



Republic of the Philippines
DEPARTMENT OF PUBLIC WORKS AND HIGHWAYS
APAYAO 2ND DISTRICT ENGINEERING OFFICE
San Isidro Sur, Luna, Apayao, Cordillera Administrative Region



T E R M S O F R E F E R E N C E

CONSULTANCY SERVICES FOR THE GEOLOGICAL
AND GEOTECHNICAL SURVEYS/INVESTIGATION

GEOTECHNICAL INVESTIGATION FOR

**Construction of Multi-Purpose Building, Sta. Filomena School of Arts and
Trades, Sta. Filomena, Calanasan, Apayao**
**Slope protection along Construction of Missing Links/ New Roads Piddig -
Carasi - Calanasan Road (Calanasan Side), Apayao**
**Construction of Tourism Multi-Purpose Building, Brgy. Butao, Calanasan,
Apayao**

I. INTRODUCTION

A. OBJECTIVE

1. The Government of the Republic of the Philippines (GOP) through the Department of Public Works and Highways – Apayao Second District Engineering Office (DPWH-ASDEO), intends to engage the services of a consulting/Engineering firm (Consultant) to undertake Soil Exploration activities for Engineering Works.
2. To explore the sub-surface conditions of the area to provide general data relating to the project.
3. To give an outline of the surface and subsoil geology, determine the arrangement of the soil strata or soil profile and engineering properties of the underlying soils, determine its compressibility, strength, and other characteristics, as well as the soil bearing capacities as basis in the engineering design of various bridges and building.
4. To analyze the data obtained and give engineering consideration and recommendation for a rational and economic design of the above subject.
5. To prepare the detailed geotechnical and geological investigation of the chosen site such as information relative to the distribution and properties of soils, groundwater and surface drainage conditions and other pertinent for the preparation of the foundation design.
6. To be able to provide a detailed sub-soil technical report.

B. PROJECT SCOPE

The proposed projects are the subject of subsurface soil exploration work including Geotechnical Report.

Name of Project	Number of Borehole	Depth in Linear meter
Construction of Multi-Purpose Building, Sta. Filomena School of Arts and Trades, Sta. Filomena, Calanasan, Apayao	1	15
Slope protection along Construction of Missing Links/ New Roads Piddig - Carasi - Calanasan Road (Calanasan Side), Apayao	4	10
Construction of Tourism Multi-Purpose Building, Brgy. Butao, Calanasan, Apayao	1	10

II. SCOPE OF SERVICES

A. GENERAL

- A.1 After the **receipt of Notice to Proceed (NTP)**, the Consultant shall **coordinate immediately with the Planning & Design Section**, particularly the Engineering Survey and Investigation Unit, the requirements for the conduct of Geological and Geotechnical Investigations as stipulated in the DPWH Design Guidelines, Criteria and Standards, Volume I - Part 1, Surveys and Investigation Manual and Technical Requirements for Surveying and Investigation of Public Works and Highways Projects and applicable provisions of existing Laws, Codes or Department Orders, to minimize changes/modifications and unnecessary delays in the preparation of final plans and estimate/quantification.
- A.2 The Consultant shall coordinate with the Planning and Design Section during the conduct of geological/geotechnical surveys and investigations on the proposed project, specifically any notable and significant geological features on site and water bearing stratum causing subsurface discharge, which could affect the stability of the structure that may affect the design of the proposed structure and provide detailed report of the field activity and

recommend technical solutions with appropriate technical justification, taking into considerations the proposed structure on the site.

- A.3 During the conduct of the Geological/Geotechnical Investigations, the Consultant shall coordinate with the Planning and Design Section to monitor/attest their day-to-day activities and accomplishments.
- A.4 The Consultant shall provide all labor, instruments/equipment materials, supplies, vehicles, etc., necessary to perform satisfactorily the investigation works. All expenses to be incurred are chargeable against funds allocated for the Geological/Geotechnical Survey and Investigation.

B. THE SERVICES

B.1. Location

The Consultant shall coordinate with the **Apayao Second District Engineering, Planning and Design Section** during the conduct of geological/geotechnical investigations regarding the location of the proposed **Building and Slope Protection projects.**

The Consultant should be able to identify areas with geological problems and difficulties, and shall conduct the following:

- Collection of available Geological information such as satellite imagery, relevant geological study, reports, documents and maps for the project areas.
- Geological mapping of fault lines specifically active ones that could affect the stability of proposed structure. Also determine seismicity within the area, to be used as basis in the design of the structure.
- Determine if the proposed project location is prone to foundation problems such as settlement and subsidence.

