# PRESIDENT'S OFFICE
# REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT

# TANZANIA RURAL AND URBAN ROADS AGENCY

# USE OF LOCALLY AVAILABLE MATERIALS TO SUPPORT COST EFFECTIVE ~~IN~~ CONSTRUCTION~~G~~ OF STONE ARCH BRIDGES AND STONE PAVED ROADS

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# Outline

1. Introduction
2. Experience
3. Design procedures
4. Socio - Economic Impact
5. Project roll-out across Tanzania
6. Challenges and the Wayforward

# 1. Introduction

**Tanzania Rural and Urban Roads Agency (TARURA)**

**Established under "the Executive Agencies Act, CAP 245; Establishment Order, 2017 GN No. 211 of 12th May 2017,**

**Mandated to manage 144,429.77Km of roads.**

## VISION

To be a leading institution in the management of rural and urban roads network

## MISSION

To plan, design, construct and maintain rural and urban roads network in a **cost effective manner** for sustainable social economic development.

# 1. Introduction Cont…

**COST EFFECTIVE ROAD CONSTRUCTION METHODS**

The overriding objective of TARURA is to provide sustainable and cost-effective maintenance and development of Rural and Urban Roads network to support socio economic development in Tanzania **using Low cost and locally available construction materials**

# 2. EXPERIENCE IN USING COBBLE STONES

TARURA started using Cobble stones in 2017/2018.

- In Singida, Kilimanjaro, Iringa, Tabora, Arusha, Morogoro, Mbeya, Ruvuma, Coast (Pwani), Mara, Rukwa and Kigoma Regions.
- In Mwanza, Rukwa and Kigoma stone paved roads has been constructed with 100 years life span. 23.18km completed

# 2. Experience Cont ….

## Cost Comparison between construction using local materials (stones) and other construction technologies

| SN | Council name | Type of construction | Average cost TSHS. '000'000 | | | |
|---|---|---|---|---|---|---|
| | | | **Cobblestone** | **Double surface dressing** | **Asphalt concrete** | **Reinforced concrete** |
| 1. | Mkalama District Council | Construction of Msingi stone arch bridge 45m long | 300.72 | - | - | 1,300 |
| 2. | Mwanza City Council | Construction of road per km | 390 | 550 | 1300 | |
| 3. | Kigoma Municipal Council | Construction of road per km | 350 | 550 | 1400 | |
| 4. | Kigoma District Council | Construction of 72 different stone arch bridges | 1,477 | - | - | 7,279 |

# 2. Experience Cont.....

## Advantages of Stone Arch Bridges

- Locally available resources are used – stone
- Labour intensive (More than 500 people employed),
- Low construction costs. (5 to 6 times less the cost of reinforced concrete)
- Environmentally friendly (lower carbon footprint, less transport costs)
- Stones cannot be stolen and resold
- Construction cost for concrete bridges require more capital

## Advantages of Stone Paved Roads

- Limit the speed up to 40km/h
- Locally available resources are used – stone, sand
- Labour intensive (More than 2000 people employed),
- Easy to repair
- High resistance to fuel and oil spillage.
- Low maintenance costs - No maintenance long period
- Can be opened to traffic immediate upon completion.
- Environmentally friendly. and
- Provision of more benefits in terms of economic and social services.

# 2. Experience in Using Stones Cont...

# OVERALL Progress report as of MAY 2023

| TANZANIAN - STONE ARCH BRIDGES REPORT MAY 2023 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | NAME OF REGION | COMPLETED BRIDGES | COST USING BRICKS (MIL) | COST USING STONE (MIL) | REINFORCED CONCRETE (MIL) | SAVING (%) | ONGOING BRIDGES | COST USING STONE (MIL) | REINFORCED CONCRETE (MIL) | SAVING (%) |
| 1 | KIGOMA | 103 | | 2,338 | 11,638 | 80 | 8 | 4,156 | 20,229 | 79 |
| 2 | SINGIDA | 24 | | 2,022 | 6,254 | 68 | 2 | 129 | 220 | 42 |
| 3 | TABORA | 5 | | 1,124 | 3,532 | 68 | 0 | - | 0 | - |
| 4 | KILIMANJARO | 10 | | 611 | 2,883 | 79 | 0 | 611 | 2,883 | 79 |
| 5 | MBEYA | 2 | | 439 | 1,150 | 62 | 0 | - | 0 | - |
| 6 | MOROGORO | 2 | | 152 | 481 | 68 | 1 | 65 | 230 | 72 |
| 7 | ARUSHA | 6 | | 212 | 948 | 78 | 0 | - | 0 | - |
| 8 | | 13 | | 926 | 3,537 | 74 | 11 | 910 | 2,615 | 65 |
| | IRINGA | 2 | 38 | 211 | 430 | 91 | 0 | - | 0 | - |
| 9 | RUKWA | 3 | | 383 | 3,380 | 89 | 6 | 413 | 2,939 | 86 |
| 10 | PWANI (COAST) | 1 | | 75 | 350 | 79 | 0 | - | 0 | - |
| 11 | RUVUMA | 3 | | 431 | 1,216 | 65 | 0 | - | 0 | - |
| 12 | MARA | | | | | | 2 | 326 | 1,099 | 70 |
| | TOTAL | 174 | 38 | 8,924 | 35,800 | 75 | 30 | 6,611 | 30,215 | 78 |

