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CASE HISTORY

Rev: 03, Issue date: July 22, 2020

GROSS FIELD DEVELOPMENT

REPUBLIC OF SAKHA, YAKUTIA, OLEKMINSKY ULUS

RETAINING WALLS & SOIL REINFORCEMENT

Products: Terramesh® System, ParaGrid®, ParaLink®, gabions, Reno mattresses®

Site Description:

Gross Mining and Processing Plant (MPP) is the new main gold mining facility of Nordgold in Russia. The mine commissioning in 2018 confirmed the Nordgold status as the industry leading constructor of state-of-the-art gold mines.

The MPP was built in the southwestern part of the Republic of Sakha (Yakutia), 125 km northeast of the Ikabya BAM station. For the field gold extraction the open pit is constructed.

The ores and rocks are drilled and blasted for excavation. BelAZ dump trucks transport the ore to crushing and dresser facility, overburden is transported to external dumps and for road filling.

Ore is processed using heap leaching: After ore stacking in an ore stack, it is irrigated with leaching solutions. At the final stage, the final product is obtained from precipitated gold and silver – base bullion (Dore alloy).

View of Gross MPP pit

Assembly of gabion structures on site

Laying of stones to face blocks of Terramesh® system

Client:

NORDGOLD COMPANY

General Designer:

SPB - GIPROSHAHT LLC

Designer:

MACCAFERRI GABIONS CIS LLC

Contractor:

NERYUNGRI - METALLIC LLC

Applied products:

TERRAMESH® SYSTEM 3 x 2 x 1 – 800 PCS.
3 x 2 x 0.5 – 560 PCS.
GABIONS 2 x 1 x 1 – 56 PCS.
RENO MATTRESSES® 6 x 2 x 0.3 – 43 PCS.
PARALINK® GEOGRID 400 – 35,775 M^2
PARAGRID® GEOGRID 200 – 27,066 M^2

Construction period:

START OF CONSTRUCTION – MARCH 2018
END OF CONSTRUCTION – OCTOBER 2018

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Gold reserves of the Gross field are estimated at 4.4 million ounces with grade of ore 0.72 g/t. The planned life of the MPP is until 2035.

Problem:
One of the main stages of ore preparation is its processing at crushing and dresser facility.

To ensure the access of heavy dump trucks to the ore discharge zone of Gross MPP coarse crushing facility, taking into account the site geomorphology, it was necessary to install high retaining walls adjacent to the crushing facility.

The main issue complicating the wall construction was the harsh local climate. The local climate is characterized by large annual fluctuations in air temperature. In December – January the temperature drop to –55 °C. The winter season is 7 months. Such conditions determine a short construction season.

The infrastructure of the region is poorly developed, the facility is located in remote areas. The nearest railway is BAM, with the stations of Hani and Ikabya, located 80 km south of the MPP.

So it was impossible to use reinforced concrete for this project. Low temperatures would negatively impact building materials, and poor transport accessibility and a short construction season would only increase construction costs and delay time.

Commencement of construction on site

Construction of retaining wall at Gross MPP

Terramesh® reinforced ground system near coarse crushing building at MPP. Construction of wall 2 top tier

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Solution

The climatic conditions of the region, technological and construction requirements were taken into account to design the retaining walls of Gross MPP coarse crushing facility and develop the main structural concept.

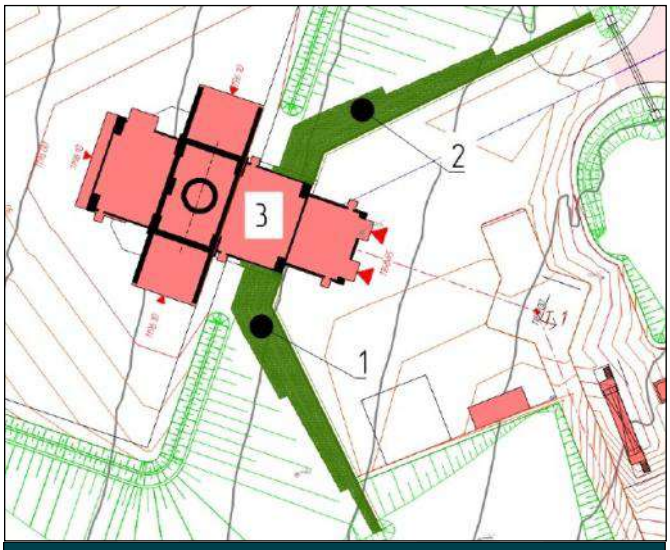
Specialists of the general design organization LLC SPb - Giproshakht in cooperation with the designers of MACCAFERRI GABIONS CIS, LLC, developed the retaining walls design using the Terramesh® soil reinforcement system.

