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Application of shape memory technology in civil structures

The last few decades have clearly demonstrated the vulnerability of civil structures to problems related to aging and natural or man-made hazards. Conventional materials have proven to be limited in terms of their ability to withstand the extreme demands imposed on them by modern societies. Hence, there is growing interest in the application of innovative and smart materials to extend the service life of civil structures. This presentation will discuss one particular class of smart materials, namely shape memory alloys (SMAs) and their potential applications in civil structures. SMAs have recently emerged as a potential construction material with unique thermomechanical phenomena, namely shape memory effect and superelasticity. These phenomena are related to the ability of SMA to recover its original shape after being extremely deformed beyond its elastic range. Both phenomena have attracted the attention of researchers and practitioners in the structural engineering industry. This presentation will provide three examples of the recently studied applications of SMAs in civil structures. The first application involves the use of SMA in performing seismic retrofit and repair of bridge columns. In this application SMA is used in the form of thermally-prestressed spirals that can apply large active confinement pressure to the columns. The second application focuses on utilizing superelastic SMA as seismic dampers and restrainers for bridges. The recentering capability of SMA is sought to prevent failure during strong ground motions. Finally, the third application focuses on developing a new type of fiber reinforced polymer composite reinforced with superelastic SMA fibers. The newly developed composite material is studied as seismic reinforcing bars for buildings. In all three applications, the performance of the proposed SMA technology is compared with that of conventional and currently used technologies.

Biography

Bassem Andrawes is a professor and CEE excellence faculty fellow in the department of civil and environmental engineering at the University of Illinois at Urbana-Champaign (UIUC), USA. He received his Ph.D. degree from Georgia Institute of Technology in 2005. He has been on the faculty at UIUC since 2006. His research interests are primarily in the areas of application of smart materials in civil structures subjected to natural and man-made hazards, constitutive modeling and testing of shape memory alloys under extreme dynamic loads, and large-scale experimental testing. He has over 130 publications. He is a recipient of the prestigious US National Science Foundation (NSF) CAREER award. He has served or is currently serving as the chair of several technical committees associated with the American Society of Civil Engineers (ASCE) and the American Concrete Institute (ACI).

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