

### Fairs

You may find it useful to show your goods overseas. The Fairs and Promotions Branch in London, again working through non-profit making sponsors, arranges collective presentations at trade fairs throughout the world. There is a charge for participation in these fairs, fifteen pounds a square metre for inside space and seven pounds fifty for outside space. This is way below the cost of exhibiting on your own, and for new exhibitors at a fair there is a fifty per-cent discount given for their first two participations in a particular joint venture. For this money we provide a stand, generally up to fifteen square metres, services, and for company representatives at fairs outside Western Europe, we pay fifty per-cent of travel costs. In some parts of the world, mainly outside Western Europe, it is necessary to have British pavilions. The charges are somewhat higher for exhibiting in a British pavilion but still very good value.

We can help too if you are thinking of organising a synopsis or seminar, which are often held in conjunction with fairs. Such seminars must bring specific products and processes or services to equally specific buyers etc. We charge a £100 fee, but what you get back is most impressive. You get hire of the auditorium, the translation of papers and filmscripts, interpreter's fees and costs of programmes, invitations and graphics. If you are travelling outside Western Europe you also get outward mission support.

### Market Entry

It may be that you will wish to set up your own organisation overseas. The Board has recently introduced a scheme to help you bear the financial risks of going overseas in such a way; it is known as the "Market Entry Guarantee Scheme". It provides for a contribution of

50% of overhead costs which is repayable, but the Board additionally underwrites the success of the venture. The details of the scheme are rather complicated, but basically we would, for the investment period, charge 3% for the insurance and would also charge 2½% over base rate for the amount of money provided. If the venture is a success, the Board's contribution is repaid by a levy on sales receipts over a long period, but if not a success, no levy payments are required and we share the loss with you.

### Other Government services

Also of interest to you gentlemen here today is an organisation which comes under the wing of the British Standards Institute. This is The Technical Help to Exporters Unit at Hemel Hempstead. THE's technical services include the identification of overseas specifications and assistance in their interpretation, detailed information on regulations and approval systems, help in meeting technical requirements such as test certificates, and testing and factory inspections in the U.K., if this is acceptable to the customer. If you have any technical problems it is well worth getting in touch with Technical Help to Exporters.

There are two other Government Departments actively involved with exporting both of which warrant a talk as detailed as this. I will however have to be content with only a short mention. If you require publicity overseas, the Central Office of Information is your contact. Two-thirds of the output of the Central Office of Information is directly concerned with promoting exports. The BBC, through their overseas networks, also can give you publicity, if you have a good "newsworthy" story. At the end of the day you still want to get paid for your export endeavours so always remember the fine facilities offered by the Export Credit Guarantee Department.

# The measurement of Mechanical and Engineering Services in Buildings

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### Introduction

The term mechanical and electrical engineering services includes the entire range of plumbing, drainage, heating and ventilating, ductwork, insulation and all types of ancillary equipment and services together with all electrical and other services. Measurement of these works is covered under sections R and S of the new sixth edition of the standard method of measurement.

Where these services are relatively straight forward such as domestic plumbing, heating and electrical installation the architect may prepare working drawings

as usual and professional quantity surveyors are frequently involved in production of bills of quantities for these elements. However, the design and purpose of these services is becoming more involved and complex and it is now usual for the architect to ask a consulting engineer to design and detail these services. The increased complexity of these

*\*The author wishes to acknowledge the research work done by E. N. Mulvihill, in his MSc thesis completed in the Department in 1977.*

services and the tendency for design and control to be concentrated in the hands of specialist engineers has created a large gap in the overall service the quantity surveyor is able to offer the client and the architect. If the quantity surveyor, as the industry's building economist, is to offer any reasonable prediction, control and advice on total building costs then he must not ignore the mechanical and electrical engineering services element which may now account for between 10% and 60% of the total cost of the building: see table 1.

