THE ROLE OF METAL CONSTRUCTION IN STRENGTHENING THE FOUNDATION OF THE BUILDING

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Abstract. The constructions supporting the slope of the pit were made in a densely built-up city area. Geological studies have been carried out, and based on the conclusion, the project of strengthening the basin was prepared for the first time, along the outer perimeter, with interlaced metal piles. Due to the insufficient length (12 m) of the metal groove piles, additional column constructions were used, which created a spatial holding structure of the basin, ensuring the stability of the basin's slopes.
Keywords: foundation pit; pile; groove; construction.

Introduction

Over the past few decades, many things have changed and improved in the Georgia construction field. In 2015, a new Georgian company, "Erti" LLC, appeared in Georgia, which, with the help of Dutch and Japanese partners, began to introduce groove pile technology.

In 1902, the Chief State Engineer of Bremen, Germany, Tryggve Larssen, developed the first example of a steel truss "U" profile with rivets, the so-called Larsen's groove. These groove piles are the most popular and have been used worldwide.

For 120 years, the production of sheet piles and the equipment used to install and dismantle sheet piles have been improved. Holland and Japan are advanced countries in the production and use of sheet piles, and the specialists of these countries are helping us to implement the technology in Georgia [1-**Error! Reference source not found.**]. In ancient times, there was only a hammer-type impact device, the downside of which was the impact on the environment and damage to nearby buildings. The principle of operation of the following devices is the vibration method. As a result, the friction force is lost, and the pile is placed in the desired location. The negative side of the vibration method is the impact on the environment, the vibration affects the surrounding structures when the geology is complex, and the deformation modulus is strong. The positive side of the vibration method is its speed; it can be said that it is the fastest and most relevant among the methods available today. Several piles can be connected and lowered to the design mark at one time. The maximum length used by the vibration method is up to 35 meters.

Base structure analysis

When processing the foundation pit, the construction organization should be guided by the current project, the project of the construction organization, and the work production project drawn up on their pit, according to construction norms and rules. At the same time, during the dismantling work, special attention should be paid to the observance of safety rules.

The selection of the type of construction vehicles and means required for the dismantling of existing buildings, the treatment of the pit and the arrangement of the retaining structures of the pit wall, and the place and time of their placement are determined according to the construction organization and the work production projects.

The absolute height of the bottom of the pit is 459.80 m. Based on the physicomechanical characteristics of the pit soils, for the drainage work, a compacted gravel pad with a thickness of 0.50 m should be arranged on the bottom of the pit, on top of which a waterproof concrete preparation with a thickness of 200 mm, concrete class B 15 will be arranged.

In the plan, the pit is an irregular polygon with dimensions of 59.20 x 33.0 (m), the area is 1375 m, the absolute height of the bottom of the pit is 459.80 m, the average height of the pit is 8.0 m, the approximate volume of soil to be removed from the pit is V=10000 m. In the present project, the supporting construction of the slope of the pit is a spatial framework. The processing of the pit and the arrangement of its slope-supporting structures should be carried out step by step, according to the scheme given in the project. The production of work can generally be described as follows:

1) Before the treatment of the foundation pit, arrange reinforced concrete drilling-wet hanging beams to which metal column will be attached;
2) before processing the pit, the installation of metal groove piles can be preceded by the arrangement of reinforced concrete piles;
3) After the installation of reinforced concrete and metal girders, the pit should be processed step-by-step (following the scheme given in the project).

According to the design task, a fastening belt should be arranged on the inner perimeter of the retaining wall of the pit slope (metal groove piles), which will be connected with horizontal bars made of metal coils. Metal groove piles must be separated by a certain distance (0.8m-1.0m) from the walls of the basement of the building provided for in the project so that it is possible to arrange the carpentry.

The current project has been calculated and processed in compliance with construction norms and rules in force in Georgia. In parallel with the construction of works, permanent geodetic monitoring should be carried out on the surrounding buildings.

Considering the location of the construction site and due to the great height of the pit, the stability and reliability of the slope-supporting structures are essential.

For necessary calculations following programs were used:

1. GEO5 reporting program;
2. "Engineering Calculator";
3. LIRA SAPR 2013.

H - the height of the slope of the pit is 8 m.

