ISSN: 2643-6876

Current Trends in
Civil & Structural Engineering

DOI: 10.33552/CTCSE.2022.08.000686

Iris Publishers

Research Article

The Case of Strengthening the Base of a Deformed Retaining Wall

Sokolov NS*

Chuvash State University, Russia

***Corresponding author:** Sokolov NS, Chuvash State University, Russia.

Received Date: January 03, 2022

Published Date: January 13, 2022

Abstract

The problem of increasing the bearing capacity of foundations is always an urgent problem in modern geotechnical construction. With additional increased external loads on existing restraint structures, the use of traditional technologies to ensure their stability is not always justified. Often there is an urgent need to use non-standard methods of strengthening the bases. There are frequent cases of using existing retaining reinforced concrete structures for new additional loads from newly erected objects. In such cases, the use of ERT drill piles and soil ERT anchors in most cases successfully solves many complex geotechnical problems of strengthening overloaded bases.

Keywords: Geotechnical construction; Electric discharge technology ERT; Drill injection pile ERT; Soil anchors ERT

Introduction

Ensuring the safe operation of newly erected facilities on sites with complex terrain and weak physical and mechanical characteristics requires a special approach [1-9]. Often, with new construction, you have to deal with previously strengthened slopes. Most often, they were reinforced with the help of recessed reinforced concrete structures used as retaining structures. In most cases, according to the design scheme, they belong to the building structures of the cantilever type. A distinctive feature of such walls from unfastened ones is that with even small additional external loads, they can be deforworldized. It is not necessary to say that they can perceive significant increased loads from a newly erected object. In such cases, a non-standard approach is needed in their use for the purpose of ensuring the sustainability of both the slope and the retaining wall itself. This article discusses the case of adaptation of the existing cantilever corner reinforced concrete retaining wall as a retaining reinforced concrete structure with significantly increased external loads of the roadbed under construction. It should be noted that the existing corner wall has already been deformed. The deviation from the vertical reached 950.0 mm with its height of 5.0 meters. It was decided to strengthen this wall with the help of additional drill-injection piles of ERT and turn from cantilevered to unfastened with the help of soil anchors ERT. Table 1 below shows one approach to using a deformed reinforced concrete retaining wall on a pile base of prismatic driven piles (Table 1).

Table 1: Resource requirements by component.

No. 3 p/p	Recessed reinforced concrete structures used in the fixture design
1	Retaining reinforced concrete structures are a complex consisting of anchor structures made of ERT anchors, a retaining wall of prismatic driven piles and reinforced concrete buttresses on a pile base of ERT drilled piles
2	Retaining wall of piles - drill injection piles by electric discharge pile technology (ERT piles), united on top by monolithic reinforced concrete rostwerks. Reinforced concrete buttresses support and connect existing ones with erected structures

3	Ground anchors manufactured by electric discharge technology (ERT anchors), manufactured using electric discharge technology (ERT anchors) are arranged at the initial stage of work and ensure the stability of the angular reinforced concrete retaining wall PS1 for the duration of the work and for the period of operation. They are prestressed elements with a reinforced concrete root obtained by electric discharge treatment of the soil along the length of the well.

Figure 1 shows a plan of recessed reinforced with ERT drill piles, ground ERT anchors and monolithic reinforced concrete buttresses (Figure 1).

