
Soil Exploration in Selected Evacuation Center

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ABSTRACT

Tanauan Leyte being one of the hardly hit areas during the devastation of typhoon HAIYAN, has been given opportunities of different rehabilitation projects to recover and furthermore give priority to disaster risk reduction and management. One of those projects was to build designated Evacuation Centers on different priority areas in typhoon stricken-communities. Wherefore, a further study was done to areas concern to build better Evacuation Centers. The following barangays identified are located along coastal area of Tanauan classified as the most vulnerable in terms of typhoon, surges and other natural calamities. Manpower was hired to help in conducting the soil exploration and utilized appropriate equipment, apparatuses for soil mechanic analysis. Soil samples were systematically gathered using auger boring method and soil penetration test for three to six meters depth using a split barrel, labeled and placed in marked containers. Soil Penetration Test was conducted to determine the soil bearing capacity as basis on the design of building and further recommend for a resilient structure. The water content and liquid limit determination is determined for a possible liquefaction. The results show the different soil classification, soil bearing capacity and liquid susceptibility among five barangays under investigation. The findings suggests that the proposed location of the four barangays are capable of bearing a two-storey structure except for one barangay provided that the structure will conform to the national building code for an evacuation center.

Keywords: Evacuation center, Soil exploration, Soil mechanics, Soil samples, Auger boring, Soil bearing capacity, Liquefaction, Site investigation, Haiyan typhoon, Disaster

INTRODUCTION

Tanauan Leyte as being one of the hardly hit areas during the devastation of the typhoon Haiyan, has been given opportunities of different rehabilitation projects to recover and furthermore give priority to disaster risk reduction and management. One of those projects was to build designated Evacuation Centers on different priority areas of Tanauan Leyte. Wherefore, the proponents have extended further study on the areas concern to give way for a resilient structure.

The importance of conducting soil exploration and assessment is to realize the extent of the soil on holding the level of load and its strength for any structure it would take. With such soil exploration and soil investigation is needed to see the status of every soil that would be carrying a load of a certain structure. That is why through a site investigation and soil exploration we can ensure that needed design for such soil will be properly implemented. And to achieve such implementation, land development is required.²

Every location has different soil classification that can carry a design load. It is very important to determine and assess the behavior and classification of the subsurface as basis for the foundation design against sliding and overturning or structure.⁽¹⁾ Due to lack of appropriate investigation, assessment and evaluation on the increasing degradation process of soil and water creates a great impact on the ecosystem services to the world in general.⁽²⁾

Soil exploration could mean a better output on the design of the structure and somehow give a good economic value to costing of the project. It is very essential to investigate the site in terms of soil bearing capacity in order to have accessible information for design and construction and likewise for environmental impact assessment. Situ tests are utilize in site exploration to define the origin, composition, distribution, soil properties and determine the allowable geotechnical design. To classify subsoil, the penetration resistances are commonly used. The parameters for the properties of the soil are accompanied with the Standard Penetration Test (SPT) which is used for primary soil investigation.⁽³⁾

The study on soil exploration and soil classification on the selected areas of Tanauan Leyte for evacuation center would be beneficial to the following group of people which would give more benefit and security on the foundation of the buildings and their recipients. For the barangay residents, the results of the study would give them more information of the soil in their areas and may somehow give them more ideas of the soils

applicability in terms of building foundations. The study would give the administrator more ideas on how the design of the building be modified and where it should be located. The result of the study would give the building officials in the municipal engineering office the security and permission on the conduct of constructing the building on a specified location. The study and its results would give the community more information about their soil and may likewise be a source of data on future and design of buildings for the community. The data gathered will be an additional information and experience on conducting soil exploration and soil investigation and somehow may lead to another research study in line with the results and recommendations of the study.

This study claims that exploring the soil for evacuation centers will establish sustainability among the projects. Thus, it will give the opportunity for proper investment of the resources.

