Integrating Structure, Architecture and Energy Efficient Systems to Achieve a Sustainable Super-tall Building

With the great need to high-rise buildings in dense cities and declining fuel resources, considering high-rise building’s sustainability should be one priority. The term sustainability refers to both structural form and energy efficiency. While there is often an interaction between architectural and structural forms and architecture and energy efficiency, there is rarely an interaction between structures and energy efficiency strategies. This paper has three parts. In part one at first, innovative structural systems appropriate for super-tall building including core and outriggers, braced bundled tubes, diagrid (with and without core system), space truss and super frame are described. The emphasis is on the diagrid system because of its efficiency form structural point of view, and its aesthetic for world increasing use of this system as architectural design concept for high-rise buildings. Then, structural principles that are necessary for architects to achieve a conceptual design are discussed and architectural limitations and advantages of each system are stated. In the second part of the paper, the effect of wind on tall buildings are reviewed and shape strategies to reduce wind power, including the use of softened corners, tapering and setbacks, varying cross-section form and porosity or openings are described. Also fresh ideas in order to gain energy from wind power in tall buildings related to the global shape and application of turbines with right place are explained. Finally, in the last part of the paper, discussion on how efficient structural forms and energy conservation and producing systems could be blended together with considering architectural expression of high-rise structures. The ideas of clustered towers with central multi-purpose area and linked towers with detached areas with core system, is explained. The main purpose is to achieve a great degree of sustainability in super-tall buildings in terms of both structure and energy efficiency. This strategy also opens up new visions in aesthetics of tall buildings.

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