



**STANDARD  
AND  
NON-STANDARD  
METHOD OF MEASUREMENT  
IN  
PAKISTANI  
CONSTRUCTION INDUSTRY.**

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## **Abstract:**

The main objective of this paper is to raise the Quantity Surveying system up to the standard mark. After a series of experience with this profession, this author's proposition concluded that local quantity surveyors (QSs) must adopt accord international standard and specifications. Further more education of QS must be started at graduate level in order to develop the understanding and importance of this profession in local construction Industry. To bring our system according to International level, QSs must be trained and educated in order to meet the standards.

This **paper** examines the standard and non-standard methods of measurement and their implementation in the local construction industry, the role of quantity take-off in the estimating process. The historical background of quantity surveying in developed and under developing countries are also outlined with an emphasis on the part play by the Standard Method of Measurement in the **Pakistan**.

This author tries to present before all consultants and quantity surveyors in Pakistan who prepare contract documents, bill of quantities and budgetary estimate that what is international method of measurement and what is being practiced in Pakistan. Quantity surveyors and cost engineers in Pakistan must be encouraged for adaptation of standard measurement methods (SMM) and motivated to join any cost engineering professional bodies (RICS or ACCEI or other) to improve their education and skills.

### **1.0 Introduction:**

The Bill of quantities (BOQ) plays a key role to the success of any project. The local construction industry is not heeding towards the importance of bills based on standard method of measurement. Author has studied and monitored the failures of the projects in local market. The main reasons are non-standard practice of bill and its costing, indifferent method of measuring quantities as well as the degree of accuracy of takeoff. In relation to the non-standard method of measurement, personnel from various engineering and architectural firms contributed extensively in studying and reviewing available documents. This **paper** presents the current situation in **Pakistan**, a proposed standard method and the benefits that can be resulted from implementing a standard method of measurement. Author took, **two items** of work (**Concrete and Plaster**), which are thoroughly analyzed. Recommendations are made to improve the current method of measurement. The two international Standard Methods of Measurement, one from RICS and other one is from CSI based on master format, are placed in appendices. Moreover **seven case study examples** are also placed in appendices.

Hopefully, in near future Pakistan Association of Quantity Surveyor will deploy one of the international standard method of measurement to the local construction industry or to launch its own SMM according to local perspective.

### **2.0 Bill of Quantities:**

A BOQ is a document used in tendering in the construction industry in which materials, parts, and labors (and their costs) are itemized. The Bills also provide a measure of the extent of work and this allows the work to be priced. The work included in the item is defined in detail by the rules in the method of measurement. The item description is therefore shorthand to allow the relevant rules of the method to be identified.

### **2.01 Function of Bills:**

- A breakdown of work and activity of the project with description of item.
- Helpful to prepare a detailed estimate budget (realistic budget).
- A breakdown of the tendered price, with no contractual status, but providing information for the selection from Tenderes.
- An estimate measure of the work for the tendered price, to be used to arrive at a revised contract price the actual quantity of work carried out are measured. This is the re-measure form of contract.
- A schedule of rates as contract basis for valuing variations in the work.
- A basis for measure of the value of work completed for interim payment.

### **2.02 Basis of Bill is Take-off**

Take-off is the measuring of construction work from drawings for bills. It is an essential function of estimating that determines the quantities of items of work to be used on a project. The procedure for taking-off is outlined in an agreed standard set of rules defining what is to be measured and how. The set of rules is known as the Standard Method of Measurement (SMM) established in United Kingdom in 1922. Standard of works serve as a guide for preparing bill of quantities or measured the work to be done or work done.

### **2.03 Role of Quantity Surveyors**

The role of a quantity surveyor is to manage the costs relating to building projects. Quantity Surveyors seek to minimize the costs of the project and enhance value for money whilst ensuring that the project meets all legal and quality assurance requirements. Quantity Surveyor on behalf of owner measures the quantities from contract drawings and prepares a standard bill of quantities to collect the rates from contractors as well as prepare a budget estimate.

Estimating can achieve a greater degree of accuracy if it follows a SMM. And it will be beneficial for both parties (contractor and owners). In Pakistan every consultant have established their own method of measurement just after technical specification under the heading "Method of Measurement". It shows that this item will be measured as per these rules.

These methods vary from person to person; as a result, every project costs vary considerably from one quantity surveyor to another. This paper promotes the idea of adaptation of standard method of measurement. It is mainly due to author's experience that using the SMM either RICS or Master format will be beneficial for construction industries as well as it will help to meet the international standard.

The main objective for using a standard method in estimating is to ensure that all contractor bidding for a job use common bill of quantities as an international standard method of measurement. In this way the probability of disputes is minimal and the owner receives the most realistic figures of the project. Wastage factors can also be minimized. Author has analyzed to show that a standard method of measurement is beneficial to all parties involved in a building construction project.

#### **2.04 Brief History of the Standard Methods of Measurement:**

In 1922, the Standard Method of Measurement for building works was first published in the United Kingdom. It provides a uniform basis for measuring building works as well as giving detailed information where necessary, in order to define the exact nature and extent of the work required. The Standard Method of Measurement applies to both proposed and completed works.

During the 19<sup>th</sup> century, the industry revolution in Britain contributed to a booming building industry. Builders had to prepare bids by measuring the same quantities from the Architect's drawings. Hence, they were duplicating the same activities for each bid. The logical solution was for them to get together and employ one individual to measure the work and detail it in Bill of Quantities booklet. After pricing the work, the successful bidder would pay the person, called a Quantity Surveyor and include his fee in the bid. Since the owner has to eventually pay for the services of the quantity surveyor, it was thought wise for him to be retained permanently and also to provide costing advice where necessary

After these changes, a common problem was that different quantity surveyors would measure work in different ways. Disputes arose where the surveyor in the measurement of a related item included extra work claimed by the builder for an item of work. These disputes led to the introduction of the Standard Method of Measurement by the Surveyor Institution in the United Kingdom. Over the years, it has been revised as construction techniques and methods change. Construction Specification Institute was founded in March 1948 by the Specification writers of government agencies, who came together to improve the quality of construction. Specification writer in the private sector, design professionals concerned about communicating this vision in construction document. Master Format is a publication of CSI and CSC is a master list of numeric and titles classified by the work results.

Both systems have very similarity but have some difference between both "Standard Methods of measurement" as I mentioned above.

#### **3.00 Importance of Quantity Take-off:**

Take-off is the measurement of construction work from drawings. It is a technical function that requires both knowledge and expertise. A thorough examination of the project plan, specifications, tender documents, designs and drawings help the estimator determine the total unit of work for each item of the project. The accuracy of the quantity take-off is directly related the reliability of the estimate.

The procedure for quantity take-off entails the listing of quantities for the various work items to be priced separately. All take-off work must be recorded properly to enable verification of the quantities. A casual way of entering quantities may lead to an estimate full of errors. Normally, two conflicting constraints occur while carrying out quantity take-off. They are the degree of accuracy required and the time allocated for the take-off.

Quantity take-off is a boring, repetitive and most time-consuming part of detail quantities. It is a view shared by most estimators. However, it must be done accurately to produce a precise estimate. Generally, cost, time and human resources determine the take-off procedure required.

