Republic of Ghana

MINISTRY OF ROADS AND HIGHWAYS

GHANA HIGHWAY AUTHORITY

DESIGN-BUILD CONTRACT

FOR

DESIGN AND CONSTRUCT OF THREE (3) BRIDGES IN THE NORTHERN REGION

LOT 1: DESIGN AND CONSTRUCTION OF BRIDGE OVER BLACK VOLTA AT BUIPE, 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, SPAN 300M

CONTRACT NUMBER:

EMPLOYER:

MINISTRY OF ROADS AND HIGHWAYS
REPRESENTED BY GHANA HIGHWAY AUTHORITY
P.O. BOX M57, MINISTRIES,
ACCRA, GHANA

CONTRACTOR:

QGMI CONSTRUCCIONES E INFRAESTRUCTURAS GLOBALES SLU
HOUSE NO. 22C NORTH RIDGE
ACCRA PMT CT 221,
CANTONMENTS

TABLE OF CONTENTS

SECTION 1 – CONTRACT AGREEMENT 3

SECTION 2 – LETTER OF ACCEPTANCE 7

SECTION 3 – THE LETTER OF TENDER 8

SECTION 4 – APPENDIX TO TENDER 9

SECTION 5 – PARTICULAR CONDITIONS OF CONTRACT 28

SECTION 6 – GENERAL CONDITIONS OF CONTRACT 48

SECTION 7 – EMPLOYER'S REQUIREMENTS 49

SECTION 8 – CONTRACTOR'S PROPOSAL 50

SECTION 9 – OTHER RELATED / RELEVANT DOCUMENTS 51

SECTION 1 – CONTRACT AGREEMENT

CONTRACT AGREEMENT

This **CONTRACT AGREEMENT** ("AGREEMENT") is entered into this 17th day of March, 2021 by and between

A) The Government of Ghana – Ministry of Roads and Highways, represented by Ghana Highway Authority, of P. O. Box M57 Accra, Ghana, hereinafter referred to as "the Employer"

And

B) QGMI Construcciones E Infraestructuras Globales S.L.U., Calle Augustin Betancourt, 25 Planta 1, Chameri, Madrid, Spain acting through its branch duly registered in Ghana, at House No. 22 C North Ridge Extension, Accra PMT CT 221, Cantonments, hereinafter referred to as "the Contractor" of the other part.

WHEREAS

The Employer desires that the Works known as **Design and Construct of Three (3) Bridges in the Northern Region, Lot 1: Design and Construction of Bridge Over Black Volta at Buipe, 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, Span 300m** should be executed by the Contractor, and the Contractor desires to execute and complete the aforementioned Works and the remedying of defects therein.

Now therefore, the Parties agree as follows:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.

2. The Accepted Contract Amount for the Works is **of Ninety-Six Million, Three Hundred and Forty-Five Thousand, Five Hundred and Six United States Dollars and Thirty-Seven Cents (US$ 96,345,506.37) equivalent Eighty-Eight Million Euros (€ 88,000,000.00) (exch. 1€:1.1US$)** for Completion in Seven Hundred and Thirty (730) Days

3. The following documents shall be deemed to form and be read and construed as part of this Agreement. The documents forming the Contract are to be taken as mutually explanatory of one another. For the purpose of interpretation, the priority of the documents shall be in accordance with the following sequence:

a) The Contract Agreement
b) The Letter of Acceptance
c) The Appendix to Tender and Schedules to this Agreement;
d) The Conditions of Contract for Plant and Design Build – Particular Conditions;
e) The Conditions of Contract for Plant and Design Build – General Conditions'
f) The Employer's Requirements;
g) The Contractor's Proposal and any amendment to the Contractor's Proposal; and
h) Any other document forming part of the Contract
   i. Minutes of Negotiation
   ii. PPA Approval

4. The Parties agree to be bound by and to conform with all provisions and covenants of the Contract, including the General and Particular Conditions, as they are modified by the Appendix to Tender attached to this Agreement as Annex 1.

5. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein, in conformity with the provisions of the Contract.

6. The Employer hereby covenants to pay the Contractor, in consideration of the execution and completion of the Works and the remedying of defects therein, the Contract Price and other amounts due to the Contract, at the times and in the manner prescribed by the Contract.

7. The Contract shall come into full force and effect on the date when all of the following conditions are fully satisfied:

   a) Cabinet and Parliamentary Approvals of the Financing Agreement and the Commercial (Contract) Agreement in accordance with Article 181 of the 1992 Constitution and Sections 55(1) and 56(1) of the Public Financial Management Act, 2016 (Act 921)
   b) Approval of the loan agreement by the Parliament of Ghana.
   c) Legal Opinion issued by the Attorney-General and Minister of Justice on the validity and legal enforceability of the Credit Facility between the Republic of Ghana and The Bank

8. If the loan agreement is not achieved within one year (or such longer period as the Parties may agree) after the date of the Contract Agreement then upon notice to the Employer, the Contractor may discharge itself from further performance of the Contract, without prejudice to the rights of either Party.

IN WITNESS WHEREOF, the Parties hereto have caused this Agreement to be executed on the day and year first written above.

The Government of the Republic of Ghana	The Contractor
By:	QGMI CONSTRUCCIONES E INFRAESTRUCTURAS GLOBALES S.L.U By:
Name: HON. KWESI AMOAKO – ATTAH	Name: ALEXANDRE DE VASCONCELOS COUTINHO
Title: Hon. Minister of Roads and Highways	Title: CONTRACTUAL DIRECTOR
MINISTER MINISTRY OF ROADS & HIGHWAYS By:	QGMI CONSTRUCCIONES E INFRAESTRUCTURAS GLOBALES S.L.U By:
Name: A B K NUNOO	Name: FAISAL GANAM DAUDA
Title:	Title: AGM & FINANCE DIRECTOR

SECTION 2 – LETTER OF ACCEPTANCE

Our Ref: GHA/Cont:1/NR/SF.28/14

Your Ref. No.....

Email: ce@highways.gov.gh
Website: www.highways.gov.gh
Digital Address: GA-107-2101

HEAD OFFICE

HIGHWAYS

GHANA
HIGHWAY
AUTHORITY

30th November, 2020

The Authorised Representative
QGMI Construcciones e Infraestructuras Globales SLU
No. 22 C North Ridge Extension,
Accra, Ghana

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. SPAN 300M

LETTER OF ACCEPTANCE

We have the pleasure to inform you that upon the approval of the Public Procurement Authority to single source your firm for the above-mentioned Project in letter No. PPA/CEO/11/2802/20, dated 4th November, 2020 the Ghana Highway Authority Tender Committee at its 018/20 sitting held on Wednesday, 25th November, 2020 has awarded to your Firm 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, 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, Span 300m

at the Accepted Contract Amount of Ninety-Six Million, Three Hundred and Forty-Five Thousand, Five Hundred and Six United States Dollars and Thirty-Seven Cents (US$ 96,345,506.37) equivalent Eighty-Eight Million Euros (€ 88,000,000.00) (exch. 1€:1.1US$) for Completion in Seven Hundred and Thirty (730) Days.

The Contract shall come into full force and effect on the date when all the following conditions are fully satisfied:

a) Approval of the loan agreement by the Parliament of Ghana
b) Both Parties have signed the Contract Agreement.

If the Loan Agreement is not achieved within one year (or such longer period as the Parties may agree) after the date of the Contract Agreement then upon notice to the Employer, the

Contractor may discharge itself from further performance of the Contract, without prejudice to the rights of either Party in respect of any previous breach of the Contract.

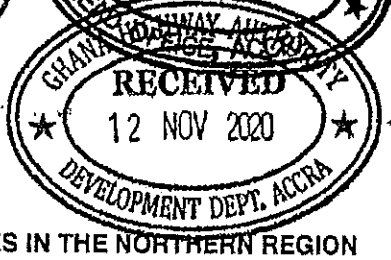
Yours faithfully,

NICHOLAS D. BROWN
CHIEF EXECUTIVE

Cc: The Chief Director, Ministry of Roads and Highways
The Deputy Chief Executive (Dev.), GHA
The Deputy Chief Executive (Mtce.), GHA,
The Deputy Chief Executive (Admin.), GHA,
Director of Contracts, GHA
The Director of Contracts, GHA,

SECTION 3 – THE LETTER OF PROPOSAL

QGMI



Accra, November 11, 2020

Ref.: QGMIESP/049/20

The Chief Executive
Ghana Highway Authority
Accra

Attn: Mr. Nicholas Brown

FINANCE, DESIGN AND CONSTRUCTION OF THREE (3) BRIDGES IN THE NORTHERN REGION

DESIGN AND CONSTRUCTION OF BRIDGES OVER BLACK VOLTA AT BUIPE, OVER WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA - TECHNICAL & COMMERCIAL PROPOSAL

Dear Sir,

Reference is made to the letter Cont.1/NR/SF.28/vol2/88 relating to the DESIGN AND CONSTRUCTION OF BRIDGES OVER BLACK VOLTA AT BUIPE, OVER WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA.

As per the abovementioned letter, QGMI has taken notice the recent decision issued by the Public Procurement Authority dated 4th November 2020, whereby your honorable authority, Ghana Highway Authority, has been approved to single source to QGMI Construcciones e Infraestructuras Globales SLU for the design and construction of Daboya, Yapei and Buipe bridges ("Works").

In view of the foregoing and Ghana Highway Authority's subsequent request to QGMI to deliver the full-fledge proposal, we kindly take this present opportunity to enclose to your attention our Technical and Commercial proposal for the implementation of the Works on a Design and Build basis as well as the financial term sheet by our partner financial institution which has considered the relevant Spanish Export Credit Agency – CESCE support as required by the Ministry of Finance.

We further highlight that the proposal herein attached includes all references to the Contractual Documentation, Exhibits and Previous Agreements which QGMI has been requested to abide.

QGMI Construcciones e Infraestructuras Globales wishes to confirm, as per the Letter referenced QGMIESP/044/20 (a copy of which is attached for ease of reference), its readiness and capability of developing the Works and structuring the financing package at utmost urgency and upon the issuance of the relevant mandates as required by the Ministry of Finance considering the lump sum amount of €88,000,000 (Eighty-eight Million Euros), in which also includes the €913,379.39 provisional sum for supervision of works by the indicated Engineer and €315,578.40 for training of relevant staff of the Employer and/or Engineer, as requested by your honourable Authority.

QGMI hereby manifest its profound appreciation and gratitude for being selected as a partner from your honourable Authority to provide a full-fledge solution to the Works' implementation by and look forward to your response.

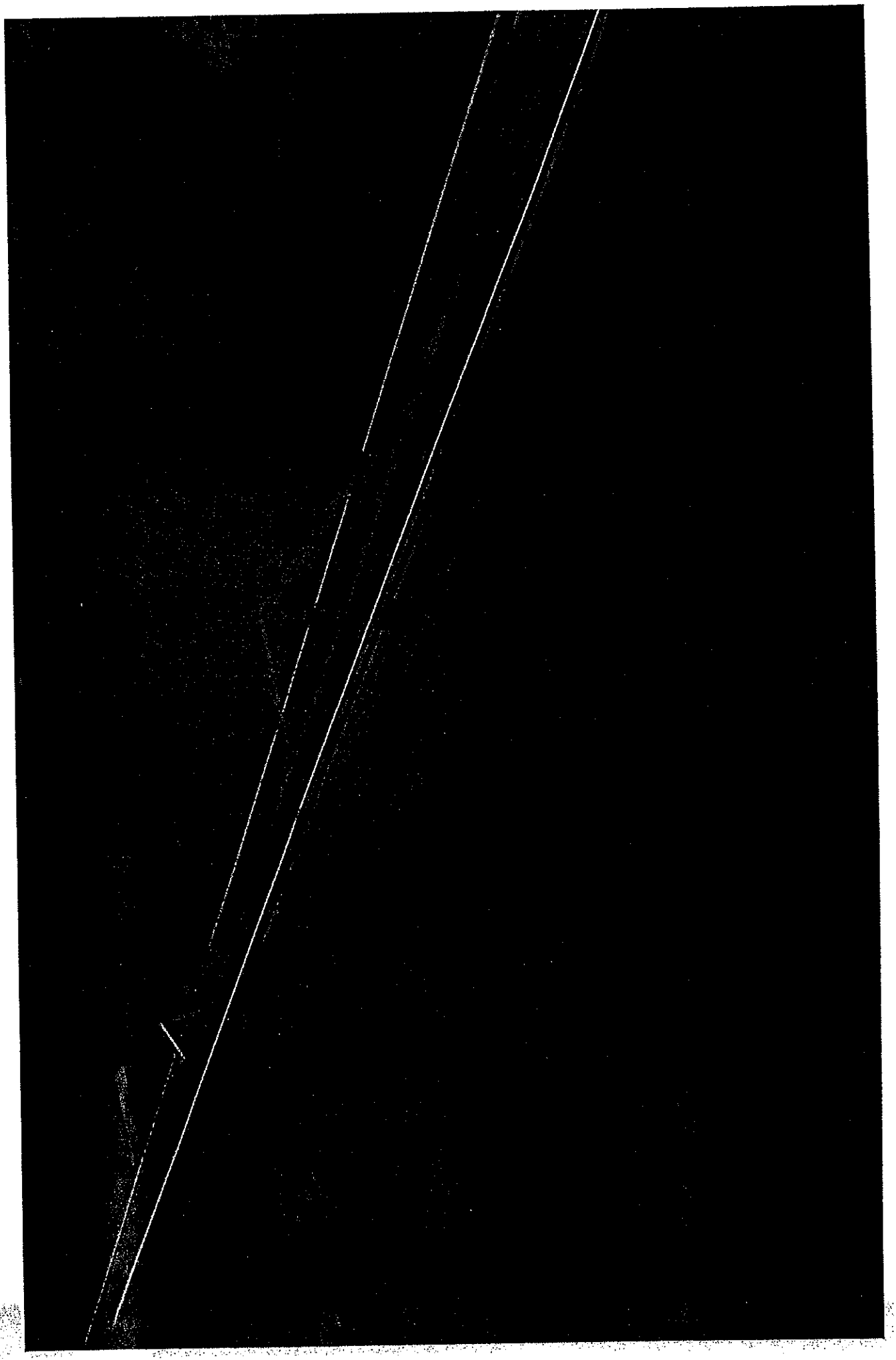
Alexandre Coutinho
Commercial Director

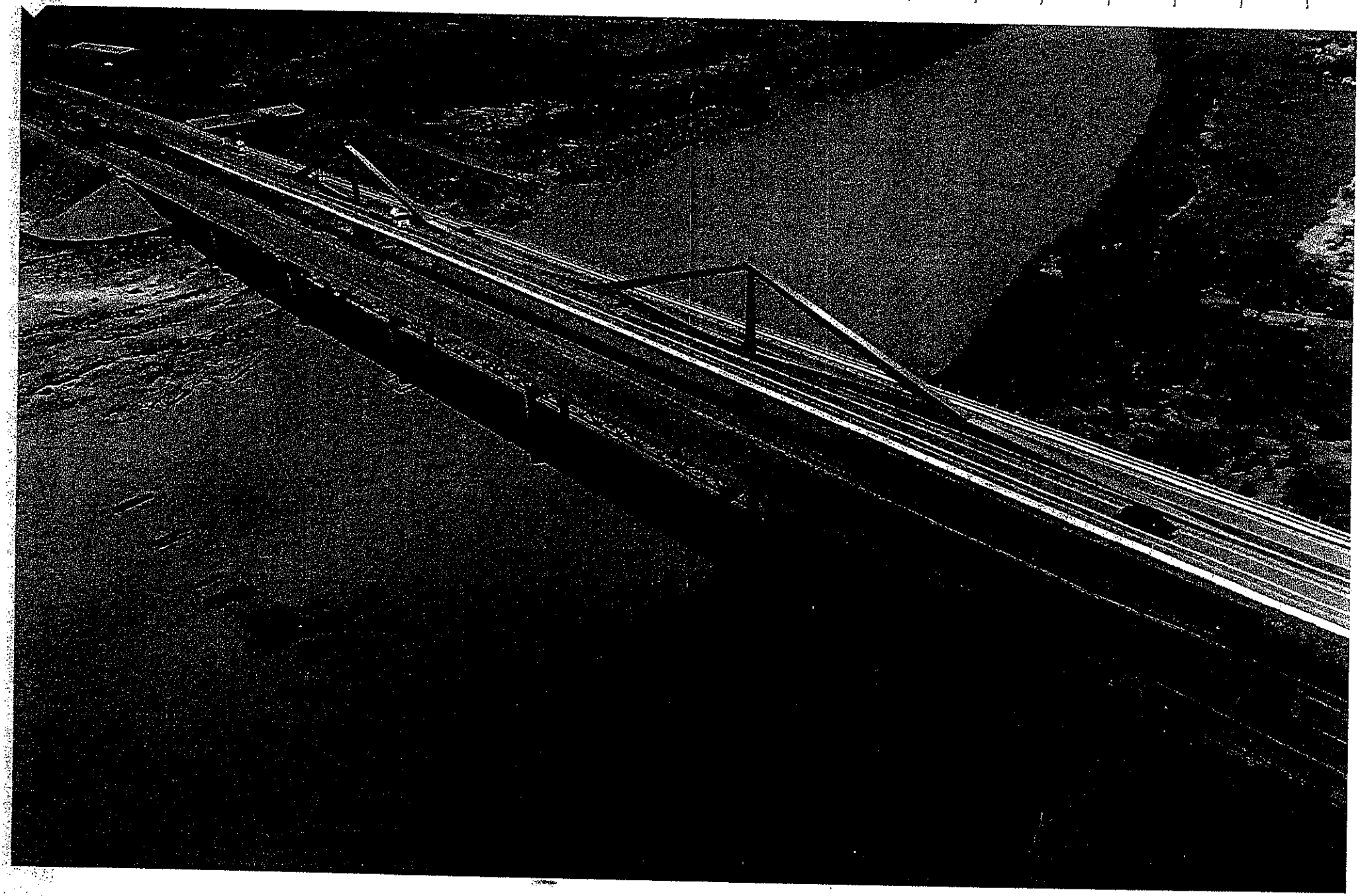
Faical Dallal
Finance & Adm Director

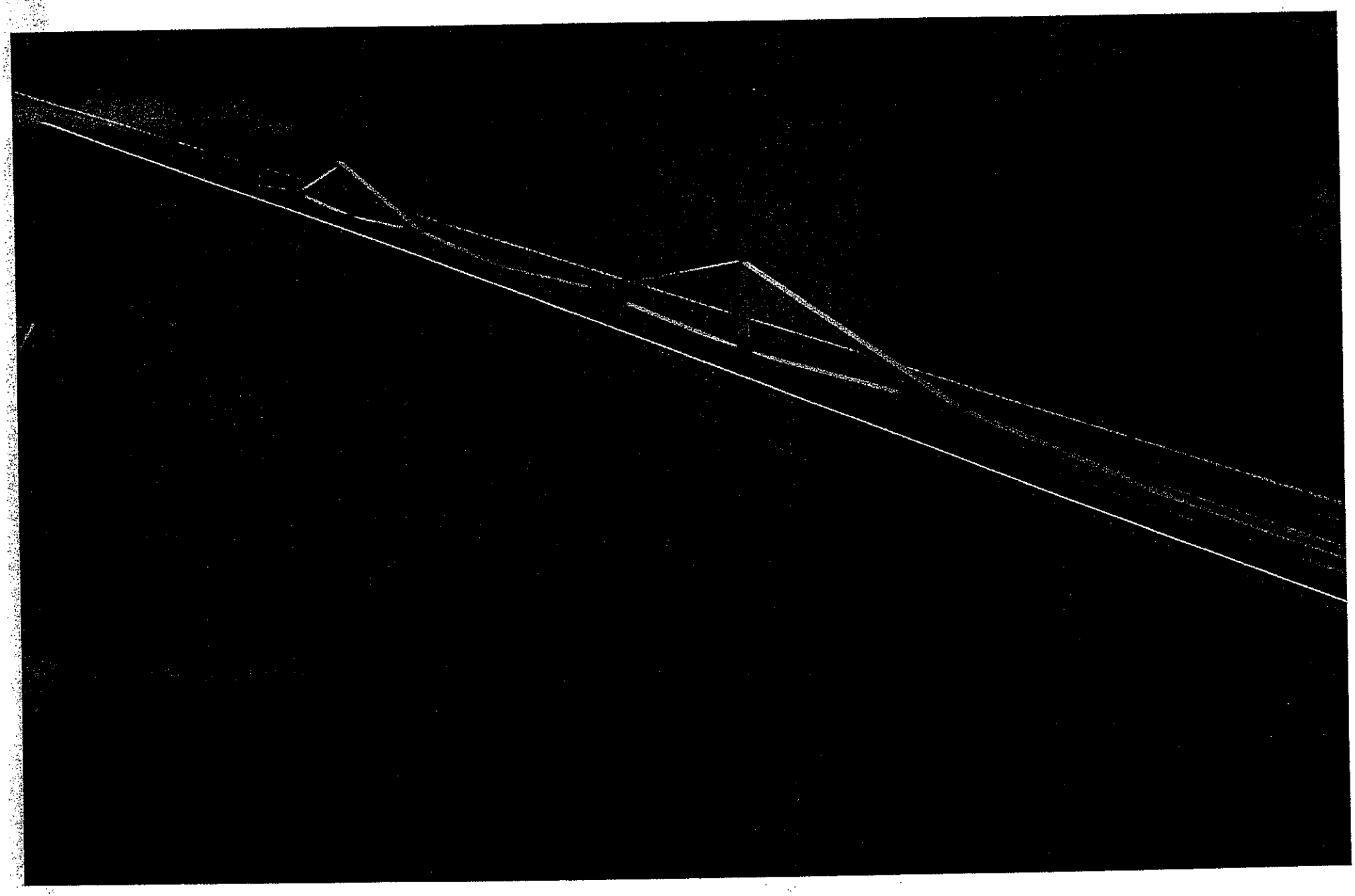
C/C:
Dy.Chief Executive (Dev.), GHA
Dir. of Contracts, GHA
Dir. Survey & Design, GHA

QGMI CONSTRUCCIONES E INFRAESTRUCTURAS GLOBALES S.L.U

QGMI Construcciones e Infraestructuras Globales SLU
Ghana Office | No. 22 C North Ridge Extension, Accra, Ghana
info-ghana@qgmic.com | +233 302747826







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

1) CONCEPT DESIGN

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

1) CONCEPT DESIGN
2) METHOD STATEMENT
3) WORKS PROGRAM
4) METHODOLOGY
5) EQUIPMENT
6) PERSONNEL
7) MAINTENANCE EXISTING BRIDGES
8) SCOPING REPORT
9) MAINTENANCE PLAN - NEW BRIDGES
10) INTEGRATED SYSTEM MANAGEMENT PLAN

	performance or for the recovery of assets or revenues; and ii the issue of any process against its assets or revenues for the enforcement of a judgment or, in an action in rem, for the arrest, detention or sale of any of its assets and revenues.
Costs and Expenses:	The Borrower will be liable in full, and will reimburse the Finance Parties and the ECA promptly on demand for: all transaction costs and expenses (including legal fees, environment & social assessment consultant's, technical consultant's and insurance advisor's fees, plus any value added tax thereunder, business-class travel and accommodation costs) incurred by the Finance Parties and the ECA in connection with the preparation, negotiation, printing, execution, perfection, enforcement and preservation of the Facility Documentation including any amendments thereto, the CESCE Cover and any other document referred to in or otherwise related to any of the above, whether or not the facility agreements or ECA Cover are signed or any drawing is made thereunder; all amendment costs (including legal fees plus any value added tax thereunder) in respect of any amendment, waiver or consent, change of currency or replacement of screen rate; and all enforcement costs (including legal fees plus any value added tax thereunder) in respect of the Finance Parties and the ECA enforcing and preserving their rights under the Facility Documentation.
Increased Costs:	The Facility Documentation will contain increased costs provisions customary for these types of facilities. The Borrower shall pay the Lenders the amount of any increased costs incurred by the Lenders or any of their affiliates as a result of (i) the introduction of or any change in (or in the interpretation, administration or application of) any law or regulation applicable to them or (ii) compliance with any law or regulation made after the date of the Facilities (including any costs attributable to Basel III or its implementation).

	concluded; or c) the Borrower breaches any of the representations contained in, or other terms of, the Facility Documentation; or d) there would be an event of default, potential event of default or mandatory prepayment event under the Facility Documentation if either of the facility agreements were to be signed.
Governing Law and Arbitration	The Finance Documents, and any non-contractual obligations arising out of or in connection with each Facility Agreement, will be governed by English law. Any dispute, controversy or claim arising out of or in connection with the Facilities or any Facility Documentation shall be referred to and finally resolved by arbitration in accordance with the Rules of the London Court of International Arbitration ("LCIA") for the time being in force. The number of arbitrators shall be three. Each party shall nominate an arbitrator and the third arbitrator, who shall be the chairman of the tribunal, shall be appointed by the LCIA Court. The seat, or legal place, of arbitration shall be London. The language to be used in the arbitral proceedings shall be English. Any arbitral award made by the arbitration tribunal shall be final and binding on the parties and without right of appeal. Judgment upon such an award may be entered and enforced in any court of competent jurisdiction
Market Flex (flexibility of terms before the signing of loan agreements):	Subject to the attached letter, the MLA may as it determines necessary, after a consultation period of not more than three (3) days with the Borrower, change the structure, terms or Interest Rate of the Facilities indicated in this Term Sheet. This does not apply once the Facilities are signed.
EURIBOR:	Set by reference to Reuters or, if not available, on the basis of rates provided by agreed Reference Banks, and if any such rate is below zero then EURIBOR as applicable will be deemed to be zero.
Hedge Break Costs:	For making any draw-down under this Facility available to the Borrower, the Lender may enter into one or more derivative transactions. Such derivative transactions may incur Hedge Break Costs which are costs or expenses incurred in respect of closing out or adjusting such transactions. Such Hedge Break Costs may be thus demanded by the Lender on the relevant portion of the loan only in the event of (1) any acceleration and/or cancellation of the Facility or any Loan after a drawdown notice has been given, or (2) a prepayment or early termination of the Facility or any Loan due to any reason, or (3) the occurrence of a hedge disruption event.
Environmental & Social Standards:	SCB is a signatory to the Equator Principles requiring us to ensure that projects for which we provide financing and/or advisory services are developed in a manner that is socially responsible and reflects sound environmental management practices. In addition, SCB have issued numerous position statements which provide SCB with a formalised framework to ensure that Our clients are adopting sound environmental and social management practices. This financing will be undertaken strictly in accordance with the Equator Principles, IFC Performance Standards and our position statements, in each case as in effect on the date of the Facility Documentation, and CESCE's policies and requirements (as relevant). To the extent applicable, the Facility Documentation will include provisions relating to Environmental & Social Standards and confirmation that the Borrower intends to adhere to the requirements of the Equator Principles.
Waiver of Immunity:	The Borrower shall waive generally all immunity it or its assets or revenues may otherwise have in any jurisdiction, including immunity in respect of: i the giving of any relief by way of injunction or order for specific

	• all amendment costs (including legal fees plus any value added tax thereunder) in respect of any amendment, waiver or consent, change of currency or replacement of screen rate; and • all enforcement costs (including legal fees plus any value added tax thereunder) in respect of CESCE or the Finance Parties enforcing and preserving their rights under the Facility Documentation.
Facility Documentation	The CESCE Facility Agreement and the Commercial Facility Agreement will be substantially based on the form recommended by the Loan Market Association ("LMA") and otherwise in form and substance satisfactory to the Finance Parties and CESCE. The Facility Documentation will include any other relevant documentation between the Finance Parties, CESCE and the Borrower. The Facility Documentation will contain standard provisions relating to, inter alia, increased costs, mandatory costs, indemnification, illegality, disclosure, anti-bribery and anti-corruption, taxes, market disruption, break costs, set-off, confidentiality, default interest, know-your-customer provisions, sanctions, FATCA, split-voting, impaired agent, transfer and assignments, security over lenders' rights, changes in currency, replacement of screen rate, material adverse effect, EURIBOR floor, waiver of immunity, as well as any terms and conditions required by CESCE and / or the Finance Parties.
Cross Default:	Both the CESCE facility agreement and the commercial facility agreement will contain customary cross default provisions including but not limited to: - Any financial indebtedness of the Borrower is not paid when due nor within any originally applicable grace period; - Any financial indebtedness of the Borrower is declared to be or otherwise becomes due and payable prior to its specified maturity as a result of an event of default (however described); - Any commitment for any financial indebtedness of the Borrower is cancelled or suspended by a creditor of the Borrower as a result of an event of default (however described); or - Any creditor of the Borrower becomes entitled to declare any financial indebtedness of the Borrower due and payable prior to its specified maturity as a result of an event of default (however described). For the avoidance of doubt, default under one Facility will result in a default occurring under the other Facility (i.e. there will be cross default between the CESCE Facility and the Commercial Facility).
Assignments, Transfers and Participations:	The Lenders may sell transfer or assign all or a portion of their loan and commitments under the Facilities without the consent of the Borrower, or sell participations therein (without any consent), to a third party and/or other financing institution.
Language	All documentation and notices shall be in the English language.
Material Adverse Change:	Subject to the attached letter, all terms and conditions mentioned herein are subject to changes in market conditions. The obligation of the Structuring Bank to arrange the Facilities will cease if: a) In their reasonable opinion and at their sole discretion there has been (whether as a consequence of events that have already occurred or which occur after the date of this term sheet) a material adverse change in any of: i. the business, condition (financial or otherwise), operations, performance, assets or prospects of the Borrower; or ii. the commercial bank, financial or capital market conditions generally, since the date of this term sheet that, in its opinion, would materially impair successful conclusion of these Facilities; or iii. the financial or political situation in Ghana; or b) the MLA believes that the Facilities cannot be completed or

Mandatory Prepayment:	Prepayment and cancellation must be made in the events where, amongst others, (i) it becomes unlawful for a Lender to perform its obligations under CESCE and/or Commercial Facilities, (ii) the Commercial Contract has been cancelled, terminated, revoked and/or there is a failure to fulfil any payment obligations (iii) CESCE support is revoked, cancelled, suspended or terminated. In such an event the Borrower shall also be liable for Break Costs incurred by the Lenders
Representations & Warranties	Customary for financings of this nature, and as required by CESCE and/or the Lenders. Subject to carve-outs, qualifiers and grace periods to be agreed at documentation stage.
Break Costs:	In addition to indemnities customary for this type of financing,. This indemnity shall apply in relation to any repayment other than in accordance with Repayment above (including, but not limited to, any prepayment, acceleration or other early demand for repayment), any change in the drawdown / repayment profile, as well as any failure to borrow the Facilities in full during the Availability Period.
Undertakings	Customary for financings of this nature, and as required by CESCE and/or the Lenders. Subject to carve-outs, qualifiers and grace periods to be agreed at documentation stage.
Events of Default	Customary for financings of this nature, and as required by CESCE and/or the Lenders. Subject to carve-outs, qualifiers and grace periods to be agreed at documentation stage.
Conditions Precedent	As customary for financings of this nature, and as required by CESCE and the Lenders, including but not limited to, issuance of the ECA Cover, receipt of legal opinions as required by the Lenders, and all relevant government and regulatory approvals. Subject to carve-outs, qualifiers and grace periods to be agreed at documentation stage
Other Terms & Conditions	As required by the CESCE and/or Lender(s) and as customary for financings of this nature (including financial covenants).
Events of Default:	The Facility Documentation will contain events of default customary for financings of this nature and as required by CESCE and/or the Lenders including but not limited to: • non-payment; • other obligations; • misrepresentation; • cross default; • rescheduling and insolvency-like proceedings; • creditors' process • cross default; • unlawfulness and invalidity; • exchange controls; • repudiation; and • material adverse change. Subject to carve-outs, qualifiers and grace periods to be agreed at documentation stage
Costs and Expenses	The Borrower will be liable in full, and will reimburse CESCE and the Finance Parties promptly on demand for: • all costs and expenses (including legal fees, environment & social assessment consultant's, technical consultant's and insurance advisor's fees plus any value added tax thereunder, business-class travel and accommodation costs) incurred by CESCE and the Finance Parties in connection with the preparation, negotiation, printing, execution, perfection, enforcement and preservation of the Facility Documentation including any amendments thereto, any other document referred to in or otherwise related to any of the above, whether or not the Facility Agreements are signed or any drawing is made thereunder;

Commercial Facility	
Purpose	Term loan facility, to finance amounts payable under the Commercial Contract that are not eligible for financing under the CESCE Facility.
Commercial Facility Amount	Up to EUR [13.20] million, representing the remainder of the Commercial Contract Amount that is not eligible for financing under the CESCE facility.
Final Maturity Date	Up to [5] years from the Commercial Signing Date.
Commercial Signing Date	The date on which the facility agreement relating to the Commercial Facility (the **"Commercial Facility Agreement"**) is signed by the authorised signatory of each relevant party.
Availability Period	The loan will be made available in line with the requirements of the Commercial Contract, expected to be [12] months from the Commercial Signing Date.
Repayment	To be repaid in no more than [8] equal and consecutive semi-annual instalments commencing 6 months after the end of the Availability Period. If the date of the last repayment falls beyond the Final Maturity Date, the last payment date will be the Final Maturity Date.
Interest Rate	Interest shall be payable on the outstanding principal amount on the following basis: • 6 month EURIBOR plus the Margin • EURIOR shall be subject to a floor of zero. Interest shall be payable at the end of each interest period semi-annually in arrears and shall be calculated on the basis of the actual number of days elapsed and a 360-day-year.
Margin	[5.50]% p.a.
Interest Periods	6 months, provided that no Interest Period shall extend beyond the Final Maturity Date.
Interest Payment Date	Interest is payable on the last day of each Interest Period.
Commitment Fee	[1.00]% p.a. Commitment Fee shall be calculated on the daily undrawn and uncancelled balance of the Commercial Facility Amount during the Availability Period. The Commitment Fees are payable by the Borrower to the Facility Agent (for the account of each Lender) semi-annually and in arrears.

General and Other Terms & Conditions	
Upfront Fee	[1.50]% flat The Upfront Fee will be calculated on the aggregate of the CESCE Facility Amount and the Commercial Facility Amount and is due upon the earlier to occur of the CESCE Signing Date and the Commercial Signing Date.
Default Interest:	Default interest shall be payable on all overdue amounts at a rate equal to a margin of 2.00% per annum. This amount is charged over the applicable Interest Rate.
Taxes & Increased Costs	All payments to be made by the Borrower will be made free and clear, and without deduction for taxes, stamp duties, levies or other charges imposed by any governmental authority. If any such deduction is required to be made, then the amount of the payments will be increased to ensure that after making the appropriate deduction, the Finance Parties receive and retain free of any liability a sum equal to that which it would have received in the absence of the requirement to make such deduction.

	Signing Date.
Starting Point of Credit ("SPOC")	To be determined in accordance with the OECD Arrangement on Officially Supported Export Credits as published at http://www.oecd.org/tad/xcred/theexportcreditsarrangementtext.html ("**OECD Arrangement**") and determined by the nature of the goods and services and timing of their supply.
Down Payment	An amount equal to at least 15% of the Export Contract Value must be made by the SPOC as a condition of support by CESCE, of which 5% must be paid on or promptly after the signature of the Commercial Contract. It is understood that the Down-payment Payment will be paid by the Commercial Facility.
Repayment Period	Up to [10] years in [20] equal and consecutive semi-annual installments, commencing from the earlier of (i) 6 months from the SPOC and (ii) a backstop date to be determined. If the date of the last repayment falls beyond the Final Maturity Date, the last payment date will be the Final Maturity Date.
Interest Rate	Interest shall be payable on the outstanding principal amount on the following basis: • 6 month EURIBOR plus the Margin • EURIOR shall be subject to a floor of zero. Interest shall be payable at the end of each interest period semi-annually in arrears and shall be calculated on the basis of the actual number of days elapsed and a 360-day-year.
Margin	[1.40]% p.a.
Interest Periods	6 months, provided that no Interest Period shall extend beyond the Final Maturity Date.
Interest Payment Date	Interest is payable on the last day of each Interest Period.
Commitment Fee	[0.50]% per annum, calculated on the daily undrawn and uncancelled balance of the CESCE Facility Amount during the Availability Period. The Commitment Fees are payable by the Borrower to the Facility Agent (for the account of each Lender) semi-annually and in arrears.
Mandatory Prepayment	Mandatory prepayment required where, amongst others: (i) It becomes unlawful for a Lender to perform its obligations under the CESCE Facility, (ii) the Commercial Contract is cancelled, terminated, revoked and/or there is a failure to fulfil any payment obligations; or (iii) the ECA Cover is revoked, cancelled, suspended or terminated.
CESCE Support Fee or CESCE Premium	In consideration of CESCE's support in the transaction, a CESCE Support Fee will be payable to, and will be determined by CESCE, based upon the details of the Commercial Contract and the terms and conditions of the CESCE Facility. Currently, the CESCE Support Fee is indicatively estimated at [12.36]% of the CESCE Facility Amount, subject to CESCE approvals and determined at the sole discretion of CESCE.
ECA Cover	Comprehensive risk cover issued by CESCE to cover [99]% of the CESCE Facility Amount providing for commercial and political risks.

Appendix I

Discussion Paper

General and Parties	
Borrower	Ministry of Finance, Ghana ("**MoF**")
Buyer	Ministry of Roads and Highways ("**MRH**")
Contractor	QGMI Construcciones e Infraestructuras S.L.U. ("**QGMI**")
Mandated Lead Arranger (MLA)	Standard Chartered Bank ("**SCB**") and/or any other financial institutions as invited by SCB
Export Credit Agency ("ECA")	Compañía Española de Seguros de Crédito a la Exportación ("**CESCE**"), the ECA of Spain
Structuring Bank	SCB
Facility Agent	SCB
Project	Yapei, Buipe and Daboya bridges in the Republic of Ghana
Facilities	The financing package may include two facilities: - CESCE supported term loan facility (the "**CESCE Facility**"); and - Commercial term loan facility (the "**Commercial Facility**").
Lenders	Financial institutions as invited by the Structuring Bank
Commercial Contract	A commercial contract to be entered into between the Buyer and the Contractor in relation to the Project.
Commercial Contract Amount	The Commercial Contract amount is subject to finalization and is estimated to be EUR 88.00 million
Currency	EUR
Finance Parties	The Structuring Bank, MLA, Lenders and the Facility Agent.

CESCE Facility	
Purpose	Term loan facility, supported by the Spanish export credit agency, CESCE, to part finance the Commercial Contract Amount and the CESCE Premium.
CESCE Facility Amount	Total amount made available under the CESCE Facility is subject to approval from CESCE, and is expected to be up to EUR [85.35] million, consisting of the aggregate of: - up to 85% of the Export Contract Value; - Local Costs capped at up to 30% of Export Contract Value; and - Up to 100% of the estimated CESCE Premium. This amount remains subject to CESCE's approval and there being evidence of payment of sufficient costs related to the Project by the Borrower as well there being a sufficient level of export contract value inside the scope of the Commercial Contract.
Final Maturity Date	Up to [12.5] years from the CESCE Signing Date.
CESCE Signing Date	The date on which the facility agreement relating to the CESCE Facility (the "**CESCE Facility Agreement**") is signed by the authorised signatory of each relevant party.
Availability Period	The loan will be made available in line with the requirements of the Commercial Contract, expected to be [30] months from the CESCE

Standard Chartered

Export Finance Bank" by Global Trade Review in 2020, 2019 and 2018, and "Best Export Finance Bank for 2019 by Global Finance. These awards recognize our leadership in Project and Export Finance.

With more than 70 experienced project and export finance professionals globally, SCB is well placed to ensure smooth execution. We have ECA specialists focused on CESCE financing and we have closed numerous transactions involving CESCE over the last few years.
This Proposal has been provided at your request based on our preliminary understanding of the Financing and without any internal approvals.

This Proposal is not intended to be a commitment or offer by us or any of our affiliates (together, the "**SCB Group**") to provide or arrange or underwrite any financing in connection with the Financing. Nothing in this Proposal (including any act, omission or representation by or on our behalf) shall render any member of the SCB Group liable to you or any other person in any manner whatsoever.

Any commitment and subsequent offer of finance from us will be subject to conditions customary for financings of this nature, including, without limitation, the completion of due diligence, loan and capital market conditions, the issuance of all internal and external approvals, and the execution of financing documents, in each case, in form and substance satisfactory to us, and you agreeing to undertake or assist in undertaking due diligence on the process leading to the award of the Commercial Contract (including, but not limited to a 'value for money audit') as may be required by the Financing parties. The Financing will be undertaken strictly in accordance with the Equator Principles and IFC Performance Standards as in effect on the date of the Financing documents, and the requirements of the Financing parties (as relevant).

This Proposal is given as of the date set out above. The SCB Group is under no obligation to update, revise or reaffirm statements made in this Proposal and subsequent developments or information may affect the statements set out in this Proposal.

We have provided this Proposal on the basis that (i) it is for the sole purposes of your consideration of the Financing and (ii) the issuance of this Proposal and its contents are confidential and shall not be disclosed to any person or be reproduced, disseminated or quoted at any time and in any manner without our prior written consent other than disclosure on a confidential and non-reliance basis to CESCE, QGMI, MRH and/or your professional advisers (or as otherwise required by applicable law or regulation).

This Proposal and any non-contractual obligations arising out of or in connection with it are governed by English law.

We look forward to working with you on the Financing.

Yours faithfully,
For and on behalf of
Standard Chartered Bank

Yoshi

Yoshi Ichikawa
Executive Director
Structured Export Finance, Head of Europe

Standard Chartered Bank

1 Basinghall Avenue
London EC2V 5DD
www.standardchartered.com +44 (0)20 7885 8888

STRICTLY PRIVATE AND CONFIDENTIAL

Standard Chartered

To: The Honorable Kenneth Ofori-Atta
Minister for Finance, Ministry of Finance

28th February Road, Finance Drive
Accra, Ghana

CC: Ministry of Roads and Highways

QGMI Construcciones e Infraestructuras S.L.U.
Spain

4th September 2020

Re: Financing of Commercial Contract between the Ministry of Roads and Highways of Ghana and QGMI Construcciones e Infraestructuras S.L.U. for the construction of Yapei, Buipe and Daboya bridges in Ghana

Dear Sirs,

We refer to the above matter and ongoing discussions between the Ministry of Roads and Highways ("**MRH**" or the "**Buyer**"), and QGMI Construcciones e Infraestructuras S.L.U. ("**QGMI**" or the "**Contractor**") in relation to the construction of the Yapei, Buipe and Daboya bridges in the Republic of Ghana through a commercial contract (the "**Commercial Contract**").

We understand that funds of up to EUR 88.00 million will be required for making scheduled payments to the Contractor under the Commercial Contract and the Ministry of Finance, Ghana is interested in raising such funds pursuant to debt facilities to finance part of or the whole amount due under the Commercial Contract (the "**Financing**").

We understand that the overall amount for the Commercial Contract is estimated to be around EUR 88.00 million (the "**Commercial Contract Amount**"):

- It is envisaged that the Commercial Contract will be partially financed through export credit agency ("**ECA**") financing to the Ministry of Finance, Ghana ("**MoF**" or the "**Borrower**") guaranteed by Compañía Española de Seguros de Crédito a la Exportación, the Spanish export credit agency ("**CESCE**").
- The MoF will act as the direct borrower under the proposed potential financings contemplated herein, hence the financing is predicated upon Ghanaian sovereign risk;

Our proposal would be to structure and arrange:

(i) A CESCE supported term loan facility (the "**CESCE Facility**") for the financing of up to:
  - (i) 85% of the export contract value in the Commercial Contract; (ii) 30% of the export contract value in the Commercial Contract or local cost, whichever is the lowest; and
  - 100% of the CESCE Premium (as defined in Appendix 1), subject to CESCE's approval; and

(ii) A commercial term loan facility for the financing of up to the balance of the Commercial Contract not financed under the CESCE Facility.

together, the "**Financing**".

Based on our discussions and the information provided by you, we are interested in further considering the Financing on the terms set out in this letter and in our proposal attached as Appendix 1 to this letter (this letter and the proposal together, the "**Proposal**").

Standard Chartered – The Right Partner

We have an award-winning global project and export finance franchise and were awarded "Best Global

Standard Chartered Bank

1 Basinghall Avenue
London EC2V 5DD
www.standardchartered.com +44 (0)20 7885 8888

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 1

4) TERMSHEET FROM STANDARD CHARTERED BANK

QGMI

QGMI presents the attached term sheet to indicate the financing which is supported by the Spanish Export Credit Agency – CESCE.
We look forward to your response in order to facilitate the Financing Package closure, the final outstanding approvals and to discuss our requested mobilisation to the Site.

Faical Fawaz Dallal
Finance Director

Alexandre Coutinho
Commercial Director

C/C:

Dy.Chief Executive (Dev.), GHA
Dir. of Contracts, GHA
Dir. Survey & Design, GHA

QGMI Construcciones e Infraestructuras Globales SLU
Ghana Office| No. 22 C North Ridge Extension, Accra, Ghana
Info-ghana@qgmic.com | +233 302747826

accepted tender price in order to commence the process leading to financial clearance and closure of the projects;

(vi) However, the Public Procurement Authority issued a decision in relation to the Tender qualification and award process whereby the authority reversed the first award and awarded to Construtora Queiroz Galvao under the abovementioned tender process only the development of Yapei Bridge;

(vii) Construtora Queiroz Galvão and Ministry of Roads & Highways signed the Contract Agreement on April 16th 2020 for the development of Yapei Bridge;

(viii) Following the signature of this Contract Agreement, Ghana Highway Authority indicated its interest to award the joint development of Yapei and Buipe bridges to Construtora Queiroz Galvão/QGMI due to the fact that the former bidder which was awarded the implementation of Buipe by the Public Procurement Authority was unable to fulfil the obligations for the signature of its own Contract Agreement;

(ix) In view of these subsequent changes (the award of three bridges, one bridge and eventually two bridges), the financing banks indicated to Construtora Queiroz Galvão their constraints to proceed with the financing arrangement;

(x) In view of the Tender Process closure by the Public Procurement Authority decision mentioned in item (viii) above, Construtora Queiroz Galvao mentioned it would not be possible to fulfil the joint implementation proposal and informed Ghana Highway Authority to conduct direct negotiations with QGMI for the purposes of assessing their capability to structure financing and implement the projects under the same basis of the original proposal presented by Construtora Queiroz Galvao in the Tender;

(xi) QGMI and Ghana Highway authority had several interactions as to clarify their acceptance of the same conditions of the previous proposals presented by Construtora Queiroz Galvao, which led to a new decision by the Public Procurement Authority on XXX awarding the development of both Yapei and Buipe bridges to QGMI.

In view of the foregoing, QGMI Construcciones e Infraestructuras Globales herbey confirms its capability to execute Works on the same conditions of the previous proposals presented by Construtora Queiroz Galvao, as well as to structure the relevant financing, namely:

(a) Design and Construction of Bridge Over Black Volta At Buipe and Over White Volta At Yapei for the amount of US$ 68, 650,750 (which, converted into Euros considering the agreed base date of the Public Procurement Authority decision is is around €63,600,000 (Sixty-Three Million and Six Hundred Thousand Euros); and

(b) Design And Construction of Bridge Over Black Volta At Buipe, Over White Volta At Yapei and White Volta At Daboya for a lump sum amount of €88,000,000 (Eighty-eight Million Euros), in accordance with the abovementioned terms and conditions of the meeting was held at GHA between 16th and 25th January 2019, where the tender price was revised to US$ 96,345,506.37, including US$ 1,000,000 for supervision and US$ 345,506.37 for training; (which, converted into Euros considering the agreed base date of the Public Procurement Authority decision is of €88,000,000 (Eighty-eight Million Euros)).

