Review of Design, Modeling and Reliability in Rotating Machinery

Robert X. Perez, Editor
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This book is part of a series on the industrial practice in the general area of rotating machinery such as gas turbines, compressors, centrifugal pumps, motors, fans and the like. This particular book focuses more on the petrochemical, petroleum refinery and gas processing industries as evident by the contents. A multi-disciplinary approach is utilized to illustrate concepts of vibration analysis, thermal systems, mechanical design, condition monitoring and other relevant topics with minimal mathematics and plenty of advice for the practitioners.

Multiple authors with significant industry and consulting background have written 14 chapters although the editor (Robert Perez) has contributed the most, based on his personal experience and knowledge; he appears to be a prolific author of similar books. According to the editor and publisher, the style of this handbook style (with stand-alone chapter) and yet a compact book is based on the principle of "a time-savings means of learning about the most up-to-date rotating machinery ideas and best practices." The book is divided into 3 main parts, namely, the Design and Analysis (Part 1, which covers about ½ of the book, from Chapters 1 to 6), Compressors (Part 2, from Chapters 7 to 10) and Pumps (Part 3, from Chapters 11 to 14). Applicable International Organization for Standardization (ISO), American National Standards Institute (ANSI), and American Petroleum Institute (API) standards are listed throughout the book, and the key word index at the end of this book is comprehensive. Some interesting quotes and folksy advice are also included to engage the reader. For instance, here is a cautionary advice to the professional who seeks to aggressively upgrade the equipment — "Don't let your enthusiasm get in the way of your company's best interests."

Part 1 starts with Chapter 1, which provides a tutorial on the rotodynamic analysis, including the natural frequencies, gyroscopic effects, casing and foundation effects and forced response analysis. Torsional analysis of pump and turbomachinery rotor assemblies is covered in Chapter 2 including torsional excitations and forced response along with a case history. The hydrodynamic bearings are addressed next in Chapter 3 along with a brief description of the Reynolds equation, dynamic coefficients, lubrication methods and thrust bearings. Chapter 4 deals with the rotating machinery data trends and correlations including static versus dynamic data, upward and downward trends and two case studies on the unpredictable vibration in fans and erratic vibration related to rotor instability. Two short chapters on sizing general-purpose steam turbines (Chapter 5) and on making the business case for machinery upgrades (Chapter 6) conclude Part 1.

Part 2 on the centrifugal and reciprocating compressors begins with Chapter 7, which discusses the selection of the best type of compressor for a typical application including the nomenclature and selection example. Chapter 8 addresses the centrifugal compressor design issues including the operational range versus efficiency, critical components and aerodynamic matching for the optimization. The next two chapters address the reciprocating compressor rod load ratings, gas loads, piston rod loads, crosshead pin loads and crankpin load (in Chapter 9) and how internal gas forces affect the reliability of reciprocating compressors in Chapter 10; examples are included.

Part 3 covers the centrifugal pumps. Chapter 11 provides advice on when to use a centrifugal pump with examples. Then, practical ways to monitor centrifugal pump performance are covered in Chapter 12. A case study on the pumps operating in parallel flow applications is presented in Chapter 13. A simpler method of determining the efficiency of a motor-driven centrifugal pump is also described to aid the reader. The final chapter (14) is on the mechanical seals and flush plans including recommendations for optimizing the service lives of mechanical seals and reliability and emission concerns.

Is this book of interest to the noise and vibration control engineers and to the readers of NCEJ? Yes, if you would like to solve a specific vibration or condition monitoring problem in the petrochemical industry. People from other industries can benefit if they are faced with rotating equipment issues. From my personal perspective, I would have liked to see more coverage of electromechanical machinery, gear boxes and the reciprocating machines (such as IC engines). Further, more frequency domain and order domain analyses and illustrations could have strengthened this book. Nevertheless, I enjoyed reading this publication and plan to use the "rules of thumb" and other advice offered in this book when faced with a serious vibration problem.

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