LIGHTING JOURNAL 34

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Front and Back Cover: *The spectacular British Pavilion at the Expo '92 fair in Seville is lit by more than 200 metal halide floodlights. Its glass and steel framework allowed the light from within to stunningly illuminate a 25m high wall of moving water. The refreshingly cool, calming white light of the floods is ideally suited to the climate of Southern Spain, where temperatures can approach 50 deg C.*

Inside Front Cover: *The famous pink marble clad towers of the Hong Kong stock exchange have recently become floodlit. The scheme involved the installation of a total of 45 1kW compact metal halide floodlights which illuminate the twin 180m curved towers and a single 130m tower which together comprise the trading hall and administrative offices.*

Inside Back Cover: *An unusual - but ideal - application for amenity lanterns at Salford Quays in Manchester. The result is an attractive day time appearance and effective night time performance.*

The sheer variety of lighting installations undertaken these days impresses upon one the fact that more and more companies, local authorities and a myriad of other clients have woken up to the fact that well thought out lighting can make a world of difference to their particular project.

Who, for example, just a few years ago, would have thought of illuminating a moving wall of water like that in the British Pavilion at Seville's Expo '92 ? Who would have thought that computers could accurately visualise a future lighting scheme in minutes ?

All these things are now with us. They are fact, not fiction, and the world of lighting is still one which holds a fascination for us all. There are still applications out there to be discovered, to be developed and to be exploited.

In this issue, we have touched upon some of those new developments and illustrated typical examples of good lighting installations. We hope you will find reading about them interesting.

Finally a glance at some impressive lighting installations around the world completes an issue which we hope provides something of interest for all our readers. If you have a specialised installation, an unusual application or just a good lighting story using our products, let us know. We may be able to use the information in a forthcoming issue of Lighting Journal.

Contents

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Left: *The visitor enters the Pavilion by crossing a steel bridge which spans a deep moat. The underwater tungsten fittings can clearly be seen in the main photograph.*

Below: *The front of the British Pavilion at night and a close up of the water wall in motion.*

LIGHTING THE BRITISH PAVILION AT EXPO '92

Since 1851, universal expositions have served to illustrate world cultural, technological and scientific advances and Expo '92 in Seville is no exception. The event was the first major spectacle of Spain's 1992 celebrations to mark the 500th anniversary of Christopher Columbus's discovery of the New World - hence its central theme 'The Age of Discovery'. In six months over 18 million people visited the hi-tech pavilions sited to the west of Seville on the hot, dry island of La Cartuja.

THE BRITISH PAVILION

At Expo '92 the British Pavilion designed by architects Nicholas Grimshaw and Partners has been heralded as being one of the world's foremost examples of structure and space utilisation. Faced with both an architectural and climatic challenge (temperatures in high summer in Seville can reach as high as 49°C) Grimshaw decided to make the whole facade of the pavilion a vast wall of moving water, powered by roof mounted solar panels. In fact the whole building has been designed to provide an environmentally controlled atmosphere with the presence of moving water being the key element. Evaporation from the water helps reduce the air temperature quite considerably and this contribution is accounted for with the necessary air handling and cooling plant.

A SPLENDID STRUCTURE

The British Pavilion is sited at the crossroads of the European and International Avenues. Visitors approaching from the east see a massive crystal structure of glass, steel and fabric some 25m high, 70m long and 40m wide. The whole eastern facade is a cascade of falling water which rushes over the glass before dropping the last 5 meters into a huge artificial lake which extends back inside the building. This shimmering water wall was designed by sculptor William Pye and can be adjusted to give various effects. Exhibition structures and a giant Union flag can be seen through the water wall. Two curtains of water mark the entry point which is served by a narrow steel bridge that passes over the moat. Once inside, the visitor enters a cavernous interior, taller than the nave of Westminster Cathedral and highly reminiscent of Sir Joseph Paxton's Crystal Palace of the 1851 Great Exhibition in London.

Visitors are moved around the five-storey building on four 50m long sloping travelators. These carry the crowds to the various viewing levels which are suspended from the pavil-

At the top of the page is a floodlit view of the west wall, constructed from freight containers and at the foot of the page the problems of installation - there being no real walls or ceilings.

ion's steel frame. Thus the exhibition areas are almost entirely separated from the external structure.
On the flat roof are the 150 S-shaped panels of solar cells and at the northern and southern ends of the Pavilion huge curved translucent fabric 'sail' walls take up the whole height of the building.
The most exposed west wall is constructed from giant steel freight containers stacked together and filled with water. Rather like the thick masonry walls of a medieval cathedral the containers help absorb and tame the heat. To ensure an even temperature within the pavilion, air handling and cooling equipment has been incorporated into the structure. All the components were designed in the UK and transported to Spain and erected in a matter of only 42 weeks.

LIGHTING CONSIDERATIONS

The decorative floodlighting of the British Pavilion by Tom Harris of consulting engineers Ove Arup and Partners in conjunction with Nicholas Grimshaw and John Hugill of THORN Lighting, observed the three key points of good exterior floodlighting. Firstly be careful not to use too much light, secondly remember that the characteristics of the surface of the building are as important as those of the illuminant and thirdly note that areas of shadow can make as useful a contribution to the final effect as illuminated areas.

METAL HALIDE SELECTED

From the outset metal halide was selected as the major light source to carry through the feeling of coolness. Multi coloured fancy theme park effects were strongly avoided.
Reflections from glass present great difficulties for floodlighting and much care had been taken to avoid any excessive spill light and glare. To merely install floodlights at ground level would only make the giant glass panels look dull and lifeless as any reflections would be directed skywards. Therefore a decision was taken to effectively light the building from within as well as from the outside.

CHOICE OF LIGHTING FITTINGS

The scheme incorporates in total one hundred and twenty two compact floodlights, each housing a single ended 150W MBI-T light source and ninety more powerful 250W metal halide areafloods.
The 150W narrow beam projectors have a selection of front glasses which provide different light distributions and peak intensities to suit the structure. A mix of stippled and prismatic lenses are used giving symmetric and di-symmetric beam performances. The prismatic versions are much softer than the stippled types and also produce a slightly broader beam and were used to light the sails. The narrow beam stippled versions were fixed at each end of the structural framework to close offset light the trusses.

THE VISUAL EFFECT

Externally the lighting designers carefully considered the key viewing positions and the main visual impact points. A row of 150W floodlights defines the futuristic lines of the structure, particularly the roof mounted trusses and steel. The 250W areafloods are used in uplight mode to bring the S-shaped solar roof panels to life.
Thus strong highlights and shadows have been created by the positioning of the units rather than resorting to light sources of contrasting colour.

The spectacular central steelwork of the interior.

Internally floodlights have been installed at high and low level to allow the light from within to stunningly illuminate the water and fabric sail walls. Again the aiming of the narrow beam floodlights was crucial to avoid spill light onto the supporting steel work and glare from the glass panels. Restraint on the number of floods used resulted in a coherent light and shade pattern across the field of view.

PROBLEMS OF INSTALLATION

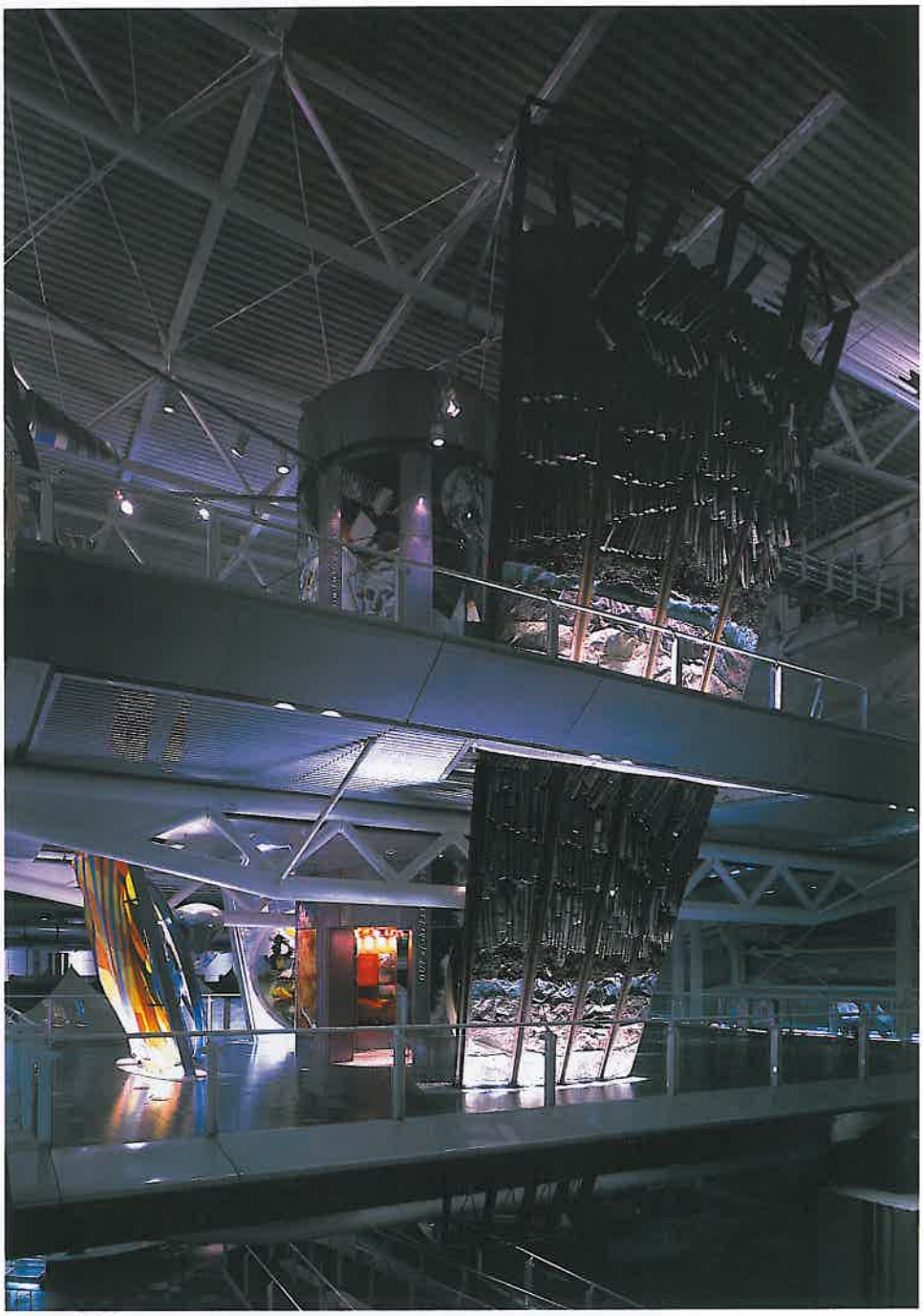
As the steel frame supporting the internal exhibition area is almost entirely separated from the external structure, installation was particularly difficult - there being no real walls or ceiling - and the electrical contractors had to use abseilers who were on site to install and commission other electrical services.