QGMI

Accra, September 18th 2020

Ref.: QGMI/ESP/044/20

The Chief Executive
Ghana Highway Authority
Accra

Attn: Mr. Nicholas Brown

FINANCE, DESIGN AND CONSTRUCTION OF THREE (3) BRIDGES IN THE NORTHERN REGION

DESIGN AND CONSTRUCTION OF BRIDGES OVER BLACK VOLTA AT BUIPE, OVER WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA - TECHNICAL & COMMERCIAL PROPOSAL

Dear Sir,

Reference is made to the meeting held on September 8th of 2020 relating to the DESIGN AND CONSTRUCTION OF BRIDGES OVER BLACK VOLTA AT BUIPE, OVER WHITE VOLTA AT YAPEI.

In view of Ghana Highway Authority request to provide the overall framework of the negotiations held so far, we kindly present herein below the interactions between QGMI and Ghana Highway Authority on the subject:

(i) On October 2017, Ghana Highway Authority invited Tenders for the design and construction of the bridges over Black Volta at Buipe, over White Volta at Yapei and over the White Volta at Daboya;

(ii) In view of the Tender requirements, QGMI proposed the participation of Construtora Queiroz Galvao S/A – Ghana Branch, a company of the same ultimate owners as QGMI, to participate in the Tender while QGMI-Sweden, acts as a subcontractor and export company, responsible for structuring the financing arrangements;

(iii) Construtora Queiroz Galvão participated in the abovementioned tender for the Construction of three Bridges: Buipe, Yapei and Daboya in the Northern Region of the Republic of Ghana and presented individual proposals for each Lot and alternative proposals for the combination of two Lots and the three lots under an optimized joint implementation;

Construtora Queiroz Galvão had presented a discounted proposal for the optimized concurrently construction of all three lots at a cost of USD 98,815,903.97 in consideration of the concurrent usage of optimized personnel and equipment;

(iv) Subsequently, a meeting was held between Construtora Queiroz Galvao and Ghana Highway Authority, with the participation of QGMI's personnel, whereby Ghana Highway Authority required some clarifications and discounts, leading to a final accepted tender price of US$ 96,345,506.37, including US$ 1,000,000 for supervision and US$ 345,506.37 for training;

(v) Following these discussions, the Ministry of Finance mandated the relevant banks presented by Construtora Queiroz Galvão/QGMI for the purposes of financing the final

QGMI Construcciones e Infraestructuras Globales SLU
Ghana Office| No. 22 C North Ridge Extension, Accra, Ghana
Info-ghana@qgmic.com | +233 302747826

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 1

3) LETTER QGMI

OGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

Design and Construction of Bridge over White Volta at Yapei, approx. span of 240 m

YAPEI

Cost Component Breakdown

Item	Description		Qty	Amount (€)
	Filling with selected excavated material other than topsoil or rock including haulage up to 20 Km	m3	44,453.08	
	Provide, lay and compact approved natural gravel subbase material 200mm thick including haulage up to 20 Km	m2	11,573.81	
	R165-Provide, lay and compact approved crushed stone 200mm thick including haulage up to 80 Km	m2	11,573.81	
	Bituminous prime coat at a rate of 1.0 Kg/m2	m2	11,573.81	
	Bituminous tack coat at a rate of 0.5 Kg/m2	m2	11,573.81	
	Asphaltic wearing course 50mm thick including haulage up to 80 Km	m2	11,573.81	
	Precast concrete kerb, gutter splayed and finished fair on all exposed surfaces, cast on and including 280 x 100mm foundation, all necessary formwork, excavation and mortar joint with 300mm gaps at 2.0m centres for drain openings	m	1,928.97	
	X181-Provide and install standard galvanized mild steel crash barrier as per specifications	m	1,928.97	
	R811.1-Provide and install concrete kilometer post, exposed 975mm with reflective markers at both sides as per specifications	un	19.29	
	3.0mm thick reflective thermoplastic roadline marking (continuous and intermittent) of any width	m	2,893.45	
	Slope protection	m2	10,609.33	
	Interference relocation	sum	1.00	
5.	Provisional Sums			
5.1	Residence and office accommodation for the Engineer		1	€ 118,739.32
5.2	Equipment for engineers as per tender documents		1	€ 118,739.32
5.3	Cars for engineers as per tender documents		1	€ 274,013.82
	Grand Total			€ 3,812,242.66

QGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

Design and Construction of Bridge over White Volta at Yapei, approx. span of 240 m

YAPEI				
Cost Component Breakdown				
Item	Description		Qty	Amount (€)
1.	Project Design			€ 1,226,885.50
2.	Mobilization and Camp Site			€ 490,754.20
3.	Bridge			
3.1	Foundation			€ 3,680,656.51
	Bored cast in place concrete piles D1500 mm, (bored, preparing heads and temporary steel casing)	m	141.78	
	Reinforced concrete C30/37 foundations	m3	1,200.40	
	Reinforcements: steel, all bar sizes B500S	kg	48,169.48	
	Excavations for foundations in any material	m3	2,990.87	
	Filling to structures with selected excavated material	m3	2,007.86	
	Sheet piles	m2	405.08	
3.2	Abutments and Columns			€ 2,453,770.01
	Reinforced concrete C25/30 approach slabs	m3	42.53	
	Reinforced concrete C30/37 elevations, beams, deck	m3	223.23	
	PVC drainage pipe 150mm diameter + geotextile	m	50.54	
	PVC drainage pipe 100mm diameter	m	3.86	
	Bearing type POT PL-700	ud	3.86	
	Bearing type POT PU-700	ud	1.93	
	Riprap	m2	833.31	
	Reinforced concrete C40/50 pier and elevations	m3	443.58	
	Elastomeric Bearing	dm3	2,266.15	
3.3	Composite Structure			€ 14,253,497.59
	Deck formwork	m2	7.57	
	Fabric. of main members for bridges. Plates. Straight. BS EN 10025 S355J2+N (erection & painting)	kg	1,690,489.23	
	Reinforced concrete C40/50 pier and elevations	m3	66.90	
	Precast planks 80 mm constant height	m2	3,197.65	
	Reinforced concrete C30/37 deck	m3	639.53	
	Loading test in deck / spam	nr	2.89	
3.4	Miscellanious			€ 736,131.90
	Elastomeric expansion joints 230 mm maximum movement	m	30.28	
	Precast edge beam cross sectional area: 0.1-0.5 m2	m	490.15	
	Drainage gully (pipe Ø105 & pot Ø160mm)	nr	17.36	
	Steel safety parapet (H3)	m	490.15	
	Metal ralling on sidewalks	m	478.48	
	Dual concrete security barrier	m	478.48	
	PVC pipe for deck utilities	m	466.81	
	LANDSCAPING			
	Landscaping	sum	1.00	
4.	Road Works			€ 2,453,771.01
	Excavate to any depth unsuitable material, haul to spoil heap and dispose off as directed	m3	10,127.09	

QGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

Design and Construction of Bridge over Black Volta at Buipe, approx. span of 240 m

BUIPE

Cost Component Breakdown

Item	Description		Qty	Amount (€)
	R165-Provide, lay and compact approved crushed stone 200mm thick including haulage up to 80 Km	m2	11,639.20	
	Bituminous prime coat at a rate of 1.0 Kg/m2	m2	11,639.20	
	Bituminous tack coat at a rate of 0.5 Kg/m2	m2	11,639.20	
	Asphaltic wearing course 50mm thick including haulage up to 80 Km	m2	11,639.20	
	Precast concrete kerb, gutter splayed and finished fair on all exposed surfaces, cast on and including 280 x 100mm foundation, all necessary formwork, excavation and mortar joint with 300mm gaps at 2.0m centres for drain openings	m	1,939.87	
	X181-Provide and install standard galvanized mild steel crash barrier as per specifications	m	1,939.87	
	R811.1-Provide and install concrete kilometer post, exposed 975mm with reflective markers at both sides as per specifications	un	19.40	
	3.0mm thick reflective thermoplastic roadline marking (continuous and intermittent) of any width	m	2,909.80	
	Slope protection	m2	10,669.26	
	Interference relocation	sum	1.00	
5.	Provisional Sums			
5.1	Residence and office accommodation for the Engineer		1	€ 118,739.82
5.2	Equipment for engineers as per tender documents		1	€ 118,739.82
5.3	Cars for engineers as per tender documents		1	€ 274,013.82
	Grand Total			€ 7,905,011.85

QGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

Design and Construction of Bridge over Black Volta at Buipe, approx. span of 240 m

BUIPE				
Cost Component Breakdown				
Item	Description		Qty	Amount (€)
1.	Project Design			€ 1,206,619.02
2.	Mobilization and Camp Site			€ 482,647.61
3.	**Bridge**			
3.1	Foundation			€ 3,619,857.07
	Bored cast in place concrete piles D1500 mm, (bored, preparing heads and temporary steel casing)	m	157.13	
	Reinforced concrete C30/37 foundations	m3	1,233.37	
	Reinforcements: steel, all bar sizes B500S	kg	49,495.68	
	Excavations for foundations in any material	m3	3,501.46	
	Filling to structures with selected excavated material	m3	2,512.90	
	Sheet piles	m2	814.74	
3.2	Abutments and Columns			€ 2,413,238.04
	Reinforced concrete C25/30 approach slabs	m3	42.77	
	PVC drainage pipe 150mm diameter + geotextile	m	50.82	
	PVC drainage pipe 100mm diameter	m	3.88	
	Bearing type POT PL-700	ud	3.88	
	Bearing type POT PU-700	ud	1.94	
	Riprap	m2	2,646.46	
	Formwok: fair. in structures	m2	685.26	
	Elastomeric Bearing	dm3	2,278.95	
3.3	Composite Structure			€ 14,027,498.05
	Fabric. of main members for bridges. Plates. Straight. BS EN 10025 S355J2+N (erection & painting)	kg	1,700,039.44	
	Reinforced concrete C40/50 pier and elevations	m3	67.27	
	Precast planks 80 mm constant height	m2	3,215.72	
	Reinforced concrete C30/37 deck	m3	643.14	
	Loading test in deck / spam	nr	2.91	
3.4	Miscellanious			€ 723,971.41
	Elastomeric expansion joints 230 mm maximum movement	m	30.46	
	Precast edge beam cross sectional area: 0.1-0.5 m2	m	492.92	
	Drainage gully (pipe Ø105 & pot Ø160mm)	nr	17.46	
	Steel safety parapet (H3)	m	492.92	
	Metal railing on sidewalks	m	481.18	
	Dual concrete security barrier	m	481.18	
	LANDSCAPING			
	Landscaping	sum	1.00	
4.	Road Works			€ 2,413,238.04
	Excavate to any depth unsuitable material, haul to spoil heap and dispose off as directed	m3	13,094.10	
	Filling with selected excavated material other than topsoil or rock including haulage up to 20 Km	m3	89,088.35	
	Provide, lay and compact approved natural gravel subbase material 200mm thick including haulage up to 20 Km	m2	11,639.20	

QGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

Design and construction of Bridge over White Volta at Daboya, approx. span of 300 m

Daboya

Cost Component Breakdown

Item	Description		Qty	Amount (€)
	Provide, lay and compact approved crushed stone 200mm thick including haulage up to 80 Km	m2	11,626.33	
	Bituminous prime coat at a rate of 1.0 Kg/m2	m2	11,626.33	
	Bituminous tack coat at a rate of 0.5 Kg/m2	m2	11,626.33	
	Asphaltic wearing course 50mm thick including haulage up to 80 Km	m2	11,626.33	
	Precast concrete kerb, gutter splayed and finished fair on all exposed surfaces, cast on and including 280 x 100mm foundation, all necessary formwork, excavation and mortar joint with 300mm gaps at 2.0m centres for drain openings	m	1,937.72	
	Provide and install standard galvanized mild steel crash barrier as per specifications	m	1,937.72	
	Provide and install concrete kilometer post, exposed 975mm with reflective markers at both sides as per specifications	un	19.38	
	3.0mm thick reflective thermoplastic roadline marking (continuous and intermittent) of any width	m	2,906.58	
	Slope protection	m2	10,657.47	
	Interference relocation	sum	1.00	
5.	Provisional Sums			
5.1	Residence and office accommodation for the Engineer		1.00	€ 118,739.32
5.2	Equipment for engineers as per tender documents		1.00	€ 118,739.32
5.3	Cars for engineers as per tender documents		1.00	€ 274,013.82

QGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

Design and construction of Bridge over White Volta at Daboya, approx. span of 300 m

Daboya Cost Component Breakdown				
Item	Description		Qty	Amount (€)
1.	Project Design			€ 1,417,245.50
2.	Mobilization and Campsite			€ 566,898.20
3.	Bridge			
3.1	Foundation			€ 4,251,736.49
	Bored cast in place concrete piles D1500 mm, (bored, preparing heads and temporary steel casing)	m	749.24	
	Reinforced concrete C30/37 foundations	m3	479.62	
	Excavations for foundations in any material	m3	8.67	
	Filling to structures with selected excavated material	m3	11.55	
	Sheet piles	m2	11.63	
3.2	Abutments and Columns			€ 2,834,490.99
	Reinforced concrete C25/30 approach slabs	m3	42.73	
	Reinforced concrete C30/37 elevations, beams, deck	m3	231.85	
	PVC drainage pipe 150mm diameter + geotextile	m	50.77	
	PVC drainage pipe 100mm diameter	m	3.88	
	Bearing type POT PL-700	ud	3.88	
	Bearing type POT PU-700	ud	1.94	
	Riprap	m2	879.87	
	Reinforced concrete C40/50 pier and elevations	m3	373.33	
	Elastomeric Bearing	dm3	2,276.44	
3.3	Composite Structure			€ 15,589,700.46
	Fabric. of main members for bridges. Plates. Straight. BS EN 10025 S355J2+N (erection & painting)	kg	1,591,985.40	
	Reinforced concrete C40/50 pier and elevations	m3	74.43	
	Precast planks 80 mm constant height	m2	3,516.79	
	Reinforced concrete C30/37 deck	m3	703.36	
	Loading test in deck / spam	nr	2.55	
3.4	Miscellanious			€ 860,347.30
	Elastomeric expansion joints 230 mm maximum movement	m	30.42	
	Precast edge beam cross sectional area: 0.1-0.5 m2	m	608.64	
	Drainage gully (pipe Ø105 & pot Ø160mm)	nr	19.38	
	Steel safety parapet (H3)	m	608.64	
	Metal railing on sidewalks	m	596.92	
	Dual concrete security barrier	m	596.92	
	LANDSCAPING			
	Landscaping	sum	1.00	
4.	Road Works			€ 2,587,726.53
	Excavate to any depth unsuitable material, haul to spoil heap and dispose off as directed	m3	3,487.90	
	Filling with selected excavated material other than topsoil or rock including haulage up to 20 Km	m3	11,083.77	
	Provide, lay and compact approved natural gravel subbase material 200mm thick including haulage up to 20 Km	m2	11,626.33	

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 1

2) RATE BREAKDOWN

CASH FLOW

PROJECT:Design and Construction of Bridge over Black Volta at BUIPE, Design and Construction of Bridge over White Volta at YAPEI and Design and Construction of Bridge over White Volta at Daboya

QGMI

Contract Amount: EUR 85,000,000.00

		MONTH 0	MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	MONTH 7	MONTH 8	MONTH 9	MONTH 10	MONTH 11	MONTH 12	MONTH 13	MONTH 14	MONTH 15	MONTH 16
Project Design	4.44%	€ 15,200,000.00																
Mobilization	1.77%		1.00%	1.00%	1.00%	1.44%												
Foundation	13.31%		0.89%	0.89%														
Abutments&Columns	8.87%				2.22%	2.22%	2.22%	2.22%	2.22%	2.22%								
Composite Structure	48.79%						1.48%	1.48%	1.48%	1.48%	1.48%	1.48%						
Miscellaneous	13.66%											5.42%	5.42%	5.42%	5.42%	5.42%	5.42%	5.42%
Road Works	8.87%																	
Provisional Sums	13.29%		0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%
TOTAL%	100%	100.00%	2.36%	2.36%	3.69%	4.12%	4.27%	4.17%	4.17%	4.17%	1.95%	7.37%	5.89%	5.89%	5.89%	5.89%	5.89%	5.89%
TOTAL USD		€ 84,900,000.00	€ 2,074,687.57	€ 2,074,687.57	€ 3,245,625.04	€ 3,628,740.91	€ 3,666,666.67	€ 3,666,666.67	€ 3,666,666.67	€ 3,666,666.67	€ 1,715,104.23	€ 6,485,590.20	€ 5,184,548.57	€ 5,184,548.57	€ 5,184,548.57	€ 5,184,548.57	€ 5,184,548.57	€ 5,184,548.57
Deduction Advance Payment		€ 13,200,000.00	€ 414,937.51	€ 414,937.51	€ 649,125.01	€ 725,748.98	€ 733,333.33	€ 733,333.33	€ 733,333.33	€ 733,333.33	€ 343,020.85	€ 1,297,118.04	€ 1,036,909.71	€ 1,036,909.71	€ 1,036,909.71	€ 1,036,909.71	€ 1,036,909.71	€ 1,036,909.71
SUM			€ 1,659,750.06	€ 3,319,500.12	€ 5,916,000.15	€ 8,819,000.08	€ 11,752,333.41	€ 14,685,666.75	€ 17,619,000.08	€ 20,552,333.41	€ 21,924,416.80	€ 27,112,888.95	€ 31,260,527.80	€ 35,408,366.66	€ 39,555,805.51	€ 43,703,644.36	€ 47,851,083.22	€ 51,998,722.07

		MONTH 17	MONTH 18	MONTH 19	MONTH 20	MONTH 21	MONTH 22	MONTH 23	MONTH 24
Project Design	4.44%								
Mobilization	1.77%								
Foundation	13.31%								
Abutments&Columns	8.87%								
Composite Structure	48.79%	5.42%	5.42%						
Miscellaneous	13.66%			1.33%	1.33%				
Road Works	8.87%					2.22%	2.22%	2.22%	2.22%
Provisional Sums	1.29%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%	0.47%
TOTAL USD		€ 5,184,548.57	€ 5,184,548.57	€ 5,184,548.57	€ 1,585,000.06	€ 2,365,625.04	€ 2,365,625.04	€ 2,365,625.04	
SUM		€ 56,082,951.15	€ 62,167,499.72	€ 63,752,499.78	€ 65,337,499.84	€ 67,703,124.88	€ 70,068,749.92	€ 72,434,374.96	€ 74,800,000.00

QGMI

Finance, Design and Construction of Three (3) Bridges in the Northern Region

GRAND SUMMARY

Item	Description	BUIPE	YAPEI	DABOYA	GRAND TOTAL
		Amount (EURO)	Amount (EURO)	Amount (EURO)	Amount (EURO)
1.	Project Design	€1,206,619.02	€1,226,885.50	€1,417,245.50	€3,850,750.02
2.	Mobilization and Camp Site	€482,647.61	€490,754.20	€566,898.20	€1,540,300.01
3.	**Bridge**				
3.1	Foundation	€3,619,857.07	€3,680,656.51	€4,251,736.49	€11,552,250.07
3.2	Abutments and Columns	€2,413,238.04	€2,453,771.01	€2,834,490.99	€7,701,500.05
3.3	Composite Structure	€14,027,498.05	€14,253,497.59	€15,589,700.46	€43,870,696.11
3.4	Miscellanious	€723,971.41	€736,131.80	€850,347.30	€2,310,450.01
4.	Road Works	€2,413,238.04	€2,453,771.01	€2,587,726.53	€7,454,735.58
5.	Provisional Sums				
5.1	Residence and offices accommodation for the Engineer	€118,739.32	€118,739.32	€118,739.32	€356,217.96
5.2	Equipment for engineers as per tender documents	€118,739.32	€118,739.32	€118,739.32	€356,217.96
5.3	Cars for engineers as per tender documents	€274,013.82	€274,013.82	€274,013.82	€822,041.45

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 1

1) COST COMPONENT BREAKDOWN

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 1

1) COST COMPONENT BREAKDOWN
2) RATE BREAKDOWN
3) LETTER QGMI
4) TERMSHEET FROM STANDART SHARTED BANK

SECTION 8 – CONTRACTOR'S PROPOSAL

8. Load Test

A load test shall be conducted in the presence of the Employer upon Taking Over of the Works by the Engineer. The Load Test shall demonstrate the accuracy of the structural model and the integrity of the bridge structure. This is achieved through comparing the deformation properties of the bridge structure with the deformation properties of the structural model.

The following procedure shall be applied:

- Define 4 benchmark points at bridge deck (positioned at the decks longitudinal beam)
- Survey of benchmark points of the unloaded deck
- Measurement of air temperature at commencement of the survey
- Positioning of loaded trucks on bridge deck
- Measurement of air temperature at commencement of the survey
- Survey of benchmarks of the loaded deck
- Removal of loaded trucks
- Measurement of air temperature at commencement of the survey
- Survey of benchmarks of the unloaded deck
- Adopting applied loads of load test in the structural model
- Structural Analyses
- Comparison of deformations of the bridge structure with deformations of the structural model to proof the structural model and the integrity of the bridge structure.

The documentation of the load test will be provided by the Contractor to the Employer for his information.

7. GEOMETRY

7.1 Clearance height

Clearance height for traffic on the bridges shall be in compliance with the existing bridge.

7.2 Bridge width

Width of carriageway: 12.5m.

Width of foot walks: 2.0m (each side).

The final width shall be analysed during final design.

The fundamental documents for change in design

All change in design shall be based on the scope as described in Section 2. Scope of Work, and detailed further in Contractor's Proposal. The criteria for altered design shall also adopt the same codes and standard in accordance with Section 5.1.

Alteration Procedure

The alteration in design shall follow the same procedure in accordance with Clause 13 Variation and other related clauses in General Conditions of Contract.

Review period for any change in design shall be 14 days after the receipt of the same.

Cost for Design Alteration

If the change of design initiated by the Contractor, he shall attach with his Proposal for Design Alteration an analysis of his cost incurred due to increased work.

If the change of design initiated by the Engineer and/or the Employer, the Contractor shall submit such an analysis within 7 days after receipt the Engineer's instruction.

The Engineer shall review the cost and give his comments. An agreement shall be reached on the additional cost to the Contractor prior to the execution of design alteration

Submittals, including manufacturers' literature, catalogue cuts, or other printed material, shall be entitled with the name of the project on each sheet and shall otherwise the identified by listing the particular Division, Section, Article, or reference of the Work and Contract Documents pertaining thereto.

6.5 Change of Design

Basic principal of alteration in design

In the process of design and construction, all approved design shall be closely followed to guide and supervise construction. It is all prohibited to alter the original design, enlarge or reduce the scale of the construction or change in the design criteria.

Alteration in design is allowed only where the following apply:

a) A new design standard and/or specification is published in the Ghana, and it shall apply to the Works.
b) The topography, geography and hydrological data entailing the design are seriously deviating from the actual situation, or there are design errors, mistakes, or unreasonableness, so that the quality and safety of the Works cannot be guaranteed if it is constructed as per the design.
c) There is a better design scheme which can reduce the quantities of the Works, save the investment and ensure the quality and safety of the Works without reducing the design criteria.
d) Change in design can speed up site progress and shorten the construction period without increasing the cost of the Works.
e) Change in design can enhance the quality and expand the life span of the Works, protect the environment and save national resource, and bring more convenience without increasing the cost of the Works.
f) The Employer may put forward new requirements.

Changes to the design should be made not more than once for any section without very compelling reasons. The breakdown of a major change in design into many small parts is also not allowed. Design changes shall be done prior to the start of such work on site, in order to avoid unnecessary waste and rework.

The application, approval, and implementation of any change in design shall be in writing and in the specified form, if any.

Notwithstanding any approval carried out by the Engineer and/or Employer, the Contractor shall take full responsibility for his design to suit fitness for purpose.

Review Process

The Contractor shall provide on each submittal a clear space for the Engineers' review stamps and comments.

After the Engineer has performed his review of submittals, he will return one print to the Contractor with one of the following notations:

(a) Proceed without change
(b) Proceed as corrected
(c) Revise and resubmit
(d) Rejected.

When submittals are returned marked with either (c) or (d), the Engineer shall explicit the reasons to do so, either against the criteria specified in Section 5.1, or against site conditions. The Contractor shall then make such revisions and/or corrections and resubmit the drawings or other materials in the same manner as specified.

When drawings and submittals are returned with authorization to proceed with the work, Contractor shall obtain and provide such number of prints or copies of drawings as is required for field distribution.

Miscellaneous

The Engineer and/or Employer will review submittals only for conformance with the design criteria and for compliance with the Contract Documents. Contractor shall make any and all corrections required.

Drawings and all supporting, data, catalogues, or similar information shall be prepared by the Contractor or his suppliers and sub-Contractor, but shall be submitted as instruments of the Contractor.

Contractor shall check the submittals of his suppliers and Sub-contractor, as well as his own submittals, before submitting them to the Engineer. In particular, Contractor shall ascertain that the submittals meet all requirements of the Contract Drawings and Specifications and conform to all site conditions.

The topographic mapping and exploration are also deemed as part of the design work, as they provide all data, survey results, and geotechnical information in each and every stage of the design.

6.4 Design Submission and Review

General Aspects

Before submitting any drawings for reviews, the Contractor shall submit a schedule of design analysis and drawings, stating the purpose for the submission, sequence of submissions and the submission dates to meet the requirements of his construction schedule and to comply with the General Conditions.

Contractors' drawings and design data submitted formally shall bear a certification signed by an authorized representative of the Contractor that the information shown therein has been checked by the Contractor and is correct for use in the Project. This shall not apply to design analysis or drawings of a preliminary nature furnished for information, which shall be clearly identified as such.

All submittals shall be made in digital form as well as in hard copy. In general design submittals shall be in English. The contractor shall provide more copies if so required by the Engineer or the Employer.

All analyses and calculations shall be submitted for the Engineer and/or Employer's review, if required, at various time throughout the design process. All analyses and calculations shall be submitted in an ordered manner with all design criteria stated, the analytical methods described and referenced, computer programmes identified, and specific input to the computer programmes identified. Computer analyses shall incorporate sensitivity analysis, and/or attached hand calculation to verify the critical results of computer analysis.

In order to facilitate the design review process, the Contractor shall give the Engineer complete access to the development of design concepts, detailed design process, and necessary explanation and interpretation.

The Engineer shall review and notify his position on any submittals of the Contractor within a period not exceeding 14 days from the date of receipt of the submittal.

Design Liability

6. Design

6.1 Design Criteria

The Design will be done according to the Employer's Requirements,

- MRH Standard Specification for Road and Bridges Works, edition of July 2007,
- Pavement Design Manual – WSA August 1998,
- Road Design Guide March 1991,
- Loads for Highway Bridges (BD 37/01) (Department of Transport UK)
- Standard Details, Road Signs and Markings for Urban And Trunk Roads
- GHA Test Manual
- GHA Standards for Road Signs and Markings
- GHA Standards for Traffic Calming Design
- GHA Work Zone Safety Manual
- GHA Manual for Road Safety Audit
- ISO 9001 – Quality Management Systems

As BS 5400 is replaced by the relevant Eurocodes, the following design codes are applied to design sub and superstructure of the bridge element:

- Eurocode 0 (EN 1990)Basis of structural design
- Eurocode 1 (EN 1991) Basis of design and actions on structures
- Eurocode 2 (EN 1992)Design of concrete structures
- Eurocode 3 (EN 1993)Design of steel structures
- Eurocode 4 (EN 1994)Design of composite steel and concrete structures

Upon coming into force of the Contract, the Contractor shall provide the Employer with 2 copies of above codes.

6.2 Units

The ISO metric system shall apply

6.3 Design Stages

The design includes Preliminary Design, Detailed Design and Construction Drawings. And at the end of construction, as-built drawings will be provided in accordance with the Contract.

5. Project Milestones

The milestones for design and construction are as shown in the following chart:

Description	In days from Commencement Date of the works
MOBILIZATION	30 days
SURVEY AND GEOTECHNICAL INVESTIGATION	60 days
DESIGN SUBMISSION	
Preliminary Design (Contract Drawings)	Submitted with Contractor's Proposal
Draft Detailed Design	90 days
Detailed Design (Shop Drawings)	150 days
CONSTRUCTION COMPLETION	730 days

4.5 Medical Facilities

Suitable first aid stations and medical staff at the sites will be the responsibility of contractors. Hospitals are located at Accra, all the regional capital and district capitals.

4.6 Construction Power

Construction power can be taped from the National Grid. However power outages are common so the contractor may need to supplement this by providing a generating plant.

4.7 Facilities/Services provided by the Employer

For the smooth execution of the project, the Employer shall provide land for the construction of the works.

4.1.3 Daboya

Neoproterozoic – (620 Ma – 635 Ma)

Belongs to the Oti-Pendjari group of the Voltaian Super group, lying between the Obosum and Kwahu group. It consists of limestone, thinly bedded to massive, micritic sandy, dolomitic towards the base (Buipe 'Mb' of the Kodjari formation), basal tillite-like conglomerate

4.1.4 Climate

The climate of Ghana is divided into the wet and dry seasons. The climate is tropical but influenced by the hot and dry North-East Wind (Harmattan) blowing from the Sahara Desert and South-West Trade Winds (Monsson) which brings cooler and humid air. The wet season extends from April to October in General. However, in the Northern parts of Ghana, the peak occurs in September while in southern Ghana the rainfall is heaviest in June, with a second rather smaller peak occurring in October.

The climate in the project area is tropical with a bimodal rainfall pattern. Annual rainfall varies between 750mm and 1200mm. The entire corridor is characterized by very high humidity and temperature. Generally, the highest temperatures occur in March and the lowest in August. The highest recorded is 43° C in the Upper East Region and lowest is 17°C in the Brong Ahafo Region respectively.

4.2 Communications

The only international airport serving the project area is in the capital city, Accra. The country is served by two sea ports at Tema (in the Greater Accra Region) and Takoradi (in the Western Region). There are domestic air flights between Accra and Tamale.

4.3 Telecommunications

International telephone, telex, e-mail and fax connections are available at Accra, and all the regional capitals. Telecommunication will be the responsibility of contractors. The Engineer shall give necessary aid to acquire these telecommunications.

4.4 Accommodation

Camp facilities at the construction sites including all lodging offices, canteens, portable cabins, workshops, water and electricity supply, sanitation, etc will be the responsibility of Contractor.

4. Site & Other Data

4.1 Geology and Climate

All these three (3) areas fall within the Voltaian Supergroup. The Voltaian Supergroup has been divided into three groups, separated by major unconformities: in upward succession the Kwahu/Bombouaka group, Oti-Pendjari group and Tamale/Obosum group.

The Kwahu/Bombouaka group unconformably overlies the Eburnean basement, it is up to 1km thick and consists mainly of medium-grained sandstones commonly with well preserved sedimentary structures. It is envisaged to have been deposited along the margins of an epicontinental sea.

The Oti-Pendjari group is up to 4-5km thick. It consists of shales and immature sandstones. It overlies the Kwahu/Bombouaka group with major unconformity, marked occurrences of a 'triad' consisting of tillites, carbonates and laminated siliceous rocks 9silexites), that can also be recognised in other Neoproterozoic successions in West Africa (Deynoux et all, 2006). The overlying parts of the Oti group have been interpreted to represent the transition from a rifted passive margin to a fully developed foreland basin related to the Dahomeyide (Pan African) orogeny to the east (Carney et al. 2010).

The Tamale/Obosum group is up to 1km thick. It consists of continental deposits, sandstones, conglomerates and other rock fragments, together with westward current directions. The Tamale/Obosum group is interpreted as molasse deposits derived from the Dahomeyide.

4.1.1 Buipe

Neoproterozoic – (620 Ma – 635 Ma)

Belongs to the Oti-Pendjari group of the Voltaian Super group, lying between the Obosum and Kwahu group. It consists of limestone, thinly bedded to massive, cherty-like beds (silexites), micritic sand, dolomitic towards the base (Buipe 'Mb' of the Kodjari Formation) Basal tillite-like conglomerate

4.1.2 Yapei

Belongs to the Tamale/Obosum group, undifferentiated comprising mudstone, siltstone, sandstone and other rock fragments.

The formation lies at the lowest sequence of the Obosum group and lies unconformly on the Oti-Pendjari group.

Manufacturer`s authorization/warranty
12. CONFIGURATION
The vehicle should sit 5 persons including the driver
The vehicle should have 2 persons in front and 3 persons at the back
The vehicle should have 4 doors
The vehicle should have first aid box fully equipped ,2 warning triangles, Jack and Bar, wheel spanner, set of hand tools, set of floor mats
The vehicle must have Power window, power door lock, Power retractable rear-view mirror, armrests, interior rear-view mirror, central remote-control lock system

Rear Window defogger
Exterior Light Indicator conform with Ghanaian regulations
8. STEERING
Power steering
SUSPENSION
Front: Double wishbone
Rear: Heavy duty rigid leaf spring
9. TYRES AND WHEELS
Tubeless 4 Radial tyres suitable to the full load rating and for/off highway ground conditions.
Rim size: 16/17in mounted
Full size spare tyre mounted on a suitable carrier with security lock
Alloyed rim
Mud guard at all tyres
10. ELECTRICAL AND ANCILLARIES
12 volts. All electrical components tropicalized
Heavy duty battery: 64Ah rating
Heavy duty alternator
Hazard warning light
3-speed electric windshield with intermittent feature and electric windshield washer
11. INSTRUMENT MONITORS AND WARNING DEVICES
All calibrations on gauge/meters to be in metric units
Speedometer, odometer, trip meter
Engine coolant temperature gauge and temperature warning light
Engine oil low pressure warning light
Battery charging indicator
Fuel level gauge and low fuel warning light
Optimum and guaranteed body protection is provided. Galvanize anti-corrosion treatment process is provided in respect of body, frame, floor and underbody
Operating manual in English
36-months 100,000-km warranty whichever comes first

Body Rust Protection
AM/FM Radio with CD player, 4 Speakers, USB, AUX (MP3/WMA capable).Antenna
Spare Wheel Anti-Theft Lock (with spare tyre)
High Mount Stop Lamp
Diesel Engine: 2500 - 3000cc
GVW (kg): 2700-3000 kg
2. INSTRUMENTS
Speedometer, Odometer, Tachometer etc. on the dashboard
Engine Temperature Gauge
Oil pressure indicator
Battery changing meter
3. ENGINE
4 cylinder in-line Diesel Engine Engine capacity:2500- 3000cc Natural aspiration Maximum Power :100- 60Kw @ 3000- 4000 rpm Maximum torque :300- 200Nm @ 2000-2300 rpm
4. Transmission
Five (5) forward gears one (1) reverse gear
5. BRAKES
Ventilated Disc (Front) Power assisted
Drum (Rear)
Mechanical Parking Brake
6. ACCESSORIES
Digital Clock
Seat Belt on all seats
Fabric seats
7. ELECTRICALS
Heavy-Duty Battery
Heavy-Duty Starter
Heavy-Duty Alternator
Hazard warning lights

Separate bucket seats for driver and front passenger
Driver and passenger sun visor; assist grip for all passengers
Seat belts on all seats
Driver and Passenger Air bag
Power mirror
Central Door locking system
Side step/ grill/ back bumper
Full tropicalized ventilation and Two(2) zone Air Conditioner (Front and Back Controls)
FM/AM radio/ CD player with auxiliary input/ USB, Bluetooth phone connectivity and 6 speakers
Digital clock
Power widow front rear
Power rear view mirrors (left & right)
7. BODY EXTERIOR
Laminated windshield and safety glass throughout
Horizontal opening (swing-type) rear doors
Rear Step
Colour finish to be determined by the client. Bidder to specify colour and trim options available.
Fuel tank with security lock and keys
9. MISCELLENIOUS
Rechargeable fire extinguisher
Warning triangle
First Aid Kit
Heavy duty vehicle jack, wheel spanner and all accessories
Makers standard toolkit
Chassis: Ladder type box section preferred. Makers standard to be specified
Protection against corrosion: Optimum and guaranteed protection is required
Operating manual in English
36-months 100,000-km warranty

Type 2: 4 X 4 Double Cabin Pick Up

No.: 9 No.

Minimum Specification
1. General Features
Air conditioned (multi outlet)
Left Hand Drive
Overall dimensions (LXBXH) : min mm:5330x1850x1810
Front Headrest (Driver +1 passenger)
Seat Cover Material – Fabric
Front Seat Belt
Seat Belt on all seats

1. ENGINE
Diesel 4 stroke 4 cylinder DOHC In-line, Turbo aspiration
Engine capacity: Max 2986cc (4 cylinder engine)
Maximum Output 127kW/ 3400rpm
Maximum torque, 410Nm @2800rpm
Fuel system: Common rail type
Heavy duty dry tape air cleaner with replaceable element
Positive oil and fuel filtering systems with replaceable elements
Dust proof crankcase breather and oil filter cap/ heavy duty, tropicalized engine cooling system with direct drive cooling fan
3. TRANSMISSION, TRANSFER AND DRIVELINE
Auto transmission; minimum 5 speeds forward all synchromesh and one reverse
Full time 4WD
Automatic free running hubs
4 STEERING SYSTEM
Left hand side control
Power assisted tilt steering
4. BRAKE SYSTEM
Dual circuit hydraulic system with vacuum booster
Front brake: Ventilated disc brakes, Rear brakes: Ventilated disc
Anti Lock Brake System (ABS)
Mechanical parking brake
6. SUSPENSION
Front: Heavy duty double wishbone suspension with coil spring and double acting, telescopic shock absorbers Rear: 4 link lateral rod
5. TYRES AND WHEELS
Radial tubeless tyres suitable to the full load rating and for/off highway ground conditions
Rim size: 17"
Full size spare tyre mounted on a rear carrier with cover
7. ELECTRICAL AND ACCILLARIES
12 volts. All electrical components tropicalized
Heavy duty battery
Heavy duty alternator
Exterior lights and indicators to confirm with Ghanaian regulations
Hazard warning light
2-speed electric windshield wiper with intermittent feature and electric windshield washer
Rear wiper and washer
6. INSTRUMENT MONITORS AND WARNING DEVICES
All calibrations on gauge/ meters to be in metric units
Speedometer, Odometer, Tripmeter
Engine coolant temperature gauge and temperature warning light
Engine oil pressure gauge and/ or low pressure warning light
Battery charging meter
Fuel level gauge and low fuel warning light
8. CAB AND ACCESSORIES
Seating capacity: 7 persons
Fabric upholstered seats

Schedule 2

Type 1: Cross Country Vehicle 4*4 Automatic (Diesel)

No.: 3 No.

Minimum Specification
1. MAKE AND MODEL
Equipment offered should be from the manufacturer's own standard range of production in current supply and conforming as near as possible to the following specifications. Vehicles should be suitable for continuous operation in tropical conditions altitudes 1,500 M above sea level. Bidder shall ensure the vehicle offered complies with the stipulated requirements of law pertaining to operation vehicles in Ghana or any modification there in effected at the time of submitting the bid. All items to be fully assembled with all the normal standard fittings and tested ready for immediate use.
2. PRINCIPAL FEATURES SOUGHT
-Left-hand drive, power assisted steering -Diesel turbo engine with maximum output power of 127kW (SAE) -GVW 2850-2990 kg approx. -FM/AM radio/ CD player with auxiliary input/USB, 6 speakers maximum -Courtesy lights on front + rear doors -4 Wheel Drive Station wagon -Chrome plated side mirrors with integrated side turn signals -2 zone air conditioner (From "left and right and back Controls) -Fabric Upholstery -Driver And Passenger Air bags + Side impact beams on all doors -Cool Box -Side Step -Body stripe -Integrated antenna in rear and side glass -Spare tyre mounted on suitable carrier underneath vehicle -Ground clearance: 220mm

Item	Description	Qty
11	Hand-held GPS suitable for site conditions inclusive of car fitting utensils	
12	Walkie-talkie radios, 20 km range, with chargers	
13	Electronic / Electrical Equipment Personal computers, Intel i7-2600, 3.4GHz with minimum 750GB hard disc, 8 GB RAM, 19" TFT screen, 1 serial and 1 parallel port, 4 USB ports, 4 in 1 card reader, DVDRW Drive, fix modem, mouse and keyboard inclusive of the latest versions of Windows MS Office Professional latest software together with licences and user manuals for all software.	
14	Intel i7 3.7 GHz with minimum 1TB hard disk, 16 GB Ram, 15.6" TFT screen, DVD-RW drive and fax modem, 4 USB ports, LAN connection, inclusive of the of latest edition of Windows and MS Office latest software, inclusive of all licences and manuals.	
15	Latest versions of MS Project, AutoCAD and AutoCAD 3D Civils software, inclusive of licenses and manuals.	
16	A3/A4 size colour and black and white laser printer, laser copier, scanner with auto feeder and collator, including toner cartridges	

(b) The Contractor shall supply new vehicles and maintain them for the exclusive use of the Engineer and his staff. This shall be provided as a Provisional Sum of US$ 900,000.00 in the Contractor's Contract Price.

A description of the number and types of vehicles to be provided is given in Schedule 2 to this Employer's Requirement. The vehicles offered should be based on the manufacturer's current standard production models, which conforms as near as possible to the minimum specifications.

Item	Description	Qty
	specifications. 847646 GeoMax Zenith35 Pro GNSS receiver, 555 channels with internal 3.75G GSM, WLAN, Bluetooth and UHF module with TAG (tilt & go) functionality, GPS+GLONASS, Multi Frequency, 20Hz positioning rate 1 832426 Zenith35 Standard Accessory Kit for Zenith GSM-UHF Variant. Includes hard container, charger, 2 batteries, GSM antenna and USB cable Quick Guide and CD. 1 760259 ZRA 100, Gainflex UHF Antenna-frequency 435-470 MHz 1. 811926 PS336, Getac rugged handheld. For the use with Microsoft Windows, Mobile compatible software. Includes Li-Ion battery and charger. 1 789350 ZHR200, Holder for attaching Handheld telescopic pole. 1 8240853 Geomax X-Pad Field "GNSS Standard" 1 789349 ZPPC200, Telescopic Carbon Fibre and Aluminium pole with 5/8" screw for GNSS. Extends to 2.5m 1 832481 ZVC 601 Compass Calibration tool for GeoMax Zenith 35 TAG GNSS series 1	
3	CTW100 Wooden Tripod or similar specifications.	3
4	ZST100 Pole Support or similar specifications.	6
5	CTP106-2 Tripod 100-165cm or similar specifications.	3
6	ZCA100 Carrier w. 5/8" screw for GNSS Antenna or similar specifications.	3
7	BeiDou option, enables tracking of BeiDou satellites with a Zenith35 Pro GNSS receiver or similar specifications.	9
8	Galileo option, enables tracking of Galileo satellites with a Zenith35 Pro GNSS receiver or similar specifications.	9
9	ZTR101 Standard Tribrach without optical plummet, black or similar specifications.	3
10	Software – Geomax Post Processing Software (GGO Full Package) or similar specifications.	

The land for the residential accommodation shall be provided by the Employer. The buildings must be gated and fully fenced.

(b) Office Accommodation for the Engineer and his Staff

The Contractor shall provide a fully furnished office accommodation of area 200m^2 with toilet facilities for the Engineer and his staff. He shall provide the equipment according to Schedule 1 to the Employer's Requirements.

The residential and office accommodation for the Engineer and his staff shall be provided as a Provisional Sum of US$ 390,000.00 in the Contractor's Contract Price.

SCHEDULE 1: EQUIPMENT FOR THE ENGINEER'S OFFICES

Item	Description	Qty
1	Zenith35 Pro GSM-UHF Base Set with ext. radio or similar specifications. 847645 GeoMax Zenith35 Pro GNSS receiver, 555 channels with internal 3.75G GSM, WLAN, Bluetooth and UHF module, GPS + GLONASS, multi-frequency, 20Hz positioning rate 1 832426 Zenith35 Standard Accessory Kit for Zenith35 GSM-UHF Variant. Includes hard container, charger, 2 batteries, GSM antenna and USB cable, Quick Guide and CD 1 760259 ZRA 100, Gainflex UHF Antenna – frequency range 435-470 MHz 1 789359 HPR2, SATEL 35W EASyPro high power radio with a 403-473 MHz tuning range. Includes power cable for connecting to a 12V battery 1 839820 ZRA 104 UHF whip antenna 430-450 MHz 5db gain for use with external radio 1 839819 ZAR201 Adaptor for mounting ZRA 104/105 antenna to a 5/8" thread, including 5m antenna cable 1 792382 ZDC221, Cable for connecting the Zenith 10/20/35 receiver to an external power supply to the EASy Pro radio. Can also be sue for only external powering the receiver. 1 645616 Measuring Tape 1 760269 ZCA 100 Carrier w. 5/8" screw for GNSS Antenna 1 790770 ZTR 103 Standard Tribrach with optical plummet, black 1 832513 ZPC201, Pole 25cm for mounting of Zenith receiver for Base setup 1	3
2	Zenith35 Pro GSM-UHF-TAG Flexible Rover Set or similar	6

3. **Facilities for the Engineer's Representatives**

The Contractor shall provide and maintain accommodation, offices, equipment and furnished housing for the Engineer and his staff, including senior staff, junior staff and technicians.

(a) **Housing Accommodation for the Engineer and his Staff**

(i) Residential Accommodation Type I: 3 No. 3-Bedroom House fully furnished with all the hard and soft furnishings. The building must have a common living room dining area, kitchen, and all the bedrooms must have en-suite bathrooms.

The approximate internal floor arrears of the main components of the house shall be as follows:

Description	Area (m^2)
Living – Dining Room	36
Master Bedroom (with en-suite toilet, bath, shower & whb)	30
Other Bedrooms (2*26m^2) (with en suite toilet, bath/shower & whb)	52
Kitchen and food store/pantry	16
Toilet cubicle with whb	3
Circulation area (internal)	20

(ii) Residential Accommodation Type II: 3 No. 2-Bedroom House fully furnished with all the hard and soft furnishings. The building must have a living area, dining room and a kitchen. The bedrooms must have en-suite bathrooms.

The approximate internal floor arrears of the main components of the house shall be as follows:

Description	Area (m^2)
Living – Dining Room	36
Other Bedrooms (2*26m^2) (with en-suite toilet, bath/shower & whb)	52
Kitchen and food store/pantry	16
Toilet cubicle with whb	3
Circulation area (internal)	10

The Health and Safety Plan shall consider and respond to the specific Health & Safety hazards and issues relevant to the Works and shall document the systems and methods to be implemented in accordance with the Contract. GHA shall review the Health and Safety Plan and to give formal approval.

2.7 Special Specification

The Contractor shall provide a Special Specification derived from the General Specification – Ministry of Roads and Highways Standard Specification for Road and Bridge Works, edition of July 2007 in relation to the proposal and the works undertaken.

2.4 Bridge Furniture and Equipment

- For the draining of the deck an adequate draining system shall be provided. No treatment of the run-off water is required.
- Adequate lighting shall be installed on the bridge and its approaches.
- Handrails shall be provided according to Eurocode.
- Traffic signs shall be installed in accordance to the local requirements.
- Mobile inspection platform capable of going the full centre span of the bridge shall be provided.
- The Contractor shall produce a video documentary of the Works.
- The Design shall make provision for accommodation of utility lines on both sides of the Bridge.
- The Contractor shall provide a permanent inspection platform for regular inspection and maintenance by the Employer after Taking Over of Works. Such inspection platform may be used by the Contractor during the Works. The inspection platform shall be designed in a manner to be used a permanent inspection platform for regular inspection and maintenance by the Employer after Taking Over. The inspection platform shall be handed over by the Contractor to the Employer upon Taking Over.

2.5 Maintenance of Existing Bridges

The Contractor shall be responsible for the maintenance of the existing bridge. The Contractor shall submit to the Engineer a programme for the maintenance of the existing bridge. He shall also undertake the following activities

- Conduct an assessment of the state of the existing bridges at Buipe andYapei.
- Schedule and conduct regular maintenance activities on the existing bridge.
- Ensure that the closure of the existing bridge for any maintenance works at any point in time shall not be more than 24 hours.

