FEEDER ROAD EVALUATION & DESIGN

(CASE STUDY: - GBAYI-GIDAN SARKIN FULANI-GUSURO ROADS 5.2KM)

BY

ABUBAKAR SADEEQ BALARABE

JULY 2000

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A PROJECT REPORT PRESENTED TO THE SCHOOL OF ENGINEERING, AND ENGINEERING TECHNOLOGY. FEDERAL UNIVERSITY OF TECHNOLOGY MINNA IN PARTIAL FULFILMENT FOR THE AWARD OF PGD SOIL AND WATER ENGINEERING (WATER OPTION).

JULY 2000

CERTIFICATION

This project title, Feeder road evaluation by Abubakar Sadeeq Balarabe meet the regulation governing the award of PGD soil and water engineering with F.U.T Minna S.E.E.T.

Project Supervisor _____

Mrs. Osunde

Head of Department _____

Engr. (Dr.) M.G. Yisa

DEDICATION

I hereby dedicate this project work to my family, office, and everybody that has a say to feeder roads evaluation.

ACKNOWLEDGEMENT

There is sunshine after the rain they said; similarly at the end of every tunnel is a light. Light indeed, I have seen my way the very day I was through with my PDG course with F.U.T. Minna S.E.E.T. the second completion of my project work crowned it all. May Almighty Allah bless the knowledge acquired and make it useful to the entire human-race and me.

I would also like to thank my beloved spouse for the support and belief she has been given me. My project supervisor Mrs. Osunde, she has been supportive and encouraging all through. My Director in my office Engineer Musa Hassan.

Finally my special thanks goes to my Head of Department Engr. (Dr) M.G. Yisa and all the lecturers and staff of the department of Agricultural Engineering.

May almighty Allah reward you all abundantly.

ABSTRACT

Feeder roads evaluation is mainly carried out by identifying the most productive agricultural areas in the state requiring improved access. This can be conducted by a reputable specialist on such a field. In this work physical inspection of case study road was conducted to identify or rather observe the existing features of the road. i.e. Total length of the road was measured and recorded as 5.2km. Soil type, undulating nature of the road was noticed. Alignment, vertical and horizontal curve of the existing road was found not to conform with the specified ruling limits. Total numbers and types of cross drainage structures was also counted and recorded as 5 numbers. A detailed survey was undertaken to Fix Beach Marks (TBM) at every (km) kilometer as well as collecting the details required for vertical and horizontal geometric design. All the observed features during inspection were recorded. The reasons for the failure of the cross drainage structures established. The design made on horizontal and vertical alignment based on the site survey and details of finished formation levels, curve, gradients, position of cross drainage works e.t.c. are shown on the drawings. The bill of quantity estimates, showing the cost of road rehabilitation as ₦ 8,922,103.92 is attached. This includes the site clearance, Earth works, Roadwork's side drains and culverts recommended in the thesis to replace the inadequate existing ones. Another estimate on the strengthening of the existing ones were also attached as ₦1,009,832.

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CHAPTER ONE

INTRODUCTION

Niger, one of the underdeveloped states in the middle belt of Nigeria situated North West of Abuja and south west of Kaduna. It is unique in its dispersed and unevenly distributed settlements and low density of communication, particularly in rural areas resulting little break through in developmental activities. The richness of the fertile land in the interior areas of the state, encouraged a large section of the farming community to settle in such isolated areas thereby cut off from the main stream of life. As these isolated settlements are not connected by any means of transport, movement of personnel and farm produce become extremely hazardous and difficult. This alarming situation retarded all the rural development strategies without any tangible result.

Road network of the state: - Three kinds of roads exist in the state VIZ. Federal, State and Local Government Area. There are 1720kms of federal roads in the state, of which 1,550km are Bitumen and the rest is Laterite . Of the total 1337kms of state roads, only 453kms are Bitumen and the remaining 884kms are Laterite type. The 7,160kms local Government roads are only earth tracks except 616kms of Laterite type.

e popular mode of transport in the state is by road. There is also some rail ransport, river and air transport play a minor part. The rail line from Lagos to Kaduna passes through the western part of the state to the northeast and has a spur to Baro and Badeggi. There are two airstrips, one at Minna and the other at Bida used mainly by charter flight. Transport on river Niger is by small boat and canoe, negligible in volume and operated by private parties.

JUSTIFICATION

Lack of all weather feeder roads is a major factor militating against planned agricultural development. i.e. Extension workers finds it difficult more often than not to get to the rural farming families in the interior to advice on the new technology and improved method of farming. Conveyance of farm inputs i.e. fertilizer, pesticides and insecticides become more difficult. Transportation of the harvested crops to the urban areas proves difficult and tedious. Also the estimated road density of the state is paved roads 24m/km^2. This does not compare favourably with the national average. The road densities on zonal basis are shown below.

Finally, the recommendations and designs brought out of this thesis would go a long way to solving the justified problems listed above. i.e. the specified ruling limit of radius of curvature 100m and 75m at flat and hilly terrain respectively. Stream and river crossing are selected at straight reaches, gradients, cross drainage

ructures etc. Sources-Anonymous 1991 Agricultural Development Services Limited, feeder road studies London.

	Density paved roads m/km^2	All weather road density m/km^2
Zone 1	19	40
Zone 2	21	31
Zone 3	32	15
Ave	24	28.7

OBJECTIVE OF THE WORK

The specific objectives are: - To determine feasibility of the road rehabilitation

: - Improve the quality of life of rural populace.

: - Easy access to convey farm input into Agricultural lands and carry produce to market.

: - To estimate the cost implications of the rehabilitation of roads.

: - To evaluate or recommend various features of road design, i.e. the type of surface to be used, depending upon the (ADT) Traffic density

: - Reduce transportation cost on feeder roads by at least 50%, which will stimulate the integration of rural

markets and directly increased/improve farmer's margins for marketed crops..

: - Instituted systematic periodic recurrent and routine maintenance.

CHAPTER TWO

LITERATURE REVIEW.

Feeder road designs: - In the design, the existing sharp curves are brought to the specified ruling limit of radius of curvature i.e. 100m and 75m at flat and hilly terrains respectively. Stream and river crossings are selected as straight reaches. Anonymous (1991) feeder road studies, Agriculture development services Ltd. 17 wigmore street London WIHGLA.

Feeder road design details include: - Horizontal Alignment, cross sectional profile, and vertical profile.

Horizontal Alignment: - In general the alignment follow the existing track. However, readjustment is called for in certain places with a view to keep safe geometric features and easy operation of vehicles besides making a compromise

etween cutting and filling. Emphasis has also been made to eliminate weak soil areas and high cutting and filling to make it more economical. Anonymous (1986) Niger State ADP working paper RIC.

