DAYLIGHTING FOR THE WORLD OF SPORT
THE NATURAL CHOICE FOR NATURAL LIGHT IN STADIA AND ARENA

TECHNICAL GUIDE
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Natural Light in Stadia

Introduction

The benefits of natural daylight within any building are well understood and are equally important for the open environment of a stadium. Daylight is essential for creating the best pitches with good quality grass that provides an ideal playing surface and looks superior for televised matches. Bringing daylight into stands whilst protecting spectators from the elements also creates a pleasant seating and viewing area and improves the overall stand environment for full enjoyment of the game. GRP and polycarbonate sheeting are excellent ways of letting natural light into stadia and can present breathtaking architectural statements.

Stadium Design and the Playing Pitch

Strong, healthy grass is critical for successful stadia and requires three elements:

- Appropriate drainage
- Good air movement
- Natural light

Opaque roofs and high stands cause reduced light levels leading to environments that are not conducive to quality grass growth. Without incorporating rooflights in the canopy over the stand, the entire pitch would constantly be in shadow and one of the three essential elements, natural light, would be missing. Areas of the pitch not receiving natural light would be vulnerable to poor grass growth and grass quality problems.

Stadium designers are now incorporating translucent materials into stadia designs to ensure adequate daylight reaches the grass whilst protecting spectators from wet weather. In addition, the benefits provided are not only in terms of improved turf performance but also in cost benefits due to the reduction in the amount of regular re-turfing required.

GRP and polycarbonate rooflights offer very effective and aesthetically pleasing ways of ensuring daylight is transmitted.

Facility Enhancement

Typically stadia have solid back, side or gable end walls which often create a dark environment towards the back of the terrace. Vertical and canopy glazing using GRP or polycarbonate sheet significantly increases natural daylight into the stands. Solar glare and heat gain can be controlled or eliminated to create the perfect environment.

Other Considerations

Apart from excellent light transmission, other material properties must be taken into account, such as longevity, weather resistance, high impact strength, fire performance and solar heat gain.

Trilite GRP and Marlon CS Longlife polycarbonate rooflights and sheeting manufactured by Brett Martin have the ideal combination of benefits required for a healthy playing pitch and a top quality spectator environment.

Translucent Trilite GRP sheets will diffuse sunlight evenly, avoiding harsh, distracting lines of shadow and ensuring all areas get a more even distribution of light with light transmissions of over 80% possible. The wide range of options provide unequalled safety margins, including Safelight sheet which remains non-fragile for over 30 years. Trilite sheeting also supplies unmatched rigidity and strength, with optimum weather performance and excellent durability.

Profiled Marlon CS Longlife polycarbonate sheet allows slightly more light onto the pitch than GRP, with light transmission of nearly 90% for clear sheet. It has exceptional impact resistance, so is ideal for use in any situation where withstanding impact from projectiles may be a consideration. Marlon CS Longlife also has co-extruded UV protection that cuts out 98% of harmful UV radiation, reducing the effect of weathering on the sheet, with tinted options allowing solar control.

Brett Martin are the only European manufacturer of all the main rooflight materials. The company’s extensive product range is backed by exceptional technical expertise, which means we can match any requirement and offer independent advice on the most appropriate product for any project.
**Grass Growth**

**Scientific Evidence**

Grass growth (by photosynthesis) is affected by many variables including temperature and the quantity and wavelength of the light it is exposed to. Graph A, taken from ‘The growth and functioning of leaves’, 1993, edited by JE Dale & FL Milthorpe, shows the variation of growth rate (yield) of plants with wavelength, clearly showing that for maximum growth, light of wavelength 425-650 nm is required. It shows that UV light, of wavelengths below 400 nm, is not required for photosynthesis.

Graph B shows the results of an independent test carried out on the light transmission through Trilite Ultra GRP rooflights. The results are qualitative rather than quantitative, but clearly show that whilst there is minimal light transmission below 380 nm wavelength, the transmission of light at the required wavelength for photosynthesis (425-650 nm) is almost unrestricted. Standard tests demonstrate that in the visible spectrum (400-750 nm) the light transmission through a Trilite Ultra GRP rooflight is actually 80-85%.

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**Natural Light in Stadia**

With over 50 years of rooflight industry experience, Brett Martin provides the total package to ensure optimum stadium grass growth.
Design Options

Complex and Bespoke Design

Brett Martin provide a bespoke rooflight service designing and manufacturing innovative and complex canopies in partnership with stadium designers from project inception to completion. Our dedicated technical team possess extensive stadia experience on an array of high profile projects, working closely with designers to develop bespoke solutions for unusual and architecturally challenging rooflight applications to customer specifications.