SPECIAL LIGHTING EFFECTS

The wonderful floodlighting effect is completed by the use of IP68 rated underwater luminaires with 300W PAR 38 tungsten lamps submerged in the ground level lake. Linked together in strings rather than used individually the fittings, constructed of copper and bronze, light the jets of water and spray at the base of the structure to about 5 metres and thus help avoid the 'floating' appearance which can often arise if the base of a building is underlit at low level.

CONCLUSION

The bold design of the Pavilion reflects Britain's Maritime History and the water wall is thought to be the world's largest. At night the elements of water, glass, steel, fabric and light combine to give a magical glow to the structure without the need for any razzamataz or bright coloured theme park effects. In every way, the Pavilion represents a showcase of British originality and technological prowess and above all, a dynamic vision of the future. Little wonder then that the pavilion won a high commendation for design and construction in the British Construction Industry Awards and was voted best European Lighting Scheme of 1992 by Architectural Review magazine.



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Management Contractor:
Trafalgar House Construction Management
Electrical Contractor:
Rotary International
Lighting Design:
Tom Harris of Ove Arup and John Hugill of THORN in conjunction with Nicholas Grimshaw.

The room shown on the left does not exist, except in a computer 's memory. It has been generated by a lighting visualisation system . Inset is the actual room.

***Below:** Visualisations of a pub scene and a typical high street at night.*

THE LIGHTING VISUALISATION SYSTEM

CAMPBELL McKELLAR represents THORN EMI Central Research Laboratories at Hayes

There are a variety of computer-based tools available to the lighting designer today to calculate interior illumination, or exterior lighting levels due to floodlights or streetlights. These tools are often quite sophisticated, but they do not allow arbitrary environments to be modelled, and more importantly they do not allow a layperson to visualise how the final lighting installation will appear.

THORN's Lighting Visualisation System (LVS) is one of a new generation of lighting design tools which simulate the propagation of light through an environment, and allow the resultant information to be viewed as a photorealistic image. Its aim is to produce an image or visualisation which will, in effect, be a 'photograph' of the final lit space, but which can be produced before the space even exists, let alone is lit !

Visualisations have many advantages over other representations of a lighting scheme. A visualisation is cheaper and easier to change than a mock-up. It is more accurate than an artist's impression, and it is easier to interpret than a set of illuminance tables.

WHAT LVS CAN DO

The LVS models the propagation of light through a general environment. The technology employed is a mix of computer graphics and lighting simulation techniques. Conventional lighting simulation software places restrictions on the types of environment that can be modelled, while conventional computer graphics image generation software allows pleasing images to be produced but does not take into account any lights or lighting. For example, diffuse inter-reflection is simulated as an ambient wash and light sources are restricted to uniformly emitting point sources. These problems mean that certain lighting schemes, such as those relying on spotlights or uplights, are impossible to simulate accurately using conventional image generation methods.

By using elements from both of these technologies, LVS provides the architect and designer with:

- The ability to calculate accurate illuminance values for general environments.
- A high degree of control over the simulation process if desired.
- The ability to simulate reflection and transmission with diffuse, specular or semi-specular - faces.
- The ability to visualise a proposed lighting scheme and thus determine whether it is aesthetically pleasing.

- The ability to present a proposed lighting scheme to a client in an easy to understand, yet accurate, way.

THE ENVIRONMENT TO BE SIMULATED

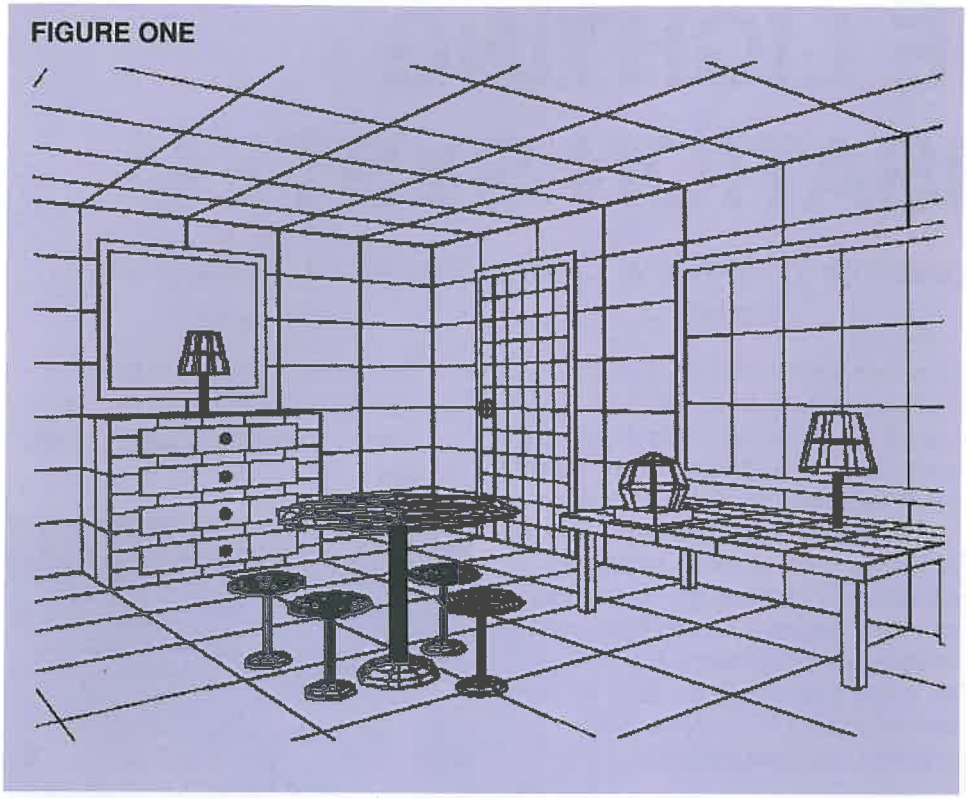
Before an environment can be simulated, it has to be defined. It is not sufficient just to say that the walls are 50% reflective, the carpet 10% and the ceiling 70%: the computer must know about colours, shapes, patterns, material types and lighting. The data needed by LVS can be broken down as follows:

- Data on the geometry of the environment (input via a commercial CAD package)
- Data on surface characteristics of objects in the environment in terms of colour, reflection etc.
- Data on lighting of the environment. LVS can simulate day or artificial light.

THE LIGHTING VISUALISATION SYSTEM

Figure One: *The sub division of a typical scene into patches.*

Below: *Proposed building refurbishment visualisation produced by Ove Arup*



To speed up the production of new visualisations, LVS maintains databases of surface and photometric data. Common furniture types can also be stored.

LIGHTING SIMULATION TECHNIQUES

The method used in LVS to simulate the propagation of light is radiosity. This was originally developed to model diffuse inter-reflections, and has since evolved into a technique capable of modelling both diffuse and specular inter-reflections of light in a general environment.
The production of a visualisation is a two stage process, comprising simulation, then visualisation. The first stage of the process, is performed using radiosity techniques, and this results in a *view-independent* lighting solution. The second stage is to visualise this lighting solution using a modified ray-tracing technique.

THE RADIOSITY METHOD

The most important feature of the radiosity algorithm is its ability to store all the lighting values it calculates. To enable this, all surfaces in an environment are divided into patches. Each patch is then responsible for storing a single lighting value, indicating how much light is diffusely reflected from or transmitted through a patch. The sub division of a typical scene is shown in Fig 1.
This method has the advantages that any surface can be patched, so that lighting levels can be determined on any surface; the light leaving any surface can be determined at any point during the simulation process and the accuracy of a simulation of a given surface is proportional to the number of patches on that surface, so can be determined by the user.

DIRECT AND INDIRECT LIGHTING

Direct light calculation is the first stage in producing an accurate visualisation. It is simply a matter of calculating how much light from each light source is received by each patch in the scene, smaller patches in some areas assisting in more accurate simulations.
In the calculation of indirect light, each patch acts as a light source, emitting its reflected and transmitted energy back into the environment to all the other patches. As the simulation continues, re-emitted energies become smaller and the process tends towards an equilibrium state. Thus the illumination of every surface by every other surface is modelled and light correctly distributed.

FLEXIBILITY

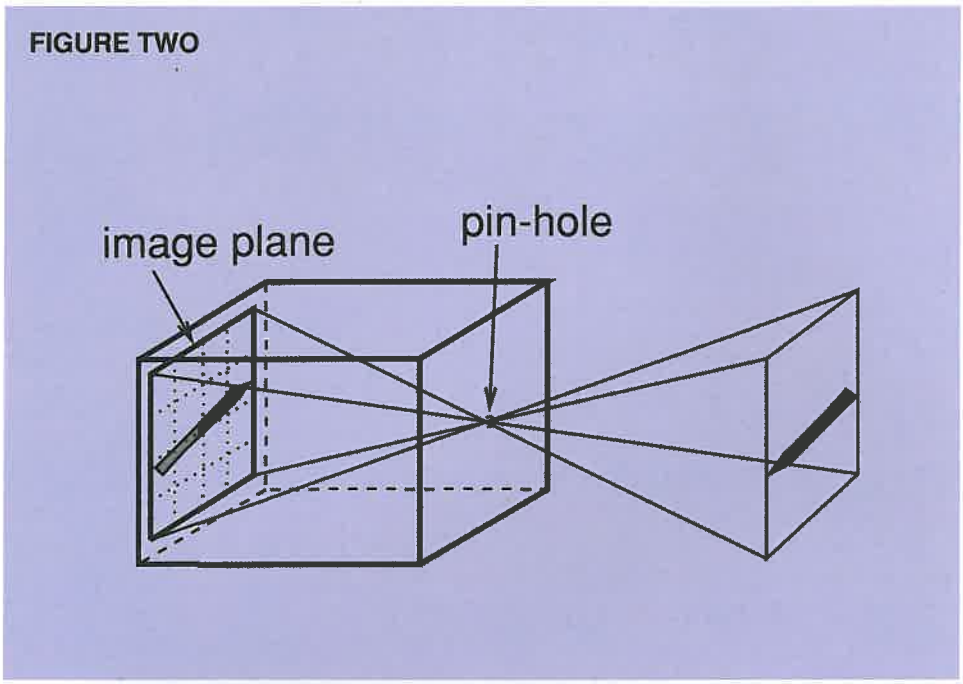
To make the simulation process efficient and fast, LVS allows users to determine exactly what to simulate and what effects can safely be ignored. The five main ways in which the user can affect the accuracy of a visualisation are:

- The detail present in the CAD model
- The number of elements/patches in the scene
- Which lighting effects to consider
- The accuracy of the rendering process used
- The resolution of the final image

For the best possible visualisation, all these variables should be maximised, but the time taken to produce a visualisation will then be excessive. It is thus up to the user to determine the most efficient way to produce a visualisation, and this will vary considerably from scene to scene.

