National Control Point Survey

Work Specifications (Draft)

NATIONAL CONTROL POINT SURVEY
WORK SPECIFICATIONS
(DRAFT)

DEPARTMENT OF LANDS AND SURVEYS,
DEPARTMENT OF STATE FOR LOCAL GOVERNMENT
AND LANDS,
THE REPUBLIC OF THE GAMBIA

CONTENTS

NATIONAL CONTROL POINT SURVEY
WORK SPECIFICATIONS
(DRAFT)

Chapter 1 General

Article 1 Objectives

1. The aim of these Work Specifications (draft) is to standardize national control point surveys by defining the work procedures and to ensure the necessary survey accuracy.
2. A national control point survey is a survey to determine the geodetic coordinates of existing first-order and second-order control points and new first-order and second-order control points based on the known coordinates of observation points (hereinafter referred to as "GPS observation points") determined using multiple Global Positioning System(GPS) satellites.
3. The national control point survey shall be carried out to establish the national control point network partially composed of existing and new first-order and second-order control points.

Article 2 Accuracy

The survey accuracy shall be 5mm+ 0.5ppm x base line length in the horizontal distance and 10mm + 1.0ppm x base line length in the vertical distance, or over. (The accuracy of the secondary national control point survey shall be 10mm + 5ppm x base line length in the horizontal distance and 20mm + 10ppm x base line length in the vertical distance, or over.)

Article 3 Expression of Position

The final positions in the national control point survey shall be expressed as the geodetic coordinates based on the WGS84 coordinate system (hereinafter referred to as "latitude and longitude").

Article 4 Work Progress Control

The organization responsible for the survey work (hereinafter referred to as the "executing organization") shall carry out appropriate work progress control based on a pre-determined work plan.

<Article 4. Standard Operating Procedure>

1. The executing organization shall report the progress status of the work as deemed appropriate.

Article 5 Accuracy Control

The executing organization shall conduct appropriate accuracy control in order to ensure the accurateness of the survey.

<Article 5. Standard Operating Procedure>

1. The executing organization shall prepare and submit an accuracy control sheet based on the result of accuracy control.

Chapter 2 Work Plan

Article 6 Preparations and Planning

The executing organization shall formulate an appropriate work plan and make preparations for the various works before commencing such works.

<Article 6. Standard Operating Procedure>

1. The work plan shall be formulated as follows:
   (1) The latest information on GPS satellites shall be collected.
   (2) The work period, work formation and work schedule shall be determined taking into account the latest information on GPS satellites.
2. Work preparations shall be made as follows:
   (1) The survey products, equipment and consumables to be used for each work shall be prepared.
   (2) The equipment shall be inspected and maintained and the safety functions of the equipment shall be checked.

Article 7 Preparation of Net Adjustment Planning Map

The executing organization shall check the distribution of the GPS observation points, existing and new first-order and second-order control points and bench marks (hereinafter referred to as "control points") by referring to topographic maps and determine the operating procedure, and prepare the plans for net adjustment.

<Article 7. Standard Operating Procedure>

1. The net adjustment planning map shall be created as follows:
   (1) 1/250,000 and 1/50,000 topographic maps shall be used.
   (2) The control points shall be clearly indicated on the topographic map.
2. The network on the net adjustment planning map shall be configured as follows:
   (1) In principle, the network shall be composed of a number of unit polygons.
   (2) A single unit polygon shall consist of one GPS observation point and three (3) or more control points. The unit polygon shall be measured simultaneously using GPS receivers.
3. The control points that are located within a distance of 5km from the benchmarks shall be connected to the benchmarks by leveling.

Chapter 3 Selection of Points

Article 8 Investigation of Actual Conditions

1. The actual conditions of the GPS observation points and control points shall be investigated referring to the net adjustment planning map .
2. Appropriate measures shall be taken for those of the existing controls points where an abnormal situation is found as a result of the investigation of actual conditions.

<Article 8. Standard Operating Procedure>

1. The actual conditions of the GPS observation points and control points that have been investigated shall be photographed.
2. The investigation of the actual conditions of existing control points shall be carried out as follows:
   (1) The loss, inclination, excessive exposure or burial, and damage of existing control points shall be verified.
3. The following measures shall be taken for those existing control points where an abnormal situation is found:
   (1) For the control points that are deemed to be abnormal, their robustness shall be checked and then they shall be treated as new stations.
   (2) If any existing control points are lost, a monument shall be set at a new point.
4. New control points shall be monumented in accordance with the specifications.

Article 9 Determination of Work Procedures

1. The conditions at the site, such as the terrain, vegetation, any radio obstructions and other features, shall be investigated based on the net adjustment planning map to determine the optimum work procedures.
2. An eccentric point shall be provided only if it is unavoidable based on the result of the site investigation.

<Article 9. Standard Operating Procedure>

1. The investigation of site conditions shall be carried out as follows:
   (1) Obstructions around the existing and new control points shall be investigated to determine the most suitable work procedure (i.e. tree cutting, construction of measuring marks and/or setting of eccentric points).
   (2) If any electromagnetic interference is anticipated due to a radio transmitting base near the existing and new control points, observation data shall be

acquired using GPS survey receivers to check whether these points are suitable for observation.

(3) The planned point for installation of the GPS antenna (including a GPS antenna tower) shall ensure that the overhead field of vision has an elevation angle of 15 degrees or more.

(4) In selecting an eccentric point, the eccentric distance shall not be more than 1000m. However, if the distance between control points is 10km or less in the corresponding unit polygon, the eccentric distance shall not be more than one tenth of the distance between the control points.

(5) As for the direction of reference in eccentric angle measurement, two directions shall be selected by the following method:

  (a) The directions shall be those to an azimuth marker (temporary pile) to be provided in the GPS observations. However, the existing control points used in the same unit polygon may be used as azimuth markers.

  (b) The distance to the azimuth marker shall be 500m or more, and more than 6 times longer than the eccentric distance.

(6) Connections to benchmarks shall be carried out in the following way:

  (a) Connections to bench marks shall preferably be carried out on the benchmark. If unavoidable, observations may be made at an eccentric point.

  (b) Depending on the site conditions, direct leveling, or indirect leveling with an electric distance meter and a theodolite, or both types of leveling shall be used to connect control points to benchmarks.

  (c) Benchmarks to be used as a known point shall be tested by carrying out measurements in reference to an adjacent benchmark. The test measurements shall be made by one-way observation and the discrepancy in elevation with the final result table shall be 20mm $\sqrt{S}$ or less, where S is the distance (in km) between benchmarks.

2. In selecting new control points, consideration shall be given to its use in subsequent works and the preservation of control points to determine the optimum location.

Article 10 Creation of Net Adjustment Map

1. Net adjustment maps shall be created based on the results of the investigation as specified in Article 8 and Article 9, and their quality shall be evaluated for approval.
2. Observation maps indicating the operating plan for GPS observation shall be created based on the net adjustment maps.

<Article 10. Standard Operating Procedure>

1. The net adjustment maps and the observation maps shall be created in accordance to the following:
    (1) The map scale shall be 1/250,000 or 1/50,000.
    (2) The unit polygons, GPS observation points and the actual range of base line analysis shall be indicated.
    (3) The existing and new control points shall be marked with their specific numbers and names and the GPS observation points shall be marked with point numbers and names.
    (4) If connections to benchmarks are carried out, the positions and numbers of the bench marks shall be indicated on the maps.
    (5) In addition to (2), (3) and (4) above, the eccentric points and azimuth markers shall also be plotted on the observation maps.
2. If there are any changes in the net adjustment map, the reason for such change shall be explained immediately and approval shall be obtained.

Chapter 4 Survey Markers

Article 11 Approval of Use of Point Site

Before setting a survey marker, approval by the owner or administrator of the site to be used shall be obtained.

Article 12 Installation of Permanent Monuments

The installation of permanent monuments shall conform to the prescribed standards and forms.

<Article 12. Standard Operating Procedure>

1. In setting control points, the various regulations shall apply
2. When setting monuments, the scene during and after setting of the monument shall be photographed.

