Bladena Services

Structural Blade Knowledge

At Bladena, we are experts in structural blade failures and how to avoid them!
Bladena offers a range of specialties

We have a strong team working within six fields:

2. Root Cause Analysis if blade failure happens during full-scale tests or during operation.
3. Measurement plan and equipment for full-scale testing, sub-component tests and repair technologies.
5. Advanced loading - Combination of loads during operation and test (blade requirements).
6. Knowledge sharing—advanced and specialised courses in blade structure.

We are experts within our fields and are passionate about wind energy. At Bladena we strive to improve the conditions and standards within the industry every day.

Our goals are to optimize the cost of operation and maintenance of your blades to extend their lifetime and thereby reduce the LCoE.

Really understanding the structural behaviour of the blades is our DNA and a goal we work towards on a daily basis.
To Help You Understand Your Blades

- Root Cause Analysis of Blade Failures
- Measurement Plan including use of advanced measuring systems in test and operation
- FEM modelling
- Support on Full-Scale and Sub-Component Tests and how to do advanced loading with combination of flap and edgewise loads
- Design Support of Blades, Cost-out etc.

With a strong academic and practical background Bladena is today the leading expert in the structural blade enhancement technologies for wind turbine generators in the industry.
Bladena’s Products and Solutions

**D-String**

The D-String® prevents cracks in the max chord area and trailing edge split by removing breathing as the root cause.

**X-Stiffener**

The X-Stiffener™ prevents peeling in the adhesive bondlines by preventing twisting as the root cause.

**D-Stiffener**

The D-Stiffener™ prevents cracks in the midsection of the blades by significantly increasing the blades buckling capacity and removes buckling as the root cause.

**Floor**

The Floor™ prevents catastrophic failures in the root section of the blade by redistributing shear loads from the max chord region to the root section.

**Cap Stiffener**

The Cap Stiffener™ is a light weight structure part of the manufacture of new blades. Blades manufactured with the Cap Stiffener™ may save 20% weight.

**Services**

Bladena holds a competitive advantage in specialized knowledge of wind turbine blades. We offer extensive services within feasibility studies, root cause analysis, structural courses as well as support for design of new blades and Cost-out.
Value creation in blade optimization

The services offered at Bladena are mainly focused on reducing the costs of manufacturing, operation and maintenance and increasing the lifetime of the blades.

Our Services are developed in collaboration with a large network of industry partners. A network that includes the full value chain within the wind turbine industry i.e. both manufacturers, turbine owners, service providers and universities.

The collaboration with industry partners ensures that we know the industry and can contribute with blade knowledge that will help you to understand your blades.

Our services will help you to understand your blades and thereby optimize your repair strategy. Understanding your failures will help you to choose the right repair and thereby reduce the LCoE.
A combined practical and theoretical approach

At Bladena, we believe the synergy between practical observations and theory creates invaluable knowledge to understand blades in operation.

The services offered at Bladena all supplement each other, hence observations and measurements in the field are validated in our FEM department as well as with sub-component tests performed at the Technical University of Denmark.

At Bladena we all hold engineering degrees with different backgrounds within either Mechanical, Materials, Manufacturing or in craftsmanship giving a multifaceted view on blades.

We believe that different views on blades creates an better understanding and knowledge of blades in operation. This knowledge is the foundation for the services offered by Bladena.

Root Cause Analysis of Blade Failures

Root Cause Analysis is the novel art of finding the underlying reason for why blades are failing. The present test standards does not require for the “real loading” i.e. combined loading, which translates into more blades failing in the field.

Based on your test results, reporting or failures in the field we are able to pinpoint the root cause of the structural failures in your blades. We have expert knowledge of blade failures in general with a competitive advantage in knowledge of structural blade failures.

Bladena holds a competitive advantage in the specialized knowledge of blades in operation and how they fail.
Whether your failure stems from a manufacturing failure or a design flaw we will in most cases be able to recommend a preferred action to repair your blades.

