# Recent contributions to limit analysis of masonry structures

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## Abstract

In this paper we present recent developments in the field of limit analysis of masonry structures. In [1–3] we presented new a limit analysis approach for masonry vaults. The approach is based on the exact geometrical representation of the surface of the vaults and on the research of the best collapse mechanisms by means of genetic algorithms in the framework of the upper bound theorem of limit analyses. Either J. Heyman assumptions or more complex material models of the masonry based on homogenization techniques are considered and solutions are provided in a very fast and simple way. In [4, 5] the approach is extended to masonry walls in-plane and out of plane loaded and to the analysis of masonry churches. The application to the study of aggregate buildings is under development.

Keywords: **Masonry, limit analysis, NURBS.**

### References

[1] Chiozzi, A., Milani, G., Tralli, A. (2017) Fast kinematic limit analysis of FRP-reinforced masonry vaults. I: General genetic algorithm-NURBS-based formulation, *Journal of Engineering Mechanics* **143**.

[2] Chiozzi, A., Milani, G., Tralli, A., (2017) Fast kinematic limit analysis of FRP-reinforced masonry vaults. II: Numerical simulations, *Journal of Engineering Mechanics* **143**.

[3] Chiozzi, A., Milani, G., Tralli, A., (2017) A Genetic Algorithm NURBS-based new approach for fast kinematic limit analysis of masonry vaults, *Computers & Structures* **182**.

[4] Chiozzi, A., Milani, G., Grillanda, N., Tralli, A., (2017) A fast and general upper-bound limit analysis approach for out-of-plane loaded masonry walls, *Meccanica*, 1–24.

[5] Chiozzi, A., Grillanda, N., Milani, G., Tralli, A., (2018) UB-ALMANAC: An adaptive limit analysis NURBS-based program for the automatic assessment of partial failure mechanisms in masonry churches, *Engineering Failure Analysis* **85**, 201–220.