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Bid document/Terms of Reference (ToR) for Tendering

Contracting Water Works contractors (WWC) of category/level six and above to conduct the construction of Shawe Gindiba Gojo Phase III SSIP expansion at Shawe kebele in H/Buluk woreda Bale zone Oromia Regional state

1. BACKGROUND

Ethiopia is one of the Sub-Saharan African countries most seriously affected by environmental problems such as land degradation. In order to reduce these impacts, the Government of Ethiopia (GoE), in collaboration with its development partners, has been implementing the Sustainable Land Management Program (SLMP) since 2008. The German Government via Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Kreditanstalt für Wiederaufbau (KfW) has been supporting the Ethiopian Government's efforts with the SLMP from the very beginning, GIZ more particularly with the Sustainable Land Management Program (GIZ SLM) operating in the country's highland regions and with the Strengthening Drought Resilience Program (SDR) which focuses on pastoralist lowland areas. In early 2016, the Federal Democratic Republic of Ethiopia and the European Union (EU) agreed to launch a new support program to SLMP under the title "EU Support to the Sustainable Land Management Program in Ethiopia" (EU Support to SLMP). The action is fully harmonized with the GoE's SLMP results framework, builds on the ongoing SLMP and the aforementioned German Development Cooperation programs and is implemented by GIZ and KfW.

"EU Support to SLMP" is fully harmonized with the GoE's SLMP results framework, contributing to both, the development goal and the environmental goal of the overall objective, namely:

Development goal: "Improve the livelihoods, food security and economic wellbeing of the country's farmers, herders and forest resource users." Indicators:

- Change in rain-fed crop land productivity in SLM investment areas for three major regional crops (t/ha)
- Change in livestock productivity in in SLM investment areas (liter milk/day)
- Number of direct beneficiaries disaggregated by sex

Environmental goal: Rebuild Ethiopia's natural capital assets by overcoming the causes and mitigating the negative impacts of land degradation on the structure and functional integrity of the country's ecosystem resources. Indicators:

- Land area restored or reforested/afforested on both individual and communal land (Ha)
- Land area with sustainable and climate-smart/resilient land management practices (Ha)

"EU Support to SLMP" will focus on three main components/outcomes:

Outcome 1: Smallholder farmers and communities in the selected watersheds/districts adopt and scale-up appropriate sustainable land and water management technologies and practices.

- Land users adopting at least three sustainable and climate-smart/resilient land management practices on individual land disaggregated by sex (# and %)
- Increased area under irrigation in the micro watersheds (Ha)
- Share of micro watersheds, where user groups apply sustainable natural resource management bylaws (%)
- Constructed community and SWC infrastructures sustainably managed by communities (%)
- Individual farmers/user group members involved in SLM based income-generating activities disaggregated by sex (#)

Outcome 2: Capacities, knowledge and skills of key stakeholders (communities, public and private service providers) involved in natural resources management are strengthened.

- Farmers' and development agents' satisfaction with trainings received under SLMP and able to apply the skills and knowledge gained (# and %)
- A context specific SLM approach for the lowlands is developed (#)

Outcome 3: Effective program portfolio management and coordination at the federal, regional, zonal and district levels has been established and operationalised.

- Share of planned versus achieved activities and budgets (%)
- Frequency of SC and coordination meetings at different levels
- Districts with M&E systems (also gender sensitive) that are contributing accurate data up to SLM program level M&E (# and %)

"EU Support to SLMP" will be implemented in eleven woredas located in two different eco-regions in Oromia region: five woredas are found within South Eastern Bale Eco-region, adjacent to Bale Mountains National Park (Dinsho, Goba, Harena Buluk, Dello Mena and Berbere), while six woredas are located in Yayu Eco-region close to Yayu Forest Biosphere Reserve (Bacho, Yayu, Dorani, Hurumu, Alge Sachu and Bilo Nopha). While eight woredas are considered typical highland woredas (Bacho, Yayu, Dorani, Hurumu, Alge Sachu, Bilo Nopha, Dinsho, Goba), three woredas in Bale are characterized as transitional/lowland woredas (Harena Buluk, Dello Mena and Berbere). In these transitional/lowland woredas, "EU Support to SLMP" will support the piloting of context specific measures and will support in of construction different rural infrastructures.

2. OBJECTIVES

Against the above-mentioned background, "EU Support to SLMP" is tendering to contract potential Water work Contractors (WWC) of category/level six and above who have experience and related skill to perform construction of Irrigation scheme at Shawe kebele in H/Buluk woreda of Bale zone Oromia regional state to:

- To mobilize resources required for the construction in the agreed period
- To implement and complete quality construction of irrigation scheme and its infrastructures and handing over to client/employer within the agreed period.

3. SCOPE OF SERVICES

General:

GIZ EU Support to SLMP wants to contract out Irrigation scheme construction works in Shawe kebele H/Buluk woreda of Bale Zone Oromia region. The scheme to be implemented is planned to irrigate additional command area in expanding the capacity in constructing one night storage pond at the downstream end and also it is planned to construct conveyance canals(lined main canal, earthen main canal, chutes, closed pipe) with all

irrigation infrastructures essential for the scheme as per described in BoQ. Therefore, the contractor to be awarded the contract is expected to deploy all necessary qualified personnel and to avail appropriate resources to implement and complete the work within the stipulated time.

Summary of the construction activities

- Construction of lined and earthen main canal totally up to 5km. There are also secondary and tertiary canals as well as drainage canals. At the downstream end near pond, closed pipe is planned to supply water to pond. The main canal receives water from the receiving division box at previous constructed main canal of phase I and conveys up to 5km. It carries 0.096m³/s discharge to irrigate 70 ha of potential land.
- There are also chutes at different locations on MC and SC.
- Drops, division boxes, culverts, off-take,
- One-night storage external dimensions including embankment is about 66mx66m. The pond is protected by constructing barbed wire fence.

The responsibility of the employer is to get site access permission from local administration and assign site supervisor.

The requirements of the work by the contractor are as follows:

1. Supply all construction materials in quality and quantity wise as per specified in the BOQ and technical specification.
2. Mobilize and deploy the essential machines/machinery in the stipulated period and complete the construction activities (all conveyance canals, all farm structures, one-night storage pond, etc as per describe in BoQ).
3. Assign experienced personnel to follow and perform the intended construction as per design
4. Preparation of as built drawing for the work carried out in the final payment

4. LOCATION

Shawe kebele is located in Oromia regional state, Bale Zone H/Buluk district, at distance of 562 km, 142km, and 20 km from Finfinne, Robe town (Zone capital city) and Angetu town (district city) respectively. The UTM Location is 577,607.4 E, 705,916.8 N, and its altitude is 1424m above sea level in command area around night storage pond.

5. TECHNICAL SPECIFICATION

Technical Specifications

1. GENERAL

Definition for some terminology

The “Engineer” is the person named in the Special Conditions of Contract (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the Works and administering the Contract.

The “Site” is the area defined as such in the Special Conditions of Contract.

“Specification” means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.

The “Start Date” is given in the Special Conditions of Contract. It is the latest date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

“Temporary Works” are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

The “Works” are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Special Conditions of Contract.

1.1. Existing Traditional Irrigation

Where works affect access of supplies of irrigation water to existing traditional irrigation, the Contractor shall be responsible for maintaining alternative access and supplies of irrigation water at all time to the satisfaction of the Engineer and the owner.

1.2. Contractors Temporary Workshops, offices etc.

The location and layout of the Contractors temporary works, workshops, stores plant yards, offices, staff housing, camp recreational facilities are already on the site which was built during the first phase construction the scheme. The client and local administration are going to negotiate and facilitate the accommodation with water user committee as much as possible.

1.3. Keeping Works Free of Water

Except where otherwise specified the Contractor shall keep the Site of the works free from water so that the work may be carried out in the dry. He shall construct any temporary divert watercourses and other works and supply and work such pumping plant as may be necessary for this purpose.

Notwithstanding any approval of the arrangements made for the exclusion of water from the works, the Contractor will be responsible for the sufficiency thereof and will be

liable for any loss of production, additional overheads or additional costs of any kind that may results.

1.4. Maintenance of Traffic

The Contractor shall be responsible for providing, maintaining and removing, at his own cost, adequate diversions to roads, access tracks and existing livestock corridors interfered with during the execution of the works, together with the complete cost of any additional policing, sign posting, and the erection of barriers.

1.5. Compensation Water Flow and Past Structures

- 1) The Contractor shall ensure that during the construction of barrages, and other structures across rivers and existing main canal and up to the time of completion of the relevant parts of the Works, the whole natural flow of the rivers shall be allowed to pass the works except for such quantity as the contractor may reasonably require for the execution of the works, unless otherwise directed by the Engineer.

1.6. Interference with Existing

- 1) The Contractor shall not interfere in any way with any existing works whether the property of such works is indicated to the Contractor by the Engineer or not, except where such interference is specifically described as part of the works either in the contractor or the Engineers instructions.
- 2) In pursuance of clause hereof the contractor shall at his own expense provide and effect to the approval of the Engineer such supports as may be required to protect efficiently all structures or works which may be endangered by the execution of the works and he shall remove such supports on completion of the works or otherwise take such permanent measures as may be required by the Engineer to protect the structures or works.
- 3) The contractor is to execute the works in such a manner that he does not damage or interfere with existing services which are located in proximity to the site. The contractor shall be responsible for any damage or interference that may be caused to these services due to execution of the works and shall carry out all necessary repairs at his own expense and to the satisfaction of the Engineer.

1.7. Dimensions

- 1) All dimensions, distances and levels of the designs are indicated in the metric system. When additional and/or working drawings are required, the contractor shall submit these drawings in the metric system. Should the dimensions shown on the drawing to coincide with standard nominal sizes available, reasonable substitutions shall be authorized. No extra payment will be allowed for such substitution without specific approval.

1.8. Abatement of Nuisance

The Contractor shall adopt such measures, as the Engineer may consider reasonable and necessary to minimize nuisance from dust, noise, or other cause. Roads in frequent use with heavy traffic shall be watered a minimum of 3 times a day at appropriate times to be agreed with the Engineer. Other roads within the site shall be

watered at least once each day. The contractor's attention is drawn to the damage to crops, which may be caused by dust. The Contractor is to take such measures as may be necessary to prevent such damage by dust arising from the execution of the Contract.

1.9. Lighting

The Contractor shall install and maintain a system of lighting to provide a reasonable degree of illumination over the area of the Contractor's offices and camp and Engineer's office and accommodation. He shall submit details of his scheme for the approval of the Engineer before any work commences.

1.10. Water Supply

The Contractor shall provide an adequate supply of safe drinking water on the site. The quality, number, capacity and location of the installations shall be to the satisfaction of the Engineer, and conform to the requirements of the appropriate authorities.

1.11. Photographs

Progress photographs in colour will be required of such portions of the works and taken at such times, as may be directed by the Engineer. The Contractor shall arrange for such photographs to be taken and shall promptly supply eight un mounted copies of each progress photograph of a size 250mm. by 200mm. and suitably inscribed. The negatives of the photographs shall be the property of the Employer and no prints from these negatives of the photographs shall be the property of the Employer and no prints from these negatives may be supplied to any person or persons unless under the authority of the Employer or of the Engineer.

1.12. Datum

The levels and grid shown on the drawings are referred to local benchmarks shown on the topographic map of the irrigation system layout, in the execution of the Contract, the Contractor shall refer all works to that datum and grid.

1.13. Surveying

The levels and grid shown on the Drawings are referred to local benchmarks shown on the topographic map of the irrigation layout datum and grid and, the execution of the Contract, the Contractor shall refer all works to that datum and grid.

- The engineer will provide the contractor with all the necessary data for the detailed setting out of the works the setting out of the main pints of the alignments embankment, canals, drains, roads and the centre lines of structures will be executed by the engineer.
- The detail setting out including the marking of all points for the works to be constructed, shall be carried out by the contractor, after the clearing and grubbing, but before the beginning of any other activity.
- The survey instruments to be used by the contractor shall be of a make and type suitable for the work to be executed in a good state of repair and well-adjusted the instruments and/or equipment shall be subject to the approval of the engineer.
- All field books, calculation, maps, etc of the survey activities mentioned above will be handed over to the engineer, immediately after the completion of the survey.
- The Contractor shall give to the engineer a surveying work program 15 days early before preceding any wok and at least 10 days written notice of his intention to commence any particular work of surveying. In these specified dates. If in any case changes his schedules shall notify five days before the date of commencement of the work scheduled as above.

1.14. Medical Arrangements

The contractor shall make arrangements according to the equations in force in Ethiopia, for treatments on the site of casualties and sick persons.

1.15. Inspection of Materials

- The Engineer may employ an inspecting engineer to may inspect materials for the works at the supplier's premises or elsewhere, and in this capacity the inspecting engineer will be regarded as the engineer's Representative with the limitation imposes by of the condition of contract.
- Whenever work is to be done at time when work is not usually in progress, or whenever the regular period for carting out such work is changed, the engineer shall be given notice in sufficient time to arrange for proper inspection.
- It required by the engineer, the contractor should supply copies of orders placed by him for materials to be incorporated in the permanent works so that inspection of the relevant materials can be arranged in sufficient time it considered necessary by the engineer.

1.16. Materials on and under the site

All soil, turf, gravel, stone, timber, or other materials obtained in the excavation, clearing of the site of the works and soil sipping, shall belong to the Employer and must not be removed from the works without the consent of the Engineer. The contractor, however, may use for the consummation of the works timber felled on the site and any of the materials excavated under the contract which the Engineer may determine to be fit for such use and shall use such materials it directed by the Engineer.

1.17. Additional Drawing

- The contractor shall supply all additional drawings for the completion and maintenance of the works these additional drawings must be based on the data and principles of the contract Drawings and be proved and submitted to the engineer in time.
- The Contractor shall supply drawings of all temporary works such as camp buildings water supply, fuel deposit, etc for the engineer.

1.18. Working Drawings and Calculations

The contractor shall submit to the Engineer for approval the following working drawings concerning.

- Shuttering and for molds for the concrete works
- Reinforcement for the concrete works, when not supplied to the contractor by the Engineer or in case of changes
- Bending schedules and bar lists for the steel reinforcement, when not supplied to the contractor by the engineer or in case of changes
- Recast concrete units including the cast in parts such as fasteners, jointing materials, lifting provisions, etc
- Masonry works, all pitching and riprap works
- All steel construction including anchor bolts, templates, etc
- If required, the contractor shall also submit calculates to the engineer for approval
- Alternative designs proposed by the engineer including calculations

- All calculations of concrete mix design

1.19. As built Drawings

The contractor shall prepare and submit to the employer via the Engineer six months prior to issuance of the maintenance certificate six paper copies and one reproducible copy of the so called as built drawings showing clearly all coactions, depths, slopes, heights, shapes and dimensions of all permanent works as executed.

All costs related to the supply to the engineer of the mentioned number of drawings and calculations shall be deemed not to be included in the rates in the bill of quantities any extra copy of the drawings and/or calculations which may be required.

1.20. Demolition and protection of works

- All materials arising from the clearance of structures, houses, etc shall be disposed of at a depot with on a radius of about 1.5km from the place of demolition. the exact location of the depot shall be indicated by the engineer.
- All voids shall be refilled with soil, compacted to the same density, as the surrounding soil and the surface shall be finished to the existing ground level and to the satisfaction of the engineer.
- The permission to remove existing objects as mentioned before shall be his responsibility the permission of remove the objects shall be provided according to the agreed time schedule of the contractor No removal shall take place before the area has temporary works and/or diversions, which have been approved by the engineer.
- Any property situated in the direct proximity of the works shall be protected against any damage, which could be cause, by vehicles, subsidence, vibration, etc. Any damage shall be repaired by the contractor to conform to the condition of the property prior to damage and costs shall be borne by the contractor.

2. EARTHWORK

2.1. Clearance of Ground

- 1) The Contractor shall clear the ground on or below which the works are to be erected by removing vegetation and all superficial obstruction. The combustible material cleared may be disposed of by strictly controlled burning, which shall be approved in each instance by the Engineer.
- 2) Trees, bushes and hedges at the site shall not be cut down, damaged or destroyed without the approval of the Engineer. Trees shall be defined as having a girth exceeding 500mm measured 600 mm above ground level except where a tree has buttresses when the measurement shall be taken immediately above the buttresses.

2.2. Agreement of Existing Ground Levels

- 1) Prior to the start of any earthworks or excavation, but after site clearance, if any, the levels of the existing ground shall be surveyed by the Contractor and agreed between the contractor and the Engineer. If the Contractor fails to take the requisite

levels the ground levels shown on the drawings or determined by the Engineer shall be taken as correct.

- 2) No allowance will be made for normal bulking or shrinking of the soil and the contractor shall make allowance for this in his rates.

2.3. Classification of Excavation

- 1) For purposes of measurement, excavation is classified as follows:

a) Excavation in rock

- i) "Hard rock": - shall be defined as a recent lava flow which may be dry or saturated material which requires the use of drifts, wedges or explosions for its removal and shall not include loose rotten shattered or fractured forms of rocks or boulders less than 0.5 m³ by volume.

"soft rock" :- shall be defined as ignimbrites, welded tuffs, volcanic ash which are dry or saturated and can be loosened or broken down effectively at a standard productivity of a single pass of bulldozer ripper of 285 HP.

- ii) All loose, shattered or fractured rock shall be removed from excavations in rock. Where blasting carries out excavations in rock, the manner and extent of the blasting shall be such as will prevent damage to the surrounding strata or ground or to the Works.

- iii) No excavations in rock shall be carried out by blasting where damage to the surrounding strata or ground or properties or to the works would result thereby. The rates for excavation in rock shall be held to include for excavation by any means, as the circumstances require.

b) Excavation in normal material

- 1) "Normal" material shall be defined as any material not classified as rock.
- 2) For the purpose of payment, items are included in the Bill of quantities for excavation in "normal".
- 3) The classification of excavation shall be agreed by the Engineer and the Contractor as the work proceeds and rocky conditions encountered. In the event of a dispute over the classification of rock, the ruling of the Engineer shall be final and binding.

2.4. Excavated Material

- 1) Excavated material approved by the Engineer for uses as backfill shall be deposited in spoil heaps confined to areas approved by the Engineer.
- 2) Topsoil shall be stored separately from the main excavated material and no account disposed of without the approval of the Engineer.
- 3) The Contractor shall include in his excavation rates for removing to tip all surplus excavated material, rubbish and waste matter and for providing tips and leaving them with an acceptable appearance, all to the approval of the Engineer.

