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# Indoor Lighting Design Incorporating Human Psychology

Albert T.P. So\* and L.M. Leung\*

*Lighting is one of the most important building services in every building, in particular, the modern commercial buildings. Without a proper lighting design, human beings cannot carry out their intended activities effectively, efficiently and comfortably. Conventionally, the horizontal illumination level, measured in lux, has been employed as the dominating factor within an overall lighting design package. However, it is the view of the authors that a lighting system not only provides adequate lumen intensity for the visual ability of occupants, but it also significantly affects the occupants' physiology and psychology. It is also felt that interior lighting design must always come with the design of the colour of wall finishes. In this paper, the relationship between lighting design criteria and human physiology and psychology is studied and a questionnaire has been prepared to investigate the psychological effects of light, in particular colour, on the activities of occupants. Here, colour refers to the colour of either the incident light directly from the luminaires or the reflected light from the wall finishes/furniture as perceived by the occupants. A list of colour finishes is recommended for different kinds of indoor environment. It is hoped that this paper will provide a reference to lighting designers of modern buildings for satisfying the user's psychology.*

## Introduction

Lighting design is a very complicated process. In accordance with the Task Group of Lighting Division Technical Committee of the Chartered Institution of Building Services Engineers [Ref. 1], a good lighting design is the result of considering scientific knowledge, practical experience, technical feasibility and economic reality. There are five procedures of a good lighting design. Objectives involve the consideration of factors affecting the design. Specifications are sets of compatible design criteria. The best type of lighting system is then chosen to achieve the desirable objectives in terms of general planning. By detailed planning, the final scheme that ensures the most economical and efficient design is adopted. Finally, the stage of verification assesses the level of success based on the design objectives and evaluates the acceptability to the clients or users. The design of lighting is, in fact, a piece of work related to both science and art. The balance between decoration, aesthetics and functions actually vary when the visual work, building form, client requirement and colour of finishing etc. are different. It is therefore worthwhile to study factors affecting the overall design of a lighting system. These factors [Ref. 2] include safety, visual tasks, space dimensions, space activities, spatial forms, furnishings, clients' expectations and age of occupants etc. [Ref. 3-5]. Bridger [Ref. 6] gave a general introduction how to design a lighting system to achieve lighting comfort. Light can be reflected, transmitted, diffused or absorbed by an area. In particular, when an indirect lighting arrangement is adopted, as in many indoor design cases, most of the light perceived by the occupants is reflected or diffused from the ceiling, walls, floor and furniture. Different kinds of surface finishes have different

reflectance, a high reflectance of the surface implying the requirement of a lower illumination intensity. An optimal surface illumination where glare is being minimised is affected by the choice of finishes, i.e. materials with different reflectance. At the same time, the surface of finishes affects the appearance of brightness, i.e. the luminance, of a space, thus affecting the feelings of occupants. Colour itself not only contributes to the appearance of the surface of the interior of the building, it also affects human mood towards work and entertainment. Just like the texture of surfaces, different coloured finishes of surfaces have different reflectance, e.g. lighter colour normally has higher reflectance than the dark one. Helms and Belcher [Ref. 7] found that colour actually influenced human beings in terms of the subjective impression of ambient temperature. People would feel an orange colour the hottest and blue the coolest. Many psychologists have studied the effects of colour of human psychology and some guidelines can be found regarding the specific feelings of human beings towards different colours [Ref. 8]. Therefore, in a cool environment, a warm colour finishes will be preferable and vice versa. Birren [Ref. 9] stated that warm illumination gave occupants a sense of "friendliness and natural" but cool light made people feel ghastly and eerie. Thus, he recommended a warm colour pattern in a room with low illumination and vice versa. McAndrew [Ref. 10] pointed out that a light coloured room would appear bigger and more spacious than a dark coloured room. But dark coloured rooms help to make people feel more expensive and richer. It is generally agreed that an appropriate atmosphere can be created for a particular application of the indoor environment if the right colour finishing has been adopted.

The colour of light perceived by the occupants is not necessarily the colour of the finishes. A white wall or ceiling will reflect coloured light from the luminaires. As a matter of fact, it is difficult to discriminate

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**Table 1**  
The result of mixing coloured light and coloured finishes

Surface Colour	Colour of Light			
	Red	Blue	Green	Yellow
Red	Bright Red	Bluish Red	Yellow Red	Light Red
Blue	Red Purple	Bright Blue	Dark Green Blue	Reddish Purple
Green	Olive Green	Green Blue	Bright Green	Yellow Green
Yellow	Red Orange	Reddish Brown	Greenish Yellow	Bright Orange
Brown	Brown Red	Blue Brown	Dark Olive Brown	Brownish Orange

between the colour of light and the colour of finishes as they are influencing each other significantly. A totally different colour perception results when light of one colour is reflected by a surface of another colour. Ivergard [Ref. 11] quoted the result of mixing coloured light and coloured finishes as shown in table 1.

