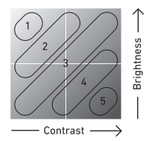
LPA 1990–2015
Tide of
Architectural Lighting Design

Kaoru Mende +
Lighting Planners Associates

Contents

Explanatory notes of project

Keyword: A theme or an important word regarding the lighting design **Designer's comment:** A summary phrase from the project team based on the experience **Custom-made fixtures:** Lighting fixtures customized or a luminous plane **Main light source:** Main light source used very often among 6 types of lamp below IL=Incandescent lamp / Halogen lamp, FL=Fluorescent lamp, HID=High intensity discharge lamp such as Metal Halide lamp, LED, Neon, Xenon=Xenon lamp **Brightness contrast level:** Index with 5 degrees of brightness and contrast. As in the chart, small value are for a bright and low contrast space. **Design period:** Design period from the kick-off in LPA to a project completion



1990 – 2015
LPA and the Shifting Tide of Architectural Lighting

Kaoru Mende

This book is a chronological and comprehensive look at the work of LPA from 1990 to 2015. The profound shifts in the global economy and the increasingly rapid pace of technological innovation in the IT field that have occurred over this time greatly impacted the social environment of architecture and architectural lighting design. These developments have also directly affected the work we do, and we should expect the work of lighting design itself to have changed in certain ways. Over the 25 years that this book covers we have completed some 700 lighting design projects. We have selected about 100 projects from among them that seem particularly significant and organized them chronologically in this book with the idea of bringing into relief the general tide over this time.

While LPA's history of 25 years is quite short it is still enough time to elucidate the extraordinary forces that have driven it forward. We want to uncover the source of those forces. Is it because of a changing global environment and socio-economic conditions? Was it brought about by innovations in lighting technology? Or is it nothing more than our singular passion for our work? We hope to reveal the shifting tides of architectural lighting design by exploring these questions.

A decade-long period of development

I committed to becoming an architectural lighting designer in 1980. I was in my second year of work at a research lab for a lighting fixture manufacturer. My inspiration was meeting the brilliant architectural lighting designer Edison Price.

Price established a small lighting company in New York City in 1952 and was active as an architectural lighting design consultant from the 50s through the 70s. As a participant in architecture projects designed by such luminaries as Mies Van der Rohe, Louis Kahn, and Philip Johnson, he developed and set a new course for architectural lighting. It is impossible to talk about the quality of American modern architecture without Price. His stories about his ideas and accomplishments in architectural lighting held me in awe. Later, on Price introduced me to two of America's leading architectural lighting designers: Claude Engle and Paul Marantz. I received several opportunities to work with them, where I spent my days finely honing my architectural lighting design skills.

I spent the ten years starting in 1980 under the guidance of a number of pioneers, most notably Marantz, old friend Arata Isozaki, and kindred spirit Toyo Ito, with whom I collaborated on Tower of Winds project. This was a time that might be described as the formative period for architectural lighting design in Japan.

What is the occupational aim of architectural lighting design? Who are its clients? What should it impart to society? How much distance should there be between the work of architectural lighting and the architect? The ten years leading up to the founding of LPA in 1990 were a kind of prelude that set the scene for the performance to follow.

An event-filled quarter-century

Many significant events have occurred over the 25 years since the founding of LPA. The fall of the Berlin Wall, the Gulf War, the launch of the European Union, the return of Hong Kong to China, the Kyoto Protocol, the founding of Google, the September 11 terrorist attacks in the United States, and the global economic crisis, to name only a few. Over that time, Japan experienced the collapse of a bubble economy, the sarin gas subway attacks, the Kobe earthquake, and the Tohoku earthquake and tsunami. Japan has endured a number of terrible events indeed during the long malaise following the end of the era of high economic growth. These events and phenomena also affected the work of lighting design in myriad ways.

German reunification and the launch of the EU prompted a realignment of the lighting design industry in Europe, while the Gulf War and fears of an energy crisis triggered a corresponding reduction in lighting consumption. Global economic crises and the collapse of bubble economies demanded that lighting design adopt a facility management perspective and search for technical solutions to the problem of energy consumption. In the wake of Japan's earthquakes and the Fukushima nuclear accident attention turned to energy conservation and natural energy, and lighting design took a close look at sustainability and energy conservation.

Technological innovation in the field of lighting during this period was even more dramatic. To begin with, a number of new light sources indispensable to lighting design appeared on the scene. The halogen and krypton lamps that were the best of the incandescent lamps, and which had been in constant use since the 1980s, were replaced in the 1990s by compact fluorescent lamps, small-sized metal halide lamps, and other high-energy efficiency light sources. Fluorescent lamps and discharge lamps also became more compact and therefore easier to use. Then, with the development at last of blue LED in 1993, the use of LED spread rapidly and the technology has now established a dominating presence all over the world. When LED first appeared its only selling point was efficiency, so I took a somewhat skeptical wait-and-see attitude. Today, however, LED is not only efficient it has made great strides in quality, so there are less and less reasons to reject it. Lighting design has at last welcomed the inevitable arrival of the LED era.

