

Chennai Metropolitan Development Authority
(Tamil Nadu Housing and Habitat Development Project)

TERMS OF REFERENCE

DGPS Survey to collect Ground Control Points (GCP) for Chennai Metropolitan Area.

Project Implementation Unit, CMDA

A. Background

CMDA is in the process of preparing the Third Master Plan for the period of 2026-2046. The new master plan would differ in several ways from the Second Master Plan. A future master plan needs to take a much broader view of planning to allow for more integrated land use and infrastructure development schemes. Compatibility of land use, improved accessibility and enhanced quality of life are among the key objectives the new master plan would pursue. The new master plan should also contribute to enhancing the resilience of the CMA by incorporating policies to enable the city in coping with urban risks and climate change mitigation and adaptation. The new master plan can provide the city with the opportunity to reshape itself around infrastructure, allowing for more sustainable urban growth, better distribution and density and the creation of vibrant economic cores that cities need to thrive.

The terms of reference (ToR) outline the scope of works, deliverables and work project for firm Differential Global Positioning System (DGPS) Survey to collect Ground Control Points (GCP) for Chennai Metropolitan Area.

For the preparation of a Master plan, the most important input is Satellite data, which will be utilized to prepare a base map and land use map. Further, the cadastral survey maps / Town Survey maps shall have to be geo-referenced to Geographic coordinate system using satellite data as base. In order to Ortho-rectify the satellite data, Ground Control Points are required to be procured using DGPS.

The GCPs (Ground Control Points) obtained will be used to rectify the satellite data - is the process of converting images into a form suitable for maps by removing sensor, satellite/aircraft motion and terrain-related geometric distortions from raw imagery. This is one of the main processing steps for evaluating remote sensing data.

B. The Project

The project comprises of collection of Ground Control Points (GCP). Differential Global Positioning System (DGPS) is an enhancement to Global Positioning System that provides improved location accuracy, from the 15-meter nominal GPS accuracy to about 1 cm in case of the best implementations.

Location of Survey: The work is to cover Chennai Metropolitan Area (about 1189 sq.km.)

Purpose of work: Collection of Primary, Secondary and Tertiary control points within the limits of the Chennai Metropolitan area (CMA)

1) Scope of work:

- a. Fixing of Primary Survey Control Points (PSCP), Secondary Survey Control Points (SSCP) and Tertiary Survey Control Point (TSCP).
- b. Before commencing the Survey,
 - Base Station shall be located at almost the center of the project area.
 - Primary Survey Control Points (PSCP) will be observed at 5km by Triangulation Network method through making a grid for the whole city.
 - SSCP (Secondary Survey Control Points) shall also be marked approximately at every 2km and TSCP (Tertiary Survey Control Points) shall be marked by Triangulation Method at 1 km a part.
 - These points will be identified on the ground wherever required to suit the site conditions which shall be identified using DGNSS (Differential Global Navigation Satellite System) and engraved and marked with yellow enamel paint and sequentially numbered on permanent structures at site for PSCPs and SSCP's as well as TSCP.
- c. Geo-referenced digital photographs of these points shall be taken from three different directions. A satellite image chip of approximate size 100 X 100m, around the selected location, should also be furnished along with other site photos. Further description of the selected location should also be provided. The measurements from permanent features identifiable nearest to the point shall also be taken and furnished for approval by the competent authority for commencing the DGPS survey.
- d. The PSCP, SSCP and TSCP shall be established at such a location so that it may not be disturbed by local people. Also, these points shall be established in such a way that further surveys can be carried out in the same coordinate system.

2) Observation of PSCP, SSCP and TSCP by DGPS survey

- a. Once the marking of Basepoint/SOI (Survey of India control points), PSCP and SSCP are completed in the field, the survey shall be commenced using Differential Global Navigation Satellite System (DGNSS) with multi-frequency receivers by static method.
- b. The observation by DGNSS/DGPS at base point shall be done for a period of 24hrs. /Survey of India Ground Control Point and PSCP shall be done for a period of 6 hours for tracking the signals from the satellite as well as receive signals from the satellite for a minimum period of 1 hour for SSCPs.
- c. DGNSS network shall be in the form of well-formed network of triangulation method. The Satellite observation for 6 hours and 1 hour simultaneously by trilateration method in static mode should be done by simple primary and secondary triangulation with all three points to get the positional and relative accuracy.

