

**GOVERNMENT OF KHYBER PAKHTUNKHWA
IRRIGATION DEPARTMENT**



**Terms of Reference/Guidelines for submission of Proposal
for
Construction Supervision of Sarozai Dam District Hangu**

DIRECTORATE GENERAL SMALL DAMS

July 2021

BACKGROUND INFORMATION OF THE PROJECT/STUDIES

Location:

The proposed Sarozai Dam site is located on Tributary of Kak Algad (Kurram River Tributary) towards South-West of Hangu at a distance of about 29 km. From Thal the proposed site is towards North-East at a distance of 23 km. The project area falls in the survey of Pakistan topo sheet No. 38-K/15 and lies between coordinates N 33° 25' 40" & E 70° 44' 48" and N 33° 23' 15" & E 70° 52' 03". The proposed dam is at a distance of 1.7 km from Sarozai village.

General description:

District Hangu is a 2nd largest district in Kohat Division of Khyber Pakhtunkhwa, Pakistan. The district has limited land and water resources. The land is much fertile but its full use cannot be made unless assured and dependable water for irrigation is provided.

The proposed dam is located near village Sarozai in District Hangu and the project area lies between coordinates 33° 25' 40" North (latitude) & 70° 44' 48" East (longitude) and 33° 23' 15" North (latitude) & 70° 52' 03" East (longitude). Sarozai village is situated on a wide terrace above the nullah bed. This terrace extends upto the Naryab Dam on Northern and Darsamand village on eastern side. Part of the lands are fed through the Naryab dam. The railway line in the east west direction is the dividing feature between the lands fed by the Naryab dam. The reservoir of the Sarozai dam would be able to irrigate the lands lying on the southern part of the Railway line and all around the Sarozai Village.

a. Project Area:

Hangu district is surrounded by mountains and hills on all sides and a central valley from south-west to north-east. Sarozai dam project is located near village Sarozai in District Hangu. -

b. Physiography:

Hangu district is surrounded by mountains and hills on all sides and a central valley from south-west to north-east. The general elevation of the district is from about 900 to 1400 m above sea level. The Bangash and Samana Garh range in the north-east, the Khattak range in the south and the Nashpa Sar range in the south-west are important. The highest point is 1495 m above sea level near Tall. The hills are broken with a general trend from east to west. In between the Bangash and Khattak ranges lies the fertile valley of lower and upper Miranzai. Several streams and nullah originate from the surrounding hills.

The drainage on the western half is from north-east to south-west while that in eastern half is from south-west to north-east. The main stream on the western side is Shkalainullah while that on the eastern half is NasarToi. The nullahs on the western side are Kak Algad, Star Algad and KhwarAlgad.

c. Climate:

The Climate of Project area is dry and hot in summer and cold in winter. The summer season begins in April and continues till October. The mean maximum temperature during the hottest months of June and July are 30 °C and 28 °C respectively. The summer rains occur mostly during July and August. The cool wave starts from somewhere in October. January and February are the coldest months with mean minimum temperature of about (-ive) 2 °C and -4 °C. The winter rains occur during January and February.

d. Hydrology:

The catchment area of the nullah upto the proposed dam site is about 7.72 sq.mile(20 sq.km). The project area lies in the rainfall region of about 37.6 inches. The annual inflow at project site is estimated from SCS method. Estimated average annual inflow is 2625 acre-ft. Most of runoff occur during February to April and the monsoon of July and August. The mean maximum temperature during the hottest months of June and July are 30°C and 28°C respectively. January and February are the coldest months with mean minimum temperature of about -1°C and -4°C. Design flood is estimated from SCS unit hydrograph using 24-hour maximum rainfall data. The spillway design outflow against 200 years is reckoned to be 168.8 cumecs. Reservoir live storage capacity at conservation level of 940 m is 2709 acre-ft and dead storage corresponding to 929 m is 432 acre-ft. The total sediment inflow rate at project site is estimated as approximately 14.46 acre-ft/year. Reservoir will lose 50% of life within operation of 112 years.

e. Water Availability

Sarozai Dam site is located on KakAlgad having perennial flow of 1 cusec and gets its water mostly from rainfall in the catchment. The high flow months are July and August, while minimum flow occurs in January.

f. Sedimentation

The stream flow at the dam site has not been observed and so is the case for sediment loads. However, sediment data for Kurram River is the nearby river for which river flow and sediment loads were observed by SWHP.

g. Geology

1. Geology of Dam

The proposed Sarozai Dam site is located on Tributary of KakAlgad (Kurram River Tributary). The aerial distance of dam site is about 29 km from Hangu and 23 km from Thal. The project area falls in the survey of Pakistan Topo Sheet No. 38-K/15. Geologically the dam axis and reservoir area consists of Sandstone and shale/clay. The sandstone is greenish grey in color, thick to massive bedded, moderately weathered, moderately fractured, strong to very strong, while shale is green to greenish and maroon in color, loose, flaky and splintery in texture.

