NOTUS

Fan Engineering

A State of the Art Approach to Fan Design and Manufacture

C Meyer & H van Kamp

"Scientists dream about doing great things. Engineers do them." – James A. Michener

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Company Profile

- NOTUS – Associated with the South Wind in Greek Mythology
- Co-owned by Hans van Kamp and Chris Meyer
- Born from 20-25 years of research on fans and cooling systems done at Stellenbosch University
- Hans van Kamp
  - Formal training at Fokker Industries (Dutch aerospace company) in aerodynamic and structural engineering
  - Manufacturing, Sales & Marketing
- Chris Meyer
  - Currently a professor at Stellenbosch University with a research focus on large-scale dry-cooled systems
  - Aerodynamic and Structural Design

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Custom Design Approach

- Not all fans are created equal
  - ESKOM's Matimba power station current fan replaced by Notus fan
  - Exactly the same volume flow rate was achieved
  - Power draw was reduced by around 20%
- Catalogue-approach forces users to compromise on performance
- Notus follows a custom design approach
  - Fan is designed for a specific installation/design criteria
  - Innovation allows for the cost-effective and rapid manufacture of new moulds
  - Manufacturing process is scalable, efficient and accurate

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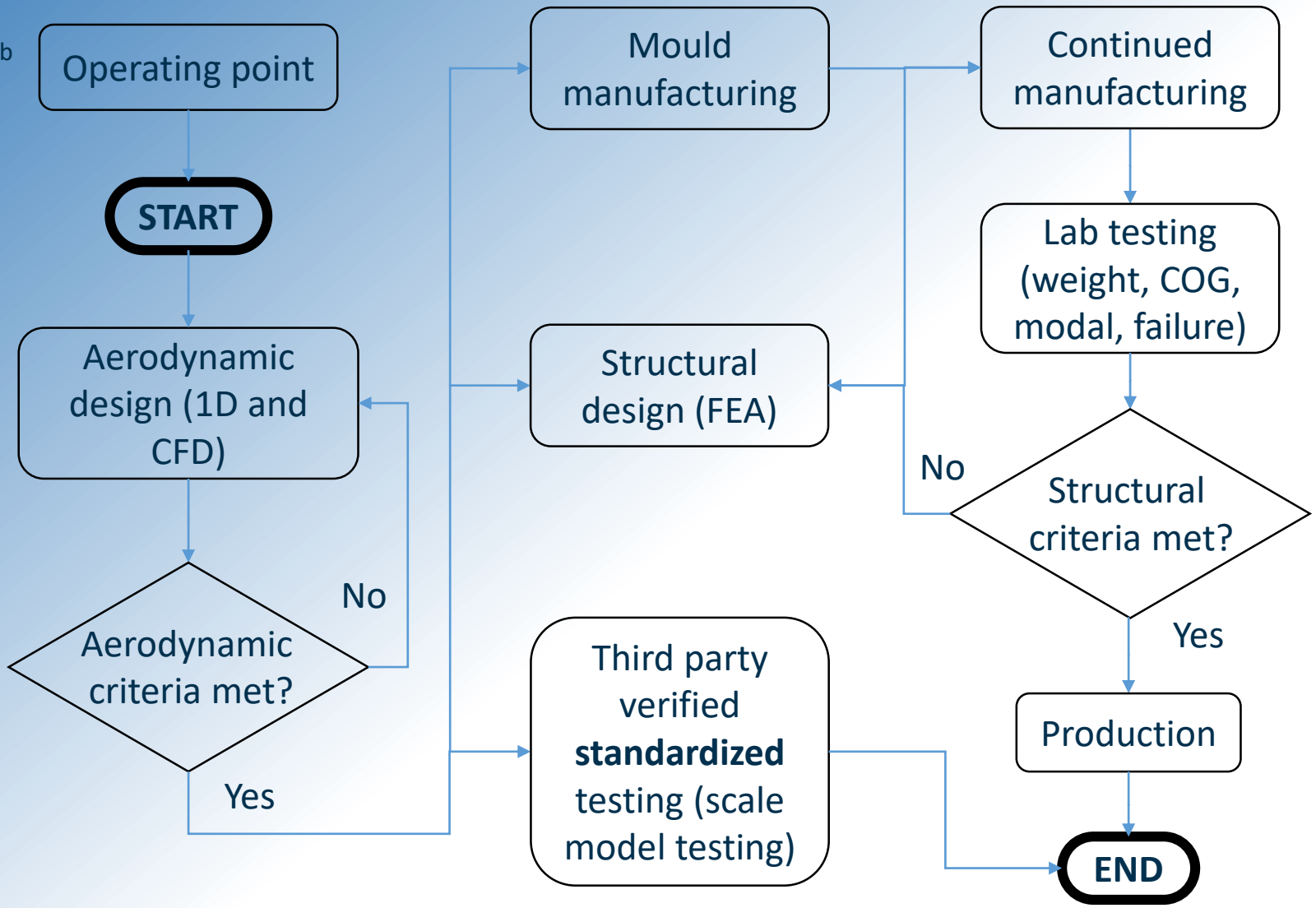
Only: V, Δp_{Fs}

