

**SALALAH LPG EXTRACTION PROJECT**  
**SALALAH, SALALAH, OMAN**

**BASAL REINFORCEMENT**

**Problem**

In 2017, 'Petrofac Onshore Engineering & Construction' secured the contract with 'Salalah LPG SFZCO LLC' to undertake the engineering, procurement, and construction of its Salalah LPG extraction project in the southern part of Oman. Under the terms of the 36-month duration EPC contract, the scope consists of the construction of the liquefied petroleum gas (LPG) unit and associated facilities, including tie-ins to existing pipeline infrastructure, together with LPG storage and jetty facilities at the Port of Salalah. The storage facilities in the project involved construction of two large tanks that will store butane and propane. The cryogenic double-walled circular tanks will be of height 43m and diameter 40m, constructed on a 1.5m thick concrete raft foundation of diameter 45m. Considering the existing soil conditions at the project site, the calculated settlement due to the final load of 450KPa (below the concrete raft foundation) will be 171mm which exceeds the allowable limit of 150mm. This scenario necessitated the adoption of suitable ground improvement techniques below the foundation of the two tanks to Limit the settlements.

**Solution**

Since conventional ground improvement techniques like stone columns, deep replacement etc will be time consuming and expensive, the EPC contractor approached Maccaferri to propose an alternate geosynthetic solution. After studying the geotechnical reports, Maccaferri proposed a 1.5m thick and 50m wide geogrid raft below the concrete foundation of the tanks. Considering a 45-degree dispersion of the loads through geogrid raft, the initial load of 450KPa reduces to 396KPa before transferring to the natural soil. The resulting settlement with the reduced 396KPa was 149mm which is within the acceptable limit of 150mm. The 1.5m thick geogrid raft consisted of 3 layers of high strength geogrid type ParaLink, at a vertical spacing of 0.5m. The bottom layer of geogrid required 300KN/m strength while 200KN/m was enough for the top two layers. The installation and backfilling of geogrid works were completed within two weeks, saving time and money for the EPC contractor. Maccaferri was involved in design, supply and site assistance of the project.

**Client:** Salalah LPG SFZCO LLC (SLPG)

**Designer / Consultant:** Petrofac Onshore Engineering & Construction

**Contractor:** Petrofac Onshore Engineering & Construction

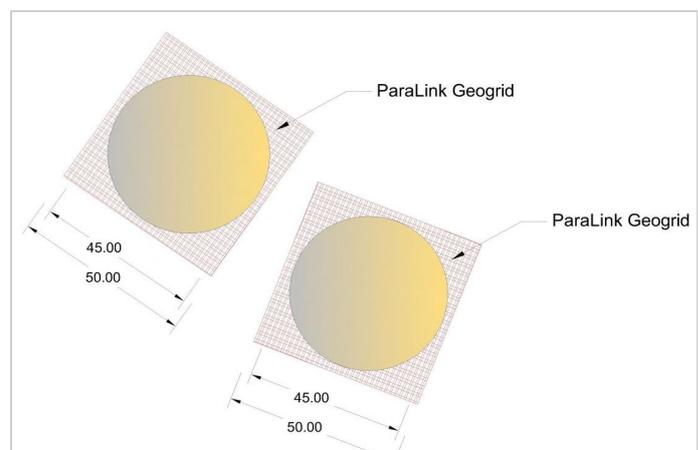
**Products used (Qty.)**

- ParaLink 33,000 m2

**Date of construction:** 01/2017 - 12/2019



Sectional detail of tank, concrete foundation and ParaLink geogrid raft



Plan view of tank foundation and extend of underlying geogrid raft layer



During construction: high strength Paralink geogrid laying in progress



During construction: backfilling in progress



During construction: concrete tank foundation in progress



During construction: tank installation in progress



Completed tanks on ground stabilized with Paralink high strength geogrid layers