REPUBLIC OF RWANDA

Kigali, 06 MAY 2016

Ref N°873/SPIU/016

RWANDA TRANSPORT DEVELOPMENT AGENCY
P.O Box 6674
KG 563 St., Queen's Land House, 1st Floor
Email: info@rtda.gov.rw
KIGALI

TO: ALL POTENTIAL BIDDERS

SUBJECT: SECOND SET OF CLARIFICATIONS ON THE BIDDING DOCUMENT FOR "REHABILITATION AND WIDENING WORKS OF KAGITUMBA-KAYONZA-RUSUMO ROAD" (TENDER REFERENCE No. 003/W/2015-2016-IO/SPIU/RTDA-AFDB-EU-JICA)

Reference is made to the above-mentioned tender that is currently under advertisement. Enclosed is a second set of clarifications on the above-mentioned tender; the first set of clarifications was issued on 6th April 2016.

Attached to this letter is the detailed response to the first and second sets of questions as well as addition of two (2) weighbridges to Lot 1 and Lot 3 respectively.

Sincerely,

Guy M. KALISA
Director General

Cc:

- Hon. Minister of Infrastructure
- Hon. Minister of State In Charge of Transport
- Permanent Secretary/MININFRA
- Country Representative/African Development Bank/Rwanda Field Office
  KIGALI

SECOND SET OF CLARIFICATIONS ON THE BIDDING DOCUMENT FOR "REHABILITATION AND WIDENING WORKS OF KAGITUMBA-KAYONZA-RUSUMO ROAD" (TENDER REFERENCE No. 003/W/2015-2016-IO/SPIU/RTDA-AFDB-EU-JICA)

The following clarifications shall be taken into consideration:

1. The deadline for submission of bids is hereby extended and shall take place on **31st May 2016 at 10:00 A.M local time (GMT+2).** Bids will be opened in the presence of bidders' representatives who choose to attend, on the same day, on **31st May 2016 at 10:30 A.M local time (GMT+2) at RTDA premises on the 2nd floor, conference room.**
2. The bid security, advance payment guarantee and performance security shall be in form of a bank guarantee and shall be issued by a recognized Bank in Rwanda or any other recognized Bank outside Rwanda. Banks outside Rwanda shall have a correspondence Bank in Rwanda.
3. RTDA Offices have shifted and the new address is as follows:
   Rwanda Transport Development Agency
   P.O Box 6674 Kigali-Rwanda
   KG 563 St./Kacyiru, Queen's Land House, 1st Floor
   Email: info@rtda.gov.rw
4. Clarifications on other parts of the bidding document:

No.	Reference section of bidding document	Information initially provided in the bidding document	Changes to be considered
a.	Procurement Notice (item no. 3)	Interested eligible bidders may obtain further information from and inspect the Bidding Documents at; **Rwanda Transport Development Agency (RTDA)** **African Union Boulevard** **P.O. Box 6674 Kigali, Rwanda** **Attention: Director of Procurement Unit**	Interested eligible bidders may obtain further information from and inspect the Bidding Documents at; **Rwanda Transport Development Agency (RTDA)** **P.O Box 6674 Kigali-Rwanda** **KG 563 St., Queen's Land House, 2nd Floor** **Email: info@rtda.gov.rw** **Attention: Director of**

No.	Reference section of bidding document	Information initially provided in the bidding document	Changes to be considered
		Tel: (+250) 788524429 And E-mail: procurement@rtda.gov.rw	Procurement Unit Tel: (+250) 788524429 And E-mail: procurement@rtda.gov.rw
b.	Volume II. Item 03-1: Construction and Maintenance of Road Diversion	This price remunerates inclusively per kilometer the construction and maintenance of all detours necessary to maintain permanent traffic under the conditions defined by the technical specifications including deviations for hydraulic structures under high embankments, areas of reconstruction of the platform and crossings. The road diversion should be constructed as follows: - Carriageway of 6m wide : 2 x 3m; - Shoulders of 3m wide : 2 x 1m. The price include the following operations: - The topographic survey and preparation of the appropriate drawings; - The expropriation operations; - The realization of necessary earthwork ; - Execution of the pavement works (base course 20 cm of crashed gravel 0/20 + Double surface coating) ; - Necessary road marking	This price remunerates inclusively per kilometer the construction and maintenance of all detours necessary to maintain permanent traffic under the conditions defined by the technical specifications including deviations for hydraulic structures under high embankments, areas of reconstruction of the platform and crossings. The road diversion should be constructed as follows: - Carriageway of 7m wide : 2 x 3.5m; The price include the following operations: - The topographic survey and preparation of the appropriate drawings; - The expropriation operations; - The realization of necessary earthworks; - Execution of the wearing course (20cm) of selected lateritic gravel 0/31.5 or selected naturel gravel 0/31.5

No.	Reference section of bidding document	Information initially provided in the bidding document	Changes to be considered
		and traffic signs ; - Necessary protection works ; - The maintenance work during the project construction period. This price will be paid to the Contractor per kilometer after acceptance by the Consultant of the related works.	- Necessary road marking and traffic signs ; - Necessary protection works ; - The maintenance work during the project construction period. This price will be paid to the Contractor per kilometer after acceptance by the Consultant of the related works.
c.	Section III. Evaluation and Qualification Criteria (item 2.5-Personnel)	Nine key staff were requested	In additional to the nine key staff required, a Mechanical Engineer with Twelve (12) years general experience at least in comparable work and complexity and with a specific similar experience of 2 projects for installation of vehicle weighbridges (static weighbridges), shall be provided under lot 1 and Lot 3

5. Bidders shall in addition to the Bill of Quantities and unit price schedule, complete the following Summary Table for each Lot:

5.1 Summary Table for Lot 1

	LOT 1 (KAGITUMBA-BUGARAGARA-GABIRO ROAD (60Km))	
No.	DESCRIPTION	AMOUNT (Tax Exclusive)
	PART A: ROAD WORKS	
1	ITEM 000 - SITE INSTALLATION	
2	ITEM 100 - PREPARATORY WORKS	

3	ITEM 200 – EARTHWORKS	
4	ITEM 300 – PAVEMENT	
5	ITEM 400 - DRAINAGE AND PROTECTIONS	
6	ITEM 500 - SAFETY AND ROAD SIGNS	
	PART B: ENVIRONMENTAL MEASURES	
9	ITEM 600 - ENVIRONMENTAL MEASURES AND ACTIVITIES	
	PART C: ANCILLARY WORKS	
10	ITEM 700-REHABILITATION OF 6 MILK COLLECTION CENTERS	
11	ITEM 800- DRILLING OF WATER BOREHOLES	
12	ITEM 900 – SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES	
	GENERAL AMOUNT (Tax Exclusive)	
	OTHER APPLICABLE TAXES	
	VAT	
	GRAND TOTAL (Tax Inclusive)	

5.2 Summary Table for Lot 2

	LOT 2 (GABIRO - KAYONZA ROAD (56Km))	
No.	**DESCRIPTION**	**AMOUNT (Tax Exclusive)**
	PART A: ROAD WORKS	
1	ITEM 000 - SITE INSTALLATION	
2	ITEM 100 - PREPARATORY WORKS	
3	ITEM 200 – EARTHWORKS	
4	ITEM 300 – PAVEMENT	
5	ITEM 400 - DRAINAGE AND PROTECTIONS	
6	ITEM 500 - SAFETY AND ROAD SIGNS	
	PART B: ENVIRONMENTAL MEASURES	
9	ITEM 600 - ENVIRONMENTAL MEASURES AND ACTIVITIES	
	PART C: ANCILLARY WORKS	
10	ITEM 700-REHABILITATION OF 4 MILK COLLECTION CENTERS	
11	ITEM 800- DRILLING OF WATER BOREHOLES	
12	ITEM 900 – SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES	
	GENERAL AMOUNT (Tax Exclusive)	

	OTHER APPLICABLE TAXES	
	VAT	
	GRAND TOTAL (Tax Inclusive)	

5.3 Summary Table for Lot 3

	LOT 3 (KAYONZA-RUSUMO ROAD (92Km))	
No.	**DESCRIPTION**	**AMOUNT (Tax Exclusive)**
	PART A: ROAD WORKS	
1	ITEM 000 - SITE INSTALLATION	
2	ITEM 100 - PREPARATORY WORKS	
3	ITEM 200 – EARTHWORKS	
4	ITEM 300 – PAVEMENT	
5	ITEM 400 - DRAINAGE AND PROTECTIONS	
6	ITEM 500 - SAFETY AND ROAD SIGNS	
	PART B: ENVIRONMENTAL MEASURES	
9	ITEM 600 - ENVIRONMENTAL MEASURES AND ACTIVITIES	
	PART C: ANCILLARY WORKS	
10	ITEM 700-REHABILITATION OF MILK COLLECTION CENTERS	
11	ITEM 800- DRILLING OF WATER BOREHOLES	
12	ITEM 900 – SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES	
	GENERAL AMOUNT (Tax Exclusive)	
	OTHER APPLICABLE TAXES	
	VAT	
	GRAND TOTAL (Tax Inclusive)	

6. Two weighbridges and related facilities have been added to the tender document, one under Lot1 and another under Lot3. The additional unit price schedule, BoQ and technical specifications for the weighbridges are as follows:

6.1 Schedule of Unit Prices and Bill of Quantities for the Installation of Two (2) Weighbridges and Construction of Related Facilities (Additional item 900)

VOLUME II.-A-1

DEFINITION OF UNIT PRICES

Part C – ANCILLARY WORKS (ITEM-900: SUPPLY AND INSTALLATION OF TWO WEIGHBRIDGES AND CONSTRUCTION OF RELATED FACILITIES)

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
900-1	**BUSH CLEARING**		
	This remunerates per square meter the realization of bush clearing, brush wood removal, cleaning the platform area and right of way of earthworks and trees felling to the extent. These operations are not included in the benefits inherent in paid work by other prizes including: - All access constraints regardless of the nature of the terrain; - Brush clearing, felling, uprooting, felling trees and grubbing in circumference measured less than 1.0 m and up to 1.5 m above the ground level; - The demolition of fences whatever their nature; - The removal, transportation of the products obtained to a licensed disposal site irrespective of the distance, stockpiling, leveling and any constraints; - The filling of holes formed by the stump removal and delivery of selected materials necessary to this filling; - Compaction until a density "in situ" equal to NINETY PERCENT (90%) of modified Proctor; - Fruit trees and agriculture plantation will be removed as directed by the Consultant. The width to be taken into account, for each profile of the concerned right of way, the horizontal design of the earthwork platform, is deducted from the existing platform. To clean and brush out of the earthworks right of way, the surfaces to be considered will be determined according to the approved project documents and after contradictory interim accounts. For existing platform the width to be considered shall be the full width of sub grade not covered by vegetation.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-2	**TOP SOIL STRIPPING ON AVERAGE THICKNESS OF**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	0.20m		
	This price pays per square meter of surface measured on the ground plan for the stripping on twenty (20) centimeters depth from surface layer of top soil in the earthwork base. It includes: - All access-related works regardless of the building land type; - Removal of the layer on its entire thickness and its loading, - Transport of stripping material to an approved place of deposit, regardless of distance; - Basic leveling of the deposal areas and ail related operations. The width to be taken into account for each concerned cross section will be the ground plan of the breadth of the earthwork base after deduction of the existing platform. For the existing platform the full width of the roadway and shoulders must take into account. The quantities to be taken into account will be those arising from joint statements.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-3	**EXCAVATION IN SOFT MATERIAL FOR OPEN DRAINS**		
	This remunerates per cubic meter of achieving the excavation in soft or shifting ground, excluding rocky cuttings. It will be applied to the cuttings necessary for the implementation of the cross section, including the rectification of the slopes for open drains. Shall be deemed covered by the application of this award the following services and all resulting constraints: - All access constraints regardless of the nature of the terrain; - The execution of the cuttings, the materials extraction and loading, the levelling of cuttings bottom and embankments along the slopes prescribed by the standard plans and approved project implementation; - Achieving the following stepped heights and back slopes		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	prescribed by the standard plans and approved project implementation; - Transportation of excavated materials to the places of employment within the embankment of the road under construction for any distances; - In case of non-reusable excavated material, transportation of excavated materials to the place of deposit or discharge, approved by the Consultant regardless of transport distance; - Leveling and unloading of materials at the site of deposition or re-employment. The quantities to be considered will be the cubes in place before extraction or resulting from contradictory interim account.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-4	**EXCAVATION IN HARD MATERIAL FOR OPEN DRAINS**		
	This remunerates per cubic meter for execution of hard material excavation by only a rock breaker (hammer). It includes: - Supplies, transportation, and all constraints necessary authorizations for the use of explosives; - Carrying out any operation necessary for removing rubble including the drilling and blasting for the fragmentation of materials with dimensions allowing their use; - Loading, transportation to a place of deposit approved by the Consultant regardless of distance. It is clear that if the contractor decides to transport the materials to a distance greater than 1 km, it could not claim any allowance; - The possible filling of cut filling excavated to a minimum depth of 20cm, including supply of selected materials and compaction in accordance with the requirements of the Technical Specifications;		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	- Transport to landfills for non reuse of materials, unloading and leveling of materials at the site of deposit authorized by the Consultant and all constraints in executing large or small mass. The quantities to be considered will be those arising from contradictory interim account prepared before ripper and calculated using the theoretical cross section. Are included in these prices the cuttings below the additional line project and the backfill materials selected to achieve the rating of the project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-5	**CLEANING AND SHAPING EXISTING OPEN DRAINS**		
	This remunerates per cubic meters the cleaning and reprofiling (reshaping) of existing open earthen ditches. It includes: - Collection of herbs, shrubs, soil and other potential products; - Full manual cleaning ditches existing coated; - Reprofiling and grading works according to the standards detailed drawings; - All execution constraints and labor; The quantities to be considered will be the volume of earthen ditch repaired as resulting from implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved by the Client.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-6	**EXCAVATION FOR SUBSOIL DRAINAGE SYSTEM**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	This remunerates per cubic meter of achieving the excavation iny any kind of soil. It will be applied to the cuttings necessary for the implementation of the cross section, including the rectification of the slopes for subsoil drainage system. Shall be deemed covered by the application of this award the following services and all resulting constraints: - All access constraints regardless of the nature of the terrain; - The execution of the cuttings, the materials extraction and loading, the levelling of cuttings bottom and embankments along the slopes prescribed by the standard plans and approved project implementation; - Achieving the following stepped heights and back slopes prescribed by the standard plans and approved project implementation; - Transportation of excavated materials to the places of employment within the embankment of the road under construction for any distances; - In case of non-reusable excavated material, transportation of excavated materials to the place of deposit or discharge, approved by the Consultant regardless of transport distance; - Leveling and unloading of materials at the site of deposition or re-employment. The quantities to be considered will be the cubes in place before extraction or resulting from contradictory interim account.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-7	**IMPERMEABLE BACKFILLLING TO SUBSOIL DRAINAGE SYSTEM BACKFILL WITH BORROW PIT MATERIALS**		
	This remunerates per cubic meter of volume up the realization of fill from impermeable soil (clays, silty clays or		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	sandy clays obtained from the excavation or suitable borrow areas) for the execution of subsoil drainage backfill. It includes: - All access constraints regardless of the nature of the terrain; - Research, the opening and operation of quarries approved by the Consultant authority. The opening of access roads to the quarries and maintenance; - Extraction after brushing, scraping, potential discovery regardless of thickness, site preparation under the embankment in accordance with the Technical Specifications etc. - Loading, transportation for any distances, the spreading, the implementation, the leveling, possible changes in moisture content, compaction to 95% of OPM after 4 days of immersion , the grading and all constraints implementation and achievement of defined qualities to Technical Requirements; - All constraints in implementing several layers of a maximum thickness 20 cm. The quantities to be considered will be those arising from contradictory interim account prepared before execution of embankments and calculated using the theoretical cross section and following the approved implementation of project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	
900-8	**BANKS AND DYKES**		
	This remunerates per cubic meter of volume up the realization of fill from borrow pit or excavated material approved by the Engineer for the execution of banks and dykes. It includes: - All access constraints regardless of the nature of the terrain; - Research, the opening and operation of quarries		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	approved by the Consultant authority. The opening of access roads to the quarries and maintenance; - Extraction after brushing, scraping, potential discovery regardless of thickness, site preparation under the embankment in accordance with the Technical Specifications etc. - Loading, transportation for any distances, the spreading, the implementation, the leveling, possible changes in moisture content, compaction to 95% of OPM after 4 days of immersion , the grading and all constraints implementation and achievement of defined qualities to Technical Requirements; - All constraints in implementing several layers of a maximum thickness 25 cm. The quantities to be considered will be those arising from contradictory interim account prepared before execution of embankments and calculated using the theoretical cross section and following the approved implementation of project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-9	**NATURAL PERMEABLE MATERIAL IN SUBSOIL DRAINAGE SYSTEMS (CRUSHED STONES)**		
	This price applies to cubic meter of drainage materials (crushed stones obtained from approved sources with 19mm nominal size. It includes: - The supply and transport of necessary draining materials for any distance and all constraints works; - The achievement of the trench by clearing land and deposition upgrade; - Compacting and levelling the bottom of the trench; - The establishment of a drainage layers of crushed stones. The quantities to be considered will be implemented volumes resulting from contradictory attachments.		
	Cubic		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Meter..... ....(Exc. VAT)	m^3	....
900-10	**NATURAL PERMEABLE MATERIAL IN SUBSOIL DRAINAGE SYSTEMS (SAND)**		
	This price applies to cubic meter of drainage materials (sand) performed as detailed plans and directions of the Consultant. It includes: - The supply and transport of necessary draining materials for any distance and all constraints works; - The achievement of the trench by clearing land and deposition upgrade; - Compacting and levelling the bottom of the trench; - The establishment of a drainage layers of sand with an equivalent of sand> 50%; - The establishment of sand layers; The quantities to be considered will be implemented volumes resulting from contradictory attachments.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-11	**PIPES IN SUBSOIL DRAINAGE SYSTEM**		
	This price applies to linear meter for the supply and execution of perforated PVC pipe Φ 200 mm to be set up in the subsoil drainage systems according to the approved drawings and in accordance with the technical specifications and Consultant instructions.		
	Linear Meter..... ....(Exc. VAT)	lm	....

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
900-12	**FILTER FABRIC FOR SUBSOIL DRAINAGE SYSTEM**		
	This price pays square meter for the supply, transport and implementation of appropriated geotextile filter fabric, Kaymat U24 or similar approved geotextile to be set up in the subsoil drainage system and enveloping the draining materials, in accordance with the provisions indicated on the plans and the requirements of the Consultant. This price includes all supplies, transportation, installation, cups and all constraints. It applies to the geotextile square meter according to the implementation plans approved by the Consultant.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-13	**CONSTRUCTION OF CONCRETE STRUCTURE FOR SUBSOIL DRAINAGE SYSTEM**		
	The price applied of unit of work of reinforced concrete outlet structure for sub-soil drainage system as per the drawings. It includes: - Execution of field excavations of any kind, - Extraction, loading and unloading of land to approved disposal sites; - The possible exhaustion of the various waters; - Field finishing earthworks of any kind including Rocky, levelling and compaction to 95% of OPM(Modified Proctor Compaction) 's trench bottom; - Supplies all the necessary materials and their transport over any distance; - Manufacture, any formwork and the implementation of a thickness of 0.1 m, a blinding concrete containing 200 kg / m3 of cement, tamping or compacting and all constraints; - Manufacture, ordinary and cared formwork and the implementation of a concrete B25 dosed at 350 kg / m3 CPA45 cement, to technical requirements; - Reinforcement in accordance with plans approved construction drawings, steel type is Fe or Fe E24 E40		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	- Stripping, damage or compaction and backfilling neat behind the front wall and the wing walls and all constraints; - All necessary formwork; - Additional protections riprap masonry according to standard plans and instructions of the Consultant, and any constraints; The number of works to be considered will be the effective implementation found by contradictory attachments and executed in accordance with the Project Execution Plans approved by the Client.		
	Unit..... ....(Exc. VAT)	U	....
900-14	**EXCAVATION IN SOFT MATERIAL FOR CULVERTS**		
	This remunerates per cubic meter of achieving the excavation in soft or shifting ground, excluding rocky cuttings. It will be applied to the cuttings necessary for the implementation of the cross section, including the rectification of the slopes for construction of culverts. Shall be deemed covered by the application of this award the following services and all resulting constraints: - All access constraints regardless of the nature of the terrain; - The execution of the cuttings, the materials extraction and loading, the levelling of cuttings bottom and embankments along the slopes prescribed by the standard plans and approved project implementation; - Achieving the following stepped heights and back slopes prescribed by the standard plans and approved project implementation; - Transportation of excavated materials to the places of employment within the embankment of the road under construction for any distances; - In case of non-reusable excavated material, transportation of excavated materials to the place of deposit or discharge, approved by the Consultant regardless of		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	transport distance; - Leveling and unloading of materials at the site of deposition or re-employment. The quantities to be considered will be the cubes in place before extraction or resulting from contradictory interim account.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-15	**EXCAVATION IN HARD MATERIAL FOR CULVERTS**		
	This remunerates per cubic meter for execution of hard material excavation by only a rock breaker (hammer). It includes: - Supplies, transportation, and all constraints necessary authorizations for the use of explosives; - Carrying out any operation necessary for removing rubble including the drilling and blasting for the fragmentation of materials with dimensions allowing their use; - Loading, transportation to a place of deposit approved by the Consultant regardless of distance. It is clear that if the contractor decides to transport the materials to a distance greater than 1 km, it could not claim any allowance; - The possible filling of cut filling excavated to a minimum depth of 20cm, including supply of selected materials and compaction in accordance with the requirements of the Technical Specifications; - Transport to landfills for non reuse of materials, unloading and leveling of materials at the site of deposit authorized by the Consultant and all constraints in executing large or small mass. The quantities to be considered will be those arising from contradictory interim account prepared before ripper and calculated using the theoretical cross section. Are included in these prices the cuttings below the additional line project and the backfill materials selected to achieve the rating of the		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-16	**BACKFILLING USING EXCAVATED MATERIALS**		
	This remunerates per cubic meter of volume the realization of fill excavated material from construction site for the execution of construction of culverts. It includes: - All access constraints regardless of the nature of the terrain; - The eventual resumption in deposit, the disintegration of large elements and rejection of unsuitable material; - The leveling, watering, compacting to 90% of OPM after 4 days of immersion, the grading and all constraints of implementation (limited heights, periods of consolidation, implementation in small quantities in the nearing structures, site preparation under the embankment in accordance with the Technical Specifications etc.) and obtaining the qualities defined in Technical Requirements; - All constraints in implementing several layers of maximum thickness of 25 cm. The quantities to be considered will be those arising from contradictory interim account prepared before execution of embankments and calculated using the theoretical cross section and following the approved implementation project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-17	**BACKFILL USING IMPORTED MATERIAL FROM BORROW PIT**		
	This remunerates per cubic meter of volume up the realization of for backfilling for the construction of culverts.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The imported material must be approved by the Engineer. It includes: - All access constraints regardless of the nature of the terrain; - Research, the opening and operation of quarries approved by the Consultant authority. The opening of access roads to the quarries and maintenance; - Extraction after brushing, scraping, potential discovery regardless of thickness, site preparation under the embankment in accordance with the Technical Specifications etc. - Loading, transportation for any distances, the spreading, the implementation, the leveling, possible changes in moisture content, compaction to 95% of OPM after 4 days of immersion , the grading and all constraints implementation and achievement of defined qualities to Technical Requirements; - All constraints in implementing several layers of a maximum thickness 25 cm. The quantities to be considered will be those arising from contradictory interim account prepared before execution of embankments and calculated using the theoretical cross section and following the approved implementation of project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-18	**CONCRETE PIPE CULVERTS (1000MM DIA.)**		
	This price applies to the linear meter of reinforced concrete nozzle dosed at 350 kg / m3 of cement, to technical requirements. it includes: - Supplies, including the reinforcement of the nozzle and their transport to all distances; - Manufacture and supply at work of the nozzle; - Ground excavations of any kind, including rocky coast to the least fifteen (-15) centimeters below the bottom		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	generator; - Development or any deviation from the bed of the flow, and the temporary diversion of traffic regardless of the nature and importance of the work, - Rehabilitation of the site after execution of the nozzle; - The implementation of large concrete barrel dosed at 250kg / m3 cement; - The performance of cement mortar joints; - The establishment of the nozzle elements and execution of joints; - Backfilling materials selected in accordance with the rules of the trade and technical requirements to the level of the seat of earthworks with contributions of any materials, compaction and any constraints; - All necessary formwork; - Loading, transport all distances, unloading and levelling to drop off the excess land or rubble from the excavation. The lengths to be considered will be those set out implementation plans approved. In case of bevel size, we take a flat rate the arithmetic mean of the largest and the shorter of the outer generator.		
	Linear Meter..... ....(Exc. VAT)	lm	....
900-19	**CAST IN SITU CONCRETE (C25) AND FORMWORK: IN CLASS A BEDDING, SCREEDS AND THE ENCASING OF PIPES, INCLUDING FORMWORK**		
	This remunerates per cubic meter supply, transport and the implementation of concrete C25 in accordance with Technical Specification. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-20	**CAST IN SITU CONCRETE (C30) AND FORMWORK: IN FLOOR SLABS FOR PORTAL OR RECTANGULAR CULVERTS, WALL, BEAM AND SLAB, HEAD WALLS AND WING WALLS, INCLUDING FORMWORK AND CLASS U2 SURFACE FINISH**		
	This remunerates per cubic meter supply, transport and the implementation of concrete C30 in accordance with Technical Specification. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints. The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-21	**CAST IN SITU CONCRETE (C30) AND FORMWORK: IN**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	INLET AND OUTLET STRUCTURES, CATCH PITS, MANHOLES, THRUSTS AND ANCHOR BLOCKS, EXCLUDING FORMWORK BUT INCLUDING CLASS U2 SURFACE FINISH		
	This remunerates per cubic meter supply, transport and the implementation of concrete C30 in accordance with Technical Specification. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints. The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter.....(Exc. VAT)	m^3	.....
900-22	**CAST IN SITU CONCRETE AND FORMWORK: FORMWORK OF CONCRETE UNDER ITEM 900-21 ABOVE (CLASS F2 FINISH)**		
	This remunerates per cubic meter supply, transport and the implementation of concrete in accordance with Technical Specification. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-23	**CAST IN SITU CONCRETE AND FORMWORK: IN CONCRETE (C15) LININGS FOR THE INVERT OF CULVERTS INCLUDING FORMWORK AND CLASS U2 SURFACE FINISH**		
	This remunerates per cubic meter supply, transport and the implementation of concrete in accordance with Technical Specification. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints. The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-24	**STEEL REINFORCEMENT: MILD STEEL BARS**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	This remunerates per ton the supply and shaping of reinforcing mild steel bars. It includes stirrup, spacers between the reinforcement and the casing, all constraints of storage or preparation, and execution of all constraints. The price in ton is determined by the quantity survey (d = 7.85 kg/dm3). It will be considered only recoveries indicated on the reinforcement drawings approved by the Consultant. Stirrup and assembly bars are not counted.		
	Ton..... ....(Exc. VAT)	Ton	....
900-25	**STEEL REINFORCEMENT: HIGH TENSILE STEEL BARS (GRADE Fy 460)**		
	This remunerates per ton the supply and shaping of reinforcing high tensile steel bars. It includes stirrup, spacers between the reinforcement and the casing, all constraints of storage or preparation, and execution of all constraints. The price in ton is determined by the quantity survey. It will be considered only recoveries indicated on the reinforcement drawings approved by the Consultant. Stirrup and assembly bars are not counted.		
	Ton..... ....(Exc. VAT)	Ton	....
900-26	**STEEL REINFORCEMENT: WELDED STEEL FABRIC**		
	This remunerates per ton the supply and shaping of reinforcing welded steel fabric bars. It includes stirrup, spacers between the reinforcement and the casing, all constraints of storage or preparation, and execution of all constraints. The price in ton is determined by the quantity survey. It will be considered only recoveries indicated on the reinforcement drawings approved by the Consultant. Stirrup and assembly bars are not counted.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Ton..... ....(Exc. VAT)	Ton	....
900-27	**BRICK WORK (115 MM THICK)**		
	This price applies per square meter of masonry wall (115mm thick) in compliance with the standard plans of the project. It includes: - Excavations in any type of ground, including until minus fifteen (15) cm below the bottom rail; - All necessary actions for site preparation, excavations, additional earthworks whatever the quantities and the type of ground, including rocky grounds; - Extraction, loading and unloading of earth Io approved places of deposit; - Any dewatering where necessary; - Finishing earthworks ln any type of ground, including rocky grounds; - Leveling and compaction to 98% of the modified Proctor compaction test of the trench bottom; - Supply of all necessary materials and their transport for any distance; - Manufacturing, formwork where necessary and the implementation of bidding concrete with 200 kg/m3 cement tamping or compaction and au ancillary operations; - Supply, manufacturing end implementation of masonry walls and sidewalls and of mortar containing 300kglm3 cement. including supply cutting stones and all ancillary actions related to the achievement of masonry walls; - Necessary adjustments to the land pattern; - Formwork, tamping or compaction and careful backfill behind the wall and ail ancillary actions; - Backfilling excavation where necessary with selected materials, including supply transport for any distance; and all action related to execution.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The linear length of wall to be taken into account will be that effectively implemented as reported by the joint statements and executed in compliance with the drawing of the execution approved by the Consultant.		
	Square Meter..... ....(Exc. VAT)	m^2	.....
900-28	**BRICK WORK (230 MM THICK)**		
	This price applies per square meter of masonry wall (230mm thick) in compliance with the standard plans of the project. It includes: - Excavations in any type of ground, including until minus fifteen (·15) cm below the bottom rail; - All necessary actions for site preparation, excavations, additional earthworks whatever the quantities and the type of ground, including rocky grounds; - Extraction, loading and unloading of earth Io approved places of deposit; - Any dewatering where necessary; - Finishing earthworks In any type of ground, including rocky grounds; - Leveling and compaction to 98% of the modified Proctor compaction test of the trench bottom; - Supply of all necessary materials and their transport for any distance; - Manufacturing, formwork where necessary and the implementation of bidding concrete with 200 kg/m3 cement tamping or compaction and au ancillary operations; - Supply, manufacturing end implementation of masonry walls and sidewalls and of mortar containing 300kglm3 cement. including supply cutting stones and all ancillary actions related to the achievement of masonry walls; - Necessary adjustments to the land pattern; - Formwork, tamping or compaction and careful backfill		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	behind the wall and ail ancillary actions; - Backfilling excavation where necessary with selected materials, including supply transport for any distance; and all action related to execution. The linear length of wall to be taken into account will be that effectively implemented as reported by the joint statements and executed in compliance with the drawing of the execution approved by the Consultant.		
	Square Meter..... ....(Exc. VAT)	m^2	....
900-29	**SERVICE DUCTS: ORDINARY PIPES**		
	This price applies to linear meter for the supply and execution of ordinary PVC pipe (Φ 110 mm) according to the approved drawings and in accordance with the technical specifications and Consultant instructions.		
	Linear Meter..... ....(Exc. VAT)	lm	....
900-30	**SERVICE DUCTS: SPLIT PIPES**		
	This price applies to linear meter for the supply and execution of split PVC pipe (Φ 110 mm) according to the approved drawings and in accordance with the technical specifications and Consultant instructions.		
	Linear Meter..... ....(Exc. VAT)	lm	....

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
900-31	**DUCT MARKER BLOCKS**		
	This price applies per unit of reinforced concrete duct marker blocks as per drawings. It includes: - The supply of prefabricated blocks and necessary materials and equipment: - Transport for any distance; - Paintings and marking in accordance with the Contract prescription; - All costs and works related to layouts (excavation, laying, etc ...) and all ancillary actions; The quantities to be taken into account are those effectively achieved and recorded in the joint statements.		
	Unit..... ....(Exc. VAT).	U	....
900-32	**HAND EXCAVATION TO DETERMINE THE POSITIONS OF EXISTING SERVICES**		
	This remunerates per cubic meter for hand excavation to determine the positions of existing services. It includes: - Supplies, transportation, and all constraints necessary authorizations for the use of explosives; - Loading, transportation to a place of deposit approved by the Consultant regardless of distance.		
	Cubic		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Meter..... ....(Exc. VAT)	m^3	.....
900-33	**DEMOLISHING AND REMOVING EXISTING REINFORCED CONCRETE AND MASONRY STRUCTURES**		
	This remunerates per cubic meter the demolition of constructed masonry, reinforced concrete or unreinforced structures (culvert box, manhole, rafts, abutments, etc),other items. It includes: - All relevant earthworks, including excavation; - The demolition of the structure itself and any constraints to implementation; - The loading, transport for any distance, unloading and stockpiling stones, rubble or material extracted from a location approved by the Consultant; - Backfilling of the excavation (unless otherwise directed by the Consultant)to the level of the old ground, and the supply of materials having the qualities defined in the technical specifications; - Compaction until a density "in situ" equal to ninety percent (90%) to that obtained with modified Proctor; The volume to be considered is the full volume of parts of structures demolished actually measured by contradictory interim accounts approved by the consultant before demolition.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-34	**SHOULDER DELINEATOR CONCRETE KERBING BLOCKS**		
	This price applies to the linear meter of supply and installation of shoulder delineator reinforced concrete kerbing bkocks in compliance with the standard plans of the		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	project. It includes: - Provision and transport of necessary materials; - Prefabrication and supply on site of barrier curb: - Staking and detail scale drawing; - excavations where necessary; - Supply and application of bedding mortar; - installation, grading In plan and level, wedging, joints, cuts, connections of any kind and various finishing~ - Jointing and connections to vents and gutters; - Removal of demolition rubbish or earth in excess to places of deposit agreed by the controlling authority. The quantities to be taken into account will be those actually installed resulting from joint statements.		
	Linear Meter..... ....(Exc. VAT)	lm	....
900-35	**CONCRETE BARRIER END SECTIONS CONCRETE KERBING BLOCKS**		
	This price applies per unit of reinforced concrete barrier end sections kerbing blocks as per drawings. It includes: - The supply of prefabricated blocks and necessary materials and equipment: - Transport for any distance; - Paintings and marking in accordance with the Contract prescription; - All costs and works related to layouts (excavation, laying, etc ...) and all ancillary actions; The quantities to be taken into account are those effectively achieved and recorded in the joint statements.		
	Unit..... ....(Exc. VAT).	U	....

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
900-36	CONCRETE CHUTES (TYPE 1): CAST IN SITU CONCRETE (C30)		
	This price applies to the linear meter of supply and installation of reinforced concrete chutes in compliance with the standard plans of the project. It includes: - Provision and transport of necessary materials; - Casting on site; - Staking and detail scale drawing; - excavations where necessary; - Supply and application of bedding mortar; - installation, grading ln plan and level, wedging, joints, cuts, connections of any kind and various finishing~ - Jointing and connections to vents and gutters; - Removal of demolition rubbish or earth in excess to places of deposit agreed by the controlling authority. The quantities to be taken into account will be those actually installed resulting from joint statements.		
	Linear Meter..... ....(Exc. VAT)	Lm	....
900-37	INLET STRUCTURES FOR CONCRETE CHUTES		
	This price applies per unit of reinforced concrete inlet structures for concrete chutes as per drawings. It includes: - The supply of prefabricated blocks and necessary materials and equipment: - Transport for any distance; - Paintings and marking in accordance with the Contract prescription; - All costs and works related to layouts (excavation, laying, etc ...) and all ancillary actions; The quantities to be taken into account are those effectively achieved and recorded in the joint statements.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Unit..... ....(Exc. VAT).	**U**	....
900-38	**TRIMMING OF EXCAVATIONS FOR CONCRET-LINED OPEN DRAINS IN SOFT MATERIAL**		
	This price pays to square meter trimming of excavations for concrete-lined open drains in soft material. It includes: - All costs and subjection of the test sections; - All work and subjection developed in the Technical Requirements; - All the costs and subjection of Implementation for qualities or specifications defined in the Technical Requirements. The quantities to be considered will be calculated from the theoretical surface of the relevant section.		
	Square Meters..... ....(Exc. VAT)	**m^2**	....
900-39	**TRIMMING OF EXCAVATIONS FOR CONCRET-LINED OPEN DRAINS IN HARD MATERIAL**		
	This price pays to square meter trimming of excavations for concrete-lined open drains in hard material. It includes: - All costs and subjection of the test sections; - All work and subjection developed in the Technical Requirements; - All the costs and subjection of Implementation for qualities or specifications defined in the Technical Requirements. The quantities to be considered will be calculated from the theoretical surface of the relevant section.		
	Square Meters..... ....(Exc.	**m^2**	....

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	VAT)		
900-40	**CONCRETE LINING FOR OPEN DRAINS: CAST IN SITU CONCRETE (C25) IN TYPE OF SIDE DRAIN**		
	This remunerates per cubic meter supply, transport and the implementation of concrete C20 as instructed by the Engineer. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints. The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-41	**CONCRETE LINING FOR OPEN DRAINS: CLASS U2 SURFACE SURFACE FINISH TO CAST IN SITU CONCRETE**		
	This remunerates per cubic meter supply, transport and the implementation of concrete C20 for the type of drain as instructed by the Engineer. It includes: - Providing all the necessary materials (cement, water, admixture, etc) ; - Implementation works; - Concrete Mix design; - Transportation cost; - And all constraints.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant. It will not be granted any increase in value if the thickness unordered by the Consultant.		
	Cubic Meter.....(Exc. VAT)	m^3	.....
900-42	**FORMWORK TO CAST IN SITU CONCRETE LINING FOR OPEN DRAINS (CLASS F2 SURFACE FINISH) TO SIDES WITH WITH FORMWORK ON BOTH INTERNAL AND EXTERNAL FACES (EACH FACE MEASURED)**		
	This remunerates per square meter supply and installation of ordinary formwork for hidden covering in concrete. It includes: - Supply of formwork and scaffolding made, - Assembly, grading and maintenance of the formwork, scaffolding and other - The strutting of all parts of articles of foundation and elevation - Dismantling of formworks, scaffolding, and all execution constraints. The quantities to be considered will be the actual square meter of covering calculated from drawings approved by the consultant		
	Square Meter.....(Exc. VAT)	m^2	.....
900-43	**FORMWORK TO CAST IN SITU CONCRETE LINING FOR OPEN DRAINS (CLASS F2 SURFACE FINISH) TO ENDS OF SLABS**		
	This remunerates per square meter supply and installation of		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	ordinary formwork for hidden covering in concrete. It includes: - Supply of formwork and scaffolding made, - Assembly, grading and maintenance of the formwork, scaffolding and other - The strutting of all parts of articles of foundation and elevation - Dismantling of formworks, scaffolding, and all execution constraints. The quantities to be considered will be the actual square meter of covering calculated from drawings approved by the consultant		
	Square Meter..... ....(Exc. VAT)	m^2	....
900-44	**SEALED JOINTS IN CONCRETE LININGS OF OPEN DRAINS**		
	This remunerates per linear meter the execution of sealed joints in concrete linings of open drains typical or as directed by the Engineer. It includes: - Providing all the necessary materials; - Implementation works; - And all constraints. The quantities to be considered will be the ultimate length as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the project implementation plans approved by the Consultant.		
	Linear Meter..... ....(Exc. VAT)	Lm	....
900-45	**STEEL REINFORCEMENT: WELDED STEEL FABRIC**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	This remunerates per kilogram the supply and shaping of reinforcing welded steel fabric (ref 193). It includes stirrup, spacers between the reinforcement and the casing, all constraints of storage or preparation, and execution of all constraints. The price in kilogram is determined by the quantity survey. It will be considered only recoveries indicated on the reinforcement drawings approved by the Consultant.		
	Kilogram..... ....(Exc. VAT)	kg	....
900-46	**POLYETHYLENE SHEETING**		
	This price pays square meter for the supply and installation of polyethylene (0.15mm thick) for concrete-lined open drains in accordance of the requirements of the Consultant. This price includes all supplies, transportation, installation, cups and all constraints. It applies to the sheeting square meter according to the implementation plans approved by the Consultant.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-47	**PLAIN STONE PITCHING**		
	This remunerates per square meter of plain stone pitching implemented in accordance with specifications and standard plans for the project dispositions relating to the consolidation of embankments. It includes: - The excavations in land of any kind, to minus thirty (-30) cm below the inferior slab, - All constraints of site preparation, excavation and earthworks whatever additional quantities and nature of the terrain, including rocky; - Extraction, loading and unloading of dirt to approved		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	disposal sites; - The eventual dewatering; - The finishing earthworks of all kinds of terrain including rock, the grading and compaction to 98% of OPM of the bottom of the excavation; - Supplies of all necessary materials and their transport over any distance; - Backfilling any excavations in selected materials, including supply, transport for any distance and any constraints to implementation; The quantities to be considered will be the surfaces actually implemented as resulting from the surfaces calculated in the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved by the Client.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-48	**GROUTED STONE PITCHING**		
	This remunerates per square meter of grouted stone pitching implemented in accordance with specifications and standard plans for the project dispositions relating to the consolidation of embankments. It includes: - The excavations in land of any kind, to minus thirty (-30) cm below the inferior slab, - All constraints of site preparation, excavation and earthworks whatever additional quantities and nature of the terrain, including rocky; - Extraction, loading and unloading of dirt to approved disposal sites; - The eventual dewatering; - The finishing earthworks of all kinds of terrain including rock, the grading and compaction to 98% of OPM of the bottom of the excavation;		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	- Supplies of all necessary materials and their transport over any distance; - Backfilling any excavations in selected materials, including supply, transport for any distance and any constraints to implementation; The quantities to be considered will be the surfaces actually implemented as resulting from the surfaces calculated in the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved by the Client.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-49	**STONE MASONRY WALLS FOR SCOUR PROTECTION OR SIMILAR: CEMENT-MORTARED STONE WALLS**		
	This price applies per cubic meter of masonry walls for scour protection. It includes: - All necessary actions for site preparation, additional earthworks whatever the quantities and the type of ground, including rocky grounds; - Any dewatering where necessary; - Leveling and compaction to 98% of the modified Proctor compaction test of the trench bottom; - Supply of all necessary materials and their transport for any distance; - Manufacturing, formwork where necessary and the implementation of bidding concrete with 200 kg/m3 cement tamping or compaction and au ancillary operations; - Supply, manufacturing end implementation of masonry walls and sidewalls and of mortar containing 300kglm3 cement. including supply cutting stones and all ancillary actions related to the achievement of masonry walls; - Necessary adjustments to the land pattern;		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	- Formwork, tamping or compaction and careful backfill behind the wall and ail ancillary actions; - Backfilling excavation where necessary with selected materials, including supply transport for any distance; and all action related to execution. The linear length of wall to be taken into account will be that effectively implemented as reported by the joint statements and executed in compliance with the drawing of the execution approved by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-50	**STONE MASONRY WALLS FOR SCOUR PROTECTION OR SIMILAR: CEMENT-MORTARED STONE MASONRY FOR STRUCTURES**		
	This price applies per cubic meter of masonry walls for scour protection. It includes: - All necessary actions for site preparation, additional earthworks whatever the quantities and the type of ground, including rocky grounds; - Any dewatering where necessary; - Leveling and compaction to 98% of the modified Proctor compaction test of the trench bottom; - Supply of all necessary materials and their transport for any distance; - Manufacturing, formwork where necessary and the implementation of bidding concrete with 200 kg/m3 cement tamping or compaction and au ancillary operations; - Supply, manufacturing end implementation of masonry walls and sidewalls and of mortar containing 300kglm3 cement. including supply cutting stones and all ancillary actions related to the achievement of masonry walls; - Necessary adjustments to the land pattern; - Formwork, tamping or compaction and careful backfill		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	behind the wall and ail ancillary actions; - Backfilling excavation where necessary with selected materials, including supply transport for any distance; and all action related to execution. The linear length of wall to be taken into account will be that effectively implemented as reported by the joint statements and executed in compliance with the drawing of the execution approved by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-51	**FOUNDATION TRENCHES**		
	This remunerates per cubic meter of achieving the excavation for foundation. Shall be deemed covered by the application of this award the following services and all resulting constraints: - All access constraints regardless of the nature of the terrain; - The execution of the trenches, the materials extraction and loading, the levelling of trenches. - Transportation of excavated materials to the approved dumping sites by the Project Manager whatever the distance or to the filling place. The quantities to be considered will be the cubes in place before extraction or resulting from contradictory interim account. **Cubic Meter**..... ....(Exc. VAT).	m^3	.....
900-52	**GABION FOR RETAINNING WALL AND PROTECTION**		
	This remunerates per cubic meter for gabion supporting embankment slopes of the platform and in structures output. It includes:		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	- All land access constraints of any kind and diversion of traffic; - All constraints of site preparation, excavation and earthworks whatever additional quantities and nature of the terrain, including rocky; - The provision, transport for any distance, any earthworks necessary for the installation, including excavation, sheeting, loading, transport for any distance, unloading and levelling to approved disposal sites of dirt and rubble excess; - The provision of galvanized meshes, transportation, manufacturing and installation of caissons and rubble filling in accordance with the stipulations of technical requirements, including the provision of stirrup, the provision and implementation of survey beacons, along the vertical edges, to ensure perfect tension of the free faces; - The supply, transport and installation work of draining materials, geotextile and Polyvinyl chloride pipes behind the walls in accordance with standard plans; - The potential contribution of additional embankments and filtering materials, with ramming and compacting for the rehabilitation and reconstruction around the roadbed all constraints for stabilization of the ground beneath the walls; - Any constraints to implementation; The quantities to be considered will be the implemented volumes of gabions measured and confirmed by contradictory interim accounts approved by the consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	....
900-53	**FILTER FABRIC**		
	This price pays square meter for the supply, transport and implementation of appropriated geotextile filter fabric, Kaymat U24 or similar approved geotextile to be set up for		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	the gabion retaimning wall in accordance with the quirements of the Consultant. This price includes all supplies, transportation, installation, cups and all constraints. It applies to the geotextile square meter according to the implementation plans approved by the Consultant.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-54	**EXCAVATION (TO SPOIL) IN SOFT SOIL**		
	This remunerates per cubic meter of achieving the excavation in soft or shifting soil ground, excluding rocky cuttings. It will be applied to the cuttings necessary for the implementation of the cross section, including the rectification of the slopes, excluding amounts paid for work by other prices (stripping, purge, for excavation works, cutting through pavement, ditches and trenches). Shall be deemed covered by the application of this award the following services and all resulting constraints: - All access constraints regardless of the nature of the terrain; - The execution of the cuttings, the materials extraction and loading, the levelling of cuttings bottom and embankments along the slopes prescribed by the standard plans and approved project implementation; - Achieving the following stepped heights and back slopes prescribed by the standard plans and approved project implementation; - Transportation of excavated materials to the places of employment within the embankment of the road under construction for any distances; - Leveling and unloading of materials at the site of deposition or re-employment. N.B: Some of this work will be executed also at Rusumo border post for the parking yard.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The quantities to be considered will be the cubes in place before extraction or resulting from contradictory interim account.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-55	**EXCAVATION IN HARD/ROCKY SOIL**		
	This remunerates per cubic meter for execution of rocky cuttings only within explosive and can not be attacked by the Ripper type D8 caterpillar bulldozer or similar. It includes: - Supplies, transportation, and all constraints necessary authorizations for the use of explosives; - Carrying out any operation necessary for removing rubble including the drilling and blasting for the fragmentation of materials with dimensions allowing their use; - Loading, transportation to a place of deposit approved by the Consultant regardless of distance. It is clear that if the contractor decides to transport the materials to a distance greater than 1 km, it could not claim any allowance; - Transport to landfills, unloading and leveling of materials at the site of deposit authorized by the Consultant and all constraints in executing large or small mass. The quantities to be considered will be those arising from contradictory interim account prepared before ripper and calculated using the theoretical cross section. Are included in these prices the cuttings below the additional line project and the backfill materials selected to achieve the rating of the project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-56	**BACKFILL WITH EXCAVATED MATERIALS**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	This remunerates per cubic meter of volume the realization of fill excavated for execution of all landfills in large or small masses. It includes: - All access constraints regardless of the nature of the terrain; - The eventual resumption in deposit, the disintegration of large elements and rejection of unsuitable material; - The leveling, watering, compacting to 90% of OPM after 4 days of immersion, the grading and all constraints of implementation (limited heights, periods of consolidation, implementation in small quantities in the nearing structures, site preparation under the embankment in accordance with the Technical Specifications etc.) and obtaining the qualities defined in Technical Requirements; - All constraints in implementing several layers of maximum thickness of 25 cm. The quantities to be considered will be those arising from contradictory interim account prepared before execution of embankments and calculated using the theoretical cross section and following the approved implementation project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-57	**ROCK FILL**		
	This remunerates per cubic meter of volume the realization of fill from excavated rock material. It includes: - All access constraints regardless of the nature of the terrain; - The leveling, watering, compacting to 90% of OPM after 4 days of immersion, the grading and all constraints of implementation (limited heights, periods of consolidation, implementation in small quantities in the nearing structures, site preparation under the embankment in accordance with the Technical Specifications etc.) and obtaining the qualities defined in		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Technical Requirements; - All constraints in implementing several layers of maximum thickness of 25 cm. The quantities to be considered will be those arising from contradictory interim account prepared before execution of embankments and calculated using the theoretical cross section and following the approved implementation project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-58	**REMOVAL OF UNSUITABLE MATERIAL (WITH LOW LOAD-BEARING CAPACITY)**		
	This price is remuneration per cubic meter for the removal, from under embankments, of low load-bearing capacity soils inappropriate as good foundation bed for embankments and their replacement with other materials for a variable thickness defined in the plans or specified by the Consultant, in order to purge the natural soil to the level of stripped terrain. - Extraction, from under the perimeter of embankments, of low load-bearing capacity soils not for a good foundation bed for embankments, for a variable thickness defined in drawings or specified by the Consultant; - Required topographic survey before and after clearing; - Evacuation of debris materials out of the project right-of-way, their transportation for any distance and their stockpiling and places approved by the Consultant; - Any incidentals relating to labour, equipment, materials and other inputs necessary to complete the work. The quantities to be taken into account are those measured on-site by establishing the difference in the profiles before and after the scaling down operation.		
	Cubic Meter..... ....(Exc.	m^3	.....

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	VAT)		
900-59	**SHAPING AND COMPACTION OF THE EARTHWORK UPPER PLATFORM**		
	This price pays to cubic meter shaping the levelling and compaction of the upper platform of earthworks cut or fill. It includes: - All costs and subjection of the test sections; - All work and subjection developed in the Technical Requirements; - Implementing the levelling, watering, compaction to 95% of the OPM after 4 days of immersion (Modified Proctor Compaction) on the upper 25cm platform earthworks. - All the costs and subjection of Implementation for qualities or specifications defined in the Technical Requirements. The quantities to be considered will be calculated from the theoretical width platform head and length of application of the relevant section.		
	Cubic Meters..... ....(Exc. VAT)	m^3	.....
900-60	**FINISHING OFF CUT AND FILL SLOPES, MEDIANS AND INTERCHANGE AREAS: CUT SLOPES**		
	This price pays to quare meter shaping the levelling and compaction of the cut slopes. It includes: - All costs and subjection of the test sections; - All work and subjection developed in the Technical Requirements; - All the costs and subjection of Implementation for qualities or specifications defined in the Technical Requirements. The quantities to be considered will be calculated from the theoretical width platform head and length of application of the relevant section.		
	Square		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Meters..... ....(Exc. VAT)	m^3	....
900-61	**FINISHING OFF CUT AND FILL SLOPES, MEDIANS AND INTERCHANGE AREAS: FILLSLOPES**		
	This price pays to quare meter shaping the levelling and compaction of the fillslopes. It includes: - All costs and subjection of the test sections; - All work and subjection developed in the Technical Requirements; - All the costs and subjection of Implementation for qualities or specifications defined in the Technical Requirements. The quantities to be considered will be calculated from the theoretical width platform head and length of application of the relevant section.		
	Square Meters..... ....(Exc. VAT)	m^3	....
900-62	**SELECTED LATERITIC GRAVEL OR SELECTED NATURAL GRAVEL 0/31.5 FOR SUB-BASE COURSE**		
	This price remunerates per cubic meter the supply of selected lateritic gravel or selected natural gravel 0/31.5, accepted by the consultant, to complete necessary material to realize the sub-base course of the roadway until the lower level of the designed base course. The realization of the sub-base course should be as defined in the technical specification and according to the designed standard cross sections. It includes: - The felling, brushing, scraping, achieving access to quarries; - The necessary geotechnical investigation; - The extraction and loading of materials after rejection of unsuitable material;		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	- The cost related to the transportation materials for any distances; - The cost related to the spreading of the supplied material on the scarified product; N.B: Some of this work will be executed also at Rusumo border post for the parking yard. The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved by the Client. It will not be granted any increase in value if the width or thickness unordered by the Consultant.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-63	**BASE COURSE IN CRUSHED STONES 0/20**		
	This remunerates per cubic meter supply, transport and implementation of crushed gravel 0/20 for the realization of road base course in accordance with the designed approved drawings and the Technical Specification. It includes: - Prospecting, opening the quarry, the achievement of access, extraction, crushing, screening and eventual washing of aggregates; - Any costs of rebuilding in quarries to obtain a grading curve that meets the requirements; - Loading and transport for any distance at the work site; - The spreading, mixing, leveling, watering and compacting the material to 100% of OPM after 4 days of immersion and any constraints to implementation as they result from contract requirements. N.B: Some of this work will be executed also at Rusumo border post for the parking yard. The quantities to be considered will be the ultimate volumes as resulting from the implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	by the Client. It will not be granted any increase in value if the width or thickness unordered by the Consultant.		
	Cubic Meter ....(Exc. VAT)	m^3	.....
900-64	**ASPHALT CONCRETE**		
	This remunerates square meter of the execution of an asphalt concrete of a layer (60mm thick) of asphalt concrete BBGS 0/14 in current section and on structures, in small or large mass, as provided in technical specifications. It includes: - Laying prime coat, sand seal cost and tack coat layers; - All supplies and materials in compliance with the technical requirements, standards and regulations, regardless of the origin and the transport distance, including the possible incorporation of dope and useful fillers; - The supply on site and transport over any distance; - All costs and manufacturing constraints developed with the requirements of the contract; - The cost of achieving the test slabs outside the right of way of the project including all constraints of supply and implementation; - The raw scan of surfaces prior to implementation; - The supply and implementation of a tack coat with an assay of residual bitumen in accordance with standards and technical requirements, including surface preparation, supply of binder at the place of employment, any heating, the spreading, sweeping, rework any of the impregnation and all constraints of supply and implementation; - The gain or loss for cementations material or aggregates; - The spreading, compacting and leveling of asphalt concrete, including in areas of implementation narrow or manual; - The vertical cutting edges in accordance with contract		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	requirements, standards and regulations and finishing longitudinal seams and transverse joints; - All costs and constraints of implementation. The quantities to be considered will be the volume as resulting from implementation projects approved and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved by the Client, net of amounts relating to the cutting edges, eventually affected of the various sanctions provided.		
	Square Meter..... ....(Exc. VAT)	m^2	....
900-65	**RIGID PAVEMENT (REINFORCED CONCRETE)**		
	This remunerates square meter of the execution of a rigid pavement (280mm thickness) as shown in drawings and as per technical specifications. It includes: - All necessary formwork; - The provision and implementation of formwork, reinforcement and a reinforced concrete dosed at 350 kg / m^3 of cement; eventual dewatering, - Execution of associated work (dowels, bars, joints, etc as shown on the drawings; - Texturing and curing concrete pavement. N.B: Some of this work will be executed also at Rusumo border post for the parking yard. The surface to be considered will be the one actually implemented and confirmed by contradictory interim accounts and executed in accordance with the Project Implementation Plans approved by the Client.		
	Square Meter..... ....(Exc. VAT)	m^2	....