Lighting design based on LED light sources wiped away past design concepts. Instead of lighting fixtures governed by reflectors, LED controls light distribution by means of lenses and films. Since LED is a point light source, several light sources can be lined up and translated onto a luminous plane surface. Moreover, extremely small LEDs can be embedded into sashes, glass, furniture, and building materials. This means its potential as a lighting fixture is virtually without limits. LED has revolutionized lighting design.

Moreover, and in connection with the development of LED, lighting control technology has made tremendous advances. With the digitalization of voltage control systems an entire lighting system can be controlled with a personal computer device. The control system regulates not only the amount of light but also color temperature (the color of light). For instance, a general office lighting system might significantly

change the light environment between morning and afternoon. In the morning, light is bright and whitish while in the afternoon illumination is slightly reduced and the light has a warm color tone. This is the greatest advantage of digital lighting control systems. What's more, control equipment is becoming more and more compact and seems headed toward devices as small as smartphones.

25 years is not a very long time, but in the world of lighting it has been a span of time full of amazing developments.

The evolution of LPA: five phases x five years

In this book, I divide LPA's 25 year history into five phases. This does not mean that there is a clear break every five years, however. Instead, it helps us pinpoint major turning points, project completions, and other important events over that time. Erwin Viray and I offer commentary for each time period. We want the reader to forget specific years and instead look at events as they have developed over these five year time periods.

We begin with a broad overview of the five years from 1990 to 1995 in a chapter titled "The Architectural Lighting Enlightenment: The Contributions of Edison Price, Arata Isozaki, and Toyo Ito" 30 years had lapsed from the time when Edison Price first pioneered the field of architectural lighting to when it was introduced in Japan. The work of LPA in its early phase, therefore, had the role of enlightening Japanese society about architectural lighting. While this period is dotted with important LPA projects done in collaboration with Nikken Sekkei, Hiroshi Hara, and others, the projects led by Arata Isozaki and Toyo Ito stand out. From these two, especially, I felt a passion for exploring the genuine role of architectural lighting, and I became utterly convinced that within architecture there are novel forms of light waiting to be discovered.

"The Saga of Public Space: Tokyo International Forum and Kyoto Station Building" is the title for Phase 2 covering the years 1996 to 2002. The chapter chronicles the role of public facility lighting in freeing Japan from twentieth-century assumptions about light. We want to plainly demonstrate to a mass public a commitment to quality of light over quantity of light. The lighting designs of Tokyo International Forum and Kyoto Station Building are expressions of this philosophy. The light quality for both of these projects moves beyond the conceptual framework for public architecture in Japan at that time. These projects were novel simply because they do not employ uniform, bright lighting.

The shadow-rich light environment of Kyoto Station Building and the lighting of public space in Tokyo International Forum with illuminance of 50 lux are both examples of new ways of lighting that are certain to contribute to better light quality in future public space.

Phase 3 from 2000 to 2005 covers the period when the LPA design style became established. This style was presented in Kaoru Mende + LPA Exhibition "A Manner in Architectural Lighting Design," an exhibition shown in fall 1999 at TOTO GALLERY-MA in Tokyo. The chapter is titled "A Manner in Architectural Lighting Design: From Sendai Mediatheque to Nagasaki National Peace Memorial Hall for the Atomic Bomb Victims." In addition to these two projects, the chapter profiles Roppongi Hills, OASIS 21, Katta General Public Hospital, Chihiro Art Museum Tokyo, among other projects. Within all of these projects dwell many of the 10 concepts and 27 manners articulated at the "A Manner in Architectural Lighting Design" exhibition, and all are heavily tinged with LPA's interpretation of and distinctive approach to lighting design.

Phase 4 covering 2005 to 2009 is titled "Overseas to Asia: Learning from Singapore, China, and Hong Kong" In 2000 — and now in its tenth year as a prospering enterprise — LPA established a group company in Singapore and set out to experience international competition in an overseas environment. We commenced on projects in collaboration with accomplished building designers and clients from all over the world. We completed lighting design for the Supreme Court of Singapore and National Museum of Singapore and established LPA's presence in the city with our work on the Shingapore's City Centre Lighting Masterplan. Just being unable use Japanese is an inconvenience when working overseas. But the snags and difficulties we knew we would meet along the way have made us more resilient than we had first anticipated.