METHODS

The Municipality of Tanauan has a population of 55,021 people and a land area of 74.81 km² comprises fifty four (54) barangays. The geographical coordinates of Tanauan has a latitude of 11 06' 34" and longitude of 125 00' 56" (WGS84).

Tanauan Leyte is Located along the Eastern side of Leyte and is one of the most vulnerable towns in terms of typhoons, Surges and other natural disasters. There are eight barangays situated along the shoreline of Tanauan such as Brgy. Mohon, Brgy. Calogcog, Brgy Sta Cruz, Brgy Magay, Brgy. San Roque, Brgy Sto. Niño, Brgy. Bislig and Brgy. Cabuynan.

The Study materialized with the proposal of building several Evacuation Centers donated by International Non-Government Organizations (I.N.G.O.) where the concerned people needed to see the areas suitability in terms of founding the designed evacuation centers. Barangays along shoreline was the main location identified to build an evacuation center.

The research design of the study is an experimental type of study where the proponents utilized the soil exploratory methods of gathering data and analyzing the data through the necessary analytical type in soil analysis and utilizing some geologic procedures to identify necessary spots in the area to gather the soil sample. Soil investigation and area investigation were also utilized.

The area of the study were conducted of the different barangay recipients of the project in the municipality of Tanauan namely: Brgy. San Miguel, Brgy Calogcog, Brgy. Mohon, Brgy. Bislig and Brgy. Licod Tanauan Leyte. The project has different sites for sampling and it took the researchers more than a year to finish the different locations of the soil exploration. Gathering data for each location differed on the values as per result of the analysis observing the same procedures.

The researchers cleared the area were the soil sampling took place by hiring people to assist the researchers in clearing and boring of the different designated spots in the area and took soil samples of different depths, labeled and marked in the different containers. Samples taken were both disturbed and undisturbed soil samples. The instruments used were commonly for clearing the area like bolos and ax, for boring the researchers' utilized auger for different soil depths, split barrels, steel pipes, pulleys, ropes, rammers. For personal protective equipment, the workers worn gloves, long sleeves, hardhat, working boots.

For the soil laboratory and soil analysis the researchers used sieve shakers, sieves of different sizes, plastic limit apparatus, oven drier, pan, containers, weighing scale and computers. To validate instruments used the researchers followed the different procedures and methods of conducting soil exploration and assessment as per American Standard for Testing and Materials (ASTM) standards.

The data gathered were computed and analyzed using the different soil testing procedures like using the Atterberg's limit, a determination of water content of the soil sample. It likewise tests the soil's plastic limit, shrinkage limit and liquid limit by using the casagrande cup apparatus. To determine the soil bearing capacity, Terzaghi's theory and method was used through soil penetration test to determine the maximum average contact pressure between the foundation and the soil as basis for the structural design allowable for an allowable maximum settlement.

RESULTS

The assessment of the soil of the site conditions is based from the data information gathered from the actual sample in the site. All sample was subjected to laboratory analysis and was carefully assess as to the soil grain size and other property that will help determine the soil bearing capacity. The result was used as one of the basis on the building design.

The standard penetration test reaches to a depth of six meters while soil sampling drilling was as depth as three meters. This methodology of soil sampling and SPT is assumed to a limit of two (2) to three (3) storey structure. There were three (3) boreholes drilled for sampling and only one 2” diameter pipe penetrated to a depth of six (6) meters. The field investigation consisted of drilling a borehole with Standard Penetration Test (SPT). Number of blows were recorded for a penetration of 15 cm in two layers.

