規格局 (Tanzania Bureau of Standards)の指導のもとに行われている。

建築関係の技術基準は、主として英国の法規・規準 (BS) を準用している他、タンザニア工業規格局の行政指導を受けている。日本の建築基準法に相当する建築法規は未整備であり、現在準備中とのことである。

建築士や積算士などの建築技術者については登録制になっており、7 つの階級に分けられ、建築・積算・建設士会 (National Boards of Architects, Quantity Survices & Building Constructors)に登録される。

工事の発注形態は、公開入札が原則であり、各地に国民入札委員会 (Regional Tender Board, National Tender Board) があり、公正な入札を期するよう運営している。

2－3 建設資材

建設界にもう１つ活況がないことからも察せられるとおり、建設資材の流通も当然鈍くなっており、市場で容易に必要量入手できる資材は限られている。特に、鉄骨・鉄筋などの建設基材の入手は大変難しく、かつ高価であり、日本から輸入した方が安上がりである。丸棒は国内で生産されているが、品質・供給量について不安がある。セメントは、本格的に生産されており、日本に比べると高価であるが、強度、供給量共に期待できる。

表2－1　主要資材価格表（1986年10月）　　単位：TSh

	資材名	DODOMA	KIGOMA	DAR ES SALAAM
①	セメント	9,400/t	6,000/t	3,800/t
②	鉄筋（丸棒）	12mmφ 28,200/t 16mmφ 29,637/t	43,000/t	45,000/t
③	鉄筋（異形）	16mmφ 39,930/t 20mmφ 35,008/t	43,000/t	45,000/t
④	現場打コンクリート	6,000/m³		7,000/m³
⑤	型鋼			45,000/t
⑥	コンクリートブロック		9"x6"x18" 45/個	35/個
⑦	レンガ（一般用）			5.25/個
⑧	レンガ（仕上用）			4.10/個
⑨	タイル（壁用）			6"x6" 30/枚
⑩	ビニールタイル		45/枚	
⑪	板ガラス			3mm 31.50/foot² 4mm 36 〃 5mm 38.75 〃
⑫	合成樹脂エマルジョン塗料			88.15/ℓ
⑬	石綿セメント板 5mm厚			42/枚
⑭	木製フラッシュ扉		2,000/枚	2.5"x0.81"x6" 2,500/枚
⑮	木製窓			1.1"x0.6"x6" 1,400/枚
⑯	配線用コンヂットパイプ			1,983/m
⑰	角材		• ℓ＝3 m 2"x2" 150/本 2"x4" 200/本 4"x4" 350/本	10,000/m³
⑱	砂		700/m³	300/m³
⑲	砕石		1,000/m³	860 ～ 1,000/m³
⑳	ベニヤ		480/枚	

2-3-1 セ　メ　ン　ト

セメントは西独の技術導入により、クンドゥーチ、ムベア、タンガの3ヶ所で生産されており、品質および生産量の面で、本プロジェクトでの使用（約250t）は充分可能と判断した。

セメント強度については、現地の通信／建設省・材料試験所で入手した表 2-2及び 2-3で示す調合例の通り、セメントモルタルで 400kg/cm²以上という値が出ており、コンクリートにおいても調合により 300kg/cm²近い強度が可能であるので問題ないと判断した。

表2－2　国産セメントを使用したモルタル強度試験結果例

THE UNITED REPUBLIC OF TANZANIA

MINISTRY OF COMMUNICATIONS AND WORKS

Telephone: 23441. Ext. 2. 26029
In reply please quote:

Ref. No. ML.337/Vol.1/

MATERIALS LABORATORY,
P.O. BOX 9452,
DAR ES SALAAM.

24 Oktoba, 1986

PHYSICAL TESTS COMPRESSIVE STRENGTH (N/mm^2)[1] USING KUNDUCHI CEMENT

CURING TEMP 27°C	SOURCE OF RAW SAND					
	UK	MBAGALA	FUGU	MPIJI	TABATA	ORDER OF SUITABILITY
Three days	20.0	17.8	18.2	20.1	18.4	UK MPIJI TABATA, FUGU, MBAGALA
Seven days	32.0	29.6	24.2	26.0	25.8	UK MPIJI TABATA, FUGU, MBAGALA
28 days	43.3	31.3	32.4	34.7	29.6	UK MPIJI FUGU, MBAGALA, TABATA

1. Results averaged from those received from Saruji Trainning Institute and University of Dar es Salaam.

2. - Mpiji Sand is highly recommended.

[通信／建設省・材料試験所]

DATE 6-MAR-86

TRIAL MIX CONCRETE.

ROOM TEMP.　　BATH WATER TEMP.　　LABORATORY ENGINEER

DESIGNATION	COMPRESSIVE STRENGTH	SLUMP	AIR VOLUME	COARSE AGGREGATE MIX	TYPE OF CEMENT	ADMIXTURE
	210 kg/cm² N/mm²	10~12 cm	3 %	30 m/m	WAZA HILL portland (N)	pozzolith 303

FINE AGGREGATE	BORROW AREA	SPECIFIC GRAVITY	BULK DENSITY	SOLID VOLUME PERCENT	ABSORPTIO	WEIGHT RETAINED ON EACH SIEVE passing 5.0	2.5	1.2	0.6	0.3	0.15	F.M
	MIISI	2.633			2.2	99.2	97.6	86.7	47.3	10.7	1.0	2.57

COARSE AGGREGATE	BORROW AREA	SPECIFIC GRAVITY	BULK DENSITY	SOLID VOLUME PERCE	ABSORPTIO	WEIGHT RETAINED ON EACH SIEVE passing 40.0	25.0	20.0	15.0	10.0	5.0	F.M
	KUNOUCHI	2.570			1.5	100	97.8	26.0	6.6	1.4	0.4	7.45

	W/C (%)	S/A (%)	C (kg/m³)	W (kg/m³)	S kg/m³ S1	S2	G kg/m³ 30 mm	40 m/m	A.E (c.c)
MIX PROPORTIONS									
Fck 210	54	38	350	164	685	—	1073	—	AE/water 25%

NOTE

Dumped Structural Mix

Cement 350 — 0.111 m³
Air 0.02 "
Water w/c 54 0.189 "
0.312 m³

Sand S/a 38% = 1000 − 312 = 688 m³
= 0.688 × 0.38 = 0.261
= 0.261 × 2623 = 685 kg/m³

C/A 38 = 0.688 − 0.261 − 0.427
= 0.427 × 2.5/3 / 2.67 = 1.073 kg/m³

Admixture
AE 350 × 23/1000 = 25 g/m³

※ Water = 189 − 25 = 164 g/m³

	Job Mix 1.0 m³	
Cement	0.111 m³	350 kg
Air	0.02 "	
Sand	0.261 "	685 kg
C/A 38	0.427	1073 kg
Water	0.164	164 "
AE/water	0.025	25 "
Total	1.000 m³	

Comp. Strength

Age		kg/cm²	
7 days	3φ×10 cm³	172	3/3
	3φ×10 cm³	201	
	3φ×10 cm³	224	
	Av.	199 kg/cm²	
28 days	10φ×20 cm³	271	3/4
	10φ×20 cm³	325	
	15×15×15 cm³	378	
	Av.	258 kg/cm²	