Figure Two: *The ray tracing method simulates looking through a pin-hole camera with the desired view position, direction and width.*

Bottom: *Simulated retail store of the future*



RAY TRACING

The result of the radiosity method is an illuminance value independent of viewing position for every patch in the scene. A ray tracing technique can then be used to generate the image from a given viewpoint using this illuminance data.

As shown in Fig 2, the ray tracing method simulates looking through a pin-hole camera with the desired view position, direction and width. It calculates which part of which object can be seen for each pixel in the image and displays the view-independent lighting values at that point. It can also display the view-dependent effects caused by surfaces with specular components. A huge variety of surfaces - glass, metal, wood, matt paint, plastic, fabrics etc can be simulated accurately and displayed realistically using these methods. If numerical tables of luminance or illuminance values are required, LVS can output a grid of these for any surface in the scene. This allows the accurate determination of average luminance or luminance range for a given surface.

OTHER APPLICATIONS

LVS can assist in producing a video walkthrough, which is an invaluable aid to give a client a much better idea of how the space would appear if he were actually in it. The LVS simply produces a set of visualisations from a sequence of viewpoints forming a walkthrough. These are then transferred to video tape.

Virtual Reality (VR) is a newly emerging technology where a participant is immersed in an artificially generated environment. This technique allows lighting designers or architects to present their ideas to clients in a very impressive way. This is because the user really does feel that the computer generated space exists and that he is in it with control over his movements.

Current VR systems are only able to display crude representations of a virtual world but because LVS can re-use lighting data, it is possible to calculate the lighting before a VR session starts. Therefore, images can be produced in real-time which includes accurate lighting effects.

Further development of LVS is being directed towards making this possible and a demonstration system has already been produced.

THE FUTURE

In its current form, the LVS provides a unique range of features beneficial to architects, interior designers, lighting designers etc. It has already been used to support major bids and for promotional purposes.

In the future, it is intended to use the software in two ways - the first will involve using LVS as a sales and marketing tool, aiding major commercial bids and promoting products. The second is to use the system to design innovative lighting schemes, eliminating the need for costly models and mockups and above all, saving time, energy and money for all concerned.

***Left:** Bridge over the River Charente, France*

DOES ROAD LIGHTING REDUCE ACCIDENTS ?

Ron Simons, Lighting Projects Consultant, THORN Lighting Ltd

It would seem logical that road lighting reduces accidents, but second thoughts raise doubts. Road lighting may lull drivers into a false sense of security or induce over-confidence leading to greater driving speeds and a increase in accidents. Also, the lighting columns themselves may introduce hazards. Thus, proof is needed that road lighting reduces accidents, especially as it costs money and public expenditure has to be justified on a cost-benefit basis.

Night-time accidents account for some 50% of the total, although night-time traffic flow is only 20-35% of the total traffic flow. Additionally, night-time accidents are generally more severe and the proportion of these accidents to the total number of accidents is higher at night.

There are also other reasons for installing road lighting - to increase public amenity and to reduce crime - but both are more difficult than accident reduction to quantify in benefit terms.

A CIE document, 'Road Lighting as an Accident Countermeasure' has been in preparation for some years now but its gestation period is now over and it is about to be published. The purpose of this article is to review its contents and discuss their implications in the revision of the CIE publication 12/2 'Recommendations for the Lighting of Roads for Motorised Traffic'.

THE VISUAL TASK

The accepted dogma concerning the driver's visual task is that an object is revealed on the road surface by silhouette vision, the assumption being that the lighted road surface allows an object to be seen as a 'shadow'. This however is an over-simplification of what really occurs. In practice, the road surface is usually obscured by vehicles, which themselves provide the background against which any object is seen.

Objects are rarely seen as silhouettes, but rather as solid subjects with some indication of their surface structure. For this reason, the silhouette principle, on which most of the world's codes of practice are based, is brought into question. Nevertheless, it has been found to provide a satisfactory basis for quantifying the lighting in terms of overall and longitudinal uniformity of luminance, average luminance, surround ratio and threshold increment. However, it is not known whether some other system of quantification of lighting parameters might prove even better in terms of driver performance and cost effectiveness.

ACCIDENT STUDIES

In the CIE document, 'Road Lighting as an Accident Countermeasure', some 63 studies from worldwide sources have been analysed. Methods of conducting the studies fall into two categories:

- surveys of existing lighting and accident rates
- before and after studies of changes in lighting - where the effect of changes in lighting on accident rates is examined.

In the first method data can be analysed as soon as it is collected but in the second method a far longer time, perhaps years, maybe needed before sufficient data is collected. During this time, there may be changes in the environment and traffic flow but a way of allowing for this is the use of controls. Here, similar, nearby roads, where the lighting has not changed, are selected and compared with those where lighting has been changed. Both are monitored for accidents. Generally, in both kinds of study, the effect of changes in traffic is reduced by relating the night-time accident rate to that occurring during the day-time.

Most of the studies included in the draft CIE report adopt the latter method and state that the lighting was upgraded from no lighting or poor lighting, to lighting of a good or higher standard.

UK STATISTICS

The publication 'Road Lighting in Great Britain' contains a section on road lighting and accidents where records from 1978 to 1988 are discussed. Over this period, the percentage of accidents in darkness fell reasonably steadily from 32.5% to 29.1%. The author of this section of the publication gives three possible reasons for this.

- It could be due to a reduction in the mileage driven at night but there are no statistics available to support this.
- It could be due to a reduction in the incidence of drink-driving.
- It could be, and this is difficult to follow, due to the increased provision of street lighting as the proportion of accidents at night on unlit streets fell by 15% compared to 12% on streets with lighting.

Figure One: *Variation of Visibility Level (VL), Average Luminance (L) and overall uniformity (U_o) - WITH SPACING*

SIGNIFICANCE OF CASE STUDIES

Owing to the expense and difficulties of carrying out road lighting and accident studies very few of the studies quoted in the CIE draft are statistically robust. In drawing up conclusions in the report, this has presented problems for the CIE drafting committee. They conclude that as a high proportion of the studies show that upgrading existing lighting or installing lighting where none previously existed, reduced the accident rate, road lighting is beneficial. Conclusions drawn show that pedestrian casualty rates are reduced by 45% to 57%; casualty accidents of all road users are reduced by 21% to 23%; injury accidents are reduced by 75% and accidents to all road users are reduced by 9% to 35%.
These conclusions are based on the 28 studies which relate to all-purpose urban traffic routes. The reduction of casualty accidents for routes without intersections varied from 16% to 60%. At intersections, accident reductions varied from 30% to 44%.
Ten studies recorded for rural motorways with continuous lighting, showed a decrease in all accidents which varied from 22% to 56% and a decrease in casualty accidents which varied from 28% to 57%. Partial lighting also gave beneficial results.
Six studies related to pedestrian crossings. These indicated that where floodlighting is used, it is beneficial, even though road lighting may already exist.

QUALITY AND QUANTITY

Various studies undertaken indicate, with a few exceptions, that the installation of lighting has a beneficial effect in reducing accidents.
Experience and experimentation have shown that average and overall uniformity of luminance affect the visibility of objects on the road.
Longitudinal uniformity, measured on defined lines along the run of a road, is firmly established and regarded as a comfort criterion, the function of which is to provide control of the striped appearance of the road resulting from the repeated pattern of lighting.
Since many objects are seen, at least partially against the surroundings, these should be adequately lit. This is quantified by the Surround Ratio (SR) but in some of the studies, it was possible to measure the luminance of the surrounds.
The prime object in road lighting is to make objects as visible as possible. If all lighting measures that are likely to affect visibility could be brought together into a single figure of merit, the Visibility Level (VL), then it would be possible to trade off one quantity against another, which would be of obvious benefit in designing and optimising installation design. This can be illustrated by citing the kind of problem the installation designer frequently meets.
Suppose a scheme is required to light a motorway to an average luminance (L) of 2 $cd.m^{-2}$ and an overall uniformity (U_o) of 0.40. With the selected lantern at the designated spacing L is 2.2 $cd.m^{-2}$ and U_o is only 0.38. Will the 10% increase in luminance balance the low value of U_o ? This is a question where a measure of visibility should be capable of providing the answer. Furthermore, if it can be shown that the visibility measure is more closely related to accident rate than any of the lighting measures taken separately there would be a double benefit by adopting it.

VISIBILITY LEVEL

Visibility Level (VL) is the method being promoted by the American National Practice for Roadway Lighting. Here a vision model is employed, allowing the target luminance, background luminance, adaptation luminance and veiling luminance to be taken into account as well as adjustments for age of observer, whether or not the silhouette is lighter or darker than the background, exposure time and angle of subtense of the target. In the draft US Standard, some of these factors are standardised. These include the age of the observers (23), angular subtense of targets (about 0.12 degrees) and reflectance of target (20%). This formulation of VL is called Small Target Visibility (STV).

