

## HELIPORT22 – Helical Steel Piles – A sustainable solution for lightweight & reusable foundations

### Summary

In recent years, the use of helical steel piles (HSP) has seen a resurgence around the world and they have proven themselves to be economical and practical competitors to other foundation types, in a variety of applications. The HSP considered in this study are those comprising a small diameter shaft (< 100 mm) and helices with a diameter about 3 to 6 times the shaft diameter. This type of HSP is typically suitable for working loads less than about 500 kN, in both compression and/or tension, and have been used for highways signage, railway signalling, powerline and telecommunications towers, foundation underpinning to augment resistance, solar PV farms, and other lightweight structures [CLEM15]. What are not considered in this study are so-called high capacity HSP (also known as screw piles) that utilise larger shaft diameters (up to 1.5 m) and lower helix to shaft diameter ratios (from 1.2 to 3) which are commensurately costlier and require much higher capacity machinery (energy) to install.

In many cases, the uptake of this type of foundation solution has been hindered due a lack of familiarity with the technique and a lack of suitable guidance in terms of design and construction, in Europe in particular there are no HSP specific design rules. Compared to reinforced concrete foundations, helical steel piles present the advantage of being able to be extracted at the end of the structure's life and either re-used or recycled which enhances their environmental credentials. Other benefits of using HSP foundations include – the use of commonly available, non-specialist construction plant and flexibility for difficult to access sites.

This research proposal is built around an industry-academia partnership between CERIS (Instituto Superior Técnico) and the Portuguese SME, Hélica (www.helica.pt) and has the aim of contributing to the wider fundamental understanding of this

type of foundation and the development of a rational basis for the design of HSP based on Limit State and Sustainability principles, while also promoting the technique through the development of design guidance and demonstrating this through case studies supported by Life Cycle Analysis comparisons with other techniques. In brief, the project will involve:

- Field testing will be undertaken to examine critical aspects of HSP behaviour, with a focus on identifying operational resistance from soil characteristics measured both in situ and in the laboratory, considering the effect of the installation process on the resistance properties of the pile-soil system.
- Development of simple models of HSP load resistance and load-transfer response which will be integrated into an online design tool complying with Eurocodes and validated using the results of the field testing supplemented by a database of quality-controlled existing test results.
- Case studies will be developed for which Life Cycle Analysis (LCA) will be used to demonstrate the economic and environmental impact of HSP applications in comparison with alternative foundation solutions, and a simplified LCA tool (based on e.g. the EFC DFI Carbon counter tool) will be integrated into the online design tool.
- Dissemination through an international symposium on HSP that will be hosted by CERIS at Instituto Superior Técnico, two free evening events to promote the project and the technology locally, two workshops on design and construction of HSP for local construction professionals, and the creation of a website to host the design software and online training modules.



### Project Reference

2022.08947.PTDC

### Leading Institution

IST-ID – Associação do Instituto Superior Técnico para a Investigação e Desenvolvimento (Portugal)

### Partners

HELICA – Helica Ground Solutions, Lda. (Portugal)

### CERIS Principal Investigator

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### CERIS Research Team

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### Funding

FCT – Fundação para a Ciência e a Tecnologia

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2023-2026

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232 962.90€

### CERIS

202 331.65€

### Project Website

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