According to the results of engineering and geological surveys, the construction site is located in the south-eastern part of the Raduzhny residential micro district of the Moskov sky district of Cheboksary. Geomorphologically, the survey area occupies the left slope of the valley of the Cheboksarka River, in the sole and middle part of the slope dissected by a dense network of filled and buried ravines, with absolute elevations from 71.2 in the floodplain of the Cheboksarka River to 112-116.0 m in the north-western part of the survey site (the south-eastern part of the planned territory of the micro district. “Rainbow”). The height difference is about 45.0 m. The general slope of the territory is observed in the southern direction - towards the valley of the Cheboksarka River. The engineering and geological structure of the site to the studied depth (40.0 m) is represented by a thickness of bedrock of the Severodvinsk and Vyatka tiers of the Upper Permian department (P3s + v), overlapped from the surface with quaternary deposits of different ages and genesis. The entire thickness from above is covered with high-power bulk soils (tQIV). The hydrogeological conditions of the construction site to the studied depth (40.0 m) for the period of surveys in August 2018 are characterized by the presence of one non-pressure groundwater horizon. Groundwater is opened in all wells at depths of 0.2 - 23.8 m (abs.marks 71.1 - 100.6 m) and is confined to tQIV bulk soils, landslide deposits dpQ (P3s + v), alluvial deposits (aQIII), Upper Permian sands of shallow, dusty, medium size, water-saturated, sandy layers in Upper Permian clays and loams (aleurites) of sandy and calcareous marls (P3s+v). The water stop is the denser underlying Upper Permian clays (P3s+v). An engineering-geological section indicating the vertical binding of the existing and newly erected walls is shown in Figure 2 (Figure 2).

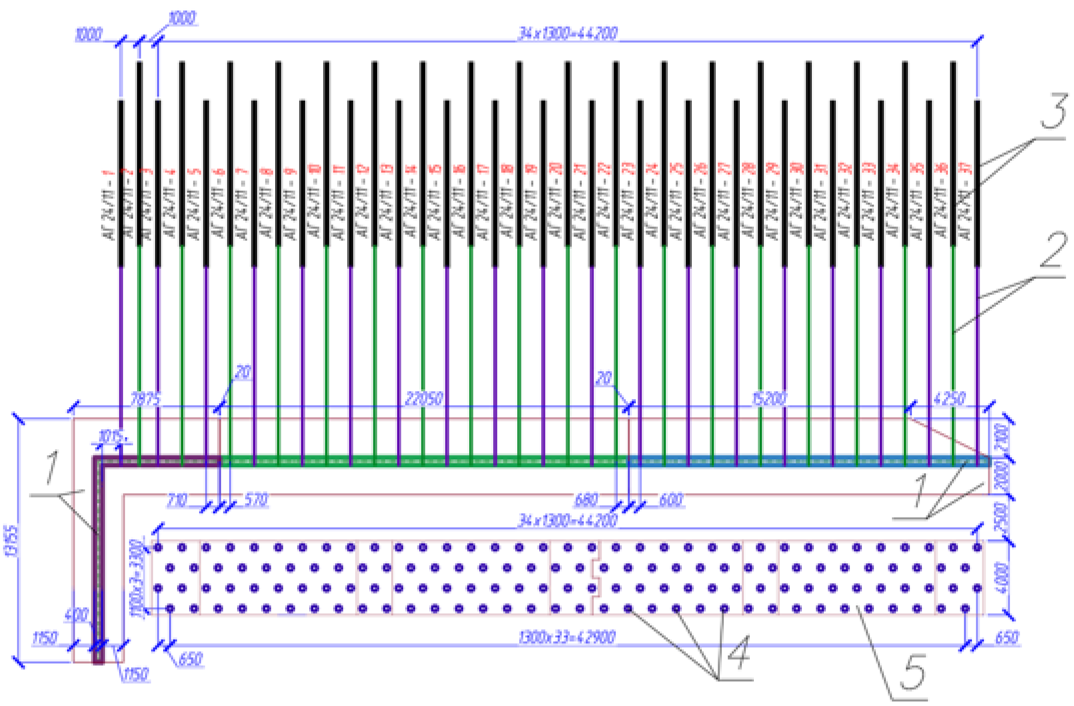


Figure 1: Scheme of the device of monolithic reinforced concrete rostwerks and diaphragms at the final stage: 1 - the existing monolithic corner reinforced concrete rostwerks; 2,3 – ground anchors ERT (2 – anchor rod; 3 – anchor root); 4 – drill-injection piles of ERT strengthening of the base; 5 – monolithic reinforced concrete rostwerk.

