Hospitals and Healthcare
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Hospitals and healthcare buildings are complex because of the diverse activities that take place within and around them. A modern hospital must combine its functional and technological requirements with the need for a caring, human environment. This brochure is a general guide to hospital lighting design and features lighting solutions not only for wards and clinical areas, but also offers an introduction to the wide range of lighting products suitable for all applications in a modern hospital development.
Energy efficiency

Lighting accounts for a significant part of any hospitals energy use. Yet use of co-ordinated design that reflects what will actually be built can lead to a substantial reduction.

Performance:
The luminaires achieve even lighting with good colour rendering, creating a bright, safe environment for the patients and staff. The patients' apartments have special functionality and safety requirements. For instance built-in LED wall lights at skirting board level function as nightlights.

Efficiency:
To maximise lighting energy efficiency the architect has optimised the use of available daylight. The living area is landscaped into the hospital grounds ensuring that there are green views from all the 48 single rooms. All linear fluorescent luminaires employed in the corridors, offices, treatment rooms and central area use advanced optics with T16 lamps to achieve low energy. The LED lights consume even less power and have a long operational life – ideal for the long burning hours.

Comfort:
For architectural integration the architect chose oblong fittings for the whole upper floor, which is characterised by numerous corridors in various directions. These provide direction and follow the building’s movements. They are also adapted for exterior use - standing upright, they function as a unique cross between park lighting and low bollards and make a strong link between the internal and external environments. On the lower floor, classic glass fittings are used to focus on the directionless and openness of the large rooms. The discreet LED’s help the patients feel secure. Overall, the lighting echoes the efforts of the architecture to create a modern, functional hospital that radiates anything but a sterile hospital atmosphere.

A major source of energy consumption in any hospital is lighting. It can account for 40% of total electricity consumption. Whilst many spaces make up this load it is often the circulation spaces that constantly use energy, often 24 hours a day.

Often lighting designers are asked to plan for surface finishes that do not match what the interior designer will use when a building is complete - the famous 70/50/20 rule for ceiling, wall and floor reflectance is often applied.

But often in health care buildings lighter surfaces are used. At one recent hospital the proposed surfaces were closer to 81% for the ceiling, 83% for the walls and 58% for the floor. Picking this up at design stage with the architect and electrical consultant our lighting designer proposed a saving of 28% installed load, in excess of 6kW just for the corridors and a further saving of 50% for all the en suites and w/c’s, saving one lamp per fitting and a further 34kW electrical load.

The cost to the project was simply three people for one hour, perhaps just over £100.
Our design saving example is shown here based on saving one 32W lamp per fitting over a number of rooms. In our original hospital design that was based on 900 rooms. The comparative fittings were a twin 32W TC-TELI downlight using 68W when 70/50/20 reflectances were quoted, versus a single 32W TC-TELI downlight when true 81/83/58 reflectances were quoted. Usage is based on 3200 hours per year.

Typical ensuite & w/c energy savings converted to financial savings assuming typical prices forecast for the next decade. This comparison shows how much the energy cost saving for a number of rooms will vary as base energy prices fluctuate in the coming years. DEFRA predict rises in Retail Electricity prices for commercial uses of between 3% and 200%. Retail prices between Quarter 1 in 2008 and 2009 rose by 22.7% in real terms.
Guidelines for hospital lighting

But of course, it’s not just a matter of supplying you with the products; well before that happens it’s essential that you get the best possible advice on how to use them to your best advantage. That’s where these guidelines come in, as does our lighting design and advisory service.

Reflecting the Needs of the User
Lighting has a vital role to play in enhancing our environment. Without it, even the most carefully designed setting will be diminished. So, what should the healthcare specifier be looking for when choosing lighting?

Firstly, before embarking on lighting design, applications or equipment, they should pay due consideration to the way that healthcare risk is managed. Invariably this will necessitate that the selected lighting supplier is well versed in modern procurement practices and can work in a collaborative supply chain environment. Thorn has a world of experience working within such ‘partnering frameworks’. The process begins with consultation: our team of specialists work in close co-operation with architects, specifiers or hospital management to help develop best value for money proposals, taking into account financial constraints and whole life costings.

