5.11 Sports lighting

Techniques

General

The purpose of sports lighting is to provide lighting that allows a sport to take place safely (i.e. designed to suit the speed of play and size of any objects used in the sport) and provide good viewing conditions, both in visibility of the sports action and comfort of the audience. Points of note are:

For all sports a good level of modelling is required. Modelling is the effect of light and shadow produced when light flows from one main direction (known as key light) and additional lower levels of lighting flow from other directions (known as fill light), producing a coherent three-dimensional image of a scene. If there is insufficient key light and all the lighting is fill light objects become flat with little discernable detail. If there is insufficient fill light harsh shadowing will occur, obscuring areas in the field of view. Both cases will cause a reduction in the ability of sports participants to correctly see and react to events on the field of play, and will also cause problems for spectators and television cameras.

For high-speed sports the elimination of any stroboscopic effects from high intensity discharge sources is important. Stroboscopic effects may make a moving object appear stationary, or make the object seem to jump from one position to another. For these sports the use of high frequency control gear is recommended.

Lighting requirements are defined by EN 12193. Additional requirements may be defined by sports governing bodies such as FIFA, Olympic Delivery Authorities, etc. and by television authorities, such as Sky.

Some sports (notably FIFA regulations for football) also define requirements for uniformity gradient (UG). This is measure of the rate of change of illuminance across an area, and is expressed as the ratio between the illuminance levels of two adjacent measurement points. That is

$$UG = \frac{E_{measurement\ point\ 1}}{E_{measurement\ point\ 2}}$$

EN 12193 defines requirements based on the lighting class (I, II, or III). This is derived from the level of competition, international and national, regional, local, training and recreational. At the lower standard of play there is flexibility with the light source options (i.e. high pressure sodium, metal halide) but at class II and III metal halide light sources with high colour rendering abilities are required.

Sports lighting

Each sport has a playing area that is the principal playing area (the area inside the line marking for tennis or football for example) and a total area that is defined as the principal playing area, plus an additional safety outside the principal playing area.

Lighting levels for sports are normally defined in terms of the minimum average horizontal illuminance on a reference plane, and a uniformity of illuminance. In some instances the plane of illuminance will be relevant to the sport and the spectator viewing distance, or TV camera-viewing plane. Here the normal to camera illuminance and vertical illuminance will be relevant.

As some sporting areas are large, have the need for high levels of illuminance or are used for a long period in the day, highly efficient lighting systems are required to keep energy consumption low. Maintenance is also important to ensure system efficiency and functionality and therefore all lighting equipment should be safely accessible and maintainable throughout life.

When lighting exterior sports facilities to achieve good uniformity lighting equipment must be mounted on masts of sufficient height to ensure floodlight aiming angles are no greater than 70°. This will ensure a high utilisation of lamp flux, minimum electrical load, and lower installed costs.

When designing lighting for sports facilities it is important to minimise obtrusive and spill light. For guidance on this see section 6.8.

All sports facilities require safety lighting (that is lighting designed to allow safe movement of players and spectators in the event of a power failure or emergency). Relevant guidelines form the sports governing bodies should be consulted for this information.

Sports halls - Points of note are;

Most sports halls are suitable for different sports and non-sporting events, all requiring different visual requirements. The most demanding visual activity should dictate the lighting design layout and light levels.

One lighting layout will generally not be sufficient to meet all requirements, as specific sports require different lighting configurations. Therefore it is essential that lighting controls are used to switch a selection of luminaires for different requirements.

Luminaires should be impact resistant against balls and projectiles, and designed and mounted to minimise the risk of objects becoming trapped within or behind them.

Sports lighting

The layout of a sports hall may be altered using partitions, and therefore care should be taken to ensure glare is controlled along all lines of sight, with and without the partitions. Additional lighting may be required when partitions are in place and this should be checked during design.

For aerial sports, e.g. badminton and volleyball, the positioning of the luminaires outside the playing area may be necessary to avoid disability glare for players looking upwards.

As a sports hall can support many types of activity it is important to ensure good uniformity is achieved throughout the hall. This allows competitors to quickly and accurately monitor an opponent's movement, particularly important in combat sports.

Key luminaires:

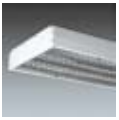


Table tennis and badminton - Points of note are;

Badminton shuttlecocks are small and fast. Players are continually required to visually follow the trajectory of the shuttlecock and there are therefore specific recommendations for luminaire positions and requirements for good vertical illuminance. A low ceiling reflection factor will help to improve the visibility of the shuttlecock.

