

# LG

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NEW ZEALAND LOCAL GOVERNMENT

**Tunnels and  
tsunamis**  
not a good mix

**Carbon file**  
tracking our  
footprint



**Prepping Eden Park**  
for the big event





## Eden Park's World Cup makeover

...Aurecon puts focus on lighting and engineering technology

**R**ights to host the 2011 Rugby World Cup in New Zealand came with the proviso that a 60,000 seat stadium with world-class broadcasting standards would be made available for the final and semi-final matches.

The solution involves Eden Park having a 50,000 permanent seating capacity, increasing to 60,000 for the 2011 Rugby World Cup. The project includes a new three-tier, 22,000-seat South Stand; a new 12,000-seat, two-tier East Stand; new Western Concourse and modifications to the existing ASB Bank Stand to accommodate new sports-lighting.

With projects such as Wembley Stadium, Melbourne Cricket Ground, AMI Stadium and Telstra Dome as part of its track record, Aurecon has been able to draw on strong local and international experience to complete this project, which will be the focal point for the 2011

Rugby World Cup.

A number of New Zealand firsts will be implemented to support the major features involved in the project, such as some of the largest steel girders ever made in New Zealand to support the new roof, complex shading and daylight analysis, world-class sports-lighting design and the first major Ethylene tetrafluoroethylene (ETFE) 'NZ Landmark Fern' facade.

To meet the challenging demands of this nationally significant project, global engineering and infrastructure consultancy Aurecon (formerly Connell Wagner) were engaged by the Eden Park Redevelopment Board (EPRB) to provide the structural engineering, daylighting and shading analysis, geotechnical, facade and wind engineering, and sportlighting design services.

### Structure and facade

The new South Stand will have 8.5m

cantilevered seating tiers supported by 1.9m deep prestressed concrete beams to maximise spectator views. The new roof will cover the upper two tiers of seating, and is designed to cantilever 33m from 'cigar' shaped feature steel columns. The roof structure is formed from specially shaped and fabricated steel box girders that are almost 3m deep and are some of the largest steel girders ever made in New Zealand.

The South Stand has a feature ETFE facade, with 'NZ Landmark' fern trusses. This will be the first major ETFE facade to be delivered in New Zealand. Aurecon's specialist facade team have made the vision of the client and architect a reality with the geometry of the design being a major challenge.

### Shading and sports-lighting

In the early days of the project when the New Zealand government took the lead role in redeveloping Eden Park for



the 2011 Rugby World Cup, Aurecon was engaged to provide strategic engineering advice on two key aspects of the project, sports-lighting and shading. To address residents concerns, Aurecon was engaged to determine if the existing sports-lighting towers could be replaced with a modern world-class sports-lighting system capable of meeting the most stringent international High Definition Television (HDTV) broadcasting standards. The solution involved placing sportslights along the leading edge of the redeveloped stadium, a solution which had previously been discounted given the low roof height. Aurecon, with its international sports-lighting design capability based in New Zealand, developed a unique interlaced aiming strategy using the very latest technology to ensure the final installation met the requirements of the International Rugby Board (IRB) and the strict controls put in place by Auckland City Council regarding spill lighting and glare.

Shading from the new South and East Stands was a major concern for residents and the Auckland City Council. Again Aurecon were able to develop a unique shading analysis methodology using advanced shading and daylight simulation software. Shading analysis and mitigation strategies were based on advanced 3D modelling techniques which had never been attempted in New Zealand before on such a scale. When the shading and daylighting analysis evidence was presented at the most recent resource consent hearing before Auckland City Council, the presiding commissioner commented that Aurecon had set a new standing in shading analysis techniques.

### Technical lighting constraints

With the end goal of lighting the sports field to the highest standard technically possible, numerous technical

constraints needed to be overcome. In addition to the more obvious budget and build constraints offering various challenges, player, spectator and camera disability glare, the reduction of spill lighting around the park, HDTV broadcasting requirements, and a multitude of other constraints all played a role in forming the design brief.