Additionally: N_F, D_F, n_b

Noise, power and weight criteria



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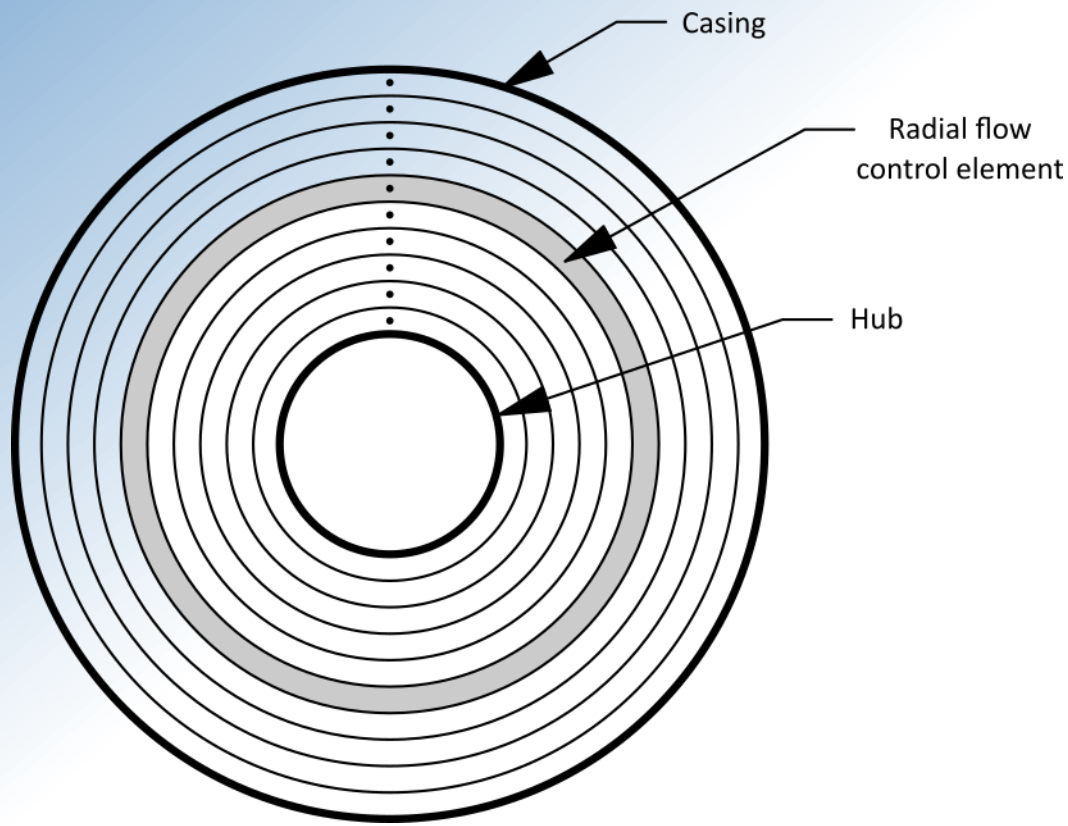
Aerodynamic Design

- First step – 1D flow field analysis and blading design



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Aerodynamic Design

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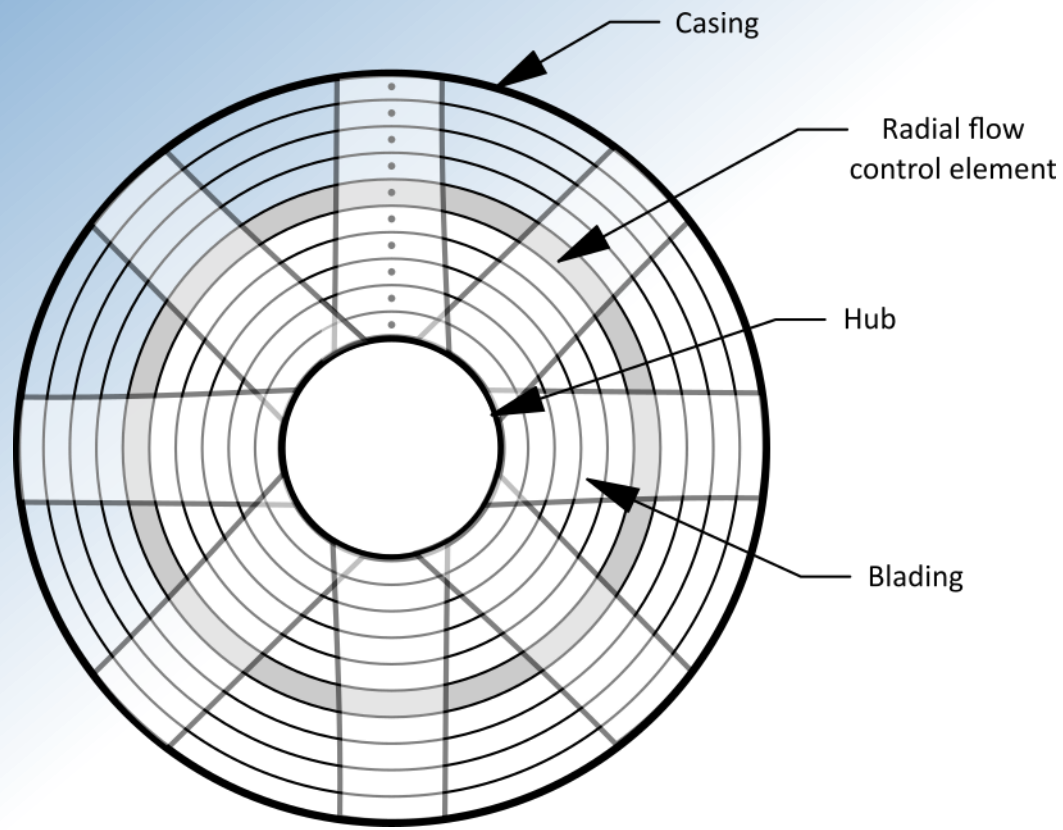

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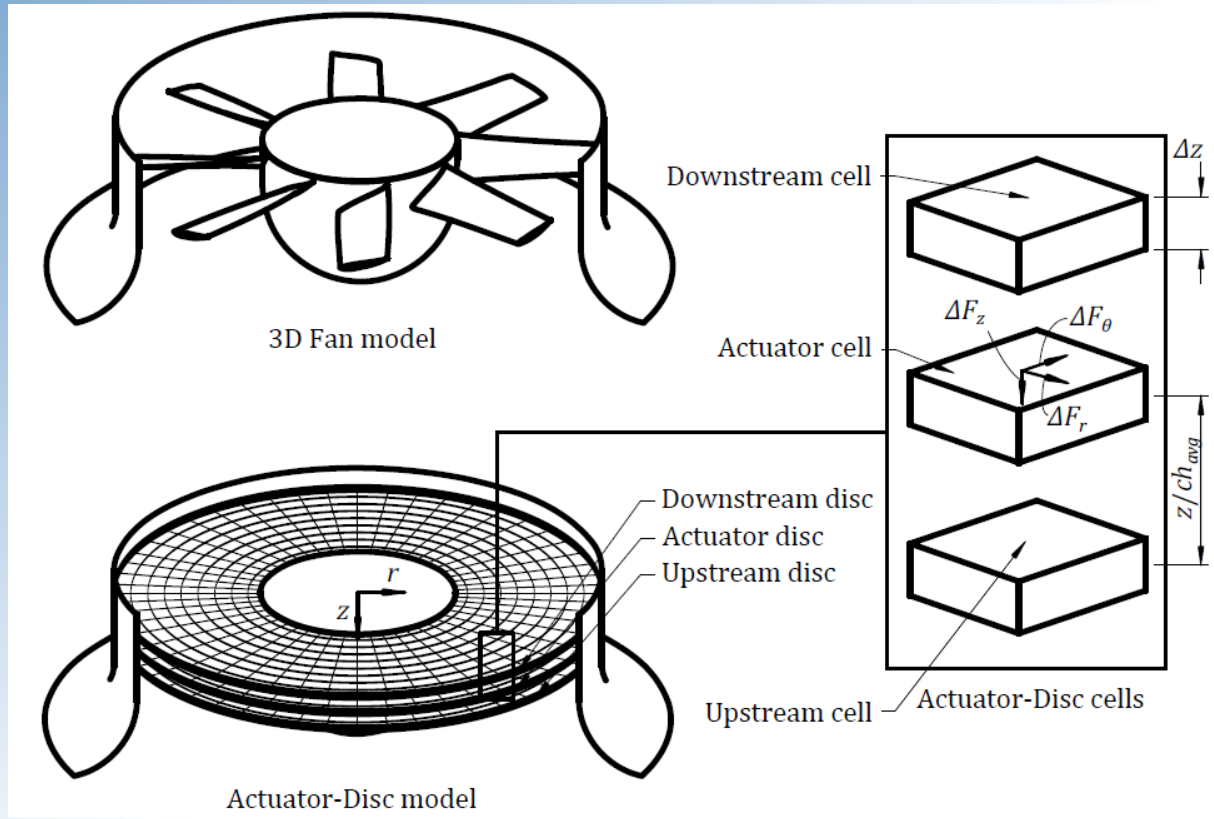
Aerodynamic Design