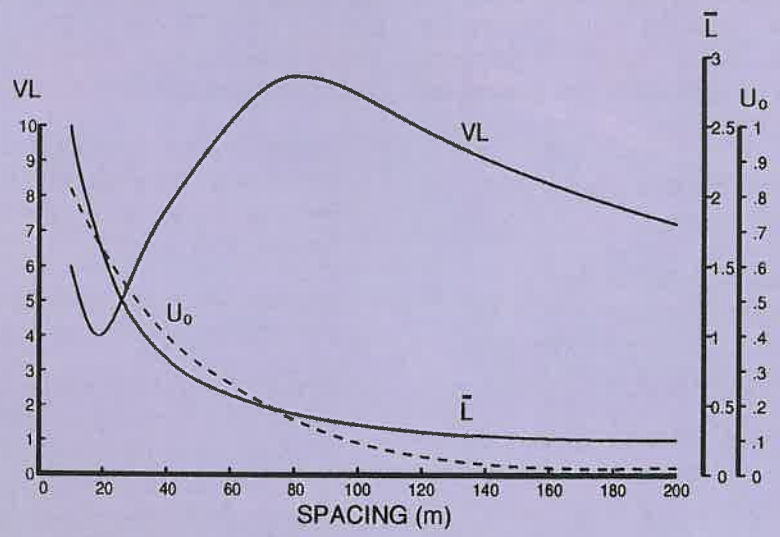
ADOPTION OF STV

In one important study in the USA it was found that the ratio of night to day

FIGURE ONE

ALPHA 8

SON 150W ; 15500 lm ; Road Width 8m ; H=10m ; Overhang 0.5m ; R3 ; MF=1 ; 2 Lanes Staggered.



Here at Clamart in France can be seen lanterns housing 150W high pressure sodium lamps.

accidents dropped as the horizontal illuminance was increased but reached a minimum at 5 lux and then rose. This indicates there is an optimum level on either side of which the night-time to day-time accident ratio rises. It may be commented that an optimum would be expected but it is surprising the level is as low as 5 lux - equivalent to a luminance of some 0.5 $cd.m^{-2}$ for a C2 road surface.

STV appears to be in conformity with these results as shown in Fig 1. From this it can be seen that VL or STV peaks when the spacing is 80m and L is only 0.45 $cd.m^{-2}$. At the same time, overall uniformity is 0.13. Whilst the graph is shown for only one lantern type and one geometry (apart from the variation in spacing) similar results have been obtained with different lanterns and different geometries.

Since a VL of at least 6 is thought necessary for satisfactory vision, spacing of over 35m will give installations that meet this criterion. Luminance levels will be lower than are recommended in BS 5489 but then the requirements in the draft NAIES specification are lower by about one half.

Also far lower uniformities are permitted. These are measured in terms of maximum to minimum luminance. For most roads, the permitted minimum for this ratio is 6:1, rising to 10:1 for less important roads. The corresponding figures in terms of U_o would be approximately 33% and 20%.

If the road surface is of uniform luminance, then some objects will be the same luminance as the road and will be rendered invisible. This is the reason for the dip in the STV graph at about 20m. In other words, non-uniform background aids visibility.

Taking the above into account, there seem good grounds for adopting STV as a criterion in future codes and standards.

LIGHTING OF MOTORWAYS

There is international disagreement where motorways lie in the hierarchy of lighting requirements. In the UK we have reserved the highest standard of road lighting for motorways. The argument for this is that the driving task on high-speed roads is more onerous than for other road categories. It demands fast reactions and any accident could lead to disaster.

It is however argued by some authorities that motorways are some of our safest roads and do not require the best lighting in all circumstances - other high speed roads where the traffic situation is complex and where there may be pedestrians present are just as deserving. As a consequence, in the draft revision of CIE Publication 12, there is a choice of levels (2 $cd.m^{-2}$, 1.5 $cd.m^{-2}$, and 1 $cd.m^{-2}$) made according to traffic complexity.

High speed roads and dual carriageways with poor traffic control and separation, may also be lit to 2 $cd.m^{-2}$. This is an instance where the original specification in the CIE Recommendations has been modified to take account of accidents, albeit on anecdotal evidence.

IN CONCLUSION

There is strong evidence in the CIE document on road lighting and accidents that good road lighting is effective in reducing accidents.

In today's crowded driving conditions, the driving task at night is much more complex than the concept of silhouette vision would suggest. For this reason and because of lack of field validation, there is strong resistance to adopting concepts such as revealing power, visibility index and visibility level as bases for national and international codes of practice at present.

Meanwhile, the conventional measures, of L, U_o, U_L, TI and SR continue to be used. The values assigned to them for various categories of road should be subject to review as experience accumulates. In the UK, they were introduced into BS5489 in 1987 and experience indicates that they are satisfactory. However, accidents on the various categories of road need to be monitored to ensure that they continue to be satisfactory.


Barrats

On the facing page is a general view of the steel structure mounted lighting, while below, are the Philippe Starck designed Villette Line lanterns.

LANDMARK LEEDS - BRITAIN'S NEWEST CITY CENTRE

The City of Leeds is preparing for the launch of its latest and most exciting development in recent years. Landmark Leeds - Britain's newest city centre - is a milestone in the City's growth and development as a major European city. The city centre boasts what is probably one of Europe's most adventurous uses of style-conscious amenity lighting.
Keen to develop and reinforce its vibrant, modern new look, Leeds has chosen an innovative lighting design scheme as part of the refurbishment of its pedestrianised core.

DESIGN CRITERIA

Keynotes of the scheme - to design a high quality environment, to reinstate commercial confidence, to attract shoppers and to reinforce and strengthen the character of the city centre as a commercial, civic, cultural and environmental focus are reflected in the special light fittings. These are designed to specifications drawn up by architects Faulkner Browns in conjunction with City engineers.

ARCHITECTURAL STRATEGY

The strategy is to use the existing fabric in the city centre as a starting point to create routes, vistas, spaces and points of activity and vitality. It is an architecture of Urban Intervention. An architecture of mending the city through intervention at its weakest points. Distinctive 'Gateway' structures have been introduced on vehicular routes into the pedestrianised zone to establish a city framework and create a basic pattern and thread of urban order throughout the streets. These structures dispersed but integrated into the city serve as signposts, and symbolic entrances to the streets. Brightly lit they become focal points, both during the day and at night. A place to meet, shelter and rest, a place

Night and day views of the Leeds City Centre lighting.

for entertainers, street traders and public information. Throughout the scheme a total design feel co-ordinates and integrates be it telephones, litter bins, seating, signs or public shelters.

In addition the spaces between the buildings are ordered and co-ordinated using a common repertory of architectural elements and steel structures to create a recognisable and identifiable Leeds city centre. The steel structures provide a framework for the lighting, signs, banners and festival decorations.

IMAGINATIVE FITTINGS

Imaginative use of the latest lighting equipment has created a safer and more attractive environment at night while the lighting design is both aesthetically pleasing during the day and energy conscious. An average light level of 50 lux has been achieved. Each street has a different lighting character relating to the existing architecture, its commercial usage and the pedestrian movement.

***Below** are close ups of the circular superdeluxe mercury lantern, various airfield runway fittings, and the Civic lantern, clearly showing the use of fluorescent 'proof' fittings.*

FOUR BASIC TYPES

The fitting designs fall into four basic types. First, there is the Villette Line designed by Philippe Starck. This sleek luminaire comprises of a linear, 230mm diameter tube finished in natural aluminium with a post top cylindrical prismatic controller that houses four 36W 2L compact fluorescent lamps. Other versions have an additional controller situated towards the base which helps emphasise the need to keep everything to a human scale.
The second fitting is a highly distinctive circular lantern using a 250W MBF Super Deluxe mercury lamp which emphasises the coolness of the visually striking steel framework to which it is attached.

The third group of fittings are more often to be found at international airports. The imaginative use of inset runway fittings at floor level, tungsten halogen floodlighting and red obstruction lights, post top mounted, has created a bright, colourful impression for the pedestrian.
Perhaps the most unique design concept is the 'Civic' lantern and column combination. A purple, perforated cylindrical aluminium housing accommodating four 1500mm outdoor fluorescent fittings with blue lamps is fixed towards the top of a tubular column to

which is mounted an aircraft warning light.
Non THORN fittings include the widespread use of fibre optic lights both to light the 'Gateways' and the curved

steel structures that run the length of certain streets.

CO-ORDINATED DESIGN

The imaginative use of materials at floor level has created an interesting, colourful environment for the pedestrian. Materials ranging from terracotta and blue clay tiles to granite and a variety of ceramics, make up a striking pattern, which is both aesthetically pleasing yet highly practical.
A range of co-ordinated street furniture, unique to Leeds, is a strong feature of the scheme. Mature trees and shrubs, and seasonal blooms create a city garden in Leeds' urban heart. Special hanging brackets fixed to some lamp posts provide the opportunity for varied and seasonal planting.

CONCLUDING THOUGHTS

Leeds has a legacy of elegant buildings and arcades, which are now enhanced by the bold features of Landmark Leeds, creating a unique city centre style.
The scheme has created a safe and welcoming environment, which is clean and attractive. New life has been injected into the city centre at a time when other cities are supporting out of town developments. A unique lighting infrastructure, imaginative landscaping, an abundance of flowers, and an extensive programme of street entertainment add up to a city centre which both looks and feels European, and is a pleasure to spend time in.

Acknowledgments

Client:
Leeds City Council
Architects:
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Lighting Design:
Russell Davenport of Faulkner Browns, Ian Butterworth of Leeds City Council and Tony Speight and Rob Robinson of THORN Lighting
Steel frameworks and columns:
Ansleys
Fibre Optic Lights:
Fibre Lite, Halesowen


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Ipswich Co-Operative Society's Solar Superstore at Stowmarket, opposite, where the desire for lighting control and low running costs lead to the introduction of a mains signalling system. The luminaires can be switched to suit the store's requirements - for instance one third illuminance for periods when the store is not open to the public.

MAINS SIGNALLING - A COST EFFECTIVE SOLUTION ?

Neil Jones is Manager, Lighting Controls of THORN Lighting at Borehamwood

Mains signalling has often seemed a mystery to many people and even regarded by some as downright dangerous - sending a signal down a live wire, whatever next ? It can though, be an extremely efficient way of controlling lighting without the need for separate control wiring and circuitry. It's no great mystery, it's safe to use and, as long as simple rules are adhered to, should present no problems in even the most elaborate of lighting installations.

Most people are able to accept radio frequency transmission as an every day part of their lives but the transmission of a signal along what is basically a pair of conducting wires - the mains wiring - still seems to hold a wealth of mysteries !

LONG HISTORY

Mains signalling as it is now popularly called, has had a long and chequered history, despite having been used at the beginning of the century for the control of street lighting installations. These days, a far more sophisticated level of control is available by using mains signalling techniques coupled with PLC's or Programmable Logic Controllers, used for Building Management System outstations.

THE MAIN CONCERNS

The major concerns a potential user of mains signalling techniques will have when considering their use are:-

- Will it work 100% satisfactorily without interference from spurious noises in the mains ?
- Will it affect other sensitive equipment being used in the same premises ?

