TEMA AFLOA PHASE 1

$220M EXPRESSWAY BETWEEN ACCRA AND TEMA, GHANA | 2017 - 2024

NURIZON
CONSULTING ENGINEERS

ENGINEERING SOLUTIONS INSPIRED BY VISION

INTRODUCTION

PROVIDING UNIQUE, INNOVATIVE AND COST-EFFECTIVE ENGINEERING SOLUTIONS SINCE 2010

The Government of Ghana urgently requires rehabilitation and upgrading of the Tema-Aflao Road. The British Government, through its Export Credit Guarantees Department (UK Export Finance), is actively financing projects undertaken by British contractors. BHM Construction International (UK) Ltd. applied for and obtained financing to design and construct these works using the UKEF Direct Lending Facility, and Nurizon International was appointed for the engineering design of the project.

The Tema Expressway roundabout to Central University junction is an important national class one (N1) road in the South-Eastern part of Ghana, and forms part of the Trans-West African Highway network that links Ghana with her ECOWAS neighbouring countries on the eastern wing, especially Togo, Benin, Nigeria and Niger progressively. It carries international, national and regional traffic. The 17km road section under consideration begins 1km east of the Tema Expressway Roundabout in the Greater Accra Region running parallel to the country's coastline, through an urban/industrial environment incorporating mixed-use towns such as Dawhenya and end approximately 3km east of the Central University intersection.

The Scope of Work comprises:

- 17km three (3) lane per direction dual carriageway expressway and two (2) lane one-way service roads on either side;
- Four (4) interchanges / bridges;
- Bus-bays and Pedestrian bridge;
- Stormwater Drainage;
- Lighting; and
- Roadside furniture, signage, traffic control devices at interchanges and road markings.

bsi. ISO 9001:2015 Quality Management
FS 691370

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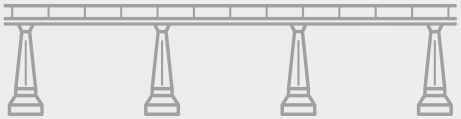
PROJECT OVERVIEW



GEOMETRIC DESIGN

Main Carriageway

- Design **Speed = 120km/h**
- **3x3.65m Lane** Bi-directional Carriageway (total **6 lanes**)
- **2.5m** paved **outer shoulder**
- **1.2m** paved **inner shoulder**
- **New Jersey barrier** median separator

Service Roads

- Design **Speed = 60km/h**
- **2x3.5mm lane** one-directional on **both sides** of the main carriageway (total 4 lanes)
- **0.25m paved** inner and outer **shoulder**
- **3m Pedestrian**/cycle lane
- **16x On-/Off-ramps** to Main Carriageway

BRIDGES

Auger piled foundations, up to **800mm diameter**

Kpone Barrier Intersection Bridge

- 4x3.5m lane two-span bridge including 0.25m shoulders
- 3m pedestrian/cycle lane
- Total **width** = **17.5m**
- **Length = 35.1m**
- Clearance **height of 5.05m**

Savannah, Afienya & PramPram Intersection Bridges

- Savanah, Afienya & Prampram
- 2x3.5m lane two-span bridge including 0.25m shoulders
- 3m pedestrian/cycle lane
- Total **width = 10.5m**
- **Length = 35.1m**
- Clearance **height of 5.05m**

Bridge decks design

- Precast post-tensioned prestressed **M Beams** with cast in situ deck slabs
  - Post Tension Tendons

Post Tensioned Tendons

- Strand **diameter** = **15.7mm**
- Prestressing **strength = 1,860Mpa**
- 1 x **7 strand tendon** & 1 x **15 strand tendon**

DRAINAGE

Major (Cross Drainage)

- A total of **24 Cross drainage structures**
- **5 x Culverts upgraded** due to insufficient capacities
- **19 x culverts extended**
- **13 x Cast in-situ culvert designs**
- **11 x pre-cast culverts**

Internal

- Main carriageway **median drains** for superelevated sections
- **2,470m Internal Pipe culverts**;
- **10,960m concrete-lined** channels
- **13,400m earth-lined** channels

PROJECT OVERVIEW

GEOTECHNICAL

Fieldwork
- Trial Pits
- DCP Testing
- Rotary Core Borehole Drilling

Analysis and Investigation Report

Laboratory Testing

SERVICES RELOCATION

Fibre-Optic
A total of **48,190m** relocated

Electrical Services
A total of **17,240m** relocated

Water Pipelines
A total of **36,650m** relocated

Fuel and Gas Lines
Protection of existing services

PAVEMENT AND MATERIALS DESIGN

Pavement design life
20 Years

Pavement Type
- Polymer Modified Asphalt surfacing.
- Graded crushed stone base.
- Stabilised gravel subbase layers.
- Granular upper and lower selected layers.
- Subgrade CBR of 3%.

