THE UNITED REPUBLIC OF TANZANIA

PRESIDENT'S OFFICE

REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

TANZANIA RURAL AND URBAN ROADS AGENCY (TARURA)

STONE ARCH BRIDGE TECHNOLOGY

PRESENTED BY : REGIONAL MANAGER'S OFFICE-MWANZA

INTRODUCTION

1. ROAD NETWORK

TARURA MWANZA operates and Maintain a total road network of **8586.763** Km as shown on Table below.

S/N	COUNCIL	NETWORK (KM)
1.	TARURA – Mwanza CC	1025.612
2.	TARURA – Ilemela MC	875.85
3.	TARURA – Buchosa DC	1001.102
4.	TARURA – Sengerema DC	1,708.00
5.	TARURA - Misungwi DC	927.54
6.	TARURA - Kwimba DC	864.18
7.	TARURA - Magu DC	1,524.15
8.	TARURA - Ukerewe DC	660.329
TOTAL		**8586.763**

2. ROAD TYPE BY SURFACE

S/N	Council Name	ROAD SURFACE TYPE (KM)					
		Paved	Stone	Concrete	Gravel	Earth	Total
1	Buchosa DC	0	0	0	133.73	867.372	1001.1
2	Ilemela DC	37.995	4.98	2.129	92.773	737.973	875.85
3	Kwimba DC	2.43	0	0	525.495	336.255	864.18
4	Magu DC	7.707	0	0	354.393	1162.05	1524.15
5	Misungwi DC	2.0	0	0	382.06	543.48	927.54
6	Mwanza CC	45.005	13.759	9.21	63.896	893.742	1025.61
7	Sengerema DC	1.43	0	0	103.03	1603.54	1708
8	Ukerewe DC	3.295	0	0	142.44	514.594	660.329
REGIONAL TOTAL		**99.862**	**18.739**	**11.338**	**1797.82**	**6659.01**	**8586.76**

2. ROAD CONDITION

S/N	Conditions	Kwimba (Km)	Buchosa (Km)	Mwanza Cc (Km)	Misungwi (Km)	Ukerewe (Km)	Magu (Km)	Ilemela Mc (km)	Sengerema (km)	Total	(%)
1.	Good	487.81	296.39	81.396	157.47	241.836	202.24	183.124	382.37	2,032.636	23.67
2.	Fair	149.68	240.65	461.865	540.76	199.492	642.16	396.056	668.11	3,298.773	38.42
3.	Poor	226.69	464.062	482.351	229.31	219.001	679.75	296.67	657.52	3,255.354	37.91
TOTAL		**864.18**	**1001.102**	**1025.612**	**927.54**	**660.33**	**1524**	**875.85**	**1708.00**	**8586.76**	**100**

ROAD CONDITION Cont.....

From road condition data in table above, majority of roads are not passable during rainy season due to lack of bridges/culverts . In order to solve the problem construction of bridges using Concrete or steel requires higher budget which is not available.

Therefore,

An Intervention was proposed to adopt a cheaper technology that will enable TARURA MWANZA to be able to construct many bridges and culverts using Cheap labour and low cost technology by learning the use of STONES to construction of Bridges.

Mwanza has abundant stones which meets specifications required for the stone arch bridges.

Mwanza has special groups of labour for stone works

POPULATION AND LABOUR

According to NBS Census 2022 , Mwanza has a Population of **3,699,872**

Distribution of populations is as below;

GENDER	COUNT		AGE	COUNT
Male	1,802,183		0-14	1,663,925
Female	1,897,689		15-64	1,923,765
TOTAL	3,699,872		65+	112,184

MOTIVES TO STONE ARCH BRIDGE TECHNOLOGY

MOTIVE 1: was to visit KIGOMA region where many stone arch bridges had been built by ENABEL. Seven (7) Engineers including Regional Manager went to KIGOMA to visit the constructed bridges in various sites at Kigoma.

