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Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
Manila

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KAYAMANAN NG BAYAN

AUG 22 2001

DEPARTMENT ORDER)
NO. 147)
Series of 2001 8.22.01 **)**

SUBJECT: Authority for DPWH Regional Directors and District Engineers to Hire Private Surveying Firms

To expedite the detailed engineering of DPWH projects being undertaken by Regional and District Offices, the Regional Directors and District Engineers are hereby authorized to hire private surveying firms in the conduct of geodetic engineering survey work and approve contracts therefor.

The following guidelines shall be strictly observed by Regional and District Offices in the prosecution of survey work done by contract:

1) The procurement of a surveying firm shall be made thru open competitive bidding subject to existing rules and regulations on hiring of consulting firms.

2) Surveying firm should be a Geodetic Engineering Partnership or Sole Proprietorship Firm.

3) Terms of Reference of the proposed survey shall be in accordance with the DPWH Design Guidelines, Criteria and Standards, Volume I (Survey and Investigation). Refer to the attached Annexes "A", "B", "C", "D" and "E" for the proforma Terms of Reference for various types of survey.

4) The unit costs of surveys as shown on the attached Annex "F" shall be used as reference in estimating the contract cost.

5) The review/checking of survey plans prepared by the surveying firm shall be undertaken by the Planning and

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Design Division/Section of the Regional/District Office. Errors should be corrected by the surveying firms at their own expense prior to approval of the survey plans by the Regional Director/District Engineer.

6) The surveying firm shall be responsible for the submission of parcellary plans and related documents to the Land Management Bureau of the Department of Environment and Natural Resources for its approval. The implementing offices shall be responsible for securing the title(s) of acquired lands in favor of the government.

7) Survey errors in the approved design plans determined during actual project stake-out shall be corrected by the surveying firm at no additional cost. To ensure compliance by the surveying firm, all payments to the firm shall be subject to retention of ten percent (10%) which shall be withheld by the Regional Office/District Office until after the completion of the stake-out survey during project implementation.

This Order shall take effect immediately.

SIMEON A. DATUMANONG
Secretary

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
Manila

ANNEX "A"

TERMS OF REFERENCE

FOR

TOPOGRAPHIC SURVEY

I. **PROJECT DESCRIPTION AND PURPOSE:** This survey will supplement the Feasibility Study/Detailed Engineering of:

_____

(For additional description, see Annex A)

_____

_____

II. **LOCATION DESCRIPTION:** (Project Location Map)

_____

_____

III. SCOPE OF WORK

The Consultant shall provide all labors, instruments, materials, supplies vehicles, etc., necessary to perform satisfactorily the survey works herein called for, viz:

A. Establishment of horizontal and vertical ground controls

B. Recovery of at least three (3) benchmarks established by Bureau of Coast and Geodetic Survey (BC & GS) for vertical ground controls and Bureau of Lands Location Monuments (BLLM's) for triangulation stations for horizontal ground controls.

C. Computations, plottings and preparation of survey plans.

IV. DETAILED SURVEY AND MAPPING REQUIREMENTS

A. Common Surveying and Mapping Requirements

The detailed topographic survey work shall be undertaken in accordance with common surveying and mapping requirements stipulated in the Design Guidelines, Criteria and Standards (DGCS) of the DPWH, Vol. 1 Part 1, Surveys and Investigations prepared by Bureau of Design (BOD). For easy reference, see Manual on

Technical Requirements for Surveying and Investigation of Public Works and Highways Projects and applicable provisions of existing laws, codes or Department Orders that includes but not limited to the following:

1) Establishment of Horizontal and Vertical Ground Controls

   a) Horizontal Ground Control

      Horizontal ground controls shall be established at or near an acceptable vicinity of subject project using at least tertiary traverse precision and accuracy. Previously established and/or existing BLLM's shall be made part of the project control.

   b) Vertical Ground Controls

      A vertical control system shall be established for the entire project which will be connected and referred to at least three (3) existing benchmarks (BM) shall be referred to a reference datum plane, either the Mean Sea Level (MSL) or the Mean Lower Low Water (MLLW) as established by the Bureau of Coast and Geodetic Survey or in the absence thereof by establishing temporary Mean Tide Level (MTL) BM based on a seven (7) day tide observation. For interior areas far from the seashore, the vertical control may be based on an assumed datum. In all cases, the datum plane shall be clearly indicated in the survey plans.

      A pair of permanent benchmarks if not available shall be established at every *poblacion*, barangay or community site and at existing or proposed bridge and structure sites within the project and at every 3.0 km distance. Benchmark shall be marked by a concrete monument measuring 40 cm by 40 cm by 100 cm long with enlarged base, top marked by an embedded brass plate with inscription as follows:

      PBM No. _____ (DPWH date established)
      Elevation _____
      Datum: (MSL or MLLW)
      Name of Project: _____

2) Intermediate Benchmarks

   Intermediate benchmarks (IBM) shall be established between PBM at 1 km interval and shall be marked by a concrete monument

measuring 15 cm square by 60 cm long with enlarged base, with inscription as follows marked on top of the monument:

IBM No. _____
DPWH (Date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

Vertical control leveling shall have the following Accuracy Requirements:

Specifications	2nd Order Accuracy	3rd Order Accuracy
1. No. of Wires read	3	3
2. Distances between		
a) PBM	3 km	3 km
b) IBM	1 km	1 km
3. Maximum length of sight	150 m	200 m
4. Allowable closing error of loops	8.4 mm $\sqrt{K}$	12.0 mm $\sqrt{K}$
5. Maximum length of line	50 km	30 km
6. Instrument used	precise	precise

K is distance or length of line in kilometers.

Line of levels shall begin and end on previously established first order benchmark. At least two benchmarks which have not changed their relative elevations must be recovered at each end of the line and at any intermediate functions of the line with previous leveling.

When leveling along railroad, the elevation of the top of rail is to be determined and along a highway or a well defined road, the elevation of the top of the road has to be determined by means of extra foresights, in front of each railroad station or at each intersection railroad, road or highway; at principal forks, at well defined angles in the road; at points opposite intersecting fence

lines defined by trees or brush, at points opposite sharp boundaries between cleared and eroded area and at bridge floors.

3. Traverse Survey

   a) All traverses for topographic survey shall start and close at previously established horizontal ground controls in the project.

   b) Succeeding turning point distances shall not exceed 100 m intervals distances from each other.

   c) Rod reading shall be read to the nearest centimeter mark.

   d) Shot points shall be made to determine the location and elevations of existing buildings, road bridges, canals and other natural features or man-made structures.

   e) Traverse error of closure shall be in accordance with the provisions of the Manual for Land Surveys in the Philippines (Land Administration Order No. 4, B.L.)

4. Recording

   a) Survey notes shall be recorded in either bound durable field books or ring type survey books. Paper shall be heavy weight not easily affected by adverse weather condition.

   b) All notes shall be properly recorded and dated indicating the type of weather, with signature of the in-charge of the survey team or Supervising Engineer/Locating Engineer, and properly referenced as to name of project and location. All members of the team involved in the particular survey activity shall be indicated in the fieldbooks.

   c) Survey notes shall be neat, legible and in English Language. No erasures shall be permitted. If it is necessary to amend or correct a note already recorded, the original information should still be legible.

   d) No note shall be discarded. If whole pages are to be revised, it shall be marked "Void" but be retained for reference purposes.

5. Survey of Existing Features

All natural and man-made topographic/physical features within the survey area and buildings, electric posts, fences, trees, drainage pipes/culverts, bridges, etc.

