



**TRADEMARK AFRICA**

**CONSULTANCY SERVICE FOR A FEASIBILITY STUDY, INFRASTRUCTURE NEEDS  
ASSESSMENT AND PRELIMINARY DESIGN, DETAILED ARCHITECTURAL AND  
ENGINEERING DESIGNS, AND THE PREPARATION OF BIDDING DOCUMENTS  
FOR THE BORDER POST AT TOG WAJAALE, SOMALILAND AND ETHIOPIA**

**TOG WAJAALE DETAILED STRUCTURAL DESIGN DRAWINGS  
(BOX CULVERT)**



**SABA ENGINEERING PLC**

**MAY 2024**

# LIST OF DRAWINGS

| NO. | TITLE   | SHEET No.          |
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| 1   | LIST OF DRAWINGS  | TWBC-01/08         |
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Client:



TRADEMARK AFRICA

Consultant:



SABA ENGINEERING PLC

Project:

CONSULTANCY SERVICE FOR A FEASIBILITY STUDY, INFRASTRUCTURE NEEDS ASSESSMENT AND PRELIMINARY DESIGN, DETAILED ARCHITECTURAL AND ENGINEERING DESIGNS, AND THE PREPARATION OF BIDDING DOCUMENTS FOR THE BORDER POST AT TOG WAJALE, SOMALILAND AND ETHIOPIA

TOG WAJALE DETAILED STRUCTURAL DESIGN DRAWINGS  
(BOX CULVERT)

Title:

LIST OF DRAWINGS

DATE

May 2024

DESIGNED BY:

Kassahun M.

DRAWN BY:

Kassahun M.

CHECKED BY:

APPROVED BY:

SCALE:

As Shown

DRG. No.

TWBC-01/08

# GENERAL NOTES

**ATTENTION!** It is mandatory that the following notes be carefully read and fully understood, and that all provisions there in be completed with strictly no work on any item be permitted to start until the the contractor has on the job, ready for use, the equipment and materials as specified. Particular attention is directed to reinforcing steel, mechanical compaction in 150mm horizontal layers behind abutments and wingwalls, and rubbing of exposed concrete surfaces with carborundum stones, as outlined below. The successful bidder is cautioned to place his order for specification of reinforcing steel immediately. He is further cautioned to have on the job, before starting work on any given item, the required special materials and equipment such as form liner, standby mixer, vibrators, carborundum stones, finishing brushes, mechanical tampers, etc, all in good condition and ready for use. Any operation found to be proceeding not in accordance with these provisions shall be suspended immediately. Any work accomplished not accordance with these provisions shall be classified as defective workmanship. It shall be satisfactorily corrected or removed and reconstructed, before any further work on the item is authorized to proceed. No delays in connection with compliance with these provisions shall be eligible for an extension of contract time except accidents classified as force majeure.

## DESIGN SPECIFICATIONS :

- ERA's Bridge Design Manual 2013
- AASHTO LRFD Bridge Design Specifications, 2012.

## BRIDGE LOADINGS :

### 1. DEAD LOADS:

Dead loads are based on the following loadings:

Superstructure Loads:

Reinforced concrete: 24KN/m3

Wearing surface, asphalt: 22.5KN/m3

Substructure Loads:

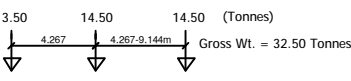
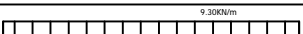
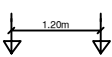
Class "B" stone masonry: 27KN/m3

Backfill materials: 19KN/m3

Reinforced concrete: 24KN/m3

### 2. LIVE LOADING

The design vehicular live loading is HL-93, as per ERA's Bridge Design Manual 2013, which comprises a combination of design truck or design tandem and lane loading as shown below

| Live Load                         | Longitudinal axle configuration and loads   | Transverse Axle width (wheel spacing) |
|-----------------------------------|---|---------------------------------------|
| DESIGN TRUCK<br>(AASHTO HS 20-44) |  <p>Gross Wt. = 32.50 Tonnes</p> | 1.80m                                 |
| LANE LOADING                      |  <p>9.30KN/m</p>                 |                                       |
| DESIGN TANDEM                     |  <p>Gross Wt. =22.00 tonnes</p>  | 1.80m                                 |

**NOTE:** Lane loading is a uniformly distributed load of 9.3KN/m over a width of 3.00m. Dynamic load allowance is not applied for lane loading application.

## MATERIALS

### 1. CONCRETE

| Grades of Concrete | Minimum 28 days cube compressive strength ( MPa ) | 28 days cylindrical compressive strength ( MPa ) | Maximum size of coarse aggregate (mm) | Applicability in Structural members   |
|--------------------|---|--|---------------------------------------|---|
| C-30/20            | 30  | 24   | 20                                    | All structural concrete components unless otherwise noted.  |
| C-35/12.5          | 35  | 28   | 12.50                                 | Bridge railings   |
| C-15/30            | 15  | 12   | 30                                    | Mass concrete, unreinforced sections, thin layers underneath footings when indicated on drawings or directed by the Engineer. |

### 2. REINFORCING STEEL

Reinforcing steel shall be deformed steel bars, conforming to AASHTO M31 (ASTM A615), of minimum yield strength as specified in the plan drawings. See special provisions for detailed specifications. Splices in adjacent bars shall be staggered as specified in drawings or placed at opposite ends.

### 3. STEEL WORKS

Structural steel works, wherever required, shall conform to the requirements of Clause 8802 of the ERA's Standard Specifications, 2013. The fabrication and assembly shall be to Clause 8805.

## CONSTRUCTION

### 1. EXCAVATION

Excavation for structures shall not extend underneath the plane of excavation shown on the plans or directed by the Engineer, and the ground underneath structure foundations shall not be disturbed.

### 2. BACKFILLING

Abutments and wingwalls shall be backfilled with selected granular materials in horizontal layers not exceeding 150mm in depth. Before placing successive layers, each layer shall be thoroughly compacted by hand operated mechanical tampers. As the backfill is built up, the fill in front of wingwalls shall be placed simultaneously and mechanically compacted. Spreading of backfill material shall be by hand.

