St Helens Hospital
Capita Architects

Arup

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A healthy future

A Healthy Future

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One of the strong business sectors Arup for Cardiff is healthcare in Wales and from Wales across the rest of the UK and Europe

Undoubtedly the biggest single workload stream is 'Designed For Life' where Arup are delivering multidisciplinary services on major hospital redevelopment in Gwent, Bridgend and Swansea. Procured under a 'construction best practice' framework of collaborative involvement of NHS, Contractor and designers this challenging programme of new and improved hospital facilities has much at stake. "Expectations are high" says Dave Pitman, Framework Director for Arup, "and we are responding to the demands placed on us with a high level of commitment-this is important for the continued success of our offices in Cardiff and Wrexham as well as the other offices of Arup in the UK and Europe that form Arup's team in the programme."

So what's different about how they design hospitals? Certainly there's more to the way that Arup do it than just being technical designers. They focus on the needs of the hospital user, the staff as well as the NHS Trust and on procurement. This means they have a strong focus on delivery by deploying project managers into their design teams to ensure that they deliver when it is called for. This is more than internal management as they have a role and presence at the decision table when managing project risk with external stakeholders and decision makers. New procurement methods are new territory for some and need proactive management of the processes that make it tick as Ceri-Ann David Project Manager identified, "all frameworks have processes at their heart and we have separated the management of these from design. It's important that we allow designers to focus on design with the management and framework leadership in a separate stream."

Designing and indeed operating hospitals to achieve whole life affordability is at the heart of the business plan and how design consultants influence this and respond to it. Social responsibility in design and management runs at the core of what we do - and indeed shapes the way we do business. There is no better illustration of this than how we are embodying a holistic approach to energy, carbon and the green agenda in the design of hospitals. Sustainability lead for Arup Anne O'Riordan explained, "Two of the biggest technical challenges in designing healthcare buildings is meeting the new Part L regulations as well as ensuring that the energy in-use remains within the NHS target of 35-55GJ/100m3." Dave Pitman added, "Sustainable healthcare buildings are buildings that are safe, non-threatening, help to aid the therapeutic process, make a positive contribution to their local surroundings, and have a minimal impact on the local and global environment both today and for generations to come."

Whilst the investment in Wales' healthcare infrastructure is important to Arup, they are designing and managing hospital projects across the UK and Europe.

The largest out of Wales is the £300million St Helens and Knowsley PFI hospital scheme, reaching new heights in off-site fabrication. Nick Ashby, Structural Associate explains, "Whilst designing close to 100,000 m2 of new hospital is a challenge it is the incorporation of off-site prefabricated toilet and bathroom pods that means we have to design in more structural flexibility-as the supply chain manufacturing decisions simply aren't made at the time we need them to be-and designers need to complete detailed design months ahead of usual in a project like this."

But the benefits are there to see-accelerated construction programmes with a quality of finish only to be expected of the factory production line-with zero defects. These are huge leaps forward in integrating production line and construction site technologies.

The challenge at Altnagelvin hospital in Londonderry is altogether different. Here the solution to the hospital estate problem is to retrofit mechanical and electrical services worthy of use in the future into 2 high rise towers which date from the 1950's. "Demands for plant and services have risen a great deal" says Alan Hurman "and threading new plant into old buildings isn't easy. The integration of new ventilation services within service risers designed for the demands of 50 years ago is a real headache." But it's a problem worth having and solving as re-using buildings is a fundamental contributor to socially responsible design defining the response to the global challenges of long term sustainability.

Wind Energy - our contribution

Wind Energy - Our Contribution

Simon Power

Arup in Cardiff have been involved in the planning for renewable energy since 2003. Starting with an early research contract for Welsh Assembly Government (Energy and Planning Divisions), they helped establish the thinking and evidence base behind Technical Advice Note 8 (TAN 8). This document sets out how the Welsh Assembly Government plan to deliver its onshore wind target of 800MW by 2010.

Through the development of seven strategic search areas (some 2000km2 in size) the plan is to facilitate larger wind farms into planned zones where the planning environment is more favourable.