Understanding the technical, clinical and human needs of various healthcare applications is a major consideration. Increasingly, fitness for a particular purpose is becoming the ultimate arbiter of good lighting, with quality rather than quantity being the order of the day. Lighting that is appropriate to a variety of healthcare users can only be selected from a comprehensive and innovative range of equipment. Service from an organisation with the capability to successfully resource and manage your project will also influence the choice.

Through life costing is another key ingredient. The latest technology, coupled with efficient design, will do much to strike the balance between capital and running costs over time. Thorn Cocal software can calculate the cost of an interior healthcare lighting installation through its life by evaluating installation, operating, cleaning and replacement lamp costs, including labour fees. The best maintenance method and schedule can be selected to minimise costs. Comparisons can be made between up to seven interior lighting products to find one with the lowest overall costs as always, it’s value for money that the client is seeking. These can be refined by assessing effective annual interest rates for the project over a period from 3 to 30 years, with luminaire replacement at regular intervals. Finally, the application can incorporate the effect of lighting controls on reducing energy use and estimate CO₂ emissions.

Thorn Lighting’s aim is to bring ever greater benefits to the end user. This attitude of adding value continues into environmental integrity – from developing energy efficient products to providing product life cycle analysis and working with your organisation on waste management initiatives.
**Luminaire Requirements**

In hospitals luminaire have to meet high standards of hygiene and safety. In particular, the luminaire should have the minimum horizontal top area on which dust may settle, because airborne dust particles can transport harmful bacteria, and be easy to clean. Noise is also an important consideration as hospitals can have a much lower ambient noise level than commercial premises and the bedhead lighting may be close to the patient. Fluorescent lamp luminaire should, therefore, employ high frequency electronic control gear. The efficiency of a lighting system will be drastically reduced if there is no maintenance or cleaning programme. All healthcare properties should have lighting maintenance programmes involving regular cleaning of luminaires and replacement of lamps.

**Light Sources**

All rooms located in clinical areas should have fluorescent lamps having a minimum clinical quality colour rendering property according to Group 1B (Ra90) or better. Indeed BS EN 12464-1 recommends that lamps with a colour rendering index lower than 80 should not be used in interiors where people work or stay for long periods.

Colour temperature should be 4000K unless it is specified for specific applications. It is recommended that consistent colour rendering be provided throughout the whole area, department or hospital complex.

**Daylight Penetration and Window Design**

To maximise the beneficial effects to patients and staff and to maximise lighting energy efficiency the designer should optimise the use of available natural daylight paying particular attention to window design, whilst avoiding overheating and solar glare. In order to benefit fully from daylight the lighting system should be controlled accordingly.
General Recommendations
CIBSE Lighting Guide 2 (LG2): Hospitals and health care buildings, published in 2009, is the most up-to-date document for lighting hospitals and healthcare buildings and is endorsed as best practice by The Department of Health. Lighting Guide 2 follows closely the recommendations of the European Standard for lighting of indoor workplaces, BS EN 12464-1, published as a British Standard in early 2003, which contains a sizeable schedule of illuminance and recommendations related to hospitals and healthcare buildings. This schedule also appears in the Code for Lighting 2002 and, the key requirements, on page 9 of this brochure. For projects covered by the Public Procurement Directive, which includes PFI projects, European Standards must be followed first, then local guidance can be applied where it does not conflict with European Norms. Therefore for such projects the schedule in BS EN 12464-1 (and the Code for Lighting 2002) should be acted upon. Other requirements of the European Standard should also be followed. For aspects of lighting not covered by the European Standard the guidance in LG2 should be followed. If LG2 gives more detailed recommendations than the European Standard, it may be appropriate to interpret the guidance in the standard making use of the recommendations in LG2. For projects not covered by the Public Procurement Directive it is normally regarded as best practice to follow the prevailing British and European Standards.