### **3.01 Method of Estimating:**

There are two categories of estimation methods used in all over world. They are preliminary estimating and detailed estimating methods.

The price per unit, price per unit volume and approximate quantities methods are all preliminary methods. They are mostly used by designers in the cost planning stages. In these methods, sufficient data is not available to give an accurate estimate. Historical data from completed projects with similar physical properties is very useful to designer who does preliminary estimates.

The detail method is more popular in this region, this method of choice for most owners as well as contractors because it offers greater accuracy. The designer has the ability to make a more reliable estimate of the probable cost of construction since drawings and specifications are present at this stage of estimating.

### **4.0 Role of Bill of Quantity in the different types of Construction Contracts:**

Three major contracts systems used in the world. In **Pakistan**, the **unit price contract** is the most common.

#### **4.01 The Stipulated Sum Contract:**

This kind of contract is the most common form of contract whereby the contractor agrees to do the work for a predetermined price within the contract time stated in the agreement. The payment includes labor, materials, equipment costs and allowances for overheads, profits and taxes. The stipulated price contract binds the contractor to perform the work in accordance with the plans, specifications, terms and general conditions of the contract. A contractor with a lump sum (stipulated) contract is responsible for all works completed by his own crew and the subcontractor he employs. Contractor takes most of the risk under this form of contract. Stipulated contracts are suitable for straightforward work such as residential and commercial work of standard construction that can be fully detailed to given maximum design detailed information and that will be executed on sites having predictable conditions and offering the least risk. Such works can be estimated quite easily and performed by an efficient contractor. In this form of contract, the bill of quantities is mostly not used.

#### **4.02 Cost plus Fee Contract:**

In this type of contract, the owner pays the contractor all of the costs for the work, plus an additional fee to cover the contractor's supervision, overhead costs and profits. In the Cost plus Fee Contracts, the owner takes a greater portion of the risks and the contractor takes very little. On the other hand, the reverse is true for the stipulated type of contract. With little or no information, no precise estimate can be made. If the owner wants the job to be done then he agrees by paying all the costs without limit.

Mostly cost plus contracts are a form of the Cost plus Fee contract whereby a maximum cost is determined based on the design information available.

#### **4.03 Unit Price Contract:**

In this kind of contract, the contractor agrees to complete the work from approximate quantities stated on a schedule showing items of work. Each unit price includes the contractor's

direct and indirect costs as well as job overheads, home office fixed overhead and profit. This form of contract is suitable for a situation where the quantities may vary or the scope may change hence the final project cost is not known until the work is completed. Unit price contracts are most common in Pakistan.

#### **4.04 Bills**

In all the above-mentioned contracts, bill of quantities are not required. But currently world and local economic conditions shows that every investor or creditor either bank, corporate or individual wants to know the ROR (rate of return) with in a specific period of time. Under these circumstances, a detailed and logical base expenses report is needed showing (construction cost (hard & soft) both). Bills based on some measurement (takeoff from drawings) are to be prepared. Putting the item rates which will be on market prevailing rate with provision of escalation margin is also to be taken into account. This will called the budget estimate base on **Bills** or total investment.

#### **5.0 Measuring Quantities:**

This section explains the role of quantity take-off and the measuring of quantities in the estimation process.

##### **5.01 Quantity Take-Off:**

Quantity take off is the first stage in the formation of Bills. It entails the measurement of work items that constitute the project. The estimator breaks down the design shown on the drawings and described in the specifications into work items. These items correspond to the operations that the contractor has to perform for successful execution of the project.

The process of taking-off follows standard rules set out by the estimating profession. The dimensions of items are stated in the order of length, width and depth or height, where applicable. Furthermore, measurements to be determined are calculated and scaled dimensions are last resorts for the estimator. In addition, leadings and notes are inserted to explain the type of work involved as well as the location of the activity. Side notes and leadings help provide a means for the estimator or any other interested parties to review the take off these are some of the notes that the estimator has to adhere to when taking off quantities.

In the initial stages of construction planning, an estimate helps to determine whether the project is feasible or not. Also the estimate is required to formulate a cost control program whereby cash flows for specific periods are allocated based on the activities to be executed.

Hence, estimates form a basis for control of expenditure on a project. In building construction, quantity take off by items is essential since most contracts result form competition among contractors. They supply goods and services according to specification to a fixed sum of money. Generally, quantity take off is a vital function in the estimation process.

##### **5.02 Accuracy of Measurement:**

Despite the existence of the “Standard Method of Measurement for Construction Works”, Canadian documents have adopted their own particular style of taking off. According to one experienced quantity surveyor, the take off procedure varies from contractor to contractor.

When dispute arise and settlements become necessary, then all quantities are corrected on basis of the Standard Method of Measurement. Hence, the accuracy of measurement is

dependent on the individual method of take off of each company. Generally, the degree of accuracy of a takeoff is closely related to the nature of the work and the cost of achieving it.

Some estimators not only in Pakistan but also in other countries apply various rules of thumb techniques to determine final quantities for each specific item, because of rush for the tender without considering it that what final cost will be at the end of project and how much variation in quantities .

### **5.03 Net in Place:**

It is a method of measuring contract work according to the dimensions shown on the contract drawings. Hence, quantities are calculated using the size and dimensions indicated on the drawings with an adjustment to the values obtained. However, allowances are made for waste in the items unit price and not on the measured quantities. The Standard Method of Measurement used in the United Kingdom specifies that all measurements shall be net in place. In North America, the final quantities of individual items are, by adding on factor to the net in place amount.

### **5.04 Unit of Measurement:**

In the Pakistan construction industry, there are two systems of measurement. These are the English and the Metric system. Square measurements may be in either square meters or square foot. It is essential for estimators to work entirely in one system according to the units used on the drawings.

Mixing of different units of measurement on one estimate increases the likelihood of errors. There are five basic categories of unit used in estimating. These are Number, Length, Area, Volume and Weight. The unit of length, area and volume are feet square and cubic feet respectively. Similarly pounds or tons are the units for weight. The unit for number is common for both systems. It is the value obtained by counting the number of items. However, the unit of length, area and volume in the metric system are the meter square meter and cubic meter respectively. In the metric system, the unit of weight is the kilogram or Metric Ton.

### **6.0 Standard and Non-Standard Measurements:**

Practically, there are two methods of measurement used in estimating namely standard and non-standard method. The discussion will explain the difference between the two methods and their effect on the quality of estimating and bill verification. Also, include in the discussion will be the reasons why Quantity Surveyors / Consultant in Pakistan adopted the Non-standard method.

#### **6.01 Standard Method of Measurement:**

As, I mentioned earlier, there are two type of Titled Classified by work and how to measure each activity, to keep uniformity for item/measurement. It is known as the Standard Method of Measurement for construction Works.

The Method of Measurement of Construction Works state that work in this category be measured in square meters or square foot. Similarly, other divisions will have sub-divisions with their respective categories and the descriptions for the measurement of each category.

In the United Kingdom, The standard Method of Measurement is used as a basis to measure construction works. It is divided into sections and utilizes metric units. The main sections are further subdivided into subsections.