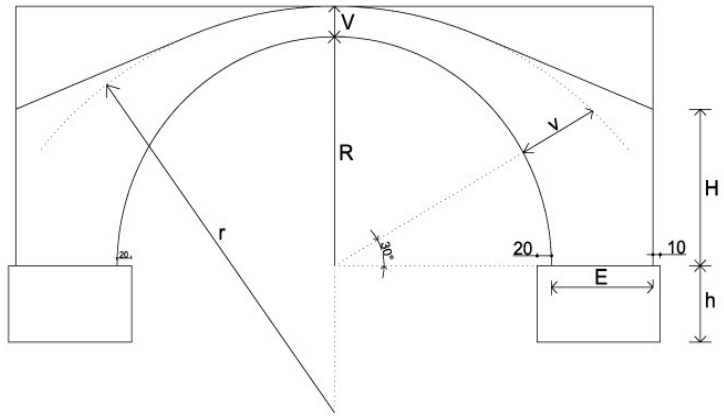
# OVERALL Progress report as of MAY 2023

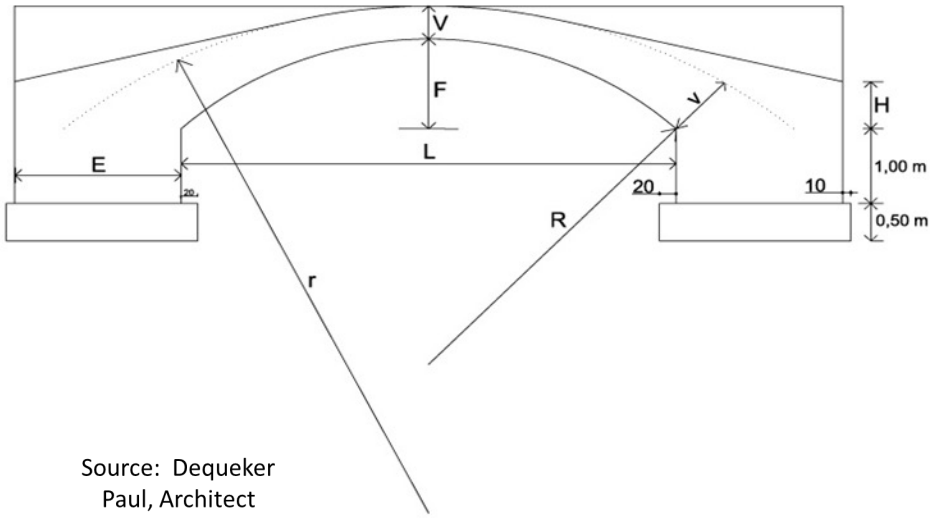
| TANZANIAN - STONE PAVED ROADS REPORT MAY 2023 | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| No. | NAME OF REGION | COMPLETED ROAD LENGTH (KM) | COST USING STONES (MIL) | COST USING DSD (MIL) | COST USING ASPHAT CONCRETE (MIL) | ONGOING ROAD LENGTH | COST USING STONES (MIL) | COST USING DSD (MIL) | COST USING ASPHAT CONCRETE (MIL) |
| 1 | KIGOMA | 3.83 | 1,340.50 | 2,106.50 | 5,553.50 | | | | |
| 2 | MWANZA | 19.00 | 6,650.70 | 10,451.10 | 27,552.90 | | | | |
| 3 | RUKWA | 0.35 | 122.50 | 192.50 | 507.50 | | | | |
| | **TOTAL** | **23.18** | **8,113.70** | **12,750.10** | **33,613.90** | **-** | **-** | **-** | |

# 3. DESIGN PROCEDURES

**a. Preliminary assessment**

- ❖ Taking GPS Coordinated
- ❖ Hydrology (Flood, discharge, river profile, risk of erosion, etc)
- ❖ Site characteristics – Soil type, river bank condition. Sub-soil - test pits to assess bearing capacity
- ❖ Economic & social importance – road to market, school, hospital
- ❖ Two types used to decide – Roman and segmental arches