6. Preparation of Survey Plans

1. Topographic/Location Plan

Topographic or location plans shall be plotted to scale and contour intervals as specified (see aforecited Reference Manual) on the upper half of a half-ruled cross section millimeter paper to indicate but not limited to the following:

a) Grid/coordinate system and north direction.
b) Exact locations of benchmarks and reference points with proper technical descriptions.
c) Existing drainage and flood control works, bridges, culverts, canals and other waterways properly plotted with correct direction of water flow, exact name and location.
d) Land use classification such as rice field, coconut plantation and etc., existing houses and buildings, electric poles, water pumps, underground and overhead public and private utility lines, etc.
e) The topography in the plan must be consistent with longitudinal profile and cross sections.

V. Survey Operations

A. The survey works herein called for shall be completed within _____ calendar days (see work schedule in Bar Chart).

B. All requirements of surveys not expressly specified herein shall conform to the provisions laid by the Manual for Land Surveys in the Philippines (Land Administrative Order No. 4, B.L.) and to the Design Guidelines, Criteria and Standard (DGCS) of the DPWH Vol. 1, Part 1 and/or Reference Manual for Surveys and Investigation of Public Works and Highways projects.

C. The Director concerned shall designate his authorized representative to oversee and evaluate the field and office works for compliance to the herein requirements and others to

be stipulated as maybe required by the Director concerned. Any recommendations, corrections or alterations required by the authorized representative on this subject survey works shall be followed accordingly. The right is reserved by this office work not consistent with the herein requirements and to incorporate other details deemed necessary but not embraced in the herein scope of work.

D. The Consultant shall submit a monthly progress report to the Director or his authorized representative stipulated among others, percentage of works completed and still to be completed constraints or other problems encountered and solutions made/to be made in order to complete the work satisfactorily and as scheduled.

E. The plans and cross sections shall first be plotted in pencil and shall be subject to review/corrections by the DPWH authorized representatives before they are finalized.

F. Drawings and other mapping requirements, such as dimension of sheets, title blocks, index maps, general notes, etc. shall be in accordance with the aforecited DGCS.

VI. SUBMITTAL OF SURVEY RETURNS

The end product of this survey shall be submitted for checking, review and approval. It shall consist of the following:

A. One set of plotted survey data which shall conform to the standard mapping requirements.

B. Computation sheets, field notes, reference location plan maps, list of established benchmarks complete with technical descriptions and the final draft of plans, cross sections and/or profiles shall first be submitted to the Director concerned through the authorized representative for final review before finalizing the plans, cross sections and/or profiles for approval.

C. Such plans, cross sections and/.or profile shall be subject to the approval of the Director concerned as the case maybe in accordance with the approved delegation of authority.

D. The Consultant shall submit ____ sets of print copies of the plans, cross sections and/or profiles including any maps/plans referred/used in the conduct of the survey works, together with the corresponding originals/tracings, as well as computation sheets, filed books, other survey returns complete with signature of Consultant or Geodetic Engineer concerned. The list of the surveying instruments, materials and equipment lent to the Consultant or purchased by the same, it any used during the conduct of this survey works, should be submitted for verification purposes.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
Manila

ANNEX "B"

TERMS OF REFERENCE

FOR

BRIDGE OR CULVERT SITE SURVEY

I. **PROJECT DESCRIPTION:** _____
(State whether Bridge or Box Culvert)

_____
(For additional descriptions, see Annex A)

II. **LOCATION DESCRIPTION:** _____
(See attached Location Plan)

_____

_____

III. SCOPE OF WORK

The Consultant shall provide all labor, instruments, materials, supplies, vehicles, etc., necessary to perform satisfactorily the survey works herein required, viz:

A. Establishment of horizontal and vertical ground controls and other common surveying and mapping requirements.

B. River/topographic, location, profile/cross-sections survey and other project survey requirements.

C. Computations, plottings and drafting/preparation of survey maps and plans.

D. Submission of survey returns.

The Consultant shall be held solely responsible for the result of this survey works and other activities under this Terms of Reference.

IV. DETAILED SURVEY REQUIREMENTS; SPECIFICATIONS

A. Common Surveying and Mapping Requirements

The detailed survey works shall be undertaken in accordance with common surveying and mapping requirements stipulated in the Design Guidelines, Criterias and Standards (DGCS) Vol. 1, Part 1, Surveys and Investigations of Public Works and Highways Projects, that includes but not limited to the following:

1. Establishment of horizontal and vertical ground controls

Horizontal and vertical ground controls shall be established in the absence of existing ones at or near the vicinity of the location distances specified herein:

a) Horizontal Ground Controls

Horizontal ground controls shall be established at or near an acceptable vicinity of the bridge or culvert site or existing/proposed structure using at least primary traverse precision and accuracy. Nearby existing Bureau of Land Boundary Monuments (BLLM's, MBM, BBM) shall be made part of the project control. The horizontal ground controls shall be connected to previously approved Bureau of Lands Location Monuments (BLLM's) and/or Triangulation stations.

Traverse or base line shall be established within the project site. It shall start and close at previously established control points of higher order in the project area.

1) Traverse stations should not exceed 200 m and no side shot-points shall exceed 20 meters interval distance from each other.

2) Traverse stations shall be marked by some identifying mark on brass tablet or on top of a monument in the form of a concrete post with enlarged base and top diameter not less than 36 cm length from 76 cm to 90 cm. The tablet shall be so fastened in the rock/concrete or the concrete post/monument embedded in the ground as to effectively resist extraction, change of elevation or rotation. The number of the station and date established and name of project shall be inscribed on top of the mark.

3) All lines should be measured using steel tapes/electronic distance meter of approved quality and reliability.

4) Rod reading shall be read to the nearest centimeter mark.

5) Shot points shall be made to determine the exact location and elevations of existing structures in the project site.

6) The traverse error of closure shall be in accordance with Table 1.

7) Astronomical observations shall be undertaken if horizontal controls are available.

TABLE 1. ALLOWABLE TRAVERSE ERROR OF CLOSURE

KIND OF TRAVERSE	ANGULAR	LINEAR
Precise	$=< 1.5" \sqrt{Pr}$	=< 1/25,000
Primary	$=< 2.5" \sqrt{P}$	=< 1/10,000
Secondary	$=< 10" \sqrt{S}$	=< 1/5,000
Tertiary	$=< 30" \sqrt{T}$	=< 1/2,000

b) Vertical Ground Control

1) Permanent Benchmarks (PBM's)

Vertical ground controls shall be established within the project site and shall be connected and referred to at least three (3) existing benchmarks. All elevations shall be referred to Mean Sea Level Datum (MSL) or Mean Lower Low Water (MLLW).

The location of benchmark should be situated with at least disturbance, accessible and can easily be sighted by instrument. Benchmark shall be marked by a concrete monument measuring 40 cm square by 100 cm long with enlarge base with the top marked by embedded brass plate with inscription as follows marked on top of the monument:

PBM No. _____ (DPWH date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

2) Intermediate Benchmarks (IBM)

Intermediate benchmarks shall be established between PBM at km interval and shall be marked by a concrete monument measuring 15 cm square by 60 cm long with enlarged base, with inscription as follows marked on top of the monument:

IBM No. _____DPWH (date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

Table 2. Specifications for Vertical Ground Controls:

Specifications	1st Order	2nd Order	3rd Order	4th Order
1. No. of Wires read	3	3	3	3
2. Distances between				
a) PBM	1 km	3 km	3 km	3 km
b) IBM	1 km	1 km	1 km	1 km
3. Maximum length of sight	100 m	150 m	200 m	200 m
4. Allowable closing error of loops	4.0 mm$\sqrt{K}$	8.4 mm$\sqrt{K}$	12.0 mm$\sqrt{K}$	25 mm$\sqrt{K}$
5. Maximum length of line	70 Km	50 km	30 km	10 km
6. Instrument used	precise	precise	precise	precise

Where K is the distance or length of line in kilometers.

