

Studying Geological Conditions for Construction Works in Thai Nguyen City Part 2: Calculation of ground deformation under construction loads under laboratory conditions

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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 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. EXPERIMENTAL RESULTS IN THE LABORATORY

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

The experimental results of 5 randomly selected works are summarized in Table 1. The stress-compression pressure relationship graphs are shown in Figure 1.

Table 1. Experimental results in the laboratory of soil mechanical and physical parameters of some buildings in the central area of Thai Nguyen

	Construction	W	γ	γ_c	γ_s	ϵ_a	n	W_{ch}	W_d	I_d	I_s	φ	C	Type of Clay
		%	g/cm ³	g/cm ³	g/cm ³	%	%	%	%	%	Độ	kG/cm ²		
1	Shopping mall	30.2	1.88	1.44	2.70	0.875	47	39.9	24.5	15.4	0.4	12°08'	0.180	hard plastic
		30.2	1.88	1.44	2.70	0.873	47	39.9	24.5	15.4	0.4	14°10'	0.190	hard plastic
2	Traffic Department Project Management Board	30.3	1.89	1.47	2.68	0.811	45	37.1	21.2	16.0	0.4	11°51'	0.196	hard plastic
		28.0	1.90	1.48	2.70	0.828	45	37.7	23.2	14.5	0.3	13°47'	0.204	hard plastic
3	College of Finance and Accounting	25.2	1.91	1.52	2.71	0.773	44	35.6	22.4	13.2	0.2	18°05'	0.230	half hard
		24.2	1.91	1.53	2.71	0.732	43	37.3	24.0	13.3	0.0	19°35'	0.237	half hard
4	Environmental Resources building	24.5	1.91	1.54	2.71	0.751	43	37.4	23.4	13.9	0.1	17°06'	0.223	half hard
		22.2	1.84	1.51	2.70	0.775	44	32.7	18.8	13.9	0.2	16°23'	0.256	half hard
5	Political school	26.6	1.90	1.50	2.71	0.809	44	35.7	22.3	13.4	0.3	14°17'	0.201	hard plastic
		28.1	1.91	1.49	2.72	0.822	45	36.0	20.9	15.1	0.5	17°38'	0.219	hard plastic