2.5. . Timbering and Dewatering of Excavations

- 1) The Contractor shall carry out timbering in accordance with the relevant requirements or as may be necessary to protect life, property and structures adjacent to the work, the work itself.
 - 2) All open excavation shall be securely timbered with suitable timber (or alternative form of sheeting other than timber) as may be required and whenever necessary to the satisfaction of the Engineer at the Contractor's expense. Timber shall not be left in the excavations as they are being filled up unless authorized by the Engineer.
 - 3) Every precaution shall be taken by the Contractor against slips and falls, and the like in the excavations, but if any slips or falls should occur the Contractor shall at once make good the same including all surface restoration and reinstatement, all at his own cost. If any such fall or slip disturbs or weakens any foundation or support to the works or adjacent buildings, pipes, etc. or causes a space to exist outside the new work itself the Contractor shall execute such additional works as the Engineer may require in consequence thereof and fill up the space so caused, with concrete if necessary, as the Engineer may direct, all at the Contractor's own expense.
 - 4) All excavation shall be kept free from water until construction work is complete and for such time as the Engineer considers necessary to safeguard the permanent work all at the Contractor's own expense.
 - 5) The Contractor shall be deemed to have included in his rates for excavation for the supply and operation of all pumps and the construction of any sumps or temporary drains necessary. Should any damage because by prolonged or excessive pumping, the Contractor at his own cost and to the Engineer's approval shall carry out making good.
 - 6) The Contractor shall comply with all instructions of the Engineer regarding the supporting of the sides and dewatering of trenches or pits but shall not be relieved of his responsibilities under the Contract because no objection has been raised to the condition of the work.
- 2.6. Preparation, Inspection and Blinding of Foundations
- 1) Where stated on the Drawings or elsewhere in the Specification, the excavation shall be carried out as described and the Final Surface treated as specified.
 - 2) The faces of excavations shall be clean and trimmed to the required lines and levels. Any parts of the formation inconsistent with the nature and texture of the main formation shall be removed if authorized by the Engineer, and the voids so formed filled with a material and in a manner approved by the Engineer. Such extra excavation including filling will be paid for by the Employer provided it is not caused by any action or negligence by the Contractor.
 - 3) Where the Final Surface is damaged or allowed to deteriorate through instructions not being complied with, the cost of the re-excavation to a firm base and making up with Grade C-15 lean mix concrete shall be borne by the Contractor.

- 4) If any slips or falls occur, the Contractor shall immediately make good the same including all surface restoration, all at his own expense.
- 5) The contractor shall stop excavation at a minimum depth of 150mm above any Final surface to be blinded. The final 150 mm excavation shall not be carried out until the Contractor is ready to protect the Final surface with blinding.
- 6) The Contractor shall not excavate below the formation level or beyond any exposed faces shown on the Drawings. Any over-excavation shall be backfilled and compacted at the Contractor's expense.
- 7) The Contractor shall give due notice to the Engineer whenever any such work or foundation is about to be ready for examination and no further work shall proceed thereon until the Engineer's approval is given.
- 8) The Contractor shall at all times afford protection to any exposed formation to obviate deterioration and, where applicable, blinding concrete shall be laid immediately following the Engineer's approval of the formation.

2.7. Filling in general

- 1) Filling embankments, refilling of trenches and other earthworks shall be formed with spoil selected or approved by the Engineer. The spoil shall be placed in layers not exceeding 150 mm thick, or such other thickness as Engineer may approved after the Contractor has demonstrated the capabilities of this plant, thoroughly compacted in accordance with clause 2.16 herein and trimmed to the levels and slope required.
- 2) The contractor shall make good in a manner as directed or approved by Engineer any damage or defects to the works caused by settlements, slips or falls in earth works and shall do all necessary work to prevent the same.

2.8. Borrow pits and quarries

- 1) If because of an insufficiency or spoil suitable for use as filling, compaction or if because of other circumstances the Engineer so agrees or orders, the Contractor shall obtain spoil for filling and may obtain other materials from approved borrow pits or quarries
- 2) The Contractor shall investigate the site or sites, which he proposes to open up, and shall provide information by means of boreholes or trials pits to satisfy the Engineer that the quality and quantity of material are suitable for the works. The Engineer may require the Contractor to investigate further until he is satisfied that adequate supplies of the required materials are assured from the proposed site or sites.
- 3) The Contractor shall be responsible for devising and effecting to the satisfaction of the Engineer, methods of working the pit or quarry so as to produce material so graded in size that a dense and stable mass of fill could be produced.
- 4) The pits and quarries shall be run in a safe manner and on completion of the works, the Contractor shall carry their reinstatement to the satisfaction of the Engineer by leaving them in a safe, tide, regular and self-draining state. All loose rock on

upstanding faces shall be barred down and no face shall be left overhanging except with the approval of the Engineer.

- 5) Notwithstanding, the foregoing, the Engineer shall have the right to order the Contractor to obtain materials from a particular source designated by him, in which case the Employer will pay any extra haulage which the Engineer is satisfied thereby incurred by the Contractor.
- 6) The Engineer may order spoil for fillings to be obtained by widening certain cuttings for permanent works beyond the specified profile. The cost such widening including all trimming to smooth and even slopes will be paid for at the rates inserted for excavation in similar ground.

2.9. Canal and pond excavation

- 1) The Excavation of all canals and drains shall be executed in such a manner as to ensure that undercutting does not endanger the side slopes. Should undercutting occur the Contractor shall take necessary measures to the approval of the Engineer to prevent slips, including back filling, compacting and trimming to the required slope or pitching or timber piling or cement stabilization as may be necessary to prevent subsequent erosions. All such remodel measures shall be at the Contractors expense.
- 2) The Contractor shall notify the Engineer without delay of any permeable strata, fissures or unsuitable ground encountered during excavation.

- 2.10. For the sake of completion in time and to be economical, the contractor should commence excavation of canal and pond using machine base (i.e. the contractor should supply and arrange excavator with different and appropriate buckets size for different canal size excavation).

2.11. Preparation of embankment foundation

Unless otherwise directed, the topsoil and other unsuitable materials shall be removed from the foundations of canal embankments and pond embankment.

Where material occurs below formation level in cuttings or on the sites of embankments which is unsuitable to remain in these position it shall, as required by the Engineer, be removed, displaced or treated in such a manner as will render it suitable.

To avoid interference with the constructing of structures, the Contractor may suspend work on embankments and/or cuttings forming the approaches to structures until such time as the construction of the latter is sufficiently advanced to permit the completion of the approaches without the risk of interference or damage the works.

2.12. Canal embankments and Pond embankment

The Canal embankments and pond embankment shall be built to the dimensions and side slopes shown on the drawings or as otherwise directed by the Engineer.

The embankments shall be hand trimmed to provide finished surfaces of neat and even appearance and with alignment and regularity of surface to the satisfaction of the Engineer.

Where the material in the embankment has been excavated in the wet, the trimming shall be carried out when the material has dried to a condition and due allowance shall be made for any further drying and shrinkage of the material.

2.13. Uncompacted filling in embankments

Excavated spoil surplus to requirements for filling may be deposited in embankments at the sides of the canals as shown on the drawings. The spoil need not be compacted but shall be placed in approximately horizontal layers, the thickness of which shall not exceed 1 meter. To prevent large unsightly embankments the Engineer may direct that in deep out the spoil be deposited in other parts of the works or in the spoil tips.

2.14. Compacted fill

In general, the specified source for the material for compacted fill in the canal and embankments will be the canal or drain excavation.

Where suitable material for compacted fill is not available in the adjacent canal or pond excavation the deficiency shall be made available from canal or pond excavation at other sections or from borrow pits, drains or elsewhere. Before starting the excavation of canal, the Contractor shall submit to the Engineer for his approval a mass haul diagram showing his proposals for obtaining this fill and giving for each section along the canal, the quantity to be placed as loose fill or spoil in the adjacent embankments or in spoil tips.

Material for fill shall be free from all organics material. Material for compacted fill, unless otherwise directed, shall not contain rock or boulders. All material shall be to the approval of the Engineer.

2.15. Compaction of soils

- 1) The fill shall be placed in uniform layers not exceeding 150mm loose thickness or such other thickness, which the Engineer may approve, and each layer shall be compacted until the required degree of compaction has been obtained using VIBRATORY ROLLER machine for pond embankment compaction. The degree of compaction required would be 95 percent of the maximum dry density of the fill material as determined by the laboratory compaction test method for moisture density relationship using the Lower Comparative Effort (L.C.E.). The in-situ dry density of the compacted fill material will be determined by the sand replacement method. The Contractor will carry out tests on the formation during the placement and compaction has been obtained. However, the backfill and compaction at canal embankment shall be conducted using simple hand compactor machine.
- 2) The moisture content of the soil shall be carefully controlled either by natural drying or wetting with a fine spray. In general, material approved for fill must have natural water content close to the optimum water content for compaction.
 - If the fill material is too wet, it shall be scarified or disked and aerated until the proper water content is attained. When the specified compaction density is not being obtained, placing of additional fill shall stop and the material in place shall be scarified, adjusted in water content and re-compacted until the required compaction is obtained.
 - Adequate compaction, equipment for uniform compaction to the specified density must be on hand before any fill operations are started by the Contractor

2.16. Scarifying of Surfaces

Where fill in embankment is to be compacted, the surface of the ground under the embankment shall be scarified and compacted to a depth of 0.15-0.20 meters so as to provide a satisfactory bond between the ground and the fill. The moisture content of the scarified surface shall be carefully controlled, either by natural drying or by wetting with a fine spray. If, for any reason, progress in compacting the fill is interrupted for an unreasonable time, the surface of the fill shall be scarified before compaction continues. All costs in connection with this work shall be included in the rates.

2.17. The rates for compacted fill shall include:

- Excavation holding deposition of excavated material from approved inner
- The selection of suitable material
- Forming the embankment as specified in Clause 2.11 above
- Scarifying or disking the surface of the ground as specified in clause 2.15
- Compacting the soil as specified in 2.14
- Wetting or drying of soil as mentioned in 2.15
- Trimming of the finished embankment to the lines and levels as shown on the Drawings
- The facilitation of test apparatus and any work, which is necessary to enable the Engineer to carry out, field tests.

2.18. Reinstatement

- 1) The Contractor shall be responsible for the temporary and permanent reinstatement of roads, fields, paths, gardens, verges and the like, whether public or private, which are affected by his operations.
- 2) When in the opinion of the Engineer a suitable period has elapsed after temporary reinstatement has been completed for there to be no further settlement, he shall allow the Contractor to carry out the permanent reinstatement. This shall not in any way relieve the Contractor of his responsibility for reinstatement and, should any further unforeseen settlement take place, the Contractor will be required to make good the reinstatement at his own expense.
- 3) Permanent reinstatement means that the ground surface shall be restored to its original form and condition.
- 4) Any diverted watercourses shall be reinstated in their former positions
- 5) And topsoil shall be spread where the ground has been stripped. The Contractor shall be deemed to have included in the rates entered in the Bill of Quantities for the full cost of such reinstatement.

3. MATERIALS SECTION

3.1. Workmanship and Material General

All workmanship shall be of the best quality appropriate to each category of work unless the materials used in the works shall approved by the Engineer all materials used in the works shall be of the best quality of their respective kinds as specified or described in the specification. Drawings and Bill of quantities shall comply wherever possible with the current issue of the appropriate standard published by the ASTM or other equivalent approved National standard.

3.2. Approval of Concrete Constituents

- 1) The Contractor shall submit to the Engineer full details of all materials, which he proposes to use for making structural or non-structural concrete as defined in related Clause above. No concrete shall be placed in the permanent works until the Engineer has approved the materials of which it is composed. Approved materials shall not thereafter be altered or replaced by other materials without the consent of the Engineer.

3.3. Water for Concrete and Mortar

- 1) Water for mixing or curing of concrete or mortar shall be to the approval of the Engineer not contain more than the following concentrations of impurities:

Max ppm

- | | |
|---|------|
| ▪ The sum of sulphates, alkali carbonates and bicarbonate | 1000 |
| ▪ Chlorides | 500 |
| ▪ Suspended solids | 2000 |
| ▪ Other dissolved solids | 2000 |
| ▪ Seawater or brackish water shall not be used | |

- 2) The results of the analysis shall be submitted to the Engineer. The sample of water sent for analysis shall be taken in the presence of the Engineer.
- 3) If the source of water is changed, it shall be tested as above. If the water contains over 80 per cent of the maximum concentrations of impurities properties given above it shall be re-tested at two monthly intervals.

3.4. Aggregates for Concrete

3.4.1. General Requirement

- a) Fine and coarse aggregates shall comply to the Standards approved and in addition they shall be chemically inert to alkali reaction and sound. There shall have moisture absorption of less than 2 percent.
- b) Aggregates of rounded shape or otherwise capable of producing concrete of good workability with the minimum addition of water shall be preferred.
- c) The Contractor shall ensure that the nature and grading of aggregates remain reasonably constant, and shall, if necessary, stockpile and include different grading to ensure that the overall grading remains constant for each section of the work.
- d) Dust or flour resulting from crushing the aggregate shall not be allowed to contaminate the stockpiles. When, in the opinion of the Engineer such contamination has taken place it shall be removed by an approved means.

- e) For mass concrete, in order to improve the consistency of the mix, dust or flour resulting from crushing the aggregates, may subject to test, be included in controlled quantities to supplement the fine aggregates.
- f) The aggregates of various sizes shall be kept separately and from all possible contamination and shall be stored on a hard-standing area or in bins, provided with proper drainage at the base of the stockpiles.

3.4.2. Grading

Except where aggregates have been otherwise specified on the Drawings the grading of the aggregates shall be as follows.

Coarse Aggregate:

- a) 10mm max. Size, graded, for all "fine" concrete.
- b) 20mm max. Size, graded, for all reinforced concrete in beams and for walls and slabs.
- c) 36mm max. Size graded for all mass concrete walls and slabs.

Fine Aggregate:

- a) For Nominal mixes, where permitted to be used, natural sand aggregate only shall be used except for non-structural concrete Class C-10(1:3:6) where all-in aggregates may be used.

3.4.3. Testing

a) Acceptance Testing

- i) The Contractor shall deliver to the Engineer samples containing not less than 50 kg of any aggregate, which he proposes to use in the permanent works, and shall supply such further samples as the Engineer may require. Each sample shall be clearly labeled to show its origin and shall be accompanied by all the information in BS 882.
- ii) Tests to determine compliance of the aggregates with all the requirements of this Specification shall be carried out by the Contractor in a laboratory acceptable to the Engineer. If the tested materials fail to comply with the Specification, further tests shall be made in the presence of the Contractor and the Engineer and acceptance of the material shall be based on such tests.
- iii) The acceptance tests carried out by the Contractor shall generally be on three representative samples of fine and coarse aggregates taken in the presence of the Engineer. Total numbers of tests required for acceptance are as follows:

Table 1

Test	Fine Aggregates	Coarse Aggregates
Water Absorption	--	3*
Flakiness Index	--	3*
Shell Content Determination	--	3*
Test for shell content (where required)	--	1
10% Fines Test or Aggregate Impact Value	--	3*

Grading	3*	3 on each nominal size
Chloride Content	3*	3*

 * One test on each sample

Test	Fine Aggregates	Coarse Aggregates
Sulphate Content	3*	3*
Soundness	--	3*
Petrography Examination	As required Minimum 3	As required Minimum 3
Clay, silt and dust determination	3	3
organic impurities	3	3

- iv) If at any time a significant physical or chemical change in the nature of the coarse or fine aggregate occurs, or a new source aggregate is used, the Engineer may direct that some of all of the acceptance testing is repeated.

b) Routine Testing

- i) The Contractor shall carry out routine testing of aggregates for compliance with the Specification during the period in which concrete is being produced for the permanent works. The tests set out below shall be performed on aggregates from each separate source on the basis of one set of tests for each day on which aggregates are delivered to site provided that no set of tests shall represent more than 250 tones of fine aggregate nor more than 500 tones of coarse aggregate, and provided also that the aggregates are of uniform quality. If the aggregate from any source is variable, the frequency of testing shall be as instructed by the Engineer.

- Grading B5 812
- Silt and clay content B5 812
- Moisture content B5 812
- Check on organic impurities Test A3 in Appendix A.

- ii) In addition to the above routine tests, the Contractor shall carry out the following tests at the frequencies stated:

- Moisture content: As frequently as may be required in order to control the water content of the concrete as required by the Specification.
- Chloride Content: As frequently as may be required to ensure that the proportion of chlorides in the Aggregates does not exceed the limit stated in the Specification.

- iii) The Contractor shall take account of the fact that when the chloride content is variable it may be necessary to test every load in order to prevent excessive amounts of chloride contaminating the concrete. For this purpose the Contractor shall use the rapid field test described in Appendix A (the quanta test). In the event of disagreement

regarding the results of the field test, the chloride content of the aggregate shall be determined in the laboratory as described in BS 812 (the Volhard test).

3.4.4. Delivery and Storage of Aggregates

- a) Aggregates shall be delivered to site in clean and suitable vehicles. Different types or sizes of aggregate shall not be delivered in one vehicle.
- b) Each type or size of aggregate shall be stored in a separate bin or compartment having a base such that contamination of the aggregate is prevented. Dividing walls between bins shall be substantial and continuous so that no mixing of types or sizes occurs.
- c) The storage of aggregates shall be arranged so that as far as possible rapid drying out in hot weather is prevented in order to avoid sudden fluctuations in water content. Storage of fine aggregates shall be arranged so that they can drain sufficiently before use in order to prevent fluctuations in water content of the concrete.

3.5. Cement

- 1) For use in the permanent works shall be Ordinary Portland Cement of an approved type complying to approved standards.
- 2) Cement shall be free flowing and free of lumps. It shall be supplied in the manufacturer's sealed unbroken bags or in bulk.
- 3) Bagged cement shall be transported in vehicles provide with effective means of ensuring that it is protected from the Weather.
- 4) Bulk cement shall be transported in vehicles or in containers built and equipped for the purpose.
- 5) Cement in bags shall be stored in a suitable weatherproof structure of which the interior shall be dry and well ventilated at all times. The floor shall be raised above the surrounding ground level and shall be so constructed that no moisture rises through it.
- 6) Each delivery of cement in bags shall be stacked together in one place separate from other deliveries. The bags shall be closely stacked but shall not be stacked against an outside wall. If pallets are used, they shall be constructed so that bags are not damaged during handling and stacking. No stack of cement bags shall exceed 3m in height. Different types of cement in bags shall be clearly distinguished by visible markings and shall be stored in separate stacks.
- 7) Cement from broken bags shall not be used in the permanent Works.
- 8) Cement in bags shall be used in the order in which it is delivered.