Line of levels shall begin and end on previously established First Order benchmark. At least two benchmarks which have not changed their relative elevation must be recovered at each end of the line and at any intermediate junctions of the line with previous leveling.

When leveling along railroad, the elevation of the top of rail is to be determined and along a highway or a well defined road, the elevation of the top of the road has to be determined by means of extra foresights, in front of each railroad station or at each intersecting railroad, road or highway; at principal forks, at well defined angles in the road; at points opposite intersecting fence lines defined by trees or brush, at points opposite sharp boundaries between cleared and wooden areas and at bridge floors.

3. Recording

A. Survey notes shall be recorded in either bound durable field books or ring type survey books. Paper shall be heavy weight not easily affected by adverse weather condition or by a diskette inside the electronic total station.

B. All notes shall be properly recorded and dated indicating the type of weather, with signature of the in-charge of the survey team or Supervising G.E./Locating Engineer and properly referenced as to name of project and location. All members of the team involved in the particular survey activity shall be noted.

C. The notes shall be neat, legible and in English Language. No erasures shall be permitted. If it is necessary to amend or correct a note already recorded, the original information should still be ligible.

D. No notes shall be discarded. If whole pages are to be revised, it shall be marked "Void" but be retained for record/reference purposes.

3. Survey of Existing Features

a) All natural and man-made features within the project site shall be included in this survey, such as waterways, houses and buildings, angles of intersection of roads, electric poles, fences, trees, drainage pipes and bridges and other features that may control the horizontal and vertical alignment of the proposed structures.

4. Preparation of Survey Plans

<u>Topographic/Location Plan of Highway Corridors</u>

Topographic or location plans of highway corridors shall be plotted to scale with contour interval of one meter or smaller.

a) Grid/geographic coordinate systems and north directions.

b) Exact locations of benchmarks, and reference points with proper technical descriptions.

c) Existing drainage facilities.

d) All existing roads to include the width of roadway and shoulders. If concrete and asphalt pavements, indicate stationing at the beginning and end of each type of pavement. Land classification, such as rice field, coconut plantation and etc., existing houses and buildings, electric poles, water pumps, underground and overhead public and private utility lines, etc.

e) The topography in the plan must be consistent with the profile and cross sections.

5. Profile

Profile shall be plotted to scale as specified to include but not limited to the following:

1) The exact elevation of each station and intermediate point that may influence the vertical design.

2) Existing drainage facilities such as bridges and culverts, canals and other waterways properly plotted with their invert elevation, station, size and length and description.

3) Flood level or high water elevations in low flat terrain subject to floods and inundations.

The profile shall be plotted in square scale, depending on the width of the river, as follows:

Width of River	Scale
Up to 30 m	1:80
30 to 60 m	1:100
60 to 120 m	1:200
120 to 250 m	1:400
Over 250 m	1:500

The profile shall show the following:

(a) Maximum experienced flood level, ordinary flood level, ordinary water level and the lowest water level.

(b) Profile of the river channel extended 200 m to 500 m upstream and downstream from the bridge centerline shall be superimposed on the profile of the road centerline in order to determine the relative drop of river bed within the distance of the section.

© If the river has more than one channel, profile of the stream bed along the centerline of the channels shall be considered. If the width of the river is considerable, additional stream profiles shall be shown.

(d) Location, depth and other boring data, if available shall be shown in the profile.

6. Cross Sections

Cross section shall be plotted to scale as specified in cross section millimeter paper to include but not limited to the following:

1) Stationing for every cross section as reflected in the plan.

2) Proposed centerline showing among others, spot elevation of natural ground.

3) Edges of existing roads.

4) Property lines of existing houses, buildings, fences, walls, drainage canals and other waterways, if any.

B. Project Survey Requirements

1. Aereal Extent (longitudinal and transverse)

a) Bridge site location/topographic survey shall cover an area of at least radius of one half width of the river channel plus 200 m from the upper bank or the bridge abutment (for existing bridges or box culvert).

b) The length of the river survey shall be at least from 200 m from the centerline of the bridges at the downstream and upstream sections of the river/stream for straight and uniform river channel or 50 m for meandering and unstable channel upstream and downstream from the bridge (culvert) centerline.

c) If the proposed bridge is for the separation of the highway grades, the area to be mapped much be large enough to include such interchange ramps as may be required. The profiles and cross sections of the intersectioning road shall be taken for a sufficient distance to include any revision that may be made.

2. Cross Sections

a) Channel cross sections shall be obtained at the proposed bridge centerline and extended at least 200 m from both banks (or bridge abutment faces) towards bridge approaches.

b) Additional cross sections shall be obtained spaced at 50 m for straight and uniform river reaches and 20 m for meandering and unstable channel along and up to longitudinal limit. The cross sections shall be extended at least 50 m to 100 m from both banks (the higher banks). Sounding shall be made at the channel centerline, at the top of the banks and/or at every change in the configuration of the channel cross section.

c) For grade separation structures at railroad crossings, a profile of the tract for 300 meters on either side of the highways centerline shall be secured. The locations of points of intersection and angle between centerline shall be determined. If the railroad is on curve, pertinent curve data shall be obtained. Cross section of the railroad shall be taken at 20 m interval and extended at least 100 m from both sides of the centerline.

3. Data to be Obtained

When existing structure is on or close to the proposed centerline of the proposed bridge, the following information shall be taken and recorded.

1. Bridge location.

2. Number of spans and length of each span.

3. Width, type and condition of existing roadway and roadway and number of structures.

4. Size, location, type, condition and invert elevations of inlet and outlet ends of the structures and all available evidences of their inadequacy or adequacy.

5. Type and foundation condition of the bridge.

6. Elevation of lowest water level when it does not go dry, ordinary flood level and the maximum experienced highest flood level shall be obtained and plotted on the channel cross sections.

7. Information on driftwoods and debris as size and concentration passing under the proposed bridge.

8. Velocity and flow direction of experienced maximum floods including depth, extent and duration of floods on the floodplain, as well as, its relation to other notable floods.

9. Distribution of flow with respect to the piers and low water channel, as well as, channel condition before and after flood, particularly noting the location of thalweg, location and shifting of sand bars, changes in the channel cross sectional configuration as to the degree of siltation, scouring and erosion of the banks.

10. Type of said materials composing the channel bed and banks.

11. Type and degree of vegetation along the banks.

12. Damages to structure and adjacent property.

V. SURVEY OPERATIONS

A. The survey works herein called for shall be completed within _____ calendar days.

B. All requirements of surveys not expressly specified herein shall conform to the provisions laid by the Geodetic Engineer Manual and to the Design Guidelines, Criteria and Standards, Volume I, Part 1, Surveys and Investigation of Public Works and Highways Projects.

