SWIM STRENGTHENING WATERSHED AND IRRIGATION MANAGEMENT

STRENGTHENING WATERSHED AND IRRIGATION MANAGEMENT (SWIM)

TECHNICAL SPECIFICATIONS
Revision-01

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Contents

Abbrevia tions

Abbreviation	Description	Abbreviation	Description
km	kilometer	lin	linear
m	Meter	cu	cubic
mm	millimeter	sq	square
ha	hectare	g	gram
m2	square meter	t	tonne
mm2	square millimeter	l	liter
m3	cubic meter	ml	milliliter
no	Number	s	second
%	Percent	min	minute
°C	degree Centigrade	NEPA	National Environment Protection Agency
kg	Kilogram	RBA	River Basin Agency
N	Newton	IS	Indian Standard
KN	Kilonewton	AASHTO	American Association of State Highway and Transportation
ISO	International Standard Organization	ASTM	American Society for Testing and Materials
USD ($)	United States Dollar	Afg	Afghani, Afghan currency
USAID	United States Agency for international Development	MPa	Megapascal
Days	Calendar days	ACI	American Concrete Institute
MEW	Ministry of energy and water	SLA	Service Level Agreement

MAIL	Ministry of Agriculture. Irrigation and Livestock	SWIM	Strengthening Watershed & Irrigation Management

1. GENERAL

1.2 Description of the Works

This Specification is prepared for use on the Canal Rehabilitation Projects by SWIM EACOM which is financed by the United States Agency for International Development (USAID). The scope of works consists irrigation rehabilitation Works will be completed on irrigation infrastructure projects in Afghanistan.

The Works are to be completed on existing, operational canals. The Works may involve installation of gated intakes, canal escapes, canal protection and reshaping, canal covers, aqueducts and super passages, pipe outlets, protection of landslide areas, dry stone pitching, canal lining , and other construction activities and river training work and etc. related works in respect to design drawings. The construction activities that can be expected include: excavation in dry and saturated conditions, concrete placement with and without steel reinforcement, canal or river diversions, dewatering, rock cutting, dry boulder placement, stone masonry, building/placing of gabions, and installation of pipe outlets.
In the context of these Contract Documents "Site" refers to a specific length irrigation canal on which a number of "elements" are to be completed. Winter weather conditions can prevent access to the sites or elements for some period.
It is the Contractor's sole responsibility to understand the scope of the works specified for the site, the construction methods needed to complete each element of the works and to understand the challenges of accessing each site and element safely and within the period of implementation of the Contract.

The projects for rehabilitation and construction are located in Five Afghanistan provinces, Balkh, Jawzjan, Samangan, Baghlan and Badakhshan. Climate conditions at the sites can vary considering Codes and standards requirements. The Contractor must be familiar with the specific climate conditions at the site he is working on and plan his work schedule accordingly.

1.3 Governing Codes

Manual of Standard Practice for Detailing Reinforced Concrete Structures - ACI-315
Specifications for Structural Concrete - ACI-301
Concrete Measuring, Mixing, Transporting, etc. - ASTM-C94
Recommended practice for Concrete Formwork - ACI-347

1.4 Project Signboards

Provide project-specific signboards and the following:
• Location, size and wording as directed by SWIM Engineer.
• Maintain in good condition for duration of the work.
• Remove on completion.
Obtain approval before display of advertisements or provision of other signboards.

1.5 Sub-Contractor's Representative

The sub-contractor must employ a suitably experienced engineer as the Site project Manager. This person must be on site during working hours, and fluent in English and technical terminology. The sub-Contractor's Site project Manager will have the authority to make all decisions concerning the project on behalf of the Contractor.

1.6 Site Meetings

Hold and attend weekly site meetings throughout the contract and ensure attendance of appropriate subcontractors, the Site project Manager and Engineer. The meeting schedule may be modified by the SWIM Engineer.
The meeting will consider the following items:
• Technical issues.
• Commercial issues.
• Program.
• Quality of work.

1.7 Completion of the Works

Final Cleaning
Before Practical Completion, clean throughout, including interior and exterior surfaces exposed to view. Clean debris from the site, and canal. Remove waste and surplus materials.

Post Construction Works
The Sub-contractor will provide the following documentation after all site construction has been completed:
• Warranty Statement
• Material Test Certificates
• As-Built Drawings
• List of the suppliers with their contact information
• Spare materials, where applicable
A condition-out survey will be conducted with the Sub- contractor and SWIM Engineer at which damages caused by the Sub-contractor will be identified. The SWIM Engineer will determine if the Contractor is to make repairs or if the damage will be deducted from the Sub-Contractor's final invoice.

1.8 Contract Documents

1.8.1 Drawings

If there are any errors in dimensions, set out or size, immediately inform the SWIM Engineer. Before starting the physical construction activities at the project site, the subcontractor survey engineer should make sure and check the elevation of each structure at the project site to comply with design drawing. If there is any error in original survey data which is not matching with the field condition, the subcontractor should inform the SWIM design team before starting construction activities by providing actual survey data using total station. Based on subcontractor provided survey data the SWIM design team will check the provided survey data and make changes in design drawing, if any, and will share the revised designed drawing with subcontractor.

1.8.2 Schedule

The schedule forms part of the contract documents. The subcontractor is responsible to implement the construction activities based on the approved schedule. If there are any errors in schedule the subcontractor should immediately inform and notify the SWIM Engineer.

1.8.3 Bill of Quantities

If there are any errors in description of items or omissions in the BOQ, immediately notify the SWIM Engineer.

If there are any items which are unclear or are not available within the project program, immediately notify the SWIM Engineer.

2. CONCRETE WORK

2.1 Scope

The work covered by this specification will consist of furnishing all labor, materials, permits, and related miscellaneous work necessary to complete the work as specified herein or as shown on the design drawings. The concrete work under this specification will include all clearing and grubbing, preparation of subgrade, furnishing and placing concrete, shouldering, and construction of fills and embankments, unless such items appear of the proposal to be bid separately.

2.2 Concrete General Information

Concrete will consist of cement, graded aggregate and water thoroughly mixed, placed and compacted as specified. Before starting to concrete the Contractor will obtain formal written permission for concreting from the SWIM field supervisor Engineer or his representative on site. The SWIM field supervisor Engineer or his representative will allow concreting after ascertaining the required lines and levels, suitability of formwork, availability of required plant and labour, proper fabrication and spacing of the steel bars and quality and quantity of cement and aggregates.

2.2.1 Concrete Mix Design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, ground slag, and admixtures; and applicable reference specifications. Provide mix proportion data using water-cement ratios for mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted.

2.2.2 Concrete Materials

2.2.3 Delivery, Storage, and Handling

All materials will be so delivered, stored, and handled as to prevent the inclusion of foreign materials and the damage of materials by water or breakage. Package materials will be delivered and stored in original

packages until ready to be used. Packages or materials showing evidence of water or other damage will be rejected.

2.2.4 Portland Cement

Cement will be Portland Type originating from approved manufacturers in sealed and labelled bags, each 50 kgs. Capacity, name and brand of the manufacturer will plainly be identified thereon and delivered to the site in good condition. The quality of cement will conform to the Standard Specification for Portland Cement of ASTM Designation:

1. Portland cement will conform to ASTM Standard Specifications C 150 Type I or Type 1A latest edition.
2. High-Early strength Portland will conform to ASTM Standard Specification s C 150 Type III or Type IIIA.
3. All cement poured under extreme heat conditions will use ASTM Standard Specifications C-150 Type II, and
4. All cement poured when high sulphate resistance is desired will use ASTM Standard Specifications C-150 Type V.

All cement will be from reputable manufacturers and conform to international standards. Cement will be stored where it cannot be damped by rain or moisture and will be free of lumps when used. Any opened bag should be immediately used. Sulphate-resisting cement will be used for foundations and ordinary Portland cement for other works or as directed by SWIM field supervisor Engineer or by his representative.

2.2.5 Concrete Aggregates

All concrete aggregates (sand & gravel) will be furnished by the Contractor from any source approved by the SWIM Field Supervisor/Water Management Engineer. They will be free from organic material, lumps of soft material, clay, chalk, lime, peat, loam, soft clayey shale or decomposed stone, vegetable and other impurities that may be harmful to concrete.

