



December 2009

Technical Audit Final Report
(Loan 2140-AFG: Andkhoy-Qaisar Road Project,
Contract Package 1)

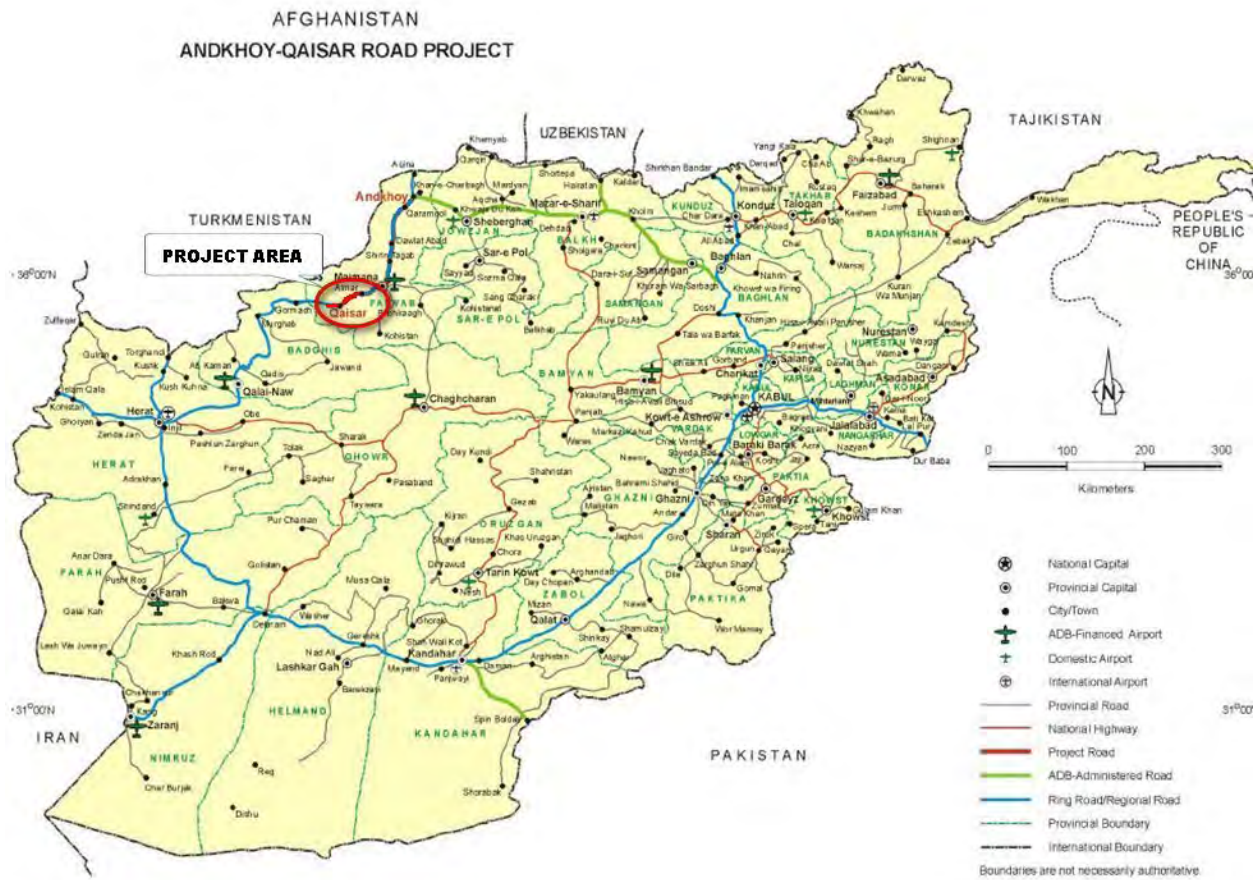
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Technical Audit Final Report

Contract Number S19303

Afghan Ministry of Public Works

Andkhoy-Qaisar Road Project, Contract 1



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RESOLUTE
CONSTRUCTION MANAGEMENT

December 10, 2009

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1. Introduction

The Asian Development Bank (ADB) has engaged Resolute Construction Management and their Consultant (the Auditor) to execute a Technical Audit for a roads project in Afghanistan. This Report is a required deliverable in accordance with the terms of contract S19303, Technical Audit of Roads in the Andhoy-Qasir region (ADB loan 2140 AFG, ICB1), funded under TA/SRC 4675, *Islamic Republic of Afghanistan: Capacity Building for Road Sector Institutions*.

In compliance with its charter to reduce poverty in Asia, ADB published Technical Assistance Report AFG 37075 in September 2003, the watershed event for the Andhkoy-Qasir Road Project. The essential goal of the project is to improve economic development in the region and reduce poverty through improvement of the main road. After a series of procedural events and project developments, contracts for a portion of the work to improve the road were awarded to Snowy Mountains Engineering Corporation (SMEC) as the Engineer and China Railway Shisiju Group Corporation as the Contractor. The Afghan Ministry of Public Works (MPW) acts as Employer and Executing Agency for this project. The work commencement date at Contract award was August 28, 2006 and the initial Contract completion date was August 27, 2008. In the interest of improving oversight for the project and to gain key information to improve performance for this and future projects, ADB commissioned a Technical Audit of Loan 2140, ICB1 in November, 2009, resulting in this Report.