### 3. FALSE WORK

All false works to be designed by the contractor are subject to the approval of the Engineer.

### 4. FORM WORKS

Form work shall be constructed such that it will not yield under the contemplated load. Forms for permanently exposed concrete surfaces shall be lined with ply wood masonite or other approved form liner. The form liner material shall be free of wrinkles, warping, open joints and other surface imperfections at the time of pouring.

All corner edges of concrete structures shall be chamfered 25mm along the face of chamfer, unless otherwise shown on the plans. Attention is directed to the fact that the requirement shall apply to all concrete edges, whether or not the chamfers are shown on the plans. Stripping of forms shall be designated by the Engineer, and the following may be used as a minimum.

Footing foundation - - - - - 03 days  
Girders - - - - - 14 days  
Deck slab - - - - - 14 days

### 5. CASTING OF CONCRETE DECK SLABS

Each deck slab shall be preferably casted in one continuous uninterrupted operation, the rate of supply of concrete and working force shall be adequate to prevent cold joints, or partial setting of concrete, prior to placing continuous batches. Before casting is authorized the reinforcing steel shall be correctly placed, tied and supported. All reinforcing steel shall be inspected by the Engineer prior to casting concrete in the forms. Rigidly fixed screed forms shall be in place for screeding of the concrete grade and contour.

The form bottom shall be clean and wetted down. All open cracks and holes shall be sealed. Runway for use in placing concrete shall be supported on the form bottom in such manner as to prevent contact with the reinforcing steel at all time. The use of aggregate or rock particles as bar supporters shall not be permitted. Cement mortar blocks, prepared for these purposes, shall consist of one part cement to two parts sand and shall be cured seven days minimum prior to use. Blocking and separation of top and bottom reinforcement shall be at one meter centers minimum each way.

### 6. RUBBED FINISHES FOR EXPOSED CONCRETE SURFACES

The concrete finishes shall be as per the requirements stated in ERA's Standard Specifications 2013. All permanently exposed concrete surfaces (except bottom of slab and interior girder surfaces) shall be given a rubbed finish, using carborundum stones, water and brush. The procedure is as explained below: Thoroughly wet the surface to be rubbed and keep it wet. Fill all surface voids with cement mortar, rub by hand with carborundum stone using a short, circular motion. When irregularities have been removed and a uniform texture is obtained, smoothen the wet surface with the brush using a light, horizontal stroke. Do not rub off powder when the surface is dry. Repeat it, when dry, the surface is not smooth, or is not of uniform color and texture. The brush may be of the type used for wall painting and shall be at least 100mm wide and perfectly wider. Attention is directed to the fact that execution of a proper rubbed finish becomes more difficult as the concrete hardens. Hence it should be executed as soon as, there is no danger of marring finished work by spillage from continuous concrete pours.

### 7. CONCRETE

Concrete classes to be used shall be as indicated below unless otherwise shown on plan drawings, in the specifications or directed by the Engineer:

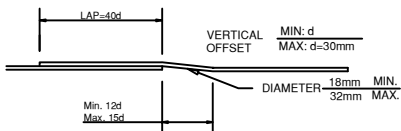
Grade C-30/20 concrete: All structural concrete members unless otherwise noted, the amount of compressive strength be specified in the Plan Drawings

Grade C-15/30 concrete: Thin layers of concrete beneath foundation or as indicated in the Drawings.

### 8. REINFORCING STEEL

a) Splicing of bars not included in the drawings shall be approved by the Engineer. No more than one bar in three shall be spliced at the same section, except where shown on the drawings. Bars drawn in full length shall have as few splices as possible.

b) If not otherwise shown on the drawings, the length of lapped splices shall be equal to 40 times bar diameter. In sections where the clear distance between lapped bars will not fulfill the requirements in paragraph (g) below the contractor has to use cranked splices.



c) Bar bending schedule shall be prepared by the contractor and submitted to the Engineer for the approval of the Engineer. Bar bending information given on the drawings is for guidelines only.

d) Bars shall be bent cold and bars partially embedded in concrete shall be, field bent, unless shown on the drawings or specially permitted by the Engineer.

e) Bars shall be bent around a pin with the following minimum bending pin diameter (D ) in relation to the diameter of the bar (d).  
Stirrups - - - - - D = 5d  
Other bars, d ≤ 32mm - - - - - D = 10d

f) If otherwise not shown on the drawings, hooks shall be made as follows:

- Semi circular turn plus an extension of at least 12 bar diameter of the free end of the bar.
- A 90 degree turn plus an extension of at least 12 bar diameters of the free end of the bar, or
- For stirrups and tie anchorage only, either a 90 degree or 135 degree turn plus an extension of at least 6 bar diameters of the free end of the bar.

g) The clear distance between parallel bars shall not be less than that shown on the drawings. The bars in the upper layer shall be placed directly above those in the bottom layer.

h) The minimum cover to reinforcement bars shall be as follows:

Main reinforcement top of slab 40mm  
Main reinforcement bottom of slab, d < 20mm 30mm  
Main reinforcement stirrups and ties in T-beam 40mm  
Main reinforcement in footings 80mm

## 9. BEARINGS

The bearings shall be steel reinforced elastomeric bearing as specified on the drawings

## 10. EXPANSION JOINT FILLER

The expansion joint filler between adjacent spans shall be Preformed Expansion Joint Filler of Bituminous type meeting the ASTM D994 unless otherwise shown or noted.

## 11. FOUNDATION

Like foreseen in the structural work, foundation level of the bridge shall be approved by the Engineer. If necessary during the course of the excavation works, the Contractor shall carryout additional investigation as directed by the Engineer. Abutment, wingwall and pier footings shall be founded at base elevations shown on the plans unless sound rock is encountered at a uniform level above the design elevation, or otherwise as directed by the Engineer. Wingwall lengths may be varied to suit actual ground conditions. Ground profiles and elevations shown on the plans are to be confirmed on site during the construction.

