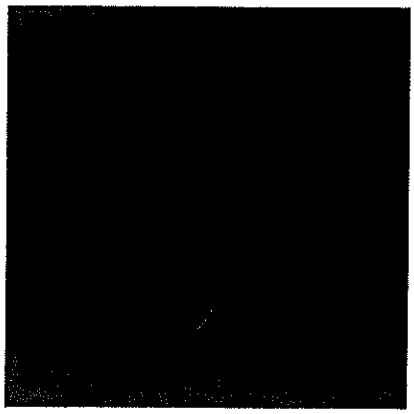

TECHNICAL PROPOSAL FINANCE FOR THE DESIGN AND CONSTRUCTION OF THREE (3) BRIGES IN THE NORTHERN REGION

MAINTENANCE SCHEDULE FOR THE EXISTING BRIDGES

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1 INTRODUCTION AND PURPOSE OF THE REPORT

The Ghana Highway Authority has issued and invitation to tender for the Finance, Design and Construction of three (3) bridges in the northern region of Ghana, namely:

- Bridge Over Black Volta at Buipe
- Bridge Over White Volta at Yapei
- Bridge Over Black Volta at Daboya

QGMI has requested FHECOR Ingenieros Consultores S.A. to teamed up for this tender process, in which FHECOR will deal with the detail design of the bridges,

This report intends to:

- Briefly describe the existing bridges.
- List the existing damages or defects that have been detected in previous inspections.
- Describe the eventual damages that could arise in the bridges structural elements and bridge appurtenances.
- Define inspection and evaluation criteria to check the bridges future overall condition.
- Outline a maintenance schedule including the recommended maintenance operations to undertake in order to minimize decrease in condition of the bridge structural elements and bridge appurtenances.

2 BRIDGES BRIEF DESCRIPTION

The Ghana N10 Highway is a major route which connects Kumasi, in the Ashanti Region, with Tamale in the Northern Region. This Route is the main transportation route for goods and passengers to access the northern part of Ghana. The N10 Highway section between Kintampo and Tamale has two main bridges, located at Buipe and Yapei.

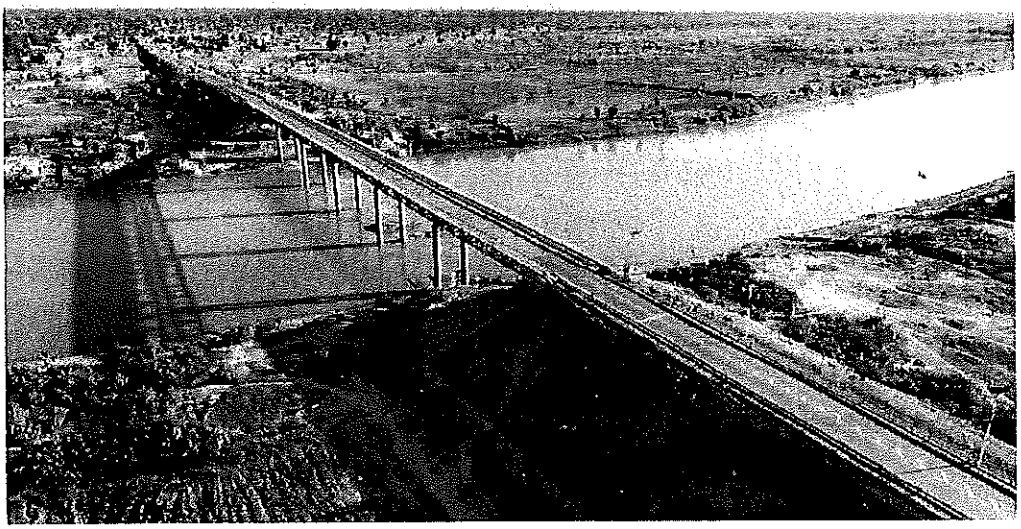


Figure 1. Aerial view of Buipe Bridge over Black Volta, towards south.

Figure 2. Aerial view of Yapei Bridge over White Volta, towards west.

Both the Bridge Over Black Volta at Buipe and the Bridge Over White Volta at Yapei were constructed in 1964 by CEMENTATION INTERNATIONAL, a UK based Company. Both bridges are approximately 240 m long. Each bridge has six spans.

Each bridge deck is formed by a steel truss that supports a reinforced concrete deck. The concrete deck is actually forms by 20 slabs, each 11,50 m long. The abutments and piers were built in reinforced concrete.

3 BRIDGES ACTUAL CONDITION

3.1 BRIDGES ACTUAL CONDITION AND RECENT MAINTENANCE ACTIVITIES

Buipe and Yapei bridges were built 53 years ago.

According to the information provided in invitation to tender, the reinforced concrete decks are in a bad condition, especially in the areas close to the deck joints, and there are signs of substantial corrosion in the flanges of the upper chord of the truss components.

In fact both bridges have been closed to traffic to undergo emergency maintenance labour during 2017. Besides these works, the Ghana Highways Authority (GHA) has set a limit of 20 tonnes for the allowable load limit on these bridges.

Buipe bridge emergency maintenance works involved repairing metal joints and broken slaps, and were completed in late March 2017.

Yapei bridge emergency maintenance works involved repairing metal joints and broken slaps, and were completed in late June 2017.

http://3news.com/yapei-bridge-to-be-closed-from-tonight-for-emergency-repair-works/

http://3news.com/buipe-bridge-to-be-closed-for-repair-works/

https://www.youtube.com/watch?v=PT9Xego9mdw

https://www.youtube.com/watch?time_continue=1&v=SRh_b1ecgzA

https://article.wn.com/view/2017/09/11/Load_limit_for_Buipe_Yapei_bridges_now_20_tonnes/

The inspection report by GHA dated August 2016 outlines the following damages in the bridges.

3.1.1 BUIPE BRIDGE OVER BLACK VOLTA RIVER

DECK

- The deck is not overlaid with any impervious materials like asphalt.
- The edges of all concrete slabs are broken off with some exposing their reinforcement.
- The riding surface has developed series of distress cracks and potholes.
- Comparison of the deck condition between March 2016 and August 2016 shows significant increase in concrete slab deterioration.
- Slab bay number 13 has developed a hole on the mid downstream of the concrete slab. A steel plate of dimension was placed over the hole by GHA early 2015, but the hole has widened beyond the width of the steel plate.

BUIPE STEEL TRUSS

- The top flanges of the upper cross beams that coincide with the joints between slabs are deteriorated, with top flange cross section reduction due to seepage of water through the joints from the deck onto the cross beam.
- A broken diagonal bracing repaired by Bridge Maintenance Unit in 2015 has three bolts sheared off, and the diagonal bracing has shifted out of position.
- Corrosion protection of the steel members has broken down and spot of rust is evident on the steel members.
- The entire diagonal steel members connecting to the cross beam, vertical members and gusset plates of the truss has water marks on them and spot of rust.

- An unusual sound emanating from the concrete slab and the steel truss is heard when a vehicle passes over the bridge. According to the report, "this is gives an indication that the shear connectors that holds the concrete slab in position are broken off".

Our perception of this noise is that probably there are significant areas of the concrete slab affected by a risk of pothole appearance in the short term, and that noise may be much more relate to the existence of cracked areas in which bonding between concrete and reinforcement is poor instead of being related with damage in shear connectors (note that concrete slab is not continuous).

3.1.2 YAPEI BRIDGE OVER WHITE VOLTA RIVER

DECK

- Five joints between concrete slabs that were in critical condition were repaired by the Bridge Maintenance Unit in 2015 and remain in good condition.
- The carriage way is overlaid with asphalt and distress cracks are not visible for visual inspection from the platform.
- The resto of the joints between slabs have started to show signs of edge breakage.
    - Two holes that developed in the deck no. 18 and 19 respectively in 2014 were patched in 2015 by the BMU.
    - However, fresh cracks have started developing from the patched hole on the underside of the deck. This is not evident on top of the bridge since it has been overlaid with asphalt.
    - Fresh hole is developing on the bridge deck. This is evident from the top of the deck

BUIPE STEEL TRUSS

- Seepage of water from the deck onto the steel members has caused breakdown of the corrosion protection of the steel truss, development of spot of rust and section loss of the top flanges.

3.2 PHOTOGRAPHIC REPORT

3.2.1 BUIPE BRIDGE OVER BLACK VOLTA RIVER

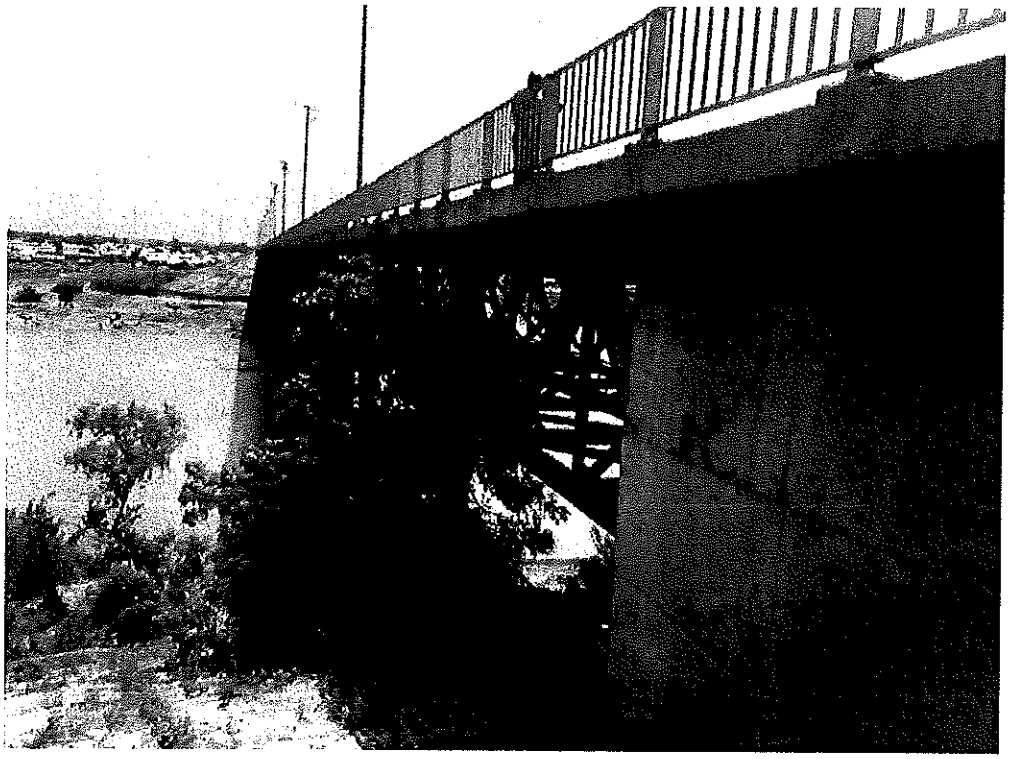


Figure 3. Buipe Bridge. Side view from the abutment.

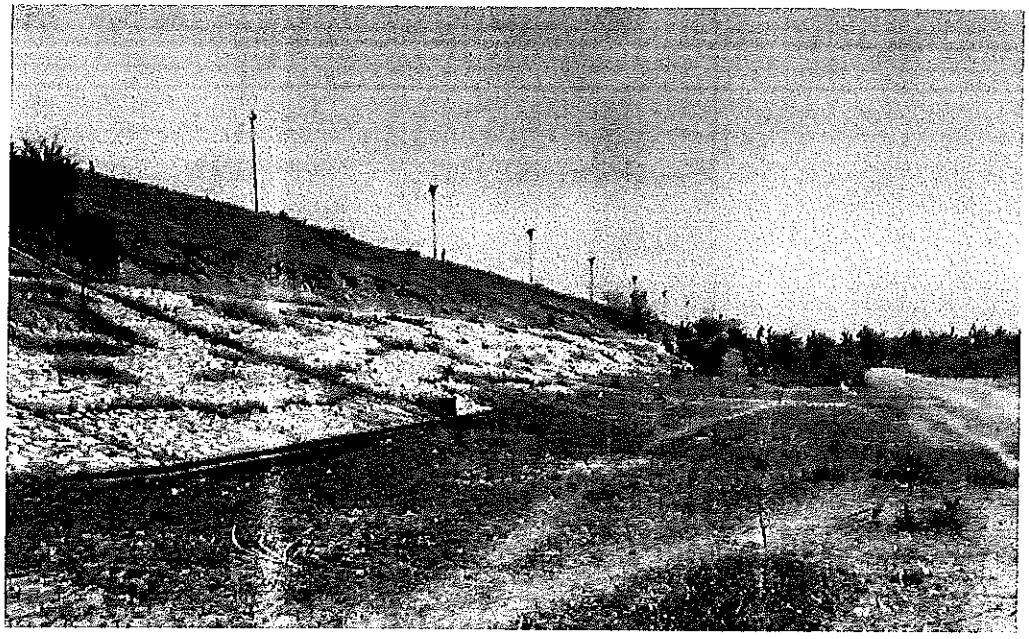


Figure 4. Buipe Bridge. Rver banks.

Figure 5. Bulpe Bridge. General view of side span.

Figure 6. Bulpe Bridge. General elevation.

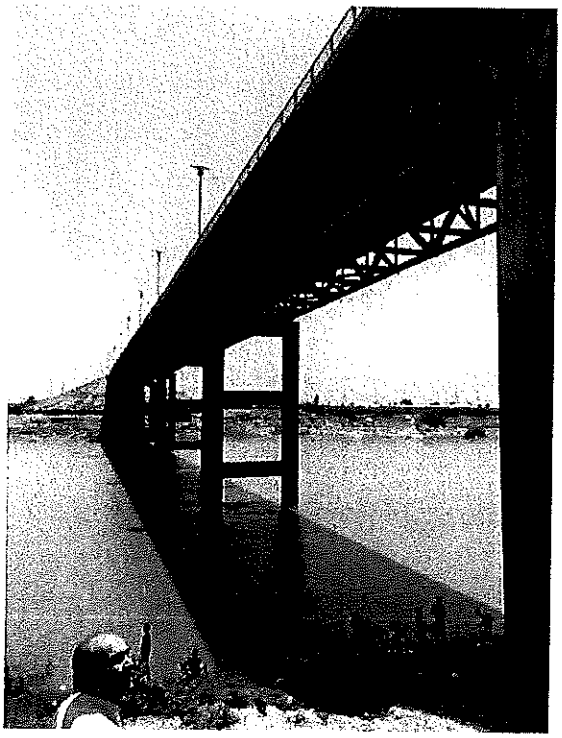


Figure 7. Buipe Bridge. Underneath view from one of the river banks.

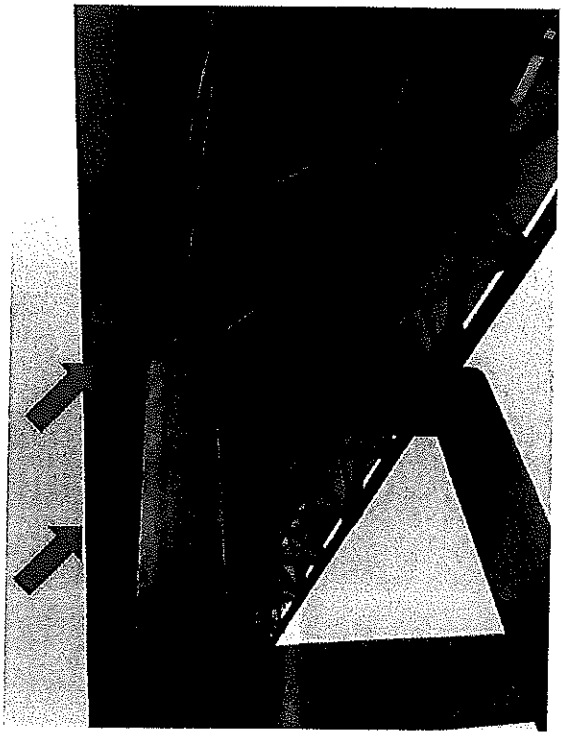


Figure 8. Buipe Bridge. Pier elevation. Red arrows mark the position of joints between slab segments.

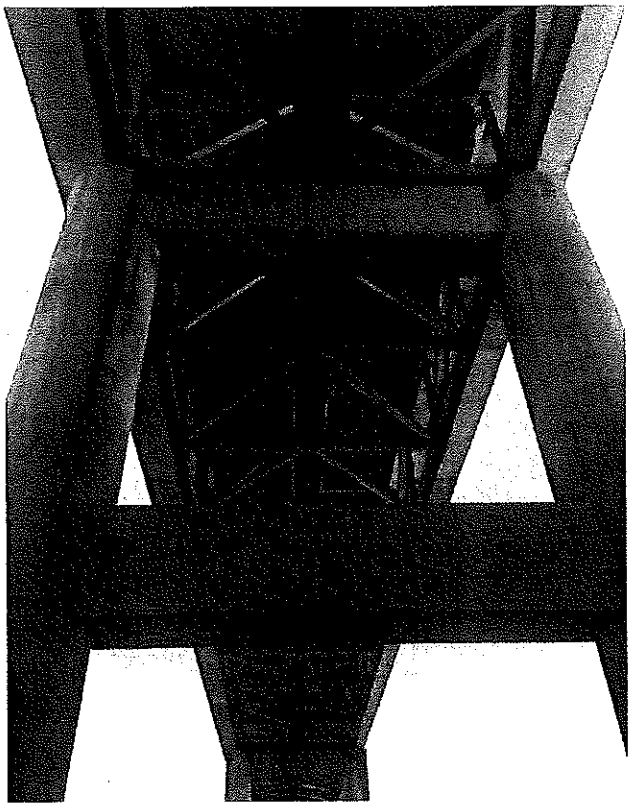


Figure 9. Buipe Bridge. Pier elevation with top and intermediate cross beams.

Figure 10. Buipe Bridge. Bridge deck platform and sidewalks.

3.2.2 YAPEI BRIDGE OVER WHITE VOLTA RIVER

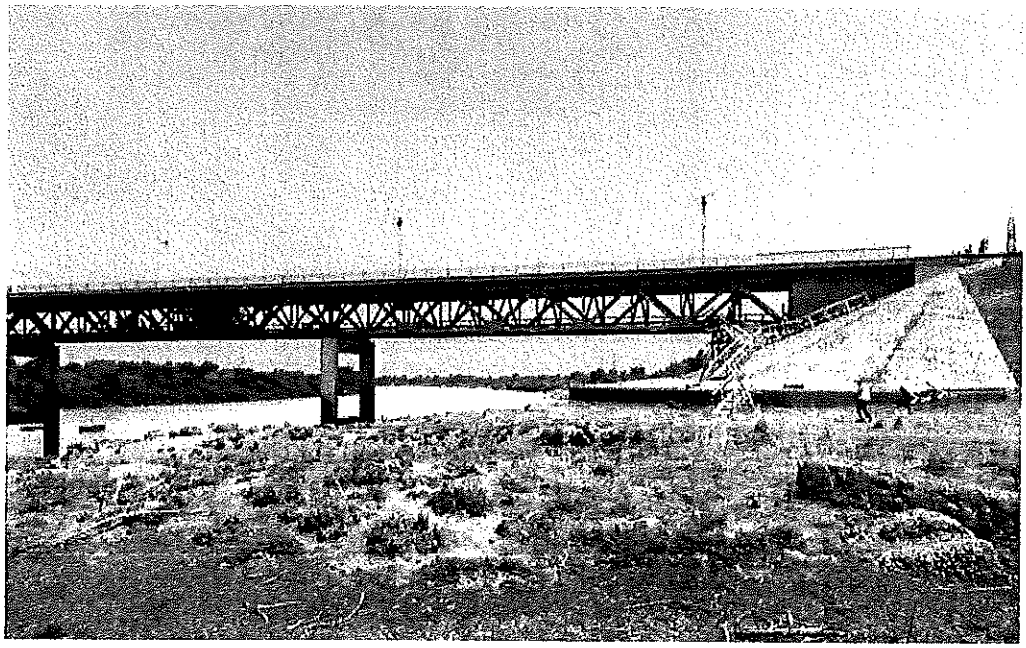


Figure 11. Yapei Bridge. Elevation view. Side span.

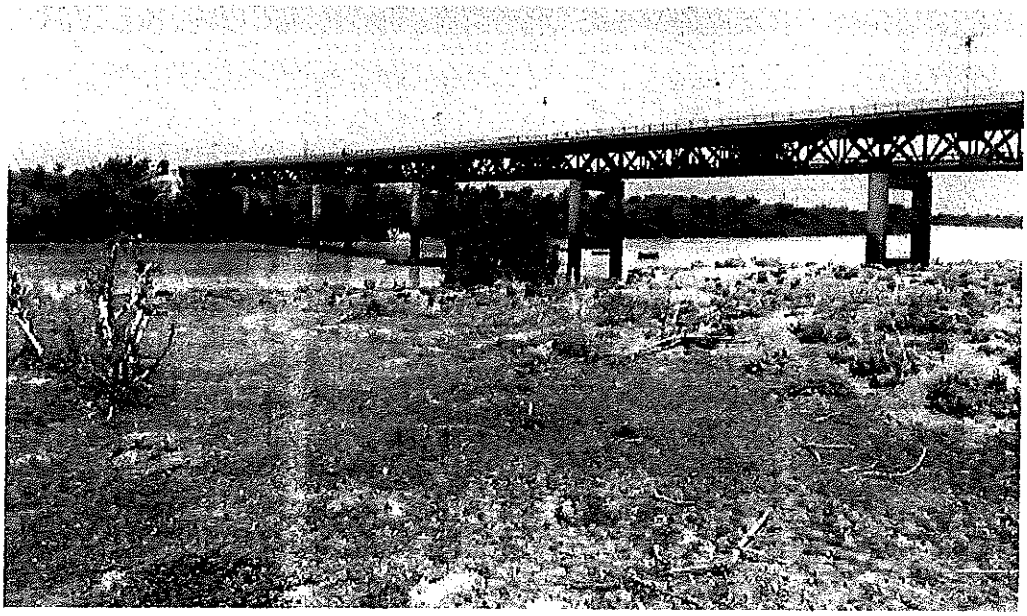


Figure 12. Yapei Bridge. Elevation view. Spans over riverbed.

Figure 13. Yapei Bridge. Rock outcropping near river bank. Red lines marking joints between slab segments.

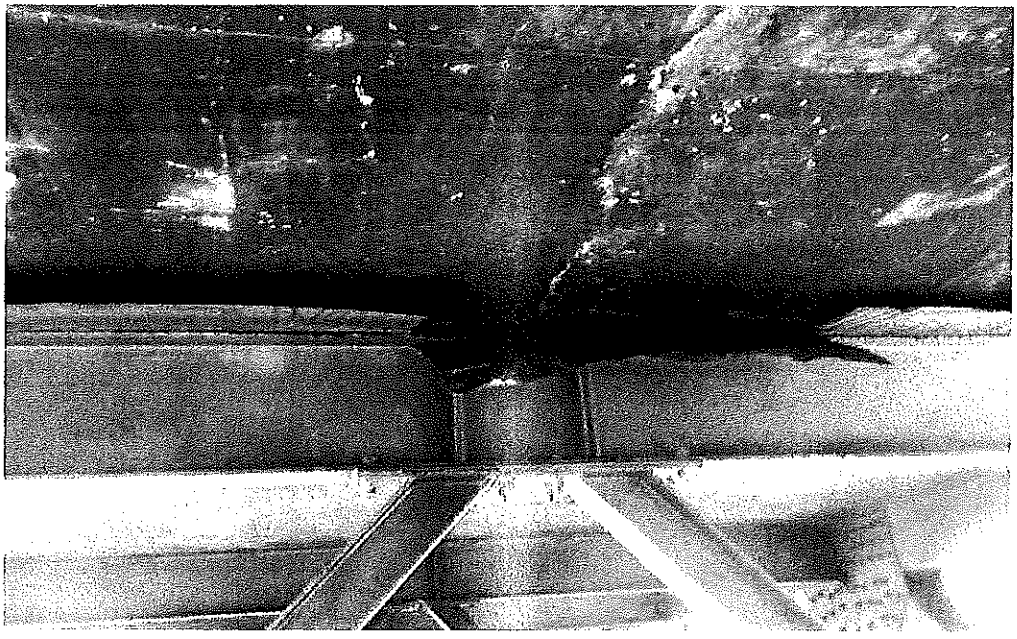


Figure 14. Yapei Bridge. Space between diaphragm top cross beam and concrete deck.

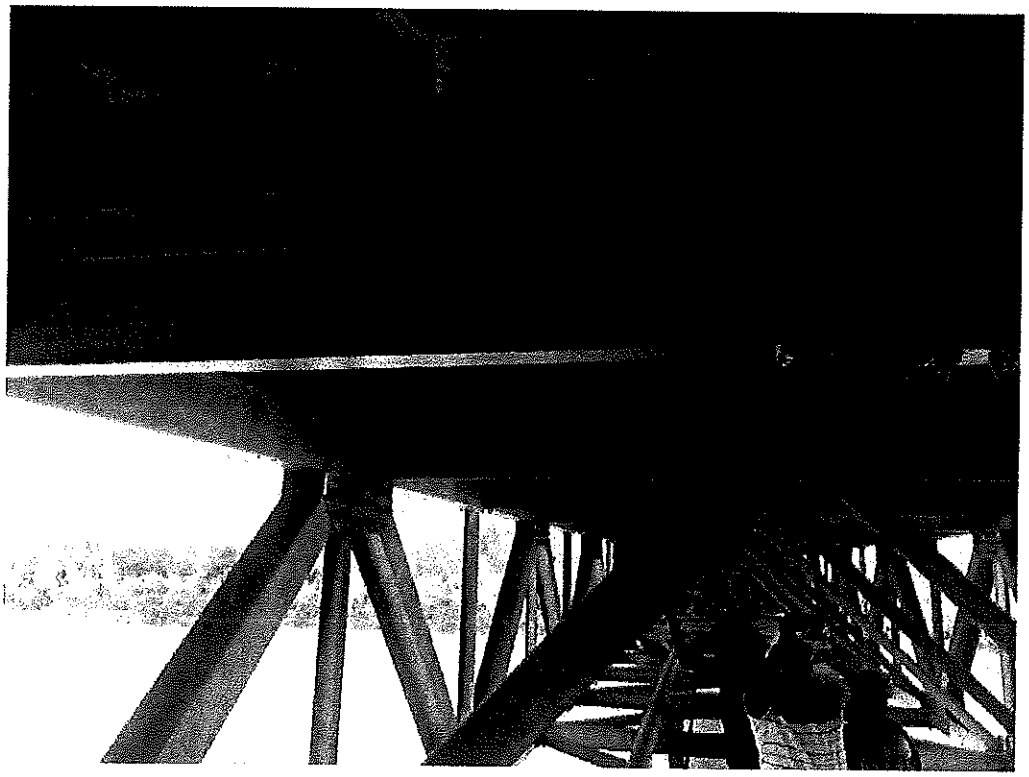


Figure 15. Yapei Bridge. View underneath the concrete deck.

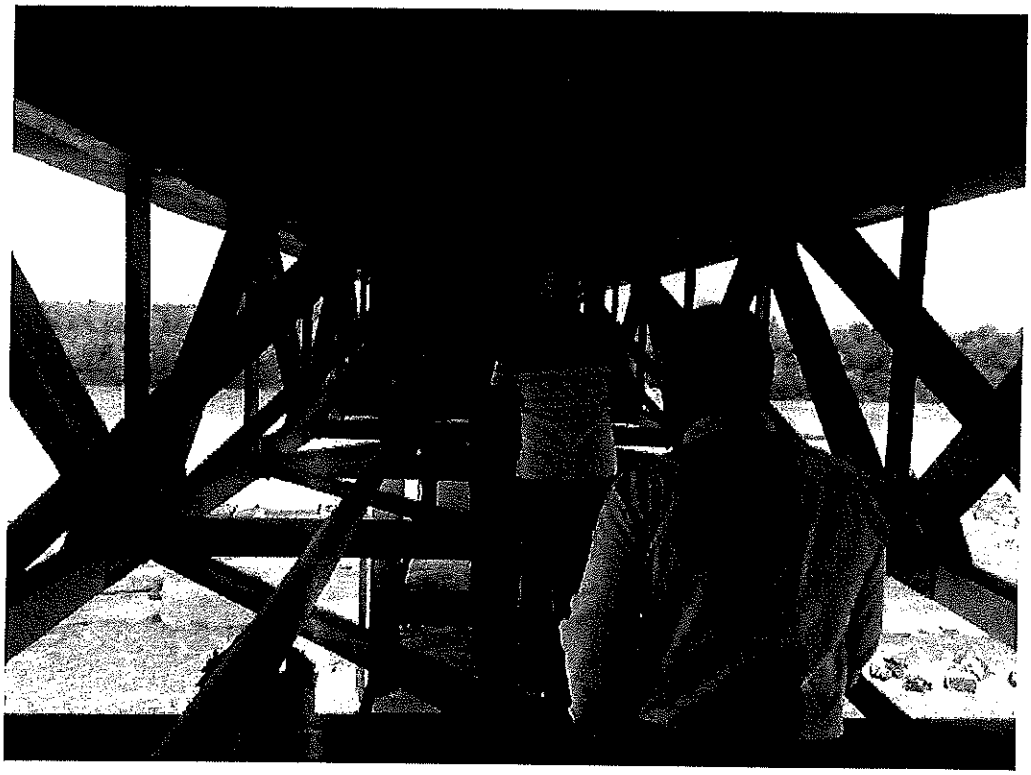


Figure 16. Yapei Bridge. Visual inspection through a walkway on the steel truss.

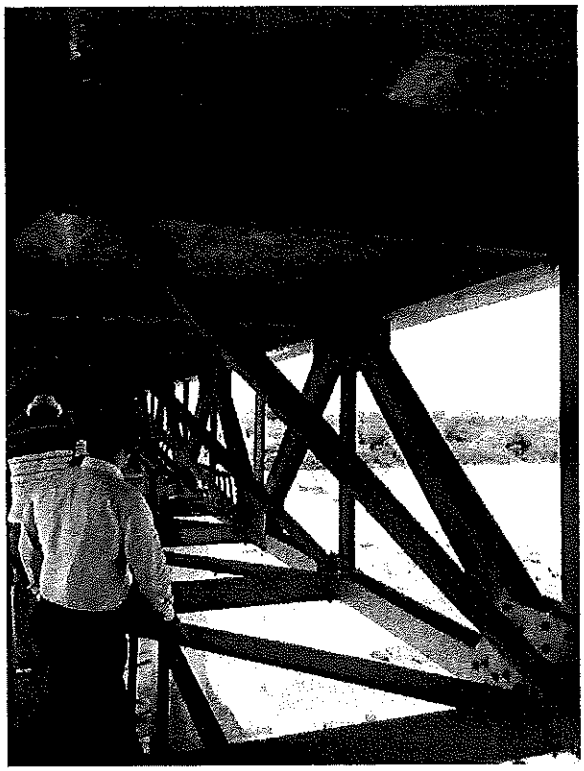


Figure 17. Yapei Bridge. Side truss over side span.

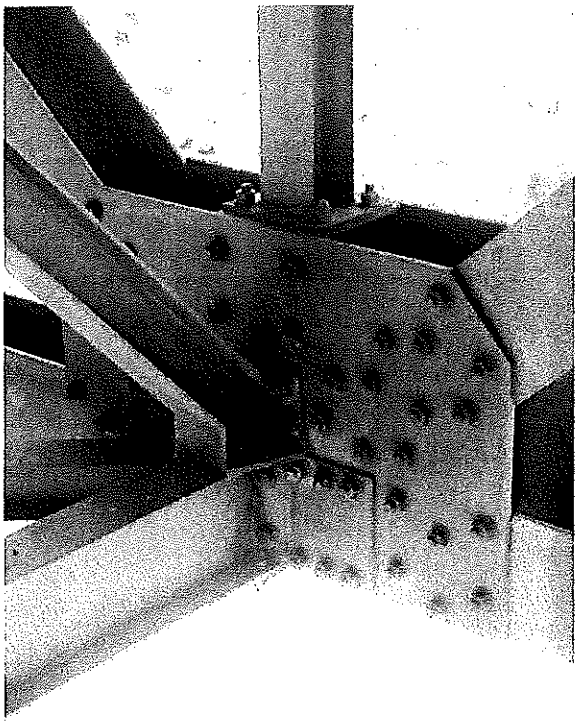


Figure 18. Yapei Bridge. Detail of truss lower node connection to intermediate diaphragm.

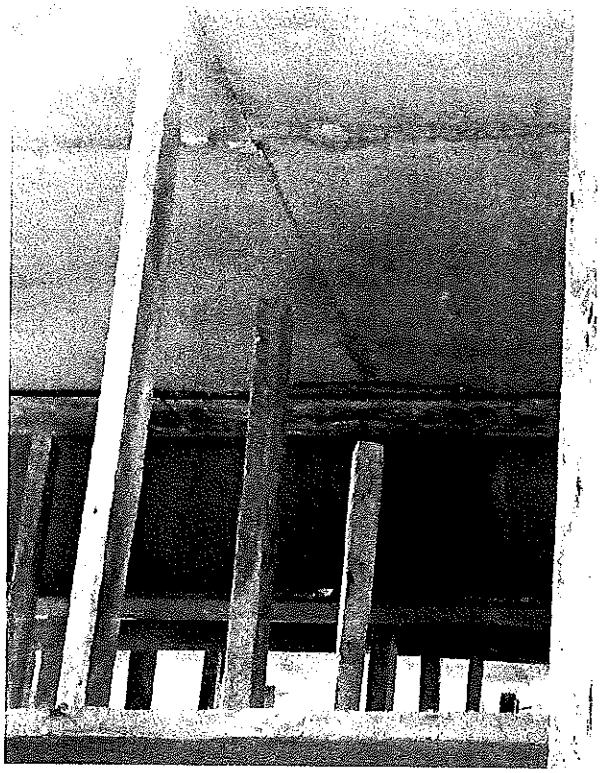


Figure 19. Yapei Bridge. Remaining support scaffolding wood elements used in recent intervention.

Figure 20. Yapei Bridge. Cracks in top of concrete pier.

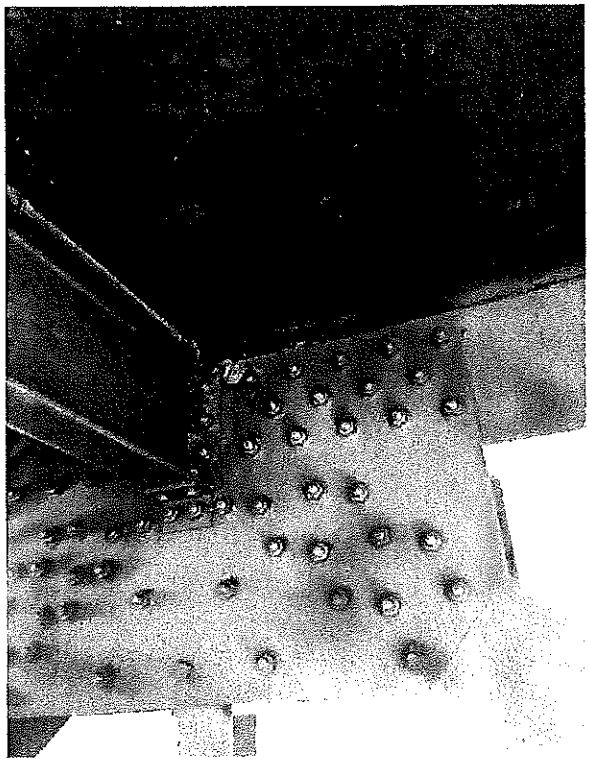


Figure 21. Yapei Bridge. Detail of truss upper node and connection to Intermediate diaphragm.

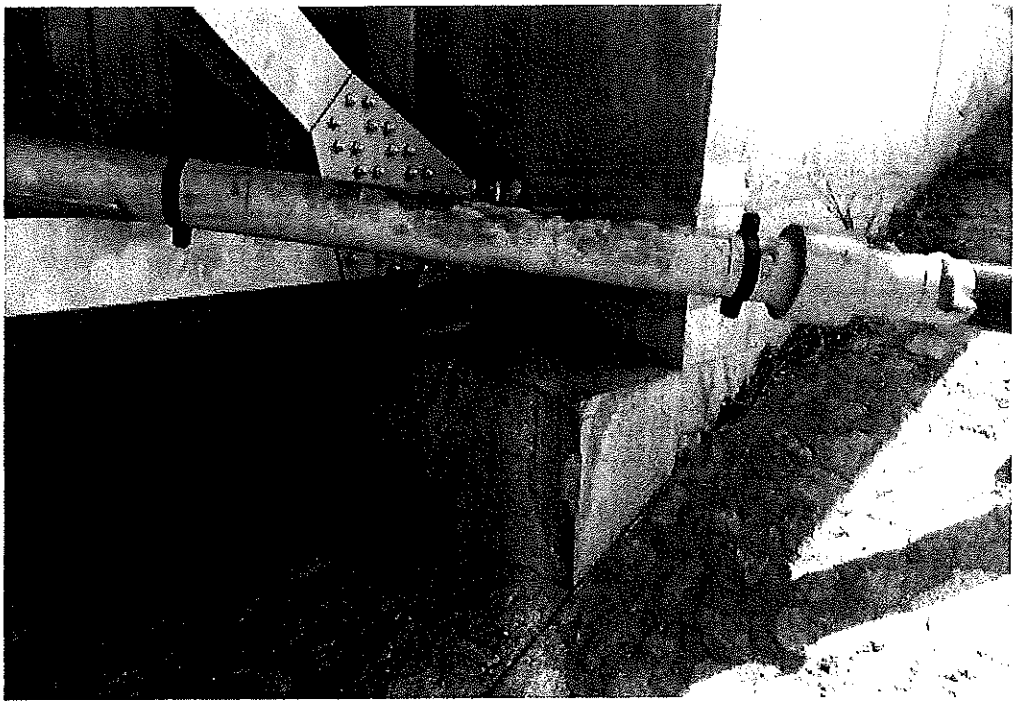


Figure 22. Yapei Bridge. Detail of support on abutments and water pipe crossing the bridge.

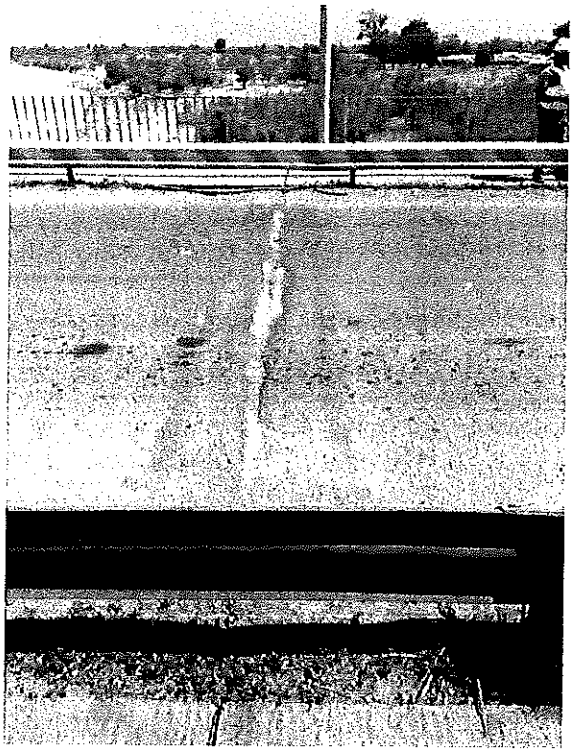


Figure 23. Yapei Bridge. Pavement close to intermediate joint between slab segments.

Figure 24. Yapei Bridge. Detail of intermediate joint between lab segments.

Figure 25. Yapei Bridge. Steel plates over intermediate joint with visible reinforcement.

Figure 26. Yapei Bridge. Steel plates spanning the void in the concrete deck in an intermediate joint.

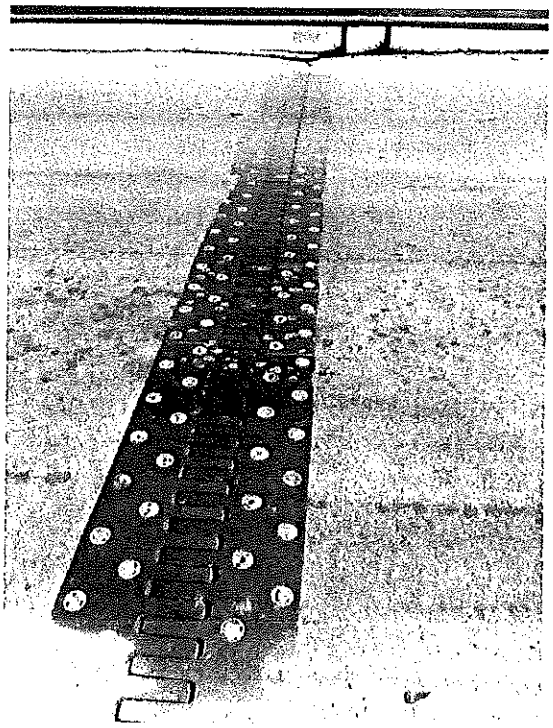


Figure 27. Yapei Bridge. Finger type steel joint in abutments.

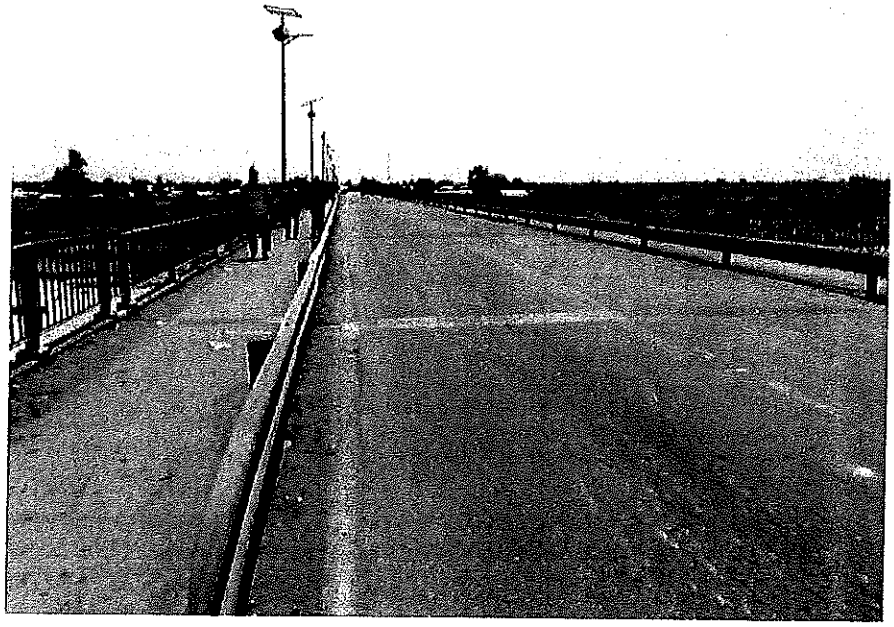


Figure 28. Aerial view of Yapei Bridge over White Volta, towards west.

3.3 POTENTIAL DAMAGES TO BE CONTROLLED DURING MAINTENANCE PERIOD

3.3.1 CONCRETE ELEMENTS

After 53 year of service life, some concrete elements show signs of cracking induced by rebar corrosion.

Typically this is cracking is related with carbonation induced corrosion. Concrete carbonation is a natural phenomenon, which consists in the reaction of Ca(OH)2 present in concrete with carbon dioxide from air.

This reaction provokes a reduction of the concrete mass alkalinity. When concrete pH drops below 9.50, concrete cannot provide protection to rebar corrosion anymore, and the rate at which embedded steel corrodes increases significantly.

This potential corrosion depends not only on concrete pH and carbonation phenomenon, but in many ambient aspects, humidity and dryness cycles being very relevant.

This is why areas close to leaking joints, malfunctioning drainage pipes, and pier elements close to joints are more prone to suffer corrosion and subsequent carbonation induced cracking.

There are some other cracked areas of the concrete slab, where cracking may be probably due to concrete fatigue. These would include the longitudinal crack in the bridge axis of the Buipe bridge, and the cracks associated with the development of potholes in the slabs.

Maintenance activities should thus consider:

- Detailed bridge inspection and assessment of carbonation, corroded areas, and areas where concrete delamination may occur (potential potholes).
- Repair project and repairing interventions to ensure service life extension at a minimum cost.
- These repairing interventions may include:
  - Located patching where necessary
  - Apply preventative measures to avoid carbonation and corrosion progress (anti-carbonation painting).
  - Eventual deck substitution. This is the recommendation included in the GHA for the mid term and seems a reasonable scenario.

The bridge may also show some other cracks associated to normal service conditions. Regarding these cracks, it should be pointed that cracks showing a width below or equal the width accepted in the actual codes will require no treatment at all. Wider cracks would have to be sealed or injected depending on their origin.

3.3.2 STEEL ELEMENTS

According to the information provided in invitation to tender, there are signs of substantial corrosion in the flanges of the upper chord of the truss components.

These signs of corrosion are concentrated close to the joints between slab segments, as they are the preferential path for water leakage through the deck, and near the deck drainage points too.

Typical deterioration in steel decks alike the Yapei and Buipe bridges are:

- Deterioration of protective coatings and associated steel corrosion.

- Loose or missing bolts in connections.
- Fatigue cracks in steel plates in nodes.
- Welding cracks.
- Local deflection in wens or flanges.
- Water blockage in truss nodes.
- Dirt accumulation in longitudinal elements.

3.3.3 BEARINGS

Bearings are of great importance for the proper response of the structure, so it is essential they are in perfect condition during its useful life.

Apparently the actual steel bearing devices show proper behaviour, with no actual evidence of damage.

Potential damages will most likely occur in those elements where dirt or abandoned construction elements may affect bearing displacement capacity. Besides this, bearings in piers with expansion joints are more likely to suffer damages due to the joints eventual loss of watertight on the.

Generally service life for this kind of devices is lower than structure's service life, and it is remarkable that the bearings behaviour has been so good for more than 50 years, considering that the range of temperature variation is significant.

Future maintenance should consider thus periodic bearing maintenance and eventual bearing substitution.

Actual piers allow for jacking devise placement for bearing removal and subtitution.

3.3.4 EXPANSION JOINTS

Expansion joints are highly susceptible to decay, especially under high and heavy traffic load condition.

Frequent cycles of stopping and starting of vehicles will made these elements to be replaced several times during the lifetime of the structure.

It is evident that expansion joints are, today, the bridges critical point both from a maintenance and traffic comfort perspective.

In some of the piers the joint is totally missing and decay has extended to the surrounding concrete deck areas, which will require local but major intervention.

Condition of all joints shall be established and, when necessary, measures shall be taken to substitute joints which are in poor condition, namely:

- Joints where sealant material has been lost.
- Joints with misalignment between asphalt and joint elements.
- Joints with missing anchor elements or bolts.
- Joints where proper operation is not possible due to external unexpected restraints.

3.3.5 DRAINAGE SYSTEM

Regular cleaning on the drainage system should be performed to prevent presence of dirt or debris in the drainage system.

Damages associated to the bridge drainage system malfunction are well known: water stains around pipes, leaks, etc. In addition to routine maintenance it is high recommended to pay special attention to cleaning and, if necessary, repair of the drainage system after storms or rain.

During the inspection it is important to pay attention to wet spots that might show an inappropriate operating of the drainage system.

3.3.6 ROAD SURFACE

Inspections should cover the asphalt conditions.

Actual pavement condition seems regular, but the age of actual pavement is unknown and cracks may appear at the end of pavement service life due to high traffic conditions.

Cracking should be corrected by sealing the cracks with mastic asphalt or other specific product.