For competition table tennis it is important that excellent uniformity is achieved over the table top and up to five metres from the table edges. The elimination of any stroboscopic effects from high intensity discharge sources is important. A good level of vertical illuminance is required to ensure visibility of any high balls.

Fluorescent lighting systems provide the best arrangements for high levels of horizontal and vertical uniformity over the playing areas. Pendant, surface or recessed T16 or T26 luminaires with a parabolic louvre are suitable.

Key luminaires:

Sports lighting

Fencing - Points of note are;

Fencing has specific requirements for both horizontal and vertical illuminance as the movements are very fast with a fine foil blade and the visual task is the torso of the players.

Fluorescent pendant, surface or recessed T16 or T26 luminaires with a parabolic louvre are suitable.

Key luminaires:

Boxing - Points of note are;

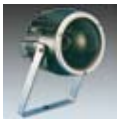
In boxing the speed and force of movement over extremely short distances requires very high lighting levels at competition levels, normally between 1000 lux and 2000 lux average horizontal illuminance. This also ensures that the referee, judges and spectators can see adequately and comfortably.

Normally a purpose made lighting assembly will support the lighting equipment above the ring. Narrow beam luminaires should be used to provide the necessary high levels of illuminance efficiently.

High colour rendering qualities are required from the light source, which is recommended to be metal halide with an Ra of 85+. This is also required for video and CTV transmissions.

Pendant or surface narrow/medium beam metal halide floodlights are suitable with baffle/louvre attachments to control glare.

Key luminaires:



Sports lighting

Indoor tennis halls - Points of note are;

Tennis can be a very fast sport demanding good visual conditions to allow judgement of the ball trajectory, its speed and anticipated bounce position on the court. Therefore good illuminance and uniformity with the elimination of shadows and glare are a requirement from the lighting system. The lighting will also need to extend beyond the playing area to cover the important zones behind the baselines and sidelines.

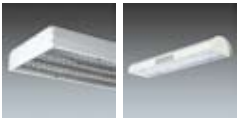
To prevent players being dazzled when looking at high balls the luminaires should be positioned outside the playing area, and not positioned behind the baseline up to a distance of three metres where serving takes place.

Luminaires should be impact resistant against balls and projectiles, and designed and mounted to minimise the risks of object becoming trapped within or behind them.

Additional wall colouring or screening with low reflectance matt material will help players to get additional information about the balls position on the court.

Pendant or surface mounted T16 or T26 fluorescent reflector luminaires with a protective grille are suitable. Alternatively pendant or surface mounted low-bay metal halide luminaires with a louvre assembly and protective grill.

Key luminaires:



Squash courts - Points of note are;

The ball used for squash is smaller than a tennis ball, is dark coloured, travels up to 200 km/h and bounces in any plane. As the walls are used to create complex trajectories with players moving very quickly across each other's line of sight early anticipation and vision are required to hit the ball accurately. Good illuminance on all four vertical planes together with high horizontal illuminance uniformity is needed against a light vertical background to improve perception of the ball.

Fluorescent lighting is most suitable with two asymmetric distribution luminaires mounted parallel to the front to wash the wall, and an asymmetric distribution luminaire washing each of the sidewalls. Mounting the luminaires at 1m from the wall prevents reflected glare.

Sports lighting

Surface mounted or recessed T16 or T26 fluorescent asymmetric reflector luminaires with a protective grille are most suitable.

Key luminaires:

Figure skating and ice hockey - Points of note are;

Most indoor rinks are used for recreational purposes with additional events carried out on specific occasions. Therefore the lighting installation needs to be flexible.

Luminaires are normally mounted over the ice in a regular array to provide good uniformity of illuminance and general average horizontal illuminance.

The ice hockey puck is black and to help spectators see it when it is flying through the air high reflectance surroundings should be used around the ice. Decreasing the spacing between luminaires near the goal increases illuminance in this critical area.

Luminaires should be impact resistant if mounted less than 5m above the ice.

High bay style luminaires with prismatic optics and metal halide lamps will help provide a good level of vertical illuminance and a high uniformity of illuminance on the horizontal plane whilst using the minimum number of luminaires. Floodlights can also be used but care should be taken to control both direct glare and reflected glare from the surface of the ice. The use of double asymmetric beam floodlights will help.

