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Abstract
This study aims at the evaluation of air cooling characteristics of vertical rectangular fins attached to a transceiver unit of the cellular base transceiver station (BTS) by laminar natural convection. The objective is to analyze the efficiency and performance of the transceiver unit's fins in peak and off-peak hours under different heating rate. The study items include (I) The influence of the rectangular fin surface along the height air flows on heat-transfer coefficient, (II) Simulation of temperature field using three-dimensional finite element analysis by commercial software PDE Toolbox, (III) Comparison of the fin's temperature distribution measured and simulated, (IV) Optimal design regarding fin thickness to fin efficiency (V) The best combinations for fin thickness and height, (VI) Analysis of optimal fin-to-fin spacing.
The simulation of temperature distribution conducted by PDE Toolbox was based on fin's geometrical model firstly and then different base temperatures in peak and off-peak hours were introduced as boundary conditions ; the heat-transfer coefficient adopted from literature around the fin exhibits that a decreasing trend with the increase of fin surface and an increasing heat-transfer coefficient with relatively higher base temperature. The simulation showed that an increasing temperature of fin along the air-flow direction. This result is in good agreement with theory of natural convection. and experiment. Then analyzing each parameter depends upon the fin efficiency and performance from several mathematical models in literature. The result shows that (1) the influence of fin efficiency is not much more obvious with fin thickness 2mm or 4mm; (2) under fixed heat-transfer coefficient, the fin thickness is as the proportion of the fin height; (3) in the range of laminar flow, the optimal spacing for fins was evaluated smaller than original design from maker. It indicates that fin spacing is allowed to smaller for better cooling effect.
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