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Stress and strain analysis of metal plates with holes BIYU HU, SANICHIRO YOSHIDA, JOHN GAFFNEY, Southeastern Louisiana University —
With our final goal of understanding how metal connectors used for housing respond to hurricane wind loads, we have conducted Finite Element Analysis (FEA) on metal plates with holes. FEA models have been built to analyze the stress and strain distributions in tensile-loaded, rectangular aluminum and tin plates. The specimen is 20 - 25 mm wide, 0.1 - 10 mm thick, and 100 mm long in the direction of the tensile axis along which two holes are drilled. We have varied the plate thickness and the hole-to-hole distance to study their effects. We have also conducted tensile experiment for specimens of the same materials and dimensions as the FEA using an optical interferometer to analyze the in-plane strain field. Comparison of the FEA and experiments indicates that band-like interferometric fringe patterns representing strain concentration coincides with the region where the von-Mises yield criterion is satisfied and that the specimen fractures at the hole that shows more concentrated plastic strain. These band-like patterns run through holes at about 45 deg to the tensile axis. Sometimes two conjugate bands cross at the hole. FEA with various thicknesses indicate that there is an optimum thickness at which the maximum plastic strain observed at an edge of the hole is minimized. This optimum thickness depends on the in-plane dimension of the specimen, but it always makes the plastic strain most evenly distributed between the two holes.

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