Bedded Areas
As already mentioned, albeit briefly, LG2 2009 clarifies certain issues relating to ward lighting. These are without lining in more detail. Bedded areas with a floor to ceiling height of 2.7m to 3m can pose particular problems for lighting designers, particularly when privacy curtains are drawn around individual beds. As modern medical practice often requires examinations to be carried out with the bed curtains drawn, the lighting philosophy employed has altered accordingly. The issue with low ceilings is to provide enough light to satisfy the medical staff while not disturbing the patient if they are trying to restor sleep. Trials have been carried out in a number of hospitals with ceiling heights of 2.7m to 3m in the bedded areas and have indicated a number of solutions, for instance ceiling recessed luminaires or luminaires that are separately wall mounted or integral with bedhead trunking (which also supplies medical gas and other services). The recommended mounting height for such trunking systems is 1.3m for gas supplies, whereas the recommended mounting height for wall mounted luminaires was 1.8m. Uplighting which is integral with, or mounted on wall trunking, needs careful optical control to avoid glare (see fig 1 below).

fig 1

This four bed ward, for a recent PFI project, shows wall mounted luminaires providing ambient upward lighting (from 2 x 28W T5 lamps) and direct lighting (1 x 54W dimmable T5) for the patient and staff at the bed. The luminaires are mounted at 1.8m to avoid strong shadows at the bed head and better graduation of illuminance over the length of the bed. Illuminance ranges between 450 lux and 280 lux respectively. Switching is via the ward entrance and nurse’s station. Night lights are provided by discrete ceiling mounted fittings.

Upwards flux distribution component
For wall mounted luminaires installed less than 1.8m above floor level, a limiting luminance value of 700 cd/m² (maximum) between the angles of 90° and 145° must be achieved.

Downwards flux distribution component
Table 5.7: Health care premises adapted from EN12464-1

<table>
<thead>
<tr>
<th>Ref. no.</th>
<th>Type of interior, task or activity</th>
<th>Em</th>
<th>UGRl</th>
<th>Uo</th>
<th>Ra</th>
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Guidelines for hospital lighting continued

Separate wall mounted uplights, frequently installed where the ceiling height does not exceed 3m should be at a minimum mounting height of 1.8 m. They may require supplementary ceiling mounted luminaires to enhance the light at floor level in the centre of the ward for circulation and nursing functions.

A selection of the most popular lighting layouts is illustrated here using visualisations (see Figure 2). LG2 makes recommendations for luminance limits as seen by a patient lying in bed. The ceiling height for suspended luminaires should not be less than 3m to ensure adequate clearance for mobile apparatus used at the bedside. The mounting height above the floor should not be less than 2.7m nor greater than 3.5m.

Wall mounted luminaires
Modern lighting systems comply with the general recommendations using only semi-direct wall mounted luminaires with fluorescent lamps.

Recessed and semi-recessed luminaires
Recessed and semi-recessed luminaires may be used in ceilings between 2.4m and 3m high. If these luminaires will not provide the illuminance required at the bedhead a dual system is required.

Dual systems
For dual systems in which supplementary lighting along the side walls of the bedded area is used, ceiling mounted luminaires may still be suitable.

Night lights
Shifting patterns of light and shade on the ceiling can trigger the subconscious and cause some patients to experience phantasmagoria and the design should avoid directly illuminating the ceiling at night. To allow staff and patients to move around safely when the main lighting is switched off at night, it is necessary to make provision for night lighting. Where uplighters are used it will normally be necessary to provide for night lighting by separate luminaires (probably downlighters). The luminance of any luminaire left on during the night should not exceed 30 cd/m² at angles of above 35 degrees from the downward vertical. Where the ward layout is fixed it would be practical to consider this limit to be at angles viewable by the patient. To allow patients to sleep the illuminance for the circulation space should be an average of 5 lux with a maximum 10 lux at any point. The illuminance on the bedhead should not exceed 0.1 lux, higher levels will be appropriate for watch lighting and for specific patient needs.

Watch lighting
This allows continuous observation of a particular patient after the general lighting has been switched off, without the disturbance which would be caused by the patient’s reading light.

