

SCOPE OF WORKS (SOW) FOR CONSTRUCTION KARIZ SALIM DAM PROJECT ZERAI DISTRICT, KANDAHAR PROVINCE SOUTHERN REGION.

Background:

With the current political instability, economic volatility, the collapse of basic services, the uncertainty over continued international aid as a source of revenue, the disruptions to trade and finance, and the impacts of climate change on food production, the risks faced by the poor are becoming more intense and less predictable. It is estimated that as of August 2021, over half a million people have already been displaced by conflict and thousands more affected by natural disasters. Up to 30 percent of the population are projected to be in either a food security crisis or emergency by the end of the year¹, and half of all children under five are already severely malnourished.

An innovative, inclusive and highly flexible approach is needed, one that put people first, targeting the most vulnerable and meets local needs by focusing on saving lives and livelihoods. UNDP is, therefore, adopting a highly integrated yet decentralized approach to programming known as the Area-based Approach for Socio-Economic Recovery and Community Resilience in Afghanistan (known as the ABADEI Program).

ABADEI is centered on addressing worsening poverty and vulnerability, supporting community resilience and social cohesion, and enabling the rehabilitation of small-scale critical infrastructure for essential needs while creating immediate sources of income through cash-for-work and agriculture infrastructure that are under threat, due to crisis, climate change and economic collapse.

Project Area:

Zerai district located western side of Kandahar province it is one of deprived district of this province which needs for urgent rehabilitations assistance regarding water, in this area live more than 90 villages in nearby areas, the area is located near to mountain and the dam area is suitable for dam construction it has sufficient catchment area and enough storage capacity.

Nature of Contract:

The required civil work for the rain water storage soil dam will be excavation, compacted backfilling, Stone pitching, pointing and PCC works are the main activity of the project, and some other related works.

a. Specific Objectives

The activities would contribute to the following ABADEI outcomes, outputs and activity results:

- Disaster and climate resilient critical infrastructure

The objective of the project is to support underground water and reduce lack of water in the area that more than 10 villages are living there and some of in downstream are under flood hazards.

b. Scope

The works shall be done as per scope of work, specifications, design, drawings, BoQs and general contract conditions, this project requires an experienced registered contractor to design and execute the job, the contractor shall provide all labor, material tools, equipment, supervision services, and other related items required to complete the project as per the design, BoQ, scope of work and specifications.

¹ IPC Integrated Food Security Phase Classification, "Afghanistan."

All related scope of work is added in technical drawings, BoQ, for more details refer to technical drawings Sheets (Tech Spe-10, 11, 12).

Workmanship and Materials

All workmanship shall be of the best quality appropriate to each category of work. Except where otherwise stated or 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 Bills of Quantities and shall comply wherever possible with the current issue of the appropriate standard published by the British Standards Institution, or other equivalent national standard proposed by the Contractor and approved by the Engineer.

The Contractor shall use locally produced materials in preference to imported materials provided that they comply with the Specification and are available in sufficient and timely quantities. Temporary Works and Care during Construction: The contractor shall construct and maintain all necessary channels, diversions and other temporary works necessary to ensure that irrigation water supplies are not interrupted during rehabilitation construction works; shall furnish all materials required therefore; and shall furnish, install, maintain and operate all necessary pumping and other equipment (if necessary) for maintaining water supplies around the rehabilitation works.

After having served their purpose, all temporary works at the construction site shall be removed in a manner approved by the Engineer, and such areas after those are removed shall be levelled and graded to the extent required to prevent obstruction in any degree whatever and maintaining the designed function of the structure.

The contractor shall be responsible for and shall repair at his expense any damage to the foundations, structures, or any other part of the works caused by floods, water or failure of any part of the temporary diversion or protective works. For more detail on this and other general works please see the general part of attached specifications.

Excavation:

All excavation shall 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 shall trim all permanent excavation to the lines and levels shown on the drawings. Excavation shall 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 shall be used in embankment and backfill for structures. The Contractor shall dispose of unsuitable or excess soil of the excavated materials in a place that is acceptable to the local community and so that they do not interfere with proper functioning of the works.

All necessary precautions shall 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 shattering to the material beyond the required excavation lines, shall be repaired at the expense of and by the Contractor. Any and all excess excavation or over excavation performed by the Contractor for any purpose or reason, except as may be directed in writing by the Engineer, and whether or not due to fault of the Contractor, shall be at the expense of the Contractor. Excavation taken out to a greater depth than is necessary shall be filled to the required level with concrete of appropriate class or other material approved by the Engineer. All such excess excavation and over excavation shall be filled at the expense of and by the Contractor.

The bottom and side slopes of excavation against which concrete is to be placed shall be finished accurately to the dimension shown on the drawings or as prescribed by the Engineer and the surface so prepared shall be moistened with water and tamped or rolled with suitable tools or equipment for the purpose of securing a firm foundation. If at any point the natural foundation material is disturbed during the excavation process

or otherwise, it shall be compacted in place, or it shall be removed and replaced with suitable earth materials or concrete at the expense of the Contractor, for more detail on this and other related work please see the earthworks part of attached specifications.

Back filling:

Backfilling with selected materials from excavation or borrow pits from approved source, In all excavations where the excavated material is required to be returned to the excavation as backfill, suitable material shall be set aside during excavation and shall be kept free from contamination with top soil, vegetable matter or other unsuitable material, failing which the Contractor shall at his own expense import suitable material from elsewhere, backfill at 95% shall be deposited in horizontal layers not more than 150 mm thick after being compacted, and shall be brought to the moisture content required for the purpose of compaction as instructed by the Engineer and the moisture content shall be uniform throughout each layer. The density of compacted random backfill shall not be less than 95 per cent of the maximum dry density obtained by compaction or, where the backfill is a cohesion less, granular material to a field dry density not less than 1950 kg/m³, backfill shall be placed carefully in the vicinity of any structure so as not to damage the structure. For more detail on backfilling and other related work please see the earthworks part of attached specifications.

STONE WORKS

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 Engineer before being used or placed. All the stone should be tested and shall have a specific gravity of not less than 2.5.

Rock used for stone pitching shall be sound durable rock selected from the harder rock from the required excavations or other approved sources. The rock shall not be less than 150 mm thick and shall be properly bedded to a uniform surface on an approved bedding material. The exposed surface of each stone shall be approximately flat and of an area not less than 0.03m².