Arup research in 2003-2005 extended into ongoing advice for the Welsh Assembly, looking at the consultation responses to TAN 8 and assisting in the formulation of the final document on its publication. TAN 8 allows Welsh Planning Authorities affected by strategic search areas for onshore wind to 'refine' the National boundaries and apply them locally. Arup were then appointed by all local planning authorities in Wales with strategic search areas to help with their detailed landscape, visual and ecological planning. Lasting over 18 months the refinement process took Arup planners, landscape architects and environmentalists to some of the most remote and attractive parts of Wales in all weathers. These local authority contracts led naturally to Arup being the consultant of choice when assisting the local authorities in planning appeal case work with respect to wind applications and the firm has completed two such appeals in 2007. Now that planning applications are arriving apace within the strategic search areas Arup have also been assisting selected local planning authorities with development control advice; grappling with the tricking subject of cumulative impacts between proposals and thresholds of acceptable impact.

Windfarm by Andrew Hazard Photography

Through their work for the public sector in Wales, Arup were appointed to assist (from Cardiff with support from other offices) the North East England Regional Assembly (and other NE local authorities) with respect to the planning of wind farms, a role that started in early 2006 and is still going; many a happy day has been spent by the team in the wilds of Northumbria although the carbon emissions of one or two of the team members might need looking at flying up and back to the region each time! Work for the NE Regional assembly led to a more wide-ranging study of planning all forms of renewable energy up to 2020 in the East of England Planning Region - a complex study still ongoing and being led out of Cardiff. Grappling with biomass and renewable heat has meant a refreshing change to onshore wind; however it would appear the East of England still needs a step change in its onshore wind deployment to meet its targets and lessons from Wales are being applied.

Not surprisingly the private sector has noticed Arup's growing expertise in this area gathered and their environmentalists, planners and engineers have been in demand since 2005. Now involved in some 200MW of onshore wind consenting activity via a number of clients, the team have been employing specialists in areas such as ornithology and hydrogeology to help turn planned projects into deliverable renewable electricity. There is now some £2bn of wind projects planned and under development in Wales, a large proportion on the Assembly government's own forestry estate. Arup helped a bidder with project design for some 1000MW of wind turbines on the forestry land and we are hoping our skills and knowledge can be transferred to as many of the successful bidders as possible as projects move forward, whether in consenting support or in design and construction.

With growing demands for climate change mitigation and renewable energy in particular, set in a context of ever increasing government targets, the Arup renewable energy team should have a busy future.

Designing Sustainable Healthcare Facilities

Sustainability is now a common word used in the design brief of almost all healthcare facilities around the world.

It does, however, have many meanings depending on the context within which it is used and hence can create a lack of clarity. In healthcare it is important that providers of healthcare, i.e. the owners/operators and their design teams, adopt a wider view of sustainability. We must consider a sustainable approach for the design of new healthcare facilities as underpinning the creation of a facility where the provision of healthcare is sustained in an efficient and effective manner over the life of the facility-it is after all about creating a sustainable business which in healthcare means satisfying a number of drivers.

Figure 1 shows the key drivers that should be considered as essential when developing a design philosophy and brief that will create a sustainable healthcare facility.

The design of any new hospital will need space flexibility to accommodate the many changes of clinical models likely to occur over the 60 year life of the facility. It is therefore important that it is designed and constructed in such a way that there is flexibility in the design solutions. Its structural engineering frame will need to accommodate changes of internal partition arrangements and its engineering systems will need to be future proofed to ensure that they can also accommodate the changing needs brought about by clinical advancement, impacting on both technical equipment and the built environment.

Not only may the changing needs reflect in an increase in the bed numbers but more likely it may mean a reduction. It is therefore important that flexibility is considered as both the need to grow and the need to shrink. A need to reduce bed numbers needs to be considered in the context of ensuring that the remaining unused asset does not become a liability.

