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## Lighting and colour for hospital design

A Report on an  
NHS Estates Funded  
Research Project

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# Lighting and colour for hospital design

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Courtesy of Elga Niemann, Colour Design Research  
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"I am inclined to think that the majority of cheerful cases is to be found among those who are not confined to one room, whatever they are suffering, and that the majority of depressed cases will be seen among those subjected to a long monotony of objects around them. A nervous frame really suffers as much from this as the digestive organs suffer from long monotony of diet. The effect on sickness of beautiful objects, on variety of objects and especially brilliancy of colours, is hardly to be appreciated. Such cravings are usually called the "fancies" of patients but these "fancies" are the most valuable indication of that which is necessary for their recovery. People say that the effect is only on the mind. It is no such thing. The effect is on the body too. Little as we know about the way in which we are affected by form and colour and light, we do know this, that they have an actual and physical effect. Variety of form and brilliance of colour in the objects presented to patients are an actual means of recovery."

Florence Nightingale

## Foreword

Lighting and colour are particularly important in the built environment. Our research in airports and railway stations has shown that the psychological power of colour and control of lighting can influence the mood of people who may be anxious, disoriented or over-emotional.

Thus, when talking about the hospital environment, how much more important lighting and colour becomes. People are likely to remain in hospital for longer. Their anxieties might well be much the same, although stretched over a longer period, and they will probably feel generally unwell.

Here is a definitive and functional publication bringing together all aspects of colour and lighting needed for contemporary hospital design. It is a user-friendly document, for reference early in a building project, which can be fully understood by both professionals and lay people alike.

It will be of positive value, and I see it taking a natural part of the evidence-based programme being undertaken by the NHS.

Straightforward guidance has been needed for a long time and this publication clearly provides it.

**Jane Priestman OBE**  
(BAA, British Rail) Design Management Consultant

# Executive summary

## PREAMBLE

This guidance document was written jointly by BRE and the Colour Design Research Centre at London South Bank University as part of a Department of Health (NHS Estates) funded project "Lighting and Colour Design for Hospital Environments". It covers the visual environment in hospitals and the use of appropriate colour design and lighting. It will be of interest to anyone involved in designing, refurbishing or maintaining hospital environments, particularly NHS specifiers, design teams and facilities managers. It includes a review of published work, visits to hospitals and interviews with designers, facilities managers, medical staff and patients.

## THE VISUAL ENVIRONMENT

The quality of the visual environment has a positive effect on the occupant's feeling of well-being and in the case of hospitals and healthcare buildings this can affect staff performance and patient recovery. The cost of hospital staff and patient treatment is considerable; therefore, measures to maximise performance through improved environments will generally be cost-effective.

For these reasons, it is essential to consider lighting and colour design at the early stages of specifying and designing a building. Only then can a truly integrated approach to the visual environment be undertaken. It may be difficult, disruptive or costly to make changes once a hospital is in use.

Hospitals have a wide range of users (section 1.2) with different requirements, from the elderly to the very young. A well-designed visual environment can be particularly helpful to patients with partial sight.

## COLOUR DESIGN AND INTERIORS

Colour (chapter 2) can play a major role in creating accessible environments. Surface textures and choice of materials provide visual and tactile clues to help people with poor vision use a building. Colour contrast can identify obstacles and hardware that might prove difficult to negotiate. Features of a building which create tonal detail or shadows can also aid the visually impaired. Well-designed, ambient environments will have transitions of lighting and colour design to allow the eye to adapt to changes in lighting levels.

The appearance and ambience of a building interior at night can be very different from daytime. It can be a frightening prospect to those with poor vision, whether a patient, member of staff or visitor. Landmarks or surfaces may not have enough contrast, colour-design highlighting or lighting to demarcate boundaries, assist wayfinding or identify potential obstacles.

## LIGHTING AND DAYLIGHTING

Windows (section 3.1) are of key importance; as well as natural light, they provide an outlook, contact with the outside and access to sunlight about which patients are extremely positive. Windows should therefore be sized and positioned to provide a view out, regardless of location, as well as a reasonable average daylight factor. Good, controllable solar shading is essential. The colour and materials of window treatments such as blinds or curtains needs to be chosen with care to enhance the interiors or control glare (section 2.4).