2.2.6 Sand (Fine Aggregate)

All sands (fine aggregates) will conform to Standard Specification for Concrete Aggregates of ASTM Designation: C-33 and to the detailed requirements give in Table A (appended here below). It will not contain harmful materials such as iron pyrites, coal, mica, shale, Alkali, coated grains, or similar laminated materials such as soft and flaky particles, or any material which may attack the reinforcement, in such a form and in sufficient quantity to affect adversely the strength and durability of the concrete. Fine Aggregate passing sieve No. 4 will not contain any voided shells.
Fine Aggregate from different sources of supply will not be mixed or stored in one pile nor used alternately in the same class of construction or mix.
Fine aggregate for concrete will be free of stones larger than 2 mm and not include significant amounts of silt and clay. If sand, when dried after wetting, adheres together then it will be considered unsuitable.
All fine aggregate will conform to the following requirements:

Table-A

Sieve Size	% Passing

3/8 inch	100%
No. 4	95-100%
No. 16	45-80%
No. 50	5-30%
No. 100	0-10%
Fineness modulus	2.50-2.15

2.2.7 Coarse Aggregate

Gravel for concrete will be uniformly graded and consist of hard and dense rock. The gravel will be free of materials finer than 5 mm and the surface will be clean. Gravel for use in Field Turnouts, and all types of concrete, will be crushed rock. Generally, natural gravel and/or crushed rock particles will be spherical or cubical in shape.

All crushed stone or gravel for concrete work will be well graded and will pass the following sieve analysis:

TABLE - 1

Sieve Size	% Passing
2 inch	100%
1-1/2"	90-100%
1 inch	20-55%
¾ inch	0-15%
3/8 inch	0-5%
No. 4	0%

2.2.8 Water for Concrete

Water for mixing of concrete will be fresh, clean and free from injurious amounts of oil, acid, salts or any other deleterious mineral and/or organic matter. It will not contain chlorides such as sodium chloride in excess of 700 ppm. It will not contain any impurities in amount sufficient to cause a change in the time of setting of Portland Cement of more than 10 percent, nor a reduction in compressive strength of mortar of more than 5 percent compared to results obtained with distilled water. The PH of the water for mixing and curing of concrete will not be less than PH 4.5 or more than PH 8.5. The water for mixing will be provided by sole expense of the Contractor and no additional allowance will be made thereof. The Contractor will furnish water for concreting and curing and for rest of project implementation.

2.2.9 Applicable tests and codes

Prior to commencement of concrete work, the Contractor will submit samples to the SWIM field Supervisor Engineer before sending them to the laboratories for testing, to establish the probability of the materials passing tests for specified requirements. All concrete aggregates, cement and water will be sampled and tested as frequently as deemed necessary by the SWIM Field supervisor All tests samples will be obtained in accordance with the latest editions of the American Society for Testing and Material (ASTM) Code or any equally approved standard.

2.2.10 Testing

2.2.10.1 Slump Test

Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders or cubes are made, and for each batch (minimum) or every16 cubic meters (maximum) of concrete.
Slump tests will be carried out periodically to ensure the appropriate water cement ratio in accordance with the Standard Method of Test of Slump of Portland Cement Concrete of the ASTM Designation: C-143.

Specifications for Slump Values (as generally accepted):

Allowable Slump	Degree of Workability	Suitable for Works
0-25 mm	Very low	Pre-cast and vibrated concrete work in roads & piles
25-50 mm	Low	Road works, mass concrete in foundation, lightly reinforced section
50 - 100 mm	Medium	Slabs, normal reinforced concrete, heavily reinforced section.
100–200 mm	High	For cast in situ pile

2.2.10.2 Compressive Test

The Compression Strength of Concrete will be obtained according to locally conducted cubical tests. Test cubes made in the field will have a dimension of 15x15x15cm. Make five test cylinders for each set of tests in accordance with ASTM C 31/C 31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each concrete placed each day not less than once a day, nor less than once for each 50 cubic meters of concrete, nor less than once for each 200 square meters of surface area for slabs or walls. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 3 MPa take a minimum of three ASTM C 42/C 42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with non-shrink grout. Match color and finish of adjacent concrete.

2.2.11 Proportioning

The proportions specified are based on surface dry aggregate, and Portland cement in standard unopened cloth or paper sacks as packed by the manufacturer considered as weighing 50kg per sack. All

measurements of cement fine and coarse aggregate will be made separately. Measurements will be based on the weight of actual dry loose weight per cubic foot of fine and coarse aggregates used.

All concrete will be proportioned based on water-cement ratio, which is defined as the ratio of the total quantity of water in the mixture, including moisture carried by the aggregate, to the quantity of cement. The maximum ratio of water & cement (W/C) will be:

S/N	Grade of Concrete	Nominal mix	Water/Cement (maximum)
	M15	1:2:4	0.6
	M 20	1: 1.5:3	0.5
	M 25	1:1:2	0.45

The mix will be as dry as possible to work the concrete. In no case will there be more than 6-1/2 gallons of water per bag of cement used. Moisture in the aggregate will be measured by a method satisfactory to the SWIM field supervisor Engineer and will give results within one kg for each 100kgs of aggregate.
The air content of the concrete shall be within the range of 4- 7% by volume based on measurements made on concrete immediately after discharge from the mixer in accordance with ASTM, C-138, C-173 or C- 231.

2.2.12 Concrete Classes

The classes of concrete to be used in the Works will be as shown on the Drawings, Bills of Quantities or as directed by the SWIM Field Supervisor Engineer. The concrete is classified based on its compressive strength at twenty-eight (28) days.

2.2.13 Concrete Consistency

The concrete will be of such consistency that it can be readily transported, placed and compacted in the Works without segregation of the materials. The resulting concrete will be uniform and free from honeycombing. The consistency of the concrete as determined by the slump test will be within the range of 2.5 cm to 10 cm. Samples for slump determination will be taken from the concrete during placing in the formwork in the presence of SWIM field supervisor Engineer or his representative (SWIM Field Supervisor Engineer).

2.2.14 Mixing Procedure

2.2.14.1 Field Mixed Concrete

Concrete will be mixed in a batch mixer for not less than 1-1/2 minutes after all the materials are in the mixer drum. Mixing will continue until there is a uniform distribution of materials and the mass is homogenous in consistency and colour. Over more than one m3 of concrete, no hand mixing or re-tempered concrete will be allowed for SWIM's canal improvements work. A full-size trial batch will be made using the aggregates and correct proportions selected for the job. If the desired workability is not

obtained, then the proportions of aggregates will be adjusted until the mix meets the approval of the SWIM Engineer.

2.2.15 Placing Concrete

Placing of concrete should be in the way that the material may be conveniently handled and placed in the required position without re-handling or segregation. Concrete will not be placed unless the SWIM Field Supervisor Engineer or his representative is present and has previously examined and approved the positioning, fixing and condition of reinforcement and any other items to be embedded and the cleanliness, alignment and suitability of the containing surfaces or formwork.
In placing concrete through reinforcement, care will be taken that no segregation of the coarse aggregate occurs. On the bottom of beams or slabs, where the congestion of steel near the forms makes placing difficult, a layer of mortar of a composition compatible with the required concrete strength as directed will be first deposited to cover the surface to a depth of minimum 3 cm.

2.2.16 Concreting in High or Low Ambient Temperature

Do not place concrete when the atmospheric temperature is below 5 degrees Celsius, or when the concrete is likely to be subjected to freezing temperatures within 24 hours after it has been deposited, unless adequate temporary heating has been provided. Maintain the concrete at a temperature not lower than 21 degrees C. for 3 days or 10 degrees C. for 5 days after placing, except when High-Early-Strength cement or concrete is used, when the temperature must be maintained at not less than 21 degrees C. for 2 days or 10 degrees C. for 3 days. The methods of heating the materials and protecting the concrete will be approved by the SWIM Field Supervisor Engineer. Salt, chemicals, or other foreign materials will not be mixed with the concrete for the purpose of preventing freezing. Unless recommended by SWIM Field Supervisor Engineer, certified anti-freeze products should be submitted for approval to SWIM Field Supervisor Engineer. Forms will be enclosed and heated at 10 degrees C. to 21 degrees C. for 2 days before the pour is made.