Masonry

Stone used in masonry shall be regular field or quarry stone of approved quality, free from seams and other defect. All masonry stone shall be kept slightly moist at the time of use. Stone used for masonry shall be two-thirds of the wall thickness.

Types of Masonry

The stone masonry will be divided into two (2) types, Type A and Type B, according to cement mortar used for jointing. The cement-sand ratio by volume is given in the following table:

Type of stone masonry	Ratio of cement-sand
Type A	One part of Portland cement to three sand (1:3)
Type B	One part of Portland cement to four sand (1:4)

Type A stone masonry shall be used for protection work against abrasion and attack by boulder and gravel. Type B stone masonry shall be used for all stone masonry structure such as flumes, walls, piers, transition

of canal structures, etc.

Sand for stone masonry mortar shall be clean well graded sand, it shall consist of crushed stone sand or natural clean well graded sorted sand or combination of any of these, sand shall be hard, durable, clean and free from adherent coating and organic matter and shall not contain any amount of clay, silt and fine dust.

Sand should be with an approximately even particle size distribution. As the smaller particles may fit in between the larger particles, this even distribution reduces the proportion of voids to solids and thus is less demanding on the binder than poorly-graded sand.)

Laying of Stones

In laying the first course a full mortar bed shall be placed on the foundation to the full thickness of the wall. The stones shall be laid by hand with 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 shall 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 final position must be done while the mortar is soft.

Surfacing and Pointing

Joints on the face of all stone masonry exposed to view shall be neatly finished. The mortar in the joints of the stone masonry shall first be removed to a depth of three (3) cm. The joint shall 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 three part of sand by volume (1:3). The surface of the face stone shall be cleaned of all mortar upon completion of the finishing operation.

Contraction Joints

Contraction joints shall be provided at intervals of ten (10) meters or less except as otherwise mentioned on the drawings or as directed by the Engineer. The contraction joint shall be a straight line perpendicular to the flow direction and, where it is necessary on such horizontal surfaces as floors, shall be parallel to the flow direction.

Weep Holes

Weep holes of sizes 150mm x 150 mm are to be left in the body of masonry walls if shown on the drawings. These weep (drainage) holes are to be covered with inverted filters on the backfill side in an area of 400mm x 400mm with a thickness of 400mm. They are to be located at 1m intervals both vertically and horizontally in a staggered way.

CONCRETE WORKS:

Concrete General:

Concrete shall consist of cement, graded aggregate and water thoroughly mixed, placed and compacted as specified.

Before starting concreting the Contractor shall obtain formal written permission for concreting from the Engineer or his representative on site. The Engineer or his representative shall 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.

All concrete to be used in the Works shall be as shown on the Drawings, Bills of Quantities or as directed by the Engineer.

Cement:

All cement shall be from reputable manufacturers and conform to international standards. Cement shall be stored where it cannot be damaged by rain or moisture and shall be free of lumps when used. Sulphate-resisting cement shall be used for foundations and ordinary Portland cement for other works or as directed by Engineer or his representative.

Concrete Aggregates:

All concrete aggregates (sand & gravel) shall be furnished by the Contractor from approved sources and to be approved by the Engineer. They shall 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.

Sand for concrete shall be clean, well graded and free of stones larger than 2mm and not include significant amounts of silt and clay. If sand, when dried after wetting, adheres together then it shall be considered unsuitable.

Gravel for concrete shall be uniformly graded and consist of hard and dense rock. The gravel shall be free of materials finer than 5mm and the surface shall be clean. Gravel for use in all concrete works, Mass Concrete, PCC and RCC shall have angular or cubical in shape. The maximum nominal size of the gravel shall be eighty (80) mm in mass concrete, forty (40) mm in structural concrete and twenty (20) mm in other thin concrete structures like slabs.

Water for Concrete:

Clean fresh water is to be used for the mixing of all concrete and mortar. Water that is safe to drink shall be considered suitable for making concrete.

Steel Reinforcing Bars:

Steel reinforcement shall be steel bars manufactured to international standards with a minimum yield stress of 250N/mm² or high yield steel grade 4501425 as indicated in the Drawings and Bill of Quantities or as directed and must comply with BS 4449, BS 4461 or another approved standard. Steel fabrics shall comply with BS 4483.

The Contractor shall be responsible for the accuracy of the cutting, bending and placing of the reinforcement. Reinforcement will be inspected for compliance with the requirements as to grade, size, and shape, length, splicing locations, position and amount after it has been placed.

Reinforcing bars or fabric shall be accurately placed and secured in position so that there will be a clear distance of at least 25mm between the bars or fabric and any adjacent embedded metal work and so that the bars and fabric will not be displaced during the placing of concrete, and the Contractor shall ensure that there is no disturbance of the reinforcing bars or fabric in concrete that has already been placed.

Chairs, hangers, spacers and other acceptable metal, plastic or concrete supports may be furnished and used by the Contractor for supporting reinforcing bars or fabric.

All reinforcement bars shall, immediately prior to placing, be free from loose mill scale, loose rust, oil, grease, dirt or other foreign matter. Reinforcement is to be placed and secured in the exact position as indicated on the drawings and kept in the correct position in the forms without displacement during the process of vibrating, tamping and ramming the concrete in place. All free ends of the plain round bars shall have hook as shown on the drawings or as directed by the Engineer. Bars shall be bound together with best mild steel wire which shall be twisted tight with proper pliers. The free ends of the binding wire shall be bent inward. Minimum concrete cover to reinforcement should be 50mm measured from the outside of the bar, unless shown on the drawings or directed by the Engineer.

The Contractor must inform the Engineer of the completion of any reinforcement in time, in order to facilitate its inspection and check of conformity with the Working Drawings well before the concrete is

placed. Relevant formalities shall be agreed upon between the Contractor and the Engineer at the appropriate time. As in this project we haven't any RCC work so the steel bar section is not included in scope for this project.

Drawings and Bar Lists:

Steel reinforcing bars or fabric shall be placed in concrete where shown on the Drawings or directed.

A bar bending schedule may be provided for the Contractor's convenience, but does not constitute a Contract Document the Contractor shall prepare for additional structures, in an approved manner, reinforcement detail drawings showing reinforcement bar lists, bar placement details and bar bending details for each structure, if not provided by the Engineer.

