FINITE ELEMENT ANALYSIS (FEA) AT TOSHIBA

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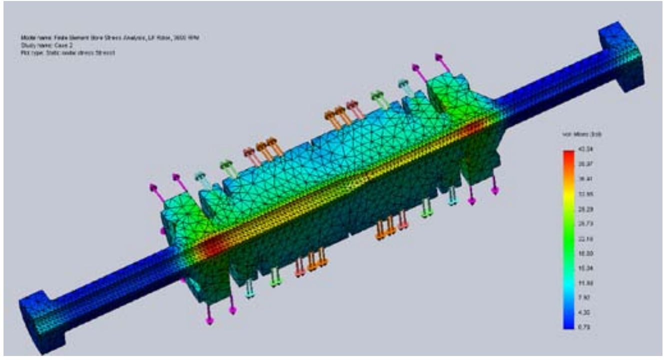
FEA is a computerized method of analysis that enables engineers to calculate stresses and deflection in parts and assemblies. It began in the 1960s and was used only on large mainframe computers through the 1980s. As the speed and memory of personal computers increased in the 1990s, FEA became a practical tool that thousands of engineers could use to analyze complex problems on their computers.

In FEA a component is modeled, which uses 3-D software such as SolidWorks, the FEA simulation module breaks the component into thousands of elements. The engineer adds loads and restraints to the model. The computer performs millions of calculations in minutes and determines the deflection and various stresses in the parts being analyzed. Complicated analyses can take several hours to run.

The engineer can watch an animation of the part as it undergoes deformation to determine if the model is performing realistically. Seeing how a part actually twists and stretches helps the engineer to see where the weak points are. Appropriate modifications can then be made until the design is optimized.

Many calculations can be done without FEA using handbooks and experience. However, if the shape of the part is complicated, or the loads are complicated, FEA is the only method that will produce accurate results.



Rotor bore stress analysis for an LP steam turbine rotor (sectional view).

One good example of an excellent use of FEA is the shrink fit of retaining rings on generator rotors and the associate stresses developed on coil slot dovetail teeth. As a retaining ring is installed on a generator rotor, it cools and squeezes the teeth of the rotor; the ring has been stretched and high compressive stresses are developed on the tooth tops. As the rotor is brought up to running speed, centrifugal force from the coil ends expands the retaining ring and greatly increases the applied stress at mid-length of the ring. This stress, with safety factors applied, is used to determine the yield strength required for replacement rings. In addition, at running speed the shrink fit is reduced and tensile stresses develop on teeth from wedge and coil loads. This alternating stress from start/stop cycles can produce fatigue cracks in regions of high stress concentration, such as the tooth radius.

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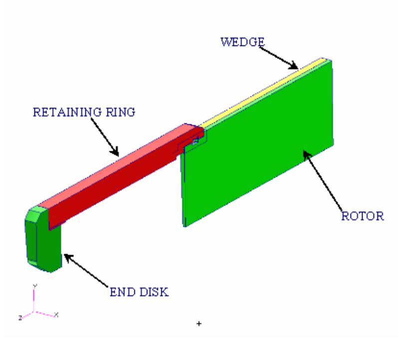

FEA model of generator rotor components (sectional view)

From the customer's perspective, complicated problems such as these are analyzed by FEA to reduce or eliminate the cracking of teeth through design modifications.

At Toshiba's Milwaukee Service Center, FEA is used in many turbine/generator applications with the intention of increasing component life through design modifications and specifically-calculated repairs.