2.2.17 Concreting in Adverse Weather

No concreting will be allowed to take place in the open during storms or heavy rains/ snowfall. Where strong winds are likely to be experienced additional precautions to ensure protection from driving rain and dust will also be taken. The SWIM Field Supervisor Engineer may withhold approval of commencement of concreting until he is satisfied that full and adequate arrangements have been made.

2.2.18 Vibration of Concrete

Only Table vibrator (Surface Vibrator) should be used to vibrate concrete in the molds for lining. Except where otherwise permitted by the SWIM Field Supervisor Engineer, concrete will be fully compacted throughout the full extent of the layer and will be brought up in level layers of such depth that each layer is readily and properly incorporated with the layer below with the use of internal vibrators or by spading, slicing or ramming. It will be thoroughly worked against formwork and around any reinforcement or embedded items without displacement. The internal concrete vibrator will be arranged by the Contractor. The duration of vibration will be limited to that required to produce satisfactory consolidation, without causing segregation. Vibration will, on no account, be continued after water or excess grout (if any) appears on the surface.

2.2.19 Curing and Protection

The Contractor will take adequate measures to ensure that the concrete will be kept damp continuously for a minimum of three (3) days after casting or for such other time as the Engineer may direct. After removal of this covering (layer of sacking, canvas, Hessian, straw mats or similar absorbent material or a layer of sand), the concrete will then be sprayed with water for minimum period of a further fourteen (14) days.
All concrete liable to be affected by running water or wave action will be adequately protected from damage during the setting period and all temporary protection works will be to the satisfaction of the SWIM Engineer.

2.2.20 Plum/ Boulder Concrete

The proportion of plums (big stones) will not exceed 50% of the total volume of plum concrete. Each plum (large boulder) will be placed to be completely embedded in concrete. No stones will touch, and there will be no unfilled pockets in the concrete. The grade of plum concrete will be as shown on the drawings or as instructed by the Supervisor. The mix design for boulder concrete is M150.

2.2.21 Joints in Concrete

The joints in concrete will be provided in a manner and position as shown on contract drawings. In the case of water retaining structures, and in-situ lining, joints will be made water- tight by the provision of a continuous water stoppers, with suitable water-resistant filler material and sealant as approved by the SWIM Field Supervisor Engineer.
The joints required by the Contractor, but not intended by the Exhibited Design, are in principle subject to the SWIM Field Supervisor Engineer's approval. The location and design of such joints are to be depicted in the Drawings that are then to be submitted to the Engineer in enough time. In determining the location of joints, the Contractor must consider the static requirements of the respective structural member, as well as the special local and climatic conditions.

2.2.21.1 Joint Sealer

For joint sealing purpose a flexible water stopper, nominally of width ≥200mm, shall be placed in joints of concrete structure as showing on the drawings or as directed by SWIM Engineer. The water stops shall be of extruded polyvinyl chloride complying with ASTM D2240. In order to protect the water stopper from damaging, the open space above the water stopper shall be filled with materials composed of weak cement sand mortar of (1:8). Before installation a suitable water-resistant filler should be approved by the SWIM Field Supervisor Engineer.

2.2.22 Gravel under Concrete

Gravel can be produced from riverbed, Crushed plant or other source to meet the requirement of structure that have recommended by Design engineer or certified by QC Engineer. The sizes of gravel should be within the range of 20-80mm. The gravel shall uniformly level and compacted with the required thickness and wideness in accordance to approved designed drawing. Before starting concrete the SWIM engineer in coordination with Subcontractor engineers should physically check the carried out graveling work and make sure that it is uniform and properly leveled.

3. PLASTER WORK

3.1 Plaster Materials

- Cement: ASTM C150, Type I Portland cement.
- Aggregate: Sands shall conform to ASTM Designation: C-33 and to the detailed requirements give in table below:

Sieve Size	**% Passing**
3/8 inch	100%
No. 4	95-100%
No. 16	45-80%
No. 50	5-30%
No. 100	0-10%
Fineness modulus	2.50-2.15

- Water: Clean, fresh, potable and free of mineral or organic matter capable of affecting plaster.

3.2 Mixes

- Except where hand-mixing of small batches is approved by the Engineer, mechanical mixers of an approved type shall be used for the mixing of plaster. Frozen, caked or lumped materials shall not be used.
- Mechanical mixers, mixing boxes and tools shall be cleaned after mixing each batch and kept free of plaster from previous mixes. Plaster shall be thoroughly mixed with the proper amount of water uniform in color and consistency. Tempering will not be permitted and all plaster which has begun to stiffen shall be discarded.
- Spatter dash Coat one-part Portland cement and maximum 2 parts of sand, proportioned by volume.
- Canal plaster shall be (1:3) composed of 475 kg of cement per m^3 of sand. Canal External Plaster shall be more than 20 mm thick or it is depends on stone masonry wall roughness, in any case contractor is responsible to obtain smooth surface for plaster.
- Mix and proportion cement plaster in accordance with approved methodology.
- Add admixtures as instructed by the manufacturer. If required in cold weather.
- Mix only as much plaster as can be used prior to initial set.
- Mix materials dry, to uniform color and consistency, before adding water.
- Protect mixtures from freezing, frost, contamination, and excessive evaporation.
- Do not retemper mixes after initial set has occurred.
- Two-coat Portland cement-based plaster shall be applied in accordance with ASTM C 926 or equivalent. The final coat shall be finished to a true and even surface free from rough areas, checks, or blemishes. Nominal plaster Finish thickness shall be as required and direct by QC Engineer in the site.

3.3 Patching

Plaster showing over sanding, cracks, blisters, pits, checks, discoloration or other defects is not acceptable. Defective plaster work shall be removed and replaced with new plaster at the expense of contractor.

Curing Method: Curing and Time between Coats (Provide enough moisture in the plaster mix or by moist or fog curing to permit continuous hydration of the cementitious materials. The most effective procedure for curing and time between coats 7 – 7 days or will depend on climatic and job conditions. Sufficient time between coats shall be allowed to permit each coat to cure or develop enough rigidity to resist cracking or other physical damage when the next coat is applied. The timing between coats will vary with climatic conditions and types of plaster base unless otherwise direct QC Engineer. Temperature and relative humidity extend or reduce the time between consecutive operations. Cold or wet weather lengthens, and hot or dry weather shortens the time period. Moderate changes in temperature and relative humidity can be overcome by providing additional heating materials during cold weather and by reducing the absorption of the base by pre-wetting during hot or dry weather.

4. REINFORCMENT STEEL

Reinforcing steel shall be deformed bars conforming to ASTM-A 615, grades and sizes as indicated. Precast concrete blocks shall have wire ties for supporting reinforcement on ground. Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI-318. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete.

4.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI-318 at locations shown plus or minus one bar diameter. Reinforcement shall not be continuous through expansion joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI-318. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

4.2 Splicing

Splices of reinforcement shall conform to ACI-318 and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 11 unless otherwise indicated. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm.

4.3 Formwork

4.3.1 System Description

The design, engineering, and construction of the formwork is the responsibility of the Contractor. Contractor shall design formwork in accordance with methodology of ACI-347 for anticipated loads, lateral pressures, and stresses, and capable of withstanding the pressures resulting from placement and vibration of concrete. Monitor the adequacy of formwork design and construction prior to and during concrete placement as part of the Contractor's approved Quality Control Plan.

4.3.2 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Provide solid backing for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6mm nor more than 25 mm deep and not more than 25 mm in diameter. Terminate the embedded portion of metal ties not less than 50 mm from any concrete surface exposed to water. Removable tie rods shall be not more than 38 mm in diameter. Plastic snap ties may be used in locations where the surface will not be exposed to view.

4.3.3 Installation

Forms shall be constructed true to the structural design and required alignment. Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements and conforming to construction tolerance. Continuously monitor the alignment and stability of the forms during all phases to assure the finished product will meet the required surface specified. Failure of any supporting surface either due to surface texture, deflection or form collapse shall be the responsibility of the Contractor as will the replacement or correction of unsatisfactory surfaces. Where concrete surfaces are to have a exposed finish, joints in form panels shall be arranged as approved. When forms for continuous surfaces are placed in successive units, care shall be taken to fit the forms over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be re-used if there is any evidence of defects which would impair the quality of the resulting concrete surface. All surfaces of used forms shall be cleaned of mortar and any other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a non-staining bond breaker.

