Comparison of ABAQUS FEA with SAFE analysis of RC Waffle Slabs to evaluate their design cost saving

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ABSTRACT

A RC-waffle slab in a steel frame is simulated using both Finite element method (FEM) in ABAQUS as well as Csi/Safe as an integrated building design software which is a popular one in building design offices. Both concrete and steel is modeled as plastic materials and their plastic behavior is shown through static gravity loads in service design loading. The gravity loads have been applied according to the '*2800Loading Regulation'*.

The simulated results visualize static evolution of equivalent instantaneous slab creep, slab and steel column normal and shear stresses, especially around the concrete slab and steel column contact surfaces.

It is shown that the results obtained from FEM are less than those of in SAFE meaningfully, and the waffle slab can be designed much lighter from the perspective of reinforcement and supporting column. So it can be saved much costs in designing long waffle slab spans through analyzing them through FEM instead of integrated design software.

Keywords: Waffle slab, FEA, ABAQUS, CSI-SAFE, Steel Frame

۱. INTRODUCTION

Building weight reducing idea and implementation of Lightweight Structures were always attractive for structural engineering experts, scholars and researchers around the world and its proven effects on improving behavior and reducing the forces acting on the structure, has urged researchers to create new designs. Concrete slabs are of a significant portion of the overall weight of the structure. The overall weight of the roof of the structure depends on the type of slabs. Slabs as the first members bearing gravity and lateral loads as well as the task of creating rigid floor and undertake transferring of lateral forces to bearing members.

The Customer Relations detailed and accurate analysis and design is required. Reinforced concrete slabs due to advantages such behavior and performance, formability, ease of implementation and suitable thickness of the slab common and abundant use of this type of slab has great flexibility, in slabs with large span to control the deflection of the load and its weight must rigidity by increasing the thickness can ensure that this will weight gain and non-economic structural concrete slab the den design is virtually no light at the mouth of big bold does not apply.

In conventional two-way flat slab constructions, the need of longer spans and/or the necessity for heavier loads demands increased slab thickness in order to limit deflections. As a solution to this, concrete below the neutral axis is eliminated, this allows an economic increase on the total thickness of the slab with the creation of voids in a rhythmic arrangement. Therefore, there occurs a reduction on the structure self-weight and a more efficient use of materials, steel and concrete. The resulting slab system is typically denoted as waffle slab construction. For long span structures like auditorium, car parking slots and meeting hall which are having spans more than 20 m, providing columns within short spans for the structure will not be appealing and it occupies more space.

If flat slab construction is employed, the columns can be provided without soffit beams and at the corners of the floor system. Waffle and grid slabs are forms of flat slab construction and hence, the columns need not be provided and the entire floor is supported at the corner columns. This reduces the space occupied by the columns and also reduces the