

Rethinking lighting
in museums and galleries

Rethinking lighting
in museums and galleries



Why revisit lighting?

Museums and galleries consume significant amounts of energy to maintain an internal environment to protect and preserve their collections. The use of lighting within both exhibition and back of house areas can account for 20% of this energy consumption. By targeting this lighting energy demand, significant energy savings can be made.

Benefits of change

Upgrading or refurbishing both daylight and electric lighting systems within museums and galleries can lead to significant cost savings, both in terms of energy reduction and reducing ongoing maintenance costs. Improving energy efficiency also provides the benefit of operating more sustainably.

Balancing energy and quality

We believe lighting within museums and galleries should be developed with lighting quality as the primary objective. This ensures that displays are experienced as the artist intended. Balancing energy savings and quality is one of the biggest challenges facing museum institutions today; where the lure of significant energy savings can sometimes lead to lighting quality being compromised.

We have the knowledge and experience to guide our clients through this process, ensuring that the outcome of any lighting system upgrade leads to the best possible lighting environment for visitors and for the artworks.

Maximising daylight

Reviewing the control of existing daylight systems or re-opening windows and skylights that have been obscured can lead to many benefits. The use of daylight within display spaces does however require careful consideration. When used successfully daylight can offset a considerable amount of electric lighting use. Daylight also has significant benefits for museum staff, where access to daylight and views can improve wellbeing and productivity.

Lighting control

The control of daylight and electric lighting is fundamental to the success of any museum and gallery lighting installation. Control systems often need recommissioning to ensure energy and conservation objectives are being achieved. New light sources can also provide opportunities to simplify control systems and, where appropriate, to consider smart control systems that can respond to occupancy or user preference.

About lighting at Arup

Our experts

Our award-winning lighting designers create unique answers to our clients' needs. We offer a comprehensive lighting design service, from initial strategic advice and concept development through to construction documents and on-site support.

Conceptual design, technical detail

With the potential to change how we perceive architecture and public space, our lighting teams are experts in designing and delivering innovative design solutions. Working closely with architects and clients at all stages of a project, we provide original and authentic conceptual design solutions and are uniquely placed to turn vision into reality, transforming creative concepts into detailed technical specifications.





Daylight for museums and galleries

Daylight is carbon free and cost free and can, if properly harnessed, play an important part in creating a low energy museum. There are, however, downsides to the uncontrolled use of daylight in museums and galleries. Sunlight has the potential to overheat a space or flood it with illumination that is too intense for the artworks.

There are many examples where museums have blocked off daylight from gallery spaces, often because they are unable to control and regulate daylight to required conservation limits. This can alter the architecture of museum buildings such that they are unrecognisable from their initial design, an issue particularly relevant for heritage museums and galleries. Our lighting team has a great deal of experience in the design and implementation of active and passive solutions for the control of the extremes of light, heat and ultraviolet (UV) radiation.

Benefits

- Energy savings
- Improved visitor experience
- Provides visitors with a link to the outside world, an opportunity to rest their eyes and relax their concentration
- Improved staff wellbeing and reduced absenteeism
- Variability in lighting condition, alters the ambience of gallery interiors so there are subtle differences on each occasion a visitor walks around

Case study

Daylight for museums and galleries

Reintroducing daylight to the Rijksmuseum, Amsterdam, Netherlands

In 2001, Spanish architects Antonio Cruz and Antonio Ortiz were commissioned to lead a team to develop the design for the refurbishment and modification of the Rijksmuseum in Amsterdam. The renovation included a complete overhaul of all existing installations for the main and surrounding buildings. Arup provided daylight and electric lighting design services for this historic 19th century museum.

The original museum design relied heavily on daylight. Over the course of time, this was reduced by blocked-up windows and suspended ceilings. The refurbishment design intended to reinstate daylight and to transform the Rijksmuseum.

Arup's lighting team analysed the expected daylight levels and explored various options for maintaining appropriate daylight levels in the galleries. This was done by comparing static and adjustable window and skylight treatments, and then studying, together with the architectural and restoration teams, how these could be best used within each space, to avoid over-exposure from daylight whilst maximising the daylight experience.

On the upper floor, daylight is admitted through laylights in the ceilings and transparent skylight sections in the roofs. The refurbishment consisted of replacing the skylight glazing to add diffusion and replacing the laylight glazing to improve uniformity of illumination within the gallery. Adjustable louvres were installed in the loft space between the laylight and the skylight glass, providing the much needed ability to fine tune daylight with seasonal daylight availability. Now, the gallery spaces are lit by homogenous light flowing in from above, reinstating the original daylight intent of these spaces whilst achieving conservation requirements at all times.