It is important to perform this maintenance to prevent water filtering to the concrete deck, which could damage the deck waterproofing system.

Deterioration on the pavement should not in any circumstance be repaired by increasing pavement thickness with a new asphalt layer, unless dictated by a specific study. Asphalt milling is necessary before applying a new asphalt layer, by milling a thickness equal to the one to be applied.

If pavement milling is planned, substitution of actual deck waterproofing system should be accounted for.

3.3.7 SIDEWALKS

On sidewalks, only pavement deterioration is to be accounted for, even if it has no structural significance. Nevertheless, this damage should be repaired for users comfort.

3.3.8 PARAPETS, RAILINGS AND BARRIERS

The most common damages on these elements are those mentioned when considering the steel elements, such as corrosion, rust stains, or painting deterioration. Together with these damages, vehicle impacts and vandalism are to take into consideration when inspecting these security elements.

The easy access to these elements makes them more susceptible to paint deterioration, so maintenance operations should be carried out more frequently than other metallic elements of the bridge.

3.3.9 LIGHTNING

As in the case of sidewalks, damage regarding lighting system on the bridge has no particular significance. Nevertheless, elements which have suffered some kind of damage should be repaired.

4 BRIDGE INSPECTION TYPES

The structures shall be periodically inspected during their remaining service life. Three levels or types of inspections are typically considered, namely: basic or routine inspection, main inspection and special inspection.

4.1 BASIC OR ROUTINE INSPECTIONS

Basic or routine inspections are those carried out by the road maintenance staff, for instance the personnel of the concessionaire company.

The goal of routine inspections is to obtain information about bridge condition during the routine maintenance operations that would be done anyway. The purpose of these inspections is to detect failures as soon as possible in order to minimize maintenance and repairing costs.

This kind of inspection includes the completion of a simple form, where only significant and severe damages are listed.

The proposed frequency of these inspections is six months, coinciding with rainy and dry season beginning.

At the end of each routine inspection, the following actions, when appropriate, will take place.

- Routine maintenance operations if no significant damages of have been recorded.
- Main or special inspection if problems which may evolve were detected.

The following listed damages will help the routine inspector identify situations on which main or especial inspection is recommended.

- Humidity stains on concrete elements.
- Misalignment between asphalt and joint.
- Fissures or cracks in welds or bolts on steel elements.
- Corrosion in steel plates with apparent thickness loss.
- Diagonal cracks on concrete piers, even those of capillary opening.
- Transverse cracks on the concrete slab, width bigger than 0.3 mm.
- Re-bar cross-section loss bigger than 10%.
- Deformations or alignment loss on the plates of truss elements.
- Excessive deformations on bearings, neoprene cracking, breaking or displacement.

4.2 MAIN INSPECTIONS

Main Inspections are visual inspections performed by qualified personnel to determine the state of deterioration of the elements thoroughly.

Main inspections require the use of filling an inspection form.

Unlike routine inspections, main inspections require participation of specialized engineers who know what to look for, where to look for it and how to interpret what they see.

The result of the inspection must consider the type of detected damages, their extension and their intensity, and must conclude in a general or overall index that corresponds to a certain degree of overall condition.

The proposed frequency for these inspections is 60 months from initial principal inspection, if not earlier necessary. Frequency could be reduced depending on the importance of damages observed in the future.

The main inspection requires particular equipment such as traffic control signalling, digital photo camera, binoculars, crack measuring card, mirror, laser distance meter, etc.

4.3 SPECIAL INSPECTIONS

Special inspections are performed with all kinds of special equipment and specialized personnel in order to study structural pathologies in detail. Consequently, they provide enough information to generate detailed structure status reports and strengthening projects when necessary.

This kind of inspection is recommended when, as a result from basic or main inspections, one or more damages have had a quick progression through time and they may result in loss of security or functionality for users. This inspection is deemed necessary too when bridges show a lack of structural capacity to withstand the traffic or other loads.

Some accidental events, such as vehicle impacts, may make necessary to perform a special inspection to assess the eventual impact of the accidental event on the structure.

Inspectors must be equipped with the instruments listed before and be completely accredited to realize the inspection.

5 MAINTENANCE SCHEDULE FOR EXISTING BRIDGES

5.1 YAPEI AND BUIPE BRIDGES - ACTUAL STATE ASSESSMENT

The invitation to tender documents points that the Applicant must submit a plan to conduct an assessment of the state of the current bridges, and refers to some Inspection Reports attached that have not been provided with the tender documents.

As inspection reports have not been available at this moment, the Applicant has performed a preliminary visual inspection in order to define the following plan to conduct the bridges actual condition assessment:

A.- EXISTING DOCUMENTS ANALYSIS

All the bridges existing and available information should be gathered together and subsequently thoroughly analyzed.

This step is critical as it may provide info about the existing material properties, dead and live loads considered in the original project, project basis of design, eventual details that may be specially sensitive to fatigue or durability problems, etc.

B.- MAIN OR SPECIAL INSPECTION

Depending on the amount of available information it may be necessary or recommendable to perform a new visual inspection or even a special inspection.

A typical inspection scope in case like this would include:

- Thorough visual inspection using the existing inspection platform. The purpose of the inspection would mainly be to allocate eventual crack in steel elements, as well as assessing extension and intensity of other damages.
- Depending on the available information and the final client requests, it may be necessary to take measures of all the dimensions and thickness of the steel elements in the deck, and of the nodes configuration. The purpose of this would be to have the necessary information to perform a structural analysis and estimate the structural capacity of the deck.
- In this particular case, it would seem appropriate to ascertain the concrete deck condition using the Hammer Sound & Chain Drag (HSCD) methods.

  These methods are typically used to detect moderate to severe delamination in concrete structures. The objective of these methods is to detect regions of the deck where the sound from dragging the chain or hitting with a hammer changes from a clear ringing sound (sound deck) to a somewhat mute and hollow sound (delaminated deck).

  Chain drag is a fast method for determining the location of moderate to severe delaminated area. The speed of chain drag varies with the level of deterioration of the deck and the experience of the inspector.

  Chain dragging is carried out using a custom-made tool consisting of one or more steel chains attached to a handle so that the operator can drag or swing the chains.

  Any normal hammer can be used for hammer sounding.

Hammer sounding is a slower method, more appropriate for smaller areas. Hammer sounding can be used in conjunction with chain drag in order to better define the size and extent of a delamination.

Chain drag and hammer sounding can be categorized as crude vibrational modal tests. The operator drags chains or strikes a hammer on the deck, listening to the resulting sound.

A clear ringing sound represents a sound deck while a mute/hollow sound represents a delaminated area.

The hollow sound is a result of the flexural oscillations of the delaminated section of the deck, creating a drum-like effect. Flexural oscillation of a delaminated area is typically in a 1 to 3 kHz range. This is within the audible range of a human ear.

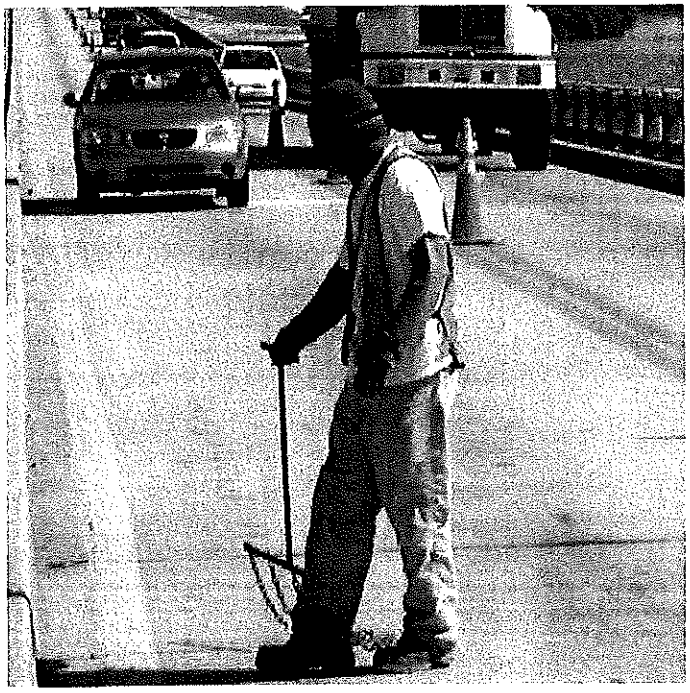


Figure 29. Chain drag in progress.

For chain dragging, the operator drags the chain on the deck while listening to the sound that the chain makes. Delaminated areas will be detected based on the audible response of the deck. A clear ringing sound represents a sound deck while a mute/hollow sound represents a delaminated deck. The operator marks the locations that are perceived as delaminated.

Chain drag gives a more general indication of the delamination location. To get more accurate information about the size and shape of the delamination, hammer sounding can be conducted by tapping the concrete surface with an ordinary masonry hammer and listening for the response. Similar to the chain drag, a clear ringing sound represents a sound deck while a mute/hollow sound represents the delaminated deck. The operator marks the detected delaminated areas during the survey.

It must be pointed, however, that chain dragging and hammer sound must be performed when traffic noise is minimal, and that both methods are generally ineffective for delamination detection on decks with asphalt overlays.

- Eventually it could be also recommendable to take some material samples to:
    - Verify that the material properties are those indicated in the original project, or that they match with the typical practice of the time of construction in the UK.
    - Perform some in situ and lab test to estimate remaining service life of concrete elements affected by carbonation induced corrosion, in case delamination extension does not imply recommending deck substitution.

C.- BRIDGES ASSESSMENT REPORT

The inspection report would cover the following topics:

- Bridge description.
- Visual inspection.
- Structural analysis and load rating.
- Estimate of remaining service life.
- Recommendation for future interventions, focused both in durability and improvement of structural capacity.

5.2 YAPEI AND BUIPE BRIDGES – PROSPECTIVE REQUIRED INTERVENTIONS

Although the available information at this point is very limited, the Yapei and Buipe bridges could require the following interventions:

5.2.1 WORST CASE SCENARIO – CONCRETE DECK SUBSTITUION

GHA reports clearly state that decks will need to be replaced in the midterm.

In case the special inspection finds major delamination, deck replacement may be more economical that pot hole repair in the short term and periodical new pothole repairing. In this scenario, prospective required interventions would include:

- Sidewalks, railing, handrail and pavement removal.
- Concrete deck removal.
- Steel deck repainting.
- Steel bearing specialized maintenance or substitution.
- Piers local patching and repairing.
- New concrete deck.
- Bridge deck waterproofing.
- New expansion joints renewal.
- New deck drainage system.
- New railing, walkway and handrail.

In case the special inspection finds limited delamination, deck replacement may not be recommendable in the short term, and in this scenario, prospective required interventions would include:

- Pavement removal.
- Bridge deck waterproofing.
- Repair of joints between slab segments.
- Repair of por holes in the concrete slabs.
- Expansion joints renewal.
- Improvement of deck drainage system.
- Refurbishment of railing, walkway and handrail.
- Concrete deck repair.
- Steel deck repainting.
- Steel bearing specialized maintenance or substitution.
- Piers local patching and repairing.

Obviously the scope of the interventions will depend upon:

- The actual condition, to be confirmed.
- The period during which the bridges need to be maintained.
- The Client requirements.

5.3 YAPEI AND BUIPE BRIDGES – ORDINARY MAINTENANCE SCHEDULE

The following maintenance schedule is defined assuming that the bridges condition is acceptable, this is, the schedule refers to the bridges maintenance to be performed once the necessary interventions recommended after the bridge assessment have been finished.

The target of maintenance operations is to guarantee that the level of security and service performance of the structure is above limits defined as acceptable during the structure service life.

The following types of maintenance operations shall be considered.

5.3.1 BASIC OR ROUTINE MAINTENANCE

Basic or routine maintenance is held regularly on the structure and is basically preventive.

However, routine maintenance is very important, as neglecting routine maintenance brings an increase in the speed of deterioration and, consequently, increases the repairing costs above those derived from regular maintenance.

Some of the recommended basic maintenance operations, which usually do not require qualified personnel, are the following:

- Cleaning and checking the good operating condition of the drainage system and drainage pipes. This checking should be done every three months and always after strong rain and storms, which can accumulate debris or dirt in the drainage system.

- Superficial humidity or dark stain cleaning. These operations are to be carried out every 12 months, at the end of raining season.
- Cleaning of the roadway and sidewalk with fresh water. Recommended frequency is every 2 or 3 months.
- Repair of non-structural chipping on concrete elements which are of little importance.
- Periodical cleaning of bearings. Recommended frequency of one year.
- Cleaning of all exterior surfaces of the structure. Recommended frequency of one year.

5.3.2 SPECIALIZED MAINTENANCE

Specialized maintenance consists of actions carried out by qualified personnel, and which may involve the substitution of elements whose service life has ended.

These maintenance operations are usually the result of previous basic or main inspections which concluded the need to act on the structure.

Some typical specialized maintenance operations are:

- Replacement of drainage elements and/or execution of new drains when existing evidence of a no proper operation of the one installed on the bridge
- Punctual rehabilitation on concrete elements with little impacts or chipping.
- Rehabilitation of concrete surface areas on which there are corrosion of reinforcement steel.
- Punctual maintenance operations on the roadway such as application of sealant materials on cracks and reparations of potholes.
- Repainting of metallic elements whose painting protection has deteriorated.
- Rehabilitation of elements affected by accidental event or vandalism.
- Repair of safety elements such as parapets and railing, lightening and safety signs.
- Reparation or substitution of the expansion joints when necessary.
- Reparation or substitution of the bearings on the bridge when necessary.

5.3.3 MAINTENANCE SCHEDULE

The following table summarizes the maintenance provisions defined in this Manual to be considered in maintenance operations.

BASIC OR ROUTINE INSPECTIONS	To be carried out at least once a year	
BASIC MAINTENANCE ELEMENT	REQUIRED OPERATION	PERIOD
Drainage system	Checking good condition	3 months or after heavy rain and storms
Drainage system	Cleaning	
Concrete surfaces	Superficial humidity or stain cleaning	12 months, end of spring or fall
Roadway and sidewalk	Cleaning with fresh water	3 months
Concrete elements	Rapair of chipping	12 months
Visual inspection of painting	To detect spots and pitting of corrosion	6 months
Bearings	Cleaning	12 months
Joint	Fill in maintenance specific form	Two years
MAIN INSPECTIONS	REQUIRED OPERATION	PERIOD
Bridge	General inspections. External and internal	60 months unless earlier necessary
Joint	According to specific maintenance manual	Two years
Bearings	According to specific maintenance manual	First year - Every five years
SPECIALIZED MAINTENANCE - ELEMENT	REQUIRED OPERATION	PERIOD
Drainage system	Missing or broken element replacement	After main inspection, if necessary
Concrete element	Superficial repairing	After main inspection, if necessary
Concrete element	Rehabilitation of areas in which there is corrosion of reinforcement.	After main inspection, if necessary
Pavement	Crack sealing and pothole repairing	After main inspection, if necessary
Steel elements	Repainting	After main inspection, if necessary
All elements	Rehabilitation after vandalism	After main inspection, if necessary
Safety elements	Rehabilitation of parapets and railing, lightening and safety signs	After main inspection, if necessary
Expansion joints	Substitution if necessary	After main inspection, if necessary
Bearings	Substitution if necessary	After main inspection, if necessary

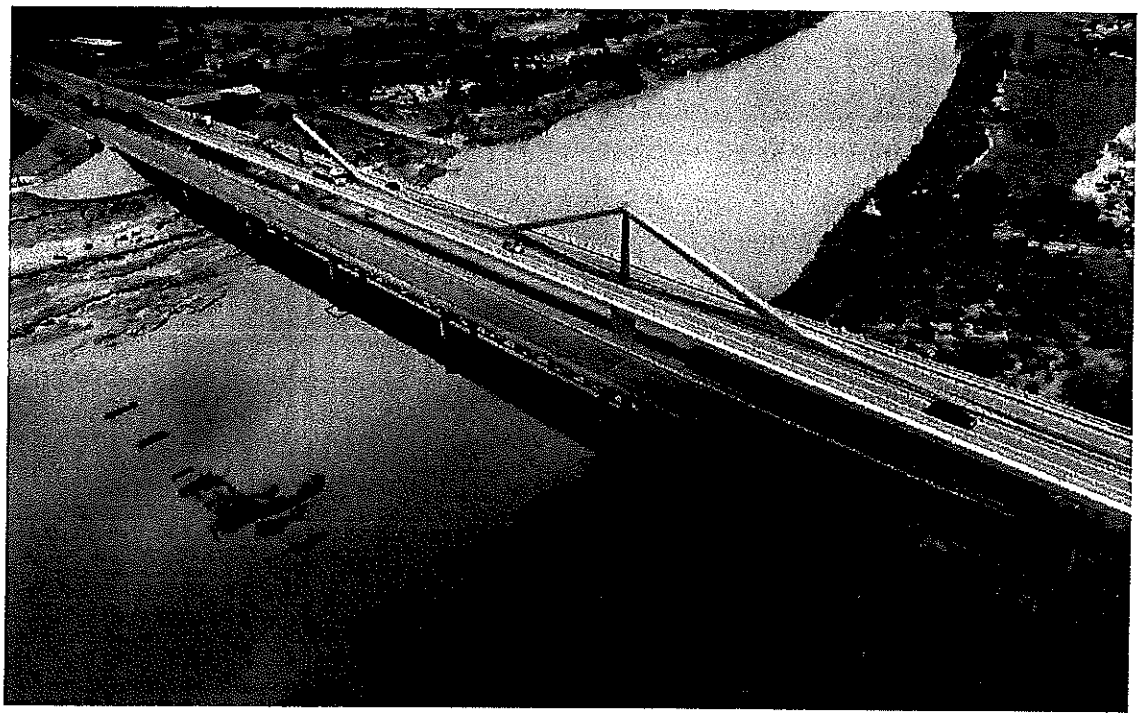
DESIGN AND CONSTRUCTION OF BRIDGES OVER THE BLACK VOLTA AT BUIPE, OVER THE WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA

Volume 2

8) SCOPING REPORT

QGMI

CONSTRUCTION OF THREE BRIDGES IN THE NORTHERN REGION



INITIAL ENVIRONMENTAL EXAMINATION

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EXECUTIVE SUMMARY

The exercise undertaken to prepare this document made it possible to examine the environmental effects and propose mitigation measures for the project.

The analysis was conducted based on desk top studies and information from the technical team designing the project. It also takes into account local and international environmental and social protection requirements.

Comparatively, the alignments proposed is socially, economically and environmentally friendly.

In light of the results obtained, it appears the project will have no significant environmental impact, provided the protective, mitigating and optimisation measures recommended in this document are heeded.

The application of the mitigation measures proposed in will serve to reduce the scope of the expected impacts to such an extent that the residual effects of the bridge project will be insignificant or negligible.

The principal residual effect expected is:

- The modification of the built environment in the communities where the projects are located.

The project will also have positive effects on the environment. The most significant include:

- Boost in local and regional economy;
- Safe linkage to other communities;
- Improved access to certain renowned tourist sites and markets in the northern region of Ghana

1 INTRODUCTION

1.1 Background

The Government has voted an amount of 75 million dollars for the reconstruction of the Buipe, Yapei and the Daboya bridges in the Northern Region. Buipe and the Yapei bridges serve important purposes for the nation as it links the north to the south of Ghana and also serve as international road for the neighbouring Burkina Faso, Mali, Niger and Côte D' Ivoir to Ghana.

The construction a new bridge on the Volta River in Daboya will eliminate the unnecessary loss of lives through boat accidents. The Northern sector of Ghana serves as food basket of the nation and that building a good road network would enhance the economic development of the north and Ghana at large.

The Ministry of Roads and Highways, acting through the Ghana Highway Authority (GHA) intends to pre-qualify Contractors for the finance, design and construction of Three (3) Bridges in the Northern Region as detailed below:

Lot 1 - Design and Construction of Bridge over Black Volta at Buipe; Approximate Span: 240m.
Lot 2 - Design and Construction of Bridge over White Volta at Yapei; Approximate Span: 240m.
Lot 3 - Design and Construction of Bridge over White Volta at Daboya, Approximate Span 300m all with approach roads of approximately 1km in each direction.

1.2 Development type

Bridge activities involve the construction of permanent engineering structures across watercourses and larger rivers. The construction of bridges may impact upon the local environment and river dynamics particularly where instream span supports are required.

The construction of bridges and their associated activities may have significant effects on the surrounding environment. This report gives an initial environmental examination of the project.

1.3 Purpose/Objective of the assignment

The overall goal of the assignment is to carry out an initial Environmental, Social and Health Examination of the location/alignment of the bridge projects. This enables the project to be designed to avoid or minimise negative environmental impacts and provides an opportunity to incorporate positive environmental enhancements into the project.

A principal objective is to identify environmental and social sensitivities and those project activities with the potential to contribute to, or cause, impacts to the environmental and social receptors.

It also ensures that the proposed development is carried out in compliance with the requirements of Environmental legislation and any other relevant legislation relating to pollution control, social and health issues.

1.4 Methodology and Approach of the assignment

- Define an appropriate area of study determined by the extent of direct and indirect impacts on the physical, biological and social environments. This would include the location of the proposed project, adjacent lands, roads, and drainage as well as surrounding communities in and adjacent to the project site that can be affected.

- Once the study area is well defined, both local laws and standards pertaining to environmental and social protection would be described and reviewed.

- Describe and map, to the extent possible, components of the physical, biological and human environments.

- Desktop studies will be carried out to establish the relative baseline data for the environmental and social setting, including an inventory of the environmental and social components that will be affected by the proposed project.

- Using a matrix approach putting in relation components of the environment and potential sources of impact, we would identify impacts on a preliminary basis. Identify and analyze all significant impacts that could arise during the proposed project and proposed mitigation measures.

2 Applicable Legislation

Introduction

The Government of Ghana has specified policy, regulations and guidelines to address the environmental and social risks of any proposed project and its associated components; to preserve and conserve the environment from any adverse impacts.

The proposed activity is subject to legislative and policy requirements at national level. A detailed description of relevant legislation pertaining to the proposed project and the permitting thereof; is outlined below.

A summary of the most relevant and significant national legislation that may apply to the project is detailed below.

2.1 The Environmental Assessment Regulations of 1999 (LI 1652)

Part 1, Section 1 states that:

"No person shall commence any undertakings to which a matter in the Schedule relates, unless prior to the commencement, the undertaking has been registered by the Agency and an environmental permit has been issued by the Agency in respect of the undertaking".

Section 2 also states that:

"No person shall commence activities in respect of any undertaking, which in the opinion of the Agency has or is likely to have adverse effect on the environment or public health unless, prior to the commencement, the undertaking has been registered by the Agency"

2.2 Environmental Protection Agency Act 1994 (Act 490)

Section 12 (1) states that:

"The Agency may by notice in writing require any person responsible for any undertaking which in the opinion of the Agency has or is likely to have adverse effect on the environment to submit to the Agency in respect of the undertaking an environmental assessment containing such information within such period as shall be specified in the notice".

2.3 The Fees and Charges (Amendment) Instrument, 2015 (LI 2228)

This instrument requires Proponents to pay processing and permitting fees before permits are issued. The above regulations specify the fees and charges for environmental permits and certificates which shall be paid to the Agency in respect of the matters specified in relation to them in the schedules.

2.4 Environmental Guidelines

The EPA has developed several documents providing guidance on regulatory requirements for environmental protection and, in particular, the environmental assessment process.

In particular, the EPA provides guidance and outlines procedures to be followed by the operator during the environmental assessment process within the document "Environmental Assessment in Ghana, a Guide to Environmental Impact Assessment Procedures" (EPA, 1996).

Other guidelines issued by the EPA and relevant for the Project are listed below:

Environmental Assessment in Ghana, a Guide to Environmental Impact Assessment Procedures (EPA, 1996);

EPA Environmental Quality Guidelines for Ambient Air;

EPA Sector Specific Effluent Quality Guidelines for Discharges into Natural Water Bodies;

EPA General Environmental Quality Standards for Industrial or Facility Effluents, Air Quality and Noise Levels;

The design, construction and operation of the proposed project will comply with the standards set by these guidelines.

2.5 Environmental and Social Management Framework (ESMF) and Resettlement Policy Framework (RFP)

The Ministry of Roads and Highways (MRH) has prepared an Environmental and Social Management Framework (ESMF) as well as a Resettlement Policy Framework (RPF) to be used as guidelines for the Transport Sector Development Program (TSDP) but with focus on road sector projects.

The ESMF and RPF represent statements of policy, guiding principles and procedures, as well as environmental and social safeguards instruments of reference for the road sector projects, agreeable to all key stakeholders such as the EPA, the World Bank, Danida, EU, AfDB, MRH and the implementing Agencies.

The purpose of the ESMF and RPF is to provide corporate environmental, social and resettlement safeguard policy frameworks, institutional arrangements and capacity available to identify and mitigate potential safeguard issues and impacts of each sub-project. It is envisaged that with the preparation and use of the above-mentioned documents/guidelines, national, local environmental and social requirements will be met which will also be consistent with the World Bank's OP4.01, OP4.12 and other applicable safeguards.

2.6 Biodiversity Legislation

The main legislative texts which regulate biodiversity in Ghana are:

- The Wild Animals Preservation Act, 1961, (Act 43);
- The Wildlife Conservation Regulations 1971 (LI 685); and
- The Wild Reserves Regulations 1971 (LI 740).

The Wild Animals Preservation Act, 1961 (Act 43), amended in 1983, allows the Minister to appoint honorary game officers. The Act addresses the collection of specimens for scientific

purposes and prohibits anyone from exporting any trophy from Ghana. The act also identifies the (wholly or partially) protected faunal species.

Regulation on trophy hunting, exporting, and penalties are written in the Wildlife Conservation Regulations 1971 (LI 685), as amended in 1989. The Regulations also provides other provisions for the conservation and protection of faunal species in Ghana.

The Wild Reserves Regulations 1971 (LI 740) allow for the designation and proclamation of protected areas, in various categories. The regulations prohibit certain activities (e.g. hunting, removal of faunal or floral species) allowed within the various reserves without a permit. The regulations forbid the pollution of water resources and littering within a protected area.

Finally, it should be noted that the Forestry Commission Act, 1999 (Act 571) establishes a Forestry Commission that is responsible for protection, development, management and regulation of forests and wildlife.

Project activities will need to adhere to the requirements set out in the above legislation in regards to the biodiversity preservation and minimising pollution to the environment.

2.7 Water Resources Commission, 1996 (Act 552)

The Water Resources Commission Act of 1996, Act 522, which established the Water Resources Commission empowers the commission as the sole agent responsible for the regulation and management of the utilisation of water resources, and for the coordination of any policy in relation to them in the country. The commission does this through granting of water rights. Section 13 of Act 522 stipulates that "No person shall divert, dam, store, abstract or use water resources; construct or maintain any works for the use of water resources except in accordance with the provisions of this act". The main objective of the Water Resources Commission is to establish comprehensive plans for the use, conservation, protection, development and improvements of Ghana's water resources. Water rights must be obtained for the use of water resources, on application from the Commission, who has the competence to grant rights for the exploitation of water resources.

The Project will need to ensure that any associated water use and construction over any waterway; as well as effluent discharged into the environment complies with the requirements under these Acts.

2.8 Water and Sewerage Corporation Act (Act 310 of 1965)

The Water and Sewerage Corporation Act, 1965 (Act 310), amended in 1969, establishes the Ghana Water and Sewerage Corporation, defines its composition, functions and maintenance, and repeals the previous Waterworks Ordinance (Cap. 67). The object of the Corporation is the provision, distribution and conservation of the supply of water in Ghana for public, domestic and industrial purposes and the establishment, operation and control of sewerage systems of such purposes. In addition, the Water and Sewerage Corporation is authorised to formulate regulations regarding the prevention of water pollution.

The Project will need to ensure that any associated water use as well as effluent and sewage released into the environment complies with the requirements under these Acts.

2.9 Pollution Control

Relating to the pollution legislation, there is currently no single integrated framework in Ghana. Pollution control is mainly defined through environmental and water resource legislation.

In particular, Section 2(f) of the Environmental Protection Act (1994) enables the EPA to issue pollution abatement notices for: "controlling the volume, types, constituents and effects of waste discharges, emissions, deposits or other source of pollutants and of substances which are hazardous or potentially dangerous to the quality of the environment or any segment of the environment [...]"

Section 2(h) of the Act also allows the EPA to prescribe standards and guidelines relating to air, water, land and other forms of environmental pollution. And, Section 2(j) requires the EPA to co-operate with District Assemblies and other bodies to control pollution.

The Water Resources Commission Act also addresses the control of water pollution. Section 24 of the Act prohibits the interference, altering, pollution or fouling of water resources beyond levels prescribed by the EPA and prescribes penalties for non-compliance.

2.10 Fisheries Act, 2002 (Act 625)

The Fisheries Act, 2002 (Act 625), which repealed the former Fisheries Commissions Act, 1993 (Act 457), aims to consolidate and amend the law on fisheries. The Act provides for the regulation, management and development of fisheries and promotes the sustainable exploitation of fishery resources.

Section 93 requires that the Fisheries Commission be informed of any activities likely to have substantial impact on fishery resources before commencement of the activity and allows the Fisheries Commission to require reports and recommendations by the proponent on the likely impact of the activity and possible means of preventing or minimising adverse impacts which shall be taken into account in the planning of the activities.

2.11 Occupational Safety and Health Policy of Ghana (Draft), 2004

The policy statement of the OSH Policy (Draft), 2004 is: 'to prevent accidents and injuries arising out of or linked with or occurring in the course of work, by minimizing as far as reasonably practicable the cause of the hazards in the working environment and, therefore the risk to which employees and the public may be exposed'. The policy is derived from provisions of Conventions 155 and 161 of the International Labour Organization (ILO), and the policy document has specific sections on objectives, scope, strategies, activities promotion and awareness creation which ensure that workers are protected.

2.12 Labour Act, 2003 (Act 651)

The Labour Act, 2003 (Act 651) amended and consolidated existing laws relating to labour, employers, trade unions and industrial relations. The Act provides for the rights and duties of employers and workers; legal or illegal strike; guarantees trade unions and freedom of associations and establishes the Labour Commission to mediate and act in respect of all labour

issues. Under Part XV (Occupational Health, Safety and Environment), the Act explicitly indicates that it is the duty of an employer to ensure that every worker works under satisfactory, safe and healthy conditions.

Summary of Applicable Laws

Applicable Legislative Instrument	Issue
Environmental Protection Agency Act, 1994 (Act 490)	Environmental Protection
Environmental Assessment in Ghana, a Guide to Environmental Impact Assessment Procedures (EPA, 1996).	Environmental Protection
EPA Environmental Quality Guidelines for Ambient Air and Noise Quality	Environmental Protection
Environmental Assessment Regulations, 1999 (LI 1652) Environmental Assessment (2002 Amendment) Regulations	EIA requirements and process
Wild Animals Preservation Act, Act 235 1964	Biodiversity
Wildlife Conservation Regulations 1971 (LI 685),	Biodiversity
Wild Reserves Regulations 1971 (LI 740)	Biodiversity
Water Resources Commission Act (Act 522 of 1996)	Water Resources
Water and Sewerage Corporation Act (Act 310 of 1965).	Water Resources
Ghana Highways Authority (Act 540 of 1997)	Transport activities
Labor Act, 2003, Act 651	Labour and Social responsibilities
The Children's Act (Act 560) of 1998	Labour and Social responsibilities
Commission on Human Rights and Administrative Justice Act (Act No. 456 of 1993)	Labour and Social responsibilities
Local Government Act 462	Land management
Town and Country Planning Ordinance, 1945	Land management
Lands Commission Act, 1994 (Act 483)	Land management

3 Project Description

The Government has voted an amount of 75 million dollars for the reconstruction of the Buipe, Yapei and the Daboya bridges in the Northern Region. The existing Buipe and the Yapei bridges serve important purposes for the nation as it links the north to the south of Ghana and also serve as international road for the neighbouring Burkina Faso, Mali, Niger and Côte D' Ivoir to Ghana. The project is to replace the over 54-year-old Buipe-Yapei bridges.

The Ministry of Roads and Highways acting through the Ghana Highway Authority is the implementing agency for the project consisting of the following,

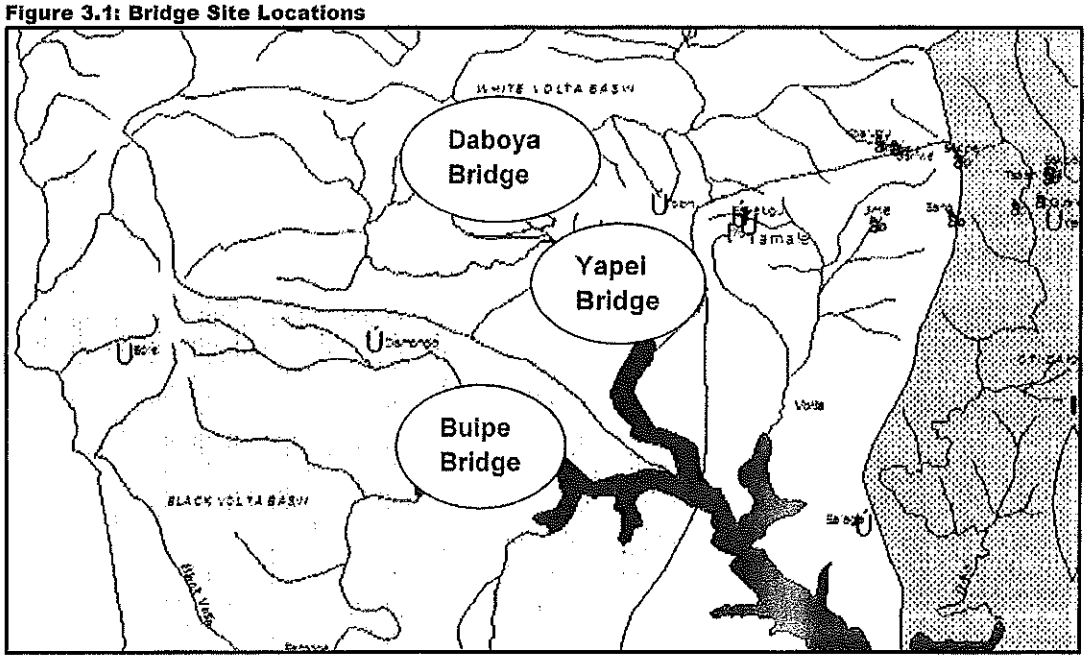
1. Design and Construction of Bridge over Black Volta at Buipe, approx. span 240m
2. Design and Construction of Bridge over White Volta at Yapei, approx. span 240m
3. Design and Construction of Bridge over White Volta at Daboya, approx. span 300m

The works are to be completed within 24 months. The Contractor will secure funding for the project of which financing terms and conditions shall be acceptable and approved by the Ministry of Finance.

3.1 Project Location

All the project bridges are located in the Northern Region. The Buipe and Yapei bridges are located in the Central Gonja District over the Black and White Volta respectively and the Daboya site is at the North Gonja district over the Volta River. For the relative locations of Yapei, Buipe and Daboya see figure below.

Figure 3.1: Bridge Site Locations



3.1.1 Yapei

The existing Yapei Bridge on the White Volta River in the Central Gonja District is about 43 km south-west of the regional capital, Tamale of the Northern region of Ghana. The White Volta River drains the catchment area and passes through Yapei in a north southward direction. The river is a perennial water body with an average width of about 150 m and headstream of the great Volta River in West Africa, which has maximum depth of 75 m, an average depth of 18.8 m and elevation of 85 m above sea level.

There are some landing stages, which were constructed in the sixties of the last century. However, these facilities are not used anymore, due to the low water levels of the White Volta, which were the result of the construction of a dam in Burkina Faso (Bonney, 2016).

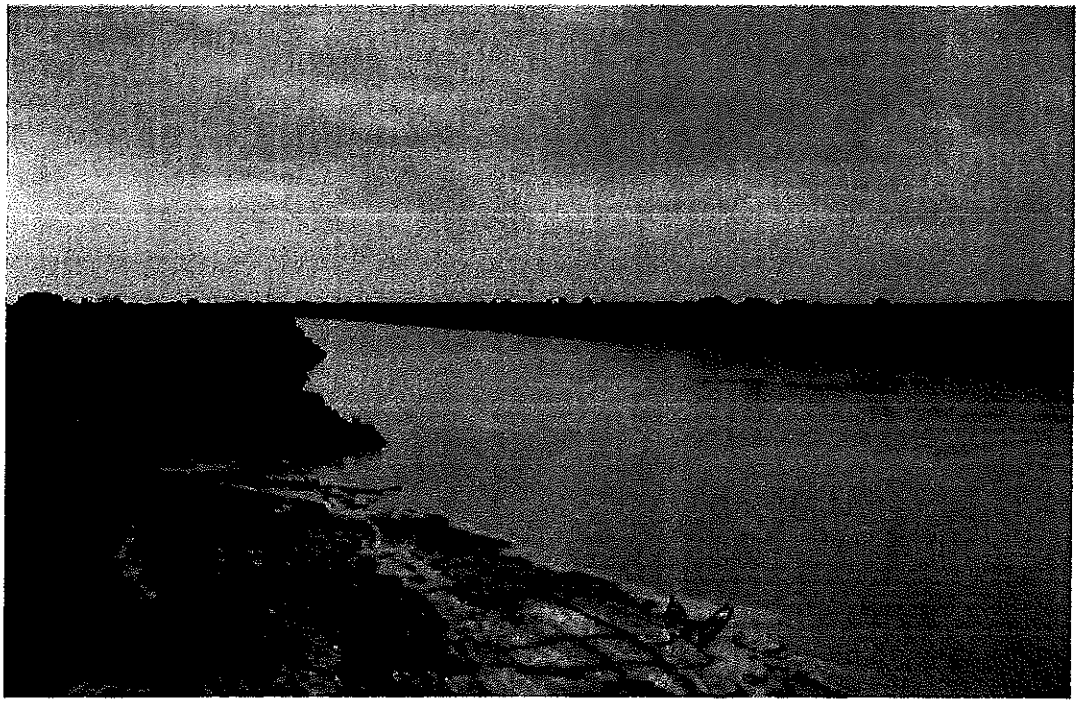


Photo 3-2: The White Volta at Yapei

3.1.2 Daboya

Daboya is located in the northwest of Tamale approximately 67 Kilometres from Tamale. The White Volta River runs by the town and offers a great deal of potential for boating, canoeing and fishing. Remnants of construction materials concrete intended for a bridge construction can still be seen along the chosen alignment for the new bridge site.

Despite its rich history and potential natural resources, Daboya remains one of the poorest and most neglected towns in Ghana. One of the prominent reasons for the poor conditions and lack of development in that area is because the town and its surrounding villages are relatively inaccessible by road due to the river. Once at the bank of the White Volta, passengers on this route will have to rely on a dugout canoe/barge to ferry them across the river to Daboya.

3.1.3 Buipe

The bridge site at Buipe, a place along the Black Volta, already has some port facilities, which were built in the mid-eighties of last century (Bonney, 2016). In fact, the only Inland Water Transport service currently active at the Ghanaian inland waters, uses Buipe Port as their most northern destination. The port is basically a landing stage for barges and has no dedicated quay equipment.

The bridge site has existing settlement to the west and the east side of the site. Existing port activity, wet market, industrial and settlements has been in operation organically and provides some quantum for the development. The site has good access since its located along the major highway between Tamale and Kumasi. Black Volta River has a high overflow during the monsoon that potentially flood the site. The existing settlements are located in the low-lying area that is prone to flood. Existing power line located on the east side of the site provide design constrain.

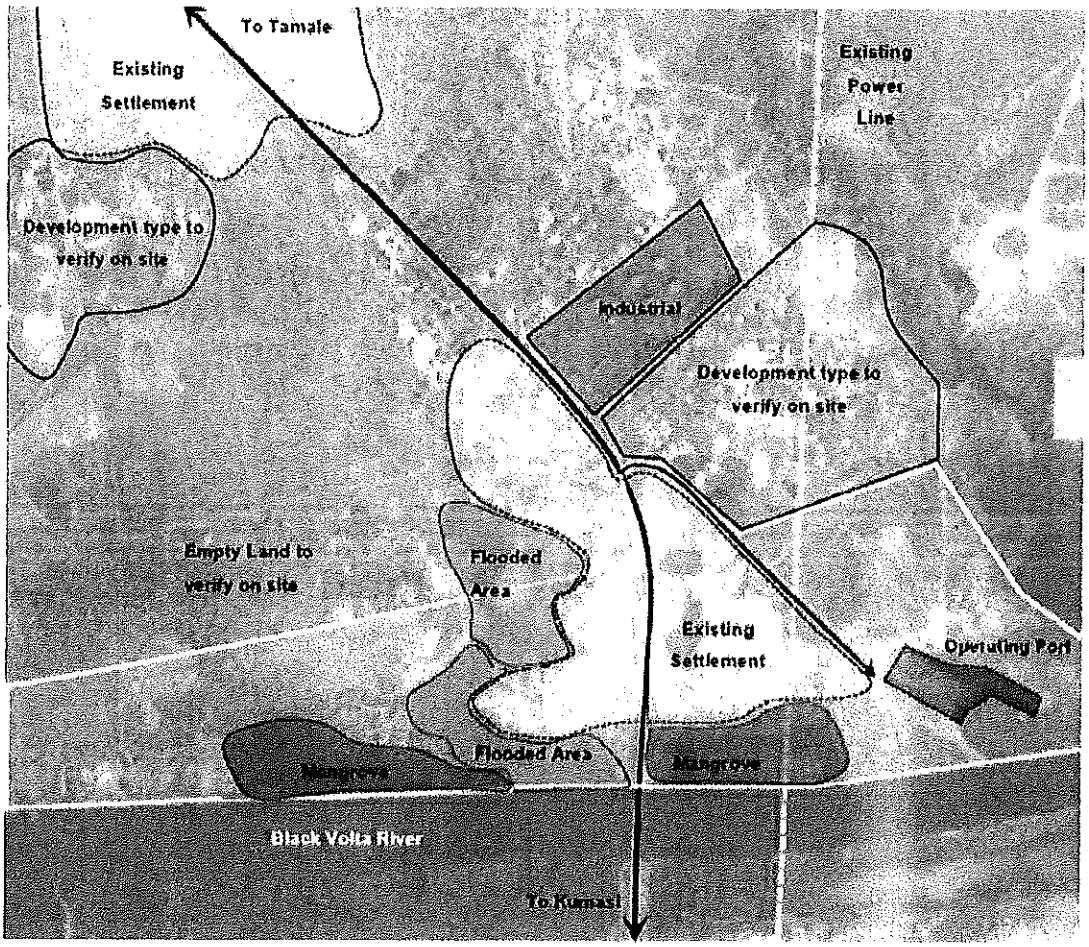


Figure 3.3: Buipe study Area

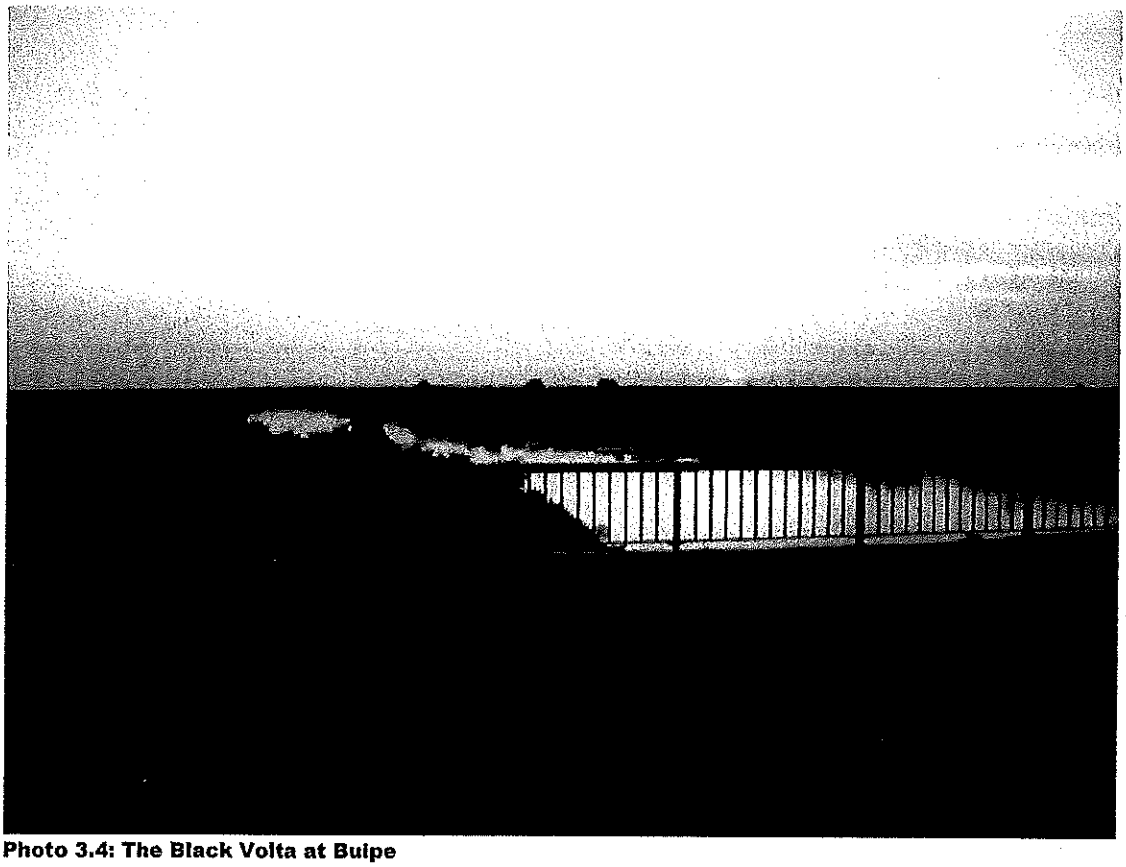


Photo 3.4: The Black Volta at Buipe

3.1.4 Proposed Design

From findings coupled with the detailed assessment of the flow regime of the hydrology and hydraulic studies for the proposed bridge construction at the chosen sites over the White and Black Volta Rivers; a 120m clear span over two (2) piers is proposed for the 240m span bridge in contrast with the existing five (5) pier bridge at Yapei and Buipe. This is will ease flow of the Rivers.

Considering high volume of traffic on the Yapei and Buipe bridges it is expedient the two independent bridges are delineated for easy construction. A 240m by 12m wide bridge is proposed. The bridge width is made up of a 7m carriageway with a 2.5m wide walkway/cycle lane on both sides. The walkway will be separated from the carriageway by a New Jersey barrier.

The proposed alignment for the Buipe bridge will be aligned 12m from the existing bridge, whilst that for the Yapei bridge will be aligned 20m from the existing bridge. The Daboya bridge will adopt the alignment already existing at the site.

