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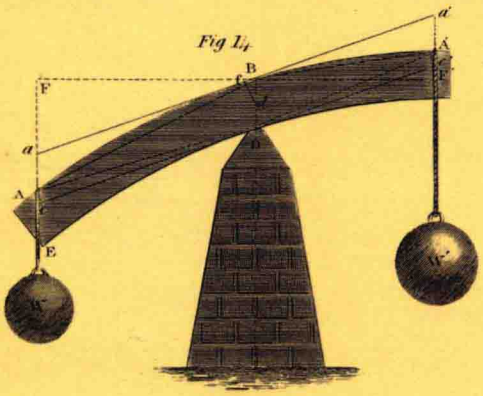
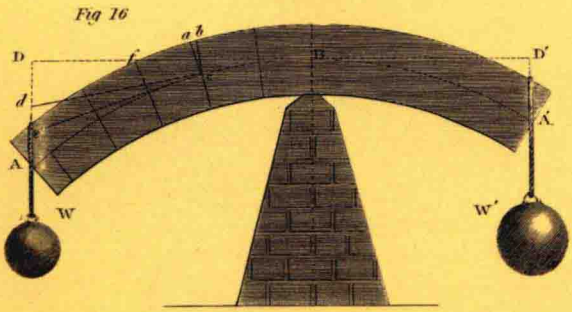
PRACTICAL ESSAY ON THE STRENGTH OF CAST IRON AND OTHER METALS

VOLUME 2

EATON HODGKINSON





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Practical Essay on the Strength of Cast Iron and Other Metals

Containing Practical Rules, Tables, and Examples, Founded on a Series of Experiments, with an Extensive Table of the Properties of Materials

VOLUME 2:
EXPERIMENTAL RESEARCHES ON THE STRENGTH AND OTHER PROPERTIES OF CAST IRON

EATON HODGKINSON

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Technology

The focus of this series is engineering, broadly construed. It covers technological innovation from a range of periods and cultures, but centres on the technological achievements of the industrial era in the West, particularly in the nineteenth century, as understood by their contemporaries. Infrastructure is one major focus, covering the building of railways and canals, bridges and tunnels, land drainage, the laying of submarine cables, and the construction of docks and lighthouses. Other key topics include developments in industrial and manufacturing fields such as mining technology, the production of iron and steel, the use of steam power, and chemical processes such as photography and textile dyes.

Practical Essay on the Strength of Cast Iron and Other Metals

Although cast iron was used in pagoda construction in ancient China, it was in Britain in the eighteenth century that new methods allowed for its production in quantities that enabled widespread use. An engineer who had educated himself tirelessly in technical subjects from carpentry to architecture, Thomas Tredgold (1788–1829) first published this work in 1822. It served as a standard textbook for British engineers in the early nineteenth century, and several translations extended its influence on the continent. Reissued here in the fourth edition of 1842, edited and annotated by the structural engineer Eaton Hodgkinson (1789–1861), who presents his own research in the second volume, this work addresses both practical and mathematical questions in assessing metallic strength. In Volume 2, benefiting from twenty years of progress since Tredgold's original publication, Hodgkinson provides details of his own advanced experiments.

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EXPERIMENTAL RESEARCHES

ON THE

STRENGTH AND OTHER PROPERTIES

OF

CAST IRON:

WITH THE DEVELOPEMENT OF NEW PRINCIPLES;

CALCULATIONS DEDUCED FROM THEM;

AND

INQUIRIES APPLICABLE TO RIGID AND TENACIOUS BODIES GENERALLY.

BY EATON HODGKINSON, F.R.S.

WITH PLATES AND DIAGRAMS.

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PART II.

EXPERIMENTAL RESEARCHES

ON THE

STRENGTH AND OTHER PROPERTIES OF CAST IRON;

WITH

THE DEVELOPEMENT OF NEW PRINCIPLES; CALCULATIONS DEDUCED FROM THEM; AND INQUIRIES APPLICABLE TO RIGID AND TENACIOUS BODIES GENERALLY.

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CONTENTS OF PART II.

on most of the subjects connected with the strength of materials. Mr. Fairbairn has likewise published the results of a great number of well-conducted experiments upon the transverse strength of bars of cast iron. An abstract, therefore, of the leading experiments made at Mr. Fairbairn's Works, and of those given by Navier, Rennie, Bramah, and others, with theoretical considerations, is all that can be attempted in this Additional Part; pointing out, as I proceed, whatever has a bearing upon the conclusions of Tredgold in the body of the Work.