## 12. QUANTITIES

All quantities of work items shall be subject to verification or remeasurement on site during construction by the Engineer.

## 13. CONSTRUCTION SPECIFICATIONS

All bridge excavations, foundations, superstructures, substructures and other associated works and materials shall be constructed in accordance with the ERA's Standard Technical Specifications 2013 and special provisions stated for this project.

## ABBREVIATIONS

AASHTO -AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPRT OFFICIALS  
ASTM -AMERICAN SOCIETY OF TESTING MATERIALS  
BS -BRITISH STANDARDS

CL - CENTER LINE  
TOP - TOP  
BOT - BOTTOM  
MIN - MINIMUM  
MAX - MAXIMUM  
VAR - VARIABLE  
mm - MILLIMETRE  
cm - CENTIMETER

m - METER  
km - KILOMETER  
EL.,ELEV. - ELEVATION  
STAT., STA. - STATION

HWM - HIGH WATER MARK  
NGL - NATURAL GROUND LEVEL

DWG - DRAWING  
m<sup>3</sup> - CUBIC METER  
Kg. - KILOGRAM

symm. - SYMMETRICAL (SYMMETRY)  
& - AND  
THRU. - THROUGH  
CL. - CLEAR COVER  
FIX. - FIXED  
EXP. - EXPANSION  
BRG. - BEARING

Client:

TRADEMARK AFRICA

Consultant:



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Project:

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TOG WAJAALE DETAILED STRUCTURAL DESIGN DRAWINGS  
(BOX CULVERT)

Title:

GENERAL NOTES

DATE

May 2024

DESIGNED BY: Kassahun M.

DRAWN BY: Kassahun M.

CHECKED BY:

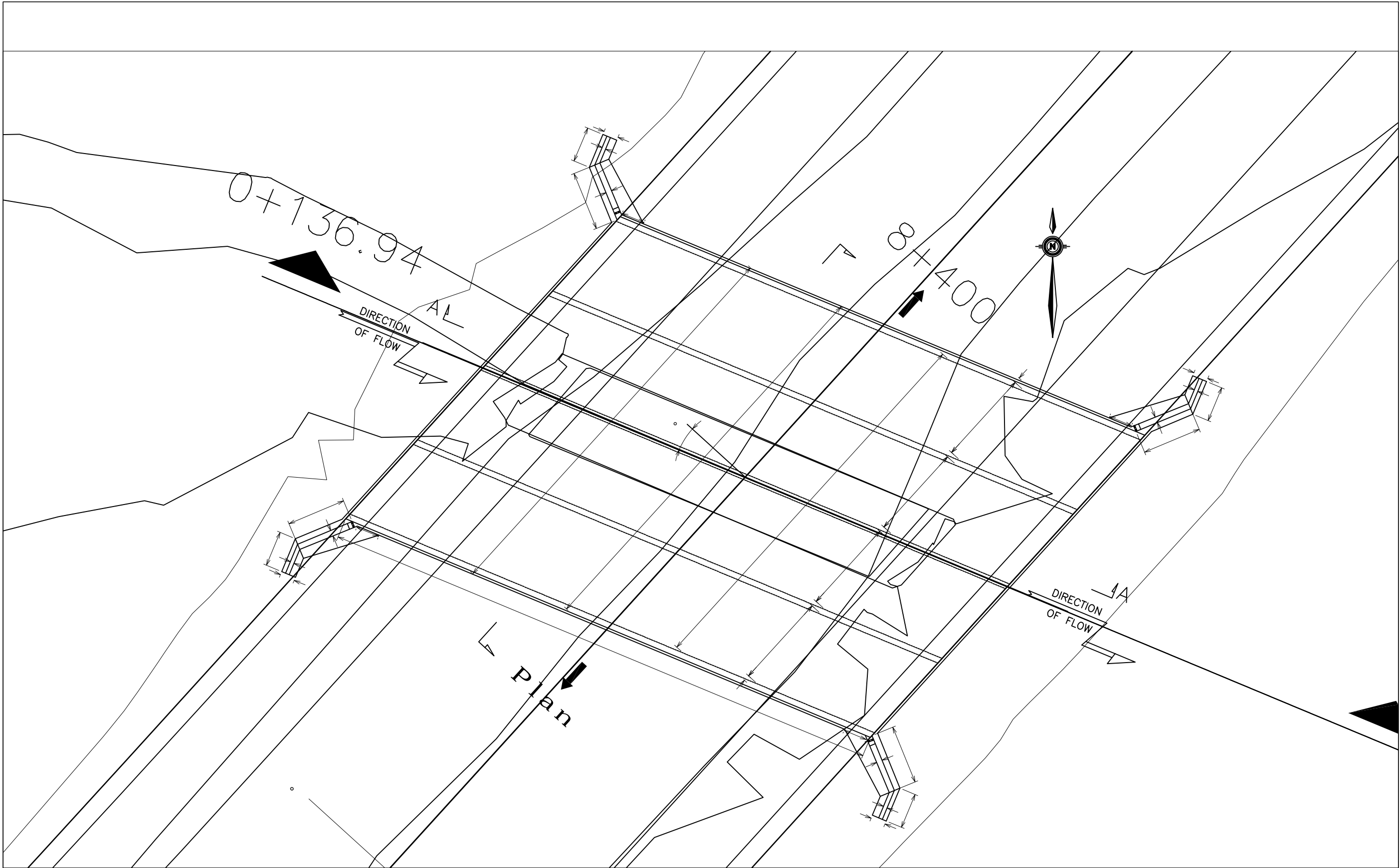
APPROVED BY:

SCALE:

As Shown

DRG. No.

