LABORATORY TESTING AND ANALYTICAL MODELING OF ARCHING AND NON-ARCHING MASONRY WALLS UNDER BLAST LOADS

Idan E. Edri[1], David Z. Yankelevsky[1], Alex M. Remennikov[2]

[1] *National Building Research Institute, Technion-Israel Institute of Technology, Haifa, Israel*
[2] *School of Civil, Mining and Environmental Engineering, Faculty of Engineering and Information Sciences, University of Wollongong, NSW 2522, Australia*

Keywords: Masonry wall, Arching, Experiment, Blast load, Dynamic response

Abstract:
The dynamic behavior of one-way masonry walls subjected to blast loads is a complex problem that involves analytical, numerical, and experimental challenges. Despite this, there is a lack of experimental studies on the blast response of masonry walls, and controlled tests with detailed documentation and rich monitoring are rare. Consequently, most of the conclusions in the literature are based on visual observations of physical damage to tested walls. This paper aims to address this knowledge gap by presenting controlled laboratory tests on one-way masonry walls using an advanced blast simulator and a rich monitoring array. These tests provide strong support for the validation of theoretical and numerical models, which can be further used for advanced analyses. The first test investigates a non-arching masonry wall, revealing its limited resistance to blast loading. The second test focuses on an arching wall and highlights the role of the arching mechanism in the dynamic response and its effect on the failure mode under blast (Figure 1).

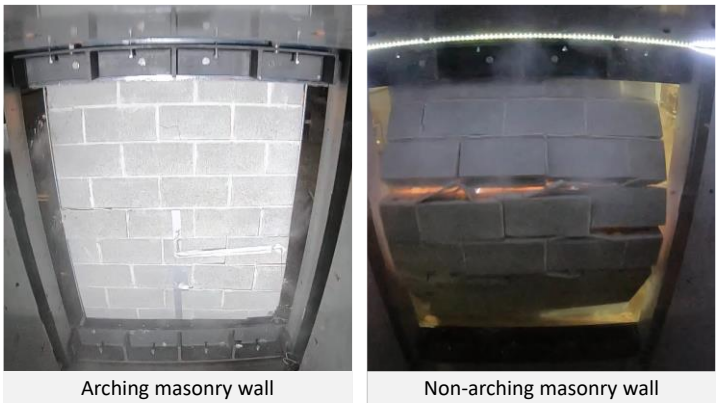

Figure 1: Arching and non-arching masonry walls under the same blast load

The experimental results are compared with a previously developed analytical model that considers the deformability of the mortar joints and the masonry units, adopting a continuous beam-type formulation. The comparisons demonstrate the capabilities of the model to capture the complex dynamic response of the tested masonry walls and emphasize the effects of support constraints on wall response and the contribution of the arching mechanism to their dynamic behavior.