**Table 1: Mechanical and Electrical Engineering Costs**

Type of building	Percentage of total cost
Offices – not air conditioned	15 – 20
Offices – air conditioned	25 – 33
Hospitals	30 – 45
Schools	20 – 30
Universities – residential	20 – 30
Universities – laboratories	40 – 60
Theatres	20 – 25
Art Centre	15 – 20
Industrial (factories etc).	10 – 20
Domestic	10 – 20

Source: W. F. J. Fussell "The measurement of engineering services" 1971.

Table 1 illustrates the dimension of the problem and ability to control costs requires not only knowledge on prices and unit rates but the ability to understand, measure and bill these services, providing a comprehensive service to the client. There is at present a lack of experience in the preparation of bills of quantities for mechanical and electrical engineering services. This is true not only of the quantity surveyor whose task it is to prepare bills but also true of the mechanical and electrical consultant who is not accustomed to preparing the necessary detailed information. The specialist engineer who may be a professional or a specialist sub-contracting firm, frequently prepares only schematic or line drawings before tender which do not give the remainder of the design team a sufficiently accurate basis for control of costs. This means that the building team is not providing the client with a totally integrated and effective design and cost control service.

A second result of this dichotomy is a failure of the principle embodied in the preparation of a uniform bill of quantities by an independent firm on behalf of all those tendering. This principle not only ensures fair competition but also substantially reduces overheads and estimating time. The discipline invoked by having to prepare a bill of quantities often ensures that design decisions are made well in advance of the commencement of construction work on site and thereby hastens the preplanning activities.

The origins of mechanical and electrical services contracting organisations may explain the dichotomy now apparent in their opinions about the use of bills of quantities. Services could be considered either as an extension of the traditional building process, such as plumbing, into a more technical era, or as the movement into building of product manufacturing concerns affording an installation service formally not associated with building. It would seem that the origins of many of the major firms in heating and ventilating are in the latter

category having their origins in the manufacture of boilers and their subsequent installation<sup>2</sup>.

### The Standard Method of Measurement for Mechanical and Electrical Engineering Services

The technical development that has occurred since the second world war in mechanical services and the use of air conditioning systems, resulted in a new section in the 1948 fourth edition of the standard method of measurement covering heating and ventilating work. Following representations from various sources in the fifties the standard methods committee conducted a study on the existing method and during this time a comprehensive alternative method of measuring heating and ventilating engineers work was issued and incorporated into the fifth edition, this has remained largely unaltered in the new sixth edition.

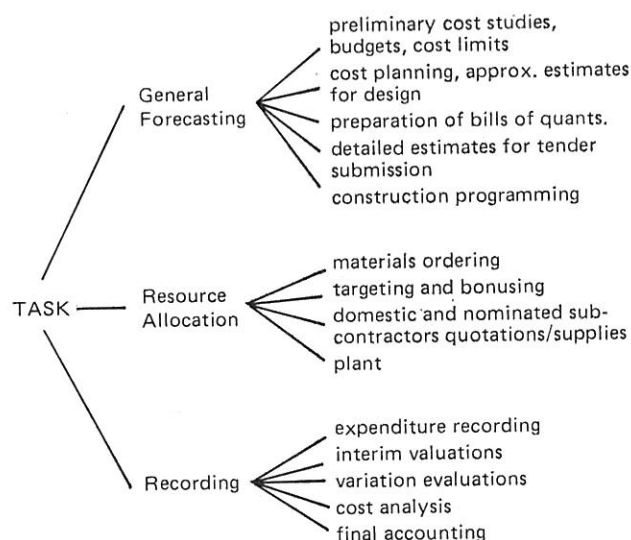
The standard method of measurement has been seen merely as an instrument for standardising the content of a bill of quantities but as the joint working party on measurement conventions (1972)<sup>3</sup> found

"it must not only state but positively encourage good practice for the measurement of building works, thus enabling both measures and recipients of measured information to adopt standard procedures for their work and avoid disputes."

The joint working party also pointed out that the predominant role of the bill of quantities is "to reduce the risks inherent in the tendering process by providing to all competitors a quantified and comprehensive description of the work required".

The working party outlined the related tasks of the building team, it is important to bear in mind the importance of these tasks and their interrelatedness. These are given in Table 2 and highlight the importance of the quantity surveyor's involvement with engineering services throughout the building process in order that he may provide a comprehensive study.