#### **6.02 Non-Standard Method of Measurement:**

The non-standard methods of measurement are the different method employed by Quantity Surveyors / Consultants in Pakistan to take off quantities. When an item is measured, the deduction of opening or waste factor is not counted for, the net quantity is not correct or two item of work combined together e.g. in supply of concrete item of formwork is also included. This should be separate as these are two different item of work.

#### **6.03 Differences between the Different Methods and their Effects on Estimating:**

The notion of listing the standard SMM gives an indication as to the degree of detail involved in the estimation process. The SMM of the RICS or Master format is more detail in content, leaving little room for missing information. *According to Keith Collier, "the fundamental purpose of a Standard method of Measurement is the consistent application of a body of language and techniques to the measurement of construction works, and greater understanding among the persons involved in construction"*. Hence, if one company develops a particular method, then it is for the general understanding among all person involved in estimating and cost accounting.

The Standard Method of Measurement determines the Bills of Quantities (BOQ) which serves as a contractual document in the Pakistan. The contractors bidding for a job is supplied with complete bills of quantities for a project. In this way, the bill serves as a basis for tendering since it is common to all bidders for pricing a job. In addition, BOQ provides interim certificates according to the percentage of work completed using the contract rates. Furthermore, the Bill assists the contractor in the organization of his work in areas such as scheduling of activities, ordering of materials and the progress of work. The owner also benefits where financial control and cash-flows are concerned. The BOQ serves as a source of cost data for the estimating department. Generally, The Method of Measurement of Construction Works of Pakistan can also be utilized in a similar manner as its counterpart in the United Kingdom.

The standard method of measurement for Concrete and Plaster works of RICS and CSI master format is placed in annexure "A" for convenience of reader, how they allow us to measure both items.

#### **7.0 Current Situation:**

In this section, I examined the two items of work with respect to the current measuring method in Pakistan. The benefits are also discussed and recommendations made with a view of improving on the current method in use. In appendices "C", I put together seven examples of different project documents, which are prepare by different reputable Consultant or Quantity Surveyor at different time period. It shows that there is no consistency in measuring the item of work. If the design engineer follow the ACI & ASTM or BS code for designing, as well as PEC is follow standardized contract document based on "FIDIC" then why not the quantity surveyor follow international standards.

#### **7.01 Reasons:**

Author feels that QS profession and as a subject is completely neglected by Pakistani society. And there is no proper education in any institute of Pakistan neither in neighboring country, this promotes the quantity surveying as recognized profession in Pakistan like other developed

countries have. Pakistan doesn't have any Association of Quantity Surveyors, who plays a vital role. Those QSs who passed the exam from RICS or ACCEI or acquired education abroad mostly prefer to stay abroad. They did not contribute anything for Pakistan's construction Industry. As mentioned above, the "Q.S. Profession" is not recognized by Pakistani society as it has recognized other professions like medicine, engineering, architecture, law, and accounting etc. This is also a reason why qualified Pakistani professionals trained in quantity surveying and cost engineering are not coming back to the Pakistan. Also there is no platform of quantity surveyors from where they can get recognition of a professional quantity surveyor.

#### **8.00 Concrete and Formwork (Item Analyzed):**

##### **8.01 Current Situation:**

Generally, Quantity Surveyors / Consultants, who prepare Bill of Quantities, measure two or three activity / items together with one item. Like concrete with formwork, some time water stoppers and construction joint also together. Also, the waste factor incorporated in the calculation varies from person to person.

When they consider two or three activities simultaneously, then it is difficult to analyze the rate. On the other hand International system allows supplying and pouring concrete separately from formwork activity. But the local system is different from international.

##### **8.02 Benefits of a Standard Method of Measurement:**

According to the SMM Construction Works, cast-in-place concrete is measured in eight categories. They are structural concrete, low density concrete, architectural concrete, concrete finishes, specially placed concrete, post-tensioned concrete and concrete curing.

It is stated that no deductions shall be made for concrete displaced by other materials cast into the concrete, nor for openings not exceeding 0.05 cubic meters in volume.

It is easy to understand for all Q.S. local and international bidder and waste factors by the contractor will be allowed as per standard no complain at all.

##### **8.03 Recommendations:**

The author recommends that the concrete should be measure as per SMM i) Supply & pouring, ii) steel reinforcement bars supply & fixing, iii) Formwork fixing and removing and iv) accessories of concrete, in respect with all allowable deduction/ provisions etc. It will be more economical as well as time saving for both parties (Owner and Contractor).

#### **9.00 Plaster Work (Item Analyzed):**

##### **9.01 Current Situation:**

As I explain above in concrete the same scenario is in the Plaster work. Quantity Surveyor / Consultants, who prepare Bill of Quantities or verify the contractor's bill, allow deduction of opening from plaster between 0.023 to 0.46 Sq. meter and no addition shall be made for revels, jambs, soffits, sills etc against of such small openings. Examples are placed in Appendices "C"

##### **9.02 Benefits of a Standard Method of Measurement:**

The type of work is measured in square meters/foot. SMM allows us that deductions shall be made for openings exceeding 2.00 square meters, this covers all labor component for expenses to use for making jambs, sills etc around opening.

The rules set out by the standard covers all the conditions and locations where plaster will be used. The Q. S. Should use the SMM of Construction Works the take off process. It would ensure that the estimates are reasonable accurate for the purpose it was intended for.

**9.03 Recommendation:**

The author recommends that a standard method of measurement must be adopted in estimating. If SMM allows a standard size of opening then it shall not be deducted more or less than that neither jambs, sills etc will not be added. It is far from the standards of the construction industry when every consultant adopts their standards for deductions of openings.

**10.0 Conclusion:**

Worldwide jobs are awarded to contractors based on quantities only. Also in Pakistan, same practice is followed. But to follow this practice efficiently, a standard method of measurement is necessary whereas, consultants and contractors in Pakistan do not follow any international standard method of measurement which results in failures of projects due to inappropriate estimation of cost.

The critic proposed that if the consultant provides the bills of quantities based on one of the International (SMM) system, which is recommended to be followed in order to provide standard framework for measuring the construction works, together with the drawings and specifications and the contractor has to price it then, least conflicts can arise and the owner would be able to receive more appropriate cost of project which will ultimately save the project time period.

The issue of whether it is more appropriate to use by a standard or non-standard method of measurement may be tested on the complexity of the project. On a large project it is advisable that accurate estimating be done to determine a realistic project cost, otherwise extra work on variations can result in escalating final cost. In addition, the time and money involved in the settlement of disputes could have been avoided if estimating was performed in a proper manner using all the available information.

Along with the adaptation of SMM, Pakistan Association of Quantity Surveyor must conduct technical surveys and introduce some courses to provide some awareness of SMM and benefits of it which will surely address the concern of multinational companies. The rapid development in our construction industry and the increase in demand of quantity surveyors force the institution of higher learning to introduce the Quantity Surveying programs.

## Section-11

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**Section C-Concrete Work:**

**C1 Generally:**

- C1.1 Reinforced poured concrete and plain poured concrete shall be so described.
- C1.2 Poured concrete required by the specification to be placed, compacted, cured or otherwise treated in a particular manner shall be so described.
- C1.3 No deduction shall be made for voids less than 1.00m<sup>3</sup>, nor for the volume of any reinforcement or structural metal enclosed in the concrete, except that voids caused by boxed or tubular structural metalwork shall always be deducted.
- C1.4 Unless otherwise described, horizontal surfaces of concrete shall be understood to be tamped.