Key luminaires:

Sports lighting

Swimming pools - Points of note are;

Swimming pool lighting caters for a variety of visual tasks. The competitive swimmer has a much different seeing task to other swimmers where the main attention is focussed on staying in lane and the turning point at the end of the lane. Water polo players need lighting with a good ambient lighting effect. Swimming instructors, coaches, pool attendants and spectators all need to see across the pool and into the water to identify swimmers and situations. For recreational swimming pools themed or decorative lighting effects may be required.

Because water reflects direct incident light the positioning of the luminaires needs to be carefully selected to avoid luminaire reflections and disability glare. Luminaires positioned around the pool help to reduce unwanted reflections. When this is not possible asymmetric distribution luminaires positioned above the water may be used but maintenance of the luminaires should be considered.

Underwater lighting will help to reduce reflected glare from the pool surface as well as improving viewing conditions on the pool bottom. Synchronised swimmers need underwater lighting to help monitor the movement and position of other swimmers. However for competitive swimming and water polo underwater luminaires should be switched off.

For diving pools supplementary lighting is required to improve the vertical illuminance, particularly for judges who need to assess the divers performance at the point of entry into the water. For springboard diving the lighting in the diving zone requires a good ratio of horizontal to vertical illuminance.

Luminaires for indoor swimming pools must be protected against chlorinated and possibly salty air and as such need to meet high standards of electrical reliability and protection against corrosion. Luminaires should be protected to IP65 and have fixings that are made of stabilised austenitic stainless steel. High ambient temperatures may require control gear to be mounted remotely to ensure long life and reliability. The use of floodlights will help resolve some of these issues as floodlights are mainly designed for exterior use and have a high degree of protection and resistance to the elements built in.

Good colour rendering lamps are required to provide the correct ambience and visual comfort for competitors and bathers. Metal halide lamps with a warm or cool appearance can be used to good effect.

Surface mounted or recessed fluorescent luminaires with an acrylic panel/ bowl are suitable, as are metal halide or high pressure sodium floodlights wall mounted or pendant mounted for uplighting or direct lighting of the pool.

Sports lighting

Key luminaires:

Outdoor football and rugby - Points of note are;

The most common approach is the use of lighting masts, approximately four each side of 12m–20m height to achieve a minimum angle above the pitch centre of 20° to the lowest floodlight, but preferably 25°. These are spaced along the long axis of the playing area, positioned away from the touchlines to avoid collisions. For football they are also positioned away from the corners to avoid glare to goalkeepers. The floodlights are normally rated 1kW– 2kW and have a double asymmetric beam shape to ensure good uniformity and glare control.

An alternative option is four corner masts where long throw symmetrical narrow beam floodlights are used. The same conditions apply to mast positioning and height to achieve high utilisation of lamp flux and the avoidance of glare.

For rugby pitches the dead-ball zone, which can be up to 22m long, will need to be adequately illuminated. In some instances the spill light from the playing area will be sufficient but only to a depth of 6m. This is in addition to the playing area length of up to 100m between goal lines. A total area shall include a strip the length of the pitch including the dead ball area of no less than 6m wide on each side of the pitch.

Lighting can be positioned on the roofs of adjacent grandstands if they are of sufficient height and location to comply with floodlight positional requirements, and of sufficient structural strength to allow the weight of the floodlights.

Double asymmetric or symmetrical beam floodlights using high-pressure sodium or metal halide lamps are suitable for this application.

Key luminaires:

Sports lighting

Hockey - Points of note are;

The playing area for hockey is slightly smaller than for football, but the lighting principles are the same with regards to mast positions and heights. The use of a smaller ball and the speed of the sport require a higher lighting level for Class III installations and a better uniformity for Classes II and III than for football and rugby.

Double asymmetric or symmetrical beam floodlights using high-pressure sodium or metal halide lamps are suitable for this application.

Key luminaires:

Track and field - Points of note are;

For track and field stadiums the most cost effective solution is to locate 6-8 masts around the whole perimeter of the track with a clearance of 4.5m from the track edge. The mast height is determined as for football but with the additional requirement of a maximum mast height to ensure adequate vertical illuminance for competitors on the outside of the track. The masts mounted along the straight section of track illuminate the centre field area providing good vertical illuminance for javelin, shot, hammer and discus events.

