Proposal of an interpolation function between the compressive and tensile meridians of failure and yielding concrete surfaces based on Bezier curves

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ABSTRACT

This paper is related with cohesive frictional materials like concrete. It is well known that the failure and mechanical behaviour of such materials depend on all the three invariants, and therefore yielding and failure surfaces involving a circular deviatoric shape, neglecting the incidence of the third invariant, cannot accurately represent the main features observed in triaxial experimental tests, particularly when low confinement levels and load scenarios leading to different Lode angles are considered. The relevance of considering the third invariant in concrete constitutive models has extensively been analyzed and discussed (a.o. Pivonka & Willam (2003)).

Several deviatoric shapes have been proposed in the literature. Most of them present a lack of smoothness and therefore, are not convenient for numerical implementations. Among the proposals considering a C1 continuity type, two approaches must be mentioned. On the one hand, the proposal by Ottosen (1977) and on the other hand, the elliptical interpolation proposed by Willam & Warnke (1974), both leading to a deviatoric shape similar to a triangle with rounded corners, with a good agreement with experimental triaxial test results. Nevertheless, the complexity involved in numerical approaches when one of the above mentioned deviatoric functions is considered, usually discourages it application, particularly in the case of non local continuum formulations like gradient based plasticity models and in multiscale approaches, enough complex even without considering a non circular deviatoric shape of the failure and yielding surfaces.

In this paper the suitability of Bezier curves to represent an appropriate deviatoric shape to be considered in the failure and yielding surfaces of concrete like materials is presented. A full derivation of a numerical approach aiming to substitute the elliptical approximation between the compressive and tensile meridians is reported. Finally, a critical discussion about the convenience or not of using these polynomials is addressed.

REFERENCES

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