Paper No. 690

QUALITY MANAGEMENT FOR TAUNSA BARRAGE REHABILITATION PROJECT

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1. SYNOPSIS

The safety and durability of any constructed product depends on the efforts made to ensure the conformance of the finished product to the design and technical requirements prescribed for the product. This ensures quality which in general terms is defined as "The totality of features and characteristics of a product or service, that bears on its ability to satisfy a given need". In brief quality can be defined as "The degree to which the project fulfills the requirements.

Quality Management

Quality management is the process of creating and following polices and procedures in order to ensure that a project meets the defined needs that it was intended to meet.

In construction processes, the quality of constructed structures has to be properly managed to achieve safe and durable structures.

Quality management has the following general attributes:

i. Quality Planning
ii. Quality Assurance
iii. Quality Control
iv. Compliance of Non Conformance Report (NCR's)
v. Quality Audits

This paper presents the Quality Management system used for construction of Taunsa Barrage Rehabilitation Project works, for sharing the quality aspects of the project works with our professional community. This presentation can also be considered as a case study.

2. INTRODUCTION

Taunsa Barrage is one of the most important diversion structures built across the Indus River and its tributaries. The Barrage serves a gross commanded area of about 2.351 million acres through the Muzaffargarh and D. G. Khan Canals, off-taking from left and right flanks of the Barrage respectively and also diverts water

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into the Chenab River through the Taunsa Panjad (T-P) link Canal on the left for mitigating serious shortages in Panjnad Canals.

In addition to regulation of irrigation supplies and flood flows, Taunsa Barrage also provides an arterial road bridge, a railway bridge, oil and gas pipelines and EHV transmission lines crossings over Indus River.

The barrage soon after its construction in 1958 ran into multiple problems of:

i. Tendency of river to revert to its old course on the right with a severe curvilinear approach causing excessive sedimentation in the DG Khan canal;

ii. Excessive retrogression of d/s water levels caused:-

- ripping off skin concrete of the downstream floor
- damage to friction blocks thereby adversely affecting the hydraulic efficiency of the structure,
- limitation on pond level;
- choking and malfunctioning of large number of pressure pipes, i.e. breakdown of subsurface flow monitoring system, and
- defects in the hoisting mechanism and mechanical installations.

Works done under this project were aimed at mitigating the serious threats posed by above elements to the safety of the structure and ensuring sustainability of the canal systems being fed from this Barrage and to provide protection to the other vital national assets

3. THE PROJECT

The project comprised two International Competitive Bidding (ICB) Contracts, first Contract was for Civil Works (ICB-01) and 2nd Contract for M&E works (ICB - 02).

ICB-01 Contract included:

i. Construction of a subsidiary weir (sub-weir).

ii. Rehabilitation/strengthening of existing barrage and its components

iii. Construction of guide banks

iv. Construction of silt excluder

v. Construction of a diversion channel

vi. Remodeling of D.G. Khan canal Head Regulator

vii. Gate Equipment for Sub Weir

viii. Remodeling of existing Fish Ladders

ICB-02 Contract covered M&E works for Taunsa Barrage Emergency Rehabilitation and Modernization Project financed by the World Bank. It comprised:

- Renovation of the Barrage gates and hoists and improvements in the operating and control system for the Barrage and canal headworks as under:
    - Rehabilitation of 31 gates of the main weir, (bay Nos. 31-61), plus 4 right undersluice gates No. 62-65 (replacement), plus Gate No. 8 in the navigation bay.
    - 19 gates for the three canals off taking from the Barrage (Replacement of 7 gates each of D.G. Khan Canal and T.P. Link Canal and rehabilitation of 5 gates of Muzaffargarh canal.
- Procurement of necessary equipment for operation and maintenance. and
- Automation of gates operation and communication

4. DEFINITIONS

4.1 Quality Planning

Quality planning is basically the process of identifying the quality standards that are relevant to the project and determining how to satisfy them.

4.2 Quality Assurance

Quality Assurance constitutes all steps and actions taken and specifications/standards prescribed to set the requirements of the capabilities of the product required for acceptance.

4.3 Quality Control

Quality control constitutes the action and steps taken to ensure that the standards and specifications prescribed under quality assurance programme are achieved. Such steps are inspections, field and laboratory tests and submission of necessary reports.

4.4 Non Conformance Reports (NCR)

A non conformance report (NCR) is the intimation of the occurrence of non conformance of a product/process with reference to the capability standards set under quality assurance programme which has to be mitigated by carrying out instructions under quality assurance and rectification of the non conformance.

4.5 Quality Audit

Quality audit process constitutes monitoring, reporting and review of quality assurance and control report to assess the extent of success of quality assurance / quality control efforts and compliance reports of NCR's.

4.6 Project Quality Management System

Taunsa Barrage Rehabilitation Project established and maintained a documented Quality Management System to the requirements of the ISO 9001-2000 Standards.

Quality System basically consists of

- Organization resources;
- Taunsa Barrage Rehabilitation Project Quality Plan and management procedures;
- The Supervision Consultant's Quality Assurance Program;
- Approved Specifications;
- Approved Method Statements and Quality Inspection Plans (QIP) for permanent works
- Approved Health, Safety and Environment (HSE) Programme
- Quality Control and Quality Assurance records.

The quality management system procedures are listed as Annex-A.

5. REFERENCES AND QUALITY ASSURANCE (QA) STANDARDS

5.1 Standard References

Indicated in the Contract Documents for the Taunsa Barrage Emergency Rehabilitation and Modernization Project Contracts ICB-01 & ICB-02.

5.2 Contract References

- Employer's participation for review, approval, monitoring and other QA activities were indicated in the contract documents.
- Supervision Consultants participation in review, approval, monitoring and other QA activities is indicated in the Particular Conditions of the Contract and the Contract for Consultancy Services.

5.3 Quality System References

For ICB-01 Contract:-

i. General Conditions of Contract Part 1 (FIDIC) Clauses 36 & 37.

ii. Technical Specifications

   a. SP-9 Approval of Materials and Equipment.

   b. SP-10 Contractor's Quality Assurance Plan.

For ICB-02 Contract

i. General Conditions of Contract Part 1 (FIDIC) Clauses 36 & 37.

ii. Method of Performing the Work – volume-I of Contract Agreement.

iii. SP-9 Approval of Materials and Equipment.

iv. SP-10 Contractor's Quality Assurance Plan.

v. Technical Specifications items

- 1.6 Standards
- 1.7 Materials
- 1.8 Test of Materials
- 1.18 Inspection and Testing
- 2.5 Commissioning Tests and Inspection

6. QUALITY PLANS

Taunsa Barrage Rehabilitation Project was a large project involving very heavy qualities of earthwork, stones, concrete, sheet piling, regulating gate works and other allied works.

Naturally the quality management had a very important role in the sustainability of the project works.

To ensure a proper quality management, the Engineer and Contractor both prepared their quality assurance programme and plan respectively and implemented with honesty and zeal. The details of these programmes/plans are too bulky/voluminous to form a part of this paper. However a brief introduction to the contents of Engineer's quality assurance plan (EQAP) and construction project quality plan (PQP) appears below and is followed by the actual steps and actions taken for ensuring good quality management by honouring the engineer and contractor's programme and plan. The project was executed under two Contracts ICB-01 and ICB-02.

7. PROJECT ORGANIZATION

The hierarchical interrelationships between the Employer, the Consultants and Contractor are identified in Annex-B.

Synthesis of the tasks and responsibilities between staff are defined in the Project Responsibilities Matrix (Annex-C)

7.1 Operative Modalities

7.1.1 General

The elements described in the following paragraphs addressed the role of the Supervision Consultants in relation to the requirements of the project contracts.

7.2 Management Responsibility

The Supervision Consultants being the Engineer were made responsible for Quality Assurance / Control. The Consultants Chief Resident Engineer was responsible for Quality activities performed in support of the Employer at the site.

The Supervision Consultant's QA Specialist provided supervision and support in relation to QA/QC tasks at site.

7.3 Authorization and Project Quality Policy

The Employer was authorized to exercise the duties and authorities as owner of the Project.

The Supervision Consultant monitored, reviewed and provided a detailed resume of the contractor's engineering, procurement, Contract Administration and construction activities during implementation of the project. Major tasks undertaken are as follows:

7.4 Engineering

- Review the contractor's planning documents, data and verify his basis of preparation;
- Monitor submission of documents and review in a timely manner the contractor's documents and compliance with the contract specifications;
- Provide timely notice to PMO of events or trends, which could have potential negative impacts on the project and proposed solutions;
- Be cognizant of and pro-active in continued review of the project for design improvements, which may result in long term benefits including cost reductions, schedule improvements and/or better operatability, maintainability, etc.

7.5 Procurement

- Respond to any major design or plan change requests submitted by the contractor;
- Attend any model tests or final workshop inspections for the plants to be installed in the project;
- Monitor procurement and expediting activities performed by the contractor;
- Witness In-works performance, Commissioning and reliability tests for major items of plant. Assess, approve/reject final test reports.

7.6 Construction

- Maintain the necessary presence until the site is cleared by the contractor.
- Develop an effective working relationship with the contractor, so that clear and appropriate lines of communication are established and maintained throughout the construction, commissioning and testing phase of the project;

- Review, comment and monitor the contractor's performance with respect to the prescribed procedures, for example:
    - Project Execution Management Plan,
    - Traffic Management Plan
    - Environmental Management Plan.
    - Canal Closure Programme
    - Monitor and make the contractor ensure compliance with design specifications and standards.
    - Communication Plan

In order to provide PMO with documentation that shows work was performed in accordance with adequate quality control procedures:

- Certify on satisfaction the contractor's requests for payment with reference to the contract requirement;
- Review and comment on the contractor's. 'As Built' Documentation before final acceptance;

To provide products, which meet the Employer's valid requirements on time a management system policy, was implemented by the Engineer with the following objectives:

i. Monitor quality compliance with the standards prescribed in the Contract, codes and statutory regulations;

ii. Satisfy the appropriate requirements of ISO 9002 Standards;

- Promote quality and service standards as being the responsibility of each and every employee in accordance with the contractor's approved PQP;
- Establish and maintain a high degree of quality awareness at every level in the Organization, and encourage individual initiative in achieving performance and quality project delivery;
- Respond in a timely and constructive manner to Contractors quality issues and monitor that appropriate remedial action is taken;
- Monitor observance of the Project Schedules;
- Revise the allocated Budgets where necessary and advise the Employer of overruns that may occur due to additional quality requirements for the project;
- Monitor compliance with safety plan in relation to the establishment of a safe work site in accordance with the approved HSE plan;

1. Monitor resolution of environmental issues such as:
    - Disposal of waste materials such as oil, rubber tires, batteries, wood cardboard and paper, among others,
    - Implementation of sanitary facilities and disposal of sanitary waste,
    - Availability of potable drinking water,
    - Contamination of off project water sources,
    - Control of dust and noise,
    - Others related to the environments as prescribed in the Environment Management Plan of the project.
2. Monitor training and performance of contractor's QA/QC personnel;
3. Monitor and measure quality performance and provide appropriate feed back to relevant employees;
4. Ensure that where quality control and audit process were established, their operation was always supportive of the construction activities while fulfilling their special assurance role;

To meet these objectives a systematic method of managing requirements of the contract was established.

It was ensured that personnel concerned with quality, safety, productivity, environment and management were fully familiar with the EQAP, PQP and associated procedures.

All personnel employed on this project performed their duties in accordance with the requirements of quality plans and in compliance with the Taunsa Barrage Rehabilitation Project QA/QC procedures and any specific project instructions.

7.6.1 Quality Management Representative

The contractor with concurrence of the Engineer appointed a Quality Assurance Manager (QAM) as Contractor's Representative for the project quality system implementation.

The contractor's QA Manager was represented and supported by Field Engineers/ Inspectors who assumed responsibilities in his temporary absence or when overtime or shift work was involved.

Consultant's Chief Resident Engineer interfaced directly with the Contractor's QAM for QA issues that developed, and generated reports to keep PM informed of major issues and trends that developed and needs for correction through periodical reports.

7.7 Design Control

The basic, conceptual, tender level and detailed design of all the component structures was done by the Consultants design office at Lahore and all the

construction drawings were also prepared and issued for construction from Lahore. Necessary quality standards were maintained.

However some supplementary and shop drawings etc were initiated prepared by the contractor and submitted to the Engineer for approval.

Supervision Consultant's Project Manager at Lahore reviewed all submittals by the contractor relating to the design and construction activities, as required for compliance with the applicable technical standards and Employer's Requirements for the Taunsa barrage Rehabilitation Project. Principal submittal categories are:

Conceptual Design:

- Construction Schedule,
- General layout Drawings of major project features,
- Project Procedures manual,
- Project Quality Assurance Manual

Detailed Design / Drawings

- Construction Drawings,
- Shop Drawings,
- Fabrication drawings,
- Method Statements,
- Catalogue clips.

During Construction

- Progress reports and Schedule updates,
- Monitor inspection and documentation of construction activities: Excavation, placement of fill, concrete work, foundation preparation and treatment, erection and testing of electrical and mechanical equipment,
- Approve milestones for the purposes of payment,
- Monitor quality control testing and results,
- Approve sources of materials,
- Approve waste disposal locations,
- Approve details for quality control of water
- Approve outline of Environmental Management plan and monitor implementation,
- Organize and document reports of weather station,
- Project signs,
- Monitor HSE arrangements

Project Completion

- Monitor and certify Substantial Completion,
- Approve request for moving out of site and final cleanup,
- Final Inspection and certification of final completion,
- Review closeout submittals,
- Review Taking over submittals.

7.8 Document and Data Control

Supervision Consultant monitored implementation of the document and data control procedures for the project established in the Project Quality Plan, and appropriate control of its own documents, data and correspondence based on the specific coding established for the project.

7.9 Construction Process Control

Supervision Consultants' chief Resident Engineer and assigned staff at site monitored implementation of the EQAP, during the different stages of construction in accordance with the approved and updated PQP & PIP. It was ensured that the contractor's operations personnel are thoroughly aware and committed to the quality requirements involved in each part of the work and that the appropriate hold points for verification of the QC and testing personnel are being followed, as established in the approved applicable specifications, work method statements and QIPs.

Supervision Consultant's staff was fully involved during construction as part of the Quality Assurance process, in addition to QA and QC activities by the Contractor, for verification that appropriate quality related procedures are implemented. The Consultant's Chief Resident Engineer interfaced closely with the Contractor's QA Manager, as needed, in the execution of the work and the Employer was kept informed of the quality of the work. The Supervision Consultant's Chief Resident Engineer and staff performed the following main tasks:

i. Review of the Construction Schedule and monthly evaluation of physical, economic and financial progress against the established schedule and budgets;

ii. Attend weekly meetings with the Contractor regarding progress of the work;

iii. Monitor the Quality of all the Permanent Works and verification of compliance with the Employer's Technical Requirements, Drawings, Specifications, Work Method Statements and that the work is carried out by the Contractor in a healthy, safe and appropriate manner in accordance with highest international engineering standards and practices;

iv. Prepare and issue Non Conformance Report (NCR) to Contractor when necessary;

v. Monitor implementation of QC procedures and test results and quality of workmanship and that the materials used in the Works are in accordance with the Contract requirements, including environmental protection requirements;

vi. Ensure that the equipment and staff provided and used by the Contractor are adequate to construct the Works and maintain the program;

vii. Participate in field verification activities and monitor results of testing related to Taking-Over Certificate Performance Certificate and Final Acceptance of the Works.

viii. Supervision Consultant's Resident Staff prepared the following reports as follows:

a. Daily reports of the work performed by the Contractor at each location. Reports were submitted to the Supervision Consultant's Chief Resident Engineer on the following day and remained in the project files as documentation for the project. The daily reports included information regarding resources used and work performed at each location, and comments regarding quality measures and Contractor's personnel observed and any difficulties encountered.

b. A weekly report was prepared by the Supervision Consultant's Chief Resident Engineer with respect to progress and other quality related issues and sent by email or fax to the Supervision Consultant's Project Manager at Lahore, with copy to the Employer. The report included weekly summary of progress versus weekly schedule presented by the Contractor and summary of the quality control testing results presented by the Contractor's quality control unit.

c. The monthly report summarized the activities performed by the Contractor in each area, progress of the work with respect to the approved schedule and summary of the quality attained on the project during each period, including actions taken to recover delays and status of resolution of NCR and quality control summaries.

7.10. Inspection and Testing

A specific Project Procedure "Inspection and Testing" was developed for this project and included in the Contractor's PQP.

Supervision Consultant's resident staff at the site ensured that appropriate Quality Control Plans – QCP, Operating Procedures (Method Statements) and work instructions were established to define the responsibilities and the methods necessary to carry out inspection and tests for verification of conformance of the works to the requirements and were known to the contractor's operations personnel.

