

focus on indoor lighting



ANOTHER MSR INITIATIVE TO IMPROVE THE PLANNING, DESIGN AND MANAGEMENT OF SPORT AND RECREATION FACILITIES

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Traditionally, sport in Australia has been an outdoor pastime. But in recent times, an increased awareness of skin cancers and other health risks, coupled with a broadening of the range of sports being played, has seen an upsurge in indoor recreational pursuits and a trend towards multi-purpose facilities. This trend has also impacted on the lighting requirements for indoor facilities, which now require systems to suit a variety of activities. This Focus Paper examines artificial lighting for indoor sport and recreation facilities. It covers the technology available and provides a guide to planning a lighting system.

INCLUDING:

- Aspects of Indoor Lighting
- Selecting a Lighting System
- Planning New Installations
- Consultants
- Suppliers
- Information Required BY the Lighting Designer
- Information Required FROM the Lighting Designer
- Types of Lamps
- Maintenance

Aspects of Indoor Lighting

Indoor lighting installations differ considerably from outdoor flood-lighting because the enclosed structure of a building produces an artificial environment. Wall and ceiling surfaces reflect light, which reduces the darkness of shadows. The overhead mounting of lights also makes it possible to achieve more uniform lighting, and the enclosed atmosphere reduces the loss of light through soiling of the luminaires.

Selecting a Lighting System

The diagram below provides an outline of points to consider in the process of planning an indoor lighting installation.

In choosing an indoor lighting system, it is essential to get expert advice. Purchasers of lighting systems often do not have the expertise to design their own lighting systems and need to be guided by the recommendations of a qualified lighting consultant or manufacturer.

Planning New Installations

It is important to decide on the type of activities which will take place in the facility before planning begins. The nature of the activities will have a large influence on the quality and quantity of light required. It will also influence the kind of system to be designed.

The majority of sport and recreation centres accommodate a range of sports and other activities, so the lighting system must be sufficiently flexible to satisfy the requirements of a full range of activities. This will require a compromise between the lighting needs of different sports. A lighting designer will attempt to do this in the most efficient and effective way.

The impact of compromises in the lighting system of a multi-purpose facility can be reduced by providing several options in the way lighting is rendered. For example, a grid of tungsten halogen, high intensity discharge and fluorescent luminaires, separately located and switched, can give different lighting combinations and enable a sports hall to cater for meetings, dances and concerts as well as sporting activities.

INDOOR LIGHTING SELECTION PROCESS

define the need

level of usage — specialist or multipurpose?
players' needs — social, training, competition?
level of players — junior, recreational, club?

define lighting required

nature of game — illuminance levels, uniformity, glare control?
method of control — manual, automatic, computers?
critical factors — sighting ball, aerial shots?
cleaning and maintenance — who does it, how often?

define budget limits

raising capital — donations, grants, loans?
long term goals — complete or staged development?
maintenance costs — changing lamps, vandalism?
running costs — electricity, cleaning?

consult a lighting designer

designer's experience in sports lighting/ referee checks?
designer's proposals — are they satisfactory?
inspection — visit other facilities to check quality
budget limits — are they realistic?
aesthetics — integration of design

evaluate proposals

Does the design meet your requirements for:
quantity of light? (lux levels)
quality of light — uniformity, colour, glare control?
capital cost — within budget limits?
running costs — within budget limits?

Indirect lighting, in association with dimmers on the switching gear, also makes it possible to vary the light, atmosphere and flexibility of a facility.

Natural lighting—another major consideration in the planning of an indoor lighting system is whether to use daylight. Despite its environmental appeal, natural light can produce problems. For example, sunlight coming through windows and roof lights can cause glare and overheating of a building. However, designs utilising indirect natural light can provide effective and comfortable solutions. Sunlight varies in its intensity through the day, so supplementary lighting possibly controlled by a photocell and an electronic controller should be provided for early morning and evening use.

Three factors must be considered in providing artificial or natural lighting for an indoor sports facility:

Quantity of light—there should be sufficient intensity of light to provide visibility and contrast appropriate to the activity and standard of play.

