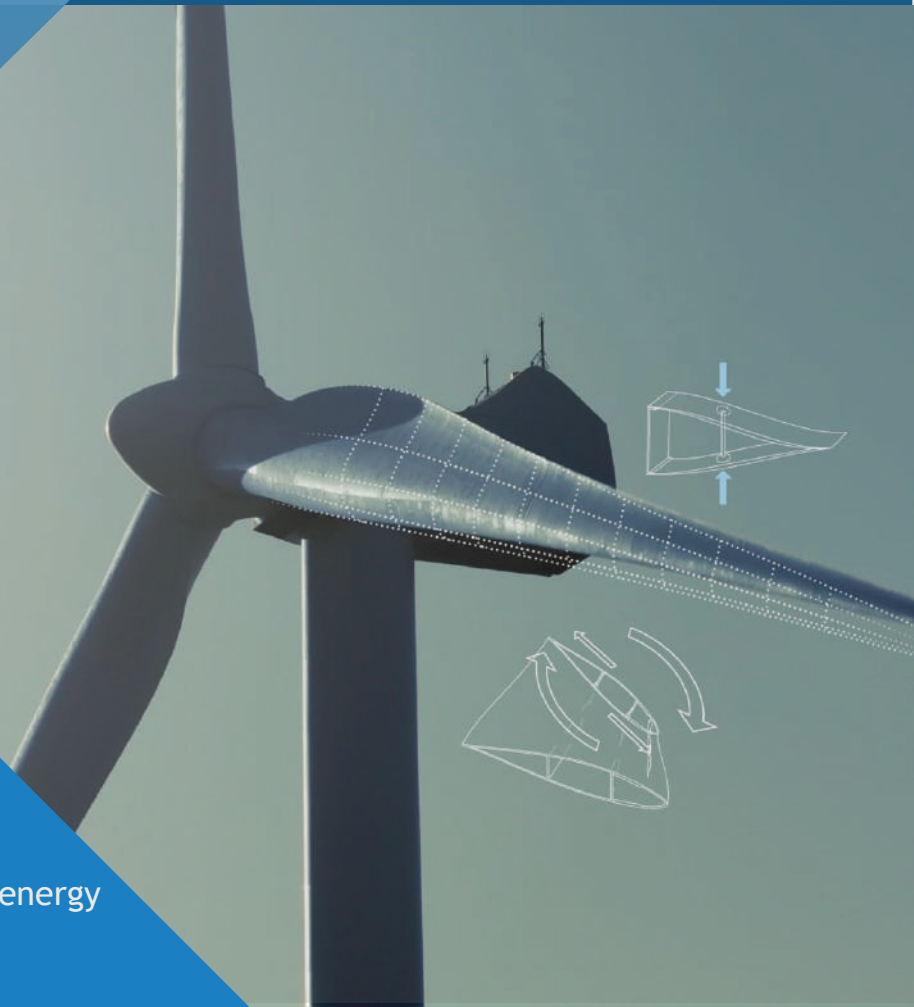


# Bladena

Experts in blades  
Services & Solutions



**Bladena** Stronger blades, More energy

BLADE ENABLER

## Who are Bladena?

We are your blade experts. In Bladena we are passionate about blades. Our business is based on advanced blade data achieved through field experience and science. We use our expertise to help you optimize your blade asset strategies.

## What do we offer?

Advisory services and repair solutions to lower the OPEX, risk of blade failure and loss of AEP during the lifetime of the blade.



# Advisory services

by Bladena

## When can you use our services and solutions?

### Bladena's services during the blade's lifecycle:



*Advisory Services and Repair Solutions allocation in the blade's lifetime is indicative and a number of advisory services and repair solutions are relevant/crucial on many stages of the blade's lifecycle.*

## Most common advisory services



### Defect Assessment

Defines the damage(s) or defect(s), benchmarking against Bladena's database and suggest next steps.



### End of Warranty Guidelines

Provides advice to the inspection campaign of the blade, ensuring that the wind turbines can be operated cost-efficiently after End of Warranty.



### Risk Assessment

Evaluates the key factors that may compromise the integrity of your blades. Helps in decision making regarding inspection strategy considering risks.



### Root Cause Analysis

Tells you why the damage(s) happened as same damage(s) may have different root causes, if it is safe to continue the operation, and indicate possible solutions to repair the damage.