During November and December of 2009 Ron Hunter, an American Professional Engineer registered in Virginia, United States of America acting on behalf of Resolute Construction Management, LLC, conducted the activities of this Audit and authored this Report. This Report comprises a summary of review activities and conclusions resulting from the Audit. The record of onsite observations and audit activities may be found at the end of this Report.

2. Scope and Purpose

The general Scope of Work for this audit is to evaluate the technical compliance of the project's documentation, work processes, and work in place. The evaluation includes document review, onsite evaluations, reporting, photography, and recommendations. The scope of this evaluation is limited to the portion of road between Chilgazi (km 343+00) and Almar (km 398+00), referenced as ICB1 in the project's Report and Recommendations to the President, November 2004.

The primary purposes of the Audit are as follows:

1. Review the original design and feasibility study and compare it to the detailed design drawings to assess net design variations/ changes and justification of the ensuing variation orders.
2. Review the contractors' means and methods, manpower, plant at mobilization and maintenance during the implementation period.
3. Check the construction at the site if undertaken according to the specifications, for the subgrade, grade, sub-base, base and top surface construction, and lab test results.

This project has been evaluated based on the technical requirements of Asian Development Bank's Loan 2140-AFG contract, AASHTO design standards current as of the original Contract date, the 1999 FIDIC *Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer* and the *Islamic Republic of Afghanistan Interim Road and Highway Standards (IRAHS) R1*, 21 March 2005. The road to be evaluated is categorized as a "Regional Highway" as defined in the IRAHS.

3. Executive Summary

This Summary includes a few brief comments regarding the project, with the intent of providing general, useful statements that can be made as a result of the findings of the Audit. The text of the Report covers each statement in more detail, with references to specific documentation and observations that support the statements made here.

The project continues past the current approved completion date of November 30, 2009. Of essential interest to the project's key stakeholders is the question of whether or not the Contractor's Requests for Extension of Time (REoT) are valid and whether or not damages should be assessed based on the Contractor's failure to complete on time. The conclusion of this Audit is that previously negotiated and approved REoT were adequate and that further time extension is not justified. Given the Contractor's history of failure to comply with its own program revisions to get the project on schedule as a result of previous negotiations, the execution of the delay damages clauses of the contract is recommended at this point.

The Contractor has submitted a Claim for escalation in materials prices that occurred during the Contract's execution period. A significant increase in earthworks quantities and associated extension of time was included in Variation order One, which was approved. There do not appear to be any significant recent changes in materials that would justify a price escalation. The conclusion of this Audit is that no requests for price escalation should be considered for the time period after the currently approved completion date. It is further recommended that for consideration, any request for escalation in rates should include detailed financial, payroll, and procurement records that indicate the specific goods or services for which escalation is requested with the dates of purchase, and in what amounts. The Construction Supervision Consultant should compile and carefully analyze all escalation-related financial information and assemble the data into a clear, comprehensive report that concludes with a justifiable lump sum for the price escalation claim. The Employer and Donor are strongly urged to reject without consideration the open-ended claims to escalation that have been previously submitted by the Contractor and Engineer.

The quality of materials observed in the completed work was found to be acceptable, with the notable exception of the cement procured for the project and used for bridge construction. The sulphate resistance and other materials properties of the procured cement should be thoroughly tested for compliance with AASHTO M85, Type II. If the cement is found to be non-compliant, appropriate mitigating action should be taken based on the conclusions of competent structural engineers and materials engineers.

The workmanship of the observed work in place was found to be acceptable with the notable exceptions of bridge bearing placement, girder placement tolerances, and bridge reinforcing steel welding. The

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Auditor recommends that the Engineer immediately engage qualified bridge engineering staff whose sole responsibility is to monitor the quality of the construction for all bridges in ICB1. The Auditor further recommends that the Contractor engage qualified quality control personnel for the same purpose, as well as welders and welding inspectors certified as required by AWS D1.4.

The project's safety measures for the project's workers and the users of the road were not found to be acceptable. Serious, preventable accidents have occurred recently, including a worker fatality and a head-on collision on the road that resulted in multiple serious injuries. A thorough review of the Contractor's safety personnel, traffic plan, equipment, procedures, and enforcement is strongly recommended.

The social and environmental conditions of the project were not found to be acceptable. The contractual requirements for social training are not implemented in any observable way. Accommodations and sanitary facilities for workers were found to be substandard, including the lack of heat and a water shortage for workers living at the asphalt plant compound.

The Contractor's security personnel, procedures, facilities, and equipment were not found to be acceptable. The Contractor has not responded adequately to ADB and SMEC instructions to plan and execute changes to security methodology. The conclusion of this Audit is that any Contractor's Claims related to security issues are not justified because of a lack of diligence on the Contractor's part. The Auditor recommends that the Contractor be required to comply with the recommendations of an independent security expert, at the Contractor's expense.

The Engineer's performance on the project was found to be substandard. In essence, contract issues have not been clarified and prioritized in a way that promotes timely and cost-effective contract management. The Engineer generally does not offer meaningful, actionable analysis and recommendations to PMU/MPW and ADB. The Engineer's staffing levels are not adequate to fulfill the obligations of their Contract. Most of the expatriate staff that is shown on the Engineer's Consultancy Agreement has demobilized or been replaced. Virtually all of the Engineer's local staff was recently demobilized, during a critical period of bridge construction. The Engineer's system of recordkeeping and the document control staff were found to be inadequate for the purposes of the Audit. The Team Leader has left the project for vacation twice this fall, leaving no responsible person in charge that can respond to communications and act on time-sensitive project issues.

