Lehrstuhl für Statik und Dynamik
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Mater‘s Thesis:

Modelling of extreme wind load scenarios: methods for structural design

This master’s thesis investigates methods for analysing and modelling extreme wind load scenarios on structures, with particular emphasis on faster ABL wind as well as non-synoptic wind events such as downbursts and tornado-like flows. These short-duration, high-intensity phenomena can generate large structural responses.

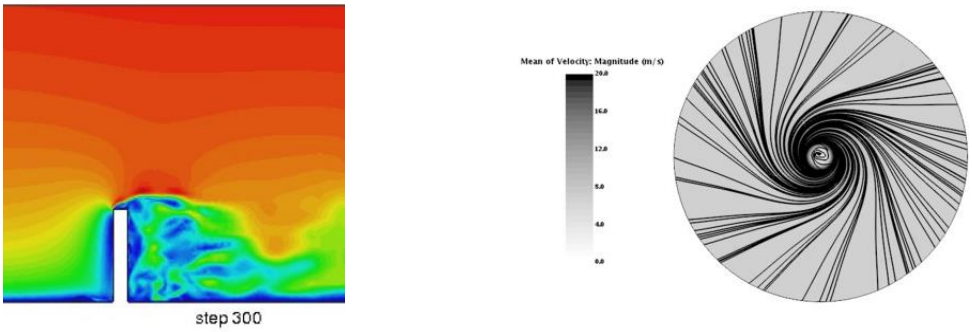

Figure 1: Flow around CAARC building under ABL (Left); non-synoptic wind profile [1] (right)

Using computational fluid dynamics (CFD), the study explores numerical approaches to represent both synoptic and non-synoptic extreme wind fields, evaluating their flow characteristics, turbulence structures, and resulting load effects on buildings. The models will be validated against available experimental and empirical data. Kratos Multiphysics will be used for the modelling. It is also interesting to look at probabilistic modelling of extreme winds. It is aimed to identify best practices for CFD-based assessment of extreme wind loads, contributing to improved structural resilience, risk-informed design, and the integration of non-synoptic wind scenarios into modern engineering frameworks.

Prerequisites:

- Structural wind engineering
- Background in Python, Kratos

Language: English

Start date: Summer Semester 2026

Supervision: Dr.-Ing. Anoop Kodakkal
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[1]:Gairola, A., Bitsuamlak, G. T., & Hangan, H. M. (2024). The effect of swirl ratio and surface roughness on the boundary layer of “tornado-like” vortices. *Journal of Wind Engineering and Industrial Aerodynamics*, 252, 105841