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978-1-107-63596-8 - Architectural Building Construction: A Text Book for the
Architectural and Building Student: Fourth Edition: Volume One

Walter R. Jaggard and Francis E. Drury

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ARCHITECTURAL BUILDING CONSTRUCTION

VOLUME ONE

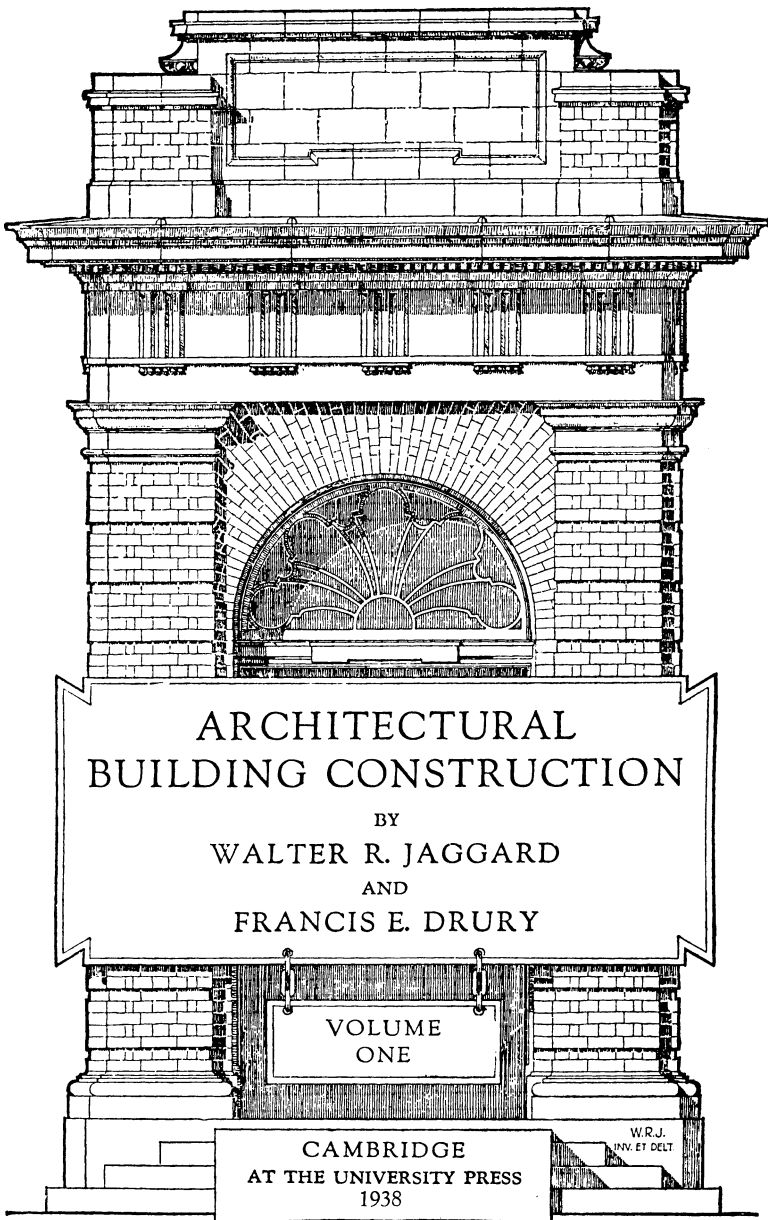
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ARCHITECTURAL BUILDING CONSTRUCTION

A TEXT BOOK FOR THE ARCHITECTURAL
AND BUILDING STUDENT

BY

WALTER R. JAGGARD

AND

FRANCIS E. DRURY

M.Sc.Tech., M.I.Struct.E., F.I.San.E.

Fourth Edition

(Revised and Enlarged by F. E. DRURY)

VOLUME ONE

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1938

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GENERAL PREFACE

IN writing and illustrating the series of works on Architectural Building Construction of which this is the first volume, the authors have been actuated by the desires and objects which are briefly set out below.

That there are many existing books on Building Construction is a well-recognized fact; that some of them have excellent matter, and others have good illustrations is also duly acknowledged, but from a long experience in the practice of Architecture, both in England and the Colonies, and many years of teaching architectural principles and the science of building construction, the authors have been forced to the conclusion that something more in the way of Text books is needed for the following reasons.

