

Principal Investigator:

Pradepp Kurup (University of Massachusetts Lowell)

Co-Principal Investigators:

Christopher Niezrecki (University of Massachusetts Lowell)

Raj Gondle (University of Massachusetts Lowell)

Student Researchers:

Husham Osman & SreeSnigdha Kolachana (University of Massachusetts Lowell)

IAB Mentors:

Ron Grife (Leeward Renewable Energy)

Adam Johs (EDP Renewables)

The dynamic forces combined with high fatigue loading on a wind turbine may result in foundation failures and affect the expected design life. Excessive tower displacements, tilt of a tower, or foundation cracks are some of the common foundation concerns. When the displacement worsens, it could lead to progressive failure due to fatigue and in some cases can even result in a cone pullout or overturning of the tower. The current practice of structural health monitoring of the foundation includes visually inspection of a turbine on a periodic basis. When surface cracks or water ingress into the foundation is reported, high-precision sensors are adopted for foundation monitoring, which can be time-consuming and very expensive. The project propose a novel, low-cost mechanical indicator to continuously monitor the wind turbine tower movement relative to the foundation. Some of the constraints placed on the mechanical indicator include: low cost, no electronics, readily discernable motion indication, and insensitivity to moisture. The mechanical device includes a spring-loaded rotary cam with a dial indicator that measures the displacement at the interface of the tower and the foundation. The device was field tested on several utility-scale wind turbine towers. The project report presents the results of field tests.

The displacement-monitoring indicator can be replaced as an effective tool for structural health monitoring of wind turbine foundations by significantly reducing the inspection costs per turbine. It is envisioned that these sensors will be deployed at large-scale to secure our energy infrastructure without compromising the lifetime of the asset.



Performance of the displacement-monitoring indicator operating at the base of a wind turbine tower's harsh environment.