ANALYZING TURBINE BLADE CREEP BEHAVIOR USING COMPUTATIONAL FLUID DYNAMICS

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Relevance. Recent research focuses on understanding how structures respond to high temperatures, especially in enhancing gas turbine performance. Methods like film cooling, coatings, and blade modifications aim to protect turbine blades from extreme temperatures up to 1400°C, extending their lifespan. This study involves simulating turbine blade behavior using computational fluid dynamics (CFD) and ANSYS software under defined temperature and pressure conditions. Through finite element method (FEM) calculations, it aims to evaluate blade performance and durability in extreme operational environments.

Goal of the work – The objective of this study is to examine the thermal behavior of the turbine blade, both with and without a thermal barrier layer. By conducting rigorous computational fluid dynamics (CFD) analysis, the CFD instrument is employed to create and simulate the airflow over the turbine blade, as well as to examine the flow characteristics of the blade. The resulting data from the simulation is then compared to the observed performance of the thermal barrier coating.

Result analysis – According to the results obtained, the gas turbine blades will operate efficiently within the temperature range of 800 to 1000 degrees Celsius. However, increasing the temperature to 1400 degrees Celsius will cause the blades to fail. This is because the total deformation will more than double, and the pressure will increase significantly compared to when the temperature is set at 800 degrees Celsius.

Conclusion. This approach is subsequently employed to predict the lifetime of a high-pressure turbine blade. The current methodology has the capability to provide a direct assessment of the progression of stress in elements, deformation due to creep, and damage in elements. This feature is highly advantageous in the prognostication of the lifespan of high-temp structures.