1. Building Construction should not be divorced from the Principles of Architectural Design. Although it is sometimes true that we find an Architect who can design pleasing structures with little or no knowledge of building construction, it is an undoubted fact that a fine conception of noble architecture must be based upon an intimate and complete knowledge of the proper use of materials, the scientific and fit assembly of the varying units, and an honest and conscientious co-ordination of the work of Architect, Builder and Craftsman.

It may be argued that with the present day use of steel and reinforced concrete, together with other modern materials and methods, we are able to construct some most extravagant fancies in architectural design, which a few years ago would have been quite impossible. Whilst this is quite true, and illustrates the age in which we live, it is also true that the very great majority of our buildings to-day are still erected with the staple materials, such as concrete, brick, stone and timber.

2. For the creation of good architecture it is necessary to study the work produced by our predecessors, and not only the work of ancient civilisations and mediæval peoples, but the best work of more modern architects must be examined. This study is rendered comparatively easy of acquisition through the rapid and cheap

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facilities offered for travel, and the many excellent books and illustrations which are constantly being published. Attention might here be drawn to the publication entitled, *The Development of English Building Construction*, written by Mr C. F. Innocent, and forming one of the volumes of The Cambridge Technical Series; its perusal will prove both agreeable and interesting. Is it possible to apply this method to the study of Building Construction? The authors have been impressed with this idea, and have endeavoured, with some success, to carry it out in their teaching. They have, however, found that in the earlier stages of education this must not be unduly pressed. For elementary students, the teacher should, to some extent, be dictatorial, and whilst selecting a well-proportioned and designed study as an example, should insist upon the construction being shown in a definite manner, although he knows that infinite variety, both in design and construction, is possible. With the more advanced student greater latitude is desirable, and in fact necessary. The authors have, therefore, impressed a certain amount of individuality in the subjects of the first two volumes, but they intend, as far as possible, in the third volume to select examples of established taste and architectural value to illustrate advanced principles of design, maintaining in some cases the constructional details given them by their designer or constructor, but in others, adapting the construction in accordance with modern methods and the more extended use of machinery.

3. Building Construction has hitherto been presented to the student in the form of isolated examples, which have no relation whatever to each other, and thus the knowledge obtained cannot be applied to the actual design of a building, even of the smallest dimensions, until a very much later date. Modern methods of teaching demand a greater cohesion. The authors have endeavoured during their teaching experience to obtain or formulate one building into which all the various items comprehended in each year's work could be fitly placed, but after many attempts it was found to be impracticable, and therefore two buildings were arranged, which embody, with few exceptions, all the items necessary for an elementary knowledge of building construction, thus enabling "teaching from the structure itself to be adopted rather than the selection of isolated examples on account of their simplicity."

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GENERAL PREFACE

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This method has been adopted in the first two volumes, but whilst the authors disclaim any idea of presenting great architecture, they do claim that the buildings designed fitly express their purpose, and enable them in a more or less pleasing manner to assemble the different units of the building, and at the same time to inculcate a sense of completeness in the student's work.

4. The acquisition of a knowledge of Building Construction should rightly be a plant of slow but sturdy growth, and in the majority of Architectural and Building Schools the course of instruction covers a period of from three to five years. The first volume of this series is designed to meet the needs of the first year student, the second volume will provide more than is generally required for a second year course, while the third volume will cover a large field of advanced work.

5. The authors have often felt that the ordinary orthogonal presentation of examples of building construction does not sufficiently convey the solidity of the object to an elementary student, and as it is not possible for each student to have, or to make, models of the different units for himself—although such a course would greatly make for efficiency of study—the illustrations have to a large extent been shown in perspective, isometric or pictorial projection. Photographs might, and in some cases will, be used, but the camera, whilst giving a faithful representation of the object, cannot be used to show the construction of hidden parts. On this account dissociated isometric and oblique sketches have been freely used with some slight shading to indicate differing planes, but cast shadows have generally been avoided as tending to obscure the construction, which it is desired to show in the clearest possible manner. *It is not intended that study shall proceed by copying the pictorial drawings. These should be translated into plan, section and elevation, in the form of ordinary working drawings.*

It is strongly recommended that in all Architectural and Building Schools correct scale models—about half full size—of the different items should be made in such a way that the parts may be disassembled, and that the student should be encouraged and advised to study and measure these carefully, and make the usual orthogonal drawings, which are, after all, the media through which Architect, Builder and Craftsman convey their ideas and wishes to one another.