TWBC-02/08



Client:

TRADEMARK AFRICA

Consultant:

  
SABA ENGINEERING PLC

Project:

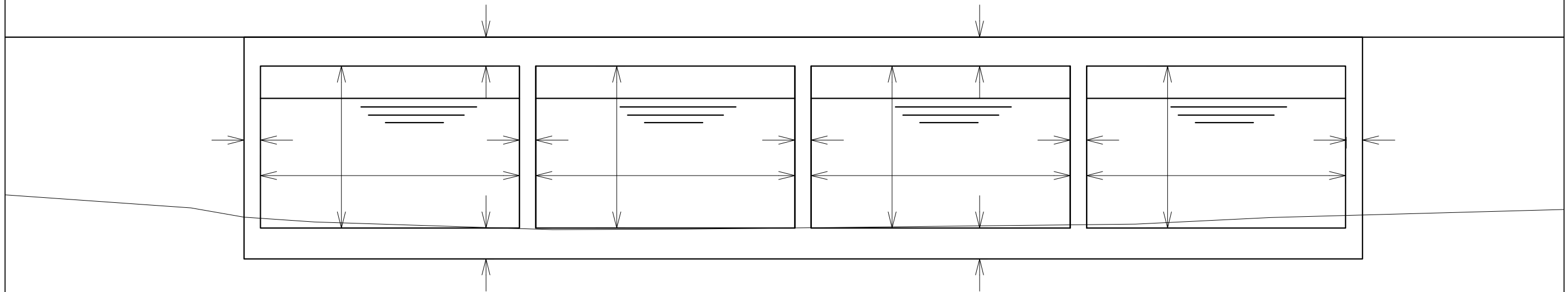
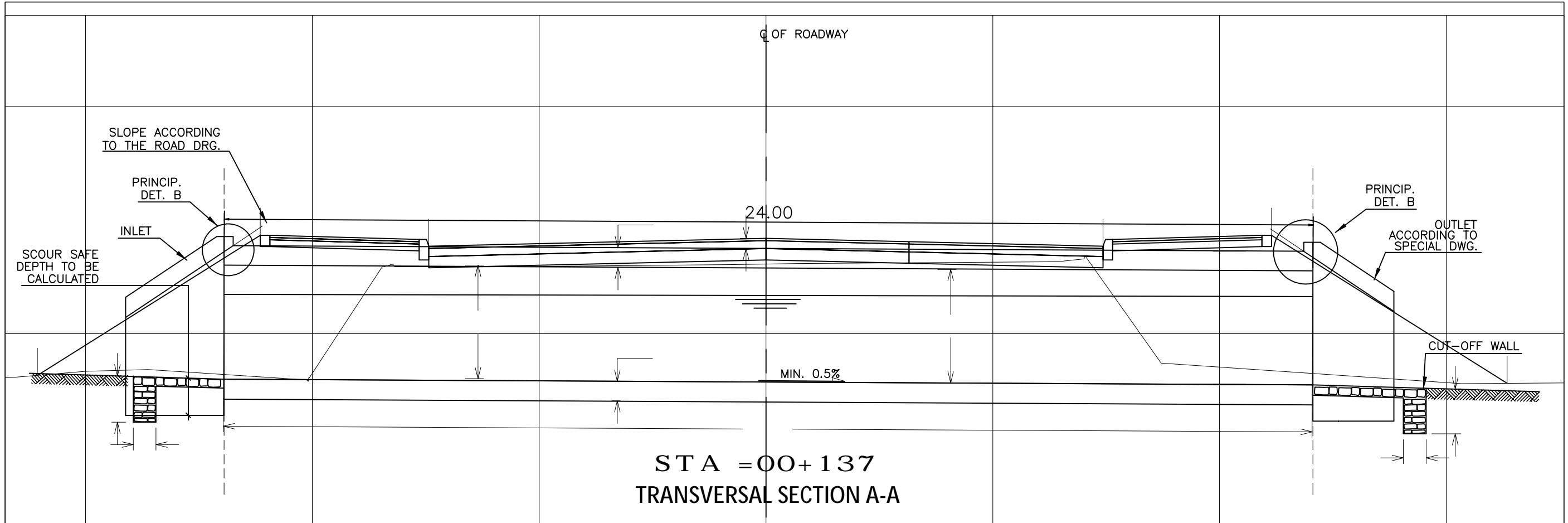
CONSULTANCY SERVICE FOR A FEASIBILITY STUDY, INFRASTRUCTURE NEEDS ASSESSMENT AND PRELIMINARY DESIGN, DETAILED ARCHITECTURAL AND ENGINEERING DESIGNS, AND THE PREPARATION OF BIDDING DOCUMENTS FOR THE BORDER POST AT TOG WAJALE, SOMALILAND AND ETHIOPIA

**TOG WAJALE DETAILED STRUCTURAL DESIGN DRAWINGS**  
(BOX CULVERT)

|              |             |          |
|--------------|-------------|----------|
| Title:       | PLAN        | DATE     |
|              |             | May 2024 |
| DESIGNED BY: | Kassahun M. |          |
| DRAWN BY:    | Kassahun M. |          |
| CHECKED BY:  |             |          |
| APPROVED BY: |             |          |

SCALE:  
As Shown

DRG. No.  
TWBC-03/08



Client:

TRADEMARK AFRICA

Consultant:

  
SABA ENGINEERING PLC

Project:

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**TOG WAJAALE DETAILED STRUCTURAL DESIGN DRAWINGS**  
(BOX CULVERT)