**C2 Poured Concrete:**

- C2.1 Unless otherwise stated, poured concrete shall be measured by volume, classified as follows:
  - 1. Foundations, which shall include combined or isolated bases
  - 2. Pile caps, which shall include ground beams
  - 3. Blinding
  - 4. Beds, which shall include roads and footpaths, stating the thickness
  - 5. Suspended slabs, which shall include floors, landing, roofs or the like, stating the thickness
  - 6. Walls, which shall include attached columns, stating the thickness
  - 7. Columns, which shall include casing to metal stanchions
  - 8. Beams (measured below the slab), which shall include lintels and casing to metal beams
  - 9. Staircase, which shall include steps and strings
  - 10. Diaphragm walls
  - 11. Other classifications (for example, tunnel linings, bridge abutments) as may be appropriate.
- C2.2 Poured concrete suspended slabs of special construction, including floors, landings, roofs or the like, shall be measured by area; coffered and troughed slabs shall be so described, giving details of solid margins or the like.
- C2.3 where an item is required to be measured by volume and the thickness stated, then items of differing thickness may be grouped together, provided that the range of the different a thickness is stated.

**C3 Reinforcement:**

- C3.1 The weight of bar reinforcement shall be the net weight without addition for rolling margin, supports, spacers or tying wire.
- C3.2 Bar reinforcement shall be measured by weight, stating the diameter; bars of differing diameters shall be given separately.
- C3.3 Fabric reinforcement shall be measured by area, without addition for laps.
- C3.4 Reinforcement shall be given as an item where the detailed design work is the responsibility of the contractor.

#### **C4 Shuttering:**

- C4.1 Unless otherwise stated, shuttering shall be measured by area, taken as the net area in contract with the finished face of concrete, classified as follow:
1. Soffits; shuttering to soffits of special construction shall be so described
  2. Sloping soffits, which shall include soffits of staircase
  3. Sloping upper surfaces, which shall include surfaces more than 15° from horizontal
  4. Sides of foundations, which shall include bases, pile caps and ground beams
  5. Sides of walls, which shall include attached columns
  6. Returns to walls, which shall include ends, projections and reveals of openings or recesses
  7. Sides and soffits of sloping beams, which shall include lintels and breaks in soffits; isolated beams shall be so described
  8. Sides and soffits of sloping beams which shall include lintels and breaks in soffits; isolated beams shall be so described
  9. Sides of columns
  10. Staircases, which shall include treads, risers and strings but exclude soffits
  11. Other classifications (for example, tunnel linings, bridges, bridge abutments) as may be appropriate.
- C4.2 Shuttering to edges, which shall include face of curb or up stand or break in upper surface of floor, shall be measured by length; items of differing height may be grouped together, provided that the range of different heights is stated.
- C4.3 Grooves, which shall include throats, rebates, chamfers or the like, 2500mm<sup>2</sup> sectional area over shall be measured by length; grooves less than 2500mm<sup>2</sup> sectional area shall be understood to be included.
- C4.4 Shuttering may be enumerated where it is more appropriate to do so (for example, decorative features).
- C4.5 Shuttering which is required by the specification to be left in position shall be so described.
- C4.6 Shuttering to curved, conical and spherical surfaces shall each be so described.
- C4.7 Shuttering to provide a special finish shall be so described.
- C4.8 Unless otherwise stated, if the volume of concrete has not been deducted, shuttering to the faces of a void shall be understood to be included.

#### **C5 Precast Concrete:**

#### **C6 Pre-stressed Concrete:**

#### **C7 Sundries:**

- C7.1 Surfaces finished to falls or cross-falls shall be measured by area.
- C7.2 Surface finishes shall be measured by area, except that tamped finishes shall be understood to be included.
- C7.3 Expansion material or the like shall be measured by area.
- C7.4 Designed joints, water spots, cast-in channels or the like shall be measured by length.
- C7.5 Forming sinking, channels or the like shall be measured by length and, where appropriate, the item may include additional excavation, hardcore, shuttering and concrete; alternatively, they may be enumerated.
- C7.6 Fixings, ties, insert or the like shall be enumerated; alternatively, they may be measured by area.
- C7.7 Mortar holes, holes or the like shall be understood to be included.

## **Section J- Finishes:**

### **J1 Generally:**

- J1.1 Work shall be measured flat without additional for laps or seams, finishes on corrugated or ornamental surfaces shall each be so described.
- J1.2 Curved, spherical and conical work shall each be so described.
- J1.3 Internal and external work shall each be so described.

### **J2 Backgrounds:**

- J2.1 Backgrounds shall be increased by area; background for floor, wall or ceiling finishes shall be so described.
- J2.2 Poured backgrounds (for example, plasterboard, expanded metal lathing) shall each be given separately.

### **J3 Finishings:**

- J3.1 Unless otherwise stated, finishing shall be measured by area, classified as follows:
  - 1. Floors, which shall include landings.
  - 2. Walls, which shall include returns, reveals of openings or recesses and attached and unattached columns.
  - 3. Ceilings, which shall include attached and unattached beams
  - 4. Staircase, which shall include treads, risers and edges of landings but exclude soffits.
- J3.2 Skirtings, bands, strings, coverings to kerbs, mouldings, coves, channels or the like shall be measured by length.

### **J4 Sundries:**

- J4.1 Non-slip inserts, dividing strips, metal angle beads, and lathing at junction of differing backgrounds or the like shall be measured by length; alternatively, they may be described with the items in which they occur.

### **J5 Suspended Ceilings:**

- J5.1 Suspended ceilings shall be measured by area, classified as follows:
  - 1. Ceilings stating the drop.
  - 2. Sides and soffits of beams or upstands.

## Method of Measurement of Construction Works. (7<sup>th</sup>. Edition) Based on CSI Master Format.

### Division 3-Concrete:

Generally:

1. The section "General Rules" is to be read in conjunction with this Division
2. The major items in this Division shall be measured in the following units unless otherwise stated:
  - i. Formwork in square meters
  - ii. Reinforcing steel in kilogram and welded wire fabric in square meters
  - iii. Concrete in cubic meters.

