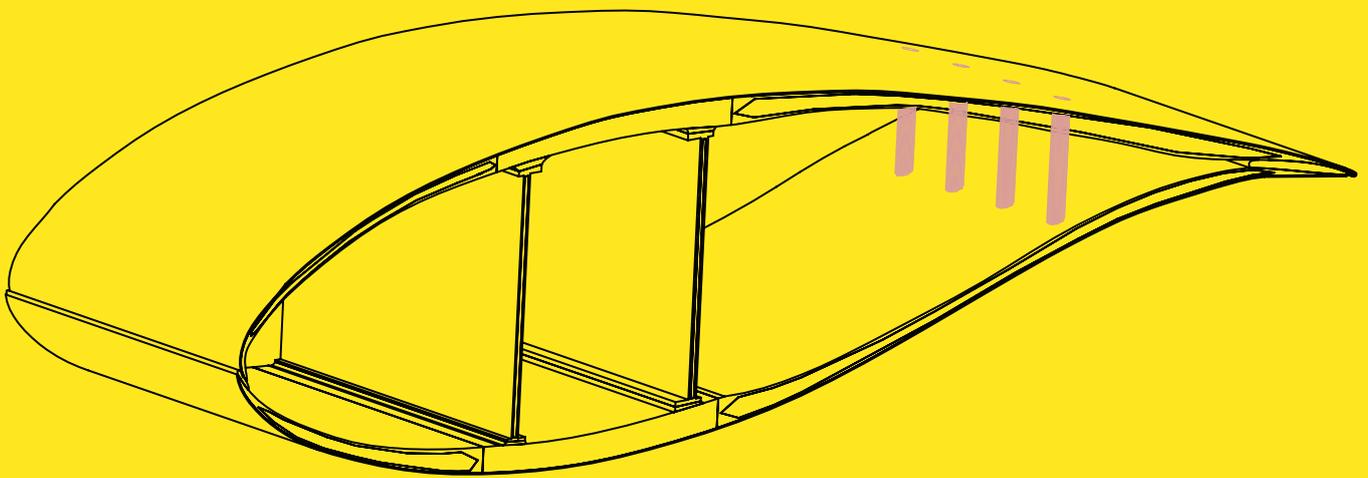


Bladena

BLADE ENABLER

D-TE™

Technical Documentation



bladena.com

stronger blades **more energy**

D-TE™

Prevent cracks and trailing edge openings from tip section to max chord region.

The D-TE™ a simple yet effective solution developed to eliminate cracks and trailing edge opening from max chord to tip section by reinforcing the blades trailing edge. Thereby removing several root causes which could lead to the mentioned damages without adding significant weight to the blade.

The installation of the D-TE™ positively affects the operation of your wind turbine.



1. The D-TE™ is a solution that eliminates the occurrence of cracks on blades.
2. The D-TE™ is a technology that eliminates possible trailing edge openings on blades.
3. The D-TE™ significantly increases the anticipated lifetime of the blade.
4. The installation of the D-TE™ does not affect the integrity of your blade.
5. Reduces the buckling tendency during events with extreme edgewise loading.
6. Decreased time for maintenance, reduces LCoE, thus increasing the profit margin.
7. The D-TE™ helps to maintain the aerodynamic profile of the blade.
8. The D-TE™ solution makes it possible to keep a blade with lightning damages in the tip area in operation.

D-TE™
by Bladena



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

The D-TE™ is a repair kit which also includes specifically designed installation tooling with optimized maintenance being the main focus.

The D-TE™ Kit

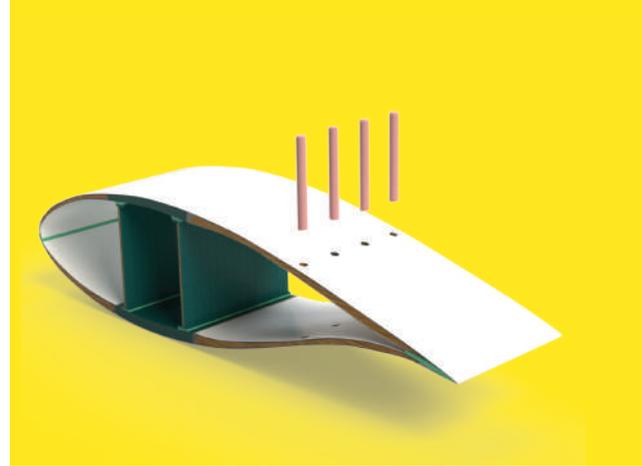


Targeted root causes

The D-TE™ solution eliminates three different root causes of the possibly occurring damages.