Cross sectional profile: - The details of the cross section are as follows:

(a) Row-20.0m

(b) Formation width-12.0m

(c) Shoulder on either side-3.00m

(d) Dept of drain-0.75m

Slope of side drain-1.3 (easy slope will prevent soil erosion from the road formation).

Slope of landside – 1.1

(e) Cross fall-5%

(f) Base material width-6.00 (provided only on)

Base material thickness-150mm (225mm on fadama land)

VERTICAL PROFILE

Formation: - On filling section the formation level in fixed so that the crown point of the road in at least 450mm above the adjoining ground level wherever necessary. At culvert points and stream crossings, the formation level is fixed in such a way that there is at least 450mm overlay over the PCC ring culverts. At

ces where RCC box are proposed, the top slap coincide with the formation vel. Anonymous 1991. Feeder road studies, Agricultural Development Service.

FILL MATERIAL.

(a) **Sub Grade**: - Only approved materials shall be used in the embarkment and it is essential to remove any soft material from the bed of formation

(b) **Compaction:** - To ensure adequate compaction, the embankment will be constructed in layers. Successive layers will be placed only after specified compaction is achieved. The layer should not exceed 225mm in thickness and compacted at omc to 150mm

Gradients: - The ascending and descending gradients are fixed in such a manner that the gradient of 6% & 8% on flat and hilly terrains respectively.

- Causes of road failure: - These are numerous, some of which are: - Lack of conducting a thorough soil survey, inadequate information on traffic count and types, improper designs, materials used in construction are improper, lack of proper supervision, inadequate assessment of discharge along cross drainage structures etc.

raffic Engineer needs information to identify the magnitude of traffic demands, problems and a quantitative approach to solve this problem. Hence traffic studies are conducted. Traffic studies measures such quantity such as volume, speed and delay. Mr. Ebo (1986) lecture notes, Transportation Engineering.

-Causes of feeder road failure: - These are similar to that of the road highway failure. However, it does have a peculiar nature, the feeder roads are built of lateritic material, lack of proper compaction, selection of good fill material, improper assessment of vent ways, lack of protection of shoulders to discourage erosion and improper design and construction within the specified ruling could all cause failure.

-Cost implication on road rehabilitation: - Road rehabilitation involves a lot of activities, some of which are: -

- Site visitation or inspection to identify the extent of damage caused
- Soil test and results used in road construction
- Realignment and redesigning of curves vertical and horizontal base on the type, purpose and use of the road etc.

This would naturally attract a big amount of money. However some of the cross drainage structures i.e. Bridge, Box culvert are avoided where necessary along a feeder road because of the following reasons:

- Construction of Bridge may not be justified in a feeder road programme due to high cost involved
- The MFL stays only for a few days
- There could be exposed sheet rock on the riverbed, which avoid the cost of foundation for a drift. Anonymous (1991) feeder road studies. Agricultural Development Services Ltd.

Effect of road failure (feeder) on socioeconomic of the rural dwellers: - When a feeder road fails:

- It becomes difficult for the rural dwellers to convey their farm produce to the town
- The local transporters due to poor nature of the road could also increase transportation cost.
- Farm input i.e. fertilizer and pesticides could not be conveyed to the farming families.
- Extension workers find it difficult to reach their farmers for education on improved farming methods. Anonymous (1986) Niger State ADP working paper.

CHAPTER 3

3.0 METHODOLOGY

3.1 SITE DESCRIPTION

Gbayi-Gidan Sarkin Fulani-Gusoro (5.2km)

This road takes off at 9km distance from Kuta Local Government Secretariat of Kuta-Zumba road at Gbayi village and passes through Gidan Sarkin Fulani and terminates at Gusoro village. It traverses through a gentle undulating plain of red loamy soil. The road passes through a sizeable area of arable land apart from connecting two Fadamas.

It serves a primary school, junior secondary school, health center and extension center.

Present Status

The carriage-way of this road is formed with laterite and is motorable. Side drains and cross drainage structures are also provided. The base course is thin and potholes, undulating etc. are common through out its length. The reach at km. 1.2 & 3.45 used to get submerged during the rains. The existing alignment is recommended for rehabilitation.

Construction Materials

Suitable construction material for sub-bare/base course is available all along the length of the road at an average haulage of 2km distance.

Cross-Drainage Works

Along the route, it crosses five minor streams, two of which traverse through fadamas. The existing cross drainage structures of P.C.C ring culverts need improvement by way of extension of barrel length construction of wing wall, strengthening of foundation etc.

3.2 Road Survey and Geometric Design.

A detailed survey was carried out throughout the length of the road to fix Bench marks (IBM) at every kilometer and to collect the details required for vertical and Horizontal Geometric Design in addition to arriving the type and number of cross drainage structures.

The design finalized on horizontal and vertical alignment based on site survey and details of finished formation level, curve details, gradients, portion of cross drainage works etc. are shown on detailed drawings.

3.3 Preparation of Individual Road Drainages

Drawings with design recommendations are prepared for the road. Each drawing covers about 1.5km length in horizontal design, the details of location of villages Temporary Bench Mark (TBM), Intersection Points (IP), Chainage (CH), Deflection angle (D), Radius of curvature (R), Tangent Length (TL), Curve Length (CL) etc. are shown along the alignment.

Parking spaces are shown on village site for a length of 30 to 50m and a width of 3m on either side of the road depending on the size of the village, vehicle-turning facility has been provided in a circular shape with a radius of 30m.

In the longitudinal profile, levels were taken for every 50m as well as the bed levels of streams and rivers. The existing ground level is shown as broken lines, while the proposed finished level is shown as firm lines. In addition the percentage of gradients depth of cutting and height of filling are also noted on the drawings with rate of change of vertical curve.

Type designs drawings prepared for P.C.C. ring culverts of different barrel lengths, R.C.C Box culverts.

3.4 Road Design Details

Horizontal Alignment

In general, the alignment follows the existing track. However, readjustment is called for in certain places with a view to keep safe geometric features and easy operation of vehicles beside making a compromise between cutting and filling. Emphasis has also been made to eliminate weak soil areas and high cutting and filling to make it more economical.

In the design the existing sharp curves are brought to the specified ruling limit radius of curvature i.e. 100m and 75m at flat and hilly terrains respectively. Stream and river crossings are selected as straight reaches.

The absolute minimum sight distance is made in every section of the road, also the safe overtaking distance.