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
900-66	**WEIGHBRIDGE (SINGLE DECK)**		
	This remunerates per unit the provision and installation of the weighbridge (single deck) and related equipmnent as prescribed in the technical requirements and in accordance with standard plans. It includes: - Its transportation - Installation of single deck weigh bridge (static) - Provision of weigh motion facilities - Commissioning. - Excavations in the field of any kind, including in rocky terrain; - All constraints of fixing on the support. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Unit..... ....(Exc. VAT).	U	....
900-67	**MARKER AND KILOMETER POSTS**		
	This price applies per unit of pre-casted marker and kilometer post defined in the technical provisions and in accordance with the standard plan. They are placed every kilometer. It includes: - The supply of prefabricated reinforced concrete mileposts and necessary materials and equipment: - Transport for any distance; - Paintings and marking in accordance with the Contract prescription; - All costs and works related to layouts (excavation, laying, sealing ...) and all ancillary actions; The quantities to be taken into account are those effectively achieved and recorded in the joint statements.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Unit..... ....(Exc. VAT).	U	....
900-68	**ROAD SIGN BOARD**		
	This remunerates per square meter of traffic sign for direction indication as prescribed in the technical requirements and in accordance with SADC traffic signs. The sign boards will have painted or colored background with symbols, lettering and borders in retro-reflective material, and the sign board constructed from sheet steel. It includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service; - The provision in site of accomplished reflectorized sign in accordance with the requirements of the SADC traffic signs standards and all constraints of fixing on the support. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Square Meters..... ....(Exc. VAT).	m^2	.....
900-69	**ROAD SIGN SUPPORT**		
	This remunerates ton of caution supports with steel tubing galvanized) for traffic and direction signs as prescribed in the technical requirements and the Consultant instruction, it includes: - Excavation and backfill in the field of any kind, including in rocky terrain; - The implementation of concrete foundation blocks dosed at 350 kg/m^3 of cement, including salient crest of		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	diamond cone shape in a mortar; - All constraints such as finishing, smoothing, leveling and repair of the area; - All constraints of fixing on the support. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant		
	Ton..... ....(Exc. VAT)	ton	....
900-70	**HAZARD PLATES (600MM X 150MM)**		
	This remunerates per unit of hazard steel plates (600mm x 150mm) as prescribed in the technical requirements and in accordance with SADC traffic sign standards. It includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service; - Excavation andbackfill in the field of any kind, including in rocky terrain; - The implementation of concrete foundation blocks dosed at 350 kg / m^3 of cement, including crest salient of diamond cone shape in a mortar; - All constraints such as finishing, smoothing, leveling and repair of the area - All constraints of fixing on the support. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Unit..... ....(Exc. VAT).	U	....
900-71	**HAZARD PLATES (600MM X 600MM)**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	This remunerates per unit of hazard steel plates (600mm x 600mm) as prescribed in the technical requirements and in accordance with SADC traffic sign standards. It includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service; - Excavation andbackfill in the field of any kind, including in rocky terrain; - The implementation of concrete foundation blocks dosed at 350 kg / m³ of cement, including crest salient of diamond cone shape in a mortar; - All constraints such as finishing, smoothing, leveling and repair of the area - All constraints of fixing on the support. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Unit..... ....(Exc. VAT).	U	....
900-72	**HAZARD PLATES (1200MM X 300MM)**		
	This remunerates per unit of hazard steel plates (1200mm x 300mm) as prescribed in the technical requirements and in accordance with SADC traffic sign standards. It includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service; - Excavation andbackfill in the field of any kind, including in rocky terrain; - The implementation of concrete foundation blocks dosed at 350 kg / m³ of cement, including crest salient of diamond cone shape in a mortar; - All constraints such as finishing, smoothing, leveling and repair of the area - All constraints of fixing on the support. The quantities to be considered will be those actually		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Unit..... ....(Exc. VAT).	U	....
900-73	**RETRO REFLECTIVE WHITE PAINT LINE OF 0,10 m WIDTH ROAD MARKING**		
	This remunerates per linear meter, the realization of a retro reflective white painted strip continuous or discontinuous of a width of 0.10 m, as prescribed in the technical requirements, it includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service and the technical sheet attached to the certificate of products whose use is proposed for approval by the consultant; - The pre-cleaning the pavement, traces, pre-markings and chalk drawings; - The provision in site of any supply, components required for use; - The realization of glass beads according to the technical specifications; - The costs of implementation, all connections, resumption, any corrections or deleting and finishing products, and all constraints of execution; The quantities to be considered will be the lengths of actually painted strips (empty excluded) according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Linear Meter..... ....(Exc. VAT)	lm	....
900-74	**RETRO REFLECTIVE WHITE PAINT LINE OF 0,30 m WIDTH ROAD MARKING**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	This remunerates per linear meter, the realization of a retro reflective white painted strip continuous or discontinuous of a width of 0.30 m, as prescribed in the technical requirements, it includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service and the technical sheet attached to the certificate of products whose use is proposed for approval by the consultant; - The pre-cleaning the pavement, traces, pre-markings and chalk drawings; - The provision in site of any supply, components required for use; - The realization of glass beads according to the technical specifications; - The costs of implementation, all connections, resumption, any corrections or deleting and finishing products, and all constraints of execution; The quantities to be considered will be the lengths of actually painted strips (empty excluded) according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Linear Meter..... ....(Exc. VAT)	lm	....
900-75	**RETRO REFLECTIVE WHITE PAINT LINE OF 0,15 m WIDTH ROAD MARKING**		
	This remunerates per linear meter, the realization of a retro reflective white painted strip continuous or discontinuous of a width of 0.15 m, as prescribed in the technical requirements, it includes: - The presentation of the certificate of approval for retro-reflective coating issued by an authorized service and the technical sheet attached to the certificate of products whose use is proposed for approval by the consultant; - The pre-cleaning the pavement, traces, pre-markings and		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	chalk drawings; - The provision in site of any supply, components required for use; - The realization of glass beads according to the technical specifications; - The costs of implementation, all connections, resumption, any corrections or deleting and finishing products, and all constraints of execution; The quantities to be considered will be the lengths of actually painted strips (empty excluded) according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Linear Meter..... ....(Exc. VAT)	lm	....
900-76	**RETRO-REFLECTIVE ROAD MARKING WITH WHITE LETTERING AND SYMBOLS**		
	This remunerates per square meter of the realization of a retro reflective white or yellow painted strip, unpaid by price No. 900-74, 900-75 and 900-76, as prescribed in the technical requirements and with the same specification as the price No. 900-74, 900-75 and 900-76. The quantities to be considered will be the surface of actually painted strips (empty excluded) according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-77	**RETRO-REFLECTIVE ROAD MARKING PAINT FOR TRAFFIC ISLAND MARKINGS (ANY COLOR)**		
	This remunerates per square meter of the realization of a retro reflective (any color) paint for traffic island markings,		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	unpaid by price No. 900-74, 900-75 and 900-76, as prescribed in the technical requirements and with the same specification as the price No. 900-74, 900-75 and 900-76. The quantities to be considered will be the surface of actually painted strips (empty excluded) according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Square Meters..... ....(Exc. VAT)	m^2	....
900-78	**ROAD STUDS**		
	This price pays per unit for the supply and installation of road studs which are devices which are bounded to or anchored within the road surface for lane marking and delineation for night-time visibility. The material to be used is a plastic body which is moulded from acrylic styrene acrylonitrite or Hi-impact polystyrene or acrylonitrite butadiene system or any material approved by the Engineer. It includes the supply of and installation of study by fixing them and any enforcement mounting constraints. The quantities to be considered will be calculated by applying the		
	Unit..... ....(Exc. VAT)	U	....
900-79	**TOPSOIL OBTAINED FROM WITHIN THE ROAD RESERVE OR BORROW AREAS**		
	This remunerates per cubic meter of volume the realization of fill organic soil (top soil) excavated from the road reserve or borrow areas. It includes: - All access constraints regardless of the nature of the terrain; - Research, the opening and operation of borrow areas approved by the Consultant authority. The opening of		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	access roads to the quarries and maintenance; - Extraction after brushing, scraping, potential discovery regardless of thickness, site preparation; - Loading, transportation for any distances, the spreading, the implementation, the leveling; - All constraints in implementing the work. The quantities to be considered will be those arising from contradictory interim account prepared before planting grass and trees, and approved implementation project.		
	Cubic Meter..... ....(Exc. VAT)	m^3	.....
900-80	**PROVIDING AND APPLYING CHEMICAL FERTILIZERS AND OR SOIL IMPROVEMENT MATERIAL**		
	This remunerates per tons of volume the realization of spreading the chemical fertilizer on ground to receive grass and tree. It includes loading, transportation for any distances, the spreading, the implementation; Chemical fertilizers shall be approved granular fertilizers. Fertilizer may be single element or compound, normal or slow release compound fertilizers. They shall be stored in waterproof sealed bags under shelter away from water and direct sunlight. Samples shall be submitted to, and approved by the Landscape Architect, before use in the Works. Organic fertilizers shall be organic products such as organic liquid fertilizer, pellets or granules manufactured primarily from organic materials. These products are to be from accredited sources and technical data indicating sources of origin and manufacturing process must be submitted and approved before use. Animal by-products must be sterilized before being packed for transport and odorous materials used on site will be rejected. The quantities to be considered will be those arising from contradictory interim account prepared before planting grass and trees, and approved implementation project.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Ton..... ....(Exc. VAT)	**Ton**	.....
900-81	**GRASSING: HAND SOWING**		
	This remunerates per square meter realization of grass (paspalum) planting from borrow areas. It includes: - All access constraints regardless of the nature of the terrain; - All access constraints regardless of the nature of the terrain; - Research, the opening and operation of borrow areas approved by the Consultant authority. The opening of access roads to the quarries and maintenance; - Loading, transportation for any distances, the spreading, the implementation, the leveling; - All constraints in implementing the work. The quantities to be considered will be those arising from contradictory interim account prepared after planting grass and approved the Engineer.		
	Square Meter..... ....(Exc. VAT)	**m^2**	.....
900-82	**WATERING THE ALREADY PLANTED GRASS, TREES AND SHRUBS DURING THE PERIOD OF DROUGHT EXPERIENCED DURING THE GROWING SEASON**		
	This remunerates per liters watering planted grass, trees and shrubs. It includes: - All access constraints regardless of the nature of the terrain; - Loading, transportation for any distances, and watering; - All constraints in implementing the work.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The quantities to be considered will be those arising from contradictory interim account prepared and approved by the Engineer.		
	Liter..... ....(Exc. VAT)	l	.....
900-83	PLANTING OF TREES		
	This remunerates per unit the supply and plantation forest and shrub species including pre-excavation, wedging, irrigation and the supply and installation of a metal grill protection with a height of 1.50m around each tree, maintenance both during work and during the warranty period. The trees must be adequate to the region. The contractor shall establish in the beginning of works a planting program in a report to be submitted to the approval of the Consultant, specifying the choice of species to plant and the maintenance actions. This package will be acquitted to the contractor with the following schedule: - Sixty percent (60%) once the primary receipt will be established; - Forty (40%) once the final receipt will be established.		
	Unit..... .... (Exc. VAT).	U	....
900-84	CONSTRUCTION OF TWO (2) GUARD HOUSES AS SHOWN ON THE DRAWINGS		
	This price pays to square meter for the construction of two guard house according to the approved drawings and the Consultant instructions. They include all constraints to construction of the building.		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	The work includes the execution of the following work and as per the Engineer instructions: Foundation with masonry stones with mortar Reinforced concrete beam on foundation External and internal walling Roof structure and covering Rainwater disposal Tiling work External and internal finishings including painting External and internal finishings including painting Ceiling finishings Windows Doors Fittings Sanitary work Electrical installation work Etc. The Consultant will perform the payment after the construction completion and acceptance.		
	Square Meter..... ....(Exc. VAT).	m^2	....
900-85	**CONSTRUCTION OF GENERATOR HOUSE AS SHOWN ON THE DRAWINGS, AND SUPPLY AND INSTALLATION OF A BACKUP GENERATOR AS PER SPECIFICATIONS**		
	This price pays to the square meter for the construction of a generator house according to the approved drawings and the Consultant instruction. They include all constraints to construction of the building. The work includes the execution of the following work and as per the Engineer instructions: Foundation with masonry stones with mortar Reinforced concrete beam on foundation External and internal walling Roof structure and covering Tiling work		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Rainwater disposal External and internal finishings including painting External and internal finishings including painting Ceiling finishings Windows Doors Fittings Sanitary work Electrical installation work Supply and installation of a backup generator as per the specifications. Etc. The Consultant will perform the payment after the construction completion and acceptance.		
	Square Meter..... ....(Exc. VAT).	m^2	....
900-86	**CONSTRUCTION OF OFFICE BUILDING AS SHOWN ON THE DRAWINGS**		
	This price pays to square meter for the construction of office building according to the approved drawings and the Consultant instruction. They include all constraints to construction of the building. The work includes the execution of the following work and as per the Engineer instructions: Foundation with masonry stones with mortar Reinforced concrete beam on foundation External and internal walling Roof structure and covering Tiling work Rainwater disposal External and internal finishings including painting External and internal finishings including painting Ceiling finishings Windows Doors Fittings		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	Sanitary work Electrical installation work Etc. The Consultant will perform the payment after the construction completion and acceptance.		
	Square Meter..... ....(Exc. VAT).	m^2	....
900-87	**CONSTRUCTION OF ACCOMMODATION BUILDING AS SHOWN ON THE DRAWINGS**		
	This price pays to square meter for the construction of office building according to the approved drawings and the Consultant instruction. They include all constraints to construction of the building. The work includes the execution of the following work and as per the Engineer instructions: Foundation with masonry stones with mortar Reinforced concrete beam on foundation External and internal walling Roof structure and covering Tiling work Rainwater disposal External and internal finishings including painting External and internal finishings including painting Ceiling finishings Windows Doors Fittings Sanitary work Electrical installation work Etc. The Consultant will perform the payment after the construction completion and acceptance.		
	Square Meter.....		

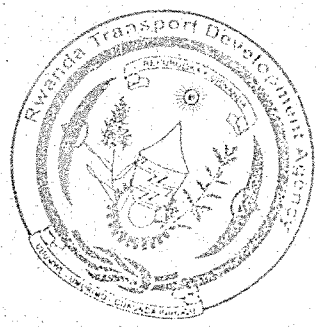
No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	....(Exc. VAT).	m^2	....
900-88	**CONSTRUCTION OF TOILET BUILDING AS SHOWN ON THE DRAWINGS**		
	This price pays to square meter for the construction of toilet building according to the approved drawings and the Consultant instruction. They include all constraints to construction of the building. The work includes the execution of the following work and as per the Engineer instructions: Foundation with masonry stones with mortar Reinforced concrete beam on foundation External and internal walling Roof structure and covering Tiling work Rainwater disposal External and internal finishings including painting External and internal finishings including painting Ceiling finishings Windows Doors Fittings Sanitary work Electrical installation work Etc. The Consultant will perform the payment after the construction completion and acceptance.		
	Square Meter..... ....(Exc. VAT).	m^2	....
600-89	**CONSTRUCTION OF FENCE AS SHOWN ON THE DRAWINGS**		
	This price pays linear meter the construction of a fence as shown on the drawings and as approved by the Engineer. It		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	includes: - All supplies, transport of necessary materials and equipment; - Excavations works in field of all kinds; - The implementation of the foundation in accordance with plans approved by the Consultant; - And all constraints of performance. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Linear Meter..... ....(Exc. VAT).	**Lm**	....
600-90	**CONSTRUCTION OF GATES AS SHOWN ON THE DRAWINGS**		
	This price pays linear meter the supply and installation of gates as shown on the drawings and as approved by the Engineer. It includes: - All supplies, transport of necessary materials and equipment; - Excavations works in field of all kinds; - The implementation of the foundation in accordance with plans approved by the Consultant; - And all constraints of performance. The quantities to be considered will be those actually implemented according to standard plans and technical requirements and confirmed by contradictory interim accounts approved by the consultant.		
	Linear Meter..... ....(Exc. VAT).	**Lm**	....
600-91	**SUPPLY AND INSTALLATION OF PERMANENT**		

No Prices	Description of tasks and unit prices in full taxes exclusive (T.E)	Unit	Unit Prices in Rwandan francs (T.E)
	TRAFFIC LIGHTS, COMPLETE WITH TWO (2) SETS OF SIGNAL HEADS, POWER SOURCE, TIMER, CABLING AND CONNECTING ALL FACILITIES (INCLUDING BUILDINGS) TO ELECTRIC POWER LINE		
	This price pays a flat rate the establishment of permanent traffic lights, complete with two (2) sets of signal heads, power source, timer, cabling and connecting all facilities (including buildings) to electric power line The price includes also all constraints for the execution of work.		
	Lump Sum:…… ……..…… ……..…… ……..……..(Exc. VAT).	**L.S**	…… …

VOLUME II. – BILL OF QUANTITIES

Part C – ANCILLARY WORKS (ITEM-900: SUPPLY AND INSTALLATION OF TWO WEIGHBRIDGES AND CONSTRUCTION OF RELATED FACILITIES)



LOT1 : KAGITUMBA - BUGARAGARA-GABIRO ROAD (60Km)
BILL OF QUANTITIES

N°	DESCRIPTION	UNIT	QUANTITIES	UNIT PRICE IN RWF(TE)	TOTAL COST IN RWF (TE)
PART C: ANCILLARY WORKS					
ITEM 900 – SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES					
CLEARING AND GRUBBING					
900-1	Bush clearing	m^2	120,000		
900-2	Top soil stripping on average thickness of 0.20m	m^2	120,000		
	DRAINS				
900-3	Excavation in soft material for open drains	m^3	350		
900-4	Excavation in hard material for open drains	m^3	100		
900-5	Clearing and shaping existing open drains	m^3	150		
900-6	Excavation for subsoil drainage system	m^3	200		
900-7	Impermeable backfilling to subsoil drainage system	m^3	250		
900-8	Banks and dykes	m^3	300		
900-9	Natural permeable material in subsoil drainage systems (crushed stone obtained from approved sources on the site : 19mm nominal size)	m^3	80		
900-10	Natural permeable material in subsoil drainage systems (sand obtained from approved sources on the site)	m^3	150		
900-11	Pipes in subsoil drainage system (Unplasticized PVC pipe, 200mm diameter slotted as indicated in the drawings)	lm	200		
900-12	Filter fabric, Kaymat U24 or similar approved	m^2	300		

900-13	Concrete outlet structures for sub-soil drainage systems	Unit	4		
	PREFABRICATED CULVERTS				
900-14	Excavation in soft material	m^3	150		
900-15	Excavation in hard material	m^3	80		
900-16	Backfilling using excavated material	m^3	150		
900-17	Backfilling using imported material	m^3	150		
900-18	Concrete pipe culverts (1000mm dia.)	Lm	120		
900-19	Cast in situ concrete (C25) and formwork: In Class A bedding, screeds and the encasing of pipes, including formwork	m^3	50		
900-20	Cast in situ concrete (C30) and formwork: In floor slabs for portal or rectangular culverts, wall, beam and slab, headwalls and wing walls, including formwork and class U2 surface finish	m^3	25		
900-21	Cast in situ concrete (C30) and formwork: In inlet and outlet structures, catch pits, manholes, thrust and anchor blocks, excluding formwork but including Class U2 surface finish	m^3	30		
900-22	Cast in situ concrete and formwork: Formwork of concrete under item 900-21 above (Class F2 finish)	m^3	200		
900-23	Cast in situ concrete (C15) and formwork: In concrete linings for the invert of culverts including formwork and class U2 surface finish	m^3	25		
900-24	Steel reinforcement: Mild steel bars	Ton	2		
900-25	Steel reinforcement: High tensile steel bars (Grade Fy 460)	Ton	2		

900-26	Steel reinforcement: Welded steel fabric	Kg	500		
900-27	Brickwork: 115mm thick	m^2	100		
900-28	Brickwork: 230mm thick	m^2	200		
900-29	Service ducts: Ordinary pipes (110mm dia PVC)	Lm	50		
900-30	Service ducts: Split pipes (110mm dia PVC)	Lm	50		
900-31	Duct marker blocks	Unit	100		
900-32	Hand excavation to determine the positions of existing services	m^3	80		
900-33	Demolishing and removing Existing reinforced (and no) Concrete and masonry Structures	m^3	50		
	CONCRETE KERBING, CONCRETE CHANNELLING, OPEN CONCRETE CHUTES AND CONCRETE LININGS FOR OPEN DRAINS				
900-34	Shoulder delineator concrete (C30) kerbing-blocks	Lm	400		
900-35	Concrete barrier end sections concrete (C30) kerbing blocks	Unit	6		
900-36	Concrete chutes (Type 1): Cast in situ concrete (C30)	Lm	30		
900-37	Inlet structures for concrete chutes (C30)	Unit	4		
900-38	Trimming of excavations for concrete-lined open drains in soft material	m^2	200		
900-39	Trimming of excavations for concrete-lined open drains in hard material	m^2	50		
900-40	Concrete lining for open drains: Cast in situ concrete lining, class 25/19 concrete in type	m^3	20		

	of side drain as instructed by the Engineer				
900-41	Concrete lining for open drains: Class U2 surface finish to cast in situ concrete: (I)Type of side drain as instructed by the engineer	m^2	100		
900-42	Formwork to cast in situ concrete lining for open drains (class F2 surface finish) (b)To sides with formwork on both internal and external faces (each face measured)	m^2	120		
900-43	Formwork to cast in situ concrete lining for open drains (class F2 surface finish) (c)To ends of slabs	m^2	20		
900-44	Sealed joints in concrete linings of open drains (I)Typical or as directed by the Engineer	lm	200		
900-45	Steel reinforcement: Welded steel fabric, ref 193	kg	1,000		
900-46	Polyethylene sheeting (0.15 mm thick) for concrete-lined open drains	m^2	400		
	PITCHING, STONEWORK AND PROTECTION AGAINST EROSION				
900-47	Plain stone pitching	m^2	100		
900-48	Grouted stone pitching	m^2	150		
900-49	Stone masonry walls for scour protection or similar: Cement-mortared stone walls	m^3	80		
900-50	Stone masonry walls for scour protection or similar: Cement - mortared stone masonry for structures	m^3	100		
900-51	Foundation trenches	m^3	200		
	GABIONS				
900-52	Gabions	m^3	40		

900-53	Filter fabric, Kaymat U24 or similar approved	m^2	200		
	MASS EARTHWORKS				
900-54	Excavation (to spoil) in soft soil	m^3	13,900		
900-55	Excavation (to spoil) in hard soil	m^3	400		
900-56	Backfill with excavated material	m^3	3,500		
900-57	Rockfill	m^3	500		
900-58	Removal of unsuitable material (material with low load-bearing capacity)	m^3	950		
900-59	Shaping and compaction of the earthwork upper platform	m^3	2,000		
900-60	Finishing off cut and fill slopes, medians and interchange areas: Cut slopes	m^2	2,200		
900-61	Finishing off cut and fill slopes, medians and interchange areas: Fill slopes	m^2	2,200		
	PAVEMENT LAYERS				
900-62	Selected lateritic gravel or selected natural gravel 0/31.5 for sub-base course	m^3	19,200		
900-63	Base course in crushed stones 0/20	m^3	2,500		
900-64	Asphalt concrete	m^3	1,000		
	RIGID PAVEMENTS				
900-65	Provide rigid pavement as shown in the drawings (as per the specification): Rigid pavement of 280mm thickness (including all the associated works of dowels, bars, joints, etc as shown on the drawings)	m^2	8,200		
	WEIGHBRIDGE (SINGLE DECK)				
900-66	Provide and install the weighbridge equipment with all the works including the transportation, commissioning	Lump Sum	1		

	and weigh in motion facilities				
	MARKER AND KILOMETRE POSTS				
900-67	Concrete posts	Unit	10		
	ROAD SIGNS				
900-68	Road sign boards with painted or colored background. Symbols, lettering and borders in Class 1 retro-reflective material where the sign board is constructed from Sheet steel	m^2	20		
900-69	Road sign supports (overhead road sign structures excluded) with steel tubing (751) galvanized	Tons	1		
900-70	Hazard plates (600 mm x 150 mm)	Unit	2		
900-71	Hazard plates (600 mm x 600 mm)	Unit	2		
900-72	Hazard plates (1200 mm x 300 mm)	Unit	2		
	ROAD MARKING				
900-73	Retro-reflective road marking paint (actually painted length to be measured) with white lines (broken or unbroken) 100 mm wide	Lm	1,500		
900-74	Retro-reflective road marking paint (actually painted length to be measured) with white lines (broken or unbroken) 300 mm wide	Lm	150		
900-75	Retro-reflective road marking paint (actually painted length to be measured) with yellow lines (broken or unbroken) 150mm wide	Lm	3,000		
900-76	Retro-reflective road marking paint with white lettering and symbols	m^2	50		
900-77	Retro-reflective road marking paint for traffic island markings (any color)	m^2	30		
900-78	Road studs	Unit	25		

	LANDSCAPING AND GRASSING				
900-79	Topsoil obtained from within the road reserve or borrow areas (free haul 1.0km)	m^3	2,700		
900-80	Providing and applying chemical fertilizers and or soil improvement material	tons	0.3		
900-81	Grassing: hand sowing	m^2	1,500		
900-82	Watering the already planted grass, trees, and shrubs during periods of drought experienced during the growing season	L	5,000		
900-83	Supply and planting and establishing trees	Unit	20		
	BUILDING WORKS				
900-84	Construction of two (2) guard houses as shown on the drawings	m^2	20		
900-85	Construction of generator house and backup generator as shown on the drawings	m^2	10		
900-86	Construction of office building as shown on the drawings	m^2	100		
900-87	Construction of accommodation buildings as shown on the drawings	m^2	220		
900-88	Construction of toilet building as shown on the drawings	m^2	20		
900-89	Construction of fence as shown on the drawings	M	400		
900-90	Construction of gates as shown on the drawings	Unit	4		
900-91	Supply and installation of permanent traffic lights, complete with two sets of signal heads, power source, timer, cabling, connecting all facilities (buildings, etc) to electric power line	Lump Sum	1		
	SUB-TOTAL 900 - SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES				

LOT2 : GABIRO - KAYONZA ROAD (56Km)
BILL OF QUANTITIES

N°	DESCRIPTION	UNIT	QUANTITIES	UNIT PRICE IN RWF (TE)	TOTAL COST IN RWF (TE)
PART C: ANCILLARY WORKS					
ITEM 900 – SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES					
CLEARING AND GRUBBING					
900-1	Bush clearing	m^2	0		
900-2	Top soil stripping on average thickness of 0.20m	m^2	0		
	DRAINS				
900-3	Excavation in soft material for open drains	m^3	0		
900-4	Excavation in hard material for open drains	m^3	0		
900-5	Clearing and shaping existing open drains	m^3	0		
900-6	Excavation for subsoil drainage system	m^3	0		
900-7	Impermeable backfilling to subsoil drainage system	m^3	0		
900-8	Banks and dykes	m^3	0		
900-9	Natural permeable material in subsoil drainage systems (crushed stone obtained from approved sources on the site : 19mm nominal size)	m^3	0		
900-10	Natural permeable material in subsoil drainage systems (sand obtained from approved sources on the site)	m^3	0		
900-11	Pipes in subsoil drainage system (Unplasticized PVC pipe, 200mm diameter slotted as indicated in the drawings)	lm	0		
900-12	Filter fabric, Kaymat U24 or similar approved	m^2	0		

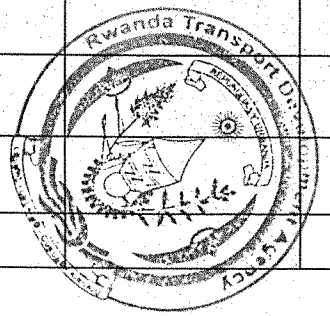
900-13	Concrete outlet structures for sub-soil drainage systems	Unit	0		
	PREFABRICATED CULVERTS				
900-14	Excavation in soft material	m^3	0		
900-15	Excavation in hard material	m^3	0		
900-16	Backfilling using excavated material	m^3	0		
900-17	Backfilling using imported material	m^3	0		
900-18	Concrete pipe culverts (1000mm dia.)	Lm	0		
900-19	Cast in situ concrete (C25) and formwork: In Class A bedding, screeds and the encasing of pipes, including formwork	m^3	0		
900-20	Cast in situ concrete (C30) and formwork: In floor slabs for portal or rectangular culverts, wall, beam and slab, headwalls and wing walls, including formwork and class U2 surface finish	m^3	0		
900-21	Cast in situ concrete (C30) and formwork: In inlet and outlet structures, catch pits, manholes, thrust and anchor blocks, excluding formwork but including Class U2 surface finish	m^3	0		
900-22	Cast in situ concrete and formwork: Formwork of concrete under item 900-21 above (Class F2 finish)	m^3	0		
900-23	Cast in situ concrete (C15) and formwork: In concrete linings for the invert of culverts including formwork and class U2 surface finish	m^3	0		
900-24	Steel reinforcement: Mild steel bars	Ton	0		
900-25	Steel reinforcement: High tensile steel bars (Grade Fy 460)	Ton	0		

900-26	Steel reinforcement: Welded steel fabric	Kg	0		
900-27	Brickwork: 115mm thick	m^2	0		
900-28	Brickwork: 230mm thick	m^2	0		
900-29	Service ducts: Ordinary pipes (110mm dia PVC)	Lm	0		
900-30	Service ducts: Split pipes (110mm dia PVC)	Lm	0		
900-31	Duct marker blocks	Unit	0		
900-32	Hand excavation to determine the positions of existing services	m^3	0		
900-33	Demolishing and removing Existing reinforced (and no) Concrete and masonry Structures	m^3	0		
	CONCRETE KERBING, CONCRETE CHANNELLING, OPEN CONCRETE CHUTES AND CONCRETE LININGS FOR OPEN DRAINS				
900-34	Shoulder delineator concrete (C30) kerbing-blocks	Lm	0		
900-35	Concrete barrier end sections concrete (C30) kerbing blocks	Unit	0		
900-36	Concrete chutes (Type 1): Cast in situ concrete (C30)	Lm	0		
900-37	Inlet structures for concrete chutes (C30)	Unit	0		
900-38	Trimming of excavations for concrete-lined open drains in soft material	m^2	0		
900-39	Trimming of excavations for concrete-lined open drains in hard material	m^2	0		
900-40	Concrete lining for open drains: Cast in situ concrete lining, class 25/19 concrete in type	m^3	0		

	of side drain as instructed by the Engineer				
900-41	Concrete lining for open drains: Class U2 surface finish to cast in situ concrete: (I)Type of side drain as instructed by the engineer	m^2	0		
900-42	Formwork to cast in situ concrete lining for open drains (class F2 surface finish) (b)To sides with formwork on both internal and external faces (each face measured)	m^2	0		
900-43	Formwork to cast in situ concrete lining for open drains (class F2 surface finish) (c)To ends of slabs	m^2	0		
900-44	Sealed joints in concrete linings of open drains (I)Typical or as directed by the Engineer	lm	0		
900-45	Steel reinforcement: Welded steel fabric, ref 193	kg	0		
900-46	Polyethylene sheeting (0.15 mm thick) for concrete-lined open drains	m^2	0		
	PITCHING, STONEWORK AND PROTECTION AGAINST EROSION				
900-47	Plain stone pitching	m^2	0		
900-48	Grouted stone pitching	m^2	0		
900-49	Stone masonry walls for scour protection or similar: Cement-mortared stone walls	m^3	0		
900-50	Stone masonry walls for scour protection or similar: Cement - mortared stone masonry for structures	m^3	0		
900-51	Foundation trenches	m^3	0		
	GABIONS				
900-52	Gabions	m^3	0		

900-53	Filter fabric, Kaymat U24 or similar approved	m^2	0		
	MASS EARTHWORKS				
900-54	Excavation (to spoil) in soft soil	m^3	0		
900-55	Excavation (to spoil) in hard soil	m^3	0		
900-56	Backfill with excavated material	m^3	0		
900-57	Rockfill	m^3	0		
900-58	Removal of unsuitable material (material with low load-bearing capacity)	m^3	0		
900-59	Shaping and compaction of the earthwork upper platform	m^3	0		
900-60	Finishing off cut and fill slopes, medians and interchange areas: Cut slopes	m^2	0		
900-61	Finishing off cut and fill slopes, medians and interchange areas: Fill slopes	m^2	0		
	PAVEMENT LAYERS				
900-62	Selected lateritic gravel or selected natural gravel 0/31.5 for sub-base course	m^3	0		
900-63	Base course in crushed stones 0/20	m^3	0		
900-64	Asphalt concrete	m^3	0		
	RIGID PAVEMENTS				
900-65	Provide rigid pavement as shown in the drawings (as per the specification): Rigid pavement of 280mm thickness (including all the associated works of dowels, bars, joints, etc as shown on the drawings)	m^2	0		
	WEIGHBRIDGE (SINGLE DECK)				
900-66	Provide and install the weighbridge equipment with all the works including the transportation, commissioning	Lump Sum	0		

	and weigh in motion facilities				
	MARKER AND KILOMETRE POSTS				
900-67	Concrete posts	Unit	0		
	ROAD SIGNS				
900-68	Road sign boards with painted or colored background. Symbols, lettering and borders in Class 1 retro-reflective material where the sign board is constructed from Sheet steel	m^2	0		
900-69	Road sign supports (overhead road sign structures excluded) with steel tubing (751) galvanized	Tons	0		
900-70	Hazard plates (600 mm x 150 mm)	Unit	0		
900-71	Hazard plates (600 mm x 600 mm)	Unit	0		
900-72	Hazard plates (1200 mm x 300 mm)	Unit	0		
	ROAD MARKING				
900-73	Retro-reflective road marking paint (actually painted length to be measured) with white lines (broken or unbroken) 100 mm wide	Lm	0		
900-74	Retro-reflective road marking paint (actually painted length to be measured) with white lines (broken or unbroken) 300 mm wide	Lm	0		
900-75	Retro-reflective road marking paint (actually painted length to be measured) with yellow lines (broken or unbroken) 150mm wide	Lm	0		
900-76	Retro-reflective road marking paint with white lettering and symbols	m^2	0		
900-77	Retro-reflective road marking paint for traffic island markings (any color)	m^2	0		
900-78	Road studs	Unit	0		



	LANDSCAPING AND GRASSING				
900-79	Topsoil obtained from within the road reserve or borrow areas (free haul 1.0km)	m^3	0		
900-80	Providing and applying chemical fertilizers and or soil improvement material	tons	0		
900-81	Grassing: hand sowing	m^2	0		
900-82	Watering the already planted grass, trees, and shrubs during periods of drought experienced during the growing season	l	0		
900-83	Supply and planting and establishing trees	Unit	0		
	BUILDING WORKS				
900-84	Construction of two (2) guard houses as shown on the drawings	m^2	0		
900-85	Construction of generator house and backup generator as shown on the drawings	m^2	0		
900-86	Construction of office building as shown on the drawings	m^2	0		
900-87	Construction of accommodation buildings as shown on the drawings	m^2	0		
900-88	Construction of toilet building as shown on the drawings	m^2	0		
900-89	Construction of fence as shown on the drawings	m	0		
900-90	Construction of gates as shown on the drawings	Unit	0		
900-91	Supply and installation of permanent traffic lights, complete with two sets of signal heads, power source, timer, cabling, connecting all facilities (buildings, etc) to electric power line	Lump Sum	0		
	SUB-TOTAL 900 - SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES				

LOT 3: KAYONZA-RUSUMO ROAD (92Km)
BILL OF QUANTITIES

N°	DESCRIPTION	UNIT	QUANTITIES	UNIT PRICE IN RWF(TE)	TOTAL COST IN RWF (TE)
PART C: ANCILLARY WORKS					
ITEM 900 – SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES					
CLEARING AND GRUBBING					
900-1	Bush clearing	m^2	120,000		
900-2	Top soil stripping on average thickness of 0.20m	m^2	120,000		
	DRAINS				
900-3	Excavation in soft material for open drains	m^3	370		
900-4	Excavation in hard material for open drains	m^3	110		
900-5	Clearing and shaping existing open drains	m^3	155		
900-6	Excavation for subsoil drainage system	m^3	200		
900-7	Impermeable backfilling to subsoil drainage system	m^3	250		
900-8	Banks and dykes	m^3	300		
900-9	Natural permeable material in subsoil drainage systems (crushed stone obtained from approved sources on the site : 19mm nominal size)	m^3	85		
900-10	Natural permeable material in subsoil drainage systems (sand obtained from approved sources on the site)	m^3	150		
900-11	Pipes in subsoil drainage system (Unplasticized PVC pipe, 200mm diameter slotted as indicated in the drawings)	lm	200		

900-12	Filter fabric, Kaymat U24 or similar approved	m^2	300		
900-13	Concrete outlet structures for sub-soil drainage systems	Unit	4		
	PREFABRICATED CULVERTS				
900-14	Excavation in soft material	m^3	180		
900-15	Excavation in hard material	m^3	95		
900-16	Backfilling using excavated material	m^3	150		
900-17	Backfilling using imported material	m^3	150		
900-18	Concrete pipe culverts (1000mm dia.)	Lm	140		
900-19	Cast in situ concrete (C25) and formwork: In Class A bedding, screeds and the encasing of pipes, including formwork	m^3	50		
900-20	Cast in situ concrete (C30) and formwork: In floor slabs for portal or rectangular culverts, wall, beam and slab, headwalls and wing walls, including formwork and class U2 surface finish	m^3	30		
900-21	Cast in situ concrete (C30) and formwork: In inlet and outlet structures, catch pits, manholes, thrust and anchor blocks, excluding formwork but including Class U2 surface finish	m^3	35		
900-22	Cast in situ concrete and formwork: Formwork of concrete under item 900-21 above (Class F2 finish)	m^3	220		
900-23	Cast in situ concrete (C15) and formwork: In concrete linings for the invert of culverts including formwork and class U2 surface finish	m^3	30		
900-24	Steel reinforcement: Mild steel bars	Ton	2		

900-25	Steel reinforcement: High tensile steel bars (Grade Fy 460)	Ton	2		
900-26	Steel reinforcement: Welded steel fabric	Kg	515		
900-27	Brickwork: 115mm thick	m^2	100		
900-28	Brickwork: 230mm thick	m^2	200		
900-29	Service ducts: Ordinary pipes (110mm dia PVC)	Lm	55		
900-30	Service ducts: Split pipes (110mm dia PVC)	Lm	55		
900-31	Duct marker blocks	Unit	100		
900-32	Hand excavation to determine the positions of existing services	m^3	100		
900-33	Demolishing and removing Existing reinforced (and no) Concrete and masonry Structures	m^3	60		
	CONCRETE KERBING, CONCRETE CHANNELLING, OPEN CONCRETE CHUTES AND CONCRETE LININGS FOR OPEN DRAINS				
900-34	Shoulder delineator concrete (C30) kerbing-blocks	Lm	400		
900-35	Concrete barrier end sections concrete (C30) kerbing blocks	Unit	6		
900-36	Concrete chutes (Type 1): Cast in situ concrete (C30)	Lm	35		
900-37	Inlet structures for concrete chutes (C30)	Unit	4		
900-38	Trimming of excavations for concrete-lined open drains in soft material	m^2	215		
900-39	Trimming of excavations for concrete-lined open drains in hard material	m^2	70		

900-40	Concrete lining for open drains: Cast in situ concrete lining, class 25/19 concrete in type of side drain as instructed by the Engineer	m^3	25		
900-41	Concrete lining for open drains: Class U2 surface finish to cast in situ concrete: (I)Type of side drain as instructed by the engineer	m^2	100		
900-42	Formwork to cast in situ concrete lining for open drains (class F2 surface finish) (b)To sides with formwork on both internal and external faces (each face measured)	m^2	120		
900-43	Formwork to cast in situ concrete lining for open drains (class F2 surface finish) (c)To ends of slabs	m^2	20		
900-44	Sealed joints in concrete linings of open drains (I)Typical or as directed by the Engineer	lm	200		
900-45	Steel reinforcement: Welded steel fabric, ref 193	kg	1,100		
900-46	Polyethylene sheeting (0.15 mm thick) for concrete-lined open drains	m^2	400		
	PITCHING, STONEWORK AND PROTECTION AGAINST EROSION				
900-47	Plain stone pitching	m^2	150		
900-48	Grouted stone pitching	m^2	150		
900-49	Stone masonry walls for scour protection or similar: Cement-mortared stone walls	m^3	100		
900-50	Stone masonry walls for scour protection or similar: Cement - mortared stone masonry for structures	m^3	100		
900-51	Foundation trenches	m^3	200		
	GABIONS				

900-52	Gabions	m^3	40		
900-53	Filter fabric, Kaymat U24 or similar approved	m^2	250		
	MASS EARTHWORKS				
900-54	Excavation (to spoil) in soft soil	m^3	14,000		
900-55	Excavation (to spoil) in hard soil	m^3	410		
900-56	Backfill with excavated material	m^3	3,600		
900-57	Rockfill	m^3	520		
900-58	Removal of unsuitable material (material with low load-bearing capacity)	m^3	950		
900-59	Shaping and compaction of the earthwork upper platform	m^3	2,000		
900-60	Finishing off cut and fill slopes, medians and interchange areas: Cut slopes	m^2	2,300		
900-61	Finishing off cut and fill slopes, medians and interchange areas: Fill slopes	m^2	2,300		
	PAVEMENT LAYERS				
900-62	Selected lateritic gravel or selected natural gravel 0/31.5 for sub-base course	m^3	19,880		
900-63	Base course in crushed stones 0/20	m^3	3,200		
900-64	Asphalt concrete	m^3	1,100		
	RIGID PAVEMENTS				
900-65	Provide rigid pavement as shown in the drawings (as per the specification): Rigid pavement of 280mm thickness (including all the associated works of dowels, bars, joints, etc as shown on the drawings)	m^2	8,880		
	WEIGHBRIDGE (SINGLE DECK)				

900-66	Provide and install the weighbridge equipment with all the works including the transportation, commissioning and weigh in motion facilities	Lump Sum	1		
	MARKER AND KILOMETRE POSTS				
900-67	Concrete posts	Unit	10		
	ROAD SIGNS				
900-68	Road sign boards with painted or colored background. Symbols, lettering and borders in Class 1 retro-reflective material where the sign board is constructed from Sheet steel	m^2	20		
900-69	Road sign supports (overhead road sign structures excluded) with steel tubing (751) galvanized	Tons	1		
900-70	Hazard plates (600 mm x 150 mm)	Unit	2		
900-71	Hazard plates (600 mm x 600 mm)	Unit	2		
900-72	Hazard plates (1200 mm x 300 mm)	Unit	2		
	ROAD MARKING				
900-73	Retro-reflective road marking paint (actually painted length to be measured) with white lines (broken or unbroken) 100 mm wide	Lm	1,550		
900-74	Retro-reflective road marking paint (actually painted length to be measured) with white lines (broken or unbroken) 300 mm wide	Lm	180		
900-75	Retro-reflective road marking paint (actually painted length to be measured) with yellow lines (broken or unbroken) 150mm wide	Lm	3,100		
900-76	Retro-reflective road marking paint with white lettering and symbols	m^2	70		
900-77	Retro-reflective road marking paint for traffic island	m^2	50		

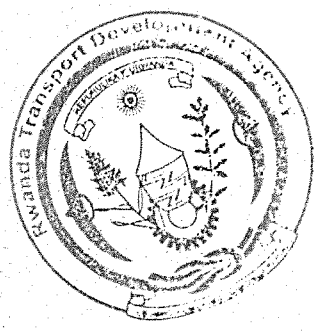
	markings (any color)				
900-78	Road studs	Unit	25		
	LANDSCAPING AND GRASSING				
900-79	Topsoil obtained from within the road reserve or borrow areas (free haul 1.0km)	m^3	2,900		
900-80	Providing and applying chemical fertilizers and or soil improvement material	tons	0.5		
900-81	Grassing: hand sowing	m^2	1,700		
900-82	Watering the already planted grass, trees, and shrubs during periods of drought experienced during the growing season	l	5,000		
900-83	Supply and planting and establishing trees	Unit	20		
	BUILDING WORKS				
900-84	Construction of two (2) guard houses as shown on the drawings	m^2	20		
900-85	Construction of generator house and backup generator as shown on the drawings	m^2	10		
900-86	Construction of office building as shown on the drawings	m^2	100		
900-87	Construction of accommodation buildings as shown on the drawings	m^2	220		
900-88	Construction of toilet building as shown on the drawings	m^2	20		
900-89	Construction of fence as shown on the drawings	m	400		
900-90	Construction of gates as shown on the drawings	Unit	4		
900-91	Supply and installation of permanent traffic lights, complete with two sets of signal heads, power source, timer, cabling, connecting all facilities (buildings, etc)	Lump Sum	1		

	to electric power line				
	SUB-TOTAL 900 - SUPPLY AND INSTALLATION OF A WEIGHBRIDGE AND CONSTRUCTION OF RELATED FACILITIES				

6.2 Technical Specification of Weighbridges and related facilities

Volume III: Technical Specifications of Works (Supply and Installation of Weighbridges and Construction of Related Facilities)

VOLUME III - TECHNICAL SPECIFICATIONS
PART C –ANCILLARY WORKS (WEIGHBRIDGES AND RELATED FACILITIES)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1.0 DESCRIPTION OF THE WORKS

The Construction of the weighbridges includes the construction of the following:

- Earthworks to widen the existing road prism, the parking areas and the circulation and bypass lanes;
- Construction of a new gravel sub-base layer on the new and widened areas;
- Spreading the material to the full width of the wider road prism, making up the layer to 200mm thickness using crushed stone and/or gravel and modifying the new base course layer thus formed uniform sectional pavement;
- Bituminous surfacing of the layby areas and shoulders;
- Cleaning and modifying of existing drainage as need be;
- Providing new cross culverts and side drainages
- Construction of Concrete / Rigid Pavements;
- Installation of railings and posts;
- construction of precast concrete safety barrier units, to be used both during the construction stage and after the construction have been completed;
- Kerbings and road markings;
- Supply, Installation and commissioning of weighbridges;
- Construction of office, toilets, guard house, store using blocks;
- Miscellaneous ancillary works.

The Works Requirements are fully defined in below technical specifications, drawings and schedule of unit prices.
The contractor will supply, install and put into operation one (1) static weighbridge, of one (01) platform (single-deck) scale as well as all the ancillary electronic equipment, remote display, external speaker system, traffic control lights and wiring in order to allow the weighing of heavy vehicles and the display of the measured weights and the printing of the weighbridge tickets and reports.
The single deck weighbridges shall be installed near Rusumo and Kagitumba border posts.

2.0 DESIGN CRITERIAL

2.1 General

The one (01) platform scale must have a gross total weighting capacity of 100-120 metric tons. The weighbridge is to be designed to weigh vehicles having a total weight of up to 30,000 kg per dual axle group and 35,000 kg for triple axle group.
The static weighbridge must be on an electronic design and must not contain any mechanical weighing elements.

2.2 WEIGHBRIDGE SCALE SRUCTURE

The platform must be able to permit the weighing of a group of axles. The platform is constructed to be of "DURBAR CHEQUERED PLATE welded steel" having a minimum thickness of 12.5 mm and an anti-slip surface, all steel shot blasted to Swedish 2.5

standards. The weighbridge platform must have an exclusive long term corrosion protection system, able to with stand daily axle weighing processes of 15 years from date of delivery.
The width of the platform dimensions must be 3.2 meters and the length of 4.0meters.

2.3 Protection of the load cells

The platform must be connected to the hermetically sealed load cells (IP 68) by means of the mounting bracket protecting the load cells from any horizontal forces due to the movement of vehicles, thermal expansion of the platform or its deflection. The platform must be fixed, so any movement must be reduced to a minimum. Standard guarantee period of weighbridge structure and load cells and digital indicators must be not less than 5 years from date of delivery.
The load cell assembly shall be constructed to perform as a rocker pick and shall have no positive fixed mechanical connectors such as bolts or links that are required in mounting the load cell to the Weighbridge or foundation base plates.

2.4 Anchors

The Contractor must foresee an anchoring system permitting the anchoring of the platform to the pit.

2.5 Maximum tolerance

The maximum permissible tolerance between the platform and the pit must not exceed 6 mm in order to avoid weight transference between axle groups of a heavy vehicle.

2.6 Quality of Scale

For ease interconnection within RTDA weighbridges network, the scale and software brand quality shall be as per command 9000 software MSDE/SQL Server data base solutions that will allow the weighbridge to be installed and operated either completely automatically or with minimum driver input.

3.0 WEIGHBRIDGE STRUCTURE

3.1 Standards

The static weighbridge and all the related elements must be designed in accordance with British Standards BS5400, Part IV for HB loading.

3.2 Structural Capacity

The static weighbridge must be properly dimensioned to withstand all the forces and weights susceptible to be applied during the normal life span of the structure.
The contractor must also supply all the structural calculations performed by a Registered or Chartered Engineer for our verification by the Resident Engineer.

3.3 Steel Structure

All the elements of the steel structure for the weighbridge scale as well as assembly bolts must be protected against corrosion.
The minimum thickness of the anti-corrosion coating will be 55 µm for the primer and 30 µm for the covering coat.

4.0 CONTROL AND INSTRUMENTATION

4.1 Load cells

The weighbridge platform must be equipped with a minimum of four load cells.
The load cells must meet the following minimum specifications

a) Load Capacity for each cell: 25 000 kg – 30,000 kg
b) Precision +/- 10 kg complying with EN 45501 (OILM R 60) of EU
c) Safe overload: 150% of rated capacity
d) Temperature range for operation: -10 to +60 ^{0}C
e) Life span 1 000 000 cycles

- The load cells should be constructed of stainless steel, hermetically sealed with protection against water and dust (NEMA 6P/IP 68)
- Load cells shall be output digital or only converted digital information to the scale instrument. Analog output of signal from the load cells is not acceptable.
- Digital output of the signals is a requirement and is necessary to carry the signals without interruption.
- Each individual load cell must be protected against lightning and over voltage.
- Replacement of the load cells must be possible without re-calibrating the scale.
- The load cells must have plug type connectors for ease of servicing the equipment.

4.2 Junction Boxes and Connections

The weighbridge platform must be equipped with a junction box. All junction boxes and other components must have easy access in order to facilitate maintenance and inspection.
All junction boxes shall be NEMA 4X RATED (CONSTRUCTED OF STAINLESS STEEL)
The junction box located under the platform of the static weighbridge must be installed as high as possible in order to avoid being submerged in water in case of flooding.
All the junction boxes must use individual terminals mounted on a DIN rail in order to complete the splice between cables.
The cables connecting the load cells and the junction box must be in one length and without splices.

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The load cell interface cables shall be sheathed in stainless steel for environmental and rodent protection.
The connectors to the load cells should be of a direct connect type in stainless steel. The connectors should be hermetically sealed and maintain an overall class of protection (NEMA 6P).
The lightning protection for the load cells (one per load cell) should be installed in the junction box located under the platform of the weighbridge.
Load cells and scale platform to scale instrument cables shall be stainless steel sheathed for environmental and rodent protection.

4.3 Controller/Digital Weight Indicator "DWI".

The controller/Digital weight indicator shall be housed in an enclosure having enough lengthen cables that is suitable for mounting at the wall or height fixed area in front of operator or near by the operator but not on top of the desk of the operator.
The controller/ Digital weight indicator shall only receive digital information from the load cell assemblies.
The controller/ Digital weight indicator must display an error code in the case of a defective load cell or of the controller/indicator. The error code must identify the defective element or any defective procedure and the cause of the defect.
The controller/Digital weight indicator must display the value in kilograms or in tones according to the terminal selection.
The controller/ Digital weight indicator must have the prerequisite components required for communication using communication protocols ETHERNET/IP RS232/422/485 at 9600 baud minimum.
The controller/ Digital weight indicator of a weighbridge system must be connected to the weighing computer as well as to the remote display systems. The controller/ Digital weight indicator should be an industrial terminal with possibility of data storage and printing. The printing of a weighbridge report is controlled from the computer.
The controller/ Digital weight indicator should be equipped with a transaction counter, which automatically attributes a sequential number for each transaction.
The controller/ Digital weight indicator should permit the display of the following information at a bare minimum;

a) Axle Group weight placed on the weighbridge platform
b) Identification number
c) Transaction counter
d) The date and time
e) A button to reset the weight system to zero

The controller/ Digital weight indicator should have the following physical characteristics.

- Display — Large figures
- Data storage — Hard disk
- Protection — IP67 Protection
- Program — ROM storage with easy alteration
- Printer — line printer with tractor feeding or ticket printer

A lightening protection system must be supplied and installed to protect the controller/indicator.