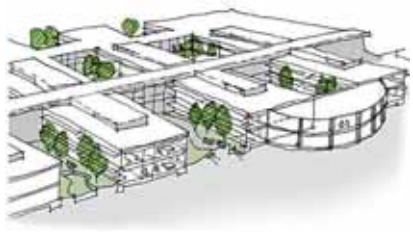

Figure 2

Hence we should create design solutions that allow a reduction in the bed numbers but offer the confidence that the space that is vacated can be utilised for another income generating opportunity. This is particularly important when considering the PFI procurement model and points the way towards a narrower plan design solution. The spatial flexibility of the facility to enable income to be generated as well as reducing the disruptive impact (noise, dust, access etc) of internal change is more realistic when aligned to a narrow plan solution.

Essential

It is essential that design solutions support a therapeutic environment. This is a design that is human in scale, non-threatening, naturally lit and acoustically pleasing with user environmental control and the use of art and colour. [It is about offering privacy but with clinical observation and support good quality external views where possible.] This design approach not only supports the wellbeing of the patients during their stay and may even speed up recovery. It also increases the wellbeing, and hence motivation, of the staff which will support the attraction and retention of staff and may also enhance the operational efficiency and increase the patient throughput.

Patient throughput and motivated staff are, after all, key requirements of a sustainable healthcare business, particularly with patient choice and payment by results being key drivers in the future success of Trusts in England.

Although the creation of a high quality therapeutic environment does not necessarily mean that clinical efficiency is compromised, it is important that high quality design solutions are developed by healthcare planning professionals who can minimise the impact of any compromise that may exist.

There will also be a need for the design team to ensure that the provision of therapeutic environments actually improves clinical efficiency. Professional healthcare planners can reduce the compromise through sensible walking distances, efficiently planned departmental adjacencies, with the architects providing a high level of spatial design quality and engineers developing appropriately serviced environments.

One of the most important decisions that can be made to satisfy a therapeutic environment is that of the provision of the single patient bedroom.

Accepted as the norm in many European countries, single patient rooms are still having to be fought for on a project-by-project basis in the UK. The single patient room together with a narrow plan concept seems intuitively to be a strong foundation for the creation of the therapeutic environment.

Figure 3.

Economic Rigour

Of particular importance is the economic rigour by which options are selected. To satisfy a sustainable approach we must base our selections on a whole life cycle cost model.

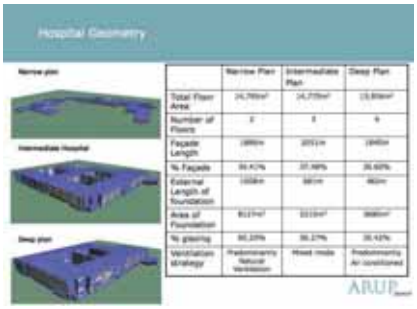

Figure 4

An example of this approach is in the selection of a foul laundry and waste removal system for a hospital. The selection of such a system will add an additional capital cost as well as having an impact on the internal space planning and engineering design. However, there are a number of benefits to be considered. Firstly, there is an immediate removal of potential reservoirs of infection from the ward area that has the added advantage of eliminating the need to carry the dirty material through other wards by porter's trolley, and hence reducing the risk of spreading the infection. There is also a reduction in the damage done by trolleys to internal walls and doors and the reduction in the numbers of porters due to the automated system. The savings are therefore in staff numbers, FM operating costs and risk of spread of infection. All the benefits quoted above can only be realised through a whole life cycle approach because of the inevitable increase in the capital cost that can only be repaid through operational efficiencies.

The carbon agenda has now reached the highest levels of Government within the UK and through much of Europe and acute hospitals are extremely important in setting the standards for energy use and carbon emissions. We must consider higher thermal insulation standards, heat recovery techniques, lighting control, the use of natural ventilation and mixed mode systems to allow facilities managers the ability to control the environment and reduce their carbon emissions as well as building in some future proofing. We should also ensure that we have evaluated appropriate renewable sources of energy generation. A design audit can best illustrate the opportunities to create lower carbon emitting facilities.