3.5 Cross section profile

fig (1) shows the proposed cross section of the road, the details of which are as follows: -

(a) Row – 20.00m

(b) Formation width – 12.00m

(c) Shoulder on either side – 3.00m

(d) Depth of Drain – 0.75m

Slope of side drain near to the road– 1:3 (easy slope will prevent soil erosion from the road-formation)

Slope of land side – 1:1

(e) Cross fall – 5%

(f) Base material width – 6.00 (provided only on carriage way)

Base material thickness – 150mm (225mm in fadama land)

3.6 Vertical Profile

Formation

On filling section the formation level is fixed so that the crown point of the road is at least 450mm above the adjoining ground level wherever necessary. At culvert points and stream crossings, the formation is fixed in such a way that there is at least 450mm overlay over the PCC ring culverts. At places where the RCC boxes are proposed, the top slab coincides with the formation level.

3.7 Fill Material

(a) Sub grade

Only approved materials shall be used in the embankment and it is essential to remove any soft material from the bed of formation. The best available material within an initial lead of 1km will be made use of the portion of the embankment

for a sub grade depth of 45cm. The select fill should have a dry density of at least 1.65g/cc. A 150mm thick borrows pit material as recommended as base course over the sub grade, whereas for fadama areas as base course thickness of 225mm is recommended when the embankment height exceeds 60cm, the fill material below 60cm should be obtained at economical lead. The intensity of pressure at 60cm below the top surface will be less and hence the available material with a density not less than 1.44g/cc can be allowed for use.

(b) Compaction

To ensure adequate compaction, the embankment will be constructed in layers Placed only after specified compaction is achieved. The layer should not exceed 225mm in thickness and compacted at omc to 150mm. The densities of compaction to be achieved in different cases are attached.

3.8 P.C.C Ring Culverts

The wing walls returns, headwall at the end of the pipe, curtain walls, collar, parapets etc. are proposed in plain concrete class B. The foundation building for wing is proposed in lean concrete 1:3:6 using 36mm hard broken stone for a thickness of 150mm. This item is recommended to take care of the unequal settlement of the sub-soil thereby causing blockage of flow due to the dislocation of individual PCC rings.

The apron is paved with R.R. masonry in cement motor 1:6 for a thickness of 300mm. The wings are splayed for 1:3 for single and double P.C.C ring and 1:2 for triple ring culvert.

3.9 Box Culverts

In this the barrel in R.C.C 1:1, 5:3. The wing walls, curtain wall at barrel and apron end beam and parapets are proposed in R.C.C 1:2:4. The apron portion is paved with R.R. masonry in cement mortar 1:6 for a thickness of 300mm. The wings are splayed at 1:1.

CHAPTER FOUR

4.0 RESULTS AND CALCULATIONS

4.1 DESIGN CALCULATIONS

Design Formula

1. Tangent length =T

   T= R tan θ/2

   R=Radius of curvature in m

   θ=Angle of deflection in ^{0}

2. Tangent point Tp_1

   Tp_1 =Ip-T

   Ip=Intersection point in m

   T=Tangent length in m

3. Tangent point Tp_2

   Tp_2 =Tp_1+d

   Tp_1= Tangent point one in m

   d= Curve length in m

   But curve length= Arc length

   Arc length $=\frac{\pi R\theta}{180}$

4. $\mu = \frac{V^2}{gR}$

Where μ=coefficient of friction

V^2=velocity in m/s

R=radius in m

g=acceleration due m/s^2

Hence if the limiting value of μ is known, the minimum curve radius can be calculated for any given design speed.

5. $\frac{V^2}{gR}\tan\alpha + \mu$

tan α=super elevation to avoid over turning and sliding of vehicles at curve section.

Design speed length (v)	Desirable minimum radius (m) for super elevation of 0.04	0.07
80	500	300
60	275	170
50	200	120
30	75	50

0.07-Highway

0.04-Urban road.

(Mr. U. Ebo (1988) Lecture Note HNDI TRANSPORTATION ENGINEERING)

Design speed km/h	Minimum stopping distance m		Slight distance passing distance	
	Urban	Rural	Urban	Rural
120	-	300	-	-
100	-	210	-	450
80	140	140	360	360
60	90	90	270	270
50	70	-	225	-
30	30	-	135	-

Jim Miduskey (1979) ROAD FORM AND TOWNSCAPE

USING THE DESIGN FORMULA INDICATED IN 4.1

Ip_1 = CHO+250

D=$04^0 25^1 51"$

R=1671m

Tc=64.644m

Cl=129.222m

Tp_1= of 185.356

Tp_2=of 314.578

X=1.25m

Ip_2 =CHO+522.76

D=$35^0 10^1 13"$

R=357m

Tc=113.140

Cl=219.140

Tp_1=0.409.615

Tp_2=0.628.755

X=17.5m

Ip_3=CH1+210

D=$07^0 33^1 15"$

R=689

Tc=45.487

Cl=90.841

Tp_1=1+164.512

Tp_2=1+255.354

X=1.50m

Ip_4=CH1+469

D=$16^0 45^1 56"$

R=232

Tc=34.188

Cl=67.886

Tp_1=1+434.812

Tp_2=1+502.698

X=2.50m

Ip_5=CH1+722.58

D=$10^0 09^1 02"$

R=686

Tc=60.926

Cl=121.532

Tp_1=1+661.654

Tp_2=1+783.186

X=2.70m

Ip_6CH2+028.44

D=$10^0 40^1 57"$

R=321

Tc=30.011

Cl=59.849

Tp_1=1+998.429

Tp_2=2+056.278

X=1.40m

Ip_7CH2+259

D=$09^0 24^1 03"$

R=207

Tc=17.02

Cl=33.964

Tp_1=2+242.37

Tp_2=2+276.334

X=0.70m

Ip_8=CH2+554.86

D=$10^0 07^1 40"$

R=434

Cl=76.715

Tp_1=2+516.401

Tp_2=2+593.117

X=1.70m

Ip_9CH2+927.86

D=$11^0 05^1 04"$

R=681

Tc=66.079

Cl=131.746

Tp_1=2+861.781

Tp_2=2+993.527

X=3.20m

Ip_{10}=CH3+184.08

D=$15^0 02^1 10"$

R=242

Tc=31.937

Cl=63.508

Tp_1=3+152.143

Tp_2=3+215.651

X=2.10m

Ip_{11}=CH3+796.48

D=$07^{0}45^{1}06"$

R=829

Tc=56.164

Cl=112.157

Tp_{1}=3+740.316

Tp_{2}=3+852.473

X=1.90m

Ip_{12}=CH3+936.98

D=$11^{0}39^{1}08"$

R=443

Tc=45.202

Cl=90.093

Tp_{1}=3+891.778

Tp_{2}=3+981.871

X=2.30m

Ip_{13}=CH4+208.28

D=$06^{0}09^{1}28"$

R=1384

Tc=74.44

Cl=171.19

Tp_1=4+133.842

Tp_2=4+305.03

Ip_{14}=CH4+791

D=$07^0 05^1 27"$

R=678

Tc=42.008

Cl=83.908

Tp_1=4+749.092

Tp_2=4+833

X=1.30m

Ip_{15}=CH1+050

D=$07^0 30^1 14"$

R=1071

Tc=70.234

Cl=140.422

Tp_1=4+911.666

Tp_2=5+052.088

X=2.30m

Ip_{16}=CH5+136.230

D=$26^0 38^1 50"$

R=100

Tc=23.683

Cl=46.508

Tp_1=5+112.317

Tp_2=5+158.825

X=2.77m

Provision of additional vent way is recommended in places where there are signs of flood over flown across the road due to inadequate vent way.

