CASE HISTORY

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SPENT POT LINING (SPL) STORAGE BUILDING

AT EMIRATES ALUMINIUM (EMAL), KIZAD, ABU DHABI, UAE

GROUND IMPROVEMENT BY HIGH STRENGTH GEOGRIDS

Product: ParaLink 300™

Problem:

The proposed warehouse building (175m x 45m), is a combined RCC-Steel structure aimed at storing the SPL materials. The foundation soil had bearing capacity and settlement issues due to the presence of a 2m thick loose soil deposits characterized by a very low SPT N-value (<4).

The calculated settlement was 70mm, the acceptable value being 50mm. For this reason, the soil consultant recommended ground improvement with stone columns for the entire footprint area of the building .

However the recommended solution was not feasible for the main contractor (M/s. Amana) due to financial & construction time reasons. In the tender, the main contractor budgeted with 'slab on grade' and the periphery footings on piles. Consideration of stone columns for the floor location exceeds the budget and construction time (8 months in total).

Design Background:

Ground stabilization by High Strength Geogrid is a simple, economical & quick method of ground stabilization and is designed following the BCR (Bearing Capacity Ratio) Method for use of geosythetics for ground improvement below rectangular loaded areas. Once the depth of geogrid reinforced mat foundation below the slab is determined, next step is to design the geogrid layer in terms of strength requirements, allowable strain, its vertical position, number of layers, etc. The contributions from the following mechanisms are considered in the geogrid designs:

Lateral confinement: This results in increase of elastic modulus of foundation ground and hence its stiffness. This will eventually result in decrease of loads on the weak foundation soil.
Load Distribution: The effect of increased load distribution below foundation will result in reduced settlements & deformations.
Tensioned Membrane Effect: This effect results in an upward vertical force that decreases the stresses applied to the weak foundation soil.

Client:
Emirates Global Aluminium (EGA)

Main contractor:
Amana Contracting & Steel Buildings - UAE

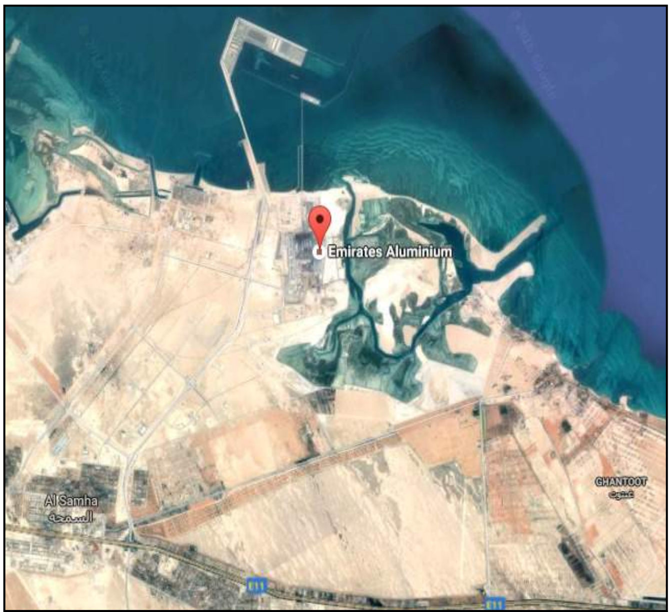
Consultant:
Tebodin Middle East

Designer:
Maccaferri Middle East LLC

Products used
ParaLink 300™

ParaLink Installation Works:

Start Date:	25-Aug-2016
Completion Date:	08-Sep-2016



Google Earth Location of Project Site

Solution:

Maccaferri was invited by the client & consultant to give an alternative solution of ground improvement. Upon review of the available geotechnical reports, an analytical ground profile was created by our geotechnical engineers. Various options of ground stabilization were checked by our technical team and finally a ground stabilization by high strength geogrids (PARALINK®300) was Maccaferri's recommenda-

Design Section & Improved Parameters:

Based on the two approaches of design namely BCR method & geogrid design, the ground improvement scheme was finalized with a layer of cross laid PARALINK 300 high strength geogrid at a depth of 0.6m below the bottom of 'slab on grade'.

With a 0.6m thick Paralink Reinforced Mat Foundation below the slab on grade, the bearing load from slab is reduced (due to better load distribution) that eventually reduces the settlement to the permissible limit of 50mm (see table for details). Settlement below the slab-on-grade was calculated by Schmertmann and Hartman (1978) Method.