### 03100- Concrete Forms and Accessories:

1. Concrete forms and accessories shall be measured in the following categories:
  - 03110- Structural cast-in-place concrete forms
  - 03120- Architectural cast-in-place concrete forms
  - 03130- Permanent forms
  - 03150- Concrete accessories
2. Formwork shall be measured to the actual surface in contact with the concrete. The function of the concrete shall be described, e.g. footing, columns, wall.
3. No deduction shall be made for **openings not exceeding 10.00 m<sup>2</sup>** , nor for the intersection of beams, slab bands, wall etc.
4. All temporary supports, bracing, strutting, re-shoring, scaffolding, guard rails, walkways and general false work shall form part of items of work to which they relate, and shall not be measured separately.
5. All form ties of whatever type, cutting back toes and grouting holes, form oil, fixings, plywood, studs, wailers, stripping, cleaning, oiling, lifting, transporting and any other labour or material necessary for the construction of the concrete formwork shall form part of the item to which they relate, and shall not be measured separately.
6. Notching and boring formwork shall not be measured.
7. Formwork to concrete surfaces not exceeding 200 mm wide or deep shall be measured in meters.
8. Formwork to circular columns shall be measured in meters.
9. Designed indents, rebates, fillets, coves, arises, mouldings, block-outs, etc; which are attached to the face of the formwork, shall be measured in meters. Such items not exceeding 300 mm in length shall be enumerated.
10. Small items attached to formwork, such as inserts, anchors, plates, pipe cones, etc; shall be enumerated.
11. Items which are at the discretion of the contractor, such as pour strips, shall not be measured.
12. Formwork which is single side shall be so described.
13. Formwork to confined spaces shall be kept separate.
14. Scribing formwork to rock face or profile shall be measured in meters.
15. Formwork to walls and columns exceeding 3.50 m in height shall be measured separately in 1.50 m in increments.

16. Formwork to underside of suspended slabs, to soffits of slab bands, column heads, drop panels and to sides and soffits of beams, shall each be grouped according to height. Where over 3.50 m high, the height shall be stated in increments of 1.50 m.
17. Anchors and inserts shall be enumerated; expansion and contraction joints, waterstops and the like shall be measured in meters.

**03200- Concrete Reinforcement:**

1. Concrete reinforcement shall be measured in the following categories:
  - 03210- Reinforcing steel
  - 03220- Welded wire fabric
  - 03230- Stressing tendons
  - 03250- Post tensioning
2. Reinforcing steel shall be classified by size being given separately. The full length including laps, bends and hooks shall be measured. Tying wire, distance blocks and ordinary spacers shall be deemed to be included, and the weight of such items shall not be added to the weight of the reinforcing steel.
3. Within each size classification main reinforcing steel shall be further classified as straight, or with up to four bends per bar. Reinforcing steel which falls outside the number of these categories shall be separately described.
4. Reinforcing steel **in lengths exceeding 13.00 m** shall be kept separate.
5. Welded wire fabric shall be measured as the area covered. No deduction shall be made for voids not exceeding **1.00 m<sup>2</sup>**. Tying wire and distance blocks shall be deemed to be included.
6. Stressing tendons for post-tensioned concrete shall be measured with category 03380.

**03300- Cast-in-Place Concrete:**

1. Cast-in-place concrete shall be measured in the following categories:
  - 03310- Structural concrete
  - 03330- Architectural concrete
  - 03340- Low density concrete
  - 03350- Concrete finishing
  - 03360- Concrete finishes
  - 03370- Specially placed concrete
  - 03380- Post-tensioned concrete
  - 03390- Concrete curing.
2. No deduction shall be made for concrete displaced by other materials cast into the concrete, nor for openings not **exceeding 0.05 m<sup>3</sup>** in volume.
3. Concrete that by reason of its location or nature, must be pumped or continuously poured, or specifically compacted or vibrated, shall be so described.
4. Integral admixtures to concrete shall be measured in cubic meters as extra over the cost of concrete to be so treated.
5. Concrete finishing, concrete finishes and concrete curing shall be measured in square meters.
6. All work associated with post-tensioned concrete shall be measured under a separate heading, with the constituent parts measured in accordance with the foregoing principles. Cables which are to be tensioned and ducts shall be measured in meters. Separate items shall be given for initial tensioning, for pressure grouting, and for additional tensioning if required. Grouting pre-stressing tendons shall be enumerated.

**03400- Precast concrete:**

**03500- Cementitious Decks and Underlayment:**

**03600- GROUTS:**

**Division 9- Finishes:**

Generally:

1. The section "General rules" is to be read in conjunction with this division.
2. Finishes shall be measured in square meters.
3. Work exceeding 4.00 m high shall be so described and height above floor level given in 2.00 m stages.
4. Where not otherwise apparent, work in this division shall be stated to be either to floors, walls or ceilings.
5. Where work to landings is required to be stated, it refers to landings not exceeding 4.00 m<sup>2</sup>. Landing exceeding 4.00 m<sup>2</sup> shall be considered to be floors.
6. Exterior work shall be so stated.

**09100- Metal Support Assemblies:**

1. Metal support assemblies shall be measured in the following categories:  
09110- Non-load-bearing wall framing  
09120- Ceiling suspension  
09130- Acoustical suspension
2. Deductions shall be made for openings exceeding 2.00 m<sup>2</sup>.

**09200- Plaster and Gypsum Board:**

1. Plaster and gypsum board shall be measured in the following categories:  
09205- Furring and lathing  
09210- Gypsum plaster  
09220- Portland cement plaster  
09230- Plaster fabrications  
09250- Gypsum board  
09260- Gypsum board assemblies
2. Deductions shall be made for openings exceeding 2.00 m<sup>2</sup>.
3. Plaster and gypsum board to columns, isolated columns, beams, bulkheads, ducts and the like shall be so stated. Where the girth of such work does not exceed 2.00 m, it shall be stated as not exceeding 1.00 m but not exceeding 2.00 m girth.
4. Gypsum board not exceeding 300 mm wide, unless caused by voids, shall be so stated.
5. Framings within plaster and gypsum board for recessed openings shall be enumerated.
6. Corner beads, causing beads, joint and strip reinforcement shall be measured in meters.
7. Angle beads, stops, casings, expansion joints, base screeds, wall mouldings and metal extrusions shall be measured in meters.
8. Plaster work to columns, isolated columns and beams shall be so stated.
9. No deductions shall be made for bases, mouldings, grounds, etc.
10. Cornices, moldings, bases, friezes, etc; shall be measured their extreme length, in meters.
11. Columns bases, caps and other enrichments shall be enumerated.
12. Patching in repair work, where partitions, bases, rails, etc; have been removed, shall be measured in meters.
13. Holes, notches, etc; in gypsum board shall be deemed include.

## Case Study:

### Appendices "C"

#### Example # 1.

**Project:** Pakland Cement Limited .  
**Location:** Dhabeji, Sind.  
**Type of Project:** Cement Plant, 3000 T/day.  
**Consultant:**  
**Year of Project:** 1982.  
**Estimated Cost:** Pak. Rs. 750.00 Million.

#### Concrete:

##### **19.00 Measurement and Payment**

- a) Measurement for payment for all concrete works will be made to the neat lines of structures as shown on the drawings or as modified by the Engineer. In measuring concrete for payment the volume of openings, recesses, ducts, and embedded items each of **which is larger than 650mm square in cross section** shall be deducted.
- b) Payment for concrete including cement and providing joints will be made at the applicable unit price per cubic meter bid in the Bill of Quantities for concrete. The amount bid shall be the fully payment for completing the works, in all respects, covered under this section of the specifications and the respective pay items in the B.O.Q.
- c) Payment for pre-cast concrete units, fair faced concrete and reinforcement will be made under respective pay items in the B.O.Q.
- d) No additional payment shall be made for placing anchor bolts or any other embedded items.

#### Plaster:

##### **6.00 Measurement and Payment**

- a) Measurement for payment will be made as **the actual area of the plastered surfaces excluding jambs, junctions, corners, edges** or thicker plastered required due to any unevenness.
- b) Payment for plastering shall be made at the applicable unit price per square meter bid in the Bill of Quantities. The amount bid shall be full payment for the work specified herein as plastering.

