HOSPITAL ENGINEERING

January/February 1980

The Journal of the Institute of Hospital Engineering

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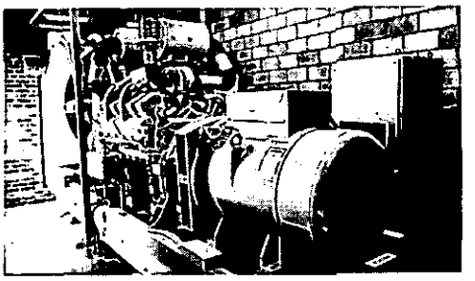

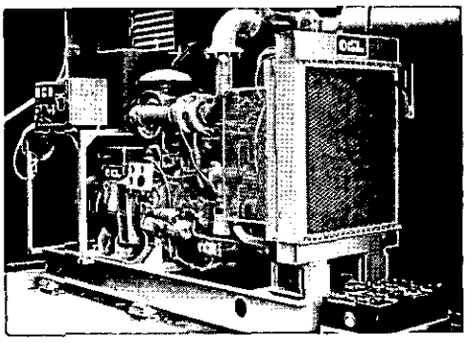

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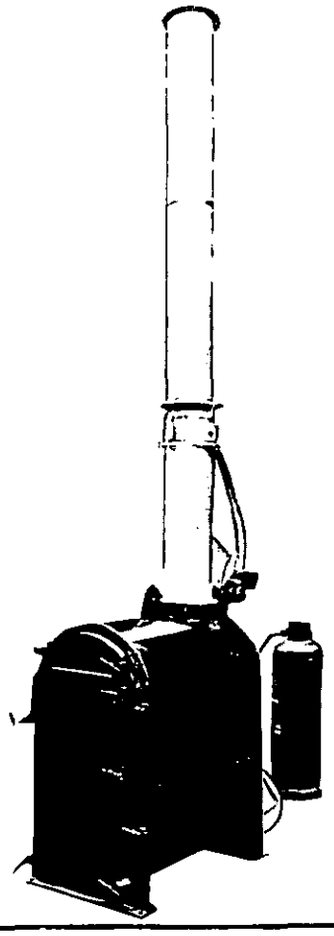

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HOSPITAL ENGINEERING

Vol. 34 No. 1

January/February 1980

The Journal of the Institute of Hospital Engineering

Contents

Front Cover:

An Aerial view of the John Radcliffe Hospital, Oxford, which is the subject of our major article "Site Progress and Valuation"

Institute News

The Institute of Hospital Engineering

The Institute will sponsor four Symposia on Health Buildings and Energy Conservation during

Hospital Energy Year 1980

First Symposium — Wednesday March 26, 1980

at The Institution of Civil Engineers, Great George Street, Westminster

PROGRAMME

10.00 Coffee

10.30 OFFICIAL OPENING by
THE RT HON PATRICK JENKIN MP
Secretary of State for Social Services

CHAIRMAN for the day
JOHN BOLTON Esq LLB(Lond) CEng FICE FIMechE FInstE FCIArb HonFCIBS HonFIPHE HonFIHospE FRSA
Chief Works Officer and Director General of Works
Department of Health and Social Security

10.40 THE NATIONAL ENERGY SITUATION
Speaker: MICHAEL POSNER
Chairman of Social Science Research Council
Member of the Advisory Council on Energy Conservation

Mr Posner will examine the current energy position in the United Kingdom and the advice given to the Secretary of State for Energy by the Advisory Council

12.00 THE ENERGY PROGRAMMES OF THE PROPERTY SERVICES AGENCY
Speaker: H. DIXON BSc(Eng) ACGI CEng FIMechE HonFIMechTE
Late Assistant Director
Directorate of M & E Services
Property Services Agency
Mr Dixon will describe the work undertaken by the PSA, the energy saved and the potential for further savings

13.00 LUNCH

14.30 DISCUSSION ON THE PSA WORK

15.00 ENERGY SAVINGS IN THE NHS PROGRESS AND POTENTIAL
Speaker: V. E. SKEGG CEng MIMechE MIMarE MCIBS MInstR
Superintending Engineer
Department of Health and Social Security

Mr Skegg will review the hospital energy saving achieved since 1972 and consider the potential for savings in the future

16.30 CLOSE AND TEA

Tickets are available only from The Institute of Hospital Engineering, 20 Landport Terrace, Southsea PO1 2RG, for £20, including morning coffee and lunch.

Secretary of State to launch Hospital Energy Year 1980

We are most pleased to announce that the Right Honourable Patrick Jenkin MP, Secretary of State for Social Services, has been advised of and has welcomed the Institute's plans to hold a series of Symposia relating to the subject of Energy Conservation/Energy Savings and for the staging of certain Papers Competitions on the subject during 1980.

The Secretary of State has kindly agreed to provide a Foreword for the exercise which will appear in the March issue of the Institute Journal, *Hospital Engineering*. The Secretary of State will, also, speak at the first of the Symposia to be held by the Institute on Wednesday March 26, 1980.

An invitation is being extended to the Secretary of State for Energy to attend, and speak at, the last of the series of Symposia, to be held on December 1, 1980. He is also being asked to present the prizes in relation to the Papers Competitions.

The Finniston Report

The Institute of Hospital Engineering has been invited to offer comment to the Department of Industry on the content of the Finniston Report (Commision of Inquiry into the Engineering Profession).

Council of the Institute has established a special Working Party to draft a submission and when this has been approved by Council it will be published in the Journal.

Meanwhile we include in this Issue the statement issued by the Council of Engineering Institutions following a meeting of the Presidents of Corporation and Affiliate members of CEI. It is fair to say that this does not necessarily reflect the opinion of every individual Corporation or Affiliate member Institution, but it is perhaps equally fair to say that this statement summarises the views of the majority.

The CEI Statement

After discussion with the Presidents of member Institutions and the Chairman and senior members of The Engineers Registration Board (ERB), the Chairman and Officers of The Council of Engineering Institutions (CEI) made the following statement:

The CEI endorses the Finniston Report's analysis of the ills of British Manufacturing Industry and its broad objectives for recognising and improving the contribution to be made by professional engineers. The Council particularly supports the view that employers must be encouraged to look on their engineers as valuable investments to be developed, rather than assets to be exploited; and the need for thorough practical training for engineers in industry.

Nevertheless, CEI has reservations about the proposed methods of attaining these objectives, and the relevance of these proposals to the practical and urgent needs of manufacturing industry will require critical examination.

The regulation of the engineering profession is now carried out by the CEI and its Engineers Registration Board in conjunction with the engineering Institutions. There is effective and economical machinery for setting standards, validating qualifications and registering those who are qualified; for imposing a code of professional conduct and applying discipline to those who infringe it. This machinery is based on many years of practical experience and operates in the public interest under the authority of CEI's Royal Charter at no cost to the public or to employers.

These arrangements are constantly evolving and are certainly capable of development, where necessary, to meet the broad objectives set in the Finniston Report.

However, instead of building on what now exists in an evolutionary way, the Report proposes to set up in its place a British Engineering Authority (BEA) with wide executive powers. CEI considers that the benefits to Industry claimed by the Report could be achieved much more cheaply and quickly by evolution rather than revolution.

It is characteristic of all professions in the UK to be largely self-regulating, which implies that the professional governing body should consist of a substantial majority of members elected, or nominated by the profession itself. Yet the Report states that, at least initially, all members of the proposed BEA shall be appointed by the Secretary of State on an individual basis. No profession can readily accept its affairs being taken out of its hands in this way and CEI is strongly opposed to this recommendation.

The proposals for changes in the education and training of engineers will have to be examined with particular care. CEI will be playing a major part in the National Conference arranged by the Department of Education and Science for autumn 1980,and again will be advocating an evolutionary approach.

However good the proposed education arrangements may prove to be, their products cannot emerge into industry as fully qualified engineers before the late 1980s, and for the next half-century the majority of practising engineers will be those who now exist or who are under training by the present methods. Unless the morale of existing engineers and international confidence in their ability are fully maintained, very great damage would be caused to the national interest. Contrary to the recommendations of the Report, it is essential that, if any new registration system is set up, there should be no invidious discrimination against existing engineers on whom so much depends.

The engineering profession is made up of Chartered Engineers, Technician Engineers and Engineering Technicians as defined in the Royal Charter of CEI. Each branch of the profession makes an indispensible contribution to industry which increasingly demands a team effort. There must continue to be effective 'ladders' by which qualified individuals may progress from one branch to another. The Finniston Report makes only passing reference to Engineering Technicians and no proposals for improving their education, training and progression. The CEI regards this omission as a serious weakness.

After detailed study of the Report, CEI will use its great experience in playing a full and constructive part in ensuring that those proposals which will benefit British industry are achieved in the quickest, most economical and most effective way.

Review of Membership Categories and Grades

For some three years Council of the Institute has been considering the position regarding the Membership structure in changing and developing circumstances.

Early in 1979 it was decided to establish a small Working Group to study the position in depth, and to submit a Report and possible recommendations to Council.

The Report and recommendations were submitted to a recent meeting of Council and accepted in principle.

There remains the question of the implementation of the recommendations, but before embarking on the lengthy consultative processes leading to the eventual tabling of appropriate Resolutions before a General Meeting of the Institute, Council determined to advise the Branches and the membership.

Accordingly, the Report of the Membership Review Group is set out in full below.

The Report

The Review Group considered at great length and in great depth the position in regard to the terms of entry for membership and the bearing on these rules resulting from the integrated works organisations created at the time of the re-organisation of the NHS.

These works organisations within the NHS, at all levels from DHSS to the Regions, Areas and Districts had brought together the various disciplines with co-ordinated working groups and to an extent where it is almost coincidental from which discipline the leader is drawn.

The experience of five years of this system in operation has shown that other disciplines were involved in 'hospital engineering' and 'managing' an integrated works organisation.

This led the Review Group to the conclusion that it was possible that a case could be presented for the admission of, say, fully professionally qualified architects or surveyors, who hold posts in works organisations, as a result of which they are in charge of engineering staff and responsible for engineering services, to some category of membership of the Institute. It was considered that such applicants could benefit from membership of the Institute and, further, what was more important, perhaps, that they could make a contribution to the Institute's well-being.

The Review Group had consulted, again, with CEI and ERB because it was known that other Institutions were considering like problems. Both these Bodies had confirmed that they had no objection to Institutions admitting 'non-engineers' to Corporate membership so long as the total number of such 'non-engineer' members did not exceed 25% of the total corporate membership. However, the Review Group was opposed to the

admission of 'non-engineers' to corporate membership. The Review Group felt that no apology need be volunteered for offering non-corporate membership via Associate grade — it is *not* second class membership.

However, the present definition applied to Associates may not be considered to cater for the fully qualified type of potential applicant described in paragraph 4 above.

The Review Group concluded, therefore, that there might be a case for the re-introduction of an *Associate Member* grade *but as a Non-Corporate Grade* to cater for fully qualified 'works Organisation' officers of a discipline other than engineering who, nonetheless, had responsibility for engineering staff and engineering services.

The existing Associate grade, remaining a non-corporate grade could then be used to cater for the rather more peripheral applicant such as, for instance, those from Industry who have an involvement in only some aspect of hospital engineering and whose total endeavour may not be confined to this field.

The Review Group then see the Institute membership as comprising a major centre core of engineers in the Corporate membership grades drawn from properly qualified 'engineering managers' within the NHS and those 'engineers' with like and suitable qualifications from the consulting engineer profession, as at present. There would then be an outer circle comprising the fully qualified professional man having senior responsibility within an 'hospital engineering' works organisation and beyond this, on the periphery of the circle those with acceptable qualifications who have an involvement in some aspect of 'hospital engineering'.

The Review Group, therefore, recommends to Council that action be taken along the lines set out in paragraphs 8 and 9 above.

Basil Hermon CBE

It is with great pleasure that we can announce that Basil Hermon, a well known member of the Institute Council, was made a CBE in the New Year's Honours List.

Since Basil is also one of the two Council members honoured recently by the Council — see the item below *New Companions of the Institute* — it is not necessary to give his full biography here.

New Companions of the Institute

At its last meeting, Council determined unanimously that K. J. Eatwell and B. A. Hermon be elected to be Companions of the Institute of Hospital Engineering.

Ken Eatwell is, of course, Regional Engineer to the South West Thames Regional Health Authority. He has been a member of Council continously since 1963 and was Vice-Chairman of the old Institution. Since Incorporation his Institution service reads:

Member, Finance and General Purposes Committee 1967-79 (Chairman 1973-1979);
Member, Education Committee, 1967-71;
Chairman, Membership Committee, 1967;
Chairman, Publications Committee, 1968-73;
Member, International Affairs Committee, 1975-1979;
Member, Bursary Committee, 1977-79;
Institute representative to CEI relative to registration as Chartered Engineer 1978-79.

Ken Eatwell

Basil Hermon is Regional Works Officer, South West Thames Regional Health Authority. He joined Council at the time of Incorporation on January 1, 1967 and has served thereon continously since that date. During this time his Committee service reads:

Member, Education Committee 1968-79 (Chairman 1974-79);
Member, Finance and General Purposes Committee 1972-79;
Member, International Affairs Committee, 1975-79 (Chairman 1975-77);
Member, Publications Committee, 1967-74 (Chairman 1971-74);
Member, Bursary Committee, 1977-79;
Institute representative on Council of the International Federation of Hospital Engineering, 1971-74.

Basil Hermon

It is, perhaps, appropriate here to quote Clause 7 of the Articles of Association of the Institute, which reads:

The Council may elect as a Companion of the Institute any Fellow who, in their opinion, is so qualified by reason of his exceptional attainments in, or services to, Hospital Engineering or to the Institute.

Soon after Incorporation, Council endorsed the following recommendation of its Membership Committee: "Committee felt that election as a Companion should only be conferred where an exceptional contribution had been made by a member. Committee was anxious that this should not become something bestowed on retirement, as it were, nor, necessarily, for long service to a branch of the Institute, but only for exceptional services to the Institute as a whole or to the profession of Hospital Engineering. Committee recommended that a ceiling be placed on the number of Companions elected."

There is no doubt that there will be wide pleasure throughout the membership at this decision of Council.

St. George's Hospital Design Consultants

It has been pointed out that the item

on page 5 of our December 1979 issue, relating to the fitting-out contract for phase 1 of the St George's Hospital and Medical School Complex at Tooting, in South West London, could be misleading.

E. G. Phillips Son & Partners have been the consultants for the design, since the initial contract was started eight years ago, and are consultants for the design of all phases of the whole scheme. They are also design consultants for the transfer of the cardiology unit from St George's, Hyde Park Corner, to Tooting.

East Anglian Branch

At the Branch Meeting held at West Norwich Hospital on September 22, 1979 members received a presentation by Mr D. Gifford, Senior EBME Technician, on *Haemodialysis*.