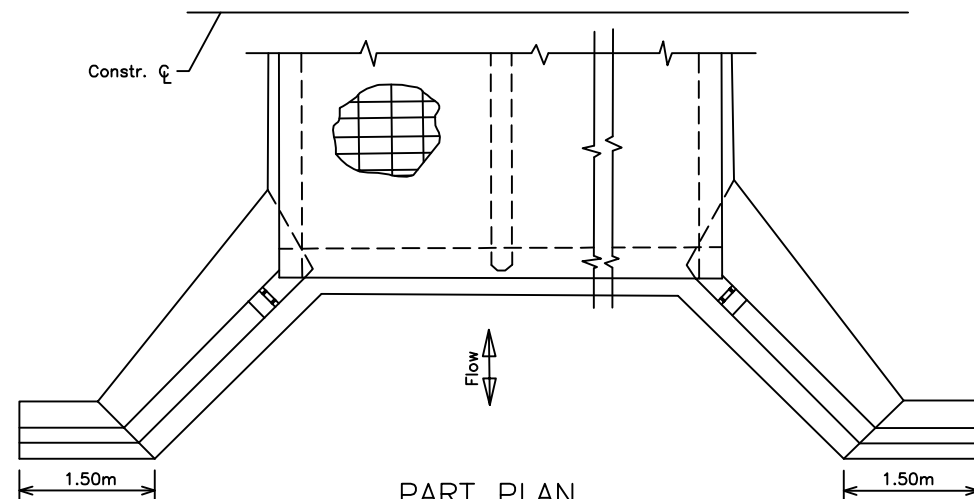
| Title: PROFILE & CROSS SECTION |             | DATE     |
|--------------------------------|-------------|----------|
|                                |             | May 2024 |
| DESIGNED BY:                   | Kassahun M. |          |
| DRAWN BY:                      | Kassahun M. |          |
| CHECKED BY:                    |             |          |
| APPROVED BY:                   |             |          |

SCALE:  
As Shown

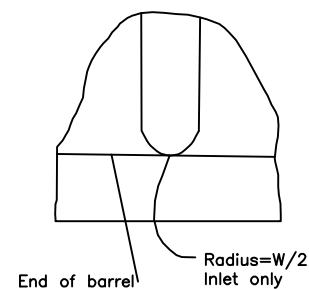
DRG. No.  
TWBC-04/08



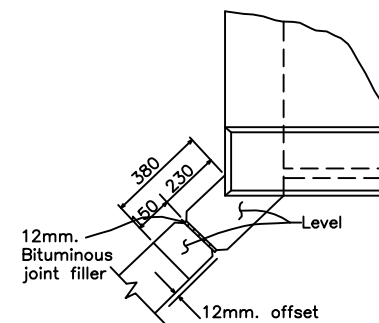




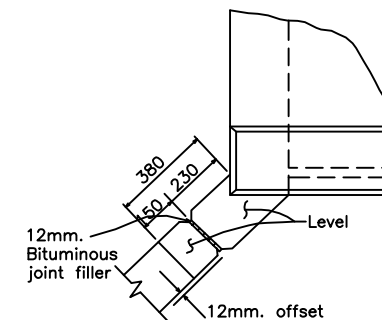
PART PLAN  
Showing Inlet & Outlet Details



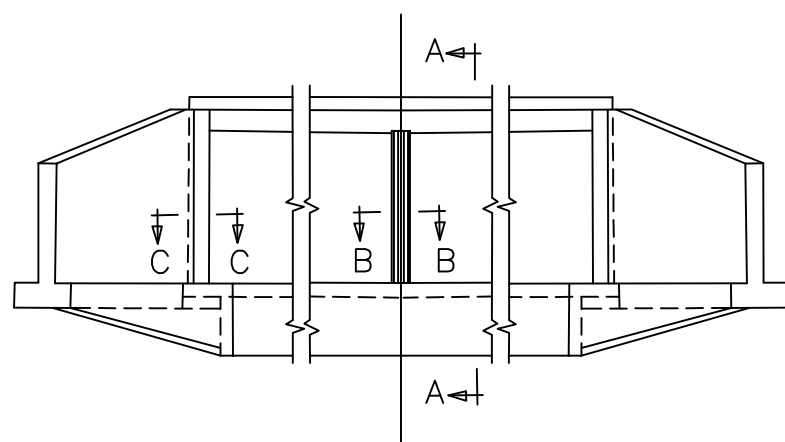
SECTION B-B  
TYPICAL DETAILS



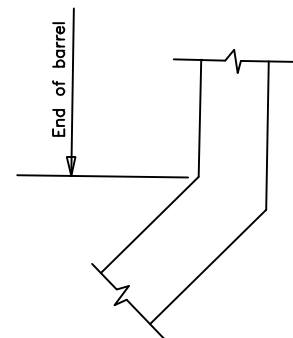
WINGWALL JOINT DETAIL  
For all barrels 3m.  
and over ( $H \geq 3m.$ )



WINGWALL JOINT DETAIL  
For all barrels  
under 3m.  
( $H < 3m.$ )

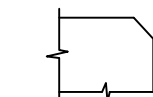
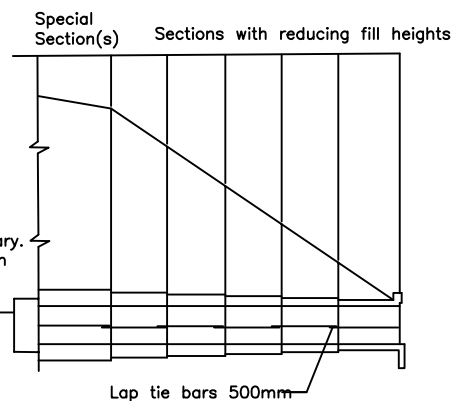