B.2. Detailed Exploration Requirements / Specifications

The conduct of geological/geotechnical investigations shall consist of, but not limited to, the following:

B.2.1 Drilling and Sampling

Number and Depth of Borings

Refer to the Project Scope above for the Location, Number and Depth of Borings. It may be necessary to extend borings beyond the required depths to better define the geologic setting at the project site, to determine the depth and engineering characteristics of soft underlying soil state, or to assure that sufficient information is obtained.

The location of the borehole shall be identified by the Project Engineer or the representative of the Planning and Design Section.

B.2.3 Exploratory Hole Drilling

At proposed Building, deep drilling with Standard Penetration Test (SPT) shall be made with the prescribed spacing/interval, or as close as possible if there are obstructions that cannot be removed, with a minimum depth of 6.00m below final ground line in ordinary soil, or as indicated in the Approved Program of Work.

Advancing exploratory holes in soils shall be a choice from various drilling methods such as auger, wash boring and percussion technique utilizing the standard split-spoon sampler. If hole deepening is impossible with the above procedures (N-Value > 50), diamond drilling method shall be employed. Hole shall be extended 3 meters below to ascertain whether the material intercepted is really rock formation or a suspended boulder.

Care shall be observed in moving the drilling rig from one site to another to prevent destroying plants. The drilling site shall be kept clean during and after drilling the

holes. No oil and grease shall be disposed of the site. Only biodegradable frilling additives shall be used when diamond drilling method is employed, specifically for loose water condition. The use of diesel fuel as an additive for drilling fluid is strictly prohibited.

B.2.4 Sampling

Standard Penetration Test (SPT) shall be made at a maximum interval of 1.50 m and at every change of soil layer, and shall be terminated when 3.00 m of penetration into stable strata/hard rock is encountered at shallower depth. In case bearing layer is not encountered beyond 6.0m, boring shall be continued until preferred layer is encountered or upon the instruction of GE. **The proposal to extend the depth of Boreholes beyond the specified depth** of boring, must be officially notified by the Consultant to the DPWH- Apayao Second District Engineering Office (ASDEO) **for approval.**

Sample shall be placed in double plastic bags with the one containing the sample. The one containing the sample will be properly labeled with the following information: site location, borehole number, depth of the sample was taken and date of sampling. The samples shall be transported to the laboratory as soon as possible and shall be properly stored while waiting to be transported in such a way to prevent moisture loss.

B.2.5 Cohesive soil Sampling

Disturbed sample of Cohesive Soils shall be obtained from the standard split spoon sampler used in SPT and should be done at depth intervals of 1.5 m and every change of strata. Moreover, undisturbed samples shall be taken as boring progresses for soft soils (N-Value < 5) that may greatly influence foundation design. This shall be made by replacing the split-spoon sampler with specifically • fabricated thin-walled seamless steel tube (610 mm in length by 51 mm in diameter). After retrieval of the thin-wall sampler, the ends shall be immediately sealed with melted wax (candle).

B.2.6 Rock Sampling

Rock Core samples shall be retrieved from diamond drilling for rock identification, recognition of discontinuities, and laboratory testing. For best core samples, the minimum bit size to be used shall be NX (56 mm diameter) or equivalent. In addition, the core barrel to be utilized shall be double or multiple tube.

Care shall be observed when removing core samples from the barrel to recover continuous and good samples. This is for better identification of discontinuities, which largely control rock stability. Core samples shall be placed in core boxes arranged and labelled in accordance to depth as soon as these are extracted from the boreholes.

B.2.7 In-situ tests

The conventional Standard Penetration Test (SPT) shall be carried out in the proposed exploratory holes. This shall be performed to estimate density, strength and compressibility of soils. The conduct of test shall be in conformity with ASTM D1586, Standard Test Method for penetration and Split-Barrel Sampling of Soils. The test shall be performed by driving the split spoon sampler 450 mm into the soil at the bottom of particular drill run. The number of blows to drive at least 300 mm represents the N-Value. The sampler is driven to the ground using a 63.6 kg. (140 lbs.) Hammer falling freely at a height of 760 mm (30 inches). SPT shall be performed at 450 mm sampling depth every 1.5-meter interval in homogenous strata and every change of strata until the desired depth is attained.

Refusal of the split-spoon sampler is considered when:

- a. Fifty (50) blows are necessary to driver any 150 mm increment
- b. One Hundred (100) blows are obtained to drive the required 300mm
- c. Ten (10) consecutive blows produce no advance.

In such occasion when the sampler refuses to penetrate, core drilling shall be performed to advance the boring.