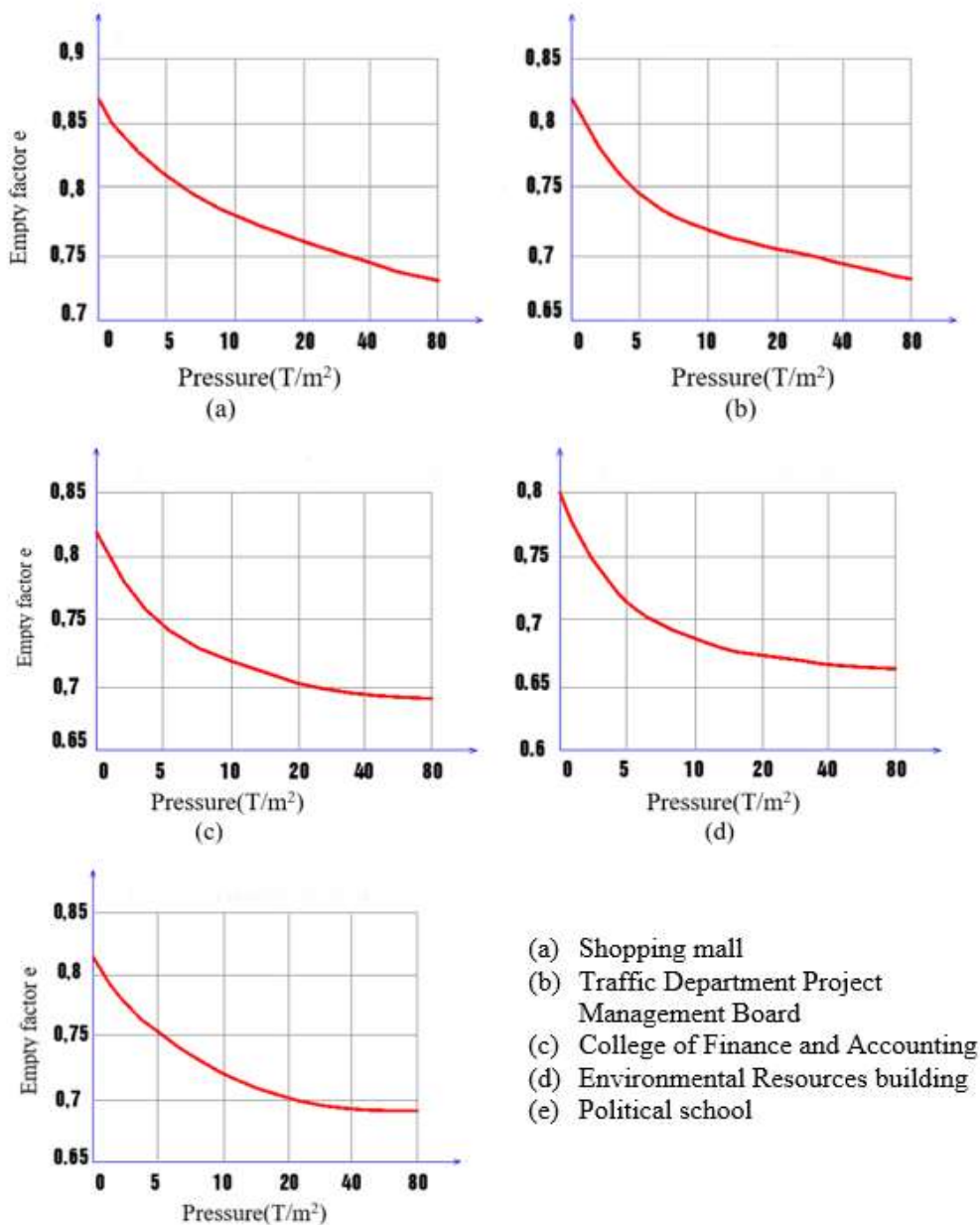


Figure 1. e-P relationship in consolidation compression test

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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REFERENCES

- [1]. Thai Nguyen Construction Consulting Company, 2012, Construction geological survey reports.
- [2]. Department of Geology of Vietnam, 1996, Map of geology and minerals at 1:50,000

- scale, Hanoi newspaper group, Vietnam Geological Department Publishing House, Hanoi.
- [3]. Cao Dinh Trieu, 1998, Zoning of Vietnam's territorial structure based on gravity and magnetic fields, Scientific Publishing House, Hanoi
- [4]. Duong Diep Thuy, Pham Quang Hung (2012), "Correlation between the base index and some physical parameters of cohesive soil in some areas of Hanoi", Journal of Construction Science and Technology 2012.
- [5]. Dinh Van Toan, 2004, Research and assessment of landslide hazards in the Northern mountainous region, Vietnam Institute of Science and Technology. Dr. Le Thanh Bon ; Pedology; Agricultural publisher; 2004.
- [6]. Nguyen Van Phat, 2011, Thai Nguyen Mineral Geological Map, 1:50,000, F-48-92-B, Science & Technology Publishing House.
- [7]. Nguyen Uyen, Nguyen Van Phuong, Nguyen Dinh, and Nguyen Xuan Dien, 2002, Engineering Geology, Construction Publishing House, Hanoi.
- [8]. Science and Technology Association specialized in engineering geology, volume 1, 1984, Construction Publishing House, Hanoi.
- [9]. Phan Hong Quan, 2006, Soil mechanics, construction publishing house
- [10]. Phan Tu Huong, 2015, Geology of underground works, a construction publishing house.
- [11]. Thai Nguyen Construction Quality Accreditation Center, 2011, Construction site geological survey reports
- [12]. TCVN 9354:2012, Construction soil – Method of determining deformation modulus at the site by flat compression plate, Construction Publishing House, Hanoi.
- [13]. Nguyen Quang Phich, The problem of surveying and exploration in the construction of underground works in the city to reduce geological hazards, Journal of Mining Science and Technology, No. 14(4-2006), P. 82-85.