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THE COMPARATIVE EXPLORATION ON EARLY PATTERN OF TALL BUILDINGS BASED ON SEISMIC DESIGN & REINFORCED CONCRETE STRUCTURE

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The Comparative Exploration on Early Pattern of Tall Buildings Based on Seismic Design & Reinforced Concrete Structure

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Abstract – Nowadays, in modern tall buildings, lateral loads induced by wind or earthquake forces are often resisted by a system of multi-outriggers. An outrigger is a stiff beam that connects the shear walls to exterior columns. When the structure is subjected to lateral forces, the outrigger and the columns resist the rotation of the core and thus significantly reduce the lateral deflection and base moment, which would have arisen in a free core. During the last three decades, numerous studies have been carried out on the analysis and behavior of outrigger structures. But this question is remained that how many outriggers system is needed in tall buildings. Reinforced concrete walls are commonly used as the primary lateral force-resisting system for tall buildings. As the tools for conducting nonlinear response history analysis have improved and with the advent of performance based seismic design, reinforced concrete walls and core walls are often employed as the only lateral force resisting system. Proper modelling of the load versus deformation behaviour of reinforced concrete walls and link beams is essential to accurately predict important response quantities. Given this critical need, an overview of modelling approaches appropriate to capture the lateral load responses of both slender and stout reinforced concrete walls, as well as link beams, is presented. Modelling of both flexural and shear responses is addressed, as well as the potential impact of coupled flexure–shear behaviour.

Keywords: Exploration, Pattern, Buildings, Seismic Design, Reinforced Concrete, Structure, etc.

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INTRODUCTION

The design of tall buildings essentially involves a conceptual design, approximate analysis, preliminary design and optimization, to safely carry gravity and lateral loads. The design criteria are. strength, serviceability, stability and human comfort. The strength is satisfied by limit stresses, while serviceability is satisfied by drift limits in the range of H/500 to H/1000. Stability is satisfied by sufficient factor of safety against buckling and P-Delta effects. The factor of safety is around 1.67 to 1.92. The human comfort aspects are satisfied by accelerations in the range of 10 to 25 milli-g. where g=acceleration due to gravity, about 981cms/sec^A2. The aim of the structural engineer is to arrive at suitable structural schemes, to satisfy these criteria, and assess their structural weights in weight/unit area in square feet or square meters (Ross, 2004). This initiates structural drawings and specifications to enable construction engineers to proceed with fabrication and erection operations. The weight of steel in lbs/sqft or in kg/sqm is often a parameter the architects and construction managers are looking for from the structural engineer. This includes the weights of floor system, gilders, braces and columns. The premium for wind, is optimized to yield drifts in the range of H/500, where H is the height of the tall building. Herein, some aspects of the design of gravity system, and the lateral system, are explored (Building a Better Quality of Life, 2000). Preliminary design and optimization steps are illustrated with examples of actual tall buildings designed by CBM Engineers, Houston. Texas, with whom the author has been associated with during the past 3 decades. Dr.Joseph P.Colaco, its President, has been responsible for the tallest buildings in Los Angeles. Houston, St. Louis. Dallas. New Orleans, and Washington, D.C. and with the author in its design staff as a Senior Structural Engineer. Research in the development of approximate methods of analysis, and preliminary design and optimization, has been conducted at WPI. with several of the author's graduate students. These are also illustrated. Software systems to do approximate analysis of shear-wall frame, framed-tube, out rigger braced tall buildings are illustrated [Tall Buildings and Sustainability, 2002). Advanced Design courses in reinforced and pre-stressed concrete, as well as structural steel design at WPI. use these systems. Research herein, was supported by giants from NSF. Bethlehem Steel, and Army.

REVIEW OF LITERATURE:

Tall building development includes different complex components, for example mass trading, style, innovation, civil regulations, and legislative issues. Around these, commercial concerns have been the essential administering variable. This new building sort itself might not have been conceivable, be that as it may, without supporting advances. A structural transformation - the steel skeletal structure - and also ensuing glass window ornament divider systems, which happened in Chicago, has prompted the current situation with the-symbolization high rise.