Figure 5

However, we should appreciate that much of the energy used in an acute hospital setting is not due to the need to create thermally comfortable environments but due to the clinical and safety needs of the staff and patients. That fact needs further consideration by those involved in the development of the legislative framework in place to reduce the UK wide carbon emissions burden.

As part of the carbon debate we must remain committed to provide a comfortable environment as well as creating a safe environment to enable achievement of current and future clinical best practice. However, importantly, we must carry out an audit to ensure that the passive design solutions are developed before we consider the more complex renewable systems approach. We should also review the parameters of comfort to ensure that we are not setting a design brief that only the air conditioning industry will be happy with -increasing the number of hours that a facility can be maintained at a maximum internal temperature can make a significant difference to the opportunity to naturally ventilate. Finally, we must ensure that there is a significant element of occupant control and that we design in the simplest but most appropriate engineering systems. We should not install complex control systems into a facility where the technology will not be understood by the operators. Over complication does not support a low carbon design.

Best Practice

There are many prescriptive codes and guides throughout the world and for any world class facility it will be important that the best practice is brought to UK projects. The NHS for many years produced first class design guidance. Much of that information now needs to be reviewed and this is currently being assessed. We are in the middle of the biggest healthcare building programme in the history of the NHS and innovative solutions are being requested by the clients. Therefore we need to maintain the high standards that remain appropriate while ensuring that we introduce appropriate innovation in the form of well proven technology, transferred from other sectors or design standards from other geographies. An example is infection control. The State of Victoria in Australia has an infection control design guide that presents the risks to spread of hospital acquired infection in five clear routes. Those routes are shown in Figure 6.

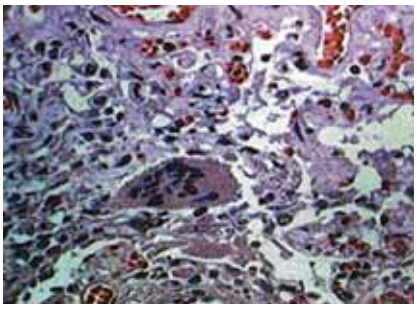

Figure 6

It is important to discuss the means in which the design supports the reduction of spread of infection through each one of the defined routes. The manner to do this will be through a holistic approach involving the design, operation and maintenance of each of the processes. This will be an ongoing discussion with the client's infection control team.

Engineers have taken this method of risk analysis in the past through the methodology that was adopted in the 1970s to reduce the risk of outbreaks of Legionnaire's disease - this is after all a hospital acquired infection transmitted through a common vehicle, i.e. water. It is

Figure 7

about understanding the chain of causation of transmission and attempting to eliminate it at every linkage point through the design process by integrating with the operational and maintenance processes.

Current technology available to the engineer to support the reduction of transmissions of infection is the use of vaporised hydrogen peroxide. This method of decontamination used in conjunction with a single patient bedroom design solution can have a significant impact on the spread of infection.

Long-term benefits

The benefit of employing a sustainable approach in the design process of a large healthcare facility is clear – decisions are made for the long-term benefits of the facility, and the facility underpins the ongoing effectiveness of the business. Further, if a sustainable model is used then the large stakeholder group normally engaged in the decision making process will find the process more inclusive. There will be an auditable trail and all decisions will have a logic and a consistency.

Figure 8

The model shown in Figure 8 is a typical sustainable model that is used to make decisions as part of the design process. The options are considered through the four quadrants of Environment, Natural Resources, Economic and Societal. Options can be evaluated by setting out a number of agreed questions that test the brief and through a workshop process gain responses from the group members. Results then emerge, illustrating the strengths of each option. The appropriate decisions can then be made knowing that there was a high degree of consistency within the process.

When models like SPEAR are used with AEDET and NEAT the result is a better understanding of what makes a sustainable facility and the options available. It is in everyone's interest to create sustainable healthcare facilities particularly given the pressures of change that are likely to be introduced in the future.

There appears to be little doubt that there will be an increase in the capital cost of a project when developing it through a sustainable model. However, these additional costs can be offset over the life of the facility by developing the concepts through a whole life cost approach. Achieving a sustainable design can have a capital cost range between 6% and 12% depending on size of the facility, the realism of the initial budget, the client expectations, the site constraints, the commitment and inventiveness of the team to engage in the process and the ability of the procurement route to support a whole life cost approach.