C. The Director concerned shall designate his authorized representative to oversee and evaluate the field and office works for compliance to the herein requirements and others to be stipulated as maybe required by the Director concerned. Any recommendations, corrections or alterations required by the authorized representative on this subject survey works shall be followed accordingly. The right is reserved by this Department to check the activities during the field and office works not consistent with the herein requirements and to incorporate other details deemed necessary but not embraced in the herein scope of work.

D. The Consultant shall submit a monthly progress report to the Director or his authorized representative stipulating among others, percentage of works completed and works still to be completed, constraints or other problems encountered and solutions made/to be made in order to complete the work satisfactorily and as scheduled.

E. The plans and cross sections shall first be plotted in pencil and shall be subject to review/corrections by the DPWH authorized representatives before they are finalized.

F. Drawings and other mapping requirements, such as dimension of sheets, title blocks, index maps, general notes, etc. shall be in accordance with the aforecited DGCS.

VI. SUBMITTAL OF SURVEY RETURNS

A. Computation sheets, field notes, diskettes, reference location plans/ maps, list of established/referred benchmarks complete with technical descriptions and the final draft of plans, cross sections and/or profiles shall first be submitted to the Director concerned

through the authorized representative for final review before finalizing the plans, cross sections and/or profiles for approval.

B. Such plans, cross sections and/or profile shall be subject to the approval of the Director concerned as the case maybe in accordance with the approved delegation of authority.

C. The Consultant shall submit ____ sets of print copies of the plans, cross sections and/or profiles including any maps/plans referred/used in the conduct of the survey works, together with the corresponding originals/tracings, as well as computation sheets, field books, other survey returns complete with signatures of Consultant or Geodetic Engineer concerned. The list of the surveying instruments, materials and equipment lent by the Consultant or purchased by the same, it any, during the conduct of this survey works, should be submitted for verification purposes.

REPUBLIC OF THE PHILIPPINES

DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS

BUREAU OF DESIGN

Manila

ANNEX "C"

TERMS OF REFERENCE

FOR

RIVER SURVEY

I. **PROJECT DESCRIPTION AND PURPOSE:** _____

(State type of Project Structure. For additional description and statement of purpose, see attached Annex A)

(See attached Location Plan)

II. **LOCATION DESCRIPTION:** _____

III. **SCOPE OF WORK**

The Consultant shall provide all labor, instruments/equipment, materials, supplies, vehicles, etc., necessary to perform satisfactorily the survey works herein required, viz:

A. Establishment of horizontal and vertical ground controls and other common surveying and mapping requirements.

B. Topographic, location, profile/cross-section surveys and other project survey requirements.

C. Computations, plottings and drafting/preparation of survey maps and plans.

D. Submission of survey returns (diskettes, field books, computations, survey plans, etc.)

The Consultant shall be held solely responsible for the results of these survey works and other activities under this Terms of Reference.

IV. DETAILED SURVEY REQUIREMENTS/SPECIFICATIONS

The detailed river survey works shall be undertaken in accordance with common surveying and mapping requirements stipulated in the DPWH Design Guidelines, Criteria and Standards (DGCS) Vol. 1, Part 1, that include but not limited to the following:

A. Establishment of Horizontal and Vertical Ground Controls

Horizontal and vertical ground controls shall be established in the absence of existing ones at or near the vicinity of the location distance specified herein.

1) Horizontal Ground Controls

Horizontal ground controls shall be established within an acceptable location in the vicinity of subject river or tributaries, or in the vicinity of proposed structure sites using at least tertiary traverse precision and accuracy. Existing Bureau of Coast and Geodetic Survey (BC & GS) and Bureau of Land Location Monuments (BLLM's) within the project shall be made part of the project control. The horizontal ground controls shall be connected to BC & GS and BLLM's or Triangulation stations of higher orders.

Traverses or base lines shall be established along subject river including affected tributaries. It shall start and close at previously established control points in the project area.

1) The distance between traverse stations should not exceed 200 m and no side shot-points shall exceed 20 meters interval distance from each other.

2) Traverse stations shall be marked by some identifying marks on brass tablets or on top of a monuments in the form of a concrete post with enlarged base and top diameter not less than 36 cm length from 76 cm to 90 cm. The tablet shall be so fastened in the rock/concrete or the concrete post/monument embedded in the ground so as to effectively resist extraction, change of elevation or rotation. The number of the station and date established and name of project shall be inscribed on top of the mark.

3) All stations should be measured using steel tapes or /electronic distance meter (EDM) of approved quality and reliability.

4) Rod readings shall be read to the nearest centimeter mark.

5) Side shot points shall be taken to determine the exact locations and elevations of existing buildings, dams, canals, bridges and other drainage irrigation and flood control structures.

6) Astronomical observations shall be undertaken at the end of the project and at every 5 km to 10 km distance to determine the accuracy of the measured horizontal angles.

7) The traverse error of closure shall be in accordance with the attached Table 1.

b) Vertical Ground Controls

1) Permanent Benchmarks (PBM's)

Vertical ground controls shall be established within the entire project area which shall be connected and referred to at least three (3) existing benchmarks of higher order. All elevations shall be referred to Mean Sea Level Datum (MSL) or Mean Lower Low Water (MLLW).

A pair of permanent benchmarks if not available shall be established on both sides (banks) of the river at every poblacion, barrio/barangay or community site and at existing or proposed bridge and structures sites within the project and at every 3.0 km/distance. Benchmark shall be marked by a concrete monument measuring 40 cm by 100 cm long with enlarged base, top marked by embedded brass plate with inscription as follows:

PBM No. _____ (DPWH date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

TABLE 1. ALLOWABLE TRAVERSE ERROR OF CLOSURE

KIND OF TRAVERSE	ANGULAR	LINEAR
Precise	=< 1. 5" $\sqrt{Pr}$	=< 1/25,000
Primary	=< 2.5" $\sqrt{P}$	=< 1/10,000
Secondary	=< 10" $\sqrt{S}$	=< 1/5,000
Tertiary	=< 30" $\sqrt{T}$	=< 1/2,500

2) Intermediate Benchmarks (IBM)

Intermediate benchmarks (IBM) shall be established between PBM at 1 km interval and shall be marked by a concrete monument measuring 15 cm square by 60 cm long with enlarged base, with inscription as follows marked on top of the monument:

IBM No. _____DPWH (date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

Vertical control leveling shall have the following requirements:

Table 2. Specifications for Vertical Ground Controls

Specifications	1st Order	2nd Order	3rd Order	4th Order
1. No. of Wires read	3	3	3	3
2. Distances between				
a) PBM	1 km	3 km	3 km	3 km
b) IBM	1 km	1 km	1 km	1 km
3. Maximum length of sight	100 m	150 m	200 m	200 m
4. Allowable closing error of loops	4.0 mm$\sqrt{K}$	8.4 mm$\sqrt{K}$	12.0 mm$\sqrt{K}$	25 mm$\sqrt{K}$
5. Maximum length of line	70 Km	50 km	30 km	10 km
6. Instrument used	precise	precise	precise	precise

Where K is the distance or length of line in kilometers.

Lines of levels shall begin and end on previously established first order benchmark. At least two benchmarks should not change their relative elevations and must be recovered at each end of the line and at any intermediate junctions of the line with previous leveling.

When leveling along railroad, the elevation of the top of rail is to be determined and along a highway or a well defined road, the elevation of the top of the road has to be determined by means of extra foresights, in front of each railroad station or at each intersecting railroad, road or highway; at principal forks, at well defined angles in the road; at points opposite intersecting fence lines defined by trees or brush, at points opposite sharp boundaries between cleared and eroded area and at bridge floors.

