A TREATISE ON THE APPLICATION OF IRON TO THE CONSTRUCTION OF BRIDGES, GIRDERS, ROOFS AND OTHER WORKS SHOWING THE PRINCIPLES UPON WHICH SUCH STRUCTURES ARE DESIGNED, AND THEIR PRACTICAL APPLICATION

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FRANCIS CAMPIN

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Trieste

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ON

IRON BRIDGES, GIRDERS, ROOFS

ETC.

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SHOWING THE PRINCIPLES UPON WHICH SUCH STRUCTURES ARE DESIGNED, AND THEIR PRACTICAL APPLICATION

ESPECIALLY ARRANGED FOR THE USE OF STUDENTS AND PRACTICAL MECHANICS, ALL MATHEMATICAL FORMULÆ AND SYMBOLS BEING EXCLUDED

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ETC. ETC.

With numerous Illustrations

SECOND EDITION, REVISED AND CORRECTED

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PREFACE.

In introducing the present work to the Public, a few prefatory words appear called for to explain the objects with which the Author prepared it. The great proficiency in mathematics requisite for the comprehension of more elaborate treatises on girders, roofs, &c., has rendered such works unsatisfactory to the great bulk of engineering students, and useless to those artizans who, having spent their early years in labour, have not had leisure for the more abstruse branches of education. For these two classes the present work has been especially written, after several years' consideration of the subject, and throughout care has been taken to preserve the pure principles of structures in their exactitude, without using any mathematical processes beyond arithmetic, except in the simple algebraical demonstrations of the rules which are inserted for the use of such as may desire to study them.

FRANCIS CAMPIN.

ADVERTISEMENT TO THE SECOND EDITION.

A SECOND edition of this Treatise having been called for, advantage has been taken of the opportunity thus offered to correct certain typographical and clerical errors that found their way into the first edition.

The Author has also carefully revised the work throughout, and, where it appeared desirable, re-written portions, but in no case has he altered the *opinions* expressed in the first edition, the practice of the intervening period of five years having in all cases tended to confirm them.

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INTRODUCTION.

THE vast progress made during the last fifty years in metallurgical art has caused the metals to assume a very forward place amongst the materials used for structures of all descriptions, such as bridges, roofs, lighthouses, and public and private buildings of all kinds, and it may specially be remarked that at the present time much more attention has been drawn to the adaptation of iron to the purposes of the builder than that subject had hitherto attracted.

Iron being, from its physical qualities, suitable for a great variety of uses, extending up to the construction of the greatest works, it is easy to account for the fact that almost only works of great magnificence have received that general consideration which smaller undertakings equally deserve. The engineer may point with justifiable pride to the bridges which in safety carry our heavy traffic over the widest rivers, and contemplate with satisfaction the colossal roofs which afford a covering to our spacious railway stations; but equally with these the student should examine the requirements and principles of those works which, though less pretentious, acquire equal importance from

their greater frequency. It cannot be denied, even by the most ardent admirer of stupendous works, that the due proportioning and arrangement of iron structures, which may perhaps form the nucleus of a future colony, and afford comfort and security to its founders, are not inferior in importance to the more elaborate designing of the most expensive structure required by the economic and æsthetic exigencies of a civilised community; hence, the engineer who would perform the duty which devolves upon him of extending his art through the widest sphere of usefulness must study the application of the materials with which he has to deal, even to works of apparent insignificance, and, moreover, by so doing he will acquire a knowledge which will subsequently be of great value to him in setting out the subordinate details of any larger structures with the execution of which he may be entrusted.

In treating of wrought and cast iron structures, we shall endeavour to set forth in the simplest possible form the fundamental principles which rule the application of the metals referred to, to structural purposes, whether as arches, pillars, girders, or trussing, and subsequently to explain the mode in which works having been designed in accordance with such principles are executed, in the iron-yard or foundry, as the case may be.

It is not sufficient that the engineer should merely be able to calculate the strength of every part of his work, which he may generally do by the aid of books of rules, &c., but he requires a keen perception of *possible contingencies* which may arise during the process of manufacture, and a knowledge of æsthetics, so that by duly considering the characters of his materials, he may produce a work combining in the highest degree utility