PMU/MPW's performance on the project was found to be marginal. PMU/MPW does not appear to have trained and engaged the staff necessary to properly manage the contract and assure its timely and compliant execution, particularly with respect to oversight of the performance of consultants. During the onsite portion of the Audit, PIU Engineers were found to be on the site and engaged with the project. However, the operational capability of PIU Engineers is curtailed by limited contact with the Engineer's team and an unclear definition of PIU's role in project execution decisions. The Auditor's impression is that PIU Engineers are not perceived to represent MPW's contractual and reporting responsibility on the project. PIU's performance is further limited by a shortage of English-proficient PIU

Engineers. At this stage of their development, PMU/MPW appears to be nearly completely dependent on consultants for project information and recommended action. The Auditor recommend further capacity development for PMU/MPW in the form of detailed staffing plans and staff training in project management, document control, safety standards, security methodology, and quality assurance.

4. Document Review Activities

The goal of the document review portion of the Audit is to determine if the project's documentation is adequate to communicate compliance as well as to evaluate the compliance of the materials and procedures used to build the project. Depending on the competency, commitment, and staffing levels of the entities engaged to document and build the project, project documentation may not be adequate to determine the compliance of work in place. In general, document review is focused on contractually required elements that will significantly impact the outcome of the project. Evaluative criteria include access to documentation, compliance with standards, and the effectiveness of the documentation in achieving the goals of the program. Details which are not strictly in compliance but which have been

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successfully executed to meet the goals of the project may be documented as part of the evaluation effort but excluded from the main body of the report for brevity.

4.1. Procurement of Goods and Services Documentation

A sampling of the available goods and services procurement documentation has been evaluated for compliance with ADB/MPW requirements and guidelines. Requests for approval and contractor bid evaluation records have been reviewed.

The procurement documentation that has been reviewed at this point appears to be in compliance with FIDIC, ADB, and PMU/MPW requirements.

The process used to procure the Engineer and Contractor were found to be in compliance with FIDIC and ADB guidelines. However, the technical review of the Contractor's bid did not detect the errors in the Feasibility Study that was used as a basis for bid.

4.2. Design Documentation

A sampling of the design and construction drawings has been reviewed and compared to the Feasibility Study design. Design drawings, calculations, and narratives have been reviewed for compliance with the perceived intent and specific technical requirements of the design elements of relevant contracts. A sampling of the construction and design drawings has been compared to the currently negotiated Bill of Quantities.

Significant discrepancies were found between the Feasibility Study design requirements and the design documents submitted by the Contractor's designer.

4.2.1. Maximum Grade Criteria

The Feasibility Study design tabulates the various geometric design criteria for the Herat-Ankхой Road Project in the Summary Report, on Sheet 19. The same information is repeated in the Feasibility Study Appendix 6, Table 1. The table is duplicated once more in the Bid Documents, Volume II, Table B01. The Design Implementation Plan submitted by the Contractor includes the same information in Table 3.1. The maximum allowable gradient for various terrain conditions are shown. The maximum allowable gradient for exceptional conditions in exceptional conditions is 18%, for mountainous conditions 14%, and for rolling conditions 8%. The applicable terrain conditions for the Heart-Andkhoy Road Project are listed on pages 20-22 of the Feasibility Study Summary Report. For the Contract 2 portion of the alignment (shown as PK 398 to PK 468) there are 20 km of level road, 45 km of rolling terrain, 5 km of mountainous terrain, and no terrain described as exceptional.

The Bid Documents, Volume II, Section B109 specify a maximum gradient of 18% in exceptional conditions, using the same terminology as the Feasibility Study.

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The November, 2004 Report and Recommendations to the President are consistent with the Feasibility Study and Bid Documents with respect to terrain classification.

AASHTO standard "*A Policy on Geometric Design of Highway and Streets*" (2001), Exhibit 7-2 makes recommendations regarding maximum grade criteria for rural roads. See section 2 for a reproduction of the exhibit, which shows a maximum gradient of 8% in mountainous areas.

To be clear, none of the design documents associated with the tender were compliant with the AASHTO standard with respect to maximum grade. Apparently the error made by Getinsa/Sheladia in the feasibility study was simply copied over to the subsequent project documentation, without referring to the AASHTO standard for verification.

Therefore the maximum gradient of the initial Contractor's design should have been 8% for compliance with the Feasibility Study design and the Bid Documents, and the Contractor's original design was non-compliant.

Any adjustment to the bid quantities based on an employer-driven variation from the requirements of the Feasibility Study and Bid Documents should have been based on an adjustment of maximum grade from 14% to 8% for 5km of the alignment.

The current design under construction includes no gradients over 8%.

4.2.2. Design Speeds

The Feasibility Study tabulates terrain categories and corresponding design speeds on Sheet 19 of the Summary Report, with flat, rolling, mountainous, and urban terrain assigned design speeds of 80, 60, 40, and 50 km/hour respectively.

