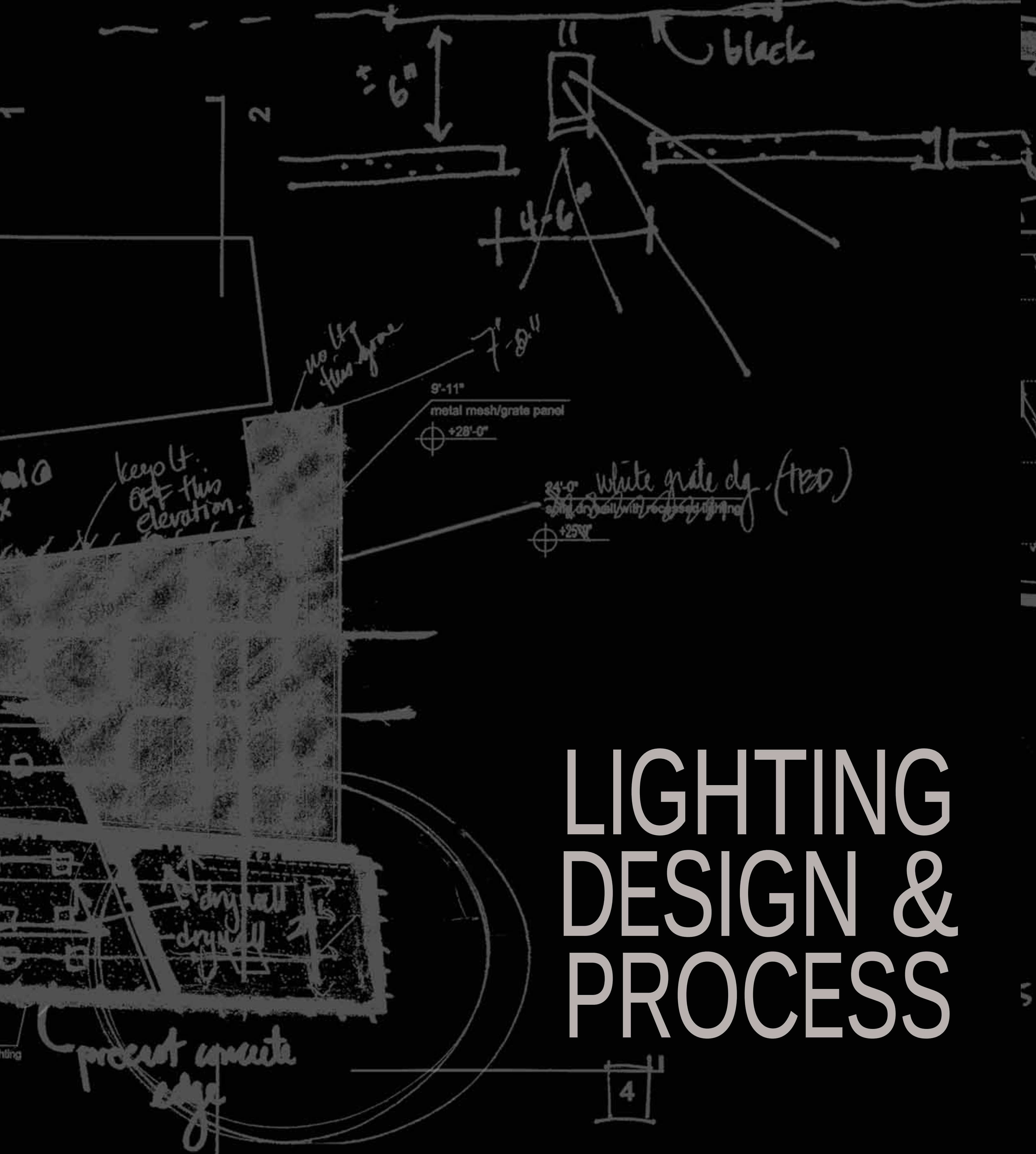

LIGHTING DESIGN & PROCESS

OFFICE FOR VISUAL INTERACTION

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Preface

Jean Sundin and Enrique Peiniger are the founders and principals behind a refreshingly different architectural lighting studio. Instead of being called in at the end of projects, they participate from very early conceptual stages, and provide creative input while designs are still being shaped.

The name of their firm—Office for Visual Interaction (OVI)—points to the possibilities of this kind of practice. Light is treated as a primary architectural component, with the ability to transform spaces through its interactions with surfaces, volumes and materials. Used to its fullest potential, light visually shapes and models architecture, without physically altering it.

Since 1997, Sundin and Peiniger have amassed an impressive portfolio, counting the world's foremost architects among their clients. The quality of their work—as well as the power of their integrative design approach—has been proven through the successful completion of signature projects around the world. In each case, lighting does more than simply meet technical requirements. It reinforces and participates in architectural gestures, and creates powerful nighttime icons.

This book documents a selection of OVI's projects. It is not a picture book, nor a glossary of technical terms and lighting formulas. Rather, it provides a glimpse of the fascinating processes by which Sundin and Peiniger develop architectural lighting design. The duo's sophisticated solutions are showcased in their progression from initial concept sketches, through advanced computer models, to final realized details.

Just as architectural design is a complex process involving a multitude of stages and decisions, OVI inhabits a parallel universe of lighting design considerations, strategies and opportunities.

by Elsa Lam

Chicago Tribune - Postcard 1925
Architects: Raymond Hood and John Mead Howells
Lighting Designer: Basset Jones

Projected Trends: Verticals on wide avenue - Metropolis of Tomorrow 1929
Architects: Hugh Ferriss

Wrigley Building
Architects: Graham, Anderson, Probst & White
Lighting Designer: HOK

Introduction

Illuminating Architecture: The work of OVI

by Prof. Dietrich Neumann

When lighting designers first approached architects to offer their services more than a hundred years ago, their overtures were met with "passive or active antipathy"[1] as one of them put it in 1909. Architects initially had little use for a new, ephemeral art that set out to illuminate the facades of their structures at night. They feared floodlights would create unsightly shadows or the glare of lightbulbs would make buildings invisible.[2] Moreover, many of them felt confident that they could handle a building's night lighting without any outside advice.

While the illumination of architecture became very popular during the 1920s, it would usually be applied as an afterthought to existing buildings, such as historic monuments, churches, city halls or banks. Rare were the cases in which an architect would involve a lighting designer in the design process from the start, with a resulting building making concessions towards its nighttime appearance. The Wrigley Building in Chicago of 1921 is one such notable case, with its terracotta skin increasingly brighter towards the top in order to offset the waning rays of the floodlights below. A few years later, Raymond Hood's Tribune Tower responded to the bright halo across the street by offering a sophisticated Gothic setback, its delicate tracery backlit by a mellow, amber glow—an "architecture of the night" as Hood called it.[3]

At the same time, European avant-garde architects dreamed of a "Light Architecture," in which light would become a true building material, and envisioned luminous structures, in which space and light were the new religion. Few critics recognized enormous potential of architectural illumination at the time. Most prominent among these was Douglas Haskell, who proclaimed in 1931: "Thousands of years went by with their changes of style, but not until this century was there electric light, which, far, far more than the familiar triad of steel, glass and concrete has changed the basis of all architecture."[4] Haskell had been deeply impressed by the vision of a Metropolis of Tomorrow, published in 1929 by Hugh Ferriss, a prominent architectural delineator, who depicted the future American City preferably in foggy night, its skyscrapers soaring under the beams of powerful floodlights.

It would take another twenty years before Richard Kelly emerged as the first independent architectural lighting designer. Trained at Yale's architecture school during World War II, Kelly developed lighting concepts that were extraordinarily sensitive to the causes of architecture. The light source became invisible—Kelly had introduced recessed ceiling lights in the 1930s—and he instead focused on luminous space, reflective materials and responses to functional change.

Kelly's career began at a felicitous moment. A range of new lighting technologies had been introduced just as modern architecture became firmly established as the dominant style. Kelly made architectural lighting design broadly accessible and comprehensible when he described his fascination with "ambient luminescence", "focal glow" and the "play of brilliants."[5] He was the first to realize the enormous lighting potential that lay in modern architecture's vast expanses of glass. Reflective and dark during the day, these surfaces could become entirely transparent and thus invisible at night. Skillful lighting would reveal a building's spatial depth and complexity.

Kelly's "nocturnal modernity" came to define the imagery of mid-century Modernism. No wonder that modern architects were eager to work with him, be they Philip Johnson (who had discovered his talent), Ludwig Mies van der Rohe, Eero Saarinen or Louis Kahn. Kelly insisted on being consulted early on in the project, and would often have substantial influence on the final design. The lobby of Mies van der Rohe's Seagram Building in New York would be polished dark green marble today, if Kelly had not talked Mies into using bright travertine instead which became a crucial element in the building's luminous presence on Park Avenue.[6] The ingenious daylighting of the Yale British Art Center and the Kimbell Museum in Fort Worth, Texas were also Kelly's creations.

Rudolf Petersdorf Department Store
Architects: Erich Mendelsohn
Lighting Designer: E. Mendelsohn / BPK

Seagram Building
Architects: Ludwig Mies van der Rohe and Philip Johnson
Lighting Designer: Richard Kelly

The New York Times Building
Architects: RPBW with FXFOWLE
Lighting Designer: OVI

The United States Air Force Memorial
Architects: Pei Cobb Freed & Partners
Lighting Designer: OVI

Today, Jean Sundin and Enrique Peiniger, with their team at Office for Visual Interaction (OVI) are among Richard Kelly's most direct successors. They occupy a similarly defining position in their profession, bringing both design and technical experience to their work; they are equally adept at artificial illumination as with daylighting. They work with many of the most prominent architects of our time, including Renzo Piano, Zaha Hadid, Enric Miralles and Benedetta Tagliabue, Adrian Smith, Gordon Gill and Foster + Partners. Jean and Enrique are involved early in the design process and often have significant influence on design decisions.

There is usually a particular creative wit, a "thinking against the grain" in OVI's work, unfolding in the stories behind each project. Who else would have pulled off the miracle of presenting the taxi-yellow luminaires on Renzo Piano's New York Times Building to a tough group of commissioners as a valid response to their Times Square ordinance for animation on the façade? For Jim Freed's Air Force Memorial in Arlington, Virginia, OVI gained permission to forego the obligatory red signal lamps at the highest points, by providing the appropriate level of brightness at the tips of the tall curved spires to meet FAA requirements.

The challenges they face—and master—vary greatly. At Zaha Hadid's Rosenthal Center in Cincinnati, Jean and Enrique borrowed Boeing aircraft technology for the captive screws that hold hardware in place when the light bulbs are changed.

The central courtyard of Zaha Hadid's cluster of crystal forms in the Saudi Arabian desert, the King Abdullah Petroleum Studies and Research Center, turns radiantly luminous at night as if to illustrate the center's mission to celebrate the benefits of fossil fuel. The complex includes moments of intense lyricism, when lighting design and architectural language engage in such apt fusion that one cannot exist without the other. Observe, for example, how the waves of sculpted shards on walls and ceilings of the library and conference center are met by a vibrant cyclone of bright lines. The dark mysticism of the prayer room results from its careful portioning of lighting from the inside and out. One is instantly reminded of the German Expressionist fantasies of the 1920s.

Enric Miralles and Benedetta Tagliabue profited enormously from their collaboration with OVI on the Scottish Parliament Building. Early on in the design process, Jean and Enrique suggested repositioning a cluster of lozenge shaped structures west of the main parliament chamber, in order to turn them into brise soleils—sun breakers. Thus, the direct influx of sunlight in the afternoon was drastically reduced, diminishing glare and enhancing the light quality for TV broadcasts. At night, the transformation of the formally rich Scottish Parliament is nothing but miraculous—OVI's careful and detailed lighting concept establishes coherence and calm, and enhances the complex's architectural quality. It finally comes into its own at night.

OVI's lighting of the Rookery in Chicago took a certain amount of courage. While just down the street from the blazing lights of the Stock Exchange, the Rookery is lit with subtlety and refinement. But this was, of course, the only option, as it respects the building's particular historic prominence. In its time it would have been lit only on festive occasions, with gas lights and oil lamps in the windows perhaps, producing an effect not unlike what we see today. Cities were darker then, and optical nerves more sensitive. The result of this approach is an effect of wonderful elegance and restraint.

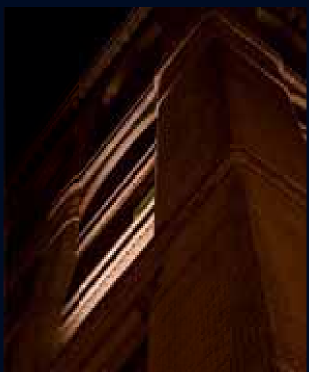
How to describe Jean and Enrique's approach? Clearly, there is no such thing as an "OVI style," no desire to impose a recognizable signature onto each project, nor any inclination towards a theatrical emphasis on the lighting as such. Instead, there is ingenuity, passion, modesty, and courage—qualities accompanied by an enormous artistic sensitivity and technical expertise. Infectious enthusiasm is coupled with an intense, uncompromising seriousness about their work. Each project is met on its own terms, no strategy is ever simply repeated. As a result, the lighting becomes such an integral part of a particular building that the structure seems incomplete without it. Often, the nocturnal view emerges as the dominant expression of a building's essence and an architect's intention.

This book differs from other accounts of lighting designers' work in its emphasis on craft and process. On the following pages, Jean and Enrique and their team share not just the results of

Kimbell Art Museum
Architects: Louis Kahn
Lighting Designer: Richard Kelly

The Scottish Parliament
Architects: Enric Miralles Benedetta Tagliabue with RMJM
Lighting Designer: OVI

King Abdullah Petroleum Studies and Research Center (KAPSARC)
Architects: Zaha Hadid
Lighting Designer: OVI



The Rookery
Architects: Daniel Burnham and John Wellborn Root
Lighting Designer: OVI

their work, but also the tools of their trade—more than once these are tools they have actually invented—in order to demonstrate the complex and often beautiful processes that led to seemingly simple solutions. Evocative renderings might translate the flow and distribution of light into fields or clouds of numbers indicating changing degrees of luminosity. We begin to understand how precisely determined the paths are on which rays penetrate darkness. From a vast range of 3D rendering techniques and complex visual arithmetics to actual, old-fashioned hand drawn sketches and cardboard models, the scope of tools reflects the seriousness and creativity of their approach. "Technical understanding develops through the powers of imagination," Richard Sennett once reminded us, when he defined craftsmanship as "the desire to do a job well for its own sake."[7] Jean and Enrique represent the essence of true craftsmanship. Always, the planning in the office is complemented by patient work and adjustment on site.

Just as Richard Kelly made full use of the new incandescent, fluorescent and neon lights of his time, Jean Sundin and Enrique Peiniger have become experts in the application of new LED technology. They enjoyed a sensational success with their revolutionary winning design for the future New York City streetlight, entirely based on LEDs, and pioneered the application of the technology for historic buildings with the Rookery in Chicago.

To this very day, architectural lighting design is easily and frequently underestimated, and many architects are still hesitant to call upon lighting experts early on in the development of a project. On the other hand, many lighting designers wait for the architects to send them reflected ceiling plans, and then just drop in the lights. What is often overlooked, as this book demonstrates, is that in the best cases, lighting becomes an indispensible part of architecture. Beyond the mere fulfillment of functional needs it can bring qualities to a building that are invisible during daytime. The complete control and flexibility of artificial light allows a selective rendering of space and determination of use that can be more specific than under daylight. Selected spaces can be emphasized, walls made to glow and windows relieved of all reflections - this means that lighting cannot be established as an afterthought, but has to be planned from the very beginning. The work of a good lighting designer is ultimately a form of rendering, and thus also the first act of a building's interpretation. Of course, the opposite is also true: thoughtlessly applied lighting can do harm, it can lessen a building's architectural qualities, ruin the atmosphere of a particular interior, deprive a building of its full potential at night.

The general public, often quite conversant about the qualities of design and architecture, still has only a rudimentary understanding of the different qualities of light. The recent debate about the environmental impact of incandescent lightbulbs and the different qualities and colors of compact fluorescents and LEDs has only begun to change this. Lighting design's central paradox is, indeed, that it has remained invisible to so many. We all might register the difference in spatial perception that a building offers at different times, without realizing its reason. Few building owners seem aware of the enormous positive impact that small changes in lighting technology, intensity and focus can have on the atmosphere of exterior and interior spaces. How different the world looks at night, once one has learned to appreciate differences in light colors and intensities, or is able to appreciate the invisibility of a light source bringing about the even glow of a particular wall.

This book, then, does more than introduce us to one extraordinary lighting design firm. It presents us with the potential scope of an entire profession and its subtle craft. It displays a masterful body of lighting design that works with the materiality of light and it helps us to recognize qualities we did not see before—it opens our eyes.

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[1] *E. L. Elliott, "Some Unsettled Questions in Illuminating Engineering." Transactions of the Illuminating Engineering Society 4, no. 3 (March 1909): 159-181.*

[2] *Emile G. Perrot, "Architecture and Illumination." Transactions of the Illuminating Engineering Society 3. no. 8 (November 1908): 619-626 and William Copeland Furber,"Illumination and Architecture." Transactions of the Illuminating Engineering Society 5, no. 8 (November 1910): 822-838.*

[3] *See Dietrich Neumann (ed.), Architecture of the Night. (New York, 2002): 54-64, 108, 142.*

[4] *Douglas Haskell, "Architecture: the Bright Lights." The Nation 132, no. 3419 (14 January 1931): 55-56.*

[5] *See Dietrich Neumann (ed.). The Structure of Light: Richard Kelly and the Illumination of Modern Architecture, (New Haven, 2010).*

[6] *Arnold Nicholson, "Mr Kelly's Magic Lights" Saturday Evening Post, July 5, 1958: 65.*

[7] *Richard Sennett, The Craftsman (New Haven, 2008): 10, 11.*

The Scottish Parliament
Landscape and Exteriors

Edinburgh / Scotland
Architects: Enric Miralles Benedetta Tagliabue with RMJM
1998-2004

Prominently situated at the endpoint of the city's Royal Mile, the Scottish Parliament extends Holyrood National Park and adjoins Holyrood Palace—the official Edinburgh residence of Her Majesty the Queen. A coherent lighting masterplan unifies the nighttime appearance of the Parliament's various buildings, while custom lighting solutions become natural extensions of the architecture, blending seamlessly during both day and night to achieve a timeless appearance with its lively architecture.

The lighting strategy balances the distinct identities of the adjacent Crown properties—a situation found nowhere else in the world—by being designed with a contemporary sensibility that keeps the Parliament harmonious with, yet clearly distinct from, the stately Queen's Palace.

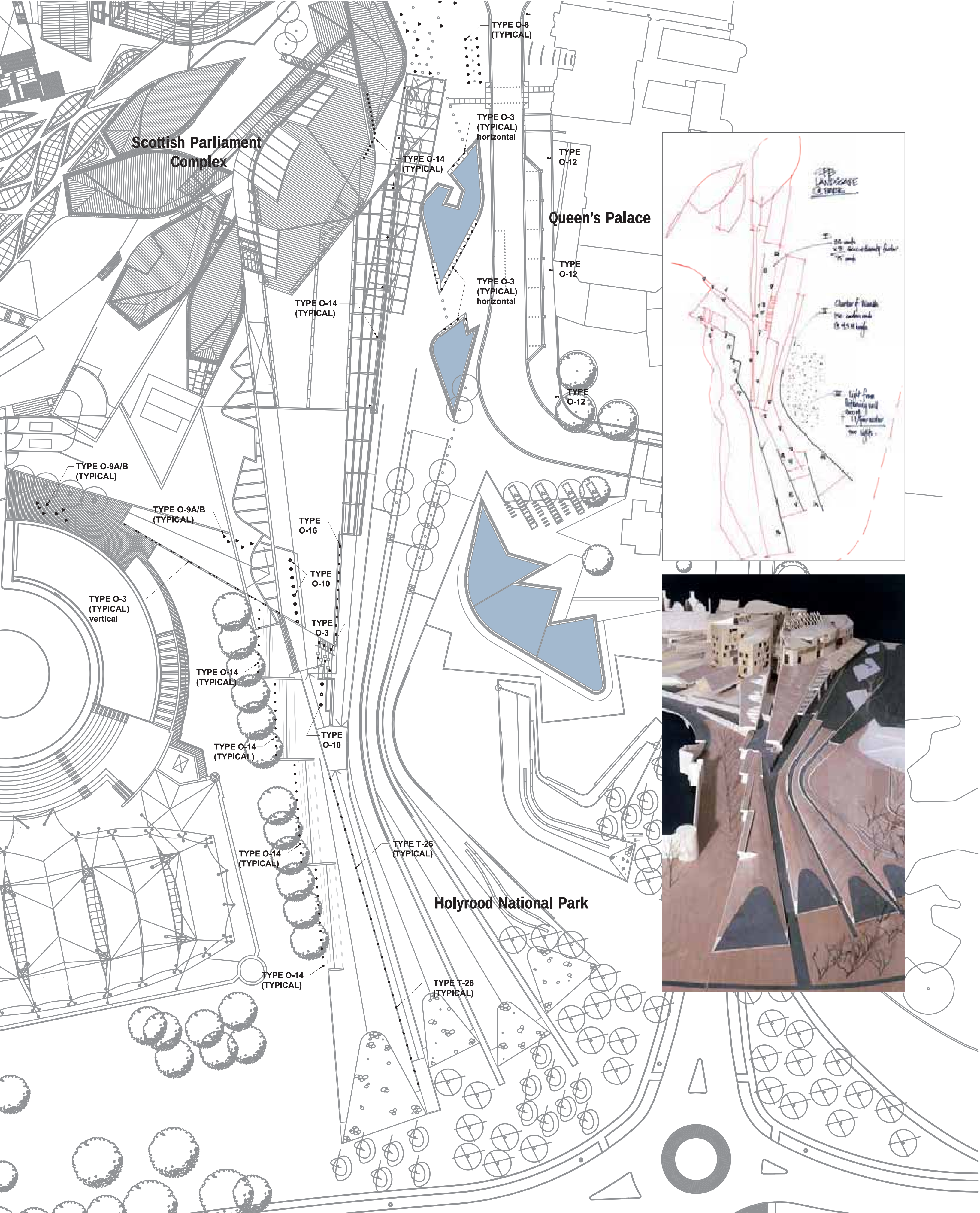
The nighttime lighting design reinforces the intended village-like atmosphere by fully utilizing the light that individual buildings emit from within. Throughout the parliamentary complex, interior lighting solutions are carefully coordinated with the exterior effects in mind.

Luminous surfaces and small-scale luminaires are used throughout the broader landscape, instead of floodlights, to achieve an energy-conscious scheme and to create an intimate scale. This modest approach to the lighting design provides clarity for comprehending the intricate architecture while visually conveying an environmentally sensitive government.

In accordance with Historic Scotland's requirements for public access across the site, lighting is strategically positioned to provide intuitive wayfinding and safety for nighttime pedestrians and cyclists. Accenting main entrances, in-grade luminaires softly catch the face of columns and underside of sculpted canopies.

For the historic Queensberry House structure—a designated landmark on the Parliament site—lighting solutions are interwoven into the restoration work, maintaining the building's historical integrity while unifying the overall nocturnal, domestic appearance.

Opposite: In-grade lights illuminate columns and canopy at The Scottish Parliament's main entrance.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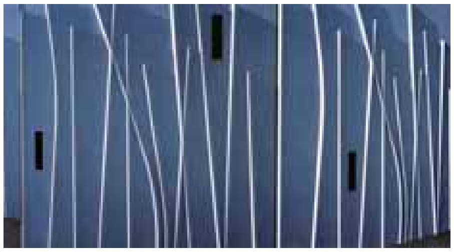
Lighting Masterplan

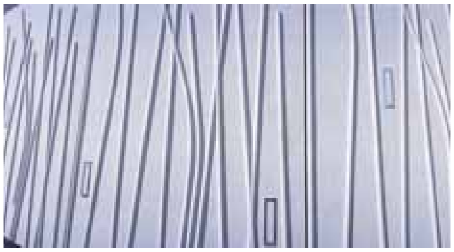
The Parliament occupies a prominent site at the end of Edinburgh's historic Royal Mile, opposite Her Majesty the Queen's Holyrood Palace. The complex consists of nine buildings, each with a unique architectural shape and size. A lighting masterplan creates a common thread to unify the different buildings, providing clarity, orientation, and wayfinding while enhancing the overall visitor experience. Because of its proximity to the Royal Palace, the Parliament also requires distinct illumination that does not compete with the Queen's residence.

Rather than brash floodlighting and a monolithic appearance, the light the buildings generate from within is harnessed as part of the overall nighttime illumination. A lighting hierarchy directly corresponds to points of interest, creates focal points and intuitively guides visitors to brighter main entrances. Throughout the grounds, tailored, small-scale luminaires are used to strategically illuminate architectural elements in a subtle way. This reinforces the tranquil, village-like atmosphere of the Parliament and creates balance with the quiet presence of the palace.

To animate the pedestrian landscape, the use of predominantly low-mounted luminaires reinforces human scale and harmonizes with the vibrant spirit of the architecture. At the main entrance plaza, standard steplights, typically mounted horizontally, are vertically oriented and rhythmically integrated with the abstract branch motifs of the concrete walls. Small custom bollards with a lantern-like quality disperse light across the paving.

An overall lighting language balances scale, proportion, luminosity, brightness and contrast, linking the structures together while allowing them to maintain their distinct character. The coordinated use of different light sources and color temperatures reinforces the domestic lighting quality throughout the complex by mimicking the characteristics of incandescent light.





Above: Entrance plaza and wall
Opposite: Landscape lighting diagram; architectural scale model
Following spread: Entrance plaza and reflecting pool

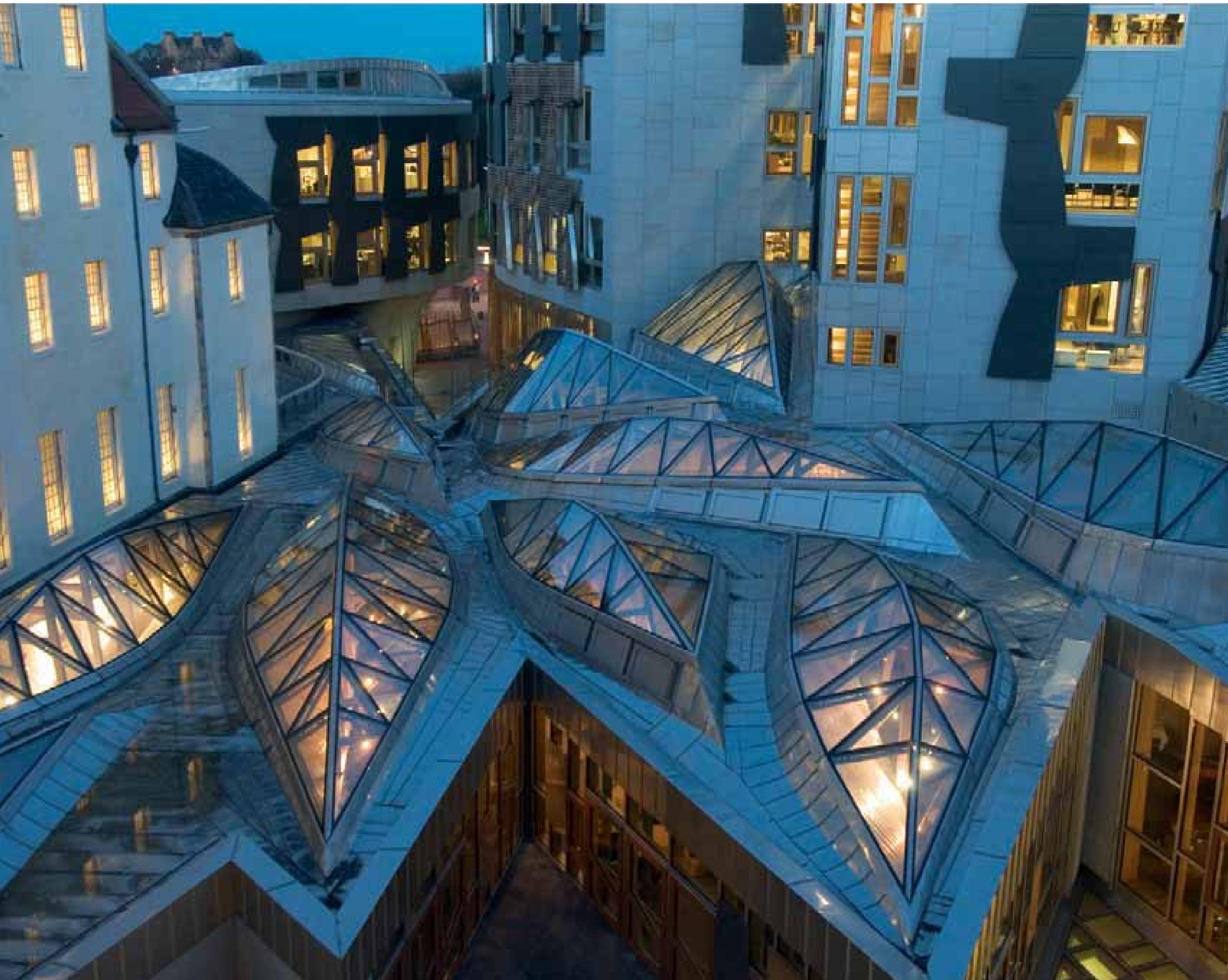
Lit from Within

Throughout the Parliament, nighttime lighting emanates from the interiors of the buildings. The articulation of windows and skylights becomes a crucial visual component, anchoring the composition and defining the exterior identity of the complex at night.

Windows are grouped to form a geometric, shifted-grid pattern on the interior courtyard façade of the Members of Scottish Parliament (MSP) building. Diagonal downpipes silhouetted against the lit offices add to the façade's liveliness. In contrast, the adjacent historic Queensberry House is demurely lit with uplights embedded in the restored windowsills.

Leaf-shaped foyer skylights, an echo of the project's signature leaf-like building volumes, extend the site topography to slide between buildings. At night, the glazed surfaces glow softly from miniature pendants suspended within, generating elegant, luminous shapes in the landscape.

Opposite: East façade of MSP building and Queensberry House
Above and below: Foyer skylights at dusk



A Historic Landmark

Historic Queensberry House, a designated landmark on the Parliament site, was renovated to accommodate modern, high-level staff offices and administrative functions. The exterior was restored to its original height and appearance, the structure reinforced with concrete and steel, shallow dropped ceilings added, and seventeenth-century interior stonework repaired. This delicate structure presents numerous challenges for lighting, since the luminaire and power locations are severely limited and the stonework could not be punctured.

To maintain a nocturnal residential effect, warm color temperature compact fluorescent luminaires are integrated within the restored window sills. These brick-sized, low-energy lights aim upwards, filling the deep-set openings with the appearance of incandescent light. At night, the lit rectangles unify the exterior appearance of the building and reinforce its welcoming, domestic character.

Opposite: West façade of MSP building and Queensberry House
Below: Queensberry House at night

The Scottish Parliament
Public Areas and Office Buildings

Edinburgh / Scotland
Architects: Enric Miralles Benedetta Tagliabue with RMJM
1998-2004

Each building in the Scottish Parliament complex has a distinct character and unique spaces, requiring imaginative, unconventional lighting solutions. The lighting design utilizes an entwined vocabulary of minimalist pendants, luminous bands and surfaces, as well as cast-in-place luminaires. These are tailored to a multiplicity of diverse situations throughout the interiors, including the illumination of vast areas without puncturing sculpted ceilings. The lighting design balances the extremes of historic restoration and modern architecture, while meeting the stringent requirements of a government building—which includes technical criteria and light levels for television broadcasting as well as daily office tasks.

In all, a multitude of custom lighting solutions—over fifty designs—were developed for the Parliament complex, while staying within the lighting budget. These state-of-the-art luminaires visually relate to each other, are user-friendly, and have a timeless appearance.

Discreet luminaires are adopted for areas featuring dynamic ceilings, balancing lighting against the dramatic architecture. In the central foyer, glowing glass bands ascend alongside the grand staircase, composed to form a pleasing interplay with the handrails and provide light where most needed. The foyer's skylights have frosted glass pendants, which provide ambient lighting and add sparkle to the space.

Circulation areas throughout the Parliament share the motif of luminous bands. In core staircases, the building itself forms part of the luminaires. Slots cast in the concrete walls house linear fluorescent sources behind custom stainless steel faceplates.

Open offices in the assembly towers are lit with linear fluorescent luminaires, recessed into continuous slots cast into the concrete ceilings. Luminaires are mounted flush with the ceiling surface and arranged in bands that integrate panels for building services.

Cast-in-place solutions require rigorous trade sequencing and meticulous attention to detail. At the time of the concrete pour, lighting layouts are literally cast in stone. Profiles of cast forms and concrete mixes are refined in consultation with specialists to ensure precise, durable results within minimal tolerances.

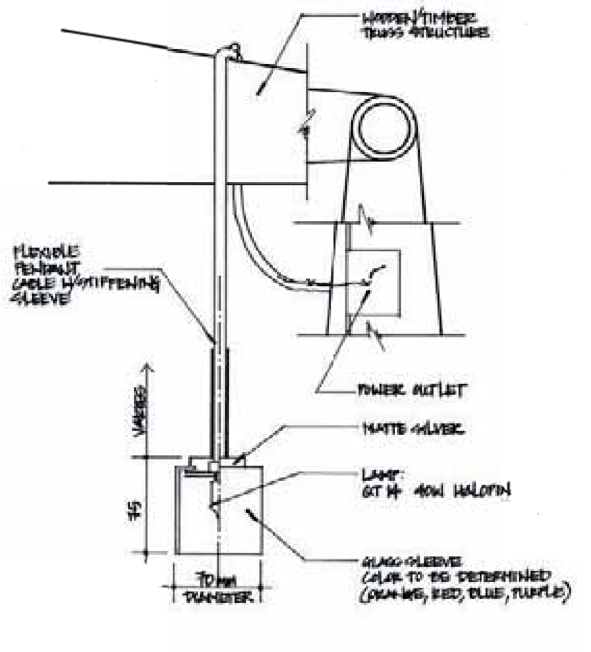
Opposite: Pendant lights inspired by the Glasgow School of Art are hung from the skylights and add sparkle to the central foyer.

Cultural Inspiration

A unique lighting solution was needed for the main foyer, a space dominated by dramatic, undulating panels of sculpted metal, wood, and glass that form leaf-like skylights. This resulted in virtually no traditional, flat ceilings. Inspiration was derived from Scotland native Charles Rennie Mackintosh's Glasgow School of Art, where the painting studio is lit with simple, suspended luminaires.

As a practical and modernized solution, modest pendants in white and amber glass are suspended from the trusses that stretch across the skylights. Pendant cables wrap around the wooden members, blending with tension rods and suggesting an arts-and-crafts look. Taking advantage of line voltage bi-pin lamps eliminated the need to accommodate transformers in the airy space. Suspended at varying heights, the pendants produce clusters of sparkling points that provide a functional, ambient light level for the lobby.

Below: Glasgow School of Art painting studio; details of luminaires in The Scottish Parliament foyer
Opposite: Foyer ceiling with pendants and skylights

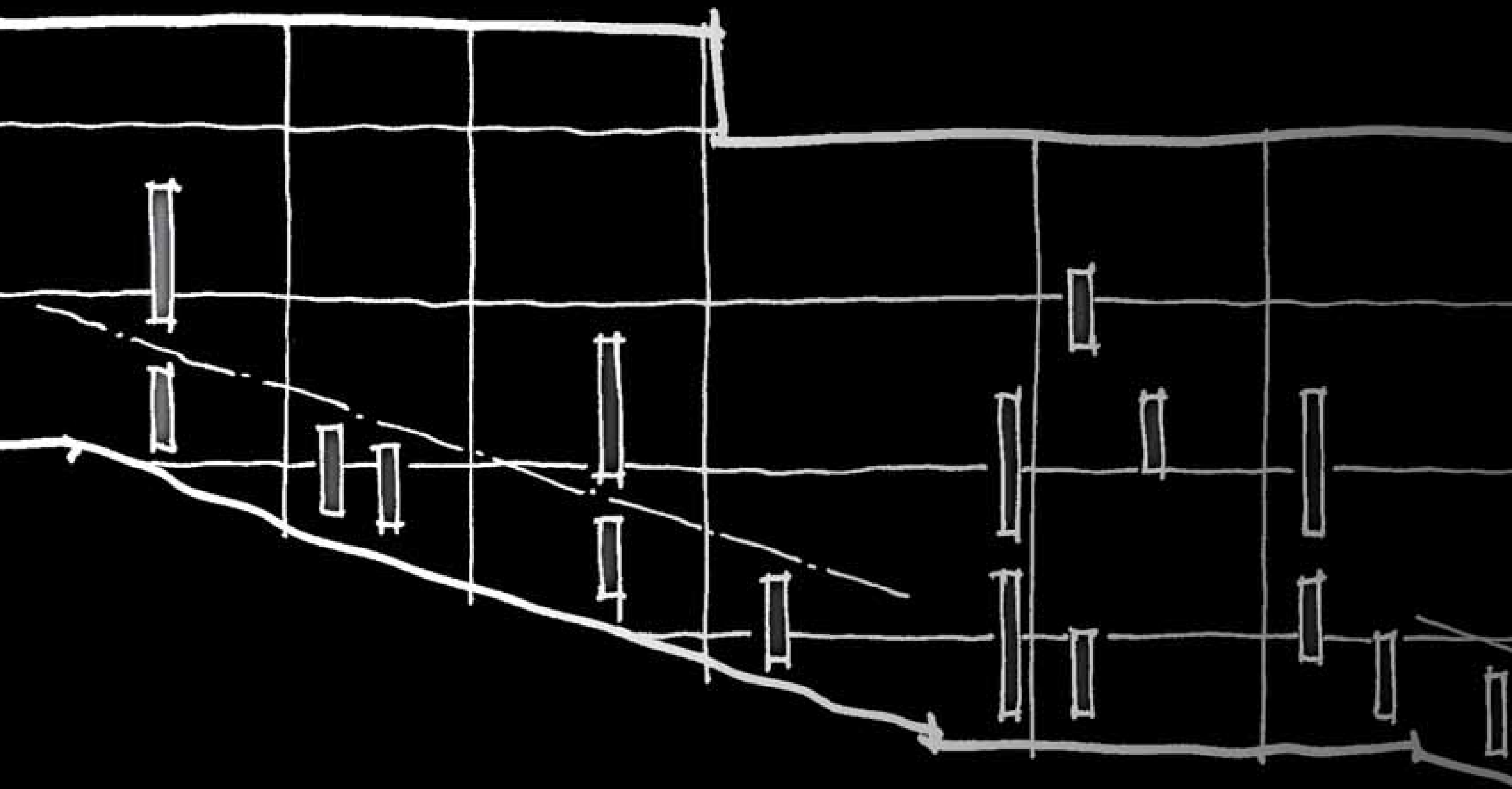


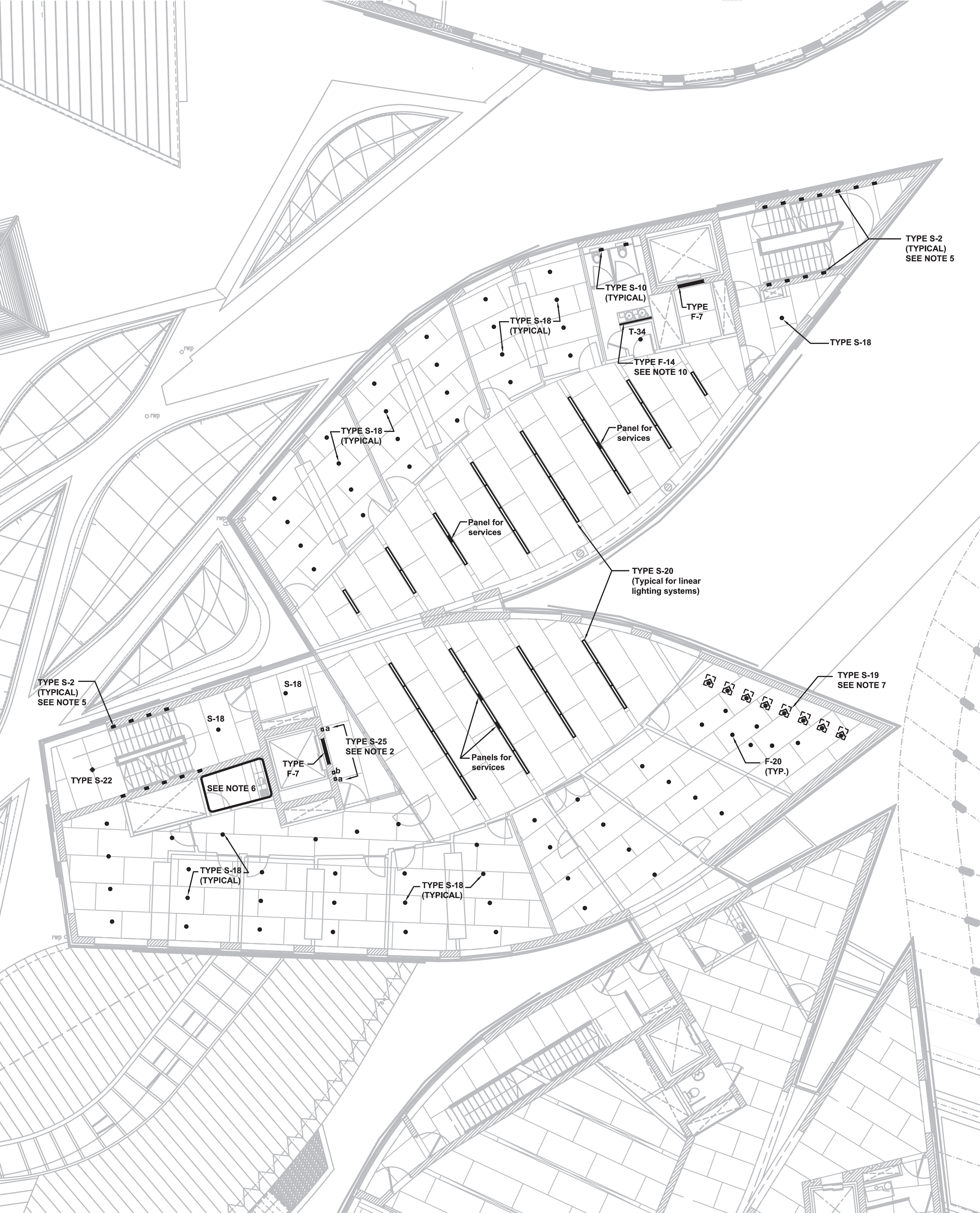
Architectural Integration

Linear lighting motifs were directly inspired by the architectural aesthetic of the project and the architect's Barcelona office, where walls are patterned in lines that alternate between historic wall and new paint. This design language was translated into vertical lighting bands that occur throughout the Parliament buildings and exterior of the complex, ranging in scale and proportion depending on their location, from small steplights to lengths exceeding 2 m (6'-6").

A layout of recessed luminous bands in the central foyer's grand staircase features linear fluorescents typically used in gypsum board ceilings, here turned vertical and inset in the concrete wall as graphic elements. This approach concentrates lighting at foot level, where it is most needed, while making the lamps easily accessible for maintenance.

Left: Enric Miralles and Benedetta Tagliabue's Barcelona office
Below and opposite: Grand staircase





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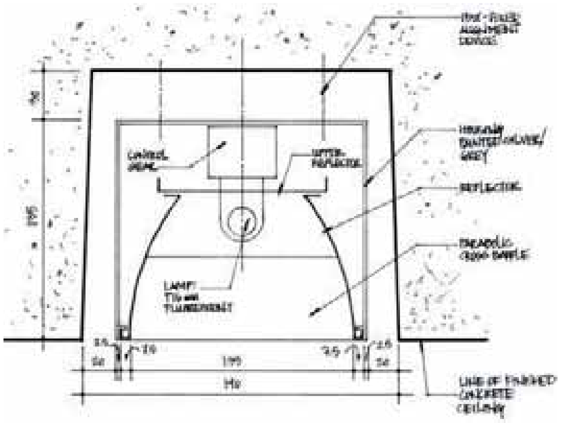
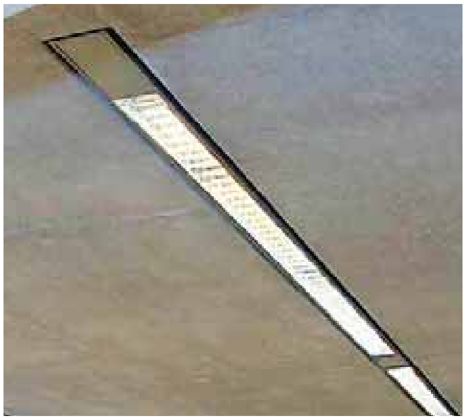
Cast-in-Place Lighting

Integrated office lighting solutions required a reverse-engineering design approach. Rather than using standard formwork for the cast concrete ceilings, the luminaire locations for the appropriate light levels became the setting out points and determined the layout of the shutter boards.

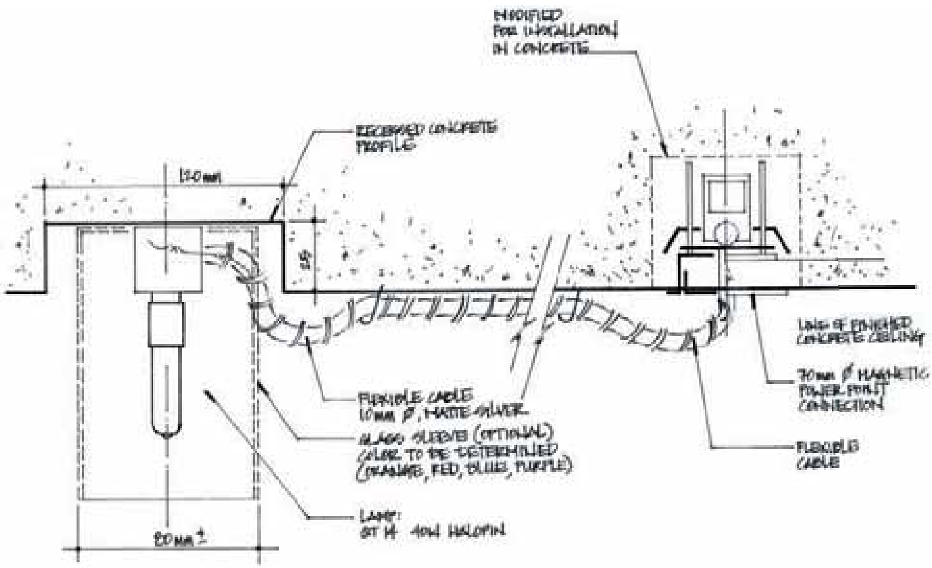
Within open plan office areas, these cast-in-concrete linear luminaires integrate service equipment including fire points, sprinklers, and speakers. This required extensive design as well as manufacturer and construction coordination to ensure accurate installation. In smaller, individual offices, a different solution was applied: recessed compact fluorescent downlights were embedded in the concrete ceiling. This provided a flexible solution appropriate for the unconventional, radiating geometry of the plans.

A discreet shadow gap technique was developed and employed throughout the Parliament, eliminating the overlapping trim that typically accompanies luminaires installed in concrete surfaces. This minimalist detail articulates the lighting slots in a sophisticated, controlled manner that matches the clean, sculptural aesthetic of the building. The shadow gaps are proportionally scaled to the widely varying ceiling heights in the complex, providing a consistent appearance from below. Trade sequencing was critical for cast-in-place lighting. For areas with downlights and wallwashers, a special concrete aggregate mixture was employed to ensure that the thin section under the luminaire housing would not crack. Wiring paths were also cast into the concrete, their locations carefully planned to be completely concealed once the luminaires were installed.



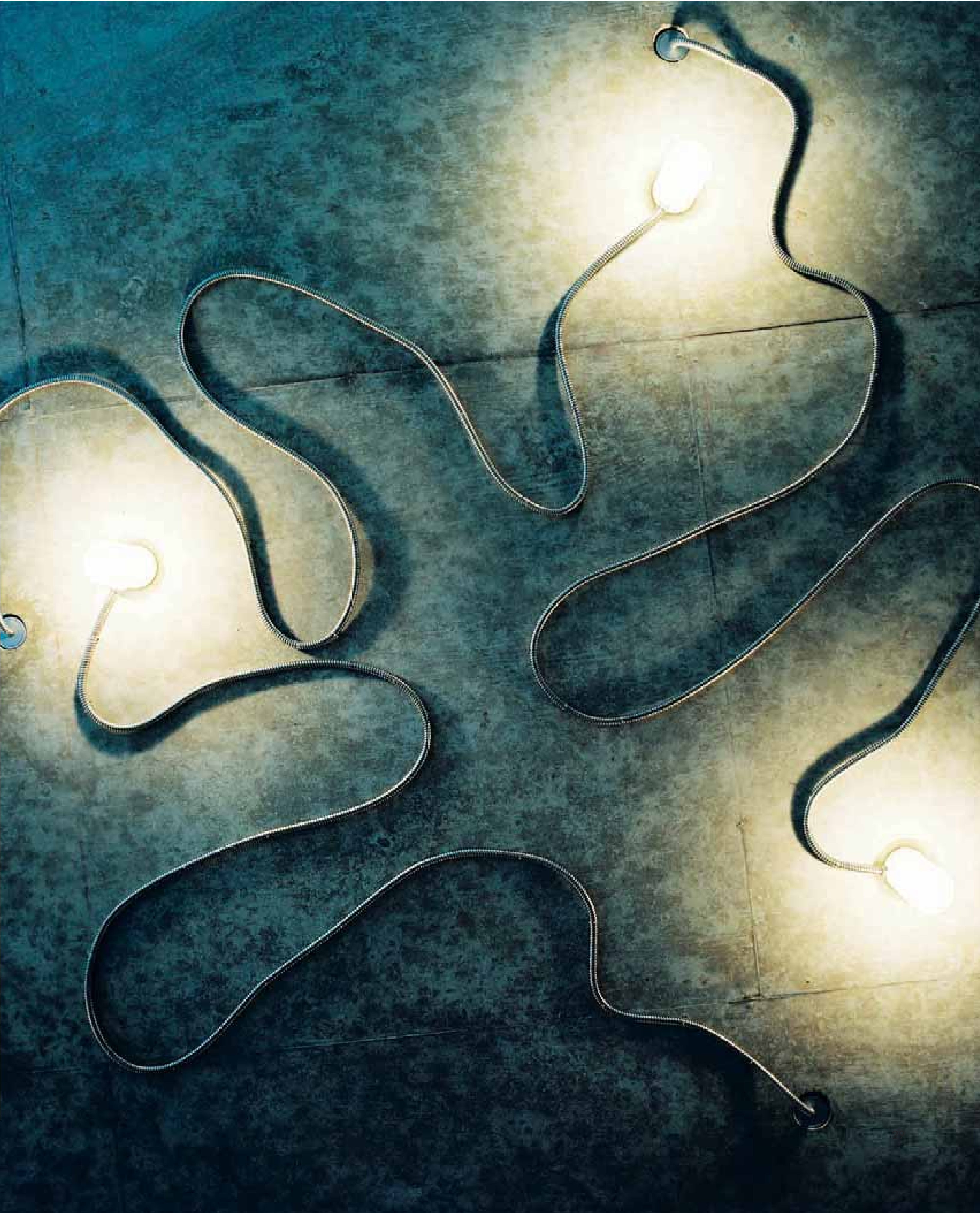


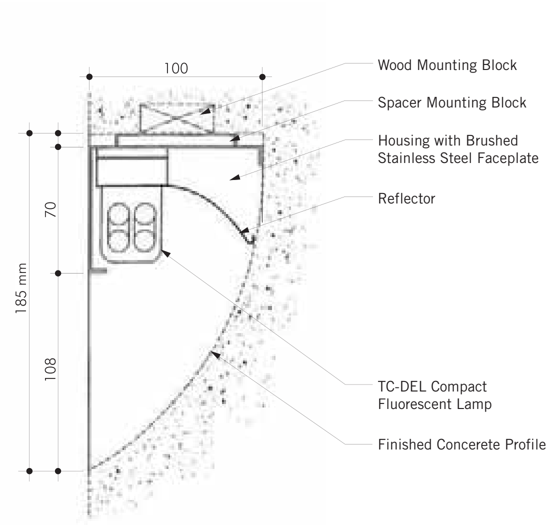
Above: Recessed lighting slots in open plan office ceilings
Left: Shadow gap lighting detail
Opposite: Office lighting plans

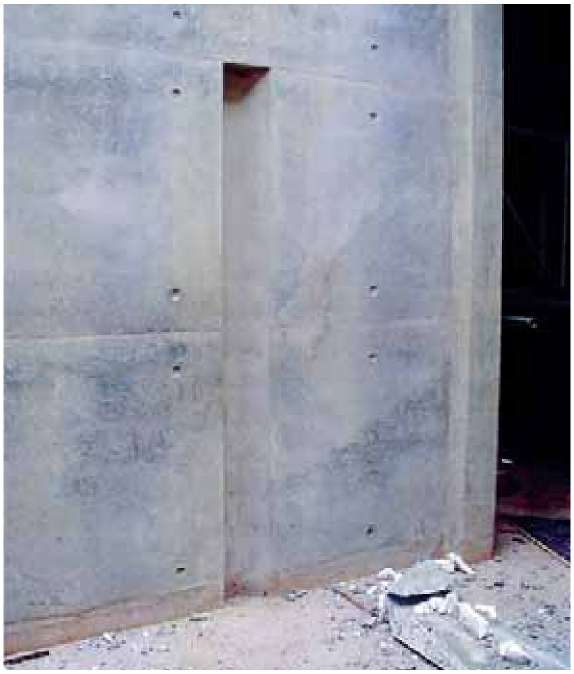


An unconventional lighting strategy is used for the cafeteria ceiling. Glowing cylinders are located in specific, predetermined positions embedded into the concrete ceiling. A semi-recessed profile provides subtle indication that the whimsical layout is intentional, not random. The same line voltage bi-pin lamps as in the foyer are used, eliminating the need for transformers. The luminaires are linked to a regular grid of flush, recessed power points with exposed cables that coil and unfurl along the ceiling.

Left: Lighting detail
Below: Main floor cafeteria
Opposite: Cafeteria ceiling







Stairwells throughout all buildings are accented by tall, luminous slots and matching steplights embedded directly into the building. In each, the concrete surrounding the lamp is cast in a scooped profile that reflects light onto adjacent wall and floor surfaces. Light sources are concealed behind non-directional, brushed stainless steel faceplates that appear uniform in both vertical and horizontal mounting orientations. The building itself serves as part of the luminaire, resulting in a lighting solution that becomes a natural extension of the architecture, and naturally ages along with it.

Left: Stairwell with cast light slot and steplights
Above: Steplight section detail; the first slot profile cast on-site

Heritage Spaces

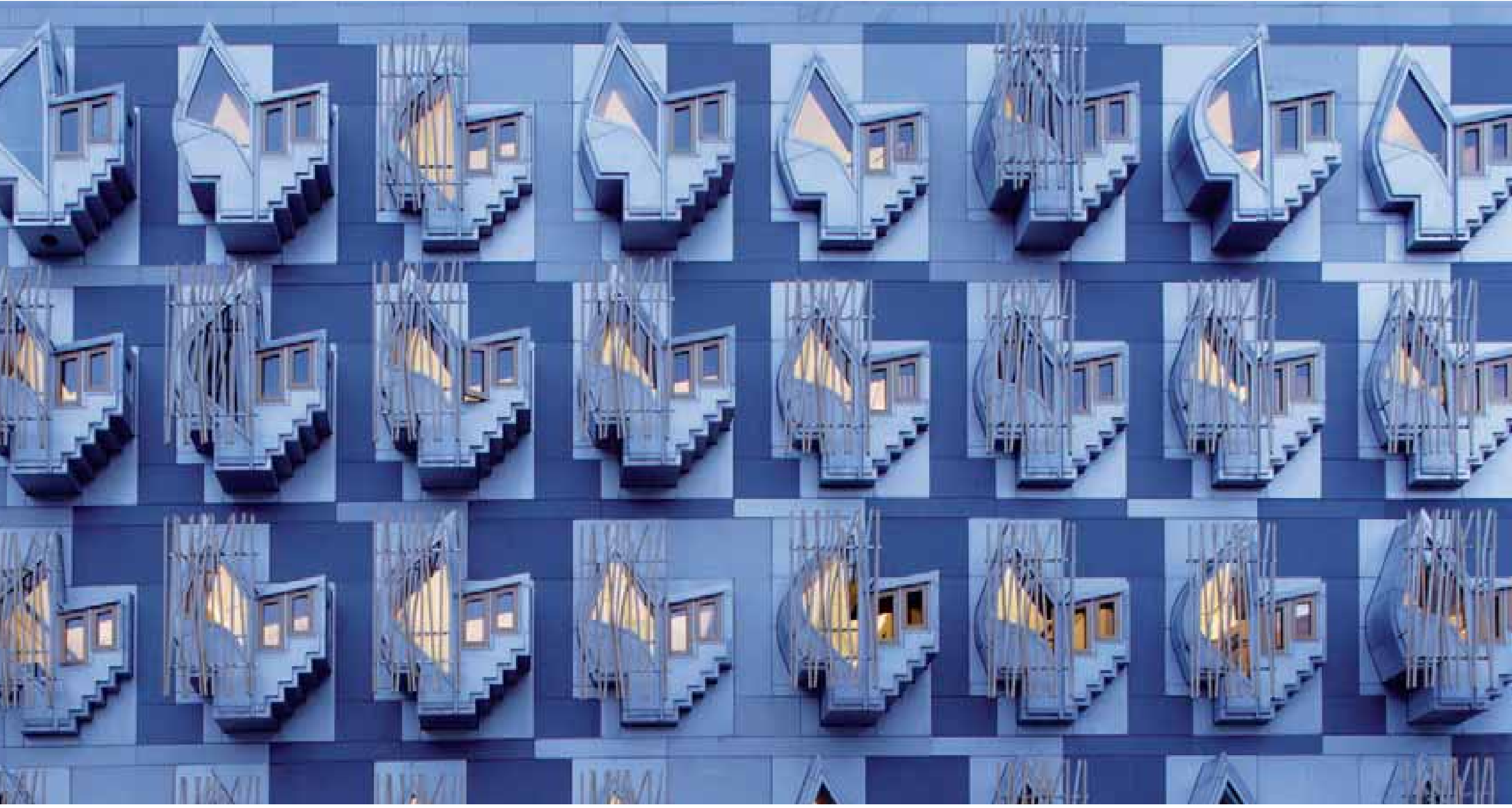
The restored, seventeenth-century Queensberry House accommodates administrative offices and meeting rooms for parliamentary staff.

Since the historic ceilings and stone walls could not be touched, shallow dropped ceilings were strategically positioned in selected areas of the building. The ceilings align with furniture placement and provide just enough depth to conceal junction boxes to hang pendant lights and allow the use of small, recessed compact fluorescent downlights to provide light levels required for offices.