If the right answer can be given to both of these questions, then the opportunities afforded by the proper implementation of a mains signalling control system can be tremendous:

- All electrical equipment can be controlled either as original equipment or on a retrofit basis with a minimum of disruption and cost.
- A mains signalling system is easy and cheap to install. It does not involve costly, complicated runs of control wiring.
- Mains signalling can provide low cost per point control which makes it ideal for lighting control where the object is to economically control a large number of small loads.
- Control regimes can be simply altered to accommodate changes in building layouts etc avoiding the costs associated with rewiring switch drops or other control circuitry.
- Control of both essential and non-essential loads without the need for duplicating circuitry.
- Load shedding which can be restructured as and when required.

To maximise the advantages of these qualities, it is important that all doubts arising from the installation and use of mains signalling techniques should be dispelled. Additionally, to enable us to discuss the integrity of mains signalling, it is important that we examine the various techniques that have been employed to send signals along the mains cabling.

MOST USED TECHNIQUE

The most commonly used technique is that of introducing an hf signal between phase and neutral. This is normally injected via a "transmitter": connected between phase and neutral using pulse position modulation signal coding. The 'receiver' or switching units are continuously monitoring the signal status and respond immediately a signal is received from the transmitter. These signals will only be present in the phase which is injected and if it is desired to cover a three-phase installation, it is necessary to devise a means of coupling the phases.

A degree of signal attenuation can be experienced by the existence of power factor correction capacitors which offer a low impedance path to the signal, reducing its strength. In many lighting control installations, these capacitors are present in every luminaire and a serious attenuation problem can be experienced. This may be overcome to some extent, by employing signal 'boosters' - amplifying devices which receive a weak signal and re-transmit it at full strength, rather like an aerial signal booster as used with a conventional TV set.

British Standard BS 6839 determines the frequency bands allowed for mains signalling and phase neutral installations are generally situated in Band C which ranges between 125 and 140kHz. This band is used for equipment

On this page can be seen Marks and Spencer's store in Orpington.

which is not continuously transmitting ie: for equipment which sends out short bursts of signals when an action is required but is otherwise inactive although it is 'on the alert' awaiting signals.
The maximum power permitted in this band is 10mW - low enough not to interfere with other mains powered equipment. Many clients opt for installing a trial system prior to full commitment, so that they can satisfy themselves on this point.

ADVANTAGES AND DISADVANTAGES

So that a higher degree of integrity could be provided, making a system more reliable an alternative signal path but still using mains wiring, was sought. This 'cleaner' path was formed using the neutral to earth route, a method of signalling offering two main advantages, but also one possible disadvantage !

The advantages are:

- The neutral conductor is common to all three phases and therefore signals injected between neutral and earth would appear throughout a building with three-phase installation.

- There is normally no coupling between neutral and earth either capacitative or resistive, which means there is no alternative short cut for the superimposed signal to take and the signal strength is normally maintained. In theory therefore, a high degree of signal integrity can be obtained from a neutral earth mains signalling system.

These two advantages are good news for mains signalling techniques and greatly simplify the installation but the disadvantage outlined below needs to be overcome.
The possible disadvantage is that the faults causing low impedance between neutral and earth, or even short circuits between neutral and earth can and do occur. This would then present a possible short circuit and thus attenuate any signals across neutral and earth.
BS 6839 allows several frequency ranges from as low as 3kHz up to 140kHz. It has been found when signalling between neutral and earth, that signals of a higher frequency do not suffer the same attenuation through low impedance as do those at a lower frequency.
In a recent 'neutral and earth' installation operating at 130kHz, it was found that there were two dead shorts between neutral and earth on one floor. One was caused by a trapped neutral in underfloor ducting and the other in a luminaire where the neutral and earth connection had been reversed in a three-pin plug top.
Despite these shorts, a signal of sufficient strength to switch all lighting was transmitted around the whole floor with only a small sample of units (3 or 4) intermittently failing to respond. The intermittent failure in fact assisted in locating the short at the luminaire. No other poor signal effects were identified within the remainder of the seven-storey building.

The reason for this high degree of signal integrity can be explained as follows:
The signal being injected at 130kHz between neutral and earth will in fact pass to the phase conductors via the resistive loads in the building. The faults in the neutral earth path are therefore bypassed by the signal in the phase and reappear in the neutral further down the circuit. As the receivers are tuned to respond to signals between neutral and earth, they are only affected by a serious (ie low impedance or short circuit) fault between neutral and earth if they are in the immediate locality of that fault.

SUITABLE FOR REFURBS AND NEW BUILDS

In practice this has not been found to be a problem, many systems having been installed in refurbished and old buildings as well as new constructions. The system commissioning has literally been to switch ON and then walk the building to check that everything is working according to plan.
The simplicity of mains signalling has meant the addition of energy effective controls to many small loads that were

Shown below is the broad and varied range of THORN mains signalling components.

not previously considered worthwhile. A recent series of installations has been in schools where the local authority had already installed a building management system connected to central headquarters for programming and monitoring purposes via a Pulse Switched Telephone Network auto-dial modem.

The addition of a mains transmitter at each school means that simple time control can be applied to lighting, immersion heaters, fan convector heaters, urinal controls and many other small loads. Thus, central control has been able to replace a large number of small stand-alone time switches, which because of their wide locations within the schools were often ignored or permanently overridden.

IN PRACTICE

Another fine example is Marks and Spencer's store in Orpington where the cabling has been all but eliminated.

In addition to using busbar trunking instead of cabling for primary power distribution, the stores hard wired control system has been replaced by a mains signalling lighting management system.

The system controls 250 recessed louvred high frequency fluorescent luminaires, hidden perimeter fittings, ceiling mounted spotlights, shop window and car park signs. Despite all this only nine of the available 16 control channels are used.

Normally all the circuits are automatically switched to a pre-arranged seven day programme, with office lighting for staff being pulsed off at half hour intervals after normal working hours. However, the options on the panel allow the sales staff to override the automatic settings to deal with special openings.

All luminaires and other items of electrical equipment have decoder units, those in the light fittings were fitted at the factory. Each decoder can be set by means of 16 selector switches to respond to any combination of control channels.

With regard to costs there is no need for a main switchroom, battery room or numerous fuseboard or switch cupboards. It is straightforward to add maximum demand load shedding, link the lighting to an intruder alarm system and alter the lighting control strategy. There are considerable cost savings, assessed for the installation as approximately 10% of the total electrical cost.

CONCLUSION

Summing up, system designers can now be very confident that mains signalling offers a case study proven means of controlling electrical loads without additional control wiring. Additionally, the opportunities for future re-configuration and programming mean that an installation made today need not determine how a building is operated for ever after !

Opposite and Below is the Penrith Plaza Shopping Centre near Sydney, recent winner of a meritorious Lighting Award from the Illuminating Engineer Society of Australia and New Zealand. The mounting method for the metal halide display floodlights is seen on the right.

MAKE LIGHT WORK OF THE SHOPPING

Well designed lighting and dramatic architecture are claimed to contribute to the instant success of the Penrith Plaza Shopping Centre, sited some 50km west of Sydney in Australia.

The Plaza, designed to make shopping a pleasure rather than a chore, has lighting schemes which complement the spaciousness and form of both public and functional areas and assist in the fast and easy movement of pedestrians, vehicles and goods.

BROAD MIX OF PRODUCT

Standard products have been installed alongside customised light fittings used in a range of applications including public concourses, walkways, underground car parks, the garden, loading bays, offices and a rooftop parking area.

The public concourses are generally lit by track suspended compact spotlights. These interior display, accent and special effect luminaires operate 150W single ended metal halide lamps for best colour and overall performance.

Customised models of these directional flood and spotlights also incorporate the public address and emergency lighting system.

The choice of light sources and fittings involved many factors including the appearance, performance, size, versatility, suitability, output, maintenance and style.

FIXING POSITIONS

An unusual visual effect is realised in their mounting method, which uses the theatrical technique of mounting along

a single bar to easily illuminate chosen parts of "the stage". This is also quite striking in appearance in the shopping centre. The building frame is complemented by the bar from which many of the luminaires are suspended.

Close off-set asymmetric interior floodlights illuminate the underside of the main roof structure. They employ integral metal halide control gear and 'barn door' attachments give that extra amount of beam control. The compact dimensions, colour and proportion assist them in blending into their surroundings and becoming a part of the background scene.

The above-ground car parking area,

MAKE LIGHT WORK OF THE SHOPPING

At the top of the page is shown the underground car park lighting and below it an illustration of the special column mounted discharge down-lights.

communicating bridges and other public walkways, together with ground floor pedestrian walkways, have been treated with architectural tubular fluorescent luminaires and customised discharge downlights.

TAILORED DOWNLIGHTS

The downlights are both column and under-canopy mounted and their circular shape and building frame colour finish was selected to blend into and appear as part of the total structure. Standard semi-recessed units are also installed conventionally in those bridges which have a conventional ceiling. They incorporate fixing points plus wiring attachments and all models have integral control gear for fast and easy installation. Long-life mercury vapour lamps have been used to reduce maintenance and electrical running costs.

TUBULAR "RAIL" SYSTEM

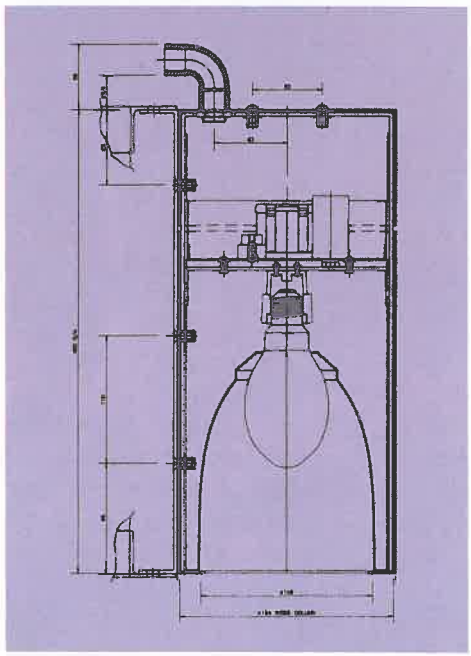
A series of 90mm diameter tubular fluorescent luminaires has been used to indirectly illuminate the underside of the main walkway ceilings - a controlled output softly defining the under-canopy form and shape.
Each extruded light fitting has lamps mounted end-to-end and control gear is housed integrally. Colour finish and circular shape are matched to the structural elements on which they are fixed and they are perceived to form part of the structure itself. A moulded prismatic lens encloses the lamp chamber. This helps to maintain the reflector performance and distribute lamp flux for the best effect.