In this paper, the relationship between lighting design criteria and human physiology and psychology is studied and a questionnaire has been prepared to investigate the effects of colour on the activities of occupants. A list of colour finishes is recommended for different kinds of indoor environment. It is hoped that this paper will provide a reference to lighting designers of modern buildings for satisfying the user's psychology.

**Physiological Effects of Light**

Wurtman [Ref. 12] divided the effects of light on human beings into two categories, direct and indirect. Direct effect means a chemical change in tissues which absorbed light energy. Indirect effect means an indirect response of tissues towards light as neural or hormonal signals.

Visible light is only one small portion of the whole electromagnetic spectrum while all kinds of luminaires not solely emit visible light but also radiate out infrared and ultraviolet radiations. The wavelength of infrared radiation is in the range of 700 nm to 10<sup>6</sup> nm. When infrared radiation strikes the human skin, heat energy is produced, resulting in the dilation of local blood vessels and the corresponding sweat glands are activated. This is the result of an experiment conducted long time ago by H.L. Logan that infrared radiation could increase circulation rate, thus ridding the body of toxins and lightening the load on the kidneys. Visible light is radiation within the range of 400 nm to 700 nm. Helms and Belcher [Ref. 13] found that visible light could disrupt bilirubin, the yellow compound produced when red blood cells died. If the bilirubin level exceeds a limit of concentration due to the exposure to excessive visible light, there will be brain damage and even death. Besides, it was generally believed that direct visible light could produce scar tissues on retina of children. However, Birren [Ref. 9], on the contrary, suggested that visible red light prevent scar formation and therefore, it is a question of the magnitude of light energy concerned. Ultraviolet is within the range of 400 nm to 100 nm. There are four classes of ultraviolet radiation. Vacuum UV is strongly absorbed by air. UV-B can cause skin tanning and even skin cancer. UV-B and UV-C can cause reddening of skin and inflammation of the conjunctiva of eyes. UV-A sometimes can cause reddening and tanning of skin but a much higher intensity is required. Moreover, UV helps to produce Vitamin D for human beings.

Regarding indirect effects, Wurtman [Ref. 12] found that the production of a powerful hormone, melatonin, was affected by the daily light patterns. Melatonin is secreted by the pineal organ, which affects sleep, ovulation, the secretion of other hormones and the regulation of the body's daily rhythm. Improper melatonin secretion can lead a human being to develop a mood of feeling unbalanced, sadness and total depression. Thus, an irregular light pattern or absence of light pattern may disturb the body clock and the daily rhythm. Researchers led by Hollwich [Ref. 14] discovered that an increase in illumination level could increase hormone production, in particular, the stress hormone cortisol. Birren [Ref. 9] stated that haemoglobin in the blood could be increased by light and decreased under darkness. Therefore, people normally feel sleepy under a dimmer environment. When the eyes are exposed from a bright environment to a dark one, dark adaptation occurs. Osborne and Grunegberg [Ref. 15] found that dark adaptation failed under red light since the rods were less sensitive to red light. Glare can make a human being feel uncomfortable (discomfort glare) and impair the visibility (disability glare). When a high luminance of an area is close to the line of sight, the scattering of light inside the eye and light adaptation will cause a reduction in the contrast of the object, affecting human vision. Glare not only reduces the sensitivity of human beings to light, but makes them feel painful and dizzy or perceive after-images and wash-out images. Both direct and indirect physiological effects of colour will affect the occupants. Birren [Ref. 9] and Marberry [Ref. 16] stated the effects of colour of light on human physiology and they are summarised in table 2.

These colour effects not only apply to the colour of finishes but also colour rendering of light. As stated by Steffy [Ref. 17], colour rendering was critical to the chromatic contrast and the general crispness or vividness of an environment. Colour contrast perceived by human beings would be diminished when poor or lower-colour-rendering lamps were used.