2.6 Health and Safety

Within a month after coming into force of Contract the Contractor shall submit to Ghana Highway Authority (GHA) a Health and Safety Plan specific to the Contract and Works. The Contractor shall complete the Health and Safety Plan in conformance with any national requirements for preparing Health and Safety Plans.

- Water collection points and deck falls shall be designed to facilitate concealed pipework.
- Structural lines shall be kept clean, clear and uninterrupted. 'Blisters' in the structure / soffit, special cover panels and other additions to conceal pipework are not permitted.
- Water shall not discharge over or onto bearings. Joints shall not be located directly over bearings.
- Manage water flow to stop leakage from construction and movement joints.
- Special attention shall be paid to waterproofing of movement joints. Water shall be collected at movement / expansion joints. Movement joints shall prevent the passage of moisture.
- Access to drainage routes is to be at deck and ground level only. Access at ground level is to be through manhole pits not access panels in piers.
- Access hatches, rodding eyes, etc. are not permitted in the surface of piers.
- Service conduits and rainwater pipes should be fully recessed into the piers and completely concealed behind robust panels that are removable for access.
- Ensure that robust kerbs and mast bases are carefully detailed to avoid compromising deck waterproofing systems and drainage falls.
- Flexible joint / funnel details in drainage pipework may be needed at movement / bearing locations.

2.3 Construction Works

The Contractor shall

- Construct the bridge and the approach road in accordance to the designs submitted, Employer's Requirements and the provision of the Conditions of Contract.
- Provide adequate advance direction signs should be considered for installation along the road corridor during construction
- Provide for road line marking and road signs for the works
- Construction of the bridge(s) and approach road(s).
    - Bridge at Buipe of width 12.5m and approx. length of 240m
    - Bridge at Yapei of width 12.5m and approx. length of 240m
    - Bridge at Daboya of width 12.5m and approx. length of 240m

- Unplanned cold / day-work joints are not acceptable in any visible works. If construction joints are unavoidable conceal with appropriate detailing.
- Matching pre-cast and in-situ concrete colours will be very difficult. Design structures and production methods to avoid visible differences in colour.
- Where pre-cast elements are joined end to end, in-situ concrete 'stitching' shall not be visible in the completed outer faces (e.g. edge beams).
- Prevent rust staining from temporarily exposed reinforcing bars and other mild steel components.
- Design pre-cast units' size, shape and layout to be sympathetic in proportion and scale to the whole structure.
- Where the 'rear' face of pre-cast units will be visible to the public, ensure that the finish is high quality.
- Consider application of texture and patterning to concrete surfaces, especially to break up large surfaces. Patterning and applied finishes provide an opportunity for local customisation.
- Where a higher quality finish is required consider these concrete finishes before considering cladding:

i. cast-in concrete finishes and / or patterns ii) post-casting finishes: e.g. acid wash, polish

ii. Where cladding is considered refer to the considerations in 'Materials and maintenance' above

2.2.10 Rainwater management

Design Principle

All water run-off, including from bridge decks, shall be fully managed, controlled and collected to prevent staining of finishes and damage to materials.

Design Considerations

- All rainwater on bridge decks shall be collected and discharged remotely from the structures.
- Waterproofing systems shall be complete, and durable for their intended design life.
- All rainwater pipes shall be concealed within the normal structural profiles.

- Fasteners and accessories for weathering steel structures shall be in compatible materials.
- Consider weathering steel columns to mitigate the risk of concrete columns being stained by water run-off from weathering steel.
- All metalwork installations shall isolate dissimilar metals to prevent electrolytic corrosion. Water run-off from one type of metal to another shall also be carefully considered and managed.
- In urban locations, weathering steel may be felt to be inappropriate in pedestrian accessible locations due to risk of rust marking to clothing. Where necessary, physical separation by handrail and/or balustrade design or paint the inside face of weathering steel parapets.
- Cleaning of grafiti from weathering steel can remove part of the sacrificial surface layer. Define how this will be dealt with if the structure is located in a high risk area for grafiti.
- Smaller components could be galvanised or zinc coated (e.g. flame sprayed). Galvanised steel is unlikely to provide a service life of 100 years, therefore resolve how galvanised components will be replaced or painted.

2.2.9 Concrete

Design considerations

- Visible concrete should be Class F3: the finish should be smooth and of uniform texture and appearance.
- Concrete colour shall be consistent within each structure. Concrete colour shall be consistent across all structures that can be seen together.
- Control aggregate choice and concrete batching to ensure colour consistency.
- Formwork lining shall not stain the concrete and shall be joined and fixed to prevent blemishes. Use one formwork type and source in each structure.
- Plan shuttering to define all joints and to prevent minor variations causing pattern staining.
- Do not use internal ties and embedded metal parts.
- Avoid horizontal construction joints. Where possible, pour walls and piers full-height or pre-cast.

- Do not use paint finishes where access for re- painting requires permanent way possessions.
- On-site cutting or drilling of coated (galvanised, painted, etc.) components is not permitted: this will require careful detailed design and fabrication.
- Movement joints should be minimised. Where they are essential, they should be properly detailed to be concealed or coordinated with the geometry and appearance of the whole structure.
- Detail structures, including piers and abutments, to avoid creating ledges which could be used by roosting birds or for climbing the structure.
- Deck finishes should be compatible with the surrounding environment. They shall provide good slip resistance and be well drained, with consideration to mud. Deck finishes should also be resistant to small scale residue.
- Large areas of plain finishes may suffer from grafiti: they shall be easy to clean. Consider anti-grafiti coatings for concrete, but there shall not affect the concrete's appearance. Higher quality finishes should be considered in intensely used locations.
- Assess and mitigate vandalism risks including litter, grafiti, malicious damage (e.g. to luminaires), theft (e.g. of metal components) and arson.
- Integrate design of secure access to bearing locations / abutments for inspection and maintenance. Maintenance access routes, steps and handrails should be included in the designs.
- Where exposed concrete finishes are not acceptable, consider:
  i. masonry cladding (brick, block or stone)
  ii. other cladding (timber, metal, mesh, etc.)
  iii. screening with vegetation

2.2.8 Steelwork

Design considerations

- Use weathering steel to minimise maintenance requirements in steel and steel composite structures.
- Note that weathering steel is produced as at plate. Rolled hollow sections are not produced.
- Detail weathering steel structures to fully manage, collect and direct water run-off.
- Prevent staining of adjacent surfaces and finishes.

Design Considerations

- Minimise and avoid the use of vertical walls (including abutments, wing walls, side walls and retaining walls) so that they will not be visible to the public: they are an alien element.
- Wing walls for abutments shall preferably be parallel to the road alignment.
- Wing walls in embankments should be aligned at approximately 45 degrees so that a slope continues in front of the wing wall, minimising the overall length of wall.
- Minimise hard landscape finishes around abutments. Use vegetated earth slopes. Use riprap in areas where planting will not thrive.
- In urban areas with hard landscaping, vertical faces for abutments and wing walls are preferred.
- Design and detailing shall manage water flow to prevent leakage from drainage behind walls and prevent staining or poor weathering of front faces.
- Design pre-cast units' size, shape and finish to be in proportion and scale to the whole structure and sympathetic to the location.
- Details at edges / interfaces will have a considerable impact upon appearance and weathering. Careful coordinate copings, handrails, connections to other construction, access / inspection hatches, etc.

2.2.7 Materials and Maintenancee

Design Principles

All materials, components and systems shall be capable of providing a service life of as close as possible to 100 years,

subject to appropriate maintenance.

The need for maintenance shall be minimised, especially where it requires permanent way access or line possessions.

Although there is an engineering presumption that structures should be accessible for inspection, some elements will inevitably be concealed, for example foundations and the back of retaining walls. Where cladding of structures is proposed pay special attention to durability of the structure and consider how the cladding may be removed for maintenance or repair of the structure.

Design considerations

- Self- finished materials are strongly preferred. If coatings are used, very long life factory applied coatings (e.g. galvanising, anodising) are preferred to paint, powder coating, etc.

- Bearings shall be accessible for inspection, maintenance and replacement. A consistent bearing zone should be used across all piers.
- Do not place bearings directly under movement joints / vulnerable waterproofing details.
- Where bridges are close or alongside each other, ensure that the pier designs and locations are coordinated and aligned. Promote open views below the bridge decks.

2.2.5 Parapets

Design Principle

Parapets shall have a consistent identity across a range of span lengths and structural cross-sections / forms.

Design considerations

- Parapet panels shall be a standardized design and sizes, used across the entire system.
- The parapet design shall be flexible enough to cope with structures that have curved setting- out, either in plan or camber in long section.
- Parapet lines shall be clean, simple and uninterrupted. Parapets shall be set-out to use whole panels only. 'Blisters' in the parapet line or special parapet panels are not permitted.
- Furniture and all accessories shall be fixed on decks between and within the deck parapets only. Nothing should be mounted on the top, outer face or underside of parapets.
- Parapets should have a down-stand that extends below deck edge cantilever. The down-stand should incorporate drip grooves to control water discharge and the potential for staining structures below.
- Parapets shall prevent trespass by eliminating climbable ledges and toe-holds on the outer faces where they are accessible from embankments or adjacent structures.
- Parapets providing guarding for personnel shall extend to at least 1100mm above the adjacent walkway surface

2.2.6 Abutments and walls

Design principle

The visible extent of concrete walls and abutments shall be minimized, before considering cladding or screening

- If crossheads are required to link pier heads to multiple deck beams, the crosshead should be contained within the overall depth of the deck to maintain continuity of the bridge soffit line.
- Decks for bridges that are set-out to a curve in plan shall be designed to provide a continuous smoothly curved appearance. Whilst straight components may be suitable, the extent of any faceting shall be carefully assessed and controlled to achieve the required appearance. For example, 3m long pre-cast bridge segments are acceptable on a curve. 30m long straight pre-cast beams would not be acceptable unless the curve was of very large radius.

2.2.4 Piers and bearings

Design Principles

Piers design shall be consistent within each structure and comply with an overall GHA line- wide identity.

Design considerations

- Pier aesthetics and setting-out shall be consistent within each structure. The number of variants within any structure shall be minimised. Pier proposals will be subject to design review by GHA.
- Pier design should be proportionally elegant and must be able to accommodate significant variation in their heights.
- Pier sizes should be minimised and piers set back from the edge of deck structures.
- A clean, simple, uncluttered appearance is required. No handrails, ladders, pipes, cables, etc. are to be fixed to any piers (or portal structures).
- The use of leaf piers shall be minimised, especially where skewed geometry creates long leaf piers.
- Exposed pile caps, sheet piles and foundations are not permitted in any location.
- Where practicable, place piers outside train impact protection zone to avoid increased pier sizes.
- The pier surface area needed for bearing replacement / jacking should be defined to permit consistent maintenance procedures. There is an option for bolt on jacking frames to minimise pier top size, but this will need line- wide coordination across line to avoid multiple different solutions.

- **Thermal Effects:**

Minimum temperature = 8°C

Maximum temperature = 60°C

- **Wind Loads:**

Wind speed during service v = 27,50 m/sec.

- **Earthquake Effects:**

Shall be considered as 8% of total dead load applied as equivalent lateral load on bearings for exceptional load case.

- **Load on parapets**

A line force of 0,80 kN/m, acting as a variable load, horizontally on the top of the parapet shall be applied.

- **Flood Levels**

A flood with a 50 years probability shall be considered in the Design.

This flood level shall be obtained by the Contractor from Volta River Authority.

- For this exceptional load case a wind load for 20% and no traffic load has to be considered.

2.2.3 Deck Structures

Design Principle

The form and detail of spanning structures shall be simple, continuous profiles modeled to minimise bulk and visual impact.

Design considerations

- Deck soffits should provide a clean, smooth continuous profile. Multi-beam decks are acceptable in this context.
- Deck edges should be cantilevered, with beams set back from deck edges, creating a shadow line to break up the bulk of the elevations. Set-backs should vary to suit different beam depths and deck widths.
- Standardised pre-cast cantilever units should be used to form deck edges.
- Visible down-stand crossheads are strongly discouraged and shall be subject to design review.

2.2.2 LOADINGS

Design for the Works shall be based on below defined standards and criteria however subordinated to the limiting factors of existing foundations, substructures and arch structure.

- **Dead Load:**

For dead load the unit weights given in EN 1991-1-1, part 2 shall be applied.

- **Traffic Loads:**

Load model 1: (shall be used for the deck)

Traffic load is applied as defined in EN 1991-2 chapter (4)

Load adjustment factor: In accordance to the limitation capacities of the remaining structures (foundation, substructure, arch), or factor α=0,80, whichever is lower.

Lane 1: Axle loads 300 kN,	uniformly distributed loads 9,0 kN/m²
Lane 2: Axle loads 200 kN,	uniformly distributed loads 2,5 kN/m²
Remaining area:	uniformly distributed loads 2,5 kN/m²
Foot-walk loading:	uniformly distributed loads 2,5 kN/m²

Impact: The dynamic amplification is included in the above values for traffic load.

Load model 2: (additionally used for concrete slab, stringers and cross girders)

Load Model 2 shall be used for local assessment only.

Load Factor of β=0,80 shall be applied.

Load model 3: (UK National Annex) to

Eurocode 1: Actions on structures

Part 2: Traffic Loads on bridges

- **Horizontal forces - Braking and Acceleration**

EN 1991-2 clause 4.4 shall be applied, using a load factor α=0,80. The maximum braking force shall be limited to 900kN.

- **Fatigue Loads**

The structural details shall be designed including the consideration of fatigue effects.

2.1.3 Topographical Survey

The Contractor shall undertake topographical survey in accordance with the MRH Standard Specification for Road and Bridge Works, 2007.

2.2 Design Works

The Contractor shall be responsible for

- Detailed engineering design of the bridge(s) and approach road(s).

  The Contractor shall be responsible for the design and the preparation of all drawings of the Works.
- Production of construction and/or shop drawings
- Provide a maintenance manual for the completed new bridge with the provision of the necessary equipment for maintenance activities.

2.2.1 Design Parameters

- Carriageway width 8.50m
- Foot Path 2.00m
- Effective Temperature Range +8°C and 51 °C
- Seismic Loading is taken as 8% total dead load.
- New bridge deck and girders must be reinforced concrete units or composite decking with steel girder system on reinforced concrete piers and abutments
- The bridge should be designed to a free board of 12m above the water level at mean flow or 1.5m above the exiting bridge level, whichever is higher.
- Detailed engineering design of the bridge and approach road(s).

  The Contractor shall be responsible for the design and the preparation of all drawings of the Works.
- Production of construction and/or shop drawings
- Construction of the bridge(s) and approach road(s).
  - Bridge at Buipe of width 12.5m and approx. length of 240m
  - Bridge at Yapei of width 12.5m and approx. length of 240m
  - Bridge at Daboya of width 12.5m and approx. length of 240m
- Pavement design for the approach roads
- Protection of Embankment

- Review of the field and laboratory work by the Geotechnical Engineer. In cases where there are limited or partial data, the Geotechnical Engineer should state this. If in the Geotechnical Engineer's opinion, the data are defective, irrelevant, insufficient or inaccurate; he/she should point this out and qualify comments accordingly. Any particular adverse test results should be considered carefully in order to determine whether they are misleading or represent a real phenomenon that must be accounted for in the design.
- Tabulation and graphical presentation of the results of the field and laboratory work in relation to the requirements of the projects.
- Determination of the depth to the groundwater table and its seasonal fluctuations.
- Sub-surface profile(s) in graphic form (geotechnical profile or model), showing the disposition of the various sub-surface formations. Detailed description of all sub-surface formations in relation to their physical properties and their compressibility and strength characteristics. Comments on irregularities such as pockets, cavities etc.
- Collating and presentation of the geotechnical data for each sub-surface formation. This presentation should be in a form which would enable selection of characteristic values for design.
- Submission of proposal(s) for further field and laboratory work, if deemed necessary, with comments justifying the need for this extra work.

(b) Conclusions and Recommendations

- The conclusions and recommendations of a geotechnical report will include, but not be limited to the following:
- Classification of the project according to geotechnical complexity.
- Selection of suitable characteristic values for the requirements of the project (geotechnical design parameters).
- Settlement and stability computations.
- Recommendations concerning problems that may be encountered during excavations, pumping operations, construction of retaining structures and ground anchors, placement of earth materials etc.
- Comment on likely interaction of work on nearby structures.
- Recommendations on any other issues e.g. for surface drainage if required. Comments on liquefaction potential, scour depth, unsuitable soil etc. if applicable.

Part 1 – Presentation of Site Investigation

The presentation of factual geotechnical information will include, but not be limited to, the following:

- Purpose and scope of the geotechnical investigation, including a discussion on the extent and scope of the investigation.
- Brief description of the project for which the geotechnical report is being compiled giving information about the location of the project, its size and geometry, anticipated loads, structural elements, materials of construction, etc., and also giving a statement of the anticipated geotechnical complexity and risk associated with the project.
- Dates between which field and laboratory work were performed.
- Detailed description of methods used for the field and the laboratory work with reference to accepted standards followed, and with discussion on rationale used to determine type, spacing, frequency and locations of all tests.
- Types of field equipment used.
- Presentation of field observations which were made by the supervising field personnel during the execution of the sub-surface explorations.
- Data on fluctuations of groundwater table with time in the boreholes during the performance of the fieldwork and in piezometers after completion of the fieldwork.
- Compilation of individual boring logs, penetrometer results etc. for each of the test locations with descriptions of sub-surface formations based on field descriptions and on the results of laboratory testing. In addition, the location and level of each of the test locations shall be accurately defined by survey control.
- Colour photographs of rock core.
- Grouping and presentation of field and laboratory test results in appendices and as summary tables.
- Names of the persons responsible for geotechnical site investigations and report writing.

Part 2 – Presentation of Evaluations, Conclusions and Recommendations

(a) Evaluation of geotechnical information

- The evaluation of geotechnical information will include, but not be limited to, the following:

- the presence of sub-artesian conditions
- the potential aggressiveness of the soil and groundwater, for example SO4, Cl, pH and Total Dissolved Solids (TDS) to buried concrete and steel.

For most cases it will be necessary to install standpipes in selected boreholes to enable sampling and observations of water to be made. An allowance in cost estimates must be given to these installations.

(d) Laboratory Testing (Post Contract Stage)

In conducting laboratory testing, procedures to be applied shall be in accordance with MRH Standards and Specifications, or American Standards (ASTM) and other relevant registered procedures. Because most bridge investigations are based upon MRH Standards requirements, those shall be applied where possible. Laboratory testing shall only be carried out in GHA accredited laboratories for the particular tests in question. All test results shall be presented as GHA endorsed reports

It is advisable to store all soil and rock samples for projects; at least until construction of the sub structure is completed. They are also valuable in the event of engineering problems or contractual disputes during construction and useful in establishing relationships between site investigation data and in situ conditions.

2.1.2.4 Geotechnical Reports (Post Contract Stage)

The information contained in the geotechnical report would be used for design, and construction purposes. The report should be prepared in two parts:

Part 1 – ("Site Investigations Report") details of all field and laboratory test data to be represented

Part 2 – ("Interpretative Report") the geotechnical evaluation, interpretation, conclusions and recommendations

Each part should be complete in itself with Part 2 containing all the information presented in Part 1, Site Investigations Report. Both parts should contain keys to all symbols, terms and abbreviations used, together with a clear statement of any limitations which apply.

understood. Communication between the bridge design engineer and the geotechnical engineer to achieve an appropriate understanding is imperative.
The types of geotechnical field investigation should be discussed with the structural and engineers. The number, location and depth of tests is to consider:

- expected sub-surface conditions
- previous geotechnical information available
- likely extent of zones in ground influenced by loading
- need to achieve a reliable geotechnical model for analysis
- size and importance of the structure
- requirement to minimise Contractor and Employer risk of changes during the construction programme due to variations in the subsurface conditions from that reported during the investigation stage.

Allowance should be made for the anticipated level of variability in ground conditions and possible changes to the design. An experienced geotechnical engineer must make these decisions and discussion on the number, location and depth of the selected tests must be a part of the geotechnical report. This discussion must enable the reader of the report to understand what factors were used to assess these variables and provide a clear understanding of the deliverables.

While the above points should be covered by a well-planned investigation there may be situations where during the investigation stage it is considered by the Employer or the geotechnical consultant that additional investigation will be required to generate a more reliable model and minimise risk. This work shall be undertaken at a schedule of rates agreed upon prior to the commencement of the investigation.

All in situ testing, for example Standard Penetration Test (SPT), etc, should be carried out in accordance with the relevant MRH Standards and supervised accordingly. The purpose of in situ testing is to determine the soil parameters necessary for the design of foundations.
Groundwater must be investigated to determine:

- the level of the permanent water table at the time of the investigation occurrence of a perched water table condition and its level
- estimated rates of inflow to excavations
- effects of de-watering on water table levels and on adjacent structures

- Notes on any exposed geology, for example the presence of boulders, bedrock exposure, swamps etc.
- The physical relationship of the proposed construction to the immediate natural surroundings and any existing developments.

The field reconnaissance survey must be diligently prepared and conducted. Experienced and suitably qualified personnel should perform the survey. Further stages of the investigation should be held until the field reconnaissance survey has been completed and reported to the Ghana Highway Authority.

(b) Desk Top Study

At the preliminary design stage site investigation should commence with a desk study directed towards collecting, collating and reviewing the following if available:

- Design drawings from any previous structure at the site.
- Geological and Topographical maps, survey data and records. Hydrological data.
- Aerial photographs.
- Regional seismicity data.
- Survey records, local knowledge and resources.

The collection and collation of the above information, where possible, could be undertaken during the field reconnaissance survey stage. However, further work to fully explore the extent of information available may be required.

During the desk study stage, an overview of complexity and risks associated with the geotechnical design should be clearly identified.

(c) Sampling and Testing

This stage of the Geotechnical Investigation will be carried out post contract stage. It involves the exploration of subsurface conditions and retrieval of test data for generating geotechnical parameters and geotechnical profiles.

Central to the investigation and subsequent design stage, an understanding of the ultimate limit state design to be adopted for design is essential. This should be done by a suitably qualified and experienced geotechnical engineer and conveyed to the personnel conducting the investigation prior to the commencement of site works. The selection of Characteristic Values of geotechnical parameters, the modification of these values by using Geotechnical Strength reduction factors and the use of these modified values in calculating ultimate limit state design capacity must be fully

- Mitigation measures in contract clauses
- Organisation structure & responsibilities
- Safe work practices and procedures
- Consultation procedures and
- Performance monitoring

2.1.2 Geotechnical Investigation

2.1.2.1 Introduction

This document has been prepared to assist in the planning, cost estimation, conduct and reporting of geotechnical investigations at the Buipe, Yapei and Daboya bridge sites.

2.1.2.2 Objectives

The objectives for the guidelines are to:

- Describe processes or stages of work to be followed for the bridge site investigations.
- Describe information required to design bridge foundations.
- Indicate standards of skill, workmanship and reporting, which are to be applied.

2.1.2.3 Stages Of Investigation

(a) Field Reconnaissance Survey

It is expected that access and environmental constraints would have major influences on cost of bridge investigations. It is therefore necessary for a field reconnaissance survey to be conducted as the first stage of a geotechnical investigation. This may be undertaken by contractor or by a consultant engaged by the contractor specifically for this survey. Information gathered from the field reconnaissance survey should provide the following results:

- Legal and physical aspects of access to site and bridge alignment – both riverbed and adjoining properties.
- Availability of any services or supplies of water, electricity, earthworks plant. Buried or overhead services.
- Photographs of surface conditions.
- Traffic control requirements.
- The possible effects of alternative investigation techniques on the environment (for example, ground disturbance, vegetation removal, water discharge, noise etc).
- On-ground survey details. - Tide, river level or other natural constraints.

2.0 Scope of the Works

The work is a design and build contract based on the FIDIC 1999 Yellow Book Conditions of Contract. The Works generally consists of designing and construction of the bridge (s) and the approach roads. It includes the engineering, construction, labour, materials and equipment to build new bridges and toll booths at Buipe, Yapei and Daboya and construction of at Buipe, a weighbridge and a rest stop.

2.1 Engineering Studies

The Contractor shall undertake various engineering studies for the Works. These shall be, but not limited to

2.1.1 Environmental Studies

The Ghana Highway Authority is obligated to provide and maintain, so far as is practicable, a working environment for its employees and members of the public, that is safe and without risk to health. As a condition of this Contract, the GHA requires that the Contractor or its Subcontractors that may be engaged to perform a service on its behalf will at all times identify and exercise all necessary precautions for the environment, health and safety (EH&S) of all persons including Contractor's Employees and members of the public who may be affected by the Works.

The Contractor will acquaint himself of all environmental, health and safety policies, procedures or measures implemented and adopted by the GHA of any premises at or within which the Contractor will perform Works under this Contract. The Contractor will comply with all such policies, guidelines, regulations, procedures or measures of the Environmental Protection Agency (EPA) of Ghana; and in the event of any inconsistency, will comply with such procedures or measures as they produce the highest level of environmental, health and safety.

Environmental and Social Impact Assessment

The Contractor shall prepare and submit an Environmental and Social Impact Assessment (ESIA) report within 4 months after Contract Coming into Force prior in line with Act 490. The ESIA shall be used to obtain an Environmental Permit (EP) from the EPA for the commencement of the Works.

The ESIA shall contain an Environmental Management Plan that shall be submitted to GHA for review and approval prior to commencement of Works under the Contract. The Management Plan must include as a minimum requirement:

- The Employer's Requirements covers the works for the design and construction of Bridge at Buipe, Yapei and Daboya

1.2 Project Outline

1.2.1 Construction of Bridge at Buipe

The new bridge to be constructed will be on a new alignment close to the existing bridge and link to the existing alignment. The existing bridge is to be maintained during the construction of the new bridge. The recommended span for the bridge is 240m

1.2.2 Construction of Bridge at Yapei

The new bridge to be constructed will be on a new alignment close to the existing bridge and link to the existing alignment. The existing bridge is to be maintained during the construction of the new bridge. The recommended span for the bridge is 240m.

1.2.3 Construction of Bridge at Daboya

The bridge site is located close to the town of Daboya which is on the southern embankment. The access road is elevated on both embankments. The ramp length of about 100m each leads down to the River. The recommended total span of the proposed bridge is between 250 – 300m

1.0 Description of the Works

1.1 Project Background

The key policy for the road sector as contained in the Highway Network Master Plan (2001-2020, "Vision 2020") is to develop an efficient and integrated transport network for the safe movement of people and goods.

The Highway N10 is a major route which connects Kumasi (second largest city in Ghana) the capital of the Ashanti Region with Tamale the capital of the Northern Region. This route is the main transportation route for goods and passengers to access the northern part of Ghana.

The section between Kintampo and Tamale has two main bridges located at Buipe and Yapei. These bridges are over the Black and White Volta respectively. These bridges were constructed in 1964 by Cementation International a UK based company. The bridges are six span steel trusse with reinforced concrete decks on reinforced concrete abutments and two reinforced concrete column pier supports.

Over the years the bridges have developed structural problems. The reinforced concrete decks are in a bad condition especially with the details of the open plate joints. There is also substantial corrosion of the steel truss component. (Flanges of the upper chord).

The Ghana Highway Authority route IR109 connects the town of Busunu with Tolon and then to Tamale. This road also serves as a detour to the Upper East and Upper West Regions of Ghana. The White Volta crosses the road near the town of Daboya.

In view of these, the Government of Ghana wishes to construct bridges at Buipe and Yapei to replace the existing bridges and also construct a new bridge at Daboya. Currently, there is no bridge at Daboya.

The project is the Finance, Design and Construction of Three (3) Bridges in Northern Ghana at Buipe, Yapei and Daboya and has been packaged into three (3) lots, namely;

- Lot 1: Design and Construction of Bridge over Black Volta at Buipe approx. span (240m) with approach roads.
- Lot 2: Design and Construction of Bridge over White Volta at Yapei approx. span (240m) with approach roads.
- Lot 3: Design and Construction of Bridge over White Volta at Daboya approx. span (300m) with approach roads.

4.2 Communications xxxv
4.3 Telecommunications xxxv
4.4 Accommodation xxxv
4.5 Medical Facilities xxxvi
4.6 Construction Power xxxvi
4.7 Facilities/Services provided by the Employer xxxvi
5. Project Milestones xxxvii
6. Design xxxviii
6.1 Design Criteria xxxviii
6.2 Units xxxviii
6.3 Design Stages xxxviii
6.4 Design Submission and Review xxxix
6.5 Change of Design xli
7. GEOMETRY xliii
7.1 Clearance height xliii
7.2 Bridge width xliii
8. Load Test xliv

Contents

1.0 Description of the Works iii
1.1 Project Background iii
1.2 Project Outline iv
1.2.1 Construction of Bridge at Buipe iv
1.2.2 Construction of Bridge at Yapei iv
1.2.3 Construction of Bridge at Daboya iv
2.0 Scope of the Works v
2.1 Engineering Studies v
2.1.1 Environmental Studies v
2.1.2 Geotechnical Investigation vi
2.1.3 Topographical Survey xii
2.2 Design Works xii
2.2.1 Design Parameters xii
2.2.2 LOADINGS xiii
2.2.3 Deck Structures xiv
2.2.4 Piers and bearings xv
2.2.5 Parapets xvi
2.2.6 Abutments and walls xvi
2.2.7 Materials and Maintenancee xvii
2.2.8 Steelwork xviii
2.2.9 Concrete xix
2.2.10 Rainwater management xx
2.3 Construction Works xxi
2.4 Bridge Furniture and Equipment xxii
2.5 Maintenance of Existing Bridges xxii
2.6 Health and Safety xxii
2.7 Special Specification xxiii
3. Facilities for the Engineer's Representatives xxiv
4. Site & Other Data xxxiv
4.1 Geology and Climate xxxiv
4.1.1 Buipe xxxiv
4.1.2 Yapei xxxiv
4.1.3 Daboya xxxv
4.1.4 Climate xxxv

SECTION 7 – EMPLOYER'S REQUIREMENTS

SECTION 6 – GENERAL CONDITIONS OF CONTRACT

FIDIC CONDITIONS OF CONTRACT FOR PLANT & DESIGN-BUILD

For Electrical & Mechanical Plant and for Building & Engineering Works, Designed by the Contractor

"(ii) rebellion, terrorism, sabotage by persons other than the Contractor's Personnel, revolution, insurrection, military or usurped power, or civil war,

"(iii) riot, commotion, disorder, strike or lockout by persons other than the Contractor's Personnel (except for the Contractor's Personnel riot, commotion, disorder or strike caused by a national, regional or sector-wide event of riot, commotion, disorder or strike)."

18. Insurance

18.1 General Requirements for Insurances

Delete Second and Third Paragraphs of Sub-Clause 18.1 and replace with the following:

"The Contractor is the insuring Party regarding the insurances included in Schedule I - *Insurances* which terms shall take precedence over the provisions of this Clause. Such insurances shall be effected with insurers and in terms approved by the Employer."

At the end of Sub-Clause 18.1 insert:

"The Contractor shall be entitled to place all insurances relating to the Contract (including, but not limited to the insurance referred to Clause 18 [*Insurance*] with insurers approved by the Employer from the country."

18.2 Insurance for Works and Contractor's Equipment

Delete Sub-Clause 18.2 (c) and replace with the following:

"(c) shall cover loss or damages according to Schedule I coverages and limits,"

18.4 Insurance for Contractor's Personnel

Delete the second paragraph of Sub-Clause 18.4 and replace with the following:

"The insurance shall cover the Employer and the Engineer against liability for claims, damages, losses and expenses (including legal fees and expenses) arising from injury, sickness, disease or death of any person employed by the Contractor or any other of the Contractor's Personnel, except that this insurance may exclude losses and claims to the extent that they arise from any act or neglect of the Employer or of the Employer's Personnel."

19. Force Majeure

19.1 Definition of Force Majeure

Delete Sub-Clause 19.1 (ii) and (iii) and replace with the following:

entitlement to financing charges under Sub-Clause 14.8 [*Delayed Payment*], take one of the following actions, namely (i) suspend work or reduce the rate of work, or (ii) terminate his employment under the Contract by giving notice to the Employer, with a copy to the Engineer, such termination to take effect 14 days after the giving of the notice; or

(i) The Contractor does not receive the Engineer's instruction recording the agreement of both Parties on the fulfilment of the conditions for the Commencement of Works under Sub-Clause 8.1 [*Commencement of Works]*."

17. Risk and Responsibility

17.2 Contractor's Care of the Work

Delete third paragraph of Sub-Clause 17.2 and replace with the following:

"If any loss or damage happens to the Works, Goods or Contractor's Documents during the period when the Contractor is responsible for their care, from any cause (i) not listed in Sub-Clause 17.3 [*Employer's Risks*], (ii) not considered as an event of Force Majeure, and (iii) any actions not attributable to the Employer, the Engineer, or any of their respective personnel or agents, the Contractor shall rectify the loss or damage at the Contractor's risk and cost, so that the Works, Goods and Contractor's Documents conform with the Contract."

17.6 Limitation of Liability

Delete the second and third paragraphs of Sub-Clause 17.6 and replace with the following:

"The total liability of the Contractor to the Employer, under or in connection with the Contract other than under Sub-Clause 4.19 [*Electricity, Water and Gas*], Sub-Clause 4.20 [*Employer's Equipment and Free-Issue Materials*], Sub-Clause 17.1 [*Indemnities*] and Sub-Clause 17.5 [*Intellectual and Industrial Property Rights*], shall not exceed the sum stated in the Appendix to Tender.

This Sub-Clause shall not limit liability in any case of fraud or deliberate default by the defaulting Party."

Arrangements] or Sub-Clause 14.7 [*Payment*], the Contractor may, after giving not less than 21 days' notice to the Employer, suspend work (or reduce the rate of work) unless and until the Contractor has received the Payment Certificate, reasonable evidence or payment, as the case may be and as described in the notice.

Notwithstanding the above, if the Bank has suspended disbursements under the loan or credit from which payments to the Contractor are being made, in whole or in part, for the execution of the Works, and no alternative funds are available as provided for in Sub-Clause 2.4 [*Employer's Financial Arrangements]*, the Contractor may by notice suspend work or reduce the rate of work at any time, but not less than seven days after the Borrower having received the suspension notification from the Bank.

The Contractor's action shall not prejudice his entitlements to financing charges under Sub-Clause 14.8 [*Delayed Payment*] and to termination under Sub-Clause 16.2 [*Termination by Contractor*].

If the Contractor subsequently receives such Payment Certificate, evidence or payment (as described in this relevant Sub-Clause and in the above notice) before giving a notice of termination, the Contractor shall resume normal working as soon as is reasonably practicable.

If the Contractor suffers delay and/or incurs Cost as a result of suspending work (or reducing the rate of work) in accordance with this Sub-Clause, the Contractor shall give notice to the Engineer and shall be entitled subject to Sub-Clause 20.1 *[Contractor's Claims]* to:

(a) an extension of time for any such delay, if completion is or will be delayed, under Sub-Clause 8.4 *[Extension of Time for Completion],* and
(b) payment of any such Cost plus reasonable profit, which shall be included in the Contract Price.

After receiving this notice, the Engineer shall proceed in accordance with Sub-Clause 3.5 [*Determinations*] to agree or determine these matters."

16.2 Termination by Contractor

Add new Sub-Clause 16.2 (h) and Sub-Clause 16.2 (i) after Sub-Clause 16.2 (g) as follows:

"(h) In the event the Bank suspends the loan or credit from which part or whole of the payments to the Contractor are being made, if the Contractor has not received the sums due to him upon expiration of the 14 days referred to in Sub-Clause 14.7 [*Payment*] for payments under Interim Payment Certificates, the Contractor may, without prejudice to the Contractor's

[*Suspension and Termination by Contractor]* or Clause 19 [*Force Majeure*] (as the case may be), the whole of the balance then outstanding shall immediately become due and in case of termination under Clause 15 [*Termination by Employer*] and Sub-Clause 19.6 [*Optional Termination, Payment and Release]*, payable by the Contractor to the Employer."

14.7 Payment

Delete Sub-Clause 14.7 and replace as follows:

The Employer shall pay to the Contractor:

(a) The advance payment within 56 days after notification of acceptance of the documents in Sub-Clause 4.2 *[Performance Security]* and Sub-Clause 14.2 *[Advance Payment].*

(b) the amount certified in each Interim Payment Certificate within 90 days after the Engineer received the Statement and supporting documents; and

(c) the amount certified in the Final Payment Certificate within 90 days after the Employer received this Payment Certificate.

Payment of the amount due in each currency shall be made into the bank account, nominated by the Contractor, in the payment country (for this currency) specified in the Contract.

14.15 Currencies of Payment

Delete the first paragraph and sub-paragraph (a) of Sub-Clause 14.15 and replace as follows:

"The Contract Price and the Advance Payment shall be paid in the currency or currencies named in the Appendix to Tender. Unless otherwise stated in the Particular Conditions, if more than one currency is so named, payments shall be made as follows:"

As a result of the above, sub-paragraphs (b), (c), (d) and (e) shall be read as (a), (b), (c) and (d).

16. Suspension and Termination by Contractor

16.1 Contractor's Entitlement to Suspend Work

Delete Sub-Clause 16.1 and replace with the following:

"If the Engineer fails to certify in accordance with Sub-Clause 14.6 [*Issue of Interim Payment Certificates*] or the Employer fails to comply with Sub-Clause 2.4 [*Employer's Financial*

The Engineer shall agree or determine the value of those parts of the Works which are to be measured, in accordance with Sub-Clause 3.5. Measurement shall be made of the net actual quantities of those parts, notwithstanding local practice.

Whenever the Engineer requires any part of the Works to be measured, reasonable notice shall be given to the Contractor's Representative, who shall:

a) Promptly either attend or send another qualified representative to assist the Engineer in making the measurement, and
b) Supply any particulars requested by the Engineer.

If the Contractor fails to attend or send a representative, the measurement made by (or on behalf of) the Engineer shall be accepted as accurate.

Except as otherwise stated in the Contract, wherever any Permanent Works are to be measured by records, they shall be prepared by the Engineer. The Contractor shall, as and when requested, attend to examine and agree the records with the Engineer, and shall sign the same when agreed. If the Contractor does not attend to examine and agree these records, they shall be accepted as accurate.

If the Contractor examines and disagrees the records, and/or does not sign them as agreed, then the Contractor shall notify the Engineer of the respects in which the records are asserted to be inaccurate. After the receiving the notice, the Engineer shall review the records and either confirm or vary them. If the Contractor does not so notify the Engineer within 14 days after being requested to examine the records, they shall be accepted as accurate.

14.2 Advance Payment

Delete Sub-paragraphs (a) and (b) of Sub-Clause 14.2 and replace with the following:

"(a) deductions shall commence in the next interim Payment Certificate following the Advance Payment; and
(b) deductions shall be made at the amortisation rate stated in the Appendix to Tender of the amount of each Interim Payment Certificate (excluding the advance payment and deductions for its repayments) in the currencies and proportions of the advance payment until such time as the advance payment has been repaid; provided that the advance payment shall be completely repaid when 80 percent (80%) of the Accepted Contract Amount has been paid.

If the Advance Payment has not been repaid prior to the issue of the Taking-Over Certificate for the Works or prior to termination under Clause 15 [*Termination by Employer*], Clause 16

in accordance with the Contract. The Engineer shall within 14 days issue a Test on Completion Certificate to the Contractor stating that all Works have been substantially completed in accordance with the Contract.

Delete sub-clause 9.1 – paragraph 4 'During.....'' and 5'' Trial.....''
Delete sub-clause 9.1 – paragraph 6 'Described in sub-paragraph (a), (b) or (c)'
Insert after end of sub-clause 9.1

During Test on Completion a load bearing test shall be executed in according to the Employer's Requirements.

13. Variations and Adjustments

13.1 Right to Vary

Delete the second paragraph of Sub-Clause 13.1and replace with the following:

The Contractor shall execute and be bound by each Variation, unless the Contractor promptly gives notice to the Engineer stating (with supporting particulars) that (i) the Contractor cannot readily obtain the Goods required for the Variation, (ii) it will reduce the safety or suitability of the Works, (iii) it will have an adverse impact on the achievement of the Schedule of Guarantees "(iv) such Variation result in the cumulative reduction in the Accepted Contract Amount by more than 15% (fifteen percent), or (v) such Variation triggers a substantial change in the type, sequence or progress of the Works.

Upon receiving this notice, the Engineer shall cancel the instruction unless, in case of any of the events described in items (iv) and (v), the Contractor agrees with the Employer the amount of any adjustment to the Contract Price and to the Time for Completion that shall apply and/or, as the case may be, the corresponding changes to the relevant Tests on Completion.

The Contractor shall not make any alteration and/or modification of the Permanent Works, unless and until the Engineer instructs or approves a Variation."

14. Contract Price and Payment

14.1 The Contract Price

At the end of the last paragraph of Sub-Clause 14.1 add

(b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and

(c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract."

7.2 Samples

Delete Sub-Clause 7.2 and replace with the following

The Contractor shall provide the necessary documents/ certificates relating to materials and plant incorporated in the Works.

8. Commencement, Delays and Suspension

8.1 Commencement of Work

Delete Sub-Clause 8.1 and replace with the following:

"The Commencement Date shall be the date at which the following conditions precedent have all been fulfilled and the Engineer's instruction recording the agreement of both Parties on such fulfilment and to commence the Work ("**Notice to Commence**") is received by the Contractor:

(a) signature of the Contract Agreement by both Parties, and if required, approval of the Contract by relevant authorities of the Country;

(b) delivery to the Contractor of reasonable evidence of the Employer's Financial arrangements (under Sub-Clause 2.4 *[Employer's Financial Arrangement]*);

(c) possession of the Site has been given to the Contractor together with such permission(s) under (a) of Sub-Clause 1.13 *[Compliance with Laws]* as required for the commencement of the Works, including the Environmental Permit to be obtained by the Employer.

(d) the receipt by the Contractor of the Advance Payment under Sub-Clause 14.2 *[Advance Payment]*; and

The Contractor shall commence the design and execution of the Works as soon as is reasonably practicable after the Commencement Date, and shall then proceed with the Works with due expedition and without delay."

9. Tests on Completion

9.1 Contractor's Obligations

Delete paragraph 3 item (a), (b), (c) and replace with the following;

The Test on Completion shall be carried out jointly by the Engineer and the Contractor as a final check of the Works or parts thereof to certify that the Works have been substantially completed

"The Contractor shall conduct an HIV-AIDS and malaria awareness programme either via Contractor's Personnel or via an approved service provider, as required by the HSP to be approved by the Employer, and shall undertake such other measures as are specified in this Contract to reduce the risk of the transfer of the HIV virus between and among the Contractor's Personnel and the local community, to promote early diagnosis and to assist affected individuals as well provide measure to reduce the incidence of malaria.

In the event of any outbreak of illness of a pandemic nature, the Contractor shall comply with and carry out such regulations, orders, protocols and requirements as may be made by the Government, health authorities or the local medical or sanitary authorities for the purpose of dealing with and overcoming the same"

Add a new Sub-Clause 6.12 as follows:

6.12 Foreign Personnel

The Contractor may bring in to the Country foreign personnel who are necessary for the execution of the Works to the extent allowed by the Applicable Laws. The Contractor shall ensure that these personnel are provided with the required residence visas and work permits. The Employer may, if requested by the Contractor, in a timely and expeditious manner use his best endeavours to assist the Contractor in obtaining any local, state, national, or government permission required for bringing in the Contractor's personnel.

The Contractor shall be responsible for the return of these foreign personnel to the place where they were recruited from or to their domicile. In the event of the death in the Country of any of these personnel or members of their families, the Contractor shall similarly be responsible for making the appropriate arrangements for their return or burial."

7. Plant, Materials and Workmanship

7.1 Manner of Execution

Delete Sub-Clause 7.1 and replace as follows:

"The Contractor shall carry out the design, fabrication, construction and erection of the bridge structure and the execution of all other Works:

(a) in the manner (if any) specified in the Contract,

without limitation, detailed plans, drawings, specifications, manuals, and related materials prepared by or on behalf of the Contractor.

5.5 Training

Delete Sub-Clause 5.5

5.7 Operation and Maintenance Manuals

Delete the first paragraph of Sub-Clause 5.7 and replace with the following:

"Prior to commencement of the Tests on Completion, the Contractor shall supply to the Engineer provisional maintenance manuals in sufficient detail for the Employer to maintain and repair the Works."

6. Staff and Labour

6.1 Engagement of Staff and Labour

Delete Sub-Clause 6.1 and replace with the following:

"Except as otherwise stated in the Appendix to Tender, the Contractor shall make arrangements for the engagement of all staff and labour, local or otherwise, and for their payment, feeding, transport and, when appropriate, housing.

The Contractor is encouraged, to the extent practicable and reasonable, to employ staff and labour with appropriate qualifications and experience from sources within the Country."

6.7 Health and Safety

Delete the first paragraph of Sub-Clause 6.7 and replace with the following:

"The Contractor shall at all times take all reasonable precautions to maintain the health and safety of the Contractor's Personnel. In collaboration with local health authorities, the Contractor shall ensure that medical staff, first aid facilities, sick bay and ambulance service are available at all times at the main Camp Sites, and that suitable arrangements are made for all necessary welfare and hygiene requirements and for the prevention of epidemics."

Add the following at the end of Sub-Clause 6.7:

(iii) Draft Design drawings and specifications illustrating and describing the engineering, architectural and drainage systems of the Works;

(iv) Any other documents or things required to illustrate, describe or depict the Draft Design and the conformity of same with the requirements of the Employer's Requirements and this Contract. The Draft Design shall include the final Cost Component Breakdown, that is, a proposed draft final cost of the Work.

(c) The Contractor shall review the report with the Engineer within twenty-one (21) days after submission of same for Engineer's approval, which shall not be unreasonably withheld. In the event the Parties agree that a modification in this report is required, Contractor shall implement such changes within fourteen (14) days or any other period as agreed between the Parties.

(d) After review of the Draft Design and incorporation of any changes agreed, the Engineer shall, within 5 (five) days from the receipt of the modified Draft Design, authorize the Contractor in writing to commence preparing the Final Design, or such part thereof as directed by the Engineer.

5.2.3 Detailed Design Report

(a) Not later than two (2) months, after the Engineer has authorized the Contractor pursuant to Sub-clause 5.2.2(d) above, the Contractor shall prepare and submit to the Engineer the complete Final Detailed Design incorporating all the modifications deemed necessary arising from the Engineer's comments in the draft final report. The proposed draft final price of constructing the designs based on the Cost Component Breakdown shall be finalized and submitted.

If the Engineer and the Contractor cannot mutually agree on the Final Detailed Design Report and Cost Component Breakdown within the Accepted Contract Amount, any of the Parties shall notify the other Party in writing, granting a period of 7 days for the other Party analysis and response of the matter. If the Party that received the notice does not provide a response and/ or the Parties do not reach an amicable solution for this dispute in 30 days from the receipt of such notice, then the dispute shall be resolved in accordance with Clause 20.

(b) The Final Detailed Design Report shall include all Design Documents which shall describe with specificity all elements, details, components, materials, and other information necessary for the complete construction of the Project and the rendering of the Project fully operational and in accordance with Employer's Requirements, including satisfaction of all testing, permitting, qualifications, certifications, validations, and obtaining regulatory approvals by all applicable regulatory authorities required to render the Project and all its components operational and functionally and legally usable in accordance with Employer's Requirements. Subject to the provisions of this Contract, the Employer shall review and approve, where appropriate, the Design Documents, or any portion thereof.

(c) Design Documents means all the design documents provided by the Contractor and approved by the Engineer pursuant to the Contract including, without limitation those for use in constructing the Works, and the rendering of the Works fully operational, and shall include,

4.24 Fossils

Delete the first paragraph of Sub-Clause 4.24 and replace as follows:

"All fossils, coins, articles of value or antiquity, and structures and other remains or items of geological or archaeological interest, graves, tombs, and religious or ancient or archeologically important monuments found on the Site shall be placed under the care and authority of the Employer. The Contractor shall take reasonable precautions to prevent Contractor's Personnel or other persons from removing or damaging any of these findings."