UNDERGROUND CAR PARKING

Surface-mounted, customised, impact resistant fluorescent lights have been installed in the underground car parks and arranged for optimum results.
A number of the units incorporate self contained emergency lighting kits comprising a battery pack and inverter unit. Duration during a mains failure is two hours. Impact resistant square profile canopies with linear prismatic sides are fitted for superior light control and protection.

IN THE GARDENS

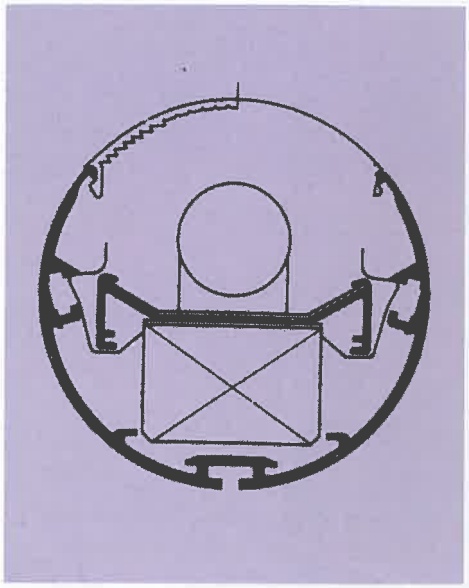
Garden beds, ornamental columns and trees add an extra dimension to the night time scene at the Plaza - especially on the entrance roadway to the underground car park. Robust ground-mounted floodlights are employed to create both mood and interest as they illuminate the garden surround.
The floodlights are located and aimed so that they achieve maximum effect and their compact size and shape makes them relatively unobtrusive.
Diecast aluminium bodies with integral discharge control equipment and IP65 rating all contribute to long service life and the vertical metal halide lamps achieve optimum output combined with good colour rendering.
In-ground uplights are installed in garden areas along the front wall and under 'significant' trees. They create impact and mood as they gently wall wash adjacent objects and highlight the foliage. Their heavy-duty cast bodies are designed for in-ground fitting and house all the control gear.
Stainless steel hardware, gasketing and impact-resistant glazing all add to the longevity of luminaires and their reflectors are designed to give a broad controlled output of glare-free light.



LOADING BAYS AND OFFICE

The loading bays are very busy areas needing good levels of quality lighting for the safe and efficient handling of all kinds of goods ranging in size from

Here we see an illustration of the ' tailored' 90mm diameter tubular fluorescent lighting. One of the pole mounted car park luminaires is shown below. In the right hand pictures garden beds and trees are picked out by inground uplights and surface mounted projectors.



egg cups to lounge suites. Wall-mounted lights house metal halide lamps, which have good colour rendering and long life. Their shallow diecast aluminium bodies are wired with integral control gear and a two part optical system comprising refractor lens and shaped for best photometric results and designed to perform in conjunction with the prismatic lens, reflecting light to all work zones and minimising glare. Recessed fluorescent luminaires incorporating performance low brightness louvres are installed in the office areas. The combination of a multi-cell louvre system and reflector offers a high light output and good visual comfort - especially useful in areas where screen-based tasks are performed in open-plan areas.

ROOF TOP CAR PARKS

Pole-mounted contemporary rectangular luminaires offering a sharp cut-off and uniform distribution are used in the roof top car parking areas. Both aesthetic and functional, rectangular poles have been used to complement the luminaire styling. They are mounted on top of cubic concrete slabs which afford them good protection against vehicle impact damage.

Pole mounting height, area light orientation, spacings and location have been selected to minimise stray or objectionable light in the surrounding areas which include adjacent streets, shops, residential, vehicle entrance roadway and railway lines.

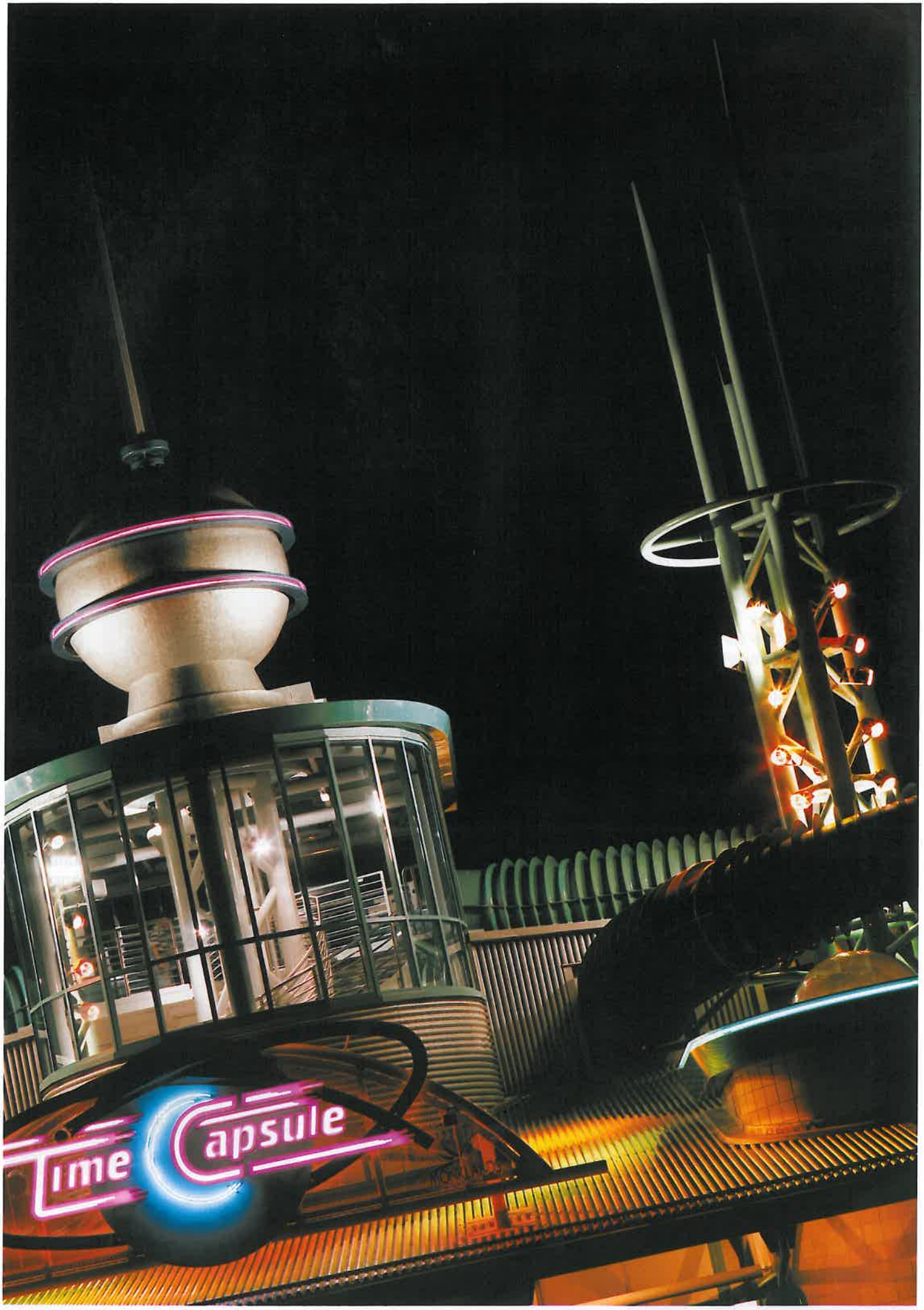
Each luminaire houses the discharge control gear on a removable tray for ease of servicing and the special reflectors allow tight beam control while low weight and windage characteristics realise cost savings on poles and their foundations.

CONCLUSION

It has been found that the artificial lighting employed in the Plaza project has a significant effect on the enjoyment and pleasure of visiting the area in addition to complimenting the building architecture. Quality standard and customised light fittings have enabled designers to realise functional and decorative effects plus create a range of moods, both indoors and out.

Acknowledgments

Lighting Design:
Land Lease Design Group in conjunction with consultant Theo Kondos


Time Capsule

***Opposite** and **below** are two views of Time Capsule Monklands at night. A combination of external and internal lighting is used for visual effect.*

On this page can be seen the ice rink lit by 400W MBIF lamps in highbay reflectors.

BACK TO THE FUTURE

Looking for all the world like a futuristic space observation station is the entrance to the Time Capsule Monklands, a new leisure complex in the Coatbridge area of Glasgow. The difficult task of floodlighting it was carried out using splashproof floodlights with tungsten halogen and low wattage metal halide lamps and coloured filters.

The projectors are mounted on the structural columns and were chosen for their high light output and the ability to provide a narrow beam of light with no unsightly striations. A programme sequencing system operates, hence the mix of light sources with the tungsten halogen used for the short 'punchy' effects and metal halide for the longer burning hours. At night it's a pretty dramatic sight, as the picture shows.

The Time Capsule Monklands caters for a wide range of ice and water based sport and social activities. Strongly themed as a journey through time, it's got the lot from Pteradons to Telestar. Exterior floodlights aren't the only fittings used in this large installation, of course. Apart from creating a stimulating exterior that draws in the

customer the lighting design had to take into account the wide diversity of interior events particularly the ice rink, the swimming pools and public areas.

