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REPUBLIC OF THE PHILIPPINES
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
OFFICE OF THE SECRETARY
MANILA

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DEPARTMENT ORDER)
No. 54)
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SUBJECT: **DPWH Standard Specifications for Construction Survey and Staking, Part B, Section B.4**

In line with the mandate of the Department in providing effective standard specifications to be used in the implementation of various infrastructure projects and in view of the need of setting standard specifications for construction survey and staking, the attached **DPWH Standard Specifications for Construction Survey and Staking, Part B, Section B.4**, are hereby prescribed, for the guidance and compliance of all concerned.

These specifications shall form part of the revised edition of the DPWH Standard Specifications (Volume II – Highways, Bridges and Airports).

This Order shall take effect immediately.

HERMOGENES E. EBDANE, JR.
Secretary

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DPWH STANDARD SPECIFICATIONS FOR
PART B, Section B.4 – CONSTRUCTION SURVEY AND STAKING

B.4.1 Description

This item shall consist of furnishing the necessary equipment and material to survey, stake, calculate, and record data for the control of work in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or as established by the Engineer.

B.4.2 Construction Requirements

B.4.2.1 General

Staking activities shall be included in the construction schedule to be submitted by the Contractor. Dates and sequence of each staking activity shall be included.

The Engineer shall set initial reference lines, horizontal and vertical control points, and shall furnish the data for use in establishing control for the completion of each element of the work. Data relating to horizontal and vertical alignments, theoretical slope stake catch points, and other design data shall be furnished.

The Contractor shall be responsible for the true setting of the works or improvements and for correctness of positions, levels, dimensions and alignment of all parts of the works. He shall provide all necessary instruments, appliances, materials and supplies, and labor in connection therewith. The Contractor shall provide a survey crew supervisor at the project site whenever surveying/staking activity is in progress.

Prior to construction, the Engineer shall be notified of any missing initial reference lines, control points, or stakes. The Engineer shall reestablish missing initial reference lines, control points, and stakes.

The Contractor for convenient use of Government-furnished data shall perform additional calculations. Immediate notification of apparent errors in the initial staking or in the furnished data shall be provided.

All initial reference and control points shall be preserved. At the start of construction, all destroyed or disturbed initial reference or control points necessary to the work shall be replaced.

Before surveying and staking, the Contractor shall discuss and coordinate the following with the Engineer:

1. Surveying and staking methods
2. Stake marking / concrete monuments
3. Grade control for courses of material
4. Referencing
5. Structure control
6. Any other procedures and controls necessary for the work

Established controls shall be within the tolerances shown in Table 1.

Table 1
Construction Survey and Staking Tolerances (1)

Staking Phase	Horizontal	Vertical
Existing Government network control points	±20 mm	±8 mm x $\sqrt{K}$ (2)
Local supplemental control points set from existing Government network points	±10 mm	±3 mm x $\sqrt{N}$ (3)
Centerline points (4) - (PC), (PT), (POT), and (POC) including references	±10 mm	±10 mm
Other centerline points	±50 mm	±50 mm
Cross-section points and slope stakes (5)	±50 mm	±50 mm
Slope stakes references (5)	±50 mm	±50 mm
Culverts, ditches, and minor drainage structures	±50 mm	±20 mm
Retaining walls and curb and gutter	±20 mm	±10 mm
Bridge substructures	±10 mm (6)	±10 mm
Bridge superstructures	±10 mm (6)	±10 mm
Clearing and grubbing limits	±500 mm	-
Roadway subgrade finish stakes (7)	±50 mm	±10 mm
Roadway finish grade stakes (7)	±50 mm	±10 mm

(1) At 95% confidence level. Tolerances are relative to existing Government network control points.
(2) K is the distance in kilometers.
(3) N is the number of instrument setups.
(4) Centerline points: PC – point of curve, PT – point of tangent, POT- point on tangent, POC – point on curve.
(5) Take the cross-sections normal to the centerline + 1 degree.
(6) Bridge control is established as a local network and the tolerances are relative to that network.
(7) Include paved ditches.

The Contractor shall prepare field notes in an approved format. All field notes and supporting documentation shall become the property of the Government upon completion of the work.

Work shall only be started after staking for the affected work is accepted.

The construction survey and staking work may be spot-checked by the Engineer for accuracy, and unacceptable portions of work may be rejected. Rejected work shall be resurveyed, and work that is not within the tolerances specified in Table 1 shall be corrected. Acceptance of the construction staking shall not relieve the Contractor of responsibility for correcting errors discovered during the work and for bearing all additional costs associated with the error, unless such error is based on incorrect data supplied in writing by the Engineer, in which case, the expense in rectifying the same shall be at the expense of the Government.

In the case of "change" or "changed conditions" which involve any change in stakeout, the Contractor shall coordinate with the Engineer and facilitate the prompt reestablishment of the field control for the altered or adjusted work.

