ENGINEERING SUSTAINABLE BUILDINGS

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Buildings account for one-third of the primary energy usage and two-thirds of all the electricity consumption (U.S. Energy Information Administration 1995). Construction, operation and demolishment of buildings generate tremendous pollutions that directly and indirectly cause urban air quality problems and climate change. Poor design of buildings and systems not only wastes resources and energy, causes adverse impacts on environment, but also creates uncomfortable and unhealthy indoor environments. In addition, as impacts of humans on the environment at both local and global scales become increasingly apparent, sustainable development of buildings have emerged as goals for human activity toward which proper actions should aspire throughout the entire life span of a building project.

Sustainability implies the ability of a system to maintain itself or be maintained over time without threatening the stability of other systems upon which it depends. However, just like their ecological counterparts, complex human-designed systems such as buildings sometimes exhibit emergent behaviors that make their sustainability difficult to model and evaluate, and thus design and optimize, especially in situations where the performance of those systems depends on many dynamic interactions among nature, human and systems. Modern design concepts of high performance buildings, associated with the usage of new building materials and advanced mechanical and electrical systems, result in an increased need of understanding the integration of building elements and systems including human who design and operate them. To reach the net-zero-energy-building goal by 2030 will require highly multidisciplinary efforts from many collaborators such as policy-makers, architects, urban planners, material scientists, civil engineers, mechanical engineers, environmental engineers, constructors, social scientists, and even public health practitioners, and through the long life cycle of buildings.

This session will introduce the emerging integration and transformation effort of the architecture/engineering/construction industry (AEC) to increase social, economic and environmental benefits via sustainable building development. The session will start with Dr. John Ochsendorf who will introduce the current challenges and opportunities for low-carbon buildings by presenting the cutting edge in benchmarking building performance and building life-cycle-cost assessment (LCCA). Using case studies of ultra low-carbon buildings his team at MIT designed, Dr. Ochsendorf will discuss the best integrated design strategies and future research and industry needs. He will be followed by Dr. John Haymaker, who will use industry case studies and surveys to summarize the difficulties that building design teams have been defining and searching through solution spaces and how this results in unsustainable designs. He will present an emerging platform of industrial and academic tools that are helping professional and student teams execute far more efficient and effective design processes. Dr. Haymaker will be followed by Dr. Jelena Srebric, who will discuss the challenges in modeling the whole building energy and environmental performance. She will define key questions that multi-scale modeling can address for an engineer facing a design of new or renovation of old buildings with

sustainability in mind. Dr. Srebric will analyze the strengths and weaknesses of the existing multi-scale modeling opportunities and conclude her talk with a discussion on future needs on developing new building multi-scale models. Dr. Chris Pyke will wrap up the session with an industry perspective that covers the use of location-based services and social networks to drive market transformation for sustainable building. His talk will demonstrate an innovative Geographic Information System (GIS) based platform for conducting dynamic, multi-criteria benchmarking and facilitating the collection and analyzing of unprecedented information about the experience of occupants in and around green buildings. He will discuss how these new tools will drive continuous performance in a number of specific areas, including greenhouse gas emissions reduction, water conservation, and public health. It is evident that the ability to identify, compare, and reward high-achieving projects and individuals is central to green building's success.