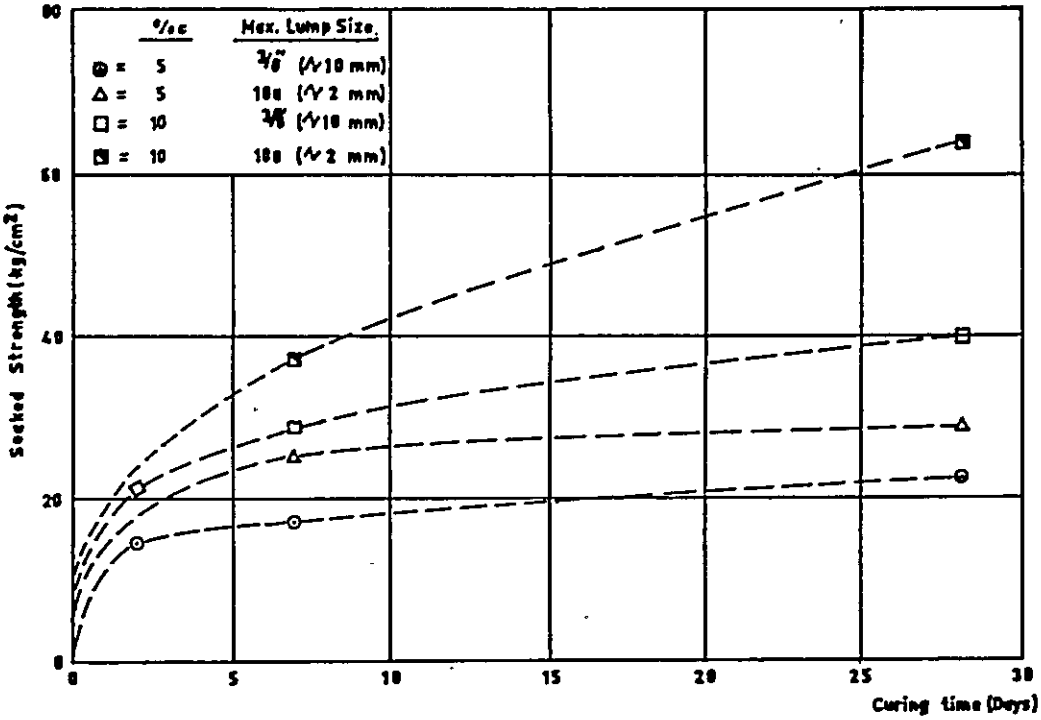
Slump 10.5 cm

2-3-2 骨　　材

粗骨材としては、花崗岩の砕石が一般的に使われており、ダルエスサラーム周辺では、クンドゥーチ（Kunduchi）で生産されている。タンザニア全土に分布しているラテライトと呼ばれる赤い粒子から成る丸砂利も使われる。

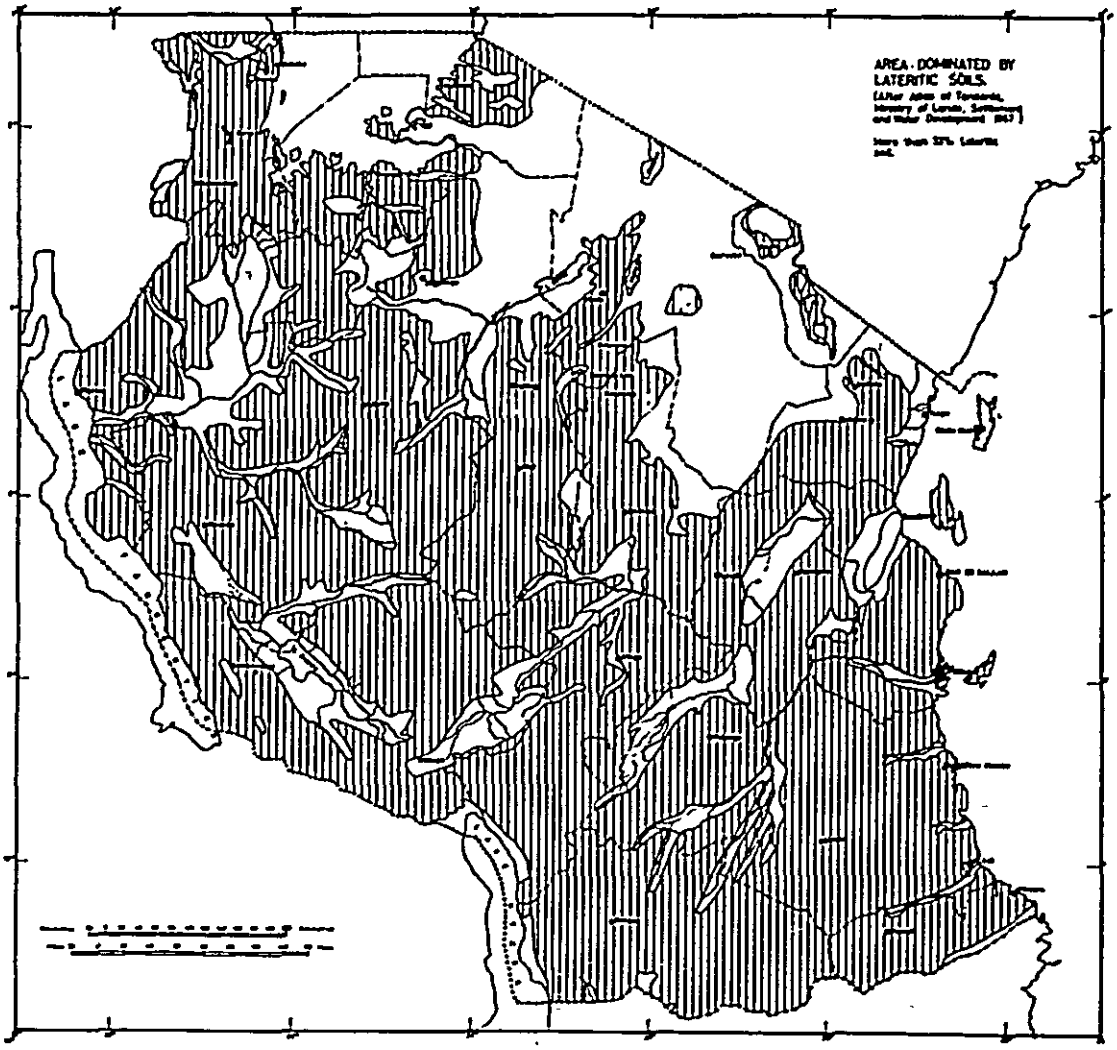
細骨材は、ラテライト性の赤砂が一般的に使われているが、粒子が細かくてコンクリート用としては適さないと判断される。ダルエスサラーム周辺では MPIJI、PUGUなどで生産される砂が良好である。なお、ラテライト性の赤砂は、Lateritic Soil-Cement として、モルタル代りに建築材料として使用されている。

表２－４　LATERITIC SOIL-CEMENT の強度



STRENGTH vs CURING PERIOD.

[MINISTRY OF LANDS HOUSING, URBAN DEVELOPMENT]



[MINISTRY OF LANDS HOUSING, URBAN DEVELOPMENT]

図２－１　　LATERITIC SOIL　分布地図

2-3-3 レ　ン　ガ

レンガは、ごく一般的な材料であり、国土全域に分布しているラテライト系土壌から製成されており、化粧積みが可能な高級品と、形状が不揃いな一般用とがある。

2-3-4 鉄　　筋

丸棒は、国産されているということであるが、品質、強度、供給量等不安がある。ほとんどは輸入品で大変高価である。

2-3-5 形　　鋼

輸入品が市場で見られるが不揃いで品質のばらつきが有り、まとまった数量の確保が困難である。必要量を輸入するしかない。

2-3-6 木　　材

国産の角材が（例えばMninga材）が手に入るが、大変堅く変形が大きく、仕上下地材としては不適当である。

2－4　労務状況と建設工事

建設界に充分な活気が見られないため、建設労働者、特に熟練労働者が不足しており、充分な人数の確保に不安がある。潜在的な建設労働者及び熟練労働者が相当いると思われるダルエスサラーム、ドドマなどの主要都市はまだしも、地方都市においては、極力熟練工を必要としない工法を採用し、現地作業を最少限とする設計が望ましい。

労働時間は官公庁や一般事務所においては、午前８時から午後２時までの作業が一般的であるが、建設労働者にあっては、午後４時頃までの作業は可能であろう。又、サイトが市街地から離れている場合は、朝・夕の労働者の移動時間も考慮に入れた労働時間の設定が必要である。

表2－5　各種労務者労賃表（1986年10月）　　単位：TSh

	職種	DODOMA	KIGOMA	DAR ES SALAAM
①	エンジニア	320／日	300／日	6,000／月
②	技術者	160／日	150／日	3,000／月
③	電気工	80／日	100／日	2,500／月
④	配管工	80／日	100／日	2,500／月
⑤	コンクリート工	64／日	100／日	2,500／月
⑥	ブロック工	64／日	100／日	2,500／月
⑦	大工	64／日	100／日	2,500／月
⑧	左官	64／日	100／日	2,500／月
⑨	塗装工	64／日	100／日	2,500／月
⑩	鉄筋工	64／日	100／日	2,500／月
⑪	製図技師	100／日	100／日	
⑫	秘書	120／日	100／日	
⑬	事務員	68／日	100／日	
⑭	タイピスト	68／日	100／日	
⑮	ストアキーパー	68／日	50／日	
⑯	ゲートマン	68／日	50／日	
⑰	ドライバー	68／日	65／日	1,000／月
⑱	コック	60／日	59／日	1,000／月
⑲	メイド	40／日	40／日	1,000／月
⑳	土工			2,000／月

