

Damaging Configurations in Arch Structures with Variable Curvature and Tapered Cross-section

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Arch structure is a widely used and important structure type all over the World. Due to its beautiful form and large spanning capacity, arch structure is widely used in bridges, tunnels and other buildings. Especially in recent decades, the large span space arch structure has a stage of development. The defects of arch structure, such as connection, material, fatigue, stress concentration and welding, will directly affect the safety of long-span structure. The study of the evolution of the damage in structures is a topic of interest since the antiquity. A well-done structural design should always account for the evolution of the damage in time, in particular if it can bring to a change in the static behaviour of the structure itself under different loading conditions [1-3].

In this paper a model for the calculation of localized damaged in arch structures is presented. In particular, using an analytical solution for the computation of the displacements filed and the consequent internal actions of very general arch shapes with variable curvature and tapered cross-section, the damage is modelled by localized depletion of the cross-sectional properties (inertia) in the different points along the arch axis. In particular, the depleted parameters are the cross-section and the bending stiffness of the arch. Finally, the model is applied to the study different configurations of the damage (localization of plastic hinges or different pattern of defects) and to consider the evolution of the damage in time.

REFERENCES

- [1] Trentadue, F., Fiore, A., Greco, R., Marano, G.C., Lagaros, N.D. (2020) Structural optimization of elastic circular arches and design criteria. *Procedia Manufact.* 44: 425-432.
- [2] Chen, Z., Xub, H., Zhao, Z., Yan X., Zhao, B. (2016) Investigations on the mechanical behavior of suspend-dome with semi-rigid joints, *J. Construct. Steel Research* 122: 14–24.
- [3] Zhen, Z. Jing W., Shaoping, M. (2014) Influence of member geometric imperfection on geometrically nonlinear buckling and seismic performance of suspen-dome structures, *Int. J. Struct. Stab. Dyn.* 14(3): 1–20.