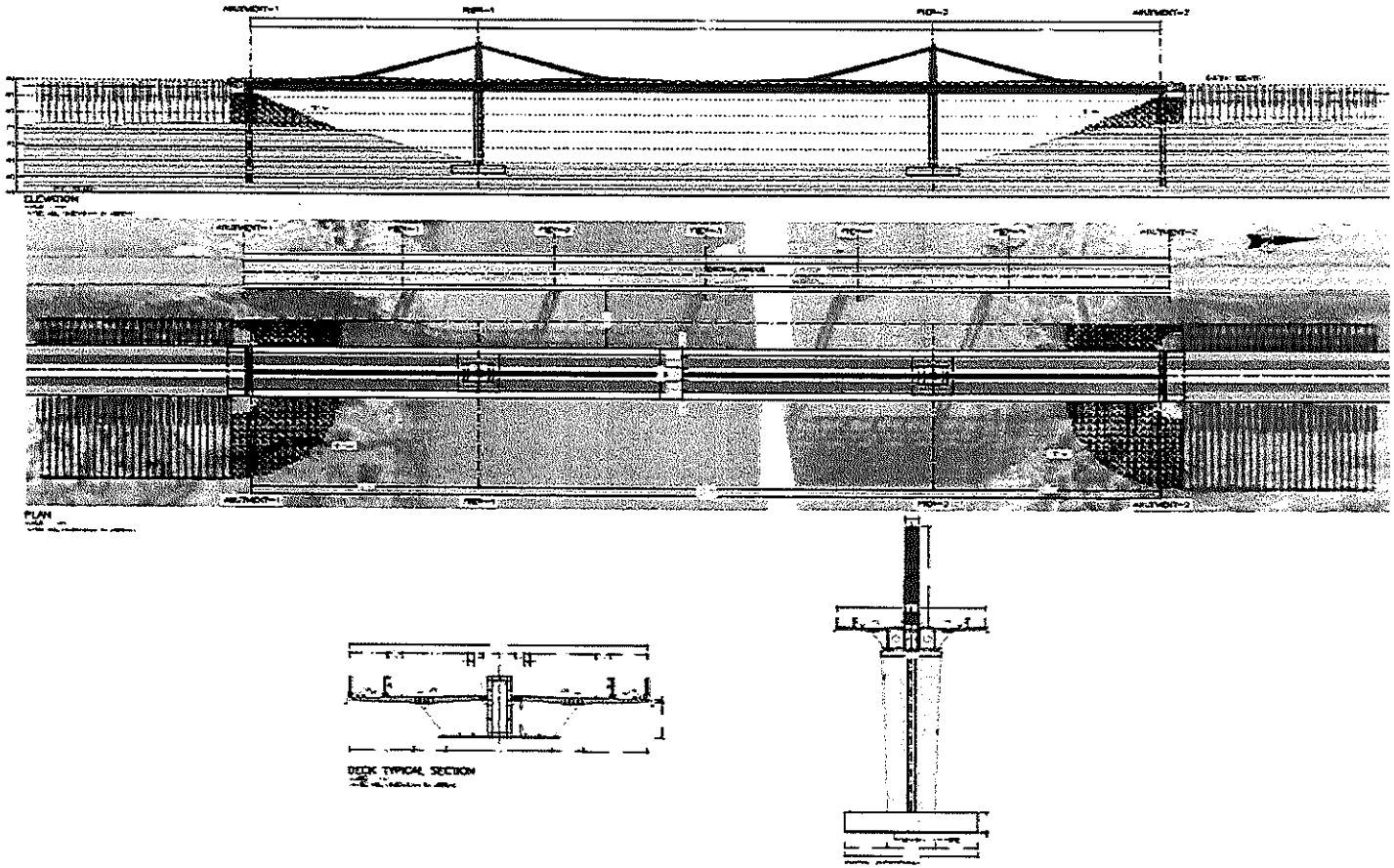
Comparatively, the alignments proposed is socially, economically and environmentally friendly.

The project as outlined above will:

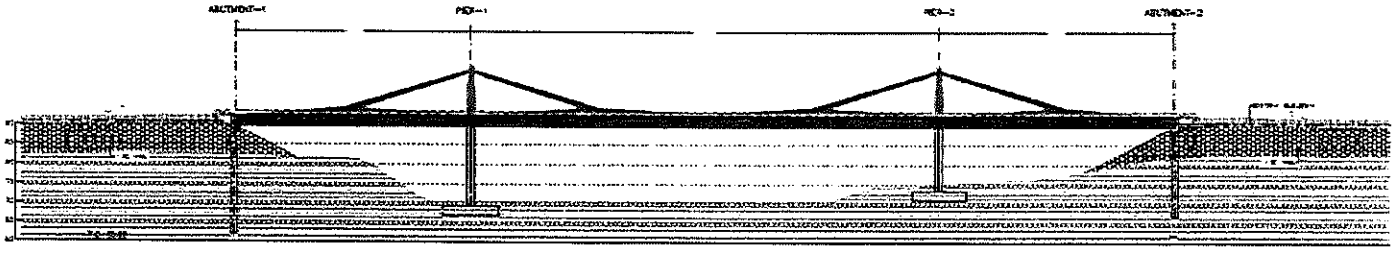
- provide safe and reliable river crossings for road transport to the travelling public;
- Allow free flow of river without impediments in the form of instream pier supports;
- enhance the economic potential and activities at the local and national level.

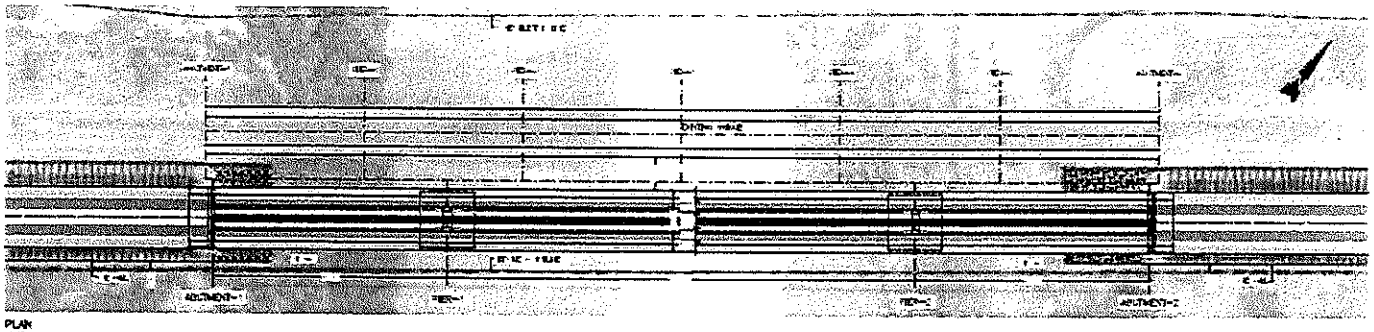
The advantages or benefits expected from this proposed bridge alignments have been outlined above. Although there are environmental implications, appropriate measures could be implemented to mitigate the adverse impacts. This explains why the solution types have been proposed for implementation.

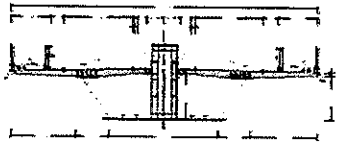
Proposed Designs

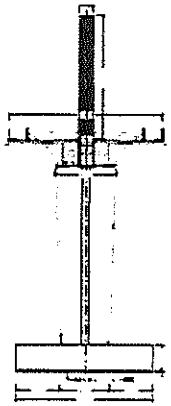


Proposed design with chosen alignment along the existing bridge at Buipe

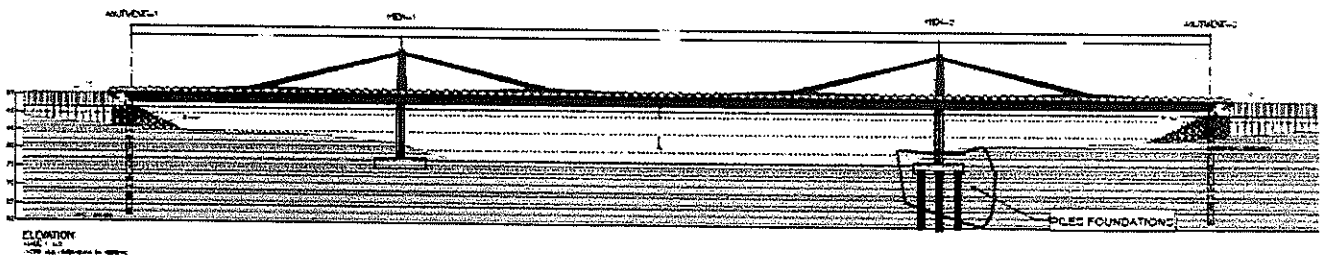


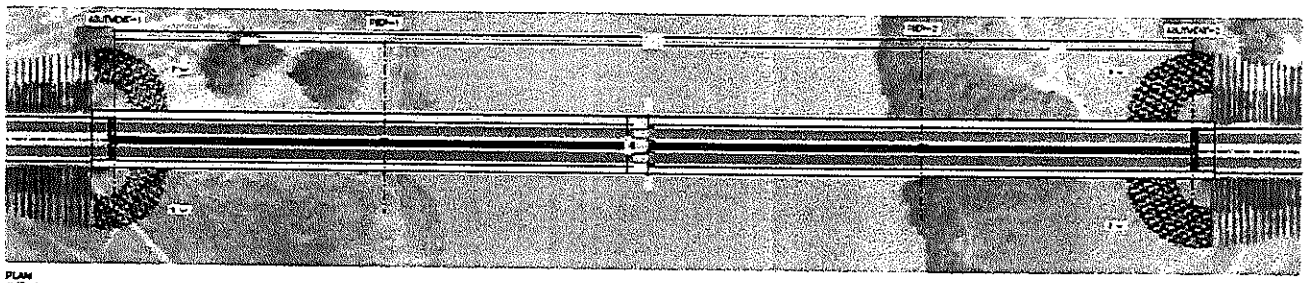


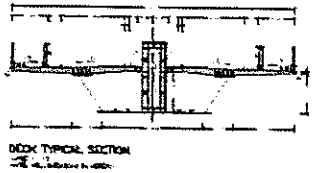


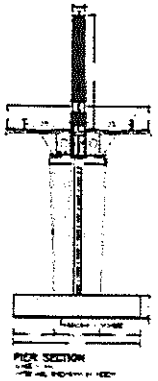


Proposed design with chosen alignment along the existing bridge at Yapei









Proposed design with chosen alignment at Daboya

4 ENVIRONMENTAL DESCRIPTION

4.1 Physical Environment

4.1.1 Topography and Drainage

The landform of the study areas is low lying but gently undulating at attitudes ranging between 150m – 300m above sea level though some parts average 600m. The area is traversed by two major rivers the White Volta which flows longitudinally through the district, and the Black Volta which forms the Southern Boundary, with Kintampo North District. A lot of streams crisscross the study areas and flow into the two Volta Rivers.

4.1.2 Geology and Soils

The study area is situated in an old geological area. The rocks are mainly of the Voltaian formation with isolated Cambrian rocks which contain valuable minerals such as gold and diamond. Limestone occurs between the lower and middle Voltaian formation around Bulpe. Generally, the soils in the study areas are fertile for agriculture purposes.

Soil types formed in the study areas are alluvial, laterite and savanna ochrosols. Alluvial soils are potentially fertile and are mostly found along the two Volta Rivers, their tributaries and the large plains.

4.1.3 Climate

The climate of the study areas lies within the tropical continental zone. The annual rainfall is unevenly distributed and limited to six months from May to October. The mean annual rainfall ranges between 1000 -1500 mm with its peak in September. The relative humidity is between 70-90 percent during the long dry season.

Temperatures are generally high and exhibit seasonal variation. The mean annual temperature of 35°C with maximum temperature of about 40°C is usually recorded in March to April. Temperatures are lowest, on average 22°C, between November and January due to the influence of the North -easterly winds otherwise known as harmattan.

4.2 Natural Environment

4.2.1 Vegetation

The study areas lie in the Guinean savannah which covers the majority of the northern portion of Ghana, or approximately 170,000 km^2. The major tree species are sheanut, Dawadawa, Baobab, Acacia, Neem and few Ebony. These trees are scattered except in most valleys where isolated wood land or gallery forest are found. Most of these trees are deciduous, shedding their leaves during the dry season in order to conserve water.

The major tree species along the project sites are mostly mangroves, Acacia and shrubs. The appearance of the study zone changes greatly with the seasons. During the wet season, the greenery dominates and the grasses grow rapidly. However, shortly after the rains have ended, the leaves change colour rapidly and fall, leaving an impression of desolation. The Guinean savannah has been greatly transformed by humanity through the years, and the landscape as it now appears is the result of repeated assaults caused by the practice of agriculture, livestock breeding and brush fires.

The original vegetation in major settlements such as Bulpe, Yapei, has been destroyed by human activities. Bush fires, charcoal burning and fetching of, in particular, firewood have reached alarming proportions which must, therefore, be checked to avoid environmental problems in future.

4.2.2 Aquatic fauna

Aquatic ecosystems include the White Volta, Black Volta. These waterways are also used for irrigation and drinking water. It is estimated that approximately 124 species of fish inhabit these waters. Abobi et al. (2014) reported Labeo senegalensis as one of the top 10 most abundant species out of 52 freshwater species encountered at the Yapei stretch of the White Volta. People in Buipe, Yapei and Daboya depend on the fisheries for their livelihood.

4.2.3 Land Use

The people are predominantly farmers using the abundant fertile lands to cultivate food and tree crops such as maize, rice, groundnuts, sorghum, millet, yam, cassava, cowpea soya bean cashew and mango. Livestock reared include cattle, sheep, goats, pigs, whilst poultry production also includes local poultry, ducks, guinea fowls and turkeys. Fishing is also an economic activity which is carried out primarily by Gonjas and Battoirs on the white and Black Volta Rivers and its tributaries across the study areas.

4.2.4 Water Resources

Potable water is generally scarce in the district, less than 10% of the population has access to potable water. A few communities depend on boreholes and hand-dag-well for domestic and other uses. There are limited prospects for development of sustainable boreholes in the district because of its difficult hydrogeological terrain. Other sources of potable water thus need to be explored and develop. The District Capital Buipe is however connected to a small-town pipe water system.

The discharges of the upstream Volta Rivers show a strong variability during a year. This is due to the local climate, which for many rivers results in hardly any discharges during the dry seasons (November – March), and peak discharges during the rainy seasons (July – September). During the rainy seasons, the discharges of the Black Volta and the White Volta can be about 5,000-7,500 m^3/s and 1,500-2,000 m^3/s respectively.

The water levels of the upstream Volta Rivers follow the same pattern as the discharges: high water levels during the rainy seasons and low water levels during the dry seasons. At several locations, the water levels during the dry period are less than a meter. Based on the hydrological data, it can be concluded that only at Buipe (Black Volta), the minimum water levels are most of the times still significant, with average water levels of several meters during the dry seasons.

BASINS	WATER RESOURCES MANAGEMENT ISSUES
BLACK VOLTA BASIN	• Regulatory, administrative and institutional conditions. • Flooding • Water pollution and improper land-use • Water shortage
WHITE VOLTA BASIN	• Flooding • Water shortage • Regulatory, administrative and institutional conditions. • High fluoride concentrations in groundwater • Water pollution and improper land-use • High salinity of groundwater • socio-cultural conditions, economic and financial aspects

5 Potential Environmental Impacts

The assessment to "identify, describe and assess the direct and indirect effects of the project on the following factors: human beings, fauna and flora; soil, water, air, climate and the landscape; material assets and the cultural heritage; and the interaction between the factors." Socio-economic issues, health and safety in the workplace, material assets and cultural heritage are all co

g the end of operations. Developers and site operators should therefore consider the impacts arising from both construction activities and operational practices and following the end of on-site activities.

Potential impacts are discussed here in broad terms only as their nature and intensity will depend on the physical characteristics of the project and the composition of any polluting materials. An assessment of proposed bridge construction activities should take these factors into account in assessing potential impacts on the environment.

This detail the activities involved in the construction, daily running and decommissioning of bridge developments, and the impacts arising from them.

5.1 Water environment

Surface water hydrology can be affected during all phases of bridge activities. Construction activities can result in compaction of soils and an increase in impermeable (or slowly permeable) surfaces. The subsequent increase in surface runoff may, in turn, increase the risk of flooding. Bridges can potentially alter the flow regimes of the river thereby affecting water velocity, depth, depositional patterns and channel morphology. These changes in turn may increase the risk of flooding and erosion.

Surface water quality could be affected by a number of factors during operations on site. Construction activities may encourage soil erosion and increase the sediment loads of nearby streams, while accidental leaks/spills of oil/fuel from storage tanks or construction, maintenance and decommissioning vehicles can also pollute surface waters.

Construction activities may also have significant impacts on groundwater hydrology and quality. The site may need to be drained to provide suitable conditions for the engineering works to occur, resulting in temporary changes to ground flow. Also, soil contaminated from a previous land use may be disturbed during construction works, causing pollutants such as heavy metals to enter ground and surface waters.

5.2 Land

Bridge projects will have implications for land-take, the physical characteristics and land use of the site. Issues to consider include the effect on landscape character from change in land use, soil erosion and compaction resulting from the construction and decommissioning phases of the development. The potential for contamination via runoff from roads and hardstandings must be addressed.

5.3 Air and climatic factors

The construction and decommissioning phases of bridge developments have the potential to affect local air quality and climate.
During these activities, local air quality may decline as a result of gaseous and particulate emissions from vehicle movements on and off site.

5.4 Ecology

The removal of native vegetation and its replacement with bridge engineering structures can cause direct damage, disturbances, fragmentation or loss of terrestrial and aquatic habitats and ecology.

Construction and decommissioning activities could also result in the increased sediment loading of streams and changes in turbidity may impact adversely upon aquatic populations. In addition to this, local ecological populations may be adversely affected by pollution incidents attributed to fuel leaks and oil spills associated with construction, maintenance and decommissioning operations on site. The physical presence of both bridge engineering structures may affect ecological populations in a number of ways. The local ecology may be disrupted as habitat corridors become severed. Bridges in particular will cause some shading of the river bank and bed thereby potentially altering the aquatic flora present in the river bed. Ecological impacts may operate over a longer time-scale, as populations take time to respond to environmental changes (time lag).

5.5 Human environment

The potential impacts of a development for bridges on the human environment may take a variety of forms. They are divided here into sections covering socio-economic and health issues; amenity and nuisance issues; and culture, heritage and archaeology.

The potential for socio-economic and health impacts (real and perceived) arising from bridge and developments is likely to be small. Such operations usually require comparatively small staffing levels and, as a result, employees are not likely to have a significant effect on local socio-economic issues.

The identification of which of these issues are significant or are perceived to be significant is an important function of public involvement during the scoping exercise. Understanding likely public concerns is a key issue and reference to experiences from other similar developments.
Other issues that commonly need to be addressed are the visual impact of the engineering structures and any additional buildings associated with it. Any restrictions to access that may arise as a result of the development should also be considered, as should the creation of nuisances

such as noise and vibration from traffic during the construction and decommissioning phases, dust in the air, and mud and slow vehicles on public roads. Also, the amenity use of nearby streams may be affected if reduced water quality causes harm to fish.

Impacts on architectural and archaeological heritage may arise from site preparation and construction, as features may be removed or disturbed.

The potential Impact table below highlights:

- Sources of impact (development activities);
- Potential impacts and Receptors for these impacts.

Potential receptor of Impact		Activities and potential Impacts		
		Construction phase	**Operation Phase/ongoing site maintenance**	**Decommissioning/post operation**
Water	Surface water hydrology and channel morphology	**Use of vehicles and machinery** • Increase in surface runoff from soil compaction **Works next to or near watercourses** • Change in flow velocities • Increased erosion and changes in bank stability • Increased flood risk **Earthworks** • Increased sedimentation of watercourses	**Physical presence of bridge** • Upstream potential impediment to flow, decreased water velocity and increased depth – increased flood risk • Change in deposition regime upstream, caused by changes in flow and potential flood risk and changes to riffle/pools • Downstream potential increased water velocity, and turbulence and erosion	**Site drainage** • Increase in surface runoff from bank areas due to soil compaction • Possible increased flood risk
	Surface water quality	**Earthworks** • Pollution from suspended material • Disturbance of contaminated soil and subsequent pollution of watercourses **Materials management** • Pollution from spills or leaks of fuel, oil and construction materials	**Physical presence of bridge** • Upstream impounded waters will reduce oxygenation • Downstream water quality may be reduced by increased turbidity.	**Materials management** • Pollution of surface water by fuel and oil spillages from vehicular activities
	Groundwater hydrology	**Earthworks and site drainage** • Reduction in water table • Changes to groundwater distribution and flow	**Physical presence bridge** • No significant impacts	**Materials management** • Pollution of surface water by fuel and oil spillages from vehicular activities
	Groundwater quality	**Earthworks** • Disturbance of contaminated soil and subsequent groundwater pollution **Materials management** • Pollution from spills or leaks of fuel, oil and building materials	**Physical presence of bridge** • No significant impacts **Maintenance work and materials management** • Contamination from spills or leaks of fuel and oil from routine maintenance work	**Materials management** • Pollution of groundwater by fuel and oil spillages from the decommissioning vehicular activities
Land	Landscape	**Excavations and earthworks** • Creation of a new landform	**Physical presence of bridge** • Change in character of landscape	**Decommissioning** • Temporary visual impacts from work being carried out on site
	Soils	**Use of vehicles and machinery on site** • Compaction • Erosion **Earthworks** • Further erosion of exposed soil • Removal or alteration of soils on site for bridge construction	**Use of vehicles and machinery for on site maintenance** • Soil compaction • Soil erosion **Physical presence of bridge** • No significant impact	**Use of vehicles and machinery on site** • Compaction • Erosion **Decommissioning earthworks** • Further erosion of exposed soil • Removal or alteration of soils on site for bridge removal
	Geology	**Excavations** • Removal of rock by excavation works		

Air	Local air quality	**Use of vehicles and machinery** • Emissions from construction site traffic • Dust generation	**Use of vehicles and machinery for on site maintenance** • Short-term exhaust emissions no significant impact	**Decommissioning activities** • Temporary vehicular emissions associated with site remediation

Flora and Fauna	Aquatic Ecology	**Materials management** • Harm to aquatic flora and fauna from oil, fuel, cement or other substances entering watercourses	**Physical presence of the bridge** • Changes to deposition, depth and water velocities may result in the loss of sensitive plant, invertebrate and fish species • Turbidity may contribute to reduced ecological diversity • Potential downstream changes to the aquatic community • Shading of the watercourse may reduce aquatic flora in the vicinity of the bridge • Potential barrier to fish migration and the movement of aquatic mammals along the river corridor **Materials management from ongoing site maintenance** • Direct and indirect effects from oil, fuel or other substances entering the aquatic environment	**Decommissioning activities** • Negative impact on aquatic flora and fauna from increased sediment loading of streams **Materials management** • Harm to aquatic flora and fauna from oil, fuel, cement or other substances entering watercourses **Restoration design** • Opportunity for enhancement of nature conservation value
	Terrestrial Ecology	**Earthworks and excavations** • Habitat removal, fragmentation or severance • Disturbance to vegetation	**Physical presence of bridge** • Loss of riparian habitat by virtue of land use adjacent to a watercourse for development	**Decommissioning activities** • Negative impact on terrestrial flora and fauna from vehicular activities, disturbance and habitat severance.

Human Environment	Socioeconomic	**Earthworks and excavations** • Disruption of services and roads where construction activities occur near to highways • Construction-related employment	**Physical presence of bridge** • Potential for disruption to commercial and recreational navigation • Changes to fishing quality near site	**Restoration design and after-use** • Public perception of the area may improve following sensitive restoration plans
	Health and safety	**Earthworks and excavations** • Risk of injury on construction site • Risk of injury through construction traffic **Negative publicity** • Adverse reaction to perceived health issues	**Physical presence of bridge** • Risk of harm to humans falling from the structure into the watercourse	**Decommissioning activities** • Risk of accident or injury to authorised and unauthorised persons on site
	Nuisance	**Use of vehicles and machinery** • Noise from construction traffic and operations • Mud on roads	**Use site maintenance vehicles and machinery** • Noise **Physical presence of bridge** • Collection of unsightly litter behind the structures	**Decommissioning activities** • Temporary noise nuisance caused to communities proximal to the decommissioning activities

6 Impact Identification and Evaluation

Definition of study Area

The extent of the assessment study covered the Area of Influence (AOI) of the Project, which was defined based on the aspects of the environment and socio-economy relating to the surrounding area in which the development will take place (i.e. within the Project 'footprint') and the areas which may be directly or indirectly affected by the proposed Project.

The study zone used for the purposes of this environmental evaluation has an indicative application boundary of width 100m and length of 2.5km for direct impacts and a radii of 5km for indirect impacts. The width and length of the zone is sufficient to take into consideration the direct and indirect impacts associated with the proposed project.

6.1 General Scope of Analysis

An environmental and socio-economic evaluation must identify and mitigate the short and long-term impacts of a project. An environmental and socio-economic impact may be positive or negative, depending on whether it enhances or degrades existing conditions of an environmental and socio-economic component.

In addition to describing the project, preparing an impact evaluation also involves performing the following steps:

- Identifying environmental and socio-economic consequences by determining interactions between potential sources of impact, and sensitive receptor components;
- Evaluating the importance of consequences observed

Based on the results of the evaluation, a management and monitoring program, including recommendations to mitigate negative environmental and socio-economic consequences and defining monitoring and follow-up activities.

6.1.1 Sensitive Environmental Components

The description of the environment in the preceding chapter identified sensitive components. These were grouped into three major categories:

- Physical environment: soil, water and air;
- Biological environment: flora and fauna;
- Human environment: land use, communities and livelihoods, health and safety

6.1.2 Degree of Impact

Although environmental consequences cannot be qualified in absolute terms, the changes and trends resulting from the project can be examined and predicted. The potential effects are described according to their degree of significance, as described below.

Negligible effect (○):

A negligible effect is barely perceptible. It affects a population, entity or specific group of individuals in a localized area and/or for a short period of time. It has the same effect as a series of small random changes associated with natural changes that have no measurable impact on a population, an environmental component or a group as a whole.

Insignificant effect (⌂):

An insignificant effect has one or more of the following characteristics:

- It affects a limited space;
- It is temporary or of limited duration (e.g., only during construction);
- It is recurrent effect lasts only for a short period during or after implementation of the project;
- It is not permanent, which means that when the source of the impact disappears, the integrity of the social/environmental components returns.

Significant effect (●):

A significant effect has one or more of the following characteristics:

- It is widespread;
- It permanently contravenes environmental legislation, regulations, standards or objectives;
- It reduces biodiversity;
- It results in the disappearance of important productive habitats;
- It permanently changes the characteristics of a community or services delivered to people, land use or ways land is occupied;
- It leads to the disappearance of archaeological and/or heritage resources.

6.1.3 Potential Impact matrix

Table 6-1 shows the potential impact matrix of the project. It illustrates the potential sources of impact associated with the project and the various environmental components described earlier.

Table 6-1: Impact Matrix

Environmental components			Sources of impact									
				Construction						Operation		
DEGREE OF IMPACT ○ Negligible effect ⌂ Insignificant effect • Significant effect ⊕ Positive effect			Acquisition of ROW	Clearing	Access construction	Earthworks & Excavations	Use of developed material	Workforce/ temporary accommodation	Material transportation	Physical presence of bridge	Use of access road & machinery for maintenance	Maintenance of bridge & road
Physical Environment	Water	Surface water hydrology		⌂		⌂	⌂	⌂	⌂	○		
		Surface water quality		⌂		⌂	•	•	•			
		Groundwater quality		⌂		⌂	•	•	•			⌂
	Land	Landscape		○	⌂	⌂				•		
		Soils		○	⌂	⌂	⌂				⌂	⌂
		Geology		⌂	⌂	⌂	⌂					
	Air	Local air quality		⌂	⌂	⌂	⌂				○	
Biological Environment	Flora and fauna	Aquatic ecology				⌂	⌂	⌂	•			⌂
		Terrestrial ecology		⌂	⌂	⌂	⌂	⌂	•			⌂
Human Environment	Nuisance	Traffic, Noise and waste		⌂	⌂	⌂		⌂		⌂	○	○
	Socio-Economics	Livelihood and Employment		⊕	⊕	⊕				⊕	⊕	
	Health and safety	Risks		⌂	○	○	○	⌂	○	⌂	○	○

6.2 Mitigation measures

Following the scoping exercise and the identification of potential environmental effects, mitigation measures should be proposed to avoid or reduce potential negative impacts to air, water, land, ecology and humans, or to introduce positive aspects to the development

A primary consideration in impact mitigation must be the siting of bridge engineering operations. These should avoid damage to important ecological sites and high-quality landscapes.

6.2.1 Mitigating the impacts of construction activities

Construction and site preparation activities have the potential to affect all environmental receptors. However, the following list summarises the mitigation measures of most relevance for these bridge projects:

- phasing of construction work to minimise disturbance to wildlife at sensitive times of year, such as during the breeding season or when young are being raised;
- use of techniques to minimise compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery.
- use of dust control strategies;
- storage of fuel, equipment and construction materials so as to minimise the risk of soil contamination or water pollution
- setting the route and timing of construction traffic so as to avoid sensitive human receptors;

6.2.2 Mitigating the impacts of the operational phase

Although sensitive siting and design of a development for bridges are the primary means for avoiding or reducing its environmental impacts, further measures can be introduced to minimize impacts occurring from the ongoing management of the site. An overall consideration is that the design and operation of the development are in accordance with the Environmental Protection and other relevant legislation.

The measures have been arranged according to their primary receptor, however it should be noted that many of the following mitigation measures are interrelated. For example, correct storage, use and disposal of chemicals used for site maintenance would reduce the risk of soil contamination, pollution of surface and groundwaters, and harm to terrestrial and aquatic ecology.

6.3 Protecting the Water Environment

In order to minimise potential impacts on the water environment in the design and running of bridge operations, the project proponent must ensure that:

- with regard to bridges, open parapets should be used to allow some over-deck flow in the event of the bridge opening becoming blocked in a major flood event;

- bridge soffit levels and flood spans should be at least 1 metre above the maximum known flood level to allow floating debris to pass freely through the structure;
- an appropriate water management system is used during the construction period;
- oil interceptors or drip trays are used where machinery and vehicles are parked;
- a risk assessment is carried out for each substance to be used or stored on site, and the appropriate containment measures installed.

6.4 Protecting the Land Environment

Impacts on soils and landscape may be mitigated by the following:

- effective stabilisation of altered landforms so as to minimise soil erosion (eg. Use of Ripraps) and the potential for water pollution from suspended solids;
- where the substratum of a watercourse is disturbed by construction, replacement should occur.

6.5 Protecting the Air environment

Developers should consider the aspects of the development that are likely to lead to air emissions.

6.6 Protecting Ecology

Measures designed to prevent or reduce impacts to water or land will also help to prevent adverse impacts on ecology. The following list identifies further measures to reduce or avoid impacts to terrestrial and aquatic species and their habitats:

- existing habitat features should be incorporated into site design and protected from change e.g. giving protection to the mangroves at the site locations;
- further habitats should be created to compensate for habitat losses and to improve the landscape and ecological potential for the site;
- consideration should be given to the provision of features within the bridge design to encourage nesting birds and bats.

6.7 Protecting the Human Environment

Some of the measures noted above can also reduce possible impacts on humans. Mitigation measures more specific to the human environment are listed below:

- management operations should aim to minimise disturbance to adjacent residential and recreational uses;
- where access restrictions result, arrangements for alternative access should be made;

- safety concerns should be addressed by such measures as implementing strict health and safety procedures, and adequate site security to prevent trespass and vandalism;

- sites of cultural interest should be respected.

6.8 Residual effects

The application of the mitigation measures proposed in will serve to reduce the scope of the expected impacts to such an extent that the residual effects of the bridge project will be insignificant or negligible.

The principal residual effect expected is:

- The modification of the built environment in the communities where the projects are located.

The project will also have positive effects on the environment. The most significant include:

- Provide safe and reliable river crossings for road transport to the travelling public;
- Allow free flow of river without impediments in the form of instream pier supports;
- Boost in local and regional economy;
- The creation of employment during the construction and operating phases;
- Improved access to certain renowned tourist sites in the northern region of Ghana

7 CONCLUSION

The exercise undertaken to prepare this document made it possible to examine the environmental effects and propose mitigation measures for the project. The analysis was conducted based on desk top studies and information from the technical team designing the project. It also takes into account local and international environmental and social protection requirements.

In light of the results obtained, it appears the project will have no significant environmental impact, provided the protective, mitigating and optimisation measures recommended in this document are heeded.

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DESIGN AND CONSTRUCTION OF BRIDGES OVER THE BLACK VOLTA AT BUIPE, OVER THE WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA

Volume 2

9) MAINTENANCE PLAN - NEW BRIDGES

MAINTENANCE PLAN

ELASTOMERIC BEARINGS

PROJECTS:

DESIGN AND CONSTRUCTION OF KWAME NKRUMAH CIRCLE INTERCHANGE AND OTHER RELATED ANCILLARY WORKS IN ACCRA
Contract No: DUR/BNPP/AMA/DB/02/12

DESIGN AND CONSTRUCTION OF RING ROAD FLYOVER
Contract No: DUR/BNPP/AMA/DB/01/2014

Alga
TECHNOLOGICAL

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ELASTOMERIC BEARINGS TYPE

ALGABLOC

Maintenance Manual

ASSICURAZIONE QUALITA'
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QUALITY ASSURANCE

Rev.	Date	Written	Approved	Description
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PRELIMINARY NOTE

1 PURPOSE AND SCOPE

1.1 PURPOSE

ALGABLOC bearings includes numerous models, classified according Table 2 European standards, are corresponding to the following types produced by ALGA
Bearings type A, ALGABLOC NB o NBC
Bearings type B, ALGABLOC NB o NBC
Bearings type C "allowing fixing", ALGABLOC NB2, NB3, NB4 o NB6
Bearings type C "profiled", ALGABLOC NB5
Bearings type D, ALGAFLON NTU o NTM (sliding only for irreversibile movements)
Bearings type E, ALGAFLON NTU o NTM
Bearings type F, ALGASTRISCIA NS
This "General recommendations of Inspection and Maintenance" of the devices, has the purpose to define the following :
The general criteria for the correct use of the devices
The procedure to be followed for proper maintenance of the devices
The maintenance program that schedules the checks to be carried out on the devices
The devices are designed to minimize the maintenance operations during their useful life. The expected use duration of the devices is 25 years, under normal conditions and a proper maintenance program with possibly replacement of wearing parts, while the lack of maintenance or improper use drastically reduces their useful life.

1.2 REFERENCE DOCUMENTS

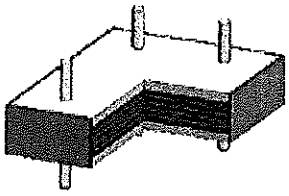
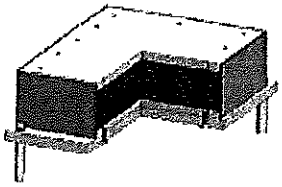
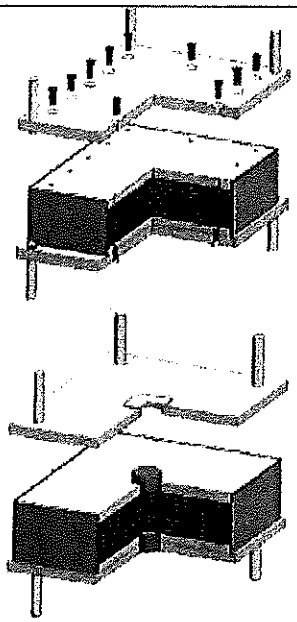
- Elastomeric Bearings Catalogue
- Drawing of Elastomeric Bearings
- Technical report
- Typical installation procedure
- EN1337 §12

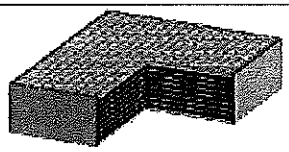
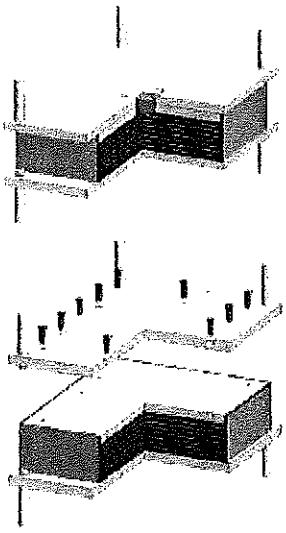
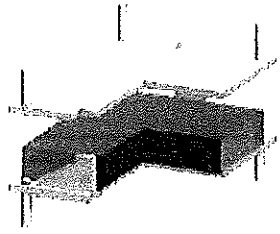
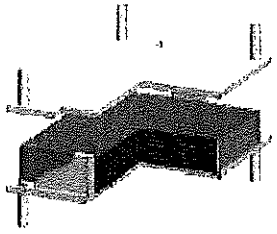
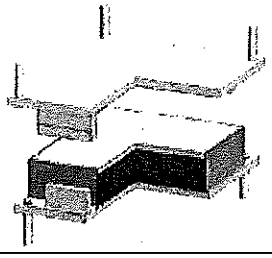
1.3 RESPONSABILITY

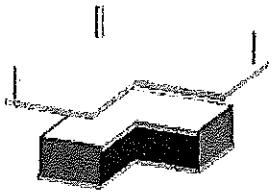
The Customer has the management, the operational and safety responsibility for all activities to be carried out in accordance with this procedure. He also has a duty to inform the Technical Department of Alga, whenever are detected anomalies or damages to the device, and should be defined the appropriate corrective action. The lack or incorrect execution of the "Maintenance program" voids the warranty on the device and on any installation or installation service.

2 DESIGNATION AND DESCRIPTION

There are numerous types of devices, to satisfy the varied fields of employment and the different methods of application. A brief description of the ALGABLOC models here follows:

ALGABLOC NB		Is the standard type consisting of alternate layers of rubber and steel without any anchorage system of mechanical nature to the structure.
ALGABLOC NB2		Is equal to NB type but endowed with external plates of fit thickness, with holes for smooth anchorage bars. It is mainly used for cast in situ structures, to decrease the risk of skid.
ALGABLOC NB3		Is equal to NB2 type, endowed with external plates, but with threaded holes. Suitable for metallic structures.
ALGABLOC NB4		Similar to NB2 but with external anchor plates connected to the bearing through pins or bolts. It can be used in any type of structure with proper connection plates.

ALGABLOC NB5		Endowed with external checkered plates of fit thickness. NB5 can be employed in any type of structure.
ALGABLOC NB6		With anchors external to the rubber print and connection pins. It may be provided with external counterplates.
ALGABLOC NBF		With restrained horizontal deformation in both directions. Suitable to resist high horizontal forces.
ALGABLOC NBU		With restrained horizontal deformation in one direction. Suitable to resist high horizontal forces in the restrained direction. In the other direction they behave like a normal rubber bearing.
ALGABLOC NTU		Rubber bearing with sliding plate (stainless steel + PTFE) and guides. It behaves like a mono directional sliding bearing. Suitable for large movements in one direction.

ALGABLOC NTM		Rubber multidirectional bearing with external sliding plate. Suitable for large movements in both directions.

3 CORRECT USE OF THE DEVICE

The correct way to use the devices, consist of all activities designed to safeguard the functionality of the system and maintain optimal conditions of operation, obtained by a proper installation according to the "General recommendation of Installation" or other "Specific installation procedure" agreed in writing by Alga. Inspection and maintenance program shall be maintained.

4 INSPECTION

The devices will be checked at each inspection visit of the civil engineering structure (Standard inspection - at least 1 year after installation and then every 5 years) and after any seismic event and other extraordinary events (Main inspection).
The overall list of checks is shown below, the controls on the various types of bearings depend on the type of device, only the applicable checks shall be performed on the bearing.

- The presence of the identification label
- No traces of oxidation
- Non loosening of the fixing bolts to the structure
- The movement capability of the devices compared to the structure's movement
- Absence of macroscopic defects visible to the naked eye:
  - rubber cracks;
  - wrong positions, parallelisms or flatnesses;
  - unexpected movements and/or deformations;
  - irregular behavior of the bulging of the rubber layers

Regular Irregular

- Absence of visible defects in the structural parts around the device

The inspection results will be recorded and archived, the control sheet in "Annex 2" is to be filled in and to be sent to Alga. In the case of defects or any doubt, contact Alga.

5 MAINTENANCE

In case of non complying item during the inspection, the maintenance program shall be executed. See "Annex 1"

ANNEX 1 – MAINTENANCE PROGRAM

6.1 MAINTENANCE ACTIVITY		Frequency of the inspections [years]																				
Checks		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	...
6.1.1	Standard inspection	X*	X					X					X					X					
6.1.2	Main inspection	after an extraordinary event (earthquake, storm, fire, ….)																					

* during the installation

6.2 MAINTENANCE CHECKS		Frequency	Activity [tools]	Acceptance level	Action in case of non-compliance	Note
1	Identification label	as § 6.1	verify the presence of identification label [visual]	presence of label	require a new label	contact the Technical Dept. of Alga
2	Anti corrosion protection	as § 6.1	verify the absence of oxidation [visual]	oxidation < 5% steel surface	re-paint the damages areas	contact the Technical Dept. of Alga
3	Bolts	as § 6.1	Non loosening of the fixing bolts/screws to the structure [visual]	bolts/ screws tightened	re-tighten the bolts/screws	contact the Technical Dept. of Alga
4	Movements	as § 6.1	measure the movements and dimensions [meter]	in the design range, compared with age, temperature, ...	others checks with different temperature	contact the Technical Dept. of Alga
5	Visible defects in the device	as § 6.1	verify the absence of defects, breakage, vibration, ...[visual, ...]	to evaluate case by case	others checks	contact the Technical Dept. of Alga
6	Visible defects in the structure	as § 6.1	verify the absence of defects, depressions, bumps or potholes, ... [visual, ...]	to evaluate case by case	others checks	contact the Technical Dept. of Alga
	.....	as § 6.1	.....	.....	.....	contact the Technical Dept. of Alga
	.....	as § 6.1	.....	.....	.....	contact the Technical Dept. of Alga

ANNEX 2 – INSPECTION REPORT

INSPECTION REPORT 1				
Location:	Device name:		Codification:	
.....	Device type:		Date: ...../...../.....	
Element n° :	External temperature: ..... °C		Weather :	
Standard inspection			Main inspection	
Signatures:				
Identification label	yes / no element	.....	Dwg. photos and notes:	.....
Anticorrosion protection	yes / no element	.....	Dwg. photos and notes:	.....
bolts/ screws tightening	Nm element	.....	Dwg. photos and notes:	.....
Longitudinal movement	mm side	.....	Dwg. photos and notes:	.....
Transversal movement	mm side	.....	Dwg. photos and notes:	.....
Defect rubber cracks	type element	.....	Dwg. photos and notes:	.....
Defect wrong position	type element	.....	Dwg. photos and notes:	.....
Defect parallelism	type element	.....	Dwg. photos and notes:	.....
Defect flatness	type element	.....	Dwg. photos and notes:	.....
Defect unexpected deform.	type element	.....	Dwg. photos and notes:	.....
.....	.....	.....	Dwg. photos and notes:	.....
Notes:				

Page ..... of .....

INSPECTION REPORT 2

Device name:	Codification: .....

Signatures:
.....
.....

Defect bulging	type element	.....	Dwg. photos and notes:	.....
Defect ptfe	type element	.....	Dwg. photos and notes:	.....
Defect sliding surface	type element	.....	Dwg. photos and notes:	.....
Defect guide	type element	.....	Dwg. photos and notes:	.....
Defect restrain	type element	.....	Dwg. photos and notes:	.....
Defect	type element	.....	Dwg. photos and notes:	.....
Misalignment Device-basement	yes / no element	.....	Dwg. photos and notes:	.....
Misalignment Device-upperstr.	yes / no element	.....	Dwg. photos and notes:	.....
Vibrations	yes / no element	.....	Dwg. photos and notes:	.....
Defects near the device	yes/no position	.....	Dwg. photos and notes:	.....
Defects near the device	yes/no position	.....	Dwg. photos and notes:	.....
.....	.....	.....	Dwg. photos and notes:	.....
.....	.....	.....	Dwg. photos and notes:	.....

Notes:
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MAINTENANCE PLAN

DRAINAGE

QGMI

MAINTENANCE MANUAL
FOR COMPOSITE BRIDGES

DRAINAGE

1 INTRODUCTION

The proper maintenance of drainage systems is essential if the works are to achieve their designed objectives.
This plan describes some recommended practices and gives guidance on this aspect to assist personnel who are involved in the day-to-day operation and maintenance of the drainage system.

Maintenance objectives

The objectives for proper maintenance and operation include:

(a) To offer a quality of service that is acceptable, having regard to costs and the effects on the environment, and to remedy recognised deficiencies.

(b) To monitor the capacity of the system and to restore the flow capacity by removal of excessive accumulation of silt and trash, etc.

(c) To monitor and maintain the structural integrity of the system.

(d) To prevent over flooding.

(e) To achieve the above service objectives making the best possible use of manpower and resources at the least cost and least disruption to the public.

2 INSPECTION PLAN

2.1. INSPECTION FREQUENCY

This plan describes some recommended Inspection frequency to assist personnel who are involved in the maintenance of the drainage system.

- **Once every 3 months**

Inspect storm drains, major box-culverts and U-channels to ensure that the drains still has a freefall if check and take necessary actions to remove any obstacles in floodwater.

- **Annually before rainy season and every time after a heavy rainfall**

Inspect storm drains, box-culverts and U-channels to ensure that the drains still has a freefall, remove obstacles in floodwater , check and take necessary actions for siltation and weed growth.

- **Annually before rainy season**

Check structural integrity of U-channels, concrete slabs, metallic slabs and box-culverts

- **Annually before rainy season**

Check for erosion, settlement, and unauthorized excavation around the drains

3 COMMON ISSUES

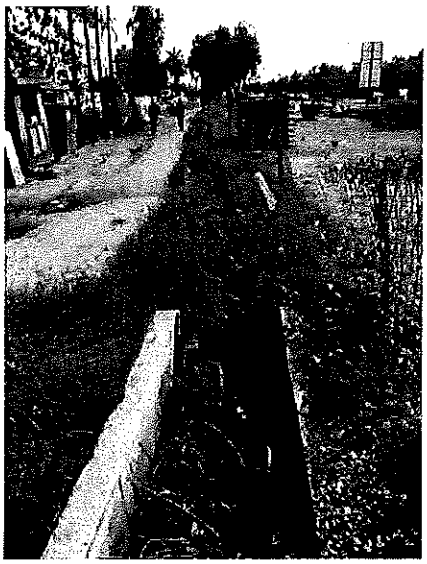
3.1. Obstacles in floodwater.

