Permanent waves

Text: David Müller

When you drive up to a hotel you have never stayed in before and are impressed by its outward appearance you are more than disappointed if the place you park your car is unattractive and not in line with the rest of the ensemble. This is especially the case when the hotel happens to be in a part of town that was formally a rough dockland area dedicated to the transport and shipping of coal. The facade of the car park in Cardiff Bay is purposefully reminiscent of sails and waves, and is a jewel in the crown of the new development on and around the bay. That's all very nice, but what happens after dark? A truly good lighting concept was called for.

The prospect of illuminating a car park is probably not one which would thrill most lighting designers. But in 2006, architects Scott Brownrigg approached the London-based lighting design practice Light Bureau to discuss developing a new urban structure for Cardiff (Wales, UK). The opportunities for the lighting designers soon became apparent and prejudices were put aside.

Previously, the site of the project had been a busy harbour. Cardiff used to be the most important coal port in the world with up to ten million tons of coal exported from there every year. It would be safe to say that the city's economy and industry were driven by the coal trade. Coal was mined in South Wales from the mid 19th century up to the late 20th century. From the 1980s onwards, coal mining was gradually replaced by other economic activities, and the region was neglected for decades. Since the beginning of the 80s coal has gradually started to lose its economical importance. The result for Cardiff, as for many other British cities: high unemployment, poverty and a decline in the infrastructure.

However, for the last ten years a regeneration programme has been transforming what was once a rough and tough bay area into a cultural and leisure destination with new commercial and cultural buildings.

As part of the new infrastructure requirements a car park became necessary for the area. With the history of the harbour the theme "sea" was obvious. "The architectural concept of the wave-like form is intended to evoke the spirit of the bay area, communicating the movement of the water," says lighting designer Paul Traynor.

"The lighting concept response was to achieve a striking night-time effect reflecting the movement of the sea in the bay immediately behind the structure". One of the main challenges for the lighting designers was to create visual impact without overwhelming adjacent structures, such as the newly built Welsh Assembly building.

The sail structure of the car park consisted of a series of undulations across an overall span of approximately 125 metres. Because those were combined with a complex structural support system an even wash of light was

Without doubt waves make for an attractive feature. They stand for uniformity, movement and energy. To be asked to illuminate a wave-like construction on a facade is a gift for a lighting designer, especially when the structure is semi-transparent and can be lit from the inside. A more intensive effect can be achieved, however, when front lighting and backlighting are combined. This also helps to minimize the problem of hot spots that would otherwise undermine the even spread of light over the curved surfaces.

Even still images seem to leave the onlooker with the impression that the facade construction is in motion. This feeling is further enhanced by the continuous change from white to blue white, and vice versa.

Facade lighting for a car park in Cardiff/UK

almost impossible. The architects had originally planned an aluminium sail form, which would have obviated back-lighting.

However, structural and budget constraints led to the development of a semi-permeable fabric structure. This fabric was tried with different lighting methods. Although permeable for wind, the solid portion is in fact opaque. Thus the only option was to front-light the sail structure.

As a functional and open structure, the car park is illuminated internally with approximately 100 lux of fluorescent light from weather-proof, non-shielded batten sources specified by the electrical engineer. Such battens are common in car parks and are efficient at creating uniform safety and orientation lighting for users, but at the expense of the visual appearance. "We did not even venture to suggest altering an internal lighting scheme which might compromise the safety of the people using the car park," says Paul Traynor. "A car park is first and foremost a functional space so we elected to work with the constraints of the functional lighting and to balance the feature lighting with the background ambient levels."

The material and permeability had a significant influence on the decision to front-light the fabric sail, which the architect readily agreed to. Now the task was to find an optimal luminaire type and solve the design technically, working within a restricted budget and of course, testing and communicating the proposal to the installer.

An obvious solution would have been to populate the façade with LED sources, but as the budget was too restricted a more economical, low-tech alternative was sought. In order to create a dynamic façade the light designers chose to investigate a dual lamp solution, and eventually settled on fluorescent technology. Linear sources with efficient reflectors were pre-requisite and the original expectation was that the designers would use T16 fluorescent lamps. However, because the structure is in an exposed situation, it was quickly identified that thermal operational issues for those lamps might be a problem. Fluorescent lamps are very susceptible to cold weather. Especially the T 16 tends to 'drop out' when being dimmed in a cold surrounding, which the designers thought might be problematic during winter time.

"We needed to be totally confident that the specified solution would work in all conditions and set about solving the thermal issues, which involved a great deal of

research," says Traynor. Light Bureau therefore investigated the older but thermally more robust T26 lamp technology. They found that T 26 performance would be acceptable in low temperature conditions, although aware that these would still be prone to potential failure if not adequately warmed up or run-in first.