The 38,000 seater stadium was the centrepiece of the facilities for the Commonwealth Games in 2002 and provided a spectacular backdrop to the Games by hosting athletics and the rugby 7s competition.

The complex curved canopy glazing was produced from Marlon CS Longlife profiled polycarbonate manufactured by Brett Martin, and was supported by the company’s superb technical support and expertise, providing a top quality service for the stadium designers. Over 60 CAD drawings were made to detail the polycarbonate sheeting and a sheet tagging system was designed to identify each sheet and its subsequent correct location on the roof canopy.

A flexible sheet interface with steel structure was manufactured, which was designed in conjunction with Broderick Structures, to allow for movement such as thermal expansion and contraction of the canopy steelwork. Two vac form tools with over 35 inserts per tool were used to produce 75 different sheet types and 1152 sheets were supplied in total to complete 76 bays in the canopy.

CASE STUDY ONE

City of Manchester Stadium for the Commonwealth Games 2002

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Design Options

The new 60,000 seat Emirates stadium, home ground to Arsenal FC, is a four-tier structure including the Arsenal museum and shop, as well as a wide range of restaurants and bars. It features an undulating roof canopy created from Brett Martin’s profiled polycarbonate sheet, Marlon CS Longlife. This is suspended in an ellipse above the stands and is designed to provide maximum natural light throughout the stadium to ensure an optimum pitch, maximise energy cost-efficiencies and meet a range of design criteria for the stadium.

THE KEY DESIGN ASPECTS WERE:

• Provision of excellent views of the pitch from all the seats within the stadium
• Creation of an exciting atmosphere for spectators and players
• Desire to maximise the pitch quality
• Need for the stadium to be immediately recognisable as the home of Arsenal football club
• Need to maximise the use of a tight space of land, taking into account transport routes in the surrounding area
• Need to design around height restrictions imposed by local planning legislation
• Need to take into account restrictions on budget
• Need to work within the time allocated for construction

Brett Martin worked with the design architects, HOK Sport, on several schemes and detail options for the roof canopy from the start of the project.

This collaboration led to the development of unique vacuum formed sheet details which were devised to ensure that the Marlon CS Longlife sheeting worked throughout the complex roof structure. This also led to a non-standard sheet being produced to accommodate the abnormally high snow load potential. The sheeting was then supplied to the roofing contractors (Prater) with coded layout plans for each individual bay to ensure trouble-free installation.

Brett Martin Daylight Systems also manufactured and supplied 144 bespoke, solid top access hatches to be fitted into the Sama membrane section of the roof, to allow easy access to the PA and lighting systems.

CASE STUDY TWO
Emirates Stadium

The new 60,000 seat Emirates stadium, home ground to Arsenal FC, is a four-tier structure including the Arsenal museum and shop, as well as a wide range of restaurants and bars. It features an undulating roof canopy created from Brett Martin’s profiled polycarbonate sheet, Marlon CS Longlife. This is suspended in an ellipse above the stands and is designed to provide maximum natural light throughout the stadium to ensure an optimum pitch, maximise energy cost-efficiencies and meet a range of design criteria for the stadium.

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Design Options

Vertical Glazing

Stadium design often involves solid back, side or gable end walls, creating a dark environment towards the back of the terrace.

A more effective design option is to utilise natural daylight by using clear or translucent glazing materials. This will significantly increase daylight into the stands and thus improve viewing whilst protecting spectators from the elements. Vertical glazing also allows maximum daylight to penetrate throughout the stadium, encouraging the growth of the pitch as well as creating a pleasant environment for fans.

Both GRP and polycarbonate prove effective vertical glazing materials allowing a choice of options to achieve the best combination for a particular project. These include:

- Light transmission
- Solar control
- Insulation control
- Fire rating
- Aesthetic appearance
- Tints and colour
- Strength
- Weight
Design Options

Rooflight Styles

Rooflights can be categorised as either ‘in-plane’ - sitting flush within the roof covering material, or as ‘out-of-plane’ - standing proud of the roof support structure or covering material. Stadia rooflights are assembled on site and the variety of style and materials, together with extensive flexibility in design and manufacture, enable the unique daylighting requirements of each stadium project to be satisfied. Quick and easy to assemble on site.

In Plane Site Assembled

Single skin rooflights fabricated from profiled or flat sheets of polycarbonate or GRP are the most common type used in stadia canopies. This system utilises a traditional steel cladding support structure to form a continuous cover of interlocking sheets, employing the principles of steel cladding with the added benefit of its ability to facilitate innovative detailing by forming bespoke complex shapes.

Rooflight Forms

Corrugated Cladding

Available in both polycarbonate and GRP, profiled translucent sheets are the simplest and most cost-effective method of cladding large canopies. This system utilises a traditional steel cladding support structure to form a continuous cover of interlocking sheets, employing the principals of steel cladding with the added benefit of its ability to facilitate innovative detailing by forming bespoke complex shapes.