Mr Gifford outlined the function of kidneys, the principle of dialysis and the treatment of acute and chronic renal failure.

Following a lively discussion members paid a visit to the renal unit of the hospital and discussed with the staff the various aspects of their work.

The November meeting was held at Fulbourn Hospital, Cambridge. The subject of the meeting was *Hospital Incineration and Waste Heat Recovery* presented by Mr J. A. J. Clarke, Senior Products Engineer with Robert Jenkins Systems Ltd. Mr Clarke explained the design principles and operating requirements for equipment required to dispose of hospital waste in the most acceptable manner and without smoke or grit emission. Not surprisingly much of the discussion was centred on the practical problems and economic benefits of waste heat recovery.

A joint one-day conference to be held by

The Institute of Hospital Engineering and The Institute of Building

The NHS Consultative Document 'Patients First' and the Economic Development and Care of the Health Service Estate

The Institution of Civil Engineers, Great George Street, London SW1P 3AA
(Adjacent to the Houses of Parliament. Nearest underground station is Westminster).

Thursday February 14, 1980

The Institutes have no views at this stage about the effect the Consultative Document proposals will have on the development and management of the Health Service Estate. They are pleased however to provide this forum for a dispassionate discussion by those with direct experience in the NHS who wish to comment on the Consultative Document.

CHAIRMAN:
H. J. CRUICKSHANK CBE CEng FIMechE FIOB

10.30 OFFICIAL OPENING by
L. F. TURNER BSc CEng FIEE FIHospE FRSA
President, Institute of Hospital Engineering

10.35 WORKING OF A COMMON SERVICES AGENCY — and in particular a building division therein
Speaker: T. ASTORGA DA DipTP RIBA FRIAS FIOB
Director of Building CSA, Scotland

11.15 WHAT SHOULD BE THE REGIONAL ROLE?
Speaker: G. BROOKE MSc(Eng) CEng FICE MBIM
Regional Works Officer Mersey RHA

12.00 THE VIABILITY OF THE NEW AUTHORITIES IN ESTATE MANAGEMENT
Speaker: R. WALKER ARIBA
Area Works Officer Hampshire AHA (T)

12.45 LUNCH

13.45 THE DISTRICT AND UNIT FUNCTIONS
Speaker: F. D. BLACKBURN AIEE FIHospE
District Works Officer, Norwich Health District

14.30 OPEN FORUM

16.00 CHAIRMAN CLOSES CONFERENCE

Tickets £35 each, including conference fees, coffee and lunch. The fee does not cover overnight accommodation. Tickets only available from the Institute of Hospital Engineering.

This paper was given at the Institute's annual conference, held last May at Watford.
Mr Dann is Resident Services Engineer, Oxford RHA.

Site Progress and Valuation

ROY DANN TEng(CEI) MIPlantE FIHospE Associate of the CIBS

Capital Works supervision, to be efficient requires application of abilities, techniques and procedures across a wide range of subjects. Nowhere is this demand for 'panoramic' knowledge greater than in the engineering services site-office. It is here (as well as in the contractors' supervision) that the multi-disciplinary design detail is required to be welded into a co-ordinated entity. Without high quality site supervision 'The best laid plans of mice and men . . .'.

Personal experience, confirmed by research in latter years, indicated that there was scope for improved efficiency in the supervision of Health building projects. The greatest need was seen to be in the sphere of site office administration techniques, thus maximising the high quality of site staff technical expertise, resulting in increased support to both Contractor(s) and Design Team.

My appointment in 1972, as Resident Services Engineer for the Multi-Million Phase II of The John Radcliffe Hospital development, provided me with the opportunity and the authority to introduce and develop my concept of integrated and efficient site procedures.

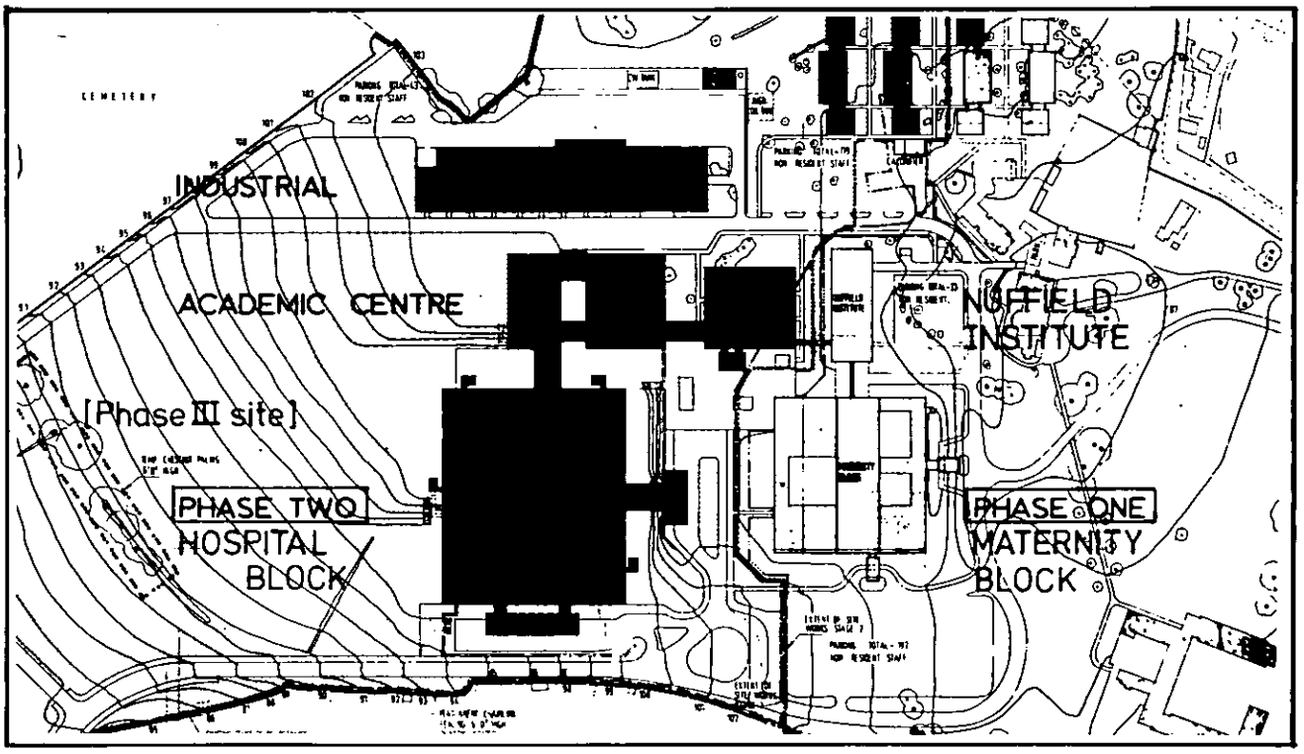
This article details the establishment of site office systems to ensure the provision of accurate progress reports and Valuations of Engineering Nominated Sub-contract works, which could be applied to capital works of any size and description. The article concludes with a summary of advantages to be gained if these principles are adopted at an early stage in any future projects.

The development, originally for the Board of Governors of The United Oxford Hospitals (in 1974, The Oxford Regional Health Authority took over the Client Function as a result of NHS Re-organisation) was designed by the following Consultant team:

Yorke. Rosenberg. Mardall	Architects.
Sir Frederick Snow & Partners	Civil, Structural & Building Services Engineers.
Davis. Bellfield. Everest	Quantity Surveyors.

Figure 1 shows the development Plan — Phase I, having completed and was occupied in 1972. Additional Residential accommodation was provided ready for occupation upon completion of Phase II (under separate contract). The extent of Phase II works is illustrated along with indication of the space allocated for the future Phase III which will provide additional ward accommodation. *Figure 2* is an exploded view, showing in greater detail the accommodation provided by the Phase II works.

Figure 1. John Radcliffe Hospital Site Plan.



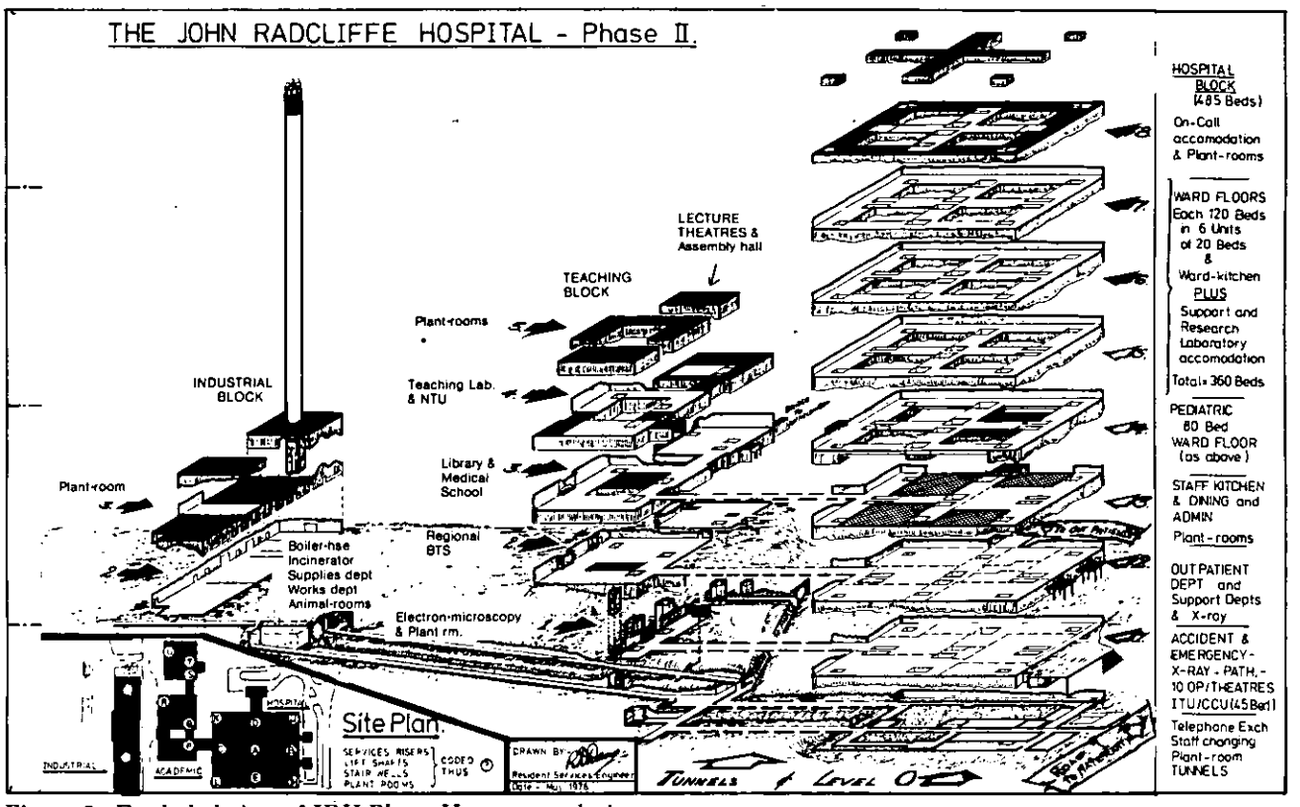


Figure 2. Exploded view of JRH Phase II accommodation.

The total costs of this phase (approximate values only) were:

At Tender (1971) — Engineering Services £4m of £12m total.
Completion (1978) — Engineering Services £7¼m — Total £20m plus.

Labour and material VOP accounts for most of the increased cost.

Among the many engineering systems installed were:

A 33 KV Ring Main to three additional HV/MV Substations, with four Standby diesel Generators. These serve more than 150 distribution centres, from which over 800 miles of subcircuit cabling supplies over 7,000 socket outlets, and 1,500 Light fitting with 23,000 lamps and a general lighting load of 1.5 Mega-watts. These are situated in 2,900 rooms and spaces, of which the total volume exceeds 250,000 cubic metres. There are eleven Lifts and three Hoists in addition to the Mechanical services which includes: Four Steam Generators supplying some 15 Autoclaves, four 20m bth/hr dual Gas/oil fired HTHW Boilers, serving fifteen Heating or DHW calorifiers and three Absorption-type Refrigeration machines (Total 900 Tons R) for air-conditioning systems, part of a total of 150 Fan and ductwork systems containing 1,054 Fire Dampers.

Among the many other services are the Piped Medical Gases and Vacuum, with a total of 1,000 outlets.

The Need for Supervision

Except for recent mammoth projects, it has been usual in the Health Service to employ only one Site Engineer and one Building Clerk of Works for each major project. The experience of the 1960's emphasised the need for improved performance by both the individual and the 'profession' as a whole.

Within the NHS little has been done, so far, to guide the development of site management techniques to the degree of proficiency required. Although individuals have achieved high personal standards that have satisfied employer/consultant design teams, this has disguised the need for improvement in overall site supervision.

Problems faced by site staff are greatest when engaged in the supervision of projects designed by Consultant teams — not through any lack of the Consultant's technical or Professional ability but by the bringing together 'On-site' of design drawings and other information presented in differing forms. These may be ideal for the internal organisation of the design office in which they were conceived, but, when considered as a whole, present many difficulties to those responsible for co-ordinating the work.

Many of these difficulties could be resolved by introducing site staff into the design team before contract action is taken. They would then be able to check the project co-ordination by application of specialist skills, not only in the technical sphere, but also in site administration and management. Further advantages would be gained by more pre-site involvement between site staff and the design team. Problems related to reporting of progress and financial control could be minimised by cultivating in each site engineer or clerk of works true cost consciousness that will develop naturally from his dealing with matters of rates, estimating costs of instructions, and assisting with the routine parts of monthly valuations.

With the prior permission of the Consulting Engineer, the engineering Inspectorate for the John Radcliffe project was encouraged to operate in this 'forward looking' atmosphere and hence — although difficult to prove —

contributed to a degree of cost monitoring and control much appreciated by the Consulting Engineer and was reflected in his direct financial reporting to the Client.

As previously stated, this new concept of integrated administrative procedures has been born not only out of personal experience, but also from questioning a wide range of engineers from both supervisory and contractor personnel.

Advantages of the concept

Evidence collected during those enquiries pointed to:

Progress Reporting

Confirming my own suspicions, the general concensus was that every report contained data produced by an individual using his own (usually unknown) method of 'measurement'. Each recipient of the report would in turn interpret the data differently. These differing interpretations often manifest themselves at Site Meetings and lead to suspicions, sometimes accusations, of manipulation in order to gain substantiation of 'claims'. Further research revealed many 'standard' methods of presentation upon either the written report, or the marked-up programme, but little about measuring, assessing or calculating the progress percentages being used therein. This problem required a solution.