All the inspectors and testing process was not only witnessed by the Engineer's staff, all the tests were performed jointly by the quality staff of engineer and contractor in a common laboratory.

Conformance was verified through the QCP and documented inspection and testing of:

i. Goods, equipment, materials purchased or supplied by the Contractor received at Site before incorporating permanent works.

ii. Verification, identification and recording of information in order to allow the immediate recall and replacement in the event of non compliance to specified requirements;

iii. Materials and products, during the construction activities (in-process), according to the quality control plans. The Contractor's QC staff provided the Supervision Consultant's staff with weekly and monthly summaries of QC test results on concrete and earthwork materials, including statistical controls, tables and graphs of test results. Supervision Consultant's staff had full access to all the QC testing information as required for quality audits. The Contractor presented weekly and monthly summaries of the materials test results, which were discussed in weekly meetings held by Supervision Consultant's Resident Staff with contractor's QA/QC personnel. Two types of Quality Control and Quality Assurance reports were presented by the Contractor to the Supervision Consultant's resident staff as follows:

    a. Monthly Quality Control and Quality Assurance Reports: The Contractor provided a written quality control and quality assurance report each month using summary formats decided upon to adequately document the quality control and quality assurance process.

    b. Periodic Quality Control and Quality Assurance Reports: The Contractor also prepared written quality control and quality assurance reports at the end of each quarter;

iv. The Employer with support from the Supervision Consultant's Chief Resident Engineer reviewed the monthly reports of test results presented by the Contractors QC staff. He also monitored testing performed in the field by the QC staff to verify that they were following acceptable standard practices. He monitored that test results were reported timely and that appropriate forms were used to record all inspection and/ or testing activity and that records of inspections and

testing of the works were collected, filed and maintained by the Contractor's QAM in the Site Office and in the Laboratory.

7.10.1. Control of Inspection, Measuring & Test Equipment (IMTE)

A specific Project Procedure, "Inspection, Measuring and Test Equipment Control", was developed for the Project as part of the PQP. Supervision Consultant's Chief Resident Engineer through his quality control staff monitored implementation of these procedures as approved and in accordance with the established standard practice. He ensured that the testing equipment was calibrated regularly and that the Checks/ Calibrations were performed by skilled personnel of QC staff.

7.10.2. Inspection and Test Status

Supervision Consultant's Chief Resident Engineer ensured that the inspection and test status of each part of the work were identified by suitable means, indicating the conformance or non-conformance of the product with regard to inspection and test performed, as established in the PQP.

7.11. Control of NCR

Supervision Consultants Chief Resident Engineer monitored Contractor's activities to verify that corrective actions were taken to resolve quality issues in accordance with the procedures indicated in the PQP. A specific Project Procedure, "Control of Non-Conformances" developed and implemented.

Two types of NCR were considered:

i. Management System NCRs, regarding deficiencies in the implementation/ application of the procedures;

ii. NCRs related to products, materials, equipment, sections of work etc.

The NCRs were identified by the Consultant's QA/QC staff, during the internal System Inspection and Audits. Non conformances were notified to the Contractor's QA Manager, who reported directly to the Contractors Project Manager supported with the technical staff's investigation report on the potential problems and proposed solutions to resolve the situation in each case. The Supervision Consultants reviewed the proposed solutions to NCRs and ensured that appropriate actions were implemented to correct the deficiencies and to prevent their recurrence.

7.11.1. Corrective and Preventive Actions

Supervision Consultant's Chief Resident Engineer ensured that the corrective and preventive actions for non conformances were implemented and recorded in accordance with the approved PQP.

7.11.2. Handling, Storage, Packaging, Preservation and Delivery

Supervision Consultant's Chief Resident Engineer ensured that adequate care was exercised by the contractor to control the activities related to handling,

storage and preservation of the materials/ products at the Site in order to prevent damages or deteriorations and to avoid dispatch of non conforming materials from the storage areas.

7.12 Control of Quality Records

A quality record is an item of objective evidence generated during the construction process on a project which demonstrates that the specified quality has been achieved for that work activity to which the record relates. A documented procedure is prepared to ensure that the identification, collation, indexing, access, filing, storage, retrieval, maintenance and disposition of quality records is undertaken at all project stations/offices.

Supervision Consultant's Chief Resident Engineer ensured that the Contractor's personnel used adequate care for the management (identification, collection, record, and maintenance) of the quality records originated by the QA/QC personnel or by external testing units.

The Project Quality records and Internal/ external audit reports were filed in the Site office and summaries and reports were prepared in accordance with acceptable standard practice to demonstrate conformance to the Contract Specifications and effective operation of the Quality System.

7.13. Personnel Training and Management / Competency, Awareness for Training

The Project Manager ensured that the following were implemented:

- Determine the necessary competence for personnel performing work affecting quality;
- Provide training for satisfying these requirements;
- Evaluate effectiveness of the training given at suitable intervals;
- Ensure that all personnel of the Consultant are aware of the relevance and importance of their actions for achieving quality objectives; and
- Maintain records of education, training, skills and experience of all personnel. Documented Procedures were prepared for the foregoing items.

Supervision Consultant's Resident Engineer managed implementation of the training program for all personnel performing activities affecting quality by the Contractor.

7.14. Statistical Techniques

Supervision Consultant's Chief Resident Engineer reviewed the Contractors QA/QC reports, summarized results of testing using statistical evaluation of the processes/ works, materials supplied, NCR, materials incorporated in the works in accordance with acceptable standard practice.

The concrete manual lays down a confidence level of 85% on quality tests. Considering the importance, sensitivity and complexity of the project, a 100% confidence limit was prescribed and ensured. In the case of uncertainties, core testing and NDE method were resorted too.

7.15. Internal Quality Audits

The Consultant prepares a documented Procedure for the conduct of Internal Quality Audits, at planned intervals, by the Quality System Manager! Quality Assurance Engineer to verify that all activities in various departments of the Consultants are being carried out in accordance with the QMS and approved guidelines and procedures. Any deviations and nonconformities are identified and suitable Corrective Action Requests (CARs) are raised. An Audit Report is prepared, signed, and distributed to all concerned. After a reasonable interval of time the QSM/QAE makes a follow-up visit to verify that the required corrective actions and preventive actions were taken by the concerned department/section. Similarly, periodic Quality Audits of the Contractor's organization are carried out to verify that his work activities are all in compliance with the Contract Specifications, approved Method Statements and Procedures and his own Project Quality Assurance Plan duly approved by the Consultant.

7.16. Equipment / Plants Management

Supervision Consultant's Chief Resident Engineer monitored Contractor's implementation of equipment maintenance program and efficiency of availability of the equipment for the project work and required corrective actions and gave specific advice to the Contractor as needed.

8. SOURCE APPROVALS

8.1 For Civil Works

The first step in the quality assurance/control (QA/QC) activities exercised on the project was the source approval of the materials intended to be used on the project by the Contractor. Source approval was granted for construction materials including steel reinforcement, aggregates, stone, cement, PVC water stops, and admixtures etc on the basis of prescribed tests, factory capabilities and will tests conducted by factory laboratory. After the source approval, regular tests were conducted in the laboratory established at the site for aggregates, concrete, bricks. For materials such as cement, steel reinforcement, samples were taken periodically from the consignments delivered at site as provided in the technical specifications of the project. These materials were got tested from Central Materials Testing Laboratory (CMTL) WAPDA, University of Engineering & Technology, Lahore, PITAC, Lahore and Deptt of earth sciences Punjab University Lahore. List of source approvals is presented in the following Table.

SOURCE APPROVAL OF CONSTRUCTION MATERIALS FOR CIVIL WORKS

S.#	Material	Approved Source /Name of the Supplier
1	Ordinary Portland Cement (OPC)	Maple Leaf, Askari, D.G Khan, Fauji, Kohat and Bestway Cement Factories
2	Fine & Coarse Aggregates	Sakhi Sarwar, Sanghar and Kohar Quarries, DG Khan District
3	Steel Reinforcement	1. M/S Fazal Steel (PVT) Ltd, Islamabad 2. M/S Pak Steel, Islamabad
4	PVC Water Stops	M/S Decora Industries, Lahore
5	Admixtures for Concrete Water Reducing Agent (SIKA) Curing Compound (SIKA) Super Plasticizer (SIKA) Non Shrink Grout Joint Filler Bonding Compound Air Entraining Agents	M/S Imporient Chemical (PVT) Ltd, Lahore (SIKA Distributors) and FosRoc
6	Interlocks Sealants(Igas-R Black) for Sheet Piles	M/S Imporient Chemical (PVT) Ltd, Lahore (SIKA Distributors)
7	PVC Water Stops	M/s Khawaja Rubber Store, Lahore
8	Vibrating wire piezometer	M/s Roctest, Canada
9	Epoxy for Rawl Bolts (Lokfix)	M/s FOSROC, USA through Local Distributors
10	Joint Sealant for Construction Joints (Thioflex 600)	M/S FOSROC, USA through Local Distributors
11	Sheet Piles Interlocks Sealant (BELTAN)	M/S ARCELOR,
12	Joint Filler	M/s Mughal Brothers
13	Granulated Ground Slag	Thatta Cement Company, Attock Cement and Zeel Pak Cement factories
14	Slag Cement	Thatta Cement Company
15	Filter Blanket Material	Zinda Pir Quarry
16	Steel Reinforcement	M/s Hyundai Corporation Korea (INI Steel Company, Pohang)

9. FREQUENCY OF TESTS FOR CONSTRUCTION MATERIALS PRESCRIBED FOR QUALITY ASSURANCE

9.1 For Civil Works

The testing frequency for various construction materials prescribed and used under the Project are contained in the following tables:

TESTING FREQUENCY FOR SOILS/EARTHWORK

Sr. No.	Test	Designation	Testing Frequency
1	Grain Size Analysis / Gradation Tests	ASTM C-136 & D-422	1 per 10,000 cft
2	Hydrometer	ASTM D-442	1 per 50,000 cft
3	Liquid Limit	ASTM D-4318	1 per 50,000 cft
4	Plastic Limit	ASTM D-4318	1 per 50,000 cft
5	Shrinkage Limit	ASTM D-427	1 per 50,000 cft
6	Specific Gravity	ASTM D-854	1 per 50,000 cft
7	Moisture Density Relationship	ASTM D-1557	1 per 50,000 cft
8	Moisture Density Relationship	ASTM D-698	1 per 50,000 cft
9	Field Density: Compacted Fill	ASTM D-1556	1 per 20,000 cft
10	Field Density: Structural Back fill	ASTM D-1556	1 per 2,000 cft
11	Field Density: Gravel Base	ASTM D-1556	1 per 5,000 cft
12	Relative Dry Density	ASTM D-4253 and D-4254	1 per 5,000 cft

TESTING FREQUENCY FOR CEMENT

Sr. No.	Test	Designation	Testing Frequency
1	Compressive Strength	ASTM C 348 and C 349	1 per 200 tons or 1 per month if consumption is < 200 tons
2	Initial and Final Setting Time (on Pure Paste)	ASTM C 191	1 per 200 tons or 1 per month if consumption is < 200 tons
3	Autoclave Expansion	ASTM C 151	1 per 200 tons or 1 per month if consumption is < 200 tons
4	Blaine's Specific Surface Area	ASTM C 204	1 per 200 tons or 1 per month if consumption is < 200 tons
5	Chemical Analysis	ASTM C 114	1 per 1000 tons or 1 after 3 months if consumption is < 1000 tons

TESTING FREQUENCY FOR STEEL REINFORCEMENT

For each delivery of steel the supplier's certificate was submitted.

In addition six (6) samples per diameter were taken at random for determining the mechanical properties for a given lot or for 200 ton if the lot exceeded 200 tons. of the same type and from the same factory/source.

If any characteristic gave an unsatisfactory result, a new set of six (6) samples from the same lot or batch was put to tests on the characteristic in question. If the results of the new tests were all satisfactory, the reinforcing bars were accepted. If this was not the case, the bars were considered defective and were not allowed to be incorporated in the project works.

Sr. #	Tests	Designation	
1	Size and weight	ASTM A 615	
2	Elongation	ASTM A 615	
3	Bending test	ASTM A 615	
4	Tensile strength and yield strength	ASTM A 615	

TESTING FREQUENCY FOR FINE AGGREGATE

Sr. No.	Test	Designation	Testing Frequency
1	Sieve Analysis	ASTM C-136	1 for 5,000 cft
2	Materials Passing # 200 Sieve	ASTM C-117	1 for 5,000 cft
3	Unit Weight	ASTM C-29	1 for 10,000 cft
4	Specific Gravity	ASTM C-128	1 for 10,000cft
5	Absorption	ASTM C-128	1 for 10,000cft
6	Moisture Content	ASTM C-566	1 for 10,000 cft
7	Soundness	ASTM C-88	1 for 50,000 cft
8	Clay Lumps & Friable Particles	ASTM C-142	1 for 20,000 cft
9	Sand Equivalent	ASTM C-2419	1 for 20,000 cft
10	Organic Impurities	ASTM C-40	5 per source for initial approval. 1 per month after approval per source or 50,000cft
11	Light Weight Particles	ASTM C-123	1 for 50,000 cft

Sr. No.	Test	Designation	Testing Frequency
12	Petrographic Analysis	ASTM C-295	3 no. per source for initial approval. Once every 3 months after approval per source if and as required by the Engineer
13	Mortar Bar Test for Potential Alkali Silica Reactivity	ASTM C-227	As required by the Engineer.

TESTING FREQUENCY FOR COARSE AGGREGATE

Sr. No.	Test	Designation	Testing Frequency
1	Sieve Analysis	ASTM C-136	1 for 5,000 cft
2	Materials Passing # 200 Sieve	ASTM C-117	1 for 5,000 cft
3	Unit Weight	ASTM C-29	1 for 10,000 cft
4	Specific Gravity	ASTM C-127	1 for 10,000cft
5	Absorption	ASTM C-127	1 for 10,000cft
6	Moisture Content	ASTM C-566	1 for 5,000 cft
7	Soundness	ASTM C-88	1 for 50,000 cft
8	Clay Lumps & Friable Particles	ASTM C-142	1 for 50,000 cft
9	Los Angeles Abrasion	ASTM C-131	1 for 20,000 cft
10	Light Weight Particles	ASTM C-123	1 for 50,000 cft
11	Petrographic Analysis	ASTM C-295	3 no. per source for initial approval. Once every 3 months after approval per source if and as required by the Engineer.
12	Mortar Bar Test for Potential Alkali SILICA Reactivity	ASTM C-227	As required by the Engineer.

TESTING FREQUENCY FOR CONCRETE

Compressive Strength	ASTM C-39	1 for 2,000 cft per class per batch plant
Slump	ASTM C-143	1 for 2,000 cft per class per batch plant
Air Content	ASTM C-231	1 for 2,000 cft per class per batch plant
Temperature	ASTM C-1064	1 for 2,000 cft per class per batch plant
Field Density	ASTM C-138	1 for 2,000 cft per class per batch plant

A set of minimum three cylinders was moulded from each pour of concrete irrespective of the above volumes and tested at prescribed periods.

TESTING FREQUENCY FOR ADMIXTURES

Air Entrainment	ASTM C-260	As required
Admixtures (water reducing)	ASTM C-494	As required
Admixtures plasticizers/ retarders, accelerators	ASTM C-494	As required
Curing Compound	ASTM C-309	As required

9.2 For Mechanical and Electrical Works

Technical Specifications of the project prescribed that materials shall be new and of first class quality, suitable for the purpose, free from defects and imperfections, and of the grades and types listed in the Contract Agreement, or their equivalents. However, while selecting the materials the Contractor shall keep in view the water analysis results and may propose materials having better qualities to resist the chemicals present in water.

Certified material test reports were furnished in triplicate to the Engineer as soon as possible after the tests were made. The test certificate identified the component for which the material was to be used and contained all information necessary to verify compliance with the Specifications.

M/s China National Electric Wire & Cable Import & Export Corporation (CCC) with Jiajiang Hydraulic Machinery Works (JHMW) as their nominated sub contractor were allotted the ICB-02 contract for rehabilitation and modernization of gates. According to the Contract, items manufactured by the Contractor had to under go a pre-shipment inspection by the Employer's Representative.

9.2.1 Jiajiang Hydraulic Machinery Works

As a specialized hydroelectric equipment manufacturer in China, JHWM has contracted with over 30 national hydro-power projects of large to medium size in China including three gorges dam. The Factory possesses "CERTIFICATE OF CONFORMITY OF QUALITY SYSTEM CERTIFICATION' according to STANDARD "GB/T 19001-1994 IDT IS09001-1994".

JHMW is also an international supplier of gate equipment and cranes, The JHMW has successfully completed following International Contracts.