Panellised

This type of system predominantly uses multi-wall or solid sheet material in conjunction with structural glazing bars to produce a flat, tiered roof with the ability to reduce both the amount and visual impact of the support structure required.

Dependant on the choice of glazing material, this type of construction can achieve large areas of un-obscured canopy within a light clean-lined framework.

Out of Plane

Vaulted

Light-transmitting vaulted rooflights on stadia are visually striking and achievable using polycarbonate solid or multiwall sheet glazed into curved structural aluminium glazing bars. Unsupported spans of up to 9m are possible, achieving visual and architectural impact whilst maximising light transmission.

EMIRATES STADIUM (ARSENAL FC)  ARCHITECT:ATHEDEN FULLER LENG

OLD TRAFFORD (MANCHESTER UTD FC)  ARCHITECT:ATHEDEN FULLER LENG

LIBERTY STADIUM (SWANSEA CITY FC) DESIGNED BY TTH ARCHITECTS

HAMPDEN PARK, GLASGOW RANGERS FC.
Brett Martin offers the widest range of polycarbonate and GRP rooflights and rooflight sheeting options available. With the technical expertise to match, we can provide impartial technical advice on rooflights and material selection to customer specifications.

Properties and Performance of Polycarbonate and GRP

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>POLYCARBONATE</th>
<th>GRP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light Transmission</td>
<td>Direct light transmission of almost 90%.</td>
<td>Diffused light, limiting glare and giving an even distribution of light at ground level with few shadows.</td>
</tr>
<tr>
<td></td>
<td>Outer skin has UV protection limiting harmful UV radiation.</td>
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</tr>
<tr>
<td>Impact Resistance</td>
<td>Exceptional shatter resistance up to 200 times greater than glass - ideal where vandalism could be a problem.</td>
<td>Available in a range of weights, including sheets with outstanding impact resistance.</td>
</tr>
<tr>
<td>Life Expectancy</td>
<td>High light transmission levels for at least 10 years and weatherability for over 15 years.</td>
<td>Can be specified with a life expectancy of over 30 years.</td>
</tr>
<tr>
<td>Safety</td>
<td>Can be specified to achieve Class B non-fragility to ACR(M) 001:2005.</td>
<td>Can be specified to achieve Class B non-fragility to ACR(M) 001:2005.</td>
</tr>
<tr>
<td>Fire Performance</td>
<td>Softens at relatively low temperatures allowing fire, smoke and hot gases to escape.</td>
<td>Available in a range of fire ratings, does not soften and is effective in containing flames, smoke and hot gases.</td>
</tr>
<tr>
<td>Service Temperature</td>
<td>Can withstand temperatures from -40°C to +100°C.</td>
<td>Can withstand temperatures from -20°C to +80°C.</td>
</tr>
<tr>
<td>Sheet Information</td>
<td>Can be used in single, double or triple skin form.</td>
<td>Can be used in single, double or triple skin form.</td>
</tr>
<tr>
<td></td>
<td>Number of sheet thicknesses available.</td>
<td>Number of sheet weights (1.8kg to 5.5kg) available.</td>
</tr>
<tr>
<td></td>
<td>Availability of wide and increasing range of profiles.</td>
<td>Availability of extremely wide range of profiles.</td>
</tr>
<tr>
<td></td>
<td>Can be supplied in any length and various widths.</td>
<td>Can be supplied in any length and various widths.</td>
</tr>
</tbody>
</table>

**Colour Tint Options**

A range of colour tints are available. Polycarbonate is available in opal, bronze and heatguard and GRP is available in opal, blue and green. These provide a number of benefits including:

- Increasing or decreasing light diffusion
- Choosing light levels to suit an individual stadium’s requirements
- Reducing solar gain and heat build up
- Protecting spectators and players from the glare of the sun
- Matching Club colours to create a cohesive stadium design
- Creating a design and aesthetic statement
Providing Everything You Need

With the widest range of rooflights available from one source, Brett Martin is able to provide the complete stadium experience. Working in close partnership with our Semi-Finished Products division, we are able to manufacture and fabricate a range of protective coverings and screens.

Polycarbonate can be fabricated into a variety of shapes, with the minimum of specialist tools and can be easily installed on site, making it ideal for protective coverings.