The details of the requirement of cross drainage works are as under.

4.2. IMPROVEMENTS RECOMMENDED TO THE EXISTING STRUCTURES

Drainage	Details of existing structures	Improvement required
1/200	2R1.29.0	Extension of barrel 10m length
3/450	Box 1.2x0.7	Extension of barrel 6.2m length
3/600	Box 1.2x0.7	Extension of barrel 6.9m length
4/200	Box 0.8x0.7	Extension of barrel 3.6m

Drainage	Type and No. of cross drainage structures recommended.
1/200	30x3mx3m
3/450	2R1.214
3/600	2R1.214
4/200	2R1.210
4/600	2R1.214

All the structures require strengthening of foundation and improvement of wing walls.

NOTE:

Type design drawings for the cross drainage structure recommended for the roads are attached.

Taking this into account 1.2m PCC wings are proposed for culvert. Based on the volume discharge, the following type design are recommended for adoption.

No	Type	Barrel lengths
1	Single wing P.C.C 1.2m	8m, 10m, 12m, 14m
2	Double wing P.C.C 1.2m	8m, 10m, 12m, 14m
3	Triple wing P.C.C 1.2m	8m, 10m, 12m, 14
4	Drift with P.C.C wings having overflow facility	The number of pipes depend on the volume of discharge of the stream at LWL
5	R.C.C box 2mx2m	8m
6	R.C.C box 2.5mx2.5m	8m
7	R.C.C box 3mx3m	8m
8	R.C.C twin box 2.5mx2.5m	-
9	R.C.C twin box 3mx3m	-
10	Wooden deck bridge	-

NOTE

In few cases the length of the barrel is been increased in proportion to the length of fill in order to keep the gradient of side slope.

4.3 Drainages

4.4 Cross drainage structures

The landscape in the state is dissected by numerous stream and river course, which result frequent crossing of stream and river along the route. None of them have a high volume of water in the raining season. Studies revealed that a good number of drainage structure along certain roads are ineffective due to improper placement or faulty design. One of the main reason of the failure of the cross drainage structure is the unrealistic assessment of vent way without due consideration to the rate of run off. Further, the type of structure required for bridges will vary from place to place depending on the run off rate, size of stream, sub-soil on the bed e.t.c.

A critical analysis of these factor has been made and the nature of cross drainage structure to be provided at each stream point is arrived at by assessing the run off from the catchments so as to ensure adequate vent way to take the volume of run off. To make optimum

use of the existing culvert/boxes wherever possible strengthening/extension is proposed to meet the requirement.

A barrel length for the minimum fill of 450mm in fixed as 8m so that there is a clear way of 7550mm both ways without any hurdle. There is a need to increase the barrel length in places where the height of fill materials is more.

A common feature observed shows that at long run, the barrel of cross drainage structure are likely to be silted up blocking the water way. This causes heading up of water on the up stream site resulting over flow across the road and consequent washing away of the road making traffic impossible. To tide over this situation, it is imperative that there should be provision for people to enter into the barrel and clear the silt. (However the traffic have to be suspended during high flood, which may last for a few days)

4.5 Side drains

The typical section recommended is shown in the cross section profile. The slope proposed for the inner face of the side drain is very

gentle (1:3) keeping in view that the water from the carriage way while draining to the side drain does not cause erosion of soil from the formation. The out side face is given a slope of 1:1

4.6 Cradle trenches and shootout

Deep scouring of drains and consequent slipping of road formation is very common where the road stretches on long steep gradient due to high velocity of flow. As a protection to the bed and side soil, it is proposed to provide cradle trenches of bulldozer blade width in the side drain at suitable intervals depending on the length and gradient of slope of the drain. Wherever possible, shootout will also be provided to over come this problem.

4.7 Gradient

The ascending and descending gradient are fixed in such a manner that the gradient fall within the specified ruling gradient of 6% & 8% on flat and Lilly terrains respectively.

As far as possible, steep gradient are not given for longer stretch. Easy gradient is given immediately after a steep gradient. The maximum

and minimum gradients assigned for Gbayi-Gidan sarikin Fulani Gusoro road are 2.48% and 0.67% respectively.

4.8 Protection and shoulders

In general soil erosion is prevalent on the shoulder and the accompanied side drain slope of the feeder road due to draining of water to the side drains. As a preventive measure, tufting is proposed on the entire work of the soft shoulder for3 meter on either side.

4.9 Environmental protection

Rehabilitation of feeder roads can lead to some environmental problem due to cutting and removal of a good number of trees and bushes. In order to make a healthy environment, it is recommended to plant avenue trees along the road. Importance can be given to plant fruit and timber trees. The crown of the avenue trees so planted should not extend beyond the pavement edge of the right of way. The trees should be at the edge of the right of way. Trees can be apart longitudinally from 15 meter onward depending on the watering point and other factor

CHAPTER FIVE

5.0 PREPARATION OF THE ESTIMATES & BILL OF QUANTITIES

Case study road: - Gbayi II-Gidan Sarkin Fulani- gusoro road (5.2km) Shiroro L.G.A.

SITE CLEARANCE

S/NO	DESCRIPTION OF WORK		QTY	UNIT	RATE	AMOUNT
101	Clear site of all bush debris vegetables and shrubs within the R. O. W. and cart to spoil		6.76	Ha	55,000	371,500.00
102	Clear site of all trees 100mm girth within 50mm on either side of row and remove all plant roots		100	Nos	150	15,000.00
103	(a)	Ditto 150mm girth	100	Nos	150	15,000.00
	(b)	Ditto 200mm girth	30	Nos	150	4,500.00
	©	Ditto 300mm girth	30	Nos	150	4,500.00

EARTH WORKS					
201	Excavate top soil within the formation width to a depth of 150mm and cart to spoil max haulage 100km	3,900	m^3	55	214,500.00
S/NO	**DESCRIPTION OF WORK**	**QTY**	**UNIT**	**RATE**	**AMOUNT**
202	Scarify the existing road to a depth not less than 100mm to receive the full material	20800	M^2	2.50	52,000.00
203	Remove unstable material within the C.W to a depth not exceeding 100mm cart to spoil max haulage 1.90km.				
	1/100-1/350	125			
	3/400-3/650	125			
	4/500-4/700	60	M^3	65	20,150.00
		310			

