ROAD SURVEY & DESIGN SPECIFICATIONS

This section describes the requirements with regard to the survey and design procedures that need to be followed to develop the Design Drawings necessary for the construction of roads under Follady Valley and Bamyan New City Roads Construction Project to be implemented under UNOPS/AGOC Transport Sector Portfolio Program.

The Design works required are as shown but not limited to the following:

• Road works, drainage, erosion control and associated site works and earthworks the application of the various standards, codes and principles to road design is intended as a guide in providing minimum standards for the geometric elements of the road. Of importance to the total development, are factors such as the coordination of vertical and horizontal alignments, fitting the road to the natural contours of the land, preservation of natural features (including vegetation). Also, consideration must be given to practicalities of public access and safety.

UNOPS’s BOQ, Technical Specification and Standard Drawings are to be used by the Contractor. Variations from these may be necessary from time to time and these are to be discussed with the UNOPS Engineer and approved prior to detail design work.

DESIGN STANDARDS AND PUBLICATIONS

Road designs should conform to the following standards:


• Ministry of Rural Rehabilitation and Development (MRRD) and Ministry of Public Works (MPW) Standards MRRD Standard Drawings.

• National Rural Access Program Standards.

• MPW technical specifications developed for NRAP.

• Ministry of Public Works, Interim Road standards dated March, 2005


• Design and Control of Concrete Mixtures, 14th Edition

• AASHTO Highway Drainage Guidelines, 2007 Edition

• Any other relevant guidelines and specifications as determined by the UNOPS Engineer

PROJECT DESCRIPTION

The work shall include preparation of a complete set of road design Drawings with required supporting documents and calculations, and associated shop drawings and Specification sections. All facilities shall
be designed in accordance with AASHTO, MOPW, MRRD and Rural Access road Standards and as directed by the UNOPS Engineer

**Road Alignment**

Using professional surveyors staff and utilizing professional survey equipment, including GPS, Total Station and automatic/digital levels, the contractor shall conduct a full topographical survey, develop primary survey controls and establish a control points’ network along the project site based on National Datum benchmark to be used in horizontal and vertical design of the road. The contractor shall develop and set out the Preliminary alignment and verify whether it suits actual field conditions. The alignment shall be modified by the contractor where necessary to give the best possible grade to suit the existing terrain conditions, and minimize the amount of cut and fill.

1.0 Topographical survey

1.1 Establishing Survey Control Points

Prior to carrying out the topographical and level surveys, permanent control points to be established for both horizontal and vertical control along the full length of all roads. The control points shall be placed at maximum intervals of 500 m and located so that a minimum of two adjacent points are inter-visible. A traverse survey shall be carried out to determine X, Y coordinates. The elevations (Z value) of the control points shall also be determined with reference to the existing National Datum.

The permanent control points shall be concreted and center shall be a stainless steel pin with 12 mm diameter. Each control points shall be marked with its reference number, date of construction, elevation and coordinates. These points shall be established at ground level in suitable ground conditions in location where they shall not be disturbed by construction works and shall be maintained throughout the contract period.

Following requirements shall be fulfilled during traverse survey;

a. Horizontal angle and distance measurement
   - Horizontal angle shall be observed by 2 round of angle on 2 different zero settings,
   - A total station will be used for horizontal angle and distance measurement.

b. Accuracy of traverse survey
   Linear miss-closure of the traverse shall be better than 1/10,000.

1.2 Leveling

Leveling shall be started from an existing National Datum benchmark.

Requirements for the leveling survey shall be as follows:
i) an automatic level or digital level shall be used;

ii) miss-closure of leveling between existing National Datum benchmarks and control points shall not exceed +30 mm D, where D is distance in kilometers.

1.3 Detailed Topographical survey

Detail topographical survey shall be carried out for the full length of the road. The extend will cover the existing right of way, if any, or a minimum 60m wide strip across the road corridor (extending 30m from the centre-line on the both sides). All topographical details like existing roads, tracks, drainage structures, buildings, services/utilities (electric, telephone and water lines), existing road furniture, right of way markers and kilometer posts shall be surveyed. At bridge location wider area shall be surveyed and the position of all features including the existing bridge, riverbank and at the water-line will be taken to accommodate possible location of the bridge and potentially high approach roads.

1.4 Cross-Section Surveys

Cross-sections shall be taken at 20m intervals and extend a minimum 60m wide strip (extending 30m from the center-line on the both sides) along straight sections. Centerline of the existing road, carriageway limit, shoulders and embankment toe shall be surveyed carefully. At curve section of the alignment and where sudden changes in elevation are encountered, cross section will be taken at closer intervals if required in order to represent the true surface profile.

2.0 Design Criteria


The typical roadway cross-section 6m carriage way and 1.5m gravel shoulder

Project: Bamyan to Folady Valley Road

Roads Type: Asphalt road

Assumed ADT (Mixed Traffic): To be determined by the Contractor through traffic surveys

2.1 Geometric Design

The geometric design criteria shall be based on the Ministry of Rural Rehabilitation and Development (MRRD) and Ministry of Public Works (MPW) Standards and requirements of AASHTO Policy on Geometric Design of Highways and Streets, Fourth Edition, 2001 (Green Book) and Rural Road Access road standards.