A drawing of the retaining structure of the pit wall and a diagram of the grooves are given in **Error! Reference source not found.**.

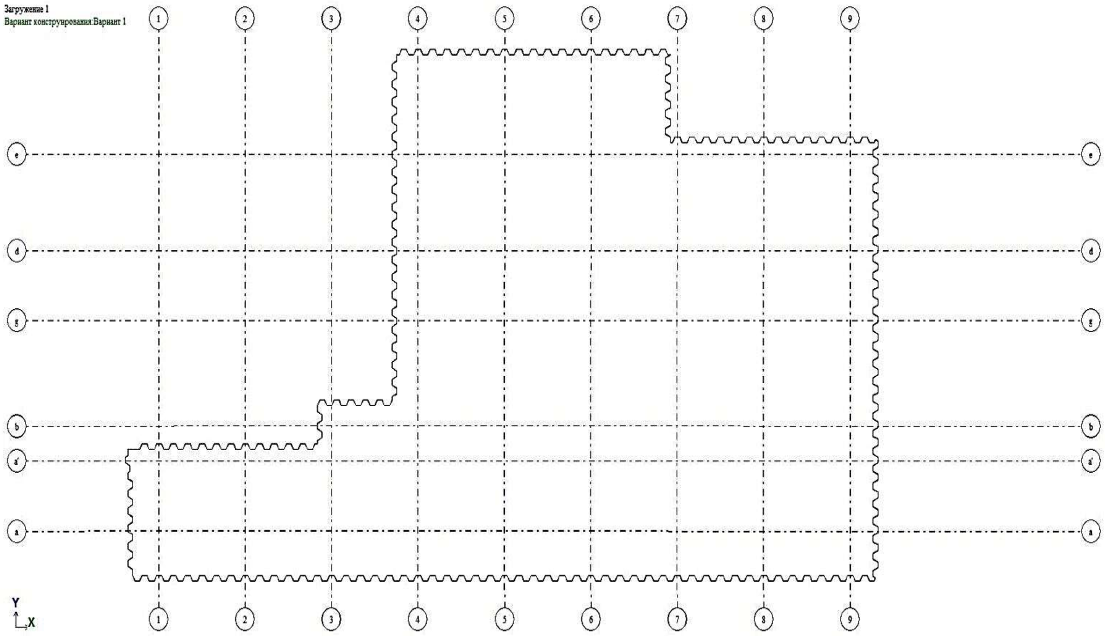
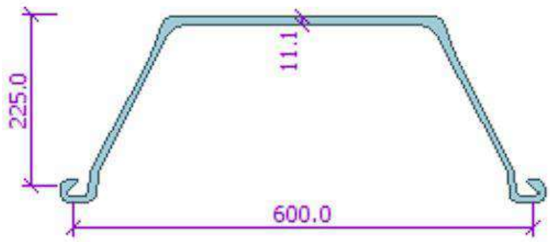


Figure 16 retaining structure of the pit wall and a diagram of the grooves

The calculation of the retaining structure of the pit slope (metal braces) was performed using the calculation program GEO6. Groove piles brand GU-21N. L=12m.



The calculation was carried out taking into account the gradual removal of the ground.

The results obtained by the calculation imply the determination of deformations, pressures on the wall of the pit, and force factors at a separate stage. The calculation was carried out taking into account the gradual removal of the ground.

The results obtained by the calculation imply the determination of deformations, pressures on the wall of the pit, and force factors at a separate stage. In the first stage, the pit was processed to a depth of 3.5 m according to the given calculation scheme (Figure 17).