- Masjed Hydropower Project in Iran, 1997-1999;
- Pak Phanang Water Conserveyed in Thailand1995-1997.
- Ghazi Barotha Hydropower Project. Pakistan 1997-2002.
- AITEK dam of SYNAS Project in Kazakhstan, 2002-2004.
- Merowe dam in Sudan, 2004 to date.
- Myanmar Paunglaung HPP, 1999-2002

Quality Policy of JHMW

- To satisfy customer with every product;
- To abide by standards and enforce principles rigorously;
- To upgrade all members' quality is crucial to quality improvement.

1. Testing at Source

As part of QA arrangement following three pre-shipment inspection visits to JHMW in Sichuan Province of China were made by project teams.

i. November 07 to 12, 2006
ii. January 09 to 19, 2007
iii. July 12 to 20, 2008

A list of items inspected during these visits is given below

i. Items inspected during first visit
    a. Gate leaf for under sluices gate (1)
    b. Embedded parts for Bulkhead gate for # 62 under sluice gate (1)
    c. Embedded parts for Bulkhead gate for standard weir gate (1)
    d. Side beam of weir gate (1)
    e. Weir gate roller guard details (1)
    f. Slide sealing place details for weir gate (1)
    g. Under sluice gate roller guard details (1)

h. Under sluice gate rocker assembly (1)

i. T.P. Link fixed wheel gate (1)

j. Under sluice gate roller train detail (1)

ii. Items inspected during third visit were mainly related to electrical systems and other equipments. Being too large in number, details are not being included.

a. Hoist Assembly for under sluice gates (1)

b. Roller Trains (6)

c. Rocker Assembly (1)

iii. Items inspected during third visit were mainly related to electrical systems and other equipments. Being to large in number, details are not being included.

Following Pre-shipment Inspection tests were conducted:

Pre-shipment Inspection Tests

ICB-02 contractor has conducted following Inspection test in Jiajiang (JHMW), China.

Sr.No	Description of Inspection	Carried out	Date	Results	Remark
1	***Dimension Inspection***				
	T.P Link Canal Gates	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 2-17
	Undersluice Gates				
	Gate leaves	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 67-76
	Roller train	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 111-115
	Rocker Assembly	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 158-160
	Roller guard	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 165-168
	Side sealing plate	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 174-176
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 206-211
	Weir Gates				
	End beam/gate leaves	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 3-19
	Roller train	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 51-53
	Rocker Assembly	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 79-80
	Roller guard	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 87-109
	Side sealing plate	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 117-121
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.07 2007.01.06	Pass	Page 197-206
2	***Material Inspection***				
	T.P Link Canal Gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 46-62
	Undersluice Gates				
	Gate leaves/Roller train	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 120-141
	Roller guard/Side sealing plate /Rocker Assembly	Manufaturer/Jiajiang, China	2006.11.08 2006.11.08	Pass	Page 181-200
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 215-222
	Hoist	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 264-295
	Weir Gates				
	End beam/gate leaves	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 33-49
	Roller train	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 60-77
	Roller guard/Side sealing plate /Rocker Assembly	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 128-149
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 216-222
	Hoist	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 264-307
3	***Purchased Products Certificate and test report***				
	T.P Link Canal Gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 63-64
	Undersluice Gates	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 142-156
	Rubber Sealing	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 201-204
	Hoist	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 301-383
	Weir Gates	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 153-195
	Rubber Sealing	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 150-152
	Hoist	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 312-425
4	***Welding Inspection***				
	Weir Gates				
	End beam/gate leaves	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 20-30
	Roller train	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 54-58
	Rocker Assembly	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 81-85
	Roller guard	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 111-114
	Side sealing plate	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 122-126
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 207-213
	Hoist	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 243-257
	T.P Link Canal Gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 18-38
	Undersluice Gates				
	Gate leaves	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 77-100
	Roller train	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 116-118
	Rocker Assembly	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 161-163
	Roller guard	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 169-171
	Side sealing plate	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 177-179
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 209-211
	Hoist	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 231-244
5	***Performance Inspection***				
	Hoist of Undersluice Gates	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 225-229
	Hoist of Weir Gates	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page226-230
6	***Anti-corrosion Inspection***				
	T.P Link Canal Gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 41-45
	Undersluice Gates				
	Gate leaves	Manufaturer/Jiajiang, China	2006.11.08	Pass	Page 101-109
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 212-214
	Weir Gates				
	End beam/gate leaves	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 31-32
	Guide frame for bulk head gate	Manufaturer/Jiajiang, China	2006.11.08 2007.01.06	Pass	Page 214-215
7	***Heat treatment Inspection***				
	Hoist of Weir Gates	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 259-262
	T.P Link Gates	Manufaturer/Jiajiang, China	2006.11.07	Pass	Page 39-40
	Hoist of Undersluice Gates	Manufaturer/Jiajiang, China	2007.01.07	Pass	Page 260-262

10. QUALITY CONTROL DATA FOR CIVIL WORKS

10.1 Quality Control Manual

To support and stream line/facilitate the implementation of quality control activities, the project consultants prepared a Quality Control Manual and issued it for use by the supervisory staff on September 19, 2005, as the quality of constructed project structures had to be maintained to the prescribed Quality Assurance standards to achieve safety and durability of the constructed works.

This manual was prepared with an aim to provide a brief and handy compendium of technical provisions for construction of civil works under the project along with some explanatory additions, for reference and use by the supervisory staff who were expected to keep this manual with them, when on duty, which was possible because of its small volume.

However, contents of this manual were only for guidance and were not to vitiate the Contract provisions original or amended, i.e. this manual was not to be considered as legal instrument.

The inspection personnel were advised to keep the following famous quotes in view while performing their duties.

- A structure is as strong as its weakest point or for that matter as eye-leasing as its most ugly part.
- A job is as good or as bad as the consciousness or lousiness of the craftsman doing it.
- A lousy inspector gets a lousy job.

10.2 Summary of Quality Tests

Following Table depicts an abstract of tests conducted on various construction materials used for project works, jointly by the quality staff of the Engineer and the Contractor in the field and a common laboratories.

Test Conducted in Field Laboratory			
Sr. #	**Tests**	**Actually conducted**	**No. Required**
1	Gradation of Coarse Aggregate	1186	1012
2	Gradation of Fine Aggregate	587	518
3	Unit Weight of Coarse Aggregate	680	516
4	Unit Weight of Fine Aggregate	449	324
5	Sp. Gravity of Coarse Aggregate	537	494

Test Conducted in Field Laboratory			
Sr. #	**Tests**	**Actually conducted**	**No. Required**
6	Sp. Gravity of Fine Aggregate	329	278
7	Sand Equivalent	370	329
8	Los Angles Abrasion	410	292
9	Absorption of Coarse Aggregate	537	494
10	Absorption of Fine Aggregate	329	278
11	Brick Testing	214	As per Requirement
12	Cylinder Testing	31593	31050
13	Cylinder Casting	32256	31800
14	Soundness of Coarse Aggregate	63	85
15	Soundness of Fine Aggregate	69	66
16	Atterberg Limits	71	As per Requirement
17	Temperature	9182	9106
18	Slump of Concrete	8084	8007
19	Cylinder Moulding	32592	31800
20	Field Density/Compaction Tests	3986	As per Requirement

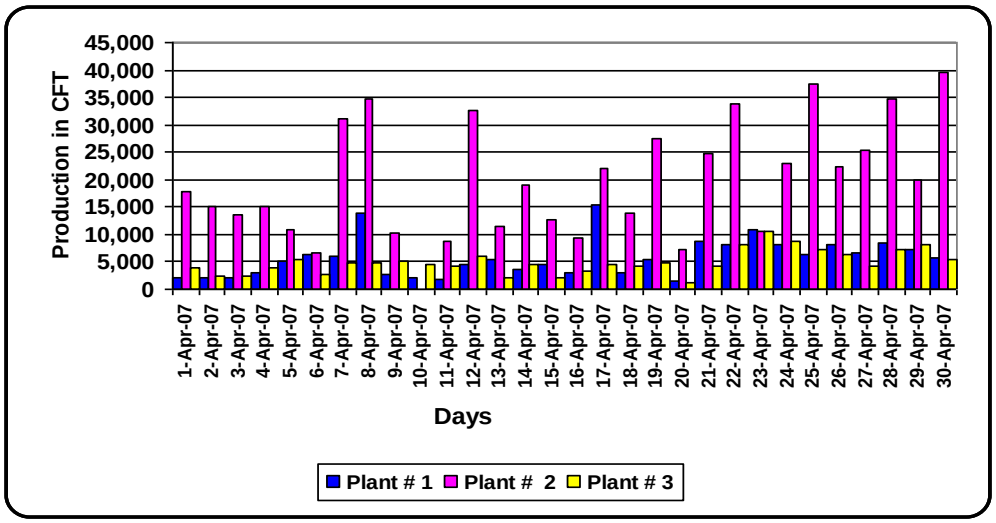
10.3 Weather Data

TAUNSA BARRAGE EMERGENCY REHABILITATION AND MODERNIZATION PROJECT MONTHLY WEATHER REPORT (A SAMPLE PAGE)

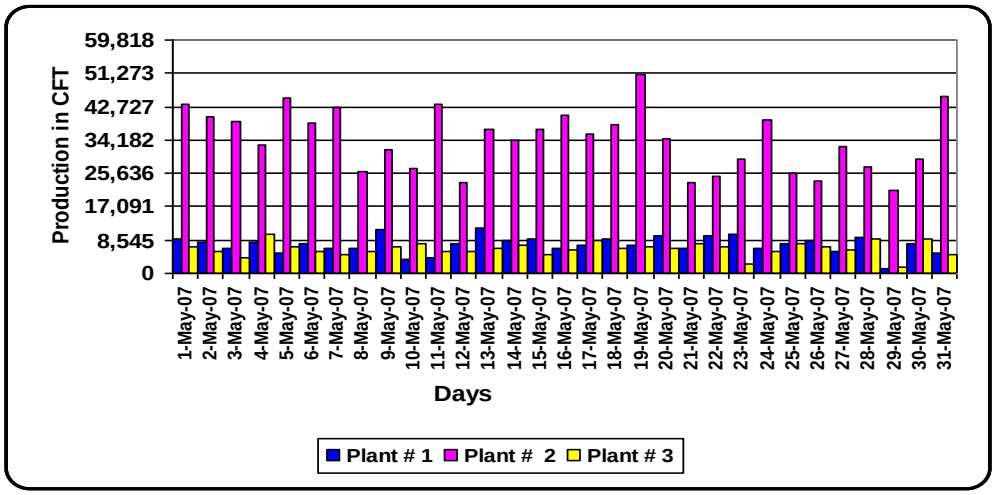
Sr. No.	Date	Temperature		Weather Condition	Humidity %	Remarks		
		Max (C^o)	Min (C^o)					
1	1-Apr-2007	36	17	Sunny	66			
2	2-Apr-2007	35	19	Sunny	87			
3	3-Apr-2007	37	18	Rainy	89			
4	4-Apr-2007	35	18	Rainy	87			
5	5-Apr-2007	37	20	Rainy	88			
6	6-Apr-2007	37	18	Sunny	86			
7	7-Apr-2007	38	22	Sunny	74			
8	8-Apr-2007	37	22	Sunny	76			
9	9-Apr-2007	40	21	Cloudy/Sunny	87			
10	10-Apr-2007	42	21	Sunny	85			
11	11-Apr-2007	44	22	Sunny	74			
12	12-Apr-2007	44	22	Fog, Clear	84	Max. Temp. C^o:	Min. Temp. C^o:	Average Temp. C^o:
13	13-Apr-2007	43	24	Fog, Clear	87			
14	14-Apr-2007	46	24	Sunny	74			
15	15-Apr-2007	46	28	Sunny	74			
16	16-Apr-2007	47	29	Sunny	78			
17	17-Apr-2007	45	23	Sunny	74			
18	18-Apr-2007	41	24	Sunny	80			
19	19-Apr-2007	42	24	Sunny	86	49	17	33
20	20-Apr-2007	44	24	Sunny	81			
21	21-Apr-2007	45	24	Sunny	83			
22	22-Apr-2007	46	25	Sunny	79			
23	23-Apr-2007	44	25	Sunny	82			
24	24-Apr-2007	46	23	Fog, Clear	76			
25	25-Apr-2007	47	25	Sunny	80			
26	26-Apr-2007	49	22	Fog, Clear	83			
27	27-Apr-2007	48	25	Sunny	86			
28	28-Apr-2007	49	22	Fog, Clear	89			
29	29-Apr-2007	49	25	Sunny	93			
30	30-Apr-2007	48	27	Sunny	91			

10.4 Production of Concrete

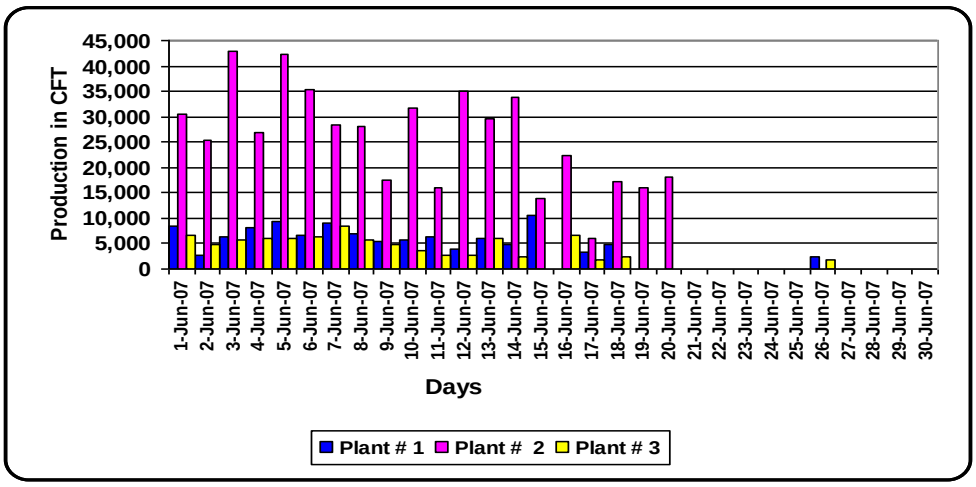
April 2007



May 2007



June 2007



The sample histograms shown above, present the monthly production of batching plants during the quarter Apr- Jun 2007. The total production of three Batching plants during the quarter (April to June 2007) stood at 3,025,514 Cft. The maximum daily production of three batching plants was recorded 64,777Cft on 19 May, 2007. Average daily production of these plants was 33,740 cft. The above record is for a sample quarter. Similar records were produced and are available for the whole construction period.

