A Multi-scale Study on Early-age Cracking of Concrete Materials and Its Practical Application

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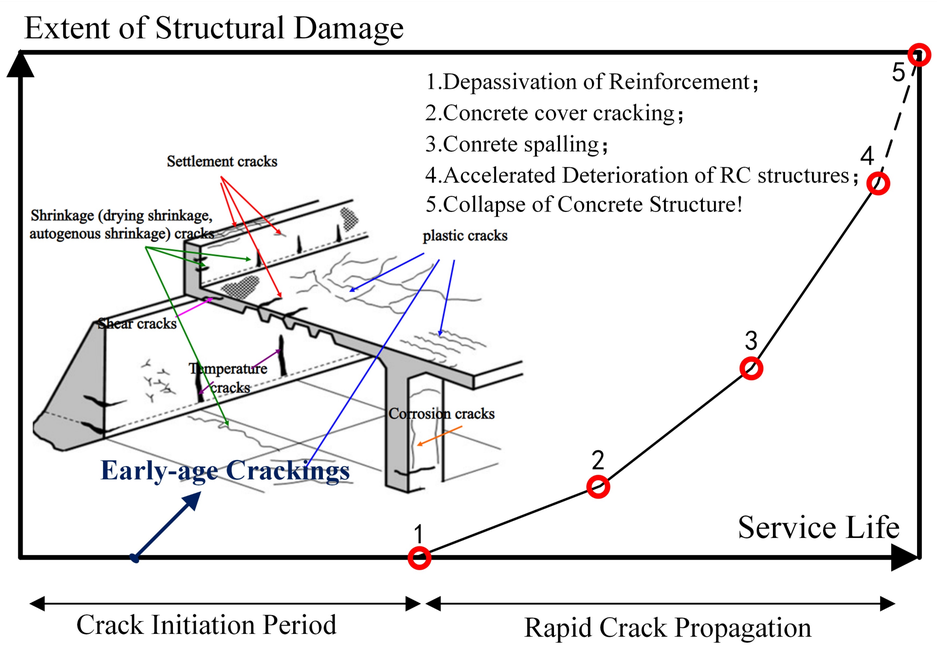
Abstract: This study develops a new experimental device to directly test the cracking performance of concrete materials. For any given mix proportions, the stress and deformation development can be tested via this machine for any temperature and restraint conditions. It could be served as a promising tool to develop brand-new concrete materials for high cracking performance in realistic engineering. Besides, the mechanism and behavior of cracking of concrete materials are also studied from a point view of micro pore structure.

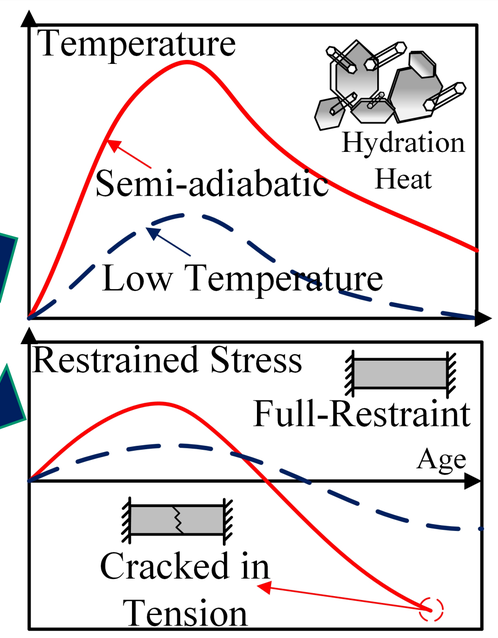
1. Background – Early-age Cracking

The early-age cracking problem of concrete material is crucial to the durability performance (closely related to the life span) of concrete structure.