B. Recording

1) Survey notes shall be recorded in diskettes, bound durable field books or ring type survey books. Paper shall be heavy weight not easily affected by adverse weather conditions.

2) All notes shall be properly dated indicating the type of weather, with signatures of the incharge of the survey team or Locating Engineer and concerned members of the team involved, in the particular survey activity.

3) The notes shall be neat, legible and in English language and that no erasures shall be permitted. If it is necessary to amend or correct a note already recorded, the original information should still be legible.

4) No notes shall be discarded. If whole pages are to be revised, it shall be marked "Void" but be retained for record/reference purposes.

C. Survey of Existing Features

All natural and man-made topographic/physical features within the survey area shall be measured, such as waterways, houses and buildings, electric posts, fences, trees, drainage pipes/culverts, bridges, etc.

D. Mapping

1. Topographic/Location Plan

Topographic or location plans shall be drawn to an appropriate scale with one (1) meter contour intervals and properly plotted in the upper half of a half ruled cross section millimeter paper to indicate but not limited to the following:

a) Grid/geographic coordinate system and north direction.

b) Exact locations of benchmarks, and reference points with proper technical descriptions.

c) Existing drainage facilities and flood control structures, bridges, culverts, canals and other waterways properly plotted indicating the correct direction of water flow.

d) The topography shown in the plan must be consistent with the longitudinal profile and cross sections.

4. Profile

Profile along the channel centerline and thalweg including the right and left banks shall be drawn to specified scale, properly plotted on the lower half of the ruled millimeter cross section paper to include but not limited to the following:shall be plotted to scale as specified to include but not limited to the following:

a) The exact location of cross section with corresponding stations and other topographic/physical features that may influence the vertical hydraulic design.

b) Existing drainage facilities such as bridges and culverts, canals and other waterways properly plotted with their invert elevations, stationing and dimension.

c) Minimum Experienced Flood levels or high water elevations with years of occurrences in low flat terrain/s subject to floods and inundations.

5. Cross Sections

Cross sections shall be plotted to an appropriate scale to include but not limited to the following:

1) Stationing for every cross section as reflected in the plan.

2) Actual channel configuration, bridges and other hydraulic/flood control and drainage structures crossed.

3) Property lines of existing houses, buildings, fences, walls, drainage canals and other waterways, if any.

E. Project Survey Requirements

1. Aerial Extent (Longitudinal and Transverse). To be accomplished as to project requirements of particular type of flood control or river trainings structure.

2. Cross Sections (To be accomplished as to project requirements of particular type or river survey).

3. Data to be Obtained (To be accomplished as to project requirements of particular river survey).

V. SURVEY OPERATIONS

A. The survey works herein called for shall be completed within _____ calendar days.

B. All requirements of surveys not expressly specified herein shall conform to the provisions laid for Land Surveys in the Philippines (Land Administrative Order No. 4, B.L.) and to the Design, Guidelines, Criteria and Standards (DGCS) of the Public Works and Highways, Vol. 1.

C. The Director concerned shall designate his authorized representative to oversee and evaluate the field and office works for compliance to the herein requirements and others to be stipulated as maybe required by the Director concerned. Any recommendations, corrections or alterations required by the authorized representative on this subject survey works shall be followed accordingly.

The right is reserved by this Department to check the activities during the field and office works not consistent with the herein requirements and to incorporate other details deemed necessary but not embraced in the herein scope of work.

D. The Consultant shall submit a monthly progress report to the Director or his authorized representative stipulating among others, percentage of works completed and works still to be completed, constraints or other problems encountered and solutions made/to be made in order to complete the work satisfactorily and as scheduled.

E. The survey plans and cross sections shall first be plotted in pencil and shall be subject to review/corrections by the DPWH authorized representatives before they are finalized.

F. Drawings and other mapping requirements, such as dimension of sheets, title blocks, index maps, general notes, etc. shall be in accordance with the aforecited Design Guidelines, Criteria and Standards (DGCS).

VI. SUBMITTAL OF SURVEY RETURNS

The end product of this survey shall be submitted for checking, review and approval. It shall consist of the following:

A. One set of plotted survey data which shall conform to the mapping requirements.

B. Computation sheets, field notes, diskettes, reference location plans/ maps, list of established/referred benchmarks complete with technical descriptions and the final draft of plans, cross sections and/or profiles shall first be submitted to the Director concerned through the authorized representative for final review before finalizing the plans, cross sections and/or profiles for approval.

B. Such plans, cross sections and/or profile shall be subject to the approval of the Director concerned as the case maybe in accordance with the approved delegation of authority.

C. The Survey Consultant shall submit ____ sets of print copies of the plans, cross sections and/or profiles including any maps/plans referred/used in the conduct of the survey works, together with the corresponding originals/tracings, as well as computation sheets, field books, other survey returns complete duly signed and dry scaled by the survey Consultant or Geodetic Engineer concerned. The list of the surveying instruments, materials and equipment lent by the Consultant or purchased by the same, it any, during the conduct of this survey works.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
Manila

ANNEX "D"

TERMS OF REFERENCE FOR PARCELLARY SURVEY

I. PROJECT DESCRIPTION: _____
(State Project Category, for additional)

_____
description and statement of purpose, attached Annex A)

_____

II. LOCATION DESCRIPTION: _____

_____
(See attached Location Plan)

_____

III. SCOPE OF WORK

The Consultant shall provide all labor, instruments, materials, supplies, vehicles, etc., necessary to perform satisfactorily the survey works herein called viz:

A. Establishment of horizontal ground controls and location/verification of property lines/monuments.

B. Traverse survey.

C. Research work of affected lots/properties.

D. Computation of survey returns.

The Consultant shall be held solely responsible for the results of this survey and other activities under this Terms of Reference.

IV. DETAILED SURVEY REQUIREMENTS AND MAPPING REQUIREMENTS

The detailed survey works shall be undertaken in accordance with common surveying and mapping requirements stipulated in the DPWH Design Guidelines Criteria and Standards (DGCS) Vol. I Part 1 and the Manual for Land Surveys in
the Philippines (Land Administration Order NO. 4, B.L.). For easy reference see Manual on Technical Requirements for Survey and Investigations of Public Works and Highways Projects that includes but not limited to the following:

1. Establishment of Horizontal Ground Controls

   Horizontal ground controls shall be established at or near an acceptable vicinity of the project area using at least primary traverse precision and accuracy. Existing Bureau of Land Location Monuments (BLLM's), Municipal Boundary Monuments (MBM) within the project shall be made part of the project control. The horizontal ground controls shall be connected to previously established BLLM's and/or triangulation stations.

2. Traverse Survey and Research Work of Affected Lots/Properties

   a) Traverses or base lines shall be established and properly monumented with concrete aggregates for convenience and ready reference..

   b) Traverses errors of closure shall be in accordance with the requirements of the Manual for Land Surveys in the Philippines (Land Administration Order No. 4, B.L.).

   c) Traverses shall start from points of reference, other traverse stations or marked corner or approved surveys and maybe a "circuit" or "loop" traverse.

   d) Traverse lines shall follow approximately the course of the boundaries of affected properties.

   e) When the tertiary control is adopted, it should be connected to secondary control and the true azimuth of at least one line shall be determined by astronomical observations.

   f) If the azimuth is derived from tertiary control of another survey or derived from Bureau of Lands, Location Monuments (BLLM's) and carried by long circuits or line of traverses to the

location of the property under survey, an astronomical observation for azimuth be done to check the carried azimuth.

g) Astronomical observations for azimuth shall be done at intervals of not more than thirty stations in circuit and loop traverses.

h) Traverse loops shall be so located to form as links or chains. Astronomical observations for azimuth shall be required at alternate loops and provided further that astronomical observations shall be made on first and last loops.

i) When the data recorded on plans of previously approved surveys are used, including points occupied, azimuth used, Bureau of Lands Survey Number and the name of the applicant of the previous surveys such shall be stated in the field notes. Azimuths of lines not included in the closed traverses of the former survey shall not be used in the traverses of the new survey.

j) The astronomical azimuth for the tertiary traverse shall be determined by one series of two sets of observations, viz:

Each series shall consist of two sets of observations. The interval of time between any two consecutive sightings within a set of observation shall not exceed one minute of time.