10.5 Tests Conducted on concrete

Sample data sheets of cylinder tests conducted on various grades/types of concrete used for construction of project follow:

10.6 Results of Tests Conducted on Soil for Earthwork Excavation and Filling

Sample data sheet for Field Density Test Results at various locations are presented below

April 2007

PBC	IRRIGATION AND POWER DEPARTMENT GOVT. OF PUNJAB Taunsa Barrage Emergency Rehabilitation And Modernization Project	DECON

SUMMARY OF FIELD DENSITY TESTS FOR SUB-WEIR LEFT SIDE

Sr. No.	Date	Area		Layer #	Location	Description of Soil	Field		Laboratory		Compaction		Remarks
		From	To				FDD g/cc	% M.C	MDD g/cc	% OMC	Obtd.	Reqd.	
470	2/4/2007	2233	2313	Final	Panel C Flat Portion	Sand	1.596	11.7	1.75	13.6	91.2	90	Pass
471	2/4/2007	2233	2313	Final	Panel C Flat Portion	Sand	1.586	10.9	1.75	13.6	90.6	90	Pass
472	2/4/2007	2233	2313	Final	Panel C Flat Portion	Sand	1.612	12.8	1.75	13.6	92.1	90	Pass
473	31/03/07	2383	2453	Final	Panel C Slope	Sand	1.609	11	1.75	13.6	92	90	Pass
474	31/03/07	2383	2453	Final	Panel C Slope	Sand	1.58	10	1.75	13.6	90.3	90	Pass
475	31/03/07	2383	2453	Final	Panel C Slope	Sand	1.469	10	1.75	13.6	83.9	90	Fail
476	1/4/2007	2383	2454	Final	Panel C Slope	Sand	1.635	13.2	1.75	13.6	93.4	90	Pass
477	1/4/2007	2383	2454	Final	Panel C Slope	Sand	1.593	11.4	1.75	13.6	91	90	Pass
478	1/4/2007	2383	2454	Final	Panel C Slope	Sand	1.607	12.6	1.75	13.6	91.8	90	Pass
479	1/4/2007	2383	2454	Final	Panel C Slope	Sand	1.618	14.2	1.75	13.6	92.5	90	Pass
480	1/4/2007	2313	2380	Final	Panel C Flat Portion	Sand	1.629	13.4	1.75	13.6	93.1	90	Pass
481	1/4/2007	2313	2380	Final	Panel C Flat Portion	Sand	1.661	12	1.75	13.6	94.8	90	Pass
482	1/4/2007	2383	2453	Final	Panel C Slope	Sand	1.624	13.4	1.75	13.6	92.8	90	Pass
483	1/4/2007	2383	2453	Final	Panel C Slope	Sand	1.634	11.2	1.75	13.6	93.4	90	Pass
484	2/4/2007	2173	2233	Final	Panel F	Sand	1.546	8.9	1.75	13.6	88.3	90	Fail
485	2/4/2007	2173	2233	Final	Panel F	Sand	1.547	10.7	1.75	13.6	88.4	90	Fail
486	2/4/2007	2173	2233	Final	Panel F	Sand	1.567	15.7	1.75	13.6	89.5	90	Pass
487	2/4/2007	2173	2233	Final	Panel F	Sand	1.609	12.4	1.75	13.6	91.9	90	Pass
488	2/4/2007	2173	2233	Final	Panel F	Sand	1.463	18.9	1.75	13.6	83.6	90	Fail
489	2/4/2007	2173	2233	Final	Panel F	Sand	1.543	15.7	1.75	13.6	88.2	90	Fail
490	2/4/2007	2173	2233	Final	Panel F	Sand	1.582	17	1.75	13.6	90.4	90	Pass
491	2/4/2007	2173	2233	Final	Panel F	Sand	1.61	14.3	1.75	13.6	92	90	Pass
492	2/4/2007	2173	2233	Final	Panel F	Sand	1.606	13.4	1.75	13.6	91.8	90	Pass
493	2/4/2007	2453	2513	Final	Panel C Slope	Sand	1.544	16.4	1.75	13.6	88.2	90	Fail
494	2/4/2007	2453	2513	Final	Panel C Slope	Sand	1.533	10.8	1.75	13.6	87.6	90	Fail
495	2/4/2007	2453	2513	Final	Panel C Slope	Sand	1.474	16.4	1.75	13.6	84.2	90	Fail
496	2/4/2007	2453	2513	Final	Panel C Slope	Sand	1.506	14.2	1.75	13.6	86.1	90	Fail
497	3/4/2007	2446	2523	Final	Panel C Slope	Sand	1.549	11	1.75	13.6	88.5	90	Fail
498	3/4/2007	2446	2523	Final	Panel C Slope	Sand	1.503	12	1.75	13.6	85.9	90	Fail
499	3/4/2007	2446	2523	Final	Panel C Slope	Sand	1.515	12.4	1.75	13.6	86.5	90	Fail
500	3/4/2007	2446	2523	Final	Panel C Slope	Sand	1.442	11	1.75	13.6	82.4	90	Fail
501	3/4/2007	2453	2520	Final	Panel C Slope	Sand	1.447	16	1.75	13.6	82.7	90	Fail
502	3/4/2007	2763	2843	Final	Panel A	Sand	1.615	12.7	1.75	13.6	92.3	90	Pass
503	3/4/2007	2763	2843	Final	Panel A	Sand	1.605	11.9	1.75	13.6	91.7	90	Pass
504	3/4/2007	2233	2380	Final	Panel C D/S Sheet Piles	Sand	1.631	14.6	1.75	13.6	93.2	90	Pass
505	3/4/2007	2233	2380	Final	Panel C D/S Sheet Piles	Sand	1.612	13.2	1.75	13.6	92.1	90	Pass
506	3/4/2007	2193	2233	Final	Panel A	Sand	1.597	16.6	1.75	13.6	91	90	Pass
507	3/4/2007	2743	2853	Final	Panel B	Sand	1.643	13.4	1.75	13.6	94	90	Pass

June 2007

PBC	IRRIGATION AND POWER DEPARTMENT GOVT. OF PUNJAB Taunsa Barrage Emergency Rehabilitation And Modernization Project	

SUMMARY OF FIELD DENSITY TESTS FOR SUB-WEIR LEFT SIDE

Sr. No.	Date	Area		Layer #	Location	Description of Soil	Field		Laboratory		Compaction		Remarks
		From	To				FDD g/cc	% M.C	MDD g/cc	% OMC	Obtd.	Reqd.	
1066	1/6/2007	4273	4300	404.17	Panel D, E, F	Sand	1.605	13.9	1.729	13.6	92.6	90	Pass
1067	1/6/2007	4273	4300	404.17	Panel D, E, F	Sand	1.624	14.2	1.729	13.6	93.7	90	Pass
1068	1/6/2007	4273	4300	404.17	Panel D, E, F	Sand	1.612	13	1.729	13.6	93	90	Pass
1069	1/6/2007	3343	3583	404.75	D/S Curtain Wall	Sand	1.584	13	1.729	14.2	91.6	90	Pass
1070	1/6/2007	3343	35883	404.75	D/S Curtain Wall	Sand	1.611	14.2	1.729	14.2	93.2	90	Pass
1071	1/6/2007	3343	3583	403.75	D/S Curtain Wall	Sand	1.628	16	1.729	14.2	94.2	90	Pass
1072	1/6/2007	3343	3583	403.75	D/S Curtain Wall	Sand	1.618	14	1.729	14.2	93.6	90	Pass
1073	2/6/2007	3553	3673	401.53	Panel D 123 ~ 124	Sand	1.584	13	1.714	13.8	92.4	90	Pass
1074	2/6/2007	3553	3673	401.53	Panel D 123 ~ 124	Sand	1.611	14.2	1.714	13.8	94.4	90	Pass
1075	3/6/2007	4243	430.5	414.75	Panel A 144, 145	Sand	1.629	13	1.734	13.6	94	90	Pass
1076	3/6/2007	4243	4300.5	414.75	Panel A 144, 145	Sand	1.586	13	1.734	13.6	91.5	90	Pass
1077	3/6/2007	4243	4300.5	414.25	Panel A 144, 145	Sand	1.612	13.5	1.734	13.6	93	90	Pass
1078	3/6/2007	4243	4300.5	414.25	Panel B 144, 145	Sand	1.628	12.4	1.729	14.2	94.2	90	Pass
1079	3/6/2007	4243	4300.5	402.13	Panel B 144, 145	Sand	1.588	14.8	1.729	14.2	91.9	90	Pass
1080	3/6/2007	3493	3613	402.13	Panel E & D	Sand	1.485	11	1.729	14.2	85.9	90	Fail
1081	3/6/2007	3493	3613	402.13	Panel E & D	Sand	1.507	10.2	1.729	14.2	87.2	90	Fail
1082	3/6/2007	3493	3613	402.13	Panel E & D	Sand	1..629	14	1.734	13.6	94	90	Pass
1083	3/6/2007	3493	3613	402.13	Panel E & D	Sand	1.638	14.5	1.734	13.6	94.5	90	Pass
1084	3/6/2007	3493	3613	402.13	Panel E & D	Sand	1.647	13.7	1.734	13.6	95	90	Pass
1085	3/6/2007	4243	4300.5	409.25	U/S Curtain Wall	Sand	1.598	10.8	1.729	14.2	92.4	90	Pass
1086	3/6/2007	4243	4300.5	409.25	U/S Curtain Wall	Sand	1.618	12.8	1.729	14.2	93.6	90	Pass
1087	3/6/2007	3673	3733	397.25	Panel C 125, 126	Sand	1.6	13.5	1.734	13.6	92.3	90	Pass
1087A	3/6/2007	3673	3733	397.25	Panel C 125, 126	Sand	1.621	12.7	1.734	13.6	93.5	90	Pass
1088	3/6/2007	3673	3733	397.25	Panel D 125, 126	Sand	1.599	14	1.714	14.2	93.3	90	Pass
1089	3/6/2007	3673	3733	397.25	Panel D 125, 126	Sand	1.576	12.3	1.714	14.2	92	90	Pass
1090	3/6/2007	3333	3513	404.75	D/S Curtain Wall	Sand	1.569	14	1.734	13.6	90.5	90	Pass
1091	3/6/2007	3333	3513	404.75	D/S Curtain Wall	Sand	1.569	14.5	1.734	13.6	90.5	90	Pass
1092	3/6/2007	3333	3513	404.75	D/S Curtain Wall	Sand	1.577	13.9	1.734	13.6	91	90	Pass
1093	3/6/2007	3333	3573	403.75	D/S Curtain Wall	Sand	1.586	12.5	1.734	13.6	91.5	90	Pass
1094	3/6/2007	3333	3573	403.75	D/S Curtain Wall	Sand	1.605	10.5	1.734	13.6	92.6	90	Pass
1095	3/6/2007	3333	3573	403.75	D/S Curtain Wall	Sand	1.56	13	1.734	13.6	90	90	Pass
1096	4/6/2007	3628	3745	412	B/W Panel & C/W	Sand	1.649	15.2	1.729	14.2	95.4	90	Pass
1097	4/6/2007	3628	3745	412	B/W Panel & C/W	Sand	1.628	14	1.729	14.2	94.2	90	Pass
1098	5/6/2007	3474	3628	412	B/W Panel & C/W	Sand	1.621	13.5	1.734	13.6	93.5	90	Pass
1099	5/6/2007	3474	3628	412	B/W Panel & C/W	Sand	1.595	13	1.734	13.6	92	90	Pass
1100	5/6/2007	3474	3628	412	B/W Panel & C/W	Sand	1.586	12.5	1.734	13.6	91.5	90	Pass
1101	5/6/2007	3697	3733	403.25	Panel D, E	Sand	1.603	12.5	1.734	13.6	92.5	90	Pass
1102	5/6/2007	3697	3733	403.25	Panel D, E	Sand	1.612	12	1.734	13.6	93	90	Pass

10.7 Summary of Inspection Requests

Sample summarized data for inspection requests for guide banks, sub weir and curtain walls are contained in the following tables:

PBC	IRRIGATION AND POWER DEPARTMENT GOVT. OF PUNJAB	
	Taunsa Barrage Emergency Rehabilitation And Modernization And Modernization Project	

SUMMARY OF INSPECTION REQUESTS FOR GUIDE BANK LEFT SIDE

Req. No	Date	Time	Location		Layer	Description	Level (ft)	Remarks
5006/GBL/497A	16/2007	6:00	0+000	0+250	9	Guide Bank	428	O.K
5006/GBL/494B	16/2007	9:15	0+209	0+230	26	Guide Bank	437	O.K
5006/GBL/666	27/06/07	17:30	0+000	0+250	20	Guide Bank	439	O.K
5006/GBL/667	27/06/07	20:30	0+000	0+057	33	Guide Bank	440.5	O.K
5006/GBL/668	27/06/07	20:30	0+000	0+250	33	Guide Bank	440.5	O.K
5006/GBL/669	28/06/07	17:30	0+000	0+057	34	Guide Bank	441	O.K
5006/GBL/670	28/06/07	17:30	0+000	0+250	34	Guide Bank	441	O.K
5006/GBL/671	29/06/07	10:30	0+000	0+057	21	Guide Bank	440	O.K
5006/GBL/672	29/06/07	10:30	0+000	0+250	21	Guide Bank	440	Not O.K
5006/GBL/673	29/06/07	17:45	0+000	0+057	35	Guide Bank	441.5	O.K
5006/GBL/674	29/06/07		0+000	0+250	35	Guide Bank	441.5	O.K
5006/GBL/672A	29/06/07	20:	0+000	0+250	21	Guide Bank	440	O.K
5006/GBL/675	30/06/07	2:40	0+000	0+057	36	Guide Bank	442	O.K
5006/GBL/676	30/06/07	2:40	0+000	0+250	36	Guide Bank	442	O.K
5006/GBL/677	30/06/07	04:	0+000	0+057	2	Guide Bank	441	O.K
5006/GBL/678	30/06/07	04:	0+000	0+250	22	Guide Bank	441	O.K
5006/GBL/679	30/06/07	17:30	0+000	0+057	37	Guide Bank	442.5	O.K
5006/GBL/680	30/06/07	17:40	0+000	0+123	7	Guide Bank	442.5	O.K
5006/GBL/681	30/06/07	22:	0+000	0+250	23	Guide Bank	442	O.K
5006/GBL/682	30/06/07	10:00	0+000	0+057	23	Guide Bank	442	O.K
5006/GBL/683	30/06/07	21:30	0+000	0+057	38	Guide Bank	443	O.K
5006/GBL/684	30/06/07	21:30	0+000	0+123	38	Guide Bank	443	O.K

PBC	IRRIGATION AND POWER DEPARTMENT GOVT. OF PUNJAB Taunsa Barrage Emergency Rehabilitation And Modernization And Modernization Project	

SUMMARY OF INSPECTION REQUESTS FOR SUB-WEIR PANEL - D

Req. No	Date	Time	Location		Level (ft)		Panel No.	Description	Status
			From	To					
5006-LSW/D-013	2/5/2007		2413	2473	398.2	401.78	83-84	Formwork	
5006-LSW/D-014	2/5/2007		2413	2473	402.38	408	83-84	Concrete	
5006-LSW/D-015	4/5/2007	1:00	2293	2413			79-82	Formwork	O.K
5006-LSW/D-016	4/5/2007	10:30	2293	2413			79-82	Concrete	O.K
5006-LSW/D-017	6/5/2007	16:00	2233	2293	401.78	408	77-78	Formwork	Resubmit
5006-LSW/D-018	6/5/2007	17:00	2233	2293	401.78	408	77-78	Concrete	Resubmit
5006-LSW/D-017A	7/5/2007	5:00	2233	2293	401.78	408	77-78	Formwork	O.K
5006-LSW/D-018A	7/5/2007	6:00	2233	2293	401.78	408	77-78	Concrete	O.K
5006-LSW/D-019	7/5/2007	16:00	2653	2713	398-2-401.8	401.78	91-92	Formwork	O.K
5006-LSW/D-020	7/5/2007	18:00	2653	2713	402.38-408	408	91-92	Concrete	O.K
5006-LSW/D-021	12/5/2007	1:00	2833	2893	398.2	401.78	97-98	Formwork	O.K
5006-LSW/D-022	12/5/2007	1:00	2833	2893	398.2	401.78	97-98	Concrete	O.K
5006-LSW/D-023	15/05/07	10:00	2713	2773	401.78	402	93-94	Formwork	O.K
5006-LSW/D-024	15/05/07	10:00	2713	2773	401.78	402	93-94	Concrete	O.K
5006-LSW/D-025	16/05/07	8:00	2533	2653	408	408	87-90	Formwork	O.K
5006-LSW/D-026	16/05/07	10:00	2533	2653	408	408	87-90	Concrete	O.K
5006-LSW/D-027	17/05/07	19:00	3133	3193	408	408	107-108	Formwork	O.K

PBC	IRRIGATION AND POWER DEPARTMENT GOVT. OF PUNJAB Taunsa Barrage Emergency Rehabilitation And Modernization And Modernization Project	

SUMMARY OF INSPECTION REQUESTS FOR SUB-WEIR PANEL - F

Req. No	Date	Time	Location		Level (ft)		Panel		Description	Remarks
			From	To			From	To		
5006-LSW/F-0056	13/04/07	18:30	2233	2293	408	412	77	78	Concrete	O.K
5006-LSW/F-0057	15/04/07	14:00	2653	2773	408	412	91	93	Formwork	O.K
5006-LSW/F-0058	15/04/07	14:00	2653	2773	408	412	91	93	Concrete	O.K
5006-LSW/F-0059	16/04/07	10:30	2353	2413	408	412	81	82	Formwork	O.K
5006-LSW/F-0060	16/04/07	11:00	2353	2413	408	412	81	82	Concrete	O.K
5006-LSW/F-0061	17/04/07	12:40	2473	2533	408	412	85	86	Formwork	O.K
5006-LSW/F-0062	17/04/07	12:40	2473	2533	408	412	85	86	Concrete	O.K
5006-LSW/F-0063	18/04/07	16:00	2543	2593	412	408	87	88	Formwork	O.K
5006-LSW/F-0064	18/01/07	16:30	2543	2593	412	408	87	88	Concrete	O.K
5006-LSW/F-0065	18/04/07	17:00	2893	2953	404.5	408	99	100	Formwork	O.K
5006-LSW/F-0066	18/04/07	17:00	2893	2953	404.5	408	99	100	Concrete	O.K
5006-LSW/F-0067	23/04/07	11:00	2668	2709	408	412	91	92	Formwork	O.K
5006-LSW/F-0068	23/04/07	12:00	2668	2709	408	412	91	92	Concrete	O.K
5006-LSW/F-0069	23/04/07	15:30	3013	3133	403.5	408	103	106	Formwork	O.K
5006-LSW/F-0070	23/04/07	17:00	3013	3133	403.5	408	103	106	Concrete	O.K
5006-LSW/F-0071	25/04/07	11:30	2709	2703	408	412	93	94	Formwork	O.K
5006-LSW/F-0072	25/04/07	12:30	2709	2703	408	412	93	94	Concrete	O.K
5006-LSW/F-0073	26/04/07	11:30	2653	2668	408	412	91	91	Formwork	O.K
5006-LSW/F-0074	26/04/07	11:30	2653	2668	408	412	91	91	Concrete	O.K
5006-LSW/F-0075	27/04/07	16:30	2773	2893	408	412	95	98	Formwork	O.K
5006-LSW/F-0076	28/04/07	16:30	2773	2893	408	412	95	98	Concrete	O.K

11. QUALITY AUDIT AND GRAPHICAL PRESENTATION OF DATA

The data contained in the preceding sections, indicates that the quality assurance and control tests conducted are more than the number prescribed by Specifications. Brief analysis of each type follows:

11.1 The Los Angeles Abrasion Tests Results

The Los Angeles Abrasion tests results (for a sample period) for coarse aggregates, are presented graphically in Figure 1. The plot shows that the loss of weight has always been very much less than the permissible limit of 40%. The average loss comes to only 26%, confirming the good quality of the coarse aggregate.