Quality of light—the light sources should provide correct colour balance, directional control and freedom from glare.

Distribution of light—the light distribution pattern should be uniform across the playing or activity area, without noticeable bright or dark spots.

Consultants

Consultants can provide purchasers of indoor lighting systems with specialised knowledge in the areas of lighting design and management. When choosing a consultant consider the following points:

- Qualifications and experience in the design of sports lighting;
- Reputation, professionalism and independence from any one manufacturer;
- References from people who have used their services;
- Interest in your project and desire for it to succeed.

The following information is based on the ACEA booklet "Guideline Fee Scales for Consulting Engineers Services" and discussions with consulting engineers. The Guideline Fee Scales allow for negotiation on fees and services.

Full Services—fees are based on a percentage of the tender price or the estimated cost of installation and range from 10% to 12% of the total cost.

Designing and drawing up a lighting installation (i.e. luminaires, control gear, mounting arrangement and cabling) also include:

- Preparing a full specification;
- Preparing a cost estimate;
- Calling tenders or quotations for the work;
- Inspecting the progress of the work;
- Field testing the finished installation.

Partial Services—for client consultation, design and documentation (plans and specification) of a typical lighting installation the fee charged is 75% of the fee for full services.

For partial services, fees are generally charged on a time basis. A basic performance specification outlining required light levels, mounting heights and locations plus lamp types and performance criteria has been estimated at eight hours.

Where quotes have been obtained from several manufacturers, a consulting engineer can examine these and give an unbiased expert opinion on each quote. The time involved in a review of quotes has been estimated at three hours.

There are few specialist lighting consultants in Western Australia. However, some electrical consultants have lighting expertise in this area.

GLOSSARY

BACKGROUND

That part of the visual field against which closer objects are perceived by contrasts in brightness or colour. The selection of background surfaces to control colour, pattern and reflective qualities is vital to the design of indoor lighting.

BRIGHTNESS

The amount of light produced by a surface that reflects or emits more light. It is a subjective term and is not used to describe lighting on a technical level.

CLEANING CYCLE

The time between the cleaning of the luminaires. This time interval varies according to the atmospheric pollution at the lamp's location and the capability of the luminaire to resist soiling and corrosion.

COLOUR RENDERING

The effect of a light source on the colour appearance of objects in conscious or sub-conscious comparison with a reference light source such as daylight.

CONTRAST

The differences in appearance between two parts of a visual field seen simultaneously or successively. The difference may be in brightness or colour, or both.

CONTROL GEAR

The equipment used with a discharge lamp to control its operation, comprising a ballast, capacitor, fuse and ignitor.

DIRECT LIGHTING

Lighting in which most of the light emitted by the luminaires reaches a surface directly; that is without reflection from other surfaces.

EMERGENCY LIGHTING

An independent lighting system which operates when the main lighting system of a building fails.

ILLUMINANCE

The amount of light falling on a unit area of a surface. The unit of illuminance is the lux.

INDIRECT LIGHTING

Lighting in which most of the light emitted by the luminaires reaches a surface indirectly; that is after reflection from the ceiling, roofs or walls.

LAMP

The bulb which houses the light source. Lamps are classified into three types: incandescent, fluorescent and high-intensity discharge.

LUMINAIRE

This is the apparatus which distributes the light emitted by a lamp and which includes all the components necessary for fixing and protecting the lamp and for connecting it to a power supply. It usually consists of lamp, housing, reflector, lens and control gear.

LUMINOUS EFFICACY

A measure of how efficiently a light source converts electrical energy to light. It is determined by the ratio of light output emitted by a lamp and the electric energy consumed by it.

RATED LIFE

The expected average operating life of a lamp, based on laboratory tests.

STROBOSCOPIC EFFECT

A flickering effect produced when a rapidly moving object or player passes through periodically varying light, producing the illusion that the object is changing speeds rather than flowing smoothly along a path. This effect is especially noticeable if discharge lamps are operating on alternating current.

TELEVISION LIGHTING

Lighting installations designed to illuminate sporting events to the standards required for television broadcasting. Generally these standards specify much higher levels of illumination than those required for normal sporting use.

