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Studying Geological Conditions for Construction Works in Thai Nguyen City Part 1: Geological data collection method in Thai Nguyen province

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ABSTRACT:From the collected results, field drilling data, and experiments, the authors found that the phase clay layer is encountered in most of the drill holes in the area. The authors also built the relationship between the deformation modulus of clay from experimental results in the room and in the field. From there, it helps the designer to rely on the experimental results in the room to adjust and calculate the deformation of the building's foundation accurately and by the actual ground construction in Thai Nguyen. Simultaneously, the authors have successfully built a geological GIS database system for Thai Nguyen city including administrative boundaries, topography, infrastructure, traffic, hydrology, surface cover, and system. GIS database specialized in engineering geology: borehole stratigraphy. With the research objectives set out, the author organizes this research into five main parts as follows. Part 1: Geological data collection method in Thai Nguyen province; Part 2: Calculation of ground deformation under construction loads under laboratory conditions; Part 3: Calculation of deformation of the ground under the action of construction loads in actual conditions; Part 4: Application of ArcGIS software in geological data management of Thai Nguyen province.

KEYWORDS: Geology, ArcGIS, soil layer, void coefficient, earth pressure

I. INTRODUCTION

Thai Nguyen is a first-class urban city of Vietnam in Thai Nguyen province, the 10th most populous city in the country, and the 3rd largest city in the North of Vietnam after Hanoi and Hai Phong. At the same time, it is the center of the midlands and mountains of the North of the country. In the future, Thai Nguyen will become a modern urban on par with major cities in the country and the region, the problem of construction development and especially underground works and high-rise buildings is inevitable. Thai Nguyen city has a long history of development, has changed its boundary many times, and has made many adjustments to the general planning (excluding local adjustments). In 1996, Thai Nguyen city was approved the general planning project, which was determined as a grade III urban center directly under the province. In 2002, it was upgraded to a grade II urban area. In 2005, the first adjusted master plan of Thai Nguyen city was prepared and approved, with the criteria of spatial orientation to 2020. In August 2012, Thai Nguyen province advocated adjusting the general planning of Thai Nguyen city for the second time. To improve the position of the city in integration, play an important urban role of the whole country, attractive to the region, as well as solve the problems of existing urban areas, it is necessary to pay attention to the work of urban planning. synchronous construction plan.

The preparation of urban infrastructure has not been synchronized. Some old urban areas are densely populated, affecting infrastructure and protecting the ecological environment. In the past time, the planning to build several new residential areas and resettlement areas has not been reasonable. It has affected the general development of the city.

Currently, the surface land fund of the central area of Thai Nguyen city is in an almost exhausted state. Green spaces, public spaces with the need for modern civilization, and urban beauty are demanding the development that must be

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directed towards the ability to take advantage of parallel development in both height and depth. In particular, the issue of depth-development of urban underground space in Thai Nguyen is happening very new, inadequate, lacking planning and regulatory framework. Thai Nguyen will build underground works for traffic, water supply and drainage, commerce, services, and car parking. From the incidents that happened with big cities like Hanoi and Ho Chi Minh City, Thai Nguyen also needs to find its orientation.

Challenges for the construction industry in Thai Nguyen have also been raised, which is the problem of construction planning and the quality of construction works. To improve efficiency in construction work, geological survey work must be one step ahead. The formation of high-rise buildings is the trend that the city is aiming for. However, how much to develop high-rise buildings to match the development needs and ensure the infrastructure of the city, so far there is no specific plan. It is necessary to prepare for the survey to have specific statistics on traffic density and infrastructure conditions in central street areas. This is the basis for evaluating whether the construction of high-rise buildings in that location is suitable for geology and infrastructure conditions.

Previously, engineering geological investigations were conducted by the Department of Geology of Vietnam, but the documents are general and focus on mineral geology. They have not been integrated into the software and do not meet the construction forms of today. Therefore, it is difficult to use existing documents for planning and construction. From that fact, it is very necessary to study the geological and engineering conditions of the region to serve the sustainable development of the Thai Nguyen urban area.