In stairways and corridors, stone surfaces are accented with lighting concealed in handrails. This brings forward the texture of the original masonry and discreetly provides the necessary light levels for circulation. In the main entrance hall, miniature glass pendants create an effect reminiscent of candle-like chandeliers. Luminaires throughout are selected as a respectful response to the historic space.

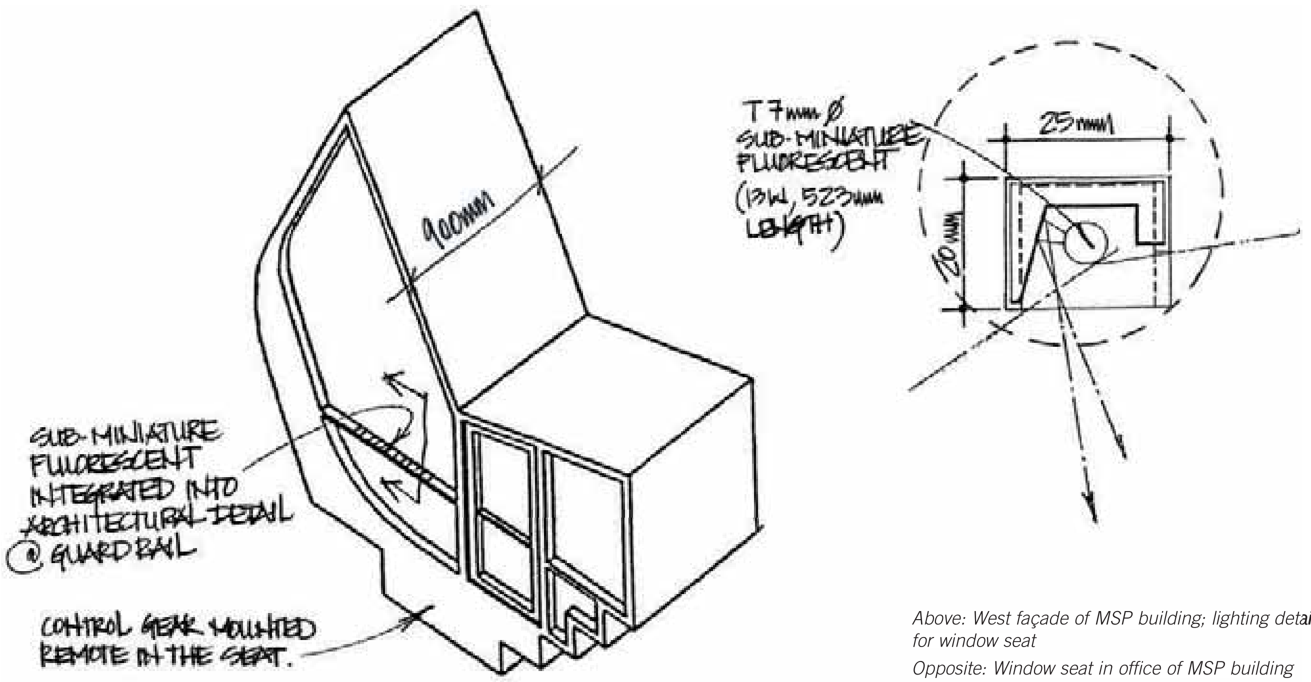
The lighting strategies meet Historic Scotland's requirements for the restored house and quietly complement its heritage.

Above: Lighting concealed in handrails
Right: Queensberry House entrance hall



Concealed Solutions

Each office in the Members of Scottish Parliament (MSP) building is distinguished by a sculptural window seat, conceived as both a means of daylighting and an intimate reading nook. The unconventional shape of the carrel precludes any traditional lighting solution. Instead, a custom sub-miniature fluorescent luminaire is incorporated in the window safety rail. To keep the profile extremely small, the control gear is remotely located and easily accessible below the seat. The compact source concentrates light at reading height, and is seamlessly integrated with the architecture.



Above: West façade of MSP building; lighting detail for window seat

Opposite: Window seat in office of MSP building

The Scottish Parliament
Debating Chamber and Committee Rooms

Edinburgh / Scotland

Architects: Enric Miralles Benedetta Tagliabue with RMJM

1998-2004

BBC television broadcasts make Scotland's parliamentary meetings accessible to the public. Accordingly, the Parliament's main meeting spaces—the Debating Chamber and six committee rooms—must meet stringent broadcast lighting criteria. Lighting quality, color, direction, as well as horizontal and vertical light levels were precisely designed to produce the desired visual effects. Instead of using technical lighting gantries that would make the spaces feel like television studios, these highly technical lighting requirements were fully integrated into the rooms' aesthetically-advanced designs.

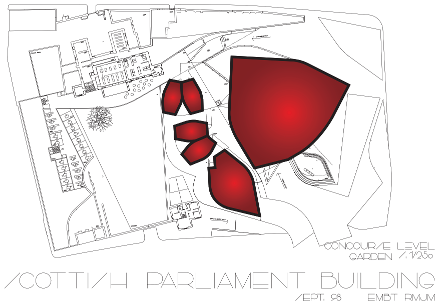
The Debating Chamber features large expanses of glazing for daylighting, intended to promote the well-being of parliamentary members. However, sunlight could potentially disrupt controlled broadcast conditions. A one-of-a-kind daylight strategy was devised during masterplanning—the footprint of the Debating Chamber was rotated and adjacent leaf-shaped towers repositioned to act as giant louvers. The towers' final locations shield the Chamber from direct sun during broadcast hours throughout the year, without the need for additional shading systems.

The Chamber's completely asymmetrical, open ceiling includes deep trusses and structural elements that could occlude light beams. To locate lighting within these parameters, advanced photometric 3D computer modeling was used, while this technology was still in its early development. Vertical and horizontal light levels were calculated as hundreds of luminaires, all with different positions in plan, aiming orientations, and heights above the floor, were individually simulated and positioned in the space.

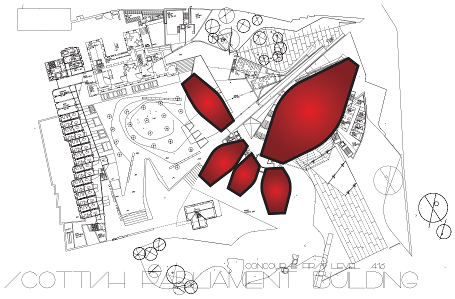
Lighting each of the six committee rooms to broadcast standards entailed a similar set of challenges. The geometrically complex rooms include compound curved ceilings and vaulted double height spaces, containing skylights, light wells, and clerestory windows. A hybrid strategy of lights recessed in ceiling slots and clustered, hanging pendants allow the positioning of luminaires in highly specific locations for optimal TV/Broadcast lighting conditions. The branch-like pendants and slotted ceiling design meet demanding lighting requirements while echoing architectural motifs.

Opposite: In the Debating Chamber, luminaires suspended at exact locations under an open ceiling provide high-precision broadcast lighting. On each desk, light colored wood inlays softly reflect light onto faces of seated parliamentary members and respond to the needs of the television cameras.

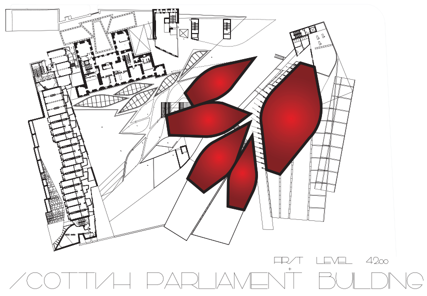
Buildings as a Brise-soleil



September 1998



February 1999

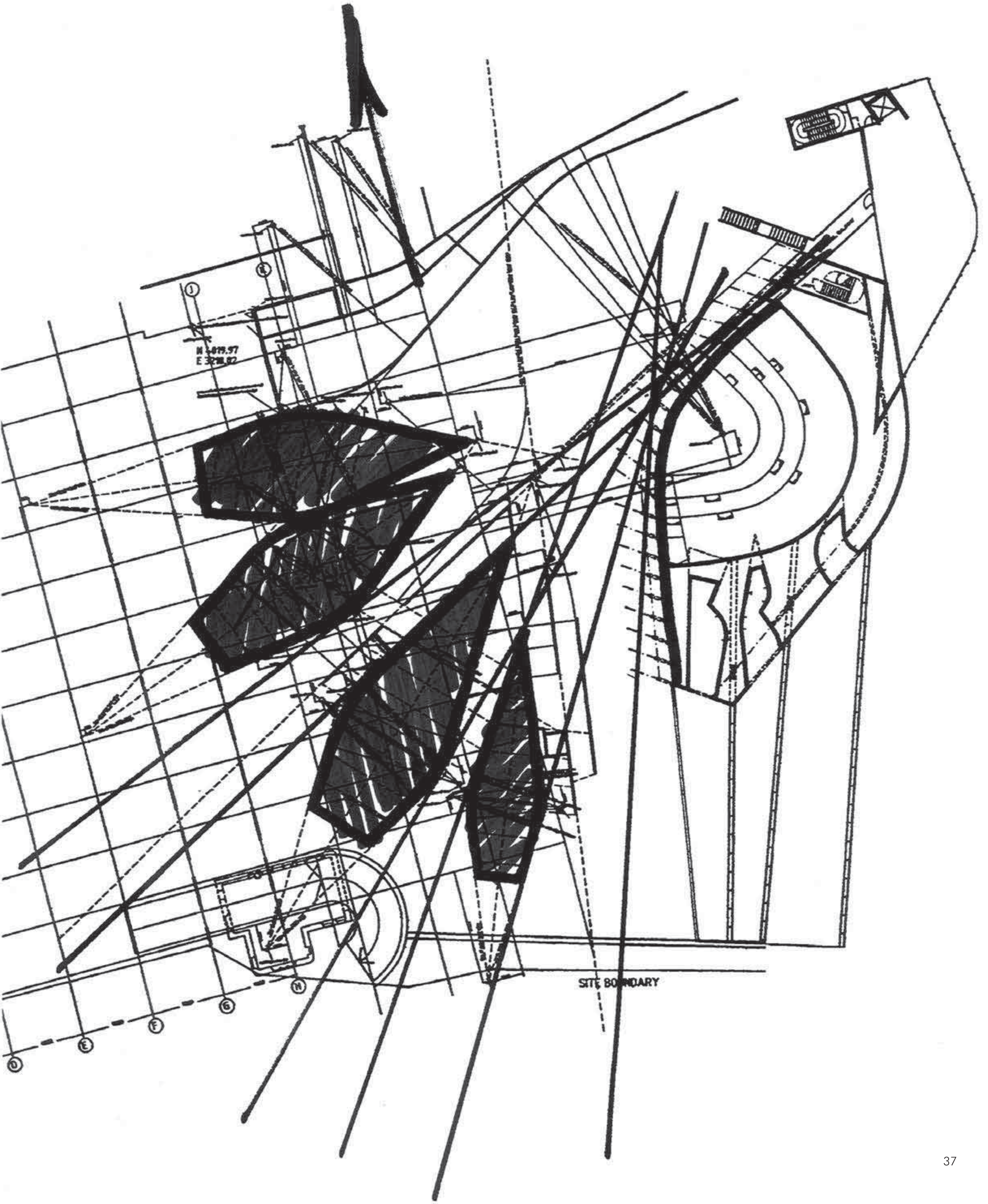


May 2000

The Debating Chamber includes expansive windows and skylights, offering views of the surrounding hills and flooding the interior with daylight. This generous architectural gesture is problematic for television broadcasting, which demands stable lighting conditions. While general daylight is acceptable, direct sunlight is a dynamic, uneven light source impacted by varying skies, shadows from passing clouds, changing color temperature and differing intensity over the course of a day. Conventional sunshades were aesthetically undesirable for controlling light entry.

During master planning, a holistic solution was envisioned: the leaf-shaped assembly buildings could be arranged like an oversized brise-soleil (sun breaker) in plan, shielding the Debating Chamber from direct sunlight. Extensive lighting studies were carried out to determine the optimal orientation of buildings, based on the solar angles (azimuth and altitude) and site orientation of the Chamber. Their final placement as solar shading devices protects the Chamber's interior from harsh patterns of direct sunlight when in use for television broadcasts, while allowing diffuse daylight to enter throughout the year. In this way, a sustainable lighting solution is fundamentally embedded in the site plan of the complex. A commemorative bank note shows the early building configurations in plan, which was later changed to incorporate the daylight design.

Left: Diagrams of early configurations of the Scottish Parliament; commemorative bank note issued in 1999
Below: Assembly buildings (view from above)
Opposite: Early sun angle study



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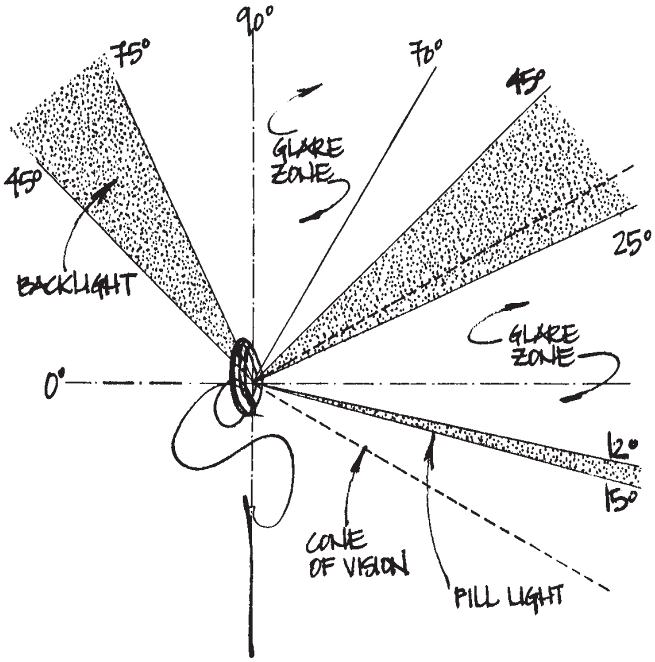
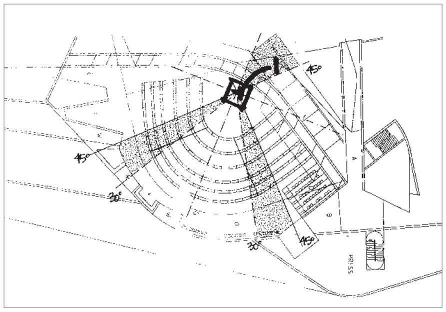
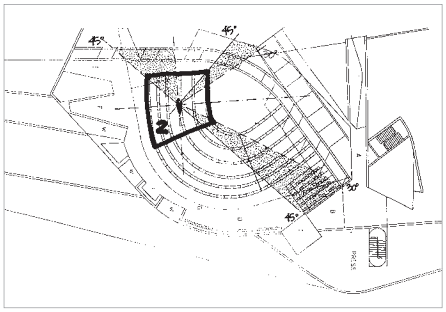
TV Broadcast Lighting

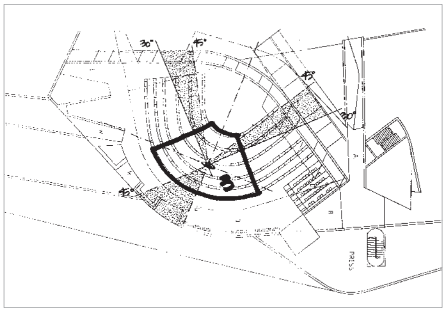
High-quality television broadcasts require precisely calibrated lighting. Light levels, color temperature, aiming angles and distribution must be controlled to produce a technically appropriate picture. Subjects at any location in the room need to be evenly illuminated from a variety of directions. Glare is averted by avoiding light from specific angles. Fill light minimizes shadows, balances the luminance range and limits dramatic contrasts. Backlight must also be present to separate subjects from their backgrounds. Broadcast lighting has to work for speakers including Her Majesty Queen Elizabeth II, who often wears a wide-rimmed hat.

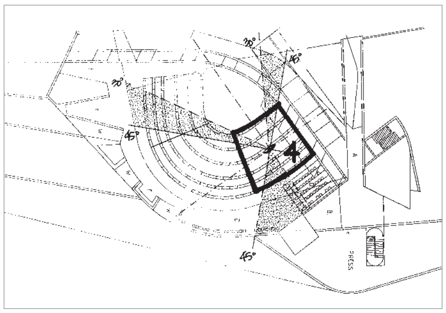
As a strategic approach to lighting calculations, the seating arrangement was analyzed and grouped into different zones with similar orientations. For each area, the aiming angles for ideal broadcast lighting conditions were identified, and luminaire locations determined. Lighting for the individual zones was superimposed into a composite plan. This formed the basis for accurate 2D drawings and a matrix identifying each luminaire's exact tilt angle, mounting height and rotation.

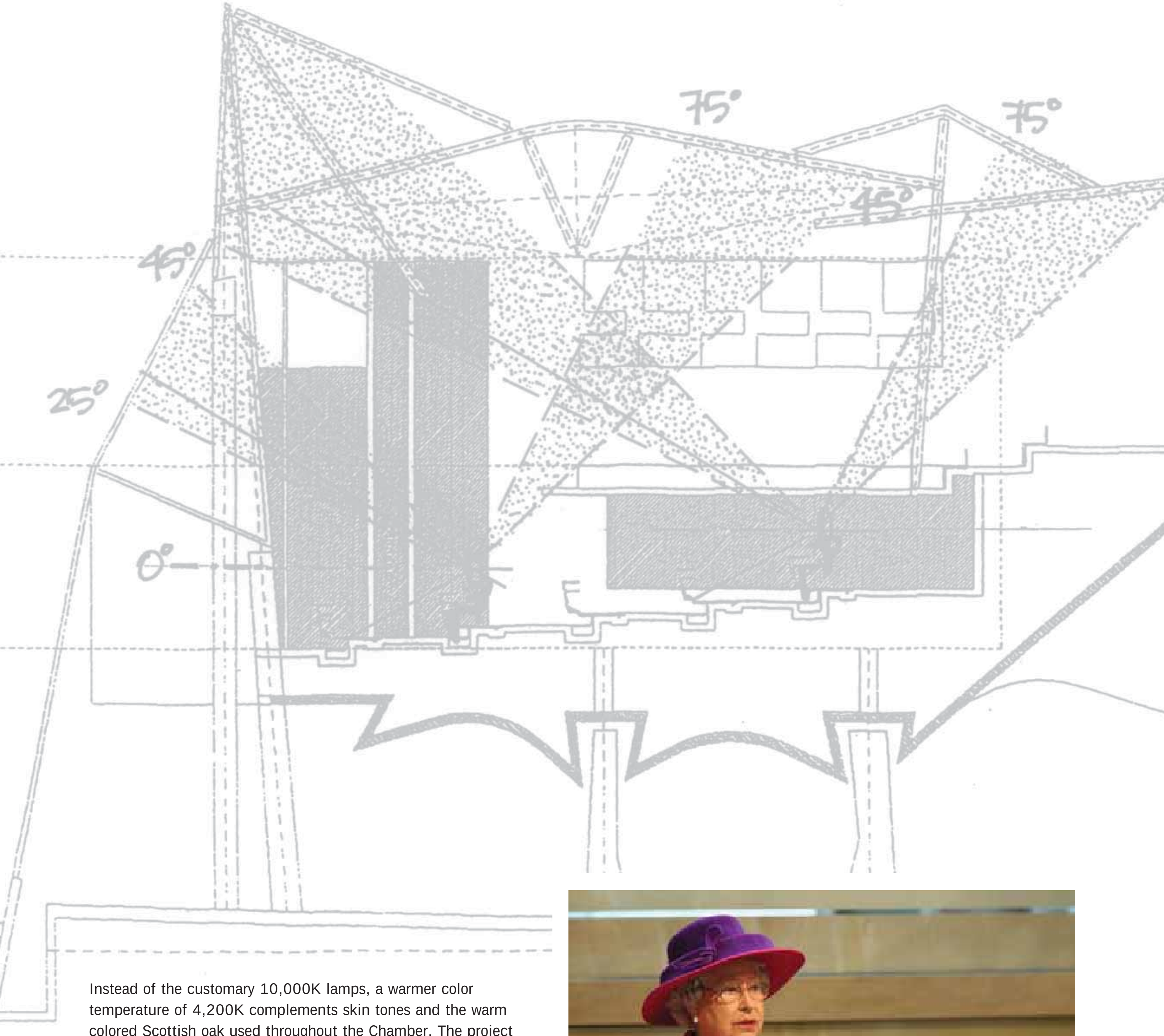












Instead of the customary 10,000K lamps, a warmer color temperature of 4,200K complements skin tones and the warm colored Scottish oak used throughout the Chamber. The project also introduced a new development in metal halide lamp technology at the time—ceramic arc tubes that allow higher and more stable arc tube temperatures, which result in better efficacy, color rendering, color stability and lamp life than their quartz arc tube counterparts. A first of its kind application, ceramic metal halide lamps also mix well with daylight on camera.

Opposite and above: Broadcast aiming angle study diagrams and lighting zone analysis

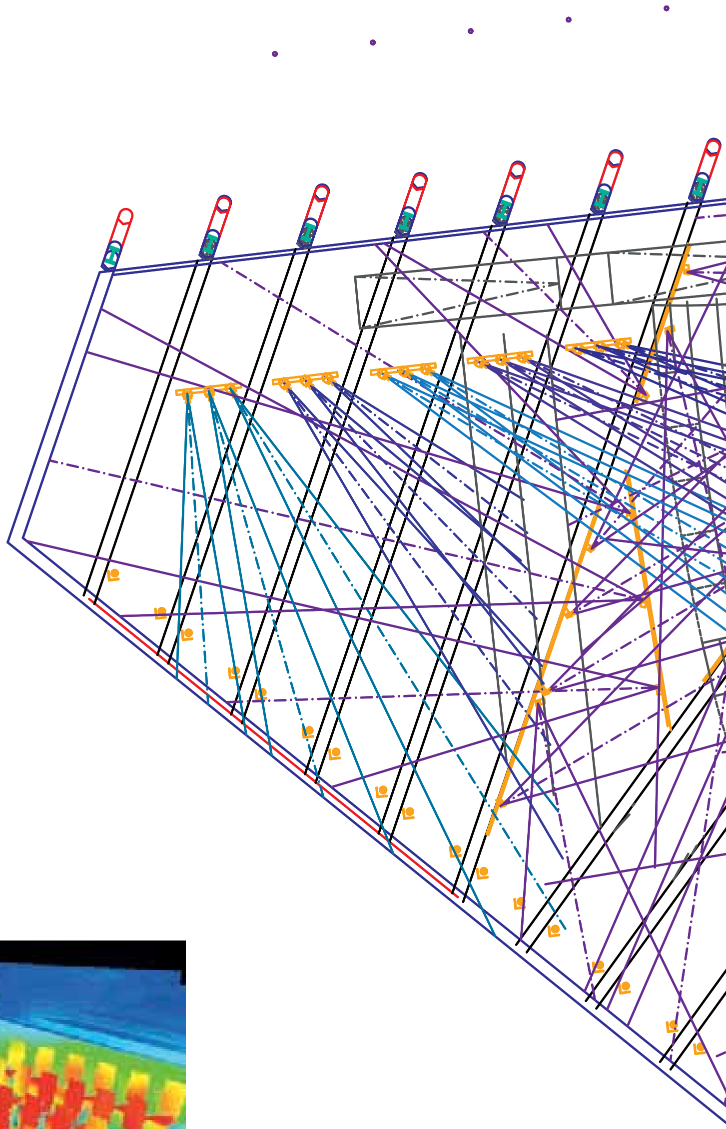
Left: Members of the Scottish Parliament in the Debating Chamber

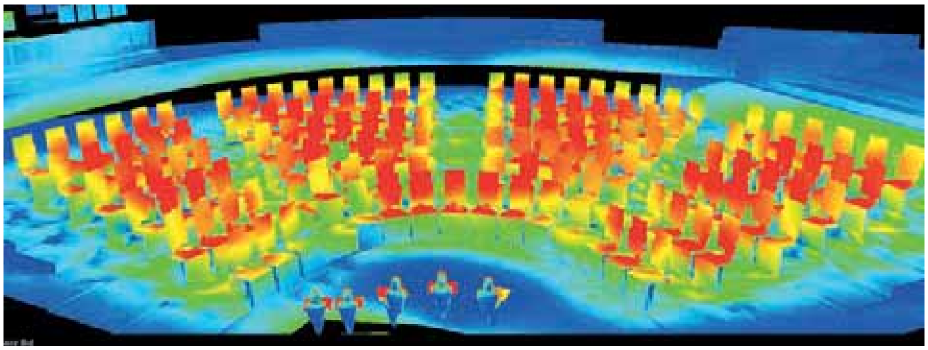
Right: Her Majesty Queen Elizabeth II at the opening ceremony

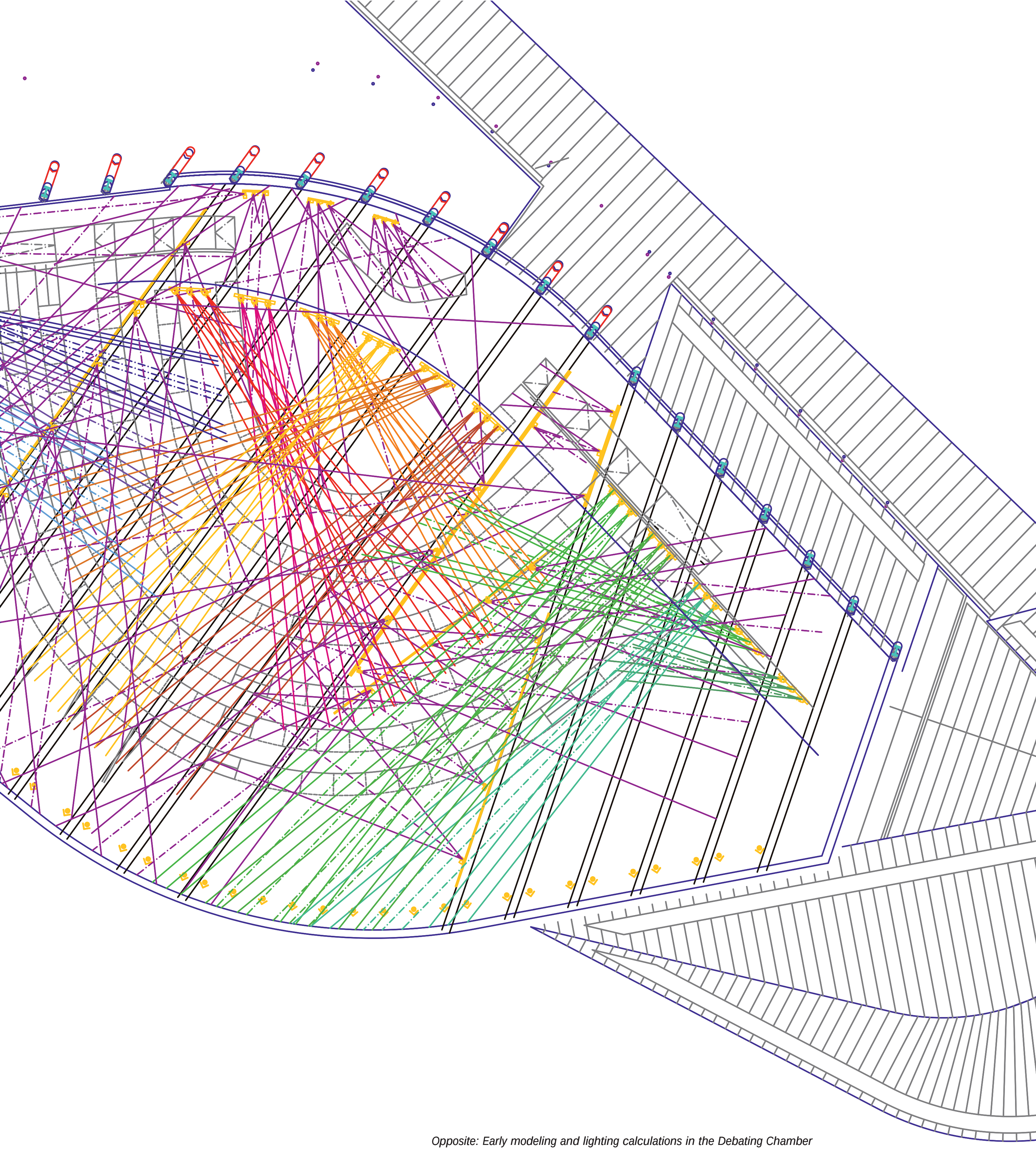
Advanced 3D modeling and photometric calculations allowed luminaries to be precisely situated and aimed to ensure the correct light levels. In collaboration with software developers, a fully integrated, real-time 3D lighting calculation engine was designed for this project. This was particularly pioneering at a time when these software programs were still in early development and typical lighting calculations required long overnight processing times. Light meter tools within the software were used to confirm horizontal and vertical light levels.

Complexity arises from the Debating Chamber's architectural design. While the seating plan is symmetric, the ceiling above is asymmetric. This creates a challenging situation for luminaire placement, particularly when broadcast requirements include symmetrical horizontal and vertical light levels from narrow-range angles. Additionally, the ceiling of the Debating Chamber presented an array of deep, exposed trusses and structural elements that potentially obstruct light beams. These structural members rotate and splay outwards, limiting optimal locations for luminaires.

Ultimately, variable beam projectors were used to accommodate the different throw distances. To produce even illumination on all subjects, longer throw distances required higher lighting intensity and narrower beam distribution, while shorter throw distances required lower lighting intensity and wider beam distribution. Luminaires with precision alignment devices and locking mechanisms were specified, so that once locked in place, aiming and beam-spread are fixed and undisturbed during maintenance.

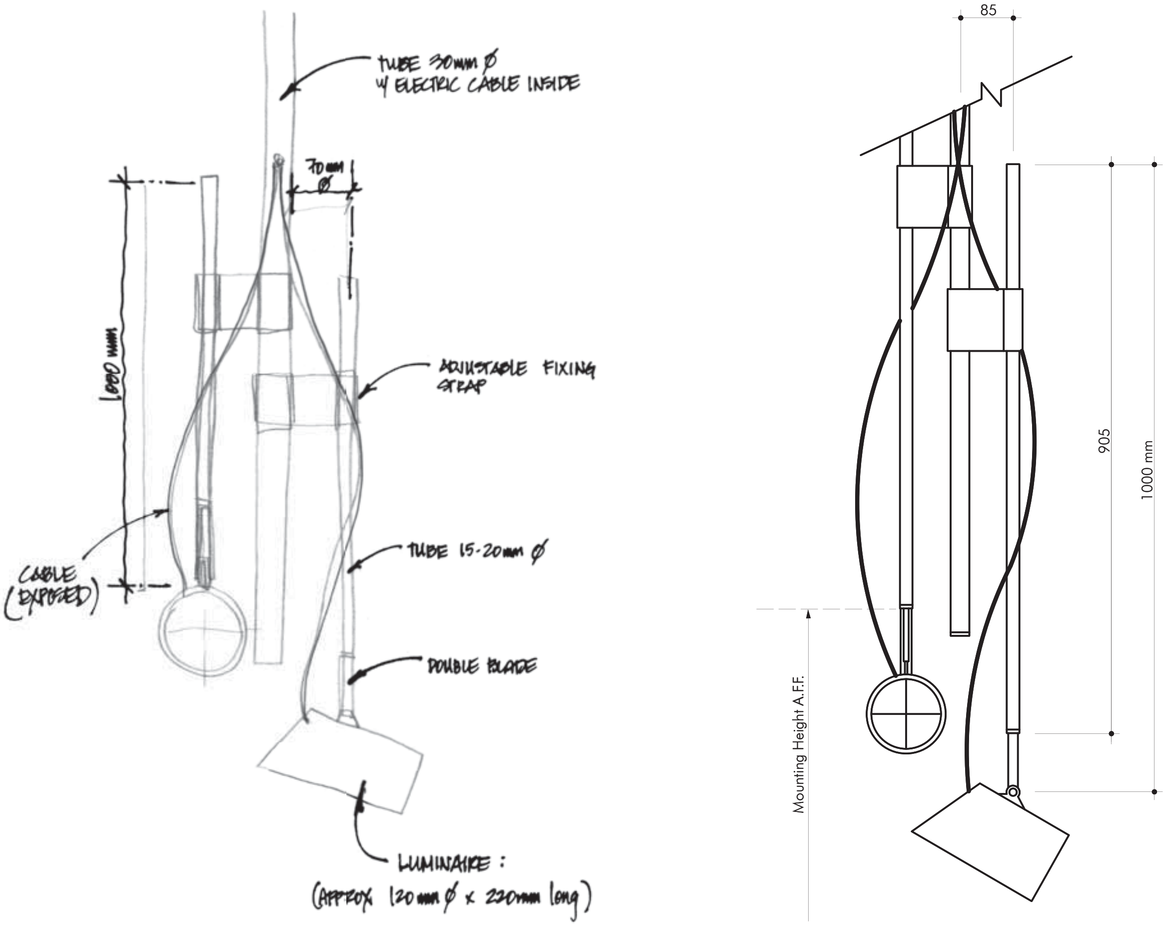






Opposite: Early modeling and lighting calculations in the Debating Chamber
Above: Composite aiming plan for the Debating Chamber

Committee Rooms



The assembly towers contain six different committee rooms, varying in size, geometry and layout. These rooms are geometrically complex with multi-height, compound curved ceilings pierced by skylights and clerestory windows. The lighting design meets the technical broadcast requirements while complementing the rooms' distinct architectural aesthetic.

In order to accommodate the rooms' variations in form while maintaining a consistent lighting language, a hybrid approach was taken. In areas with lower, curved ceilings, linear slots house luminaries mounted on tracks. In areas with high, vaulted ceilings where slots would have appeared distorted, custom pendant lights hang in clusters.

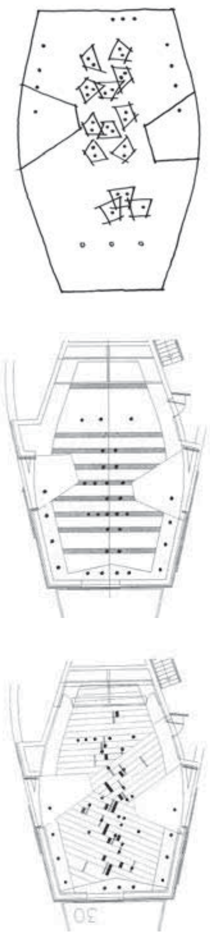
The multi-stem pendant design is inspired by the branch motif used throughout the Parliament. Custom designed as a technical lighting instrument, it boasts of a high level of functionality. Key to the design is a telescoping mechanism, which allows up to four luminaires to be placed at various heights. Adjustable connecting straps offset counterbalancing tubes from the permanently fixed central support stem. This allows each luminaire to be independently positioned, and provides clearance for luminaires to tilt and rotate, while keeping the beams of each luminaire uninterrupted. The assemblies were painted white to harmonize with the ceilings, adding visual texture without creating a bold contrast.

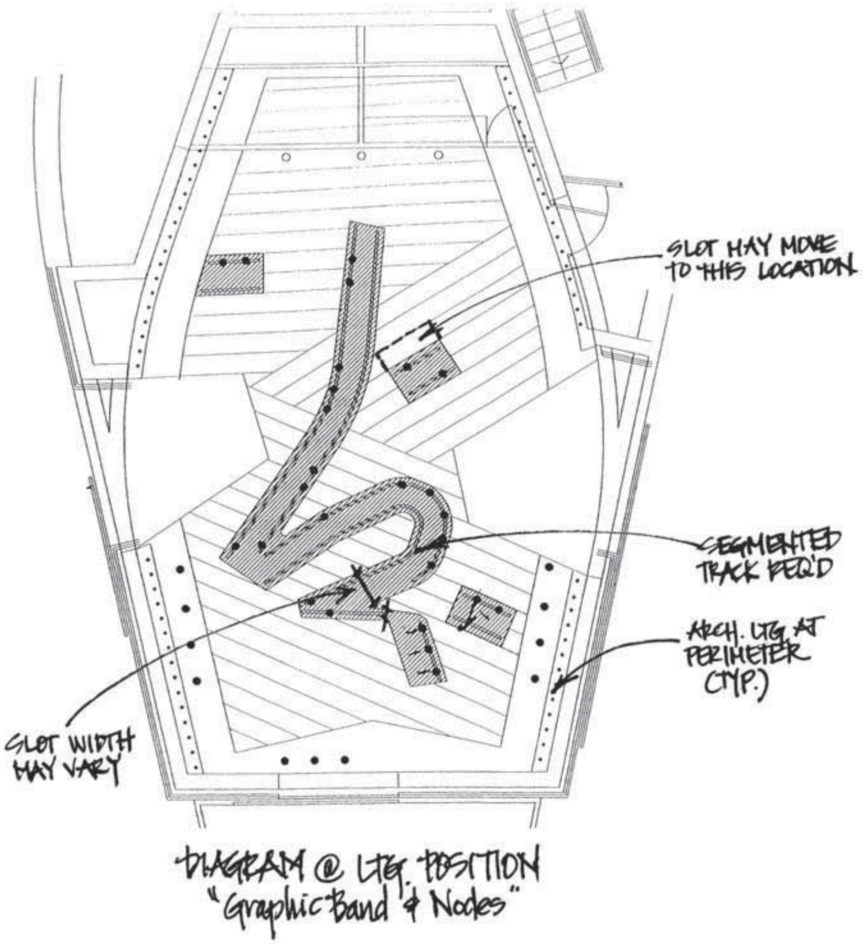
Opposite: Pendants in Committee Room with high, vaulted ceiling
Above: Custom luminaire, early sketch and diagram
Right: Architect's leaf-and-branch concept sketch for the Parliament

Design Evolution

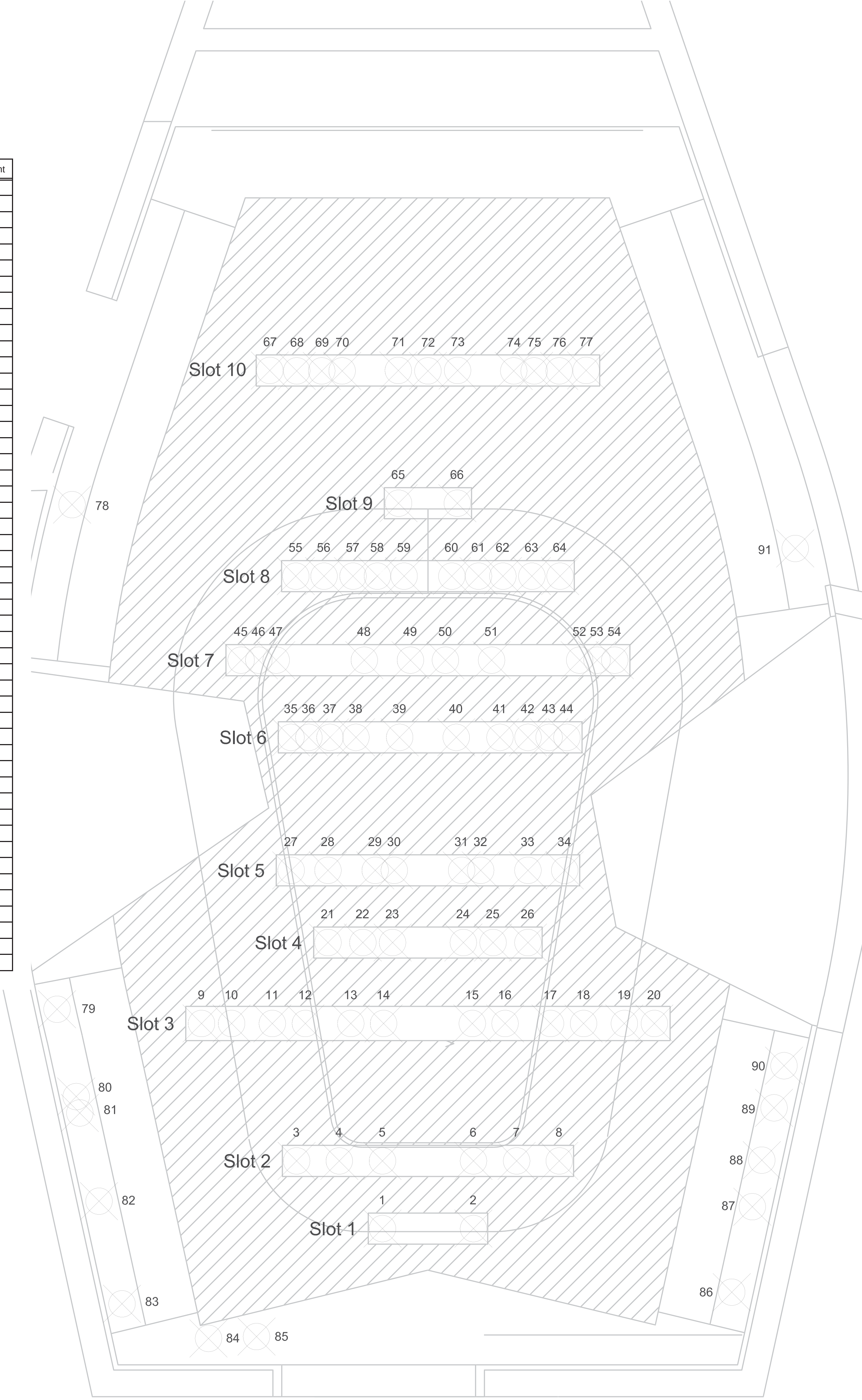
Each committee room hosts meetings which may be broadcasted, and accommodates between 50 to 150 Parliament members and representatives. The design process began by identifying ideal positions for lighting to meet broadcast requirements, based on the ceiling geometries of the rooms. These positions were tested with photometric calculations to verify results. Luminaires were grouped in a variety of configurations, each of which achieved the required light levels and aiming angles, while ceiling patterns were explored to aesthetically integrate these lighting positions. Options included polygonal ceiling panels, crossed grids, and a ribbon-like pattern based on the architect's whimsical ceiling design for the Members of Scottish Parliament office block. Finally, a graphic layout of slots was chosen which provides flexibility and a more subtle lighting approach than a typical TV broadcast gantry system hanging in the space. The final slot locations, along with corresponding luminaire mounting heights and lamp beam spreads, were documented and coordinated with the architect. This lighting language was used throughout the six different committee rooms, lending consistent lighting design logic to these highly technical spaces.

Below: Exploratory ceiling studies for lighting; early architectural ceiling models
Opposite: Lighting layout for one Committee Room





Location	ID	Lamp Type	Mounting Height
Slot. 01	01	50w. 24°	3385.0
Slot. 01	02	50w. 24°	3385.0
Slot. 02	03	50w. 10°	3100.0
Slot. 02	04	50w. 24°	3370.0
Slot. 02	05	50w. 24°	3515.0
Slot. 02	06	50w. 24°	3515.0
Slot. 02	07	50w. 24°	3365.0
Slot. 02	08	50w. 10°	3100.0
Slot. 03	09	50w. 24°	2680.0
Slot. 03	10	50w. 24°	2895.0
Slot. 03	11	50w. 24°	3145.0
Slot. 03	12	50w. 24°	3345.0
Slot. 03	13	50w. 24°	3515.0
Slot. 03	14	50w. 24°	3655.0
Slot. 03	15	50w. 24°	3655.0
Slot. 03	16	50w. 10°	3515.0
Slot. 03	17	50w. 10°	3345.0
Slot. 03	18	50w. 10°	3145.0
Slot. 03	19	50w. 10°	2895.0
Slot. 03	20	50w. 10°	2680.0
Slot. 04	21	50w. 10°	3295.0
Slot. 04	22	50w. 24°	3590.0
Slot. 04	23	50w. 24°	3660.0
Slot. 04	24	50w. 24°	3660.0
Slot. 04	25	50w. 24°	3590.0
Slot. 04	26	50w. 10°	3295.0
Slot. 05	27	50w. 10°	3290.0
Slot. 05	28	50w. 10°	3340.0
Slot. 05	29	50w. 10°	3620.0
Slot. 05	30	50w. 24°	3660.0
Slot. 05	31	50w. 24°	3660.0
Slot. 05	32	50w. 10°	3620.0
Slot. 05	33	50w. 10°	3340.0
Slot. 05	34	50w. 10°	3290.0
Slot. 06	35	50w. 24°	3385.0
Slot. 06	36	50w. 24°	3435.0
Slot. 06	37	50w. 24°	3575.0
Slot. 06	38	50w. 24°	3590.0
Slot. 06	39	50w. 10°	3660.0
Slot. 06	40	50w. 10°	3660.0
Slot. 06	41	50w. 24°	3590.0
Slot. 06	42	50w. 24°	3575.0
Slot. 06	43	50w. 24°	3435.0
Slot. 06	44	50w. 24°	3385.0




F-20
(TYP.)
F-20
(TYP.)
F-20
(TYP.)
TYPE S-18
TYPE S-2
(TYPICAL)
SEE NOTE 5
TYPE S-25
SEE NOTE 2
TYPE
F-7
S-3
TYPE
S-22
TYPE F-14
SEE NOTE 10
TYPE S-10
S-18
S-3 (SEE NOTE 1)
TYPE S-25
SEE NOTE 2
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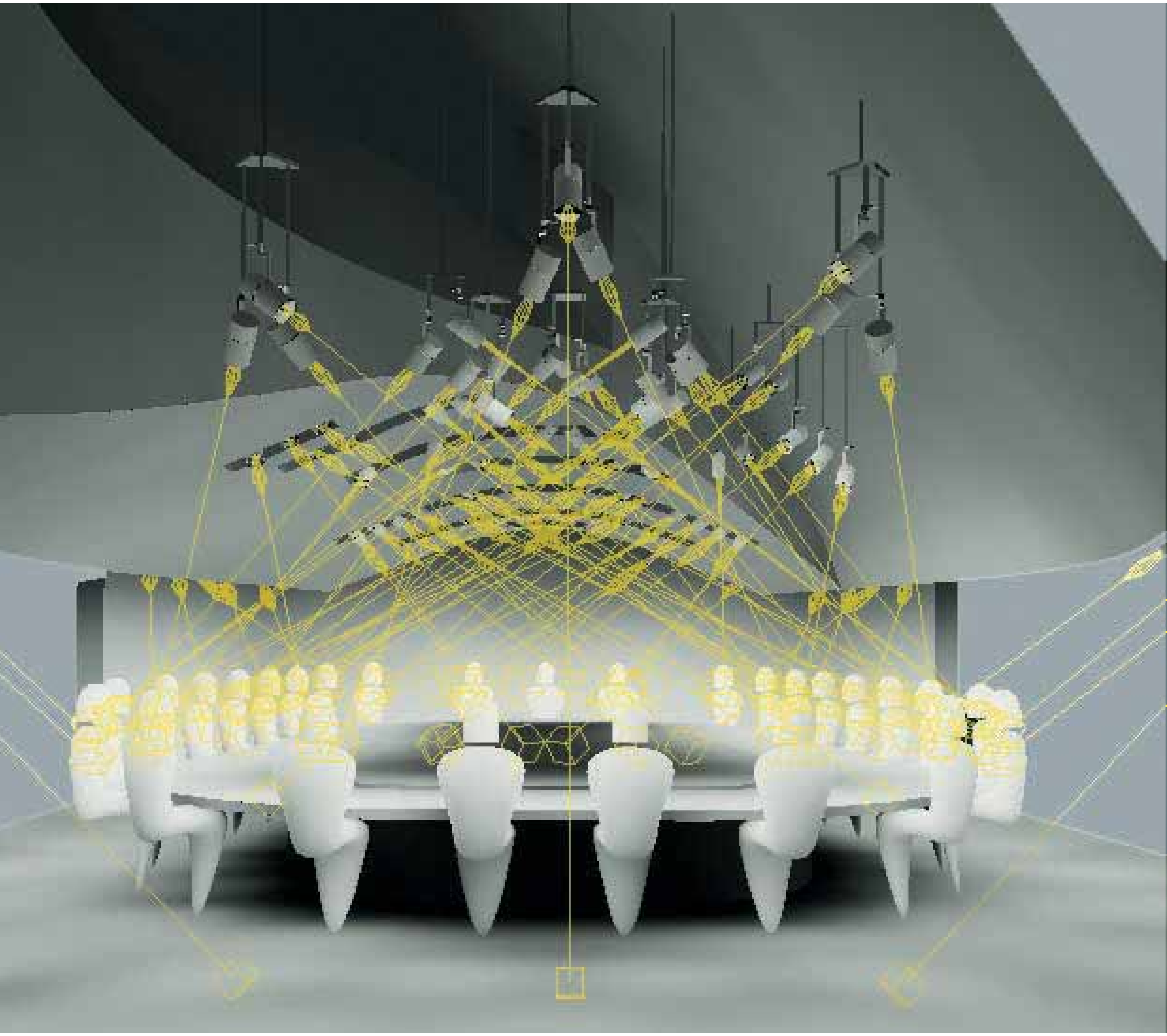
F-7
S-18
TYPE
S-19
SEE
NOTE 7
T-34
TYPE
S-19
SEE
NOTE 7
S-10
(TYP.)
TYPE S-2
(TYPICAL)
SEE NOTE 5
TYPE F-14
SEE NOTE 10
TYPE
S-22
S-18

The spacing and variable lengths of the slots were determined in coordination with specific requirements for TV broadcast lighting. Within each slot, luminaires mounted on tracks closely follow the ceiling contours. The lighting slots and luminaires are aesthetically integrated with the ceiling, while simultaneously providing a high degree of functionality, locking mechanisms and variable stem lengths.

Another critical aspect of the design is providing visual comfort by minimizing glare. To achieve this, custom luminaires were designed with special lensing and integral cross baffles.

Opposite: Reflected ceiling plans for Committee Rooms
Below: Ceiling slots under construction and completed

As with the Debating Chamber, extensive computer modeling was used to configure lighting for each of the committee rooms. To compensate for the different distances of luminaires from the subjects' faces and work surfaces due to the complex geometry of these rooms, a variable beam width fixture was specified, and dense clusters of luminaires used at strategic locations to achieve optimal broadcast lighting conditions.



Small scale luminaires complement the architectural scale of the committee rooms, with the use of MR16 halogen lamps instead of metal halide sources. At the time, these light sources were available only in a standard 2,800K. During the course of the design, new technology emerged with a “cool color” 4,000K MR16 lamp, making them suitable for TV broadcast use. The color temperature produced by these lamps matched the metal halides in the Debating Chamber, leading to a consistent camera-calibrated appearance across all TV broadcast areas.

Lois and Richard Rosenthal Center for Contemporary Art

Cincinnati, Ohio / USA

Architects: Zaha Hadid with KZF Design

1997-2003

Located on a prominent corner in downtown Cincinnati, the Lois and Richard Rosenthal Center for Contemporary Art houses an ever-changing cycle of exhibitions devoted to progressive artists. The building assembles gallery spaces, performance venues, administrative offices, and a children's education center in a jigsaw puzzle of volumes. Tailored lighting solutions employing contrast, perspective, and silhouette enhance the Center's architectural drama and energy.

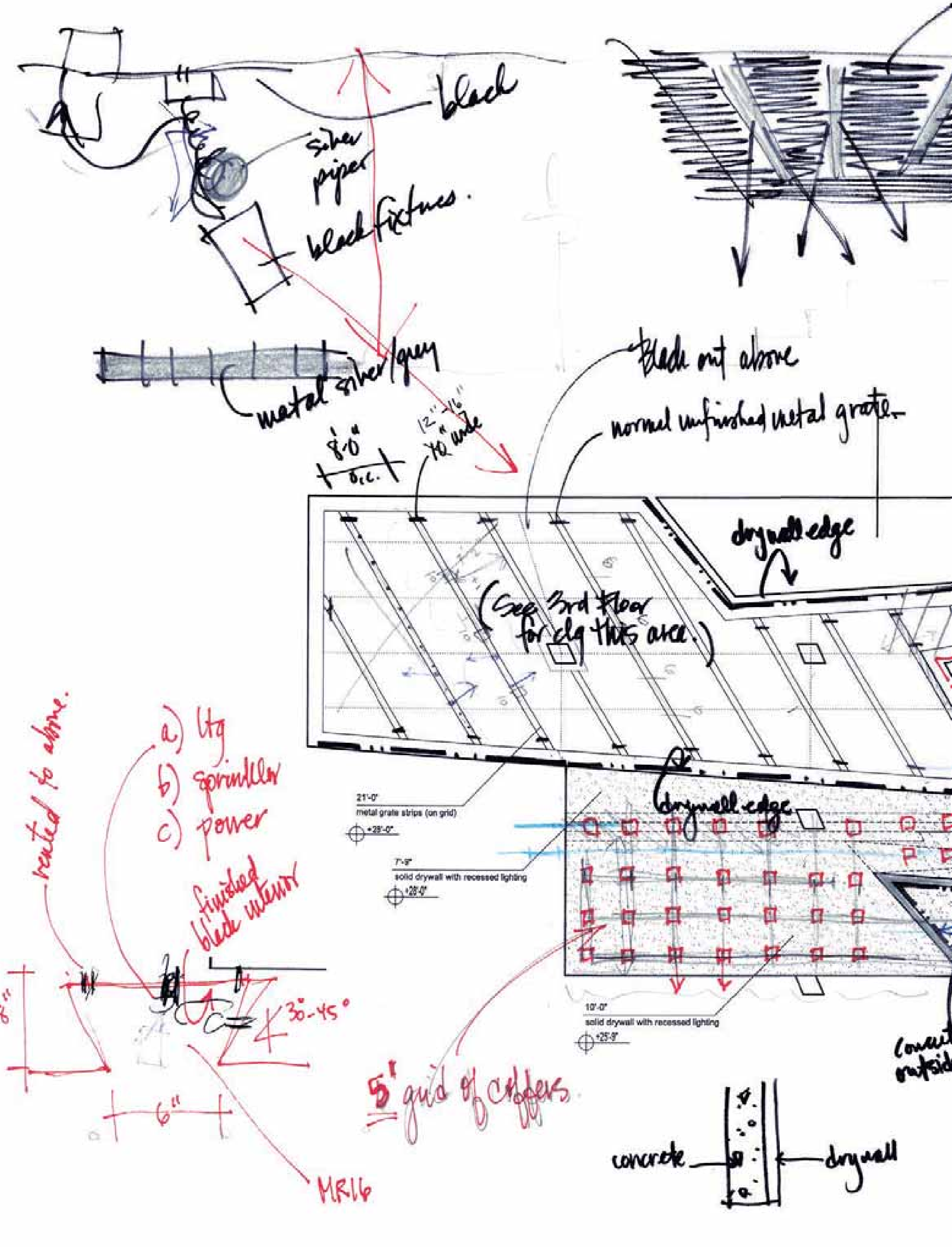
Instead of traditional floodlights, linear luminaires concealed in the exterior parapets outline the building's stacked volumes. Office ceilings are critical to the nighttime identity of the project due to the fact that they add spatial depth and become an integral part of the façade. Visible from the outside, luminous bands are arrayed in an accelerated pattern in the open-plan spaces. This creates an exaggerated perspective effect that subtly reinforces the architecture's sense of movement.

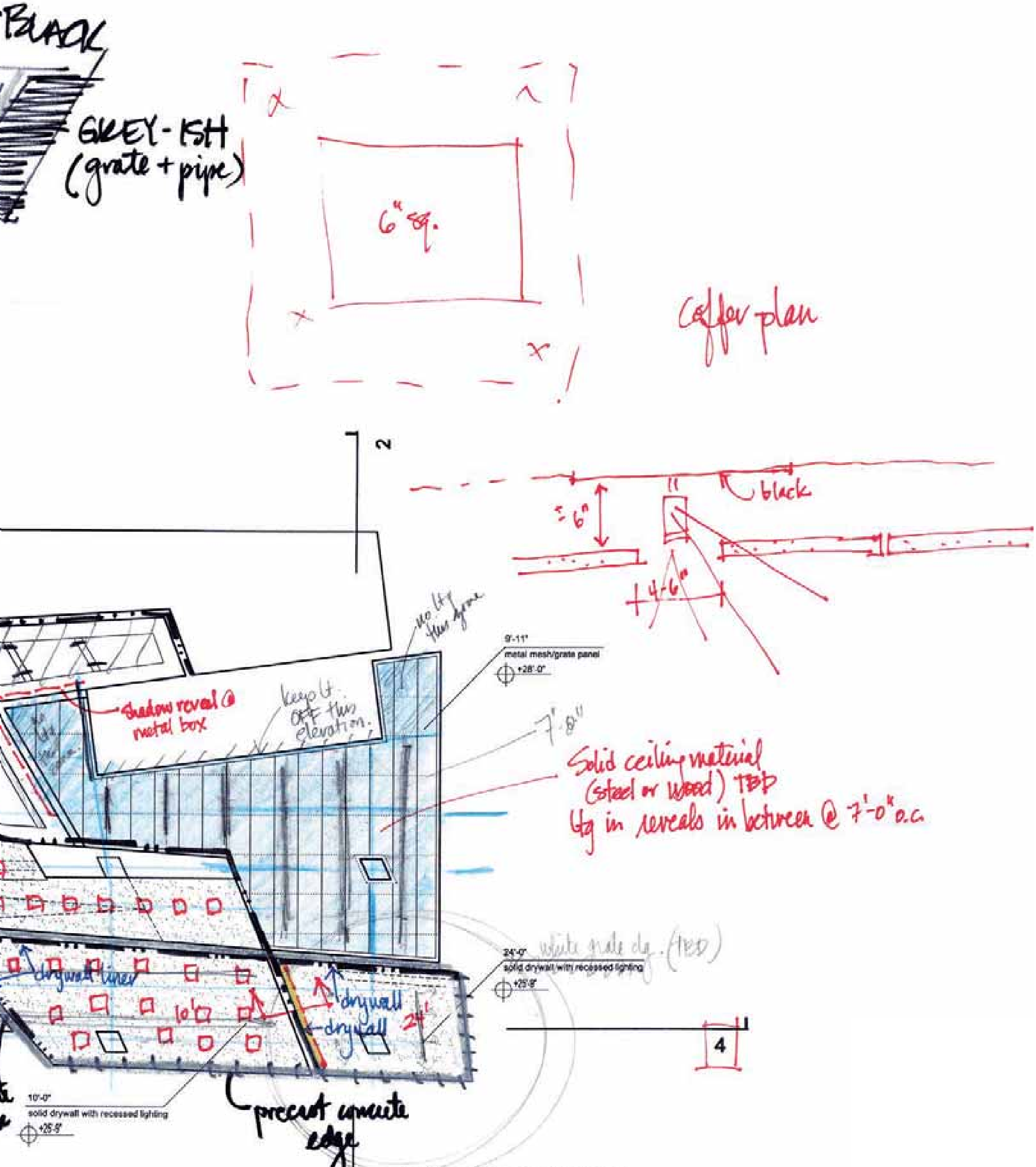
Enticing visitors to enter, the sidewalk paving continues through the lobby and curves up the back wall of the space. A suspended feature stair at the rear is silhouetted, adding to its dramatic presence. Reinforcing the spatial continuity between inside and out, luminous slots in the flooring radiate from the lobby, extending out into the sidewalk.