Interim Valuation

If the term 'progress payment' is used, it is axiomatic that a valuation is a natural follow on from a progress report. Research confirmed my view that this was rarely true. In practice, the amount certified will relate either to an overall assessment made by the Engineer during a recent site visit or, the amount will relate to the Contractors' "Application for Payment" or, usually, a combination of the two. The first type of valuation has its use in minor works only, whilst the second ignores several risks underestimated by many Engineers.

These risks relate to the need of every contractor to ensure an adequate cash flow. To ensure adequate cash-flow, all contractors apparently include in their applications an amount to cushion against 'Unwarranted reduction' by the Engineer prior to Interim Certification by the Architect. The cushion amount cannot be quantified, as it will vary with the experience of the contractor concerned. So it is not possible to use an application as a basis for valuation unless the back-up information supplied with it is in such detail that it may be thoroughly checked and substantiated in the time available. Such a facility would be rare.

The Engineer and Architect have a duty to ensure against over-payment to the contractor under the Fee Agreement. Such responsibility has been upheld in the courts in recent times. The need therefore is to avoid both under and over-payment.

How do we achieve this accuracy and what will be different from the existing ad hoc methods criticised above? The answer to both questions lies in the assessment of progress in accordance with strict criteria known to the contractor and carried out with his full co-operation — as already provided for in most engineering specifications.

Progress reporting is a standard duty of every site engineer/clerk of works, but the ever-increasing sophistication of engineering services and the introduction of HTM 17 *Commissioning of Engineering Services* has led to a proliferation of paperwork that needs to be processed within the site office, which detracts from the primary function of continuous inspection for which these staffs are employed.

The important need for more efficient contract works supervision cannot be denied, and now assumes new dimensions when related to large complex projects which demand the appointment of a site inspectorate team. In these circumstances problems are no greater than those faced by the lone site engineer on a medium-sized project, but they are certainly different. Whereas the 'lone ranger' can rely to a large extent upon his memory, an inspectorate must be encouraged to share all information. To achieve this it is important to foster the team spirit in every possible way, recognising that in the beginning each member will be an individualist used to methods he has developed according to his own experience. Many of these methods will make valuable contributions to the needs of the new site organisation, and room must be left for incorporation of every such good idea into any overall plan. Introduction of the organisational framework I had conceived for the Oxford project was intentionally slow, each idea being subjected to critical examination by each individual in the light of his experience. A few ideas fell by the wayside; more were modified; but most were recognised as being of immediate advantage. The heart of the system was the creation of an office 'data-bank' which, by operating on a principle of 'keep it simple', could be maintained with minimum effort and yet enabled any member of the team to retrieve up-to-date information on any subject quickly. Perhaps in the future, site staff will be assisted in this effort by the use of the new generation of mini-computers. In the meantime, as at Oxford, it remains necessary to maximise the use of more conventional office methods.

The Broad Objectives

From all the foregoing, certain broad objectives become apparent:

1 For the site inspectorate, (or lone site engineer) creation of a framework of procedures, based upon maximum simplicity, minimum duplication of effort, with all parts being fully integrated. Thus the vital Client Function of Site Supervision will be developed to its full potential.

2 From the facilities provided by the above, improve the clarity of communication to both design team and contractor, and ensure regular submissions of accurate, and unambiguous Progress Reports, formulated in such an atmosphere of cost consciousness and control that the reports are suitable for —

3 Accurate computation of that routine portion of the Interim Certificate valuation which relates to installation progress and materials on site.

Site Office Organisation

"An engineering site office is the 'Spaghetti-Junction' of all project correspondence, information and data Traffic".

There is no way of avoiding the proliferation of paperwork generated during design and construction of a major project. However, with careful consideration, processing methods can be arranged which not only ease the burden but make a major contribution to increased efficiency overall. On the John Radcliffe site considerable success was achieved by the following method.

It was intended from the start that all 'codes' would be based upon, as far as possible, subject initial letters of the everyday description terms. It was believed this would

lead to quick and easy recognition, the value of which can only be appreciated by those who need to refer constantly to code reference charts.

Alphabetical coding by subject initial was applied to two problems which, quite naturally, became an integrated system. The first of these was cost coding.

Cost Control

Immediately upon my appointment, in discussion with the Consulting Engineer, it was agreed that a system of cost control was required, and that I would be allowed to develop it according to principles I put forward. My intention was to produce a system of coding which would maintain, as far as possible, the analysis facilities provided in tender breakdowns, as required by Capricode. This facility had been maintained in each schedule of rates which had for the first time in my experience been rigorously checked to ensure that the elemental totals matched those in the tenders, and that the detailed make-up was fully representative of the works content.

In the long term, I believe the continuous analysis facility provided in this system (being of Capricode form) will allow instant feed-back of cost trend in ongoing capital works, thus permitting the DHSS to up-date design cost limits in a manner more sensitive to inflation than is possible from only tender and final account information. To increase the attractiveness of this system, care has been taken to maintain utmost simplicity for ease of computerisation of data.

Figure 3 shows the office code system used, amended to include further improvements, having overcome several initial difficulties.

CASHcode and File Index

The title 'Cost Analysis System, Hospital — code' was chosen to avoid confusion with its direct relative Capricode, from which bracketed cross-references appear against the various engineering services descriptions.

In the services identification 'double column' it will be seen that there was considerable manipulation of subject headings in order to obtain the best use of the alphabetical codes, with repeats and overflow subjects being allocated single digit number codes. Other means could be used for extending the range of alphabetic initials, such as two or three letter combinations if necessary. It was decided not to use them on this occasion. Such an extension may prove advantageous if wider application is intended in the future. The restraint accepted, use of single letter (or number code) caused a degree of compromise such as the inability to match the quantity of codes available in Capricode. Yet at the same time it confirmed the original intention of maintaining a 'practical link' with the intended relationship (explained later) to the content of each drawing series. For example, all ventilation and air conditioning systems — covered by more than seven codes in the Capricode documentation — were combined upon one series of design drawings. Therefore it was very convenient to apply the common code 'E' — "Environmental Engineering" to all these services. As a result, the responsibility for maintaining the final detailed analysis tended to return to the Engineer/Surveyor, although he was assisted by site staff. They ensured that all instructions issued for these services included, within the work description, the reference number of the fan/ductwork system being varied (all supply plants referenced SP1, 2, 3, etc, and Extract Plants — EP1, 2, 3 . . .). The Engineer/Surveyor would

Figure 3. CASH Code and File code index chart.

1. PROJECT SECTION & Main File Group title(s)	2 SUB-CONTRACT & File sub-group description	3 MECHANICAL SERVICE OR ELECTRICAL SERVICE Services subject matter [open file for each of repeating systems - as required]		4 COST ALLOCATION ORIGIN OF or REASON FOR INSTRUCTION
A Architect	A Administration	A Automatic Controls (1.10)	Alarm Systems (3.12)	A ARCHITECT / C.of W's.
B Building	B BUILDING	B Boiler Plant & auxiliaries (1.12.7)	Boiler Plant Supplies (3.14.7)	B BUILDING REGULATIONS
C "CONTRACT"	C Commissioning	C "CO-ORDINATION"		C CONTINGENCY FUND
D Drawings	D Defect Lists	D Drainage [internal] (1.8)	Distribution (3.1.3/4 & 3.7.2)	D DESIGN RESERVE
E Engineer	E ELECTRICAL	E Environmental Engineering (1.3.2-5 & 1.5)	Emergency Generators (3.7.1)	E EMPLOYER
F Financial Reports	F Fire Policy & Reports	F Fire containment [f.dampers etc.]	Fire Detection & Alarms (3.15.11 & 3.12.1)	F F.O.C. REGS. Etc..
G GENERAL	G Group II Equipt schedules	G Gas:- town or natural (1.6)	"GENERAL CARCASSING" All systems	G
H HOSPITAL	H HIGH VOLTAGE	H Heat source (1.2, 2/3) H.P.H.Water.	Heating - electric. (3.3.3)	H HEALTH & SAFETY EXEC.
I INDUSTRIAL	I Instructions	I Industrial Compressed Air (1.13.8)	Illumination systems (3.2. & 3.7.3)	I I.E.E. REGS.
J ACADEMIC BLOCKS	J	J Joint-M-services Control Panels & Electrical Supplies to H&V (3.6)		J
K	K	K Kitchen Equipment (1.12.1)	Kitchen Equipt. & Supplies (3.14.1)	K
L Labour Returns & Time-sheets	L LIFTS	L Laboratory Equipt. (1.12.2)	Lift Supplies (3.4)	L LOCAL AUTHORITY BY-LAWS
M Meeting Minutes	M MECHANICAL	M Medical Gases & Vacuum (1.7)	M.V Switchgear (3.1.2)	M MAINTENANCE NECESSITIES
N	N NOMINATIONS	N	Nurse Call [etc] Systems (3.8.1)	N
O OVERLAP	O Organisation & Methods	O Other Equipt.	Other Services (3.13)	O OVERLAP OPERATIONS
P Progress	P Programmes	P Plant [central] calorifiers (1.13.1)	Power System (3.3.1/2 & 3.7.4)	P P.C. & PROVISIONAL SUMS
Q Questions to Design Team	Q Query sheets from Contractors	Q (1.12.4) PHARMACY EQUIPT. (3.14.4)		Q
R Regional Health Authority	R Reports	R Refrigeration [central] Plant (1.3.7)	Radio/T.V./Bed-Head Units (3.8.3)	R
S Site Staff Engineers	S STATUTORY SUPPLY	S Steam & Condensate (1.2.3a)	Site Lighting (4.13)	S SITE ENGINEER
T TUNNELS	T TELEPHONE EQUIPT.	T Thermal Insulation. (1.11)	Telephones (3.15)	T TESTING [additional to spec'n]
U User	U	U "USER OPERATING & MAINTENANCE MANUALS: RECORD DRGS."		U UNCOVER HIDDEN WORK [Cl. 6]
V "VALUATIONS"	V	V Vacuum Systems [not 'M'] (1.13.9)		V V.O.P. MATERIALS
W	W Work-in-connection	W Waste Disposal (part 1.12.6)		W WAGE AWARD - V.O.P Labour
X EXTERNAL WORKS	X EX-CONTRACT	X "X"-RAY SERVICES (3.5)		X EX-CONTRACT "Attendance"
Y	Y	Y (1.12.3) LAUNDRY EQUIPT. (3.14.3)		Y
Z	Z	Z (1.12.5) STERILIZER EQUIPT. (3.14.5)		Z
		1 Mains/Drinking Water (1.1)	H.V. Services. (3.1.1)	
		2 Fire Service/Hosereels (1.2)	Batteries & Chargers [Emergency] (3.7.5)	
		3 Cold [untreated] Water (1.3)	Clocks (3.11)	
		4 Treated Water (1.4) Demin. Water.	Laboratory Equipt. & Supplies (3.14.2)	
		5 Low Press. H.W. Heating (1.2.2/3)	Lightning-protection. (5.K.3)	
		6 Chilled Water Mains (1.3.9)	Staff Location Systems (3.15.10)	
		7 Hot Water Supply (1.4)		
		8 Condenser Cooling Water		
		9 Cold Water Storage Tanks (1.13.6)		

"COST ANALYSIS SYSTEM for HOSPITALS"

All SITE INSTRUCTIONS to quote four-element code in margin together with estimate of cost.

Site Office Filing to be based upon use of first one, two or three element selection to suit individual requirements

C.A.S.H.CODE & FILE INDEX

Project:-

By:- Roy D Dann Resident Services Engineer

not, it was thought, find it too onerous to re-allocate cost when required, as it would be unnecessary for the majority of the other codes. (This truly "Systematic" referencing together with the Cashcode is exampled again later).

With the full agreement of the Consulting Engineer/ Surveyor, all Site Instructions would contain marginal notes of the relevant Cashcodes and, for each, an estimate of cost effect derived by the Site Engineer from the appropriate contractors' Schedule of Rates.

As is clear from the Cashcode chart, each CASHcode comprised four-elements indicating in turn:

1. The Project Section — to which the instruction related.
2. The Sub-Contractor nominated to perform the work.
3. The Mechanical or Electrical service being varied.
4. Cost Allocation; Reason for Instruction.

The last code letter, unlike the first three, appears only in Cashcode applications. It was built into the system to indicate to the engineer the identity of outside agencies causing an effect upon engineering Cost Control — for which, under his fee agreement, he was directly responsible to the Client. Having provided this facility, it was natural to extend its advantages over the range now catalogued in the last column.

File Indexing

Each 'CASHcode', as intended, performed the additional function of providing a reference for the 'support file', thus maintaining the same systematic clarity necessary for instant recognition and quick information retrieval. This proved of special value during the later periods of commissioning; checking 'as fitted drawings'; and collation of 'hand-over' information.

CASHcodes were given priority during allocation of index letters however, by means of 'manipulation'. Spares were created and allocated for 'administrative' purposes (in columns 1 and 2) in the same easily identifiable method, and at the same time this enhanced the intentional system 'flexibility' which it is hoped will encourage others to adopt the same principle.

As examples of the flexible nature of the file referencing shown, the Site Engineer on a small site may prefer to have one file for every item of correspondence, (code 'G' General). This is an over-simplification of course. In practice he would segregate at least to one file for each sub-contract ('GE', 'GH', 'GM' etc) progressing to 'GME' and 'GME-SP1, SP2, — EP1, EP2', according to the dictates of project complexity and/or personal preference.

Similarly, division of filing according to each major section of a very large project is catered for (using the same example) by 'IME-SP101', 'HME-EP25' and 'JME-SP75'. (The use of 'J' instead of 'A' as the code for the Academic Blocks' was not a result of title manipulation to provide the latter 'A' for 'Architect' alone, but because 'J' was the index code letter used upon all drawings for that building).

Other Codes, 'AI', 'EI' 'BW' are of course self explanatory and serve to demonstrate further the simple logic of the file system.

With the creation of the dual purpose code system, the first of the listed broad objectives was, to a large extent, satisfied. Final achievement of the objective was due to the success experienced during the use of the codes as soon as they were applied. New staff were able to use the codes for both purposes in a matter of hours, and this created within each team member a desire to improve other procedures towards a similar level of efficiency. One sphere of technical and administrative activity which improved as a result is described below.

Site Office Master Drawings

Based upon previous experience, it was my intention to ensure that only one copy of each drawing would be used by each member of the site inspectorate team in order that everyone would be aware of day-to-day alterations. To achieve ultimate efficiency in this respect, every site inspectorate should be organised so that both the Architectural and Engineering teams amalgamate their drawings (or other records) and maintain them in one central 'drawing office'.

This Master Drawing approach is not original. However, one of the Site Engineers in the JRH team, Mr Peter Nettleton, demonstrated that this could be developed to a level of efficiency which far exceeded my original requirements. Following his example, it soon became routine for each site engineer to update drawings to show the extent of work inspected, together with the date, test certificate and defect list reference number at each demarcation point. Also included were notes of any 'query' or observation received from the contractor(s) or raised by a team member and referred to the design team.