3. Project Survey Requirements. (This shall be accomplished as project requirement, see Project Description).

V. COMPUTATIONS, PLOTTING AND PREPARATION OF SURVEY PLANS

Computation, plotting and preparation of survey plans shall be done in accordance with the requirements of the Bureau of Lands.

1. Computations shall be done in accordance with the following:

   a) Azimuth error of closure to the nearest one minute of arch shall be distributed as in the case of secondary traverses, except that one minute of arch shall be used as unit instead of fifteen second of arc.

   b) After the distribution of the azimuth error of closure, the latitudes and departures shall be computed using five place logrithmic functions or calculations to the nearest centimeter. The bearings and distances to be used in the computations shall be to the nearest minute of arc and centimeter, respectively.

   c) The linear of closure shall not be greater than one part of two thousand (1:2000) of the perimeter or better for Secondary and Primary Survey requirements as the case may be.

2. Preparation of Survey Plans

   This shall be in accordance with the followings:

   a) Vertical and Horizontal lines of plans coordinates divisible by five shall be accurately drawn of the original plan and inked in red.

   b) The latitude and longitude lines of corner one (1) of a lot or any corner one (1) of a group of adjoining lots shall be drawn in fine black ink on the original survey plans.

   c) Survey plans shall clearly and neatly be drawn in drawing ink and shall show the following:

      1) The boundaries of the property in full black ink lines heavier than those of adjoining properties. Permanent walls along the boundaries shall be drawn by convenient symbols.

2) The control stations from which side shots were taken by dotted red ink lines.

3) The relative position of adjoining surveyed properties indicating by dotted lines the boundaries between them, the names of all adjoining owners and all important improvements, roads and streams shall be indicated.

4) The corners shall be indicated by small circles two millimetres in diameter drawn in black ink and their respective descriptions noted.

5) The boundary lines with corresponding bearings and distances in black ink.

d) All descriptions, notes, scales specified in the plans shall conform to the Manual for Land Surveys in the Philippines (Land Administrative Order No. 4, B.L.).

VI. SURVEY OPERATIONS AND SUBMITTAL OF SURVEY RETURNS

a) Survey operation shall commence immediately upon notice and it shall be completed within _____ calendar days.
b) The Consultant shall submit a monthly progress report to the Director concerned or his authorized representative.
c) Project payment shall be as per physical accomplishment reflected in the monthly progress report duly certified by the Project Engineer, concurred in by the Director concerned, or his duly designated representative.
d) All other requirements of survey not expressly specified herein shall conform to the provision laid by the Manual for Land Surveys in the Philippines (Land Administrative Order No. 4, B.L.).
e) Processing and approval of survey returns and parcellary plans shall be the responsibility of the Bureau of Lands.
f) Survey plans approved by the Director of Land s shall be submitted to the Director concerned together with the survey report and 6 sets of print copies.

REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
BUREAU OF DESIGN
Manila

ANNEX "E"

TERMS OF REFERENCE

FOR

SURVEY OF HIGHWAYS PROJECTS

I. **PROJECT DESCRIPTION:** _____

II. **LOCATION DESCRIPTION:** _____
(See attached location plan)

III. SCOPE OF WORK

The Consultant shall provide all labor, surveying equipment/instrument, materials, supplies, vehicles, etc., necessary to perform satisfactorily the survey works herein required, viz:

A. Establishment of horizontal and vertical ground controls and other common surveying and mapping requirements.

B. Location – strip topographic surveys, profile/cross-sections surveys and other survey requirements

C. Computations, Plottings and Preparation/Drafting of survey maps and plans.

D. Submission of survey returns (Diskettes, Field Books, Computations, etc.)

The Consultant shall be held solely responsible for the results of the survey works and other activities under this Terms of Reference.

IV. SURVEY

A. GENERAL

Before commencing any survey it is necessary for the Project Engineer to study the road to be surveyed and give instructions to the Highway Location Engineer on the standards to be adopted in the detailed design, e.g. class of road, design speed, etc. The Location Engineer can then organize the survey parties required to undertake the work. A typical survey team is outlined in Appendix 2-1.

B. SURVEY PROCEDURE

1. Reconnaissance

The Highway Location Engineer should carry out a reconnaissance of the existing road or track in order to plan the best possible horizontal and vertical alignment of the proposed road. Rock cut, water logged ground, expensive buildings and crops should be avoided as far as possible. If widening of the road in built up areas is inevitable, it is preferable to align the road only, to avoid the lengthy process of land acquisition. On steep side slopes, the alignment should be such that the construction would be in cut, rather than in fill subject however to the slope stability of soil materials. A combined cut and fill section should also be taken into consideration provided that the embankment materials rest on a stable/solid foundation/subgrade.

During reconnaissance, the traverse stations should be located such that it will serve as reference of the horizontal intersection points (IP s) in the final design except for a few exceptions.

2. Monumenting

The traverse stations should be monumented as soon as possible after they have been located. These monuments should be 10 mm steel pins approximately 700 mm in length and should normally be surrounded by concrete of not less than 0.01 m3 (Figure 1. Typical Traverse Station/Reference Marker) except where they fall within the existing pavement. The monuments may either be precast or cast in situ.

Each traverse station should be referenced by at least three reference marks which may be established on adjacent fixed objects such as trees, rocks, buildings or any object not likely to be moved before or during construction. Where no suitable objects exist, concrete reference marks similar to the traverse station monuments should be established in positions where they are least likely to be disturbed. Paint may be used to indicate the position of these reference marks.

3. Traversing

The traverse party will be responsible for:

(a) The measurement of angles at each traverse station, by taking four readings of each angle with a theodolite, two on "face left" and two on "face right". A careful check should be made that the four angles agree and are correct for the final angle.

(b) The measurement of distances of each traverse leg by means of either steel tape or EDM. These should be measured twice and the two values should not differ by more than 0.4 / d meters where d is the distance in kilometers of the traverse leg. The final distance shall be the mean of the two measurements.

© The fixing of the reference marks from each traverse station. Clear descriptions of the reference marks should be made in the field books.

4. Horizontal Alignment

The traverse should be plotted at a scale of 1:1000 on rolled graph papers. The Highway Design Engineer can then design the horizontal geometry on this plan and produce through stationing. The Location Engineer using this information should establish the proposed centerline on the ground including the lay-out of the curves. The necessary stationing (normally every 20 meters) should be marked for the convenience of the cross section and parcellary parties.

