**Urban Policy Unit**
**Planning & Development Department**
Government of Khyber PakhtunKhwa
*30-A, Jamaluddin Afghani Road, University Town, Peshawar*

**Terms of Reference**
**Geometric Design Standard Manual**

## Introduction to Geometric Design:

The geometric design of roads is the branch of Highway Engineering concerned with the positioning of the physical elements of the roadway according to standards and constraints. Road geometric design refers to analysis and calculations. The geometric design of roads are entirely based on the geophysical character of the soil surface and topography of the terrains of KPK by the designer keeping in mind the safety, service and performance standards. It is mainly concerned with the elements of road that are visible to the drivers and users. However, the designer must consider the social and environmental impacts of the road geometry on the surrounding environment.

The geometric design of roadways deals with the dimensions and layout of visible features of a roadway with the objective of creating the roadway facility to the characteristic and behavior of drivers, vehicles, traffic and terrain. Geometric design standards cover a wide range of issues such as choice of horizontal and vertical alignment, road x-section, overtaking provision, etc. However, all geometric road design standards have some underlying basis of vehicle dynamics, vehicle size, driver characteristics or some combination of these. Thus, the physical performance of a roadway is a result of the interaction of vehicular characteristics, human characteristics and the characteristics of the roadway facility. Physical design standards link physical performance of design elements such as horizontal alignment, vertical alignment, cross section, and various design details. Vehicular characteristics include physical dimensions such as length, width, height, wheelbase, axle load, including acceleration and deceleration characteristics; maximum speed.

Geometric roadway design can be broken into three main parts: alignment, profile, and cross-sections. These provide a three-dimensional layout for a roadway.

The alignment is road direction, in combination with a series of horizontal and vertical curves.

The profile is the vertical aspect of the road i.e. longitional section showing the formation and ruling gradient of the roads.

The cross section shows the lateral profiles and the design width of the road for different vehicles running on the road.

## Purpose:

The purpose of Geometric design manual is to provide guidance and recommendations for all categories/classes of the roads fallen in KPK, to the road designers given responsibility to carry out the geometric design of roads in KPK. The use of the procedures in this manual should help in achieving reasonable uniformity in geometric design for a given set of conditions. It should be designed to assist the road designers, researchers, academia and other practitioners to achieve their intended objectives. The manual should contains all the table,

graphs etc which co-relates the elements of geometric design so the user may reach to decision. With a glance, it may clearly shows the input data required for achieving the results from a respective table or graph.

**Objectives:**

To optimize efficiency and safety along with minimizing the maintenance cost and environmental damages, fuel consumption & emissions reduction. Geometric design also affects an emerging objective called "livability," which is defined as designing roads to foster broader community goals, including providing access to workplaces, schools, businesses and residences, accommodating a range of travel modes such as walking, cycling, transit, and automobiles. Following are some more objectives:

To design a road that provides, in a cost-effective and safe manner, an adequate level of service to meet the needs of all road users, including pedestrians, cyclists and motorcyclists,etc.

Determine within the allowance permitted by the design standard and road reserve, the routing of the proposed road.

Incorporate, within the design standard, various physical features of the road alignment to ensure that drivers have sufficient view of the road (obstacles) ahead of them to adjust vehicle speed in order to maintain safety and ride quality.

Provide a basis for the road designer to evaluate and plan for the construction of the proposed road.

To check the importance and function of various roads in KPK and then classify these roads accordingly like District Roads, Feeder Roads, Village Roads, Provincial Highway etc. Now in order to bring uniformity in the similar class of roads. A need has felt that each class of road should have same geometric parameters (X-Sections) so it has been decided by the Provincial Government to Draft Geometric Design Manual for KPK

**TASKS:**

The Government of Khyber PakhtunKhwa through Urban Policy Unit P&DD has organized to introduce Geometric design manual for various classes of road with the assistance of the USAID (Municipal Services Program) as donor, to hire a consultant to deliver in accordance with the best international practices (DMRB, ASHTO and AUSTROAD) those suits in the conditions of KPK for the tasks mentioned below:

1. Review standards and other arrangements being adopted in KPK for road geometry. Identify major weakness, constraints and gaps/conflicts among adopted standards in KPK, other provinces of Pakistan and international standards.

2. Assess impacts of these standards on operation of Transport Infrastructure. Identify and assess existing practises and capacity of relevant agencies/entities involved for geometric design of roads.

3. Presentation of workshops to elaborate and explain elements of geometric design. To explain various tables, Co-relations and updated softwares to resolve the issues related to the elements of geometric design. Indentify various issues such as geometric design philosophy, units of measurements, language, departures from standards and organisation of the Manual.

4. Develop or set standards to address road classification. This should include both administrative and functional classes. It should also focus on dimensions and selection of appropriate road design class. Moreover level of service (LOS) for each class of road shall be fixed.