4.4 Weighbridge report printout

The printer of the weighbridge report should be of minimum size for a desktop installation.
The printer should be connected to the controller/computer via a direct connect cable at each end, and not requiring any modification to the controller/ digital weight indicator. It should print all the information received from the controller/weighing computer.
The communication protocol between the controller// digital weight indicator should be serial parallel or ENTERNET/IP
The following basic data should be included in the printout

1. Weighbridge station	Name appear automatically
2. Date	appear automatically
3. Time	appear automatically
4. Sequential ticket number	appear automatically
5. Legal axle load and gross vehicle weight limits	appear automatically
6. Actual axle load, tandem loads, tri-axle loads readings	automatically same as DWI
7. Adjusted axle load limits (inclusive 5%)	calculated automatically.
8. Actual gross vehicle Weight	appear automatically
9. Name of scale operator	appear automatically as per log in
10. Overload in terms of Axle load and Gross vehicle Weight	appear automatically
11. Registration number of vehicle	typed by operator after reading vehicles card.
12. Driver/vehicle operator's name	typed by operator after reading driver's card
13. Origin	typed by operator
14. Destination	typed by operator
15. Type of load	typed by operator
16. Transporter name	typed by operator after reading card

Overloading fees (in US DOLLARS) both for axles and gross vehicle mass overloads,(based on schedule 1 and 2 of the road traffic act) - **appear automatically**
The printer should be capable of being set to print at least two copies of the printout

1. For the driver or operator
2. For the weighbridge staff

The data system should handle at least three conditions during the weighing operations as follows:

1. Loaded vehicle within limits:
   a. All data is entered normally and a weighbridge certificate is issued
2. Overloaded vehicle:

a. All data is entered normally and a first printout is issued followed by an overload indication and calculated fee if exceeding the limit plus allowance.
b. The vehicle is reweighed with the adjusted or reduced load. The system must be able to recall the information from step 1 above with the exception of the weighing results. A weighbridge certificate is then issued.

3. Be able to export the processed data and sorted reports comprising columns and rows in spread sheets for analysis.

4.5 Exporting the Processed Data in Excel Data Systems.

The software shall make the weighing computer to process all data in section 4.4 above to be processed in the exported weighbridge reports in excel data analysis format having columns and rows as per the data taken during weighing.

4.6 Configuration of the Operation Center

The contractor is solely responsible for configuration of the operations station and the configuration of the installed system. He must configure the operations station according to Rwanda Transport (RTDA) criteria and put it in service.
The Contractor must also carry out all other programming or necessary configuration required for the proper functioning of the system and to RTDA satisfaction.
The Scale software Systems shall have the minimum requirement to interface with RTDA LAN / WAN for transferring data on vehicles processed and gathering data from a central database (requests based on information such as license, plate numbers, truck operator, company name, transporter name etc).
Minimum requirements of the Scale Software System for allowing data exchange with LAN/WAN are:

a) The software must natively install on Microsoft Windows XP Pro
b) Be functioning over TCP/IP connectivity.
c) Capability to connect to and use a centrally located database over VPN (Virtual private network) and WAN (Wide Area Network).
d) Must be able to function locally in case of WAN network outage and be able to synchronize data with the centrally located Database when the network is back up.

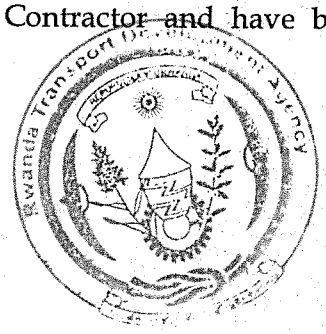
The software must be sparing in bandwidth
The programming of the weighing system must permit, at a minimum, to obtain the following information and perform the following functions:

a) The weight on the platform
b) The display in real time on the monitor

All licenses and software must be registered in the name of RTDA.

4.7 Remote display

a) The displays should be supplied by the Contractor and have been on the market for at least one year.



b) TWO displays are required for the platform to indicate the axle group weight measured in kilograms.(one remote display for entering or leaving the weighbridge platform)..
c) The displays should be numeric and be of a red LED type
d) The displays should be operational between - 100 Celsius and + 600 Celsius.
e) The height of the characters should be at least 200 mm high
f) The outside box should be weather and corrosion resistant.
g) Installation of any Remote Display must be at least 01 meter away the protecting stones of the weighbridge ramps as per directives of the resident engineer at the site.
h) Installation of any Remote Display must be installed at a distance not less than 25 meters from the center of the weighbridge platform (LEFT/RIGHT) and must be protected by the surrounded cone headed plinth of concrete of grade C 20 column guarded post, 50cm diameter and 01 meter above ground level and those high concreted plinth shall be Red and white

Zebra painted at 45^0 diagonally or to be specified by the resident engineer at the site.

5.0 WIRING AND CABLES

5.1 Method of Wiring

a) Control cables are to be kept separate from power cables
b) Power cables as well as signal cables must be steel armored cables of type PVC/SWA/PVC/CU system.
c) Power cables are of 2.5 mm^2 PVC/SWA/PVC/CU.
d) Signal cables are of 1.5 mm^2 PVC/SWA/PVC/CU.
e) Use separate conduits for instrumentation signals, alternating current circuits and ground cables
f) Use separate conduits for voltage where the origin is different
g) Ensure that each and every cable and wire is continuous and without splices from its origin to its destination
h) Cables installed inside the weighbridge office shall be tighten by cable tire and covered protected by trucking or suitable hard wooden materials box.
i) The power tapping cable from main power supply to the weighbridge house must not be less than 16mm^2 PVC/SWA/PVC/PVC/CU

5.2 Material

a) All wiring must be copper material
b) Unless otherwise indicated, all wiring must be installed in conduits including the control cables, instrumentation cables and communication cables.
c) For all wiring, ensure the length is sufficient

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d) Use 18 – gauge AWG wiring for direct current instrumentation signals with minimum 600 volt insulation
e) Use 14 gauge AWG with minimum 600V insulation for digital control signals

5.3 Special cables

a) Use only the cable type recommended by the manufacturer in the instance where a special cable is required (example: Communication).
b) Ensure that cabling as well as the installation method is in accordance with the recommendations of the manufacturer in order to preserve the structural integrity of the electronic signals and the measuring devices, however the supplied cables in the weighbridge platform as well as in the weighbridge cabin are protected against external damages like animal chewing or dust attacked.
c) All special cables must be installed in a rigid conduit resistant to corrosion from its origin to its destination.

5.4 Installation

a) Supply and install, at each end, accessories permitting the identification of the wires and conductors.
b) No splicing or connection will be permitted. Connections will be allowed if undertaken within a junction box and approved by the Resident Engineer prior to installation.
c) Do not mix low voltage signal wiring with instrumentation signals or control signals in the conduits, junction boxes, cable trays or other locations.
d) The conduits must cover the totality of the length of the wires.

5.5 Quality control on site

a) Take the necessary actions in order to ensure a resistive value to ground of no more than 10 ohms.
b) Verify the quality of the grounding prior to applying voltage to the system
c) Supply a written report certifying the continuity of the circuits and the quality of the ground.
d) Undertake all necessary tests prior to applying voltage to the system.

6.0 ANCILLARY EQUIPMENT

6.1 Traffic control Lights

a) The 02 control traffic lights will comprise four aspect lights. The top aspect light will be red, the second, amber up arrow, the third, amber down arrow and the bottom-most light, green, an aluminum sign located beside the lights will describe each of the light functions in both English and KINYARWANDA As follows

1. *Red* STOP / HAGARARA.
2. *Amber up arrow* ADVANCE SLOWLY / IMBERE GACYE GACYE.
3. *Amber Down Arrow* BACKUP SLOWLY / INYUMA GACYE GACYE.
4. *Green* GO/ GENDA.

b) The colors of the lights (*in italic above*) will not be included in the signage. The size of the writing must be sufficient to enable the driver to easily read the signs. The lettering will be black on a white background. The contractor will be responsible for fixing the sign beside the traffic control lights in a solid and permanent method. Additional lighting for night-time operations must be considered and installed.

c) The control of traffic lights is the manual system with switches or pushbuttons and relays installed and placed on top of the table for weighbridge operators.

d) Installation of any Traffic lights control must be at least 01 meter away the protecting stones of the weighbridge ramps as per directives of the resident engineer at the site.

e) TWO traffic lights systems have to be installed at described points below for allowing double weighing direction weighbridge.

f) Installation of any Traffic lights control must be installed at a distance of 25 meters from the center of the weighbridge platform (LEFT/RIGHT) and must be protected by the surrounded cone headed plinth of concrete of grade C 20 column guarded post, 50cm diameter and 01 meter above ground level and those high concreted plinth shall be Red and white Zebra painted at 45^0 diagonally or to be specified by the resident engineer at the site.

6.2 External Loudspeaker

An external loudspeaker will be fixed to the external weight display post. This loudspeaker will be a minimum of 20W and be weather resistant. An interior microphone with a PTT (Push to talk) button on a stable base and associated 20 Watt amplifier and power supply will be located inside the weighbridge control office.

6.3 Weighbridge Office Equipment

The following equipment although not exhaustive, should be supplied as standard office equipment:

a) Two (02) complete weighing computers with weighing software (latest model Dell with at least 320 GB HD, 4 GB RAM, CD-ROM, integrated NETWORK CAR 10/100/100 ENTERNET, Universal PCI 2 – Port RS 232 Serial card, integrated modem, pre-installed with window XP or Higher Windows mode (Windows 8, 10 etc), anti-virus and MS Office) – (these will be for one computer weighing the second is a standby computer system.)

b) Two (02) 22 inch flat screen monitor with anti-glare surface.

c) Ticket printer (OKI ML – 320 printer and HP Printer series (P 4015n- P 4010- P4510 Series))
d) Laser jet Report Printer of ratings (HP DeskJet 4610 series (color Printer: Scanner with digital fax setup Wizard Manage fax setting etc).
e) UPS with minimum standby time of 1 hour rated 1600 VSA (for load cells, and Screen, printer and CPU).
f) 03Complete Computers (latest) one for communications, 02 for processing daily, monthly, ESA, abnormal permits reports, overloading and demerit system controls reports.

7.0 DRAWINGS AND DOCUMENTATION

The contractor will furnish the resident Engineer copy to the Employer with all technical drawings for the scale installation and the pit showing the required dimensions for each type of weighbridge. He/she will also supply operation manuals, calibration charts for the load cells and all other relevant documentation.

8.0 SUPPLY OF MATERIAL

Unless otherwise indicated, all material required for the completion of the works shall be new, supplied and paid for the Contractor.

9.0 ACCEPTANCE AND CERTIFICATE OF APPROVAL

All the equipment will be accepted officially only after all installation and relevant performance tests are successfully completed. All tests will be carried out in the presence of the Contractor, the Client and the Resident Engineer.
All approval certificate from the Commissioner of Weights and measures must be issued for the weighbridge prior to commissioning. This certificate must clearly indicate that the present weighbridge can be used for axle weight control proceedings on the road network.

10.0 TRAINING

The Contractor shall propose and carryout a training program for 8 days on site. Participants for the training will consist of up to ten (10) weighbridge operators, four (4) technical staff from RTDA Headquarters.
The training program will include but not be limited to the following:

a) Technical construction and features of the scale.
b) Practical use of the scale (5 – 6 days).
c) Maintenance and fault handling (trouble shooting)
d) The regulations, laws and procedures for handling the weighbridge and weighbridge operations will be provided by the experts who will be directed by the resident engineer at the site in collaboration with procedures and request of RTDA HQ.

11.0 WARRANTY PERIOD

The contractor will warranty the entire assembly of the weighbridge, including the weighing platforms, the load cells, the exterior weight indicators, the controllers, printers as well as all accessories for a period of two (2) years against all defects resulting from a defect in manufacturing, from a defect in assembly or installation, from a lightning strike or over-voltage as well as for a period of two (2) years towards any hidden defect from the day of delivery.

The Contractor will replace and/or repair at his own cost all equipment or material that becomes defective during this period. All costs relating to the repair or replacement of defective pieces, including expenses relating to labor, travelling time and costs, materials costs, shipping and handling and others are deemed to be included.

The Contractor must also provide full backup service during the specified guarantee period. Furthermore, the Contractor will submit the following:

a) A list of authorized Agents for service, repair and spare part facilities and outlets in EAST AFRICAN COMMUNITY COUNTRIES.
b) A statement on spare parts availability for the equipment for a minimum of five (5) years following delivery.
c) A statement on, and description of emergency spare parts supply organizations (based on fastest possible supply) from abroad
d) A detailed description of the warranty conditions
e) A statement on the possibility of, and conditions for offering service contract.

The contractor will also provide for minimum consumables and spare parts (i.e. paper rolls for printers, ribbons, etc to be supplied as per manufacturer's specifications during the guarantee period.

12.0 DOCUMENTATION

The contractor will submit to the Resident Engineer, the copies of weighbridges operations manuals, all test results, calibration data, inspection reports and certificates of certification. Likewise, he will submit the manufacturer's warranty, manufacturer's instruction manuals and other documents received with the equipment.

12.1 Certificate

The contractor will issue certificates of training Attendance to the participants of the weighbridges staff who he/she trained at the end of the training carried.

13.0 TIMETABLE OF THE WORKS

Within three weeks after signing of the contract, the Contractor will submit to the Resident Engineer all the technical information of the scales and dimensions of the pit to permit construction works to begin.

14.0 OFFICE BUILDINGS

The Contractor shall construct weighbridge office building, generator house, public toilet block and approach roads in accordance with the drawings. The office building shall be provided with potable water, permanent electric supply, adequate lighting ceiling fans and sanitary installations as well as sewerage disposal by thru construction of septic tank and soak-away pit and have the following furnishings:

- 4 office desk + 4 office Chairs
- 4 guest chairs
- 2 tables + 6 chairs for meeting room

The drainage system of the weighbridge pit shall be free and never discharge to weighbridge office sewerage systems.

The lighting provisions shall include distribution board, auto change over switch and the following lighting and sockets including ceiling fans:

However every street light pole with sodium vapor lamps 250 Watts explained in table below must be installed at a span of 50 meters from pole to pole around the weighbridge office as well as around the parking yard.

Office Building	Station Office	Operation Office	Revenue Office	General Office	Hall	pantry	Shower	WC 2 Nos.	External	02 Guards houses
Fluorescent luminary 1200 mm	2 No	2 No	2 No	2 No	3 No	-	-	-	-	10 No
Circular ceiling luminary	-	-	-	-	-	1 no	1 no	2x 1No		-
Bulkhead luminary oval polycarbonate diffuser	-	-	-	-	-	-	-	-	6 no	-
Flush light, 1000W									3 No	-
13A Double switch sockets	2 no.	2 no.	2 no.	2 no.	2 no.	2 no.	-	-	-	04 no.
Ceiling fan with regulator	1 no	1 no	1 no	1 no	1 no	-	-	-	-	02 no.
Sodium vapor lamps 250W (YELLOW COLOUR LIGHT OUTPUT)mou	-	-	-	-	-	-	-	-	5 No.	-

nted on 6m high L-type galv. steel pipe										
Sodium vapor lamps – 250W(YELLOW COLOUR LIGHT OUTPUT) mounted on 6m high Y-type galv. Steel pipe.	-	-	-	-	-	-	-	-	10 No.	-

15.0 FIXING OF THE SCALE INTO PRE PREPARED PIT AND ACCESSORIES

The Contractor shall make sure that the weighbridge office is fitted with all necessary required wiring compatible to the technical drawings provided by the supplier. The contractor shall construct the 50 meters, at 0% gradient heavy concreted finish (Rigid Pavement) uniform, straight weighbridge approach roads and weighing scale pit with extra dimensions of 3.5m wide,4.5m long and a suitable depth. The length of each 0% gradient heavy concreted weighbridge approach road is 25 meters from the center of weighbridge platform to both entrance and outraces directions of the weighbridge platform.

The supplier shall fit the electronic axle load scale into the prepared pit and make all necessary connection and installation of accessories for the scale to become operational. However the installation of the DWI must be hanged at wall or any structure near the weighbridge operator, avoid of putting so many electronic equipment at the table of weighbridge operators.

16.0 ADDITIONAL INFORMATION FOR THE PARKING YARD AND ENTRANCE LINES.

As a complimentary to the weighbridge layout drawings additional information need be captures;

1. The entry lanes, approach slabs, and exit lanes should be on cement concrete, this type of pavement is considered stable to withstand almost static loading.
2. The weighing platform should be fixed at a distance equal or more than 30 m from the main road carriageway centerline.
3. The Parking yard should be able to accommodate a minimum of twenty five (25) Trucks.
4. The parking yard stand shall be of concrete finish i.e. Concrete slabs (in panels) or of paving blocks of 14cm width.

5. The Parking yard should be well secured with rounded steel fence.
6. The Security Guards huts are needed to be built at the entrance and out race of the Parking yard, furnish those huts by putting 02 office chairs, an office table and one complete computer system for recording and storing data of the vehicles entered and leaved the parking yard.

17.0 MAINTENANCE SCHEDULE

The manufacturer should provide a maintenance program for the equipment. The program should also indicate how often the equipment should be inspected and tested and the procedure for carrying out inspection and tests

18.0 STANDBY GENERATOR SET AND INVERTERS SYTEMS

The weighbridge is required to work all the time of the day (24 hrs). The Electronically Operated weighbridge will require the clean electrical power from standby generator and their accessories and Inverters systems for working in the absence of the normal electrical power supply.

The following equipments have to be supplied and installed at the weighbridge station as narrated as follows

18.1 STANDBY GENERATOR SET: (01 STANDBY GEN SET)

Has to be a canopy sound attenuated with weather protected enclosure and of the following technical specification:-

A. OUTPUTBRATINGS -3 PHASE GENERATOR SETS:

1. Voltage 380V- 415V, 50HZ; and able to get 210-240V AC.
2. Prime mover KVA: 27.0 KW 21.6
3. Standby KVA: 30 KW 24
4. 3 Cylinder Range machine.

B. SOUND PRESSURE LEVELS (d BA).

FOR 50 HZ at 1,500 r. p. m.						
Sound power level LWA		15M		7M		1M
	75 % Load	100% Load	75% Load	100% Load	75% Load	100% Load
TBA	63.2	65.2	69.2	71.2	80.6	82.8

C. GENERATOR

Type	Self-existed, brush less.
Voltage regulation	0.5% at steady state from No. Load to full load.
Frequency	0.04% for constant load from no load to full load.
Wave form distribution	THD<4%
Over speed limit	2,250 r. p.m.
Insulation Class	H Class

Temperature Rise	with in class H limits.

D. ENGINE

Type	4-cycle
Aspiration	Naturally aspirated
Cylinder configuration	3 in- Line.
Bore / stroke-mm (in)	91.4/127.0
Compression ratio	16.5.1
Engine Speed	1,500 r.p.m at 50 Hz

Piston Speed at 50 HZ is 6.3 m/sec

Maximum power
Stand by at 50 HZ is 27.7 KW
Prime at 50 HZ is 25.5 KW
Regenerative power at 50HZ is 5.3 KW
Motor starting capacity at 50Hz is 19.0 KW

E. MORE GENERATOR SET (Technical data to follow)

Generator Set Technical Data	**Units**	**Stand by 50 HZ**
Package Performance:		
Power rating	KVA (KW)	30.0 (24.0)
Lubricating System:		
Type :oil pump &lubrication sump		

Generator Set Technical Data	Units	Stand by 50HZ
Oil filter: Spin-on, full flow Oil cooler : Water Oil type required: API 15W-40 Total Tube capacity Oil pan capacity	 Liters Liters	 145 5.7
Engine Electrical System Voltage/ground: 12 DC / negative Battery Charging alternator of ampere rating	 Amps	 45
Cooling System: Water pump type : Centrifugal Cooling system capacity Maximum coolant static head Coolant flow rate Minimum temperature to Engine Temperature rise across Engine Heat rejected to coolant at rated power Radiator fan load	 Liters M(H20) Liters/hrs ^{0}C ^{0}C Kw kw	 11.9 2.6 1920 76 6 12.9 0.6
Air Requirement: Combustion air flow Maximum air cleaner restriction Radiator cooling air Generator cooling air	 m^3/min Kpa m^3/min m^3/m	 1.6 5.6 72 9.0
Full Load efficiency	%	88.6or above

18.2 NECESSARY ELECTRICAL ACCESSORIES NEEDED TO BE SUPLLIED AND INSTALLED WITH THE STAND BY GENERATOR UNIT.

S/N	DESCRPTION	UNIT	QTY
1.	Underground cable (RYBN) Armored cable 16 mm²	Mtrs	Suitable Length between generator house and weighbridge house
2.	Saddle clips (Mild Steel type) for 16 mm² cable	Pcs	
3.	By-Pass Changer over switch type EP2 63A-415V 50 HZ	Pcs	01
4.	Earth rod pure copper 3(m)	Pcs	02
5.	Earth wire 16 mm²	Mtrs	06
6.	63A- 3phase Top plug	Pcs	01
7.	1 ½" P.V.C pipe	Mtrs	06
8.	1 ½" P.V.C pipe Elbow joints	Pcs	06
9.	3 Gang 1 way switch	Pcs	01
10.	4 ft Fluorescent lamps 40w starter less complete type	Pcs	03

11.	2 core Flexible cables 1.5 mm^2 cable	Mts	05
12.	Bolts(6 inch) Steel type	Pcs	04
13.	STD PVC flat Mould boxes(shorter type)	Pcs	03
14.	20A DP Switches with Neon lights	Pcs	03
15.	Stabilizer heavy duty 2,000Watts, (180V-250V) Constant electrical power supply unit.	Pcs	01
16.	(RYBN) flexible cable 6 mm^2PVC/PVC/CU	Mtrs	Suitable length between changeover switch to inverter system in the weighbridge house.
17	100A, 4 Ways, 3 phase and neutral distribution boards main switch (MEM or equivalent) with Circuit breaker.	Pcs	01

18.3 INVERTERS SYSTEMS NECESSARY TO BE SUPPLIED TO THE WEIGHBRIDGES STATIONS.

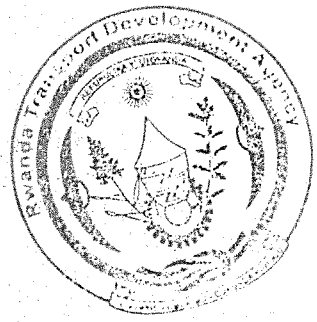
S/N	DESCRIPTION	UNIT	QTY
1	DC to AC power Inverters DC 12V to ac 220-250V 50HZ rated 5kva / 48DC V. 1ø Input, 1ø output- Pure Sinusoidal wave.	equipment	01
2	Pure Maintenance free batteries units (Top up) Heavy duty N200 Type dry cells. Rechargeable rated 12 D.C output at 200AH.	pcs	04
3	Wall brackets hangers (steel type) 30cm size	pcs	04

19.0 REMARKS and Table Schedules.

1. These specifications are minimum requirements; equipment with better qualities will be accepted.
2. The Supplier shall furnish the Employer with all technical drawings for the pit and scale installation. Operation manuals, calibration chart for load cells and attach any other relevant documentation.
3. The following table schedules (first, second, third and fourth) and the Sample Ticket instructions given are very important to be observed and followed by the software designer to full fill the axle load control regulations.

FIRST SCHEDULE
MAXIMUM GROSS VEHICLE MASS

S/No	Vehicle description	Maximum Gross Vehicle Mass (KGs)
a.	Two axle vehicle	18,000
b.	Three Axle Vehicle	26,000
c.	Four (or More) axle vehicle	28,000
d.	Vehicle plus semi-trailer with 3 axles	28,000
e.	Vehicle plus semi-trailer with 4 axles	36,000
f.	Vehicle plus semi-trailer with 5 axles	44,000
g.	Vehicle plus semi-trailer with 6 axles	50,000
h.	Vehicle and draw-bar trailer with 4 axles	37,000
i.	Vehicle and draw-bar trailer with 5 axles	45,000
j.	Vehicle and draw-bar trailer with 6-axles	53,000
k.	Vehicle and draw-bar trailer with 7 - axles	56,000



SECOND SCHEDULE

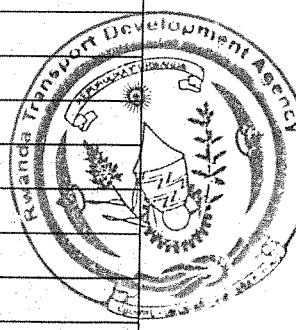
S/No	Type of axle/group of axles	Abbreviation	No. of Tires	Max load on axle/group of axles
i.	Single Steering drive operated	SS	2	8
ii.	Two steering drive operated	SD	4	14
iii.	Single steering draw bar controlled	DR2 OR SDR	2	8
iv.	Single steering draw bar controlled	DR4	4	9
v.	Single non steering	S2	2	8
vi.	Single non steering	S4	4	10
vii.	Tandem non steering	D4	4	12
viii.	Tandem non steering	D6	6	15
ix.	Tandem non steering	D8	8	18
x.	Tandem steering (dolly	DR8	8	16
xi.	Triple non steering	T10	10	21
xii.	Triple non steering	T12	12	24
xiii.	Triple super single tires	TS6	6	24

However the software supplier must leave out more space to accommodate **unlimited more axles standards expected** to appear in future in the East African countries.

THIRD SCHEDULE

SCHEDULE OF OVERLOADING FEES FOR AN AXLE AND GROUP OF AXLES

OVERLOAD (KILOGRAMS)	FEES US$	Overload (Kilograms)	Fees US$
100	8.00 $	5100	836.00 $
200	16.00 $	5200	864.00 $
300	25.00 $	5300	892.00 $
400	34.00 $	5400	921.00 $
500	43.00 $	5500	950.00 $
600	52.00 $	5600	980.00 $
700	62.00 $	5700	1010.00 $
800	72.00 $	5800	1041.00 $
900	82.00 $	5900	1073.00 $
1000	92.00 $	6000	1106.00 $
1100	103.00 $	6100	1138.00 $
1200	114.00 $	6200	1172.00 $
1300	126.00 $	6300	1206.00 $
1400	137.00 $	6400	1241.00 $



1500	149.00 $	6500	1276.00 $
1600	161.00 $	6600	1312.00 $
1700	174.00 $	6700	1349.00 $
1800	187.00 $	6800	1387.00 $
1900	200.00 $	6900	1425.00 $
2000	214.00 $	7000	1464.00 $
2100	228.00 $	7100	1503.00 $
2200	242.00 $	7200	1543.00 $
2300	257.00 $	7300	1584.00 $
2400	272.00 $	7400	1626.00 $
2500	287.00 $	7500	1688.00 $
2600	303.00 $	7600	1711.00 $
2700	319.00 $	7700	1755.00 $
2800	335.00 $	7800	1799.00 $
2900	352.00 $	7900	1845.00 $
3000	369.00 $	8000	1891.00 $
3100	387.00 $	8100	1937.00 $
3200	405.00 $	8200	1985.00 $
3300	425.00 $	8300	2033.00 $
3400	443.00 $	8400	2083.00 $
3500	462.00 $	8500	2133.00 $
3600	482.00 $	8600	2183.00 $
3700	502.00 $	8700	2235.00 $
3800	523.00 $	8800	2288.00 $
3900	544.00 $	8900	2341.00 $
4000	566.00 $	9000	2395.00 $
4100	588.00 $	9100	2450.00 $
4200	610.00 $	9200	2506.00 $
4300	633.00 $	9300	2563.00 $
4400	657.00 $	9400	2621.00 $
4500	681.00 $	9500	2679.00 $
4600	705.00 $	9600	2739.00 $
4700	730.00 $	9700	2799.00 $
4800	756.00 $	9800	2860.00 $
4900	782.00 $	9900	2923.00 $
5000	809.00 $	10000 or more	2986.00 $

FOURTH SCHEDULE
SCHEDULE OF OVERLOADING FEES FOR MAXIMUM GROSS VEHICLE MASS

GVM OVERLOAD (Kilograms)	FEES US$	GVM OVERLOAD (KILOGRAMS)	FEES US$
500	22.00 $	16500	2331.00 $
1000	45.00 $	17000	2536.00 $
1500	70.00 $	17500	2760.00 $
2000	95.00 $	18000	3006.00 $
2500	122.00 $	18500	3275.00 $
3000	150.00 $	19000	3569.00 $
3500	180.00 $	19500	3893.00 $
4000	211.00 $	20000	4248.00 $
4500	244.00 $	20500	4638.00 $
5000	279.00 $	21000	5067.00 $
5500	316.00 $	21500	5538.00 $
6000	355.00 $	22000	6057.00 $
6500	397.00 $	22500	6628.00 $
7000	441.00 $	23000	7258.00 $
7500	489.00 $	23500	7952.00 $
8000	539.00 $	24000	8716.00 $
8500	593.00 $	24500	9560.00 $
9000	651.00 $	25000	10491.00 $
9500	712.00 $	25500	11519.00 $
10000	779.00 $	26000	12653.00 $
10500	850.00 $	26500	13906.00 $
11000	926.00 $	27000	15291.00 $
11500	1009.00 $	27500	16821.00 $
12000	1098.00 $	28000	18512.00 $
12500	1195.00 $	28500	20381.00 $
13000	1299.00 $	29000	22448.00 $
13500	1412.00 $	29500	24735.00 $
14000	1535.00 $	30000	27264.00 $
14500	1668.00 $	30500	30062.00 $
15000	1813.00 $	31000	33158.00 $
15500	1971.00 $	31500	35000.00 $
16000	2143.00 $	And above	

Rwanda Transport Development Agency

SAMPLE TICKET
***** RTDA – WEIGHBRIDGES *****
" KAGITUMBA BORDER - Weighbridge Station"

Vehicle Reg.	Ticket No.(7 Digits)	0,000,118	Time:
Vehicle Reg. No. 2	Date	14 MAR,2015	14:10
Transporter's name			
Driver's name			
Axle configuration.....SS,D8,DR4,D8,D8.....			
Origin:			
Destination:.....			
Type of Load:.....			

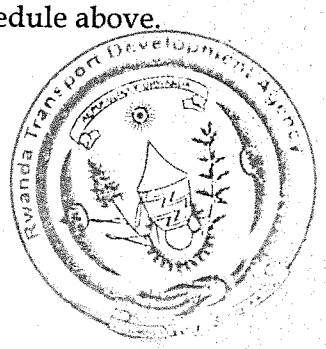
Actual Wt	Toll (%)	Allowed Wt	Adjusted Wt	Overload	Fees $
8,400 kg	5	8,000 kg	8,400 kg	0 kg	0.00 $
17,950 kg	5	18,000 kg	18,900 kg	0 kg	0.00 $
9,600 kg	5	9,000 kg	9,450 kg	150 kgs	16.00 $
21,900 kg	5	18,000 kg	18,900 kg	3,000kgs0	369.00 $
18,000kg	5	18,000 kg	18,900 kg	0	0.00 $
0 kg		0 kg	0 kg	0	0.00 $
Total GVM 75,850 kg		71,000 kg	74,550 kg	3,150 kg	385.00 $
GVM (75,850 – 56,000) KG =19,850 KG					**4,248.00 $**

Operator's Signature----------
Log on names 9 Characters

(1) **NOTE:** According to Rwanda Laws and Regulations, the Transporters will be charged the higher fees of the axle or GVM fees i.e. US **$ 4,248.00** as above on the G.V. Mass Overload. *The 385.00 $ for axle overload will be neglected and vice versa.*

(2) **NOTE:** In dealing with G.V. MASS OVER LOADING. No addition of 5% TOLERANCE. The total allowed G.V.M. weight at column (3) shall not be more than 56,000 kg. This is the maximum allowed GVM of the vehicles in EAC.

(3) **NOTE:** If the Total sum of allowed GVM weight (at column (3) above table) obtained is less than 56,000kg, the difference of actual GVM sum subtract the allowed GVM weight will be taken by software to look up the appropriate overloading fee for that GVM in Fourth schedule above.



20.0 ADDITIONAL GUIDELINES ON WEIGHBRIDGE LAYOUT

As a complimentary to the weighbridge layout drawings additional information need be captures;

A. The entry lanes, approach slabs, and exit lanes should be on cement concrete this type of pavement is considered stable to withstand almost static loading.

B. The weighing platform should be fixed at a distance equal or more than 30 m from the main road carriageway centerline.

C. The Parking yard should be able to accommodate a minimum of twenty five (25) Trucks.

D. The parking yard stand shall be of concrete finish i.e. Concrete slabs (in panels) or of paving blocks of 14cm width.

E. The Parking yard should be well secured with rounded steel fence.

F. Provide a table, one complete computer and chair to every security guard house at the entrance and out race of the parking yard.

21.0 ROAD WORKS AND DRAINAGE

Technical specifications for road works (rehabilitation and widening of Kagitumba-Kayonza-Rusumo road) will apply for the construction of related facilities. These include the following works:

- Preparatory works
- General earthworks
- Pavement, sidewalk and shoulders
- Drainage and protection works
- Road signs and safety equipment
- Environmental measures and activities

22. RIGID (CONCRETE) PAVEMENTS

This work includes the construction of a surface course of Portland cement concrete, with or without reinforcement, and includes, inter alia, the specifications for materials, the placing and compacting of concrete, applying the surface texture, and constructing the joints.

22.1. Material for concrete

(a) Cement

Cement used for concrete shall be Portland cement, Type I or Type II conforming to AASHTO M 85 or equivalent ISO standard class.

Portland cement, Type II, which has been pre-blended with a maximum of 15 percent fly ash, by weight, and conforming to AASHTO M 240, may be used. When blended Portland cement is used, no additional fly ash shall be added.

Different brands of cement, or the same brand of cement from different mills, shall not be mixed.

The use of other cementitious binders may be allowed by the Engineer, provided that it can be proved by the Contractor that they perform similarly to the cements specified above.

Suitable means shall be provided for storing and protecting the cement against dampness. Cement which for any reason has become partially set or which contains lumps of caked cement will be rejected. The temperature of the cement at the time of delivery to the mixer shall not exceed 71oC.

(b) Water

Water used in mixing or curing shall be clean and free of oil, salt, acid, alkali, sugar, vegetable, or other substances injurious to the finished product.
Water will be tested in accordance with and shall meet the requirements of AASHTO T 26. Water known to be of potable quality may be used without test.
Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other foreign materials.

(c) Admixtures to concrete

No admixtures shall be used without the written permission of the Engineer.

Accelerating, Retarding and water-Reducing Chemical admixtures shall comply with
AASHTO M 194.

When a retarding admixture is required it shall be Type D, a water -reducing - retarding admixture as designated in the above specification.

Care should be taken not to combine chemical admixtures together in to a mixture unless they are compatible.

Chloride accelerators shall not be used. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine. An air-entraining agent shall be included in the mix.

The Contractor shall submit details of the nominated mix and the Contractor shall nominate the proprietary source, type and name for each admixture to be used. Documentary evidence of the quality and chemicals compatibility shall be furnished by the Contractor to the Engineer upon request at any stage of the work.

(d) Air-entraining admixtures

Air -entraining admixtures shall comply with AASHTO M154.

A certified affidavit and test result evidence based on tests made in a recognized laboratory shall be submitted to the Engineer by the Contractor.

(e) Aggregates

Aggregates from a single source shall be used in any one-construction work unless specifically authorized by the Engineer. The maximum soluble sulphate salt content of aggregates, expressed as percentage SO3 by mass, shall not exceed 0.1 %.

Aggregates containing more than the maximum permissible amount of sulphates or with visible encrustation of salts shall be washed and drained before being used in concrete. The Engineer may direct washing or re washing of the aggregates until he is satisfied that harmful quantities of salts are not present.

i) *Fine Aggregate*

1) Aggregate can be natural sand, manufactured sand, or a combination of natural and manufactured sand, meeting the following requirement

a) Natural Sand - shall be composed of clean, hard, durable, uncoated grains, free from lumps or flaky particles, organic matter, loam, or other deleterious substances.

b) Manufactured sand - shall be made from stone meeting all the quality requirements for coarse aggregates.

c) Mixtures of Natural Sand and Manufactured sand - when the blend is approved the two materials shall be stored and batched separately.

2) Organic Impurities
All fine aggregate shall be free from injurious amounts of organic impurities. Fine aggregates subjected to the colorimetric test of AASHTO T 21 for organic impurities and producing a colour darker than 3 shall not be used unless the following criteria is met: A fine aggregate with the colour darker than 3 may be used provided that the relative strength at 7 and 28 days is not less than 95% when tested in accordance with AASHTO T 71.

3) Soundness
When the fine aggregate is subjected to five alternations of the sodium soundness AASHTO T 104 the weighted loss shall not exceed 10% by weight.

4) Gradation of Fine Aggregate

For all classes of Portland cement concrete and concrete shall confirm to the following gradation:

Table 22-1 Gradation of Fine Aggregate

AASHTO Standard Sieve Designation	Percentage by weight passing
9.5 mm	100
4.75 mm	95-100
2.36 mm	80-100
1.18 mm	50-85
0.600 mm	25-60
0.300 mm	10-30
0.150 mm	1-10
0.075 mm	0-3

(ii) Coarse Aggregate

Coarse aggregate for Portland cement concrete shall conform to the following requirements:

1) General- Coarse aggregate shall be clean, tough, durable gravel, crushed gravel, hard durable rock, metallurgical furnace slag or gravel. It shall be free from soft, thin, elongated or laminated pieces. If required, coarse aggregate shall be washed to produce a clean aggregate.

2) Los Angeles abrasion AASHTO T96 shall not exceed 40%.

3) Sodium sulphate soundness test AASHTO T 104, the weighted loss shall not exceed
15%.

4) Adherent coating in accordance with FLH T 512 shall not exceed
1.0%.

5) The nominal size of coarse aggregate shall not exceed 37.5 mm. When the spacing between longitudinal reinforcement is less than 90 mm, the nominal size of coarse aggregate shall not exceed 19 mm.

In addition, when the slab thickness is 150 mm and over but less than 175 mm, the nominal size of coarse aggregate shall not exceed 25 mm, and when the slab thickness is 100 mm and over but less than 150 mm, the nominal size of coarse aggregate shall not exceed 19 mm.

6) Gradation of Coarse Aggregate are as follows:

Table 22-2 Gradation for Coarse Aggregate

AASHTO Standard Sieve(mm)	Percentage by Mass Passing								
	50	37.5	25	19	12.5	9.5	4.75	2.36	1.18
37.5 to 19.0	100	90-100	20-55	0-15		0-5			
37.5 to 4.75	100	95-100		35-70		10-30	0-5		
25.0 to 12.5		100	90-100	20-55	0-10	0-5			
25.0 to 9.5		100	90-100	40-75	15-35	0-15	0-5		
25.0 to 4.75		100	95-100		25-60		0-10	0-5	
19.0 to 9.5			100	90-100	20-55	0-15	0-5		
19.0 to 4.75			100	90-100		20-55	0-10	0-5	
19.0 to 2.36			100	90-100		30-65	5-25	0-10	0-5
12.5 to 4.75				100	90-100	40-70	0.15	0-5	
12.5 to 2.36				100	90-100	40-70	5-25	0-10	0-5

(f) Materials for joints

(i) Preformed Expansion Joint Filler

Preformed fillers for joints shall conform to AASHTO M 33, AASHTO M 153 Type II, and AASHTO M 213 and shall be punched to admit the dowels. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint. When the use of more than one piece is authorized for a joint, the abutting ends shall be fastened securely, and held accurately to shape by stapling or other positive fastening.

The use of preformed, closed-cell, polyethylene foam backer joint filler shall conform to ASTM D 3204, Type I and shall be limited to vertical applications only.

(ii) Preformed Elastomeric Compression Seals

Preformed elastomeric compression seals used shall comply with the requirements of AASHTO M 220. The seals shall be manufactured in accordance with an extrusion process, from an elastomeric material consisting entirely of polychloroprene, which is subsequently vulcanized.

(iii) Preformed Self-Expanding Cork Joint Sealer

This shall comply with the requirements of AASHTO M 153.

(iv) Joint Sealers

Hot-poured joint sealer shall conform to AASHTO M 301. Cold-poured joint sealant shall be silicone type conforming to US Federal Specification TT-S-1543A, Class A. The sealant shall be a one-part,

low-modulus silicone rubber type with an ultimate elongation of 1200 percent.

Silicone Sealant -when specified, shall meet the detailed requirements as stated in the special provisions or as provided by the manufacturer. The test methods shall conform to ASTM-D-792, ASTM D 2240, ASTM C 794 & ASTM C793-7. The silicone joint sealant shall be grey in colour and shall be stored and installed in accordance with the manufacturer's written instructions.

(g) Materials for reinforcing steel, tie-bars and dowels

Reinforcing steel for concrete pavements shall be of the type, length, size, spacing, and quantity shown on the draiwings and shall meet the requirements specified herein after.

All steel shall be clean and free from mill scale, loose rust or oil.

Reinforcement steel may be either deformed steel bars or cold-drawn steel wire conforming to the following:

(i) Bar Mats

Bar mats shall be cold-drawn steel wire or deformed steel bars from new billet steel conforming to AASHTO M 31 M. The bars shall be size No. 10. All bars shall have the tensile requirement of Grade 300 or 400.

Fabrication of bar mats using deformed steel bars shall be in accordance with ASTM A 184/A
184 M. Bar mats fabricated using rolled cold-drawn steel wire shall be in accordance with
ASTM A 82.

(ii) Welded Steel Wire Fabric

Welded steel wire fabric shall conform to AASHTO M 55M/M 55.

Wire fabric shall not be less than 1.5 meters in width and shall be shipped in sheets and not in rolls.

(iii) Tie Bars & Dowels

Tie bars shall be deformed bars conforming to AASHTO M 31 M. All bars shall have the tensile requirements of Grade 400.

Tie bars for use across joints shall have an epoxy coating conforming to AASHTO M 284/M

284 M except that the thickness of the cured coating shall be 250 +/- 50 microns.

Dowel bars shall be plain, round bars conforming to AASHTO M 254 type A or B. They shall be free from burring or other deformation restricting slippage in concrete.

Dowel bars shall be coated with an approved material to break the bond between the steel and concrete.

Place dowels and tie bars across joints where indicated, correctly aligned, and securely held parallel to the surface of the finished pavement, such that after placement they remain in their specified location. The spacing and vertical location of dowels and tie bars shall be as detailed except where the planned spacing cannot be maintained because of form length or interference with form braces. In such cases, closer spacing with additional dowels or tie bars shall be used.

All reinforcement, dowels and tie bars shall be clean and free of oil, grease, loose rust and other foreign material when the concrete is placed. Paint free portions of dowel S, including ends, with two coats of bituminous emulsion. The unpainted portions of dowels shall be installed in the initially placed concrete slab.

Dowels installed in contraction joints during paving operations shall be held securely in position by means of rigid metal frame cradles to prevent them from rising, sliding out or becoming distorted under paving operations.

Dowels and tie bars in fixed form paving shall be placed by the bonded-in-place method. Installation by removing and replacing dowels and tie bars in preformed holes, including their withdrawal to assist in form stripping, will not be permitted.

(h) Curing materials

Curing materials for Portland cement concrete shall conform to the following:

Liquid membrane-forming compounds shall conform to AASHTO M 148, Type 1-D, clear or translucent with fugitive dye, or Type 2, white pigmented.

Burlap cloth made from jute or kenaf shall conform to AASHTO M 182, Class 4.

White polyethylene sheeting shall conform to AASHTO M 171 for white opaque polyethylene film.

White burlap-polyethylene sheeting shall conform to

AASHTO M 171. Waterproof paper shall conform to

AASHTO M 171.

Hay or straw when used for insulation in cold weather shall be dry and shall not be reused unless otherwise approved.

Liquid membrane -Forming compounds, shall conform to AASHTO M 148

(i) Separation membrane

Separation membranes, to be used between jointed reinforced concrete surface slabs or unreinforced concrete surface slabs and the sub-base, shall be impermeable plastic sheeting 125 microns thick.

(j) Concrete requirements

(i) Proportions

Concrete shall be composed of Portland cement, fine aggregate, coarse aggregate, fly ash, water-granulated blast- furnace slag, water, and chemical admixtures as proposed by the Contractor and approved by the Engineer to produce concrete of the specified strength and workability.

Mix design, manufacture, placing, compaction and finishing of concrete shall be the responsibility of the Contractor.

Concrete Strength- the mix will be designed to produce concrete with a minimum class of C30/25.

The concrete shall contain the amount of cement as directed by the Engineer but in no case shall the concrete contain less than 350 kg/m^3 .

Water cement ratio, including moisture on the aggregates, shall not be more than 0.53. This shall be maintained by use of chemical admixtures and or additional if necessary.

Workability of Concrete -concrete shall be uniformly plastic and workable. The consistency of the concrete shall be determined by the slump test in accordance with Method SC-T-42. The slump shall be in the range of 25 mm to 60mm or 37.5mm +or- 25mm for slip - form paving and 4 inches maximum for hand or other means of paving.

Air Content -Where the Contractor wishes to use an air-entraining agent, the total air content in the freshly mixed concrete shall be M ± 1%, where M is the target value within the limits of 2% to 4%. Tests shall be conducted in accordance with ASTM C 231.

The percentage of entrained air voids in the mix shall be from 3 to 6 percent.

Where concrete is to be cast between fixed forms the nominal maximum size of the mix shall be 40mm.

Where the Engineer has approved of the placement of concrete by means

of a self-propelled slip-form paving machine, the mix design, slump and workability shall suit the machine proposed for use.

(ii) Determining the Mix Proportions

1. General

The preliminary proportions of cement and aggregate required for producing concrete which complies with the requirements of these Specifications shall be determined by way of laboratory tests on concrete manufactured from the cement, coarse and fine aggregates, admixtures (if any) and water proposed for use in the works.

2. Preliminary Tests

At least sixty days prior to the construction of the trial pavement as specified in Clause 7117, the Contractor shall submit to the Engineer samples of all the components of the concrete he proposes to use, and a report by an approved testing laboratory showing the mix proportions proposed for each combination of material sources for the concrete. The report shall also show the following:

- The results of tests on the specified properties of all components.
- The relationship between the 28-day compressive strength and flexural strength of the concrete at each of at least three water : cement ratios namely 0.48, 0.53 and 0.58.
- The effect of the particular admixture (if any) proposed by the Contractor in regard to variations in admixtures, air content (if air entraining) and concrete setting and sawing times.
- The effect of at least three water contents on concrete consistence.

In determining the relationship between compressive and flexural strength, the tests shall be based on not less than six compressive-strength specimens and six flexural-strength specimens for each water : cement ratio. All strength tests shall be conducted in accordance with ASTM C 39 and ASTM C 78.

3. Changes in the Mix Proportions or the Materials

If during the progress of the work the requirements set out in Sub-clause 7102(j) are not being met by concrete manufactured from the materials or material mix proportions being used, the Contractor shall immediately cease producing such concrete and shall effect such changes to the mix proportions and/or materials as may be necessary in order to meet those requirements.

If during the progress of the work the Contractor wishes to use materials or mix proportions other than those originally approved, or if the materials from the sources originally approved change in regard to properties, he

shall before proceeding with further work submit adequate evidence to the Engineer that the new materials or combination of materials will produce concrete which complies with the requirements of Sub-clause 7102(j) and will not bring about detrimental changes in the properties of the concrete.

Any such changes made shall be at the Contractor's expense, and no extra payment will be allowed by reason of such changes.

Where concrete is placed by hand and vibrated or finished with hand equipment, the requirements of Sub-clause 7102(j) shall remain applicable irrespective of the size of the concrete panel or concrete patch placed. The mix proportions, however, shall be adjusted to promote hand placing, vibrating and finishing, and only if the Contractor has produced written proof to the Engineer that the requirements of Sub-clause 7102(j) cannot be complied with under the circumstances, will the Engineer change the requirements in accordance with Sub- clause 7102(j)(ii)4 at his own discretion.

(iii) Changes in Requirements

The Engineer shall have the power, at any time during the progress of the work, to order changes in the requirements set out in Sub-clause 7102 J.In such cases, the Contractor shall be compensated in accordance with the terms of the General Conditions for the additional cost of materials or additional handling, placing and/or other costs, if any, entailed by such changes. If such changes result in savings, the Engineer shall recover such savings from the Contractor.

(k) Handling, measuring and batching materials for concrete

(i) Storing the Materials

Stockpiling of aggregates, the location and preparation of the sites, the minimum size of pile and the method adopted to prevent coning or other segregation of component sizes shall be subject to the approval of the Engineer.

Stockpiles shall be built up in layers of not more than 3 feet in thickness. Each layer shall be completely in place before beginning the next, which shall not be allowed to cone down over the next lower layer. Under no circumstances will coning of stockpiles be permitted.

Aggregates from different sources shall not be stockpiled together unless approved by the Engineer.

The fine aggregate and coarse aggregate shall be separately weighed into the hopper in the respective amounts set by the Engineer in the job mix approval.

Cement shall be stored in a silo or in a dry weatherproof shed with a

raised wooden floor, and each consignment shall be stacked separately. Cement shall be used in the order in which it has been delivered at the site.

The various types of admixtures shall be properly marked and stored separately.

(ii) Transporting

When mixing of the concrete is to be done at the job site, materials shall be transported from the batching plant to the mixer in vehicles appropriate for this job.

In the dry batch process, bulk cement shall be transported to the roadside paver in watertight compartments carrying the full amount of cement required for the batch, or, if permitted, between the fine and coarse aggregate.

Concrete shall be so transported to its final position that segregation or loss of any of the ingredients, or contamination will be prevented and that the mix is of the required workability at the point and time of placing.

Concrete shall be protected against rain, heat, direct sunlight and/or evaporation by means of covers on all open vehicles. No additional water may be added in transit or where delivered.

The time lapse from the moment when the cement and aggregate are intermingled up to the time of placing and compacting the concrete shall not exceed 60 minutes when concrete is transported In truck agitators, and shall not exceed 45 minutes in mild weather or 30 minutes when the concrete temperature is $30^{O}C$ or higher when transported in ordinary trucks.

(iii) Proportioning the Components

All components shall be accurately proportioned in approved automatic proportioning devices to within the following tolerances, and supplied separately at the mixing drums.

a) Cement: ± 2% of the prescribed mass of cement.
b) Aggregate: Each fraction within ± 3% of the prescribed mass of the fraction in question.
c) Water: ± 2% of the prescribed volume or mass.

Admixtures: Admixtures shall be admixed in part of the mixing water after having been carefully measured in an automatic proportioning device capable of proportioning the admixture in quantities, which will not deviate by more than 2% from the required quantities, and shall be done so as to spread the agent uniformly throughout the entire concrete mix during the mixing process.

Water for the mix may be measured by volume or by weight. The accuracy

of the water - measuring equipment shall be within a range of error of not over 1%, and shall be so arranged that the measurement will not be affected by variations of pressure in the water supply line and will be accurate under all construction conditions encountered.

Methods and equipment for adding air-entraining agent or other admixtures into the batch, shall be as recommended by the manufacturer.

(iv) Mixing the Concrete

1. Batch mixing

All concrete shall be mixed in mechanically operated batch mixers. The concrete may be mixed at the site of the work in a central-mix plant, in truck mixers when allowed, or in a roadside paver.

The mixing period shall be at least 90 seconds, but may be reduced to as little as 50 seconds by or increased by the Engineer if necessary, to produce a homogeneous mass.

The production capacity of the mixing plant shall be in accordance with the capacity of the paver used. Where the mixing plant is supplied with more than one drum, the same unit shall be used for proportioning the components.

The drums shall always be kept clean, and all build-up shall be removed. The total period between the times that the cement is placed in the drums until mixing starts shall not exceed 15 minutes.

An overload up to 10% above the mixers nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency is satisfactory and no spillage of concrete occurs.

Concrete shall not be mixed when either the coarse or fine aggregate contains frozen particles. No more concrete shall be mixed than can be placed, finished, and covered during daylight, unless the Engineer approves an artificial lighting system.

2. **Transit-mixing**

The Contractor will be permitted to use appropriate truck mixers, which agitate previously mixed concrete in transit.

Mixed concrete from the central - mixing plant shall be transported in truck mixers, truck agitators, or non-agitating trucks. The time elapsing from the time water is added to the mix until the concrete is deposited in place shall not exceed 30 minutes when the concrete is hauled in non-agitating trucks, nor 60 minutes when hauled in truck mixers or truck agitators.

22.2. Placing concrete

(a) Compacting

The concrete shall be fully compacted by means of approved equipment and shall be free from honeycombing and planes of weakness. The average amount of air voids as measured in concrete cores shall not exceed 3% without air-entrainment when measured by ASTM C 173.

Over-vibration resulting in segregation, surface laitance, or leakage (or any combination of these) will not be acceptable.

No paving in the downhill direction will be allowed if tearing of the concrete occurs. The Contractor shall take the necessary measures to the satisfaction of the Engineer to prevent tearing of the concrete for example by carrying out the paving in the uphill direction.

(b) Time for placing and compacting

The placing, compacting and finishing of the concrete shall be carried out as quickly as possible, and the operations shall be so arranged that in any transverse section of the pavement the concrete shall be fully compacted and finished within 2.5 hours of having been mixed. This time shall be reduced by half an hour for every $5^{o}C$ by which the concrete temperature is above $20^{o}C$ at the time of placing, unless otherwise permitted by the Engineer.

Unless adequate lighting facilities, approved by the Engineer, are provided beforehand by the Contractor, the placing of concrete pavement shall cease in good time so that the finishing operation can still be completed during daylight hours.

(c) Adverse weather conditions

(i) Protection against rain and hail

No concrete shall be placed during rainy weather. For the concrete to be properly protected against rain and hail before it has sufficiently hardened, the Contractor shall have available at all times frame-mounted waterproof covers for protecting the surface of the unhardened concrete. In addition, when slip forms are used, the Contractor shall also provide acceptable emergency protection for the slab edges.

When rain appears to be imminent, all paving operations shall cease and the Contractor shall take the necessary steps to protect the unhardened concrete. The Contractor shall be responsible for the repair of any damage to the concrete, the texturing or the curing compound that may occur.

(ii) Cold-weather paving

All reasonable precautions shall be taken to prevent the temperature of the pavement concrete from failing below $5^{o}C$ during the first 48 hours after casting.

When prevailing temperatures are low or when cold weather is forecast and there is a danger that the temperature of the freshly constructed concrete pavement will fall below the prescribed limits, the Contractor shall either cease all pavement operations or he may be permitted to proceed, provided that the Engineer is satisfied that adequate protective measures are available and will be taken to ensure that the temperature of the pavement will be maintained above $5^{o}C$ for the period stated.

The Contractor will be responsible for the quality and strength of the concrete placed during cold weather, and any concrete injured shall be removed and replaced without additional compensation.

Concrete shall not be mixed when either the coarse or fine aggregate contains frozen particles.

(iii) Hot-weather paving

When paving is done during hot weather and when the temperature of the fresh concrete can be expected to exceed $25^{o}C$, the Contractor shall implement appropriate precautionary measures to place the concrete at the coolest temperature practicable.

Paving operations shall cease when the concrete temperature as discharged at the paver exceeds $32^{o}C$.

(iv) Responsibility for protection

The Contractor shall be responsible for the quality and strength of the concrete placed and for its protection, and any concrete damaged by adverse weather (e.g. any combination of high ambient temperature, low humidity, wind, rain and hail) shall be removed and replaced at the Contractor's expense.