**Psychological Effects of Light**

Psychology is a very broad area. Holahan [Ref. 18] defined environmental psychology as an area of psychology whose focus was on the inter-relationship between the physical environment and human behaviour and experience. Therefore, the psychological effects of light on humans include the feelings, behaviours and performances of the lighting systems on the occupants. Feeling is a subjective impression which refers to how a lighting system makes a person feel and it can be studied by questionnaires. Behaviour means how light can influence a person's actions and it can be studied by experiments and observations. Performance is how fast and how good a person can perform on his/her work and it can be

**Table 2**  
Effect of colour of light on human physiology

Colour	Effects
Red	Prevention of scar formation and exciting and raising blood pressure
Green	Healing high blood pressure
Blue	Relieving headaches, bleeding and open wounds etc.
Violet	Reduction in stress and creating of calmness

graded by counting the speed and accuracy of the person to complete a visual task. Three concepts [Ref. 18,19] are important in the study of psychological effects, namely environmental perception, environmental cognition and environmental attitudes.

Regarding the feelings of occupants, it was discovered by the author, based on a set of questionnaires as detailed in the next section, that 94% of people felt more concentrated under a high illumination level provided that there was no glare and 64% felt relaxed under low illumination level. Many people felt 'free' under a low illumination level (56%) and complete darkness (34%). It was also found that most people would choose a path that took a longer time to walk through if the other choices had a lower illumination level. That revealed that illumination level provided people with a sense of protection and security. Champness [Ref. 20] discovered the effect of illumination level on people's reaction towards strangers. Regarding contrast, Flynn [Ref. 21] found that people felt a room more spacious if the illumination level had been uniformly distributed. However, non-uniformity of lighting pattern would give people a sense of privacy, relaxation and pleasantness. People would particularly feel high privacy when they were under low illumination with high illumination at a distant place. Regarding colour temperature, it was reported that [Ref. 1] light from 2800 K to 3200 K was warm toned and 3500 K was neutral white. Light from 3700 K to 4200 K was cool toned and 5400 K was blue-white. Light from 2500 K to 3700 K, i.e. warm-white to neutral-white, could make people feel relaxed.

Regarding the behaviour of occupants, Flynn [Ref. 21] observed that if two seats, one facing a bright wall while the other facing a dark wall, were available, people would normally choose the one facing the bright wall. When people enter a lecture room, most people would choose to sit where the illumination level is higher. However, Geragen [Ref. 22] reported that people in darker rooms tended to talk more, speak more freely and have more body language and more body contact with other people. Helms [Ref. 7] explained that this behaviour had been due to three issues. Firstly, darkness increases feelings of anonymity. Secondly, darkness is associated with uninhibited behaviours as in the daily life, such as a bar or a bedroom. Thirdly, darkness isolates an aggressor for a victim. Sanders [Ref. 23] found that the sound pressure level measured in a darker corridor in the university had been lower than expected elsewhere. That is in conflict with what has been mentioned before that

people tend to feel 'free' under low illumination. The point is due to contrast. If people are under a low illumination level next to an area of high illumination level, they become quiet and less aggressive. Regarding colour, Birren [Ref. 9] noted increased restlessness when people were exposed to red colour and green colour was towards the other extreme. He also noted that blue light would lessen activity and make people cry easily. An experiment by Stark [Ref. 24] reported the behaviour of people towards gambling under red and blue environments and the results are listed in Table 3.

Regarding the work performance of occupants, it is generally agreed that people tend to work faster and more accurately when accomplishing a task under a higher illumination level and that will be saturated as the level gets too high, say 3000 lux. The performance also increases as the contrast is increased but if the contrast is too large, glare will hinder the performance of human beings. Regarding colour, Ott [Ref. 25] conducted research on four Grade 1 classes. Two classes were under lighting with full-spectrum while the other two were under cool white light. The result showed that students under cool white light tended to become hyperactive, fatigued and irritable. Students under full spectrum performed well academically. That indicates that a balanced spectrum is essential to enhance the work performance of people.

**Use of Colours for Indoor Lighting Design**

As mentioned in the previous sections, colour is so important towards the physiology and psychology of human beings and thus, a questionnaire exercise was carried out. A copy of the questionnaire is included as Appendix 1. Subject to the limitations of space, the raw results are not included here but a summary of the recommended colours for different applications, based on the results of the questionnaire exercise, are attached as appendices. Appendix 2 shows the moods associated with different colours. Appendix 3 suggests the recommended colour applications for residential buildings. Appendix 4 shows the recommended colour applications for educational buildings. Appendix 5 shows the recommended colour applications for office buildings. Appendix 6 shows the recommended colour applications for retail buildings. Appendix 7 shows the recommended colour applications in places of public assembly. Appendix 8 shows the recommended colour applications in hospitals.

