

Nonlinear Finite Element Analysis of Non-Structural Components Anchorage under Extreme Wind Loads

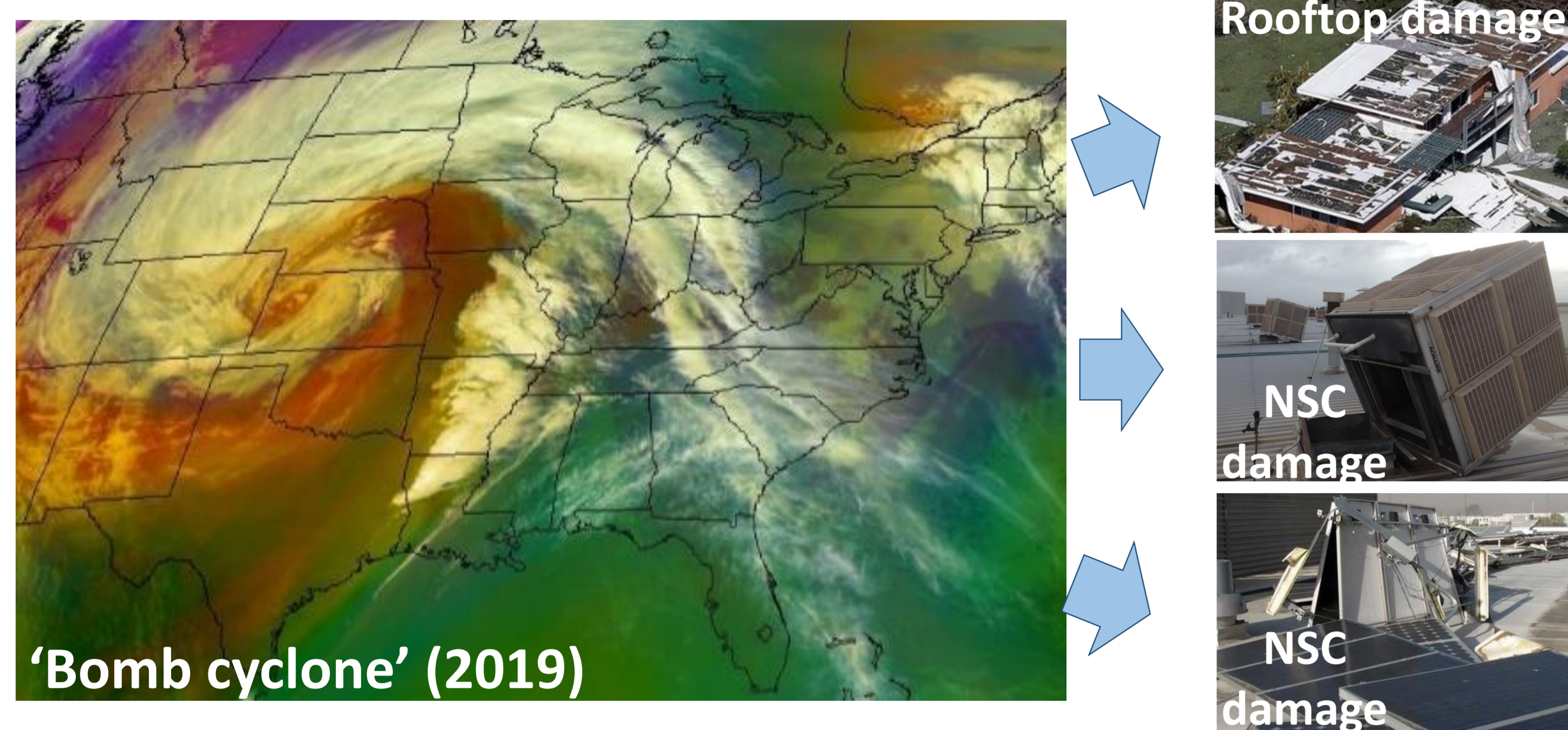