- d. Fixing of TSCP by radial method with one hour observation on static mode with reference to Primary and secondary points. During fixing of base point and observation, utmost care shall be taken such as:
- The triangle should not be an acute or obtuse angle, open to sky for minimum of 15°.
 - No pylons, transmission lines and water bodies and data logging at closer time interval of 5" epoch. The threshold value shall not exceed 05 for PDOP (Positional Dilution of Precision) and HDOP (Horizontal Dilution of Precision).

3) Procuring the data and reports

The raw data in Receiver Independent Exchange Format (RINEX) format (9 decimal places in degrees for Latitude and Longitude) shall be post-processed with network adjustment based on the Survey of India coordinate system (Geographic) in WGS 84/ITRF 2014 as a datum and UTM as a projection with specified semi major axis, semi minor axis; and flattening 1/f values shall be calculated and coordinates shall be submitted. The triangles shall be well formed and preferably not too acute nor obtuse, with sufficient redundancy so that a baseline could be confirmed by observations from multiple control points. The accuracy of network adjustment shall be 1: 50,000.

The following survey parameters for transformation shall be submitted along with the survey report.

- Semi major axis
- Semi minor axis
- Flattening 1/f values
- Central Meridian
- Scale factor at Central Meridian
- Zone code for the surveyed area

The topographical survey shall be carried out with reference to the datum WGS84/ITRF2014 & EGM – 2008 and UTM coordinate system.

4) Map Content:

Coordinate grid: Data shall be in metric system and ITRF2014/WGS 84 reference frame on the UTM projection system shall be properly maintained with pacing the grids at 1km and East & West values in bottom and North & south values in left side.

5) Items to be delivered:

- 1) List of PSCP, SSCP, TSCP with spherical and UTM coordinates and ellipsoidal height.
- 2) Rinex files
- 3) Occupation Details
- 4) Report for network adjustment

5) Soft copy of drawing files in Auto CADD 2010 and.SHP file with reference to the UTM coordinates.

6) Geo-referenced Photographs

7) Equipment:

- The Survey Firm shall supply, maintain and operate all the equipment necessary to carry out the Work in accordance with this specification. An equipment itinerary sufficient for each survey team to work simultaneously shall be submitted to CMDA when a firm expression of interest in the Work, and shall be confirmed by the Survey Firm prior to commencement of any fieldwork. The Survey Firm shall ensure that all equipment necessary to carry out the Work has been calibrated within 12-months prior to commencing field work. Copies of relevant calibration certificates shall be made available to the CMDA for review, as requested, prior to commencement of Work.
- The Survey Firm shall communicate as and when necessary with CMDA staff. The Survey Firm shall have computer capabilities with high-speed modem and appropriate communication software for transfer of survey information via standard communication links. All technical information shall be sent to CMDA in native format - e.g. drawings in AutoCAD/shape, tabulations in a database format or Excel or equivalent, etc. Signature certified data can be sent in Adobe PDF format together with an unsigned native format copy. Formats of deliverables are further discussed below.
- The survey map shall represent the information gathered during the survey and shall be prepared using AutoCAD and .shp
- Team Composition for the survey

S.No.	Position of Key staff	Qualification / Experience	Job Responsibilities
1.	Team Leader	BE Civil/ BE (GeoInformatics) With 8 years of experience and 4 years of managing surveying projects in undertaking topographical surveys	(i) Manage and coordinate the field survey activities; (ii) Ensure overall quality control; (iii) Manage data processing and drawing production; (iv) Be responsible for managing the preparation and timely delivery of all outputs; and, (v) Liaise with CMDA.
2.	Support staff: i. Senior Surveyor ii. Assistant Surveyor iii. Senior Draughtsman	Diploma in Civil or ITI Surveying or Equivalent With minimum experience of 3 years in surveying field	(i) To assist the Team leader (ii) Undertake the fieldwork (iii) Data processing and preparation of deliverables

	iv. Assistant Draughtsman		
3.	Other non-key staffs		

6) Output schedule:

In addition to the reporting schedule discussed below, the Survey Firm is also responsible for submission of works covered under CMDA area. The data from the output of this sub-packages earlier completed shall be used to assess the quality and performance of the initial Works and allow changes to procedures if necessary with the Draft Final Report. All field work shall be completed within 6 months of mobilization.