Article 13 Tree Cutting

If it is necessary to cut down trees that may obstruct the reception of signals from GPS satellites, approval of the owner or administrator of the trees shall be obtained in advance.

<Article 13. Operating Procedure>

1. Tree cutting shall preferably be carried out in the presence of the owner or administrator of the trees.

Chapter 5 Observation

Article 14 Observation

1. Observations shall be carried out by setting up the GPS receivers at observation points, receiving signals from GPS satellites and recording the phase and other data (hereinafter referred to as “GPS observations”), referring to the observation maps.
2. GPS observations shall be carried out under appropriate observation conditions.

<Article 14. Standard Operating Procedure>

1. Satellite almanac information including a “sky plot” and a PDOP shall be prepared before carrying out GPS observations.
2. The satellite almanac information shall be prepared in accordance with the following:
   (1) The satellite almanac information shall be prepared based on the latest satellite orbit information.
   (2) If the method (1) above is difficult, such information may be prepared from the observation data obtained during a 30-minute session at a favorable point for receiving GPS satellite signals using a single GPS receiver.
3. The observation plan, including the work schedule, shall be drawn up based on the satellite almanac information.

Article 15 Units of Observation Values

The observation values shall be recorded in given units and to a given place.

<Article 15. Standard Operating Procedure>

1. The units and places of observed and measured values shall be as specified in the table below.

Equipment Type	Unit	Place	Remarks
GPS receiver	m	0.001	Results of base line analysis
Electric Distance Meter	m	0.001	
Theodolite	sec (deg/min/sec)	1	
Level	m	0.001	
Thermometer	°C	1	
Barometer	hPa	1	

2. The units and places in measuring the height of equipment shall conform to the table below.

Equipment Type	Unit	Place	Remarks
Antenna	m	0.001	
Electric Distance Meter	m	0.001	
Theodolite	m	0.001	

Article 16 Performance of Survey Equipment

The performance of the main equipment used in observation shall be equal or higher than that described in the table below.

Equipment Type	Performance
GPS survey equipment	Capable of receiving the P-codes of frequencies L1 and L2 and AS compatible (encryption of P-codes).
Electric Distance Meter	Medium-range distance meter
Theodolite	Minimum reading value of 1"
Level	Automatic leveling
Rod	With rod level and having an accuracy of 1mm.
Thermometer	Having a reading accuracy of 1°C.
Barometer	Having a reading accuracy of 1hPa or better.

<Article 16. Standard Operating Procedure>

1. For the electric distance meter and theodolite, the total station may be used. The data collector shall be capable of automatic input and output of observed values.

Article 17 Testing and Checking of Equipment

1. The GPS receivers, electric distance meter, theodolite and steel measure tape shall be checked in accordance with given testing procedures before operation and, if necessary, shall be adjusted.
2. The level, thermometer and barometer shall be checked in accordance with given testing procedures before operation.
3. The equipment mentioned in clause 1 and clause 2 shall also be checked during the work period if necessary.

<Article 17. Standard Operating Procedure>

1. The main equipment used for observation shall be checked before each observation work by the personnel engaged in such work as specified in the

following sub-clauses:

(1) Functional check of GPS survey equipment

  (a) The optical plumbing device shall operate normally.

  (b) The digital display shall be normal.

  (c) The antenna cable shall be normal.

  (d) The connectors shall be normal.

  (e) The power supply voltage shall be within the specified range.

(2) Functional check of Electric Distance Meter

  (a) The optical plumbing device shall operate normally.

  (b) The digital display shall be normal.

  (c) The values indicating light reception, power supply voltage and others shall be within their normal ranges as specified in the operation manual of the electric distance meter.

(3) Functional check of theodolite

  (a) The optical plumbing device shall operate normally.

  (b) The rotation of each axis shall be smooth.

  (c) The adjustment mechanism of the bubble tube shall be normal and bubble movement shall be smooth.

  (d) The telescope visibility control mechanism shall be normal and visibility during observation shall not vary.

  (e) The reading device for horizontal and vertical angles or the digital display shall be normal and able to read or record the angles correctly.

(4) Check by observation of horizontal angle

  (a) The horizontal angle (i.e. the angle where the target is at the same height as the theodolite) shall be observed in a series of three directions having a given included angle.

  (b) Observations shall be carried out to obtain one reading for one sighting in each direction and in two sets, each set consisting of three pairs of sessions.

  (c) The allowable range of observation shall be as shown in the table below, in which the discrepancy between the sets shall be the difference of the average values within each set.

Double angle difference	Observed differential	Discrepancy between sets	Graduations as viewed from the indicator
11 sec.	7 sec.	4 sec.	(0°, 60°, 120°) (30°, 90°, 150°)

(5) Check by observation of vertical angle

   (a) Observations shall be carried out for three targets, each having different heights.

   (b) Observation shall be carried out to obtain one reading for one sighting of each of the three targets and in one pair of sessions.

   (c) The allowable range of observation shall be determined by the height constant of the three targets and the discrepancy shall be within 10 sec.

(6) Functional check of total station

   (a) Sub-clauses (2) and (3) shall apply accordingly.

(7) Functional check of data collector

   (a) Once input, the observed values should not be able to be processed.

   (b) The function of checking the observed values shall be provided.

   (c) The function of re-measuring any observed value that exceeds a given allowable range shall be provided.

(8) Functional check of level

   (a) Rotation of the vertical axis shall be smooth.

   (b) The adjustment mechanism of the bubble tube shall be normal and bubble movement shall be smooth.

   (c) The telescope visibility control mechanism shall be normal.

   (d) The cross-hair control mechanism shall be normal.

   (e) Rotation of the leveling screw shall be smooth.

   (f) Rotation of the micrometer shall be smooth.

(9) Check and adjustment of level

   (a) Two rods shall be erected at an interval of 30m, at the center of which the level shall be set up to observe the elevation difference between the two rods. The level shall then be shifted 18m if possible on the line connecting the two rods to observe the elevation difference between the rods again. The level shall be adjusted so that the discrepancy between the two observed values is within 3mm.

   (b) In addition to the adjustment (a) above, observations shall be carried out with the level in a horizontal state midway between the two rods spaced at an interval of 30m and with the level at an incline where the bubble of the circular level is inside the concentric circle mark. The level shall also be adjusted so that the discrepancy between the two observed values is within 3mm.

(10) Check of leveling rods

(a) Each leveling rod shall be normal, with no error, peeling or striking out of its graduation marks.

(b) The leveling screw attached to the level shall be normal.

2. Clause 2 in Article 17 shall apply to the inspection of the level during the work period.
3. Steel measuring tapes with a scale constant of 15mm or more per 50m (at 20° and tension of 10kg) shall not be used.

Article 18 Implementation of Observation Work

GPS observations shall be implemented by the static positioning method.

<Article 18. Standard Operating Procedure>

1. In setting up the survey equipment, close attention shall be paid particularly to centering. When centering, the leveling board shall be installed in a horizontal place (such as on a tripod). Centering shall be checked before and after observation and the allowable range of discrepancy before and after observation shall be 3mm.
2. The height of the equipment shall be measured accurately along the vertical line by the use of a measure with little elasticity. Measurements shall be made twice each, before and after observation. The allowable range of observation discrepancy and discrepancy before and after observation shall be 3mm.
3. GPS observations shall be carried out in accordance with the observation maps and the observation plan.
4. The units and places input into the GPS receivers shall be as shown in the table below.

Input Item	Unit	Place	Remarks
Latitude/longitude	sec. (deg/min/sec)	1	Manual entry (Values in WGS84 coordinate system)
Ellipsoidal height	M	10	
Antenna height	M	0.001	
Observation hour	min. (local hour/min)	1	UTC is also available.

In the case of manual entry of latitude/longitude, the values of the eccentric point, azimuth marker and bench mark may be read from the topographic maps.

5. GPS observation shall be carried out for each unit polygon and the observation period and other times shown in the table below shall be standard.

