

# QATAR GAS II LNG T4 & T5

## RAS LAFFAN – QATAR

### DYNAMIC REPLACEMENT

Category: Industrial / Infrastructure / Tanks  
 Developer: Qatar Gas  
 Engineer: Chiyoda Technip JV  
 Contractor: Vinci  
 Area / Quantity: 10,000 m<sup>2</sup>



#### PROJECT DESCRIPTION

As the biggest gas field in the world is in the marine territories of Qatar it is no surprise that the industrial region of Ras Laffan, located 70 km north of Doha, is rapidly becoming the hub of world LNG.

In this respect a number of LNG tanks were under construction, including LNG T4 and T5.

The capacity of both tank was 140,000 m<sup>3</sup>. The outer tank's inner diameter was 76.3 m, and the inner tank's height was 35 m. Maximum LNG height was 34 m.

#### SOIL CONDITION / GEOTECHNICAL PROBLEM

##### **Project soil profile:**

According to the geotechnical investigation data, the soil profile under the Tank T4 and T5 could be summarized in the table 1 below:

Layer	Elevation (m)	
	Top	Bottom
Upper soil above GWT	+2.1	0.0
Upper soil below GWT	0.0	-2.2
Weathered limestone	-2.2	-4.0
Upper limestone	-4.0	-9.5
Lower limestone	-9.5	-15.5
Weak Limestone	-15.5	-18.5
Calcareous siltstone	-18.5	-65.5
Calcareous sandstone	-65.5	-140

Cavities have been encountered in the siltstone layer between elevation -18.5 QNHD and -23.5 QNHD. The thickness of the upper soil layer was 4.2m in average and the Existing Ground Level (E.G.L.) was in the range of +2.1m QNHD.

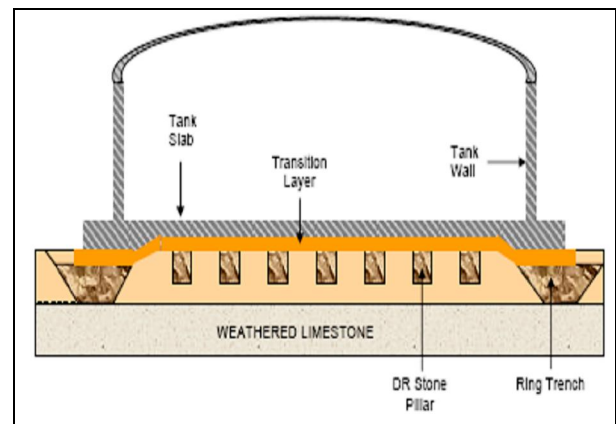
The use of the concrete foundation directly lying on the original soil was not recommendable as the upper loose sand layer in particular would have been subject to:

- excessive settlement amplitude, which may be damageable to the structure.
- Bearing capacity limitations.

#### MENARD SOLUTION

Menard developed a unique solution that combined a shear trench ring under the wall and dynamic replacement within the tank.

In this process, the soil in the ring area was replaced by stones and dynamically compacted. Stones were also dynamically driven into the ground within the tank's boundaries.



**Principle of Menard Solution**

Soil improvement was carried out as per the design and construction drawings.

#### QUALITY CONTROL

Pressuremeter tests were carried out to provide calculation parameters. Elasto plastic Finite element analyses for different cases were able to prove that the project requirements were fully satisfied.

In addition, a number of plate load tests were also performed.

Ultimately, the tank's hydrotest loading proved that in reality the settlements were even better than the calculations and in the range of 20 mm.