Hospital Building in the NHS

Ideas and designs II: harness and nucleus

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While East Anglia was busily producing best buy hospitals, on the other side of the country the Oxford region was pursuing its own form of standardisation. The DHSS has consistently tried to standardise elements like operational policies, briefing data, and room data, leaving the actual design to the architects. Oxford has taken the opposite approach. The Oxford method is systems building. It comprises a set of building parts and components that fit together with engineering elements into a standard grid. The system is now computerised so that draft plans and layouts can be easily produced and as easily rejected or developed. The Oxford planners argue that this allows them to spend more time at the early planning stage exploring different layouts rather than spend most of their time on routine production drawings.

Oxford has not managed to persuade any other English region to adopt its system, though the Department of the Environment has used it to build hospitals for the army and hospital authorities abroad have used it. The major drawback is the small scale of the enterprise. Systems building is expensive and works well when time is short and economies of scale can be exploited. For example, the CLASP system was used successfully to build many British schools in the wake of the 1944 Education Act. Time, as opposed to money, is rarely short in the NHS building programme, and there are not enough hospitals needing building in England, let alone one region, to take advantage of cheap production runs of components.

Beyond the standards

Despite all the activity on standardisation most hospitals built in England during the 1960s and '70s were to one off designs, although many incorporated individual departments built to regions' own standards. Many of these hospitals followed the general fashion for ward tower blocks and podiums—the match-box on the muffin—and relied heavily on mechanical ventilation. This was especially true of teaching hospitals, which tended to be larger than the average district general hospital. Many of these hospitals too were designed not by regional architects or the DHSS team but by private firms. One particular firm, Llewelyn-Davies Weeks, has been responsible for many hospitals both in Britain and abroad. Both its partners were members of the Nuffield team that did the first studies into the function of hospitals in the 1950s.¹ John Weeks is a leading exponent of flexibility in hospital design—as exemplified by the traditional form of a hospital where a linear street provides access to wards and departments opening off it. He likens designing a hospital to town planning²: providing a street with entrances to individual departments which have space to create their own identity and to expand without affecting their relationships with other departments. Change is made easier by using an extendable structural system and a modular engineering

Top: The new hospital at Milton Keynes, built by the Oxford method. Middle and bottom: Northwick Park Hospital, Harrow (Llewelyn-Davies Weeks).

services system. The most notable example of this theory in practice is probably Northwick Park Hospital. Here Weeks has taken his principle of flexibility—he calls it indeterminacy—to its logical conclusion and has given the end façades of departments temporary walls and removable fire escapes. The hospital can thus grow by extending the street and adding more departments or by each department growing outwards. And the shape of each department is determined by its own function—be it a seven storey block or a much lower rise psychiatric department. The price to be

paid for this degree of flexibility, as the users of Northwick Park will tell you, is sometimes long distances between clusters of departments.

Harness

In a very different way the Department of Health and Social Security also returned to the hospital street. After best buy it was obvious that the needs of hospitals were more varied than best buy allowed for and that standard plans therefore had to be more flexible. In 1972 there were thought to be about 70 or so DGHs of 400-700 beds that still needed building, and there was a more generous spirit abroad. Since most regions had been working on their own standard departments, the DHSS decided to coordinate that effort and get the regions working to the same set of operational policies and to a common set of dimensions. The individual departments could be put together to form whole hospitals within the framework of a "harness" of communications and engineering services—just like Lego. The standard departments were to come in a range of sizes so that an authority would select the functional content it wanted, and the whole system was to be computerised to provide a total precontract package: operational policies, schedules of accommodation, room data sheets, detailed plans, integrated engineering drawings, and bills of quantities.

The project was extremely ambitious and bore the seeds of its own destruction in the assumption that more money could be spent. Most observers now consider that harness was over the top in conception and cost. It used a grid of 15 m² with clear spans of 15 m to allow large unencumbered spaces that would accommodate a wide variety of uses, but there were structural problems with spans this long, and runs of engineering services became very long and costly. Few harness hospitals were built: a geriatrics unit at Southlands Hospital and district general hospitals at Stafford and Dudley.