When developed to its full potential, this approach provided two further advantages beyond improved communication between all site staff.

The first of these was the provision of a 'natural' and continuous record of 'Work properly executed', (to which we return later). Secondly, it provided a similar 'natural' and permanent record of all technical data and monitoring of inspections in a manner more easily maintained than that suggested by HTM 17 — "Commissioning of Engineering Services". Yet it satisfied all the major requirements of that document, especially when combining the Master Drawing with the more detailed information contained in the support file system.

There were initial problems resulting from frequent revision of design drawings during the first few weeks of the construction period. When a revised drawing is received in the site office it is necessary to transpose all the notes which appear upon the initial copy. Whilst in time revisions become less frequent and the transfer workload is reduced to acceptable dimensions, much can be done by our colleagues in design offices to aid both site staff and contractor whenever a revised drawing is necessary.

Up-to-date drawings are of course a pre-requisite of efficient construction and supervision. As described above, site staff can carry a major part of this reponsibility during the period between drawing revision, but when a new issue is made this should incorporate not only the design change which prompts the issue, but all known variations that have occurred since last 'full' issue. To achieve this in practice the design office would have to be located 'on-site' or have access to the annotated drawings which exist in the site office. A reasonable compromise is for the design office to make daily revisions to the drawing negative when copies of Site Instructions, Site Staff Observations or Answered Technical Queries are received. As each alteration is incorporated, its extent should be highlighted by a 'pencilled' circle or elipse, together with note of origin (repeated in revision note column if of significant effect). Thus, not only will the design office be given the facility

to judge when a revised issue of the drawing becomes appropriate, but also, when called upon to make a major variation or change of design, this can be achieved to the standard of 'co-ordination' which always was necessary, and is now being demanded.

After such re-issue (to a full distribution lists) all pencil circles, elipses and notes may be removed from the negative so that the cycle may be re-commenced.

The Site Engineer will still need to transfer other notes and will therefore automatically check upon the accuracy of revision. But like the Contractor, he will have an immediate indication of any changes requiring action.

Progress Record Drawings

Each engineering specification for the JRH project contained a standard clause requiring the contractor to maintain on site, available for inspection, one set of drawings continuously marked-up to indicate the progress of the works. Such a requirement is not unusual, but compliance with it is rare, due in all probability to lack of use of the facility by both Engineer and site staff on the one hand, and on the other, a consequent reluctance on the part of the contractor to spend time and money upon an activity he sees as being non-productive.

As these drawings played a significant part in my plans for both progress reporting and valuations (as will be seen), the contractors were made aware that compliance with the specification would be insisted upon. In order not to antagonise him at this stage, he was at the same time given an insight into the benefits he could expect by co-operation in this matter, as had been discussed and agreed with the Consulting Engineer/Surveyor. The main benefit outlined was the direct linking of Interim valuations with the installation progress indicated upon the Progress Record Drawing in the Contractor's office. Thus it was 'suggested' that if his 'mark-up' was not up-to-date, then neither might be the valuation amount. Although this 'suggestion' would not have been followed through, it provided sufficient emphasis to the importance attached to the requirement to encourage the contractor to implement the necessary arrangements and co-operation.

Figure 4(a) illustrates the original intended graphics for each of the 'work stages' to be separately monitored, (the reasons for each being amplified later). In practice those illustrated in *Figure 4(b)* were found to be more appropriate and practical for monitoring Second Fix and Commissioning activities except for the early application to drainage systems.

The mark-up graphics illustrated were developed from those already in use upon the site office Master Drawings, and were used by the contractor(s), with one significant difference. Site Engineers used different colours to indicate the progress of individual systems, thus improving their understanding of the drawings and spacial co-ordination, and preparing for later commissioning activities. The Contractor on the other hand used a distinct colour change each month, standard for every system and trade, to highlight each month's progress, and to remove the need to examine drawings of areas where no installation work had been carried out during the current month. This gave the advantage of making it possible to check any progress assessment in the event of later dispute between contractor and site staff, such checks being possible after several months, and in various circumstances, such as investigation of claims for delay, etc.

The organisation and practice of marking-up progress was as follows. At regular intervals (preferably daily) each Trade or Area foreman marked-up the drawing(s) to indicate the physical progress of the installation work (indicating at the same time any deviations from the drawing for 'as-fitted' drawing purposes). From so doing, the foremen became quite enthusiastic, maybe because of technical pride, but also because it gave a convenient demonstration of their productivity, or documentation of the factors preventing progress. It is therefore obvious that the procedure can be of great value to a contractor operating bonus-incentive schemes.

The Contractor's Site Agent, Project Engineer or Senior Foreman gains similar advantages, plus improved facilities for planning co-ordination between trades and other sub-contractors, and for labour and material forward-planning.

By the combined action of all trade and section foremen, the Progress Record Drawing provided the specified continuous and up-to-date indication of installation progress.

Figure 4. Progress record drawings.
Figure 4a. Method of 'mark-up'.

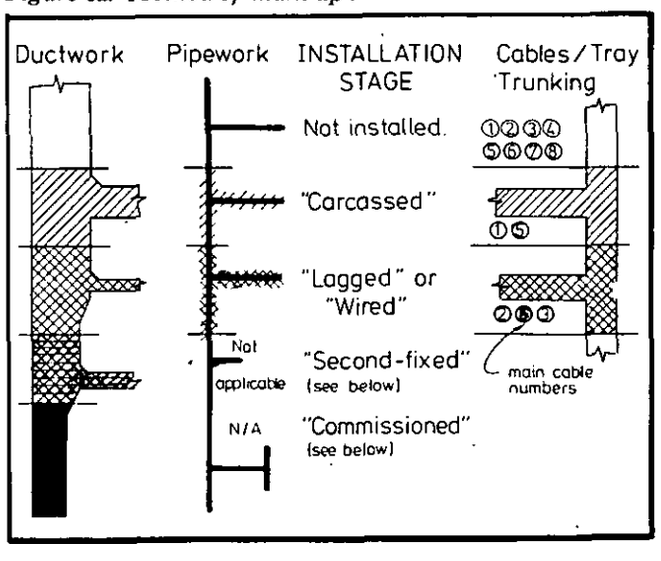
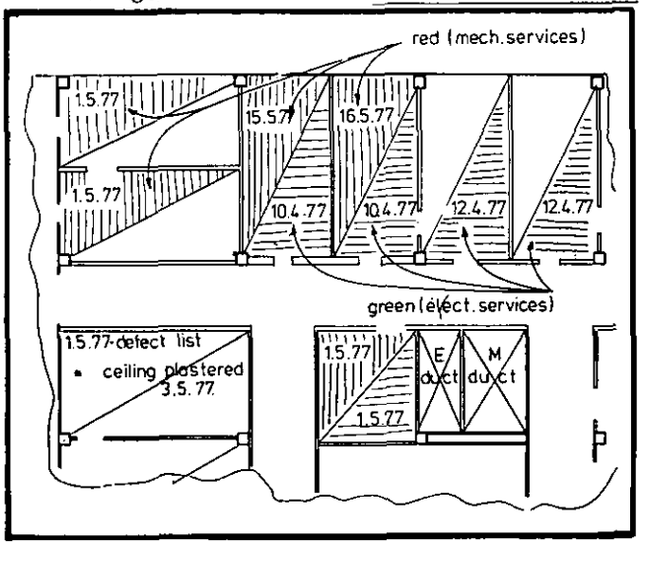


Figure 4b. Stage inspection of rooms E and M (eg — above ceilings).



Concurrently, the Site Engineer(s) have recorded on the Master Drawing the extent of the installed work that has been 'offered' for, and satisfactorily passed, inspection.

Except where testing apparatus created restraint, the amount of installation work subjected to 'critical inspection' (as distinct from that performed day-to-day) was dictated by the size of the work 'parcel' offered by the contractor's foreman. Generally these proved to be quite small, and resulted in a continuous inspection and test workload for the site engineers, bringing the additional advantage that other areas of work were not neglected during long inspection routines. Also, defects noted during inspection of a small parcel tended to be rectified without delay or the necessity for a 'return visit' to the location by the contractor. In other words, there was mutual benefit from ignoring (except on rare special occasions) the specified requirement for prolonged notice of readiness for inspection and testing to be given.

Thus, we now have available at any time, particularly at the end of each month, two up-to-date records of progress. They are the contractor's, showing total installation, and the 'Master' drawing indicating that quantity which by inspection, is known to be 'work properly executed'. And, because of rapid follow-up inspection, the difference between the two quantities will be minimal, even if no allowance was made by the Site Engineer in recognition of the usual standard achieved, as would be expected when assessing progress.

As previously mentioned, it was found easier to monitor Second Fix and Testing/Commissioning using a method based upon *Figure 4(b)*.

Using A3 size reduced scale drawings of complete floors, several activities were progress monitored, as appropriate, by either the Site Engineer (mechanical) or (electrical), or combined action upon one drawing. A few examples recorded upon separate sets of reduced drawings, are given below:

Completion of M & E carcassing above false ceilings;
Completion of M & E carcassing in dry partition walls;
Cabling of final sub-circuits;
Second fixing of electrical outlets;
Second fixing of vent grilles, diffusers, and other terminal fittings;
Commissioning/testing of air distribution systems;
Electrical testing of lighting, power and specialist systems.

Some, as in the illustration, are monitored on a room-by-room basis, others on a 'distribution-area' method.

Each of these activity monitoring procedures made it possible to control the release of rooms (or areas) for following trade activities, minimising the amount of engineering works 'covered up' before inspection (and resultant remedial works being checked and passed). Where the control failed, the Architect was requested to issue instructions under contract clause 6, 'open up for inspection'. If no such instruction was issued, the documentary evidence would be useful in attributing responsibility for any latent defect and damage it causes (eg stained ceilings due to condensation from cold pipes left un-insulated, or others of greater potential).

Progress Reporting

With one notable exception, all the pre-requisites for Progress reports of considerable accuracy have been established. Along the way, the procedures described have already created many incidental advantages, through integration with other site activities that existed naturally, or that were manufactured during the method's development.

The one problem to be resolved related to the existence of major valued items within an engineering system which, it will be claimed (by the contractor) represent an instantaneous increase in overall progress. Such a reaction is natural under the average system of reporting if it is believed that, subsequently, a valuation will be based upon progress report information alone. Therefore, for the JRH Project, it was decided to remove all opportunity for such argument during progress assessment, by the simple expedient of listing separately all items of high individual value if these did not appear to contribute to an average system value density. For example, on the deep plan air-conditioned levels 1 and 2 of the Hospital Block, the mixing boxes or constant volume boxes were many and evenly distributed. They did not warrant separation from the assessment of general progress. Compare this with plant costs in a plant room where the cost of one item could represent (in terms of total value for the area) say, 50% progress, and yet require little or no installation effort.

The ultimate decision as to which plant and equipment was to be extracted was agreed with the contractor, on the understanding that progress reporting would not be modified to account for any reason such as outlined above.

The main purpose of non-financial progress reporting upon engineering services installation work, is to provide the means of monitoring progress of the total project works in general, and at the same time separately to monitor the performance of the nominated sub-contractor against the Main Contractor's 'Programme for the Works'. The latter consideration relates to the Client's responsibility expressed in JCT Contract clauses 23(g) (to quote one example) by which the Main Contractor may 'claim' the right to an extension of time (with inevitable cost effect) in respect of 'delay on the part of nominated sub-contractors (or suppliers) which the Main Contractor has taken all practical steps to avoid, or reduce'. Thus it is incumbent upon the client's representatives to guard against the development of such circumstances.

It naturally follows that to monitor progress against the Main Contractor's 'Programme' effectively, the report format must bear maximum relation to the separate 'event' breakdown of the programme.

Most Programmes will follow a standard basic pattern which can be anticipated, dictated as it will be by the content and natural split of the project (which is illustrated in the Pyramid Breakdown Chart examined in depth later). However, there may be subtle variations in the more detailed breakdown into 'event bars' which will depend upon the methods adopted by individual programmer/planning engineer. An illustration of the average programme breakdown is shown in the extract for one floor level of the JRH Hospital Block, see *Figure 5*.

In the extract it can be seen that The Plant Room which occurs at this level has been separately programmed, as is the work in vertical ducts. There were nine of these, coded by letters (as shown upon the inset to *Figure 1*) in a sequence difficult to remember until a reminder 'phrase' was devised, reading left to right, north to south, in which the sequence LCKEADMBJ became Lets Come Klean, Engineers And Draughtsmen Must Be Joking!

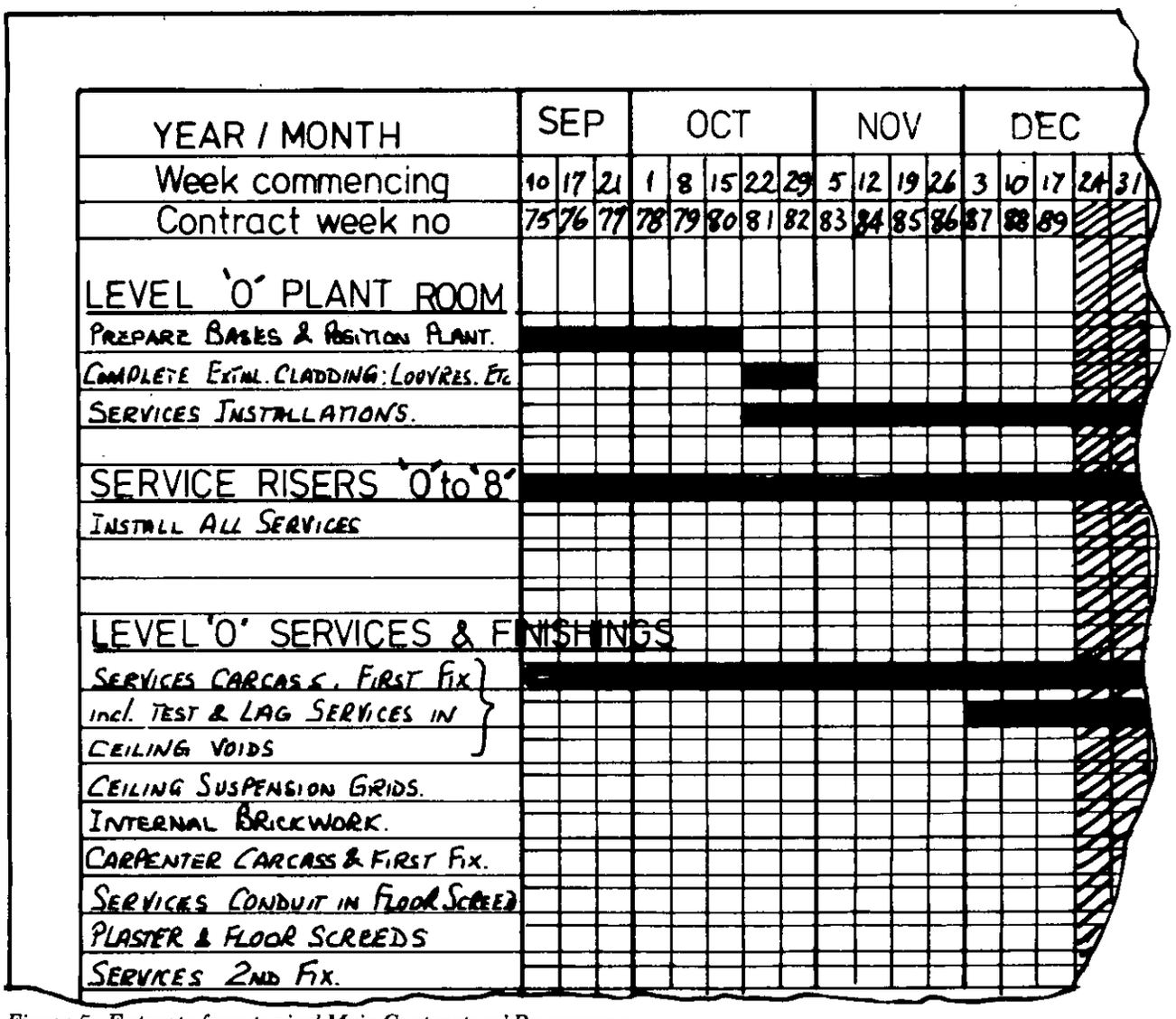


Figure 5. Extracts from typical Main Contractors' Programme.