Electric lighting for museums and galleries

The electric lighting industry has been subjected to an unprecedented era of change, driven by changes in legislation and advances in lighting technology. Both these factors offer attractive advantages for museums and galleries, in particular the potential for savings in energy consumption and maintenance costs.

As the museum sector is driven towards the adoption of these new lighting technologies, it is necessary to carefully consider the implications of this change, in particular where existing lighting systems are refurbished and upgraded. Upgrading lighting systems can offer both opportunities and potential drawbacks. Our designers have a thorough knowledge of lighting technology and its application in museums and galleries. We are uniquely placed to guide our clients through this process, ensuring a successful outcome for all.

Benefits

- Significant energy savings
- Reduction in size of luminaires
- Reduction in relamping costs
- Enhanced flexibility
- Ability to tune lighting according to visitor and curator preference (colour temperature, illuminance level)
- Enhanced control, where lighting can be linked to presence (potentially reducing illumination exposure as well as energy use)
- Recording and logging of illumination exposure
- Customised lighting spectrum tuned to the object being lit

Case study

Electric lighting for museums and galleries

Royal Academy of Arts Lighting Upgrade, London, UK

The Royal Academy of Arts (RA) is a unique organisation that was established when a group of prominent artists petitioned George III in the 1760s, in a bid to professionalise art practice in Britain. The RA remains true to its origins since 1768 as a place where art is made, exhibited and debated.

Over the years, the RA used a variety of track mounted, mains dimmed halogen luminaires, for the display galleries in Burlington House (BH).

Due to the discontinuation of most halogen light sources, the RA established the need to replace their current stock of gallery luminaires with new LED luminaires, without the need to change their existing electrical infrastructure and lighting controls. The RA was also experiencing significant cost due to the need to re-lamp the luminaires every 4 months.

Arup assisted and guided the RA through this process from inception to completion.

Arup developed a specification which outlined the required performance, quality and compatibility of the luminaires that formed the basis of selection for the new track luminaires. The specification included a requirement for the luminaires to be controlled using the latest Bluetooth technology. This would provide additional flexibility to the RA as it will allow them to monitor luminaires, group luminaires, set different scenes and quickly adjust dimming levels from a mobile phone application.

Three luminaire mock-ups were organised to assist in the selection of the gallery luminaires. For each mock-up, a different gallery space was selected for the set-up and the existing gallery track was used to energise the luminaires.

The benefits of using Bluetooth technology are already being seen by the RA who now spend less time to set-up the luminaires while they can quickly adjust the dimming levels of each painting

The improved performance of the luminaires has also reduced visual clutter in the ceiling, improving the way people experience the Grade 2* listed building and the art on display.





Selected experience

We have worked with museums and galleries across the world to provide lighting solutions to both new-build and refurbishment properties. Additionally we can create site-specific lighting artworks either independently or in collaboration with external artists.

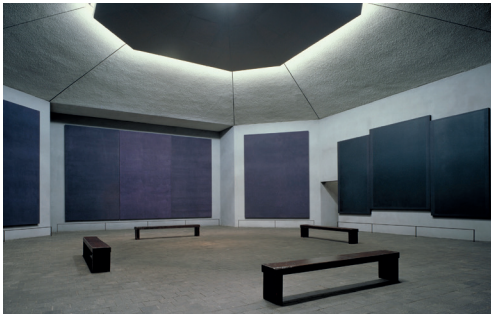
Above: The New Rijksmuseum, Amsterdam, Netherlands.



GABRIEL METSV

1630-1667

Selected museum and gallery refurbishment projects



Rothko Chapel,
Houston, USA

The Rothko Chapel, a 400m² art gallery and non-denominational chapel was the result of collaboration between artist Mark Rothko and architect Philip Johnson. Conservation teams felt daylight was contributing to the visible deterioration of the paintings within. We worked to re-design the daylight and electric lighting systems while remaining sensitive to the history of the chapel. The final result is very close to how Rothko originally intended it - a serene, spiritual space, daylit, with a sense of conditions outside retained.