3.1.1. U-Channel Blocked by Sand and Trash

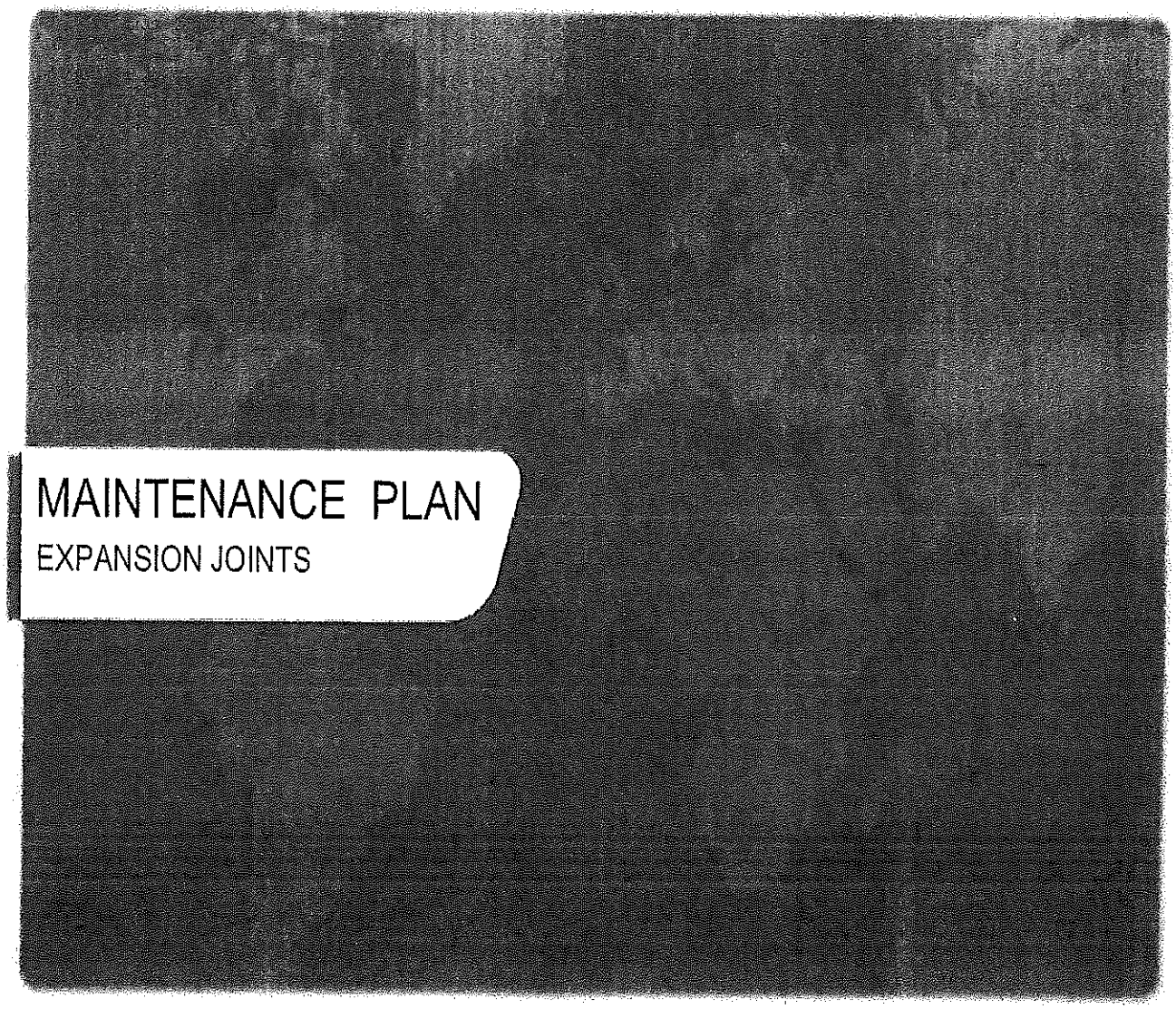
Actions to be implemented:

Remove any obstacles in floodwater, cover it with concrete slabs to make it difficult the blockage again.

3.1.2. Weed Growth



Actions to be implemented:
Remove vegetation cover it with concrete slabs to make it difficult the blockage again.



MAINTENANCE PLAN

EXPANSION JOINTS

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MAINTENANCE MANUAL
FOR COMPOSITE BRIDGES

EXPANSION JOINTS

1 INTRODUCTION

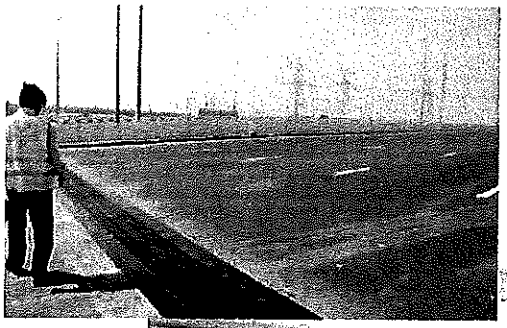
This document contains basic rules for common maintenance of a Transflex® expansion joint.The same used for Kwame Nkrumah interchange and as these projects have similar characterises of Kwame Nkrumah Project, so we will consider the same expansion joint.
It must be clearly stated from the onset that maintenance is essential in order to obtain optimum performance and durability of this and any other type of road-surface joints.

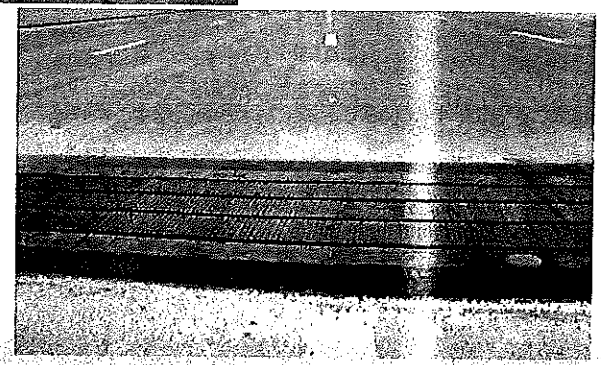
2 MAINTENANCE GUIDELINE

The main actions to carry on are the following, which should be carried out at the specified frequency:

2.1. Every six months:

- Check state of sealing of the anchorage cavities.
- Check state of the transition strips.
- Check state of the road surface next to the joint.
- Observe the passage of traffic over the joint to determine whether there is movement of the device due to untightening of any of the anchoring or to problems related to the seat bed.
- Check general state of the joint device. Eye inspection

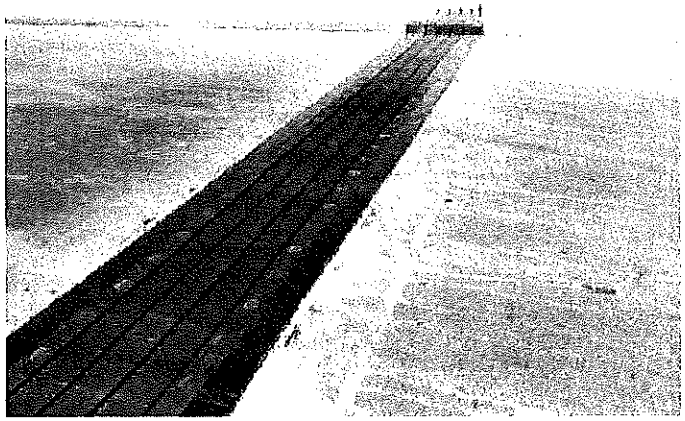




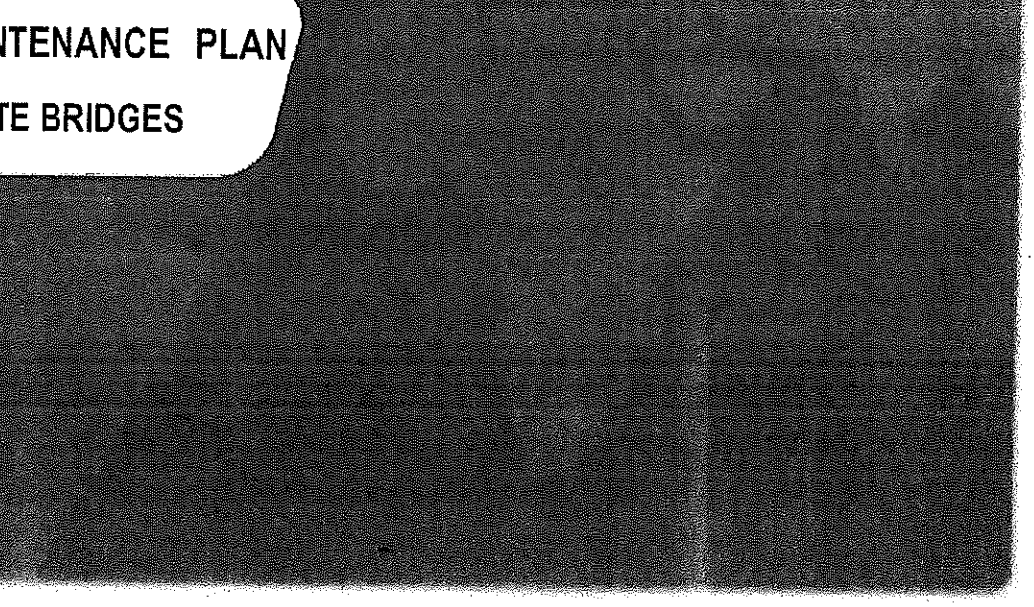
3 General Information

- Any minor damages observed should be immediately repaired in order to avoid further damage to the device.
- The durability of the expansion joints will depend to a greater extent on the vulnerability of the adjacent elements (asphalt surfacing, abutment, etc.), on the installation of the device and on a correct choice and use of the auxiliary materials, rather than on the joint device itself. It is worth highlighting that this type of joints requires little or no maintenance.

Therefore, the actions listed above can be considered recommendations for maintenance.



GENERAL MAINTENANCE PLAN FOR COMPOSITE BRIDGES



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- Cleaning and checking the good operating condition of the drainage system and drainage pipes. This checking should be done every three months and always after strong rain and storms, which can accumulate debris or dirt in the drainage system.
- Superficial humidity or dark stain cleaning. These operations are to be carried out every 12 months, at the end of raining season.
- Cleaning of the roadway and sidewalk with fresh water. Recommended frequency is every 2 or 3 months.
- Reparation of non-structural chipping on concrete elements which are of little importance.
- Periodical cleaning of bearings. Recommended frequency of one year.
- Cleaning of all exterior surfaces of the structure. Recommended frequency of one year.

7.3 SPECIALIZED MAINTENANCE

Specialized maintenance consists of actions carried out by qualified personnel, and which may involve the substitution of elements whose service life has ended.

These maintenance operations are usually the result of previous basic or main inspections which concluded the need to act on the structure.

Some typical specialized maintenance operations are:

- Replacement of drainage elements and/or execution of new drains when existing evidence of a no proper operation of the one installed on the bridge
- Punctual rehabilitation on concrete elements with little impacts or chipping.
- Rehabilitation of concrete surface areas on which there are corrosion of reinforcement steel.
- Punctual maintenance operations on the roadway such as application of sealant materials on cracks and reparations of potholes.
- Repainting of metallic elements whose painting protection has deteriorated.
- Rehabilitation of element affected by accidental event or vandalism.
- Repair of safety elements such as parapets and railing, lightening and safety signs.
- Reparation or substitution of the expansion joints when necessary.
- Reparation or substitution of the bearings on the bridge when necessary.

8 APPENDIX N°1—SUMMARY OF MONITORING AND MAINTENANCE PROVISIONS

The following table summarizes the maintenance provisions defined in this Manual to be considered in maintenance operations.

BASIC OR ROUTINE INSPECTIONS	To be carried out at least once a year	
BASIC MAINTENANCE ELEMENT	REQUIRED OPERATION	PERIOD
Drainage system	Checking good condition	3 months or after heavy rain and storms
Drainage system	Cleaning	
Concrete surfaces	Superficial humidity or stain cleaning	12 months, end of spring or fall
Roadway and sidewalk	Cleaning with fresh water	3 months
Concrete elements	Rapair of chipping	12 months
Visual inspection of painting	To detect spots and pitting of corrosion	6 months
Bearings	Cleaning	12 months
Safety elements	Cleaning	12 months
Joint	Fill in maintenance specific form	6 months
MAIN INSPECTIONS	REQUIRED OPERATION	PERIOD
Bridge	General inspections. External and internal	60 months unless earlier necessary
Joint	According to specific maintenance manual	Two years
Bearings	According to specific maintenance manual	First year - Every five years
SPECIALIZED MAINTENANCE-ELEMENT	REQUIRED OPERATION	PERIOD
Drainage system	Missing or broken element replacement	After main inspection, if necessary
Concrete element	Superficial repairing	After main inspection, if necessary
Concrete element	Rehabilitation of areas in which there is corrosion of reinforcement.	After main inspection, if necessary
Pavement	Crack sealing and pothole repairing	After main inspection, if necessary
Steel elements	Repainting	After main inspection, if necessary
All elements	Rehabilitation after vandalism	After main inspection, if necessary
Safety elements	Rehabilitation of parapets and railing, lightening and safety signs	After main inspection, if necessary
Expansion joints	Substitution if necessary	After main inspection, if necessary
Bearings	Substitution if necessary	After main inspection, if necessary

MAINTENANCE PLAN

GUARDRAILS AND HANDRAILS

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MAINTENANCE MANUAL

FOR COMPOSITE BRIDGES GUARDRAILS AND HANDRAILS

PERIODICAL INSPECTIONS, MAINTENANCE AND REPAIRINGS

It must be defined and supported, by road Designer/Management, a proper program of periodical inspections and maintenance of the installed security device, to ensure the verification of the security parameters themselves.

It is advisable to check the following parameters during the performance of road security barrier:

- Preservation of anchor-bolts supporting performance – particular conditions of stagnation of meteoric waters may cause long-term corrosive phenomena at galvanization layer, steel, anchor-bolts and lower part of posts;

- Exposure environment corrosion for the durability of the whole device (particular exposure environments may cause long-term corrosive phenomena of the basic steel of various components besides galvanization).
  According to the particular type of intervention fixed: periodical inspection for an ordinary maintenance or repairing of damages after a crash by a deviated vehicle, the checking of the above parameters require as much more attention as more elevated is the potential danger of deviation by the vehicles themselves.

Some general indications in such sense (except different provisions of the road Designer/Management) are the following:

PERIODICAL INSPECTIONS – MAINTENANCE

The parameters to be checked to ensure the preservation of performance and security features of the installed device are:

- Preservation of the features typical of the first installation as concerns the anchorage on concrete:
  - Features to be checked: lack of anomalies such as adjustments, cracks and failures;
  - Type of intervention proposed: restoration of first installation conditions;

- Preservation of the features typical of the first installation as concerns structural components and accessories:
  - Features to be checked: Integrity and performance of all structural components (ex.: posts, spacers, beams, diagonals, bolts and nuts, etc.); integrity and performance of all accessory components (ex: Presence of reflectors, dirty reflectors which are not sufficiently visible any more, etc.);
  - Type of intervention proposed: Restoration of first installation conditions;

- Preservation condition from corrosion either of protection galvanized coating or of basic steel:
  - Features to be checked: visual presence of a significant corrosive attack or of a deterioration of the hot dip galvanized coating; checking of the residual zinc thickness by a specific magnetic tool; presence of a significant corrosive attack or deterioration of the anchorage system (anchor-bolts) on concrete foundation;
  - Type of intervention proposed: restoration of first installation conditions by the removal and replacement of the components subject to unacceptable corrosion.

In relation to the particular conditions of the exposure environment and of installation conditions, it is sufficiently precautionary – except different instruction of the road Designer/Management, an inspection program with a periodicity of three years to ensure a correct preservation and a general performance of the whole device.

Such inspection and maintenance program must include routine checking to assure the preservation of the original and specific performance features of road security barrier, such as:

- Correspondence of geometrical and alignment features (horizontal and vertical) as concerns the items exposed to the traffic;
- Correspondence of tightening torque of connecting bolts and nuts, even of anchor bolts on concrete (bridges, flat arches, walls, etc.).

REPAIRING INTERVENTIONS

In case of damaged device following to an accidental crash by a deviated vehicle, the repairing intervention (removal and replacement of damaged items), must be made with the utmost timeliness because such damage may cause a very high danger for the traffic besides conditioning the performance of the whole structure.

Repairing interventions must be performed in such way to restore the first installation conditions of the road security barrier: If there are used components of third suppliers, the declared level of conformity must be the same of the barrier itself; otherwise it is necessary to increase the checking to get such level.

The wreckage (essentially steel hot dip galvanized section bars) may be given to authorized disposing companies according to the environment security norms in force (recycling).

MAINTENANCE PLAN
METALLIC STRUCTURE

QGMI

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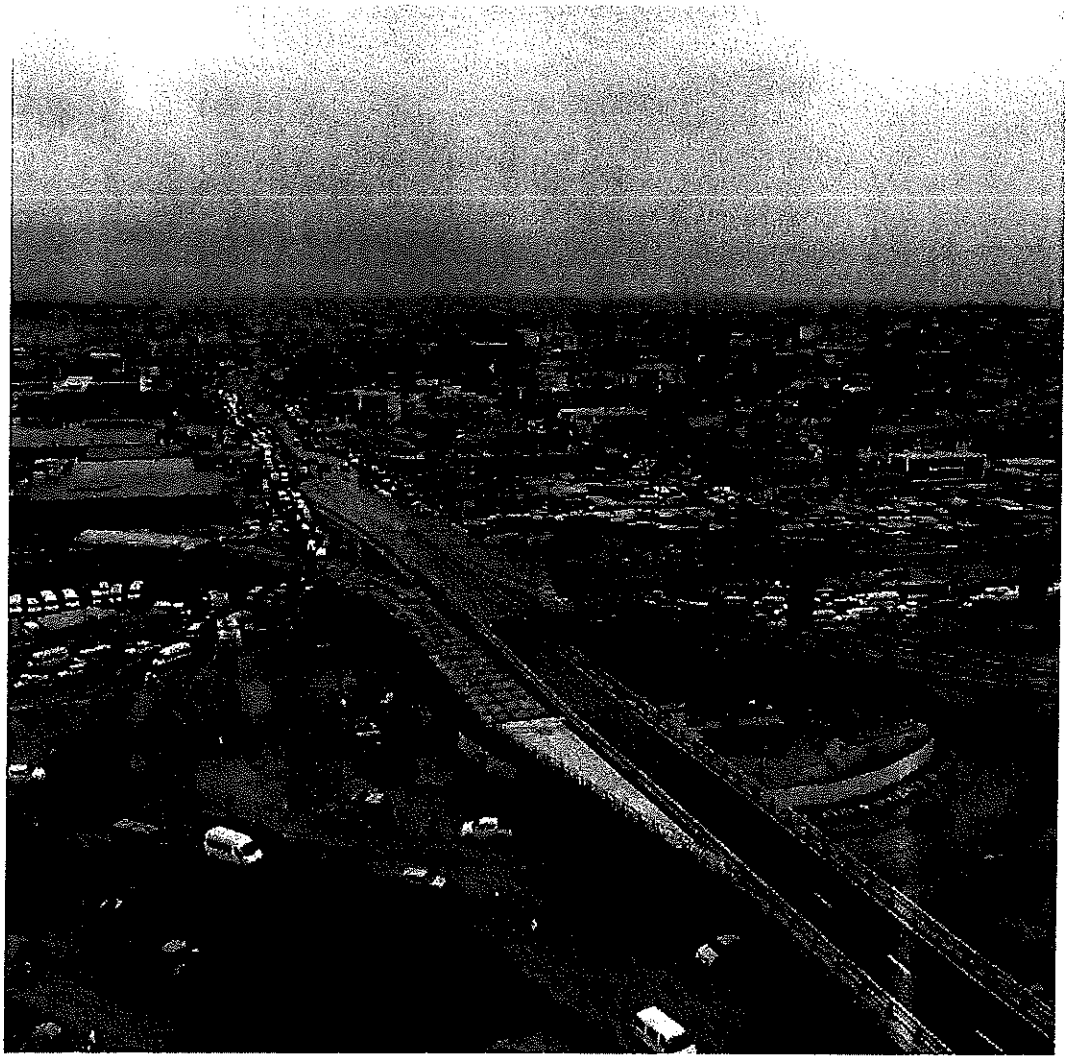
1 OBJECT

This document is intended to describe the proper procedure of maintenance for the treatment to be applied to the steel structure that makes up the proposed project for Buipe Bridge, Yapei Bridge and Daboya Bridge.

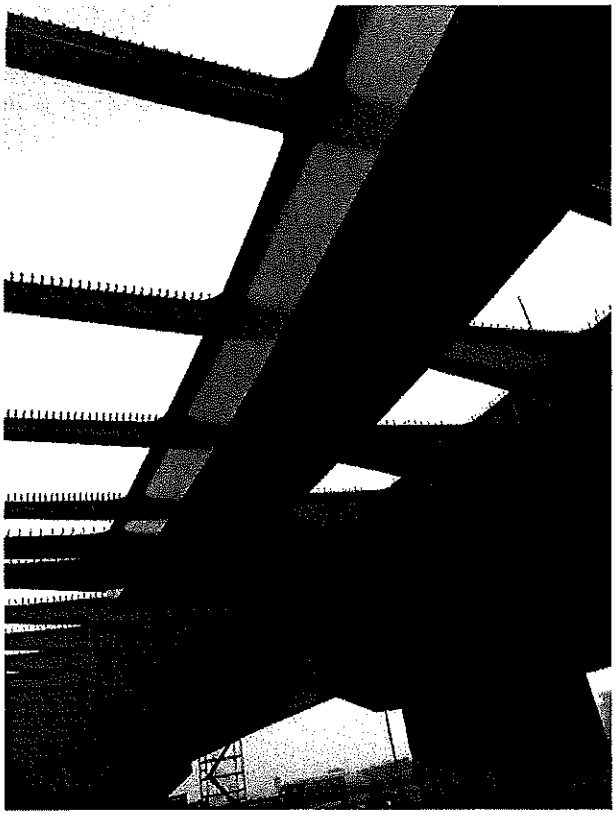
This specific maintenance plan, for metallic structure, complements to the "General maintenance plan for composite bridges", which is the main reference guide to have in mind for general maintenance of the project.

2 SCOPE

The project has the similar characteristic with the Kwame Nkrumah interchange, a series of bridges circulation of traffic in Accra Ghana and one of the first composite bridges used in Ghana.



The atmospheric-corrosively category for steel elements of girders, according to EN ISO 12944-2, is C2 (medium), is the environment corresponds to a rural area however the protective coating system shall be designed for superior corrosivity category C3



It is therefore necessary a maintenance plan so that the structure remains protected against corrosion. This maintenance will be different degrees of inspection, preventive actions and remedial measures. Depending the type of action will have to be carried out by maintenance personnel of the road or by specialized staff.

The estimated lifespan, for the painting protection scheme, is approximately 15 years.

3 MAINTENANCE AND/OR INSPECTION TYPES

The structures shall be periodically inspected and maintained during their service life. Two levels or types of maintenance with three levels or types of associated inspections are considered in this maintenance manual, namely:

- Basic or routine maintenance: Periodic maintenance to preserve the steel structure under appropriate conditions;
- Basic or routine inspections: These are the periodic inspections associated with this maintenance to determine the need for more specialized inspection or maintenance;

- Specialized maintenance: Extraordinary maintenance for repairing damage detected in any of the two types of inspection, listed below:
- Main inspection: Periodic inspection or for accidental events. Performed by qualified engineers;
- Special inspection: Extraordinary inspection form onset of severe damage or fast deterioration advancement;

All inspection types & periods are specified in the "**General maintenance plan for composite bridges**".

3.1. BASIC OR ROUTINE MAINTENANCE AND INSPECTIONS

Basic or routine maintenance and inspections are those carried out by the road maintenance staff, for instance the personnel of the concessionaire company.

The frequency of these maintenance or inspections is three or six months and/or after heavy rains or storms.

This is the most important maintenance to carry out; because in this way, the steel structure remains constantly clean and maintained, minimizing and avoiding the appearance of subsequent defects and damage. It is the cheaper maintenance, since it is a preventive action that extends the life of the structure, preventing or repairing minor damage, which if not corrected at an early stage, can lead to more serious damage. Without routine or basic maintenance, any minimal and easy to repair damage, can turn into a serious pathology.

This routine maintenance, in turn implies the realization of a basic inspection, that allows to detect and identify all significant damages to be studied by a competent technician (expert engineer in metallic structures, certifying entity to inspection of metallic structures, manufacturer of metallic structures or specialized company in paint treatments) and that may be the result of a more specific reinspection. The purpose of these routine inspections is to detect failures as soon as possible in order to minimize maintenance and repairing costs.

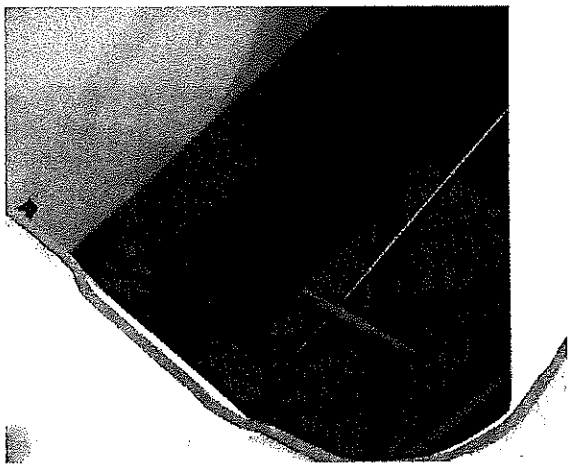
At the end of each routine maintenance and inspection, the following actions, when appropriate, will take place:

- Complete routine maintenance operations if no significant damages of have been recorded;
- Carry out main or special inspection if problems which may evolve were detected;
- A record of each inspection will be made, indicating the relevant observations and actions to be taken. Format in Annex 1;

Some of the recommended basic maintenance operations, which usually do not require highly qualified personnel and that can be performed by appropriately trained staff, are the following:

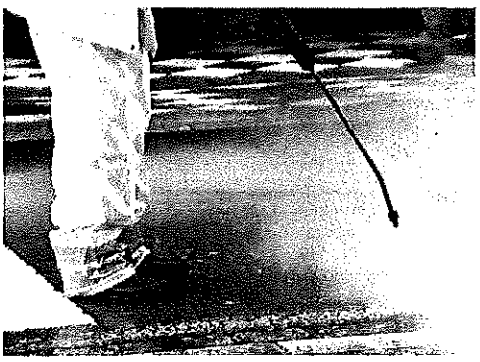
- Cleaning of all exterior surfaces of the steel structure with pressurized water, brushes, mop, ... Recommended frequency is every 6 months;

- Cleaning and checking the good operating condition of the drainage system and drainage pipes. Standing water in recesses or holes can result in creating a corrosive atmosphere to accelerate the process of degradation of the paint protection. This checking should be done every three months and always after heavy rain and storms, which can accumulate debris or dirt in the drainage system;

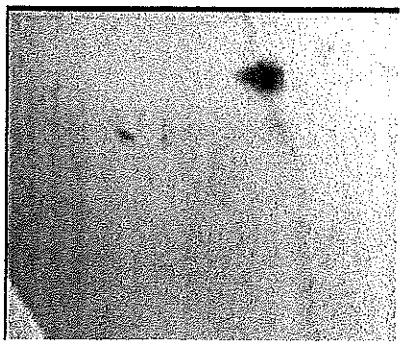


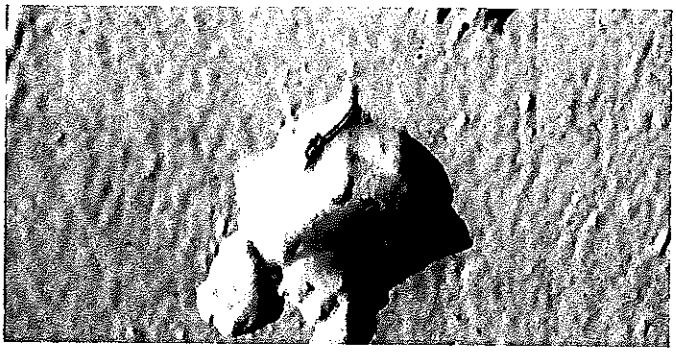
- Superficial humidity or dark stain cleaning. This checking should be done every six months and always after heavy rain and storms;

- Removing any organic waste adhered to the structure and any vegetable elements to grow in contact with the structure. The accumulation of organic wastes produces an aggressive decomposition and accelerating oxidation. The accumulation of debris should be avoided, they must be removed with pressurized water Recommended frequency is every 6 months.

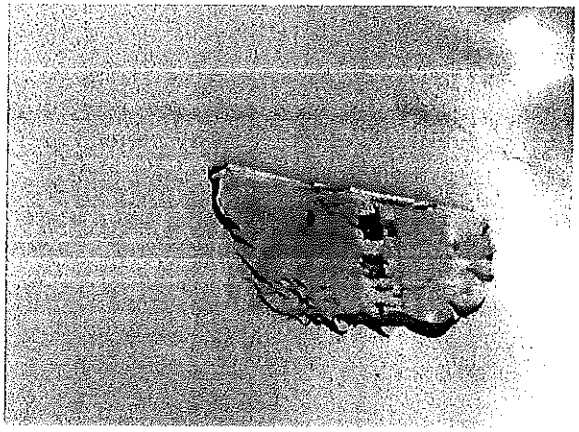


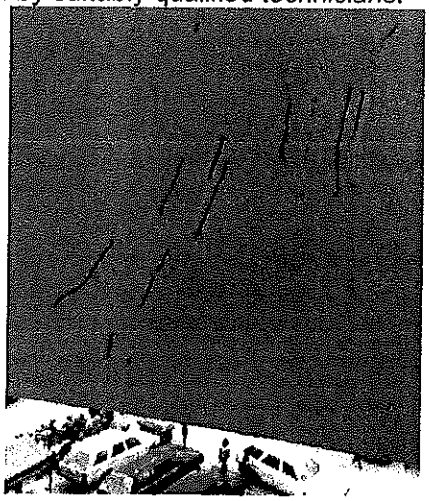
- Cleaning and detection of small areas of corrosion. Recommended frequency is every 6 months. All these damages must be properly registered to proceed to a more profound inspection by suitably qualified technicians.



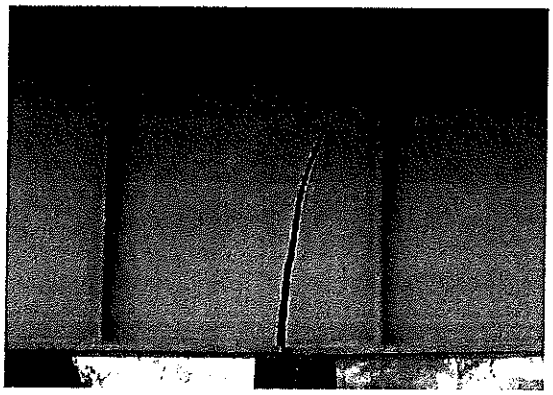


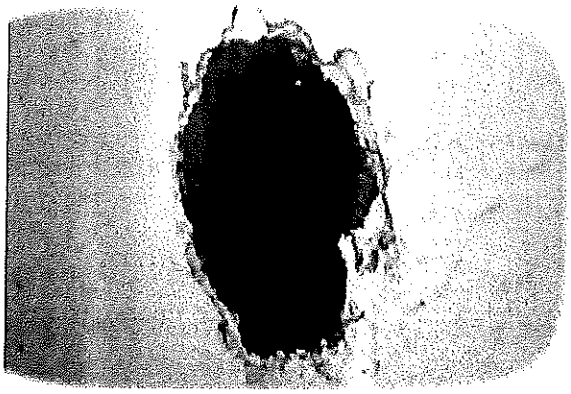
- Review, identify and repair small dings, scratches or the appearance of corrosion in the paint system. Recommended frequency is every 6 months. All these damages must be properly registered to proceed to a more profound inspection by suitably qualified technicians.



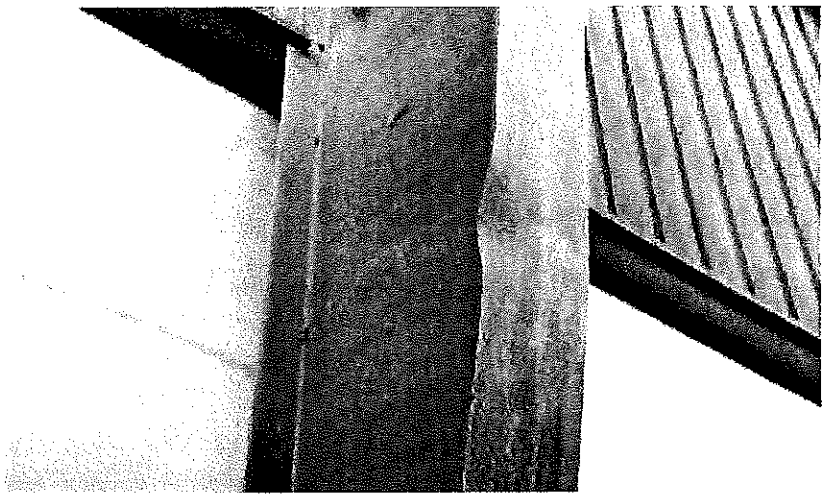


- Review and identification of possible impacts, cracks or fissures in the steel structure to determine the need for a more exhaustive inspection and / or extent of repair. Recommended frequency is every 6 months. All these damages must be properly recorded and reported immediately to carry out a main inspection or special inspection, by suitably qualified and skilled technicians (expert engineer in metallic structures, certifying entity to inspection of metallic structures, manufacturer of metallic structures or specialized company in paint treatments).

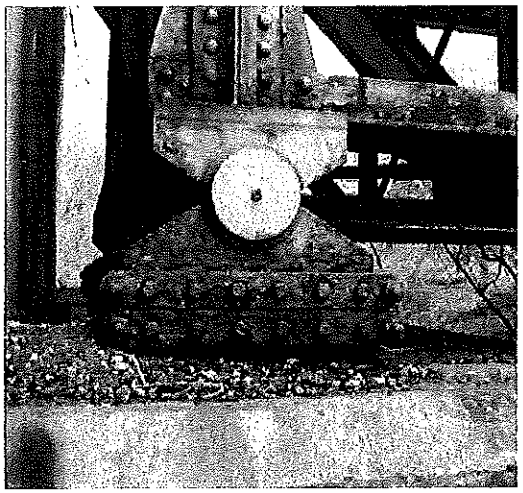




- Review and identification of deformations or alignment loss in structural elements to determine the need for a more exhaustive inspection and / or extent of repair. Recommended frequency is every 6 months. All these damages must be properly recorded and reported immediately to carry out a main inspection or special inspection, by suitably qualified and skilled technicians (expert engineer in metallic structures, certifying entity to inspection of metallic structures, manufacturer of metallic structures or specialized company in paint treatments);



- Review and identification of appearance of large areas of corrosion or general corrosion in steel structural elements to determine the need for a more exhaustive inspection and / or extent of repair. Recommended frequency is every 6 months. All these damages must be properly recorded and reported immediately to carry out a main inspection or special inspection, by suitably qualified and skilled technicians (expert engineer in metallic structures, certifying entity to inspection of metallic structures, manufacturer of metallic structures or specialized company in paint treatments);



During basic maintenance it is very important to consider the following:

- Cleaning methods used cannot damage the paint system.
- It is necessary to prevent shock and scratches in the paint during maintenance works.
- For cleaning only water should be used. For the use of any other product, it is essential prior consultation of compatibility with the paint system.
- It is important to check the maximum water pressure for cleaning by mechanical means.
- Small and located corrosion points, surface scratches or minor impacts, (less than 5 cm and existing of localized form) can be cleaned by water, light sanding surface (without damaging the bottom paints) and roller application of a double patch of paint (80□m of a prime coat "Sigmafast 302" + 150µm of intermediate coat "sigmafast 213") and roller application of a finishing paint coat (60µm of a final coat "Sigmadur 520/550"), so as to avoid the propagation of corrosion (see paint scheme in attached document "GPS- 140226-DIZMAR-GHANA-V2"). Anyway, all these damages must be properly registered to proceed to a more profound inspection by suitably qualified technicians. These minor repairs will be made according to specified (and applicable for small localized damages) in the paragraph "4.1 Localized repairs (Grade ≤ or ≥ Ri3 Ri3) and / or repair General section: (Grade ≤ Ri3) of this document.
- It is very important to identify and notify immediately, the appearance of any damage that cannot be repaired by the basic maintenance and need to a main or special inspection.

3.2. SPECIALIZED MAINTENANCE. MAIN AND SPECIAL INSPECTIONS

Specialized maintenance consists of actions carried out by qualified personnel, and which may involve the substitution of elements of steel structure whose service life has ended, as the paint system repairs.
Some typical specialized maintenance operations on steel structure are:

- Replacement of drainage elements and/or execution of new drains when existing evidence of an improper operation of the one installed on the bridge;
- Repainting of metallic elements whose painting protection has deteriorated;
- Rehabilitation of element affected by accidental event or vandalism;

These specialized maintenance operations are the result of previous main or special inspections which concluded the need to act on the steel structure.

3.2.1. Main Inspections

Main Inspections are visual inspections performed by qualified personnel (expert engineer in metallic structures, certifying entity to inspection of metallic structures, manufacturer of metallic structures or specialized company in paint treatments) to determine the state of deterioration of the elements thoroughly.
Main inspections require the use of filling an inspection form.
Unlike routine inspections, main inspections require participation of specialized engineers who know what to look for, where to look for it and how to interpret what they see.
The result of the inspection must consider the type of detected damages, their extension and their intensity, and must conclude in a general or overall index that corresponds to a certain degree of overall condition.
The proposed frequency for these inspections is 60 months from initial principal inspection (inspection to final approval the construction), if not earlier necessary. Frequency could be reduced depending on the importance of damages observed in the future.
The main inspection requires particular equipment such as traffic control signalling, digital photo camera, binoculars, crack measuring card, mirror, laser distance meter and meter tape, etc.

3.2.2. Special Inspections

Special inspections are performed with all kinds of special equipment and specialized personnel (expert engineer in metallic structures, certifying entity to inspection of metallic structures, manufacturer of metallic structures or specialized company in paint treatments) in order to study structural pathologies in detail. Consequently, they provide enough information to generate detailed structure status reports and refurbishment projects when necessary.
This kind of inspection is recommended when, as a result from basic or main inspections, one or more damages have had a quick progression through time and they may result in loss of security or functionality for users.
Some accidental events, such as vehicle impact, may make necessary to perform a special inspection

to assess the eventual impact of the accidental event on the structure.
Inspectors must be equipped with the instruments listed before and be completely accredited to realize the inspection.

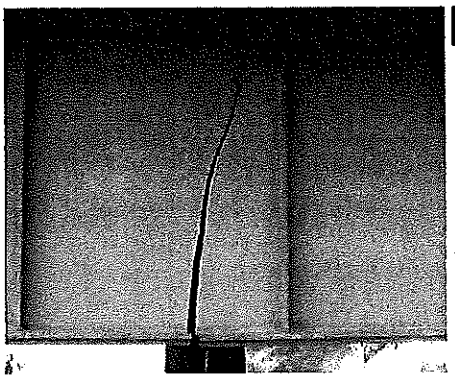
3.2.3. **Specialized Maintenance**

In the metallic structure, specialized maintenance consists especially in acting on the paint system (the anticorrosive protection).

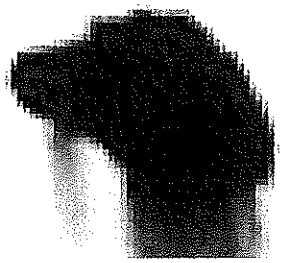
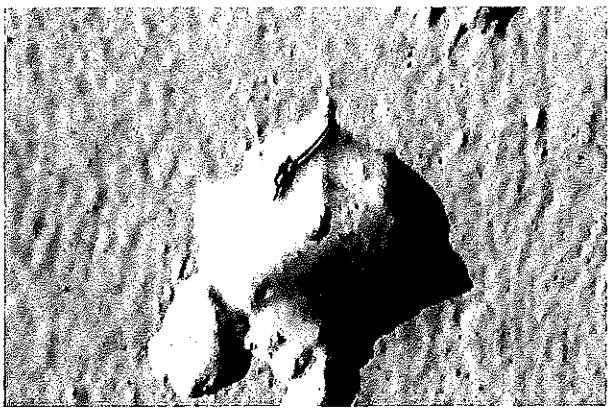
The frequency of this maintenance is determined by the conclusions obtained from the main or special inspections.

The types of damage that required specialized maintenance are the following:

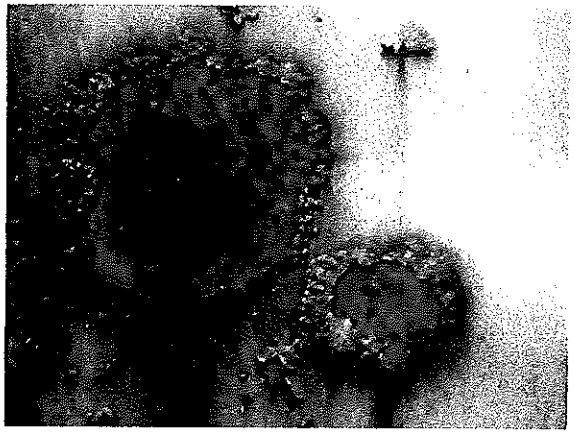
- All accidental damage or degradation of the paint system, that can not be repaired by routine maintenance and that despite presenting no corrosion, are likely to cause the onset and progress of corrosion in a short period of time: Important impacts, cracks or fissures in the steel structure and deformations or alignment loss in structural elements. All these damages should be repaired as soon as they detect and analyzed by competent technicians or engineers;

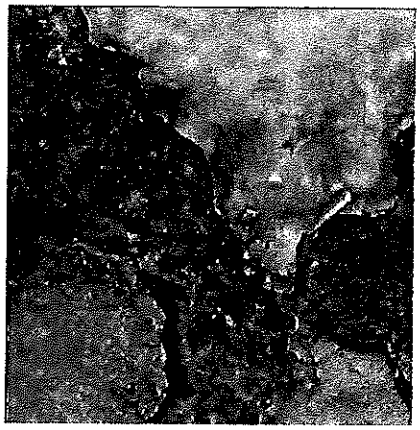


- Localized area of corrosion. Grade ≤ RI3. Localized areas of corrosion, greater than 5 cm, where the state of corrosion is not very advanced. The surface of the steel plates is slightly affected. Maintenance periods determined by main or special inspections.

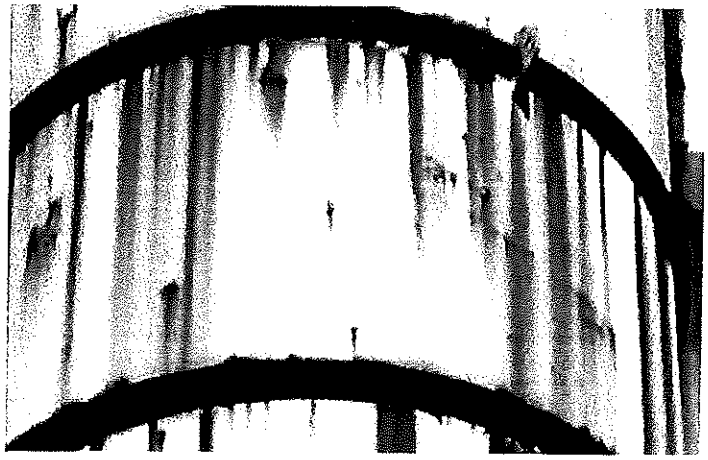



- Localized area of corrosion. Grade ≥ Ri3. Localized areas of corrosion, greater than 5 cm, where the state of corrosion is very advanced. The surface of the steel plates is strongly affected. Maintenance periods determined by main or special inspections.

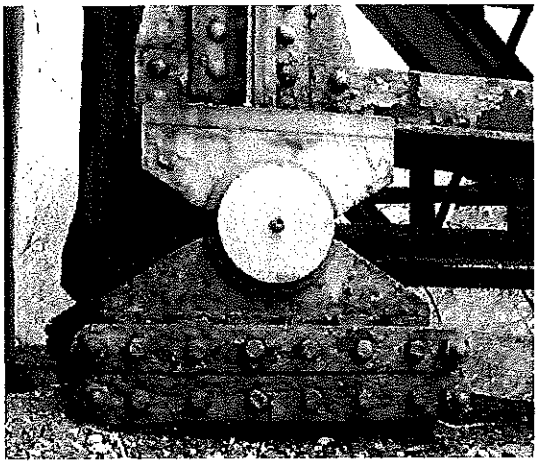


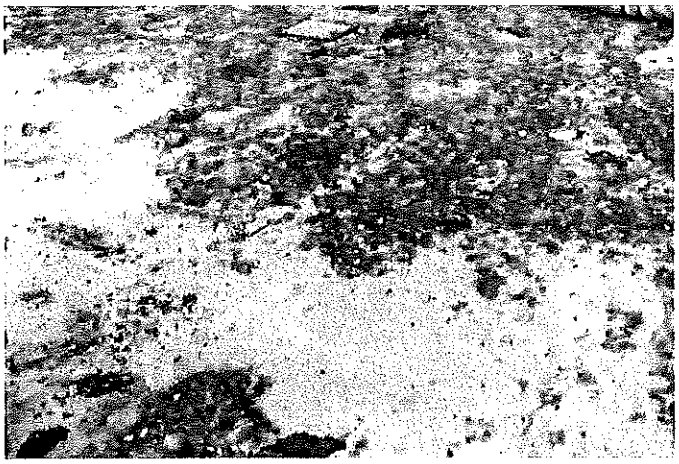


- General corrosion of structure. Grade ≤ Ri3. The existence of corrosion is widespread throughout the surface of the structure, but the state of corrosion is not very advanced. The surface of the steel plates is slightly affected. Maintenance periods determined by main or special inspections.



- General corrosion of structure. Grade ≥ Ri3. The existence of corrosion is widespread throughout the surface of the structure and the state of corrosion is very advanced. The surface of the steel plates is strongly affected. Maintenance periods determined by main or special inspections.





The process of repair and maintenance the paint scheme, which protects the steel structure, is described below; according to the recommendations of the paint manufacturer PPG COATINGS SPAIN S.A PROTECTIVE and the general painting specification used for the construction of Kwame Nkrumah Project.
These projects have similar characterises of Kwame Nkrumah Project, so we will consider the attached document "**GPS-140226-DIZMAR-GHANA- V2".**

4 SPECIALIZED MAINTENANCE. PAINT MAINTENANCE TREATMENT

Maintenance paint treatment must be carried out by specialized technicians (specialized company in paint treatments) with extensive experience in this sector.

The development of systems of paint and corrosion protection are constantly evolving. Therefore, to carry out this type of maintenance, it is essential to have the collaboration of a specialized company in this type of works; so as to obtain the greater guarantees of durability and corrosion protection with treatment applied.

All paint works must be coordinated and supervised by a team of highly qualified and experienced workers (specialized company in paint treatments).

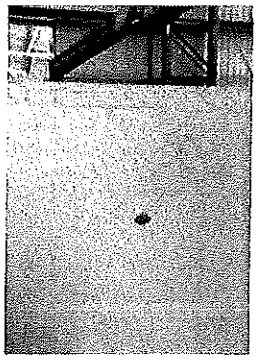
Before performing any maintenance, it is necessary to establish the repair procedure to be used and their scope; verifying the compatibility with the existing paint system, if this is partially preserved.