All reinforcing bars shown on the reinforcement detail drawings shall be identified on the bar lists in accordance with the standard reinforcing bar shapes as shown on the Drawings.

All bar lists shall be identified with the relevant reinforcement detail drawing and all bars scheduled on the bar lists shall be defined and dimensioned in a manner approved by the Engineer.

Concrete Classes:

The classes of concrete to be used in the Works shall be as shown on the Drawings, Bills of Quantities or as directed by the Engineer. The concrete is classified on the basis of its compressive strength at twenty-eight (28) days as well as the maximum size of the aggregate as shown below and nominal mix proportions shall be used only as a guide.

Concrete Max Slump(mm)	Concrete Class	Characteristic Cube Strength at 28 days (kg/cm ²)	Maximum Aggregate size(mm)	Maximum water/ cement ratio (%)	Approx. cement content	Nominal Mix proportions (Kg/m ³)
75	M25	250	20	45	400	1 : 1 : 2
75	M20	200	20	45	400	1 : 1.5 : 3
75	M15	150	40	50	310	1 : 2 : 4
100	M10	100	80	55	220	1 : 3 : 6
100	M5	50	20	60	170	1 : 4 : 8

Type	Description
M25& M20	Reinforced concrete for all RCC works, etc.
M15	For various types of concrete works such as Mass Concrete structures and PCC works.

Consistency:

The concrete shall be of such consistency that it can be readily transported, placed and compacted in the Works without segregation of the materials. The resulting concrete shall be uniform and free from honey-

combing. The consistency of the concrete as determined by the slump test shall be within the range of 5 cm to 10 cm. Samples for slump determination will be taken from the concrete during placing in the formwork.

Mixing Concrete and stonemasonry mortar by Machine:

Unless otherwise authorized by the Engineer, concrete and mortar shall be machine mixed at site.

Where the concrete is to be mixed in machines, these shall be of the batch mixing or other approved type. The machines shall ensure that all the concreting materials including the water are thoroughly mixed together before any portion of the mixture is discharged. The machines must be capable of discharging their contents while running.

All classes of concrete shall be mixed for a period not less than 1½ minutes after all materials, including water, are in the mixer. All mixing water shall be introduced before one-fourth of the mixing time has elapsed. The mixers shall not be loaded beyond their rated capacity, nor be operated at a speed in excess of that recommend by the manufacturer, generally between 15 to 20 revolutions per minute. The mixer shall produce a concrete of uniform consistency and appearance. All mixing equipment's shall be cleaned before commencing mixing and shall be kept free from set concrete.

Concrete for All Mass Concrete works, RCC works, & Stone Masonry Mortars shall be mixed by Machine, Hand Mixing is not permissible.

Mixing Concrete by Hand:

Where concrete is mixed by hand, this shall be done as near as practicable to the site where it is to be deposited. Clean mixing bankers of platforms of sufficient areas for the proper execution of the work shall be provided. These platforms if constructed of timber shall consist of planks closely jointed so as to avoid the loss of any grout or liquid from the wet concrete. The whole of the aggregate and cement shall be turned over on the banker in a dry state at least three (3) times. The water shall then be added gradually through a rose head, after which the materials shall again be entirely turned over in a wet state at least three (3) times before leaving the banker.

Mixing Concrete by hand is allowed only for small quantity works of less than 1M3

Foundation Preparation for Concrete:

Before placing concrete on foundations, the Contractor shall remove from all such surface oil, objectionable coatings, loose or unsound fragment of earth mud, debris and standing water, to the satisfaction of the Engineer and he shall keep such surfaces clean and free from standing water during concreting operations. Where new concrete is to be deposited on or against rock, the surface of the rock shall be toothed to form an adequate bond

Placing of Concrete:

The arrangements for placing concrete are to be such that in all cases the material may be conveniently handled and placed in the required position without re-handling or segregation. Except where otherwise directed, concrete shall not be placed unless the 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 shall 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 shall be first deposited to cover the surface to a depth of approximately 3 cm.

Concrete shall not be placed in or in contact with standing or running water unless so specified or approved. Concrete shall not be placed against placed concrete which has been in position for more than 30 minutes unless a construction joint is formed as hereafter specified. When stoppage of concreting operations occurs for any reason, construction joints shall be placed. Before concreting operations are resumed, the surface of the concrete shall be cut or chipped to remove all laitance and to expose the aggregate. The surface of the concrete shall be thoroughly saturated and coated with a proportion of weight of 1:2 cement mortars one (1) cm thick before the placing of the concrete is resumed.

Concrete as reinforced concrete work shall be deposited in small quantities in a plastic state with a water cement ratio such to give the specified strength. The depositing of concrete in individual members shall be continued without stoppage up to an approved pre-arranged construction joint or until the member is completed and shall be finished off in such a manner that the junction of members shall be monolithic unless otherwise specified.

Concreting in High or Low Ambient Temperature:

Where the ambient temperature exceeds thirty-two degrees Celsius (32°C), the Contractor shall take special measures in the mixing, placing and curing of concrete. The temperature of the concrete when deposited shall not exceed thirty degrees Celsius (30°C). The Contractor shall carry out all necessary special measures to ensure that the maximum concrete temperature after placing shall not exceed thirty degrees Celsius (30°C) at the time of placing. During placing suitable means shall be provided to prevent premature stiffening of the concrete placed in contact with hot surfaces. The Contractor shall not mix and place concrete when the ambient temperature falls below three degrees Celsius (3°C).

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 shall also be taken. The Engineer may withhold approval of commencement of concreting until he is satisfied that full and adequate arrangements have been made.

Vibration of Concrete:

Except where otherwise permitted by the Engineer, concrete shall be fully compacted throughout the full extent of the layer and shall 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 shall be thoroughly worked against formwork and around any reinforcement or embedded items without displacement. The internal concrete vibrator will either be arranged by Contractor himself.

The duration of vibration shall be limited to that required to produce satisfactory consolidation, without causing segregation. Vibration shall, on no account, be continued after water or excess grout (if any) appears on the surface.

Curing and Protection:

The Contractor shall take adequate measures to ensure that the concrete shall 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 shall 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 shall be adequately protected from damage during the setting period and all temporary protection works shall be to the satisfaction of the Engineer.

Joints in Concrete:

Joints in concrete shall be provided in manner and position as shown on contract drawings. In the case of water retaining structures, joints shall be made water-tight by the provision of a continuous water stop, with suitable water-resistant filler material and sealant as approved by the Engineer.

