Wind Turbine Blade Inspection Technologies Training Course

Professional Development Training Course Outline

Category	Renewable Energy	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Wind Turbine Blade Inspection Technologies Training Course provides a practical, future-focused foundation in advanced inspection, non-destructive testing (NDT), drone-based inspection, thermography, computer vision, artificial intelligence (AI), structural health monitoring (SHM), predictive maintenance, and digital twin technology for modern wind-energy assets. As wind farms expand and turbines become larger, inspection programs increasingly combine high-resolution optical imaging, infrared thermography, ultrasonic testing, acoustic emission, robotics, sensor analytics, and automated data interpretation. Recent research demonstrates growing integration of thermal/RGB imaging with AI for automated blade anomaly detection, while hybrid approaches combine drone screening with robotic ultrasonic assessment for deeper characterization.

The course develops the knowledge required to move from inspection planning and data acquisition to defect identification, condition assessment, risk-based decision-making, digital reporting, and predictive O&M. Participants examine emerging inspection workflows such as AI-enabled thermographic inspection, autonomous drone imaging, and digital-twin-enabled lifecycle monitoring. Current industry and research developments show increasing emphasis on safer remote inspection, reduced downtime, automated anomaly detection, and data-driven maintenance decisions.

Programme Curriculum

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Course Duration

5 days

Course Objectives

1. Understand wind turbine blade architecture, materials, failure mechanisms, and structural integrity.
2. Apply advanced visual inspection and drone-based imaging techniques.
3. Understand UAV-enabled inspection workflows, image capture, coverage, and data quality.
4. Interpret infrared thermography for surface and subsurface anomaly detection.
5. Explore AI, computer vision, machine learning, and anomaly detection for automated inspection.
6. Understand ultrasonic NDT, phased-array inspection, and volumetric defect characterization.
7. Introduce acoustic emission and structural health monitoring (SHM) for early damage identification.
8. Evaluate erosion, cracks, delamination, debonding, impact damage, lightning-related damage, and manufacturing defects.
9. Apply risk-based inspection (RBI) and condition-based maintenance principles.
10. Integrate inspection findings with SCADA, sensor data, and predictive analytics.
11. Understand digital twins and lifecycle asset-health management for wind turbine blades.
12. Develop professional inspection reports, defect classification, evidence management, and maintenance recommendations.
13. Evaluate emerging autonomous inspection, robotic NDT, multimodal AI, and smart O&M technologies.

Target Audience

1. Wind turbine inspection engineers
2. Wind farm O&M professionals
3. Blade maintenance technicians and supervisors
4. UAV/drone inspection professionals
5. NDT and condition-monitoring specialists
6. Renewable-energy engineers and asset managers
7. Reliability, integrity, and predictive-maintenance professionals
8. Engineering consultants, researchers, and technology developers

Course Modules

Module 1: Wind Turbine Blade Technology & Failure Mechanisms

- Blade **aerodynamics, composite materials, structural architecture, and load paths**

- Common damage mechanisms.
- Manufacturing defects versus operational degradation.
- Blade loading, fatigue, environmental exposure, and failure progression.
- **Case Study:** Lifecycle assessment of blade damage from manufacturing through operational maintenance.

Module 2: Drone-Based Visual Inspection & Computer Vision

- UAV inspection planning, flight concepts, imaging geometry, and data acquisition.
- **High-resolution RGB imaging** and automated surface-defect detection.
- Image quality, lighting, positioning, coverage, and inspection traceability.
- Computer-vision workflows for **segmentation, classification, and anomaly detection**.
- **Case Study:** Drone-based screening workflow for operational wind turbine blades, reflecting current industry approaches using high-resolution imagery and AI-enabled analysis.

Module 3: Infrared Thermography & Thermal Inspection

- Fundamentals of **infrared thermography** and thermal signatures.
- Passive thermography for identifying potential subsurface anomalies.
- Thermal-image acquisition, environmental influences, and interpretation.
- **Multimodal RGB + thermal imaging** and AI-assisted anomaly detection.
- **Case Study:** DTU's **AQUADA** technology combines drone-based thermal imaging, computer vision, and AI to inspect blades without conventional shutdown-based inspection workflows.

Module 4: Ultrasonic & Advanced NDT Technologies

- Fundamentals of **ultrasonic testing (UT)** and composite-material inspection.
- **Phased-array ultrasonic testing** and volumetric imaging concepts.
- Detecting delamination, voids, debonding, and internal defects.
- Integrating robotic scanning with targeted inspection.
- **Case Study:** A hybrid approach uses drone optical/infrared screening to identify areas for follow-up robotic ultrasonic inspection and detailed damage characterization.

Module 5: Acoustic Emission & Structural Health Monitoring

- Principles of **acoustic emission (AE)** monitoring.
- Sensor placement, signal acquisition, and damage-source localization.
- **Strain gauges, accelerometers, fiber-optic/FBG sensors**, and other SHM technologies.
- Continuous monitoring versus periodic inspection.
- **Case Study:** Integrating acoustic-emission data with digital-twin concepts for damage localization and structural-health assessment.

Module 6: AI, Machine Learning & Automated Defect Detection

- **Machine learning, deep learning, computer vision, and anomaly detection**.
- Image preprocessing, feature extraction, segmentation, and classification.
- **Multimodal AI** combining thermal and RGB inspection data.
- Model performance, false positives, false negatives, and human-in-the-loop validation.
- **Case Study:** The 2026 AQUADA-DTEC research applies a Swin-Transformer-based approach and curriculum learning to thermographic blade anomaly detection, reporting improved detection performance for small, low-contrast anomalies.

Module 7: Digital Twins, Predictive Maintenance & Smart O&M

- Fundamentals of **digital twins and lifecycle asset intelligence**.
- Connecting inspection data with **SCADA, SHM, sensor networks, and maintenance records**.
- Damage progression, remaining-life concepts, and predictive maintenance.
- Risk-based prioritization of inspection and repair activities.
- **Case Study: ReliaBlade-2** explores digital twins for remote monitoring and inspection of operating turbine rotors and blades, linking lifecycle data with predictive decision-making.

Module 8: Inspection Reporting, Risk Assessment & Future Technologies

- Defect documentation, **severity classification, evidence management, and digital reporting**.
- Risk-based inspection and maintenance decision frameworks.
- Inspection-to-repair workflows and **condition-based maintenance**.
- Emerging **autonomous drones, robotic inspection, multimodal sensing, AI analytics, and digital certification**.
- **Case Study:** Development of automated inspection systems capable of combining autonomous imaging, thermal data, AI analytics, and targeted NDT to support faster and safer blade-maintenance decisions.

Training Methodology

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
21 Sep 2026	25 Sep 2026	Online	$1,000
21 Sep 2026	25 Sep 2026	Physical	$1,500
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0
21 Sep 2026	25 Sep 2026	Physical	$0

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