- 9) Bulk cement shall be stored in weatherproof silos, which shall bear a clear indication of the type of cement contained in them. Different types of cement shall not be mixed in the same silo.
- 10) The Contractor shall provide sufficient storage capacity on site to ensure that his anticipated program of work is not interrupted due to lack of cement having due regard to factors outside the Contractor's control.
- 11) Cement, which has become hardened or lumpy or fails to comply with the specification in any way, shall be removed from the site.
- 12) The manufacturer or the Contractor shall test all cement used in the permanent works in a laboratory acceptable to the Engineer. The Contractor shall supply two copies of each test certificate to the Engineer.
- 13) Cement which is stored on site for longer than one month shall be retest in a laboratory acceptable to the Engineer at the rate of one set of tests for every 200 tonnes or remaining part of any single delivery, whichever is the lesser amount. Testing shall be repeated at monthly intervals thereafter. .
- 14) Cement, which does not comply with the specification, shall not be used in the permanent works.
- 15) The Contractor shall keep full records of all data relevant to the manufacture; delivery, testing and use of all cement used in the permanent works and shall provide the Engineer with two copies thereof.

3.6. Mortar

- 1) Mortar shall be composed of fine aggregate as specified in Clause 3.3 and the type of cement as specified in Clause 3.5 The mix proportions shall be as stated on the Drawings or if not stated shall be one part of cement to three parts of fine aggregate by weight.
- 2) Small quantities of mortar may be hand mixed but for amounts over 0.5 m³ a Mechanical mixer shall be used.
- 3) The Water content of the mortar shall be as low as possible consistent with the use for which it is required but in any case, the water/cement ratio shall not be more than 0.5
- 4) Mortar, which is specified, as 'dry pack' shall be mixed with sufficient water for the mix to become cohesive but not plastic when squeezed in the hand. Dry pack mortar shall be rammed into the cavity it is required to fill, using a hand rammer with sufficient force to ensure full compaction.

3.7. Reinforcement

1. Reinforcement steel shall be either hot rolled round mild steel bar, or deformed cold worked steel bar, to appropriate standards.
2. The Contractor shall obtain from his supplier certificates of the mechanical and physical properties of the reinforcement and shall submit them to the Engineer for approval.
3. At the time of fixing, reinforcement shall be free from loose mill scale, rust scale, and shall not be contaminated by grease, dirt, oil, paint, soil or any other agency, which may impair the bond or initiate or accentuate any reinforcement corrosion.
4. Tying wire for steel reinforcement shall be 1.6mm diameter annealed soft iron wire.
5. Cover and spacers shall be designed to maintain the correct clear cover or concrete over steel reinforcement, shall be as small as possible consistent with their purpose, and of a shape acceptable to the Engineer.
6. Concrete cover blocks shall be manufactured with a 10 mm maximum aggregate size and otherwise produces to the same specification as the surrounding concrete. Wire cast in the block for the purpose of tying it to the reinforcement shall comply with sub clause 3.7 (4).
7. Spacers shall be of rustproof material and shall not produce staining, or otherwise be detrimental to the concrete or steel.

3.8. Form work

- 1) The formwork may be of seasoned, planed, tongued and grooved timber, plywood, blackboard, and tempered hardboard, steel or as specified on the Drawings.
- 2) All timber used for form work shall be sound wood, well seasoned and free from loose knots, shakes, large checks, warping and other defects. Before use on the work, it shall be properly stacked and protected from injury from any source. Any timber that becomes badly warped or cracked, prior to the placing of concrete shall be rejected. All form work for outside surfaces above final ground level shall be either tongued and grooved or provided with a suitable lining to produce a smooth surface finish.

4. CONCRETE AND FORMWORK

4.1. Definitions

1. Structural concrete is any class of concrete, which is used, in reinforced, pre stressed or un reinforced concrete construction, which is subject to stress and which is required to comply with other clauses of the Specification.
2. Non-structural concrete is composed of materials complying with the Specification but for which no strength requirements are specified and which is used only for filling voids and similar purposes where it is subjected to significant stress.
3. A formed surface is a face, which has been cast against formwork. A free surface is a horizontal or nearly horizontal surface produced by spreading or trio welling to the level and finish required. A pour refers to the operation of placing concrete into any

mould, bay or form work, etc..., and also to the volume that has to be filled. Pours in vertical succession are also referred to as lifts.

4. Water/cement ratio is the ratio by weight of the free water in the mix divided by the weight of cement in the mix. Free water is the water in the mix including water absorbed by the aggregate.
5. Forms, form work or shuttering shall mean all temporary moulds forming the concrete to the required shape together with any special lining that may be required to produce the concrete finish specified.
6. False work or cantering shall mean the furnishing, placing and removal of all temporary construction such as framing, props and struts required for the support of forms.

4.2. Standard Specifications

Concrete and all related work shall conform to the specifications hereunder or to other equivalent standards approved by the Engineer.

4.3. Concrete

4.3.1. Concrete Mixes & Requirements

- 1) The mix proportions shall be selected to ensure that the workability of the fresh concrete is suitable for the conditions of handling and placing, having regard to the structural element being constructed, the disposition of reinforcement, the climatic conditions prevailing and the limitations set by Table 3.2 of this clause for the particular class of concrete specified.
- 2) Notwithstanding the strength requirement of this Specification, in order to ensure adequate durability of the finished concrete, While at the same time limiting its shrinkage characteristics the limits shown in Table 2 shall not be exceeded.

Table 2 Concrete and Water-Cement Relationships

Class of Concrete	W/C By weight) Max	Total Water Per 50kg of Cement (Liters)	Cement Content per M3 of finished Concrete (kg) Min
C-15(1:2:4)	0.55	27.5	265
C-20(1:1.5:3)	0.50	25	272
C-25(1:1:2)	0.50	25	295
C-30(1:0.75:1.5)	0.50	25	350

- 3) In all cases of mix proportion, the added water shall be included with due allowance for the moisture contained in the aggregate and shall be the minimum consistent with the workability requirements. Where difficulty is experienced in maintaining the correct workability for the water cement ratio outlined in Table 2 the use of a water reducing additives may be permitted by the Engineer.

- 4) Where the concrete is to be used in structures protected from the elements, which are not water retaining, the water content indicated in Table 2 may be increased by 2 liters per 50 kgs of cement.

4.3.2. Cyclopean Concrete

Cyclopean Concrete is to be formed using the available large rocks from the approved source by the Engineer. Clean cobbles or quarried rock size 300-500mm to 20mm are to be placed in approximately 600mm. Concrete class C-15 is placed in such away as to fill the interstices and bind the mass together. The result is approximately 40 percent concrete and 60 percent cyclopean rock. Concrete is to be placed with large bottom dump buckets, lowered to discharge directly over and into the rock mass. Concrete can also be poured using pipe hoses for the advantage to discharge at a more uniform rate and with less segregation and laitance.

4.3.3. Strength

- 1) The basis for assessing the strength of concrete shall be related to the characteristic strength, defined as the Strength of the concrete at 28 days, as determined by an approved standard method of testing below which not more than 5% of the test results shall fall.
The relationship between the class of the concrete and characteristic Strength shall accord with Table 3.

Table 3 Concrete Strength Requirements

Class of Concrete	Characteristic Strength MN/m ²	
	28-Days	7-Days
C-15	15	11
C-20	20	15
C-25	25	19
C-30	30	22

4.3.4. Mixes

- 1) Structural concrete proportion shall be determined either by an approved Mix Design Method or by using the Standard Mixes set out in Table 4 having regard for the limitations indicated for fine aggregate grindings referred to under section 3.3 for small sections of work the Engineer may give permission for Nominal Mix proportioning to be used. Non-structural Concrete shall conform to the requirement set out in Table 4.
- 2) If in the opinion of the Engineer, the Standard Mix or Nominal Mix methods of Proportioning will not produce concrete to satisfy the requirements of this specification, the mix shall be designed.
- 3) Details of the designed mixes shall be subject to the approval of the Engineer before use.
- 4) Proportions for the several classes of concrete shall conform to the requirements of Table 4 and 5.

Table 4

Class of Concrete	Approx. Volume of aggregate m3 per ton cement		Min. Cement Per m3 finished Concrete kg	Remark
	Fine	Coarse		
Non-Structural Class C-10	5		186	Aggregates max, size not exceeding 36mm All-in aggregate permitted.
Class C-15	0.7	2.5	265	Aggregate max. Size to be natural sand.

4.3.5. Production

- 1) Aggregates cement and volume batching shall proportion water.
- 2) The amount of water added shall conform to the requirements of Table 2

4.3.6. Workability

- 1) Workability of fresh concrete shall be such that the concrete can be handled and places without segregation and, after compaction, shall completely fill the Form work and around all reinforcement and ducts.
- 2) The quantity of water used shall not exceed that required to produce a concrete with appropriate workability to be placed and compacted in the required location.

4.4. Transporting, placing and compacting

- 1) Concrete shall not be placed in any part of the permanent works until the Engineer's consent has been given in writing, and the Contractor shall give the Engineer at least 18 hours notice of his intention to place concrete.
- 2) The time elapsing between mixing and placing a batch of concrete shall be as short as practicable and in any case no longer than will permit completion of placing and compaction before the onset of initial set. If the placing of any batch of concrete is delayed beyond this period, the concrete shall not be placed in the permanent works.
- 3) If concrete placing is not commenced within 24 hours of the Engineer's consent, the Contractor shall again request written consent as specified above.
- 4) The concrete shall be discharged from the mixer such that the loss of slump between discharge from the mixer and placing shall not exceed 25mm.
- 5) Excavated surfaces on which concrete is to be deposited shall be prepared as set out in section 3 of the Specification.
- 6) Existing concrete surfaces shall be prepared as set out in the relevant clauses. Before deposition of further concrete they shall be clean, hard and sound and if required by the Engineer shall be wet but without any freestanding water.
- 7) Any flow of water into an excavation shall be diverted through proper side drains to a sump, or be removed by other suitable methods that will avoid washing away

the freshly deposited concrete or any of its constituents. When they are no longer required any under drains constructed for this purpose should be completely grouted up or dealt with by a method agreed by the Engineer.

- 8) If so instructed by the Engineer rock surfaces against which concrete is to be placed shall receive a prior coating of mortar mixed in the proportions similar to those of the fine portion in the concrete to be placed. The mortar shall be kept a head of the concrete. The mortar shall be well worked into all parts of the excavated surfaces and shall be not less than 5 mm thick.
- 9) If any fissures have been cleaned out as described in the Specification or as instructed by the Engineer, they shall be filled with the mortar or with concrete as instructed by the Engineer.
- 10) The amount of mortar placed at any one time shall be limited so that it does not dry out or set before being covered with concrete.
- 11) The concrete shall be deposited as neatly as possible in its final position. It shall be placed so as to avoid segregation of the concrete and displacement of the reinforcement, other embedded items, or Formwork. It shall be brought up in layers approximately parallel to the construction joint planes and not exceeding 500mm in compacted thickness unless otherwise permitted or directed by the Engineer, but the layers shall not be less than four times the maximum nominal size of aggregate in thickness.
- 12) Layers shall not be placed so that they form feathered edges nor shall they be placed on a previous layer, which has taken its initial set. In order to comply with this requirement, a layer may be started before completion of the preceding layer.
- 13) All the concrete in single bay or pour shall be placed as a continuous operation. It shall be carefully worked round all obstruction, irregularities in the foundations and the like so that all parts are completely full of compacted concrete with no segregation or honeycombing. It shall also be carefully worked round and between water stops, reinforcement, embedded steelwork and similar items that protrude above the surface of the completed pour.
- 14) All work shall be completed on each batch of concrete before its initial set commences and thereafter the concrete shall not be disturbed before it has set hard. No concrete that has partially hardened during transit shall be used in the permanent works and the transport of concrete from the mixer to the point of placing shall be such that this requirement can be complied with.
- 15) Concrete shall not be placed during rain, which is sufficiently heavy or prolonged to wash mortar from coarse aggregate on the exposed faces of fresh concrete. Means shall be provided to remove any water accumulating on the surface of the placed concrete. Concrete shall not be deposited into such accumulations of water.
- 16) In dry weather, covers shall be provided for all fresh concrete surfaces, which are not being worked on. Water shall not be added to concrete for any reason.

- 17) When concrete is discharged above its place of final deposition, segregation shall be prevented by the use of chutes, down pipes, trucking, baffles or other appropriate devices.
- 18) Forms for walls, columns and other thin sections of significant height shall be provided with openings or other devices that will permit the concrete to be placed in a manner that will prevent segregation and accumulations of hardened concrete on the formwork or reinforcement above the level of the placed concrete.
- 19) When it is necessary to place concrete under water the Contractor shall submit to the Engineer his proposals for the method and equipment to be employed. The concrete shall be deposited either by bottom-discharging watertight containers or through funnel-shaped remise which are kept continuously full with concrete up to a level above the water and which shall have the discharging bottom fitted with a trapdoor and immersed in the concrete in order to reduce to a minimum the contact of the concrete with the water. Special care shall be taken to avoid segregation.
- 20) If the concrete in a termite pipe is allowed to fall to such an extent that water enters the pipe, the latter shall be removed from the pour and filled with concrete before being again lowered into the placing position. During and after concreting under water, pumping or de-watering in the immediate vicinity shall be suspended if there is any danger that such work will disturb the freshly placed concrete.
- 21) If concrete placing is interrupted for any reason and the duration of the interruption cannot be forecast or is likely to be prolonged, the Contractor shall immediately take the necessary action to form a construction joint so as to eliminate as far as possible feather edges and sloping top surfaces and shall thoroughly compact the concrete already placed in accordance with the Specification. All work on the concrete shall be completed while it is still plastic, and it shall not thereafter be disturbed until it is hard enough to resist damage.
- 22) Equipment and materials to comply with this requirement shall be readily available at all times during concrete placing.
- 23) Before concreting is resumed after such an interruption the Contractor shall cut out and remove all damaged or un compacted concrete, feather edges or any other undesirable features and shall leave a clean sound surface against which the fresh concrete may be placed.
- 24) If it becomes possible to resume concrete placing without contravening the Specification and the Engineer consents to resumption, the new concrete shall be thoroughly worked in and compacted against the existing concrete so as to eliminate any cold joints.
- 25) Unless otherwise agreed by the Engineer, pours shall not be more than two meters high and shall as far as possibly have a uniform thickness over the plan area of the pour. Concrete shall be placed to the full planned height of all pours except in the event of an interruption to placing in which case action shall be taken as specified.

- 26) The Contractor shall plan the dimensions of pours in such a way that thermal or shrinkage stresses are minimized.
- 27) The Contractor shall arrange that as far as possible the intervals between placing successive lifts of concrete in one section of the permanent works be of equal duration. This duration shall normally be not less than neither three nor more than seven days under temperate weather conditions unless otherwise agreed or instructed by the Engineer.
- 28) Where required by the Engineer to limit the opening of construction joints due to shrinkage, concrete shall not be placed against adjacent concrete, which is less than 21 days old.
- 29) If concrete has to be placed against recently cast concrete within a period of less than 21 days, the pour shall be carried out as early as possible after the adjacent pour, but precautions shall be taken to minimize shrinkage. The methods described in clause 5.8 can be used to that effect. However the Contractor shall submit for approval a proposed method and program for placing of concrete.
- 30) When the Drawings call for contraction gaps in concrete these shall be of the widths and in the locations shown on the Drawings.
- 31) The concrete shall be fully compacted throughout the full extent of the placed layer. It shall be thoroughly worked against the formwork and around any reinforcement and other embedded items, without displacing them. Particular care shall be taken at arises and other confined spaces. Successive layers of the same pour shall be thoroughly worked together.
- 32) Concrete shall be compacted with the assistance of mechanical immersion vibrators, unless the Engineer agrees to another method.
- 33) Immersion vibrators shall operate at a frequency of between 7,000 and 10,000 cycles per minute. The Contractor shall ensure that vibrators are operated at pressures and voltages not less than those recommended by the manufacturer in order that the comp active effort is not reduced.
- 34) A sufficient number of vibrators shall be operated to enable the entire quantity of concrete being placed to be vibrated for the necessary period and, in addition, stand by vibrators shall be available for instant use at each place where concrete is being placed.
- 35) Vibration shall be continued at each point until the concrete ceases to contract, a thin layer of mortar has appeared on the surface and air bubbles have ceased to appear. Vibrators shall not be used to move concrete to penetrate the layer underneath at regular spacing that shall not exceed the distance from the vibrator over which vibration is visibly effective.
- 36) Vibration shall not be applied by way of reinforcement nor shall vibrators be allowed to touch reinforcement or other embedded items. The vibrators shall be inserted vertically

into the concrete to penetrate the layer underneath at regular spacing that shall not exceed the distance from the vibrator over which vibration is visibly effective.

4.5. Curing

- 1) Concrete shall be protected during the first stage of hardening from loss of moisture and from the development of temperature differentials within the concrete sufficient to cause cracking. The methods used for curing shall not cause damage of any kind to the concrete.
- 2) Curing shall be continued for as long as may be necessary to achieve the above objectives but in any case for at least ten days or until the concrete is covered by later construction whichever is the shorter period.
- 3) The above two objectives are dealt with in the following sub-clauses, but nothing shall prevent both objectives being achieved by a single method where circumstances permit.
- 4) The curing process shall commence as soon as the concrete is hard enough to resist damage from the process, and in the case of large areas or continuous pours shall commence on the completed section of the pour before the rest of the pour is finished.
- 5) Details of the Contractor's proposals for curing concrete shall be submitted to the Engineer before the placing of concrete commences in the permanent Works.
- 6) Exposed concrete surfaces shall be closely covered with impermeable sheeting, properly secured to prevent its removal by wind and the development of air spaces beneath it. Joints in the sheeting shall be lapped by at least 300 mm.
- 7) If for some reason it is not possible to use impermeable sheeting, the Contractor shall keep the exposed surfaces continuously wet by means of a water spray or by covering with a water adsorbent material which is kept wet, unless this method conflicts with the other sub-clauses of this Clause.
- 8) Water used for curing shall be of the same quality as that used for mixing as stated in Clause 3.3.1.
- 9) Formed surfaces may be cured by retaining the formwork in place for the required curing period.
- 10) If the use of the foregoing methods is inappropriate, surfaces, which will not have further concrete, bonded to them and which are not to receive an application of a finish may be cured by the application of a curing compound having an efficiency index of at least 90 percent when tested in accordance with Test A8. Curing compounds shall contain a fugitive dye to enable the extent of the spread to be seen easily.
- 11) Curing compound used on surfaces exposed to the sky shall if instructed by the Engineer, contain sufficient finely divided flake aluminum in suspension to produce

a complete coverage of the surface with a metallic finish when applied at the rate recommended by the manufacturer.