J. & D. I.

b

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GENERAL PREFACE

It is necessary to impress strongly upon a student in the early stages of his work, that his knowledge must be presented in a clear and unmistakable way and with some architectural character. A study of the first-named author's two volumes of Architectural and Building Construction Plates would be of material value in the conception and arrangement of drawings embodying the principles of construction.

Students should be encouraged carefully to complete all their drawings with full naming of parts, references, and adequate dimensions, and to ink-in and colour, or otherwise distinguish, the materials of construction. They will thus acquire the habit of thoroughness, which is of inestimable value to both draughtsman and craftsman.

In conclusion, the authors' chief endeavour has been to make these volumes of primary importance to students—architect, builder or craftsman—and since in this study, at least, they all meet upon common ground, although each with different aims and objects in life to accomplish, yet, each finding help and guidance herein, there is an augury of the future happy relations which should exist between those engaged in all the branches of the practice of architectural building.

W. R. J.

F. E. D.

June 1916.

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PREFACE TO VOLUME I

THE object of the scheme adopted in this volume is to provide an elementary course of instruction in "Architectural Building Construction," by embodying all the forms of building detail which are necessary for such a course in "proposed buildings, their surroundings and appurtenances."

By elucidating the details of construction of a whole building, a student, in his earliest study of the subject, is brought into contact with the necessity for treating each element of a structure as a unit in a complete scheme, and the problems that arise therefrom in the choice and suitability of site, selection of material for the work, elementary rules of construction as laid down by building bye-laws, and harmony in the detail and conception of the structure.

We should also observe that such a scheme almost equally benefits the professional student and craftsman, because:

(a) The professional student is, at an early period, engaged in the preparation of complete plans and details of architectural buildings.

(b) The craftsman or artisan student is engaged in preparing (or assisting in the preparation of) detached parts, whose successful assemblage in the structure goes to make the "preconceived whole" of the architect's design. These "parts" have necessarily to be detached from their surroundings for their construction, but being made to fit they eventually become an integral part of the latter.

Further, it is part of the professional training of the architect to prepare himself to foresee the artisan's difficulties in realising his conceptions, thus developing his art on the lines of satisfactory craftsmanship. The study will further tend to the realisation of the need for good will and co-operation between the designer and constructor if a successful end is to be attained.

Order of procedure in practical work is made clearer and thus leads to a better idea of the supervision of work in progress and of the preparation to be made for one trade to follow another in the execution of the work. The need for combined setting out of architectural features involving two or more trades, in order to avoid error and confusion, is also easier of demonstration.

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The volume to follow this will develop the work further, by the consideration of larger and better class buildings in urban areas, where more restricted conditions call for special care and treatment, in order to meet the requirements of public health.

A glance at the contents of this volume will show that no pains have been spared to give the information decided upon in the clearest possible manner.

As the authors hope that this volume may be considered worthy of adoption for technical class work as well as professional and private study, and from personal experience they realise that no volume giving information to be merely copied can be considered satisfactory, they have, by giving the information in the clearest pictorial fashion, *left the teacher at liberty to train his students to prepare orthogonal projections of the details supplied*. Copying can thus be avoided and the faculties of the students directed to the practical method of detailing, in order to present to others the knowledge they are presumed to have gained from the explanatory diagrams. A student would, in addition, do much freehand sketching in recording his impressions of practical examples submitted for his consideration.

Many details of the work will appeal to the students in a much more interesting way than the usual isolated details for class teaching.

One prominent feature of this kind is the setting out of dimensions for doorways, windows, intermediate spaces, and hence the complete external dimensions of the building, to suit brick sizes and the bond to be adopted.

The special consideration of building materials has been omitted in this volume, as we desire to encourage students to obtain their first knowledge of this important section by personal examination and experiment. It will then be possible to deal with their selection and application more logically and exhaustively in the subsequent volumes than would otherwise be the case.

A study of a companion volume in this series, *Experimental Building Science*, by Mr J. Leask Manson, B.Sc. Eng., will provide a satisfactory basis for our purpose.

The authors desire to make due acknowledgment of the assistance derived from the study of many valuable works, a list of which will be given in a later volume.