The development of tall buildings and tall building structural systems closely follows that of material, analysis and non-structural system, (mechanical), developments. The earliest buildings were constructed of masonry. Chicago's sixteen stories Monadnock building (1981) is the tallest masonry structure ever built ref (ACI 318, 2008). At the base its walls were over six feet thick ref (Elwood and Eberhard, 2009). Such seemingly ridiculous proportions were required by code. The taller the building, the greater the volume of masonry was required per unit area of floor space. These early structures provided inherent stability against overturning moments in their extreme dead loads.

Table 1: Tall Buildings in Regions (2006, based on most active cities in the regions reported in *Emporis.com).*

REGION	COUNTRIES (No.)	PERCENT (%)	BUILDINGS (No.)
Asia	20	32.2	35,016
North America	18	23.9	26,053
Europe	20	23.7	25,809
South America	10	16.6	18,129
Oceania	7	2.6	2,839
Africa	20	1.0	1,078
TOTAL	95		108,924

Their enormous heights at that time were accomplished not through notable technological evolution, but through excessive use of structural materials (Idriss, 2008). Due to the absence of advanced structural analysis techniques, they were quite over-designed.

In terms of architectural expression of tall buildings at this time period, as can be observed from many eclectic style tall buildings, architects returned to the traditional architecture for representational quality, after a short pursuit of a new style for a new building type based on new technologies mostly by Chicago architects in the late nineteenth century.

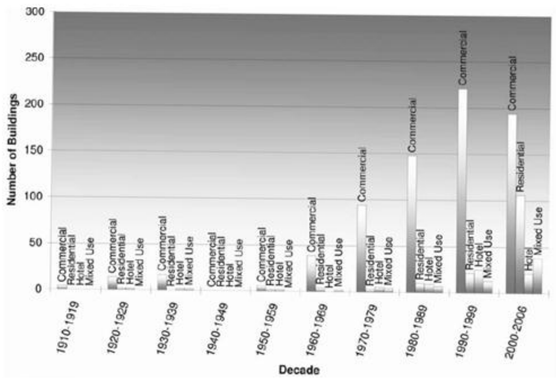

Fig 1: Building type distribution

However, the rebirth of the early Chicago spirit and the application of European modern movements to tall buildings were only a matter of time (Jin and El-Tawil, 2003). The mid-twentieth century, after the war, was the era of mass production based on the International Style defined already before the war, and the technology developed earlier. The major driving force of tall building developments was economy. Even the once- prevalent height race did not occur after World War II until the construction of the World Trade Center in New York and the Sears Tower in Chicago, completed in 1973 and 1974, respectively.

Structural systems for tall buildings have experienced tragic changes since the end of the ordinary unbending casings in the 1960s as the prevalent sort of structural framework for steel or cement tall buildings (IS: 1893-Part-1,, 2002). With the development of the tubular shapes even now adjusting to the International Style, such changes in the structural shape and association of tall buildings were required by the developing structural patterns in design in conjunction with the budgetary requests and mechanical developments in the domains of sound structural analysis and design made conceivable by the appearance of high-speed digital computers. Starting in the 1980s, once-common Miesian tall buildings were then to a great extent traded by the veneer aspects of postmodern, authentic, diagrid and DE constructivist statements (SAP-2000, 2004. Chowdhury and Dasgupta, 2002). This was not undesirable on the grounds that the new era of tall buildings broke the repetitiveness of the outside tower structure and offered rise to novel high-rise representations. Imaginative structural systems including tubes, mega frames, center and-outrigger systems, falsely damped structures, and blended steel-cement systems are a percentage of the new developments since the 1960s.

CONCLUSION:

The design issues for preliminary design and optimization have been briefly summarized, and a rational methodology of design was shown. This enables optimization of initial structural systems for drift and stresses, based on gravity and lateral loads.

Some insight into the design of many types of tall building structural systems and their subsystems was provided based on past experience in tall building design. The design issues are efficiency of systems, stiffness, member depths, balance between sizes of beam and column, bracings, as well as spacing of columns, and girders, and areas and inertias of members. Drift and accelerations should be kept within limits. Good preliminary design and optimization leads to better fabrication and erection costs, and better construction. The cost of systems depends on their structure weight. This depends on efficient initial design. Efficient structural design also leads to a better foundation design, even in difficult soil conditions. The structural steel weight is shown to be an important parameter for the architects, construction engineers and for fabrication and assembly. We have discussed a wide range of Economic, Environmental, Resource and Social issues, illustrating ways to improve sustainability in all building types, and drawing out, where relevant, the opportunities or constraints applicable to tall buildings.

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