Joints required by the Contractor but not intended by the Exhibited Design are in principle subject to the 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 sufficient 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.

Construction Joints:

Definition: Concrete surfaces, upon or against which concrete is to be placed and to which new concrete is to adhere, that have become so rigid that the new concrete cannot be incorporated integrally with that previously placed, are defined as construction joints.

Location of Construction Joints: The Contractor shall submit for approval, drawings showing his proposed location of construction joints not less than 30 days before placing concrete.

Forming Construction Joints: Construction joints shall be approximately horizontal or vertical unless otherwise shown on the Drawings or directed and shall be given the prescribed shape by the use of forms, where required, or by other means that will ensure suitable jointing with subsequent work; provided that unless otherwise shown on the Drawings, key-ways will not be required at construction joints. All intersections of construction joints with concrete surfaces which will be exposed to view shall be made straight and level or plumb.

Joint Sealer:

The joint sealing material must be resistant to oil, the most common chemicals and sunlight. It shall be of permanent elasticity, be suitable to carry the structural deformations and must possess an outstanding

adhesion to the concrete. The elastic extension must be at least 150 % and the resistance to heat shall be between 50 degrees Centigrade and +120 degrees. Centigrade, which are to be confirmed by submission of verified test certificates.

Joint sealer shall be the make of a recognized manufacturer, such as THIPFLEX 600 or EXPANDITE or equivalent approved. Joint sealer shall be supplied with primer coats, backing material and/or bond breakers to the joint fitter, as required by the manufacture's recommendations.

The Contractor shall submit to the Engineer a statement from the manufacturer(s) of the joint filler and sealing materials, that these materials are suitable under the prevailing local and structural conditions.

Water stopper:

Size and Material: Water stopper, nominally 225 mm wide, shall be placed in joints of concrete structures as shown on the Drawings or as directed. The water stopper shall be of extruded polyvinyl chloride complying with BS 2571: Class 3, Compound Type G4. The water stopper shall be of sufficient stiffness so that they remain in their correct position during concreting. The type shall suit the particular 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.

Water stopper used in each location shall include at least one approved nailing strip so located that the efficiency of the water stop is not impaired, shall have a minimum thickness of 4 mm and shall be as approved. The width of the water stop shall be within a tolerance of 10 mm of the nominal width exclusive during storage. The Contractor shall store the water stopper in such a way that the material does not deteriorate during storage.

Joints: The number of joints in the water stopper shall be the minimum practicable and all joints and bends shall be made as approved by the Engineer. The number of straight field joints shall be kept to a minimum and all 'Tee' and 'Cross' joints shall be factory produced. The Contractor shall protect the water stopper against perforation or damage during the progress of the work. All joints shall be made in such a manner as to ensure:

that the material is not damaged by heat, searing or by the application of cementing materials:

that the splices have a tensile strength not less than 80 per cent of that required of the specified material;

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.

Form Work:

Formworks for concrete shall be constructed from materials of sufficient strength and supported to ensure that there is no deflection when concrete is placed. The formwork shall conform to the shapes, lines and dimensions of structures shown on the drawings. Where the concrete finished surface is exposed, the formwork shall be of good quality and free of gaps. Formwork shall not be removed until the concrete has obtained sufficient strength. Normally, formwork can be removed from walls after 2 days and from beneath slabs after 2 weeks.

The minimum periods between concreting and the removal of forms shall be as follows:

Sides of beams, walls, columns and piles	24 hours
Soffits of secondary slabs (props left in)	4 days
Soffits of main slabs (props left in)	8 days
Soffits of beams (props left in)	8 days
Removal of props - secondary slabs	10 days
Removal of props - beams and main slabs	21 days
Arch centers, wedges eased	8 days
Arch centers, struck	21 days

The times in the above table are given as a guide and are based on average weather conditions and the use of Ordinary Cement. They may be changed if other types of cement are used, subject to the Engineer's agreement. Formwork shall be constructed so that it can be removed without undue shock or vibration and so that side shutters of members can be removed without disturbing the soffit shutters; if the contractor wishes to leave some of the props in place when the soffit shutters are removed, these props shall not be disturbed during the striking. The detailed arrangements of the props shall be submitted in advance to the Engineer. In the case of heavy loading, folding wedges shall be provided. For pre-stressed units the side shutters shall be eased as early as possible and the soffit shutters shall permit movement of the units when the pre-stress is applied. All formwork must be removed without damage to the concrete. All formworks must be according to specification, BoQ and instruction of engineer.

For more detail on concrete work please see the attached specifications.

Gabion Basket:

Provide, install and fill the gabion basket with stone in place, having mesh size as per relevant drawing, BoQ, specification and complete satisfaction of the site engineer including required tests as per the attached testing plan. (3 mm galvanized mild steel wire should be used for the mesh and 4 mm galvanized mild steel wire for the frame, Gabion galvanized iron wire tensile strength should be 350-575 N/mm² & quantity of zinc should be 275g/m² for 3mm wires and 290 g/m² for 4mm gabion wires. Crashed mountain stone shall be used for all gabion works & gabion boxes shall be fabricated 'Maccaferri' type or equivalent supplied by an approved manufacturer. The cage shall be constructed with 4 mm dia G. I. mild steel wire)

Weep Holes:

Weep holes of sizes as directed by engineer are to be left in the body of masonry walls if shown on the drawings. These weep (drainage) holes are to be covered with inverted filters on the backfill side in an area of 400mm x 400mm with a thickness of 400mm. They are to be located at 1m intervals both vertically and horizontally in a staggered way.

Workmanship:

Workers working on the site shall be skilled in their job and have related job experience.

Materials:

All materials used on this work shall be new and conforming to the contract specifications as per , specifications, International and local codes.

Materials shall conform to the latest International Standards specifications as amended to date and carry certification mark. Contractor shall submit material samples and catalog for preapproval.

All materials used on the project shall be approved by the engineer (UNDP). before use. Any changes/substitutes on material shall be approved by (UNDP). before proceeding.

Storage of Materials:

All materials shall be stored in a proper manner protected from natural elements so as to avoid contamination and deterioration.