(d) Maintaining continuity during placing

The Contractor shall make adequate advance arrangements for preventing delay in delivering and placing the concrete.

An interval of more than thirty minutes between the placing of any two consecutive batches or loads of concrete shall constitute sufficient reason for the Engineer to have the paving operations stopped, and the Contractor shall then, at his own expense, make a construction joint in the concrete already placed, at the location and of the type directed by the Engineer.

Paving operations shall be continuous, and the rate of paving shall be adjusted to suit the rate of delivery of the concrete.

(e) Width of placing

The width of concrete pavement strip to be placed in a single uninterrupted operation shall be as shown on the Drawings or specified in

the Project Specifications.

22.3. Side-forms, rails and guide wires

(a) Side-forms

Side-forms and rails shall be so designed, manufactured, set and supported that the completed concrete pavement will comply with all the requirements of Clause 7118.

Where the forms are tested with a 3m straightedge, the top edge shall not deviate by more than 3 mm at any place, neither the sides by more than 6 mm. The sides shall not deviate by more than 3 mm from the vertical. The height of the side-forms shall not be less than the nominal thickness of the concrete slab less 15 mm, and the resulting opening between the side-forms and the layer on which it is supported shall be caulked with a stiff mortar consisting of one part of rapid-hardening cement and 3 parts of sand by volume and finished vertically on the inside, and the mortar shall have hardened before any concrete may be cast against it.

The rails, side-forms and running surface shall be kept clean in front of the wheels of all paving equipment.

Side-forms shall not be removed before the concrete has hardened sufficiently to prevent damage being done to the sides and loosening of tie-bars or dowels, if any, and not earlier than 6 hours after the completion of the construction of the slab. The side-forms shall also be removed in a timely manner to permit the sawing of transverse joints up to the edges of the concrete slab.

Projecting tie-bars and/or the concrete shall not be damaged during removal of the side-forms. Before any side-forms may be ordered or brought onto the site, particulars regarding the side forms shall have been approved by the Engineer.

(b) Rails

The wheels of spreading and finishing machines and frame-mounted covers shall not run directly on the top surface on the side-forms but on rails rigidly attached to the forms, unless the forms are specially made to double as rails.

(c) Electronic control systems

Where a slipform paver is used, the alignment levels for placing the concrete shall be controlled automatically from guide wires by sensors attached at the four corners of the slipform paving machine. The alignment and level of ancillary machines for finishing, texturing and curing shall be automatically controlled relative to the guide wires and to the surface and

edges of the slab.

Guide wires shall be so designed, manufactured and fixed that the paver will be capable of producing a completed slab, which will comply with the requirements of Clause 7118.

Other control methods will also be considered, and should the Engineer be satisfied that they will produce satisfactory results, their use will have to be approved in writing.

(d) Inspection of side-forms, guide wires and rails

Before any concrete may be cast, the Engineer shall approve all assembled side-forms, guide wires and rails. For this purpose, the Engineer shall be given sufficient notice and opportunity.

Approval by the Engineer will not relieve the Contractor of any of his obligations to construct the concrete slab in accordance with the specified dimensions and tolerances.

22.4. Placing, compacting and finishing with side-forms

The paving train shall consist of several powered machines that spread, compact, finish, texture and cure the concrete in a continuous operation.

(i) Placing and Spreading

The concrete shall be spread uniformly by means of a purpose-made mechanical hopper spreader running on rails and capable of spreading the concrete uniformly to a specified level and to a uniform uncompacted density over the entire surface of the slab. The machines shall be capable of being rapidly adjusted for changes in slab thickness or cross fall.

(ii) Compaction

The concrete shall be fully compacted by vibration or by a combination of mechanical surface vibration, internal vibration and tamping. The power supply to the vibrators shall cut out automatically as soon as the compaction equipment stops moving.

Suitable internal vibrators shall be used against the side forms and at joint assemblies to ensure compaction throughout the pavement layer.

(iii) Final Finishing

The surface of the concrete shall be finished smooth and true to grade and level by means of an initial finishing machine equipped with a transverse or oblique oscillating beam.

The final finish of the surface of the slab shall be carried out by a machine that incorporates twin oblique oscillating finishing beams. The beams in the case of both machines shall be readily adjustable for both height and

tilt. The leading beam shall be vibrated. The beam shall be supported on a carriage with two wheels on either side, at least 4 metres apart in the longitudinal direction. The oscillating beams shall be of rectangular section, spanning the full width of the slab and each weighing not less than 170 kg/m.

Hand-finishing of the concrete surface shall be reduced to the absolute minimum and shall be used only to correct minor imperfections and marks on the surface.

Before the concrete starts setting, all pavement edges and the edges of joints shall be rounded off to the prescribed radius.

After finishing, the Contractor shall test the concrete surface with a straightedge of at least 3 metres in length. Irregularities indicated by the straightedge shall be removed with a long- handled hand-operated scraping straightedge of at least 3 metres length. A gangplank shall be used when walking on the concrete.

(iv) Constructing the Concrete Pavement in More than One Contiguous Strip

Where concrete is placed adjacent to an existing pavement, that part of the paving equipment running on the existing pavement shall have flanged wheels on flat-bottom section rails weighing not less than 15 kg/m or by replacing the flanged wheels on that side of the machines by smooth flangeless wheels. Before the paving operation commences, the surface regularity of the existing pavement shall comply with tests specifications and be thoroughly cleaned and brushed to remove all extraneous materials. The wheels shall run at a distance of not less than 300 mm from the edge of the pavement to prevent the pavement edge from spalling or cracking.

No equipment shall be run on the existing pavement until the concrete is strong enough to prevent damage from occurring, but in any case not earlier than 14 days after the construction of the slab.

Where visible cracks occur or any other damage is done to the pavement, further work involving the paver shall be suspended immediately.

The Contractor shall repair all damage at his own cost.

22.5. Placing, compacting and finishing with slipform equipment

(a) General

Slipform paving equipment shall be used for spreading, compacting, floating and finishing the concrete in a continuous operation and in such a manner that a minimum of finishing by hand will be required and a dense and homogeneous concrete to the proper level and grade will be produced.

(b) Placing and spreading the concrete

The concrete shall be deposited without segregation ahead of the paver across its whole width and to a height, which at all times is in excess of the required surcharge.

The deposited concrete shall be struck off to the necessary average and differential surcharge by means of a strike-off plate or screw auger device extending across the entire width of the slab. The strike-off equipment shall be capable of being rapidly adjusted for changes in slab thickness or crossfall.

(c) Compacting and finishing

The slipform paver shall compact the concrete over the full paved width by means of internal vibration only or by a combination of internal and surface vibration. The vibration shall be variable with a maximum energy output of at least 2.5 kN per meter width of slab per 300 mm depth for a laying speed of up to 1.5 metres per minute or prorata for higher speeds.

The level and grades of the surface shall be automatically controlled within the prescribed tolerances by means of a sensing device running on guide wires as specified.

The consistence of the concrete shall be so controlled that the edge slump will not exceed the tolerance specified in Division 10100 of these specifications.

If approved by the Engineer, metal side-forms of sufficient thickness may be used to maintain the proper shape and line.

After the concrete has been finished by the finishing devices incorporated in the slip form paving equipment, the surface of the concrete shall be checked by means of a straight-edge of not less than 3.0 metres in length. High spots indicated by the straightedge shall be removed by hand floats.

After the final finishing and texturing of the concrete, but before curing, the pavement edges shall be rounded to the prescribed radius.

(d) Constructing the concrete pavement in more than one contiguous strip

Except for the wheels, which are in the case of slipform pavers to be replaced with rubber cushioned crawler tracks; the provisions of Sub clause 7106(iv) shall apply when concrete is being placed in more than one contiguous strip.

(e) Track support

The Contractor shall at his own cost ensure that adequate track support is provided to suit the needs of the slip form paver, either by extending the upper pavement layers or by providing alternative support layers.

22.6. Placing, compacting and finishing with hand equipment

(a) General

Where the slabs are too small or irregular, or the site is so restricted as to render the use of the methods described in Clauses 7106 and 7107 impracticable, concrete shall be placed, compacted and finished by means of hand-guided twin vibratory beams and poker vibrators. If necessary, the consistence of the concrete shall be adjusted so as to be suitable for placing with hand operated equipment.

(b) Forms

Side forms complying with the requirements of Clause 7105 shall be used.

(c) Placing, spreading, compacting and finishing the concrete

The concrete shall be placed and spread uniformly to a surcharge of about one-fifth more than the final pavement thickness and shall then be compacted, struck off and finished to the level of the side forms.

The concrete shall be compacted by means of vibrating finishing beams. In addition, internal poker vibrators shall be used for slabs thicker than 150 mm. where used, the pokers shall be inserted at points not more than 500 mm apart over the whole area of the slab, and adjacent to sideforms or the edge of a previously constructed slab.

The surface shall be regulated and finished to the level of the sideforms or adjacent slabs by using twin vibrating beams. The beams shall be of metal with a contact surface at least 50 mm wide and a vibrating unit having a minimum centrifugal force of 4 kN with a frequency recommended by the manufacturer or an equivalent compactive effort. The vibrating beams shall be moved forward at a steady speed of 0.5 m to 1.0 m per minute while vibrating over the compacted surface, to produce a smooth finish.

The surface shall then be further smoothed by at least two passes of a scraping straightedge with a blade length of not less than 2.4 m.

The final surface finish of the concrete shall be effected by means of hand-operated floats. The finishing of the concrete surface shall be to the same standard as specified in Division 8200 of these specifications.

22.7. Steel reinforcement

(a) General

Spacing of bars shall be as indicated on the Drawings or specified in the Project Specifications.

Laps in longitudinal bars shall not be less than 35 bar diameters or 450 mm whichever is greater. In continuously reinforced concrete slabs, only one

third of the laps may be in any one transverse section, except in single bay width construction where half the laps may be in any one transverse section. There shall be a minimum of 1.2 m longitudinally between groups of transverse laps or laps in prefabricated reinforcement sheets. Alternatively, the reinforcement may be butt welded.

Laps in any transverse reinforcement shall be a minimum of 300 mm.

Where prefabricated reinforcement sheets are used and longitudinal and transverse laps would coincide, no lap is required in the transverse bars within the lap of the longitudinal reinforcement. These transverse bars may be cropped or fabricated shorter so that the requirements for cover are met. Alternatively, prefabricated sheets incorporating splices (i.e. flying ends) may be used to provide nesting of reinforcement in both directions at lap positions. The lengths of the laps shall be the minimum values previously stated.

If the reinforcement is positioned prior to concreting, it shall be fixed on metal supports and retained in position at the required depth below the finished surface and distance from the edge of the slab so as to ensure that the required cover is achieved.

Reinforcement assembled on site shall be tied, or firmly fixed, at sufficient intersections to provide sufficient rigidity to ensure that the reinforcement remains in the correct position during construction of the slab.

Alternatively, when a reinforced concrete slab is constructed in two layers, the reinforcement in the form of prefabricated sheets may be placed on or into the bottom layer, which shall be spread and compacted to such a level that it will support the reinforcement without distortion at the required position in the slab. The sheets shall be tied together at overlaps and after the second layer has been spread and compacted, the reinforcement shall have the required cover.

When a reinforced concrete slab is constructed at maximum width of 6 m or more, the transverse reinforcement in the center of the slab shall be a minimum of 12 mm nominal diameter bars at 600 mm center to center. This reinforcement shall be at least 600 mm longer than one third of the width of the slab and be lapped to other transverse reinforcement bars or sheets, or be continuous across the whole width of each slab.

(b) Jointed reinforced concrete slabs

The reinforcement shall be so placed that after compaction of the concrete, the cover below the finished surface of the slab is as indicated on the Drawings, with a tolerance of +/- 10 mm for slabs less than 270 mm thick and +/- 20 mm for slabs 270 mm thick or more.

The vertical cover between any longitudinal joint groove forming strip and

any reinforcement shall be a minimum of 300 mm.

Any transverse bars shall be at right angles to the longitudinal axis of the carriageway. Any transverse reinforcement shall terminate at the specified distance from the edge of the slab and longitudinal joints as shown on the Drawings, with a tolerance of +/- 25 mm. No longitudinal bar shall lie within 100 mm of a longitudinal joint. The reinforcement shall terminate 300 mm +/- 50 mm from any transverse joint, excluding emergency construction joints.

(c) Continuously reinforced concrete slabs

The reinforcement shall be positioned with the diameters and spacings as shown on the Drawings. Except where otherwise shown on the Drawings, the longitudinal bars shall be parallel to the centreline of the road.

The reinforcement shall be positioned so that, after compaction of the concrete, it shall be at mid-depth of the specified thickness of the slab +/- 25 mm. No longitudinal bar shall lie within 100 mm of a longitudinal joint. In reinforcement assembled on site, longitudinal bars shall be placed immediately above any transverse bars, which shall be at right angles to the longitudinal axis of the carriageway or as otherwise specified or shown on the Drawings.

Any transverse reinforcement shall terminate at the specified distance from the edge of the slab and longitudinal joints as shown on the Drawings, with a tolerance of +/- 25 mm.

22.8. Surface texure

(a) General

After the concrete has been placed, spread, compacted, finished and completed and before the curing membrane is applied, the surface of the concrete shall be provided with a surface texture.

The direction of texturing shall be at right angles to the longitudinal axis of the pavement.

The surface texture shall be applied and completed before the concrete is so hard that the surface will be torn and coarse aggregate unduly loosened during texturing.

(b) Equipment

The required texturing shall be effected by means of a machine which spans the full width of the concrete pavement and which is guided in regard to both level and direction by the rails in the case of sideform construction or by the paver guide wires in the case of slipform construction.

(i) Burlap Drag Equipment

Unless otherwise authorized by the Engineer, the burlap drag shall be attached to the front of the texturing machine or to an additional machine which spans the full width of the concrete pavement and is placed in such a way that the full width of the concrete pavement is covered in one operation and, when not in use, the entire drag can be lifted clear off the pavement.

The dimensions of the burlap drag shall be such that at least 1.0 m of the material is in contact with the surface of the concrete pavement measured in the direction in which the drag is being moved. The burlap drag shall consist of at least two layers of approximately 340 g/m^2 burlap with the bottom layer at least 150 mm longer than the top layer at the dragging end; however, at the discretion of the Engineer, the number of layers may be increased to four. The transverse threads of the trailing 150 mm to 300 mm of the burlap drag shall be removed.

(ii) Tine Grooving Device (Grooving Comb)

The pavement shall be grooved by means of a metal tine grooving device. The tines shall be made from flat spring steel approximately 0.6 mm in thickness and 3 mm in width, 125 mm in length and spaced at between 12 mm and 25 mm in an approved random pattern. The Engineer may, however, require a different random pattern or equal spacing of the tines during the course of the work, and provision shall be made to supply different sets of combs as required. No additional payment will be made for the first two changes in the spacing of the tines.

The combs for applying the texturing shall be at least 3.0 m wide. It must also be possible to adjust the combs to a lower position in order to compensate for wear.

(iii) Burlap-Drag-and-Grooved Texture

This texture shall be obtained by first applying a burlap-drag finish to the concrete surface and then by grooving it with a grooving comb.

The first pass of the burlap drag shall be made as soon as construction operations permit and before the wet sheen has disappeared from the surface. Burlap dragging shall be repeated until a gritty and uniform texture having the required depth of texture has been obtained.

Every morning the burlap drag shall be wetted and kept moist throughout the day. At the end of each day's pour the burlap mats shall be cleaned or discarded and replaced with new burlap if cleaning is not possible.

After the concrete has hardened, all loose particles generated by the cutting of the grooves shall be broomed off the surface with stiff hand

brooms or mechanically operated rotary brooms.

When measured with a suitable depth gauge, the grooves shall be not less than 2 mm and not more than 4 mm in depth.

The Engineer may permit the use of texturing equipment other than the grooving comb, provided that it produces a texture similar to that produced by the metal tines.

(c) Hand texturing

Texturing the surface with hand-held brooms or combs shall be allowed only where the pavement is so small or irregular, or the site is so restricted as to make the use of the texturing machine impracticable, or in cases of mechanical breakdown of the texturing machine, in which case it may be used for the required texturing of concrete already placed. The brush or comb to be used then shall be of the same type and width used in the machine.

In order to ensure straight grooves, the comb shall be operated against a straight-edge placed at right angles to the pavement centreline.

The same requirements regarding groove dimensions or texture depth as for machine- texturing will apply.

22.9. Curing

The exposed surfaces, including the sides of the slab, shall be treated immediately after the required texturing of the surface has been effected and after the side formwork has been removed by the application of a white-pigmented curing compound as specified in sub-clause 7102.8 above in accordance with the directions of the manufacturer.

The curing compound shall be sprayed onto the surface at a rate of 0.35 liter/m^2 or as approved by the Engineer by means of a mechanical distributor capable of producing a fine fog-type of spray, which will not damage the surface of the concrete. The curing compound shall be applied in two layers with the distributor moving in opposite directions for the two applications. Coverage shall be uniform over the entire surface and the rate of application of the curing compound shall be carefully controlled.

During spraying operations, the curing compound shall be continuously stirred mechanically to keep the pigmentation in suspension. The spray nozzles shall be adequately protected against wind.

After shutting off the spray nozzles, no dripping of curing compound on the concrete surface may occur. If necessary, the Contractor shall provide drip pans suspended below the nozzles to prevent dripping of the curing compound onto the pavement.

The curing membrane shall be maintained intact for at least seven days after the concrete has been placed. Any damage to the curing membrane,

caused by the Contractor's activities, shall be repaired by hand-spraying the affected areas.

Areas inaccessible to the mechanical distributor such as odd shaped areas, or those with varying widths or shapes, shall be sprayed with curing compound by means of approved hand spraying equipment, at the specified rate of application.

22.10. Transverse joints

(a) General

Transverse joints shall be provided in unreinforced and jointed reinforced concrete slabs and shall be contraction, expansion or warping joints at the spacings shown on the Drawings or as specified in the Project Specifications.

Transverse joints shall be straight within the following tolerances along the intended line of the joint, which is the straight line transverse to the longitudinal axis of the carriageway except where otherwise shown on the Drawings.

(i) Deviations of the filler board or bottom crack inducer from the intended line of the joint shall not be greater than +/- 10 mm;
(ii) The best fit straight line through the joint groove as constructed shall not be more than 25 mm from the intended line of the joint;
(iii) Deviations of the joint groove from the best fit straight line of the joint shall not be greater than 10 mm.

Transverse joints on each side of a longitudinal joint shall be in line with each other and of the same type and width.

Concrete pavement layers shall be isolated from fixed structures by expansion joints, or earthworks or a granular layer over the structure, or by bridge-type expansion joints, or by lengths of fully flexible pavement construction. End of pavement surface slabs shall have a transition bay as shown on the Drawings, leading into the fully flexible construction.

(b) Contraction joints

Contraction joints shall consist of:
(i) A sawn joint groove
(ii) Dowel bars
(iii) A sealing groove

(c) Expansion joints

Expansion joints shall consist of:

(i) A joint filler board
(ii) Dowel bars
(iii) A sealing groove

The filler board shall be positioned vertically within the prefabricated joint assemblies along the line of the joint within the tolerances given in Sub-clause 7112(a) above, and at such depth below the surface as will not impede the passage of the finishing beams on the paving machines.

The joint filler board together with the sealing groove shall provide a complete separation of adjacent slabs and any spaces around dowel bars and between the layer underlying the slab and the filler board shall be packed with a suitable compressible material after fixing the joint assembly.

(d) Warping joints

Warping joints shall consist of:

(i) A sawn groove
(ii) Tie bars
(iii) A sealing groove

(e) Construction joints

Construction joints made at the end of a working day in unreinforced concrete slabs and jointed reinforced concrete slabs shall be contraction joints. In the event of mechanical breakdown of the concreting machinery, or at the onset of adverse weather, emergency joints may be formed.

Emergency joints in unreinforced concrete slabs shall be contraction joints not less than 2.5 m from the preceding or succeeding joint position.

Emergency joints in jointed reinforced concrete slabs shall be not less than 2.5 m from the preceding or succeeding joint position. The stop end formwork shall be sufficiently rigid to ensure that dowel bars, tie bars or reinforcement will be held in position in compliance with the Specification, and placed in such a position that it permits the longitudinal reinforcement to project through the joint for a distance of at least 750 mm.

Construction joints in continuously reinforced concrete slabs at end of day or in an emergency shall not be constructed within 1.5 m of any lap in the longitudinal reinforcement. The stop end formwork shall be sufficiently rigid to ensure that the longitudinal reinforcement and the tie bars, which project through the joint, are held in the correct position.

Longitudinal joints

(a) General

Sawn or wet-formed longitudinal joints shall be provided in surface slabs at the positions as shown on the Drawings. Generally, bay widths are not to be greater than 4.2 m (or 5.0 m with limestone aggregate) for unreinforced slabs, or 6 m (or 7.6 m with limestone aggregate) for reinforced concrete surface slabs with transverse reinforcement.

Wet-formed longitudinal joints shall consist of wet-formed joint grooves, a bottom crack inducer and tie bars except where transverse reinforcement is permitted in lieu.

Longitudinal joints shall be constructed within the following tolerances:

i) Deviations of the bottom crack inducer from the intended line of the joint, parallel to the axis of the road shall be not greater than ± 13 mm;

ii) The joint groove shall be located vertically above the bottom crack inducers within a horizontal tolerance of ± 25 mm;

iii) The best fit line along the constructed joint groove shall be not more than 25 mm from the intended line of the joint;

iv) Deviations of the joint groove from the best fit line of the joint shall not be greater than 10 mm.

Sawn longitudinal joints shall consist of joint grooves.

Tie bars may be replaced by continuous transverse reinforcement across the joints in continuously reinforced concrete slabs which are constructed in more than one lane width in one operation, provided that the transverse reinforcement is a minimum of 12 mm diameter bars at 600 m centers. The transverse reinforcement in these circumstances shall be protected by suitable bituminous paint or equivalent coating for a distance of at least 75 mm either side of the joint.

(b) Longitudinal construction joints

Longitudinal construction joints between separate slabs shall have tie bars with a joint groove. Alternatively, if split forms are used, the transverse reinforcement, if 12 mm diameter or more, may be continued across the joint for a minimum of 500 mm or 30 times the diameter of the transverse reinforcement bars, whichever is the greater. The transverse reinforcement in these circumstances shall be protected by suitable bituminous paint or equivalent coating for a distance of at least 75 mm either side of the joint. Where the edge of the concrete slab is damaged, it shall be made good before the adjacent slab is constructed.

22.12. Joint grooves

(a) General

Transverse contraction or warping joint grooves shall be sawn in the hardened concrete. Transverse joint grooves, which are initially constructed less than the full width of the slab shall be completed by sawing through to the edge of the slab and across longitudinal joints as soon as any forms have been removed and before an induced crack develops at the joint.

(b) Sawn transverse and longitudinal joint grooves

Sawing shall be undertaken as soon as possible after the concrete has hardened sufficiently to enable a sharp edged groove to be produced without disrupting the concrete and before random cracks develop in the slab.

The grooves shall be between ¼ and 1/3 of the specified depth of the slab and of any convenient width not less than 3 mm.

The sealing groove may be sawn to the required width later. Expansion joint sealing grooves shall be sealed as soon as practical after sawing.

(c) Wet-formed longitudinal joint grooves

When slabs are constructed in more than one lane width in one operation, a joint groove shall be formed by inserting a groove former ahead of the finishing beams from dispenser. The concrete so displaced shall be recompacted by a vibrating compactor or similar device, at least 300 mm wide operating symmetrically along the line of the joint.

After finishing the concrete, the groove-forming strip shall be in the correct position and alignment, within 10 of the vertical, and to sufficient depth below the surface to allow for the passage of the finishing beam within the range of 0-3 mm below the finished level of the slab. Groove forming strips in wet-formed longitudinal joint grooves shall be left in place.

(d) Construction joint grooves in surface slabs

The grooves shall be formed by fixing a groove former or strip or cork seal along the top edge of the slab already constructed, before concreting the adjacent slab.

Where the edge of the concrete is damaged, it shall be ground or made good before fixing the groove-forming strip.

Alternatively, the subsequent slab may be placed adjacent to the first and a sealing groove sawn later in the hardened concrete to the minimum depth specified or to the manufacturer's instructions if greater, and to sufficient width to eliminate minor spalling of the joint arris, up to a maximum of 25 mm for longitudinal joints and 40 mm for transverse joints. The joint shall be sealed in compliance with Clause 7116.

(e) Groove formers and bottom crack inducers

Except where joint grooves are sawn, a bottom crack inducer shall be provided at each longitudinal joint position. The bottom crack inducer shall be triangular or inverted Y-shaped fillet, with a base width not less than the height, made of timber or rigid synthetic material. It shall be firmly fixed to the sub-base so as to remain in position during the whole process of constructing the slab.

The combined depth of groove formers and bottom crack inducers shall be between ¼ and 1/3 of the depth of the slab and the difference between the depth of the groove former and the height of the bottom crack inducer shall not be greater than 20 mm.

Groove forming sealing strips for wet-formed longitudinal joints shall be inserted continuously along the joint.

22.13. Tie bars and dowels

(a) Tie bars

Tie bars at the time of use shall be free from oil, dirt, loose rust and scale.

Tie bars in warping joints and wet-formed longitudinal joints shall be made up into rigid assemblies with adequate supports and fixings to remain firmly in position during the construction of the slab.

Alternatively, tie bars at longitudinal joints may be mechanically inserted by vibration from above using a method which ensures re-compaction of the concrete around the tie bars.

At longitudinal construction joints, tie bars may be adequately fixed to side forms or inserted into the side of the slab by a method which ensures re-compaction of the concrete around the tie bars and adequate bond.

Tie bars in warping joints shall be positioned from the top surface of the slab within20, -10 mm of the mid depth of the slab.

Tie bars in other joints shall be positioned and remain within the middle third of the slab depth, approximately parallel to the surface and approximately perpendicular to the line of the joint, with the centre of each bar on the intended line of the joints within a tolerance of 50mm, and with a minimum cover of 30 mm below any top crack inducer of joint groove for slabs 200 mm thick or more, or 20 mm for slabs up to 200 mm thick.

At transverse construction joints in continuously reinforced concrete, tie bars shall be fixed at twice the normal spacing midway between the longitudinal reinforcement bars so that 750 mm extends each side of the joint at the same level as the longitudinal reinforcement and be tied to the transverse reinforcement. Where paving from a construction joint is not resumed within 5 days, an extra longitudinal reinforcement bar 8 m long shall be lapped and tied to each tie bar. These extra bars may be combined

with the tie bars. Where the spacing between longitudinal reinforcement and the extra 8 m long bars is less than 90 mm, the nominal size of aggregate shall be 20 mm for a sufficient number of concrete batches to complete that section of pavement.
Where tie bars are used in longitudinal joints in continuously reinforced concrete they shall be placed at the same level as the transverse reinforcement and tied to the longitudinal reinforcement.

(b) Dowels
Dowel bars shall be free from oil, dirt, loose rust and scale at the time of concreting.
Dowel bars shall be rigidly supported, both in vertical and horizontal alignment, on cradles in prefabricated joint assemblies positioned prior to construction of the slab. For contraction joints, as an alternative to prefabricated assemblies, dowel bars may be mechanically inserted with vibration into the concrete by a method, which ensures full recompaction of the concrete around the dowel bars, and the surface finished by a diagonal finishing beam, or a longitudinal oscillating float travelling across the slab.

Dowel bars shall be positioned at mid-depth from the surface level of the slab ±20 mm. They shall be aligned parallel to the finished surface of the slab, to the centreline of the carriageway and to each other within the following tolerances after construction of the slab:

(i) all bars in a joint shall be within ±6 mm per 300 mm length of bar;
(ii) two thirds of the bars shall be within ±4 mm per 300 mm length of bar;
(iii) no bar shall differ in alignment from an adjoining bar by more than 6 mm per 300 mm length of bar in either the horizontal or the vertical plane;
(iv) bars shall be equally positioned about the intended line of the joint within a tolerance of 25 mm.

Cradles supporting dowel bars shall not extend across the line of the joint.

22.14. Sealing of joint grooves
(a) General
All transverse joints in surface slabs, except for construction joints in continuously reinforced concrete slabs shall be sealed using one of the joint seals described in sub-clause 7102 F. Additionally, longitudinal joints, which are sawn or widened, shall be sealed.

(b) Preparation of Joint Grooves for Sealing
That part of the groove former used to form the sealing groove or any temporary seal shall be removed cleanly without damaging the joint

arrises to a minimum depth of 25 mm where compression seals are used or otherwise to such depth as will provide an applied seal to the dimensions shown in the Drawings after allowing for any necessary caulking material.
If joint grooves are not initially constructed to provide the minimum dimensions for the joint seals as given in the Drawings, they shall be widened by sawing. Joint grooves formed by tapered formers need not be widened. The sealing grooves shall be cleaned out immediately after sawing using high-pressure water jets, to remove all slurry from the joint, before the slurry hardens.
If rough arrises develop when grooves are made, they shall be ground to provide a chamfer approximately 5 mm wide. If the groove is at an angle up to 10^0 from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10^0 the joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defects up to a maximum width, including any chamfer, of 40 mm for transverse joints and 25 mm for longitudinal joints.

For applied sealants, the sides of the joint sealing groove shall be scoured by dry abrasive blasting. This shall not be carried out before the characteristic compressive strength of the concrete is expected to reach 15 MPa. When compression seals are used, the sides of the groove may be ground or wire brushed.
For hot and cold applied sealants, compressible caulking material, de-bonding strip or tape or cord compatible with the sealant, of a suitable size to fill the width of the sealing groove, shall be firmly packed or stuck in the bottom of the sealing groove to such a depth so as to provide the correct depth of seal as shown in the Drawings with the top of the seal at the correct depth below the surface of the concrete.
All groves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. The groove shall be clean and dry at the time of priming and sealing.
For applied sealants, the joint grooves shall be primed with the relevant primer for the hot or cold applied sealant in accordance with the manufacturer's recommendations. When necessary, the joint grooves may be primed and sealed earlier than 14 days after construction, as soon as the grooves have been grit-blasted and cleaned.

(c) Sealing with applied sealants
Sealing shall be carried out continuously along the full length of joint in any one rip, except for remedial areas. When hot or cold applied sealants are used, the sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint groove
to be sealed is below 10^0C, except that between 8^0 and 10^0C it may be carried out when the temperature is rising.

Hot-applied sealants shall be heated in and applied from a thermostatically controlled, indirectly heated dispenser with a recirculating pump. The sealant shall not be heated to a temperature higher than the safe heating temperature nor for a period longer than the safe heating period, both as specified by the manufacturer. The dispenser shall be cleaned out at the end of each day and reheated material shall not be used.
The components of cold-applied sealants shall be thoroughly mixed in the correct proportions in an automatic metering and mixing dispenser or, for hand application, using a power operated paddle mixer for sufficient time to produce a homogenous mix and without entrapped air. As soon as possible after mixing and within the work life of the sealant, the material shall be dispensed into the joint, or applied using a caulking gun, to the concrete below the concrete surface. The tack-free time shall be achieved within 3 hours for machine dispensed material, or within 12 hours for hand applied material.

(d) Sealing with compression seals

When compression seals are used, the widths of the seal shall be selected in relation to the width of the sealing groove, the bay lengths and the manufacturer's recommendations so that the estimated maximum width of the joint opening shall be not more than 70% of the original width of the seal, the estimated maximum width being calculated on the basis of a movement of 4 mm per 10 m run of slab. The maximum calculated width of sealing groove shall be 30 mm. The depth of groove shall be such that the contact face of the seal shall be a minimum of 3 mm below the surface of the concrete.
Compression seals shall be inserted into the grooves without prior extension or rotation and, where recommended by the manufacturer, with a lubricant adhesive which is compatible with the seal and the concrete. The adhesive shall be applied to both sides of the sealing groove or the seal, or to both. The seal shall be positioned with its axis perpendicular to the concrete surface. Excess adhesive on top of the seal shall be removed to prevent adhesion of the top faces of the seal under compression. Except when compression seals are used in longitudinal joints, the transverse joint seal shall be continuous across the slab and the longitudinal joint groove forming strips shall be cut to the required depth after the concrete has hardened for the transverse seal to be inserted. If compression seals are used in longitudinal joints where the grooves have been sawn after construction of the slab, they shall be continuous across transverse joints, with the transverse seals butted and fixed to the longitudinal seals with adhesive.

22.15. Trial pavement
(a) General

When commencing with paving operations, the Contractor shall construct a trial section of pavement, in a position approved by the Engineer, to demonstrate the capability of the Contractor to construct the pavement in accordance with the Specifications.
The trial section shall be constructed with the same materials, concrete mix, plant and equipment as those intended for use by the Contractor for the pavement, and he shall also demonstrate the methods he proposes to use for applying the required surface texture, the construction of joints and the placing of tie-bars, dowels, etc.
Before the Contractor commences with the construction of the trial section, he shall demonstrate to the Engineer that all items of his paving equipment are in a satisfactory working order.
An initial trial section of not less than 150 m in length for mechanical construction, and at least 30 m in length for manual construction, shall be constructed in one continuous operation and be submitted for approval.
The Engineer shall also be entitled to call for a new trial section to be constructed at any stage of the contract when changes by the Contractor in the approved equipment, materials, mix or rate of paving warrant the construction of another trial section.
The Contractor will be paid for the actual length of trial pavement constructed as initial trial section and trial sections constructed in consequence of changes in mixes, techniques, materials, etc, effected by the Contractor, up to a maximum total length of 300 m for mechanical construction, and 60 m for manual construction. In addition, he will be paid for any trial lengths necessary as a result of similar changes required by the Engineer, notwithstanding the fact that the trial section built by the Contractor complied with the specified requirements.

(b) Further trial sections and permission to start constructing the pavement

The Contractor may, unless advised of any deficiencies in the trial section, proceed with the construction of the pavement ten days after the completion of the trial section or such earlier time as the Engineer may determine.
In the event of deficiencies in the trial section, the Engineer may order the Contractor to construct a further trial section, which will again be regarded as the initial trial section. The Contractor may then proceed with the construction of the pavement ten days after the satisfactory completion of the second or subsequent trial section.

22.16. Construction tolerances

The Construction tolerances shall be as specified under Division 10100 of these specifications.

22.17. Process control

The Contractor shall conduct a sufficient number of tests necessary for ensuring compliance with the requirements specified in this Division during all phases of the work.

Accelerated early compressive-strength shall be conducted regularly with a view to predicting the 28-day compressive strength of the concrete. Test procedures and methods for the prediction of 28-day compressive strength shall be determined in consultation with the Engineer.

Where the accelerated tests indicate that the required 28-day compressive strengths will not be attained, the Contractor shall immediately effect the necessary changes to the materials and/or mix proportions in order to ensure that further work will comply with the requirements.

22.18. Quality control and workmanship

(a) General

Routine inspection and testing will be carried out by the Engineer to determine whether the quality of materials and workmanship complies with the requirements of this Division.

The assessment of test results and measurements, and the acceptance of the work, shall be done in accordance with a procedure developed by the Engineer.

The following shall also apply:

(b) Compressive-strength control

The Engineer may, at his discretion, decide to use the Contractor's test results in the acceptance plan, if he is satisfied that the Contractor has complied with all the process control requirements.

(c) Relationship between the Compressive and Flexural Strengths of Concrete

The relationship between the 28-day compressive and the 28-day flexural strengths of the concrete established by the preliminary tests shall be monitored during paving operations by regular tests at the discretion of the Engineer.

For this purpose, sets of three samples each for both flexural and compressive strength tests shall be manufactured from the same batch of concrete and tested for flexural and compressive strength respectively.

If the test results indicate a relationship which deviates from that established by the preliminary tests, the specified compressive strength, as specified in Sub-clause 7102(j)(i) shall be adjusted accordingly.

(d) Air Content of Concrete

If any test for air content shows a value falling outside the specified limits, the quantity of air- entraining agent added to the concrete mix shall be adjusted, until the air content of the concrete is within the specified limits.

(e) Unacceptable Work or Materials

Any work or materials which do not comply with the specified requirements shall be removed and replaced with work or materials which comply with the requirements or, if the Engineer so permits, shall be repaired as specified in Clause 7121, so that it shall comply with the specified requirements after having been repaired.

(f) Acceptance of Concrete of Inferior Strength or Thickness at Reduced Payment

In lieu of requiring the removal of work that has been rejected on account of insufficient strength or thickness, the Engineer may accept such work, at his sole discretion, at reduced payment for the pavement concrete, on the following conditions:

Where concrete is deficient in thickness or in strength, the reduced payment shall be calculated in accordance with the following formula:

$$P = \frac{(dw)^5 (fw)^4}{(ds)^5 (fs)^4} \times 100$$

where:

P= percentage of normal compensation

dw= actual average thickness of slab

ds= specified average thickness of slab

fw= actual 28-day compressive strength of slab (average of 28-day compressive- strength tests)

fs= specified 28-day compressive strength of slab

The above shall be subject to the rejection of a pavement with an average thickness of less than 93.1% of the specified thickness or strength of less than 91.5% of the specified strength, as determined above.

Where both thickness and strength are deficient, it will be rejected if P is less than 70%. Where P exceeds 100%, normal compensation only will be payable.

22.19. Remedial work

In addition to the requirements specified in Clause 1208, the following shall apply specifically to concrete pavements:

(a) Removing concrete

Where any section of the pavement which does not comply with the specified requirements is to be removed and reconstructed, the entire portion of the slab shall be removed and reconstructed as prescribed by the Engineer in writing.

(b) Removing high spots

Where the Engineer so permits, high spots may be removed by approved power chisels and planers. After the high spots have been removed, the Contractor shall, if required, grind the surface up to the nearest longitudinal and transverse joint in order that all the ground areas will be neat rectangular areas with a uniform texture.

On all portions of the pavement where the surface texture has been destroyed or reduced in depth by grinding, the surface texture shall be restored by grooves being cut into the concrete surface. The grooves shall be approximately of the same size and spacing as specified in Sub- clause 7110(b).

(c) Repairing joints

Joints along which spalls occur that exceed 5 mm in depth at any point measured from the top surface of the pavement, or any other joints, which in the opinion of the Engineer are unacceptable, shall be repaired with an approved epoxy resin mortar. The method of repairing joints requires the prior approval of the Engineer.

(d) Repairing the cracks

The Contractor shall be responsible for constructing a pavement which will not exhibit any cracks.

Where cracks occur in the pavement which, in the opinion of the Engineer, do not warrant the removal and reconstruction of the particular section of pavement, the Contractor shall, if so required by the Engineer, repair such cracks, in accordance with a method approved by the Engineer.

(e) Rehabilitation of concrete pavements

Where concrete pavements have to be widened or where long continuous sections of concrete pavement have to be replaced and, in the opinion of the Engineer, the concrete can be placed with pavers, the work shall be regarded as, and shall be measured and paid for as, new work under the applicable items for new work.

(i) Removal of existing concrete

Where any section of the concrete pavement has to be removed, the whole panel between longitudinal and transverse joints shall be removed, unless it is specified in the Project Specifications or ordered by the Engineer that only part of the panel be removed. In such cases, the concrete shall be removed either over the full length or over the full width of the panel between joints. Where the edge of the section to be removed coincides with an existing joint, the edge shall be accurately demarcated in a straight line and sawn with an approved concrete saw to a depth of at least 50 mm before the removal of the concrete may commence.

Existing concrete may be broken up in any approved manner, but strict control shall be exercised to ensure that the adjacent concrete is not

damaged in any way. The Contractor shall repair any damage to the adjacent concrete at his own cost in accordance with the instructions of the Engineer. Such remedial work may involve the partial or complete replacement of the damaged panel should it be deemed necessary by the Engineer.

Care shall be taken at existing joints to ensure that tie bars or dowels are not damaged or bent so as to render them useless.

Broken-up concrete shall be removed to approved spoil dumps.

(ii) Placing new concrete

Before concrete is placed, the underlying surface or layer shall be prepared as specified.

Except where concrete is placed in continuous lengths exceeding 50 m, placing, compacting and finishing with hand equipment shall be carried out as specified in Clause 7108. Where new concrete is placed next to existing concrete, the edge of the existing pavement shall be properly cleaned and all bituminous and other jointing material shall be removed.

Where various adjacent panels are constructed, the concrete in every alternate panel shall first be placed. The concrete in the rest of the panels may be placed only after the concrete in the first panels has sufficiently hardened so that no damage will be done to the first panels during construction activities. All formwork shall remain in position for at least 24 hours.

(f) Surface texture

Unless otherwise specified in the Project Specifications, the Contractor shall produce a surface texture on the new concrete panels which shall be the same as that on the existing panels.

(g) Joints, tie bars and dowels

Joints shall be shaped and tie bars and dowels shall be placed where indicated on the Drawings and as specified in Clauses 7112 up to and including 7116.

At joints in new concrete, the tie bars and dowels in the existing concrete shall be cleaned, and the tie bars shall be straightened, should any such bars be indicated on the Drawings.

In regard to bent dowels, the Contractor shall follow the instructions of the Engineer. Before concrete is placed, all the bars shall be accurately aligned as indicated on the Drawings and specified in Clause 7115. Where the sliding end of a dowel occurs in existing concrete, the dowel shall be extracted, cleaned and treated in accordance with the Specifications and then replaced.

Where tie bars or dowels are shown on the Drawings at joints between existing and new concrete, but no such bars occur in the existing concrete, holes shall be drilled in the existing concrete and fresh bars placed and fixed as prescribed in the Project Specifications. In such cases, the dowels

shall be placed with their sliding ends in the new concrete.
Where no bars are required between the existing and new concrete but such bars do occur in the existing concrete, such bars shall be cut off flush with the concrete edge.
All joints between the existing and new concrete shall be sawn after the new concrete has hardened sufficiently to prevent splintering or other damage from occurring. Sawing the joints may normally be done from two to five days after the placing of the concrete. The width and depth of the sawn grooves shall comply with the requirements set in the Project Specifications and on the Drawings.

(h) Repairing joints and cracks in existing concrete pavement
Repairing the joints and cracks in the existing concrete pavement shall be done in accordance with the requirements set out in the Project Specifications and on the Drawings, and as required by the Engineer.

(i) Retexturing
Where in the opinion of the Engineer the skid resistance of the concrete pavement surfaces is too low, or the texture is too irregular, and where so specified in the Project Specifications, such surfaces shall be provided with a fresh texture.
The depth of texture and groove spacing shall comply with the requirements of the Project Specifications. The work shall be done with approved sawing equipment.

22.20. Opening to traffic
No vehicle with an axle load exceeding 20 kN shall travel over the completed surface within 14 days after it has been completed, or such longer period as may be directed by the Engineer.

23.0 BUILDING WORKS
Technical specifications for the rehabilitation of milk collections centers will apply for these works. However below are additional specifications.

23.1. Sanitary appliances
Any sanitary appliance provided with a siphon and connected with a gate valve. Pipings are made of galvanized steel of quality and dimension as provided in the technical specifications.

23.2. Discharge pipes in PVC
All the sanitary appliances shall be connected to the drainage network by means of P.V.C pipes following the indications given in the plans, with a minimum slope of 2 cm per linear meter. The unit price also includes cut-and-fill of the trenches, as well as other accessories necessary (elbows, t-pieces...)
Dimensions: P.V.C diameter 90 mm, 110 mm, 160mm

The valves and fittings will be subjected to the prior approval of the Employer. The taps ¾ that is to say 19 mms external diameter chromes.
Apparatuses: out of white porcelain fixed at the wall in posed on column in accordance with the parts to pose. The PVC siphons in antisyphonic action and PVC 63 mm the taps square are envisaged pure each apparatus the WC with English: out of vitrified white porcelain fixed with screws and provided with taps square.
The contractor must prepare all the supports for fixing and prepare the apparatuses in such way that they are ready to be installed as soon as the progress of the work allows it. To fix the taps and the pipes, to prepare the bolts, holds discs and other materials for an effective assembly. The joints between the downpipes and the drainages in the ground must be stopped with hessian, plus a sand and cement mortar or with suitable cement.

23.3. Conduits for water conveyance
The conduits will be in galvanized steel diameter ¾ and will include all accessories, safety valve to any ramification of the network towards a flow apparatus, t-pieces, elbows, , taps braces and connection with the sanitary appliances.

23.4. Inspection chambers (manholes)
The inspection chambers shall be carried out of bricks jointed by the cement mortar proportioned at 250 kg/m^3 of sand ;

- Interior walls shall thoroughly smoothened;
- Outside walls shall be protected by a sealing film;
- The foundation shall be carried out on a gravel bed without earth;
- Dimensions: plan view: 40 X 40 X 40 cm
- The cover shall consist of a reinforced concrete slab 10 cm thick and provided with a hook to allow its opening at a convenient period;
- The manholes shall be built away from the pavements

23.5. Septic tanks
The septic tank shall be carried out in accordance with the plans and shall be inspected and approved before its closing.

23.6. Soakway pit
Soak away pits shall be carried out according to the plans and shall be approved before their closing. It includes earthworks, filling using brickbat and gravel without earth (the filling shall be carried out up to 10 cm below the in-let pipe). It includes works of a protection fence made out of stick of minimum 10 cm diameter.

- Dimensions: Diameter: 1,20 m, Depth: min. 6 m to 12 m according to the type of the soil
- Cover out of reinforced concrete 15 cm thick.

23.6. Plumbing

Sanitary work of facilities relates to the distribution of water inside the building, the supply and the installation of all the apparatuses, piping of water supply. This includes all subjections of installation, borings, distinct etc. The adjustment of the installation, services necessary to the tests and the acceptance, maintenance, repair and the replacement of all the parts that would have appeared defective during the guarantee period including the supply and the installation of the water tanks.

a. Water supply

This includes generally the following:

- the passage of the drains through any wall will be done by steel sleeves sealed with cement of a diameter such as they allow the free dilation of piping which they protect;
- Of the flock of asbestos or plastic will be always interposed between drain and sleeves, no noise due to dilations, will have to be audible. The sleeves will exceed the grounds finished of approximately. 2 cm;
- the slopes must be always established automatically to allow the evacuation of the air towards the points of purging the rising mains;
- the air escapes of columns will be done on the last draw-off faucet;
- the contractor will ensure after main laying with the sleeves, the obturation of the passages which will be reserved to him;
- account of dilations will hold to be absorbed by natural fixing (quadrants, curves);
- The conducts will be out of tubes galvanized internally and outside with a diameter 19 mm assembled by screwed sockets and hot galvanized malleable pig iron connections; the sealing being ensured by Ribbon Teflon on threading, no oxycutting will be allowed.

b. Piping in PVC

PVC pipes: polyvinyl chloride pipes will be of minimum type PN10. Their assembly will be obligatorily carried out by means of the nontoxic products and accessories suitable such as the t-pieces, elbows, sleeves, valves and fittings etc... All the downpipes for the rain drainage will be out of PVC diameter 110 mm; they will be hard and ringed. In the test of deformation, a 200 mm length will be uniformly charged at the ambient temperature with (20+2) ° C. The charge to be applied is 2 N/Cm2 of projected surface, namely 2N/cm2x20 cmx10 cm = 400N after 30 minutes under charge, the malformation should not exceed the 12% of the initial external diameter.

23.7. Plumbing accessories

In addition to the sanitary apparatuses and piping, the contractor will have to envisage the plumbing accessories for the rehabilitation of the sanitary devices and existing plumbing. These are: The taps, siphons, valves of square,

Niple, Tenflon, flexible Pipe, complete mechanism for WC, lid for WC and drives out box union etc.

23.8. Protection and Tests (galvanized steel piping)

Protection of the pipes

A particular care must be taken during construction to preserve the pipes. It is necessary to stop the open end of the pipes with a bridge plug. The contractor will have to make sure that the stoppers remain in place until the installations are complete.

Sleeves

All pipings crossing the floors or walls, will pass to through a galvanized soft forged pipe, cut to the width suitable and of diameter higher of 6 mm minimum than the pipe having to cross the floor.

Test

All work must be tested according to the section required before being covered. All the distributions of water must be tested with a pressure twice higher than the normal pressure throughout one 15 minute. All the buried pipes and pipes of ventilation must be tested with a pressure of two meters at the highest level and maintained for 4 hours duration. The contractor will have to include all the equipment and the necessary manpower for the tests. After the distribution system passed the test, with satisfaction. The system must be completely washed before water is used for domestic use.

7. Response to bidders' requests for clarifications:

No.	Questions as raised by potential bidders	Client's Response
1.	Volume I, Section III Evaluation and Qualification Criteria, in sub factor 2.4.2 Specific experience, quantities for key activities are not specified. Please clarify	Please use information provided in the bidding document.
2.	In clarification on the bidding document issued on 6th April 2016, Item 12, you instructed bidders to add lines for taxes and for total with all taxes inclusive. In order to avoid any misinterpretation and confusion, please correct summary page for each of the lots.	A summary table for each lot has been provided as indicated above
3.	In clarifications on the bid documents, in Item 3 it is stated that word format documents will be provided by email to all bidders. Please provide us with a said document.	Word format for the Bill of Quantities and Schedule of Unit Price has been sent by email to all bidders who have purchased the bidding document.
4.	In Bid Securing Declaration, after words: "We accept that we will automatically be suspended from being eligible for bidding in any contract with the borrower for the period of time of "[Employer to insert number of months or years] starting on [insrt date] ", suspension period start date is not stated. Please fill missing data"	Note that the Bid Securing Declaration is not applicable in this tender. Only a bid security from a recognized Bank shall be accepted as indicated in the Invitation for Bids
5.	In Tender Documents, Schedule of Adjustment Data tables A-for local currency and B-foreign currency, weighting coefficient for nonadjustable is not included. Please advise.	Bidder will propose
6.	In accordance with clause 7.1 of the instructions to bidders we kindly request clarifications as follows: Please refer to volume II-"Price Schedules and Detailed Bill of Quantity-Item 100-9-Demolition of existing buildings". The unit of the item is number. Considering the high number of buildings, please make available the sizes and type of the building to be demolished	The details of sizes and types of buildings are attached in annex 1 to these clarifications
7.	There is no reinforcement drawing for box culvert, nozzles and reinforcement cover slab, so should the bidder design reinforcement themselves or client will provide the designed reinforcement drawing?	i. Reinforcement drawings for box culverts are shown in annex 2 ii. Reinforcement

No.	Questions as raised by potential bidders	Client's Response
		drawings for nozzles: It is stipulated in the Article 18 of the Volume III (Technical Specifications) that the type of nozzle to be prefabricated should have a class 90A and according to standards NFP 16100 and 16341. The Contractor shall provide the adequate prefabricated reinforcement nozzle to support the corresponding backfilling height. iii. Reinforcement drawings for box culvert (60 x 60) to be constructed at the access roads are shown in annex 3; iv. Reinforcement of cover slab of reinforcement trapezoidal ditch are shown in annex 3; v. Reinforcement of cover slab of concrete rectangular gutter to be constructed in the sidewalk are also shown in annex 3.
8.	As stated in article 13.8.3 of GC, the b, c, d are coefficients representing the estimated proportion of each element related to the execution of works, as stated in the relevant table of adjustment data, but in the table A&B (schedule of adjustment data), there is no definition of b,c,d,e, please clarify it.	Use same definition as provided under GCC 13.8.3

No.	Questions as raised by potential bidders	Client's Response
9.	Also for table A (schedule of adjustment data) for local currency, the source of index normally should be got from National Institute of Statistics of Rwanda (NISR), but we could not find out the index for labor, equipment and material (diesel, reinforcement, cement, bitumen and so on) in PPI, so please clarify it if we can use the other country's index for local currency?	If the source of index is not available from National Institute of Statistics of Rwanda (NISR), bidders may use indices from any East African member country.
10.	Below forms are unreadable in Tender Documents you submitted: □ Form of Bid Security and □ Letter of Bid Please kindly submit these forms in readable format.	Readable format has been submitted by email
11.	We kindly request a time extension of three weeks	Sufficient time extension has been granted as indicated above
12.	Clause Ref. Clarification Ref No.6646/SPIU/016 Clause no.3 Word format for the Bill of Quantities and Schedule of unit price will be provided by email to all bidders who purchased the tender document. Kindly provide the word format through the provided email addresses	Document has been submitted by email
13.	As per bid documents - ITB 11.1 "the bidder shall submit Certified Balance Sheets and certified Audit Reports within the last five (05) years", statement further confirmed by clarifications issued on April, 6th. Unfortunately our audit report for year 2015 won't be ready before May 28th, so it will be impossible to attach it to our bid. Will it be accepted to submit certified balances from 2010 to 2014?	Please comply with bidding document requirement
14.	"Volume I, 3-201; GC Clause 14.1 The Contract Price (Alternative text for GC Clause 14.1.1 (e)) According to the international practices, we shall pay only the residual value of the Contractor's Equipment and spare parts to be exported. Please consider if this is feasible."	Please comply with bidding document requirements
15.	"Site visit report on Mar 2016, on page 2, Clause 2 mention "By pass road at Cyunuzi 1.6Km (lot 3)", Drawing name: Location Map for Lot 3, mention the length of road division is 1.6Km more or less.	The by pass road (1.6Km) at Cyunuzi will be a permanent road to be constructed and used mainly by large vehicles.

No.	Questions as raised by potential bidders	Client's Response
	The quantity of pay item No. 03-1 "Construction and maintenance of road diversion" in Lot 1 is 20Km, and lot 2 is 18Km, lot 3 is 30Km"	Item No. 03-1 refers to estimated temporary road diversions to be provided by the contractor for the execution of rehabilitation works.
16.	Volume III, 50.7.2 page 111, Technical specifications, Part A: Road Work, Article 50. It mentions the sanctions: if the compactness "Rc" of asphalt concrete road way between 96 and 100, will reduce the compacted quantity of road way construction. According to the international practices, the compactness "Rc" not less than 96 is applied for all the asphalt concrete road course	Please comply with bidding document requirements

ANNEX 1: Number, Sizes and Type of the Buildings to be demolished

Ref.	No of buildings	Size (Length, width)	Type of Building to be demolished
1	1	13m x 12m	Foundation: Stones and mortar Wall: bricks masonry with mortar Lintel: Reinforced concrete Roof: Steel roof sheets Fence: No fence
2	1	4m x 3m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
3	1	8m x 5m	Foundation: Stones with mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
4	1	6m x 5m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
5	1	7m x 7m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
6	1	8m x 6m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
7	1	4m x 3m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
8	1	7m x 5m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: No fence
9	1	13m x 4m	Foundation: Stones with mortar

Ref.	No of buildings	Size (Length, width)	Type of Building to be demolished
			Wall: bricks masonry and mortar Lintel: Reinforced concrete Roof: Steel roof sheets Fence: bricks masonry wall
10	1	10m x 10m	Foundation: Stones with mortar Wall: bricks masonry and mortar Lintel: Reinforced concrete Roof: Steel roof sheets Fence: bricks masonry wall
11	1	5m x 4m	Foundation: Stones and mortar 1Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: bricks masonry wall
12	1	18m x 5m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: bricks masonry wall
13	1	10m x 8m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: bricks masonry wall
14	1	9m x 7m	Foundation: Stones and mortar Wall: adobe bricks Lintel: timber and adobe bricks Roof: Steel roof sheets Fence: bricks masonry wall
15	1	15m x 12m	Foundation: Stones with mortar Wall: bricks masonry and mortar Lintel: Reinforced concrete Roof: Steel roof sheets Fence: bricks masonry wall

ANNEX 2: Reinforcement Drawings for Box Culverts

Calculation note of box culvert

1. Standard and materials

1.1. Standard:

The justification of the calculations are carried out according to the Frensh regulation 'BAEL91' as revised in 99 and the issue 62 title V.
Road surcharge loads are defined in the issue 61 title II "design, calculation and testing of structures " of the French CPC .