Root Cause 1. - Panel breathing

Breathing in turbine blades is caused by edgewise loading due to gravity and induces peeling in the adhesive bond-lines near the trailing edge and close to the webs. Peeling in the adhesive bond-lines directly causes cracks, which may lead to severe failures in your blades.



Root Cause 2. - Buckling (mid-span)

The bending of the blade due to extreme aerodynamic forces and reduced buckling capacity of the blade in mid-span and mid-span towards the tip creates premises for failure.

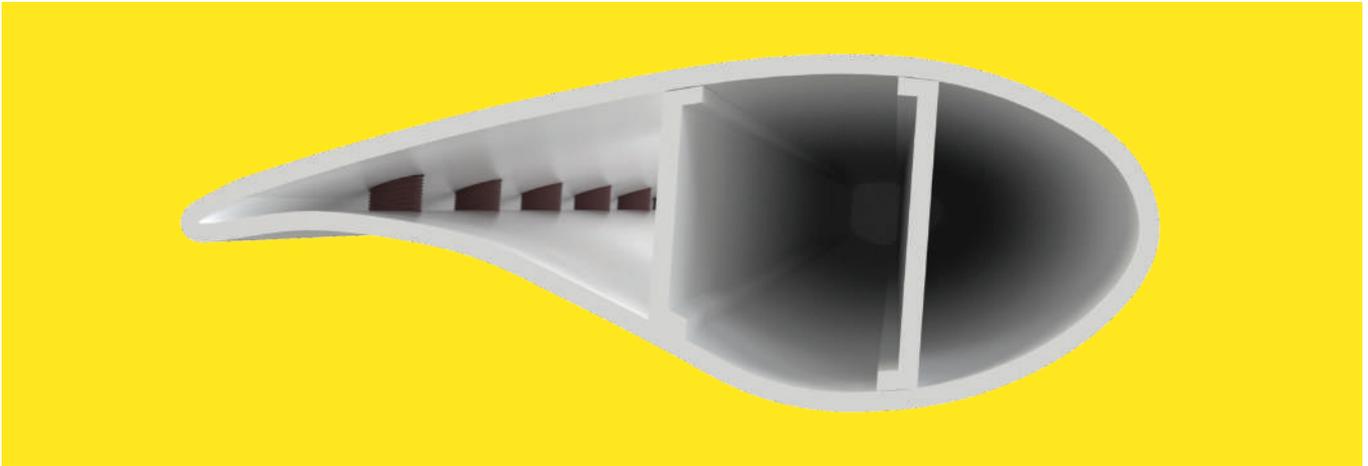


Root Cause 3. - Edgewise vibrations

In case of vibrations, such as an earthquake, the blade is loaded in a manner which it is not designed for. The D-TE™ does not remove the extreme vibrations, however it increases the blade capacity to withstand them.

D-TE™ for lightning damages

The D-TE™ in the tip area prevents the detachment of the two shells due to lightning strikes.



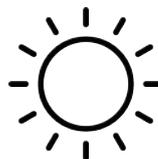
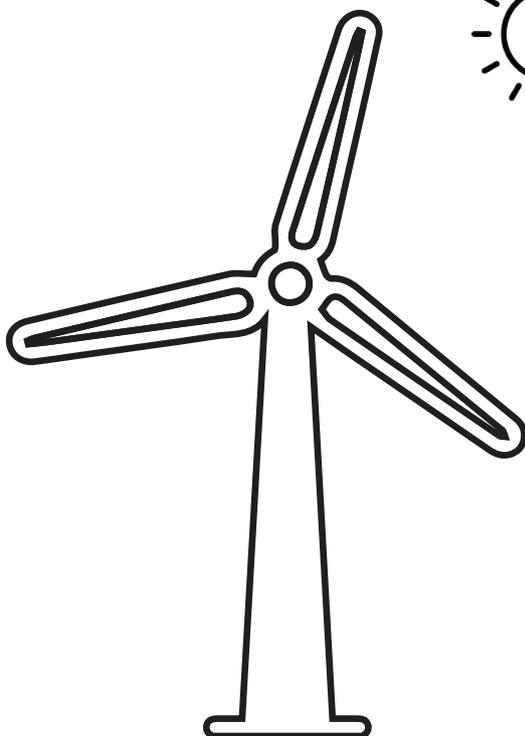
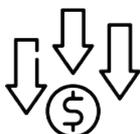
The use of D-TE™ for lightning damages addresses the tip opening issue of the wind turbine blade.