What is clear from the modelling that we have carried out is that by adopting a holistic approach to the design and evaluation process the solutions become mutually supportive hence the whole becomes greater than the sum of the parts in terms of the savings generated overtime as well as the not easily identifiable or calculated clinical carbon, staff and societal benefits.

Key costs would be incurred through the provision of narrow plan templates, maximisation of single rooms, high quality facades and landscaping. The financial evaluation must consider the geometric options of the facility and the subsequent construction programme and related costs. Further consideration would involve the engineering systems and spatial requirements for laundry and waste removal and general engineering services and plant distribution. Detailed financial evaluation of the right building option can reduce the difference in payback of the additional capital investment from approximately 20 years down to five years.

The benefits would include less threatening internal and external environments, the increased use of natural ventilation, reduced maintenance costs, reduced plant replacement costs, reduced opportunities for spread of infection and a reduction in the carbon emissions.

A sustainable approach to the design of healthcare facilities in the UK is essential if we are to maximise the business effectiveness for the whole life of the facility. There is no doubt that there is a greater level of understanding needed, along with a holistic approach to the design of the process, an additional capital costs burden and also personal operational sacrifices. It is not easy to achieve, if it were we would be doing it already.

Urban Transit Systems

Stuart Watkins

Phil Nedin

Phil Nedin is a Chartered Mechanical Engineer and a Director of Arup. Phil's primary role is as global leader of the Arup Healthcare business. The Arup Healthcare network is global with skills based in USA, Asia, Australia and Continental Europe and has a project portfolio of almost 2,500 healthcare projects completed to date.

Phil's main priority is to bring design best practice from wherever it is found and deliver it through the global network to the Arup clients.

Prior to joining Arup in 1988 Phil worked for 7 years at the North West Thames Regional Health Authority in London. Phil is involved in lecturing at the University College of Wales on both the Architectural Engineering and Integrated Engineering multi-discipline project has led Arup research sponsorship in infection control and the therapeutic environment.

Phil's primary interest is in the integration of disciplines to achieve a holistic approach to the design of healthcare facilities.

Phil is a Board Member of the Healthcare KTN (Knowledge Transfer Network)

In May 2006 Phil was elected as President of the Institute of Healthcare Engineering and Estate Management and will serve in that post for a two year period.

Swansea is implementing its ground-breaking Metro project. Cardiff continues to consider Personal Rapid Transit (PRT) and other urban transport developments. Newport progresses with a new railway station and bus station and has ideas up its sleeve to provide direct cross-city links.

The coming decade should see movement in our cities transformed. At Arup, we are very pleased with the way our ideas and concepts for urban transit are unfolding as the local authorities in Wales move forward with plans for public transport.

The Swansea Metro project is a partnership venture between bus operator First Group, the City and County of Swansea and Arup to design and deliver a new public transport system for Swansea based on the "ftr" concept. This concept is to introduce a new type of vehicle called a StreetCar that has tram-like characteristics despite running on rubber tyres. It must also have the reliability and quick journey times of a tram and therefore requires extensive priority infrastructure to be developed along the proposed route. The result is to be a new vehicle servicing a new cross-city route from Morriston to the Mumbles and improving access to many major destinations, including two hospitals, the new stadium, the bus and rail stations, County Hall and the University. The system could be expanded in the future. The project is also intended to contribute to the regeneration of Swansea City Centre. The infrastructure works in the City Centre, which includes filling in a roundabout, a two-way 'Metro' track and a one-way gyratory system for general traffic are nearing completion.

Arup has been involved in every step of the process, working in partnership to design and implement the vision of the City and County of Swansea and First Group for a new mode of transport.

The first full production ULTra PRT vehicle has been delivered to the Cardiff trials site. The system is currently being implemented to link car parking with Terminal stations at Heathrow Airport. Cardiff watches on with interest!!