1.2. Materiels:

1.2.1. Concrete:

The used concrete is a concrete dosed at 350 kg/m3, the compressive strength at 28 days is equal to 25 Mpa.
The tensile strength of the concrete after 28 days , Ft_{28} = 2.1 MPa.

- Constraint limit of concrete at U.L.S: σ_{bu} = 14.2 MPa.
- Constraint limit of concrete at S.L.S: σ_{bs} =15 MPa.
- Instantaneous deformation modulus of concrete: E_{i28} = 3216420 t/m².
- Limite shear stress of concrete: τu = 2.5 MPa.

Unit weight of concrete is equal to 2.5t/m^3.

1.2.2. Steel:

The used steel is a steel with high adhesion Fe40 (Fe=400MPa.), The elastic modulus is equal to 200000 MPa.
Unit weight of steel is equal to 7850 kg/m^3.
σs = 201,6 MPa, for conditions of harmful cracks.

1.2.3. Embankment and soil materials:

- Unit weight of embankment γr = 2 t/m3.
- Friction angle ϕr = 30°.
- Consider two extreme values of coefficient of thrust : Kmax = 0.50; Kmin = 0.25.

2. Notations:

- Lc : Calculation width taken along through the joints between the meduim fibers of two consecutive sidewalls ;
- Hc :Height calculation taken between the middle fibers of the top slab and bottom slab ;
- e : Thickness of sidewalls, the top slab and bottom slab ;
- γr : Unit weight of embankments ;
- γ_{ba} : Unit weight of concrete;
- Hr : Embankment height ;
- Tg : Left span ;
- Tm : Center span ;
- Td : Right span ;
- SR : Embankment surcharge .

3. Calculation method:

3.1. Hypotheses:

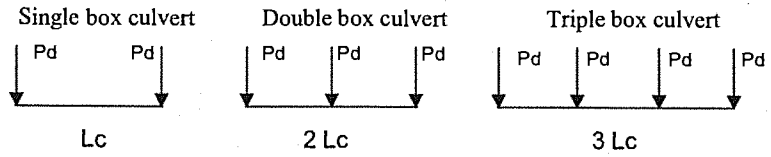
The stresses in the scuppers are determined using the Kleinlogel formulas . The calculations are made to a band of 1m wide. Operating expenses are applied by full span.
The calculation takes into account scuppers the construction phase: Considering first the stresses in the bottom slab from the weight of the sidewalls.
However, when the moment induced by weight of th sidewalls is favorable, it will not be taken into account (because it strongly depends on the stiffness of the soil).

4. Calculation of the loads:

4.1. Permanents loads:

4.1.1. Sidewalls:

The dead weight of sidewalls Pd is included in the construction phase according to the following figures:
$Pd = \gamma_{ba} \times e \times H_c$ (t/ml).



4.1.2. Load on top slab:

Dead weight of the top slab: $Pt = e \times \gamma_{ba}$ (t/m²/ml).
Embankment load: $Pr = hr \times \gamma r$ (t/m²/ml).
These loads are applied to all cells.

4.1.3. Force soil pressure on the extremes sidewalls:

Minimum force soil pressure at the level of T.S : $P_{1min} = K_{min} \times \gamma r \times (Hr + e/2)$ (t/m²/ml).
Minimum force soil pressure at the level of B.S : $P_{2min} = K_{min} \times \gamma r \times (Hr + e/2 + Hc)$ (t/m²/ml).
Maximum force soil pressure at the level of T.S : $P_{1max} = K_{max} \times \gamma r \times (Hr + e/2)$ (t/m²/ml).
Maximum force soil pressure at the level of B.S : $P_{2max} = K_{max} \times \gamma r \times (Hr + e/2 + Hc)$ (t/m²/ml).

With:
T.S: Top slab
B.S: Bottom slab

4.2. Road surcharge load:

The verload considered in the calculation include the system of charges Bc, Bt, Br and Mc120 .
The system of charges Bc, Bt, Br, Mc120 is considered to uniformly distrubuted loads with densities, including increase in compared to the S.L.S. The maximum density will be used to load specifically a single span (full). Along their longitudinal impact defined in 4.2.7 , these loads are also applied on two adjacent spans or on all of the spans.
In all cases, overload applied to the box culvert are not less than 2t/m2 (2,4 t/m2 in SLS) .For triple box culvert , the minimal overload can be applied on both spans extemes or on the three spans when the impact length of MC120 is insufficient to load all three spans.
A force soil pressure due to surcharge on the embankment and acting the sidewalls , Qr = 1 t/m², is also taken in account ($SR_{max} = K_{max} \times Qr$)

4.2.1. Load diffusion:

It is assumed a diffusion at 30° in both directions in the embakment and a 45° diffusion in the concrete.

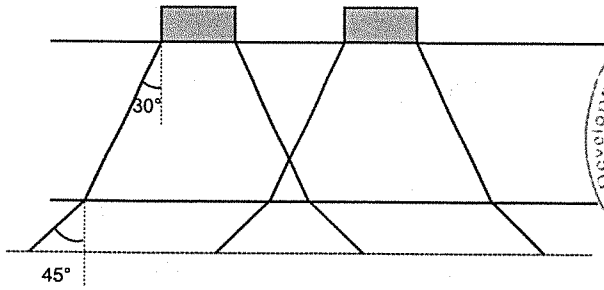
The impact rectangle at the neutral fiber level is u x v such as :

Calculation note of box culvert

$u = u_0 + 2 \tan(30) \times Hr + e$ u_0 : Width of the wheel.

$v = v_0 + 2 \tan(30) \times Hr + e$ v_0 : Length of the wheel.

$2 \tan(30) = 1.15$.



4.2.2. Coefficient of dynamic increase:

$\delta = 1 + 0.4 / (1+0.2xL) + 0.6 / (1+4xG/S)$ δ equal to 1.4 .

4.2.3. Coefficients of increse of systems Bc and Bt:

bc equal to 1.1 and bt equal to 1

4.2.4. Bc system:

Impact rectangle of Bc wheel : $u = v = 0.25 + 1.15\ Hr + e$

QBc (at S.L.S) $= 1.2 \times 6 \times bc \times \delta$ x | if $u>4.5$: $12/[(6+u).(4.5+u)]$ if $2<u<4.5$: $8/[(4.5+u).(1.5+u)]$ if $1.5<u<2$: $4/[(1.5+u).(0,5+u)]$ if $0.5<u<1.5$: $2/[(0.5+u).u]$ |

4.2.5. Bt system:

Impact rectangle of Bt wheel: $u = 0.25 + 1.15\ Hr + e$; $v = 0.6 + 1.15\ Hr + e$

QBt (at S.L.S) $= 1.2 \times 8 \times bt \times \delta$ x | if $v>2$: $8/[(1.35+u).(5+v)]$ if $1<v<1.7$: $2/[u.(1+v)]$ if $1.7<v<2$: $4/[(1.35+u).(1+v)]$ with $v=1.7 \Leftrightarrow u=1.35$ |

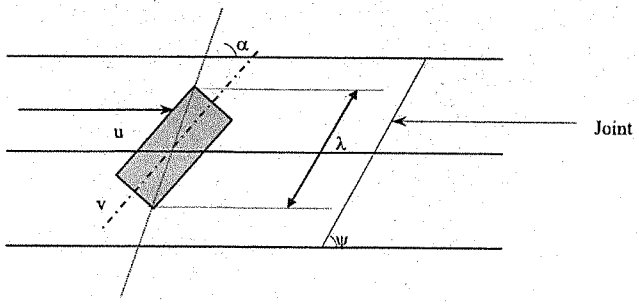
4.2.6. Mc 120 system:

Impact rectangle : $u = 1.00 + 1.15\ Hr + e$; $v = 6.10 + 1.15\ Hr + e$

$QMc120$ (at S.L.S) $= 55 \times \delta$ x [2 / (3.3 + u)] if u > 3.3 [1 / u] else x [1 / v]

4.2.7. Longitudinal impact loads:

This quantity is used to distinguish for each combination the overload to apply and in particular of those double and triple box culverts.



Joint

The impact length is given by : $\lambda = \sqrt{u^2 + v^2}\ \frac{\sin\alpha}{\sin\psi}$

Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 9** **Box culvert (2,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,80 m	1,80 m	0,30 m	2,0 t/m3	0,55 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²)

Q_{hc}	Q_{ht}	Q_{hr}	M_{cl20}
11,10	8,95	8,87	5,66

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,582	-0,106	-0,048	0,000
2	-0,398	-0,106	-0,048	0,000
3	-0,398	0,299	0,150	0,000
4	-0,398	-0,106	-0,058	0,000
5	0,582	-0,106	-0,058	0,700
6	-0,398	-0,106	-0,058	0,000
7	-0,398	0,299	0,150	0,000
8	-0,398	-0,106	-0,048	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

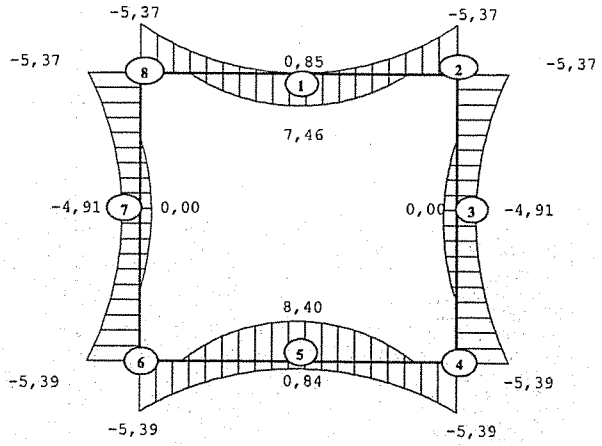
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,85	11,10	0,25	0,50	0,35	0,70	0,90	1,80	1,35

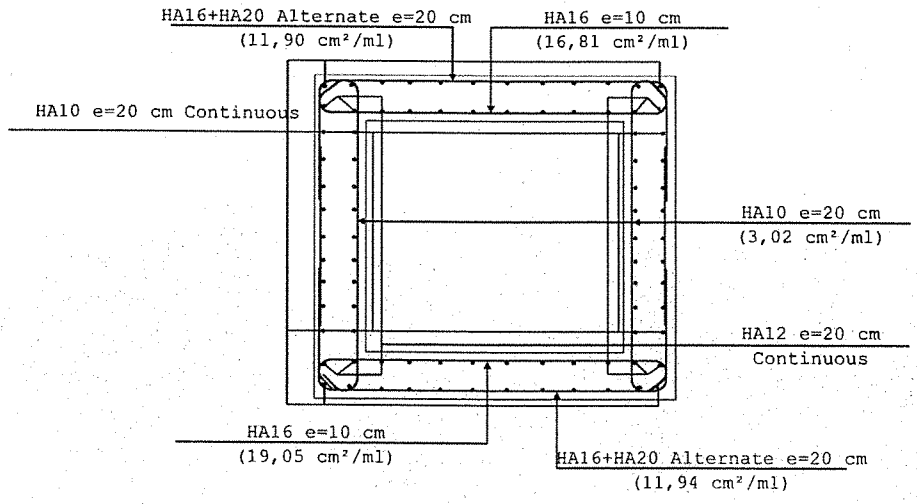
Verification of shear force

τu max = 1,05 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 16** **Box culvert (2,50 x 2,00)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,80 m	2,30 m	0,30 m	2,0 t/m3	0,62 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{hl}	Q_{hr}	M_{c120}
9,92	8,12	7,91	5,37

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,621	-0,199	-0,090	0,000
2	-0,359	-0,199	-0,090	0,000
3	-0,359	0,462	0,230	0,000
4	-0,359	-0,199	-0,109	0,000
5	0,621	-0,199	-0,109	0,700
6	-0,359	-0,199	-0,109	0,000
7	-0,359	0,462	0,230	0,000
8	-0,359	-0,199	-0,090	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

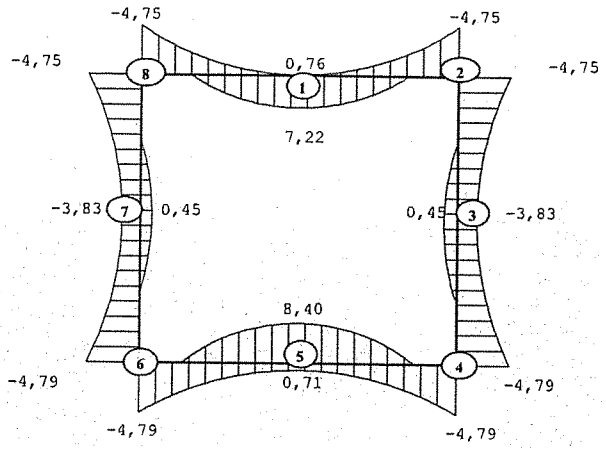
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,99	9,92	0,25	0,50	0,39	0,77	1,15	2,30	1,73

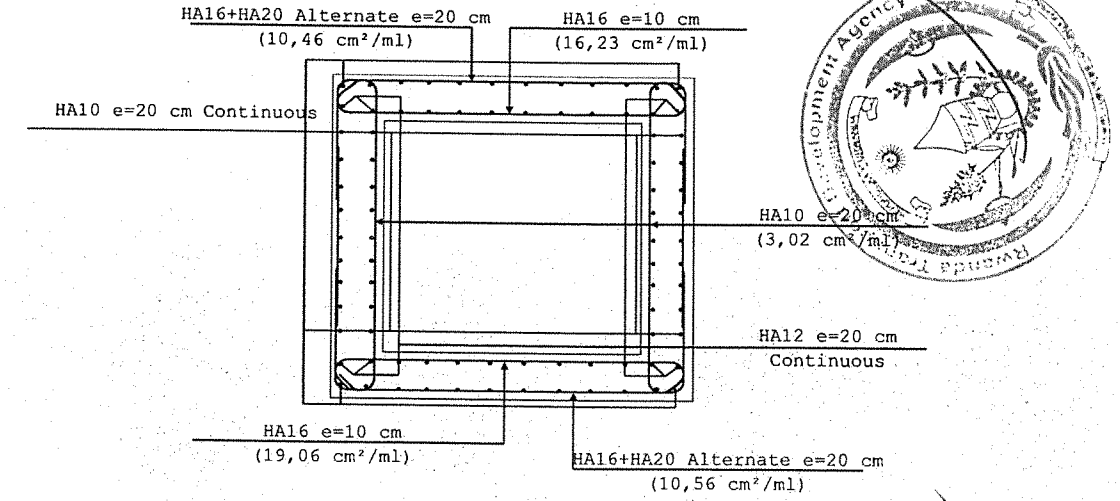
Verification of shear force

τu max = 0,99 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	c	γr	Hr	Fc28	Fc	σs	δ	bc	bt	Imposed skew	Geo.skew
4,32 m	2,85 m	0,35 m	2,0 t/m3	0,84 m	25 MPa	400 MPa	202 MPa	1,35	1,10	1,0	70,0	65,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hi}	Q_{hr}	M_{r120}
	2,40	6,73	6,08	5,22	4,31
Relative to the maximum charge density	0,36	1,00	0,90	0,78	0,64
Longitudinal impact loads according to imposed skew	*12,96*	*4,15*	*4,51*	*2,78*	*8,46*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	1,005	-0,235	1,239	-0,096	-0,041	0,000
2	-0,671	0,201	-0,872	-0,385	-0,186	0,000
3	-0,671	0,128	-0,799	0,630	0,335	0,000
4	-0,671	0,055	-0,726	-0,385	-0,199	0,000
5	1,005	-0,089	1,121	-0,096	-0,055	1,350
6	-1,998	-0,817	-1,181	0,193	0,090	1,080
7	0,000	-0,364	0,364	0,000	0,000	0,000
8	0,000	-0,657	0,657	0,000	0,000	0,000
9	-1,998	-0,671	-1,327	0,193	0,103	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,64	0	0	0	1,2	0	1	0	1	1
2	1	0,64	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

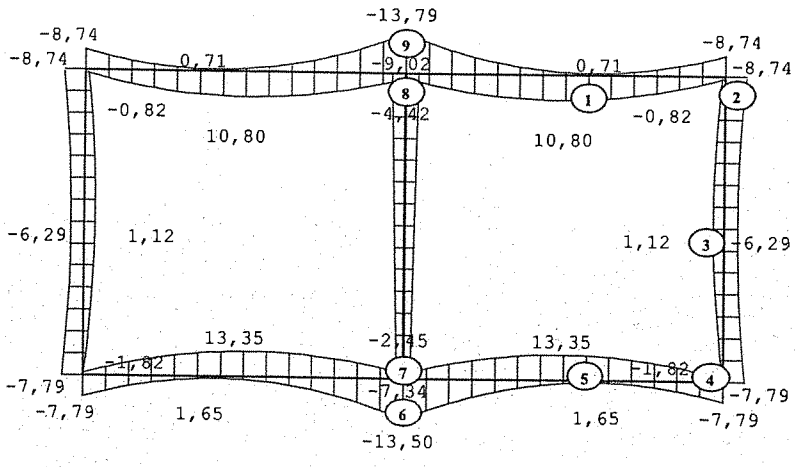
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,56	6,73	6,73	6,73	0,25	0,50	0,51	1,02	1,43	2,85	2,49

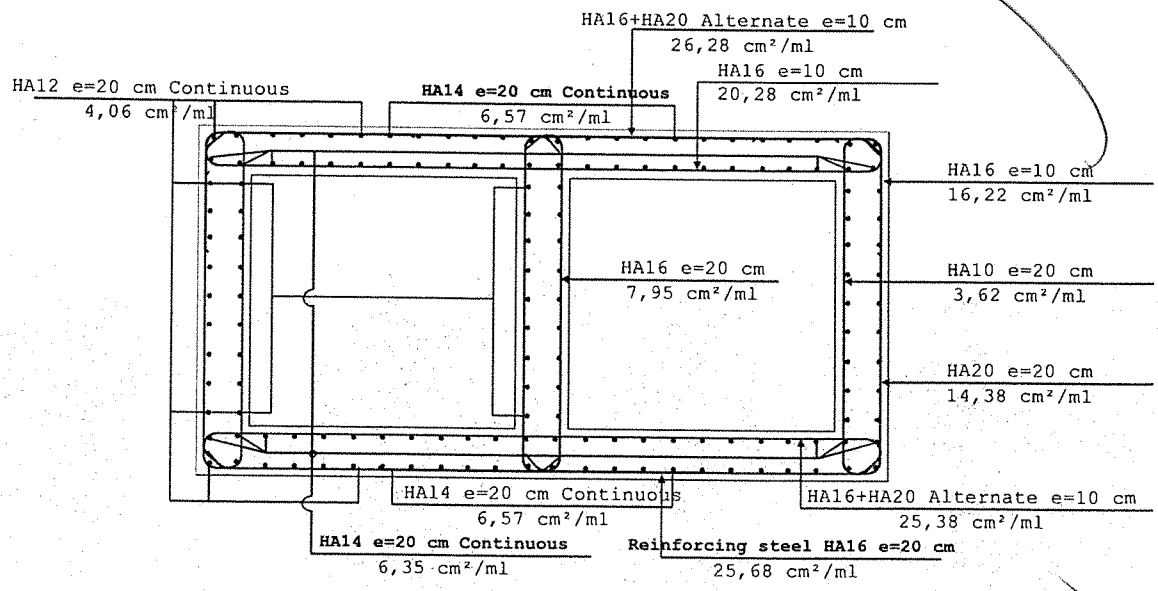
Verification of shear force

τu max = 1,02 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 25** **Box culvert (2,00 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}	Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
2,25 m	1,75 m	0,25 m	2,0 t/m3	2,01 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40	2,80	3,15	1,85	2,49

Densities pondered loads at S.L.S (t/m²) :

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,396	-0,112	-0,051	0,000
2	-0,237	-0,112	-0,051	0,000
3	-0,237	0,271	0,135	0,000
4	-0,237	-0,112	-0,061	0,000
5	0,396	-0,112	-0,061	0,563
6	-0,237	-0,112	-0,061	0,000
7	-0,237	0,271	0,135	0,000
8	-0,237	-0,112	-0,051	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	
2	1	0	0	0	1	0	1	0	
3	1	1	0	1,2	0	1	0	1	
4	1	1	0	0	1	0	1	0	

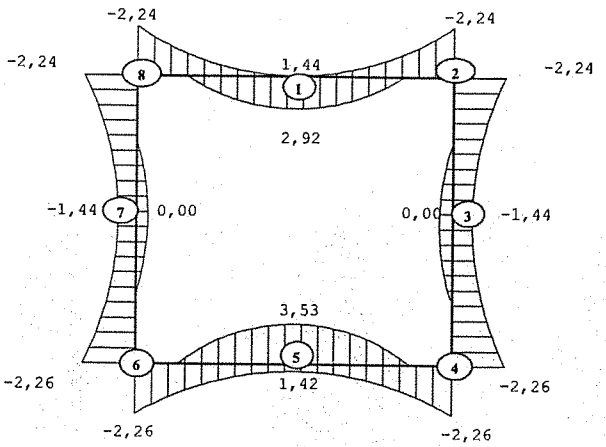
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
4,65	3,15	0,25	0,50	1,07	2,14	0,88	1,75	1,09

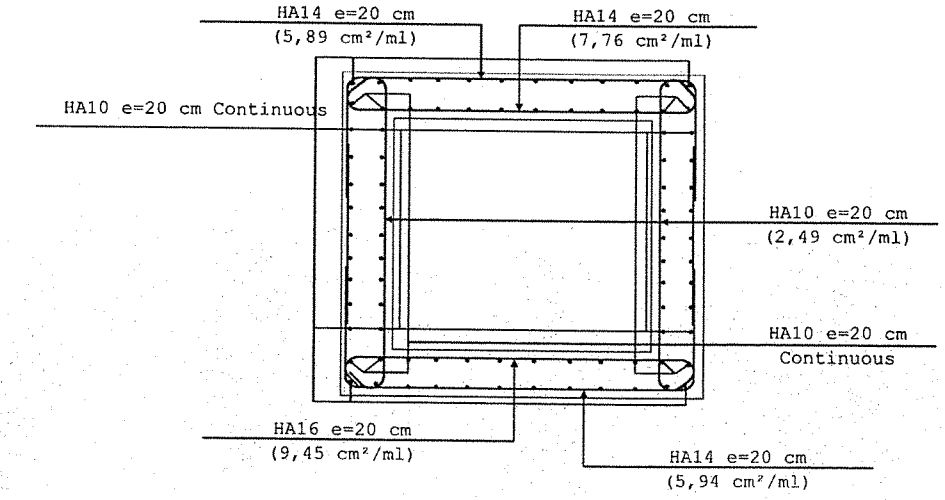
Verification of shear force

τu max = 0,65 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
4,32 m	2,85 m	0,35 m	2,0 t/m3	1,24 m	25 MPa	400 MPa	201,6 MPa	1,35	1,10	1,0	130,0	150,0

Densities pondered loads at S.L.S (t/m²) :

ω_{min}	Q_{hc}	Q_{hs}	Q_{hr}	M_{c120}
2,40	4,78	4,53	3,27	3,39
Relative to the maximum charge density 0,50	1,00	0,95	0,68	0,71
Longitudinal impact loads according to imposed skew *12,96*	*0,79*	*0,00*	*0,23*	*4,05*

units moments

Section	*Q (2T)*	*Q (Tg)*	*Q (Td)*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	1,005	-0,235	1,239	-0,096	-0,041	0,000
2	-0,671	0,201	-0,872	-0,385	-0,186	0,000
3	-0,671	0,128	-0,799	0,630	0,335	0,000
4	-0,671	0,055	-0,726	-0,385	-0,199	0,000
5	1,005	-0,089	1,121	-0,096	-0,055	1,350
6	-1,998	-0,817	-1,181	0,193	0,090	1,080
7	0,000	-0,364	0,364	0,000	0,000	0,000
8	0,000	-0,657	0,657	0,000	0,000	0,000
9	-1,998	-0,671	-1,327	0,193	0,103	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,71	0	0	0	1,2	0	1	0	1	1
2	1	0,71	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

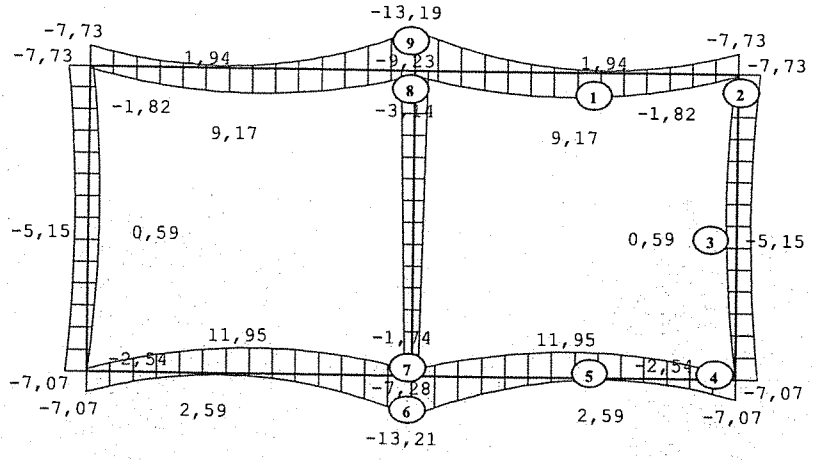
Loads

Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,36	4,78	4,78	4,78	0,25	0,50	0,71	1,42	1,43	2,85	2,49

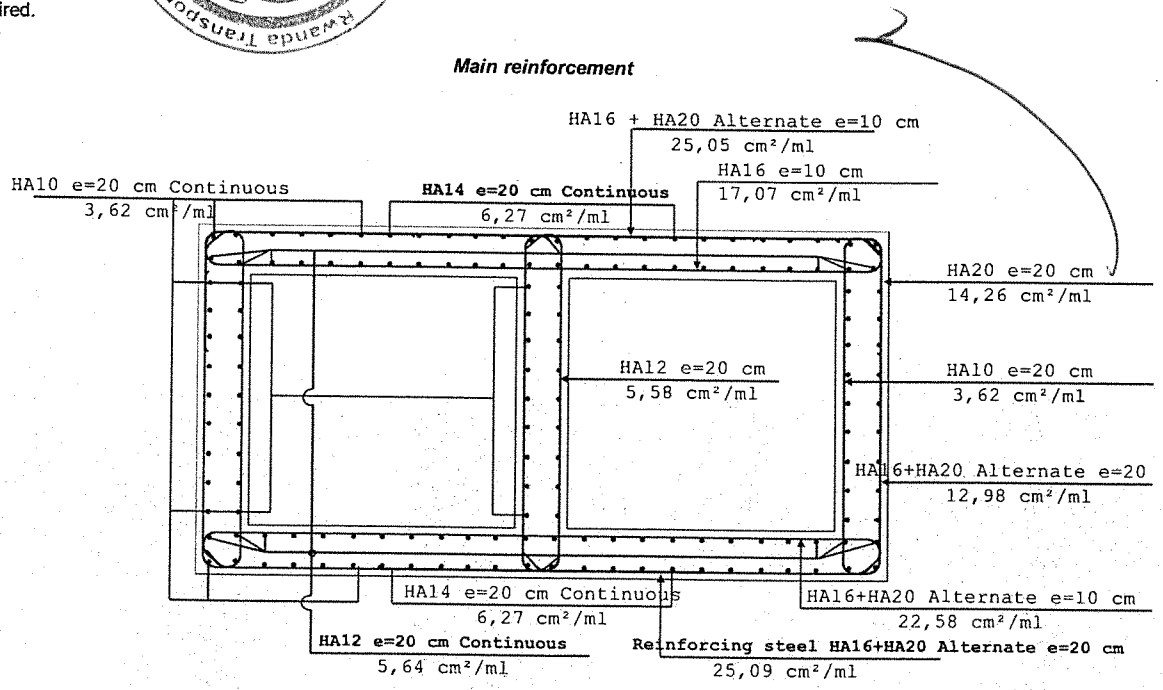
Verification of shear force

τu max = 0,91 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
3,30 m	2,30 m	0,30 m	2,0 t/m3	2,91 m	25 MPa	400 MPa	201,6 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{tr}	Q_{tn}	Q_{hr}	M_{c120}
2,40	1,86	1,94	1,00	1,98
1,00	0,94	0,98	0,50	1,00

Relative to the maximum charge density

Longitudinal impact loads according to imposed skew *9,90* *5,41* *5,26* *4,25* *9,76*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,589	-0,141	0,731	-0,064	-0,027	0,000
2	-0,379	0,117	-0,496	-0,257	-0,124	0,000
3	-0,379	0,075	-0,454	0,405	0,216	0,000
4	-0,379	0,033	-0,412	-0,257	-0,133	0,000
5	0,589	-0,055	0,661	-0,064	-0,037	1,031
6	-1,172	-0,483	-0,688	0,128	0,060	0,825
7	0,000	-0,205	0,205	0,000	0,000	0,000
8	0,000	-0,373	0,373	0,000	0,000	0,000
9	-1,172	-0,399	-0,772	0,128	0,069	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	1,00	0	0	0	1,2	0	1	0	1	1
2	1	1,00	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

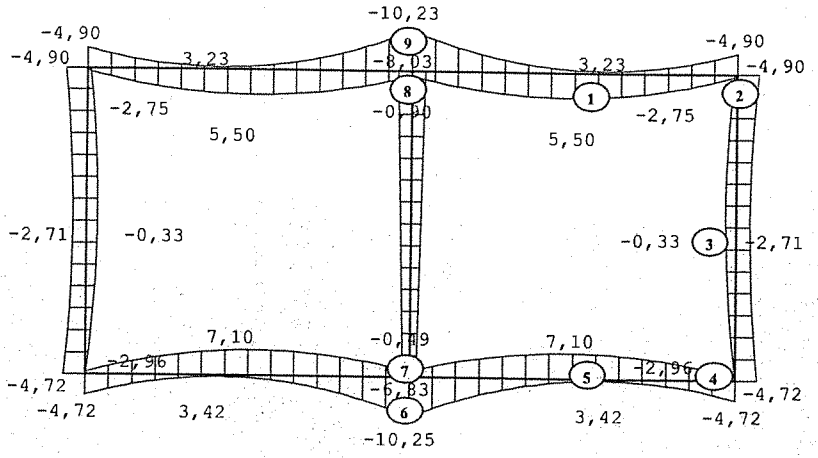
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
6,57	2,40	2,40	2,40	0,25	0,50	1,53	3,06	1,15	2,30	1,73

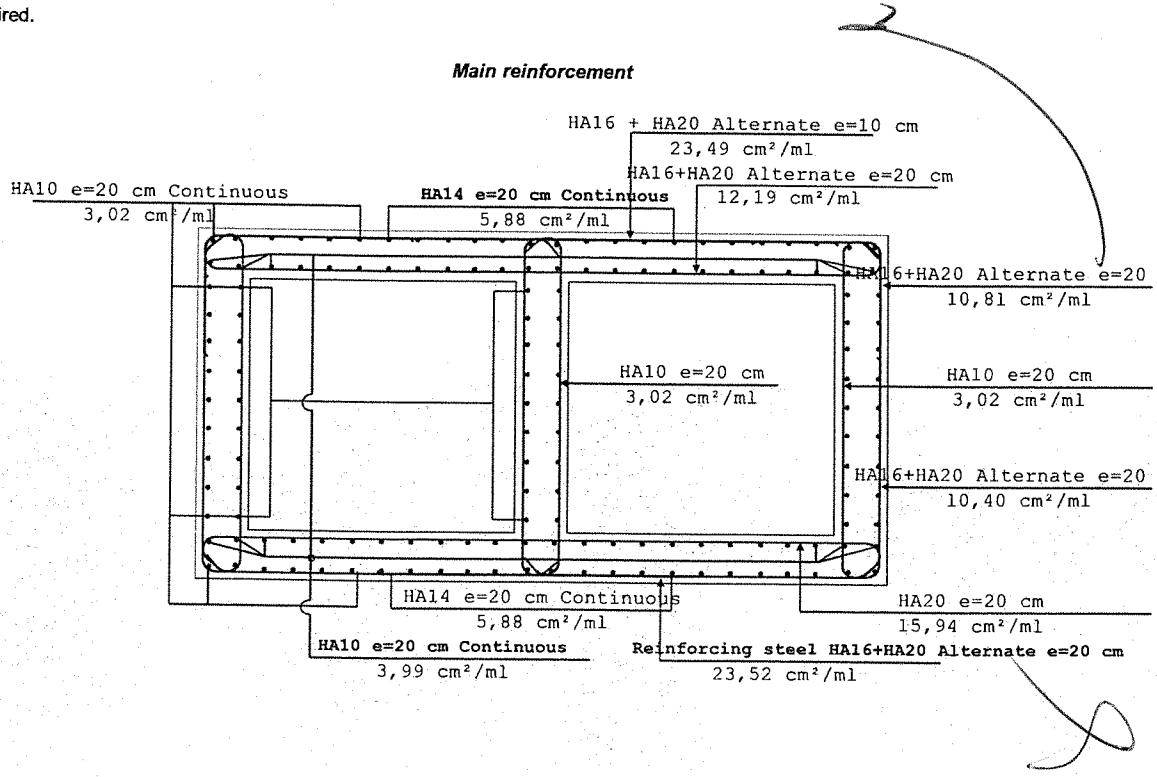
Verification of shear force

τu max = 0,95 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
4,95 m	4,95 m	0,45 m	2,0 t/m3	0,46 m	25 MPa	400 MPa	201,6 MPa	1,35	1,1	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{bc}	Q_{bv}	Q_{br}	M_{c170}
2,40	10,03	8,16	8,01	5,29
Relative to the maximum charge density	0,24	1,00	0,81	0,80	0,53
Longitudinal impact loads according to imposed skew	*14,85*	*1,23*	*2,58*	*1,58*	*7,08*

units moments

Section	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	Unif.pouss.	RIAN;POUSS	Cons.phase
1	1,552	0,002	-0,218	1,768	-0,464	-0,206	0,000
2	-0,743	0,532	-0,821	-0,453	-1,299	-0,623	0,000
3	-0,743	0,052	-0,031	-0,763	1,763	0,948	0,000
4	-0,743	-0,428	0,759	-1,074	-1,299	-0,676	0,000
5	1,552	-0,164	0,342	1,313	-0,464	-0,258	1,155
6	-2,413	0,780	-2,118	-1,076	0,371	0,159	0,000
7	-0,186	0,636	-1,202	0,380	0,186	0,073	0,000
8	-0,186	-0,642	1,697	-1,240	0,186	0,113	0,000
9	-2,413	-0,528	0,385	-2,270	0,371	0,212	0,000
10	0,835	-0,458	1,751	-0,458	0,186	0,099	0,000
11	-2,228	0,114	-1,311	-1,031	0,186	0,099	0,000
12	-2,228	0,144	-0,916	-1,455	0,186	0,086	0,000
13	0,835	0,451	0,105	0,451	0,186	0,086	0,990

Combinations

	Pt +Pr	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,24	0	0	0	0	1,2	0	1	0	1	1
2	1	0	1	0	0	0	1,2	0	1	0	1	1
3	1	0	0,24	0	0,24	0	1,2	0	1	0	1	1
4	1	0	0,24	0	0,24	0	0	1	0	1	0	1
5	1	0	0	0,24	0	0	1,2	0	1	0	1	1
6	1	0	0	0,24	0	0	0	1	0	1	0	1
7	1	0	0	0,53	0,53	0	1,2	0	1	0	1	1
8	1	0	0	0,53	0,53	0	0	1	0	1	0	1
9	1	0	0	0	1	0	1,2	0	1	0	1	1
10	1	0	0	0	1	0	0	1	0	1	0	1

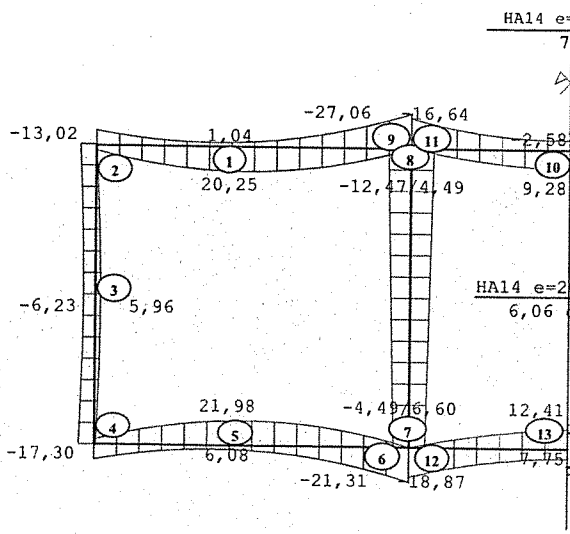
Loads

Pt +Pr	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,05	10,03	10,03	10,03	10,03	0,25	0,50	0,34	0,69	2,48	4,95	5,57

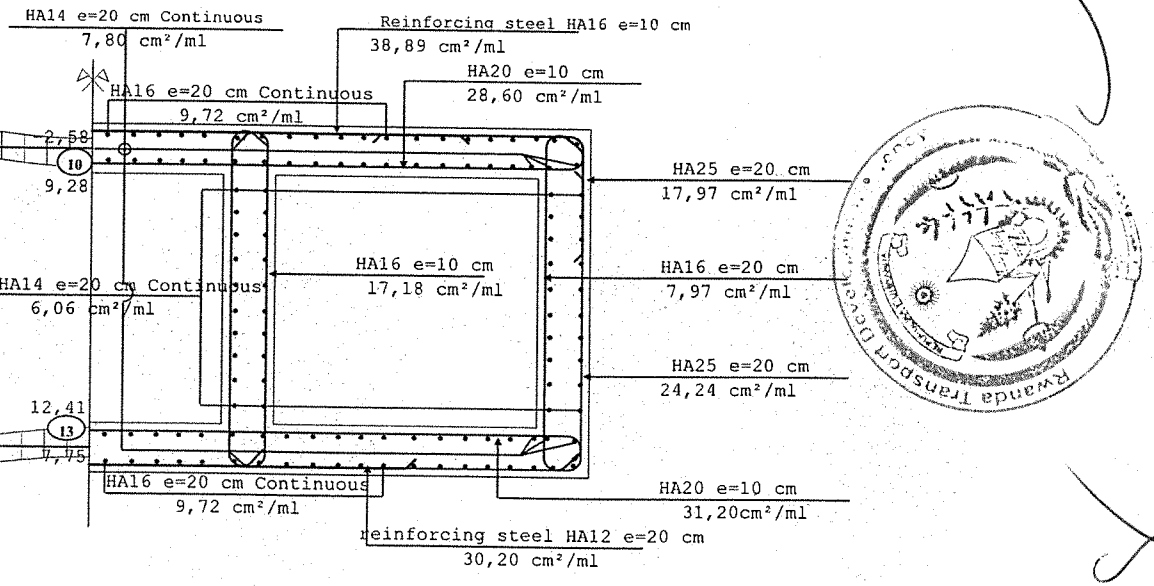
Verification of shear force.

τu max = 1,14 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 124** **Box culvert (2,00 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,25 m	1,75 m	0,25 m	2,0 t/m3	1,86 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m³) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
2,99	3,36	2,08	2,67

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,396	-0,112	-0,051	0,000
2	-0,237	-0,112	-0,051	0,000
3	-0,237	0,271	0,135	0,000
4	-0,237	-0,112	-0,061	0,000
5	0,396	-0,112	-0,061	0,563
6	-0,237	-0,112	-0,061	0,000
7	-0,237	0,271	0,135	0,000
8	-0,237	-0,112	-0,051	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

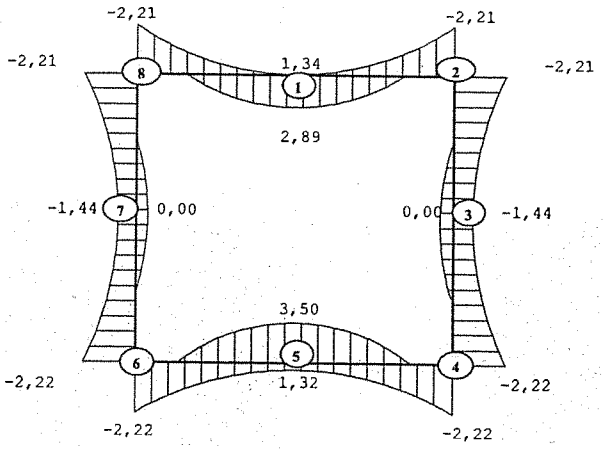
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
4,35	3,36	0,25	0,50	0,99	1,99	0,88	1,75	1,09

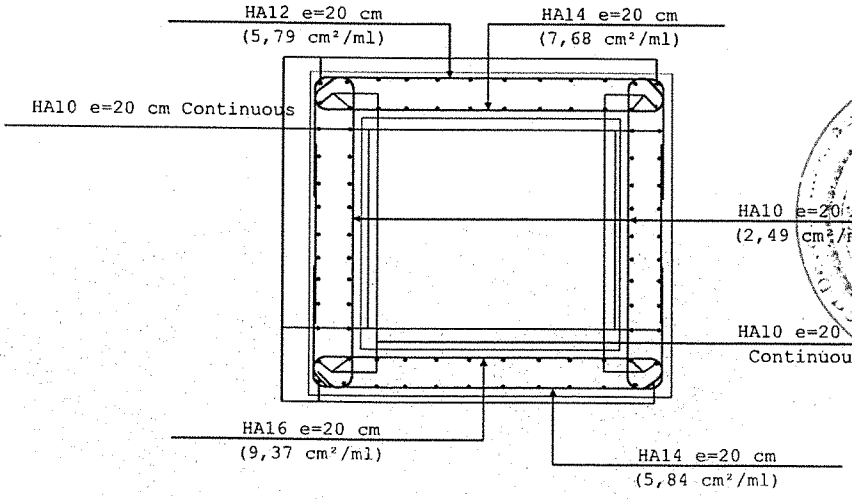
Verification of shear force

τu max = 0,64 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
3,80 m	2,80 m	0,30 m	2,0 t/m3	1,16 m	25 MPa	400 MPa	201,6 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	ω_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{c120}
	2,40	5,47	5,12	3,88	3,77
Relative to the maximum charge density	0,44	1,00	0,94	0,71	0,69
Longitudinal impact loads according to imposed skew	*11,40*	*3,39*	*3,24*	*2,23*	*7,74*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,786	-0,193	0,979	-0,097	-0,042	0,000
2	-0,486	0,153	-0,640	-0,389	-0,187	0,000
3	-0,486	0,098	-0,585	0,591	0,315	0,000
4	-0,486	0,044	-0,530	-0,389	-0,202	0,000
5	0,786	-0,078	0,886	-0,097	-0,056	1,188
6	-1,562	-0,650	-0,912	0,195	0,090	0,950
7	0,000	-0,262	0,262	0,000	0,000	0,000
8	0,000	-0,481	0,481	0,000	0,000	0,000
9	-1,562	-0,540	-1,022	0,195	0,104	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,69	0	0	0	1,2	0	1	0	1	1
2	1	0,69	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

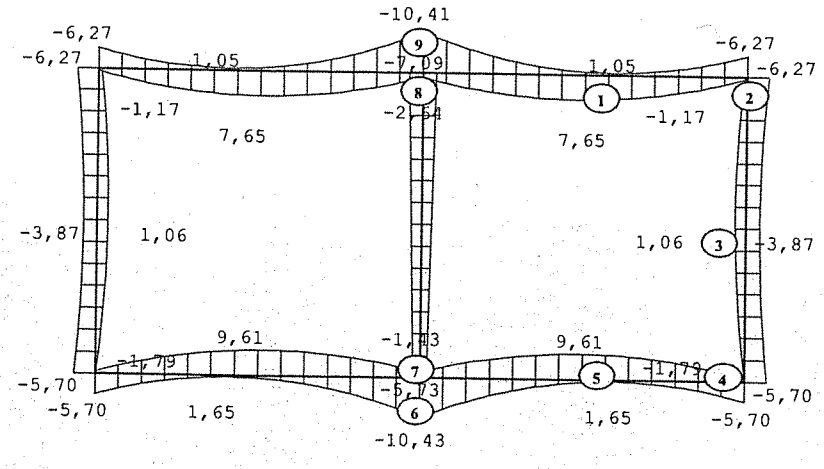
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,07	5,47	5,47	5,47	0,25	0,50	0,66	1,31	1,40	2,80	2,10

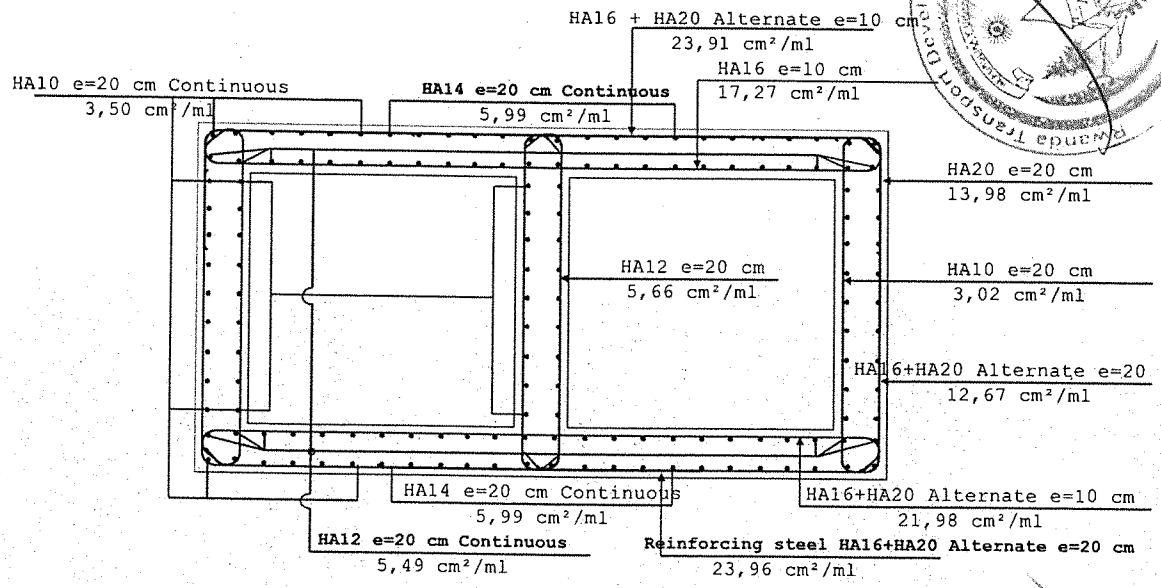
Verification of shear force

τu max = 1,00 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 148** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	1,04 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
6,54	5,12	4,95	4,27

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

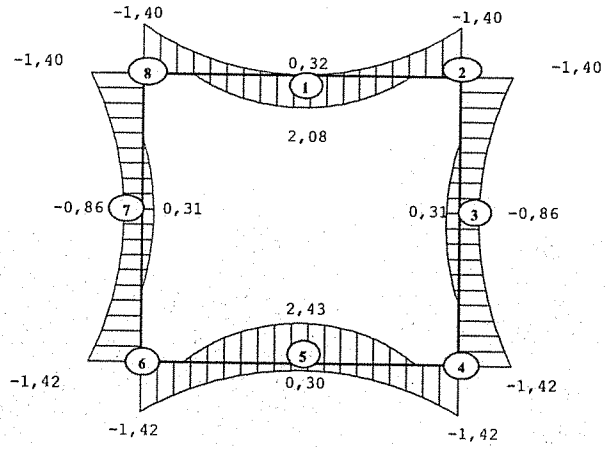
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,58	6,54	0,25	0,50	0,57	1,14	0,85	1,70	0,85

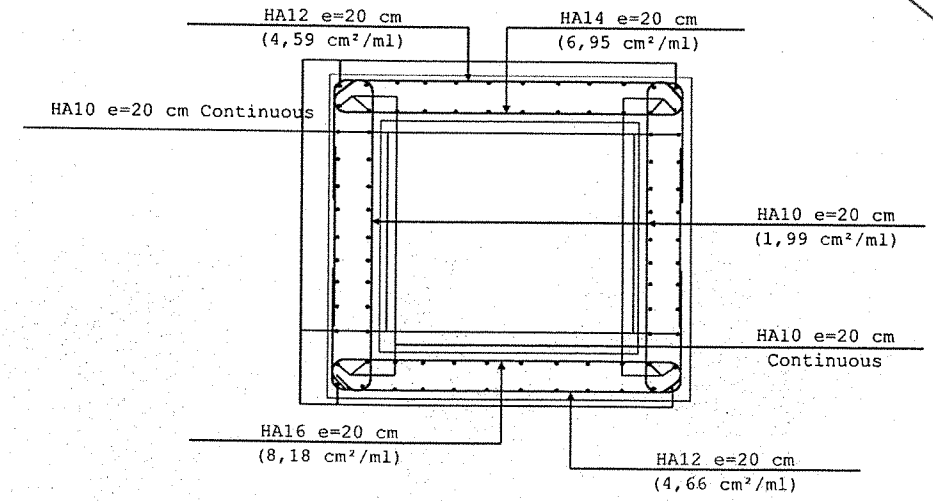
Verification of shear force

τu max = 0,70 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 151** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	0,77 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²)

Q_{bc}	Q_{bt}	Q_{br}	M_{c120}
9,00	7,46	7,17	5,13

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

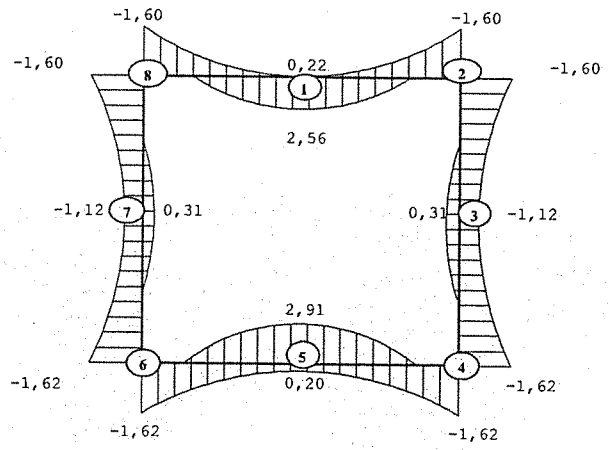
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,04	9,00	0,25	0,50	0,44	0,87	0,85	1,70	0,85

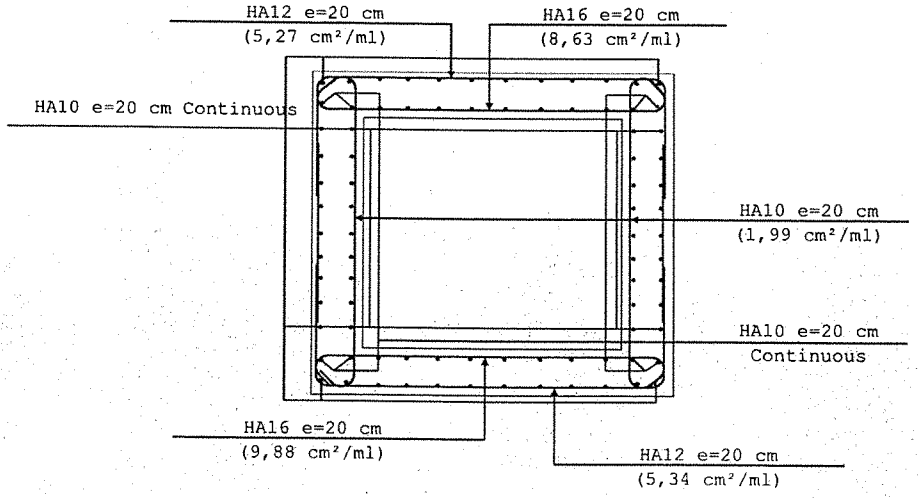
Verification of shear force

τu max = 0,84 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 152** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	1,04 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{bc}	Q_{bt}	Q_{br}	M_{c120}
6,54	5,12	4,95	4,27

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

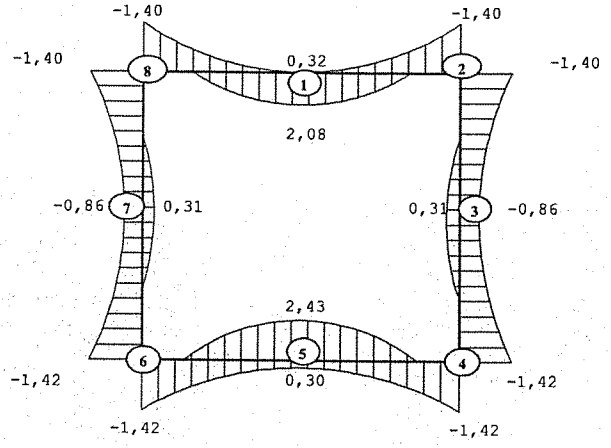
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,58	6,54	0,25	0,50	0,57	1,14	0,85	1,70	0,85

