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The study of historical mortars from Notre-Dame de Paris cathedral

Abstract: The fire at Notre-Dame cathedral in Paris on April 15th 2019 was a catastrophic event but also a real opportunity to develop scientific studies. Access to inaccessible parts of the partially destroyed cathedral was made possible by the presence of scaffolding inside and outside the buildings thus facilitating unusual sampling opportunities and observations. Along with other subjects (structural stability, metal reinforcement, materials supplies, etc.), the study of historical mortars contributes to our understanding of the construction of a cathedral during the Middle-Age. Indeed mortars are the material that binds the stones together and participates in load transmission in the structural elements of the buildings.

From a historical point of view, many questions remain such as the constancy of the mix design (components, mix proportioning, etc.) during the 80 years of construction or how well the mix properties were adapted to usage (pilars, vaults, wall filling, etc.). Specific analyses in different fields (chemistry, petrography, physics) using a wide range of techniques (X-rays diffraction / fluorescence / tomography; thermo-analyses; mercury intrusion porosimetry; optical and electronical microscopy, etc.) have enabled seven types of mortar to be defined that are based on two chemical binders – pure lime and plaster. Their respective mix proportionings were also defined and reproduced experimentally to produce equivalent mortars. These 'copies' are used in mechanical tests that enable us to understand the properties (mechanical strength, deformation modulus) of the historical mortars in their fresh and the hardened states. The first results of this study were also used to define the mortars for the reconstruction of the vaults of Notre-Dame de Paris.

Biography: Jean-Michel Mechling is a Professor at the Université de Lorraine and Head ot the Team Materials for Civil Engineering at the Institut Jean Lamour (UMR CNRS 7198, Nancy, France). His research focuses on current cementitious binders with the objective of recycling industrial waste and demolition concrete or of reducing the environmental footprint of civil engineering materials. Also, for over twenty years, he has studied ancient mortars from different archaelogical sites (France, Jordan, etc.) and several epochs of Antiquity (Gallo-Roman, Bysantine) up to the Middle-Age and the Renaissance.