Several people breathed a quiet sigh of relief when the whole project was ditched after the oil crisis in 1974. But without harness the hospital building programme might have suffered more than it did, for harness was raided unashamedly to produce nucleus.

The poor man's harness

Nucleus took the hospital street, the 15 m² grid (though spans are shorter), and the cruciform shape from harness. From best buy it took the economical use of space, the central treatment department, and the emphasis on natural light and ventilation, with courtyards breaking up the space.

Because nucleus is intended to be a first phase, providing the nucleus of a service which can be supported and supplemented from elsewhere and added to later, a limited range of departments is offered. The shape of the building—the cruciform templates on either side of the street—has been determined by seven principles: the need for (a) growth, (b) good functional relationships, (c) safety from fire, (d) economy, (e) flexible choice of content, (f) a compatible engineering philosophy, and (g) an aesthetic scale.

The emphasis on growth and change is sometimes more apparent in the rhetoric than in practice: expansion is meant to be possible by simply adding on more cruciforms—for example, in wards—or by planned misuse of space, allowing the intensive care unit to take over coronary care beds and resiting coronary care beds elsewhere. This is one reason why the DHSS emphasises the importance of thinking about future phases at the outset. Just how important was discovered at Newham, where the planners of one of the earliest nucleus hospitals decided to go straight on and design a second phase; to do this they had completely to redesign the service block and think hard about how to convert a four theatre operating department into a workable eight theatre department.

The medical profession has tended to criticise nucleus because of its limited content—because, for example, it embodies the idea

that pathology services should be split between sites, or because there is no anaesthetic department and poor facilities for junior staff. It has also criticised the element of blackmail—the "nucleus or nothing" attitude. The DHSS originally offered nucleus as a package to regions, and it was an offer that many regions were pleased to take up because it was quick to plan and its costs were known. Recently, however, ministers have "encouraged" its use by asking regions to consider nucleus first when deciding to build a new hospital and to justify rejection if they decide not to use it. Although the greatest benefits in time saved and accurate costing come from using nucleus as it is, most nucleus schemes so far have in fact included some local modifications, often a non-standard pathology department. Indeed, the latest users' guide to nucleus

emphasises the need for users to be aware of nucleus assumptions before adopting it: to make sure that nucleus policies match existing ones and that there is the necessary degree of support from other services.³

Few people have criticised the aim of nucleus—to provide a widely applicable standard—and few have criticised its operational and briefing data, but the actual design solution—the cruciform template—has been widely criticised.

Tyranny of the template

Cramming everything into a single shape has the advantage of providing flexibility in the overall layout of the hospital, but in places the squeezing shows. The wards particularly have been criticised for being niggardly. Here the cruciform shape has forced an elongated shape on to the two wards that share a template. Elsewhere the grouping of departments within a template—although the groupings are generally sensible—does pre-empt some decisions about the overall relations among departments.

The common criticism of nucleus is that the facilities and space for patients are ample but those for staff are not. There are complaints of too little storage space, too few offices, not enough changing room in the theatres. Some of the earliest nucleus hospitals are being evaluated by the Medical Architecture Research Unit, but there are already a few specific criticisms that probably should be acted on—for example, the absence of proper preparation rooms for the theatres. The DHSS has said that it will modify nucleus in the light of users' comments and evaluations, and it is already making some modifications. The longer term success of nucleus will depend on the willingness of the DHSS to adopt modifications.

Model of Colchester Hospital, which has just been completed by North East Thames Region. The planners here used nucleus briefing data, but the architects produced a different design solution—which, claims the region, meets the brief more successfully than the nucleus plans. Hence Colchester does not show the familiar cruciform templates. (Photograph from Percy Thomas Partnership.)

