

SOUTH AFRICAN ROAD FEDERATION
SYMPOSIUM ON THE PREPARATION OF CONTRACT DOCUMENTATION
AND ADMINISTRATION OF CIVIL ENGINEERING CONTRACTS
CHAPTER 7: THE BILL OF QUANTITIES

CONTENTS

	Page No.
1. INTRODUCTION	2
2. DEFINITIONS	2
3. TYPES OF INFORMATION	4
4. TYPES OF ITEMS	8
5. PRICING INSTRUCTIONS	11
6. ISSUING OF BoQ AS COMPUTER FILE	12
7. CONCLUSION	12

SOUTH AFRICAN ROAD FEDERATION
SYMPOSIUM ON THE PREPARATION OF CONTRACT DOCUMENTATION
AND ADMINISTRATION OF CIVIL ENGINEERING CONTRACTS
THE BILL OF QUANTITIES

1. INTRODUCTION

The phrase “bill of quantities” is synonymous with “schedule of quantities” and the CIDB Standard for Uniformity has, in its terminology, adopted the expression “bill of quantities”. This is now commonly used in GCC 2010 and GCC 2015. The FIDIC conditions also use this expression. These notes will therefore refer to the “bill(s) of quantities” or BoQ.

The Bill of Quantities (BoQ) is one of the documents normally included in papers making up a tender or contract. The qualification “normally” is used because it is quite possible to have a tender or contract, for civil engineering type work, which does not include this schedule. Without a BoQ it would be up to the tenderer to make his own assessment of the quantities involved in order to arrive at his tender price. Without the BoQ the valuation of any variations during the construction stage would be more complex.

Some contracts make provision for a Schedule of Rates which is very similar to the BoQ except that it does not include quantities; with a BoQ the interpretation of the rate is that it is the rate applicable to the quantity scheduled and may require modification should the quantity change, with a Schedule of Rates one is normally dealing with a lump sum contract and the rates tendered are intended to deal with any variation in the directed work.

2. DEFINITIONS

“Civil Engineering Quantities” (CEQ) describes the BoQ as follows:-

“The Bill of Quantities is a list of items giving the estimated quantities and brief descriptions of the work to be performed and materials to be provided under the contract. The quantities and the descriptions are derived from the drawings and specification and space is provided for the insertion of prices or rates against each item and for the extension of totaling the prices. The Bill of Quantities is intended, in the first instance, to give information to tenderers and to enable them by pricing each individual item as it relates to the conditions of contract, drawings and specification, to arrive at total tender prices all of which are founded on a basis common to all tenderers. When priced, the Bill of Quantities affords assistance to the adjudicator in comparing the various tenderers.

After the contract has been entered into, the priced Bill of Quantities provides the means whereby the work executed may be valued for payment, the prices or rates being applied to the quantities of work finally measured as actually carried out”.

CSRA defines the BoQ as:-

“1.(1)(p) Bill of Quantities means the document that forms part of the contract documents and in which are stated the estimated quantities of the work, labour, materials and articles required for the execution of the contract, together with the prices and rates to be paid to the Contractor for these, as agreed by the Employer and the Contractor”.

GCC 2004 has the following definition:-

“1.1.2 “Bill of Quantities” means the document so designated in the Pricing Data that lists the items of work and the quantities and rates associated with each item to allow the Contractor to be paid at regular intervals an amount equal to the agreed rate for the work multiplied by the quantity of work completed”.

This is a very brief and concise definition which is not very constructive from the point of view of directing anyone as to how the BoQ should be set up, however the GCC contain many references to the application of the Schedule (*note that “Schedule” or “Schedules” is a generic term commonly used, which in general terms will include the Bill of Quantities*) and it is obviously essential that the Schedule must be produced in such a way that it can be used for its intended applications.

GCC 2015 has the following definition:-

“1.1.1.2 “Bill of Quantities” means the document so designated in the Pricing Data, if any”. This means that anyone preparing a tender document based on GCC 2010 must be aware that the Pricing Data (previously referred to as the “Preamble” to the BoQ) requires attention during drafting to identify and designate the Bill of Quantities”.