All exposed joints, edges and external corners shall be chamfered by molding placed in the forms unless the drawings specifically state that chamfering is to be omitted or as otherwise specified. Chamfered joints shall not be permitted where earth or rock-fill is placed in contact with concrete surfaces. Chamfered joints shall be terminated 300 mm outside the limit of the earth or rock-fill so that the end of the chamfers will be clearly visible. Forms for exposed finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions Forms and embedded items shall be inspected in sufficient time prior to each concrete placement in order to certify to the SWIM Engineer that they are ready to receive concrete.

4.3.4 Form Removal

Forms shall not be removed without approval of SWIM assigned engineer. The minimal time required for concrete to reach a strength adequate for removal of formwork without risking the safety of workers or the quality of the concrete depends on a number of factors including, but not limited to, ambient temperature, concrete lift heights, type and amount of concrete admixture, and type and amount of cementitious material in the concrete. It is the responsibility of the Contractor to consider all applicable factors and leave the forms in place until it is safe to remove them. Formwork for walls, columns, sides of beams, gravity structures, and other vertical type formwork not supporting the weight of concrete shall not be removed in less than 24 hours after concrete placement is completed. Formwork supporting weight of concrete and shoring shall not be removed until structural members have acquired enough strength to safely support their own weight and any construction or other superimposed loads to which the supported concrete may be subjected.

4.3.5 Inspection

Forms and embedded items shall be inspected in enough time prior to each concrete placement in order to certify to the SWIM assigned engineer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

5. EARTHWORK

5.1 Definition

The following definitions of earthworks materials will apply to this and other clauses of the Specification in which reference is made to the defined materials:

"Suitable material" will comprise all material which arises from excavations within the Site and which is approved by the SWIM Field Supervisor Engineer as acceptable for use in the Works.

"Unsuitable material" will mean other than suitable material and will comprise:

- material from swamps, marshes and bogs.
- logs, stumps and perishable materials.
- material susceptible to spontaneous combustion; and
- Clay of liquid limit exceeding ninety (90) and/or plasticity index exceeding sixty-five (65).

"**Common**" material will mean all material other than that defined as "rock".

"**Rock**" will mean any hard natural or artificial material requiring the use of approved pneumatic or hydraulic breakers and tools for its removal but excluding individual masses less than 0.5 m^3.

5.2 Classification of Excavation

Following classes of excavation will apply:

Common excavation: this comprises all excavation made in all kinds of soil or soil and sand mixed with pebbles, boulders in the river/seasonal stream bed or banks or canal profiles.

Rock Excavation: Rock will include any hard material complying, in the opinion of the SWIM field supervisor Engineer/Supervisor

Borrow Excavation: will be limited to excavation taken from borrow pits and cut areas.

5.3 Excavation

All excavation will be carried out to the lines and levels shown on the drawings or to such

lines and levels as the Engineer may direct. The Contractor will trim all permanent excavation to the lines and levels shown on the drawings. Excavation will generally be executed in such a manner as to ensure that the side slopes, as shown on the drawings, are not in any way endangered by undercutting. As far as practicable, all suitable materials from the excavations will be used in embankment and backfill for structures. The Contractor will dispose of unsuitable or excess soil of the excavated materials in a place that is acceptable to the local community and approved by the local authority**,** and so that they do not interfere with proper functioning of the works.

All necessary precautions will be taken to preserve the material below and beyond the lines of all excavation in the soundest possible condition. Any damage to the work due to the Contractor's operations, including shuttering to the material beyond the required excavation lines, will be repaired.

5.4 Embankment Earth-filling

Material for filling will be obtained from approved sources or selected from excavations and will contain no organic, plastic or undesired perishable matter. It will be graded to ensure a dense, stable and homogeneous fill when compacted. All embankments will be constructed to the lines and levels shown on the drawings or as directed by the Field Supervisor/SWIM field supervisor Engineer.

During placing and spreading, the materials should be thoroughly compacted by hand tampers or mechanical compactors. The distribution of the materials will be such that the tamped materials will be homogenous and free form lenses, pockets, streaks or other discontinuities.

5.5 Back Filling

In all excavations where the excavated material is required to be returned to the excavation as backfill, suitable material will be set aside during excavation and will be kept free from contamination with top soil, vegetable matter or other unsuitable material, failing which the Contractor will at his own expense import suitable material from elsewhere. Back filling will not be placed in waterlogged excavations. Backfill material which is in the opinion of the Engineer too wet, will not be used until it has dried out sufficiently. Excessively dry backfill material will be watered during backfill. The Contractor's rates will allow for any additional costs these measures any may entail.

No back filling will be carried out without the permission of the SWIM Field Supervisor Engineer that will normally only be given when the Work has been inspected, tested and approved. After such permission has been given back filling will be carried out as soon as possible. The utmost care will be taken to ensure that no damage occurs to the Works and compaction methods employed will be approved by the SWIM Field Supervisor

Engineer and will ensure that excessive loads are not placed on pipes or structures upon or around which the backfill is being placed.

5.6 Borrow Pits

If there is an insufficiency of suitable material for use in back filling of trenches, road formation or due to other circumstances the Field Supervisor Engineer so agrees or orders, the Contractor will supply such materials from borrow pits. However, the Contractor will obtain the approval of the SWIM Field Supervisor Engineer to the location of borrow pits and will adhere to instructions in regard to the area, width, depth and slope of the borrow pits and also to the depth of overburden if any, which has to be removed. Prior to excavating materials from borrow pits, the Contractor will strip all unsuitable overburden and lay it aside. However, the use of this as fill and other unsuitable material will not be permitted.

After the use of a borrow pit has been finally discontinued, the overburden and any other unsuitable material previously laid aside will be replaced in the pits, spread and levelled as required. The sides of the borrow pits will be graded and the whole area will be left in a tidy, regular and self- draining state, all to satisfaction of the SWIM Field Supervisor Engineer. In case of payment for imported fill such fill will be measured solid, after compaction net as shown on Drawings. The supply of material from borrow pits will, except where otherwise specified, be deemed to cover the supply, spreading and compaction of the fill in the works and any other costs the Contractor might have, including negotiations with owners, stripping and handling of overburden and the satisfactory reinstatement after completion.

5.7 Compaction Requirements

Unless otherwise specified in the contract documents, fill and backfill layers shall be uniformly compacted in accordance with the following density and moisture content requirements:

1. Structural Fill/Backfill Compaction Densities

a. Structural fill/backfill shall be compacted to at least 90% of the maximum Modified Proctor density in accordance with ASTM D1557, or 95% of the maximum Standard Proctor density in accordance with ASTM D698:
   i. Culvert, access road, turnout base - 95% relative compaction
   ii. Arround culvert and turnout zone- 95% relative compaction
   iii. Trench zone - 95% relative compaction.

b. Granular soil used as structural fill that does not exhibit welldefined moisture-density relationship shall be compacted to at least 80% relative density in accordance with ASTM D4253 and ASTM D4254.

2. General Fill/Backfill Compaction Densities

These are defined as fill/backfill around the non loading bearing structures like trenches behind canal lining and retaining walls that can be backfilling and left without compaction for natural settlement after due resulting from rains or flooding.

a) General fill/backfill shall be compacted to at least 80% of the maximum Modified Proctor density in accordance with ASTM D1557.

b) Granular soil used as general fill/backfill that does not exhibit welldefined moisture-density relationship shall be compacted to 70% to 75% relative density in accordance with ASTM D4253 and ASTM D4254.

5.8 Backfill Placement

A. Prior to backfilling, clean make sure that the excavated trench is free of trash and debris and shape the subgrade or existing materials to conform to the typical sections shown on the plans or as directed.
B. Placing, spread and shape backfill materials into a uniform layer to the thickness shown on the plans, not greater than 15 cm depending on the site condition and applicable type of compaction equipment.
C. Place successive lifts and finish courses using the same construction methods throughout and do not proceed with additional layer until required density is obtained
D. Place backfill material in such a manner that unbalanced horizontal or vertical loads will not applied to the structure.