Design Load
Varies between **15 MESA and 75 MESA** (Million Equivalent Standard Axle loads) **(ES15 to ES75).**

LANDSCAPE DESIGN

Main Objectives
- Controlling **soil erosion**
- Efficient **rehabilitation**
- Minimize long term **cumulative impacts**
- Minimize risks - long term **maintenance and monitoring**

ELECTRICAL DESIGN

Lighting of expressway for the **3 lanes dual carriage** with median

Lighting of service roads for the **2 lanes plus sidewalk/bicycle lane**, service roads on either side of the expressway

Lighting of bridges

TRAFFIC ENGINEERING DESIGN

Existing Traffic Counts
- **14x Intersections count** locations for three consecutive days
- **2x Link count locations** for 24 hours over 7 days
- 2 x sets of **verification surveys**

Traffic Forecasts & Signalling
- Design Traffic **Forecast of 20 years**
- Signalling Design for **Base Year (2021)**
- Signalling Design for **Horizon Year (2041)**

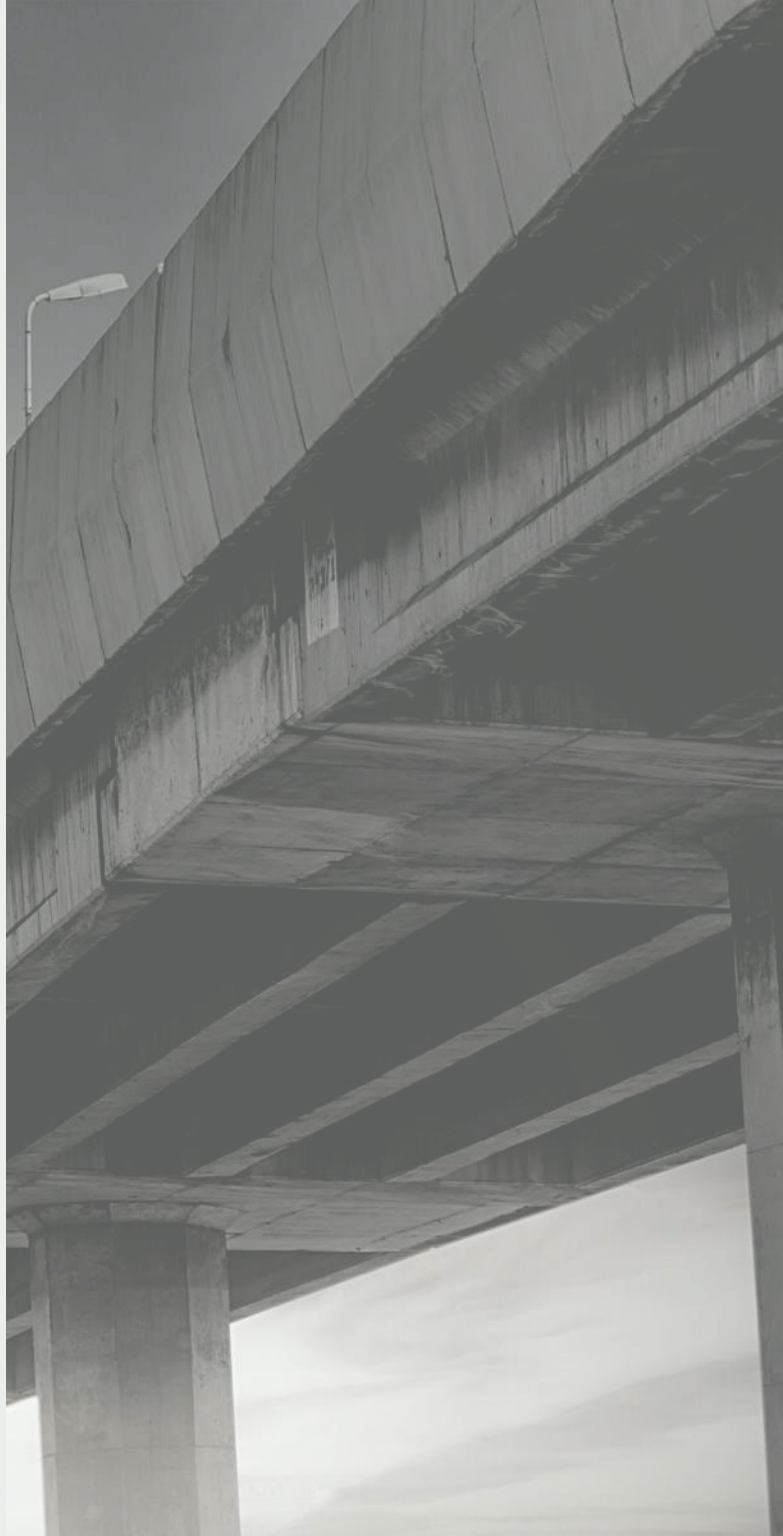
ROAD MARKINGS

- **782km** broken and unbroken **line markings**
- **2,845m² symbols** and island **paint markings**

SCOPE OF WORKS

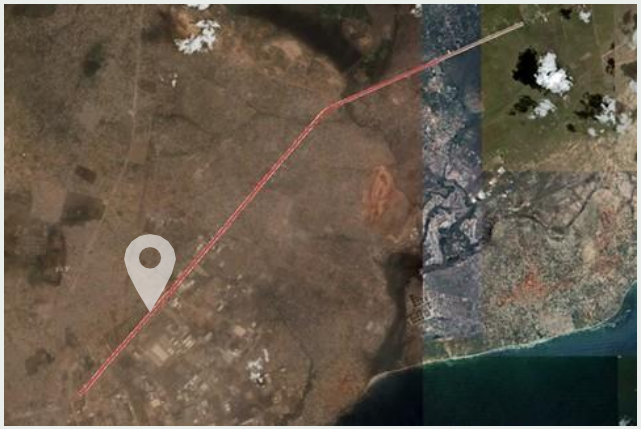
THE SCOPE OF WORKS ENTAILS THE CONSTRUCTION OF A NEW EXPRESSWAY AND SUPPORTING ROAD INFRASTRUCTURE

- **3-lane per direction dual carriageway expressway** (designated Main Carriageway) over the full length of the section
- **Concrete barrier along the median** of the main carriageway
- **2-lane one-way service roads** on either side of the main carriageway
- **Grade separation** of the service roads and main carriageway with **security fencing**
- **Four interchanges** at the following locations:
  - Kpone Barrier
  - Savannah
  - Afienya
  - Prampram
- Extension of existing **cross drainage structures** across full width of the road reserve
- Provision of a **rational drainage design** within the road reserve including **open V-drains, kerbs and channels** and appropriate **inlet and outlet structures**
- Provision of **pedestrian facilities** including:
  - **Pedestrian bridges** across interchange bridges
  - Separate pedestrian bridge at Dawhenya
  - **Pedestrian walkway and bicycle lane** along the extent of the service roads
- **High mast lighting**
- Appropriate roadside furniture, **signage, traffic control devices** at interchanges and **road markings**

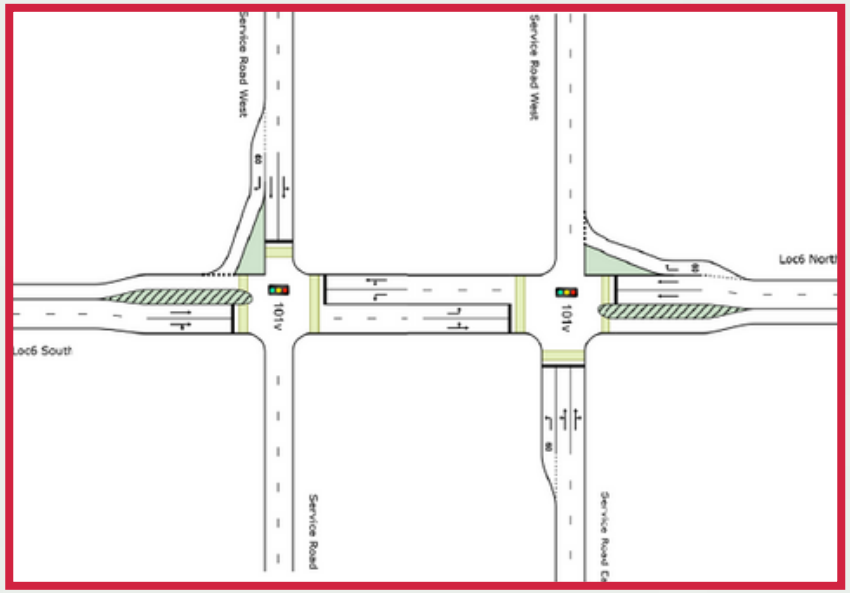


INTERSECTIONS

KPONE BARRIER INTERSECTION



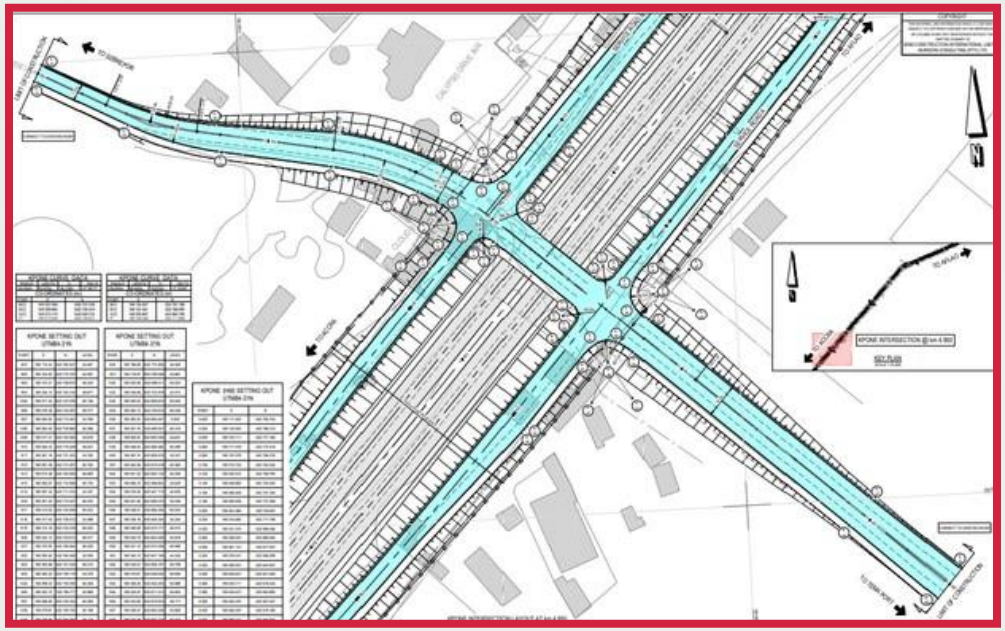
Kpone Barrier Intersection Location



Kpone Barrier Intersection Configuration

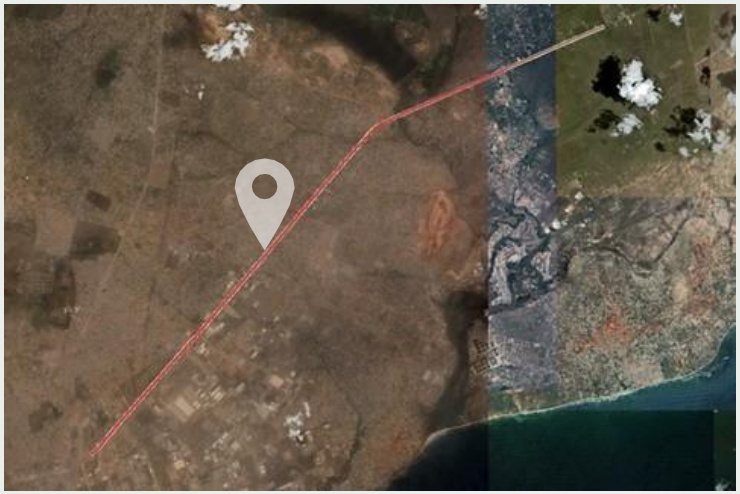
The traffic study concluded that one turning lane on the service Road B, going over the bridge, and one turning lane from the service road A, toward the harbor would be required. The layout of the intersection includes 2 lanes per direction crossing the main carriageway, which is illustrated in the figure to the right.

Traffic lighting will provide the required signal control for optimized traffic flow based on current traffic and future demand.

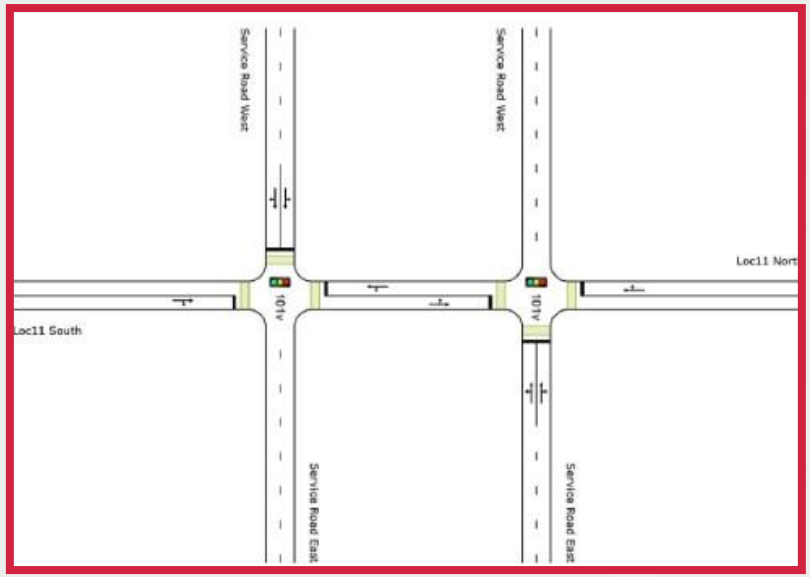


INTERSECTIONS

SAVANNAH INTERSECTION



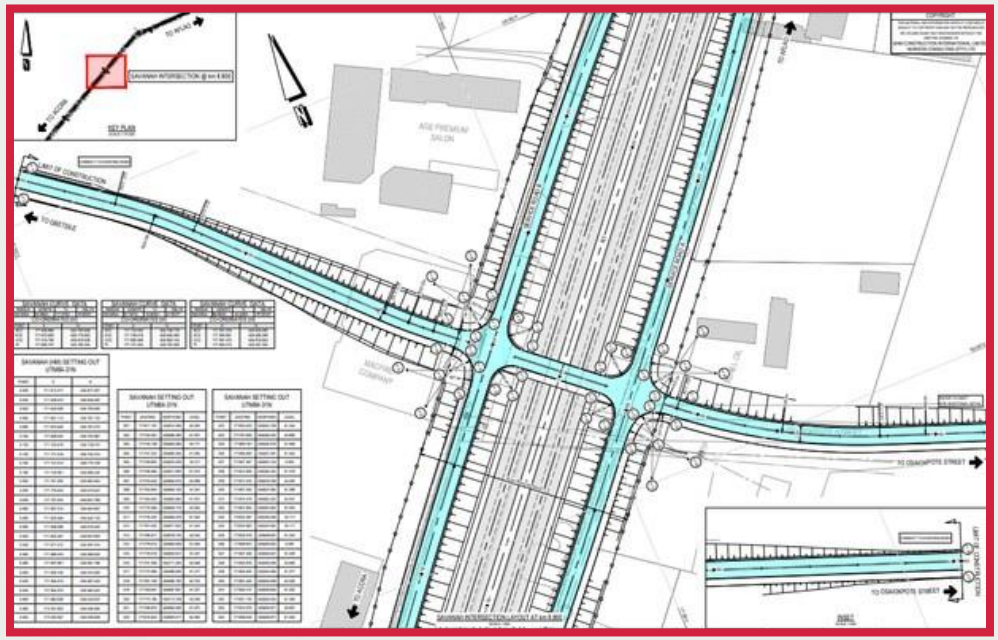
Savannah Intersection Location



Savannah Intersection Configuration

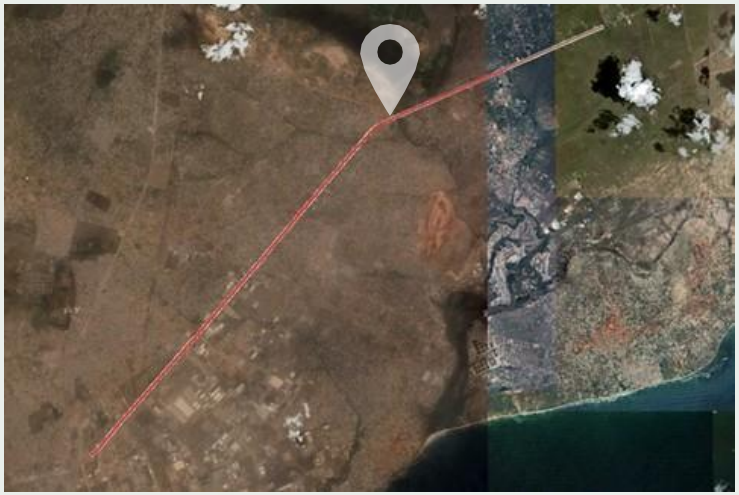
The traffic study concluded that no additional turning lanes were required for this intersection. The layout of the intersection includes one lane per direction, crossing the main carriageway, which is illustrated in the figure to the right.

Traffic lighting will provide the required signal control for optimized traffic flow based on current traffic and future demand.

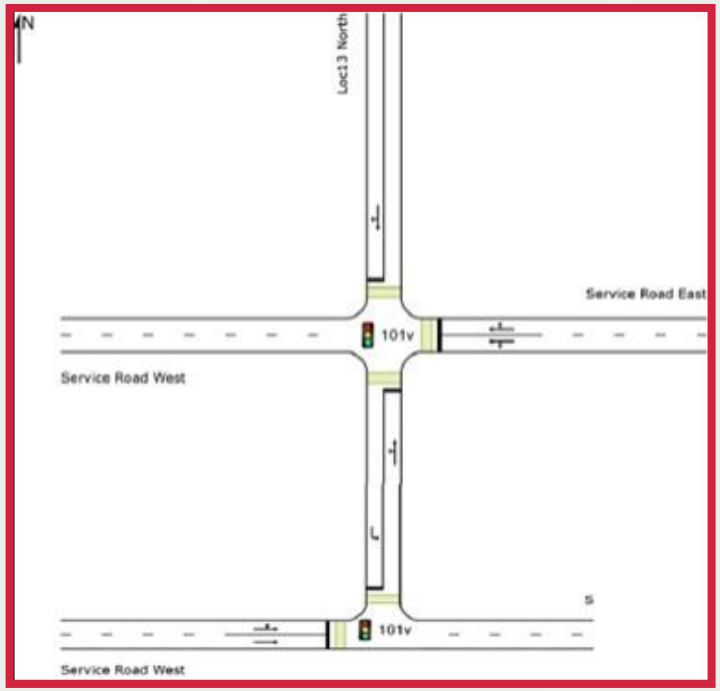


INTERSECTIONS

AFIENYA INTERSECTION



Afienya Intersection Location



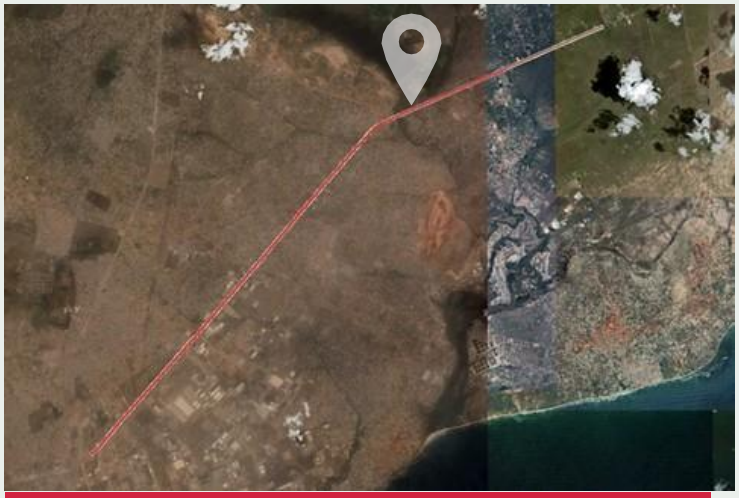
Afienya Intersection Configuration

Afienya bridge was designed with a single approach from the west side.
No additional turning lanes were required for this intersection. The layout of the intersection includes one lane per direction, crossing the main carriageway, which is illustrated in the figure to the right.

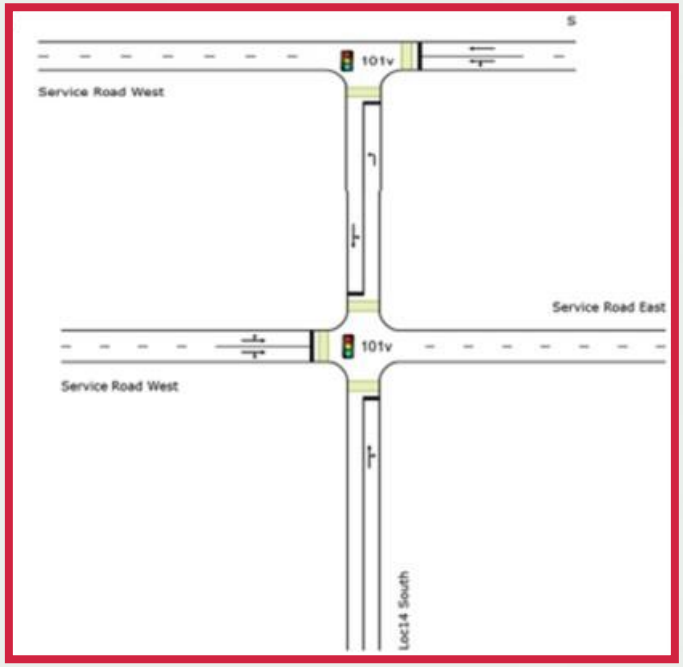
Traffic lighting will provide the required signal control for optimized traffic flow based on current traffic and future demand.

INTERSECTIONS

PRAMPRAM INTERSECTION



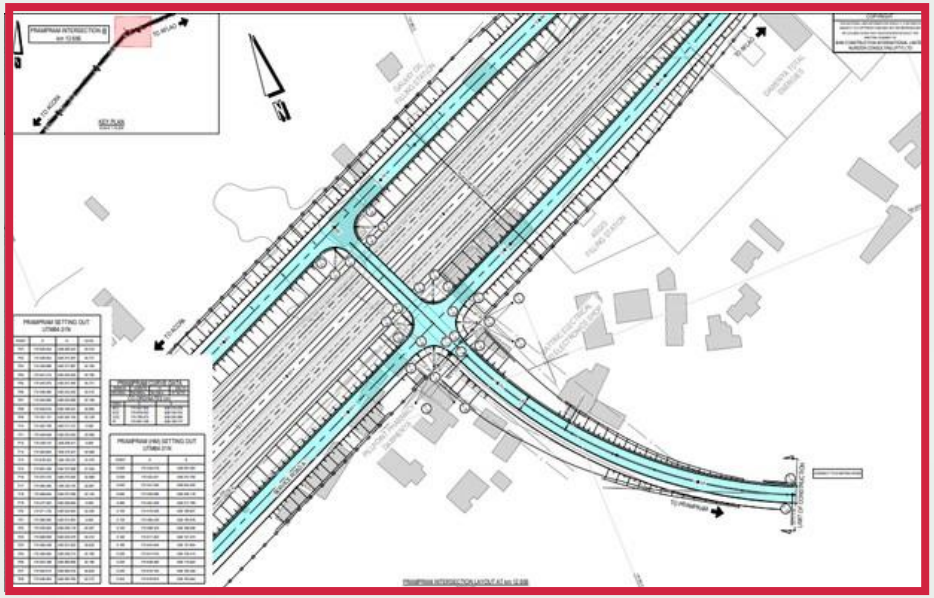
Prampram Intersection Location



Prampram Intersection Configuration

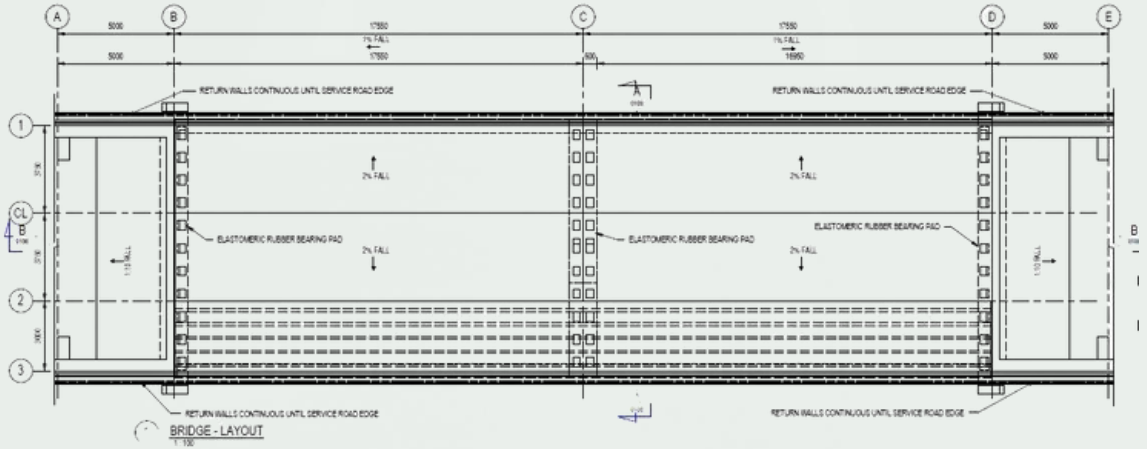
Prampram bridge was designed with a single approach from the east side.
No additional turning lanes were required for this intersection. The layout of the intersection includes one lane per direction, crossing the main carriageway, which is illustrated in the figure to the right.

Traffic lighting will provide the required signal control for optimized traffic flow based on current traffic and future demand.

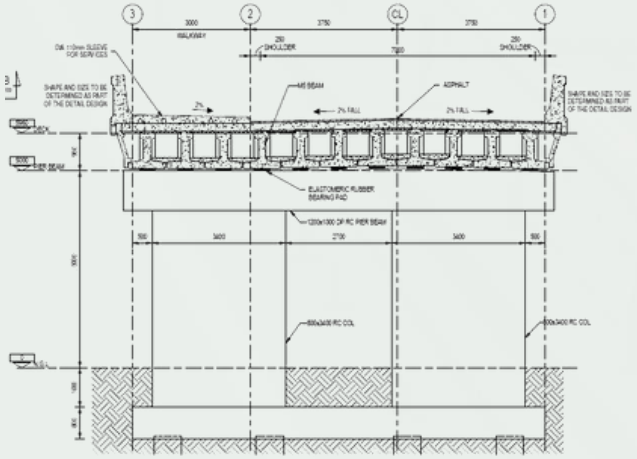


BRIDGES

BRIDGE DESIGN



BRIDGE LAYOUT



SECTION A THROUGH BRIDGE

M-beams Layout

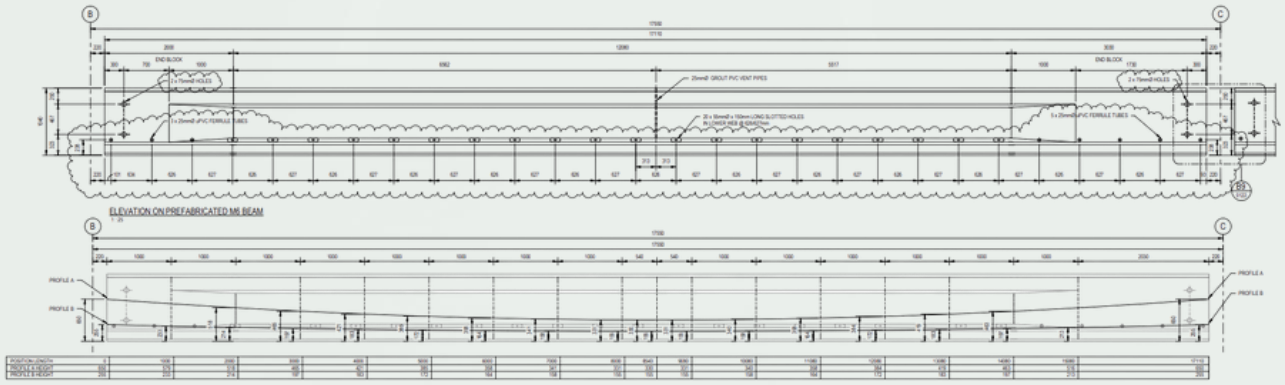
Two post tensioned tendons are used as part of the design with an ultimate pre-stressing strength of 1860MPa.
The two tendons consist of 1 x 7 strand tendon and 1 x 15 strand tendon.

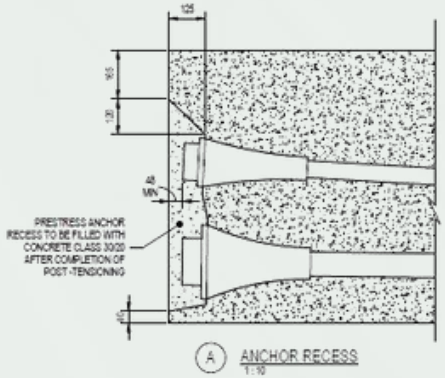
Positive features:

- Economical solution in terms of bridge span and for Prestressed beams.
- Economical solution in terms of construction time. Beams are precast and thus no requirement for bridge beck soffit formwork and supports.
- Bottom flange of beam is packed against each other, thus eliminating the need for formwork below bridge deck. This minimizes impact on traffic below.
- Considerable range of beam sizes, ranging from 720mm to 1360mm

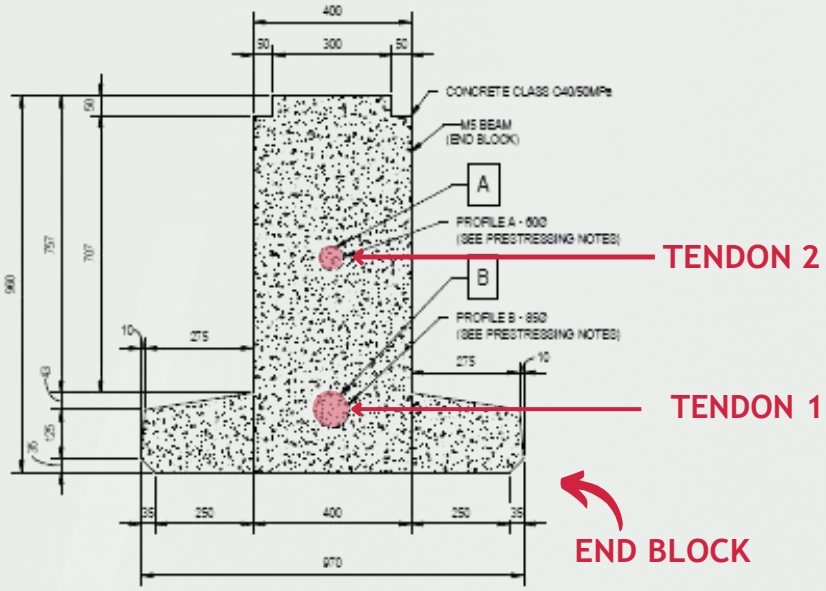
BRIDGES

BRIDGE DESIGN

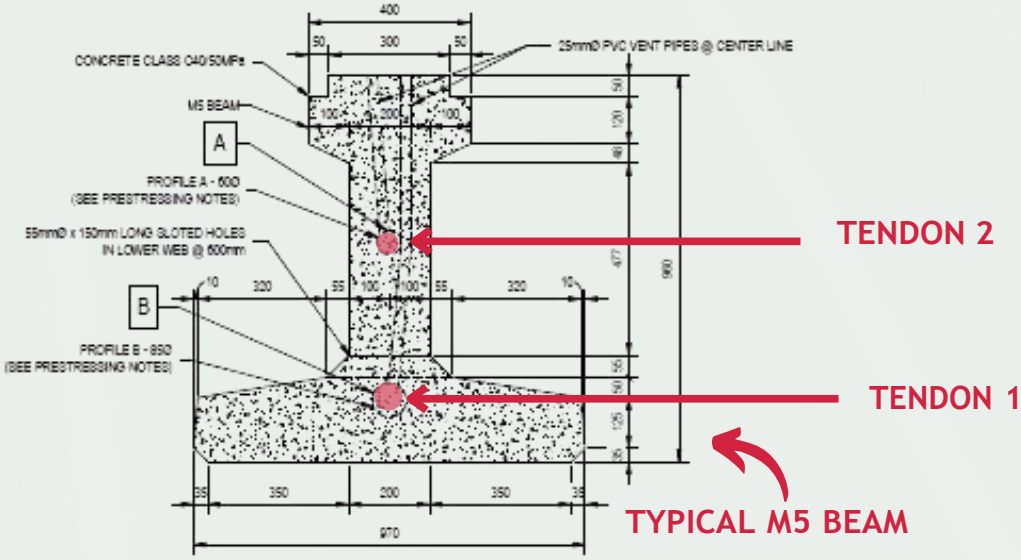




Anchor blocks are provided at the end of the beams to seal the dead and live anchors while assisting with corrosion protection.



The end blocks provide the neccessary space and strength requirements for the tendon anchors.



The bridge beams consist of modified M5 beams. M-beams are ideally suited for bridges with single spans up to 30m.

YOUR **AFRICA** ENGINEERING EXPERTS

PROVIDING UNIQUE, INNOVATIVE AND COST-EFFECTIVE ENGINEERING SOLUTIONS SINCE 2010

Nurizon has been built on a solid foundation of three core values – Innovation, Professionalism and Openness. With these fundamentals in place, we have built invaluable trust-relationships with local and international clients, continually providing them with security, comfort and confidence as we continue to deliver quality integrated solutions for their projects.

With many years of combined experience, we are able to assist from the onset to completion of your project, to ensure the finest possible outcome. Our 'beyond boundaries' approach makes us renowned for our adaptability, as we naturally view every project with an element of uniqueness. Consistently maintaining remarkably high standards, we continue to thrive on repeat business, secured by work relationships built on integrity, by applying our core values in every aspect of conducting business.

AFRICA EXPERTS

Having completed numerous successful projects on the African continent over the past decade, with a head office based in South Africa, we understand the challenges in terms of logistics and politics within the African environment.

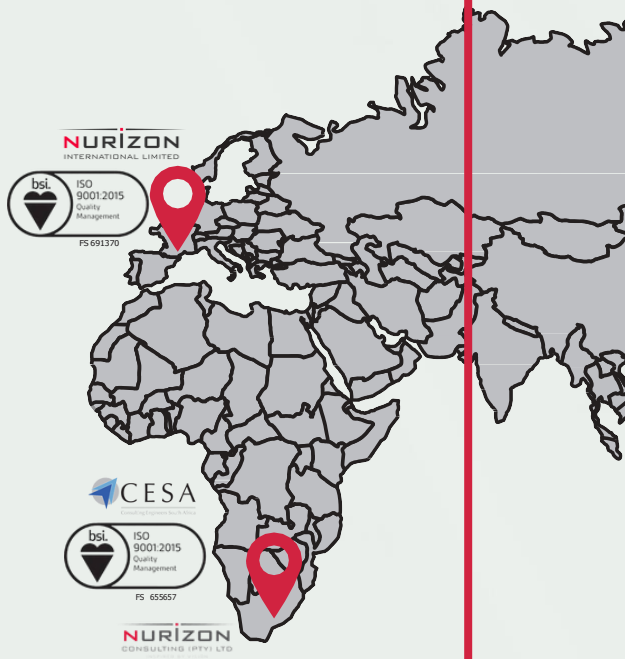
Our Directors and Senior staff members are hands-on from the onset to completion of each project and we pride ourselves on providing quality service.

MULTI-DISCIPLINARY

With our vibrant team of hand-picked engineers and support staff, well experienced in working **in various multidisciplinary engineering environments,** no challenge is too great for the NuTeam to take on!

INTERNATIONAL FOOTPRINT

Our project portfolio is exceptionally varied, with 430+ successfully completed **projects in 24+ different countries** across the African, European and Oceania continents. Our head offices in UK and South Africa provides for easy access to the African and European contents.



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