- First step – 1D flow field analysis and blading design
- Second step – Actuator disc CFD analysis



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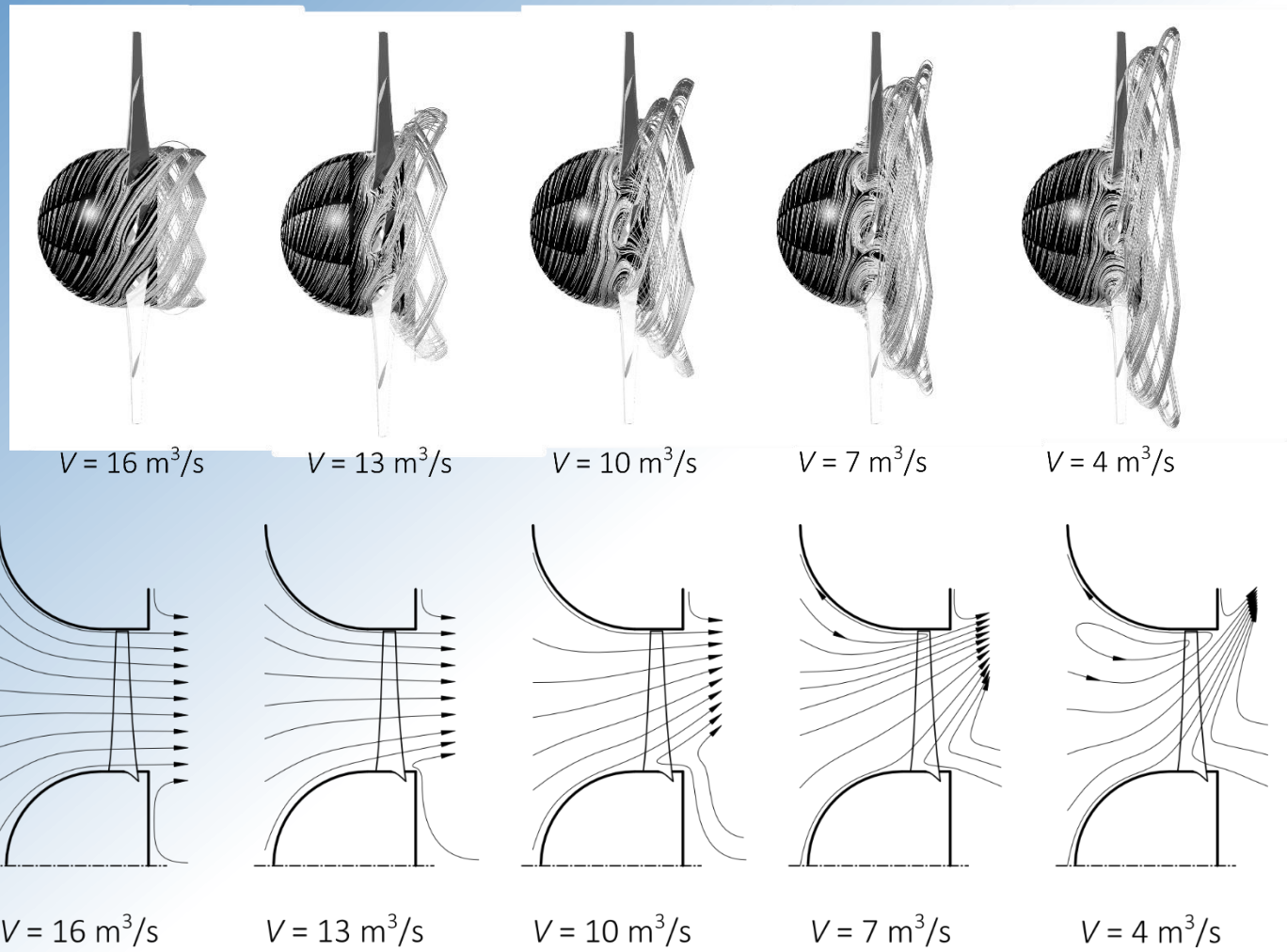