**Table 3**  
Behaviour of people gambling under red and blue environments.

Red Environment	Blue Environment
Bet more frequently	Bet less frequently
Higher stakes	Lower stakes
Greater risk taken	Lesser risk taken

## Conclusions

The physiological effects can be categorised into direct and indirect items while the psychological effects can be categorised into human feelings, behaviours and performance. The importance of colour of finishes and colour of lighting is highlighted in the paper. Here, we are referring to the colour of light perceived by the occupant's pair of eyes, irrespective of the colour of the finishes or the colour of light from the luminaires. A questionnaire exercise was carried out and more than 120 result sheets have been available for analysis.

The 120 feedbacks, divided into four categories in terms of age, were mainly Chinese in Hong Kong with some 10% from overseas. The first category consisted of young people below an age of 20, 73% of which from secondary schools and 27% of which from City University. Category II consisted of people from 21 to 40 years old, 13% of which from international feedbacks via Internet, 8% of which from street interviews and 79% of which from random interviews within the university. The third category consisted of people from 41 to 60 years old, 5% of which from Internet replies, 15% of which from street interviews and 80% from the parents of friends of the co-author of this paper. The parents were mainly housewives and clerical staff. The last category consisted of people above 60 years old and all had already retired. The findings of the questionnaires include moods associated with different colours, feelings of people related to the illumination level of the occupied space and the effects of lighting on human behaviour. Such feedbacks have been used to produce a list of recommendation for colour design of different indoor environments.

Although we tried our best to widen the range of interviews, we still faced some problems here and that would be future works of researchers who have gone through this paper and have built up their interests to follow up with. First of all, the questionnaire exercise, though having 10% feedback from overseas, has been very localised in Hong Kong. Therefore, this exercise has considered less on requirements and feelings of different races. Secondly, we have not distinguished between introverts and extroverts as they may have different responses towards colours. Thirdly, our emphasis has been on the user's point of view. For example, for those items related to hospital applications, our concern has been on the patients instead of the surgeons and doctors etc. As a matter of fact, colour in hospitals is not just a matter of the patient's 'required moods'. There are more critical conditions which must be provided to enable a proper clinical evaluation of a patient's condition which may be life-threatening. One example is to identify the difference between jaundice and cyanosis while the latter, if not correctly identified but taken to be jaundice, could lead to death sometimes. Actually, there are Australian Standards [Ref. 26], currently under review and about to be revised, dealing with the colour selection of light sources and environments in hospitals. All locations, such as operating theatres, waiting spaces and corridors outside the operating theatres, recovery rooms, intensive care rooms, observation rooms etc. are being considered in terms of the colour of light sources, colour of wall surfaces and even colour of observer's clothing.

It is, in general, hoped that this paper will help to provide a useful reference to designers of indoor lighting systems so that both the physiology and psychology of the users or clients can be taken into account, versus the conventional approach of focusing merely on lux level and glare index. Furthermore, it is hoped that this paper will initiate a more international study on similar issues so that a comprehensive guideline on colour selection will be formulated in the near future. One of the major goals of intelligent buildings in the modern world is to enhance the productivity of occupants using building services of high quality. The mood of occupants, being affected by the colour of the indoor environment, certainly affects the activity and performance of them and eventually the productivity.