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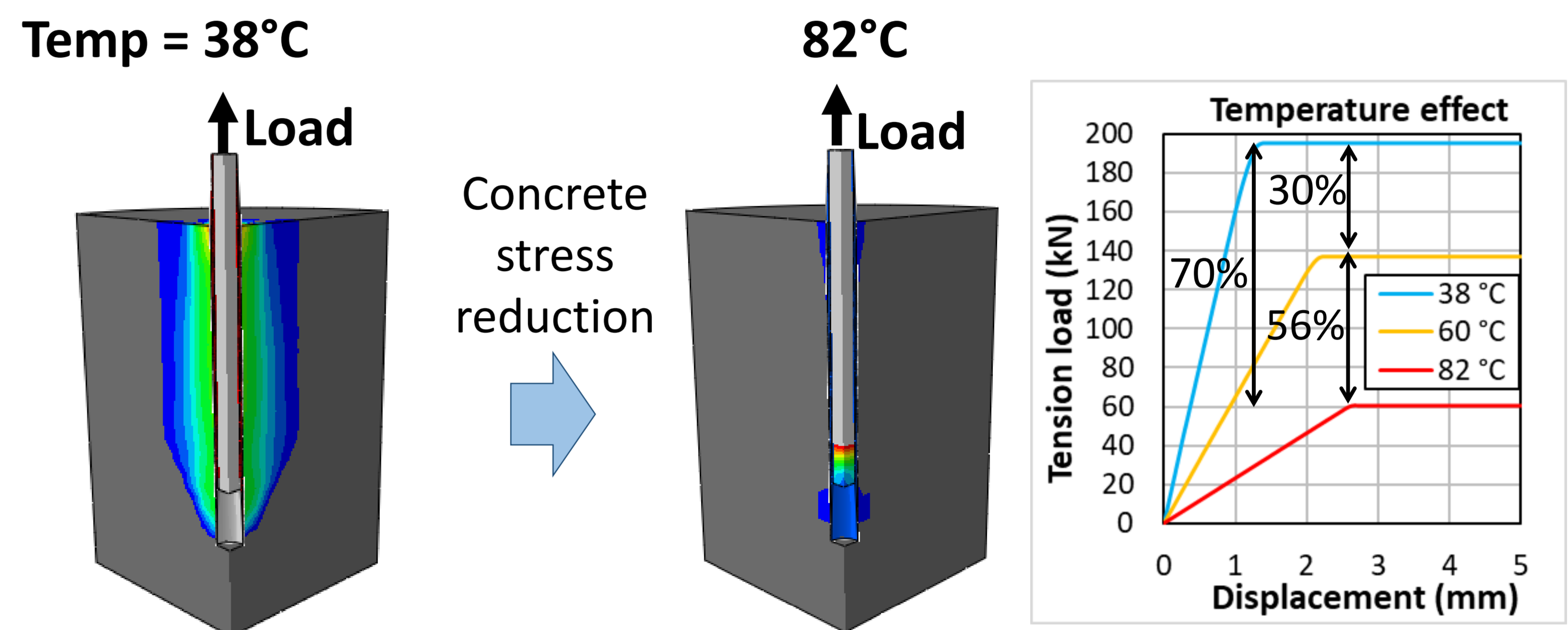
Problem Statement

