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LOCALIZING GRADIENT DAMAGE MODEL FOR MIXED MODE FRACTURE OF CONCRETE

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Nonlocal integral and/or gradient enhancements are widely used to resolve the mesh dependency issue with standard continuum damage models. However, it has been reported that whereas the structural response is mesh independent, a spurious damage growth is observed. Consequently, a wrong damage profile is predicted. The underlying cause is ascribed to the constant length scale parameter adopted in a conventional nonlocal damage model. To address this issue, a class of modified nonlocal enhancements is developed in literature, where the interaction domain increases with damage. In this presentation, we adopt a contrary view that the interaction domain in a gradient damage model *decreases* with damage. Physically, this represents the fact that the fracture of quasi-brittle materials typically starts with a diffuse network of microcracks, before localizing into a macroscopic crack. To ensure thermodynamics consistency, the micromorphic theory is adopted in the model development. The ensuing microforce balance resembles closely the Helmholtz expression in a conventional gradient damage model. The superior performance of the localizing gradient damage model is demonstrated for two benchmark examples in mode I and II failures respectively [1]. For both cases, a localized deformation band at material failure is obtained. Finally, we consider several examples of concrete in mixed failure modes. It is shown that the localizing gradient damage model is able to predict accurately the failure profiles, which cannot be obtained with a conventional gradient damage enhancement.

REFERENCES

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