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PREFACE TO VOLUME I

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They desire also to thank the undermentioned firms for their kindness in supplying information relating to specialities and materials of construction, and for their interest in the preparation of this volume:

S. and E. Collier, Ltd, Reading, and The Ravenhead Sanitary Brick and Tile Company, Ltd, St Helens, Lancashire (*bricks and tiles*); Carter and Aynsley, Ltd, 214 Bishopsgate, E.C. (*door and window fastenings*); Walter Macfarlane and Co., Saracen Foundry, Glasgow (*cast iron gutters and down pipes*).

W. R. J.

F. E. D.

*June 1916.**Preface to Fourth Edition*

Advantage has been taken of the necessity for a reprint of this volume to make some slight changes and additions to the text and illustration. The following illustrations have been added:

A diagram showing the modern treatment of concrete foundations, without footings, due to the general use of Portland cement concrete. Two plates of diagrams showing some of the varied methods of building up the foundation for the modern type of plywood-faced flush door. Three plates giving details of the simple methods of constructing double-hung sliding sashes; these are arranged firstly to give a clear understanding of the essentials without confusion by the introduction of mouldings and other complications, and secondly to illustrate the use of tongued joints in assembling the sash boxes—again without introducing moulded linings. After studying these new drawings the elementary student will be able to grasp the more elaborately designed example of first-class construction which forms the main feature of the chapter on windows. It should be noted that double-hung sashes are still in great use for commercial buildings as well as houses. In many cases dwelling-houses are fitted with double-hung sashes on the ground floor and casements on the first floor. An example is also given of a modern three-light steel sash and finishings.

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PREFACE TO FOURTH EDITION

The chapter on stairs has been revised to introduce more economical methods of construction, especially in regard to stair strings, and the diagrams have been generally revised accordingly. Many of the general illustrations have been re-drawn and either revised in small details or clarified by firmer outlines.

Thanks are due to Mr R. A. Bix for valuable assistance in the preparation of drawings for this edition.

F. E. DRURY.

28 *March* 1938.

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INTRODUCTION

(*For the student*)

MOST students, before reaching the stage of education where the study of “Building Construction” has become their special object, will have passed through some course of preliminary study including mechanical drawing. Where this is the case, a student must already possess some knowledge of the form, value, care and use of drawing instruments.

We shall not, therefore, occupy space by teaching him the most elementary matters concerning drawing, but merely impress one or two points which need reiteration with many students.

(a) Remember that instruments, to be of any value, must be in good working condition. *This is your special care.* First-class instruments are always advisable, but they need to be kept in first-class condition for satisfactory work. Cheaper instruments *may* do satisfactory work if cared for.

(b) Keep everything you employ for drawing purposes *clean*—paper, board, squares, rubber and hands. Don’t sharpen pencils *on the board*. Use good pencils sharpened to a *long* rounded point; flat or chisel points, while advisable for geometry, are not suitable for the production of architectural drawings, which necessitate a large amount of freehand work in the profiles of mouldings, lettering and dimensions.

(c) For work to be completed in pencil, don’t use a hard lead. “HB” is hard enough and can be employed for all purposes.

(d) Obtain a soft indiarubber and keep it in a case, not in your pocket.

(e) *For class notes*, a note book 9" × 5½" faint ruled on one page and ⅛" squared on the alternate page is suitable for elementary work.

For drawings, half imperial sheets are sufficiently large and satisfactory work can only be produced on paper of good quality.

(f) Study, under any conditions, must be *thorough* and *continuous*.

(g) The scales generally adopted for architectural work are ⅛", ¼", ½" and 1", and we recommend one instrument containing these scales on separate edges, known as the “Architect” scale, which is obtainable in boxwood or ivory.

Compound scales, having several scales on one edge, tend to confusion and error.

Cardboard scales are often not reliable and their edges quickly deteriorate with regular use.

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INTRODUCTION

(h) Every student of building construction should endeavour to attain a good standard of draughtsmanship; he can make little progress without it.

Ability to express one's thoughts clearly and fully whether in freehand or mechanical drawing is to acquire the "language" of the architect and builder. It is just as indispensable as speech. Clear freehand sketching forms a large part of his equipment in explaining his conceptions to others and can only be obtained by constant practice.

