

Problems Related to the Siting of the Laboratory Building for Civil Engineering Department at the University of Warmia and Mazury in Olsztyn, Poland

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Abstract. This paper deals with the conditions underlying and the problems arising from the siting of a building with specialist laboratories in a developed part of the university campus in Olsztyn, Poland. The topography of the terrain and the need to house civil engineering laboratories in the planned building had an immense impact on the shape of the building and consequently on its foundations, whose dimensions responded to the ground conditions and the specification of various loads they would have to support, including the equipment for the laboratories. The siting of a building as a step in the construction process entails several problems, which are first taken into consideration at the stage of making preliminary concept plans and are subsequently verified while working on the final construction plan. The required information included geotechnical documentation, survey of the ground conditions and the data regarding the predicted loads on the building, necessary to select the right type of foundations. All these problems grow in importance when dealing with such unique buildings like the discussed example of a laboratory building for the Civil Engineering Department, built on a site within a conservation zone on the campus of the University of Warmia and Mazury in Olsztyn, Poland. The specific character of the building and the specialist equipment with which it was to be furnished (a resistance testing machine, a 17-meter-long wave flume) necessitated a series of analyses prior to the siting of the building and selecting suitable foundations. In turn, the fact that the new building was to be erected in the conservation zone meant that collaboration with the Heritage Conservation Office had to be undertaken at the stage of making the plan and continued during the construction works. The Heritage Officer's recommendations concerning the building's shape, divisions, dimensions, materials used, etc., created a situation where the team of designers and architects had to become engaged in the process of landscape and spatial management. The above requirements concerned the functions of the building and its siting on a land parcel that was difficult to handle, also because of the protected trees growing there. Other constraints included the small size of this site, the developed surroundings, and the pre-defined programme of functions and use of the new building. On the other hand, the siting of the planned building had to be accommodated to the existing underground infrastructure (utilities). All the above circumstances made the task difficult and demanded good coordination between individual teams of engineers and architects, both at the stage of making the plan and during the construction works.



1. Introduction

The siting of a building as a step in constructing an architectural structure entails several problems, which are first taken into consideration while making preliminary concept plans and are then verified while elaborating the construction plan. These are such issues as the need to prepare the geotechnical documentation, to make a survey of the ground conditions and to design appropriate foundations based on the specification of loads on the building. This problem grows in importance when we are faced with the task of constructing a non-standard building, such as the one housing laboratories of the Civil Engineering Department and planned to be erected in the conservation zone on campus of the University of Warmia and Mazury in Olsztyn, Poland [1]). The specific functions performed by this building, housing some specialist equipment, necessitated a series of analyses prior to the siting of the building and designing appropriate foundations. In turn, the location of the building in the conservation zone demanded that collaboration with the Heritage Officer be undertaken at the stage of making the concept and construction plans, and continued throughout the construction works. The Heritage Officer's recommendations regarding the building's form, divisions, dimensions, building materials, etc., were associated with the functions assigned to the building and the conditions underlying its siting in not a very obvious location, also because of some groups of protected trees growing on the site. The small size of the land plot, the surrounding fabric of the historic part of the campus, the underground networks of utilities and, finally, the superimposed programme of functions and use of the new building all created additional problems while planning and constructing the building. These were the reasons why this scheme proved to be a challenging task and demanded precise coordination between individual teams of architects and engineers involved in it, at the stage of making the plan and while constructing the building.

2. The ground conditions for the siting of the building

The oldest part of the university campus in Olsztyn is designated as a historical heritage protection zone [2]. The high density of buildings in this area leaves virtually no space for new structures [3]. The investment project discussed in this article was classified as belonging to the second geotechnical category. During the geotechnical survey, 20 drill holes were made to the depth of 10.5 m below the surface, and the probing was performed with a light (DPL) and heavy (DPH) dynamic probes. From geomorphological point of view, the ground under the building was identified as Holocene made ground and Pleistocene fluvio-glacial deposits. The Holocene made ground is composed of fine-grain sand, fine-grain sand with humus, ceramic particles, gravel and plant roots, silty sand, medium-grain sand and sandy loam, which classifies this fill as low strength ground (Figure 1).

This meant that it had to be either replaced or compacted. During the investigations, it was determined that the frost line lay at a depth of 1.0 m below the terrain level and that the foundations for the building should be calculated for fine-grain sands with the relative density of $I_D = 0.50$. The groundwater level was at a depth of 4.5 – 9.5 m below the terrain level. This structure of the ground did not make it easy to design adequate foundations, composed of stop and continuous footings.

