FAYOUM UNIVERSITY

FACULTY OF ENGINEERING

WEIGHT OPTIMIZATION OF 3D STEEL STRUCTURES CONSIDERING ARCHITECTURALLY CONSTRAINED BRACING SYSTEMS UNDER SEISMIC LOADS USING GENETIC ALGORITHM

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ABSTRACT

This study bridges the gap between optimization theory and practical structural design, contributing to the development of innovative engineering solutions that enhance safety, cost, and aesthetic appeal in the built environment. It introduces an advanced computational tool for optimizing steel structures, combining SAP2000's analytical capabilities with an enhanced Genetic Algorithm (GA) to refine bracing configurations while meeting safety standards and architectural constraints. A modified GA approach is incorporated to improve computational efficiency.

Through four distinct case studies—featuring both asymmetrical, irregularly spaced designs and symmetrical, uniformly spaced layouts—the tool demonstrates its versatility in handling complex structural challenges. The GA systematically explores design possibilities, minimizing structural weight without compromising stability, thereby improving cost and performance efficiency.

The findings validate the tool's practical application in real-world architectural projects while providing valuable insights for optimizing structural integrity in steel buildings. The research underscores the potential of computational optimization in advancing structural engineering practices.