**TABLE 2**



Source: Report of Joint Working Party on Measurement Conventions NFSTIE/RICS 1972

### The Heating and Ventilating Contractors Point of View

A report published in 1971 by the Heating and Ventilating Contractors Association (HVCA)<sup>4</sup> criticised the existing form and approach to bills of quantities by quantity surveyors. The conclusions reached were that for most heating and ventilating contracts a bill is inappropriate and unnecessary because:

- (i) adequate drawings and a properly prepared specification are all that a contractor needs to submit a lump sum tender.
- (ii) The production of bills of quantities would require a change in design practice to give much greater detail than on single line drawings and would result in a rise in design fees, increasing the pre-contract period and additional fees for building.
- (iii) That some variations occur is almost inevitable but the need for them should be anticipated so that requirements and costs are settled in advance of carrying them out. Cost control is lost; not through absences of a bill of quantities but rather that variations are executed without an agreed valuation being attached to them at the time and being left until final account before settlement.

Since this report by HVCA in 1971 the association has formed a joint working party with the hospital regional engineers association on a co-operative exercise which it was hoped would improve a working procedure in circumstances where bills of quantities for mechanical services would be adopted with advantage<sup>5</sup>. The objective of this exercise was to produce a standard method of measurement, a model form of bills of quantities and a code of practice, and it is understood that these have just been produced.

### Range of Measurement Techniques

The major difficulty with engineering services is that the more sophisticated the installation the more likely the involvement of a specialist designer and sub-contractor with a consequent tendency towards lack of measurable detail. Barnes<sup>6</sup> identified a spectrum of stability of technology and of consequent engineering influence. At the low technology end would be plumbing and domestic heating and he suggested that detailed application of quantity surveying procedures would be more likely to be beneficial here than at the high engineering or fast developing technology end. At this highly specialist end of the spectrum a series of sums to cover the major parts of installations would be all that would be included in the bills. These parts could be described in terms of their function and any design constraints but not necessarily in terms of their physical nature. This would be similar to the performance specification approach.

Barnes' approach with mid range examples along the spectrum of engineering and technological complexity is given in figure 1.

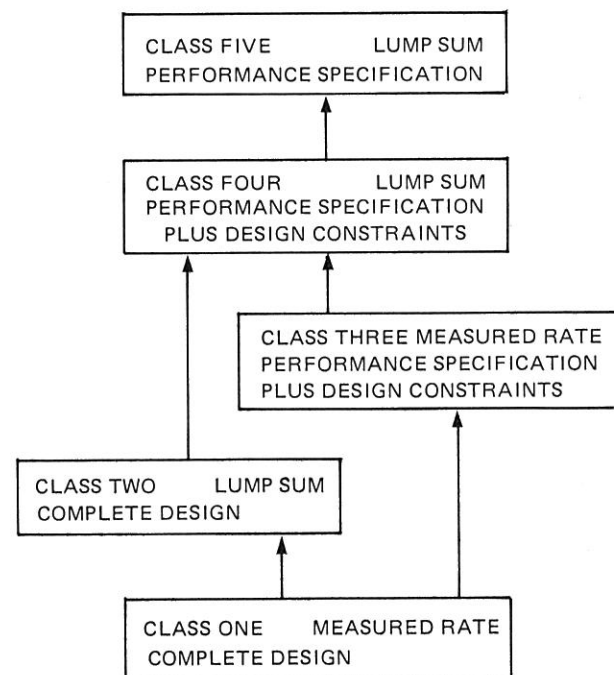
In the existing standard method of measurement three differing ways may be detected in descriptive approach regarding the measurement of mechanical and electrical engineering services.

- (i) those items such as pipework, trunking, insulation and the like which are capable of measurement. It is interesting to note that SMM6 has introduced an alternative method of measurement for ductwork (R.20) allowing measurement by weight.