This system was selected basing on its following advantages:

- Economic efficiency of Terramesh® soil reinforcement system is 20% or higher versus the traditional reinforced concrete retaining walls and sheet piling, depending on the height and length of a structure;
- Local rock material was used for the construction;
- Installation of the system is simple and quick, because does not require skilled labor and heavy equipment;
- The wall can be constructed at low temperatures using dry masonry;
- The wall can be erected in confined area;
- The technology allows to reduce the construction time up to 3 times;
- Walls built using the Terramesh® technology have high bearing capacity and are durable;
- The wall is able to accommodate local deformations without compromising its reliability and durability.

The structural concept of Gross MPP reinforced soil retaining wall includes the following elements:

- Terramesh® system;
- Reno mattresses®;



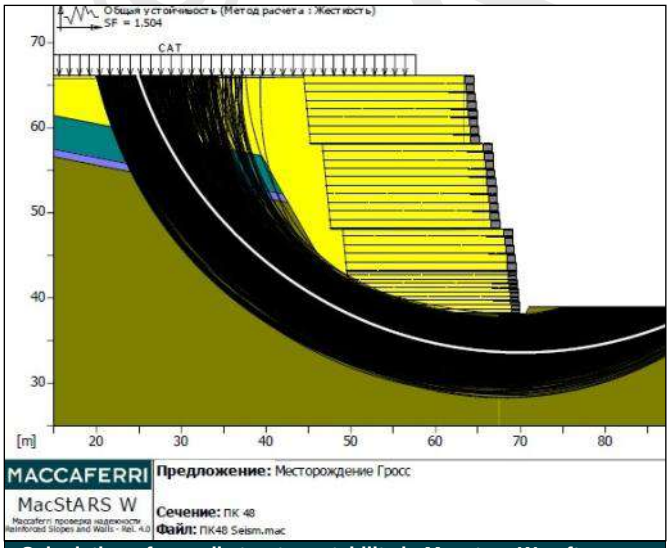
Designed layout of facilities, where 1 – retaining wall No. 1, 2 – retaining wall No. 2, 3 – crushing building.

- Geosynthetic grids ParaGrid® and ParaLink®;
- Rock material for gabion structures filling;
- Backfill soil.

The criticality rating of the designed structure was adopted as – ELEVATED. The design height of the reinforced soil retaining wall was 28 m.

Maccaferri technical experts performed reliability assessment using two certified software systems – MacStars W4 and Plaxis 2D. The first SW was used to analyze the structure reliability, the second one – to assess the overall reliability of the structure and deformations.

Soil reinforcement retaining walls near the crushing facility form so-called "wing walls". Retaining wall No. 1 adjoins the crushing facility to the south. Its length is 48 m, and its height varies from 6 to 28 m. The retaining wall No. 2 adjoins the crusher to the north. Its length is 57 m, and the height also varies from 6 to 28 m.



Calculation of overall structure stability in Macstars W software

General view of reinforced ground retaining wall at Gross MPP

The retaining walls were installed in two stages:

- In March – April, the gabion structures were manually assembled. The structures were assembled in heated shed to prevent damage to the polymer coating of the wire mesh under physical stress and freezing temperatures. In the same period, the foundation was prepared for retaining walls.

- From May to September, the Terramesh® system was installed near coarse crushing facility. All gabion structures were filled with local rock material produced at site using drilling and blasting. As a backfill soil, a local, incoherent soil was used.

High strength ParaLink® and ParaGrid® geogrids were supplied to the construction site during autumn-winter and stored outdoors. The geogrids performance and mechanical properties did not deteriorate at low temperatures.