The Bid Documents, Volume II, Section B108 (highway design) specifies the same design speeds and terrain classifications as the Feasibility Study, again with no mention of any exceptional conditions and 5km of mountainous terrain. The Bid Documents, Volume II, Section B109 (pavement design) specifies 100km/hour design speed for the entire alignment for horizontal curves, with appropriate reductions in urban areas. Section B109 specifies the Feasibility Study design speeds for vertical curves and superelevation.

The Contractor's May 2006 Design Implementation Plan duplicates the design speeds and curve radii requirements shown in the Feasibility Study.

To summarize the grade change discussion, there appears to have been enough information in the bid documents for bidders to correctly base their proposals on earthwork quantities that were determined from a design that included a maximum grade of 8%. Further there appears to have been enough information available to the technical bid evaluation committee to find the erroneous earthwork quantities and request revised bids. However, the responsibility for delays due to design changes lies

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with the Contractor's designers since the information to submit a compliant design was available at bid time.

4.2.3. Sight Distance

Stopping sight distance often controls the vertical alignment design with respect to maximum grade. The details of the discussion (references, dates, etc) regarding stopping sight distance are similar to those for maximum grade and will not be repeated here. Similar to the maximum grade error, Getsina/Sheladia's Feasibility Study did not comply with the minimum stopping sight distance recommended in AASHTO Exhibit 7-1, "Minimum Sight Distances for Arterials". The Feasibility Study showed a minimum distance of 55 meters, while AASHTO 7-1 requires a minimum distance of 65 meters. This error was apparently also transferred to subsequent documentation without reference to the AASHTO standards.

4.3. Project Team Effectiveness

The approval process for resolution of variation orders, changes to procurement plans, materials approvals, and changes to bill of quantities has been evaluated. The Engineer

The effectiveness of the project's organizational structure in resolving project issues in a timely and efficient way has been evaluated. The project's organizational structure is not conducive to timely and concise resolution of urgent project issues. The Engineer and Contractor are directly involved in meetings and decision-making that is the purview of MPW, according to the available project organization chart. The Contractor successfully accesses the project's key players and, if unsuccessful in influencing decisions inappropriately, certainly creates daily unwanted distractions for MPW's PM teams and senior management. To improve this situation the authorship of a communications plan template for MPW personnel is recommended. Such a template should include protocols for Engineers and Contractors, particularly with respect to meeting schedules.

4.4. Construction Progress Documentation

The available progress documentation has been reviewed and compared with the project's actual progress. The reported progress appears to be accurate.

The probability of achieving the Contractor's projected completion date has been evaluated. Based on observed site conditions and the Contractor's available resources, the project could be completed in approximately 30 days. However, most of the equipment at the project site is idle and the Contractor's PM stated repeatedly that there is little intention to accelerate project activities until the outstanding Variation Order is approved.

4.4.1. Contractor's Extension of Time requests

It is the conclusion of this Audit that the Contractor has not shown due diligence and good faith in attempting to complete Contract 1 on schedule. Several alternatives to accelerate work on the project are available to the Contractor that are essentially unrelated to the grade change, and were not begun or still incomplete with a minimal commitment of personnel and resources at the time of the Auditor's site visit:

1. Initial Mobilization.
2. New bridge construction.
3. Procurement and placement of road furniture for the flat areas of the alignment.
4. Completion of wearing course paving.

Weather has been stated as a factor in the Contractor's current request for extension of time. Onsite observations indicate that the Contractor failed to provide diversions for the waterway as required by the Contract, building an embankment under the bridges to allow easy access to pier tops and girders. Therefore the resulting damage to ongoing bridge abutment construction and delays are the result of the Contractor's negligence, not exceptionally inclement weather.

The security risks of working in rural Afghanistan are clearly explained in the bid documents. Security has been stated as a cause for project delay. The Contractor has not demonstrated that any delay outside the Contractor's control has resulted from these incidents. The Contractor has been advised repeatedly to develop an action plan for improving the security on the project. The Contractor's failure to implement revised security measures or submit an action plan discredits their claim for time extension based on the security environment.

4.4.2. Contractor's Escalation Requests

The original Contract as revised on April 23, 2008, including signed stamps from China Railway Shijisu Group Corporation (CRSGC) and the Ministry of Public Works was reviewed. The Specific Contract Conditions, Section 8A, specifically states that adjustments for changes in cost and tables of Adjustment Data as shown in the General Conditions of Contract are "not applicable". Section 12.3 clearly states that "The unit rates for all items of the Works described in the Bill of Quantities shall remain fixed during the whole contract period". There was some discussion of consideration of escalation claims during the October, 2009 videoconference with ADB, MPW, and CRS GC.

The recommendation of this Audit is to not consider the Contractor's escalation claims for the following reasons:

1. Escalation and price adjustment are specifically excluded by the contract terms.
2. CRS GC has not shown due diligence in executing the contract on schedule to mitigate the cost of such escalation claims.

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3. Consideration of the escalation claims is time consuming, delays the project's contract administration, and provides an incentive for CRSGC to further delay the project.

4.4.3. Contractor's Payment Requests

The Contractor's approved payments are frequently delayed. A review of the payment process is recommended, particularly with respect to MPW's interaction with MOF. MOF's invoicing guidelines and other procedural requirements should be reviewed by MPW and the Engineer, to assure that there are no unnecessary delays in the Contractor's approved payments.

4.5. Maintenance Manuals

FIDIC 4.1 (d) Contractor's General Obligations, requires the submission of maintenance manuals with the as-built drawings.

