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Dilation of building materials submitted to frost action

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On monuments, several weathering figures can be attributed to frost action. Change of water into ice causes volume dilation and water movements that can create different pressures on the material structure and lead to its cracking. Effect of these pressures and evolution of the material before cracking can be approached by studying dilation behaviour of materials. Six geomaterials, used in building of different monuments showing more or less weathering that could be attributed to frost action, were studied: two sandstones used in east of France, a molasse and a limestone used in west of Swiss, a Japanese tuff widely used in Japanese buildings and a brick from an abandoned railway tunnel in central Japan. Samples of each material were submitted to unidirectional freezing simulations during which temperature and dilation were measured. Different factors were tested: saturation, freezing time and freezing temperature. The aim of these experiments was to understand which internal (material properties) or external (frost conditions) factors prevailed on dilation that will lead to cracking. First results showed that water supply and repetition of freeze-thaw cycles were most important in dilation of materials. They also showed that the materials with the weakest transfer properties by capillary absorption were the most sensitive to frost action.