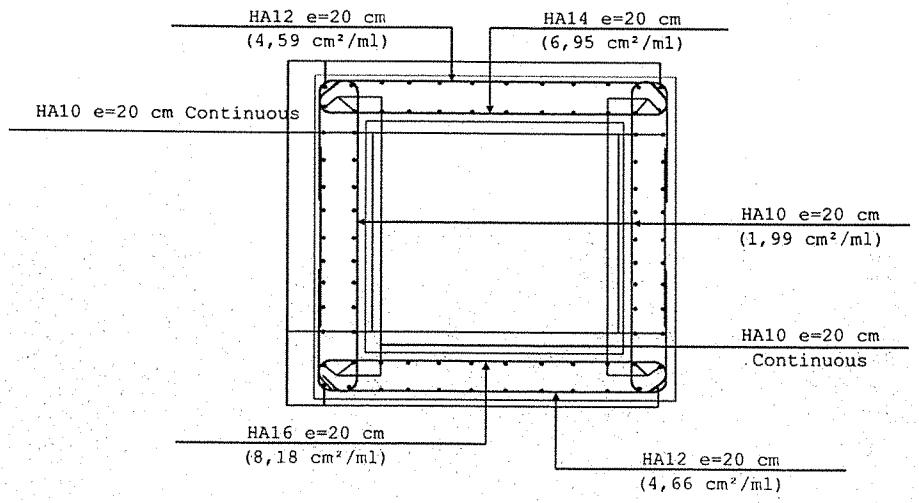
Verification of shear force

τu max = 0,70 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO — **HS 156** — **Box culvert 2x (2,00 x 2,00)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σbc	bc	bt	Imposed skew	Geo.skew
2,25 m	2,25 m	0,25 m	2,0 t/m3	0,58 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m³) :

	Q_{min}	Q_{hc}	Q_{hi}	Q_{hr}	M_{cl20}
	2,40	11,35	9,12	9,08	5,71
Relative to the maximum charge density	0,21	1,00	0,80	0,80	0,50
Longitudinal impact loads according to imposed skew	*6,75*	*1,17*	*2,52*	*1,52*	*7,02*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,284	-0,080	0,363	-0,070	-0,029	0,000
2	-0,141	0,050	-0,191	-0,281	-0,135	0,000
3	-0,141	0,033	-0,173	0,352	0,190	0,000
4	-0,141	0,015	-0,156	-0,281	-0,147	0,000
5	0,284	-0,036	0,328	-0,070	-0,041	0,703
6	-0,563	-0,244	-0,318	0,141	0,064	0,563
7	0,000	-0,074	0,074	0,000	0,000	0,000
8	0,000	-0,144	0,144	0,000	0,000	0,000
9	-0,563	-0,209	-0,353	0,141	0,076	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,50	0	0	0	1,2	0	1	0	1	1
2	1	0,50	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

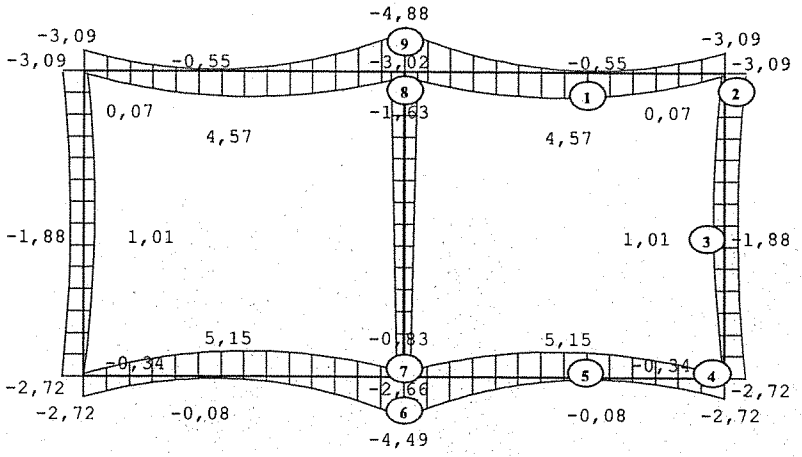
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,79	11,35	11,35	11,35	0,25	0,50	0,35	0,71	1,13	2,25	1,41

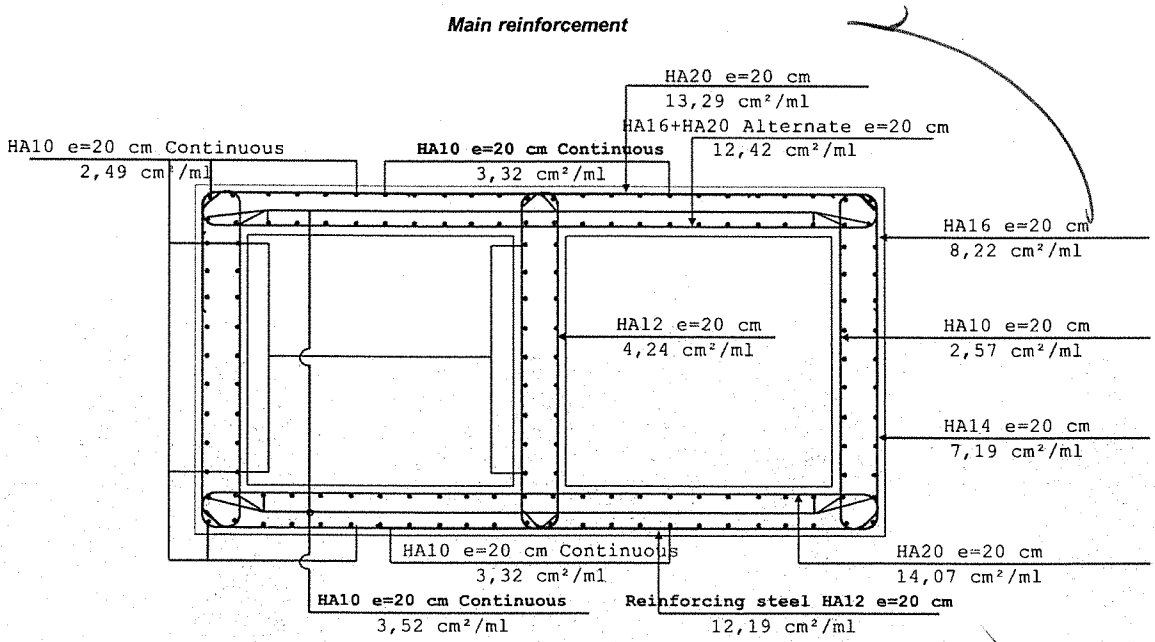
Verification of shear force

τu max = 1,08 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,80 m	1,80 m	0,30 m	2,0 t/m3	0,55 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m³) :

ω_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{cl20}
2,40	11,10	8,95	8,87	5,66
Relative to the maximum charge density 0,22	1,00	0,81	0,80	0,51
Longitudinal impact loads according to imposed skew *8,40*	*1,19*	*2,54*	*1,53*	*7,04*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,421	-0,097	0,518	-0,038	-0,016	0,000
2	-0,286	0,085	-0,371	-0,152	-0,073	0,000
3	-0,286	0,054	-0,340	0,253	0,135	0,000
4	-0,286	0,023	-0,309	-0,152	-0,079	0,000
5	0,421	-0,036	0,468	-0,038	-0,022	0,875
6	-0,837	-0,341	-0,496	0,076	0,035	0,700
7	0,000	-0,155	0,155	0,000	0,000	0,000
8	0,000	-0,279	0,279	0,000	0,000	0,000
9	-0,837	-0,279	-0,558	0,076	0,041	0,000

Combinations

	Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,51	0	0	0	1,2	0	1	0	1	1
2	1	0,51	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

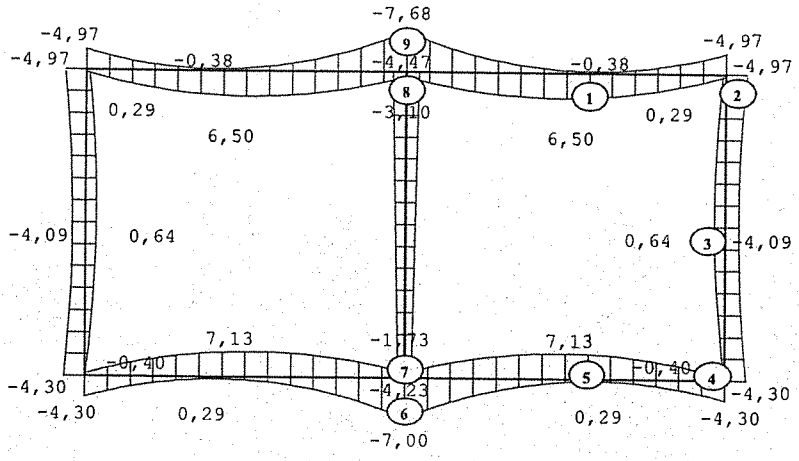
Loads

Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,85	11,10	11,10	11,10	0,25	0,50	0,35	0,70	0,90	1,80	1,35

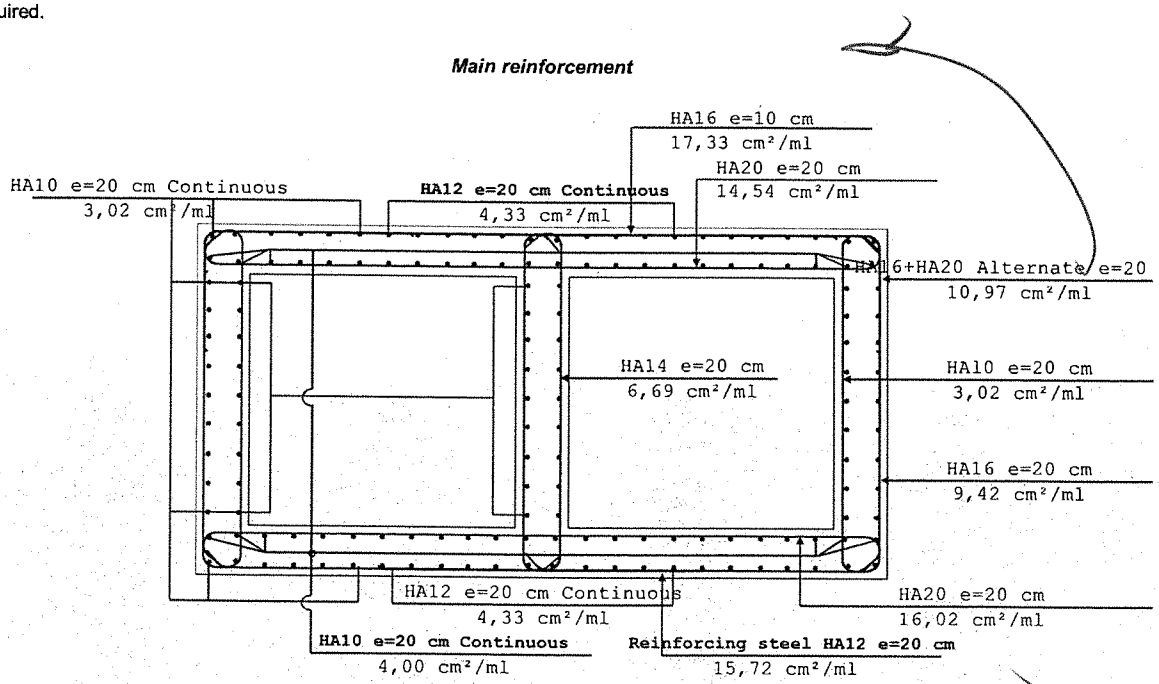
Verification of shear force

τu max = 1,07 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO

HS 183

Box culvert 2x (2,50 x 1,50)

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,75 m	1,75 m	0,25 m	2,0 t/m3	0,66 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
	2,40	9,97	8,15	7,96	5,38
Relative to the maximum charge density	0,24	1,00	0,82	0,80	0,54
Longitudinal impact loads according to imposed skew	*8,25*	*2,76*	*2,61*	*1,61*	*7,11*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,405	-0,093	0,499	-0,036	-0,015	0,000
2	-0,277	0,082	-0,359	-0,143	-0,069	0,000
3	-0,277	0,052	-0,329	0,240	0,127	0,000
4	-0,277	0,022	-0,299	-0,143	-0,074	0,000
5	0,405	-0,035	0,451	-0,036	-0,020	0,859
6	-0,807	-0,328	-0,479	0,071	0,033	0,688
7	0,000	-0,151	0,151	0,000	0,000	0,000
8	0,000	-0,270	0,270	0,000	0,000	0,000
9	-0,807	-0,268	-0,539	0,071	0,038	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,54	0	0	0	1,2	0	1	0	1	1
2	1	0,54	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

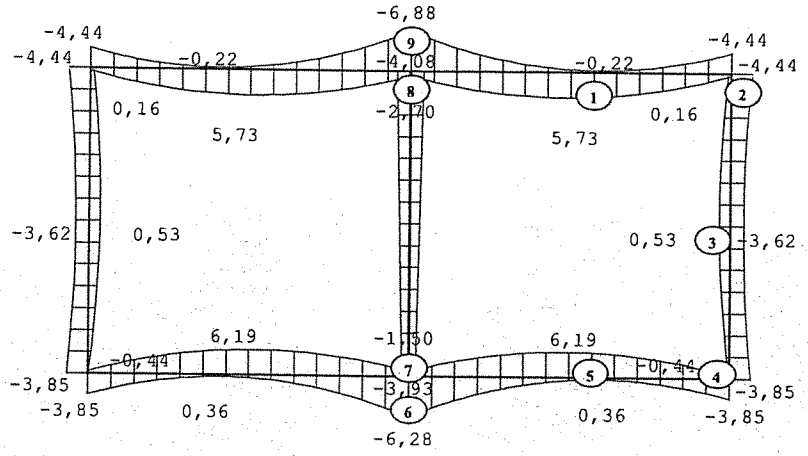
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,95	9,97	9,97	9,97	0,25	0,50	0,39	0,79	0,88	1,75	1,09

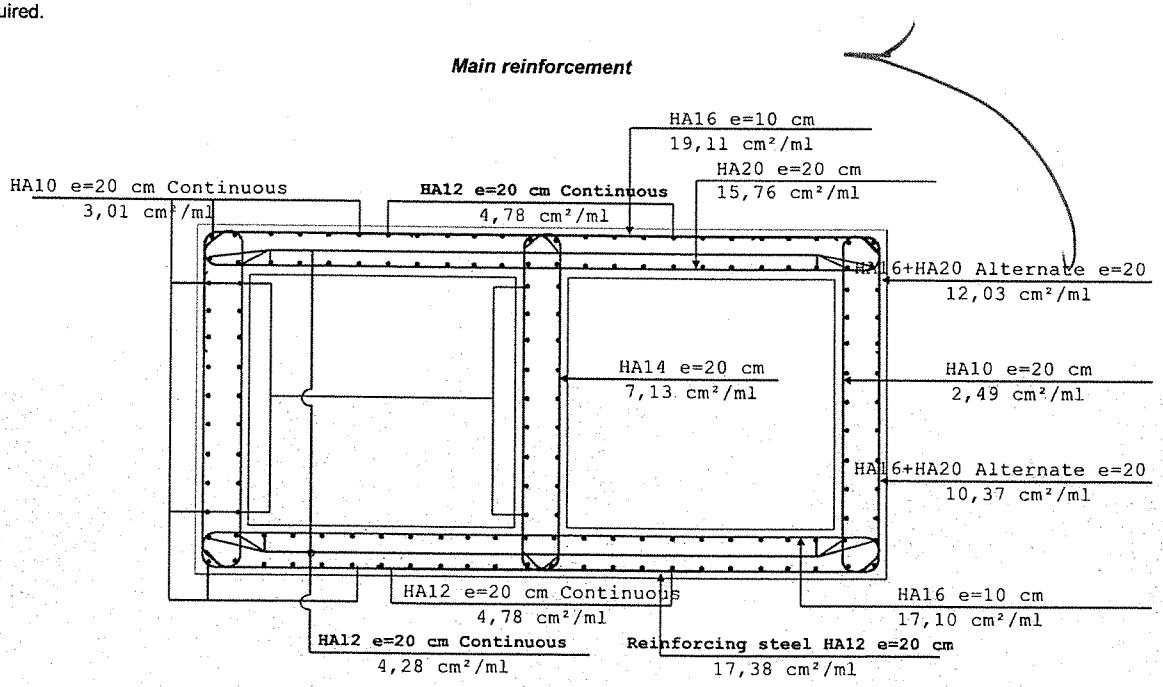
Verification of shear force

τu max = 1,17 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	c	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,25 m	2,25 m	0,25 m	2,0 t/m3	1,32 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hi}	Q_{hr}	M_{c120}
	2,40	4,98	4,72	3,42	3,52
Relative to the maximum charge density	0,48	1,00	0,95	0,69	0,71
Longitudinal impact loads according to imposed skew	*6,75*	*3,52*	*3,37*	*2,37*	*7,87*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,284	-0,080	0,363	-0,070	-0,029	0,000
2	-0,141	0,050	-0,191	-0,281	-0,135	0,000
3	-0,141	0,033	-0,173	0,352	0,190	0,000
4	-0,141	0,015	-0,156	-0,281	-0,147	0,000
5	0,284	-0,036	0,328	-0,070	-0,041	0,703
6	-0,563	-0,244	-0,318	0,141	0,064	0,563
7	0,000	-0,074	0,074	0,000	0,000	0,000
8	0,000	-0,144	0,144	0,000	0,000	0,000
9	-0,563	-0,209	-0,353	0,141	0,076	0,000

Combinations

	Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,71	0	0	0	1,2	0	1	0	1	1
2	1	0,71	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

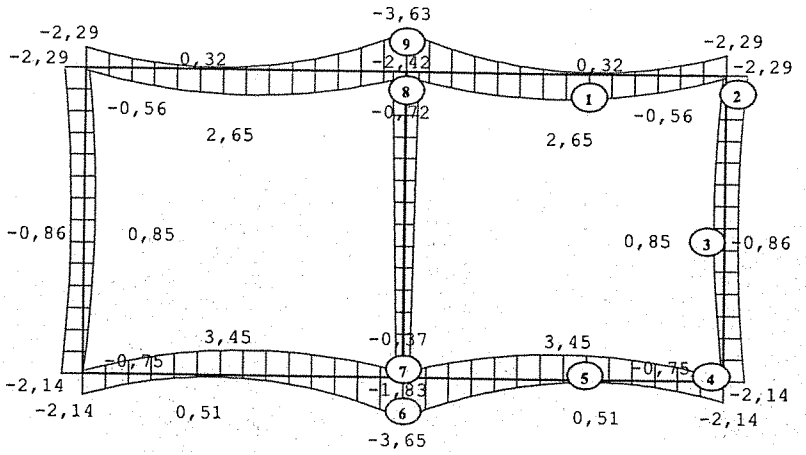
Loads

Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,27	4,98	4,98	4,98	0,25	0,50	0,72	1,45	1,13	2,25	1,41

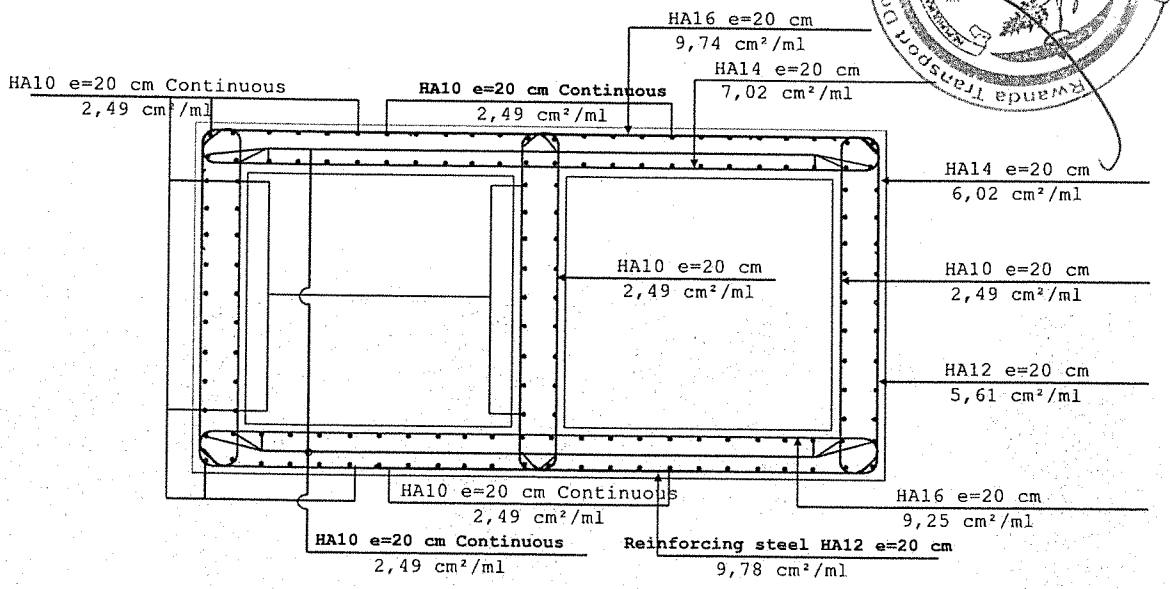
Verification of shear force

τu max = 0,70 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,75 m	2,25 m	0,25 m	2,0 t/m3	1,02 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{c120}
2,40	6,41	5,86	4,81	4,21
0,37	1,00	0,92	0,75	0,66
8,25	*3,18*	*3,03*	*2,02*	*7,53*

Relative to the maximum charge density

Longitudinal impact loads according to imposed skew

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,416	-0,107	0,523	-0,065	-0,028	0,000
2	-0,239	0,079	-0,318	-0,262	-0,126	0,000
3	-0,239	0,051	-0,290	0,371	0,199	0,000
4	-0,239	0,023	-0,262	-0,262	-0,136	0,000
5	0,416	-0,045	0,473	-0,065	-0,038	0,859
6	-0,826	-0,349	-0,477	0,131	0,060	0,688
7	0,000	-0,127	0,127	0,000	0,000	0,000
8	0,000	-0,239	0,239	0,000	0,000	0,000
9	-0,826	-0,293	-0,532	0,131	0,071	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,66	0	0	0	1,2	0	1	0	1	1
2	1	0,66	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

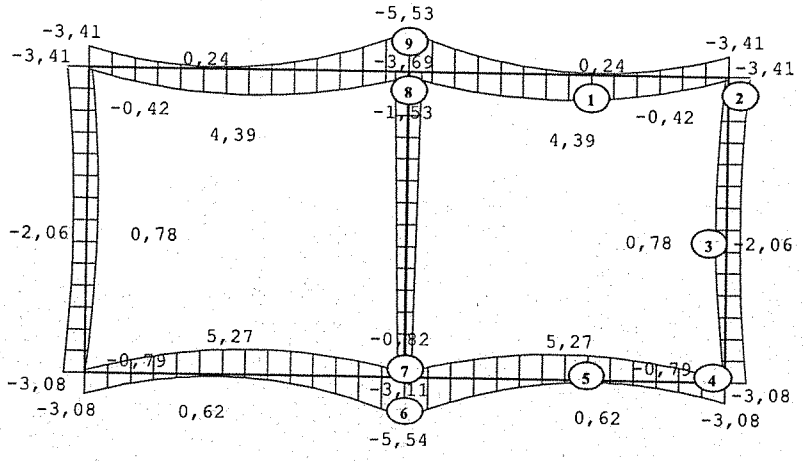
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,67	6,41	6,41	6,41	0,25	0,50	0,57	1,15	1,13	2,25	1,41

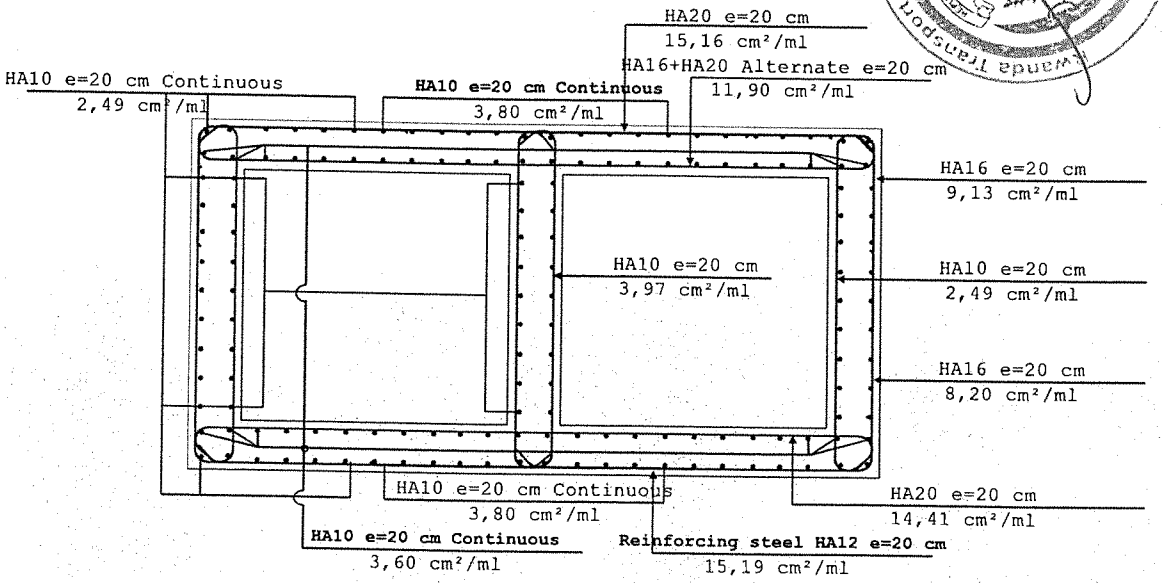
Verification of shear force

τu max = 0,92 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 201** **Box culvert (2,50 x 2,00)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,75 m	2,25 m	0,25 m	2,0 t/m3	3,90 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
1,27	1,63	0,62	1,57

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,599	-0,190	-0,086	0,000
2	-0,347	-0,190	-0,086	0,000
3	-0,347	0,443	0,221	0,000
4	-0,347	-0,190	-0,104	0,000
5	0,599	-0,190	-0,104	0,688
6	-0,347	-0,190	-0,104	0,000
7	-0,347	0,443	0,221	0,000
8	-0,347	-0,190	-0,086	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

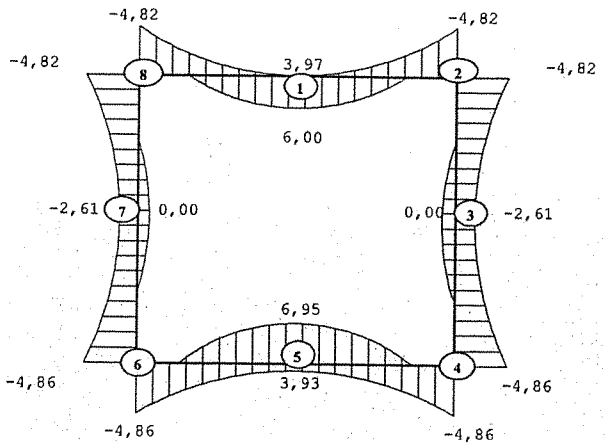
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
8,43	2,40	0,25	0,50	2,01	4,03	1,13	2,25	1,41

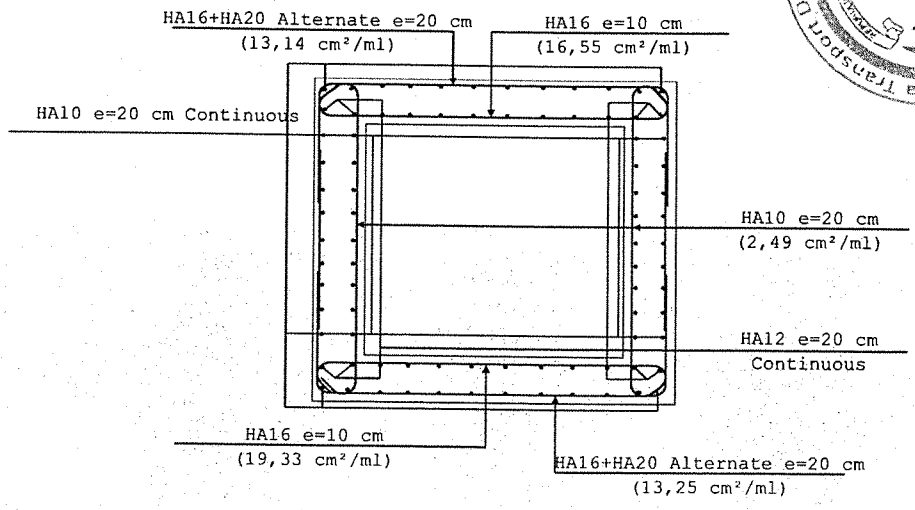
Verification of shear force

τu max = 1,07 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 213** **Box culvert (2,00 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,25 m	1,75 m	0,25 m	2,0 t/m3	0,70 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{e120}
9,37	7,73	7,47	5,23

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,396	-0,112	-0,051	0,000
2	-0,237	-0,112	-0,051	0,000
3	-0,237	0,271	0,135	0,000
4	-0,237	-0,112	-0,061	0,000
5	0,396	-0,112	-0,061	0,563
6	-0,237	-0,112	-0,061	0,000
7	-0,237	0,271	0,135	0,000
8	-0,237	-0,112	-0,051	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

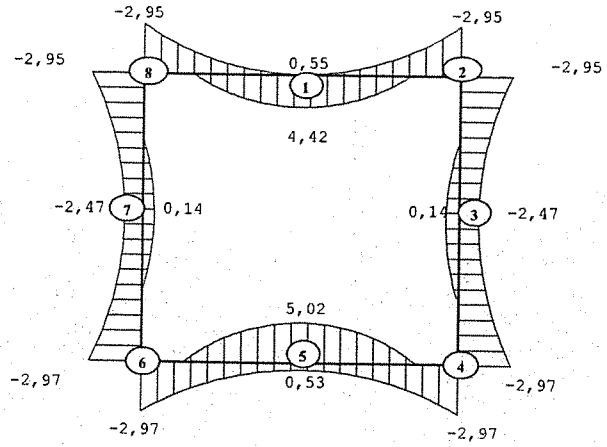
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons.
2,03	9,37	0,25	0,50	0,41	0,83	0,88	1,75	1,09

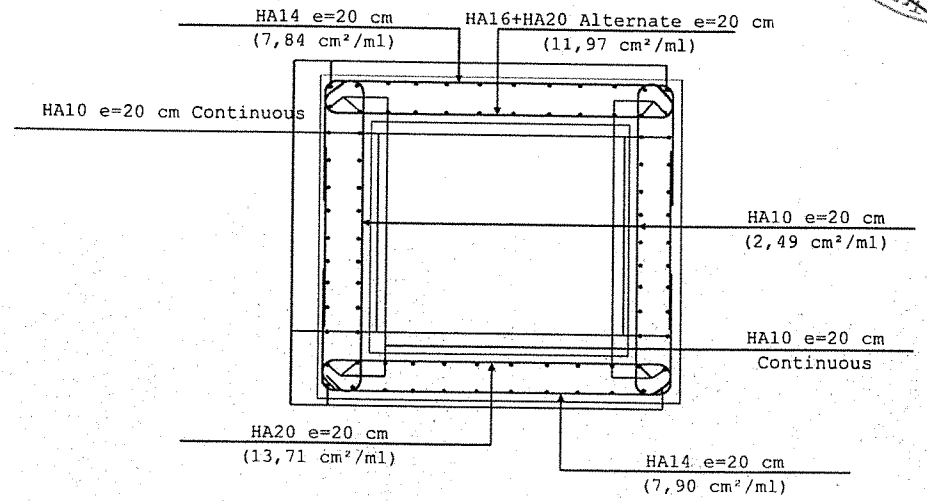
Verification of shear force

τu max = 0,91 Mpa < 0,07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fc	σs	δ	bc	bt	Imposed skew	Geo.skew
2,75 m	2,75 m	0,25 m	2,0 t/m3	0,98 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hr}	Q_{hi}	Q_{hr}	M_{c120}
	2,40	6,64	6,05	5,05	4,32
Relative to the maximum charge density	0,36	1,00	0,91	0,76	0,65
Longitudinal impact loads according to imposed skew	*8,25*	*3,13*	*2,98*	*1,98*	*7,48*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,424	-0,119	0,543	-0,105	-0,044	0,000
2	-0,210	0,075	-0,285	-0,420	-0,201	0,000
3	-0,210	0,049	-0,259	0,525	0,284	0,000
4	-0,210	0,023	-0,233	-0,420	-0,219	0,000
5	0,424	-0,053	0,490	-0,105	-0,062	0,859
6	-0,840	-0,365	-0,475	0,210	0,096	0,688
7	0,000	-0,110	0,110	0,000	0,000	0,000
8	0,000	-0,215	0,215	0,000	0,000	0,000
9	-0,840	-0,313	-0,528	0,210	0,114	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,65	0	0	0	1,2	0	1	0	1	1
2	1	0,65	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

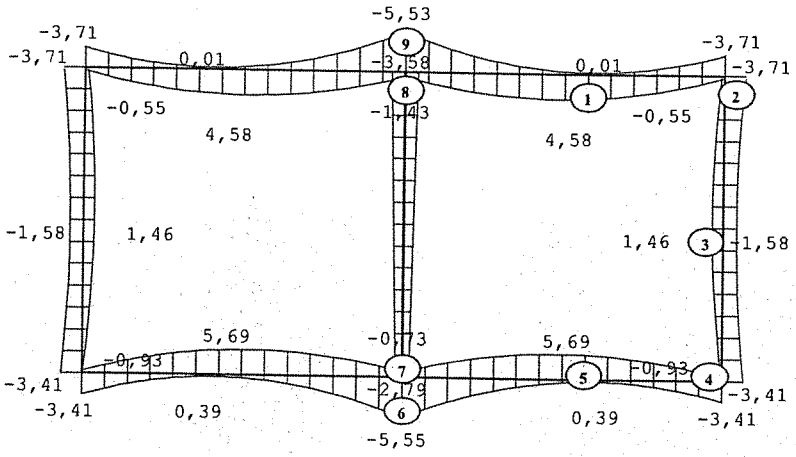
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,59	6,64	6,64	6,64	0,25	0,50	0,55	1,11	1,38	2,75	1,72

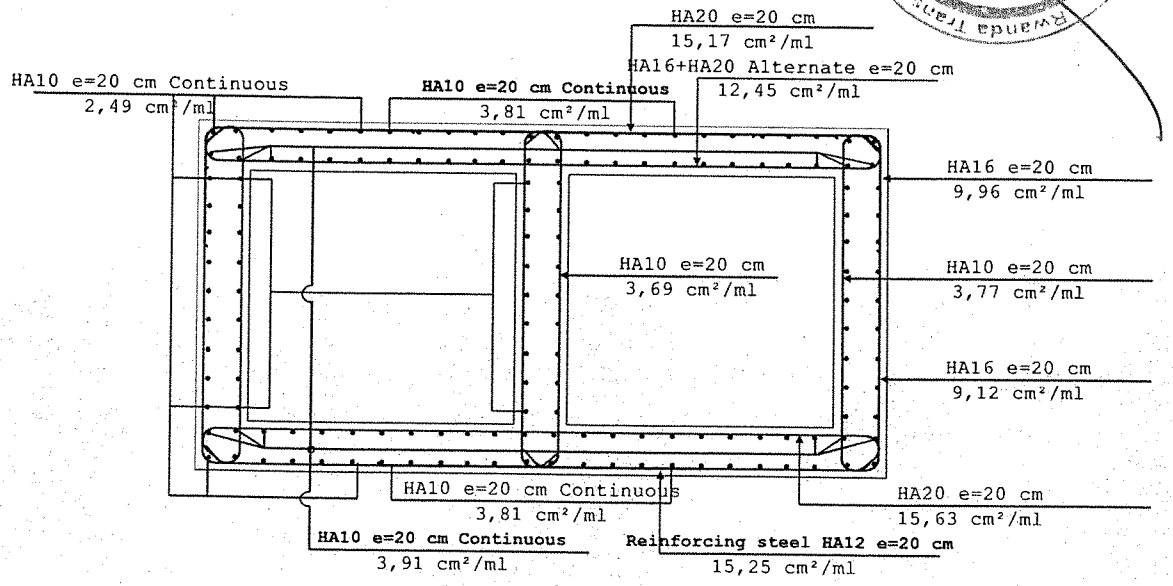
Verification of shear force

τu max = 0,95 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
4,95 m	4,95 m	0,45 m	2,0 t/m3	1,69 m	25 MPa	400 MPa	201,6 MPa	1,35	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

ω_{min}	Q_{hc}	Q_{hs}	Q_{hr}	M_{c120}
2,40	3,27	3,24	2,00	2,57
Relative to the maximum charge density	0,73	1,00	0,99	0,61	0,79
Longitudinal impact loads according to imposed skew	*14,85*	*4,15*	*4,00*	*2,99*	*8,50*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	1,374	-0,385	1,759	-0,340	-0,141	0,000
2	-0,681	0,243	-0,924	-1,361	-0,651	0,000
3	-0,681	0,158	-0,839	1,702	0,920	0,000
4	-0,681	0,073	-0,754	-1,361	-0,710	0,000
5	1,374	-0,172	1,588	-0,340	-0,199	1,547
6	-2,723	-1,183	-1,539	0,681	0,311	1,238
7	0,000	-0,356	0,356	0,000	0,000	0,000
8	0,000	-0,696	0,696	0,000	0,000	0,000
9	-2,723	-1,013	-1,709	0,681	0,369	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,79	0	0	0	1,2	0	1	0	1	1
2	1	0,79	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

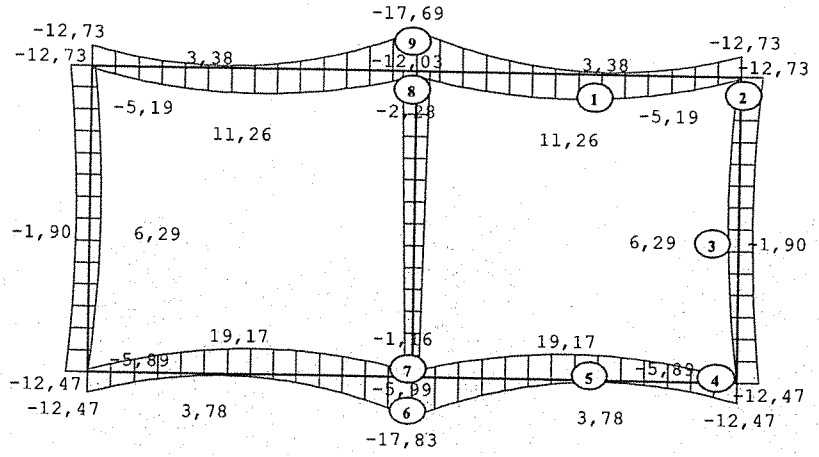
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
4,51	3,27	3,27	3,27	0,25	0,50	0,96	1,92	2,48	4,95	5,57

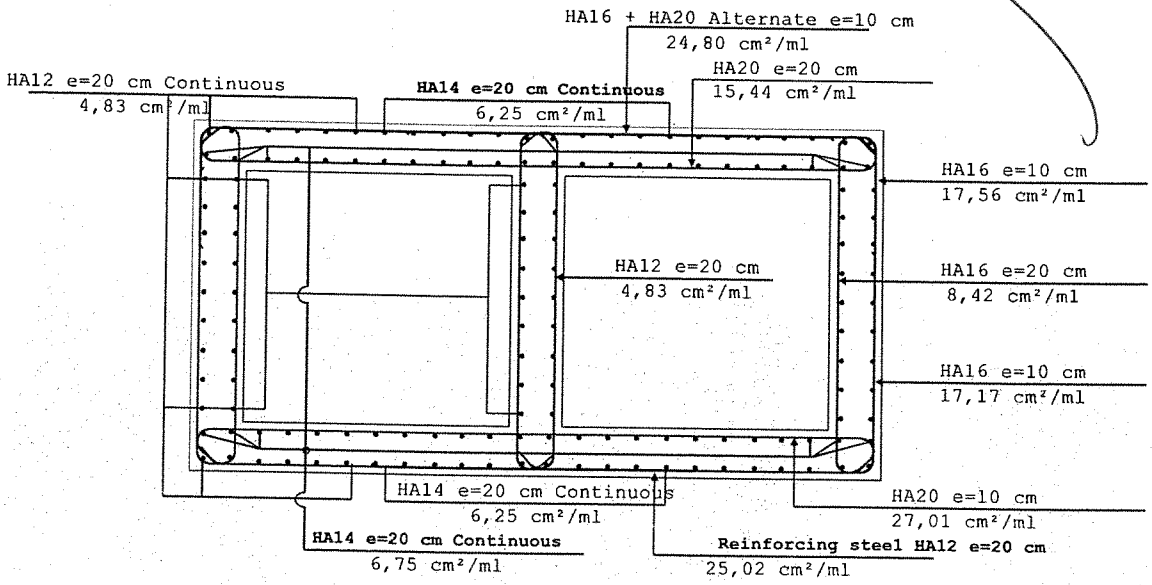
Verification of shear force

τu max = 0,83 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 222** **Box culvert (2,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,80 m	1,80 m	0,30 m	2,0 t/m3	0,60 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
10,24	8,34	8,17	5,45

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,582	-0,106	-0,048	0,000
2	-0,398	-0,106	-0,048	0,000
3	-0,398	0,299	0,150	0,000
4	-0,398	-0,106	-0,058	0,000
5	0,582	-0,106	-0,058	0,700
6	-0,398	-0,106	-0,058	0,000
7	-0,398	0,299	0,150	0,000
8	-0,398	-0,106	-0,048	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

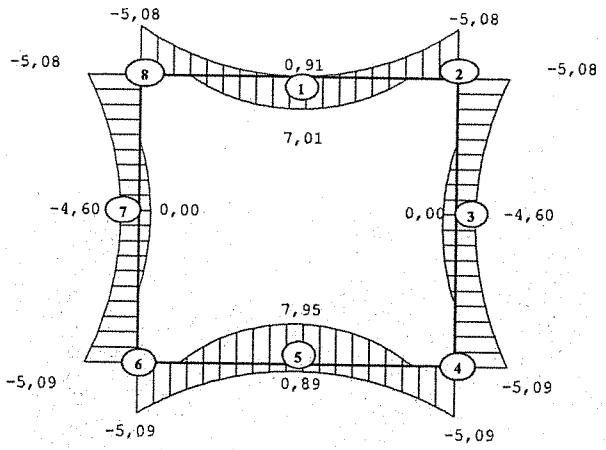
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,95	10,24	0,25	0,50	0,38	0,75	0,90	1,80	1,35

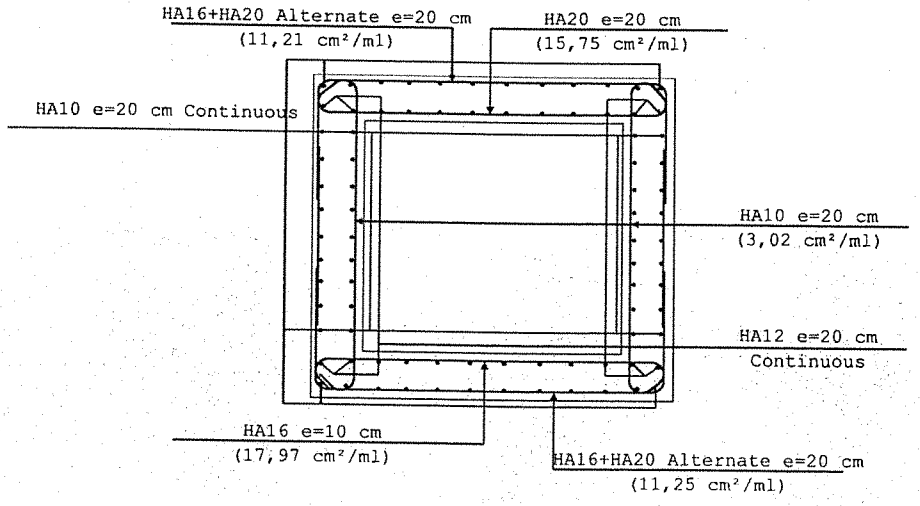
Verification of shear force

τu max = 0,99 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,25 m	1,75 m	0,25 m	2,0 t/m3	0,90 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{c120}
2,40	7,15	6,44	5,61	4,55
0,34	1,00	0,90	0,78	0,64
6,75	*3,04*	*2,89*	*1,89*	*7,39*

Relative to the maximum charge density

Longitudinal impact loads according to imposed skew

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,277	-0,070	0,347	-0,039	-0,016	0,000
2	-0,165	0,053	-0,218	-0,155	-0,075	0,000
3	-0,165	0,034	-0,199	0,227	0,122	0,000
4	-0,165	0,015	-0,180	-0,155	-0,081	0,000
5	0,277	-0,029	0,314	-0,039	-0,022	0,703
6	-0,550	-0,231	-0,319	0,078	0,036	0,563
7	0,000	-0,088	0,088	0,000	0,000	0,000
8	0,000	-0,164	0,164	0,000	0,000	0,000
9	-0,550	-0,193	-0,357	0,078	0,042	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,64	0	0	0	1,2	0	1	0	1	1
2	1	0,64	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

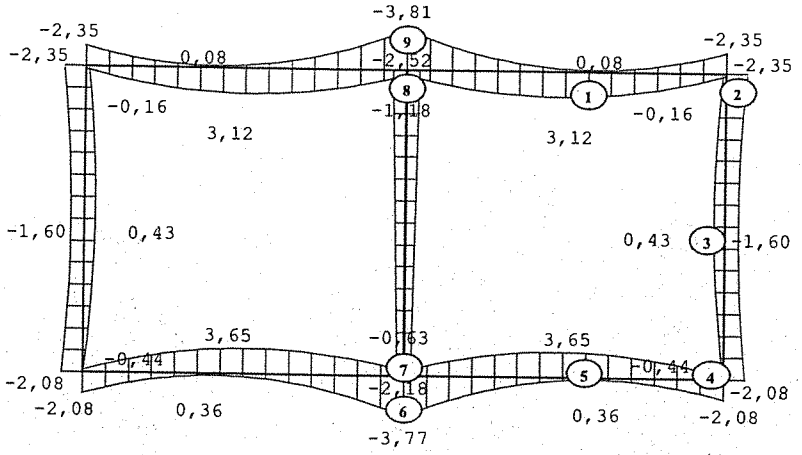
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,43	7,15	7,15	7,15	0,25	0,50	0,51	1,03	0,88	1,75	1,09

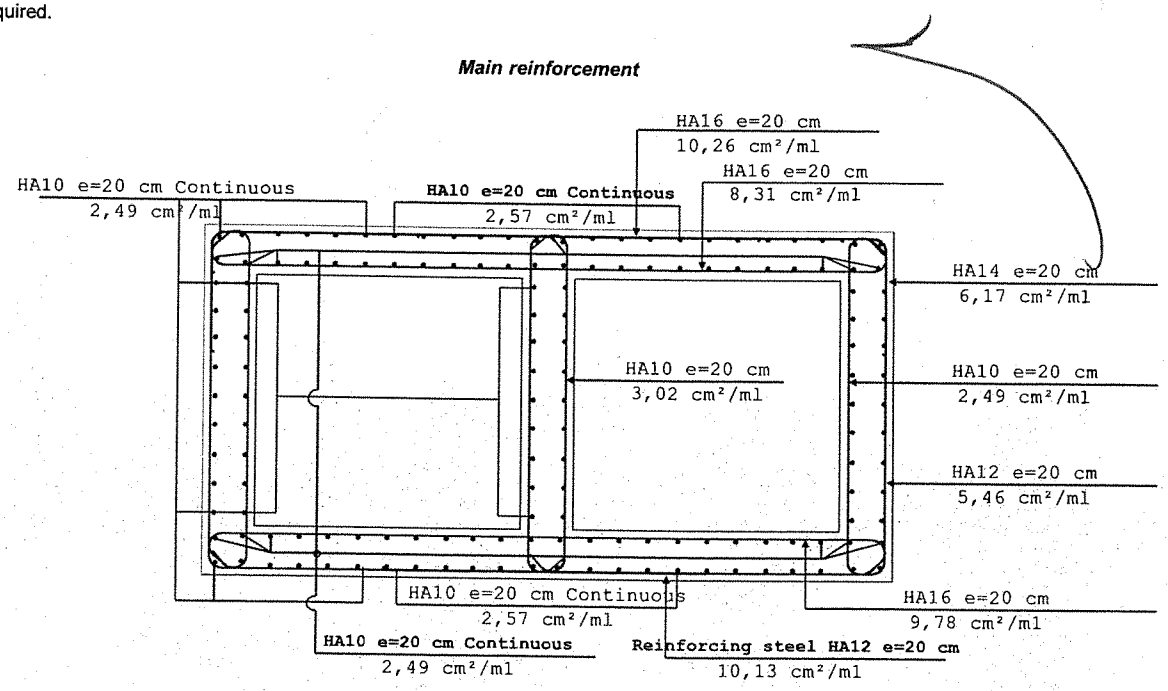
Verification of shear force

τu max = 0,79 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 224** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	0,53 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
13,37	10,49	10,72	6,15

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

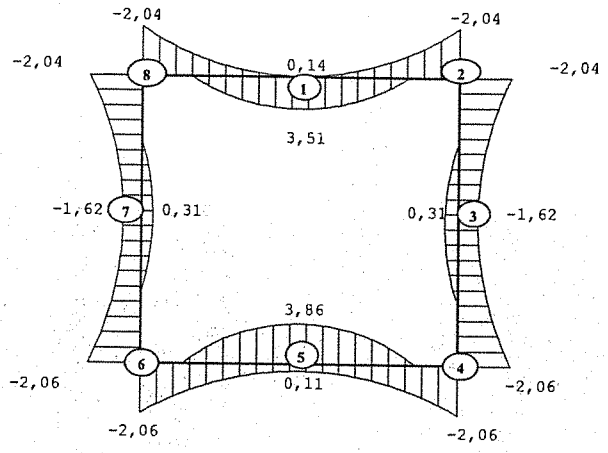
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,56	13,37	0,25	0,50	0,32	0,63	0,85	1,70	0,85

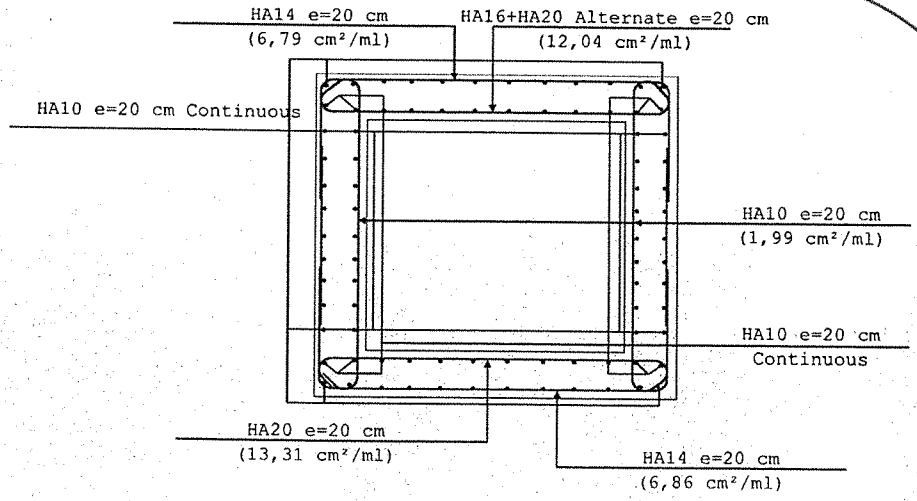
Verification of shear force

τu max = 1,11 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 225** **Box culvert (2,50 x 2,00)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,75 m	2,25 m	0,25 m	2,0 t/m3	1,25 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
5,27	4,48	3,68	3,67

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,599	-0,190	-0,086	0,000
2	-0,347	-0,190	-0,086	0,000
3	-0,347	0,443	0,221	0,000
4	-0,347	-0,190	-0,104	0,000
5	0,599	-0,190	-0,104	0,688
6	-0,347	-0,190	-0,104	0,000
7	-0,347	0,443	0,221	0,000
8	-0,347	-0,190	-0,086	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

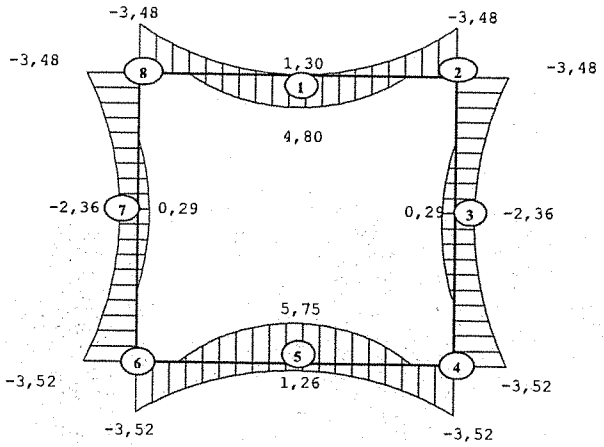
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,13	5,27	0,25	0,50	0,69	1,38	1,13	2,25	1,41

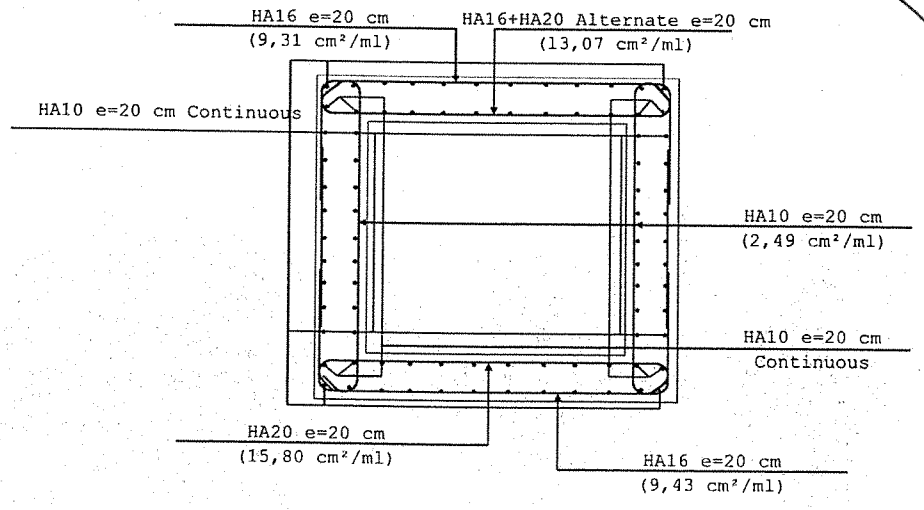
Verification of shear force

τu max = 0,85 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 227** **Box culvert (2,50 x 2,00)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,75 m	2,25 m	0,25 m	2,0 t/m3	0,67 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
9,81	8,04	7,83	5,34

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,599	-0,190	-0,086	0,000
2	-0,347	-0,190	-0,086	0,000
3	-0,347	0,443	0,221	0,000
4	-0,347	-0,190	-0,104	0,000
5	0,599	-0,190	-0,104	0,688
6	-0,347	-0,190	-0,104	0,000
7	-0,347	0,443	0,221	0,000
8	-0,347	-0,190	-0,086	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

