

Civil Engineering Department

## NHL grout injection technique



**FCT** Fundação para a Ciência e a Tecnologia  
MINISTÉRIO DA EDUCAÇÃO E CIÊNCIA



F. Jorne<sup>1</sup>, L. Baltazar<sup>2</sup>

1 - PhD student ; 2 - PhD

Advisors:

- F.M.A. Henriques
- M.T. Cidade

- 6 publications in international journals;
- 4 publications in international conferences;

## Objectives

Multiple leaf masonry walls are a construction types in many urban centres worldwide and its section is composed by two resistant external leaves and an inner core made of rubble material with voids and cracks as well as few or any bonds between external leaves. Thus, the masonry has a weak and vulnerable behaviour under vertical and horizontal loads.

In order to stabilize such walls and to prevent structural failure several consolidation techniques such as grout injection are today commonly employed.

The aims of this research work were the study and optimize the performance of grouts for masonry injection and consolidation.

## Methodology

- Improvement of natural hydraulic lime-based grouts performance, particularly in what concerns stability, strength and durability;
- Combination of organic and inorganic materials to improve the fresh grout behaviour;
- Optimization the grout formulations through rheometry (Fig.1);
- Evaluation of the injectability (Fig.3) and mechanical characteristics (Fig.4) by means of reduced physical models that simulate old stone masonries (Fig.2.and 3);
- Analyses of injection characteristics for different porous media using ultrasonic tomography (Fig.5)

## Expected Results

- Injection grout performance is affected by a large number of parameters, including additive type and dosage, water/binder content as well as, mixing time, mixer type, energy and sequence of mixing;
- Temperature is a factor that strongly influences how such grout microstructure responds and evolves in time;
- It is necessary to characterize all parameters of the porous medium (old masonry) in order to estimate the grout injection capacity;
- Ultrasonic tomography is a useful tool to control the effectiveness of grout injection technique (Fig.5).



Fig.1



Fig.2



Fig.3



Fig.4

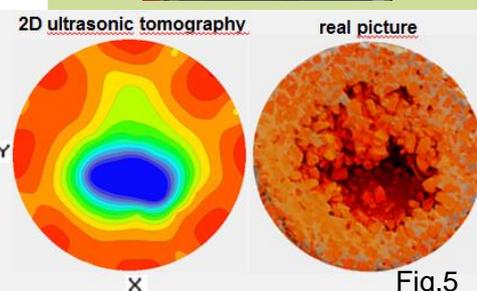


Fig.5