A key challenge was developing a flexible lighting strategy for the Center's highly varied gallery spaces, which form a three-dimensional interlocking matrix of solids and voids at the heart of the building. Each gallery is completely unique in geometry and scale, with heights ranging from 2.3 m (7'-6") to 7.6 m (25') and there are no identical floor or ceiling plans.

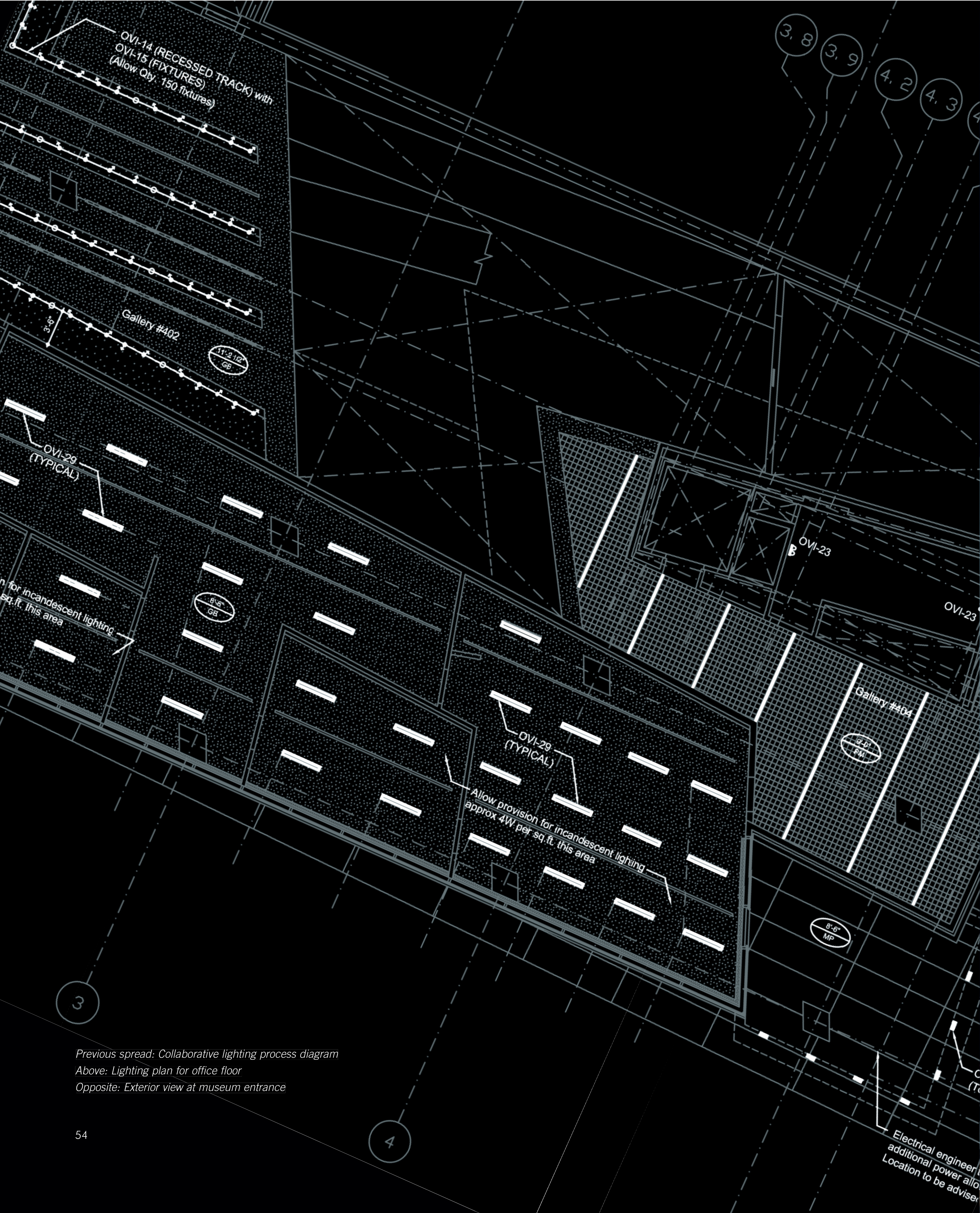
To accommodate this diversity, track-mounted lights are recessed into ceiling channels in lower galleries and concealed above metal mesh panels in the tallest spaces. The same family of user-friendly luminaries is specified throughout. All the luminaires have identical mounting and handling so that they can be simply exchanged from gallery to gallery as needed.

Opposite: Lights concealed in parapets outline the museum's stacked volumes.


black
silver pipes
black fixtures.
metal silver/grey
8'-0" o.c.
12"-16" wide
Blade cut above
normal unfinished metal grate
drywall edge
(See 3rd floor for clg this area.)
drywall edge
21'-0"
metal grate strips (on grid)
+28'-0"
7'-9"
solid drywall with recessed lighting
+28'-0"
10'-0"
solid drywall with recessed lighting
+25'-9"
vented to above.
a) ltg
b) sprinkler
c) power
finished blade interior
6-8"
6"
30°-45°
5' grid of coffers.
MR16
concrete
drywall



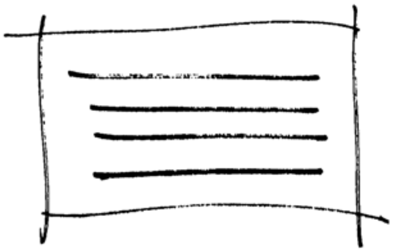
REFLECTED CEILING PLAN
2ND FLOOR
SCALE 1/16" = 1'
21-05-00



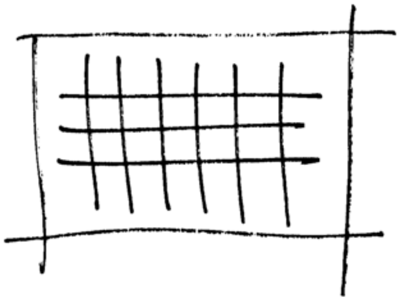
Previous spread: Collaborative lighting process diagram
Above: Lighting plan for office floor
Opposite: Exterior view at museum entrance


ROSENTHAL CENTER FOR CONTEMPORARY ART

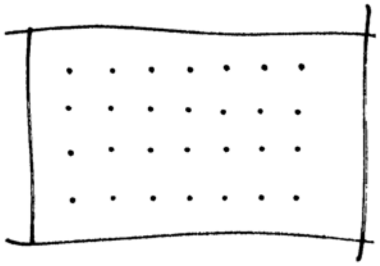
Technology Transfer



Lines



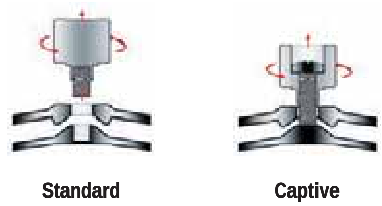
Grid



Points

Flexible lighting is a primary requirement for the Rosenthal Center, since the institution specializes in hosting temporary exhibits. Thus, the spaces and lighting must be capable of accommodating contemporary art of highly varied sizes, characters, and configurations. In preliminary studies, different lighting strategies of grids, points, and lines for achieving this flexibility were proposed. In each case, the key was achieving adequate lighting coverage.

Combining these strategies, recessed linear channels dominate the ceiling, a gesture that echoes the architecture, while point source track luminaires provide flexible lighting for specific artworks.

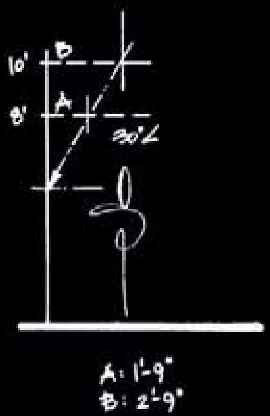


Lighting solutions for the Center are geared towards simplicity, enabling staff to set up and maintain galleries with ease. The track luminaires are intuitive to focus and aim, and although of two different sizes, are identical in product handling and use of interchangeable screw-based lamps. After extensive research, OVI envisioned a technology transfer from Boeing aircraft and introduced captive screws to the track luminaires. This ensures that adjustable hardware does not fall out when maintaining luminaires in high-ceilinged galleries.

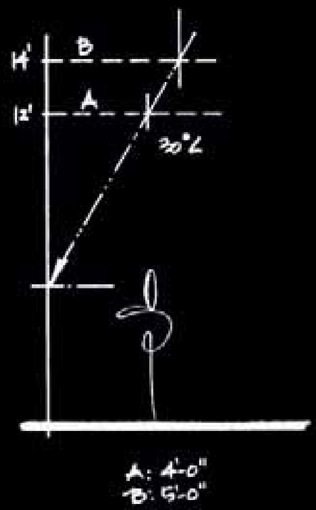
Instead of the standard cylindrical lights often found in museum settings, refined industrial-style luminaires are chosen to complement the building's aesthetic. These luminaires are expressed as technical tools in keeping with the architectural design.

Opposite: Ceiling channels for track lights reinforce a sense of linearity in a low gallery
Above: Diagram of captive screws
Left: View through galleries with multiple ceiling heights

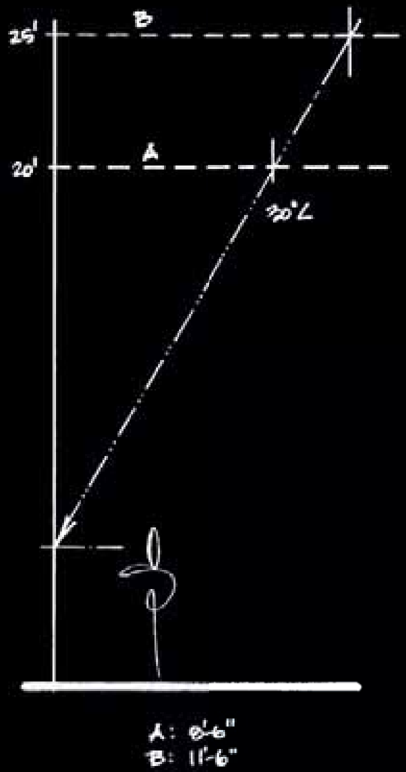
A Modern Classic



Low ceilings



Mid-height ceilings



High ceilings

The luminaires in each gallery are configured to perform a range of functions: from providing wall illumination for paintings and works on paper, to spotlighting sculptures distributed on the floor. With each different gallery height, the spacing of luminaires is carefully calculated to ensure adequate light coverage. Classic museum illumination angles dictate positions, but the lighting is integrated in a more modern way.

Lighting and ceiling materials are synchronized with the architecture to generate a coordinated appearance in the various galleries. As the galleries increase in height, ceiling materials become rougher and more industrial in appearance, reinforcing the sense of scale. In the highest spaces, a large-scale metal grate, normally used for sidewalks, is paired with bigger luminaires. In lower spaces, solid ceilings provide a clean look suited to intimate spatial proportions. Recessed tracks follow the main lines of these rooms and house smaller luminaires discretely detailed at the ceiling.

Above and right: Lighting scale and material diagrams
Opposite: High ceiling gallery

A continuation of the sidewalk, what the architect dubs an "urban carpet" extends from the exterior to interior and curves up the back wall, creating a backdrop for a dramatic suspended staircase. In order to emphasize this key feature, an inverse lighting solution was chosen—silhouette. Luminaires are integrated into the staircase's handrail and concealed in its oblique side, facing the curved wall. These luminaires create a halo of light that subtly enhances the staircase's dark silhouette as it zigzags up to the galleries. The effect is emphasized by the black color of the stairs, which sharply contrast with the surrounding space.

In the main lobby, ceiling lights are of two types. On the east-west axis, fluorescent coves echo the linear architecture and enhance the perspective of the space. On the north-south axis, multi-lamp point source luminaires generate ambient and event lighting as needed.

Opposite: "Urban Carpet" and feature stair
Right: Silhouetted stair, view from below

Bergisel Ski Jump

Innsbruck / Austria
Architects: Zaha Hadid
1999-2002

The Bergisel Ski Jump is part of an Olympic arena refurbishment for the Austrian city. An international sensation at the time, the architectural design of the structure is a hybrid between a tower and a bridge. Combining a highly specialized sports facility, café, public viewing terrace, and access elevators into a single sculptural element, it extends the topography of the slope towards the sky.

Dramatic lighting makes the 50 m (164') high structure stand out against the backdrop of the Alps at night. A glow of colored light radiates from the jumper's starting point and accelerates down the ramp, hinting at the structure's sports function. Seen from downtown Innsbruck, windows surround the top of the structure and form a luminous slice. Silhouettes of activity in the top-floor restaurant and viewing gallery are revealed within.

During evening ski events, a specialized set of lights is activated. Multi-lamp luminaires line the sides of the ramp, providing optimal lighting conditions with minimal glare. This allows athletes to evaluate minute variations in the snow surface to perform at top speeds.

In collaboration with the architects, finishes were selected to enhance the natural lighting of the ski jump. The structure is clad in brushed finish metal panels which catch daylight and provide a smooth gradation of light and shadow to sculpt the form. This was chosen over a mirror-polished finish, which would have produced flashes of reflected glare.

Opposite: The iconic gestural sweep of the ski jump is brilliantly illuminated, making the structure visible at night from surrounding areas.

Opposite: Ski jump nestled by the Alps
Clockwise from above: View of downtown Innsbruck; jumper; light massing diagram

Experimental Media and Performing Arts Center (EMPAC)
at Rensselaer Polytechnic Institute

Troy, New York / USA
Architects: GRIMSHAW with Davis Brody Bond
2001-2008

Positioned on a bluff overlooking the Hudson River, the Experimental Media and Performing Arts Center (EMPAC) builds on Rensselaer Polytechnic Institute's heritage of technological leadership. Rensselaer's research groups include the Lighting Research Center, a nexus of independent expertise on the latest LED lighting research. Inspired by the institute's spirit of innovation, the new facility is illuminated with state-of-the-art technology.

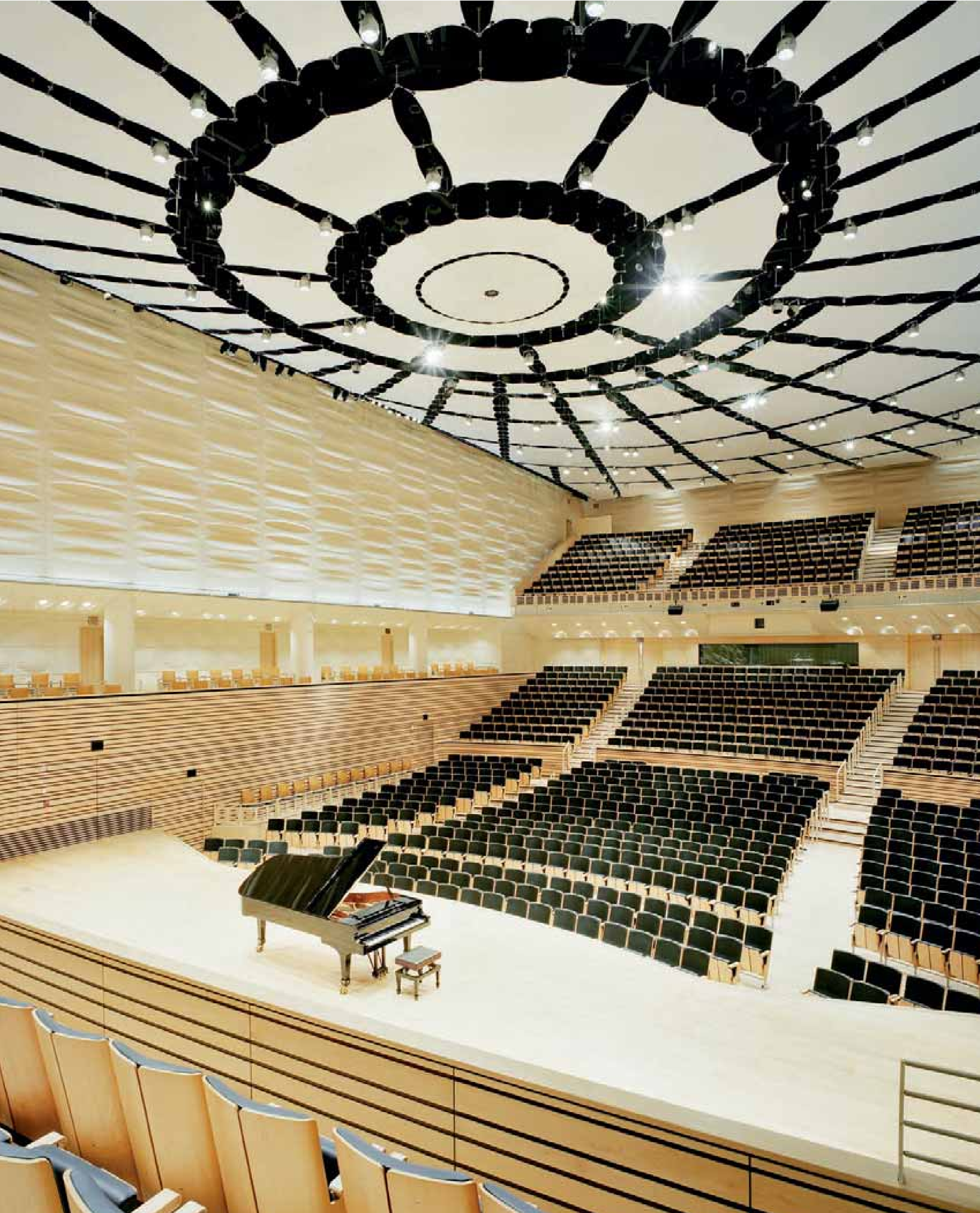
Providing world-class, specialized facilities for artistic production, performance, and research, EMPAC comprises a vast number of different spaces, from a formal concert hall and a theater to informal experimental studios. As well, it includes a complete spectrum of rehearsal spaces, professional production and post-production facilities. Serving the campus, regional and international arts communities, EMPAC's rich combination of professional facilities is nowhere else found under a single roof.

The lighting design simultaneously corresponds to and provides a cohesive visual structure for EMPAC's diverse range of formal and informal spaces. Lighting solutions accomplish a multiplicity of tasks, fulfilling precise technical and aesthetic criteria, while fully coordinating with stringent acoustic requirements and integrating with the distinctive architecture. Innovative lighting strategies include the use of long-life solid-state technology to illuminate the concert hall. These unprecedented solutions involved extensive research and development in close collaboration with the industry.

The core of the Center is the main concert hall, designed for a wide range of performances from traditional to contemporary. Inside, luminaires providing ambient illumination are skillfully integrated within a geometrically complex fabric ceiling. Lighting showcases the architecture, with textured wall panels lit by nearly invisible lines of light and small profile ceiling downlights precisely integrated within the curved, scalloped balcony ceilings. The design is an inventive twist to the conventional approach of deploying decorative chandeliers or sconces as eye-catchers.

At night, the exterior wooden hull of the concert hall glows behind an elegant glass façade, accentuating the highly sculptural volume and creating an iconic nighttime appearance.

Opposite: Lighting enhances sculpted wall panels and radiates from a fabric ceiling in the formal concert hall.



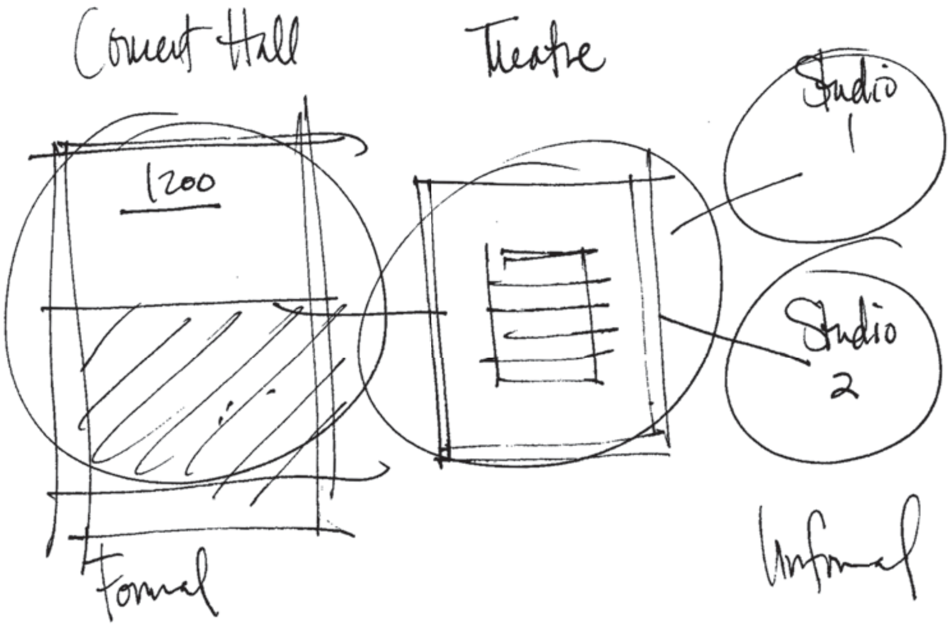
Multiple Venues, One Lighting Language

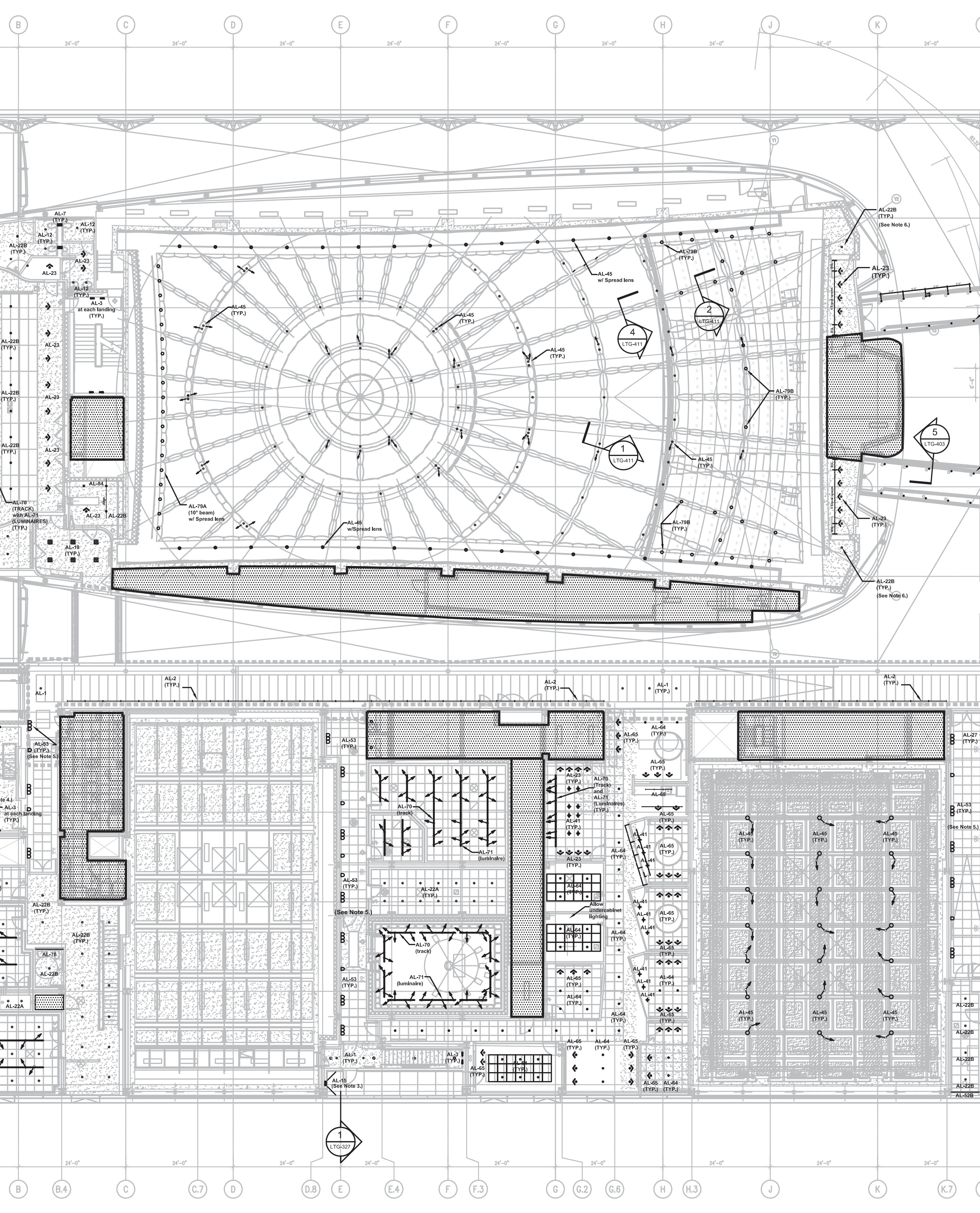
EMPAC's 20,440 m^2 (220,000 ft^2) facility comprises venues which include: a 1,200-seat formal concert hall, a 400-seat theater, and two flexible-use studios for performance art and workshops. In addition, the facility's extensive support spaces include rehearsal studios, professional audio-video recording and post-production facilities, offices, meeting rooms, green rooms, VIP lounge and a digital broadcasting center. A unified lighting vocabulary provides architectural cohesion to this vast diversity of spaces. A hierarchy of tailored lighting solutions distinguishes between formal and informal functions, fulfills precise technical criteria, and complements the unique aesthetic of each room.

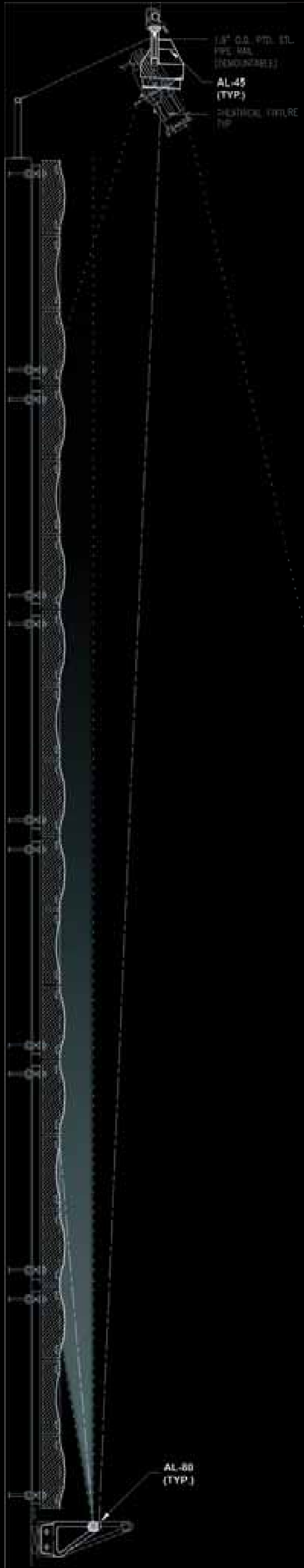
In the main concert hall, luminaires are carefully concealed within architectural detailing, forming nearly invisible lines of light that accent sculpted acoustic wall panels. Within the stretched-fabric ceiling, semi-concealed luminaires provide ambient illumination. In the theater, a more informal approach is taken, with exposed industrial luminaires mounted to catwalks. Flexibility characterizes the experimental studio spaces, where architectural luminaires reside alongside theatrical luminaires, attached to pipes above an accessible ceiling. Luminaires are skillfully deployed as technical extensions of the architectural language in each case.

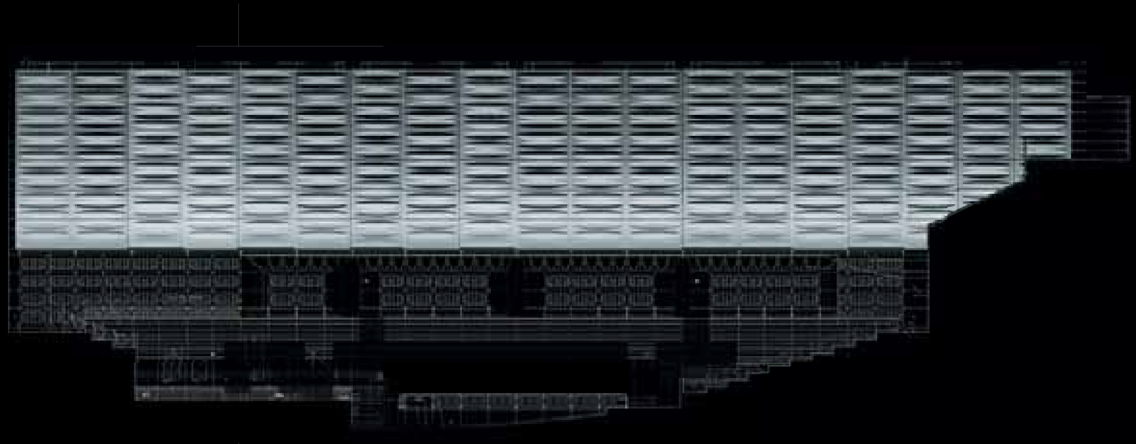
A carefully selected family of luminaires with a coordinated silver-grey finish is used throughout the facility to complement the refined industrial aesthetic of the architecture.

Below: Lighting concept diagram; main concert hall; theater; studio
Opposite: Lighting plan




B
C
D
E
F
G
H
J
K
24'-0"
AL-7 (TYP.)
AL-12 (TYP.)
AL-22B (TYP.)
AL-23
AL-3 at each landing (TYP.)
AL-45 (TYP.)
AL-45 w/ Spread lens
AL-79B (TYP.)
AL-22B (TYP.) (See Note 6.)
AL-23 (TYP.)
2 LTG-411
4 LTG-411
1 LTG-411
5 LTG-403
AL-84
AL-70 (TRACK) with AL-71 (LUMINAIRES) (TYP.)
AL-18 (TYP.)
AL-79A (10" beam) w/ Spread lens
AL-45 w/Spread lens
AL-2 (TYP.)
AL-1 (TYP.)
AL-1
AL-53 (TYP.) (See Note 5.)
AL-53 (TYP.)
AL-64 (TYP.)
AL-65 (TYP.)
AL-70 (Track) and AL-71 (Luminaires) (TYP.)
AL-70 (track)
AL-71 (luminaire)
AL-22A (TYP.)
(See Note 5.)
AL-41 (TYP.)
AL-68
AL-41
Allow undercabinet lighting
AL-27 (TYP.)
AL-78
AL-22A
AL-15 (See Note 3.)
AL-52B
1 LTG-327
B.4
C.7
D.8
E.4
F.3
G.2
G.6
H.3
K.7

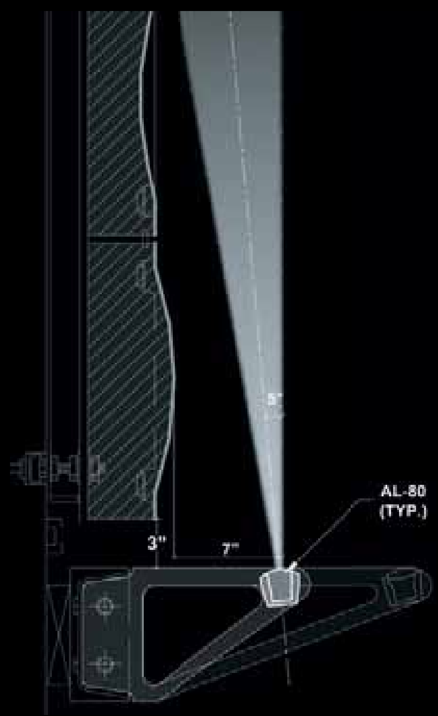




Designed as a first-class venue for orchestras and video performers alike, the 1,200-seat concert hall is the showpiece of the Center. Lighting aligned with architectural detailing provides ambient illumination.

Along the walls, elegant, cast panels with scalloped profiles encourage acoustic diffusion. Linear LED luminaires at the base of these panels produce a smooth gradient of illumination that articulates the rhythmic texture of the walls and feathers towards the top. Illumination from narrow beam floodlights concealed in the ceiling above are used to create a variety of effects in the space. Luminaire lengths are precisely coordinated to lock seamlessly in position and align with the architectural modulation of each wall panel. Nearly invisible, the unobtrusive 50 mm (2") luminaire housing profiles blend with the architecture so effectively that empty housing profiles were obtained from the luminaire manufacturer and installed parallel to the lighting, and used to conceal acoustic equipment. Drivers are remotely located in order to maintain the high performance acoustics needed for the concert hall. The result is a fully coordinated and integrated scheme.

EMPAC represents a pioneering installation of LED light sources in a formal concert hall—an application that has since become common practice.



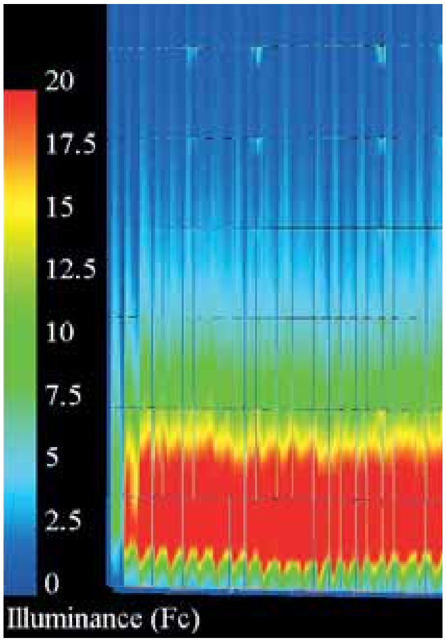
Above: Exploratory lighting studies
Opposite: LED luminaires enhance textured acoustic wall panels

Full Size Mock-ups

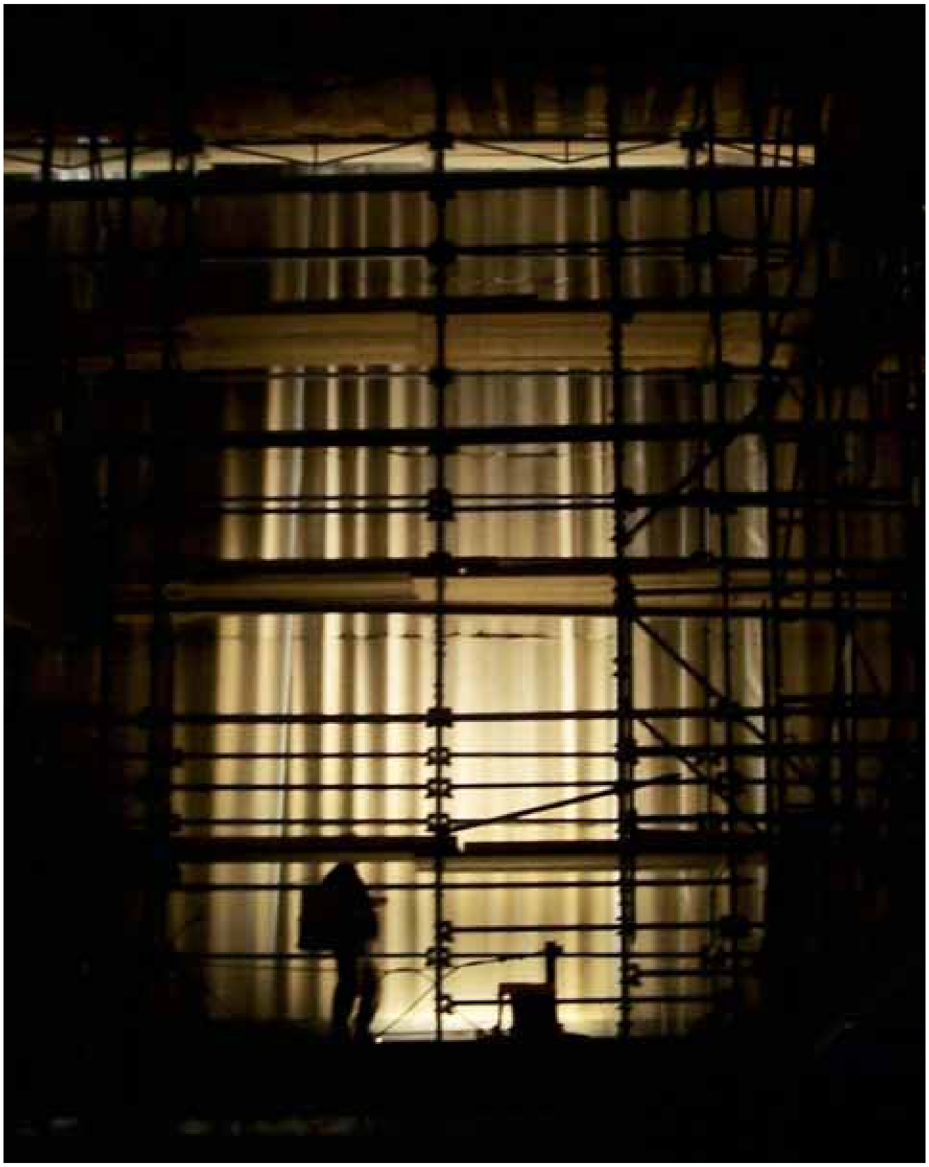
In addition to lighting calculations and computer simulations, full size mock-ups were created to refine the architecture, acoustics, and lighting for both the interior and exterior of the concert hall.

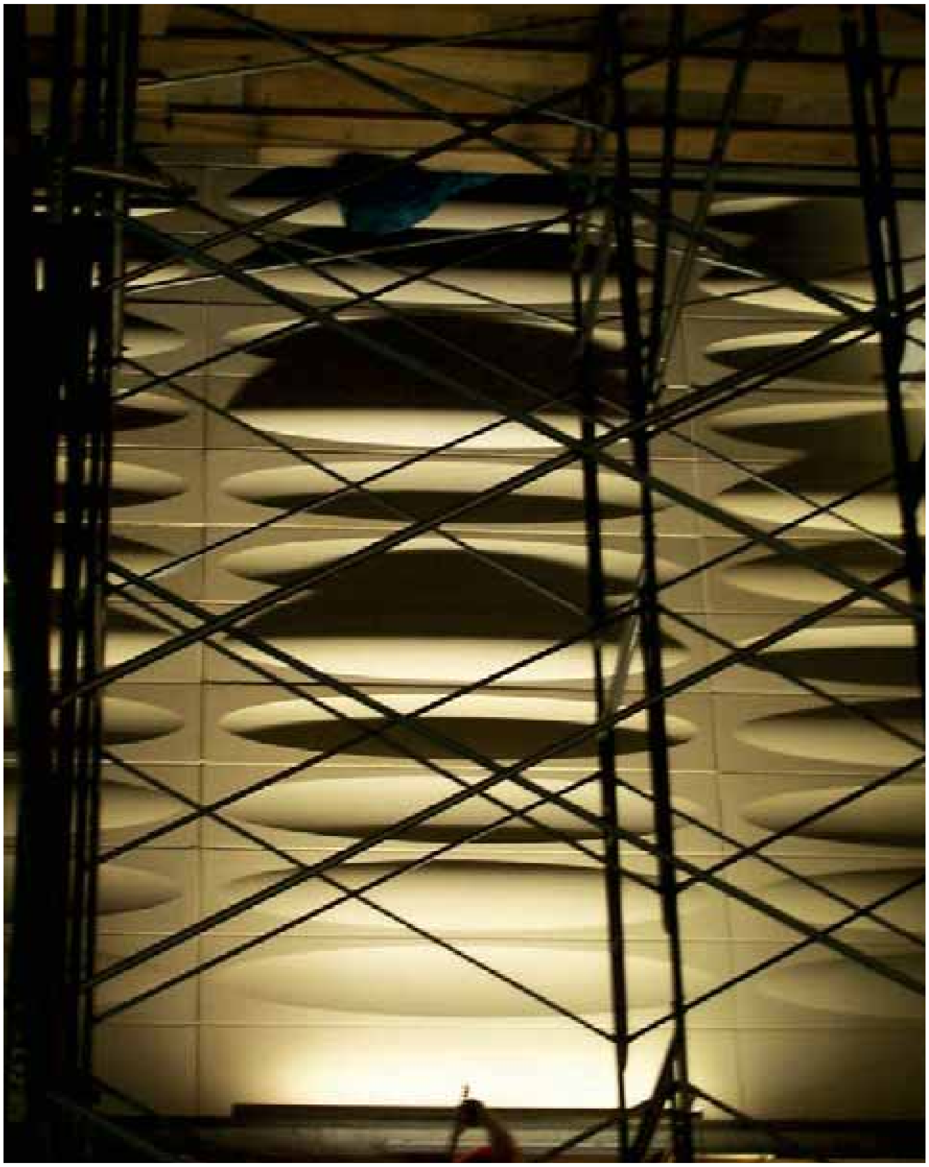
For the interior, mock-ups of acoustic wall panels allowed for the fine-tuning of the position and aiming of lights to provide optimal modeling of the surfaces. Based on trials, a 3,000K color temperature was confirmed to give a neutral, warm tone to the acoustic panels and blend with other light sources used in the space.

For the exterior wooden hull, full size material samples were used to verify color and sheen under the proposed illumination. A satin finish was chosen, rather than the typical gloss finish, to minimize reflected glare of light sources on the wall surface.

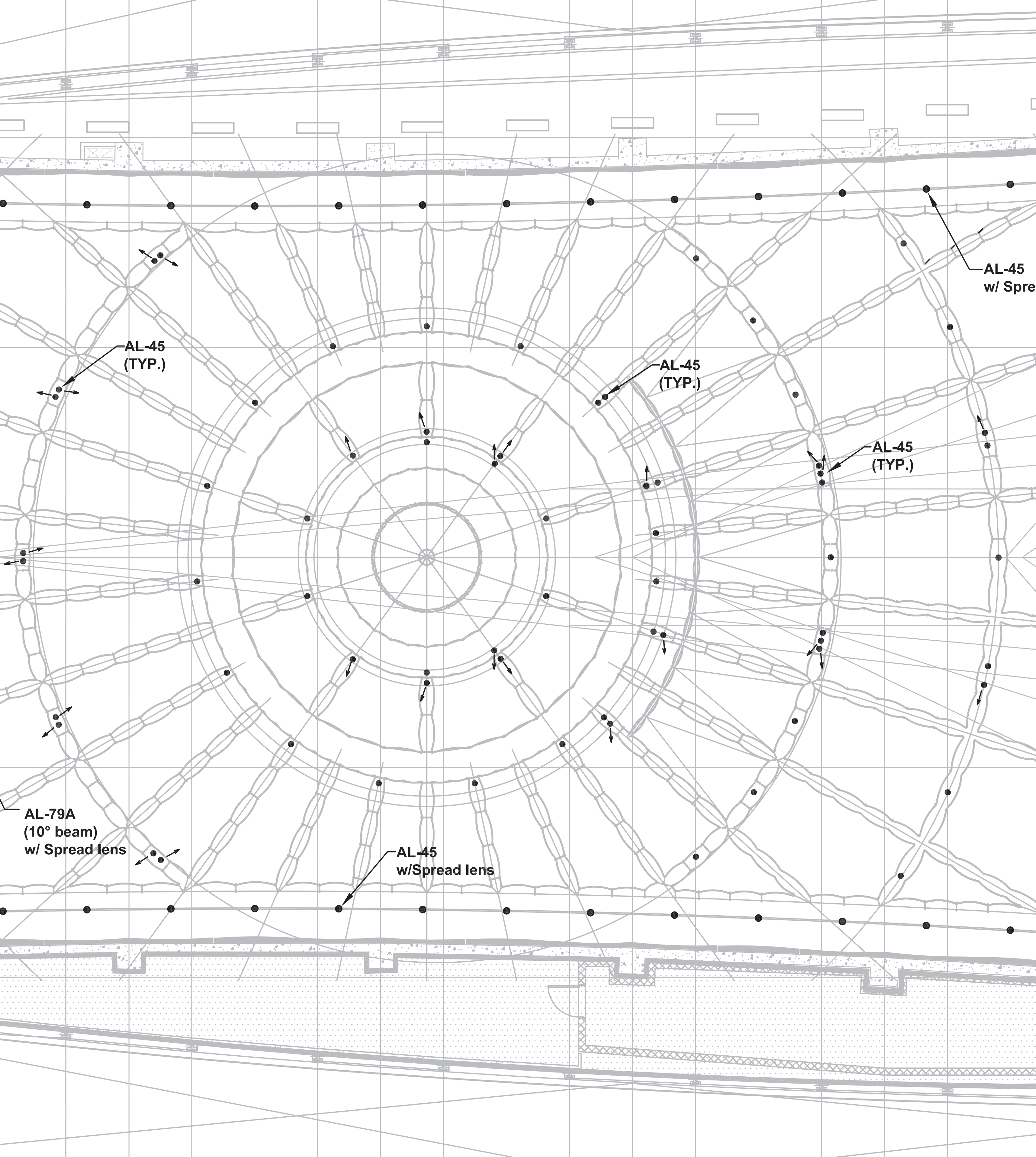


Below: Upstage wall mock-ups
Opposite: Side wall mock-ups



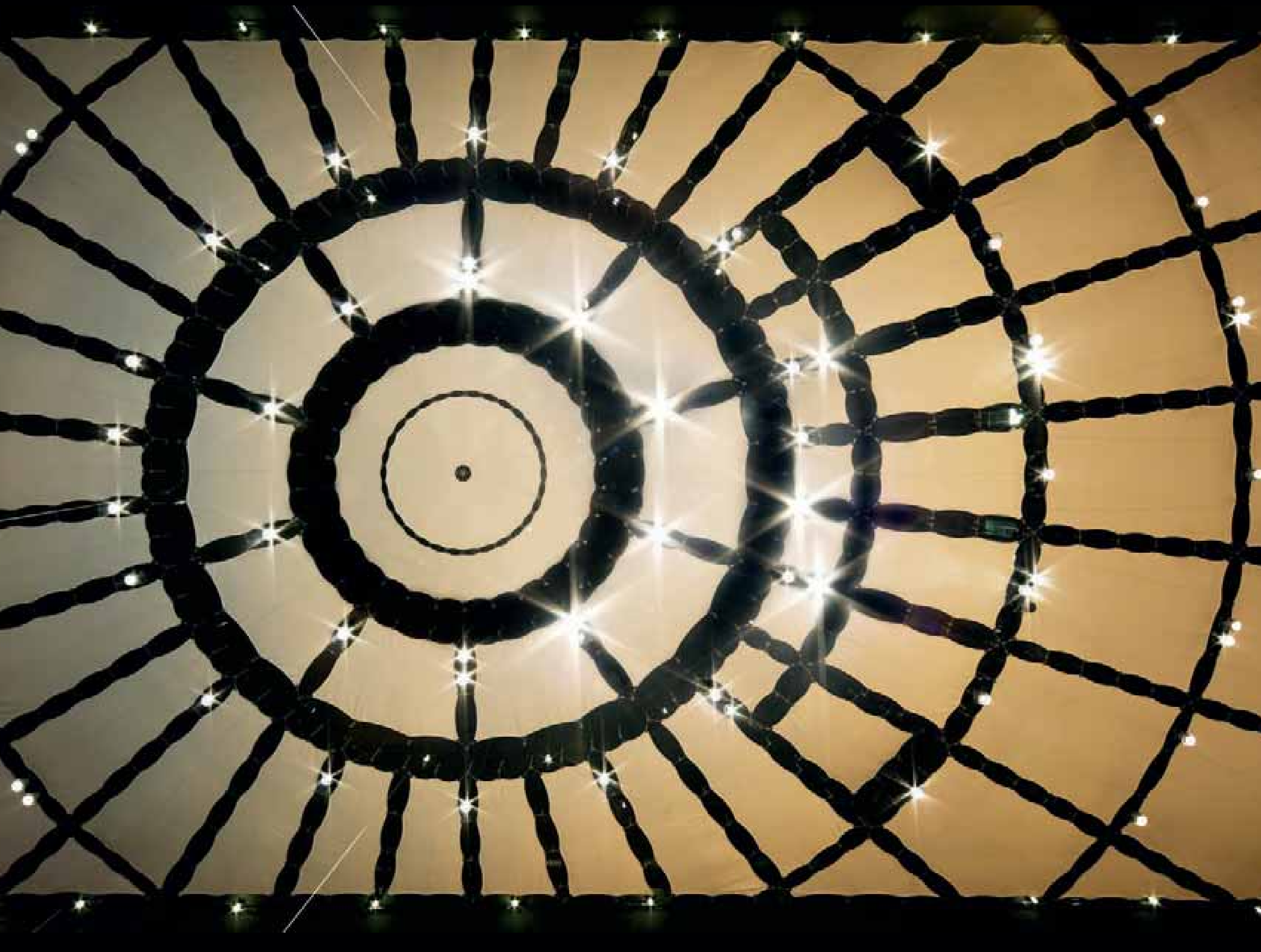
Ceiling Integration and Detailing



The concert hall's unique ceiling comprises a quilt of suspended fabric panels, composed in a radial pattern. Contoured in both the north-south and east-west directions, the ceiling presents geometric limitations on positions and aiming angles for lighting. In addition, the raked seating arrangement gives rise to multiple heights within the space. The lighting layout provides even light levels required for the stage, seating, and balcony areas while aligning with the asymmetric ceiling design. Extensive lighting calculations and modeling aided in determining precise locations for luminaires to achieve the desired lighting effects.

In the final arrangement, adjustable luminaires with locking mechanisms are clamp-mounted onto metal pipes that suspend from the ceiling structure. They are carefully coordinated within the voids of the fabric ceiling design.

Right: Lighting at scooped ceiling of balcony areas
Below: View of fabric ceiling from below
Opposite: Lighting plan at concert hall ceiling



By day, EMPAC appears as a reflective and solid glass box. At night, the building is transformed with lighting. Luminaires mounted on custom brackets activate the internal wooden hull and visually sculpt its volume. The eye sees through to this surface, revealing the architecture's transparency and depth—the glass façade in front is rendered invisible.

This lighting strategy provides sufficient light levels to safely illuminate the adjacent multi-story feature staircase while minimizing the quantity of fixtures needed to light the area. State-of-the-art lighting solutions work in harmony with EMPAC's architectural design while fulfilling stringent technical requirements.

The New York Times Building

New York, New York / USA

Architects: Renzo Piano Building Workshop with FXFOWLE

2001-2008

Acclaimed as the most significant addition to the Manhattan skyline in decades, The New York Times Building is located in the heart of the Times Square District—named after the newspaper's 1904 headquarters in the neighborhood. The iconic area has become identified with colorful signage, displays, and illuminated advertisements.

Lighting plays an essential role in enhancing the dynamic presence of the building while creating a modern classic appearance. The glass and steel skyscraper is draped with lace-like screens of ceramic tubes, creating an airy façade that reflects subtle changes in natural light throughout the day. Nighttime lighting reinforces the structure's elegance by creating a precise gradation of light, laser-aimed along each façade: brightest at the base and tapering to a soft glow at the summit. From a distance, this gives the tower a sensation of soaring lightness on the city skyline.

To meet Times Square District requirements for lighting and an animated façade, select luminaires above pedestrian level are painted "taxi-yellow"—a cultural reference to midtown traffic. Together with the logo graphic, this solution avoids the usual illuminated billboards and large video screens. Luminaires and mounting brackets are custom crafted to key to architectural modulation and detailing. From its concept to every executed detail, the lighting scheme complements the building's elegant architecture.

The building has no ledges or setbacks, so all exterior luminaires are situated at the base and atop the building's podium. Controlled illumination stretches across the façades solely from these low positions, using a family of luminaires with one lamp type and different optics.

In the lobby, lighting reinforces the building's layering of spaces. By creating a hierarchy of light levels and focal points throughout the depth of the ground floor, the scheme visually connects the main lobby, a central open-air garden, and a glass-fronted auditorium.

Typically, a wide variety of luminaires, lamp types, and wattages are mixed in order to light a building of this size and prominence. Through skillful lighting design engineering, the overall number and kinds of light sources were minimized. The entire base building uses only twelve different lamp types—all by the same manufacturer—radically simplifying maintenance requirements and ensuring the long-term endurance of the lighting scheme.

Opposite: "Taxi-yellow" luminaires visually punctuate the tower and create a smooth gradient of light on the façade above.


The New York Times
DEAN & DELUCA

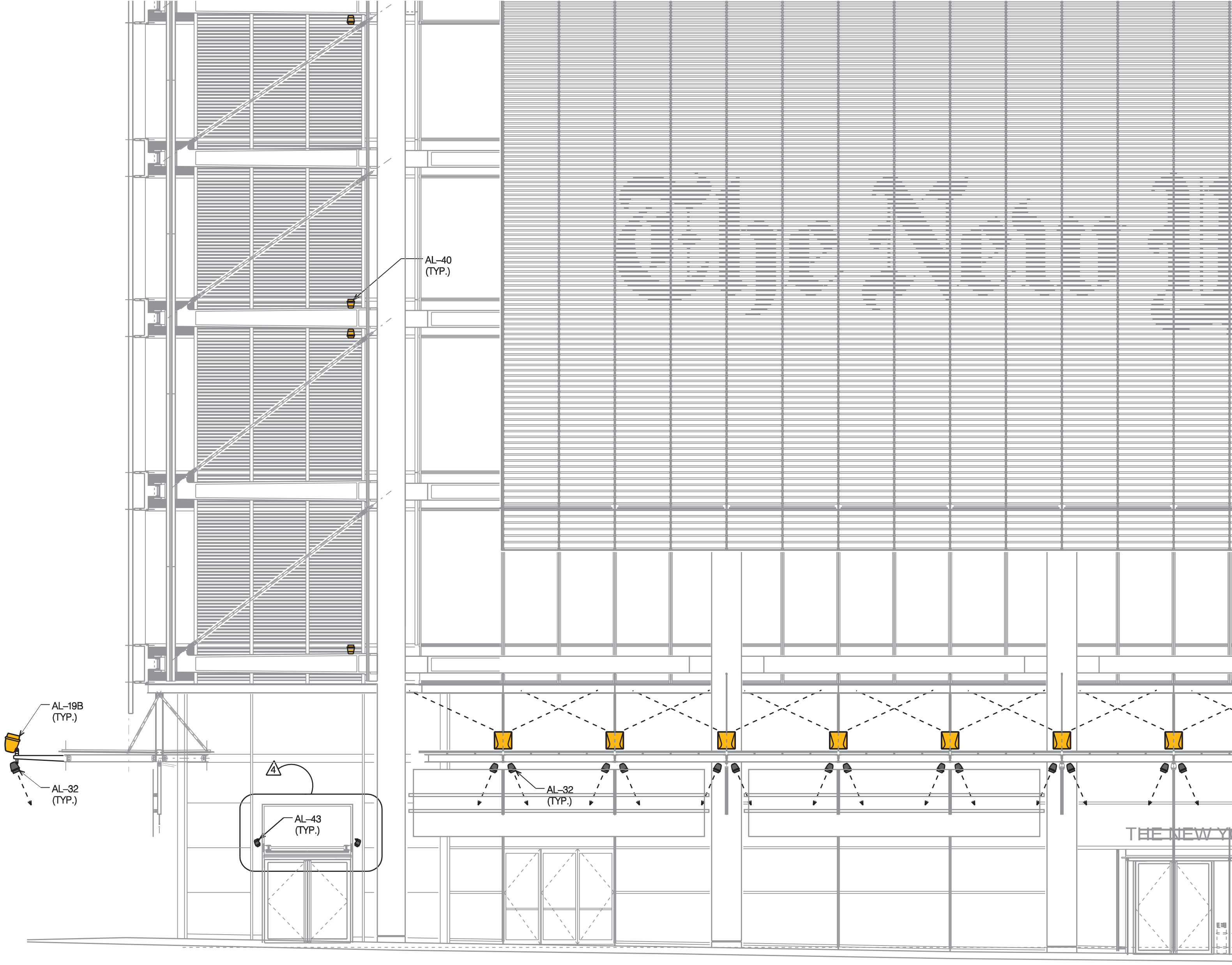
Signature Color

The Times Square District has specific requirements for illuminated signage and overall surface areas that must be illuminated. Many of the area's buildings meet these requirements by using bright façade lights and animated signage boards.

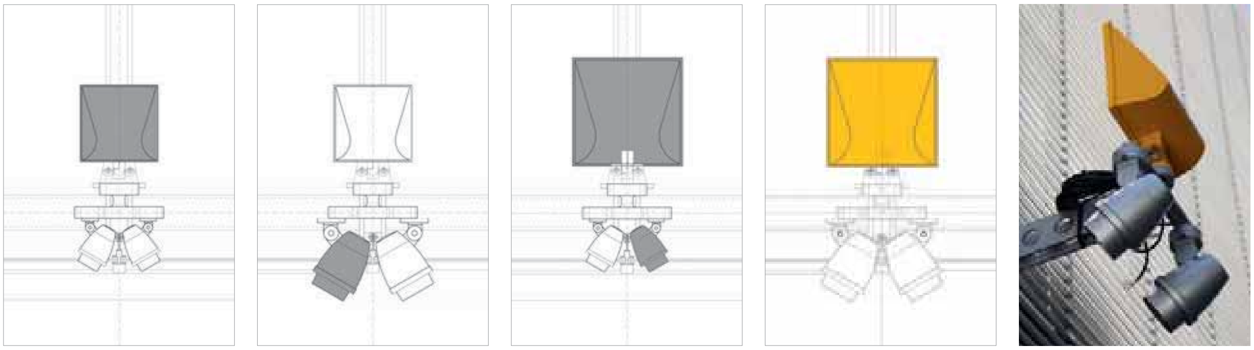
Inventive lighting strategies are used to support The New York Times Building's image of prestige and elegance while also respecting the Times Square District requirements. Instead of brash floodlighting, the building is lit in a subtle manner that plays up the transparency of its screen façade. By utilizing the reflectance value of the building's off-white ceramic rods, the scheme also saves power, while appearing to achieve similar light levels to adjacent buildings.