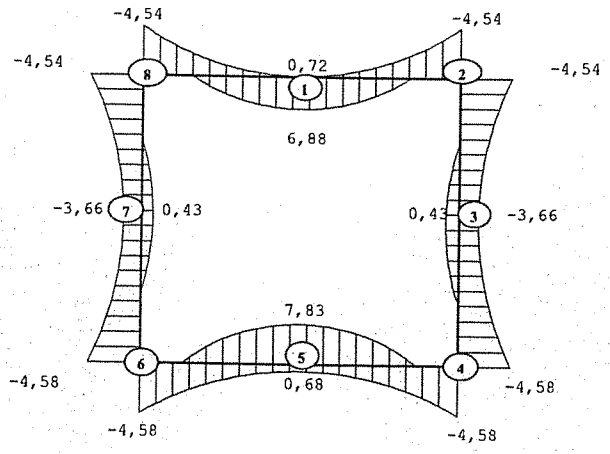
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,97	9,81	0,25	0,50	0,40	0,80	1,13	2,25	1,41

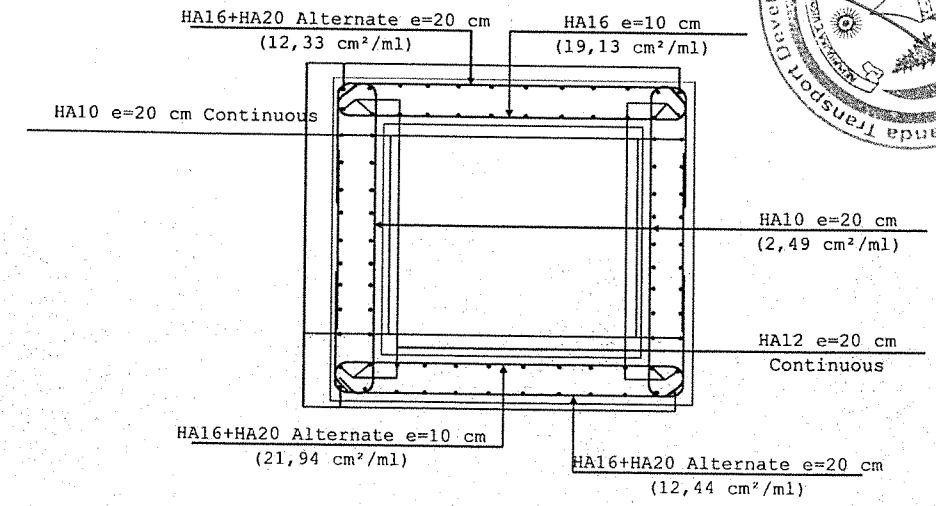
Verification of shear force

τu max = 1,15 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 228** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	1,06 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
6,43	5,06	4,83	4,22

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

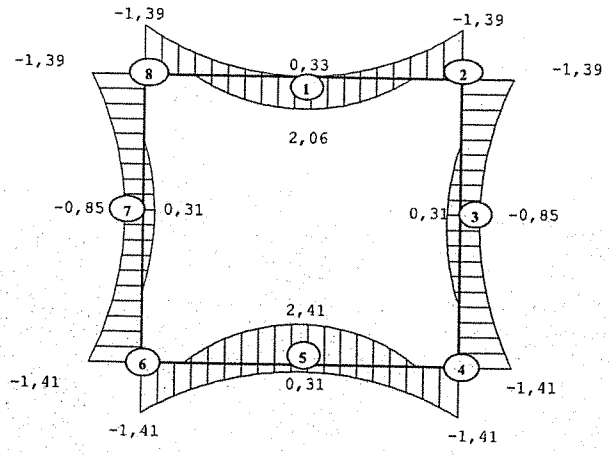
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,62	6,43	0,25	0,50	0,58	1,16	0,85	1,70	0,85

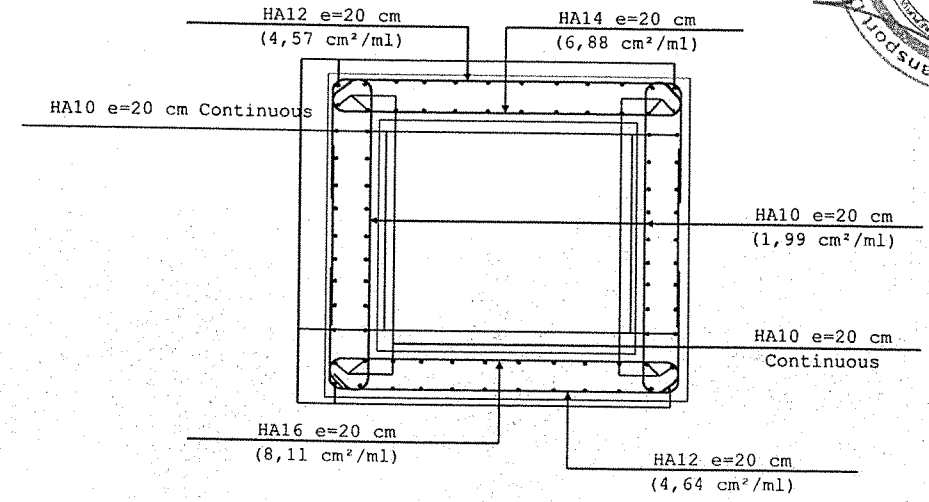
Verification of shear force

τu max = 0,70 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 232** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}	Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
1,70 m	1,70 m	0,20 m	2,0 t/m3	0,78 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40	8,87	7,37	7,07	5,09

Densities pondered loads at S.L.S (t/m²) :

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

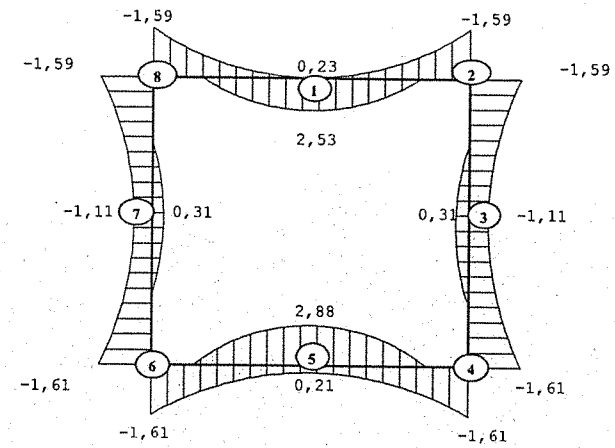
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,06	8,87	0,25	0,50	0,44	0,88	0,85	1,70	0,85

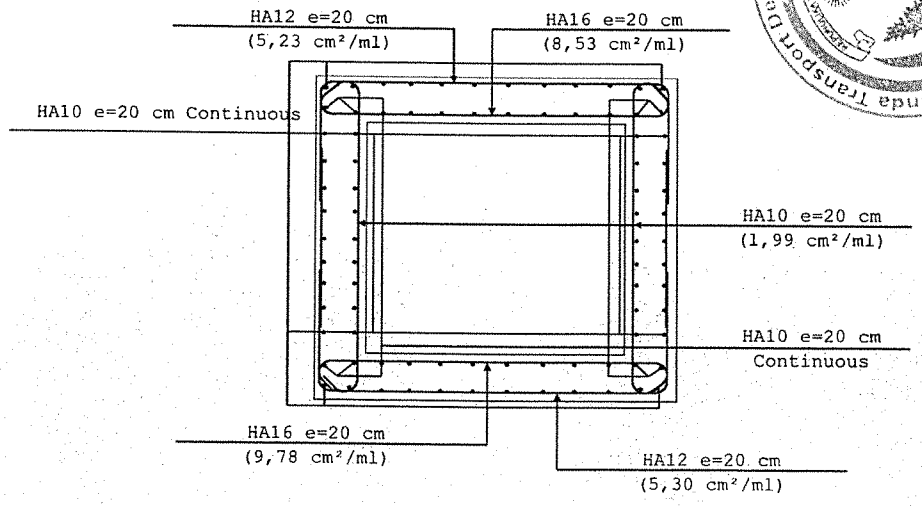
Verification of shear force

τu max = 0,83 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
3,80 m	2,80 m	0,30 m	2,0 t/m3	0,87 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hl}	Q_{hr}	M_{c120}
	2,40	7,07	6,37	5,51	4,51
Relative to the maximum charge density	0,34	1,00	0,90	0,78	0,64
Longitudinal impact loads according to imposed skew	*11,40*	*3,05*	*2,90*	*1,90*	*7,40*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,786	-0,193	0,979	-0,097	-0,042	0,000
2	-0,486	0,153	-0,640	-0,389	-0,187	0,000
3	-0,486	0,098	-0,585	0,591	0,315	0,000
4	-0,486	0,044	-0,530	-0,389	-0,202	0,000
5	0,786	-0,078	0,886	-0,097	-0,056	1,188
6	-1,562	-0,650	-0,912	0,195	0,090	0,950
7	0,000	-0,262	0,262	0,000	0,000	0,000
8	0,000	-0,481	0,481	0,000	0,000	0,000
9	-1,562	-0,540	-1,022	0,195	0,104	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,64	0	0	0	1,2	0	1	0	1	1
2	1	0,64	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

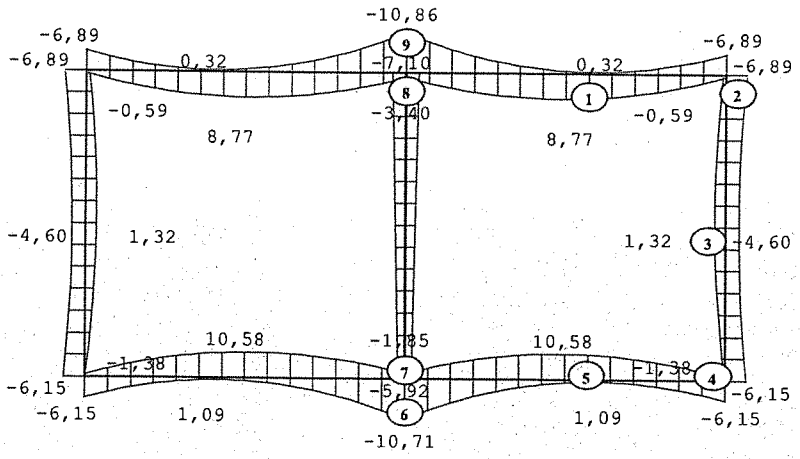
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase.cons
2,49	7,07	7,07	7,07	0,25	0,50	0,51	1,02	1,40	2,80	2,40

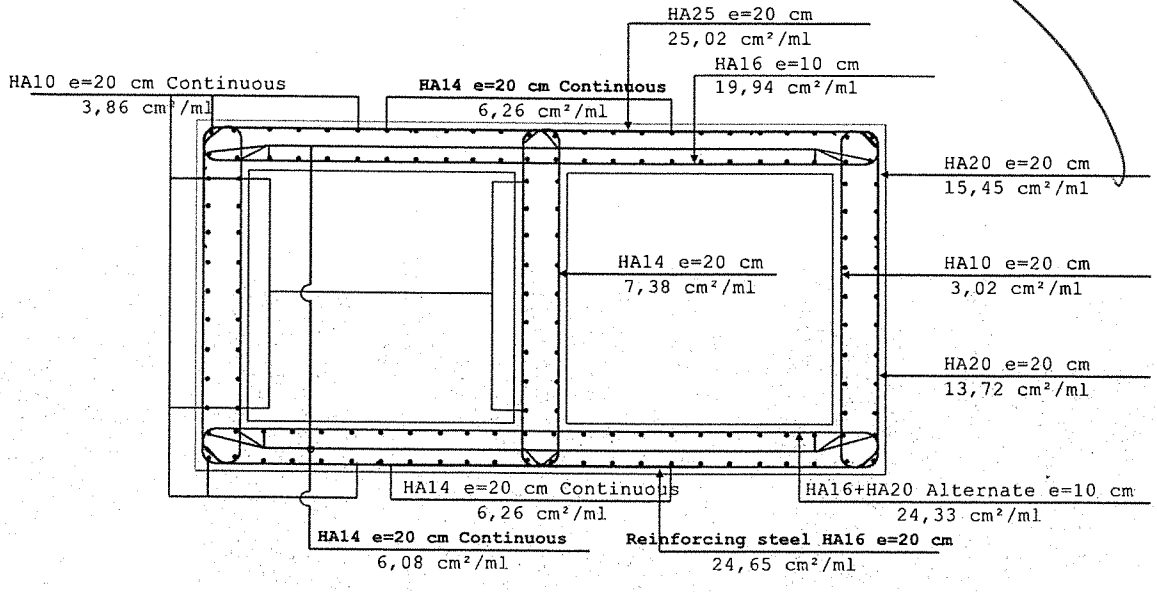
Verification of shear force

τu max = 1,10 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
5,00 m	4,50 m	0,50 m	2,0 t/m3	0,40 m	25 MPa	400 MPa	201,6 MPa	1,35	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hl}	Q_{hr}	M_{c120}
	2,40	10,31	8,35	8,23	5,36
Relative to the maximum charge density	0,23	1,00	0,81	0,80	0,52
Longitudinal impact loads according to imposed skew	*15,00*	*1,21*	*2,56*	*1,56*	*7,06*

units moments

Section	*Q (2T)*	*Q (Tg)*	*Q (Td)*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	1,388	-0,373	1,760	-0,271	-0,114	0,000
2	-0,744	0,255	-0,999	-1,085	-0,520	0,000
3	-0,744	0,165	-0,910	1,446	0,779	0,000
4	-0,744	0,076	-0,820	-1,085	-0,564	0,000
5	1,388	-0,162	1,591	-0,271	-0,158	1,563
6	-2,753	-1,180	-1,573	0,542	0,249	1,250
7	0,000	-0,393	0,393	0,000	0,000	0,000
8	0,000	-0,752	0,752	0,000	0,000	0,000
9	-2,753	-1,000	-1,753	0,542	0,293	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,52	0	0	0	1,2	0	1	0	1	1
2	1	0,52	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

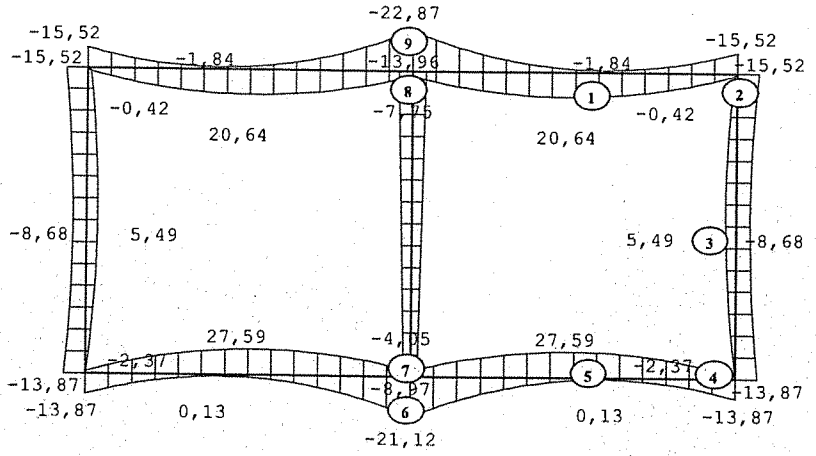
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,05	10,31	10,31	10,31	0,25	0,50	0,33	0,65	2,25	4,50	5,63

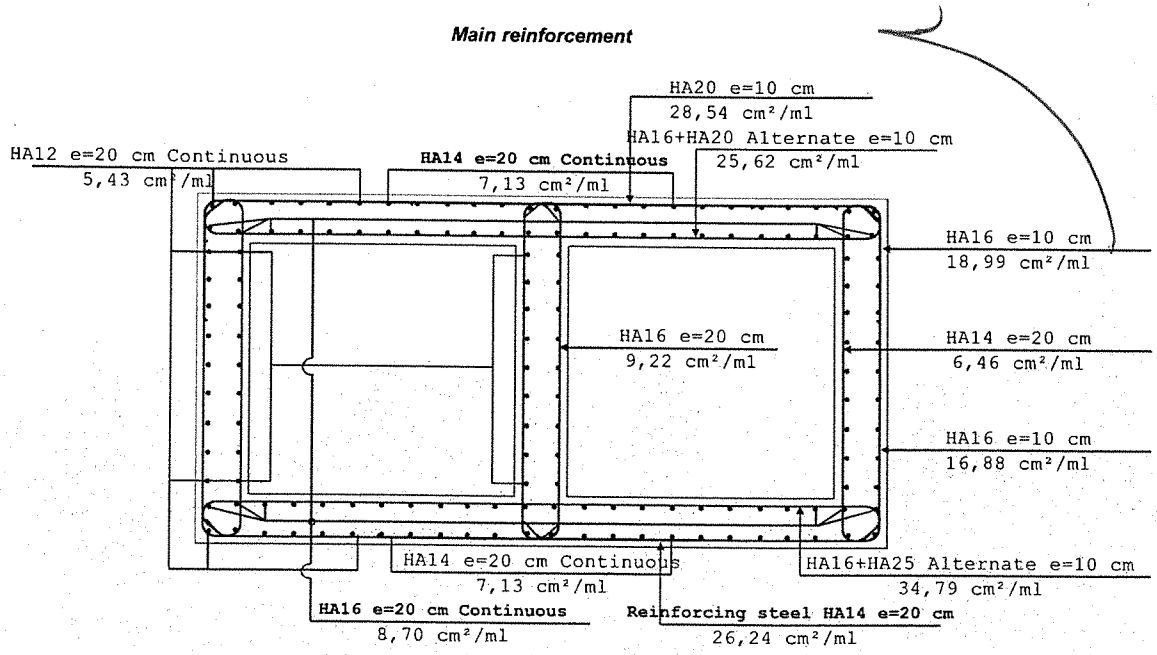
Verification of shear force

τu max = 1,07 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,25 m	1,75 m	0,25 m	2,0 t/m3	0,50 m	25 MPa	400 MPa	201,6 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{hc}	Q_{hi}	Q_{hr}	M_{c120}
2,40	13,05	10,28	10,46	6,08
0,18	1,00	0,79	0,80	0,47
6,75	*1,08*	*1,08*	*1,43*	*6,93*

Relative to the maximum charge density

Longitudinal impact loads according to imposed skew

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,277	-0,070	0,347	-0,039	-0,016	0,000
2	-0,165	0,053	-0,218	-0,155	-0,075	0,000
3	-0,165	0,034	-0,199	0,227	0,122	0,000
4	-0,165	0,015	-0,180	-0,155	-0,081	0,000
5	0,277	-0,029	0,314	-0,039	-0,022	0,703
6	-0,550	-0,231	-0,319	0,078	0,036	0,563
7	0,000	-0,088	0,088	0,000	0,000	0,000
8	0,000	-0,164	0,164	0,000	0,000	0,000
9	-0,550	-0,193	-0,357	0,078	0,042	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,47	0	0	0	1,2	0	1	0	1	1
2	1	0,47	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

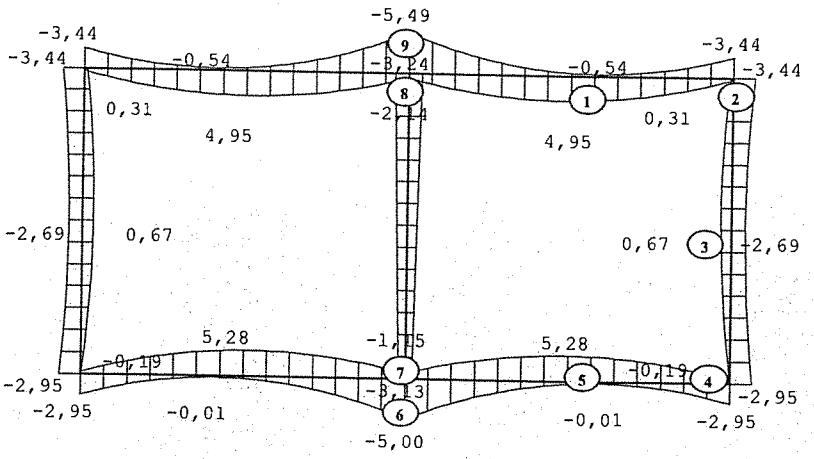
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,63	13,05	13,05	13,05	0,25	0,50	0,31	0,63	0,88	1,75	1,09

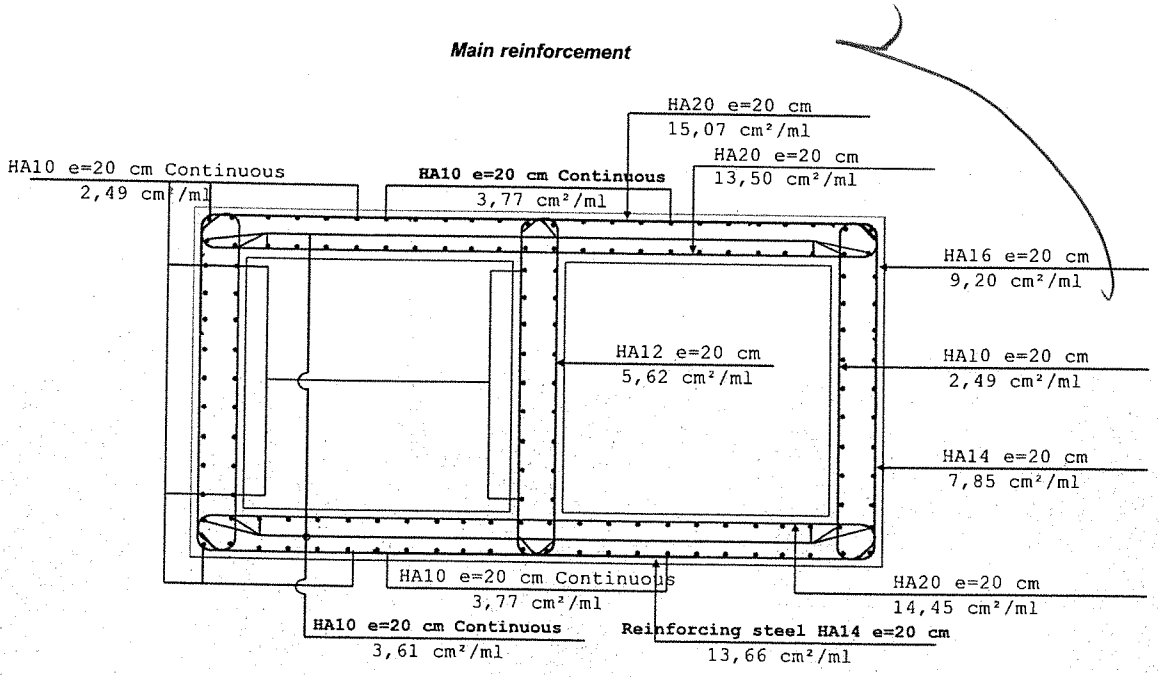
Verification of shear force

τu max = 1,18 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,25 m	1,75 m	0,25 m	2,0 t/m3	1,08 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{hr}	Q_{hr}	Q_{hr}	M_{c120}
2,40	6,08	5,60	4,47	4,06
Relative to the maximum charge density 0,39	1,00	0,92	0,74	0,67
Longitudinal impact loads according to imposed skew *6,75*	*3,25*	*3,10*	*2,09*	*7,60*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,277	-0,070	0,347	-0,039	-0,016	0,000
2	-0,165	0,053	-0,218	-0,155	-0,075	0,000
3	-0,165	0,034	-0,199	0,227	0,122	0,000
4	-0,165	0,015	-0,180	-0,155	-0,081	0,000
5	0,277	-0,029	0,314	-0,039	-0,022	0,703
6	-0,550	-0,231	-0,319	0,078	0,036	0,563
7	0,000	-0,088	0,088	0,000	0,000	0,000
8	0,000	-0,164	0,164	0,000	0,000	0,000
9	-0,550	-0,193	-0,357	0,078	0,042	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,67	0	0	0	1,2	0	1	0	1	1
2	1	0,67	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

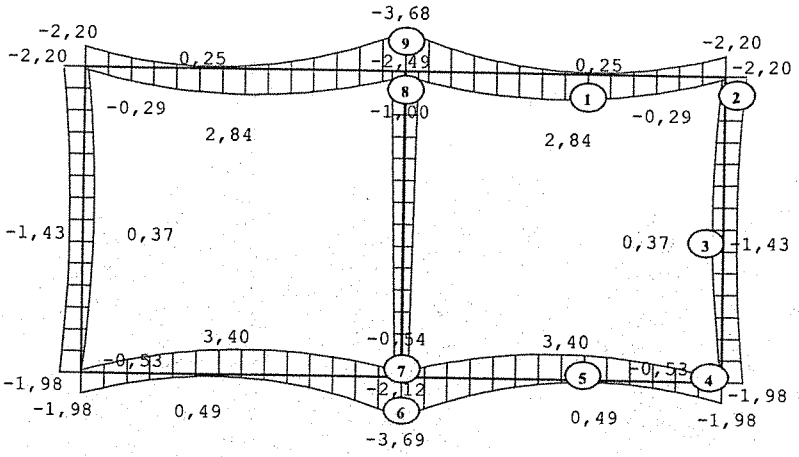
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,79	6,08	6,08	6,08	0,25	0,50	0,60	1,21	0,88	1,75	1,09

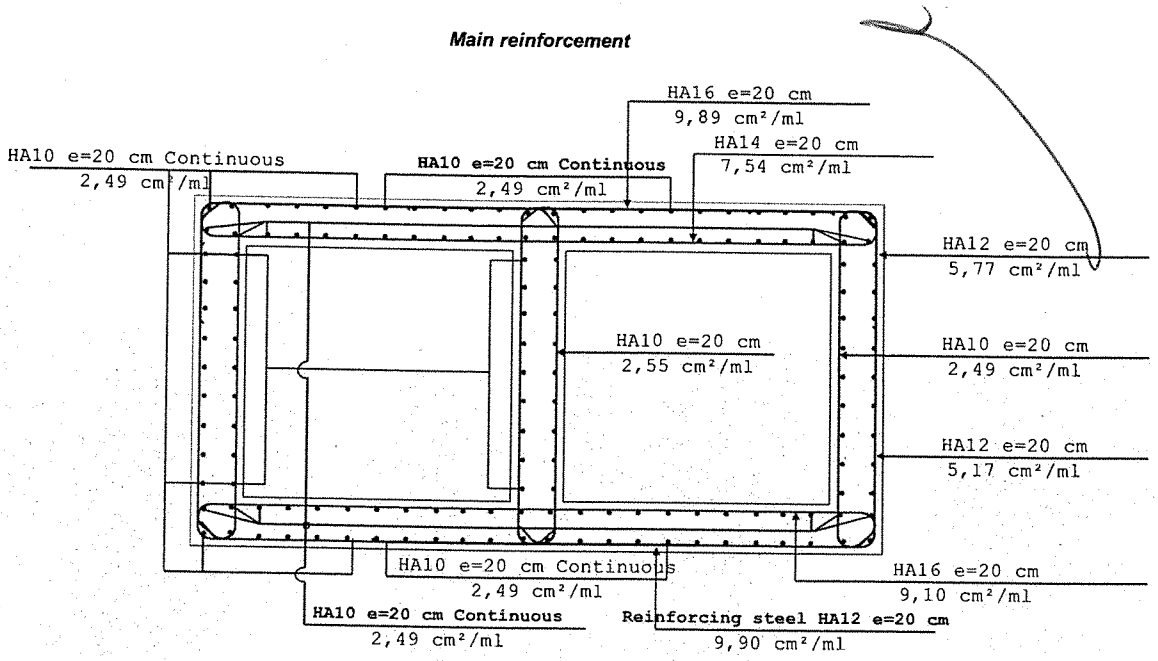
Verification of shear force

τu max = 0,74 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 263** **Box culvert (3,50 x 3,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
3,90 m	3,90 m	0,40 m	2,0 t/m3	5,13 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
0,96	1,14	0,37	1,17

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	1,268	-0,634	-0,285	0,000
2	-0,634	-0,634	-0,285	0,000
3	-0,634	1,268	0,627	0,000
4	-0,634	-0,634	-0,349	0,000
5	1,268	-0,634	-0,349	0,975
6	-0,634	-0,634	-0,349	0,000
7	-0,634	1,268	0,627	0,000
8	-0,634	-0,634	-0,285	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

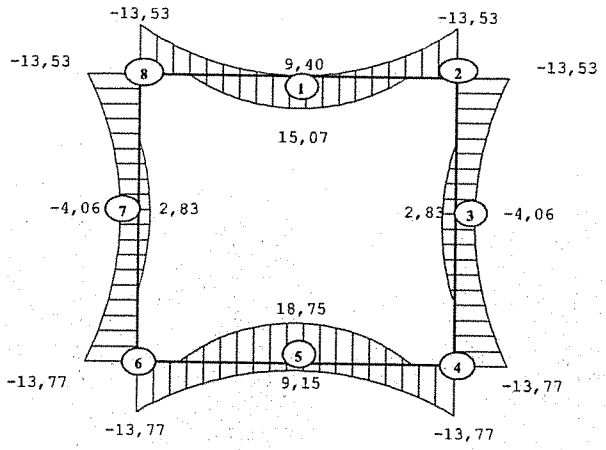
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
11,26	2,40	0,25	0,50	2,67	5,33	1,95	3,90	3,90

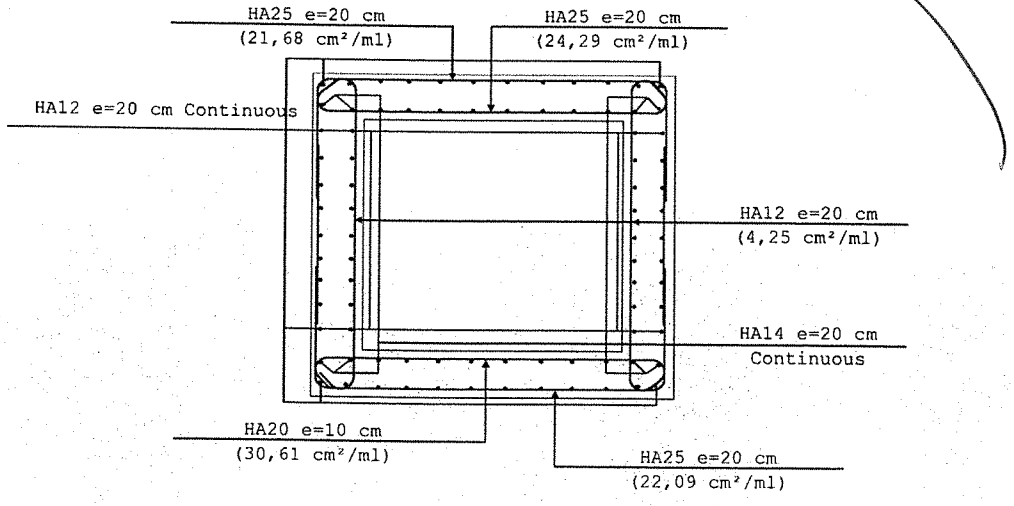
Verification of shear force

τu max = 1,18 Mpa légèrement supérieur à 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 273** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	1,05 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{cl20}
6,48	5,09	4,89	4,25

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	
4	1	1	0	0	1	0	1	0	1

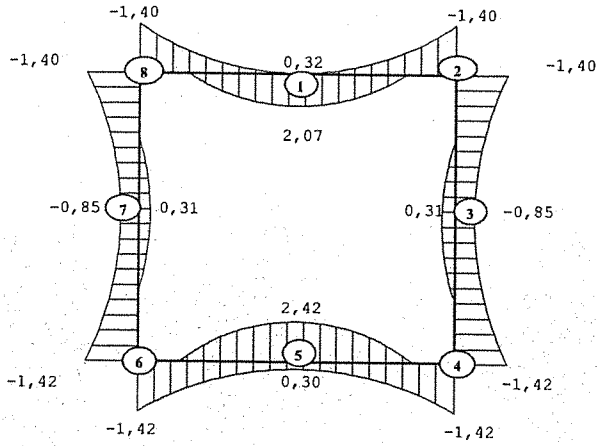
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,60	6,48	0,25	0,50	0,58	1,15	0,85	1,70	0,85

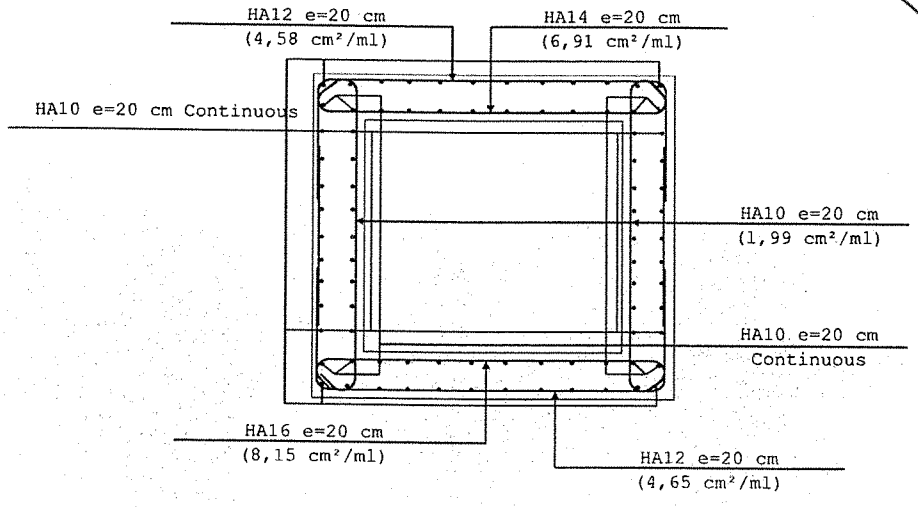
Verification of shear force

τu max = 0,70 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 283** **Box culvert (4,50 x 4,00)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
5,61 m	4,50 m	0,50 m	2,0 t/m3	0,88 m	25 MPa	400 MPa	201,6 MPa	1,30	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{bc}	Q_{bt}	Q_{br}	M_{el20}
5,56	4,50	4,07	3,73

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	2,480	-0,751	-0,340	0,000
2	-1,456	-0,751	-0,340	0,000
3	-1,456	1,780	0,888	0,000
4	-1,456	-0,751	-0,411	0,000
5	2,480	-0,751	-0,411	1,403
6	-1,456	-0,751	-0,411	0,000
7	-1,456	1,780	0,888	0,000
8	-1,456	-0,751	-0,340	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

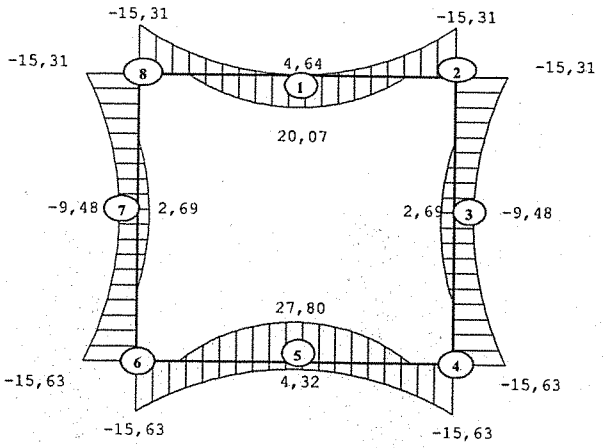
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,01	5,56	0,25	0,50	0,57	1,13	2,25	4,50	5,06

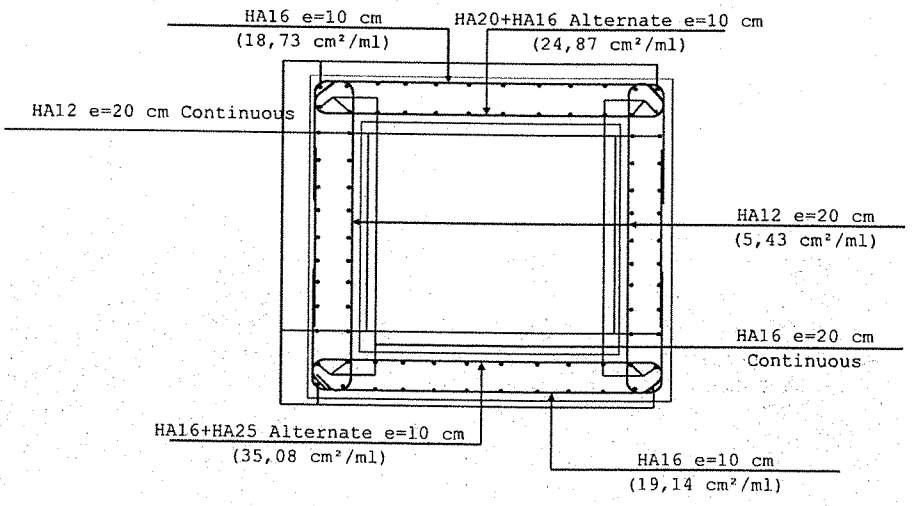
Verification of shear force

τu max = 0,89 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
4,35 m	3,85 m	0,35 m	2,0 t/m3	0,66 m	25 MPa	400 MPa	202 MPa	1,35	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hr}	Q_{hr}	Q_{hr}	M_{c120}
	2,40	8,43	7,05	6,71	4,87
Relative to the maximum charge density	0,28	1,00	0,84	0,80	0,58
Longitudinal impact loads according to imposed skew	*13,05*	*2,86*	*2,71*	*1,71*	*7,21*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	1,049	-0,280	1,328	-0,197	-0,083	0,000
2	-0,569	0,194	-0,763	-0,789	-0,379	0,000
3	-0,569	0,126	-0,695	1,064	0,572	0,000
4	-0,569	0,057	-0,627	-0,789	-0,411	0,000
5	1,049	-0,121	1,200	-0,197	-0,115	1,359
6	-2,081	-0,890	-1,191	0,395	0,181	1,088
7	0,000	-0,301	0,301	0,000	0,000	0,000
8	0,000	-0,574	0,574	0,000	0,000	0,000
9	-2,081	-0,753	-1,328	0,395	0,213	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,58	0	0	0	1,2	0	1	0	1	1
2	1	0,58	0	0	0	0	1	1	0	1	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	1	0	1	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	1	0	1	1

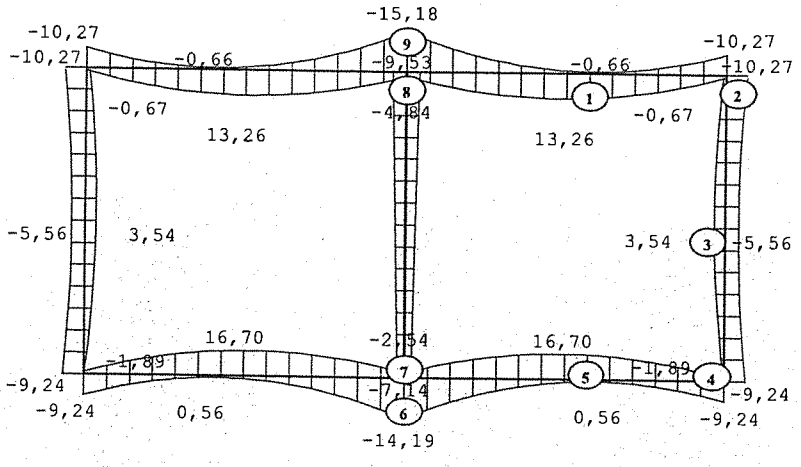
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,20	8,43	8,43	8,43	0,25	0,50	0,42	0,84	1,93	3,85	3,37

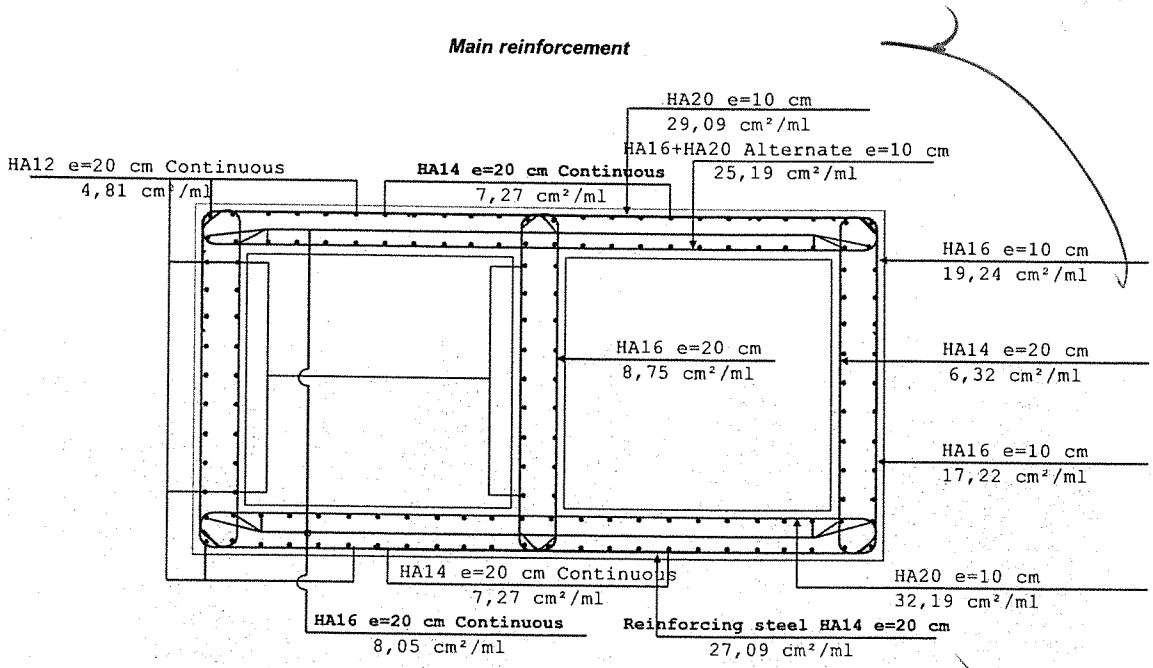
Verification of shear force

τu max = 1,18 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 295** **Box culvert (4,50 x 4,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}	Q_{hc}	Q_{ht}	Q_{hr}	$M_{ot/m}$
4,95 m	4,95 m	0,45 m	2,0 t/m3	0,82 m	25 MPa	400 MPa	201,6 MPa	1,35	1,1	1,0	2,40	6,33	5,77	4,79	4,13

Densities pondered loads at S.L.S (t/m²) :

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	2,042	-1,021	-0,459	0,000
2	-1,021	-1,021	-0,459	0,000
3	-1,021	2,042	1,010	0,000
4	-1,021	-1,021	-0,562	0,000
5	2,042	-1,021	-0,562	1,238
6	-1,021	-1,021	-0,562	0,000
7	-1,021	2,042	1,010	0,000
8	-1,021	-1,021	-0,459	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

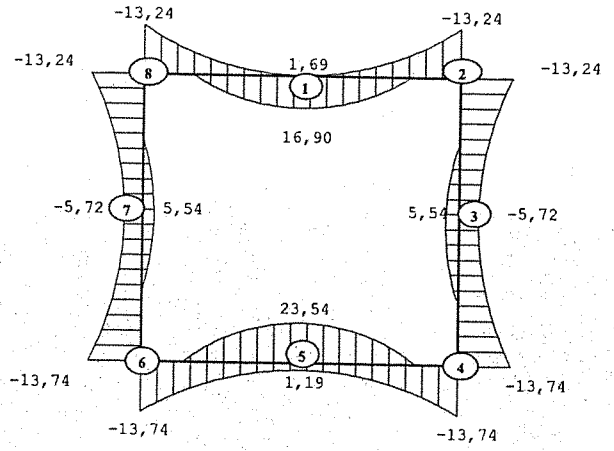
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,77	6,33	0,25	0,50	0,52	1,05	2,48	4,95	5,57

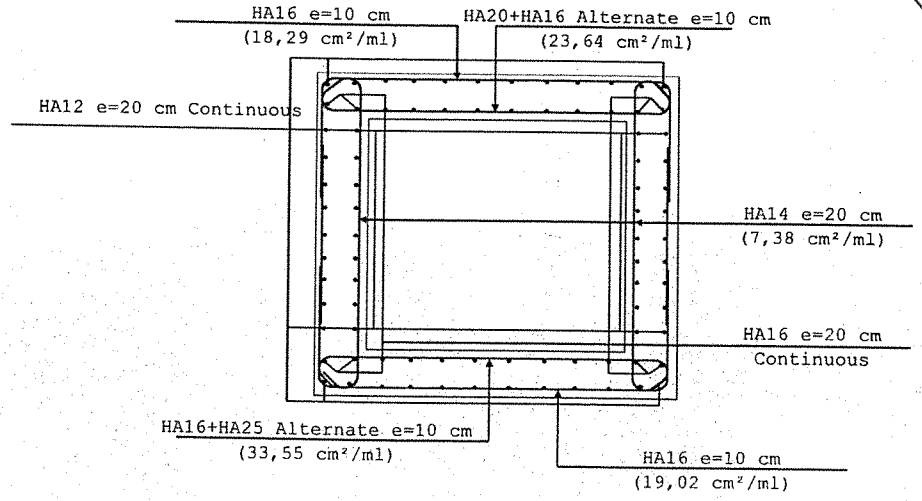
Verification of shear force

τu max = 0,95 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 300** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	2,52 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m³) :

Q_{hc}	Q_{hr}	Q_{hr}	M_{c120}
2,32	2,62	1,33	2,03

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

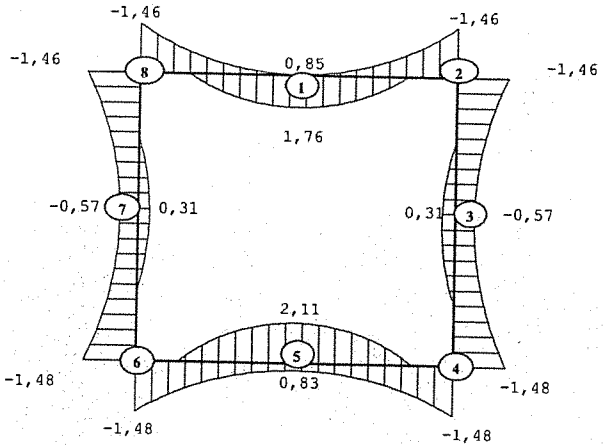
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons.
5,54	2,62	0,25	0,50	1,31	2,62	0,85	1,70	0,85

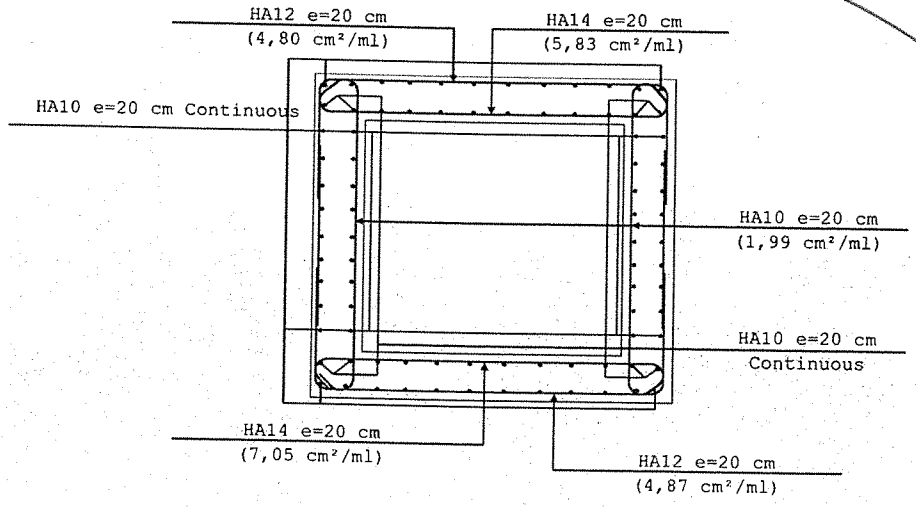
Verification of shear force

τu max = 0,64 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
4,95 m	4,95 m	0,45 m	2,0 t/m3	3,11 m	25 MPa	400 MPa	201,6 MPa	1,35	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

Q_{min}	Q_{hc}	Q_{hi}	Q_{hr}	M_{c120}
2,40	1,54	1,63	0,81	1,76
1,00	0,88	0,93	0,46	1,00
14,85	*5,79*	*5,64*	*4,63*	*10,14*

Relative to the maximum charge density

Longitudinal impact loads according to imposed skew

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	1,374	-0,385	1,759	-0,340	-0,141	0,000
2	-0,681	0,243	-0,924	-1,361	-0,651	0,000
3	-0,681	0,158	-0,839	1,702	0,920	0,000
4	-0,681	0,073	-0,754	-1,361	-0,710	0,000
5	1,374	-0,172	1,588	-0,340	-0,199	1,547
6	-2,723	-1,183	-1,539	0,681	0,311	1,238
7	0,000	-0,356	0,356	0,000	0,000	0,000
8	0,000	-0,696	0,696	0,000	0,000	0,000
9	-2,723	-1,013	-1,709	0,681	0,369	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	1,00	0	0	0	1,2	0	1	0	1	1
2	1	1,00	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

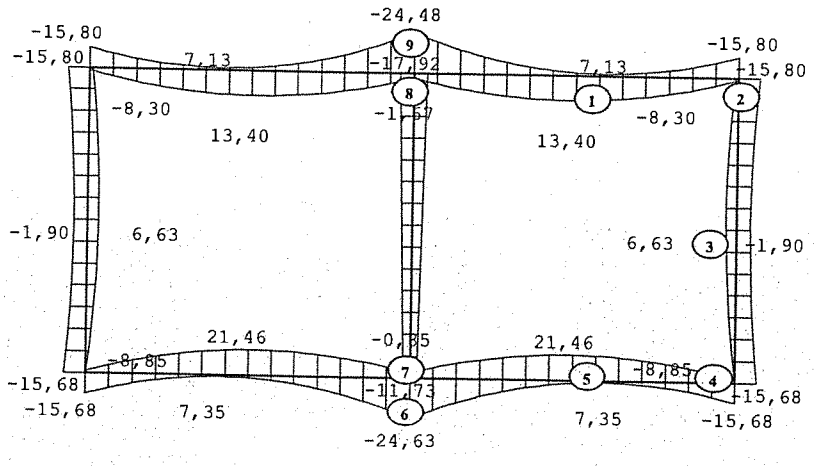
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
7,35	2,40	2,40	2,40	0,25	0,50	1,67	3,34	2,48	4,95	5,57

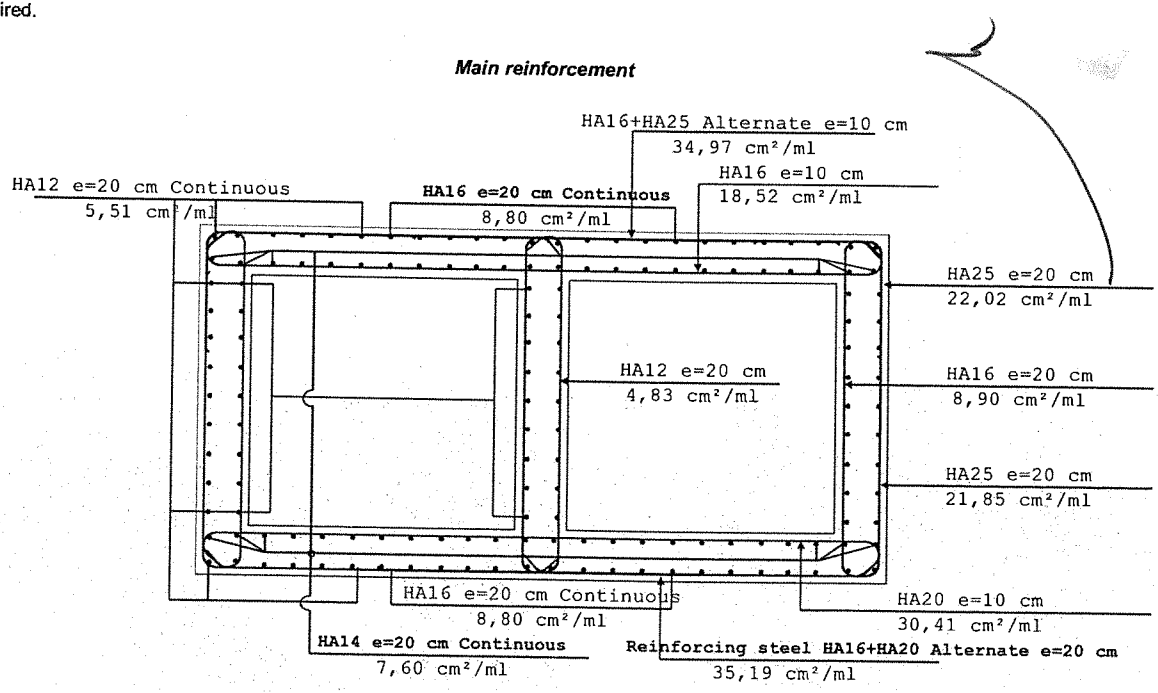
Verification of shear force

τu max = 1,00 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 313** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}	Q_{hc}	Q_{hi}	Q_{hr}	M_{c120}
1,70 m	1,70 m	0,20 m	2,0 t/m3	0,80 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40	8,61	7,25	6,86	5,02

Densities pondered loads at S.L.S (t/m³) :

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

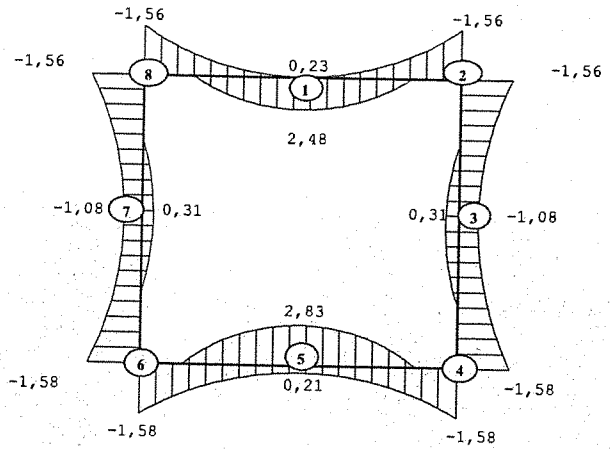
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,10	8,61	0,25	0,50	0,45	0,90	0,85	1,70	0,85