Reading lights
The provision of separate reading lights is nowadays reduced to long-stay wards and/or for the elderly since; hospital beds are used more intensively, few patients stay for long periods and generally TV is available. The patient’s reading light is required to give 30 lux directly on a 1m by 1m area based around the pillow area and can also be used by staff for nursing tasks at the bedhead.
Basic Lighting Controls
The recommended illuminances given in this guide reflect accepted policy on the efficient use of energy. It should be remembered that the Building Regulations call for lighting systems with appropriate lamps and sufficient controls so that energy can be used efficiently and also that compliance needs to be shown.

Lighting control systems deliver the best results when they have been carefully planned and thoughtfully implemented, with the most effective strategy’s being dependent upon the user’s pattern of occupancy, the arrangement of equipment and the availability of daylight. A good lighting control system should ensure that all occupants have exactly the lighting they want when they need it. In short it should eliminate all unwanted use, but not switch off lights so compromising safety. Neither should it be complicated to set-up or difficult to use. Nor should it ever devalue the quality, sensitivity and aesthetics of a good lighting design, but should serve to enhance it. As long as it is correctly matched to the needs of the occupants and the use of the building it will produce the desired savings.

Four types of control sub-systems are detailed here. Frequently a combination is used, dependent on the application.

Daylight-linked
Daylight linking results from simple photoelectric on/off switching or dimming. Recent technical progress in digital enabled luminaires has greatly increased the impact of dimming for fluorescent lighting. For instance light falling on the working plane is constantly monitored and the light output of the luminaire is adjusted according to daylight, to maintain this design illumination. Additionally, numerous groups of luminaires can now be linked without the need for a central controller or special operating software.

Occupancy-linked
Presence detection is usually achieved using passive infra-red sensors which switch either one or a group of luminaires on when occupancy is detected and off after the last movement is detected. They can be recessed, surface mounted or built into luminaires. For larger areas microwave detectors can be used to the same effect. It is important to have a time delay built into the system to avoid nuisance switching.

Localised Switching
Localised manual switching is helpful in areas where occupants want the choice of switching lights above their workstations ON or OFF. Equipment includes wall switches, pull cords or hand held infra-red controllers.

Timed Control
Time controls may be derived from a variety of devices ranging from the simple timer to signals being transmitted along a communications channel from central timers or systems.
The following pages offer some guidance on lighting particular health care spaces and what sort of luminaires may be useful for each. To help a typical hospital building has been split into seven key areas:-

1. **Entrance and Waiting Areas**
   - Reception Area
   - Suspended systems/Downlights
   - Accident/Emergency/Consulting Rooms
   - Recessed and surface fluorescent/Downlights

2. **Ancillary Areas**
   - Offices/Conference Rooms
   - Recessed fluorescent/Intelligent luminaires/Uplights
   - Storage and Maintenance
   - Waterproof, dustproof and cleanroom luminaires

3. **Restaurants/Kitchens**
   - Downlights/fluorescent battens/cold storage

4. **Basics of hospital and healthcare lighting**

5. **Ancillaries**

6. **Exteriors**
   - Car Park
   - Outdoor Amenity

7. **Exteriors**
   - Car Park
   - Outdoor Amenity
Wards and Bedrooms

Wards
Bedhead luminaires/
Uplights/Reading Lights/
Low Level Lighting

Bedrooms
Bedhead and bathroom
luminaires/Low Level
Lighting

Operating Theatres and Clean Rooms
Intensive Care/
Operating Theatre
Bedhead consoles/
Cleanroom luminaires

Circulation Areas
Corridors and Stairs
Indoor amenity/Emergency
Lighting
Entrance and Waiting Areas

At entrances and in waiting areas, light has an important role to play in creating a welcoming and friendly atmosphere.

At the same time entrances and in waiting areas need to convey an air of brisk efficiency and safety. Lobbies and transition spaces must put the patient and the visitor instantly at their ease. Pay special attention to grading the illuminances and reflectances of successive spaces, so that important spaces feel welcoming.

The lighting of an entrance canopy should draw attention to its location. Such lighting should be suitable for recognising a face and should illuminate any changes in level.

Internally mark doorways and other crossings, illuminate reception desks, notice-boards and provide adequate reading lighting for seating areas.