MOTIVE 2: To induce Stone arch bridge technology to local fundi's, Four (4) local fundi's from Mwanza were attended the training which was organized by ENABEL and TARURA at KIGOMA for a period of One (1) Month.

MOTIVE 3: To construct One (1) Roman Arch bridge at Pamba Street (PAMBA Stone Arch Bridge) at Nyamagana District using trained local fundi's as demonstration.

PAMBA ARCH BRIDGE- DEMO PROJECT

LOCATION	PAMBA STREET in Nyamagana DC
COORDINATES	491620.84 m E,9720667.78m S
COST OF PROJECT	TZS. 19,799,450
MODE OF EXECUTION	Force Account
PROJECT DURATION	3 Months
FINANCIER	Roads Fund (Emergency Funds)
SPAN	4.0 METRE
WIDTH	5.5 METRE CARRIAGEWAY
TYPE	ROMAN ARCH

COST COMPARISON

CONCRETE BOX 4.0M SPAN

The construction of Concrete Box Culvert of 4.0m span using Contractors cost Tsh. **40,000,000.**

STONE ARCH 4.0M SPAN

Construction of 4.0m span Stone arch technology cost Tsh. **19,799,450**

(No community contribution)

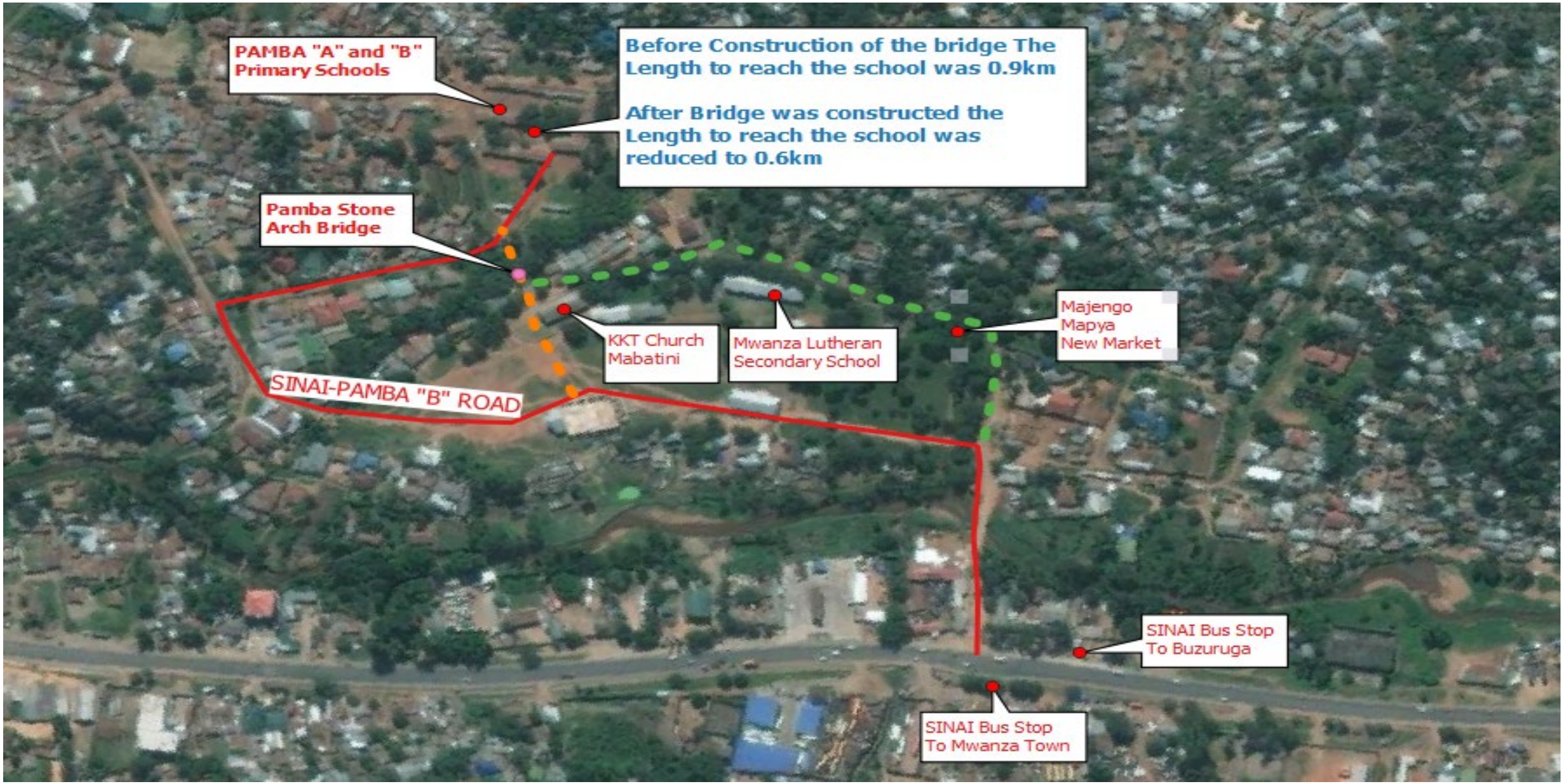
SAVING

= 40,000,000 -19,799,450

= 20,200,550

Saving = 50.5%

PAMBA STONE ARCH BRIDGE LOCATION MAP



PAMBA BIDGE SERVES ACCESS TO

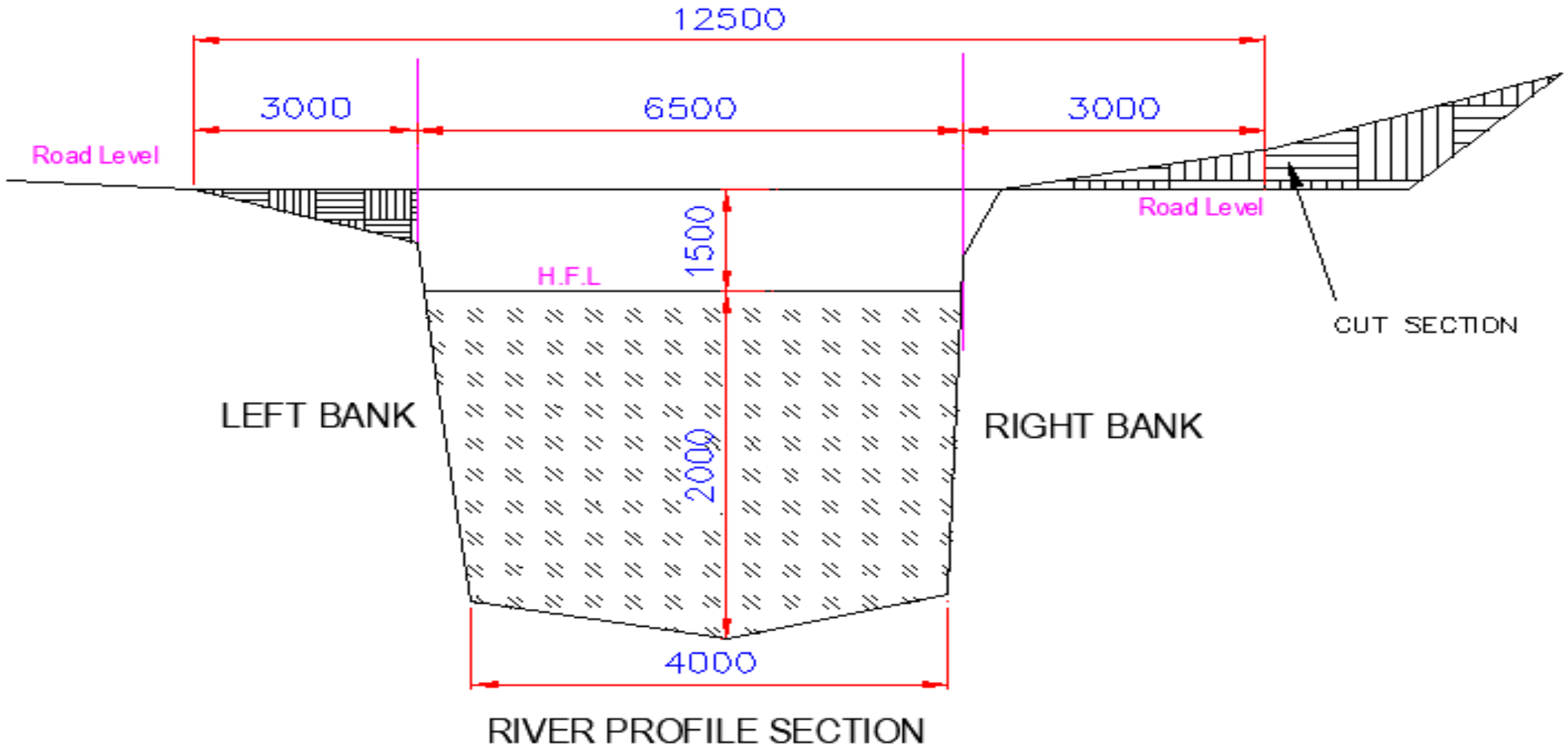
- Pamba “A & B” Primary Schools ,
- Majengo Mapya New Market ,
- KKT Church Mabatini,
- Mwanza Lutheran Church Secondary School,
- To and from Sinai bus stops,
- …..