Students are also advised that they cannot make satisfactory progress in their studies as the work becomes advanced, unless they possess an adequate knowledge of practical mathematics, geometry and experimental science. Special attention should be paid to such parts of these subjects as are of vital importance in the design and construction of buildings. (See "Courses for building students" such as are generally available and also the companion volumes in this series.)

DESCRIPTION OF THE BUILDINGS, THE CONSTRUCTION OF
WHICH IS TO BE STUDIED IN THIS VOLUME

In the preface to this volume it has been pointed out that the authors at first desired to formulate one building into which could be fitly introduced the varying items usually comprehended in an elementary scheme of Building Construction, but the aggregation of conflicting details and doubtful combinations of materials would of necessity render such a building too complicated to answer the authors' main purpose, viz., to deal in the clearest possible way with forms of construction which may be fitly assembled in a comparatively simple structure.

With this aim in view they have therefore selected two buildings for study, one being a detached cottage of two storeys, built in brick and roofed with tiles, and suitably erected in a country district for the accommodation of a gardener, gamekeeper or some agricultural worker; the other, a single storied workshop built in brick and stone, having a slated roof and overlooking an open yard. The workshop might reasonably be erected on the outskirts of a provincial town for the accommodation of a plaster worker, a stone or marble carver, or any craft desirably housed in a building presenting some architectural character.

It is not intended that these two buildings should have any relation to each other, nor is it contended that they are suitable for erection in all districts. The authors rather desire to impress upon students the need for careful study of local materials, and their preferable use where suitable, in order to avoid the importation of foreign materials with their attendant cost.

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DESCRIPTION OF BUILDINGS

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THE COTTAGE

The cottage is detached and, as will be seen from the general working drawing in pocket of binding, consists of a two-storied main block, L-shaped in plan and covering a superficial area of about 966 square feet with a small one-storied back addition having a superficial area of approximately 120 square feet.

Externally the walls are built of brick in Flemish bond, the ground floor walls of main building being $1' 1\frac{1}{2}"$ thick, while the upper floor walls and those of the back addition are $9"$ thick. The window openings have brick cills, and brick arches surmount both window and door openings. All the roofs are covered with plain tiles, and are supplied with cast iron gutters and rain water down pipes. The majority of the windows are fitted with sliding sashes, but the scullery, larder and earth closet windows have solid frames and casements. A small open porch, finished with a flat lead-covered roof, is placed as a protection around the main entrance doorway, while a covered way forms a part of the back addition and provides a sheltered approach from the scullery door to the tool store, fuel shed and earth closet. This covered way is paved with concrete, but the porch is finished with brick paving.

The accommodation of the cottage is as follows: On the ground floor. An entrance lobby, $5' 7\frac{1}{2}"$ wide by $4' 6"$, with the stairs to the upper floor directly opposite the entrance door; the lobby contains two doors, the one on the right leading into a sitting room or parlour, $14' 3" \times 13' 9"$, which has a boarded floor, one window, a fireplace and a large recess; the other door leads into a large living room, $18' 9"$ long by $14' 3"$ wide. It also has a boarded floor, two windows, a large fireplace, and a recess opposite, which might suitably contain a dresser. Another door from this room leads into a scullery, about $18' 0"$ long by $9' 3"$ wide, with a recess $7' 6"$ wide by $3' 4\frac{1}{2}"$ deep, in which could be placed a sink. This room is lighted by two windows and is to be paved with concrete. Doors from this room lead into a large store cupboard arranged under the stair to the upper floor, and into a larder, $5' 3" \times 3' 0"$, containing shelves and lighted and ventilated by a casement window. Another door from this room forms the back entrance to the cottage and leads, by means of a covered way, firstly to a tool store, $5' 3" \times 3' 0"$, which is arranged to balance the larder on the plan, thence to an open fuel shed, 6 feet square, and finally to an earth closet, $5' 6" \times 3' 0"$, lighted and ventilated by a casement window. The floors of these latter are finished with cement on a concrete base.