Table 1. Soil classification using the Unified Classification Triangle

Barangay	% Sand	% Silt	% Clay	Soil classification	Soil bearing capacity
Barangay Calogcog	32.27	40.52	7.26	Silt Loam	80 KPa
Barangay Licod	86.95	8.70	4.35	Sand (loose)	220 KPa
Barangay Mohon	95.04	3.97	0.99	Sand (loose)	180 KPa
Barangay Bislig	86.39	11.94	1.67	Loamy Sand	123 KPa
Barangay San Miguel	85.82	13.80	0.38	Loamy Sand	158 Kpa

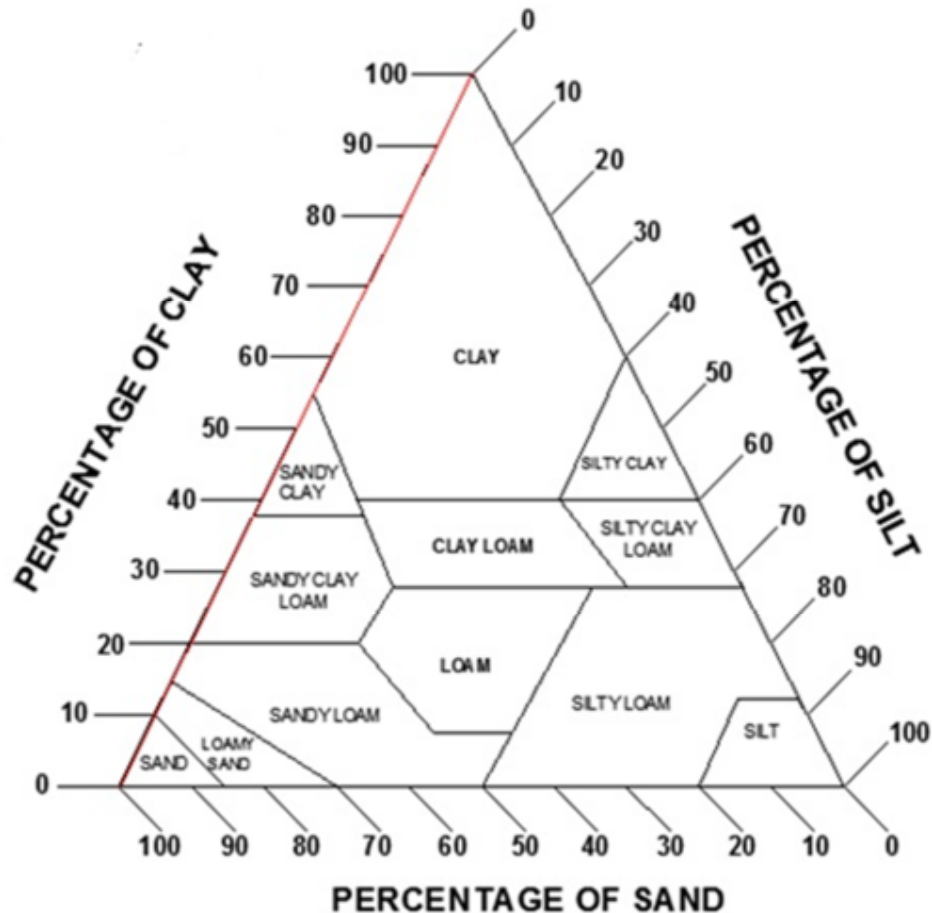


Figure 2. Unified Classification Triangle

DISCUSSION

Tests for determining the soil strength are vane shear test, standard penetration test, core penetration test, borehole shear test, flat dilatometer test, the pressure meter test and the plate load test. The design of foundation of every structure needs to be validated with the safe bearing capacity. Theories of Terzaghi, Meyerhof and Vesic are the principles in the evaluation of safe bearing capacity caused by the shearing stress.⁽⁷⁾

Particle size distribution defines the texture as a determining variable of the soil's structure and function. The importance of classifying soil according to grain size is to determine its properties and textures in terms of percentage of clay, silt and sand. Soil classification subjected to continuous particle size distribution results to several textural parts with particles ranges the size from medium sand, fine silt, etc.⁽⁵⁾