204	Cut and fill the approved material over the carriage way spread in layer of 225mm shape, water, roll and compact to approved specification to 150mm depth (full material below 60cm)	1/550	m^3	75	866,250.00
205	Haul approved borrow pit material of maximum dry density not less than 1.44cm/cc spread over the carriage way in layers 225mm shape, water, roll and compact specification to 150mm depth including all cutting, filling conveyance etc complete				

Total quantity as per levels

	Filling	Cutting
CH0-1km	5721.38	23.04
1km-2km	12893.00	25.76
2km-3km	6834.60	44.52
3km-4km	8594.19	3207.36
4km-5km	6676.00	-
5km-5/200	701.10	-
	41520.27	3300.68
i.e.	41520m^3	3300m^2

Filling quantity as per level	-41520
Add quantity as per item 201 & 203	-4210
Total quantity of filling	-45730 m^2

S/NO	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT
205	Deduct 1. Cutting quantity 2. As per 204 3. Base material as per item 302 4. Deduct item 401 5. Deduct item 402	3300 1/550 5850 10800 690			
	Net quantity under their item	15340	M^2	300	4,062,000
ROAD WORKS					
301	Grade the compacted sub-base over the C.W and shoulder to specified road camber, water, roll and compact to approved specification	3,900	M^2	4.50	175,500
302	Haul approved base material spread over the C.W in layers of 150mm, shape, water, roll and compact to 100mm thick at OMC to approved specification	5850	M^2	-	-

	to get a maximum dry density not less than 1.65cm/cc including all cutting, filling conveyance etc complete				
303	Grade the compacted base course over the carriage way to specified road camber, roll and compact to approved specifications compacted surface to be tasted to confirm to specified standard in the contract document.	39000	M^2	4.50	175,500
304	Turfing the shoulder excluding laterite pavement portion and watering fill the grass takes root.	23400	M^2	5.40	126,360
305	Planting avenue trees instructed by the engineer on the edge of row including cost of seedling, planting, manuring, watering, fencing, shading etc	104	Nos	10.50	1,092

SIDE DRAINS CULVERT, DRIFT & BRIDGES

S/NO	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT
401	Provide by cutting clean and compacted 'V' shaped side trains to depth, line and level as indicated in the drawing.	108000	M^3	-	-
402	Ditto for cut off drains with 2.1m top and 0.6m bottom width and 0.75 depth and 1:1 side slope where the topography towards the road	690	M^3	-	

Cross drainage works new proposed structures

CH 1/200 - 3mx3m Box

CH 3/450 - 2R1.2 14

CH 3,600 - 2R1.214

CH 4/200 - 2R1.210

CH 4/600 - 2R1.214

3	Foundation excavation in all classes of soil except hard rock which require blasting up to a depth of 5m from G C to the underside of foundation and stock pile of approved for back fill or cart to spoil if unsuitable. CH 1/200 - 72.146 CH 3/450-70.586 CH 3/600-70.586 CH 4/200-54.296 CH 4/600-70.586				
	Total	338.200	M^3	500	169,100

4	Provide foundation concrete 1:3:6 are blinding to foundation using 36mm hard broken stone including boxing, curing etc. complete. CH 1/200 CH 3/450 CH 3/600 CH 4/200 CH 4/600	 5.788 9.688 9.688 7.796 9.688			
	TOTAL	**42.648**	**M^3**	**6500**	**277,212.00**

5	Cost and conveyance of PCC rings of 1.2m ϕ including handling charges loading and unloading etc CH 3/450 CH 3/600 CH 4/200 CH 4/600	 28.00 28.00 20.00 28.00			
		104.00m	LM	6500	676,000.00
6	Hoisting and fixing PCC rings in position in line and levels and directed by the engineer including hire charges of tripod, pulley rope etc and cost of labour material for joining the rings				
	Quantity as per item 405	101.00m	LM	500	52,000
	Provide reinforced cement concrete 1:1 ½:3 using 18mm				

	hard broken stone including boxing, curing etc. but excluding cost of reinforcement. CH 1/200	31.68	M^3	8,500	269,280
8	Provide reinforced cement concrete 1:2:4 using 18mm hard broken stone including boxing, curing etc. but excluding cost of reinforcement CH 1/200	40.782	M^3	8,500	346,647.00
9	Cost, conveyance and labour ms/tor steel reinforcement bend, tie and placed in position including cost of tying wire etc, CH 1/200	4.422	Tons	25,160	111,257.52
	rovide class B concrete for				

	super structure including cost of boxing, curing etc. complete CH 3/450 CH 3/600 CH 4/200 CH 4/600	 12.276 12.276 12.276 12.276			
TA		49.104	M^3	9,500	466,488.00
1	Random nibble masonry 1:6 using hard granite broken stones for apron paving. CH 1/200 CH 3/450 CH 3/600 CH 4/200 CH 4/600	 37.05 6.13 6.13 6.13 6.13			
	TOTAL	61.57	M^3	1,500	92,355.00
	Provide backfill on board portion with approved soil				

	material at 150mm layer and compacting it with power roller at OMC as directed by the engineer to achieve the desired dry density including cost and conveyance of fill material.				
	CH 3/450				
	CH 3/600	66.206			
	CH 4/200	66.206			
	CH 4/600	47.29			
	TOTAL	66.206			
3	Dumping hard broken stones not less than 20dm^3 size downstream end of the apron to arrest erosion of soils as directed by the engineer.	245.908	M^3	300	73,772.40
	CH 1/200	7.2			
	CH 3/450	2.43			
	CH 3/600	2.43			
	CH 4/200	2.43			

/NO	DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT
	CH 3/450 CH 3/600 CH 4/200 CH 4/600	66.206 66.206 47.29 66.206			
	Total	245.908	M^3	300	73772.40
13	Dumping hard broken stone not less than20d M^3 size down stream end of the apron to arrest erosion of soils as directed by the engineer CH 1/200 CH 3/450 CH 3/600 CH 4/200 CH4/600	 7.2 2.43 2.43 2.43 2.43			
	TOTAL	16.92	M^3	2000	33,840.00
414	Allow for taking to site removal from site and maintenance on site, staff labour and equipment for construction.	Provisional			250,000.00
	TOTAL				8,922,103.920