FIDIC conditions do not give a detailed definition of “Bill of Quantities” but have the following:-

“1.1.1.10 “Bill of Quantities” and “Daywork Schedule” mean the documents so named (if any) which are comprised in the Schedules”.

The term “Schedules” is given its own definition as follows:-

“1.1.1.7 “Schedules” means the document(s) entitled schedules, completed by the Contractor and submitted with the Letter of Tender, as included in the Contract. Such document may include the Bill of Quantities, data, lists, and schedules of rates and/or prices”.

It can be seen from the excerpts above that the different conditions of contract have different approaches and varying degrees of ‘definition’ with GCC 2015 and FIDIC saying very little as to what actually comprises the “Bill of Quantities”. The conventional approach to the structure of the BoQ is discussed below.

3. TYPES OF INFORMATION

The generally accepted format for the BoQ provides for information to be set out in seven columns:-

“Item no.”

In case of a GCC 2010, GCC 2015 or FIDIC BoQ the numbers will run sequentially, without omissions, using the “legal style” (i.e. numbering similar to “3.1.5”); apart from making cross-reference convenient (particularly since each item will have its own unique number) the numbering system also highlights the logical structure of the ordering of the items in the Schedule and clarifies the range of applicability of many of the “payment clause” references in the adjoining column. In the case of CSRA the items are not necessarily sequential and there are likely to be numbers missing since it is unlikely that all potential items of work will be included in each contract.

Most BoQ’s will consist of a number of sub-schedules, parts or sections and the numbering system is then adapted by prefixing or suffixing the basic item number with the reference letter (or number) of the sub-unit.

“Payment Clause”

Since the “Short Description” column does not provide full details for the work to be covered by each item in the schedule, it is essential to provide a reference to the clause which does provide full details of the requirements. Care must be taken to ensure that the reader’s attention is directed to all relevant payment clauses; while the “obvious” clauses are seldom omitted, special care is needed to make sure that special requirements of the project specification, possibly stated as “notwithstanding any statements made anywhere else in this document, no payment will be made for overhaul”, are referred to at the point where they are needed. Irrespective of whoever may be responsible for an error from the

legal/contractual point of view it is better to eliminate any source of error rather than later argue about liability.

“short description”

The short description should contain sufficient information to ensure that it covers the main components of the item plus any unusual aspects required in terms of the project specification clauses contained within the scope of the work (this is notwithstanding that the Payment Clause reference directs attention to all the requirement). Again it is better to avoid error than to sort out liability later or to have an inequitable situation arise.

“quantity”

It is in this column that we find the information that is the fundamental reason for the existence of the BoQ. It would be wrong to regard it as the most important because none of the information can be regarded in isolation and the quantities would be meaningless without the related specification and payment clauses; however, it is the quantities that perhaps deserve the greatest attention for the present purposes particular since there seems sometimes to be a tendency for people to minimize the importance of accurate quantities.

Looking back to the definitions and descriptions of the BoQ given in the GCC's and in Civil Engineering Quantities we note:-

- they are estimated quantities;
- they are used to give information to tenderers;
- they are used to assist in evaluation of tenders;
- they are used to value the work done; and
- they are used as a basis for the valuation of variations.

“estimate” is defined in Chambers Twentieth Century Dictionary, restricting ourselves to the aspects relevant to us, as “to judge the worth or size of anything; a rough calculation; a preliminary statement of the probable cost of a proposed undertaking”. Perhaps too often emphasis is placed on the “rough calculation” aspect of this rather on the other, far more applicable portions of the definition. It is suggested that from our point of view an estimate is “a preliminary statement of the probable quantity with accuracy suitable for the

intended purpose subject to the stated limitations of the information available". The estimate should be the best available on the basis of the available information. If the tender drawings are of a preliminary nature, eg a 1/2000 scale layout of an urban sewer system, as opposed to 1/5000 detailed construction drawings, one can anticipate a different order of accuracy of the quantities and this can and should be anticipated by the parties. One would expect that, using construction drawings, the scheduled quantities should be the same as the final except for those items subject to variation to suit detailed conditions on site (eg hard and rock excavation etc); other items may vary because of the impracticality of doing a precise measurement before construction; in a wooded area removal of individual measured trees is likely to be estimated for the BoQ on the basis of some area scaled up and only during construction would a precise count be made.