## References

1. The Lighting Division Technical Committee of the Chartered Institution of Building Services Engineer's Task Group, *CIBSE Code for Interior Lighting*, CIBSE, London, 1994.
2. STEFFY G.R. and FIALD IES, *Architectural Lighting Design*, Van Nostrand Reinhold, New York, 1990.
3. N. *Aging and Human Performance*, John Wiley & Sons, Chichester (England), 1985.
4. SANDERS M.S. and MCCORMICK E.J. *Human Factors in Engineering and Design*, 7th Edition, McGraw-Hill, Singapore, 1992.
5. Weale R. "Retinal illumination and age", *Trans. of the Illuminating Engineering Society*, 1961, pp. 26.
6. Bridger R.S. *Introduction to Ergonomics*, McGraw-Hill, N.Y., 1995.
7. HELMS R.N. and BELCHER M.C. *Lighting for Energy Efficient Luminous Environments*, Prentice Hall, Englewood Cliffs, New Jersey, 1991.
8. EISEMAN L. and HERBERT L. *The Pantone Book of Colour*, Harry N. Abrams, N.Y., 1990.
9. BIRREN F. *Light, Colour and Environment*, 2nd Edition, Van Nostrand Reinhold, N.Y., 1988.
10. MCANDREW F.T. *Environmental Psychology*, Wadsworth, San Francisco, 1993.
11. IVERGARD T. *Handbook of Control Room Design and Ergonomics*, John Wiley and Sons, Chichester, 1989.
12. WURTMAN R.J. "The effects of light on the human body", *Scientific America*, Vol. 1, No. 1, 1975, pp. 68.
13. HELMS R.N. and BELCHER M.C. *Lighting for Energy-efficient Luminous Environments*, Prentice Hall, New Jersey, 1991.
14. HOLLWICH F., DIECHKUES B. and SCHRAMEYER B. "Die wirkung des natuerlichen und kunstlichen lichtes uber das auge auf den hormonund stoffwechselhaushalt des menschen", *Klin Mbl Augenheilk*, Vol. 171, 1977, pp. 98.
15. OBORNED J. and GRUNEBERG M.M. *The Physical Environment at Work*, John Wiley & Sons, Chichester, 1983.
16. MARBERRY S.O. and ZAGON L. *The Power of Colour: Creating Healthy Interior Spaces*, John Wiley & Sons Ltd., N.Y., 1995.
17. STEFFY G.R. and FIALD IES *Lighting the Electronic Office*, Van Nostrand Reinhold, N.Y., 1995.
18. HOLAHAN C.J. *Environmental Psychology*, Random House, N.Y., 1982.
19. GIFFORD R. *Environmental Psychology: Principles and Practice*, Allyn and Bacon, N.Y., 1987.
20. CHAMPNESS N. *Aging and Human Performance*, John Wiley & Sons, N.Y., 1985.
21. FLYNN J.E., SPENCER T.J., MARTYNINK O. and HENDERICK C. "Interim study of procedures for investigating the effect of light on impression and behaviour", *Journal of Illuminating Engineering Society*, Vol 3, 1973, p.87.
22. GERAGEN K.J., GERGEN M.M. and BARTON W.H. "Deviance in the dark", *Psychology Today*, October, 1973, pp. 129.
23. SANDERS M., GUSTANSKI J. and LAWTON M. "Effect of ambient illumination on noise level of groups", *Journal of Applied Psychology*, Vol. 59, 1974, p. 527.
24. STARK G.M., SAUNDERS D.M. and WOOKEY P.E. "Differential effects of red and blue coloured lighting on gambling behaviour", *Current Psychological Research*, Vol 2, 1982, p. 95.
25. OTT J. "Colour and light: their effects on plants, animals and people pt. 1", *Journal of Biosocial Research*, Vol. 7, 1985, p. 18.
26. Australian Standard *Artificial Lighting for Clinical Observations: 1765:1975 and a new standard*, about to be published (late 1997): *Interior Lighting: 1680.2.5:1997 (Section on Lighting for Hospital and Medical Tasks)*.

Appendix 1  
Questionnaire

Age \_\_\_\_\_

Sex \_\_\_\_\_

a) 0-20

b) 21-40

c) 41-60

d) 61 or above

1) Please ascribe mood(s) to the following colours (more than one option can be chosen).

Red \_\_\_\_\_

Burgundy \_\_\_\_\_

Pink \_\_\_\_\_

Orange \_\_\_\_\_

Yellow \_\_\_\_\_

Yellow Cream \_\_\_\_\_

Green \_\_\_\_\_

Yellow Green \_\_\_\_\_

Navy Blue \_\_\_\_\_

Dark Blue \_\_\_\_\_

Light Blue \_\_\_\_\_

Deep Purple \_\_\_\_\_

Light Purple \_\_\_\_\_

Gold \_\_\_\_\_

Silver \_\_\_\_\_

Copper \_\_\_\_\_

Dark Brown \_\_\_\_\_

Light Brown \_\_\_\_\_

Black \_\_\_\_\_

White \_\_\_\_\_

Cream \_\_\_\_\_

Neutral Grey \_\_\_\_\_

1 Active 22 Dignified 43 Loud 64 Secure

2 Authoritative 23 Distress 44 Mature 65 Serene

3 Bland 24 Durable 45 Mysterious 66 Serious

4 Boring 25 Dynamic 46 Nervous 67 Romantic

5 Bright 26 Elegant 47 Neutral 68 Shiny

6 Calm 27 Energetic 48 Old 69 Sinister

7 Cheerful 28 Evil 49 Passionate 70 Sober

8 Classical 29 Exciting 50 Peaceful 71 Soft

9 Clean 30 Feminine 51 Playful 72 Soothing

10 Comfortable 31 Free 52 Powerful 73 Sophisticated

11 Confidence 32 Fresh 53 Practical 74 Spirited

12 Conservative 33 Friendly 54 Professional 75 Sunny

13 Cool 34 Fun 55 Provocative 76 Sweet

14 Creative 35 Glowing 56 Pure 77 Tasty

15 Credible 36 Happy 57 Quality 78 Tender

16 Criminal 37 Hopeless 58 Quiet 79 Traditional

17 Cute 38 Hot 59 Rage 80 Upset

18 Dangerous 39 Innocent 60 Regal 81 Vital

19 Death 30 Jaundice 61 Relaxing 82 Warm

20 Defiant 41 Lazy 62 Restful 83 Youthful

21 Depression 42 Lively 63 Rich 84 Others

2) Which condition leads you feel more able to concentrate on your work?

