

**ENGINEERING PAPERS.  
MORTAR;  
PRACTICAL IRONWORK;  
RETAINING WALLS**

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Engineering Papers. Mortar; Practical Ironwork; Retaining Walls by C. Graham Smith

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**C. GRAHAM SMITH**

**ENGINEERING PAPERS.  
MORTAR;  
PRACTICAL IRONWORK;  
RETAINING WALLS**





# ENGINEERING PAPERS.

## MORTAR:

A PAPER READ AT A SUPPLEMENTAL MEETING OF THE INSTITUTION OF CIVIL ENGINEERS, MAY 23RD, 1873,—TO WHICH THE COUNCIL AWARDED A "MILLER PRIZE,"—AFTERWARDS READ WITH THE ADDENDA AT THE EDINBURGH AND LEITH ENGINEERS' SOCIETY.

## PRACTICAL IRONWORK:

A PAPER READ AT A SUPPLEMENTAL MEETING OF THE INSTITUTION OF CIVIL ENGINEERS, APRIL 24TH, 1874,—TO WHICH THE COUNCIL AWARDED A "MILLER PRIZE."

## RETAINING WALLS:

A PAPER READ AT A MEETING OF THE EDINBURGH AND LEITH ENGINEERS' SOCIETY, MAY 6TH, 1874.

WITH ADDENDA

BY

C. GRAHAM SMITH, STUD. INST. C.E.,

MEMBER OF COUNCIL OF THE EDINBURGH AND LEITH ENGINEERS' SOCIETY;  
MEMBER OF THE LIVERPOOL POLYTECHNIC SOCIETY.

*Previously published in the 'Engineer,' 'Engineering,' 'Architectural,' and other Scientific Journals*



LONDON:

E. & F. N. SPON, 48, CHARING CROSS.

NEW YORK:

446, BROOME STREET.

1875.

TO

JOHN FOWLER, Esq., F.G.S.,

PAST PRESIDENT OF THE INSTITUTION OF CIVIL ENGINEERS,  
&c. &c. &c.

THESE PAPERS

ARE

Dedicated,

AS A TRIBUTE OF ESTEEM,

AND A SLIGHT EXPRESSION OF GRATITUDE

FOR HIS MANY ACTS OF KINDNESS

TO

THE AUTHOR.



## PREFACE.

---

IN submitting these papers to the public, it has been deemed advisable strictly to adhere to the originals; therefore, with the exception of the Addenda to *Mortar*, they are substantially as read. The allotted time for reading at the meetings being limited they are necessarily short, yet by omitting all superfluities a considerable amount of matter has been condensed into them.

In connection with all subjects there are many points which it is impossible to touch upon when reading a paper. Statements involving numerical results, which may be of great value, are very uninteresting and generally entirely fail to command the attention of an audience; some of these closely bearing on the subject-matter have been introduced at the end of each paper, along with such other explanations as have seemed necessary, and it is trusted they will render the whole of interest to engineering students.

The opinions elicited in the discussions are appended, with the author's replies fully worked out by subsequent thought and experience.

Should this volume meet with the same reception from the public as the papers have already received from the scientific press, and from those to whom they have been addressed, the author will feel that his slight endeavours to promote engineering science have been amply rewarded.

DOCK YARD, LIVERPOOL,

*January 1, 1875.*



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