3. Construction and architectural solutions

The principal problems in designing a new laboratory building arose from the conditions set by the Heritage Officer, and revolved around the question of how to adapt the functions of the building to the specific character of civil engineering as a course of studies (laboratories for testing construction solutions) while creating an architectural form that would be harmonious with the historic buildings in this part of the campus [4], Figure 2.

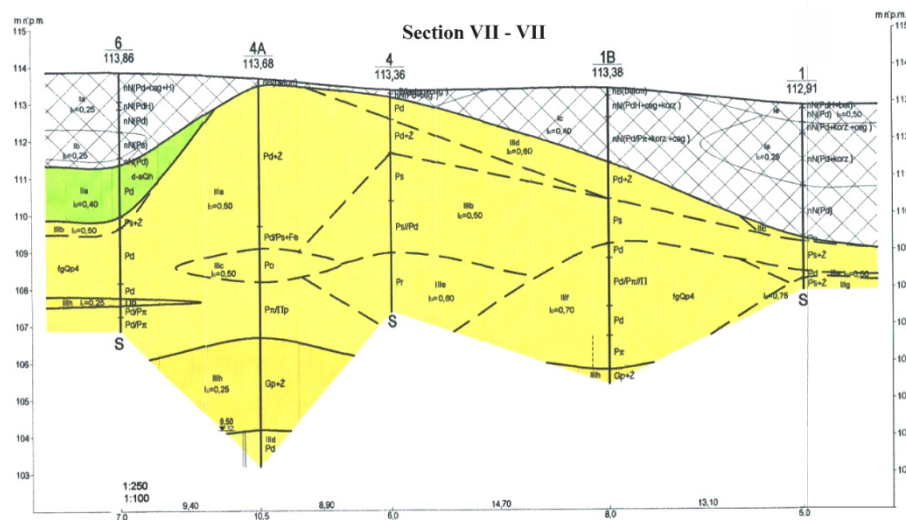


Figure 1. A sample geotechnical cross-section of the ground under the building



Figure 2. The laboratory building of the Department of Civil Engineering, the UWM in Olsztyn

The heritage preservation requirements contained detailed specification of the building's scale, built-up surface area, shape of the building, exterior wall patterns and materials, which in turn had to be adjusted to the previously approved programme of functions and use of the building. The size of the biggest laboratory for testing building constructions forced us to divide the building into two parts, connected by a glass patio (Figure 3). The laboratory contains a resistance testing machine, hence a specially designed, 80-cm-thick grillage floor with ferroconcrete binding joists had to be constructed to ensure adequate operating conditions for this piece of equipment.

The machine is anchored into the building, hence the stop footings in this part of the building are 2.4 m broad, 4.8 m long and 1.7 m high. These dimensions demonstrate what powerful forces are generated by this machine. The need to install specialist equipment caused other engineering problems. The 17-meter-long wave flume or the resistance testing machine are two pieces of equipment to which, due to their dimensions and operating conditions, the whole building had to be

adapted, including its siting and adequately designed foundations. Having to satisfy all the above conditions while adhering to the guidelines arising from the functional programme, proposed technologies and heritage conservation requirements meant that producing a plan for the building and performing the construction works constituted a great challenge (Figure 4).



Figure 3. The laboratory building of the Department of Civil Engineering, the UWM in Olsztyn – the patio



Figure 4. The laboratory building of the Department of Civil Engineering, the UWM in Olsztyn – works on the frontage

4. Results

The siting of a large university building, which was to house civil engineering laboratories and which needed to satisfy various expectations of future users (education and research & development processes) and of the investor, is not an easy undertaking. In the case discussed herein, an additional problem stemmed from the fact that the construction site was a small land parcel located in a conservation zone and surrounded by historically developed and at places chaotic structures [5].

The problems raised in the paper, related to the siting of a university building serving both teaching and research purposes and located in a conservation zone prove that in such a case the plan-making and construction process must be preceded by a series of analyses and requires close cooperation between different teams of architects and engineers. One underlying reason is that the building had to serve some specific functions, e.g. providing space for specialist laboratory equipment, which determined the way it was sited. To ensure sufficient room for the laboratories, it was necessary to

divide the building into two parts, which necessitated the use of dilatations and different solutions in the construction of the foundations. Apart from quite a number of engineering problems to be solved, architecturally it was crucial to harmonize the new building with the historic surroundings, designated the status of a conservation zone. The whole scheme could therefore be seen as bordering on a regeneration and revitalization effort. The achieved result has beneficial influence on the development of the university teaching and research facilities, which contributes to an improved quality of work conditions for academic teachers and researchers.

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