Safety:

The UNDP assumes no responsibility for injuries or damages suffered by Contractor, Contractor is responsible and shall continue management and implementation of a safety and health program throughout construction. The UNDP reserve the right to suspend work when and where Contractor's safety and health program is considered to be operating in an inadequate or non-complying manner. Contractor shall provide all Personal Protective Equipment for the workers as per the requirement of the site. Work will be stopped in case the proper protection equipment is not found with the workers and the lapse of time shall be at the Contractor's expense. Contractor will not leave the work site in an unsafe condition or any other condition that might cause injury to personnel, damage to existing work, plants or equipment. Contractor will use all safety gadgets e.g. hard hats, cotton gloves and goggles as required on site to avoid the accident. Any equipment or work considered dangerous shall be immediately discontinued.

Site Location:

The project site location is Kariz Salim valley in northern side of Zerai district, Kandahar province, for GIS map and project exact location please see the attached drawings.

Contractors are advised to visit the site, verify the existing site conditions, and check the area from all aspect like soil types, construction materials availability and so on.

Drawings:

Detail drawings are attached to the documents.

c. Works on Brief

The project scope of works explained above and attached BOQs and specifications

d. Schedules and payments

The payment will be paid based on satisfactory delivery of following Milestones

Milestones	Description	Percentage	Timeline	Total cost in USD
Milestones 1	Progress Payment upon completion of the actual works done as per the agreed contract, BoQ and specifications, duly certified by the UNDP regional team.	100%	5 Months (20 Weeks)	

Liquidity damage /retention money will be 10% of total contract amount, or according to UNDP procurement rules and policy.

The contractor shall guarantee that all work performed will be free from all defects in workmanship and materials and that all activities will provide the capacities and characteristics specified. The contract further guarantees that if, during a period of one year from the date of the certificate of completion and acceptance of the work, any such defects will be repaired by the contractor at his own cost.

CASH FOR WORK ARRANGEMENT

In consultation with CDCs, UNDP field coordinator will identify the most suitable labourers/beneficiaries based on the beneficiary selection criteria. Except in outstanding circumstances, one family can have maximum one labourer. This is to ensure as many households benefit from the intervention as possible.

Vulnerabilities that will be considered for beneficiary selection include:

- households struggling with poverty
- women-headed households
- No child labour will be hired during project
- households with members who are unemployed, have disabilities and elderly

When the number of eligible labourers are high, a maximum number of working days per labourer could be set in order to ensure that as many households benefit from the intervention as possible.

The minimum pay per day for unskilled labour is 500 AFN

e. Key Performance Indicators and Service Level

The project will be regularly monitored by UNDP regional office, specifically by Field engineer who will be the project engineer for the said project, all the activities should be according to drawings, scope of work and given specification and have to be completed on given timeline and work plan, if there is anything found that were not according to drawings, scope of work and specification or have not done in good workmanship, the contractor should immediately repair the mentioned part according to given instruction by UNDP engineers.

Contractor shall not proceed with next activity until previous activity will be checked and approved by UNDP engineers. Contractor shall mention all inspection dates in the schedule chart, contract should work closely with UNDP engineers during the project implementation and share their Weekly

schedule/activity plan, day to day activities plan for the duration of the project prior to the start date.

For dismantling/blocking or making connection to any existing services or any shutdown, contractor shall inform the (UNDP). at least three working days in advance and proceed with the work only after the permission from the UNDP. All dates and time schedule agreed upon should be strictly adhered to. Contractor shall notify the UNDP in advance regarding anticipated problems through the project.

f. Supervision

The project will be supervised by UNDP team, the contractor should report to UNDP regional offices or UNDP engineers and seek any type of approval, acceptance and assistance (based on contract) from them. The contractor should report weekly to UNDP office; the report should be comprehensive consisting of a narrative within 7 days following the completion of the services, the report must be sufficiently detailed (Date and time, activities description, pictures before and after, videos, issues, problems, challenges and recommendations) to allow certification of deliverables and expenditures, with all supported documents. The contractor should provide daily report if there were need or requested by UNDP.

The contractor shall establish an efficient mechanism to ensure that a systematic update in regard to the implementation progress are available to UNDP and other parties of the project. The contractor shall provide the project manager/Engineer of the UNDP with a weekly plan for the visits and activities to be implemented on daily basis, besides the submission of weekly reports that indicate the accomplished activities in accordance to the submitted weekly plans.

g. Facilities to be provided by UNDP

Everything will be the responsibility of the contractor. UNDP will only do the inspection and providing the installments based on the progress.

h. Expected duration of the contract/assignment

The project duration stated in work plan is 5 months, the contractor should strictly follow the work plan in order to complete the project on given time. The contractor should commence work within 7 days from the date on which he shall have been given access to the site and received the notice to commence from the UNDP and should perform and substantially complete the project on given time, in accordance with the contract. The contractor should provide all materials, supplies, labor and other services necessary to that end.

The estimated lead time for UNDP to review progress reports, certificate of payment, give comments, approve/accept outputs, etc. will be upon the rules and policy of UNDP.

The Defect Liability Period for this project will be 12 months after the completion of the project. If any defects happen during this period, the contractor is responsible to repair them by its own expenses.

i. Duty Station

The project site location is Kariz salim valley of Zerai district, Kandahar province, for GIS map and project exact location please see the attached drawings.

The Contractor shall make his own arrangements, at his own expense, for all local accommodation he may require for offices, yards stores labor camps etc. and all buildings and all services in connection therewith which are required for the efficient execution of the Work

Evaluation Table:

Technical Evaluation Criteria – Detailed evaluation

Description	Pass or Fail
Please refer to RFQ evaluation criteria	
Please refer to RFQ evaluation criteria	

Key personnel – Detailed evaluation

Contractor shall employ and provide one full time team to supervise the project and has experienced of carrying out such type of work. The below table show the staff and their experience for implementation of this project: Please refer to RFQ evaluation criteria

S/N	Position/Item	Academy requirement	Experience (please detail on what)	No
1	Project Manager (engineer)/ Focal Point	Degree in Civil Engineer (For example)	A minimum of 5 years work experience in construction project management	1
2	Site Engineer	Degree in civil engineering	A minimum of 5 years' work experience in construction project supervision and implementation	1
3	Field Supervisor/foreman	Degree in engineering or relevant field	A minimum of 2 years' experience in construction project supervision	1
4	Quality control engineer	Degree in engineering or relevant field	A minimum of 5 years' experience in QC/QA, testing materials and laboratories	1