II. DATA COLLECTION METHODS

The collected documents include all documents related to the geotechnical conditions of the study area, including:

- Documents on geology, stratigraphy, topography, hydrogeology of the area, map of the current state of the study area.
- Documentation of geological survey works that have been and will be built in the study area.
- Floor plan of the city center.
- Documentation of soil sample testing in boreholes at construction sites.
- Mineral geological map of Thai Nguyen province has been digitized on Mapinfo software.
- Collecting experimental data of soil and rock samples of 1000 drill holes, each hole is 10-50m deep.

Based on the collected documents and geological data, the authors have conducted actual drilling and surveying and analyzed the general characteristics of the geology of the area

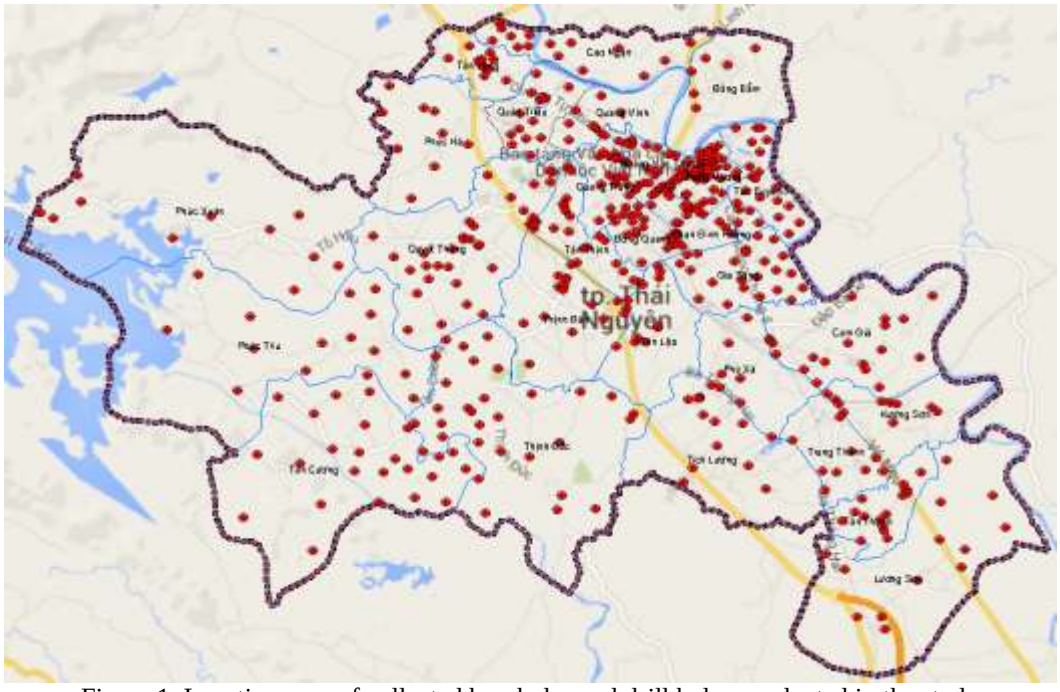

Figure 1. Location map of collected boreholes and drill holes conducted in the study

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The study area is divided into soil layers with the following characteristics:

Layer 1: Cultivated land, backfill soil, pond mud.
It is composed of backfill soil, silty soil, old fields yellow brown red brown gray brown yellow. Do not take samples for testing in this soil layer. Removed during construction design

Layer 1a: Soft plastic clay
It has a composition of mixed clay with yellow-brown red brown gray brown yellow color. Do not take samples for testing in this soil layer. Removed during construction design.

Layer 2: Mixed clay, hard plastic, medium, and weak structure.
Clay mixed with gray-brown, dark gray color, hard plastic state, medium-weak compact structure. This class is found in most of the survey areas.

