A FORECASTING TOOL FOR ANCHORED WIRE MESH BEHAVIOR UNDER OUT-OF-PLANE LOADS

Fabio Gabrieli[1], Maddalena Marchelli[2], Antonio Pol[3]

[1] ICEA dept, Univ. of Padova, via Ognissanti 39, 35129, Padova, Italy
[2] DIATI, Politecnico di Torino, Corso Duca degli Abruzzi 24, I-10129 Torino, Italy
[3] IATE, Univ. Montpellier, INRAE, Institut Agro, F-34060 Montpellier, France

OBJECTIVES

Across the globe, anchored wire meshes serve as key protective measures against rockfall hazards. Although their behavior is commonly investigated through standardized laboratory experiments (ISO 17746:2016, UNI 11437:2012), these tests rarely mirror real in-situ conditions. The goal of this work is to introduce a simple yet robust tool for evaluating the behavior of an anchored mesh panel under out-of-plane loading. The semi-empirical analytical framework is calibrated on discrete element method (DEM) simulations and laboratory punch tests, extending laboratory parameters to conditions representative of field applications. It provides an estimate of the full force–displacement curve, accounting for the influence of several variables. These include more realistic loading conditions (eccentricity and size of the punching element, inclination) and geometrical configurations (panel aspect ratio, plate size, and anchor pattern—diamond or square) [1,2]. On the one hand, the tool can be highly useful for practitioners, allowing performance evaluation under serviceability limits and ultimate conditions. In addition, by leveraging in-situ displacement measurements, the tool makes it possible to evaluate residual performance, estimate remaining service life, and plan maintenance or retrofitting interventions effectively. On the other hand, it may also serve as a starting point for academics interested in developing more refined design approaches.

MATERIALS AND METHODS

- Discrete elements simulation (DEM) are used to characterize the mechanical behavior of mesh panels.
- The DEM model is validated against experimental punch test data (ISO 17746, UNI 11437) and extended to represent idealized in-situ conditions.
- Analytical relationships describing the influence of key parameters on system response are derived from a comprehensive set of numerical simulations.

MAIN RESULTS AND CONCLUSIONS

- A forecasting tool has been developed to predict for the complete force-displacement curve of anchored wire mesh system in idealized in-situ conditions providing estimates of both the ultimate capacity of the system (ULS) and its performance in serviceability conditions (SLS).
- The tool enables practitioners to evaluate and compare various design configurations, considering both USL and SLS, supporting more efficient design decisions.
- By assessing displacement over time, the tool also offers insights into retrofitting needs and long-term performance, helping plan maintenance strategies and extend system service life.
- The tool is freely available online (https://geotechlab.dicea.unipd.it).

REFERENCES

[1] A. Pol, F. Gabrieli, L. Brezzi, (2021), Discrete element analysis of the punching behaviour of a secured drapery system: from laboratory characterization to idealized in situ conditions. *Acta Geotechnica*, *16*(8), 2553-2573

[2] M. Marchelli, A. Pol, D. Peila, F. Gabrieli, (2023), Towards a hybrid design approach of anchored drapery systems. *Geosciences*, *13*(5), 147.