Low energy hospital

Energy is a major cost, even in hospitals that do not rely entirely on artificial ventilation; in those that do the costs may be crippling. So the DHSS performed a major study into reducing energy use in hospitals. Taking a 300 bedded nucleus hospital as a model, it worked out the energy consumption. Rather surprisingly the researchers found that space heating accounted for only 7% of energy use, while catering accounted for 22%, hot water for 20%, and air heating for 20%. The target was to reduce consumption by half—through good design and housekeeping and through heat recovery. The results of the study are being incorporated into a nucleus hospital being built at Newport, Isle of Wight, and a second one likely to be built at Ashington, Northumberland. At St Mary's, Newport, energy consumption will be reduced by including high levels of natural light and ventilation, particularly in the top floor wards, which have roof lights, admitting much more light than usual to the back of the nucleus ward. The hospital will also use high efficiency lighting, heating, and cooking equipment and will include energy recovery devices. Landscaping of the site to deflect winds over the building should also reduce heat loss. The layout of the hospital, with a curved street and a stepped profile, is partly due to the need to create an "energy centre" with heavy users of energy grouped round it, but it also shows that nucleus hospitals need not all look the same.

Maintaining the existing stock

But most of Britain's hospitals are still not new, and they are not particularly well maintained. Maintenance money has continually been raided for more pressing clinical needs, and planners have too easily tended to think in terms of building something new rather than remodelling existing property. The straitened circumstances of the '80s have forced a more realistic look at the NHS's estate. The DHSS itself estimates that it would cost about £2 billion to bring hospitals in England up to an acceptable standard for practising modern medicine.⁴ Hence the current interest in the NHS estate and a more sophisticated approach to the use of resources.

Several years ago the planners in the Oxford region suggested that hospital buildings would have to be much more intensively used if the NHS was to surmount the problems of its maintenance backlog. The problem does not dimin-

ish, because hospitals built since the war may have a shorter life than some built in the nineteenth century. The planners suggested that the NHS would have to contract its estate considerably and use what was left much more intensively, running expensive facilities round the clock.

This would clearly have revenue implications. But one of the problems in the NHS has been the sharp division between capital and revenue. These are allocated separately and, despite exhortation, have been thought about separately. There is often little integration between service and capital planning. The DHSS now insists that authorities should do full appraisals of all the options for service development—including options that envisage new building and those that do not. It has also made a more radical attempt to get the NHS to view its buildings not simply as property but more positively as a resource to be managed. As a result of a report in 1983 on underused and surplus property in the NHS there is now financial clout to the exhortation. The report urges authorities to assess their property and its use and to identify surplus property and sell it.⁴ In return a district may now keep the proceeds of its sales, and a scheme of notional rents has been introduced to make authorities aware of the value of their property and the cost of misusing it.

Upgrading

The NHS is not immune from general fashion, and, just as the large tower block hospitals of the late '60s and '70s reflected the values of the time, so too does the current interest in reusing and refurbishing the many soundly built buildings of the nineteenth century. But refurbishment is not necessarily an easy option. It generally takes more ingenuity and effort to work out a good solution in an existing building than it does to start from scratch. The Nelson Hospital project, another of the DHSS's research projects, showed this.

In 1977 the Nelson Hospital, in south west London, had about 110 surgical beds, a single operating theatre, a small x ray department and pathology outstation, and a maternity unit. The maternity unit transferred to the local district general hospital, leaving a two storey block behind, and the health authority set up a project team to see whether the geriatric beds at the nearby Wimbledon Hospital could be moved into the Nelson Hospital, allowing Wimbledon Hospital to close. The team concluded that it was not possible because the maternity block was the wrong size and shape and half the beds would have had to be on the first floor. As one of the planners said, "The exercise might well have stopped there had it not been for the extra planning resources that were available because of the DHSS's research interest."⁵ So they thought further and solved two problems. The Nelson's theatre was inadequate, so they built a new theatre in the former maternity unit and relocated 48 surgical beds and 12 gynaecology beds, which freed three Nightingale wards on the ground floor. In them they provided 48 geriatric beds and part of a day hospital; the other

Model of the low energy hospital at Newport, Isle of Wight. (Photograph from Ahrends, Burton, and Koralek.)

part was made out of the old operating theatre across the corridor. The cost of remodelling was about £500 000, but the authority saved £500 000 a year through closing the Wimbledon Hospital and got £1.5m from its sale.

Buildings as resources

The Medical Architecture Research Unit of the Polytechnic of North London, which is currently evaluating several nucleus hospitals, has extended the idea of treating buildings as resources in its studies on the use of space within hospitals.