- 12) Curing compounds shall become stable and impervious to the evaporation of water from the concrete surface within 60 minutes of application. The material shall not react chemically with the concrete and shall not crack, peel or disintegrate within 21 days after application.
 - 13) If instructed by the Engineer, the Contractor shall, in addition to the curing provisions set out above provide a suitable form of shading to prevent the direct rays of the sun reaching the concrete surfaces for at least the first four days of the curing period.
 - 14) The Contractor shall limit the development of temperature differentials in concrete after placing by any means appropriate to the circumstances as accepted by the Engineer, which shall include the following:
 - a. Limiting concrete temperatures at placing as set out in the relevant clause.
 - b. Using low heat cement, subject to the agreement of the Engineer.
 - c. Insulating exposed concrete surfaces by using insulating blankets. Such blankets shall have a thermal conductance C values less than $1.0 \text{ W/m}^2/^{\circ}\text{C}$.
 - d. Leaving formwork in place during the curing period. Steel forms shall be suitably insulated on the outside.
 - e. Preventing rapid dissipation of heat from surfaces by shielding from wind.
 - f. Avoiding the use of water sprays when such use would cause rapid cooling of the surface.
 - 15) Freshly placed concrete shall be protected from rainfall and from water running over the surface until it is sufficiently hard to resist damage from this cause.
 - 16) No traffic shall be allowed on any concrete surface until such time as it is hard enough to resist damage by such traffic.
 - 17) Concrete placed in the permanent works shall not be subjected to any structural loading until it has attained at least its minimum average strength as defined in Clause 4.3.3.
 - 18) If the Contractor desires to impose structural loads in newly placed concrete, he shall make at least ten test cubes and cure them in the same conditions as the concrete they represent. These cubes shall be tested singly at suitable intervals in order to estimate the time at which the minimum average strength is reached.
- 4.6. Cutting, Bending and Fixing of Reinforcement
- 1) The Contractor shall be responsible for preparing all bending schedules in compliance with B5 4466 (Bending dimensions and scheduling of reinforcement for

concrete) and the checking of those provided from the following information that will be given on the construction drawings:

- Required bar diameter
- Required steel specification
- Bar locations and plan area covered
- Bar spacing
- Bar cover
- Required lap length

2) The Contractor shall be responsible for determining.

- Required number of bars
- Required shape code
- Required bending dimensions
- Overall length of each bar

3) Reinforcement shown on the drawings will be that required for structural purposes only. The contractor shall be responsible for designing all reinforcement necessary for positioning and supporting structural reinforcement (chairs, spacing bars and the like).

4) The Contractor shall provide test certificates for all reinforcement-giving details of compliance with the required specification.

5) All bars shall be hot rolled deformed, unless otherwise permitted by the Engineer. Bar reinforcement shall be tagged with identifying tags, showing the size and mark of the bar. The bundles shall be stacked clear of the ground in easily accessible positions that do not in any way hinder the progress of work and shall be kept clean.

6) When placed in the work reinforcement shall be free from coatings or dirt, detrimental scale, paint, oil or other foreign substances. When steel has on its surface rust, loose scale and dust, which is easily removable, it may be cleaned by a method approved by the Engineer.

7) All reinforcing bars, ties links and fabric shall be fixed in the positions shown on the Drawings within the tolerances specified in B5 4466. In no case shall the cover specified on the Drawings be increased by more than 5 millimeters.

8) Displacement of reinforcement beyond the specified tolerance shall be prevented by supporting the bars sufficiently and securely fixing them together at intersections where necessary.

9) The ends of all tying wires shall be turned into the body of the concrete and not allowed to project towards the surfaces of the concrete.

10) Spacers shall be used to maintain the cover to all steel and shall be made of dense cement mortar of one part cement and two parts sand.

11) Spacers shall be rectangular in section and the flat sides shall bear against the formwork and the steel. Wire cast into the blocks to fix them to the reinforcement

shall be 1.6 millimeters diameter soft annealed iron. The Engineer may approve the use of spacers made of other materials. Spacers shall not be used on the wet face of water retaining or water excluding structures. Chairs, stools, etc. shall be used to maintain clearance between two or more layers of reinforcement.

- 12) Nothing shall be allowed to interfere with the specified position of reinforcement. The fixing of reinforcement shall be checked before and during concreting, and particular attention shall be given to the position of top steel in cantilever sections. During concrete placing competent steel fixer shall be in attendance to adjust and correct the position of any reinforcement, which may be displaced.
- 13) All reinforcement shall be provided in full lengths as indicated on the Drawings. Splicing of bars, except where shall not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible. Bar reinforcement shall not be welded without the Engineers written permission.
- 14) In lapped splices, the bars shall be placed in contact and wired to gather in such manner as to maintain between bars of not less than 50 millimeters.
- 15) Mesh or mar reinforcement shall overlap sufficiently to maintain a uniform strength and shall be securely fastened at end sedges. The wedge lap shall not lees than 40 diameters of the mesh reinforcement bar or two mesh widths whichever is greater.

4.7. Construction Joints

- 1) Except where construction joints in Concrete are shown in the Contract, the Contractor shall obtain the Engineers approval to the positions and details of such joints before any work is commenced
- 2) Joint lines shall be clean, true and regular, and, wherever possible, arranged in horizontal and vertical lines to coincide with features of the finished work.
- 3) Concreting shall be carried out continually up to construction joints.
- 4) Concrete shall not be allowed to run to a featheredge. Vertical joints shall be formed against a stop board auditable notched to the reinforcement. The top surface of each lift of concrete shall be straight and level unless shown otherwise in the Contract.
- 5) Where a kicker is used, it shall be at least 70 mm high and shall be integral with the previous concrete.
- 6) Whenever concrete is to be boned to other concrete which has hardened, the surface of contact between the sections shall be deemed a construction joint.
- 7) Where construction joints are shown on the Drawings, the Contractor shall form such joints in those positions. The location of joints, which the Contractor requires to make for the purpose of construction, shall be subject to the agreement of the Engineer and details shall be submitted with the programme of Works requires

by the Conditions of Contract. The exact location of all construction joints shall be submitted to the Engineer at least 28 days prior to the start of construction of the relevant part of the works. Construction joints shall be in vertical or horizontal plans.

except in sloping slabs where they shall be normal to the exposed surface or elsewhere the Drawings require a different arrangement.

- 8) Construction joints shall be so arranged as to reduce to a minimum the effects of shrinking in the concrete after placing, and shall be placed in the most advantageous positions with regard to stresses in the structures and the desirability of staggering joints.
- 9) Feather edges of concrete at joints shall be avoided and any feathered edges, which may have formed where reinforcing bars, project through a joint shall be cut back until sound concrete has been reached.
- 10) The intersections of horizontal or near horizontal joints and exposed faces of concrete shall appear as straight lines produced by use of a guide strip fixed to the formwork at the top of the concrete lift, or by other means acceptable to the Engineer.
- 11) Construction joints formed as free surfaces shall not exceed a slope of 20 per cent from the horizontal.
- 12) The surface of the fresh concrete in horizontal or near horizontal joints shall be thoroughly cleaned and roughened by means of high pressure water and air jets when the concrete is hard enough to withstand the treatment without the leaching of cement. The surface of vertical joints shall be similarly treated if circumstances permit the removal of formwork at a suitable time.
- 13) Where concrete has become too hard for the above treatment to be successful, the surface whether formed or free is to be thoroughly scabbled by mechanical means or wet sand blasted and then washed with clean water. The indentations produced by scabbling shall be not less than 10 mm deep and shall not extend closer than 40mm to a finished face.
- 14) If instructed by the Engineer the surface of the concrete shall be thoroughly brushed with a thin layer of mortar complying with Clause 3.7, all as set out in Clause 5.7 immediately prior to the deposition of fresh concrete. The mortar shall be kept just ahead of the fresh concrete being placed and the fresh layer of concrete shall be thoroughly and systematically vibrated to full depth to ensure complete bond with the adjacent layer.

- 15) No mortar or concrete may be placed in position on or against a construction joint until the joint has been inspected and passed by the Engineer.
- 16) Expansion and contraction joints are discontinuities in concrete designed to allow for thermal or other movements in the concrete.
- 17) Expansion joints are formed with a gap between the concrete faces to permit subsequent expansion of the concrete. Contraction joints are formed to permit initial contraction of the concrete and may include provision for subsequent filling.
- 18) Expansion and contraction joints shall be formed in the positions and in accordance with the details shown on the Drawings or elsewhere in the Specification.

4.8. Form work

- 1) All forms shall be of wood or metal and shall be built grout-tight and of sufficient rigidity to prevent distortion due to the construction operations. Forms shall be constructed and maintained so as to prevent warping and the openings of joints due to shrinkage of the timber.
- 2) The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. The design of the forms shall take into account the effect of vibration of concrete as it is placed.
- 3) A grout check formed from 25 millimetres square hardwood timber shall be incorporated in the Form work to provide a clean, level horizontal joint on exposed concrete surfaces at the top of each lift.
- 4) All joints in the Formwork shall be either horizontal or vertical. End Formwork shall be square across the mass of concrete.
- 5) Where concrete is to be deposited to a slope steeper than 20 degrees to the horizontal, top form work shall be used to enable the concrete to be properly compacted unless the Engineer agrees otherwise.
- 6) Openings for the inspection and cleaning of the inside of form work for walls, piers and columns shall be formed in such a way that they can be closed conveniently before commencing to place concrete.
- 7) Form clamps, tie bolts and anchors shall be used to fasten forms. The use of wire ties to hold forms in position during placing of concrete will not be permitted. Tie bolts and clamps shall be positive in action and of sufficient strength and number to prevent spreading or springing of the forms. They shall be of such type that no metal part shall be left within the specified concrete cover. For water retaining sections,

methods of fixing the forms, which result in holes through the concrete section when the formwork is removed, shall not be used and built-in wall ties shall be fitted with water baffles.

- 8) All forms for outside surfaces shall be constructed with stiff walls at right angles to the studs and all form clamps shall extend through and fasten such walls.
- 9) The shape, strength, rigidity, grout tightness and surface smoothness of forms, which are re-used, shall be maintained at all times. Any warped, bulged or otherwise damaged timber shall be replaced. Forms, which are unsatisfactory, shall not be re-used. If the surface finish on the formed concrete deteriorates as a result of deterioration of the faces of the forms, the Engineer shall instruct that forms be resurfaced, or discarded.
- 10) All forms shall be treated with approved mould or similar oil or be soaked with water immediately before placing concrete to prevent adherence of concrete. Any materials, which adhere to or discolour concrete, shall not be used.
- 11) All forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall remain in place for periods, which shall be as specified in relevant clause. When forms appear to be unsatisfactory in any way, either before or during the placing of concrete, the Engineer shall order the work stopped until the defects have been corrected.
- 12) The Engineer shall approve all formwork before concrete is placed within it. The contractor shall, if required by the Engineer, provide copies of calculations of the strength and stability of the Formwork and False work. Notwithstanding the Engineer's approval of these calculations, the contractor shall be held responsible for the safety and adequacy of Formwork.

4.9. Removal of Form work

- 1) Formwork shall be carefully removed without shock or disturbance to the concrete. No formwork shall be removed until the concrete has gained sufficient strength to withstand safely any stresses to which it may thereby be subjected.
- 2) The minimum periods, which shall elapse between completion of placing concrete and removal of forms shall be decided by the Engineer

4.10. Remedial Work to Defective Surfaces

- 1) If on stripping any form work the concrete surface is found to be defective in any way, the Contractor shall make no attempt to remedy such defects prior to the Engineer's inspection and the receipt of any instructions, which the Engineer may give.

- 2) Defective surfaces shall not be made good by plastering nor by sealing with Vender or any other sealing compound
- 3) Areas of honeycombing, which the Engineer agrees may be repaired, shall be cut back to sound concrete or to 75mm whichever is the greater distance. In the case of reinforced concrete the area shall be cut back to at least 25mm clear distance behind the reinforcement or to 75mm, whichever is the greater distance. The cavity shall have sides at right angles to the face of the concrete. After cleaning out with water and compressed air, a thin layer of cement grout shall be brushed on to the concrete surfaces in the cavity and it shall then be filled immediately with concrete of the same class as the main body and will vibrated/compacted with the provision of a lip to enable concrete to be paced. The form shall be filled to a point above the top edge of the cavity.
- 4) After seven days the lip of concrete shall be broken off and the surface ground smooth.
- 5) Surface irregularities, which are outside the limits of tolerance set out in Clause 5.13, shall be ground down in the manner and to the extent instructed by the Engineer.
- 6) Defects other than those mentioned above shall be dealt with as instructed by the Engineer.

4.11. Hand Mixed Concrete

- 1) Concrete for structural purposes shall not be mixed by hand. Where non-structural concrete is required, hand mixing may be carried out subject to the agreement of the Engineer.
- 2) The mixing shall be done on a hard impermeable surface. The materials shall be turned over not less than three times dry, water shall then be sprayed on and the materials again turned over not less than three times in a wet condition and worked together until a mixture of uniform consistency is obtained.
- 3) For hand mixed concrete the specified quantities of cement shall be increased by 10% and not more than 0.5 cubic meters shall be mixed at one time. During windy weather efficient precautions shall be taken to prevent cement from being blown away during the process of gauging and mixing

4.12. Protection of Buried Concrete

4.12.1. Concrete in Contact with Ground

- a) Where directed by the Engineer or shown on the Drawings concrete work which will be placed directly against rock or soil or which will subsequently have backfill placed against it will be protected in the following way from the aggressive action of salts contained in rock, soil or ground water.
 - i) Concrete placed directly against cut-face shall be protected by a layer of plastic sheeting laid over the area to be concreted. All laps shall be at least 300mm wide and sufficient surplus sheeting shall be left to enable a margin of at least 30 mm width to proceed above the ground/concrete interface to be sealed onto the adjacent finished concrete surface with the bitumen coating. Special care shall be taken to avoid damage to the plastic sheeting during concreting.
 - ii) Formed or free concrete surfaces against which backfill will subsequently be placed will be protected by the application of bitumen coating.
 - iii) No protection will be applied to surfaces against which concrete will subsequently be placed, except as described in the following sub-clause.

5. STONE WORK

5.1. Stone

Stone for all kinds of work shall be of good quality, solid and durable, void-less and without soft weathered or decomposed parts. The stone and quarry where it is excavated shall be approved by the Engineer. On the Engineer's request, the

Contractor shall submit samples of stone proposed for work prior to the placing of order or prior to the beginning of quarry excavation.

5.2. Pitching

Pitching is used for paving of horizontal or sloping ground surfaces. It includes one layer of manually placed stone forming an even smooth surface. Pitching shall be one of the types given below.

- 1) "Dry pitching" means pitching without using of binding material, instead of it, the clearances are wedged by stone fragments and filled with well compacted gravel or sand.
- 2) "Pitching on mortar" means pitching in which clearances are filled with cement mortar. Stone shall be placed in the layer of fresh concrete the grade of which is indicated on the drawings.
- 3) For all pitching types the quality of stone shall be as indicated in Clause 5.1. Stones shall be of random length and width but not less 0.03m³ by volume and either thickness shown on the drawings. The sides of all stones shall be roughly shaped with a hammer to obtain a sufficiently good fit.
- 4) The site for pitching shall be well compacted and even. Over this site, in the case of dry pitching, a layer of sorted filter material is laid, consisting of one or more layers, to the dimensions shown on the drawings or as directed by the Engineer. For pitching on mortar, the under layer shall consist of concrete of the grade specified on the drawings and 100mm thick. Over this layer the stones are laid with each stone rigidly fixed with its natural surface square to the open surface to form an even face with broken joints

5.3. Masonry Works

- 1) Masonry shall be constructed from random stones set in cement-mortar and shall be built the lines and levels shown on the Drawings or as directed by the Engineer.
- 1) The stones shall be from an approved source and shall be sound and clean. Any stones, which in the opinion of the Engineer are not perfectly clean, shall be washed before use. Stones shall be set in position with their natural beds as near as possible to the horizontal and the interstices between the stones shall be completely filled with mortar. The stones are to be selected and placed so as to keep the amount of mortar to a minimum. One exposed face, stones shall be selected and where necessary roughly dressed so as to provide a fair face showing an even distribution of stone sizes.

- 2) The face of the masonry is to be kept wet while the pointing is proceeding and for as long thereafter as the Engineer may deem necessary. Provision shall be made to clean all exposed faces both as work proceeds and on completion so that they are left in a neat, tidy and clean condition. This cleaning is deemed to be included in the rates for masonry.
- 3) Before a general start on a structure of large dimensions is begun the Contractor will be required to build a small portion of the walling of required type and pointing for approval by the Engineer. After approval has been given, the remainder of the work will be required to conform to the samples.
- 4) In all cases where pipes or the like are built into walls, the masonry, together with any concrete or brickwork associated therewith, shall be fitted around pipe work and caulked or sealed with flexible waterproof material to prevent leakage around the pipe or fracture of the pipe.
- 5) Where shown on the Drawings or directed by the Engineer, masonry shall be anchored to the concrete footing by means of steel reinforcing bars cast into the concrete whilst still plastic.
6. **RCC Pipe**
 - The concrete pipe that to be used for the construction should be made from C-20 and reinforced as per ERA standard.
 - It should be connected and joined securely using mortar and at each joining point, masonry anchoring at each side is provided as shown on the drawing. Bedding materials like hard coring, masonry at some place and concrete will be used.

7. MACHINERY FOR CONSTRUCTION

- There should be important equipment/ machinery types required for the construction of irrigation scheme, which is very essential like Dump truck, pickup, dewatering pump water truck, Vibratory Roller machine, excavator, hand compactor machine, and surveying instruments). Thus, the contractor should supply/deploy those machinery at site for the execution of irrigation construction.