Within the programming of both the Plant Room, and the remainder of the floor level 'O', it will be seen that conventional terms, well understood throughout the construction industry, either appear in the descriptions, or, can be used to embrace the activity actually described. These terms are of course:

Carcass;
Lag (or Wire electrical services);
Second Fix;
and Finishings, which in the engineering sense embraces final testing, balancing and commissioning — which appeared upon a different JRH programme sheet than that in the illustration.

Full examination of the Main Contractor's Programme proved that it was generally compatible with the Pyramid breakdown shown in *Figure 6*, although some events on the programme encompassed the combined efforts of all sub-contractors, and the many engineering works they were to perform, which would demand separate engineering progress assessment.

It was decided that assessment would be based upon the content of each drawing 'series' as shown in the Pyramid, and that the Main Programme bars would be re-drawn in a manner allowing separate mark-up 'bars' for each service group (matching the report format) from which a composite picture could be derived if necessary.

Monthly Assessment of Installation Progress

Upon a date very near to the end of the month, the Contractor's Agent and the Site Engineer(s) held a joint meeting at which, following the natural sequence of each drawing series, the progress graphically indicated by the trade foremen was assessed and entered upon the appropriate Progress Record Sheet. *Figure 7a* shows part of one such record, which for convenience, is on the standard blank form that will be seen throughout this paper. The example also illustrates the method used to obtain the required 'average progress' for floor levels which required several 1:50 scale drawings (Zones) for complete coverage. Where reduced scale full-floor plans were used for Second Fix and Test recording, single entries were easily assessed direct.

During these assessments, the Site Engineer was able to call for modification of the progress percentage if his Master Drawing indicated a significant difference between the amount 'installed' and that which had been

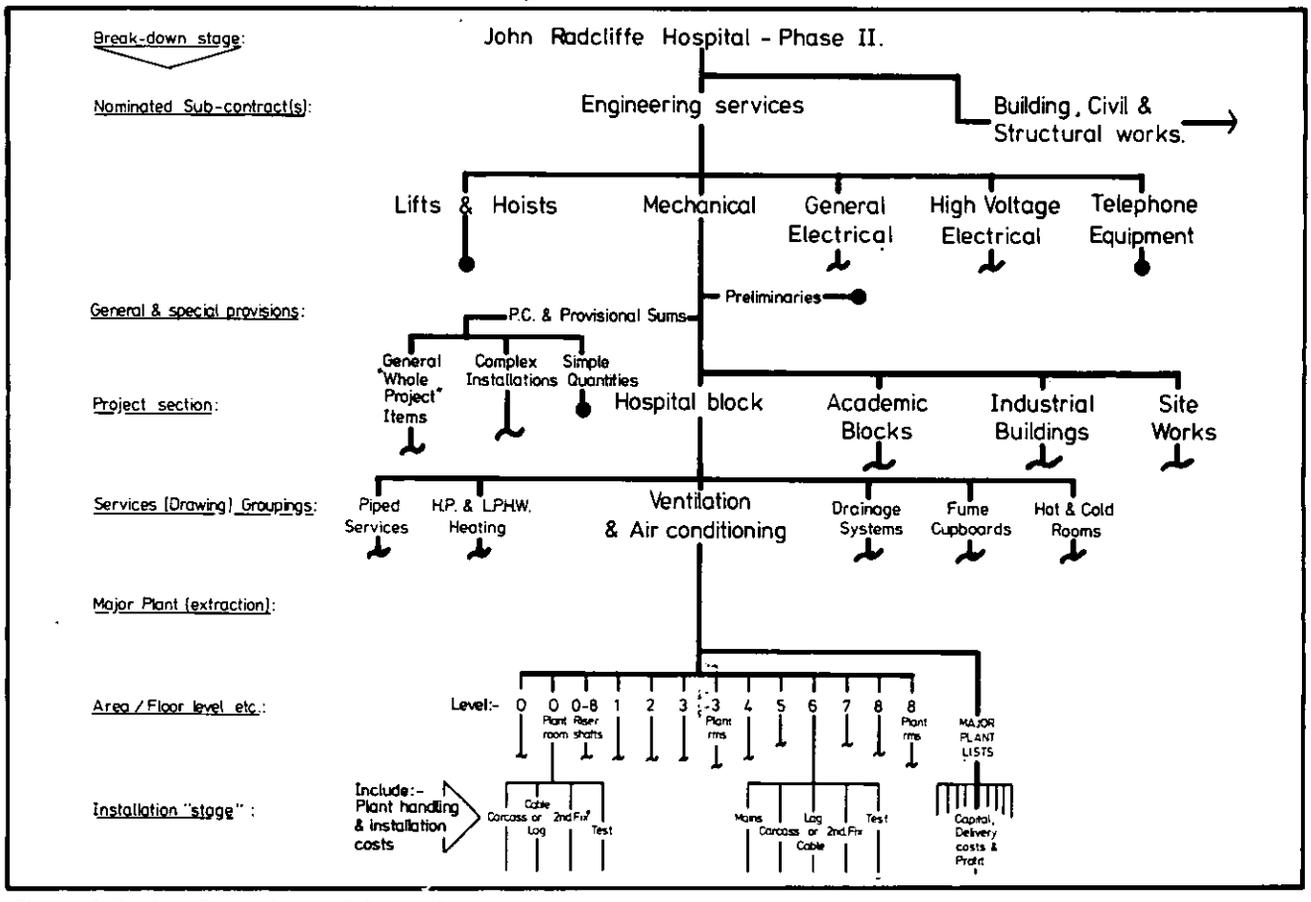


Figure 6. Project Pyramid breakdown diagram.

inspected and proved 'properly executed' (a pre-requisite for later inclusion of value in the next Interim Certificate).

It may be quite a surprise to many that this assessment process never took any longer than half a day, even at the height of installation activity for the sub-contracts involved, one of which had an original tender value exceeding £3m. It is because of this speed of assessment that the joint meeting could be held within the last two or three days of each month, as is appropriate and called for in the JCT Contract Clause 30(2). Compare this with the not unusual prolonged procedures which demand a start in the middle of the month in order to achieve the desired end date.

Arrangements must always exist, as they did at Oxford, for any assessment dispute between Agent and Site Engineer to be referred to the next senior grade in each organisation for independent re-assessment. When this fails, the Contractor's assessment should be noted pending a ruling by the Engineer/Surveyor.

From the completed Progress Record Sheets, the agreed percentage progress figures for each area and group of services are transferred onto a non-financial Progress Report which may be laid out to any desired form.

If all recipients of the progress report are made fully aware of the criteria used in its production, they will be able to interpret the report with confidence and all copies of the Main Contractor's Programme may thus be marked-up individually but with identical results.

Note: This stage in the paper represents a convenient 'Cut-off' for those organisations who chose not to involve site staff in matters relating to valuations. However, where the ability and willingness exists at site level, there is much to be gained by extending their involvement along the lines now to be described. Among these benefits are increased job satisfaction for those on site, increased cost-consciousness among site engineers, leading to greater cost control and, for the Engineer/Surveyor, freedom from the workload of the 'routine content' of monthly valuations. This leaves them more time for critical examination of the non-routine items such as 'claims' which demand the professional training and expertise at their disposal, and in any case lie outside the 'legal responsibility' of the traditional site engineer.

Where further site staff participation along the lines suggested is to take place, it must be on the same clear understanding that existed throughout the JRH Project. That is, that any monetary value quoted upon the forms submitted to the Engineer by the site staff/contractor shall be purely advisory, and shall be subject in their entirety to authentication (or modification) by the Engineer/Surveyor, before forming any part of the next Interim Certificate issue.

Pyramid Breakdown of Costs

In *Figure 6* the first two breakdown stages are obvious since it is intended to obtain a valuation for each sub-contract.

The next subdivision sets aside 'Prelims, general and special conditions' which are discussed later.

Division into Project 'Section', the next stage, is logical since each building may be considered a separate mini-project and except for a few engineering system overlaps

could have been constructed under separate contracts. Each Section contained distinctly different types of accommodation and degrees of engineering servicing, which would be reflected in the Design Cost limits applicable. Hence it is again logical to provide for this same separate monitoring of costs.

To have provided the infinite cost breakdown to satisfy all the sub-divisions to be found at each stage of the CAPRICODE document was clearly impractical. However, since the Tender Breakdown provided the necessary Analysis total costs for each element, it was realised that the desired continuous analysis could be maintained by the Design Engineer/Surveyor providing variations (especially those issued at site level) containing adequate system identification information. (This allowed the development of CASHcodes as already described.) The next stage of Project cost-breakdown is thus allowed to follow the divisions already established by the presentation of the contract drawings, in which, for example, a series of drawings covered the combination of several similar services (ie hot, cold and drinking water). Thus it remained possible to report progress in group form, and at the same time to monitor variation cost effects by using individual cost coding of instructions. The chosen split by 'Drawing series' (basic service groups) provided the ideal system for routine drawing-by-drawing monthly assessment of progress.

Considering each Drawing series and engineering service in turn, it was found by examination that the density of 'servicing' on floor plans fell into three distinct categories that would apply to any project:

Plant rooms;
Service distribution shafts and tunnels;
Occupied and accommodation areas.

Because of the design and Departmental distribution in the John Radcliffe, the density of servicing in accommodation areas tended to remain constant for any given floor level (although in specialist installations wide variations were apparent). Changes in density of General services were obvious when comparing a deep-plan floor to others utilising, for example, natural ventilation and lighting. Other projects will, according to their design, lead to different conclusions as to the best separation to account for different levels of servicing to be found when comparing administrative, laboratory and patient accommodation areas. For example, an extensive single storey development may require division on a 'departmental basis'.

It will be noted that the Pyramid shows the extraction of Major Plant (as described earlier). This action was primarily to remove a cause of argument during progress assessment. Having decided to extract all high cost major plant onto separate lists, it was necessary to leave, as part of the area value, all cost of 'placing into position', and of 'installation and connections'. (The valuation of these separately listed items is described later.)

The degree of final breakdown into installation work stages can be influenced by the method of construction. *Figure 6* shows (for Level 'O') the basic Pyramid breakdown used at Oxford. In practice (and with hindsight) it would have been better to use the extra 'split' shown (for Level '6') as the construction method, and thus the building programme, demanded that high level carcassing of all services be carried out before internal dry partition walls were erected. For the John Radcliffe it thus became necessary to carry out exploratory measurements to derive, for each service, a representative proportion of carcassing value which was to be installed in the walls during a second visit to the area. Thus completion of 'first stage carcassing' in fact appeared upon progress reports as something less than the expected 100%. Thus, it should be noted, the decision as to the number of Installation work stages for any project is important, and cannot be arrived at until the method of construction is known by the design team. The Main Contractor should in turn produce his programme according to the same dictates and should be so directed to do so in the Contract documents.

The next stage of development of the John Radcliffe procedures involved considerable effort because of the need to derive for each component the value of the work involved, and the material content, from the Contractors' Schedule of Rates.

The re-scheduling of values for virtually all mechanical services was carried out personally before the introduction of the procedures to the contractor (for fear of causing rejection of the proposals before the benefits could be demonstrated to him). However, by the time work was to commence upon re-scheduling the electrical sub-contractor's schedule of rates, his surveyor had become aware of the many advantages, and was so enthusiastic and willing to co-operate that he carried out most of the work himself, in order to implement the procedures without unnecessary delay.

In the future, the greater use of bills of quantities will make it possible to itemise the work stages in order to obtain, from the start, all the costs in breakdown form. It would also be possible, given sufficient encouragement, to obtain from a Contractor a schedule of rates in the same desirable form, because the present composite rate form can only be derived from knowledge of these same work-stage costs.

As no such preparatory work had been carried out for the JRH Project, the time consuming process of re-scheduling had to be performed if I was to achieve my ultimate objective. In practice the process, though laborious, proved relatively uncomplicated. Taking each section of the Schedule of Rates in turn, each group of entries or page was allocated the appropriate Cashcode in order to ensure transfer of costs to the correct 're-grouping'. Each individual entry was then coded C= Carcass; L=Lag; W=Wire; 2=Second fix; T/C=Test and/or Commission. Each page was then totalled under these separate classifications before the values could be carried forward to the appropriate new summary column, which depended upon the now familiar headings:

Section (Building)
(and of course — Sub-contract);
Engineer Service (or group of services);
Floor level (or Area);
and finally — according to workstage, Carcass, etc.

There was also the transfer to separate lists of the capital cost of all Major Plant and Equipment, together with, (where itemised) the separate costs of delivery and off-loading. As mentioned earlier, cost of lifting into position and of connections remained part of installation cost, usually as carcassing, or occasionally as second fix. Where these many elements were not segregated, intelligent guesses had to be made for confirmation or adjustment by the sub-contractor later.

Valuation Report Sheets

In order to minimise printing costs, care was taken to produce a blank form of standard layout which could either be 'over-printed' or completed in manuscript, according to three or four basic needs. These in turn would show maximum standardisation of headings, as will be obvious in the various parts of *Figure 7*, and in *Figure 8*.