2. Geology of Left Abutment

The left abutment is cover up to 4 meters with silty clay gravel and cobble of sedimentary origin. Shale on left abutment encounter at 4 meters depth which is light green to greenish and maroon in color, fine to medium grained, weak to moderately strong in strength moderately to highly weathered. The left abutment slope is relatively steep and composed of shale with an expose bed of sandstone on the nullah side. The sandstone is greenish grey in color, thick bedded to massive, slightly too moderately weathered, moderately fractured, medium to high strength.

3. Geology of Right Abutment

The exposed rock on this abutment is shale with minor beds of sand stone and boulders of limestone. The shale is green to greenish and maroon in color, loose and highly disturbed in nature. Sandstone is light green to greenish in color, fine to medium grained, moderately to highly strong in strength, and slightly to moderately weathered. While the boulders of limestone is light grey to grey, hard in strength and slightly weathered.

h. Existing Agriculture Practices

Most of the area is used as rainfed agriculture for growing crops for domestic consumption. The cropping pattern is generally based on the availability of water and the time and intensity of rainfall in the area.

1. Major Components of the Project

a. Main Dam

It is proposed to construct a 27 m high and 397 m long zoned embankment (clay core) type of dam to store the flood water. This dam would create a gross storage of 3141 AF out of which 2709 AF is live storage. The dam is zoned with a central impervious clay core and shoulders of river bed. The upstream slope of the dam from the crest up to dead storage is 1:2.5 where a 3 m horizontal bench is provided and the remaining slope upto nullah bed is 1:3. The downstream slope of the dam is 1:2.5. The 0.6 m thick riprap is provided on upstream side of dam while on the downstream side a 0.3 m thick riprap is proposed. The crest elevation of the dam is fixed as 944 m.

b. Spillway

The spillway is proposed on left side of the dam axis. A two steps ogee spillway with stilling basin is proposed for Sarozai dam. Design discharge of spillway is taken as 168.8 cumecs for 200-year design flood and spillway crest is kept at 944 m. Surcharge height above spillway crest is 2.5 m.

c. Intake and Outlet System

It is proposed to have a well type C shape of intake structure located on the right side of the reservoir as close to the reservoir bank as possible. The intake structure (2.25 x 2.56 x 16.5) meter is proposed to be located outside the body of the dam. A 300 mm dia steel pipe emanates from the bottom of the tower having an invert level of 928 m. It is laid on a Right abutment and terminates into Baffle Impact Type-7 (USB) energy dissipation chamber through a regulating valve. For lowering down of stop logs and opening/closing of the gate an access bridge has to be built.

d. Irrigation Network

Water leaving the energy dissipation chamber enters directly in the irrigation channel. About 1030 acres land can be irrigated at annual demand of about 2671 acre-ft at 145 % cropping intensity. The design discharge of the channel is 6 cusecs. About 4.75 km long irrigation network is proposed to irrigate the command area on both sides of the Khawar.

INSTRUCTION REGARDING SUBMISSION OF PROPOSALS

1. Three copies of the technical and one copy of financial proposals in stippled/fixed binded form are required to be submitted. Proposal should be in a sealed envelope indicating original or copy on each enclosure, as appropriate.
2. The proposals shall be valid for a period of 180-days after the last date of submission, which is extendable on the expiry of above period through mutual agreement.
3. The technical and financial proposals of the consultants will be evaluated according to criteria for procurement of consultancy services of the Government of Khyber Pakhtunkhwa, applying weight-age formula of 80:20 for technical and financial proposals respectively.
4. Financial proposals of Technically Qualified consulting firm will be considered and opened by competent forum in presence of the competitive firms representatives. The contract agreement will be governed by laws and regulations of the Govt. of Khyber Pakhtunkhwa.
5. Any observation/ clarification on the TOR and EOI must be brought into the notice of the department before last date of submission of the proposals. No objection will be entertained after the submission of Technical and Financial proposals.
6. The employer reserves the right for any addition alteration or amendment in the TOR of the Project.
7. Technical proposal should include the following information as well.
 - i. Year of formation, year of registration of the firm, postal address, e-mail, telephone/fax numbers with name of partners/proprietor and head and branch offices.
 - ii. Registration Number and latest renewal certificate of Pakistan Engineering Council.
 - iii. National Tax No. (NTN) with copy of the certificate.
 - iv. List of Similar nature works completed by the firm during last 10 years with detail of year of start/completion, cost of consultancy services, scope of the work and actual services performed by the firm individually and / or in a joint venture with specific details to be given in annexure.