5.9 Compaction

A. Any equipment mechanical equipment capable of producing required backfill densities shall be permitted.
B. In those parts of the structure which are inaccessible to the specified rolling equipment, or around and in contact with structures and in proximity to structures, where the rolling equipment is not permitted to operate, compaction shall be accomplished by mechanical or pneumatic rammers of approved type as directed.
C. All materials to be compacted or tamped shall be spread in layers/lifts not exceeding 150 cm thick when loose and the moisture content of the material and the amount of tamping shall be such as to produce a degree of compaction equal to the specified degree of compaction to at least:
D. 95% compaction around load bearing structures as the areas around culverts, access roads, turnouts etc. unless otherwise direct by QA/QC Engineer in the field.
E. 80 % compaction around non load bearing structures, agricultural areas and rural areas.
F. Special care shall be exercised to obtain good contact and bond with surface of concrete or masonry structures.

G. The size and weight of compacting equipment shall depend on nature of material, the height and load assumed in design of a structure. The backfill close to the structure up to the rolled layer shall be compacted in suitable uniform layers, using pneumatic tampers to a dry density of at least 80% of standard proctor depending on location and type of structure (load bearing or non loading bearing)

A. Do not cause the canal wall to shift or be damaged by the compaction operation. When placing backfill do not allow sharp or heavy equipment or material to drop directly onto the wall. Do not

use compaction equipment adjacent to walls or retaining walls that may cause the wall to become over stressed or moved from final alignment. Do not backfill against walls until concrete has obtained 75% of design strength. Restore any damaged structure to its original strength or condition and backfill to specifications.

B. Rework, recompact, and refinish material that fails demonstrate adequate compaction performance. Finish rework before the next course is placed or the project is accepted. Continue work until specification requirements are met.

5.10 Final Clean-up

A. After backfilling, grade the right-of-way to the contours of the original ground and match the adjacent undisturbed ground. Make surfaces free of all cleared vegetation, rubbish and other construction wastes. Dispose of all excavated or surface rocks and lumps which cannot be readily covered by spreading.

B. Replace in kind street improvements, such as asphalt concrete, concrete paving, striping and markings, curbs and gutters, barricades, traffic islands, signalization, fences, signs, mail boxes, landscaping, irrigation systems and other existing improvements that are cut, removed, damaged, or otherwise disturbed by the construction.

C. Scarify surface, reshape, and compact to required density completed or partially completed areas of WORK disturbed by subsequent construction operations or by adverse weather.

D. Maintain and correct backfill and canal embankment settlement

5.11 Disposal of Excess Excavated Materials

A. SUBCONTRACTOR shall make its own arrangements for removal and disposal of the excess material and bear all incidental costs. It is the intent of these Specifications that all surplus material not required for backfill or fill shall be disposed of legally by the SUBCONTRACTOR outside the limits of the public rights of-way and/or easements at no cost or liability to the SWIM.

No excavated material shall be deposited on private property unless written permission from the private property owner thereof is secured by the SUBCONTRACTOR. The private property written permission agreement shall be submitted to the SWIM for review and approval prior to hauling any material to the private property site. Before the SWIM will accept the work as being completed, the SUBCONTRACTOR shall file a written release signed by all property owners with whom he has entered into agreements for disposal of surplus excavated material absolving the SWIM and its officers, agents, and employees from any liability connected therewith.

5.12 Measurement of and Payment for Earthworks

The tendered prices for earthworks will include for all associated work, such as setting out in plan and in level, side sloping, timbering, shoring strutting, storm water protection, dewatering, draining, trimming to line and level or grade, **removing tree roots** and **obstructions as specified disposal of soil and surplus material, testing to confirm compliance with the specification** and all other contingent works not billed specifically.

All excavations will be measured net to the lines and levels specified on the drawings or otherwise by the Engineer. Where not specified by the Engineer, to the contrary sides of the excavations will be taken as vertical. The depth of the excavation will be taken as the depth from the actual cleared ground level to the formation level specified by the Engineer or, in the case of trench excavation for sewer, water, drainage or other pipes or culverts to the invert level specified by the Engineer. The Contractor will be deemed to have allowed in his rates for any additional excavation.

6. STONE WORKS

6.1 Stone

Stone for all purposes shall be the best of its kind, sound and durable, free from flaws and from soft, weathered or decomposed parts. In general, the stones should be of uniform size to avoid voids between stones. The stone and the quarry from which it is obtained shall be subject to the approval of the SWIM Field Supervisor/ Engineer before being used or placed. The stone shall have a minimum compressive strength of 28MPa in dry condition perpendicular or parallel to the bedding or rift. The minimum specific gravity of stone shall be 2.5 with a maximum water absorption of 7.5%.

Rock used for **stone pitching** will be sound durable rock selected from the harder rock from the required excavations or other **approved sources**. **The rock will not be less than 150 mm thick** and will be properly bedded to a uniform surface on an approved bedding material. The exposed surface of each stone will be approximately flat and of an area not less than 0.03 m^2 or 300 cm^2.

6.2 Masonry

Stone used in masonry will be regular field, river or quarry stone of approved quality, free from seams and other defects. All masonry stone will be **kept slightly moist** at the time of use. **Stone used for masonry will be two-thirds of the wall thickness**. Round stone will be permitted only in limited amount in combination with angular stone and will not be used in walls having a thickness less than forty (40) cm.

6.3 Mortar

Mortar of Type B (1:4) will be considered as per stone masonry purposes stated in following types of Masonry. The mixing contents like Water, Cement and fine aggregate (Sand) will be as per given in Cement Concrete specifications above.

All mortar not used within 30 minutes after adding water to the mix will be discarded. Any mortar remaining unused after 60 minutes of the addition of cement will not be allowed for use and will be rejected. The consistency of mortar (Workability/fluidity) will be in the range of water cement ration of about 0.6. The mortar content in one cubic meter of masonry is expected to range between 0.32 m3 to 0.38 m3; the average being assumed to be 0.35 m3, which is 35%. Compressive strength tests of mortar cubes will be conducted. A minimum of 3 test specimens will be made from each type/class of mortar and tested for their 28 days strength. The acceptance criteria of compressive strength of 1:4; mortar type is (0.76 Kg/mm^2) 7.5N/mm^2 respectively.

6.4 Laying of Stones

In laying the first course a full mortar bed will be placed on the foundation to the full thickness of the wall. The stones will be laid by hand with a specified mix of mortar in between two stones and a 12 cm layer of mortar on the bottom of the new layer. The finished surface of the masonry will be made as the shape and size of the stones will permit, varying not more than 4 cm from the required contour. Each

course is carefully plumbed and checked for vertical alignment. All alignment and plumbing of each unit to a final position must be done while the mortar is soft.

6.5 Surfacing and Pointing

The joints on the face of all stone masonry exposed to view will be neatly finished. The mortar in the joints of the stone masonry will first be removed to a depth of three (3) cm. The joint will then be cleaned thoroughly with a wire brush of all loose materials and filled with cement mortar with a mix proportion of one port-land cement and two part of sand by volume (1:3). The surface of the face stone will be cleaned of all mortar upon completion of the finishing operation.

6.6 Contraction Joints

The contraction joints for stone masonry will be provided at intervals of twenty (30) meters or less, except as otherwise mentioned on the drawings or as directed by the SWIM Field Supervisor Engineer. The contraction joint will be a straight line perpendicular to the flow direction and, where it is necessary, on horizontal surfaces as floors, will be parallel to the flow direction. The fillers and for joint sealing purpose a flexible water stopper, nominally of width ≥200mm, shall be placed in joints of concrete structure as showing on the drawings or as directed by SWIM Engineer. The water stops shall be of extruded polyvinyl chloride complying with ASTM D2240. In order to protect the water stopper from damaging, the open space above the water stopper shall be filled with materials composed of weak cement sand mortar of (1:8). Before installation a suitable water-resistant filler should be approved by the SWIM Field Supervisor Engineer.

6.7 Weep Holes

A weephole comprised of PVC pipe of 10cm diameter will be placed in a stone masonry wall at 3m center to center at a staggered position, unless otherwise mentioned or shown in the drawings. The PVC pipe should be laid at 2.5 percent slopes, towards the exposed face or canal or drain side, as applicable. The PVC pipe at a backfill portion should stick out at a minimum of 5 to 10cm. A graded gravel filter, as shown in the drawing or as approved by the Supervisor, should be laid around the protruded pipe section. The vertical height of lower weephole in the exposed face will not be lower than 1m.

6.8 Riprap / Stone Pitching Protection

The stones for riprap will be a natural, of a large size, of an irregular shape, having a minimum **weight of 30 kg** and minimum **thickness of 20 cm** when measured at the thinnest section. At least 60% of the stones will have a minimum weight of 40 kg each, with minimum volume of 0.03 m^3.