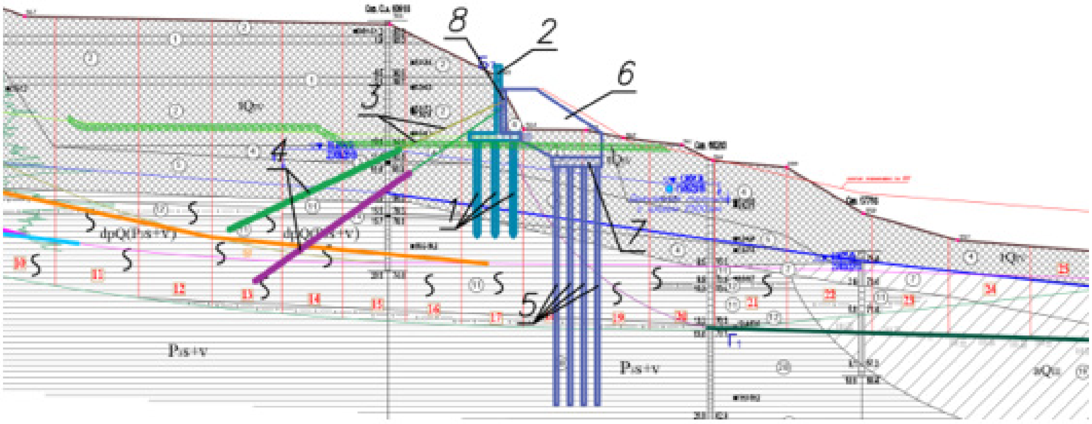
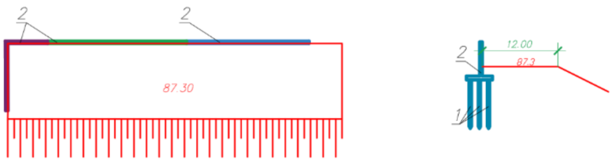
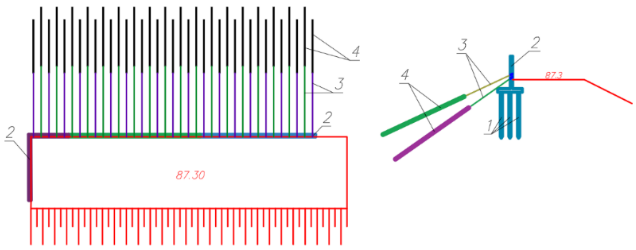
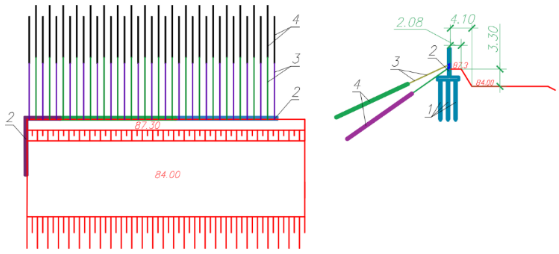