5. Design

5.1 General Design Obligation

"Upon receiving notice under Sub-Clause 8.1 [*Commencement of Works*], the Contractor shall scrutinize the Employer's Requirements (including design criteria and calculations, if any) and the items of reference throughout the Design Phase, as provided in Sub-Clause 5.2.1, 5.2.2 and 5.2.3. The Contractor shall give notice to the Engineer of any unforeseeable errors, faults and defects in the Employer's Requirements or these items of reference within ninety (30) days from the Commencement Date."

5.2 Contractor's Documents

Add the following Sub-Clauses (5.2.1-5.2.3) to Sub-Clause 5.2

5.2.1 Design Reports

"The Contractor shall prepare and submit to the Employer a Draft Design Report and a Final Detailed Design Report".

5.2.2 Draft Detailed Design Report

"(a) Not later than three (3) months after the Employer has received the notice of the Commencement Date, pursuant to sub-clause 8.1, the Contractor shall submit to the Engineer the Draft Detailed Design Report for the Works.

(b) The Draft Design Report shall address all requirements of the Works and shall include, without limitation, the following:

(i) Draft Design drawings which illustrate each of the basic components of the Works including the size, scale, location, dimensions, and character of each relevant structure or component;

(ii) Draft Design drawings which illustrate each exterior view of the Works;

At the end of Sub-Clause 4.3, add:
"the Contractor's Representative, or these persons, is not fluent in English, the Contractor shall make a competent interpreter available during all working hours.

4.4 Subcontractors

Add to the first paragraph of Sub-Clause 4.4

Subcontracting shall not exceed 40% of the Accepted Contract Amount

4.6 Co-operation

Delete the first sentence of Sub-Clause 4.6 and replace with the following:

"The Contractor, as specified in the Contract or as instructed by the Engineer, may be required to allow appropriate access for:"

4.8 Safety Procedures

Replace Sub-Clause 4.8 (e) with the following:

(e) provide any Temporary Works (including temporary diversions for traffic and pedestrians, guards and fences) which may be necessary, because of the execution of the Works, for the use and protection of the public and of owners and occupiers of adjacent land.

The Contractor shall notify the Engineer within 48 hours or as soon as reasonably possible after the occurrence of any accident which has resulted in damage or loss of property, disability or loss of human life, or which could reasonably be foreseen to have a material impact on the environment and shall submit to the Engineer and Employer no later than 28 days after the occurrence of such an event, a summary report thereof."

4.16. Transport of Goods

Delete Sub-Clause 4.16(a) and replace with the following:

"(a) the Contractor shall give the Engineer not less than 21 days' notice of the date on which any Plant or a major item of other Goods will be delivered to the Site, so the Employer can assist the Contractor to obtain the necessary security approvals and escort whenever necessary;"

The Employer shall not replace the Engineer with a person against whom the Contractor raises reasonable objection by notice to the Employer, with supporting particulars.

The Employer shall not remove that first Engineer until a replacement has been appointed. In case of resignation or refusal to act of a duly appointed Engineer, the Employer shall ensure that a replacement Engineer is appointed within 14 days."

Insert a new Sub-Clause 3.6 as follows:

3.6 Management Meetings

"The Engineer or the Contractor's Representative may require the other to attend a management meeting in order to review the arrangements for future work. The Engineer or the Contractor, as agreed between both, shall record the business of management meetings and supply copies of the record to those attending the meeting and to the Employer. In the record, responsibilities for any actions to be taken shall be in accordance with the Contract."

4. The Contractor

4.2 Performance Security

Delete the first and the second paragraphs of Sub-Clause 4.2 and substitute with the following:

"The Contractor shall obtain (at his cost) a Performance Security in the form of the document attached as Schedule VI for proper performance, in the amount and currencies stated in the Appendix to Tender.

The Contractor shall deliver any such Performance Security to the Employer before the disbursement of the Advance Payment, and shall send a copy to the Engineer. The Performance Security shall be issued by a bank located in the Country or by a foreign bank acceptable to the Employer. Any such Performance Security shall be in the form and substance of the Schedule VI to the Appendix to Tender."

4.3 The Contractor's Representative

At the end of paragraph 2 add the following
he Contractor shall not later than 30 days prior to the Commencement Date notify the Employer of the names, addresses and particulars of the Representatives of the Contractor. The Contractor's Representatives shall be fluent in English.

a) Sub-Clause 4.12 (*Unforeseeable Physical Conditions*): Agreeing to or determining an extension of time and/or additional cost.

(b) Sub-Clause 13.1 (*Right to Vary*): Instructing a Variation, except;
(i) in an emergency situation as determined by the Engineer, or
(ii) if such a Variation would increase the Accepted Contract Amount by 5%.

(c) Sub-Clause 13.3 (*Variation Procedure*): Approving a proposal for Variation submitted by the Contractor in accordance with Sub-Clause 13.1 (*Right to Vary*) or 13.2 (*Value Engineering*).

(d) Sub-Clause 13.4 (*Payment in Applicable Currencies*): Specifying the amount payable in each of the applicable currencies.

Notwithstanding the obligation, as set out above, to obtain approval, (i) to avoid doubt the preceding provisions of this Sub-Clause 3.1 relating to deemed approval shall in any event apply and (ii) if, in the opinion of the Engineer, an emergency occurs affecting the safety of life or of the Works or of adjoining property, he may, without relieving the Contractor of any of his duties and responsibility under the Contract, instruct the Contractor to execute all such work or to do all such things as may, in the opinion of the Engineer, be necessary to abate or reduce the risk. The Contractor shall forthwith comply, despite the absence of approval of the Employer, with any such instruction of the Engineer. The Engineer shall determine an addition to the Contract Price, in respect of such instruction, and such instruction shall be regarded as a Variation initiated by the Engineer, in accordance with Clause 13 [*Variations and Adjustments*] and shall notify the Contractor accordingly, with a copy to the Employer."

3.2 Delegation by the Engineer

At the end of Sub-clause 3.2 add the following;

The Employer shall, not later than 30 days prior to the Commencement Date, notify the Contractor of the names, addresses and particulars of the representatives of the Engineer appointed for the project.

3.4 Replacement of the Engineer

Delete and replace Sub-Clause 3.4 as follows:

"If the Employer intends to replace the Engineer, the Employer shall, not less than 21 days before the intended date of replacement, give notice to the Contractor of the name, address and relevant experience of the intended replacement Engineer.

2.4 Employer's Financial Arrangements

Add the following at the end of Sub-Clause 2.4:

"In addition, if the Bank has notified the Employer that the Bank has suspended disbursements under its loan, which finances in whole or in part the execution of the Works, the Employer shall give notice of such suspension to the Contractor with detailed particulars, including the date of such notification, with a copy to the Engineer, within 7 days of the Borrower having received the suspension notification from the Bank. If alternative funds will be available in appropriate currencies to the Employer to continue making payments to the Contractor beyond a date 60 days after the date of Bank notification of the suspension, the Employer shall provide reasonable evidence in such notice of the extent to which such funds will be available.

If at any time and from time to time it should appear that the sum of the Contract Price plus any other amount to be paid by the Employer to the Contractor pursuant to this Contract is reasonably likely to exceed the Accepted Contract Amount, then the Contractor may give notice to the Employer requesting for reasonable evidence that financial arrangements have been made and are being maintained which will enable the Employer to pay the final Contract Price. For the purpose of this sub-paragraph "reasonable evidence" means the existence of an escrow account with the requisite funding level immediately accessible by the Contractor upon a payment default of the Employer, or any other evidence acceptable to the Contractor."

3. The Engineer

3.1 Engineer's Duties and Authority

Substitute the first sentence of the first paragraph of Sub-Clause 3.1 with the following:

"The Employer shall at least 28 days before the Commencement Date give notice to the Contractor of the name, address and relevant experience of first Engineer intended to be appointed."

Add the following at the end of Sub-Clause 3.1:

"(d) Any act by the Engineer in response to a Contractor's request except otherwise expressly specified shall be notified in writing to the Contractor within 28 days of receipt."

The Engineer shall obtain the specific approval of the Employer before taking action under the following Sub-Clauses of these Conditions, provided always that the preceding provisions of this Sub-Clause relating to deemed approval shall in any event apply:

"The Contractor's and the Employer's Personnel shall disclose all such confidential and other information as may be reasonably required in order to verify compliance with the Contract and allow its proper implementation.

In addition, the auditors appointed by the Bank shall have access to all information it may require about the Contract.

Each of them shall treat the details of the Contract as private and confidential, except to the extent necessary to carry out their respective obligations under the Contract or to comply with applicable Laws. Each of them shall not publish or disclose any particulars of the Works prepared by the other Party without the previous agreement of the other Party. However, the Contractor shall be permitted to disclose any publicly available information, or information otherwise required to establish his qualifications to compete for other projects."

Add a new Sub-Clause 1.15 as follows:

"1.15 Inspection and Audit by the Bank

If required by the Employer, the Contractor shall permit the Bank and/or persons appointed by the Bank to inspect the Site and/or the Contractor's records relating to the performance of the Contract and to have such records audited by auditors appointed by the Bank if required by the Bank."

2. The Employer

2.2 Permits, Licences or Approvals

Delete Sub-Clause 2.2 and replace with the following:

"The Contractor shall be responsible exclusively for obtaining the permits, licences and approvals stated in the Appendix to Tender.

The Employer shall provide, at the request of the Contractor, such reasonable assistance as to allow the Contractor to obtain any permits, licences or approvals required by the Laws of the Country:

(i) which the Contractor is required to obtain, as indicated in the Appendix to Tender;
(ii) for the delivery of Goods, including clearance through customs, and
(iii) for the export of Contractor's Equipment when it is removed from the Site."

1.1.6.8 "**Unforeseeable**" means not reasonably foreseeable by an experienced contractor by the Base Date.

At the end of Sub-Clause 1.1 insert:

1.1.7 Additional Definitions

1.1.7.1 '**Bank**' means the financing institution (if any) named in the Appendix to Tender

1.1.7.2 '**Financial Closing**' means the signature of the contract for financing the Works between the Employer and the Bank, and the satisfaction or waiver of any conditions precedent to its full effectiveness.

1.2 Interpretation

Add a new Sub-Clause 1.2 (e) as follows:

'(e) in these conditions, provision including expression 'cost plus reasonable profit' require this profit to be five percent (5%) of this cost.

1.5 Priority of Documents

Replace the list as follows:

(a) the Contract Agreement,
(b) the Letter of Acceptance
(c) the Appendix to Tender
(d) the Particular Conditions
(e) the FIDIC Conditions of Contract for Plant and Design-Build General Conditions, First Edition, 1999
(f) the Employer's Requirements
(g) the Contractor's Proposal
(h) any other documents forming part of the Contract.

1.12. Confidential Details

Delete Sub-Clause 1.12 and replace with the following:

PARTICULAR CONDITIONS

1. General Provisions

The following definitions shall be amended as follows:

1.1. Definitions

1.1.1 The Contract

1.1.1.6 "**Schedules**" means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such documents may include data, lists and schedules of payments and/or prices comprising, among others, the Bills of Quantities."

1.1.4 Money and Payments

1.1.4.1 "Accepted Contract Amount" means the amount accepted in the Letter of Acceptance for the execution and completion of the Works and the remedying of any defects. The Parties acknowledge and agree that the Accepted Contract Amount is an estimate of costs for the execution and completion of the Works and the remedying of any defects, subject to the provisions of this Contract.

1.1.6 Other Definitions

1.1.6.1 "**Contractor's Documents**" means the designs, calculations, computer programs and other software, drawings, manuals, models and other documents of a technical nature (if any) supplied by the Contractor under the Contract as described in Sub-Clause 5.2 (*Contractor's Documents*).

1.1.6.3 Replace "Specification" with "Employer's Requirements"

1.1.6.7 "Site" means the places where the Permanent Works are to be executed, including storage and working areas, and to which Plant and Materials are to be delivered, and any other places as may be specified in the Contract as forming part of the Site.

SECTION 5 – PARTICULAR CONDITIONS OF CONTRACT

For and On Behalf of:-

Name of Bank or Financial Institution:_____

Address: _____

Seal: _____

Name of Authorised Representative of the Bank or Financial Institution_____

Signature of Authorised Representative:_____

Designation of Authorised Representative:_____

Date: _____

Witness:

Name: _____

Signature: _____

Designation: _____

Date: _____

***Note:** All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.*

RETENTION MONEY SECURITY

DEMAND GUARANTEE

[LETTER HEAD OF GUARANTOR]

Retention Money Guarantee No.: **Date:**

TO:
THE HONOURABLE MINISTER
MINISTRY OF ROADS AND HIGHWAYS
ACCRA

THROUGH:
THE CHIEF EXECUTIVE
GHANA HIGHWAY AUTHORITY
ACCRA

Dear Sir,

NAME OF CONTRACT: .....

We have been informed that _____ *[name of Contractor]* (hereinafter called "the Contractor") has entered into Contract No. _____ *[reference number of the contract]* dated _____ with you, for the execution of _____ *[name of contract and brief description of* Works*]* (hereinafter called "the Contract").

Furthermore, we understand that, according to the Conditions of the Contract, *[name and address of Contractor]* (hereinafter called "the Contractor") shall deposit with MINISTRY OF ROADS AND HIGHWAYS an unconditional and irrevocable Bank Guarantee to guarantee the payment of Retention Money amounting to _____ *[amount of Guarantee]*_____ *[amount in words]* which would have been retained.

We _____ *[name of Bank or Financial Institution]*, as instructed by the Contractor, hereby irrevocably undertake to pay you any sum or sums not exceeding in total an amount of _____ *[amount in figures]* (_____) *[amount in words]*[1] upon receipt by us of your first demand in writing accompanied by a written statement stating that the Contractor is in breach of its obligation under the Contract.

This guarantee shall expire, at the latest, 28 days after the date when the Employer has received a copy of the Defects Liability Certificate issued by the Engineer. Consequently, any demand for payment under this guarantee must be received by us at this office on or before that date.

---

[1] *The Guarantor shall insert an amount representing the amount the Retention Money denominated either in the currency(ies) the Retention Money as specified in the Contract, or in a freely convertible currency acceptable to the Employer.*

Seal of the Guarantor _____
Name of Bank _____
Address _____
Date _____

SIGNED ON _____ on behalf of the Guarantor _____

By (*Name and Signature*) _____ in the capacity of _____

In the presence of (*Witness*) (*Name and Signature*) _____ in the capacity of _____

***Note:** All italicized text (including footnotes) is for use in preparing this form and shall be deleted from the final product.*

PERFORMANCE GUARANTEE

DEMAND BANK GUARANTEE

[LETTER HEAD OF GUARANTOR]

PERFORMANCE GUARANTEE No.: _____ Date:

TO:
THE HONOURABLE MINISTER
MINISTRY OF ROADS AND HIGHWAYS
ACCRA

THROUGH:
THE CHIEF EXECUTIVE
GHANA HIGHWAY AUTHORITY
ACCRA

NAME OF CONTRACT:.....

Whereas *[name and address of Contractor]* (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. *[number]* dated *[date]* to execute *[name of Contract and brief description of Works]* (hereinafter called "the Contract");

And whereas it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;

And whereas we have agreed to give the Contractor such a Bank Guarantee;

Now therefore we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of *[amount of Guarantee] [amount in words]*,[1] such sum being payable in the types and proportions of currencies in which the Contract Price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of *[amount of Guarantee]* as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed thereunder or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any such change, addition, or modification.

This Guarantee shall be valid until a date 28 days from the date of issue of the Performance Certificate.

[1] An amount is to be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract, and denominated either in the currency(ies) of the Contract or in a freely convertible currency acceptable to the Employer.

This Guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until MINISTRY OF ROADS AND HIGHWAYS recovers full repayment of the said amount from the Contractor.

For and On Behalf of:-

Name of Bank: _____

Address: _____

Seal: _____

Name of Authorised Representative of the Bank: _____

Signature of Authorised Representative: _____

Designation of Authorised Representative: _____

Date: _____

Witness:

Name: _____

Signature: _____

Designation: _____

Date: _____

Note: All italicized text is for indicative purposes only to assist in preparing this form and shall be deleted.

ADVANCE PAYMENT GUARANTEE

[LETTER HEAD OF GUARANTOR]

Advance Payment Guarantee No.: Date:

TO:
THE HONOURABLE MINISTER
MINISTRY OF ROADS AND HIGHWAYS
ACCRA

THROUGH:
THE CHIEF EXECUTIVE
GHANA HIGHWAY AUTHORITY
ACCRA.

Dear Sir,

NAME OF CONTRACT: .....

BANK GUARANTEE FOR ADVANCE PAYMENT

In accordance with the provisions of the Conditions of Contract, Clause 14.2 ("Advance Payment") of the above-mentioned Contract, _____
[name and address of Contractor] (hereinafter called "the Contractor") shall deposit with MINISTRY OF ROADS AND HIGHWAYS an unconditional and irrevocable Bank Guarantee to guarantee the Contractor's proper and faithful repayment of the Advance Mobilisation monies amounting to _____ *[amount of Guarantee]*_____ *[amount in words]*.

We, the _____ *[Bank or Financial Institution]*, as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to MINISTRY OF ROADS AND HIGHWAYS on their first demand without whatsoever right of objection on our part and without their first claim to the Contractor, in the amount not exceeding the outstanding balance of the Advance Mobilisation monies.

We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed thereunder or of any of the Contract Documents which may be made between MINISTRY OF ROADS AND HIGHWAYS and the Contractor, shall in any way release us from any liability under this Guarantee, and we hereby waive notice of any such change, addition, or modification.

SCHEDULE IV TO THE APPENDIX TO TENDER

FORMS OF GUARANTEES

CONTRACTOR PERMITS

The Contractor shall obtain the following licenses, permits and approvals:

- Building Permits for the Camp Sites; and
- Quarries Licenses.
- All such permits and approvals as per Section 6 of Ministry of Roads and Highway Specification, July 2007

SCHEDULE III TO THE APPENDIX TO TENDER

CONTRACTOR PERMITS

SCHEDULE II TO THE APPENDIX TO TENDER

SCHEDULE OF PAYMENTS

Automatic Reinstallment after loss	To be included
Imminent Perils (Sue and Labor)	5,000,000
Advance Payments	50%
DEDUCTIBLES	
Natural Perils - Design Fault – Maintenance	50,000
Other Events	50,000
TPL (for property damage only)	5,000
TPL (for bodily injury)	NIL

- Exclusions of coverage from the CAR/EAR Policy shall be approved by Employer

2. **Insurance for Third Party Liabilities (to be arranged and maintained by Contractor)**

Included under CAR/EAR policy above

3. **Insurance for Equipment – CPE Policy (to be arranged and maintained by the owner of the equipment)**

Sum Insured	Value of machinery at new condition considering the same specification and same capacity, including all freight cost to site, erection cost and customs duties and other due
Term	While staying at Site

4. **Insurance for Personnel (to be arranged and maintained by both Contractor and Employer, each one in relation to their respective employees)**

Insurance for personnel required by law and required to cover employer's liability.

1. Insurance for Works, Plants and Materials – CAR/EAR Policy (to be arranged and maintained by Contractor)

Coverage and Limits	
Sum Insured	Full Contract Value
Term	According to program
Extended Maintenance	12 months
Basic All Risk	Full Contract Value
Earthquake	Value at risk
Storm, cyclone, flood inundation, land slide	Value at risk
Clearance of Debris	5,000,000
TPL & Cross Liability	20,000,000
Faulty Design - DE5	Value at Risk
Inland Transit -MR113	500,000
Expediting Expenses - MR006	500,000
Airfreight -MR007	500,000
Existing property -MR119	10,000,000
Riots, Strike, Terrorism, Vandalism	5,000,000
Off Site Storage -MR013	3,000,000
Vibration, removal or weakening of support-MR120	To be included
Architects, Consulting Engineers Fees	1,000,000
72 hours	To be included
Automatic Sum Insured Increase	15%

SCHEDULE I TO THE APPENDIX TO TENDER

INSURANCES

Maximum amount of deductibles	18.2(d)	Equivalent of USD 5,000.00 per occurrence
Minimum amount of third-party insurance	18.3	Equivalent of USD 1,000,000.00 per occurrence with the number of occurrences unlimited
Number of DAB	20.2	DAB shall be 3 Members
Appointment (if not agreed) to be made by	20.3	President, Ghana Institution of Engineers
Language of Arbitration	20.6	English
Place of Arbitration	20.6	Accra, Ghana

Currencies of Advance Payment	14.2	Euros
Start repayment of Advance Payment	14.2	Deductions commence in the next Interim Payment Certificate following the Advance Payment
Repayment amortisation of advance payment	14.2(b)	20.0%
Retention Money	14.3 (c)	10% of each invoice until it reaches 5% of the Accepted Contract Amount. The retention may be replaced by a Retention Demand Security in the form indicated in Schedule IV.
Minimum amount of Interim Payment Certificates	14.6	4% of the Accepted Contract Amount
Publishing source of commercial interest rates for financial charges in case of delayed payment	14.8	**Local Currency:** Bank of Ghana (BOG) Local currency: BOG published commercial rates for Construction Industry + 2% **Foreign Currency:** London Inter-bank Offered Rate (Libor) plus two percent (2%)
Currencies of Payment	14.15	Euros
Limitation of Liability	17.6	The product of *1.0* and the Accepted Contract Amount.
Insurance – Periods for submission of insurance a. Evidence of insurance b. Relevant policies	18.1	14 days 30 days

		Independence Day (6th March) Good Friday Easter Monday Labour Day (1st May) Africa Unity Day (25th May) Republic Day (1st July) Founder's Day (21st September) Farmer's Day (1st Friday in December) Christmas Day (25th December) Boxing Day (26th December) Id-ul-Fitr Id-ul-Adha The Contractor shall also allow for a further two unspecified public holidays per calendar year that may be announced by the Republic of Ghana with no prior notification.
Time for Completion of Works	8.2	730 days
Delay Liquidated Damages	8.7	0.01% of the Accepted Contract Amount per day
Delay Liquidated Damages Limit	8.7	10% of the Accepted Contract Amount.
Defects Notification Period	11.1	365 days
Provisional Sums	13.5	15%
Adjustments for Changes in Cost	13.8	Not Applicable
Advance Payment	14.2	15% of the Accepted Contract Amount
Number and timing of Advance Payment instalments	14.2	1 instalment

		Over White Volta at Yapei, Span 240m, Lot 3: Design and Construction of Bridge Over White Volta at Daboya, Span 300m
Country	1.1.6.2	Ghana
Communication	1.3	By hand against receipt, mail, courier or fax
Governing Law	1.4	The governing law of the Contract shall be laws of Ghana.
Ruling Language	1.4	The ruling language of the Contract shall be English.
Language for Communication	1.4	The language for all communications made under Contract shall be English
Contractor Permits	1.13	The Contractor shall be responsible for obtaining the permits, licenses, and approvals listed in Schedule III to this Appendix to Tender.
Right of access to the Site	2.1	The Employer shall give the Contractor right of access within 21 days of the Commencement Date
Performance Security	4.2	A Performance Security in the form indicated in Schedule IV to this Appendix to Tender, in the amount equivalent to 10% of the Accepted Contract Amount.
Normal hours/working days	6.5	8hrs per day Monday to Friday, Saturdays and Sundays set aside for rest. National Holidays in Ghana: New Year's Day (1st January)

APPENDIX TO TENDER

Item	Sub-Clause	Entry
Employer's name and address	1.1.2.2 1.3	Employer's Name: Ministry of Roads and Highways represented by Ghana Highway Authority Employer's Address: P O Box M57, Accra, Ghana
Contractor's name and address	1.1.2.3	Contractor's Name: QGMI Construcciones e Infraestructuras Globales SLU Contractor's Address: House No. 22c North Ridge Extension, Accra PMT CT 221, Cantonments
Engineer's Name and Address		Chief Executive Ghana Highway Authority P. O. Box 1641, Accra Email ce@highways.gov.gh
Time for Completion	1.1.3.3	730 days
Defects Notification Period	1.1.3.7	The Defects Notification Period shall be 365 calendar days.
Foreign Currency	1.1.4.6	To be determined in accordance with the Financing Arrangement which has been approved and acceptable by Ministry of Finance
Local Currency	1.1.4.6	Ghana Cedis
Section	1.1.5.6	Lot 1: Design and Construction of Bridge Over Black Volta at Buipe, Span 240m Lot 2: Design and Construction of Bridge

SECTION 4 – APPENDIX TO TENDER

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

2) METHOD STATEMENT

QGMI

Index

1. INTRODUCTION 3
2. KNOWLEDGE OF PROBLEM 3
2.1. PROJECT OVERVIEW, GENERAL BIO-PHYSICAL CHARACTERISTICS 3
2.1.1. PROJECT OVERVIEW 3
2.1.1.1. Location Map 3
2.1.1.2. GENERAL BIO-PHYSICAL CHARACTERISTICS 3
2.1.1.2.1. CLIMATE 3
2.1.1.2.2. TOPOGRAPHY AND DRAINAGE 4
2.1.1.2.3. GEOLOGY AND SOILS 5
2.1.1.3. OBJECTIVES OF THE PROJECT 5
2.2. BACKGROUND OF THE PROJECT 6
2.3. PROPOSED DESIGN SCHEME 8
2.4. GENERAL TECHNICAL APPROACH 12
2.4.1. INTEGRATION OF PROJECT TEAM PERSONNEL 12
2.4.2. TIME COMPLETION OF THE PROJECT 12
2.4.3. QUALITY ASSURANCE 13
2.4.4. INNOVATIVENESS 13
2.4.5. MANAGEMENT APPROACH 14
2.4.6. SUPPORT FROM HEAD OFFICE 14
3. PLANNING AND CONTROL 14
3.1. PROJECT TIMELINE AND RESOURCE ALLOCATION 14
3.1.1. BASIC PREMISES 14
3.1.2. PLANNING AND CONTROL SYSTEM 15
3.2. PROCUREMENT PLAN 20
3.3. SITE'S INSTALLATION 24
3.3.1. PREPARE AND LOCATION OF UNITS 24
3.3.2. CONSTRUCTION SITES 38
3.4. ORGANIZATION, MOBILIZATION AND PERSONNAL SCHEDULLE 45
3.4.1. ORGANIZATION 45
3.4.2. WORKSITE PERSONNEL SUPPORT LOGISTICS 49
3.4.2.6.2. RESOURCES FOR THE PREVENTION OF ACCIDENTS, CONSIDERING THE RISK GRADES INHERENT TO THE NATURE AND CONDITIONS OF THE FORESEEN CONSTRUCTIONS 52
3.4.2.6.3. INDIVIDUAL AND COLLECTIVE PROTECTION 52
3.4.2.6.4. ENVIRONMENTAL PRESERVATION 52
4. BUILDING PROCESS 52

4.1. LAND CLEANING 52
4.2. EARTHWORKS 53
4.2.1. MECHANICAL EXCAVATIONS 53
4.2.2. MANUAL EXCAVATIONS 54
4.2.3. BACKFILL 55
4.2.4. DRAINAGE 55
4.3. EXECUTION OF CONCRETES 55
4.4. BRIDGES CONSTRUCTION 66
4.4.1. ROOT PILE FOUNDATIONS 66
4.4.2. FOUNDATION BLOCKS 67
4.4.3. PILLARS 68
4.4.4. CONCRETING ON SITE 71
4.4.5. CONTENTION OF BRIDGE HEADS EMBANKMENT WITH REINFORCED EARTH 71
4.4.5.1. MATERIALS 72
4.4.5.2. CONSTRUCTION 74
4.4.6. SUPERSTRUCTURE 76
4.4.6.1. Composite Deck Structure 76
4.5. EXECUTION OF TRENCHES 77
4.6. DRAINS 78
4.7. PAVING 82
4.7.1. REGULARIZATION OF THE SUB-GRADE 82
4.7.2. GRANULOMETRY STABILIZED BASE WITHOUT MIXTURE 83
4.7.3. GRANULOMETRY STABILIZED BASE OF GRADUATED CRUSHED ROCK OR UNDEFINED GRANULOMETRY CRUSHED ROCK 84
4.7.4. PRIMING 84
4.7.5. HOT MIX BITUMINOUS CONCRETE COATINGS – (HMAC) 85

1. INTRODUCTION

QGMI CONSTRUCCIONES E INFRAESTRUCTURAS GLOBALES S.L.U. presents to the Government of Republic of Ghana acting by and trough it's Ministry of Roads and Highways hereinafter referred to as the "MRH", presents his Technical Proposal to implementation of the **Finance, Design and construction of three (3) Bridges in the Northern Region.**

The Government of Ghana recognizes the provision of infrastructure as crucial for sustainable socio- economic development

The Government is pursuing a rigorous program for improvement and development of country's road network and transportation facilities

The Ministry of Roads and Highways is the sector Ministry charged with oversight responsibility for the development and management of the country's road infrastructure and related facilities

QGMI CONSTRUCCIONES E INFRAESTRUCTURAS GLOBALES S.L.U., a limited liability company is engaged in planning , designing , supervision and construction of transport infrastructure including roads, bridges, harbors, railways and other related facilities

2. KNOWLEDGE OF PROBLEM

2.1. PROJECT OVERVIEW, GENERAL BIO-PHYSICAL CHARACTERISTICS

2.1.1. PROJECT OVERVIEW

2.1.1.1. Location Map

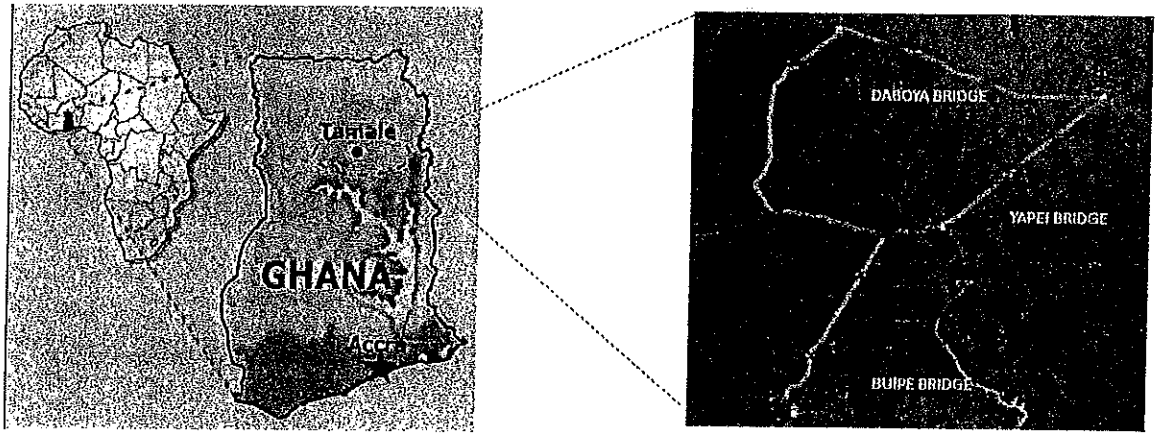


Figure 1-Project Location

2.1.1.2. GENERAL BIO-PHYSICAL CHARACTERISTICS

2.1.1.2.1. CLIMATE

The project location lies within the Northern Ghana that is classified as "Aw" according to Köppen

climate classification. The classification "Aw" is charactierised as "Tropical wet and dry climates".

The Köppen climate classification is one of the most widely used climate classification systems. It was developed by Wladimir Köppen, a German climatologist, around 1900. It is based on the concept that native vegetation is the best expression of climate; thus, climate zone boundaries have been selected with vegetation distribution in mind. It combines average annual and monthly temperatures and precipitation, and the seasonality of precipitation. Köppen climate classification scheme divides the climates into five main groups and several types and subtypes. Each particular climate type is represented by a 2 to 4 letter symbol.

The "Tropical wet and dry climates"" are characterized by constant high temperatures (at sea level and low elevations) — all 12 months of the year have average temperatures of 18 °C or higher. The climates have a pronounced dry season, with the driest month having precipitation less than 60 mm and also less than 1/25 the total annual precipitation.

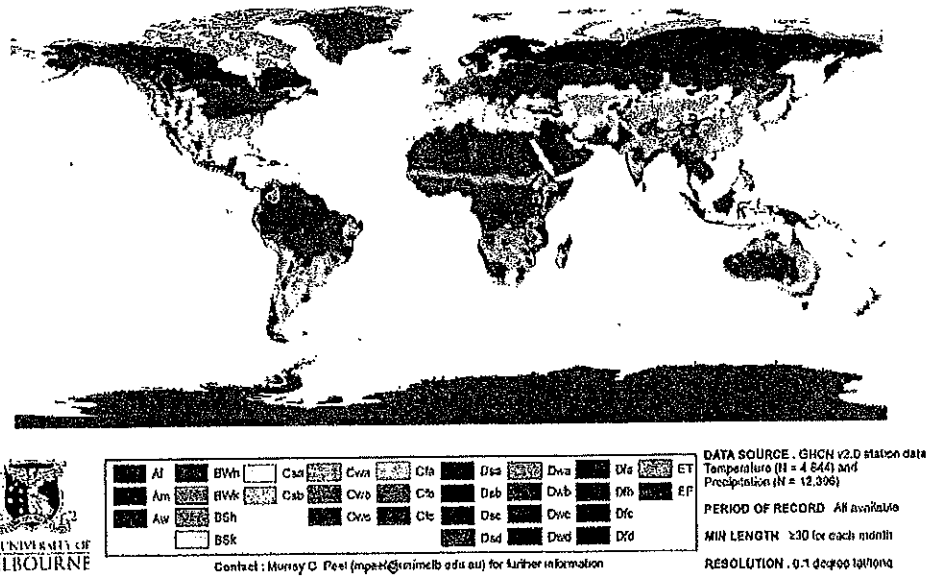


Figure 2-World Map of Koppeng-Geiger climate classification

The dry tropical climate of the region is influenced in particular by the Harmattan, a seasonal hot dry wind coming from the Sahara.

The dry season is usually from November to early April, influenced by the dry North-Easterly (Harmattan) winds. The rainy season is influenced by the moist South Westerly winds.

2.1.1.2.2. TOPOGRAPHY AND DRAINAGE

The project is located in the north of the country and it's the largest of the 10 existing regions which are generally flat with few isolated hills except in the north-eastern corner with the Gambaga escarpment and along the western corridor.

The Regions is drained by the Black and White Voltas and their tributaries (p.e. Nasia, Daka).

The metropolis is poorly endowed with water bodies. The region is drained by the Black and White Voltas and their tributaries, Rivers Nasia, Daka, etc.This is attributed to the low underground water table. The only natural water systems are a few seasonal streams which have water during the rainy season and dries up during the dry season. Notable among these streams are the Pasam, Dirm-Nyogni and Kwaha. All these streams have their headwaters from Tamale which is situated on a higher elevation. These aside, some artificial dams and dug-outs have been constructed either by individual community members or by non-governmental organizations (NGOs) in the metropolis. Two of such dams are the Builpela and Lamashegu dams. These dug-outs serve as watering sources for animals as well as for domestic purposes.

2.1.1.2.3. GEOLOGY AND SOILS

In the Northern region the rocks are mainly of the Voltaian formation, with isolated Cambrian rocks which may contain valuable minerals.

Limestone occurs towards the southern tip of the Voltaian formation. The main soil types in the Metropolis are sandstone, gravel, mudstone and shale that have weathered into different soil grades. Generally, the soils are fertile for agricultural activities and purposes. Due to seasonal erosion, soil types emanating from this phenomenon are sand, clay and laterite ochrosols. The availability of these soil types have contributed to rapid real estate development in the area where estate developers have resorted to the use of local building materials such as sea sand,gravel and clay.

Geology of the Northern Region

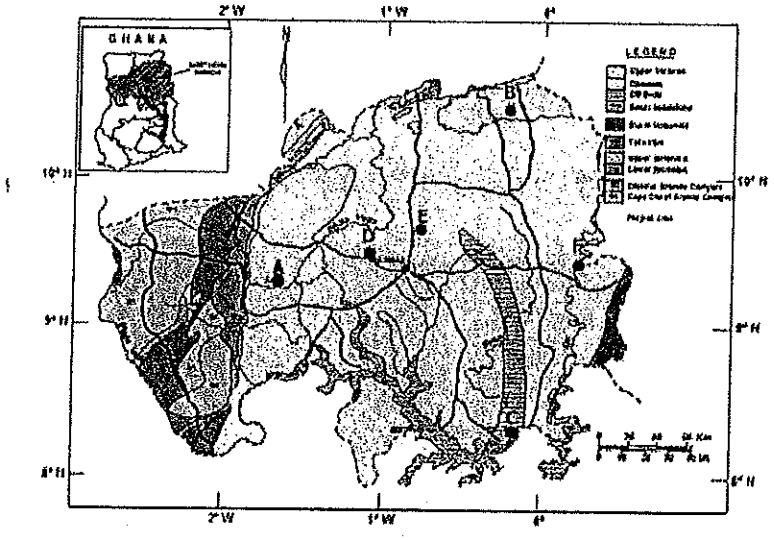


Figure 3- Geological Map Northern Region

2.1.1.3. OBJECTIVES OF THEPROJECT

The overall objective of the project this study is to develop an efficient and integrated transport network for the safe movement of people and goods.

This is sub- divided into the following specific objectives:

- Detailed engineering design of the bridge(s) and approach road(s);
- Production of construction and/or shop drawings;
- Construction of the bridge(s) and approach road(s);
  - Bridge at Buipe of width 12.5m and approx. length of 240m.
  - Bridge at Yapei of width 12.5m and approx. length of 240m.
  - Bridge at Daboya of width 12.5m and approx. length of 300m.
- Provision of street lighting for the bridge;
- Maintenance;
  - Conduct an assessment of the state of the existing bridges at Buipe and Yapei.
  - Schedule and conduct regular maintenance activities on the bridges
  - Provide a maintenance manual for the completed bridge with the provision of the necessary equipment for maintenance activities.
- Pavement design for the access roads
- Protection of Embankment
- Geotechnical report for Buipe and Yapei

2.2. BACKGROUND OF THE PROJECT

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.

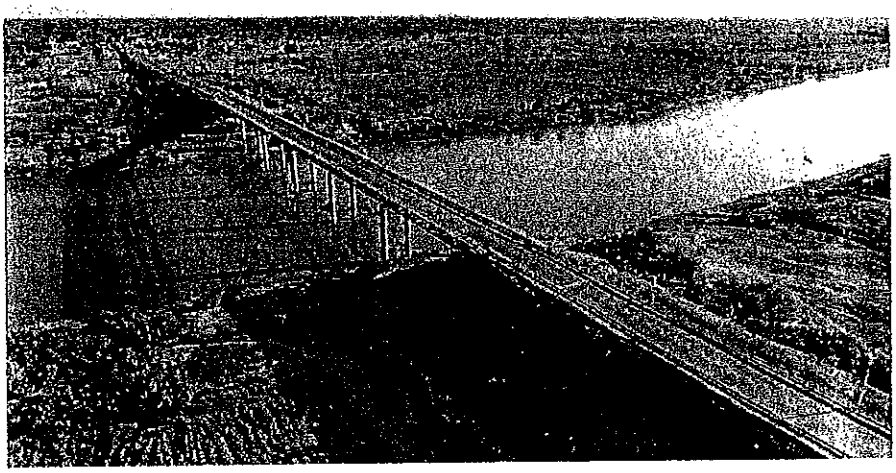


Figure 4-Aerial view of Buipe Bridge over Black Volta, towards south

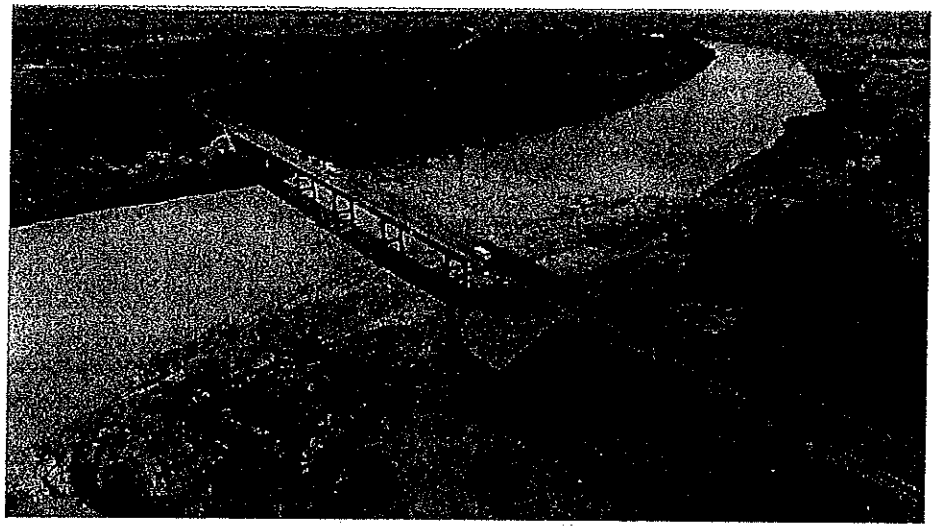


Figure 5- Aerial view of Yapei Bridge over White Volta, towards west

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 Ghana Highway Authority route IR109 connects the town of Busunu with Tolon and then to Tamale. This road also serves as a detour to the Upper East and Upper West Regions of Ghana. The White Volta crosses the road near the town of Daboya.

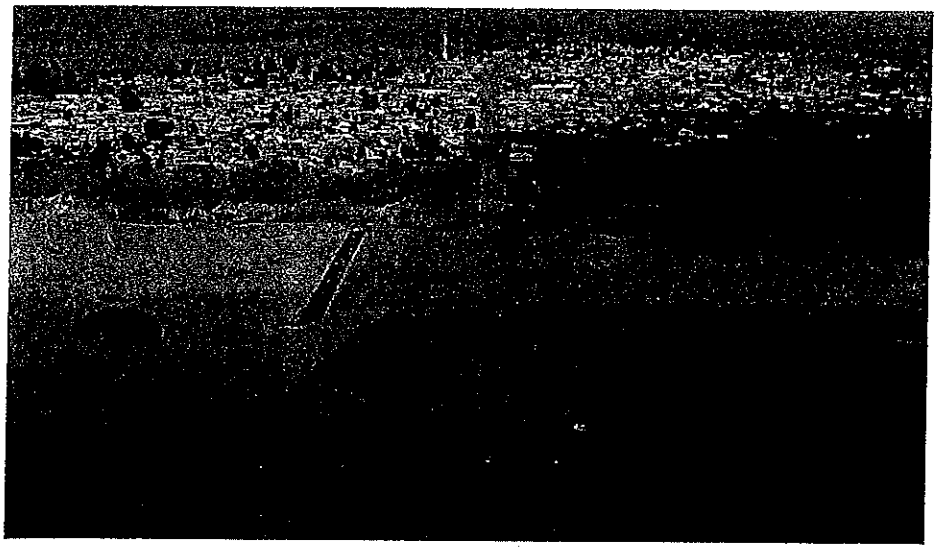


Figure 6- Aerial view of Daboya

In conclusion, the project overall scope will be to construct bridges at Buipe and Yapei to replace the existing bridges and also to construct a new bridge at Daboya (Currently, there is no bridge at Daboya). The project will be essential for improving the quality of life of the population from the region as well widening trade routes contributing to the increase of the region's economy.

2.3. PROPOSED DESIGN SCHEME

The structural solution chosen to cross the Black Volta River in Yapei is an extradosed bridge, with a total length of 240 meters, which corresponds to the most modern structural bridge type.

The extradosed bridges first appeared in Europe in the late 20th century although they have had their biggest development in Japan. This bridge typology can be described in practice as an intermediate solution between variable-depth girder bridges and cable-stayed bridges, in which two resistant mechanisms are combined efficiently: the bending capacity of the deck and the support of the cable system. The optimal main span length of extradosed bridges is between 100 meters and 200 meters.

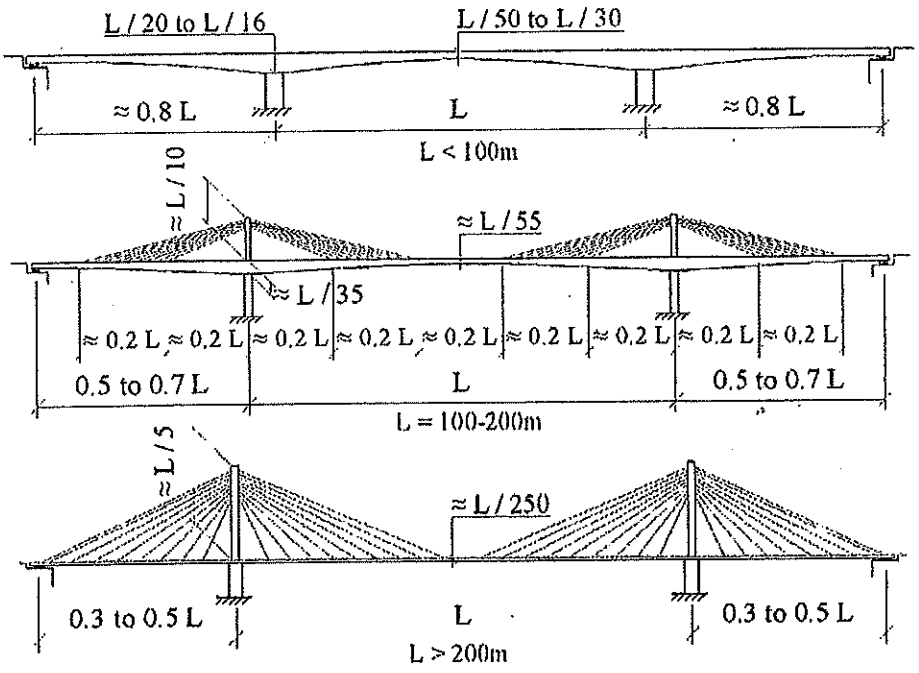


Figure 7 - Common configurations of prestressed box girder, extradosed bridges and cable-stayed

Initially, the concept of extradosed bridges was associated with above-deck cable-stayed bridges featuring the following characteristics: their pylons were shorter, their cables were less inclined and their decks were more rigid than in usual cable-stayed bridges. But eventually, the concept evolved to include new structural solutions with rigid stays or cable-panels, including solutions with dorsal fin beams, which are usual when vertical clearance is a limitation.

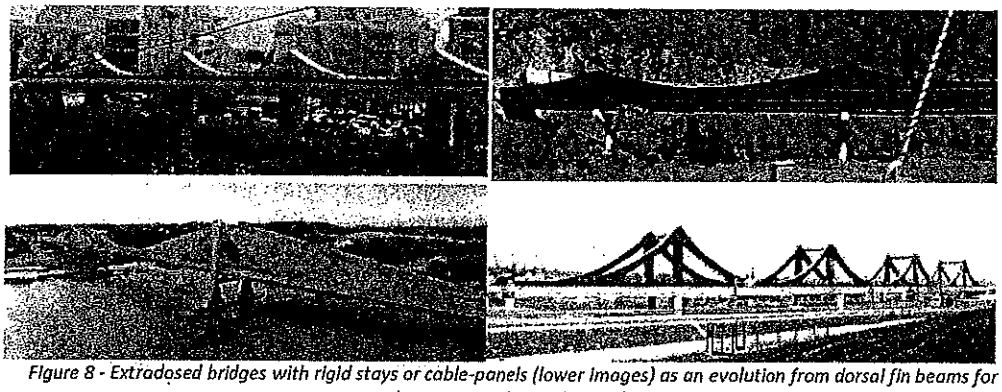


Figure 8 - Extradosed bridges with rigid stays or cable-panels (lower images) as an evolution from dorsal fin beams for longer spans (upper images).

Cable-stay systems are supplied worldwide by a small number of companies and these solutions require a careful installation sequence as well as a demanding maintenance after construction. Consequently, the participation of one of these companies is required which makes this solution less competitive for smaller spans.

Figure 9 - Cable-stayed bridges maintenance: Inspection cable with special vehicle; thermography NDT; critical stay damage and patented system of stay replacement.

