

Control Survey Guideline

(as of October 2015)

Maldives Land and Survey Authority (MLSA),

Ministry of Housing and Infrastructure.

Control Stations which are used as origin, intermediate check, and closure points such as but not limited to, inter-visible station pairs and/or RTK base station points are recommended to be permanent in nature. Examples include and are not limited to, poured-in-place concrete monuments with uniquely stamped disks, feno rods with disks, steel rods with caps uniquely identifiable, and drill holes in solid foundations.

General Rules for Control Stations

- Establishment or replacement of any permanent control station should be done under the direct supervision of a Surveyor registered by the Ministry of Housing and Infrastructure. The Registered Surveyor should take utmost care and professional practice when establishing and determining its coordinates.
- Permanent Station Mark Request Form should be completed and submitted to MLSA to obtain the Station Point Number for each Control Station.
- Control Survey Report should be prepared as mentioned in this guideline and all deliverables mentioned in this guideline should be submitted to MLSA for approval and to include in the Control Station Data Registry. Any survey results referenced/reduced to an unregistered PSM mark cannot be approved by MLSA.
- Locality Diagram of the control station must be sketched close-to-scale with recovery ties and should contain descriptions in a text format to fully identify the station.
- For all the Control Stations except where horizontal positioning is irrelevant a Visibility Obstruction Diagram should be prepared.
- All Permanent Station Marks (PSM) should be named and labeled according to the guideline set by MLSA.

Control Station Survey Report

A report containing the following details should be produced to MLSA for registration.

Introduction: A brief introduction about the survey including purpose/s.

Site/Location Description: Location of the site including administrative details.

Declarations: Declaration of Registered Surveyor responsible for the survey and declaration of the personnel in-charge of the Site (Example: Inhabited Island, Uninhabited Island, Resort or Industrial Island).

Survey team: Details of the Registered Surveyor and his/her assistants involved in the survey.

Survey Equipment: Details of equipment used including Brand, Model, Serial Number, Manufacture's Specifications, On-board and Office Software and calibration certificates where applicable.

Survey Method: Details of survey method including the pre-analysis, observation time, and field records. The original field records (or acceptable copies), including sketches, record books, and project reports, are required. MLSA will retain these records. This is necessary if questions arise

concerning the surveys on which the adjusted data are based. Instead of the original notes, high quality photo copies and print outs are acceptable. The material in the original field books or sheets are needed, not the abstracts or intermediate computations.

Data processing method: Details of post processing and adjustment procedures for horizontal and vertical values.

Final Map: Final map should be in A3 size and should depict GNSS control network along with Points ID labeled Survey Marks, a grid with 50 meter intervals (coordinates labeled in easting/northing), North Arrow, Graphical and Absolute Scale and all reduced/final coordinates in tabular format.

Coordinate system and Format: All coordinates to be provided in -

- Geographic Coordinate System {PointID, Longitude, Latitude, Ellipsoid Height} and
- Projected Coordinates {PointID, Northing, Easting, Ortho Height}.
- Ellipsoid Height and Ortho height (reduced to Mean Sea Level) should be provided.
- Projection: UTM Zone 43 N or UTM Zone 43 S
- All angular coordinates in degrees, minutes, seconds and all linear coordinates in meters.

Deliverables of Control Survey

- All reports printed in A4 sized paper and maps printed in A3 sized paper.
- All reports (Microsoft Word docx and Adobe pdf), maps (AutoCAD dwg and Adobe pdf), spreadsheets (Microsoft Excel xlsx) and raw data (GNSS Receiver native format) in a CD/DVD.

Permanent Station Mark (PSM)

- Permanent Station Mark (PSM) is the main control station for all the surveys of every island. Minimum of three (3) PSMs are to be established in each island. At least two PSM should be inter-visible and preferably all PSMs should be more than 100 meters apart. **Approval from the Maldives Land and Survey Authority should be obtained before establishing a PSM.** The names of PSMs will be issued from Maldives Land and Survey Authority.
- The horizontal coordinates (Easting, Northing) of the first PSM of any island should be determined if possible relative to the Male' IGS Station. If relative positioning is not possible, single point localization should be done for more than six hours with a GNSS receiver.
- The vertical coordinate (Height) of the first PSM of any island should be related to the mean sea level which should be determined after an analysis of local tide with relation to the prediction of the nearest tide gauge provided by Department of Meteorology.
- All successive PSMs of any island should be related to the first PSM of that island.
 - Horizontal control of successive PSM: 0.010m
 - Length of the observation session should be more than 30 minutes (static mode)
 - GDOP at observations should be less than 4.
 - Dual or Single frequency High Precision GNSS receivers should be used.