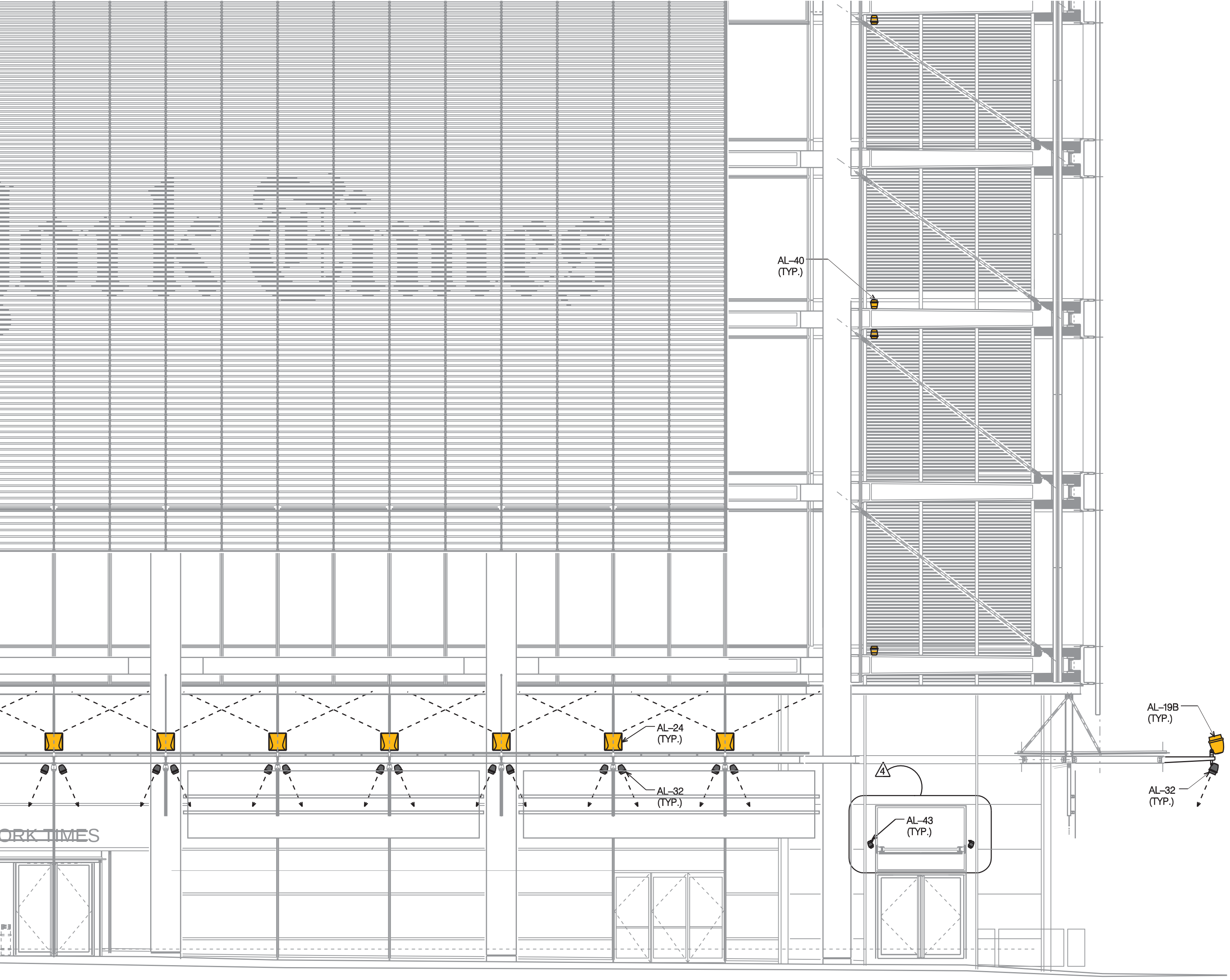
Rather than deploying typical illuminated signage boards to generate visual interest, select luminaires are custom painted "taxi-yellow", echoing the cultural context of midtown traffic. This color is a first-of-its-kind finish for luminaires normally only found in black, white and gray.

Opposite and below: Times Square District at day and night

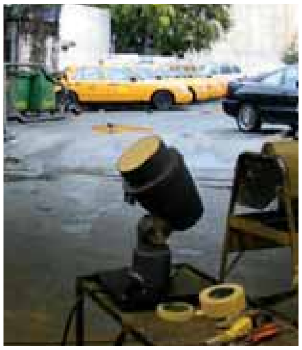


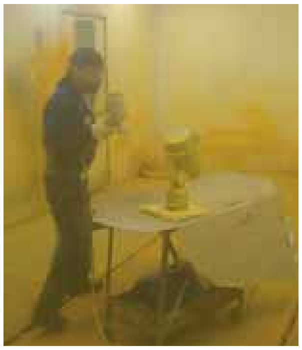
At intervals corresponding to the building's structural bays, clusters of luminaires cantilever out from the façade on custom metal brackets. Each cluster on the main façade includes an uplight aimed at the façade and paired downlights to illuminate the sidewalk below. Select "taxi-yellow" luminaires add visual punctuation to the tower, while appearing to be an integral part of the building's façade system. Various configurations were explored to find the correct combinations of luminaire size, proportion, light distribution, and color.





To achieve an accurate finish for the yellow luminaires, a local taxi shop painted a sample luminaire with the color used on New York City cabs. The sample was then shipped to the manufacturer, who custom-painted the luminaires to achieve an exact match of the prototype's signature yellow hue. A mapping diagram was prepared to aid the team in placing the yellow and silver luminaires.



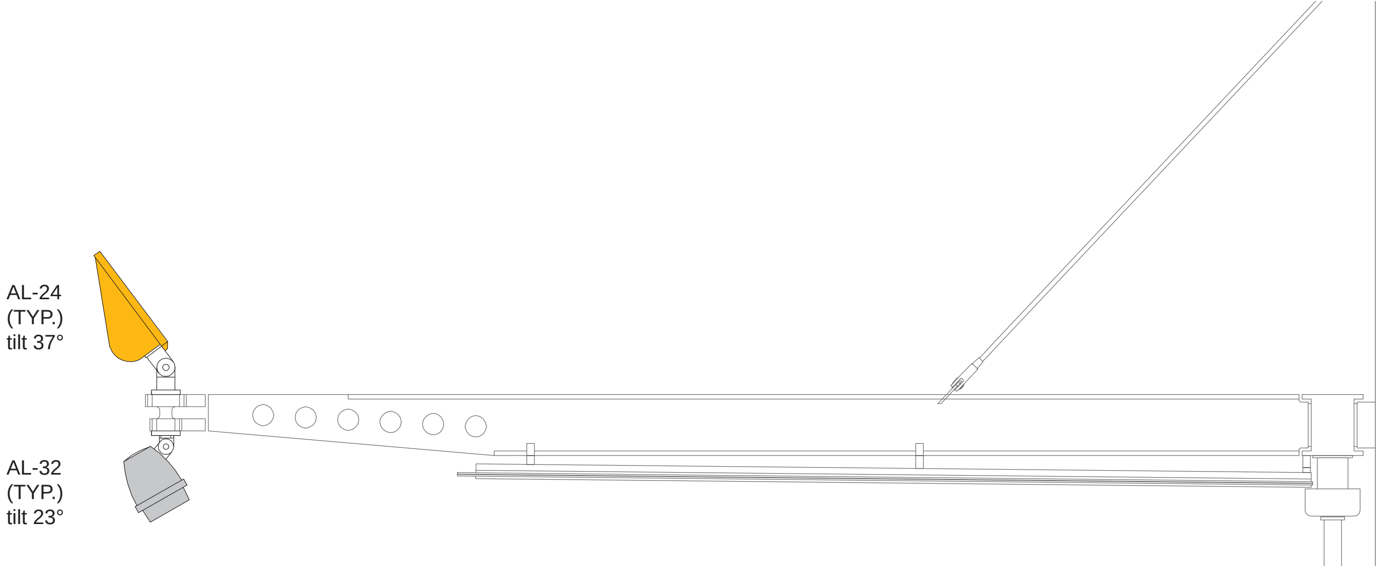


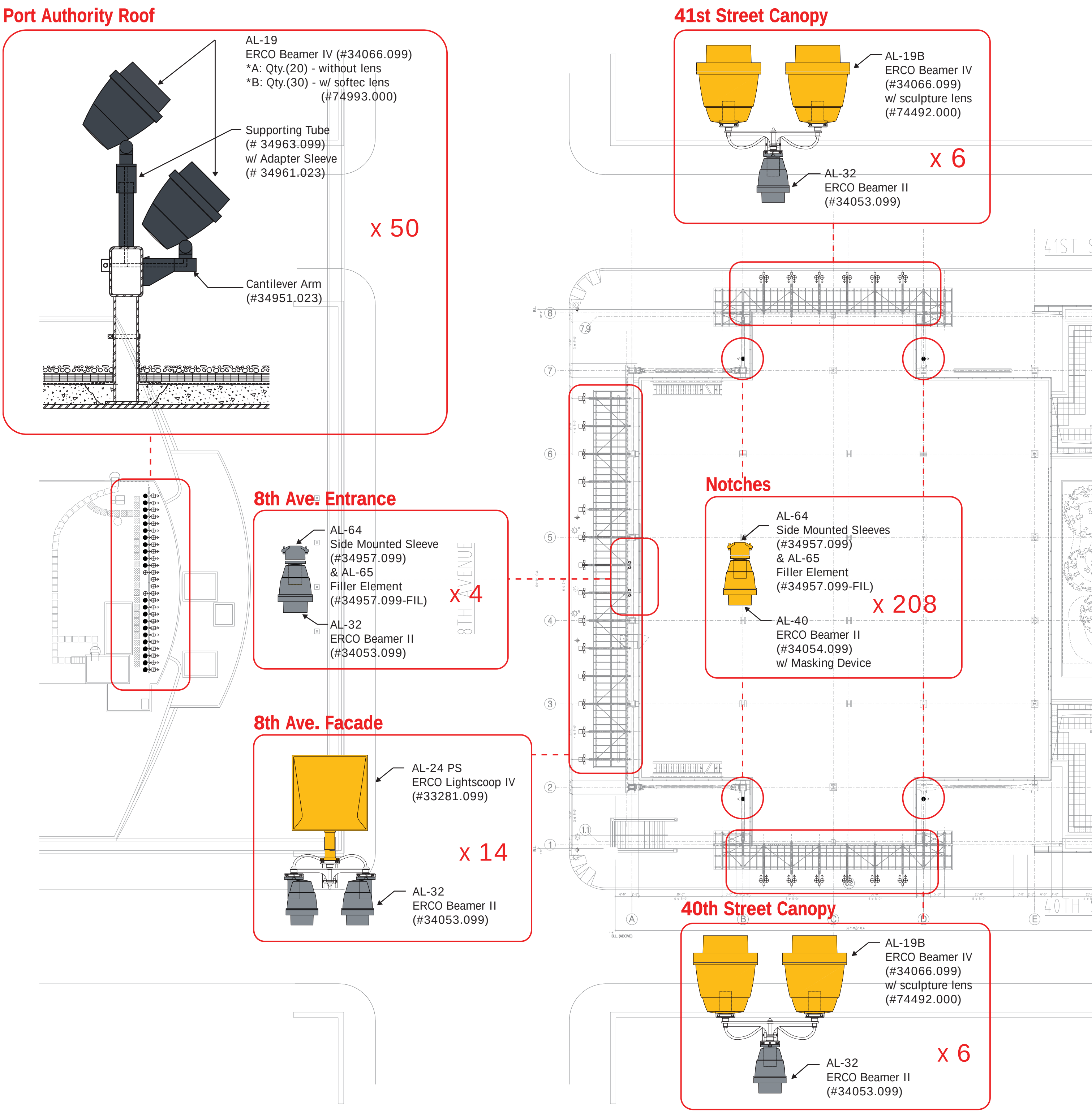
Precision Integration

Brackets, luminaire mounting, and cable type are tailored to achieve a refined industrial appearance, so that the lighting clusters appear as extensions of the architecture. Spacing of the clusters ties to the building's modulation, while custom-designed brackets and rotating mounting elements complement architectural detailing. The luminaire base fits onto the silver canopy with surgical precision, resulting from rigorous coordination with the architect and façade manufacturer. Stainless-steel braided-mesh cables are integrated and specified for the main power leads.

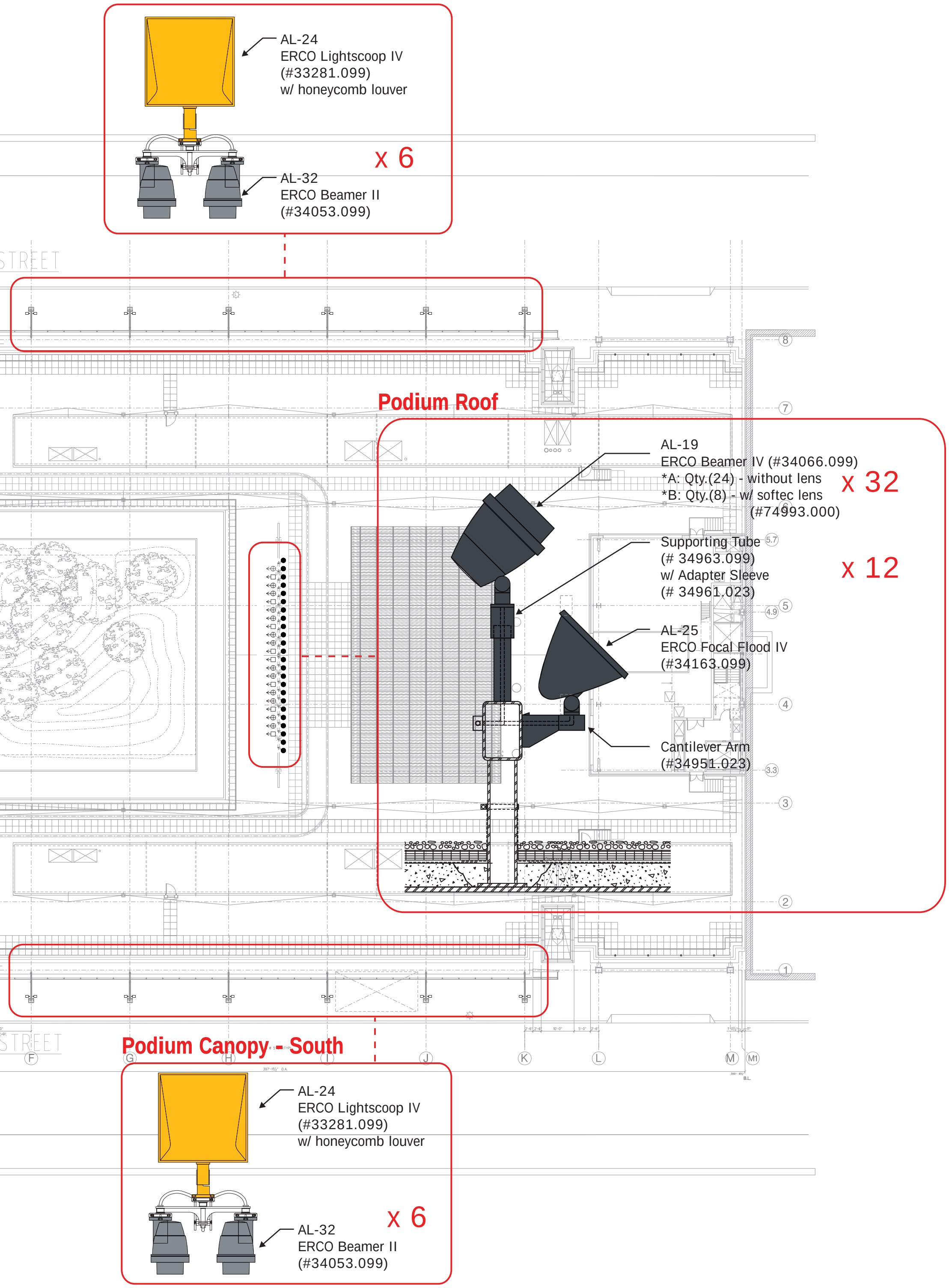
Although their exterior housing remains in the same product family, each cluster of lights is equipped to meet the particular lighting requirements of its location. For instance, the yellow "scoop" luminaires are fitted to accommodate two different optic systems for metal halide lamps. Standard scoops provide a soft wash of light at the podium, while double-lamp versions provide a punch of light at the Eighth Avenue façade, such that light travels further up the building. Customized lamping, lensing, and reflectors focus light as needed to illuminate the façades, and draw attention to entrances, while avoiding glare on exposed glass surfaces.

Below and opposite: 8th Avenue façade; close-up view of light clusters
Following spread: Mapping of exterior luminaires


AL-24
(TYP.)
tilt 37°
AL-32
(TYP.)
tilt 23°

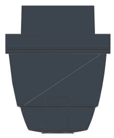


Port Authority Roof
AL-19
ERCO Beamer IV (#34066.099)
*A: Qty.(20) - without lens
*B: Qty.(30) - w/ softec lens
(#74993.000)
Supporting Tube
(# 34963.099)
w/ Adapter Sleeve
(# 34961.023)
x 50
Cantilever Arm
(#34951.023)
41st Street Canopy
AL-19B
ERCO Beamer IV
(#34066.099)
w/ sculpture lens
(#74492.000)
x 6
AL-32
ERCO Beamer II
(#34053.099)
41ST S
8th Ave. Entrance
AL-64
Side Mounted Sleeve
(#34957.099)
& AL-65
Filler Element
(#34957.099-FIL)
x 4
AL-32
ERCO Beamer II
(#34053.099)
8TH AVENUE
Notches
AL-64
Side Mounted Sleeves
(#34957.099)
& AL-65
Filler Element
(#34957.099-FIL)
x 208
AL-40
ERCO Beamer II
(#34054.099)
w/ Masking Device
8th Ave. Facade
AL-24 PS
ERCO Lightscoop IV
(#33281.099)
x 14
AL-32
ERCO Beamer II
(#34053.099)
40th Street Canopy
40TH
AL-19B
ERCO Beamer IV
(#34066.099)
w/ sculpture lens
(#74492.000)
x 6
AL-32
ERCO Beamer II
(#34053.099)



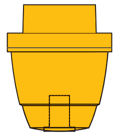
NYC Taxi yellow
RAL Silver (to match architect's sample)
Graphite M

* The following requirements equipment for sheets LSK-018A, B and C:
See individual sheets for detailed breakdown and locations.



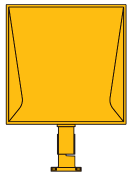
*AL-19A: 120V	no lens	x 20
*AL-19A: 277V	no lens	x 24
*AL-19B: 120V	w/ sculpture lens	x 30
*AL-19B: 277V	w/ softec lens	x 8
*AL-19B: 277V	w/ sculpture lens	x 8

AL-19
ERCO Beamer IV(#34066.099)



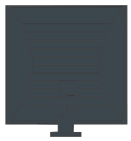
x 24

AL-19B
ERCO Beamer IV(#34066.099)
w/ sculpture lens



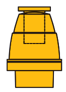
*AL-24PS x 14
*AL-24 x 12

AL-24
ERCO Lightscoop IV(#33281.099)



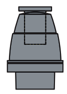
x 20

AL-25
ERCO Focalflood IV(#34163.024)



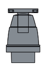
x 208

AL-40
ERCO Beamer II(#34054.099)



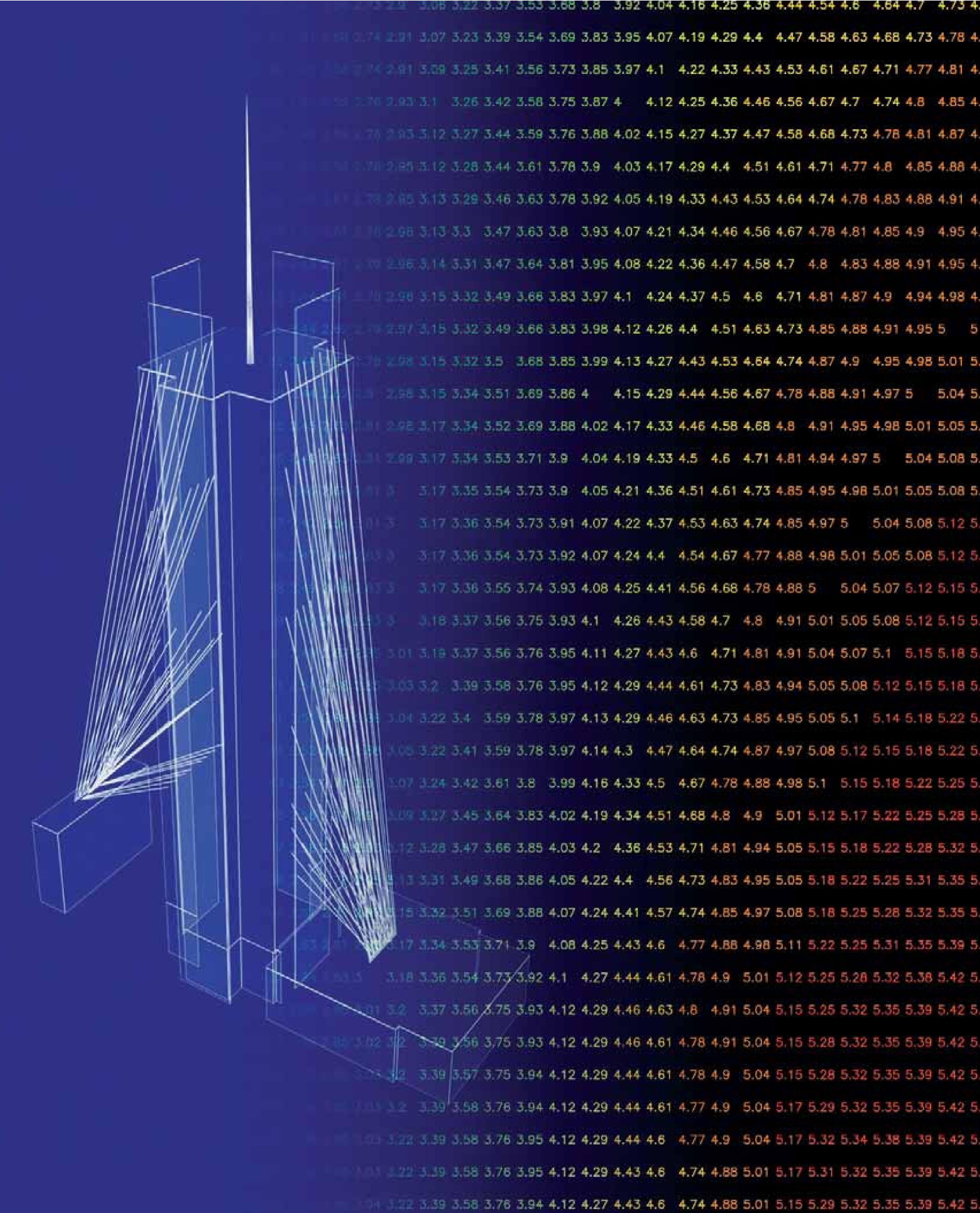
x 68

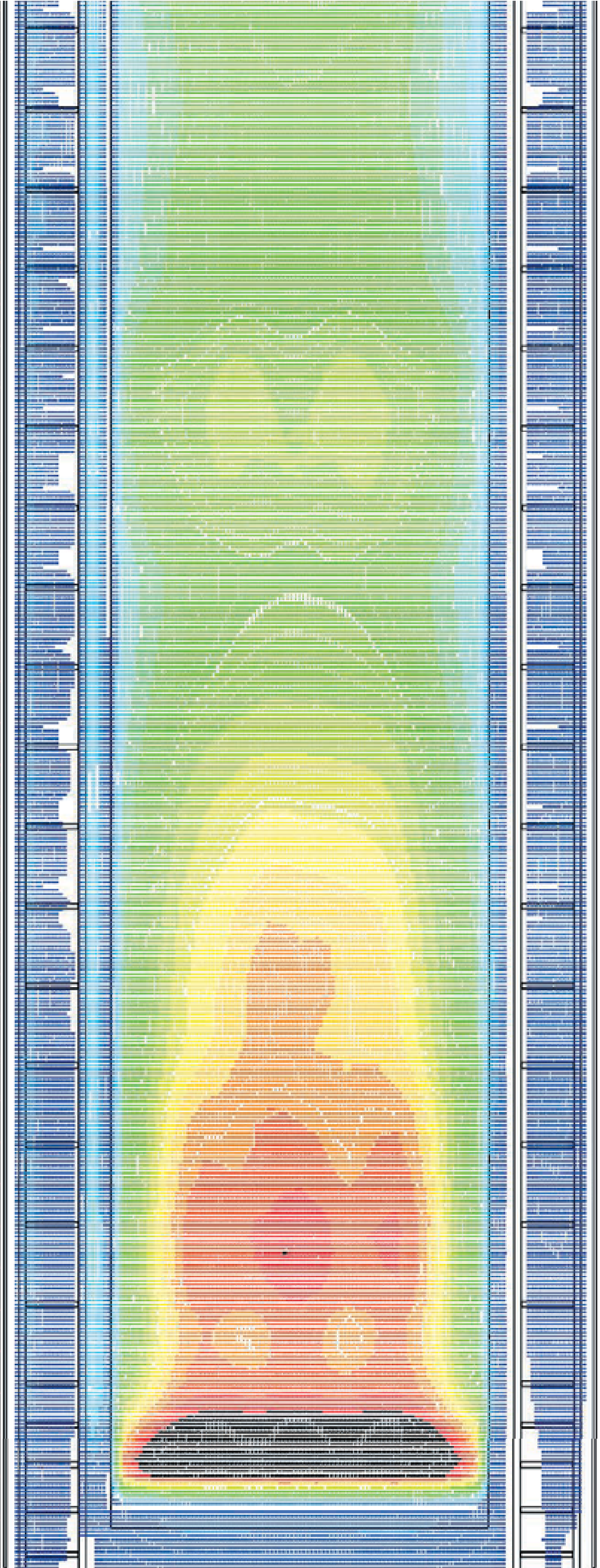
AL-32
ERCO Beamer II(#34053.099)



x 54

AL-43
ERCO Beamer I(#34050.099)





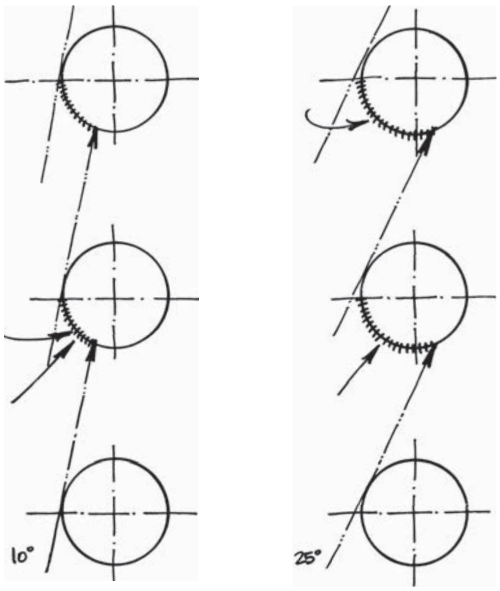
The lighting design for The New York Times Building was composed in relation to the city's major skyscrapers. At an early stage, luminance and illuminance levels of the Empire State Building, Chrysler Building, and other iconic landmarks on the skyline were measured. Based on these values, ideal lighting levels for the new structure were calculated to give it a defined presence, without rendering it into an overpowering beacon of light.

Creating a controlled gradation of light across the 261 m (856') façades was particularly challenging since the tower has no ledges or setbacks on which to conceal lighting equipment. Advanced lighting studies, extensive calculations, computer simulations, and full-size mock-ups were undertaken to determine the best way to achieve the desired effects. In the final configuration, luminaires positioned at the building's base and podium are equipped with precision optics that allow them to illuminate the tower to its uppermost levels.

The building's ceramic screens are shaped with light in different ways. The wide, east-west façades receive a soft gradation of illumination to the summit of the tower, while the narrow north-south façades feature an intense burst of brightness at the bottom, tapering quickly to a soft glow. This sculpts the building's volume rather than flattening it with even illumination on all four sides.

Luminaire spacing, aiming angles, and light intensity levels are calibrated to accurately model the rod screen elements. A warm white 3,000K color temperature is specified to complement the off-white tone of the ceramic screen. Calculation points are spaced at tight 91 cm (3') intervals to ensure a balanced 3:1 ratio of brightness on the light-colored façade.

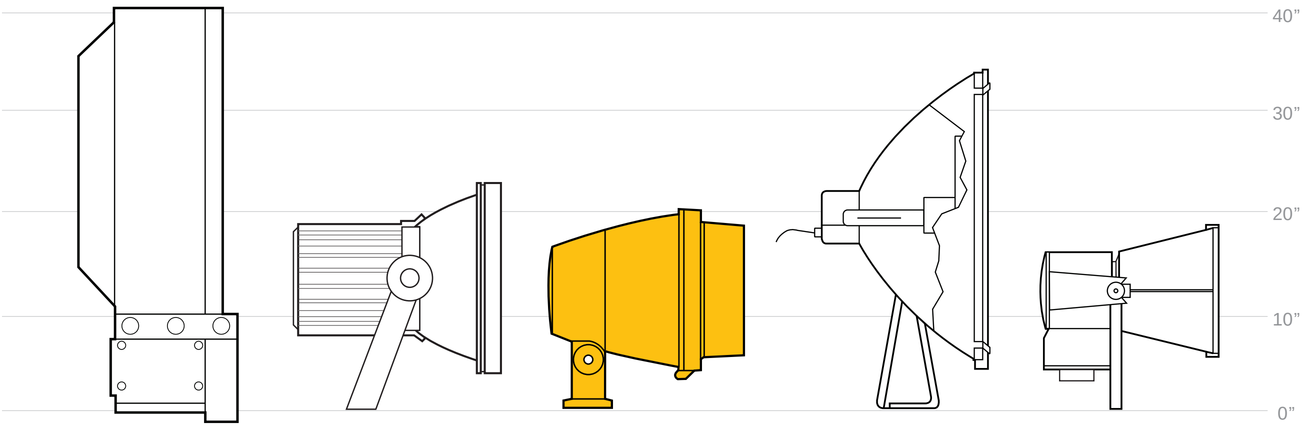
Opposite: Lighting positions for façade illumination
Left and below: Lighting calculations and aiming angles



Typical aiming angle top of façade **Typical aiming angle center of façade**

Laser Aiming

Exceptional for a building of this size, floodlighting is achieved with a single family of luminaires and one lamp type. Luminaires equipped with metal halide lamps pair with varying optical systems to create the inverted, 261 m (856') wall wash effect. The top of the building is lit by luminaires with narrow beam optics that give a long throw of light. Mid-levels receive illumination using narrow beams with spread-lenses. Finally, wide floods cast light on the base of the building. The luminaires are precisely focused using laser aiming devices, and locked in place once adjusted.



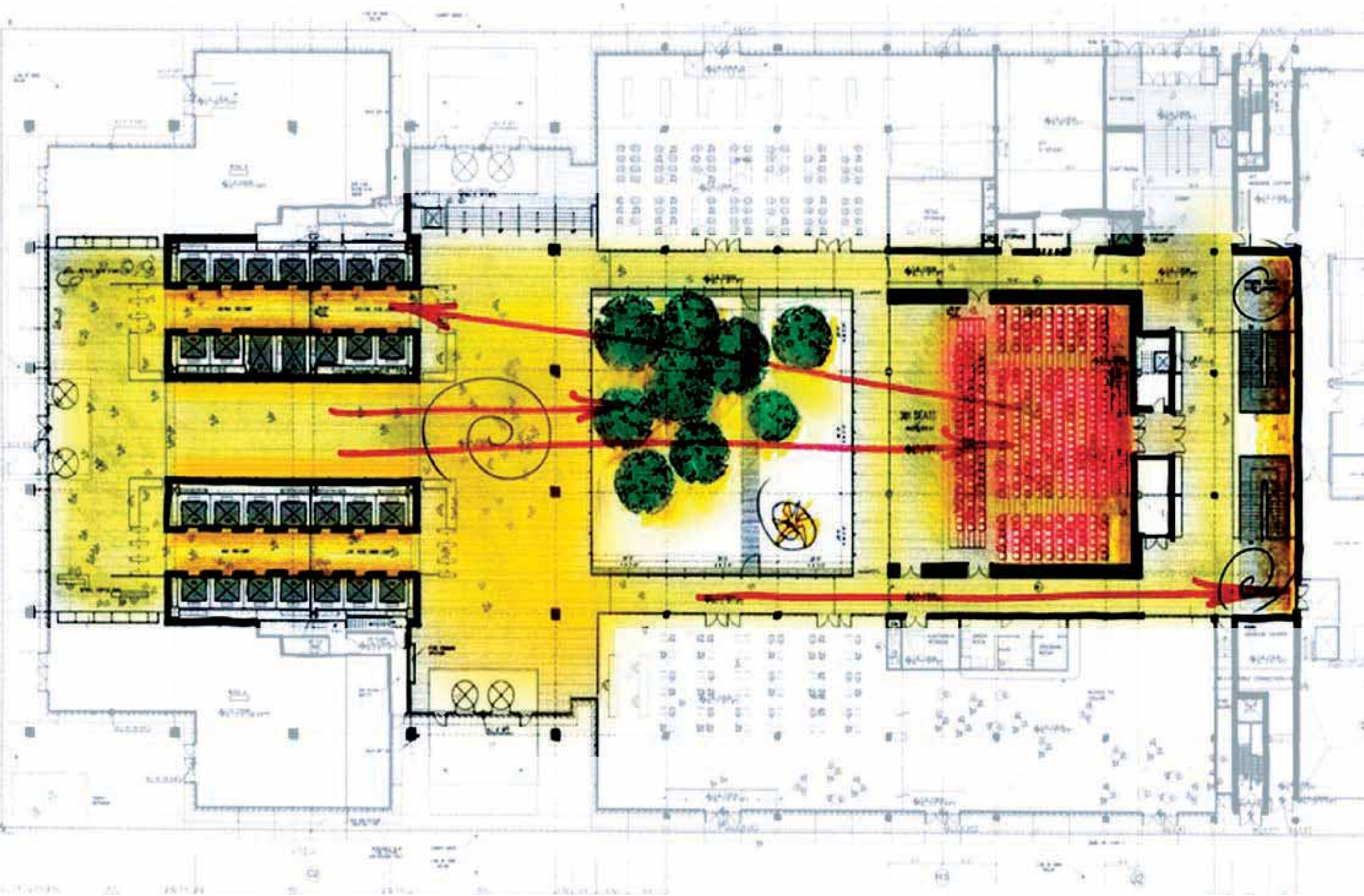
Opposite: Laser aiming of luminaires to pre-determined façade locations
Above: Exterior product evaluation
Below: Luminaires cast light up the 261 m (856’) façade

Transparency and Depth of Space

Lighting visually activates and connects a succession of spaces on the ground floor, from the main lobby and central open-air garden to the glass-fronted auditorium. In the center of the ground floor, a four-sided glass garden courtyard presents a unique lighting challenge: rendering the glass volume as a visible object, while also conveying the effect of transparency.

Focal points were designated to draw the eye through the depth of these sequential spaces. In the lobby, golden Venetian plaster walls are activated to frame views to the garden and beyond. Capping the view, the glass-fronted auditorium's illuminated red seats and warm cherry wood walls create a rich backdrop for views from the lobby. Technical guidelines stipulate specific lighting requirements for each area and light levels are balanced to prevent one space from visually overpowering one another.

Below: Golden Venetian plaster walls in the lobby frame views to the garden and auditorium beyond
Opposite: View of lobby; diagram of lighting focal points and depth of space



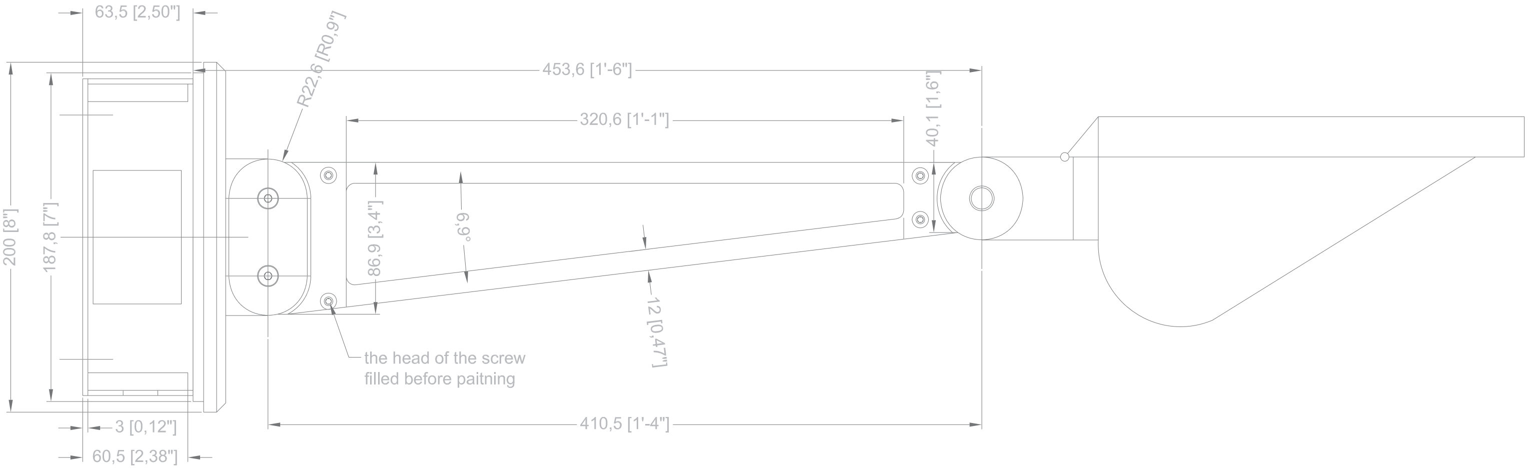
Custom Luminaire Detailing

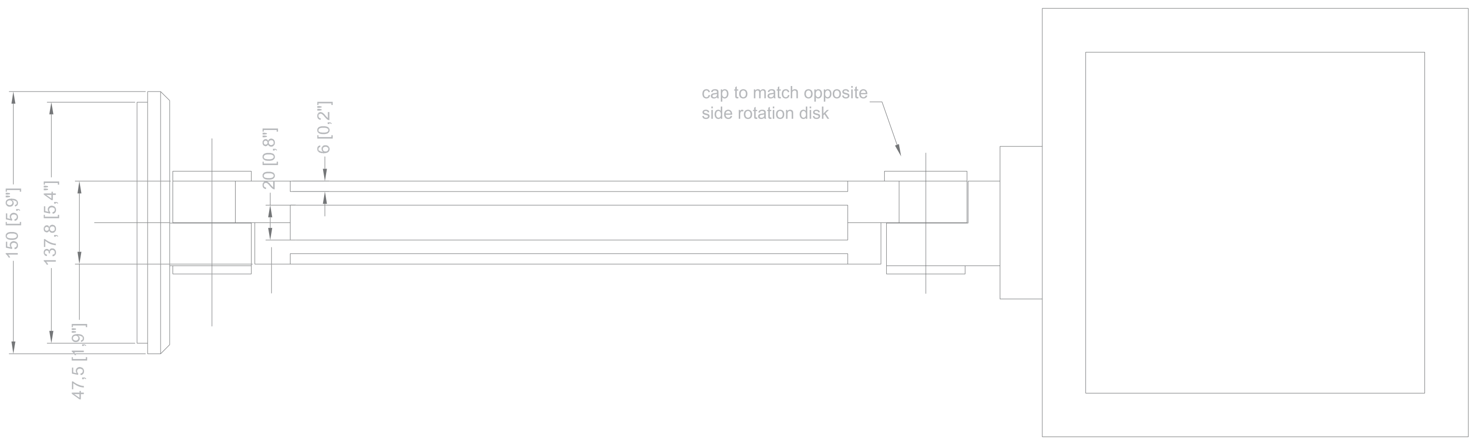
Uplights punctuate the golden feature walls of the lobby, creating soft clouds of light on the ceiling above. Derived from the same family as the exterior lights, these luminaires contribute to the open, plaza-like atmosphere of this space. As an alternative to the traditional vocabulary of pendant chandeliers used in lobbies, the luminaires are extensions of the architectural language of the building, not decoration.

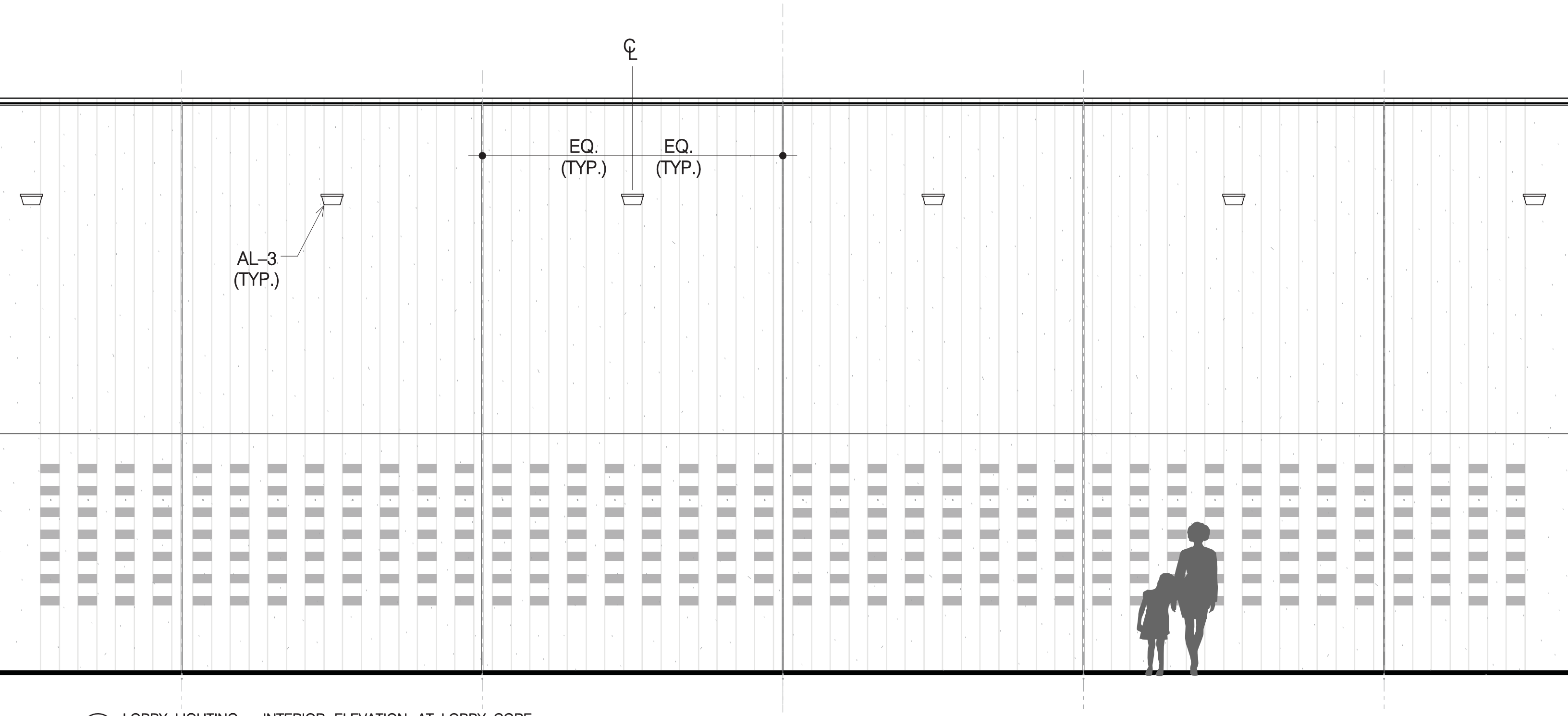
A custom luminaire arm complements the refined interior architecture. The gently tapered, double-blade design includes embossed side panels that provide a subtle sense of depth. The arm interlocks neatly with the luminaire's knuckle joint and incorporates channels for concealing power cables. A white glass custom diffuser covers the lamp, resulting in a clean exposed edge without the greenish tint of standard glass.

The uplights are rhythmically aligned and carefully coordinated with cables from an LED text-screen art installation. Wall wash light levels are balanced with this display. Throughout the ceiling, downlights are precisely arranged in a classic grid pattern, creating a silent field of ambient light.

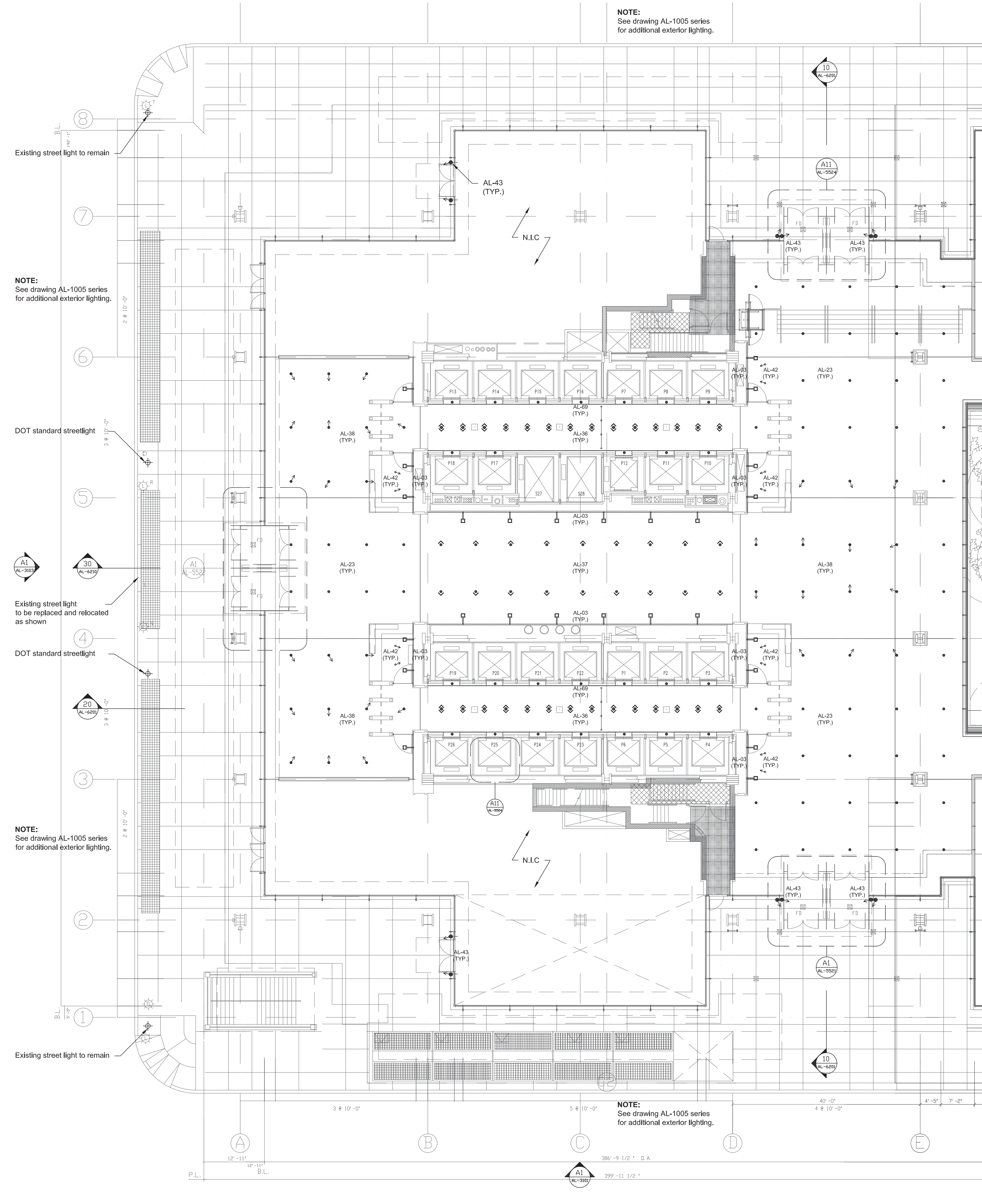
Below: Lobby with uplights and art installation
Opposite: Details of custom mounting bracket; lobby wall elevation
Following spread: Ground floor lighting plan

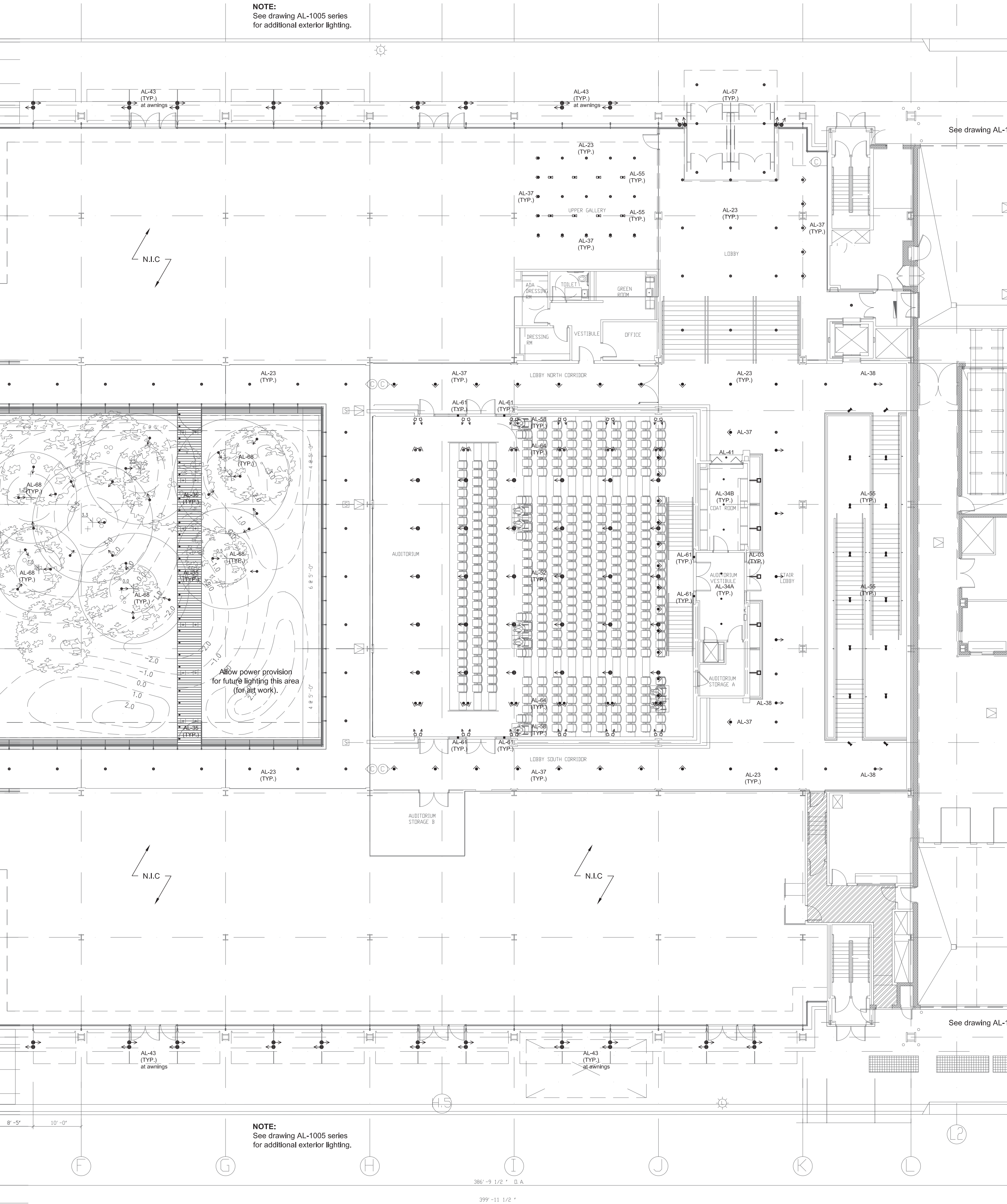






30 LOBBY LIGHTING – INTERIOR ELEVATION AT LOBBY CORE
SCALE : 1/4" = 1'-0"


NOTE:
See drawing AL-1005 series
for additional exterior lighting.
Existing street light to remain
AL-43
(TYP.)
N.I.C
DOT standard streetlight
Existing street light
to be replaced and relocated
as shown
AL-23
(TYP.)
AL-37
(TYP.)
AL-38
(TYP.)
AL-36
(TYP.)
AL-69
(TYP.)
AL-03
(TYP.)
AL-42
(TYP.)
3 @ 10'-0"
5 @ 10'-0"
4 @ 10'-0"
40'-0"
386'-9 1/2" O.A.
399'-11 1/2"
12'-11"
B.L.
P.L.


NOTE:
See drawing AL-1005 series
for additional exterior lighting.
AL-43
(TYP.)
at awnings
AL-57
(TYP.)
See drawing AL-1
AL-23
(TYP.)
AL-55
(TYP.)
AL-37
(TYP.)
UPPER GALLERY
LOBBY
N.I.C
ADA
DRESSING
RM
TOILET
GREEN
ROOM
DRESSING
RM
VESTIBULE
OFFICE
LOBBY NORTH CORRIDOR
AL-38
AL-61
(TYP.)
AL-58
(TYP.)
AL-64
(TYP.)
AL-41
AL-34B
(TYP.)
COAT ROOM
AL-68
(TYP.)
AL-35
(TYP.)
AUDITORIUM
AL-52
(TYP.)
AL-03
(TYP.)
AUDITORIUM
VESTIBULE
AL-34A
(TYP.)
STAIR
LOBBY
AUDITORIUM
STORAGE A
Allow power provision
for future lighting this area
(for art work).
LOBBY SOUTH CORRIDOR
AUDITORIUM
STORAGE B
NOTE:
See drawing AL-1005 series
for additional exterior lighting.
F
G
H
I
J
K
L
386'-9 1/2" O.A.
399'-11 1/2"

Classic Timeless Design

Proudly reflecting the city's dynamic culture, the lighting scheme for the Manhattan skyscraper is a pioneer in energy efficiency. The exterior lighting employs only 42 kilowatts—80% less energy at the time than the 208 kilowatts used for the top portion of the Empire State Building alone. Using a fraction of the power, the lighting scheme makes The New York Times Building a nighttime icon in its own right. Equipped with the latest innovations in lamp technology and optics design, The New York Times Building stands out on the city skyline as a landmark of both elegance and efficiency.

Above: View of the building from 8th Avenue; view of the façade from within the garden
Opposite: Manhattan taxi cab; views from the roof of the building



The TimesCenter

New York, New York / USA

Architects: Renzo Piano Building Workshop with FXFOWLE

2001-2008

Conceived as an integral part of The New York Times Building, The TimesCenter is a performance venue consisting of a 378-seat auditorium and a reception space. The glass-fronted auditorium hosts the TimesTalks television series, book signings, and various performances against the unexpected backdrop of a garden courtyard.

Lighting supports the unique configuration of the auditorium and visually unifies the spaces of The TimesCenter, garden and the main lobby of the tower. Luminaires, positioning, and details from The New York Times Building are carried into The TimesCenter and establish a common lighting vocabulary between the spaces.

The auditorium is the end point in a sequence of transparent areas that begins in the main lobby of The New York Times Building. Enhancing the space's rich finishes, lighting enriches the auditorium's warm cherry wood walls and intensifies the color of its plush red seats. These features act as vivid focal points in the layered design of the ground floor. This generates visual depth of space, drawing views into the auditorium from the garden and main lobby.

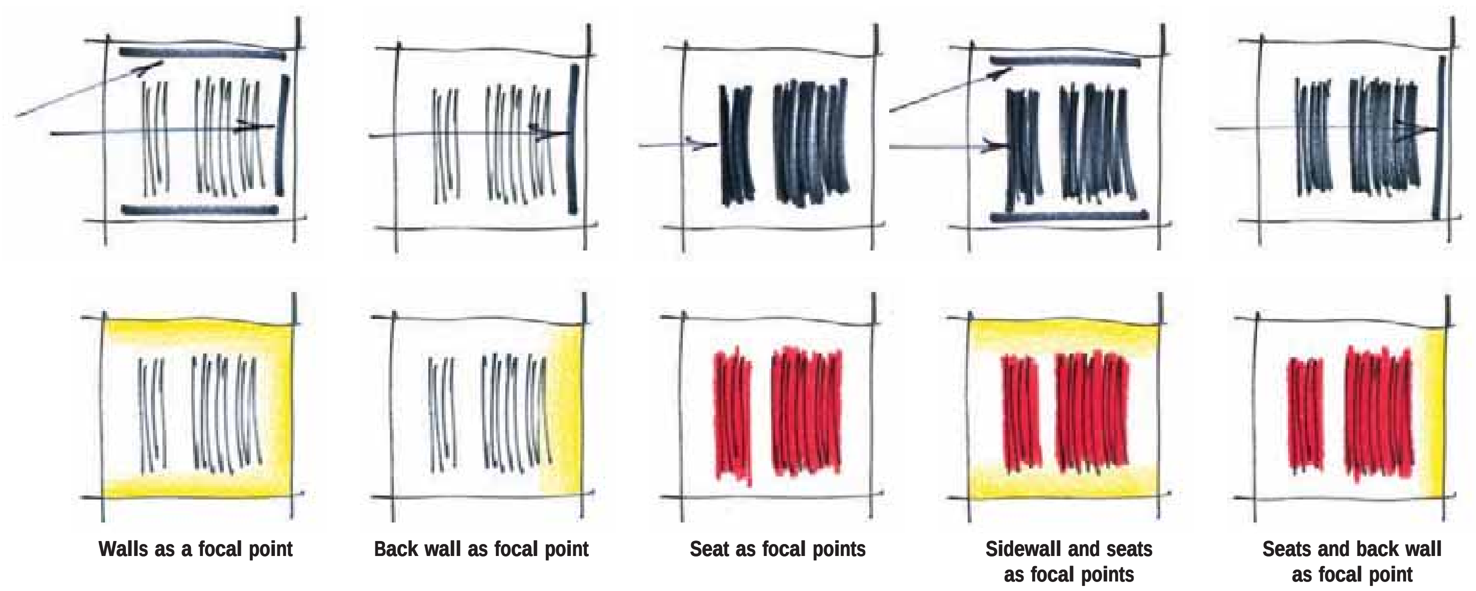
The auditorium's architectural lighting was specially finished and detailed to visually blend with theatrical and acoustic equipment. Refined industrial-style luminaires, in matte black, are clamp-mounted to ceiling and wall gantries alongside stage lights. This gives all of the technical equipment in the room a cohesive appearance.

Small lights embedded in the seating were developed in coordination with the chair manufacturer. This custom detail illuminates the adjacent aisles, providing orientation for visitors and lends a final, elegant touch to the space.

