

Theme 3-4: Smart and Sustainable Manufacturing - 2023

Title	Name of the PI	List the Names of the Co-Is	Department	Abstract	Starting Date	Ending Date	Funding	Amount of Funding
"Investigation of Automated Self-Repaired R.C. Beam Using Smart Materials	Adil K. Tamimi	N/A	CVE	<p>Smart materials are being used to construct smart self-repaired structures. A particular type of smart structure is the smart concrete obtained by adding Shape Memory Alloy (SMA) bars which exhibits stable super elasticity above a reverse transformation finish temperature, and therefore works as a super elastic material to handle macro-size cracks. Self-repairing concretes have embedded adhesives, which are released from hollow fibers inside the concrete when and where cracking of the matrix and the fibers occurs. In this study, combination of adhesive and SMA will work simultaneously when the structure is exposed to sudden failure to increase its elasticity, returns to its original shape with the cracks filled with adhesives. The hybrid SMA with steel reinforcement bar are embedded into the concrete beam to resist tensile stresses before the concrete are set in order to avoid the structural failure. The flexural strength and load deflection characteristic need to be evaluated in order to investigate the potential and capacity of SMA for deflection and crack control with automated injection mechanism to fill and repair the cracks once the failure happened exceeding the allowable limits. A total of 24 reinforced concrete beams will be casted and evaluated for flexural strength using different combination of adhesives and SMA and compared with control beam. The challenge in this study is to setup an automated repair mechanism includes installation of strain gauges in critical zones of the beam's maximum shear and tensile sections. The strain gauges are connected to sensors to detect any crack width exceeding 0.003 as per ACI 318-11 due to static cycling loads for a reinforced concrete under service loads for a dry air exposure. The system will trigger a stationed pump that automatically inject repair materials. The PI has been invited to co-advise a PhD. Thesis where all experiments involved manually repaired structural beams have been conducted at AUS laboratories. The combination of SMA and adhesives controlled by automation system will be investigated to create reversed forces known as recovery forces in the structure which lead into closing of concrete cracks in tensile zone and maintain its serviceability to save time, efforts, cost and avoid drastic accident.</p> <p>Keywords: SMA, Smart Self-Repair, SE Super Elastic, Adhesive, Automation, Flexural strength, Cracks width.</p>	01/06/2022	31/05/2024	FRG	369300