MARU has always taken the line that hospitals should be seen not as static collections of rooms but as accommodating organisations. Indeed, one of its criticisms of early building notes was that they concentrated too much on room schedules instead of thinking about how an organisation worked and the need to generate spaces to house that activity. The idea is not new. The Nuffield report of 1955 on the function and design of hospitals pointed out that better timetabling in outpatient clinics would allow the waiting area to be much smaller.¹ But it is a lesson that still needs to be learnt.

Hospital provision tends to be calculated on the basis of norms—so many beds per 1000 population, so many surgical beds per theatre, and so on. In examining the use of operating theatres MARU discovered that the assumptions behind the norm of one theatre per 45 surgical beds were wrong and that many theatres were considerably underused. Policies on keeping a theatre free for emergencies and on routine maintenance had a large effect on the

overall use of the theatres, as did their location. One study showed, for example, that a hospital that was replacing eight scattered theatres by a central suite needed to build only seven theatres because they could be used much more effectively by being grouped together. The methods developed by MARU can be applied to other departments and will be included in DHSS guidance.

The drawback of using such methods, of course, is that they take more effort than simply applying a norm, and users need an incentive. The incentive can be only that there is a chance of saving money that can be spent on something else. And that in turn depends on the DHSS being rather more flexible than it is at present on interpreting cost allowances.

The NHS has taken a long time to get to grips with its estate. Only now are authorities taking a more sensitive approach to both new and existing hospitals, ironically at a time when expectations are much lower. During the boom years of the '60s and early '70s ambition was often compounded by ignorance, and a lot of things went wrong—as next week's article shows.

- 1 Nuffield Provincial Hospitals Trust. *Studies in the functions and design of hospitals*. London: Oxford University Press, 1955.
- 2 Weeks J, Hoare J. Designing and living in a hospital: an enormous house. *Journal of the Royal Society of Arts* 1979;July:464-80.
- 3 Department of Health and Social Security. *Nucleus users guide*. 2nd ed. London: DHSS, 1982.
- 4 Department of Health and Social Security. *Underused and surplus property in the NHS*. London: HMSO, 1983. (Davies report.)
- 5 Howells S. New hospitals from old stock. *Health and Social Services Journal* 1979 Nov 23:1512-3.

Lesson of the Week

Insertion of intrauterine contraceptive device in a patient with a ventricular septal defect: need for antibiotic prophylaxis

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The development of infective endocarditis after insertion of an intrauterine contraceptive device is a rare occurrence,^{1,2} and hence the need for antibiotic prophylaxis in patients with pre-existing cardiac abnormalities is easily overlooked. We report the case of a young woman with a known ventricular septal defect in whom infective endocarditis occurred after insertion of an intrauterine device without antibiotic cover.

Case report

A 28 year old woman was admitted by her general practitioner with a three week history of lethargy, evening nausea, pains in the back and thighs, and

The insertion of intrauterine contraceptive devices carries a small but definite risk of infective endocarditis; antibiotic prophylaxis is required in susceptible patients

nocturnal sweats. She had had an intrauterine contraceptive device inserted four weeks earlier.

At the age of 5 the patient had been noted to have a pansystolic murmur; ventricular septal defect (maladie de Roger) was diagnosed clinically but no further investigations or treatment were considered necessary. She had, however, been advised about antibiotic prophylaxis for dental procedures. Five months before admission she had had a normal delivery, although dilatation and curettage had been required at seven days for postpartum haemorrhage. She had been given antibiotic cover with metronidazole and cephalixin for these events but had developed an allergic rash, presumed to be due to the cephalixin.

On examination she was flushed and feverish (38.2°C). She was in sinus rhythm at 72/min, blood pressure was 90/60 mm Hg, and jugular venous pressure was not raised. There was a pronounced systolic thrill over the precordium and auscultation disclosed a loud pansystolic murmur, loudest at the left sternal edge. Tip of the spleen was just palpable but she had no other sign of infective endocarditis. Vaginal examination showed the uterus to be normal and anteverted, the coil in situ, and no evidence of vaginal

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