Source: Dequeker Paul, Architect

# 3. Design Procedures

**b. Geotechnical investigation**

**c. Hydrology And Hydraulic Analysis**

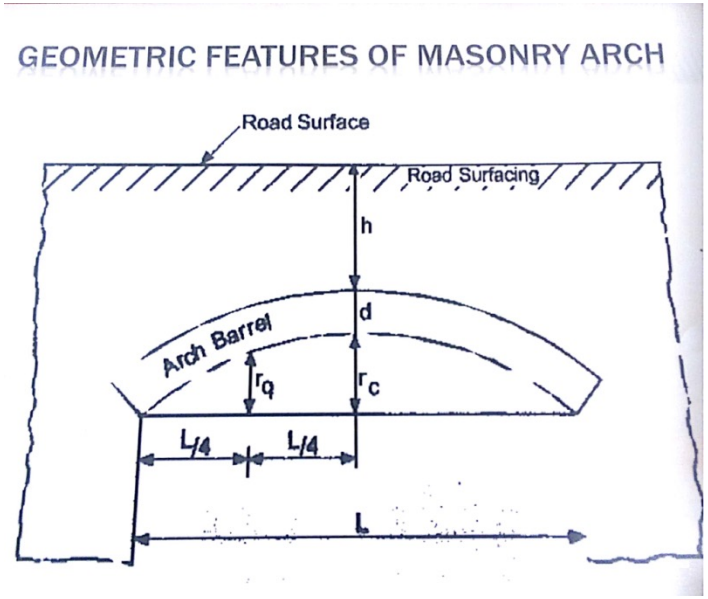
Method used to assess and to determine the peak discharge (Q m3/s Maximum are;

- Rational method (For small catchment area up to 10km2)
- Transport and Road Research Laboratory (TRRL) East African Flood Model (EAFM) (For larger catchment areas from above 10km2)

d. Loading and strength analysis

- MEXE method (Military Engineering experimental Establishment, UK)

Archie-M and RING Software



# 4. Socio - Economic Impact

- Economic – Access to market and storage

  Agriculture produce maize, sunflower, rice, cassava, banana etc

  Price

- Socially – Access to schools, Hospital, Dispensary, churches, mosque

  Reduces dealth rate

# 5. PROJECT ROLL-OUT ACROSS TANZANIA

**Actions taken to date:**

a). TARURA presented the program on the ARMFA EA Focal Group Technical Workshop 17th – 19th September 2019, Zanzibar

b). TARURA presented the program on Annual Engineers Day conducted from 3-5 February 2020 Mwanza

c). TARURA presented the program on Annual Engineers Day conducted from 01 – 03 Sept. 2021, JKCC – DODOMA

d). TARURA presented the program on Annual Engineers Day conducted from 22 – 23 Sept. 2022, JKCC – DODOMA

e). According to the assessment conducted in November 2021 by Dr. Adrienn Tomor, our bridges are built to a very high standard can stay for more than 100 years.

- To incorporate in donor funded project

  **RISE project – 32 stone arch bridges**

  - Ruvuma Region
    - Madaba District – 15m span – 1NO
  - Morogoro Region
    - Mrimba District – 15m span – 1No
    - Morogoro District – 30m span – 1No
    - Gairo District – 25m span – 1No
  - Manyara Region
    - Kiteto District – 30m span – 1No

- To incorporate in donor funded project - **Cont.**
  - ❖ Dodoma Region
    - ➢ Mpwapwa District – 30m span – 1NO
  - ❖ Mara Region
    - ➢ Serengeti District – 30m span – 1No
  - ❖ Rukwa Region
    - ➢ Karambo District – 50m span – 1No
    - ➢ Sumbawanga – 20m span – 1No
  - ❖ Tabora Region
    - ➢ Sikonge District – 5m span @ – 8Nos Culvert

- To incorporate in donor funded project - **Cont.**
  - ❖ Arusha Region
    - ➢ Longido District– 5m span @ – 4Nos Culvert
  - ❖ Tanga Region
    - ➢ Korogwe TC – 10m span – 1No
    - ➢ Korogwe DC – 20M span – 1No
    - ➢ Bumbuli District – 20m span – 1No
    - ➢ Muheza District – 6m span – 1No
  - ❖ Katavi Region
    - ➢ Tanganyika District – 20m span – 1No
  - ❖ Tabora Region
    - ➢ Sikonge District – 5m span @ – 8Nos Culvert

- To incorporate in donor funded project – **Cont.**

❖ Simiyu Region

- Maswa District – 12m span – 1No
  - 33m span – 1No
  - 25m span – 1No
- Meatu District – 52m span – 1No
- Bariadi District – 25m span – 1No
- Itilima District – 32m span – 1No
- Busega District – 75m span – 1No