	Primary control point	Secondary control point
Data acquisition intervals	Within 30 sec.	Within 30 sec.
Continuous observation period	6 hours	2 hours
Number of sessions	1	1

6. GPS satellites shall be used for GPS observation as specified below.
   (1) GPS satellites with an elevation angle of 15 degrees or more shall be used.
   (2) GPS satellites with a normal health status shall be used.
   (3) Four satellites or more shall be used simultaneously for observation.
7. GPS observation shall be carried out in strict conformity with the following rules:
   (1) When installing the antenna, the specified side of the antenna or the mark inscribed on the antenna shall be directed to the north.
   (2) Any objects such as vehicles that may generate radio interference shall not be allowed to approach within 10m of the area around the antenna.
   (3) During GPS observation, no radio equipment shall be used. If unavoidable, however, such radio equipment shall be used at a distance of 100m or more from the antenna.
8. The GPS observed data (hereinafter referred to as "observed RAW data file") shall be recorded in the recording media, and in another recording media as a backup copy.
9. The antenna height and other information necessary for GPS observations shall be recorded in the GPS observation book.
10. Connections to benchmarks shall be carried out by the following procedure:
    (1) The observation period when using GPS receivers shall be as shown in the table below.

Data acquisition interval	Within 30 sec.
Continuous observation period	1 hour
Number of sessions	1

    (2) For direct leveling, go and back observations shall be made at a sight distance of within 60m.
    (3) Vertical angle observations in indirect leveling shall adopt the simultaneous observation method, in which the distance between measuring stations shall be within 3km.
    (4) Clauses 3 and 4 of Article 19. Standard Operating Procedure shall apply accordingly to measuring procedures and allowable ranges in sub-clauses (2) and (3) above.

11. The operating conditions of GPS observations (including the tripod and GPS antenna tower) shall be photographed for later verification.

Article 19 Measurement of Eccentric Elements

If there is an eccentric point in a GPS observation, the eccentric elements shall be measured by the procedure described below.

<Article 19. Standard Operating Procedure>

1. The eccentric elements shall be measured as follows:

   (1) The observation procedure and allowable ranges of the eccentric angles shown in the table below shall be standard.

<table>
<tr><th rowspan="3">Eccentric distance (e)</th><th colspan="4">Eccentric angle observation procedure</th><th rowspan="3">Adoption of eccentric angle Unit (Φ)</th></tr>
<tr><th colspan="2" rowspan="2">Measuring Instruments</th><th colspan="2">Allowable range</th></tr>
<tr><th>Double angle difference</th><th>Observed difference</th></tr>
<tr><td>Less than 2m</td><td colspan="4">trilateration using measuring paper (2 sessions)</td><td>30'</td></tr>
<tr><td>2m or more, and less than 7m</td><td rowspan="5">Theodolite</td><td rowspan="3">2 pairs of sessions</td><td rowspan="2">3'</td><td rowspan="2">2'</td><td>5'</td></tr>
<tr><td>7m or more, and less than 20m</td><td>1'</td></tr>
<tr><td>20m or more, and less than 100m</td><td>50"</td><td>40"</td><td>30"</td></tr>
<tr><td>100m or more and less than 500m</td><td>3 pairs of sessions</td><td>20"</td><td>15"</td><td>5"</td></tr>
<tr><td>500m or more</td><td>3 pairs of sessions (2 sets);
Discrepancy between sets: 4"</td><td>11"</td><td>7"</td><td>1"</td></tr>
</table>

   The graduations as viewed from the indicator in 2 sets of observations shall be (0°, 60°, 120°) and (30°, 90°, 150°).

   (2) The measuring procedure and allowable range of the eccentric distance shown in the table below shall be standard.

Eccentric distance (e) (measured)	Measuring instrument
Less than 30cm	Ruler
30cm or more and less than 50cm	Steel tape
Minimum measuring distance or more	Electric distance meter or total station

2. When using a steel tape for measuring the eccentric distance, the following procedure shall be adopted:

   (1) Two sets of measurements shall be taken, one set consisting of two measuring sessions. In the second set of measurements, the persons doing the measuring at the front and back shall change places.

(2) The temperature shall be measured at each set of observations.

(3) The allowable range of discrepancy between sets shall be 1/10,000 of the measured distance. However, the allowable range of discrepancy shall be 2mm when the measuring distance is 20m or less.

3. Measurement of the eccentric distance using an electric distance meter or total station shall be made according to the following procedure:

(1) Three sets of measurements shall be made, one set consisting of two measuring sessions. The measuring interval between sets shall be 5 minutes or more. Furthermore, targeting shall be repeated at each set.

(2) Measurement of climatic factors shall be made at the instrument station and the reflection station at the beginning of each set of observations. In this case, the value on one side may be obtained by calculation instead of measurement. If the elevation difference is less than 400m, the measurement may be made at only one side. The temperature measurement shall be made at a distance of 1.5m or more from planimetric features, vegetation and the ground.

(3) The allowable range of the measured values shall be a discrepancy of 5mm within the set, and the discrepancy between sets after climatic correction shall be 5mm.

(4) The measurements shall be verified by changing the instrument height or by another method.

4. The measuring procedure and allowable range of elevation difference between the top of the monument and the eccentric point shown in the table below shall be standard.

Eccentric distance (e)	Elevation distance measuring instrument and method	Allowable range of measured value
Less than 30cm	Install the eccentric point at the same height as the control point using an independent level.	—
30cm or more and less than 100m	The go and back observations using a level. The go and back observation may be carried out at one measuring point using the same rods for foresight and backsight. (In the case of direct leveling)	Discrepancy of the go and back observations: 2mm

Eccentric distance (e)	Elevation distance measuring instrument and method	Allowable range of measured value
	Vertical angle observations in the forward and backward directions using a theodolite or total station. One-way vertical observations may be made at different instrument heights instead of the forward and backward vertical observation. (In the case of indirect leveling.)	Discrepancy of height constants: Eccentric distance: less than 10m: 40 sec. 10m or more: 25 sec. Forward and backward discrepancy of elevation difference or discrepancy between 2 sessions: 5mm
100m or more	The go and back observations using a level. (In the case of direct leveling)	Discrepancy of the go and back observations: less than 300m: 3mm 300m or more: $5mm\sqrt{S}$ S: Measured distance (km)
	Vertical angle observation in the forward and backward directions using a theodolite or total station. (In the case of indirect leveling)	Discrepancy of height constants: Eccentric distance: less than 500m: 12 sec. 500m or more: 9 sec. Discrepancy of elevation differences in forward and backward directions: 15mm

Vertical angle observations shall be made to obtain one reading for one sighting in each direction and in two sets, each set consisting of one pair of sessions.

5. Article 18. Standard Operating Procedure (excluding clause 4) shall apply to the observation procedure when the azimuth markers are installed, but the continuous observation period using the static positioning method shall be 3 hours.
6. In the case of an eccentric bench mark, observations to connect to bench marks shall be made in accordance with the measuring procedure in clause 4 of Article 18. Standard Operating Procedure.

Chapter 6 Calculations

Article 20 Calculations

The coordinates of the control points, ellipsoidal height and related factors shall be calculated.

<Article 20. Standard Operating Procedure>

1. The calculations shall be made in accordance with the national control point survey calculation formula. However, other calculation formulas may be used if it ensures accuracy equal to or higher than these formulas.
2. Trial computations shall be carried out to check that the programs on the computer used for the calculations are accurate and error-free.
3. The observation RAW data files shall be converted into RINEX format (hereinafter referred to as "observation RINEX data file") and stored in the recording medium. This recording medium shall be used for subsequent calculations.

Article 21 Base Line Analysis by Broadcast Ephemeris

The field check calculations based on the broadcast ephemeris shall be made using GPS observation data to determine the three-dimensional relative position of the measuring points and related factors, and the results shall be indicated to the place shown in the table below.

Item	Unit	Place
Base line vector element	m	0.001

<Article 21. Standard Operating Procedure>

1. The calculations for checking the base line vectors shall be made according to the following procedure:
   (1) The orbit elements of the GPS satellites shall be based on the broadcast ephemeris.
   (2) The coordinates of the measuring point fixed in the base line analysis shall be converted into the WGS84 coordinate system (B, L, H).
   (3) In the base line analysis, the base line vectors between measuring points shall be calculated in accordance with the observation maps. The selection of the fixed points and the order of the base line analysis may be arbitrary.
   (4) The base line analysis shall be made using two frequencies and the preset value of the minimum elevation angle shall be 15 degrees.

