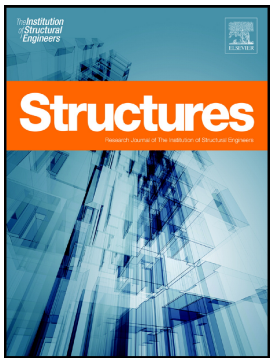

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The Effect of Cutting Openings on the Behavior of Two-Way Solid Loaded Slabs

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Abstract

It is often necessary to cut openings in existing two-way reinforced concrete slabs due to late design requirements. Those openings should be studied extensively; as they pose a break in the continuity of the reinforcing bars hence; they weaken the slabs and reduce their load carrying capacity. The purpose of this research is to investigate the behavior of two-way RC beamed slabs with openings introduced after casting. The method of cutting the slab under service loading and the strengthening methods' efficiency are the main parameters. Ten square reinforced concrete two-way beamed slabs were prepared to be tested experimentally. They were divided into two cases: (case A), and (case B). Case A consisted of: five slabs cast with a square 300mm side opening in the mid-span of the slabs, and case B was composed of: five slabs with no openings.

For (case A), the five slabs were divided into: a control two-way slab with an opening in the mid-span; which was not strengthened, three two-way slabs each with an opening in the mid-span; they were strengthened internally using extra reinforcing steel bars around the opening; which had different development length, and finally, a slab with a mid-span opening strengthened with externally bonded Carbon Fiber reinforcing polymer (EB-CFRP) laminates at the tension side. Whereas, (case B's) five slabs were: a square control slab, it was examined till failure to evaluate the slabs' capacity, and four two-way squared reinforced concrete slabs with no openings, they were tested following a certain sequence. It was as follows; the four two-way squared reinforced concrete slabs were loaded till the initial cracking load as that of the control slab. Then, the strengthening was installed, and the opening was cut at the mid-span. The loading continued till failure occurred. The strengthening was carried out using Near Surface Mounted Technique (NSM) and EB CFRP. Strength, deflection and energy dissipation were calculated, and compared for both groups.

The experimental results were verified numerically using Yield Line Theory.

Keywords

Two-way slabs, Openings, Near Surface Mounting Technique, Externally bonded Carbon Fiber Reinforcing Polymer, Near Surface Mounting Technique and Yield line Theory.

Introduction

Nowadays, we are living in a fast-paced world; the evolution had reached every aspect of life. In this technological era, there is always a continuous need of change. Many consumer goods were modified to adapt to the new situation. By the same way, buildings' uses were changed; which require several modifications as: cutting openings in existing slabs to situate cables, escalators,