- v. List of Similar nature works in hand with cost of consultancy services, scope of the work and actual services performed by the firm, date of start and expected date of completion individually and / or in a joint venture with specific details to be given in annexure.
 - vi. Only those similar projects will be considered for evaluation for which the scope of services is mentioned in the data sheet of the firm furnishes evidence to this effect.
 - vii. The experience of the firm includes project handled by the firm and not by the individual employees of the firm in their personal capacity.
 - viii. List of professional staff and CV's of the key experts (duly signed by them or by the authorized representative of the firm) who will be handling the assignment with names, qualifications, year of passing various degrees and post qualification practical experience.
 - ix. A comprehensive write-up about approach and methodology, proposed work plan and manning schedule of various experts on a bar chart showing man-months of each expert, their responsibility and total time schedule for completion of the assignment.
8. Consultants shall be responsible for payment of all kind of taxes (direct & indirect both), levies etc in vogue time to time by Govt. in respect of personnel and other activities with no liability to the client.
 9. The Consultants cost shall be inclusive of all kind of Taxes (direct & indirect both), levies etc. However, the Sales Tax as per applicable law shall be mentioned separately.
 10. The Consultants' financial bid/ proposal shall be deemed to cover expenses for each and every item of the scope of work/TORs. No payment shall be made for any item(s) mentioned in scope of work/TORs that the Consultant have intentionally or unintentionally presented as conditional, missed or not included in their technical and financial proposal, the consultants shall have to perform the same at their own expenses.
 12. Payment for the personnel will be made as per actual time consumed on the Project but not in excess of the provision of man months made in the T.O.R. of Consultancy.
 13. Payment to the Consultants for the survey and Geo-technical investigation and other investigation (if required) will be made as per actual work done.
 14. On the satisfactory performance of the services, the payment to the Consultants shall be made as per actual inputs, while in case of incomplete assignment; the payment will be made for the work done in accordance with the breakup of the services submitted by the Consultants and as determined by the Employer/Client.
 15. Security deposit and income tax/sale tax etc will be deducted as per the prevailing Government rules notified during currency of the project.
 16. The Consultant shall establish complete Project Office at Peshawer/nearest to site.

17. Consultants shall appear in Project meetings and site visits and shall also make presentation if so directed by the department for which no TA/DA, boarding, lodging and claim for incidental charges etc, shall be entertained.
18. The Consultant except with prior approval of the competent authority shall not sublet the study or any part thereof.
19. If the Consultant fails to complete any activity or part of the activity, the client reserves the right to execute the same at the consultant risk & cost.
20. If a project or part of project is dropped due to any reason, man months of the consultant key staff and logistics will be curtailed proportionally.
22. Consultant will be responsible for security of their staff. However, the security issues will be taken up with concerned security agencies.
25. Consultant shall provide indemnity bond.
26. Employer reserves the right to replace/withdraw/shared vehicle, person and equipment from the consultant if required.
27. The Consultant will have to adjust given/estimated Man-months for entire period till completion.
28. TORs will be part of contract agreement.
29. Third Party validation (if required) of the Detailed Engineering Design local or International (as required by the Employer), will be the responsibility of the consultants, to get verify their contents of the study.
30. If the client (Irrigation department, Government of Khyber Pakhtunkhwa) suffer any loss due to proven design faults by the consultants, then the consultants shall have to reconstruct the said failed structures at their own cost.
31. The successful bidder/consultancy firm will deposit performance security @ 5% of bid cost in shape of bank guarantee or CDR as per KPPRA rule. (Para 24.2 standard procedure for selection of consultant).

EVALUATION CRITERIA OF PROPOSALS

Proposals of the consultancy firms will be evaluated as under

S.No	Description	Maximum Marks
A	Qualification & Experience of Technical Key Personnel	50
B	Experience of firm in undertaking Projects of dam & Hydraulic structures of similar nature & complexity	30
C	Work Plan/Manning Schedule & Methodology	20
	Total	100

Note.