An electric lighting installation (section 3.2) serves a number of needs; some are obvious, such as being able to see to move around safely or to carry out tasks which might be easy or complex.

Lighting has a considerable effect on the appearance of a space. The visual appearance of the lit space also applies to the way lighting equipment integrates with the architectural design and the physical elements of the building. It is equally important to ensure that electric light integrates with daylight.

For both lighting and colour design, a proper maintenance plan needs to be drawn up at the design stage, and carried out at regular intervals, to ensure that the quality of the visual environment remains high following installation or refurbishment.

Energy efficiency has a direct influence on running costs. The use of efficient lamps, ballasts and luminaires, coupled with appropriate lighting controls, can be highly cost-effective and help to meet energy targets for the NHS.

During the planning stage, it is essential to consider the running costs over the life of the installation as well as its capital cost. Lighting installation costs, even those involving high quality equipment, will be tiny compared

with the cost of staff and medical equipment. If high quality lighting makes just a small improvement on the performance of the hospital, in terms of either staff productivity or patient recovery rates, then it will be a price worth paying.

## THE HOSPITAL ENVIRONMENT

Chapter 4 of the guide deals with the design of specific areas: general (public) areas (section 4.2), circulation areas (section 4.3) and care areas (wards) (section 4.4). Specialist medical areas such as operating theatres are not covered in this guide.

For general areas and circulation areas (sections 4.2, 4.3) there are two priorities: to provide a pleasant environment for all hospital users, and to help and guide them as they move through the hospital.

Lighting design will concentrate on the appearance of spaces with enough light on walls and ceilings. Spaces will be more pleasant if daylight and views out are available.

Even in general areas, there is a surprising range of visual tasks; staff and users will need to be able to see to perform these tasks and to move around the building.

Hospitals must have emergency escape lighting to switch on automatically in a power failure. In some areas of a hospital, it will be necessary to provide stand-by lighting to enable procedures to be continued or shut down safely.

Sometimes a relatively minor change to the colour design or lighting of spaces can solve an ongoing, apparently insurmountable, problem (for example, extra lighting on walls with accent colour to brighten up a gloomy area). Colour design and lighting consultants can often pinpoint the reason why a place does not "feel" right. For example, a change of floor colour from light to dark or vice-versa can affect a whole area dramatically. Section 5.1 of the guide is intended to help here. It enables the facilities manager to troubleshoot common difficulties, suggesting appropriate solutions.

## CONCLUSION

A properly designed visual environment, with the appropriate use of colour and lighting, will have important benefits in hospitals (see section 5.2). A relatively small investment in good, thoughtful colour and lighting design may reap major dividends over many years for patients, staff and visitors.

# Acknowledgements

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The research was supported by an Advisory Panel comprising NHS Estates specialists, representatives of care organisations, accessible environments, patients associations, and manufacturers, hospital architects, designers and experts in the field. The Advisory Panel have provided help and advice and comments on an early draft of this guide.

The report is made on behalf of BRE and the Colour Design Research Centre, London South Bank University. By receiving the report and acting on it, the client – or any third party relying on it – accepts that no individual is personally liable in contract, tort or breach of statutory duty (including negligence).

Our very special thanks go to the large number of hospital staff, including facilities managers, nurses, doctors and ancillary staff, who gave up their valuable time to discuss colour design and lighting and to show us round their hospitals, providing a wealth of valuable comment and feedback. This report would not have been possible without their contributions. The hospitals are listed here:

1. Allgemeines Krankenhaus, Vienna, Austria
2. Bradford Royal Infirmary, West Yorkshire
3. Brighton General, Sussex
4. Bristol Royal Hospital
5. Southend, BUPA, Essex
6. Charing Cross, London
7. Chelsea & Westminster, London
8. Darent Valley
9. Derriford, Plymouth
10. Edinburgh Royal Infirmary
11. Great Ormond St Children's Hospital
12. Guys and St Thomas's – London Bridge
13. Guys and St Thomas's – Westminster
14. Kingston upon Thames, Surrey
15. North Middlesex
16. Poole, Dorset
17. St George's, Tooting, London
18. St Peter's, Chertsey, Surrey
19. Surrey County, Guildford
20. West Dorset General, Dorchester
21. Whipps Cross, London
22. Winchester, Hampshire

