



# New Configurations for Super-Tall Buildings Based on Structural Concepts and Energy Efficiency Principles

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## Abstract

The term sustainability refers to both structural form and energy efficiency, especially for high-rise buildings. In this paper at first, structural systems appropriate for super-tall buildings are described. Structure-architecture interactions that are necessary to achieve a conceptual design are discussed. Shape strategies and global forms appropriate for high-rise buildings subjected to wind load are illustrated. The paper aims to show how efficient structural forms and energy conservation and generation principles could be blended together with considering architectural expression of high-rise structures. Innovative configurations for super-tall buildings based on the principles of wind and structural engineering to achieve sustainability in global form are defined. In fact the new configurations have the characteristics of a sound structural system and meantime they reduce wind load on global body of structure, are efficiently able to produce energy in creative ways by their innovative configuration. The configurations consist of single and clustered forms each one with three subdivides. Considering sustainability in super-tall buildings in terms of both structure and energy efficiency could absolutely open a new vision in aesthetics of high-rise buildings.

**Keywords:** super-tall buildings, influence of energy efficiency on configuration, sustainability

## 1. INTRODUCTION

The need to create tall buildings in dense cities is obvious. With Feeling a great need to super-tall building, considering the whole aspects of tall building in order to achieve sustainability in the design process should be one priority. It has been demonstrated that super-tall buildings could benefit from its great height to achieve sustainability [11]. In that paper, the temperature, air pressure, wind, moisture and solar effects on super-tall buildings has been discussed, but how a super-tall building can be primarily designed to have the potential of sustainability. The term sustainability should be referred to structure, architecture and energy efficiency. In this era architects, structural engineer, developer and urban planners should cooperate together to reach the goal of real sustainable tall buildings [7]. In the age of increasing structure-based architecture and also energy efficient architecture, there is rarely an interaction between structural form and energy efficient strategies. In fact architect and structural engineer can collaborate and use structurally resistant forms for considering sustainable design facts in addition to carrying gravity, earthquake and wind loads [7]. This approach needs a great understanding of different structural systems appropriate for super tall buildings, energy resources and its impact on the building and an “engineering-aimed creativity” to come up with an attractive architecture which has a great sustainable story behind it!

The principles of efficient structural design of a tall building are as follow (Halvorson, 1988), [9]:

- Resisting the overturning forces due to lateral forces on vertical elements placed as far apart as possible.
- Channeling gravity loads to those vertical elements resisting overturning forces.
- To the extent possible, resisting lateral forces with members axially loaded in compression rather than tension or bending.

For each tall building's structural design procedure, the prior concepts should be reducing overturning forces due to lateral loads, shear lag effect and lateral story drifts so that every tall building's structure should include the mentioned concepts to be accounted as appropriate tall building structure.