- (ii) those items whose physical characteristics are of less importance than the ability to comply with a performance specification. Included in this group would be boilers, air conditioning plant etc. They would be fully described and enumerated.
- (iii) those instances where a specialist would be requested to submit a proposed scheme. Drawings of the structure may be supplied showing where the unit is to fit or alternatively, the specialist may specify where ducts, holes etc. are to be formed to accommodate this plant. It would be normal in this instance to insert a PC or provisional sum in the bill of quantities.

**FIGURE 1**  
**THE LEVEL OF "SPECIALIST INFLUENCE**  
**UPON DESCRIPTION AND MEASUREMENT OF**  
**SERVICES INSTALLATIONS**

**HIGH ENGINEERING RELIANCE UPON SPECIALIST**  
**SUPPLIER/CONTRACTOR**



**LOW ENGINEERING LEVEL**

### Types of Contract for Engineering Services

There are fundamentally four types of contract identified by RICS engineering services working party report (1976)<sup>7</sup> under which engineering services may be carried out:

- (i) Direct contract in which the services contractor is employed by the building owner.
- (ii) Direct contract in which the installation of services is carried out by the main contractor with his own employees as part of the construction works.

**Table 3: Mulvihill's results (1977)<sup>a</sup>**

**Questionnaire to Quantity Surveying practices (12 respondents)**

1. With regard to the following works, which form part of a building contract, would your practice apply one or more of the following means to include them in tender documents.

	PERCENTAGES			
	ALWAYS	FREQUENTLY	SELDOM	NEVER
1.1 Prepare a bill of quantities for plumbing	17	83	—	—
1.2 Prepare bill for mechanical services	—	—	50	50
1.3 Include a prime cost item for plumbing	—	8	92	—
1.4 Include a prime cost for mechanical services	50	50	—	—
1.5 Include a provisional sum for plumbing	—	—	33	66
1.6 Include a provisional sum for mechanical services	—	—	33	66
1.7 Other means for plumbing	—	—	—	100
1.8 Other means for mechanical services	—	—	—	100

- (iii) Nominated sub-contract between a main contractor, originating from a nomination of the services sub-contractor by the architect or engineer. In this case the services are covered in the main contract by a prime cost sum, this representing the total of the sub-contract bills of quantities.
- (iv) Sub-contract between the main contractor and a services sub-contractor of the main contractors own choice. In this case the services are normally measured in detail in the bills of quantities for the construction works and not covered by a PC sum.

**Extent of Measurement of Engineering Services by Quantity Surveyors**

The research conducted by Dr. D. Ferry at the University of Aston in 1974<sup>a</sup> for the RICS into quantity surveying indicated that only ten per cent of private practice quantity surveyors compile mechanical and electrical services bills regularly and that only five per cent of public sector quantity surveying departments did likewise.

A more recent study by E. N. Mulvihill in 1977<sup>a</sup> confirms this view that there are a few practices which have developed expertise in this field but only a minority of these prepare bills for complex engineering services. Mechanical services contractors in general found bills of quantities useful but seldom received them. Mulvihill's results are given in Table 3.

**SUMMARY**

The standard method of measurement is seen as a document which enables both measurer and recipient of measured information to adopt common terminology and avoid disputes. The role of the bill of quantities is regarded as reducing the risks inherent in the tendering process by providing to all competitors, a quantified and

**Questionnaire to Mechanical Engineering Services Contractors (15 respondents)**

1. Do you receive bills of quantities for heating and ventilating services

always —  
frequently 6%  
seldom 67%  
never 27%

	Yes	No
2. Are these quantities useful for:		
2.1 estimating your work load	73	27
2.2 gaining suppliers quotations	91	9
2.3 obtaining sub-contractor quotations	91	9
3. Are the billed items and rates suitable for the negotiation of payment for variations	82	18
4. Are the billed items and rates suitable for the negotiation of interim payments	73	27
5. In terms of costs of maintaining estimating services within a firm would an increase in billed quantities affect you by:		
5.1 decreasing the work load per tender	91	9
5.2 decreasing the cost of preparation	91	9
5.3 decrease the time of preparation	82	18



comprehensive description of the work required. The problem of definition of detail and fineness of measurement are particularly difficult in complex mechanical and electrical engineering services work and it may be appropriate for the quantity surveyor to adopt a flexible and varied approach perhaps incorporating a range of measured work and performance specifications. However, if the quantity surveyor is to be able to provide the building team with a complete cost and quantification service it is essential that he include the measurement of mechanical and electrical services.