The stone will be laid by hand, to the required lines and grades and to the thickness shown in the Drawings and placed so that it will thoroughly tamped, or driven into place. The space between the larger stone will be filled with spills of a suitable size driven to face, varying not more than 60 mm from the required contour. Before placing riprap rocks, the bedding which consists of well- graded sand will be provided with the required thickness shown on the drawings or as directed by the SWIM Field Supervisor Engineer. Such sand bedding will be compacted thoroughly by mechanical tampers. The rocks in the riprap will then be dumped and graded off on the sand bedding.

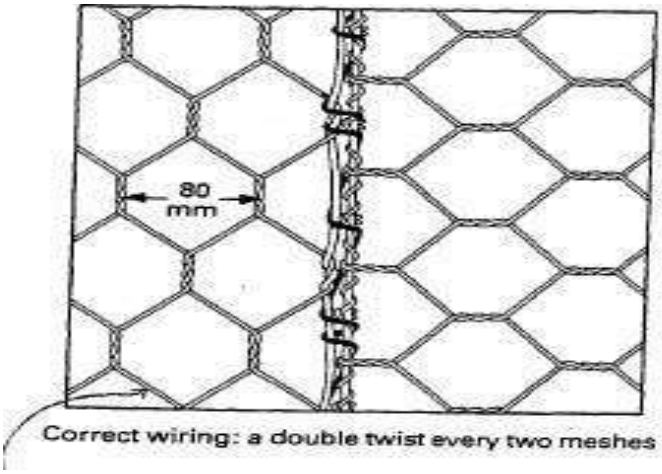
6.9 Curing of Stone Masonry Works

The curing of masonry will commence after about 4 to 8 hours of construction (depending on the weather conditions and atmospheric temperatures) and gently sprayed with water. All exposed surfaces of masonry will be kept moist for a period of 14 days.

7. GABION WORKS

Stone size for gabion shall range from (20-30) cm. Small stones should be avoided. the stones used should have a minimum size of not less than "d" (mesh width) and not greater than 3.5 times "d", where d is the specified mesh width. larger stones can be used provided that their total volume does not exceed 5% of the cell volume. Galvanized iron wire of specified thickness (3mm) should be properly woven and knotted together to form the required mesh in hexagonal/ rectangular shape of size (6-8) cm for gabion basket and (10-12) cm for gabion mattress to fabricate gabion boxes to the satisfaction of the Engineer. Principal wire along the gabion edges (selvedges) for Gabion boxes should be of Galvanized Iron having minimum thickness of 4mm. The size of gabion boxes should be in accordance to design drawings.

Stone used for gabions and gabion mattress shall be clean, natural, hard and durable. Stone shall preferably be rounded rather than angular.



Correct wiring: a double twist every two meshes

7.1 Method of Construction

The boxes and mattresses will be placed in their final position on the prepared formation and wired to adjacent boxes or mattresses before filling commences, unless otherwise approved by the SWIM Project Manager or assigned Engineer.

7.2 Filling and Placement

The foundation for each gabion and mattress will be prepared by the Contractor to the satisfaction of the SWIM Field Supervisor Engineer. Irregularities in the foundation will be excavated or tightly filled with gravel to produce a surface which has no protrusions or cavities in excess of 100 mm.

The empty gabions will be placed to line and level as shown on the Drawings or as directed by the SWIM Field Supervisor Engineer and then stretched so that the gabions regain their shape on being filled. A gabion will not be completely filled until the adjacent basket or mattress has been half-filled, unless otherwise directed, in order not to cause displacements from bulging during filling.

Before filling, adjacent boxes should be secured together using steel lacing wire provided for the purpose. The sides must be secured in straight lines, with no gaps left between the sides of adjacent boxes. Where more than one layer of boxes is laid, they must be placed as shown on the Drawings, or as directed by the SWIM Field Supervisor Engineer.

All gabions must be connected to each other along corners with the same lacing operation. For correct lacing operation, the wire should be passed through each mesh, making a double twist every other mesh. Careful attention must be given to the filling operation to ensure that the stones are placed evenly in the baskets with minimum voids between them. Smaller stones can be used to fill the central voids of the boxes, but all external stones must be at least 1.5 D, where D is the diameter of the mesh.

The stones selected for the top layer of gabion baskets must have a flat surface to ensure that the wire that does not rest on sharp corners. They must have a minimum dimension of 1.5 D in all directions and be placed to ensure a minimum number of voids.

7.3 Measurement and payment of Pitching and Gabions

7.3.1 Stone Pitching

Measurement, for payment, of constructing stone pitching will be made of the actual area of stone pitching in place to the lines, grades and dimensions shown on the Drawings or directed. Payment for constructing stone pitch will be made at the rate per square meter tendered in the priced Bill of Quantities.

7.3.2 Gabions and Mattresses

Measurement, for payment, of furnishing and placing gabions and mattresses will be made of the volume of completed gabions and mattresses in place to the lines, grades and dimensions shown on the Drawings or as directed. Payment for furnishing and placing gabions and mattresses will be made at the applicable rate tendered thereof in the priced Bill of Quantities. These rates will include the cost of all freight, labour, fabrication, erection, filling and placing of gabions and mattresses required to complete the work.

8. WATER STOPS

8.1 Size and Material

Water stops, nominally of width ≥200mm, shall be placed in joints of concrete structure as showing on the drawings or as directed by SWIM Engineer. The water stops shall be of extruded polyvinyl chloride complying with ASTM D2240. The water stops shall be of enough stiffness so that they remain in their correct position during concreting. The type shall suit the location in the structure in which the water stop is to be placed and the pattern shall be such that concrete can be placed all around it with complete consolidation and no voids or crevices.

The contractor shall store the water stops in such a way that the materials does not deteriorate during storage. The number of joints in the water stops shall be minimum practicable and all joints and bends shall be made as approved by the Engineer. The contractor shall protect the water stops against perforation or damage during the progress of work. All joints shall be made in such manner as to ensure:

- that the material is not damaged by heat, searing or by the application of cementing materials.
- that the splice is watertight and free of air bubbles, and
- that the ribs and central bulb, where applicable, match up exactly and are continuous.

Manufacturer's catalog data including sample shall be submitted by the subcontractor at least 10 calendar days prior to start of specified work.

9. GALVANIZED GUARDRAIL

Installation of Galvanized steel pipe of 2inch diameter with 2mm wall thick shall be securely positioned by using 6mm thick bearing plates and 12mm diameter J shape nut in concrete in accordance to design drawings. Use fasteners fabricate from same basic steel, unless otherwise indicated. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fastener is unavoidable or are a standard fastening method for handrail and railing indicated. Assemble railing in shop to greatest extent possible to minimize filed splicing and assembly. Disassembled units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Perform cutting, drilling, and fitting required for installation of guardrails. Set guardrails and accurately in location, alignment, and elevation, measured from established lines and levels. Use connections that maintain structural value of joined pieces. Protect installed products until completion of the project. Touch up repair or replace damaged products before substantial completion.

10. CONCRETE BLOCKS

Concrete blocks shall be made from good mix of cement and sand and shall be sound moulded. They shall be regular and uniform in size and shape with sharp square edges and parallel faces. They shall be free from flaws, cracks and chips. Blocks not meeting the above requirements shall not be used in work. The sizes of concrete blocks should be in accordance to design drawings. The crushing strength of blocks shall be tested in a laboratory. The average crushing strength of blocks shall not be less than 15MPa. At the start of the works samples of the blocks shall be tested for crushing strength, and masonry work shall only commence when the SWIM Engineer has approved the blocks.

10.1 Mortar Materials

Cement: Cement shall conform to the requirements of ASTM specification C-150 Type 1 or similar approved standard for normal Portland cement.

10.2 Sand

Fine aggregate with a low clay content selected for grading, sharp and free from efflorescing salts. River or pit sand should be sharp, angular, hard, clean uncoated particles free from clay and organic impurities.

10.3 Water

Water to be used for the mixing of mortar should be clean and free from oil, acid, alkali, salts, organic materials or other substances that are harmful to the mortar mix.

11. BOULDERS

The WORK includes excavation, grading, compaction, and installation of boulders placed at the locations shown on the DRAWINGS. The work under this Section includes providing all labor, materials, tools and equipment necessary for furnishing and placing boulders, as shown on the Drawings, or as directed by the SWIM ENGINEER.

