THE ELEMENTS OF THE MECHANICS OF MATERIALS AND OF POWER TRANSMISSION

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The Elements of the Mechanics of Materials and of Power Transmission by William R. King

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WILLIAM R. KING

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THE ELEMENTS
OF THE
MECHANICS OF MATERIALS
AND OF
POWER TRANSMISSION

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PREFACE

THIS book is the result of an experience of some years in classroom work with engineering students, and is intended for use in technical schools and colleges.

It has frequently occurred to me that there is needless obscurity of statement in the average engineering text, with the consequent discouragement and retardation of young students. It has been my aim, therefore, to characterize the demonstrations in this text by completeness and simplicity of statement, in the belief that such treatment will greatly facilitate the study of more advanced works.

The Calculus has been introduced necessarily, but only in its elementary form, and chiefly in demonstrations and solutions. Such use of it will be, I believe, beneficial to the young student in showing him possibilities in the application of the subject to practical problems.

The book is in two parts. Part I is devoted to the elements of the Mechanics of Materials, and Part II to the elements of Power Transmission. It has been the aim to present both subjects only to the extent that will impart such a working knowledge of the fundamentals as will enable the student to grasp more extended works without aid.

Much of the matter on iron and steel in Chapter IX, Part I, has been taken by permission from Durand's "Practical Marine Engineering," and the chief sources of reference have been the works of Goodman and Unwin.

I am under obligation to my assistants in engineering, William L. De Baufre, Charles E. Conway, and Samuel P. Platt, — to the first two for valuable aid and suggestion and to the third for the care with which he made the tracings for the cuts.

WILLIAM R. KING.

BALTIMORE, *July* 4, 1911.

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PART I

THE ELEMENTS OF THE MECHANICS OF MATERIALS

CHAPTER I

MOMENTS. CENTER OF GRAVITY. MOMENT OF INERTIA. RADIUS OF GYRATION

1. **Introductory.** — The mechanics of materials, embracing the strength of materials, is an all-important subject to the engineering student. It includes all the calculations connected with the design of machines which admit of motion between some of their parts in the transmission of force, thus involving dynamical principles; and of the design of structures which remain in the static state of rest. It presupposes for the student a course in mechanics, but the questions of moments, center of gravity, moment of inertia, and radius of gyration are of such frequent application in mechanical design that a partial review of those subjects is given in this chapter.

2. **Moments.** — The moment of a force acting on a body may be defined as the tendency of the force to turn the body about a point, or about a fixed axis, and its measure is the product of the force by the perpendicular distance from the point, or from the axis, to the line of action of the force. The point, or axis, about which the moments are taken is called the *center of moments*, and the perpendicular distance