UNIVERSITY of HAWAIʻI at MĀNOA
MECHANICAL ENGINEERING

**Wednesday, April 1, 2026**
**10:00 am – 12:00 pm**
**Zoom: https://hawaii.zoom.us/j/89231368826**
**Meeting ID: 892 3136 8826**
**Passcode: 895743**

# EXPERIMENTATION AND SIMULATION OF THE EVOLUTION OF STRESS IN FILLET-WELDED A36 STEEL PATCH PLATES DUE TO CREVICE CORROSION


## Sonya Ling
Ph.D Candidate, Mechanical Engineering
University of Hawaiʻi at Mānoa



## Abstract
Industry has used A36 steel for structural purposes to include buildings, bridges, and structural membrane for tanks because of its material properties (tensile and yield strength), and its machinability and weldability. A36 is a mild, low carbon steel alloy that corrodes when mitigation is not in place and corrosion products can occupy up to five times the volumetric space. This unique characteristic of expansion can become problematic when corrosion occurs in a crevice. For example, industry uses fillet-welded A36 patch plates as repairs to existing material that produces a crevice. When corrosion occurs, the resulting expansion can propagate stress and plastic strains to the weld-plate interface and cause permanent deformation. This can undermine the structural and material integrity of the weld and plate system. The impact is investigated using Finite Elemental Analysis (FEA) to validate and evaluate the corrosion effects on the weld and plate system for defect sizes of ¼, ½, 1-, and 2- inch diameter holes and the effectiveness of Jotun 86, an inorganic zinc silicate corrosion inhibiting coating. This study utilizes data collected through experimental testing through environmental exposure in the presence of corrosive chlorides, for 24 months, and lab exposure testing that replicates prolonged, accelerated periods of time for 300 cycles. A validation test and COMSOL Solid Mechanics FEA was performed to find agreement between the model and the controlled experiment. The model was refined and executed for the experimental plate configurations and the resulting FEA von Mises stress, equivalent plastic strain, and displacement plots were used to determine the effect of crevice corrosion and the effectiveness of the use of a coating. COMSOL was also used to model and simulate the patch plate as the resulting corrosion cell. COMSOL Corrosion Module modeled a thin, 10 μm, and thick, maximum displacement observed ~10 mils (≈254 μm), electrolyte film, and the impact of film thickness on the corrosion potential and current density of the plate and hole sizes were evaluated.


## About the Speaker

Sonya Ling is a PhD candidate in the Hawai'i Corrosion Lab under Dr. Lloyd Hihara. She graduated with her B.S. and M.S. in Mechanical Engineering from the University of Hawai'i at Manoa. She has over a decade of industry experience working for the U.S. Navy in safety and Ship Design. Her current role is at Naval Sea Systems Command as the Deputy Bridge Design Integration Technical Warrant Holder, providing engineering and integration support to the U.S. Navy ships.