The dam related detailed scope of work is figured out below on numeric order:

1. The cutoff trench And Nucleus (core) portion of Dam Filling Materials must be consider of impervious material that have more than 80 percent Clay , that will not allow the passage of any water (i.e. impervious).
 - i. For Cover Portion of Dam use impervious material that have more than 55 percent Clay , that will not allow the passage of any water (i.e. impervious).
2. Basically, the textural classes involved are as follows: Any soil with more than 55 percent clay can be considered as a 'clay'. A 'sandy clay' is a soil with between 33 percent and 55 percent clay and up to 65 percent sand. A 'sandy clay loam' has between 20 percent and 30 percent clay and up to 80 percent sand and loam.
3. Texture tests:

- i. Texture tests are carried out to determine soil types.
Excluding stones and gravels,
- 4. The mineral part of the soil is made up of particles in three size ranges
 - i. C - Sand: 0.05-2.00 mm diameter.
- 5. Rapidly fluctuating water levels for long periods the dam should have impervious Foundation If seepage is excessive this can lead to instability and eventual failure of dam.
- 6. Most dams, homogenous or zoned, can benefit from the construction of a cutoff in
 - i. The foundation. A cutoff will reduce seepage and improve stability.
 - ii. Whether stable clay, or other material is being used, the cutoff trench must be excavated to a depth that will minimize all possible seepage. Ideally, the cutoff trench should be dug down to solid rock that extends to great depths. If underlying rock is assured or uneven it can be cleaned off and concreted to offer a good surface on which the clay can be laid.
- 7. For larger indentations or cracks, slush grouting should be used, which is a thick slurry mix of cement and water poured and boomed any question do contact with quality control engineer.
- 8. Generally, homogeneous dams should have relatively flat slopes (1:3 upstream and
 - a. 1:2 downstream) as insurance against possible instability, for this project we consider 1:3

for more stability, it have a huge catchments area.

- 9. A flatter upstream slope, required by all earth dams, allows the saturated section below water level to resist slumping.
- 10. . Also the weight of the water stored above it exerts a down force which, when combined with the weight of the dam, equals or exceeds the horizontal thrust
 - i. Exerted by the depth of the water against the embankment.
- 11. Water levels should not be allowed to fall or rise too fast, especially if the embankment material is impermeable. This is because a rapid lowering of the reservoir could lead to slumping of the upstream face or, if the wall has been allowed to dry, a rapid rise in level could lead to erosion through cracks and fissures. Both may eventually result in erosion, loss of material and, in a worst case scenario, a breach.
- 12. Every layer must be well compacted and if the whole dam length cannot be completed at any one time. Each section must be well keyed and bonded to the next since the cutoff trench and core are designed as one homogeneous unit to avoid seepage and structural problems, any more question do contact with Quality Control Engineer.
- 13. Compaction can be carried out by hand (tamping damp material by ramming poles 100-150 mm diameter) or by machinery (rollers or vibrators), or a combination of both.
- 14. Light irrigation of the borrow area, some hours before excavation, can often assist in the scraping and scooping of the material, as long as it is not too wet.

15. Rain on the site can cause problems and an over-wet clay will prove difficult to compact. In this situation it is better to wait for the soil to dry before continuing with construction.
16. Continual or, at least frequent, monitoring of core material quality, moisture content and layering procedures is advisable, especially where inexperienced plant
17. Soil pits and trenches dig soil pits and auger holes to assess the top and subsoil layers and the foundation condition in the embankment area.
18. Auger holes dug on a grid to depths of 3 m throughout a potential source area will allow a general assessment of soil types to be made. A series of trial pits and trenches can then be dug in more promising areas to allow a visual assessment of the soil profile to be made in line with local soil coding and classification techniques.
19. Samples can be taken for subsequent texture and laboratory analysis, any question do contact with Quality Control Engineer.

20. INVESTIGATIONS

Ideally, the entire earth fill should be drawn from within the reservoir area and, if required, from any cut spillway areas.

21. The importance of a correct analytical approach to determine the various soil types for a zoned embankment cannot be stressed too much.
22. Although using a soil laboratory is expensive, the results can more than repay the cost involved and, more often than not, will ensure the exclusion of doubtful material in the construction process. This approach will include selecting the soils to be used, laboratory testing and mechanical analysis (if such facilities are available) to ensure the selected materials are suitable and interpretation of the results of these tests by an experienced engineer or technician to permit the appropriate materials to be used, any more question do contact with Quality Controlee Engineer.

23. Core and cutoff material

A soil is required that will limit the passage of water but not to such an extent that undesirable differential pressures could build up across and within the embankment. The impermeability of the soil used will vary between localities, but some standardization of water tightness can be achieved through varying the degree of compaction involved.

24. A more pervious material will require greater compaction and vice versa. Generally, soils containing a significant percentage of clay are ideal for the core but clays with a tendency to crack should be avoided. If the latter are used they should be carefully compacted, placed in lower parts of the dam that are unlikely to dry out (such as in the cutoff trench) or covered by a gravel layer or topsoil with grass.
25. Sands and clays, and combinations of them, are most suitable for earth dam construction. Generally, however, silty soils are unsuitable because of their inherent instability when wet and should not be included in any of the earthworks.

26. To precisely define textural classes requires laboratory techniques but, with experience and specific local knowledge, hand testing to determine texture can prove important for the initial stages of identifying appropriate earth fill materials.
27. Clay soil areas can be demarcated in the field with the better soils (i.e. higher percentage

i. clays) being reserved for the core and upstream shoulder of

ii. the embankment.