Double asymmetric or flat glass double asymmetric beam floodlights using high-pressure sodium or metal halide lamps are suitable for this application.

Key luminaires:

Sports lighting

Freestyle skiing and ski jumping - Points of note are;

Downhill skiers require the whole piste uniformly illuminated from beginning to end so depressions and surface irregularities are revealed. As high speeds can be achieved the position of floodlights are important to provide the correct visual conditions, therefore floodlights are placed either side of the piste whilst being aimed across and down the slope to reduce glare to the skiers.

Wide horizontal and narrow vertical angle floodlights metal halide lamps mounted on masts up to 12m high are suitable for this application.

Ski-jumpers require good horizontal lighting at the take-off and at the landing or touchdown point for judging and safety. The landing area needs to have a high level of uniformity (0.7) for the class III standard of skiing. The illuminance on the jump hill is measured on the surface of the snow.

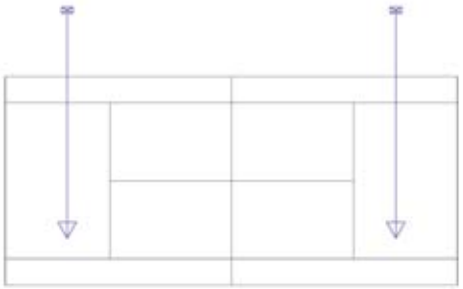
Key luminaires:

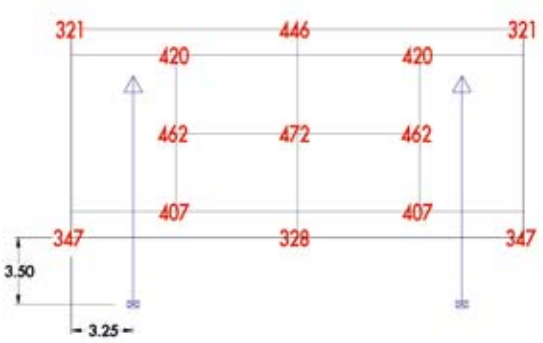


Sports lighting

Schemes

Tennis court





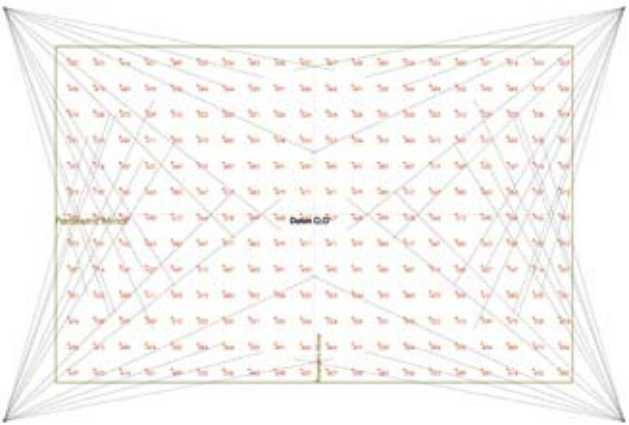
Scheme: Double tennis court, 24m x 11m
Luminaire(s) used: 4 x Champion 2kW HQI-TS/N/L, 12m mounting height
Pitch: E_{av} = 397 lux, E_{min}/E_{av} = 0.81

Lighting from the edges helps prevent glare to players.

Sports lighting

Schemes

Football Stadium



Scheme: Football stadium with 4 x 25m corner columns
Luminaire(s) used: 48 x Mundial R 2kW HQI-TS
Pitch: E_{av} = 538 lux; E_{min}/E_{av} = 0.76

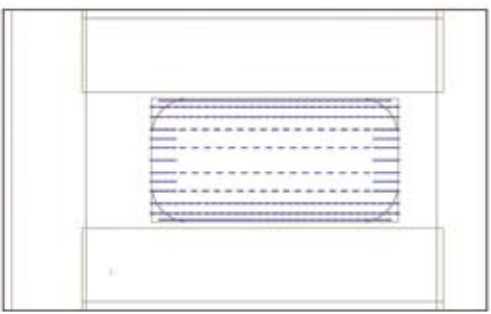
A football stadium lit using Mundial floodlights. The luminaires are mounted along the roof of the stand down two sides of the pitch, and a mix of light distributions is used to correctly illuminate all the playing area. Lighting levels for television are supplied by ensuring good levels of vertical illumination in the camera directions.

