# Quantitative Evaluation of Concrete Surface Roughness Using Smartphone-Based 3D Reconstructions

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Concrete surface roughness plays a pivotal role in determining the shear resistance at the concrete interface, as it directly impacts structural integrity. Inadequate roughness can weaken bond strengths between newly added and existing concrete, leading to shear failures. Despite its significance, current evaluations of this roughness are primarily qualitative, relying on visual comparisons with reference patches. Addressing this gap, this research utilizes the images captured from commercial smartphone cameras as a tool for rapid and quantitative evaluation of the concrete surface roughness. This novel approach leverages high-fidelity image-based reconstructions to create precise 3D profiles of concrete surfaces. The authors adopted two 3D reconstruction processes: photogrammetry and the use of miniature LiDAR sensors on consumer mobile devices. To quantify roughness, the authors introduce a robust point cloud-based roughness evaluation metric, allowing precise and objective measurements of roughness characteristics. To validate the accuracy of this approach, comprehensive testing was conducted on various rough concrete surfaces and the results will be compared with data from a structured light surface profiler as a ground truth, having sub-millimeter precision. Overall, by combining the convenience of smartphone cameras with cutting-edge reconstruction techniques, this research represents a substantial leap in concrete surface analysis, providing a trustworthy and efficient solution to quantify concrete roughness.