ENGINEERING-BASED TORNADO DAMAGE ASSESSMENT (ETDA) TOOL: METHODOLOGY OF TORNADO WIND FIELD AND WILD LOAD CHARACTERISTICS ESTIMATION

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Prevatt and Peng (2014) developed an Engineering-based Tornado Damage Assessment (ETDA) Tool, that can be used to estimate the tornado damage caused to communities with a simple set of engineering inputs from typical structures and the size and strength of the tornado. The ETDA numerical tool was developed in MATLAB to compute the aggregated total damage and economic loss occurring to low-rise wood framed structures located within the passage of a tornado. Using a Monte-Carlo simulation engine, the ETDA Tool integrates four modules: 1) Tornado Wind Field module, 2) Tornado Wind Load module, 3) Wind-borne Debris module, and 4) Structural Resistance module. Validation of the predictive power of the tool was established using empirical data from a tornado damage data set from the Garland/Rowlett Tornado in Texas 2015.

In this paper, the authors seek to demonstrate an improved predictive power of the ETDA Tool by implementing modifications to the tornado wind load and wind field modules. Currently a simple Rankine Vortex Model (1888) is implemented, which includes many simplifications and assumptions for wind flow that are unrealistic. The authors will implement the recently developed Baker Vortex model (2017) which is more physics based and includes fewer assumptions. Using the existing empirical data set from the Garland/Rowlett tornado, the predictive power of the modified ETDA Tool using the Baker Model is compared against the previous version. The results are presented, and the paper also discusses special aspects, of tornado models in general and the uncertainties related to accuracy of the physical and mathematical description of the real tornado vortex used in engineering techniques. Finally, the future application and validation of the ETDA Tool is discussed in the context of utilizing Computational Fluid Dynamics (CFD) simulations for further incorporation to the Tornado Wind Load module of the ETDA Tool.