Phase 5 covering 2008 to 2015 brings us to the LPA of the present under the title "Designing with Shadow: New Lighting Values Taught in 2011." In 2010, LPA published a book titled "Designing with Shadow."

The following year Japan experienced the Tohoku Earthquake, and from every corner came calls to conserve power. Even as recovery from the nuclear power plant accident stalled light returned throughout Japan, but the disaster made people reflect on a past that thought of light only in terms of quantity. "Lighting design starts with darkness and restores beautiful shadow." This is what the world has told us in the starkest terms. The disaster has taught us the value of light.

The LPA exhibition "Nightscape 2050 — A Dialogue between Cities·Light·People in the Future" opens in August 2015. The exhibition will tour Berlin, Singapore, Hong Kong, and Tokyo and hold workshops and symposiums together with people in each region. The exhibition will also include light interactive exhibits and exhibits drawing lessons from nightscapes from around the world. The theme is "the life of light in the future/where do we go from here?"

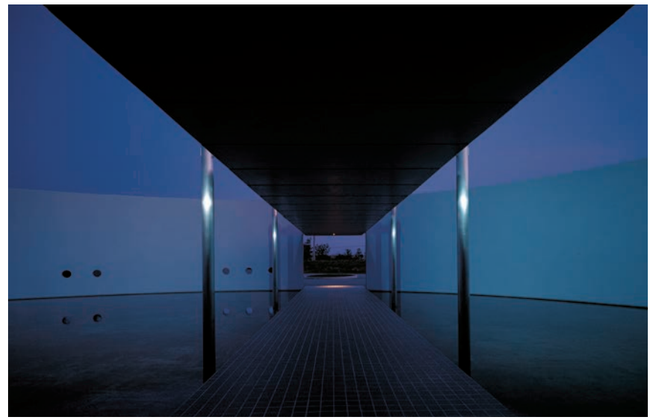
The 25 years and 101 lighting design projects presented in this book form an archive for understanding the present and imagining the future. The world of lighting design is always changing, and it is our hope that in the years ahead it will evolve for the better.

Hotel Poluinya

1992 Hokkaido, Japan
Design | Toyo Ito & Associates, Architects
Client | Nexus

Keyword : Minimal and Low Cost
Designer's comment : Grateful for the darkness of Hokkaido
Custom-made fixtures : Patrol Light

Main light source : IL, FL
Brightness contrast level : 4
Design Period : 2 years



This quiet hotel sits at the foot of Mount Shari amid the beautiful Hokkaido landscape. Architect Toyo Ito was commissioned to design this low-cost yet deeply inviting hotel.

The lighting design is intended to bring out the landmark quality of the glass block wall in the guest room hallway, and the symbolic power of the entrance court with its thin layer of water. Above all, the change in appearance of the glass block guest room hallway from day to night is a clear statement of the dynamism of architectural lighting. This is a fine example of how simple details can be used to create the necessary and sufficient lighting effect.

Kyoto Concert Hall

1995 Kyoto, Japan
Design | Arata Isozaki & Associates
Client | Kyoto City

Keyword : Lighting as a Part
Designer's comment : Highly detailed lighting!
Custom-made fixtures : Theatre Lanterns
Main light source : IL
Brightness contrast level : 3
Design Period : 3 years

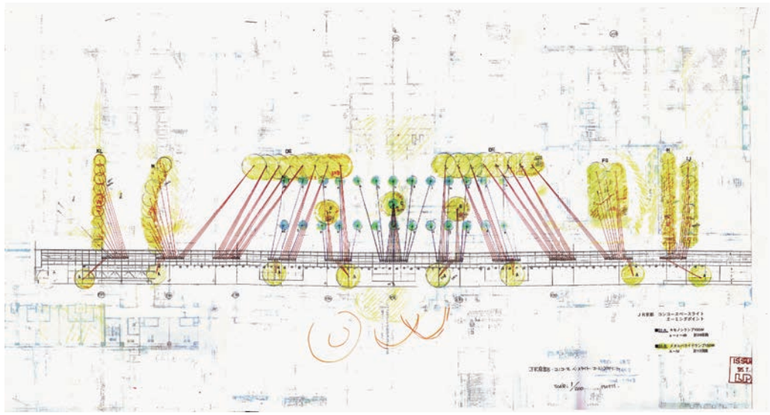
This 22,412㎡ facility built by Kyoto city to commemorate the 1200th anniversary of the founding of the ancient capital is the home of the Kyoto Symphony Orchestra. It consists of a 1,839 seat shoebox-shaped large hall with pipe organ and a 514 seat small ensemble hall. The architect insisted throughout on a design that both mirrors the context of the city and integrates architecture and lighting.