5. Set standards to deal with road planning and survey requirements. Specifically, it should list procedures for road planning, identification of potential alignments in the route selection process, environmental considerations, economic evaluation and road survey requirements including survey procedure.

6. Develop standards for (1) Traffic data presentation (2) Elaboration of terms like (a) Design vehicle (b) Driver characteristic (c) Speed and speed terms related to design (d) Highway Capacity and parameter related to Highway capacity like design volume, congestion, traffic volume, acceptable degree of congestion for various classes of road, level of services and design capacities for various categories of roads

7. Develop standards to deal with cross section elements, which should discuss mainly lane widths, shoulders, medians, clear zones, right of ways, side and back slopes and gives typical cross sections of the different design classes of roads.

8. Set standards to deal with alignment design, which should take care of the various sight distances (Stopping sight distance, Decision sight distance, Intersection sight distance, Corner sight distance, Curve sight distance, Overtaking sight distance), horizontal alignment, vertical alignment including their co-ordination, minimum radius of curve, Sag and Crest curves, maximum rate of super elevation, diagrammatic profiles showing method of attacking superelevations, maximum & minimum grades, minimum cross slopes and minimum length of vertical curves.

9. Identify standards for various classes of roads for at grade intersections, including design requirements, procedures,selection of intersection type, T-junctions, Uncontrolled and yield controlled intersections, Cross junctions, Roundabouts, All-way stop control, signalized intersections and intersection elements including turning lanes, auxiliary lanes, acceleration & deceleration lanes, channelization and traffic islands.

10. Analyse standards to deal with grade-separated intersections or interchanges.

11. Describe road furniture and other facilities including miscellaneous items.

12. Describe black spots, set up the standard for various parameters like superelevation,grade limits or sight distances to avoid black spots.

13. Develop guidelines for road signage in line with MUTCD (Manual of Uniform Traffic Control Devices) its correct dimension, height, locations and spacing for the safety of road users. In addition to the above grade of various reflective sheets of signs,color, and appropriate road marking for various speed and classes of road.

14. Set standards for improvement of existing roads and specify design drawings requirements. A set of standard X-sections shall be established for various class to bring uniformity with the same class.

**Defined Deliverables / Reporting Requirements:**

| Sr. No. | Title of Deliverable | Schedule for Submission |
|---|---|---|
| 1 | Inception Report to include methodology and strategy. Consultant shall also be required to make a Presentation. Detail presentation on geometric design task 3 | Within maximum of 2 weeks of signing the contract. |
| 2 | Interim report1(task1 to task2).To cover review of prevailing standards for road geometry in KPK and its weakness/gap with the standard. Presentation will also be required | Within maximum of 3 weeks of approval of Inception report. |
| 3 | Interim report 2 (task 4 to task 6). To cover Road Classification, Road Planning & Survey requirements and Design Control. Presentation will also be required | Within maximum of 7 weeks of approval of Inception report. |
| 4 | Interim report 3 to (task 7 to task 14). To cover Cross section elements, Alignment design, At &grade separated intersection, Road Furniture & Drawing requirements. Introduction to MUTCD, dimension, height and placing of signage and road marking etc. Presentation will also be required. | Within maximum of 11 weeks of approval of Inception report. |
| 5 | Consolidated Draft report (Covering all the tasks to develop Geometric Design Manual). Presentation will also be required | Within maximum of 14 weeks of approval of Inception report. |
| 6 | Consultation of stakeholders. Consultant shall be required to make a Presentation. | Within maximum of 2 weeks of approval of consolidated draft report |
| 7 | Final Report | Within maximum of 20-weeks of signing of the contract |

**Notes:**

- All the deliverables shall be evaluated and approved by the Technical Evaluation Committee, comprising experts nominated in accordance with the scope of TORs.
- Any delay on the part of client shall be excluded from the given time line of the assignment.

- Any delay on the part of Consultant shall be penalized.
- The consultant shall provide all data in both soft and hard form as follow:
- Four hard & soft copies of inception report
- Four hard & soft copies of data report
- Four hard & soft copies of each draft report and consolidated draft report
- Fifteen hard & soft copies final report and soft format.
- Payments are subject to approval of the report/ reports against each deliverable.

**Key Personnel and Staff-Month Rate**

| Positions | Qualification | Staff-Month | Min. Experience |
|---|---|---|---|
| Team Leader: Civil Engineer or Highway Engineer | PhD or M.Sc | 6 | 15 years |
| Highway Engineer (Traffic Engineering as Major) | M.Sc | 6 | 8 years |
| Structural Engineer | M.Sc | 1 | 8 years |
| Electrical Engineer | M.Sc | 1 | 8 years |
| Sewer & Sanitation Engineer | M.Sc | 2 | 8 years |
| Transport Engineer (Road Safety as Major) | M.Sc | 3 | 8 years |
| Supporting Staff | | 6 | 5 years |
| Auto Cad Technician | | 2 | 5 years |