表2－6　工事費単価表（1986年10月）　　単位：TSh

	工事名	DODOMA	KIGOMA	DAR ES SALAAM
①	根切り	300／m³		100-150／m³
②	埋戻し	200／m³		100-150／m³
③	コンクリート型枠	250／m²		
④	コンクリート打	6,000／m³		
⑤	鉄筋	60／kg		75-80／kg
⑥	ブロック壁	800／m²		600／m²
⑦	タイル張(壁)	2,500／m²		
⑧	〃 (床)	2,500／m²		
⑨	モルタル塗(壁)	350／m²		150／m²
⑩	〃 (床)	350／m²		400／m²
⑪	〃 (天井)	350／m²		150／m²
⑫	鉄板屋根	800／m²		550／m²
⑬	波型石綿屋根	750／m²		500／m²
⑭	アスファルト防水屋根	450／m²		
⑮	アスファルト簡易舗装	400／m²		

参考資料

資料－1　ドドマ・キゴマ地質調査報告書

THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF COMMUNICATIONS AND WORKS

GEOTECHNICAL INVESTIGATION WORKS FOR THE PROPOSED DEVELOPMENT PROJECTS FOR MEDIUM WAVE RADIO BROADCASTING NETWORK AT DODOMA AND KIGOMA

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November, 1986

GEOTECHNICAL INVESTIGATION WORKS FOR THE PROPOSED DEVELOPMENT PROJECTS FOR MEDIUM WAVE RADIO BROADCASTING NETWORK

1.0: INTRODUCTION:

The Radio Tanzania Dar es Salaam (RTD) is proposing to install two (2Nos) New Transmitting Stations at Dodoma and Kigoma. The proposed site at Dodoma is situated in Mundemu village which is along Dodoma-Arusha Road about 36Km from Dodoma Town centre. At Kigoma the proposed site is situated at Mahembe Village which is Kigoma-Kasulu Road about 16Km from Kigoma Town centre.

The site investigation works were awarded to the Central Materials Laboratory of the Ministry of Communications and Works. The subsoil investigation works for both sites were carried out one after another between 15th October 1986 and 30th October 1986.

The scope of the investigation works was laid down by Mr. K. Ueda from M/S.All Japan Radio & Television Co Ltd JAPAN on behalf of the RTD. All full investigation with borings, Laboratory tests and analysis of the results including presumed bearing value were required. The borings were required to a minimum of 10m depth. In fact such depth was not reached due to hard strata met with at shallow depths. Four (4Nos) open pits two at each site were dug up to 3.0m depth to ascertain the soil strata.

..2/..

2.0: EQUIPMENT AND MACHINERY USED

The following equipment and machinery were used for work at both sites:-

(1) Rotary boring machine with accessory tools - KAUNO TYPE
(2) 63.5Kg S.P.T. hammer
(3) Hand tools e.g. spades, hoes etc.

3.0: SCOPE OF THE WORKS CARRIED OUT

Summary of the field and laboratory tests carried out and the procedures followed in performing them are:-

3.1; Field Tests:

(1) Boring of bore holes 15cm diameter two (2Nos) at each site at Dodoma and Kigoma. These were bored by using the Rotary boring machine up to the refusal depth. Observation of the soil strata and SPT tests were performed at every 1.0m depth interval.

(2) Collection of disturbed samples and samples for determing field density.

(3) Digging of open pits two at each site was done upto the depth of 3.0m disturbed soil samples were collected. Also soft rock samples were collected from Kigoma site. It was not possible to collect Undisturbed samples as the strata at both sites were very stiff or rather hard.

..3/..

3.2: Laboratory Tests

The following laboratory tests were performed on the disturbed soil samples and the soil properties are evaluated and reported.

3.2.1: Soil Identification Tests

Grain size analysis (Gradation), field moisture content, atterberg limits, specific gravity etc.

3.2.2: Mechanical Tests

The soil strata met with at both sites i.e.at Mundemu Dodoma and Mahembe at Kigoma were very dry, stiff and/or dense compacted such that collection of undisturbed samples was impossible. Only samples for determining field density were collected from the SPT levels.

Stone samples collected from the open pits at a depth of 3.0m below ground level from Kigoma site were made into small cubes of 5cm size then crushed after the determination of their density.

4.0: GENERAL DESCRIPTION OF MUNDEMU - DODOMA SITE

Generally the sites for radio wave transmission should be located when ever possible on the highest elevation of the region. Such elevation will make the antanae to have good vicinity for receiving and transmitting the waves.

..4/..

The proposed site at Dodoma is located along Dodoma-Arusha road about 36km from Dodoma town centre and a few kilometres from the junction of the road heading to Mundemu village. The area is rectangular in shape (see Figure 1) measuring about 300 by 1000m and it is well fenced by barbed wires. Although the site is located on one of the peaks of Mundemu hills, the area is very flat and it is surveyed. It is covered with short grasses with scatered short trees.

There is only one road passing nearby heading to Mundemu village. There is no existing building or structure neither in the vicinity of the site nor in the site itself eliminating as such compensation costs. The region is very dry with no river or stream near to the site. The only source of drinking water is from shallow wells. The site looks as if it has never been used except for livestock grazing.

5.0: REGIONAL GEOLOGY OF DODOMA

Dodoma region is at the centre of Tanzania main land (see also Fig.1). The formation of the geology in Dodoma region belongs to early Archaeal era and lies Between Karroo and post Karroo sediments. Dodoma area is transversed by five parallel faults extending in the direction of North-east to South-east and belonging to Anorogenic type i.e a geological feature that twas formed during the period of tectonic quiescence. Also the area is transversed by orogenic rocks i.e, belts of deformed rocks which in many places are accompanied by metamorphic and plutonic rocks of geosyncline.

..5/..

The rocks belong to the oldest group of the precambrian era. They are foliated and synogeric granite i.e emplacement of pleutonic rocks and recryptallization of metamorphic rocks of all ages with zones of shearing and dislocations.

In Southern Dodoma, the parent rocks consist of amphibonite, schits of medium to coarse grained matamorphic rocks with sub-parallel orientation and micaceous minerals, and quartzites associated with both migmatites i.e rocks consisting of composite igneous or igneous looking and/or metamorphic minerals and composite gneisis. Also synorogenic granitic rocks are present.

The granite rocks are of parallel holding with varying thicknesses and lengths. In general the rocks are foliated and bounded indicating flow of parallelism. The exposed rocks are grey in colour. They are regarded as composing of highly altered sediments associated with igneous rocks and belong to the upper division of the group known as Tanganyika Basement complex.

The superficial deposites are alluvium red brown to red earths. They are formed from weathering and deposition of the parent rocks.

On the seismic map of Tanzania Dodoma region is located in earthquake zone 2, which is subjected to moderately to frequently and with no violent earth tremours. On the Retchers oclas of magnitude Dodoma region is at the rate of 5-6 with ground acceleration factor Ka = 0.050.

..6/..

6.0: DESCRIPTION OF SUBSOIL STRAT. OF MUNDEMU-DODOMA SITE

The subsoil strata at Mundemu Dodoma site is described by using the SPT (N) value together with the visual inspection of the soil encountered from the boreholes and/or open pits for shallow foundations.

The following observations were made at the site:-

BH No.	D e p t h	Description of the soil strata	SPT (N) Value
1 (For the Transmitting Antenae)	0-1.m	Dry dark grey clayey silt. Very plastic, removal of the SPT sampler barrel during boring was difficult	N > 60
	1.0-2.5m	Dry light brown to reddish clayey silt soil the strata is very stiff as observed from open pit.	
2 (For the Building)	0-1.0m	Light brown to red compacted fine gravelly clay soil	N > 50
	1.0-3.0m	Brown soil very compacted coarse gravel strata	N > 60

..7/..

7.0: TEST RESULTS ANALYSIS AND DISCUSSION FOR DODOMA SITE

7.1 Field Tests

Two bore holes were made at the site at two different points. See Fig. 1. The subsoil strata met with at BH No.1 (for the transmitting antenae) up to the depth of 1.0m below ground level consists of stiff to very stiff clay soil. The SPT (N) value obtained at 1.0m depth is of the order of 75 blows per 10cm penetration (see also Fig. 2). This indicates that the soil is of very hard/stiff consistence.