1 EXTENSION AND STRENGTHENING OF THE EXISTING CULVERT.

DESCRIPTION OF WORK	QTY	UNIT	RATE	AMOUNT
CH 1/200 Existing 2r 1.2D 9.0 Extension required = 10m Adopt structure Similar to 2-ring culvert 10m length.				
1. Foundation excavation in all classes of soil except hard rock which require blazing up to a depth of 5m from GL to the underside of foundation and stock pile if approved for backfill or cart to spoil if inscrutable.	27.071	M^3	500	13,535.50
2. Filling the foundation of the barrel portion with clear gritty river sand before concreting including cost of conveyance.	9.45	M^3	750	7,087.50
3. Providing foundation concrete 1:3:6 as blinding to foundation using 36mm hard broken stone including boxing curing etc complete.	7.796	M^3	6,500	50,674.00
4. Cost and conveyance of PCC rings of 1:2m d including handling charges, loading and unloading etc.	20	LM	6500	130,000.00
5. Hoisting and fixing PCC rings in position line and levels as directed by the engineer including hire charges of tripod pully, rope etc and cost of labour and material for joining the ring.	20	LM	500	10,000
6. Provide class B concrete for super-structure including cost of boxing curing etc complete.	12.276	M^3	9,500	116,622.00
7. Random rubble masonry with cement mortar 1:6 and using hard granite broken stones for apron paving.	6.13	M^3	1,500	9,195.00
8. Dumping hard broken stone at the down stream end of the	2.43	M^3	2000	4,860.00
TOTAL				341,974

16	CH 3/450 Existing length = 7.8m Extension = 6.20m				
	1. Foundation excavation in all classes of soil except hard rock which require blasting up to a dept of 5m from GL to the underside of foundation and stock pile if approved for backfill or cart to spoil if unsuitable.	25.914	M^3	500	12,957.00
	2. Providing foundation concrete 1:3:6 as blinding to foundation using 36mm hard broken stone including boxing, curing etc complete.	6.743	M^3	6500	43,829.50
	3. Provide class B concrete for super structure including cost of boxing curing etc complete.	10.708	M^3	9,500	101,726.00
	4. R.R 1:6 for Apron	3.065	M^3	1500	4,597.50
	5. R.C.C. 1:2:4 for slab	2.232	M^3	8,500	18,972.00
	6. Reinforcement bend tied and placed in position.	151	kg	500	75,500.00
	TOTAL				257,582
	CH 3/600 Existing length = 6.50m Extension = 6.90m Adopt the same section as on CH 3/450.				
	1. Foundation excavation {Specification similar to (416-1)}	27.454	M^3	500	8,727.00
	2. Provide foundation concrete 1:3:6	6.863	M^3	6500	44,609.50
	3. Provide class B concrete for super-structure	11.051	M^3	9500	104,984.50

	including cost of boxing, curing etc complete.				
	4. R.R 1:6 for apron	3.065	M^3	1500	4,597.50
	5. R.C.C 1:2:4 for slab	2.484	M^3	8500	21,114.00
	6. Reinforcement bend, tie and placed in position	167	LG	500	83,500
	TOTAL				267,532.50
18	CH 4/200				
	Existing length = 6.80m				
	Extension = 3.60m				
	1. Foundation excavation specification similar to (416-1)	18.754	M^3	500	9,377.00
	2. providing foundation concrete 1:3:6	2.306	M^3	6500	14,989.00
	3. Provide class B concrete for super-structure including cost of boxing, curing etc. complete	8.434	M^3	9500	80,123.00
	4. R.R 1:6 for apron	3.065	M^3	1500	4,597.50
	5. R.C.C. 1:2:4 for slab	0.842	M^3	8500	7,157.00
	6. Reinforcement bend, tie and placed in position.	53.0	KG	500	26,500
	TOTAL				142,743.50
	GRAND TOTAL				N 1009,832

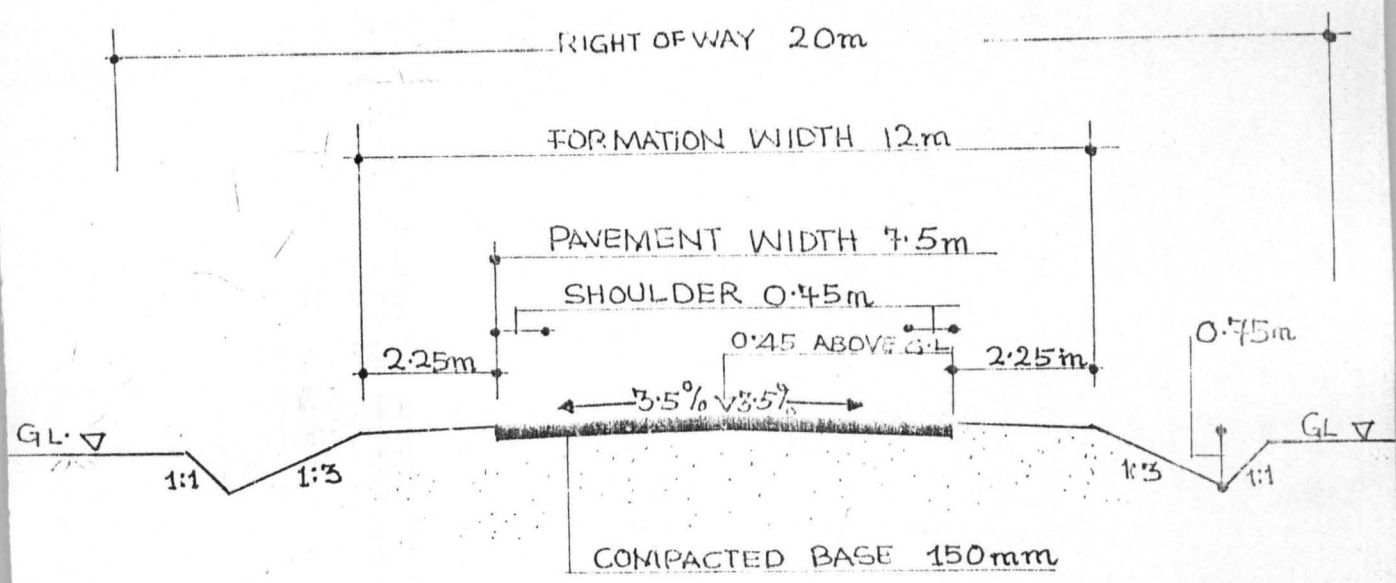
5.2 CONCLUSION AND RECOMMENDATION

For a feeder road to justify the cost of construction incurred on it, the actual job of construction should confirm to the specified ruling limits of construction as well as the design recommended in the thesis. This would enable such roads live up to it's life span period bearing in mind adherence to the specified method of maintenance.