Cases	Contact pressure in weak soil (KPa)	Total Settlement (mm)*
Without Stabilization	86	70
When Stabilized by High Strength Geosynthetics	64	48
* Permissible total settlement was 50mm		

Reduced Contact Pressure & Foundation Settlement

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Liquefaction Analysis:

In addition to above mentioned design checks and calculations, Liquefaction analysis were also done, as requested by the consultant due to loose soil deposits and shallow water table within the building location.

Seed-Idriss method of liquefaction analysis was followed which is most widely used worldwide & is based on Standard Penetration Test (SPT) results.

Factor Of Safety (FOS) against liquefaction were calculated from the following equation. The minimum required factor of safety against liquefaction triggering is 1.0.

$$\mathbf{FOS = CRR_{M=Given\ M} / CSR}$$

CRR = Cyclic Resistance Ratio (CRR)

CSR = Cyclic Stress Ratio

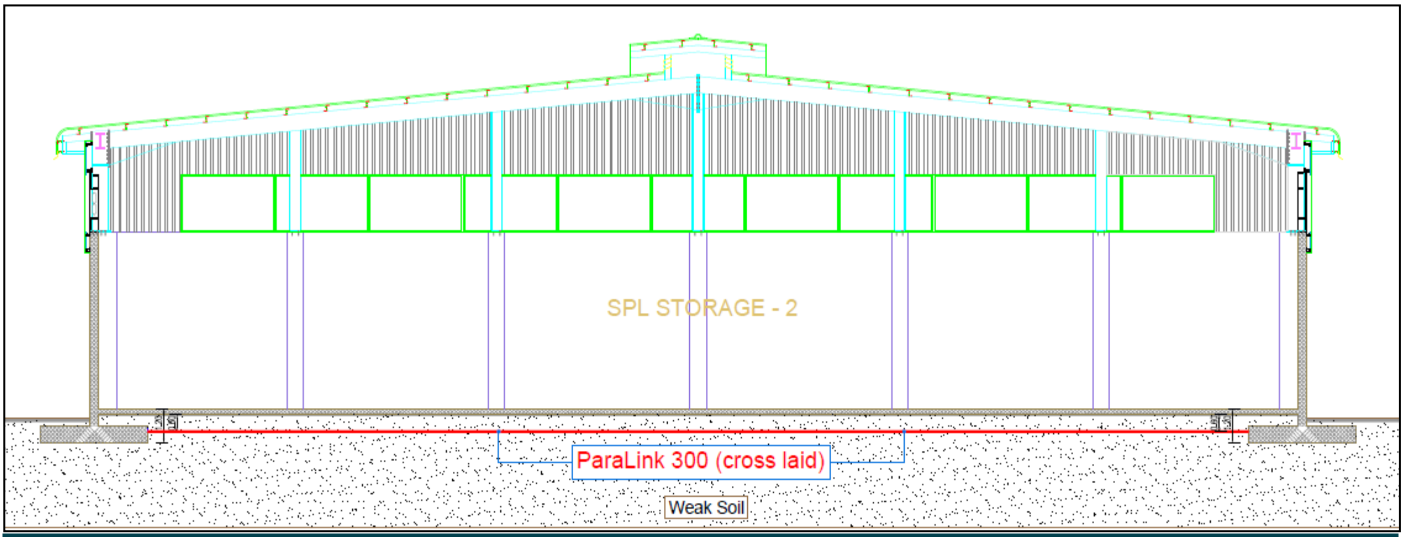
Depth (m) below EGL	FOS Against Liquefaction (a_{max}=0.15g, M_w=6.0)		Conclusion
	BH-2	BH-3	
1	5.91	5.91	**Soil will NOT liquefy** in the event of the given Earthquake as **all FOS>1.0**
2	5.62	5.62	
3	10.50	10.50	
4	4.45	4.77	
5	1.19	1.18	
6	1.11	1.68	
7	3.39	3.36	
8	3.07	3.06	
9	2.94	4.57	
10	7.25	5.60	
11	6.92	6.86	

Cost-Time Comparison:

A real-time construction cost & time comparison of Maccaferri's Ground Stabilization were made by the main contractor, with the initially recommended stone column solution & is given in the table to the right.

The comparison table clearly shows that Maccaferri's solution is much cheaper & fast when compared to other solution initially considered by the client.

Ground Improvement Methods	Stone Columns	Maccaferri's Solution
		By High Strength Geogrid (PARALINK 300)
Cost (USD)	590,625 (4.6 times Higher)	127,350 (22% of Stone Column)
Time	45 - 50 Days	10 - 12 Days



Section Drawing

Building Under Construction (Outside View)

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Installation Process of PARALINK®300

Paralink Installation & Slab On Grade Construction Concrete Works

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