

Bills of quantities seem to have been the result of a historic accident. In the 1700s, the apprehensive owner of a new building would have been presented with bills of expenditure for the finished work of each trade, measured and valued on completion in accordance with local custom and practice.

In the early nineteenth century, so we are told, "... the revolution in contracting ... produced the all-trades contract and the single building contractor.

We know that architects were engaging surveyors to take out quantities for the use of all the tenderers well before 1837.

To do this surveyors continued to follow their normal customs and practice for the after-measurement of completed works, even though they were now working from drawings and a specification. It was all they knew, and it was what builders and their tradesmen could price. The sole object of such BQs was to provide a basis for tendering and payment, and this is still the case.

Nowadays, there appears to be some dissatisfaction with the measurement and valuation of in-place work, with its exhaustive rules of measurement, and prices that combine the costs of materials and labour.

Perhaps it should be replaced with something more appropriate to the beginning of a project rather

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Leslie Holes introduces his own three level bill of quantities as a usable alternative to the traditional method of bill production

than its end. Obviously, the data in the document must continue to define the contents of a contract and be arranged to suit the process of estimating and tendering. In addition, it should be of use in organising and managing the project.

A new kind of bill

As an alternative, I propose a bill of quantities where the emphasis is on the inputs to the construction process rather than the outputs. We shall assume that the drawings and specification are sufficiently detailed for the work to be constructed, once suitable materials, labour and plant are on the site. The object of the bill will be to present such details of the project that will enable these resources to be identified, quantified and valued.

Before work can start, every

builder or subcontractor has to calculate what quantities of materials to order. I propose that the bill should supply the built-in quantities of all the materials independently called for by the design. These will both define the contract and indicate the nature and duration of the construction operations. The estimator will have to allow for those fixing, jointing and other materials that are dependent on the technical needs of the ones that are given.

In general, the market place will determine the units in which materials are ordered, and no measurement rules are necessary. However, measured quantities such as the areas covered by paints and plasters would be given where there is uncertainty.

Then we must decide how to group these materials. I suggest that, in the main, the viewpoints of designers and constructors come

together in the construction of what we will call the parts of functional elements. Such parts could be constructed during one or more sequential operations and are the smallest portions of work that can be realistically costed and estimated. An element must consist of the fewest parts that will enable it to function satisfactorily with respect to neighbouring elements and to adjacent building spaces. Thus, the meanings given to the terms *part* and *element* are somewhat different from those in the SfB system and the UK Standard Form of Cost Analysis.

Some examples

The approach is best demonstrated by examples. Figure 1 shows the details of a bill item for the solid upper floors element. Each item deals with the parts of a complete element or group of similar elements.

This one contains details of (1) the columns and (2) the floor and

Figure 1: Solid upper floor element

Ref	Item Details	Amount	Unit	Quant	Rate	Total
a	SOLID UPPER FLOORS ELEMENT			ITEM 1		
	500 X 500MM COLUMNS	95.00	lin m			
	55 x 600mm COLUMNS	30.00	lin m			
	exposed sides of column	256.00	sq m			
	C25 ready mixed concrete	35.00	cu m			
	25 hot rolled mild steel bars	7.00	tonne			
	8 hot rolled mild steel bars	0.05	tonne			
	200mm thick SUSPENDED FLOOR	805.00	sq m			
	350 x 750mm deep ATTACHED BEAMS	25.00	lin m			
	400 x 800mm deep ATTACHED BEAMS	91.00	lin m			
	exposed soffit of floor	755.00	sq m			
	exposed edges of floor	9.00	sq m			
	exposed sides & soffits of beams	224.00	sq m			
	C25 ready mixed concrete	195.00	cu m			
	5.55Kg/M ² long mesh fabric (C636)	205.00	sq m			
	12 hot rolled mild steel bars	14.00	tonne			
	32 hot rolled mild steel bars	14.00	tonne			