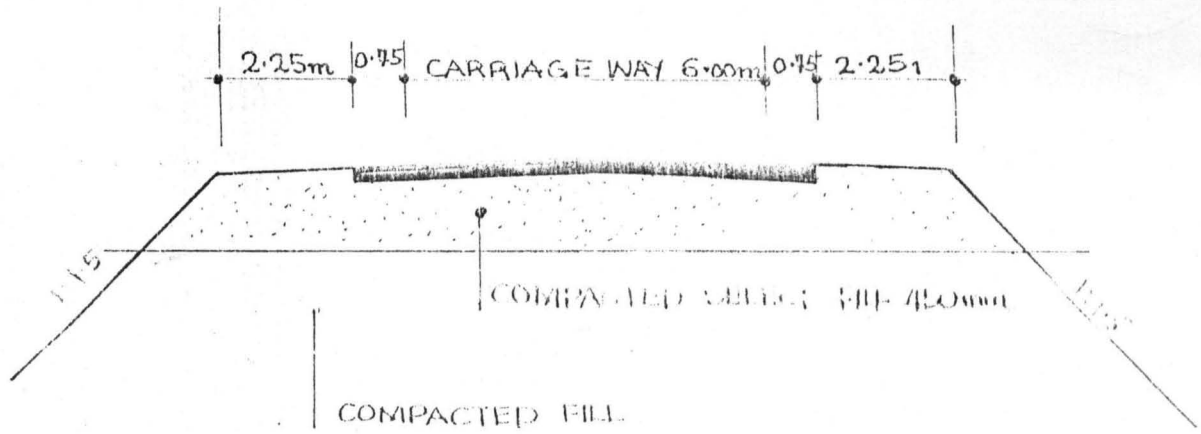
Observation on the case study road revealed that side drains and cross drainage structures are provided, but all the 5nos cross drainage provided are inadequate. The discharge rate was not taken into consideration when constructing the vent ways. This necessitated the washout or failure of such culverts. Attached to the thesis are recommendations and strengthening of the existing one's as well as cost for the two separate method for comparison. Undulations were common through out the length of the road, due to lack of side drain routinely maintenance, as well as the recurrent maintenance exercise on the carriage way i.e. restoring the lost laterite and shaping to the specified ruling camber to facilitate drainage. The existing aligment was also recommended for rehabilitation, for the straights and curvers found throughout the length of the road does not conform to the specified ruling limits of construction. Attached to the thesis are recommended designs on longitudinal profile for references.

Attached also are appendix to the thesis are the worldly accepted maximum dry densities of filling material required for construction as well as standard on cross drainages construct for reference.

5.8 APPENDIX



TYPICAL CROSS SECTION



TYPICAL CROSS SECTION ON FILL

WHEN DEPTH OF FILL EXCEEDS 600mm

PPENDIX 5.4

lls below 3m Height		Fills above 3m height	
b. Max. dry nsity gm/cc	Minimum field compaction requirement % max. lab	Lab. Maximum dry density gm/cc	Minimum field compaction requirement of lab. Max. dry density
ss than 1.44	Unsuitable and may be avoided for construction	Less than 1.52	Unsuitable and may be avoided for construction
4 to 1.64	100	1.52 to 1.64	100
5 to 1.75	98	1.65 to 1.75	100
6 to 1.91	96	1.76 to 1.91	98
2 and above	95	1.92 and above	96

juirement of minimum sub-grade/base course compaction

. Max. dry density gm/cc	Minimum sub-grade compaction requirement % of Lab. Max. dry density
s than 1.65	Usually unsuitable and may be avoided
to 1.91	100
and above	98

PECIFICATIONS AND QUANTITIES

YPE DESIGNS FOR CROSS DRAINAGE WORKS

he quantities and specifications for a standard 8m length single ring P. C. C. culvert are ven below:

INGLE RING CULVERT (1R1.2∅8)

1. Foundation excavation in all classes of soil except hard rock which requires blasting and stock pile if approved for backfill or cart to spoil if unsuitable.

   $31m^3$

2. Provide foundation concrete 1:3:6 as blinding to foundation using 36mm hard broken stone including boxing, curing etc. complete. $4.186m^3$
3. cost and conveyance of P.C.C. rings of 1.2m ∅ including charges on loading, unloading etc. 8m
4. Hoisting and fixing P.C.C. rings in position in lines and levels as directed by the Engineer including hire charges of tripod, pulley, rope etc. and cost of labour and material for jointing the rings. 8m
5. Provide class B concrete for super-structure including cost of boxing, curing etc. complete. $9.49m^3$
6. Random rubble masonry 1:6 using hard granite broken stones for apron paving.

   $3.065m^3$

7. Provide backfill on barrel portion with approved soil fill material at 150mm layers and compacting it with power roller at OMC as directed by the Engineer to achieve the desired dry density including cost and conveyance of fill material.

   $28.152m^3$

Dumping hard broken stones not less than $20dm^3$ size at the down stream end of the apron to arrest erosion of soil as directed by the Engineer.

$1.75m^3$

ities for different barrel length of single, double and triple ring culverts are given e 1.

TABLE 1

QUANTITIES OF P.C.C. RING CULVERTS SINGLE/DOUBLE/TRIPLE FOR 8M/10M/12M/14M/LENGTHS

Item No.	Short specification	Single ring				Double ring				Triple ring			
		8M		10M	12M	14M	8M	10M	12M	14M	8M	10M	12M	14M
503	Foundation Excavation	M^3	30.994	35.674	40.354	45.034	46.016	54.296	62.576	70.856	66.336	78.216	90.096	101.976
504	Cement concrete 1:3:6	M^3	4.186	4.682	5.178	5.674	6.850	7.796	8.742	9.688	9.090	10.490	11.890	13.290
505	Cost and conveyance of pipe	M	8.00	10.00	12.00	14.00	16.00	20.00	24.00	28.00	24.00	30.00	36.00	42.00
506	Hoisting and placing of pipe	M	8.00	10.00	12.00	14.00	16.00	20.00	24.00	28.00	24.00	30.00	36.00	42.00
510	Class B concreting	M^3	9.489	9.489	9.489	9.489	12.276	12.276	12.276	12.276	15.235	15.235	15.235	15.235
511	R.R.1:6 in cm	M^3	3.065	3.065	3.065	3.065	6.130	6.130	6.130	6.130	10.512	10.512	10.512	10.512
512	Refill the trench	M^3	28.152	35.190	42.288	49.266	37.832	47.290	56.748	66.206	52.800	66.000	79.200	92.400
513	Dumping of dry Rubble	M^3	1.750	1.750	1.750	1.750	2.430	2.430	2.430	2.430	3.400	3.400	3.400	3.400
			R1.2Ø8	R1.2Ø10	R1.2Ø12	R1.2Ø14	R1.2Ø8	R1.2Ø10	R1.2Ø14	R1.2Ø14	R1.2Ø8	2Ø10	Ø12	14