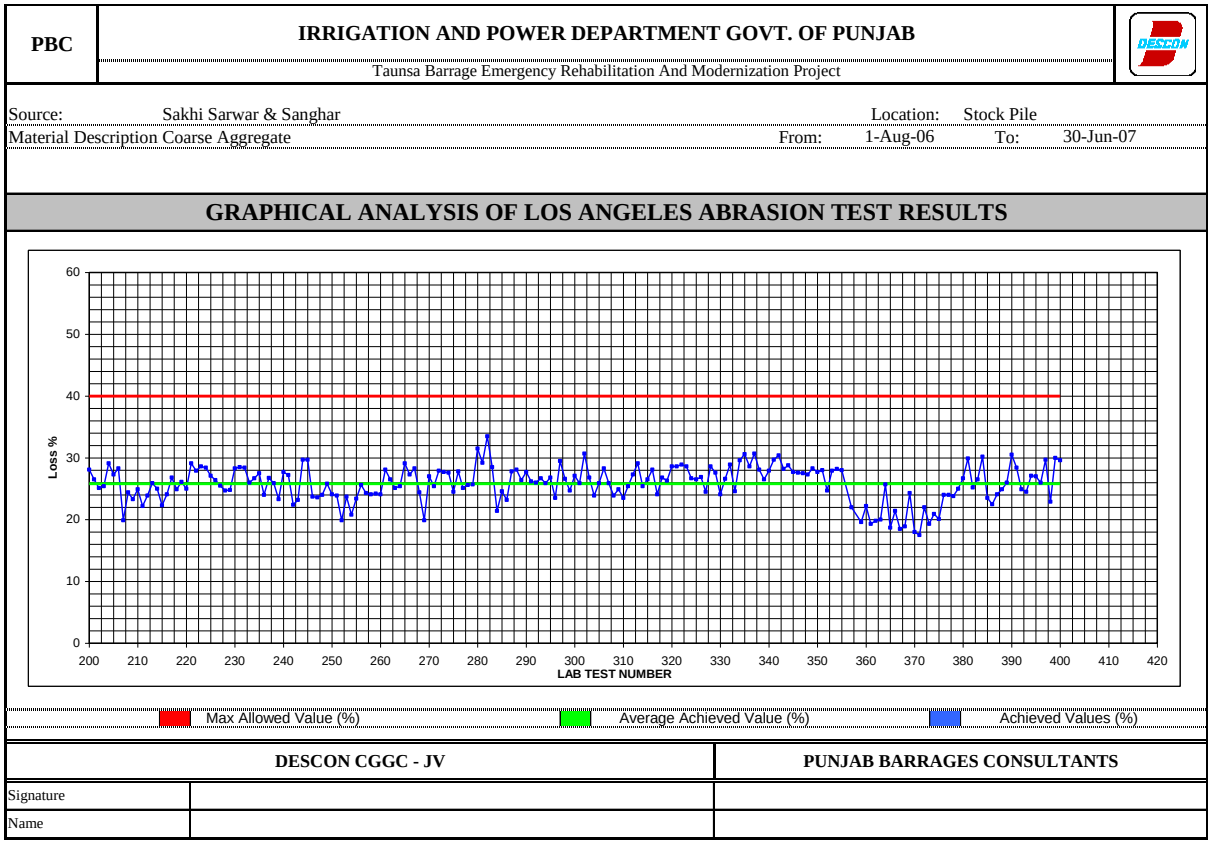


Figure 1: Los Angeles Abrasion Test Results

11.2 Sand Equivalent Tests Results for Fine Aggregate

The plot of sand equivalent tests results for fine aggregates (Figure 2) indicates that sand equivalent values for all tests have been above the permissible base value of 80% except in only 5 out of 169 tests. The average values come to 82.25%. Failing consignments were rejected and removed from the site.

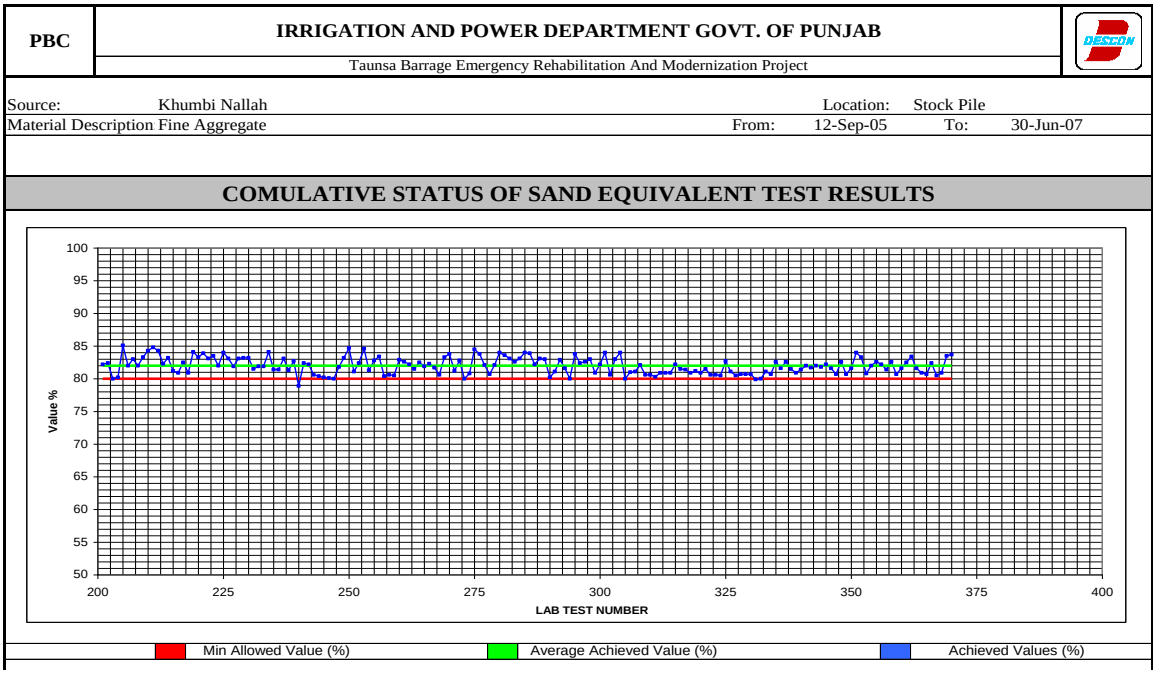


Figure 2: Sand Equivalent Test Results for Fine Aggregate

11.3 Soundness Tests for Coarse Aggregate

The values of percentage weight loss for coarse aggregate after 5 cycles of sodium sulphate treatment is only 1.1% (max), 0.2% (min) and 0.7% on the average against a permissible value of 12%, establishing the soundness of coarse aggregates used (Figure 3).

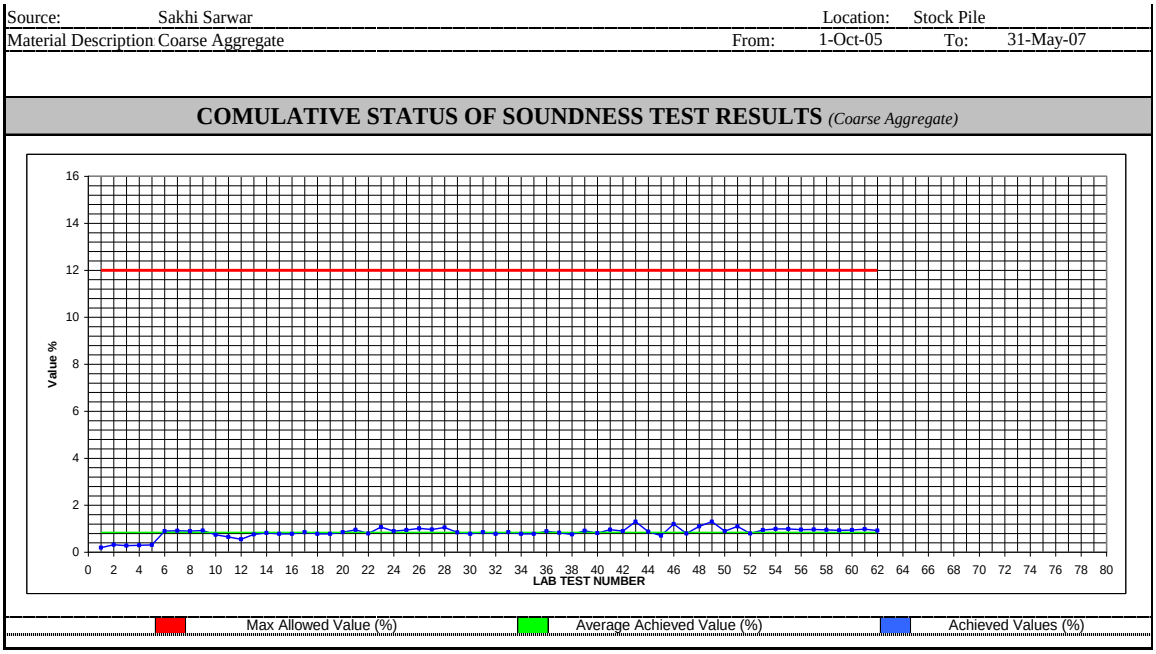


Figure 3: Soundness Tests for Coarse Aggregate

11.4 Soundness Tests for Fine Aggregate

The plot of these tests in Figure 4 indicates that the weight loss after soundness test has been 2.5% (max), 1.6% (min) and 2% on the average, against a permissible value of 12% establishing the soundness of the fine aggregates used.

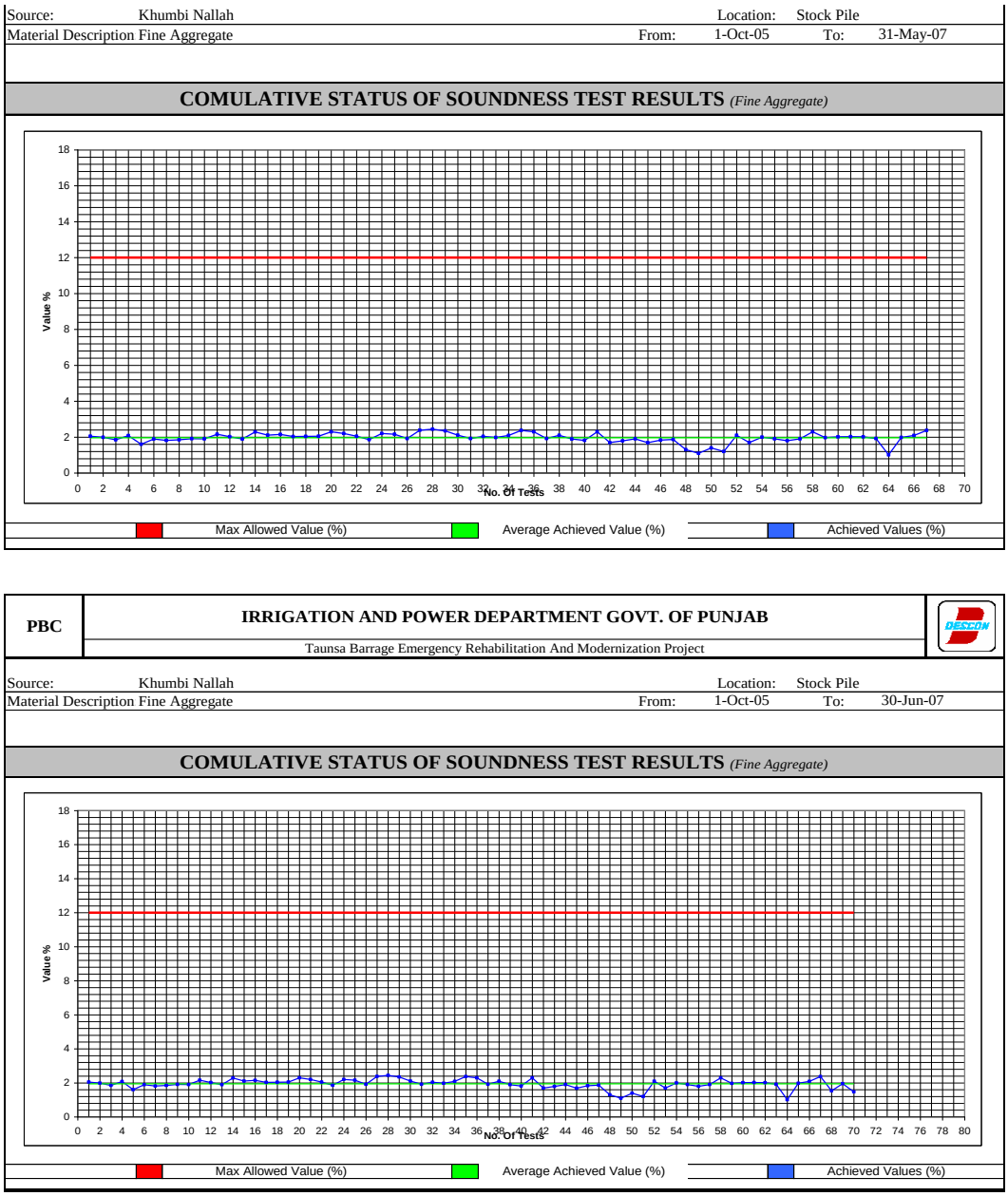
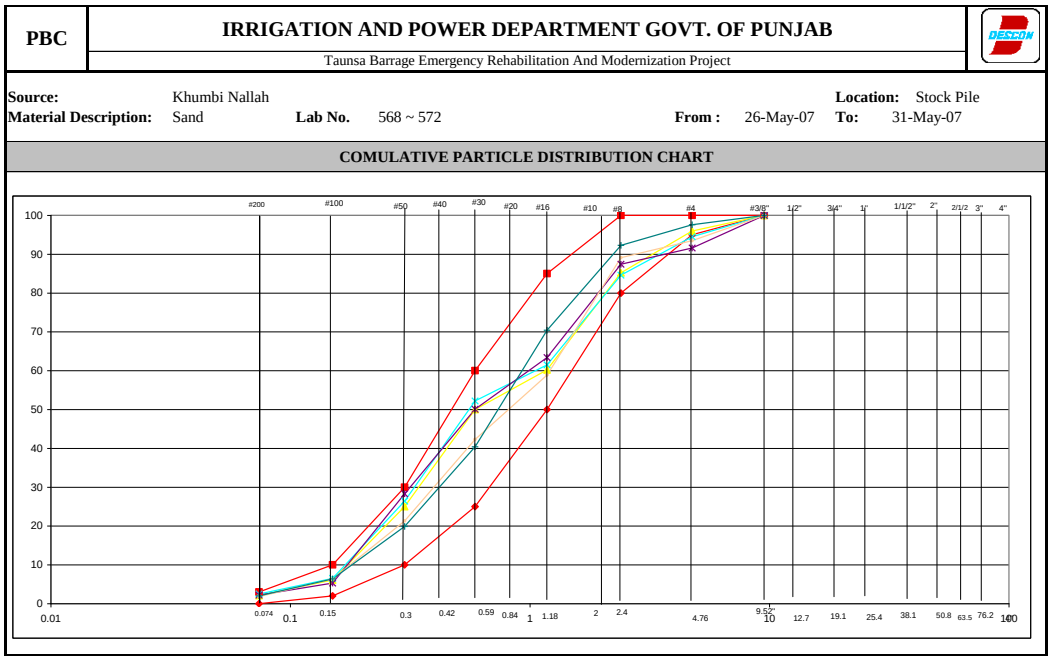


Figure 4: Soundness Tests for Fine Aggregate

11.5 Gradation Charts of Fine Aggregate

The gradation charts (for a sample period) prepared from the sieve analyses of fine aggregates plotted in Figures 5 indicate that the aggregates used were well graded. The red lines in the figures 5 to 7 represent maximum and minimum envelope curves while the actual gradation of sand is in between these two envelopes.