(5) The climatic correction shall be based on the standard atmosphere used by the base line analysis software.

(6) In principle, the cyclic slips shall be automatically compiled using the base line analysis software.

(7) After the base line analysis has been carried out, the internal accuracy shall be examined according to statistical indices (such as the standard deviation and data rejection rate).

(8) The statistical indices used after the base line analysis has been carried out shall be the standard values shown in the table below. If the values are different from these standard values, the cyclic slips shall be manually re-compiled before the base line analysis is made. In this case, this fact shall be recorded in the GPS analysis record book.

Distance	Standard value of standard deviation
	m m
0 – 10km	0.02 + (0.004·Dkm) or less
10 – 20km	0.03 + (0.003·Dkm) or less
20 – 30km	0.04 + (0.0025·Dkm) or less
30 – 40km	0.04 + (0.0025·Dkm) or less
40 – 60km	0.08 + (0.0015·Dkm) or less
60 – 100km	0.17 or less
100km	0.20 or less

2. GPS observation and record books shall be prepared based on the results of the base line analysis.

3. If an eccentric point is set, the eccentric reduction shall be made to obtain the base line vector between the control points by the following procedure:

(1) The eccentric calculations shall be made based on the WGS84 coordinate system (X, Y, Z) and the eccentric reduction value shall be applied to the base line analysis.

(2) The azimuth used for the eccentric calculations shall have been obtained from the base line analysis. One of the two directions shall be checked and verified.

Article 22 Re-Observation

If the GPS observations do not satisfy the given observation conditions and allowable ranges, the observations shall be repeated.

Article 23 Field CheckCalculations

After completion of GPS observations and base line analysis based on the broadcast ephemeris, check calculations for accuracy control shall promptly be made.

<Article 23. Standard Operating Procedure>

1. Check calculations of base line vector
   (1) A base line analysis between two points of each unit polygon shall be made using the data for half the time of the continuous observation period in one session, and the coordinate difference between the two results shall be compared (to obtain the primary control point). However, this method shall not apply to observations for benchmark connections or for azimuth marker installation.
   (2) If the cyclic slip is compiled manually in the base line analysis, the circuit closure calculation of the base line vector elements in the unit polygon shall be made to check the closure errors.
   (3) The comparison of coordinate differences and the allowable range of closure difference shown in the table below shall be standard.

Item	Base line vector element	Allowable range of root	Remarks
Comparison of coordinate differences	ΔX, ΔY and ΔZ between 2 points	1ppm x ∑D	D: Sloop distance
Comparison of duplicatedbase line in different sessions	Discrepancy of base line vector element Δ (ΔX, ΔY, ΔZ)	Within 20mm	
Closure error	∑ΔX, ∑ΔY, ∑ΔZ of a unit polygon	1ppm x ∑D (20mm x √n at the secondary control point)	n: number of sides

2. If the result of the check calculations exceeds the allowable range, and if re-observation is carried out for any reason such as inadequate observation conditions, the following procedure shall be followed:
   (1) The re-observation point in the unit polygon shall be checked and determined. If there are only two other normal points or fewer, all the points in the unit polygon shall be re-observed.
   (2) Except in the case of the re-observation of all points as in (1) above, the re-observation point shall be included in another nearby unit polygon (not

observed) to form a new unit polygon and GPS observation shall be performed at the re-observation point.

3. If any change appears in the unit polygon by re-observation, the net adjustment map shall also be changed accordingly.

Article 24 Base Line Analysis by Precise Ephemeris

Base line analysis shall be carried out using the precise ephemeris with the GPS observation stations as fixed points to determine their geodetic coordinates.

<Article 24. Standard Operating Procedure>

1. Calculations shall be made for each unit polygon. If the net adjustment map is changed due to re-observation, the calculations shall be based on the new net adjustment map.
2. Base line analysis calculations by the precise ephemeris shall be made in accordance with the International Earth Rotation Service(IERS) Terrestrial Reference Frame Coordinate System (hereinafter referred to as "ITRF (IERS Terrestrial Reference Frame) coordinate system"). The results of the calculations shall be stored in the recording medium as a "precise analysis result file".
3. For an eccentric point, re-calculations shall be made based on the ITRF coordinate system in accordance with clause 3 of Article 22. Standard Operating Procedure.
4. The results using the ITRF coordinate system shall be converted into the final results of the WGS84 coordinate system (B, L, H). In this case, the ellipsoidal height shall be used.
5. The X, Y and Z components of the final results shall be indicated to 0.0001m.

Article 25 Adjustment Computation

After completion of the check calculations, the geodetic coordinates and elevations shall be determined by adjustment computation.

<Article 25. Standard Operating Procedure>

1. Adjustment computation shall be made in accordance with the three-dimensional network adjustment computation program.
2. Three-dimensional network adjustment computation (hereinafter referred to as "adjustment computation"), in which a point is fixed, shall be performed by the following procedure:

(1) The adjustment computation shall be performed using all the base lines on the net adjustment map. If some base lines are duplicated, as a rule, the base line first observed shall be used.

(2) In the adjustment computation, a point whose elevation was connected to a bench mark shall be used as the fixed point.

(3) In the adjustment computation, the input data (i.e. latitude, longitude and height of a new point) shall have been obtained from the base line analysis.

(4) The allowable range of the computation results shown in the table below shall be standard.

Type	Allowable range	Remarks
Corrected values of ΔX, ΔY and ΔZ components	10mm	

(5) The final results of the computation shall be values based on the WGS84 coordinate system.

(6) The adjustment computation shall be performed using a given calculation formula and the results shall be expressed as shown in the table below.

Item	Unit	Place	Remarks
Latitude/longitude	Sec (deg/min/sec)	0.0001	
Elevation	m	0.01 0.001	 In direct leveling
UTM coordinates	m	0.001	
Azimuth	Sec (deg/min/sec)	0.1	
Distance	m	0.001	

Article 26 Preparation of Point Description

A point description shall be prepared for all the control points used in the GPS observations.

<Article 26. Standard Operating Procedure>

1. The antenna height as well as the necessary items shall be included in the point description for each control point. Furthermore, the position of eccentric points with an eccentric distance of 10m or more shall be indicated on the sketch map.
2. “National control point survey” shall be entered in the Remarks column.

Chapter 7 Arrangement

Article 27 Arrangement

All the survey results and records shall be arranged and classified into observation RAW data files, observation RINEX data files, precise analysis result files, observation books, GPS analysis books, calculation books, point descriptions, accuracy control sheets, national control point survey network maps and a control point distribution map.

<Article 27. Standard Operating Procedure>

1. The national control point survey network maps shall be created on 1/250,000-scale topographic maps based on the plans of net adjustment. (The eccentric points, antenna heights, benchmarks and GPS observation stations shall also be entered on the maps.)
2. The control point distribution maps shall be created on 1/250,000-scale topographic maps.