12 billion dollars are spent yearly due to hurricane damage to non-structural components (NSC). The influence of **adverse environmental conditions** and **highly-dynamic loads** has not been quantified.



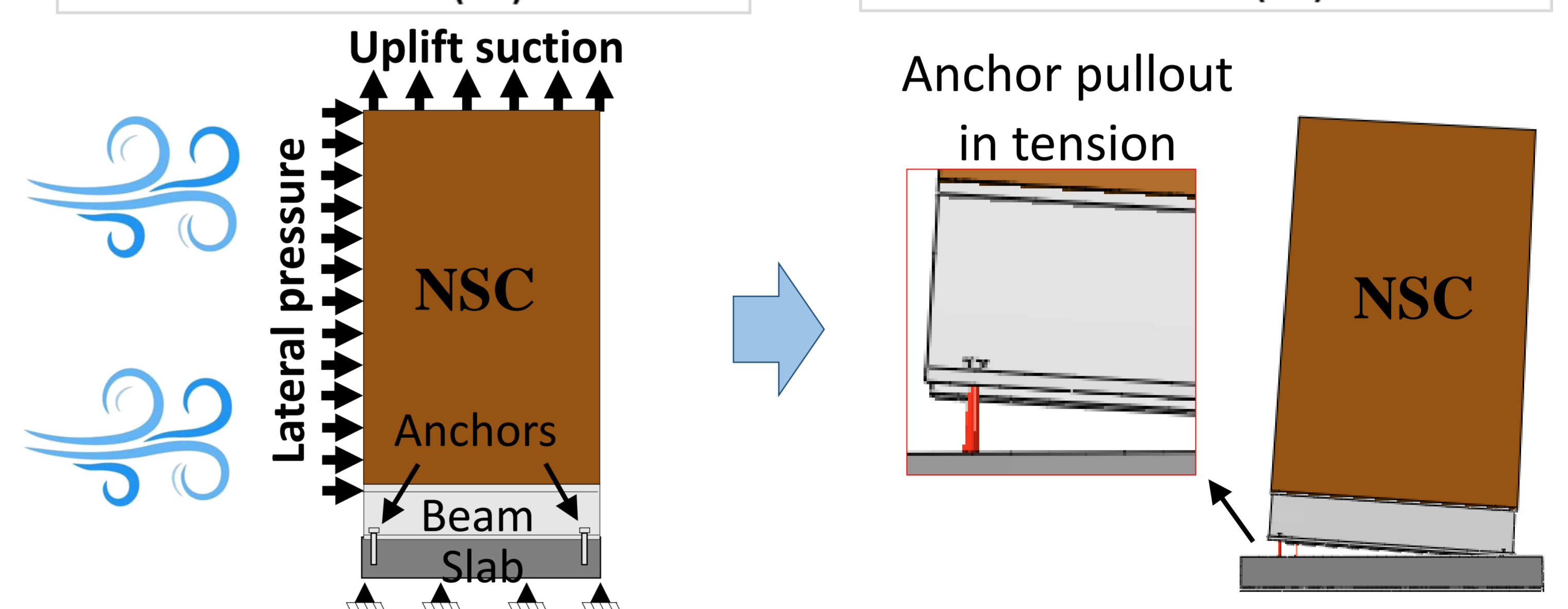
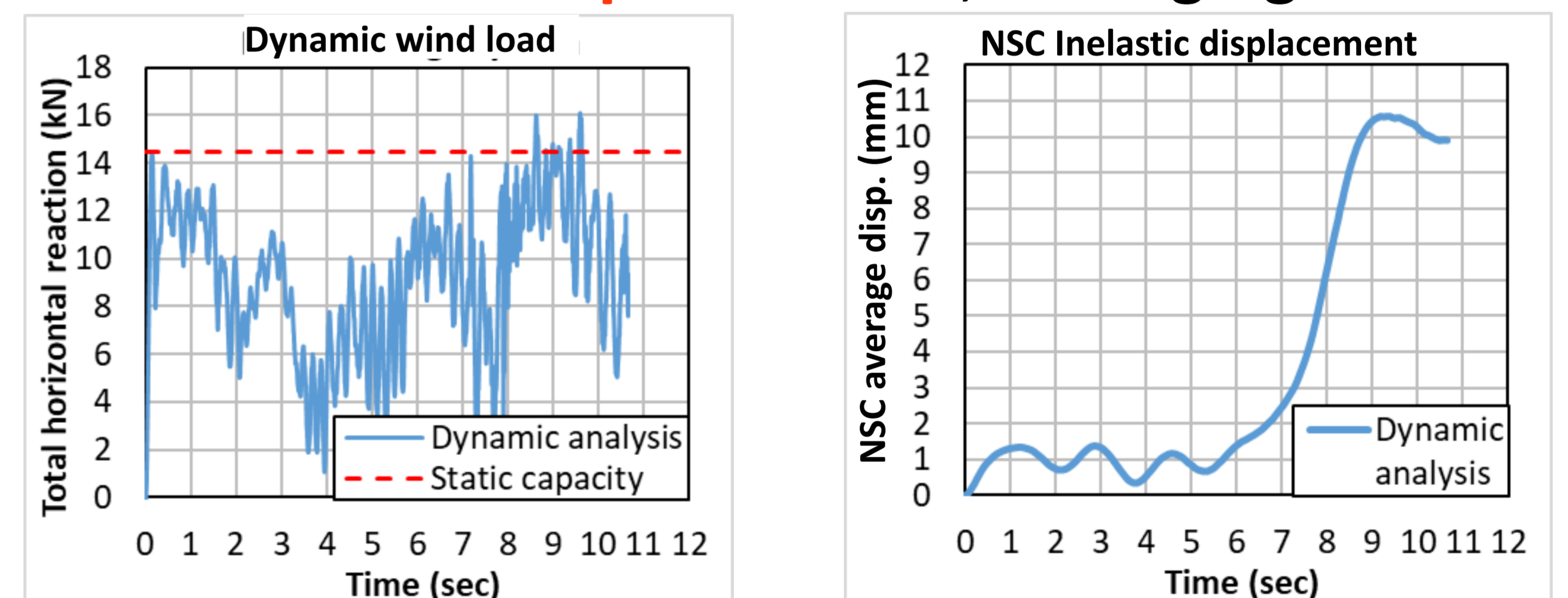
Temperature Effects

Rooftop temperatures in the U.S. can **exceed 75°C** and **decrease the anchor strength** by up to **70%**.