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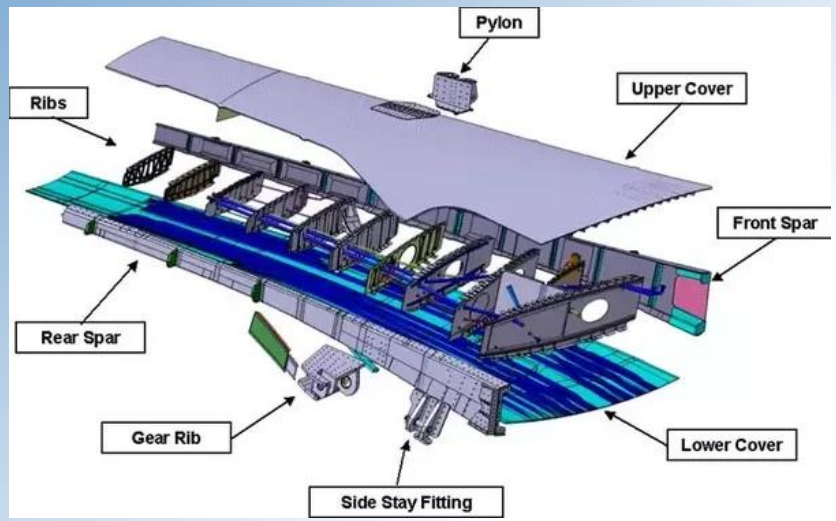
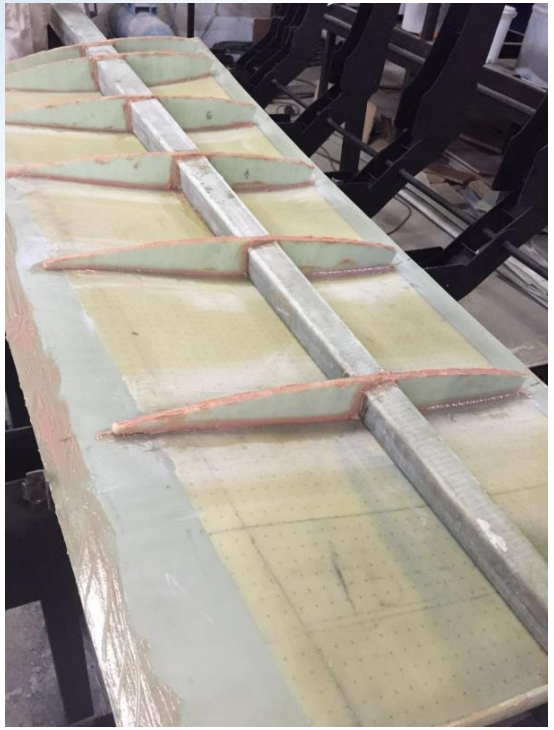
Structural Design

- Design philosophy similar to aircraft wing
- Design for steady **and** unsteady state conditions





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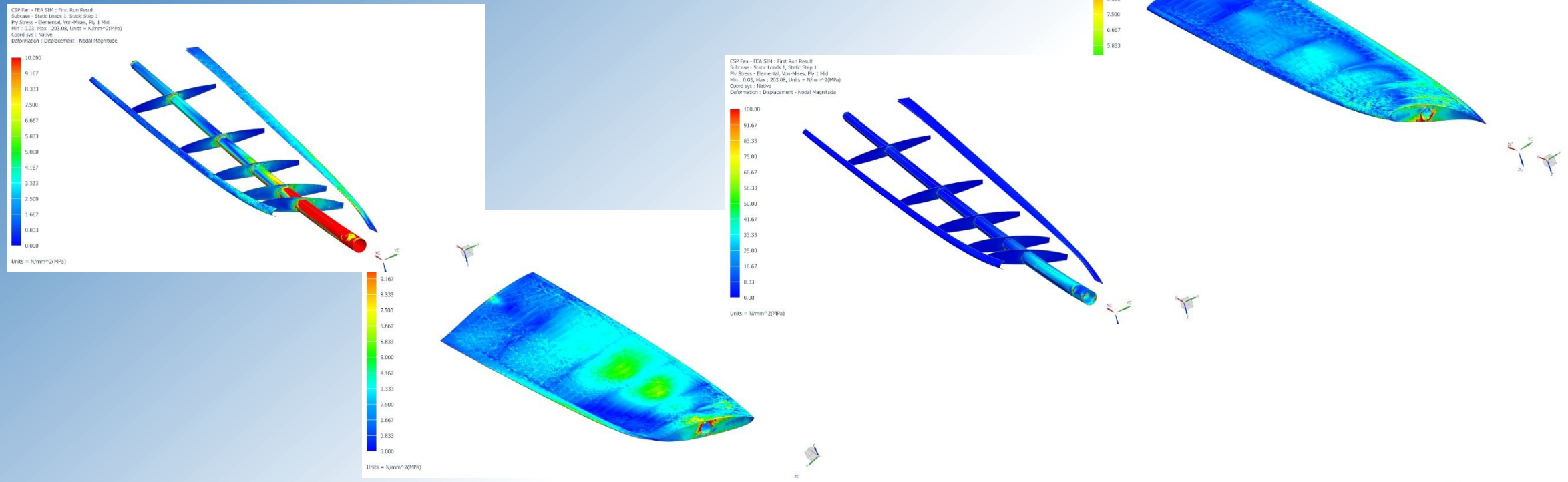
Structural Design

Loading conditions obtained from simplified CFD fan model

Max stress (FEM): 203 MPa, Break stress: 380 MPa



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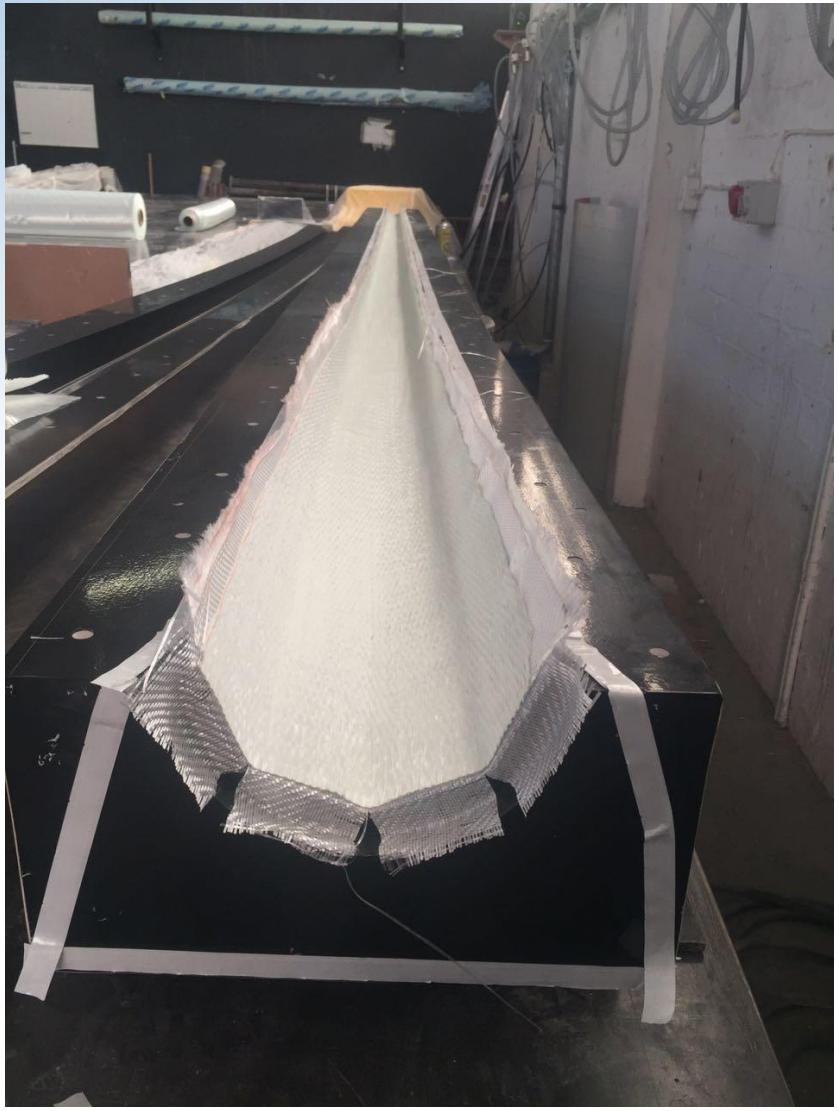
Manufacturing - Moulds