TACTIC projects – 15 stone arch bridges

UNDER DISCUSSION

Inhouse projects – 80 stone arch Bridges

**2023/2024 – output 127 SONE ARCH BRIDGES**

# TARURA PLAN FOR FINANCIAL YEAR 2022/2023

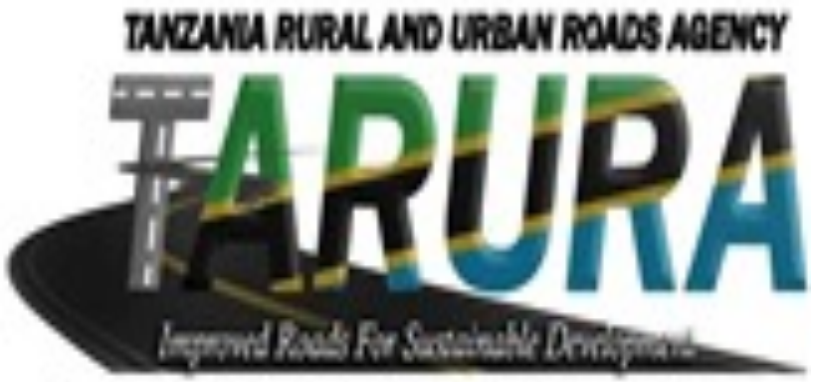
- Tshs. 2,062,800,000 committed in 2018 for construction of 100 bridges in Kigoma region by June 2023, to date 103 completed and 8 ongoing
- Tshs. 687,600,000 committed for capacity building in the financial year 2022/2023
  - ✓5 regions (5 demo bridges will be constructed, 1 per selected region)
  - ✓Training for masons and engineers / center of excellence Kigoma

**International**

- Network UCL (University College of London) – Agreed exchange programme.

# 6. CHALLENGES AND THE WAYFORWARD

| CHALLENGES | WAYFORWARD |
| --- | --- |
| 1. Lack of Stone masons | 1. To conduct Training in collaborating with VETA |


# TARURA TUNAKUFUNGULIA BARABARA KUFIKA KUSIKOFIKIKA

## AHSANTENI KWA KUNISIKILIZA



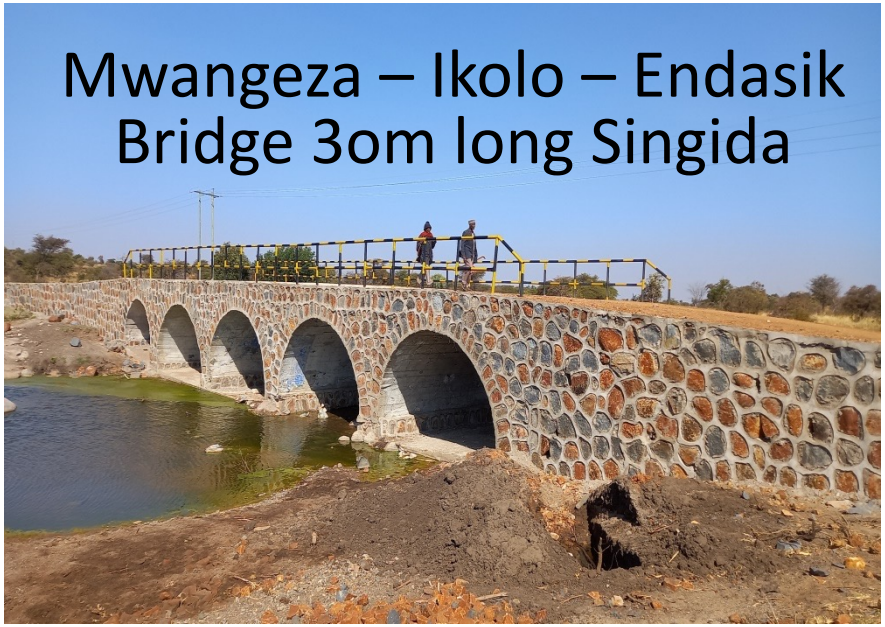


# Stone Arch Bridges Kigoma Region

Msingi bridge 45m span – Mkalama District

Miganga bridge 28m long – Mkalama District

Mwangeza – Ikolo – Endasik Bridge 3om long Singida



Nyabigufa stone arch bridge 32m long Kigoma

Chankabwimba stone arch bridge 25.3m long Kigoma

Igambiro – Igombe Stone Arch Bridge 32m long Tabora

Kazima – Inara Stone Arch Bridge 16.4m Long TABORA

Nyabula Stone Arch Bridge 15m Long Iringa

# PHILLIPS BRICK ARCH BRIDGE 10M LONG IRINGA

# MWANZA STONE PAVED ROADS