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# Uniaxial compressive tests in refractory masonry walls at high temperature

## Introduction

The industrial requests for more efficient products, with better insulation and better mechanical and chemical resistance, lead to the significant improvements in refractory ceramics [1]. The technology of the refractory linings of industrial vessels is also under constant development.

Numerical simulations are often used to predict the behaviour of refractory linings in service conditions and to optimize their design, as this technique is reliable, cheap and efficient. However, the numerical models must be developed and validated based on experimental results.

## Uniaxial compressive tests in masonry walls at high temperature

The aim of this test is the thermomechanical characterization of refractory masonry subsystems in real scale. The test specimens are placed in a horizontal electric furnace, submitted to a pre-compressive load and then heated.

The test setup is presented in Figure 1. A reaction frame is used (presented in red) to support the hydraulic jacks, two reaction beams are used to ensure the required stiffness and control the displacements at the reaction frame during the test. The pre-compression load will be applied by two hydraulic jacks (presented in yellow). A load application beam (presented in green) is used to guarantee an uniform distribution of the vertical load on the wall. An electric vertical furnace (presented in blue) is responsible to heat the wall. A similar test setup has previously been used successfully [2].

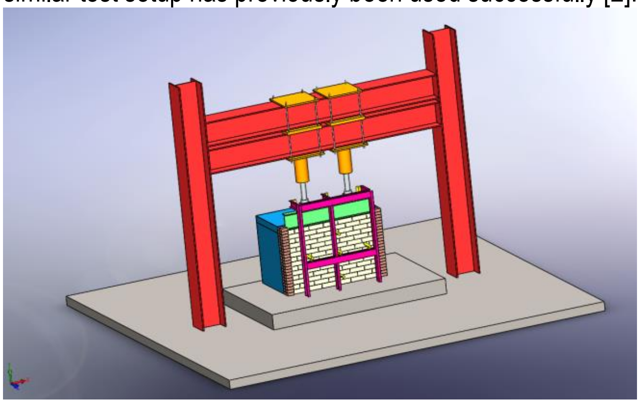

*Figure 1 – Experimental setup.*

## Instrumentation

Only one face of the wall is heated, which leads to a thermal gradient across its thickness, as presented in Figure 2. Type K thermocouples are used to measure the temperatures at different locations in the wall. The measured temperatures may be used to validate numerical heat transfer analysis.

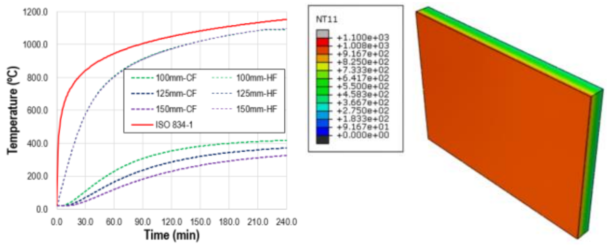


*Figure 2 – Thermal fields along the test*

The strains and the displacements of the wall are monitored using the DIC (Digital Image Correlation) technique. Moreover, LVDTs (Linear Variable Displacement Transducers) are used to measure displacement in different positions of the wall. The forces applied by the hydraulic jack are recorded by a load-cell. The displacement fields (presented in Figure 3) are used to calibrate and validate the developed numerical models.

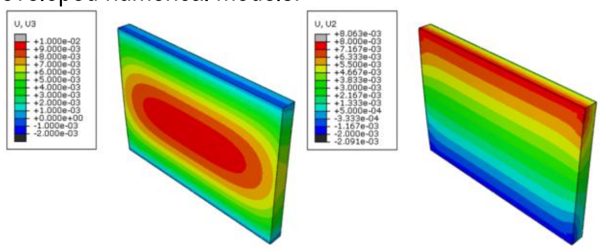


*Figure 3 – Displacement fields along the test: (a) Out-of-plane displacements, (b) Vertical displacements*

## Expected Result

The outputs of the experimental campaign, such as the temperature fields, the displacements fields and the strains, represent the behaviour of a full scale sample in service conditions. These data are used to develop new constative models and to validate numerical analysis and non-linear homogenization techniques. After the validation of the numerical models, they may be used to optimize the design of refractory linings.

## Acknowledgments

This work was supported by the funding scheme of the European Commission, Marie Skłodowska-Curie Actions Innovative Training Networks in the frame of the project ATHOR - Advanced THermomechanical multiscale mOdelling of Refractory linings 764987 Grant.

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European Commission
Horizon 2020
European Union funding
for Research & Innovation