ELEMENTARY PRINCIPLES OF AEROPLANE DESIGN AND CONSTRUCTION

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ARTHUR W. JUDGE

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OF

AEROPLANE DESIGN AND CONSTRUCTION

A TEXT-BOOK FOR
STUDENTS, DRAUGHTSMEN, AND
ENGINEERS

BY

ARTHUR W. JUDGE

WHITWORTH SCHOLAR; ASSOCIATE OF THE ROYAL COLLEGE OF SCIENCE; DIPLOMATE OF THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY; ASSOCIATE MEMBER OF THE INSTITUTION OF AUTOMOBILE ENGINEERS; ASSOCIATE FELLOW OF THE AERONAUTICAL SOCIETY, ETC.

AUTHOR OF "THE DESIGN OF AEROPLANES," "THE PROPERTIES OF AEROFOILS AND AERODYNAMIC BODIES," "HIGH-SPEED INTERNAL COMBUSTION ENGINES," ETC., ETC.

WITH 13 TABLES, 56 ILLUSTRATIONS, NUMEROUS
EXERCISES AND ANSWERS

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PREFACE

THE object of the present volume is to endeavour to fulfil the needs of students, draughtsmen, and others, for an inexpensive book of an elementary nature, dealing with the fundamental principles underlying the design and, to a certain extent, the construction of aeroplanes.

The subject of aeroplane design is essentially one involving a thorough knowledge of mathematics and mechanics, combined with a practical knowledge of the existing conditions to be fulfilled, and a firm acquaintance with the results of aerodynamical research.

To the student approaching the subject for the first time much difficulty is presented, owing to the widely scattered sources of information, and to the specialized and often difficult nature of the information when obtained. It is therefore hoped that the present book will prove helpful in placing before the reader, in a more or less intelligible form, the general principles underlying aeroplane design, and in serving as a "breach" or introduction to more advanced treatises.

The general scheme of the book, which is based upon the author's larger revised volume "Design of Aeroplanes," is to deal with the aerodynamical and stability principles first, and to follow on with the general application of these and of the mechanical principles to design work. The treatment has been intentionally confined to principles rather than to particular cases, tabulated data, etc., for it is the common experience that, given the necessary preliminary training in mathematics, graphics, mechanics, and other ground subjects, a thorough knowledge of principles is of greater importance in design and constructional work than the absorption of a mass of disconnected facts and figures. The latter information is, however, essential when it becomes necessary to apply the principles

to practical design and constructional work in the more advanced stages of the subject.

In conclusion, the writer would be grateful if his attention were drawn to any printer's errors, slips, etc., which may have inadvertently been overlooked, in spite of repeated revisions of the proofs, and would welcome practical suggestions for increasing the utility of the book within the scope of its title.

A. W. J.

LONDON, 1919.

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CHAPTER I

GENERAL PRINCIPLES

INTRODUCTION.

The subjects of aeroplane construction and design are very closely interconnected, and a knowledge of the one necessitates an understanding of the principles of the other.

Aeroplane design is the process of determining the proportions of aircraft and their components, in order to fulfil specified requirements of stability (including control), performance, and strength conditions.

Before an aeroplane can be constructed,* it must now be properly designed so as to fulfil each of the specified requirements; a knowledge of the lightest and most reliable methods of aircraft construction, and of the properties and processes of the materials employed, is necessary for design purposes.

Aeroplane construction, whilst being based mainly upon the results of design methods, also requires a thorough knowledge of the methods of utilizing to the full advantage the most suitable materials. Present-day constructional work utilizes materials having the greatest strength to weight ratios (see p. 2), whilst possessing reliability and resistance to shock and fatigue; for this reason it is usual to employ such materials as spruce and ash for stress-bearing parts, similar to the wing-spars, interplane, and interspar struts, longerons and other members; high tensile steel (such as nickel, nickel-chrome or chrome-vanadium) for wire-attachment clips, brackets, and similar parts under repeated stress action; aluminium alloys for complicated shapes, requiring castings, or

* The early "trial and error" methods, involving many accidents, have now been replaced by the more scientific methods of careful design, based upon the results of aerodynamical research, and experience derived from testing actual machines.