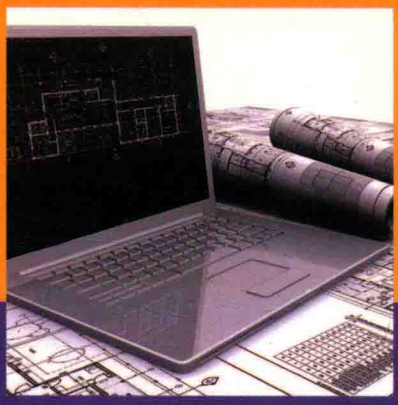
12th Edition

Sandra Lee | William Trench | Andrew Willis

Willis's Elements of Quantity Surveying



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Preface

This book was first published in 1935, and in the preface to that first edition it stated that it was intended 'to be a book giving everything in its simplest form and to assist a student to a good grounding in first principles'. Each successive edition has been brought up to date; however, we have always striven to maintain the original guiding principles, which are as relevant today as they were 70 years ago.

Whilst the use of the traditional bill of quantities continues to decline and today is only one of a variety of options open to the industry for the procurement of construction contracts, nevertheless, the skills of measurement are still very much required in some form or another under most procurement routes.

This edition recognises the publication by the Royal Institution of Chartered Surveyors (RICS) of the second volume of the *New Rules of Measurement – Detailed Measurement for Building Works* (NRM2), and the text has been updated accordingly.

The basic structure of the book generally follows that of previous editions, setting down the measurement process from first principles and assuming the reader is coming fresh to the subject.

Whilst it is recognised that modern computerised measurement techniques utilising standard descriptions might appear far removed from traditional taking-off, it is only by fully grasping such basic principles of measurement that they can be adapted and applied to alternative systems. It is for this reason that the examples continue to be written in traditional form.

The book opens with an overview of the need for measurement and the differing rules governing measurement at different stages of the design or project cycle. The main focus of the book remains on the detailed measurement of elements of a building using the rules from NRM2 and concludes with guidance on how to use the data collected during the measurement process to create the tender documents.

Whilst the role of the quantity surveyor is subject to continual change, we hope that students will find this book as useful as their predecessors have.

Sandra Lee
William Trench
Andrew Willis

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Abbreviations

a.b.	as before
a.b.d.	as before described
agg.	aggregate
BCIS	Building Cost Information Service
BS	British Standard
CAWS	Common Arrangement of Work Sections
c/c	centres
ddt	deduct
diam.	diameter
d.p.c.	damp proof course
d.p.m.	damp proof membrane
EDI	Electronic Data Interchange
e.w.s.	earth work support
ex	out of
hw.	hardwood
JCT	Joint Contracts Tribunal
n.t.s.	not to scale
PC	Prime Cost
MC	Measurement Code
n.e.	not exceeding
NRM	*New Rules of Measurement – Order of cost estimating and elemental cost planning*
r.c.	reinforced concrete
RIBA	Royal Institute of British Architects
RICS	Royal Institution of Chartered Surveyors
r.w.p.	rainwater pipe
SMM	Standard Method of Measurement
sw.	softwood
swg	standard wire gauge

Contents

Chapter 1
Introduction

The modern quantity surveyor

The training and knowledge of the quantity surveyor have enabled the role of the profession to evolve over time into new areas, and the services provided by the modern quantity surveyor now cover all aspects of procurement, contractual and project cost management. This holds true whether the quantity surveyor works as a consultant or is employed by a contractor or subcontractor. Whilst the importance of this expanded role cannot be emphasised enough, success in carrying it out stems from the traditional ability of the quantity surveyor to measure and value. It is on the aspect of measurement that this book concentrates.

The need for measurement

There is a need for measurement of a proposed construction project at various stages from the feasibility stage through to the final account. This could be in order to establish a budget price, give a pre-tender estimate, provide a contract tender sum or evaluate the amount to be paid to a contractor. There are many construction or project management activities that require some form of measurement so that appropriate rates can be applied to the quantities and a price or cost established.

The general approach adopted in this book is to concentrate on the traditional approach to construction whereby the client will employ a designer, and once the design is complete the work is tendered through the use of bills of quantities. Other procurement approaches move the

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need for detailed measurement to later stages of the project cycle and away from activity undertaken by the client's team to that of the contractor's team.

The need for rules

The need for rules to be followed when undertaking any measurement becomes clear when costs for past projects are analysed and elemental rates or unit rates are calculated and then applied to the quantities for a proposed project. For greater accuracy in pricing, it is important to be able to rely consistently on what is included in an element or unit, and this helps build a more reliable cost database.

Following the Royal Institute of British Architects (RIBA) 2013 Work Stages, the measurement undertaken at Stage 1 – 'Preparation' –needs to be of basic areas or functional units, and the guidelines of the Royal Institute of Chartered Surveyors (RICS) *Code of Measuring Practice* are commonly followed. This enables comparisons to be made between different schemes and options when assessing the feasibility of a project.