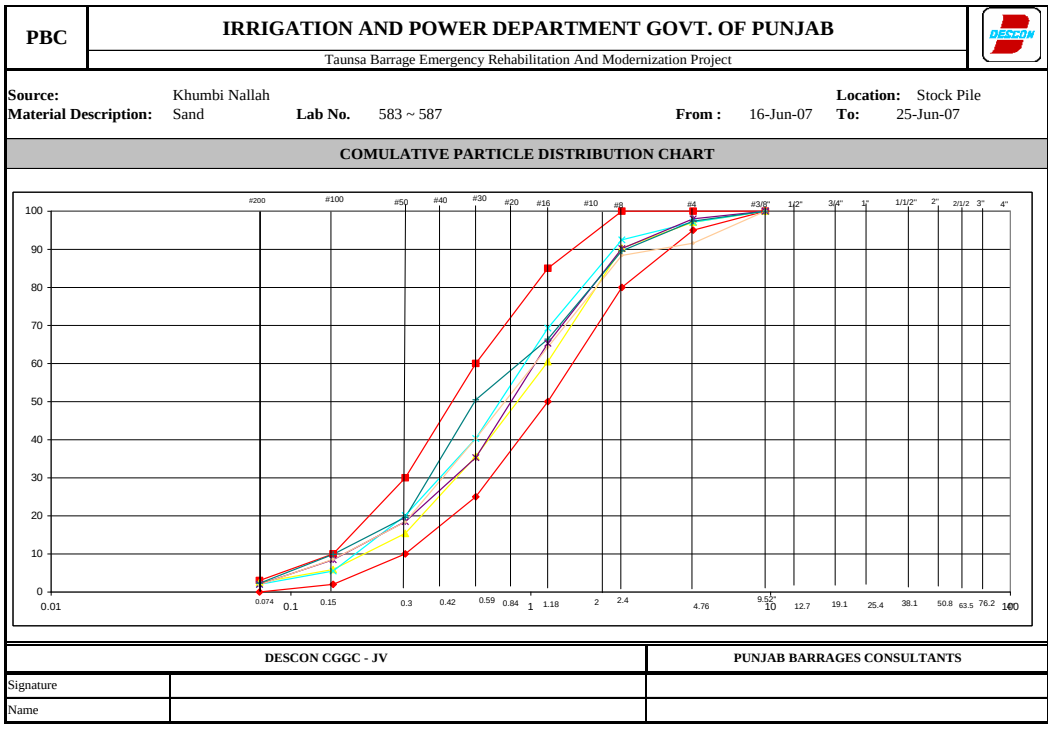
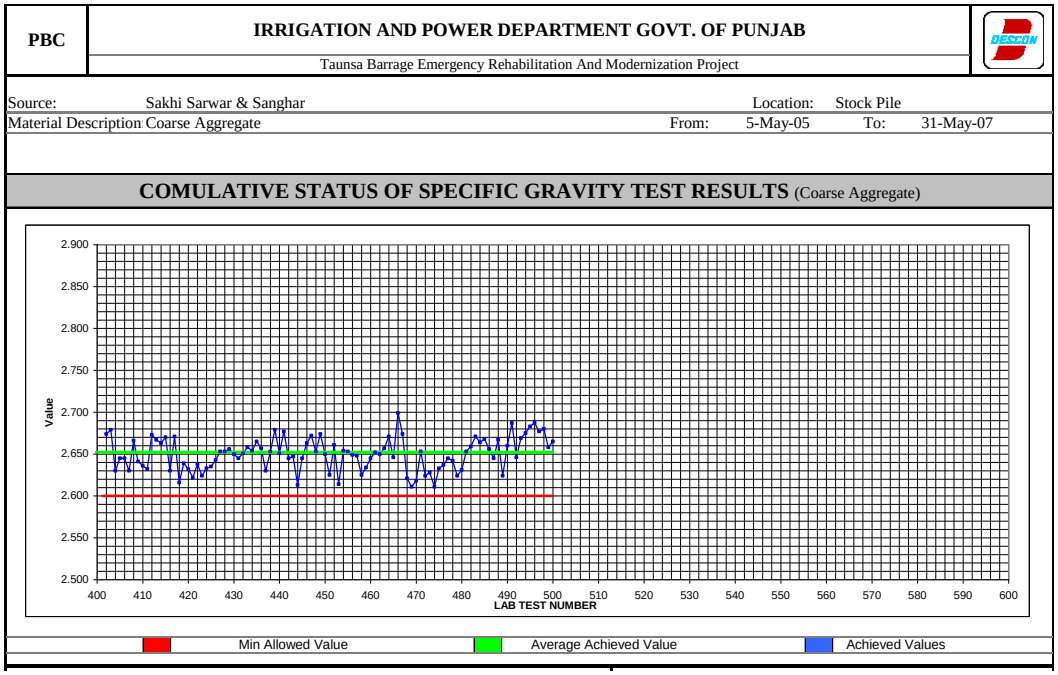


Figure 5: Gradation Chart of Fine Aggregate

11.6 Specific Gravity Tests for Coarse and Fine Aggregates

The results for 328 tests plotted in Figure 6 indicate that the specific gravity of the coarse aggregates was observed to be 2.70 (max), 2.610 (min) and 2.650 on the average against a prescribed value of 2.60 establishing the denseness of the aggregates. Similarly the results for 166 tests plotted in Figure 8 indicate that the

specific gravity of the fine aggregates has been observed to be 2.73 (max), 2.59 (min) and 2.65 on the average against a prescribed value of 2.60 establishing the denseness of the aggregates.



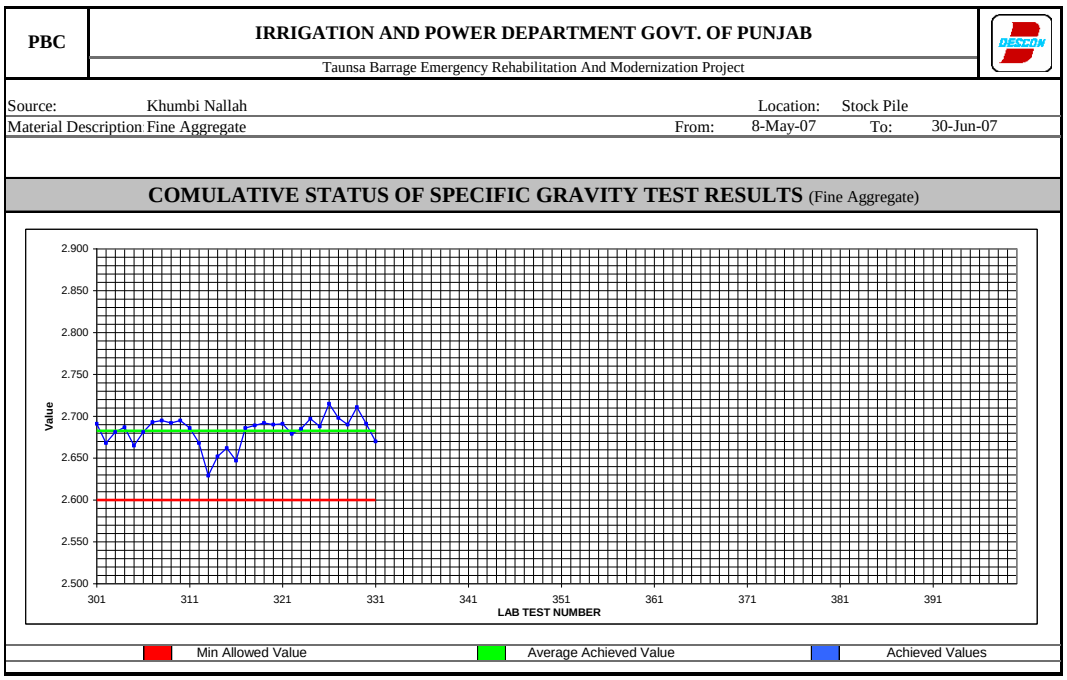
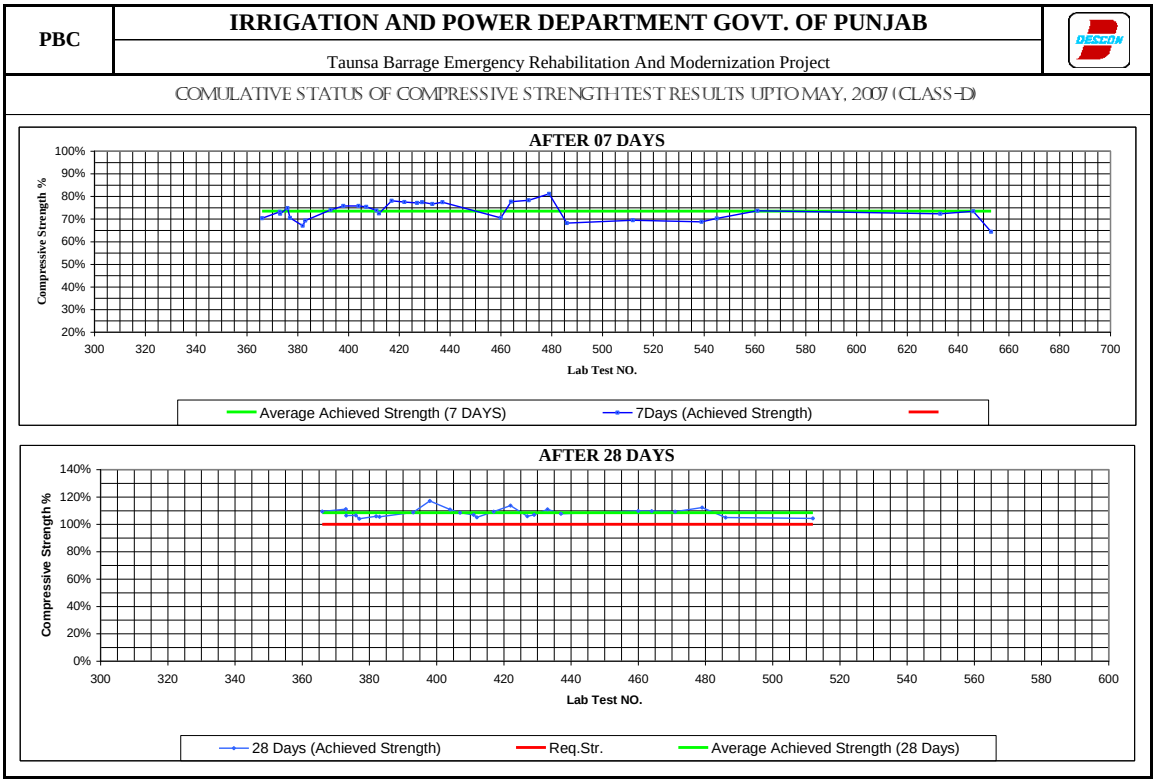


Figure 6: Specific Gravity Tests for Coarse and Fine Aggregates

11.7 Compressive Strength Results for Class D Concrete

The graphical presentation of compressive strength results for 28 days for class D concrete in Figure 7 are always higher than the prescribed values, thus

showing the good quality of concrete. Due to lean mix, the 7 days strength of some samples is a bit less but after 28 days more than required strength was achieved.



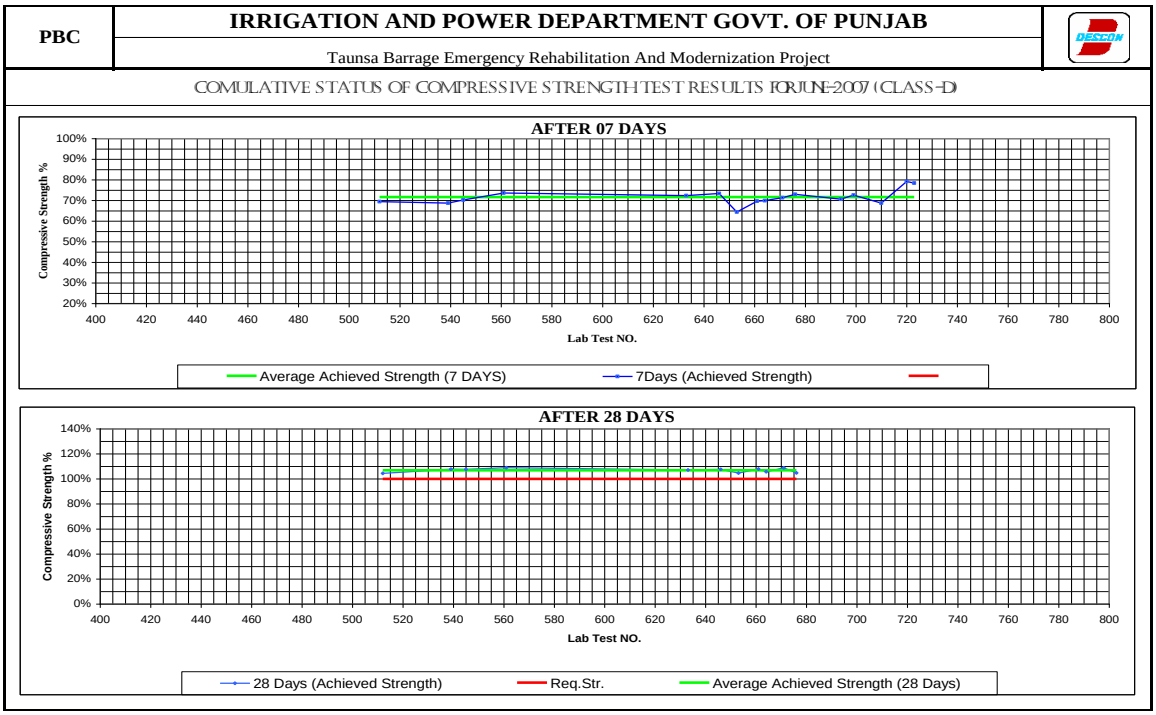


Figure 7: Compressive Strength Results for Class D Concrete

11.8 Compressive Strength Results for Class AA Concrete

Graphical presentation of compressive strength results for 7 and 28 days for class AA concrete in Figure 8 shows higher than the prescribed strength values, thus establishing the good quality of concrete.

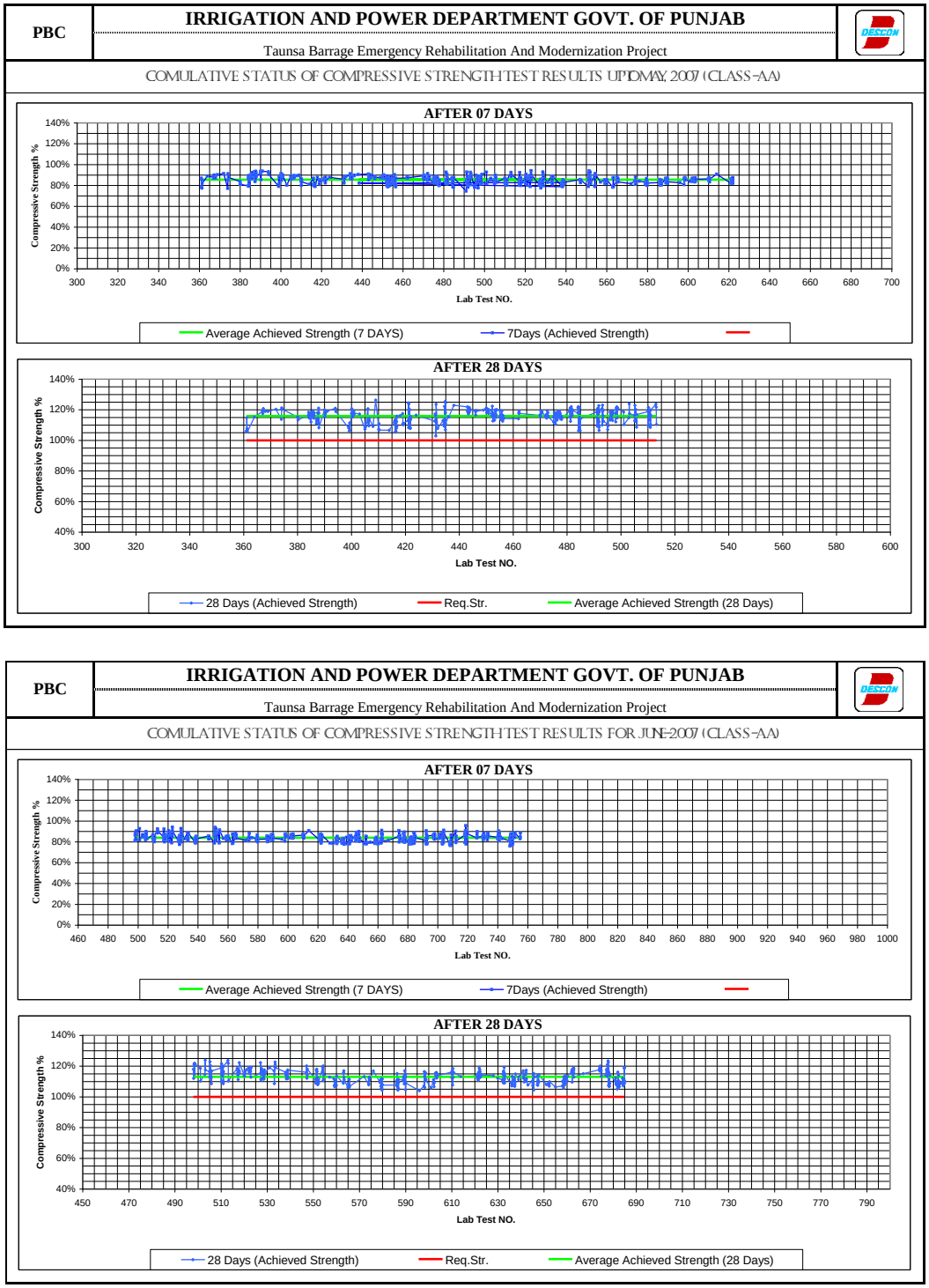


Figure 8: Compressive Strength Results for Class AA Concrete

11.9 Compressive Strength Results for Class BB Concrete

Graphical presentation of compressive strength results for 7 and 28 days for class BB concrete in Figure 9 shows higher than the prescribed strength values, thus establishing the good quality of concrete.