The September 5, 2006 Engineer's Consultancy Agreement, Clause 2, Bullet number five states clearly requires the production of a " Maintenance Manual detailing routine and periodic maintenance tasks that will be required to maintain the completed Project, to be submitted within 12 months of commencing services".

BoQ Item 113 of the April 2006 Design-Built Contract requires that the Contractor maintain the carriageway and remove snow in the winter. Planning for maintenance tasks is an important component of successful and cost-effective road maintenance.

Discussions with the Engineer and Contractor indicate that neither feels that the authorship of maintenance manuals is required by the Contract. Maintenance manuals do not appear to be in production or planned at this time.

In the interests of minimizing the risks to timely project completion and the public safety in the coming winter months, the Engineer should immediately produce the required maintenance plan for the coming winter season.

4.6. Quality Control Documentation

The Contractor's Quality Control Plan has been reviewed for consistency with the Technical Specifications and applicable Standards. A sampling of the required outputs of the plan has been evaluated for consistency with the Quality Control Plan.

The Contractor appears to have a quality control system that assures completeness of recordkeeping and quality control personnel were observed to be following the procedures as described in the plan with respect to materials testing, compaction procedures, and placing of permanent roadwork. QC was observed to be acceptable for cast-in-place concrete work and precast concrete work. QC was found to be poor to non-existent for bridge erection work.

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Observed compliance issues were resolved via verbal notification by the Resident Engineer and rework. The Contractor documents test failures and rework activities on the appropriate test documentation. The Engineer does not appear to have a complete record of compliance issues and does not appear to have the onsite staff to properly document the project's test failure rate and level of compliance.

Observed Inspection procedures appear to be in compliance with contract requirements and industry standards. However, the Engineer is passive with respect to inspection and does not inspect the work without a formal Request for Inspection. Based on discussions with the Resident Engineer and observations of onsite activities and staffing, the Engineer is able to observe approximately 20% of the testing and work methods of the Contractor. Bridge construction in particular is underinspected by the Engineer.

Based on a review of the available documentation and interviews with Engineer personnel, the Engineer's staff cannot be considered to be consistent and effective.

4.7. Quality Assurance Documentation

Section C100, Quality Control and Quality Assurance of the Bid Documents, Volume II requires that the contractor establish quality assurance procedures pursuant to Clause 4.9. Volume IV, Section 3.8 of the April 2006 Design-build contract requires that "The contractor will establish and operate throughout the execution of the works a quality assurance system similar to the ISO standard." and "...the Contractor will prepare the Quality Assurance Plan that will be applied to the project and it will be reviewed and updated throughout the execution of the project as may be necessary..."

The Contractor Quality Assurance Plan is included as a part of the Contractor's "QC/QA Plan". No differentiation is made between Quality Control and Quality Assurance activities or personnel in the text of the plan. There is apparently no Quality Assurance Plan for this project. This approach indicates a lack of understanding of the critical role of Quality Assurance in construction. The Resident Engineer expressed in the October 5 interview that there is no perceived responsibility on the Engineer's part for Quality Assurance activities.

Quality Assurance planning and implementation is clearly assigned to the Contractor in Section C100 and the BoQ preamble of the Contract, with provisions for the Engineer to provide this service at the Contractor's expense in lieu of the Contractor's compliance.

For compliance with generally accepted construction quality assurance practices and ISO 9000 requirements, the personnel involved with quality assurance review should not be the same personnel that are executing the project's quality control plan. The contractor's method statements and the "QA/QC" approach are not in compliance with generally accepted practice and contract requirements.

As a recommended mitigating measure for future projects, the Auditor recommends the following: Clearly define quality assurance procedural and personnel requirements, with specific QA tasking. Assign specific QA tasking to the Engineer or, preferably, require that the Executing Agency engage an

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independent party for the purpose of quality assurance monitoring and training of EA personnel in QA methodology.

4.8. Level of effort for value engineering during the design phase of the project.

Though a significant level of effort was expended on numerous design studies and cost analyses in an effort to achieve a reasonable compromise between cost and acceptable design compliance as a result of the initial design's compliance issues, it is the conclusion of this Audit that these efforts do not constitute a specific value engineering activity. The process that negotiated the quantities and rates that were approved for Variation Order One lacks the organizational and analysis elements that are necessary to produce a meaningful VE product. The Engineer relies on the Contractor's personnel and technical expertise for outputs, a situation that is not conducive to optimum pricing.

5. Evaluation of Onsite Activities

The goal of onsite observations is to directly assess the project without any intervening opinion between the Auditor's observations and the reporting to the Donor.

5.1. Personnel Qualifications and Staffing Levels



Figure 1 - ICB1 Engineer and Contractor management team. ADB project sign is to the right.

The staffing levels of both the Engineer and the Contractor were evaluated and found to be insufficient to properly monitor and document the project. The Engineer's administrator was not found to be competent to manage engineering and construction documentation. The Engineer's Team Leader was not found to be objective with respect to review of the Contractor's outputs, offering little in the way of meaningful, actionable analysis. The Engineer's Team Leader was not found to be efficient in project communications and did not offer useful clarifications while under the Auditor's observation.

The Contractor does not have full-time Security, Safety, or Quality Assurance personnel assigned to this project. The Contractor takes a passive attitude towards safety, security, and quality assurance, offering no apparent training programs for local staff.