- Reporting Requirements and Schedule

Document	No.of Copies	Submission Date and months after initiation
Inception Report	3	Within 3 weeks of LOA(Initiation)- First month
Weekly Progress Reports	Digital	Weekly
Draft Final Report	3	Within 2 weeks of completing fieldwork
Final Report	3	Within 2 weeks of receiving comments from CMDA

- The Inception Report shall comprise, amongst other things: (i) the project-specific quality plan; (ii) a technical method statement; (iii) the proposed survey, drawing and document reference system; (iv) work plan and personnel schedules to complete the Work; (v) the primary survey control plan; (vi) a monthly progress report proforma; and, (vii) project team organogram and contact details of senior team members.
- The Survey Firm shall prepare weekly progress reports in digital format for electronic correspondence for CMDA to review, which shall document: (i) activities undertaken during the week; (ii) progress made during the week and the overall progress with reference to the work plan.
- Any problems encountered and envisaged, and steps taken to alleviate these problems to avoid delaying the contract schedule; and, (iv) intended activities for the next month. This report may be of a brief nature and should be submitted every month first week.
- The Draft Final and Final Reports shall address: (i) the scope of works (specified and achieved); ii) description of the works undertaken including: a) survey overview; b) horizontal and vertical positioning systems; c) equipment configurations; d) description of survey instrumentation, and (iv)

an explanation of the reference system used and table of contents for all data and material being delivered; (v) survey results (vi) personnel; (vii) equipment calibration certificates; and, (viii) photos of points of interest.

- CMDA may issue comments on all outputs and the Survey Firm shall duly incorporate these comments into the issue of their final deliverables. Copies of the above reports and documents shall be submitted to CMDA by the submission deadline. In addition to the printed versions, the Survey Firm shall submit three electronic copies on clearly labeled CD or DVD or other approved media, conforming to the following requirements:
- The report contents shall be clearly indexed and stored in an editable format. The data should be submitted in a compatible format with the map formats available at CMDA, it should come with a self-explanatory data directory as well as in metadata format for future reference, which would facilitate verification by CMDA.
- The final dataset should be submitted to CMDA in CD or DVD and contain all data in the formats required as specified for all survey data with a self-explanatory data dictionary and/or metadata, including but not limited to: surveyed cross section and BM stations. These are to be held in separate directories which are suitably titled according to the agreed reference system.
- In general, only standard commercially available licensed software shall be used in the work and the Survey Firm shall list the software they propose to use with the approval of CMDA.
- All reports and other study documents shall be in the English language. Printing and binding shall be of high quality, suitable for presentation to government and international funding agencies. All reports shall be in A4 paper format (with fold-out A3 sheets where required), except for the drawings which should be A2. Metric units according to the International System of Units are to be used throughout. All the maps have to be submitted in a digital format that is clear and of high resolution in the suggested projection system, so as to enable CMDA to use the data as input for other studies.
- **Meetings.** The Survey Firm's participation in certain non-productive activities may be required. These activities may include, but not be limited to, meetings to be held with CMDA

Resources to be provided by the client

C. Resources to be provided by the Government

- CMDA shall provide AOI in .kml format along with the grid.

- A blanket letter will be provided to access government offices/buildings to set up primary/secondary/ tertiary control points for making necessary observations.
- Requisite letters shall be provided to collect data from other agencies and to validate the same.

D. Payment Schedule

S.No.	Deliverable	Time (weeks)	Payment schedule on Contract value (%)
1.	Inception Report	3 weeks	10%
2.	Draft Final Report	17 weeks	70%
3.	Final Report	4 weeks	20%

E. Review Committee

S.No.	Name and Designation
1.	Representative from Survey and Land Records (Not less than a rank of an EE)
2.	Representative from the Institute of Remote Sensing (Not less than an Associate Professor)
3.	Representative from Greater Chennai Corporation (Not less than a rank of an EE)
4.	Representative from CMWSSB (Not less than a ran of an EE)