Major Plant

JCT Contract Clause 30(2) excludes material value from Interim Certificate if such materials are delivered prematurely. However, during times of inflation it is generally advantageous to the Client to set aside this provision and thus to minimise Materials cost increases where provided for by a VOP clause in the contract. There are of course circumstances which may outweigh this advantage, for example; the current financial climate now demands that greater attention be given to specifying items that need to be purchased as late as possible. This method is already used for the (Ex-Contract) supply of X-ray equipment, in order to ensure installation of the latest possible design. There are other areas of rapid obsolescence which may need to be identified and treated the same. Another disadvantage to early purchase of plant is the expiry of manufacturer's guarantee long before hand-over, and, in the case of very large projects, even before installation. Happily the vast majority of manufacturers are prepared to take a responsible attitude and to extend (often to considerable lengths) their legal responsibilities. However, the already extensive risk is greater for the Nominated Sub-contractor as the cost of remedials increases, for he, and he alone, carries the contractual liability throughout the Contract Defect Liability Period.

Separate scheduling *(Figure 7b)* has the advantage of encouraging inspection of all plant on delivery, at which time the Site Engineer can make note of any damage or deficiency in the item delivered. In the event that the item is not to specification, the Site Engineer will advise the Contractor accordingly. Assuming acceptance of the item, the Site Engineer is also encouraged to examine the method and quality of storage, in order that the Contract Clause 30(2) requirement for 'adequate protection against weather or other casualty' is provided. Without this, inclusion in Interim Certificate can be withheld. Where damage or deficiency exists, the Site Engineer will note this and either suggest or make appropriate reduction.

Plant certified as valued off-site by the Engineer could be included without cost of delivery and off-loading which would be added when appropriate.

Convenient service grouping of items within the separate listing can provide for monitoring delivery against programme and at the same time making 'valuation' a continuous activity, substantially reducing the 'end-of-month' workload to that of up-dating extended values and re-totalling each sheet. Invoice values may be inserted in the 'Estimate value column'. This will give the Engineer/Surveyor advance notice of increased costs. Alternatively it may be decided that such increases must be claimed separately (VOP Contracts) or allowed for in the Price Adjustment by Formula method.

Finally, the separate listing with values provides a monthly review facility which will highlight quickly any increased cost, which the contractor will (in the case of VOP contracts) claim separately and directly from the Engineer.

Unfixed Materials

The treatment of Unfixed Materials will follow somewhat conventional lines, lists being submitted by the sub-contractor together with estimated values. It might be convenient to arrange that such lists are forwarded upon standard forms *(Figure 7c)*. Where possible items should be listed in groups relative to the service for which they are intended. By doing so it makes it possible to assess the quantities on site against the quantities shown in schedules of rates or Bills of Quantities. This guards against the rare but not unknown event of temporary funding the supply of materials being stored on one site which are for incorporation into other works.

As with Major Plant, inspection of materials as soon as they are delivered to site provides for early confidence in specification compliance in bulk, thus minimising the need for repetitive checks during routine day-to-day inspection of installation works.

Similarly, inspection will establish whether or not the materials are adequately protected against weather or other casualty as before.

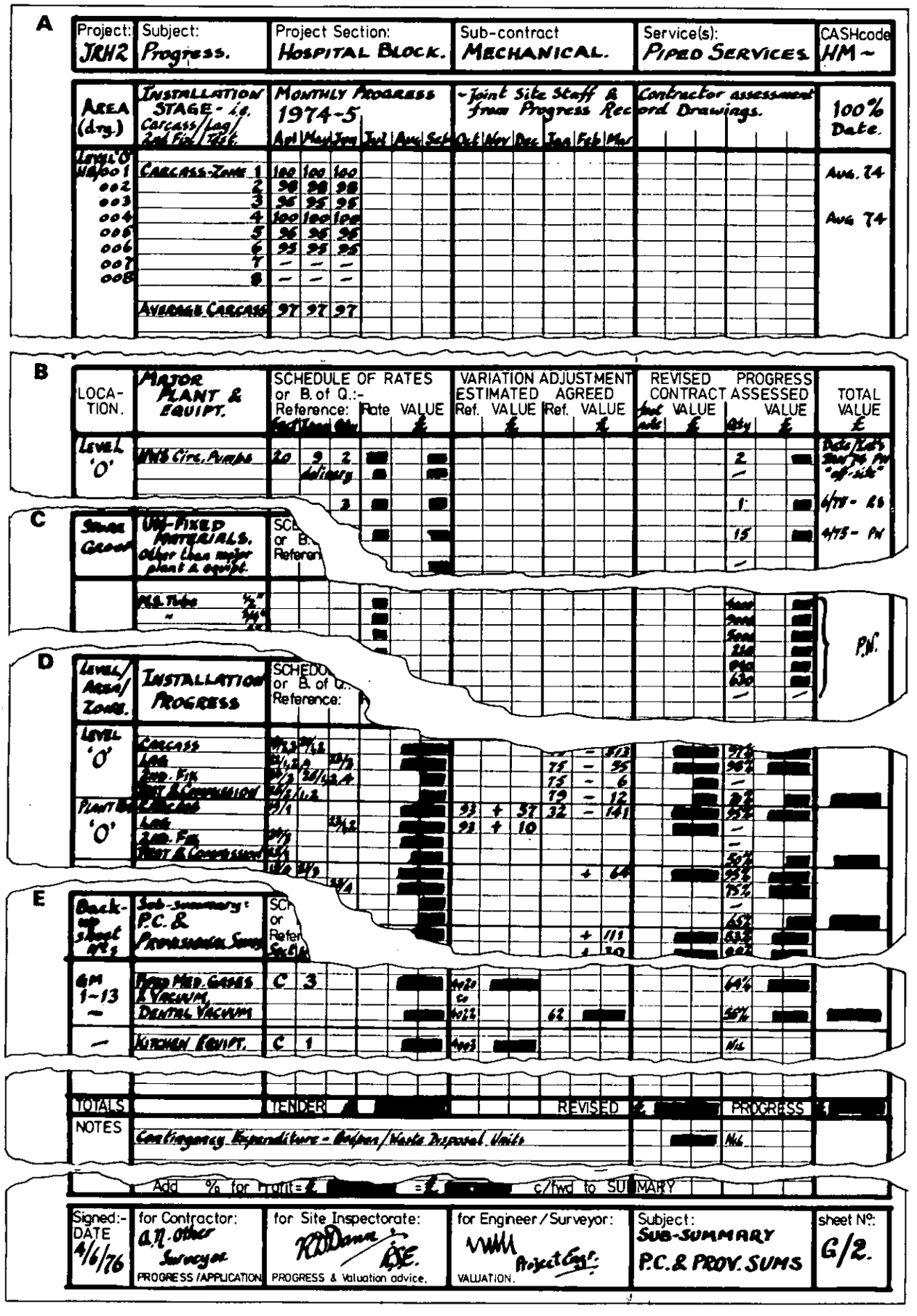
Whilst discussing valuation of unfixed materials I feel very strongly that insufficient attention is paid to the reduction of wastage which can be seen on almost all sites. There is a misconception that the contractor alone carries this risk in association with his insurance cover. This may appear true 'on the surface', but in fact the value of all losses is eventually paid for by the clients of the construction industry, in the form of rates which reflect these and other losses. Items of stores such as tube fittings, screws, parts of brackets and a whole range of small items are all too frequently found in piles of rubbish destined for the rubbish skip and removal from site. I believe that such losses are every bit as expensive as pilferage by the DIY fraternity, which receives greater attention.

Since it is ultimately the Client that pays for all wastage I believe that future contracts should be framed to encourage, or if necessary to enforce, the introduction of strict stores control by insisting upon full-time storemen, stock control, stock cards, copy advice notes and invoices. This would also make valuation of unfixed materials more precise than the ad-hoc checking of contractor's summary sheets that is normal at present. As with all unfixed material, stocks reduce with progress. Ultimately it becomes more appropriate to assess stocks and delivery against outstanding works.

Site Progress Valuation

The Major Plant and Unfixed Materials aspects have already been discussed, to these we will return later. What follows is the description of the end-of-month activity and the preparations made to ensure rapid

Figure 7. Valuation Report Sheets (opposite). (a) Progress record, completed by Site Engineer and Contractor. Can be used as non-financial progress report. (b) Major Plant and Equipment Sheet. (Maintained by site staff and Contractor). (c) Unfixed materials sheet (submitted by Contractor, checked by site staff or Engineer/Surveyor. (d) Installation Progress/Valuation Report Sheet. (Prepared by Contractor, checked by Resident Services Engineer). (e) Progress/Valuation Report — Sub-summary of Prime Cost and Provisional Sums. (Prepared by Contractor, checked by Resident Services Engineer).


A
Project: JRH2
Subject: Progress.
Project Section: Hospital Block.
Sub-contract MECHANICAL.
Service(s): Piped Services.
CASHcode HM ~
Area (drg.)
Installation Stage - i.e. Carcass/Lag/2nd Fix/Test.
Monthly Progress 1974-5
Apl May Jun Jul Aug Sept
~ Joint Site Staff & from Progress Record Drawings.
Oct Nov Dec Jan Feb Mar
Contractor assessment
100% Date.
Level 'O' Wards 001 Carcass-Zone 1 100 100 100 Aug. 74
002 2 98 98 98
003 3 95 95 95
004 4 100 100 100 Aug 74
005 5 96 96 96
006 6 95 95 95
007 7 — — —
008 8 — — —
Average Carcass 97 97 97
B
Location.
Major Plant & Equipt.
Schedule of Rates or B. of Q.:- Reference: Rate VALUE £
Variation Adjustment Estimated Ref. VALUE £ Agreed Ref. VALUE £
Revised Contract VALUE £
Progress Assessed Qty VALUE £
Total Value £
Level 'O' HWS Circ. Pumps 20 9 2 delivery 2
3 1
15
4/75 - PM
4/75 - AB
C
Stores Group
Unfixed Materials. Other than major plant & equipt.
M.S. Tubes ½" ¾" 1"
P.M.
D
Level/Area/Zone.
Installation Progress
Schedule or B. of Q. Reference:
Level 'O' Carcass
Lag
2nd. Fix
Test & Commission
Plant Room 'O' Carcass
Lag
2nd. Fix
Test & Commission
E
Back-up Sheet Nos
Sub-summary: P.C. & Provisional Sums
Schedule or Reference
Gas Med. Gases & Vacuum C 3 64%
Dental Vacuum 56%
— Kitchen Equipt. C 1 N/A
TOTALS
TENDER £
REVISED £
PROGRESS £
NOTES
Contingency Expenditure - Bedpan/Waste Disposal Units N/A
Add % for Profit = £ = £ c/fwd to SUMMARY
Signed:- DATE 4/6/76
for Contractor: A.N. Other Surveyor PROGRESS/APPLICATION
for Site Inspectorate: R.D. Dann R.S.E. PROGRESS & Valuation advice.
for Engineer/Surveyor: Project Engr. VALUATION.
Subject: SUB-SUMMARY P.C. & PROV. SUMS
sheet No: G/2.

evaluation and reporting.

Installation Progress Valuation

Following the Pyramid breakdown principle established earlier, the costs for each natural or programme component of the Project had been determined. These values were entered upon each of the report sheets against the installation-stage description for each area of each floor and building, with one sheet for each engineering service or group of services depending upon drawing content. The example in *Figure 7d* relates to all Piped Services within the Hospital Block.

Examination of the illustration will show that all Schedule of Rate (Tender) Values can be authenticated by reference to their origin. These have been 'Totalled', and when added to all other sheet values, proved the same as Total Tender.

Variation Adjustments in the example appear mainly in the Agreed column, those in the Estimated columns referring only to very recent instructions.

These adjustment amounts would continuously be up-dated between valuations, using pencil for all entries. Immediately prior to valuation day, a new complete set of report forms will have been produced (at Oxford by the Contractor, by photocopying), the current Revised contract value then being calculated and entered.

From the Progress Record Sheet (or Non-Financial Progress Report) all 'Agreed Assessment' percentages are then entered in the appropriate columns and used as multipliers to achieve a 'line' Progress value, which is extended to Area totals, then totalled for the Service and Building. Whether or not 1/39th is added at this stage depends upon several factors. At Oxford it was done at this stage.

The completed form for each Building and individual Service gives a wealth of information in easily understood form, about progress throughout the whole building, just as is available from the non-financial report. However, the additional expression in cost terms allows much deeper interpretation, particularly to the contractor, who requires to get maximum reward (cash-flow) for his labour input within any restraints of the Programme. Conversely, delays caused by other trades, although evident on the marked-up programme, are here emphasised in terms of reduced Cash-flow, and he can again take appropriate action.

Sub-Summary
Prime Cost and Provisional Sums

Depending upon the quantity of each, these may require (and benefit from) separate presentation.

The headings used on the blank form are as before and require no further explanation *(Figure 7e)*.

Comparison of the types of work involved will show why some installation work requires back-up Installation Progress sheets similar to that examined above. Because of the specialist nature of the work in these 'provisions', coverage of the whole building will rarely be required. However, average service density (cost-spread) over areas may need detailed examination and the introduction of 'agreed correction factors'. Alternatively, the breakdown of stage costs can be related to Zones or even part-zones, and progress percentages applied direct. Each must be treated according to circumstances in a manner which follows established criteria, preferably with the agreement of the sub-contractor, and the co-operation of the Specialist sub-sub-contractor, for in the absence of schedules of rates, he alone will be able to provide installation stage costs in the form necessary.

For each PC or Provisional Sum, the progress value obtained either by back-up sheets or by direct 'line-item' assessment represents the amount due to the sub-sub-contractor concerned (before any retention deduction direct and indirect). Thus for these sheets, the sub-contractor's profit percentage will be added at total stage before being carried to summary. 1/39th will also be added at this stage if appropriate.

The benefit of specialist sub-sub-contractor involvement and co-operation in preparing for the application of the procedures is two-way. The specialist will co-operate to ensure his cash-flow, the single progress assessment produces both sub-contract valuation and specialist entitlement, without duplication of effort.

Sub-Contract Valuation Summary

Complying entirely with the Pyramid breakdown of the project, this summary is intended to convey, with speed and clarity, both financial and progress information to senior staff who have neither time nor the need for detailed back-up information *(Figure 8)*.

The presentation format, chosen with care, permits a considerable degree of component information, which will be communicated clearly to experienced senior personnel. The introduction of 'equivalent percentage progress' (derived from values) results from witnessing senior executives performing mental gymnastics to achieve the increased understanding they derive from such expressions. However, these must not be allowed to confuse those figures related to true installation progress as previously established.

For each Building (Project Section) information is presented in two groups:

Installation Progress for each engineering service (or drawing) together with real progress figures.
This is extended to provide both 'real' value and progress percentage.