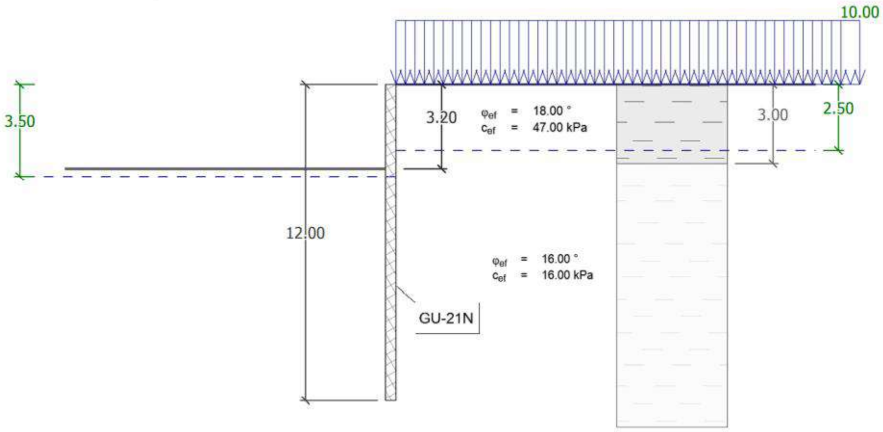


Figure 17. Calculation scheme

The obtained forces, deformations, and pressures, which are caused by the influence of the ground in the slope support structure, are given (Figure 18).

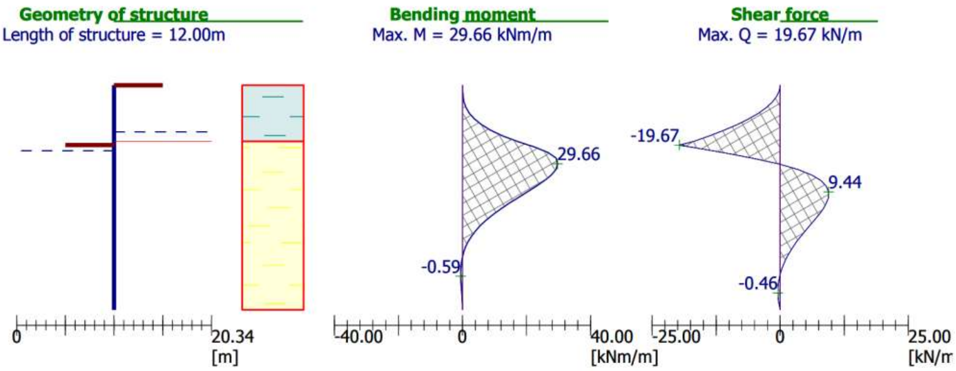


Figure 18. Boundary conditions which structure must withstand.

Maximum shear force = 19.67kN/m
Maximum bending moment = 29.66 kNm/m
Maximum displacement = 7.3 mm
The pressure on the retaining wall of the pit (Figure 19).

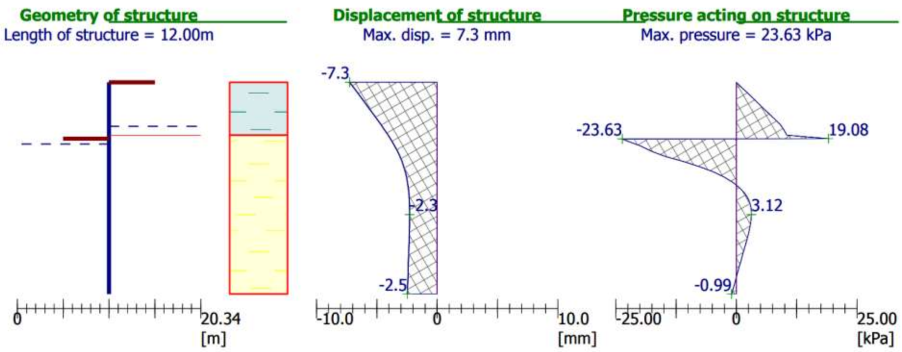


Figure 19 The pressure on the retaining wall of the pit slope

In the 2nd stage, in the pit with a depth of 3.20m, we attach grooves to the columns every 3.6m (Figure 20).