#### Example # 2.

**Project:** Islamic Chambers of Commerce Industry & Commodity Exchange.  
**Location:** Clifton, Karachi.  
**Type of project:** Office Building.  
**Consultant:**  
**Year of project:** 1987  
**Estimated Cost:** N.A.

##### **4.2.12 Method and Measurement of Concrete Work:**

- 1) Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of, but not limited to, the following:
  1. Labour and all costs in connection therewith.

2. Materials, good and all costs in connection therewith, e.g. Conveyance, delivery, unloading, storing, returning, packing, handling, hosting, lowering.
  3. All fixtures and all costs in connection therewith for precast works.
  4. Fitting and fixing materials and goods in position.
  5. Use of plant.
  6. Waste of materials.
  7. Square cutting.
  8. Establishment charges, overhead charges and profit.
  9. All other expenses, charges and taxes specified in Conditions of Contract.
- 2) Works shall be measured net as fixed in position as per drawings and instructions of the Architect. Each measurement shall be taken to the nearest 12mm.

3) Concrete:

1. Concrete shall be measured as executed but no deduction shall be made for the following:
  - Volume of any steel embedded in the concrete.
  - Volume occupied by water pipes, conduits, etc; not exceeding 25cm<sup>2</sup> each in cross-sectional areas.
  - Voids not exceeding 1000cm<sup>2</sup> in work given in square centimeters. If any void exceeds 1000cm<sup>2</sup> total void shall be deducted.
  - Voids not exceeding 0.03m<sup>3</sup> in work given in cubic meters. If any void exceeds 0.03m<sup>3</sup>
  - Total void shall be deducted.
2. Voids, which are not to be deducted as per section 4.12.3.1 above, refer only to openings or wants which are wholly within the boundaries of measured areas. Opening or vents which are at the boundaries of measured areas shall always be subject to deduction irrespective of size.
3. Junction between straight and curved works shall in all cases be deemed to be included with the work in which they occur.
4. Concrete work shall be classified and measured separately as follows unless otherwise described elsewhere:
  - Blindings, foundation beams, foundation slabs, footings, bases of columns, machine foundations, mass concrete, etc; in m<sup>3</sup>.
  - Floors slabs on ground, grouped with floor beams in m<sup>3</sup>.
  - Walls in foundation, plinth and superstructure in m<sup>3</sup> stating thickness.
  - Columns, piers, pilasters, pillars, etc; in m<sup>3</sup>.
  - Lintels, beams and brackets in m<sup>3</sup>.
  - Suspended floors, roofs and stair landings in m<sup>2</sup> stating thickness.
  - Stairs (excluding landing) in m<sup>3</sup>.
  - Railings in m, m<sup>2</sup> or m<sup>3</sup> stating description.
  - Parapets, purdees and the like in m<sup>3</sup> stating thickness.
  - Jali blocks in m<sup>2</sup> stating thickness and description.
  - Precast concrete items shall each be enumerated, except if otherwise shown in the Bill of Quantities, separately stating the description.
5. Measurement of walls shall be taken between attached columns piers or pilasters. The thickness of attached columns, piers or pilasters shall be taken as the combined thickness of the wall and the columns, piers or pilasters. Attached or isolated columns, piers, pilasters and the like (except where caused by openings) having a length on plan

not exceeding four times the thickness shall be classified as columns. Those having a length over four times the thickness and caused by openings in wall shall be classified as wall. Columns shall be measured from the top of footing/beams or floor surfaces to the underside of beams or slabs as the case may be. Where the width of the beams is less than the width of columns, the extra width at the junction shall be included in the beam. The depth of the beams shall be measured from bottom of the slab to the bottom of the beams, except in case of inverted beams where it shall be measured from top of slab to the top of beam. The cross section below or above the slab.

#### 4) Formwork

1. Formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be measured in m<sup>2</sup> as the actual surface of the finished structure which required to be supported during the deposition of the concrete, including the upper surfaces to the work sloping more than 15<sup>0</sup> from the horizontal. No allowance shall be made for overlaps and passing at angle and no deduction shall be made for the following:
  - Voids not exceeding one m<sup>2</sup>.
  - Intersections of main beams with walls or columns.
  - Intersections of secondary beams with main beams.
2. Formwork shall be deemed to be inclusive of but not limited to items detailed in Section 4.2.12.1 and the following:
  - Batten struts, reversed cut strings, bolting, oiling, wedging, easing, striking, removing, and making good exposed face of concrete after removal of formwork. Also yokes, wales, sheathing, jack rods, jacks, working platforms and finishers' scaffolds, etc.
3. Forming chamfers not exceeding 50mm wide and forming splayed internal angles not exceeding 12mm wide shall not be paid for extra.
4. Temporary stop ends for constructed joints shall not be measured and paid for.
5. Classification of formwork (if separate and extra payment is specifically stated in the B.O.Q.) shall be as follows:
  - To horizontal or sloping soffits or suspended slabs, floor, roofs, staircase, landings, and the like.
  - To sloping upper surfaces or suspended slabs, floor, roofs and the like where more than 15<sup>0</sup> from horizontal.
  - To vertical or battering sides of foundations. Foundation beams and slabs, ground beams, machine foundations and the like.
  - To vertical or battering sides of wall, solid balustrades and the like.
  - To vertical or battering sides.
  - To vertical or battering sides of stanchion casings, columns, piers, plasters and the like.
  - To sides and soffits of horizontal or sloping beams casing, beams, brackets, lintels, staircase strings and the like.
  - To sides and soffits of opening in walls, recesses in walls, projecting panels on walls and like.
  - To sloping upper surfaces of beam casings, beams, brackets, lintel, staircase strings and the like where more than 15<sup>0</sup> from horizontal.
  - To edges of beds, roads, footpaths, pavings and the like.
  - To edges of suspended slabs, floors, roofs, landing and the like.
  - To sides of kerbs, upstands and the like.

- To risers of steps and staircases.
6. Formwork to throats, grooves, chases, rebates, chamfers over 50mm wide, splayed internal angles over 12mm wide, mouldings and the like shall each be measured separately in linear meters stating the size.

**Plaster:**

**4.9.6 Measurement and Payment:**

1. Plaster work shall be measured acceptably net completed area of the plastered surface in m<sup>2</sup> including joints, junctions corners, drip course, edges of thicker plaster required due to any unevenness. Measurement shall be taken to the nearest 12mm.
2. Deduction shall not be made for ends of joints, beams, posts, etc; and openings not exceeding 0.5m<sup>2</sup> each. In case of **openings of area above 0.5m<sup>2</sup> each**, deduction shall be made for the openings. No addition shall be made for reveals, jambs, soffits, sills, etc; or these openings nor for finishing the plaster around ends of joints, beams, posts, etc.
4. Plaster on metal lath shall not be measured separately and the cost of finishing metal lath shall be deemed to be included in the unit of plaster work.
5. Joints, grooves, drip courses, etc; wherever required as shown on drawings, or as direct by Architect shall be deemed to be included in the rates of plaster.