The quantities must be a fair estimate and CEQ is emphatic that the quantities should not be inflated to allow for contingencies or additional works.

CEQ states "the process of taking-off in order to determine quantities should be completed as accurately as possible".

I H Seely in Civil Engineering Quantities states "the quantities should be as accurate as the information available allows". From this it follows that an accurate BoQ can have the effect of reducing the cost of tendering thus giving the Employer a better basis for comparison of Tenders.

If the quantities are significantly incorrect the Employer could well begin to query whether design decisions were made on the correct basis.

"unit"

Most payment clauses define the unit to be used for measurement or at least whether the unit is linear, by area or by volume etc. and the entry in this column should obviously correspond. Where the payment clause allows for a choice the unit chosen should suit the contractor's input and cost sources.

"rate"

This is filled in by the tenderer and, if the tender is accepted, then becomes binding on the parties subject to the variation provisions of the GCC. The amount of input required from the tenderer at the tendering stage is such that there is no justification for the Engineer, in determining the quantities for the Schedule, to fail to produce the best estimate available. (here the term 'engineer' is used in a very general sense to cover any of the multiplicity of

persons who may be involved in the various processes; definitely not restricted to the Engineer defined in the Contract nor to a person with some specific theoretical qualification).

“amount”

No comment is necessary on this other than that, should there be a discrepancy between what is entered here and the product of the rate and quantity, traditionally most contracts contained provision for the rate to be taken as correct. This traditional approach highlighted that the tenderer was offering rates and that the sum named in the Form of Offer was derived from those rates and was thus subject to recalculation should the extensions or quantities be wrong or changed. However, this traditional approach has been changed in the CIDB SFU which requires that a certain procedure be followed during tender evaluation if arithmetic errors are found in:

- line item totals resulting from the product of a unit rate and a quantity in bills of quantities; or
- the summation of the prices.

That procedure is detailed in the Standard Conditions of Tender (SCoT) as follows:

“F.3.9.3 Notify the tenderer of all errors or omissions that are identified in the tender offer and either confirm the tender offer as tendered or accept the corrected total of prices.

F.3.9.4 Where the tenderer elects to confirm the tender offer as tendered, correct the errors as follows:

- a) If bills of quantities or pricing schedules apply and there is an error in the line item total resulting from the product of the unit rate and the quantity, the line item total shall govern and the rate shall be corrected. Where there is an obvious gross misplacement of the decimal point in the unit rate, the line item total as quoted shall govern, and the unit rate shall be corrected.*
- b) Where there is an error in the total of the prices either as a result of other corrections required by this checking process or in the tenderer's addition of prices, the total of the prices shall govern and the tenderer will be asked to revise selected item prices (and their rates if bills of quantities apply) to achieve the tendered total of the prices.”*

The extended amounts are totaled on each page (in some systems, the individual page totals are then carried forward to a summary page) carried forward/brought forward to the next page and a total found for each section of the work which is then carried to the summary page. Totals for the individual sections are totaled, provision for contingencies

at say 10% is added (dependent upon the Employer's wishes), possibly an addition is made for anticipated escalation over the construction period and then VAT is added at the applicable rate to arrive at the tender sum.

The corrective procedure in the CIDB SCoT (as above) has been found to be inappropriate on larger contracts, although it is suitable for application to building contracts and smaller civil engineering contracts. Authorities such as SANRAL and the Trans Caledon Tunnel Authority (TCTA) have retained the traditional approach to the correction of arithmetic errors in the evaluation of tenders for their projects.

4. TYPES OF ITEMS

“normal”

The majority of items in a schedule will be the straight forward measurement and payment items for some definite physical quantity of output whether it is a cubic metre of concrete, a metre of pipe supplied and laid (and bedded, tested, corrosion protected etc.) or the supplying, transporting, placing, processing, compacting and trimming of a base layer measured either by volume or by area of specific thickness.

As with any other item, the few lines of text appearing in the short description column imply paragraphs in the relevant payment clauses which are themselves tied to pages of specifications either directly bound into the documents or imported by reference. The cubic metre of concrete involves detailed specifications for the materials to be used (sand, cement, water, additives), for their proportions under numerous sets of circumstances, for the methods of mixing and placing, for their testing and for the method and limitations of measurement; in addition there are numerous Acts, laws and bye-laws which apply. In inserting a rate in the relevant column the tenderer has to take account of all these components.