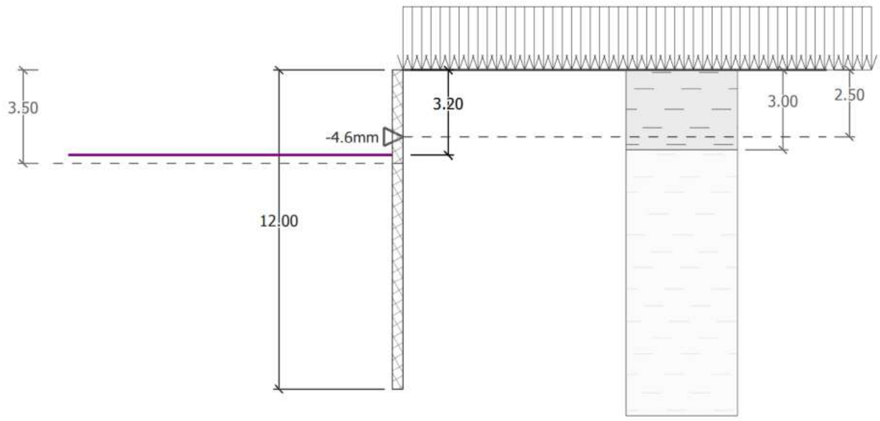


Figure 20. Attachment between groove and column.

In the 3rd stage, when processing the foundation pit into sections, we attach 8m spacer mounts in the depth zone (Figure 21)

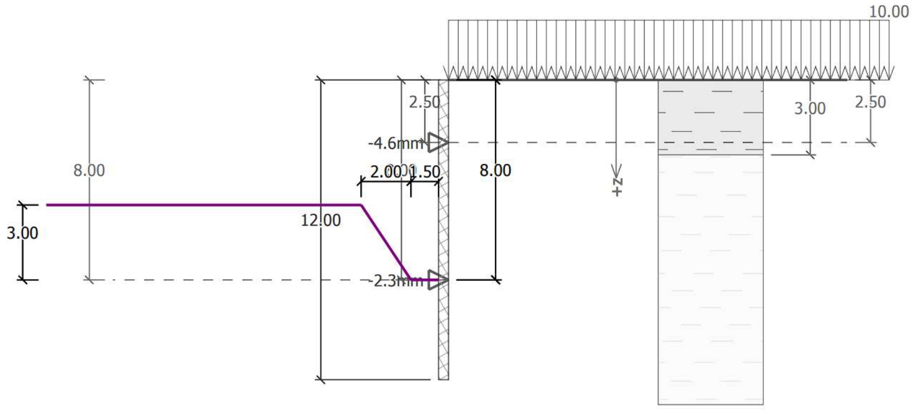


Figure 21. Column attachment scheme

The obtained forces, deformations, and pressures, which are generated by the influence of the ground in the base structure, are given (Figure 22).

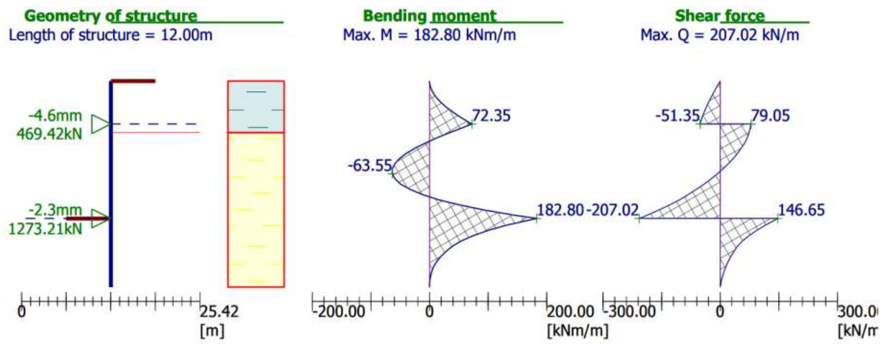


Figure 22. Boundary conditions from the ground

Maximum thrust = 207.02kN/m
Maximum bending moment = 182.8 kNm/m
Maximum displacement = 7.8 mm
The pressure on the retaining wall of the pit slope (Figure 23).

