

KEYNOTE - 1

Architecture and Engineering for Sustainable Buildings

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Buildings are vital to the development of civilization. They are the very first structures created first for shelter, and eventually enhanced the family life and helped the establishment of neighborhoods. These, neighborhoods later became villages and then cities, bringing both added benefits and requirements. In buildings, industry has flourished and art forms have been created. These structures were the natural extension of the human and societal needs. They were expected to provide the bottom-line protection from the elements of nature, including rain, snow, wind, sun, and the wrath of potential intruders. With the development of technology, they were also expected to protect the inhabitants from more severe calamities such as earthquakes and tornadoes. As their functionality increased, so has their cost. Energy use in such buildings has become prohibitive with their increasing size, and they also have started becoming environmental concerns. The materials used in buildings added more to these concerns, not only from their manufacturing but also from their transportation to the construction site. With the buildings, various industries and cities have grown, adding additional strain to the environment and the energy use density. Of course, this growth also fueled the need for transportation and logistics, and their eventual impact to environmental issues.

All living organisms live within their means, and most of the time they are in harmony with nature. Humans, however, have deviated from this natural path over the centuries with the increasing size of villages and cities, and their appetite for buildings, roads, transportation and industry which fuel all these so called unavoidable requirements. This unsustainable path eventually yielded discussions about sustainable building and sustainable city concepts. Returning to these ideas came with the increasing awareness about the World we live in and the damage we have infused on to it over the years. The heavy energy use, particularly those generated from fossil fuels have caused accumulation of greenhouse gases and their impact to climate change. This awareness was possible with the extensive use computers and internet. They have also helped in finding possible solutions to alleviate these problems. It was obvious that there were ways that allowed us to build structures with the materials that have minimum impact to environment and at the same time use less energy. That was possible by considering the basic forms of such buildings with their energy use patterns. Naturally, architecture and engineering are to be considered in tandem to maximize the benefits of the elements, such as sun, wind, earth and air, and have provided more natural conditions for dwellings. This know-how has also been coupled with the state-of-the art developments in materials, in sensors and in communication technologies. This coupling allows the design of smart structures and cities where the daily and hourly changes in the external conditions and requirements can be accommodated easily in building energy use patterns. These smart, or adapting, structures are the key to the future human civilization.

The advances in these sustainable buildings would only be possible by educating the future architects and engineers who learn how to communicate from day one in their education. This was the basic suggestion of the participants of a recent Workshop (1). What needs to be taught includes history, nature, design principles and the state-of-the-art engineering principles. Also, the ability to communicate effectively the spoken and written words, being

in harmony with the nature as well as being aware of the local culture, prevailing trends, and the societal impact are essential. Keeping the soul of the city, particularly those in historical cities, while preparing them to the future are crucial.

It is commonly agreed that integrated and improved building design can have the largest and most cost-effective impact on the environment through reduced energy demands, improved water use, reduced materials consumption, and use of sustainable materials and fabrication methods. Improving exchange of the latest knowledge base and thinking on these subjects and enhancing their incorporation in global architecture and engineering practice is therefore likely to impact the society. To be able to do all these effectively, one needs to establish the methodologies and emphasize the understanding of the requirements, not necessarily only of engineers and architects but also those of developers, business owners, industrial decision makers, public administrators, historians and the person on the street. In short, all stake holders need to be part of these decisions, and then exchange the ideas and solutions.

In this presentation, an overview of the recent work conducted at CEEE on these concepts will be discussed. The details of sustainable buildings and their extension to sustainable cities will be outlined. An overview of the recent attempts to couple the architecture and engineering for the developments of smarter buildings will be listed and suggestions for new education methodologies will be provided. Also, the work being conducted under a recent collaborative demonstration project, NEED4B, will be summarized (2).

(1) Workshop on Architecture and Engineering of Sustainable Buildings, Organized by Ozyegin University and the University of Illinois, May 2011, Istanbul, Turkey. Report: November 2012.

(2) New Energy Efficiency Demonstration for Buildings (NEED4B), EU-FP7-PPP project (Partners from Spain, Turkey, Italy, Belgium and Sweeden), 2012-2018 (www.need4b.eu)