CALCULATION FORMULAE
FOR
NATIONAL CONTROL POINT SURVEY

1. Transformation of Ellipsoid

(1) Parameter of Ellipsoidal

(a) Values used by Clarke 1880

Semi-major axis: a_b=6378249.145m

Flattening: f_b=1/293.465000

(b) Values used by GPS (WGS84)

Semi-major axis: a_w=6378137m

Flattening: f_w=1/298.257223563

(2) Transformation from latitude, longitude and height to a 3-dimensional rectangular coordinate system

$$X = (N + H)\cos\phi \bullet \cos\lambda$$
$$Y = (N + H)\cos\phi \bullet \sin\lambda$$
$$Z = \{N(-e^2) + H\}\sin\phi$$
$$N = a / \sqrt{(1 - e^2 \bullet \sin^2\phi)}$$
$$e^2 = f(2 - f)$$

where

ϕ :	Latitude	λ :	Longitude
H :	Height from the ellipsoid	N :	Radius of curvature of prime vertical
a :	Semi-major axis	e :	First eccentricity
f :	Flattening		

(3) Transformation from a 3-dimensional rectangular coordinate system to latitude, longitude and height

$$\lambda = \tan^{-1}(Y / X)$$
$$P = \sqrt{(X^2 + Y^2)}$$
$$H = P / \cos\phi - N \qquad (\phi \text{ is repeatedly calculated.})$$
$$N_{1\text{-}1} = a/\sqrt{(1 - e^2 \bullet \sin^2\phi_{1\text{-}1})}$$
$$\phi = \tan^{-1}\{Z / (P - e^2 \bullet N_{1-1} \bullet \cos\phi_{1\text{-}1})\}$$

where

Convergence condition of ϕ: $\phi_1 - \phi_{1\text{-}1} \leqq 10^{-12}$(rad)

$\phi 1$: i^{th} computation result

$\phi_{0:}$ $\tan^{-1}$(Z/P)

(4) Transformation of coordinates

(a) General formula for transformation from Gambian's geodetic coordinate system to WGS84 coordinate system

$$\begin{pmatrix} X_w \\ Y_w \\ Z_w \end{pmatrix} = \begin{pmatrix} \Delta X_0 \\ \Delta Y_0 \\ \Delta Z_0 \end{pmatrix} + (1+\Delta)\begin{pmatrix} 1 & +\Omega_Z & -\Omega_Y \\ -\Omega_Z & 1 & +\Omega_X \\ +\Omega_Y & -\Omega_X & 1 \end{pmatrix}\begin{pmatrix} X_B \\ Y_B \\ Z_B \end{pmatrix}$$

where

X_B, Y_B, Z_B :	UTM coordinates values based on Gambian's geodetic coordinate system (Clarke ellipsoid)
X_w, Y_w, Z_w :	UTM coordinates valued based on WGS84 coordinate system
ΔX_0, ΔY_0, ΔZ_0 :	Value of parallel shift of origin from Gambian's geodetic coordinate system to WGS84 coordinate system
Δ :	Value of scale correction from Gambian's geodetic coordinate system to WGS84 coordinate system
Ω_x, Ω_y, Ω_z :	Rotation of the X, Y, Z-axis from Gambia's geodetic coordinate system to WGS84 coordinate system

(b) Actual method of transformation

2. Eccentric Reduction Calculation

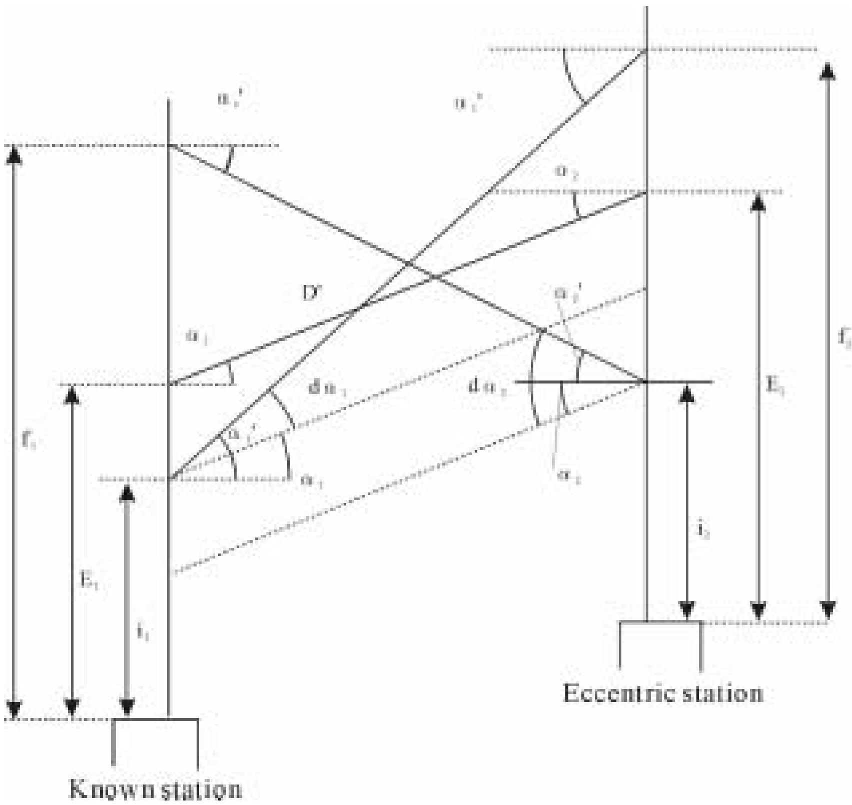
2.1 Eccentric reduction calculation

(1) Correction computation of elevation angle necessary for eccentric reduction computation

$$\alpha_1 = \alpha_1' + d\alpha_1$$
$$\alpha_2 = \alpha_2' + d\alpha_2$$
$$d\alpha_1 = \sin^{-1}\{(i_1 - E_1 + E_2 - f_2) \bullet \cos\alpha_1' / D'\}$$
$$d\alpha_2 = \sin^{-1}\{(i_2 - E_2 + E_1 - f_1) \bullet \cos\alpha_2' / D'\}$$

where

α_1, α_2 :	Elevation angle of measured line from each survey point
α_1', α_2' :	Observed elevation angles
$d\alpha_1$, $d\alpha_2$:	Correction of elevation angles of measured line
D' :	Measured Slope distance
E_1, E_2 :	Height of Electric distance meter or reflecting mirror at the time each point is observed
i_1, i_2 :	Height of theodolite
f_1, f_2 :	Height of target



(2) Distance calculation necessary for eccentric reduction calculation

$$D = \sqrt{(D' \bullet \cos\alpha_m)^2 + (D' \bullet \sin\alpha_m + i_1 - f_2)^2}$$
$$\alpha_m = \left(\alpha_1' - \alpha_2'\right)/2$$

where

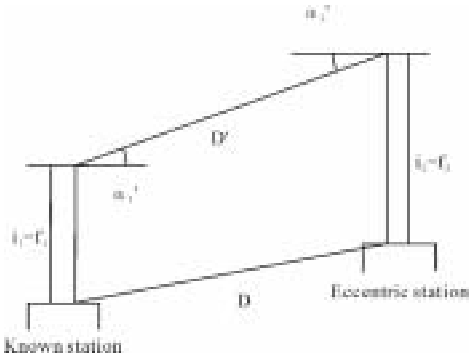
D : Slope distance of known station and eccentric station

D' : Measured slope distance

α_1', α_2' : Observed elevation angles

i_1, i_2 : Height of instrument

f_1, f_2 : Height of target



(3) Correction computation of elevation angle necessary for eccentric reduction calculation

$$\alpha_1 = \alpha_1' + d\alpha_1$$
$$\alpha_2 = \alpha_2' + d\alpha_2$$
$$d\alpha_1 = \sin^{-1}\{(i_1 - f_2) \bullet \cos\alpha_1' / D\}$$
$$d\alpha_2 = \sin^{-1}\{(i_2 - f_1) \bullet \cos\alpha_2' / D\}$$

where

α_1, α_2 : Elevation angles of known station and eccentric station

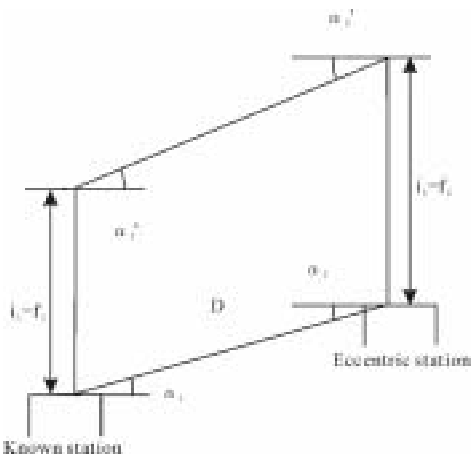
α_1', α_2' : Observed elevation angles

$d\alpha_1$, $d\alpha_2$: Correction value of elevation angles

D : Slope distance of known station and eccentric station

i_1, i_2 : Height of instrument

f_1, f_2 : Height of target



(4) Computation of azimuth necessary for eccentric reduction computation

(a) Azimuth angle of known point from eccentric point

$$\beta = \beta_0 + \theta$$

$$\beta_0 = \tan_{-1}(Dy / Dx)$$

$$\begin{pmatrix} Dx \\ Dy \\ Dz \end{pmatrix} = \begin{pmatrix} -\sin\phi \bullet \cos\lambda & -\sin\phi \bullet \sin\lambda & \cos\phi \\ -\sin\lambda & \cos\lambda & 0 \\ \cos\phi \bullet \cos\lambda & \cos\phi \bullet \sin\lambda & \sin\phi \end{pmatrix} \begin{pmatrix} \Delta x' \\ \Delta y' \\ \Delta z' \end{pmatrix}$$

where

β : Azimuth angle of known point from eccentric point

β_0 : Azimuth angle of azimuth marker

θ : Eccentric angle

Dx, Dy, Dz :