Dome and vault rooflights create a bright internal environment and can transform dark internal areas into bright attractive spaces. Tubular rooflights are ideal for bringing maximum natural light into rooms such as changing rooms and shower areas, which may not have natural windows.
Training and Sports Facilities

Brett Martin rooflights are suitable for an extensive range of training and sports facilities, where the provision of natural daylight creates pleasant, daylight interior environments that encourage optimum effort and performance.
Solutions for any Requirement

Case Study - Manchester City

Project
- Major re-working of the City of Manchester stadium, originally built for the 2002 Commonwealth Games for Manchester City FC. Work included the ground being lowered by up to 10m to accommodate an extra 10,000 seats to bring the capacity up to 48,000, with the original playing surface and running track replaced by a full-size playing pitch and warm-up pitch. The unique bowl design of the stadium was also finished to create a fully completed curving canopy.

Material
- Approximately 1500 linear metres of 1.5mm thick Marlon CS Longlife profiled polycarbonate was used to produce the front third of the canopy profiled to match the Ward 371/000 metal sheet that forms the remainder of the roof.
- 6mm thick Marlon FSX Longlife solid polycarbonate sheet was used below the roof as clear vertical glazing, with individual rhomboid panels used to create louvres and the effect of a floating canopy.

Project Team
- Main contractor: Laing Construction
- Roofing contractor: Speedwell Roofing

Special Features
- Marlon CS Longlife was produced to accommodate curvature through three planes and to allow for easy on-site installation into the roof support system.
- Marlon FSX Longlife supplied weather protection to the spectators whilst still allowing air to circulate.
Case Study - Killanin Stand, Galway Racecourse

Project
• A new four storey stand topped with a 14m cantilever roof built on the site of the previous west stand. The two lower levels house a free-seating area for 700 spectators, bar facilities, snack area, restaurants, tote hall and toilets while the two upper levels house the corporate hospitality boxes. In all there is capacity to hold 6,000 spectators. Work to demolish the old stand and complete the build of the new stand took place during a strict eleven month window between the course’s 2006 and 2007 race festivals.

Material
• Almost 2,500 square metres of Trilite Ultra 36 translucent GRP weather sheets installed in lengths over 17 metres. The GRP sheets are opal tinted to provide 50% light transmission with a superlife finish for enhanced UV protection and durability.
• An Xlok Ultra interlocking panel system installed inverted to form the canopy soffit with opal tinted Marlon ST 25mm 5wall structured polycarbonate glazing sheets.

Project Team
• Main contractor: Michael McNamara & Company
• Roofing contractor: Deane Roofing & Cladding

Special Features
• Opal tinting on both of the glazing materials used in this project provides a soft, diffused daylighting effect, creating a relaxing and ambient environment for spectators.
• Superlife finish on the Trilite Ultra weather sheets provides enhanced UV protection and durability.
Solutions for any Requirement

Case Study - Brit Oval

Project
• An new four storey stand that sweeps around the Vauxhall End ground, providing seating for up to 14,500 spectators.

Material
• 2200 square metres of 2mm thick clear Marlon CS Longlife profiled polycarbonate with an embossed finish were installed on the innovative canopy roof which arcs over the stand.
• Sheets were manufactured to PMF R32/1000 profile in a variety of straight and tapered sheets to satisfy the complex requirements of the crescent shaped roof.

Project Team
• Installed by Keyclad Ltd

Special Features
• Embossed sheet was used to reduce shadows glare and reflection by diffusing the daylight evenly without reducing the light transmission of almost 90%.
• Marlon CS Longlife has a co-extruded UV-absorption layer which minimises the harmful effects of the sun - for this project this was included on both surfaces of the sheet to further protect the sheets from discoloration and degradation, increasing their longevity.
Case Study - Leicester City

Project

• A new £27million, 32,000 seat stadium for Leicester City FC at Freemans Wharf to replace the Club’s Filbert Street ground. A curving bowl shape stand was chosen to emphasise the team and game spirit within the building design.

Material

• Detailed light path analysis by Keyclad resulted in the use of 3416m² of Marlon CS Longlife profiled polycarbonate over the West and South stands.

• A further 1920m² of Marlon CS Longlife was installed vertically on all elevations into the concourse areas, chosen for this element as it proved the best solution in a value engineered situation.

Project Team

• Main contractor Birse Stadia
• Roofing contractor Keyclad

Special Features

• Marlon CS Longlife is a strong and lightweight material with a light transmission of almost 90%, providing maximum natural daylight, one of three essential elements required to create a quality pitch.

• Polycarbonate benefits spectators by creating a pleasant environment whilst sheltering them from the elements.
All reasonable care has been taken in the compilation of the information contained within this literature. All recommendations on the use of our products are made without guarantee as conditions of use are beyond the control of Brett Martin. It is the customer’s responsibility to ensure that the product is fit for its intended purpose and that the actual conditions of use are suitable. Brett Martin pursues a policy of continuous product development and reserves the right to amend specifications without prior notice.