SPECIFICATION OR R. C. C. BOX CULVERTS

4.1.2 R.C.C 2m X 2m BOX CULVERT

1. Foundation excavation in all classes of soil except hard rock which requires blasting and stock pile if approved for back fill or cart to spoil if unsuitable. $49.749m^3$
2. Provide foundation concrete 1:3:6 as blinding to foundation using 36mm hard broken stone including boxing, curing etc. complete. $3.592m^3$
3. R.C.C 111/2:3 for barrel using 18mm hard broken stone including boxing, curing etc. But excluding cost of reinforcement $16.376m^3$
4. R.C.C. 1:2:4 using18mm hard broken stone for wing walls, parapet, curtain wall etc. including boxing, curing, etc. but excluding cost of reinforcement $22.035m^3$
5. MS/Tor steel reinforcement bent, tied and placed in position. 3983kg
6. Random rubble masonry in 1:6 using hard granite broken stones for apron paving. $15.76m^3$
7. Dumping hard broken stones not less than $20dm^3$ size at the down stream end of the apron to arrest erosion of soil as directed by the Engineer. $4.82m^3$

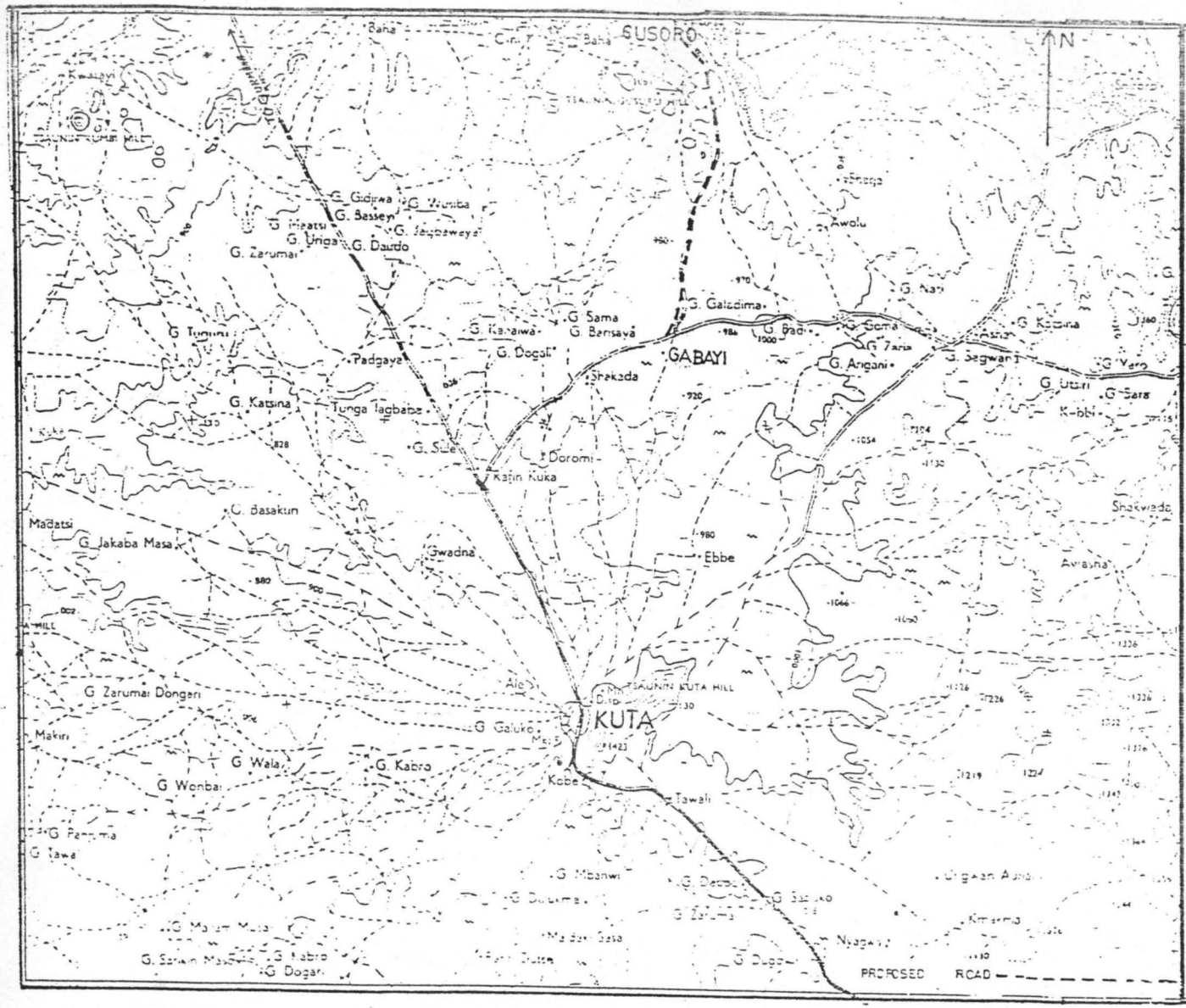
Note:

Quantity for different sizes are given in table II.

TABLE II

QUANTITIES FOR DIFFERENT SIZES OF R.C.C BOXES

				SIZE OF BOX			
ITEM NO.	DESCRIPTION	UNIT	2MX2M Single	2.5x2.5	3.00x3.00	Twin 2.5x2.5	Twin 3mx3m
503	Foundation excavation	M^3	49.749	58.945	72.146	82.746	107.59
504	Lean concrete 1:3:6	M^3	3.592	4.723	5.788	6.455	7.837
507	R.C.C. 1:11/2:3	M^3	16.376	26.88	31.258	44.584	52. 704
508	R.C.C. 1:2:4	M^3	22.035	31.258	40.782	33.237	43.127
509	Reinforcement	Tonnes	4.065	4.331	6.811	6.448	9.361
511	R.R. 1:6	M^3	15.760	26.40	37.050	35.409	49.647
513	Dumping D.R.	M^3	4.82	6.075	7.200	7.304	8.653



LOCATION MAP

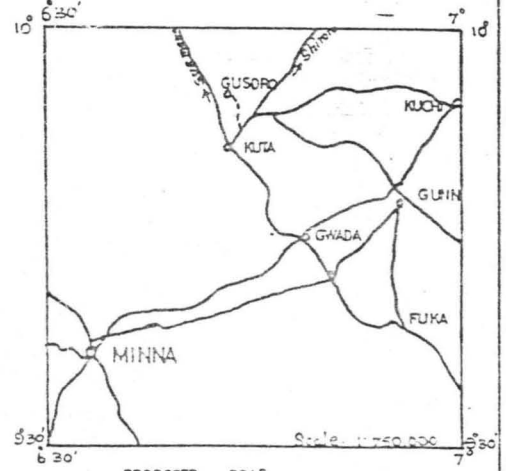
SABAYI — GIDAN SARKI GUSORO ROAD

LENGTH — 5·2 KMS

L. G. A SHIRORO

ZONE — II

SCALE 1:100,000



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