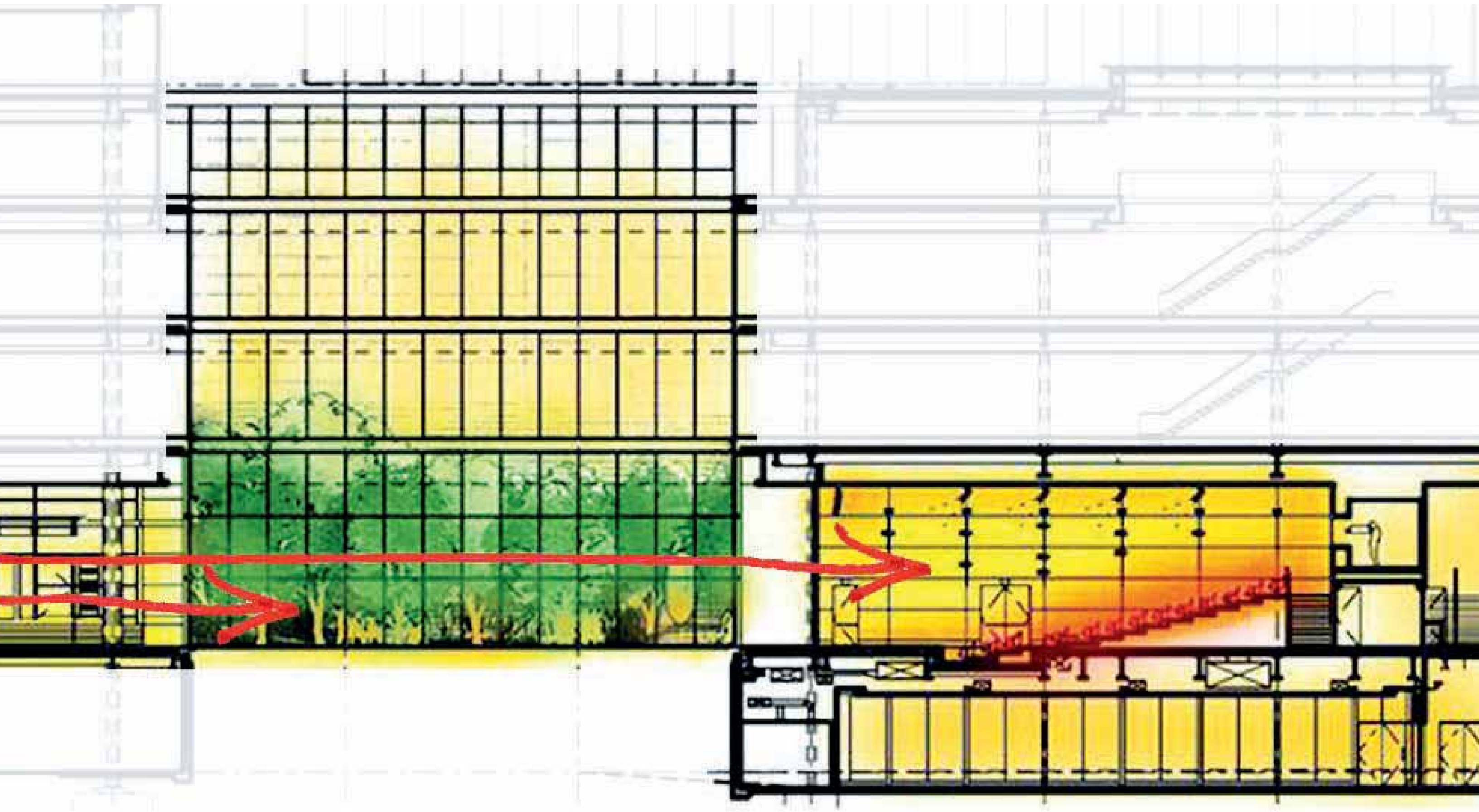
Opposite: Industrial-style clamp-mounted lights highlight cherry wall panels, while seat-integrated luminaires create pools of light along the aisles.

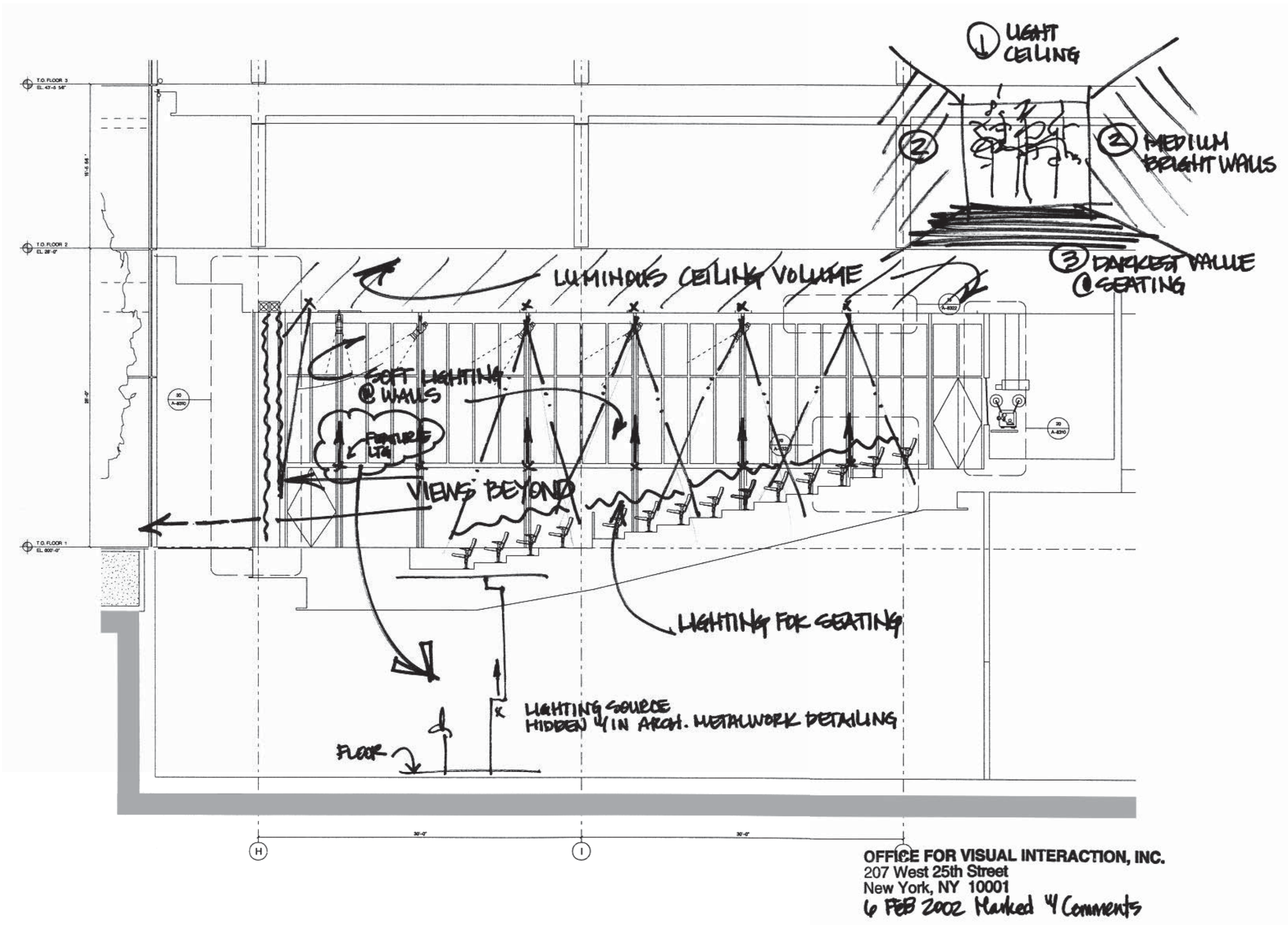

EXIT

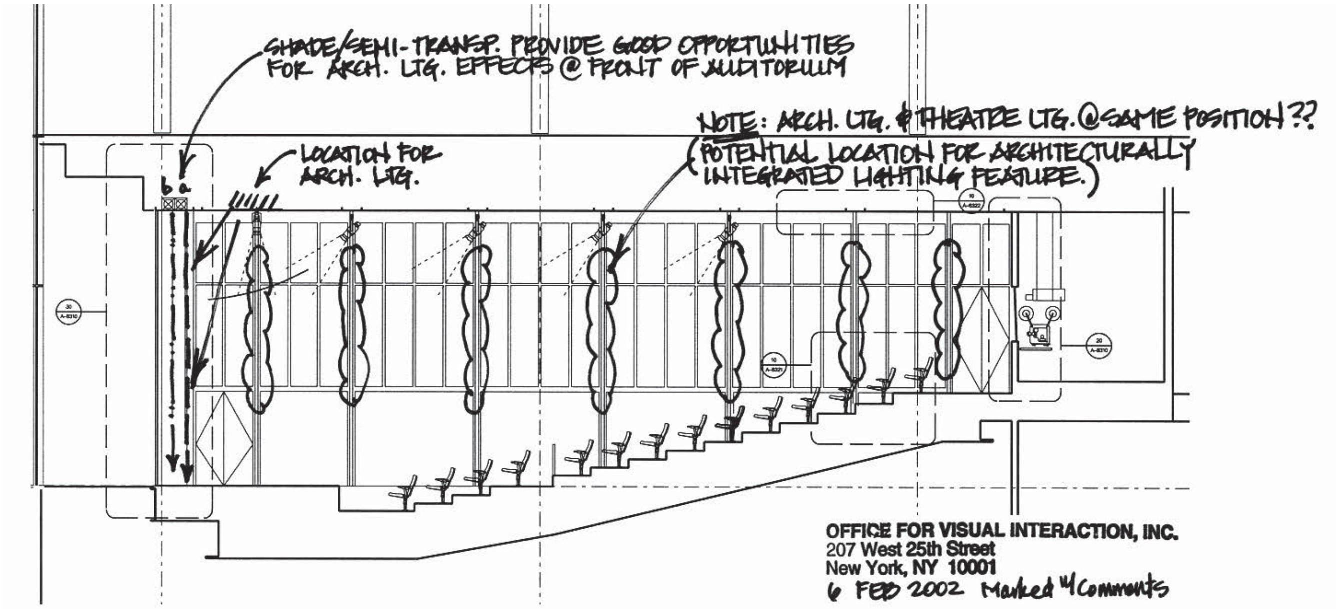
Exploratory Lighting Studies



Above: Lighting diagrams explore activating the surfaces of the auditorium
Below: Section through garden courtyard and The TimesCenter
Opposite: Early lighting coordination diagrams




1 LIGHT CEILING
2 MEDIUM BRIGHT WALLS
3 DARKEST VALUE @ SEATING
LUMINOUS CEILING VOLUME
SOFT LIGHTING @ WALLS
FEATURE LTG
VIEWS BEYOND
LIGHTING FOR SEATING
LIGHTING SOURCE HIDDEN W/IN ARCH. METALWORK DETAILING
FLOOR
OFFICE FOR VISUAL INTERACTION, INC.
207 West 25th Street
New York, NY 10001
6 FEB 2002 Marked W/Comments


SHADE/SEMI-TRANSP. PROVIDE GOOD OPPORTUNITIES FOR ARCH. LTG. EFFECTS @ FRONT OF AUDITORIUM
LOCATION FOR ARCH. LTG.
NOTE: ARCH. LTG. & THEATRE LTG. @ SAME POSITION??
(POTENTIAL LOCATION FOR ARCHITECTURALLY INTEGRATED LIGHTING FEATURE.)
OFFICE FOR VISUAL INTERACTION, INC.
207 West 25th Street
New York, NY 10001
6 FEB 2002 Marked W/Comments

Clamp-mounted luminaires, finished matte black to match theatrical lighting equipment, are installed along the walls and ceiling of the auditorium. At night, these lights dramatically highlight the red upholstered seats and cherry wood interior, drawing views into the space from the lobby—while the garden becomes a scenic backdrop for the speakers and performers on stage.

Below: View from lobby to the auditorium; 41st street entrance
Opposite: The TimesCenter auditorium

The United States Air Force Memorial

Arlington, Virginia / USA
Architects: Pei Cobb Freed & Partners
2002-2006

Situated on a promontory overlooking the Pentagon, the United States Air Force Memorial takes its place in the ranks of the capital city's key monuments. Lighting is an essential aspect of establishing the nighttime identity of each of these structures. At the Air Force Memorial, three stainless-steel spires evoke the precision and weightlessness of flight. Illuminated with a variation in intensity, the sweeping curves of the arcs are accentuated, and their tips brilliantly lit. Illumination appears to emanate from within the monument itself, gliding along the slender forms and bursting into the night sky.

Lighting for the memorial is a highly technical challenge. Each spire has a different-sized triangular footprint, varying in proportion and height. Their surface area tapers dramatically to tips that are 23 cm (9") wide, and sway up to 46 cm (18") in the wind. Moreover, the convex contours of the arcs turn away from the center of the monument necessitating a peripheral lighting strategy.

An additional challenge is posed by the monument's location on the commercial flight path to Ronald Reagan Washington National Airport. To meet Federal Aviation Association (FAA) requirements, red beacons would typically be placed at the tip of each spire, to alert approaching pilots. Upon a close reading of the guidelines, a creative interpretation allowed for the upper portions of the spires to be brightly lit to aviation regulation levels, as an alternative to the red beacons.

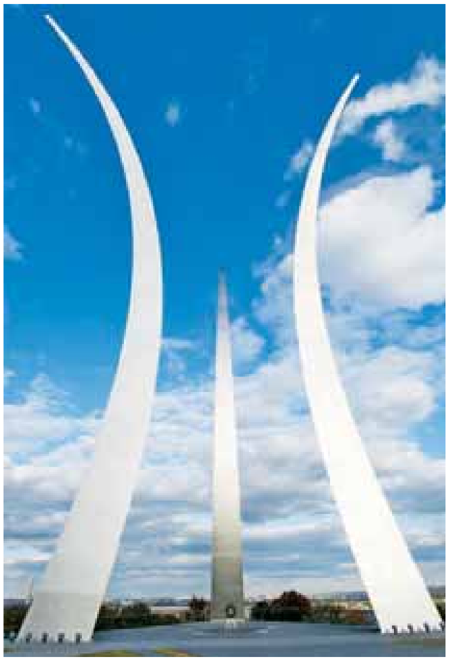
Luminaires concealed behind granite walls provide the primary lighting for the monument. The lights have precise narrow beams, deep-set optics and integral cross baffles to minimize potential glare for pilots. Additional luminaires near the base of the spires are cleanly detailed into the granite paving. Instead of an even wash of light, the overall illumination brightens in a calibrated gradient to subtly accentuate the base and curving tips.

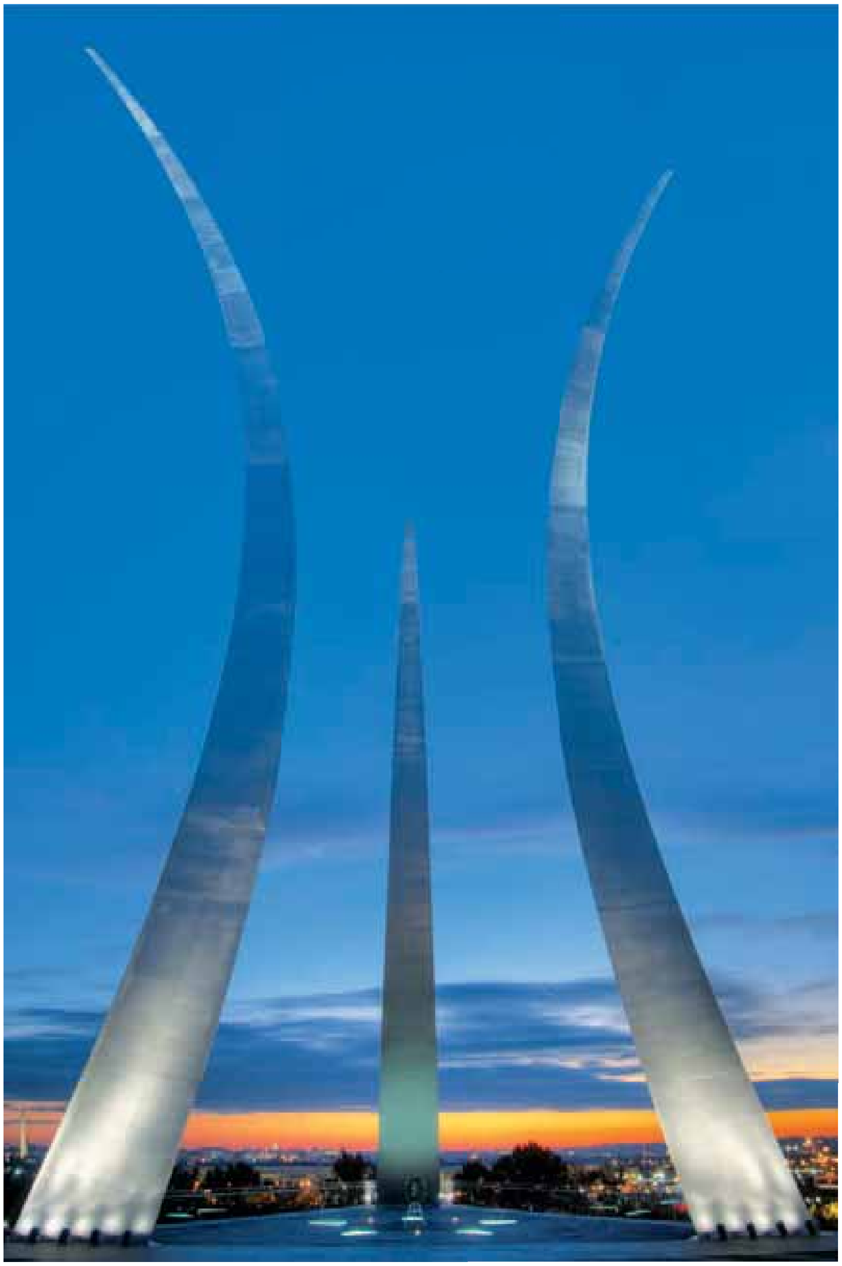
Granite inscription walls flanking the spires are lit by in-grade wall-washers, housed behind custom-fabricated stainless steel hoods that minimize glare and match the material of the spires. In the central viewing area, oversized glass pavers in the form of an Air Force Star logo are backlit by LEDs, that generate an ambient glow of light.

To meet the National Capital Planning Commission's and Fine Arts Commission's exacting standards, the project's rigorous technical lighting requirements are balanced with its overall aesthetics. Longevity, ease of maintenance, and meeting FAA requirements were important considerations in developing the lighting design to ensure that the lighting will uphold its performance and appearance over time.

Opposite: Lighting accentuates the sculptural forms of the monument's slender spires, reinforcing its elegance.

Creating a Lighting Gradient



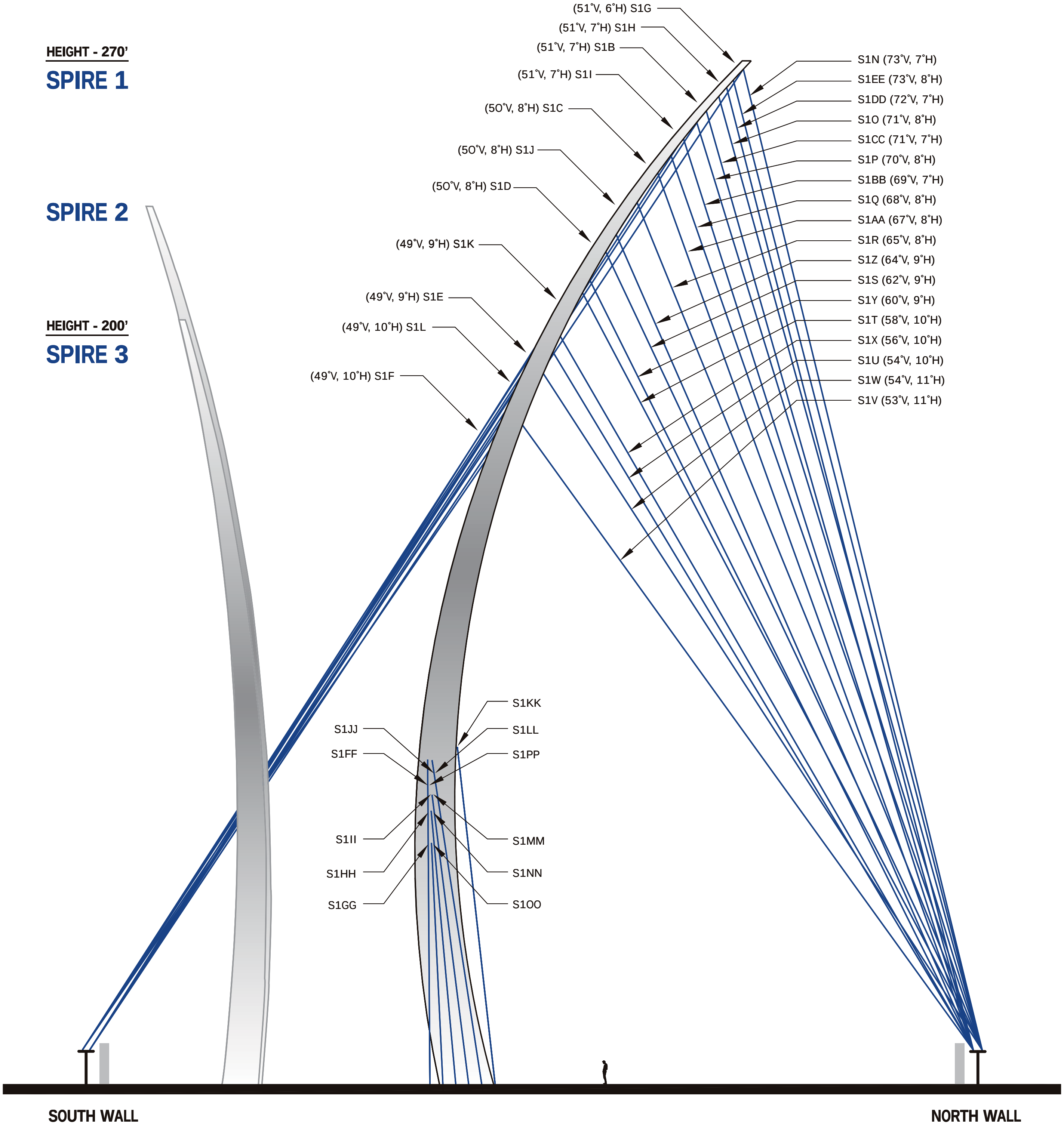


Meeting Federal Aviation Association (FAA) requirements and minimizing glare for pilots was critical and integral to the lighting scheme. As an alternative to red warning lights, the upper portions of the spires are brightly lit to meet regulation levels. Using these light levels as a baseline, a precise lighting gradient graces the curving form of each arc. The light ratios and gradients for each spire enhance their contours rather than flattening their appearance with typical floodlighting.

Exact aiming was a rigorous challenge for achieving this effect. All three spires rise to a different height—82 m (270'), 70 m (231'), and 61 m (201')—and present a slim surface area. Moreover, the decision to conceal primary lights behind peripheral granite walls dramatically increases the distance between the luminaires and the spires.

In order to accurately aim spotlights across distances of over 100 m (328') to hit a target area of only 23 cm (9") wide, lasers were attached to the luminaires, and each one pinpoint-aimed to its pre-calculated position along the contour of each spire. Advanced computer modeling and 3D lighting simulations were used to calculate the aiming to precise coordinates, achieve the gradient effect, determine quantities, compensate for wind sway of the spires, and meet FAA light levels.

Above and left: Views of the spires
Opposite: Light-aiming diagram


HEIGHT - 270'
SPIRE 1
SPIRE 2
HEIGHT - 200'
SPIRE 3
(51˚V, 6˚H) S1G
(51˚V, 7˚H) S1H
(51˚V, 7˚H) S1B
(51˚V, 7˚H) S1I
(50˚V, 8˚H) S1C
(50˚V, 8˚H) S1J
(50˚V, 8˚H) S1D
(49˚V, 9˚H) S1K
(49˚V, 9˚H) S1E
(49˚V, 10˚H) S1L
(49˚V, 10˚H) S1F
S1N (73˚V, 7˚H)
S1EE (73˚V, 8˚H)
S1DD (72˚V, 7˚H)
S1O (71˚V, 8˚H)
S1CC (71˚V, 7˚H)
S1P (70˚V, 8˚H)
S1BB (69˚V, 7˚H)
S1Q (68˚V, 8˚H)
S1AA (67˚V, 8˚H)
S1R (65˚V, 8˚H)
S1Z (64˚V, 9˚H)
S1S (62˚V, 9˚H)
S1Y (60˚V, 9˚H)
S1T (58˚V, 10˚H)
S1X (56˚V, 10˚H)
S1U (54˚V, 10˚H)
S1W (54˚V, 11˚H)
S1V (53˚V, 11˚H)
S1KK
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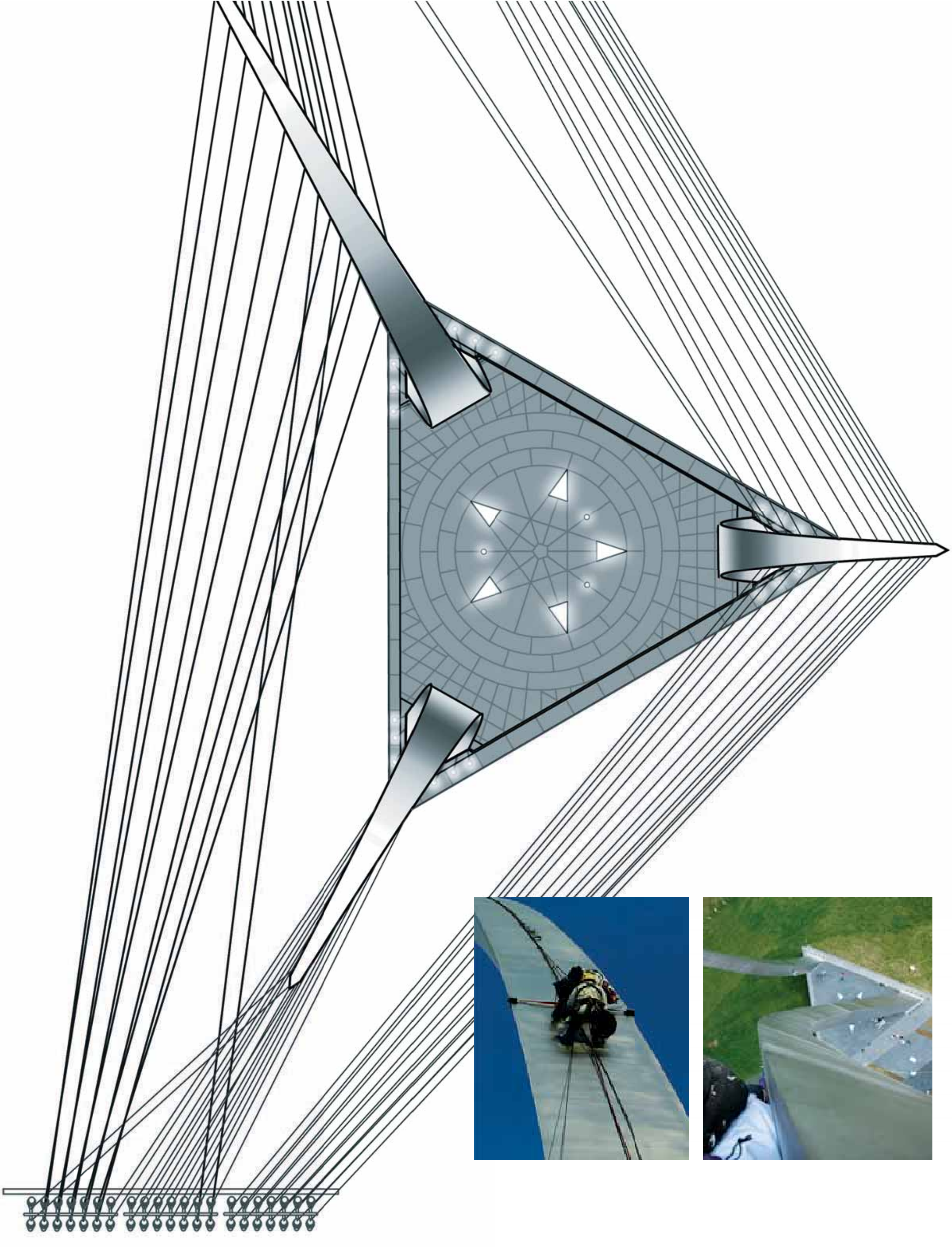


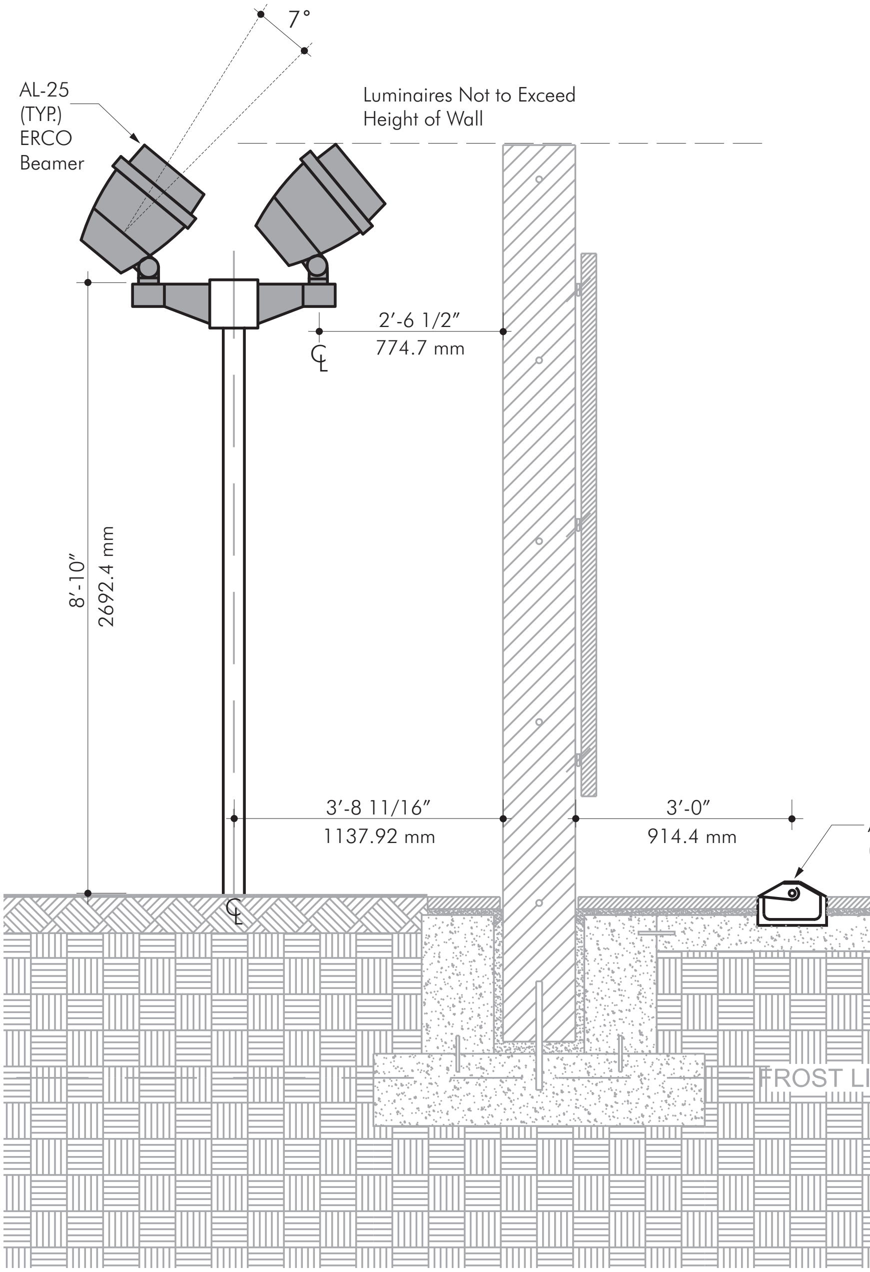
Precision Detailing

Meticulous detailing ensures that lighting is seamlessly integrated with the monument. Luminaires aimed to the top of the spires are positioned on custom mounting frames behind granite inscription walls. The setback and height of these luminaires conceal them from view by visitors, without obstructing the beams of light. Additional lights are precisely embedded into the granite paving at the base of each spire. Luminaires used throughout the memorial are treated with a corrosion resistant finish used by the automobile industry—instead of the standard polyester powder coat—and have fully integrated, non-exposed cables to minimize maintenance over decades.

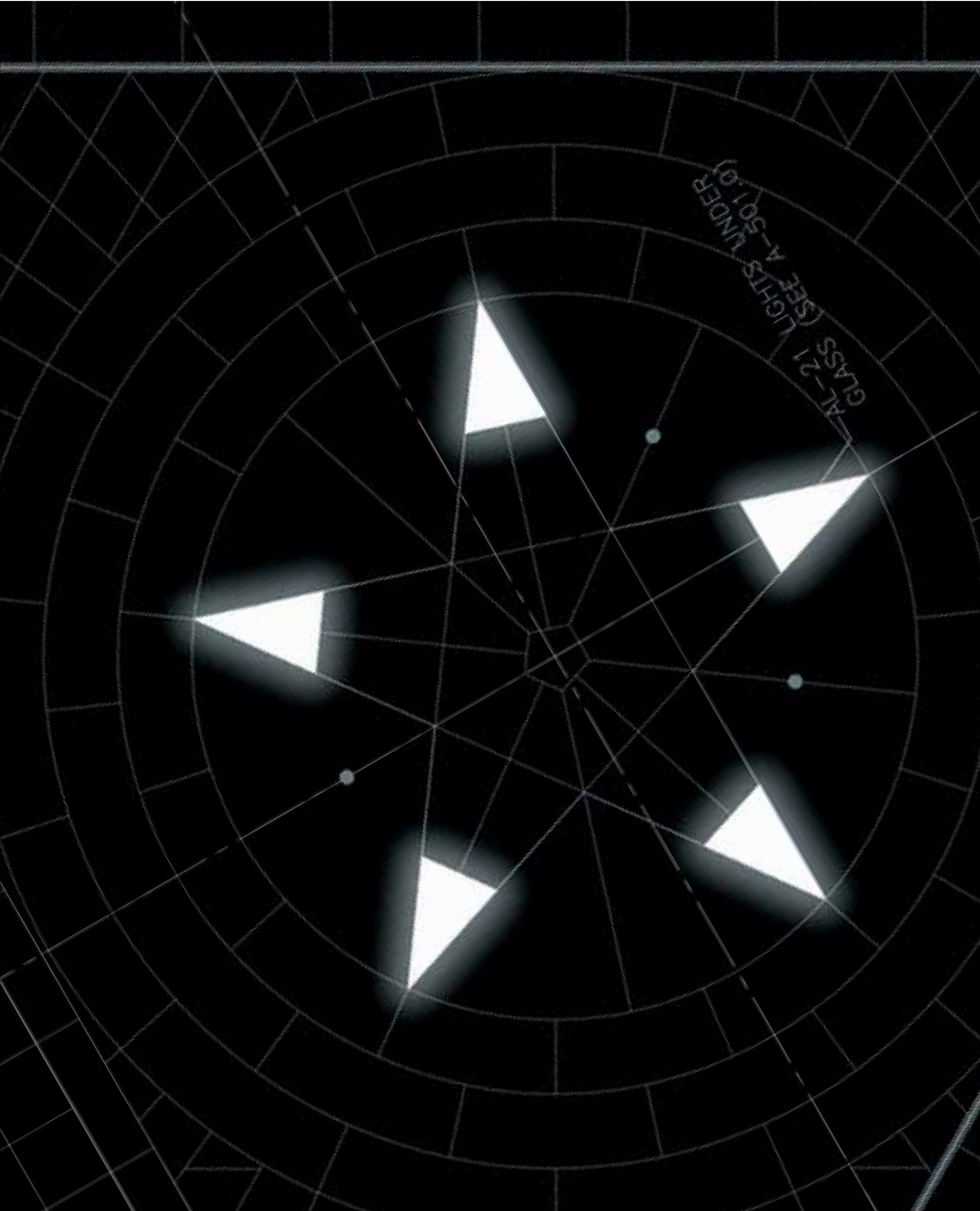
Specialist climbers who scaled the monument to conduct seismic measurements also took light readings using hand-held meters to reconfirm the lighting calculation data.

Opposite: Light-aiming diagram (plan view); specialist climbers taking seismic and light level readings; climbers' view from above

Below: Lighting mounting details



This page: The architectural gesture of the spires is inspired by bomb burst maneuvers



Ambient Glow

The Air Force Star logo is embedded in the pavement design, creating a luminous orientation point for the memorial under the shelter of the towering spires, at the promontory overlook.

The illuminated star luminaire is composed of 6-foot-long triangular panels of laminated, frosted glass—and a construction designed to support the weight of utility vehicles. The custom luminaires also feature a frameless trim detail for a minimal and precise appearance and are equipped with LEDs so that the entire assembly fits within the 15 cm (6”) depth of the granite paving.

Below and left: Air Force Star at the promontory overlook

Above and right: Illuminated inscription walls
Below: Custom casting process for the stainless steel hoods

Forged in Stainless Steel

In-grade luminaires are equipped with protective metal hoods that reduce and shield their aperture and provide even, low-glare illumination of the vertical wall surfaces. The honed granite walls serve as a backdrop for the polished inscription panels. The architectural materials and lighting work together to minimize the distracting reflections along the length of the wall that are commonly created with traditional uplights and polished granite panels meeting the floor.

Instead of using standard bronze hardware, the hoods are cast in stainless steel, matching the spire's material and architectural integrity of the monument. The custom casting process is highly involved. Each piece is individually forged in a precision mold and hand-finished. With a fixed date for the dedication ceremony, the sequencing of casting and fabrication was determined years in advance.

Lights at the base of each spire create a smooth gradient of illumination over the lower portion of the structures, highlighting their elegant contours. The glowing Air Force Star is visible at the overlook between the spires.

Soft backlighting generates a subtle depth of space between the honor guard and the granite inscription wall, which is lit by custom-cast luminaires. Pavement-embedded lights dramatically illuminate the sculpture like a museum object.

Museum of Modern Art (MoMA) Design Store

New York, New York / USA

Architects: Yoshio Taniguchi (museum), Gluckman Mayner (design store)

2004-2005

The MoMA Design Store has an international reputation for classic sensibility and functionality, just like the kind of objects it sells. Lighting for the store's flagship location inside the Museum of Modern Art follows in this spirit. Custom lighting systems are seamlessly incorporated into the clean-lined surfaces and furnishings of the midtown Manhattan space, in keeping with the institution's modernist aesthetic and philosophy.

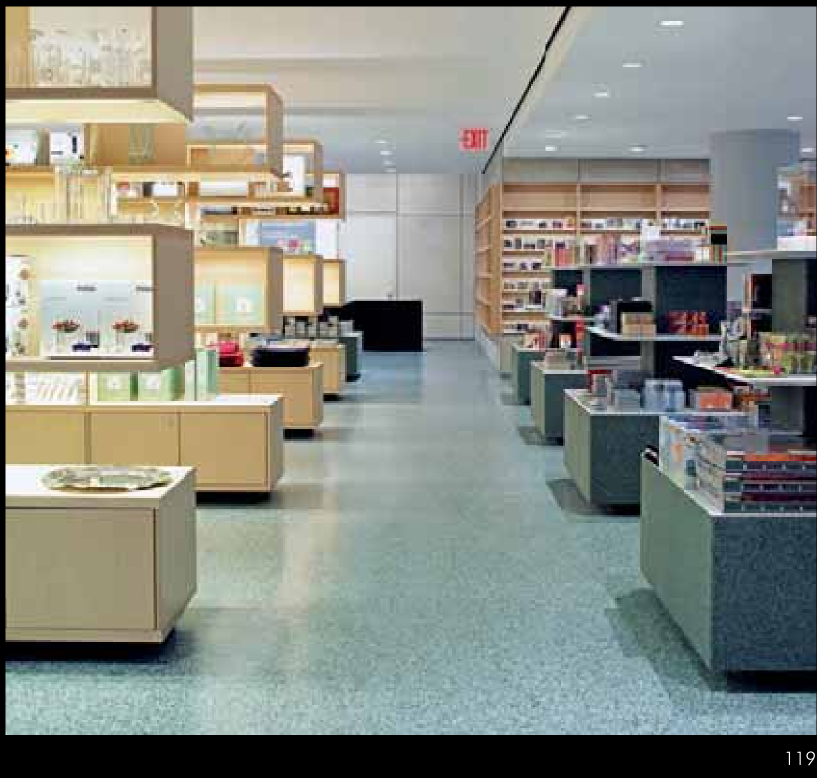
Each of the store's three zones uses a minimalist, controlled design approach to generate dramatic lighting effects. Marking the main circulation corridor, a line of luminous coves doubles as a striking graphic element on the ceiling. Miniature profile luminaires are integrated in the custom shelving that occupies the center of the store. In remaining areas, book and object displays are precisely lit by small-aperture, ceiling recessed luminaires.

The custom shelving system integrates bespoke display lighting. Early in the design process, millwork dimensions were coordinated to accommodate extremely slim luminaire profiles, while the bases of the units house the control equipment. The concealed luminaires cast a warm 3,000K color temperature light on objects within and on top of the shelves, eliminating the need for typical ceiling lights in this area. This integrated lighting approach features the objects in optimal lighting conditions, without any shadowing or silhouette generated from luminous surfaces behind or underneath the objects.

Above the freestanding product displays and cashier areas, accent lights are arrayed in a disciplined grid, marked by square apertures. The varying heights of display stands, counters, and tabletops are taken into account in determining each luminaire's focus and direction. By implementing a lighting design that gives different luminaires (spotlights, wallwashers and downlights) a uniform aperture and appearance from below, the store is endowed with a minimalist field of lights. Functionality unites with pristine form.

Opposite: Lighting draws views to product displays within the MoMA Design Store.


EXIT


EXIT

C.V. Starr East Asian Library
at the University of California, Berkeley

Berkeley, California / USA
Architects: Tod Williams Billie Tsien with Tom Eliot Fisch
2003-2007

Berkeley's C.V. Starr East Asian Library contains over 900,000 volumes, as well as thousands of manuscripts, stone rubbings, bronze objects, and inscriptions, making it one of the largest collections of East Asian language materials and artifacts in the United States. A subtle lighting approach highlights the library's carefully crafted architecture and contents.

At the entrance, a custom lantern acts as a vertical light beacon, illuminating the cantilevered entry bridge. On the façades, cast bronze screens inspired by Asian motifs catch and diffuse daylight into the library, while shielding against the glare of direct sun. At night, the bronze screens transform into glowing, golden veils. Illuminated by LED sources located along their base, the miniature size of the linear luminaire—50 mm (2") square in profile—makes it nearly invisible and allows for a seamless integration at the façade. Specifically highlighting the screen instead of floodlighting the entire façade, the lighting creates a sparkling presence at the heart of the Berkeley campus and marks the library as a destination.

At the time of the design and construction, large-scale outdoor applications of LEDs were rare. Mock-ups were conducted to determine optimal spacing to best accentuate the texture of the deep-set screens. The chosen color temperature of 3,000K enhances the rich tones of the bronze.

To complement the library's serene interior atmosphere, a discreet approach is taken to lighting the collections. In reading rooms, lanterns are hung at varying heights, creating delicate focal points and contributing to the intimate feel of these study environments. While library stacks are usually illuminated using linear fluorescent luminaires, point source compact fluorescent lights are deployed here to maintain a non-directional and visually unobtrusive ceiling.

A multitude of lighting calculations were performed to determine a pattern that would provide appropriate vertical illumination for sliding compact stacks in their ever-changing configurations. Optimization of the layout, along with the use of high-efficiency sources, maximizes lighting where it is needed while minimizing energy use. These strategies assure the scheme's compliance with Title 24, California's rigorous energy code. Both the interior and exterior lighting for the library remains visually discreet, enhancing the space's open and airy architecture while quietly meeting the stringent technical requirements for this building type.

Opposite: Glowing like golden veils at night, bronze screens are illuminated from below, while a vertical lantern draws visitors to the upper-level main entrance.


C.V. STARR EAST ASIAN LIBRARY

New York City Streetlight

New York, New York / USA

Architects: Thomas Phifer and Partners

2004 - Winning Competition Entry
2008 - Design, Testing and Fabrication of Prototypes

In 2004, New York City's Department of Design and Construction, together with the Department of Transportation, launched an international design competition to create a new standard streetlight for the City of New York. OVI was the lighting designer for the winning team of the "Citylights Competition", which drew over 200 entries from 23 countries, with multi-disciplinary teams including architects, engineers, urban planners, lighting designers, industrial designers, and manufacturers. In 2008, the design, testing and fabrication of prototypes began based on the winning design.

Solid-state technology has become so common, it is hard to believe that the winning design was a breakthrough and sensation in the exterior lighting industry at the time. High-performance LEDs were an emerging technology and in 2004, the design was ahead of its time in calculating that LEDs could perform in this demanding application. The sleek form of the streetlight derives from the possibilities of LEDs. In contrast to the bulky luminaire heads associated with traditional lamps, the streetlight takes on a slim, elongated profile enabled by the tiny size of its light sources, which do not require a hefty decorative enclosure. The curving arc of the luminaire is a direct expression of the linear arrays of LEDs it contains. It is also a heat sink for the luminaire designed to dissipate and distribute the heat produced by the LEDs along the length of the luminaire housing itself.

Compared to standard streetlights with a single point source, the LED streetlight's distribution of light is more even, produces better contrast ratios, renders colors with greater accuracy, and minimizes glare. All of these aspects contribute to better safety and security along city streets and sidewalks.

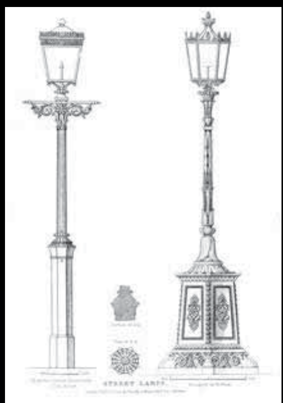
Each luminaire houses a series of LED 'modules' which contain an LED light engine, optical lensing, and a heat sink. First developed in the 2004 competition entry, the idea for the innovative modular design builds future flexibility into the system. LED technology continues to improve at a rapid rate, and the streetlight was designed to accommodate this change: LED modules can be replaced with more efficient types and enhanced glare control in the future without changing the entire luminaire. The streetlight thus has the ability to keep pace with the evolution of technology while the overall appearance remains the same.

Designed as a one-to-one replacement for the ubiquitous 250-watt high-pressure sodium Cobra Head, introduced over fifty years ago, the LED streetlight will be added to the Department of Transportation's street lighting catalogue, making it the new citywide standard for installations within the five boroughs. In 2011, the initial LED streetlight prototypes—the first of their kind for New York City—were installed near City Hall in downtown Manhattan.

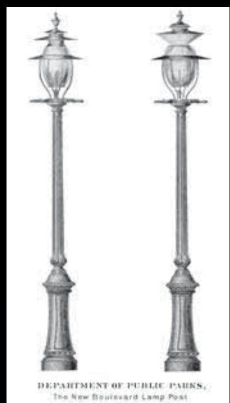
Opposite: The first prototypes installed in downtown Manhattan.

Two Centuries of Streetlights in New York City

Oil - 1762



Gas - 1825



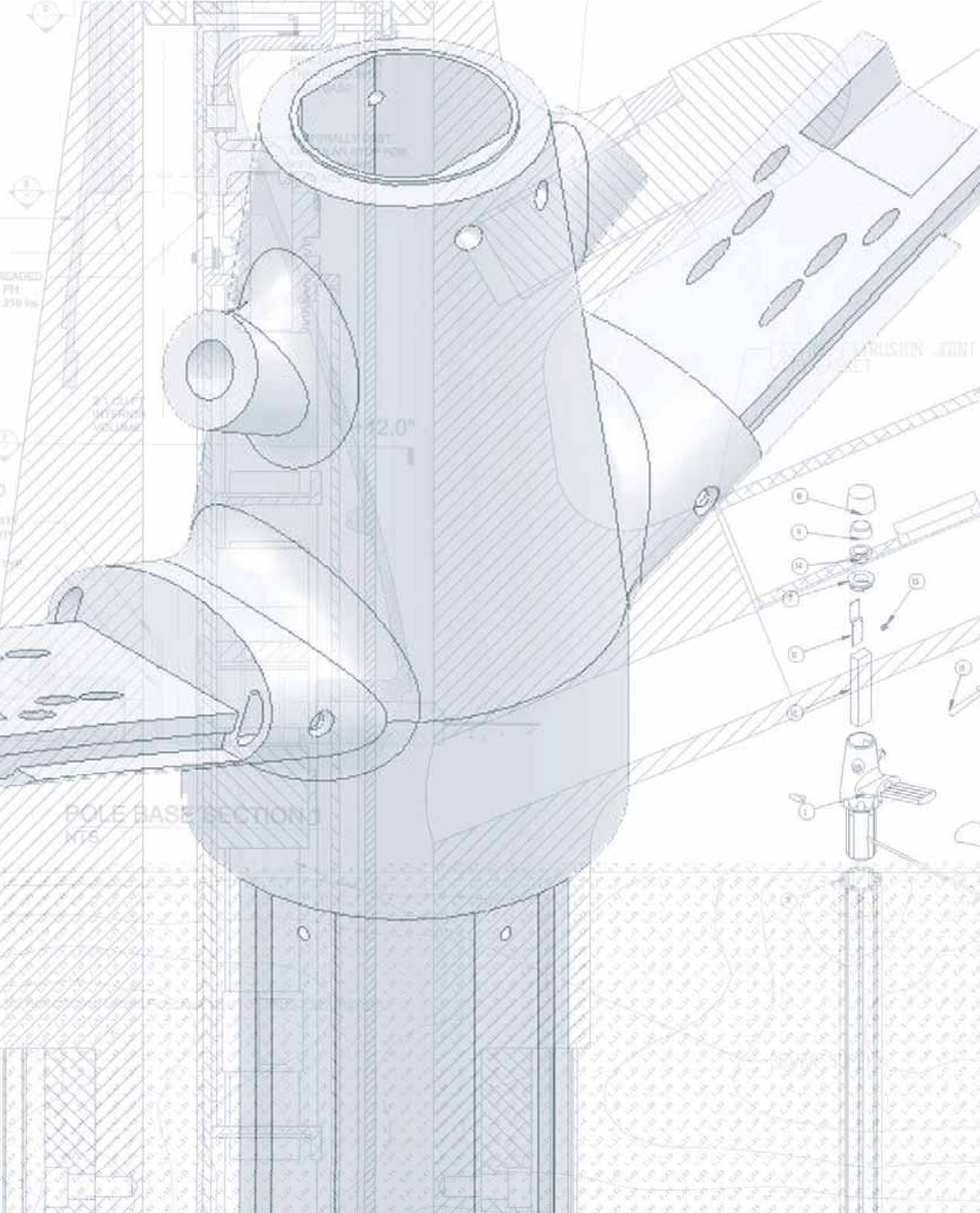
Gas - 1871

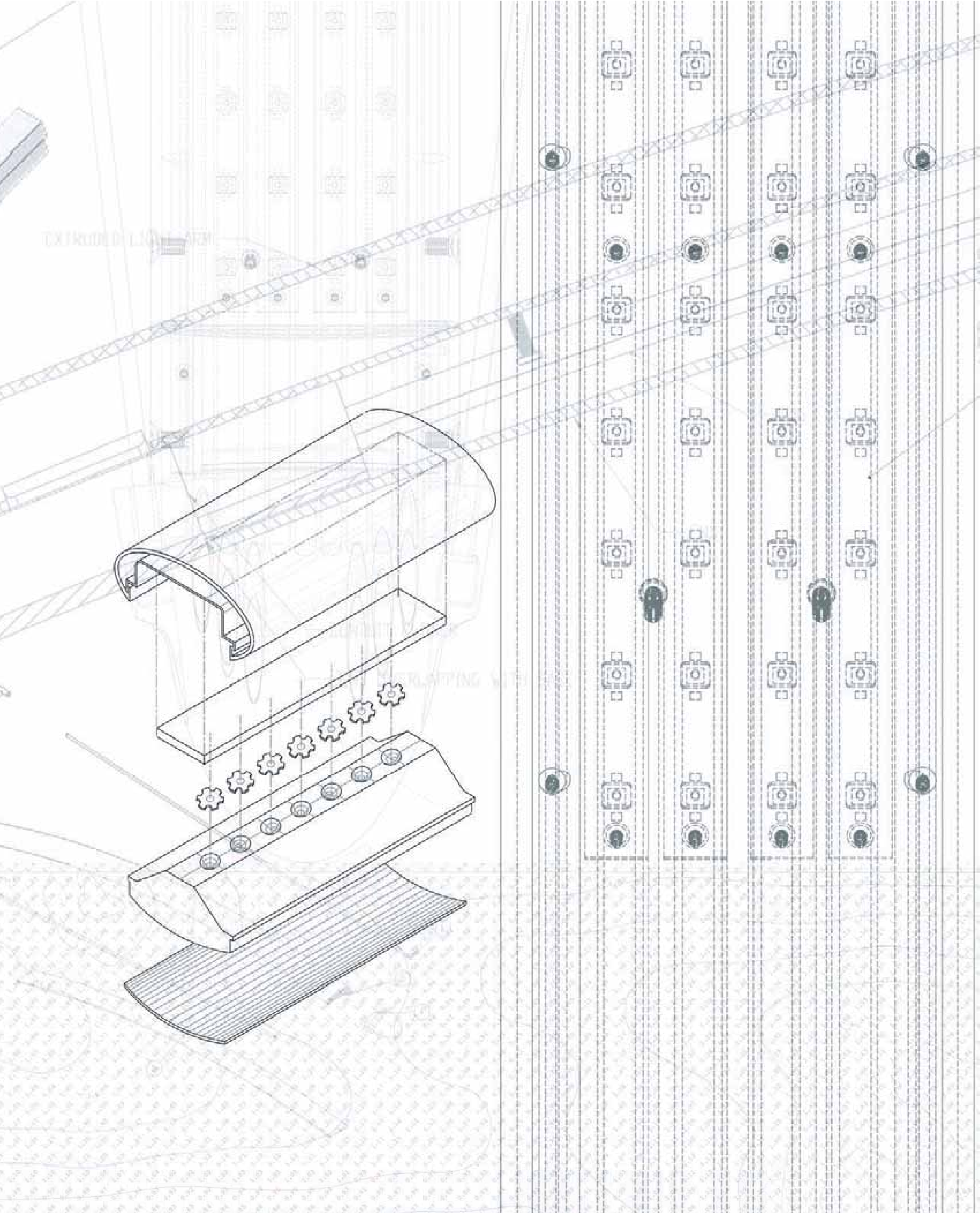
Electric - 1880

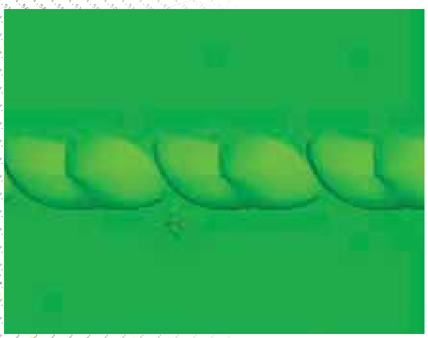
Sodium vapor - 1933

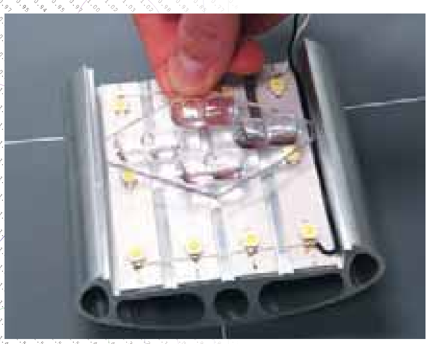
High pressure sodium - 1960

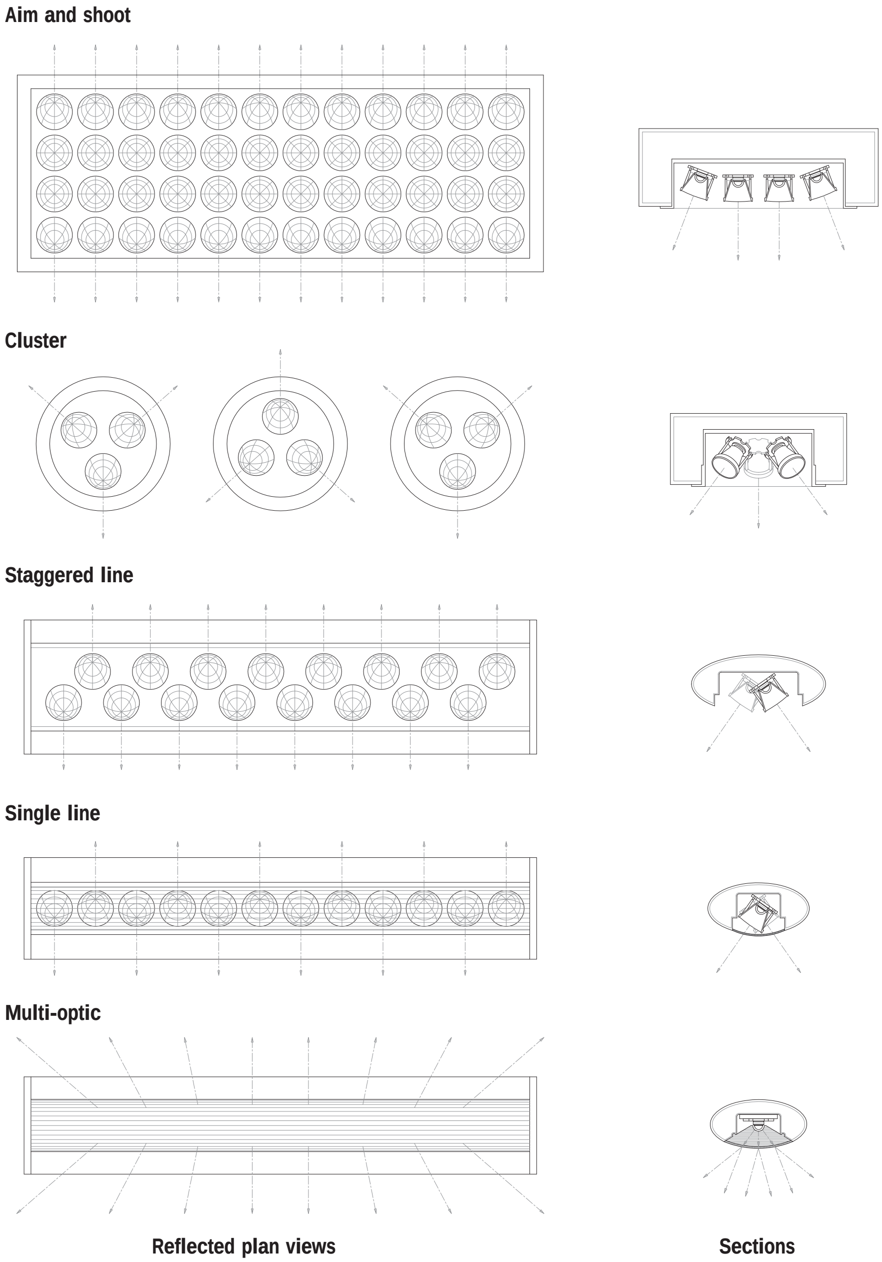
Solid-state lighting - 2004

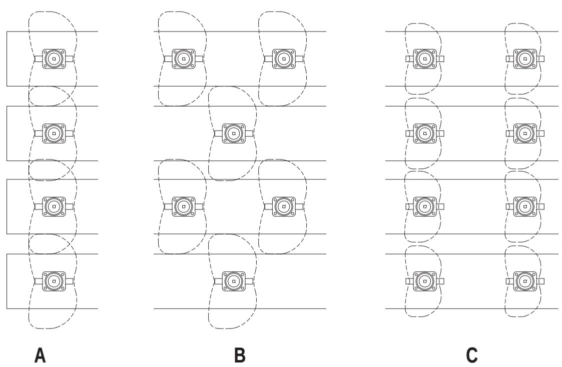

12.0"
POLE BASE SECTION
NTS








Aim and shoot
Cluster
Staggered line
Single line
Multi-optic
Reflected plan views
Sections


A
B
C

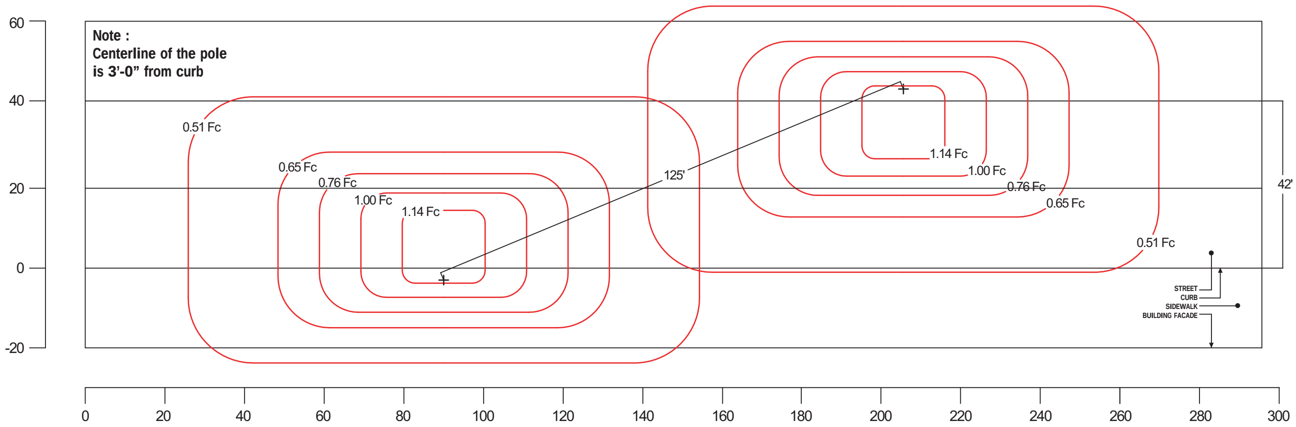
Technology Transforms Design

A variety of LED clustering options were explored to define and optimize the LED configuration. At the initial stage, each LED with its individual optics was tilted and aimed to produce the required light levels and distribution. During the evolution of the design, LEDs were eventually staggered, then streamlined into a linear array and paired with multi-lens optics, significantly reducing luminaire size and fabrication cost.