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Of particular concern is the Contractor's management of subcontractors. In discussions with the Employer, Engineer and Contractor it has become apparent that there are knowledge gaps team-wide regarding the responsibility of the Contractor to assure that subcontractors are meeting all of the requirements of the main contract. In particular insurance, safety, and worker accommodations are not managed or monitored appropriately. The Contractor and Engineer seem to be satisfied to report that a subcontractor is deficient in a particular area, without assuming responsibility for their work and assuring contract compliance through enforcement.

5.2. Plant and Construction Equipment

An informal count of the equipment engaged and an assessment of the construction progress on the project indicate that the Contractor and Engineer may be overreporting the amount of plant and construction equipment actually engaged on the project. Onsite observations contradict the Engineer's statements in progress reports that the Contractor is increasing resources and productivity to achieve the project schedule. The following series of photos shows that virtually all of the plant and construction equipment at the project site was idle on Thursday, November 26. This should have been a busy workday for a Contractor whose project is behind schedule.

Also of concern with respect to the Engineer's equipment inventory sheet is the lack of information regarding the insurance of the equipment onsite. The recent traffic fatalities and arson events highlight the importance of insurance verification in compliance with Contract requirements.



Figure 2 – Asphalt batch plant is idle



Figure 3 - Idle equipment at the Qasir equipment yard on Thursday, November 26.



Figure 4 - Idle equipment at the Qasir equipment yard on Thursday, November 26.



Figure 5 - Idle equipment at the Qasir equipment yard on Thursday, November 26.



Figure 6 - Idle equipment at the Qasir equipment yard on Thursday, November 26.

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5.3. Materials and materials handling procedures

Stockpiles were observed at the contractor's compounds and along the road alignment. Aggregate materials handling procedures and travel times appear to be in compliance with industry standards and specifications. Some subgrade aggregates at the Douwtab yard were observed to have an apparently low content of crushed faces (see photo). For comparison, Figure 7 shows similarly sized aggregates at the Mainema yard for ICB2. The Contractor and Engineer were evasive when asked about this, first claiming that the aggregate was for another project, then stating that 75% crushed faces are in accordance with the spec but admitting that the material had not yet been tested. It is the recommendation of this Audit that the Engineer be requested to produce thorough documentation regarding what aggregates were installed for the project, and to demonstrate via analysis and reporting that all of the aggregates installed were found to be compliant via a compliant testing program.



Figure 7 - Aggregates for the asphalt mix with low crushed face content-ICB1



Figure 8 - Aggregates for the asphalt mix with low crushed face content-ICB1



Figure 9 - Random Sample of Coarse Aggregate at Mainema-ICB2 (shown for comparison)

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5.3.1. Road Furniture and Hardware

Road furniture and bridge hardware had not yet been shipped to the site at the time of the site visit. The Engineer has stated repeatedly in progress reports that this is a problem, yet has consistently approved payment for these items in accordance with the original program. The recommendation of this Audit is that the Engineer and Employer halt all payment for road furniture, bridge hardware, and similar items until the Contractor shows with photographic evidence that the items have been installed.

Reinforcing steel is stored outside on the ground in unacceptable weather conditions. The Engineer's plan to require inspection and cleaning of reinforcing steel before installation is an unacceptable substitute for proper storage as required by the specifications. The Engineer appears to be complicit in this and most other site issues of concern, offering excuses for noncompliant work rather than noting and responding to the issues found by the Auditor during the site visit. There are costs associated with specifications compliance and the Contractor is very unlikely to comply with quality requirements without the Engineer's diligence.



Figure 10 - Reinforcing steel is not stored as required by the specifications.

5.3.2. Cement

The specifications, C900 Part A state AASHTO M85 as the required compliance standard for Portland cement for Contract 2. There are eight categories of portland cement available to designers in AASHTO M85. Sulphate Resistant Cement (Type II or SRC) is strongly recommended for bridge construction, particularly for subgrade and at-grade elements such as approach slabs, abutments, pier foundations, etc. Similarly Type II cement is recommended for concrete culverts. Depending on the sulfate content of soils or if the soils sulfate content is unknown, Type V cement with high sulfate resistance is recommended. A thorough Engineer's analysis of this material is recommended, including a soils assessment for sulfate content and a chemical analysis that indicates the sulfate resistance characteristics of the concrete in place and its predicted impact on design life. The following photos show that Ordinary Portland Cement is being used for bridge construction.



Figure 11 - Cement Bag-Front



Figure 120 - Cement Bag-Back. Bags do not include the Type I/Type II designation as required by the Engineer.

5.4. Roadway Construction

The procedures, personnel, and equipment observed during the placement of the hard shoulder were found to be acceptable. Photos of the observed operation are shown below. In general the surface quality of the finished roadway was found to be acceptable.



Figure 13 – Hard shoulder compaction

5.5. Bridge Construction

The welded reinforcing steel that is being installed for bridge construction is a major concern for this project. While welding of reinforcing steel splices is permitted by part E of the specifications by the statement “Welding shall conform to the Structural Welding Code, Reinforcing Steel, AWS D1.4 of the American Welding Society and applicable special provisions.”, such welding is problematic under the best of circumstances and should not have been permitted for this project. Certified welders and specialist welding inspectors are required to assure that the welds transfer stresses in accordance with design requirements. The Engineer and Contractor’s Project Manager stated in discussions onsite that there are no certified welders or inspectors engaged on the project, thus there is no way to produce compliant construction or verify compliance through inspection.