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Manufacturing – Resin Infusion

- Materials are laid dry into the mould
- Vacuum draws the resin into the laminate
- Optimal fibre-to-resin ratio is guaranteed
- Repeatable manufacturing process and results in a stronger, lighter and consistent product

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Manufacturing

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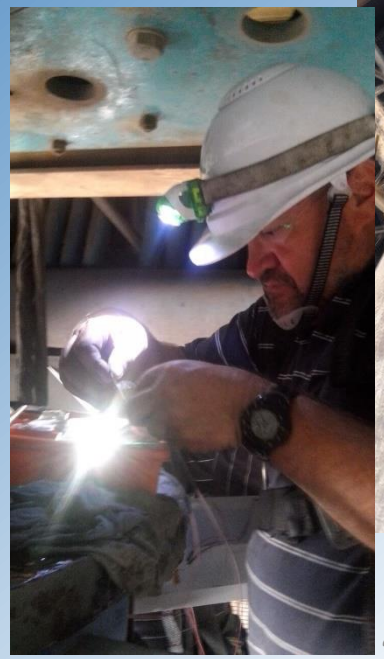
Matimba - Installation and Test Results



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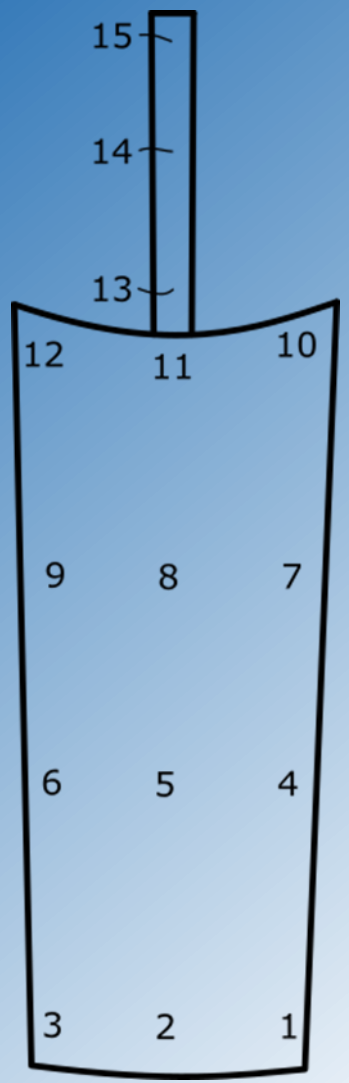
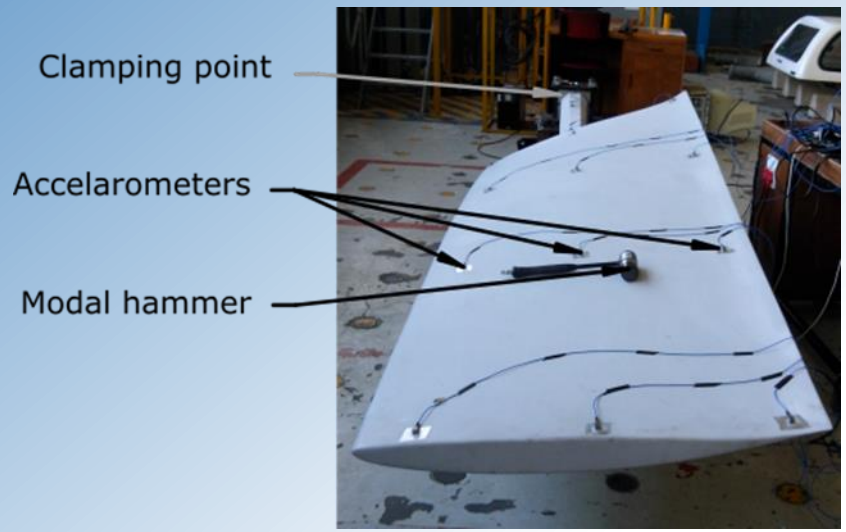
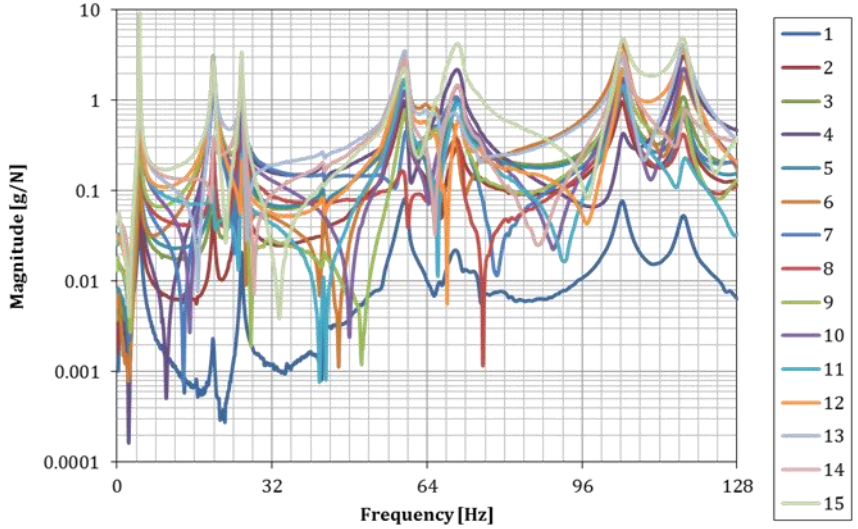
Matimba – Vibration Tests







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Matimba – Vibration Tests

Frequencies		Mode
Blade 1	Blade 2	
[Hz]	[Hz]	
4.63	4.60	1st global bending
19.82	20.02	1st global torsional
25.70	25.68	2nd global bending
59.39	59.02	Local mixed mode (torsion & bending)
70.27	67.30	2st global torsional
5.00	4.96	1st global bending (lag-wise)
42.74	42.27	2nd global bending (lag-wise)

