APPLICATION OF THE RESIDENTIAL TORNADO DAMAGE DATABASE TO QUANTIFY WIND SPEEDS ASSOCIATED WITH COMMON DAMAGE TYPES

Marc Levitan[*1], Pataya Scott[1,2], Timothy McIntyre[1], Harrison Kraus[1]

[1]National Institute of Standards and Technology, Gaithersburg, MD 20899, USA; [2]Texas Tech University, Lubbock, TX 79409, USA.

*marc.levitan@nist.gov

Using the Residential Tornado Damage Database being developed at NIST, as described in the THWARTS presentation by Scott et al., we have begun to explore relationships between building architectural characteristics and levels of damage, as a function of tornado hazard characteristics. Additional relationships explored using the database include how modeled estimated wind speeds at homes with various types and intensities of damage occur compare to estimated wind speed ranges assigned to the ten Degrees of Damage (DoDs) for the one- and two-family residential structure (FR12) Damage Indicator (DI) in the Enhanced Fujita (EF) Scale.

Each house in the database contains detailed information on the type, extent, and location of damage visible from available aerial and ground-based photographs. Damage fields in the database include (but are not limited to) the damage descriptors used to determine residential DoDs, such as: percent of roof cover loss, roof deck loss, and exterior wall failure; inward collapse of garage doors; house shifting off foundation; and all the others described in FR12. DoDs are assigned to each house automatically by interrogating the appropriate damage database fields against rules based on the FR12 DoD descriptions. This process has several disadvantages compared to the traditional approach of assigning DoDs based solely on fieldwork, including having to rely on expected values for wind speeds since the imagery does not provide enough detail to be able to adjust toward the upper or lower bounds. The database method also has several advantages, including a better view of roof damage than is often available from the ground. Significant advantages and disadvantages of the database method for assigning DoDs will be addressed in the presentation. An analysis of the range of estimated wind speeds associated with each of the ten DODs will be presented, along with the relative contributions of damage types (roof, wall, garage door, etc) to the assignment of DoDs.

One specific type of failure will be discussed in further detail. Garage door damage was investigated as a function of estimated peak wind speed and direction. The consequences of garage door failure, such as subsequent failures of adjacent walls and/or the roof over the garage, have previously been documented at least anecdotally in the literature. Preliminary analysis of the damage database seems to show a very strong and quantifiable linkage between garage door failure and localized additional damage, as well as increased damage to the building as a whole.