



# QuEST

Engineering

India

# ANSYS®

## Overview

Existing turbomachinery rotors had flat profile dovetails for attaching blades. These were proving to be life limiting regions. The design for these rotors had to be changed while meeting design requirements. This had to be done without increasing the cost of the final product. This was achieved using ANSYS software in a design of experiments (DOE) framework having both discrete as well as continuous parameters in the design space.

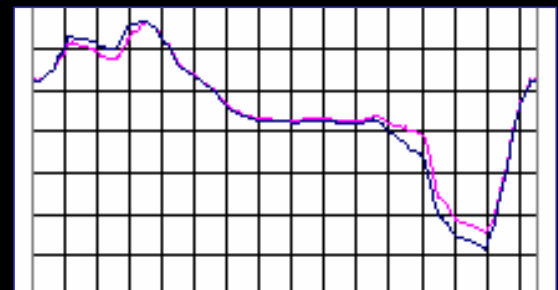
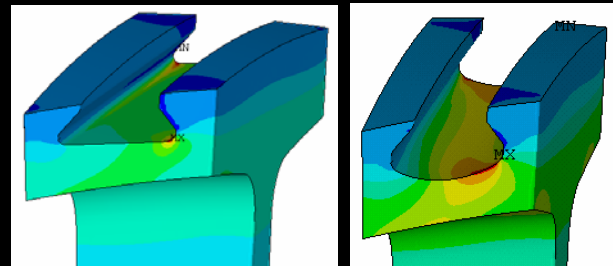
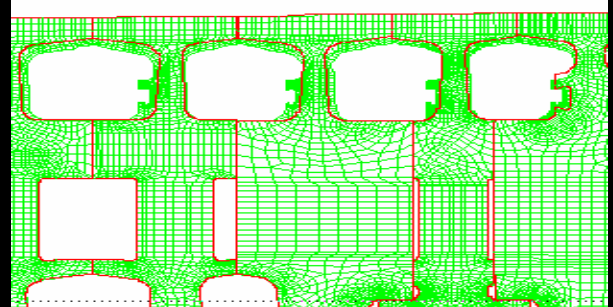
## Testimonial

Flat profile dovetail rotors experience stress concentration driven by the design of the slot profile. The design was therefore changed to a round profile dovetail. This design change also resulted in an increase of web overhang portion to accommodate the round profile dovetail. This concept also led to strengthening of the rotor web below the round profile.

After incorporating this design change a six-fold improvement in low cycle life fatigue was obtained. As shown in the figure the stresses, especially the hoop stresses reduced significantly. All the rotors wherein this design change was applied met the design and gas turbine life requirements.

This design change increased the rotor bending (outer rotor web) marginally because of the extra mass addition, but no rims closed throughout the mission cycle.

The overall process of arriving at the final design was achieved by carefully selecting the design space and then using ANSYS to support the DOE and final design qualification.



## Challenge

The real challenge was to reduce the cost of the final product by making use of existing tooling. Incorporating a new concept would have meant increase of cost by a few million dollars. Carefully choosing the design space with both continuous as well as discrete factors was key to making sure the cost was minimized.

## Solution

To come up with a good solution took a reasonable number of iterations with various concepts. After making some DOE studies a final model which met both design requirements as well as tooling constraints was arrived at.

## Benefits

The first and foremost benefit was cost reduction in manufacturing and tooling phases of the product. The proposed concept was one which could be used for other design improvement projects.

The second major benefit was the improvement in low cycle fatigue by six times. This helped in performance improvement of the turbomachinery rotor using an already existing manufacturing process capability.