

GROUND IMPROVEMENT USING PRE-FABRICATED VERTICAL DRAIN ALONG WITH TRIPURA, NORTHEAST, INDIA

Basal Reinforcement

Problem

Agartala- Akhaura rail project is proposed to help increase railway connectivity between the two countries (India and Bangladesh). The Agartala Akhaura rail project was conceptualized in 2010. Later, India and Bangladesh signed a Memorandum of Understanding (MoU) on a couple of issues including the rail project in 2013. The 15.054 km long rail project in west Tripura district proposed to be constructed. It connects Akhaura in Bangladesh with Tripura's capital Agartala through Nischintapur in the Indo-Bangla border.

The railway track with embankment at different location is proposed. From chainage Ch 3+900 to Ch 5+100, the foundation stratum was found very weak soft clayey soils with maximum percentage of decomposed wood and which extends up to greater depth. Sand is not easily available as drainage layer. The bearing capacity of such soil is very low and settlement would be excessive. Hence, IRCON approached M/s Maccaferri Environmental Solutions Pvt. Ltd. to carry out the design for the ground improvement from Ch 3+900 to Ch 5+100.

Solution

Considering the extremely challenging site situation in terms of weak, compressible foundation strata, Maccaferri suggested the pre-fabricated vertical drain MacDrain V (PVD) with basal reinforcement ParaLink (BBA certified high strength uniaxial geogrid) as the ground improvement solution. The prefabricated vertical drain and basal reinforcement were provided as per IS15428 part II and IRC 113.

In order to study the performance of compressible soils under reclaimed fill, geotechnical instruments like piezometers and settlement gauges were installed.

Along with prefabricated vertical drains MacDrain V, the preloading of 6-9m was constructed for accelerated consolidation of soft soil. The preloading period was of 4 months to achieve appx 90% consolidation. A layer of ParaLink was laid for rotational stability and load distribution. Layer of MacDrain was used replacing conventional drainage layer of sand/gravel.

Client: Ircon International Limited

Designer / Consultant: NIT Agartala

Contractor: Nayak and Triveni

Products used (Qty.)

- ParaLink 1.3 lakhs sqm
- MacDrain W 5000 sqm
- MacDrain V 50,000 m

Date of construction: 07/2019 - 12/1969



MacDrain V (PVD) installation



MacDrain V installation



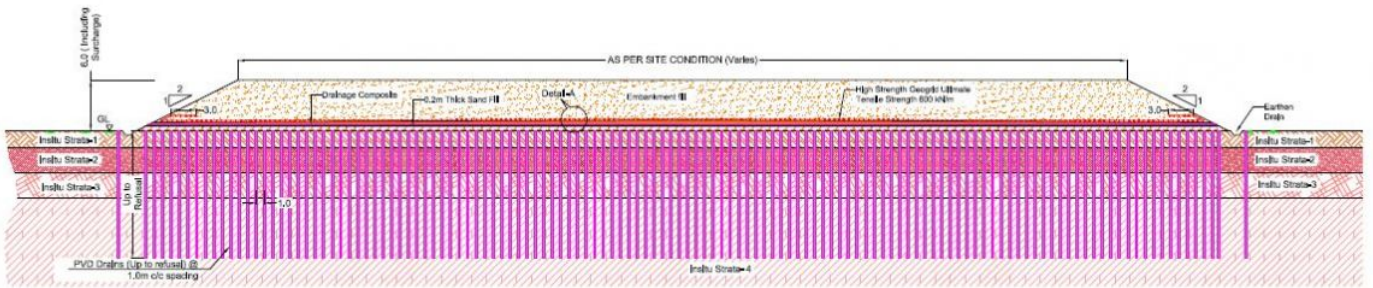
Laying of MacDrain V as drainage layer



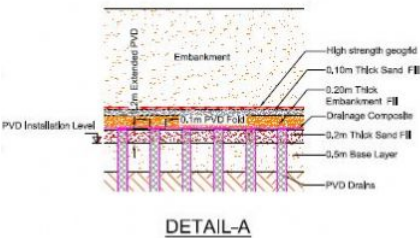
Surface drain arrangement



Laying of Paralink as basal reinforcement



CROSS SECTION FOR GROUND IMPROVEMENT FOR RAILWAY TRACK (CH-04+400 to CH 4+700 KM)



DETAIL-A

NOTES:

General

1. All Dimensions are in meters unless otherwise specified.

Material Specifications

- High strength geogrid is a geogrid manufactured from high tenacity polyester yarns.
- High strength geogrid at the foundation level (i.e. as shown in figure) could enhance the performance of Railway embankment as it resists the shear failure in the soft soil. It reduces the differential settlement by distributing the stress uniformly over the soft strata.
- Pre-fabricated vertical drain (PVD) is of 7 KN/m wide width tensile strength in machine direction (for material) and 2.5 KN/m tensile strength (in material), having 100mm width and 4mm thickness with all leads and lifts, manpower and machinery.
- Drainage Composite is a Geocomposite for planar drainage (GCC) realized by thermobonding a draining core in articulated macrolements (GMA) with two filtering nonwoven geotextiles, draining three dimensional core with W configuration as longitudinal parallel channels.

Construction:

- Foundation strata to be inspected and verified by the engineer in charge and further work to start only after their approval.
- Foundation shall be excavated to level indicated in the drawing.
- The sand having high density and fitness modulus ranging between 1.6 to 1.8, increases effective utilization of High strength geogrid reinforcement.
- The Drainage Composite shall be provide for proper drainage of water.
- The PVD Drains should be installed (As shown in the drawing).
- Surface on which High strength geogrid is to be placed should be free of debris and inordinate irregularities.

Design Considerations**

1. Strata properties

STRATA	C (kN/m ²) Cohesion	φ (Degree) Friction Angle	γ (kN/m ³) Unit Weight
BAND FILL	0	30	19

2. Embankment fill properties have been considered based on Test Report of Borrowpit having Reference No. NG/04/19-20 Dated: 16.10.2019. Issue date: 02.11.2019 of JOB No. NEST/20/19/2703(A).

3. In Situ Strata Properties have been considered in the design as per Soil Investigation Report received from IRCON Reference No. IRCON/2055/ANR/PL/Geo tech Invest for PVD/S/08 Dated: 12.04.2016.

4. Load combinations considered for the Design are:
A) Static Load + Railway load
B) Setback Load + Railway load

108 KPa has been considered as railway load.

** The design is based on the typical characteristics of the materials manufactured by the Maccaferri group & above mentioned parameters. Its result will not be valid if a different material is used. Any violation of above mentioned design parameters at site shall result in change of design & same should be intimated to Engineer-in-charge.

Schematic diagram of the solution provided

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