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Analysis of the Seismic Performance of Various Irregularly Shaped Concrete Columns on Residential Buildings

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Abstract

The shape of the columns can affect a structure's seismic resistance. A building's important structural and architectural components are columns. Seismic resistance requires lateral strength and stiffness. Architects and engineers commonly use L-shaped, T-shaped, and plus-shape for composite columns. The researchers assessed the capacity of irregular concrete columns under seismic stress circumstances, which may help structural designers for future designs. In order to accomplish this, the researchers investigated and analyzed the seismic strength of the columns using STAAD, as well as the finite element approach, which were used to validate the STAAD results. The results showed that using square columns for a three (3)-story building resists seismic waves better than other columns, while the irregular-shaped columns resist seismic waves better for five (5) and seven (7)-story residential buildings. Compared to rectangular and irregularly shaped columns, square columns are more ideal for low-rise residential buildings. For residential buildings over three floors, irregular-shaped columns are recommended to be able to withstand seismic waves.

Keywords: Seismic capabilities, storey drift, irregularly shaped columns, finite-element method

1.0 INTRODUCTION

Columns are structurally and architecturally critical elements of a building. The book De Architectura, published in the 1400s, established column measurements based on the number and type of columns to be utilized, as well as the temple style required. The height of the column was determined as a multiple of the diameter.

During the Elizabethan and Jacobean periods, large columns were brought to the greatest homes, although their proportions did not necessarily complement the property. Symmetry became increasingly essential during this period, and homes were designed to face outward rather than inside into courtyards.

In terms of structural behavior, a column is identical to a wall. In a perfect world, the column would be loaded axially rather than eccentrically, which would cause a moment and weaken the column (Smith, 2016). One of the challenges that structural engineers typically confront is balancing the architectural design with the seismic design of the project. Engineers are in charge of choosing a material that can withstand lateral forces operating on the system as well as gravity forces adding additional stress to the structure.

The basic criteria for a structural part to be seismically sound is that it be made of concrete. Its lateral strength and stiffness are resistant. All lateral loads resisting in the structure's components must be stiff to make the structural system more seismically resistant. Tremors have a complicated effect on the structure. The duration of a structure's shaking, the type of soil it's built on, and the frequency of earthquakes are all instances of this. To avoid the effects of tremors, a structure should be constructed to adapt to an earthquake. Design economy is achieved by allowing the structural part to flex beyond its elastic limit.

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