- Each page of the proposal must be numbered & signed by the owner of firm.
- Passing marks in each category will be 60%
- Proposals must be stippled binded. Ring binding will not be considered.
- Client reserves the right to make any change in TORs& marking criteria which is commonly applicable to all proposals.
- Any observation/clarification required should be brought in notice of the Client / Employer before submission of the proposal during clarification meeting.
- Proposals shall be submitted in two copies (Marked as Original & Copy)
- Any mis-statement or false information provided in the technical or financial proposal will render the proposal as non-responsive and shall make the firm liable for punitive action under the relevant rules.

- **Qualification & Experience of Technical Key Personnel**

Marking criteria of Personnel

S.No	Description	Marks	Criteria
1	Qualification	20	BS or M.Sc. (16 Years Education)=80%, MS or M.Phil.=90%, Ph.D=100%
2	Languages	05	Pashto=2 (R W S) Urdu=1.5 (R W S) English=1.5 (R W S)
3	Experience	30	
	General Experience	7.5	Experience after completion of 16 Years education (15 years of general experience will carry full marks)
	Relevant Experience	15	Experience of particular discipline (10 years of general experience will carry full marks)
	Similar (DAM) Projects	7.5	Full marks for 10 Projects
4	Experience of Local Environment	05	Khyber Pakhtunkhwa=03 Pakistan=02
	Total	60	Will be adjusted to 50

Below proforma must be available on top of each CV in addition to the information to be provided as per standard format, Otherwise will not be considered.

1	2	3	4	5	6		
S#	Position	Proposed Personnel	Qualification	Knowledge of Languages	Experience		
					General	Relevant	Dam Projects
7	8	9					
Experience of Local Environment	Cell No	Duration with firm					

Note.

- The proposals must contain salary details, last degree, PEC registration certificates of the key staff
- Each CV must be signed in Original by the Personnel & owner of the firm.
- Personnel above the age of 70 will be in eligible

• **EXPERIENCE OF FIRM.**

S.No	Description	Maximum Marks
1	Relevant/Specific Experience of Firm (Completed/In progress Dam Projects in last 10 Years)	18 Feasibility Study= 25% marks, Detailed Design= 25% Marks, Procurement= 10% Marks Construction supervision= 40% Total= 100%
2	General Experience of Firm (Any completed Project of Hydraulic Structures in last 10 Years)	12 Feasibility Study= 25% marks, Detailed Design= 25% Marks, Procurement= 10% Marks Construction supervision= 40% Total= 100%

Note

- Consultancy Services of the Projects with cost less than Rs 500 million will not be considered.
- Five (05) Projects in each category will entitle the firm for full marks.
- Award & completion documents must be available in support of projects claimed as experience.
- Below proforma must be attached for any projects of sr No 1& 2 in addition to standard format.

1	2	3	4	5	6	7
S#	Name of Project	Location with Province & Country	Client	Address, Phone & Fax No of Client	Handled as: • Single Firm/ : • Lead Firm/ : • Joint Venture : Partner	Cost of Project
8	9	10		11		
Cost of Services	Scope of services • Feasibility • Detailed design • Procurement • Construction Supervision	Scope of Work				

UNDERTAKING

It is hereby certified that the above are true statements based on facts and we take full responsibility for the correctness and accuracy of the information supplied herein to the best of our knowledge and belief. This is also to certify that the owner/partners/directors working solely for the consulting engineering profession. This is further to certify that we are independent consulting engineer and have no interest in any construction and conflicting commercial industrial and business activities which are likely to influence our professional independence and neutrality. We also undertake to fully abide by KPPRA act/rules & the Pakistan Engineering Council (Conduct and Practice of Consulting Engineers) Byelaws 1986 & registered with Khyber Pakhtunkhwa Revenue Authority

TERMS OF REFERENCE FOR CONSTRUCTION SUPERVISION

The Consultant shall represent the client on site and shall engage all experts for review of design and deploy a full-time supervision team on site. The consultants shall be responsible for supervision of all the construction activities of the project.

The Consultant's tasks shall include, but not be limited to the following:

1. Coordination with design consultants regarding any issue, observations, clarification etc in design of the project components including dam embankment, spillway, irrigation conduit, intake and outlet structures, irrigation network, intake structure for drinking water supply, road and buildings etc and recommend technically and financially viable design changes if any.
2. Carry out additional topographic , Geophysical surveys and additional sub-surface geotechnical investigation (if required and with approval of the client) during execution of the project.
3. Review of Construction Drawings.
4. Furnish "Detail Cost Estimate" and make periodic updating of the cost of project during construction phase along with reasons for increase/decrease of cost of individual items.
5. Assist the employer in Tendering Process/Bid Evaluation.
6. Approval of construction schedule submitted by contractor.
7. Facilitate Sites Handover for the Works to the Contractors.