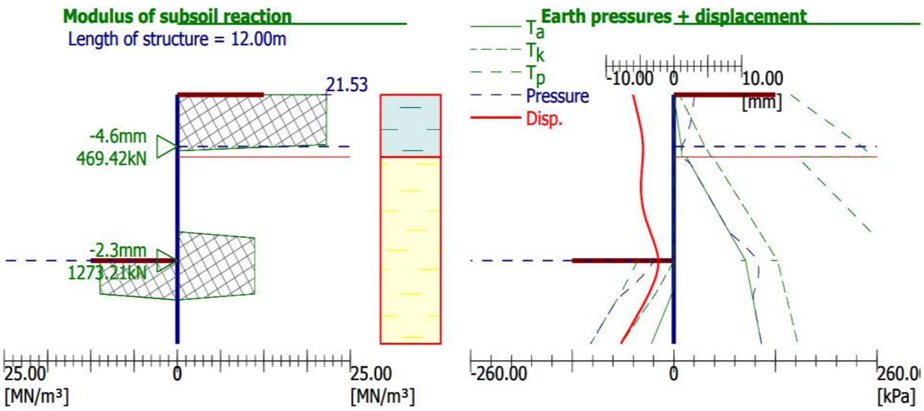


Figure 23. The pressure on the retaining wall of the foundation pit slope

At this stage, the pit is completely processed, and the soil is completely removed. The obtained forces, deformations, and pressures, which are generated by the influence of the ground on the support structure of the slope, are given (Figure 24).

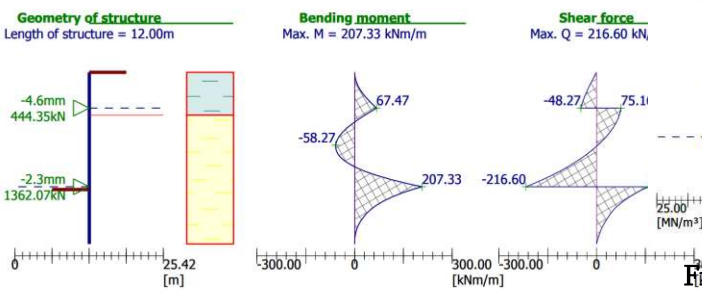


Figure 24 Boundary conditions from the ground

Maximum shift force = 216.6kN/m
Maximum bending moment = 207.33kNm/m
Maximum displacement = 10.2 mm (figure)
The pressure on the retaining wall of the pit slope (Figure 25-Figure 26).

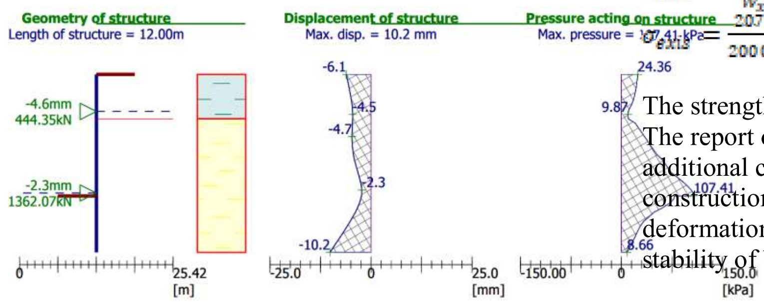


Figure 25 Boundary conditions from the ground

(Figure 27).

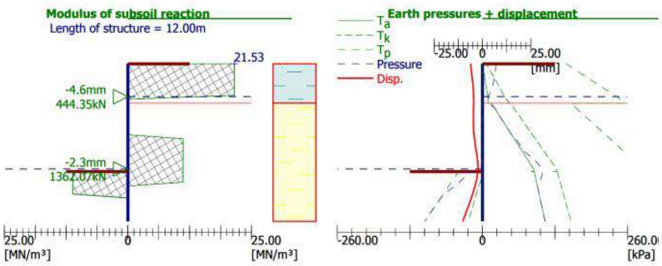


Figure 26 Boundary conditions from the ground

According to the calculation results, it is necessary to check the strength of the selected section GU 21N.
Maximum bending moment M_{max} = 207.33 kNm/m
Elastic section modulus Wx = 2000 cm3/m
Steel grade S235GP

$$\sigma_{exis} = \frac{M_{max}}{W_x} \leq \sigma_{allow} = \frac{f_y}{\gamma_m}$$

$$\sigma_{exis} = \frac{207}{2000} 10^3 = 103.67 \leq \frac{235}{1.5} = 156.0 N/m^2$$