Layer 3: Mixed clay, hard plastic, medium compact structure.
This layer is composed of clay mixed with yellow-grey brown-yellowish-brown, red-brown, in the hard plastic state, medium-tight structure, weak in some places. This layer distributes most of the survey area.

Layer 4: Fine-grained coarse sand, medium-tight texture, sometimes less tight.
This soil layer is composed of coarse-grained sand of gray-brown, gray-green color, the texture is medium and sometimes less tight. This layer is found in boreholes in the areas of Phuc Xuan, Thinh Duc, Thinh Dan, Tich Luong, Quan Trieu, and Tan Long communes.

Layer 4a: Coarse sand mixed with gravel, medium compact structure.
This soil layer is composed of coarse-grained sand and gravel, gray-brown, gray-white in color, medium compact in texture. This layer is only found in Phuc Xuan, Thinh Duc, and Thinh Dan communes.

Layer 5: Clay mixed with siltstones, semi-hard, medium-tight.
This soil layer is composed of clay mixed with a few weathered siltstones of yellow-brown, gray-green color.

Layer 6: Weathered siltstone interspersed with phased clay circuit, hard and tight state.
This soil layer is composed of weathered siltstone of gray-brown, blue-gray colors interspersed with phased clay circuits, solid state, tight structure. This soil layer is distributed in Tan Long, Quan Trieu, Phuc Ha, Thinh Dan, Tich Luong, Thinh Duc, Thinh Dan, and Phuc Xuan wards. Sampling in the drill core and testing the siltstone clay sample is:
One-axis instantaneous compressive strength: R_n = 250 kG/cm^2
Saturated single-axis instantaneous compressive strength: R_n saturated= 150 kG/cm^2
Conduct standard penetration test (SPT) in the field in this layer for the following values: NTB > 50 (hammer/ 30cm).

Layer 7: Claystone is cracked, cracked, hard state, tight structure.
This soil layer is composed of claystone, cracked and broken, gray-brown, gray-green, hard state, tight texture. This class is located in Cam Gia, Phu Xa, Thinh Dan, Tich Luong, Thinh Duc, and Phuc Xuan wards.
Sampling in the drill core and testing rock samples are:
One-axis instantaneous compressive strength: R_n = 300 kG/cm^2
Saturation single-axis instantaneous compressive strength: R_n saturated = 200 kG/cm^2
For grade 7 when calculating, it is recommended to choose compressive strength: R_n saturated = 200 kG/cm^2
The field standard penetration test (SPT) in this layer gave the following values: NTB > 50 (hammer/ 30cm).

Layer 8: Claystone, hard state, tight structure.
This soil layer is composed of claystone, blue-gray, dark gray, solid state, very tight structure. We have in-hole sampling and rock testing.
One-axis instantaneous compressive strength: R_n = 550 kG/cm^2
Saturation single-axis instantaneous compressive strength: R_n saturated = 450 kG/cm^2

Layer 9: Pebbles
Pebbles, gray, yellow-gray, very tight state. The thickness of this layer has not been drilled through. According to the experimental results, the results of mechanical and physical parameters are as follows:
Specific weight(γ_s): γ_s=2,66 (g/cm^3).
Standard penetration resistance SPT (N_{30}): N_{30}>100
The cobblestone layer has a very large total strain modulus E_0.
Standard calculation pressure: R_o = 6,0 (KG/cm2)

Layer 10: Shale interspersed with limestone

Formation composition includes shale, thinly layered mineralized siltstone, microgranular limestone, clay limestone, in some places with coal shale, thin lens. Mineral composition includes calcite 95-97%, clay 3-5%.
Standard penetration resistance SPT (N_{30}): N_{30}>100 (Hammer)

III. CONCLUSION

The collection of engineering geological survey documents has been available in the study area to reduce the volume of engineering geological survey work. On the other hand, this work brings economic efficiency, avoiding waste due to duplication between geological exploration works. The collected documents are guaranteed to be complete, accurate, and clear.The obtained geological exploration drilling data will be used as a database for geological management software for the urban planning process, traffic planning process, etc.

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