The shoebox-shaped concert hall strives for a seamless unity between stage and audience, so we proposed finely contoured ceiling lighting that combines acoustic paneling and audience lighting. For the ensemble hall we developed a novel ceiling system that integrates to the greatest extreme possible stage and audience lighting.

Kyoto Station Building

1997 Kyoto, Japan
Design | Hiroshi Hara + Atelier ϕ
Client | West Japan Railway, Kyoto Station Building Development

Keyword : In Praise of Shadows
Designer's comment : A darkness found only in Kyoto
Custom-made fixtures : Wall-embedded Up Lights
Main light source : HID
Brightness contrast level : 5
Design Period : 5 years



Kyoto's history and patina as Japan's ancient capital dates back more than 12 centuries. Kyoto Station Building is enclosed in an immense 470 meter long, 60 meter high atrium. The station's predecessor had a shadow-poor light environment due to materials that were almost entirely white and a lighting system designed for uniform high-illuminance lighting. At Kyoto Station Building, in contrast, a lighting design for the black granite flooring guided by "in praise of shadows" philosophy restores beautiful shadow and also contributes to more efficient energy use. Primary lighting is provided by elevated 150W narrow angle metal halide spotlights. These lights are sparingly used in spots only where needed, proving that an economical approach gives birth to meaningful shadow.

Nagasaki National Peace Memorial Hall for the Atomic Bomb Victims

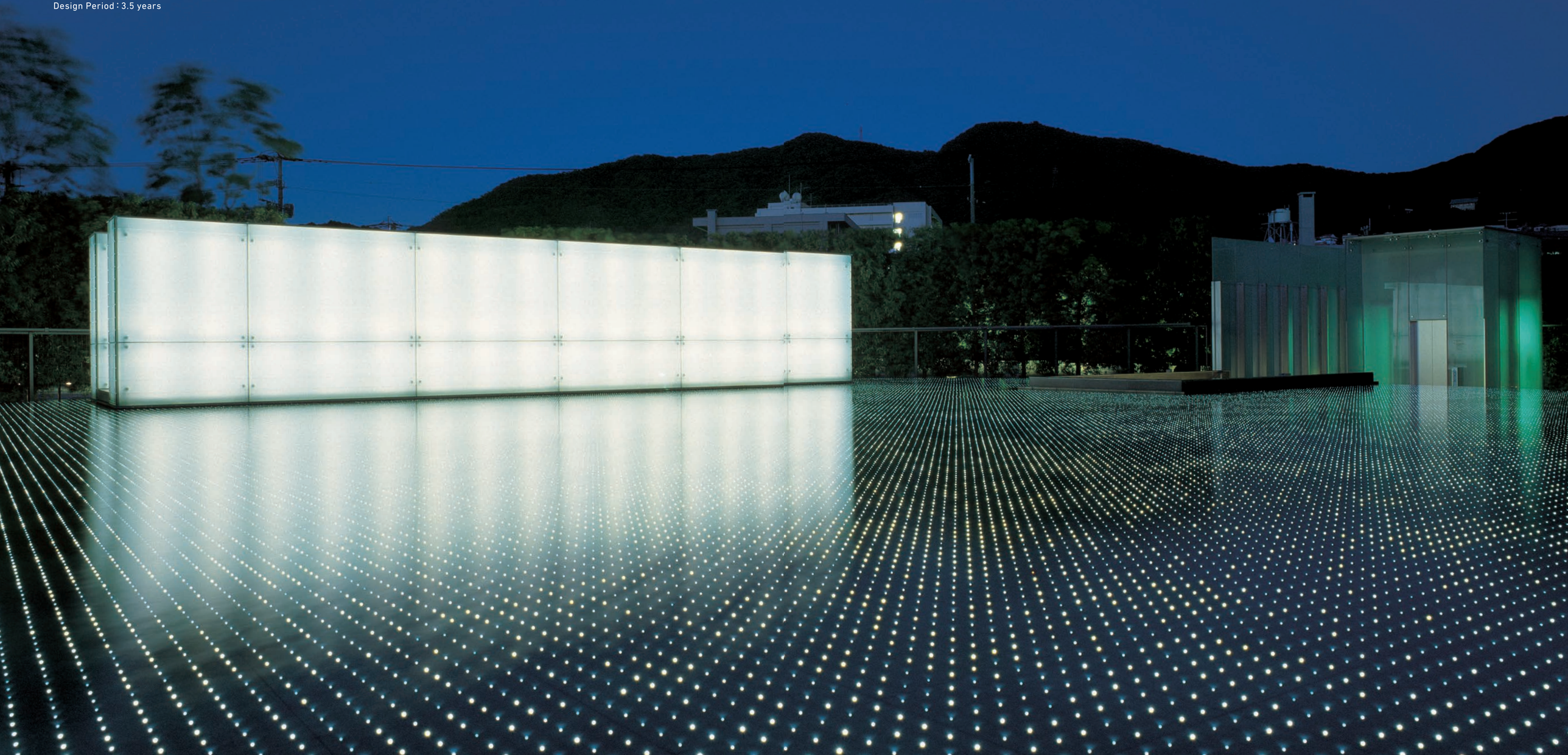
2003 Nagasaki, Japan
Design | Kyushu Regional Development Bureau, Akira Kuryu Architect & Associates
Client | Ministry of Health, Labour and Welfare