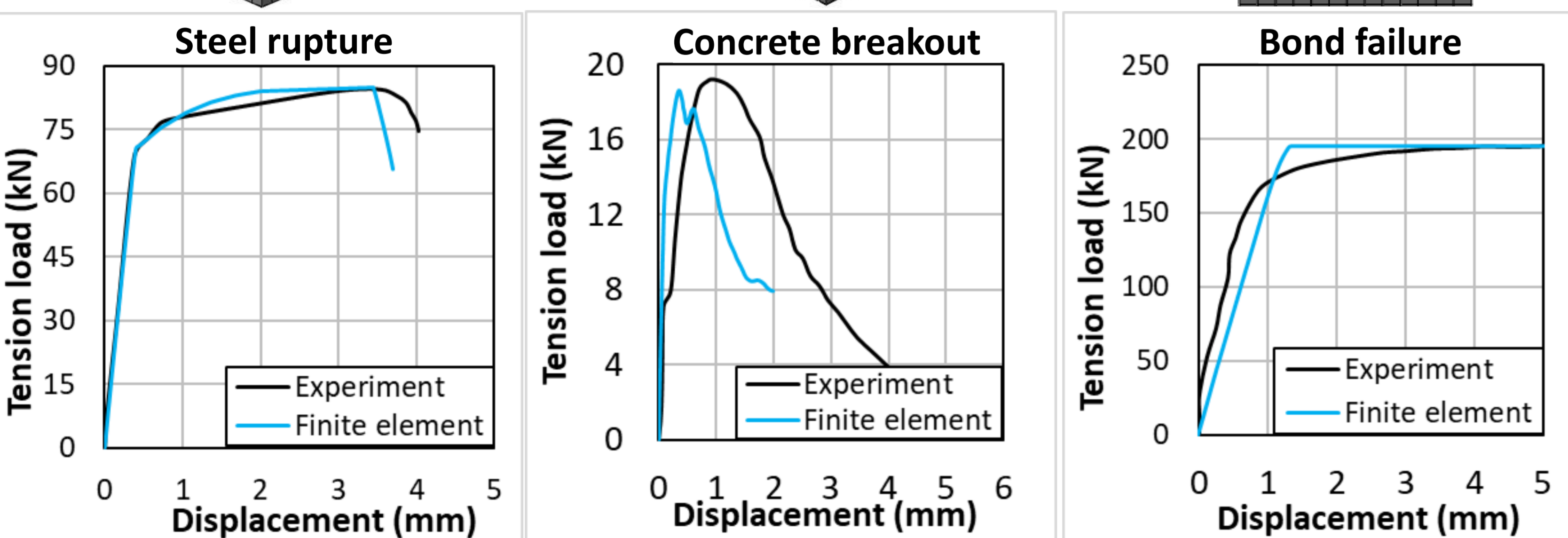
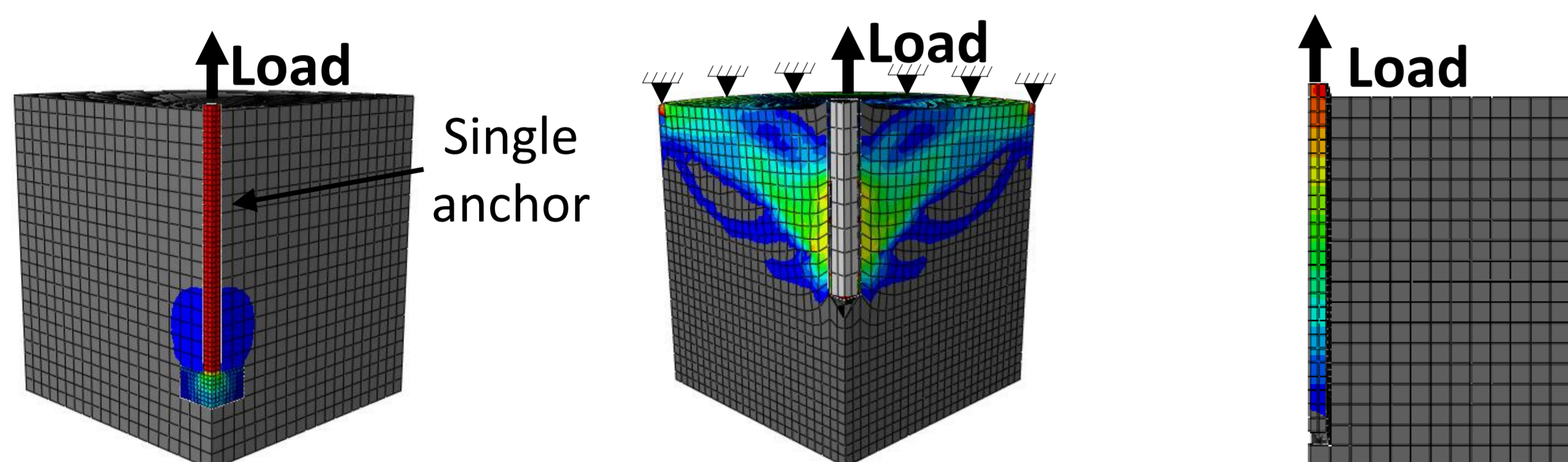
System-Level Analysis