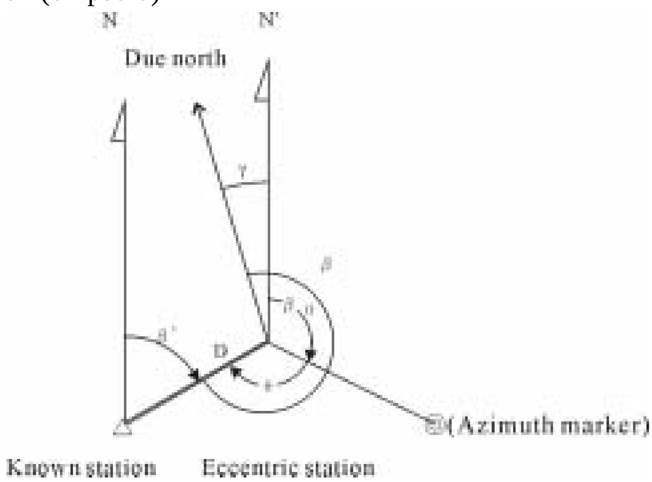
Components of base line vector in local horizontal coordinates

ϕ : Latitude of eccentric station (ellipsoid)

λ : Longitude of eccentric station (ellipsoid)

$\Delta x'$, $\Delta y'$, $\Delta z'$:

Components of base line vector in geocentric rectangular coordinate system (three-dimensional difference in the coordinates of the eccentric point and azimuth marker)



(b) Azimuth computation of eccentric point from known point

$$\beta' = \beta \pm 180^0 - \gamma$$
$$\gamma = S' \bullet \sin\beta' \bullet \tan\phi_c \;/\; Nc$$
$$S' = D \bullet \cos\alpha_m \bullet R / (R + Hm)$$
$$\phi c = \phi_1 + X / M$$
$$X = S' \bullet \cos B'$$
$$\alpha_m = (\alpha_1 - \alpha_2) / 2$$
$$H_m = (H_1 + H_2) / 2$$
$$R = \sqrt{M \bullet N_c}$$
$$N_c = a / \sqrt{(1 - e^2 \bullet \sin^2 \phi)}$$
$$M = a(1 - e^2) / \sqrt{(1 - e^2 \bullet \sin^2 \phi)^2}$$

where

β :	Azimuth angle of known point from eccentric point (The values calculated in 2.1, (4) (a). shall be used)
γ :	Meridian convergence angle
S' :	Distance on reference surface (on the ellipsoid)
D :	Slope distance of known point and eccentric point
ϕ_1 :	Latitude of the known point (on the ellipsoid)
N_c :	Radius of curvature of the prime vertical (on the ellipsoid: the argument shall be ϕ_c.)
M:	Radius of curvature of the meridian (on the ellipsoid: argument shall be ϕ_1.)
R:	Average radius of curvature (on the ellipsoid: argument shall be ϕ_1.)
α_1, α_2:	Elevation angle of known point and eccentric point
H_1, H_2:	Height of known point and eccentric point (on the ellipsoid)

Note: The calculation of γ shall be made with the value of $\beta_0' = \beta + 180°$ and repeated until $|\beta - \beta_0'| \leqq 0.1''$ is satisfied.

(5) Eccentric reduction computations (The transformation of the base line vector components in the local horizontal coordinate system to the geocentric rectangular coordinate system)

$$\begin{pmatrix} \Delta x \\ \Delta y \\ \Delta z \end{pmatrix} = \begin{pmatrix} -\sin\phi \bullet \cos\lambda & -\sin\lambda & \cos\phi \bullet \cos\lambda \\ -\sin\phi \bullet \sin\lambda & \cos\lambda & \cos\phi \bullet \sin\lambda \\ \cos\phi & 0 & \sin\phi \end{pmatrix} \begin{pmatrix} D \bullet \cos\alpha_m \bullet \cos\beta \\ D \bullet \cos\alpha_m \bullet \sin\beta \\ D \bullet \sin\alpha_m \end{pmatrix}$$

$$\alpha_m = (\alpha_1 - \alpha_2) / 2$$

where

Δx, Δy, Δz : Three-dimensional eccentric reduction

ϕ : Latitude of known point (on the ellipsoid)

λ : Longitude of known point (on the ellipsoid)

D : Slope distance of known station and eccentric station

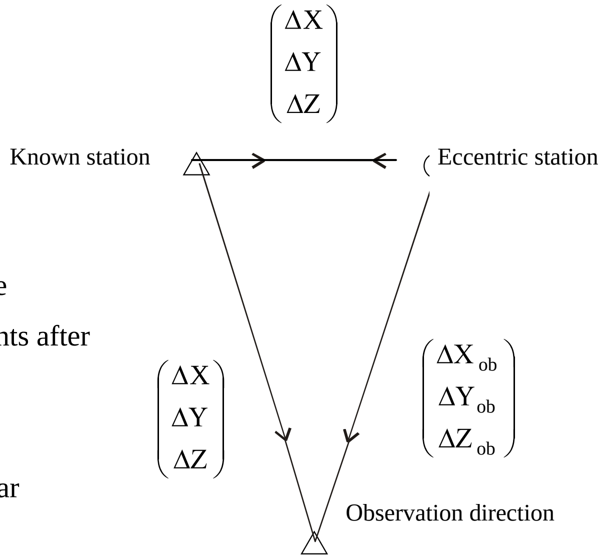
α_1, α_2 : Elevation angle of known station and eccentric station

β : Azimuth angle of eccentric point from known point or known point from eccentric point (on the ellipsoid)

2.2 Method of eccentric reduction

(1) Eccentric observations performed at the eccentric points and known points

$$\begin{pmatrix}\Delta X\\ \Delta Y\\ \Delta Z\end{pmatrix}=\begin{pmatrix}\Delta X_{ob}\\ \Delta Y_{ob}\\ \Delta Z_{ob}\end{pmatrix}\pm\begin{pmatrix}\Delta x\\ \Delta y\\ \Delta z\end{pmatrix}$$



where

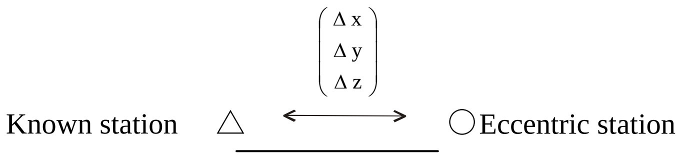
ΔX, ΔY, ΔZ : Three-dimensional coordinate difference between the two points after eccentric reduction (Components in the geocentric rectangular coordinate system)

ΔX_{ob}, ΔY_{ob}, ΔZ_{ob} : Three-dimensional coordinate difference between the two points observed at the eccentric point (Components in the geocentric rectangular coordinate system)

Δx, Δy, Δz : Eccentric reduction (The values calculated in 2.1, (5) "Eccentric reduction computation" shall be used.)