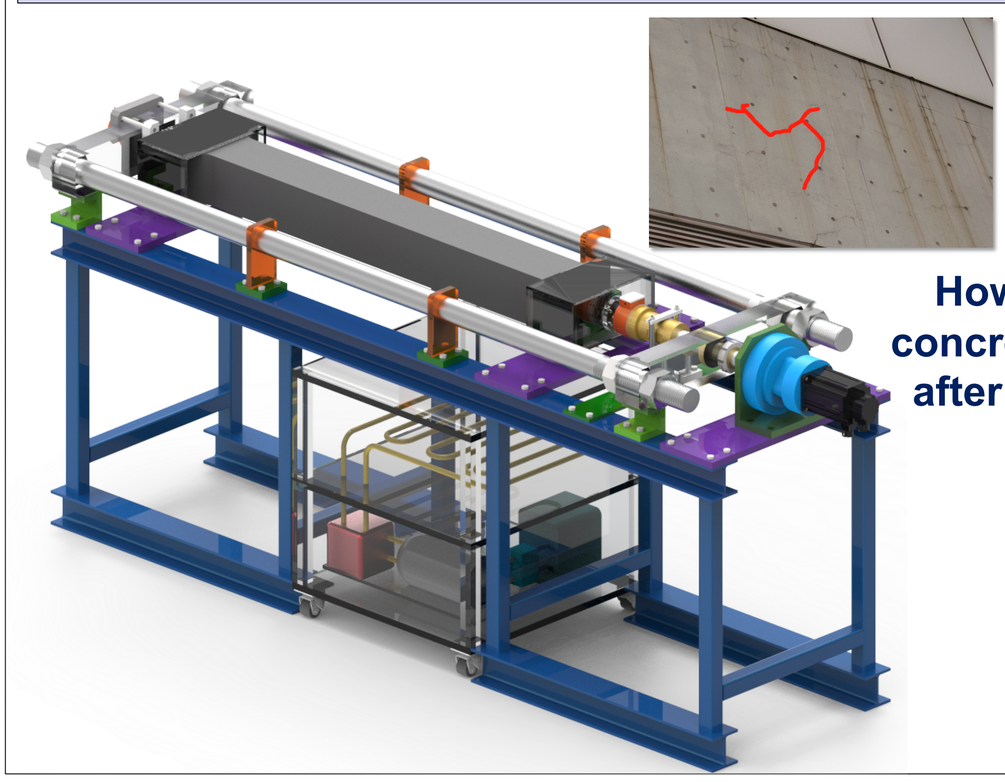
2. Objectives

☐Main Objective: Provide a practical evaluation method for early-age stress evolution, which serves as a guidance to mix design of concrete materials in practice.



3. Design of TSTM

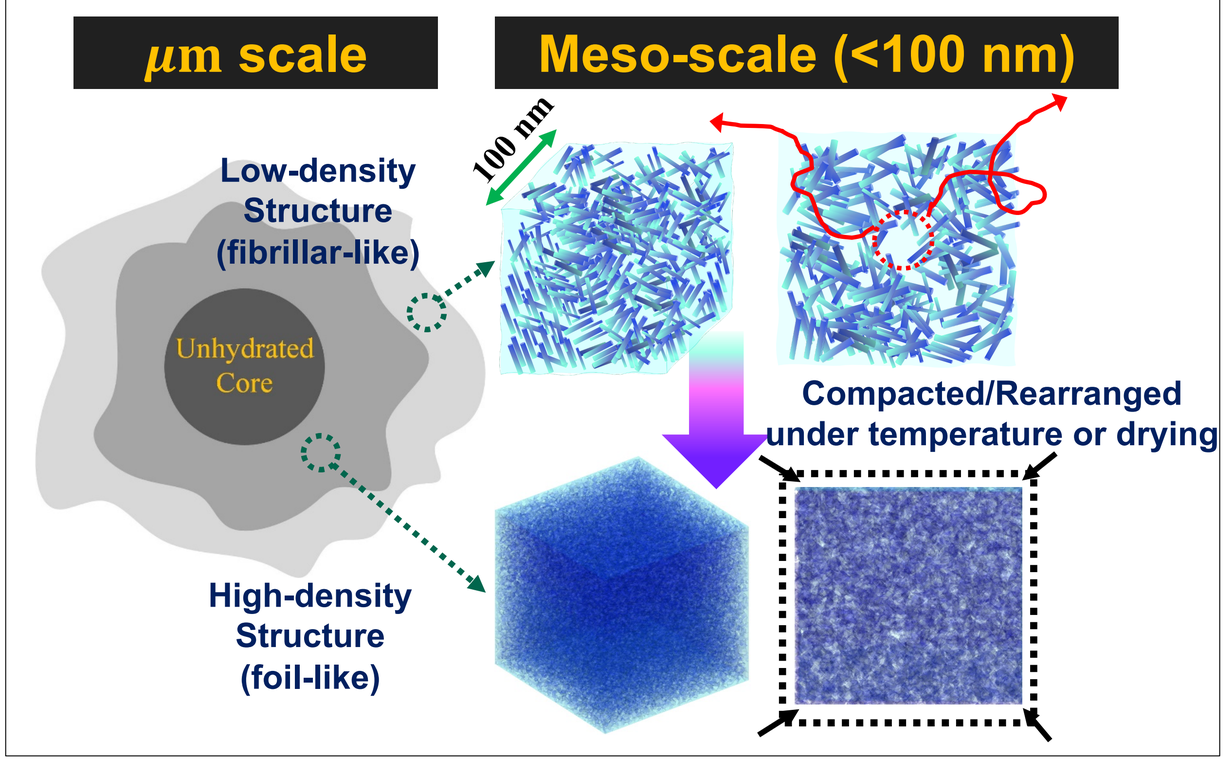
→ A Developed Temperature Stress Testing Machine



How & Why concrete cracks after casting?

4. Multi-Scale Understanding and Modelling

We attempt to interpret the behaviour using multi-scale model



Conclusion:

1. The developed TSTM (Temperature Stress Testing Machine) is able to quantify the early-age stress and deformation development of concrete materials, which serves as a promising tool for future development of any new mix design or new concrete materials.
2. The microstructure of concrete materials and the water distribution/transport behavior govern its shrinkage properties, which requires a sophisticated and scientific understanding. The multi-scale model can be renewed by these advanced understanding.

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