1. Research activity

Title: **New methods for the consolidation of Historical Gypsum Stuccoes and Handworks**

Objective: Creation of tested innovative methods of consolidation for gypsum stuccoes with nano materials.

research activity:

- Research on the behavior of gypsum crystals;
- Identification of deteriorated stuccoes from several areas where their usage is known (Europe and Iran);
- Research over the new consolidants;
- *Sampling*
  For structural analyses and survey in gypsum deterioration process, sampling of various historical buildings was carried out from different climatic conditions. The samples were collected from historical monuments of three cities of Iran (Esfahan-Yazd-Saveh) and a monument in Italy (San Giovanni in Argentella Abbey) with different condition of temperature and humidity. A total of 36 historical and non-historical samples were analyzed.
- *thermogravimetric analysis*
  thermal analysis was carried out on historical and new samples to compare changes. The tests were started from 30˚C to 900 ˚C, 10 ˚C/min. the obtained diagrams were studied carefully and it has been noted that there are two specific weight lost by increasing temperature. The first one from ~ 60˚C to 200˚C which is for water bounded lost and the second one at ~600˚C which is for CO_2 lost of carbonate. By calculating the percentage of purity of calcium sulphate dehydrate and the presence of anhydrite and carbonate, an approximate relationship between the sample resistant and deterioration and the components was obtained.
- *Fourier Transform-Infraredspectroscopy (FTIR)*
  FTIR spectroscopy has been used to identify the degradation phases and to establish the structural relationship between samples. All of samples were analyzed to determine boned water condition, impurities like calcium carbonate, silica, calcium oxalate and etc.
- *X-Ray Diffraction (XRD)*
  A few of samples are investigated by XRD analyses in order to identify calcium sulphate phases. In some deteriorated samples a significant amount of anhydride was observed and the quantity of calcium sulphate dehydrate was less.

the aim of the above analyzes is knowledge of gypsum structure, historical gypsum, structural changes over time and the influence of environmental and internal factors on gypsum crystals and laboratory analog sample preparing for consolidation tests. We are in contact with Department of Industrial and Information Engineering and Economics of university of L'Aquila to prepare and produce of nano materials for future tests.