NEW TOOLS USED FOR D-R 61 PT BLADE REPAIR ANALYSIS

By Chris Sykora

In order to perform a stress and/or vibration analysis via the finite element technique, one has to discretize the geometry into many calculation points called a "mesh". RMS is now leveraging new capabilities in the ANSYS® Workbench package to create that "mesh" directly from the solid model of turbomachinery part geometry. This can enable "meshing" almost any geometry. These techniques add another tool to our analysis toolbox in addition to the "classic" methods you have previously seen at RMS. Both techniques are entirely valid and can provide accurate results. The new "meshing" techniques just provide more options. A recent example of their use was demonstrated on a job for a North American peaking power plant customer.

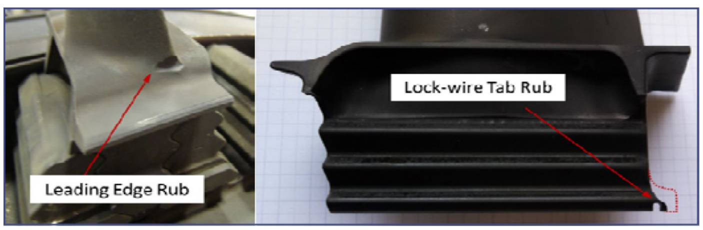

Figure 1

The power plant operates a D-R 61 two stage power turbine. During rotor overhaul, rub damage was discovered on both stages of rotor blades. Stage 1 had rubbed the leading edge of the airfoil near the base. Stage 2 had rubbed the lock-wire tab area such that the tab was extremely thin. RMS performed finite element structural analysis to predict the stress impact of two proposed repairs. These included blending the damaged area on the 1st stage blade where it traditionally would not be allowed and machining a slot in the bottom of the 2nd stage blade for mechanical retention of a lock-wire tab replacement instead of scrapping the entire set of blades. In both cases, "meshing" the repaired geometry would have been more difficult with the "classic" methods.

On the 1st stage blade, the analysis was used to compare the stress levels of an original, undamaged blade vs. a blade blended smooth in the damaged area. Traditionally, blending the blade near the base of the airfoil is not allowed due to highest stresses found at the platform to airfoil fillet. However, structural analysis can provide more insight into the areas even in the fillet where stress might be low enough for some blending. In this case, we found that stress in the airfoil was minimally changed at the front leading edge since the highest stress was actually located further aft on the suction side of the blade. Therefore a blend repair of the 1st stage blades was recommended instead of expensive replacement.

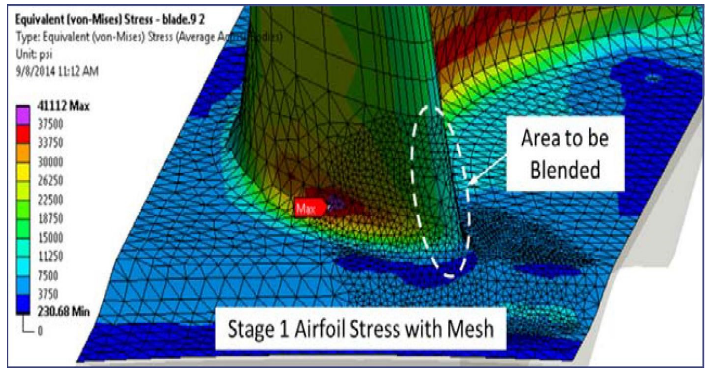

Figure 2

On the 2nd stage blade, the analysis was used again to compare the stress levels of an original, un-slotted blade vs. a blade with a tangential slot machined in the bottom of the blade fir tree area to be used for retention of a separate lock-wire tab replacement piece. In this case, the analysis was used to iterate on multiple slot configurations to find one that had the lowest impact on blade stresses. We were able to use the same basic analytical model to evaluate 8 different slots by slightly changing the geometry and re-meshing. Ultimately a slot shape was found that only had a maximum increase in stress of 1.3%. Since this was a very minimal increase, that shape was recommended for replacing the lock-wire tabs instead of an expensive replacement of the entire blade.

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