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- Q. People are complaining that the lighting is too dim
- Q. Not enough light on task
- Q. Space too gloomy
- Q. Lighting too bright in daytime
- Q. Patients complain of night-time spill light (for example from corridors)
- Q. Glare, or reflections in VDU screens or medical equipment
- Q. Lighting flickers
- Q. Photoelectric controls don't work
- Q. How can we create a pleasant environment in places with no windows, eg internal corridors?
- Q. What advice do you have for selecting pale colours for large environments?
- Q. How could the impact of contrast between an old, existing scheme and a bright, new refurbishment be minimised?
- Q. How does colour contrast in environments help visually impaired or elderly people?
- Q. On colour design, how can maximum visual impact be achieved at minimum cost?

Which features/elements give greatest individual impact?

- Q. This room is tired, how can I make it look fresher?
- Q. How can colour be used on doors to comply with the Disability Discrimination Act?
- Q. How can I use colour and lighting to make a room look bigger?
- Q. Could you give us some simple examples of colour design good practice from NHS Trust hospitals?

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# 1. Background

## 1.1 Introduction

This publication provides guidance on the use of light and colour design in hospitals. It complements the CIBSE Lighting Guide: 'Hospitals and healthcare buildings' [1.1]. In particular, it is concerned with public spaces, which include the entrance and reception areas, circulation spaces and hospital wards. It does not consider the specialist clinical areas.

The guide has been produced to aid design teams, the hospital trusts that commission a facility and also the people who are responsible for its operation and maintenance.

Of all the human senses, vision is by far the most powerful in providing information about the world around us [1.2]. For the visual process to be effective, there needs to be good lighting to enable people to carry out tasks which can range from the relatively simple to the highly complex. It also informs us about the environment around us, not just in an objective way by determining things such as a room's shape, size and colouring but by creating a psychological sensation which can induce feelings of comfort, security, stimulation and much more [1.3].

The visual environment is formed by the interaction of its physical elements and the light that illuminates it. Thoughtful use of colour application can achieve so much in interior design. However, it is the nature of the physical elements and of the illumination together with the interaction between them that will determine its quality. Colour has a vital role here in enhancing the environment and providing information and spatial orientation, helping occupants make sense of their surroundings. Aesthetically, it can provide attractive, pleasing conditions for patients, visitors and staff.

There is some evidence (chapters 2 and 3) that the design of the visual environment, particularly with regard to the composition of light and colour, can have a positive effect on the well-being of the occupants [1.4–1.6]. For example, in some hospitals, it has been found that the quality of the visual environment has had a positive effect on the recovery rate of patients and of the effectiveness of staff, although research evidence is often limited. Nevertheless, this aspect of design should not be overlooked.

The physical aspects of the design of a building are the responsibility of the architect and the interior designer, if one is appointed. They in turn may appoint a specialist lighting designer as well as a colour design consultant to help ensure that a high quality visual environment is achieved. In a hospital, this is particularly important because of its function, its many requirements and the different people it serves.

The application of colour and design to patients' accommodation should take account of the emotional and psychological factors which can affect

their well-being. This should include the likes and dislikes of user groups of all age groups and cultures. The primary objective is to achieve a friendly and welcoming atmosphere with variety and interest for patients and visitors.

The skilful use of colour can help to overcome the sensory deprivation caused by lack of visual stimuli associated with drab or monotonous environments. Older people, long-stay patients and people with mental health problems have particular needs here (see sub-section 'Patients and visitors' in section 1.2).

Some hospital patients can go through emotional upheavals, which makes them more sensitive, and at the same time more receptive, to the emotional stimuli of colour and lighting. Patients with mental health problems have a particularly emotional experience and their reactions to colour have been shown to be extreme [1.7].

While colour does not in itself act as a cure, it does affect mood [1.8]; thus, the right colours can help to create an attitude which is therapeutic in the sense that it inspires confidence and can banish fear. The quest for the "correct" colour, however, is not as important as devising a scheme which enhances the building, whatever age it is, and thereby creates a harmonious environment.

Colour does, of course, also have a practical and functional use in patients' accommodation. Used with subtlety in all environments, it can be used to control reflected light, to make the most of available daylight and to help reduce glare. Used with strength, it can also be used for coding and identification purposes.