The field moisture content (see Table 1) is 8.1 percent with field dry density 1593 kg/m^3. This can be said that the soil is at low to medium moisture content with medium density. An open pit was dug close to BH No.1 up to 3.0m depth below ground level. The observation from the open pit reveals that the soil strata do not vary much from each other and the soil appears to be very stiff.

The subsoil strata encountered at BH No.2 (for the Building) indicates that upto the depth of 1.0m the soil is dry stiff and compacted fine gravel material. At the level of 1.0m depth (see Fig.2). SPT value, N = 58 was obtained. The field moisture content is 9.0 percent with field dry density 1609 kg/m^3. SPT value at 2.0m depth is N=71 blows per 5cm penetration indicating that the soil is of hard consistende.

..8/..

7.2: Laboratory Tests

7.2.1: The Grain Size Distribution

The grain size distribution of all the soils collected from BH Nos 1 & 2 was determined by the method of sieving.

A scruting to the gradation (see also Table 1) and the grain size distribution curves see Fig. 4 shows that the materials from BH No. 1 have a maximum size of 9.52mm. The materials are by and large well graded with 58 percent of fine materials passing the BS Sieve No.200 (0.075mm). The materials from BH No. 1 may generaly be described as being a fine grained.

The samples from BH No.2 (see Table 1) have a maximum size of 38.1 mm. The materials (see Fig.5) cover a wider range of particle sizes and the finer part passing the BS Sieve No.200 is about 20 percent. The materials may be described as coarse grained with little fines.

7.2.2: Atterberg Limits

The liquid limit (LL) plastic Limit (PL) and the Plasticity Index (PI) of the soils were determined according to known standard procedures. For BH No.2, (see Table 1) the LL for the soils at the depth of 0 - 1.5m was found to be 45 percent with a corresponding plasticity Index of 17 percent. The soil met with at a depth of 1.5 - 2.0m had a Liquid Limit of 39 percent and a plasticity Index of 15 percent. This indicates that the soils from BH No. 1 are of medium plasticity.

..9/..

For BH No.2 the Liquid Limit ranges from 21 to 22 percent and the plasticity index ranges between 7 and 9 percent. This indicates that the soils are of low plasticity.

7.2.3: Soil Classification

A number of classification systems are known for classification of soils. In the present work the Unified Classification System has been adopted. The Unified classification system divides soils into fine-grained and coarse-grained using the criterion of 50 percent passing or retained on the BS Sieve No.200 (0.075mm) taking also into account the plasticity of the materials.

In the present study the materials from BH No.1 are classified as falling under the CL group (see also Table 1). The soils are thus In organic clays of low to medium plasticity or sandy-clays, silty-clays or lean clays.

The materials from BH No.2 at the depth ranging from 0-1.5m below ground level are found to fall under the borderline classifications of SM-SC. This indicates that the soils consists of silty-sands or sand-silt mixtures with clayey-sands and/or sand-clay mixtures. At a depth ranging from 1.5 - 2.0m below ground level the soils are classified as falling under the GL group. The soils are therefore clayey-Gravels or gravel-sand-clay mixtures.

..10/..

7.2.4: Specific Gravity

The specific gravity of the materials from BH No.1 was found to be 2.25 for materials collected from the depth of 0-1.5m and a specific gravity of 2.36 was obtained from materials collected from a depth of 1.5 to 2.0m below ground level. The materials from BH No. 2 at a depth of 1.0 to 1.5m below ground level the specific gravity was 2.34 and a specific gravity value of 2.42 was obtained for materials at a depth ranging between 2.0 and 2.5m below ground level.

8.0: PRESUMED BEARING VALUE FOR THE FOUNDATION SOIL

In deducing the bearing values the following assumptions were made:-

(1) the ground and its soil strata are level and reasonably thick

(2) there is no layer of higher compressibility below the foundation levels

(3) the site is protected from deterioration

(4) to cater for these assumption a factor of safety of 2.5 is applied to the presumed bearing value

Limiting the foundations at a minimum depth of 1.5m below ground level then based on the SPT N values and the subsequent discussions the following is deduced:-

..11/..

BH No.	General Description and remarks of the soil	Presumed Bearing Value kN/m² for Foundation width		
		1.0m	2.0m	4.0m
BH No.	Cohesive dry stiff clayey soil			
	Not possible to obtained undistu-bed samples for strength determination assumed C > 150 kN/m²	500	400	200
	with F.O.S.=2.5	200	160	80
BH No.2	Very compacted gravelly clay soil, GC, N > 50	600	500	400
	with F.O.S.=2.5	240	200	160

9.0: DESCRIPTION OF THE SITE AT MAHEMBE KIGOMA

The proposed site at Kigoma is located at Mahembe Village about 16km from Kigoma town centre along the Kigoma-Kasulu road. The area (see Fig.6) is almost hexagonal in shape enclosed within beacons No.399, 400, 401, 402 as it's boundaries. It is situated on a very steep area on the slope of one of the Mahembe hills.

..12/..

The site is being used for farming and at present it has cassava farms. Also there are some few mangoe trees. Unlike the site at Dodoma the region is not dry. There is a stream which is not very far from the site. There is an access road passing nearby heading to Mahembe Village.

10.0: Regional Geology of Kigoma

In the map of Tanzania, Kigoma region is found on the west at the shore of Lake Tanganyika. The oldest rocks of this region are gneisis and schists which occur in North-west and intermitently along the lake shore to Mtanga in the South. The rocks are often veined with acid injections material and hornblend chlorite rocks and also are frequently invaded by pink veins of quartz and potash feldspar .

These rocks represent an ancient series of sediments, probably shales, sandstones and greywackes which have been altered by regional metamorphism and migmatization to their present high grade. Overlying this system is the type of rock known as the Kigoma Quarzite. The formation consists almost of coarse to medium grains, white, cream mauve, pure quartzites and sandstones with occasional bands of pebbles of quartz. There are few horizons of shalybeds which often show signs of shearing and a few basalt conglomerates.

..13/..

In the extreme South-west the rocks are ttun bedded maroon-red calcareous shales, shales and silty shales with some thin dolomitic limestones. In the North-east the strata comprise of mainly red-maroon shales and mudstones sandstone and thin pale-grey dolomitic limistone. These bedds are overlain by a thicker more persistent grey stromatolithic dolomitic limestones which become more important to the east. In the west of Uvinza these types of rocks are known as Kigonero Flag. The formation is over 180 m thick.

There are other strata, the Gagwe Amygdaloidal Lavas overlying the Kigonero Flag and occupy most of the eastern part. The formation has not yet been sub-divided but it is known that there are several flows present each of the order of 91 to 121 metres thick. Several rock types exist within the lava the most common being a dark grey fine grained basalt which may be on not amygdaloidal. Occasionally reddended rocks and tuff do occur.

A thin layer known as Ilaga Dolomitic Limestone over-lies the Gagove Amygdaloidal Lavas with unconformity. Also there occurs a white to dark grey fine grained dolomitic limistone with occasional stromatolithic structure which in some areas it is pale-scream grey or which has silicified banded rock.

There are other rock beds, the Manyovu Red Beds which overlay the Ilagal. Dolomitic Limestone. Rift faults have affected the Manyovu Red Bedds and produce narrow down faulted block bordering the lake shore. There have been distinct episodes and folding which one the origin of the unstable zone. The Tanganyika Rift is almost connected to this unstable zone although it developed at a much later date.

..14/..

Near Ujiji large quantities of uncolidated sands and boulders occur at the lake level. Also a fine, red sandy soil covers most of the Ujiji area.

On the seismic map of Tanzania, Kigoma region is located in earthquake zone 3 which is subjected to to strong and frequently risk level earth tremours. On the Ritchers scale of magnitude it is at the rate of 6-7 with ground acceleration factor, K_a = 0.075.

11.0: DESCRIPTION OF SUBSOIL STRATA OF MAHEMBE -KIGOMA SITE

The following observations of the subsoil strata of the Mahembe/Kigoma site were made:-

BH No.	D e p t h	Description of the Soil Strata	N-(SPT) Value
1	0-1.0m	Brown to red fine silt clayey soil, very low to non-plastic. The strata is medium to stiff	N > 20
	1.0-2.0m	Red gravelly silt soil of very low plasticity to non-plastic. The strata were stiff to very stiff strata	N > 60
	2.0-30m	Reddish purple boulders soft weathered rock or tuff rock strata	Observations from open pit

..15/..