UNIFORMITY RATIO

A measure of the evenness of light distribution provided by a lighting installation. The ratio of the minimum lighting level to the average level over a given area.

Suppliers

Lighting manufacturers offer advisory and design services, many of which are based on sophisticated computer-aided design systems. These services are offered without charge as an inducement to potential customers to buy their products. Reputable manufacturers have a vested interest in the performance of their products, and will assist their customers to select appropriate fittings for each particular application.

As with any design service, the quality of the end product depends largely on the quality of the information supplied by the client. Where a client gives a manufacturer a well-considered list of requirements, including budget limits, a competent and economical design can be expected.

Services offered include:

- General advice on lighting requirements;
- Computer design print-out — luminaires and control gear only;
- Performance data sheet giving luminaire and lamp types, illuminance levels, mounting heights, initial cost and running costs;
- Detailed quotation for the supply of the luminaires and control gear;
- Supply of luminaires and control gear;
- Installation advice to the electrical contractor;
- Field testing of the finished lighting installation.

Information Required BY the Lighting Designer

The following information should be provided to the lighting designer to assist the planning process.

Drawings or sketches—of the playing areas giving main dimensions and showing the proposed locations of spectator areas, windows and doors.

Finishes—information on floor and wall surface colours and finishes is also important as the lightness or darkness of materials and their surface reflective qualities impacts on the lighting design.

Lighting budget limit—including initial costs and running costs. This information is essential for an economic design.

Type of sport—a brief description of the nature of each activity or sport, and critical factors such as sighting the ball, aerial shots and movement patterns.

Future plans—information on plans for future expansion of the building or lighting system. This is necessary for calculating cable sizes, switchboard capacity and control systems, and it will assist in saving money when the next stage is built.

Information Required FROM the Lighting Designer

The lighting designer should provide the following information to client groups so the merits of different schemes can be assessed. It is particularly important to have this information if competitive proposals are being considered so a fair comparison can be made.

Lighting layout—this should show the number and positions of the luminaires, their mounting height, the switching arrangements and the proposed method of cleaning and servicing units.

Type of lamp recommended—the lamp should be chosen to suit the type of service, colour rendering and cost structure of the installation.

Luminaire recommended—this information should specify the shielding angles, the proportions of light emitted upwards, downwards and the means of access for cleaning and lamp replacement.

Average illuminance expected in service—this should specify both the general illuminance across the playing area and the illuminance on specific areas (such as goal areas) if supplementary or localised lighting is to be used.

Initial cost and running cost—the estimate of the initial cost should preferably include installation charges; data on the running costs should include the electrical consumption (including control gear losses), maintenance costs, the replacement cost of individual lamps, and their rated life in hours.

Letter of guarantee—once a particular lighting system and supplier has been selected and the system is installed, it is recommended that a “letter of guarantee” be obtained from the supplier. This letter should guarantee the outputs and inputs of the system including average light levels, uniformity ratios and power consumption.

Types of Lamps

Three types of lamps are generally used in indoor sports lighting:

- Tungsten halogen lamps
- Fluorescent lamps
- High-intensity discharge (HID) lamps

Each type has its advantages and disadvantages, depending on the type of installation that will be required.

Tungsten halogen lamps—provide good lighting in terms of colour correctness, are low in initial cost, and are easy to replace. However, they are inefficient in energy use and have a short life in comparison with other types.

Fluorescent lamps—provide good lighting in terms of colour correctness, are medium priced, more energy efficient, and have a longer life than incandescent lamps. However, because of the lamps’ elongated shape, it is practically impossible to produce a concentrated light beam.

High intensity discharge lamps—provide extremely energy-efficient lighting and last longer than either of the other types. These lamps are commonly used for lighting of large indoor areas. Balanced against these advantages are high initial and replacement costs.

Maintenance

Unless a lighting installation is properly maintained, lamp depreciation and dirt accumulation on the luminaires and other surfaces will cause an ever-increasing loss of light. This loss should not be underestimated.

To prevent waste of light it is necessary to:

- Make provision for maintenance when planning the installation;
- Establish a regular cleaning schedule and see that it is properly carried out;
- Replace worn-out lamps promptly.

