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# Influence of Substrate Moisture State and Roughness on Interface Microstructure and Bond Strength: Slant Shear vs. Pull-Off Testing

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**Abstract**

There are conflicting views in the literature concerning the optimum moisture state for an existing substrate prior to the application of a repair material. Both saturated-surface-dry (SSD) and dry substrates have been found to be preferable in a variety of studies. One confounding factor is that some studies evaluate bonding of the repair material to the substrate via pull-off (direct tension) testing, while others have employed some form of shear specimens as their preferred testing configuration. Available evidence suggests that dry substrate specimens usually perform equivalently or better in shear testing, while SSD ones generally exhibit higher bond strengths when a pull-off test is performed, although exceptions to these trends have been observed. This paper applies a variety of microstructural characterization tools to investigate the interfacial microstructure that develops when a fresh repair material is applied to either a dry or SSD substrate. Simultaneous neutron and X-ray radiography are employed to observe the dynamic microstructural rearrangements that occur at this interface during the first 4 h of curing. Based on the differences in water movement and densification (particle compaction) that occur for the dry and SSD specimens, respectively, a hypothesis is formulated as to why different bond tests may favor one moisture state over the other, also dependent on their surface roughness. It is suggested that the compaction of particles at a dry substrate surface may increase the frictional resistance when tested under slant shear loading, but contribute relatively little to the bonding when the interface is submitted to pull-off forces. For maximizing bond performance, the fluidity of the repair material and the roughness and moisture state of the substrate must all be given adequate consideration.