a) Too bright light which makes you feel uncomfortable

b) Sufficient light but not makes you feel uncomfortable

c) Dim environment

d) No light

e) Flicking light

3) Which condition leads you feel more relaxed?

a) Too bright light which makes you feel uncomfortable

b) Sufficient light but not makes you feel uncomfortable

c) Dim environment

d) No light

e) Flicking light

4) Which condition leads you feel 'free'?

a) Too bright light which makes you feel uncomfortable

b) Sufficient light but not makes you feel uncomfortable

c) Dim environment

d) No light

e) Flicking light

5) When you are in a new environment, there are two paths (A and B) which you can use to reach your destination. But Road A needs you to walk 15 minutes more than Road B. Which road will you choose? When:

a) Lighting on A is brighter than B \_\_\_\_\_ (if choose Road A, why? \_\_\_\_\_)

b) Lighting on B is brighter than A \_\_\_\_\_

c) Same lighting level on A and B \_\_\_\_\_

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Appendix 2  
Moods Associated with Different Colours

Colours	Associated Moods	
	Positive	Negative
Red	active, dynamic, energetic, exciting, happy, hot, passionate	dangerous, provocative, rage
Burgundy	classic, dignified, elegant, mature, rich, tasty, warm	
Pink	cute, feminine, innocent, romantic, soft, sweet, tender, youthful	
Orange	bright, fresh, friendly, fun, happy, hot, playful, vital, warm, youthful	loud
Yellow cream	cheerful, happy, soft, sunny, sweet, warm	
Yellow	bright, cheerful, happy, hot, spirited, warm, youthful	jaundice
Green	classical, cool, dignified, peaceful, quiet, rich, serious, spirited, traditional	lazy
Yellow green	comfortable, fresh, lively, neutral, youthful	
Navy blue	authoritative, classical, confidence, conservative, credible, professional, quiet, serene, traditional	
Dark blue	classical, mature, mysterious, serious, warm	upset
Light blue	calm, comfortable, clean, cool, fresh, happy, peaceful, restful, soft, youthful	upset
Deep purple	dignified, mysterious, powerful, regal, rich, spirited	upset
Light purple	creative, romantic, royal, youthful	loud
Gold	dignified, rich, shiny, warm	
Silver	bright, classical, cool, dignified, exciting, rich, shiny, spirited	
Copper	classic, mature, mysterious, rich, serious	criminal, old
Dark brown	durable, mature, rich, secure, serious, warm	
Pale brown	classical, neutral, serious, soft, warm	bland, lazy, old
Black	classical, durable, mature, mysterious, powerful, serious, sophisticated	criminal, death, depression, evil, hopeless, sinister
White	bright, classical, clean, cool, peaceful, pure	
Cream	classical, dignified, neutral, rich, soft, soothing, sweet, warm	bland
Netural Gray	classical, cool, practical, quality, serious, sober	boring, hopeless

Appendix 3  
Suggestions of Colour Use in Residential Buildings

Types of usages	Required Moods	Proposed colours
<i>Flats/bedsits</i>		
Entrance lobbies	Dignified, regal, warm, happy, cheerful, comfortable, neutral and classic.	Yellow cream, deep purple and cream.
Lounges	Comfortable, relaxing, tender, peaceful, restful, fun, friendly, fresh, serene, soft, warm, neutral, happy and cheerful.	Cream, light blue, yellow, orange and yellow cream.
Kitchens	Comfortable, cool, tender, neutral and fresh.	White, light blue, and cream.
Bedrooms	Comfortable, relaxing, peaceful, restful, fresh, serene, soft, neutral, free and cheerful.	Cream, light blue and yellow cream.
Bathrooms	Comfortable, calm, relaxing, peaceful, restful, fresh, serene, soft, warm, neutral, free, happy and cheerful.	Cream, light blue and yellow cream.
Toilets	Comfortable, fresh, soft, warm, neutral and free.	Cream and yellow cream.
<i>Communal areas</i>		
Main entrances	Dignified, regal, rich, warm, happy, cheerful, comfortable, neutral and classic.	Yellow cream, deep purple and cream.
Corridors	Comfortable, pure, bright, warm, soft and neutral.	Cream, white and yellow cream.
Staircases	Comfortable, pure, bright, warm, soft and neutral.	Cream, white and yellow cream.
Lounges	Comfortable, calm, relaxing, tender, peaceful, restful, fresh, serene, soft, warm, fun, friendly, neutral, happy and cheerful.	Cream, light blue, orange and yellow cream.
Television lounges	Comfortable, calm, relaxing, tender, peaceful, restful, fresh, serene, soft, warm, neutral, happy and cheerful.	Cream, light blue and yellow cream.
Quiet/rest rooms	Comfortable, clam, relaxing, tender, peaceful, restful, fresh, serene, soft, warm, neutral, happy and cheerful.	Cream, light blue and yellow cream.
Dining rooms	Happy, cheerful, relaxing, comfortable, peaceful, restful, warm, tender, neutral and fresh.	Cream and yellow cream.
Laundries	Neutral and fresh.	Light blue, white.
Stores	Clean, neutral and bright.	White.
Treatment rooms	Relaxing, comfortable, peaceful, restful, warm, tender, neutral and fresh.	Cream and yellow cream.
Libraries	Classic, serious, clean, soft, classic, neutral, peaceful, serene, quiet and clam.	Gray, light blue, cream and white.

