

About the book

The objective of this book is to provide guidelines for engineers helping them to improve machine lifetime performance and reliability. Many books are written about machine design. Most of these are focussed on selection and computation of basic machine elements. Those calculations generally relate to the strength and stiffness of machine elements. In practice, it appears that few machine problems are caused by these issues thanks to the attention paid to strength calculation.

Most machine problems occur with the passage of time, from dynamic loading and interacting surfaces in relative motion. Friction and wear of interacting surfaces in relative motion may take on an unacceptable form, resulting in play, frictional heat or jams. In rolling contacts surface fatigue is generally the predominant failure mode. Cyclically loaded machine elements may suddenly result in fatigue fracture after a large number of load cycles. It is estimated that approximately 95% of all machine problems are related to fatigue fracture and tribology phenomena as friction and wear. The science focussing on the management of friction, wear and fatigue consequently deserves the necessary attention.

The purpose of this book is to give insight, through case studies and a wide range of illustrations, into how machine performance deteriorates, how machine elements may fail, how to analyse the cause of performance deterioration and failure, and, most importantly, how failures may be prevented and performance can be improved. The possibilities of pushing the boundaries of load-carrying capacity, and motion control are explored. With newly-gained insights the engineer is better equipped to reach innovative solutions to further optimize machine lifetime performance, improve machine reliability and simultaneously to minimize the need of maintenance.

Many design tools, design charts and guide lines are discussed. User-friendly PC calculators of the formulae derived in this book are made available, including calculators for calculating dynamic load capacity, friction, frictional heating and wear of machine elements in relative motion. Using these calculators design engineers will save much time in determining the outcomes of selecting specific design parameters. The formulae used in the calculators are also available in Mathcad files. With these files the designer may in a user-friendly way adapt or extend calculations for specific applications. In fact this book is a goldmine of information for any engineer who intends to improve machine lifetime performance and reliability.

The first part of this book concerns the fundamentals of *“Design for lifetime performance and reliability”*, including design procedures to estimate and improve machine reliability, failure analysis, fatigue strength, static and dynamic load rating of concentrated contacts, friction phenomena, wear mechanisms, machine lubrication and material selection. The second part concerns *“Design of high performance and high reliability applications”*, including the design of hydrodynamically lubricated bearings and sliders, viscous dampers, dynamic sealing systems, hydrostatic bearings, pressurised air bearings, flexure mechanisms and many other specialty bearings. Although the designer using this book is expected to have a good background in mathematics, the objective is that the design tools illustrated by cases will be useful anyhow.

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