B.2.8 Laboratory Analyses

- Laboratory Tests shall be conducted by a Laboratory Testing Center duly accredited by DPWH-Bureau of Research and Standards with geotagged pictures to be attached in the final technical report.
- The laboratory tests shall be made in accordance with American Society for Testing and Materials (ASTM) designated standard for particular analysis.
- For Test that are not possible due to nature and characteristics of soil, Include justification on the report

B.2.9 Groundwater/Water Table Elevation

Groundwater has significant effects on foundation design and construction. Hence, depth to water table must be established accurately. Determination of Groundwater elevation shall made in all the proposed exploratory holes. Water table elevation shall be observed and recorded in the borehole after at least 2 hours from its completion.

The review and approval of the geological/geotechnical investigation reports, plans and other related documents by the DPWH- Apayao Second District Engineering Office (ASDEO) do not relieve the Consultant(s) from the responsibility of determining the sufficiency and appropriateness of the geological/geotechnical investigation works including the laboratory tests and evaluation of results.

C. PREPARATION AND SUBMISSION OF REPORTS

C.1 BRS accreditation Certificate

A copy of BRS accreditation Certificate of Laboratory Center where the testing of samples was performed.

C.2 Work Schedule

A schedule of work noted and approved by the head of the DPWH-Apayao Second District Engineering Office or his designated representative shall be submitted by the Consultant before commencing the subsurface exploration. The subsurface exploration works including laboratory tests shall be completed within the time frame upon receipt of the Notice to Proceed.

C.3 Geotechnical Plan

The geotechnical Plan shall be in accordance to latest DO regarding the preparation of DED plan.

Refer to DO 75, s. 2024 Annex: Sample Geotechnical plans

C.4 Inception Report

During the period of the contract, the Consultant shall prepare a monthly progress report to be certified by the designated Civil Engineer preferably Materials Engineer/Geotechnical Engineer of the consultant and submit same to the Quality Assurance Section, and Planning and Design Section every after one (1) Borehole that has been completed. The report shall consist and/or discuss, but shall not be limited to the following:

- a. Schedule of Work;
- b. List of equipment used;

- c. Organizational Chart; and
- d. Detailed progress charts.

C.5 Monthly Progress Report (MPR)

Monthly Progress Report (MPR) During the period of the contract, the Consultant shall prepare Monthly Progress Report (MPR) in a form to be approved by the DPWH qualified representative and submit them to DPWH Apayao 2nd DEO (PDS) on the 25th day of each reporting month. The MPR shall consist and/or discuss, but shall not be limited to the following:

- a. Overall summary of accomplishment
- b. Core drilling progress
- c. Laboratory tests accomplishment
- d. Schedule of work e. List of equipment used f. Detailed progress of charts

C.6 Partial on Investigation Results

Partial on Investigation Results. The Consultant is required to submit partial reports consisting of completed results the of boring in the form of a final boring log and soil profile for immediate use in preliminary design work.

C.7 Draft and Final Reports

Upon completion of the geological/geotechnical services, the Consultant shall prepare and submit the electronic copies and the draft reports to the DPWH- Apayao Second District Engineering Office (ASDEO) for preliminary review.

Final Technical Report including recommendations after review and evaluation by the DPWH-ASDEO shall be duly signed by a licensed Geotechnical Engineer and submit to the Planning and Design Section.

The draft and final report shall include, but not limited to, the following:

I. Introduction

- a. Project Description/Background
- b. Project location and site description

II. Narrative description and recommendation

Description of work done, method of investigation and recommendation including exploratory hole location plan and boring section.

III. Objectives and Scope of Work

IV. Site/Regional Geology

- Regional Geology of the project area.
- Geologic Map (Scale of 1:50,000 or more detailed).
- Field Photographs of Geologic Mapping (showing outcrops, geologic structures).

V. Discussion on Seismicity

Flood Control and Slope Protection

- Deterministic Hazard Approach (DSHA) using Fukushima and Tanaka Equation from Design Guidelines Criteria and Standards (DGCS) Volume 2A
- Ground Motion parameters: Peak Ground Acceleration (PGA), Seismic horizontal coefficient (Kh), Seismic vertical coefficient (Kv),
- Soil Profile Type

Building

- Approach (DSHA) using NSCP 2015
- Seismic source type
- Near-source factor (N_a , N_v)
- Seismic Response Coefficient (C_a , C_v)
- Soil Profile Type

Bridge

- Ground Acceleration Maps Probabilistic Seismic Hazard Analysis (PSHA) Maps from Bridge Seismic (BSDS) 2013 or Direct Seismic Hazard (Peak Ground Acceleration, Long and Short Spectral Acceleration – 1,000 year return period)
- Seismic Factors (Ground Type, PGA Coefficient, Spectral Acceleration Coefficient at period of 0.2sec (S_s), Spectral Acceleration Coefficient at period of 1.0 sec (S_l))