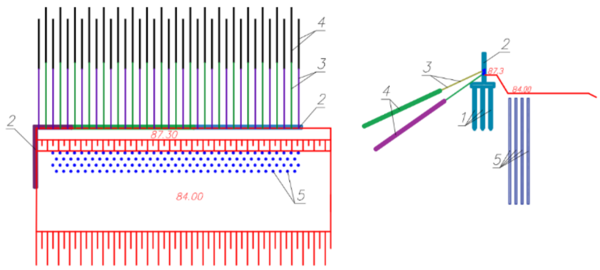
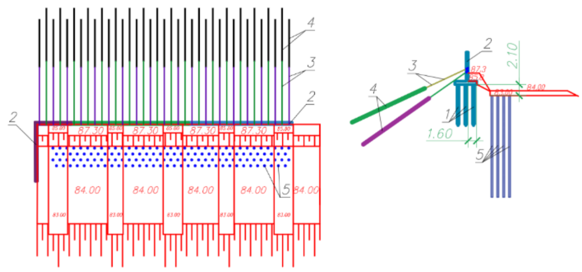
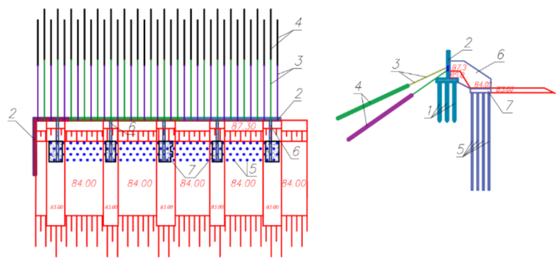
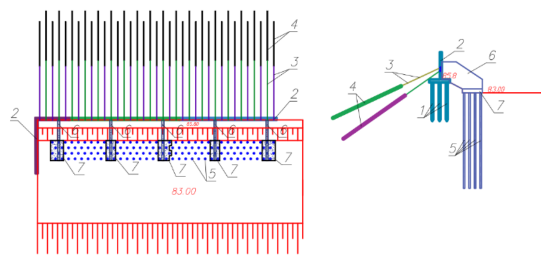
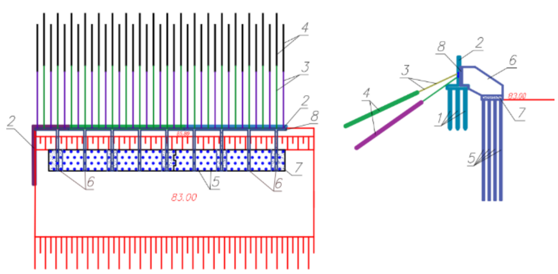
Figure 2: Vertical binding of pile foundations in the engineering and geological section: 1 – pile base of prismatic reinforced concrete piles under the existing; 2 – monolithic reinforced concrete corner rostwerk; 3, 4 – ground anchors ERT (3 – anchor thrust; 4 – anchor root); 5 – drill-injection piles of ERT reinforcement of the base; 6 – monolithic reinforced concrete buttresses; 7 – monolithic reinforced concrete rostwerk; 8 – wall-mounted linear drainage.

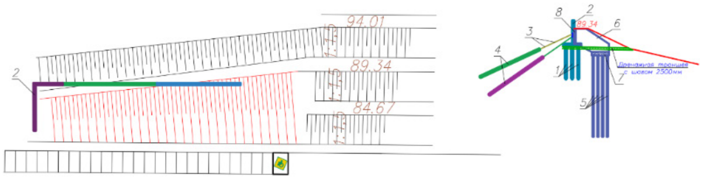
To use the existing retaining wall for the purpose of its perception of additional increased external loads, a project was developed for a device with the device of additional recessed reinforced concrete structures using ERT drill-injection piles, ground ERT anchors, monolithic reinforced concrete buttresses and the transformation of its design scheme from cantilevered to unfastened. Table 2 below shows the algorithm for the production of geotechnical works, divided into stages. It should be noted that their division into stages is associated with the need to ensure the stability of the slope during construction and to create safe working conditions (Table 2).

Table 2: Resource requirements by component Algorithm of geotechnical works.

No. 3 p/p	Name of geotechnical stage	Diagram of the geotechnical stage
1	Device bermы to from 87.3	 Diagram of the device of the soil berm to otm. 87.3: 1 – prismal reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk
2	Diamond drilling of holes, device and tension of ERT ground anchors	 Scheme of drilling holes in the rostwerk for the device and tension of ground anchors ERT: 1 – prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT
3	Soil development to otm. 84.0	 Scheme of soil development to otm. 84.0: 1 – prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT

Citation: Sokolov NS. The Case of Strengthening the Base of a Deformed Retaining Wall. Cur Trends Civil & Struct Eng. 8(3): 2022. CTCSE.MS.ID.000686. DOI: 10.33552/CTCSE.2022.07.000686.