Figure 2: Trench excavation element

Ref	Item Details	Amount	Unit	Quant	Rate	Total
b	TRENCH EXCAVATION ELEMENT			ITEM 1		
	600 X 900mm deep TRENCH	75.00	lin m			
	800 x 900mm deep TRENCH	13.00	lin m			
	800 x 150mm deep TRENCH	63.00	lin m			
	1000 x 1200mm deep TRENCH	40.00	lin m			
	1100 x 1200mm deep TRENCH	192.00	lin m			
	1500 x 150 x 150 1500mm widening to trench	6	nr			
	sides of trench	912.00	sq m			
	prepare bottom of trench for concrete	359.00	sq m			
	excavation in normal soil	400.00	cu m			
	excavation in rock	29.00	cu m			
	redig and fill around foundations	59.00	cu m			
	remove surplus soil from site	370.00	cu m			

ALTERNATIVE

its attached beams. The arrangement of the identifiers is partly due to my computer software, one objective being to enable estimators to produce a priced bill and a list of resources quantities. Other formats might be better when producing bills manually.

Each size of column is given separately. Their horizontal dimensions are kept in the description; their heights are added together to give the quantity. The principle of measuring only those dimensions that indicate the extent of the part (ie. the 'extensive' dimension) is followed throughout. The identifiers of the parts are followed by those of exposed surfaces, although, perhaps, such areas are unnecessary as the dimensions from which they are calculated are all given.

From this surface area, and

knowing the sizes and lengths of columns, the estimator can assess the likely costs of formwork, etc. Lastly come the materials, both the concrete and the reinforcement that will be incorporated into columns. As the floor has two extensive dimensions, its spanning area is given as its quantity but otherwise, it and all other concrete parts are treated similarly.

Estimating the times of fixing reinforcement and formwork and for concreting operations can be done by reference to the sizes of the work being produced and to the quantities of materials involved. Note that the meaning of every identifier is enhanced by placing it in a context of related identifiers. The approach allows for the inclusion of both direct and indirect costs.

The various kinds of site preparations are treated as if they

were elements. **Figure 2** shows the trenches 'element', the parts being the various widths and depths of trenches, with their lengths and enumerated widenings etc. The areas of the side and bottoms come next. Then the volumes of excavation and disposal. Drainage trenches are treated similarly. Estimators are expected to consider the trench widths, depths and lengths, and decide for themselves what working space excavation, supporting sides, etc. are required. Detached pits and basement voids are counted but otherwise treated similarly. In the description of the external walls element on **Figure 3**, the individual walls come first. Part identifiers are in capitals.

Again the quantities of the parts are based on measuring the

extensive dimensions of the design. Any projections would come next.

These are followed by the identifiers and actual quantities of all the independently chosen materials that are incorporated at the time the walls are built.

Identifiers should match those on the drawings and can include specification clause references. Masonry walls are regarded as being of composite construction, and mortar quantities are given. However, estimators will be expected to allow, for instance, for the mortar for bedding a coping.

Some other aspects of the approach are illustrated on **Figure 4**, the skeleton roof construction element. Because a part must contribute some attributes to the element as a whole, and be able to be constructed in one operation, the whole of the spanning

Figure 3: Masonry external walls element

Ref	Item Details	Amount	Unit	Quant	Rate	Total
c	MASONRY EXTERNAL WALLS ELEMENT		ITEM	1		
	112mm FACING BRICK OUTER LEAF OF CAVITY WALL	278.00	sq m			
	60mm wide CAVITY & INSULATION	275.00	sq m			
	140mm BLOCK INNER LEAF OF CAVITY WALL	260.00	sq m			
	900 x 140mm blockwork attached piers	40.00	lin m			
	675 x 562mm FACING BRICK DETACHED PIERS	20.00	lin m			
	Peatling Green facing bricks	20.44	thous			
	140 solid concrete blocks	2924	nr			
	140mm cavity closer blocks	200	nr			
	cement lime & sand mortar (1-1-6)	11.50	cu m			
	50mm thick cavity wall insulation	275.00	sq m			
	Stainless steel retainer type wall ties	1.39	thous			
	1350mm heavy duty steel lintel (50-65 cavity)	14	nr			
	1800mm heavy duty steel lintel (50-65 cavity)	24	nr			
	112 polythene damp-proof course	21.00	lin m			
	140 polythene damp-proof course	145.00	lin m			
	Preformed Type X 35deg Cavitrays	54	nr			