The least dimension of any piece of stone shall be not less than 1/4 its greatest dimension. Boulders shall dense, sound and natural in form. Deliver boulders from the source location to the project site. Place boulders in the approximate locations and according to the details shown on the drawings. During construction of boulders work the following points should be considered:

- Foundation and other necessary excavation shall be completed and approved by the SWIM Engineer before the placing of boulders is begun. Slopes to be protected with boulders shall be free of brush, trees, stumps and other objectionable material and shall be dressed to a reasonably smooth surface.
- The stones shall be handled or placed with an excavator as to secure a stone mass of the thickness, height and length shown on the Drawings, or as staked, with a minimum of voids.
- Undesirable voids shall be filled with small stones or spalls. The rock shall be manipulated sufficiently by means of a bulldozer, excavator, rock tongs, or other suitable equipment to secure a reasonably regular surface and mass stability.
- All boulders shall be so placed and distributed that there will be no large accumulation or

area composed mainly of either the larger or small sizes of stone.

11.1 Payment

The work performed in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for " Boulder Installation". This price shall be full compensation for delivering (if required) and placing boulders and for all labor, tools, equipment and incidentals necessary to complete the work.

12. STEEL GATES

The gate shall consist of a steel skin plate supported by horizontal stiffening members connected to vertical side guiding and stiffening members contained within the grooves. Arrangements shall be provided for attaching the gate to the operating spindle. Provide finished welds which are free of surface and internal cracks, slag inclusion, and porosity.

Minimum Thickness- The actual skin plate thickness should not be less than 6mm, unless otherwise shown on the Drawings. Unless otherwise shown on the Drawings, plates (other than skin plates) rolled steel angles and tee sections used in the construction of gates shall have a minimum thickness of 6 mm and the webs of rolled steel beams and channel sections shall have a minimum thickness of 6 mm. For protection of the gate three coats of paint (one coat of red-oxide+ two coat of enamel paint) shall be used.

12.1 Inspection at Place of Manufacture

Inspection of materials, workmanship, manufacture of the gates, shall be carried out by the SWIM's Engineer at his discretion and shall include the following:

a. Checks on steel and other materials used to ensure compliance with accepted standards.
b. Dimensional checks to ensure conformity with approved Drawings.
c. Weld inspection and testing where required.
d. Inspection of cleaning and painting of steelwork.
e. Witnessing erection and testing at the project site.

12.2 Erection of Metalwork

The erection of the metalwork at the Site shall comply with approved designed drawings. When lifting and fitting metalwork into position care shall be taken that the parts thereof are not strained, twisted, bent or damaged in any way whatsoever. Should any parts be strained, twisted, bent or damaged they shall be rectified in such manner as the SWIM's Engineer may approve. Any parts that are, in the opinion of the SWIM engineer, too badly damaged for rectification in the manner aforesaid shall be replaced by new material. All rectification and/or replacement shall be carried out at the Contractor's own cost.

Every care and precaution shall be taken to ensure the safety of all persons engaged in such work and to prevent damage to any metalwork in the process of being erected or already erected or to any part of the Works from the results of any mishap, failure, breakdown or other accident to any of the aforesaid lifting appliances and equipment.

12.3 Testing after Erection

After erection, the Contractor shall check that the gates and gate hardware are complete and in working order, and satisfactorily fulfils the purpose for which it is intended.

The Contractor shall test all gates to the satisfaction of the SWIM's Representative. Each gate shall be made to move through a full cycle of operation using the equipment specified for the purpose, unless otherwise instructed, and each gate when closed shall affect a watertight seal to the approval of the SWIM's Representative. The Contractor shall supply and deliver to the Site a enough quantity of priming paint to make good any damage during delivery, handling and erection.

12.4 Measurement and Payment

Measurement for payment shall be made in the unit rate as indicated in Bill of Quantities. The unit rate shall cover the cost of all materials, fabrication, manufacturing, painting, loading and unloading labour, furnishing and installing the slide gate including frame, hoist, operation hand wheel and all other accessories, cost of operation test.

13. ENVIRONMENTAL COMPLIANCE

Environmental regulation defined by Title 22, Part 216 of the U.S. Code of Federal Regulations on environmental procedures (22 CFR 216) and GoIRA environmental requirements for canal scheme rehabilitation (SWIM Component 1 activities). USAID's environmental requirements are provided in Section 1 below. SWIM has received a certificate of approval from the GoIRA National Environmental Protection Agency (NEPA) that is included in the environmental manual and also attached at the end of each Environmental Review Report (ERR).
(Refer to the environmental manual for SWIM component 1 activities and approved ERR).

13.1 Usaid Environmental Requirement

USAID's environmental policy requires that the potential adverse impacts of USAID-funded and managed activities be assessed prior to implementation via an Initial Environmental Examination (IEE) process defined by Reg. 216.
In the IEE that USAID has prepared for the Afghanistan SWIM Project (OAPA-15-MAR-AFG-0015, approved on 3/27/2015), specific guidance is provided on environmental requirements for SWIM components. In terms of the EMMP for component 1, and SWIM specifically follow-up the activities of this component within EMMP perspective with detail manual; (Refer to the environmental manual for SWIM component 1 activities and approved ERR). Threshold determination for SWIM component 1 activities are assigned as follows:

TABLE 1. Swim Component 1 Activities

SWIM Component 1 Activities	IEE Threshold Determination	Requirement
Component 1: Increased Productive and Sustainable Use of Water in Agriculture 1.1: Rehabilitate and increase efficiency of irrigation infrastructure 1.2: Rehabilitate and restore degraded upper watersheds	Negative Determination with Condition	Programmatic Environmental Assessment, including Scoping Statement (SS) and PEA Report (PEAR) are prepared by DT Global (formerly AECOM International Development), with mitigation, monitoring and reporting measures to be implemented by DT Global under SWIM; both SS and PEAR shall be reviewed and approved by the BEO/OAPA

13.2 Negative Determination with Condition Activities

Activities under SWIM Component 1 are designed as Negative Determination with Conditions. The conditions in the IEE state that all SWIM activities qualifying as Negative Determination with Conditions shall require an Environmental Mitigation and Monitoring Plan (EMMP) to ensure environmental compliance during the implementation of these activities in a way that will minimize or eliminate environmental and social risks. This EMMP document sets forth the procedure for environmental screening, monitoring, review and reporting during implementation. Pursuant to the requirements of the IEE, it consists of the following three parts:

a. The Environmental Verification Form (Section 5 of this Environmental Manual);
b. The Environmental Mitigation and Monitoring Plan to address specific environmental threats (Section 6);
c. The Reporting Form (Section 7).
"Refer to the approved EMMP and environmental manual for SWIM component 1 activities"

As part of the SWIM EMMP, DT Global (formerly AECOM International Development) in collaboration with the COR and MEO (or Regional Environmental Adviser, as warranted) will review all ongoing and planned activities under the contract to determine if they are within the scope of the approved Regulation 216 environmental documentation.

If DT Global plans any new activities outside of the scope of the approved Regulation 216 environmental documentation, an amendment to the current IEE will be prepared for USAID's review and approval. No such new activities will be undertaken prior to receiving written USAID approval of environmental documentation amendments. If for any reason ongoing activities are found to be outside the scope of the approved Regulation 216, environmental documentation will be halted until an amendment to the documentation is submitted and written approval is received from USAID.
The following standards and guidelines will be applied:

- Guidelines in this EMMP Report, based on IEE Conditions
- Environmental Review Form and Environmental Review Report (ERF/ERR) template;
- USAID Sectoral Environmental Guidelines, available at

https://usaidgems.org/
https://www.yumpu.com/en/document/read/40330153/the-environmental-review-form-usaid-africa-bureau-office-of-

The SWIM Environmental Compliance Specialist will prepare the Environmental Review Form (ERF) and Environmental Review Report (ERR); (see ERF/ERR templates via above link) for each canal rehabilitation and this ERF/ERR will be submitted by SWIM COP to USAID. Also, similar activities in multiple locations over a period of time may be combined in one document.

Monitoring checklists are developed as a best practice to ensure compliance with the mitigation measures listed the EMMP. Checklists are based first on the stage of implementation (construction, operation, etc.) and then the frequency of monitoring (daily, weekly, monthly, etc.).