#### References

1. W. F. J. Fussell. "The Measurement of Engineering Services". Spon Ltd. 1971.
2. "Then and Now" - Anon. *Building Services Engineer*. April 1977, Vol. 45, pp. A28-A68.
3. Report of the Joint Working Party on Measurement Conventions. NFBTE/RICS. 1972.
4. "Bills for Heating and Ventilating?" Heating and Ventilating Contractors Association. 1971.
5. Heating and Ventilating Contractors Association Annual Report 1974/75, para 5.105.
6. N. M. L. Barnes. Development Unit Report. March 1974. RICS.
7. Engineering Services Technical Working Party Report No. 1. "A Guide to Tendering and Contract Procedure based on Bills of Quantities". RICS. 1970. (QSESC/pp. 1).
8. "A Study of Quantity Surveying Practice". RICS. 1974 by Dr. D. Ferry. (QSRIC/pp. 10).
9. E. N. Mulvihill. "To Bill or Not to Bill Mechanical Engineering Installations". MSc Project Report (unpublished) 1977. University of Aston.

## Examiners' Reports on the 1978 Third and Direct Membership Examinations and TPC

*The following comments have been made by the Examiners on the papers submitted by candidates for the Institute's Third and Direct Membership Examinations and the Test of Professional Competence held in March this year. Comments on the First and Second Examinations appeared in the November, 1978, issue of the Journal.*

### THIRD EXAMINATION AND DIRECT MEMBERSHIP EXAMINATION (Old Syllabus)

#### Quantities

The overall standard of paper submitted was higher than in 1977 and the taking off was to better quality.

*Question 1* involved the taking off of a relatively straightforward piece of work and most candidates were able to make a reasonable attempt. There were, however, some disconcerting points in some answers. For example, some candidates measured excavation of trenches and pits "through" the bulk filling with no indication that this was a special requirement of the architect or engineer. Too many candidates did not appreciate the significance of the removal of top soil in relation to the position of the cut and fill line, very often penalising themselves in terms of time. In some papers surface excavation over 300 mm deep was not kept separate from that not exceeding 300 mm deep, and a few candidates averaged the maximum depth of filling and the maximum depth of excavation to produce virtually no dig or fill. Unfortunately the point of incorporating a water table in the example appeared to have little significance to many candidates.

*Question 2* highlighted candidates' lack of understanding of the relationship between the architect and the quantity surveyor in the design period. In particular many answers seemed to require all working drawings to be produced before taking off could commence. Although no candidate was penalised for a reasonable estimate of the time required for taking off sections of work, many answers revealed that some had no idea at all of how

long it would take to produce the contract documents for a £500,000 school.

*Question 3* was a relatively straightforward question and was adequately answered by those who attempted it. Unfortunately bad spelling and lack of command of the language have become all too common. There were many howlers of which "rouge items" was the most common. However, "environmental bills of quantities" may be worthy of a learned paper from their inventor.

*Question 4*, where it was attempted, showed that few candidates are aware of current developments in their profession and even fewer have ideas of their own.

#### Variation Accounts and Interim Valuations

Once again, the standard of script proved to be most disappointing, with standards of presentation showing a further decline over previous years.

*Question 1*. On the whole fairly well answered, but students failed to appreciate the essentials of bringing all three quotations to a common denominator. It is not enough just to rewrite the quotations in the appendix and extend the same. A large number of candidates took no account of the additional cost of hardstanding to be added to quotation No. 2.

Some entrants even confused cash discounts for prompt payments with that allowed under the J.C.T. contract for Nominated Accounts. The validity of quotation No. 3 was not challenged by a proportion of scripts.

The recommendation to the Architect either by report or letter was non-existent with some papers.