SafeBuild: Risk-Based Analysis of Overhead Electric Distribution Facilities

Lew, Jennifer (School: Palos Verdes Peninsula High School)

Every year in California, broken utility poles and conductors ignite approximately 500 fires. In 2017 and 2018, four utility-caused fires destroyed 27,000 buildings, killed 133 people, and caused $35 billion of damage. These incidents occurred because utility companies' faulty software prevents them from calculating how much wind their infrastructure, e.g., poles and conductors, can withstand before breaking and igniting a fire. Existing pole design programs rely on an outdated methodology that does not account for material strength variability. As a result, existing programs lack the mathematical ability to calculate a probability of failure for a component due to external conditions such as a wind gust or the impact from a falling tree branch. A finite-element based structural engineering program called SafeBuild was created that employs a risk-based methodology for designing poles, crossarms, and conductors. SafeBuild calculates the stress on poles, crossarms, and conductors using beam elements, stress elements, and cable elements, respectively. Subsequently, SafeBuild calculates the probability of failure of any component using z-scores based on material median strengths and coefficients of variation. SafeBuild also models other forms of failure that do not involve wind. SafeBuild models the electromagnetic and thermal properties of conductors to determine if they will melt under abnormal currents. SafeBuild also models fatigue failure due to wind drag and lift forces. SafeBuild will decrease the number of wildfires by allowing users to design poles, crossarms, and conductors to withstand external conditions to any desired confidence level. Future work includes 3D modeling and linking an SQLite database.

Awards Won:

Fourth Award of $500