# Hyperbolic paraboloid roofs with elliptical plane shape

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## Summary

No parametric data exists in the main international standards to calculate wind action on buildings with hyperbolic paraboloid roofs. This type of roof, however, is particularly efficient in covering medium to large spans and is highly competitive compared to traditional structures. Our research aims at parameterization of pressure coefficients on roofs with hyperbolic paraboloid shapes with four different footprints, respectively, square, rectangular, circular and elliptical. This paper studies the elliptical shape in particular. Aerodynamic wind tunnel tests have been performed on these shapes with the object of calculating pressure coefficients. A comparison is also made between elliptical and circular shapes in order to demonstrate the high efficiency of the elliptical shape.

**Keywords:** Wind tunnel testing, Pressure coefficients, Hyperbolic paraboloid roofs, Elliptical shape.

## 1. Introduction

Results for square, rectangular and circular shapes have been presented in previous papers (F. Rizzo et al. (2011) [1] Structures and Engineering, F. Rizzo et al. (2012) Journal of Wind Engineering and Industrial Aerodynamics) [2] illustrating research to parameterize pressure coefficients on hyperbolic paraboloid roofs with medium and large spans (hereinafter HYP). These papers described wind tunnel tests conducted to measure pressure coefficients. Interesting results were obtained by comparing data between different geometric parameters: different heights, roof surface curvatures and footprints. Research aims at answering the need to have reference data for hyperbolic parabolid roofs since no parametric data about this type of geometric shape is to be found in national and international standards. This deficiency is a source of difficulty for designers who want to perform preliminary dimensioning of a hyperbolic parabolid roof, calculating, for example, cables nets, a commonly used structure to cover large spans with small thicknesses. This type of structure has very high performance characteristics and, due to the low structural weight, is particularly suited for buildings built in seismic areas. Wind tunnel tests have been done using models of elliptical shape HYP roofs to complete this study of the main, most popular and most flexible shapes for buildings that need free large spans without intermediate supports. This shape is used to design sports arenas and indoor swimming pools but could also be ideal for concert and conference spaces. This footprint, combined with a hyperbolic paraboloid roof, gives a very complex and special configuration and it is impossible to use pressure coefficient data published in technical codes for flat, dome or inclined roofs to make a preliminary evaluation of the wind action. The object of these tests is to compare data evaluated using the elliptical model with those evaluated on circular models. Roof deflections and spans, when determining the geometric shape of the model, have been chosen to equal the values reported in Rizzo et al. (2011) Structures and Engineering. It is to be hoped that the parametric data resulting from this research will be incorporated in technical codes to be used by designers for preliminary design of wind action on HYP roofs before they carry out specific aerodynamic tests. This preliminary step is, in fact, very important for choosing one type of structure rather than another and, in particular, for selecting a tension structure rather than a traditional structure. [3] [4] [5] [6] [7] [8]

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