Wind loads are highly dynamic and repetitive. They promote loads higher than the static capacity and **significant inelastic displacements**, damaging the NSC.



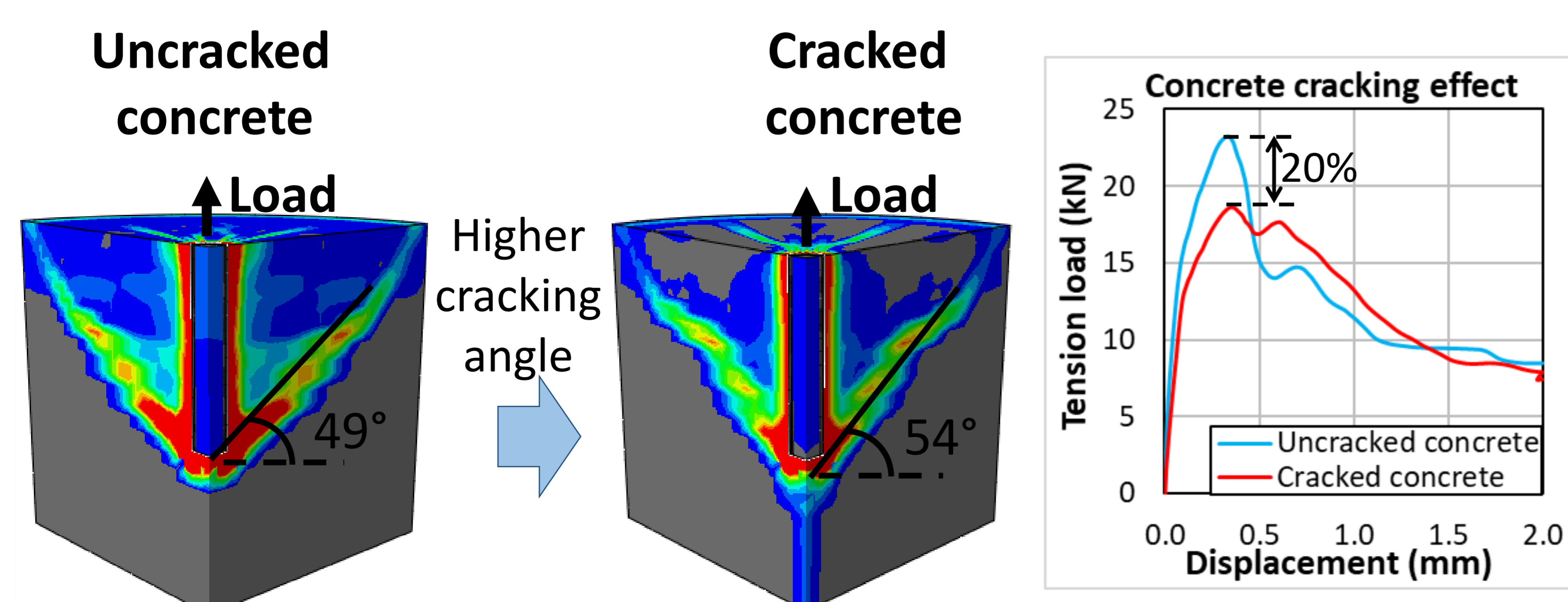
Finite Element Modeling

Finite element (FE) models can capture the **main anchor failure modes**.



Concrete Cracking Effects

NSC anchorage is subjected to existing rooftop concrete cracking, which can **reduce the anchor capacity by 20%**.



Conclusions

- The **hurricane dynamic load capacity** was found to be comparable to the static capacity.
- Hurricane loads** cause inelastic displacement, which damages the NSC before its load capacity is reached.
- Thermally-resistant** resins must be used to prevent premature temperature-related anchor failure.
- Rooftop concrete cracking** increases the concrete breakout angle, reducing its load-resisting area.