When preparing a cost plan, the need to include the same items in each element is important so that costs for that element can be accurately applied. In May 2009, the RICS published the first in its planned new set of rules for measurement dealing with the order of cost estimates and elemental cost planning. The RIBA work stages and the *New Rules of Measurement* (NRM) are explained further in Chapter 2.

The same need for rules applies when measuring for bills of quantities. If a document is to be used for tender purposes and included in a contract, then the contractor needs to know the basis of the measurement and what is included or excluded from an item to be priced. Historically, standard methods of measurement have been used to provide these rules and are available in various forms worldwide. The RICS NRM – detailed measurement for building works (NRM2) – have now been published and are part of the RICS 'black book' guidance for accepted practice in the United Kingdom. At post-contract stages, it is important that the rules used in the contract document (if applicable) are followed to minimise disputes.

Establishing the approach

The approach to take for any measurement is to decide its purpose and the level of design detail available, enabling the adoption of the most appropriate rules and procedures.

Chapter 3 will look at the early stages of a building project, and the remainder of the book will then focus on the detailed measurement for bills of quantities. Having an ability to read and understand the rules for measurement for bills of quantities should enable the measurer to appreciate the requirements of different rules and approaches.

Chapter 2
Detailed Measurement

Method of analysing cost

It is evident that if a building is divided up into its constituent parts, and the cost of each part can be estimated, an estimate can be compiled for the whole work. It was found in practice that by making a 'schedule' setting out the quantity of each item of work for a project, the labour and material requirements for these could be more readily assessed. This schedule at RIBA stage 5 can be in the form of a bill of quantities which, when priced by a contractor, provides a tender sum for a project. It must not be forgotten that a traditional bill of quantities only produces an estimate. It is prepared and priced before the erection of the building and gives the contractor's estimated cost. Such an estimated cost, however, under the most commonly used construction contracts, becomes a tender and a definite price for which the contractor agrees to carry out the work as set out in the bill. The bill must, therefore, completely represent the proposed work so that a serious discrepancy between actual and estimated cost does not arise.

Origin of the bill of quantities

Competitive tendering is one of the basic principles of most classes of business, and if competitors are given comprehensive details of the requirements it should be fair to all concerned. However, historically when tendering based on drawings and specification, builders found that considerable work was involved in making detailed calculations and measurements to form the basis for a tender. They realised that by getting

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together and employing one person to make these calculations and measurements for them all, a considerable saving would be made in their overhead charges. They began to arrange for this to be done, each including the surveyor's fee for preparing the bill of quantities in their tender, and the successful competitor paying. Each competing builder was provided with the same bill of quantities which could then be priced in a comparatively short space of time. It was not long before this situation was realised by the architect and employer. Here the employer was paying indirectly for the quantity surveyor through the builder, whereas the surveyor could be used as a consultant if a direct appointment was made. This would give the employer greater control over the amount paid to the surveyor and the opportunity to increase the service that was provided. In this way, the quantity surveyor began to get the authority of the employer and was employed to prepare a bill of quantities for tendering purposes.

The measurement process

The main purpose of a bill of quantities is therefore for tendering. Each contractor tendering for a project is able to price the work on exactly the same information with a minimum of effort. This gives rise to the fairest type of competition.

Despite the demise of bills of quantities on large projects, over 50% of the value of all building work in the United Kingdom is still let using lump-sum contracts with firm or approximate quantities. Most other procurement routes, such as design and build and management contracting in its various forms, also involve quantification of the work in some form or other by the main contractor, subcontractor or package contractor, and therefore the measurement process continues to be of importance.

Computerised and other alternative measurement systems have become more and more widely used. However, it is only by having a detailed understanding of the traditional method of setting down dimensions and framing descriptions that such systems can be fully understood and properly utilised. There continues to be development of 3D computer-aided design software that integrates with building information modelling, and the potential exists to generate quantities directly from the computer model. These software programs, however, have difficulty in producing quantities in accordance with any standard method and as yet have not removed the need for the quantity surveyor to prepare the tender and contract documents.

Attributes of a quantity surveyor

What, then, are the desired measurement skills of a good quantity surveyor? An ability to describe clearly, fully and precisely the requirements of the designers and arrange the bill of quantities so that the contractor's estimator can quickly, easily and accurately arrive at the estimated cost of the work is essential. This being so, it is obviously important that the surveyor should be able to write clearly in language that will not be misunderstood, and have a sound knowledge of building materials and construction and of customs prevailing in the industry. Moreover, the surveyor must be careful and accurate in making calculations, have a systematic and orderly mind and be able to visualise the drawings and details.