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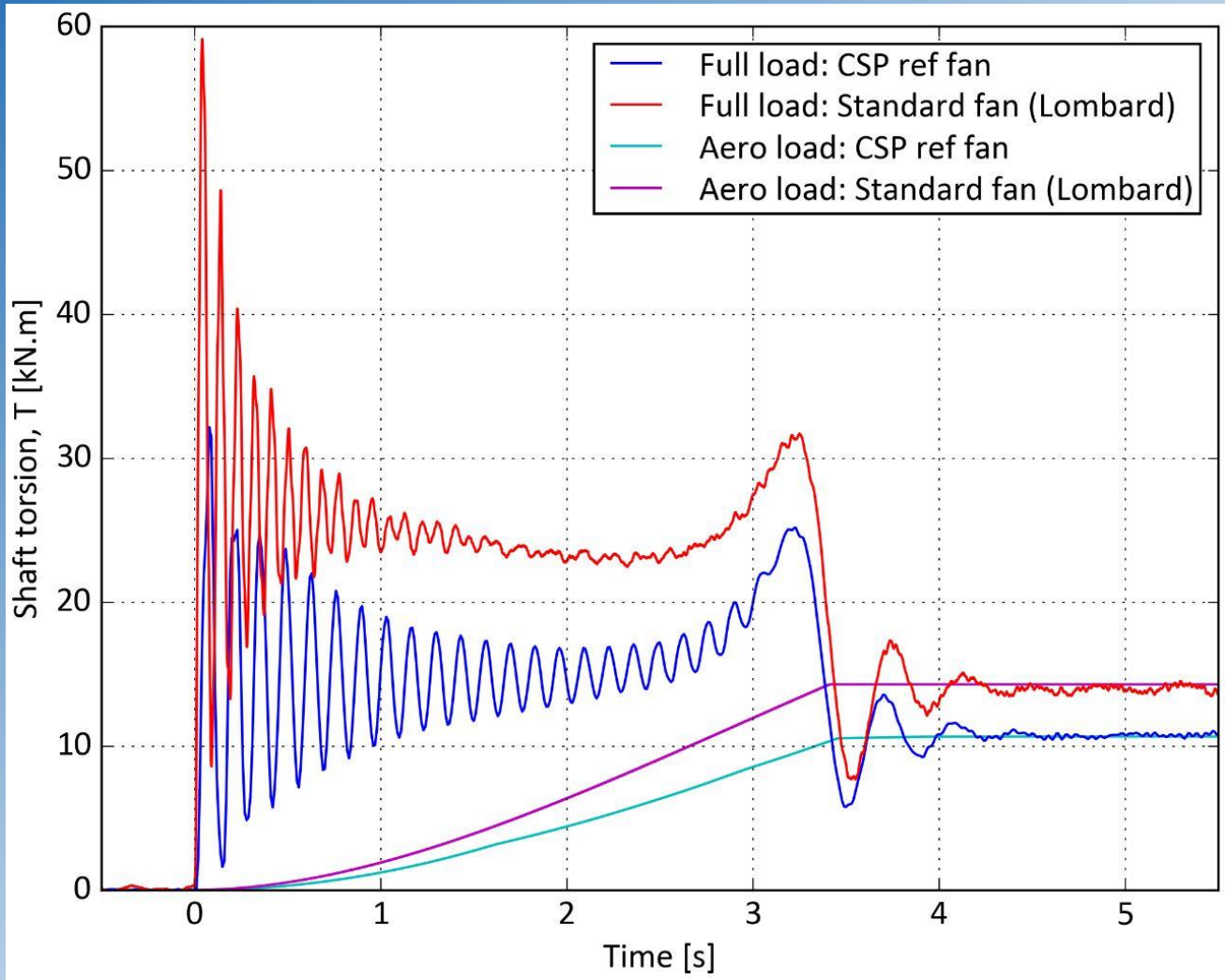
Matimba – Start-up and Running Torque



- Volume flow rates of both fans are similar
- Significant reduction in peak start-up torque: ±50%
- Running torque reduced by 20%
- 2 years continuous operation – no sign of fatigue/deterioration

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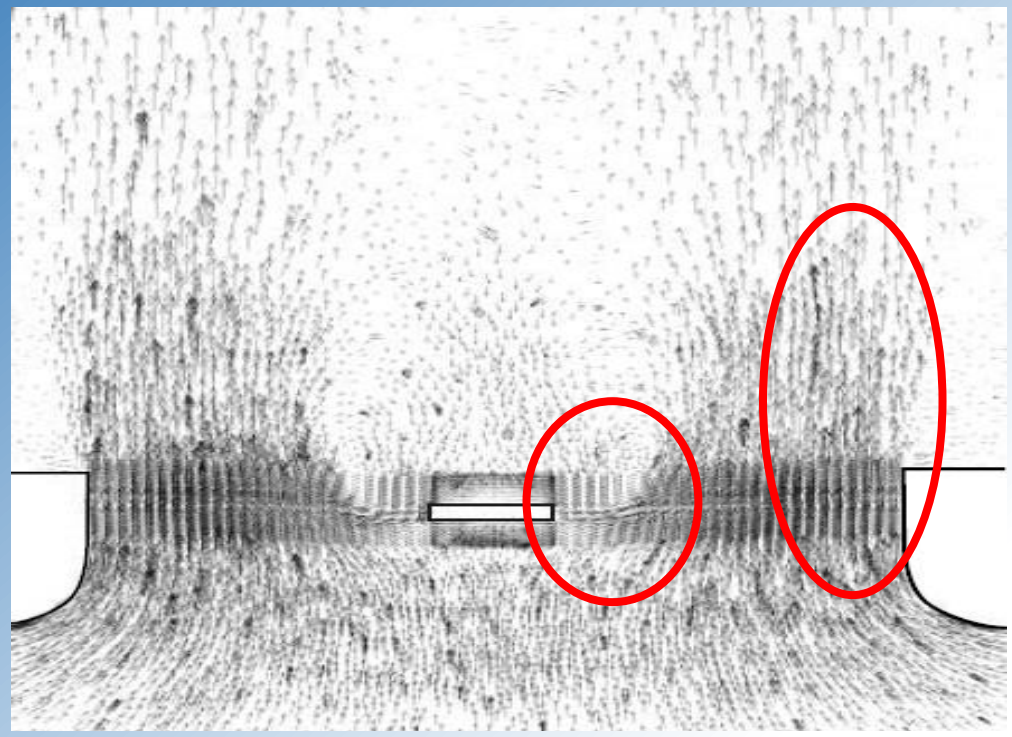
Matimba – Uni-Flow Fan