As a guideline, it proceeds as follows, according the general painting specification used for the construction of this project: attached document **"GPS-140226-DIZMAR-GHANA-V2". This specification is only valid using the products indicated, and according to the mode of application defined. It is possible to use other products not defined in this document, but the study and development of a specific repair procedure, for this purpose, will be necessary.**

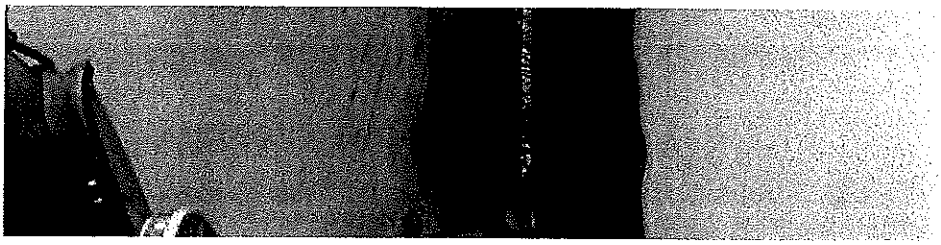
4.1. LOCALIZED REPAIRS (GRADE ≤ RI3 or ≥ RI3) and/or GENERAL REPAIR (GRADE ≤ RI3)

4.1.1. Sanding and Brushing

The areas subject to corrosion damage will be sanding and brushing with rotary pneumatic or electric machines to leave surfaces clean, according to the ISO -8501 standard to grade St- 3. This will be done in an area covering at least three times the area that presents the point of corrosion.
This process can also be performed during routine maintenance in small damages (less than 5 cm and existing of localized form)





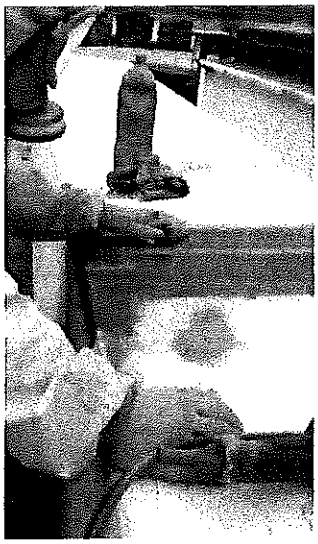



St3: Very thorough hand and power tool cleaning

(This image corresponds to the degree of cleanliness should reach the surface before applying the repair scheme, when corrosion has already appeared)

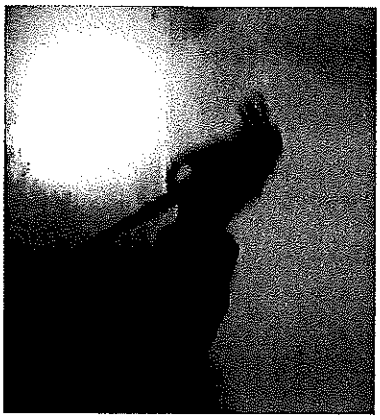
4.1.2. **Cleaning Mopping or Water Pressure**

The damaged surface is cleaned with mops and solvent to leave it free of salts, greases and dust that may impair adhesion and creating a uniform film.
This process can also be performed during routine maintenance in small damages (less than 5 cm and existing of localized form)
If it is a general repair, it will be necessary to clean the entire surface by a pressurized water.



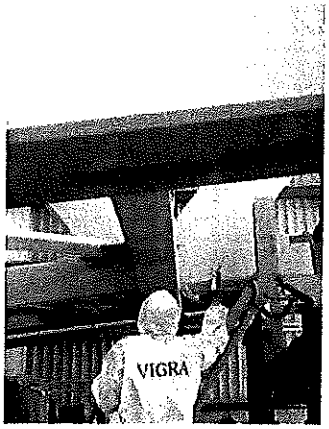
4.1.3. **Patching Paint**

It proceeds with double patch of paint on the damaged areas (80µm of a prime coat "Sigmafast 302" + 150µm of intermediate coat "sigmafast 213"). It can be applied with a roller (in areas of difficult access or for basic or routine maintenance), or by spray air less (only for specialized maintenance)
This process can also be performed during routine maintenance in small damages (less than 5 cm and existing of localized form).
For each layer, it should be applied the thickness dry microns specified in the paint scheme or technical specifications of the manufacturer.
Before applying any layer of paint, it must be verified that environmental conditions are suitable according to manufacturer's specifications.
Drying times must be respected between the applications of different layers.



4.1.4. **Final Paint Layer**

Painting by roller (for basic or routine maintenance) or spray air less application (only for specialized maintenance) with continuous and uniform final layer (60□m of a final coat "Sigmadur 520/550"). It should be applied the thickness dry microns specified in the paint scheme or technical specifications of the manufacturer.
This process can also be performed during routine maintenance in small damages (less than 5 cm and existing of localized form).
If it is localized repair, finish coat is only necessary to apply in the damaged area and in its vicinity. If it is a general repair, finish coat is applied on the entire surface of the structure.
Before applying any layer of paint, it must be verified that environmental conditions are suitable according to manufacturer's specifications.



4.1.5. **Checking Thickness**

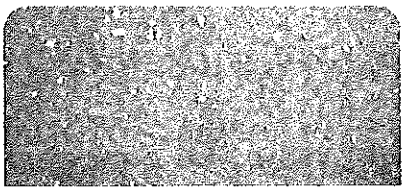
Once finalized the painting process, it should verify that the thickness dry microns of the paint are according to paint scheme or manufacturer's specifications.

4.2. GENERAL REPAIR (GRADE ≥ RI3)

4.2.1. Surface Shot Blasting

All surface will be shot blasting cleaning with angular grit gush to grade Sa2½ gush, according to ISO -8501 standard to grade Sa2 minimum.

Conventional blasted surface (SA2)



(This image corresponds to the degree of cleanliness should reach the surface before applying the repair scheme, when corrosion has reached the Grade ≥ RI3)

4.2.2. Blowing with Compressed Air

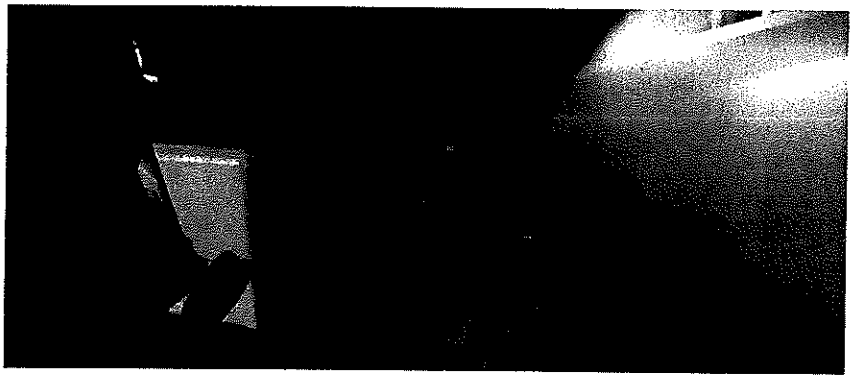
The surface is blowing with compressed air to leave it free of salts, grease and dust that may impair adhesion and creating a uniform film.

4.2.3. General Paint with Double Primer Layers

It proceeds to paint, with double primer layers, the general surface of steel structure. It will be applied with a spray air less.
For each layer, it should be applied the thickness dry microns specified in the paint scheme or technical specifications of the manufacturer.
Before applying any layer of paint, it must be verified that environmental conditions are suitable according to manufacturer's specifications.
Drying times must be respected between the applications of different layers.

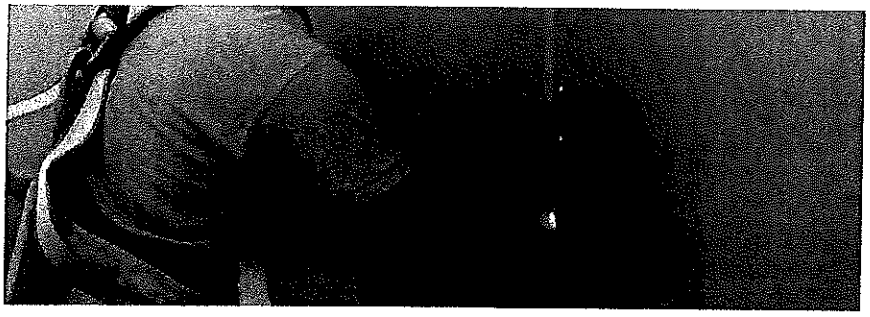
4.2.4. **Final Paint Layer**

Painting by spray air less application with continuous and uniform final layer on the entire surface of the structure. It should be applied the thickness dry microns specified in the paint scheme or technical specifications of the manufacturer.
Before applying any layer of paint, it must be verified that environmental conditions are suitable according to manufacturer's specifications.



4.2.5. **Checking Thickness**

Once finalized the painting process, it should verify that the thicknéss dry microns of the paint are according to paint scheme or manufacturer's specifications.



4.3. **GOOD PRACTICES OF APPLICATION**

4.3.1. **Paint and Dry Times**

In the application of any paint scheme it is very important to respect the drying times. When a surface is shot blasted or grinding it tends to oxidize very quickly, so it should not pass between blasting and application of the first layer over 4-5 hours.

Moreover it is important consult the technical specifications of products where overcoating periods and the right conditions are indicated.

4.3.2. **Dew Point**

As a general rule, one can never apply a layer of paint on a surface when the difference between the temperature of the piece and the dew point temperature is below 3 ° C.
The dew point calculation can be performed by different methods.

- Data Table- It´s necessary to have data from relative humidity and temperature.

		AMBIENT TEMPERATURE ºC									
		4	6	8	10	12	30	32	34	36	40
% RELATIVE HUMIDITY	90	-6,5	-1,3	3,5	8,2	13,3	18,3	90	23,2	33	38,2
	85	-7,2	-2,0	2,6	7,3	12,5	17,4	85	22,1	32,0	37,1
	80	-7,7	-2,8	1,9	6,5	11,6	16,5	80	21,0	31,0	36,2
	75	-8,4	-3,6	0,9	5,6	10,4	15,4	75	19,9	29,6	35,0
	70	-9,2	-4,5	-0,2	4,5	9,1	14,2	70	18,6	28,1	33,5
	65	-10,0	-5,4	-1,0	3,3	8,0	13,0	65	17,4	26,8	32,0
	60	-10,8	-6,4	-2,1	2,3	6,7	11,9	60	16,2	25,3	30,5
	55	-11,6	-7,4	-3,2	1,0	5,6	10,4	55	14,8	23,9	28,9
	50	-12,8	-8,4	-4,4	-0,3	4,1	8,6	50	13,3	22,2	27,1
	45	-14,3	-9,6	-5,7	-1,5	2,6	7,0	45	11,7	20,2	25,2
	40	-15,9	-10,8	-7,3	-3,1	0,9	5,4	40	9,5	18,2	23,0
	35	-17,5	-12,1	-8,6	-4,7	-0,8	3,4	35	7,4	16,1	20,6
	30	-19,0	-14,3	-10,2	-6,9	-2,9	1,3	30	5,2	13,7	18,0

- Dew point meter - This type of equipment indicates you the difference of the temperature of the piece with the dew point.

4.3.3. **Control of WetThickness**

The applicators can control the thickness of layer being applied, knowing the amount of solids by volume In the paint and the nominal value of microns to by apply.

For example:

DFT =120µm 120µm x100%/80%=150µm

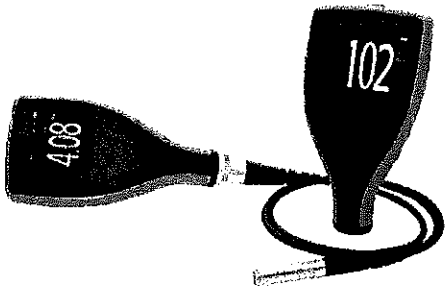
Solids for volume of paint =80%

120µm x100%/80%=150µm we need apply

This can be measured with a wet thickness meter:

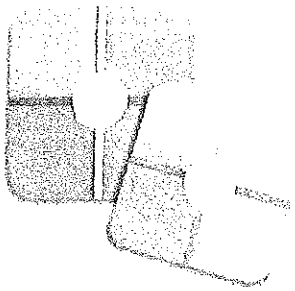
4.3.4. **Control of Dry Thickness**

Once finalized the painting process, it should verify that the thickness dry microns of the paint are according to paint scheme or manufacturer's specifications.
The most common is with a digital thickness meter. The thickness must be measured by different methods (magnetic field, eddy currents, ...) but all show the same result.



4.3.5. **Grade of Roughness**

The degree of roughness required, can be checked with a feeler compared the type G (Grit)

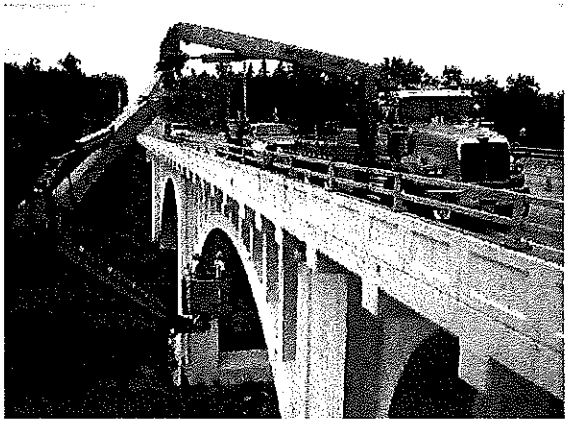


5 EQUIPMENT AND MATERIAL FOR MAINTENANCE

5.1. EQUIPMENT FOR BASIC OR ROUTINE MAINTENANCE

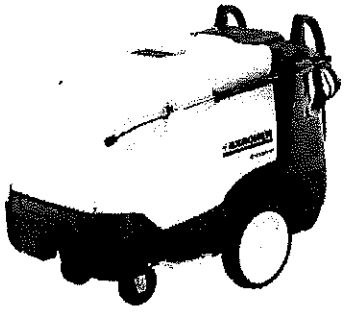
5.1.1. **Elevation**

Considering the location of the structure often have to use Boom platforms and/or Underbridge platforms.
In these cases, the use of a safety harness and helmet structure it is indispensable.



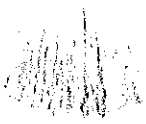
5.1.2. **Pressure Washer**

Cleaning machine with pressurized water, eliminating all kinds of dirt in structure.



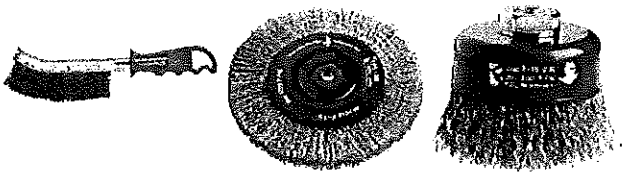
5.1.3. **Dishcloths, Mop, Brush, ...**

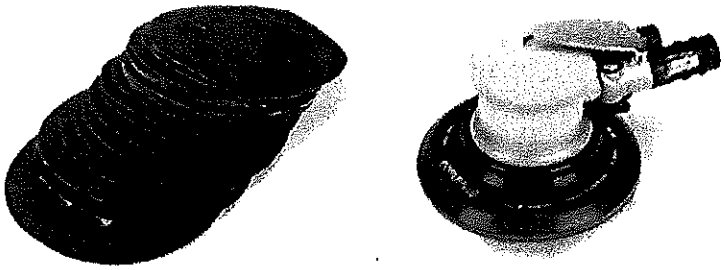
Different kind of tools for cleaning steel surfaces.



5.1.4. Sanding and Brushing Tools

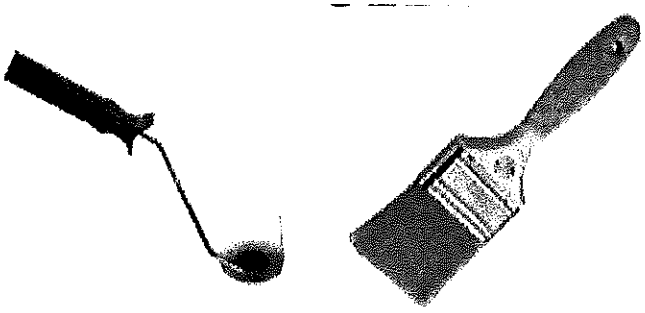
Sanding needs to be carried out with pneumatic rotary electric machines or brushes.
Depending of the reparation, different tools are used, just as with the rotary sandpaper that will use more coarse grains when we want to clean almost on steel or finer grain to smooth the surface after it has been hit or damaged





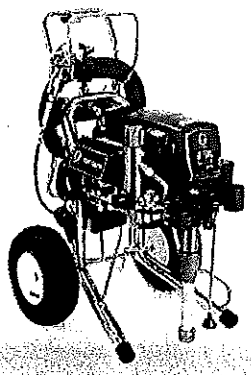
5.1.5. Paint Roller, Paintbrush, ...

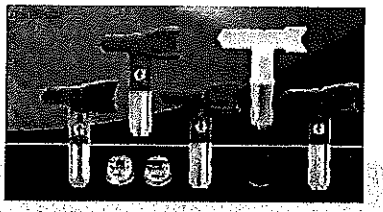
Tool for manual application of paint treatment in small areas or areas with difficult access.
Equipment only for specialized maintenance



5.1.6. Spray Airless Paint Machine

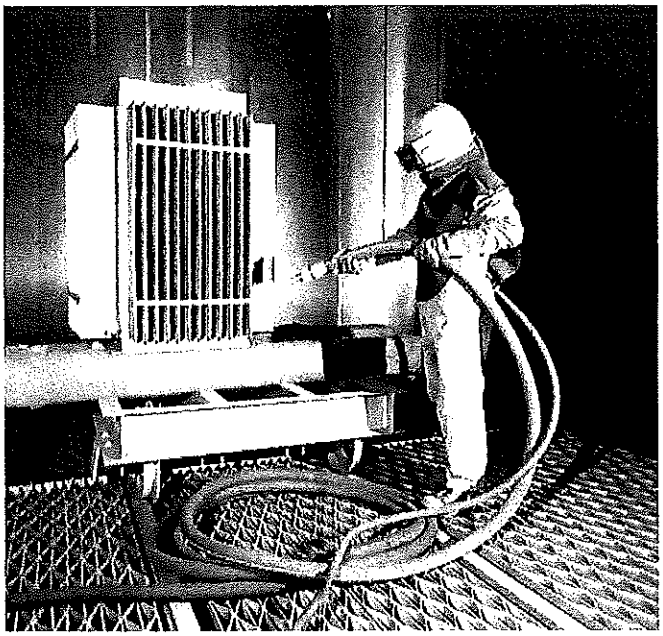
The most practical and effective paint treatment application is by airless machine.
This equipment applies a thin layer of pulverized painting onto the surface, obtaining a soft and homogeneous superficial one.





5.1.7. **Shot Blasting Machine**

The shot blasting is carried out with a type of machinery that projects grit on the particle surface at high speed creating a roughness and cleaning the substrate. Operators should be protected with special equipment such as the image below: mask, gloves and brown suit, which protects the whole body from shot blasting impacts.



6 CONCLUSIONS

It is very important to carry out the routine or basic maintenance and inspections regularly, keeping the structure clean and maintained; in order to tackle, as soon as possible, specific corrosion problems that may arise. In this way, extend the life of the structure with the lowest possible cost. The most likely points that usually start to corrode are edges, corners, cracks of all kinds, transit areas, friction and all those sites that can produce accumulations of water.

It is essential to intervene and repair any damage detected in the structure as soon as possible, and not neglect the maintenance of the bridge to avoid reaching a degree of advanced deterioration. It is very important to avoid reaching a higher corrosion grade Ri3, since to greater the degree of deterioration, greater repair costs.

A good routine maintenance and immediate intervention of qualified staff to repair any damage, will ensure a long service life of the steel structure with very low maintenance costs.
All inspections types and inspections periodicities established in **the "General maintenance plan for composite bridges"**, will be always respected.

ATTACHED 1:

Basic and routine inspection sheet

BASIC AND ROUTINE INSPECTION **Metallic structure** Inspection Sheet Number:	STRUCTURE: PLACE: PK INSPECTOR: Date: / /

	Inspection point	**Evaluation criteria**		**Observation**	**Foto**
		No	**yes**		
1	Surface cleaning	☐	☐		
2	Drenaige system / Drenaige pipes	☐	☐		
3	Superficial humidity or dark stains	☐	☐		
4	Organic waste/Vegetable elements	☐	☐		
5	Small areas of corrosion	☐	☐		
6	Large areas of corrosion / General corrosion	☐	☐		
7	Small dings / Scratches	☐	☐		
8	Impacts, cracks or fissures	☐	☐		
9	Deformations / Alignment loss	☐	☐		

ATTACHED 2:

Main inspection sheet. Metallic girders

Main Inspection Bridge Form

13 Girders (*N*=number of considered girders) N____ Position____ **Material: Steel**

Structure____ Place____ km____ Inspector____ Date: __/__/__

N°	Damage description	Checked	G	Extension K_1			Intensity K_2			N° Photograph	Notes
				0,2	0,5	1	0,2	0,5	1		
3.1)	Damages on welds	☐	4	☐	☐	☐			☐		
3.2)	Cracks on welds	☐	5	☐	☐	☐			☐		
3.3)	Spalling on painting	☐	2	☐	☐	☐			☐		
3.4)	Damages on bolts or rivets	☐	5	☐	☐	☐	☐	☐	☐		
3.5)	Loose bolts or nuts	☐	4	☐	☐	☐			☐		
3.6)	Brocken bolts or nuts	☐	5	☐	☐	☐			☐		
3.7)	Buckling on plates	☐	3	☐	☐	☐	☐	☐	☐		
3.8)	Buckling on hollow section webs	☐	3	☐	☐	☐			☐		
3.9)	Accumulated water on steel elements	☐	1	☐	☐	☐			☐		
3.10)	Damages on unions	☐	5	☐	☐	☐			☐		
3.11)	Corrosion	☐	4	☐	☐	☐			☐		
3.12)	Rust stains	☐	2	☐	☐	☐			☐		

ATTACHED 3:

Safety Information Sheet. Maintenance Works. (SIS0014)

MAIN RISKS
• RUNNING OVER
• OVERTURN
• COLLISION
• FALL AT HEIGHT
• FALLING MATERIALS
• FIRE
• EXPLOSION
• ELECTRICAL CONTACTS
• POISONING

Equipment's
• MOBILE CRANE
• MAN LIFT PLATFORM
• UNDERBRIDGE PLATFORM
• PRESSURE WASHER PUMP
• HAND TOOLS
• PNEUMATIC ROTARY

PREVENTION MEASURES

- Provide training / specific information complementary to the activity affects workers, about this procedure, enabling those responsible facing knowledge of materials, equipment and processes associated with various phases;
- Proper supervision is required for the job;
- Use of experienced and skilled workers for the task;
- Ensure that all employees use the necessary PPEs for the assigned tasks;
- Manual load handling shall only be conducted when mechanical sources are not practicable;
- Check that all equipment used, as well as the respective accessories are properly, certified and that no signs of wear;
- Check if the mechanical equipment have reverse gear acoustic signalling well as other legal requirements;
- Ensure that the working area is well signal and delimitated, provided with warning signs to restrict any entries;
- In case of interference with traffic, implement temporary signalling schemes;
- The work area should be clean and tidy in order to avoid possible tripping and falling at the same level. Should always be preserved in passageways and work;
- Observe the maximum load capacities for the equipment and accessories for lifting loads and the choice of these should be the most appropriate, taking into account the dimensions and shapes of the structures to raise;

- The fittings of lifting loads to use these works must be in full working order (no signs of wear, fatigue, kneading or rupture) and duly certified. The use of the same must comply with the rules of the manufacturer;
- Check that the cables or chains do not have seams or wires / rings broken. Should this situation arise, they are replaced immediately and removed from the work;
- Ensure that the place where the crane will be positioned has adequate ground conditions (resistance) and it's well compacted;
- Ensure that the outriggers are fully extended and the outrigger pads are appropriate;
- All workers must maintain space during the lifting;
- All electrical cables to be organized well and protect from sharp edges;
- All electrical cables, connections and plugs must be weatherproof;
- Inspect all electrical tools and equipment;
- Defective tools and equipment should not be used and taken away from job site and report to supervisor;
- Only competent and certified personnel to carry out any electrical works;
- Must be provided and wear warning vests or other suitable garments marked with or made of reflectorized or high visibility material;
- Use safety harness when working with the man lift platform;
- All organic-based solvents – including white spirit, solvent-based paints, solvent-based thinners and primers, as well as paint strippers – represent potential health hazards, and require that particular precaution be taken both in use and in storage.
- Here are some tips:
- Read the label carefully for information on safety and health-related issues;
- Solvents are highly flammable – keep these paints away from all sources of heat, and never expose directly to an open flame;
- Store in cool, well-ventilated areas;
- Dispose of rags properly – rags soaked with oil-based materials can ignite spontaneously if not spread out to dry;
- Skin protection:
- Wear the appropriate gloves: cloth or leather gloves for sanding and scraping, impermeable gloves for applying water-based paint, solvent-resistant chemical gloves for handling solvent- based products;
- Eye protection:
- Use eye goggles or glasses, or a facemask;
- Lung Protection:
- Wear an anti-dust mask whilst sanding a surface or a solvent-respirator if working with solvent-based products;
- Remove sources of ignition;

REVISION HISTORY		
Review	**Date**	**Modification Description**
00	25/07/2015	Issued for approval

DETAILS OF CHANGES IN LASTEST REVISION:

ATTACHED 4:

General painting specification "GPS-140226-DIZMAR-GHANA-V2

DIZMAR

SURFACE TREATMENT
Dr. KWAME NKRUMAH INTERCHANGE
- GHANA -

VIGRA Surface treatments

TÜVRheinland® CERT
ISO 9001
ISO 14001
BS OHSAS 18001

CONTENT

-ooOoo-

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1. GENERAL REQUIREMENTS

1.1. Scope of Works

This specification is applicable to the metallic structure of the **Dr. KWAME NKRUMAH INTERCHANGE** project.

The purpose of this document is to define the paint systems to be used with surface preparation thicknesses and number of coats.

This Specification covers the general requirements for painting work of the project. This specification further outlines the type of paint, surface preparation, touch up for prime coat(s), number of prime and finish coats, dry film thicknesses.

The Contractor shall furnish all labour, materials and equipment, including paints and thinners of the best quality and made available also to every subcontractor. The paints shall be supplied by a paint manufacturer with international experience and internationally available products. Only experienced personnel shall apply paints.

The general guides for the work shall be:

(a) This Specification

(b) ISO 12944-5

(c) The paint manufacturer's product data sheets and instructions for paint application

(d) Main regulations concerning safety of work with paints and coatings;

2. PREPARATION OF SURFACES

2.1. Preparation of steel

All surfaces which are to receive painter's finish shall be carefull cleaned and properly prepared for the application of the first coat of finish. Unless otherwise specifically recommended or required for the coating surfaces shall be dry when the work is performed. No paint or coating shall be applied aver dust or other non- adhering matter or over grases, oil or other incompatible material.

2.2. Preparation of surfaces

The quality degree required by the specifications according to the international standard ISO 8501-1:2007 is Sa2½. Plate surface roughness, is defined by reference to "sight and touch" according to ISO8503-1:1998 sector 2-3 between 40-80 µm.

It shall be checked that plate temperature in course of blasting is 3°C at least above the dew point determined from hygrometry measurements (using a DEW point calculator). In any case, painting shall not be carried out under adverse weather conditions, such as low temperature (below 4°C), above 90% relativè humidity, during rain, fog, high winds or sand storm.

Any contaminants must be removed from the surface to assure good wetting of it by the primer and its good adherence.

No loose paint, dirt, grease, rust, scale, weld slag, spatter must be left;

Oil, grease, soil, cement, salts, acids, corrosive chemicals must be removed by solvents, emulsions or cleaning compounds leaving no detrimental residues.

Newly formed rust must to be removed in the specified manner.

Sharp edges must be rounded off, especially if linings are to be applied.

Machined surfaces must be protected against further contamination.

No blast cleaned surfaces are to be left uncoated overnight, and all cleaned metallic surfaces shall be coated as soon as possible.

Workshop protected steelwork must be cleaned of contaminants.

2.3. Surface preparation methods

Bare steel surfaces should be prepared methods described below and in accordance with ISO 8501.

A. Wire Brush – shall mean power wire brush cleaning in so far as possible, where power brushing is not possible, hand brushing in accordance with the relevant approval standards. Wire brushing shall be including solvent cleaning as necessary to remove oil or grease.

B. Solvent cleaning – shall be in accordance with the relevant approved standards.

C. Sandblasting – Shall be commercial sandblast in accordance with the relevant approved standard. Sand shall be clean, fine and dry to give approximately 40-80 µm anchor pattern.

D. Galvanized surfaces – Shall be solvent cleaned of all oil, grease and "white rust" prior to primer coat.

3. MATERIALS

3.1. General

The manufacture and the type of all paint and protective coatings including complete Specification etc. must be submitted for Engineer's approval before beginning of the works.

3.2. Mixing

Paint shall e mixed and applied in compliance with the manufacturer's directions.

4. APPLICATION

4.1. Total thickness and number of coats

The type and number of protective coats for any item requiring painting during the project shall be in accordance with the attached tables 'Paint System schedules' and must be considered as a required.

Generally, all parts shall receive the specified prime coat(s) and sealing at the supplier's works to ensure that no corrosion occurs during transport to the site and storage in the corrosive climate at the site. Parts which cannot be damaged during transport shall receive the full number of coats in the workshop. Pre-painted must be compatible with paint system and the supplier of the this paint system will provide the corresponding compliance document.

4.2. Pre-painted plates and shapes

Prior to pre-painting, there must be documentary evidence of the fulfillment of point 2.2 of this document.

The purpose of pre-painted plates and shapes is to supply clean steel to the fabricator, avoid excessive corrosion during transportation and storage and ease surface preparation for application of the final paint system.

Plates and shapes shall then be coated with a weldable zinc shop primer Hempel's 1589, Dry Film Thickness 25 to 30µm.

The shop primer shall *not be considered* as part of the paint system, if necessary it shall be cleaned before applying the final paint system and it shall be removed from welds.

Prior to applying the primer coat of the paint system, provide for a sweep blasting Sa1 or St3 of the non deteriorated surfaces, deteriorated areas must be blasted to quality degree Sa 2½.

4.3. Application of primer coat

Primer coat shall be applied immediately after blasting on the same day, in any case before any evidence of incipient rusting on carbon steel surfaces to be painted.

Small areas, areas of difficult access and sharp edges shall receive brush strip coating of primer before applying a full coanting by airless spray.

Climate conditions (minimum and maximum temperatures, relative humidity) laid down in paint manufacturer's specifications shall be met. In the case of evidence of incipient surface oxidation, surfaces shall be blasted again in to fulfill the required quality degree.

4.4. Touch-up of shop coats

Structural and miscellaneous steel will require touch-up of bolts, welds and damaged in transit or installation shal be built-up with putty fillers, as recommended by that paint manufacturer, or with successive coat of paint, allowing proper drying between applications, smoothed to an unblemished uniform surface before applying intermediate coat.

4.5. Touch up of Finished Coats

All items and equipment, including structural steel, requiring touch-up of finish painting shall be build-up and refinished in the same manner as specified for touch-up of shop coats.

All items and equipment supplier shall furnish sufficient quantities of touch-up paints in all finish colours for items requiring finish paint. Paints shall be in new, unopened containers supplied as spare parts as outlined within these Specifications. (See point 8).

4.6. Durability

The durability is understood to be applicable whenever rusting degree Ri 3 (S4) as defined by ISO 12944 and ISO standard 4628-3 reache a part.

Outdoor installation: Category C4 for internal structure and C5I for external structure, according to standard EN ISO 12944.

All paint film thicknesses quoted in the attached table 'Paint Systems Schedules' refer to the dry film condition. For final acceptance, a surface area of 10 m2 per 150 m2 will be measured. One measurements of dry film thickness (dft) per m2 will be taken. Of the 50 single dft measurements only 10 may be below 20% of the specified dft. If results do not meet specification, additional coats must be applied until the specified thickness is reached. For measuring the dry film thickness a nonodestructive dry film thickness gauge be used.

Results of the measurements shall be entered on the inspection report.

Usually the required minimum dry film thickness has to be checked for each complete coating system. In specific cases it is necessary to measure the wet film thickness per coat, for example the priming coats.

The corrosion protection of coated surface be given for a 15 year durability according to ISO 12944.

The period will begin on the day of the completed application work.

To provide proof of durability, various test patches that are identified and recorded must be applied.

Should any defect arise during the system durability, it must be reflected in the test patches.

5. COLOURS

5.1. Colours

Colours shall be as indicated in the painting Schedule, approved before beginning the works.

6. PAINTING SCHEDULE

6.1. Structural (external)

All welds shall be primed carefully (strep coat) to the last coating system.

Surface preparation	Paint system				Application	
	Coat	Generic type	N° of co	Thickness Per coat (µm)	IN SHOP	ON SITE
Sa2½ (plates and shapes)	Pre-painted	Hempel's shopprimer zs 1589	0	15-25[1]	X	
Sa2½ (welds) Sa1 ór St3 other surfades	Prime	Solvent based zinc primer (Sigmafast 302)	1	80	X	
	Interme diate	High build polyamide epoxy v. (Sigmafast 213)	2	150	X	
	Finish coat	Alkyl bases hard paints (Sigmadur 520/550 Ral 7038	3	60	X	
		Total thickness NDFT		290		

[1] *The shop primer shall not be considered as part of the paint system.*

6.2. Structural (internal)

Surface preparation	Paint system				Application	
	Coat	Generic type	N°of coat	hickness Per coat (µm)	IN SHOP	ON SITE
Sa2½ (plates and shapes)	Pre-painted	Hempel's shopprimer zs 1589	0	25-30 [1]	X	
Sa1 ór St3	Prime	High build polyamide epoxy (Sigmafast 278)	1	100	X	
	Finish coat	High build polyamide epoxy (Sigmafast 278)	2	100	X	
		Total thickness NDFT		200		

[1] *The shop primer shall not be considered as part of the paint system.*

7. INSPECTION

Inspection shall be performed continuously throughout the various phases of the painting work.

Finished paintwork shall have the correct shade and evenness, and after drying/curing it must be free from tackiness after drying / curing, and from cracks, holidays, sags, wrinkles of big size.
Drops and wrinkles do not affect the quality of the anticorrosive system, but its appearance.

The film tickness shall be subject to inspection Elcometer Dry Film Gauge, or a similar approved measuring instrument,.

The Contractor and/or paint supplier shall carry out any tests or inspections deemed necessary or required by the Engineer. They must be agreed before the beginning of any work.

Coating material shall be applied by experienced personnel according to supplier the specification of the
After coating work is completed, a general final check of the coating application must be made.

Property	Test Method
Surface preparation	ISO 8501
Adhesion	ISO 4624
Measurement thickness	ISO19840

8. REPAIRS TO COATING

Localized defects in the coating shall be repaired by the same system. The defects will qualify in three types:

a) Faults in the layer of polyurethane

b) Faults in the intermediate layer

c) Faults in uncovered steel

In any case, the repair will be done by one overlap minimum of five centimeters.

a) Faults in the layer of polyurethane

1. Clean and elimination of loose paint by means of scraper
2. To sand the surface.
3. Application of one or two layers of Sigmadur 520 to roller up to obtaining the nominal thickness.

b) Faults in the intermediate layer

1. Clean and elimination of loose paint by means of scraper.
2. To sand the surface.
3. Application of one or two layers of Sigmafast 213 to roller up to obtaining the intermediate coat nominal thickness.
4. Application of one or two layers of Sigmadur 520 to roller up to obtaining the finish coat nominal thickness

c) Faults in uncovered steel

1. Cleanliness to the degree St3 by means of mechanical equipments, to obtain a suitable ruggedness.
2. Application of two or three layers of Sigmafast 213 to roller up to obtaining the first and intermediate coat nominal thickness.
3. Application of one or two layers of painting to roller up to obtaining the finish coat nominal thickness

9. TECHNICAL DATA SHEETS AND REPORT TEST OF SYSTEM

PPG Protective &
Marine Coatings

Viguesa de Granallados
Muelle de Reparaciones de Bouzas Nave 8
Vigo Pontevedra
Atc: Joaquin Diaz

Madrid, 01 of july of 2014

Compatibility PPG products vs shop primer
Dr. Kwame Nkrumah Interchange Project

Dear Sir:

Serves this letter to confirm you that our products SigmaFast 302 and SigmaFast 278 are compatible with Shop primer Hempel's Shopprimer ZS 1589.

Expecting will be of your conformity and approval, remain at your disposal for any clarification required.

José González Álvarez
Protective Coatings Manager

SIGMA COATINGS
AMERCOAT

HEMPEL'S SHOPPRIMER ZS 15890

15890: BASE 15899: HEMPEL'S LIQUID 99751

Description:
HEMPEL'S SHOPPRIMER ZS 15890 is a two-component, solvent-borne zinc ethyl silicate shopprimer, designed for automatic spray application. Especially suited, where welding (MIG/MAG) and gas-cutting properties are of importance.

Recommended use:
For short to medium-term protection of abrasive blast cleaned steel plates and other structural steel during the storage, fabrication, and construction periods.

Certificates/Approvals:
Approved as a welding primer by Lloyd's Register of Shipping.
Approved as a welding primer by Det Norske Veritas
Approved as a welding primer by Germanischer Lloyd.
Approved as a welding primer by Bureau Veritas.
Complying with IMO MSC.215(82) as shop primer for ballast tank coating systems. Certified by major classification societies. Contact your local Hempel representative for more info and specific certificates.

Availability:
Part of Group Assortment. Local availability subject to confirmation.

PHYSICAL CONSTANTS:

Shade nos/Colours:	19890* / Reddish grey
Finish:	Flat
Volume solids, %:	28 ± 1
Theoretical spreading rate:	18.7 m²/l [749.9 sq.ft./US gallon] - 15 micron/0.6 mils
Flash point:	22 °C [71.6 °F]
Specific gravity:	1.3 kg/litre [11.1 lbs/US gallon]
Dry to handle:	4 - 5 minute(s) 20°C/68°F
Fully cured:	72 approx. hour(s) 20°C/68°F (75% RH)
VOC content:	620 g/l [5.2 lbs/US gallon] (According to EPA Fed Ref Method 24)
Shelf life:	1 year (25°C/77°F) from time of production. Shelf life is dependent on storage temperature. Shelf life is reduced at storage temperatures above 25°C/77°F. Do not store above 40°C/104°F or below 5°C/40°F. Shelf life is exceeded if the liquid is gelled or if the mixed product forms gels before application.

**other shades according to assortment list.*

The physical constants stated are nominal data according to the HEMPEL Group's approved formulas.

APPLICATION DETAILS:

Version, mixed product:	**15890**
Mixing ratio:	BASE 15899: HEMPEL'S LIQUID 99751 2 : 3 by volume
Application method:	Airless spray / Air spray / Brush (touch up)
Thinner (max.vol.):	08570 or 08700 (30%) / 08700 (30%) / 08570 or 08700 (15%) According to separate APPLICATION INSTRUCTIONS
Pot life:	24 hour(s) 20°C/68°F (Closed container, constant stirring) see REMARKS overleaf
Nozzle orifice:	0.019 - 0.023 "
Nozzle pressure:	80 bar [1160 psi] (Airless spray data are indicative and subject to adjustment)
Cleaning of tools:	HEMPEL'S THINNER 08700 or 08570.
Indicated film thickness, dry:	15 micron [0.6 mils] see REMARKS overleaf
Indicated film thickness, wet:	Not relevant
Overcoat interval, min:	According to separate APPLICATION INSTRUCTIONS
Overcoat interval, max:	According to separate APPLICATION INSTRUCTIONS

Safety:
Handle with care. Before and during use, observe all safety labels on packaging and paint containers, consult HEMPEL Safety Data Sheets and follow all local or national safety regulations.

IMPRIMACERO **GRUPO HMF**

BLASTING AND AUTOMATIC PAINTING PROCEDURE

1. OBJECT

This procedure describes the operations to perform, according to ISO9001 standards

2. DESCRIPTION

2.1 RECEPTION OF MATERIAL

Checking the material and batch or stored travel.
Is identified, marking the number of pieces, treatment, customer, etc.

2.2 ABRASIVE BLASTING

Surface cleaning with spherical abrasive.

2.3 CLEANLINESS GRADE

Sa 2 ½ o Sa 3, according to specification

2.4 RUGOSITY

Ra= 10/12 microns/ Rz = 60/75 microns

2.5 PAINTING

The application of automatic shop-primers such as Epoxy, Zinc inorganic of silicate, Ceramic, etc.

Dry film thickness between 20 and 30 microns

2.6 TRACEABILITY

The material is marked and identified its serial.

3 QUALITY CONTROL

IMPRIMACERO works with a total quality system under ISO 9001 standards.

The quality system is hold by an Inspection Points Program. Includes inspections such as enviromental temperature and humidity, oxide grade incial, surface temperature, surface cleaning grade and rugosity, dry film thickness and adherence level.

The Quality Certificate is drawn up in accordance with the results obtained.

J. Ignacio Menéndez

Director of Quality

PPG Protective &
Marine Coatings

Viguesa de Granallados
Muelle de Reparaciones de Bouzas Nave 8
Vigo Pontevedra
Atc: Joaquin Diaz

Madrid, 07 de marzo de 2013

Protection system ISO 12.944 C5 I&M
Dr. Kwame Nkrumah Interchange Project

Dear Sirs:

Serves this letter to confirm you that our protection system described in the attached certificate complies with the requirements of the standard ISO 12.944 classification C5I and C5M environment and high life expectancy more than 15 years.

Besides the own certification ISO 12944 C5I H, according to testing laboratories COT, also meets the ACQPA French requirement for this same durability and environment C5 M H.

As a significant reference enclosed you the bridge Millleau (40.000tns.) and recently BusVao viaduct (3.500 tns.) projects, protected with this same system.

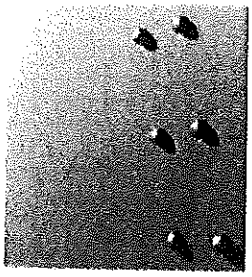
Expecting will be of your conformity and approval, remain at your disposal for any clarification required.

José González Álvarez
Protective Coatings Manager

SIGMA COATINGS
AMERCOAT

COT
guarantee for quality

COT
Independent advice, research and management for construction and industry



REPORT

Testing of system SIGMAFAST 302 / SIGMAFAST 213 / SIGMADUR 550 according to Test Regime 2 of ISO DIS 12944 C5-I

LABORATORY
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Haarlem, 17 December 2007
NB/MH

Client	:	SigmaKalon Marine & Protective Coatings Netherlands BV P.O. Box 43 1420 AA Uithoorn
Contact person	:	Mr R. Kruijt
Project number	:	20070304
Reference	:	COT07-2940-REP
Handled by	:	Mr N. Blokker

CONTENTS

1 INTRODUCTION 3

2 GENERAL DATA 3

3 PAINT APPLICATION AND CURING 3

4 RESULTS 4

5 CONCLUSION 4

1 INTRODUCTION

By order of SigmaKalon Marine & Protective Coatings Netherlands BV, the Centrum voor Onderzoek en Technisch advies (COT BV) has carried out tests according to Test Regime 2 of ISO DIS 12944 C5-I.

The order has been given in the Memo dated July 18th 2007.

2 GENERAL DATA

Samples:

Table 1: Received samples

COT sample number	Description
20-07-07/590 - 11	coated steel test panels

COT project number : 20070304

Received : 20 July 2007

3 PAINT APPLICATION AND CURING

The coating system has been applied at SigmaKalon on grit blasted mild carbon steel panels.

Table 2: DFT applied coatings (given by client)

	Trade name	NDFT (µm)
1st coat	SigmaFast 302	80
2nd coat	SigmaFast 213	150
3rd coat	SigmaDur 550	60

Required durability: C5-I, Test Regime 2

4 RESULTS

Table 3: Test results

TEST				REQUIREMENTS
	Ref. panel (4)			
Measured DFT (µm)	391 ± 20			
Assessment before tests: ISO 4624 (MPa) Break	15.4 ± 0.3 in system			≥ 5
	Panel 1	**Panel 2**	**Panel 3**	
Measured DFT (µm)	379 ± 23	391 ± 16	356 ± 12	
ISO 11997-2 Exposure time: 2688 hours Assessment after testing:				
ISO 4628-2 (blistering)	0 (S0)	0 (S0)	0 (S0)	0 (S0)
ISO 4628-3 (rusting)	Ri 0	Ri 0	Ri 0	Ri 0
ISO 4628-4 (cracking)	0 (S0)	0 (S0)	0 (S0)	0 (S0)
ISO 4628-5 (flaking)	0 (S0)	0 (S0)	0 (S0)	0 (S0)
ISO 4624 (MPa) Break	14.5 ± 1.0 in system	15.2 ± 1.6 in system	14.2 ± 1.7 in system	≥ 5
Annex A (corrosion of the substrate from scribe in mm)	3.6	4.2	3.8	≤ 6 mm

5 CONCLUSION

The system SigmaFast 302 / SigmaFast 213 / SigmaDur 550 meets the requirements of Test Regime 2 of ISO DIS 12944 C5-I.

CENTRUM VOOR ONDERZOEK
EN TECHNISCH ADVIES (COT)

Ing. M. Walrave
Manager Laboratory

J.R.S. Brakenhoff
Project manager Coatings

DATA

SIGMAFAST 302

Globally Available

5 pages

June 2012
Revision of January 2011

Description	two component silicate zinc epoxy primer
PRINCIPAL CHARACTERISTICS	– good anticorrosive properties – fast curing – fast handling – topcoats must be unsaponifiable – cures at temperatures down to -5°C – reduced risk of mudcracking – ACQPA approval 21251
COLOURS AND GLOSS	bluegreen, grey – flat
BASIC DATA AT 20 °C	(1 g/cm³ = 8.35 lb/US gal; 1 m²/l = 40.7 ft²/US gal) (data for mixed product)
Mass density	2.1 g/cm³
Volume solids	63% ± 2%
VOC (Directive 1999/13/EC, SED)	max. 204 g/kg (Directive 1999/13/EC, SED)
VOC (UK PG 6/23(92) appendix 3)	max. 419 g/l (approx. 3.5 lb/gal)
Recommended dry film thickness	50 - 80 µm depending on system
Theoretical spreading rate	12.6 m²/l for 50 µm *
Touch dry after	10 min. at 20 °C
Overcoating interval	min. 25 min. * max. 1 year *
Shelf life (cool and dry place)	at least 12 months * see additional data
RECOMMENDED SUBSTRATE CONDITIONS AND TEMPERATURES	– steel; blast cleaned to ISO-Sa2½, blasting profile 40 - 70 µm – substrate temperature must be at least 3°C above dew point – during application and curing a substrate temperature down to -5°C is acceptable provided the substrate is dry and free from ice
INSTRUCTIONS FOR USE	mixing ratio by volume: base to hardener 80 : 20 – the temperature of the mixed base and hardener should preferably be above 15°C, otherwise extra solvent may be required to obtain application viscosity – too much solvent results in reduced sag resistance and slower cure – thinner should be added after mixing the components
Pot life	4 hours at 20 °C
AIR SPRAY	
Recommended thinner	Thinner 21-06
Volume of thinner	15 - 20%, depending on required thickness and application conditions
Nozzle orifice	1.6 mm
Nozzle pressure	0.3 - 0.6 MPa (≈ approx. 3 - 6 bar; 44 - 87 p.s.i.)

SIGMAFAST 302

June 2012

AIRLESS SPRAY

Recommended thinner	Thinner 21-06
Volume of thinner	5 - 15%, depending on required thickness and application conditions
Nozzle orifice	approx. 0.38 - 0.53 mm (= 0.015 - 0.021 in)
Nozzle pressure	15 MPa (= approx. 150 bar; 2176 p.s.i.)

BRUSH/ROLLER

Recommended thinner	Thinner 21-06
Volume of thinner	0 - 5%

CLEANING SOLVENT Thinner 90-53

Film thickness and spreading rate

theoritical spreading rate m2/l	12.6	7.9
dft in µm	50	80

Overcoating table for SigmaFast 302 for dft up to 80 µm

substrate temperature	0°C	10°C	20°C	30°C
Max recoat – minimum interval	60 min.	50 min.	40 min.	35 min.
Max recoat – maximum interval	12 months	12 months	12 months	12 months

- surface should be dry and free from any contamination
- an interval of several months can be allowed under clean interior exposure conditions
- zinc rich primers can form zinc salts on the surface; preferably they should not be weathered for long periods before overcoating
- before overcoating any visible surface contamination must be removed by high pressure water cleaning, sandwashing, sweep blasting or mechanical cleaning

Overcoating table for SigmaFast 302 for dft up to 50 µm

with SigmaFast 213, SigmaCover 456, SigmaCover 435, SigmaCover 410

substrate temperature	0°C	10°C	20°C	30°C
Max recoat – minimum interval	45 min.	30 min.	25 min.	20 min.
Max recoat – maximum interval	12 months	12 months	12 months	12 months

- surface should be dry and free from any contamination

SIGMAFAST 302

June 2012

Worldwide availability

Whilst it is always the aim of Sigma Coatings to supply the same product on a worldwide basis, slight modification of the product is sometimes necessary to comply with local or national rules/circumstances.
Under these circumstances an alternative product data sheet is used.