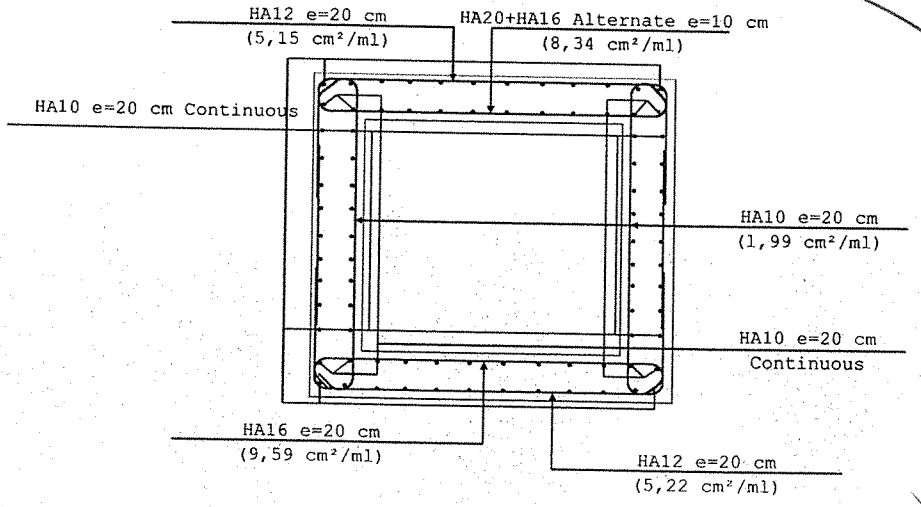
Verification of shear force

τu max = 0,81 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 315** **Box culvert (2,00 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}	Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
2,25 m	1,75 m	0,25 m	2,0 t/m3	0,82 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40	7,87	6,87	6,26	4,80

Densities pondered loads at S.L.S (t/m³) :

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,396	-0,112	-0,051	0,000
2	-0,237	-0,112	-0,051	0,000
3	-0,237	0,271	0,135	0,000
4	-0,237	-0,112	-0,061	0,000
5	0,396	-0,112	-0,061	0,563
6	-0,237	-0,112	-0,061	0,000
7	-0,237	0,271	0,135	0,000
8	-0,237	-0,112	-0,051	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

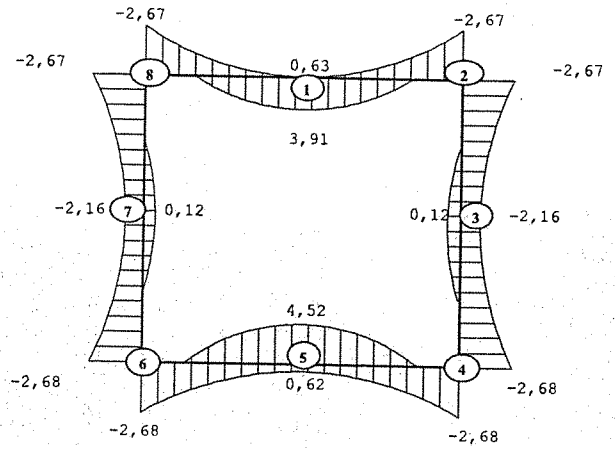
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,27	7,87	0,25	0,50	0,47	0,95	0,88	1,75	1,09

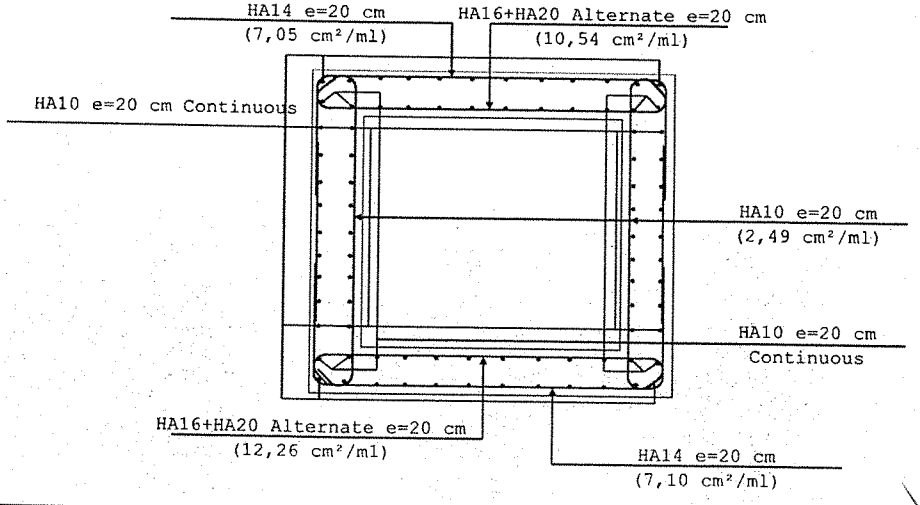
Verification of shear force

τu max = 0,82 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
2,25 m	1,75 m	0,25 m	2,0 t/m3	0,66 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{cl20}
	2,40	9,97	8,15	7,96	5,38
Relative to the maximum charge density	0,24	1,00	0,82	0,80	0,54
Longitudinal impact loads according to imposed skew	*6,75*	*2,76*	*2,61*	*1,61*	*7,11*

units moments

Section	*Q (2T)*	*Q (Tg)*	*Q (Td)*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,277	-0,070	0,347	-0,039	-0,016	0,000
2	-0,165	0,053	-0,218	-0,155	-0,075	0,000
3	-0,165	0,034	-0,199	0,227	0,122	0,000
4	-0,165	0,015	-0,180	-0,155	-0,081	0,000
5	0,277	-0,029	0,314	-0,039	-0,022	0,703
6	-0,550	-0,231	-0,319	0,078	0,036	0,563
7	0,000	-0,088	0,088	0,000	0,000	0,000
8	0,000	-0,164	0,164	0,000	0,000	0,000
9	-0,550	-0,193	-0,357	0,078	0,042	0,000

Combinations

	Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,54	0	0	0	1,2	0	1	0	1	1
2	1	0,54	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

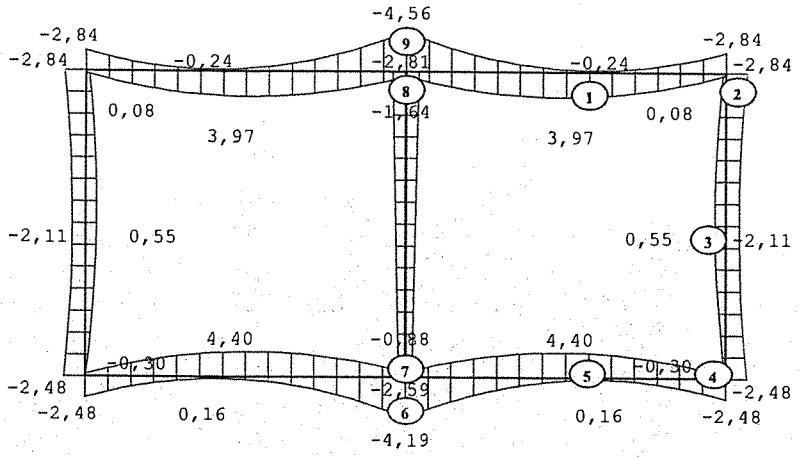
Loads

Pt+Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,95	9,97	9,97	9,97	0,25	0,50	0,39	0,79	0,88	1,75	1,09

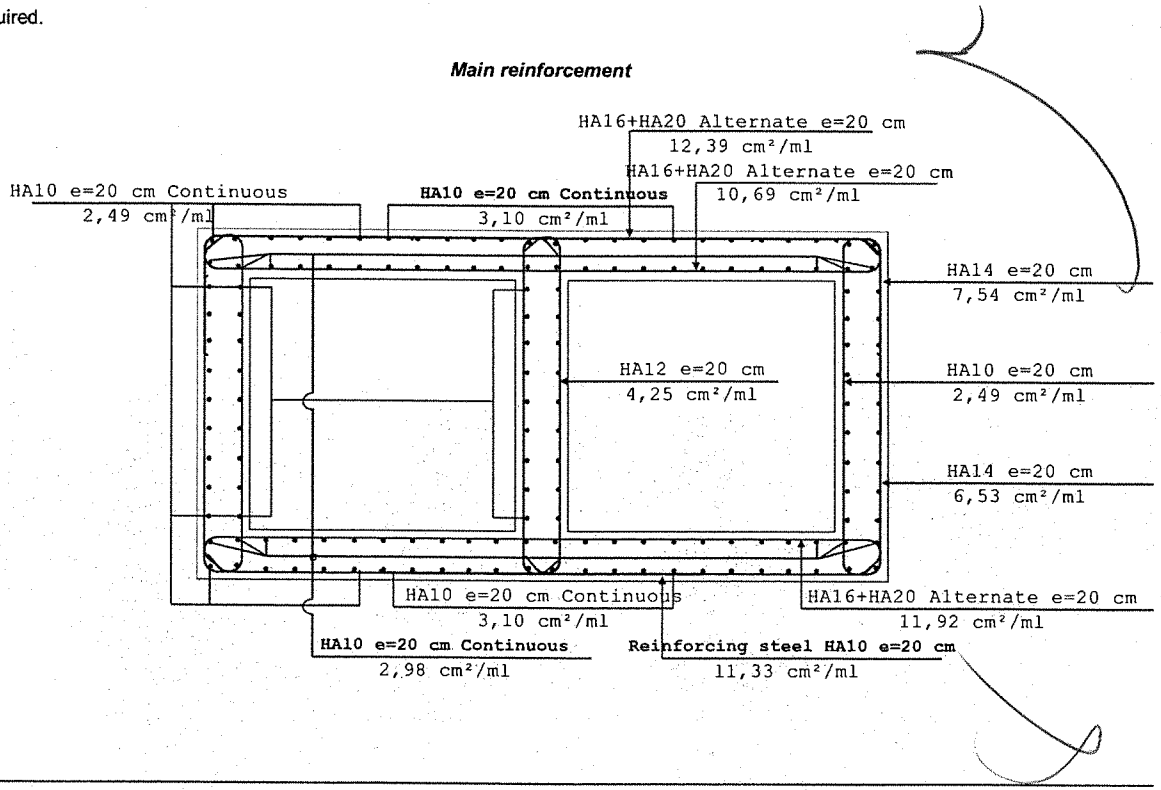
Verification of shear force

τu max = 0,97 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 319** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	1,00 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
6,26	4,98	4,65	4,14

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

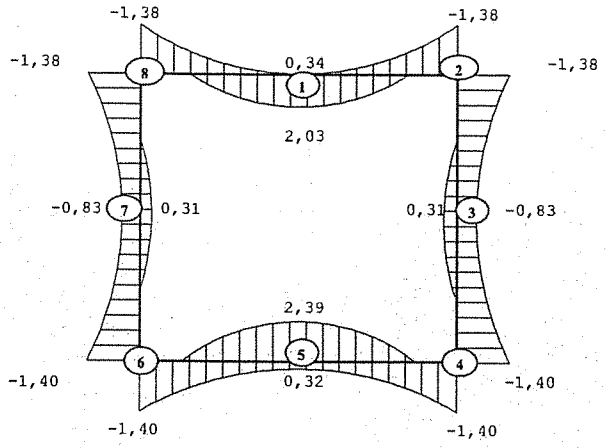
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,68	6,26	0,25	0,50	0,60	1,19	0,85	1,70	0,85

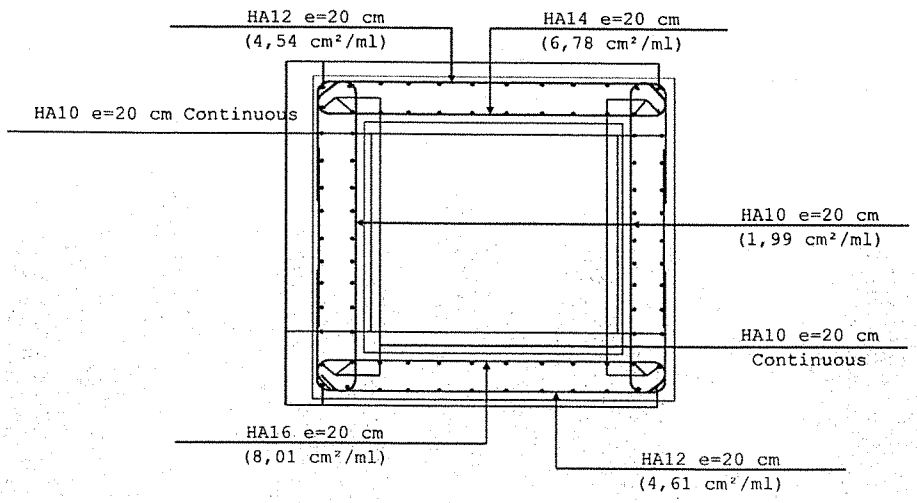
Verification of shear force

τu max = 0,69 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
1,70 m	1,70 m	0,20 m	2,0 t/m3	0,78 m	25 MPa	400 MPa	202 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{cl20}
	2,40	8,87	7,37	7,07	5,09
Relative to the maximum charge density	0,27	1,00	0,83	0,80	0,57
Longitudinal impact loads according to imposed skew	*5,10*	*2,85*	*2,70*	*1,70*	*7,20*

units moments

Section	*Q (2T)*	*Q (Tg)*	*Q (Td)*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,162	-0,045	0,207	-0,040	-0,017	0,000
2	-0,080	0,029	-0,109	-0,161	-0,077	0,000
3	-0,080	0,019	-0,099	0,201	0,109	0,000
4	-0,080	0,009	-0,089	-0,161	-0,084	0,000
5	0,162	-0,020	0,187	-0,040	-0,024	0,531
6	-0,321	-0,140	-0,182	0,080	0,037	0,425
7	0,000	-0,042	0,042	0,000	0,000	0,000
8	0,000	-0,082	0,082	0,000	0,000	0,000
9	-0,321	-0,119	-0,202	0,080	0,044	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,57	0	0	0	1,2	0	1	0	1	1
2	1	0,57	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

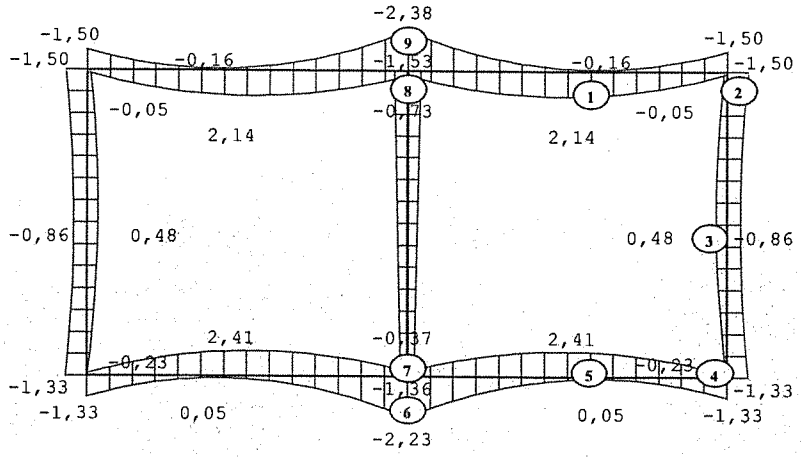
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,06	8,87	8,87	8,87	0,25	0,50	0,44	0,88	0,85	1,70	0,85

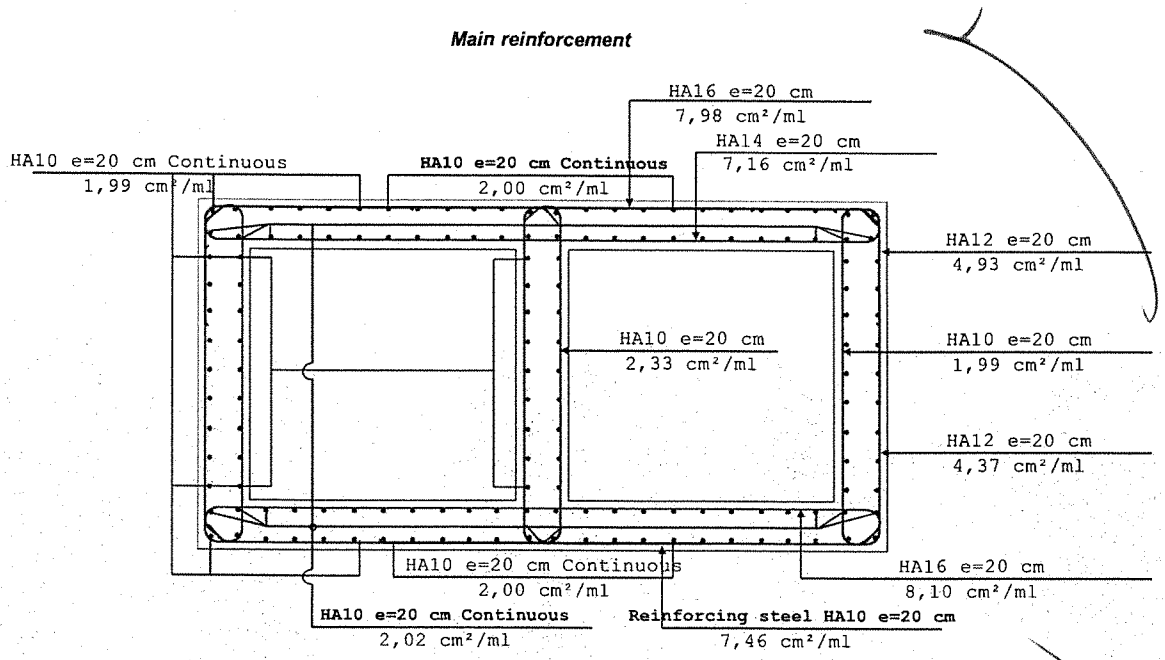
Verification of shear force

τu max = 0,85 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	n
4,99 m	3,95 m	0,45 m	2,0 t/m3	0,50 m	25 MPa	400 MPa	201,6 MPa	15

bc	bt	Imposed skew	Geo.skew
1,10	1,0	70,0	65,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{tr}	Q_{tx}	Q_{tv}	M_{c120}
	2,40	9,42	7,72	7,51	5,14
Relative to the maximum charge density	0,25	1,00	0,82	0,80	0,55
Longitudinal impact loads according to imposed skew	*14,98*	*3,70*	*4,06*	*2,33*	*8,01*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	1,367	-0,347	1,715	-0,199	-0,084	0,000
2	-0,805	0,262	-1,067	-0,797	-0,383	0,000
3	-0,805	0,169	-0,974	1,154	0,618	0,000
4	-0,805	0,076	-0,881	-0,797	-0,413	0,000
5	1,367	-0,144	1,550	-0,199	-0,115	1,561
6	-2,715	-1,143	-1,573	0,398	0,184	1,249
7	0,000	-0,430	0,430	0,000	0,000	0,000
8	0,000	-0,803	0,803	0,000	0,000	0,000
9	-2,715	-0,956	-1,759	0,398	0,214	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,55	0	0	0	1,2	0	1	0	1	1
2	1	0,55	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

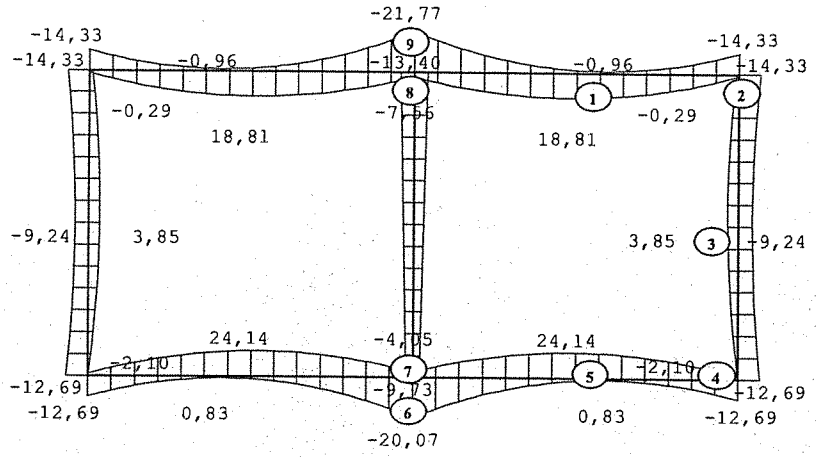
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,13	9,42	9,42	9,42	0,25	0,50	0,36	0,73	1,98	3,95	4,44

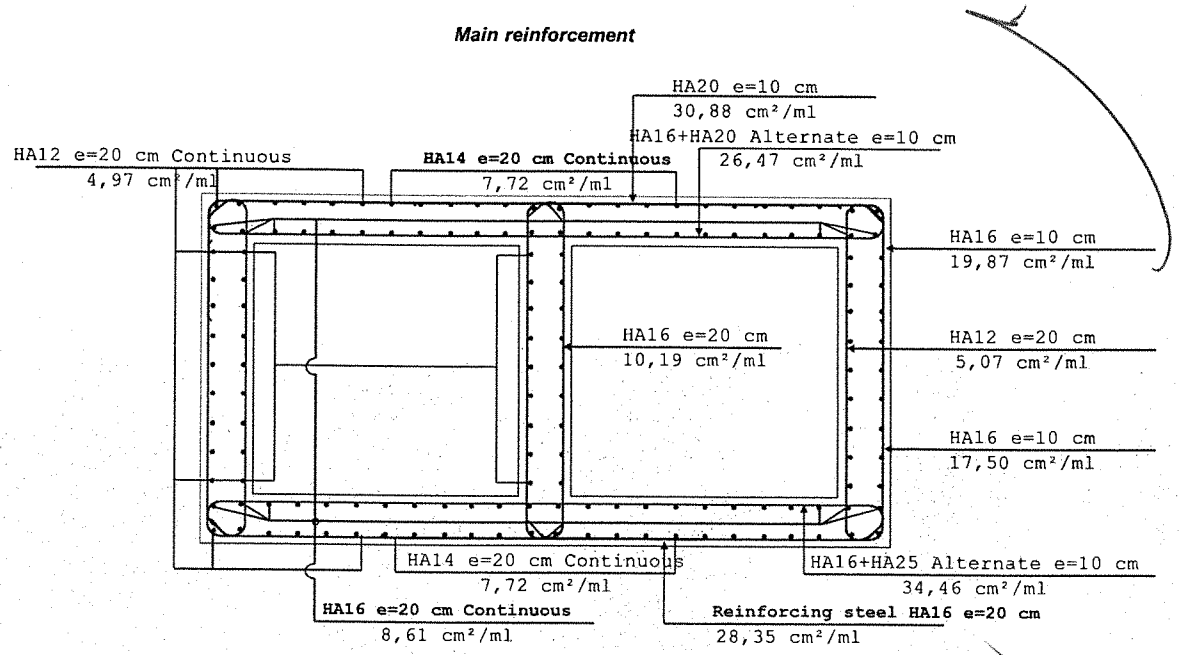
Verification of shear force

τu max = 1,11 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
4,99 m	3,95 m	0,45 m	2,0 t/m3	0,50 m	25 MPa	400 MPa	201,6 MPa	1,35	1,1	1,0	70,0	65,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{bc}	Q_{bt}	Q_{hr}	M_{x120}
	2,40	9,42	7,72	7,51	5,14
Relative to the maximum charge density	0,25	1,00	0,82	0,80	0,55
Longitudinal impact loads according to imposed skew	*14,98*	*3,70*	*4,06*	*2,33*	*8,01*

units moments

Section	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	Unif.pouss.	RLAN;POUS	Cons.phase
1	1,523	-0,001	-0,202	1,726	-0,265	-0,419	0,000
2	-0,867	0,553	-0,837	-0,583	-0,758	-0,365	0,000
3	-0,867	0,064	-0,043	-0,889	1,193	0,636	0,000
4	-0,867	-0,425	0,752	-1,194	-0,758	0,393	0,000
5	1,523	-0,169	0,347	1,288	-0,265	-0,146	1,165
6	-2,443	0,779	-2,136	-1,085	0,228	0,100	0,000
7	-0,203	0,696	-1,267	0,367	0,127	0,053	0,000
8	-0,203	-0,686	1,863	-1,380	0,127	0,075	0,000
9	-2,443	-0,554	0,432	-2,322	0,228	0,128	0,000
10	0,878	-0,405	1,688	-0,405	0,101	0,053	0,000
11	-2,240	0,132	-1,430	-0,942	0,101	0,053	0,000
12	-2,240	0,083	-0,870	-1,453	0,101	0,047	0,000
13	0,878	0,094	0,170	0,094	0,101	0,047	0,999

Combinations

	Pt +Pr	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,25	0	0	0	0	1,2	0	1	0	1	1
2	1	0	1	0	0	0	1,2	0	1	0	1	1
3	1	0	0,25	0	0,25	0	1,2	0	1	0	1	1
4	1	0	0,25	0	0,25	0	0	1	0	1	0	1
5	1	0	0	0,82	0	0	1,2	0	1	0	1	1
6	1	0	0	0,82	0	0	0	1	0	1	0	1
7	1	0	0	0,55	0,55	0	1,2	0	1	0	1	1
8	1	0	0	0,55	0,55	0	0	1	0	1	0	1
9	1	0	0	0	1	0	1,2	0	1	0	1	1
10	1	0	0	0	1	0	0	1	0	1	0	1

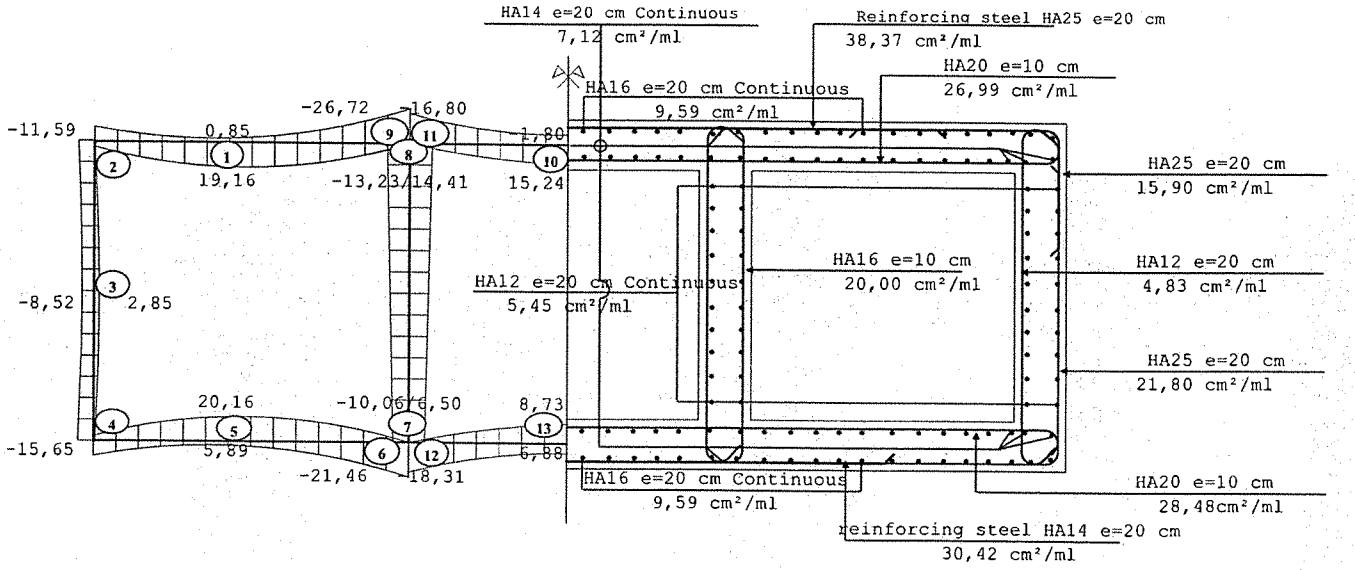
Loads

Pt +Pr	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,13	9,42	9,42	9,42	9,42	0,25	0,50	0,36	0,73	1,98	3,95	4,44

Verification of shear force.

τu max = 1,10 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement

Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 328** **Box culvert (1,50 x 1,50)**

Data:

Lc	Hc	e	γr	Ht	Fc28	Fe	σs	δ	bc	bt	Q_{min}
1,70 m	1,70 m	0,20 m	2,0 t/m3	0,69 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m²) :

Q_{hc}	Q_{ht}	Q_{hr}	M_{c120}
10,18	8,30	8,13	5,43

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,241	-0,120	-0,054	0,000
2	-0,120	-0,120	-0,054	0,000
3	-0,120	0,241	0,119	0,000
4	-0,120	-0,120	-0,066	0,000
5	0,241	-0,120	-0,066	0,425
6	-0,120	-0,120	-0,066	0,000
7	-0,120	0,241	0,119	0,000
8	-0,120	-0,120	-0,054	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

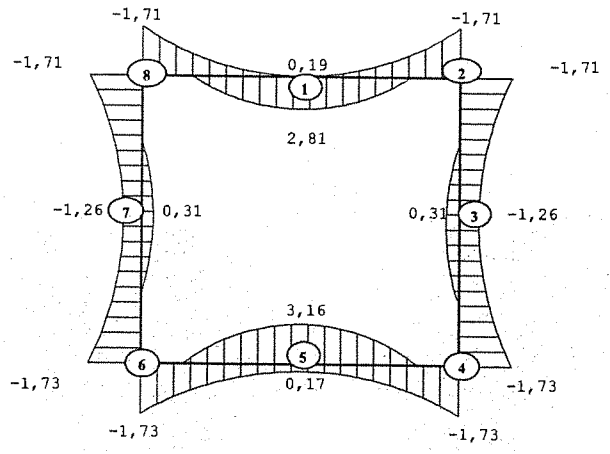
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,88	10,18	0,25	0,50	0,40	0,79	0,85	1,70	0,85

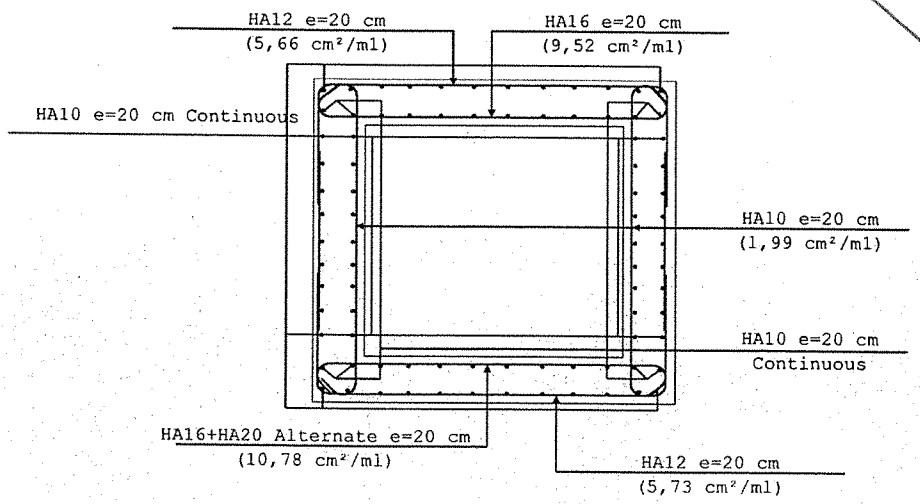
Verification of shear force

τu max = 0,91 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Rehabilitation and widening of KAGITUMBA-KAYONZA-RUSUMO **HS 331** **Box culvert (2,00 x 1,50)**

Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Q_{min}
2,25 m	1,75 m	0,25 m	2,0 t/m3	0,72 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	2,40

Densities pondered loads at S.L.S (t/m³) :

Q_{hc}	Q_{bt}	Q_{hr}	M_{c120}
9,09	7,53	7,25	5,15

units moments

Section	*Q*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,396	-0,112	-0,051	0,000
2	-0,237	-0,112	-0,051	0,000
3	-0,237	0,271	0,135	0,000
4	-0,237	-0,112	-0,061	0,000
5	0,396	-0,112	-0,061	0,563
6	-0,237	-0,112	-0,061	0,000
7	-0,237	0,271	0,135	0,000
8	-0,237	-0,112	-0,051	0,000

Combinations

	Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0	0	1,2	0	1	0	1	1
2	1	0	0	0	1	0	1	0	1
3	1	1	0	1,2	0	1	0	1	1
4	1	1	0	0	1	0	1	0	1

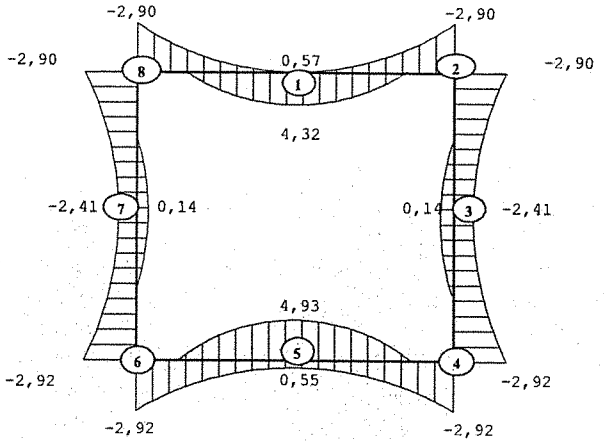
Loads

Pt +Pr	Q	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,07	9,09	0,25	0,50	0,42	0,85	0,88	1,75	1,09

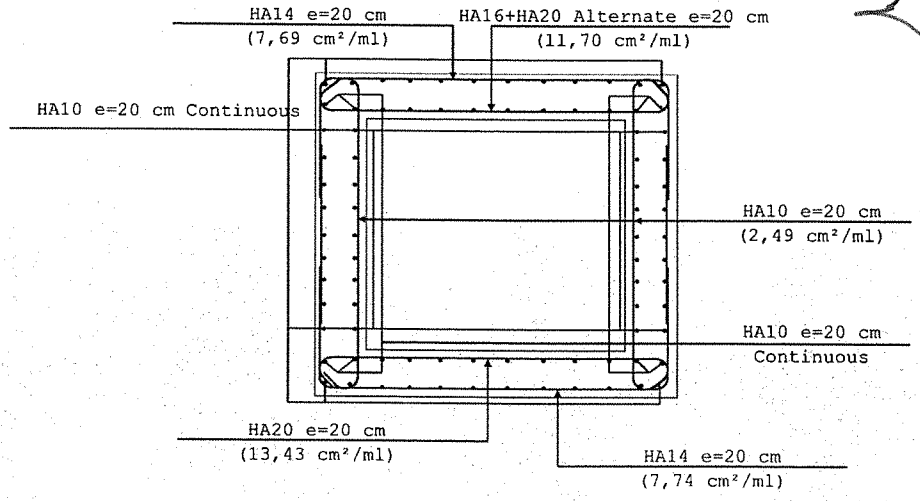
Verification of shear force

τu max = 0,89 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	c	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
3,85 m	2,85 m	0,35 m	2,0 t/m3	0,67 m	25 MPa	400 MPa	201,6 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{c120}
	2,40	8,61	7,25	6,86	5,02
Relative to the maximum charge density	0,28	1,00	0,84	0,80	0,58
Longitudinal impact loads according to imposed skew	*11,55*	*2,87*	*2,72*	*1,72*	*7,22*

units moments

Section	*Q (2T)*	*Q (Tg)*	*Q (Td)*	*Unif.pouss.*	*Trian.pouss.*	*Cons.phase*
1	0,807	-0,199	1,006	-0,101	-0,043	0,000
2	-0,498	0,157	-0,655	-0,404	-0,195	0,000
3	-0,498	0,101	-0,599	0,611	0,326	0,000
4	-0,498	0,045	-0,543	-0,404	-0,209	0,000
5	0,807	-0,080	0,910	-0,101	-0,058	1,203
6	-1,604	-0,668	-0,936	0,202	0,094	0,963
7	0,000	-0,268	0,268	0,000	0,000	0,000
8	0,000	-0,493	0,493	0,000	0,000	0,000
9	-1,604	-0,555	-1,048	0,202	0,108	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,58	0	0	0	1,2	0	1	0	1	1
2	1	0,58	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

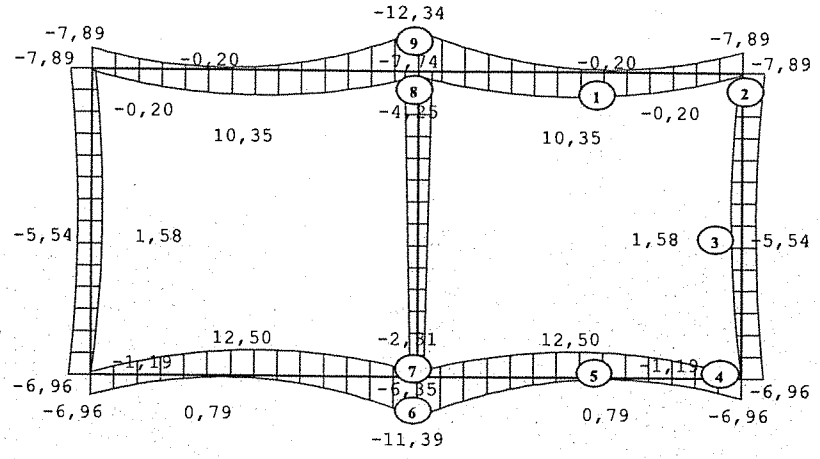
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
2,22	8,61	8,61	8,61	0,25	0,50	0,42	0,85	1,43	2,85	2,49

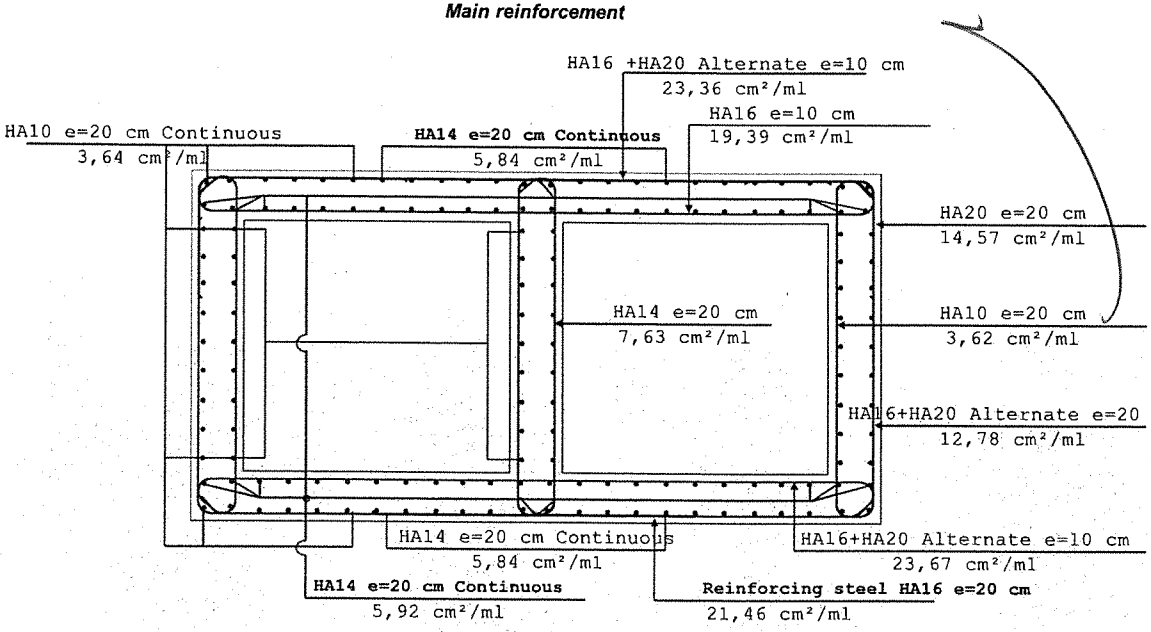
Verification of shear force

τu max = 1,05 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments
(t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ
3,80 m	2,80 m	0,30 m	2,0 t/m3	1,55 m	25 MPa	400 MPa	201,6 MPa	1,40

bc	bt	Imposed skew	Geo.skew
1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{bc}	Q_{bt}	Q_{br}	M_{c120}
	2,40	4,07	3,95	2,62	3,04
Relative to the maximum charge density	0,59	1,00	0,97	0,64	0,75
Longitudinal impact loads according to imposed skew	*11,40*	*3,84*	*3,69*	*2,68*	*8,19*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,786	-0,193	0,979	-0,097	-0,042	0,000
2	-0,486	0,153	-0,640	-0,389	-0,187	0,000
3	-0,486	0,098	-0,585	0,591	0,315	0,000
4	-0,486	0,044	-0,530	-0,389	-0,202	0,000
5	0,786	-0,078	0,886	-0,097	-0,056	1,188
6	-1,562	-0,650	-0,912	0,195	0,090	0,950
7	0,000	-0,262	0,262	0,000	0,000	0,000
8	0,000	-0,481	0,481	0,000	0,000	0,000
9	-1,562	-0,540	-1,022	0,195	0,104	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,75	0	0	0	1,2	0	1	0	1	1
2	1	0,75	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

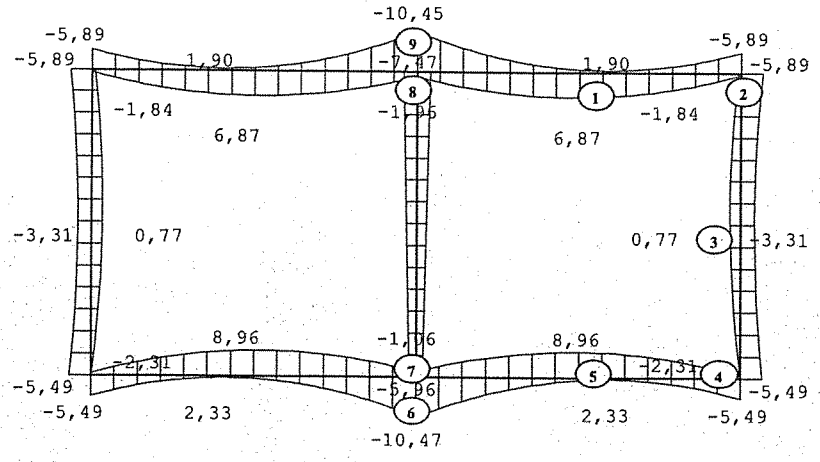
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,85	4,07	4,07	4,07	0,25	0,50	0,85	1,70	1,40	2,80	2,10

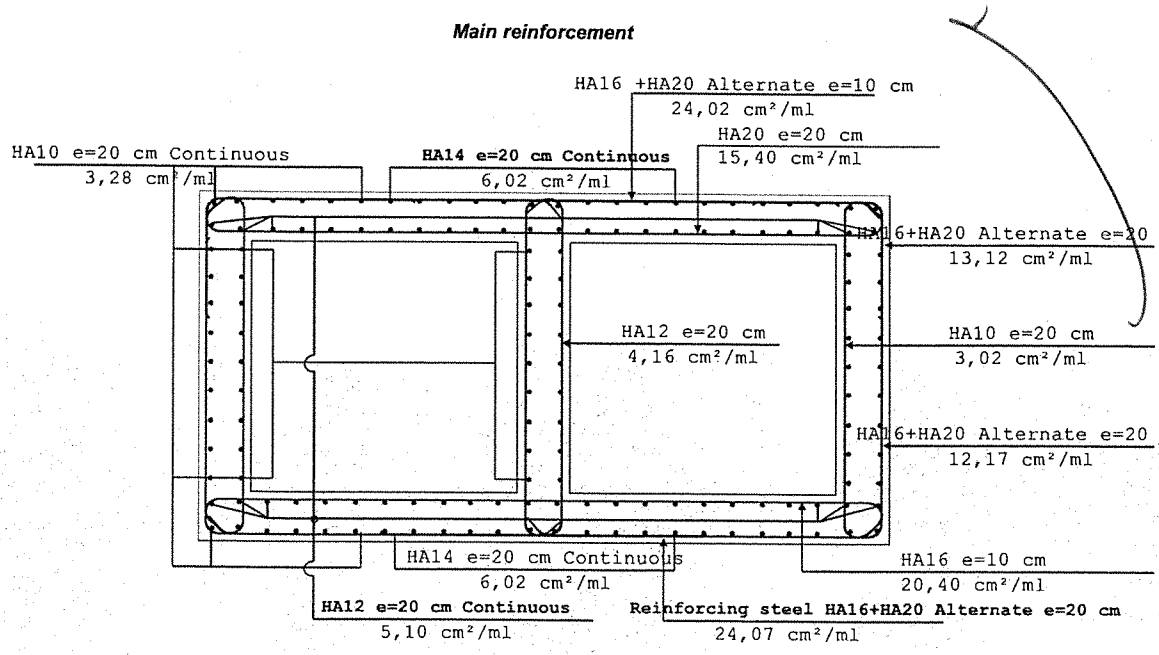
Verification of shear force

τu max = 0,94 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
3,35 m	3,35 m	0,35 m	2,0 t/m3	0,52 m	25 MPa	400 MPa	201,6 MPa	1,40	1,1	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{he}	Q_{hr}	Q_{hr}	M_{c120}
	2,40	10,86	8,78	8,68	5,60
Relative to the maximum charge density	0,22	1,00	0,81	0,80	0,52
Longitudinal impact loads according to imposed skew	*10,05*	*1,20*	*2,55*	*1,55*	*7,05*

units moments

Section	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	Unif.pauss.	RIAN;POUSS	Cons.phase
1	0,711	0,001	-0,100	0,810	-0,213	0,094	0,000
2	-0,340	0,244	-0,376	-0,208	-0,595	-0,285	0,000
3	-0,340	0,024	-0,014	-0,350	0,808	0,434	0,000
4	-0,340	-0,196	0,348	-0,492	-0,595	-0,310	0,000
5	0,711	-0,075	0,157	0,601	-0,213	0,118	0,782
6	-1,105	0,357	-0,970	-0,493	0,170	0,073	0,000
7	-0,085	0,291	-0,550	0,174	0,085	0,033	0,000
8	-0,085	-0,294	0,777	-0,568	0,085	0,052	0,000
9	-1,105	-0,242	0,176	-1,040	0,170	0,097	0,000
10	0,383	-0,210	0,802	-0,210	0,085	0,046	0,000
11	-1,020	0,052	-0,601	-0,472	0,085	0,046	0,000
12	-1,020	0,066	-0,420	-0,666	0,085	0,039	0,000
13	0,383	0,207	0,048	0,207	0,085	0,039	0,670

Combinations

	Pt +Pr	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,22	0	0	0	0	1,2	0	1	0	1	1
2	1	0	1	0	0	0	1,2	0	1	0	1	1
3	1	0	0,22	0	0,22	0	1,2	0	1	0	1	1
4	1	0	0,22	0	0,22	0	0	1	0	1	0	1
5	1	0	0	0,22	0	0	1,2	0	1	0	1	1
6	1	0	0	0,22	0	0	0	1	0	1	0	1
7	1	0	0	0,52	0,52	0	1,2	0	1	0	1	1
8	1	0	0	0,52	0,52	0	0	1	0	1	0	1
9	1	0	0	0	1	0	1,2	0	1	0	1	1
10	1	0	0	0	1	0	0	1	0	1	0	1

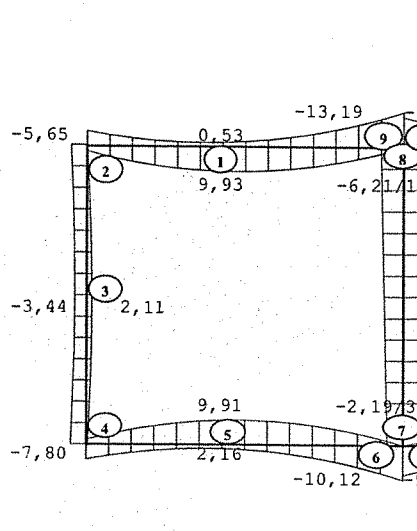
Loads

Pt +Pr	Q (3T)	Q (Td)	Q (Tm)	Q (Tg)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
1,92	10,86	10,86	10,86	10,86	0,25	0,50	0,35	0,70	1,68	3,35	2,93

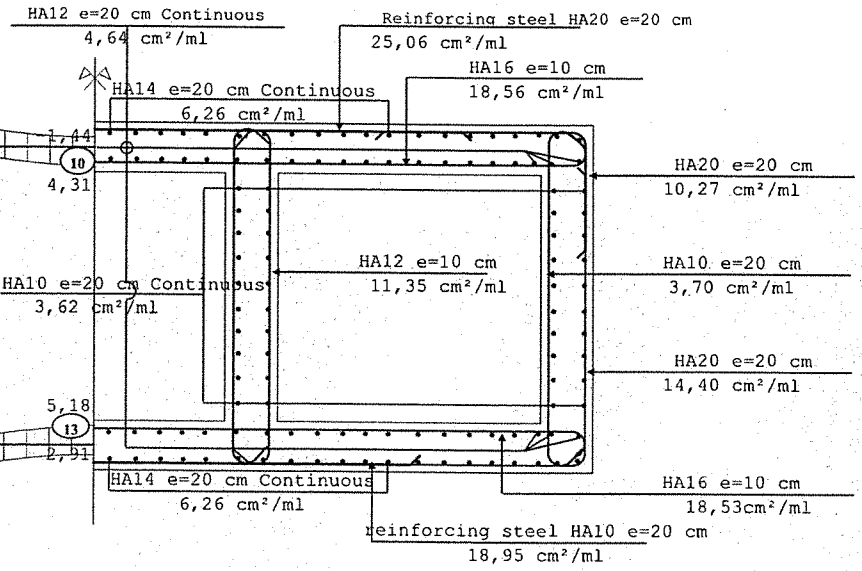
Verification of shear force.

τu max = 1,09 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcements are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



Data:

Lc	Hc	e	γr	Hr	Fc28	Fe	σs	δ	bc	bt	Imposed skew	Geo.skew
3,80 m	2,80 m	0,30 m	2,0 t/m3	1,24 m	25 MPa	400 MPa	201,6 MPa	1,40	1,10	1,0	100,0	100,0

Densities pondered loads at S.L.S (t/m²) :

	Q_{min}	Q_{hc}	Q_{hr}	Q_{hr}	M_{c120}
	2,40	5,13	4,84	3,55	3,60
Relative to the maximum charge density	0,47	1,00	0,94	0,69	0,70
Longitudinal impact loads according to imposed skew	*11,40*	*3,48*	*3,33*	*2,33*	*7,83*

units moments

Section	Q (2T)	Q (Tg)	Q (Td)	Unif.pouss.	Trian.pouss.	Cons.phase
1	0,786	-0,193	0,979	-0,097	-0,042	0,000
2	-0,486	0,153	-0,640	-0,389	-0,187	0,000
3	-0,486	0,098	-0,585	0,591	0,315	0,000
4	-0,486	0,044	-0,530	-0,389	-0,202	0,000
5	0,786	-0,078	0,886	-0,097	-0,056	1,188
6	-1,562	-0,650	-0,912	0,195	0,090	0,950
7	0,000	-0,262	0,262	0,000	0,000	0,000
8	0,000	-0,481	0,481	0,000	0,000	0,000
9	-1,562	-0,540	-1,022	0,195	0,104	0,000

Combinations

	Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Cons.phase
1	1	0,70	0	0	0	1,2	0	1	0	1	1
2	1	0,70	0	0	0	0	1	0	1	0	1
3	1	0	1	0	0	1,2	0	1	0	1	1
4	1	0	1	0	0	0	1	0	1	0	1
5	1	0	0	1	0	1,2	0	1	0	1	1
6	1	0	0	1	0	0	1	0	1	0	1

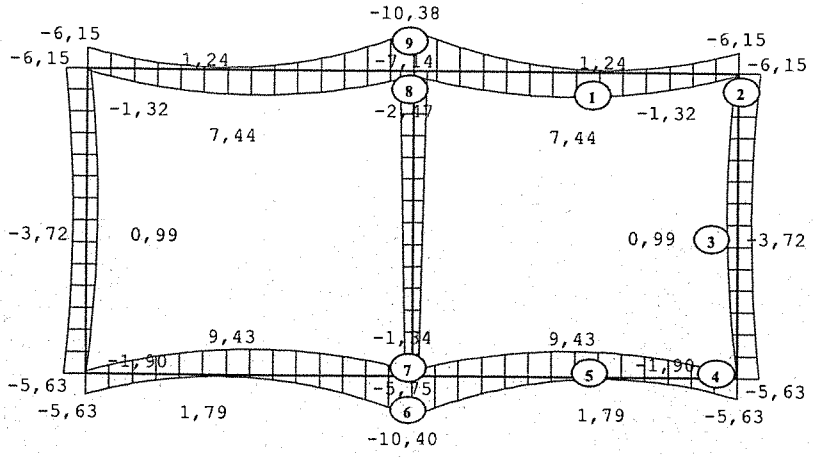
Loads

Pt +Pr	Q (2T)	Q (Tg)	Q (Td)	SRmin	SRmax	P1min	P1max	(P2-P1)min	(P2-P1)max	Phase cons
3,23	5,13	5,13	5,13	0,25	0,50	0,70	1,39	1,40	2,80	2,10

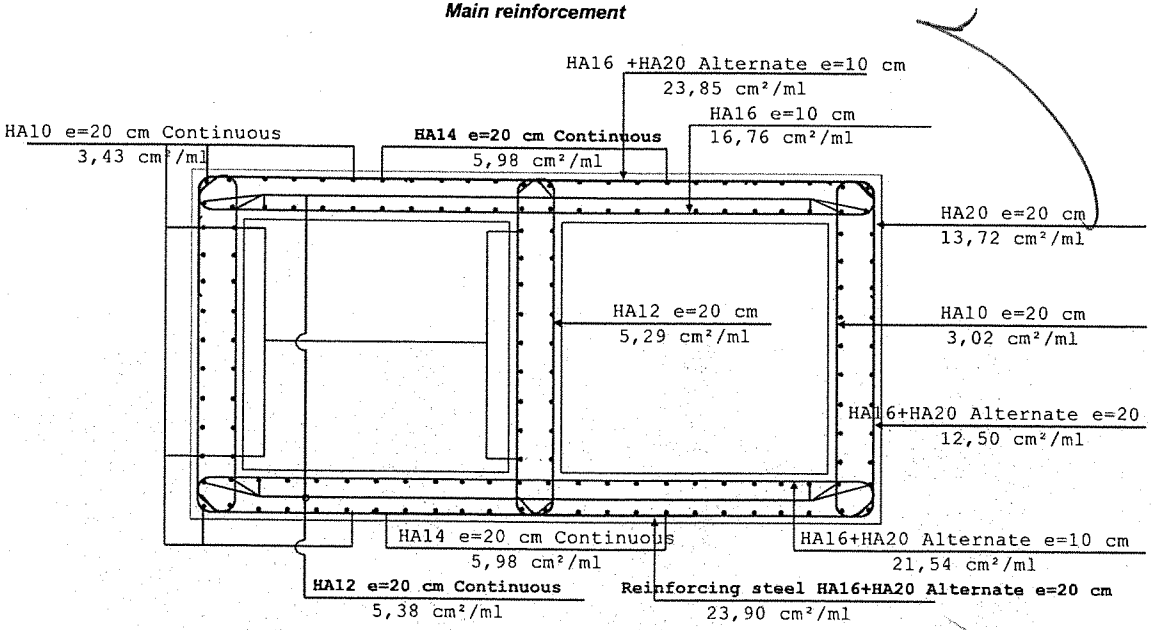
Verification of shear force

τu max = 0,98 Mpa < 0.07 fc28/1.5 = 1,17 Mpa. The transverse reinforcement are not required.

Envelope curve of moments (t.m/ml)



Main reinforcement



ANNEX 3: Reinforcement drawings for box culvert (60 x 60), cover slab and concrete rectangular gutter