VI. Discussion on Geomorphology, Topography, and Climate

- Geomorphological Map (Discuss and attach map)
- Topographic Map (Discuss and attach map)
- Climate Map (Discuss and attach map)

VII. Discussion on Geohazard Susceptibility

- Volcanic Hazard with supporting Map
- Rainfall-induced landslide with supporting Map
- Earthquake-induced landslide with supporting Map
- Flood Hazard and Discussion on Fluvial Hazards with supporting Map
- Liquefaction Hazard with supporting Map
- Tsunami, Seiches and Storm Surge Hazard with supporting Map
- Mining Tenement with supporting Map (Locations of previous open pits, underground portals, etc.)
- Karst Hazard

VIII. Discussion on Problematic Soils

- General/Data of findings
- Potentially liquefiable soils based on findings
- Expansive Soils
- Poorly Compacted Fills
- Highly Compressible Soils
- Contaminated Soils
- Collapsible Soil

IX. Liquefaction Assessment

Liquefaction analysis report

- Software generated liquefaction analysis report
- Graphic Report of Test
- Liquefaction Assessment of soils layers based on the results of Geotechnical Investigation (as per BSDS 2013 and DGCS Volume 2A)
- Preliminary screening analysis (based on grain size analysis & Atterberg limit test, water table as per BSDS 2013)
- Calculation of Cyclic Resistance Ratio and Cyclic Stress Ratio (based on geotechnical parameters of soil)

X. Preliminary Calculation and Analysis

Building

- Allowable bearing capacity (shallow foundation)
- Allowable bearing capacity (deep foundation)
- Other needed technical data in the Detailed Engineering Design

Flood Control

- Global Stability Analysis using Software
- Allowable bearing capacity (shallow foundation)
- Allowable bearing capacity (deep foundation)

Bridge and Slope Protection

- Global Stability Analysis using software for slope protection/ Retaining wall
- Shallow Foundation
 - (Ultimate & Allowable bearing capacity)
 - (Factored and Unfactored bearing capacity)
- Deep Foundation
 - (Ultimate & Allowable bearing capacity)
 - (Factored and Unfactored bearing capacity)
 - Rock Mass Classification (Bridge only)
 - Rock Mass Rating

XI. Geotechnical Parameters per layer

(Unit Weight including Unit weight saturated and Unit weight dry, LL, PL, PI, SL, Specific Gravity, Natural Moisture Content, Angle of Friction, Cohesion, Soil Strength, Void Ratio, Compression Index, Deformation Modulus, Swell Index, permeability, spectral acceleration for short period (Ss) and long period (S1) etc.).

XII. Conclusions and Recommendations

- Evaluation and Recommendation (Shallow and/or Deep Foundation)
- Allowable bearing capacity (Shallow and/or Deep Foundation)
- Ground Improvement Technique/s
- Recommendations such as type of proposed counter measure/structure to address geotechnical problems, foundation type and required geotechnical parameter for design.

XIII. Appendices

a. Appendix A – Borehole logs or subsurface exploration log

Final Boring Logs

Use standard format as per DO 75, s. 2024

Legends for soil and Rock shall be in accordance to Annex D: Borehole logging of DPWH DGCS Volume 2C

- Job, borehole number, date, time, boring/drilling foreman and supervisor
- Weather conditions
- Depth of water level, if applicable
- Method of penetration and flushing system
- Description of soil strata encountered
- Depth of soil boundaries
- Size, type and depth of samples and sample number
- Type and depth of in-situ test
- Standard Penetration Tests Resistance, "N" values
- Detailed notes on boring/drilling procedure, casing sizes and resistance to driving, description of wash water or spoil from boring/drilling tools
- Depth of boring, borehole location (Station, Easting, Northing and Elevation) properly geotagged pictures
- Other relevant information such as RQD, percent core recovery, angle of friction etc.

b. Appendix B (Laboratory Test Results)

1. Summary of tabulated test result
(use standard format as per DO 75, s. 2024)
2. Laboratory Test Report

Soil

- Routine Soil Classification Tests
 - a. Particle Size Analysis (Grading)
 - b. Atterberg limit test (LL, PL, PI, SL)
 - c. Natural Moisture Content
 - d. Specific Gravity, Unit weight and Soil classification
 - e. Organic Content of Impurities
- Permeability Test (k=coefficient of permeability)
- Soil strength test: Unconfined Compressive test, Triaxial/Direct shear (shear strength, angle of friction, cohesion)
- Consolidation Test (compressibility parameters: Cc,Cs,Cr , stiffness in terms of concentrated modulus, pre-consolidation stress. Rate of consolidation, creep rate, Deformation Modulus)
- Swell Index test