8. CONTRACTOR'S CAMP

1 The contractor shall make arrangements as necessary for the housing, feeding and welfare of his own employees by providing, servicing and maintaining a camp on the site or sites as indicated on the camp drawing BOQ. The contractor will not be permitted to such camps with in irrigable areas.

2 The camps constructed according to the above clause will not be demolished by the contractor. They will be transferred to the Water users.

3. The contractor's main site workshops, additional stores, plant yard, offices, etc are to be located on sites which will arrangement, and way of construction of these facilities will be subject to the approval of the engineer. However, here the camp was already constructed during the first phase of irrigation construction. The local administration and/or client will discuss, negotiate and request water users committee for the camp facilitation. In case if there is some damage of camps, the contract is responsible to repair the camp with his/her own expense.

9. Specific conditions

9.1. Notice of important operations

The contractor shall give full and complete written notice of all-important operations to the Engineer sufficiently in advance to enable the Engineer to make such arrangements as the Engineer may consider necessary for inspection and for any other purpose. The contractor shall not start any important operation without the written approval of the Engineer.

9.2. Breaching

If river bunds or other flood protection works either temporary or existing, require to be breached, the contractor shall submit detailed proposals for carrying out the work together with drawings and calculations to the Engineer at least one month before work is due to start. No work shall be started until the Engineer has given his approval in writing.

9.3. Temporary works

Not less than fourteen days before commencing any portion of the works, the contractor, if so ordered, shall submit to the Engineer for his approval complete drawings of all temporary works the contractor may require for the construction of that part of the works.

Notwithstanding approval by the Engineer of any design responsible for their efficiency, security and maintenance and for all obligations and risks in regard to such temporary works which are specified or implied in the contract.

Except where specific items are provided for the Bill of Quantities, the costs of all temporary works of every description, including dewatering temporary diversions of canals, roads and footpaths shall be included in the rates.

The contractor shall submit to the Engineer his detailed proposals for carrying out this work and shall confirm strictly with clause 1.6 and 1.7 of these specifications, so that there is sufficient time for the Engineer to consult with the Authority and other concerned parties.

The contractor shall not start the work without written approval of the Engineer and the cost of all such work shall be included in the rates.

9.4. Connections to works made under separate contract

1. When ordered by the Engineer, the contractor shall carry out all works, which may be necessary to permanently connect the works constructed under the contract, with works to be made under a separate contract.

9.5. Source and types of materials

The contractor shall make all arrangements for location, selecting and processing of natural materials in accordance with the General Technical Specifications and shall submit to the Engineer for approval full information regarding the proposed source will in advance before using the material. Approval of source does not imply that all material in that source is approved.

Before placing any order for materials for incorporation in the works, the contractor shall submit to the Engineer for approval the names of suppliers and manufactures and the origin, manufactures specification, quality, weight, strength, description, etc. of the materials. The contractor shall supply a copy of each order placed, which copy shall be retained by the Engineer. No materials shall be ordered or obtained from any firm or supplier, which the Engineer has not previously approved in writing.

9.6. Quality of equipment

All equipment to be employed by the contractor shall be fully in accordance with the contractor's proposal and to Engineer's approval.

If, in the option of the Engineer, the equipment shall be found not to comply with the requirements set forth in the contract and those agreed between the Engineer and the contractor, or if the equipment shall be out of order for more than a week, the Engineer may order the relevant equipment to withdrawn and replaced by alternative equipment which complies with the, requirements mentioned above. The extra cost involved in such replacement shall be borne by the contractor.

9.7. On farm works

2. All fill materials can be taken from the cut areas and if this may not be sufficient be obtained from borrow a pit which is not utilized for cultivation in consultation with the community.

9.8. Primary (main) and secondary canals

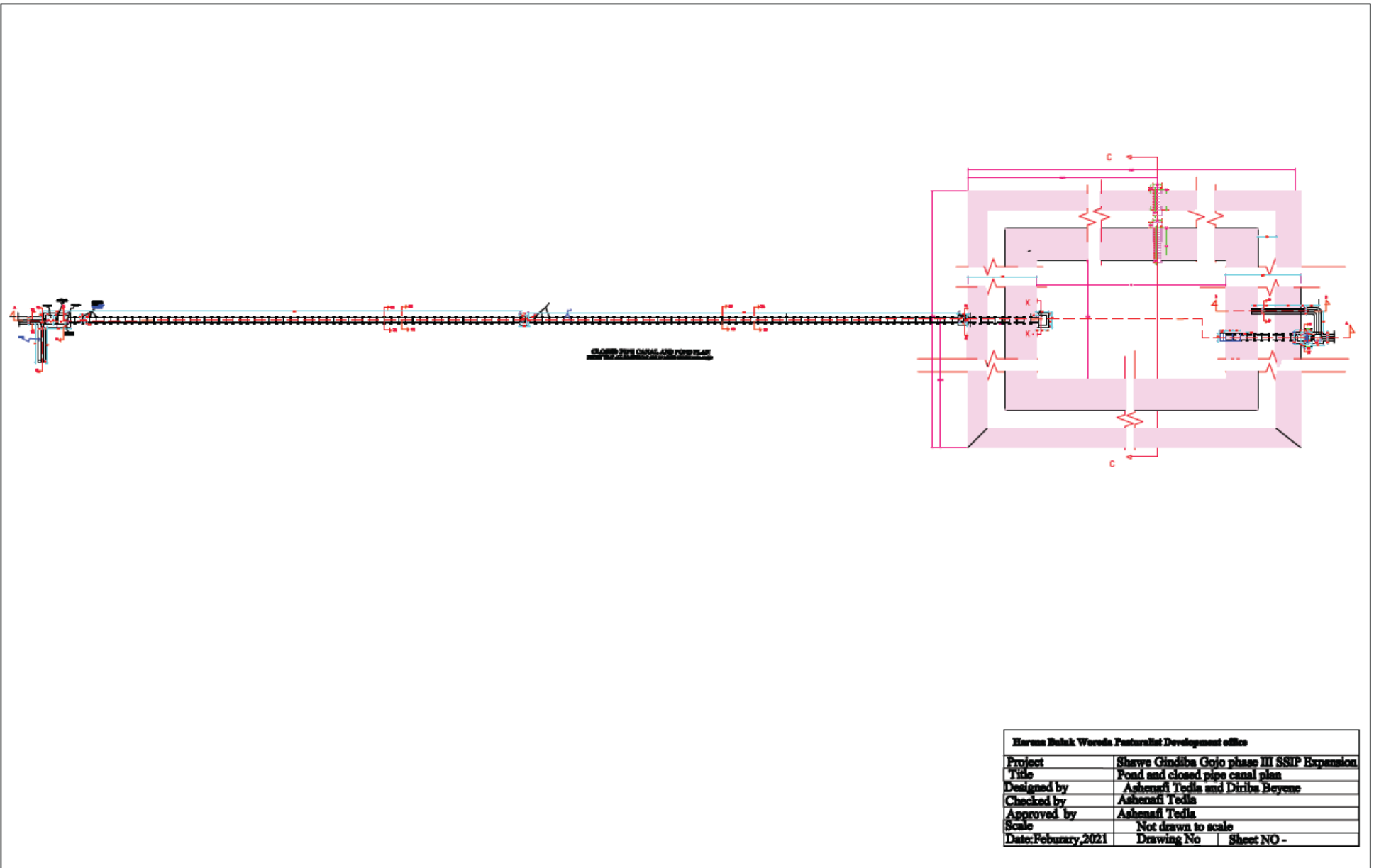
All main and secondary canals could be constructed according to the Drawings. The contractor may execute the work either in labor or machine intensive.

The surplus excavated soil shall be deposited outside the reserved area for the canal in final state. The negative soil balance which requires fill has to be excavated from borrow areas outside the cultivated farm or may obtained from the cut areas if the materials is suitable for use in fill and being approved by the Engineer. All the borrow pits shall be reinstated to its natural levels.

9.9. Structures

Alignments, levels and dimensions of the structures are shown on the Drawings. Except for the members of the constructions, a major part of the structures will be erected in masonry. All related members of each structure, such as structural steel works, stone protections, water level, weep holes if any, etc shall be provided and fixed in accordance with the Drawings.

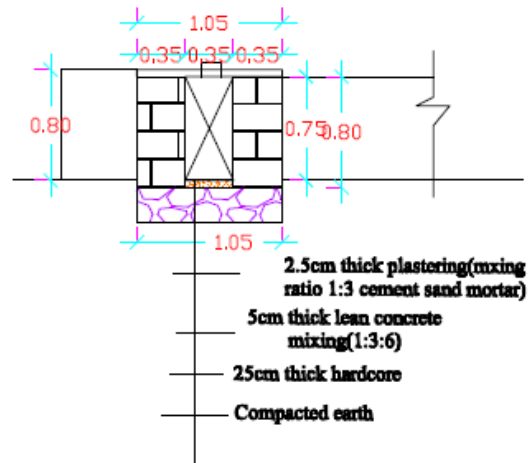
6. DRAWINGS



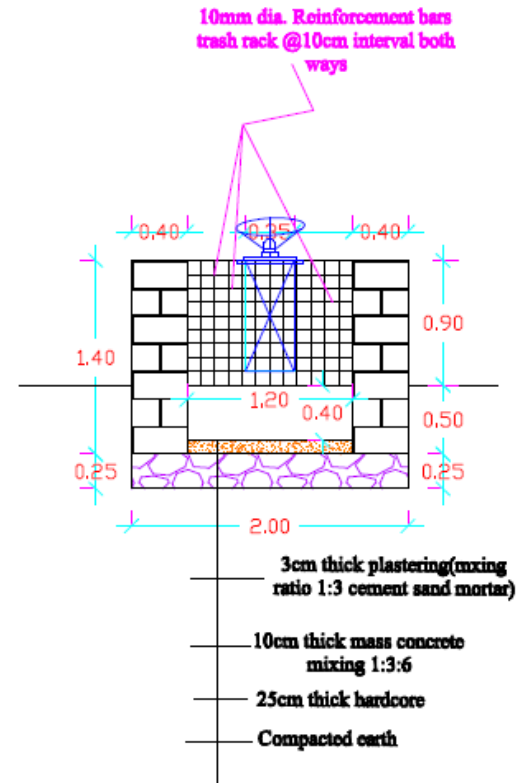


Shawee Gold Mine Water Treatment Development plan		
Project	Shawee Gold Mine phase III SSIP Expansion	
Title	Section A-A	
Designed by	Adamski, Tullin and Diksha Rayana	
Checked by	Adamski, Tullin	
Approved by	Adamski, Tullin	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -

Page 45

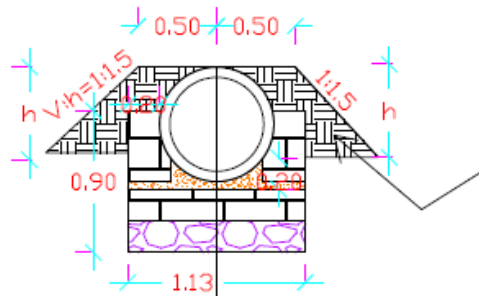


SECTION N1-N1
**NOTICE THAT ALL DIMENSIONS ARE
 IN METER UNLESS EXPLAINED**



SECTION R-R
**NOTICE THAT ALL DIMENSIONS ARE
 IN METER UNLESS EXPLAINED**

Harene Buluk Woroda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Section N1-N1 & R-R	
Designed by	Ashenafi Tedia	
Checked by	Ashenafi Tedia	
Approved by	Ashenafi Tedia	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -



6.4cm upper wall
/thickness of RCC
pipe

60cm internal
diameter RCC pipe

6.4cm lower wall
/thickness of RCC pipe

5 to 20cm thick lean concrete
mixing 1:3:6

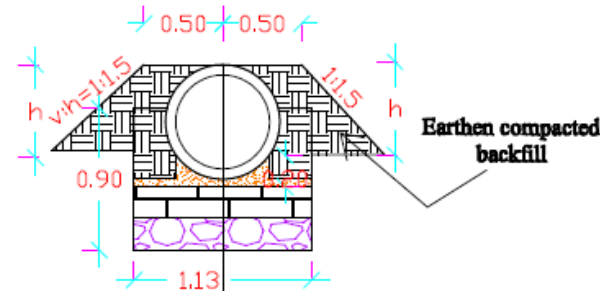
20cm thick masonry with mixing of
ratio 1:4 cement sand mortar

20cm thick hardcore

Compacted earth

SECTION B1-B1

NOTICE THAT ALL DIMENSIONS ARE
IN METER UNLESS EXPLAINED



6.4cm upper wall
/thickness of RCC pipe

60cm internal
diameter RCC pipe

6.4cm lower wall
/thickness of RCC pipe

5 to 20cm thick lean
concrete mixing 1:3:6

20cm thick masonry with mixing
of ratio 1:4 cement sand mortar

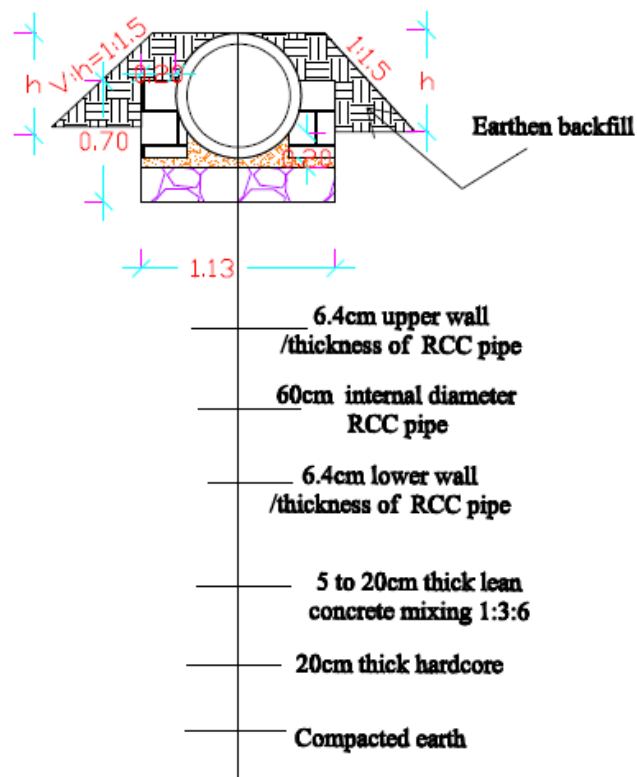
20cm thick hardcore

Compacted earth

SECTION B2-B2

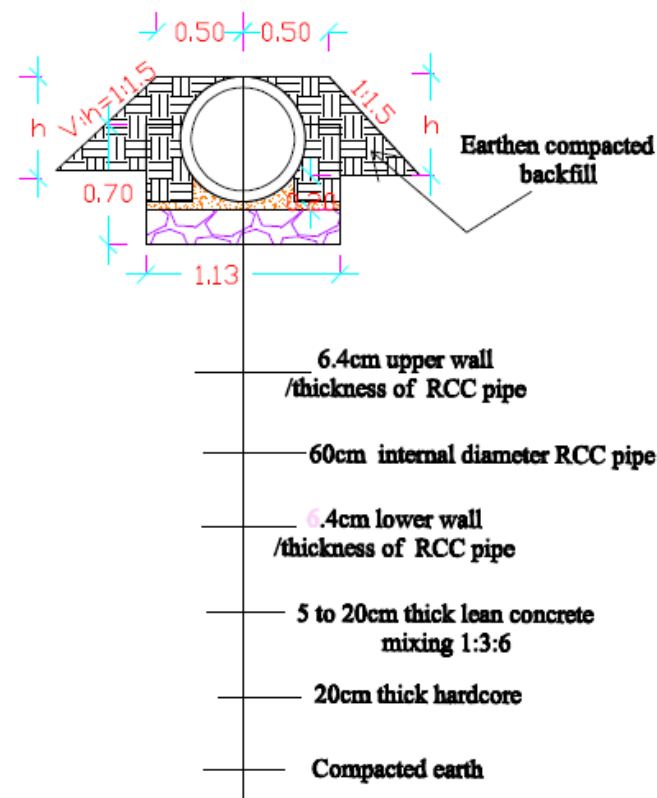
NOTICE THAT ALL DIMENSIONS ARE
IN METER UNLESS EXPLAINED

Haroma Bulak Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Section B1-B1 & B2-B2	
Designed by	Ashenafi Tedia	
Checked by	Ashenafi Tedia	
Approved by	Ashenafi Tedia	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -



SECTION B3-B3

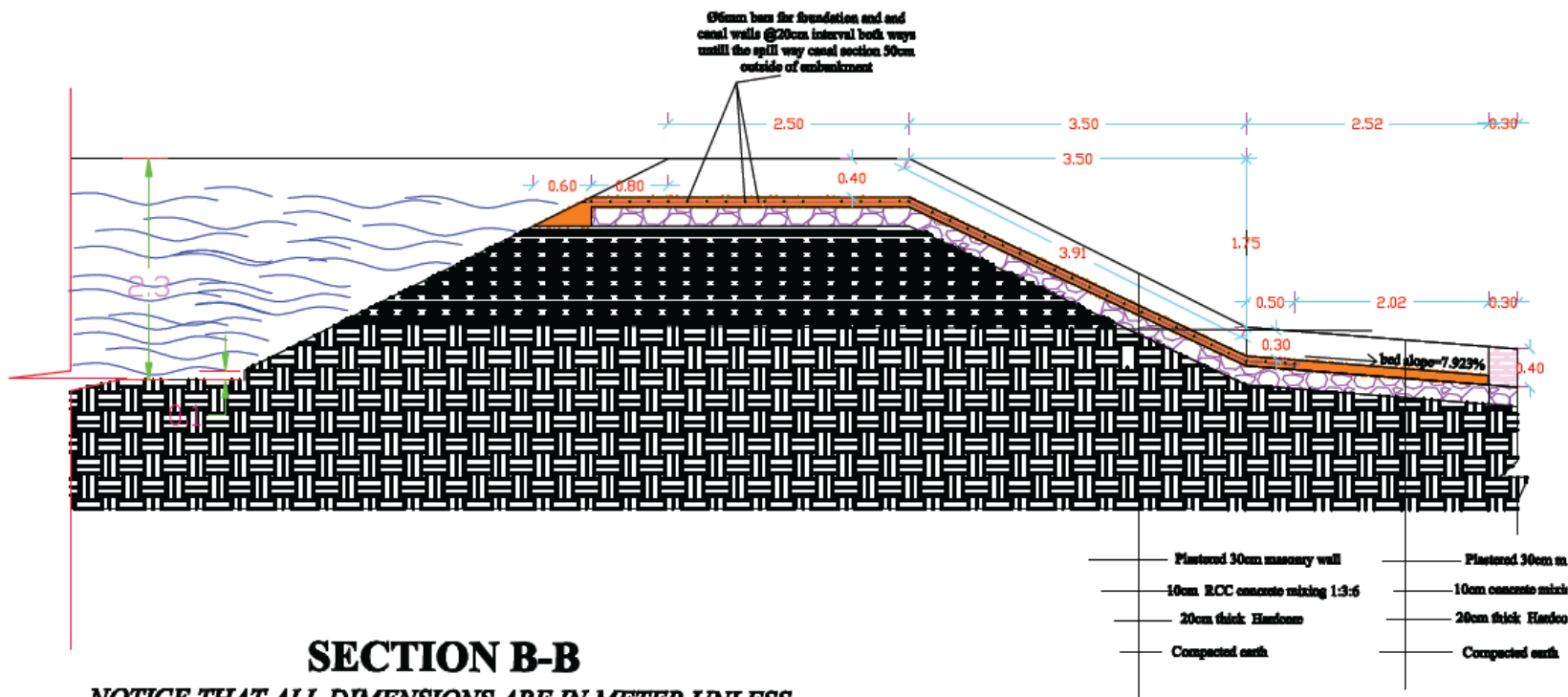
NOTICE THAT ALL DIMENSIONS ARE IN METER UNLESS EXPLAINED



SECTION B4-B4

NOTICE THAT ALL DIMENSIONS ARE IN METER UNLESS EXPLAINED

Harana Baluk Wereda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Section B3-B3 & B4-B4	
Designed by	Ashenafi Tedia	
Checked by	Ashenafi Tedia	
Approved by	Ashenafi Tedia	
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Date: February, 2021	Drawing No	Sheet NO -