Major Plant: Value of plant delivered (or valued off-site) with an equivalent 'progress' percentage expression. This is grouped by service to co-relate with installation statements above.
This is extended as for Installation.

The Section Total — together with a further derived 'equivalent progress' permits appreciation of what could have been a contractural entity, and will be of significance where 'Phased sectional hand-over' is required.

The collection of other brought-forward items and values requires no explanation, nor does the entry for Prelims, beyond stating that the value is assessed and entered direct at this summary stage.

At the foot of the summary sheet can be found entries giving details of submissions made direct to the Consulting Engineer/Surveyor during the JRH Project, in which the site staff had no direct dealing. Increased Labour and Material Claims, and others, were for convenience summarised here (by the Contractor) in order that the summary would duplicate (if not form) his Application for Interim Payment in respect of Gross and Nett value for the month.

Note. At this stage it is important to note once again that the Site Valuation(s) derived from application of these procedures by Site Staff had no contractual legality until authenticated by the Engineer, then by the Architect. (In this way it might be said that they rank

Project:	Subject:	Project Section:	Sub-contract:	Service(s):	costcode:
JRH2	SUMMARY	WHOLE PROJECT	MECHANICAL	ALL SERVICES	GM-

Back-up sheet Nº	PROJECT SECTION	PROGRESS SUBJECT DESCRIPTION	DRAWING SERIES	REVISED CONTRACT VALUE	PROGRESS VALUES Subject %	Instal'n. or M/plant. Equiv %	PROJECT SECTION VALUE.
-	Tender section A 'Prelims'	Installation/Record drgs /manuals Warranty			——	-	
G/2	P.C. & Prov. Sums				——	34%	
G/3	Unfixed Materials	other than major plant.			——	-	
H/1	HOSPITAL BLK.:-	Piped services	HB		70%		
2	Installation	H.p.h.w. & l.p.h.w heating	HC		73%		
3	Progress	Drainage	HD		95%		
4		A/C. & Vent.	H/9600		85%		
5		Fume-extract.	H/Granville		73%		
6		Fume cupboards	ZK 905		—— 0		
7		Hot & Cold rooms	ZK 904		58%	80%	
H/MP/1,2	Major Plant.	Piped services			91%		
3		H.p.h.w. & l.p.h.w. htg.			82%		
4-13		A/C. & Vent.			97%		(81%)
14		Control Panels Nº 1-14.	Inc. Instal'n.		64%	86%	
A/1	ACADEMIC BLKS.	Piped services	AB		65%		
2	Installation	H.p.h.w. & l.p.h.w. htg.	AC		53%		
3	Progress	Drainage	AD		90%		
4		A/C. & Vent.	A/9600		73%		
5		Fume-extract.	A/Granville		28%		
6		Fume cupboards	ZK 905		—— 0		
7		Hot & Cold rooms	ZK 904		35%	66%	
A/MP/1	Major Plant.	Piped services			72%		
1		H.p.h.w. & l.p.h.w. htg.			100%		
2-5		A/C. & Vent.			99%		(71%)
6		Control Panels Nº 15-18			99%	96%	
I/1	INDUSTRIAL BLK.	Boiler house - COMPLETE			37%		
2	Installation	ALL OTHER SERVICES /	OTHER AREAS		72%		
3	Progress	H & C rooms / Fume cupboards			41%	62%	
I/MP/1	Major Plant	Piped services			100%		
2		H.p.h.w. & l.p.h.w. htg.			92%		
3		A/C. & Vent.			93%		(78%)
4		Control Panels Nº 19-21			97%	93%	
X/1.	EXTERNAL WORKS	Installation progress all services			——	93%	(84%)
X/MP/1		Major Plant			——	74%	
							(80%)
	COLUMN TOTALS:-				——		
	Claims submitted direct:-						
	FLUCTUATIONS: Labour						
	Less S.E.T.						
	Materials:-						
	Plus 1/39th.:-						
	Claim summary:- FGA Dayworks - yet to be agreed						
	HHS ditto ditto						
	Drg. cost/delay & disruption/rev. M/holes						
	VALUATION (Preliminary) TOTAL						
	Less previous application				-		
	VALUE THIS MONTH				——		£

Signed:	for Contractor:	for Site Inspectorate:	for Engineer/Surveyor:	Subject:-	Sheet Nº:-
DATE:- 4/JUNE 1976	PROGRESS/APPLICATION	PROGRESS & Valuation advice.	VALUATION.		

Figure 8. Progress/Valuation Report — sub-contract Summary. (Prepared by Contractor, checked by Resident Services Engineer).

with Site Instructions). Each Sub-contractor, and the Main Contractor was informed of this from the very beginning, and reminded every month verbally and by the qualification appearing in signature boxes upon each form. Thus the professional responsibility remained throughout with those vested with that authority, and veiled suggestions that this was 'usurped' have no foundation in fact. In practice, as a measure of efficiency achieved, and/or confidence demonstrated, the valuation was altered only twice in respect of any item other than directly submitted claim values.

Conclusions

From the support procedures which contribute to the production of the reporting facilities the following advantages were of great value:

Cashcodes

These provide:

control 'information' to the Engineer;
analysis facilities compatible with original Tender, and Capricode breakdowns.

This in turn facilitates —

Continuous up-dating of Cost Limits by DHSS, particularly if computer programmed in the future.
Encourages clear instructions issued by site staff, and indirectly fosters clear identification of each element of contractor's variation estimates.

File Codes

The benefits derived from this system of alphabetical indexing using both Cashcodes and additional file codes was an unqualified success, as already stated.

Disadvantages

These are mostly subjective, and are created by the lack of clear contractual provisions to substantiate each detailed step of the procedures introduced. Most of these were achieved by liberal interpretation of those few provisions that did exist (within either the Main Contract or the Engineering Specification) accompanied by maximum encouragement, persuasion and a small measure of (shall we say) 'charm'.

The considerable quantity of work required to reallocate costs to each work stage could in future be avoided, if the format demanded for schedules of rates from lump-sum tenderers was broken down into those stages. This could be done without too much difficulty, if the objectives were clearly stated to tenderers at the outset. After all, their estimators need to work through each stage to produce their composite rates. Where, on the other hand, Engineering Bills of Quantities are produced as part of the Tender documents, these could already be in the appropriate form.

Combined Progress/Valuation Reports

In addition to all the advantages listed for the simple Progress report, the combination procedures:

Encourage 'On-delivery' inspection of Plant and Materials creating greater confidence in quality control;
Produce improved attention to the requirement of adequate protection of materials and right of inclusion in valuation;

Give early identification of missing components, or incorrect or damaged major plant, thus minimising the possibility of future delays from these causes.

Reduce the need for continuous re-checking of materials against specification during routine inspection of the works;

Can also 'highlight' 'premature deliveries' (in comparison with programme) allowing the Engineer to decide if inclusion in valuation is warranted.

Dependence of valuation upon marked-up Progress Drawings fosters greater attention to continuous up-date of detail for production of accurate Record Drawings, which in turn —

Facilitates early production of basic record drawings, hence —

Allows checking of Record drawings to be carried out at proper time, and

Enables the full issue of All Record drawings to be achieved at time of Final Completion and Hand-over, with full issue of advance prints provided to User well before hand-over.

The overall content of the combined report provides improved 'support' to the professional design Engineer and his design team colleagues.
The Site Engineer of appropriate ability gains increased 'Job satisfaction' from financial involvement, which in turn —
Fosters greater cost control of site-initiated instructions.

Finally:

Full valuations in respect of works installation and material content, totalling well over £2m each, can be achieved on-site in no more than a few man-hours, compared with several days by more traditional and possibly less accurate methods.

In addition to sharing the advantages listed above, Contractors can detect, from close examinations of the resulting cashflow, any shortcomings in their estimating procedures and rates. One particular sphere that appeared to warrant examination was the allowances in the tender for the labour intensive activities relative to final completion and commissioning of Engineering services. This was appreciated from the final months of net valuations compared with the obvious high wages bills that had to be paid over the same period.

There are probably other areas of concern and benefit already known to each of the contractors who participated in these procedures.

In conclusion, I emphasise that it is realised that the content of the paper is not likely to be adopted, in full, by any individual or organisation. For that reason I have at each stage underlined the in-built flexibility which provides maximum freedom to tailor the methods to suit individual preferences and project content.

However, I hope the reader will recognise the value of the principles discussed, and will be encouraged to adopt any small part, if not the whole of the integrated procedures that have been illustrated. From them he may gain at least in part, the advantages that were found most welcome during the extended trial on the John Radcliffe project.

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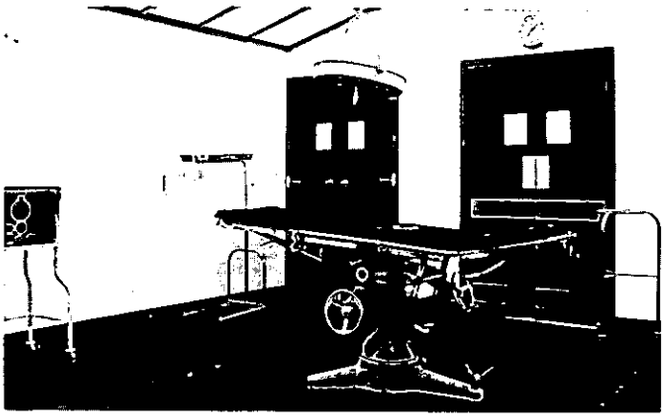

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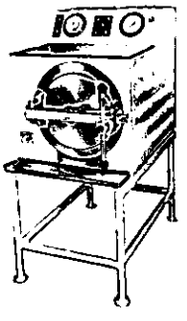
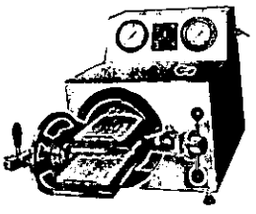


32 P.S.I.
Cat. No. 1374
Chamber 12 in. dia. x 20 in. long
14 min. Auto Cycle.



Cat. No. 1370.
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Cat. No. 1372.
8 in. dia. x 18 in. long.
32 P.S.I. Bench Mounted.
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Salary Scale £4,980–£5,499 pa

Applications are invited from Chartered Engineers and Corporate members of one of the Institutions of Mechanical, Electrical or Electronic and Radio Engineers or Corporate members of CIBS for Principal and Main Grade posts, and from technicians having a minimum of ONC for Grades I and II, with a minimum of HNC for the Technical Officer post.

Application forms and further details are obtainable for Post Ref. No. U234 from: Appointments Section, Common Services Agency, Trinity Park House, South Trinity Road, Edinburgh EH5 3SE. For all other posts: Personnel Department, Building Division, Clifton House, Clifton Place, Glasgow. Please quote appropriate ref. numbers. Closing date for receipt of completed applications is February 22, 1980.

St Mary's Hospital Portsmouth

SENIOR ENGINEER

for this general hospital of 900 beds. The appointed officer will be responsible for all mechanical and electrical services within the hospital and some community health buildings. Applicants are required to hold H.N.C. in either Mechanical Engineering or Electrical and/or Electronic Engineering or an acceptable equivalent, together with a certificate in Industrial Administration, and to have completed an apprenticeship or five years' relevant experience.

Salary: £5,628-£6,519 per annum plus allowance for operating a bonus scheme. (Further pay award under negotiation).

For application form and job description ring 24 hour ansaphone on Portsmouth (0705) 22090.

ESSEX AREA HEALTH AUTHORITY

COLCHESTER DISTRICT
SENIOR ENGINEER

Following the promotion of the present holder, a Senior Engineer is required to be responsible to the District Engineer for the operation and maintenance of Essex County Hospital, St Mary's Hospital and Colchester Maternity Hospital, together with their associated properties.

Applicants should hold an HNC in Mechanical, Electrical or Electrical and Electronic Engineering or have obtained a C & G full technological certificate. A recognised qualification in Industrial Management will also be required.

Salary scale £5,628 rising by five increments to £6,519 *plus bonus payments as appropriate.*

Further details may be obtained from Mr D. Sherratt, District Engineer, on Colchester 69244.

Application forms and job description are available from: District Personnel Officer, Health Offices, Turner Road, Colchester, Essex. Telephone Colchester 47171 Ext 57.

Coombe Lying-in Hospital

Dublin 8

MAINTENANCE SUPERINTENDENT

Applications from suitably qualified personnel are invited for the above post.

Candidates must:

A. Be holders of the National Diploma (NCEA) specialising in any of the following fields: Civil Engineering, Electrical Engineering, Mechanical Engineering or a qualification at least equivalent thereto.

B. Have a number of years' work experience related to the required qualifications as at (A) of which a suitably lengthy period must have been completed in a supervisory capacity with responsibility for the control of staff.

Salary scale: £5,374 – £5,604 – £5,811 – £6,017 – £6,225 – £6,433 – £6,639 – £6,718 (will attract second phase 1979 Pay Agreement from March 1, 1980).

Application forms, available from the Personnel Officer, must be returned to the undersigned not later than 9.30 am on Friday, February 15, 1980.

Maureen Smithwick,
Secretary/Manager

Aylesbury & Milton Keynes Health District

Senior Engineer

Salary: £5,628–£6,519 (increase pending) plus Allowance of up to 15% bonus.

Responsible for all aspects of Engineering in our Aylesbury Division (based at St John's Hospital, Stone).

Applicants, male or female, should be experienced in Engineering and estate maintenance, including management of labour, energy conservation and the implementation of minor works schemes.

Qualifications: HNC Engineering or equivalent with Certificate in Industrial Administration/Management, together with at least five years' industrial or maintenance experience.

Application form and further details for either post obtainable from District Works Office, 9 Bicester Road, Aylesbury, Bucks. Tel: Aylesbury 84111, ext 5081.

Buckinghamshire Area Health Authority

Brent & Harrow Area Health Authority
Harrow District

NORTHWICK PARK HOSPITAL & CLINICAL RESEARCH CENTRE
Watford Road Harrow Middlesex HA1 3UJ. Tel: 01-864 5311.

SENIOR ENGINEER

£5,628–£6,519 + £398 London Weighting Allowance and 5% bonus per annum.

To be responsible for the maintenance of all electrical and mechanical plant and equipment with the Community Establishment, these include two small geriatric units, a Health Centre, community clinics and the residential blocks throughout the District including those at Northwick Park Hospital.

Applicants should possess HNC in Mechanical Engineering or City & Guilds Full Technical Certificate (Plant Engineering) which includes Industrial Administration and have served an appropriate apprenticeship.

ENGINEER

Applicants are invited for this interesting and stimulation post which would ideally suit those wishing to further their experience in a wide variety of duties primarily concerned with the maintenance of electrical and mechanical equipment installed in various establishments, including a large modern District General Hospital and Clinical Research Centre. The design of small works and the preparation of specifications and drawings associated with equipment will also form part of the duties.