Keyword : Healing Light
Designer's comment : A beauty that almost brings tears to my eyes
Custom-made fixtures : Fiber Optic Underwater Lighting
Main light source : FL, IL
Brightness contrast level : 5
Design Period : 3.5 years

At 11:02 in the morning on August 9, 1945, a plutonium implosion atomic bomb was detonated over Nagasaki, killing 70,000 people. This memorial is an expression of mourning for the atomic bomb victims and a prayer for everlasting peace on behalf of the nation and a place for fostering a deeper understanding among the people of the world of the horrors of the atomic bomb and a place that preserves the experience of atomic war for future generations.

While the memorial is mostly underground, the design includes a circular monumental water basin 29 meters in diameter. Reflecting the nation' s wish to express the enormity of the destruction and the opinions of the local building committee, a light particle for each person who had died was placed on the bottom of the water basin. 70,000 light fiber particles swaying gently in the Nagasaki wind create a solemn nighttime scene for remembering the dead.

The memorial stands as an earnest plea to abolish all nuclear weapons from the earth.



PROPOSED LIGHTING MASTERPLAN FOR SINGAPORE'S CITY CENTRE

Lighting Design for Singapore City Centre

The signature of a true cosmopolitan city, calls for a beautiful and evocative nightscape .
We envision lighting that departs from tne convention set by Western cities and that is unique to a sophisticated, high tech city in the tropics.
Lush tropical greenery, culturally interesting streets, modern architecture and an expansive waterfront -these are the city centre's inherent features. Here, we propose ways on how to enhance these defining charateristics with lighting while keeping in mind basic considerations for visual safety and energy efficiency.
The redevelopment of the CBD lighting environment can approached from 3 key aspects:

Nightscape Lighting
A skyline that is designed as a coordinated composition while giving acknowledgement to the towering skyscrapers and the waterfront. Singapore's image as a tropical city is signified by the enhancement of the rich green colour of tropical plants.

Entertaining Lighting
The waterfront and other places of interest as settings for enjoyment of entertaining and interactive lighting effects and demonstration platforms of new technology.

Functional Lighting
Reexamining road lighting levels and increasing vertical illuminance for traffic safety and human comfort.

Seven Technical Standards for the 21st Century

Horizontal Illuminance
Illuminance is a unit indicating the amount of light in a specific place. The illuminance measured on horizontal surfaces, such as street, floor, or desk surfaces, is called "horizontal illuminance." Lux is the illuminance unit indicating the density of luminous flux (lm) striking on the measured surface from all directions. E.g. 100,000 lux under the direct sunlight in summer, 10,000 lux in cloudy weather, 5,00 lux in an fully lit office, 100 lux in an average private home living room, 1 lux under an emergency sign, and 0.2 lux under a full moon. While these data are useful to refer to illuminance for task lights, it is very dangerous to regulate the brightness we feel simply through illuminance data.

Vertical Luminance
The luminance is the strength of a light emitted in a particular direction (over a surface area), measured in candela/m2(cd/m2). Luminance reflects more of human sense of vision, as it is related to the light directly emitted from a specific light source and the amount of light reflected on an object. Our perception of brightness and level of comfort in all types of environment often depends on the balance of this luminance. It is especially important for the creating brightness for indoors and outdoors, where higher vertical luminance is desired on indoor wall lighting, color walls and facades of buildings and trees.

Color Temperature
Different light sources have different colorations. Kelvin (k) is the unit to indicate those color temperatures. For example, the color temperature of a flame (1,500k) is reddish, a light bulb (2,800k) is orange, and white moon light(4000k) and the light of a mercury vapour lamp(4500k) are white to blue shades. Thus, with a change of the coloration from red via orange and yellow to white and blue, the color temperature rises. As the existing streets in the CBD are equipped with high-pressure sodium lamps, which have a low color temperature, we plan the streets inside the CBD to be lit by high temperature and dynamic lights that will symbolize the round-the-clock city. Using this as a basic consideration, illumination for spaces of relaxation, is kept on a low color.