All flagging, lath, stakes, and other staking materials shall be removed and disposed after the project is completed.

B.4.2.2 Equipment

Survey instruments and supporting equipment capable of achieving the specified tolerances shall be furnished.

Acceptable tools, supplies, and stakes of the type and quality normally used in highway survey work and suitable for the intended use shall be furnished. Stakes and hubs of sufficient length to provide a solid set in the ground with sufficient surface area above ground for necessary legible markings shall also be furnished.

B.4.2.3 Survey and Staking Requirements

All survey, staking, recording of data, and calculations necessary to construct the project from the initial layout to final completion shall be performed. Stakes shall be reset as many times as necessary to construct the work.

1. Control Points

Established initial horizontal and vertical control points in conflict with construction shall be relocated to areas that will not be disturbed by construction operations. The coordinates and elevations for the relocated points shall be furnished before the initial points are disturbed.

2. Roadway Cross-Sections

Roadway cross-sections shall be taken normal or perpendicular to the centerline. When the centerline horizontal curve radius is less than or equal to 150 meters and vertical parabolic curve radius is less than or equal to 100 meters, cross-sections shall be taken at a maximum centerline spacing of 10 meters. When the centerline horizontal curve radius is greater than 150 meters and vertical parabolic curve radius is greater than 100 meters, cross-sections shall be taken at a maximum centerline spacing of 20 meters. Additional cross-sections shall be taken at significant breaks in topography and at changes in the typical roadway section including transition change to superelevated sections. Along each cross-section, points shall be measured and recorded at breaks in topography and at changes in typical roadway section including transition change to superelevated sections and shall be no further apart than 5 meters. Points shall be measured and recorded to at least the anticipated slope stake and reference locations. All cross-section distances shall be reduced to horizontal distances from centerline.

3. Slope Stakes and References

Slope stakes and references shall be set on both sides of centerline at the cross-section locations. Slope stakes shall be established in the field as the actual point of intersection of the design roadway slope with the natural ground line. Slope stake references shall be set outside the clearing limits. All reference point and slope stake information shall be included on the reference stakes. When initial references are provided, slope stakes may be set from these points with verification of the slope stake location with field measurements. Slope stakes on any section that do not match with the staking report within the tolerances established in Table 1 shall be recatched. Roadway cross-section data shall be taken between centerline and the new slope stake location. Additional references shall be set even when initial references are provided.

4. Clearing and Grubbing Limits

Clearing and grubbing limits shall be set on both sides of centerline at roadway cross-section locations, extending one (1) meter beyond the toe of the fill slopes or beyond rounding of cut slopes as the case maybe for the entire length of the project unless otherwise shown on the plans or as directed by the Engineer.

5. Centerline Reestablishment

Centerline shall be reestablished from instrument control points. The maximum spacing between centerline points shall be 10 meters when the centerline horizontal curve radius is less than or equal to 150 meters and vertical parabolic curve radius is less than or equal to 100 meters. When the centerline horizontal curve radius is greater than 150 meters and vertical parabolic curve radius is greater than 100 meters, the maximum distance between centerline points shall be 20 meters.

6. Grade Finishing Stakes

Grade finishing stakes shall be set for grade elevations and horizontal alignment, at the centerline and at each shoulder of roadway cross-section locations. Stakes shall be set at the top of subgrade and the top of each aggregate course.

Where turnouts are constructed, stakes shall be set at the centerline, at each normal shoulder, and at the shoulder of the turnout. In parking areas, hubs shall be set at the center and along the edges of the parking area. Stakes shall be set at all ditches to be paved.

The maximum longitudinal spacing between stakes shall be 10 meters when the centerline horizontal curve radius is less than or equal to 150 meters and vertical parabolic curve radius is less than or equal to 100 meters. When the centerline horizontal curve radius is greater than 150 meters and vertical parabolic curve radius is greater than 100 meters, the maximum longitudinal spacing between stakes shall be 20 meters. The maximum transverse spacing between stakes shall be 5 meters. Brushes or guard stakes shall be used at each stake.

7. Culverts

Culverts shall be staked to fit field conditions. The location of culverts may differ from the plans. The following shall be performed:

a. Survey and record the ground profile along the culvert centerline including inlet and outlet channel profile of at least 10 meters and as additionally directed by the Engineer so as to gather all necessary data for the preparation of pipe projection plan.

b. Determine the slope catch points at the inlet and outlet.

c. Set reference points and record information necessary to determine culvert length and end treatments.

d. Plot into scale the profile along the culvert centerline reflecting the natural ground elevation, invert elevation, the flow line, the roadway section, and the size, length and the degree of elbow of culvert, end treatments, grade and other appurtenances.

e. Plot into scale the cross-section of inlet and outlet channel at not more than 5 meters interval.

f. Submit the plotted Pipe Projection Plan for approval of final culvert length, alignment and headwall.

g. When the Pipe Projection Plan has been approved, set drainage culvert structure survey and reference stakes, and stake inlet and outlet to make the structure functional.