- Minimum of one PSM should be used as a base station.
 - Network Adjustment should be done after post processing.
 - Standard of accuracy to be 1:10,000.
 - Maximum length of from base station for single frequency is 8km and dual frequency is 20km.
- Vertical control of successive PSM: 0.015m
 - Standard of accuracy to be maintained in the closing error defined by the following equation. Error = $0.024 \sqrt{k}$ meters, where k is the distance between terminals in kilometers.
- Monument of PSM shall be constructed to the *Monument Type A* specification.
 - If the use of an existing structure or a solid rock is more suitable, both in stability and location wise, construction of a Type A monument is not necessary. Any survey mark should be made of either stainless steel or brass.

[Naming of the station marks.](#)

The name and other details of PSM should be engraved on a stainless steel plate as below and fixed on the monument. If monument is completely buried the name plate can be fixed to a nearby long lasting object such as a quay wall. In such case location of the name plate should be indicated in the location sketch diagram and also stated in the control point description.

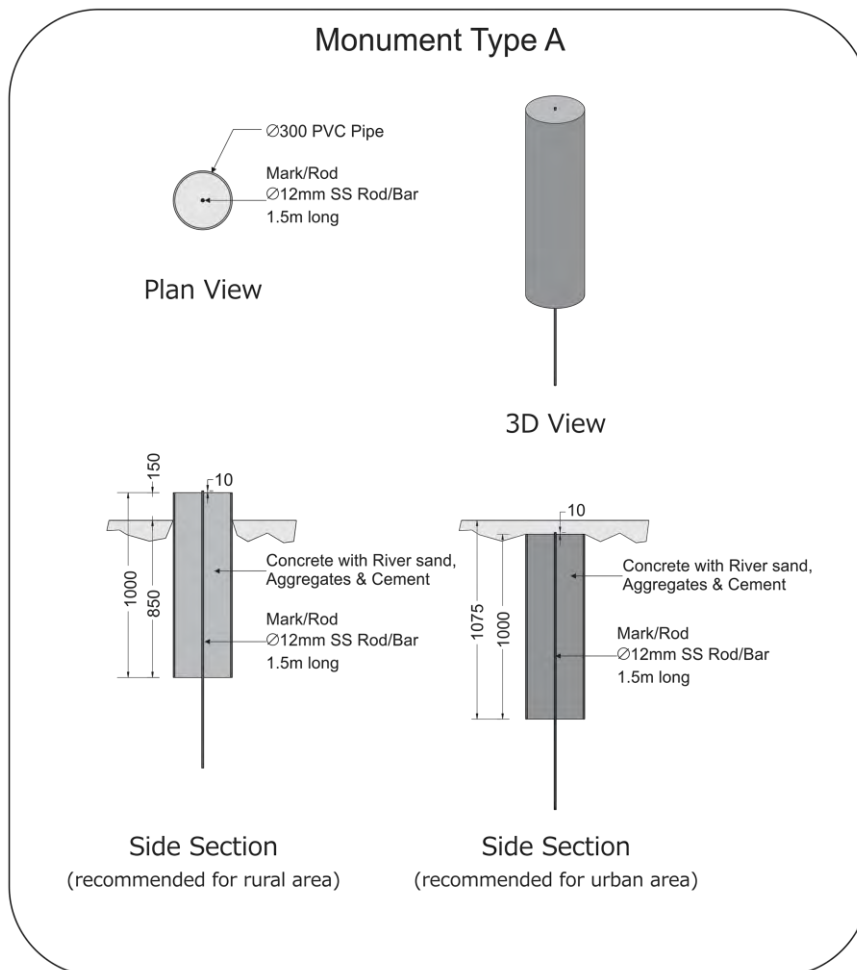
Example:



Please contact Maldives Land and Survey Authority for further information regarding the numbering sequence.

Monument Type A

- The mark / stainless steel rod should be placed in the top of a concrete block cast in-situ and shaped as shown below.
- In urban areas it is recommended to bury the whole monument until the top is about 75mm below the surface of the ground.
- In rural areas it is recommended to bury the monument leaving the top 150mm above the surface of the ground.
- A stainless steel bar with a diameter between of 12mm should be inserted from the top of the concrete as the mark.
- One cm of the rod should be left above the top surface of the concrete in order to place the leveling staff.
- This bar/rod should be lengthy enough to reach the hard ground.



Concrete materials estimated for per monument.

Item	Bags
Cement	1
Sand	2
Aggregate	3