SECTION B-B

NOTICE THAT ALL DIMENSIONS ARE IN METER UNLESS
EXPLAINED

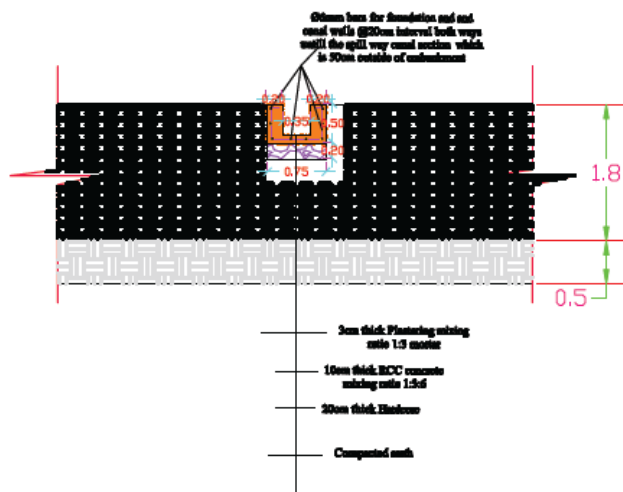
Harena Buluk Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expans	
Title	Section B-B	
Designed by	Ashenafi Tedla and Diriba Beyene	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date:Feburary,2021	Drawing No	Sheet NO -



SECTION C-C

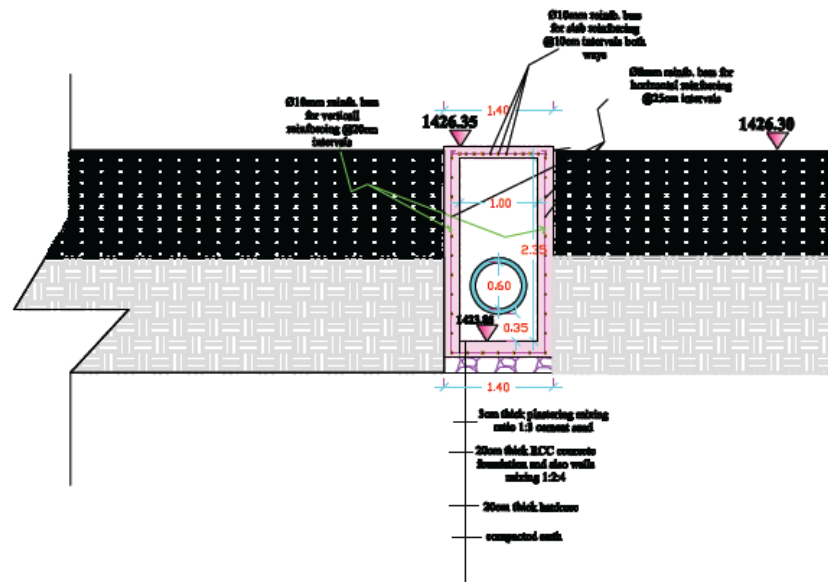
NOTICE THAT ALL DIMENSIONS ARE IN METER UNLESS EXPLAINED

Harena Buluk Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Ex	
Title	Section C-C	
Designed by	Ashenafi Tedla and Diriba Beyene	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date:Feburary,2021	Drawing No	Sheet NO -



SECTION D-D

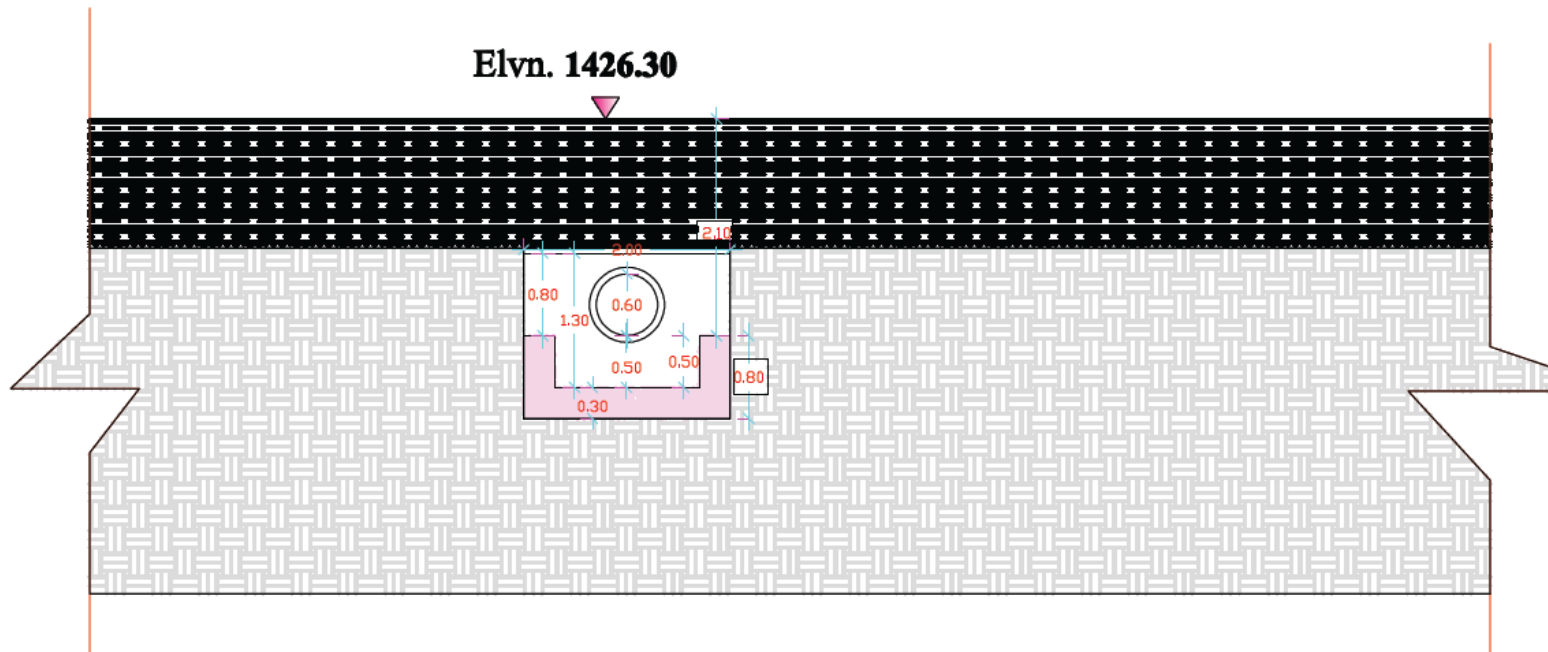
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UNLESS EXPLAINED



SECTION Z-Z

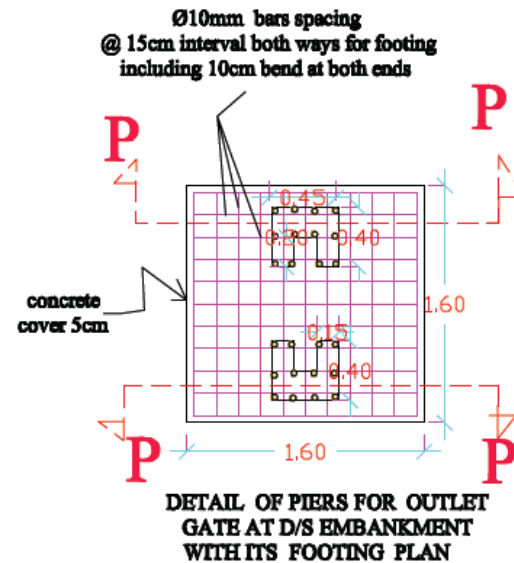
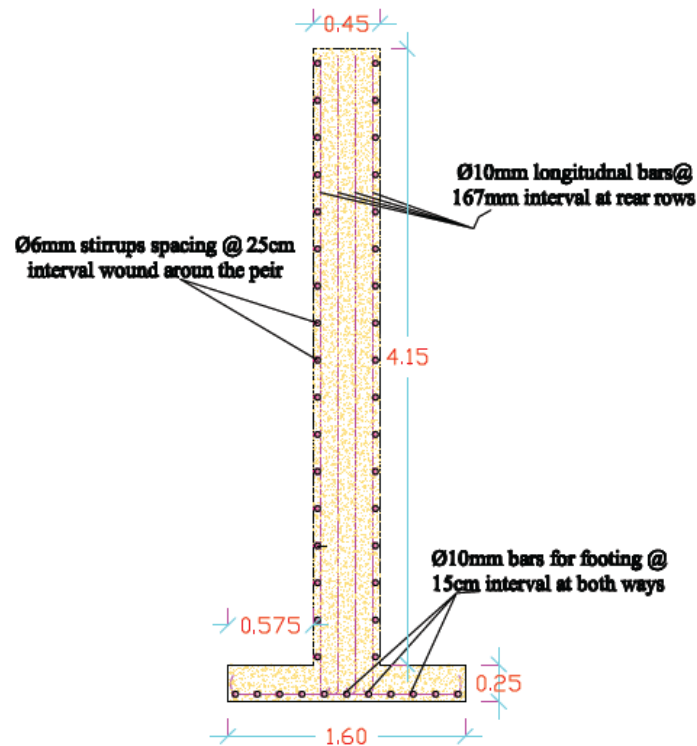
NOTICE THAT ALL DIMENSIONS ARE IN METER
UNLESS EXPLAINED

Harama Buluk Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Exp	
Title	Section D-D & Z-Z	
Designed by	Ashenafi Tedla and Diriba Beyene	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -



SECTION X-X
*NOTICE THAT ALL DIMENSIONS ARE IN METER UNLESS
 EXPLAINED*

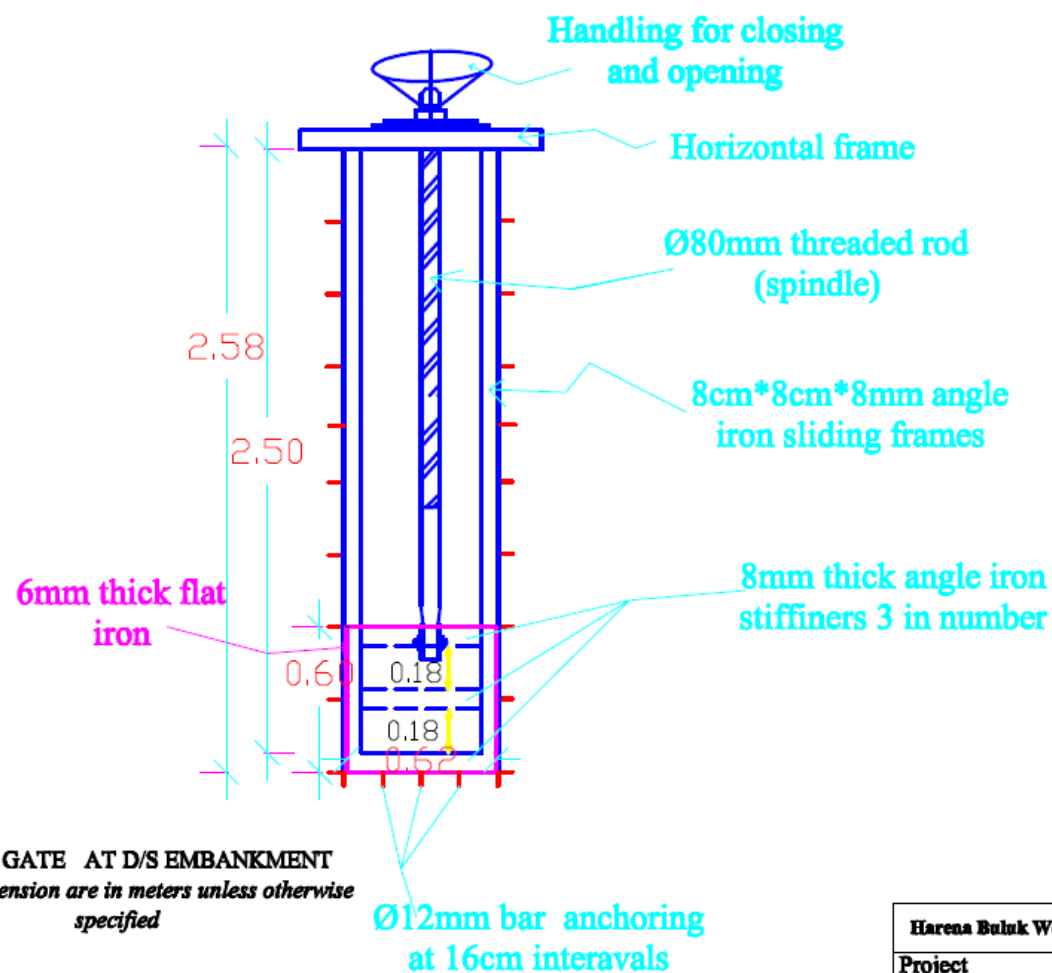
Harena Buluk Wereda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Exp	
Title	Section X-X	
Designed by	Ashenafi Tedla and Diriba Beyene	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -



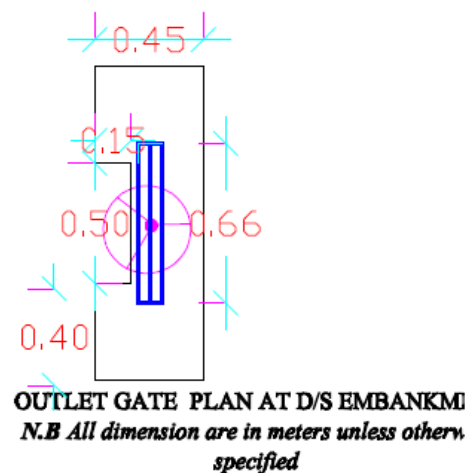
SECTION P-P

NOTICE THAT ALL DIMENSIONS ARE IN METER UNLESS EXPLAINED

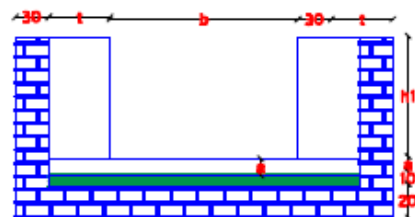
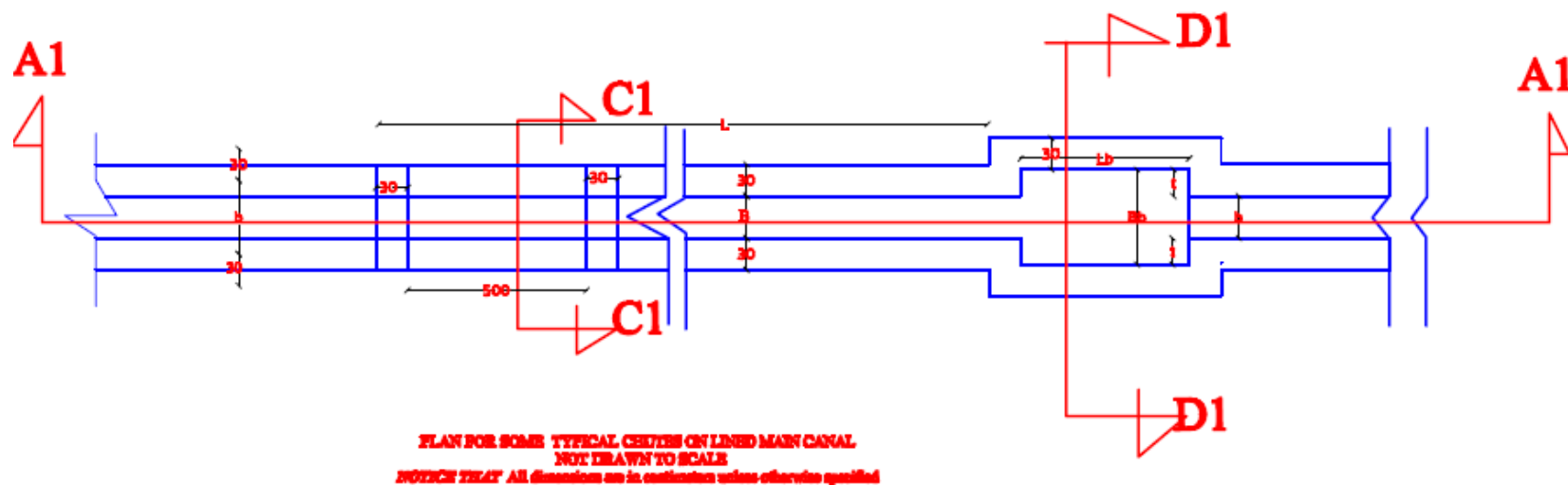
Harena Buluk Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Exp	
Title	Section and plan detail of piers	
Designed by	Ashenafi Tedla	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -



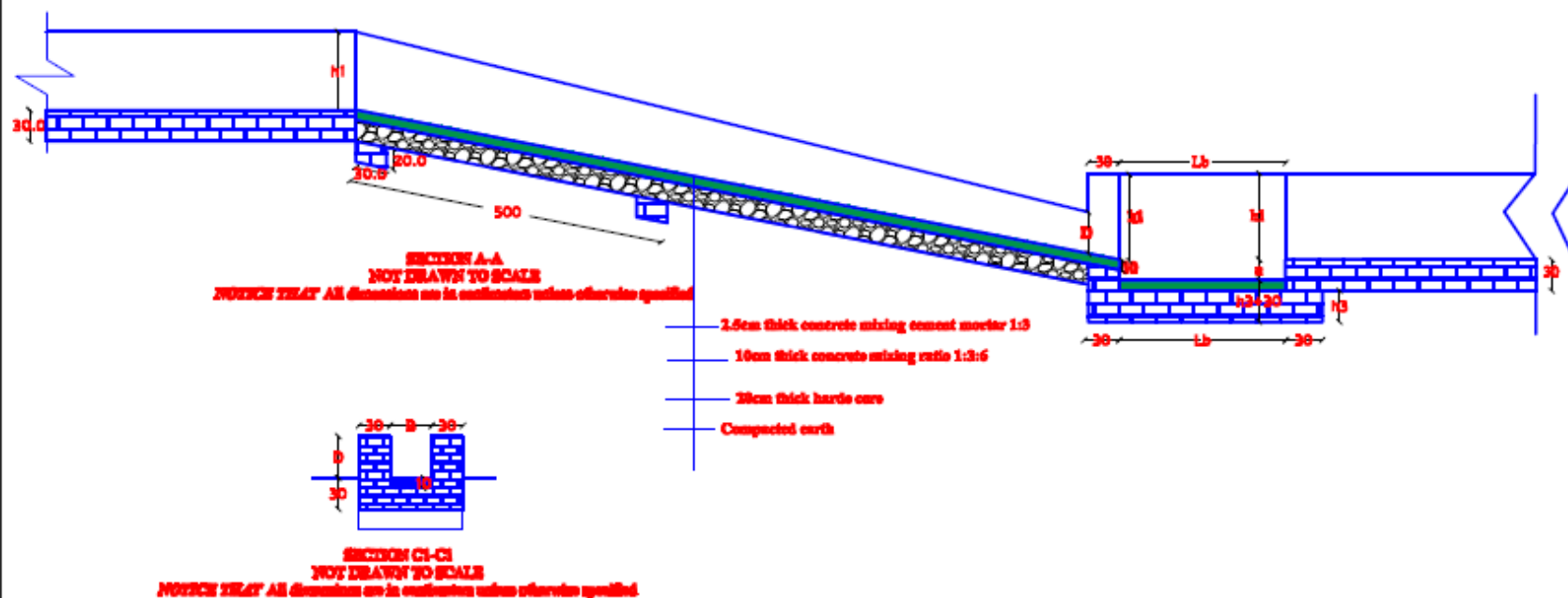
DETAIL GATE AT D/S EMBANKMENT
N.B All dimension are in meters unless otherwise specified



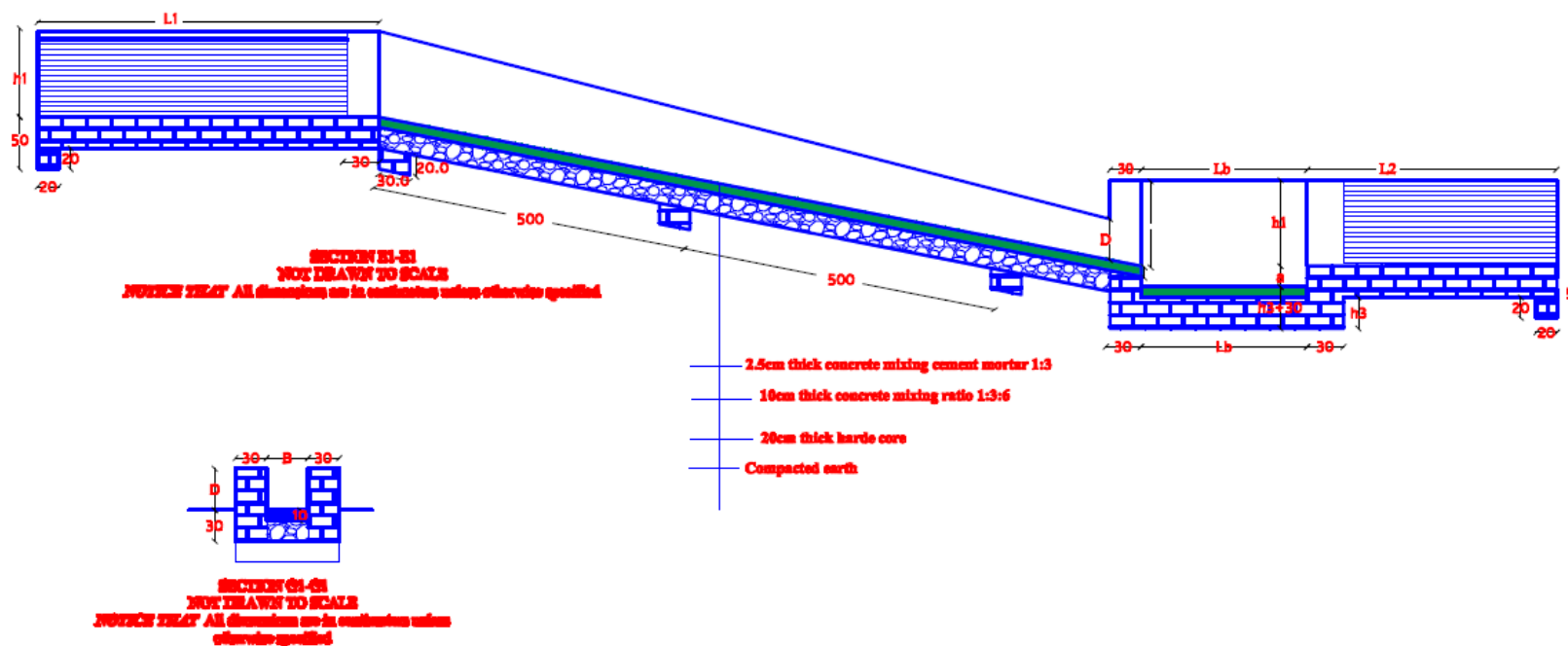
Harena Buluk Woreda Pastoralist Development office	
Project Title	Shawe Gindiba Gojo phase III SSIP Expar
Designed by	Ashenafi Tedla
Checked by	Ashenafi Tedla
Approved by	Ashenafi Tedla
Scale	Not drawn to scale



Hareza Buluk Wereda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Plan of chutes on lined MC & section D1-D1	
Designed by	Ashenafi Tedla	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date: February, 2021	Drawing No	Sheet NO -



Harena Buluk Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Sections A-A & C1-C1	
Designed by	Ashenafi Tedla	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date:Feburary,2021	Drawing No	Sheet NO -



Hareza Buluk Woreda Pastoralist Development office		
Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Section E1-E1 & G1-G1	
Designed by	Ashenafi Tedla	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date:February,2021	Drawing No	Sheet NO -

TABLE OF DIMENSIONS FOR SOME TYPICAL CHUTES OF RAINFALL FEED CANAL																					
Location at Canal	Beginning Chute (m)	Beginning O/S (m)	Beginning D/S (m)	L1	S	h1	b	h0	L2	H	D	L3	h4	h5	a	c	V ₉₀ /s	Q ₅ /s	Chute Slope (m)	Chute Length (m) -L	Remark
MC	1+715	1,448.795	1,448.385	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.05	24.0	2.25	14.5	Chute #6 on Northern side canal
	1+815	1,441.895	1,441.671	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.77	28.0	2.0	8.0	Chute #7 on Northern side canal
	2+185	1,435.655	1,435.435	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.25	26.0	2.0	8.0	Chute #8 on Northern side canal
	3+355	1,431.775	1,431.455	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.07	24.0	2.0	8.0	Chute #9 on Northern side canal
	3+525	1,430.885	1,430.151	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.21	26.0	4.5	4.5	Chute #10 on Northern side canal
	3+655	1,435.635	1,435.415	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.45	24.0	4.5	8.0	Chute #11 on Northern side canal
	3+725	1,438.385	1,437.955	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.25	26.0	2.5	12.0	Chute #12 on Northern side canal
	3+775	1,437.295	1,437.225	1.25	0.45	0.45	0.35	0.35	1.25	0.35	0.35	1.25	0.35	0.35	0.10	0.135	2.25	24.0	2.5	8.0	Chute #13 on Northern side canal

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED

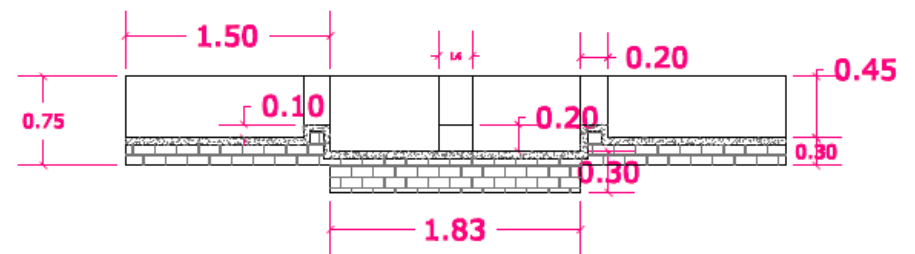
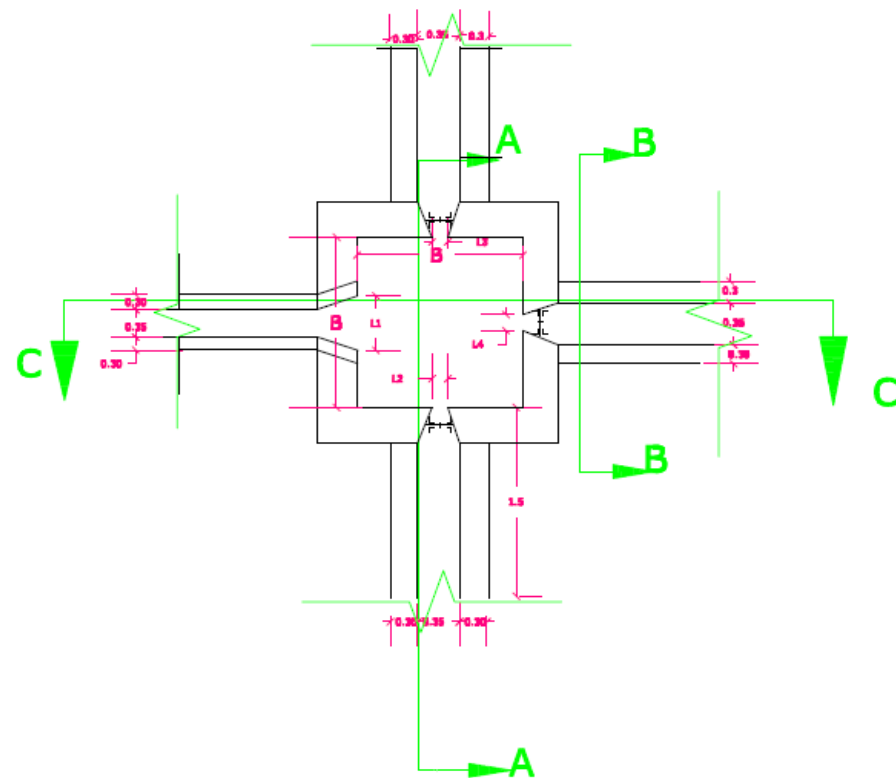
TABLE OF DIMENSIONS FOR SOME TYPICAL CHUTES OF ZEPED MAIN CANAL																	
Location at Canal	Beginning Chute (m)	Beginning O/S (m)	Beginning D/S (m)	b	H	h ₁	L _b	c	h ₁	a	h ₀	D	V ₉₀ /s	Q ₅ /s	Chute Slope (m)	Chute Length (m) -L	Remarks
MC	0+000	1,431.385	1,431.135	0.35	0.35	0.35	0.35	0.135	0.45	0.10	0.10	0.35	1.75	22.0	1.75	41.5	Chute #1 on 1 st level side canal
	0+004	1,445.895	1,445.815	0.35	0.35	0.35	1.25	0.135	0.45	0.10	0.10	0.35	2.05	24.0	2.5	61.5	Chute #2 on 1 st level side canal
	0+754	1,437.295	1,437.255	0.35	0.35	0.35	1.25	0.135	0.45	0.10	0.10	0.35	1.87	22.0	2.5	14.5	Chute #3 on 1 st level side canal
	1+020	1,447.455	1,446.125	0.35	0.35	0.35	1.25	0.135	0.45	0.10	0.10	0.35	1.87	24.0	2.5	20.5	Chute #4 on 1 st level side canal
	1+415	1,448.155	1,448.775	0.35	0.35	0.35	1.25	0.135	0.45	0.10	0.10	0.35	1.85	22.0	1.85	28.5	Chute #5 on 1 st level side canal

ALL DIMENSIONS ARE IN METERS UNLESS OTHERWISE SPECIFIED

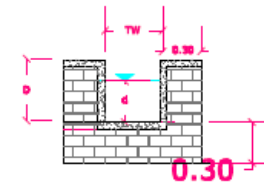
Harena Buluk Woreda Pastoralist Development office

Project	Shawe Gindiba Gojo phase III SSIP Expansion	
Title	Table of dimensions for chutes	
Designed by	Ashenafi Tedla	
Checked by	Ashenafi Tedla	
Approved by	Ashenafi Tedla	
Scale	Not drawn to scale	
Date:Feburary,2021	Drawing No	Sheet NO -

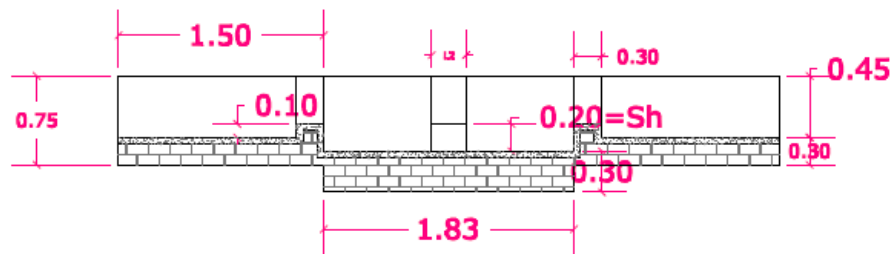
Plan of sample division box



Section A-A



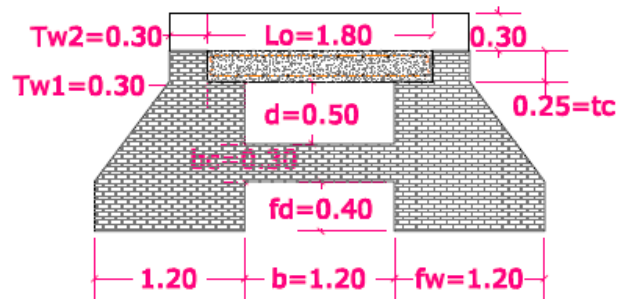
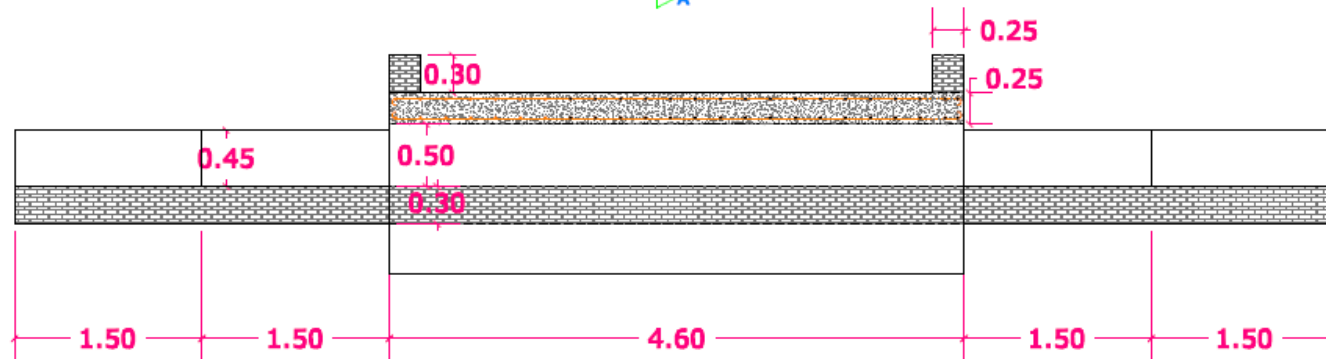
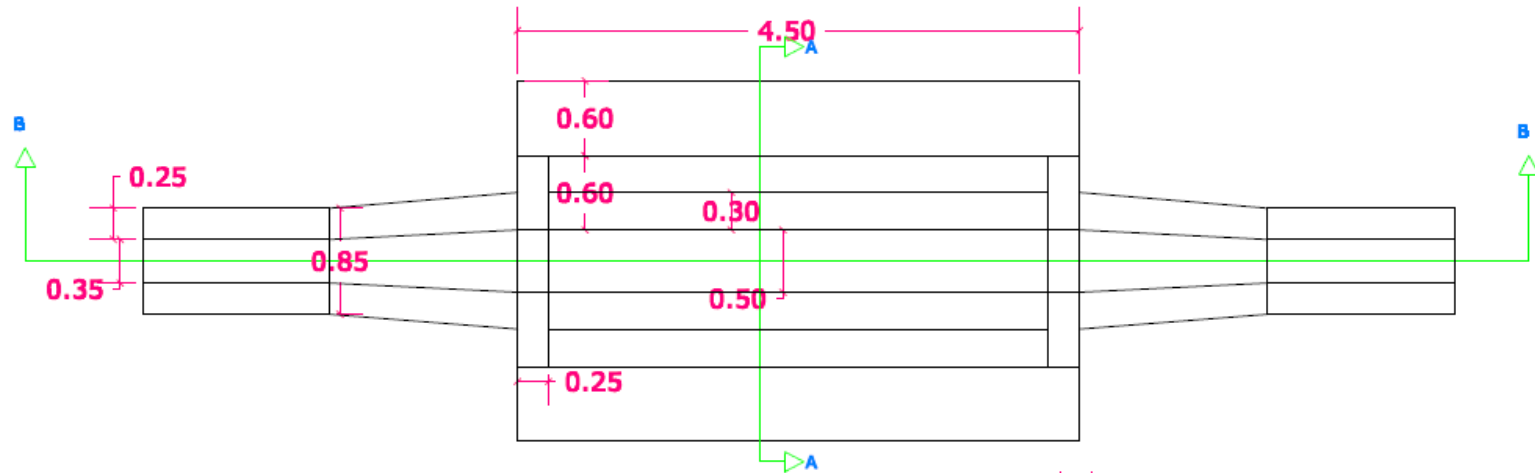
Section B-B