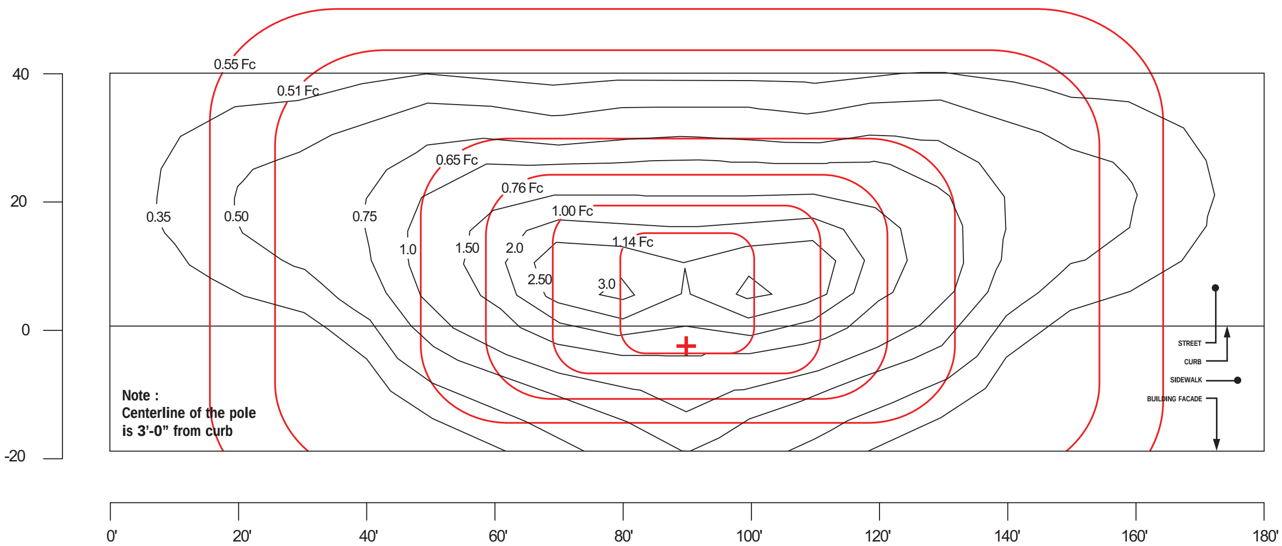
Using optics, precise calibration of the beams produced by individual LEDs results in optimal lighting distribution without the need for aiming. A controlled overlap between light beams accounts for the possibility of an LED failure, ensuring uniformity on the roadway.

The New York Department of Transportation requires that streetlights be staggered on a 38 m (125') diagonal from each other and achieve one footcandle in the overlap zone of the light distribution. The LED streetlights situated in this manner provide light levels equivalent to existing installations and a much more even and controlled distribution of light, free of lighting hot-spots and neatly directed along the length of the street.

Opposite: Exploratory study diagrams for LED arrays
Below: Isolux diagrams comparing footprint of LED streetlights (red) to HPS Cobra Heads (grey)
Previous spread: Drawings and diagrams of the LED streetlight design and development



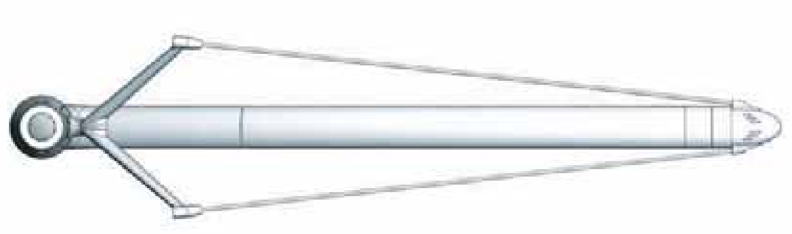
LED streetlight footprint - 250W HPS equivalent



LED streetlight footprint (red) overlayed on existing HPS cobra head footprint (grey)

Modular Design

ELEVATION



TOP VIEW

The design and development of the streetlight has kept pace with the evolution of LEDs, taking full advantage of the technology's possibilities. The development of high output, "small package" LEDs—each one the size of a ballpoint pen tip—has allowed refinement of the original proportions compared with the competition design. Instead of a 2.7 m (9') long luminaire, the final design is more balanced at approximately 2.4 m (8') long. The energy performance of the streetlight also improved: while the original competition design used (64) 3-watt LEDs, the initial prototypes generate the same light footprint with (80) 1.7-watt LEDs, a significant energy savings from the 250-watt high-pressure sodium lamp and further energy savings can be anticipated.

Standard practice with earlier generations of LED technology was to attach LED circuit boards directly to the luminaire housing. Instead, the design of the New York City streetlight was the first to pioneer a modular approach which has quickly become an industry standard. In the initial prototypes, each luminaire arm accommodates five modules containing sixteen LEDs each, complete with optical lensing. Each module can be easily replaced, while the electronic drivers and luminaire housing remain undisturbed.

The use of a modular system facilitates fabrication and installation of the lights, while building future flexibility into the system. As the technology improves, lighting modules can be swapped out with new modules, which may use fewer LEDs to generate the same overall footprint and amount of light. The streetlight thus has the ability to advance with time, becoming less costly and more energy-saving as technology develops.

Opposite: Streetlight assembly diagram
Right: Early pole prototype rendering

Below: Installation of streetlight prototypes
Opposite: Daytime view of streetlight prototype
Following spread: Nighttime view of streetlight prototypes

The first of its kind

The apparent simplicity of the streetlight design belies its technical complexity. Even the support pole has multiple design features and requirements: slight tapering over its 9 m (30') height slims its appearance while maintaining an indiscernible conical shape that provides increased structural stability. As the pole connects to both the luminaire housing and to the base of the streetlight it becomes the dimensional setting out point and the tolerances must be exacting.

Distinguished from other LED streetlights that have appeared on the market since the groundbreaking design, the Citylights streetlight has undergone rigorous testing and prototyping to meet the stringent requirements of New York City's Department of Design and Construction, Department of Transportation and Public Design Commission—a process that assures the quality and performance of the streetlight. The resulting streetlight's sleek form is entwined with state-of-the-art lighting technology and is poised to illuminate streets, sidewalks, and parks within the five boroughs of New York.


AFRICAN BURIAL GROUND AND THE COMMONS HISTORIC DISTRICT
BROADWAY
ONE WAY
NO STANDING
ANY TIME
EXCEPT AUTHORIZED
VEHICLES
CHCC
Phone

Museo del Acero – Museum of Steel

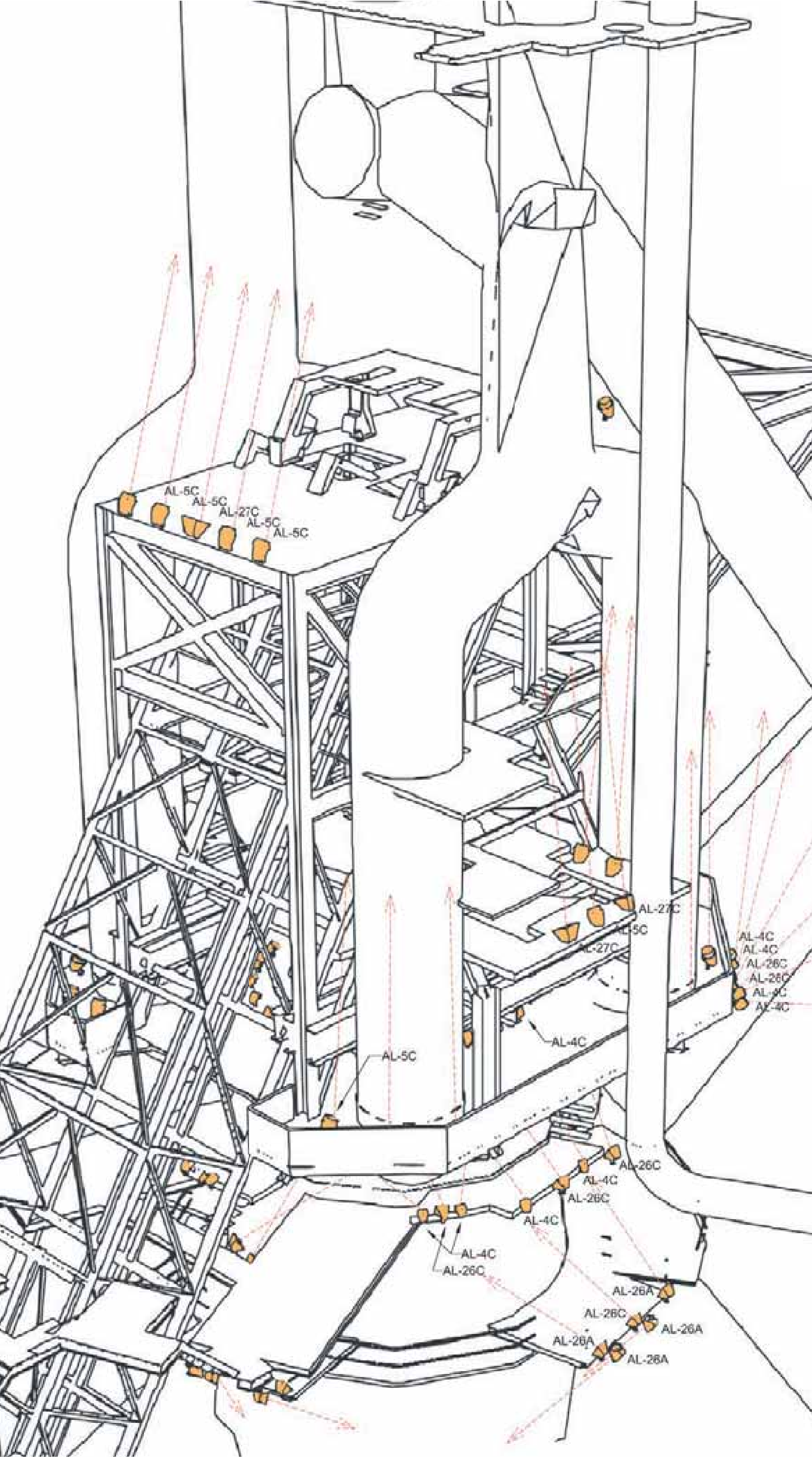
Monterrey, Mexico
Architects: GRIMSHAW with Oficina de Arquitectura
2005-2007

Lighting creates an evocative nighttime identity for the Museo del Acero, a restored blast furnace at the center of Monterrey's urban Parque Fundidora. Visible from the surrounding city, the structure glows with iconic colors that call to mind its heritage as an active manufacturing site and present-day life as a steel museum.

While many industrial structures are over-lit with an arbitrary variety of colors, lighting for the museum carefully considers the site's history. The theatrical and colorful approach to the lighting scheme is based on studies of the steel-casting process. When in operation, the interior of the furnace blazes with the yellow-orange glow of intense heat of molten metal, and is surrounded by smoldering flames in blue and purple tones.

Transferred to the exterior, this spectrum generates a powerful lighting identity for the structure. Color choices were refined through on-site mock-ups, using metal halide luminaires with an industrial appearance, equipped with color filters of varying tones and saturations. Exposed work lights add sparkle at the terrace and catwalks.

Opposite: Lighting evokes the Museo del Acero's earlier life as a blast furnace.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AL-26A

A unique challenge at the time was communicating the intended positions of lights on the blast furnace's complex, catwalk-encrusted structure. A set of axonometric lighting drawings was generated as an inventive tool to convey the placement and aiming of each luminaire. This information would have been nearly impossible to document through traditional plan, section and elevation drawings.

On-site mock-ups facilitated the refinement of exterior lighting color choices. Testing involved using different filters, color saturations, and light levels to find the most evocative combinations.

Previous spread: Museum at dusk
Above and left: On-site mock-ups
Opposite: Axonometric lighting and aiming drawing

Al Hamra Firdous Tower

Kuwait City / Kuwait

Architects: Skidmore, Owings & Merrill with Al-Jazera Consultants

2005-2012

Standing 412 m (135') high, the Al Hamra Firdous Tower is the tallest skyscraper in Kuwait City and the world's highest sculpted building. Carefully configured interior and exterior lighting emphasizes the structure's unique architectural identity. Lighting enhances its landmark presence as a dramatic focal point, visible throughout the city and from the Arabian Gulf.

The tower's fully glazed façades resolve into a pair of ribbon-like concrete veils to the south, providing protection against the harsh desert sun. The brilliantly-lit ribbons of concrete form a striking contrast and give the twisting tower a spectacular skyline presence. Variations in brightness are used to articulate the curvilinear forms. A controlled gradation of illumination highlights the interior surface of the flared veils, drawing the eye up to the tower's apex.

Inside, a soaring 20 m (66') high lobby soars above visitors. Arched vaults and screens recalling woven Arabic motifs crown the space. A combination of lighting techniques intensifies the visual layering of this architectural feature.

The use of daylight is an important consideration for the all-glass office tower façades. Because of the hot climate, a balance must be struck between allowing natural light to enter and shielding against excessive solar heat gain. Daylighting studies were carried out to verify light levels and advise on glass fritting patterns for the curtain wall. A gradient pattern was developed to achieve the desired results, pairing light-reflecting white ceramic dots on the exterior glass with glare-reducing black dots on the interior panes.

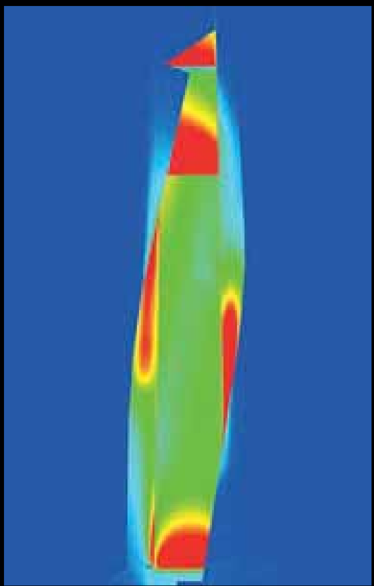
Opposite: At night, the tower's curving concrete veils are brilliantly lit, forming soaring ribbons of light.

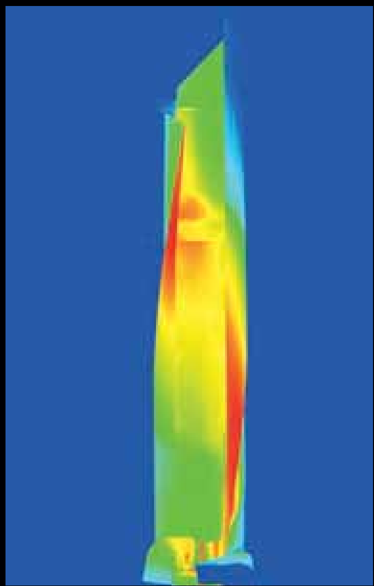
Sculpting with Light

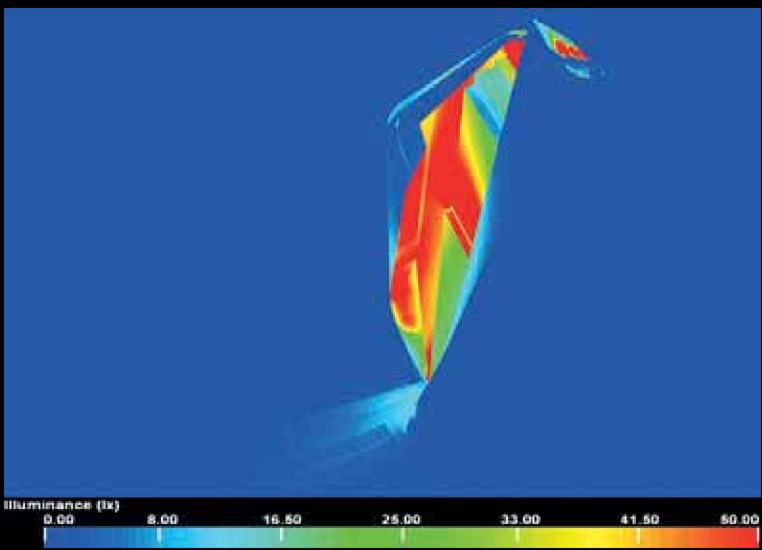
Controlled gradations of light accentuate the twisting geometry of the tower at night. Well-shielded, narrow beam luminaires highlight the unique shape of the flared veils. Light levels intensify within the dynamic turns of the structure, culminating at its upper tip. The illuminated curved elements advance to the foreground, drawing views up to the tower's apex and beyond into the night sky.

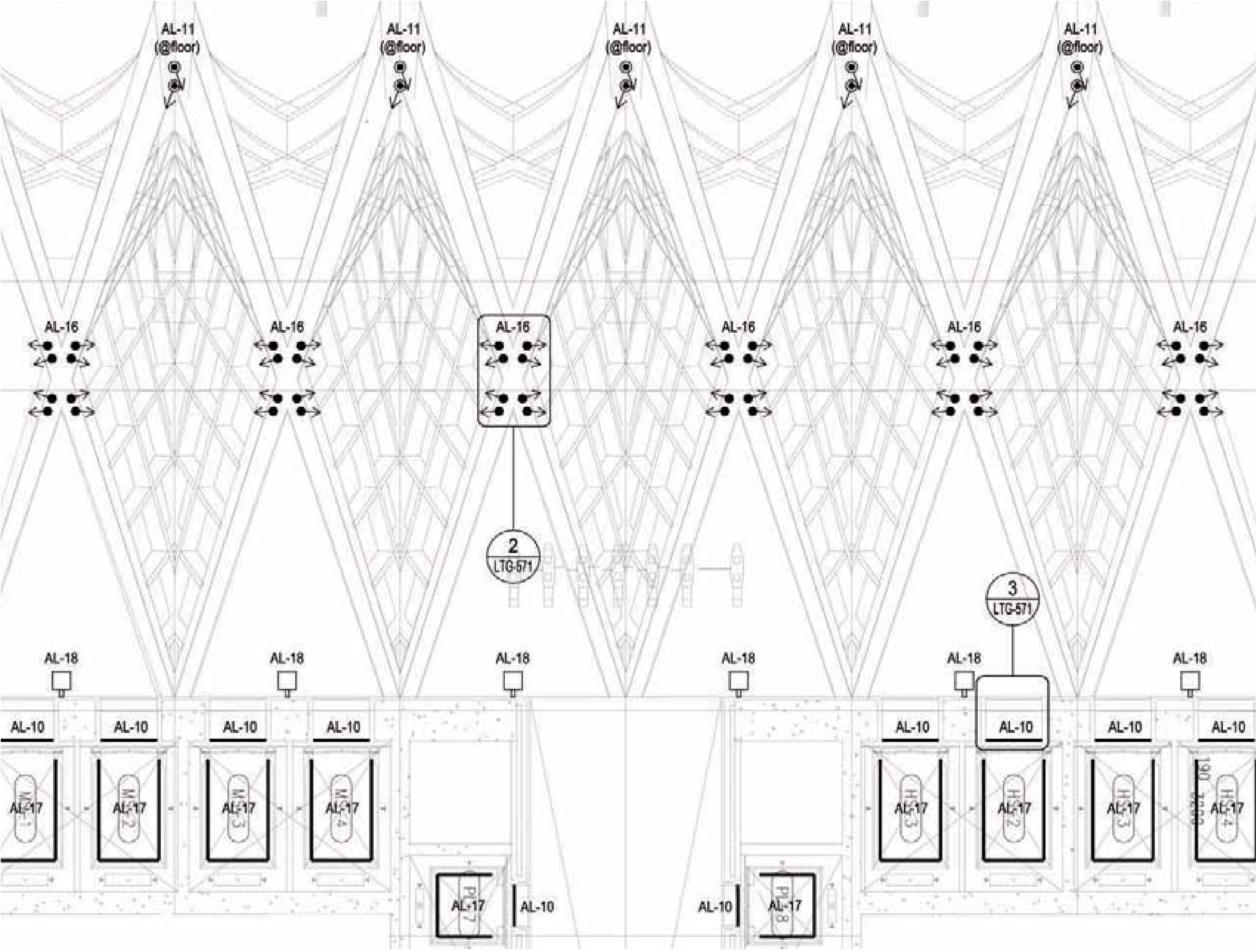
To achieve the desired visual modeling of the tower's form, lights are grouped at specific locations. Two banks of metal halide floodlights set on the podium roof are aimed to calculated points on either side of the curved concrete veils. Additional luminaires, discreetly concealed within the parapet and building setbacks, highlight the curling tip. Together, these shape the perception of the twisting tower at night, by defining its contours and creating contrasts of light and shadow across its surfaces.

Below and right: Light-aiming diagrams and calculations









A central feature of the tower is its soaring eight-story high lobby space, crowned by a filigree concrete ceiling structure. Between the curving parabolas of the vaults, structural members form a filigree screen. A combination of luminaires enhances the visual layering of these elements, evoking the overall height of the space. Bursts of illumination from in-grade lights catch on the curved arched columns supporting the ceiling. Concealed above the ceiling, long-life metal halide downlights provide the principle source of illumination for the lobby. Uplights above the screen reveal the presence of a spatial volume beyond the latticework, creating an added depth of space.

Above: Lobby lighting plan
Right: Lobby during construction

This page: Building under construction
Opposite: Daytime view

Canadian Museum for Human Rights

Winnipeg, Manitoba / Canada
Architects: Antoine Predock with Smith Carter
2008-

The Canadian Museum for Human Rights is strategically located in the heart of downtown Winnipeg, at the junction of the historic Red and Assiniboine Rivers, an area known as the Forks. The site was chosen because of its historical significance as a center of settlement and trade among the nation's indigenous people. Conceived as a center of learning about human justice and liberty, the museum's architecture signifies hope for a changed world. The architectural design creates an intuitive experience for the visitor progressing from darkness to light, symbolizing the journey towards achieving greater human rights.

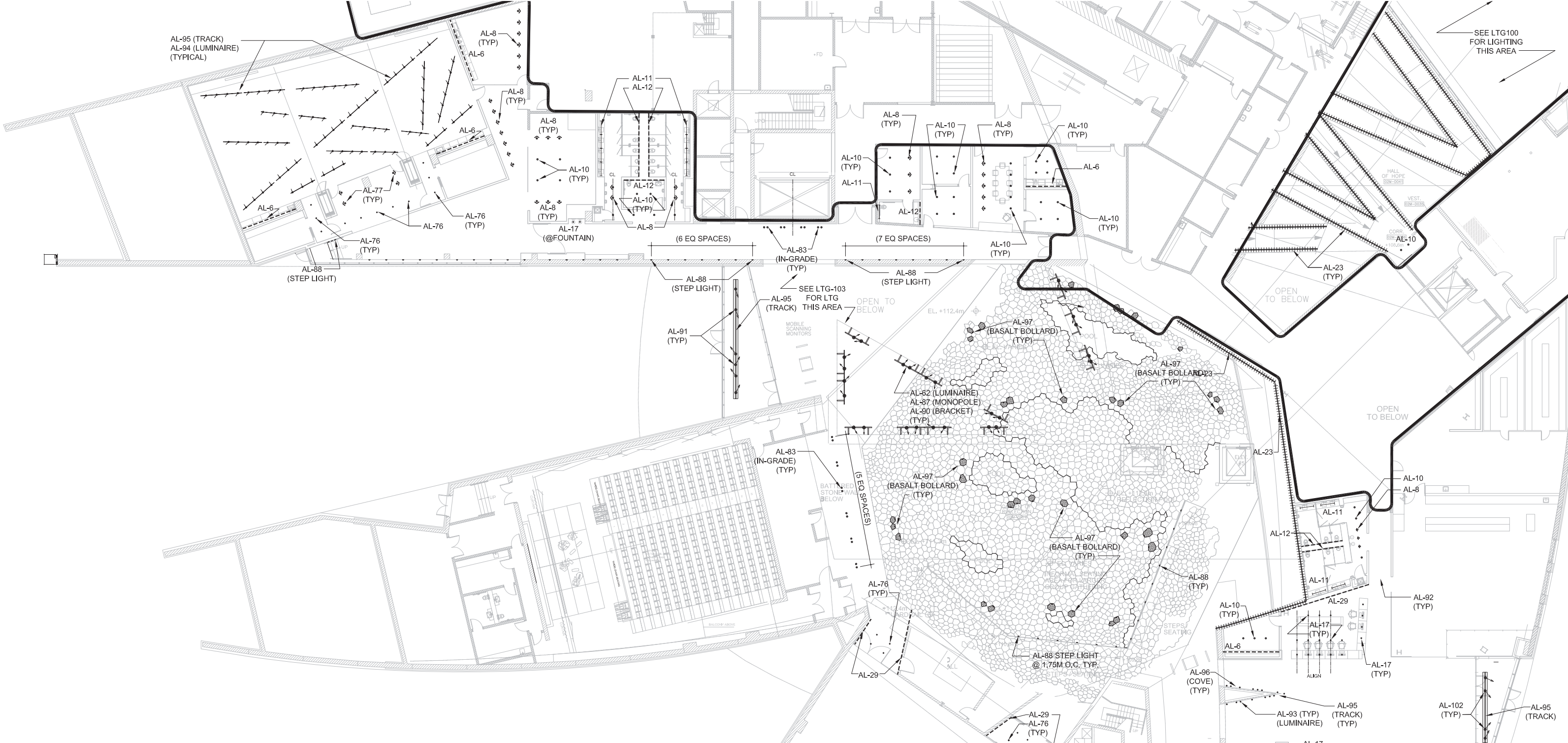
The architectural form is inspired by universal themes, local culture and Canadian landscape imagery: roots, dove wings, ice shards and clouds. Lighting enriches these architectural elements and establishes the building's nighttime identity. A succession of spaces and strategic use of light and shadow direct visitors along the narrative path.

Visitors enter the museum between the outstretched "roots"—a framework of stone arms with roof terraces and outdoor seating that extends into the landscape. The use of contrast characterizes the cavernous entrance. Dark finishes cover the walls, while narrow beams of light focused on the floor intuitively draw visitors to the entrance lobby, providing wayfinding and orientation. Within the lobby's rough concrete interior, recessed lights with shielded lamp filaments in low ceilings provide an intimate atmosphere. The space shifts dramatically and opens up to the soaring daylight filled atrium where the "garden of reflection" is situated. Lights camouflaged within the surrounding structural framework supplement the ambient light when needed. A field of steplights are embedded within low height, basalt columns that act as bollards, creating sparkle at night.

Continuing into the museum, visitors walk along glowing, alabaster bridges that cascade up through the atrium and lead to colored portals of light that mark entrances to galleries. At the apex of the space, visitors ascend to the 23 story high "tower of hope", a crystalline, ice-shard inspired structure. The tower's glass structure appears as a beacon illuminated by brilliant, sparkling points of light, melding with the night sky. Meanwhile, the cascading glass panels of the spiraling stairs are internally lit, creating a glowing, swirling form that reinforces the verticality of the tower.

Embracing the museum like the wings of a dove, the light-filled, glass "cloud" structure accommodates offices and the functional support spaces for the museum. Both architecture and lighting are entwined allowing this volume to float in sharp contrast to the weighty atmosphere of the "roots" and galleries. A gradated white frit renders the glass cladding opaque in some sections and transparent in others, creating a feather-like effect and coordinated with interior functions: open in offices and opaque in service areas.

Opposite: The museum's crystalline "tower of hope" emerges from the surrounding "cloud" structure.



In early design stages, various lighting strategies were explored for shaping the museum’s nighttime image. Lighting the tower brightly would create a lone beacon of light, while emphasizing the cloud-like cladding would render the museum as a luminous mass. A combination between these two strategies balances the brightness of both major building elements. The shard-inspired central “tower of hope” is illuminated to accentuate its sharp lines and crystalline qualities. Narrow beam metal halide floodlights produce sparkling points of light, and are mounted to the structural truss work. To maintain the integrity of the translucent “cloud” volume, the ceiling is kept visually clean, and receives a soft bounce of light from furniture-integrated fluorescent uplights instead of typical office lighting. This creates a soft glow of light at the undulating façade with no direct view of luminaires, enhancing the volume of the “cloud”.

At the ground level, the wedge-shaped profiles of the “roots” are lit with a composed layered effect of light and shadow. The landscape illumination is kept visually silent with only the ground surface gently lit for safety and orientation, so that the building remains a luminous focal point at night.

Above: Lighting plan
Below: “Garden of reflection”
Opposite: Exterior lighting rendering

Perot Museum of Nature and Science

Dallas, Texas / USA
Architects: Morphosis with Good Fulton & Farrell
2009-2013

The Perot Museum of Nature and Science, conceived as an immersive, curiosity-stimulating environment, resides in Victory Park within the heart of the Arts District in uptown Dallas. The cube-shaped structure sits atop a landscaped plinth that undulates dramatically above the entrance plaza. Revealing different views from every approach, the design evokes a sense of discovery and insight as visitors meander through the site.

The lighting design is woven into the architecture and reinforces the overall themes of the project—the dynamic juxtaposition between the natural and man-made environments and the exploration of unexpected spatial relationships while providing an iconic nighttime identity.

At night, a glowing atrium core visually bursts through the crevice-like glazing at the façade accentuating the building's sharp, sculpted form. Defined vertical surfaces within the atrium are more intensely illuminated, while the exterior façades glow softly from floodlights positioned in the surrounding landscape. A continuous-flow escalator emerges from the façade and is treated with a central luminous light line, reinforcing the sense of upward movement. The interior glow from glazing at the entrance level allows the building to hover and gives the impression of a gravity-defying, floating cube above.

Color temperatures are playfully calibrated to enhance the building's distinctive nighttime identity. Instead of employing one color temperature throughout, the interior, warmer color temperature visually contrasts against the cooler exterior escalator, emphasizing the dynamic signature of the building.

Inside, lighting strategies continue to inspire visitors to engage with the building. In the main lobby, lighting is a visual echo of the architectural facades. Light lines of different lengths and arranged in a 'stitch-pattern' are suspended above the undulating metal mesh ceilings creating a sense of movement that complements the refined industrial style of the architecture. Denser fields of luminaires are clustered towards focal areas that require higher light levels, while dispersed patterns are used to illuminate circulation areas. Oversized pod-shaped forms become crystalline lanterns leading visitors thru transition zones.

Light and shadow articulate architectural elements and focal points of various scales throughout the building. Atrium walls and façades are evenly lit to express their spatial volume and provide visual anchor points for key spaces. Luminous lines provide ambient light levels and draw visitors throughout the museum, creating an intuitive way-finding system such that escalators, bridges, and stairways dramatically penetrate through spatial voids. In the theater, these lines become fluid, unexpected wave forms standing in sharp contrast to the cubist form of the building itself.

Opposite: Light emerges through crevice-like glazing at the façade, dramatizing the building's signature nighttime appearance.

Above and right: Lobby lighting arranged in a 'stitch-pattern' suspended above undulating metal mesh ceilings; exterior path at entrance; crystalline pod-shaped lanterns

Opposite: Fluid bands of light in the theater


EXIT

King Abdullah Petroleum Studies and Research Center (KAPSARC)

Riyadh / Saudi Arabia
Architects: Zaha Hadid
2009-

Situated in Riyadh, the King Abdullah Petroleum Studies and Research Center (KAPSARC) is a global center for international energy analysis, environmental research and policy studies. The overall site exceeds 500,000 m^2 (5,000,000 ft^2) and consists of multiple buildings including a research center, conference center, musalla (prayer room), IT center and research library. The complex also includes shaded outdoor spaces, courtyards, gardens and open atria woven together by an open-air central plaza, known as the Place of Icon.

The architectural design features a series of interlocking, cellular structures—dune-like forms rising from the desert landscape. Hexagonal in plan and section with varying heights, these structures encompass of a multitude of different architectural elements including folded ceiling planes, hexagonal skylights, open atria, canted walls, triangulated niches, sloped ceilings, and shard-like panels that wrap walls and ceilings. Both the interior and exterior spaces are highly atypical and asymmetrical, having no right angles or identical sections.

An overall lighting design logic was critical to visually unify the diverse buildings—ranging from administrative and gathering spaces, to auditoriums and a worship hall and reinforce the avant-garde architectural aesthetic. Lighting is utilized throughout the complex to emphasize angular geometries, while being completely integrated to become an extension of the architecture.

Innovative lighting strategies also support the facility's agenda as a global sustainable energy research center. A lighting masterplan of energy efficient and sustainable solutions throughout the complex help the project meet its LEED Platinum goal, a first of its kind in Saudi Arabia. The overall control strategy employs a digitally addressable lighting interface system, zoning controls, dimming capabilities, daylight and occupancy sensors, and energy monitoring software capabilities. These allow for a holistic, integrated scheme for energy efficiency that balances the overall quality and brightness of artificial lighting in relation to usage and natural daylight.

At night, a choreographed play of light and shadow accentuates the multi-faceted geometry of the façades, supporting the complex's iconic visual character. Lighting for the Place of Icon—a luminous focal point—visually connects the buildings and radiates into the vast landscape.

Opposite: Rendering of the KAPSARC complex with its distinctive angular geometry.

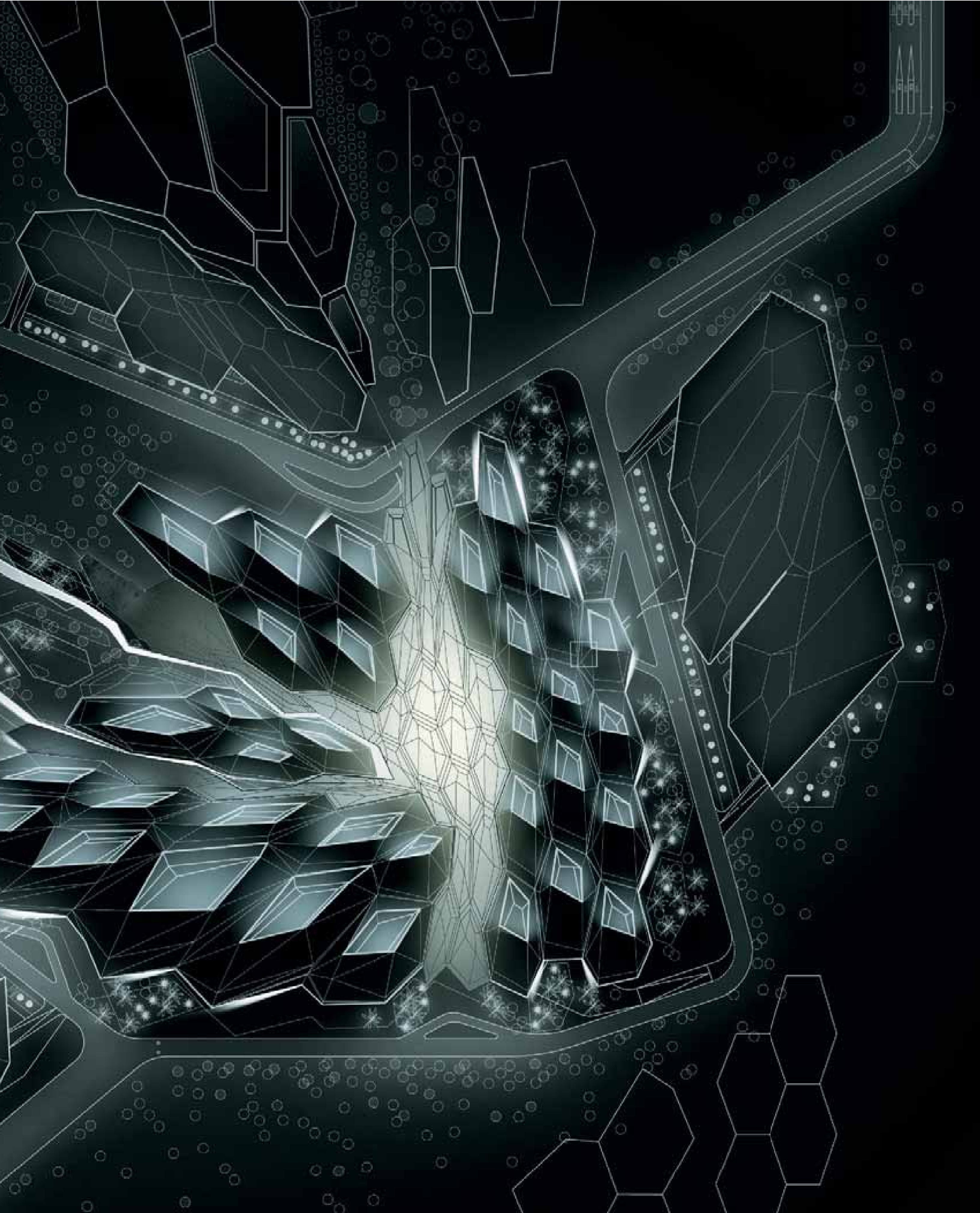
Site Lighting Masterplan

The project site is a vast parcel of land outside Riyadh, and a city onto itself. Light emanates from the Place of Icon at the center and radiates into the landscape. In addition to landscaped areas, urban infrastructure within the development includes roadways, a visitor's center and security buildings. The lighting masterplan and hierarchy of illumination play critical roles in unifying the complex, while providing intuitive navigation and wayfinding.

Coordination of the lighting for the landscapes and streetscapes was an involved undertaking. An architectural approach was taken for security lighting, to meet illumination levels in a strategic way without floodlighting. In addition to fulfilling light level requirements, lighting poles at roadways and checkpoints had to accommodate surveillance cameras and meet wind deflection values, to ensure that security footage would be consistent and undisturbed.

With every shift in the layout of the complex's numerous roadways and circulation paths, lighting had to be adjusted to follow suit. The design required collaboration with numerous trades and specialists, all working in sync to achieve well-designed and well-coordinated streetscapes.

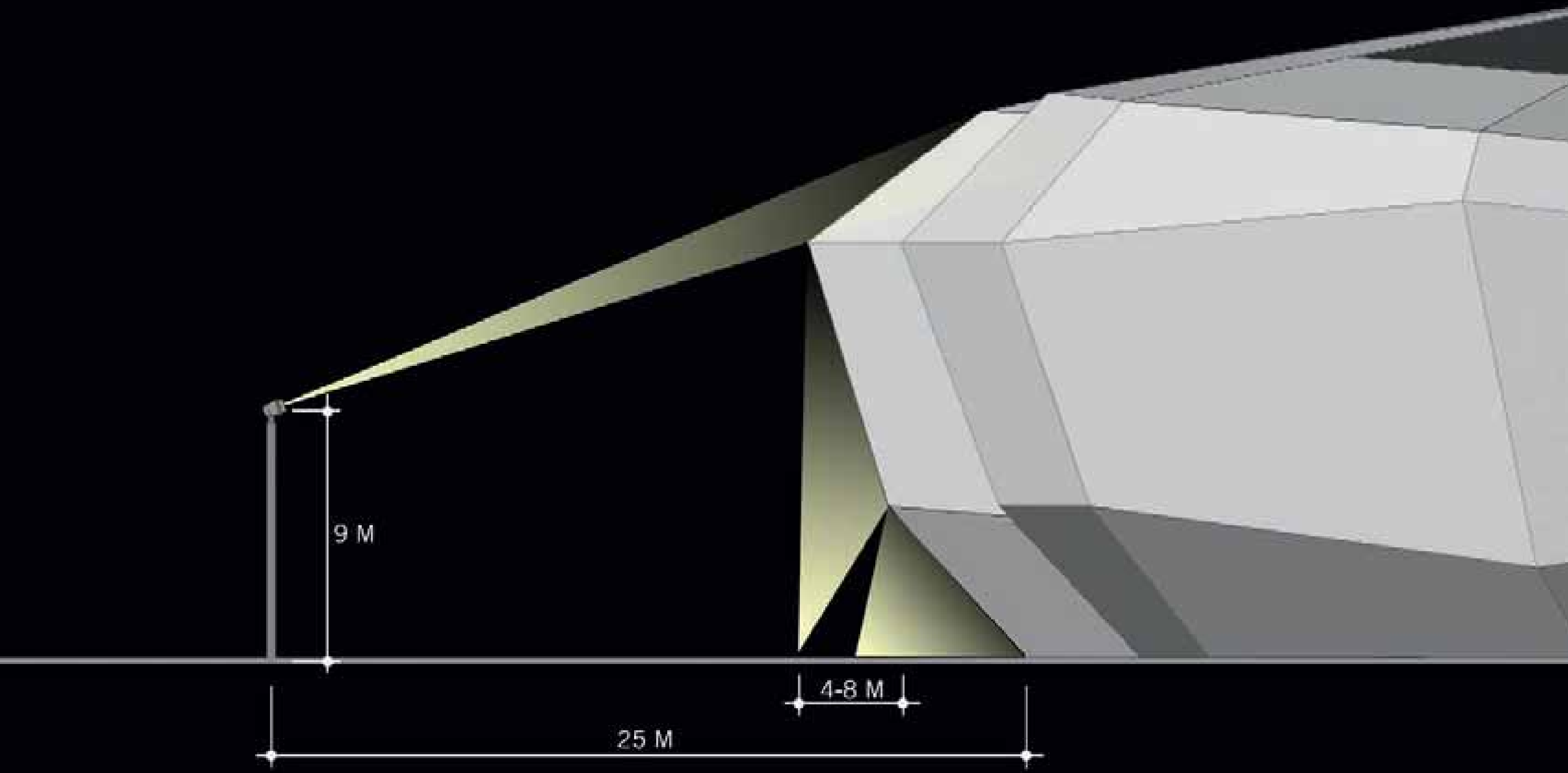
Right: Site lighting concept diagram

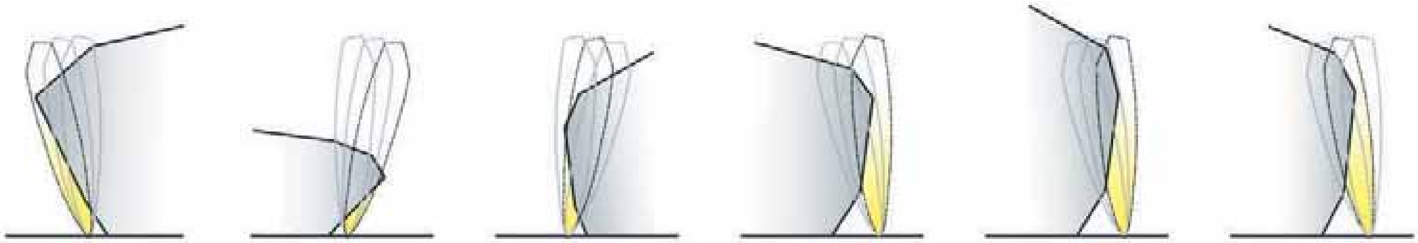


At night, differing intensities of light and shadow reinforce the distinctive, folded honeycomb geometry of the volumes. A combination of in-grade and pole mounted luminaires is used. Lower faceted surfaces are grazed with steep, intense bursts of light, while higher planes are gently lit from strategically positioned pole-mounted luminaires. As each façade has a different height and contour, detailed lighting studies and calculations were performed for each individual condition to determine the appropriate position of luminaires and aiming angles.

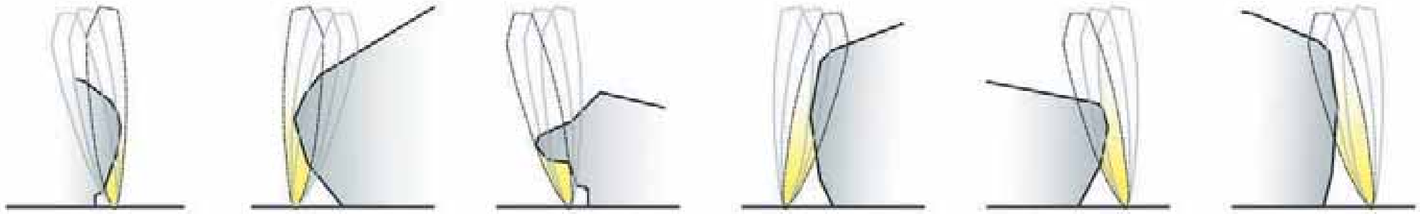
In the surrounding landscape, luminaires concealed within handrails, underneath benches and tucked below curbs provide ambient illumination and reinforce angular geometries. This creates navigation paths that flow from the complex. At strategic locations, trees and greenery are highlighted creating focal points and harmonizing the overall visual composition of the landscape.

Right: Construction photos
Below and opposite: Façade lighting study diagrams

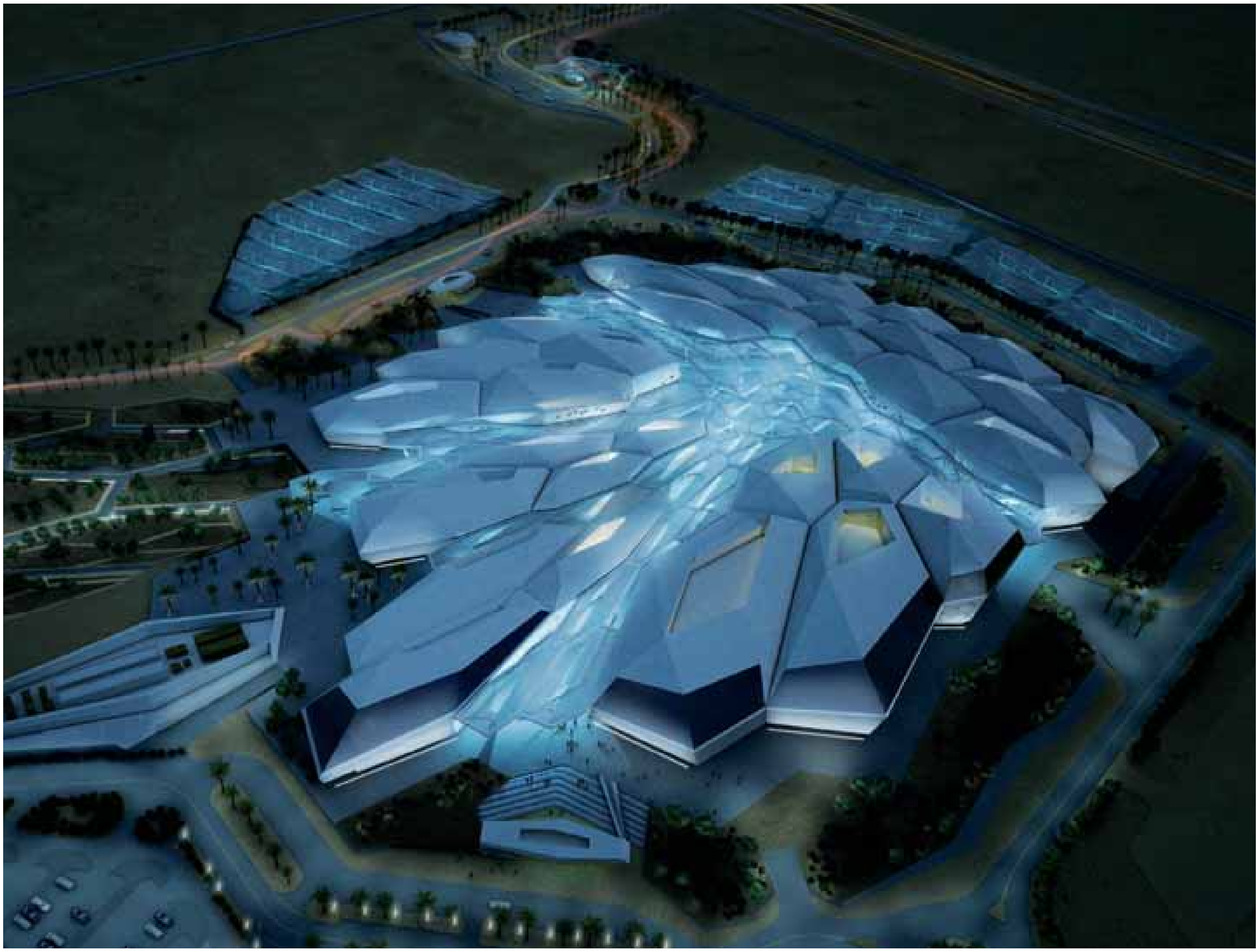




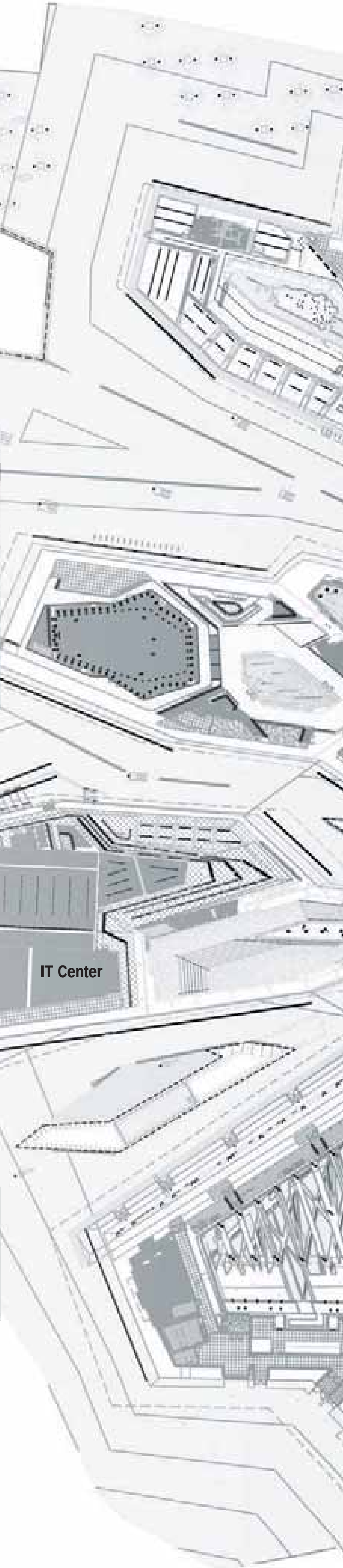
Lighting studies (façade profiles at Research Center Building)



Lighting studies (façade profiles at Library Building)



Interiors





Research Center



Library

Place of Icon


Musalla

IT Center



Conference Center

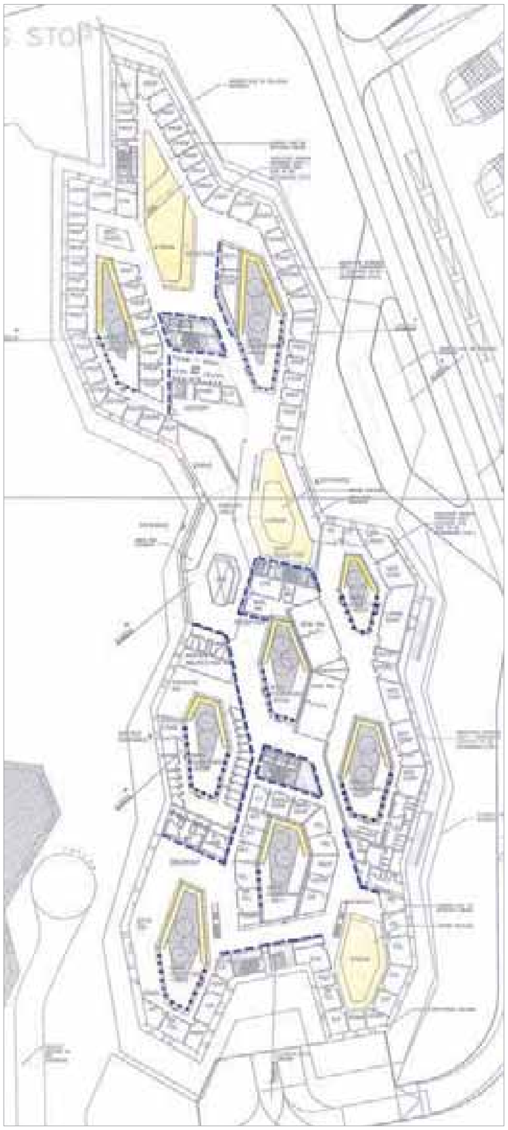

Library
Musalla
Place of Icon
Research Center
Conference Center

Reinforcing cellular geometry

The complex aspires to be a symbol for innovative architecture, sustainable design and energy performance. Creating lighting design strategies to meet LEED Platinum objectives involved analyzing light level and power density requirements. At the time of the design, an all-LED facility was proposed, but luminaires with solid state technology were still being developed for high performance applications. The ambitious scheme was well-received, but the lack of product availability and proven track record in the region prevented the proposal from going forward. Instead, lighting solutions primarily using fluorescent and metal halide sources are deployed, and LEDs are used in strategic applications requiring small profile luminaires such as handrail lighting, shard walls and ceilings, and to illuminate filigree screens.

Lighting plays an important role in supporting the architectural gesture of the spaces, using a linear vocabulary of continuous and segmented luminous bands, concealed coves, recessed ceiling lights, suspended light lines and handrail lighting. In lobbies, offices and corridors, luminous bands follow the faceted walls, reinforcing the cellular architectural geometry while fulfilling functional requirements for lighting. These linear motifs are fine-tuned to respond to the scale and proportion of each space.

As there are no right angles or identical spaces throughout the buildings, a wide range of special intersections and corner conditions are customized to ensure the continuity and seamless appearance of the light lines. Light sources and lamp combinations are also synchronized to account for the unique and radically different shape of each room. A major challenge is providing a uniform visual appearance and single lighting

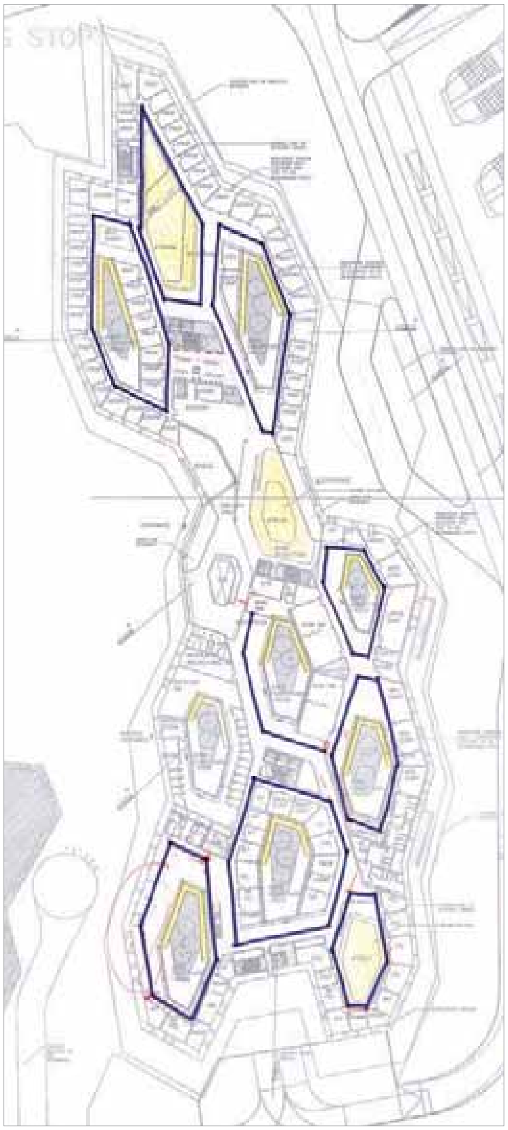


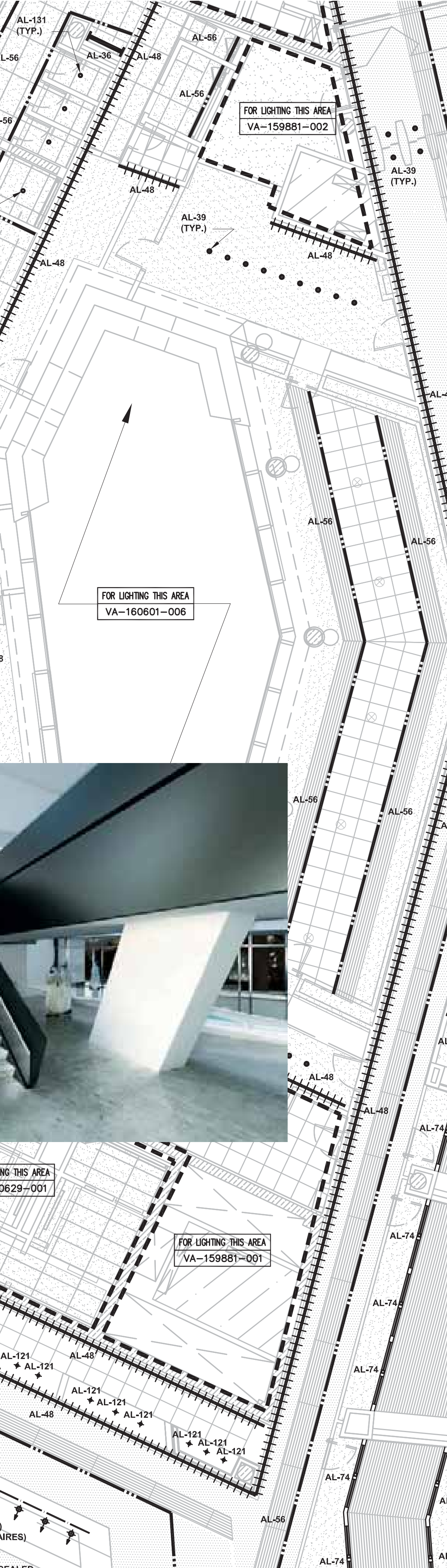
strategy that can be adapted to all space types—from rooms that are narrow and very high, to wide rooms with low ceilings, and everything in between. This is achieved while minimizing the overall number of lamp varieties used.