In pricing these items the tenderer also has to take account of how his method of operation may result in his having to do (produce) a greater quantity of the item than is paid for. For instance, pipe trench excavation payment is measured on the basis of a specified width which is also specified as the minimum width that will be allowed; the contractor is thus bound to exceed that width and must allow, in his rate for the specified width, for his additional costs in excavating and backfilling, in bedding and in surface re-instatement outside that specified width.

In compiling the schedule care must be taken to recognize the often not stated limitations of standard pay items in the specification. SANS 1200 provisions for restricting surface re-instatement payment to the specified width are, in the case of a trench crossing a road

at, or near, right angles are perfectly reasonable but for a trench near parallel to and running at a varying distance from the road special provisions are required. Similarly the provisions for protection of services crossing the trench apply well for minor pipelines and cables but cannot be used for a 600mm main water supply line.

Attention is needed also with respect to the limits specified for items measured over a range, for example:

- Trench excavation for depths less than 1,0m;
- Trench excavation for depths greater than 1,0m but not exceeding 2,0m.
- Etc

The questions to be asked are:

- Does the excavation fall near the average of the range or, because of pipe diameter and specified cover is it just under or over the limit value?

A watch should be kept for special site circumstances arising due to existing features and special additional pay items should be specified in order that the Contractor may allow for these costs separately, for example - laying pipes one metre from a fence; working on steep cross slopes.

“contractual liabilities”

Many items cover, not the production of a physical portion of the works, but the contractor's liabilities with respect to the provision of insurances, deed of suretyship, infrastructure such as site offices, temporary works (cofferdams, access roads etc.) which may not be specified as required but which the contractor will require in order to carry out his operations.

Normally such items are grouped together in the first section or part of the schedule under the heading “Preliminary and General” with provision made for fixed cost items and for those where the cost is time-related; such time-related costs are often specified as being those which will be used for the assessment of any payment due for an extension of time but usually qualified with “appropriate” or applicable”.

“extra over”

The concept of “extra over” is often used to provide for some variation in a single property of the item to be supplied or operation to be carried out. Typical example is where all excavation will be scheduled as though it is in “all materials” and the tenderer is required to price it on the basis that it is in soft; further items are provided allowing for an extra over

payment for those additional costs incurred when the material is not soft but is “hard” or “rock”.

“prime cost”

CEQ defines “prime cost item” as a sum fixed by the Engineer and entered in the BoQ as the net sum provided to cover the cost of specific goods or materials to be supplied under the contract, or the net sum to be paid by the contractor to merchants or others for such articles or materials”. CEQ requires provision in the BoQ to permit tenderers to fill in amounts to be added to cover costs, overheads and profits both as a fixed sum and as a percentage.

“provisional sum”

CEQ defines this as “a sum of money fixed by the Engineer and entered in the BoQ to provide for work not defined at the tender stage and includes any allowance specifically made for unforeseen contingencies”. Hyman however states “A provisional sum will be included in the Bill of Quantities when the Engineer has not yet decided whether the work concerned is to be done. The work will only be done if it ‘has been ordered by the Engineer’”. In the light of these differing definitions and the general rule that in calculating the value of “Variations exceeding 15 per cent”, the Provisional Sums are deducted from the Tender and Contract sums, there is room for debate as to whether the tenderer’s “time for completion” includes or excludes for the Provisional Sum work.

Note that these items are not the same as “provisional quantity” items which Loots (Page 244) defines as “... are used to indicate that the quantity of a particular item is more than usually difficult to predict”.

“daywork”

Daywork is the method of valuing work on the basis of the time spent by workmen, the materials used and the equipment employed; items may be included as provisional sums. Alternatively, scheduled items may be included for pricing by the tenderer in order to obtain rates for various classes of workmen and equipment hire. These daywork rates can be applied in dealing with work not similar to that covered by the rates elsewhere in the BoQ. It is also a useful method for allowing for the cost of such activities as the location of existing services.

To some extent, the provision of “daywork” in an admeasure contract is equivalent to measuring a portion of the work as a “cost plus % fee” contract.