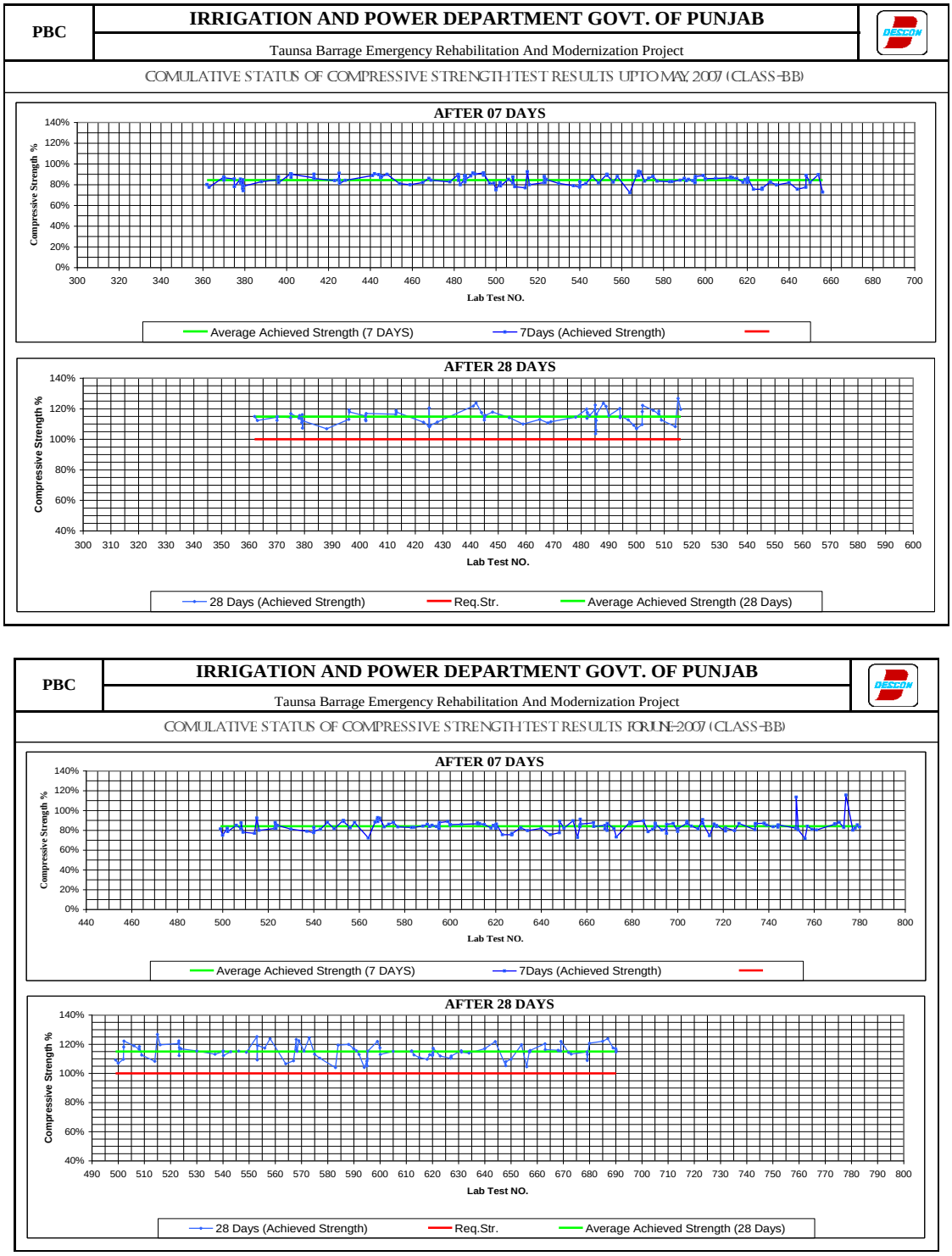


Figure 9: Compressive Strength Results for Class BB Concrete

12. QA/QC ACTIVITIES PERFORMED BY ICB-02 CONTRACTOR

Mechanical and Electrical works were covered under ICB-02 Contract. Under this contract, rehabilitation of 31 weir gates and 1 navigation lock gate including raising of gate by 1 ft., replacement and repair of Canal Gates, hoisting arrangement, counter weights and superstructure were covered. The works done at the site was put to following Quality checks by the Consultants during the reporting period:

i. Visual & measurement checks, tensile test & chemical composition test of material.

ii. Straightness of grooves facing, side seals plates & roller guard and gate guide shoes.

iii. Alignment of gate leaf, rocker assembly, roller train & guide, rope drums & hoist.

iv. Welding visual & measurement checks, dye penetrant test (DPT) & ultrasonic test (UT)

v. Painting appearance checks & dry film thickness (DFT) test by Elecometer.

vi. Rise in temperature measured at various parts/points of hoist.

vii. Electrical parameters (voltage, ampere & phase sequence) & insulation test of three phase induction motor & trial test run of gates operations

Details of the quality assurance/control activities ICB-02 works for rehabilitation of main weir gates and upstream navigation lock gate no. 8 are as follows:

Mechanical Works					
1) Side sealing plate					
Description	Straightness	Flatness	Chipping	Concreting	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site
NL-08	OK	OK	OK	OK	At site

2) Facing of rocker assembly base					
Description	Straightness	Flatness	Depth machined	Grinding	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site
NL-08	OK	OK	OK	OK	At site
3) Assembly of rocker assembly					
Description	Straightness	Flatness	Movement	Junction gap	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site
4) Gate leaf					
Description	Dimension	Welding	Paint	Sealings	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site
NL-08	OK	OK	OK	OK	At site

5) Roller guard					
Description	Straightness	Clearance	Chipping	Concreting	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site
NL-08	OK	OK	OK	OK	At site
6) Sill beam					
Description	Straightness	Flatness	Level	Concreting	Location
NL-08 (U/S)	OK	OK	OK	OK	At site
NL-08 (D/S)	OK	OK	OK	OK	At site
7) Bracket for bulkhead gates					
7.1) Installation of bracket					
Description	Straightness	Flatness	Verticality	Weld joint	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site
7.2) Concreting of bracket					
Description	Chipping	Drilling	Concreting	Pouring	Location
WG-31	OK	OK	OK	OK	At site
WG-32	OK	OK	OK	OK	At site
WG-33	OK	OK	OK	OK	At site
WG-34	OK	OK	OK	OK	At site
WG-35	OK	OK	OK	OK	At site
WG-36	OK	OK	OK	OK	At site
WG-37	OK	OK	OK	OK	At site

13. QUALITY REPORTS

The Contractor and Consultants generated monthly and quarterly quality reports, which contained periodical data and review of quality processes. These reports were submitted to the Government (owner) and the World Bank (Financiers).

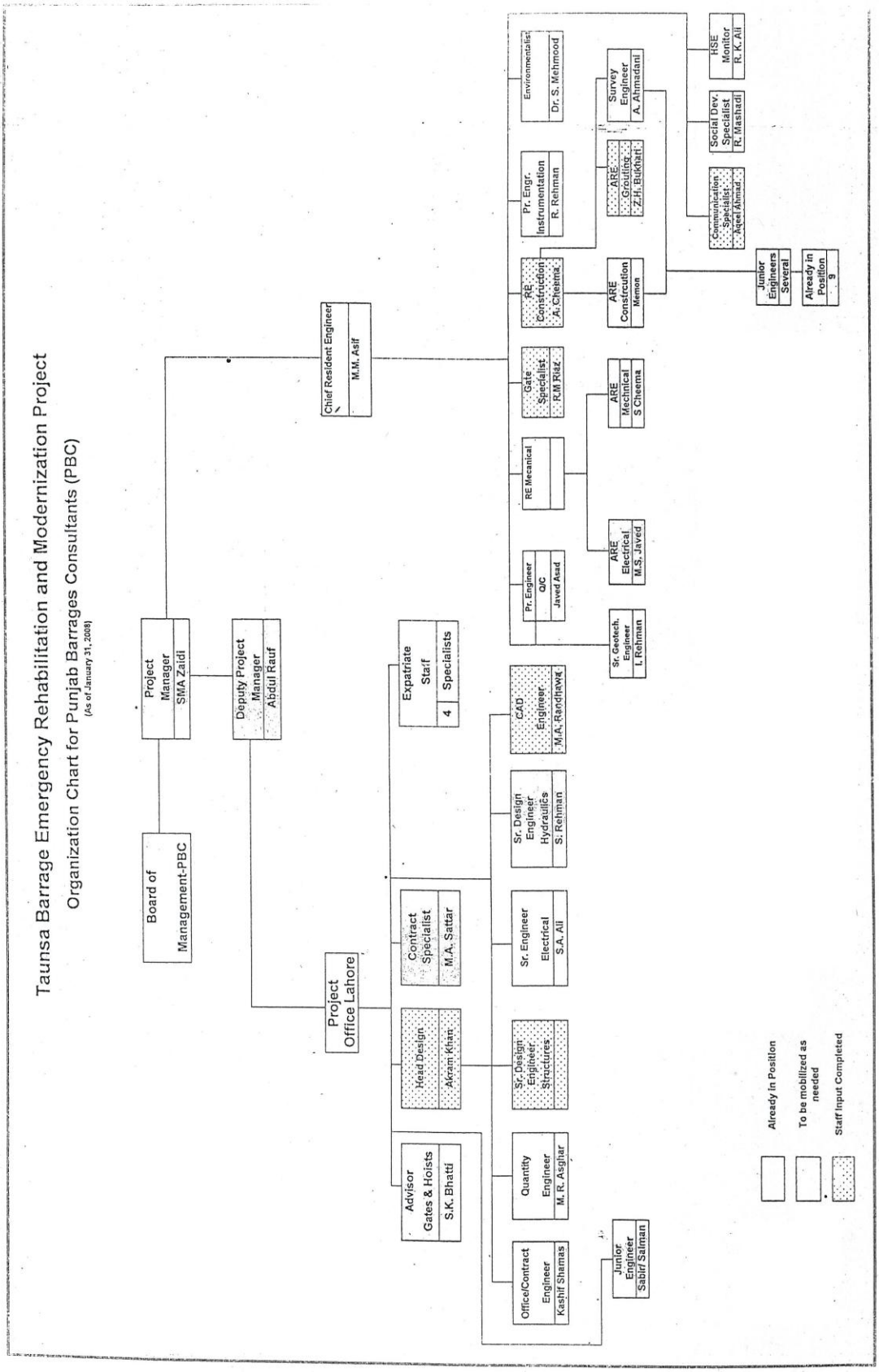
14. OVERALL ASSESSMENT

Looking at the preceding narration in an overall perspective, we find that the Quality Assurance and Quality Control planning, the plans and their implementation has been quite good and in line with International Standards (ISO 9001-2000). State of the Art systematic control has yielded high quality works.

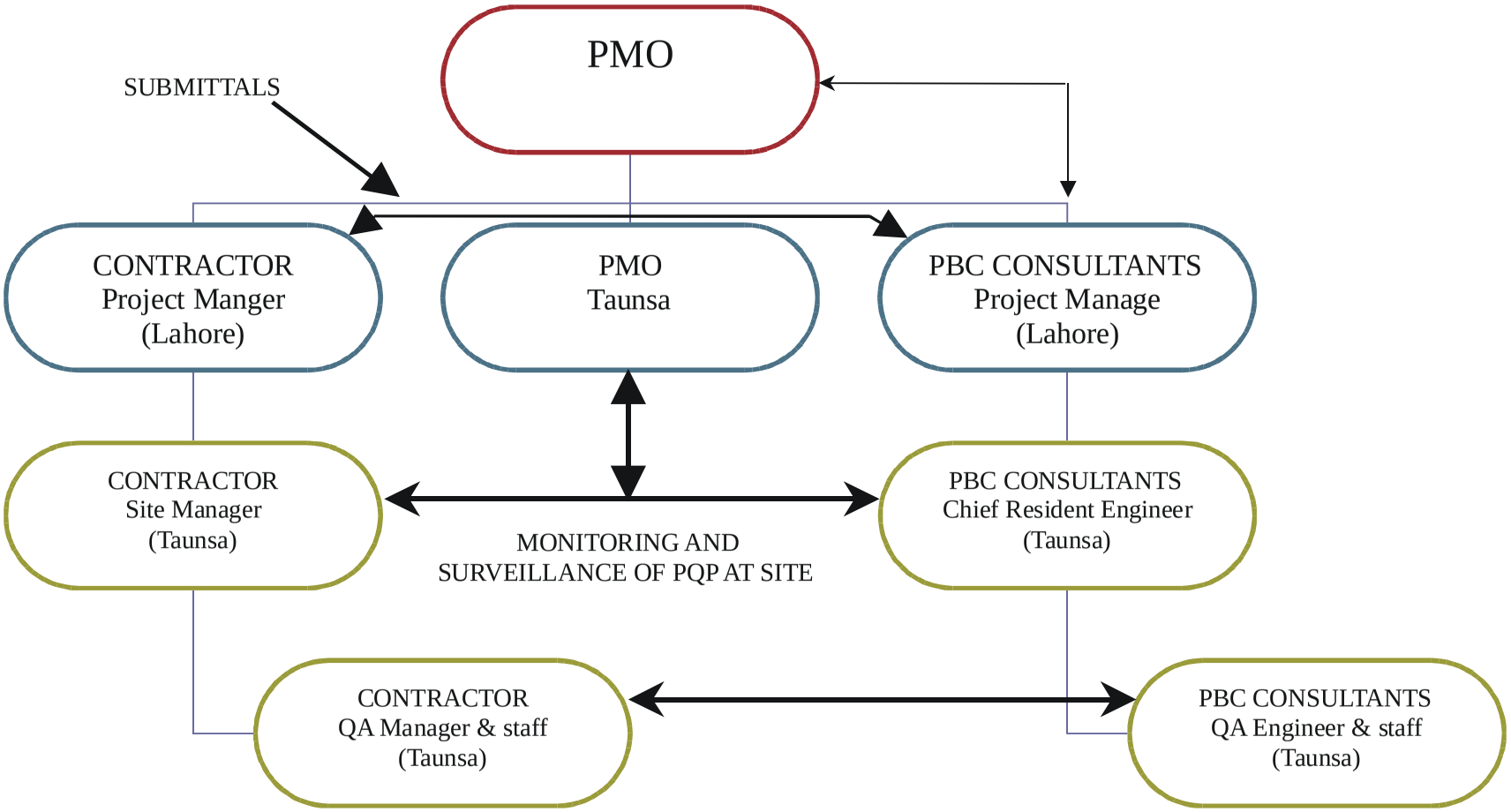
All the project works were done in full conformance with the prescribed standards, drawings and specifications and no significant quality incident occurred. However as a routine measure any deficiencies observed by the supervisory staff in preparation stage were notified through necessary field memos verbal instructions and letters and pursued till rectification to ensure quality.

The quality control data was put to internal audit and the works quality was found to be very good in all aspects.

The project works were visited by a large number of professionals from various organizations like Pakistan Engineering Congress, FWO, Engineers of 2nd Corps Multan, World Bank teams, Panel of Experts and others, who appreciated the works quality. The project also provided training and experience of this special type of works after 35 years, all through domestic resources.