Royal Academy of Arts,
London, UK

The Royal Academy of Arts (RA) is one of the oldest arts institution in Britain. The acquisition of 6 Burlington Gardens enabled the RA to extend and expand its facilities to the north of Burlington House. Arup designed the daylight and electric lighting systems for the Masterplan project. The Laboratories Galleries are daylit through the original clerestory windows. The windows were re-glazed and a re-directing film applied to them. This system ensures that exhibits are uniformly illuminated with diffuse daylight. Circulation spaces are lit by custom luminaires which provide general lighting.



York Art Gallery,
York, UK

Arup was commissioned to develop a refurbishment scheme for the Grade 2 listed gallery, to rediscover and reveal the fabulous Secret Gallery and deliver a modern gallery space to house and display the City's art collection. The lighting proposals were skillfully developed to accommodate the wide range of exhibited media whilst providing the gallery with maximum flexibility for rotation of exhibitions and new acquisitions. Arup worked closely with the curatorial staff, to advise on daylight performance criteria and set acceptable exposure limits for the gallery spaces.



Musée Unterlinden,
Colmar, France

Arup were commissioned to provide lighting consultancy services for the gallery and public spaces for the new Musée Unterlinden in Colmar, France. The overall project included the renovation and refurbishment of existing historical buildings as well as a new-build extension linking these and doubling the size of the existing museum. The key challenge was to develop a lighting scheme to provide high quality accent lighting to the artworks while remaining sensitive to the historic fabric of the existing heritage spaces.



V&A Medieval and Renaissance Galleries,
London, UK

The Medieval and Renaissance project is the largest refurbishment the V&A has undertaken since the British galleries opened in 2001. The fundamental goal of the project was to illuminate the refurbished galleries with daylight for its ability to create atmosphere and drama. Addressing sustainability in the project required the balancing and optimisation of a range of issues that had the potential to create conflicts, such as between art conservation and energy use or improving accessibility whilst conserving the existing listed building.



Courtauld Connects,
London, UK

The Courtauld Institute of Art is one of the world's leading centres for the study of the history and conservation of art and architecture. Arup have been commissioned to provide specialist daylight and electric lighting design with the aim to strike a balance between costs, aesthetics and function. Daylight will be utilised in conjunction with artificial lighting to provide high quality illumination, visual comfort and low energy consumption. Electric lighting will be designed so that it is closely integrated with the architecture.



Above: V&A Medieval Renaissance Galleries, London, UK.

Selected museum and gallery exhibition lighting design projects



**New Acropolis Museum,
Athens, Greece**

Arup provided daylight and electric lighting design for this new museum building with 14,000m² of exhibition space to accommodate ancient works from the Archaic period to the Roman Empire, as well as the architectural sculptures from the Parthenon. Our design ensures optimum display lighting for the museum's prized artefacts balanced with a daylight ambience throughout, re-creating a sense of the outdoor conditions in which its sculptures were originally viewed. The electric lighting plays a complimentary role navigating the visitor through the interiors.



**Galleries of the Islamic World,
British Museum, London, UK**

Arup were commissioned to design the lighting for the British Museum's Islamic Galleries. The two rooms are top-lit from a series of roof lights, which provide daylight through a combination of clear glass and a custom designed external shading system. The shading system creates a downward volume of daylight which focuses light to the central display cases. The electric lighting is focused within the cases; linear diffuse light provides general lighting while miniature magnetic spotlights provide accent. Perimeter uplighting creates a soft glow to the ceiling while additional ceiling mounted track lights provides accent to wall mounted exhibits.



**V&A Photography Galleries,
London, UK**

The lighting strategy for the V&A Photography Galleries was designed to reveal the exhibits with sensitivity to the conservation requirements and the architectural vision. The flexibility of the lighting system delivers soft focused light at very low illuminance levels suitable for light sensitivity of the objects. Wall mounted exhibits are illuminated from track mounted spotlights located at high level. Low level display cases feature linear diffuse light to provide general lighting while miniature magnetic spotlights provide accent. Track mounted spotlights are used to wash a series of painted lunettes, dating from the late 19th century.



**Musée du Louvre-Lens,
Lens, France**

Arup provided daylight and electric lighting design, including exhibition lighting, for the new Musée du Louvre in Lens. In the two main galleries, daylight enters through a fully glazed roof. Above the glazing, a specially designed grating ensures direct sun is blocked at all times while maximising the incoming daylight and views out to the sky. Our electric lighting design is unobtrusive to complement the architecture, whilst ensuring the museum's need for flexibility, quality and efficiency were achieved.