Appendix 4  
Suggestions of Colour Use in Educational Buildings

Types of usages	Required Moods	Proposed colours
Assembly halls	Serious, comfortable, classical, neutral and clean.	Light blue, gray, cream and white.
Teaching spaces	Comfortable, happy, spirited, energetic, cheerful, soft, warm, neutral, classical, and clean.	Cream, white and yellow cream.
Lecture theatres		
General	Comfortable, happy, spirited, energetic, cheerful, soft, warm, neutral, classical, and clean.	Cream, white and yellow cream.
Demonstration benches	Comfortable, energetic, warm, neutral, soft, classical, professional and clean.	Yellow cream, cream and gray.
Seminar rooms	Comfortable, happy, spirited, energetic, cheerful, soft, warm, neutral, classical, and clean.	Cream, white and yellow cream.
Art rooms	Spirited, comfortable, creative, neutral, energetic, soft, warm, fun, playful, cheerful, happy, lively, friendly, youthful, clean and bright.	Cream, yellow cream, pink, orange, white and yellow green.
Needlework rooms	Comfortable, creative, warm, clean, happy, cheerful and bright.	Cream, white and yellow cream.
Laboratories	Professional, classical, serious, clean, quality, serene, quiet and calm.	Gray and light blue.
Libraries	Classic, serious, clean, quality, peaceful, serene, quiet and calm.	Gray, light blue, and white.
Music rooms	Spirited, comfortable, creative, neutral, energetic, soft, classical, warm, cheerful, happy, youthful, lively, friendly, clean and bright.	Cream, white, yellow green, yellow cream and pink.
Sports halls	Spirited, neutral, energetic, soft, warm, cheerful, happy, youthful, lively, friendly, spirited, fun, clean and bright.	Cream, white, yellow green, yellow cream and pink.
Workshops	Comfortable, happy, spirited, energetic, cheerful, soft, warm, neutral, classical, and clean.	Cream, white and yellow cream.

**Appendix 5**  
Suggestions of Colour Use in Office Buildings

Types of usages	Required Moods	Proposed colours
<i>Offices</i>		
General offices	Causal, neutral, cheerful, happy, soft, warm, energetic, confidence, service, spirited, pure and clean.	Cream yellow, cream, gray and navy blue.
Computer work stations	Causal, neutral, cheerful, happy, soft, warm, energetic, pure and clean.	Cream, gray and yellow cream.
Conference rooms and executive offices	Professional, sophisticated, classical, serious, clean, warm, mature, quality, credible, authoritative, conservative, confidence, regal, serene, quiet, calm.	Navy blue, light blue, cream and gray.
Computer and data preparation rooms	Causal, neutral, cheerful, happy, soft, warm, energetic, pure and clean.	Cream, gray and yellow cream.
Filing rooms	Causal, neutral, soft, warm, classical, clean and practical.	Cream, gray, light yellow and white.
<i>Drawing offices</i>		
General	Causal, neutral, soft, warm, fresh, comfortable, energetic, quiet, relaxing, spirited, professional, pure and clean.	Navy blue, cream, light blue, yellow cream and gray.
Drawing Boards	Causal, neutral, soft, warm, fresh, comfortable, energetic, quiet, relaxing, spirited, pure and clean.	Navy blue, cream, light blue, yellow cream and gray.
Computer-aided design and drafting	Causal, neutral, soft, warm, fresh, comfortable, energetic, quiet, relaxing, spirited, pure and clean.	Navy blue, cream, light blue, yellow cream and gray.
Printing rooms	Causal, neutral, soft, warm, pure and clean.	Cream and yellow cream.