The concept of the Liquid Limit is the state of the soil with corresponding water content which changes from plastic to liquid phase. The water content of a soil sample in which the state of soil changes from plastic to liquid phase is the concept of Liquid Limit. Gradual transition of soil from plastic to liquid limit, state shear strength do not zero with respect to water content. The liquid limit of the soil sample can be determined through a standard test procedure.⁽⁶⁾

The soil in Barangay Calogcog is highly susceptible to liquefaction considering the particle size that an average of 80% by weight passes in between 2.0 mm to 0.075 mm sieve. The average N value for the SPT is lesser than 10, the soil is saturated and non-plastic. The soil classification is silt loam therefore has a soft property and has a low bearing capacity and not suitable for foundation and high possibility of settlement. The water content of the soil sample 29.84% and as classified as the liquid limit corresponding to 25 blows. The soil classification is Silt Loam with estimated percolation rate range (minutes/inch). When dry, it appears quite freely cloddy, but lumps are easily broken to a soft and powdery form and when saturated with water, the soil freely runs together. This kind of soil is non plastic. The soil bearing capacity of 80 kPa which is not capable of holding the designed structure.

The result of the Standard Penetration Test of Barangay Licod resulted to a 15 mm settlement which is tolerable for a two storey structure with an allowable soil bearing capacity of 220 kPa using the Terzaghi Bearing Equation. The soil is highly susceptible to liquefaction considering the particle size that an average of 85% by weight passes in between 2.99 mm to 0.075 mm sieve. It is further recommended that the foundation located not less than 2 meters depth from the natural grade line and the gravel floor should be elevated about 1 meter high.

The result of the Standard Penetration Test of Barangay Mohon resulted to an eight (8 mm) settlement which is tolerable for a two storey structure with an allowable soil bearing capacity of 180 kPa using the Terzaghi Bearing Equation. Laying of boulders in the soil foundation is necessary to strengthen the base foundation. From the on-site exploration, there is a high level of Saturation with a high recommendation to pump water before pouring concrete. Further, there is a need to make suitable forms needed for footing to avoid liquefaction and erosion to add protection to the foundation with a floor line elevated about 1-meter high due liquefaction.

The result of the Standard Penetration Test of Barangay Bislig resulted to a 25 mm settlement which is tolerable for a two storey structure with an allowable soil bearing capacity of 123 kPa using the Terzaghi Bearing Equation. To increase the soil bearing capacity of the soil, a deeper foundation should be observed or an increase of footing width design.

From the on-site exploration in Barangay San Miguel, it has been observed that water is evident at one (1) meter depth of soil boring, therefore there is a high level of saturation with a high recommendation to pump water before pouring concrete. Further, there is a need to make suitable forms needed for footing to avoid liquefaction and erosion to add protection to the foundation with a floor line elevated about 1-meter high due liquefaction. The allowable soil bearing capacity is 158 Kpa and it is tolerable for a two storey building.

CONCLUSION

The soil classifications of the five barangays were sought to be silty loam for Barangay Calogcog, sand for Barangay Mohon and Barangay Licod and loamy sand for Barangay Bislig and Barangay San Miguel. The soil bearing capacity for the four barangays were sought to be tolerable for a three storey building while the site location for barangay Calogcog is not a good location site due to high saturation and possible liquefaction.

It is recommended that the specified design for the building is suitable for the area if it follows the rules of the national building code of the Philippines during its construction. It is also recommended that a further research on soil exploration and site investigation be done on the different project of the municipality of Tanauan. Another location site for barangay Calogcog is highly recommended to further establish a good

foundation of the structure. For area with soil bearing capacity less than 100-150 KPa, footings should be at least two meters from the natural grade line.

Moreover, the design criteria for seismic should not be less than intensity 7 and the ground floor elevation should be one meter from the ground elevation. Slope protection for structure flooring perimeter must be introduced. Foundation is likewise recommended to have a depth of not less than two meters depth.

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