

# Wind Blade Analysis for Wind Power - Pre-Analysis & Start-Up

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Problem Specification

1. Pre-Analysis & Start-Up

2. Geometry

3. Mesh

4. Physics Setup

5. Numerical Solution

6. Numerical Results

7. Verification & Validation

Exercises

Comments

## Pre-Analysis & Start-Up

### Pre-Analysis

The governing equations to be solved using Ansys Fluent are shown below.

## Governing Equations

- Use rotating frame of reference
  - Don't need to move mesh in this reference frame
  - $\vec{v} = \vec{v}_r + \vec{\omega} \times \vec{r}$
- Reynolds-averaged continuity
  - $\nabla \cdot \vec{v}_r = 0$
- 3D Reynolds-averaged Navier-Stokes equation
  - with Coriolis and centripetal accelerations
  - $\rho(\vec{v}_r \cdot \nabla)\vec{v}_r + \rho(2\vec{\omega} \times \vec{v}_r + \vec{\omega} \times \vec{\omega} \times \vec{r}) = -\nabla p + \mu \nabla^2 \vec{v}_r + \nabla \cdot \vec{\tau}_{turbulent}$
  - The last term represents the turbulent or Reynolds stresses
- Equations for  $k$  and  $\omega$ 
  - $k$  and  $\omega$  are used to calculate the turbulent stresses from the averaged velocity field
  - $k$ : Turbulent kinetic energy
  - $\omega$ : Specific dissipation rate



[Go to Step 2: Geometry](#)

[Go to all FLUENT Learning Modules](#)