TYPICAL ELEVATION

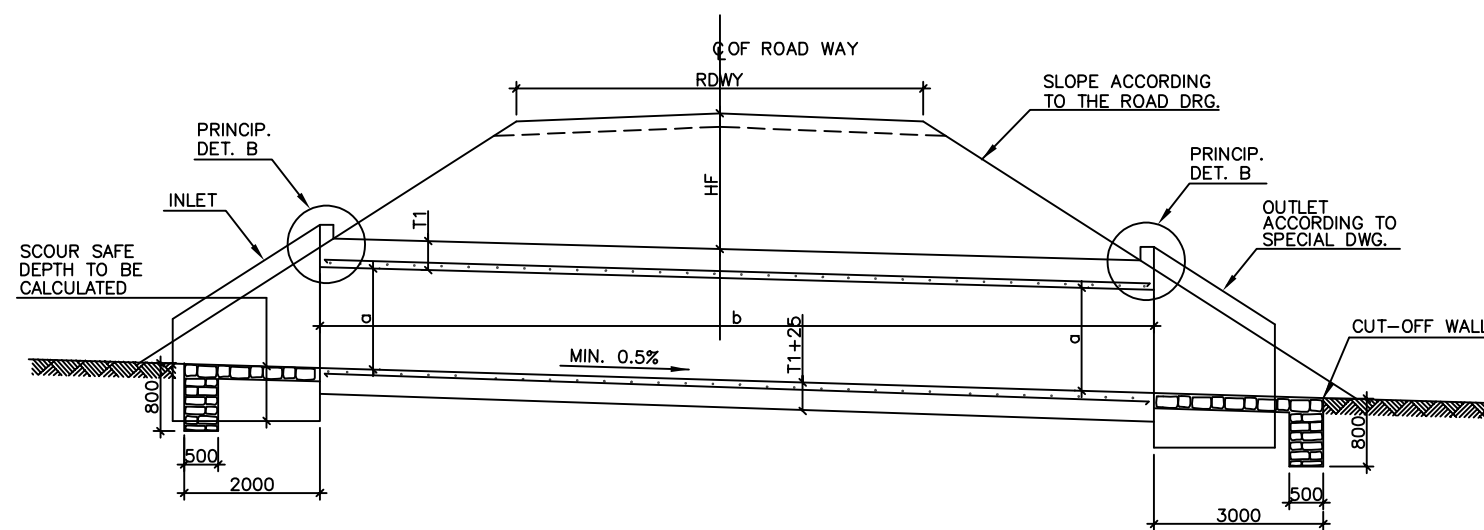


SECTION C-C

NOTE:  
Specially designed sections  
shall be used along with the  
standard barrels when necessary.  
Thicknesses of top and bottom  
slabs vary with depths of fill  
as shown.



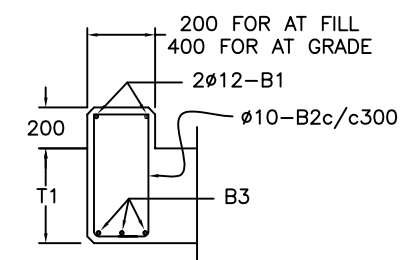
Chamfer all exposed  
Unless otherwise noted.  
This note applicable to  
all culvert Sheets pertaining  
to the project.



TRANSVERSAL SECTION A-A

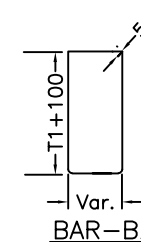
#### LEGEND

T1 - TOP SLAB THICKNESS  
W - WIDTH OF WALL  
HF - HEIGHT OF FILL  
b - WIDTH OF SLAB  
(LENGTH OF ABUTMENT)  
RDWY- ROAD WAY WIDTH  
Sb - BED SLOPE  
S - CLEAR SPAN LENGTH  
H - HEIGHT OF WALL



EDGE BEAM DETAIL B (SC. 1:25)

\* WHERE T1 IS TOP SLAB THICKNESS  
B3 IS EDGE BEAM MAIN REINFORCEMENT GIVEN IN TABLE-2



BAR-B2

Client:

TRADEMARK AFRICA

Consultant:



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TOG WAJAALE DETAILED STRUCTURAL DESIGN DRAWINGS  
(BOX CULVERT)

Title:

RC QUADRUPLE SPAN BOX CULVERT  
STRUCTURE DETAIL (4X4m-SPAN) DETAIL-2

DESIGNED BY: Kassahun M.  
DRAWN BY: Kassahun M.  
CHECKED BY:  
APPROVED BY:

DATE

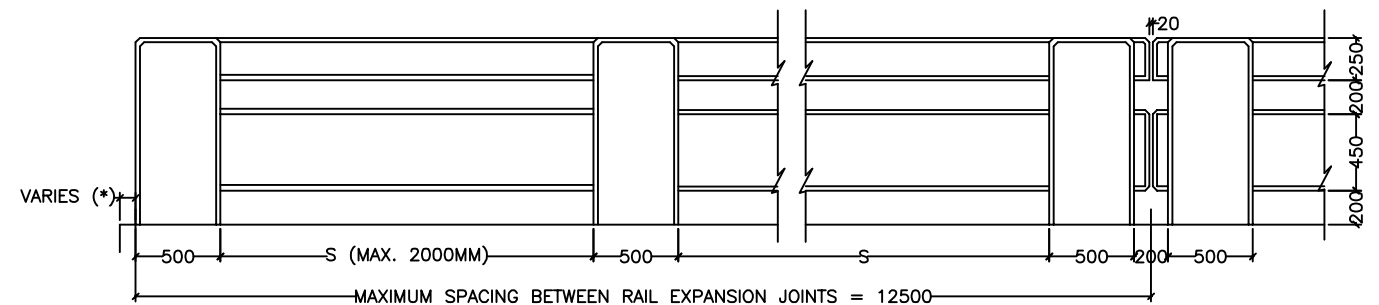
May 2024

SCALE:

As Shown

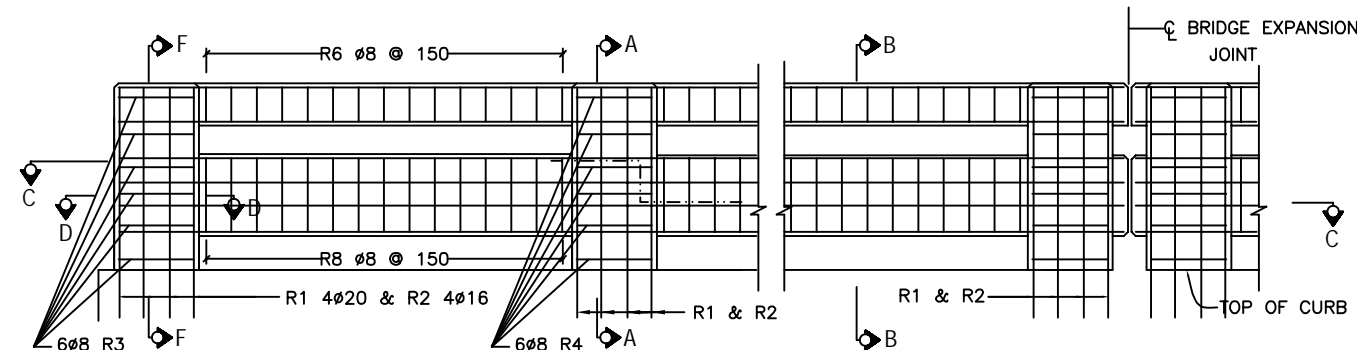
DRG. No.