MATERIAL QUANTITIES FOR 4.0 M SPAN

S/N	MATERIALS	QUANTITY
1.	Stones	60 Trips @ 3.0 m3
2.	Sand	16 Trips @ 4.0 m3
3.	Timber 1x3 (as soffit)	184 pcs
4.	Timber 2x4 (Truss & struts)	25
5	Timber 2 x 6	90 pcs
6.	Props	30
7.	Cement (50kg)	180 bags
8.	Nails (Assorted)	80kg

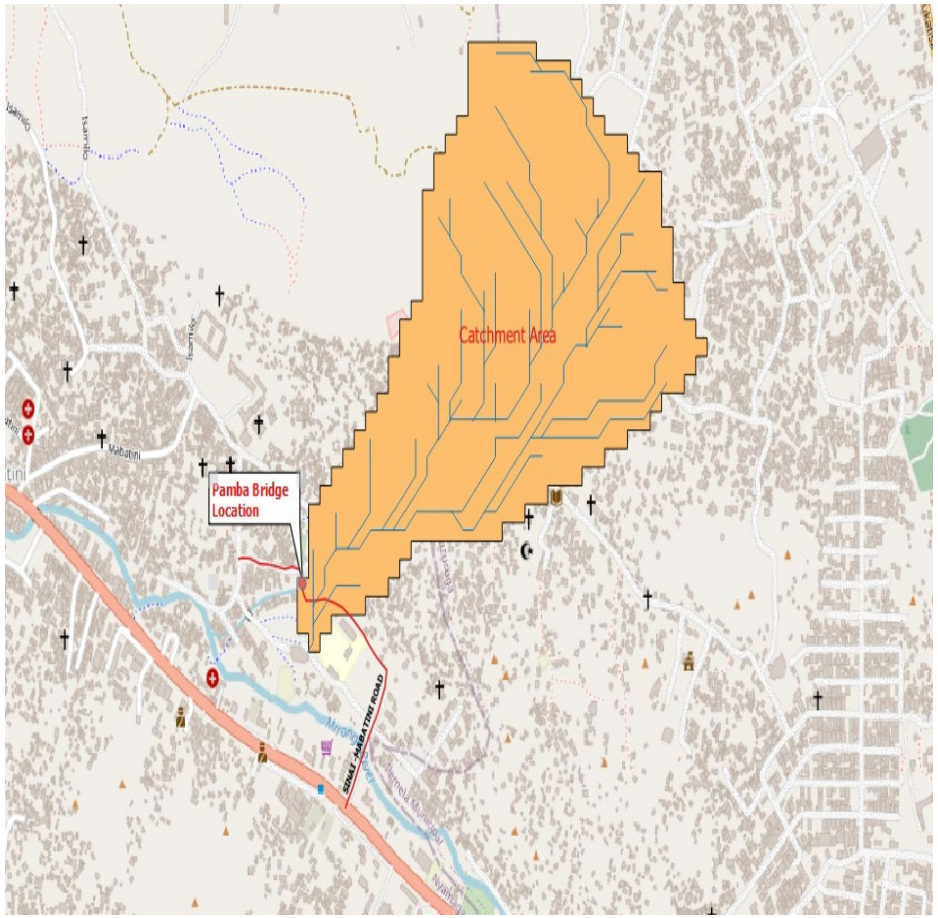
DESIGN FOR HYDROLOGY

1. River Profile determination



2. Catchment , Discharge & Flow area

Catchment area = 0.542 km^2



Discharge “Q” was found as **11m3/s** and Velocity of flow “V” as **3.4m/s**

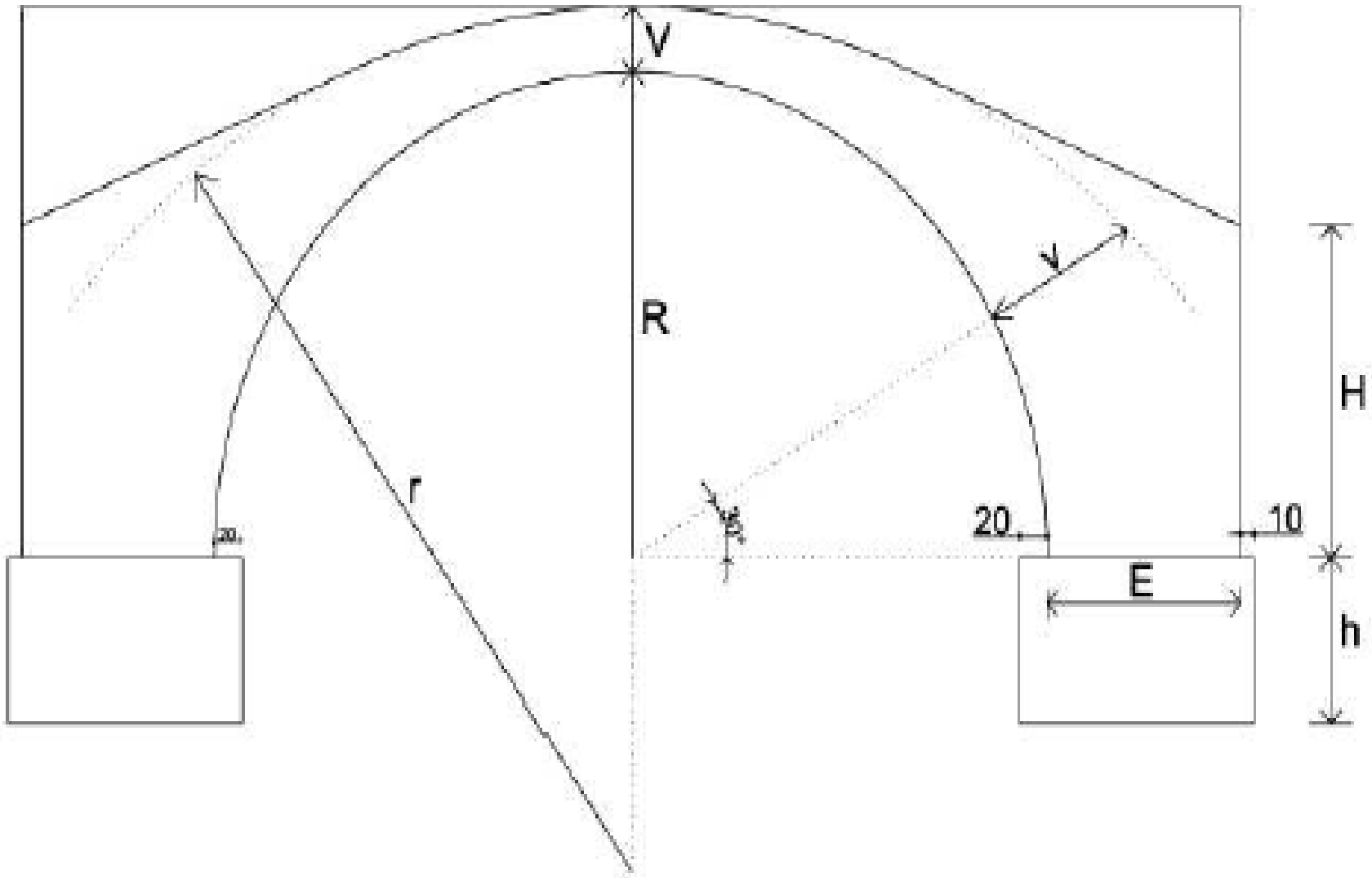
(Using TRRL Method)