Appendix 6  
Suggestions of Colour Use in Retail Buildings

Types of usages	Required Moods	Proposed colours
<i>Fashion and household stores</i>		
Departmental store	Happy, tender, bright, free, spirited, energetic, neutral, sweet, warm, fun, soft, lively, fresh, regal and mature.	Light blue, cream, yellow cream, pink, white, green and orange.
Chain store	Happy, tender, bright, free, spirited, energetic, neutral, sweet, warm, fun, soft, lively, fresh, regal and mature.	Light blue, cream, pink, white, green and orange.
Specialist retailer	Professional, mature, sophisticated, classic, clean and soft.	Gray, cream and white.
<i>Retailing catering outlets</i>		
Food court	Comfortable, warm, soft, happy, cheerful, relaxing, peaceful, clean, classic, quiet, soothing, fresh, neutral, regal and tasty.	Cream, light blue, yellow cream, white and burgundy.
Fast food outlet	Comfortable, warm, soft, happy, cheerful, relaxing, clean, fresh and netural.	Cream, white and yellow cream.
Family restaurant	Comfortable, warm, soft, happy, cheerful, relaxing, clean and fresh.	Cream, white and yellow cream.

**Appendix 7**  
Suggestions of Colour Use in Places of Assembly

Types of usages	Required Moods	Proposed colours
<i>Assembly rooms</i>		
Public rooms, village halls, church halls	Serious, comfortable, peaceful, fresh, soft, warm, neutral, pure, and clean.	White, light blue, cream and yellow cream.
<i>Concert halls, cinemas and theatres</i>		
Foyers	Classical, comfortable, neutral, happy, cheerful, warm, soft, relaxing, restful and peaceful.	Cream, white, yellow cream and light blue.
Booking offices	Clean, comfortable, neutral, warm and classical.	White and cream.
Auditoria	Classical, comfortable, neutral, warm, soft, regal, tasty and elegant.	Burgundary, light brown and cream.
Dressing rooms	Comfortable, neutral, soft, clean and bright.	White and cream.
Projection rooms	Comfortable, happy, clean, soft, warm, neutral, and classical.	Cream, white and yellow cream.

Appendix 8  
Suggestions of Colour Use in Hospitals

Types of usages	Required Moods	Proposed colours
<i>Operating and treatment areas</i>		
Operating room	Fresh and relaxing. (colour could lessen the eyestrain during operations)	Green.
Endoscopy	Comfortable, soft, warm, fresh, soothing, neutral and pure.	Cream, white and yellow cream.
Anaesthesia room	Comfortable, soft, warm, fresh, soothing, neutral and clean.	Cream, white and yellow cream.
Minor treatment	Comfortable, soft, clam, soothing, neutral, clean and classic.	Light blue, yellow cream, cream and white.
Major treatment	Comfortable, soft, clam, soothing, neutral, clean and calssic.	Light blue, yellow cream, cream and white.
Recovery room	Comfortable, soft, clam, soothing, neutral, clean, calssic, peaceful, restful, quiet and happy.	Light blue, navy blue, cream and white.
Scrub-up room	Fresh, comfortable, soft, warm, and relaxing.	Green and yellow cream.
Viewing	Comfortable, soft, warm. fresh, soothing, neutral and clean.	Cream, white and yellow cream.
<i>Utility areas</i>		
Bathroom and shower	Comfortable, clam, relaxing, peaceful, restful, fresh, serene, neutral and free.	Cream, light blue and yellow cream.
Changing room	Soft, warm, happy, neutral and comfortable.	Yellow cream and cream.
Cloak room	Soft, warm, happy, neutral and comfortable.	Yellow cream and cream.
Dark room	Clean, pure, bright and neutral.	Cream and white.
Clean and dirty utility rooms	Clean, pure, bright and neutral.	Cream and white.
Laundry	Clean, pure, bright and neutral.	Cream and white.
Stores	Clean, pure, bright and neutral.	Cream and white.
<i>Wards</i>		
Circulation	Clean, pure, bright, warm and happy.	Cream and white.
Intensive care and observation areas	Professional, classical, calm, soothing, soft, netural and clean.	Gray, light blue and white.
Baby care unit	Cute, soft, sweet, tender, fun, warm, peaceful, restful, fresh, happy, cheerful, sunny, glowing, friendly.	Cream, pink, light blue, yellow cream, orange and green.
Nurses' station	Comfortable, clam, relaxing, restful, clean, peaceful, happy and fresh.	Yellow cream, cream and white.