Figure 4: Skeleton roof construction

Ref	Item Details	Amount	Unit	Quant	Rate	Total
a	SKELETON ROOF CONSTRUCTION ELEMENT		ITEM	1		
	SKELETON PITCHED ROOF CONSTRUCTION	1	nr			
	6m span x 2.4m rise trussed rafter	45	nr			
	3m wide x 2.4m rise half-span trussed rafter	1	nr			
	38 x 75 treated sawn softwood	0.60	100m			
	50 x 150 treated sawn softwood	0.45	100m			
	63 x 100 treated sawn softwood	0.55	100m			
	Galanised truss clip for 38mm thick truss	92	nr			
	30 x 2.5 x 60mm type VU vertical strap	10	nr			
	30 x 5 x 80mm long type HL horizontal strap	12	nr			
	300 x 200mm high ROOF EAVES	30.00	lin m			
	22 x 225 PAR softwood	0.03	100n			
	12mm external quality plywood	9.00	sq m			
	ex 38 x 50 treated softwood tilting fillet	0.30	100n			
	30 x 48 resawn softwood	0.15	100m			
	Eaves roof space ventilator	80	nr			
	150mm ROOF INSULATION	230.00	sq m			
	150 fibreglass Crown 75	230.00	sq m			
	ROOF EDGE DECORATION	15.00	sq m			
	one coat of highbuild microporous woodstain	15.00	sq m			
	two coats of highbuild microporous woodstain	15.00	sq m			

Figure 6: Ceiling finish

Ref	Item Details	Amount	Unit	Quant	Rate	Total
b	CEILING FINISHES ELEMENT B			ITEM 1		
	12mm thick FINISH TO CEILINGS AND BEAMS	135.00	sq m			
	One coat of lightweight bonding plaster	135.00	sq m			
	One coat of finishing plaster	135.00	sq m			
	DECORATION TO PLASTER CEILINGS AND BEAMS	135.00	sq m			
	Two coats of emulsion paint	135.00	sq m			

structure is regarded as a single part. The materials are measured as purchased, ignoring the fact that they might be called rafters, purlins, etc. when in-place. The eaves are treated similarly, only the materials for making the fascias, soffits, etc. being given. The same applies to the construction of stud walls, joisted floors, etc.

Decoration is always the last part in an element, the nature of the work being indicated by the identifiers of the parts being decorated. The quantity of the decoration and of each coat of paint, etc is the actual brushed area.

The treatment of openings is illustrated on Figure 5, the internal doors element. Linings, trims and doors are all items, the materials (mostly counted components with no extensive dimensions) providing their details. Note that hardware is included in the materials for completed doors.

Figure 6 shows a ceiling finish. External wall and roof finishes, and ceiling, wall and floor finishes are all regarded as elements. No distinction is made between narrow

and wide insitu coatings and decoration. These cannot be costed separately, and the detail is conveyed in the drawings and elsewhere in the bill.

Applications

When estimating, materials are dealt with separately from labour. Estimated prices for materials can be entered against the individual identifiers. The variable times for constructing the parts can be estimated after considering their sizes and the quantities of the materials to be incorporated. Their direct costs, including subcontract quotations, can be added to the fixed costs and entered against the individual parts, or they can be aggregated for each element.

On site, valuations can be based on the aggregated totals for parts or elements. The durations of operations will be available for construction planning.

Estimated and actual times and costs can be directly compared and the variances calculated. The materials and labour content of variations can be priced separately. Elemental costs are available for design cost analysis, cost planning,

achieved third party registration and many more are progressing management systems in full or broad compliance with the standard.

Practices who wish to pursue assessment are faced with the task of demonstrating that their procedures are in compliance with a standard that was originally drafted for the manufacturing industry. It is often necessary to interpret or tailor the standard.