Some practical suggestions:

1. Choose a luminaire and light source that will be easy to clean and replace.
2. Provide safe and ready means of access. A ladder will usually be good enough if there are only a few low-mounted units to be serviced, but for a large installation of high-mounted units more elaborate devices such as elevating platforms should be considered.

- Clean units regularly and replace defective lamps immediately.
- Scratch the installation dates of discharge lamps onto the lamp base so that premature failure can be noted and a warranty claim made if necessary.
- Removable parts should preferably be hinged or otherwise made fast. Plug-in control gear can also lead to easier maintenance.

Comparison of Lamp Types

There are various types of lamps available for indoor sports lighting. The following lamp comparison summarises their main characteristics.

Type	Relative Cost	Wattage Range	Luminous Efficacy Lumens/watt	Average Life (hours)	Colour Rendering	Start-Up Time
Tungsten Halogen	medium	up to 2000	20–25	2000	good	instant
Fluorescent	low	up to 215	40–80 (average 65)	7000–10,000	varies	immediate
Mercury Vapour	medium	up to 2000	35–55	10,000	good	up to 5 minutes
Metal Halide	high	up to 3500	60–100	1000–10,000 (average 5000)	excellent	up to 5 minutes
High Pressure Sodium	high	up to 1000	80–130	8000	poor	immediate to few minutes

Source: AS 2560 — *Guide to Sports Lighting*

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This paper is a summary of the matters relating to indoor lighting for sport and recreation facilities. The contents should not be used or relied upon as a substitute for professional advice.

Ministry of Sport and Recreation

PERTH

Sir Thomas Meagher Pavilion
Meagher Drive, Perry Lakes
Floreat, Western Australia
PO Box 66, Wembley WA 6014
Telephone: (08) 9387 9700
Facsimile: (08) 9387 9726
info@wamsr.ausport.gov.au
www.msrr.wa.gov.au

CENTRAL SOUTH

Mclver House
297 Fitzgerald Street
PO Box 55, Northam WA 6401
Telephone: (08) 9622 0150
Facsimile: (08) 9622 0160
msr@avon.net.au

GASCOYNE

1st Floor
Gascoyne Memorial Centre
14 Robinson Street
PO Box 140, Carnarvon WA 6701
Telephone: (08) 9941 2153
Facsimile: (08) 9941 4055
msr@wn.com.au

GERALDTON MID-WEST

Mid-West Sports House
77 Marine Terrace
PO Box 135, Geraldton WA 6531
Telephone: (08) 9964 5333
Facsimile: (08) 9921 6555
msr@midwest.com.au

GOLDFIELDS

Goldfields Sports House
25 Porter Street
PO Box 1036, Kalgoorlie WA 6430
Telephone: (08) 9021 5399
Facsimile: (08) 9021 5335
msr@gold.net.au

GREAT SOUTHERN

1st Floor
234 Stirling Terrace, Albany WA 6330
Telephone: (08) 9841 6800
Facsimile: (08) 9842 1660
msr@omninet.net.au

KIMBERLEY

Shop 24, Kununurra Shopping Centre
Konkerberry Drive
PO Box 1127, Kununurra WA 6743
Telephone: (08) 9168 1987
Facsimile: (08) 9168 3035
cmaclean@wn.com.au

MIDLANDS

Mclver House
297 Fitzgerald Street
PO Box 55, Northam WA 6401
Telephone: (08) 9622 0150
Facsimile: (08) 9622 0160
msr@avon.net.au

PEEL

45 Mandurah Terrace
Mandurah WA 6210
Telephone: (08) 9535 0009
Facsimile: (08) 9535 2119
msr_peel@hotmail.com

PILBARA

State Government Offices
Cnr Searipple & Welcome Rds
PO Box 294, Karratha WA 6714
Telephone: (08) 9185 0194
Facsimile: (08) 9185 0198
msr@kisser.net.au

SOUTH WEST

61 Victoria Street, Bunbury WA 6230
Telephone: (08) 9791 7100
Facsimile: (08) 9791 7963
msr@gateway.net.au