Returning now to the entrance lobby; a stair $3' 3"$ wide, and containing 15 steps, leads in a straight flight to the upper floor

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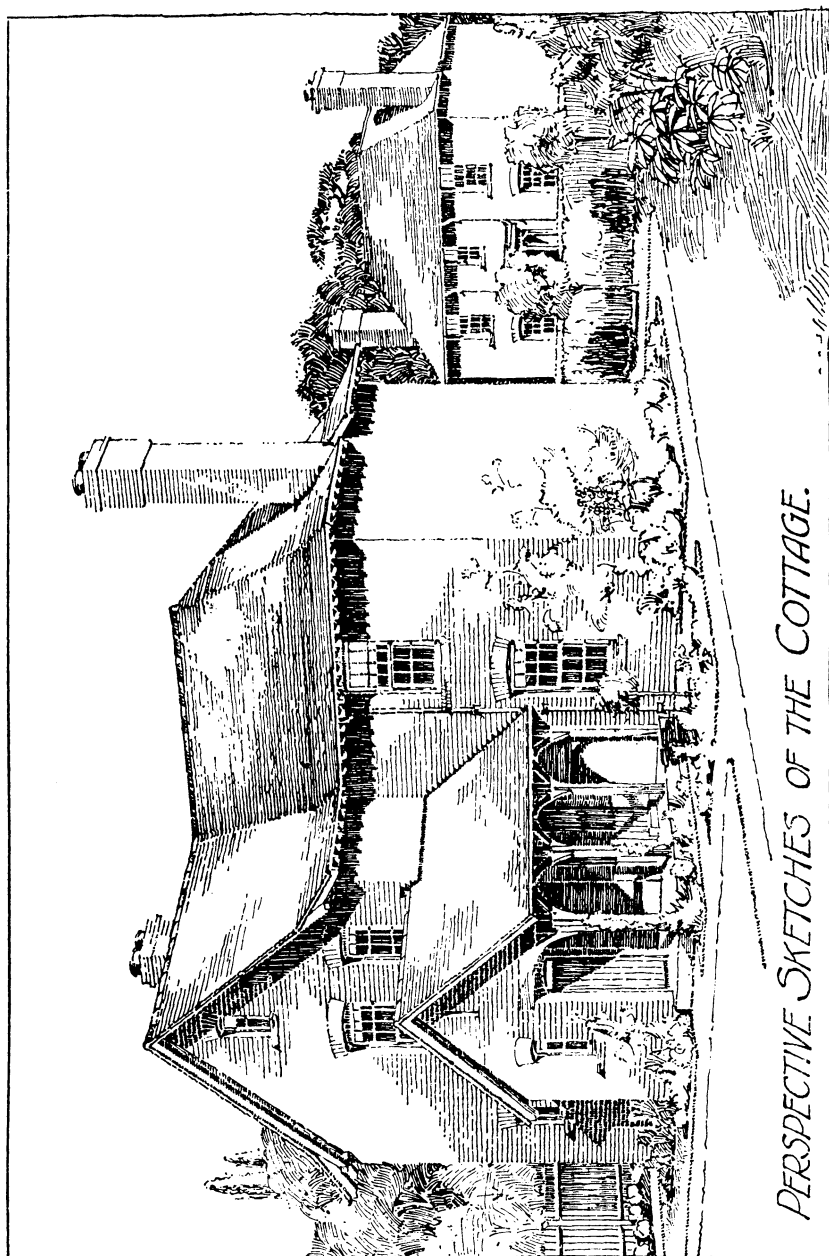
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DESCRIPTION OF BUILDINGS



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DESCRIPTION OF BUILDINGS

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landing, which is placed over a part of the scullery below. This landing is $8' 6'' \times 4' 9''$ and has four doors opening upon it. The one on the left leads into a large bedroom, over the living room below, and is 9" longer and $4\frac{1}{2}''$ wider than the latter, because the external walls here are only 9" thick as compared with $1' 1\frac{1}{2}''$ on the lower floor. The room is lighted by two windows, and has a fireplace and recess, similar to the living room. The door on the right of the landing leads into a second bedroom, over the sitting room below, and is $4\frac{1}{2}''$ larger each way than that room. It has one window and a fireplace, and communicates with the large bedroom already mentioned, by means of doors, opening upon a landing or balcony, placed over the entrance lobby, and protected by a balustrade. This landing also serves by means of a window to light and ventilate the staircase. Two other rooms are arranged on this floor, both placed over the scullery, and entered from the main landing. The larger is 13 feet by 12 feet, and has two windows, while the smaller room is $7' 9'' \times 7' 0''$, with one window, and could conveniently contain a bath and lavatory basin. A trap door is placed in the ceiling of the main landing to provide access to the roof. The surfaces of the upper floors are boarded, and the walls, ceilings and partitions throughout are plastered.