5. Bench Mark Levelling

The leveling party should establish accurate level on Bench Marks (BM's) along the route. These BM's may be the traverse stations or, where these are situated in safer positions, their reference marks. If IP's are more than 500 meters apart, intermediate permanent Bench Marks must be established. All Bench Marks are to be leveled in closed circuits, independent of the longitudinal or cross sectional leveling. Particular care shall be taken to ensure that the correct level is carried forward on each successive circuit by including at least two fixed points of known level from a previous circuit in each subsequent circuit. The

leveling error shall not exceed 10 /d mm where d is the distance between the Bench marks measured in kilometers.

6. Longitudinal and Cross-Sectional Leveling

The cross sectioning party follows the leveling party and takes cross sections at the required interval along the proposed centerline established by the centerline marking party. The longitudinal profile is also leveled at this time.

Cross sections at right angles to the proposed centerline should normally be taken at intervals of 20 m station including those where there is significant brisk in grade in order to establish the actual configuration of the ground from both sides. Cross sections should usually extend 15 meters on each side of the centerline or such further distance as the design requires. On the average nine levels will be taken, four on either side of the centerline or as the terrain dictates. Hand levels are acceptable only for measurement of steep slopes outside the existing carriageway width or in thick vegetation. In all other cases a surveyor's level should be used. One most important duty of the cross section party is to obtain any information on maximum flood levels in the area from the local residents. These are to be leveled and recorded.

When taking cross sections, the following standard method of booking the levels shall be adopted. With the observer's back to zero and looking toward increasing chainage, the cross sectional levels shall be taken from left to right, offsets to the left of centerline being recorder preceded by "L" and the right hand offsets by "R".

7. Plotting of Profiles and Cross Sections

The existing longitudinal profiles shall be plotted to a scale of 1:1000 horizontal and 1:100 vertical. The existing cross sections shall be plotted to a scale of 1:100. Longitudinal profiles and cross sections should be plotted on transparent metric graph sections (preferably with 1 mm and 10 mm squares).

The cross sections are to be plotted on A1 size sheets. Generally there will be six cross sections on each sheet starting with the lowest station at the bottom. The levels taken at each point on the cross section should be stated under the plot. A typical example of a plotted cross section is shown in Appendix 2-4. It

should be noted that the cross sections of the proposed roads will later be plotted on these sheets which will be spiral bound (on the short edge) in order that they may be available for inspection by the tenderer during the tender period and subsequently issued to the contractor at the construction stage.

V. SURVEY TEAM

The Survey Team should be split into more than one party to undertake the following duties. The number of parties will be at the discretion of the Location Engineer and any one party may be called on to carry out more than one of the duties listed below:

(1) Reconnaissance

The Highway Location Engineer should determine the position of IP's on the ground. Sufficient assistants should be available either in situ or to place precast monuments in the ground.

(2) Traverse

This party should consist of a transit surveyor, a linear measurement surveyor and chainmen. This party is responsible for the accurate survey of the traverse and the fixing of the reference marks.

(3) Control leveling

This party should consist of a leveling surveyor and chainmen and is responsible for the accurate leveling of IP's and Bench Marks.

(4) Centerline Marking

This party should consist of the Location Engineer, a transit surveyor, a linear measurement surveyor and chainmen. It is responsible for laying out all curves in the field and tying these to the original traverse. Most important is the establishment of a running chainage along the proposed centerline with markers at every 20m.

(5) Cross Section Leveling

This party should consist of survey aids capable of fixing the required detail by compass and tape or plain offsets from centerline markers established in (4) above.

VI. DETAILED SURVEY REQUIREMENTS AND SPECIFICATIONS

A. Common Surveying and Mapping Requirements

The detailed survey works shall be undertaken in accordance with common surveying and mapping requirements stipulated in the Design Guidelines, Criteria and Standards (DGCS) Vol. 1 of the DPWH, which includes but not limited to the following:

1) Establishment of Horizontal and Vertical Ground Controls

Horizontal and vertical ground control shall be established in the absence of existing ones at or near the vicinity of the location distances specified herein.

a) Horizontal Ground Control

Horizontal ground controls shall be established within the highway corridor and at vicinity of the bridge or culvert site or existing/proposed structure using at least precise traverse precision and accuracy. Nearby existing Bureau of Coast and Geodetic Survey (BC & GS) and Bureau of Lands Location Monuments BLLM's, MBM, BBM shall be made part of the project control. The horizontal ground controls shall be connected to previously approved Bureau of Lands Location Monuments (BLLM) and/or Triangulation stations of higher order established by the Bureau of Coast and Geodetic Survey (BC & GS).

1) Traverse stations should not exceed 200 m and no side shot-points shall exceed 20 meters interval distance from each others.

2) Traverse stations shall be marked by some identifying mark on brass tablet or on top of a monument in the form of a concrete post with enlarged base (frustum type) and top diameter not less than 36 cm length from 76 cm to 90 cm. The tablet shall be so fastened in the rock/concrete or the

concrete post/monument embedded in the ground as to effectively resist extraction, change of elevation or rotation. The number of the station and date established on top of the mark.

3) All lines should be measured using steel tapes of approved quality and reliability and/or electronic distance meters (EDM).

4) Rod reading shall be read to the nearest centimeter mark.

5) Shot points shall be made to determine the exact location and elevations of existing structures in the project site.

6) The traverse error of closure shall be in accordance with the attached Table 1.

TABLE 1. ALLOWABLE TRAVERSE ERROR OF CLOSURE

KIND OF TRAVERSE	ANGULAR	LINEAR
Precise	$=< 1.5"\sqrt{Prc}$	$=<1:25,000$
Primary	$=< 2.5"\sqrt{P}$	$=<1:10,000$
Secondary	$=< 10.0"\sqrt{S}$	$=<1:5,000$
Tertiary	$=< 30.0"\sqrt{T}$	$=<1:2,000$

7) Astronomical observations shall be undertaken at maximum interval of one kilometer.

8) Include scale and all the existing structures/facilities needed in the presentation of horizontal alignment plan, see items 5/6 requirements under vertical control.

b) Vertical Ground Control

1) Permanent Benchmarks (PBM's)

Vertical ground controls shall be established within the project site and shall be connected and referred to at least three (3) existing benchmarks. All elevations shall be referred to Mean Sea Level Datum (MSL) or Mean Lower Low Water (MLLW).

The location of benchmarks should be at places of least disturbance, accessible and can easily be sighted by instrument. Benchmarks shall be marked by a concrete monument measuring 40 cm square by 100 cm long with enlarge base (frustum type) with the top marked by embedded brass plate with inscription as follows marked on top of the monument:

PBM No. _____ (DPWH date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

2) Intermediate Benchmarks (IBM)

Intermediate benchmarks shall be established between PBM at 1 km interval and shall be marked by a concrete monument measuring 15 cm square by 60 cm long with enlarged base (frustum type), with inscription as follows marked on top of the monument:

IBM No. _____DPWH (date established)
Elevation _____
Datum: (MSL or MLLW)
Name of Project: _____

TABLE 2. SPECIFICATIONS FOR VERTICAL CONTROLS

Specifications	1st Order	2nd Order	3rd Order	4th Order
1. No. of Wires read	3	3	3	3
2. Distances between				
a) PBM	1 km	3 km	3 km	3 km
b) IBM	1 km	1 km	1 km	1 km
3. Maximum length of sight	100 m	150 m	200m	200m
4. Allowable closing error of loops	4.0 mm$\sqrt{K}$	8.4 mm$\sqrt{K}$	12.0mm$\sqrt{K}$	25mm$\sqrt{K}$
5. Maximum length of line	70 Km	50 Km	30 Km	10 Km
6. Instrument used	precise	precise	precise	digital/ordinary

Where K is distance or length of line in kilometers.