The entire system is operated via an astronomical time clock based on a DMX protocol interfaced with DALI ballasts. To ensure that the lamps worked and dimmed reliably, the system ignites the lamps one hour before sunset each day, allowing the lamps to warm up before the dynamic cycle starts. The lamps 'warm-down' for half an hour at 11pm every night.

These precautions have ensured reliable operation of the installation with no failures by greatly reducing thermal stress, thus extending the longevity of the lamps. By comparison, the standard batten luminaires for the car park, which are controlled via presence detectors, are regularly re-lamped as the switching cycle and thermal issues are causing the lamps to fail.

To extract as much light in the desired direction as possible, twin reflector luminaires were selected. It was important that the fitting have a single body but with two separate reflector housings, one for each lamp. The designers calculated all scenarios where the sail structure was close to and furthest from the building to select the appropriate beam angle of the luminaire as well as the optimum aiming angle.

Each luminaire is mounted on a special bracket and precisely placed so that they followed the contours of the sail structure, thus avoiding views of the lamps from the roadway or glare from within the car park.

The luminaires are fitted with a separate blue and white (4000K) T26 lamp within the individual reflectors. In some cases, fittings incorporate a combination of medium beam for the inner lamp and narrow for the outer lamp. In total there are twelve specific variations of the same luminaire to satisfy the mounting and offset requirements. Each fitting uses two separate DALI ballasts to achieve the degree of control need by the concept. The lamp colours are cool 4000K lamps for the white lamp and a blue lamp for the colour.

Light Bureau elected not to use coloured over-sleeves due to the longevity issues of these, the access difficulties for maintenance and the sheer quantities involved. Osram's blue T8 lamp is marginally more efficient than an over-sleeved lamp. The concern over the background ambient levels of the car park lighting steered the designers further in the direction of the coloured lamp. The blue tone was a good fit in terms of the moving water concept.

In order to test the concept the sail supplier, Base Structures, erected a large sample area at a workshop in Bristol, England. Norka supplied a number of the specified fittings with alternative reflectors on the basis that these would be used and modified where needed to suit the actual installation. A mock-up was established.

"It's possible to achieve much by design and experience but there is no substitute for real-life testing," says Traynor. "Besides, it is a good way of demonstrating the idea to the client who does not always fully understand the concept from visuals, especially when creating dynamic installations."

The height at which the designers had expected to mount the fittings was discovered to be too low. Installed as expected they would have been very visible from the adjacent roadway. Positions were adjusted and Control Lighting were able to try different sequences of program to show the client the gradual movement the lighting designers were aiming to achieve. As part of the mock-up white light sources were also placed behind the sail structure to assess the amount of interference these would give to the façade scheme and how visible they would be through the fabric. There were still concerns about the actual installation. However, from the mock-up, the designers were now confident that the fittings were efficient and producing sufficient intensity on the sail forms.

Paul Traynor is satisfied with the final result: "The scheme has been well received and, as hoped by the client and design team, has lifted a multi-story car park structure from the mundane functional space into an architecturally interesting civic focus."

Project team:

Architects: Scott Brownrigg

Lighting designers: Light Bureau, London/UK

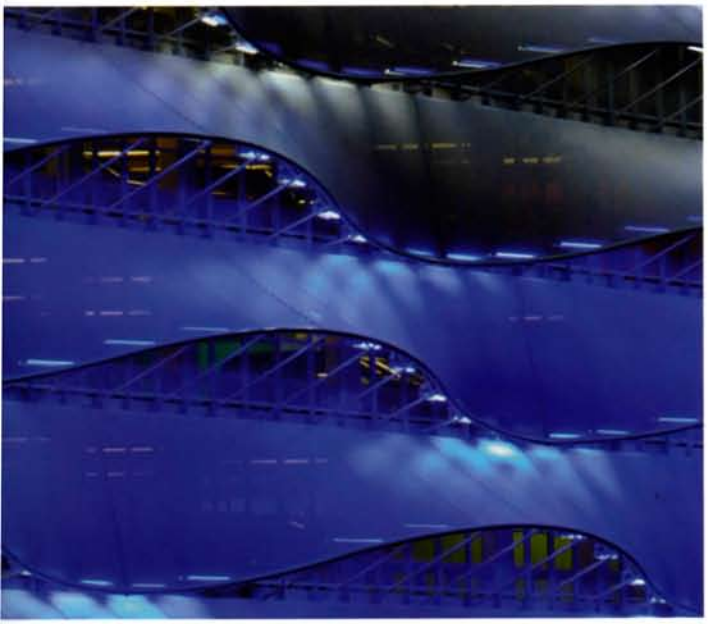
Electrical engineers: Arup

Tensile fabric sail designer and supplier: Base Structures

Products applied:

Twin reflector luminaires: Norka UK

Lighting control: Dynalite



The concept showing combined front and backlighting.