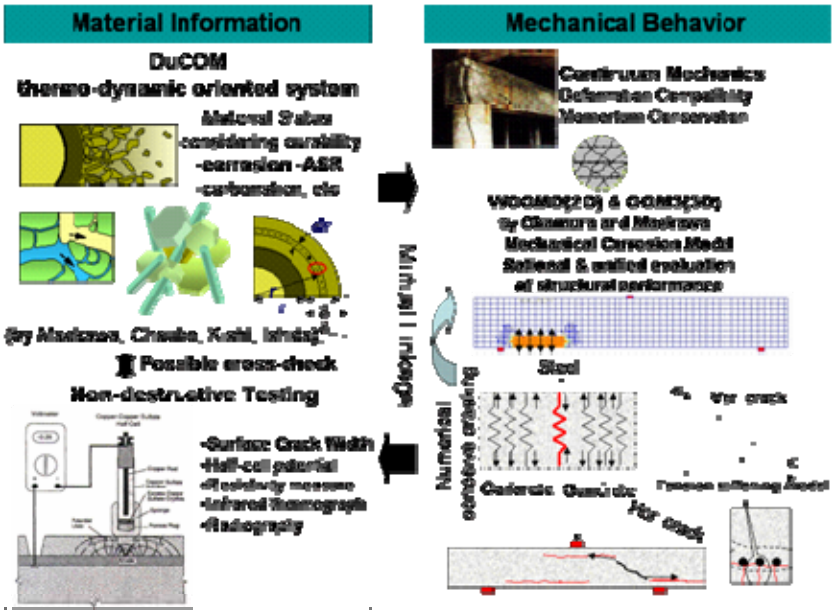
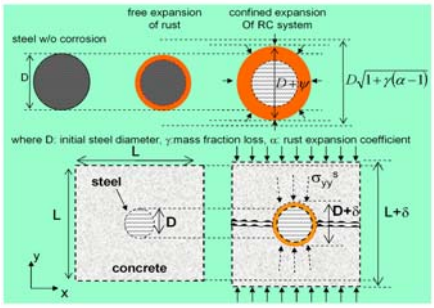
Computational Assessment for Structural Performance of Damaged Reinforced Concrete

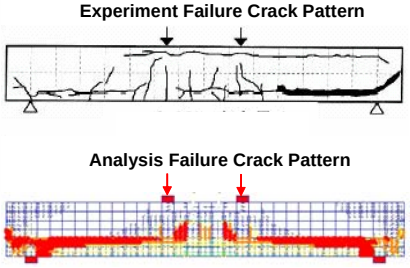
Inevitably, real RC structure will be more or less subjected to one or other forms of environmental menaces. Many possible forms of damages from the environmental action can be possibly introduced to the structures. Reinforcement corrosion and alkali silica reaction are the most urgent durability problems. In both cases, damage in term of cracking may be introduced due to expansion of produced substances inside RC domain; corrosion product or rust in case of reinforcement corrosion and silica gel in case of ASR.

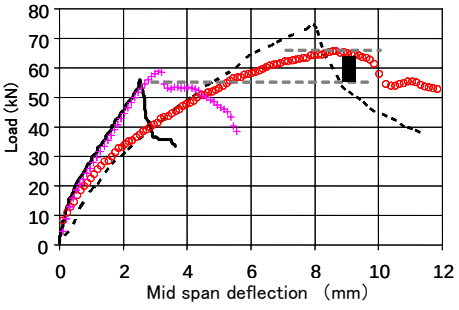


For explicitly taking into account corrosion cracks in structural safety performances, a multi-mechanical model is presented to deal with materialized corrosive substances around steel bars and equilibrated damage in structural concrete. The multi-mechanics of corrosive product and cracked concrete are integrated with a nonlinear multi-directional fixed crack modeling so that corrosion cracks in structural concrete can be simulated in a unified manner.

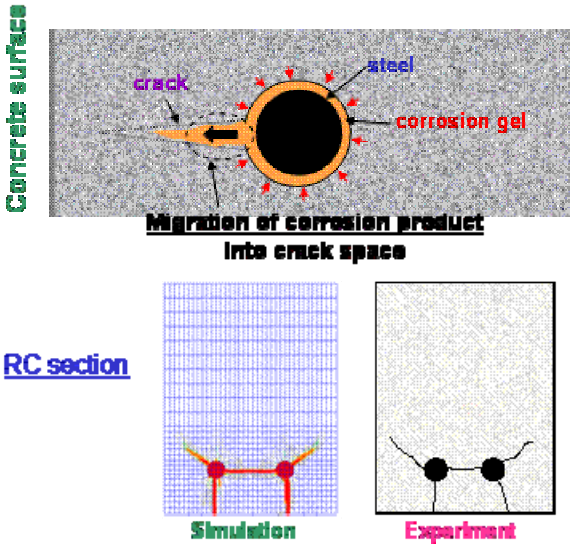
Consideration of inherent cracking on corroded RC members is proven to be crucial for structural performance assessment and the anchorage failure of longitudinal reinforcement is found to cause considerable decay of member capacity.







Furthermore, the challenge was also achieved in the numerically simulation on corrosion induced cracking and its propagation over a section of RC members and focused in the penetration of corrosive gel product into crack spaces. In the case where a corrosive crack stably propagates such as large cover and/or comparatively small diameter of steel, the injection of corrosive gels into evolving cracks is clarified to be substantiated, and the coupled system of gel formation, migration and crack propagation are newly presented.



A mechanical effect of fractured stirrups due to corrosion or alkali-aggregate reaction was investigated. Significant reduction in shear capacity was found with no yielding of reinforcement when all web steel anchorage was incomplete near the tensile steel. The longitudinal cracks were formed ultimately along the tensile steel where the cut-off of web reinforcements lies due to insufficient anchorage performance at the fractured portion.

A non-linear FEM analysis was employed to investigate the failure process. The bond deterioration zone at the fractured portion was assumed to be ten times diameters of damaged steel bars. This simple assumption was experimentally verified to be reasonably acceptable for safety performance assessment.