Color Rendering Properties
A red flower looks fresh and vivid under a light bulb, while under an ordinary fluorescent lamp the same red color appears dull. This is one example of how different light sources effect the appearance of a color.Color rendering properties are used as a method to judge the quality of reproducing colors.
The evaluation system for color rendering properties is standardized throughout the world. The value is measured in general color rendering index (Ra) calculated from spectral distribution. The higher the numerical value is, the better are the color rendering properties, whereas Ra100 is the highest possible number. The proportions of color rendering properties and the efficiency of a lamp are almost in inverse proposition.

Glare, Luminous Intensity Distribution
Glare is what we call an undesirably dazzling brightness. We can distinguish between discomfort glare, which causes discomfort to the human eye, and visual deterioration glare, which deteriorates the visual performance. A shiny bright lighting fixture on the ceiling that causes psychological discomfort, is an example for discomfort glare, while the blinding headlights of an oncoming car falls under visual deterioration glare. To create a pleasant visual environment, glares have to be eliminated first, and according to the specific surroundings, the highest tolerable luminance value should be standardized. Furthermore, since glares usually occur within a horizontal visual field of +/-30-40 degrees, the glare cut-off angle is a functional aspect of lighting fixtures that requires proper consideration.

Height of Light Source
Light sources at a high position usually cause a tense atmosphere, and the lower the position of a light source is set, the better are the results when intending to create a relaxing environment. This can also be observed on the various psychological effects of the sun during its transition through various positions, moving gradually down from its highest point at high noon to disappear at the horizon in the evening. For the installation of lighting fixtures we refer to the same principle. Outdoor illumination include high-mast lamps higher than 20m, or road lighting fixtures of 12m, 8m or 5m, but a much friendlier environment can be created with low lighting fixtures of 3m or 1m height. The appropriate height for a light source should be chosen in accordance with the respective space and its function.

Light Control
All kinds of dimming control technologies are summarized by the generic term, "light control." The adjustment of light intensity and color temperature of identical lighting fixtures, or flashing light control through the installation of light circuits, are most common, but also automatic dimming devices that adjust the light via computer-controlled timers or daylight sensors, have recently become popular. Not only does such light control contribute to energy conservation by avoiding superfluous illumination, but, by changing the light environment of a place according to the time, place and occasion, it also plays a role to activate the space and visualize the flow of time. In the case of intense illumination, it is important to monitor the amount of light using lighting control devices, while for outdoor illumination, night lighting operation plans should be made to save energy as a part of infrastructure.

Proposed Lighting Plan for CBD
Scale 1 : 2500

Entertaining Lighting

The waterfronts around the Marina Bay and Singapore River are perfect settings for entertaining lighting effects and the display of new technology. Shimmering LED lights, beautiful reflections along the waterfront, luminous jellyfish-like lamps juxtaposed against the boats and people - these enhance the experience of visitors.
Indicator lights, glowing 'firefly' optic fibre lighting and other forms of interactive lighting can visually connect areas between prominent leisure areas and pockets parks e.g. Merlion Park, One Fullerton, Lau Pa Sat.

Skyline

Energy efficient lights are used to emphasize the base of the towers and the individual designs of the building crowns, with the tallest building tops as the focal points.
The composition of this nightscape is based on the use of cool bluish white colours.
Many possibilites can be considered, e.g. 'light necklace', lantern effect, floodlighting, etc.

Building Crown Lighting Methods

Functional Lighting

We propose to plan the illuminance levels along the roads and intersections at a 1:3 proportion.
Vertical illumination of the street can also be achieved by lighting of façades.
Tree lighting can greatly improve visibility and human comfort along the streetscape.

Lighting for typical junctions and road sections are illustrated as shown.

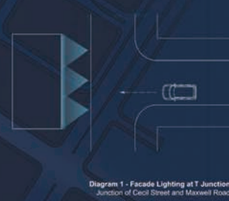
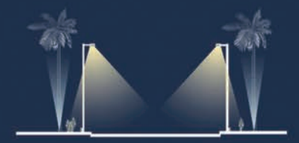
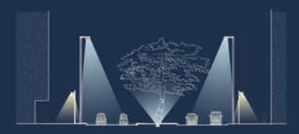


Diagram 1 - Facade Lighting at T Junction
Junction of Cecil Street and Maxwell Road

Diagram 2 - Cross Junction Lighting
Junction of Robinson Road and Boon Tat Street



Typical Road Section AA'
Palm tree lighting and Pole lighting



Typical Road Section BB'
Tree Uplight and Pole lighting

Typical Section CC'
Facade lighting

Lighting simulation

Lighting survey and on-site experiments were conducted in the CBD.
We look at 4 conditions in which the streetscape can be greatly enhanced by vertical lighting and landmark elements.