On the other hand, the same materials are used for the deck and cable-panels of extradosed bridges with rigid stays: prestressed concrete or structural steel. This characteristic makes easier their construction and their maintenance during its service life.

A steel deck solution has been selected for an extradosed bridge with rigid stays. In this way, the uncertainties related to the construction over an abundant river are limited. The fabrication at a workshop of the deck-segments, with complete independence of weather conditions, will assure, firstly, a better quality and durability of the completed structure and, secondly, a reduction in the construction time of the bridge. Steel solutions provide lighter deck-segments which facilitate assembly operations and reduce foundation requirements. Additionally, steel decks can be strengthened and widened more easily to adjust for future traffic increments.

In order to assure the durability of the bridge, protection of the steel structure against corrosion is mandatory. The anti-corrosive paint system is the most commonly used worldwide system against corrosion. Anti-corrosive paint systems are comprised of three layers (primer, intermediate coat, and finish coat) and their composition is defined according to the aggressiveness of the atmosphere at bridge location. The service life of the new anti-corrosive paint systems, before they have to be completely restored, can reach up to thirty (30) years if applied correctly and periodic inspections detect and correct local damages of the protection system.

The new bridge in Yapei will cross the Black Volta River, near an existing bridge, with a total length close to 240 meters. The road surface will be one and a half meters above the road surface of the existing bridge and thus the intrados of the deck will be twelve meters above the normal level of the river.

The span distribution adopted is the following: 60 meters - 120 meters - 60 meters. With this span distribution, the bridge spans the majority of the riverbed, minimizing the affection to navigation and river flow. The new bridge will be situated downstream of the existing bridge, between it and a covered pipeline, due to the presence of a high voltage line upstream of the existing bridge. To avoid damaging the covered pipeline, the embankments will be contained by reinforced-soil walls. These walls will be covered by gabions to decrease their visual impact.

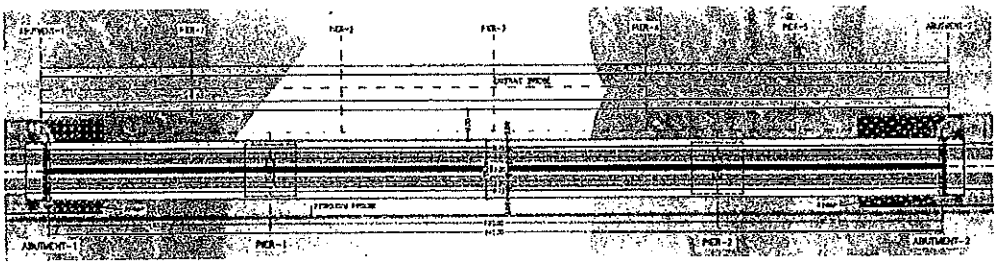


Figure 10 – Bridge Plan.

Visits to the location site, as well as geotechnical investigations conducted, confirm the beginning of a siltstone and claystone layer at the bottom of the riverbed. Consequently, the piers can have shallow foundations by means of concrete footings. Pile-abutments have been chosen in order to avoid affecting the embankments of the existing bridge, although they could have been shallow foundations in consonance with the geotechnical conditions.

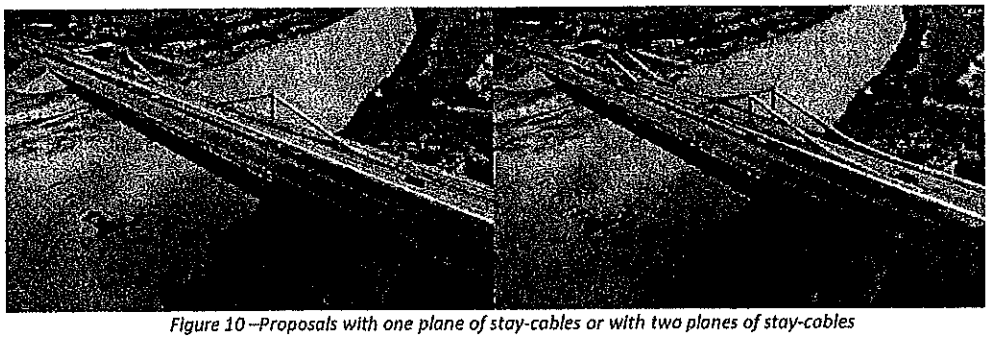


Figure 10 –Proposals with one plane of stay-cables or with two planes of stay-cables

Solutions with one and two planes of rigid stays have been studied. The chosen solution, for aesthetic reasons, has only one plane of rigid stays.

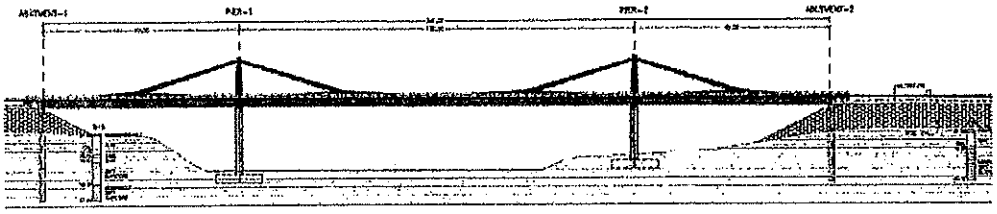


Figure 11 - Bridge elevation

The composite deck will be composed of a steel box and a reinforced concrete slab on top. The final configuration of the deck is the following:

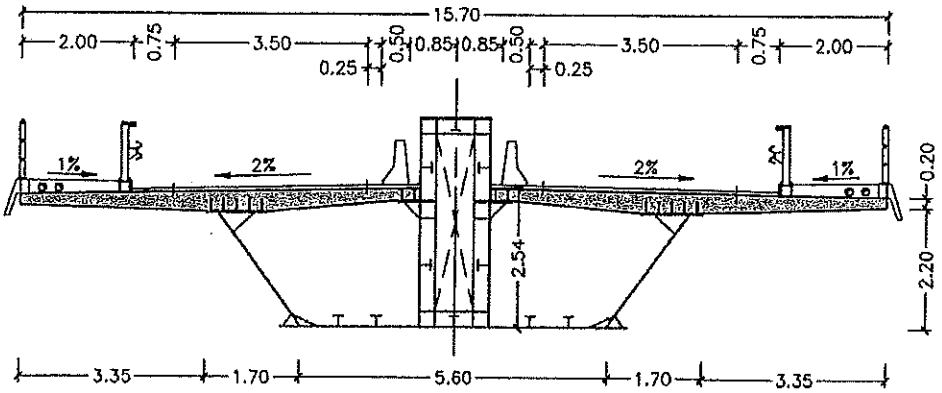


Figure 12 – Deck typical section

- Left footpath: 2,00 m
- Left lane and shoulder: 4,50 m
- Barrier: 0,50 m
- Central space for cable system: 1,70 m
- Barrier: 0,50 m
- Right lane and shoulder: 4,50 m
- Right footpath: 2,00 m

The extradosed supporting system comprises a composite (concrete and steel) pylon and two steel box-section stays. The system height is 12,50 meters.

The deck and the stays will be inside accessible for inspection which will ease its maintenance.

The piers will have a rectangular cross-section varying from 6,3 meters depth at the top level to 5,0 meters at the foundation level. The connection between the piers and the deck can be rigid or simply supported by elastomeric bearings.

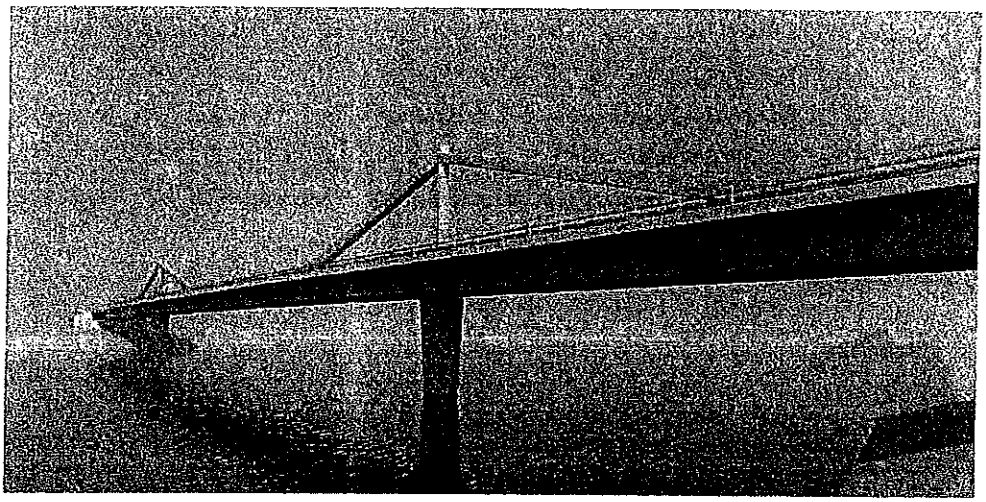


Figure 13 – Proposed bridge configuration

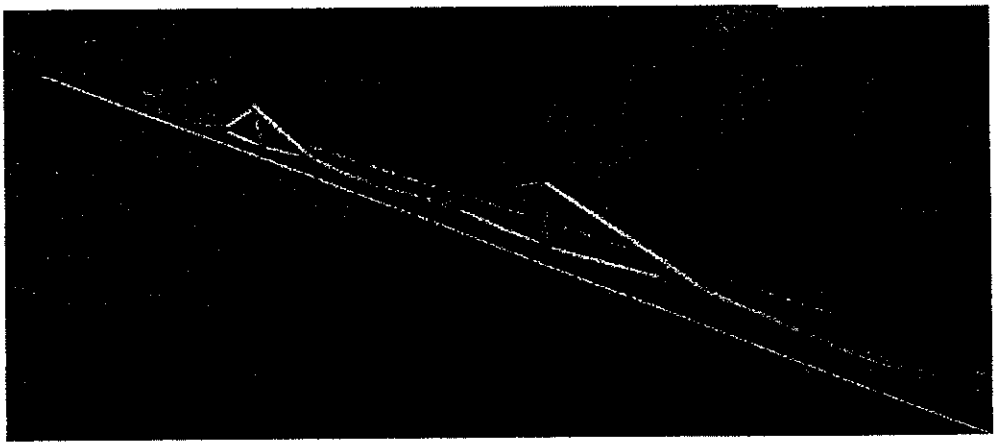


Figure 14 – Bridge night view

2.4. GENERAL TECHNICAL APPROACH

2.4.1. INTEGRATION OF PROJECT TEAM PERSONNEL

As the project preparation work for the assignment requires the inputs of Engineers/Specialist in various fields, a well-coordinated and interdisciplinary approach including regular and close interface and coordination with the Client and the counterpart staff will be ensured. By this approach, all the key personnel would be assimilated into one team where each one is aware of one's own and others responsibilities and authority, the overall objectives of the services and the benchmark levels of the quality. To achieve this, the following would be done:

- Selection of a strong and balanced team of suitably qualified and experienced expatriate and local professionals for each type of services to address requirements as per the objectives and Client's Terms of the prequalification document and to fit the team into an organization which will ensure:
  - Delivery of the services in accordance with highest professional standards and practices;
  - Adoption of appropriate technology and methods;
  - The closest liaising with the Client;
  - Sound management practices.
- Proposal to develop a contract management tool which drives, monitors, reports and manages the assignment;
- Regular meetings with the Client (at least one meeting each month) to facilitate expeditious decisions / approval as may be necessary to remove bottlenecks in the progress of work;
- As part of technology transfer, local professionals as part of the team and Ministry of roads and highway authority counterpart staff shall fully participate in various activities and thus acquire a thorough understanding of the methods and the techniques for carrying out the study.

2.4.2. TIME COMPLETION OF THE PROJECT

The team will ensure that the project preparation work is completed in time and as per the work plan. This will be possible through constant and close monitoring during all stages. The delay in execution of assignments of this nature is common knowledge and occurs usually due to:

- Delays in mobilization;
- Non-availability of sufficient experienced staff for the study which involve planning, engineerin surveys, investigations, structural analysis/ design etc.;
- Lack of coordination with other agencies;
- Delay in response from the Client and other agencies;
- Delays in analysis and preparation of draft reports and approvals.

The Team has adequate competent staff to carry out all the tasks / activities required to complete the assignment within the time schedule. There is also the availability of adequate in- house resources and capabilities for conducting all field surveys and investigations. The Team has also the requisite experience of working in Ghana and is familiar with the local conditions, rules / regulations and other pertinent requirements. The Team will take the following measures to complete the assignment within the time schedule:

- Mobilizations as per plan and commencement immediately on formal signing of the contract. The Team for this reason has proposed the international key experts largely from among their full time staff to ensure availability without any delay;
- To ensure the availability of resources in a timely manner as is required for the engineering surveys/ investigations and other surveys, a number of teams will be deployed simultaneously for field work to have the necessary data within the earliest possible time;
- Regular monitoring of the work plan / schedule and make revisions wherever necessary to catch up with slips if any;
- Analyze data and prepare various reports and documents as per work plan;
- Regular meetings with the Client and counterpart staff.

2.4.3. QUALITY ASSURANCE

Effective quality management on the Project will be achieved by the application of relevant procedures which include definition of responsibilities and duties, implementation of project planning and review, appropriate verification of inputs and project work, quality auditing and where necessary, corrective action.

2.4.4. INNOVATIVENESS

The team intends to apply the latest and innovative approaches that have proven and produced positive impacts in the smooth execution of similar projects. Some of the innovative approaches to be applied for this project would be

2.4.5. MANAGEMENT APPROACH

The emphasis of the team will be to ensure a proper management of all the issues and obligations under the assignment. The Team's approach to proactive management of services will be based on the following actions

2.4.6. SUPPORT FROM HEAD OFFICE

Taking into account the scope of the Project, the Time Frame and Work Schedules for implementation and the need to maintain proper quality control, the team will make pertinent arrangements for providing a continuous technical, administrative and management support from our headquarters in Brazil, Accra and associates as required.

3. PLANNING AND CONTROL

3.1. PROJECT TIMELINE AND RESOURCE ALLOCATION

3.1.1. BASIC PREMISES

In order to complete a construction project of this scale, perfect planning of the undertaking is necessary. A thorough project Plan depends on project complexity, project location, choice of construction methods and processes the detailed analysis of resources required to carry out the project.

Based on the company's experience, a construction plan was elaborated detailing works to be executed. Guiding these studies are the considerations listed below:

- Attention to scheduled dates, timelines, and milestones in the project plans;
- Maintain a consistent standard of quality in all works required by the contractor;
- Preserve the environment;
  (Industrialize construction methods and processes where applicable)
- Detailed study of budget plan from the bidding process;
- Proximity of works to both local labor force and adequate system of communication systems and service;
- Adequate size of stone quarry for supporting construction works;
- Predicted workshift of 8 hours daily.

3.1.2. PLANNING AND CONTROL SYSTEM

The planning and control of a project require the possibly best detailed knowledge about the project itself, what can only be reached through a careful analysis of its composing elements. Therefore, such analysis is the first step for the best planning.

The Project Analytical Structure - PAS is a hierarchical way of showing the Project division into levels of information detail, compatible with the different Project implementation phases.

Planning: Starts from a logically established initial plan, based on the knowledge of all data referring to the Project, in such a way that these data be available at the time of the initial plan. This plan constitutes the Preliminary Master Plan and will serve as a guideline for the Project implementation during it's first stages, and will vary according to the precision involving the estimated attributes of the Project's different activities. After checking the initial hypothesis, the Preliminary Master Plan is transformed into the Definitive Master Plan, when a fraction of the total term foreseen for Project completion is reached and the information necessary to the forecast for completion is considered reliable enough.

The Master Plan includes, without limitation, the following elements:

- Project descriptive summary;
- Specifications of the characteristics and levels of performance of the end product;
- Definition of the methodology for performing the works;
- Allocation of resources for labor, materials and equipment with the relevant distribution histograms and "S" curves;
- Matrix of responsibilities;
- Organization of the Project, with it's operational structure;
- Supervision Management Plan
- Project Information System;
- Project Control System.

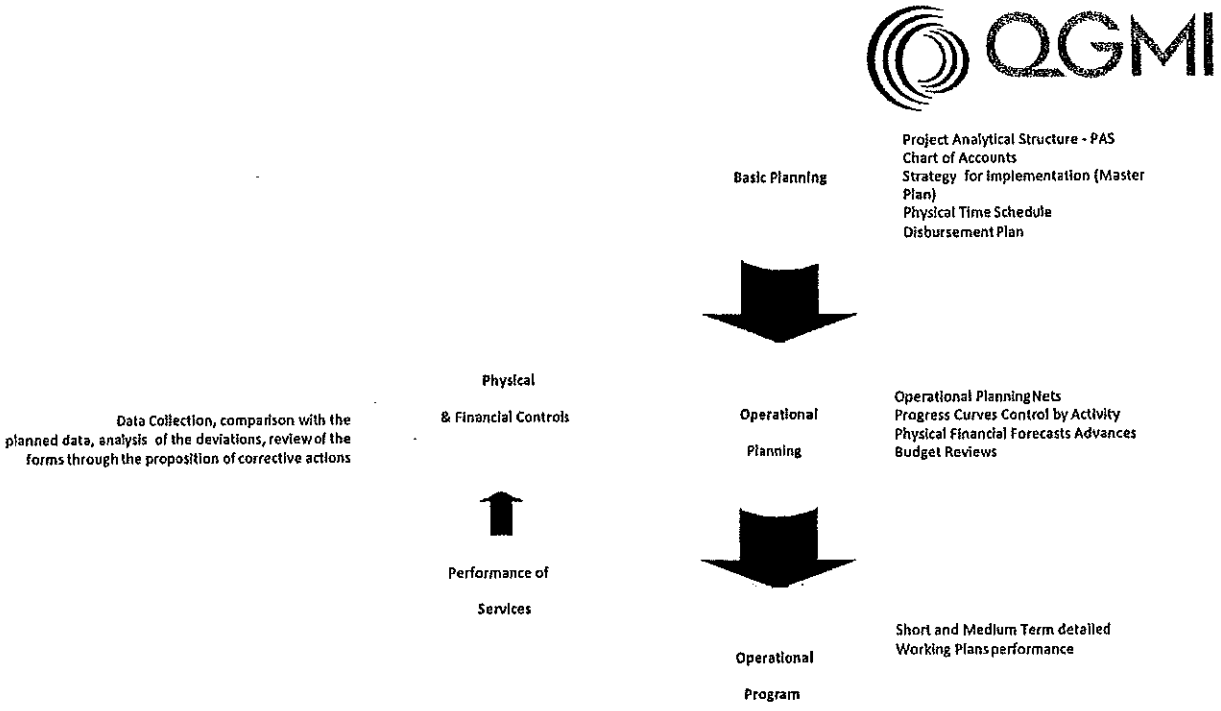


Figure 1 – Steps of planning

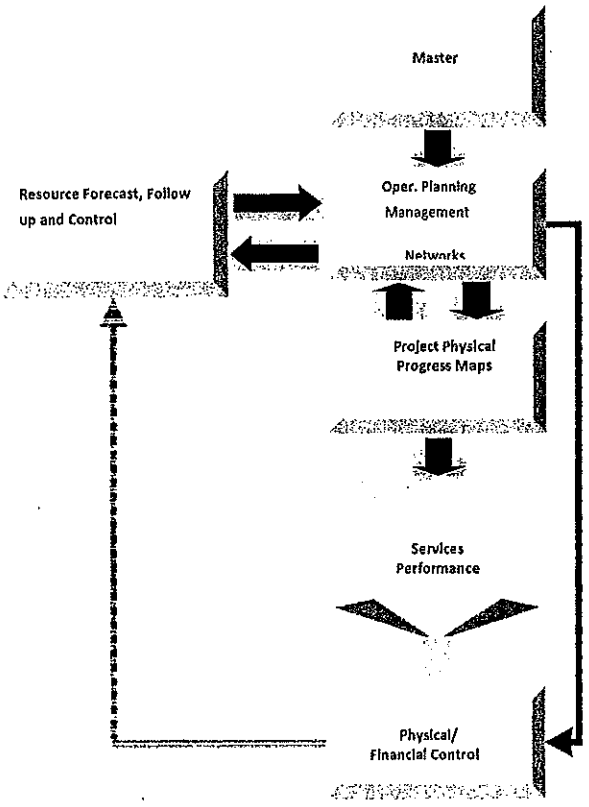


Figure 15-Planning Structure

The Methodology for Project Planning shall follow these steps:

a) identify the activities to be performed through the analysis of the elements and information available: basic or detailed design, specifications, etc.;

b) arrange the identified activities in a logical sequence, in accordance with the methodology and the performance process defined for the Project (PAS to be used as a matrix making all possible combinations);

c) establish benchmarks and objectives;

d) determine the performance time for each activity;

e) determine the Project Performance Term;

f) allocate and level resources for the labor, materials and equipment as well as re-evaluate the Project Performance Term;

g) determine the Project Basic Cost Estimate;

h) establish the Project Control System.

Control: Consequently, during its development, the Project is expected to present deviations relatively to the Master Plan. In order to measure these deviations, it is necessary to control the significant Project parameters and compare them with the goals established in the Master Plan for such parameters, along the different phases of the Project.

Depending on the magnitude of the verified deviation, the Master Plan is then reformulated and measures are taken in order to adapt the subsequent activities to the verifying date in order to attend the final aim. Both the control and planning activities must be developed in a continuous way, being mutually complementary, and their linking in the Master Plan constitute the Project Feedback Cycle.

Monthly updating of the services scheduling, comparing "performed x "programmed"

Monthly checking of the compatibility of the services scheduling and their effective performance regarding to equipment, personnel, environmental protection measures, quality control programs and other relevant items

In this activity, it is essential that the measurement of the performed services be monthly made, in order to supply the necessary data for the physical and financial follow-up of the works, and from there the following information will be extracted

Physical Control: Initial Forecast, quantities performed during the aggregate period, quantities yet to perform, physical advance per activity and the Project as a whole.

Financial Control: Budget Forecast for each item of service; values performed within the period and accumulated up to date, balance of each activity and financial progress for service, contract or the Project.

The performance indicators for the works and services shall be calculated from the Physical and Financial Controls, where the difference between the planned and performed progress will indicate the deviation for a given activity.
Data and information from the measurements of performed services and on site follow-up will arise, which will enable the planning cycle feedback, aiming mainly to the following points:

- Weekly services schedule updating, comparing "performed" x "programmed";
- Monthly checking of the compatibility of the services scheduling and it's performance regarding equipment, personnel, environmental protection measures, programs for the quality control and other relevant items.

The operational planning network will utilize PERT/CPM technique, defining a logical sequence for the performance of the services and guarantying perfect integration among the several phases of Project implementation, becoming an essential tool for decision making against the possible variations and deviations in order to make up for them.
The operational planning network will be structured through the use of the specific software, the so called Primavera Project Planner for Windows, which main characteristics are (See Figures 9, 10 and 11):

- Windows Standard Interface - friendly and interactive, enabling the planning staff to perform his/her functions easily, quickly, safely and with creatively;
- Network Management with a high number of activities;
- Precedence Diagram Method (PDM);
- Determination of the project critical path;
- Multi-user utilization, including *e-mail* addresses for updating information in local network environments;
- Control of access through a password and management of logged-in users;
- Multiple calendars by project;
- Following up through time units;
- Enabling several "targets", for comparisons and simulations;
- Unlimited utilization of resources by project, enabling the cost variation and availability by resource;
- Creation of several control structures - WBS, EAP;
- Costs Management;
- Non-linear resource assignment;
- A large number of pre-formatted graphics, reports and time schedules;
- Total customization of the output reports;
- Enables the exchange of information with other systems and databases - ODBC (Open Data Base Connectivity).

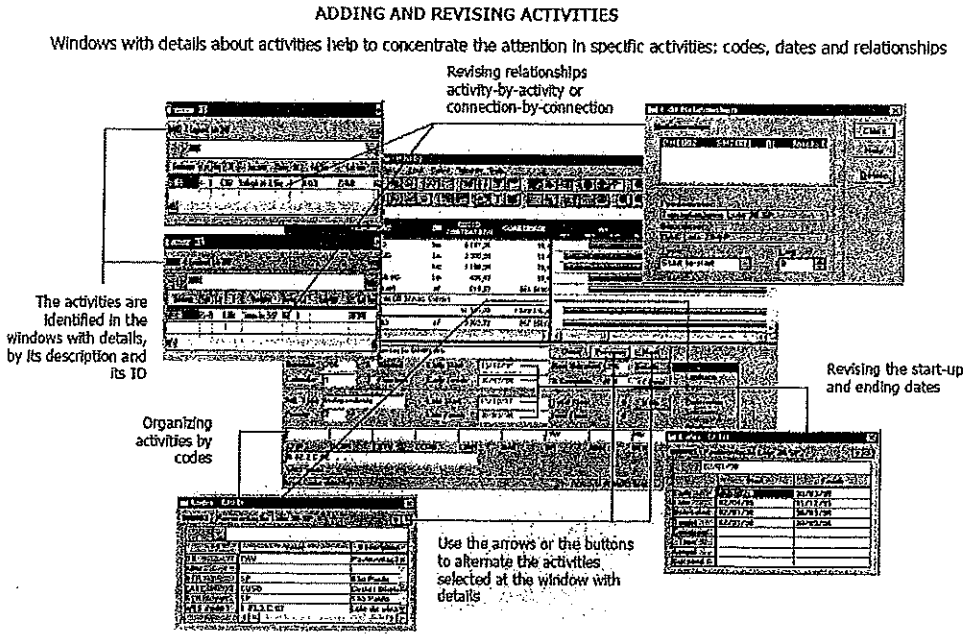


Figure 16-Adding and Revising Activities

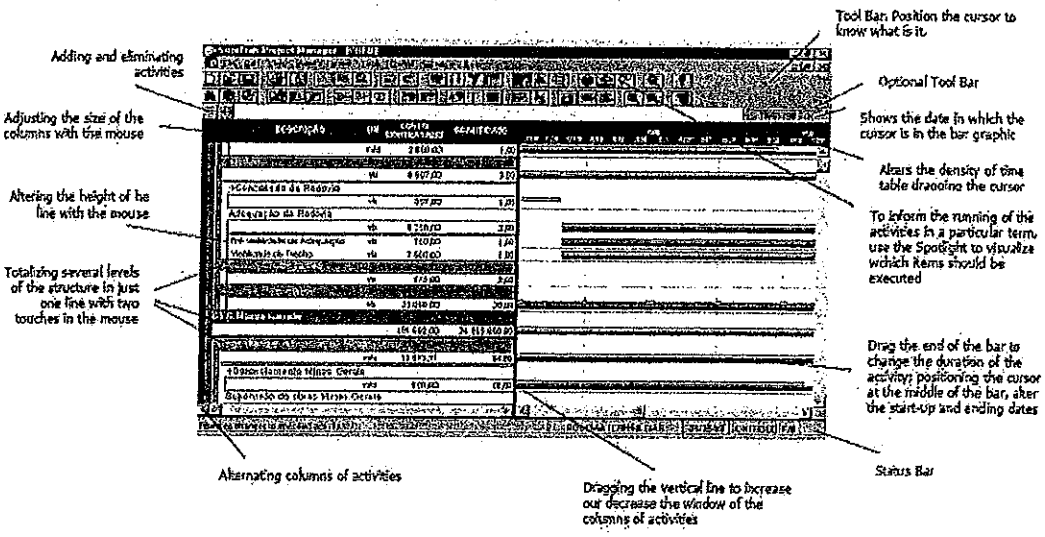


Figure 17- Primavera Project Planner and Sure Trak Project Manager

ANALYSING AND OPTIMIZING RESOURCES

Analysis of the necessity of resources with graphics and tables, to make a leveling of its utilization. In order to have a better use of its team.

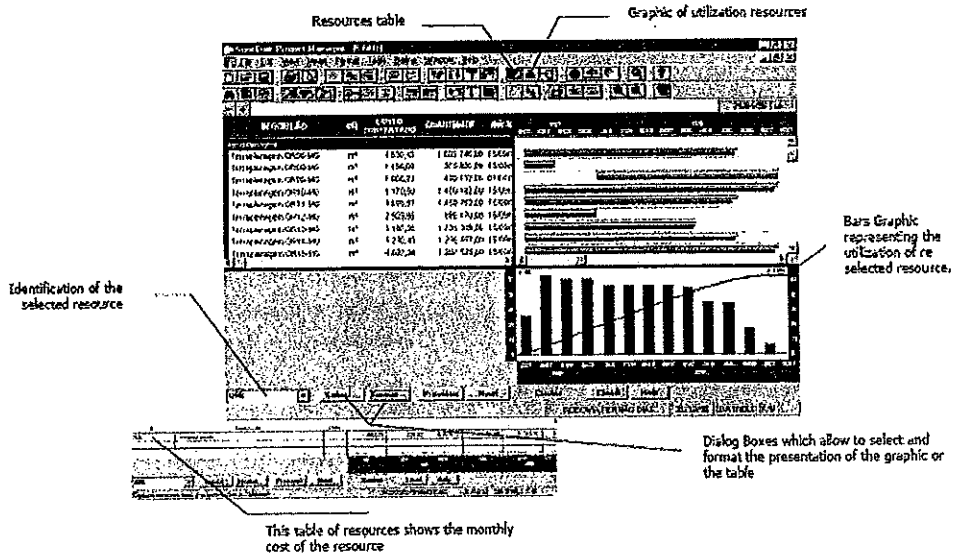


Figure 18- Analyzing and Optimizing Resources

3.2. PROCUREMENT PLAN

Due to the location of the works, it is necessary to prepare a good procurement plan and keep reasonable stocks at the site to minimize the effects of additional traffic in an area already extremely busy.

Introduction

The procurement process includes all the stages related to obtaining material, from acquisition to application, which means transportation, handling, storage, quality control and stock control.

The BIDDER will use the Support Office to the Administration and Procurement in Accra, where the Contract Manager, the technician responsible for the works before Ghana Government and the CLIENT will be based.

This office will have the support of the BIDDER's main office in Rio de Janeiro and that of the São Paulo branch, the main supply centers in Brazil.

Availability and limitations for acquisition and transportation of all materials at the relevant supply centers complying with the specifications were taken into due account for the preparation of this Proposal.

At first, the Company intends to acquire the materials necessary for current use at regional sources, always giving priority to suppliers located in Ghana.

Steel and materials of greater responsibility (scaffolding, sliding forms, etc.) will be acquired or leased in Ghana or other city's in Europe.

After receipt of the Service Order, the program for contracting supply and transportation of materials will immediately be put into action by the Works Supply Sector.

Objectives of the Procurement

Basic Objectives

Normally the objectives of the activities of the procurement process aim at the following basic points:

- Competitive prices;
- Maximum turnover of stocks;
- Lowest cost of acquisition;
- Quality compatible with Ghanaian regulations and design specifications;
- Uniformity of suppliers;
- Transportation of material;
- Control of stock;
- Storage;

Limits of the Organization

In the case of construction, the focus of the procurement process must be analyzed including the various undertakings that are normally outside the headquarters, which means, each work is practically an isolated point of activity and requires "sui generis" procedures, involving specialized personnel, otherwise problems may occur with the supply and continuity of the performance of the services.
In a broader manner one can consider the activities of supply according to the following basic points:

- Work under direct influence of headquarters, branch or office. In this case, the system of supply is practically defined at the headquarters of the company and purchasing office in Accra and the work is restricted to small activities of supply, meaning that the acquisition of materials will be under total responsibility of the management of the company. This is the case of this job.

- Work far from the main points of support of a company isolated from the major production centers. In these cases, the procurement activities must be implemented in a nearby city with

better resources, associated with the command of the job itself and connected to the management of the company. It is the case of planning a supporting office in Accra.

Sensitivity

It is necessary for the company and the leaders of the work, especially from the procurement sector, to have sensitivity relatively to the market, in order to avoid unexpected situations in the progress of the Project construction. Thus, it is necessary to establish clear rules that are independent of any market, taking into consideration the reaction of suppliers and the competition among them, besides interventions and inevitable activities on the part of the constructor himself.

The supply sector must be attentive to the changes that can occur in the market of materials due to abnormal consumptions and which can become critical, exceeding the original budget and making impracticable the performance of the services.

Trends

The procurement sector must do a research of the trends of the market related to production, as well as prices, in order to prevent surprises during the implementation of the Project.

Starting from the type of works, the location, the materials consumption histogram, the construction details, the culture of the company, the economic analysis, a plan of supply is prepared, taking into account the following basic points:

- Classification of materials as of absolute, average or little importance;
- Consideration of dimensions, unit weight, shape and perishability of materials to be used;
- Flow of supply, terms and speed of deliveries, occasional deliveries, discontinuances, etc.;
- Analysis of the works progress, as it determines the rhythm of the supply of materials;
- Consideration of local conditions: topography, means of access, availability;
- Classification of spare parts for equipment as of absolute, average or little importance;
- Convenience of acquiring materials in advance;
- Global and specific foreseen budget for certain materials

Schedule

The engineering sector will prepare a materials use schedule, which means the breakdown of the exact moments when the materials must be available at the work, their volume and technical specifications as per the Ghana Highways Authority regulations and design specifications.

The supply schedule is the main working instrument for the acquisition of materials and the following points must be observed:

- Preparation of the schedule with sufficient time in advance with regard to the performance of the services, so that the procurement sector may interpret it, checking whether it has all the

basic information so as not to be obliged to take hasty decisions hoping to be right.

- The schedule must be ready in due time, so that the procurement sector may analyze the commercial conditions and the relationship of offer-demand of the specified materials.
- The schedule must be prepared in advance so that the procurement agents give their opinion beforehand on the best price within the delivery terms and quality of product.
- The schedule must clearly and exactly indicate the quantities so that the procurement sector be able acquire lots on an economic scale.
- The schedule must indicate the estimates of monthly consumption, so that the procurement sector may group the purchases in economic lots, in accordance with the financial area of the company.

Procurement Chart

The engineering sector, together with the areas of production, procurement and maintenance, will prepare a chart of supply of materials and basic spare parts in accordance with the volumes foreseen during the months of the work and their origin.

This chart is the starting point for Procurement to define, together with the Financial Sector of the Company, the guidelines for the acquisition of these products.

Transportation

The activity of transporting a product to the jobsite is fundamental for the construction activity. The transportation sector is responsible for the interaction of the problems that occur in all phases, such as: hiring or using own means of transportation, selection of means of transportation, accompaniment and dispatch, reception, handling and storage in the warehouse of the jobsite.

Warehouse - Parts - Materials

Due to the great affinity between the maintenance and procurement sectors, it is common to store material and equipment spare parts in the same building, under the responsibility of the sector that controls the assets of the works.

These facilities must be well sized to provide efficient service to the job.

3.3. SITE'S INSTALLATION

3.3.1. PREPARE AND LOCATION OF UNITS

For a start, the area where the works will be carried out may be isolated, depending on the permission granted by the Ministry of Roads and Highways due to the vulnerability of the Area.

An area of approximately 11.250 m2 (125mx90m) will be available, on an unused terrain near the construction site, for the Proponent build its installations of the Construction site, initially named as Main, and its lay out corresponds to the Construction Site Type I, presented ahead.

Before the installation of the construction site, the area will be cleaned, flattened and, if necessary, land filled to make compatible the elevation with the other installations.

It is foreseen the installation of support containers near the work front.

The site's area, at first, will be located in an existing free area nearby the construction site.

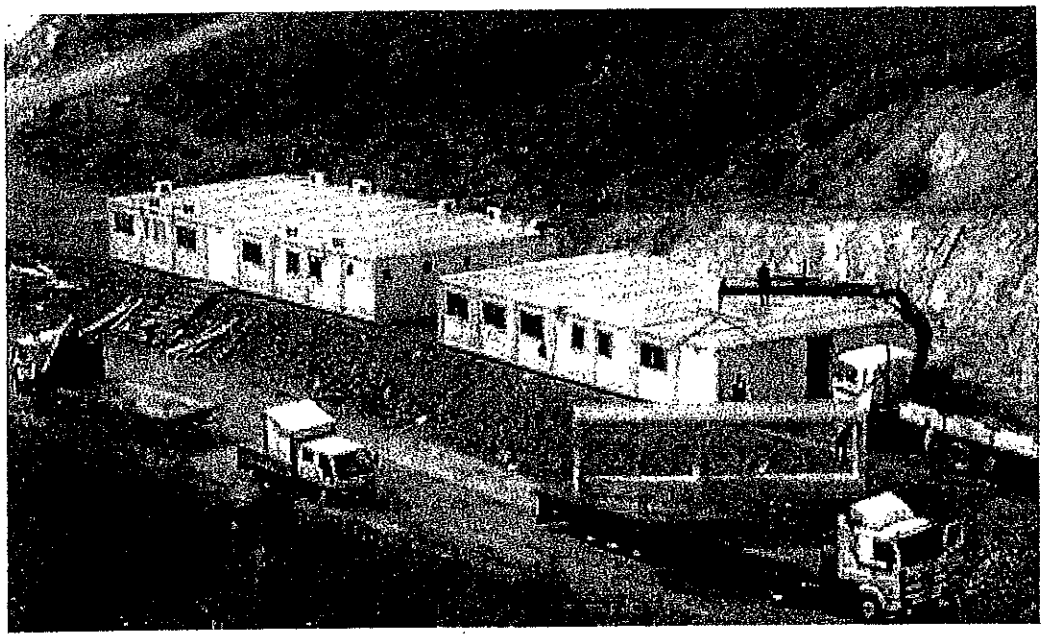


Figure 19- Containers structures

In any case, the definitive position of the work site will be in a place to be chosen by common consent with the Contractor Surveillance.

The site's premises include the administrative and industrial premises that will be necessary for the execution of the work.

These premises are planned bearing in mind to benefit the work with an efficient support structure in such a way that all of them are able to immediately respond to the requests regarding supplies, labor, maintenance, communication, water, energy, fuel supplies, etc.

Thus, it may be confirmed that the correctly dimensioning of the premises, a lay-out in conformity with the work's purpose and its implementation on the appropriate period of time are the main factors to meet the needs of production and determinant for the good progress of the services.

Therefore, during the initial phase of the implementation, when several problems usually arise, such as the mobilization of resources, team building, and setting up an infrastructure to meet meals requirements, clearance of the implementation areas, recruitment and selection of staff, basic support for the first mobilized equipment, quick and safe solutions will be adopted to settle the problems.

In the intended area for the administrative site, the Builder's and Surveillance's back offices, refectory, infirmary/CIPA, toilettes and dressing rooms, entrance hall / card holder compartment, cistern and elevated water tank, etc. will be distributed in temporary constructions - containers. All area comprehended by the site will be protected against any type of pollution and will be properly discharged by the end of the works.

Premises will be distributed in a way to offer full work conditions, minimizing the distances and providing a safe scheme for the development of the several work phases. Likewise, water and energy will be made available at a point to be established by common consent with the Surveillance. All premises will comply with ASTM and Ghana Design Standards.

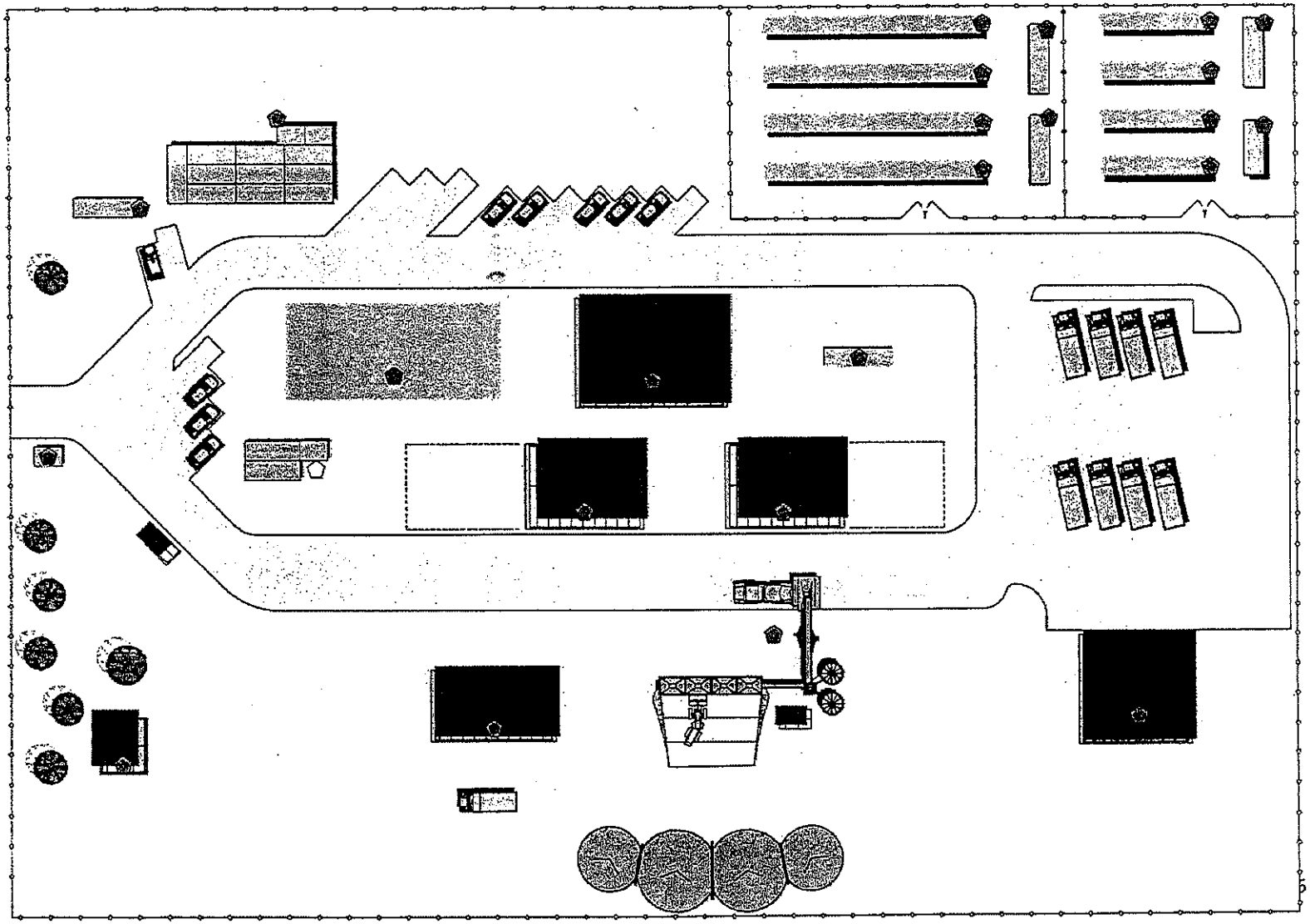
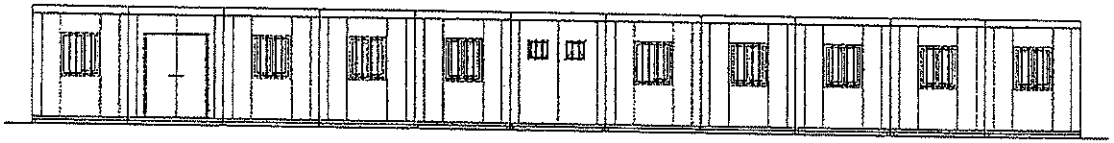
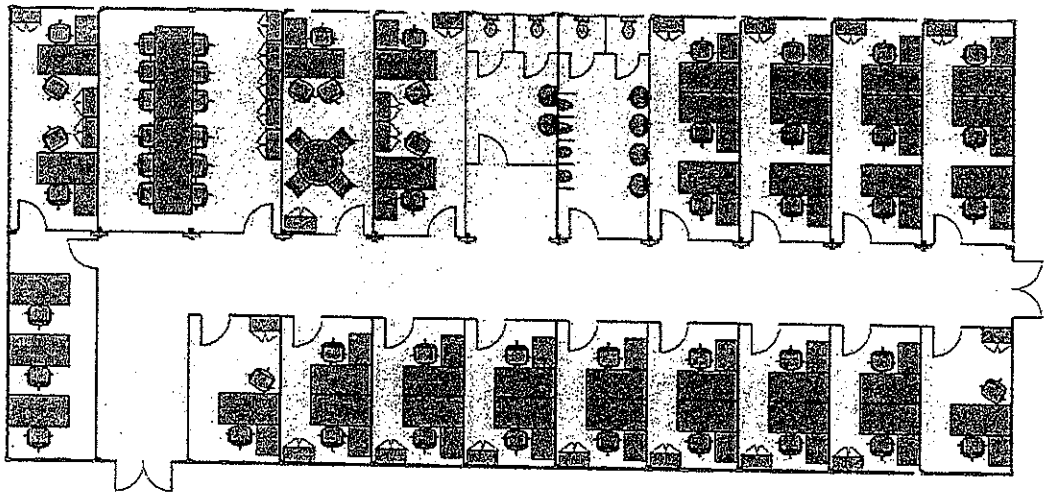