8. Ensure that the Contractor's procurement schedule indicates all materials are from the right source, quality and of sufficient quantities.
9. Advise the Employer on contractual obligations and establish early warning systems to minimize occurrence from potential compensation events and subsequent claims for idle machinery, time extension and cost.
10. Ensure that the Contractor conforms with the legal, health and safety standards and all safe guards' requirements.
11. Supervise the Contractors' actual work progress versus the scheduled work programme and to make it sure that delays are kept to a minimum and, that the Contractor at their cost takes necessary steps to make up for time lost and pull the project back to planned schedule.
12. Supervise construction of the project in the capacity of Engineers Representative, to ensure that the project including all components are being constructed satisfactorily in accordance with approved drawing, design, specifications and required quality.
13. Verification/checking of contractors statements of executed quantities for making progressive payment to the contractor.
14. Verification and checking of the interim and final payment to the contractor for approval of the employer.
15. Coordinate between contractor and employer to implement the project in accordance with the contract.
16. Undertake and prepare revised designs, improvements or modifications as necessary during construction in consultation with the client.
17. In consultation with the client, and if necessary, prepare and issue variation orders to the contractor after approval of the competent authority.
18. Timely issue to the Contractors all the necessary correspondences related to information, instructions, clarifications and and revised construction drawings if required to ensure consistency in quality, positive progress and planned costs.
19. Inspect, determine and approve the part of works before, during and after construction of part and, or whole of the works to ensure all time compliance with the specifications and standards.
20. Supervise and approve the Contractors' procurements, ensuring that all materials are from the right source, quality and of sufficient quantities.

21. Supervise the material testing in contractor's field laboratory and keep record of respective test reports.
22. Provide adequate technical assistance, consultation and advice to the Client / Employer in matters that crop up during execution, may include redesigning and connected issues.
23. State all methods and procedures that are intended to ensure robust quality control, execute all procedures accordingly, and report on all quality control undertakings and their results to the client.
24. Prepare and submit Monthly Progress Report to the Client / Employer indicating any issue that could affect the work pace.
25. Participate in progress meeting convened at site and in Regional or Divisional offices at Peshawar/Kohat or any other place as and when required.
26. Maintain daily site records on prevailing weather conditions, labour productivity, availability and operational condition of key plant, plant productivity, daily activity outputs, and disputes between employers and staff as well as between contractor and local residents, and all other observations that may be of importance in case of any arbitration or legal disputes.
27. Revision of PC-I if cost of the project over runs beyond approved cost or if there is a substantial change in the scope of work but the project cost remains within the approved cost.
28. To provide sufficient and appropriate technical and support staff at site as per requirement or as directed by Client / Employer in the interest of work.
30. To submit duly verified as built drawings.
31. The consultants shall provide assistance during the defect liability period and visit the project from time to time for pointing out any defect etc. the same shall be reported to the employer in the form of punch list and monitor its rectification.
32. To appear, if required, and assist the client in the court of law, in case of any litigation by the contractor or stakeholder.
33. Preparation of Revenue Chakbandi and WaraBandi system for Irrigation system.

REPORTING AND DOCUMENTATION FOR CONSTRUCTION SUPERVISION

- Preparation and submission of monthly progress report (10 copies).
- Preparation and submission of as built drawings in (10 copies).
- All correspondence, surveys, lab test results and construction drawings along with soft copies in binded form.
- Preparation of operation and maintenance manual for the project.
- Preparation of PC-IV for the project (10 copies).
- Preparation of draft revised PC-I Proforma in (05 copies) and final revised PC-I Proforma in required numbers if required as directed by the client.
- Preparation and submission of Punch list in defects liability period.

MODE OF PAYMENT

Dsign Review and Construction Supervision (Completion period 36-months)

- I. Payment will be made to the consultants as per actual physical & personnel inputs regardless of the approval/award of submitted proposals.
- II. No other expenses as Remunerations or Direct cost will be paid to the consultants by the client.
- III. 10% of each running payment shall be withheld by the employer as security deposit which shall be released on satisfactory completion of services and submission of all reports/documents stipulated in TOR and admittance thereof by the employer.

Note:

The mode of payment indicated is tentative subject to alteration and is not to be considered as the cost of any activity but it is progressive payment for the facilitation of the consultants.

