GEOTECHNICAL ENGINEERING AND GEOMECHANICS RESEARCH SEMINAR

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FOUNDATION SOIL RESPONSE TO WIND TURBINE GENERATOR LOADING

A wind turbine generator (WTG) structure is typically supported on an large octagonal (at the base) mass of concrete and steel rebar reinforcement that supports overturning, rotational stiffness, and bearing capacity stability requirements. The overturning stability and maximum bearing pressure of the system vary as a function of wind speed and direction. The highly eccentric loading conditions (i.e., large ratio of overturning moments to vertical gravity loads) lead to an uneven pressure distribution that can be assumed (incorrectly) as a uniform soil pressure distribution over an oval-shaped effective area offset from the center of the foundation by the system eccentricity. However, this assumed distribution is mechanically incorrect. Current WTG foundation theory relies on elastic halfspace models that have been developed for other purposes, with little physical evidence to support the model in a WTG foundation system. Because of this, field verification of dynamic shear modulus values and pressure distribution assumptions are highly relevant to establishing mechanistically correct WTG foundation responses, along with dynamic stress-strain relationships versus depth correlations (relevant for stiffness and settlement analyses). UW-Madison is working with Heartland Community College (Illinois) on an instrumented field project, with emphasis on evaluating the dynamic forces and the foundation soil response to in-service wind action. The monitoring will measure dynamic force parameters (magnitudes and periods), monitor foundation soil responses, and analyze and develop recommendations for a mechanically validated, dynamic foundation response.

Bio: Dr. James Tinjum is an Assistant Professor in Geological Engineering and Civil and Environmental Engineering at the University of Wisconsin-Madison. During his 11 years as an engineering consultant with CH2M HILL (Denver and Philadelphia) and RMT (Madison), Dr. Tinjum worked as a geotechnical engineering consultant on projects involving landfills, water and wastewater plants, highway infrastructure, metals remediation, and power plants. Since Dr. Tinjum’s return to academia, he has established an energy geotechnics program at UW-Madison, emphasizing wind energy geotechnical design and geothermal heat transfer applications. Dr. Tinjum directs nationally recognized and attended engineering short courses, including Foundation Engineering Design and Wind Turbine Foundation and Tower System Design.