Lighting design should consider both daylighting and electric lighting. Both have important roles to play in providing appropriate visual conditions in terms of visual function and visual amenity. Visual function deals with the ability of the occupants to carry out their tasks efficiently. This not only includes the staff but also the patients and their visitors. Visual amenity refers to the creation of a lit environment that is appropriate for its purpose – to help the occupants feel comfortable, the staff to feel stimulated and the patients to feel confident and relaxed. The composition of surface colours will help with this visual impression; colour has both an aesthetic and practical function in changing the appearance of spaces [1.9]. Consideration of the interaction between light and surface colour and surface reflectance also needs careful examination (see sub-section 'Blankets and top linen' in section 2.4). Experiments have shown that a quantity termed "visual lightness" is positively correlated with occupant satisfaction [1.10].

High reflectance materials are required to give visual lightness, otherwise the surface – and hence the space itself – is likely to appear dark, even when high levels of light are used. Equally, limited areas of strong colour, such as those sometimes used in murals for children's wards, will need to be well-lit for them to have the full sense of vibrancy and to maintain interest after twilight. Lighting of such complex coloured designs needs to maintain a consistent appearance from day to night.

The architectural integration of the colour scheme and the lighting installation, including the equipment and the light pattern it provides, is another important aspect of design often overlooked [1.11]. Without

awareness of these issues, there could be visual confusion and discord. The lighting and colour design needs to grow naturally from the architecture and the building use, and consultation between the various members of the design team is essential. The inherent colour of the construction materials used for the fabric of the building can form the first element in the planning and creation of a building's interior colour palette.

A lighting installation needs to be effective not only in human terms but also in terms of its energy efficiency. This will optimise the electricity used for lighting, which will have benefits in terms of hospital running costs as well as the wider implications of global warming. This stresses the need to balance capital costs against running costs to ensure the best through-life cost solution. Low capital costs can often lead to high running costs which over the life of the installation is an economy that can quickly be eroded. In this area, the designer will need to consider the equipment used, how the design is organised with respect to natural light, its use and how lighting is to be controlled both manually and automatically. It will also be necessary to comply with the Building Regulations Part L2 2000 [1.12].

Maintenance is another important area that needs to be considered at the design stage to ensure that both colour design and lighting are at a premium throughout the life of the facility. Damaged and dirty paintwork or dirty light fittings and failed lamps suggest poor housekeeping and can give out the wrong message to visitors, patients and staff.

A poorly maintained lighting or colour scheme will also waste money through wasted energy when the lighting loses its effectiveness. It will also affect users' perceived level of confidence in the efficiency of the environment.

This publication deals with colour (Chapter 2) and lighting (Chapter 3) in more detail, and provides specific guidance for the range of situations and applications covered by this guide in Chapter 4.



## 1.2 Hospital users

Hospital design needs to reflect the wide range of their users, whether patients, visitors or staff.

### Patients and visitors

For patients and visitors, entering a hospital is often a stressful and uncertain time. To meet their needs, the NHS strategy has been to provide flexibility in services and to adopt a patient-oriented attitude towards improving the hospital environment.

A UK study on improvements in patient recovery [1.4] found that patients were released one-and-a-half days earlier in a refurbished environment compared with an unchanged one, and time spent in an intensive supervisory care area in a mental health unit was reduced by 70%.

A USA research project [1.13] established eight consistent themes in what patients and their families look for in the hospital's built environment. They wanted an environment that:

- facilitates connection to staff;
- facilitates connection to the outside world. This included an indoor environment that revealed sights and scenes from nature (see Figure 1.1);
- is conducive to a sense of well-being; that is "homely" (particularly in long-term care), "attractive", "inviting", "cheerful", relaxing, with positive distractions in waiting areas and an environment that facilitates autonomy and independence;
- is convenient and accessible – clear signs, visual clues and easy wayfinding were important;
- promotes confidentiality and privacy;
- is caring of the family;
- is considerate of impairments – long corridors, lack of seating, inappropriate signage are cited as problems;
- is safe and secure.

For patients and visitors, colour and lighting design can bring a welcome distraction from the problems that have resulted in hospitalisation. This can be accomplished with a careful selection of details such as décor, landmarks, artwork, the skills of interior landscape gardening and window designs (see Figures 1.2 and 1.3). In one hospital, an aerial photograph of the area is used on the ceiling of an examination and treatment area, which is a particularly stressful environment. Patients become absorbed searching for their home in the photograph.