(2) For eccentric points with unknown coordinates

$$\begin{pmatrix}X\\ Y\\ Z\end{pmatrix}=\begin{pmatrix}X_1\\ Y_1\\ Z_1\end{pmatrix}\pm\begin{pmatrix}\Delta x\\ \Delta y\\ \Delta z\end{pmatrix}$$



where

X, Y, Z: Three-dimensional coordinates of eccentric point (Components in the geocentric rectangular coordinate system)

X_1, Y_1, Z_1: Three-dimensional coordinates of known point (Components in the geocentric rectangular coordinate system)

Δx, Δy, Δz : Eccentric reduction (The values calculated in 2.1, (5) "Eccentric reduction computation" shall be used.)

3. Computation of Closed Vector

Closed vectors: $(\sum \Delta X、\sum \Delta Y、\sum \Delta Z)$

where

$\Delta X, \Delta Y, \Delta Z$: Three-dimensional difference between the coordinates of the two points after eccentric reduction (Components in the geocentric rectangular coordinate system)

4. Computation of Elevation

(1) Elevation angle: when using the mean of face left and face right readings

$$H_2 = H_1 + D' \bullet \sin 1/2(\alpha_1 - \alpha_2)\sec(D'/2R) + E_1 - E_2$$

(2) Elevation angle: in the case of separate computation in face left and face right readings

$$H_2' = H_1 + D' \bullet \sin\alpha_1 + E_1 + E_2 + K_1 \text{ (face left)}$$

$$H_2'' = H_1 - D' \bullet \sin\alpha_2 - E_2 + E_1 - K \text{ (face right)}$$

$$H_2 = (H_2' + H_2'')/2$$

$$K_D = (1-k)D^2/2R$$

$$k = 0.133$$

where

H_1, H_2 : Elevation of each survey point

D' : Measured slope distance

E_1, E_2 : Height of Electric distance meter or reflecting mirror at the time each survey point is observed

α_1, α_1 : Elevation angle to measured line from each survey point

K_D : Correction for earth's curvature and refraction

K : Refraction coefficient

R : Earth's radius (6,370km)

5. Base Line Analysis

5.1 Net Adjustment

$$V = AX - L$$
$$\left(A^T PA\right)X = \left(A^T PL\right)$$
$$X = \left(A^T PA\right)^{-1} A^T PL$$
$$P = B^{-1} = \begin{pmatrix} \sigma\Delta_x\Delta_x & \sigma\Delta_x\Delta_y & \sigma\Delta_x\Delta_z \\ \sigma\Delta_y\Delta_x & \sigma\Delta_y\Delta_y & \sigma\Delta_y\Delta_z \\ \sigma\Delta_z\Delta_x & \sigma\Delta_z\Delta_y & \sigma\Delta_z\Delta_z \end{pmatrix}^{-1}$$

where

V: Residual vector

A: Coefficient matrix of unknown parameters

X: Vector of unknown parameters

L: Vector of constant term

P: Weight matrix

B: Variance-covariance matrix of ΔX, ΔY and ΔZ

5.2 Relation of variance-covariance matrix and correlation matrix

$$\rho_{ij} = \sigma_{ij} / \sqrt{\left(\sigma_{ii} \times \sigma_{jj}\right)}$$

5.3 Correlation matrix

$$C = \begin{pmatrix} 1 & \rho\Delta_x\Delta_y & \rho\Delta_x\Delta_z \\ \rho\Delta_y\Delta_x & 1 & \rho\Delta_y\Delta_z \\ \rho\Delta_z\Delta_x & \rho\Delta_z\Delta_y & 1 \end{pmatrix}$$

5.4 Standard deviation

Standard deviation of ΔX : $\sigma\Delta_x = \sqrt{\left(\sigma\Delta_x\Delta_x\right)}$

Standard deviation of ΔY : $\sigma\Delta_y = \sqrt{\left(\sigma\Delta_y\Delta_y\right)}$

Standard deviation of ΔZ : $\sigma\Delta z = \sqrt{\left(\sigma\Delta_z\Delta_z\right)}$

Standard deviation of slope distance (D) : $\sigma D = \sqrt{\left(\sigma_{DD}\right)}$

$$\sigma_{DD} = G \bullet B \bullet G^T$$
$$G = \left(\Delta X / D, \Delta Y / D, \Delta Z / D\right)$$
$$D = \sqrt{\Delta X^2 + \Delta Y^2 + \Delta Z^2}$$

where

B : Variance-covariance matrix of ΔX, ΔY and ΔZ

6. Others

In addition to these formulas, formulas that are confirmed to have equal or greater accuracy may also be used.

Request for Transfer of Equipment

THE REPUBLIC OF THE GAMBIA

Department of Lands and Surveys
12 Mummar Al Ghaddafi Avenue
Banjul

10th September, 2002

THE MANAGING DIRECTOR
SOCIAL DEVELOPMENT STUDY DEPARTMENT
JAPAN INTERNATIONAL COOPERATION AGENCY

Dear Sir,

REQUEST FOR TRANSFER OF EQUIPMENT TO THE DEPARTMENT OF LANDS AND SURVEYS

As provided for in the technical agreement signed between JICA and this department, I wish to make a request for the transfer of all the equipment supplied under the project ; The Study for Establishment of Geographic Database in The Republic of The Gambia. After its completion these equipment will not just boost our abilities for a while, but will enable us to independently create and revise spatial information that bear great potentials in many respects.

Enclosed is a list of all the equipment under the custody of JICA mission team for the above-mentioned study in the Gambia.

May I assure you that all the Equipment will be put to good use by the Department and the country at large.

On behalf of the Secretary of State for Local Government and Lands, the Permanent Secretary and the entire staff, I wish to extend to you sincere thanks and appreciation from the Government and people of The Gambia to the Government and People of Japan through JICA, for this great assistance.

Grateful for your usual co-operation..

Yours faithfully

DEPARTMENT OF LANDS & SURVEYS
DESPATCHED

Alieu .S. Jobe
FOR: Director of Lands and Surveys

Cc: Permanent Secretary - DOSLG & Lands
JICA Dakar Office

DEPARTMENT OF LANDS & SURVEYS

LIST OF EQUIPMENT PROVIDED BY JICA HEADOFFICE FOR THE STUDY FOR ESTABLISHMENT OF GEOGRAPHIC DATABASE IN THE REPUBLIC OF THE GAMBIA

Nos.	Description Goods	Quantity	Remarks
1	Personnal computer ARMADA M700 COMPAQ	1 SET	
2	DATA EDITING SYSTEM PC	1 SET	
3	DELL Precision Workstation 530 with WINDOWS 2000(English)	(1 PCS)	
4	With CD-RW DRIVE DELL CW5J758	(1 PCS)	
5	MONITOR for PC DELL 2000FP 20inch	2 PCS	
6	PC SERVER DELL PowerEdge 2500	1 SET	
7	With WINDOWS 2000 Server (English)	(1 PCS)	
8	With HARD DISK UNIT DELL 7G600	(1 PCS)	
9	With MEMORY UNIT DELL E72RNH	(1 PCS)	
10	MONITOR for SERVER DELL E151FP 15inch	1 PCS	
11	NETWORK HUB HP ProCurve 10/100 24 J3295A	1 SET	
12	With LAN CABLE	5 PCS	
13	PRINTER HP Laser Jet 5000n C4111A	1 SET	
14	With CONNECTION CABLE	1 PCS	
15	With TRANSFORMER	1 PCS	
16	PLOTTER JC9000NET	1 SET	
17	With OPTIONAL MEMORY 64MB	1 PCS	
18	With MANUAL (English/Japanese)	2 VOL	
19	With CABLE CA4015	1 PCS	
20	SCANNER TS7010	1 SET	
21	With MANUAL (English/Japanese)	2 VOL	
22	With SOFTWARE (SCANNER DRIVER)	(1 PCS)	
23	With SCSI INTERFACE BOARD AHA-2930U JARTLKIT	1 PCS	
24	With SCSI CABLE SC0006	1 PCS	
25	UNINTERRUPTED POWER SUPPLY	2 SETS	
26	APC Smart-UPS 1500 USB	(2 PCS)	
27	With SOFTWARE (PowerChute)	(1 PCS)	
28	SOFTWARE Microsoft Office XP Professional	1 PCS	
29	SOFTWARE Microimages TNTmipsV.6.5 (M50)	1 PCS	
30	SOFTWARE Microimages PRINTER DRIVER (P15)	1 PCS	
31	SOFTWARE Microimages SDK (SDK3)	1 PCS	
32	SOFTWARE Adbe Illustrator9	1 PCS	
33	SOFTWARE Adbe Photoshop6.0	1 PCS	
34	PRINTER PAPER JC36R-ST2 (W914mm XL45m)	6 PCS	
35	PRINTER HEAD (4color/set)	1 SET	
36	INK TANK (4color/set)	8 SET	
37	TONER CARTRIDGE HP C4129X	1 PCS	
38	GPZ Receiver Z-xtrem (S/N. ZE120013415, ZE120013418, ZE1200013417)	3 SETS	
39	GPZ Antena (S/N. 5934,5943.5950)	3 SETS	
40	GPZ Antena Cable	3 SETS	
41	Compag Aero 1550 Handy Controler	3 SETS	
42	GPZ Accessory	3 SETS	
43	Tripods	3 SETS	
44	Post-prossing Analysis software	1 SET	
45	(Original and Upgrade software)	4 VOL	