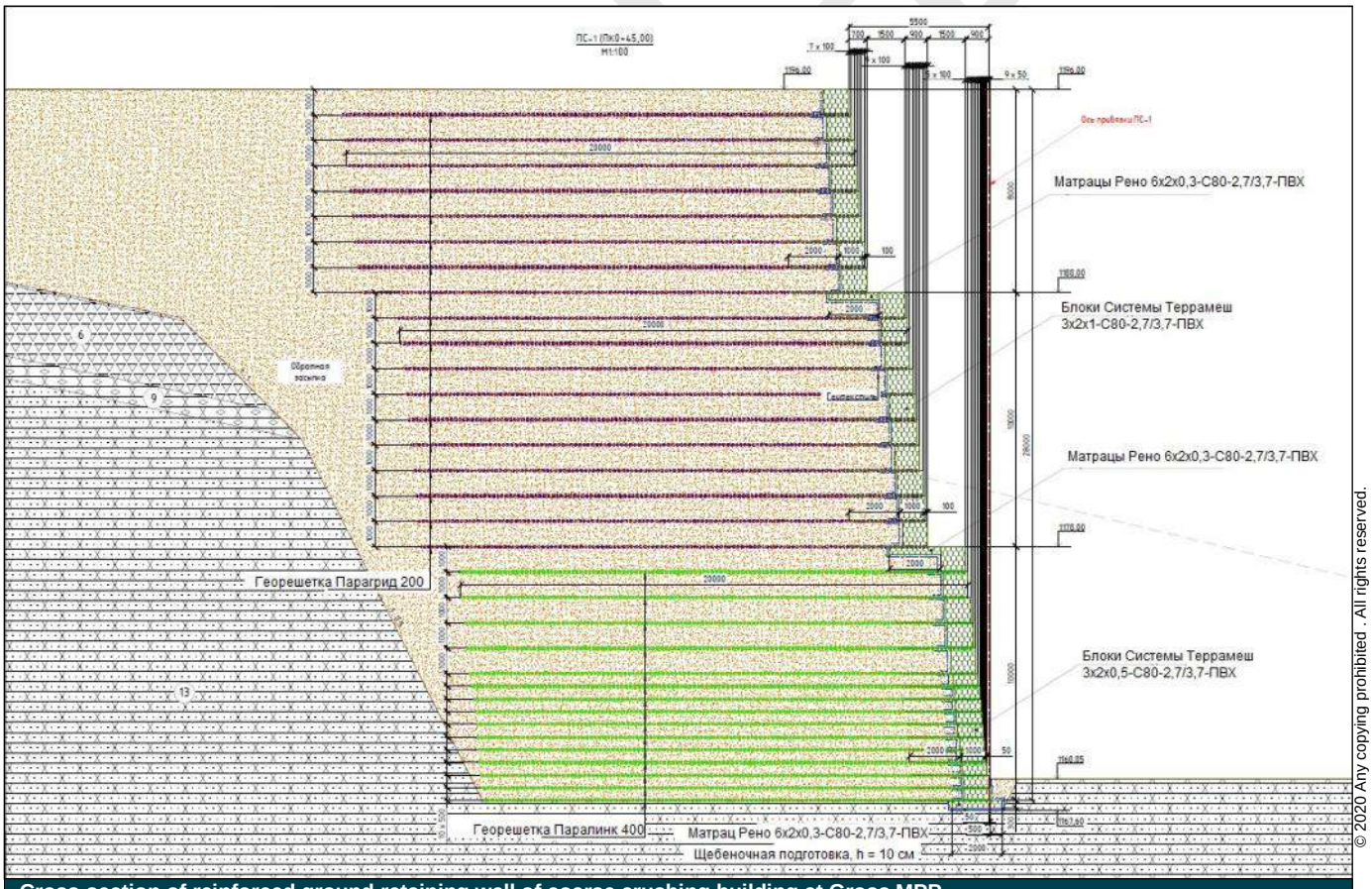
The finished structure is twenty-eight-meter embankment with soil reinforcement consisting of three layers (lower layer – 10 m, middle one – 10 m and upper one – 8 m) and divided in height by two intermediate berms with 1.5 m width.

The embankment layers were reinforced with ParaLink® 400 and ParaGrid® 200 geogrid having corresponding strength performances. For ParaLink® 400 geogrid reinforcement vertical pace was 0.5 m, for ParaGrid® 200 geogrid – 1 m.

The reinforcement length (L) was 12 m for retaining wall up to 10 m height (H), L= 18 m with H ≤ 20 m, L= 20 m with H > 20 m.

The embankments reinforced with high-strength ParaLink® and ParaGrid® geogrids support heavy loaded BelAZ and Komatsu mining dump trucks up to 330 tons.

The local materials were used to construct the Terramesh® soil reinforcement system for coarse crushing facility access road. It triply accelerated the construction rate and reduced construction cost.



Cross-section of reinforced ground retaining wall of coarse crushing building at Gross MPP

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