2.2 Pavement Design

The gravel and Asphalt pavement design shall be developed by the Contractor to suit actual field conditions that include, but are not limited to:
• Traffic count data
• Climatic conditions
• Existing soil conditions
• Hydrological/geotechnical conditions

All pavements shall be designed in accordance with the AASHTO pavement design standards. The minimum pavement section shall be designed based on a natural sub grade CBR as evaluated from the geotechnical site investigation. The material used for constructing all pavements shall be in accordance with the approved technical specifications and as Directed by the UNOPS Engineer. The design of the pavements and shoulders shall be developed consistent with the site specific geotechnical investigation and submitted for approval to the UNOPS Engineer.

2.3 Drainage

The Contractor is required to design each drainage structure to be constructed to suit the site specific requirements. Roadways are to be viewed as primarily for use by vehicular and pedestrian traffic and for providing access to property by vehicle and foot. They are not to be viewed as primary for drains and floodways. Public amenity and safety are to be paramount considerations;

• Consideration is to be given to the impact of the proposed drainage system on existing drains and buildings and downstream catchments.

• The drainage system is to be designed to ensure adequate removal of rain, flood and irrigation water from the roadway and adjacent road structures.

• Diversion of upstream catchments to independent catchments by the construction of a new road will not be permitted. The designer shall ensure that provision of floodways and culverts is made to ensure catchments are not altered and that no downstream catchment is effected detrimentally.

• Environmental considerations are a major consideration. Erosion and sediment control are required.

• No encumbrance of any land designed, or intended to be utilized as a floodway will be permitted.

• During the wet season, the ground becomes saturated and all drainage design should be carried out with the view that there will be 100% runoff from any and all sites.

• To avoid mosquito breeding, all drainage systems and associated structures should be designed to have no ponding of water.

• Where drainage outlets or outfalls are influenced by tidal action a discharge vs. probability analysis is to be undertaken to ensure that the appropriate annual occurrence probability is being catered for.

The design shall follow the guidelines for Afghanistan Ministry of Public Works, Interim Road standards dated March 2005, Ministry of Rural Rehabilitation and Development (MRRD) and Ministry of Public Works (MPW) Standards, NRAP standards. Due to the variation of land, land use and soil types it is not
practical to list Coefficients of Run-off in these Guidelines. The designer is to assess and confirm the coefficients prior to undertaking drainage design for the proposed development. The designer is to treat any and all drainage catchments as being totally saturated.

The Contractor is to examine the total drainage catchments and ensure that the drainage system for the road is capable of carrying the ultimate design flow from the upstream catchments.

All drainage pipes and culverts including headwalls and aprons are to be constructed in accordance with the Standard Drawings and Technical Specification.

2.4 GEOTECHNICAL INVESTIGATION AND REPORT

3.1 Site Specific Information

Gathering site specific geotechnical information necessary to design and construct the pavement and drainage structures on this project shall be the Contractor's responsibility. The Contractor shall determine all necessary geotechnical conditions by appropriate field and laboratory investigations and supporting calculations.

2.5 Geotechnical Report

The Contractor shall produce a detailed geotechnical report containing the field exploration and testing results, laboratory testing results, evaluations, recommendations, calculations and descriptive supporting text. Information in the report shall include, but not be limited to:

- Existing geotechnical (e.g., surface and subsurface) conditions,

- Subsurface exploration logs, location of exploration points, foundations selected, soil bearing capacity, pavement design criteria (e.g., CBR values, K Values), ground water levels, and road embankment and pavement construction recommendations.

- Materials (e.g., concrete cement, asphalt and aggregates).

- Slope and rock stability evaluation, protection measures.

Two copies of the detailed geotechnical report shall be submitted to the UNOPS Engineer.

All geotechnical engineering design parameters shall be developed by a geotechnical engineer or geotechnical firm responsible to the Contractor. The geotechnical engineer or geotechnical firm shall be qualified by: education in geotechnical engineering; professional registration; a minimum of ten (10) years of experience in geotechnical engineering.

2.6 Design Analysis

A design analysis shall be submitted for review by the UNOPS Engineer. The design analysis is a written explanation of the project design which is expanded and revised (updated) as the design progresses. The design analysis shall contain all explanatory material giving the design rationale for any design decisions which would not be obvious to an engineer reviewing the final drawings and specifications. The design analysis contains the criteria for and the history of the project design, including criteria furnished by the
Engineer, letters, codes, references, conference minutes, and pertinent research. Design calculations, computerized and manual, are included in the design analysis. Narrative descriptions of design solutions are also included. Written material may be illustrated by diagrams and sketches to convey design concepts.

