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Stress Analysis of Hexagonal Element for Precast Concrete Pavements

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Abstract : While the use of cast-in-place concrete for an airfield and highway pavement overlay is very common, the application of precast concrete elements is very limited today. The main reasons consist of high production costs and complex structural behavior. Despite that, several precast concrete systems have been developed and tested with the aim to provide a system with rapid construction. The contribution deals with the reinforcement design of a hexagonal element developed for a proposed airfield pavement system. The sub-base course of the system is composed of compacted recycled concrete aggregates and fiber reinforced concrete with recycled aggregates place on top of it. The selected element belongs to a group of precast concrete elements which are being considered for the construction of a surface course. Both high costs of full-scale experiments and the need to investigate various elements force to simulate their behavior in a numerical analysis software by using finite element method instead of performing expensive experiments. The simulation of the selected element was conducted on a nonlinear model in order to obtain such results which could fully compensate results from experiments. The main objective was to design reinforcement of the precast concrete element subject to quasi-static loading from airplanes with respect to geometrical imperfections, manufacturing imperfections, tensile stress in reinforcement, compressive stress in concrete and crack width. The obtained findings demonstrate that the position and the presence of imperfection in a pavement highly affect the stress distribution in the precast concrete element. The precast concrete element should be heavily reinforced to fulfill all the demands. Using under-reinforced concrete elements would lead to the formation of wide cracks and cracks permanently open.

Keywords : imperfection, numerical simulation, pavement, precast concrete element, reinforcement design, stress analysis
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