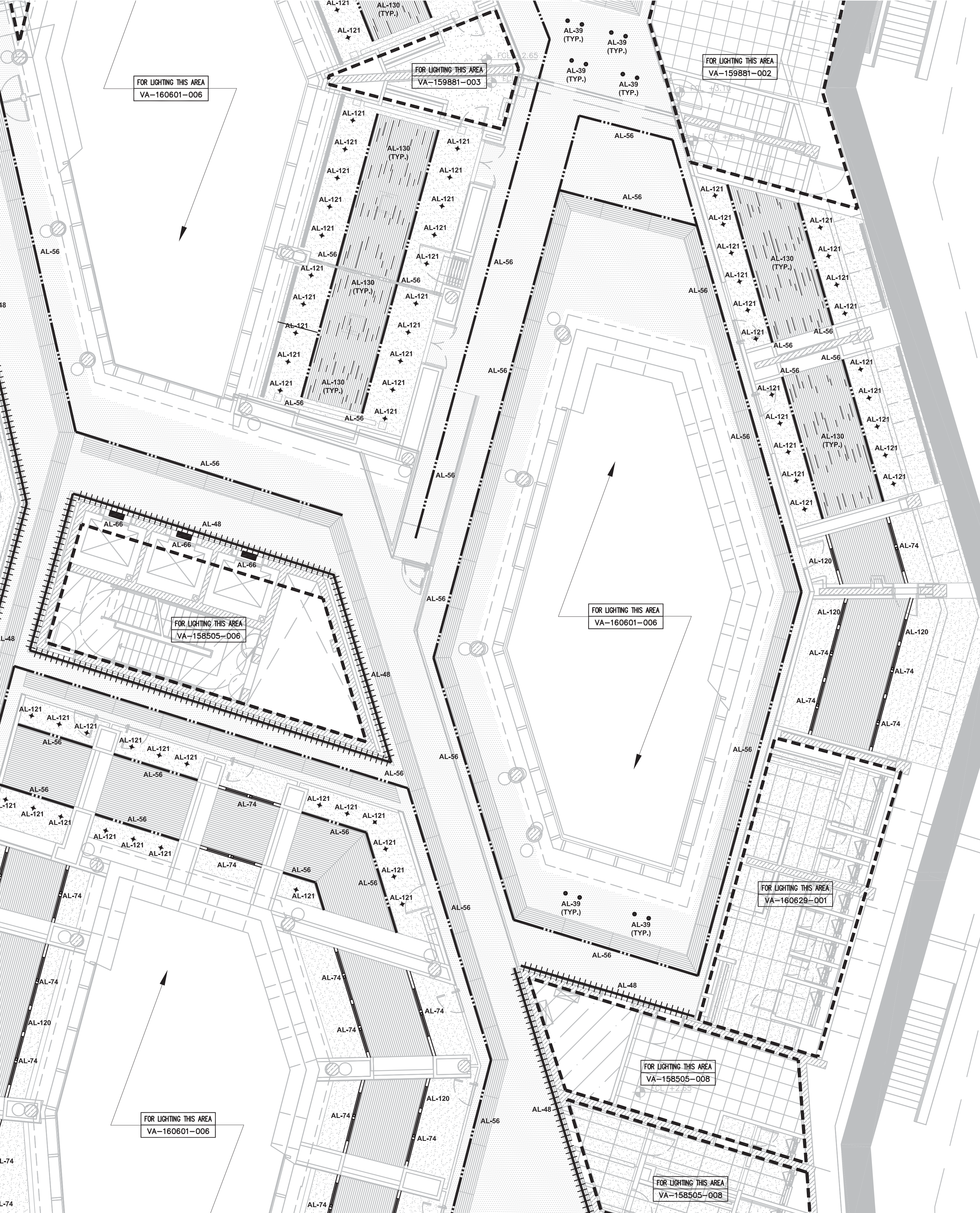
Offices continue the lighting vocabulary with luminous bands in ceiling-recessed, linear profiles that incorporate smoke detectors, sprinklers and other service hardware, and are coordinated with chilled beam locations. In conference rooms, a staggered arrangement of segmented light lines is integrated within a slotted ceiling design. On the highest floors, suspended bands of light float in the space to maintain a clean appearance for the ceiling, formed by the exposed underside of the sculpted outer shell of the building.

Keeping architectural wall and ceiling surfaces free of lighting hardware posed several challenges, especially when illuminating large open areas from limited locations. For instance, the atriums present expansive spaces with multi-story, highly sculpted walls topped by hexagonal skylights. Track luminaires are cleanly detailed around the perimeter of the skylights, with additional lighting strategically concealed within handrails, coves and reception desks to provide ambient illumination and intuitive wayfinding. Lighting solutions are tailored to each space, requiring extensive and precise coordination.

Below: Exploratory lighting studies
Following spread: Lighting plan and renderings of Research Center




AL-36
(TYP.)
AL-131
(TYP.)
AL-56
AL-36
AL-48
FOR LIGHTING THIS AREA
VA-159881-002
AL-39
(TYP.)
AL-131
(TYP.)
AL-39
(TYP.)
AL-48
FOR LIGHTING THIS AREA
VA-160601-006
AL-56
FOR LIGHTING THIS AREA
VA-160629-001
FOR LIGHTING THIS AREA
VA-159881-001
AL-74
AL-121
AL-102 (TRACK)
AL-97 (LUMINAIRES)
AL-102 (TRACK)
AL-124 (LUMINAIRES)
NOTE:


FOR LIGHTING THIS AREA
VA-160601-006
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VA-159881-003
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VA-159881-002
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VA-158505-006
FOR LIGHTING THIS AREA
VA-160601-006
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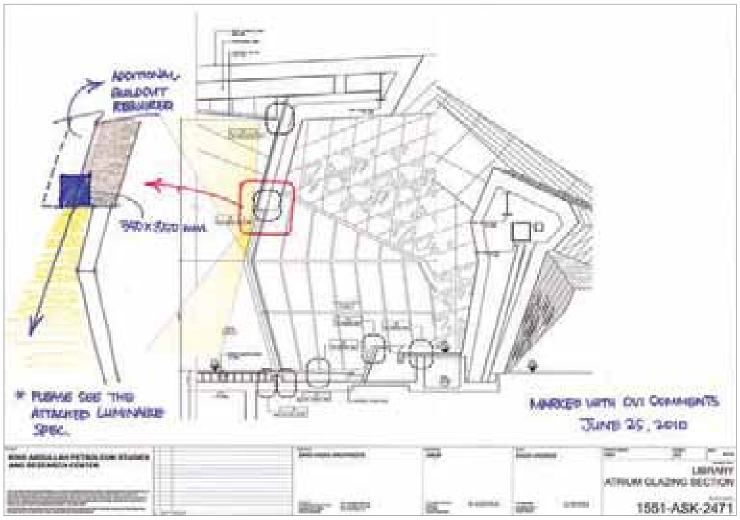
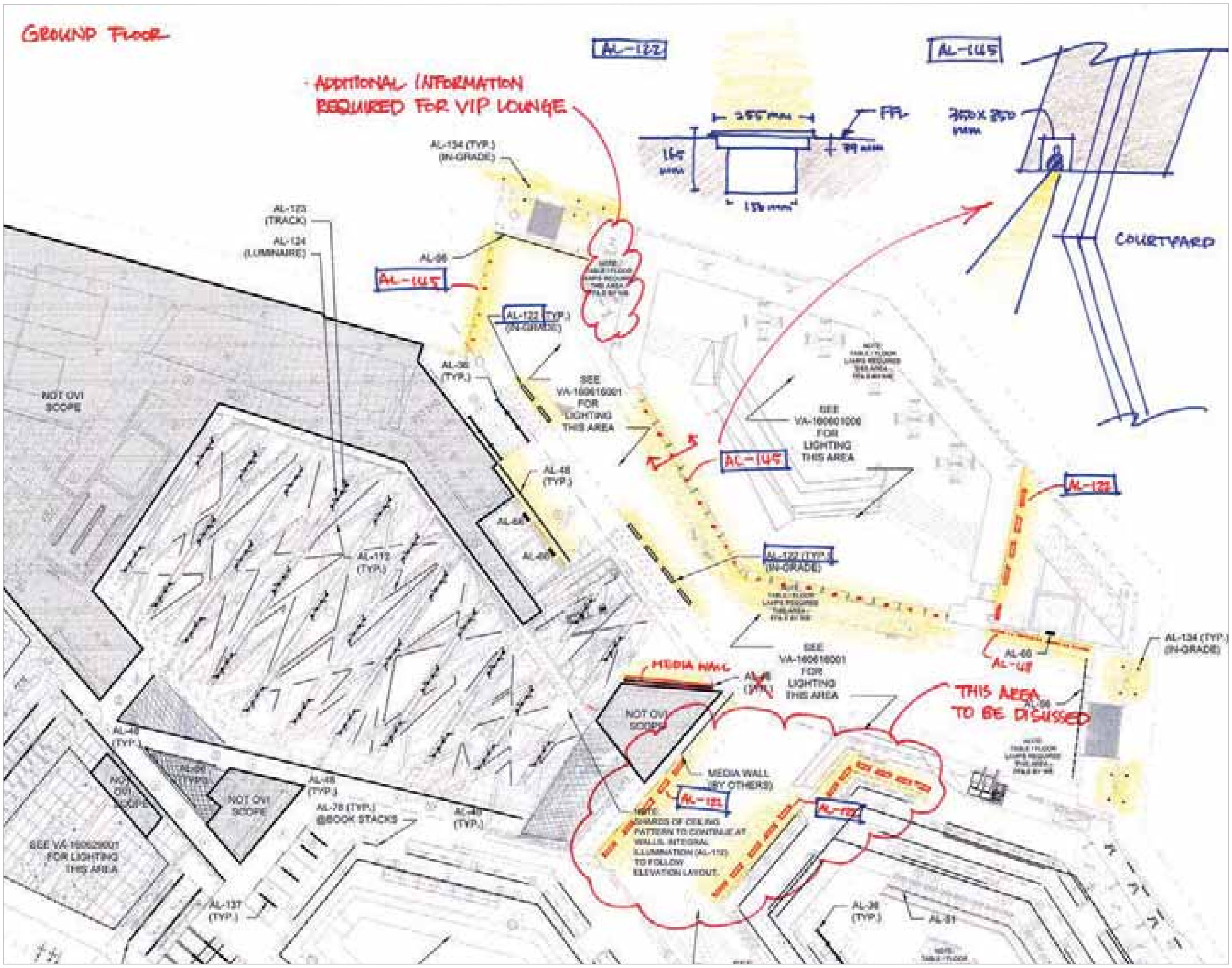
VA-160629-001
FOR LIGHTING THIS AREA
VA-158505-008
FOR LIGHTING THIS AREA
VA-160601-006
FOR LIGHTING THIS AREA
VA-158505-008
AL-39 (TYP.)
AL-56
AL-121
AL-130 (TYP.)
AL-48
AL-66
AL-74
AL-120

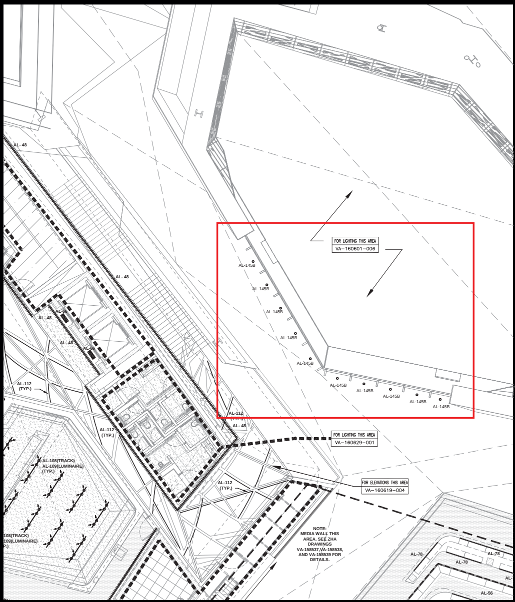
Lighting Integration

At multi-story atriums and entrance foyers, the depth of window headers is coordinated to ensure that optimal locations and sufficient space are provided to integrate lighting hardware. Compact, adjustable luminaires are aimed towards the center of the space without creating glare. Lighting calculations and 3D computer modeling are used to verify that sufficient ambient light levels are achieved. Additional lighting is incorporated into stair handrails to supplement illumination to lower level spaces.

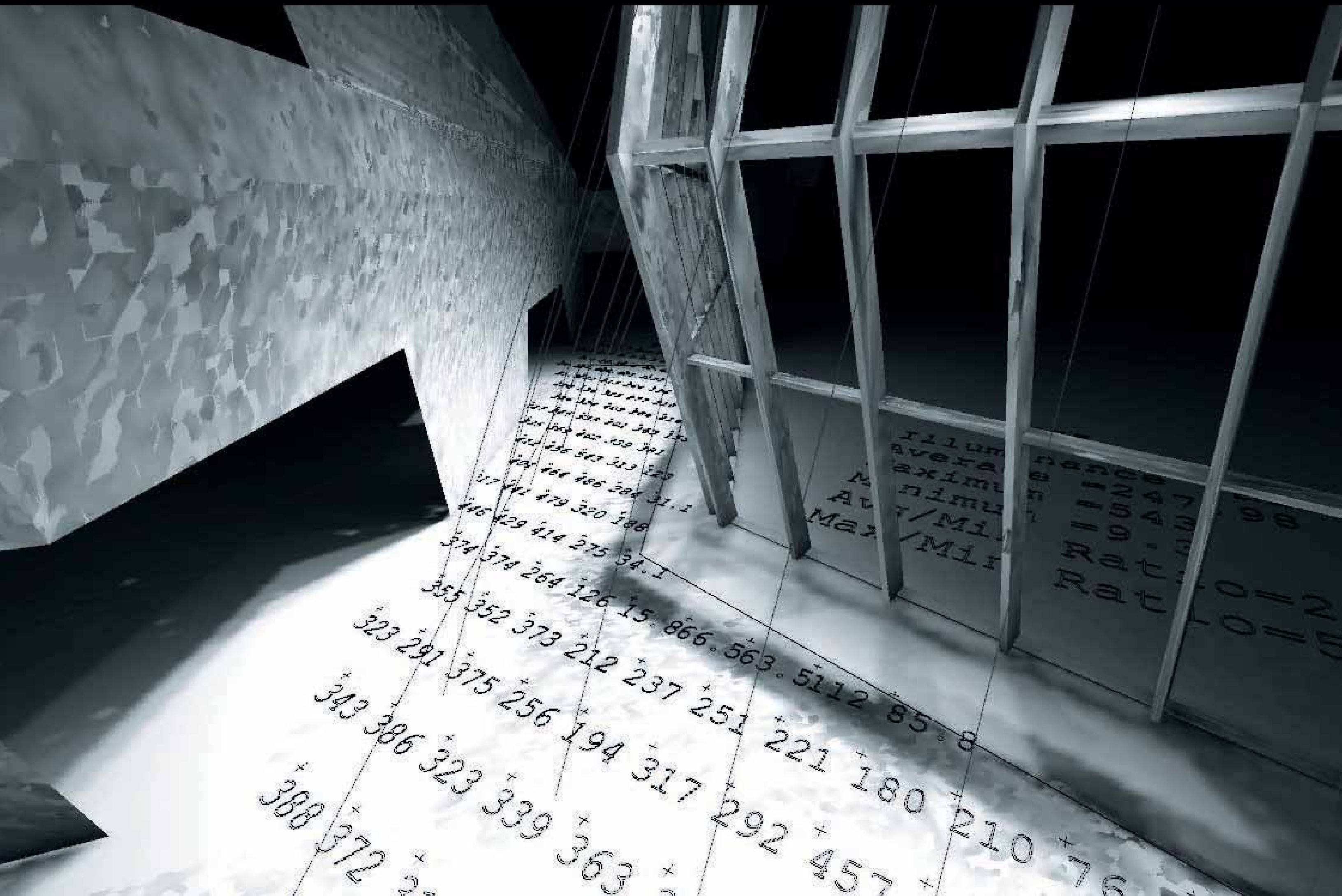
Below and right: Lighting coordination sketches







Left: Plan of library atrium
Above and below: Light calculations and rendering



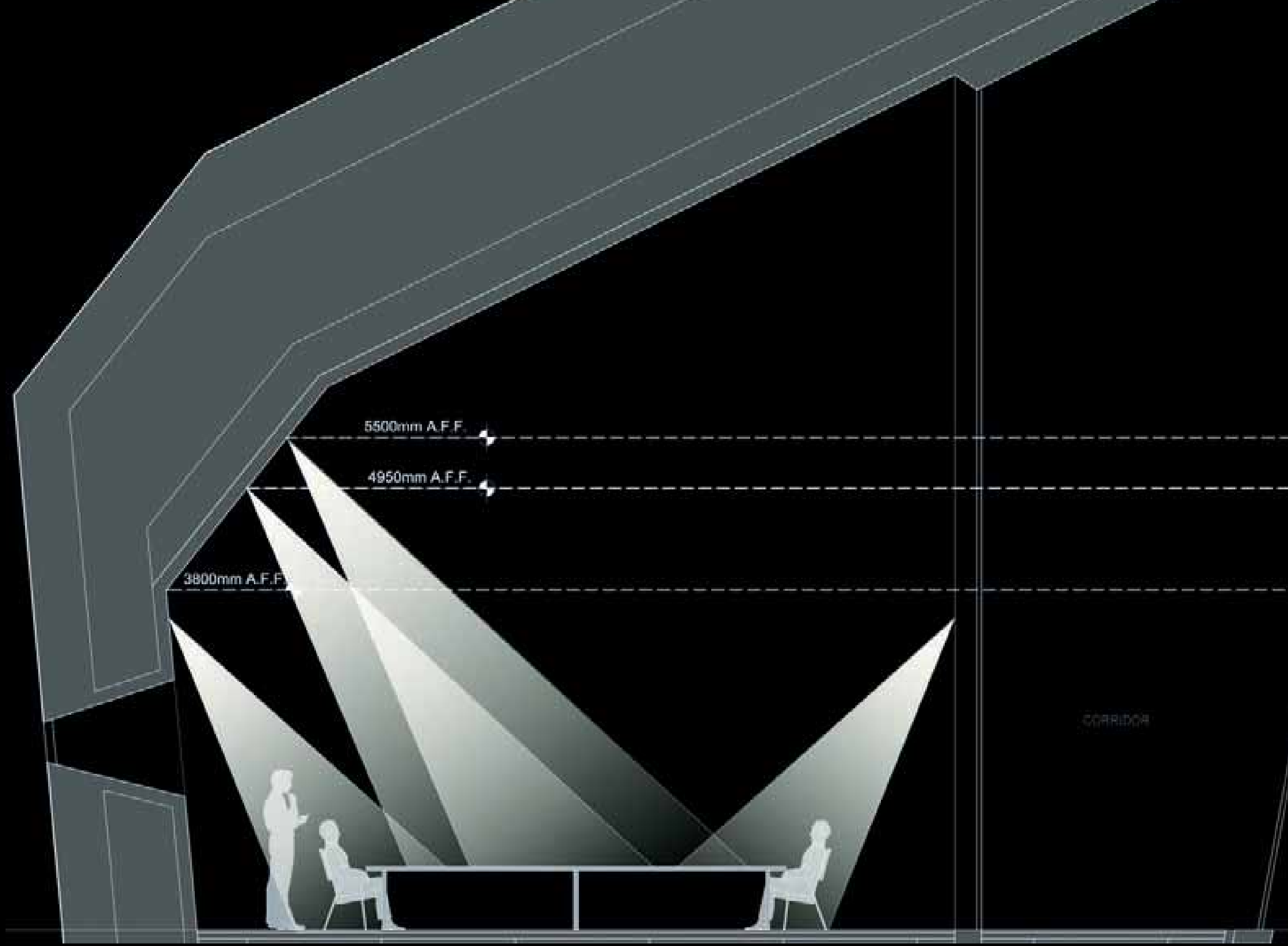
Lighting Niches

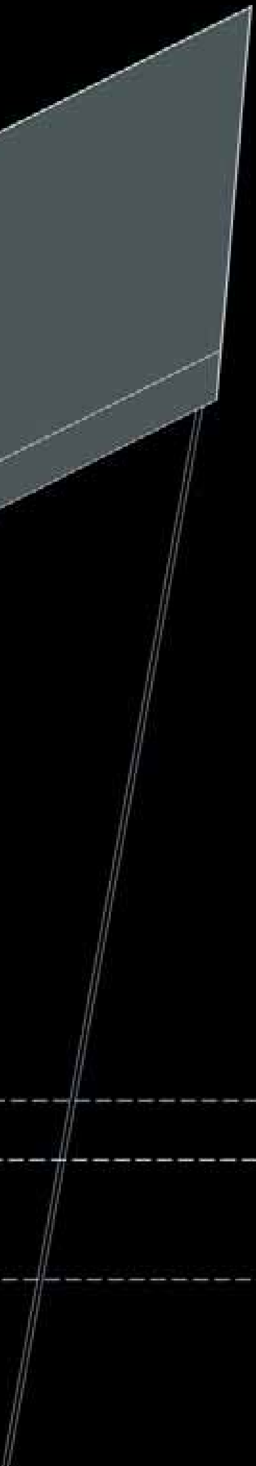
The façades of the complex feature triangulated window patterns which wrap around the entire structure. Translating this motif into a lighting solution, triangular wall niches were introduced to the interior as part of the lighting design. The niches are inset at perimeter hallways, conference rooms and lounges. Two kinds of niches were created: luminous frosted glass panels that fill spaces with soft, ambient light, and “dark void” screen-mesh panels that conceal small, adjustable flood lights which are aimed onto table and floor surfaces. When turned on, the panels activate surfaces, providing required light levels while gently echoing the architectural motifs.

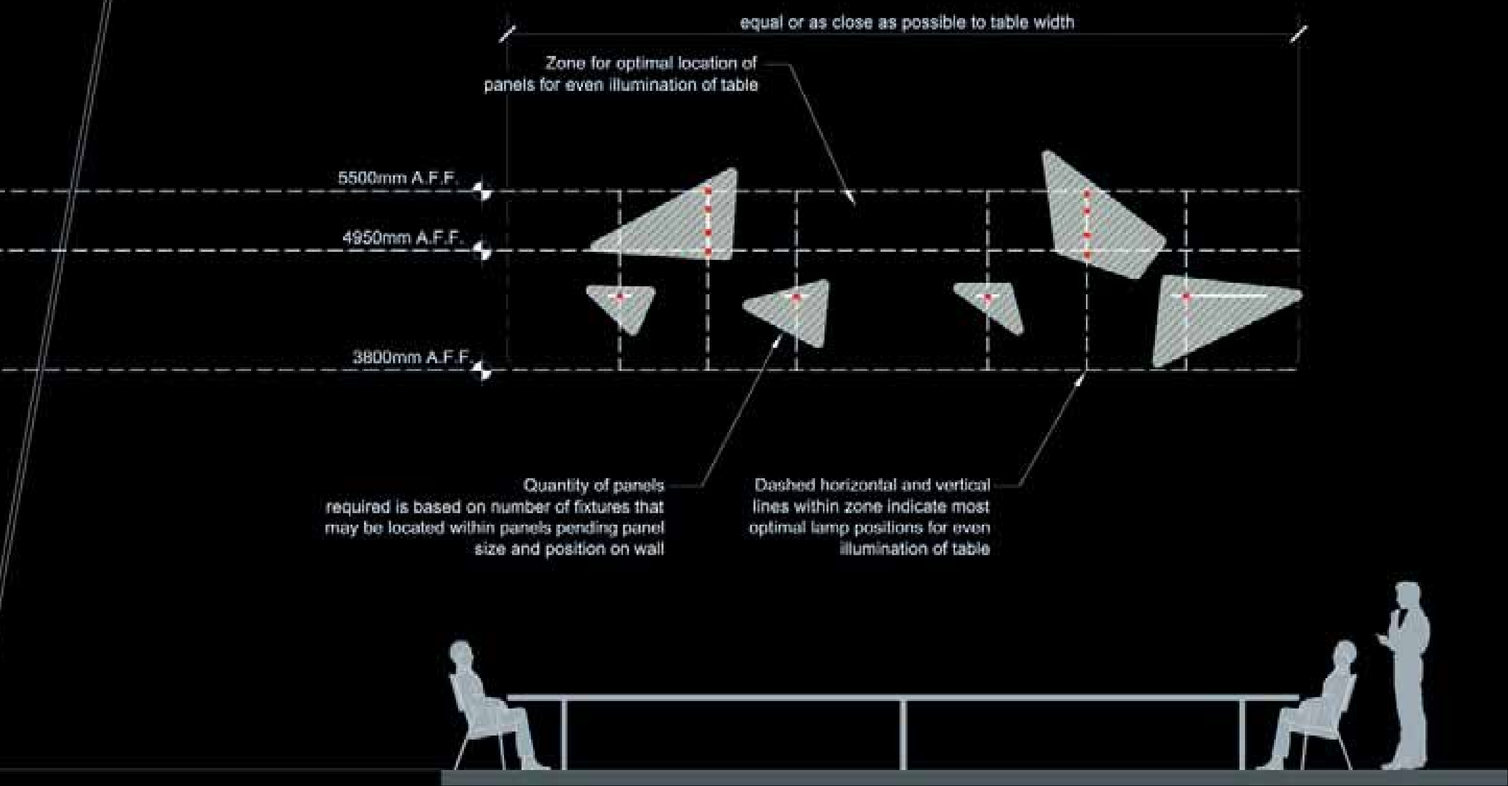
Each niche has a different shape, size and dimension that relates to the building façade geometry. Optimal locations for lighting and geometries for the niches are determined based on considerations of sufficient light levels, even illumination and appropriate aiming angles that avoid glare. As each wall has a different contour, lighting angle studies were performed for each individual condition, while the overall composition of the niche layout is adjusted for each wall.

Numerous drawings and diagrams precisely communicate and coordinate the location and dimension of the niches with the architect and interior designer so as to ensure a choreographed final design. The creation and skillful placement of these devices solve lighting challenges, while integrating completely with the architectural design.

Below: Conference room lighting and beam study diagram
Opposite: Rendering and lighting detail diagrams





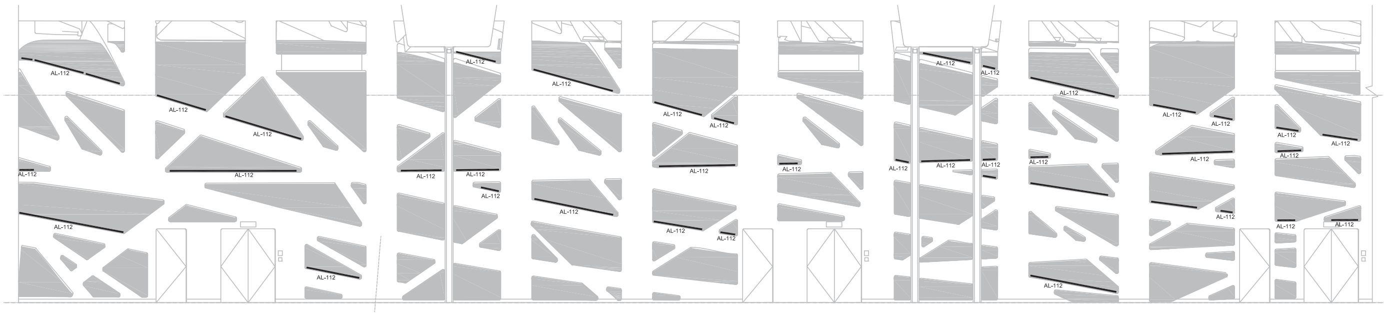

equal or as close as possible to table width
Zone for optimal location of
panels for even illumination of table
5500mm A.F.F.
4950mm A.F.F.
3800mm A.F.F.
Quantity of panels
required is based on number of fixtures that
may be located within panels pending panel
size and position on wall
Dashed horizontal and vertical
lines within zone indicate most
optimal lamp positions for even
illumination of table

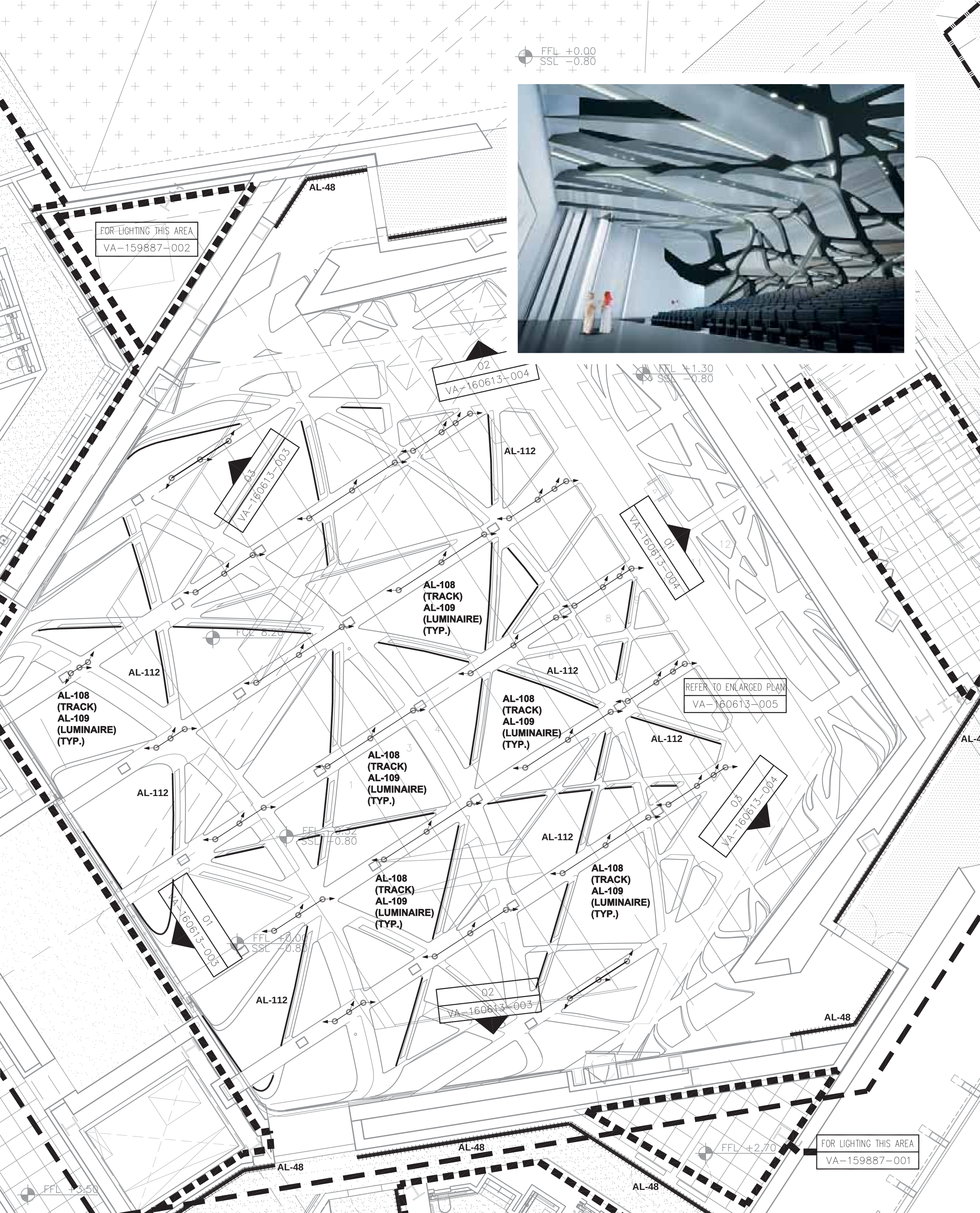
Architectural Chandelier

Waves of sculpted shards stretch across entire wall and ceiling surfaces in the multipurpose hall and auditorium and are met by a vibrant cyclone of bright lines. Concealed behind selected panels, light coves with miniature LED luminaires create a floating back-lit effect that express the unique contours of the shards and form an abstract architectural “chandelier”. Additional lights located between the panels are aimed downwards to provide ambient illumination on the floor. Meanwhile, the overall layout evokes a sense of movement and imparts a dynamic expression to the architecture.

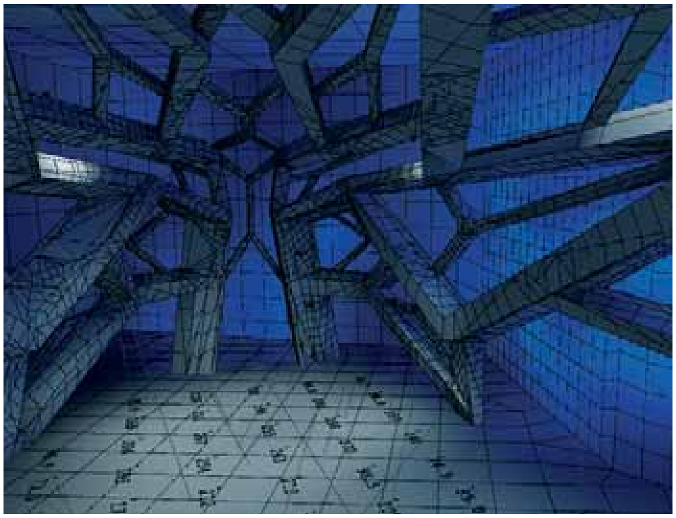
Locations to illuminate the completely asymmetrical ceilings were meticulously studied and mapped in order to fulfill light level requirements and provide adequate coverage, while composing a compelling visual effect.

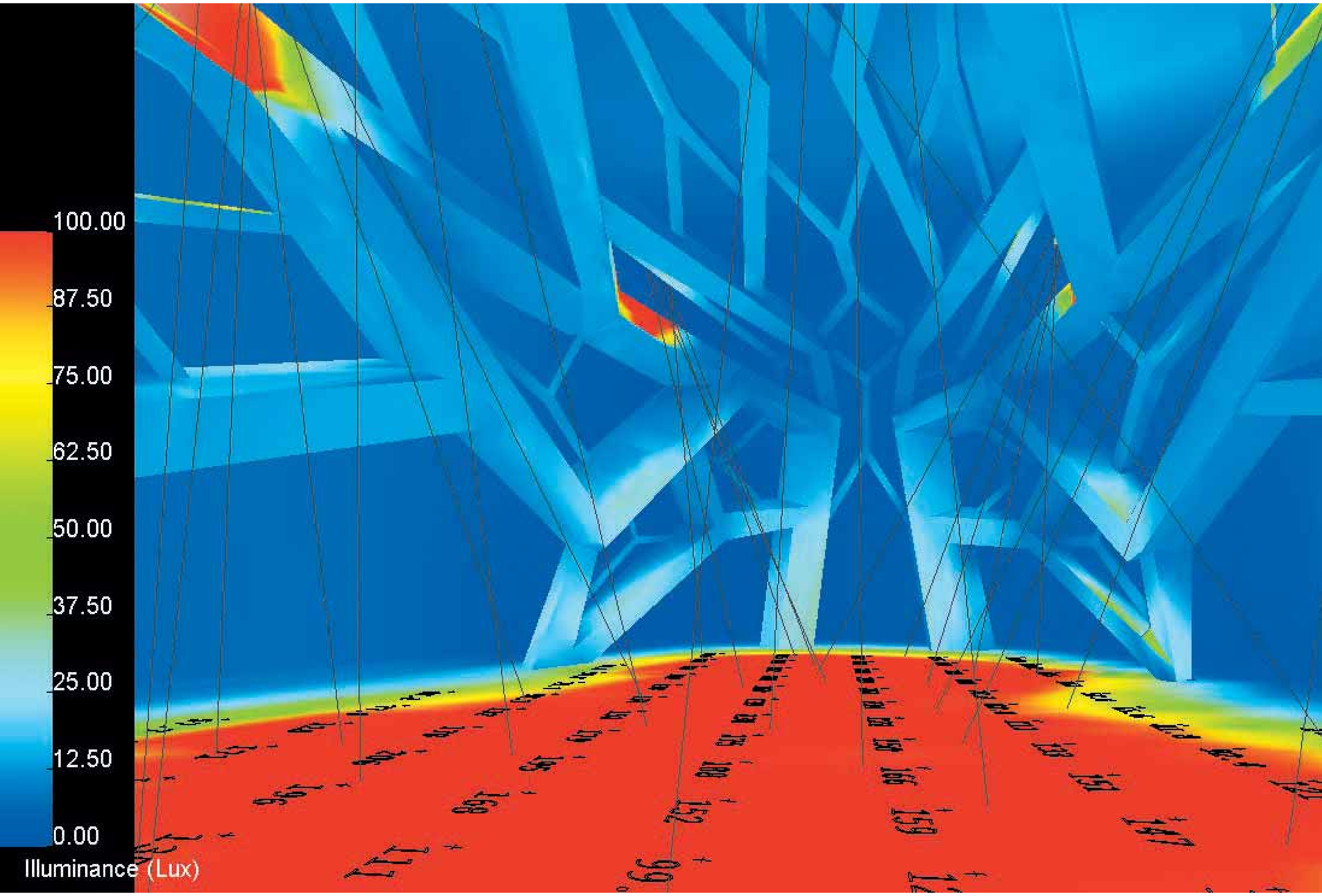
Below: Rendering and lighting elevation of multipurpose hall
Opposite: Rendering and lighting plan of auditorium




FFL +0.00
SSL -0.80
AL-48
FOR LIGHTING THIS AREA
VA-159887-002
02
VA-160613-004
FFL +1.30
SSL -0.80
03
VA-160613-003
AL-112
01
VA-160613-004
AL-108
(TRACK)
AL-109
(LUMINAIRE)
(TYP.)
FCL 8.20
REFER TO ENLARGED PLAN
VA-160613-005
03
VA-160613-004
FFL +0.32
SSL -0.80
01
VA-160613-003
FFL +0.00
SSL -0.80
02
VA-160613-003
FOR LIGHTING THIS AREA
VA-159887-001
FFL +2.70
FFL +3.50

Filtered Light





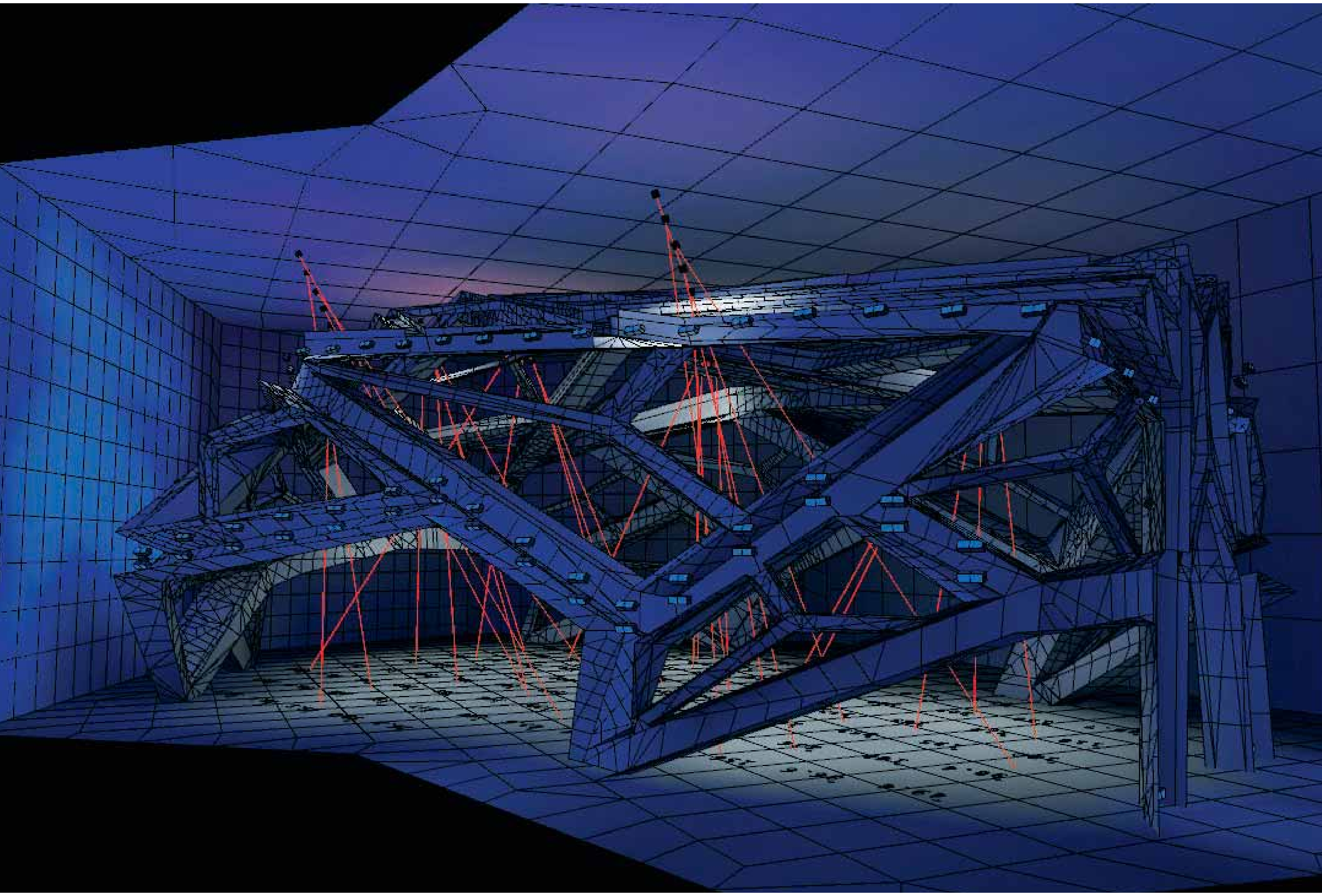
The Musalla, a prayer room, is a completely enclosed space that accommodates up to 300 worshipers. Inside, it is characterized by a large, organic structural framework that sits within the building's architectural shell. Screen panels fill the openings of the frame.

A serene glow of white light emanates from behind the screens and sets the tone in the worship hall. Keyed to periods of prayer throughout the day, the lighting gradually shifts from the golden tones of dawn, to the cool blue light of midday and the warm crimson hues of dusk, suggesting the passage of time. An intense glow of light creates a powerful focal point where the Imam emerges to lead prayers.

All lighting in the Musalla is completely concealed. Luminaires mounted to support structures behind the ribbed frame provide an atmospheric glow of light that enhances the silhouettes of the frame and the filigree screen. Bounce light reflects off the outer architectural shell and reveals the depth of space beyond, while floodlight projectors pierce through the screen and provide accent lighting in focal areas. Screen patterns, geometries and densities are coordinated with the architect to ensure sufficient light transmission. Lighting is precisely tuned through a control system to balance focal points and echo the contemplative atmosphere of the space.

Extensive lighting calculations and 3D computer modeling were conducted to determine an optimal layout, and coordinated with catwalk locations for maintenance access.

Opposite and below: Rendering, 3D lighting model and lighting calculations for Musalla



Canadian Parliament – West Block

Ottawa / Canada

Architects: ARCOP with Fournier Gersovitz Moss Drolet & Associates

2009-

Located on the Southern bank of the Ottawa River, Canada's Parliament Hill is a national historic site with nineteenth century Gothic Revival buildings. The centerpiece of the current modernization is the West Block courtyard, which is being transformed into a new parliamentary debating chamber and series of committee rooms.

Replacing the existing Chamber of Commons from 1859, the new Chamber will be daylit, spacious, and equipped with the latest technology. In line with this transformation, the broadcast-ready space will be entirely lit with LEDs—making it one of the first Chambers of this kind in the world.

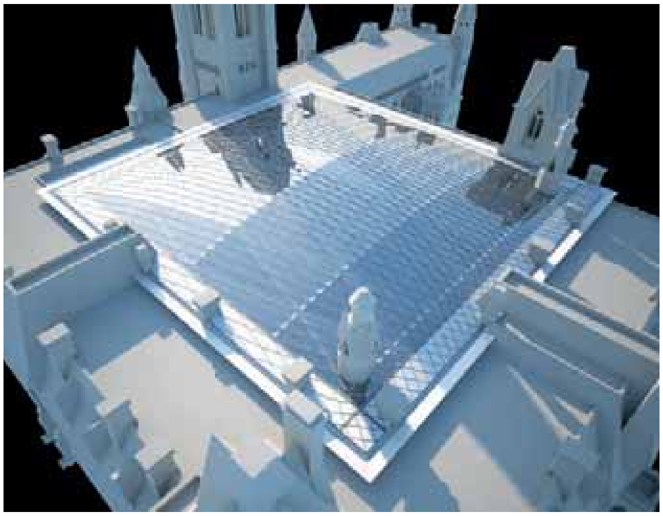
Inspired by natural motifs, the new Chamber is a modern counterpart to the historic context of the site. The refined architectural design features a glass roof supported by a series of tree-like columns. Located around the perimeter of the courtyard, these structures delicately branch out to support a glazed roof. Lighting maintains transparency through the roof and around the new structural supports, connecting the new interior with its historic backdrop.

The design of the Chamber responds to a variety of uses, from public visits to high definition television (HDTV) broadcasts of parliamentary sessions. Lighting accommodates the functional and aesthetic criteria for each of these scenarios, while responding to the dynamic presence of daylight and integrating seamlessly with the architecture and interior design. Coordination with daylight requirements ensure that natural light levels in the Chamber are regulated and balanced with architectural and TV broadcast lighting.

As a setting out point, the lighting design integrates the highly technical requirements for broadcast lighting with the architecture, avoiding technical lighting gantry systems that would make the spaces feel like television studios. As the use of LEDs for HDTV broadcast lighting is in its early stages of development, the light source and luminaire platform had to be pioneered for this unique application. Furthermore, as LED technology is constantly changing and improving, the development of the lighting design must anticipate the technology's future possibilities with regards to light output and performance. This requires foresight and thorough coordination well in advance of technology development and construction.

To meet the exacting standards of diverse experts including the architects, Public Works and Government Services Canada, the House of Commons, and the Parliament's information technology staff, a comprehensive approach of team dialogue is essential. The resulting lighting design balances the project's rigorous technical lighting requirements with its overall aesthetics in a fully integrated way.

Opposite: The historic Canadian Parliament, located on a hillside site in downtown Ottawa.



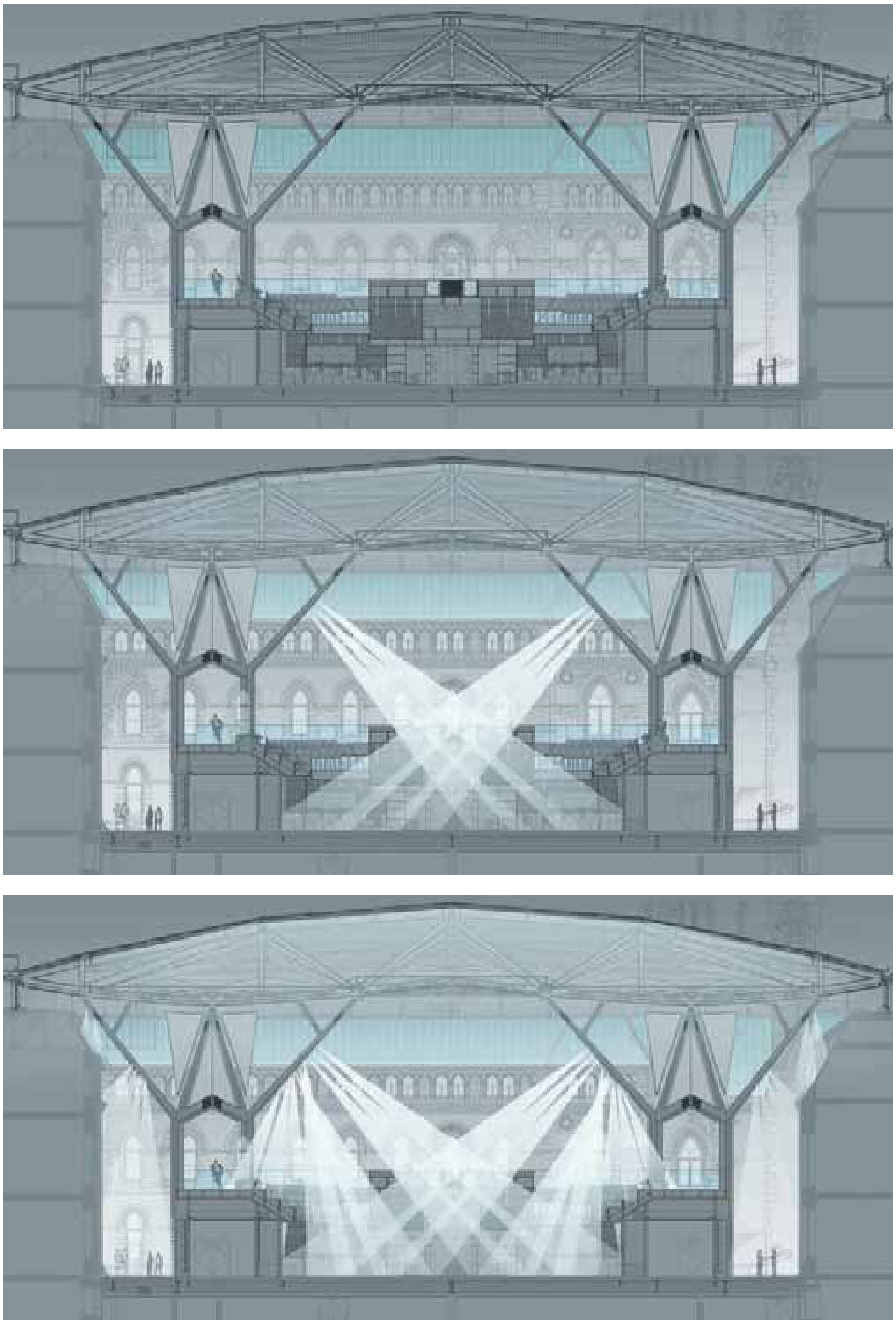
At an early stage, exploratory lighting studies were carried out to define the precise locations and aiming angles necessary for TV broadcast lighting. Working from these setting out points, the positioning of the branching columns was coordinated with structural requirements to optimize the tilt angles needed for TV broadcast lighting—and avoiding a typical gantry system suspended in the space. Extensive coordination allows the luminaires to be visually integrated into the design of the column branches, and become a natural extension of the minimalist architecture and interior design.

Working with experts, a key aspect of the Chamber's success is in controlling daylight and screening direct sunlight to ensure stable lighting conditions as required for television broadcasting, and to avoid the high contrast ratios that often interfere with daylit spaces. Horizontal and vertical light levels, maximum transmission values of the roof glazing, shading systems, and glazing combinations were coordinated by the team to balance the overall brightness in relation to TV broadcast lighting needs.

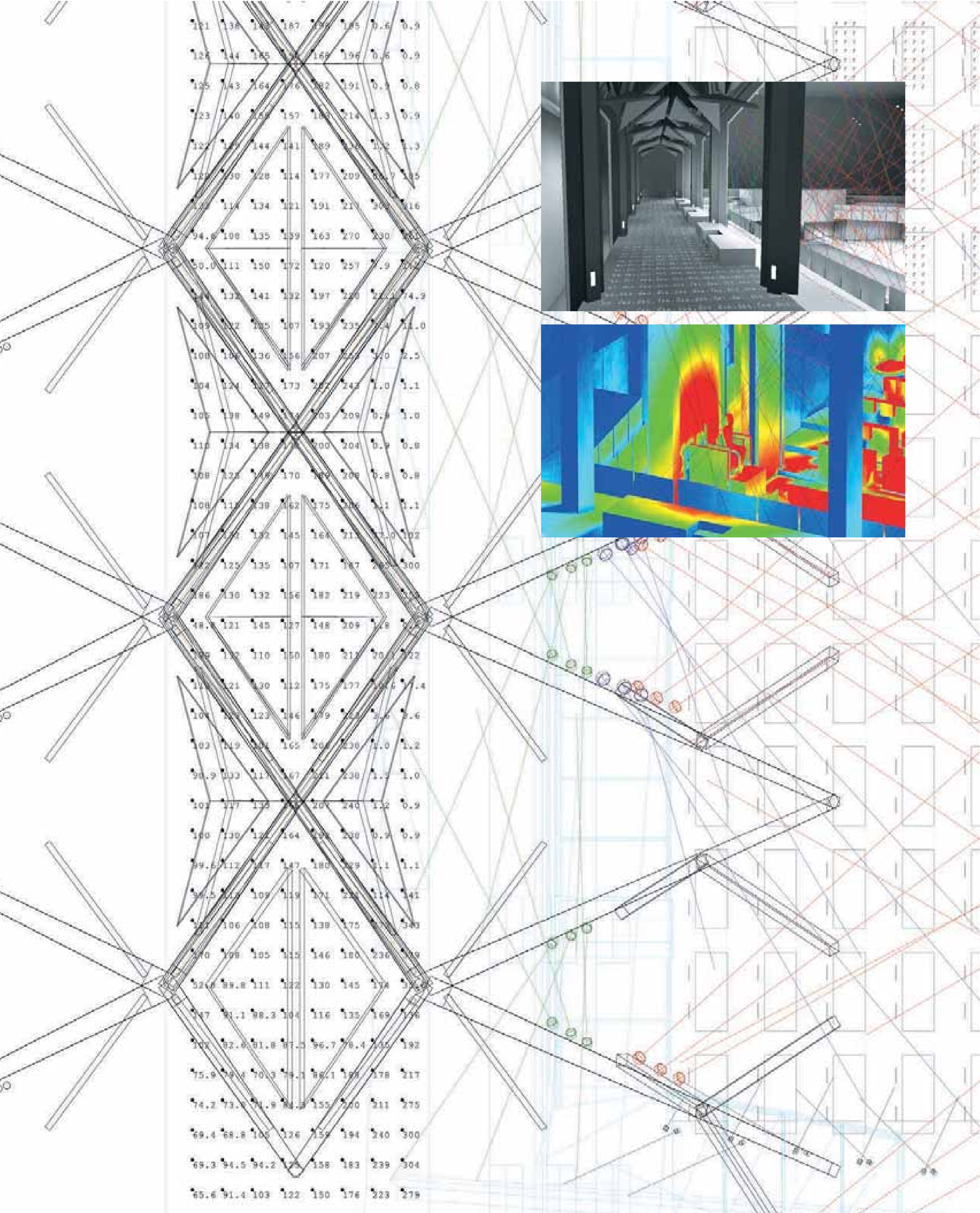
Above: Rendering of the Chamber's glass roof (aerial view)
Below: Rendering of Chamber

Layered Lighting

The lighting for the Chamber is composed as a series of layers. Used in different combinations, these lighting layers accommodate various activities within the Chamber at different times of day, ranging from public tours and television broadcasts to evening functions. A first layer of lighting softly activates the Gothic masonry façades and mansard roofs that surround the new Chamber, enhancing the texture of the historic building fabric. Additional layers such as luminaires concealed within wall coves accentuate the materials and finishes of the new interiors, enhancing the intricate wood screens, paneled walls and rich curtain fabric. Finally, luminaires at the structural branches that cantilever across the Chamber provide broadcast lighting at the chamber floor and illumination for visitor and press galleries.



Left: Exploratory lighting diagrams



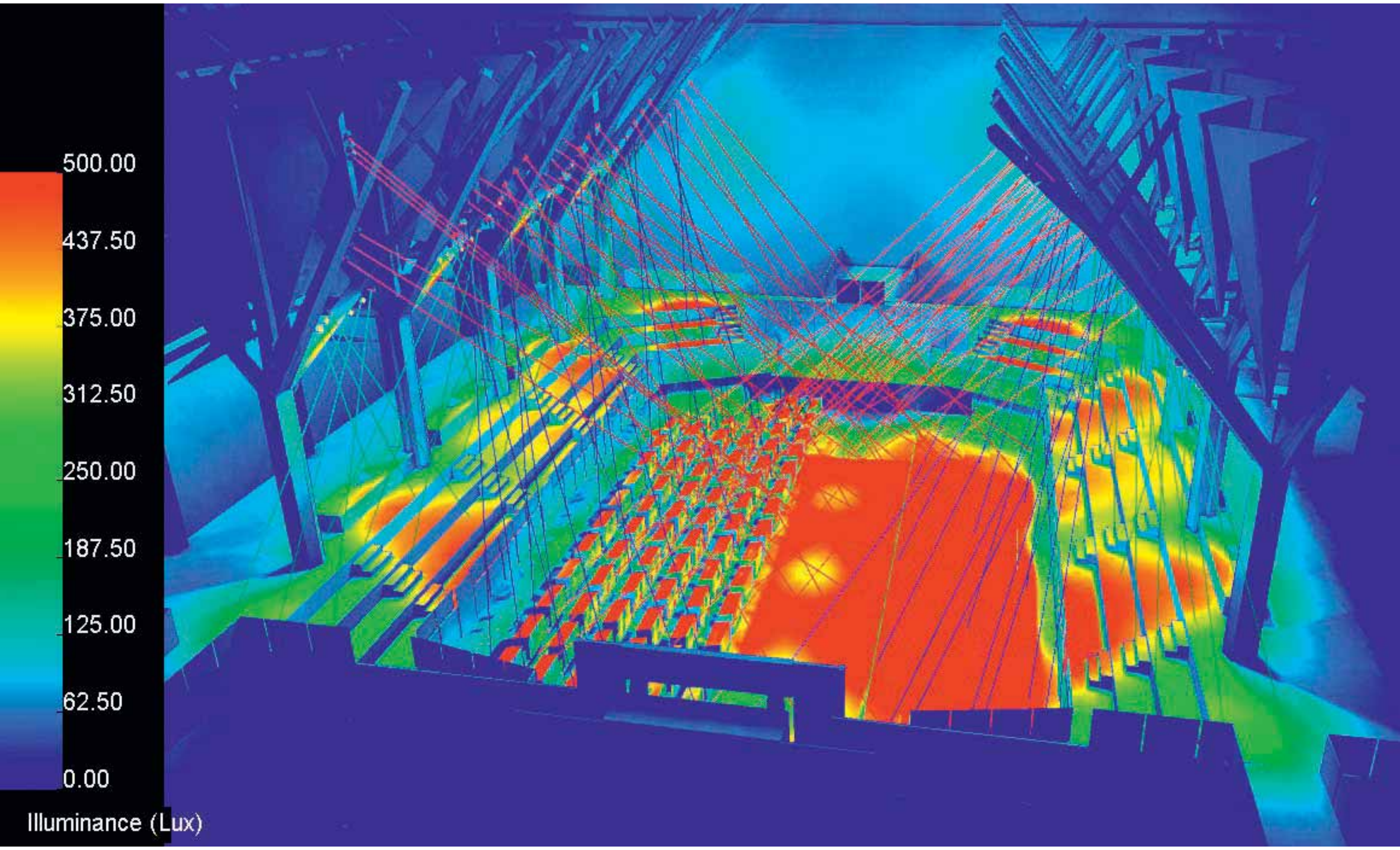
Evolving Technology

The most critical role of the Chamber's lighting is to properly illuminate each of the Members of Parliament to TV broadcast requirements, which demands precisely calibrated lighting. A correct picture requires the control of light levels, color temperature, aiming angles and distribution. Successful TV broadcast lighting also requires separating subjects from their background, avoiding shadows on their faces, minimizing glare from light sources and providing visual comfort for the users. Using advanced 3D computer light modeling and photometric calculations, precise positions and tilt angles required for optimal key lighting, back lighting, and fill lighting are determined and light levels are calibrated to give definition and shape to the Members of Parliament while on television.