The Flow area “A” required to Convey The maximum Discharge Q was found

A = Q/V = 11.0/3.4= **3.3 m^2**

Providing a roman arch of span 4.0m gave flow area equal to **6.2 m^2**

3. ROMAN ARCH COMPONENTS

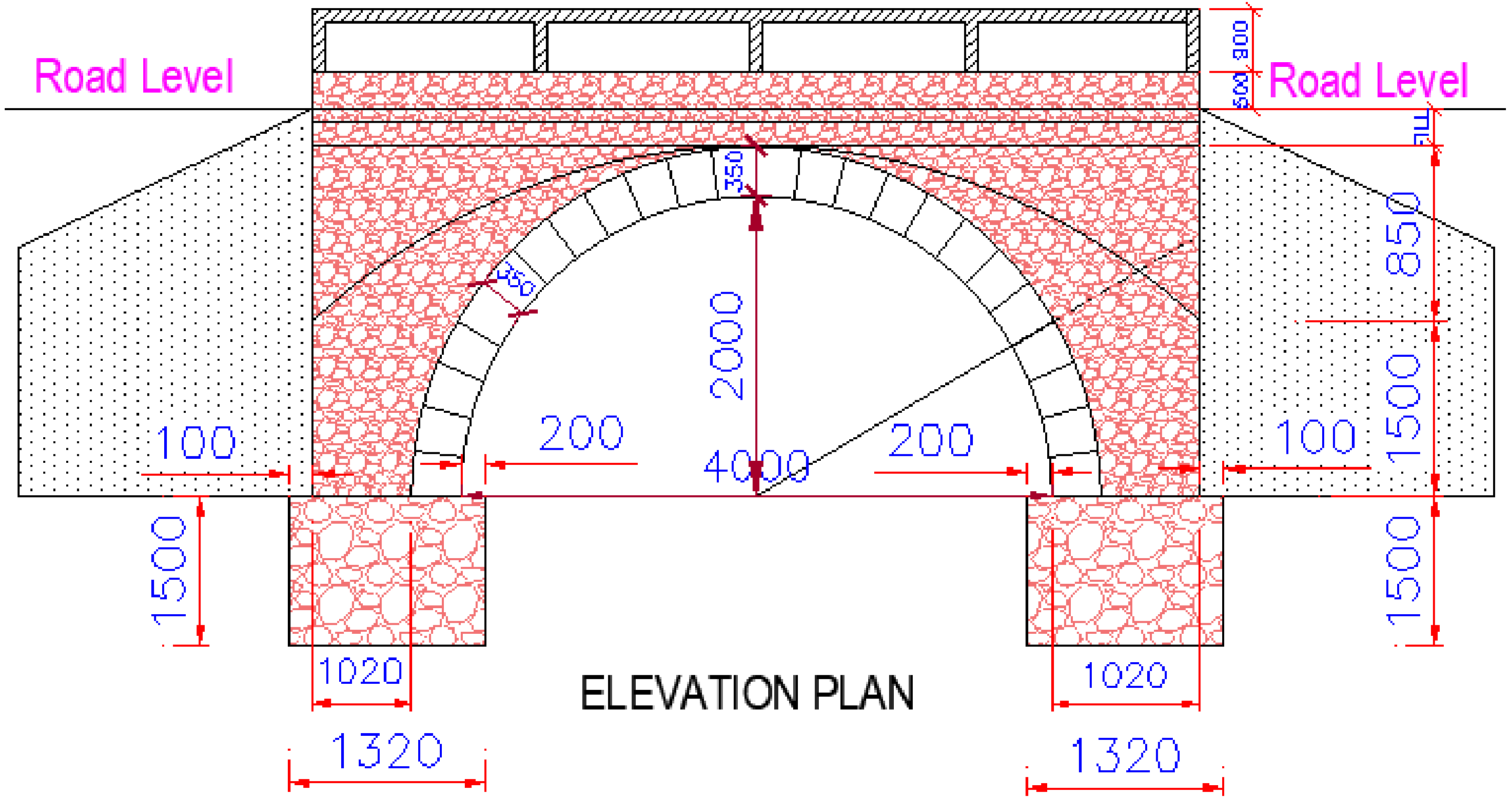


3. Selection of Bridge Size From TABLE

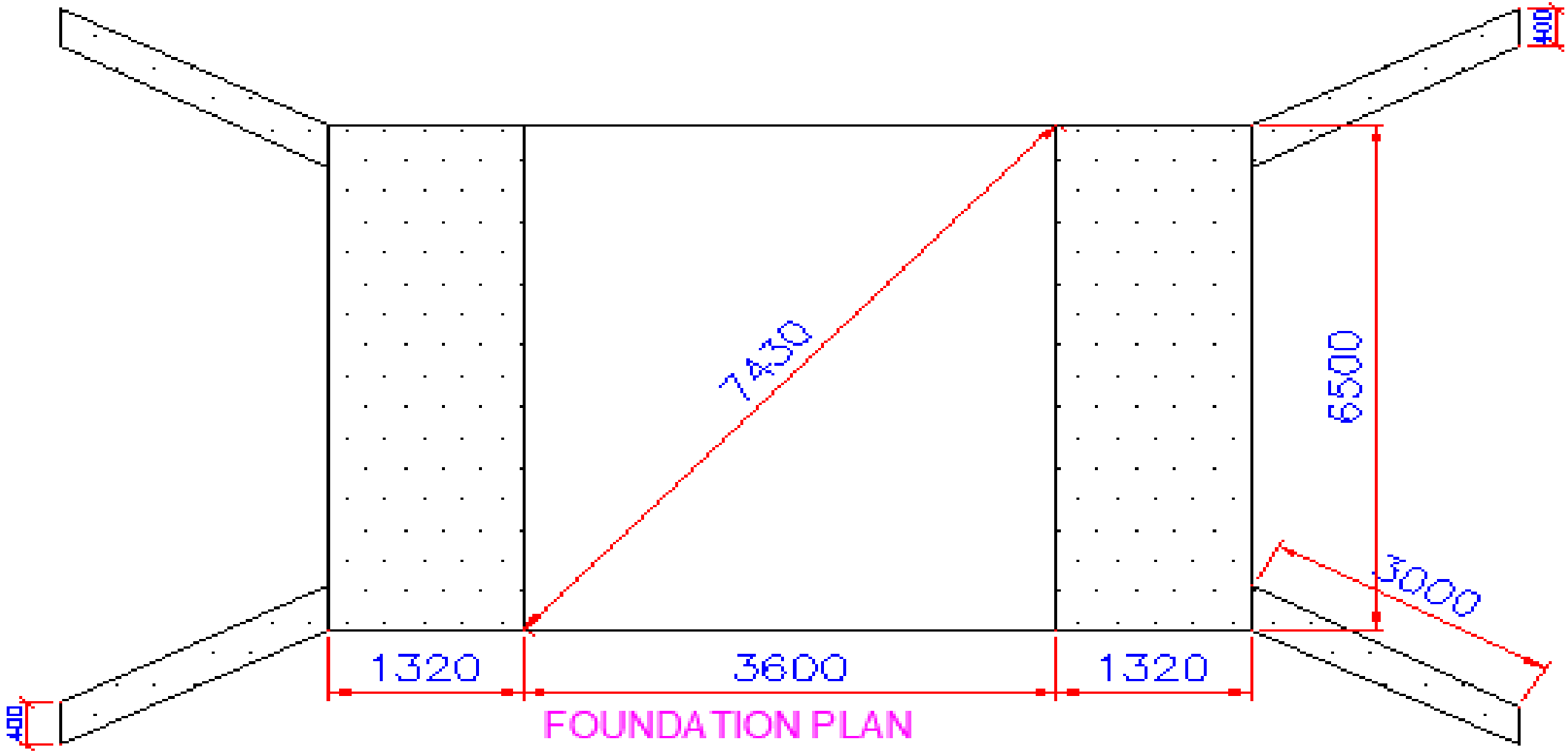
Span (m)	Thickness keystone	Thickness at 30°	Radius extrados	Thickness abutments	Height abutments	Min. Depth foundations	Masonry volume (incl. foundations) /m	Masonry volume (incl. foundations) for 3m width
2R	V	v	r	E	H	h	m³	m³
1	0.28	0.75	4.00	0.44	0.63	0.50	2.32	6.97
2	0.30	0.82	3.38	0.63	0.91	0.60	3.79	11.36
3	0.33	0.89	3.70	0.83	1.19	0.70	5.40	16.19
4	0.35	0.96	4.19	1.02	1.48	0.80	7.16	21.47
5	0.38	1.02	4.74	1.21	1.76	0.90	9.07	27.20
6	0.40	1.09	5.32	1.40	2.05	1.00	11.13	33.38
7	0.43	1.16	5.91	1.59	2.33	1.10	13.33	40.00
8	0.45	1.23	6.51	1.78	2.61	1.20	15.69	47.07
9	0.48	1.30	7.11	1.98	2.90	1.30	18.20	54.59
10	0.50	1.37	7.72	2.17	3.18	1.40	20.85	62.55
11	0.53	1.43	8.33	2.36	3.47	1.50	23.66	70.97
12	0.55	1.50	8.94	2.55	3.75	1.60	26.61	79.83
13	0.58	1.57	9.56	2.74	4.04	1.70	29.71	89.14
14	0.60	1.64	10.17	2.93	4.32	1.80	32.97	98.90
15	0.63	1.70	10.79	3.13	4.60	1.90	36.37	109.11

