Thesis Abstract: Nanomaterials and Building Materials:
Effect of nanomaterials on the structure and mechanical properties of cementitious materials

The aim of this thesis is the synthesis, characterization and study of the properties of cementious nanocomposite materials. The use of nanomaterials is attempted to be determined, mainly from a technical point of view and how they affect the performance of the final nanocomposites.

In this thesis nanocomposite structural materials were composed and their properties were studied. The purpose of the study is the development of nanocomposite structural materials with high mechanical strength and low permeability (decreased capillary absorption and low porosity).

In particular, mortars were prepared with high-strength white cement (CEM I 52.5 R) and with the addition of: a) cellulose nanofibers, b) carbon nanofibers, c) carbon nanotubes, and d) graphene oxide.

The dispersion of nanomaterials in mortars was thoroughly studied and an optimized technic was created and for their optimal dispersion a suitable polymer was used as an additive. Nanomaterials were added at different rates from 0.1% to 1% by weight of cement. The impact of the use of nanomaterials was investigated mainly in their mechanical (in micro and nano scale), structural and physical.

The use of SBR as an additive appeared to help the reduction of open porosity and sorptivity and at the same time it maintained the mechanical strength.

Cellulose nanofibers did not contribute to improving the mechanical characteristics of the nanocomposites as well as all the measurements were close to the plain cementitious materials. SEM images demonstrate their good adhesion into the cement matrix.
Nanocomposites with carbon nanomaterials gave improved mechanical characteristics, which reached an increase up to 50% in compressive strength for the nanocomposite with the graphene oxide.

Comparison between cementitious materials with different percentages of carbon nanofibers from 1 to 0.1% showed that the lowest rate of nanofibres cause the greatest increase in compressive strength, which reaches up to 37% compared to the plain cementitious materials.