“rate only”

Rates are often requested for an item which it is not required to be extended into the amount column. This may, for example, be for alternative pipe material types but of similar diameter. Where the rate is tied to a specific quantity, this is a practical approach but must not be used without a quantity. A Contractor's rate is made up of the cost of a number of inputs some of which are tied directly to the quantity involved and others of which are to a large extent fixed by the operating conditions and independent of the quantity. Where the Engineer insists on a rate only item without a quantity he leaves an opening for claims by the Contractor no matter what quantity is actually encountered.

“labour intensive”

Depending on the type of labour intensive contracts this may either require a totally different type of Schedule or, if labour intensive methods are achieved by restricting the use of equipment, may look exactly the same with similar items except that the ranges and descriptions will have to be re-assessed to suit the hand operations. Trench depths need to be in 1,5m steps to suit the provision of intermediate platforms; overhaul will be based on the use of a wheelbarrow and will extend perhaps from 2m to 100m.

5. PRICING INSTRUCTIONS

The CIDB SFU have modified earlier terminology and what used to be known as the “Preamble” to the BoQ is now termed the “Pricing Instructions”. However, the purpose thereof and the details contained therein have not really changed. The Pricing Instructions set out how the BoQ must be interpreted and how it must be completed. In compiling a document based on the CIDB SFU the tendering instructions are kept separate from the instructions etc. relevant to the Contract eventually entered into between Employer and Contractor. Thus it is important to ensure that the Pricing Instructions are correctly positioned in the document to enable them to become a part of the final contract.

Generally the information contained in the Pricing Instructions should not be repeated elsewhere in the document. This is a practice that should be avoided, which requires careful attention in the drafting stage.

Despite the preamble being such a common feature of contract documents it is interesting to note that GCC 2010, GCC 2015, FIDIC, SANS 100120 and CEQ do not provide a pro forma or standard.

6. ISSUING OF BoQ AS COMPUTER FILE

There are increasing appeals, particularly from contactors, for the issuing of the BoQ as a computer file. While, for a consulting engineer, there are likely to be no problems in issuing the BoQ (though whether the format he can make available will suit that of each contactor is another problem) there are problems if the contractors wish to submit a similar file as the tender. It would be ideal if there were a standard format for all concerned so that the BoQ needs be produced once only whether for invitation, pricing, or analyzing tenders or for payment certificate purposes. Those initially producing the schedule may be using different software, or, if using the same are using different versions; contractors are using different programs for doing their tender pricing and consultants each have their own preferred way of tender analysis and, later, of measurement certificate format.

Further problems are:-

- How will changes to the BoQ introduced through Addenda be dealt with?
- What constitutes the invited schedule? The printed BoQ or that on CD?
- What constitutes the tendered schedule; those issued or the CD returned or the Contractor's print-out of his CD?
- How is the integrity of the data to be protected?
- Are there risks of virus transfer?
- What is the legal status of computer submitted data?

The general practice now is to issue the BoQ to the tenderers electronically purely for the purpose of assisting in their analysis and costing activities. Tenderers do not want to have to re-type the entire tender BoQ into their own estimating system and the issue of a CD containing the BoQ in a format that can be downloaded into the tenderer's system saves considerable man hours. The condition to be attached to this is that only a hard copy of all documents comprising the tender (including the BoQ) will constitute a conforming tender. Tenderers are therefore to be advised in the Tender Data that no electronic tenders will be acceptable. Added to this tenderers have also to be advised that their acknowledgement of receipt of any Addenda issued, which may introduce amendments to the BoQ, will serve as confirmation that they have taken into account in their tender offer any such amendments.

7. CONCLUSION

Remember, the BoQ is not just a formality to be completed between completion of design to getting on with the construction side of the project; it is an essential and very important component of many aspects of the work of the parties involved in the Contract.

It is not a shopping basket for the Employer and Engineer to pick and choose options to decide on the “best” design.

It is going to be used by the Client/Employer (as developer and financier), by the Contractor (as planner, pricer and claimer) and by the Engineer (as designer, specifier, estimator and certifier).

It is up to the Engineer to ensure that the diverse needs of the various participants are fully satisfied.