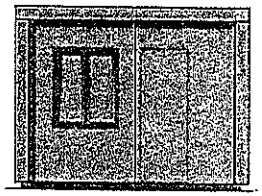
Figure 20 - Campsite

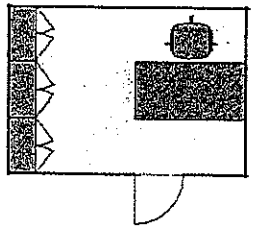
Offices

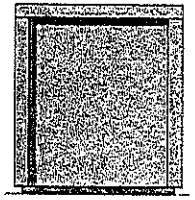




Entrance Clerk



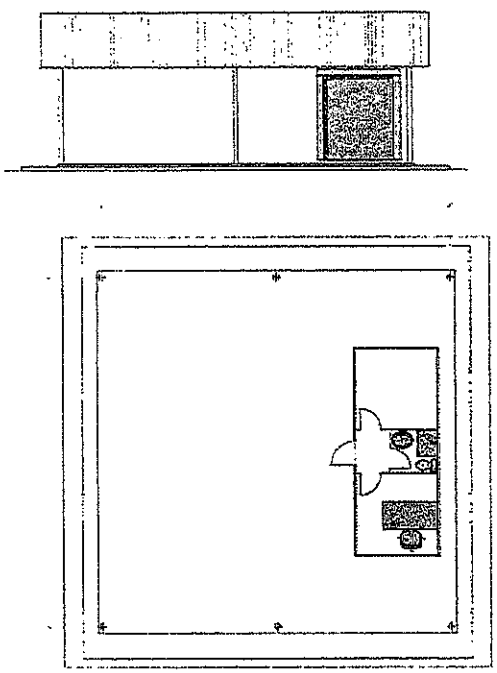


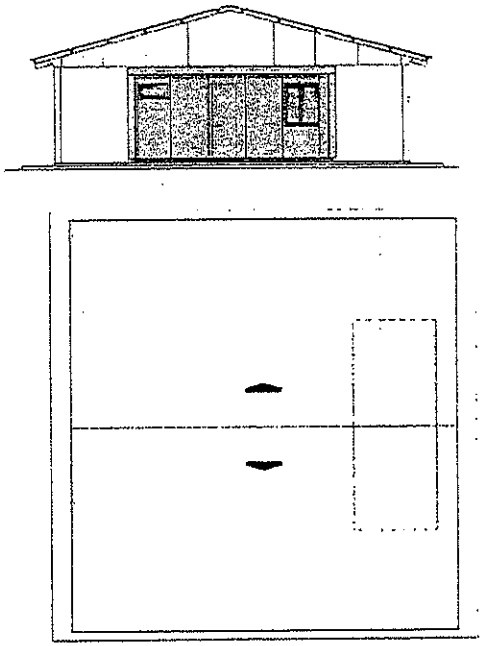


CONSTRUCTION SITE

MANAGEMENT OFFICE, OFFICE 1, BATHROOMS AND ENTRANCE CONTROL

Mechanical Service Shops



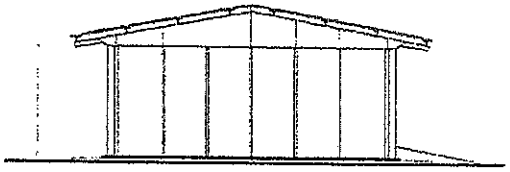


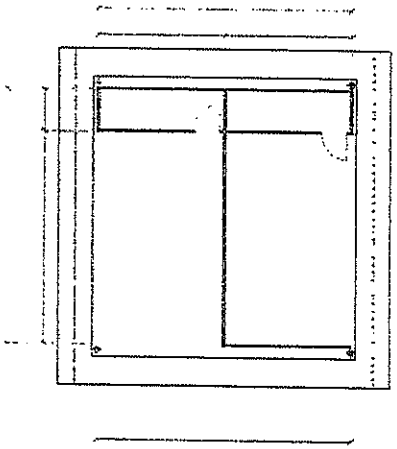
CONSTRUCTION SITE

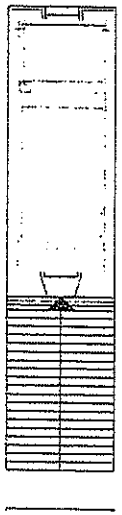
MECHANICAL WORKSHOP

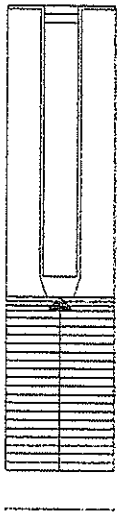
QGMI

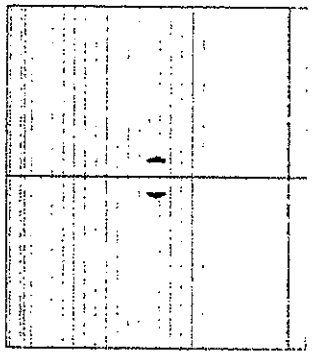
Washing, Lubrication and Fuel







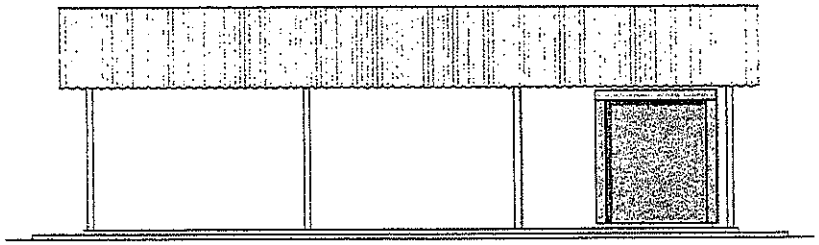


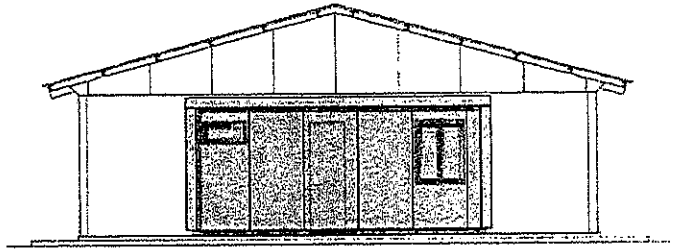


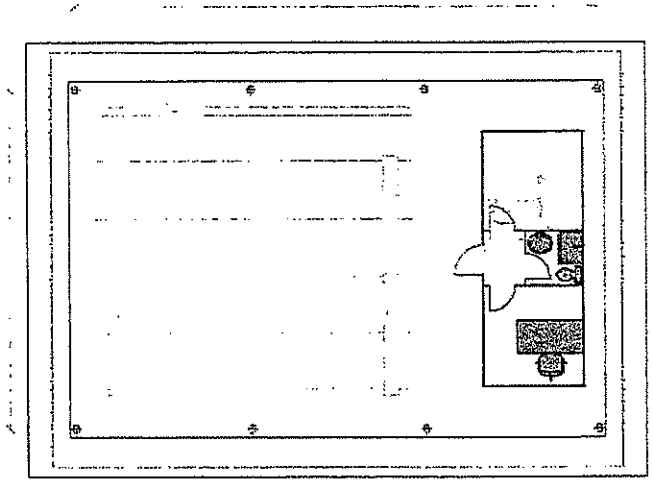
CONSTRUCTION SITE

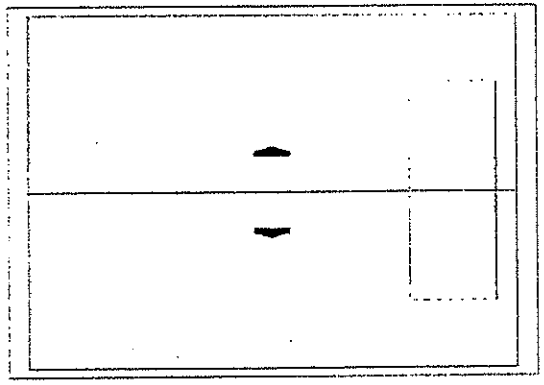
WASHING, LUBRICATION AND FUEL

Rebbar Setting Shop







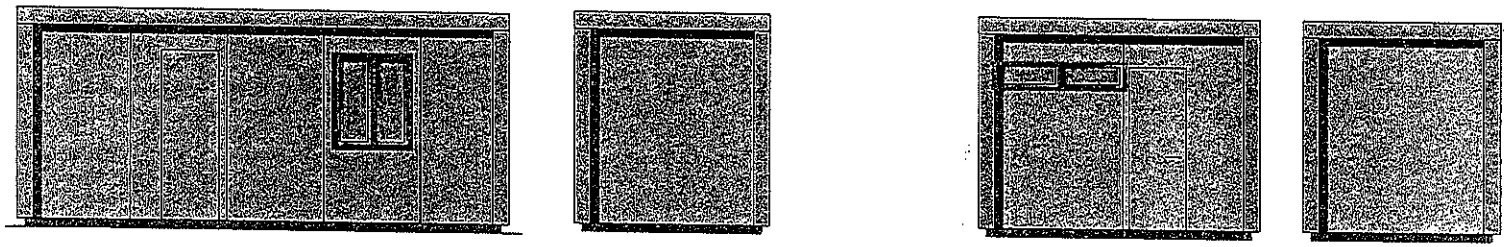


CONSTRUCTION SITE

REBAR SETTING SHOP

QGMI

Office 2 and Bathrooms

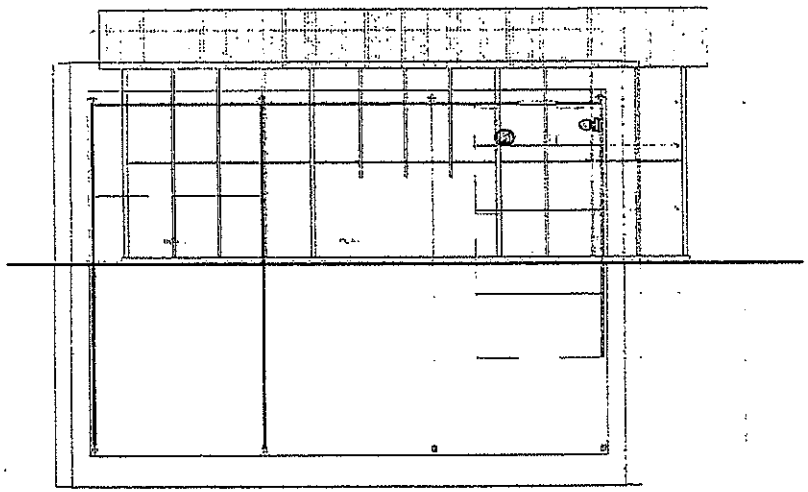


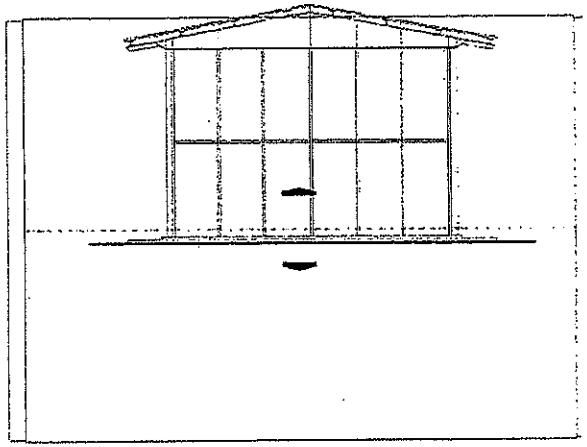
CONSTRUCTION SITE

OFFICE 2 AND BATHROOM

QGMI

Mechanical Shop

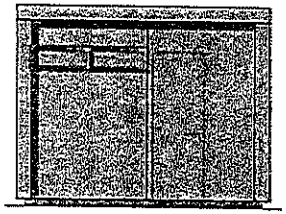


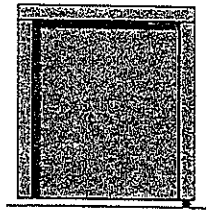


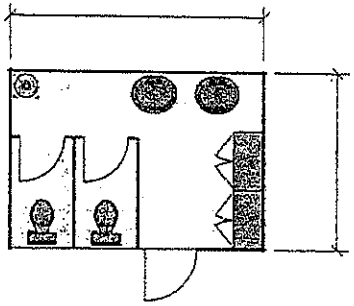
CONSTRUCTION SITE

WORKSHOP

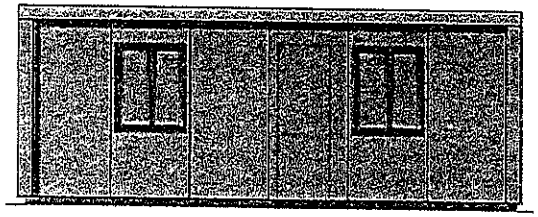
Dressing Room

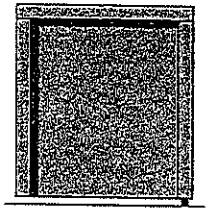


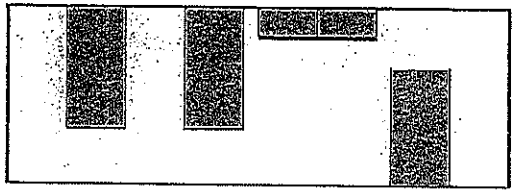




Office



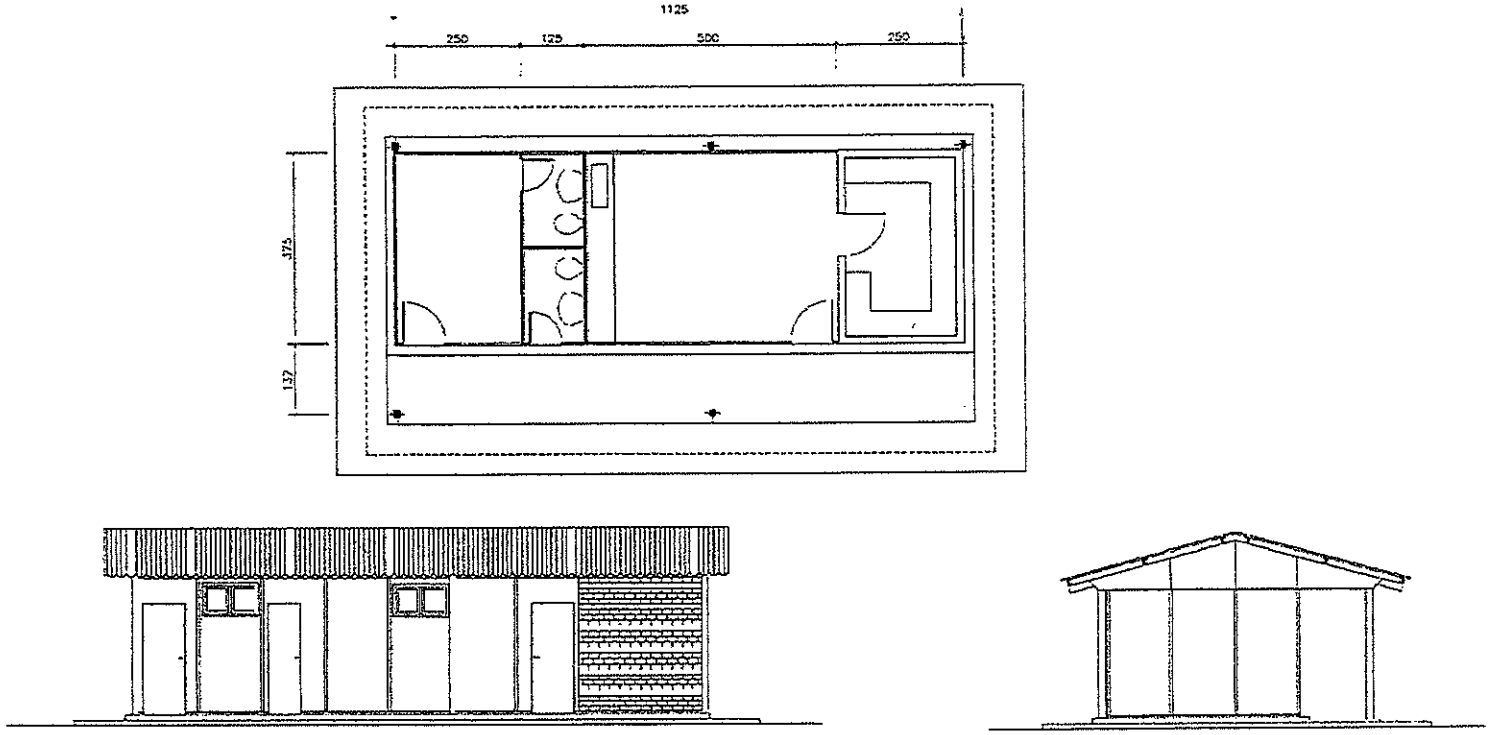




CONSTRUCTION SITE

DRESSING ROOM AND OFFICE

Laboratory

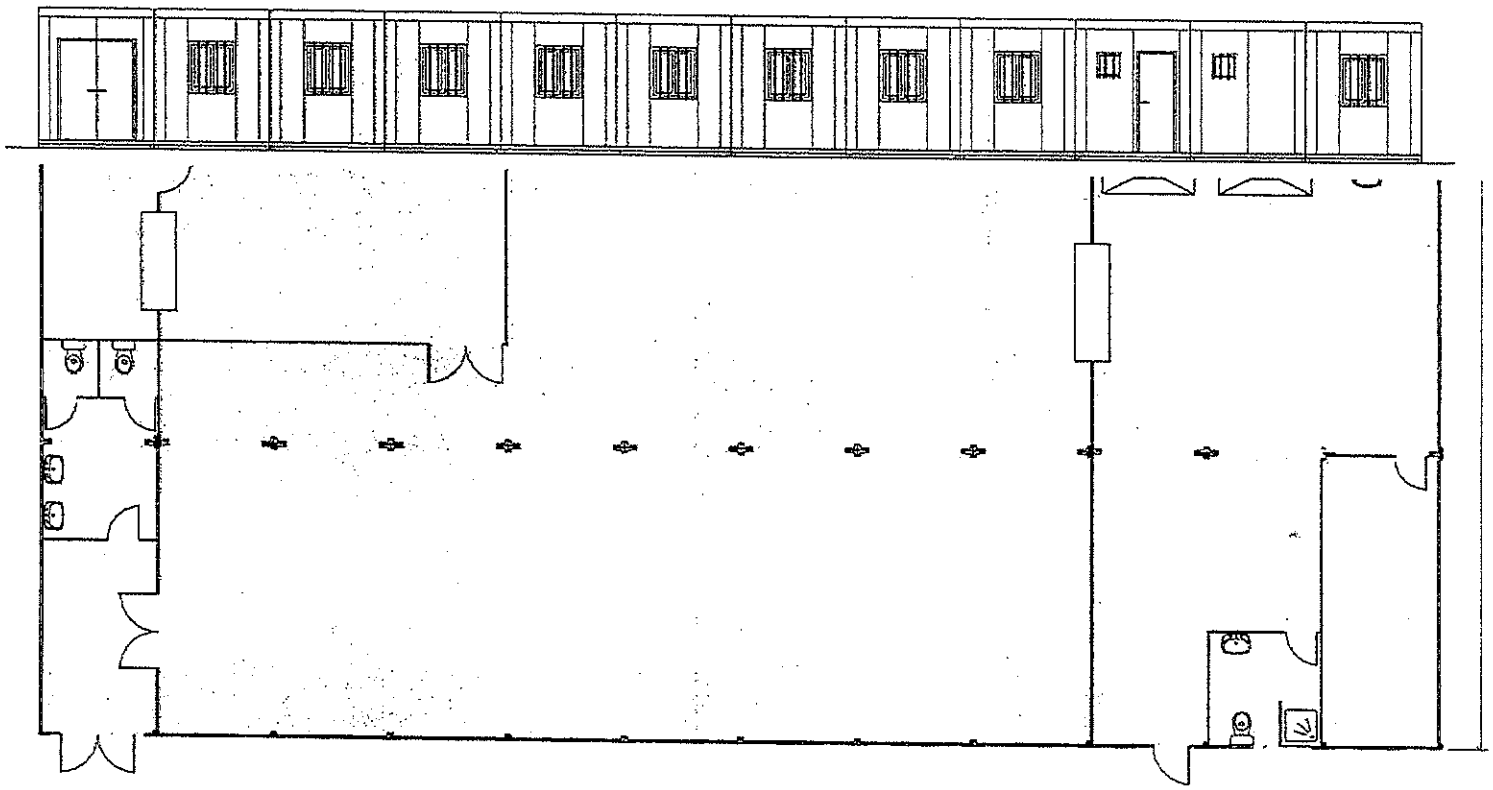


CONSTRUCTION SITE

LABORATORY

QGMI

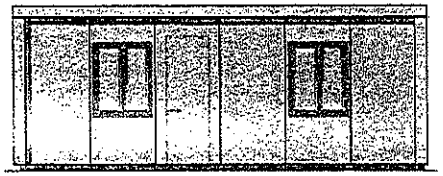
Kitchen and Mess Room

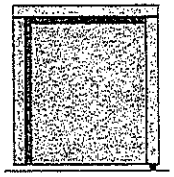


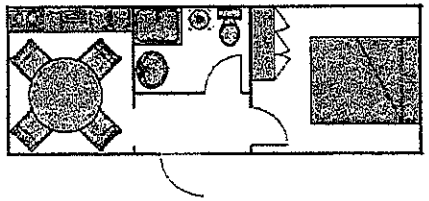
CONSTRUCTION SITE

KITCHEN AND MESS ROOM

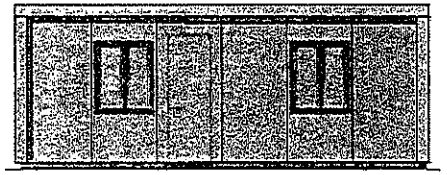
Lodging Type I

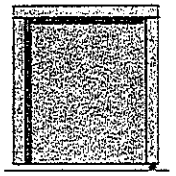


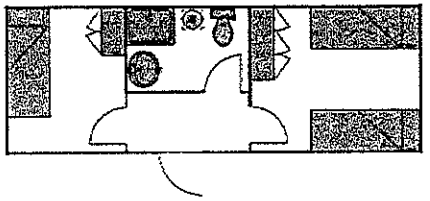




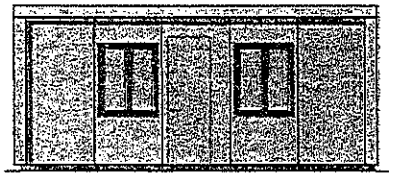
Lodging Type II

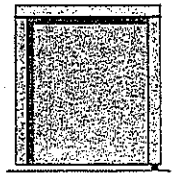


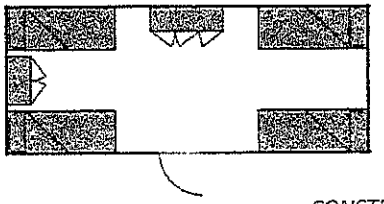




Lodging Type III





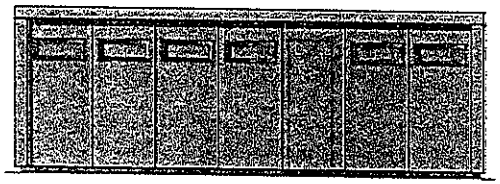


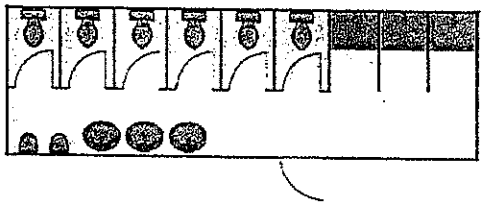
CONSTRUCTION SITE

LODGINGS

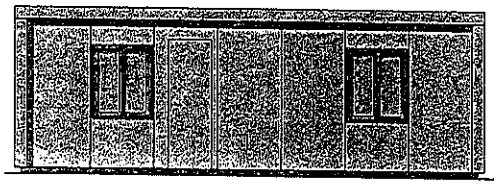
QGMI

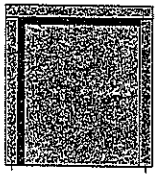
Sanitariums

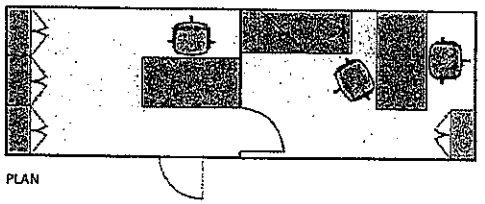




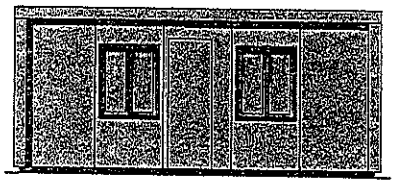
Ambulatory

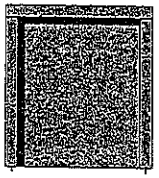


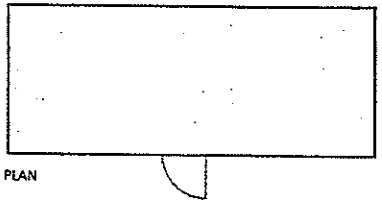




Recreation Area







CONSTRUCTION SITE

SANITARIUMS, AMBULATORY AND RECREATION AREA

3.3.2. CONSTRUCTION SITES

3.3.2.1. SUPPORT LOGISTICS

a) Administration of Human Resources

One of the bases of the enterprise policies from the Proponent is to search satisfaction of its employees, which constitutes the motivation agent for quality, efficiency and interest in the job. This posture to form a stable and motivated human asset has characterized its action along time, with excellent results, due to the offer of:

- Opportunities for development and training;
- Adequate remuneration levels;
- An ample social benefits' program.

Actuating in this form it became possible to constitute, on each worksite, a motivated crew with low rotation indexes and have an effective return of the investment through the work productivity and quality. The policies and general directions from the company referring to those topics are described in this item, together with those developed specifically for this project.

- **Recruitment and selection**

The selection of the availabilities for transferences and local recruitment will be the responsibility of the personnel sector on the worksite, who will use the most efficient communication systems for each type of personnel which will be needed (announcement in major regional newspapers, particularly those preferred by social position to which the professionals belong, and community entities) and will forward the candidates to the selection process, which will be made by specialized personnel, by means of interviews, practical tests, analysis of previous experience and medical examinations prior to admittance, besides psychological tests for candidates to positions which present risks for accidents.

Those candidates approved in all phases will be contracted and directed to the initial training.

- **Meals**

Balanced meals will be served, with a diversified menu and containing an adequate content in calories. The meals will be supplied without charges.

The meals will be produced in the worksite area with own personnel or leased to a qualified regional supplier. The company will follow up the quality of the meals, maintaining contact with the supplier, whenever necessary. The meals will be consumed in the mess room to be built in the construction site, in accordance with description provided in the specific item.

It is forecasted the supply of breakfast and lunch for the whole crew. The dinner will be served only for those which will be working during the night shift (security personnel) and for the transferred personnel, living in the camp.

- **Transportation**

For the transportation of the personnel hired in the vicinity of the worksite, buses will be used to transport personnel from the lodging area to the work places and from the nearby communities

to the construction site or to the work fronts.

For the part of the administration personnel which live in places nearby the construction site, will be used station wagons or pickup trucks, which will collect the personnel from certain predetermined point, and will be transported up to the construction site. This transportation will be without any charges.

- **Supplies**

To provide technically satisfactory alternatives, a preliminary survey of existing inputs in both regional and outside the country will be made, selecting suppliers based on the quality of products and delivery punctuality.

This cadaster will be complemented with information about the performance of those suppliers and with new alternatives which may be identified.

As verified, the Tamale city has a commercial structure which allows not only the assurance of the supply conditions of inputs, as well as providing trustworthy alternatives, as is the case with crushed stone and natural material for construction, food, etc..

Purchases will be made by supply sector of the worksite, following the usual company routines.

It will have a control of stock which will allow the administration of the adequate levels for each item, taking into consideration its use, time for reposition and degree of urgency for its delivery.

The transportation of materials purchased in Ghana will be made, whenever possible, by the suppliers. In case this is not possible, adequate own vehicles will be used to collect the materials from the suppliers.

The mess room was dimensioned with 1.00 m^2 per employee per shift, and it may operate with up to 3 sequent serving shifts and is positioned such as to not interfere with the operation of the other units.

This unit will consist of a building set up as one single pavement, containing:

- Mess room;
- Pantry;
- Bathroom;
- Lavatory;
- Drinking fountain;

- **Bathroom/Dressing Room**

The bathrooms are dimensioned taking into consideration the use of toilets, a washbasin, besides individual lockers and circulation areas, for each group of 20 employees, besides a shower for each group of 10 employees, resulting in approximately 7.00 m^2 per each group of 10 employees.

This will be a single pavement building, containing 4 toilets, washbasins, urinals, 8 showers and individual lockers for each group of 80 employees.

The sanitary installations will be built with resistant and washable materials, waterproof and anti slip, with adequate lighting and ventilation in order to proportionate well-being for users.

For sanitary sewage, the Proponent will provide septic tanks, anaerobic filters and/or septic drain pits in number and dimensions compatible with the number of employees.

The septic tank will be used to receive the raw sewage, separating through decantation, the heavier solids from the liquid, which will be transported through pipes to the anaerobic filter and/or to the septic drain pit.

- **Utilities**

It is Proponent' responsibility to provide the supply for the needs of water, as well as the complete installation of the water and sewage network. It is responsibility of the Proponent the care for the needs of power for the worksite, including tension reduction, if necessary, installation of poles and a distribution network.
The other needs for the Construction Site, such as: sealing, treatment and/or supply of drinking water, collection and drainage of sanitary and/or industrial effluents, communication, security, maintenance, operation, etc., will also be under the responsibility of the Proponent.

The installations of the Construction Site will fully comply with the dispositions of the safety, quality and environment norms and will include, whenever applicable, the items below listed:

- Field drinking fountains;
- Mess room, bathrooms and dressing rooms;
- Work benches for molds, rebar setting, assembling, under others, properly covered;
- Security and access control for the Construction Site;
- Safety and training room;
- Storage for gases, paints, flammable materials and fuels, in accordance with the pertaining legislation;
- Stalls for the storage of bulk materials, such as sand, crushed stone and others;
- Fire fighting system;
- Parking areas covered, at least, with crushed stone;
- Perimeter of the area of the Construction Site will be properly fenced.

- **Directives for Construction of the Construction Site**

The Proponent will use following directives and recommendations:

- All buildings from the Construction Site shall contain the following minimum specifications:

a) Containers with steel plates with walls in some places, with masonry and smooth cement floor, ceramic, PVC plastic or wood, always without saliencies and waterproofed against soil humidity;

b) Cemented walkway around with, at least, 80 cm width;

c) Coverage of the industrial installations with fibrocement (without asbestos) or metallic tiles, with internal finishing in order to guarantee the appropriated thermal comfort;

- It will be the responsibility from the Proponent the operation, maintenance and preservation of its worksite installations, maintaining them always in the best work and hygiene conditions, eliminating all work methods and environments favorable to proliferation of vectors (noxious insects and rodents).
- The offices will have compartments with a minimum area of 7 m² each (except bathrooms) and will have furniture, equipment's and accessories which are adequate for its use, and there are also forecasted 4 (four) cabinets with 3.0 x 3.0 m size, equipped with furniture, air conditioning, point for power plugs, telephone and for the web (Internet), for the use of Ministry of Roads and Highways inspectors.
- It is also foreseen the installation of chemical toilets along the work fronts, in a proportion of 1:20 employees complying with the requirements and environmental norms in force and they shall have reservoirs with a capacity for 7 (seven) days. The collection of the chemical sanitary effluents will be made by the Proponent, by means of companies properly licensed and approved by Ministry of Roads and Highways. The contracts referring to the rental of the toilets and the collection of effluents will be available on the work fronts for the proper checking by Inspection.
- The Proponent will provide an appropriated and exclusive space where the employees may have their meals, and will be responsible for the maintenance, hygiene and daily cleaning of the place, and it will not be allowed to prepare, heat up or have any type of meal or lunch outside the mess hall, considering also:

a) Besides the meal room, the mess hall will have also a reception area and one for the reception and conditioning of food to be served, and an area for collection and delivery of used cups and utensils;

b) Washbasins are foreseen at the entrance, in a number proportional to the demand, provided with paper towels, soap and rubbish baskets, and on the way out, baskets for selective rubbish will be available;

c) The mess room will have equipment to heat up food (when necessary), drinking water served in plastic cups, desks covered with plastic washable material, and individual chairs;

d) The sewage of the residual waters, after the proper treatment for grease, will be interconnected to the adopted sewage system;

e) The Proponent will be responsible for the management of residues from the Construction Site, forwarding them to places properly licensed or indicated by Ministry of Roads and Highways.

- For the Collection and Treatment of Effluents system, the Proponent will adopt following procedures:

a) Effluents will never be directed to water bodies (lakes or rivers) or to the rain water drainage network;

b) Effluents from showers and washbasins, are also considered sanitary effluents, and as such will be object of treatment;

c) The sanitary sewage and residual waters will be conducted and interconnected to the existing collector system. In case this option does not exist, the Proponent will built a sewage treatment system, dimensioned to collect all sewage and served waters generated in the Construction Site, which do not generate effluents, and those will be collected by adequate companies, properly licensed for this activity, in accordance with the existing environmental norms;

d) In places where oil spilling may occur (service shops, garages, areas of mechanical maintenance, under others) a specific drainage with water and oil separators will be installed;

e) The oil collected in the separators will be removed from the site in appropriated containers, by credentialed transport means.

- The stores (warehouses), service shops, carpentry, industrial installations in general, as well as those aimed for the cutting and bending of construction steel, various welding, use of rotary tools in sheds and similar, will comply with following conditions:

a) Will be preferably built with metallic structures, properly grounded;

b) All benches will have appropriate grounding;

c) Lights inside the installations will be protected against impacts originated by cutting and grinding of pieces;

d) Under no hypothesis the storage of flammable liquid fuels will be made inside the shops.

- For the electric power installations, will be considered following procedures:

a) For transformers, they will be fixed in isolated places, fenced and with restricted access, and with signs identifying tension and pointing out the risks;

b) For oil transformers are foreseen boxes for the collection and later treatment of the spills;

c) The distribution panels will be grounded, with residual circuit breakers, and must have individual circuits for lighting and for plugs for each unit of the Construction Site;

d) The distribution panels will be built in steel and closed;

e) The cables for interconnection or distribution will be mounted on poles and, in open areas, all plugs will be fixed on easels and protected against water;

f) Installations for Protection Against Atmospheric Discharges are foreseen, in accordance with the present norms.

3.3.2.2. COMPOSITION AND DESCRIPTION OF THE UNITS OF THE CONSTRUCTION SITE

The Construction Site is constituted by units for Administration and Production, Industrial Area and Community Area, whose numbering of the units indicate its position in the Construction Site Plan, involving:

- **Administrative area and production of Rebars and Molds / Carpentry**

a) Entrance Control (5);

b) Office (1);

c) Infirmary (12);

d) Bathrooms (11);

e) Generators (17);

f) Store/Warehouse (2);

g) Kitchen and Mess Room (7);

h) Carpentry (3);

i) Rebar Setting Shop (4);

- **Industrial Worksite**

The industrial worksite includes the support installations aiming the construction activities of the work itself. It will be composed by the following units:

a) Parking for Machines and Trucks (20);

b) Mechanical Shop (15);

c) Batching Plant (14);

d) Laboratory (6);

e) Fuel Service Station (16).

- **Community Area**

a) Recreation Area (13);

b) Lodgings type I (8);

c) Lodgings type II (9);

d) Lodgings type III (10);

- **Description and Objective of Proposed Installations**

a) Entrance Control

Its objective is to make the access control of vehicles, equipment and persons circulating within the internal area of the Construction Site and for the frequency control of employees besides maintaining the security of the site. It will have the proper signaling, 2 entrances for persons, and punch card terminals.

b) Management Office

This office was prepared to comply with the needs of the crews responsible for the technical-administrative works on the civil works. The dimensioning, as well as the necessary Sectors, were defined in accordance with the forecasted Indirect Labor.

This Unit will consist of one building with one sole pavement and will contain rooms for the technical- administrative sectors, meetings, toilets and pantry for the employees of the Sector.

The usage coefficient for spaces will be 4 m^2 per employee.

c) Inspection Office

The Inspectors Office will take into consideration the needs for the Construction control, supervision and inspection crews.

It will consist of a single pavement building, dimensioned in accordance with the specific needs, containing work and meeting rooms, toilet and pantry for the Sector employees.

d) Physician Ambulatory and Labor Safety

This unit has the objective to comply with the needs of the GQSMA crew (Quality, Safety, Health and Environment), within the safety, hygiene and comfort standards required by the Norms,

providing proper installations for the activities of the medical crew and the labor
e) Safety crew.

The Unit has toilet, waiting room, medical ambulatory and rooms for labor safety.

f) Store/Warehouse

The Store/Warehouse was planned for the storage and in and out control of materials to be used during Construction.

It consists of closed and covered buildings, dimensioned to comply with the Work needs, containing shelves, balcony, tool shop and room for the warehouse keeper. Outside, it will have a patio for the storage of non-perishable materials. This area will be isolated by a fence, in order to promote greater security and control of stored materials.

g) Mechanical Shop

The Shop was planned for the maintenance and lubrication of equipments to be used on the Construction. It consists of a closed and covered building, dimensioned to be adequate for the construction needs, containing shelves for spare parts, tools and a room for the maintenance foreman.

h) Kitchen and Mess Room

The kitchen and mess room were conceived to serve meals to everybody allocated to the Construction Site.

The mess room was dimensioned considering 1.00 m^2 per employee per shift, and may operate with up to 3 shifts per meal to be served and positioned in order to not interfere in the operation of the other units.

This Unit will consist of a building with a single pavement, containing:

a) Mess Room;

b) Pantry;

c) Toilets;

d) Washbasins: located on the external part;

e) Drinking fountains;

i) Bathrooms

The bathrooms were dimensioned to take into consideration the use of toilet, a washbasin, besides individual lockers and circulation areas, for each group of 20 employees, besides a shower for each group of 10 employees, resulting in approximately 7.00 m^2 per each group of 10 employees.

It corresponds to a building with a single pavement, containing washbasins, lavatories, urinals, showers and individual lockers for each group of 80 employees.

The sanitary installations will be executed in resistant and washable materials, watertight and anti slip floors, adequate lighting and ventilation in order to proportionate the well-being of users.

For the sanitary sewage, the Proponent has foreseen the installation of septic tanks, anaerobic

filters and/or septic drain pits, compatible in number and dimensions with the number of employees. The septic tanks will have the function to receive the raw sewage, separating through decantation, the heavier solids from the liquid, which will be transported through pipes to the anaerobic filter and/or septic drain pits.

3.4. ORGANIZATION, MOBILIZATION AND PERSONNAL SCHEDULLE

3.4.1. ORGANIZATION

3.4.1.1. ORGANIZATION CHART

The teams to be employed in the constructions activities for this works were dimensioned for the perfect attending of the works necessities detected, regarding to the foreseen terms and the local conditions, based on the experience of the PROPONENT COMPANY in the conduction of works of similar size and object to the ones in this current Tender.

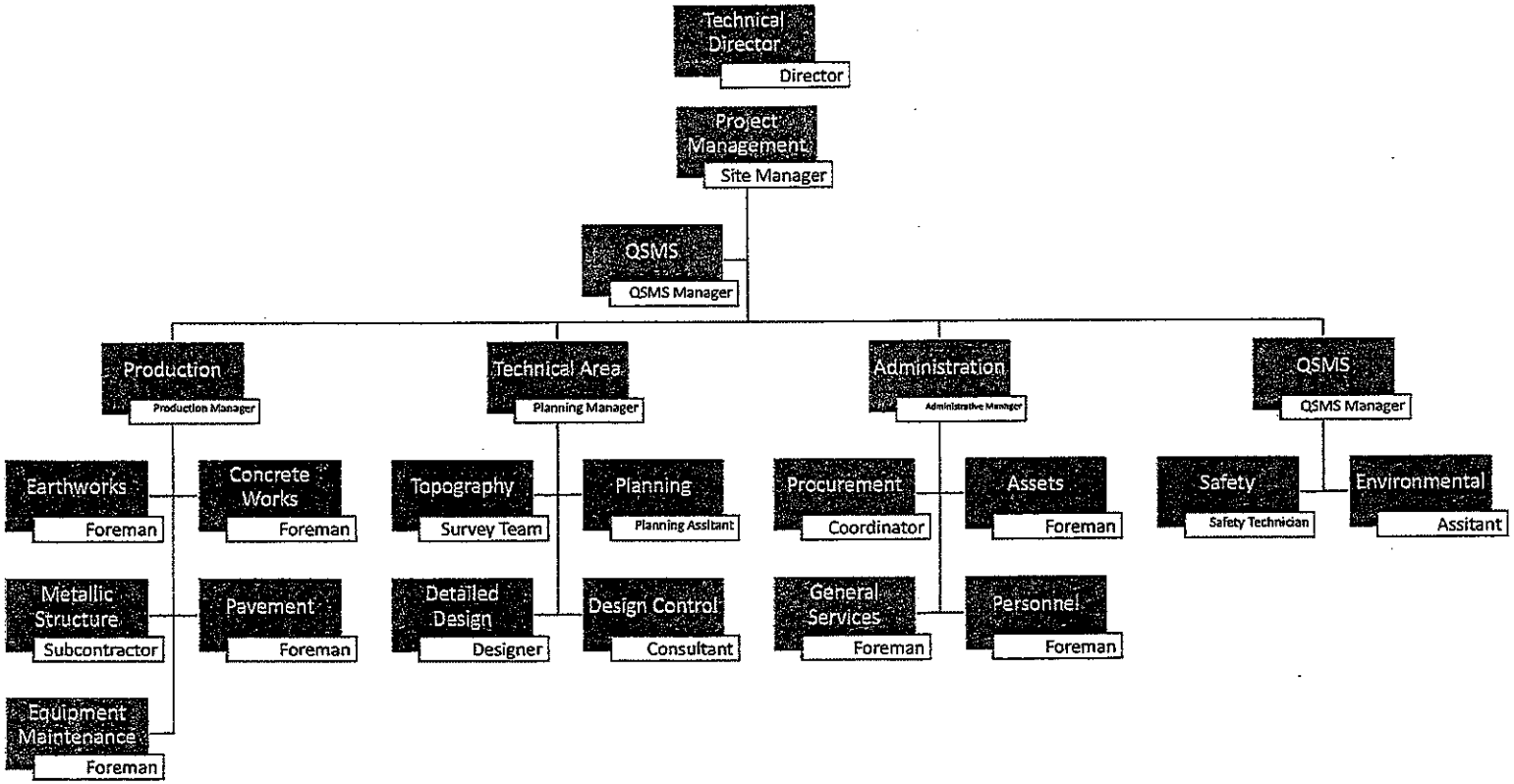


Figure 21- Organization Chart

3.4.1.2. DESCRIPTION OF ATTRIBUTIONS AND TASKS OF KEY ELEMENTS

- **Project Manager**

The Project Manager will be in charge of the work involving coordination of the technical-administrative teams foreseen for the performance of services, as well as the relationship and representation of the PROPOSING PARTY at the CONTRACTING PARTY.
Such manager will also be in charge of executive planning and scheduling of production services, labor and materials forecasts and administration of human and financial resources, and maintenance of machines, vehicles and equipment, service measurements and sub-contractor agreements.

The Project Management Engineer will be an engineer with vast technical and administrative knowledge, with leadership skills and of easy relationship and shall bear the general responsibility, being the representative of the PROPOSING PARTY, in matters regarding performance of works. Such engineer bears direct command of Operation Coordination at company level, represented by the Technical Director.

Will count with three sections, sub-divided into the following sectors listed below so as to obtain efficient performance of his/her tasks:

- **Production**
    - **Production Engineer**

The production sections will be lead by Senior Engineers bearing the denomination of Production Engineers, who will be in charge, at technical and decision levels, of al activities related to performance of such services foreseen for the works.

The tasks of such engineer will basically comprise coordination of the respective production and technical areas seeking to comply with the executive scheduling and the cost control goals and pre-established quality guarantees.
This engineer will count with the support of 3 (three) Production Engineers and of masters from various Fronts;

    - **Production Sections**

Such will be responsible, at executive level, for the performance of al activities regarding the construction works.

The Production Sections will be lead by Production Engineers and with Medium Level Masters and Foremen, with vast experience in production areas of works construction.

- **Transportation and Maintenance Section**

Will be in charge for deployment of materials and labor for the performance of services, including external personnel, materials and equipment transportations.

Shall have, also, the basic attribution of rendering support to all preventive and corrective maintenance services of equipment and vehicles of the PROPOSING PARTY, allocated at the works.

- **Technical Area**

Support attributes for the Production Engineers, the Technical Area include the Sections of Planning and Control, Topography, Design and Quality Control.

Works of relative complexity, such as those currently bid, demand maintenance of a work site, a technical team specialized in interpretation of projects, topography, scheduling of service performance, dimensioning of resources and other activities related to the perfect planning of building services. Such supervision aims at performance of this roll at the work site, solving the problems that take place in such situations. The following sections are available for support so as to obtain perfect performance:

a) Planning and Control: in charge of controlling human resources and the materials used in the productive activity, and for the physical follow-up of services performed, as well as for the control of operating costs.

b) Topography: in charge of performing topographic services, developing such activities inherent to the location of axles and leveling of quotas established in the project, for the protection and preservation of all marks and references, as well as for the relocations or re-markings deemed necessary, as well as for the elaboration of all physical measurements deemed necessary for topographic surveys to be carried out.

c) Design: in charge of reception, analysis and distribution of works projects, detailing of executive methods for construction, guidance of topographic services and technical file.

d) Quality Control: in charge of implementation of quality assurance processes, especially the Technological Control performance coordination for the works.

- **Administration**

To render administrative-financial support to the Production and Technical Areas, lead by person with vast experience in works of similar size.

In charge of all administrative activities that involve human and financial resources, and the auxiliary services that comprise surveillance, meals, lodging do company working contingent, hygiene, occupational health and safety and such activities inherent to provisioning of materials for the works.

There will be four sections available for support for the development of such activities: Occupational Labor Health and Safety; Supplies; General Services and Human Resources.

a) Occupational Health and Safety: will bear the objective of developing activities that directly contribute to enhance the safety condition of personnel involved in the works, as well as avoid accidents and damage to equipment, installations and services of the works already performed or in progress. The Labor Health area will be in charge of carrying out pre-admission and periodic tests, first aid attendances and attendance and administrative guidance of benefits at social security entities.

b) Supplies: will be in charge of all activities inherent to the provision of materials for the works, their movement and storage.

c) Personal: in charge of human resources management;

General Services: will be in charge of developing such activities involving the relationship in all functional, juridical and social aspects, in addition to being responsible for the financial movement destined to payment of employees and suppliers located in the region of the works, and by the surveillance services.

3.4.2. WORKSITE PERSONNEL SUPPORT LOGISTICS

3.4.2.1. LABOR RECRUITMENT AND SELECTION PLAN

In accordance with bidder philosophy, human resources are the essential base for production and success of any enterprise. Special attention will be given to mobilization of human resources for this job, by allocation of personnel, which is part of company permanent staff, or by proper selection of external resources.

In this way, staff crew for this job and their direct auxiliaries (management, specialized technicians, sector heads, supervisors, etc.) will be mobilized from permanent human resources lists of bidder, and will have provable experience in jobs similar to that of present Bid.

Since it is bidder's policy, in relation to human resources, to add value to local labor, personnel recruitment will be made preferably near the work area and nearby areas in the Northern Region.

But, whenever it will become impossible to obtain local labor, due to specialization of tasks, necessary work markets will be activated.

Selection of personnel to be contracted will involve qualification of candidates. Labor mobilization will be based of Labor Time Chart.

3.4.2.2. MEDICAL/SOCIAL ASSISTANCE

Within adopted policy, to support allocated human resources on the work, it is forecasted, besides medical assistance, also preventive medicine. Medical assistance will include an ambulatory on the work site, with physician present twice a week. Emergency and hospital support will be provided by clinics convened with Bidder. For development of preventive medicine, within present legislation, following program is forecasted:

- Pre-admission examination;
- Periodical examinations;
- Attendance and control of work accidents aiming preventive measures;
- Inoculation campaigns.

In this form, bidder will be prepared to comply with proposed objectives and prevent health problems, which may occur with human resources allocated to the job, making possible productivity levels that are compatible with forecasted terms.

3.4.2.3. PERSONNEL LIVING QUARTERS, TRANSPORTATION AND MEALS

This procedure, although preliminary, consists basically in creating "embarking/disembarking points" for employees, in strategically distributed locations and as near as possible to the living areas. For those living at greater distances from "embarking/disembarking points", they will be supplied with "transport tickets" in order that employees sacrifice is the least possible.

This study will be complemented after Personnel Selection and Recruitment, since only then, knowing living place of each employee, the strategic embarking/disembarking points will be known or, another alternative system will be activated.

Vehicles for mass transportation will be buses, which must offer comfort and safety for employees. Same criteria will be used for specialized personnel; vehicles to be used are type Pick-up.

Bidder unit responsible for this task will be composed by trained employees to comply with pertinent legislation as well as norms stipulated by bidder.

Strategy to be adopted to solve food supply for personnel will be to supply meals in a mess hall work site.

It is common practice the correlation between meals/kitchen sector and Medicine and Labor Department, through existing regulatory norms, to exercise strict control on hygiene, food balance, etc.

3.4.2.4. EQUIPMENT MOBILIZATION

Mobilization of equipment's will be responsibility of Project Manager, together with Industrial Manager, as indicated in Equipment Mobilization and Sojourn Period Table, presented in item 3.1.4, prepared by technical division.

Main equipment's forecasted to be used on the job are bidder's property and are available on equipment yards works in close.

Equipment's reserved for this job and which will be transferred to the work site, will be repaired and or corrected, if necessary, at origin, so they arrive on destination point in perfect work conditions.

It should be stressed that all bidder equipment, undergo preventive and corrective maintenance, and it can be said they are in good working conditions and, consequently, with full operational capacity.

3.4.2.5. SECURITY ON WORK AREAS AND WORK POINTS

Property Security aims to preserve collectivity well-being, the property of Bidder as well as respect within work areas.

Security will be responsible for control of entry and outgoing of materials, equipment's and persons, on work areas.

Policy to be adopted will be surveillance by Company personnel, without use of guns, distributed in 12 hours shifts, including Sundays and Holidays, according to a "Shift Scale Table", prepared and released previously.

Since this is an activity of extreme importance for the job, special attention will be given to selection process and personnel training, so they become a specialized group.

3.4.2.6. MEDICINE, WORK SAFETY AND ENVIRONMENTAL PRESERVATION

3.4.2.6.1. OBJECTIVES

The specialized services within the Engineering areas of Work Safety and Medicine will have as a main objective to promote health and to protect the workers integrity in their working place.

This Sector, also subordinated to the Resident Engineer, will be responsible for the daily verification of the work conditions, besides the inspection of the mandatory use of individual protection equipment by all the employees.