The sub-contractor is required to monitor the implementation and performance of mitigation measures by completing Environmental Monitoring Checklists on a daily, weekly, or monthly basis, as required. The SWIM site engineer verifies on the field and submits the checklist to the SWIM North Regional Office on a weekly basis. The checklists will be reviewed by the Local Environmental Compliance Specialist in Kabul and by the DT Global Home Office Specialists in Arlington, VA. A summary Environmental Mitigation and Monitoring Report (EMMR) will be prepared for submission to USAID on a quarterly or annual basis, as required by USAID.

SWIM Environmental Checklists are provided in Section 3 below for sub-contractor use at the project sties:

13.3 Environmental Monitoring Checklists

13.3.1 Environmental Checklist Prior To Canal Rehabilitation

							SWIM Checklist for Canal Infrastructure Complete PRIOR

Activity:					
Name of Individual that Completed Form:					
Signature:	**Date:**				

Directions: <u>Complete this form once PRIOR to canal rehabilitation</u> in order to verify the mitigation measures listed in the EMMP for this project are implemented. Checking "Yes" to each question below indicates the best practice were followed to minimize risks to the environment and human health. Notes and pictures can be provided to explain circumstances or situations that are not applicable and adjustments needed.

EMMP Ref. No.	Questions	Yes	No	N/A*	Picture Provided
	Rehabilitation of small-scale water canal infrastructure				
1	**Mitigation measures to minimize or prevent risks of unsustainable use of water resources**				
1.1	Was a water resource assessment conduct and the river water availability evaluated given the anticipation of demand for irrigation water, with considerations for dry season conditions, climate change impacts over the next 30 years, and needs of downstream water users?				
2	**Mitigation measures to minimize or prevent risks of non-compliance with government regulations on rehabilitation and design standards**				
2.1	Were designs compliant with any NEPA, MAIL, MEW, or MoLSAMD standards and regulations for irrigation infrastructure design and rehabilitation?				
3	**Mitigation measures to minimize or prevent risks of non-compliance with USAID environmental Regulation 216**				
3.1	Were EMMP requirements incorporated into rehabilitation sub-contract, and were the checklists reviewed with during the kick-off meeting?				
3.2	Were rehabilitation monitoring checklist provided and the requirements reviewed during the kick-off meeting?				
4	**Mitigation measures to minimize or prevent risks of increased greenhouse gas emissions and loss of carbon sinks from irrigation development**				
4.1	Was the clearing of forested land for agriculture purposes prohibited?				
5	**Mitigation measures to minimize or prevent risks of injury or loss of life due to unsafe rehabilitation practices**				

5.1	Was the Health and Safety Plan (HSP) prepared for rehabilitation?				
5.7	Were rehabilitation plans and activities communicated to community leaders to keep the community informed of areas to avoid during rehabilitation?				
7	**Mitigation measures to minimize or prevent risks of erosion and damage to vegetation and riparian areas and riverbeds**				
7.2	Were areas identified were work will occur in the river or riverbeds, and plans to minimize machinery in these areas was created to implement erosion control measures accordingly?				
11	**Mitigation measures to minimize or prevent risks of air pollution from dust**				
11.1	Was a water tank provided for the use of dust control management?				
*** If not applicable, provide an explanation in the 'Notes' section below:**					
Notes:					
If pictures were provided, please describe in detail:					

13.3.2 Weekly Environmental Checklist for Canal Rehabilitation

				SWIM **Checklist for Small-Scale Canal Infrastructure** **Complete WEEKLY**							
Activity:											
Name of Individual that Completed Form:											
Signature:		**Date:**									
Directions: **<u>Complete this WEEKLY form</u>** during the canal rehabilitation in order to verify											

the mitigation measures listed in the EMMP for this project are implemented. Checking "Yes" to each question below indicates the best practice were followed to minimize risks to the environment and human health. Notes and pictures can be provided to explain circumstances or situations that are not applicable, and adjustments needed.					
EMMP Ref. No.	**Questions**	**Yes**	**No**	**N/A***	**Picture Provided**
	Rehabilitation of small-scale water canal infrastructure				
4	**Mitigation measures to minimize or prevent risks of increased greenhouse gas emissions and loss of carbon sinks from irrigation development**				
4.1	Was the clearing of forested land for agriculture purposes prohibited?				
5	**Mitigation measures to minimize or prevent risks of injury or loss of life due to unsafe rehabilitation practices**				
5.2	Was an individual designated to monitor and report on the implementation of the Health and Safety Plan on a daily basis?				
5.3	Was appropriate Personal Protection Equipment (PPE) provided to all workers and community volunteers?				
5.4	Were workers trained and monitored on the use of PPE and other safety rehabilitation practices?				
5.5	Were all workers required to follow proper safety requirements?				
5.6	Was the irrigation canal rehabilitation area clearly demarcated and access was controlled for children, pedestrians, and unauthorized community members?				
6	**Mitigation measures to minimize or prevent risks of improper waste disposal**				
6.1	Was the disposal of rehabilitation waste in appropriate locations designated by local authorities and in accordance with local requirements?				
6.3	Were drip pans used when changing oil for heavy machinery, dumping oil and petroleum prohibited on soil, and disposed of in appropriate designated locations?				
7	**Mitigation measures to minimize or prevent risks of erosion and damage to vegetation and riparian areas and riverbeds**				
7.1	Was degradation to existing vegetation minimized by proper cleanup and daily removal of spoils and refuse, along with the restriction of vehicles and heavy machinery to roads?				
7.3	Was revegetation completed to areas that were disturbed during irrigation canal rehabilitation? (as needed)				
7.4	Were riparian areas vegetated along stream banks, leaving a 50-meter-wide strip between waters and croplands? (as needed)				
8	**Mitigation measures to minimize or prevent risks of sedimentation and pollution of water resources**				

8.1	Were sedimentation screens or other erosion control measures provided? (as needed)				
9	**Mitigation measures to minimize or prevent risks of excessive noise and emissions from heavy equipment and truck activity**				
9.1	Were trucks and motorized equipment not permitted to idle their engines for more than 10 minutes at the project location?				
9.2	Were time limits set on the time of irrigation canal rehabilitation operations to occur each day?				
10	**Mitigation measures to minimize or prevent risks of pools of stagnant water created that harbor disease vectors**				
10.1	Was adequate drainage on rehabilitation sites provided to enable excess water and rainwater to drain to avoid accumulation of water for more than 3 days?				
10.2	Were borrow pits and other sites where soil, sand, or gravel has been removed filled in? (as needed)				
11	**Mitigation measures to minimize or prevent risks of air pollution from dust**				
11.2	Was dust controlled through the application of water?				
11.3	Were vehicles and heavy machinery restricted to roads?				
12	**Mitigation measures to minimize or prevent risks of the spread of water-related disease such as malaria or schistosomiasis from standing water in canals**				
12.1	Was monitoring for and the elimination of standing water in canals for more than 3 days completed?				
12	**Mitigation measures to minimize or prevent risks of the spread of water-related disease such as malaria or schistosomiasis from standing water in canals**				
12.2	Was monitoring for and the removal of vegetation in canals that can slow water flow and harbor disease vectors completed?				
12.3	Was monitoring and repairs for leaks in broken pipes aqueducts, faulty valves, and other structures completed?				
*** If not applicable, provide an explanation in the 'Notes' section below:**					
Notes:					
If pictures were provided please describe in detail:					

SWIM
Checklist for Small-Scale Canal Infrastructure
Complete AFTER Rehabilitation

Activity:	
Name of Individual that Completed Form:	
Signature:	**Date:**

Directions: **Complete this form AFTER canal rehabilitation** in order to verify the mitigation measures listed in the EMMP for this project are implemented. Checking "Yes" to each question below indicates the best practice were followed to minimize risks to the environment and human health. Notes and pictures can be provided to explain circumstances or situations that are not applicable, and adjustments needed.

EMMP Ref. No.	Questions	Yes	No	N/A*	Picture Provided
	Rehabilitation and construction of small-scale canal infrastructure				
6	**Mitigation measures to minimize or prevent risks of improper waste disposal**				
6.2	Was the site cleaned and left free of debris at the complete of rehabilitation?				

*** If not applicable, provide an explanation in the 'Notes' section below:**

Notes:

If pictures were provided, please describe in detail: