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NUMERICAL STUDIES OF TELESCOPIC ADJUSTABLE PROPS

João André [1)], António M. Baptista[1)], Dinar Camotim[2)]

[1)] Laboratório Nacional de Engenharia Civil (LNEC)
Av. Brasil 101, 1700-066 Lisboa, Portugal
Research Trainee - jandre@lnec.pt
Senior Research Officer – ambaptista@lnec.pt

[2)] Departamento de Engenharia Civil e Arquitectura,
Instituto Superior Técnico (I.S.T.)
Av. Rovisco Pais, 1049-001 Lisboa, Portugal
Associate Professor - dcamotim@civil.ist.utl.pt

ABSTRACT

Telescopic adjustable props represent one of the most common temporary structural elements used in the construction, rehabilitation or retrofit of permanent structures, to support the formwork during construction, for example.

However, the design of these elements is frequently associated with high uncertainty levels, due to insufficient information about their real behaviour at the construction site – in particular, little information is available about the influence of geometric imperfections or load eccentricities on their resistance.

In the scope of this reality, a research project about adjustable telescopic props was developed at the Portuguese National Laboratory for Civil Engineering (LNEC), involving experimental and numerical studies, during which the structural response of these elements under axial load was characterized, and the most relevant parameters determining their strength capacity were identified.

The final goal of this study consisted on (i) a contribution for the increase of the available knowledge about the stability and structural resistance of adjustable telescopic props

under axial load, and (ii) to develop, calibrate and validate a buckling curve for the design of these elements, fulfilling a gap of the existing standardisation.

In Portugal, the most common telescopic adjustable props are made of steel, consisting in two slender tubes, with circular hollow sections of different diameters. The connection between these two tubes consists on a pin and a collar nut, by which one can control the extension length of the prop. Usually, the base plate of each tube is not mechanically connected to the foundation, working through friction and bearing action.

Props are subjected to different types of imperfections: (i) due to the play between the two tubes; (ii) geometrical imperfections of the tubes and the base plates, and (iii) load eccentricities.

The behaviour and resistance of telescopic adjustable props can be controlled either by the plasticity of the material or by second order effects, depending on their extension length, as well as by the resistance of the connection between the two tubes.

Moreover, props are reused several times, and in general they are not properly cared during their life cycle; it is relatively common to see reused props with important imperfections on their components.

These features constitute difficult challenges to the numerical study of these elements. This paper presents different approaches tested within the frame of this work to solve the problems found due to the inclusion of these conditioning factors in the numerical modelling of these structural elements. The advantages and disadvantages of each solution have been emphasized by means of the comparison between the numerical results and those obtained in a large series of experimental tests of telescopic props, carried on the frame of this research project.

First, the paper will describe the validation of different numeric models, including: (i) the selection of the finite element type, namely (i.1) the finite element order and (i.2) the finite element formulation; (ii) the selection of the finite element mesh configuration and density; (iii) the type of contact algorithm; and (iv) the influence of special numerical techniques in the results.

Then, the verification process will be presented, by comparing the numerical and the experimental results, and discussing of their differences.

Additionally, the numerical procedure proposed in the European Standard EN 1065:1998 (telescopic props product standard) to determine the strength of these structural members will be discussed.

Finally, the conclusions of this work will be presented.