**Example # 3.**

**Project:** Lucky Cement plant,  
**Location:** Lucky Marwat,  
**Type of Project:** Cement Plant 3000 T/day  
**Consultant:** e Co  
**Year of Project:** 1994.  
**Estimated Cost:** Pak. Rs. 1200.00 Million

**Concrete:**

**Measurement and Payment**

- a) Measurement for payment for all concrete works will be made to the neat lines of structures as shown on drawings, or as modified by the Engineer. In measuring concrete for **payment the volume of openings, recesses, ducts and embedded items each of shall be deducted.**
- b) Payment for concrete including cement and providing joints will be made at the applicable unit price per cubic meter bid in the Bill of Quantities for concrete. The amount bid shall be the full payment for completing the work in all respects, covered under this section of the respective pay items in the B.O.Q.
- c) Payment for pre-cast concrete units, fair faced concrete and reinforcement will be made under respective pay items in B.O.Q.
- d) No additional payment shall be made for placing anchor bolts or any other embedded items.
- e) Cement supplied by Owner/Employer shall be deducted at the rate per ton of cement specified in condition of contracts.

## Plaster

### Measurement and Payment

- a) Measurement for payment will be made as the **actual area of the plastered surface excluding jambs, junctions, corners, edges** or thicker plaster required due to any unevenness.
- b) Payment for plastering shall be made at the applicable unit price per square meter bid in the Bill of Quantities. The amount bid shall be full payment for the work specified herein as plastering.

### **Example # 4.**

<b>Project:</b>	Creek Vista at Creek City.
<b>Location:</b>	Phase – VIII, D.H.A., Karachi.
<b>Type of Project:</b>	Residential. , (12 Towers, Basement+ G.F.+ 17 Typ. Floors)
<b>Consultant:</b>	
<b>Year of project:</b>	2002
<b>Estimated Cost:</b>	Pak. Rs. 4.0 Billion.

#### **4.21 Measurement and Payment:**

##### **4.21.1 Formwork:**

All costs for **formwork must be included in the concrete prices and will not be measured and paid for separately.**

##### **4.21.2 Reinforcement:**

- a) Reinforcing bars will be measured as per Drawings in consideration of the volumetric weight of **7.85 t/m<sup>3</sup>**, without additions for rolling tolerances, deformations waste length and binding wires and paid per ton at the unit rate entered in the Bill of Quantities.
- b) The prices shall include all costs involved with the supply, transportation, storage and protection, the cutting, bending and placing, inclusive of concrete spacers, supports, stands, tying into position, etc.
- c) Assembly stands, spacers etc, whether designated in the Drawings or not or otherwise demanded by the Engineer will not be measured and paid for separately.
- d) If installed reinforcement must be dismantled under certain circumstances or where additional reinforcing bars are to be provided on Engineer's instruction, the Contractor is not entitled to any compensation, if such additional supplies and/or performances are required and demanded by the Engineer due to the Contractor's faulty execution of the respective work.

##### **4.21.3 Concrete:**

- a) Concrete works shall be measured and paid for as per theoretical volumes calculated on the basis of the Drawings, or as otherwise approved by the Engineer and paid at per cubic foot at the rates entered in the Bill of Quantities.
- b) Recesses (e.g. openings in slabs, break-through and the like) with an individual volume of more than **1 sq. ft or 2 cft.** Shall be deducted.
- c) The prices for concrete works shall include all cost for the complete work and are not limited to the cost of formwork, its support, anchoring, chamfers, construction joints etc, the required scaffolding, falsework, temporary works, post-treatment and, if necessary, repair of concrete, all preliminary and routine tests, as well as the required static checks and drawings for Temporary Works in connection with the concrete works.

- d) The cost for special finishing of exposed concrete surfaces such as fair faced finish etc. shall be included in the unit price applicable to the respective structural member and will not be compensated for separately.
- e) The cost of all concrete admixtures and additives shall not be paid for separately and is deemed to be included in the unit rates of respective items of the BOQ.

**Plastering:**

**6.12 Measurement and Payment:**

Plaster shall be measured and paid per square foot, complete and approved, at the unit rates entered in the Bill of Quantities, including preparations, junction reinforcements, angle beads, plaster stops, framing and metal furring, metal lathe, chamfered edges, rounding off corners etc. and in the thickness as specified in the Bill of Quantities.

**Example # 5.**

<b>Project:</b>	Attock Cement Pakistan Ltd.
<b>Location:</b>	Hub Chowki Lasbela.
<b>Type of Project:</b>	Cement Plant 3000 T/day.
<b>Consultant:</b>	
<b>Year of project:</b>	2004
<b>Estimated Cost:</b>	Pak. Rs. 830.00 Million.

**Concrete:**

**16. Measurement and Unit Prices:**

- a) Measurement for payment for concrete shall be of the net volume of concrete placed in the works. In measuring volume of concrete openings upto and including **0.025 m<sup>2</sup> in cross sections shall be ignored.**
- b) Payments for concrete shall be made at the unit prices per volumetric unit tendered for the appropriate item in the Bill of Quantities. The unit price tendered shall include the cost of supplying all materials, mixing, supply, fabrication and fixing of formwork, placing concrete, compaction, removal of formwork, curing and finishing including all plant, operations, procedures and requirements necessary to complete this work as per drawings, these specifications and as additionally directed by the Engineer.
- c) In case of Precast concrete element the unit rate quoted shall include the cost of precasting arrangement, handling any number of time until final placement and any bedding mortar required for proper seating and sealing of joints.
- d) The Unit Rate tendered shall be deemed to be fully payment for completion o f the works specified herein and in accordance with the terms of this Contract.
- e) No measurement for formwork shall be made. The unit rate tendered for concrete shall include the cost of supplying, fabrication fixing and removing of all formwork, scaffolding and supports, making of all openings in the formwork etc, complete.

**Plaster:**

**12. Measurement and Unit Prices:**

- a) Measurement for payment of plaster shall be made of the net area of the surface plastered. **Deduction for opening shall be made but the area of the jambs and soffit of opening shall be added.**

- b) Payment for plastering shall be made at the Unit Price per area unit tendered for the appropriate item in the Bill of Quantities. Unit Price included the cost of all materials, labour, scaffolding, appliances and performing all operations stipulated herein before including making and trimming all openings, recesses and access panels, if any.
- c) The Unit Price tendered shall be full payment for completion of the works specified herein and in accordance with the terms of this Contract.

**Example # 6.**

**Project:** Centre Point.  
**Location:** Phase – VIII, D.H.A., Karachi.  
**Type of project:** Commercial. (G.F.+28<sup>th</sup>. Floors).  
**Consultant:**  
**Year of project:** 2009  
**Estimated Cost:** Pak. Rs. 1.00 Billion.

**18. Method of Measurement of Concrete Works:**

**18.1 General:**

1. Unless otherwise specifically stated in the Bill of Quantities, or herein, all items shall be deemed to be inclusive of as stated in section 1 (scope), but not limited to, the following:
  - a. All fixtures and costs in connection therewith for precast works.
  - b. Waste of materials, and square cutting.
  - c. Establishment charges, overhead charges and profit.
  - d. All other expenses, charges and taxes specified in Conditions of Contract.
  - e. Works shall be measured net as fixed in position as per drawings and instructions of Engineer. Each measurement shall be taken to the nearest ½" (12 mm). This rule shall not apply to any dimensions stated in descriptions.