Additional luminaires on the inside of the canopy lights the seating areas and ensures the security and safety of spectators.

Sports lighting

Schemes

Ice Hockey Stadium



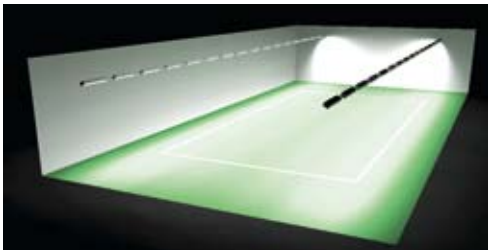
Scheme: Ice hockey stadium, 117.5m x 17.3m x 23m
Luminaire(s) used: 316 x Indus XS, 2 x 80WT16, 17m mounting height
Pitch: E_{av} = 422 lux ; E_{min}/E_{av} = 0.07

A relatively high level of illumination is required due to the fast moving nature of the game and the small size of the puck. Lighting levels by the goals are increased to aid the ability of the goalkeeper, officials and spectators to see the puck.

Sports lighting

Schemes

Indoor tennis court



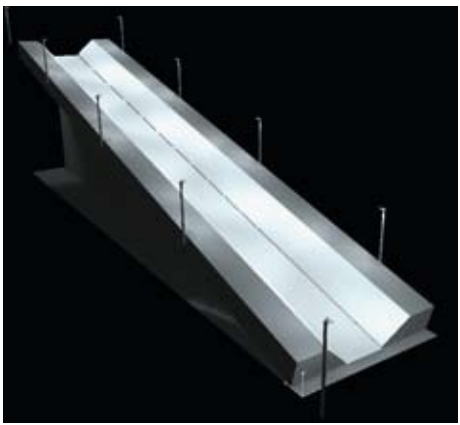
Scheme: Indoor tennis court, 36m x 18m x 6m
Luminaire(s) used: 32 x Titus Sport, 3x49W 5m mounting height
Tennis court: E_{av} = 531 lux ; E_{min}/E_{av} = 0.35

Indoor tennis courts lit using the Sporting luminaire. The luminaires are integrated into the architecture of the roof and are positioned to light from the edges of the playing areas, preventing players having to look directly at a luminaire.

Sports lighting

Schemes

Ski shute



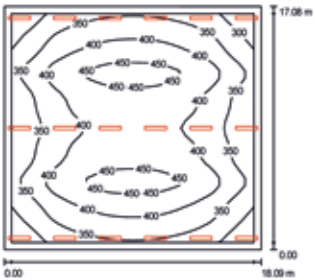
Scheme: Ski shute, 30m x 150m
Luminaire(s) used: Either 36 x Sonpak 25/40 with HIT400W or 27 x Sonpak 25/40 with HST400W
Ski slope: HIT 400W E_{av} = 1.24 lux; E_{min}/E_{av} = 0.02
HST 400W E_{av} = 1.41 lux; E_{min}/E_{av} = 0.02

A ski slope lit using 270 Mundial 2kW floodlights. The floodlights are positioned and aimed to prevent glare to skiers, whilst revealing the texture of the surface of the slope to ensure safety. This requires aiming away from the direction of view of skiers, and the use of glancing angles to show surface texture. Additional care should be taken to prevent reflected glare from the snow.

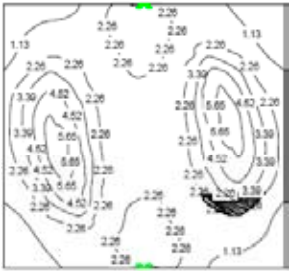
Sports lighting

Schemes

Sports hall



Scheme: Multi-purpose sports hall, 17m x 18m x 7.6m
Luminaire(s) used: 18 x Titus Sport 4 x 49W, 7.6m mounting height
Floor: E_{av} = 364 lux; E_{min}/E_{av} = 0.61



Scheme: Multi-purpose sports hall, 17m x 18m x 7.6m.
Emergency lighting
Luminaire(s) used: 2 x Voyager Twinspot, 6m mounting height
Floor: E_{av} = 2.46 lux; E_{min}/E_{av} = 0.23

When lighting sports venues it is essential to consider the safety of the participants and spectators in the event of loss of power or an emergency. Therefore emergency lighting should be installed that complies with the relevant requirements and standards.