**Harvard Art Museums,
Cambridge, MA, USA**

As part of the renovation and a significant new addition to the existing Fogg Art Museum, Arup provided full lighting design services, including exhibition lighting design. In collaboration with Renzo Piano Building Workshop and WHY, Arup designed exhibition lighting to reinforce the aspiration to create a unified art viewing experience by employing a streamlined, simple and elegant lighting design language. In total the project includes over 130 cases for a diverse collection of approximately 250,000 objects dating from ancient times to the present.



**Science Museum Mathematics: The Winton Gallery
London, UK**

The lighting concept for the Science Museum's Mathematics Gallery connects complex mathematical ideas to everyday experience with a striking visual clarity. Fluid lighting was integrated with static lighting to showcase the mathematical significance of a key feature of the gallery: a full size 1929 Handley Page aircraft. The lighting scheme follows the aerodynamic field of the plane, depicting turbulence and flow lines generated by the propeller. Dedicated case lighting completes the design, focusing on high quality rendering and modelling of artefacts.



Above: New Acropolis Museum, Athens, Greece.

Selected light art and artist collaboration projects



The ArcelorMittal Orbit,
London, UK

The Orbit is the largest sculpture in the UK (2012) and created for the 2012 London Olympic & Paralympic Games. The two observation platforms at 80m and 85m above ground provide visitors with stunning views over London. Arup provided electric lighting design from concept to completion. We worked closely with designers Anish Kapoor and Cecil Balmond to create a lighting scheme that highlights the sculpture's complex geometric form, and to create a "must see" element to the sculpture at night.



Soon – Nuit Blanche,
Toronto, Canada

Nuit Blanche is an all night arts festival which takes place annually in multiple cities all over the world. One of the 5 top commissioned pieces, entitled SOON, envisioned by London-based artists Iain Forsyth and Jane Pollard, was designed to create a sense that an unknown ominous event was about to occur. Arup lighting and acoustics collaborated with the artists to produce this experiential public art piece which evokes a feeling of an impending catastrophic event.



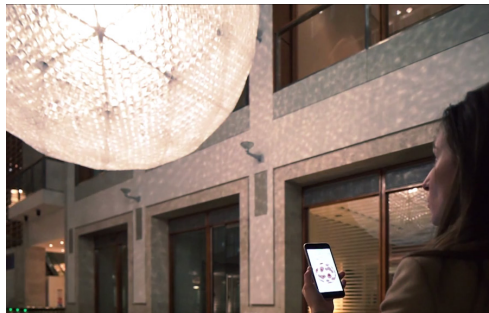
UP, and Away!,
Travelling Exhibition

This was an invitation to fly; to empower oneself with a pair of psychedelic wings, and to go; UP, and away! Designed, curated and assembled by Arup, it consisted of five sets of psychedelic wings on recycled bicycles. The faster one pedalled the brighter the wings became. This was made possible through an intelligent circuit board that took input from a device on the wheel and correspondingly controlled the brightness of the LED lights.



'Ricochet' installation for Vivid Sydney 2013
Sydney, Australia

Arup collaborated with Frost* on 'an interactive environment through light and sound' installed in the Suez Canal laneway in The Rocks, Sydney. 'Ricochet' is introduced as a piece, and features as an intersecting network of laser beams, using the long narrow form of the Suez Canal to create a green laser web, which strobes on and off combining with a soundscape to create an immersive, experiential environment.



myCUP,
London, UK

Commissioned for Earth Day by Bank of America Merrill Lynch the installation aims to educate and inspire employees to recycle at work as part of the bank's commitment to environmental sustainability. Arup worked on the lighting design and user interaction of the 6 diameter globe installation composed of 8,000 plastic cups. When visitors arrive at the installation, they can join the myCup Wi-Fi network, enabling access to an interactive interface that allows them to control the lighting within.



Hennessy: The Quest,
Cognac, France

The Quest is a permanent kinetic light sculpture, which combines art, technology and natural world morphologies. Arup designed the light to be cast through crystalline forms and generate a kinetic light sculpture; a living and constantly shifting artwork. A roving beam, controlled by a robotic arm with fluid, human-like movements, shines its light from inside a parametrically-generated structure studded with hundreds of individually crafted shards. As the light pierces the shards in turn, the "DNA" of each one is projected in the form of elaborate caustics.



