Geogrid Stabilized Working Platform for Ringer Crane in Southern US

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This project involved the design and construction of a geogrid stabilized working platform for use with a ringer crane to construct a petrochemical facility in the southern US. Work on the geogrid stabilized platform began in 2016 and was completed in 2017. The Mammoet PTC-200 DS ringer crane was configured with a maximum bearing pressure of 4,000 psf (192 kPa) and rated as the 3rd largest in the world. The working platform needed to accommodate a load spreader ring having outside and inside diameters of 184 ft and 109 ft (53 m and 33.2 m), respectively. A 100-ft (30.5-m) deep boring exhibited predominantly fat clays that were oftentimes slickensided, the occasional presence of sandy silt lenses and pockets, and a ground water table varying between 4 to 6 ft (1219 to 1829 mm) below existing grade. Original plans for the crane bearing pad were to construct a deep foundation system composed of 200 18-in (457-mm) square concrete piles driven to a depth of 65 ft (19.8 m) and with a 200-ft (61-m) diameter concrete pile cap to provide support for the crane operation. Project engineers and contractors teamed with Tensar International for developing an alternative foundation system to improve allowable bearing capacity of the soil and to decrease potential settlement while ultimately being less expensive than the concrete deep foundation system. To this end, a geogrid mechanically stabilized working platform 6 ft (1829 mm) thick was designed and constructed to provide support for the ringer crane operation. The platform consisted of five layers of multi-axial hexagonal geogrid with triangular apertures 1.6 x 1.6 x 1.6 in. (40 x 40 x 40 mm) and crushed angular graded aggregate fill classified as a road base material. A leveling base layer of sand 4-in. (100-mm) thick was placed between the uppermost stone layer and the load spreaders for the crane. This leveling base layer acted as a pontoon cushion and was wrapped in a geotextile to prevent any possible washout. Additionally, the working platform had a drainage system incorporated with the sand bed to prevent ponding of rainwater within the footprint. The approximate extents of the crane platform were 205 ft (62.5 m).

Aside from the less than desirable soil conditions and water table elevation, the major challenge in the platform design for operation of the ringer crane was to satisfy very stringent criteria for allowable total and differential settlement. Although total settlement was of some concern, differential settlement was critical for successful ringer crane operation. Notwithstanding a maximum allowable total settlement of 9 in (228 mm), differential settlement across the ringer diameter must not exceed 2.2 in (56 mm) over the 184-ft (56-m) diameter. The working platform design was based on analyses of a pseudo rectangular section 38 ft x 80 ft (11583 mm x 24384 mm) representing the load spreader annulus area at four different locations; center, corner, midpoint of short side, and midpoint of long side of the rectangular section. Using various settlement methodologies and analyses, estimated maximum total settlement was in the range of 2 to 4.5 in (51 to 114 mm) and the largest deformation corresponded to the center location on the annulus. Estimated maximum differential settlement comparing the center of the annulus to the corner of the annulus, ranged less than 2 in (51 mm).

The ringer crane pad was installed on time and on budget in spite of numerous construction delays due to heavy seasonal rains. The success of the ringer crane geogrid stabilized platform was further demonstrated when the working platform withstood Hurricane Harvey in August 2017 without damage and the crane operation resumed the day after the storm had passed. Operation of the crane during a massive lift is illustrated in Figure 1. Estimated total cost savings of $3.1 million included completing the project 32 days ahead of schedule and thereby not requiring multiple crane rentals, and reusing the working platform crushed stone at other site locations compared to a concrete pad alternative. A testimonial by the crane engineers summed up the geogrid stabilized working platform performance as undergoing zero settlement issues and the best pad they have ever had under one of their PTC cranes … and has set the gold standard for future crane pad designs.

Figure 1. Third largest ringer crane in the world operating on a multi-axial geogrid stabilized working platform in the US

The primary reason for the success of this project can be attributed to a combination of the following factors: direct timely involvement of the project engineering and consulting team members to explore an alternative design solution, timely requests for design and analyses assistance from specialized engineers with expertise in geogrid stabilized platforms, and the willingness of the owner and their geotechnical engineers to consider an alternative design solution.

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