In certain locations the use of more architectural decorative luminaires can be employed that do not compromise the lighting requirements. This is particularly so in residential homes and for that matter non clinical areas in hospitals. Versions with high frequency control gear, when fluorescent lamps are used, are preferable to reduce noise, and flicker and lamps of warm colour appearance can be employed for a welcoming effect. Finally, in waiting areas, luminaires that are easy to keep clean are an asset in the fight against hospital acquired infection.

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Circulation Areas

Lighting for general circulation around hospitals and clinics, requires attention to be paid firstly to the adequate illumination of direction signs.
Nowhere is the need for even, high quality illumination more apparent than in the operating theatre.

General lighting is usually provided from fully recessed, sealed, fluorescent luminaires, which can be easily cleaned and use lamps with clinical quality colour rendering.

Local lighting on the operating table is provided by specialised luminaires. While this may deliver illuminance in the region of 10,000 – 100,000 lux into the cavity it is usual to provide a background illuminance for the theatre staff to carry out ancillary tasks, which usually calls for recessed, sealed, fluorescent luminaires employing digital dimming control gear. Finally, emergency lighting should be of equal, or near equal quality, to that provided by the normal lighting.

Good visibility does not end with the operating theatre. The preparation and inspection of pharmaceuticals for example demands consistent lighting conditions shift after shift. Other important considerations are corrosion, contamination and cleanliness. Additionally, all the luminaires will need to be regularly cleaned and accepted practice is to use cleanroom luminaires.
Wards and Bedrooms

Good visibility cannot end with the operating theatre; that is why we have given considerable thought to clinical areas, such as ward units, consulting and treatment rooms.

In most hospitals a ward has one to four beds. The lighting of any ward unit must satisfy the requirements of both the patient and the nursing staff throughout the day and night. Both need general lighting in the early morning and evening when daylight is not available, and patients may require light at the bed head for reading. Wards are generally provided with good day lighting, but in some cases it may be necessary to consider supplementary lighting for the areas further from the windows.
Ancillary areas

There’s no doubt about it. It’s hard working areas such as these that are the linchpin of your care operation.

And with so much that’s vital to the efficiency of your premises going on behind the scenes, it would be a sad mistake if your efforts to provide a well-lit working environment stopped here.

Apart from anything else, Health and Safety Regulations demand that minimum standards be maintained. But it would be short-sighted to regard these as the final word. Over and above any statutory duty, it makes sense to supply the best illumination possible in areas where delicate instruments are handled or where stock is checked.

While it may be true that the patient is king, your staff are also an important human resource. Therefore it makes sense to make the behind-the-scenes lighting as restful as you can, particularly as these ancillary areas may be used for extended periods.
Restaurants and Kitchens

When it comes to restaurants and kitchen work areas, lighting is a key ingredient. Nobody wants to eat or prepare food in a dull and dreary environment.
Exteriors

Light is a language in itself, encompassing the full spectrum of needs and emotions.

Good exterior lighting can be a guarantor of maximum safety in a hospital entrance or of reassurance in a lonely car park. Safety is enhanced by strategically positioned lights on stairs, walkways or approach roads. As for security, exterior lighting is known to be the simplest and most cost effective deterrent to the would-be thief or vandal.

Entrances, pathway intersections and, of course, hazards such as changes in level, should be marked by “beacons”. Bollards and bulkheads are typically used to light pathways and approaches to entrances. There is sufficient choice to be able to make a luminaire selection that blends with the surrounding architecture. Points to consider are the height of the luminaire, the lighting performance, the ingress protection and degree of vandal resistant offered. Many models have a wall or ceiling mounted bulkhead to match the design of the bollard too.

Car parks, entrance and service roads all need adequate lighting, and the route to the entrance needs to be correctly defined and lit. There should be no areas left in darkness. There are now many attractive high performance decorative lanterns to choose from that deliver friendly illumination with a touch of style.

Remember too that exterior lighting needs careful thought to include light nuisance control especially considering most health care buildings are sited within areas of higher populations. Modern luminaires design incorporate flat cut off optics rather than plain flat glass and benefit from improved efficiency as a direct result.

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