P-07 | Development of a new standard method for evaluating the freeze-thaw performance of 3D-printed concrete

COA SHOWCASE

Evan Kennedy

Currently, the impact of freezing temperature and moisture variations on concrete leading to material distress is well-known. The material's performance is typically assessed via standardized methods of testing such as ASTM C666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing. However, such methods are devised to establish the performance of concrete materials in extreme environments such has pavement and bridge deck applications. For decades, durability of transportation infrastructure has governed the development of standard methods of testing. However, with new applications and a changing construction industry, the means by which concrete products are being evaluated for performance acceptance must be representative of its intended use. At present, ASTM C666 fails to provide concurrent methodologies and procedures for testing 3D printed material. This study investigates the freeze-thaw performance of 3D-printed concrete, aiming to develop a standardized testing method suited for vertical building applications. Both the cyclic temperature and moisture exposure regimen and means of testing is being evaluated to devise a comprehensive test methodology for industry. For the first phase of the study, nondestructive test methods, including Resonant Frequency (RF), Ultrasonic Pulse Velocity (UPV), and Surface Resistivity (SR), are assessed to determine their sensitivity in detecting changes in material properties over three hundred (300) freeze-thaw cycles. Initial findings show that specimens exhibiting greater surface scaling, mass loss, also demonstrated a change in dynamic modulus of elasticity, suggesting freeze-thaw damage. These findings will help in establishing a test methodology baseline for evaluating freeze-thaw damage for 3D-printed concrete.