TEXT-BOOK OF THE MATERIALS OF ENGINEERING

Published @ 2017 Trieste Publishing Pty Ltd

ISBN 9780649719372

Text-Book of the Materials of Engineering by Herbert F. Moore

Except for use in any review, the reproduction or utilisation of this work in whole or in part in any form by any electronic, mechanical or other means, now known or hereafter invented, including xerography, photocopying and recording, or in any information storage or retrieval system, is forbidden without the permission of the publisher, Trieste Publishing Pty Ltd, PO Box 1576 Collingwood, Victoria 3066 Australia.

All rights reserved.

Edited by Trieste Publishing Pty Ltd. Cover @ 2017

This book is sold subject to the condition that it shall not, by way of trade or otherwise, be lent, re-sold, hired out, or otherwise circulated without the publisher's prior consent in any form or binding or cover other than that in which it is published and without a similar condition including this condition being imposed on the subsequent purchaser.

www.triestepublishing.com

HERBERT F. MOORE

TEXT-BOOK OF THE MATERIALS OF ENGINEERING



TEXT-BOOK

OF THE

MATERIALS OF ENGINEERING

BY

HERBERT F. MOORE RESEASCH PROFESSOR OF ENGINEERING MATERIALS, ENGINEERING EXPERIMENT STATION, UNIVERSITY OF ILLINOIS.

FIRST EDITION

McGRAW-HILL BOOK COMPANY, Inc. 239 WEST 39TH STREET. NEW YORK

LONDON: HILL PUBLISHING CO., Ltd. 6 & 8 BOUVERIE ST., E. C. 1917 COPYRIGHT, 1917, BY THE McGraw-Hill Book Company, Inc.

THE MAPLE PRESS YORK PA

215700 FEB 23 1918 SDK MT8

11 7 1 2 =

PREFACE

The object of this text-book is to furnish a concise presentation of the physical properties of the common materials used in structures and machines, together with brief descriptions of their manufacture and fabrication. The book is intended primarily for use in technical schools in connection with courses in the Mechanics of Materials, or in connection with courses in the Materials Testing Laboratory. It is hoped, however, that the book may prove to be of use to draftsmen, inspectors, machinists, and others who, dealing with the materials of engineering in their daily work, wish to become familiar in an elementary way with the properties of those materials.

The text is distinctly elementary in character, and for the reader who may wish to pursue his studies further there is given at the end of each chapter a list of selected references. The books and periodicals named in these lists will be found in nearly all technical school libraries, and in many city libraries. For the convenience of teachers who may use this book as a text, a list of questions on the various chapters is given at the end of the last chapter.

This work is, of necessity, a compilation of data from various sources, and the author has endeavored to give credit where it is due. He acknowledges his indebtedness to the references given in the lists and to the various individuals who have assisted him.

HERBERT F. MOORE.

Urbana, Illinois, August 5, 1917.

(3) (2)

CONTENTS	PAGE
PREPACE	V
ARREST AND	
CHAPTER I	
Introductory. Scope of Subject—General Properties of Materials, Strength— Stiffness—Elasticity and Plasticity—Toughness and Brittleness— Ductility and Malleability—Adaptability to Engineering Con- struction and Facility in Fabrication—Uniformity and Reliability —Durability—Electric and Magnetic Properties—Classification of Materials—Tests of Materials.	
CHAPTER 11	
Strain, Unit Strain—Stress, Unit Stress—Stress-Strain Diagrams for Materials—Elastic Limit, Proportional Limit, Yield Point—Ultimate Strength—Significance of the Elastic Limit, the Proportional Limit and the Yield Point—Behavior of Materials in a Partially Plastic State—Effect of Stress Beyond the Yield Point—Resistance of Materials to Impact—Stiffness, Significance of the Modulus of Elasticity.	9
CHAPTER III	
Working Stress; Factor of Safety; Selection of Materials Working Stress—Consequence of Failure of Material—Factor of Safety—Standard Allowable Working Stresses—Materials for Various Classes of Machines or Structures.	
CHAPTER IV	
THE MANUFACTURE OF PIG IRON. Occurrence of Iron in Nature—Ores of Iron—Reduction of Ore to Pig Iron—Fuel for the Reduction of Iron Ore—Flux Used in Reducing Iron Ore—The Blast Furnace—Preheating the Blast, Hot Stoves—Production of Pig Iron—Utilization of Blast-furnace Slag.	
CHAPTER V	
THE MANUFACTURE OF WROUGHT IRON. Importance of Wrought Iron—Definition of Wrought Iron—The Puddling Process—Characteristics of Wrought Iron—Charcoal Iron.	
vii	