Programme for Technology Transfer Seminar

THE STUDY FOR
ESTABLISHMENT OF GEOGRAPHIC DATABASE IN
THE REPUBLIC OF THE GAMBIA

PROGRAMME FOR HANDING OVER OF PROJECT PRODUCTS
8TH October 2002, JAAMA HALL, KAIRABA HOTEL
CHAIRPERSON:- Badara Joof – Permanent Secretary

09:30 –10:00	(30)	Reception
10:00 – 10:30	(30)	Opening Address 1. Statement by **Ousman Semega-Janneh** Director of Lands & Surveys 2. Statement by **Mr. Komori** (Representative of JICA Dakar office) 3. Keynote Address by **Manlafy Jarju** - SOS For Local Government & Lands
10:30 – 11:30	(60)	Conclusions and Recommendation of the Study:- **Mr. Akira Nishimura** (Study Team Leader)
11:30 – 11:50	(20)	Coffee Break
11:50 – 12:30	(40)	Exhibition of Products & Demonstration of GIS Database:- **Mr. K. Yamada, Mr. K. Masuda** & **Ms. C. Kigasawa**
12:30 – 13:30	(60)	Signing on M/M for Draft Final Report:- **Ousman Semega-Janneh** - Director of Lands & Surveys **Mr. A. Kira Nishimura** Handing Over of Inventory of Products:- **Mr. Komori** to **Mr. Badara Joof** – Permanent Secretary. Closing Address **Mr. Badara Joof** - Permanent Secretary
13:30 – 15:00	(90)	Lunch Party

SECOND DAY (9TH October 2002)

9:30 – 10:00 (30)		Reception
10:00 – 10:45	(45)	National Control Point **Mr. Morten Strand** (Study Team)
10:45 – 11:05	(20)	Tea Break
11:05 – 11:50	(45)	Aerial Photogrammetry **Mr. Keiji Yamada** (Study Team)
11:50 – 13:15	(85)	LUNCH
13:15 – 14:00	(45)	GIS Outline - **Mr. Kazutoshi MASUDA**
14:00 – 14:45	(45)	GIS Applications - **Ms. Chiyo KIGASAWA**
14:45 – 15:15	(30)	Discussion

Receipt of The Equipment Transferred

THE REPUBLIC OF THE GAMBIA

Department of State for Local Government & Lands
12 Marina Parade
Banjul

ADM 218/250/01(9)

8th October 2002

The Managing Director
Social Development Study Department
Japan International Cooperation Agency

RECEIPT OF THE EQUIPMENT TRANSFERRED TO THE DEPARTMENT OF LANDS AND SURVEYS

I hereby confirm receipt from the Japanese International Cooperation Agency (JICA) The following equipment (see attachment) on behalf of The Gambia Government, as provided in the Technical Agreement signed between JICA and The Department of Lands and Surveys; under the project - the Study for the Establishment of Geographic Database in the Republic of The Gambia.

I take this opportunity, on behalf of The Government and people of The Gambia, to thank the Government and people of Japan, through The Japanese International Cooperation Agency (JICA).

And I would like to assure you that these equipment will be put into good use, during the course of the implementation of the Geographic Database in The Gambia.

Thanking you once again for the usual cooperation.

RECEIVED BY :-

B. A. Joof
....
B. A. Joof
Permanent Secretary
Date..8th/10/02

WITNESSED BY :-

....
Abdoulie Manneh
Deputy Permanent Secretary
Date:..8/10/02.

DELIVERED BY:

小森 正勝
....
M. Komori
JICA Dakar Office
Date:..8. Oct. 2002

WITNESED BY:

西村 明
....
A. Nishimura
JICA Study Team Leader
Date:..8. Oct. 2002

LIST OF EQUIPMENT PROVIDED BY JICA HEADOFFICE FOR THE STUDY FOR ESTABLISHMENT OF GEOGRAPHIC DATABASE IN THE REPUBLIC OF THE GAMBIA

Nos.	Description Goods	Quantity	Remarks
1	Personnal computer ARMADA M700 COMPAQ	1 SET	
2	DATA EDITING SYSTEM PC	1 SET	
3	DELL Precision Workstation 530 with WINDOWS 2000(English)	(1 PCS)	
4	With CD-RW DRIVE DELL CW5J758	(1 PCS)	
5	MONITOR for PC DELL 2000FP 20inch	2 PCS	
6	PC SERVER DELL PowerEdge 2500	1 SET	
7	With WINDOWS 2000 Server (English)	(1 PCS)	
8	With HARD DISK UNIT DELL 7G600	(1 PCS)	
9	With MEMORY UNIT DELL E72RNH	(1 PCS)	
10	MONITOR for SERVER DELL E151FP 15inch	1 PCS	
11	NETWORK HUB HP ProCurve 10/100 24 J3295A	1 SET	
12	With LAN CABLE	5 PCS	
13	PRINTER HP Laser Jet 5000n C4111A	1 SET	
14	With CONNECTION CABLE	1 PCS	
15	With TRANSFORMER	1 PCS	
16	PLOTTER JC9000NET	1 SET	
17	With OPTIONAL MEMORY 64MB	1 PCS	
18	With MANUAL (English/Japanese)	2 VOL	
19	With CABLE CA4015	1 PCS	
20	SCANNER TS7010	1 SET	
21	With MANUAL (English/Japanese)	2 VOL	
22	With SOFTWARE (SCANNER DRIVER)	(1 PCS)	
23	With SCSI INTERFACE BOARD AHA-2930U JARTLKIT	1 PCS	
24	With SCSI CABLE SC0006	1 PCS	
25	UNINTERRUPTED POWER SUPPLY	2 SETS	
26	APC Smart-UPS 1500 USB	(2 pcs)	
27	With SOFTWARE (PowerChute)	(1 PCS)	
28	SOFTWARE Microsoft Office XP Professional	1 PCS	
29	SOFTWARE Microimages TNTmipsV.6.5 (M50)	1 PCS	
30	SOFTWARE Microimages PRINTER DRIVER (P15)	1 PCS	
31	SOFTWARE Microimages SDK (SDK3)	1 PCS	
32	SOFTWARE Adbe Illustrator9	1 PCS	
33	SOFTWARE Adbe Photoshop6.0	1 PCS	
34	PRINTER PAPER JC36R-ST2 (W914mm XL45m)	6 PCS	
35	PRINTER HEAD (4color/set)	1 SET	
36	INK TANK (4color/set)	8 SET	
37	TONER CARTRIDGE HP C4129X	1 PCS	
38	GPZ Receiver Z-xtrem (S/N. ZE120013415, ZE120013418, ZE1200013417)	3 SETS	
39	GPZ Antena (S/N. 5934,5943.5950)	3 SETS	
40	GPZ Antena Cable	3 SETS	
41	Compag Aero 1550 Handy Controler	3 SETS	
42	GPZ Accessory	3 SETS	
43	Tripods	3 SETS	
44	Post-prossing Analysis software	1 SET	
45	(Original and Upgrade software)	4 VOL	