

# Seismic behaviour analysis of diaphragm arches: case studies from Catalan Gothic churches.

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## ABSTRACT

The Gothic style spread, starting from the 12<sup>th</sup> c., from the Ile-de-France to England and other countries of the Mediterranean area, such as Spain and Italy, according to different configurations and construction techniques, influenced by economic, environmental and social factors. The so-called Catalan Gothic style is not exclusive to the architecture of the Principality of Catalonia but extends to the territories of the Crown of Aragon and Southern France. Its most important characteristics, based on the unitary conception of space and horizontality, had as their major reference religious architecture, in particular the wide aisleless- or hall-churches. Among other structural elements, the large use of diaphragm arches, built transversally to the longitudinal direction of the nave and supporting the beams of the timber roof, has been identified as peculiar both in ecclesiastic and civil Catalan Gothic architecture [1] [2]. Although this technique is widely diffused in the rest of the Mediterranean Europe, it is considered there as singular structural typology, not being part of a popular or generalizable construction system (with rare exceptions among the monastic constructions belonging to the Cistercian architecture). The seismic behaviour of diaphragm arches, as well as their load-bearing capacity under gravity actions, could not be directly associated to ordinary arches or two-dimensional frame. On the basis of these premises, the present study, which is part of a wider research activity aimed at assessing the seismic vulnerability of existing masonry churches, focuses on the behaviour of this construction system under horizontal loads. Therefore, after some brief notes on the history, origins and evolution of diaphragm arches, in order to understand their structural logic and constructive methodology, preliminary outcomes obtained by means of seismic analyses are provided in this paper. In particular, the possible collapse mechanisms of such remarkable curved structures have been firstly investigated and then seismic analyses by means of numerical models [3] have been carried out on real examples present in the Catalan area. The procedure, based on the evidences of studies retrieved in literature which highlight a limited seismic capacity for this type of structural elements, could be exported to other context as a predictive model for those areas affected by a higher seismic hazard, as Italian territories.

## REFERENCES

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