Immobilized Cells; Markov Chain Modelling of Reliability Analysis and Prediction Under Mixed Mode Loading

Salvinder Singh[1], Shahrum Abdullah[1], Nik Abdullah Nik Mohamed[2], Mohd Salmi Mohd Noorani[3]
[1]Department of Mechanical and Materials Engineering, Faculty of Engineering & Built Environment, Universiti Kebangsaan Malaysia, 43600 UKM, Malaysia, Bangi
[2]Department of Mechanical Engineering, Universiti Malaysia Pahang, Pekan, 26600, Pahang, Malaysia
[3]School of Mathematical Sciences, Faculty of Science and Technology, Universiti Kebangsaan Malaysia, 43600 UKM, Bangi, Malaysia

ABSTRACT

The reliability assessment for an automobile crankshaft provides an important understanding in dealing with the design life of the component in order to eliminate or reduce the likelihood of failure and safety risks. The failures of the crankshafts are considered as a catastrophic failure that leads towards a severe failure of the engine block and its other connecting subcomponents. The reliability of an automotive crankshaft under mixed mode loading using the Markov Chain Model is studied. The Markov Chain is modelled by using a two-state condition to represent the bending and torsion loads that would occur on the crankshaft. The automotive crankshaft represents a good case study of a component under mixed mode loading due to the rotating bending and torsion stresses. An estimation of the Weibull shape parameter is used to obtain the probability density function, cumulative distribution function, hazard and reliability rate functions, the bathtub curve and the mean time to failure. The various properties of the shape parameter is used to model the failure characteristic through the bathtub curve is shown. Likewise, an understanding of the patterns posed by the hazard rate onto the component can be used to improve the design and increase the life cycle based on the reliability and dependability of the component. The proposed reliability assessment provides an accurate, efficient, fast and cost effective reliability analysis in contrast to costly and lengthy experimental techniques.

KEYWORDS: Reliability; Weibull; Markov Chain; Mixed mode; Failure

DOI: 10.3901/CJME.2015.0112.012