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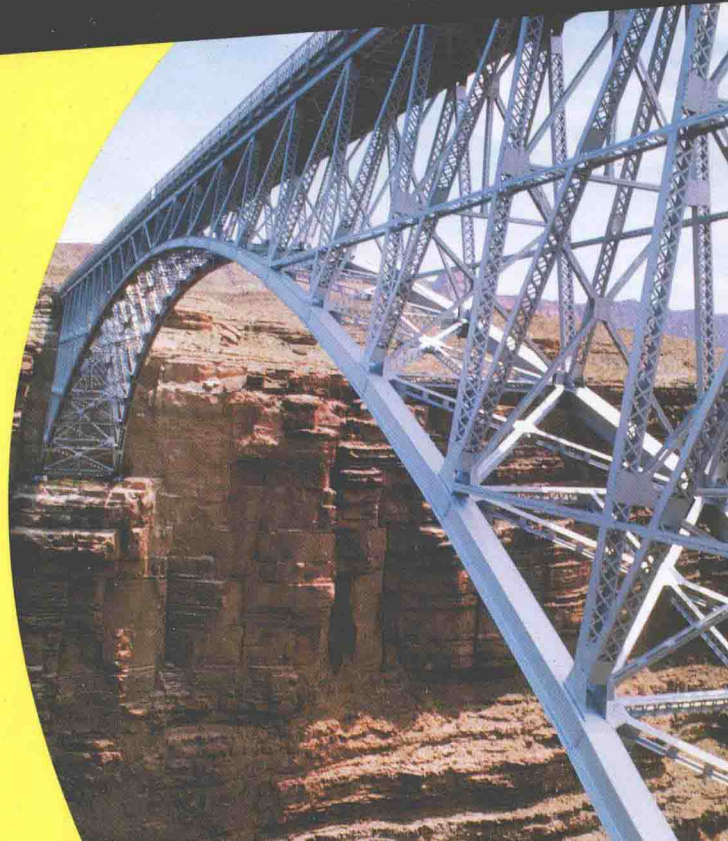

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Statics FOR DUMMIES®

by James H. Allen III, PE, PhD

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Dedication

To my wife Miranda for her unconditional love and support.

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Introduction

As I watch students working toward mastering the principles of statics, I find myself frequently answering some of the same basic questions. Despite countless hours of working through examples and homework problems from their textbooks, students often seem to be confused on the same several topics.

The problem isn't that the material in a typical statics class is overly difficult; I think the issue is just several simple misconceptions that manifest themselves through poorly written examples and unnecessarily complex wording in conventional statics textbooks.

That's why I've written *Statics For Dummies* — to help students of the subject get a better understanding than they may otherwise get in a classic textbook. In this book, my goal is to answer those basic questions by using simple explanations and eliminating a lot of the extra technical jargon.

About This Book

No statics book can tell you how to solve every possible problem you encounter. What *Statics For Dummies* tells you is what you need to know and why you need to know it. Why are three-dimensional problems easier to solve with vector formulations than with scalar methods? What exactly is equilibrium, and how do Newton's laws guarantee it? How do you know the difference between a truss and frame? All of these topics are at the heart of understanding statics; after you've got these basics down, actually solving a statics problem is a snap!

In statics, one of the most important habits to form is being as methodical as possible, which means that statics lends itself very nicely to a large number of checklists or simple steps to remember and follow. Throughout this book, I try to organize certain techniques by outlining the steps that you need to follow. Just like when you go grocery shopping, the checklists help you remember what fruits and vegetables (or equations or free-body diagrams) you need to put in your basket.

The best part of this book is that *you* have complete control on where you want to start. If you just want the tips for solving specific problems, jump to Part VI. If you find you need a bit of a refresher on vectors, that's in Part II. Let the table of contents and index be your guides.

Conventions Used in This Book

I use the following conventions throughout the text to make things consistent and easy to understand:

- New terms appear in *italic* and are closely followed by an easy-to-understand definition.
- **Bold** is used to highlight the action parts of numbered steps, as well as keywords in bulleted lists.

I also use other, statics-specific conventions that I may not explain every time, so following is a brief list of concepts and terms that I use frequently throughout the book.

- **Decimal places:** I try to carry at least three decimal places in all my calculations in this book. This move helps ensure enough precision in my calculations to demonstrate the fundamental principles without getting bogged down in the pesky numerical accuracy issues I cover in Chapter 2.
- **Vector variables:** The most important aspect of statics is that you take all effects into consideration; if you forget even the smallest behavior on an object, solutions in statics can become impossible to accurately calculate. To help keep track, I usually use **F** or **P** to indicate force vectors, and **M** to indicate a moment vector. I also use **i, j,** and **k** to represent those common unit vectors in the text; in equations, they appear as $\hat{i}$, $\hat{j}$, $\hat{k}$.
- **Bold (not in steps):** Aside from its use in numbered steps and bulleted lists, I also use **bold** text to represent a vector equation. If you see a bolded variable, that indicates a vector is lurking in the discussion. This convention is common to most classical textbooks, so I replicate it here just for the sake of consistency with vectors you may have already been exposed to in a conventional statics or physic class.
- **Arrows on top of vector names:** Another method of denoting a vector is to use the label or name of the vector with an arrow over the top such as $\vec{F}$ or $\overrightarrow{\text{Weight}}$. If you see an arrow on top of a letter or word in an equation, you know that I'm working with vectors.
- **Italics (not as definitions):** I also adopt a second sign convention from other textbooks: When I talk about a vector's *magnitude* (length) in the text, I use the name or label of the vector in italics.
- **Absolute value brackets:** To represent the magnitude of a vector in an equation, I surround it with absolute value brackets, such as $\left|\vec{F}\right|$ or $\left|\overrightarrow{\text{Weight}}\right|$. Because magnitudes are properties of vectors, I still include the vector arrow over the label. Just remember that the absolute value brackets take precedence, so if you see those, you know I'm primarily talking about a scalar magnitude.
- **Plus signs (+) with vector senses:** Although it's not required, I use the plus symbol before positive numbers in some vector calculations as a

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