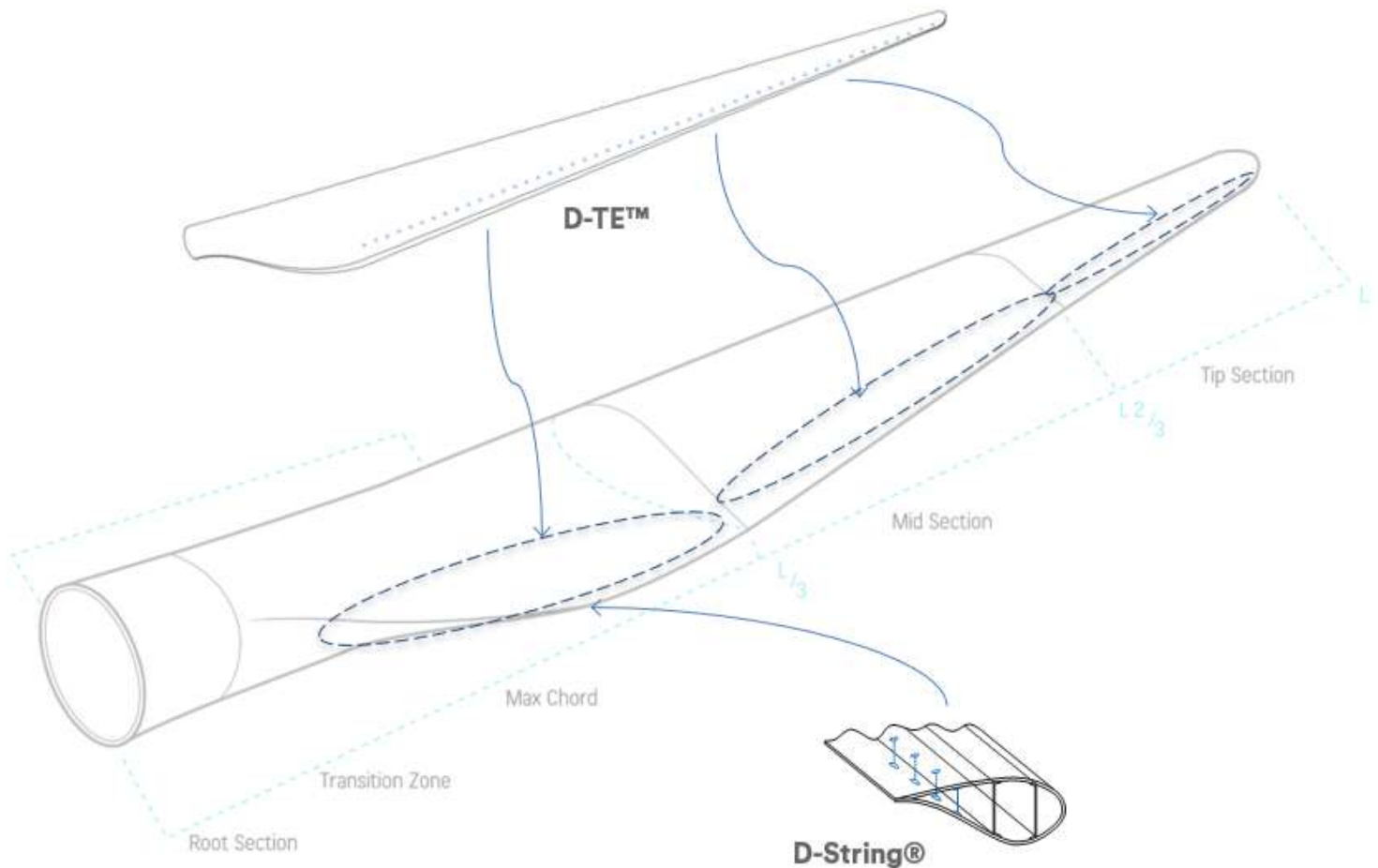
### Technical Due Diligence

An assessment of a specific blade design during the project development or purchase of turbines stage. The TDD is not a re-certification of the blade, but an assessment of what has been done on the top of what standards require.

# Repair solutions (Structural upgrades)

by Bladena

## Our retrofit solutions cover...

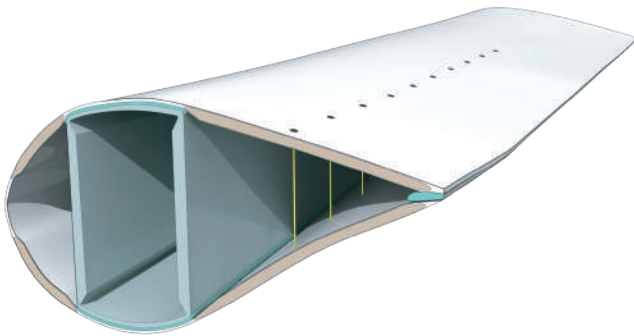


**... the entire blade.**

The Bladena retrofit/repair solutions (structural upgrades) are suited to any blade design and solve the specific root cause(s) for the damage(s) to the blade.

## Root cause and failure mode

The D-String® prevents breathing of the trailing edge (TE) panels thereby reducing the peeling stresses in the adhesive bondlines in the blade's max chord area and eliminates cracks in the trailing edge max chord area.



## Technical description

The D-String® technology is made out of three main components: two cones, a fuse and a Vectran Ø2.5 mm string. The solution can be installed up-tower using simple tools from a rigged platform.