The lighting design criteria was as follows:-

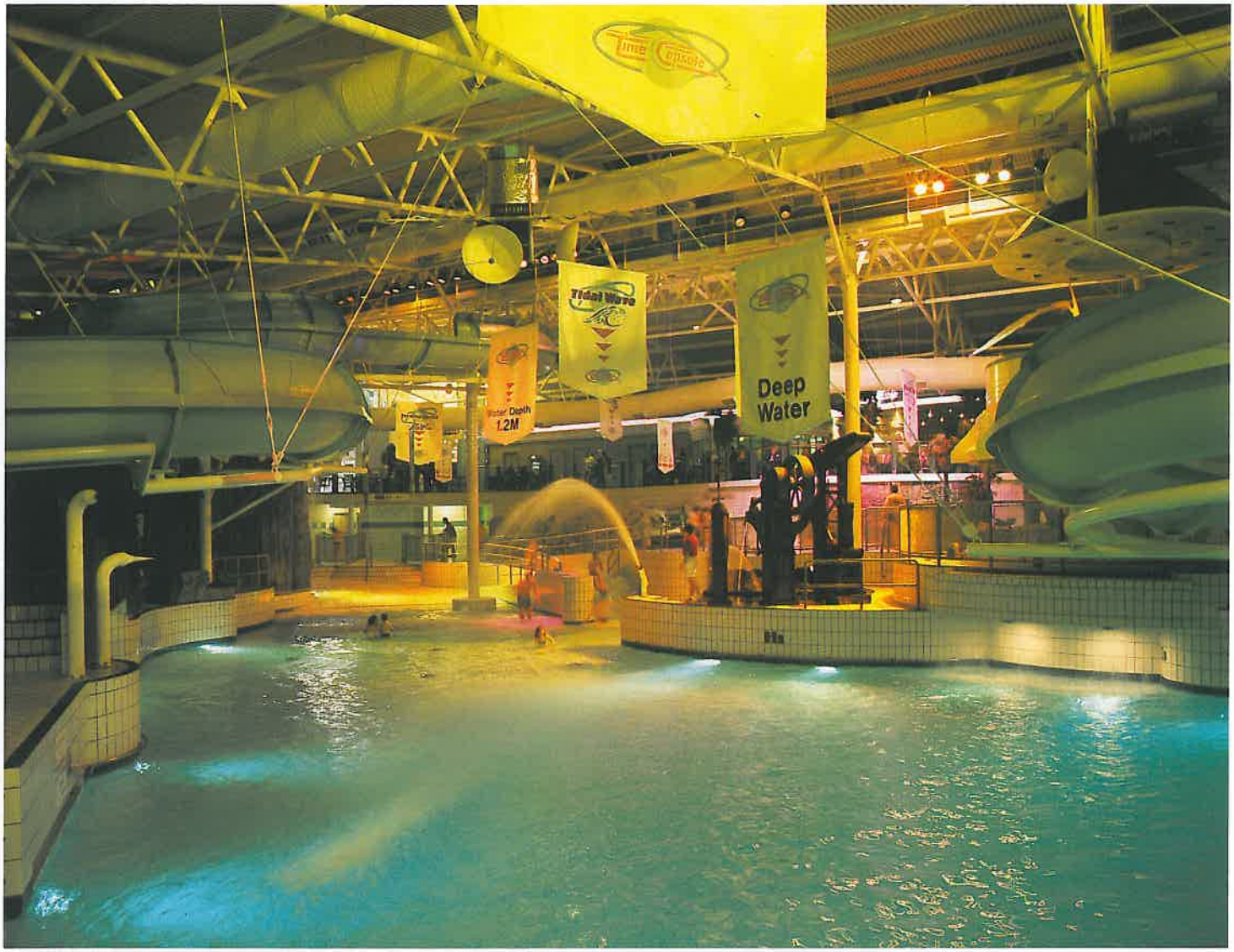
- provide an illuminance in line with the relevant CIBSE code.
- minimise glare to both user and spectator with careful attention being paid to safety in respect of swimmers.
- careful selection of light sources to create an atmosphere that would offer a warm and friendly environment with a feeling of safety to both parents and children.
- to provide mood and excitement including the sequenced switching of luminaires.
- the requirement for easy access for maintenance of the lamps and luminaires at all times.
- use energy efficient lighting equipment

THE ICE RINK

The main ice rink, which features an arctic landscape complete with trees, snowdrift and its own resident giant mammoth uses a conventional layout of high bay industrial reflector fittings with 400W MBIF metal halide lamps to an illuminance of 500 lux. This helps to provide a clean, white, appearance with a cool feel. The rink is used as a

BACK TO THE FUTURE

The lighting in the swimming pool hall is installed on a single, central boom which is more clearly seen in the larger photograph. Strong but sympathetic colours were chosen to illuminate the dominant features.



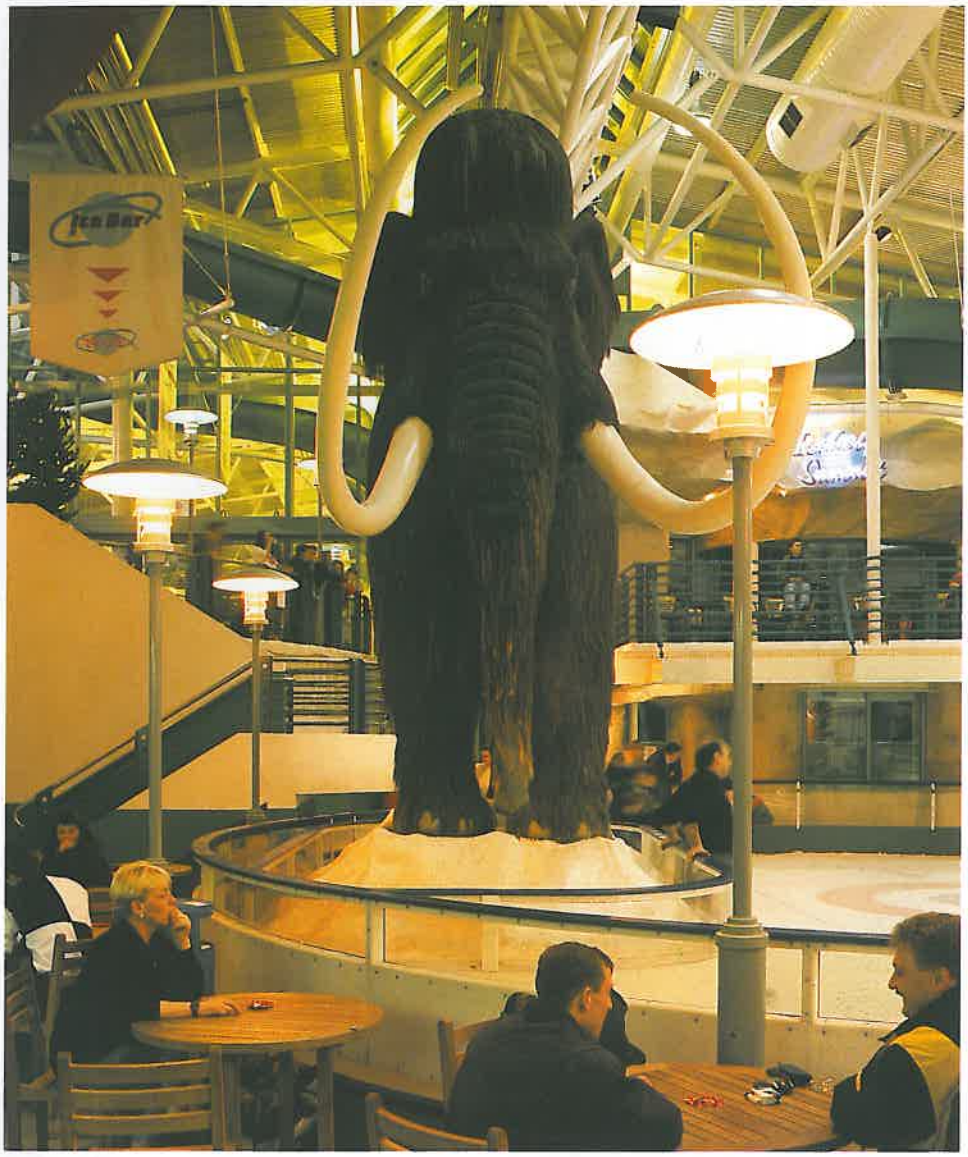
multi purpose arena and a sophisticated arrangement of disco lights is provided (not from THORN), mounted on three suspended square gantries. A video wall gives extra atmosphere to the ice rink. One particular problem facing the lighting designer is the wall which encloses part of the rink. This has been revealed by the use of wall-mounted floodlights which flood the wall in light.

SWIMMING AREAS

The swimming pool is separated from the ice rink by a giant glass screen. Irregular in shape it houses many dominant features including water sprays, rapid effects, waterfalls, flood surges and wave machines. It is strongly themed throughout with a 'river of life' theme where light, water and sound are all utilised thus allowing the swimmer to experience the history of man, starting with the prehistoric era and working up to a rocket ship launch. There are seven experiences in all including a volcano beach area and an origin of time monsoon - all are interlinked and take place only a short distance from each other.

The primary objective of swimming pool lighting is safety; the pool attendant must be able to see a swimmer in difficulty clearly. The design solution at the Time Capsule was to use 400W SON deluxe lamps in adjustable area floodlights with fibreglass bodies to withstand the humid and corrosive atmosphere. The fifty floodlights are mounted in uplight mode and provide 300 lux of golden white light. SON de luxe was chosen not only for its efficiency but for its pleasant golden white appearance. In addition thirty three underwater tungsten fittings have also been positioned within the pool to provide a much more decorative effect, with a far lower ambience than that of the general lighting.

Below: *Lamp sequencing and dimming is used to boldly pick out features in coloured light. The smaller picture shows a few of the many low energy compact fluorescent luminaires and bottom right is a striking arrangement of decorative amenity lanterns.*



TAILOR MADE FITTINGS

The designated themed areas and interesting features are boldly picked out by 100 purpose made theatre style floodlights housing 1kW CP60/61 lamps to allow for full dimming. These floodlights are fitted with a variety of lenses, both clear and prismatic to give variations to the beam performance. A wide range of dichroic filters are used to add visual interest through dramatic colour contrast. As you can see from the many illustrations the effect is superb.

As with the exterior, a sophisticated computer programme ties together the water, light and sound effects in order to helpfully support the experience, for example as the swimmer passes by the prehistoric cave walls, coloured lighting effects are timed with the sound of people working with flints.

All the lighting in the pool hall has been installed on a single, central boom thus allowing easy access for maintenance.

PUBLIC AREAS

An unusual - but ideal - application for amenity lanterns was seized upon for the cafes and general walkways. Thirty post top decorative circular lanterns have been installed around the viewing balustrades, ten using 80W MBF lamps the remainder 70W SON lamps. The public areas are lit with an appropriate mixture of 16 and 28W 2D compact fluorescent luminaires and low voltage tungsten halogen accent spotlighting.

CONCLUDING THOUGHTS

For the users of these half ice, half water facilities the lighting has created an extremely pleasant atmosphere throughout the activity areas with a high degree of visual comfort and interest.

For the management of the centre the imaginative use of modern equipment has provided an aesthetically pleasing installation that is both energy conscious and low on maintenance.

