

# **A MECHANIZED ANCHORAGE SYSTEM FOR QUICK DEPLOYMENT STRUCTURES**

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Research was conducted for the development and evaluation of an alternative ground anchorage system for US Army quick deployment structures. The following criteria were required: mechanized anchor installation with manual backup, ability to anchor TEMPER structures with internal pressure of 2.6 psf (124.5 Pa) in 65 mph (29.1 m/s) winds, functionality in all expected deployment soil types, and the anchors must be mechanically simple, retrievable and reusable to minimize cost and facilitate easy shipping and handling.

An extensive literature survey was carried out, leading to the review and presentation of analysis methods and test results. Based on this review, capacity evaluation curves for different anchor types in different soils were developed. Comparisons of the reviewed measured laboratory and field capacities to the estimated capacities were carried out in order to establish the applicability and accuracy of the existing analysis methods.

Structural analyses of the TEMPER structure were performed to establish anchor load requirements under various wind velocities and loading combinations. Based on the comparative study and the structural analysis, a medium-pitch helix anchor was chosen as the primary anchor type. The helix size was based on the relations between installation torque's and ultimate capacity. The concept of the proposed anchorage system is a common shaft with three interchangeable anchor heads to permit anchorage in all soil types. The tips include a stake tip for hard soils, single-helix anchor tips for loose to dense and soft to stiff soils, and an expansion tip for anchoring in cemented and/or very dense and stiff soils, and rock. Full-size prototypes of the proposed anchorage system were designed and fabricated.

A reaction frame for multidirectional load application during testing along with soil containers and a pluviation device for uniform sample preparation were designed and fabricated. Systems for measuring multidirectional in-plane anchor displacements during testing were developed and evaluated.

Laboratory and field testing of existing US Army stakes and the proposed system were performed and analyzed. The testing program confirmed the superiority of the proposed system over the existing stakes. It showed that the helix anchors mobilize the required capacities with minimal anchor displacement and they maintained a significant post-peak capacity. Installation torque's required for the developed helix anchors are such that manual installation is possible, even in dense soils. The testing demonstrated that due to their different resistance mechanisms, the stake anchors require large displacements in order

to mobilize their ultimate capacities, followed by a low post-peak resistance.

The developed system provides the US Army with a simple and efficient anchorage system enabling the installation of large numbers of anchors with improved capacities, thereby meeting the given requirements.