

Solving Statics Problems with EES

Preface

The purpose of this book is to integrate the computer tool Engineering Equation Solver (EES) with statics concepts to enable engineering students to tackle interesting, real world problems in this discipline that they would otherwise not be able to solve.

It is generally acknowledged that students need to solve problems to integrate the concepts and skills that they are learning. Further, the more closely these problems resemble “real world” engineering problems the more motivated students are to solve them and the more interested they are in the results. Statics is a foundational course taken by students who are just starting their engineering education. It is therefore the perfect opportunity to get students excited about both statics and their engineering career. The key to introducing this type of problem into a statics course is the integration of an easy to use but powerful computer tool. Familiarity with this tool will enable students to solve complex and interesting problems that would be tedious to do by hand and carry out parametric design and optimization studies using their solution.

The effort required to solve a statics problem can be broken into two parts. First, it is necessary to identify the fundamental relationships that describe the problem. The necessary set of equations results from the application of appropriate theory, simplified with justified assumptions. Identifying these equations is the conceptual part of the problem and no computer program can provide this capability. Once the appropriate equations have been identified, they must be solved. In our experience, much of the time and effort required to solve engineering problems by hand is not pedagogically useful after the underlying skills have been mastered. Though necessary for obtaining a solution, these tasks contribute little to the learning process. For example, once the student is familiar with taking a cross-product, further calculations of this type do not contribute to the student's grasp of the subject - nor does carrying out the tedious algebra that is required to solve a large set of equations. Practical problems that focus on real engineering issues tend to be more interesting to students, but also more mathematically complex. The time and effort required to do problems without computing tools may actually detract from learning the subject matter by forcing the student to focus on the mathematical complexity of the problem rather than on the underlying concepts. The integration of an easy to use but powerful engineering tool like EES is therefore an important component of a successful statics course.

This book is meant to accompany the first part of the textbook *Engineering Mechanics: Statics and Dynamics* by Plesha, Gray, Witt, and Costanzo (2023) which is the basis of a typical undergraduate level engineering statics class. This book is not meant to stand alone as a statics textbook. Instead, each chapter of this book introduces some features of EES and then applies concepts from the corresponding chapter of Plesha et al. (2023) to problems that are integrated with EES. In this way the student is able to see the application of this computer software to challenging and relevant statics problems. Over the course of the book, the student will build up to problems that involve parametric studies and design optimization.