28. Silts are often similar in both appearance and feel to wet clays when dry but can usually be differentiated when wet as the clay will exhibit sticky, plastic-like characteristics while silt has a silky, smooth feeling with a tendency to disperse.
29. Hand-testing techniques involve the taking of a small sample of a soil - usually in the hand not required for making notes - dampening it (avoid soaking it) and rolling it into a ball to examine its cohesive constituents.
30. A better quality clay can be manipulated into a thin strip without breaking up, rolled into a ball and dropped onto a flat surface from waist height without cracking unduly. Also, when cut it will exhibit a shiny, smooth surface.
31. The best clay soil is always reserved for the core and cutoff and must be well compacted. Basically, the lower the clay percentage (to an arbitrary minimum as low as 3-5 percent), the more compaction and care in construction is
32. Sandy clay soils are most suited for inclusion in this upstream section as they compact well, have much reduced seepage characteristics but do not allow the buildup of high soil-water pressures.
33. Clays are not required in the downstream shoulder as it is essential that this section is free draining.
34. Within a river valley a cross-section of soils may be available. The valley sides, where less leaching has occurred, can provide soils with a higher proportion of clay. The more heavily leached areas can provide amounts of sands, gravels and/or silts. The streambed proper should be a source for silts, sands and gravels, the latter being useful for drains and concert work.
35. Of great economic importance is the need to find such materials close to the dam site, preferably within the reservoir area, and in large enough quantities to justify their removal. Avoid complete removal of impervious materials, as exposure of more permeable layers beneath could lead to seepage problems in later years, especially when under pressure of several meters of water.
36. Embankment materials Semi-pervious materials such as sandy clays and clay loams with a proportion of fines, such as clay or perhaps silt particles, are suitable for inclusion in the upstream shoulder. These will allow a limited passage of water and, in a properly constructed embankment, will resist slumping when wet. Where poorer soils are used,

special attention to compaction techniques will have to be given to minimize the volume of air spaces in the soil and to maximize its stability when wet.

37. Pervious materials such as coarser grained sand and Gravels - suitably washed and Screened/sieved for size and grade - are used in the downstream shoulder and sections of the embankment requiring mass and drainage.
38. Always seek specialist advice for use of these materials in drainage and filter works. These can often be better compacted dry or if only slightly damp. Once completed, a dry downstream Face will prevent slippage and reduce risk of failure.
39. Materials to avoid should there be any question about a soil's suitability, it is safest to avoid using it. Some materials should never be used in dam construction, in particular the following: Organic material (except when used to top dress the embankment and other parts of the dam site at the end of the construction period).
40. Decomposing material. Material with a high proportion of mica, which forms slip Surfaces in soils of low clay percentages. Calcite soils such as clays derived from limestone which, although generally stable, are usually very permeable.
41. Fine silts, which are unsuitable for any zone of the dam. Schists and shales which, although often gravelly in texture, tend to disintegrate when wet. Schists may also contain a high proportion of mica.
42. Cracking clays that fracture when dry and may not seal up when wetted in time to prevent piping through them. Sodic soils, which are fine clays with a high proportion of sodium. They are difficult to identify in the field, so any fine clay should be analyzed.
43. PH is the standard measure of acidity related to the concentration of hydrogen ions. A pH of
44. Neutral, soils with a pH between 1 and 7 are acidic and those above 7 (to 14) are alkaline.
45. A soil with a predominance of sand should not be used in dam construction. A sandy soil can be used in the downstream shoulder but should not be used elsewhere unless there is no alternative. If a sandy soil is used in the rest of the dam special attention must be paid to compaction, the best soil reserved for the core, and some consideration given to obtaining embankment water tightness by other means. Sands do have an important role in larger dams as a filter material.
46. LABORATORY TESTS
47. Laboratory tests on selected samples should be undertaken to confirm the field evaluations and to determine the physical properties of the soils. Say in a silty-clay, but care must be taken in its use and application to ensure it is balanced with other soils and to keep percentage contents low. As they can be confused with fine clays, it is important to differentiate the two when testing for texture. Laboratory analysis may, therefore, be required.
48. FREEBOARD
49. Freeboard for small dams should never be less than 1.0 m preferred. Where wave action is likely, additional freeboard may be required.
50. SETTLEMENT ALLOWANCE
51. The embankment will always settle a little after construction and the finished crest should be given a settlement allowance that raises it above its design height at the mid-point by between 5 percent and 10 percent and tapering off to the spillway and valley sides.

52. **STONE PITCHING AND TRAINING BANKS** Stone pitching is usually not necessary, as a good grass cover is normally sufficient to protect the embankment here. However, occasionally training banks may require stone pitching protection, depending on the climatic regime and likely flood flows.
53. The training banks should be long enough to divert water safely away from the downstream toe of the dam. They should have the same proportions and crest level as the main embankment. Where natural spillways are to be used.
54. **COMPACTION EQUIPMENT AND TECHNIQUES**
The compaction of soil is essential to increase the shear strength of a material to achieve high levels of embankment stability. A high degree of compaction will increase soil density by packing together soil particles with the expulsion of air voids. Comparing the shear strength with the moisture content for a given degree of compaction, it is found that the greatest shear strength is generally attained at moisture contents lower than saturation. If the soil is too wet, the material becomes too soft and the shear stresses imposed on the soil during compaction are greater than the soil's shear strength, so that compaction energy is dissipated largely in shearing without any appreciable increase in density. If the soil is too dry, a material compacted in this condition will have a higher percentage of air-spaces than a comparable soil compacted wet. It will take up moisture more easily and become more nearly saturated with consequent loss of strength and impermeability.
55. **CONSTRUCTING THE EMBANKMENT**, the core/cutoff trench as this is the most important part of any embankment, great care is necessary in the excavation, fill and use of material. Width and depth should have been determined at the design stage. Width (2m) minimum will often depend on the equipment used in the excavation and also on the size of the dam otherwise use formula if you have any question do contact with QC engineers.
56. The minimum depth necessary will depend on site conditions but in all excavations the cutoff trench must be taken down to good quality impermeable material such as clay or solid rock
57. If rock is located and is generally good, it is permissible to fill any cracks or fissures with compacted clay or mortar, provided they can be fully cleaned and traced to ensure seepage paths will not develop later.
58. If permeable material is found it is vital that the cutoff is taken through it to a depth sufficient to find more impermeable material.
59. Before backfilling, the excavation should be checked to ensure that the conditions above have been complied with. Short cuts taken at this stage can prove costly later and seepage through the embankment can become excessive if the correct depth into the correct material is not achieved. A little extra time and care in the excavation of the core is usually worthwhile,
60. Other requirements such as coffer dams, special compaction, dewatering equipment and safety provisions in the trench should be considered before excavation starts, to allow the work to be carried out efficiently.
61. An assessment of the site condition, for example to ascertain groundwater levels, at the design stage would allow such special provisions to be included in the cost estimates.
62. Once the excavation has been checked and found satisfactory, backfilling can occur. The best clay soil should be used and compacted in layers no more than 75-100 mm thick (50-75 mm is best), throughout the length of the trench.
- SPILLWAY :**
63. Natural spillways are generally best for all earth dams but often some degree of cut is required to obtain the necessary design slopes. In all cases the movement of machinery over the spillway area should be minimized to avoid over compacting the existing soil.