BH No.	Depth	Description of the soil strata	N-(SPT) Value
2	0-1.0m	Darkbrown, red silt sandy soil with very low plasticity to non-plastic medium to stiff strata	$10 < N < 20$
	1.0-2.0m	Light brown to red compacted gravelly silty soil with very low plasticity to non-plastic	$N > 50$
	2.0-3.0m	Brown to red gravel purple soft-weathered or tuff rock strata	Observation from Open pit

12.0: TEST RESULTS ANALYSIS AND DISCUSSIONS FOR THE SITE AT KIGOMA

12.1: Field Tests

Two bore holes were made at two different points. (See Fig. 6a). Borehole No. 1 is at a reduced level of 0.00m while bore hole No.2 is at a reduced level of 15.00m (see also Fig.6b).

The subsoil strata met with at BH No.1 upto the depth of 1.0m is dry and of medium density with SPT value N=16 (see also Fig.7). Field dry density 1600kg/m^3 and a field moisture content of 7.1 percent were obtained (see also Table 2). The soil strata at a depth of 1.0m to 2.5m below ground level is dry and very stiff (dense) with SPT value N = 49 blows per 25cm penetration.

..16/..

The field dry density at 2.0m depth is 1747kg/m³ with field moisture content of 5.1 percent.

An open pit was dug close to BH No.2 upto 3.0m depth below ground level; a level at which reddish soft/ weathered (turf) rock strata was met with. The average density of the rock is 2339kg/m³.

The subsoil strata met with at BH No.2 do not differ very much from BH No.1. From 0-1.0 depth below ground level (see Fig.8) the strata is dry with field moisture content of 9.2 percent and field dry density of 1495 kg/m^3. The SPT value obtained at the level of 1.0m, depth N = 23 indicating that the soil strata is of medium density. The strata 1.0m-2.0m is also dry, stiff with field density 1638kg/m^3 and field moisture content 7.1 percent. The SPT value is of the order of N > 50 see also Figure 8 indicating that the soil strata is of hard consistence. Also an open pit was dug upto 3.0m depth at level at which a reddish soft/ weathered (tuff) rock strata was met with the average density of the rock was found to be 2359kg/m³.

12.2. Laboratory Tests

12.2.1 Grain Size Distribution

The Sieve analysis for soil samples collected from BH No.1 (see table 2 and Fig.9) has revealed that the maximum size of the soil particles is 19.1mm. Fine particles passing the BS sieve no.200 (0.075mm) for the materials collected at a depth of 1.0-1.5m is about 30 percent.

...17/..

For materials collected at a depth of between 2.0 and 2.5m below ground level the percentage of materials passing the BS Sieve No.200 is about 17 percent. This indicates that as we go deeper there is a reduction in the quantity of fines.

For Bore Hole No.2 (see Fig.10) the max. size of the soil particles is 37.5mm. The material passing the BS Sieve No.200 ranges between 14 and 15 percent. This indicates the soils contain little fines.

12.2.2: Atterberg Limits

Tests to determine the liquid Limit (LL), Plastic Limit (PL) and the plasticity have revealed that the soils from both Boreholes are non plastic (see also Table 2).

12.2.3: Soil Classification

Based on the results from the sieve analysis and the determination of atterberg limits the soils (see Table 2) may be classified as falling under the GM group using the unified classification system. The soils may therefore be described as being silty gravels and/gravel-sand-silt mixtures.

12.2.4: Specific Gravity

The specific gravities (see Table 2) for materials collected from BH No.1 at a depth of 1-1.5 and 2.0-2.5 were 2.41 and 2.40 respectively. The specific gravity for materials from BH No.2 were 2.41 and 2.44 for the depth of 1-1.5m and 2.0-2.5m below ground level.

..18/..

12.2.5: Crushing Strength of Rock (tuff) Samples

The reddish soft weathered rock (tuff) samples recovered from OPEN Pit No.1 and as well as open pits No2 at a depth of 3.0m below ground level were subjected to crushing strength tests. Due to difficulties encountered in the recovery process of the rock samples no standard size rock samples could be used in the crushing tests.

However using the non standard size samples crushing strength value of 1635 kN/m^2 was obtained for rock recovered from OPEN pit No.1 and a crushing strength value of 1862 kN/m^2 was obtained for rock samples recovered from open pit No.2. This indicates that the rock sample is soft.

13.0: PRESUMED BEARING VALUE FOR MAHEMBE/KIGOMA SITE

Before evaluating the bearing value of the foundation soil at Kigoma site the following assumptions were made:-

(1) The ground and the subsoil strata are not level.
(2) A reasonably thick layer of tuff/rock is at a depth of 3.0m below ground level.
(3) The site is to be protected from detereoration.
(4) A factor of safety of 2.5 applied to the presumed bearing values is reasonable enough.

Now, limiting the foundation to a minimum depth of 1.5m below ground level the following is deduced.

..19/..

BH.No.	General description and remarks of soils	Presumed Bearing Value kN/m² for foundation width:-		
		1.0m	2.0m	4.0m
BH No.1	Reddish coarse to fine fine gravel silt N > 50	600	600	400
	F.C.S. 2.5	240	200	160
BH No.2	Dark brown to reddish purple gravel silt N > 50	do as for BH.1	do as BH No.1	do as BH No.1

14.0: CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are made based upon the field and laboratory tests carried out, analysis and discussions made on the test results. The two sites are located at different regions their conclusions are set separately:-

14.1: MUNDEMU/DODOMA SITE

1. The site is generally flat and is on the peaks of Mundemu hills.
2. The subsoil strata met with at BH No.1 is classified as CL dry very stiff with field dry density 1593 kN/m³ and field moisture content 8.1 percent. There is no change of the soil strata upto 3.0m depth.

..20/..

3. The SPT value of N >71 at level of 1.0m below ground level was obtained.
4. By limiting the foundations to a minimum depth 1.5m below GL and maximum foundation with 4.0m presumed bearing capacity of 400 kN/m^2 can be adopted.
5. At BH 2 the soil strata is classified as SM-SC and GC at 0-1.0m and 1.0-3.0m depth respectively.
6. The field density ranges from 1609 kg/m^3 to 1740 kg/m^3 with moisture content ranging from 9.0%, to 10.1 percent respectively.
7. Limiting the foundation at this point to 1.5m depth with a maximum width 4.0m presumed bearing value of 500 kN/m^3 can be adopted.
8. No water table was met upto to the level of analysis.
9. It is recommended that the foundations are kept dry to avoid deterioration of the subsoil strata beneath the foundation level.

14.2: Kigoma Site

1. The location of the site is very steep and is on one of the hills at Mahembe village about 16km from Town centre.
2. The field dry density and moisture content was found to vary from 1660 kg/m^3 to 1727 kg/m^3 and 7.2% and 5.2% at 1.0m and 2.0m depths respectively.

..21/..

3. Two boreholes and two open pits were made upto a depth of 3.0m below ground level. It was found out at this level which that the strata is underlain by reddish soft/weathered (tuff) rock.

4. The density of the tuff rock was found to vary from 2339 kg/m^3 to 2359kg/m^3.

5. The crushing strength of the non standard size rock/tuff samples varied between 16.35 and 1862 kN/m^2.

6. Foundations at a minimum depth of 1.5m below ground level with maximum width of 4.0m can be adopted giving a maximum presumed bearing value of 400 kN/m^2.

7. The foundations should always be kept dry to avoid deterioration of the subsoil strata beneath the foundation level.

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4) "Foundation Engineering", Ralph Perk, W.E. Hansen, T.H. Thornburn, Willey Eastern Limite, New Delhi-Second Edition, 1974.

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BORE LOG

Project RTD NEW TRANSMITTING STATION – DODOMA Location MUNDEMU-36km FROM DODOMA

Bore Hole No. 1 Ground Elevetion _____ Boring by J.Y.MREMA Date 16.10.86

Depth in cm	Depth in (ft.)	Elevation	Thickness	Legend	Type of soil, colour & consistency	Sample No.	S.P.T. S.C.P. Blows per 6" 15cm	12" 30cm	(N—Value) 10 20 30 40 50 N
30	1				Light grey stiff Heavy Clay-Silt				
60	2								
90	3						75/10cm		
120	4				Very Stiff Reddish Clay Silt Strata				
150	5								
180	6								
210	7								
240	8								
270	9								
300	10								
140	11								
370	12								
400	13								
430	14								
460	15								
490	16								
520	17								
550	18								
580	19								
610	20								
640	21								
670	22								
700	23								
730	24								
760	25								
790	26								
820	27								
850	28								
880	29								
910	30								

Figure 2: Borelog for BoreHole No.1 of Mundemu -Dodoma site.