**18.2 Concrete:**

1. Concrete shall be measured as executed but no deduction shall be made for the followings:
  - a. Volume occupied by water pipes, conduits etc, not exceeding 4 square inch (2500 sq.mm) each in cross-sectional area and reinforcing bar.
  - b. Voids not exceeding 1 square foot in work given in square feet and 0.1 sq m in work given in sq meters.
  - c. Voids not exceeding 1 cubic foot in work given in cubic feet, 0.03 cubic meter in work given in cubic meter.
2. Junctions between straight and curved works shall in all cases be deemed to be included with the work in which they occur.
3. Concrete work shall be classified and measured separately as follows unless otherwise described elsewhere:
  - i. Buildings, foundation beams, foundation slabs, footings, bases of columns, machine foundations, mass concrete etc, in cubic feet (Cubic Meter).
  - ii. Floor slabs on ground with floor beams in cubic feet (Cubic Meter).
  - iii. Walls in foundations, plinth and superstructure in cubic feet (Cubic Meter) stating thickness.
  - iv. Columns, piers, pilasters, pillars etc, in cubic feet (Cubic Meter). pier
  - v. Lintels, beams and brackets in cubic feet (Cubic Meter).
  - vi. Suspended floors, roofs and stair landings in square feet (Sq. Meter), Cu.Ft, Cu. M. stating thickness.
  - vii. Stairs (including landing) in cubic feet (Cubic Meter).

- viii. Railings in cubic feet (Cubic Meter), square feet (Sq. Meter), or linear feet (Meter) stating description.
  - ix. Parapets, purdees and the like in square feet (Cubic Meter) stating thickness.
  - x. Jali, blocks in square feet (Sq. Meter) stating thickness and description.
  - xi. Precast concrete items shall each be enumerated except if otherwise shown in the Bill of Quantities, separately stating the description.
4. Measurement of walls shall be taken between attached columns, piers or plasters, if any. Columns shall be measured from the top of footings/beams or floor surfaces to the underside of beams or slabs as the case may be. Where the width of the beams is less than the width of columns, the extra width at the junction shall be included in the beam. The depth of the beams shall be measured excluding the depth of the slabs.

### **18.3 Formwork:**

1. Formwork (if separate and extra payment is specifically stated in the Bill of Quantities) shall be measured in square feet (Sq. M) as the actual surface of the finished structure which required to be supported during the deposition of the concrete, including the upper surfaces to the work sloping more than 15 degree from the horizontal. No allowance shall be made for overlaps and passings at angles and no deduction shall be made for the following:
  - i. Voids not exceeding ten square feet (1 Sq. M).
2. Formwork shall be deemed to be inclusive of, but not limited to items detailed in section 12.1 and the following:

Batten, struts, reversed cut strings, bolting, oiling, wedging, easing, striking, removing and making good exposed faces of concrete after removal of formwork. Also yokes, wales, sheathing, jack rods, jacks, working platforms and finishers, scaffolds, etc.
3. Temporary stop ends for constructed joints shall not be measured and paid for.
4. Formwork to throats, grooves, chases, rebates, chamfers over 2" wide (50 mm) splayed internal angles over 1/2" wide (12.5 mm) mouldings and the like shall each be measured separately in linear feet stating the size.

### **18.4 Rate of Reinforcement:**

1. The rate tendered for any type of reinforcement by Contractor shall also be inclusive of the cost of binding wire wastages, and the cost of concrete metal or plastic chairs and spacers or hangers etc.
2. All reinforcement shall be provided in length shown in Drawings and as per specifications. Should the Contractor provide lengths of reinforcement which are greater than shown on the Drawings no payment of extra length shall be made.
3. The Contractor shall be paid for reinforcement by weight computed from linear measurements of reinforcements actually used at Site as per the Drawings, Specifications and instructions of Engineer. Contractor shall not claim for the difference in the actual weights of bars and their standard weights given in ASTM/BSS standards. For the purpose of this tender 1 ton shall be taken as (1000 kgs).

## Example # 7.

<b>Project:</b>	Creek View Hut.
<b>Location:</b>	Phase – VIII, D.H.A., Karachi.
<b>Type of Project:</b>	Commercial
<b>Consultant:</b>	
<b>Year of project:</b>	2009.
<b>Estimated Cost:</b>	Pak. Rs. 450.0 Million

### 14.2 Plain and Reinforced Concrete:

#### 14.2.1 Measurement:

Concrete shall be measured as executed but no deduction shall be made to the followings:

1. Volume of any steel embedded in the concrete.
2. Volume occupied by water pipes, conduits etc. not exceeding 25 square centimeters each in cross-sectional area.
3. Voids not exceeding 0.1 square meter. If any void exceeds 0.1 square meter total void shall be deducted.
4. Voids, which are not be deducted as specified above, refer only to openings or vents, which are wholly within the boundaries of measured areas. Openings or vents which are at the boundaries of measured areas shall always be subject to deduction irrespective of size.
5. Concrete work shall be classified and measured separately as listed under items of Bill of Quantities.
6. Junction between straight and curved works shall in all cases be deemed to be included with the work in which they occur.
7. Measurement of walls shall be taken between attached columns or pilaster. The thickness of attached columns, or pilaster shall be taken as the combined thickness of the wall and the columns, or pilaster. Attached or isolated columns, pilaster, and the like (except where caused by openings) having a length on plan over four times the thickness and are caused by opening in wall shall be classified as walls.
8. Columns shall be measured from the top of footing beams or floor surfaces to the underside of beams or slabs as the case may be.
9. Where the width of beams is less than the width of columns, the extra width at the junction shall be included in the beams.
10. The depth of the beams shall be measured from bottom of the slab to the bottom of the beams except in case of inverted beams where it shall be measured from top of slab to the top of beam. The cross-section of the beam shall be the actual cross-section below or above the slab.
11. Measurement of acceptably completed works of plain and reinforced cement concrete will be made on the basis of number of cubic meter concrete placed and compacted in position within the neat lines of the structure as shown on the Drawings or as directed by the Engineer.

#### 14.2.2 Payment:

Payment will be made for the acceptable measured quantity of plain and reinforced cement concrete on the basis of unit rate per cubic meter quoted in the Bill of Quantities and shall constitute for compensation for all the works related to the item.

### 12.2 Plain Plaster/Textured Plaster:

#### 12.2.1 Measurement:

- a) Deduction shall not be made for ends of joints, beam posts, etc, and opening not exceeding 5 square feet each and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings non for finishing the plaster around ends of joints, beams posts, etc.

- b) In case of opening of area exceeding 5 square feet each, deduction shall be made for the openings and also no addition shall be made for reveals jambs, soffits, sills, etc, of these openings.
- c) Measurement of acceptably completed works of plaster will be made on the basis of number of square meter of the surface area plaster as shown on the Drawings, or as directed by the Engineer.

**12.2.2 Payment:**

Payment will be made for acceptable measured quantity of plaster on the basis of unit rate per square meter quoted in the Bill of Quantities and shall constitute full compensation for all the works related to the item.

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# NOTES

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