4	Installation of boroinjective ERT piles	 Scheme of the device of soil anchors ERT reinforcement of existing rostwerks (3,4) and drill injection piles ERT (5) reinforcement of the base: 1 - prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT
5	Local development of soil in trenches for rostwerks to otm. 83.0 m	 Scheme for local development of soil in trenches for rostwerks to otm. 83.0 m: 1 – prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT; 5 – boroinjection piles ERT reinforcement of the base
6	The first stage of the device of mo-nolite zhe-lezobeton rost-werks and diaphragms	 Scheme of the first stage of installation of monolithic reinforced concrete rostwerks and diaphragms: 1 – prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT; 5 – brown-injection piles of ERT strengthening of the base; 6 – monolithic reinforced concrete buttresses; 7 – monolithic reinforced concrete rostwerk
7	Development grunta to the department 83.0 m	 Scheme of soil development up to the mark 83.0: 1 – prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT; 5 – drill-injection piles of ERT reinforcement of the base; 6 – mono-cast reinforced concrete buttresses; 7 – monolithic zhele-so-concrete rostwerk
8	Completion of monolithic rein-forced concrete rostwerks and diaphragms	 Scheme of installation of monolithic reinforced concrete rostwerks and diaphragms at the final stage: 1 – prismatic reinforced concrete piles; 2 – existing monolithic corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT; 5 – drill-injection piles of ERT reinforcement of the base; 6 – mono-cast reinforced concrete buttresses; 7 – monolithic reinforced concrete rostwerk

9	Drainage device, filling the sinuses of a monolithic reinforced concrete corner retaining wall, site layout	 Scheme of the device of wall linear drainage, backfilling of the sinuses of the retaining wall and layout of the site: 1 – pris-mat reinforced concrete piles; 2 – existing mono-cast corner reinforced concrete rostwerk; 3, 4 – ground anchors ERT; 5 – drill injection piles of ERT strengthening of the backbone; 6 – monolithic reinforced concrete buttresses; 7 – mono-cast reinforced concrete rostwerk; 8 – wall-mounted linear drainage

Findings

1. The approach of adapting the existing restraint structure using ERT drill piles, ERT ground anchors and monolithic reinforced concrete buttresses considered in the article to create a completely new retaining fastening retaining wall.

2. The newly designed and erected retaining wall made it possible to ensure the stability of the overloaded base and created conditions for safe work.

Acknowledgement

None.

Conflict of Interest

No conflict of interest.

References

1. Ilyichev VA, Mangushev RA, Nikiforova NS (2012) Experience of mastering the underground space of russian megalopolises Osnovy, foundations and mechanics of soils, 2: 17–20.
2. Ulickij VM, Shashkin AG, Shashkin KG (2010) Geotechnical Support of Urban Development. Saint Petersburg: Georeconstruction, p. 551.
3. Ilichev VA, Konovalov PA, Nikiforova NS, Bulgakov LA (2004) Deformations of the Retaining Structures Upon Deep Excavations in Moscow. Proc. Of Fifth Int. Conf on Case Histories in Geotechnical Engineering, April 3–17. New York, USA, pp. 5–24.
4. Ilichev VA, Nikiforova NS, Koreneva EB (2007) Computing the evaluation of deformations of the buildings located near deep foundation tranches. Proc. of the XVIth European conf. on soil mechanics and geotechnical engineering. Madrid, Spain, Geo-technical Engineering in urban Environments 2: 581–585.
5. Nikiforova NS, Vnukov DA (2011) Geotechnical cut-off diaphragms for built-up area protection in urban underground development. The pros, of the 7thI nt. Symp. Geotechnical aspects of underground construction in soft ground, tc28 IS Roma, 57NIK.
6. Nikiforova NS, Vnukov DA (2004) The use of cut off of different types as a protection measure for existing buildings at the nearby underground pipeline's installation. Proc. of Int. Geotech. Conf. dedicated to the Year of Russia in Kazakhstan. Almaty, Kazakhstan, pp. 338–342.
7. Petrukhin VP, Shuljatjev OA, Mozgacheva OA (2003) Effect of geotechnical work on settlement of surrounding buildings at underground construction. Proceedings of the 13th European Conference on Soil Mechanics and Geotechnical Engineering. Prague.
8. Sokolov NS (2018) Ground Ancher Produced by Electrical Discharge Technology, as Reinforced Concrete Structure. Key Engineering Materials. pp. 76–81.
9. Sokolov NS (2018) Use of the Piles of Effective Type in Geotechnical Construction. Key Engineering Materials, pp. 70–74.