64. Any large volume spillway cut should be done at a time when the excavated material (if suitable) can be included with the material being moved to construct the main embankment or reserved to fill in borrow pits. Smaller volumes of cut material can usually be included in the training bank.
 65. Slope (cross fall) towards the upstream side of the embankment to permit the safe drainage of rainwater to the reservoir rather than the downstream slope. Over the next few months, and finally after one year, the embankment should be rechecked to assess settlement and to allow the placement of soil at any sections that settle to below horizontal.
 66. The spillway should be checked to prove the design slopes were adhered to. If large flood flows occur, or are expected, stone pitching or concreting of the end of the embankment and one or both sides of the spillway channel may be necessary to reduce the risk of erosion.
 67. It is very important that good grass cover, preferably of creeping grass type, is established on both the embankment and the spillway before the likelihood of heavy rains. This could mean constructing most of the spillway before work on the embankment itself starts, ideally at the end of the previous rainy season when water for establishing grass is available.
 68. Either way, the last soil layers to be laid on the embankment, and on any spillway cut sections, should be of good quality topsoil so as to encourage rapid and dense grass growth. Manuring and irrigation may prove beneficial. To minimize erosion caused by people and animals the embankment should be fenced and gated and, in some cases, special protected pathways for watering livestock should be provided to keep animals well clear of sensitive areas.
 69. If erosion does occur, particularly at the early stages, much time and effort can be saved by prompt remedial action. After any heavy rainstorm the dam should be inspected. Any rills or gullies filled in and replanted with grass before the situation becomes too advanced. Where soil and grass cover are difficult to establish, wiring of the topsoil and vegetation may assist in re-tariffing with suitable sods in any holes that occur. All new dams that have not completely stabilized and settled require frequent visits again and, again, the beginning of the rainy season.
- INSPECTION REQUIREMENTS:
70. At the time of siting the dam it should have been made clear to the local community/dam owner that to maintain the dam in good condition and to prolong its life as a sound, useful water resource, competent and timely inspection and maintenance are going to be required. Once the excavation has been checked and found satisfactory, backfilling can occur. The best clay soil should be used and compacted in layers no more than 75-100 mm thick (50-75 mm is best), throughout the length of the trench.
 71. All dams must be inspected at least annually. In dry season climates the best time to carry out this work is before the beginning of the rainy season, when most of the dam and its reservoir area can be seen.
 72. Time after the inspection (and before the rains begin) must be allowed for to complete any remedial or repair work.
 73. All dams with grass spillways must be visited after every heavy rainstorm and flood. This is most important at the beginning of the rainy season when, because of limited grass cover, erosion risks are highest.
 74. Season is an important time, especially if a grass cover has not been established. After the first year or so, a more routine inspection programme can commence. Initially visits (which will vary from site to site) should not be less than twice a month and after every rain or flood.
- Seepage and drainage:
75. All earth dams will leak to some extent and seepage only becomes a problem if it endangers the embankment - either by encouraging erosion in the downstream area or by causing water logging of the dam and thus affecting its stability.

76. Dirty water seeping from the downstream face of any dam is cause for concern. As finer materials are eroded, and carried out of the embankment, this could lead to piping or slumping in the structure.
77. At the time of construction and, particularly if the dam does not have a dry, well-drained downstream foundation area, drains should be installed before the embankment is built. If this was not done and seepage has become excessive, the following may reduce the problem:
Settlement:
78. However well the dam was built, it will always experience some settlement. Most dams settle out in the first year or so after construction. Invariably most settlement occurs at the highest point of the dam where mass is greater and other pressures highest.
79. At the time of construction a settlement allowance should have been incorporated on the top of the embankment. At every inspection the crest must be checked to ensure it remains horizontal and that no low spots have developed.
80. All over settlement must be attended to with backfill and additional monitoring. If this is neglected, and should either the crest level fall overmuch, or an exceptional storm lead to backing up of floodwater from the spillway, the dam will overtop, water will concentrate in the low spots and serious damage result.
81. Unusual settlement in an older dam can indicate foundation movement or removal of embankment material by seepage or erosion. Always seek expert assistance when this occurs. Another form of settlement can arise when, due to poor construction techniques, the core has been compacted comparatively more than other parts of the embankment.
82. The upstream and downstream sides or shoulders of the embankment settle more than the core as they are less well compacted and, as the foundation is firm (and it cannot fully absorb the differential settlement), cracks appear along the crest edges as the settlement takes place. These cracks do not represent a serious problem and can usually be treated by ramming in damp soil complete with grass as soon as they develop. It is important to prevent water entering such cracks (otherwise erosion and water logging will follow) and in the rainy season it may be necessary to sandbag the area to minimize runoff.
83. When large, deep cracks appear on older dams (indicating foundation movement or slumping of either shoulder), the reservoir water level must be lowered and expert assistance must be sought without delay.
- TREES AND BUSHES:
84. Do not allow trees, bushes or other deep-rooted plants to grow anywhere near the embankment the spillway and its outfall. Keep all parts of the dam clean with a low grass cover to protect against erosion and assist inspection and maintenance. Trees on the embankment do not help stabilize the soil and their roots will eventually reach to water. When dead and decomposed, pathways for insects, animals and water are then formed. Therefore, remove all trees and bushes before they become established.
85. In a situation where large, old trees have been allowed to establish themselves on the embankment they should be removed when the upstream water level is low. The trees should be cut as low as possible and, if the stumps cannot be excavated, they should be soaked in petrol and burnt or treated with chemicals to most gullies in the spillway areas and on embankment slopes are started when rainfall and the subsequent runoff concentrate in depressions caused by footpaths, vehicle tires or animal tracks.
86. To determining foundation strengthen and impermeability it is required to test it stability against settlement as well result of laboratory test should be check by QC engineer.

87. Embankment back fill materials should be checked in laboratory to determine its imperious characteristic of materials which is used on dam body construction based on project requirement, after QC engineer approval it can go ahead for remaining construction activities.
88. Several compaction and backfill materials laboratory tests are needed to be considered in estimation volume schedule (BoQ) that one laboratory is assigned for all project life cycle.