Reference

Explanation to product data sheets	see Information sheet 1411
Safety in confined spaces and health safety	
Explosion hazard - toxic hazard	see information sheet 1431
Safe working in confined spaces	see information sheet 1433
Directives for ventilation practice	see information sheet 1434
Cleaning of steel and removal of rust	see information sheet 1490
Safety indications	see information sheet 1430
Conversion tabels	see information sheet 1410
Specification for mineral abrasives	see information sheet 1491
Relative humidity - substrate temperature - air temperature	see information sheet 1650

SAFETY PRECAUTIONS

- for paint and recommended thinners see safety sheets 1430, 1431 and relevant material safety data sheets
- this is a solvent borne paint and care should be taken to avoid inhalation of spray mist or vapour as well as contact between the wet paint and exposed skin or eyes

SIGMAFAST 302

June 2012

WARRANTY

PPG warrants (i) its title to the product, (ii) that the quality of the product conforms to PPG's specifications for such product in effect at the time of manufacture and (iii) that the product shall be delivered free of the rightful claim of any third person for infringement of any U.S. patent covering the product.

THESE ARE THE ONLY WARRANTIES THAT PPG MAKES AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, UNDER STATUTE OR ARISING OTHERWISE IN LAW, FROM A COURSE OF DEALING OR USAGE OF TRADE, INCLUDING WITHOUT LIMITATION, ANY OTHER WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR USE, ARE DISCLAIMED BY PPG.

Any claim under this warranty must be made by Buyer to PPG in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life of the product, or one year from the date of the delivery of the product to the Buyer, whichever is earlier. Buyer's failure to notify PPG of such non-conformance as required herein shall bar Buyer from recovery under this warranty.

LIMITATIONS OF LIABILITY

IN NO EVENT WILL PPG BE LIABLE UNDER ANY THEORY OF RECOVERY (WHETHER BASED ON NEGLIGENCE OF ANY KIND, STRICT LIABILITY OR TORT) FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN ANY WAY RELATED TO, ARISING FROM, OR RESULTING FROM ANY USE MADE OF THE PRODUCT.

The information in this data sheet is intended for guidance only and is based upon laboratory tests that PPG believes to be reliable. PPG may modify the information contained herein at any time as a result of practical experience and continuous product development. All recommendations or suggestions relating to the use of the PPG product, whether in technical documentation, or in response to a specific inquiry, or otherwise, are based on data, which to the best of PPG's knowledge, is reliable. The product and related information is designed for users having the requisite knowledge and industrial skills in the industry and it is the end-user's responsibility to determine the suitability of the product for its own particular use and it shall be deemed that Buyer has done so, as its sole discretion and risk.

PPG has no control over either the quality or condition of the substrate, or the many factors affecting the use and application of the product. Therefore, PPG does not accept any liability arising from any loss, injury or damage resulting from such use or the contents of this data sheet (unless there are written agreements stating otherwise). Variations in the application environment, changes in procedures of use, or extrapolation of data may cause unsatisfactory results.

This data sheet supersedes all previous versions and it is the Buyer's responsibility to ensure that this data sheet is current prior to using the product. Current data sheets for all PPG Protective & Marine Coatings products are maintained at www.ppgpmc.com.
The English text of this data sheet shall prevail over any translation thereof.

SIGMAFAST 302

June 2012

	PDS	7704
216759	bluegreen	1000002200
218818	bluegreen	1000002100
267560	grey	5000002200

DATA

SIGMAFAST 213

Globally Available

4 pages

November 2012
Revision of September 2009

Description	two component high build polyamine cured vinyl epoxy primer
PRINCIPAL CHARACTERISTICS	– epoxy primer or build coat in protective coating systems for steel structures in atmospheric exposure – tough, with long term flexibility – cures at temperatures down to -5°C – fast drying and handling
COLOURS AND GLOSS	grey, yellow – flat
BASIC DATA AT 20 °C	(1 g/cm³ = 8.35 lb/US gal; 1 m²/l = 40.7 ft²/US gal) (data for mixed product)
Mass density	1.5 g/cm³
Volume solids	60% ± 2%
VOC (Directive 1999/13/EC, SED)	max. 235 g/kg (Directive 1999/13/EC, SED)
VOC (UK PG 6/23(92) appendix 3)	max. 345 g/l (approx. 2.9 lb/gal)
Recommended dry film thickness	80 - 180 µm depending on system
Theoretical spreading rate	7.5 m²/l for 80 µm 3.3 m²/l for 180 µm *
Touch dry after	50 minutes at 20 °C *
Overcoating interval	min. 45 min * max. 1 year *
Shelf life (cool and dry place)	at least 12 months * see additional data
RECOMMENDED SUBSTRATE CONDITIONS AND TEMPERATURES	– steel; blast cleaned to ISO-Sa2½, blasting profile 40 - 70 µm – during application and curing a substrate temperature down to -5°C is acceptable provided the substrate is dry and free from ice – substrate temperature should be at least 3°C above dew point – maximum relative humidity during application and curing is 85%
INSTRUCTIONS FOR USE	mixing ratio by volume: base to hardener 80 : 20 – the temperature of the mixed base and hardener should preferably be above 15°C, otherwise extra solvent may be required to obtain application viscosity – too much solvent results in reduced sag resistance and slower cure – thinner should be added after mixing the components
Induction time	15 minutes at 20°C
Pot life	6 hours at 20 °C * * see additional data

SIGMAFAST 213

November 2012

AIR SPRAY

Recommended thinner	Thinner 21-06
Volume of thinner	20 - 30%, depending on required thickness and application conditions
Nozzle orifice	1.5 - 3 mm
Nozzle pressure	0.3 - 0.4 MPa (= approx. 3 - 4 bar; 44 - 58 p.s.i.)

AIRLESS SPRAY

Recommended thinner	Thinner 21-06
Volume of thinner	20 - 30%, depending on required thickness and application conditions
Nozzle orifice	approx. 0.48 mm (= 0.019 in)
Nozzle pressure	15 MPa (= approx. 150 bar; 2176 p.s.i.)

BRUSH/ROLLER

Recommended thinner	Thinner 21-06
Volume of thinner	0 - 5%

CLEANING SOLVENT

Thinner 90-53

ADDITIONAL DATA

Film thickness and spreading rate

theoritical spreading rate m2/l	7.5	6	3.3
dft in µm	80	100	180

Overcoating table for 150 µm dft

substrate temperature	0°C	10°C	20°C	30°C
minimum interval	4.5 hours	2.5 hours	1 hour	35 min.
maximum interval	12 months	12 months	12 months	12 months

- surface should be dry and free from any contamination

Overcoating table for 80 µm dft

substrate temperature	0°C	10°C	20°C	30°C
minimum interval	3 hours	1.5 hour	45 min.	25 min.
maximum interval	12 months	12 months	12 months	12 months

- surface should be dry and free from any contamination

SIGMAFAST 213

November 2012

Worldwide availability

Whilst it is always the aim of Sigma Coatings to supply the same product on a worldwide basis, slight modification of the product is sometimes necessary to comply with local or national rules/circumstances.
Under these circumstances an alternative product data sheet is used.

REFERENCES

Conversion tabels	see information sheet 1410
Explanation to product data sheets	see information sheet 1411
Safety indications	see information sheet 1430
Safety in confined spaces and health safety	
Explosion hazard - toxic hazard	see information sheet 1431
Safe working in confined spaces	see information sheet 1433
Directives for ventilation practice	see information sheet 1434
Cleaning of steel and removal of rust	see information sheet 1490
Specification for mineral abrasives	see information sheet 1491
Relative humidity - substrate temperature - air temperature	see information sheet 1650

SAFETY PRECAUTIONS

- for paint and recommended thinners see safety sheets 1430, 1431 and relevant material safety data sheets
- this is a solvent borne paint and care should be taken to avoid inhalation of spray mist or vapour as well as contact between the wet paint and exposed skin or eyes

SIGMAFAST 213

November 2012

WARRANTY

WARRANTY STATEMENT PPG warrants (i) its title to the product, (ii) that the quality of the product conforms to PPG's specifications for such product in effect at the time of manufacture and (iii) that the product shall be delivered free of the rightful claim of any third person for infringement of any U.S. patent covering the product. THESE ARE THE ONLY WARRANTIES THAT PPG MAKES AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, UNDER STATUTE OR ARISING OTHERWISE IN LAW, FROM A COURSE OF DEALING OR USAGE OF TRADE, INCLUDING WITHOUT LIMITATION, ANY OTHER WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR USE, ARE DISCLAIMED BY PPG. Any claim under this warranty must be made by Buyer to PPG in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life of the product, or one year from the date of the delivery of the product to the Buyer, whichever is earlier. Buyer's failure to notify PPG of such non-conformance as required herein shall bar Buyer

LIMITATIONS OF LIABILITY

LIMITATION OF LIABILITY IN NO EVENT WILL PPG BE LIABLE UNDER ANY THEORY OF RECOVERY (WHETHER BASED ON NEGLIGENCE OF ANY KIND, STRICT LIABILITY OR TORT) FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES IN ANY WAY RELATED TO, ARISING FROM, OR RESULTING FROM ANY USE MADE OF THE PRODUCT. The information in this sheet is intended for guidance only and is based upon laboratory tests that PPG believes to be reliable. PPG may modify the information contained herein at any time as a result of practical experience and continuous product development. All recommendations or suggestions relating to the use of the PPG product, whether in technical documentation, or in response to a specific inquiry, or otherwise, are based on data, which to the best of PPG's knowledge, is reliable. The product and related information is designed for users having the requisite knowledge and industrial skills in the industry and it is the end-user's responsibility to determine the suitability of the product for its own particular use and it shall be deemed that Buyer has done so, as its sole discretion and risk. PPG has no control over either the quality or condition of the substrate, or the many factors affecting the use and application of the product. Therefore, PPG does not accept any liability arising from any loss, injury or damage resulting from such use or the contents of this information (unless there are written agreements stating otherwise). Variations in the application environment, changes in procedures of use, or extrapolation of data may cause unsatisfactory results. This sheet supersedes all previous versions and it is the Buyer's responsibility to ensure that this information is current prior to using the product. Current sheets for all PPG Protective & Marine Coatings Products are maintained at www.ppgpmc.com. The English text of this sheet shall prevail over any translation thereof.

	PDS	7705
219313	yellow	3000002200
219315	grey	5000002200

SIGMADUR 520
(SIGMADUR HB FINISH)

Globally Available

4 pages

May 2013
Revision of March 2010

Description	two component high build semigloss aliphatic acrylic polyurethane finish
PRINCIPAL CHARACTERISTICS	– easy application by roller and airless spray – unlimited recoatable – excellent resistance to atmospheric exposure conditions – good colour and gloss retention (aluminium version becomes grey) – non-chalking, non-yellowing – cures at temperatures down to -5°C – tough and abrasion resistant – resistant to splash of mineral and vegetable oils, paraffins, aliphatic petroleum products and mild chemicals – can be recoated even after long atmospheric exposure
COLOURS AND GLOSS	full colour range and aluminium as RAL 9006 available – semigloss
BASIC DATA AT 20°C	(1 g/cm³ = 8.35 lb/US gal; 1 m²/l = 40.7 ft²/US gal)
	(data for mixed product)
Mass density	1.4 g/cm³ (white) 1.1 g/cm³ (aluminium)
Volume solids	58 ±2% (white), 48 ± 2% (aluminium)
VOC (Supplied)	max. 287 g/kg (Directive 1999/13/EC, SED) (white) max. 377 g/kg (Directive 1999/13/EC, SED) (RAL 9006) max. 383 g/l (approx. 3.2 lb/gal) (white) max. 405 g/l (approx. 3.4 lb/gal) (aluminium)
Recommended dry film thickness	50 - 75 µm depending on system
Theoretical spreading rate	11.6 m²/l for 50 µm 7.7 m²/l for 75 µm *
Touch dry after	1 hour at 20°C
Overcoating interval	min. 6 hours * max. unlimited
Full cure after	4 days *
	(data for components)
Shelf life (cool and dry place)	at least 24 months * see additional data
RECOMMENDED SUBSTRATE CONDITIONS AND TEMPERATURES	– previous coat; (epoxy or polyurethane) dry and free from any contamination and sufficiently roughened if necessary – during application and curing a substrate temperature down to -5°C is acceptable provided the substrate is dry and free from ice – substrate temperature should be at least 3°C above dew point – maximum relative humidity during application and curing is 85% – premature exposure to early condensation and rain may cause colour and gloss change

SIGMADUR 520
(SIGMADUR HB FINISH)

May 2013

INSTRUCTIONS FOR USE

mixing ratio by volume: base to hardener 88 : 12

- the temperature of the mixed base and hardener should preferably be above 10°C, otherwise extra solvent may be required to obtain application viscosity
- too much solvent results in reduced sag resistance
- thinner should be added after mixing the components
- Aluminium version has lower gloss than standard version and color could be different by application method

Induction time: none
Pot life: 5 hours at 20 °C *
*see additional data

AIR SPRAY
Recommended thinner: Thinner 21-06
Volume of thinner: 5 - 10%, depending on required thickness and application conditions
Nozzle orifice: 1.0 - 1.5 mm
Nozzle pressure: 0.3 - 0.4 MPa (= approx. 3 - 4 bar; 44 - 58 p.s.i.)

AIRLESS SPRAY
Recommended thinner: Thinner 21-06
Volume of thinner: 0 - 5%, depending on required thickness and application conditions
Nozzle orifice: approx. 0.46 mm (= 0.018 in)
Nozzle pressure: 15 MPa (= approx. 150 bar; 2176 p.s.i.)

BRUSH/ROLLER
Recommended thinner: Thinner 21-06
Volume of thinner: 0 - 5%

CLEANING SOLVENT

Thinner 90-53

ADDITIONAL DATA

Film thickness and spreading rate

theoretical spreading rate m²/l	colours 11.6 m/l aluminium 9.6 m/l	colours 7.7 m/l aluminium 6.4 m/l
dft in µm	50	75

Overcoating table for SigmaDur products

substrate temperature	-5°C	0°C	10°C	20°C	30°C	40°C
minimum interval	24 hours	16 hours	8 hours	6 hours	5 hours	3 hours
maximum interval	unlimited when cleaned from any contamination					

- surface should be dry and free from any contamination

SIGMADUR 520
(SIGMADUR HB FINISH)

May 2013

Curing

Curing table

substrate temperature	dry to handle	full cure
-5°C	24 hours	15 days
0°C	16 hours	11 days
10°C	8 hours	6 days
20°C	6 hours	4 days
30°C	5 hours	3 days
40°C	3 hours	2 days

- adequate ventilation must be maintained during application and curing (please refer to sheets 1433 and 1434)
- premature exposure to early condensation and rain may cause colour and gloss change

Pot life (at application viscosity)

10°C	7 hours
20°C	5 hours
30°C	3 hours
40°C	2 hours

Worldwide availability

It is always the aim of PPG Protective and Marine Coatings to supply the same product on a worldwide basis. However, slight modification of the product is sometimes necessary to comply with local or national rules/circumstances. Under these circumstances an alternative product data sheet is used

REFERENCES

Conversion tabels	see information sheet 1410
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Explosion hazard - toxic hazard	see information sheet 1431
Directives for ventilation practice	see information sheet 1434
Safe working in confined spaces	see information sheet 1433
Relative humidity - substrate temperature - air temperature	see information sheet 1650

SAFETY PRECAUTIONS

- for paint and recommended thinners see safety sheets 1430, 1431 and relevant material safety data sheets
- this is a solvent borne paint and care should be taken to avoid inhalation of spray mist or vapour as well as contact between the wet paint and exposed skin or eyes
  - contains a toxic polyisocyanate curing agent
  - avoid at all times inhalation of aerosol spraymist

SIGMADUR 520
(SIGMADUR HB FINISH)

May 2013

WARRANTY

PPG warrants (i) its title to the product, (ii) that the quality of the product conforms to PPG's specifications for such product in effect at the time of manufacture and (iii) that the product shall be delivered free of the rightful claim of any third person for infringement of any U.S. patent covering the product. THESE ARE THE ONLY WARRANTIES THAT PPG MAKES AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, UNDER STATUTE OR ARISING OTHERWISE IN LAW, FROM A COURSE OF DEALING OR USAGE OF TRADE, INCLUDING WITHOUT LIMITATION, ANY OTHER WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR USE, ARE DISCLAIMED BY PPG. Any claim under this warranty must be made by Buyer to PPG in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life of the product, or one year from the date of the delivery of the product to the Buyer, whichever is earlier. Buyer's failure to notify PPG of such non-conformance as required herein shall bar Buyer from recovery under this warranty.

LIMITATIONS OF LIABILITY

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	PDS	7524
119852	white	7000002200
183212	aluminium	9006262200

COT bv
Independent advice, research and management for construction and industry

REPORT

Testing of the system
SIGMAFAST 278 (100 µm) / SIGMAFAST 278 (100 µm)
according to ISO 12944-6 C4 High

Civil projects
Corrosionprotection
Laboratory

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E info@cot-nl.com
I www.cot-nl.com

Haarlem, September 20th, 2012

Client	:	PPG Protective and Marine Coatings Koprawag 35 Westpoort 7615 1047 BP Amsterdam The Netherlands Contact person: Mr. M. de Haan
Project number	:	20120389
Report number	:	LAB12-0658-REP
Handled by	:	Mr. Ing. A.R. van Marion

Conclusion
The system SigmaFast 278, DFT 100 µm / SigmaFast 278, DFT 100 µm (COT sample number 13-06-12/0403) meets the requirements of ISO 12944-6 C4 High.

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1 INTRODUCTION

1.1 Order

By order of PPG Protective and Marine Coatings in Amsterdam, The Netherlands, the Centrum voor Onderzoek en Technisch advies (COT bv) in Haarlem, The Netherlands has carried out tests on the system SigmaFast 278 / SigmaFast 278 according to ISO 12944-6 C4 High.

The order has been given by signing the COT quotation with reference LAB12-0410-OFF on July 9th, 2012.

1.2 General information

Table 1: Samples received.

COT sample number	Description	Received
13-06-12/0403	7 coated panels, 150 x 75 x 2 mm	30-05-2012

Table 2: Coating system

Coating system	Colour	DFT (µm)
1st layer SigmaFast 278	RAL 7035	100
2nd layer SigmaFast 278	White	100

2 PAINT APPLICATION

The coating system has been applied by the client on standard (steel Sa 2½, according to TDS) panels. The system has been allowed to cure at least 3 weeks under laboratory conditions.

Requirements : ISO 12944-6
Corrosivity Category : C4
Durability range : High

3 PROCECURE

3.1 Water Condensation test

Three samples have been placed in a Cleveland Condensation tester according to ISO 6270-1. The apparatus consists of an electronically heated water bath, designed so that the cover is formed by the test panels. The temperature has been controlled at 38 ± 2 °C and the tester is placed in a 23 ± 2 °C environment.

The test panels are exposed at an angle of 60 ± 5° to the horizontal and no scribe is made. Immediately after the test the panels are examined for defects according to ISO 4628; the adhesion is determined after a 24 hours recovery period according to ISO 2409, including the adhesion of the reference panel.
In deviation of the standard ISO 6270-1, the dry film thickness has been measured according to ISO 2178 instead of ISO 2808.

Before the test the dry film thickness (DFT) of the panels, including a reference panel, has been measured by means of a magnetic gauge (COT E004) according to ISO 2178.

3.2 Neutral Salt Spray test

Three samples have been placed in a salt spray cabinet (COT S006) according to ISO 9227 (COT instruction 30.01.27). In the cabinet, a 5 % NaCl solution in deionised water with conductivity lower than 20 µS/cm, is sprayed at a temperature of 35 ± 2 °C. The amount of the collected spray is between 1 and 2 ml per hour per 80 cm^2, the pH of the collected spray is 6.5 - 7.2 and the salt concentration of the collected spray is 5.0 ± 0.5 % (m/m). The angle at which the samples have been inclined was approximately 20° to the vertical.

The panels have been vertically scribed to the bare metal with a scribing tool according to ISO 2409.

Immediately after the test the panels have been examined for defects according to ISO 4628 and corrosion creep from the scribe according to Annex A of ISO 12944-6. The adhesion has been determined according to ISO 2409 after a 24 hours recovery period, including the adhesion of the reference panel.

Before the test the dry film thickness (DFT) of the panels, including a reference panel, has been measured by means of a magnetic gauge (COT E004) according to ISO 2178.

4 RESULTS

4.1 Assesment of the reference panels

Table 3: Reference values

Reference values	COT Sample number 13-06-12/0403 Panel 7	Requirements
DFT (µm)	179 ± 11	--
Adhesion (classification)	1	0-1

4.2 Assesment after Water Condensation test

Test started: July 2nd 2012. Test ended: July 23rd 2012

Table 4: Assessment after 480 hours condensation testing.

480 hour ISO 6270-1	COT Sample number 13-06-12/0403			Requirements
	Panel 4	Panel 5	Panel 6	
Average DFT (µm)	195 ± 7	190 ± 11	192 ± 6	--
ISO 4628-2 (blistering)	0(S0)	0(S0)	0(S0)	0(S0)
ISO 4628-3 (rusting)	Ri0	Ri0	Ri0	Ri0
ISO 4628-4 (cracking)	0(S0)	0(S0)	0(S0)	0(S0)
ISO 4628-5 (flaking)	0(S0)	0(S0)	0(S0)	0(S0)
ISO 2409 (classification)	0	0	0	0-1

4.3 Assesment after Neutral Salt Spray test

Test started: July 9th 2012. Test ended: August 8th 2012

Table 5: Assessment after 720 hours NSS testing.

720 h ISO 9227 NSS	COT Sample number 13-06-12/0403			Requirements
	Panel 1	Panel 2	Panel 3	
Average DFT (µm)	193 ± 4	194 ± 8	184 ± 10	--
ISO 4628-2 (blistering)	0(S0)	0(S0)	0(S0)	0(S0)
ISO 4628-3 (rusting)	Ri0	Ri0	Ri0	Ri0
ISO 4628-4 (cracking)	0(S0)	0(S0)	0(S0)	0(S0)
ISO 4628-5 (flaking)	0(S0)	0(S0)	0(S0)	0(S0)
ISO 2409 (classification)	1	0	0	0-1
Annex A (corrosion of the substrate from the scribe) (mm)	1.5	0.2	0.6	≤ 1

5 CONCLUSION

The system SigmaFast 278, DFT 100 µm) / SigmaFast 278, DFT 100 µm (COT sample number 13-06-12/0403) meets the requirements of ISO 12944-6 C4 High.

CENTRUM VOOR ONDERZOEK
EN TECHNISCH ADVIES (COT)

Ing. A.R. van Marion
Laboratory Technician

J.R.S. Brakenhoff
Technical Manager Laboratory

SIGMAFAST 278

4 pages

March 2013
Revision of July 2012

Description	two component high solids, zinc phosphate epoxy primer and build coat, rapid curing and overcoat even under low temperature
PRINCIPAL CHARACTERISTICS	– epoxy primer or build coat in protective coating systems – excellent corrosion resistance in atmospheric exposure – cures at temperatures down to -5°C – speed curing in steel fabrication – easy application by airless spray – wide application range
COLOURS AND GLOSS	redbrown, grey and a selected range of (MIO) colours – flat
BASIC DATA AT 20 °C	(1 g/cm³ = 8.35 lb/US gal; 1 m²/l = 40.7 ft²/US gal) (data for white, for mixed product)
Mass density	1.5 g/cm³
Volume solids	80% ± 3%
VOC (Directive 1999/13/EC, SED)	max. 153 g/kg (Directive 1999/13/EC, SED)
VOC (UK PG 6/23(92) appendix 3)	max. 230 g/l (approx. 1.9 lb/gal)
Recommended dry film thickness	75 - 250 µm
Theoretical spreading rate	6.4 m²/l for 125 µm
Touch dry after	1 hour at 20 °C
Overcoating interval	min. 2 hours * max. unlimited * (data for components)
Full cure after	3 days * at 20 °C *
Shelf life (cool and dry place)	at least 24 months * see additional data
RECOMMENDED SUBSTRATE CONDITIONS AND TEMPERATURES	– steel; blast cleaned to ISO-Sa2½ or power tool cleaned to min. ISO-St3 – galvanized steel; cleaned from grease, salts, contaminations and roughened up – previous suitable primer; dry and free from any contamination and zinc salts, and sufficiently roughened if necessary – when applied to zinc silicate, a mist coat and full coat technique is required – during application and curing a substrate temperature down to -5°C is acceptable provided the substrate is dry and free from ice – substrate temperature should be at least 3°C above dew point
INSTRUCTIONS FOR USE	mixing ratio by volume: base to hardener 75 : 25 – the temperature of the paint should preferably be above 15°C, otherwise extra thinner may be required to obtain application viscosity – too much solvent results in reduced sag resistance and slower cure – thinner should be added after mixing the components
Induction time	none
Pot life	1 hour at 20 °C *

SIGMAFAST 278

March 2013

AIRLESS SPRAY

Recommended thinner	Thinner 91-92
Volume of thinner	0 - 10%, 30-40% when mist coat applied
Nozzle orifice	approx. 0.45 - 0.53 mm (= 0.018 - 0.021 in)
Nozzle pressure	20 - 25 MPa (= 200 - 250 bar; 2901 - 3626 p.s.i.)

BRUSH/ROLLER

Recommended thinner	Thinner 91-92
Volume of thinner	0 - 5%

- Application by roller will leave roller marking and is suitable for minimum d.f.t. requirements only
- A roller suitable for epoxy application must be used

Application by brush may show brush marking, due to the thixotropic nature of the paint and is most suitable to small areas, tight angle areas or for stripe coating or touch up.

CLEANING SOLVENT

- Thinner 90-53

Film thickness and spreading rate

theoretical spreading rate m²/l	10.6	6.4	3.2
dft in µm	75	125	250

Overcoating table for SigmaFast 278 for dft up to 125 µm

with various two pack epoxy- and polyurethane coatings

substrate temperature	-5°C	0°C	10 °C	20°C	30°C
minimum interval	24 hours	14 hours	4 hours	2 hours	1 hour

- This product has an unlimited maximum overcoating interval provided the surface is free from chalking and other contamination, in which case it should be cleaned and roughened up to ensure good adhesion of subsequent coat.
  - The optimum intercoat adhesion is obtained when the subsequent coating is applied before the full cure time of the previous coating has elapsed
  - Tendency to yellow exposure in the sun; this has no influence on the performance nor does the yellowing affect any topcoat applied.

SIGMAFAST 278

March 2013

Curing

Curing table at 125 µm

substrate temperature	touch dry	dry to handle	full cure
-5°C	16 hours	38 hours	--
0°C	11 hours	24 hours	21 days
10°C	4 hours	8 hours	8 days
20°C	2 hours	4 hours	4 days
30°C	1.0 hour	2 hours	3 days

- adequate ventilation must be maintained during application and curing (please refer to sheets 1433 and 1434)

Pot life (at application viscosity)

-5 °C	20 hours
0 °C	10 hours
10 °C	3 hours
20 °C	1 hour
30 °C	0.5 hour

Worldwide availability

It is always the aim of PPG Protective and Marine Coatings to supply the same product on a worldwide basis. However, slight modification of the product is sometimes necessary to comply with local or national rules/circumstances. Under these circumstances an alternative product data sheet is used

REFERENCES

Explanation to product data sheets	see information sheet 1411
Safety indications	see information sheet 1430
explosion hazard- toxic hazard	see information sheet 1431
Safe working in confined spaces	see information sheet 1433
Directives for ventilation practice	see information sheet 1434

SAFETY PRECAUTIONS

- for paint and recommended thinners see safety sheets 1430, 1431 and relevant material safety data sheets
- this is a solvent borne paint and care should be taken to avoid inhalation of spray mist or vapour as well as contact between the wet paint and exposed skin or eyes

SIGMAFAST 278

March 2013

WARRANTY

PPG warrants (i) its title to the product, (ii) that the quality of the product conforms to PPG's specifications for such product in effect at the time of manufacture and (iii) that the product shall be delivered free of the rightful claim of any third person for infringement of any U.S. patent covering the product. THESE ARE THE ONLY WARRANTIES THAT PPG MAKES AND ALL OTHER EXPRESS OR IMPLIED WARRANTIES, UNDER STATUTE OR ARISING OTHERWISE IN LAW, FROM A COURSE OF DEALING OR USAGE OF TRADE, INCLUDING WITHOUT LIMITATION, ANY OTHER WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE OR USE, ARE DISCLAIMED BY PPG. Any claim under this warranty must be made by Buyer to PPG in writing within five (5) days of Buyer's discovery of the claimed defect, but in no event later than the expiration of the applicable shelf life of the product, or one year from the date of the delivery of the product to the Buyer, whichever is earlier. Buyer's failure to notify PPG of such non-conformance as required herein shall bar Buyer from recovery under this warranty.

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PDS 6829

VIGRA
Surface treatments

SURFACE TREATMENT REPORT

Customer	DIZMAR		Order No.			
Plant	GHANA		Purch.No.			
Detail			Ref.			
Dwg. No.						
Outside Pre treatment			**Inside Pre treatment**			
Removal of welding sparks etc	T.Dizmar					
Surface preparation	Sa2½ (welds)	other Sa1	St3 (welds)	other St2		
Blasting material	Fe					
Rinsing method before painting	Air Pressure					
Time from blasting to first paint						
Outside Painting				**Inside Painting**		
Bacht n° (A)						
Bacht n° (B)						
Layer / Coat No.	1	2	3	4	5	6
Paint type	Sigmafast 302	Sigmafast 213	Sigmadur 520	Sigmafast 278	Sigmafast 278	
Colour	Green	Grey	Ral 7038	Grey	Gey	
Method of application	Airless	Airless	Airless	Airless	Airless	
Date/ time for start of appl.						
Relative humidity % (Hr)						
Surface temperature °C (Ts)						
Environment Temp °C (Ta)						
Dew point °C (Tr)						
ΔT °C						
Measured dry film thickn	80	150	60	100	100	
No. of measurements						
Measured min. dry film thick.						
Measured max. dry film thick.						
Average dry film thickness						
Remark						
Control	Pre treatment			Painting		
	Date/ sign.			Date/ sign.		
Supplier						
Supervisor						
Customer						
Approved						

QGMI

SERVICE LIFE TIME EXPECTANCY

Required service life is a parameter to be defined by codes or by the client if it was the case. No requirements were received by the client during the project phase regarding this issue. Nevertheless, expected service life time for the bridges should be 100 years.
Service life time of replaceable elements can be lower than the mentioned value if these elements are not part of the main structural elements.
Next table shows, as a reference, the estimated service life time expectancy for joints, bearings, drainage system, pavement, painting, railings, etc.

ELEMENT	SERVICE LIFE TIME
Pavement	8 — 15 years
Waterproofing membranes	25 — 30 years
Metallic Structure Painting	15 years
Joints	15 — 30 years
Bearings	25 years

The following table summarizes the maintenance provisions defined by the General Maintenance Manual to be considered in maintenance operations.

BASIC MAINTENANCE ELEMENT	REQUIRED OPERATION	PERIOD
Drainage system	Cleaning	03 months or after heavy rain and storms
Roadway and sidewalk	Cleaning with fresh water	03 months
Visual inspection of painting	To detect spots and pitting of corrosion	06 months
Joint	Fill in maintenance specific form	06 months
Concrete elements	Repair of chipping	12 months
Bearings	Cleaning	12 months
Safety elements	Cleaning	12 months
Concrete surfaces	Superficial humidity or stain cleaning	12 months, end of spring or fall
MAIN INSPECTIONS	REQUIRED OPERATION	PERIOD
Bridge	General inspections. External and internal	60 months unless earlier necessary
Joint	According to specific maintenance manual	Two years
Bearings	According to specific maintenance manual	First year - Every five years
SPECIALIZED MAINTENANCE - ELEMENT	REQUIRED OPERATION	PERIOD
Drainage system	Missing or broken element replacement	After main inspection, if necessary
Concrete element	Superficial repairing	After main inspection, if necessary
Concrete element	Rehabilitation of areas in which there is corrosion of reinforcement.	After main inspection, if necessary
Pavement	Crack sealing and pothole repairing	After main inspection, if necessary
Steel elements	Repainting	After main inspection, if necessary
All elements	Rehabilitation after vandalism	After main inspection, if necessary
Safety elements	Rehabilitation of parapets and railing, lightening and safety signs	After main inspection, if necessary
Expansion joints	Substitution if necessary	After main inspection, if necessary
Bearings	Substitution if necessary	After main inspection, if necessary

DESIGN AND CONSTRUCTION OF BRIDGES OVER THE BLACK VOLTA AT BUIPE, OVER THE WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA

Volume 2

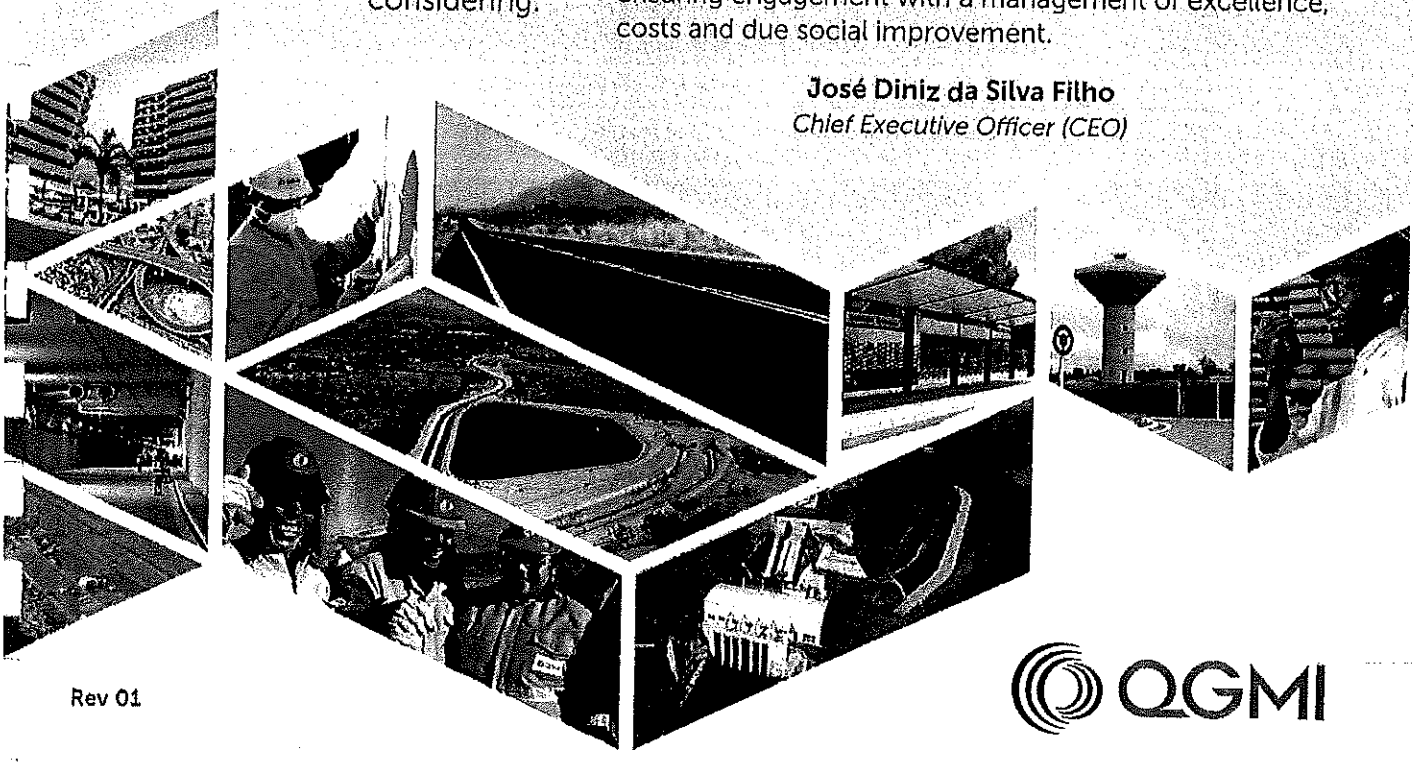
10) INTEGRATED SYSTEM MANAGEMENT PLAN

INTEGRATED MANAGEMENT SYSTEM POLICY

In **QGMI** we ground our strategic actions to achieve the business objectives under the management of: **Occupational Health, Safety, Environment, Quality and Social Responsability aspects;** committed to continuous improvement of processes, products and services as well as to consolidate corporate objectives, considering:

- Reliability, Loyalty, Quality and Work as non-negotiable values;
- Maintain an ethical and transparent business environment, being a social agent catalyst for the sustainable development in the countries where we operate;
- Compliance with applicable legislation and regulations as a fundamental basis for the commitment to quality, in the continuous search for the good international industry practices;
- Reduction of risks when carrying out activities to prevent occupational injuries and diseases, with the commitment of all, seeking to achieve the highest standards of safety and integrity adopted in our projects;
- Contribute to the improvement of the quality of life of the people as a way to expand our positive contribution to the society;
- Management of generated waste and prevention of pollution, promoting rational use of natural resources, and thus guaranteeing the protection of biodiversity and ecosystems; and
- Satisfaction of stakeholders and to meet their needs by ensuring engagement with a management of excellence, costs and due social improvement.

José Diniz da Silva Filho
Chief Executive Officer (CEO)



Rev 01

QGMI

TÜV NORD

CERTIFICATE

Management system as per
ISO 9001 : 2015

In accordance with TÜV NORD CERT procedures, it is hereby certified that

QGMI Construcciones e Infraestructuras Globales, S.L.U
Calle Agustín de Betancourt, 25 - Planta 1°
28003 - Madrid - Spain

applies a management system in line with the above standard for the following scope

Complete management of engineering Works within the EPC cycle (Engineering, Procurement and Construction) in development of: roads, bridges, tunnels,urban mobility, airports, hydraulic Works, energy, electromechanical assembly, buildings and other Works, including concessions of public services.

Certificate Registration No. 44 100 18 31 0004
Audit Report No. BR 999

Valid from 2018-9-27
Valid until 2021-9-26
Initial certification: 2018

Certification Body
at TÜV NORD CERT GmbH

Barueri, 2018-9-27

This certification was conducted in accordance with the TÜV NORD CERT auditing and certification procedures and is subject to regular surveillance audits.

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D-ZM-12007-01-01

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DAkkS Deutsche Akkreditierungsstelle D-ZM-12007-01-01

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Certificate Registration No. 44 116 181233
Audit Report No. 3522 5298

Valid from 2018-09-27
Valid until 2021-03-11
(until 2021-09-26 in case of migration to ISO 45001:2018)
Initial certification 2018

S. Vetter
Certification Body
at TÜV NORD CERT GmbH

Essen, 2018-09-27

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DAkkS
Deutsche
Akkreditierungsstelle
D-ZM-12007-01-01

Review	Date	Summary Description
00	02/01/2018	Initial issue
01	02/09/2019	Annual review of procedures with the lessons learned for the continuous improvement of the company's management process. Added aspects related to good international environmental and social practices. Language compatibility review

(1) This document is equivalent to version 01 of the original in Spanish.

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1 Purpose

Describe the general guidelines of the Integrated Management System (IMS) based on ISO 9001:2015, ISO 14001:2015 and OHSAS 18001:2007 standards, to ensure that IMS policy, objectives and other elements are understood, implemented and maintained at the headquarters of QGMI as well as at the Group's the Management Units.

2 Application

The guidelines expressed in this manual applies to all Management Units, including consortiums contracts and any business of any other nature.

3 Clarifications / Definitions

Following are presented the acronyms used:

AD-COM: Corporate Communication.

AD-CPL: Responsible for Compliance.

ADD-INS: Responsible for Institutional Relations.

ADD-OFI: Responsible for Financing Operations.

CEO: Responsible for QGMI management

COEX: Executive Committee

Deputy CEO: Responsible for the management of the company QGMI, supporting the CEO.

DIDEN: Country Directorfor Business Development.

DIENP: Corporate Direction for Engineering and Planning.

DISUG: Corporate Direction for Operational Support.

EP-EQP: Management Team.

EP-NST: Nucleus of corporate technical support.

EP-ORC: Responsible for budgeting / bids.

Hazard identification: process through which it is recognized that a hazard exists, and its characteristics are defined.

Hazard: Source or situation of damage in terms of injuries or negative effects on people's health, damage to property, damage to the workplace environment or a combination of these.

Note 1: The term hazard can be replaced by the term damage according to each Management unit.

IFC: International Finance Corporation

IMS: Integrated Management System

Incident: Event related to work that causes an injury, illness, or fatality, or an event that could have happened. An accident is a type of incident with injury. An emergency is a particular type of incident.

Integrated Management System Manual (IMSM): Corporate manual that describes the guidelines of the Integrated Management System.

Integrated Management System Plan (MSP): Specific plan that describes the IMS guidelines of the Management Unit or Project.

MP: Management Procedure. Corporate-level procedure applicable across all Management Units.

Management Units: All the sites where the IMS is implemented (Subsidiaries, Offices, Branches, Regional, Superintendence, Equipment Maintenance Workshops and Projects works), solely owned by QGMI or in consortium, when QGMI is the leader.**OHS:** Occupational Health and Safety

OHS: Occupational Health and Safety

QSMSRS (HESQSR): Corporate Management responsible for the areas of Quality, Safety, Health, Environment and Social Responsibility, for the integration of the corporate documents under QSMSRS.

READI: Responsible for Administration.

REMAN: Responsible for Maintenance.

REPLAN: Responsible for Planning.

REPRO: Responsible for Production.

RESGI: Responsible for the Integrated Management System.

RETEC: Responsible for Technical Room.

Risk assessment: General process of estimating the magnitude of the risk and deciding whether that risk is tolerable or not.

Risk: Combination of the probability and the consequence(s) that are derived from the materialization of a specified event.

SG-ADM: General Administration Support.

SG-CON: Accounting Support.

SG-FIN: Financial Support.

SG-JUR: Legal Support.

SG-PHU: Strategic Human Patrimony.

SG-STI: Information Technology Support.

SUDEN: Commercial Responsible in the countries in support of DIDEN

SUOPE: Responsible for Contract Operations.

4 Description

QGMI supports this Manual as a reference for the Integrated Management System.

4.1 Context of QGMI (understanding the company and its context)

The Queiroz Galvão group began as a small company in Pernambuco in 1953, being today one of the most solid business groups in Brazil.

In 1984, after being consolidated at a national level the company started its internalization process and supported, through engineering expertise, the development of other countries.

Throughout these years there has been a solid and responsible path in the countries where the company operates. To respond to these countries' confidence, we constantly invest in the creation of a structure of systems, equipment, and people that can guarantee the same level of excellence wherever we operate.

Being aware of the importance of the construction sector as a generator of jobs and opportunities, the group has among its priorities the creation of local teams, taking advantage, whenever possible, of the national workforce.

In 2012, as a result of the maturity of this activity and the identification of new business opportunities in the international market, the Brazilian construction company decided to create a new identity to consolidate the three international divisions that it had with a focus mainly in Africa and Latin America.

In 2013, a "spin off" of the international construction division started the embryo of QGMI, with the objective of adding value to its operations with an increase in governance processes, suppliers, compliance and transparency, technology, and financing, all based on Good International Industry Practice (GIIP) practices such as the ones outlined by the IFC.

In 2016, **QGMI** was formally incorporated in Madrid, Spain, and brought together the Group's synergy in its more than 64 years of activity, development of infrastructure, in the areas of construction, oil and gas, energy, infrastructure management and services, environmental engineering, real estate and shipbuilding (shipyards).

QGMI upholds high ethical standards and as stated in our code of conduct. The company requires employees to treat others with respect, dignity, and equality, not to abuse power by any means, discrimination, threats, intimidations, violence, moral or sexual harassment. The use of child or forced labour, sexual exploitation, or human traffic either directly or either or by third parties will not be tolerated.

4.1.1 Principles and Values of the organization

The values represent the foundation of the organization to face the inconstancy of the market, being:

- Unchangeable: no matter the size of the challenge or difficulty
- Unnegotiable: position towards business and relationships is invariable

refusing to participate in criminal proceedings, even if this leads to a loss of business of the organization.

The responsibilities of the Chief Compliance Officer (CCO) are to:

- Promote and continuously monitor the implementation and effectiveness of the criminal compliance management system in the different areas of the organization.
- Ensure that ongoing training support is provided to the members of the organization to ensure that all relevant members are trained regularly.
- Promote the inclusion of responsibilities for criminal compliance in the job descriptions and performance management processes of the members of the organization.
- Implement a system of information and documentation of criminal compliance.
- Adopt and implement processes to manage information, such as complaints and / or comments received from hotlines, a whistleblowing channel, or other mechanisms.
- Establish performance indicators of criminal compliance and measure the performance of criminal compliance in the organization.
- Analyse performance to identify the need for corrective actions.
- Identify and manage criminal risks including those related to business partners.
- Ensure that the criminal compliance management system is reviewed at planned intervals.
- Ensure that employees are provided access to compliance resources.
- Inform the governing body about the results derived from the application of the criminal compliance management system.

In this sense, those responsible for any area or Department are obliged to provide the QGMI Ethics and Compliance area with any information that they may request about any activity that may incur in any offense.

4.1.3 Understanding the needs and expectations of stakeholders

The categories of stakeholders that have been defined are:

- Clients;
- Employees;
- General Public (as end users of infrastructure);
- Media;
- Local communities;
- Suppliers;
- Shareholders;
- Competitors;
- State Regulatory Institutions;
- Financial institutions / Lenders;
- Government, socio-environmental institutions, trade unions, social organizations, amongst others; and
- Non-governmental organisations.

> **STAKEHOLDER**
>
> Person or *organization* that may affect, be affected, or be perceived as affected by a decision or activity.

To determine these interested parties, the following has been considered:

- Those with whom the company has a legal, operational or fiscal responsibility, including interested parties with which contracts are established.
- Those who have influence to deter or promote the activities of the company.
- People and organisations in the areas or countries where the company operates that can either be affected by the activity of the company or can influence its effective operation.

STAKEHOLDERS	Social Responsibilities	Stakeholder Interest	QGMI Interest
Clients	• Services and products that are socially beneficial.	• Product quality. • Compliance with the established requirements. • Compliance with deadlines.	• Client satisfaction through the achievement of the established agreements. • Image of the company and the product on the market. • Fair and sufficient profit.
Employees	• Employment and training. • Comply with the terms of their contract. • Must not knowingly endanger health, safety or environment at work.	• Job security. • Personal and professional development. • Incentives. • Satisfaction. • Right to a form of worker representation/voice	• Productivity. • Development of skills and staff training. • Preserve the intellectual assets within the organization. • Continuity.
General Public	• Reduction of environmental impacts and pollution. • Respect for the customs of the environment (local culture).	• Development of the community. • Mutually beneficial relationships.	• Continuity in operational activities. • Develop good relationship with communities.
Media	• Disclosure of public interest information	• Disclosure of public interest information about QGMI projects	• Maintain a neutral relationship • Support to disclosing information about QGMI projects and

STAKEHOLDERS	Social Responsibilities	Stakeholder Interest	QGMI Interest
			activities in a balanced manner
Local communities	• Identification of social investment opportunities.	• Benefit from QGMI projects (employment and supply chain opportunities)	• Employment of local workforce • Securing social licence to operate/construct
Suppliers	• Management of environmental and social impacts of their products, activities and supply chain	• Strategic alliances. • Mutually beneficial relationships. • Compliance with agreements and deadlines. • Continuity.	• Strategic alliances. • Provision of quality products and services. • Compliance with agreements and deadlines. • Economies of scale.
Shareholders	• Enhance the benefits / positive impacts of infrastructure development	• Obtaining profits. • Efficiency in processes and continuous improvement. • Position in the market.	• Image and competitiveness in the market.
Competitors	• -	• Financial capability. • Transparency.	• Position in the market. • Financial capacity. • Compliance.
State Regulatory Institutions	• Tax • Compliance with applicable laws	• Collecting taxes • Enforce tax, labour laws, among others.	• Maintain economic and employment solvency with the state.
Financial Institutions / Lenders	Manage the environmental, social and economic risk of financing/lending	• Bankable projects • Manage the environmental, social and economic risk of financing/lending	• Secure financing for projects • Maintain licence to operate

STAKEHOLDERS	Social Responsibilities	Stakeholder Interest	QGMI Interest
		• Manage reputational risk • Sustainable lending	
Government-based socio-environmental institutions, trade unions	• Compliance with applicable laws.	• Beneficial relationships. • Reduction of environmental impacts. • Prevention of accidents and occupational diseases, complying with the corresponding legislation. • Labour Agreements / Worker representation	• Compliance with regulations for the fluidity of operations. • Work together on common or mutually beneficial initiatiaves.
Non-governmental organisations	Meet the environmental, social and other goals of their stakeholders and beneficiaries.	• Meet the environmental, social and other goals of their stakeholders and beneficiaries. • Environmental and social aspects of QGMI activities.	• Maintain social licence to operate. • Work together on common or mutually beneficial initiatiaves.

4.1.4 Scope of the Integrated Management System

To determine the scope of the integrated system implemented in QGMI, the context, the requirements of the stakeholders, and the products and services it provides relative to the:

"COMPLETE MANAGEMENT OF ENGINEERING WORKS WITHIN THE EPC CYCLE (Engineering, Procurement and Construction) in the following undertakings: Roads, Bridges, Tunnels, Urban Mobility, Airports, Hydraulic Works, Energy, Electromechanical Assembly, Buildings and other works, including concession of services public. "

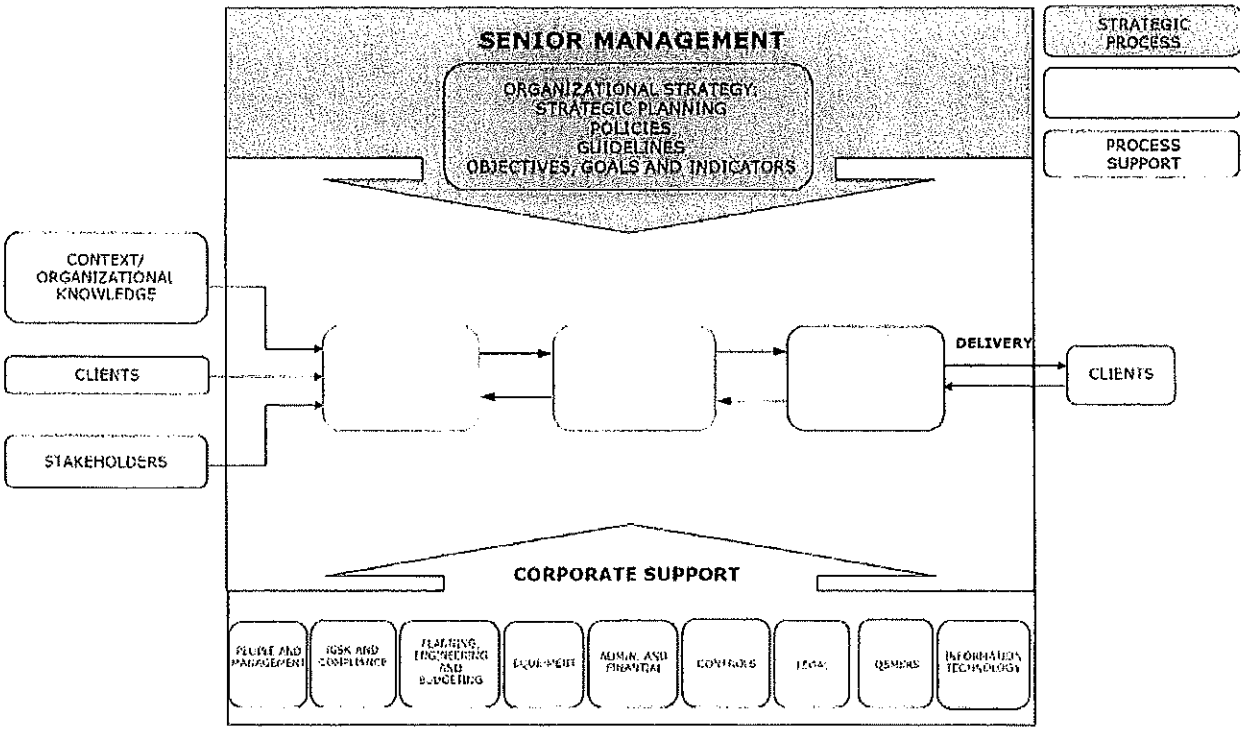
4.1.5 Quality management system and its processes

QGMI needs not only to control its operation respecting the procedures, but also to be responsive, effective, and competitive.

When defining and planning the processes, the risks and opportunities that can influence and therefore create insecurities to reach the objectives have been taken into account.

By identifying and monitoring the key processes, the procedures evolve, fulfilling the expectations of the clients (internal and external) and tailored to the performance of each process.

The IMS proposes that each process has its quality, environment, occupational health and safety, and social aspects integrated as a whole, helping to make its management more effective. This defines the process map as illustrated below:



The interactions between the processes, their main means of control, their purpose, inputs and outputs, and risks are described in the various documents that make up the IMS.

Inputs and Outputs of Production and Service Providing Processes

INPUT	PROCESS/ ACTIVITY	OUTPUTS
SUPPORT DIRECTION		
▶ Edict ▶ Invitation Letter ▶ Official Journal / Press ▶ Technical / Commercial Information ▶ Contract ▶ Request for contractual alteration ▶ Technical information analysed	**Business Development / Budget**	▶ Technical / Commercial Proposal ▶ Contract ▶ Change orders / Contract Amendment ▶ Measurements ▶ Technical information for analysis ▶ Technical / Commercial Information
▶ IMSM ▶ Management Procedures ▶ Specific procedures ▶ Corporate Goals and Targets ▶ Corporate Critical Analysis ▶ Rules ▶ Legislations	**QSMSRS / HESQSR**	▶ IMS Plans ▶ PEs (Project) ▶ Goals and Target (Management Units) ▶ Critical Analysis (Management Units) ▶ Internal Audit Report ▶ External Audit Report ▶ IMS Certificates
▶ Request for technical support for engineering, supplies and equipment	**Technical Support**	▶ Response letter ▶ Technical opinion ▶ Technical report

INPUT	PROCESS/ ACTIVITY	OUTPUTS
▶ External communications ▶ Formal or informal support request	**Communication**	▶ Registration and Control of external communication ▶ Publications
▶ Formal or informal support request	**Human Resources**	▶ Recruitment and selection of talents. ▶ Evaluation of job profiles and functions. ▶ Planning of corporate trainings ▶ Training records ▶ Evaluation of effectiveness of corporate trainings
▶ Formal or informal support request	**Information Technology**	▶ Backups of systems and information ▶ Software availability ▶ Hardware availability ▶ Maintenance of systems
▶ Formal or informal support request	**Equipment Control**	▶ Equipment transfer ▶ Control of equipment availability ▶ Control of assets ▶ Strategic acquisition of equipment
▶ Project related information ▶ Technical information for analysis ▶ Legal requirements and technical standards ▶ Technical information provided by supplier(s)	**Engineering**	▶ Project approved by the client ▶ Technical Information for Analysis by Provider (s) ▶ As built ▶ Technical information for planning

INPUT	PROCESS/ ACTIVITY	OUTPUTS
▶ Technical information review		
▶ Contract ▶ Technical / Commercial Proposal ▶ Edict ▶ Approved Technical Information ▶ Information on Mobilization ▶ Information about the Execution Processes (own or third parties) ▶ Legal requirements ▶ Material Reception Information	**Planning and Monitoring**	▶ Technical Information Review Request ▶ Mobilization / Demobilization Plan ▶ Plan for the Acquisition of Materials / Services ▶ Execution Plan ▶ Information on Quality of Services Provided ▶ Cost Control ▶ Site Advance Control ▶ Compliance schedules
▶ Mobilization and Demobilization Plan ▶ Material ▶ Personal ▶ Legal requirement ▶ Machinery and equipment	**Mobilization/ Demobilization**	▶ Material ▶ Personal ▶ Equipment ▶ Subcontractor
▶ Plan for the Acquisition of Materials / Services ▶ Information on the Quality of Services Provided ▶ Information on the Quality of Materials Received	**Acquisition/ Supply**	▶ Application for Acquisition of Materials / Services ▶ Acquisition Information for Hosting ▶ Information on the Quality of Materials Received ▶ Information on Receiving the Material ▶ Approved Material

INPUT	PROCESS/ ACTIVITY	OUTPUTS
▶ Information on Acquisition ▶ Materials and Equipment		
▶ Approved Material ▶ Third Party Services ▶ Execution Plan ▶ Material, Staff and Equipment (Mobilization) ▶ Release for Payment of Services Executed ▶ Approved project	**Production**	▶ Material, Staff and Equipment (Demobilization) ▶ Executed Services ▶ Completed Work ▶ Information on the progress of the Services ▶ Information for project alteration
▶ Maintenance plan ▶ Control of Hours Worked ▶ Maintenance request ▶ Authorization for maintenance ▶ Parts exchange request / Acquisition ▶ Materials ▶ Technical Team / Staff ▶ Breakdown information / shutdown of machines and / or equipment ▶ Maintenance and correction request	**Preventive / Corrective Maintenance**	▶ Supply of machines and / or operating equipment ▶ Register of used parts ▶ Maintenance control performed ▶ Fuel Consumption Control ▶ RHE (Historical Record of Equipment)
▶ Formal request of reception of the project by the client ▶ Formal request for corrections by the client	**Delivery / Guarantee**	▶ Acceptance term ▶ Correction activities, when applicable ▶ Settlement with suppliers ▶ Return of Guarantees

4.2 Leadership and commitment

QGMI's Senior Management provides the path to follow, demonstrating that the IMS processes are integrated into the business, thus measuring its effectiveness, taking responsibility for the activities, and being able to explain the results achieved, thereby committing to the following:

- Establishes an IMS Policy with general strategic objectives of quality, environmental, occupational safety and health and sustainability management, taking into account the strategic direction and context of QGMI.
- Provides focus on processes and the identification and assessment of risks and opportunities. The designed approach achieves an effective flow of inputs and outputs and integrates both the requirements of environmental management and the safety and health requirements of employees.
- Follows the current and future workloads and calendars to ensure that adequate resources are provided for the IMS when and where they are needed.
- Communicate through internal meetings, email, personal conversations, intranet, bulletin board, etc. the need, value, and benefits of the IMS and its commitment to fulfil its requirements.
- Ensures that the IMS achieves the expected results by tracking the outputs. In some cases, actions may be required to correct deviations or improve processes. In these cases, it ensures that the actions are assigned and, if necessary, provides the necessary resources.
- Ensures the commitment of all, directs and supports personnel to disseminate and share this commitment across the organisation, encouraging employees to participate in and lead on continuous improvement projects and initiatives.
- Establish effective communication channels so that audit findings, management reviews, or suggested improvements are broadly understood in order to maximise the value of the implemented management systems, which can be done through meetings, intranet, communications, etc.
- Provide support and guidance to people in other management positions to help them demonstrate leadership, make decisions or push for improvements when necessary.

4.2.1 Focus and Client Satisfaction

The client is the main stakeholder for QGMI and the basis on which all integrated management is oriented to guarantee compliance with their requirements and ensure their needs are met.

Communication processes will be established with the client to assess compliance with their needs and expectations.

4.2.2 Client's appraisal

Based on its own criteria, the client performs an evaluation of the Project, taking into consideration contract requirements (explicit) and the implicit requirements, which are not described in the contract or contractual guideline.

, After receiving the satisfaction appraisal by the client, the Management Unit must analyse the results and if necessary, establish and implement immediate actions. When applicable, corrective or preventive actions are to be registered a Report of Non-conformances and Corrective actions.

4.2.3 Appraisal carried out by the Management Units

Management Units carry out appraisals based on its own criteria as per the IMS requirements. This evaluation must occur at least once per quarter. The evaluation must be carried out by means of an interview with the client or responsible person designated by the client. The criteria for evaluation are the following:

Criteria	Concept
Service Quality	Perception of the client in relation to quality requirements, which can be obtained through inspections carried out by the client.
Realisation	Realization of contractual deadlines and / or compliance with the client's pertinent requests.
Criteria	**Concept**
Relationship	Relations between the company and the client focussing on cordiality,

	professionalism, transparency, and capacity to solve eventual disagreements
Workforce	Technical capacity, skills and competencies used for the execution of contracted activities
Equipment Machinery / Tools	Provision of equipment, machines and tools, in good working order, and calibrated as applicable.
Legal and Other Requirements and	Compliance with legal and other requirements related to Quality, Safety, Environment, Health and Social Responsibility.

Evaluation criteria:
Worst (01-02) – Bad (03-04) – Regular (05-06) – Good (07-08) – Excellent (09-10).

To calculate the score that corresponds to the level of Client Satisfaction, the Management Unit must apply the following formula:

$$\frac{\Sigma \text{ score attributed for each criterion}}{\text{Number of criteria scored}} = \text{Value attributed to satisfaction level}$$

The level of Client Satisfaction should be ≥ 7.

4.2.4 Final Client Satisfaction Analysis - Corporate Offices

The main indicator of client satisfaction is the Term of Acceptance or acceptance of the Project by the client.

The **DIENP** must obtain and evaluate the information related to the Term of acceptance or reception of the Project by the client.

That evaluation must occur at least once per semester, i.e. twice per year. This will allow the Project to establish guidelines and promote improvements in the IMS that contribute to increasing client satisfaction.

Depending on the results of the appraisal, the claims or needs of the client, the management can lead changes in the processes, operations and management of the unit to improve relationships and the degree of satisfaction.

4.2.5 Policy

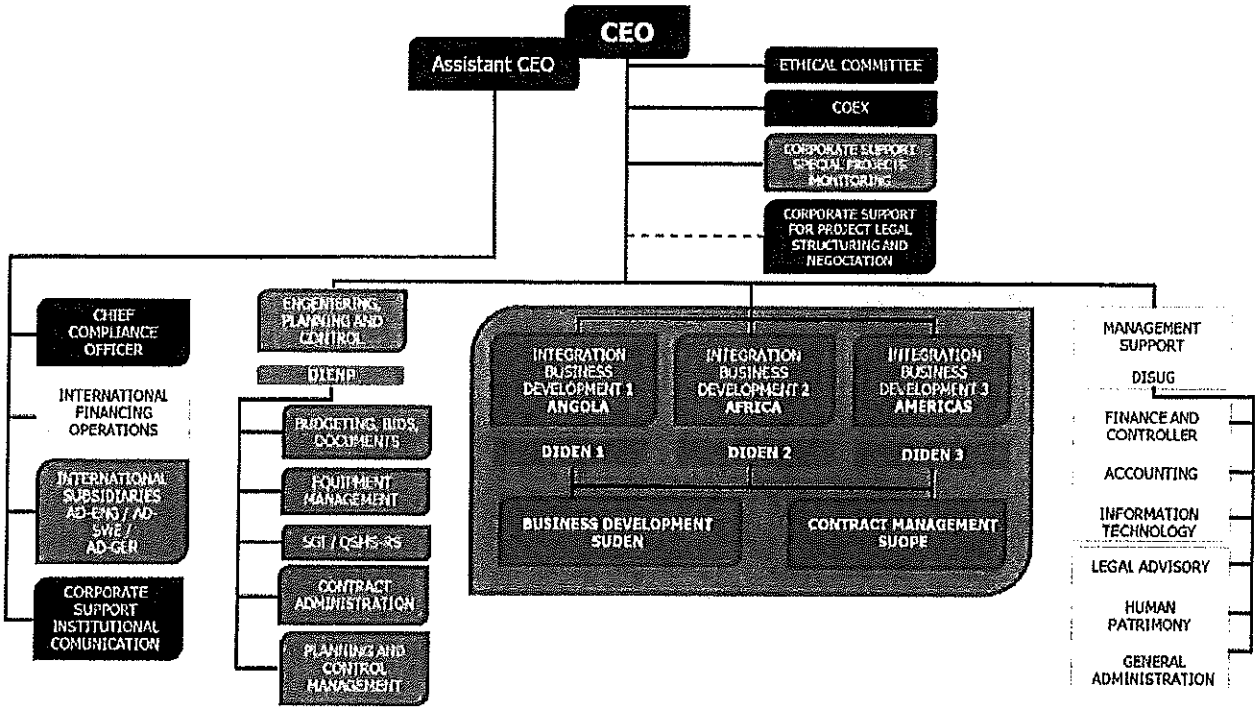
At QGMI we base our strategic actions to achieve the business objectives under the management system: **Quality**, **Safety**, **Occupational Health** and **Social** and **Environmental**, committed to the continuous improvement of processes, products, and services to consolidate corporate objectives, considering:

- Reliability, Loyalty, Quality, and Work as non-negotiable values.
- Maintain an ethical and transparent business environment, being a social agent catalyst for sustainable development in the countries where we operate.
- Compliance with applicable legislation and regulations as a fundamental basis for commitment to quality in the continuous search for the best market practices in our segment;
- Reduction of risks in carrying out activities to prevent occupational injuries and diseases with the commitment of all, seeking to achieve the highest standards of safety and integrity practiced in our projects;
- Contribute to the improvement of the quality of life of people as a way to expand the positive contribution in society;
- Management of generated waste and prevention of pollution, promoting the rational use of natural resources, thereby guaranteeing the protection of biodiversity and ecosystems;
- Satisfaction of stakeholders and meeting their needs, ensuring engagement with a management of excellence, costs, and due social improvement.

Note 2: The IMS policy is available on the company's website and intranet. The signed original is in the custody of QSMSRS.

4.2.6 Roles, responsibilities and authorities in the organization

QGMI's management has established an organization chart where areas, responsibilities, and authorities are defined.



Integrated Management System Requirement	Corporate				Management Units
	CEO	DIENP	QSMSRS	DISUG	SUOPE
Leadership and Commitment	X	X	X		X
Integrated Management System Policy	X	X	X		
Planning of the Integrated Management System		X	X		X
Actions to address risks and opportunities		X			X
Control of documents			X		X
Control of Records			X		X
Responsibilities and Authority		X			X
Management representative		X			X
Internal and External Communication			X		X
Critical Analysis of the IMS			X		X
Provision of resources	X	X			X
Human Resources				X	X
Competency, awareness and training				X	X
Infrastructure		X		X	X
Operations environment		X	X	X	X
Monitoring and Measurement			X		X
Client satisfaction		X			X
Clearing of Products and Services		X			X
Control of non-conforming outputs		X			X
Audits			X		X
Non-conformances and corrective action		X			X
Continuous Improvement		X	X	X	X

Other responsibilities are defined in the specific procedures of the IMS.

4.3 Planning

4.3.1 Actions to address risks and opportunities

The Engineering and Contract Administration (DIENP) processes are fundamental when planning the system in general and the processes in particular. The process of identifying the uncertainties and expectations prepares QGMI to accept them, face them, eliminate them, or position themselves accordingly. This will allow actions to be taken in order to be less vulnerable.

RISK

Effect of uncertainty.

An effect is a deviation from the expected, either positive or negative

These uncertainties, in principle, should not always be considered as negative. In some cases they can also represent opportunities for QGMI.

In the Management Procedure (MP) 15 Risk Management the methodology is established to identify and assess the risks and opportunities.

The final objective of the assessment is to make decisions based on the results obtained and to report those risks that require a special approach and / or are priorities for QGMI to actively manage.

The corresponding actions can be:

- Avoidance: Renouncing the activity affected by the risk, in cases where the unacceptable and serious consequences have been considered, or their probability or consequences have diminished.
- Acceptance: Taking them as an opportunity.
- Elimination: Eliminating the source of the risk.
- Sharing with other parties: Including contractual clauses with clients and / or suppliers.
- Retention: If it is considered that the importance of a risk is not high as compared to the cost of treating it. Accept the risk without doing anything about it. This option should be used only if the mitigation cost would be higher than the damage an incident would incur.

QGMI employees will also be informed of the identified risks and opportunities as appropriate:

- Quality management: Described in the processes.
- Environmental management: Determined in the spreadsheet of environmental aspects and impacts.
- OHS management: Determined in the hazard and damage/risk assessment forms.

Actions and controls are defined for each of these risks, as well as the persons responsible for implementing and monitoring them.

4.3.2 Objectives, Indicators and planning to achieve them

The Management Units must document their objectives. These should be measurable whenever possible in their key processes and need to be monitored for their relevance and impact on the product.

When defining their objectives, the Management Units must consider:

- Risks and opportunities;
- Legal requirements and other subscribed requirements;
- Significant environmental aspects;
- Risks for OHS;

- Technological options;
- Financial, operational, and commercial requirements;
- Client satisfaction;
- Social and cultural means in which the Management Units are inserted;
- Any others that are deemed indispensable to the efficient and effective management of the IMS.

The objectives must be coherent with the Integrated Management System Policy.

The objectives and goals of the management units must take into account as a reference the Corporate Objective and Targets Program in order to define specific actions, different action from those established in it, while following client requirements, contracts, legal regulations, etc. The goals established in the Program of Objectives and Goals of the works must meet the minimum of the values established by corporate.

Corporate objectives and goals are defined and reviewed annually and reported to all management units.

Performance Indicators				
Process	**Indicator**	**Indicator Goal**	**Formula**	**Target/Lim. (Tentative)**
Project Engineering	Index of work overdue according to the delay of the project	Indicate how much the delay in the development of the project is delaying the execution of the work	# of days of delay / number of days total	≤ 5%
Planning	Services executed	Indicate the progress of the executed services compared to the planned	Executed services = Projected curve X Actual curve	95%
Planning	Economic result	Indicate or advance the economic result compared to planned.	Economic Result = Service performed - cost	Commitment Term (TC)[1]
Planning	Financial results	Indicate or advance financial result comparing with or established.	Financial Result = Received - Disbursement	TC
Attention to the requirements of the Client	Client satisfaction index	Indicate if the clients are satisfied with the development of the enterprise.	Result of the evaluation by client criteria or average of the notes attributed using or form	≥ 70%
Production	Soil compaction and moisture index (HILF method) ≥ 95%	Indicate the degree of compaction and deviation of soil moisture.	Number of Tests with results below the specified / Total Test Count * 100	0%
Production	Concrete rejection index	Indicate the quality of the concrete executed in the project.	Analysis quantity with result below the specified / Qty. of analysis * 100	≤ 3%
Production	Compaction Index of Hot Machined Bituminous Concrete (CBUQ).	Guarantee structural stability of flexible pavement	Extraction result of the CBUQ test body	≥ 97%

[1] Term of Commitment (TC), is a document signed between the project management and QGMI detailing the goals of the contract.

Performance Indicators

Process	Indicator	Indicator Goal	Formula	Target/Lim. (Tentative)
Production	Repair index of welded joints	Number or % of repairs in welded joints inspected by ultrasound / radiography.	Number of welded joints with result below the specified / Number of welded joints * 100	≤ 2.5%
Suppliers	Supplier Evaluation Index (Materials and Critical Services)	Indicate the average of the evaluation notes of the suppliers in the management unit	Average = Σ notes two Suppliers / Number of critical suppliers)	≥ 90
Compliance	Proportion/Index of employees that have received training on and have read the Code of Ethics	Number or % of employees that have taken up the Code of Ethics	% added = Total employees that have signed the Code / Employees on the payroll	≥ 90%
Compliance	Proportion/Index of third parties and suppliers that have received training on and signed the Code of Ethics	Number or% of third parties that have taken up the Code of Ethics	% added = Total third parties and suppliers that have signed the Code of Ethics / Number of workers employed by the active third parties and carrying out duties for or on behalf of QGMI.	≥ 85%
Compliance	Proportion of contracts with Anti-corruption clauses.	Number or % inclusion of anti-corruption clauses in the contracts of the management units	Contracts with anti-corruption clause / Contracts in progress * 100	≥ 85%
QSMSRS	Lost-Time Injury Frequency Rate (with medical rest) (LTIFR)	Report number of incidents resulting in lost-time injury (LTI) as a proportion of working hours of exposure to employees' risk	Total lost-time injuries (LTIs) * 1,000,000 / Hours Exposure to risk	≤ 2.50
QSMSRS	Non-Lost-Time Injury Frequency Rate (without medical rest) (NLTIFR)	Report number of incidents involving non-lost-time injuries as a proportion of hours of exposure to employees' risk	Total injuries without lost time/days * 1,000,000 / Hours Exposure to risk	≤ 25.0
QSMSRS	Severity Rate (SR)	Report number of days lost due to occupational incidents/injuries	Total lost days x 1,000,000 / Hours Exposure to Risk	≤ 150
QSMSRS	Total Training Index	Report number of HSEQ-SR training hours delivered in the Project	(Hours of training for Operational staff + Hours of training for Management staff) * 100 / Hours Risk Exposure	≥ 1.25
Health	Total medical attentions	Monitor medical attention/appointments checking for possible disease/illness incidences/trends	Σ of occupational care + medical care + nursing care	Not established
Health	Monitoring and control of absence due to occupational illness or injury	Assist employees who have to take time off from work due to work-related illness or injury, supporting their recovery/rehabilitation process	-	Not established
Grievance Management	Open /Unresolved grievances	Number of open grievances	N° of open grievances / Total n° of grievances	Monitor
	Time to resolve grievances	Average time (in days) taken to close or resolve a grievance	Average number of days to resolve grievances (total n° of days / total n°of grievances)	≤ 30 days

Performance Indicators

Process	Indicator	Indicator Goal	Formula	Target/Lim. (Tentative)
Attention to Legal Requirements	Rate of fines and / or environmental, labour and other seizures	Indicate there are no serious threats from NON-attendnance of legal requirements	No fines, seizures and / or seizures	0
Operational Control (Environmental)	No. of spills of chemical products and / or fuels ≥ 0.2 m³	Indicate that there are no serious threats to the image of the company due to non-compliance with legal requirements.	Total number per year	0
	Total weight of waste destined to waste dump	Control the amount of waste generated by the company	Total weight per year in tons	Monitor
	Total weight of reused waste		Total weight per year in tons	Monitor
	Total weight of waste destined to landfill		Total weight per year in tons	Monitor
	Total weight of waste sent to landfill / waste dump as civil construction waste		Total weight per year in tons	Monitor
	Total weight of waste sent to recycling		Total weight per year in tons	Monitor
	Total weight of incinerated / processed waste		Total weight per year in tons	Monitor
	Total weight of waste shipped to industrial landfill/treatment (hazardous waste)		Total weight per year in tons	Monitor
	Percentage of total volume of water recycled and reused	Know the percentage of water reused by the company	Reused water volume / water volume used * 100	Monitor
	Vol. Total petrol consumed in the work	Know the non-renewable direct energy consumption by the company	Total volume per year in m³	Monitor
	Total volume of diesel consumed on site		Total volume per year in m³	Monitor
	Total amount of electricity consumed (camps, Lodgings, Republics, Industrial Areas, etc).	Minimize consumption	Total electrical energy consumed per month (kW/h)	Monitor
	Total amount of drinking water consumed (camps, Lodgings, Republics, Industrial Areas, etc).	Know the drinking water consumption of the management unit	Total volume consumed per month (m³)	Monitor

4.3.3 Change Management

In face of new situations, planning is carried out in order to maintain the integrity of the system, for example:

- New contracts
- Restructuring/Revision of guidance
- Identification or restructuring of processes
- New information or communication technologies
- Changes in legislation
- Changes in requirements

QGMI evaluates the impact of the changes in the IMS and takes the necessary actions to prevent undesired effects, considering:

- The object of the change and its possible consequences;
- Effect on the system as a whole: an integrated overview of a system or a process is maintained, in light of the changes;
- That we have the resources, for example, to train people, new equipment needs, new software, etc.
- The need for assignment or reassignment of roles and responsibilities.

4.3.4 Environmental Aspects

QGMI has evaluated the environmental aspects of its activities, products and services that it can control and on which it has influence from a life cycle perspective.

ENVIRONMENTAL ASPECT

Element of the activities, products or services of an organization that interacts or can interact with the environment.

The identification and assessment are carried out in accordance with the requirements established in MP 03 - Aspects Impacts, Hazards and Risks. The identification and assessment of the aspects is reflected in the "Aspects and Environmental Impacts Spreadsheet" or applicable legal document.

4.3.5 Hazard identification, risk assessment and establishing of controls

QGMI has identified the hazards and assessed the risks with the methodology used in the MP 03 - Aspects Impacts, Hazards and Risks, and it is presented in the "Occupational Hazard and Risks Spreadsheet" or applicable legal document.

The basic documents that will form the basis of the preventive activity are:

4.4.7 Communication

The Objective of the internal communication is to allow that, under the Integrated Management System, all relevant information may be transmitted and shared with relevant personnel. Internal communication shall cover but not be limited to the following subjects:

- Client Requirements;
- Policy, objectives & goals of the Integrated Management Systems;
- Responsibilities and Authorities;
- Integrated Management System Effectiveness;
- Performance Indicators;
- Awareness of employees about the relevance and importance of their activities and contributions to the achievement of the objectives of the IMS;
- Involvement in the development and critical analysis of the guidelines and the Risk Management Procedures;
- Consultation by the Internal Commission for the Prevention of Accidents, whenever changes that may affect their Safety and Health take place at work;
- Representation in reference to subjects regarding Health & Safety;
- Always informed who their Representative(s) is(are) and/or the Representative appointed by the administration for the IMS subjects, specifically for the Social Responsibility Management System.

Internal communication can be carried out via e-mail, information frames, murals, internal newsletters/papers, "intranet", reports, specific and critical analyses meetings, during trainings, IMDR (Integrated Management Daily Dialogs), and so forth.

When there are contractual requirements related to communication with interested parties, the enterprises must document the applicable system, directly in the Integrated Management System Plan or Specific Procedure.

The guidelines related to the Communication are detailed in the procedure MP 06 Internal and External Communication.

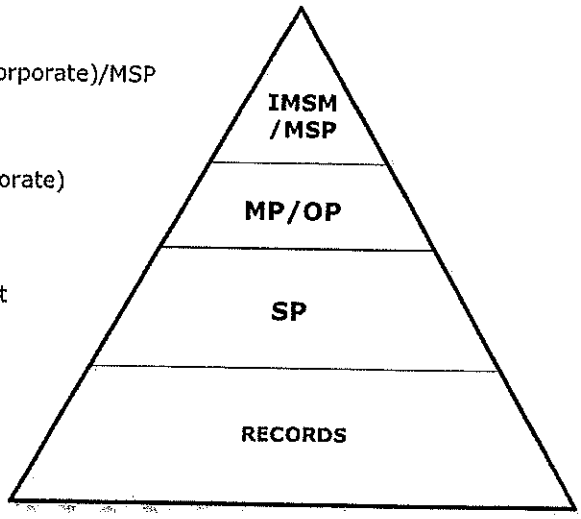
4.4.8 Documentation

The documentation structure of the Integrated Management System is the following:

IMSM – Integrated Management System Manual (Corporate)/MSP – Management System Plan (Company)

MP – Management Procedures (Management - Corporate)
OP – Operational Procedures

SP – Specific Procedures (Operational – Management Units)



The Integrated Management System Manual (IMSM) shall be the corporate guiding document for the establishment of guidelines.

A Plan of the Integrated management system can be established by the management units according to the specifics of the contract, which might be:

- Integrated Management System Plan (IMSP) – Specific plan that integrates the requirements of all the standards;
- Quality Management System Plan (QMSP) – Quality Specific Plan;
- Environmental Management System Plan (EMSP) – Specific Plan for the environment;
- Health & Safety Management System Plan (HSMSP) – Specific Plan for Occupational Safety Health.

Management Procedures (MPs) – Corporative procedures comprising the activities and responsibilities related to IMS on a managerial level.

Operational Procedures (OPs) - Procedures that describe the operative processes necessary for the implementation at corporate level and / or of the management unit.

Specific Procedures (SPs) – Procedures developed by the Management Units which describe the necessary processes for the accomplishment of product or service on an operational level.

The systems that describe the control of the documented information maintained and conserved is described in the MP 01 – Control of Documented Information.

4.4.9 Participation and consultation

QGMI provides, as established in section 4.4.7 of this manual, a procedure to establish internal and external communications.

In addition to the communication channels established by management, for the disclosure of the hazards and the management of occupational health and safety between the different levels and functions of the organization, the management encourages participation through the completion of timely and controlled consultations with employees. For example:

- Investigation of incidents;
- Hazard identification process, risk assessment and controls;
- Meetings and talks given by the OHS area;
- During the daily dialogues of Integrated management;
- When changes occur that may affect the OHS;
- When there are changes in the activities of the company or in its planning that have the potential to affect the health and safety of employees;
- When employees responsible for OHS are desginated, or when the contracting of a service related to OHS is being considered.

A record of these consultations shall be kept and filed.

4.5 Operation

4.5.1 Planning and operational control

The general planning of the Management Unit must meet the contractual requirements where the QGMI's obligations are defined.

Depending on the planning, specific plans and procedures related to Quality, Environment, Safety and Health in the workplace (materials, services, equipment and product) are to be developed.

Planning processes shall integrate and take into consideration: the needs of the client, environmental legislation and permitting requirements, OHS requirements, social impacts on communities; as well as budget limitations.

All aspects and environmental impacts, hazards and potentially significant damages identified through a risk assessment process require the establishment of operational controls as defined in MP 09 - Guidelines for Environmental, Safety and Health Monitoring.

4.5.2 Products and Services Requirement

Client communication

The person responsible for the contract and / or the technical manager shall:

- Communicate the details of the product or service to be provided through meetings, email, telephone, formal communications, etc.
- Establish the method of communication between the client and QGMI that allows the flow of information (consultations, changes, claims, among others) in an effective and formal manner.
- Inform the client, where appropriate, about the organization, management, and treatment of the client's property, and communicate any incident related to the client's property.
- Communicate, where appropriate, contingency actions to be undertaken to avoid effects on compliance with the client's requirements, for example, in labour conflicts, natural disasters, among others.

Definition of requirements related to products and services and their revision

The critical analysis of the requirements related to the product can be made considering the following stages regarding the conquest of the business:

- Identification and analysis of the business possibility;
- Acquisition / analysis, visit to the premises, elaboration of Technical / Commercial Proposal;
- Approval of the Technical / Commercial Proposal and formalization of the Contract.

Any change in the specifications of the Technical / Commercial / Contract Proposal is presented to and renegotiated with the client and formalized by means of the "Contract Additive", "Work Journal", "Letter" or other form of communication.
The detail of this process is specified in the procedure PG 10 Conquest of the Business and Budget.

Before the acceptance of contracts, the requirements related to products and services must be analysed critically. This process is detailed in the PG 10 Conquest of the Business and Budget.

4.6 Design and Development of Products and Services

The planning and control of the project and development of the product and service must be carried out, contemplating the stages of:

- Critical analysis, verification and validation of the project and development of the product and service.
- Definition of responsibilities and authorities for project and development of the product and service.
- Management of the interfaces between the different groups involved in the project and development of the product and service.
- The detail of this process is specified in the procedure PG 11 - Guidelines for Project and Development.

4.6.1 Control of processes, products and services supplied externally

Acquisitions must be analysed critically prior to approval and formal documentation for purchase. That authorization is approved by the person in charge of the Contract and / or direct responsible designated.

The suppliers of products, supplies and services are selected and evaluated considering their capacities to meet the quantities, specifications, terms and prices previously agreed, among other requirements.

The detail of this process is specified in the procedure PG 13 Guidelines for Acquisition, Management of Materials and Services.

In the management units where there is the process of purchasing and receiving materials, the units must establish the material specifications, measurement and monitoring in the reception and appropriate storage conditions.

When applicable, for the acquisition, controls on the purchase of materials and the contracting of services for the execution of construction activities, laboratory services, project services, specialized engineering services, and the location of equipment considered

critical must be considered for the attention of the demands of the clients including management of environmental and social aspects.

4.7 Production and Service Provision

4.7.1 Control of production and service provision

Each Management Unit prepares and implements its control procedures for the production process and provision of the service as applicable.

4.7.2 Identification and Traceability

The characteristics of the project / studies / work will be defined in the specifications: PG 10 Conquest of the Business and Budget.

The control of the projects will be carried out in accordance with procedure MP 11 Guidelines for the project and development.

Traceability, when applicable, must be carried out by means of specific records to accompany the production processes and service / product provision.

Management Units must ensure the identification and traceability of information during the production process in order to be able to determine when undesirable events may occur that lead to, among others, non-conformances, the input information will be the client's requirements and legal requirements.

4.7.3 Client's property

When any client property is being used or incorporated by the Project (including intellectual property), it must be identified, protected and safeguarded. In the event that the client's property is lost, damaged or considered unsuitable for use, the client must be informed and records must be maintained evidencing the communication and conditions of the client's property.

4.7.4 Preservation

In those Management Units where applicable, the inputs, products, and instruments must be received, managed and preserved.

4.7.5 Activities after delivery

The activities following the delivery (guarantees, maintenance, among others) of the product and / or service are directly related to the specifications of the contract between

the client and QGMI, legal requirements, among others, will be established by each Management Unit as required.
It is advisable to review the input requirements in order to demonstrate that they have been attended.
The delivery protocol must be documented and conserved.

4.7.6 Change Control

QGMI reviews and controls changes that occur during the production and provision of the service, as determined in PG 11 - Guidelines for Project and Development.

4.7.7 Clearance of products and services – client approvals of the product

QGMI obtains and documents the Client's decision as to whether it approves or not the use of the good or service delivered by QGMI. This decision is based on the criteria defined by the Client at the start of a Project, or as part of a scope of work. These provisions are described in PG 11 - Guidelines for Project and Development.

4.7.8 Control of non-conforming outputs

The outputs that do not comply with the requirements in the different phases of the design and development are controlled in order to prevent their unintentional use or delivery.
In an event that during the process there has been an output that does not comply with the requirements, one of the following decisions is taken:

- The process for analysis and correction of nonconformance is carried out;
- Causes of non-compliance are eliminated;
- The client is informed and, where appropriate, his/her concession is obtained.

Once corrected, a non-conformance is verified again to ensure that it meets the requirements.
Documented information is etained on:

- Non-conforming outputs at all stages of production and service provision;
- The actions taken to correct the non-conformances;
- Persons with responsibility to approve the release of the non-conforming product or service.

In MP 05 Non-Conforming Product, Non-conformances and Corrective Action, the action systematics is described.

4.8 Emergency response and preparedness

Potential emergency situations must be identified by the Management Units, according to the MP 03 Aspects and Impacts, Hazards and Risks.

The knowledge of the potential emergency situations allows the Management Units to establish and implement preventive measures that can prevent the occurrence of incidents. However, even when taking preventive measures incidents may occur and for this reason Management Units must establish Contingency and Emergency Procedures. This will minimize the consequences to the environment, damage to property, and the health of people.

The Management Units must prepare and implement a Specific Procedure for contingencies and emergencies considering the context of the project, the guidelines are described in the procedure PG 08 Guidelines for Contingencies and Emergencies.

4.9 Performance evaluation

4.9.1 Monitoring, measurement, analysis and evaluation

The experience and maturity of the IMS at QGMI has allowed the company to identify those activities subject to monitoring and those subject to monitoring and measurement.
Among the indicators are objectives and goals, inspection and testing plan, engineering controls, supplier evaluation, monitoring of client satisfaction, monitoring the effectiveness of OHS controls, etc. when appropriate for monitoring. It requires records, incidents, surveys, verifications, audits, reviews and interviews.
The Management Units must regularly monitor and measure the main characteristics of their operations that may have environmental impact and / or safety and occupational health, according to the specific Procedure prepared by the Management Unit, considering the procedure MP 09 Guidelines for Environmental, Safety and Health Monitoring.

Compliance with legal requirements and other requirements is evaluated, as specified in the procedure MP 04 - Legal and Other Applicable Requirements.
The results of this monitoring allow the identification of non-conformances, performance trends and opportunities for improvement.

QGMI's IMS states the following:

- That it is necessary to follow up and what is necessary to measure.
- Monitoring, measurement, analysis and evaluation methods, as applicable, to ensure valid results.
- When monitoring and measurement should be carried out.
- When the results of monitoring and measurement must be analysed and evaluated.

We keep documented information as evidence of the results.

4.9.2 Internal audits

The audits must be planned annually, considering:

- Results of previous audits;
- Importance of the activities to be audited;
- Importance of the environmental impacts related to them;
- Evaluation of the risks of the activities;
- Legal, contractual and other requirements subscribed by the Management Units.

The internal audits of the IMS must be carried out by qualified auditors and their objective is to evaluate the effectiveness of the System.

The effectiveness of the corrective actions implemented can be verified by means of an accompanying audit.

The activities related to internal audits, including the qualification of the auditors, are described in the MP 12 Internal and External Audit procedure.

4.10 Management Review

The Senior Management of each Management Unit must ensure that the critical analysis of the IMS is carried out at planned intervals.

The project, after carrying out the Critical Analysis of the Integrated Management System, must send a copy of the respective register for the QSMSRS.

QSMSRS must analyse the content of all the critical analyses received and consolidate the data pertinent to the performance of the IMS; preparing, in this way, the Global Critical Analysis of the system. This analysis should also contemplate the performance of the Integrated Management System of the Headquarters.

The person responsible for QSMSRS must provide the Global Critical Analysis records of the IMS through any means.

The following inputs should be considered for the management review:

- The status of the actions of the previous management reviews;
- The changes in:
  - ❖ External and internal factors that are relevant to the management system of the Integrated Management System;
  - ❖ The needs and expectations of interested parties including legal requirements and other requirements related to environmental management;
  - ❖ Evaluation of the applicable legal compliance and other requirements that the organization subscribes with respect to OHS;
  - ❖ The results of consultation and participation in OHS;
  - ❖ Significant environmental aspects;
  - ❖ Environmental risks and opportunities.
- Information on the performance and effectiveness of the IMS, as appropriate, including trends related to:
  - ❖ Client satisfaction and feedback from relevant stakeholders;
  - ❖ The degree to which the objectives of the IMS have been achieved.
  - ❖ The performance of the processes and conformity of the products and services;
  - ❖ Non-conformances and corrective actions;
  - ❖ The status of incident investigations, corrective and preventive actions in OHS;
  - ❖ The results of monitoring and measuring the IMS.
  - ❖ The results of the audits;
  - ❖ The performance of external suppliers;
- The adequacy of resources;
- Relevant communications from interested parties including their environmental and OHS complaints;
- The effectiveness of the actions taken to address risks and opportunities;
- Opportunities for improvement in quality and OHS and continuous environmental improvement.

The outputs of the review by management must include decisions and actions related to:

- Opportunities to improve the IMS;
- Any need for change in the IMS;
- Resource needs;
- Conclusions on the continued suitability, adequacy and effectiveness of the IMS;
- The performance of OHS;
- The Policy and objectives of IMS;
- The necessary actions when the objectives of the IMS have not been achieved;
- Other elements of the OHS system;
- Opportunities to improve the integration of the system to other business processes, if necessary;
- Any involvement for the strategic direction of the organization related to environmental management.

The Management Units, or as a minimum, the person responsible for the Contract and / or the person responsible for the IMS must participate in the analysis. At Headquarters, as a minimum, the director of the DMEC and the corporate manager of the QSMSRS must participate.

Critical analysis records must be prepared containing the following items, necessarily in this order:

- Objective;
- Name of the participants;
- Issues addressed (each and every one of the points mentioned above must be dealt with);
- General conclusion.

4.10.1 Internal Communication of the Critical Analysis

The project must send a copy of the critical analysis record for the QSMSRS and a copy to their respective Branches, Regional Direction or Superintendence, when applicable.

The QSMSRS must analyse the content of all the critical analysis records received and consolidate the data pertinent to the performance of the IMS, preparing in this way the consolidated critical analysis of the IMS.

The Management Representative (RD), or in the absence thereof, the person responsible for the QSMSRS must keep the critical analysis of the IMS for all the Management Units.

4.11 Improvement

4.11.1 General

Opportunities for improvement are established at QGMI through;

- Implementation of actions to achieve the expected results;
- Development of opportunities for improvement identified in the IMS;
- The correction of non-conformances;
- Taking corrective actions;
- The improvement of the performance of the processes, of the environmental management and the performance of the OHS;
- Projects aimed at significant changes in existing processes;
- Introduction of new technologies.

4.11.2 Non-conformance and corrective action and incidents and accidents

At QGMI, non-conformances and corrective actions are managed in accordance with MP 05 Non-Conforming Product, Non-conformances and Corrective Action.

4.11.3 Continuous Improvement

Continuous improvement is achieved:

- Compliance with quality objectives, environmental management and OHS;
- Improving the convenience, adequacy and effectiveness of the IMS;
- Efficacy and efficiency of the processes;
- Increase of the compliant outputs of the processes;
- Promoting amongst employees the improvement identification.

OGMI	Type of Document Management Procedure	Document Code MP 03	
	Document Title Aspects, Impacts, Hazards and Risks	Review 01	Page 1/15

Review	Date	Short Description
00	02/01/2018	Initial Issue
01	15/06/2020	General Review

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1 Purpose

Describe the corporate guidelines and to guide the Management Units in the preparation and gathering of information on environmental aspects and OHS risks.

2 Application

This document applies to all environmental aspects and impact generated during the development of QGMI activities and to the OHS hazards and risks arising from the execution of these activities, as well as to those responsible for their identification and assessment.

3 Clarifications/Definitions

Disease: An identifiable adverse physical or mental condition caused or aggravated by a work or work-related situation.

Emergency: Event arising from a critical situation that results in or may result in injury or death of persons, damage to the environment or to one's own property or that of third parties.

Environmental Aspect: Elements of an organization's activities, products or services that can interact with the environment.

Environmental Impact: Any modification to the environment, adverse or beneficial, resulting in whole or in part, from the environmental aspects of an organization.

Harm: Consequence of a hazard in terms of injury or illness, or a combination of these.

Note 1: The term "harm" is commonly used to refer to an adverse impact.

Hazard: A hazard is any source, situation or activity that has the potential to cause harm in the form of injury or illness, or a combination of the two.

Incident: A work-related event in which a material damage, injury, illness (regardless of severity) or fatality occurred or could have occurred.

Note 2: An accident is an incident that resulted in injury, illness or fatality.

Note 3: An incident or unplanned event in which injury, illness, fatality or damage does not occur, but could have occurred, is called a "**near miss**". It can also be called a "near hit" or "close call".

Note 4: An emergency situation is a particular type of incident.

INSHT: In Spain: Instituto Nacional de Seguridad e Higiene en el Trabajo (Spanish Institute for Safety and Hygiene at Work).

Life Cycle: Consecutive and interlinked states of a system of a product or service, from the acquisition of the raw material and its generation, from natural resources to final disposal. The life cycle stages include the acquisition of the raw material, project, production, transport and delivery, use, post-use treatment and final disposal.