Remarks:-

Driller:-

MATERIALS ENGINEER.

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BORE LOG

Project RTD NEW TRANSMITTING STATION DODOMA on MUNDEMU

Bore Hole No. 2 Ground Elevetion _____ Boring by MREMA Date 15.10.86.

Depth in cm	Depth in (ft.)	Elevation	Thickness	Legend	Type of soil, colour & consistency	Sample No.	S.P.T. S.C.P. Blows per 6" 15 cm	12" 30 cm	(N—Value) 10 20 30 40 50 N
30	1				Reddish brown				
60	2				Stiff gravel sand				
90	3				clay		6	58	
120	4					SPT			
150	5				very compacted brown				
180	6				gravel sand-clay				
210	7					SPT	71	5cm	
240	8								
270	9								
300	10								
340	11								
370	12								
400	13								
430	14								
460	15								
490	16								
520	17								
550	18								
580	19								
610	20								
640	21								
670	22								
700	23								
730	24								
760	25								
790	26								
820	27								
850	28								
880	29								
910	30								

Remarks:-

Figure 3 - Borelog for Borehole No.2 of Mundemu Dodoma Site.

Driller:-

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BORE HOLE No, 1

1.0 - 1.5M

1.5 - 2.0M

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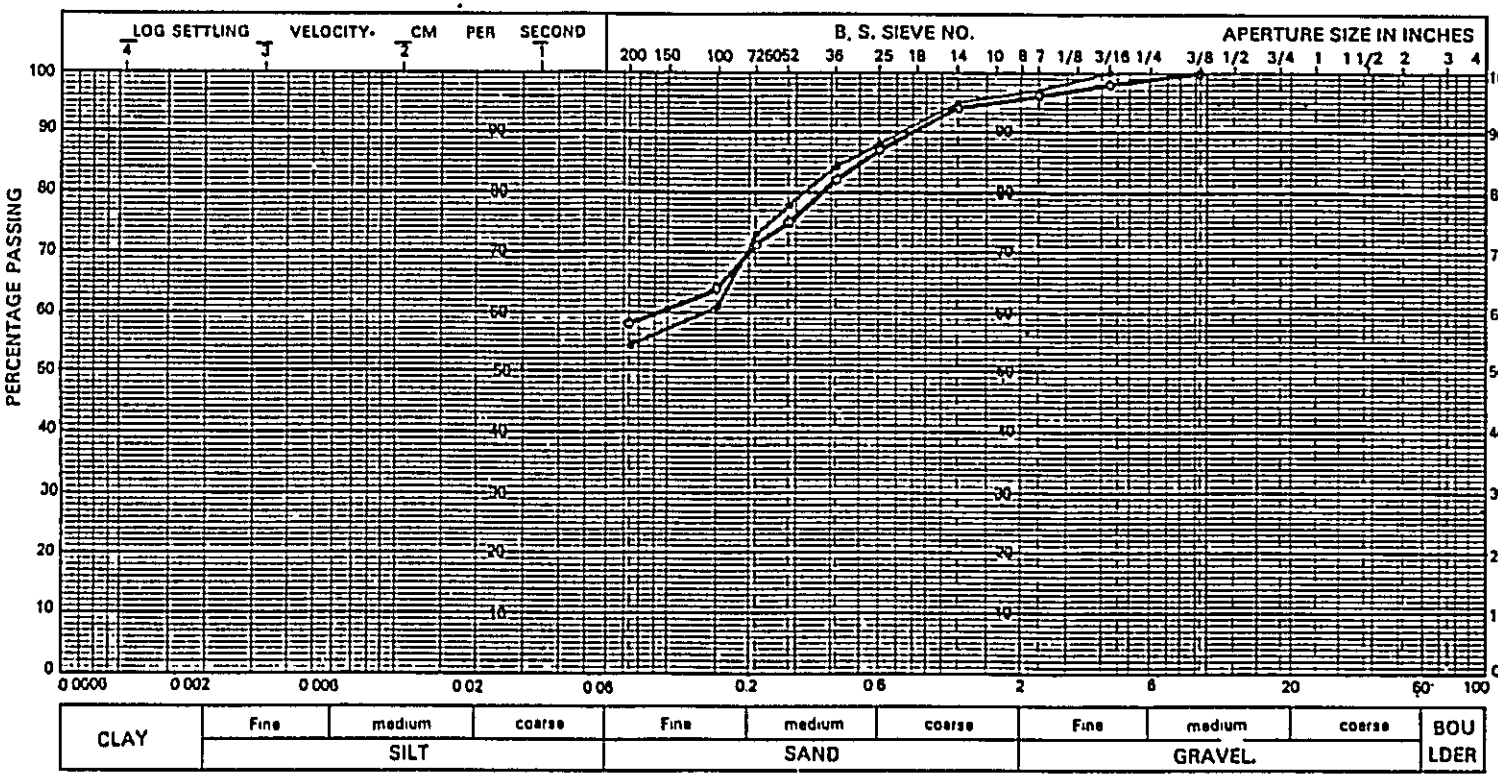
PROJECT NEW R.T.D TRANSMITTING	LOCATION DODOMA	DEPTH 1.0 - 1.5 M, 1.5 - 2.0M	DATE
SAMPLE NO. 1, 2	LABORATORY NO.	SIEVING DRY/WET	OPERATOR



MATERIAL ENGINEER SIGNATURE _____

COLOUR	
SULPHATE CONTENT	
ORGANIC CONTENT	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	
GROUP INDEX	
SPECIFIC GRAVITY	
FIELD DRY DENSITY	
FIELD MOISTURE CONTENT	
RELATIVE COMPACTION	

CLASSIFICATION

P.R.A.	UNIFIED

COMPACTION

	STANDARD	MODIFIED
M.D.D.		
O.M.C.		

C.B.R.

DENSITY % OF M.D.D.	95	100	95	100
MOULDING M/C				
UNSOAKED				
1 DAY SOAKED				
4 DAY SOAKED				
SWELL %				

FIG. 4 Grading Curves for Soils from BH No. 1 - Mundemu Dodoma.