The solution connects the pressure side and suction side to prevent the detachment of the two shells of the tip, caused by the internal thermal expansion of the moist air inside the tip when a lightning strike hits the tip.



Main benefits over classic lightning damage repair

1. The D-TE™ significantly reduces the repair time.
2. The D-TE™ repair costs are low, as the repair is simple and easy to do up-tower regardless of the weather conditions.
3. The D-TE™ installation does not affect the weight and aerodynamic integrity of your blade.
4. The D-TE™ makes it possible to keep a blade with lightning damages in operation

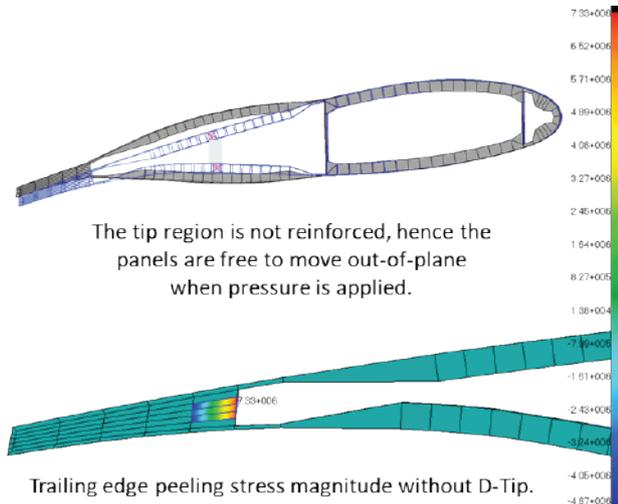


D-TE™ for lightning damages

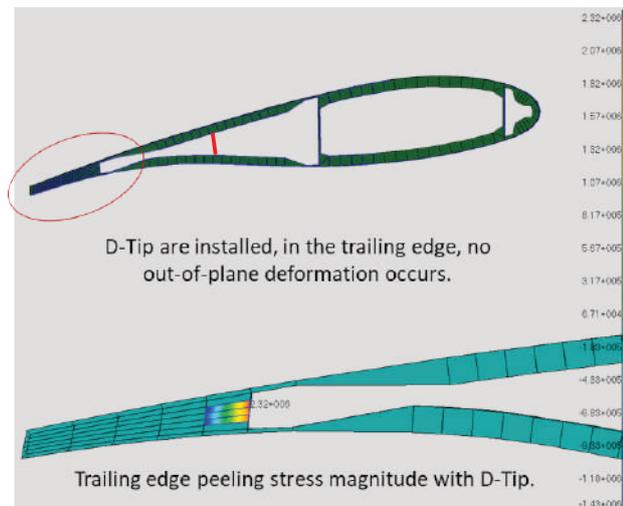
Verified by a Numerical FEM Simulation

The D-TE™ is installed in the tip region and a comparison of the blade with and without D-TE™ with the same pressure applied is presented below.

With D-TE™ installed



Without D-TE™ installed



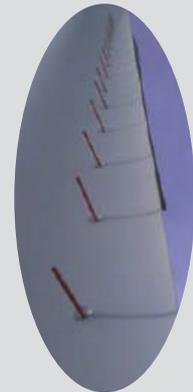
Conclusion

Based on the simulation, installing D-TE™ in the tip region, trailing edge (TE), will decrease the peeling stress level by approx. 70% when pressure from a lightning strike will deform the panels out-of-plane. The pressure applied in this scenario does not reflect the real-life situation. The comparison is only for the purpose to verify the D-Tip™.

Examples and turbine references

Bladena has assisted in several trailing edge reinforcement installation previously on different kind of blades, the feedbacks and results were only positive in every case. These reinforcements were installed in Europe, USA and South America.

Blade model B53
Year 2021
Failure Crack in TE panel, mid-span
Open TE, tip



Blade model LM42.2
Year 2015
Failure Open TE, tip



Blade model G97
Year 2017
Failure Crack in TE panel, mid-span

Blade model G58
Year 2018
Failure Crack in TE panel, mid-span



The D-TE™ by Bladena is designed for effortless, retrofit up-tower installation.

Without compromising the integrity of the blade, the D-TE™ reduces the formation of cracks in the trailing edge section from max chord to tip.

- The D-TE™ has a significant positive impact on the anticipated lifetime of your blades.**
- The D-TE™ decreases the LCoE thus increasing the profit margin.**
- The D-TE™ helps to maintain the aerodynamic profile of the blade.**
- The D-TE™ reduces risk at damage operation.**

Want to talk more about your blades?

Simply contact Bladena

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D-TE™