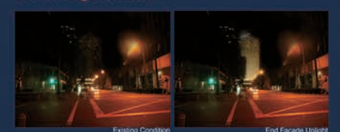
1. Uplighting of Palm Trees
Experiment location : Point (1) Along Cecil Street

Existing Condition — With Uplighting of Palm Trees

2. Symbol Tree Uplight at Traffic Island
Experiment location : Point (2) Junction of Anson Road and Robinson Road

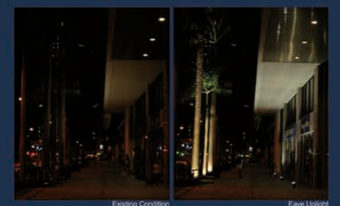
Existing Condition — Tree Uplight at Traffic Island

3. End Facade
View location : Point (3) Along Cecil Street



Existing Condition — End Facade Uplight

4. Eave Lighting
Experiment location : Point (1) Along Cecil Street



Existing Condition — Eave Uplight

Proposed Lighting Masterplan for Singapore's City Centre
LPA Lighting Planners Associates Inc.

CBD Survey images
Existing Skyline
Recreation areas
Existing Streetscape

Reference images
Skyline of major cities
Entertaining lighting
Functional lighting

Proposed Lighting Masterplan for Singapore's City Centre
LPA Lighting Planners Associates Inc.

Preservation and Restoration of the Tokyo Station Marunouchi Building

2012 Tokyo, Japan
Design | Design consortium consisting of the East Japan Railway Tokyo Construction Office, JR East Tokyo Electrical Construction and System Integration Office, JR East Design and JR East Consultants
Client | East Japan Railway

Keyword : Sustainable Nightscape
Designer's comment : Continuous days of late-night work
Custom-made fixtures : Custom-made LED Flood Light, Retractable Multiple Spot Light System
Main light source : LED, HID
Brightness contrast level : 4
Design Period : 3 years

The area around Tokyo Station continues its rapid redevelopment and the centerpiece of the district' s new ambience is the newly restored Tokyo Station, built more than 100 years ago. The lighting of this Important Cultural Asset with its red brick façade standing amid an ever-changing modern cityscape of iron, glass, and concrete creates a new scene with timeless quality.

Rather than a gaudy display of light, we deployed state-of-the-art lighting technology to restage this cultural treasure. We believed that the building's character required lighting that creates a "peaceful scenery."

Five Lighting Design Strategies and Six Fundamental Lighting Elements

1. Creating contrast among building elements

The building façade extends 400 meters north to south and consists of four architectural elements: the central section (A), the north and south domes (B), the north and south edges of the façade (C), and the overall building façade (D). Uniformly illuminating the entire exterior would not only consume vast amounts of energy it would decrease the value of the light by half. Carefully balanced light and shadow is essential to the design. Our study to find the perfect and most picturesque balance for a poised and beautiful presentation arrived at a luminance ratio of A:B:C:D = 7:10:5:3.

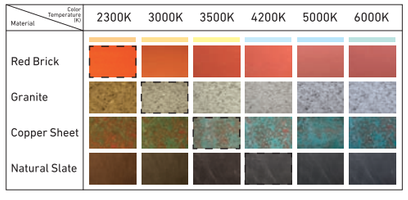
C=North End	B=North Dome	D=General Architectural façade	A=Middle Section	D=General Architectural façade	B=South Dome	D=General Architectural façade 3	C=South End
5	10	3	7	3	10		5

2. Dramatic gradation

Rather than sharp contrasts of light and shadow, creating a composed overall presentation is best achieved with gently and naturally diminishing gradation. When illuminating the exterior, highlighting the roundness of the domes, and so on, we made every effort to cast beautiful gradations of light from the ground up.

3. Light suitable for each type of material

The exterior deploys four types of materials: brick, stone, slate, and copper sheeting. We assumed that each of these materials has different light requirements and cast different kinds of light on them to find the most suitable color temperature for each. The color temperature of light casts on the natural slate roof is 4,200K and on the copper sheeting 3,500K. To recreate the best light environment for the station' s stately red brick façade, we accent the finely crafted granite columns with 3,000K to contrast with the 2,300K cast on the brick. As light radiates from the ground upward the color temperature gradually changes from warm to cool hues. Inside the building, 2,200K light cast on the drapery achieves a warm ambience. Stable color temperatures within the 2,200K to 4,200K range are achieved with the latest LED technology.



The most suitable color temperature for each material

4. Sustainable lighting system

Lighting design can no longer rely on inexhaustible energy sources. Most important is easy maintenance and low running cost. Besides the use of long-lasting LED, sustainable lighting requires sustainable, waste-free, and durable mounting detail. Sustainable design also rests on timeless lighting design uninfluenced by the latest fads that also creates environmentally-friendly light.