LEGEND

BORE HOLE No, 2

o——o 1.0 - 1.5M

o——o 2,0 - 2.5M

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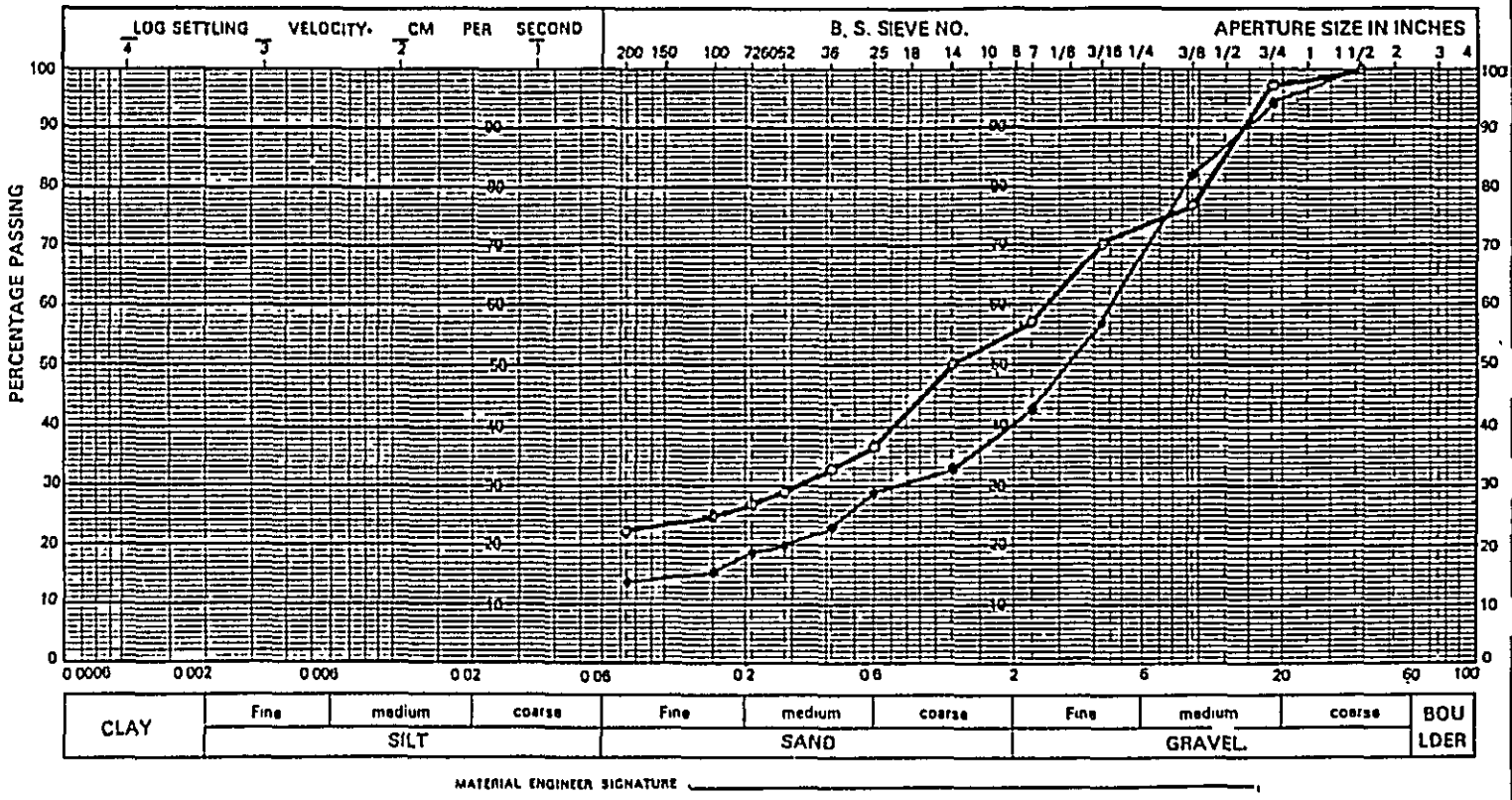
ENGINEERING SOIL ANALYSIS

PROJECT NEW R.T.D TRANSMITTING	LOCATION DODOMA	DEPTH 1.0-1.5M, 2.0-2.5M	DATE
SAMPLE NO. 1, 2'	LABORATORY NO.	SIEVING DRY/WET	OPERATOR



COLOUR	
SULPHATE CONTENT	
ORGANIC CONTENT	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	
GROUP INDEX	
SPECIFIC GRAVITY	
FIELD DRY DENSITY	
FIELD MOISTURE CONTENT	
RELATIVE COMPACTION	

CLASSIFICATION

P.R.A.	UNIFIED

COMPACTION

	STANDARD	MODIFIED
M.D.D.		
O.M.C.		

C.B.R.

DENSITY % OF M.D.D.	95	100	95	100
MOULDING M/C				
UNSOAKED				
1 DAY SOAKED				
4 DAY SOAKED				
SWELL %				

MATERIAL ENGINEER SIGNATURE _____

FIG. 5 Grading Curves for Soils from BH No, 2 - Mundemu Dodoma

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BORE LOG

Project NEW RTD TRANSMITTING STATION Location MAHEMBE/KIGOMA

Bore Hole No. 1 Ground Elevetion _____ Boring by J.Y.MREMA Date 28/10/86

Depth in cm	Depth in (ft.)	Elevation	Thickness	Legend	Type of soil, colour & consistency	Sample No.	S.P.T. S.C.P. Blows per 6" 15 cm	Blows per 12" 30 cm	(N—Value) 10 20 30 40 50 60
30	1				Light grey, brownish red fine silty clay				
60	2								
90	3								
120	4					SPT	15	23	
150	5								
180	6				Roddish to brown coarse gravel silt				
210	7					SPT	30/8cm		
240	8								
270	9								
300	10								
340	11								
370	12								
400	13								
430	14								
460	15								
490	16								
520	17								
550	18								
580	19								
610	20								
640	21								
670	22								
700	23								
730	24								
760	25								
790	26								
820	27								
850	28								
880	29								
910	30								

Remarks:-

Figure 7: Bore log for BH No.1-Mahemba/ Kigoma site.

Driller:- MATERIALS ENGINEER.

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BORE LOG

Project RTD NEW TRANSMITTING STATION-KIGOMA Location MAHEMBE- 16km-From-Kigoma

Bore Hole No. 2 Ground Elevetion _____ Boring by J.Y.MREMA Date 23.10.86

Depth in cm	Depth in (ft.)	Elevation	Thickness	Legend	Type of soil, colour & consistency	Sample No.	S.P.T.S.C.P. Blows per 6" 15cm	Blows per 12" 30cm	(N—Value) 10 20 30 40 50 60
30	1				Top Soil dark grey Silt sand				
60	2				Stiff				
90	3				Dark Brown Sand				
120	4				Silt clayey soil	SPT	3	16	
150	5								
180	6								
210	7					SPT	9	49/25cm	
240	8				very dense -stiff				
270	9				Reddish clay-silt				
300	10				sand				
340	11								
370	12								
400	13								
430	14								
460	15								
490	16								
520	17								
550	18								
580	19								
610	20								
640	21								
670	22								
700	23								
730	24								
760	25								
790	26								
820	27								
850	28								
880	29								
910	30								

Remarks:- Figure 8- Bore Log for Borehole No.2 -Mahembe/Kigoma site.

Driller:-

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BORE HOLE No. 1

o——o 1.0 - 1.5 M

o——o 2.0 - 2.5 M

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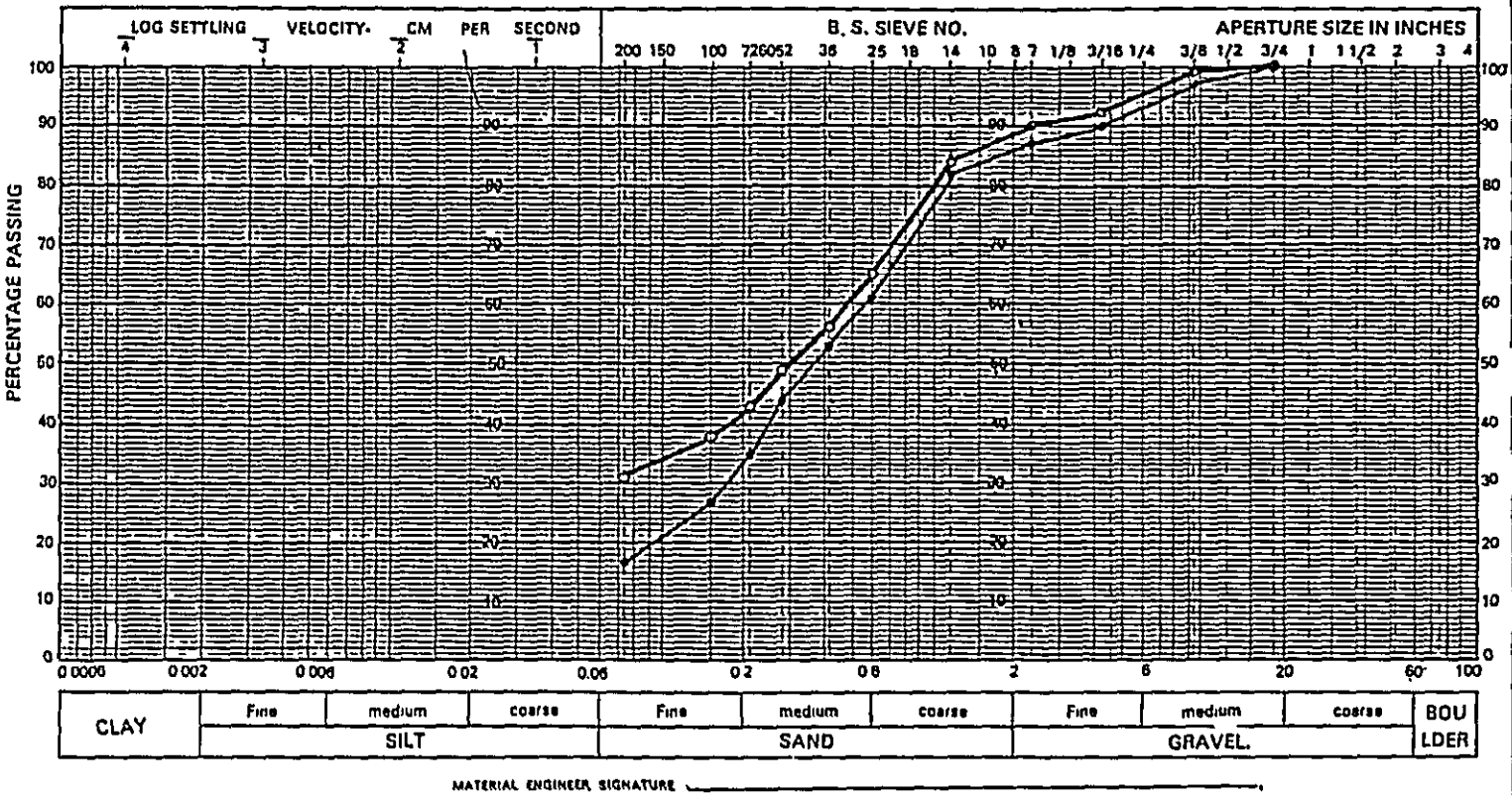
ENGINEERING SOIL ANALYSIS