TENSILE STRENGTH OF CAST IRON.

2. To determine the direct tensile strength of cast iron, I had models made of the form in Plate I. fig. 1.

The castings from these models were very strong at the ends, in order that they might be perfectly rigid there, and had their transverse section, for about a foot in the middle, of the form in fig. 2. This part, which was weaker than the ends, was intended to be torn asunder by a force acting perpendicularly through its centre. The ends of the castings had eyes made through them, with a part more prominent than the rest in the middle of the casting, where the eye passed through; fig. 3 represents a section of the eye. The intention of this was that bolts passing through the eyes, and having shackles attached to them, by which to tear

the casting asunder, would rest upon this prominent part in the middle, and therefore upon a point passing in a direct line through the axis of the casting. Several of the castings were torn asunder by the machine for testing iron cables, belonging to the Corporation of Liverpool; the results from these are marked with an asterisk. Others were made in the same manner, but of smaller transverse area; these were broken by means of Mr. Fairbairn's lever (Plate II. fig. 40), which was adapted so as to be well suited for the purpose.

The form of casting here used was chosen to obviate the objections made by Mr. Tredgold (art. 79 and 80) and others against the conclusions of former experimenters. The results are as follow:

3. *Results of Experiments on the Tensile Strength of Cast Iron.*

Description of iron.	Area of section in inches.	Breaking weight in lbs.	Strength per sq. in. of section.	Mean in lbs. per square inch.
				tons. cwt.
Carron iron, No. 2, hot blast	4·031	56,000	13,892*	
Do. do. do.	1·7236	22,395	12,993	13,505 = 6 0½
Do. do. do.	1·7037	23,219	13,629	
Carron iron, No. 2, cold blast	1·7091	28,667	16,772	
Do. do. do.	1·6331	27,099	16,594	16,683 = 7 9
Carron iron, No. 3, hot blast	1·7023	28,667	16,840	
Do. do. do.	1·6613	31,019	18,671	17,755 = 7 18½
Carron iron, No. 3, cold blast	1·6232	22,699	13,984	
Do. do. do.	1·6677	24,043	14,417	14,200 = 6 7
Devon (Scotland) iron, No. 3, hot blast	4·269	93,520	21,907*	21,907 = 9 15½
Buffery iron, No. 1, hot blast	3·835	51,520	13,434*	13,434 = 6 0
Buffery iron, No. 1, cold blast	4·104	71,680	17,466*	17,466 = 7 16
Coed-Talon (North Wales) iron, No. 2, hot blast . .	1·586	25,818	16,279	
Do. do. do.	1·645	28,086	17,074	16,676 = 7 9
Coed-Talon (North Wales) iron, No. 2, cold blast . .	1·535	30,102	19,610	
Do. do. do.	1·568	28,380	18,100	18,855 = 8 8
Low Moor iron (Yorkshire), No. 3, from 5 experiments	1·540	22,385	14,535	14,535 = 6 10
Mixture of iron,—4 experiments further on (art. 7.)				16,542 = 7 7¾
Mean from the whole				16,505 = 7 7⅛

4. The preceding Table, excepting the two last lines, is extracted from my Report on the strength and other properties of cast iron obtained by hot and cold blast, in vol. vi. of the British Association.

5. In the second volume published by the Asso-

ciation, there are given the results of a few experiments, which I made to determine the tensile strength of cast iron of the following mixture: Blaina No. 2 (Welsh), Blaina No. 3, and W. S. S., No. 3 (Shropshire), each in equal portions.[1]

6. In these experiments the intention was to determine, first, the direct tensile strength of a rectangular mass, when drawn through its axis, and next the strength of such a mass, when the force was in the direction of its side. The castings for the experiments on the central strain were of the form previously described; and in the others the force was exactly along the side. The experiments were made by means of the Liverpool testing machine.

7. Force up the middle.

Experiments.	Area of section in parts of an inch.	Breaking weight in tons.	Strength per square inch.
1	3·012	22·5	7·47
2	2·97	21·0	7·07
3	3·031	25·5	8·41
			tons. mean 7·65 = 17136 lbs.
4	2·95	19·5	6·59 different quality of iron.

[1] This mixture of iron is the same as I had employed in some experiments on the strength and best forms of cast iron beams, (Memoirs of the Literary and Philosophical Society of Manchester, vol. v., second Series,) of which an account will be given further on.