DIGITAL IMAGE PROCESSING MEASURES FLEXURAL STRAINS

To effectively design unreinforced and reinforced concrete structures, it is necessary to understand the behaviour of concrete elements. Experimental work is an essential element of research on such elements. Experimental work poses certain challenges when the load-deformation and complex non-linear stress-strain behaviour of a flexural test specimen is to be captured.

Traditional experimental methods – strain gauges, linear variable displacement transducers (LVDTs) and demountable mechanical strain gauges (DEMECs) – to determine the stress-strain relationship of concrete members in bending proved to be insufficient. Unreinforced concrete is brittle and fails suddenly and too fast to capture the final stage of failure accurately with conventional mechanical measuring devices. Although electrical devices have the capability of measuring fast enough, they could damage when crack formation occurs at the positions where they were placed. In addition, the exact location of the cracked region is not known a priori.

Recent developments in the field of digital image processing (DIP) show promise as a potential new method of strain measurement. By being able to capture a beam failing in bending (thus tension failure) on digital video film, computer software can use mathematical algorithms to calculate the stress-strain relationship of the beam. This is done frame by frame, and allows engineers to gain a better understanding of the stress-strain relationship of the concrete beam.

With her research, Ms Chanellé Coetzee demonstrated the feasibility of video digital image processing as a method to determine flexural strains in concrete. Video digital image processing was successfully used to measure strains and to determine various structural mechanics relationships for concrete beams with little or no reinforcement. The results led to an improved understanding of the cracking behaviour of concrete beams and to the determination of the fracture mechanics parameters for concrete.

*Coetzee's project was supervised by **Dr John Robberts and Prof. Ben van Rensburg**.*

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→ *Chanellé Coetzee receives the Stewart Scott International Prize for the most innovative final-year research project in civil and biosystems engineering (2006) for her research into the measurement of flexural strains in concrete by using digital image processing*