PROJECT NEW R.T.D TRANSMITTING	LOCATION KIGOMA	DEPTH 1.0 - 1.5 M. 2.0 - 2.5 M.	DATE
SAMPLE NO. 1, 2 RED	LABORATORY NO.	SIEVING DRY/WET	OPERATOR



MATERIAL ENGINEER SIGNATURE _____

COLOUR	
SULPHATE CONTENT	
ORGANIC CONTENT	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	
GROUP INDEX	
SPECIFIC GRAVITY	
FIELD DRY DENSITY	
FIELD MOISTURE CONTENT	
RELATIVE COMPACTION	

CLASSIFICATION

P.R.A.	UNIFIED

COMPACTION

	STANDARD	MODIFIED
M D D.		
O.M.C.		

C.B.R.

DENSITY % OF M D D	95	100	95	100
MOULDING M/C				
UNSOAKED				
1 DAY SOAKED				
4 DAY SOAKED				
SWELL %				

FIG. 9 Grading Curves for Soils from BH No. 1 - Mahembe Kigoma Site.

BORE HOLE No, 2

——— 1·0 - 1·5 M

——— 2·0 - 2·5 M

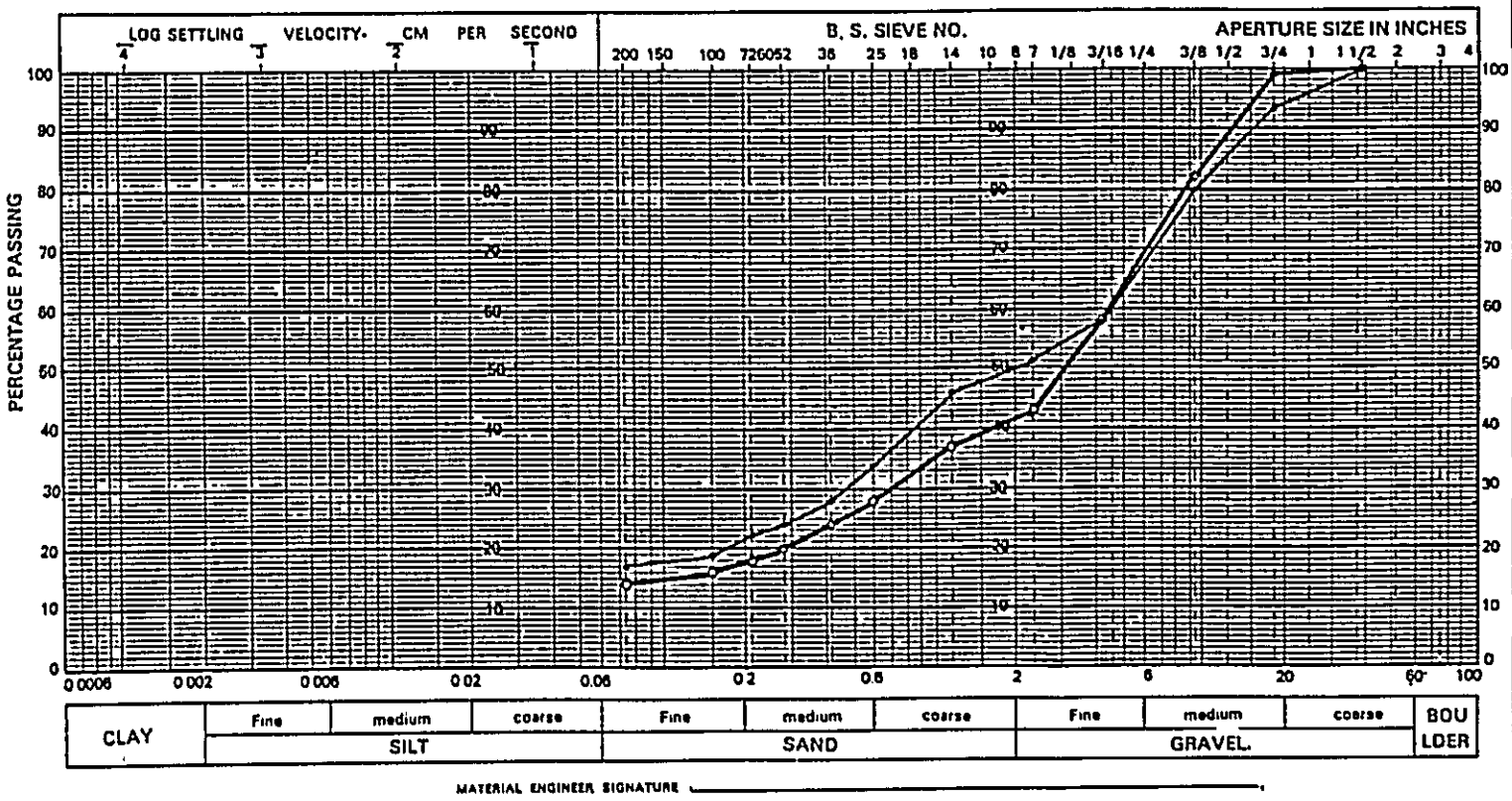
GOVERNMENT OF TANZANIA

MINISTRY OF WORKS

MATERIALS LABORATORY

ENGINEERING SOIL ANALYSIS

PROJECT NEW R.T.D TRANSMITTING	LOCATION KIGOMA	DEPTH 1·0 - 1·5M, 2·0 - 2·5M	DATE
SAMPLE NO. 1, 2	LABORATORY NO.	SIEVING DRY/WET	OPERATOR



COLOUR	
SULPHATE CONTENT	
ORGANIC CONTENT	
LIQUID LIMIT	
PLASTIC LIMIT	
PLASTICITY INDEX	
GROUP INDEX	
SPECIFIC GRAVITY	
FIELD DRY DENSITY	
FIELD MOISTURE CONTENT	
RELATIVE COMPACTION	

CLASSIFICATION

P.R.A.	UNIFIED

COMPACTION

	STANDARD	MODIFIED
M D D.		
O M C.		

C.B.R.

DENSITY % OF M D D	95	100	95	100
MOULDING M/C				
UNSOAKED				
1 DAY SOAKED				
4 DAY SOAKED				
SWELL %				

FIG. 10 Grading Curves for Soils from BH N: 2- Mahemba Kigoma

資料－２　タンザニア国産セメントの新聞紙上広告

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go for quality cement,
and that is

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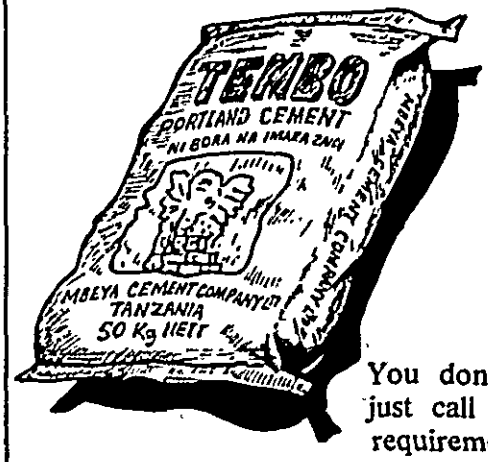

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