Rock

- Specific Gravity, Unit weight and Soil classification
- Soil strength test: Unconfined Compressive test, Triaxial/Direct shear (compressive strength, angle of friction, cohesion)

c. Appendix C (Geological/Geotechnical Plan)

Use standard format as per DO 75, s. 2024

- North arrow
- Name of project/location
- Borehole location captured in a google map with coordinates
- Geologic Cross-section & Idealized Soil profile showing the boreholes and N-Values results
- Type of Recommended Foundation Drawn Adjacent to Boring Log with SPT Graph
- Vicinity map (showing coordinates of the project site)
- Appropriate signatories in the title block

d. Appendix D (Geohazard Maps)

- Seismicity in the area showing distance from the project with blown up nearest active fault and length of active fault line with Historical records of seismicity with in area (3 earthquake sources)
- Peak ground acceleration map
- Liquefaction map
- Geomorphic map
- Climate Map
- Geomorphological Map
- Volcanic Hazard with supporting Map
- Rainfall-induced landslide Map
- Flood Hazard and Fluvial Hazards Map
- Tsunami, Seiches and Storm Surge Hazard Map
- Mining Tenement Map (Locations of previous open pits, underground portals, etc.)

e. Appendix E (Geotagged Pictures/Videos)

Geotagged photos showing name, location and borehole No. of the subject borehole during borehole drilling and sampling shall be taken by the Consultant and form part of the report.

The photographs to be taken shall depict the following:

- Equipment used
- Core drilling operation
- Water level measurements
- Performance of SPT sampling
- All cores in core boxes and SPT and shelby tube samples
- Date photographs were taken
- Geotagged photos of the project location
- Material Testing activities

III. IMPLEMENTATION

A. STAFFING

- The consultant shall assign senior drillers and material engineer including core drillers and driller aides to perform the job.
- The Geotechnical Engineer shall visit the site for proper assessment and validation to come up with a better recommendation in the final reports.

Key Personnel:

Key Staff		Task	Required Classification
Geotechnical Engineer	1	<ul style="list-style-type: none"> • Overall guidance, direction, supervision and coordination of members of the team • Evaluation of geological information on the project sites • Evaluate the laboratory tests, prepares and signs Geotechnical Investigation Report with recommendations 	<ul style="list-style-type: none"> • BS in civil engineer, masters or doctoral degree in geotechnical engineering • Duly licensed/registered engineer • At least 10-year experience on soil, sub surface and geotechnical survey and study of roads, bridges and related structures
Materials Engineer	1	<ul style="list-style-type: none"> • Supervises the field drilling sampling and Testing of materials 	<ul style="list-style-type: none"> • DPWH Accredited Material Engineer • At least 5-year experience on soil, sub surface and geotechnical survey and study of roads, bridges and related structures
Senior Driller	1	<ul style="list-style-type: none"> • Handles the drilling machine during field boring and assist retrieved of samples 	<ul style="list-style-type: none"> • At least 5-year experience on soil, sub surface and geotechnical survey and study of roads, bridges and related structures
Laboratory Technician	1	<ul style="list-style-type: none"> • Performs the laboratory tests, encode the laboratory test results and assists the laboratory supervisor. 	<ul style="list-style-type: none"> • BS in civil engineer • Duly licensed/ registered civil engineer • At least 2-year experience on soil, sub surface and geotechnical survey and study of roads, bridges and related structures

B. DURATION OF CONSULTANCY SERVICES

- The Consultant's contract period for undertaking the geotechnical investigation shall not be more than **57 Calendar Days** and the Consultant shall commence work within seven (7) days after receipt of Notice to Proceed (NTP).

C. ASSISTANCE TO BE PROVIDED BY THE CLIENT

- The DPWH shall ensure that the Consultant has access to all relevant information of the proposed project necessary to the performance of the above services.

D. SUB-CONTRACTING

The consultant may sub-contract portions of the Consulting Services to an extent as may be approved by the Procuring Entity, provided that the Consultant shall directly undertake, using its own personnel and resources, not less than **eighty percent (80%)** of the contract works in terms of cost.

E. VARIATIONS

If variations are identified during the course of the project, the Consultant must notify the Head of Implementing Section immediately, including detailed documentation and evidence of the variance.


F. PAYMENT

- There should be no Advance Payment for Consultancy. The final payment shall be made only after the final statement, identified as such, shall have been submitted by the Consultant and approved as satisfactory by the Procuring Entity.

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