The D-String® connects the two trailing edge (TE) panels, thus reducing the peeling stresses in the blade, thereby eliminating cracks developing in the TE max chord area. Unless otherwise specified, 12 D-String® need to be installed per blade.



## Blade references

Installation of the D-String<sup>®</sup> will positively impact the operation of your wind turbines by reducing cost for O&M, hence lowering the LCoE:

**Turbine** V80 (Denmark)  
**Year** 2013  
**Failure** Transverse crack in Trailing Edge panel



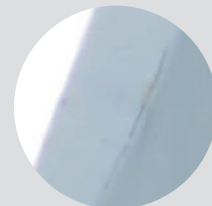
**Turbine** 1.5 MW 37c, 34a (US)  
**Year** 2014, 2015, 2016, 2017  
**Failure** Bond line crack, Trailing Edge



**Turbine** Senvion MM92 LM 45.3 (US)  
**Year** 2015  
**Failure** Transverse crack in Trailing Edge panel



**Turbine** Vestas V90 (Canada)  
**Year** 2016, 2017  
**Failure** Longitudinal crack in Trailing Edge



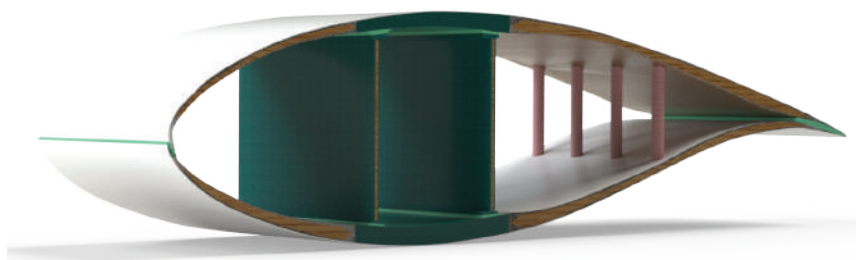
**Turbine** Senvion MM82 LM40  
**Year** 2018  
**Failure** Transverse crack in Trailing Edge panel





## Root cause and failure mode

The D-TE™ prevents cracks and trailing (TE) edge openings from the tip section to the max chord region by reinforcing the blade's trailing edge. Thereby removing several root causes which could lead to the mentioned damages without adding significant weight to the blade. Moreover, the D-TE™ provides an effective solution to temporarily repair damaged tip sections due to lightning strikes.



## Technical description

The D-TE™ consists of one main component which is a simple engineered threaded rod. The rod is made out of a fiber reinforced epoxy resin system with special additives. The solution is offered as a repair kit which includes specifically designed installation tooling with optimized maintenance being the main focus.

The D-TE™ increases the buckling capacity of the trailing edge (TE) of the blade by increasing the stiffness of the blade panels. It connects the two TE panels, reducing breathing thereby eliminating crack development in the TE section of the blade from max chord to tip.

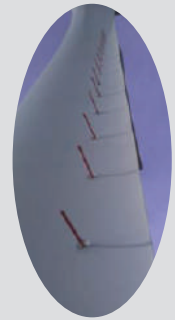




## Blade references

Installation of the D-TE™ will positively impact the operation of your wind turbines by reducing cost for O&M, hence lowering the LCoE:

**Blade model** B53  
**Year** 2021  
**Failure** Crack in Trailing Edge panel, mid-span



**Blade model** GE34  
**Year** 2017  
**Failure** Crack in Trailing Edge panel, mid-span



**Blade model** G97  
**Year** 2017  
**Failure** Crack in Trailing Edge panel, mid-span

**Blade model** G58  
**Year** 2018  
**Failure** Crack in Trailing Edge panel, mid-span



# Structural Blade Course

by Bladena

## Why this course?



Focused on the specific needs



Taught by experts



State-of-the-art knowledge

## Course outcome:

- Understand wind turbine blades from a WTO and ISP perspective
- Apprehend the loads on blades under different field operation conditions
- Classify structural blade damages and understand the risk of each damage type
- Basic understanding of blade design and testing philosophy
- Understand different inspection methods leading to big data
- Offered as a webinar, in-house or at Bladena

**Contact us for more details about the next available course!**



**[sales@bladena.com](mailto:sales@bladena.com)**



**[www.bladena.com](http://www.bladena.com)**

# Bladena Blade Handbook

2022 Edition

Used by the entire wind industry all around the world and nominated several times for its excellent communicatory design. The Blade handbook has become the go-to manual for the industry to easily communicate about wind turbine blades.

Over the past 7 years, the Blade Handbook has been commonly used by utility companies (WTOs), manufacturers (OEMs), and service providers (ISPs) as the book is designed to create a common language in the industry.



## Editor & contributor

**Bladena**  
BLADE ENABLER

## Concept & Design

Communication design, illustration and graphic design



## Contributors



## Partners



Get in touch to learn more about your blades.

 [sales@bladena.com](mailto:sales@bladena.com)

 [www.bladena.com](http://www.bladena.com)

 [www.linkedin.com/company/bladena](http://www.linkedin.com/company/bladena)