

# Techniques Used in Petrographic Examinations of Construction Materials: A State-of-the-Art Review

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## *Abstract*

A state-of-the-art review of sample preparation and various petrographic techniques used for analyses of clinker, cement, aggregate, concrete, masonry units, mortar, stone, and tile is presented. The article is divided into two sections. The first section deals with sampling and various methods of **sample preparation** including fracturing, scratching, vacuum impregnating, sectioning, grinding/lapping, polishing, powder mounting, thin-sectioning, staining, etching, aggregate sectioning, surface preparation for air-void analysis, conductive coating, ultra-thinning, etc. The second section deals with various **petrographic techniques** such as: (a) the classical, light optical, microscopical examinations using stereomicroscopes, petrographic microscopes, and metallurgical microscopes; (b) fluorescent light (transmitted and/or reflected) microscopical examinations; (c) scanning electron microscopical examinations including secondary electron imaging, backscatter electron imaging, and elemental mapping by energy dispersive x-ray spectroscopy; (d) environmental scanning electron microscopy, (e) transmission electron microscopy; (f) x-ray diffraction; (g) photography and photomicrography; (h) image analyses for air-void and water-cement ratio determinations; (i) advanced techniques such as soft x-ray microscopy and infrared microscopy; and (j) various supplementary physicochemical techniques such as chemical analysis, thermal analysis, porosity and permeability measurements, etc. The applications of these techniques are described in determinations of microstructure, composition, defects, alterations, and qualitative and semi-quantitative estimations of components. The advantages and limitations of each technique are also described.

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