PROFESSIONALS/ KEY PERSONNEL'S REQUIREMENTS

Consultant Bid Cost will be sum of Key Personnel's & Logistic requirement as per below details. Payment of survey, other investigation & vehicle (Running & maintenance) will be made as per actual inputs .

A. DESIGN REVIEW AND CONSTRUCTION SUPERVISION (24 Months)

S.No	Position	Man Months	Billing Rate (Rs)	Total Amount
1	Project Manager/Dam Engineer	24		
2	Structure Engineer	06		
3	Resident Engineer	24		
4	Geologist	06		
5	Lab Technician	24		
6	Site Inspector	24		
7	Land Surveyor	24		
8	Quantity Surveyor	24		
9	Site Supervisor (03 Nos)	72		
10	Ziladar	03		
11	Patwari	03		
Support Staff				-
1	AutoCAD Operator	04		
2	Computer Operator	24		
3	Peon	24		
4	Chowkidar	24		

• LOGISTICS

S.No	Description	Unit	Quantity	Rate
Project Office&Camp Accommodation				
1	Furnished Office and Camp Accommodation	Months	24	
2	Electricity, Water & Gas Charges	Months	24	
3	Office Supplies & Stationary	Months	24	
4	Printing & Photocopying Charges	Months	24	
5	Fax, Postage, Courier & Telephone Charges	Months	24	
6	Hired Vehicle Including POL, Maintenance & Driver	Months	24	
7	Geophysical survey along Dam & appurtenant structures	Job		

Qualifications and Experience of consultant's key personnel.

Consultants will assign adequately qualified key personnel to carry out the implementation of the Project as described in TOR, man-month inputs for which are indicated above. The key personnel should possess the qualifications and experience as indicated against each position.

Project Manager/Dam Engineer

- Should have at least a Bachelor Degree in Civil Engineering from a recognized university. Additional qualification will carry extra marks.
- Should be able to lead the team of consultations and assist Small Dams Organization in timely completion of the services with quality output.
- Overall experience should be 10-years with 5- years on dam projects and 02-years as Team Leader for the Projects.

Structure Engineer

- Should have Master degree in Hydraulics Engineering/Structure Engineering from recognized university.
- Post Master qualification in related discipline will be given additional weight age.
- He should have at least overall experience of 10-years with 03-years experience in exposure to the design related activities.

Resident Engineer

- Should have Bachelor degree in Civil Engineering from recognized university.
- Post Bachelor qualification in related discipline will be given additional weight age.
- He should have at least overall experience of 5-years with 03-years experience in exposure to the design related activities.

Geologist

- Should have Master/M. Phil degree in Geology from recognized university.
- Post Master qualification in related discipline will be given additional weight age.
- Should have at least overall experience of 10-years with 3-years experience in exposure to the related activities.

I. LABORATORY TESTING CONSTRUCTION MATERIAL STUDIES.

S.NO	DESCRIPTION	QTY
1	Sieve Analysis/Gradation of coarse & fine Aggregates	75
2	Flakiness and Elongation Index	40
3	Atterberg Limits (LL, PL, PI)	40
4	Specific Gravity wet and dry	10
5	Sodium sulphate soundness test	10
6	Los Angeles Abrasion Test (Coarse Aggregate)	30
7	Un-confined compression and direct shear tests of clay samples	30
8	Crushing Strength of rock and rip rap some samples	25
9	Direct shear (rock and soil)	30
10	Swell potential of soil samples	30
11	Uniaxial Compressive strength test with Modulus of Elasticity	30
12	Water Absorption test of coarse and fine aggregates	20
13	Alkali Silica Reaction tests	10
14	Organic impurity test	10
15	Complete chemical analysis of water sample i/c TDC, Cl, SO ₄ and pH	10
16	Coefficient of permeability	30
17	Abrasion test	15

II. LABORATORY TESTING CONSTRUCTION MATERIAL STUDIES.

S.NO	DESCRIPTION	QTY	
1	Grain Size Analysis	45	
2	Hydrometer Analysis	45	
3	Atterberg Limits (LL, PL, PI)	25	
4	NMC	30	
5	Un-confined compression test	Dry condition	30
		Saturated condition	30
6	Unconsolidated Un-drained Triaxial Test (UU0)	10	
7	Consolidated Un-drained Test (CU)	15	
8	Consolidation Characteristics	15	
9	Swell Potential of Dam Core Materials	15	
10	Standard Proctor Compaction	25	
11	Modified Proctor Compaction	25	