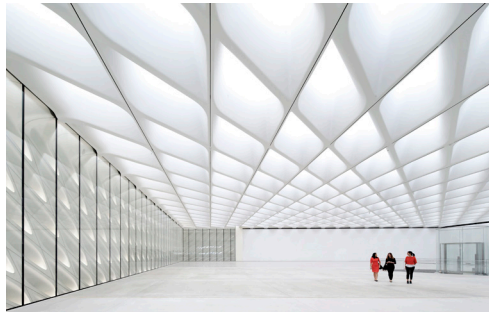
Above: Janet Echelman TED 2014 Sculpture, Vancouver, Canada.

Selected museum and gallery new-build projects



**Tate Modern Switch House,
London, UK**

Arup collaborated with Herzog & De Meuron to provide daylight and electric lighting design services for a significant 22,000m² addition to the existing museum. Lighting plays a key role in connecting the spaces, and in orientating people throughout the new vertical structure as it integrates with the existing building and links with it to create one Tate Modern. Sophisticated manipulation of light was key to enhancing the theatrical drama experienced at art galleries.



**The Broad Museum,
Los Angeles, California, USA**

One of the highlights of the museum is the open plan third-floor gallery day-lit by over 300 north-facing skylights and a fully shaded glazed east wall. Arup designed the skylights and veil structure to serve as a light filtration device, bringing indirect, diffuse daylight into the gallery. The skylights include exterior motorised blinds that can be used to create zones with reduced daylight levels through their partial deployment. Arup also assisted in the development of custom LED wallwashers which are used to uniformly illuminate the 23ft gallery walls.



**Turner Contemporary Art Gallery,
Margate, UK**

Arup provided daylight and electric lighting design for a 3,000m² museum for the Turner Contemporary Art Museum, situated on Margate's seafront. The light that fills the galleries is free from direct sun, but varies considerably as the maritime atmosphere changes. Daylight modelling influenced the form and arrangement of the gallery spaces, and careful positioning of windows and skylights enables the galleries to be lit with indirect daylight and diffused sunlight without the need for complex control systems.



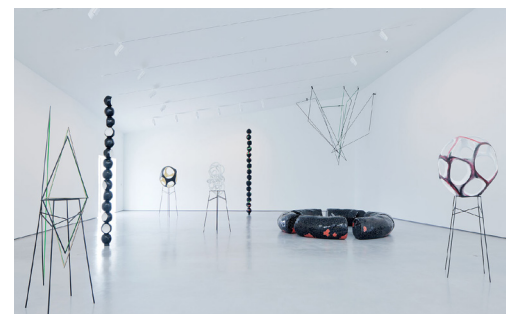
**Gagosian Gallery Grosvenor Hill,
London, UK**

Daylight in galleries comes with an array of benefits including improved visitor experience, a link to the outside, and a variability in lighting conditions. Due to site constraints, it was not possible to integrate skylights in the galleries. Arup specified high quality LED strips to backlight a series of glazed laylights. A photocell and colour temperature meter collect real-time data on the exterior daylight conditions. The interior lighting adapts dynamically creating an environment that responds instantaneously to the prevailing environmental conditions.



**V&A Dundee,
Dundee, UK**

The design of the V&A began in 2010 with the Japanese architect Kengo Kuma winning an international design competition. The lighting brief was developed by Arup in close collaboration with the architect and the V&A. Arup provided the front of house lighting, gallery lighting, exterior façade lighting and the surrounding adoptable street lighting for the public plaza around the building. The distinctive architecture presented clear objectives for lighting the spaces with an emphasis on daylight, architectural integration and sustainability.



**The Hepworth Gallery,
Wakefield, UK**

The Hepworth Gallery required daylight and electric lighting design for a new build art gallery development, which houses the original plaster sculptures of Barbara Hepworth, as well as Wakefield's own art collection and temporary exhibitions of contemporary art. The galleries are daylit using a combination of skylights and vertical windows, arranged asymmetrically to create a gentle but definite variation of daylight levels. This allows a variety of art using different media to be displayed in one room.



Above: Parrish Art Museum, Water Mill, New York, USA.

Contact

Arup lighting design,
13 Fitzroy Street, London,
W1T 4BQ, UK

t: 020 7636 1531
e: lighting-design@arup.com

About Arup

Arup is a global firm of planners, designers, engineers and business consultants. We provide a diverse range of professional services to clients around the world, exerting a significant influence on the built environment. The firm is the creative force behind many of the world's most innovative and sustainable building, transport and civil engineering projects and design technologies.

Established in 1946, Arup has over 11,000 employees based in more than 90 offices across 39 countries, working on up to 10,000 projects at any one time. Its unique structure, with the firm held in trust on behalf of its employees, gives us complete independence.