Applicants should possess ONC in Engineering or higher qualifications and have completed an appropriate apprenticeship and/or have 5 years' relevant experience.

Single accommodation may be available.

The District Works Officer (ext 2949) will be pleased to discuss the post and duties with prospective applicants.

Job Description & Application form available from Personnel Department (ext 200).

WEST BIRMINGHAM HEALTH DISTRICT
DUDLEY ROAD HOSPITAL – DISTRICT WORKS DEPARTMENT

Senior Engineer — Power & Works Services

Due to the promotion of the present holder, a vacancy now exists for a Senior Engineer to join a team of Engineers responsible for the maintenance of plant and services of a busy District General Hospital.

The main areas of responsibility will be the District Laundry (180,000 pieces p/w). Centre Site Boiler House (50,000 lb/h) and Main Site Services (Mechanical and Electrical) and Energy Conservation.

Salary Scale: £5,628–£6,519. New entrants to the Service commence at bottom of scale.

Job description and application form from: District Works Officer, Dudley Road Hospital, PO Box 293, Dudley Road, Birmingham B18 7QH. For further information telephone: Mr D. Hall, District Engineer, 021-554 3801 ext 4838. Please quote Ref: 917/HE.

Dartford and Gravesham Health District

(Kent Area Health Authority)

Engineers

Following the introduction of the new Works Officers' structure Project Works and Maintenance have been separated. Vacancies now exist for Engineers, male or female, in both sections. However, applicants must have a broad engineering background (Mechanical and Electrical) together with Managerial experience of work planning and organization as they will be expected to be able to work in either section.

Applicants must possess ONC in Engineering or acceptable equivalent, completed an apprenticeship and relevant experience will be an advantage.

Salary £5,178 to £5,784 pa (Pay Award pending).

For Job Description and Application form: District Personnel Officer, District Headquarters, Darenth Park Hospital, Dartford, Kent.

Closing date for application February 18, 1980.

DEVON Area Health Authority

Exeter Health Care District

DISTRICT ENGINEER

(Salary Scale £7,818–£9,306)

Due to the retirement of the present holder, applications are invited for the above post.

The District comprises a wide range of Health Service properties including District General and Community Hospitals, large Mental Illness and Mental Handicap Hospitals, totalling approximately 4,000 beds.

Application forms and job description are available to suitably qualified and experienced engineers on application to the District Personnel Officer, Dean Clarke House, Southernhay East, Exeter. Telephone Exeter 52211 ext 219.

Closing date for receipt of completed applications Friday February 22, 1980.

SENIOR ENGINEER (Area)

Salary Scale: £5,628 pa rising by annual increments to £6,519 pa (further increase pending)

Applications are invited for this newly created 4th-in-line post within the Area Works Department. The person appointed will be required to assist the Area Engineer throughout the whole range of duties, covering all engineering aspects in the general field of maintenance, operation of plant, energy management and capital works.

Interested applicants should possess a good knowledge of engineering work in relation to Health Service buildings together with a demonstrated managerial ability and be able to work effectively with colleagues in and outside their own discipline.

The minimum technical qualifications required are HNC Mechanical, Electrical or Electronic Engineering. If candidate is in the Health Service, should be qualified in accordance with PTB paragraph 2531.

Mr W. A. Mosedale, MCIBS, Area Engineer will be pleased to receive informal enquiries and can be contacted on Leicester (0533) 549394 ext 318.

Application form with job description available from the Area Personnel Officer, Leicestershire Area Health Authority (Teaching), 24-28 Princess Road West, Leicester LE1 6TY, telephone: 0533 549394 ext 342.

Closing date for receipt of completed applications is: February 25, 1980.

Leicestershire Health Service

LEICESTERSHIRE AREA HEALTH AUTHORITY (TEACHING)

SOUTH WEST DISTRICT

PLANNER MANAGER

Applications are invited from suitably qualified Engineers for a post of Planner Manager in connection with the implementation of the incentive bonus scheme for Works Staff. Salary £5,178-£5,784 plus bonus payment (current maximum 15%). The duties will include the management of a team of Planner/Estimators and will provide a sound basis for further career progress within the works management structure.

The minimum qualification is an ONC in engineering. Specialist training will be given.

If you would like further details or to discuss the post please contact the District Works Officer, tel. (0533) 541414 ext 5467.

Application form and job description is available from The District Personnel Department, The Leicester Royal Infirmary, Infirmary Square, Leicester. Tel. Leicester 544342.

Closing date for receipt of completed application forms February 18, 1980.

Leicestershire Health Service

LEICESTERSHIRE AREA HEALTH AUTHORITY (TEACHING)

SENIOR ENGINEER

(TWO POSTS)

Applications are invited from suitably qualified and experienced engineers having:

(a) served an engineering apprenticeship
(b) held a position of a plant engineer and responsible for the supervision and control of engineering trades staff preferably in hospitals
(c) HNC or HND (Mech/Electrical) with endorsements, proven management skills, or equivalent qualifications.

POST A:
To be responsible to the District Engineer for the operation and maintenance of all mechanical and electrical plant and services of a small group of properties commensurate with those generally found in a Health District. The base shall be at Accrington Victoria Hospital and the post offers the opportunity to develop both experience and confidence in all aspects of District Engineering responsibilities.

POST B:
To be responsible to the District Engineer for specialist duties connected with plant engineering throughout the District. Duties shall include maintenance contracts, medical plant and equipment, energy conservation and regressional analysis. The post is a progressive development and experience of electronics is an advantage and is based at Queen's Park Hospital.

Salary: £5,628-£6,519 (plus bonus 15% and on call Pay).

Application forms and job descriptions available from: The District Personnel Department, Queen's Park Hospital, Blackburn. Tel: Blackburn 661311 Ext 281/223.

Closing date: February 25, 1980.

BLACKBURN HEALTH DISTRICT
Lancashire Area Health Authority

GWYNEDD HEALTH AUTHORITY

SENIOR ENGINEER

Salary £5,628 to £6,519 pa

required for the new District General Hospital, Bangor (Ysbyty Gwynedd) to control the maintenance and operation of the Engineering Services within a large hospital complex. the successful candidate will be in control of a staff of Engineers and Tradesmen for which he will share responsibility with others for their section. Duties will include both operations and maintenance work.

Applicants should have a broad engineering background (both mechanical and electrical) and possess the following qualifications: HNC in Mechanical or Electrical Engineering or C & G 293, 255 Part 3 or Full Technological Certificate No 57 or 281 and an appropriate management qualification. Previous training must include an apprenticeship.

Applications from persons without hospital experience will be considered, but evident managerial ability or experience is essential.

Application form and job description available from: Area Personnel Officer, Area Offices, Coed Mawr, Bangor, Gwynedd. Tel: Bangor 51551.

Further information may be obtained from: Area Works Officer, Tel: Caernarfon 4667/8.

Closing date: February 25, 1980.

ENGINEERING OPPORTUNITIES IN THE UNITED ARAB EMIRATES

Allied Medical Group have vacancies for the following Engineering Staff at Al Corniche Hospital in Abu Dhabi.

AC2 **WORKS OFFICER — Salary 8,353 Dirhams per month**
available from June 1980

AC3 **HOSPITAL ENGINEER — Salary 5,495 Dirhams per month**
available from August 1980

(8.4 Dirhams = £1)

Al Corniche is a busy 120-bed Obstetrics and Gynaecology Hospital pleasantly situated on the Coast. Contracts are for one or two years (renewable) and include the following benefits:

Tax-free salary plus one month's salary as bonus at the end of each completed year of service.
Return flight at the beginning and end of Contract (plus flight home mid-term for 2-year Contracts)
Free modern accommodation plus medical care and subsidised dining room.
Sports and social facilities.

If you are interested in this post, please telephone or write, quoting Ref. Nos., to:

The Personnel Department
Allied Medical Group Ltd
18 Grosvenor Gardens
London SW1W 0DZ

Telephone 01-730 4511 EXT 293

Allied Medical Group

SOUTH WEST DISTRICT

ENGINEER

Leicester Royal Infirmary

Applications are invited for the above post. The successful candidate will be responsible for the supervision of the day to day operation and maintenance of the hospital's engineering services. The Leicester Royal Infirmary is the major teaching hospital in Leicestershire with approximately 1000 beds. Candidates should have previous experience of the supervision of maintenance staff and a good knowledge of works services in either a hospital or factory environment. They will have an ONC in Engineering or equivalent and have served an engineering apprenticeship.

Salary scale: £5,178–£5,784 (37 hour week).

New entrants to the National Health Service start at the minimum of the scale.

Job descriptions and application forms are available from the District Personnel Department, the Leicester Royal Infirmary, Infirmary Square, Leicester. Telephone Leicester 544342.

Closing date for receipt of completed applications February 18, 1980.

Leicestershire Health Service

LEICESTERSHIRE AREA HEALTH AUTHORITY(TEACHING)

IRELAND

Engineering Foreman (2 posts)

Required for Galway Regional Hospital and Merlin Park Regional Hospital, Galway, Eire to control the maintenance and operation of the Engineering Services within a large hospital complex.

Salary: £5,374–£6,718 per annum.

Duties will include both operations and maintenance work and applicants should have a high standard of training and experience in the installation and maintenance of engineering plant and equipment in large institutions or alternative appropriate experience.

Application forms and further particulars may be obtained from the Personnel Officer, Merlin Park Regional Hospital, Galway.

The latest date of receipt of completed application forms is 5 pm on February 27, 1980.

CENTRAL PUBLIC HEALTH LABORATORY
SENIOR ENGINEER

for the operation and maintenance of the engineering services and related building maintenance. Applicants must be experienced Maintenance Engineers and have a practical knowledge of boilers, mechanical and associated electrical equipment, with a knowledge of plumbing installations an advantage. HNC or City & Guilds in Engineering or equivalent qualifications.

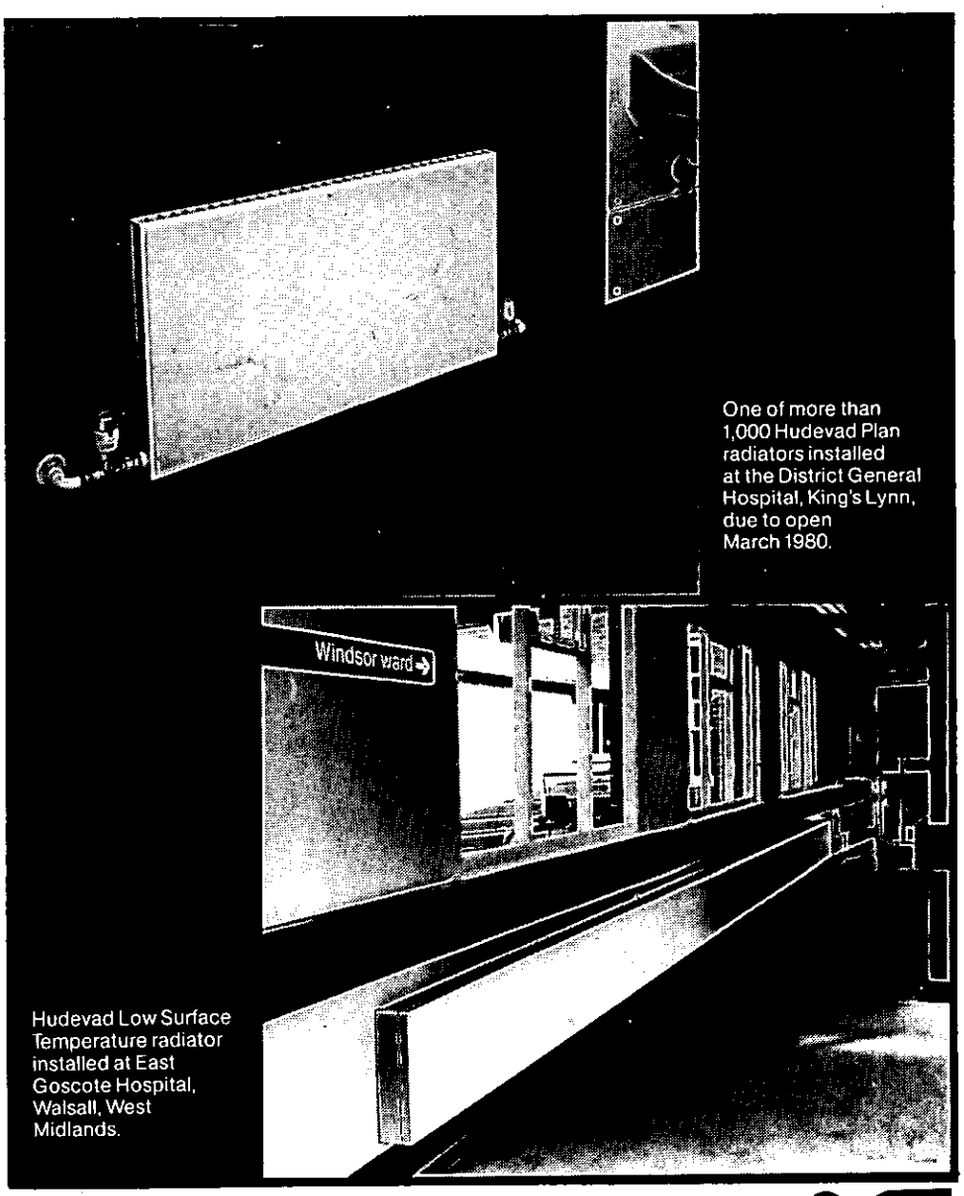
Whitley Council salary scale for Senior Hospital Engineers at present £8,026 rising by five annual increments to £8,917 inclusive of London Weighting.

For application form together with a more detailed job description please apply to Personnel Officer, Central Public Health Laboratory, Colindale Avenue, Colindale, London NW9 5HT. Telephone No. 01-205 7041. Open to male and female applicants.

RADIATORS

by Hudevad, of course

The Plan and Profil, the P5 and now... the Low Surface Temperature Radiator, especially suitable for psychiatric and geriatric wards. Over the past four years, Hudevad radiators have been installed in 194 hospitals and health centres in 47 counties.



One of more than 1,000 Hudevad Plan radiators installed at the District General Hospital, King's Lynn, due to open March 1980.

Hudevad Low Surface Temperature radiator installed at East Goscote Hospital, Walsall, West Midlands.

Hudevad Radiators

Normal delivery 5-8 weeks, whatever the specification or accessories.

Made-to-measure in virtually any shape or size, curved or angled if required.

Safe, robust, efficient, easy to clean.

Ask for details

HUDEVAD BRITAIN

Hudevad House, 262 Hook Road, Chessington, Surrey, KT9 1PF. Tel: 01-391 1327. Telex: 896749.

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