Source: Dequeker Paul, Architect

BRIDGE DRAWINGS



BRIDGE DRAWING Cont....



Site condition before

Students crossing at a collapsed slab

Rock ground provides stable foundation

Setting out and Excavations

- Setting Out

- Excavation of foundation

Excavation and foundations construction cont....

Formwork preparation

Trusses

- Truss erection to the abutments

Wedges For easy dismantling of formworks

Soffits

Construction of stones for arch

Construction of stones for arch cont.....

Wings, Parapet, and Retain walls construction

Backfilling with gravel materials

Completed passable bridge

CHALLENGES

1. Non acceptance of stone arch bridges technology to people /community who saw the technology for the first time
2. There is No stone arch specialized contractors in Mwanza
3. Just few local fundi's in Mwanza Region have learned knowledge of stone arch bridges
4. Improper planning especially during (cost estimate)may cause budget increase during implementation. For the first time we forgot;
   - Some of the very important Working Tools were forgotten to be included in the estimate budget
   - Improper setout of Arch Rise/Height caused More fill of material to be brought which were not included in the budget

WAY FORWARD

- After the bridge was completed, people likes, and have gained awareness about the stone arch bridges technology and have started to gain acceptance.
- Training to contractors Should be done to induce them to stone arch bridge technology.
- The trained local fundi needs to impart knowledge to other fundi by working with them.
- Through the challenges faced during the implementation of the first bridge we have learned the need to do proper planning especially preparation of realistic cost estimates

Thank you!