OHS: Occupational Health and Safety

Risk: Combination of the probability of occurrence of a hazardous event or exposure and the severity of the injury or illness (damage) that may be caused by this event or exposure.

SESMT: Specialized Service of Security and Occupational Medicine.

Social Aspect: Element of relationships, processes, products and services of an organization, which can interact with the economic and social context.

Social Impact: Any modification of the economic or social context, adverse or beneficial, resulting, in whole or in part, from the relationships, processes, activities, products or services of an organization.

4 Responsibilities

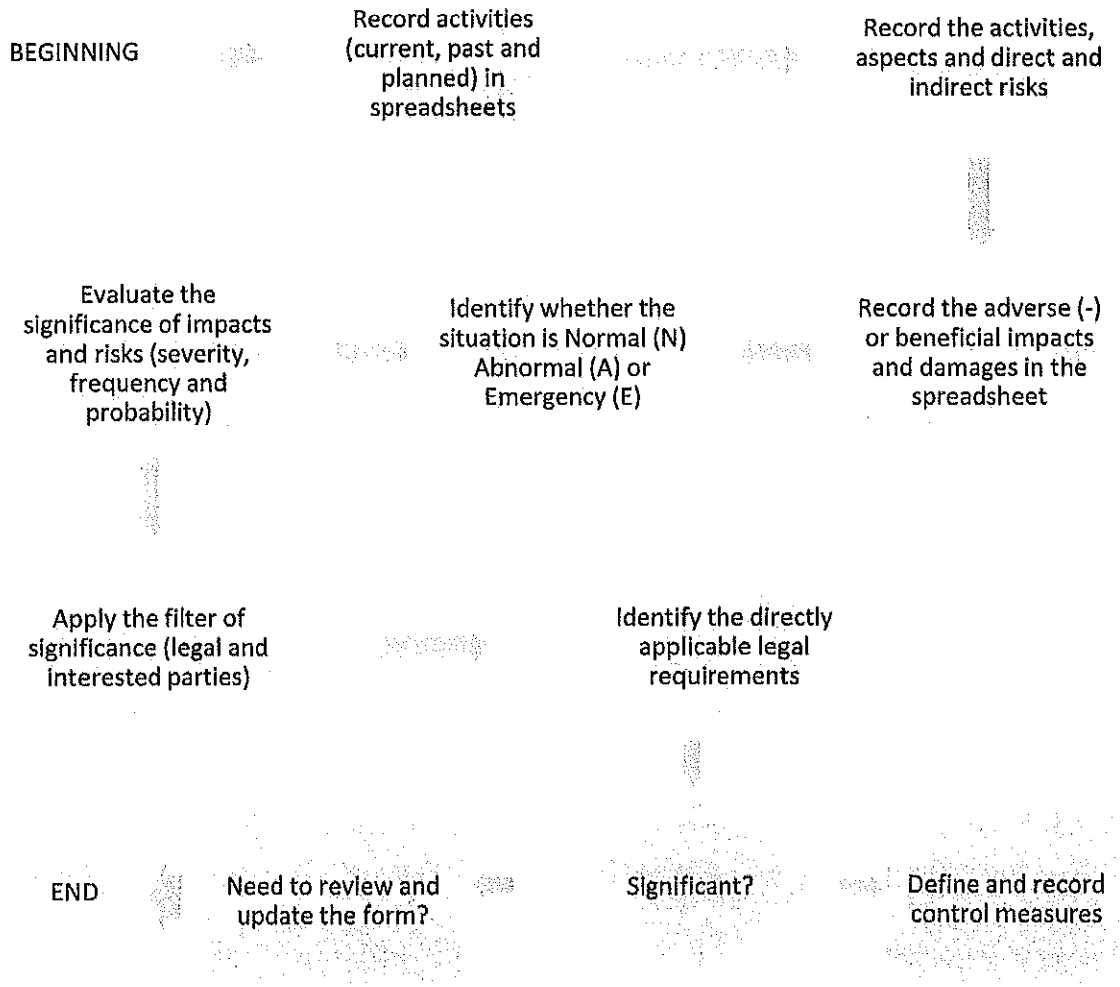
Management Units Identify aspects and hazards and evaluate the impacts and risks generated by QGMI activities.

Evaluate the risks and opportunities related to QGMIs activities, products and services.

Conduct monitoring when necessary and disseminate this information throughout the Management Unit.

5 Description

Flowchart of Activities



5.1 Environmental Aspects and Impacts

5.1.1 Identification of Activities

It is essential that the activities be grouped in a rational manner including, where appropriate, infrequent tasks such as maintenance, as well as routine production activities, which include services carried out inside and outside the Management Units, activities carried out by subcontractors, regardless of the period (present and future).

The activities carried out by the Management Units are identified and the respective tasks or stages listed in the schedule in the annex.

5.1.2 Identification of Environmental Aspects and Impacts

The aspects are identified considering the inputs and outputs associated with present and planned activities, products and / or services, when applicable.

For each task listed, the aspects in the corresponding column of the annex form are identified.

When the aspects are determined, the perspective of the life cycle is considered, considering the stages of the life cycle that may be under QGMI control or influence, and this is described in the template for each identified aspect.

5.1.3 Identification of Impacts

For each aspect, the respective associated impacts are identified, that is, the consequences identified in relation to the aspects generated.

5.1.4 Direct or Indirect Aspects

The aspects can be direct, when the control is exercised directly by the Management Units and is measurable, or indirect, when the aspect cannot be directly quantified, for example, the discharge of toilet water in the offices.

5.1.5 Beneficial or Adverse Impacts

The impacts can be beneficial or adverse, that is, the modification generated can be positive (+) or negative (-). For example, wastes can alter the quality of the soil in a beneficial way

if the pH of the waste is alkaline and can be applied to reduce the acidity of the soil. In this case, the modification of the pH can be considered a beneficial impact.

5.1.6 Characterization of the Aspects

Normal (N) and Abnormal (A) Operational Situation

Normal: are those situations that occur during routine, controlled, operations.

Abnormal: are non-routine scenarios, but that can be controlled/managed, for example, during specific work maintenance situations.

Emergency Operational Situation (E)

They are situations of non-routine or unintentional functioning, uncontrolled, unplanned and unpredictable in time.

For example, situations related to incidents such as the collapse of structures, equipment or facilities failure, natural events or hazards, which are inherent to the activities, products or services that may result in damage to the environment.

5.1.7 Evaluation of the Aspects

Once the aspects have been identified, they are evaluated considering the criteria below:

Under normal and abnormal conditions

- ✓ Frequency (F): refers to the frequency with which the appearance occurs
- ✓ Probability (P): refers to the probability of an environmental accident occurring (the number of times an event has occurred in the area being evaluated is assessed).

FREQUENCY (F)		
Normal	Abnormal	Score
Low: aspect occurs at most 1 time per month	Abnormal aspect occurs at most 1 time a year	1
Medium: aspect occurs at most 1 time a week	The abnormal aspect occurs with a frequency greater than 3 months and less than 12 months (between 3 and 12 months)	2
High: the aspect occurs one or several times a day (daily)	The abnormal aspect occurs at least every 3 months.	3

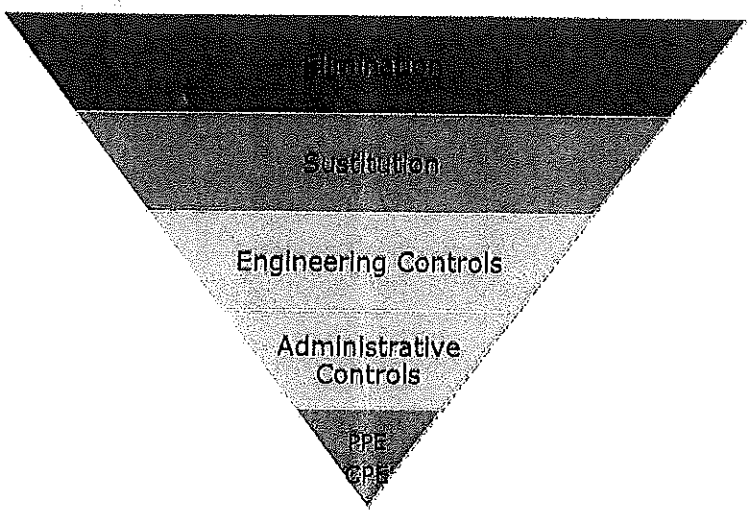
- There are claims of an individual or group affected by the environmental performance of the Management Units in relation to their environmental aspects.
- Corporate rules or guidelines are broken.
- There is a financial loss/damage considered significant by the establishment.
- The risk to the community is considered to be significant by the establishment.
- Mark ('X') on the schedule/form in the Annex whenever a significance filter applies.

5.4 Control Measures

The risks identified as significant may be controlled through operational procedures, objectives and goals, emergency / contingency plans, or other appropriate mechanisms to prevent and mitigate impacts.

QGMI stipulates that the Management Units, when establishing their occupational health and safety control and prevention measures, must follow the following hierarchy of controls to mitigate risk. Starting with the most effective, these are:

- Elimination: Physically remove or eliminate the hazard altogether.
- Substitution: Replace the hazard.
- Engineering Control: Isolate or separate workers from danger.
- Administrative Control: Change the way people work.
- Personal Protective Equipment: Protect the worker individually with personal protective equipment.



5.5 Inclusions, Changes and Exclusions

The updating of the Aspects, Impacts, Hazards and Risks Identification Worksheet may be required in the following situations:

- New or modified legislation related to products, activities or services;
- Performance assessment of activities carried out by the responsible sectors;
- Redefinition of priorities in business administration;
- Occurrence of incidents;
- Emergence of new demands by interested stakeholders;
- Changes to of productive processes, installation of new equipment or new projects; and
- Progression of project timeframes/schedules.

6 Records

6.1 Environmental Aspects and Impacts Worksheet

6.2 Occupational Hazards and Risk Worksheet

6.3 Social Aspects and Impacts Worksheet

7 References

MSGI – Manual of Integrated Management System.

8 Attachments

8.1 Environmental Aspects and Impacts Worksheet

8.2 Occupational Hazards and Risk Worksheet

8.1 Environmental Aspects and Impacts Worksheet

8.2 Occupational Hazards and Risk Worksheet

Version	Date	Short Description
00	02/01/2018	Initial Issue
01	02/01/2019	Revision of item 5.2
02	07/10/2020	General review.

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1 Purpose

To describe the system for identifying and verifying compliance with legal requirements related to the Integrated Management System (IMS).

2 Application

Applies to all legal requirements and other requirements applicable to processes, activities, and products developed by QGMI, particularly those environmental aspects and OHS hazards identified in the organization. This procedure applies to all management units where the EMS is implemented with specific focus on identified environmental aspects and OHS hazards.

3 Clarifications / Definitions

Other requirements: Standards, Practice Codes, Agreement Requirements, and any other requirements to be adopted by Management Units.

RELAP: Legal Requirements and Other Applicable Requirements

4 Responsibilities

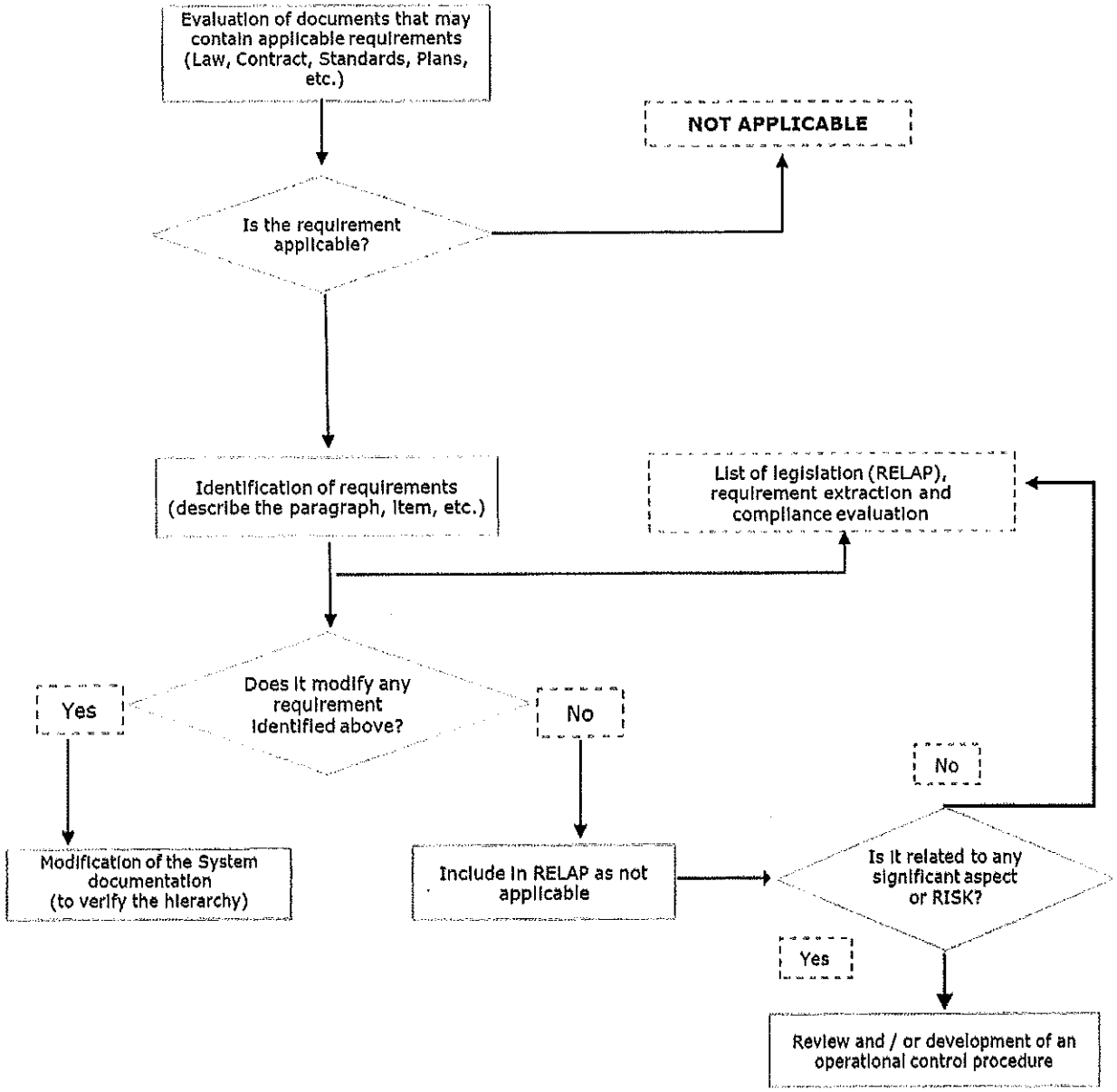
Management Unit: Develop a RELAP table describing all legal and other requirements applicable to aspects, impacts, hazards and risks at national, state/province and municipal levels; and verify those legal requirements every 6 months.

The table should indicate where legal and other applicable requirements (project specifications, union agreements and other considerations) relate to environmental aspects and OHS hazards at national, state/ province and municipal levels.

The Management Unit is to verify compliance with these requirements every quarter. Management Units may choose to verify compliance with legal requirements at shorter intervals.

5 Description

5.1 Flow Chart



5.2 Requirement Access and Identification

Management Units are responsible for accessing legal requirements and other requirements related to these matters (voluntary commitments, including in documents of service conditions, etc.)

The source of requirements can be local legislation, newsletters, bulletins, National Legislation, decrees, etc.

Management Units shall identify legal and normative requirements and other requirements (industrial licenses, permits, environmental permits, client and provider's environmental requirement, etc.) applicable to QGMI, through access and consultation, at least every 6 months.

Based on these sources of information, the Management Unit compiles the applicable legislation, according to the activity and location of the work centre, drawing up the corresponding RELAP and keeping the register up to date.

5.3 Checking if Legal Requirements and Other Applicable Requirements are met

The management unit must designate a person responsible for the verification of the requirements.

The RELAP will carry out verification of compliance with legal and other applicable requirements every 3 month. Where applicable the RELAP will communicate with the internal legal department regarding the results of the monitoring undertaken to confirm extent of compliance with legal and other applicable requirements.

5.4 Update Control of Legal Requirements and Other Applicable Requirements

The Management Unit is responsible for keeping the RELAP spreadsheet or any other electronic spreadsheets used up to date.

Underscoring the client focus, Management Units shall identify and register client's requirements, in order to meet them, with the purpose of increasing client satisfaction. Management Units shall update clients, when appropriate, according to information obtained from the client.

5.5 Communication on Legal Requirements and Other Applicable Requirements are met

Management Units must disclose legal requirements to stakeholders and other relevant interested parties, and maintaining records of this communication.

6 Records

RELAP spreadsheet.

7 References

- IMSM - Integrated Management System Manual.
- MP 03 - Aspects, Impacts, Hazards and Risks.

8 Attachments

N/A

QGMI	Document type Management Procedure	Document Code MP 08	
	Document Title Contingency and Emergency Response Guidelines	Review 02	Page 1 / 10

Review	Date	Short Description
00	02/01/2018	Initial Issue
01	05/11/2018	Language compatibility review
02	11/11/2020	Review

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1 Purpose

Corporate guidelines to guide the development of Contingency and Emergency Response Plans in each Management Unit, which allow assessment of safety of the incident scene, preservation of life, damage reduction, safe and secure evacuation of the workplace and avoidance of panic and its consequences. In addition, mitigate environmental, occupational and economic impacts, when applicable, as well as guide the investigation of incidents.

2 Application

To all the Management units, their Project and reasonable identified emergency scenarios.

3 Clarifications/Definitions

Assembly Points: Pre-established locations where workers and site visitors can safely gather, to allow and facilitate the response to contingencies and emergencies.

Contingency and Emergency Response Plan: Plan that describes the resources, responsibilities and actions that must be taken to mitigate environmental, occupational, social and economic impacts related to emergencies.

Contingency situation: Sudden event where there is a likelihood of causing harm to people, the environment or property, considering a disturbance of normal activities in any workplace, establishment, operation unit, companies, public or private institutions and that demand an immediate action.

Emergency Response Team / Support Group: Group of employees duly trained, with specific knowledge to act in the event of a range of emergency scenarios, such as a fire.

Emergency Drill: Activity that is carried out in order to test the effectiveness of different parts of a contingency and emergency plan. An emergency drill is carried out on predetermined dates and should be as realistic as possible to be effective. The outcomes and result must be assessed to define and implement necessary changes and improvements.

Emergency: Any situation that requires the immediate interruption of work routines, such as explosion, fire, gas leak, chemical spill or leak, natural disaster, road traffic accident or a fall from height involving injury or fatality.

Note 1: An emergency situation is a particular type of incident.

Environment: surroundings, in which an organization operates, including air, water, soil, natural resources, flora, fauna, human beings and their interrelations.

Environmental Condition: state or characteristic of the environment, as determined at a certain moment.

Environmental Emergency: Any unforeseen event that can generate a significant environmental impact (on water, soil, atmosphere), which puts human health and safety or the survival of fauna and flora at risk. For example, an explosion, fire, gas leak, chemical spill or leak, natural disaster.

Evacuation: Removal of personnel not involved in the emergency response from the scene of the incident to a place of safety.

Incident: Event related to the work activities in which an injury or illness occurred or could have occurred regardless of its severity or fatality.

Note 2: An incident in which no illness, injury, damage or other loss occurred, but that had the potential to do so, is called a "near miss" a "near hit" or a "dangerous occurrence".

Note 3: An accident is an incident that resulted in injury, illness or fatality.

Main and Alternative Circulation Routes (escape routes): Includes the roads and corridors, stairs and ramps that the employees will use to leave the work areas at the time of the emergency. These roads must be clearly identified with signage, remain clear and free of any obstruction.

Emergency Assembly Point: Pre-established safe location where personnel should be told to congregate in the event of a contingency and / or emergency scenario, in order to enable the emergency response work to proceed.

Radiation Emergencies: Radiation emergencies are situations caused by an unplanned event or an incident in which people receive or may receive abnormal radiation doses. In addition, some of these events can cause environmental and property damage.

NC/CAR: Non-conformance and Corrective Action Report.

Spill Kit: A spill kit consists of a set of tools and supplies that can be used in case of hazardous substance spill. Spill kits are to be tailored to the volume and type of substance spilled, such as hydrocarbon, chemical or acid. Contents can include sa sturdy container or sack for placing contaminated materials, sawdust, sand, shovel, broom, security seals, tape, absorbent pads, drain covers).

Workplace: any physical space in which work-related activities are performed, under the control of the organization.

4 Responsibilities

Management Units

- Design and implement a contingency and emergency plan based on risk-based emergency scenarios;
- Ensure that employees, sub-contractors and site visitors are made aware of the relevant aspects of the site contingency and emergency plan as it relates to their role and work area, through inductions, training and Toolbox Talks etc.;
- Plan and deliver training for Emergency Response Teams / Support Groups;
- Implement a drill schedule to test responses to different emergency scenarios and assess preparedness.
- Approve the necessary resources for the implementation of this procedure.

5 Description

All Management Units and Projects must establish a Contingency and Emergency Response Plan, consistent with the potential emergency scenarios identified by means of a risk assessment in line with corporate Management Procedure 03 - Aspects and Impacts, Hazards and Risks.

The Plan may be influenced by external procedures or documents as well as legal requirements. It must contain the response protocols and mitigating actions for the identified emergency scenarios.

For a clear definition of the Plan, special attention must be paid to Legal and Other Requirements in this regard.

Note 4: An office, branch, etc., where only administrative tasks are performed and have a small number of personnel, may decide to develop a simpler or 'abridged' Contingency and Emergency Response Plan in line with its risk profile, provided it aligns with local regulations and the regulations of the building / development where the office is located. The Plan's effectiveness must still be guaranteed, and drills are indispensable.

5.1 Structure of the Contingency and Emergency Plan

Contingency and Emergency Plans of the Management Units must adequately cover the following information:

- Response protocol/steps for each emergency scenario identified by risk assessment, including environmental, occupational and community based;
- Internal and external communication and emergency contact details, including stakeholders if applicable;
- Emergency Response Team / Support Group organisational structure, roles and responsibilities;
- Resources to be available, including communication systems, medical equipment, spill kits and first aid kits, support from public services;
- Training requirements;
- Evacuationt plans, including escape routes and assembly points;
- Mitigation of environmental, occupational and community health and safety impacts;
- Medical response (and where necessary, evacuation) plan for accident victims;
- Incident investigation.

5.2 Simulation / Testing of the Contingency and Emergency Plan

The Management Units must establish a schedule and plan drills to test the effectiveness of the Contingency and Emergency Plans established.

The scenarios foreseen in the Contingency and Emergency Plans must be simulated, at least, annually.

5.3 Evaluation of the Emergency and Contingency Plan Drill

Following emergency response tests / drills, the Management Unit shall prepare an Emergency Response Test Report to evaluate response effectiveness and capture lessons learnt and actions. As a minimum, the Emergency Response Test Report shall include the following aspects:

- Emergency response test scenario (example: slope collapse, tunnel rescue, road traffic accident etc.);
- Test start time;
- Test end time;
- If it involves evacuation of personnel, the staff count before and after the simulation;
- Things that worked well;
- Lessons learnt and improvements needed;
- A list of the preventative and corrective actions to address any lessons learnt and required improvements;

- Schedule the next emergency response test.

5.4 Guidelines for Incident Investigation

5.4.1 Interview for Incident Investigation

The Management Units' Contingency and Emergency Response Plans must define incident investigation procedures.

Such investigation must be carried out considering, at minimum, the following steps:

1 – Opening of a Non-conformance and Corrective Action Report (NC / CAR).
2 - Constitution of a team to investigate the incident, which may include:

- Interview with injured person, whenever possible;
- Interview with witnesses;
- Interview with the line manager / direct supervisor;
- Photographic record and reconstitution, if possible;
- Determination and assessment of the cause(s) and contributing factors; with significant / serious incidents requiring in-depth root cause analysis.

3 – Preparation of an incident investigation report with the following data:

- Incident description;
- Immediate action;
- Corrective action;
- Attachment: interviews and photos obtained as described in item 2.

5.5 Response Protocols and Actions for Environmental, Community and Occupational Health and Safety Emergencies

The Management Units must establish a set of protocols and actions to respond to Contingency and Emergency scenarios. The following scenarios shall be considered in the development of Contingency and Emergency Response Plans, provided they are deemed reasonable on the basis of risk assessment in line with MP 03 – Aspects, Impacts, Hazards and Risks Assessment.

Scenario-specific response protocols shall consider the particularities of each Management Unit, including size and capacity of teams, geographic spread, remoteness / access and availability of emergency services.

5.5.1 Environmental and Occupational Health and Safety Emergencies

- Explosion / Fire
- Earthquake
- Flood
- Accident with Nuclear Densimeter
- Gas leak

5.5.2 Environmental Emergencies

- Spillage of oil or fuel in soil and / or water
- Spillage of hazardous substances when being transported
- Spillage of stored dangerous substances
- Spilling of concrete in progress or water channel by concrete wash
- Spill of treatment sludge
- Wastewater spill
- Overfilling of white-water tanks / damage to white water pipe

5.5.3 Medical Emergencies

- Road-traffic accidents involving workers and/or road users / community members
- Work accidents (Asphyxiation, falls of the same or different level, entry of foreign bodies to the eyes, wounds, fractures, insect bites, snake bites, fainting, among others)
- Electric shock
- Burns
- Emergency in confined spaces

5.6 Evacuation Plan

Management Units must anticipate Evacuation Plans within their respective Contingency and Emergency Response Plans, considering the following:

- The communication of / alerting to emergencies and contingencies;
- Escape and evacuation routes;
- Emergency Assembly Points;
- Identification of fire brigade / emergency response members;
- Person responsible for communicating with external emergency services (police, fire brigade, hospital);
- Distribution of ambulances;
- Person responsible for disconnecting electrical panels;
- Ensure personnel and visitors are made aware and can follows the evacuation plan and instructions; and
- Restricted access to the emergency site for emergency responders only.

6 Records

- Management Unit Emergency Response Test Schedule
- Emergency Response Test Report
- Incident / Accident Investigation Report
- Non-conformances and Corrective Actions Report

7 References

- Integrated Management System Manual
- IFC Performance Standard

- IFC/WB EHS General Guidelines

8 Attachments

N/A

QGMI	Document Type Management Procedure	Document Code MP 09	
	Document Title Guidelines for Environmental, Safety and Health Monitoring	Review 02	Page 1/10

Review	Date	Short Description
00	02/01/2018	Initial Issue
01	01/08/2020	General revision of the procedure
02	11/11/2020	Review

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1 Objective

Describe the corporate guidelines, necessary to guide the development of monitoring plans and environmental measurement, safety and health at work.

2 Application

This document applies to all Management Units related to the Integrated Management System of QGMI.

3 Explanations/Definitions

CA: Corrective Action

Environmental Monitoring: Detailed and systematic evaluation that observes compliance with the environmental preventive measures that accompany the different activities of each Project's work, seeks to identify environmental impacts not foreseen to propose corrective and preventive measures, and perform their subsequent monitoring.

Health and Safety Monitoring: Detailed and systematic evaluation that observes the behaviuor of people, productive processes, equipment status and functioning, state of manual and mechanical tools, and work positions, to propose solutions, corrective and preventive actions, and perform their follow-up.

Monitoring / Inspection: Evaluation of compliance through observation and opinion compared against standards or thresholds. Inspections done according to a plan, programme with a defined frequency are called planned inspections.

MP: Management Procedure

NC/CAR: Nonconformity and Corrective Action Report.

4 Responsibilities

Responsible for the Management Unit

- Designate a person / persons responsible for the development of an environmental,, safety and health monitoring plan.
- Accompany information on operating licenses, environmental control plans, as well as other legal requirements related to environmental and occupational aspects identified in the respective Management Units.

5 Description

The Management Units must identify the operations related to the significant environmental aspects, the risks for safety and health at work and those associated with objectives and goals, in order to determine the parameters to be monitored, the type of monitoring, the equipment to use, the frequency of measurements or monitoring and the records generated to guarantee the conditions of control and measurement to be carried out.

Some Criteria to monitor are:

- Environmental and SST aspects identified
- Legal and other requirements
- Actions to address the risks
- The environmental and SST objectives
- Planned changes and consequences of unforeseen changes, taking actions to mitigate the adverse consequences
- Processes contracted externally
- In the project and development
- Environmental and SST requirements in purchasing processes

The main objective in conditions of controlled operation is that monitoring begins at the earliest stages in order to maintain control over critical activities, without forgetting the orientation of the strategy towards the life cycle of the products and services provided.

The Management Units can adopt this procedure without the obligation to establish a specific procedure (PE), being enough the elaboration of a form with all the necessary information to the planning and realization of the monitoring and measurements.

5.1 Monitoring related to the Environment

5.1.1 Waste Management

Whenever necessary, the Management Units should develop specific procedures to detail the necessary and applicable requirements for waste management, in case there are no requirements in this regard, this PG should be considered sufficient for the control of the waste. Environmental aspects related to waste.

5.1.2 Waste Classification

All material generated during the activities of the Management Unit, not reusable, must be evaluated by the person responsible for the environmental activity for the definition of its class.

Note 1: Waste management should be established, preferably, based on the requirements of this procedure. In the meantime, for the Management Units operating in other countries, the legal requirements and local customs must be considered.

Note 2: Any class II waste (II A or II B) contaminated with class I waste must be treated as class I waste.

CLASSIFICATION		JUSTIFICATION
Class I Hazardous wastes		Flammable, toxic, pathogenic, corrosive, reactive, which may present risks to public health, causing mortality, incidence of diseases or accentuating their indices; and that present a risk to the environment when the waste is improperly managed.
Class II Non-hazardous waste	Class II A Not inert	Those that do not fit as class I hazardous waste or class II B waste - inert. They may have properties such as biodegradability, combustibility or solubility in water.
	Class II B Inert	Any waste that, when tested in a representative manner, according to ABNT NBR 10007, did not have any of its constituents solubilized at concentrations higher than water portability standards.

*** Classification can change by local guidelines (laws, regulations, etc.).**

5.1.3 Collection, Storage and Identification

The waste generated in the field must be collected manually or by means of machines and / or tools, obeying the applicable safety guidelines.

Inert waste (for example, concrete, soil, wood, scrap, etc.) can be packaged in debris boxes mounted on or outdoors and fenced, when applicable, and there is no need for coverage.

The untreated solid, semi-solid and liquid waste generated by the work must be conditioned in suitable containers according to their pollution potential.

The following table is shown as a reference for the disposal of waste and its separation, when there is a different color convention in another country that should prevail.

TYPICAL RESIDUES GENERATED BY MANAGEMENT UNITS	COLORS
Paper / Cardboard: Sulphite, brochures, envelopes, cards, newspapers, magazines, packaging, cardboard, posters, long life boxes, etc.	**BLUE**
Plastic: Glasses of water and coffee, containers of water and soda, margarine, shampoo and detergent, vessels, toys, caps and PVC tubes, etc.	**RED**
Glass: Bottles, cups, pieces, containers in general.	**GREEN**
Metal: Aluminium and steel cans, pans, wires, wires, plates, bottle caps, containers, nails, pipes, etc.	
Wood	**BLACK**
Hazardous wastes	**ORANGE**
Ambulatory and Health Services Wastes	**WHITE**
Radioactive wastes	**PURPLE**
Organic wastes	**BROWN**
General Waste Not Recyclable or Mixed, or Contaminated Not Passable for Separation .: Carbon, photographs, fax, towel and hygienic papers, adhesive labels, sockets, biscuit and candy containers, Clips, steel sponges, mirrors, flat glass, among others.	**GREY**

*the classification / colors can change by local guidelines (laws, standards, etc.)

All containers in use must be correctly identified according to the use.

The practice of incineration of waste is prohibited (to "open sky" or in incinerators), except when there is legal support for such practice.

Non-biodegradable liquid waste or that has the potential to contaminate soil, air or bodies of water, when necessary, can be mixed with sawdust or other absorbent materials and treated as hazardous waste (class I).

5.1.4 Waste Treatment

TYPE	TREATMENT
Metal scrap with or without debris and / or electrode tips.	Disposal in the mason of the work in appropriate premises or sell to recycling companies.
Chips, sawdust, rubble, remains of earth, sand, clay or concrete not contaminated by hazardous waste or effluents.	Re-use, landfill disposal or sale to recycling companies.
Waste paper or plastic separated selectively.	Sale to recycling companies, landfill disposal.
Personal protection equipment used (without contamination with hazardous waste).	Sale to recycling companies, landfill disposal.
Ink cans clean or containing inert residues of dry pigments.	Disposal in the mason of the work in appropriate premises or sell to recycling companies.
TYPE	TREATMENT

Wastes not separated from food, sweep and / or offices of the advanced works masons.	Disposal in landfill disposal or sale to recycling companies.
Wastes not separated from food, sweep and / or offices of the advanced works masons.	Disposal in landfill disposal or sale to recycling companies.
Pit cleaning waste	Controlled landfill or public sewer.
Hospital garbage.	Conditioning in sealed plastic bags and shipping to industrial landfill.
Used batteries, etc.	Send back to suppliers, sale to recycling companies or those permitted by law, legal picket points, or an industrial dump.
Fluorescent lamps	Separate collection for the work and routing for recycling companies or industrial landfill.
Inert material contaminated with hazardous waste or effluents.	Conditioning in sealed containers and identified with subsequent disposal in industrial landfill and / or controlled incineration in specialized companies.
Ink cans containing residues with solvent.	Removal of the remaining liquid ink without using and drying the liquid film by evaporation or absorption with sawdust.
Inks and other hazardous effluents absorbed in sand, clay, earth or sawdust.	Conditioning in dated and identified drums, with subsequent disposal in a controlled landfill or controlled incineration in specialized companies.

5.2 Environmental Monitoring

Management Units must prepare a form for planning the monitoring and measurements that must be carried out, aiming to meet all the environmental requirements.

Environmental monitoring should be based on operating licenses, environmental control plans and the requirements specified in the legal requirements and other requirements related to the environmental aspects identified in the Management Unit. The monitoring may be related to liquid effluents, surface water and groundwater, waste, atmospheric emissions, environmental noise, mobile source noise and exhaust opacity, total suspended particle evaluation, anti-spillage kit provisions, concrete truck washing, etc.

Note 3: The tests must be carried out in laboratories qualified according to the MP 14 Guidelines for the control and calibration of Monitoring and Measurement Equipment. When necessary, the samples are collected by the Management Unit personnel itself or by a contracted company, according to the procedure presented by an external laboratory or legal requirement that guides such procedure.

Note 4: The instruments and equipment used for measurements of environmental parameters must be calibrated and the Management Unit must maintain the records.

5.3 Monitoring related to Health and Safety at Work

The monitoring and measurements related to Occupational Health and Safety must be carried out in accordance with legal or contractual requirements. The Management units must establish a Form with the measurements that must be made, frequency and permissible limits, attending mainly the following types, when applicable:

- ✓ Water Quality Analysis for consumption;
- ✓ Lighting Analysis;
- ✓ Temperature Analysis;
- ✓ Breathable dust analysis;
- ✓ Ergonomic analysis;
- ✓ Inspection of machinery, hoists, slings, scaffolding, fire extinguishers, etc.;
- ✓ Periodic medical evaluations for officials;
- ✓ Verification of the medical equipment used for the medical evaluation of the officials.

Note 5: The tests must be carried out in laboratories qualified according to the MP 14 Guidelines for the control and calibration of Monitoring and Measurement Equipment. When necessary, the samples are collected by collaborators of the Management Unit itself or by a contracted company, according to the procedure presented by an external laboratory or legal requirement that guides such procedure.

Note 6: Instruments and equipment used for measurements of SST parameters must be calibrated, when applicable, and the Management Unit must maintain the records.

5.4 Result Treatment

The results of the monitoring and measurement must be compared with the legal and / or contractual limits.

When the analytical results do not fit within the legal and / or contractual limits, depending on factors that are not related to the activities of the Management Unit, they can be communicated to the competent government body, aiming at the adoption of different standards of the conventional or other providences; the opening of the Non-Conformity and Corrective Action Report is not mandatory.

When the monitoring results are above the legal and / or contractual limits, the Report of Nonconformity and Corrective Action must be opened in the following situations:

- Daily test - Results above the legal and / or contractual limits 3 (three) times per month;
- Weekly test - Results above legal and / or contractual limits 2 (two) times per quarter;
- Biweekly test - Results above the legal and / or contractual limits 3 (three) times per semester;
- Monthly test - Results above the legal and / or contractual limits 2 (two) times per semester;
- Bimonthly to biannual test - Opening of Report of Non-conformity and immediate corrective action.

Results of these measurements must be disclosed to the officers of the Management unit.

These results should be part of the input data for the review by the address.

Records derived from these monitoring must be controlled in accordance with the provisions of PG 01 Control of Documented Information.

5.5 Order and Cleaning Programs

As a good practice the Management Units must carry out programs for the preservation of order, organization and cleanliness of the areas, providing improvements in quality of work, optimization of time, preservation of the environment, increase of productivity, reduction of waste and prevention of accidents.

In order to maintain the organization and cleanliness in the Management Units, the collaborators must be instructed regarding the selective collection, isolation and identification of materials, washing of the area after the activities and the correct storage of the tools and materials when not are in use

The Management Units can make mechanisms to monitor compliance with the practice of order, service and cleaning; and the non-conformities identified must be treated as described in the procedure PG 05 Non-compliant Product, Non-Conformities and Corrective Actions.

The Management Units can make use of educational plaques to help in the awareness of the collaborators about the maintenance of order, organization and cleanliness.

6 Records

- Results of the monitoring and measurements.
- Calibration records of measuring and monitoring instruments and equipment.
- Non-Conformity and Corrective Action Report

7 References

MP 04 Legal and other Applicable Requirements

8 Attachments

N/A

SECTION 9 – OTHER RELATED / RELEVANT DOCUMENTS

MINUTES OF NEGOTIATIONS HELD IN THE GHANA HIGHWAY AUTHORITY BOARDROOM FROM 16TH JANUARY 2019 TO 25TH JANUARY 2019

FINANCE, DESIGN AND CONSTRUCTION OF THREE (3) BRIDGES IN THE NORTHERN REGION

LOT 1: DESIGN AND CONSTRUCTION OF BRIDGE OVER BLACK VOLTA AT BUIPE
LOT 2: DESIGN AND CONSTRUCTION OF BRIDGE OVER WHITE VOLTA AT YAPEI
LOT 3: DESIGN AND CONSTRUCTION OF BRIDGE OVER WHITE VOLTA AT DABOYA

IN ATTENDANCE

GHANA HIGHWAY AUTHORITY

NAME	DESIGNATION
Mallam Issah Ishak	Director of Estates – Chairman, GHA
Mr Yakub Koray	Ag. Director of Bridges, GHA
Mr Paul Duah	Chief Engineer (Survey and Design), GHA
Mr Victor Annan	Chief Engineer (Contracts), GHA
Mr Joseph Tengey	Quantities Manager (Quantity Surveying), GHA
Mrs Cynthia Arthur	Head, Financing and Investor Relations Unit, PID, MoF
Mr Atta Dabone Snr.	Principal Economics Officer, DMD, MoF
Mr Francis Ahlidza	Deputy Director – Monitoring and Evaluation, MRH
Nana Pomaa Karikari	Principal Engineer (Contracts), GHA

MESSRS QUIEROZ GALVAO (TENDERER)

Mr Alexandre Coutinho	Commercial Director
Mr Duarte Goncalves	Director of Engineering and Operations
Mr Claudio Goncalves	Planning Manager

No.	Item	Discussion	Action
1	Opening	The negotiations took place from 16th January, 2019 to 25th January, 2019 with a series of meetings. At the first meeting held on 16th January, 2019, the Chairman welcomed everyone to the meetings. He stated that the negotiations were in furtherance of the procurement process leading to the award of contracts for the: Finance, Design and Construction of Three (3) Bridges in the Northern Region Lot 1: Design and Construction of Bridge Over Black Volta At Buipe Lot 2: Design and Construction of Bridge Over White Volta At Yapei Lot 3: Design and Construction of Bridge Over White Volta At Daboya He informed members that the Ghana Highway Authority had received approval from the Central Tender Review Committee for the Employer to engage the Highest Ranked Tenderer, Messrs Queiroz Galvao in negotiations. The negotiations were on the proposed Contract Price, deviations identified in the Tenderer's Technical and Financial proposals.	

		The issues for discussion with the Tenderer were broken down as follows: • Deviations in the Technical Proposal • Financial Proposal	
2.0		ISSUES	
2.1	Deviations in the Technical Proposal	**2.1.1 Sample Signatures of the grantee on the Power of Attorney** As part of the comments made by the Tender Evaluation Panel, the sample signatures of the grantees who had been given the power of attorney had not been provided. The Tenderer provided this information under the cover of letter CQGGH002/19 and dated 21st January, 2019. **2.1.2 Lines of Credit** The Tenderer provided a line of credit of Fifteen Million United States Dollars (US$ 15,000,000.00) for all the three Lots from the United Bank for Africa (UBA). This met the requirements of the Tender. **2.1.3 Signature on Personnel Form** The Key Personnel provided by the Tenderer had not indicated their availability for the works by signing the personnel availability form. This was completed by the Tenderer and submitted under the cover of letter CQGGH002/19 and dated 21st January, 2019 **2.1.4 Life Cycle of Materials and Accessories** The Tenderer was requested as part of his Tender to indicate the life cycle of Materials and Accessories to be used in the Works. This he submitted under the cover of letter CQGGH002/19 and dated 21st January, 2019. The Negotiation Panel reiterated that the Tenderer would have to comply with the terms of the Employer's Requirements which required that the service life of the Materials and Accessories used should be as close as possible to the service life of the bridges which is one hundred (100) years. The Tenderer stated that the Materials and Accessories to be used would be the best available on the market and their service life would be as close as possible of to the service life of the bridges.	
2.2	Financial Proposal	**2.2.1 Reduction in Tender Price** The Negotiation Panel requested for a reduction in the Tender Price. A request was also made for provision to be made for Supervision of the Project and for Training. The Panel espoused the attributes of the proposed bridge and the advantage to be gained through knowledge transfer in the design and	

		construction of the bridges. The Tenderer in their letter CQGGH002/19 and dated 21st January, 2019 indicated that they were willing to reduce the Tender Price from US$ 98,815,903.97 to US$ 96,345,506.37. The revised Tender Price of US$ 96,345,506.37 includes a provision of US$ 1,000,000.00 for Supervision and US$ 345,506.37 for Training. This revised Tender Price and breakdown was however, dependent on a number of considerations. These are **1. Optimization of the indirect costs regarding the supervision.** The Tenderer considered that the Employer's provision in the Tender for Lot 1 and 2 for the Supervising Engineer be consolidated into one. This proposal was rejected and the Tenderer understood that the provision in the Tender was for the Employer and was not available to the Tenderer in any form. **2. Consideration of QG Konstruktion AB for direct payment by the Employer** The Tenderer indicated that QG Konstruktion AB who is their major subcontractor for the assembly of the bridge works with an estimated services agreement, of thirty-five percent (35%) of the Tender Price be allowed to directly invoice the Employer for services rendered by it. As part of the Tenderer's Financial Proposal for the financing of the Works and to comply with the Export Credit Agency support component, Messrs Queiroz Galvao subcontracted QG Konstruktion AB to perform specific services regarding the assembly of the proposed bridges under the same Ultimate Beneficial Ownership. The Panel did not have any objection to this request. **2.2.2 List of Principal Quantities and breakdown with accompanying Payment Schedule** The Tenderer submitted a list of their Principal Quantities and an accompanying payment schedule. They submission was on their revised Tender Price of US$ 96,345,506.37. **2.2.3 Adjustment on Provisional Sum** The Negotiation Panel with the Tenderer concluded that adjustment on provisional had been taken care of in the Tenderer's prices. The adjustment on Provisional Sum would not be applicable on sums provided under Provisional Sums.	
3	Attachments	• Attendance Sheet at all the meetings held • Submissions made by the Tenderer	

4. Minutes of the meeting represents the true outcome of the negotiations process and attested to by

Name	Position	Capacity	Signature
Mallam Issah Ishak	Director of Estates, GHA	Chairman	
Mr Yakub Koray	Ag. Director of Bridges, GHA	Member	
Mr Paul Duah	Chief Engineer (Survey and Design), GHA	Member	
Mr Victor Annan	Chief Engineer (Contracts), GHA	Member	
Mr Joseph Tengey	Quantities Manager (Quantity Surveying), GHA	Member	
Mrs Cynthia Arthur	Head, Financing and Investor Relations Unit, PID, MoF	Member	
Mr Atta Dabone Snr.	Principal Economics Officer, DMD, MoF	Member	
Mr Francis Ahlidza	Deputy Director – Monitoring and Evaluation, MRH	Member	
Nana Pomaa Karikari	Principal Engineer (Contracts), GHA	Secretary	
Mr Alexandre Coutinho	Commercial Director	Representative of the Queiroz Galvao	
Mr Duarte Goncalves	Director of Engineering and Operations	Representative of the Queiroz Galvao	
Mr Claudio Goncalves	Planning Manager	Representative of the Queiroz Galvao	

PUBLIC PROCUREMENT AUTHORITY

PRIVATE MAIL BAG 30
MINISTRIES – ACCRA

In case of reply the Number and date of this Letter should be quoted.

Our Ref. No. PPA/CEO/11/2802/20

Tel: 0302-738140-6

Toll free: 0800 10070

ADDRESS: GL-126-5328

REPUBLIC OF GHANA

GHANA HIGHWAY AUTHORITY
RECEIVED
05 NOV 2020
4796
HEAD OFFICE, ACCRA

Website: www.ppaghana.org
Email:info@ppaghana.org

4th November, 2020

RE: FINANCE, DESIGN AND CONSTRUCTION OF THREE (3) BRIDGES IN THE NORTHERN REGION

LOT 1: DESIGN AND CONSTRUCTION OF BRIDGE OVER BLACK VOLTA AT BUIPE, APPROX. SPAN 240M

LOT 2: DESIGN AND CONSTRUCTION OF BRIDGE OVER WHITE VOLTA AT YAPEI, SPAN 240M

LOT 3: DESIGN AND CONSTRUCTION OF BRIDGE OVER WHITE VOLTA AT DABOYA, APPROX. SPAAN 300M

We make reference to your letter no. GHA/Cont.1/NR/sf 28/42 and dated 26th October, 2020 and all previous correspondences regarding the above mentioned subject matter.

At the Board Technical Committee Meeting No. 52 (052/20) held on Wednesday, 4th November 2020, the Board found the reasons adduced in your letter as satisfactory. Consequently, approval is granted to ***GHANA HIGHWAY AUTHORITY (GHA)*** to use the Single Source Procurement Method, in line with Section 40 (1) (b) of Act 663 as amended, to procure the services of ***Messrs. QGMI*** for the Construction of Three (3) bridges at Buipe, Yapei and Daboya in the Northern Region of Ghana at a total cost not exceeding **USD98,815,903.97**, as per the Lot listed below:

Lot 1:	Buipe Bridge
Lot 2:	Yapei Bridge
Lot 3:	Daboya Bridge

This letter supersedes our earlier approval letter no. PPA/CEO/05/987/20 and dated 7th May, 2020

Please ensure that all documentation regarding this procurement is appropriately kept to facilitate future procurement and tax audits and also you are reminded to post the contract award notice on the Public Procurement Website: www.ppaghana.org.

We count on your usual co-operation.

FRANK MANTE
AG. CHIEF EXECUTIVE

THE CHIEF EXECUTIVE
GHANA HIGHWAY AUTHORITY
ACCRA

ATTN: NICHOLAS D. BROWN