Line of levels shall begin and end on previously established First Order benchmark. At least two benchmarks which have not changed their relative elevation must be recovered at each end of the line and at any intermediate junctions of the line with previous leveling.

When leveling along railroad, the elevation of the top of rail is to be determined and along a highway or a well defined road, the elevation of the top of the road has to be determined by means of extra foresights, in front of each railroad station or at each intersecting railroad, road or highway; at principal forks, at well defined angles in the road; at points opposite intersecting fence lines defined by trees or brush, at points opposite sharp boundaries between cleared and wooden areas and at bridge floors.

3. Recording

a) Survey notes shall be recorded in either bound durable field books or ring type survey books. Paper shall be heavy weight not easily affected by adverse weather condition or by a diskette inside the electronic total station.

b) All notes shall be properly recorded and dated indicating the type of weather, with signature of the in-charge of the survey team or Supervising G.E./Locating Engineer and properly referenced as to name of project and location. All members of the team involved in the particular survey activity shall be noted.

c) The notes shall be neat, legible and in English Language. No erasures shall be permitted. If it is necessary to amend or correct a note already recorded, the original information should still be legible.

d) No note shall be discarded. If whole pages are to be revised, it shall be marked "Void" but be retained for reference purposes.

Survey of Existing Features

All natural and man-made features within the project site shall be included in this survey, such as waterways, houses and buildings, angles of intersection of roads, electric poles, fences, trees, drainage pipes and bridges and other features that may control the horizontal and vertical alignment of the proposed structures.

4. Preparation of Survey Plans

Topographic/Location Plan of Highway Corridors

Topographic or location plans of highway corridors shall be plotted to scale with contour interval of one meter or smaller.

a) Grid/coordinate system and north direction.
b) Exact locations of traverse stations, benchmarks, and reference points with proper technical descriptions.
c) Existing drainage facilities
d) All existing route to include the width of roadway and shoulders. Land classification such as ricefield, coconut plantation and etc., existing houses and buildings, electric poles, water pumps, underground and overhead public and private utility lines, etc.
e) The topography in the highway survey plan must be consistent with the profile and cross sections along the highway corridor.

5. Profile

Profile shall be plotted to Scales 1:100 for vertical and 1:1000 for horizontal to include but not limited to the following:

1) The exact elevation and grid coordinates/geographic positions of each station and intermediate points that may influence the horizontal and vertical design of road alignments.

2) Existing drainage facilities such as bridges and culverts, canals and other waterways properly plotted with their crown and invert elevations, sizes and lengths and descriptions.

3) Flood level or high water elevations along the highway corridor if subject to floods and inundations.

4) Location, depth and other boring data, if available, shall be shown in the profile along the centerline of the road/highway corridor.

6. Cross Sections

Cross section shall be plotted to Scale 1:100 for both horizontal and vertical to include but not limited to the following:

1) Stationing for every cross section shall be the standard 20 meter interval.

2) Proposed centerline of highway showing among others, spot elevation of natural ground.

3) Limits of the Right-of-Way boundaries and adjoining ownerships.

4) Property lines of existing houses, buildings, fences, walls, drainage canals and other waterways, if any.

7. Project Survey Requirements

1) Aerial Extent (Longitudinal and transverse)

a) The highways corridor location/topographic survey shall cover an area within the limit of the width of the Road Right-of-Way (RROW).

b) The width of the highway corridor shall be based on the RROW.

VII. SURVEY OPERATIONS

A. All survey works herein called for shall be completed within _____ calendar days.

B. All requirements of surveys not expressly specified herein shall conform to the provisions laid by the Geodetic Engineer Manual and to the Design Guidelines, Criteria and Standard (DGCS), Volume 1, Public Works and Highways Projects.

C. The Director concerned shall designate his authorized representative to oversee and evaluate the field and office works for compliance to the herein requirements and others to be stipulated as maybe required by the Director concerned. Any recommendations, corrections or alterations required by the authorized representative on this subject survey works shall be followed accordingly. The right is reserved by this Department to check the activities during the field and office works not consistent

followed accordingly. The right is reserved by this Department to check the activities during the field and office works not consistent with the herein requirements and to incorporate other details deemed necessary but not embraced in the herein scope of work.

D. The Consultant shall submit a monthly progress report to the Director or his authorized representative stipulating among others, percentage of works completed and works still to be completed constraints or other problems encountered and solutions made/to be made in order to complete the work satisfactorily and as scheduled.

E. The plans and cross sections shall first be plotted in pencil and shall be subject to review/corrections by the DPWH authorized representatives before they are finalized.

F. Drawings and other mapping requirements, such as dimension of sheets, title blocks, index maps, general notes, etc. shall be in accordance with the aforecited DGCS.

VIII. SUBMITTAL OF SURVEY RETURNS

A. Computation sheets, field notes, diskettes, reference location plans/ maps, list of established/referred benchmarks complete with technical descriptions and the final draft of plans, cross sections and/or profiles shall first be submitted to the Director concerned through the authorized representative for final review before finalizing the plans, cross sections and/or profiles for approval.

B. Such plans, cross sections and/or profile shall be subject to the approval of the Director concerned as the case may be in accordance with the approved delegation of authority.

C. The Consultant shall submit ____ sets of print copies of the plans, cross sections and/or profiles including any maps/plans referred/used in the conduct of the survey works, together with the corresponding originals/tracings, as well as computation sheets, field books, other survey returns complete with signatures of Consultant or Geodetic Engineer concerned. The list of the surveying instruments, materials and equipment lent by the Consultant or purchased by the same, it any, during the conduct of this survey works, should be submitted for verification purposes.

ANNEX "F"

SURVEY COSTS AND BASIC SPECIFICATIONS FOR HIGHWAY AND BRIDGE PROJECTS

I. LOCATION/ALIGNMENT AND TOPOGRAPHIC SURVEYS

1. Topographic Survey & Road Alignment Survey (including cross-sections) ---------- **P 15,000.00/kilometer**

2. Bridge Site/Culvert Site Survey (strip topographic survey, centerline profile and river/stream cross-sections) --------- **P 10,000.00/hectare**

II. PARCELLARY SURVEY

1. Lot survey, monumenting, researches, computations, plottings, and preparation of survey plans ---------- **P 10,000.00/lot**

III. BASIC SPECIFICATIONS

A. Highway Project

1. Twenty-meter (20 m.) cross-section interval.
2. Sixty-meter (60 m.) minimum width coverage for the topographic survey.

B. Bridge Project

Stream cross-section shall be taken at every one hundred-meter (100 m.) interval for straight and uniform stream reaches and fifty-meter (50 m.) interval at stream bends. The cross-sections shall be taken within a stretch of two hundred fifty meters (250 m.) from the proposed bridge centerline both upstream and downstream of the bridge. Cross-sections must be extended one hundred fifty meters (150 m.) from both the left and right banks of the stream.

NOTE:

1. Permanent horizontal and vertical ground controls must be established within the project site at one (1) kilometer interval for highways, and one hundred (100) meters from the proposed bridge abutments and at every abutment.

2. For other specifications, refer to DPWH Design Guidelines, Criteria and Standards Volume I (Survey and Investigation).

Checked/Reviewed by:

EUSTACIO Y. CANO
OIC, SID, BOD
08/07/2001

Noted:

BIENVENIDO C. LEUTERIO
Director IV
7/8/7