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Observed bridge bearings were found to be installed on uneven pedestals. Significant visible gaps were observed between the elastomeric bearings and the girder soffit. It is unlikely that the bearing manufacturer will honor any warranty claims related to the bearings in the future given the installed bearing conditions.



Figure 14 - Uneven bearing at Bridge 3

The elevations of the top surfaces of installed precast girders appear to exceed the 5mm tolerance allowed by C300, Part 2, Table 3-3 of the specifications.



Figure 15 - Girder Positions at Bridge 3



Figure 16 - Top surface of precast bridge girders do not appear to meet specified tolerances.



Figure 17 face of precast bridge girders do not appear to meet specified tolerances.

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5.6. Compliance with training and social requirements

Subclause 6.7 of the Bid Document stipulates that the Contractor shall "...throughout the contract (including the Defects Liability period): (i) conduct, Information, Education and Consultation Communication (IEC) campaigns, at least every other month, addressed to all the Site staff and labor (including all the Contractor's employees, all Subcontractors and Consultants' employees, and all truck drivers and crew making deliveries to Site for construction activities) and to the immediate local communities, concerning the risks, dangers and impact, and appropriate avoidance behavior with respect to of Sexually Transmitted Diseases (STD)- or Sexually Transmitted Infections (STI) in general and HIV/AIDS in particular; (ii) provide male or female condoms for all Site staff and labor as appropriate; and (iii) provide for STID and HIV/AIDS professional screening, diagnosis, counseling and full treatment as for HIV/AIDS opportunistic infections (except that in case of HIV/AIDS, cases treatment shall be limited to referral edal to a dedicated national STI and HIV/AIDS program, unless otherwise agreed) of all Site staff and labor."

The Contractor's Project Manager stated in interviews that there is no social training program on this project. No training materials, meeting minutes, or other documentation supporting the existence of an IEC program was provided. No posters, signs, personnel, or other evidence of a IEC campaign or professional health care staff was observed during the course of the audit.

5.7. Road and Highway Signage Evaluation

The signage and other road furniture shown on the design drawings appear to have been designed in compliance with contract requirements and applicable international standards.

No signage or other road furniture or striping work had been completed on Contract 2 at the time of this report. Kilometer stones and marker posts are being fabricated at the Mainemah camp. No other fabrication of road furniture was underway at the time of the audit.

5.8. Safety Considerations

According to the Contractor's September, 2006 Method Statement, Section 3.6, "The Contractor will immediately report to the Engineer the particulars of any accident or any unusual or unforeseen occurrences at site, regardless of whether or not they are likely to affect the progress of Works."

The Contractor and Engineer were not able to produce any safety records for this project prior to October 11, 2009. According to the Contractor's September, 2009 progress report, and the Engineer's December, 2006 Progress Report, no Safety Officer or Safety Manager have been employed for the project, positions that are clearly indicated in the Contractor's September, 2006 Method Statement.

Serious, preventable accidents have occurred recently, including two fatalities. A thorough review of the Contractor's safety personnel, equipment, procedures, and enforcement is strongly recommended before the winter snows exacerbate the situation.

5.8.1. Worker Safety

The scene of a fatal accident involving an equipment operator was observed on November 26. According to statements from witnesses to the accident, the operator was cutting earth with a bulldozer on an unstable slope and the bulldozer rolled down the hillside, catching fire. The operator died from burns and injuries either on the way to the hospital or at the hospital.

The performance of the Contractor's and Engineer's teams in response to the accident can only be rated as grossly negligent. Onsite interviews with the Contractor's Project Manager and the Engineer's Resident Engineer indicated that their responsibility with respect to the fatality ends with the issuance of a memo. Since the equipment was subcontracted and the worker was a subcontractor's employee, both the Contractor and the Engineer stated that the worker is responsible for personal safety, working conditions safety, and insurance. Onsite the Auditor strongly urged the following actions as a result of the accident, and urges the readers of this Report to follow up on the suggestions below with sanctions for noncompliance:

- 1. Thorough and competent investigation into the accident's cause. Adjust safety procedures and personnel in response to the results of the investigation.**
- 2. Recognition of a failure in safety procedures that led to a fatality.**
- 3. Add staff to include safety officers for the worksite. Designate a Safety Manager with responsibility for worker's safety.**
- 4. Adjust safety procedures to include daily inspections with written documentation, emergency transportation, and personnel with basic first aid training.**
- 5. Compensation for the accident victim's family.**
- 6. Verification of adequate and current insurance coverage for all subcontractors, for equipment and personnel.**
- 7. Submit written documentation of actions 1 through 6 above to the Engineer, Employer, and Donor as soon as possible.**



Figure 18 - Scene of fatal equipment operator accident

5.8.2. Road Safety

This road construction project can only be rated as poor with respect to the safety and comfort of the users of the road. No road furniture, signage, or striping has been installed to improve the road's safety for the winter months. Though it was snowing during part of the site visit, no snow removal or ice mitigation equipment was observed to be in operation on the road. The scene of an accident with serious injuries was observed on November 26. Witnesses reported that vehicle speed was a major factor in the accident's cause. If speed limits were posted or the road had been salted/sanded the accident may have been prevented. There were multiple injuries and the most seriously injured victims had been transported to the hospital when the Auditor arrived on the scene.