24

*

CHAPTER VI	
	AGE
The Manufacture of Open-Hearth Street. General Features—Basic and Acid-steel Processes—The Open-hearth Furnace—Charging the Open-hearth Furnace—The Control of the Open-hearth Process—Recarburization of Steel—Other Types of the Open-hearth Furnace—Fuel for the Open-hearth Furnace—Arrangement of Open-hearth Steel Plants—Uses and Limitations of Open-hearth Steel.	46
CHAPTER VII	
THE MANUFACTURE OF STEEL BY THE BESSEMER PROCESS	54
CHAPTER VIII	
CEMENTATION STEEL, CRUCIBLE STEEL, AND ELECTRIC-FURNACE STEEL The Cementation Process—Cementation Steel—Case-carbonized Steel—The Crucible Process—The Electric Furnace for Refining Steel—Types of Electric Steel Furnaces—Electric Reducing of Iron Ore.	61
CHAPTER IX	
IRON AND STEEL CASTINGS Cast Iron; the Cupola—Air-furnace Iron—Open-hearth Furnaces for Cast Iron—Semi-Steel—Gray Cast Iron, White Cast Iron, Chilled Cast Iron—Malleable Cast Iron—Steel Castings.	68
CHAPTER X	
THE MECHANICAL TREATMENT OF STEEL; ROLLING, FORGING AND PRESSING. Uses of Rolled Steel—Steel Ingots—Defects in Steel Ingots—Effects of "Pipes" and Their Prevention—Effects of Segregation and its Prevention—Effects of Honeycombing and its Prevention—The Rolling Mill—Cold-rolled and Cold-drawn Steel—Forging and Pressing Processes.	74
CHAPTER XI	
THE CRYSTALLINE STRUCTURE OF IRON AND STEEL AND ITS SIGNIFICANCE THE HEAT-TREATMENT OF STEEL. The Importance of the Crystalline Structure of Metals—Crystallization of Pure Iron—Solutions, Solid Solutions—Illustrations of	83

PAGE

the Action of Solutions, Eutectics—The Cooling of Iron-carbon Alloys—The Solidification of Cast Iron—The Cooling of Steel to Solidification and after Solidification—The Critical Temperature of Steel, the Recalescence Point—The Tempering of Steel—Grain Size of Iron and Steel—Strength of Steel under High Temperatures.

CHAPTER XII

THE EFFECT OF VARIOUS INGREDIENTS ON THE PROPERTIES OF IRON AND STEEL . 9.

The Importance of Chemical Compositions of Iron and Steel—Commercial Pure Iron—Carbon—Silicon—Phosphorus—Sulphur—Manganese—Nickel—Chromium—Vanadium—Tungsten and Molybdenum—Copper—Titanium—The Corrosion of Iron and Steel—Strength and Ductility of Iron and Steel.

CHAPTER XIII

The Non-Ferrous Metals and Alloys.

Importance of Non-Ferrous Metals—Copper—Uses of Copper—Physical Properties of Copper—Aluminum—Uses of Aluminum—Properties of Aluminum—Zinc—Properties of Zinc—Uses of Zinc Non-ferrous Alloys—Copper-zinc Alloys; Brasses—Copper-tin Alloys; Bronzes—Three-metal Alloys—Special Bronzes—Bearing Metals.

CHAPTER XIV

Uses in Engineering Construction—Principal Varieties of Structural Timber—Production of Timber in the United States—Structure of Wood—Strength of Timber—Elastic Properties of Wood—Strength of Large Pieces of Timber—Effect of Moisture on the Strength of Timber—Time Element in the Strength of Timber—Common Defects in Timber—Nominal and Actual Sizes of Commercial Lumber—Seasoning of Timber—Shrinkage of Timber during Seasoning—Decay of Wood—Preservatives for Timber—Preservative Processes for Timber—Uses of Impregnated Timber—Strength of Treated Timber.

CHAPTER XV