8. Bridges

Adequate horizontal and vertical control and reference points shall be set for all bridge substructure and superstructure components. The bridge chord or the bridge tangent shall be established and referenced. The centerline of each pier, bent, and abutment shall also be established and referenced.

Set at least three (3) reference points each at downstream and upstream portion. Conduct topographic survey and plot into scale at least 100 meters upstream and downstream from centerline of bridge.

9. Retaining Walls and Other Types of Slope Protection Works

Profile measurements along the face of the proposed wall and 2 meters in front of the wall face shall be surveyed and recorded. Cross-sections shall be taken within the limits designated by the Engineer at

every 5 meters along the length of the wall and at all major breaks in terrain. For each cross-section, points shall be measured and recorded every 5 meters and at all major breaks in terrain. Adequate references and horizontal and vertical control points shall be set.

10. Borrow and Waste Sites

The work essential for initial layout and measurement of the borrow or waste site shall be performed. A referenced baseline, site limits, and clearing limits shall be established. Initial and final cross-sections shall be surveyed and recorded.

11. Permanent Monuments and Markers

All survey and staking necessary to establish permanent monuments and markers shall be performed.

12. Miscellaneous Survey and Staking

All surveying, staking, and recording of data essential for establishing the layout and control of the following shall be performed, as applicable:

a. Approach roads and trails

b. Road Right of Way and Construction limit in accordance with the approved Parcellary Plan.

c. Curb and gutter

d. Guardrail

e. Parking areas

f. Paved waterways and outfall structures

g. Lined canals and other ditches

h. Chutes and Spillways

i. Turf establishment

j. Utilities

k. Signs, delineators, and object markers

l. Pavement markings

B.4.3 Method of Measurement

Construction survey and staking shall be measured by the kilometer.

Bridge survey and staking, and retaining wall survey and staking shall be measured by the lump sum.

Slope, reference, and clearing and grubbing stakes shall be measured by the kilometer.

Centerline reestablishment shall be measured by the kilometer. Centerline reestablishment shall be measured only one time.

Culvert survey and staking shall be measured by the each.

Grade finishing stakes shall be measured by the kilometer. Subgrade shall be measured one time and each aggregate course shall be also measured one time.

Permanent monuments and markers shall be measured by each unit placed and installed at the proper locations.

Miscellaneous survey and staking shall be measured by the hour of survey work ordered or by the lump sum. For miscellaneous survey and staking paid by the hour, the minimum survey crew size shall be 2 persons. Time spent in making preparations, traveling to and from the project site, performing calculations, plotting cross sections and other data, processing computer data, and other efforts necessary to successfully accomplish construction survey and staking shall not be measured separately but deemed included as subsidiary for each of the Pay Item.

B.4.4 Basis of Payment

The accepted quantities, measured as provided in Section B.4.3, shall be paid for at the contract unit price for each of the Pay Item listed below that is included in the Bill of Quantities.

Payment shall constitute full compensation for surveying, staking, calculating/processing by any means and recording data, for furnishing and placing all materials, and for furnishing all equipment, tools and incidentals necessary to complete the Item.

The construction survey and staking lump sum item shall be paid as follows:

a. 25% of the lump sum, not to exceed 0.5% of the original contract amount, shall be paid following completion of 10% of the original contract amount.

b. Payment of the remaining portion of the lump sum shall be prorated based on the total work completed.

The bridge survey and staking and the retaining wall survey and staking lump sum items shall be paid on a prorated basis as the applicable work progresses.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
B.4 (1)	Construction survey and staking	Kilometer
B.4 (2)	Slope, reference, and clearing and grubbing stakes	Kilometer
B.4 (3)	Centerline reestablishment	Kilometer
B.4 (4)	Culvert survey and staking	Each
B.4 (5)	Bridge survey and staking	Lump sum
B.4 (6)	Retaining wall survey and staking	Lump sum
B.4 (7)	Grade finishing stakes	Kilometer
B.4 (8)	Permanent monuments and markers	Each
B.4 (9)	Miscellaneous survey and staking	Hour
B.4 (10)	Miscellaneous survey and staking	Lump sum

References:

1. DPWH Standard Specifications for Public Works and Highways, Volume I, Requirements and Conditions of Contract
2. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP-03, Metric Units), Federal Highway Administration, U.S. Department of Transportation
3. Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects (FP-96, Metric Units), Federal Highway Administration, U.S. Department of Transportation
4. Design Guidelines Criteria and Standards for Public Works and Highways, Volume 1
5. Surveying Principles and Applications, 4th Edition, by Barry F. Kavanagh and S.J. Glenn Bird