Section C-C

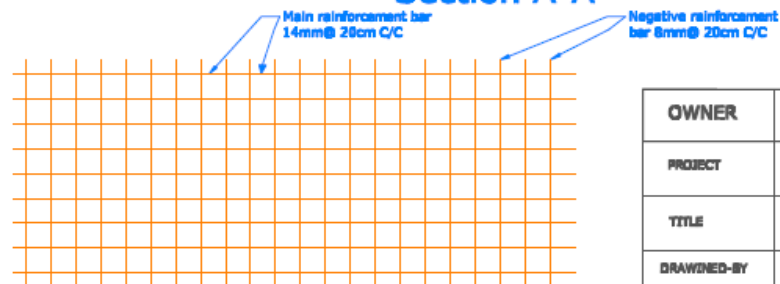
OWNER	Harena Buluk pastoralist Development office		
PROJECT	Shawe Gindiba Gajal-SSIP-III		
TITLE	Sample-ORT-take DRAWING		
DRAWNED-BY	Diriba Beyene	DRND	
DESIGNED-BY	Diriba Beyene	SCALE	
CHECKED-BY		DATE	
APPROVED-BY			

Plan of road crossing



Section B-B

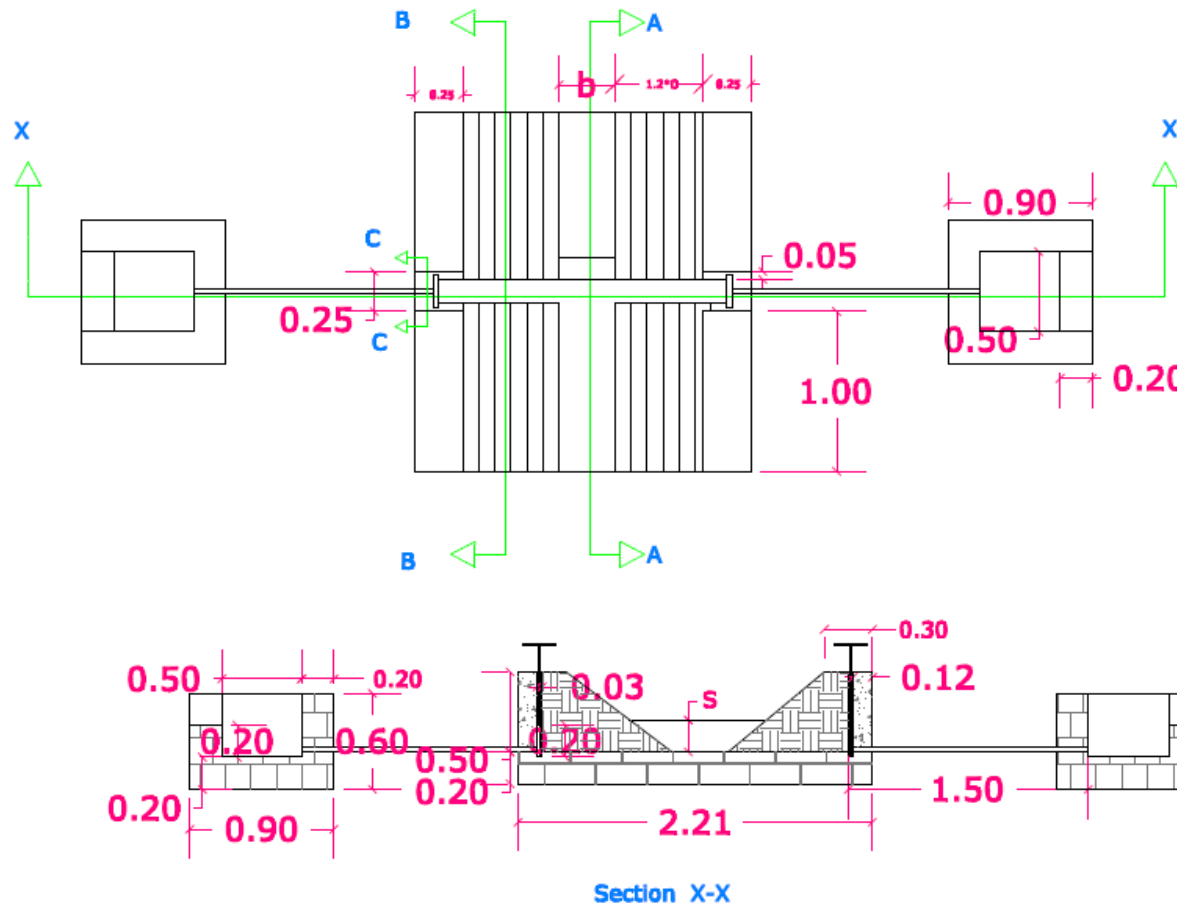
Section A-A



Bar arrangement

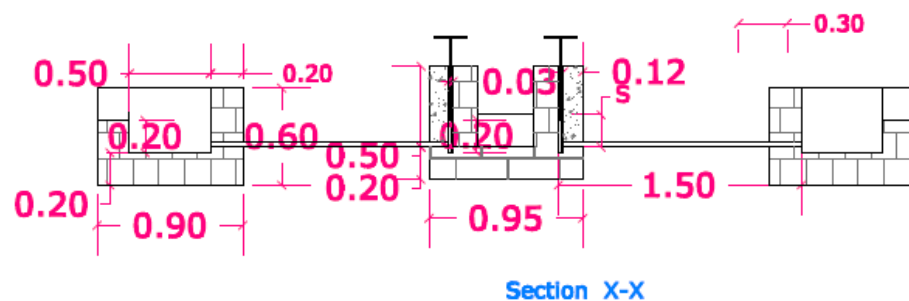
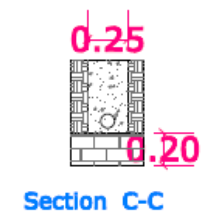
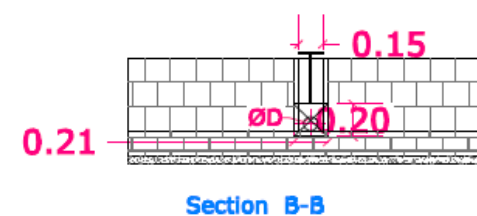
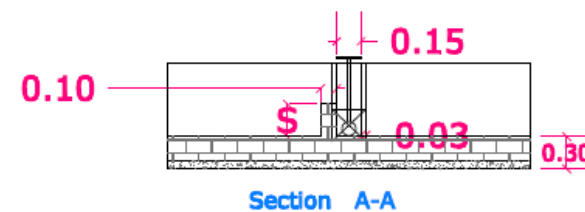
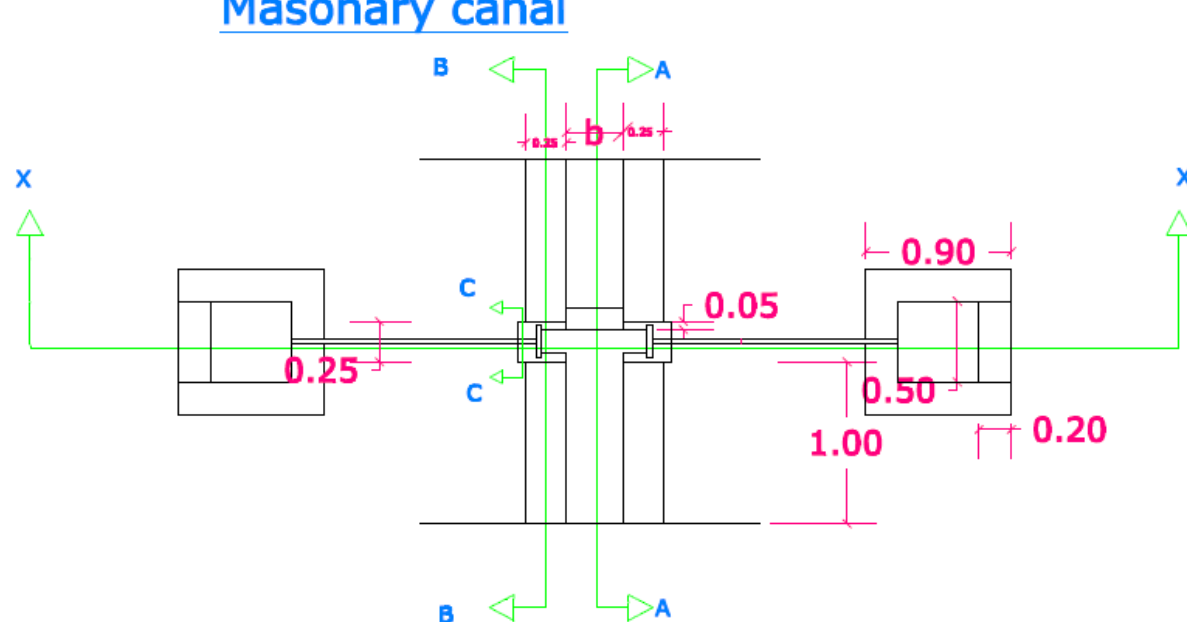
OWNER	Harena Buluk pastoralist Development office		
PROJECT	Shawe Gindile Gajal-SSIP-III		
TITLE	Sample-Culvert DRAWING		
DRAWNED-BY	Diriba Beyene	DR.NO	
DESIGNED-BY	Diriba Beyene	SCALE	
CHECKED-BY		DATE	
APPROVED-BY			

Sample Off-Take Plan & section view (all dimensions are in meter) on earthen canal



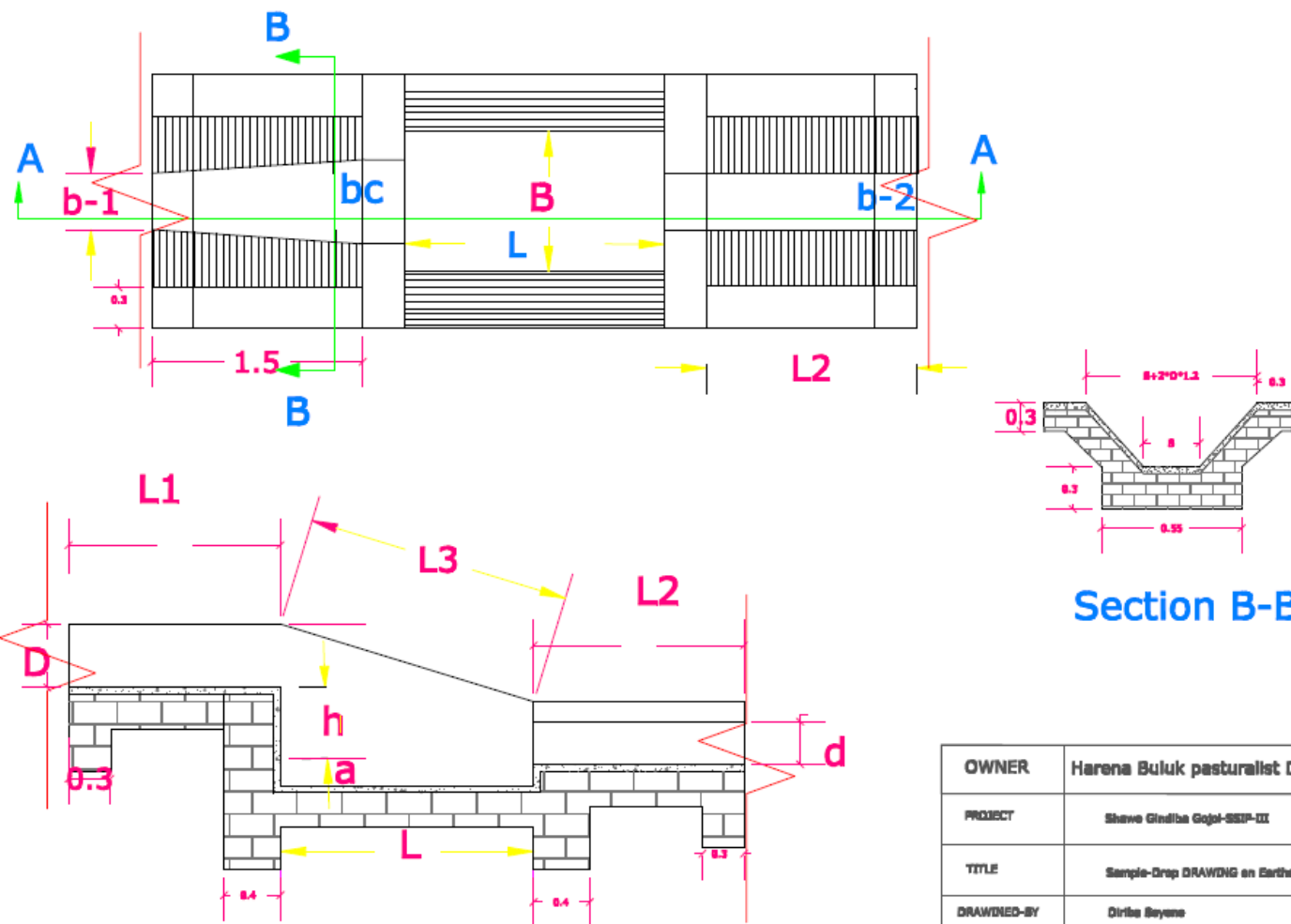
OWNER	Harena Buluk pastoralist Development office		
PROJECT	Shawe Gindiba Gajel-SSIP-III		
TITLE	Sample-Choice DRAWING		
DRAWNED-BY	Diriba Beyene	DR.NO	
DESIGNED-BY	Diriba Beyene	SCALE	
CHECKED-BY		DATE	
APPROVED-BY			

Sample Off-Take Plan & section view (all dimensions are in meter) on Masonry canal



OWNER	Harena Buluk pastoralist Development office		
PROJECT	Shawe Gindiba Gajal-SSIP-III		
TITLE	Sample-Check DRAWING		
DRAWNED-BY	Diriba Beyene	DRLNO	
DESIGNED-BY	Diriba Beyene	SCALE	
CHECKED-BY		DATE	
APPROVED-BY			

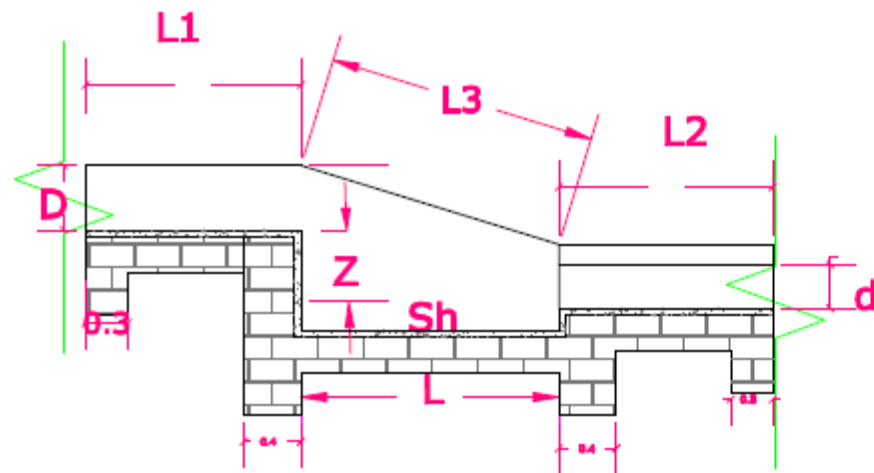
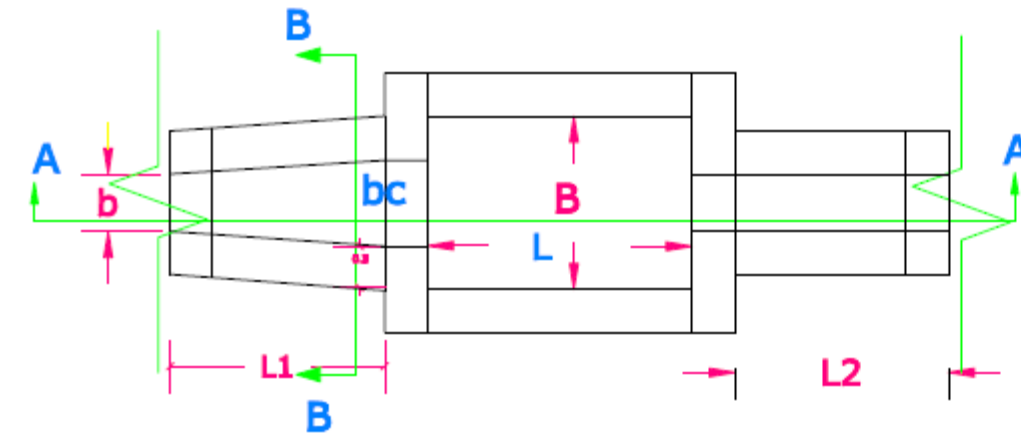
Plan of sample drop on trapezoidal canal



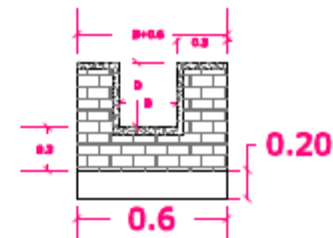
Section B-B

Section A-A

OWNER	Harena Buluk pastoralist Development office	
PROJECT	Shawe Gindiba Gopai-SSIP-III	
TITLE	Sample-Drop DRAWING on Earthen MC	
DRAWNED-BY	Diriba Beyene	DR.NO
DESIGNED-BY	Diriba Beyene	SCALE
CHECKED-BY		DATE
APPROVED-BY		



Section A-A



Section B-B

OWNER	Herana Buluk pastoralist Development office		
PROJECT	Shawe Gindles Gindis-SEP-III		
TITLE	Sample-Draw DRAWING on Local PC		
DRAWN BY	Dirlos Beyene	DATE	
CHECKED BY	Dirlos Beyene	SCALE	
APPROVED BY		DATE	