This Sector will have as attributions:
a) to prepare, install and maintain all the plates, advertising and signalizing posters, etc., b) study and investigate the causes of eventual work accidents, searching

solutions for such possible failures;

c) to elaborate statistics about work safety;

d) promote lectures and films presentations about this subject.

- **C.I.P.A. (Internal Commission for Accident Prevention)**

CIPA has the purpose of observing and reporting risks conditions in the working environment and request measures taken in order to reduce - till their elimination - the existing risks and/or neutralize them, discuss the accidents occurred, sending the results of the discussion to the specialized Work Safety and Medicine Engineering and to the Employer requesting measures that can avoid similar accidents and still orientate the other workers about the accidents prevention.

CIPA will be composed by the Employer's and Employees' representatives.

- Ambulatory

There will be a place for the Physician and the Auxiliary to Work Nurse, implanted with all the sub- structure for the perfect performance of the Work Medicine.

Work Safety Technician

The Work Safety Technician will undertake the responsibility for:

- Inspecting the individual protection equipment, mechanical equipment, electrical equipment, hydraulics equipment and construction;
- Analyze the risks at work and determine the causes of accidents;
- Evaluate the rates about particular hazardous areas and suggest preventive measures;
- Revise, periodically, the safety installations and equipment.

Work Physician

The Work Physician will undertake the responsibility for:

- Proceed the pre-admission exams to the candidates for the jobs in the company, analyzing the results of the complementary exams and issuing a final technical report;
- Attend, diagnose and treat professional diseases and the urgent cases in the event of occurrence of work accidents;
- Proceed, periodically, exams in all the employees in order to detect diseases that can impede the exercise of the profession or that put in risk the health of the other employees.

3.4.2.6.2. RESOURCES FOR THE PREVENTION OF ACCIDENTS, CONSIDERING THE RISK GRADES INHERENT TO THE NATURE AND CONDITIONS OF THE FORESEEN CONSTRUCTIONS

The material resources for the prevention of accidents that the Builders will use during the development of the works shall the most technologically modern and will avoid accidents in the transport, handling and hoisting of cargos and work materials.

3.4.2.6.3. INDIVIDUAL AND COLLECTIVE PROTECTION

The utilization of Individual Protection Equipment - I.P.E. depending on the tasks being performed, will be mandatory and shall be in the correct manner, in accordance with the British Regulation and Environment Standard.

If it is not possible to eliminate the risks, the I.P.E.s necessary to each type of service will be planned based on the Environmental Risk Map. The supplying, control and the obligation of use shall be in compliance to the British Regulation and Environment Standard.

A minimum spare stock of I.P.E. and working suits equals to 20% of the total number of employees in that function, shall be kept ready for use.

- **Specific Conditions for Machinery, Equipment and Tools Safety**

Will be attended regarding to machinery, equipment and tools.

3.4.2.6.4. ENVIRONMENTAL PRESERVATION

The "Environmental Programs", recommended at the time of the Works License shall be attended as well as the special measures adopted regarding to the maintenance of work sites, safety of vehicles within the work site and the accesses, disposition of going-away areas.

4. BUILDING PROCESS

4.1. LAND CLEANING

Tree cutting, pulling tree stumps and general cleaning will be made with use of caterpillar dozers, complemented with use of manual services.

This will involve following activities:

- Cut and removal of all vegetation, whatever its density;
- Cut and removal of tree stumps and roots;
- Removal of soil or organic matter layer, up to 20 cm, as well as any other materials and undesirable objects eventually existent:
- Material deriving from above mentioned operations will be removed or stored, in accordance with criteria defined in environment prevention specifications;

- Minimum area in which above mentioned operations will be done is that between off-sets, adding 2 m to each side;
- Along cuts care will be exercised so that layer up to 60 cm below land grading grade is exempt of stumps and roots;

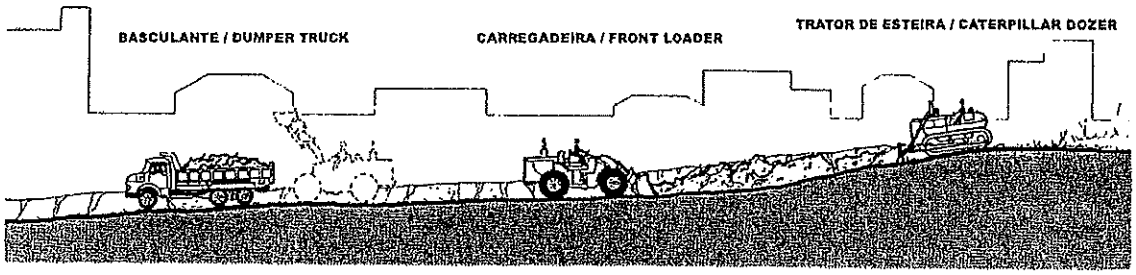


Figure 22- DEFORESTATION AND MECHANICAL CLEANING OF LAND

4.2. EARTHWORKS

4.2.1. MECHANICAL EXCAVATIONS

As a rule, all excavation will be executed by means of mechanical processes, wherever the access of equipment is possible, except in the following cases where the excavation will be manual:

- Areas where the access of equipment is not allowed;
- Registered or detected nearness of the interferences;
- Regularization of bottom of trench;
- Stub pipes for the execution of piping connections;
- Other areas according to the criteria established by Inspection.

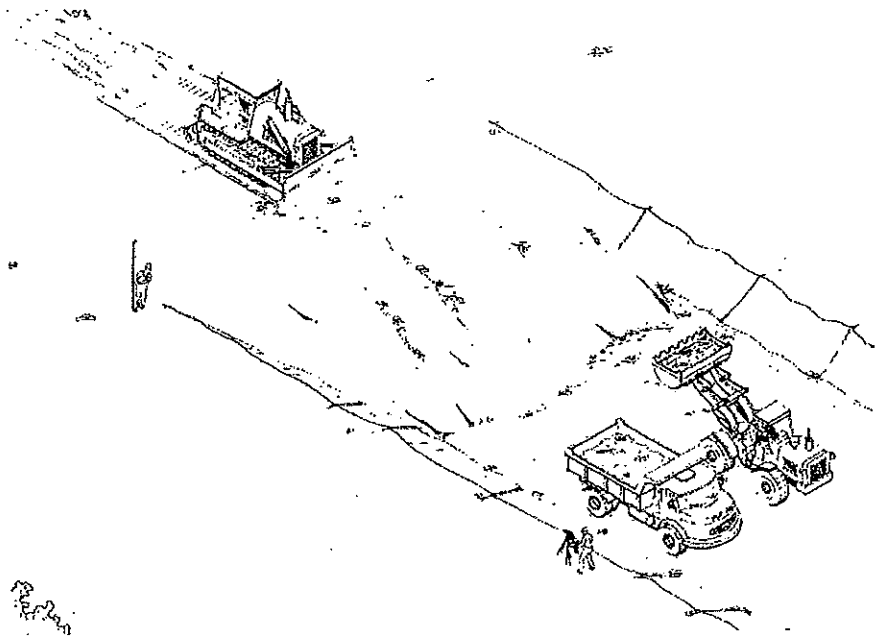


Figure 23-Mechanical excavation

The materials inadequate to compacting and considered not stable to support the required loads, shall be removed and taken to the waste area, which localization will be previously approved by Inspection.

The bottom of the excavations will be leveled in accordance with the elevations indicated in the engineering design, allowing for a small variation below the required elevation, in accordance with the Inspection criteria, without being considered as an extra payment.

The earth coming from the excavations will be utilized for embankment, re-embankment backfill or taken to the waste area as indicated by Inspection.

4.2.2. MANUAL EXCAVATIONS

Manual excavations will be performed in the foundations and trenches, whenever no conditions are present for the safe performance of mechanical excavation. The manual excavations will be executed in compliance with the areas, alignments, dimensions, shapes and elevations established by the engineering design for the works. The dimensions of the manual excavations will be the minimum compatible with the execution of the services and in accordance with the Inspection's criteria. The manual excavations will be executed in such a way to prevent interruption of the works, in order to avoid erosion or slips that can might damage future services.

4.2.3. BACKFILL

Earth backfill next to concrete structures or piping will be performed with soil free of stones, wood, debris or any material that might damage the installations, equipment or any other element inside the trench.

The soil necessary to the backfill will come from the excavation itself or from selected sand or clay pits.

Earth backfill close to structures shall only be started after completion of the necessary time for the development of enough resistance of the structural concrete and after the necessary tests.

Backfill shall also be developed at the same time of the removal of occasional bracings

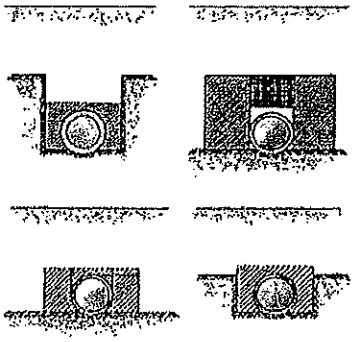


Figure 24- Backfill

4.2.4. DRAINAGE

Drainage will be performed whenever necessary at the bottom of the trenches/lateral open ducts, in order for the water to be collected by the pumps at adequate points. Pump sieves shall be placed in small internal wells to these drains and covered with crushed rock in order to avoid erosion.

After the rains and after completion of the drainage of trenches/open ducts flooded by the water torrent, any pipes already set shall be cleaned internally. Pipes with closed ends shall be duly stabilized with ballast to prevent floating, should the trenches be flooded.

Protection of trenches against flooding by surface waters will be accomplished by the construction of longitudinal low walls at the boards of the trenches, which will deviate the waters to the adequate discharge place.

4.3. EXECUTION OF CONCRETES

a) Materials

The materials which will be used for the construction of eventual concrete structures on the Access Branch and effective on the Rotary Car Turner will mainly be the following:

- Concretes and mortars;

- Rebar cages for reinforced concrete;
- Molds and centering.

a.1) Concretes and mortars

The materials which constitute those mixtures will be:

- Cement, which will be the common Portland cement or blast furnace type, and which will comply with the prescriptions of British Regulation and Environment Standard;
- Small size aggregates, which will be natural sand, whose physical characteristics comply with the prescriptions of norm British Regulation and Environment Standard or, artificial sand (Stone powder) which will only be used after checking the resistance of the mixture to compression, with laboratory assays and experimental on the worksite;
- Big size aggregates, which is material deriving from the crushing of untethered rock and/or rolled pebbles, whose physical characteristics comply with the prescriptions of the British Regulation and Environment Standard;
- Water: the water to be used to prepare concretes shall have physical and chemical characteristics which comply with the prescriptions of norm British Regulation and Environment Standard;
- Addictive's: the addictive, which will be of dispersant, aeration, plasticization, accelerating or retarding type, under others, will be used with the previous authorization from the Inspection, adequately dosed and applied, complying with the specifications from the suppliers.

In addition to the British standards, local standards are being respected.

a.1.1) Structural Concrete

- **Dosing**

The dosing of the structural concrete acquired from plants will be rationally made, by a specialized and officially recognized laboratory.

In the definition of dosing to establish the proportion of materials to be used in the construction, the following conditions and requirements will be complied:

- Peculiar conditions existing on the works;
- Need of weather-proofing characteristic of the concrete that will be used;
- Resistance to wear;
- Aggressiveness of the waters on the concrete to be used in structures which will stay in contact with water;
- Aesthetic aspects for the finishing of the exposed surfaces;
- Local conditions which affect and define the type o usage of concrete.

The chosen proportion of components will be tested in the construction site, with the rupture of concrete specimens molded on the site, with 7 days age and with 28 days age, to confirm their mechanical resistance as foreseen in the project for each type of structure.

In the case of non-structural concrete, the proportion will be made experimentally, complying with

the prescriptions of the British Regulation and Environment Standard.

The concretes to be used shall have resistance characteristics which are adequate to the type of structure to be executed, as defined in the project.

In addition to the British Regulation and Environment Standards, local standards are being respected.

- **Concrete manufacturing**

The concrete will be prepared in the concrete mixing plant, installed inside of the construction site.

The preparation of the concrete will be made complying with following privileges:

- The concrete will be prepared only in quantities necessary for the immediate use;
- The concrete mixer truck will be of a type and characteristics adequate to the type of concrete to be prepared
- The measurement of the material which composes the mixture will be preferably made on weight base using automatic or manual command gravimetric installations, properly verified

For the measurement of the water volume for kneading, measurement devices which will guarantee the measurement of the water volume with less than, or equal to 3% will be used

The introduction of the materials in the concrete mixer of the concrete truck will be made respecting the following sequence: part of the kneading water, part of the big size aggregate, cement, sand, the rest of water and as last, the rest of the big size aggregate

The addictive's will be added to the kneading water

- **Concrete transportation**

The concrete will be transported up to the molds in the minimum time possible.

The transportation means shall assure a minimum transportation time, to avoid segregation of the aggregates or variation of the workability of the mixture. The traffic of persons and equipment's on the concreting place will be disciplined by mean of pranks and walkways.

- **Laying**

The concrete laying will be initiated after the previous checking of the correct assembling and positioning of the reinforcement, and if the molds were adequately humidified and the unmolding material was applied.

Figure 25- - Laying Concrete

The maximum free fall of the laying will be 2 meters, using for higher depth, devices such as gutters or temier pipes, to avoid the segregation of the concrete.

The concrete launching process will be chosen as function of the location and of the characteristics of the structure to be concreted, which may be of following types, under others:

- Using the truck tap;
- By means of dumpers, dumper cards and wheelbarrows used for transportation;
- By buckets moved by cranes of adequate size;
- By gutters, pipes or channels covered with metallic plates;
- By pumping.

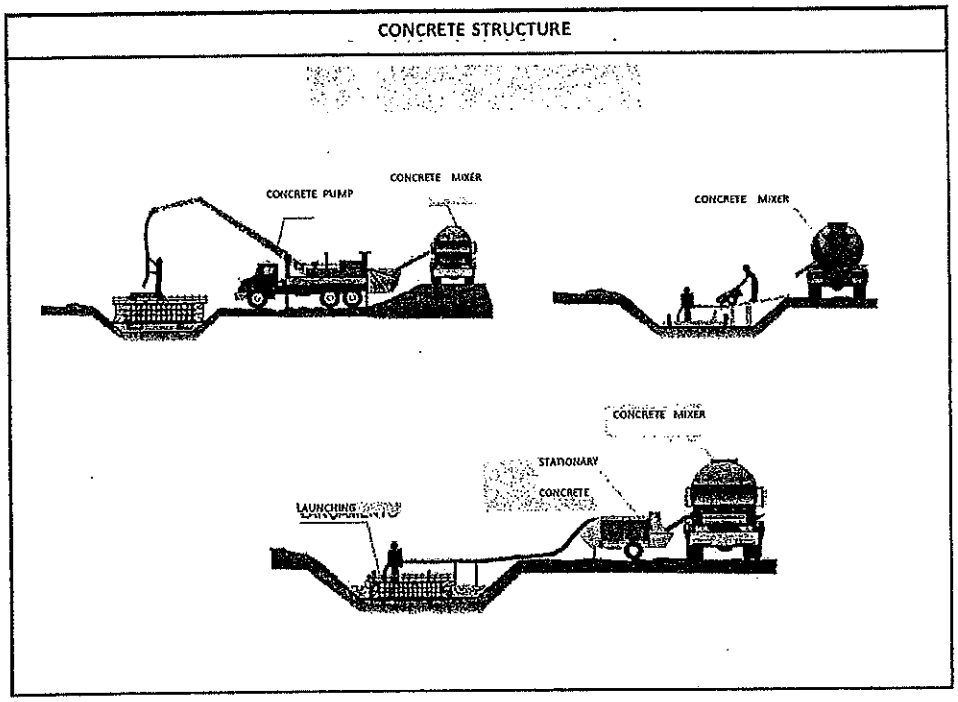


Figure 26-Concrete structure

- **Increasing density**

The increase in density will be made with the use of immersion vibrators or vibratory plates.

The vibrators will have the adequate size to the dimensions of the piece and to the density of the rebar, and will be used preferably in the vertical position, respecting a minimum distance of 10 cm between to contiguous vibration points

The concrete will be laid in layers of 50 cm, which corresponds to 3/4 of the length of the vibrator needle, which during its operation, will deepened up to the lower layer to proportionate its

integration with the just laid layer.

Figure 27- Concrete Levelling

- **Concreting**

The concrete laying will be made after approval from the Client, of the respective concreting plan and checking of molds, reinforcements and cleaning.

As general, the concrete will be launched directly from the concrete truck, through a tap in the case of blocks and pieces below soil level.

For the structures out of the direct reach of the concrete mixer truck, the concrete will be launched with the help of a concrete pump with arm launching the concrete up to 17 meters distance (which contemplates all heights foreseen in the construction).

Concreting plans will be developed previously, studying the concreting sequences, joints, retraction effects, hydration heat dissipation, deformations, etc.

- **Preparation of concreting joints**

The concrete surface will be washed with compressed air jets, while the concrete is still fresh, to remove all the cement cream which may form over it and to not allow the adherence of two concreting sections. This technique is known as green cut.

Up to when the concreting is reinitiated the surface will be maintained in a saturation state with water and, before laying the new concrete over the old one, a layer of mortar, with the same proportions of the concrete mortar will be laid, with the objective to make the connection between the two layers.

- **Preparing the expansion joints**

On the places were expansion joints are foreseen, and the concrete is in the process of hardening, washing of the joint surface will be made with a water and air jet under pressure, with the purpose to remove any loose material and all the cement cream eventually existing making this surface the most rugose possible.

If, eventually, the operation is only performed after the hardening of the cement, the cleaning of the joint will be made with the help of a compressed air jet, after surface pestle.

To apply the joint, the surface of the pasting areas must be exempt of concrete cream, lose or

contaminated parts. After this stage apply the proper joint adhesive Jene or equivalent, on the wall of the substratum. Clean the profile with the appropriate solution and apply the adhesive. Install the profile with the same width of the joint at 20º C (neutral point), press and remove the excess adhesive. After hardening of the adhesive remove the pressurization valve.

- **Finishing**

The surfaces without molds, not molded, will have the finishing executed with leveling rod, wood trowel or steel trowel, according to the case.

- **Concreting Joints**

The joints referred in this topic correspond to construction joints obtained during the necessary interruption of concreting and expansion joints according to the project.

In the case of impossibility to end the concreting in one period, or due to reasons which impede its continuity, concrete construction joints will be created.

Those joints will be left during the concrete lay out and density increase, in order to make possible its later preparation and continuity of concreting.

The preparation of the construction joint surface consists in the cleaning of the concrete previously laid, by applying successive jets of air and water under high pressure, proportioning a rough texture, humidified and clean, immediately before the new concrete.

The expansion joints will be executed rigorously in accordance with the project, with the details and technical specification indicated in the invitation letter.

During the concreting some special care will be taken during the lay out and density increase of the concrete, in order to involve the flap of the joint along its whole extension without displacing it. For that, the mixture will be deposited on the side of the flap, and transported through vibration in order to obtain a complete involvement of the flap and thus the filling of both sides of the joint.

After the proper concrete hardening period and structure unmolding, the joint will be carefully cleaned and the still open space will be filled with elastic mastic, according to specifications from the manufacturer together with the Inspection.

- **Construction Joints**

For this case specific materials will be used, like: Fugenband O22 joints, polyethylene blanket and polystyrene plates.

Those materials are handled and applied in accordance with recommendations of manufacturers and project specifications.

- **Hardening period**

The hardening process of the concrete will extend for 7 days at least.

The processes to be used will be defined as function of the type of structure, its geometric characteristics, and will be from following types, under others:

- Chemical hardening with the use of a water proof membrane;
- Application of a 4 cm thick water layer (for horizontal surfaces);

- Maintaining the concrete surface continuously wet;
- Applying a layer of sand with is maintained continuously humid;
- Application of continuously wet burlap bags;
- Hardening through vapor used for reinforced concrete elements in the pre-manufacturing phase.

a.1.2) Mortars

The mortars are mechanically prepared in concrete mixer and are applied within a period of 45 minutes after preparation.

a.2) Quality Control

The technologic control of materials used will be constituted by following tests and checking:

- Cement: characterization tests as forecasted in norms British Regulation and Environment Standard;
- Minor size aggregates: samples will be collected for each 50 m^3 and tested in accordance with norm British Regulation and Environment Standard;
- Major size aggregates: samples will be collected for each 50 m^3 and tested to comply with British Regulation and Environment Standard;
- Water: its quality will be analyzed and tested, to provide its characterization, as indicated in British Regulation and Environment Standard;
- Mechanical resistance of concrete: its characteristic will be tested with rupture of test specimens, with 7 days and 28 days age, in accordance with British Regulation and Environment Standard.

b) Metallic Reinforcement and Inlaid

The reinforcements of the concrete structures will be executed according to the project to be detailed. The steel used for the reinforcement of the concrete pieces, as well as the assembling shall comply with the prescriptions of British Regulation and Environment Standard.

The Company will supply and position all steel reinforcements, including mechanical connections, fixtures, wires, and anchor bars, locks, superposition or welded connections, and everything else necessary for the execution of those services, in accordance with indications of the project.

A rebar central strategically located in the construction site will be set up, containing all resources necessary for the reinforcement assembling.

The rebars will present homogeneity of geometric and mechanic characteristics, besides being exempt of failures such as bubbles, cracks and corrosion. They will be acquired cut and bended by a traditional supplier, in accordance with approved standards and by well-known mechanical methods.

Before the molds' assembling and, if necessary, also before concreting, the reinforcements will be carefully cleaned looking for dirt, grease, rust and other materials which may decrease the adherence to the concrete.

The rebars will be carefully assembled and fixed on the crossings with annealed wire, and shall stay

in the positions indicated in the project before and during the concreting.

The position of the metallic pieces will be rigorously checked and, once positioned, the piece will be strongly fixed to the molds, to avoid displacements during the concreting.

- **Executive Method**

To increase the speed of works, it is programmed the acquisition of bars already cut and bended by a specialized company, and delivered at the construction site, where the selection of parts, identified in accordance with the application site will be made.

All assembling of the pieces will be made on the construction site, either in the construction site central, or on the application site, as a function of the complexity of the structural piece.

When there is the possibility, as a function of the projects, the rebar pieces will be pre-molded on site and positioned in the molds.

The bars used will be exempt of dirt, grease and rust, which may compromise the adherence with the concrete.

Eventual impurities, such as soil, will be removed with water, rust crusts with steel brushes and, oil and/or grease with oakum and non-oily solvent. The storage of steel will be suspended from the ground, in order to avoid impurities.

The positioning of the rebar reinforcement will be in rigorous concordance with the positions, sizes, recovering and spacing defined in the project. To guarantee the minimum project overlap PV plastic or concrete spacers will be used.

Where it is necessary to fix the negative rebar, stubs of bars of any diameter, bended will be used.

Overlapping of steel bars will be used, which will strictly follow the project. Anchors will also be in accordance with the project.

Any rebar structure will have a concrete coverage, which will never be less than the thicknesses prescribed in the project and in British Regulation and Environment Standard. Plastic spacers will be used to guarantee the minimum coverage forecasted in the project.

Figure 28-Steel bars

The steel bars will be conveniently cleaned from any substance which can be harmful to the adherence, removing layers eventually affected by oxidation. The cleaning of the rebar structures will be made outside their respective molds.

In case the cleaning of the rebar structures is made already inside the molds, it will be executed in such a way as to avoid that the materials deriving from the cleaning process do not stay retained inside the molds.

The bending of bars, including hocks, must be made with a curve radius forecasted in the project, respecting the minimums established in British Regulation and Environment Standard. The steel bars are always bended cold. The bars will not be bended near the welded connections.

- **Emendations**

The trespassing emendations will be executed in conformity with the executive project. The welded emendations, or of other types, will be executed in conformity with the recommendation of British Regulation and Environment Standard.

In any case, the process shall also be approved through executive tests, in accordance with British Regulation and Environment Standard.

- **Fixings and Spacers**

To maintain the positioning of the rebar structure during the assembling, concrete launching and condensing operations, fixings and spacers will be used, in order to guarantee the minimum coverage indicated in the project.

Those devices will be totally involved by the concrete, in order to not produce blurs or deterioration of the external surfaces.

- **Protection**

Before and during the concrete launching, the service platforms must be positioned in order to not produce the displacement of the molds.

The "waiting bars" will be protected against rust, by painting them with cement cream and, when the concreting is reinitiated, the will be cleaned in order to allow a good adherence.

- **Metallic Inlaid**

All metallic inserts, as well as their components, will be manufactured in accordance with the material specifications and with the dimensions and details indicated in the specific projects.

The pieces which will be manufactured will be checked and assembled, in order to assure the perfect adjustment of the component parts. Once assembled, they will be protected with grease of the threads, tagged and transferred to the construction site.

The position of the metallic pieces will be made through their topographic control, where each piece will be rigorously checked once in position. Each piece is strongly fixed to the molds in order to not suffer displacements during concreting.

c) Molds and Bracings

The molds will be executed and used where necessary, to confine the concrete and mold it according to required lines, dimensions and joints. The molds will have the necessary resistance to support the pressure resulting from launching and concrete vibration and will be totally tight to avoid the loss of mortar or cement cream.
Without compromising the surface finishing, our intention is to use the molds as many times as possible.

In the greatest part of the constructions, we foresee the use of molds in pre-assembled panels and assembled in accordance with the recommendations of the manufacturer, to reach a better productivity index and quality of the services. When using wood molds, material of good quality will be used, of plywood and/or regular and leveled planks and rafter to assure the perfect assembling. This assembling is completed with wood wedges and nuts working as tie rods, staying inlaid in the concrete at a minimum distance of 5 cm from the surface. The lateral molds will be removed after 24 hours after the end of the concreting, in a carefully manner to avoid cracks and breaks in the corners of the surfaces. This operation is made after approval from the Inspection.

c.1) Plywood Molds

- **Introduction**

The material from the molds will be compatible with the finishing desired and indicated in the project.

The woods will be stored in covered places, where the piles will have an adequate spacing, in order to avoid the occurrence of fires. The material deriving from the unmolding, if not anymore usable, will be removed from the work area.

The execution of the molds shall comply with the prescriptions of British Regulation and Environment Standard. It will be the exclusive responsibility from the Contractor the preparation of the project of the support and bracing structure, or centering of the molds.

A mold central was dimensioned and strategically positioned and equipped to be able to comply with the construction demand, inside the construction site, as detailed in Chapter 6 of this proposal.

- **Executive Method**

Plywood plates will be used for the apparent parts and their thickness will be in accordance with

the need of the span and height of the reinforced concrete structure piece. The mold central will manufacture molds with modulated dimensions, their assembling in the field will be greatly simplified. For those services, we foresee the use of special panels build with a wood and plywood structure.

The panels will be perfectly cleaned and must receive an unmolding product, not being allowed the use of oil. The tightness of the molds must be guaranteed, in order to not allow the loss of cement cream. All molds' water tightness will be guaranteed through juxtaposition of the pieces, avoiding the possibility to use of calking with paper, oakum and other materials.

To guarantee the geometry of the pieces after concreting, the molds will be tied with steel tie rods with pressure thread bolts giving thus a great stiffness to the set.

All services will be carefully inspected by a foreman in charge, to guarantee that the pieces are in accordance with the project.

c.2) Precast Metallic Molds

- **Introduction**

The system of metallic flat mold for reinforced concrete will be executed with modulated panels recovered with phenol-melamine plates equipped with size 5/8"reusable tie rods. The set of molds of the system will be rented from specialized companies.

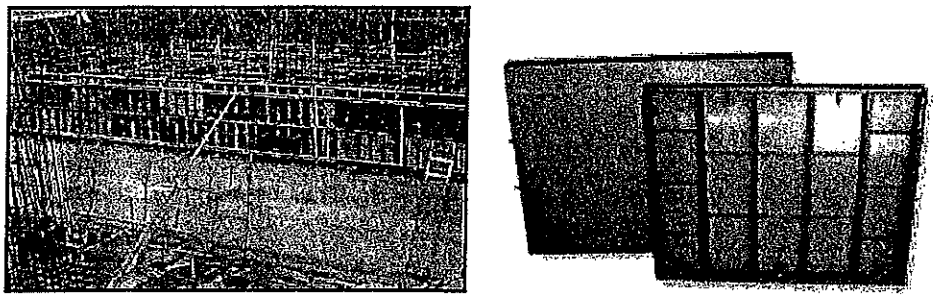


Figure 29-Metallic mold

- **Advantages of the System**
- The cotter pins will be fixed to the panels eliminating the possibility of losses and reworks.
- The connection between panels is made manually with the use of fixed with cotter pins to the structure itself, and proportionate time gain of labor, since they are already fixed on place and the connection of one panel with another is of fast and easy execution.
- Thus the time lost with the reposition of accessories which were previously lost adds another time reduction for the construction production.
- The positioning of the passage of the tied rods is not located on the sides of the panel, which totally eliminates the efforts produced by the tie rods and the spilling of the concrete cream.
- The panel structures were designed with criteria with the objective to conceive a light, versatile and resistant mold. Following a quality pattern, all measures are tolerated and the structures are all assembled in our deposit in templates which do not allow assembling

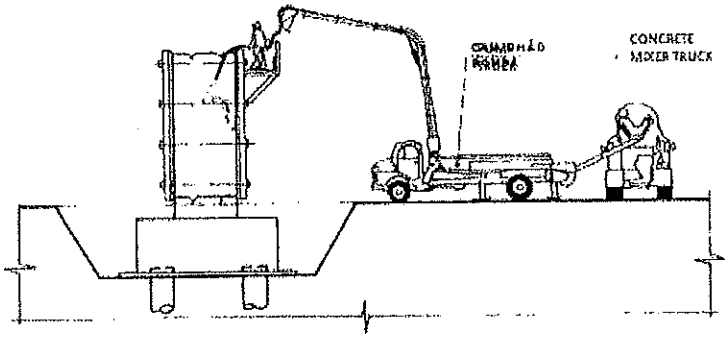


Figure 32-Illustration pouring concrete phase2

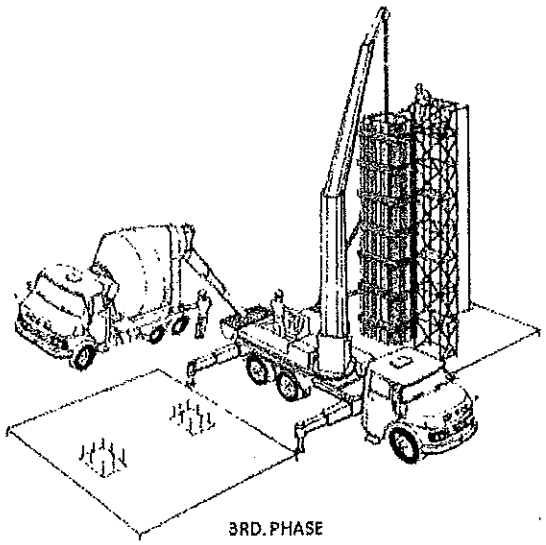
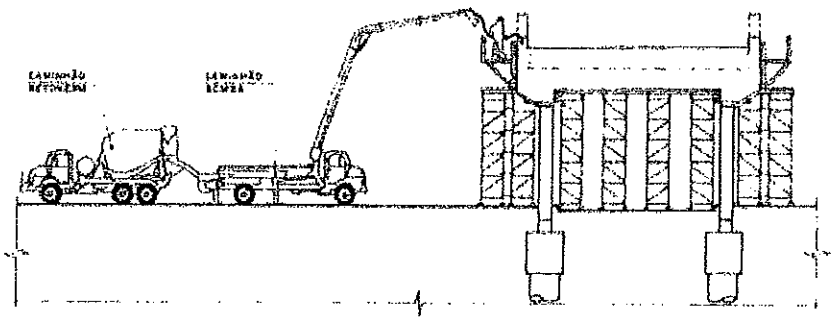


Figure 33- Illustration pouring concrete phase 3



4TH. PHASE - CONCRETING PILLARS AND TRANSVERSE GIRDERS

Figure 34- Illustration pouring concrete phase 4

4.4.4. CONCRETING ON SITE

Once the pre-slabs are assembled, the rebar of the slab itself is positioned, and then the concreting is made using a concrete pump positioned on the right margin of the river, near the construction site.

After concreting of the slab and at the end of the period established in the project, the final pro-tension of the longitudinal girders and the finishing of the anchor boxes are made.

Finally the beams of the para-ballast are concreted and their drainage pipes are fitted

4.4.5. CONTENTION OF BRIDGE HEADS EMBANKMENT WITH REINFORCED EARTH

- **Description**

The Reinforced Earth massifs, with the use of steel rebar are constituted by the association of earth and rebar, complemented by a flexible external parameter, the "skin".

The 3 main components of Reinforced Earth are:

- The earth: which involves the rebars and occupies a space named "reinforced volume";
- The rebars: which are linear and flexible elements, providing traction and which must present good resistance to corrosion. They are fixed to the skin through bolts. They are normally prepared with steel type 1010/20 up to 1045, hot galvanized, with a minimum thickness of 70 micra of zinc;
- The Skin (external parameter): generally vertical, and always flexible, may be constituted by flexible metallic scales or concrete scales which are capable to allow minor differentials between them.

4.4.5.1. MATERIALS

a) Scales

- **Of Concrete**

These are pre-molded cross-format concrete plates made of Portland cement, which shall present:

  - Characteristic resistance to compression Fck ⍰ 25 MPa (axial compression of cylindrical concrete specimens). The content of cement shall not be less than 350 kg/m³ of concrete.
  - Characteristic resistance to compression after 7 days: Fc7 ⍰ 16 Mpa

- **Not allowed**

  - Hardening Accelerators or Retarders, or air incorporators or plasticizers which contain aggressive additives for metallic pieces in the concrete.
  - Neither other additives, except with the authorization from the Designer.

- **The connections (galvanized steel rods inserted in the scales)**

The rods, the anchor bolts and the reinforcement rebar (steel CA50) must be positioned and maintained in their places in accordance with the dimensions and tolerances of the project.

- **Tests and Inspection**

The scales are accepted based of compression tests of the concrete and on the visual inspection.

The scales may be accepted with ages under 28 days if the resistances to compression indicate that the specified resistance will be reached.

The contractor will be in charge of all which is necessary for the sampling and test in a fast and satisfactory manner.

- **Molding**

The scales are molded in flat areas with the apparent face turned down. The concrete pouring for each scale will be made without interruption. They will be condensed with a needle vibrator. The condensing will be completed manually, whenever necessary, to force the concrete to fill the corners of the mold and avoid the formation of cavities or cleavage planes

The oil for the molds must be:

  - a special type for this purpose;
  - always clean;
  - of the same manufacturer (in each construction).

- **Hardening**

The scale must harden during the time necessary to reach the specified compression resistance.

- **Unmolding**

The sides of the mold are generally opened 4 hours after concreting and removing the piece after 20 hours (those times are subject to variation, in accordance with the local temperature and hardening conditions).

- **Finishing**

The apparent face will have a smooth finishing with a good aspect. The other face (backside) will have a rustic finishing made with leveling rod to eliminate spaces or saliencies of more than 7 mm height.

- **Tolerances**

All scales shall comply with following tolerances:

- Differences of not more than 10 mm, for all project dimensions;
- Angular distortions cannot produce differences above 10 mm between scale diagonals.

- **Resistance to compression**

The tests will be made on cylinder concrete specimens, in a minimum proportion of 3 concrete specimens for each concreting, for rupture tests at 7 days, 14 days and 28 days. They shall be hardened in the same way as the scales.

- **Molding date and identification of the type of scale**

They will be clearly painted on the rustic face of the scale.

- **Handling, storage and transportation**

All scales are handled, stored and transported in order to eliminate risks of cracks, fractures or breaks or even excessive flexure tensions.

The stored scale will be firmly supported on wood joists intercalated together with the connection edges in order to avoid they are bend or crumbled.

- **Base**

Will be made of non reinforced concrete with characteristic resistance (Fck = 15 Mpa).

- **Metals**

Those are the object of a separate specification.

b) Rebars

They are steel strips with low carbon content, galvanized with a bathing in molten zinc.
They will be cut and perforated in accordance with the tolerances stipulated in the manufacturing drawings.

All rebars must be carefully inspected to verify if they have the correct dimensions and are exempt

of imperfections which may harm their resistance or durability (galvanization failures).

c) High resistance bolts and nuts

The bolts and the heads of the nuts will be hexagonal.

They will comply with norm DIN for type 8.8., or ASTM A394. The bolts must have 12mm diameter and 30 mm length, as nominal measures.

d) Joints

- **Vertical joints**

The joints will be filled with polyurethane foam, flexible, with open cells, with 4 x 4 cm transversal section, with filtering function.

- **Horizontal joints**

Those joints will be filled with EPDM support plates, in accordance with project dimensions and also with the foam with filtering function.

e) Material for the Filling of the Reinforced Volume

Filling material must always be exempt of organic matter and/or other aggressive materials. It shall satisfy, in principle, following granulometry conditions:

- Not contain stones greater than 350 mm;
- Not contain more than 25% of stones with dimensions greater than 150 mm;
- Not contain more than 15% of particles with dimensions of less than 0.074 mm

If the available materials do not satisfy the conditions above (sufficient, but not absolutely necessary), other materials may be used, if previously approved in writing by the Project designer.

4.4.5.2. CONSTRUCTION

a) Assembling

The concrete scales will be positioned.

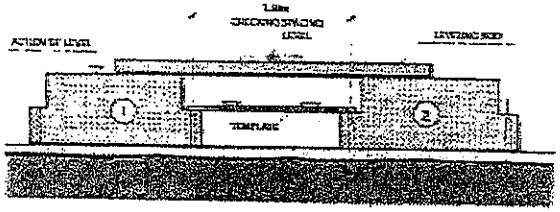
For assembling, the scales are lifted through the anchor bolts fixed on the upper face.

The placement of the scales will be developed in successive horizontal lines, in the sequence indicated in the Assembling Instructions.

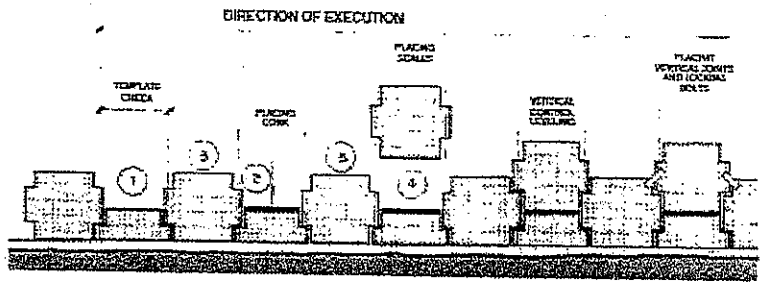
During the placement of the landfill layers, a set of wood wedges and alignment holders will be temporarily installed to maintain verticality and the alignment.

QGMI

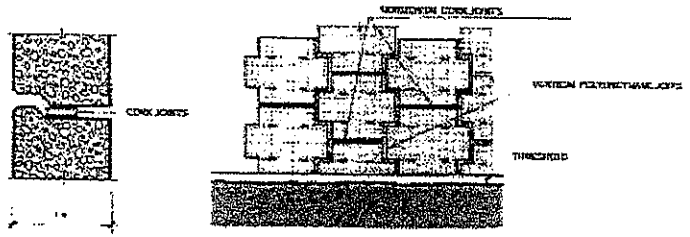
ASSEMBLING OF FIRST SCALES



SEQUENCE OF SCALE ASSEMBLING

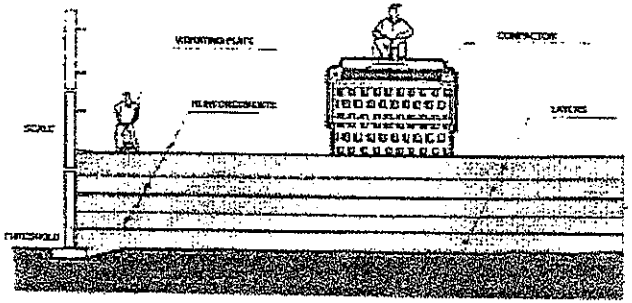


SEQUENCE OF SCALE ASSEMBLING



1 - POSITIONING SCALE "1"
2 - POSITIONING SCALE "2"
3 - CHECKING WITH THE TEMPLATE
4 - CHECKING HORIZONTALITY WITH LEVELLING ROD
5 - CHECKING VERTICALITY OF SCALES
6 - BRACING
7 - POSITIONING FULL SCALE "3"
8 - HORIZONTALITY AND VERTICALITY OF SCALE "3" AND IMMEDIATE BRACING
9 - CHECKING HORIZONTAL JOINTS
10 - POSITIONING HALF SCALE "4"
11 - POSITIONING SCALE "5"
12 - CHECKING WITH TEMPLATE BETWEEN SCALES "3" AND "5"
13 - HORIZONTALITY AND VERTICALITY OF SCALE "5"
14 - CHECKING HORIZONTAL JOINTS
15 - CHECKING WITH THE LEVEL AND LEVELLING ROD HORIZONTALITY OF SCALES "3" e "5"
16 - BRACING SCALE "5"
17 - POSITIONING BEHIND THE POLYURETHANE VERTICAL JOINTS
18 - FIXING THE LOCKING BOLTS TO THE SCALE
19 - REPEATING THE OPERATIONS WITH SUCCESSIVE SCALES WHICH WILL COMPLETE THE FIRST LINE OF SCALES
20 - CHECKING IF THE ALIGNMENT IS CORRECT

LANDFILL COMPACTION



MECHANICALLY STABILIZED EARTH CONSTRUCTION PROCESS

4.4.6. SUPERSTRUCTURE

4.4.6.1. Composite Deck Structure

The steel structure will be fabricated at a workshop and transported to the construction site where it will be joined working on top of the embankments.

Figure 35- Fabrication and transportation

Once each half of the deck is assembled, they will be launched: the steel frame can be moved by rolling over saddles incorporating rollers or by sliding on skids. The required pulling force is usually generated by winches, less frequently by cable launching jacks or by a thrust frame. After moving the steel frame to a position vertically above its permanent bearings, it is lowered onto its permanent bearings. Finally, the slab is poured after the reinforcement is placed.

Figure 36- Examples of similar assembly and launching processes

The execution sequence will be the following:

- Stage 1:
  - Preparation of assembly and launching areas.
  - Execution of temporary embankment.
  - Construction of piers and abutments.

- Stage 2:
  - Assembly of bridge first half over temporary supports.
  - Placing of the precast concrete deck slabs in the back span.
  - Partial concreting of the back span slab, to act as a counterweight.
- Stage 3
  - Start of bridge first half launching over sliding bearings
- Stage 4
  - Finish of bridge first half launching
- Stage 5
  - Assembly of bridge second half over temporary supports
  - Placing of precast concrete deck slabs in the back span
  - Partial concreting of the back span slab, to act as a counterweight
- Stage 6
  - Start of bridge second half launching over sliding bearings
- Stage 7
  - Finish of bridge second half launching
- Stage 8
  - Elevation adjustment by jacking in piers
  - Central closure
- Stage 9
  - Deck slab reinforcement and concreting
- Stage 10
  - Deck waterproofing, pavement, railing and other appurtenances

4.5. EXECUTION OF TRENCHES

The crossing under the track will be like concrete culvert and the central section of the roundabout will be retaining wall in reinforced concrete.

The trenches will follow the executive sequence below:

- Execution of the lateral wall structures with concrete culvert;
- Excavation of the soil between walls with the help of water sheet lowering with help of pumps;
- Concreting the bottom slab;
- Execution of the slab in the covered interval.

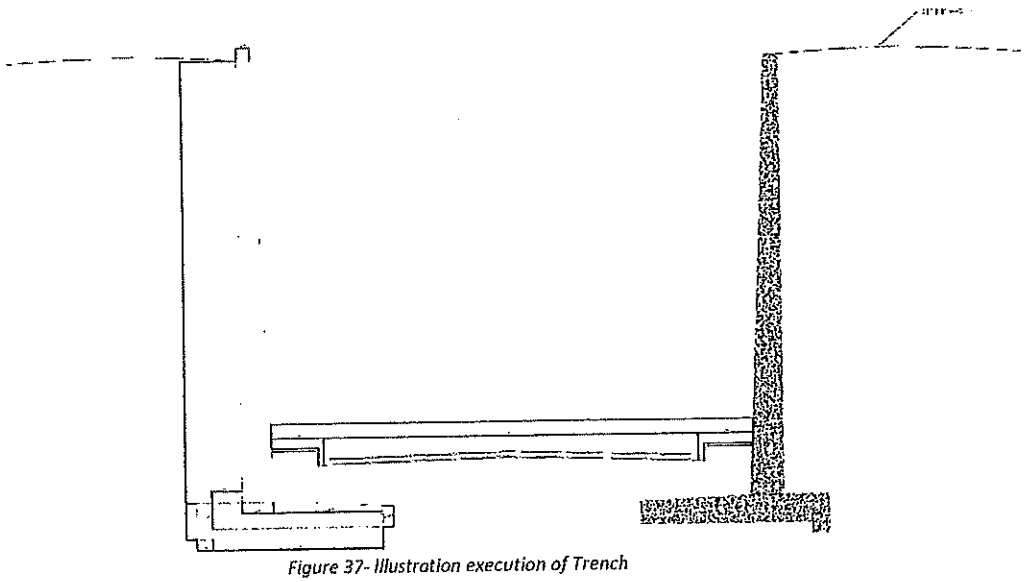


Figure 37- Illustration execution of Trench

4.6. DRAINS

- **Excavation of trenches**

Two processes are used:

- Mechanical excavation

This will be basically made by a hydraulic excavator or backhoe loader. The material resul ing from the excavation will be transported by dump trucks.

- Manual excavation

In this work tools like picks, pickax and shovels will be used. The removal of the material will be made with wheelbarrows to places in which the material may be loaded by mechanical means into trucks.

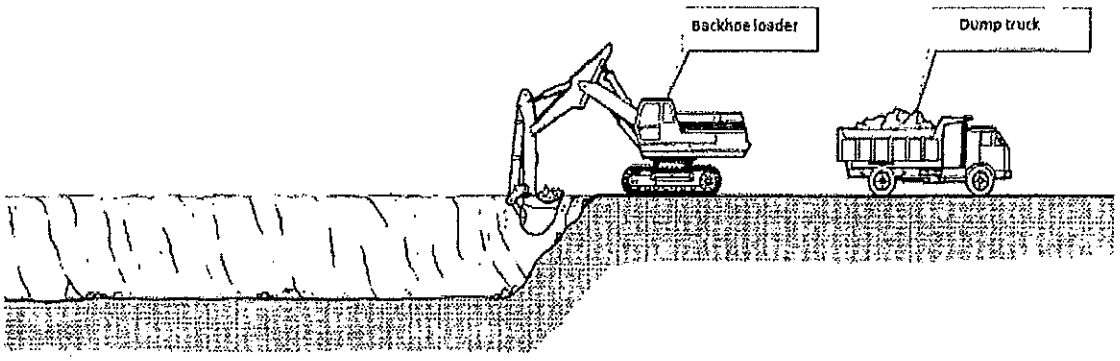


Figure 38-Illustration execution of Mechanical excavation of trenches constructive process

- **Tubular Concrete Storm Drains**

The execution of this service will be preceded by the protection of the area against the action of rainwaters, as well as deviation of existing watercourses. In places where the water table is elevated, water pumps activated by engines or pneumatic pumps run by portable compressors will be installed.

The excavation will be made by hydraulic backhoe loaders or manually, depending on the local conditions. All materials considered inadequate for the foundations of the storm drains will be removed and transported outside the area.

Once finished the excavation down to the project depth measurements, the foundation will be prepared and the construction of the cradle will be initiated.

For storm drains with concrete cradles, an initial concreting will be made allowing the layout of the pipes. Once finished the assembling the concreting involving the pipes will be made.

In the case of pipes with crushed stone cradle the procedure will be analog, initially executing the crushed rock mattress for laying out the pipes according to the heights indicated in the project and later, finishing the cradle. In this case the material will be compacted with vibratory plates Dynapac CM-20.

The pipes will be laid out in the trench with the help of a crane, hydraulic excavator or laid manually.