Consulting Bladena is part of lowering your risk of future blade failure.

Blades in operation are subject to combined loading, i.e. the “real” total loading comprised of the edgewise loading (gravity) and aerodynamic forces (wind) leading to a complicated 3-dimensional loading scenario that will force the blades to deflect, leading to blade failures.

Failure modes leading to blade failures

- Breathing
- Buckling
- Geometric waves
- Peeling in bondlines
- Twisting / Cross Sectional Shear Distortion
- Non-linear Brazier loads

CASE STUDY - TWISTING OF BLADES WITH COMBINED LOADING

Bladena has performed a number of Root-Cause Analysis of serious damages on +60m blades - both with and without the flat-back designs -

It was concluded that excessive peeling stresses in the adhesive bondlines were critical and would potentially lead to cracks and bondline failures.

White Deformed Shape
Purple Undeformed Shape
Finite Element Modelling, FEM simulation

Wind turbine blades are exposed to different loads and weather due to site specific environmental factors. This cause each fleet to experience different failure modes which should be handled individually.

Bladena performs FEM studies of various cases in order to predict the best cause of action to secure your blades.

For example, Bladena has performed FEM studies of the effect of an earthquake on wind turbine blades. It was discovered that during an earth quake the blades are exited, which are found to damage the blades.

The Buckling phenomenon can be seen on blades in operation as shown below. A phenomenon that is worsened/intensified during an earthquake. The picture clearly shows early trailing edge split, which is seen on the picture on the right.
Tests

Bladena performs a number of tests both sub-component, large-scale, full-scale- and field tests. The tests are used to support and calibrate the findings from the FEM studies, thus the Root Cause Analysis are relying on a practical case to ensure the results are supported.

Static- and Dynamic Tests

All blade parts investigated are tested in both static- and dynamic tests in order to simulate the ”real” loading of an operational turbine. Failures which are clearly visible during fatigue tests may prove undetectable in static tests or when the tests are not running.

We know how to detect different failures based on experience with different measurement techniques, such as NDT, acoustic emission and Digital Image Correlation (DIC).
Measurement Equipment and NDT

Bladena holds extensive experience within sub-component, large-scale, full-scale and field testing. Through numerous test campaigns for our customers and through in-house development we have used a wide range of measurement equipment to both measure deformations and to defect following failures.

Measurement equipment used during testing

We use both high tech and low tech measurement equipment depending on the specific loads or deformations measured. Standard measurement equipment used is equipment such as, strain gauges, posi-wires and tension metres.

Failure detection

Detection of failures are done both during static and dynamic tests. Often failures are only visible during testing which complicates detection. At Bladena we use both advanced NDT as well as cameras to detect and document our findings. Bladena works closely with industry leading companies within failure detection and have extensive experience with analysis of results.
Technical Innovation and Development

Large Network of Industry Partners

Bladena collaborates with a number of industry partners and universities to gain knowledge in otherwise unknown fields. The interdisciplinary collaboration creates synergies that helps to understand the blades in depth.

Research and Demonstration Projects

Bladena is managing several large development projects, ranging from Wind Turbine Owners to Manufacturers and Universities.

Bladena is also Partner in a EU Project headed by Catapult which offer their 7MW offshore turbine to have Bladena’s X-Stiffener™ demonstrated.

These connections creates a large network of specialized knowledge, such as Life time extension, Fracture mechanics, sub-component- and full-scale testing, which supplement the core advantage Bladena holds in Finite element modelling and Root Cause Analysis.

RATZ kick-off meeting in 2016 with 18 Partners; Bladena, EON, Vattenfall, Statkraft, EWII, Nordex, LM WindPower, DNV-GL, DEWI OCC, Total Wind, Blaest, Aalborg University, Technical University of Denmark, G2D, Kirt-Thomsen, DIS , ENGIE and ECC.
Products and Services for wind turbine blades

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We can help you understand your blades

Want to hear more about your blades?
Simply contact Bladena

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