Existing Fan



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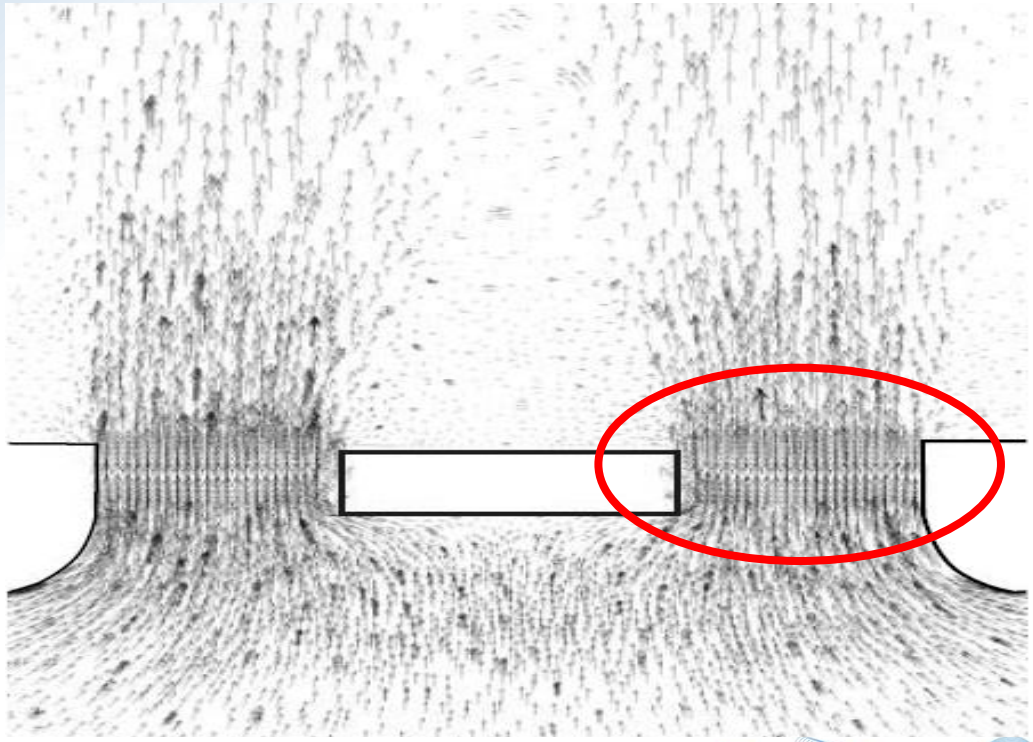

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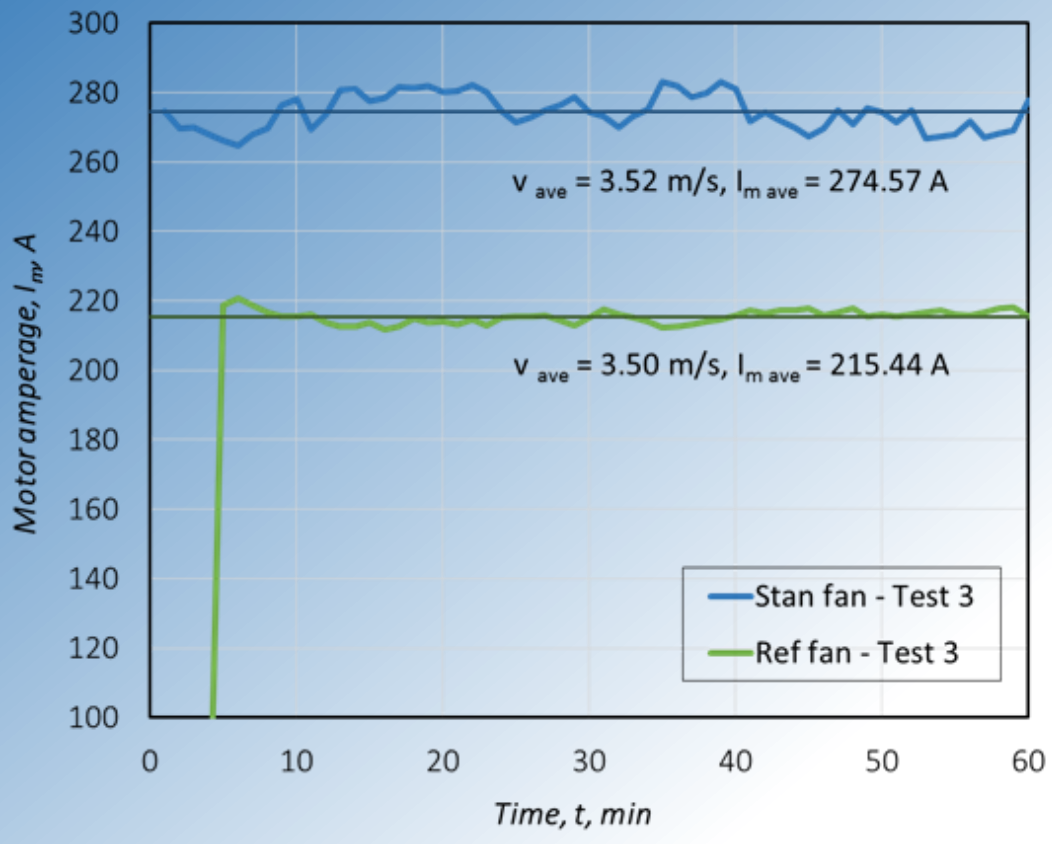
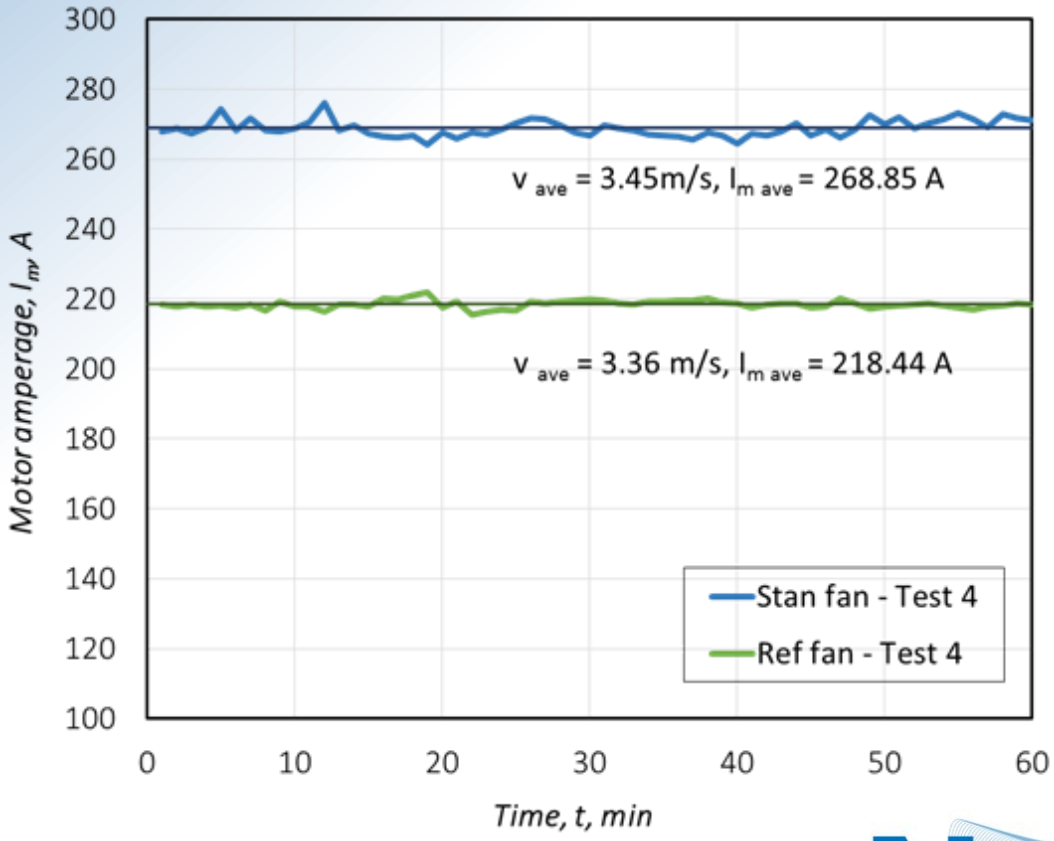
Matimba – Power Draw Reduction (20%)