The lighting upgrade also needs to cater for all future stadium events and their different lighting requirements. For example, cricket and rugby have very different lighting and broadcasting needs. Cricket needs to have a 15-degree 'sterile' zone that is void of luminaires behind each wicket. Rugby requires very good vertical illumination in the try line areas, whereas cricket requires them around the stumps and boundaries. Sky glow, spill light and environmental effects were all factors to consider during the design process whilst taking into account council bylaws, resource consent constraints and the local residents concerns. To ensure punters wouldn't be left in the dark, electrical supply and failsafe backup systems, which provide more than three lines of defence against a blackout, and switching methodologies, were also major background design issues.

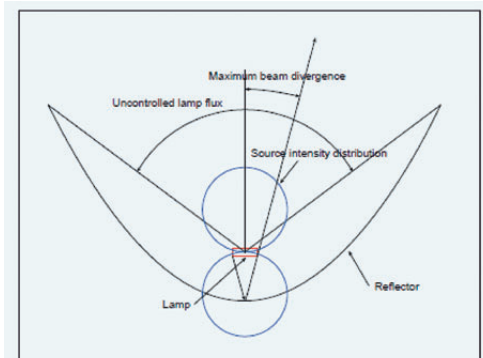
### IRB lighting requirements

The International Rugby Board requires 2200lux on the horizontal playing surface, which is not that difficult to achieve. The IRB's real technical challenge, however, is to achieve 1600lux on the vertical surfaces of the players, with a uniformity of 70 per cent and the crucial factor, limited glare at various points across the field. HDTV and TV referee technologies are making this requirement more and more important, as technology progresses. The premise that good lighting should never have an influence over a match decision is vital, as bad ones sometimes do.

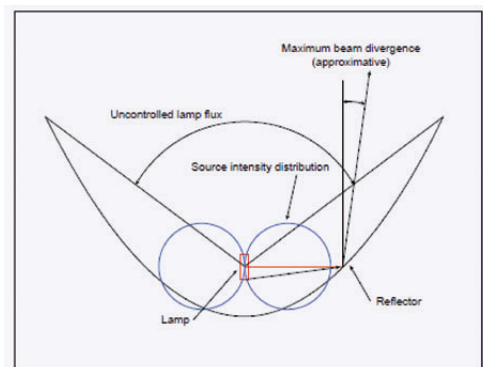
### The solution

Aurecon's unique interlaced aiming strategy and previous experience on Wembley Stadium in particular, formed an important part of the solution.

Philips' Arenavision 3 was the preferred baseline luminaire chosen for the concept design, after a rigorous tendering process. 480 fittings, with their 220,000 lumen, double-ended, two kilowatt lamps were modelled in an AGI digital lighting software model. Each lamp emits the equivalent light output of about 180 X 100W GLS tungsten lamps. When the aiming angles are switched on together in the model, it can look like a game of 'pick up sticks'. This initial model was developed around three years ago. During the detailed design phase, Philips launched Arenavision 4, with a host of significant improvements on its version 3. The lamp itself was changed from a double-ended to a single-ended lamp. This offered massive benefits to Aurecon and the



Previous MVF403 Transversal lamp-optic system; the lamp is in horizontal position



New MVF404 Axial lamp-optic system; the lamp is in vertical position

Eden Park project. The lamps' arc-tube is aligned axially with the aiming angle of the luminaire, instead of transversely. This means that the reflector around the crucial areas close to the lamp arc tube and the beams' symmetry are vastly improved. This leads to an improved light output ratio, which is effectively the percentage of light produced by the lamp that actually makes it out of the luminaire.

The main benefit however, as shown in DIAGRAM 1, is that the beam control is far better and that the 'doughnut' of spill or waste light around the usable beam is therefore dramatically reduced. Even though the single-ended lamps' lumen output is slightly reduced at 204,000 lumens, more of the light produced by the lamp reaches the target area with far less waste light being lost as unwanted glare. This has delivered a win-win situation for both Eden Park and concerned residents in terms of spill lighting and glare.

Glare mitigation, as a basis of the Aurecon unique sports-lighting design methodology, ensures that the aiming strategy maximises the use of every luminaire on the field and makes it impossible for a player, camera or spectator to catch an eye or lens-full of more than one floodlight at a time. They twinkle, rather than blast.