TWBC-06/08

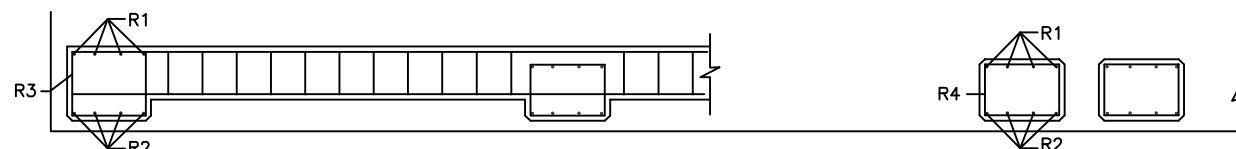


FOR POST SPACING REFER GENERAL PLAN & ELEVATION SHEET

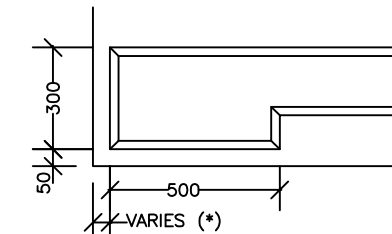
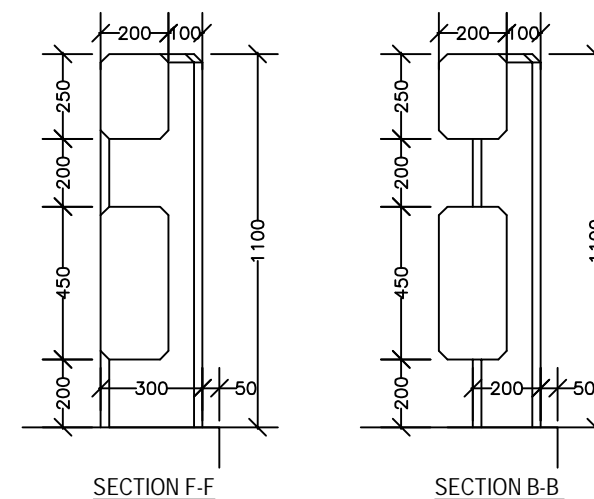
ELEVATION



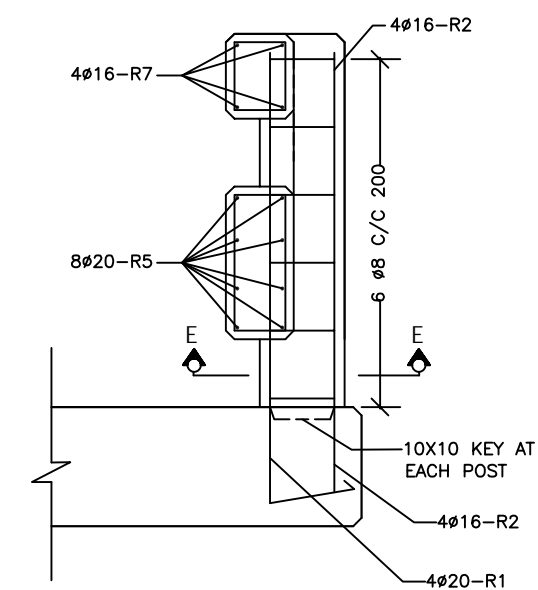
ELEVATION SHOWING REINFORCEMENT



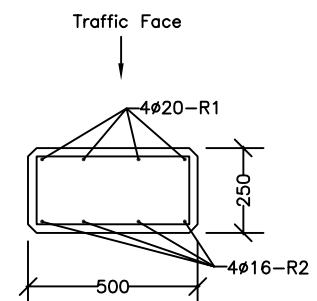
SECTION C-C



PLAN OF END POST



NOTE : BRIDGE REINFORCEMENT NOT SHOWN  
SECTION A-A



SECTION E-E

|  |   |  |  |
|--|---|--|--|
| <p>L = 1640 R1 - <math>\phi 20</math></p>                            | <p>L = 1400 R2 - <math>\phi 16</math></p>                 | <p>L = 1580 R3 - <math>\phi 8</math></p>                             | <p>L = 1480 R4 - <math>\phi 8</math></p>                   |
| <p>Rail length - 100</p> <p>L = Varies R5 - <math>\phi 20</math></p> | <p>90 320 120</p> <p>L = 760 R6 - <math>\phi 8</math></p> | <p>Rail Length - 100</p> <p>L = Varies R7 - <math>\phi 16</math></p> | <p>120 370 90</p> <p>L = 1160 R8 - <math>\phi 8</math></p> |

### NOTES

LOADING USED: AS PER AASHTO-92(DO NOT SATISFY AASHTO-2010 LOADING)

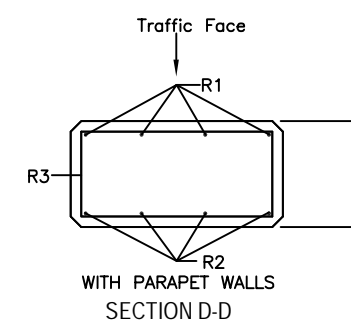
CONCRETE: MINIMUM CYLINDRICAL COMPRESSIVE STRENGTH OF 24 MPa. AFTER 28 DAYS. REINFORCEMENT: DEFORMED BARS WITH A MIN. YIELD STRENGTH OF 400 MPa FOR BAR DIA.  $\geq 20$ mm AND 300 MPa FOR BAR DIA.  $< 20$ mm.