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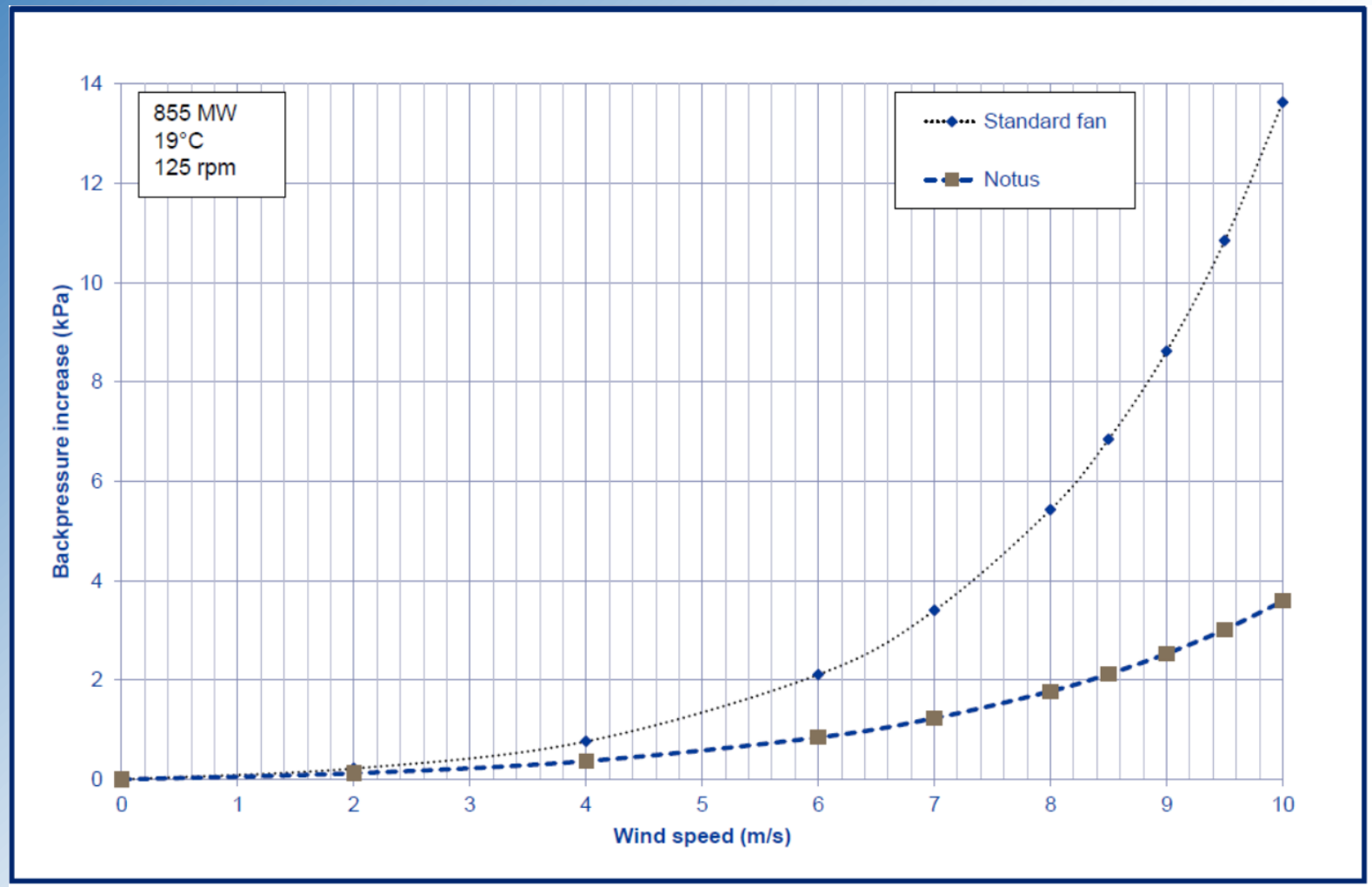
Matimba – Back Pressure Prediction (Eskom)



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Large Scale Test Facility
Stellenbosch University

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Large Scale Test Facility – Results

- Blade weights – within 1%
- All blades have near-identical natural frequencies
- Safety factor > 3
- Light-weight blade design – easy installation
- Accurate blade setting angle

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BIAS

Blade Indexing and Adjustment System

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THANK YOU !!!

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