The creation of a road hazards mitigation plan by the Contractor in close cooperation with the Engineer is recommended.



Figure 19 - Damaged vehicle in November 25 accident.



Figure 20 - Accident victim



Figure 21 - Damaged vehicle



Figure 22 - Accident victim

6. Design Standards

For materials handling and testing, AASHTO “Standard Specifications for Transportation and Methods of Sampling and Testing 2001” shall be used as the prevailing standard.

For road design, AASHTO standard “A Policy on Geometric Design of Highway and Streets” (2001) as modified by the “Islamic Republic of Afghanistan Interim Highway Standards” (2005) shall be used as the basis for evaluation. Various ASTM standards required in the Technical Specifications, too numerous to list here, will also be used as the basis for evaluating the project.

For bridge design, the “AASHTO Standard Specification for Highway Bridges” (2002) shall be used as the design standard, with loading and other design criteria as shown in the technical Specifications.

- a. Bid Documents for the project were created by a consultant on behalf of PMU/MPW and finalized in March, 2005. Section B104 on Page 16, Volume II of the Bid Documents states “The design and construction documents shall comply with the Country’s national standards...”.
- b. The maximum grade shown on Table B01 *Main Geometric Design Standards Parameter* [sic] on page 22, Volume II of the bid documents shows the maximum allowable grade in mountainous areas as 14%, or 18% “exceptional”.
- c. The March 21, 2005 revision of the *Islamic Republic of Afghanistan Ministry of Public Works Interim Highway Standards* (IRAHS) was in effect as of the date on the cover of the Bid Documents. The required maximum vertical grade for major roads in mountainous areas shown on Table 2 of the IRAHS is 8%.
- d. The AASHTO publication “A Policy on Geometric Design of Highways and Streets”, 4th Edition, 2001 is explicitly referenced in the Contract, Feasibility Study, and the IRAHS as the prevailing design criteria for this project. Exhibit 7-2 from the AASHTO policy is reproduced here for reference:

Grades

The length and steepness of grades directly affect the operational characteristics of an arterial. Exhibit 7-2 presents recommended maximum grades for rural arterials. When vertical curves for stopping sight distance are considered, there are seldom advantages to using the maximum grade values except when grades are long.

Type of terrain	Metric Maximum grade (%) for specified design speed (km/h)								US Customary Maximum grade (%) for specified design speed (mph)								
	60	70	80	90	100	110	120	130	40	45	50	55	60	65	70	75	80
Level	5	5	4	4	3	3	3	3	5	5	4	4	3	3	3	3	3
Rolling	6	6	5	5	4	4	4	4	6	6	5	5	4	4	4	4	4
Mountainous	8	7	7	6	6	5	5	5	8	7	7	6	6	5	5	5	5

Exhibit 7-2. Maximum Grades for Rural Arterials

8% is again indicated as the maximum allowable grade at 60km/hr in mountainous areas.

- e. For technical Contract compliance, the maximum grade for any bid submitted for the project should have been 8%, or the discrepancies above should have been resolved before any bid was accepted. The responsibility for publishing tender documents with these technical discrepancies lies with the Bid Documents' authors and reviewers, i.e. PMU/MPW or their consultant. The responsibility for resolving the technical discrepancies associated with the tender process lies with the tender servicing agency, presumably PMU/MPW. A review of the technical bid process documentation, particularly the bidders' requests for clarification, did not reveal that any bidders requested clarification on this issue.
- f. The maximum slope currently shown on the reviewed design drawings is 8%, in compliance with the March 21, 2005 IRAHS.

7. Recommendations Summary and General Conclusions

For the best assessment of the conclusions of this Report, the reader is encouraged to refer to the main text and Executive Summary. For brevity and reference, the main recommendations and conclusions are restated here:

1. The earthworks quantity changes shown in Variation Order One appear to be consistent with the change in the maximum design grade. Bridge concrete, asphaltic components and bitumen quantities shown in VO1 should be reviewed for accuracy by the Engineer, taking appropriate action as necessary.
2. Extension of Time requests beyond those already awarded and associated escalation are not justified.
3. Installed roadway materials and workmanship were found to be acceptable. Installed bridge workmanship and materials were found to be inadequate in some cases. Bridge bearings should be checked for all load conditions.
4. Maintenance Plan is required and should be generated as soon as possible for the upcoming winter snows.
5. Immediate measures should be taken to improve safety conditions for road users and workmen. A full-time Safety Officer should be hired. The Contractor should develop and submit a project-specific Health and Safety Plan and implement it, with monitoring and reporting by the Engineer.
6. The Contractor should comply with previous requests to produce an effective security management plan, following the recommendations of an expert security consultant. The Contractor should hire a Security Officer whose only responsibility is security.
7. The Contractor and Engineer should be required to significantly increase Quality Control and Quality Assurance staff. The Contractor should submit and implement a discrete Quality Assurance Plan, with non-QC personnel to implement it.
8. The Contractor should implement the social contractual requirements in all aspects, with monitoring and reporting by Contractor's QC personnel and the Engineer.
9. PMU/MPW should develop and execute a capacity development plan that assures that there are adequate trained personnel for critical monitoring of Consultants' performance.