Reduced environmental burden

The lighting design uses LED only and also minimizes the brightness for nighttime scene transitions. This achieves significant energy conservation by reducing energy consumption by 56% compared to consumption before the station's preservation and restoration.

<Energy Reduction (daily average)>

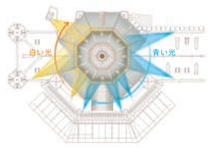
	Power consumption	CO_2 emissions
Before renewal	134[kWh]	56[kg]
After renewal	59[kWh]	24[kg]
Energy Reduction	75[kWh]	32[kg]

Keys to a Low Carbon and Low-Impact Environmental Design

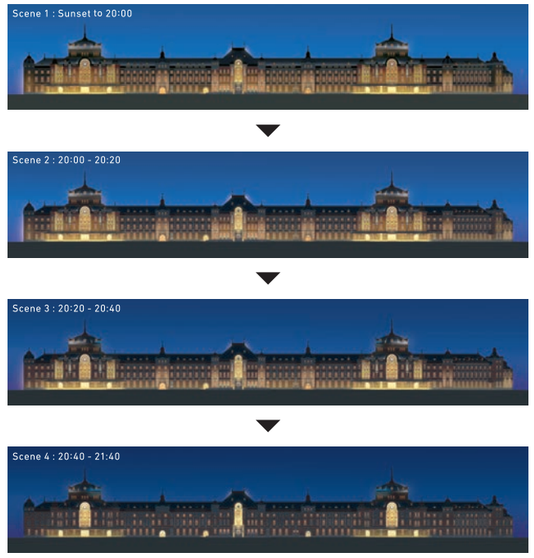
1. Adopt the use of highly efficient, long life LEDs
2. Apply the use of high quality luminaries
3. Vertical Planar Brightness
4. Targeted Light Distribution
5. Integrate dimming controls and scene operations

5. Well-presented and energy-efficient operation

Lighting brightness and on-off transitions are time controlled. The lighting scheme both creates an almost imperceptibly changing nightscape and conserves energy.
Over the course of the day, from dusk to lights out, the lighting plan deftly transforms the scene. Moreover, operation takes into account seasonal power demand, including programs synchronized with holidays throughout the year.



Lights are turned on at dusk, when there is still some natural light in the sky, and then gradually fade as the evening progresses until finally dissolving entirely in the night sky around 9PM. The tops of domes are carefully illuminated at 8 locations. Gradually changing light color continually transforms the scene like the waxing and waning of the moon.



Six Fundamental Lighting Elements

1. Illuminated red brick façade

A bottom section softly illuminated in warm light accentuates the red brick.

2. Illuminated columns

The white granite columns spaced amid the red brick are illuminated to accent the overall design.

3. Illuminated main arches

Fastidious illumination of the arches located in the building's south, north, and center create subtle shadow.

4. Illuminated dome roofs

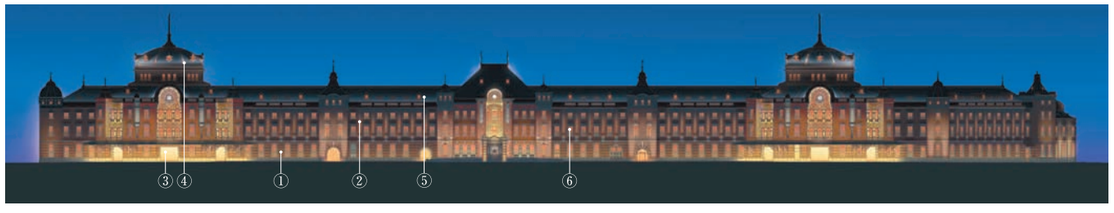
The beautifully shaped domes are illuminated as the building's signature feature. Light operation continually transforms the illumination as time passes.

5. Linear illumination of the slate roof

A linear band of light accentuates the building's south-to-north horizontal axis.

6. Window lighting

Warm light from the windows is a key element of the exterior at night.



Gardens by the Bay, Bay South

2012 Singapore
Design | Grant Associates, Wilkinson Eyre Architects, CPG Consultants
Client | National Parks Board

Keyword : Organic Lighting
Designer's comment : On-site adjustments for this expansive project required an all-out effort.
Custom-made fixtures : Variety of Organic Bollards
Main light source : LED, HID
Brightness contrast level : 4
Design Period : 4 years

With the construction of the Singapore Flyer and Integrated Resorts, Singapore's Marina Bay district has experienced frenetic development over the last few years. This development includes Gardens by the Bay, a waterfront garden composed of three areas totaling 101 hectares, among which the largest is Bay South. For this project, we proposed "Entertainment with Organic Lighting" as our concept for adapting outdoor entertainment to a new age.