Traditional and, in some cases, contemporary schemes often suffer from the problems caused by clustering large quantities of very high output luminaires next to each other. This usually creates a glare and contrast problem. No matter what the viewing angle or how high the poles are, a large bank of luminaires in ones peripheral vision is always annoying. A cameraman following a cricket ball for instance, cannot track the ball when it's near the luminaire clusters.

The wraparound nature of Eden Park's new architecture ensures that the leading edges of the North and South Stands offer adequate mounting height for a symmetrical, linear, lighting array using the Aurecon-developed interlaced aiming strategy, a first for New Zealand. On the South Stand an overhang steps up to accommodate the sportslighting beneath it. This has the effect of mitigating sky glow and reducing glare and spill lighting. The North Stand uses a frame on top of the leading edge of the roof in order to mount the luminaire

arrays fitted with their anti-glare cowls. This has the effect of balancing the mounting heights of the luminaires between the two stands.

## Maintenance factor mitigation

As part of the new lighting solution, Aurecon has paid particular attention to the switching modes for cricket and rugby. Very few luminaires serve only one or the other mode. The few that do are generally those that serve the cricket outfield areas that are covered by stands during a rugby match. This is part of the efficiency and luminaire maximisation strategies which Aurecon targeted throughout the design process.

All lamps suffer from lumen depreciation over time. Metal halide lamps, such as those used on Eden Park, have a significant technical drawback in that their lumen depreciation is fairly severe. Traditionally, lighting designers would design to a maintained illuminance. In this instance, lumen depreciation is typically 70 per cent light output at 3000 hours of burning. This entailed stating the expected lamp life of an installation, thereby giving the owners a lamp replacement maintenance cycle and hefty cost.

This method accounted for the fact that a percentage of the lamps would fail early, or in this case, somewhere before 3000 hours. Applying these two factors to a maintenance factor calculation usually means over-lighting the scheme, on initial switch-on, by 40 per cent at least. Eden Park's new Dyalite lighting control system gives a central computer individual control over all sportslighting luminaires across the stadium. Aurecon have conceptualised a system whereby the lamp lumen depreciation and lamp survival factor are mitigated, by controlled switching. The end benefit is that the field will never be over-lit by more than 10 per cent, instead of the typical 40 per cent of a traditional method. Cameras get a more stable light level, lamp life across the installation is maximised and large quantities of energy are saved. The detailed design has retained the 480 luminaire quantity in order to ensure that the sports-lightings' quality is uncompromisingly good. The good news is that this is one installation where value management has considered the 'performance to cost ratio' of the end result, paramount.

## 'Smarts' summary

Eden Park's sports-lighting 'smarts' include some remarkable performance achievements. The sky glow problems of the old lighting scheme will effectively be wiped out. The use of the 'wrap around, leading edge' means that the annoying glare of large headframe banks will disappear. The tight beam control of the advanced luminaires employed in the scheme mean that efficient use has been made of the available lumens, with little waste. Lumen depreciation over lamp life and the lamp survival rate have been mitigated with a groundbreaking switching control methodology. Future-proofing is assured with the careful use of the right type and quantity of luminaires.

## Legacy

Eden Park's future may include the extension of post 2011 rooflines and structures. The new scheme could easily be tailored to suit such upgrades without the need for significant luminaire additions or rethinks. The redevelopment of Eden Park's sports-lighting is an enduring, efficient scheme, bristling with smarts and firsts. When nations of players, camera crews and fans swarm in on New Zealand in 2011, Auckland will have at least one glowing standard of excellence to showcase in the theatre of rugby.

To see more project images visit [www.localgovernmentmag.co.nz](http://www.localgovernmentmag.co.nz)

## CREDITS

### Client:

Eden Park Redevelopment Board

### Sports-lighting

Aurecon New Zealand

### Structural and facade

Aurecon New Zealand

### Sports-lighting supplier

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### Project manager

RCP

### Architect

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### Quantity surveyor

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### Contractor

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### Building services

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### Civil

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