A number of certification bodies have been approached by practices who seek third party registration. This has prompted the need for some coordination of these interpretations.

As the standard becomes more widely used in an industry, service or profession the various

Ref	Item Details	Amount	Unit	Quant	Rate	Total
b	INTERNAL DOORS ELEMENT			ITEM 1		
	HARDWOOD LININGS FOR INTERNAL DOORS	1	item			
	40 x 160 hardwood lining for 726 x 2040 x 44 door	1	nr			
	40 x 120 hardwood lining for 826 x 2040 x 44 door	28	nr			
	40 x 120 hardwood lining for 926 x 2040 x 44 door	8	nr			
	ARCHITRAVES AND OTHER DOOR TRIMS	1	item			
	25 x 50 hardwood architrave	1.92	100m			
	TRENT INTERNAL FLUSH DOOR LEADERFLUSH	1	item			
	826 x 2040 x 44mm thick flush door	15	nr			
	926 x 2040 x 44mm thick flush door	8	nr			
	76 cast iron butt hinges	23	3pair			
	76mm upright 3-lever mortice lock ref 88111	23	nr			
	Pairs of level handles ref 121007	23	nr			
	SOLIDCORE FLUSH DOORS FROM LEADERFLUSH	1	item			
	726 x 2040 x 44mm Solidcore internal flush door	1	nr			
	826 x 2040 x 44mm Solidcore internal flush door	13	nr			
	100 cast iron butt hinges	14	pair			
	Pairs of lever handles ref 121007	14	nr			
	76mm upright 3-lever mortice lock ref 8811	14	nr			
	100 aluminium barrel bolt	2	nr			
	INTERNAL DECORATION TO FLUSH DOORS	131.00	sq m			
	INTERNAL DECORATION TO LININGS & ARCHWAYS	50.00	sq m			
	Three coats translucent interior stain	181.00	sq m			

Figure 5: Internal/doors element

and approximate estimating. There is the possibility of a two-stage approach to bill production, starting with just the part identifiers.

Essentially, the 3-level bill is based on a few rules, including:

- Separately presenting the materials in each of the parts of each element,
- Giving the built-in quantities of

materials in commercial units,

- Measuring only the extensive dimensions (if any) of the parts, and

- Relying on the drawings, the specification and the materials identifiers and quantities for the details of the parts.

The approach seems to be applicable to both building and civil engineering construction.

Guiding readers

The RICS produced an introductory guide to quality assurance dated January 1989. This publication was issued to the senior partners of all practices and gave principle information on the meaning and merits of formal management systems.

Formal quality systems and quality assurance procedures have been considered and implemented by the partners of a considerable number of quantity surveying practices.

Having developed formal quality management systems, practices may wish to consider assessment and registration by a third party to demonstrate compliance with BS 5750, the UK national standard for quality systems.

A number of practices have

certification bodies may each develop, in conjunction with a trade organisation, an interpretation of the principles of BS 5750. This may either be set down as informal interpretations and guidelines or formal quality assessment schedules which become mandatory supplements to the British standard. Quality assessment schedules may impose additional criteria beyond BS 5750 which must then be taken into account when a practice is assessed by a certification body.

A QS division working party has considered this matter in conjunction with the main certification bodies and leading practices.

It is the consistent view of participants that the British standard should not be formally supplemented or amended. The detailed interpretation of the standard should remain a matter of

some flexibility rather than have more defined working practices or effectively imposing a single method of assessment.

Concise guidelines have however now been prepared by the RICS to aid the consistent interpretation of BS 5750 for QS services.

The principal certification bodies have supported the development of this document so that each operates on a similar basis when assessing quantity surveying practices.

Copies of these guidelines are available to members from Surveyors Bookshop priced £3.50. Working party members are:

- C L Hobbs – chairman E C Harris & Partners
- T A McCarthy – PSA Quality Assurance Unit.
- D S Taylor – Summers & Partners
- I V Watson – Wilson Large & Partners.