Acknowledgements

Lighting Design
Iain Maclean, THORN Lighting
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Limbriek Grayshaw Associates, Glasgow
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Wallace and Whittle and Partners
Electrical
Forth Electrical Services of Stirling

NEW INSTALLATIONS

Here, we illustrate a range of new installations which not only give an idea of light at work but shows the versatility of the types of light fittings available both in the UK and overseas.

BAHRAIN AIRPORT

A total of 6,000 hf fluorescent fittings have been used to illuminate the newly extended terminal building at Bahrain Airport in the Middle East.
Recessed into a suspended ceiling, some of the luminaires provide overhead illumination for the check-in desk areas, while others are subtly housed in wall-ceiling enclosures.

FRENCH CATHEDRAL

The front elevation of the St Front Cathedral in Perigueux, county town of France's Perigord region, has been floodlit by over 80 high pressure sodium projectors in a scheme designed by lighting engineers in conjunction with the town council's engineers and the conservation body for the region's historic monuments. The cathedral, built on the style of a Greek Cross with Eastern style domes, is illuminated by the lamps mounted on the roofs of adjacent buildings. St Front is now highly visible during the night from three different angles, including the banks of the Isle River.

AUSTRALIAN ATRIUM

A series of CSI 1kW downlights has been installed around the perimeter of an atrium in the new BMW Import Centre in Melbourne. Arranged around the ceiling void, they recreate natural sunlight and provide a spectral mix with ideal lumen output in one

package. Each downlight is directionally adjustable and is fitted with a lens which enables the beam width to be easily varied from narrow to wide when required.
The architecturally-integrated lighting scheme enhances the visual appearance of the atrium, as well as plant, rockeries, pool and shrubbery, giving a clean fresh cool feel to the building.

The downlights are also instrumental, with their effect of creating natural sunlight, in helping the plantlife to thrive.
Necessary maintenance of the lighting installation is carried out from above via the ceiling cavity, as the atrium is three and a half stories high and the plantlife is some 8m below the lights. The lighting system was devised by Electrical consultants Simpson Kotzman.

BRISTOL ZOOLOGICAL GARDENS

The outdoor area of the Bristol Zoological Gardens restaurant is now bathed in the golden glow of high pressure sodium. Only four 250W grp floodlights have been used to enhance the structures profile. Each IP65 rated projector is inverted and used as an uplight. The zoo is strongly committed to conservation and has recently upgraded its lighting equipment. It is

anticipated that the new lighting may lead to the zoo becoming a popular night-time attraction.

SOUTH WALES ELECTRICITY

Floodlighting does not have to be expensive or complicated to have quite an effect. When the South Wales Electricity Company refurbished its offices in Cwmbran town centre a simple scheme using floodlights with 150W metal halide lamps was used to emphasise the green structural supports for the building cladding. Fittings located at both ground and eaves levels direct light upwards and downwards. The building is shown both before and after renovation.

GERMAN WASSER UND SCHIFFAHRTSDIREKTION

The design of the German Wasser und Schiffahrtsdirektion (shipping authorities) building in Mainz is impressive, with its glass facade and semi-circular architecture. The unusual shape of the building was a major consideration in the design of the lighting, examples of installations being required including the adoption of a lighting scheme which fitted in with the overall shape of the building and which was harmonious with the ceiling design and shape.

Other considerations included glare-free lighting in office areas using VDU screens and non-directional lighting to highlight the architecture.

To meet the requirements of the building, surface-mounted fluorescents (1 x 36W) with high-spec louvre design and electronic control gear were installed. These luminaires provide a reduced luminance of <200 cd/m² above an angle of 60 degrees, thus preventing direct reflection in VDT screens.

The entrance hall and canteen - the most frequented areas of the building, are lit by downlights - either 18W compact fluorescents or high pressure mercury lamps. Several halogen downlights have been used to increase the overall effect of the interior design of the conference room, these complementing the existing general illumination.

THE GOLDEN HINDE

High-pressure sodium lighting has been employed at Salford's newly-developed dockland area, to accentuate the 'golden' effect of a full-size reproduction of the Golden Hinde.

NEWCASTLE INTERNATIONAL AIRPORT

Newcastle International Airport has replaced its apron floodlighting with twenty four floodlights each containing two 400W high pressure sodium

lamps. Each lamp can be individually switched, giving the Airport authority greater control over the amount of light provided on the apron.
The floodlights' unique precision reflectors have dramatically improved the uniformity of light distribution on the apron, thus increasing safety, and the higher lighting levels have meant that the total number of fittings has been reduced. Apart from the reduced installation costs of the new scheme, the installed lighting load has also dropped from 26.78kW to 20.74kW, despite lighting levels improving by 80 per cent.
Substantial savings in maintenance have also been made. The control gear for all of the fittings has been sited remotely but conveniently in an easily accessible area inside the pier. The original floodlights had integral control gear which involved engineers working at the installation height of 17 meters in order to carry out maintenance.

RENAULT, FRANCE

The lighting design in Renault's quality control department demonstrates an important combination of imagination, technical excellence and close co-operation with the client.
Enough light has to be available for Renault inspectors to check the paint finishes on the cars thoroughly, but lighting designers had to avoid excess glare. The solution was developed with Renault's technical department and uses special low brightness fluorescent fittings mounted at specific angles. The resulting alternative pattern of matt and specular reflections produces a clear image on the surface paintwork which enables Renault to meet its target of zero defects.

DAGENS NYHETER, SWEDEN

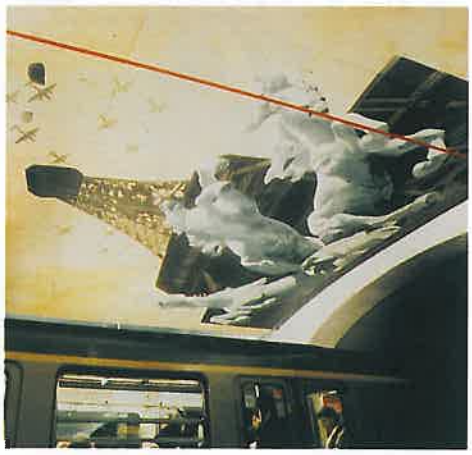
Journalists and staff at Sweden's biggest selling newspaper Dagens Nyheter (The Daily News) are working under a totally new lighting concept, using the "System 90" lighting system which integrates upward and downward light with the data and telecommunications links.
The fitting uses a 2D compact fluorescent lamp and apart from providing excellent low glare lighting, is easily portable - especially important where office layouts are frequently changing and maximum flexibility is required.

VINCENNES TROTTING TRACK

The Vincennes trotting track in Paris, one of the largest in Europe and home of the Prix de l'Amérique, one of the world's richest horse races, now has a spectacular new lighting installation.
The new lighting system comprises some 460 2kW metal halide floodlights, together with a hundred 1kW and 500W tungsten projectors used mainly for emergency lighting.
Approximately 1000 lux is provided in the vertical plane and 600/700 horizontal, thus giving excellent viewing conditions for spectators and television cameras and much reducing the risk of accidents on the track. The mounting positions are simplified by the fact that the stands are all on one side of the arena, so that the floodlights can be aimed away from the spectators.

PARIS METRO STATION

Although the first sight the lighting of the Paris metro station appears quite conventional, it has one very unusual feature. The indirect lighting from powerful floodlights changes every 10 seconds and not only brings the painted ceiling, by artist Jean-Paul Chambas, to life but provides general illumination for the traveller.
The scheme at Chaussée d'Antin station was designed by Laurent Fachard with the help of RATP engineers and the contractor Servignat. The narrow beam, high intensity floodlights are mounted in pairs and are fitted with special cylindrical low glare louvres. PAR 64 lamps are used. The rear section of the floodlight housing the lampholder is removable for relamping without disturbing the aiming angle.
The switching system regulating the whole installation produces a total of 3253 different lighting effects. The painting finds its mirror in the rails which are lit by low pressure sodium bulkheads.



EUROPEAN LIGHTING AWARDS

Organised by the European Lighting Council the European Lighting Awards commended excellence and innovation in lighting design. Following the contests of 1988 and 1990, which had as subjects Public Lighting and Lighting at Work respectively 1992's chosen theme was Lighting for Selling which included financial services. Here we focus on two winning refurbishment projects:-

Lighting's magical ability to highlight the key aspects of an historic building is wonderfully illustrated at The Royal Bank of Scotland's St Andrew Square Branch in Edinburgh. The jury considered the lighting of the domed-roof banking hall, which dates back to 1858, deserving of a special prize as it "presented an interesting solution to a challenging lighting problem". Eight powerful 1500W metal halide floodlights, mounted two per corner behind special decorative mouldings help restore the hall to its former glory. The floodlights are fitted with reflectors which disperse the light evenly and

allow it to gently 'run back' over the curvature and height of the ceiling. "Hot Spots" and glare at low level have been avoided and the choice of light source with its excellent colour rendering displays the colour scheme perfectly.
Lighting design was by Ron Millar and Sturrock Power International of Edinburgh carried out both the electrical design and installation work.

gramme was undertaken. The lighting solution was based on compact fluorescent downlights providing the general lighting supplemented by lines of low voltage spotlights above the balustrades of the upper galleries. Hidden tungsten halogen floodlights in the lattice work above the main axis of the shopping mall accentuate the succession of decorative arches along the sides of the complex.

The refurbished "Belle Epine" shopping centre in Thiais, France was awarded an honourable mention. Faced with a twenty year old lighting scheme that relied after dark on the spill light from the shop windows and signs, a major refurbishment pro-

The warm-white light colour used throughout not only creates a cosy, inviting atmosphere, but provides sufficient contrast with the lighting in the shop windows, thus maintaining these as the focus of customer attention. Shoppers now benefit from a modern, energy efficient lighting scheme. Lighting design was by Bernard Chaudron and Georges Brusmann.

KALLIO LIBRARY, HELSINKI

The thoughtful creativity of the Finns is wellknown and the downlighting of the "Kallio" library in Helsinki is no exception. As with much Finnish design glass is used to help create a powerful visual effect which is perhaps not at all surprising in a country that turns to ice for such long periods each year.
The design team of architect Pekka Manner, consultant Olavi Friberg and

THORN Orno Oy used 42 special downlighters for the project thus providing ample illumination without any apparent source of light. These specials were based on a standard surface mounted white cylinder downlight (model 5601) equipped with a 100W metal halide lamp. In order to produce a wider light distribution the integral reflector was modified and a decorative glass disc attachment designed. The latter is 8mm thick and is constructed of matt, sandblasted and hardened glass. The installation height of the library is 2.2 to 3 metres.

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