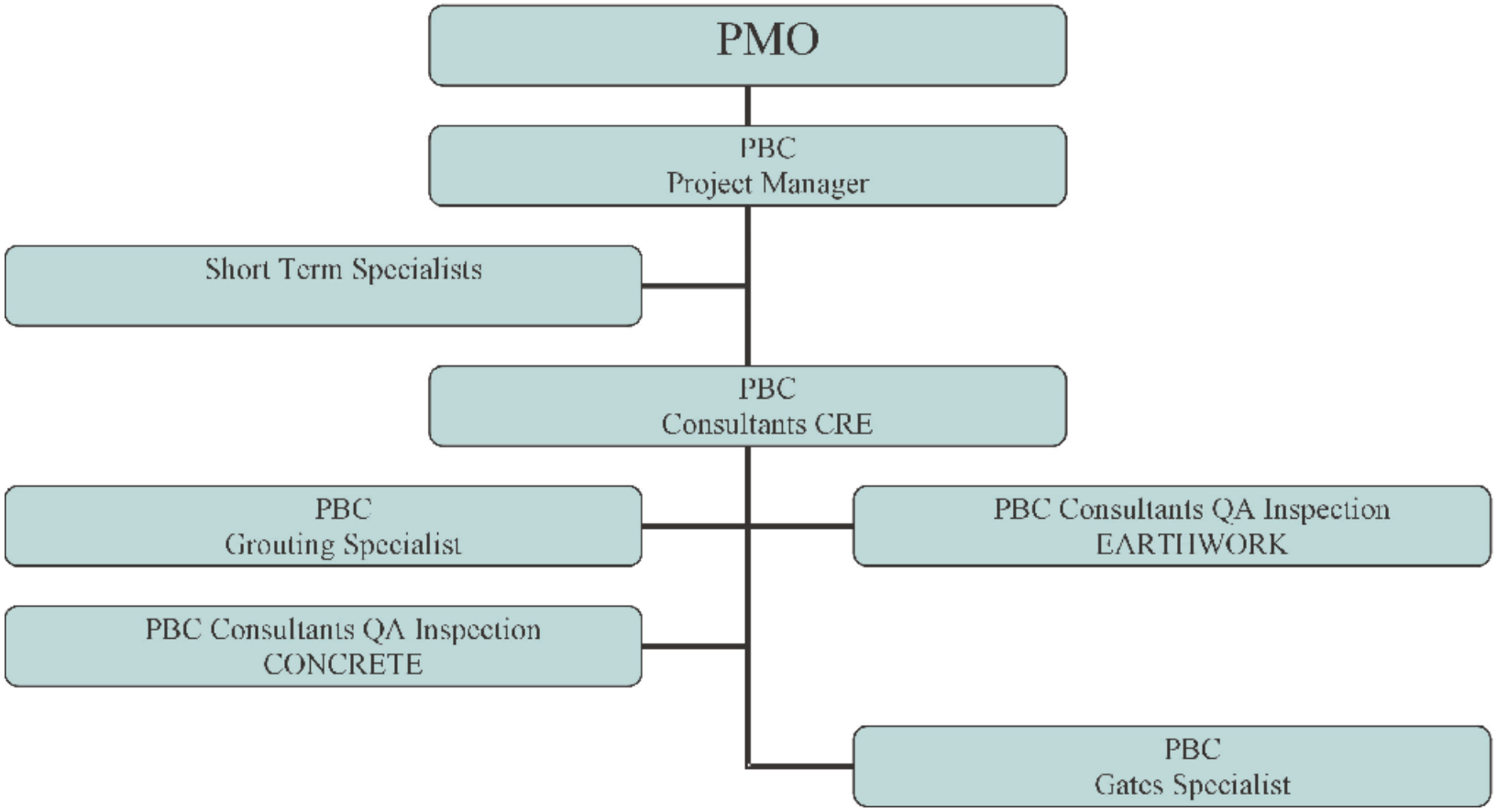

Taunsa Barrage Emergency Rehabilitation and Modernization Project
Organization Chart for Punjab Barrages Consultants (PBC)
(As of January 31, 2008)
Board of Management-PBC
Project Manager
SMA Zaidi
Deputy Project Manager
Abdul Rauf
Chief Resident Engineer
M.M. Asif
Project Office Lahore
Expatriate Staff
4 Specialists
Contract Specialist
M.A. Sattar
Head Design
Akram Khan
Advisor Gates & Hoists
S.K. Bhatti
Quantity Engineer
M. R. Asghar
Office/Contract Engineer
Kashif Shamas
Junior Engineer
Sabir Salman
Sr. Design Engineer Structures
Sr. Engineer Electrical
S.A. Ali
Sr. Design Engineer Hydraulics
S. Rehman
CAD Engineer
M.A. Randhawa
Sr. Geotech. Engineer
I. Rehman
Pr. Engineer
O/C
Javed Asad
RE Mecanical
ARE Electrical
M.S. Javed
Gate Specialist
R.M Riaz
ARE Mechnical
S Cheema
RE Construction
A. Cheema
ARE Construction
Memon
Pr. Engr. Instrumentation
R. Rehman
ARE Grouting
Z.H. Bukhari
Environmentalist
Dr. S. Mehmood
Survey Engineer
A. Ahmadani
Social Dev. Specialist
R. Mashadi
HSE Monitor
R. K. Ali
Communication Specialist
Aqeel Ahmad
Junior Engineers
Several
Already in Position
9
Already in Position
To be mobilized as needed
Staff Input Completed

TAUNSA BARRAGE EMERGENCY REHABILITATION AND MODERNIZATION PROJECT ORGANIZATION AND FLOW OF



TAUNSA BARRAGE EMERGENCY REHABILITATION AND MODERNIZATION PROJECT
SUPERVISION CONSULTANTS QUALITY ASSURANCE AND QUALITY CONTROL PROGRAMME

Summarized Organization Chart



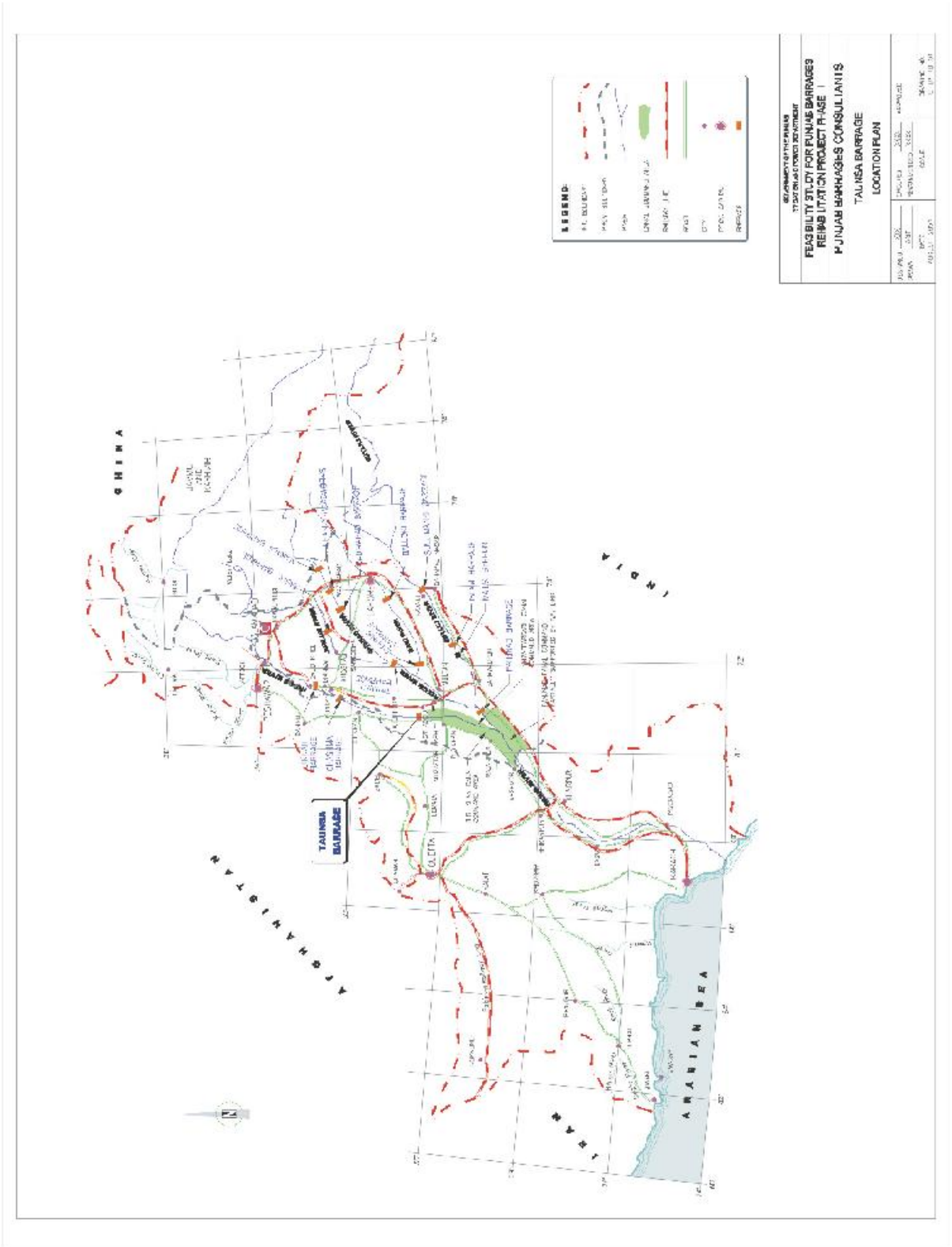


Figure 10: Location plan of the Barrage

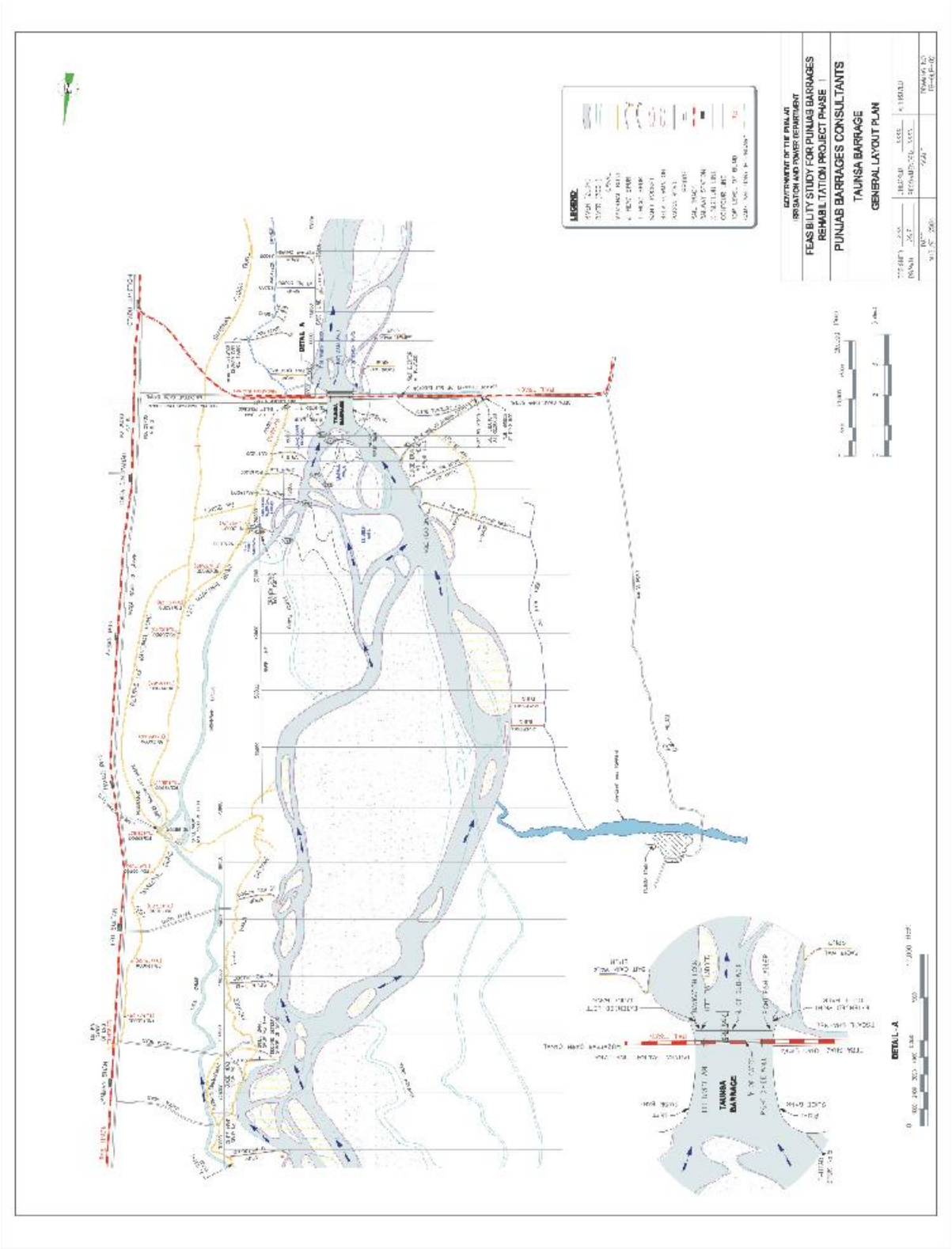


Figure 11: Layout of the Barrage



Figure 3: Upstream View of the Barrage

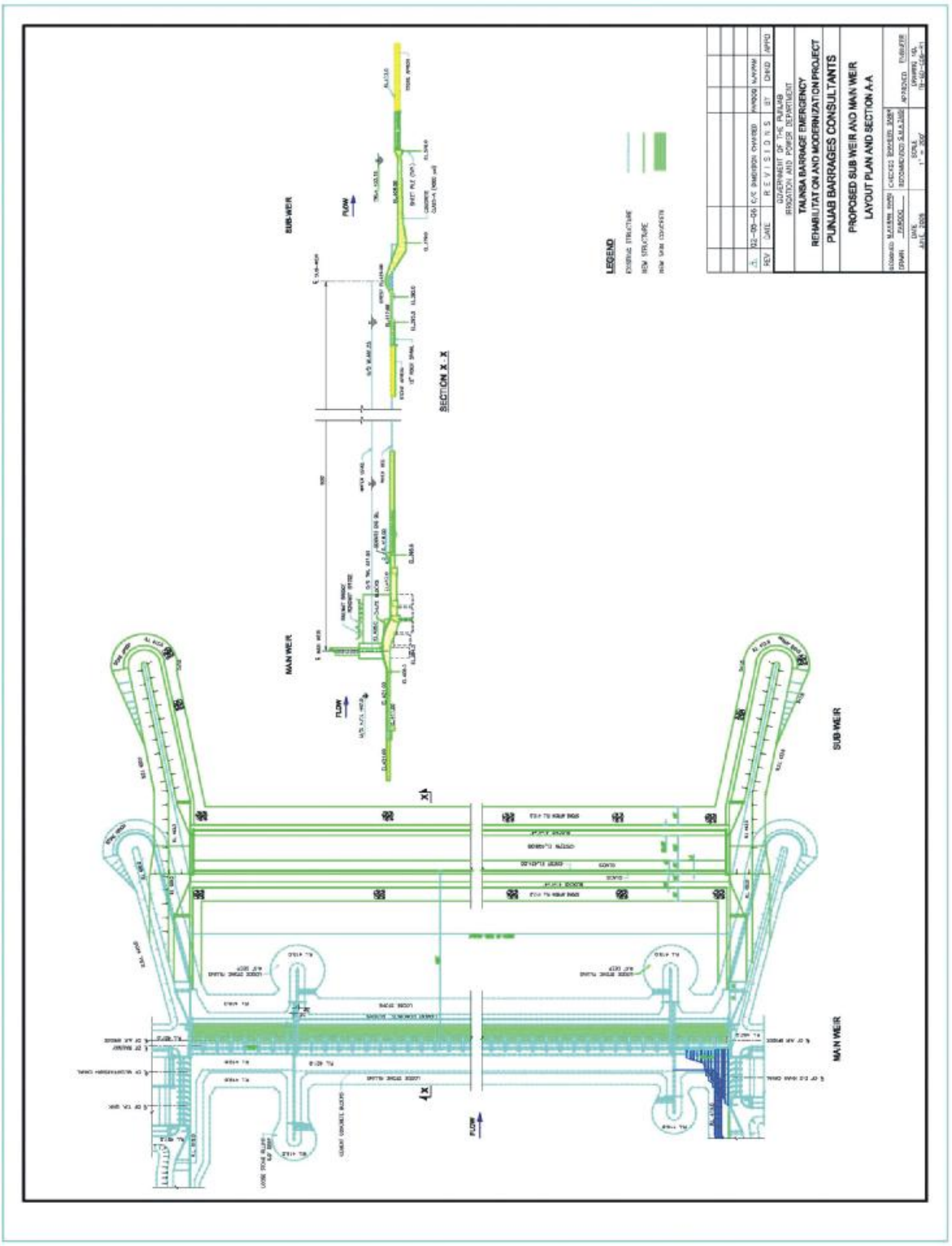


Figure 12: Main Existing Barrage and Sub-Weir - Plan and Cross Section