The ground floor level is placed $1' 6''$ above the ground, and the ground floor rooms have a nett height of $8' 6''$ from floor to ceiling, or $9' 6''$ from floor to floor, the upper rooms being $8' 6''$ from floor to ceiling.

The cubic content of this building, measured from the top of the concrete foundation to half the height of the roof, is approximately 28,500 cubic feet.

It will be noticed that no sanitary fittings of any description or stoves or ranges are included in the building, and these together with many other small fittings and appliances, some of which are necessary adjuncts, while others would add materially to the comfort and convenience of the occupants, have been purposely omitted by the authors, as not being within the province of this volume.

THE WORKSHOP

The workshop occupies a site at the angle of two streets with frontages respectively of 55 feet and 44 feet, and, as the general working drawing in pocket of binding will show, consists of a main building with a superficial area of approximately 1132 square feet, together with an enclosed yard, having an area of about 1100 square feet, of which 840 square feet is uncovered, the remainder forming an open fronted shed, with an earth closet at one end. The external walls of the workshop, fronting the two streets, are $1' 8\frac{1}{2}''$ thick, with

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a stone facing, averaging 7" on bed, backed with brickwork in English bond. These two walls are designed with moulded plinth, channel jointed piers, stone dressed windows, and moulded cornice surmounted by a stone parapet wall, one end being carried up as a gable. The opposite end wall is also finished as a gable with a stone coping; this gable wall and the wall facing the yard are 1' 6" thick, built in English bond, and the back wall is strengthened by attached piers. The windows in this latter wall have stone cills and heads, and a special feature has been made of the entrance doorway, which is carried out in brick, and is emphasised by a carved brick panel, which has been specially made from the authors' designs, set up, baked, and photographed by the Ravenhead Brick and Tile Company, Ltd, St Helens, Lancs. The roof is covered with slates, and advantage has been taken to introduce a parallel lead lined gutter behind the parapet walls, with a cast iron gutter and down pipes to the side overlooking the yard.

The boundary walls of the yard are 9" thick, strengthened with piers and buttresses, and are built in garden wall bond with the piers in English bond. The wall facing the street has brick plinth courses and a pair of entrance gates is hung to piers in the centre, giving access to the yard and workshop. A smaller door or gate might be placed in the boundary wall between the larger gates and main building and would probably be found very convenient. At the back of the yard is placed an open fronted shed 22 ft. long by 9 ft. deep, divided in the centre by a brick pier 1' 1½" square which supports a lean-to roof covered with open slating or pantiles. At one end of this shed is placed an earth closet 4' 0" × 3' 0" lighted and ventilated by a casement window, and approached from a small lobby. The shed and earth closet are to be paved with bricks and the yard laid with gravel. The windows to the workshop are intended to be solid frames with casements, but an alternative known as a standsheet sash will also be illustrated.

The main building is, internally, 40' 6" long by 25' 0" wide, and is divided into five bays by piers 1' 6" wide, carrying king post roof trusses over. The workshop itself occupies four of these bays, the other one, forming the angle of the two streets, is divided from the workshop by a glazed screen carried up from the floor to the underside of the roof truss, and by means of a similar screen at right angles to it is arranged to form an entrance lobby, 8' 0" × 4' 10", giving access to the workshop and to a large office about 20' 0" long by 8' 0" wide, which could be again subdivided, in order to provide a small private office. The office and lobby would have a ceiling at the height of the roof ties, the walls would be plastered and the floor laid with wood blocks upon concrete. In the workshop a ceiling is

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DESCRIPTION OF BUILDINGS

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unnecessary and the whole roof is left open to view, the height from floor level to underside of roof trusses being 14' 10". The brick walls would not be plastered, but the window openings finished with bull-nosed brick or stone internal cills, and the floor finished with cement laid upon a concrete base.

The cubic content of the building, measured in the same way as the cottage, is approximately 26,000 cubic feet, and is exclusive of boundary walling and gravelling to yard, and of any sanitary appliances that may be required, which, as previously mentioned, do not come within the scope of our study in this volume.