ALL CONCRETE EDGES SHALL BE CHAMFERED 25mm.

RAILS AND POST SHALL BE GIVEN A RUBBED FINISH IN ACCORDANCE WITH E.R.A. SPECIFICATIONS.

RAILING SHALL NOT BE ERECTED UNTIL FALSE WORK OF SUPERSTRUCTUE HAS BEEN REMOVED AND THE SPAN IS SELF SUPPORTING. FOR CLASS OF FINISH REFER TO TECHNICAL SPECIFICATION

DIMENSIONS OF BAR ARE OUT TO OUT. MINIMUM BENDING PIN DIAMETER TO BE 5 TIMES BAR DIAMETER.  $\phi$ =BAR DIAMETER IN mm.



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ROUTE 3 DETAILED STRUCTURAL DESIGN DRAWINGS  
(BOX CULVERT)

Title:

STANDARD DETAIL OF REINFORCED CONCRETE BOX CULVERT RAILINGS/BARRIER

DATE

May 2024

DESIGNED BY: Kassahun M.  
DRAWN BY: Kassahun M.  
CHECKED BY:  
APPROVED BY:

SCALE:

As Shown

DRG. No.  
R3BC-07/08



| ESTIMATED QUANTITIES FOR QUADRUPLE SPAN BOX CULVERT (4X4m)   |                |          |
|--|----------------|----------|
| PAY ITEM & DESCRIPTION   | UNIT           | Quantity |
| DIVISION 3000 DRAINAGE   |                |          |
| 3100 OPEN DRAINS, CASCADES, BANKS, DYKES AND SUB SOIL DRAINS:  |                |          |
| 3200 Culvert and Appurtenant Structures  |                |          |
| 32.01 Excavation   |                |          |
| 32.01 (a) Excavating soft material, irrespective of depth  | m3             | 73.00    |
| 32.01 (b) Extra-over sub-item 32.01(a) for excavation in hard material, irrespective Depth   | m3             | 109.50   |
| 32.02 Backfilling  |                |          |
| 32.02 (a) Using excavated material   | m <sup>3</sup> | 0.00     |
| 32.02 (b) Using imported selected material   | m <sup>3</sup> | 0.00     |
| 32.03 Concrete pipe culverts   |                |          |
| 32.03 (b) i On Class B bedding (Diameter 42", Type3 Pipe Culvert)  | m              | 0.00     |
| 32.03 (b) ii On Class B bedding (Diameter 48", Type4 Pipe Culvert)   | m              | 0.00     |
| 32.06 Cast in situ concrete and formwork   |                |          |
| 32.06 (a) Cast in site concrete Class A, Grade 30 bedding screeds and the encasing, including formwork                               | m <sup>3</sup> | 460.02   |
| 32.09 Steel reinforcement  |                |          |
| 32.09 (a) Reinforcement for structures, Mild yield steel bars, deformed grade-40   | ton            | 20.41    |
| 32.09 (b) Reinforcement for structures, High yield steel bars, deformed grade-60   | ton            | 30.51    |
| 3300 Kerbing, Channeling, Open Chutes, Downpipes, and Lining of Open Drains  |                |          |
| 33.01 Kerbing  |                |          |
| 33.01 (a) Concrete kerbing (precast or in-situ concrete)   |                |          |
| 33.01 (a) i Class 25/20 Concrete Curbing (Size 0.45mX0.17m)  | m              | 0.00     |
| 33.01 (a) ii Class 25/20 Concrete Curbing (Size 0.20mX0.25m)   | m              | 0.00     |
| 33.09 Concrete lining for open drains  |                |          |
| 33.09 (a) Cast in-situ concrete lining (Class 25/20 concrete for rectangular open drain) including formwork (with U2 surface finish) | m <sup>3</sup> | 0.00     |
| 3400 Stone Pitching, Masonry, Precast Concrete Block and Riprap  |                |          |
| 34.01 Stone Pitching   |                |          |
| 34.01 (b) Grouted pitching   |                |          |
| 34.01 (b) i For outlet and inlet of culverts   | m <sup>2</sup> | 66.00    |
| 34.01 (b) ii For road side drains  | m <sup>2</sup> | 0.00     |
| 34.01 (b) iii For ditch on benches and paved furrow ditch  | m <sup>2</sup> | 0.00     |
| 34.02 Riprap   |                |          |
| 34.02 (a) Packed riprap (Class 3)  | m <sup>3</sup> | 0.00     |
| 34.02 (b) Dumped riprap (Class 3)  | m <sup>3</sup> | 0.00     |
| 34.03 Stone Masonry Walls  |                |          |
| 34.03 (b) i Cement - mortared stone masonry walls Class B (Cross Drainages)  | m <sup>3</sup> | 0.00     |
| 8700 Parapets, Railings  |                |          |
| 87.07 Reinforced concrete parapets/railings above deck slab  | lm             | 34.50    |

Client:

TRADEMARK AFRICA

Consultant:



SABA ENGINEERING PLC

Project:

CONSULTANCY SERVICE FOR A FEASIBILITY STUDY, INFRASTRUCTURE NEEDS ASSESSMENT AND PRELIMINARY DESIGN, DETAILED ARCHITECTURAL AND ENGINEERING DESIGNS, AND THE PREPARATION OF BIDDING DOCUMENTS FOR THE BORDER POST AT TOG WAJALE, SOMALILAND AND ETHIOPIA

TOG WAJALE DETAILED STRUCTURAL DESIGN DRAWINGS (BOX CULVERT)

Title:

ESTIMATED QUANTITIES

DATE

May 2024

DESIGNED BY: Kassahun M.

DRAWN BY: Kassahun M.

CHECKED BY:

APPROVED BY:

SCALE:

As Shown

DRG. No.

TWBC-08/08