Finished the layout of the pipes, the trenches will be filled with material up to 1.0 m above the upper generatrix.

The refill will be manual, using hand compactors and the vibratory plate Dynapac CM-20.

- **Concrete Cellular Storm Drains**

The operations for the protection of the area of services, excavation and refill will be executed in a similar way to those described for the layout of the pipe storm drains.

The concreting of the storm drains begins after conclusion of the cradle and will be made in three phases.

In the first phase the base of the drain will be concreted, on the second the walls and finally the roof.

The molds will be made with wood, recovered with plywood plates and prepared in the Carpentry. The transportation of the molds will be made with flat bed trucks equipped with a Munck vehicular crane.

The molds will be maintained in position using convenient bracing. The correct spacing between molds will be guaranteed with the use of pre-molded concrete bricks, associated to metallic tie rods conveniently distributed.

The rebar cages will be prepared in the Rebar Central and transported to the work front by flat bed trucks.

The concreting will be made using concrete mixer trucks coming from the batching plant or through concrete prepared on the site. The transportation to the launching place will be made with wheelbarrows.

- **Execution of the Surface Drainage**

The works include the construction of trenches recovered with a bed of concrete, descent of water and dissipating boxes.

- Trenches

In all situations their execution will made simultaneously with the earthworks.

The small excavations, which will become necessary, will be executed manually or eventually with the help of backhoe loaders.

In the case of trenches, the material resulting from the excavation will be deposited aside, in layers of 15 cm and compacted with manual vibratory plates type Dynapac CM-20.

Once finished the excavation, the pipes will be laid out over a concrete bed.

After finished the excavation surface, transversal wood templates will be fixed, spaced in order to orient the launching operations. The spread out and finishing will be manual with the help of appropriate tools.

- Water Descent in half-round concrete gutter

The execution of this type of drainage device will be initiated as soon as allowed by the earthworks can allow it. Complete spans will be build, this is, sections between the base and the trenches; between successive trenches or yet, between the trench and the landfill border.

The construction will be made from downstream to upstream, this is, from bottom to top.

As soon as the parts are concluded, they will be interconnected to the trenches or to the border of the landfill, whichever is the case.

This executive sequence allows the complete control of the rainwaters outflow; protects the massifs against erosion and allows the device to perform its functions even during the construction

phase.

The excavation will be made manually according to the dimension of the project.

- **Concrete Curbs and Gutters**

The ground for the construction of the curbs and gutters will be prepared as the earthworks are being concluded. The preparation will include a strip with of one meter and will include the services of regularization, compaction and surface finishing.

The curbs, with one meter length pieces, made of pre-molded concrete of molded on site, will be laid out over a plastic state concrete berth and will be supported on the joints. On the face of the sidewalk will be prepared a filling manually compacted, with a minimum width of one meter, to avoid accidental displacements of the pieces.

The gutters will be molded on site over a base of lean concrete with a thickness of 5 cm. To limit its molding, wood molds will be made, fixed at a height which will allow a transversal slope of 10% towards the curb and fixed in order to avoid any movements.

Contraction joints of the weakened section type will be build at every 3 meters intervals, with 1 cm thickness.

On places in which the gutter is higher than the surface of the adjacent pavement, it will be molded with a slope towards the pavement. Such situation corresponds to the highest borders of super-elevations or tracks with a sole transversal slope.

In any situation, the layout of the curbs precedes the construction of the gutters, and those will be executed before the paving.

- **Deep Drainage**

The deep drainage services include the execution of longitudinal drains.

- **Deep Longitudinal Drain**

The trench will be excavated from downstream to upstream, using for this operation a hydraulic backhoe loader equipped with an adapted bucket, so that the excavated trench will have the project width.
After the excavation a Bidin blanket and the filling with aggregate initiates.

The material will be compacted in 20 cm layers using manual vibratory plates Dynapac CM-20.

After this the blanket is closed, involving the aggregate and the sealed trench with conveniently compacted material.

If the project indicates longitudinal drains constituted by perforated pipes, those will be laid out at the heights foreseen in the project.

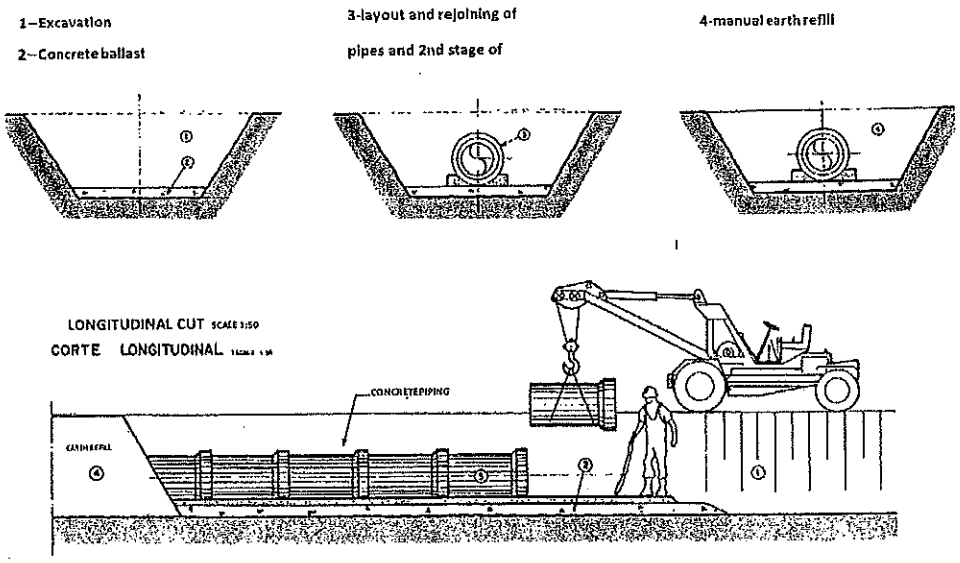


Figure 39-Illustration of reinforced concrete pipes constructive process

4.7. PAVING

4.7.1. REGULARIZATION OF THE SUB-GRADE

- After the topographic delimitation of the sub-grade, next step will be the scarification of up to 0.20 m below the project height, using a motor grader, and then the scattering of the scarified material up to the height established for the loose material, so that after compaction and finishing the project height will be reached.
- In case it becomes necessary to import materials, they will be launched after scarification and scattering. The roots and stone blocks (Ø > 76 mm) eventually existent will be removed.
- The spread out material will be homogenized with the use of a combination of disc harrow and motor grader. The homogenization will continue up to when no more heterogeneity is visible. This phase will be complemented with the removal of roots, stone blocks (Ø > 76 mm) and other strange materials.
- To distinguish the range of humidity in which the material will be compacted, tank trucks (for humidification), motor grader and disc harrow will be used. The humidity range for compaction will be fixed through a compaction curve, considering the (h_{ot} – 1.5)% to (h_{ot} + 1.5)% interval.
- The compaction will be preferably executed with a vibratory sheep foot roller (with vibration frequency control) with "short feet". Eventually smooth vibratory rollers will be used and the pneumatic self propelled or towed.

- The finishing operation will involve compactor rollers and motor grader which will provide the longitudinal and transversal geometry of the surface.

The geometric conformity will be allowed only through cutting. The minor "depressions and saliencies", resulting from the finishing with the use of self propelled vibratory sheet foot rollers, or towable, are not a problem for the finished surface

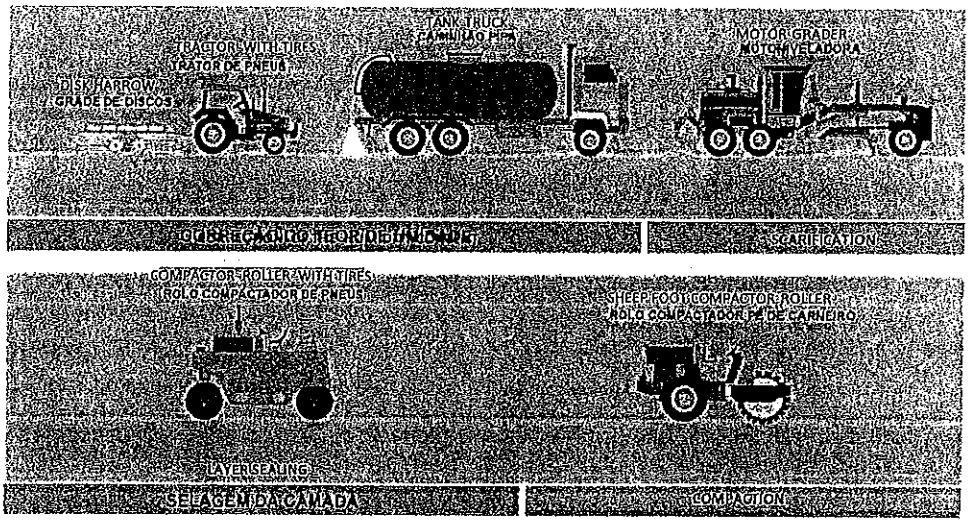


Figure 40-Illustration of execution of the sub Ballast

4.7.2. GRANULOMETRY STABILIZED BASE WITHOUT MIXTURE

- The spreading out of material deposited in the platform will be made with a motor grader. The material will be spread out so that the layer stays with a constant thickness. Compacted layers with a thickness above 20.0 cm will not be executed, neither those with less than 10.0 cm.
- The spread out material will be homogenized with the combined use of a disk harrow and motor grader. The homogenization will continue up to the point in which it is not possible to distinguish one material from the other. In this phase strange materials (Stone blocks, roots, etc.) will be removed.
- To reach the range of humidity content in which the material must be compacted, tank trucks (for humidifying), motor grader and disk harrow (for aeration) will be used. The range of humidity will be preferably fixed through the CBR versus humidity curve, entering the value of the pre-fixed CBR value and determining the range of the "compaction humidity content".
- If, for any reason, it is not possible to trace the CBR x h curve, the following range will be adopted: $(h_{ot} - 1.5)\%$ to $(h_{ot} + 0.5)\%$.
- The compaction will be preferably executed with a vibratory sheep foot self propelled roller (short feet) in combination with a self propelled smooth vibratory roller, but it may be possible to use only one of the rollers, in isolated form.

- A list will be prepared on the track showing the "number of roller passes versus degree of compaction" (passes over a same point) for a same type of material.
- The finishing operation will be executed with the same compactor rollers used, which will provide the longitudinal and transversal conformation of the platform, according to the project, and with the help of the motor grader. The geometric conformation will be only allowed through cutting.

4.7.3. GRANULOMETRY STABILIZED BASE OF GRADUATED CRUSHED ROCK OR UNDEFINED GRANULOMETRY CRUSHED ROCK

- The spread out of the material deposited on the platform will be made with a motor grader. The material will be spread out so that the layers will not have compacted thicknesses above 20.0 cm neither less than 10.0 cm. For better homogeneity of the materials on the track, the spreading of the material with more quantity will be made first and, over this layer, the other material will be spread out.
- The spreading out materials will be homogenized with the combined use of disk harrow and motor grader. The homogenization will continue up to when it is not anymore possible to visually distinguish on material from the other. In this phase strange materials (Stone blocks, roots, etc.) will be removed.
- To reach the humidity content range in which the material will be compacted, tank trucks (for humidifying), motor scraper and disk harrow (for aeration) will be used. The humidity range will be preferably fixed through the CBR versus humidity curve, introducing the CBR fixed and determining the range of the "compaction humidity content".
- If, due to any reason it will not be possible to trace the CBR x h curve, the following range will be adopted: $(h_{ot} - 1.5)\%$ to $(h_{ot} + 0.5)\%$.
- The compaction will be preferably executed with a smooth self-propelled vibratory roller in combination with a self-propelled pneumatic roller, but it is possible to use only one of those rollers, in isolated form.
- For a same type of mixture a list on the track, between the "number of roller passes versus compaction degree" to determine the necessary number of "passes" (passes over a same point) will be prepared.
- Special care will be taken with the mixtures of soil with graduated crushed rock or with total crushed rock, in relation to compaction. Those materials have the tendency to increase their density for energies above the Modified Proctor without degradation. In this case the compaction energy will be determined through the "density versus energy" curve, considering the energy which practically transforms the curve, and becomes asymptotic curve.
- The finishing operation will be executed with the compactor rollers used above, which will provide the longitudinal and transversal geometric conformation of the platform, according to the project, and with the help of a motor grader.
- The geometric conformation will only be allowed through cutting.

4.7.4. PRIMING

After the perfect geometric conformation of the granular layer is made, a surface sweeping will be

made, in order to eliminate the powder and existing loose material.

- The adequate asphalt binder will be applied next, in a temperature compatible with its type, in the right quantity and, in a uniform manner. The asphalt binder will not be distributed in case the air temperature is below 10º C, or during rainy days, or when the rain is eminent. The application temperature of the asphalt binder will be fixed for each type of binder, as a function of the temperature-viscosity relation.
- The whole track must be primed during one same work shift and will stay closed for the traffic.

4.7.5. HOT MIX BITUMINOUS CONCRETE COATINGS – (HMAC)

The bituminous mixtures, prepared hot, will be processed in an asphalt plant with intermittent production and gravimetric dosage, existing in the region.

The transportation of the mixtures from the plant to the track is made with dump trucks. In all occasions and under any weather condition, the material will be covered with canvas, to avoid loss of temperature.

On the track, the material will be spread out using self-propelled vibro-pavers AP-1050 Caterpillar, with crawlers, working in tandem. The laying temperatures are regulated so that, after compression, the layers will have the thicknesses corresponding to the project specifications.

The laying widths of the vibro-paver will be adjusted, within its inherent resources, to obtain the coverage of the total width of the track with the lowest possible number a strips. It will also be taken into consideration the need to care that the longitudinal construction joints stay situated under the traffic lane limiting signaling.

For the layers compaction will be used a smooth vibratory compactor roller or a variable pressure tire compressor roller associated to a tandem roller with smooth metallic wheels

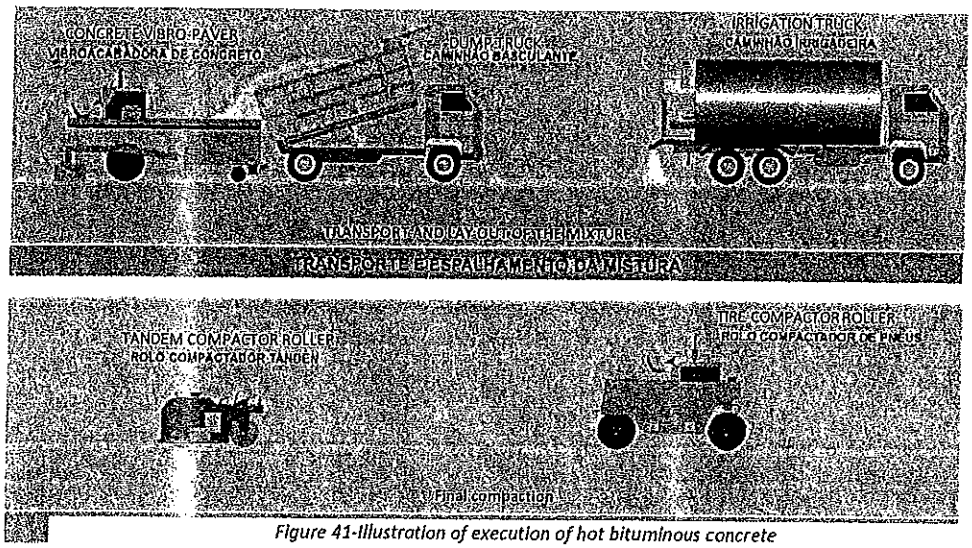


Figure 41-Illustration of execution of hot bituminous concrete

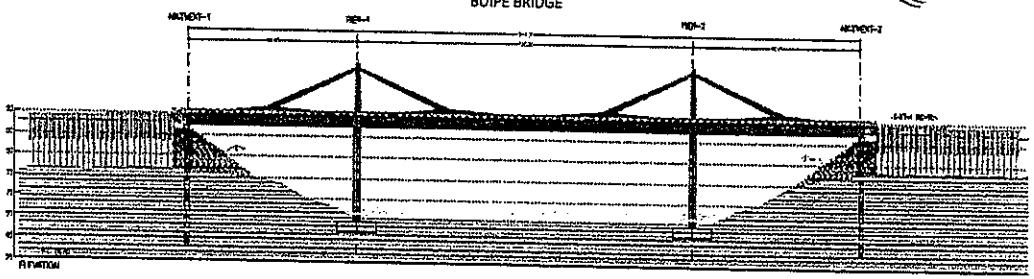
DESIGN AND CONSTRUCTION OF BRIDGES OVER THE BLACK VOLTA AT BUIPE, OVER THE WHITE VOLTA AT YAPEI AND OVER THE WHITE VOLTA AT DABOYA

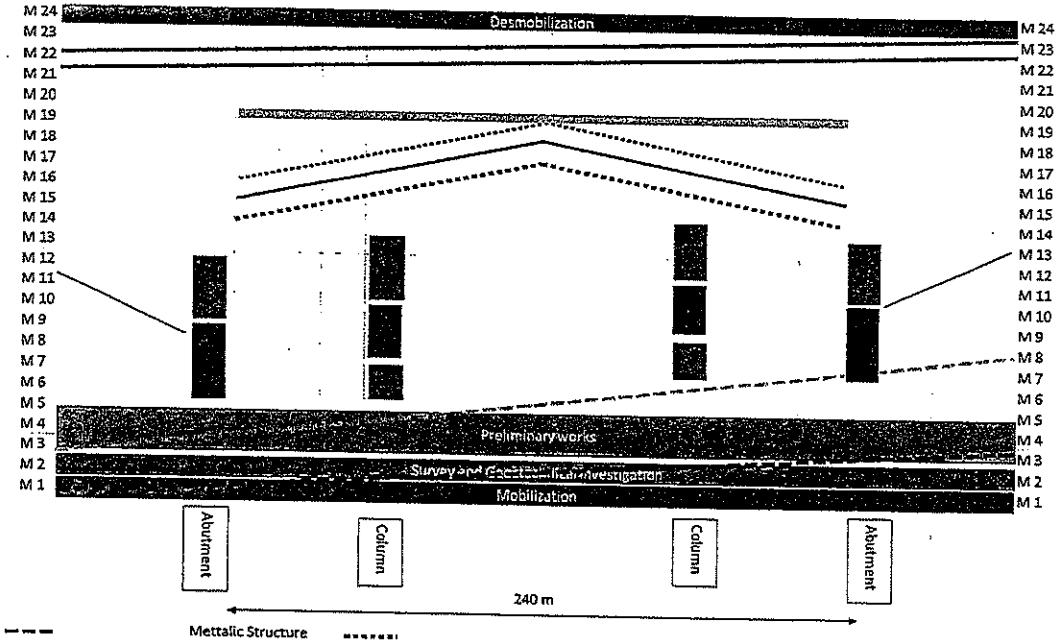
Volume 2

3) WORKS PROGRAM

QGMI

BUIPE BRIDGE





Design

Interference Relocation

Foundation

Elevation

Peninsula

Embankment

Mettalic Structure

Precast Slabs

Reinforcement

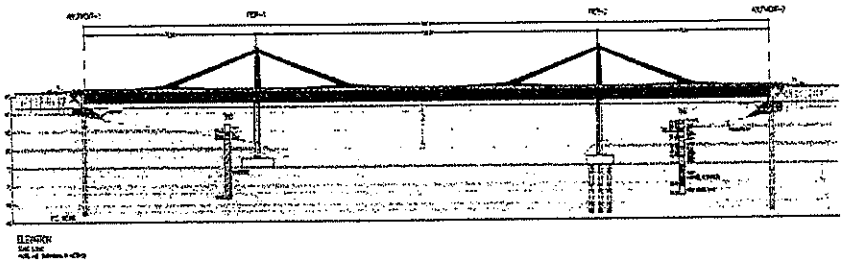
Consolidation

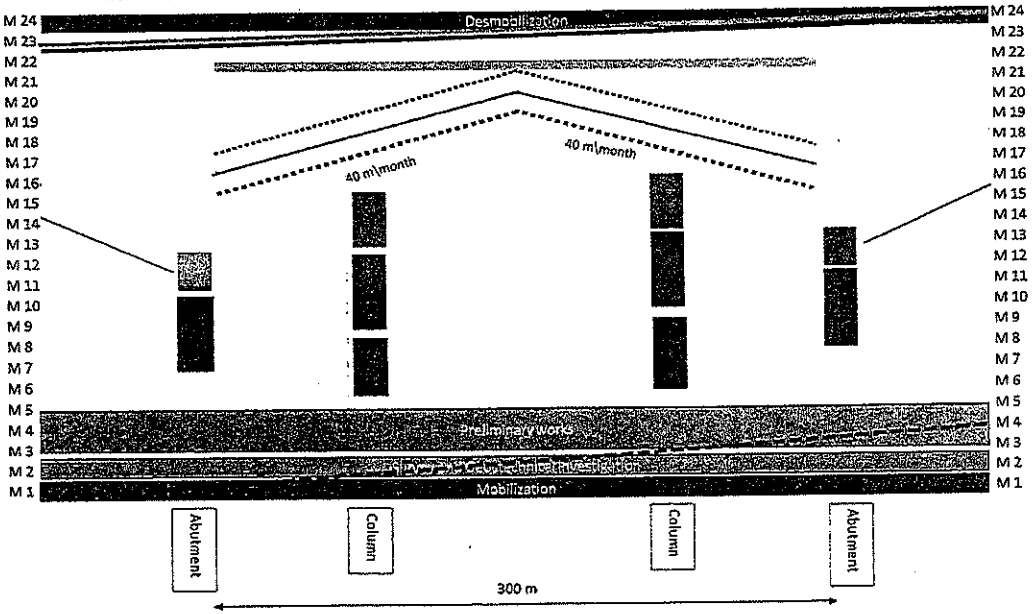
Pavement

Accessories

QGMI

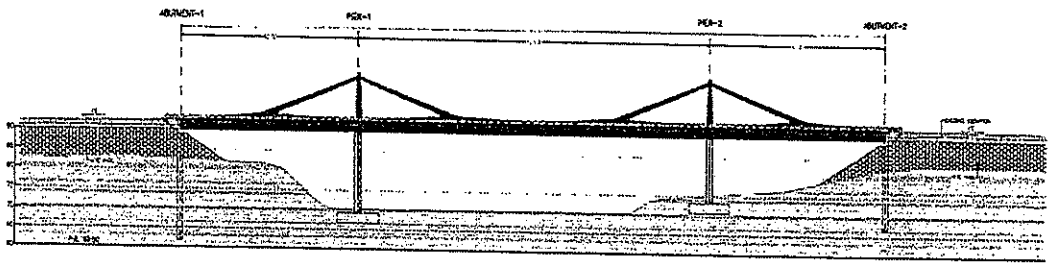
DABOYA BRIDGE

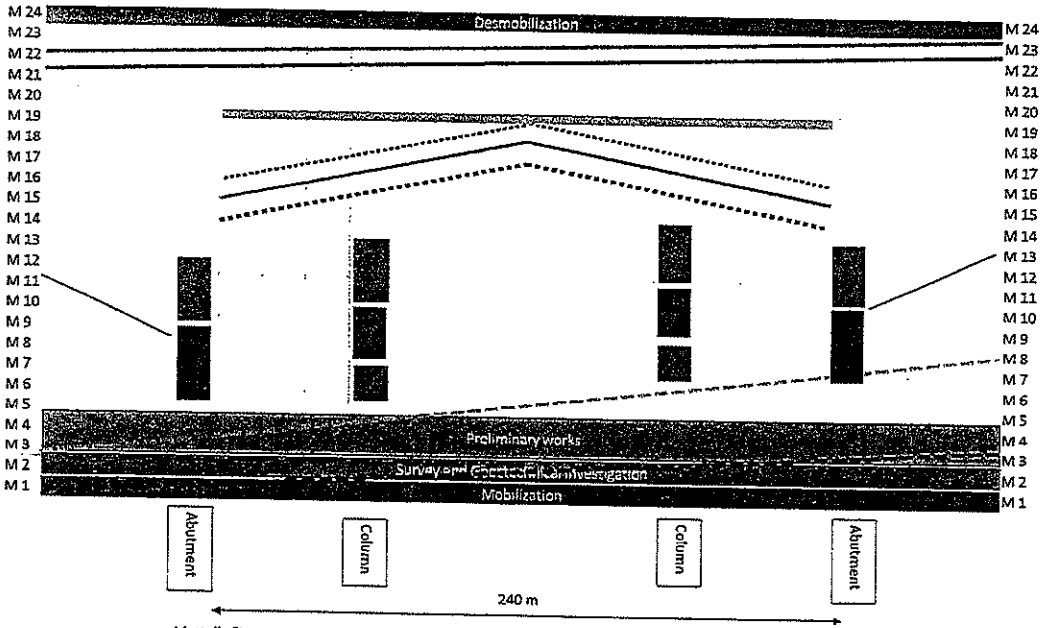




Design		Mettalic Structure	
Interference Relocation		Precast Slabs	
Foundation		Reinforcement	
Elevation		Consolidation	
Peninsula		Pavement	
Embankment		Accessories	

YAPEI BRIDGE





Design

Interference Relocation

Foundation

Elevation

Peninsula

Embankment

Mettalic Structure

Precast Slabs

Reinforcement

Consolidation

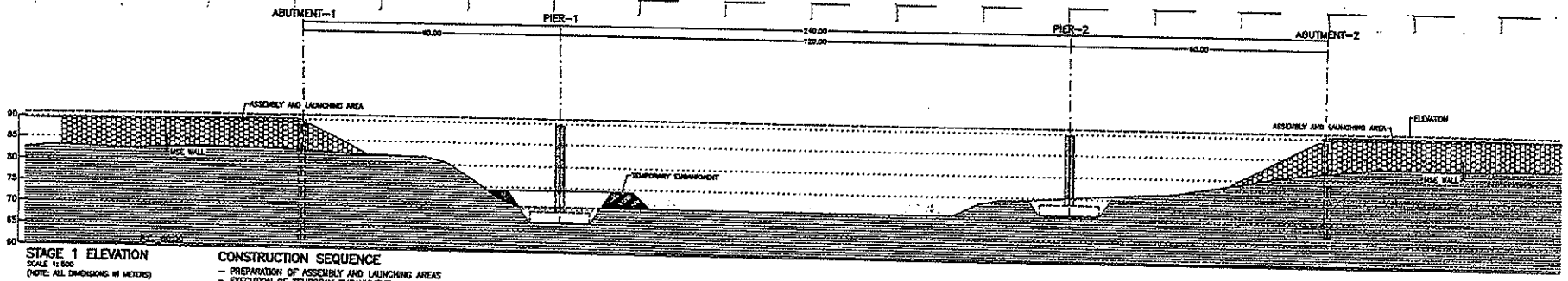
Pavement

Accessories

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

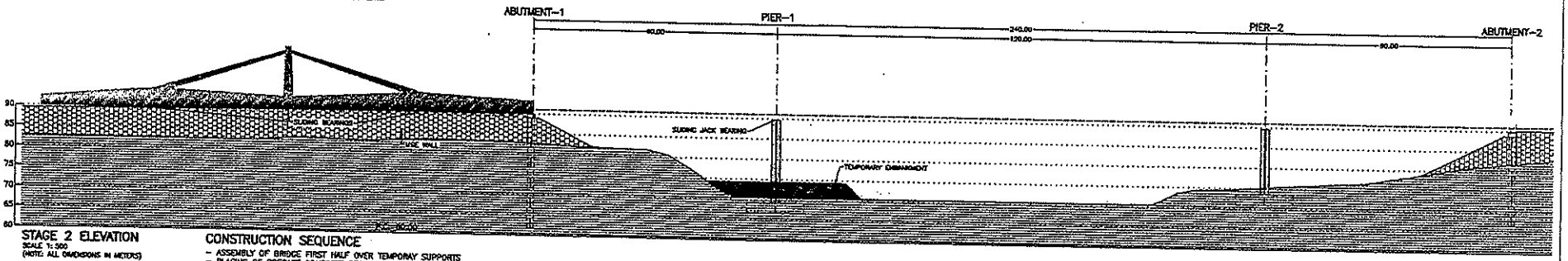
Volume 2

4) METHODOLOGY



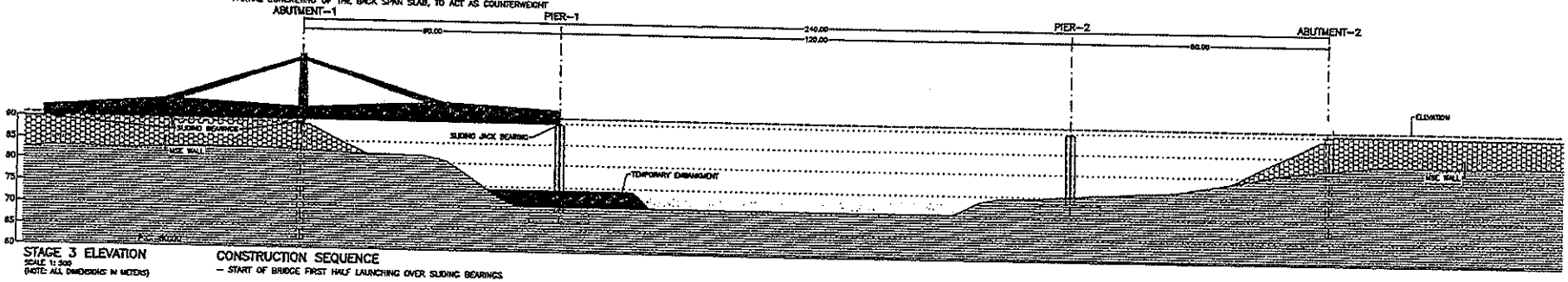
STAGE 1 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
- PREPARATION OF ASSEMBLY AND LAUNCHING AREAS
- EXECUTION OF TEMPORAY EMBANKMENT
- CONSTRUCTION OF PIERS AND ABUTMENTS



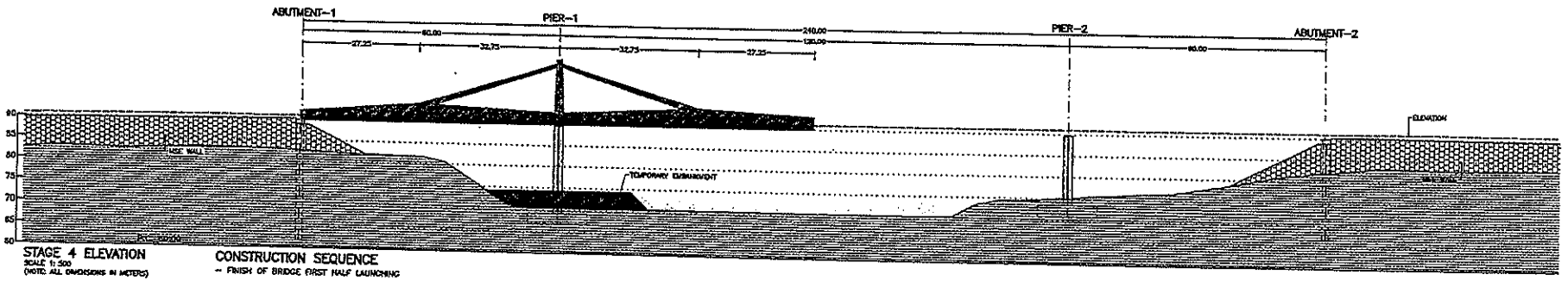
STAGE 2 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
- ASSEMBLY OF BRIDGE FIRST HALF OVER TEMPORAY SUPPORTS
- PLACING OF PRECAST CONCRETE DECK SLABS IN THE BACK SPAN
- PARTIAL CONCRETING OF THE BACK SPAN SLAB, TO ACT AS COUNTERWEIGHT



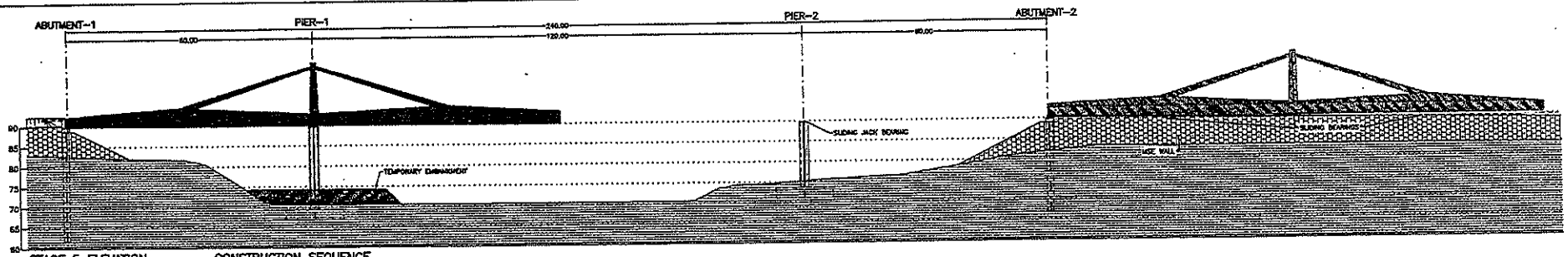
STAGE 3 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
- START OF BRIDGE FIRST HALF LAUNCHING OVER SLIDING BEARINGS



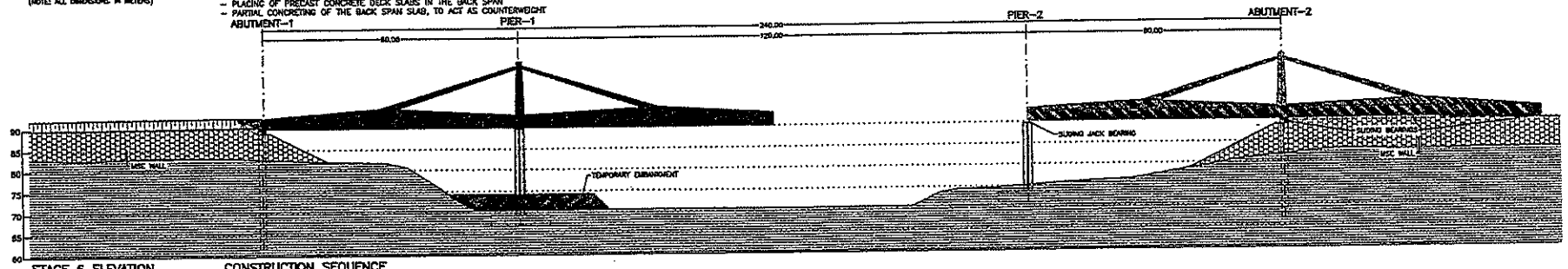
STAGE 4 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
- FINISH OF BRIDGE FIRST HALF LAUNCHING



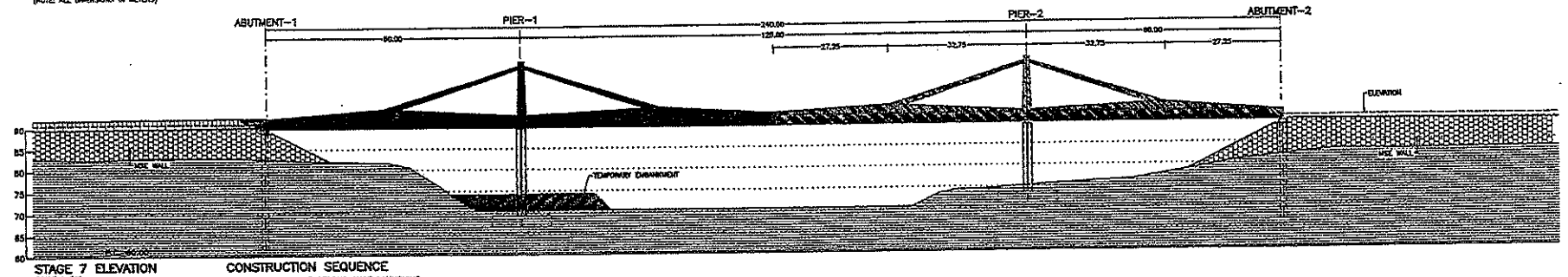
STAGE 5 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
- ASSEMBLY OF BRIDGE SECOND HALF OVER TEMPORAY SUPPORTS
- PLACING OF PRECAST CONCRETE DECK SLABS IN THE BACK SPAN
- PARTIAL CONCRETING OF THE BACK SPAN SLAB, TO ACT AS COUNTERWEIGHT



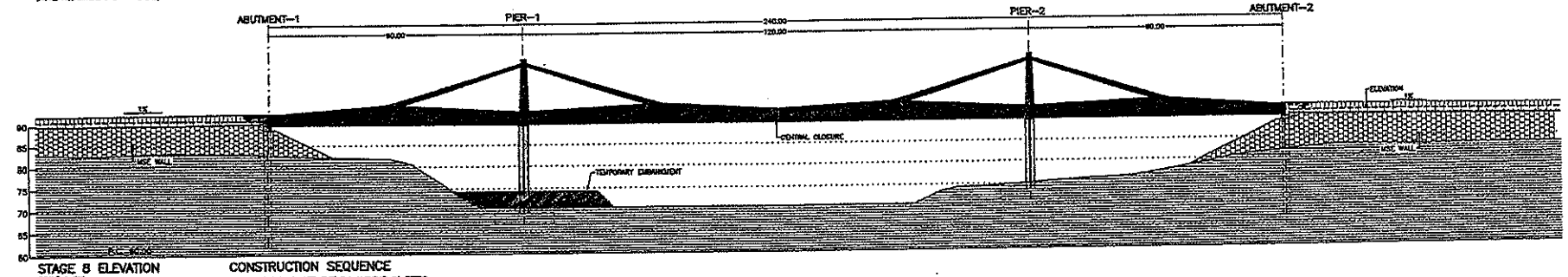
STAGE 6 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
- START OF BRIDGE SECOND HALF LAUNCHING OVER SLIDING BEARINGS



STAGE 7 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

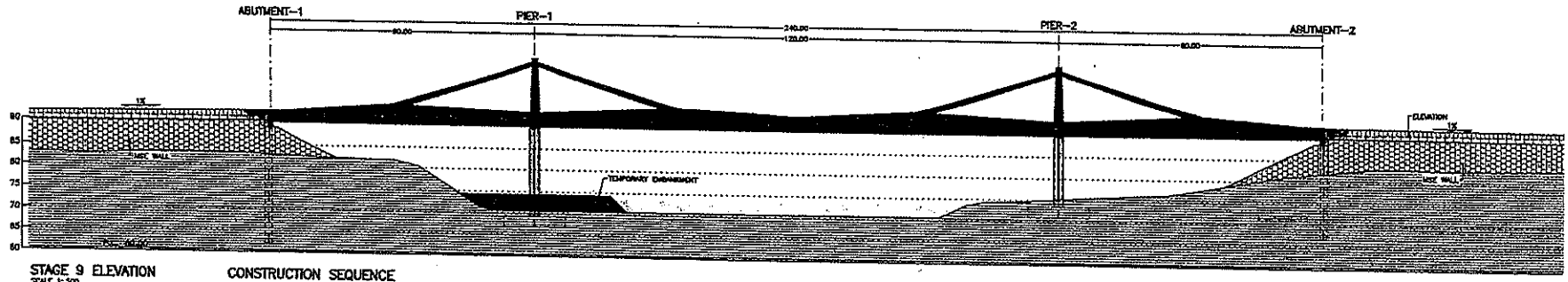
CONSTRUCTION SEQUENCE
- FINISH OF BRIDGE SECOND HALF LAUNCHING



STAGE 8 ELEVATION
SCALE 1: 500
(NOTE: ALL DIMENSIONS IN METERS)

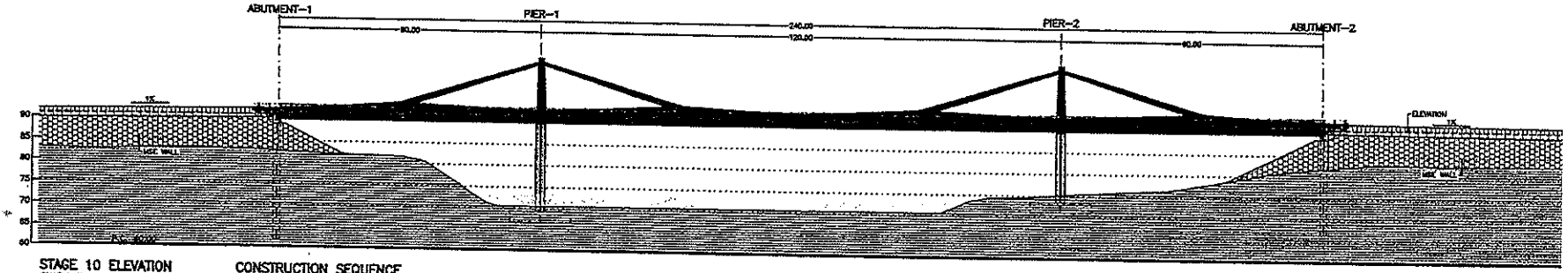
CONSTRUCTION SEQUENCE
- ELEVATION ADJUSTMENT BY JACKING IN PIERS
- CENTRAL CLOSURE

BRIDGE 1. CONSTRUCTION SEQUENCE(2)



STAGE 9 ELEVATION
SCALE 1:500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
– DECK SLAB REINFORCEMENT AND CONCRETING



STAGE 10 ELEVATION
SCALE 1:500
(NOTE: ALL DIMENSIONS IN METERS)

CONSTRUCTION SEQUENCE
– DECK WATERPROOFING, PAVEMENT, RAILING AND OTHER APPURTENANCES

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

5) EQUIPMENT

NORTHERN BRIDGES - CONSTRUCTION EQUIPMENT FOR ONE BRIDGE - YAPEI / BUIPE / DABOYA (Estimation based on the Direct Labour for the Construction Phase of ONE BRIDGE)

ITEM	DESCRIPTION	ESTIMATED MAXIMUM QUANTITY	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
1	Hydraulic Excavator	1						1	1	1	1	1	1	1	1	1	1	1	1	1	1					
2	Heavy Truck 14m3 (Dumper or similar)	11				5	6	11	11	11	11	11	11	11	11	10	10	9	9	9	6	4	4	2	2	
3	Wheel Loader	2					1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	
4	Crane Truck 20T- 50T	3						1	3	3	3	3	3	3	3	3	3	2	2	2	1	1	1	1	1	
5	Backhoe Wheel Loader	2					1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	
6	Auger Machine or Similar (Soil Investigations and Foundations as per Design)	1			1	1	1	1	1	1																
7	Hydraulic and Rolling Device for Bridge Launching (Deck / Girder)	2										1	1	1	2	2	2	2	2	1						
8	Rough Terrain Crane (Rigging and Lifting)	1										1	1	1	1	1	1	1	1							
9	Bulldozer 20-25 T	1					1	1	1	1	1	1	1	1	1											
10	Road Grader	1					1	1	1	1	1	1	1	1	1	1	1	1	1	1						
11	Rolling Compactor (Rolled Wheel / Sheepsfoot / Pneumatic)	4					1	2	3	4	4	4	4	4	3	2	1	1	1	1	1	1	1	1	1	
12	Generator 40 kva (Light Comercial - towable)	4					1	2	4	4	4	4	4	4	4	3	3	3	3	2	2	2	2	2	2	
13	Vibrating Plate Compactor	4						3	3	4	4	4	4	3	3	2	2	1	1	1	1	1	1	1	1	
14	Water Tank Truck 20M3	3						2	3	3	3	3	3	3	3	2	2	2	2	2	1	1	1	1	1	
15	Concrete Mixer Truck 8M3 (6x4 290CV)	5					4	5	5	5	5	5	5	5	5	5	4	4	2	2						
16	Cargo Truck 7 T	1						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
17	Concrete Plant 50 M3 p.hour	1						1	1	1	1	1	1	1	1	1	1	1	1	1						
18	Concrete Vibrator and Tools	8						4	6	8	8	8	6	4	3											
19	Concrete Pump	3						3	3	3	3	3	3	3	3	3	3	3	3	3						
20	Generator 75 kva (Light Comercial - towable)	5						5	5	5	5	5	5	5	5	5	5	5	5	5	1	1	1	1		
21	Generator 165 kva (Light Comercial - towable)	3								1	3	3	3	3	3	3	3	3	3	3	2					
22	Motor Pump- Diesel (towable , 30 HP, Exit = 03")	4						4	4	4	4	4	4	4	4	4	4	4	4	4	2	1	1	1	1	
23	HiLight Tower - towable (4 x 1000 W)	2						2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	
24	Precision Oxycut Set for Rebar and Construction elements	1						1	1	1	1	1	1	1	1	1	1	1	1	1						
25	Topography and Geo-Survey Device and Tools	2		1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	
26	Pneumatic Air Compressor	2						2	2	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	
27	Maintenance Truck	1						1	1	1	1	1	1	1	1	1	1	1	1	1	1					
28	Fuel / Lube Oil Tank Truck (6.000 lts)	1						1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
29	Semi trailer load - bed Truck 02 AXLES 35T	2					1	2	2	2	2	2	2	2	2	2	1	1	1	1	1					
30	Bus for urban transport 45+1 Seats	4					2	4	4	4	4	4	4	4	4	4	4	2	2	2	1	1	1	1	1	
31	Pickup Vehicle 4 x 4 Double Cab (Main Contractor)	5	2	4	4	4	4	5	5	5	5	5	5	5	5	5	5	5	5	5	3	2	2	2	2	1
32	Ambulance Vehicle (Removal only)	1				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
33	Asphalt Paver	1																1	1	1	1	1				
	TOTAL MACHINERY		2	5	6	12	26	73	81	86	87	88	87	84	82	74	71	67	65	64	34	24	24	21	20	1
	HEAVY MACHINERY	17	0	0	1	1	6	11	14	15	14	15	15	15	14	12	11	11	11	11	6	5	5	4	4	0
	LIGHT MACHINERY/ VEHICLES	48	2	4	4	10	19	42	45	46	48	48	48	48	48	45	43	40	38	37	22	15	15	13	12	1
	INDUSTRIAL PLANT	1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	VARIOUS / OTHERS	26	0	1	1	1	1	19	21	24	24	24	23	20	19	16	16	15	15	15	6	4	4	4	4	0

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

6) PERSONNEL

NORTHERN BRIDGES - NUMBER OF EMPLOYERS FOR ONE BRIDGE - YAPEI / BUIPE / DABOYA (Estimation based on the Direct Labour for the Construction Phase of ONE EXTRADOSED STRUCTURE)

ITEM	DESCRIPTION	ESTIMATED MAXIMUM QUANTITY	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16	M17	M18	M19	M20	M21	M22	M23	M24
1	Unskilled labor	29	4	8	8	16	16	16	29	29	29	29	29	29	29	29	29	18	18	16	16	16	16	16	12	4
2	Light machine / vehicles operator	38	2	4	4	10	9	32	35	36	38	38	38	38	38	35	33	30	28	27	22	15	15	13	12	1
3	Heavy machine operator	15	0	0	1	1	6	11	14	15	14	15	15	15	14	12	11	11	11	11	6	5	5	4	4	0
4	Carpenter	5						3	5	5	5	5	5	5	5	5	5	3	2	2	1	1	1	1	1	
5	Stone mason	5						3	5	5	5	5	5	5	5	5	5	3	2	2	1	1	1	1	1	
6	Rebar Setter	16					1	16	16	16	16	16	16	16	16	16	10	10	10	8						
7	Foreman	4	1	1	1	2	2	2	4	4	4	4	4	4	4	4	4	3	3	3	1	1	1	1	1	1
8	Equipment Mechanic / Industrial Worker	5	0	0	0	3	3	3	3	3	3	3	5	5	5	5	5	5	5	5	3	1	1	1	1	0
9	Electrician	1			0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1			
10	Welder	5			0	1	1	1	1	1	1	1	1	1	4	5	5	5	5	4	3	1	1	1	1	
	TOTAL MONTHLY MANPOWER		7	13	14	34	39	88	113	115	116	117	119	119	121	117	108	89	85	79	54	42	42	38	33	6

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

7) MAINTENANCE EXISTING BRIDGES