The strength condition is satisfied.
The report of groove pile led to the arrangement of additional constructions. The use of the mentioned construction limits the occurrence of large deformations in groove pile and ensures the stability of base

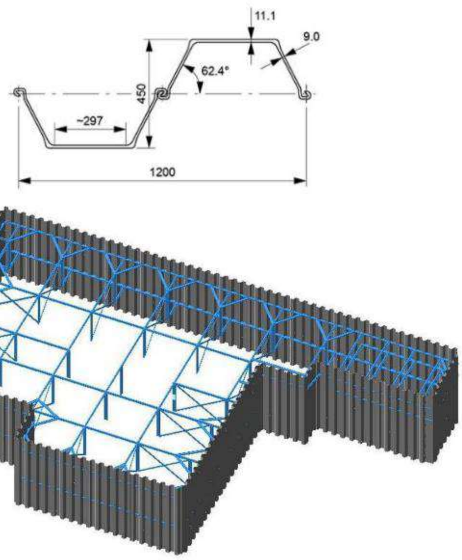


Figure 27. Base construction.

A spatial report of the retaining structure of the slope of the pit was carried out in the report program LIRA SAPT 2013. Based on the obtained results, the necessary sections of metal elements were selected. The deformations caused by the load applied to the slope of the pit were determined. (Figure 12) shows the deformations obtained by moving the metal frame structure along the "6" axis:

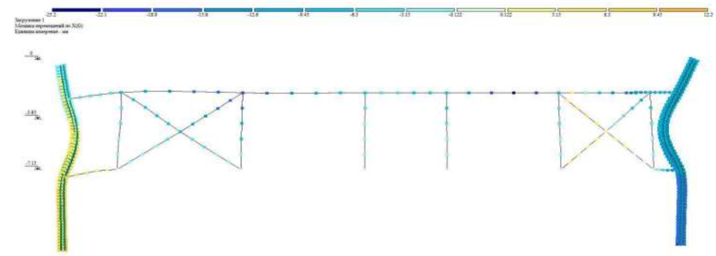


Figure 28. Displacement on the X axis

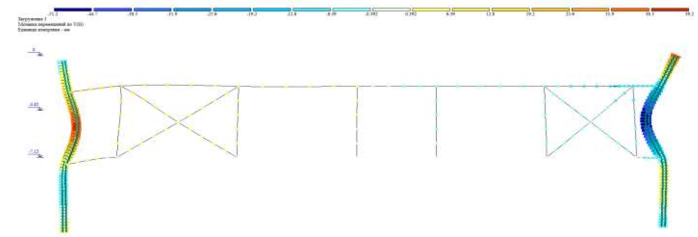


Figure 29. Displacement on the Y axis

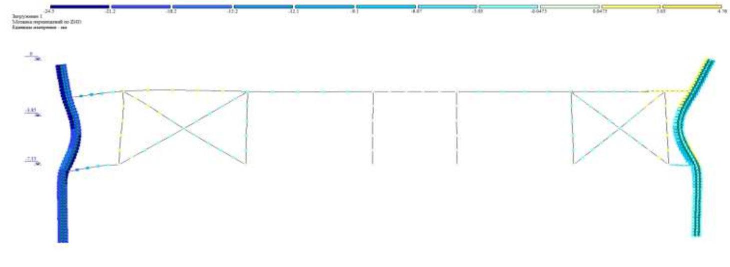


Figure 30. Displacement on the Z axis

Conclusion

The so-called metal Larsen groove is technically wholly safe and economically justifiable compared to other means of strengthening the foundation pit, and it is the fastest way. When these criteria are profitable in construction compared to other means, this is already a sign of great success.

Metal groove piles and the machines needed for their consumption were refined. European grooves are expensive compared to others but economically better because European technology is so good in its data that it is twice and sometimes more times stronger than tongues made in other countries.

In European countries, machines with more vibration methods are developing; in Japan, pressing machines without noise and vibration have been developed. In these countries, science is developed at such a level that every year more and more modernized and new devices are offered. In 2022, the production of fully electric vehicles began, and this direction will be improved in the following years.

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