### Older people and the visually impaired

Older people form an important and growing subset of the hospital population. They are more likely to need several treatments and to stay in hospital for longer periods (on average one-to-three weeks). They have particular visual and non-visual requirements that make good lighting and colour design important.

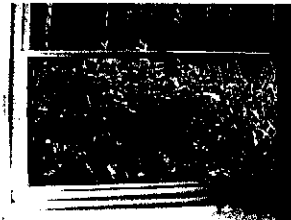


Figure 1.1 A window, view out or internal view onto a courtyard is a vital link to the outside world



Figure 1.2 Patients find landmarks and décor a welcome distraction. They can also aid orientation and wayfinding



Figure 1.3 Courtyard and landscape gardening can provide visual interest in an urban or suburban context

As a person's visual system ages, various changes become apparent [1.14, 1.15]:

- The eye finds it harder to focus at close range. Older people usually require reading glasses or varifocal lenses for close work.
- The retina receives less light because of increasing lens absorption and reduced pupil size. It is estimated that, for the same light level, a 60-year-old receives about one-third the retinal illuminance of what a 20-year-old receives. It is recommended that [1.14] "at least three times more light will be needed in task areas to see fine details".
- More light is scattered within the eye. This has two impacts: (1) the contrast of the image on the retina decreases, making it harder to see; (2) the scattered light also decreases the vividness of colours.
- Because of yellowing in the lens, older people become less sensitive to wavelengths of light at the blue end of the spectrum.
- The eye becomes slower to adapt between bright and dim conditions. Travelling from dim to bright appears to be the most disabling [1.16] (see Figure 1.4).

Older people are more likely to have some more serious form of visual defect. Other users of hospitals may also have difficulty seeing. They do not have to be registered blind or visually impaired people, but could be people who have forgotten their correction equipment (glasses, etc) or people who have temporary impairment due to an illness, stress or a treatment (for example, migraine headaches).

A person's type of visual impairment and their visual acuity determine what they can see. Only 4% of registered blind people have no sight at all. Many are able to make out shapes and contrasts in colour [1.17]. People with cataracts are more likely to have problems with glare (Figure 1.5) and a reduction in the ability to see short wavelengths (blues), while long wavelengths (yellows, oranges) are accentuated [1.18]. For difficult visual tasks, a cooler colour of light may be preferred (see sub-section 'Task illumination' in section 3.2). It is important that (total colour-blindness) is frequently observed in diabetic retinopathy [1.18]. This obviously has implications for the colour design of signage (see sub-section 'Signage' in section 2.3).

Visually impaired and older people like to feel comfortable and in control. Feeling in control includes knowing where they are and where they are going [1.19]. People with low vision concentrate on looking at floors or at waist level at walls. They use the ceiling for spatial perception and orientation, skirting-floor and skirting-wall junction for assistance, and door handles and frames for identifying doors [1.19] (Figure 1.6). Visually impaired people feel more confident if they can identify the location of doors [1.18]. Strong contrast between objects and obstacles as well as text in signage (Figure 1.7) is required. The use of colour for wayfinding or orientation (section 2.3) should be boosted by careful illumination to provide adequate guidance and safety [1.19].

### Other disabled people

Other categories of disabled people [1.20] have special requirements for sensitive lighting and colour design:

- Wheelchair users need lighting on low level controls. Signage should be clearly lit when viewed from wheelchair level. Places where people



Figure 1.4 Adaptation between extremely different lighting conditions is slower as a person's visual system ages. Lighting design should provide well-lit transition areas to accommodate moving from dim to brightly-lit areas



Figure 1.5 Strong lights shining from back-illuminated signage can cause glare problems for people with cataracts

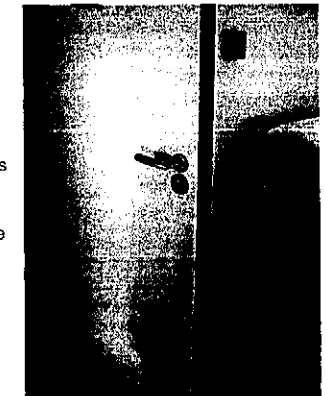


Figure 1.6 Use of strong contrast on potential obstacles, such as edges of doors, aids safety and accessibility for all