Divisions of bill preparation

The traditional preparation of a bill of quantities divides itself into two distinct stages:

(1) The measurement of the dimensions and the compilation of the descriptions from the drawings and specification. This process is commonly known as *taking-off*.
(2) The preparation of the bill. This involves the calculation of volumes, areas etc. (*squaring the dimensions*). Traditionally, this was followed by entering the descriptions and the squared dimensions on an abstract (*abstracting*) to collect similar items together and present them in a recognised bill order. From this abstract, the draft bill was written (*billing*).

Through the utilisation of computerised systems, the various stages have become more integrated. The facility now exists for direct input of quantities and formulation of descriptions through the use of standard libraries of descriptions, and the lengthy collating and bill preparation processes are carried out automatically. It should be noted that there is often still the need to produce preliminaries and preambles separately and to input uncommon items (*rogue* items) that are peculiar to the particular project. Checking total quantities and careful editing of the bill are still required to identify any data entry errors.

Quantities as part of the contract

Where a contract with quantities is used for a project, the bill of quantities forms one of the contract documents, with the contract providing that the quantity of work comprised in the contract shall be that set out in the bill of quantities. In such a case, the contractor is expected to carry out and the employer to pay for neither more nor less than the quantities given, an arrangement that is fair to both parties. Thus, it will be seen how important accuracy is in the preparation of the bill, and how a substantial error might lead an employer to enter into a contract that involved a sum considerably beyond that contemplated.

So that contractors appreciate how the quantities have been prepared and what is included in each item, the quantity surveyor uses the rules from a standard method of measurement. In the United Kingdom, the current standard method used for measuring building works is *NRM2*. A bill of quantities will be interpreted by a number of contractors in competition, and it must therefore be complete and a suitable basis for a contract.

Contractor-produced quantities and estimates

The subject of quantity surveying is dealt with in this book chiefly from the point of view of preparing a bill of quantities, but the ability to prepare quantities is also very necessary to the contractor for the compilation of tenders where quantities are not supplied, which is common in design and build and small contracts. A contractor may well produce quantities for an estimate including only the main items of work and not all of the items that would have been measured using *NRM2*. The descriptions would be shorter and usually the pricing is worked out alongside the quantities, thus avoiding abstracting and billing. The contractor's estimate is solely for internal pricing. If mistakes are made or short-cuts are taken which lead to errors, the contractor alone suffers. The contractor is free to adapt the general principles of measurement to the company's needs and the specifics of an individual project.

Nevertheless, the contractor's surveyor must be able to check a bill of quantities and measure variations on the basis of that bill. It is therefore essential that the contractor's surveyor should understand how the bill is prepared, and there should be no difficulty in adapting this knowledge to suit the somewhat different requirements when preparing quantities for a contractor's estimate.

Differences of custom

It must be understood that, as a good deal of the subject matter of this book is concerned with method and procedure, suggestions made must not be taken as invariable rules. Surveyors will have in many cases their own customs and methods of working which may differ from those given here, and which may be equally good or, in their view, better. The procedure advocated is put forward as being reasonable and based on practice. Furthermore, all rules must be adapted to suit any particular circumstances of the project in hand.

Method of study

It is advised in the first place to study Chapter 4 in order to grasp thoroughly the form in which dimensions are usually written, irrespective of whether a computer system will eventually be used to record dimensions in practice.

Knowledge of elementary building construction and simple mensuration and trigonometry is assumed; where knowledge is weak in these subjects, further study is recommended before proceeding further with measurement.

Chapter 5 explains some of the alternative systems that are used in practice, and Chapter 6 explains how girths and centre lines are calculated.

Chapter 7 contains notes on general procedure rules for taking-off which should be read before attempting to study actual examples of measurement, and to which subsequent referral may also be useful.

Chapters 8 to 19 represent the sections into which the taking-off of a small building might be divided, and these should be worked through one at a time. The principal applicable clauses of *NRM2* are referred to in each chapter and should be studied concurrently. After the chapter has been read, the examples should be worked through. It should be possible to follow every measurement by reference to the drawing.

The examples of taking-off in this book are small isolated parts of what could be the dimensions of a complete building and are not a connected series. When they have been mastered in their isolation, it will be much easier to see how they might be expanded and fitted together to make up the dimensions of a complete building.

Chapters 20 and 21 deal with preliminaries and bill preparation, which are more logically dealt with after taking-off, as this is often a separate process.

Examples

The examples are included to illustrate the methods of measurement of a small unit of a building. They assume that full specification clauses would be set out in preambles to the bill (see Chapter 21).

The dimensions that are set down in the dimension column when taking-off are given to the nearest two decimal places of a metre. Side casts (or waste calculations, as they are sometimes called) are used to calculate these dimensions, and are given in millimetres to ensure accuracy.

The examples in the chapters are presented in a traditional dimension format, this being considered the best system for a textbook and what the candidate will usually be faced with in the examination room. Abbreviations have been used for deductions where a description sufficient to recognise an item clearly is all that is required. The abbreviations used in the descriptions are listed in the 'Abbreviations' section at the beginning of this book.