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Micromechanical modeling of fracture and fatigue in structural steels

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Fracture and fatigue are the most common causes of damage in steel structures subjected to extreme loading conditions. The main aim of this talk is to expose the audience to the latest developments in the broad area of fracture and fatigue modeling of structural steels. To this end, fracture and fatigue tests conducted on ASTM A992 steel specimens will be presented. The fracture initiation and propagation mechanisms in ASTM A992 steels under monotonic and cyclic loading will be presented. On the modeling front, detailed micromechanical analyses that can simulate the growth of damage in ASTM A992 steels at various stress states will be discussed. Based on these novel micromechanical analyses, new criterion for the prediction of fatigue life and a multiscale damage model for predicting fracture under monotonic loading will be proposed. The proposed fatigue life criterion and damage model for fracture will be calibrated and validated from the experimental data. The challenges associated with implementing the damage models in to general finite element framework and some innovative solutions to address these challenges will be demonstrated. The directions for future research in fracture and fatigue modeling of structural steels will be listed at the end of the presentation.

Biography

Ravi Kiran Yellavajjala is an Assistant Professor in Civil and Environmental Engineering Department at North Dakota State University. He received his PhD in Structural Engineering from University of Notre Dame in fall 2014. After his PhD, he worked as a Post-doctoral Researcher at Notre Dame and Brown University. Among other awards, he received 2014 O H Ammann Structural Engineering Research Fellowship, stood runner-up in 2014 computational mechanics poster competition and received 2008 German academic exchange fellowship. He is interested in enabling engineers to design resilient and sustainable structures by developing a fundamental understanding of how construction materials behave until failure under service and extreme loading conditions using principles of theoretical and experimental solid mechanics.

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