Catalog cuts and manufacturer's data for all equipment items, shall be submitted. Copies of all previous design phase review comments and the actions assigned to them shall be included with each submission of the design analysis. Specific requirements for the design analysis, listed by submittal phase, are contained hereinafter.

2.7 Design Calculations

When they are voluminous, they shall be bound separately from the narrative part of the design analysis. The design calculations shall be presented in a clean and legible form incorporating a title page and index for each volume. A table of contents, which shall be an index of the indices, shall be furnished when there is more than one volume. The source of loading conditions, supplementary sketches, graphs, formulae, and references shall be identified. Assumptions and conclusions shall be explained. Calculation sheets shall carry the names or initials of the computer and the checker and the dates of calculations and checking. No portion of the calculations shall be computed and checked by the same person.

2.8 Drawings

- 2 printed copies and an electronic copy of Structural Drawings where required, i.e. bridges, culverts, causeways, retaining walls, fences, footings; lined drains, etc.

- 2 printed copies (final drawings) and an electronic copy of all Civil Design drawings made up as follows:
  - Road works Layouts (Plans), Longitudinal Sections (Profiles); Typical Cross Sections;
  - Drainage Layout; Longitudinal Sections; Sub Soil Drainage layout
  - Intersection and Details where required (each individual intersection/junction);
  - Design Cross Sections (20m interval);
  - Location Plan and General Notes;
  - Any other relevant drawings.

Each road shall be drawn in plan and profile and design cross sections are to be provided showing all of the following:

- widths of all pavements, verges and medians;

- Distances (chainages) and stations along center line of road (in Km);

- Horizontal curve data;
• Existing and proposed levels;
• Proposed traffic management devices;
• Survey and bench marks and horizontal and vertical datum information;
• Cross Sections to show the offset from the road center line and level differences
• Road center line;
• Traffic lane
• Shoulder widths and levels
• Gradients at any change in cross fall;
• Earthworks limit
• Cuts and fills extending into properties.

Longitudinal Sections
• Existing surface levels along center line (optional both property lines);
• Design levels for road center line
- Levels at 50m maximum spacing for straight grades and 20m maximum for vertical curves
- Levels to be shown at horizontal and vertical curve tangent points and other required locations
• Lengths of grade lines with grades expressed as percentages;
• Intersection and tangent point changes of grade;
• Length of vertical curves and other information;
• Transition and super elevation details.
• Intersections,
• All adjacent lot boundaries;
• Geometric details;
• Design levels at appropriate points;
• Design grades and vertical curve details around curve radials;
• Drainage and other services;
• Right-of-Way Plans
3.0 DELIVERABLES

Delivery schedule for the design submittals shall be developed by the Contractor and approved prior to commencement of design work.

The design documents shall be packaged and submitted as listed below for UNOPS Engineering review.

30% Design Submittal (2 sets A3 size paper copies of drawings, 1 set of reports, analysis, 1 CD with all Documents)
Design Criteria
Topographical Survey
Traffic Count
Geotechnical Report
Pavement Design (based on actual traffic count)
Outline of Technical Specifications
Alignment Drawings
Typical Cross Section Drawings

60% Design Submittal (2 sets A3 size paper copies of drawings, 1 set of reports, analysis, 1 CD with all documents)
Design Analysis/Calculations
Alignment & Profile Drawings
Design Cross Sections at 20m intervals
Typical Details Drawings
Structural and Drainage Design
Hydrology and Hydraulic Report
Environmental Report (considerations)
Technical Specifications
Bill of Quantities
90%-95% Design Submittal (2 sets A3 size paper copies of drawings, 1 set of reports, analysis, 1 CD with all documents)

Final Drawings

Final Technical Specifications

Final Design Analysis/Calculations

Final Reports

Final Bill of Quantities

100% For Construction Set Submittal (3 sets of A3 size hard copies of drawings, 1 full size set of drawings

For construction, and 2 electronic copies- CD. 2 sets of reports and calculations)

Final plans, specifications, design analysis/calculations, reports and BoQ incorporating all

Corrections and comments from engineering reviews.

4.0 AS-BUILTS

4.1. Final As-Built Drawings.

Upon completion of the road under this contract, the Subcontractor shall finalize and furnish the as-built drawings to the UNOPS Engineer for review and approval. The as-built drawings shall be a record of the construction as installed and completed by the contractor. They shall include all the information shown on the contract set of drawings, and all deviations, modifications, or changes from those drawings, however minor, which were incorporated in the work, including all additional work not appearing on the contract drawings, and all changes which are made after any final inspection of the contract work. In the event the contractor accomplished additional work that changes the as-built conditions of the road after submission of the final as-built drawings, the contractor shall furnish revised and/or additional drawings and drawing files as required depicting final as-built conditions. The requirements for these additional drawings shall be the same as for the as-built drawings specified in this paragraph.

The contractor shall furnish to UNOPS one full hard copy set of the approved as-built drawings along with the digital as-built drawing files in the format native to either Auto Desk AutoCAD 2007 or later version as well as in PDF format.