HDTV cameras are much more sensitive than regular broadcast equipment due to the extremely high speed and number of frames used. The pioneering combination of LED lighting with HDTV technology entails many challenges, including dimming LEDs without color temperature shifts, calibrating the pulse width modulation of LEDs to work with the frequency of HDTV and optical design to replace conventional sources while maintaining a CRI of 90+. Furthermore, working with an evolving technology requires continual customization and optimization since the data, output and performance characteristics of solid state sources continue to improve.

In the design stage, calculations are run and decisions taken based on technical performance of the luminaires. By working closely with lighting manufacturers, luminaires are being developed powerful enough to meet light levels required for television broadcasting and compact enough to be integrated with the architectural and interior design elements. Each luminaire will also have an individual DMX address to allow for precise dimming and flexibility, responding to changing needs and daylight levels within the Chamber.

Below and opposite: 3D modeling and lighting calculations of the Chamber

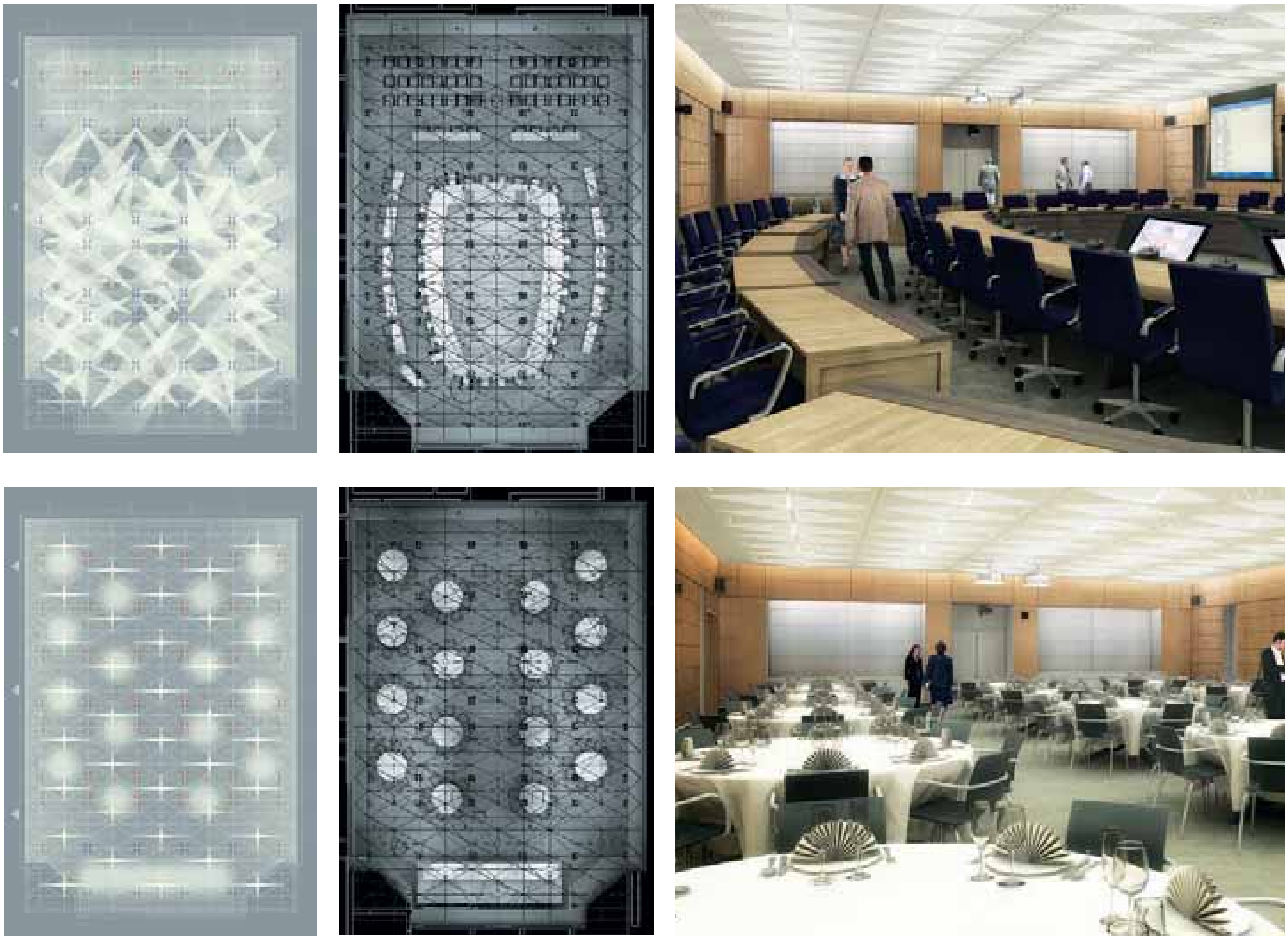


Committee Rooms

The subterranean committee rooms seem ideal for lighting design, since they offer a controlled environment for TV broadcast with no interference by daylight. However, the 2.4 meter-high ceilings pose a major challenge. Their relatively low height does not allow much space for the light to spread out. In addition, the rooms are used for multiple functions including Parliamentary committee meetings, presentations with theater-style seating, and official receptions. Each of these configurations entails a different furniture arrangement and carries unique illumination requirements, including the need in many cases for HDTV broadcast lighting—all under the same ceiling with the same luminaire positions.

After many exploratory studies and trial layouts, a user-friendly solution was developed that takes into account the lighting conditions required for multiple furniture arrangements. The interior design of the ceiling pattern coordinates precisely with the lighting layout that emerged from this extensive study process. The resulting design is a sculpted, geometric ceiling with medallions of light. Diamond-shaped ceiling panels undulate and open at their center, revealing a starburst of light within. Small-aperture luminaires, grouped in clusters, are integrated within the patterned ceiling and aimed to provide ideal broadcast lighting conditions. Each luminaire has a DMX address and is individually dimmed and controlled to accommodate various room configurations without needing to physically re-aim the luminaires. The choreographed integration of light transforms the ceiling into a textile-like surface.

Below: Committee rooms with different furniture configurations for HDTV broadcast and banquet settings
Opposite: Lighting diagram of committee room ceiling



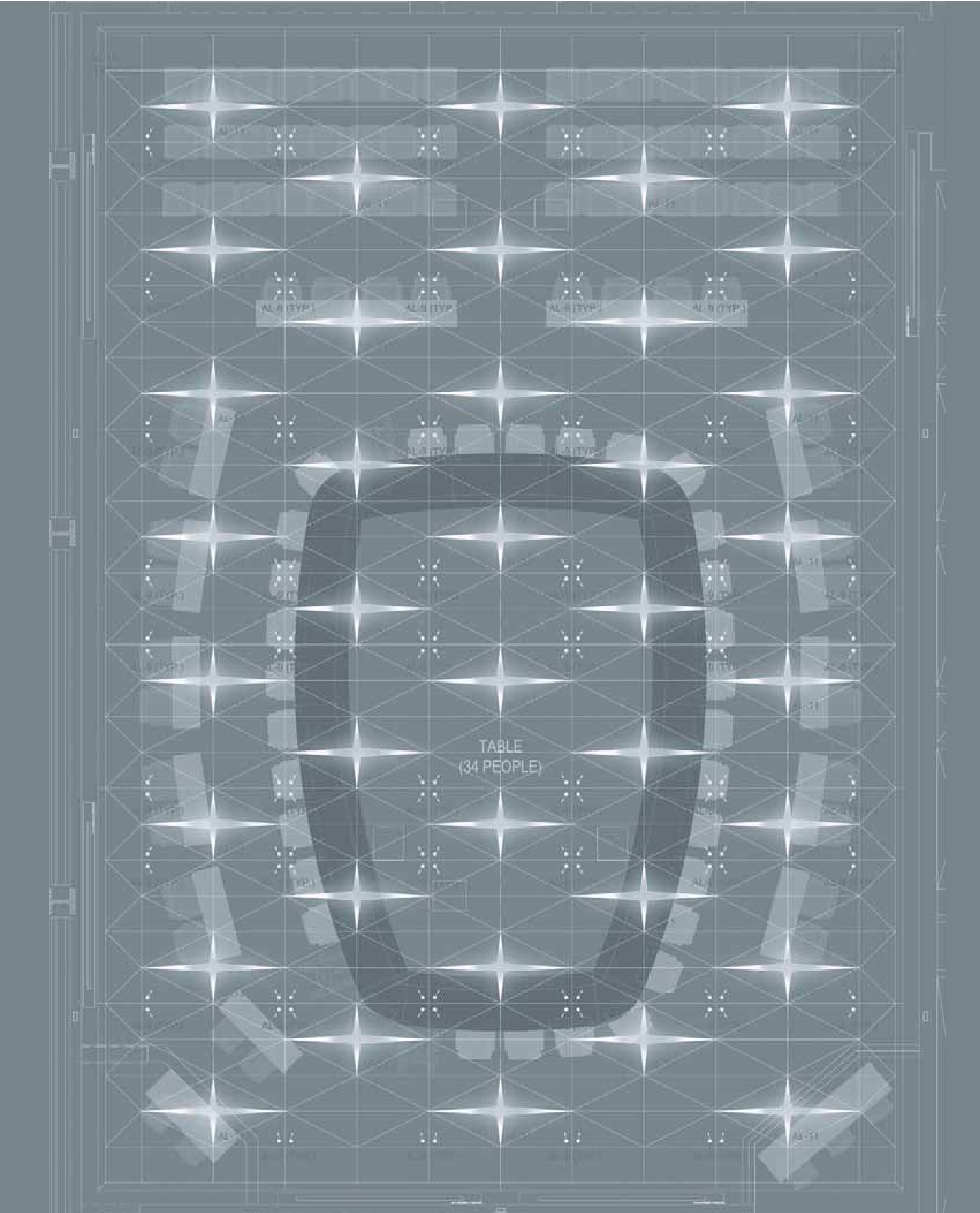


TABLE
(34 PEOPLE)
AL-9 (TYP.)
AL-31

New Istanbul Iconic Tower

Istanbul, Turkey
Architects: Foster + Partners
2010-

The tallest structure in the city, the 52 story New Istanbul Iconic Tower is a new destination and an icon of optimism for the world's third largest metropolis. The tower houses a 190-room, five-star hotel, 325 luxury apartments, indoor and outdoor pools, function spaces and spa facilities. At its crown, a three-story restaurant and public viewing terrace offer unparalleled views over the Bosphorus.

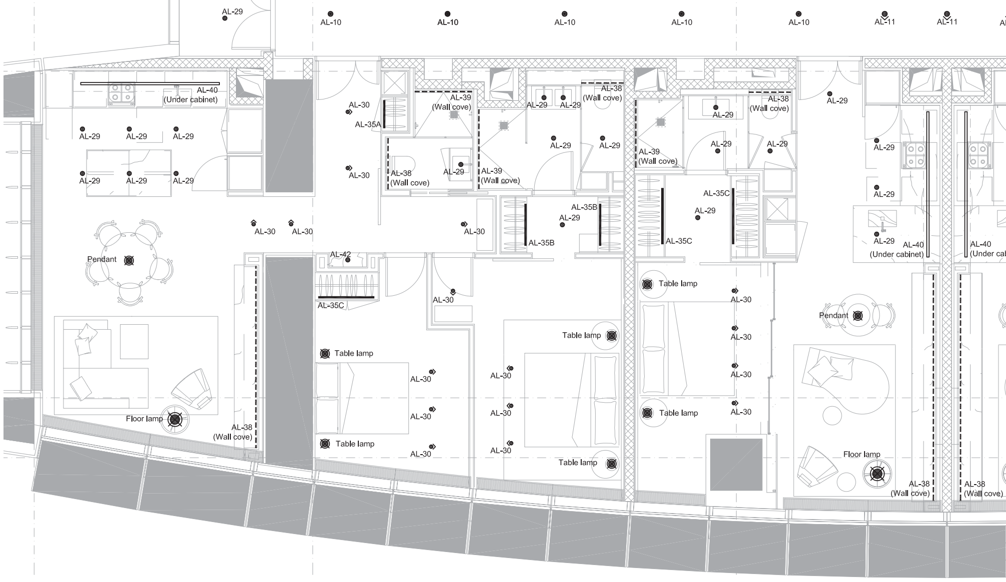
Lighting creates drama throughout the project, accentuating rich finishes and materials using brightness, contrast and shadow as design tools. In the hotel lobby and throughout the ground floor, light intuitively guides visitors between spectacular focal points. Alabaster walls glow from within, while light shimmers from behind the filigree of intricate screens and wall panels. The grand ballrooms—large enough to host up to a thousand guests—feature composed ceilings where interlocking screen panels of different sizes and patterns entwine with light, forming modern, abstracted chandeliers.

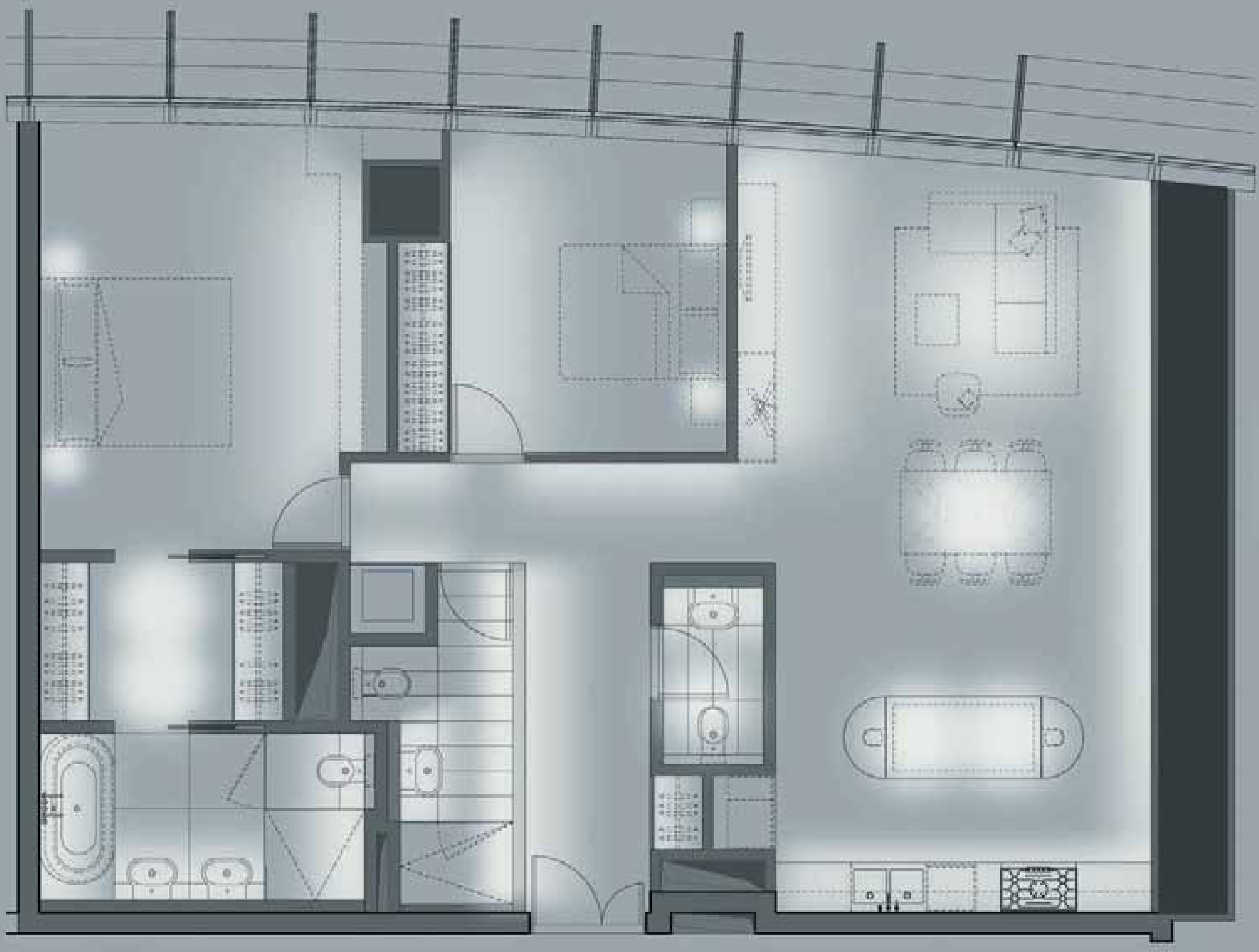
The lighting strategy continues throughout the sophisticated interiors of the hotel rooms and residences. Miniature luminaires and concealed lighting details produce a variety of lighting effects enhancing focal points and creating a sense of comfort and intimacy.

The entire project deploys state-of-the-art lighting technology and long-life sources. In addition, user-friendly lighting control systems provide a high degree of flexibility, with multiple settings that can subtly modify the identity and atmosphere of the spaces.

Opposite: Interior rendering of hotel lobby, with illuminated filigree screens forming a dramatic focal point.


Table lamp
Floor lamp
Pendant
AL-7 (Wall cove - Typical)
AL-10
AL-11
AL-29
AL-30
AL-35A
AL-35B
AL-35C
AL-38 (Wall cove)
AL-39 (Wall cove)
AL-40 (Under cabinet)
AL-42
AL-43
AL-44 (Uplight ceiling cove)





Hotel rooms and residences feature architecturally integrated lighting while minimizing purely decorative elements. Although the sizes of these spaces vary from king-bed studios to five-bedroom apartments, a similar set of lighting principles is used throughout, generating a consistent identity.

High-end materials are designed as enhanced focal points: alabaster walls are rendered luminous, textured screens are brushed with light and concealed coves shape and sculpt the spaces.

Opposite: Lighting plan of typical floor and renderings
Above: Lighting diagram for interior unit
Left: Rendering of hotel room

The Rookery

Chicago, Illinois / USA
Architects: Daniel Burnham and John Wellborn Root

1888 - Original building
2011 - Exterior lighting

The Rookery is a milestone in American architecture. Designed by Daniel Burnham and John Wellborn Root and completed in 1888, its masonry is supported by a steel frame—an innovation in construction at the time that allowed the building to achieve the unprecedented height of twelve stories.

Added to the National Register of Historic Places in 1970 and designated a Chicago Landmark in 1972, The Rookery is now considered one of the greatest surviving examples of early commercial skyscrapers and Chicago's oldest standing high-rise. Its stately dark red brick and terracotta façade with elaborate masonry is unmatched in architectural detailing. This is complemented by a rich and inviting environment within the building, with architectural features including a mesmerizing oriel staircase and stunning light court.

The Rookery makes history again as nighttime lighting graces its façade for the first time in the edifice's over century-long history. Previously, the building's distinctive dark red color made it visually "disappear" at night, especially when compared to the lighter colored buildings nearby. Lighting now softly activates the intricate masonry carving, giving the structure an elegant nighttime presence and distinguishing it from its neighbors.

Upon a close look one notices the building is not 'floodlit' which would flatten it's appearance, but instead the façade is grazed with a veil of illumination that catches the undersides of windows and ledges, enhancing the architectural beauty and texture of the building.

The historic building is illuminated solely with LEDs—the most advanced state-of-the-art lighting technology available.

Developed in close collaboration with the client and the Chicago Landmarks Commission, the exterior lighting design creates a subtle presence of brightness, shadow, and contrast that renders the building visible without overpowering it with light. By activating the façade with a soft veil of illumination, The Rookery's distinct character and historic integrity are respected and maintained.

Opposite: Illumination from window sill-mounted LEDs grazes up The Rookery's façade, highlighting its masonry details.

Lighting for Historic Preservation

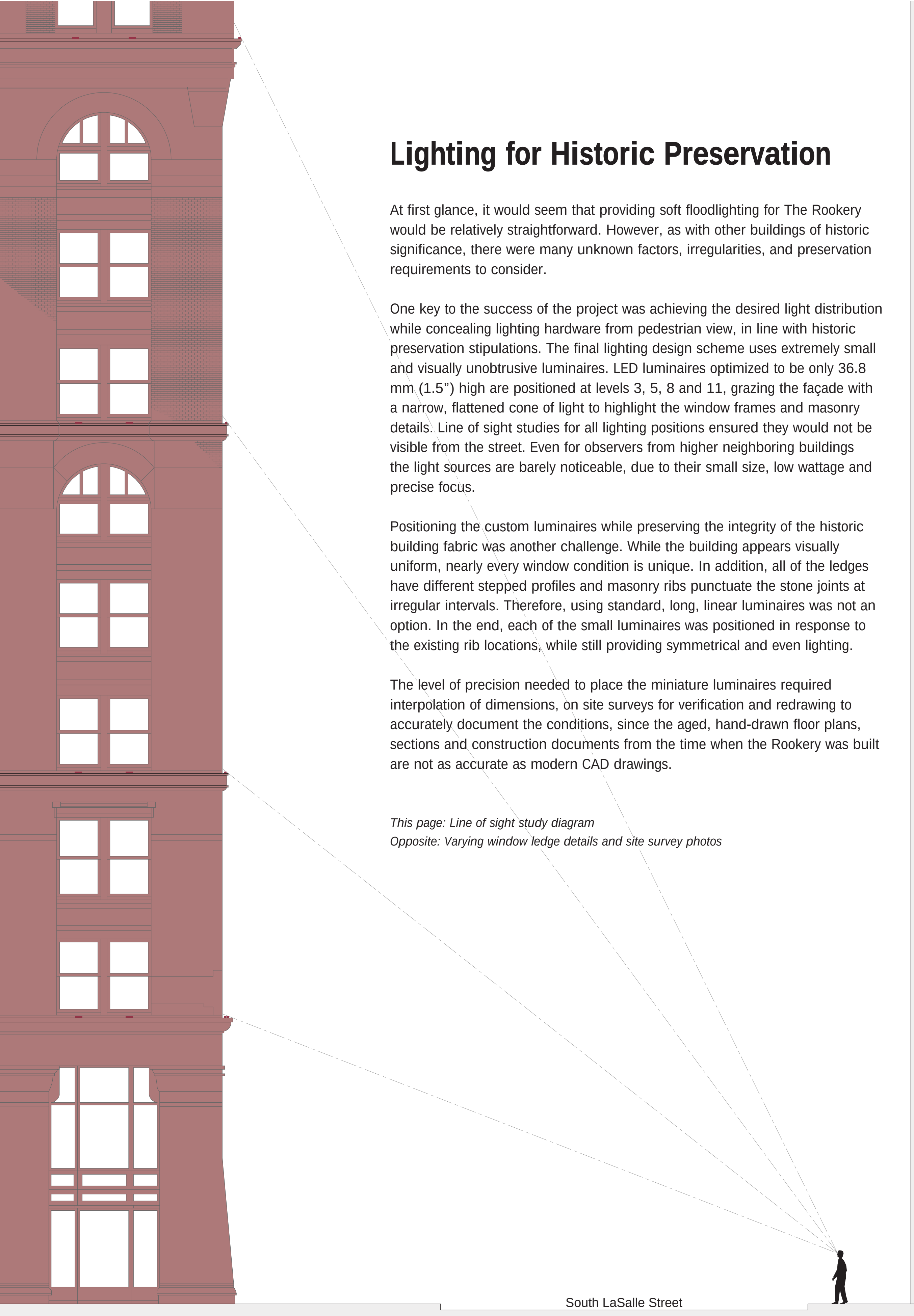
At first glance, it would seem that providing soft floodlighting for The Rookery would be relatively straightforward. However, as with other buildings of historic significance, there were many unknown factors, irregularities, and preservation requirements to consider.

One key to the success of the project was achieving the desired light distribution while concealing lighting hardware from pedestrian view, in line with historic preservation stipulations. The final lighting design scheme uses extremely small and visually unobtrusive luminaires. LED luminaires optimized to be only 36.8 mm (1.5”) high are positioned at levels 3, 5, 8 and 11, grazing the façade with a narrow, flattened cone of light to highlight the window frames and masonry details. Line of sight studies for all lighting positions ensured they would not be visible from the street. Even for observers from higher neighboring buildings the light sources are barely noticeable, due to their small size, low wattage and precise focus.

Positioning the custom luminaires while preserving the integrity of the historic building fabric was another challenge. While the building appears visually uniform, nearly every window condition is unique. In addition, all of the ledges have different stepped profiles and masonry ribs punctuate the stone joints at irregular intervals. Therefore, using standard, long, linear luminaires was not an option. In the end, each of the small luminaires was positioned in response to the existing rib locations, while still providing symmetrical and even lighting.

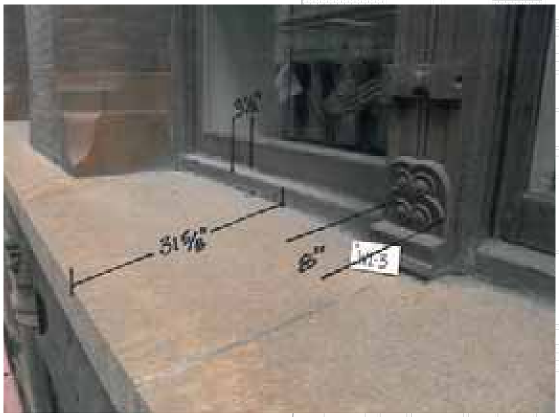
The level of precision needed to place the miniature luminaires required interpolation of dimensions, on site surveys for verification and redrawing to accurately document the conditions, since the aged, hand-drawn floor plans, sections and construction documents from the time when the Rookery was built are not as accurate as modern CAD drawings.

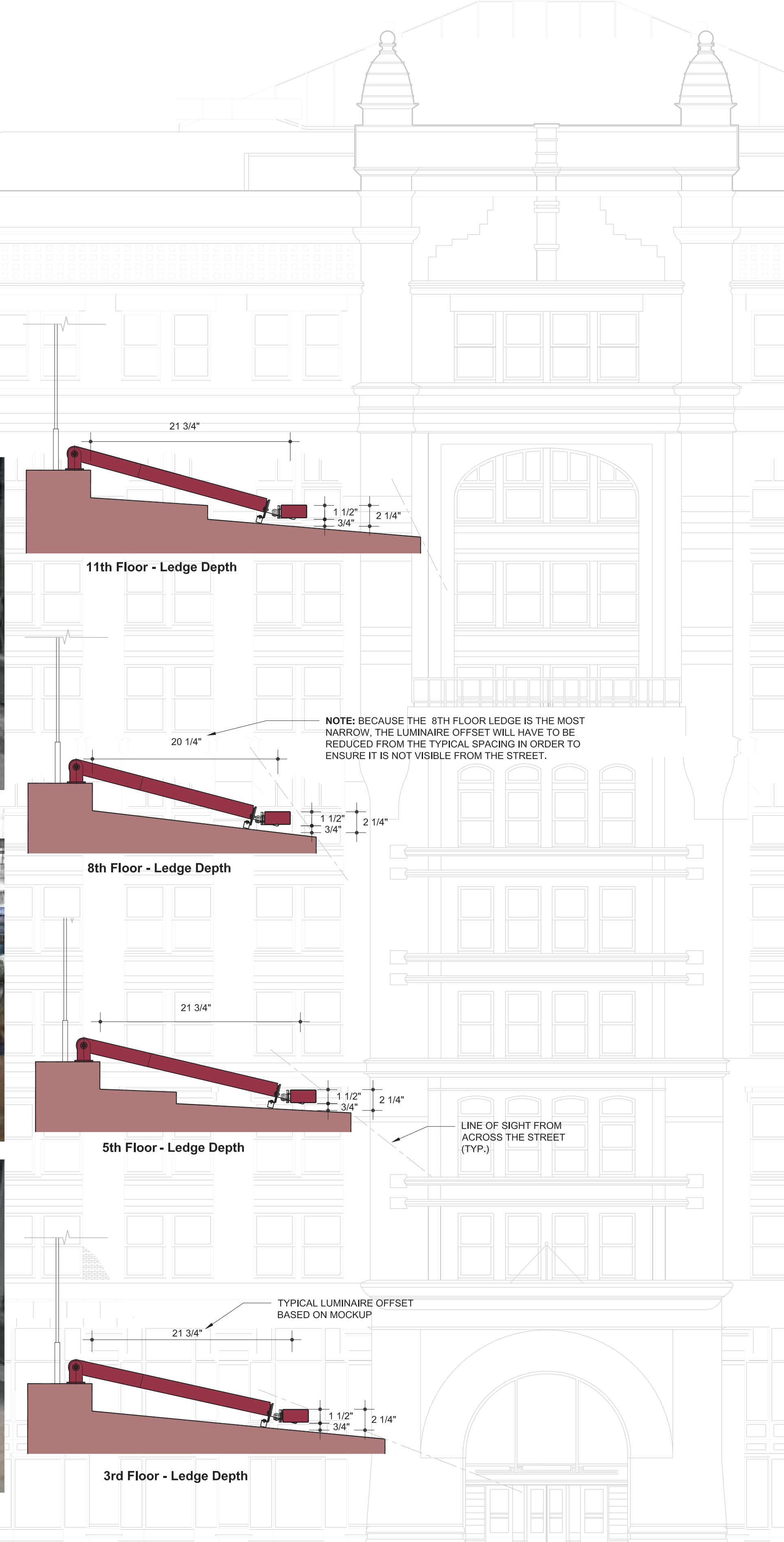
This page: Line of sight study diagram
Opposite: Varying window ledge details and site survey photos

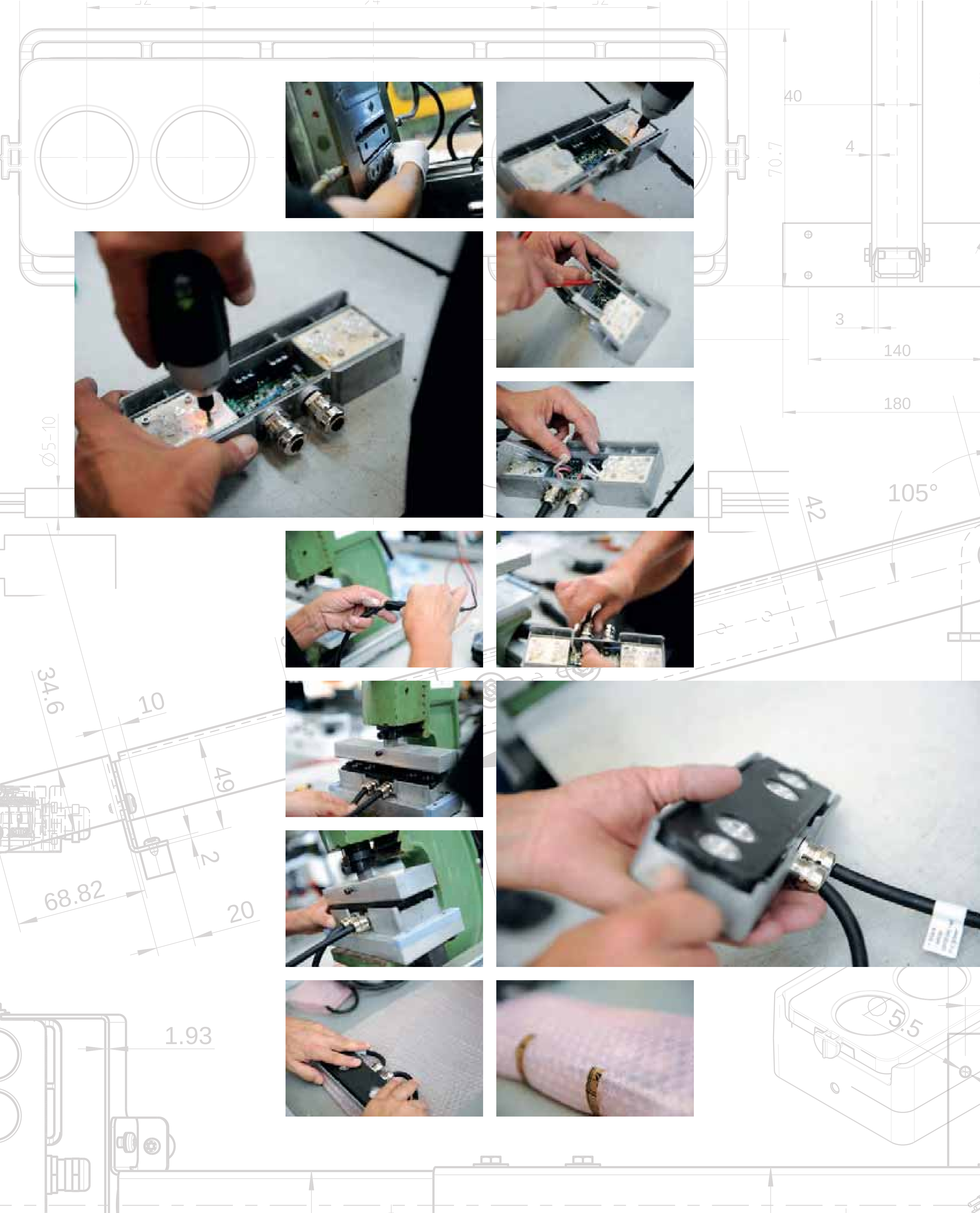



W1-5


W1-5


W1-3


21 3/4"
1 1/2"
3/4"
2 1/4"
11th Floor - Ledge Depth
NOTE: BECAUSE THE 8TH FLOOR LEDGE IS THE MOST NARROW, THE LUMINAIRE OFFSET WILL HAVE TO BE REDUCED FROM THE TYPICAL SPACING IN ORDER TO ENSURE IT IS NOT VISIBLE FROM THE STREET.
20 1/4"
1 1/2"
3/4"
2 1/4"
8th Floor - Ledge Depth
21 3/4"
1 1/2"
3/4"
2 1/4"
LINE OF SIGHT FROM ACROSS THE STREET (TYP.)
5th Floor - Ledge Depth
TYPICAL LUMINAIRE OFFSET BASED ON MOCKUP
21 3/4"
1 1/2"
3/4"
2 1/4"
3rd Floor - Ledge Depth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3
140
180
105°
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34.6
10
49
2
68.82
20
1.93
Ø5.5
Ø5-10

Based on observations made during on-site mock-ups, a custom luminaire with special optics was developed to optimize the amount of light on the façade while minimizing power consumption of the system and light spill into the night sky. The final design uses high performance LED luminaires with custom optics that create a flattened cone of illumination extending up three stories. The resulting custom luminaire is small enough to fit into the palm of a hand.

The entire lighting scheme utilizes LED luminaires, positioned at building ledges to graze up the façade and accentuate masonry details. The LED luminaires consume only 14.4 watts each, for a total of 2,304 watts to illuminate the entire façade. A 3,000K warm white color temperature is chosen to enhance the distinctive red color of the building without rendering it orange.

A critical issue for the Chicago Landmarks Commission was preventing damage to the Rookery's masonry. A custom telescoping mounting arm was designed to minimize direct physical contact with the façade, whose geometry varies considerably at each level. The design allows the luminaires to be anchored to the granite window sills, instead of attaching them to the masonry and terracotta elements. The telescoping design accommodates the different ledge conditions and allows for lockable field adjustment and aiming. The brackets' polyurethane feet rest on the ledges minimizing direct contact with the historic building surfaces and the assembly is finished in official Rookery-red to match the façade.

Opposite: Luminaire assembly process
Above: Telescoping mounting arm

The lighting for The Rookery was officially inaugurated with a lighting ceremony that took place on November 30, 2011. As evening set in, a reception took place under the filigree ceiling of the lobby's Light Court, with a theme entitled "Brilliant Past, Brighter Future". A road closure on South LaSalle street allowed the crowd to gather outside the building to witness the illumination of the façade for the first time in its history. The kind of attention usually accorded to a new building's completion was trained on the red stonework as the building transformed from a shadowy silhouette into a nocturnal presence as one of Chicago's beloved landmarks. The Rookery's elegant and restrained nighttime identity links it to the time of its creation, emphasizing the importance and beauty of its architecture.

Opposite: The Rookery by day and night

Above: Exterior façade lighting mockup

Presidential Library of Kazakhstan

Astana, Kazakhstan
Architects: Foster + Partners
2011-

Kazakhstan was the last Soviet republic to declare itself independent in 1991. The Presidential Library in Astana is part of a new cultural landscape for the country, which, since 2000, has enjoyed significant economic growth attributed to its oil, gas, and mineral reserves.

Today, knowledge is no longer centralized. Instead, libraries have become nodes of a global knowledge network. Modern library buildings such as the Presidential Library accommodate these developments with open floor plans that replace traditional bookstacks and allow adaptation for new media, virtual technologies, and future developments. In addition to its books and archives, the Presidential Library houses reading and study halls, language learning spaces, roving special collections, and a digital media center—all within a dramatic nine-story armored pod.

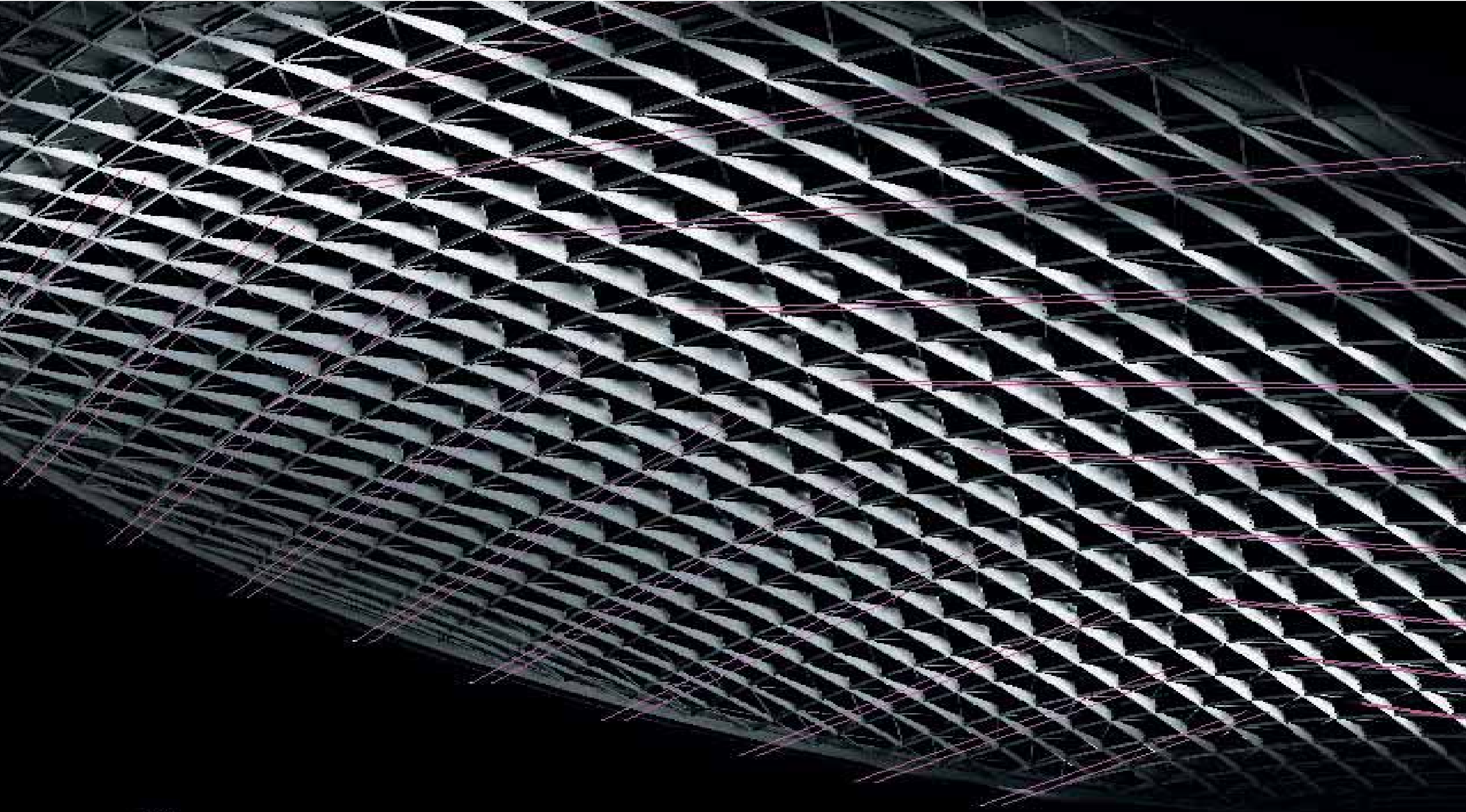
Lighting is modulated to the library's distinct architectural geometry. From outside, the main atrium's glass roof—a 39-meter high, 90-meter diameter series of panels tilted like a sundial—glows dramatically, emphasizing the breadth of the structure. Inside, the atrium ceiling remains clear of lighting hardware. Its textured surface is grazed with light from luminaires at the perimeter. Stacked, horse-shoe shaped balconies, rimmed with light, wrap the vast space. These ascend to culminate in a Presidential office suite and VIP areas on the top floor.

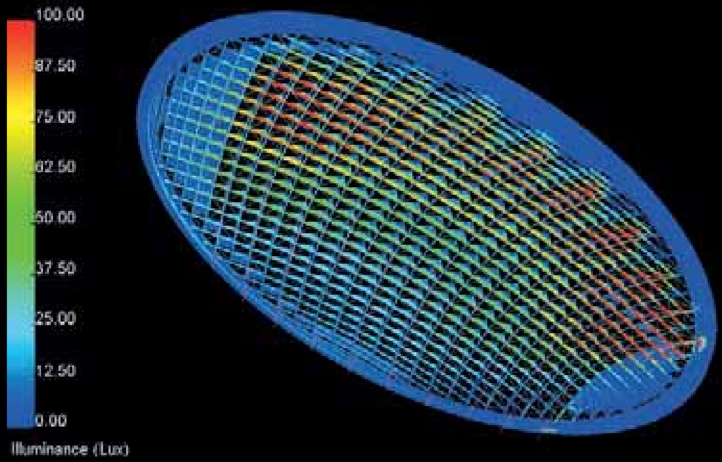
On upper level ceilings, linear luminaires are arranged in splayed bands that radiate outward from the atrium, reinforcing the building's strong radial geometry. Micro-scale units are meticulously integrated into the ceilings to form lines of light, spaced and calibrated to generate consistent light levels. On exhibition floors, the same channel locations are used with track lights, maintaining the radial pattern while providing flexible lighting for changing displays.

At night, bollards line the path leading visitors to the library. Soft floodlighting sculpts the building's distinctive profile, gently complementing the light that emanates from within the entrance area and skylit roof.

Opposite: Nighttime rendering of the Presidential Library.

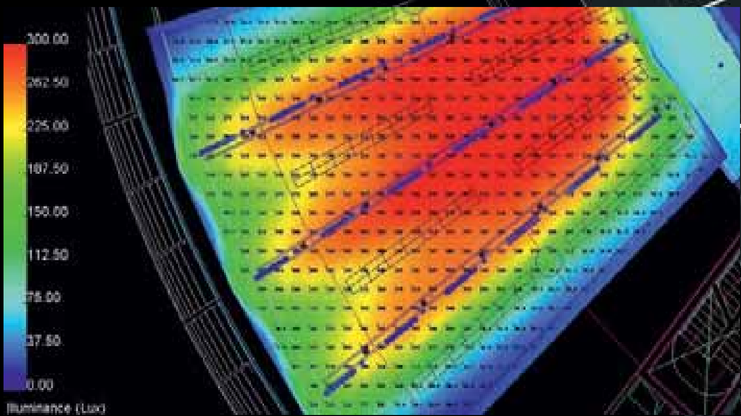

Luminaire
(TYP.)

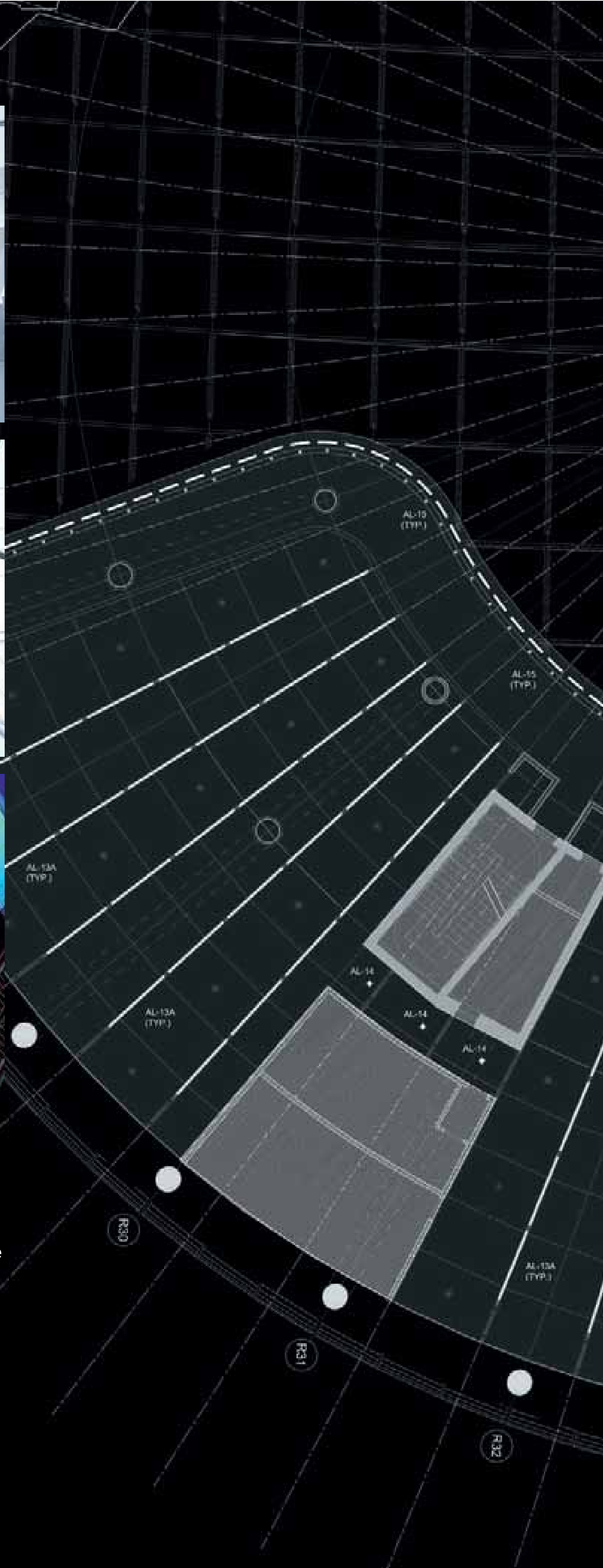




The central atrium is topped by a tilted, louvered glass roof. Luminaires integrated within a ledge around the perimeter graze the textured glazing, activating it with light. This reinforces the skylit roof's dramatic presence, while allowing the space-frame structure to remain pristine and clear of lighting hardware.

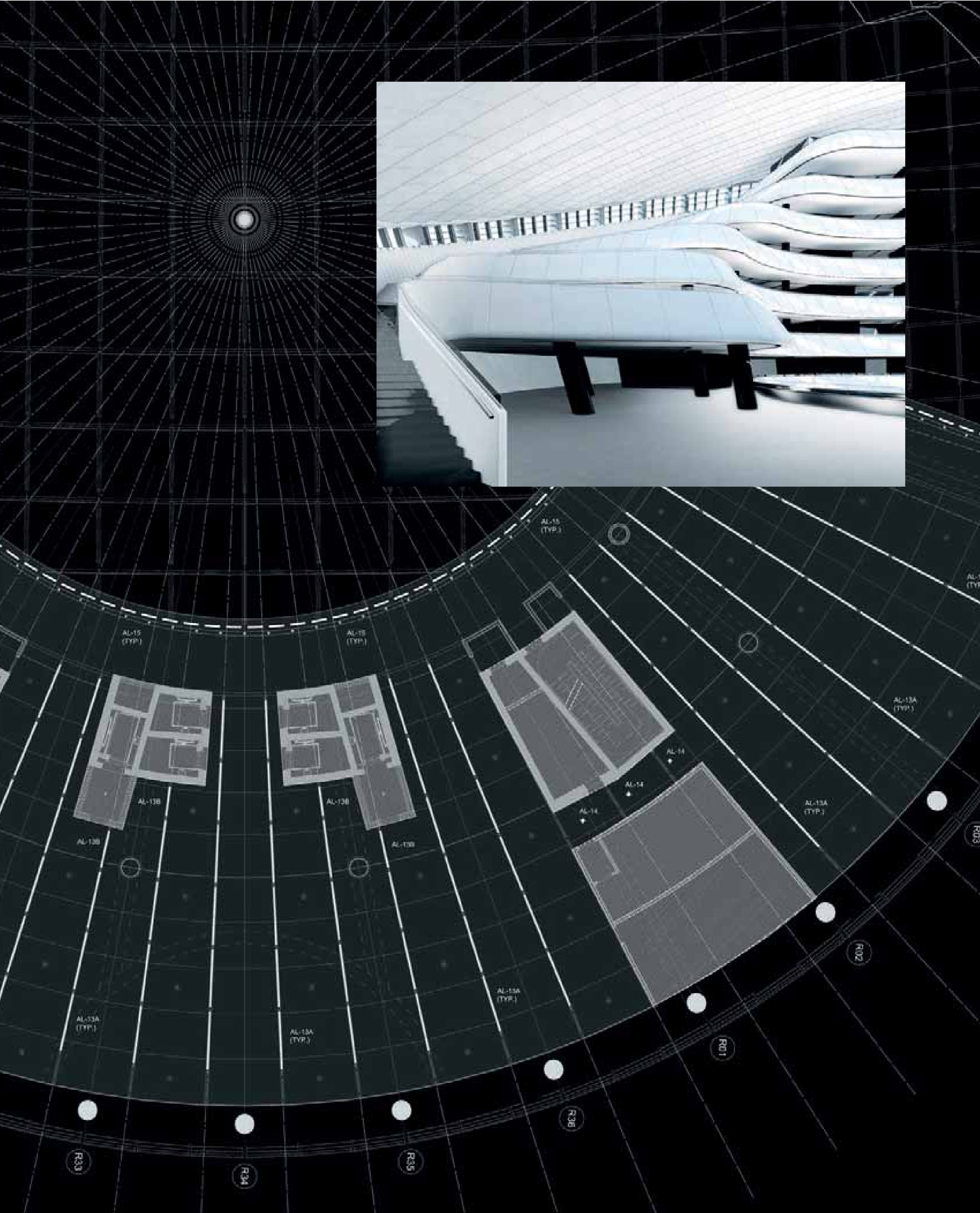
Opposite: Rendered lighting model and reflected ceiling plan of atrium with lights at perimeter
Above and right: Light aiming and calculation diagrams at atrium roof; cross-section building model





On the upper levels, micro-scale luminaires are arranged in radiating bands that also integrate speakers and sprinkler heads. State-of-the-art technology allows a thin, 50mm luminaire profile to provide light levels for work areas. Spacing between the radial bands is coordinated architecturally and photometrically to provide sufficient light levels, while accommodating service equipment and aligning with the building's structural modulation.

Above: Office renderings and light calculation diagram
Opposite: Lobby rendering; reflected ceiling plan at typical floor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R03

Dancing Dragons

Seoul, Korea

Architects: Adrian Smith + Gordon Gill Architecture

2011-

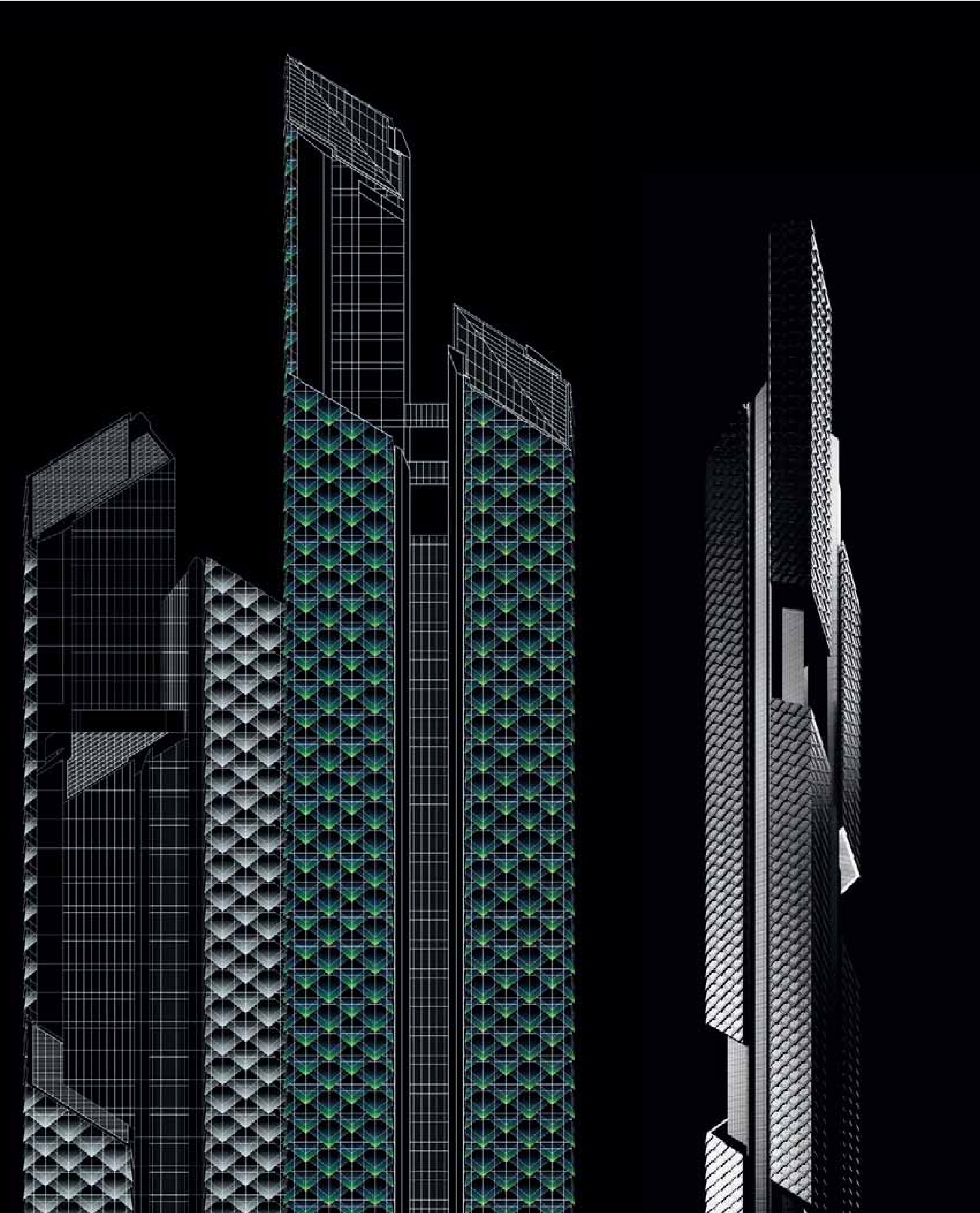
Dancing Dragons, a pair of mixed-use skyscrapers, stands proud in Seoul's new Yongsan International Business District. The pair of 450 meter high towers with glass scales, consist of slender, sharply angled mini-towers cantilevered around a central core—a new typology for super-tall buildings. At the top, the mini-towers become independent, rising above the core, creating luxurious penthouse residences with spectacular 360-degree views of downtown Seoul and the adjacent Han River.

The name of the towers comes from their scale-like glass building skin, which allows for natural venting and visually evokes the mythical dragon, a strong Korean symbol. The buildings abstractly recall historic structures, through their cantilevered volumes and in their textured façades, similar to traditional Korean temple roofs and eaves. The shingle-clad volumes and rhythm of cuts creates an impression of the two towers moving in tandem around their cores, as if dancing together. Reinforcing the theme, the area in which the landmark buildings are located, Yongsan, translates as "Dragon Hill".

This new architectural typology requires equally inventive lighting design solutions. The super-tall structures and scale-like glazing do not respond to traditional floodlighting schemes. There are no ideal luminaire locations or ledges to conceal lighting equipment. And, due to the sheer height of the towers, the overall distance makes floodlighting not an option. Instead, a unique combination of state-of-art lighting technology, micro-sized light sources and various glazing treatments are balanced to enhance the building's distinctive appearance.

A ceramic frit pattern applied to the glass shingles varies in density from nearly opaque at the lower tip to totally transparent at the top of each pane. The density and location of the frit pattern are coordinated to maintain views at eye level and create visual privacy. Each glass shingle is edge-lit using micro-sized LED luminaires. As the ceramic frit reflects light, each of the diamond-shaped forms is articulated. This reinforces the building's architectural nighttime identity, rather than allowing the towers to be overcome by the interior lighting alone.

Opposite: Individually-lit façade scales give the towers an animated, iconic appearance.

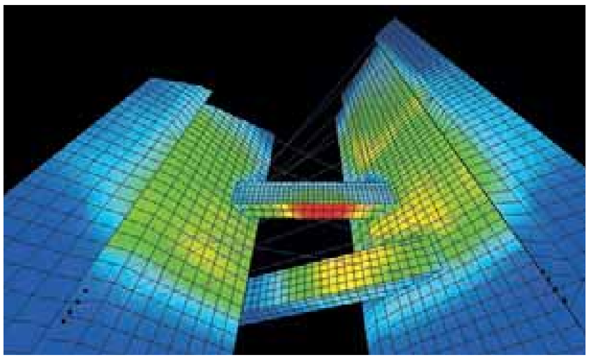


Scale-like façades

At night, the scale-like façade of the towers are enlivened with illumination. A series of exploratory lighting strategies for the exterior included emphasizing the mega-columns and accentuating the textured cantilevered volumes.

Playing on the building's identity, LEDs allow the building to 'breathe' in different colors for special events, changing from white to fire-like amber hues and cool, blue-green tones. Articulating the shingled façade produces a distinctive appearance from a distance and generates a unique visual experience of the dragon-scale building skin.

Right: Close-up of glass façade
Left: Lighting diagrams showing white and colored options
Below: Rendered view of towers from above; lighting calculation



OVI Exhibition – ‘Lighting Powers of 10’ at the Architectural Forum in Berlin

Berlin, Germany

2010

The work of Office for Visual Interaction (OVI) was showcased in an exhibition entitled ‘Lighting Powers of 10’ at the Aedes Architecture Forum in Berlin, Germany. The exhibition was conceived, designed and planned by OVI, and marks the first time a lighting design firm has been featured at the Forum, renowned as one of the world’s premier institutions for the advancement of architectural culture. ‘Lighting Powers of 10’ provides a guiding framework for the recognition of lighting design as an important partner in contemporary architecture.

The exhibition was conceptualized to highlight OVI’s unique design approach. Instead of a simple presentation of projects, the exhibition documented OVI’s thinking and working process. Inspired by the Charles and Ray Eames’ film entitled ‘Powers of Ten’ in communicating the way the universe can be perceived at different scales, OVI translated this idea to the architecture and lighting design fields.

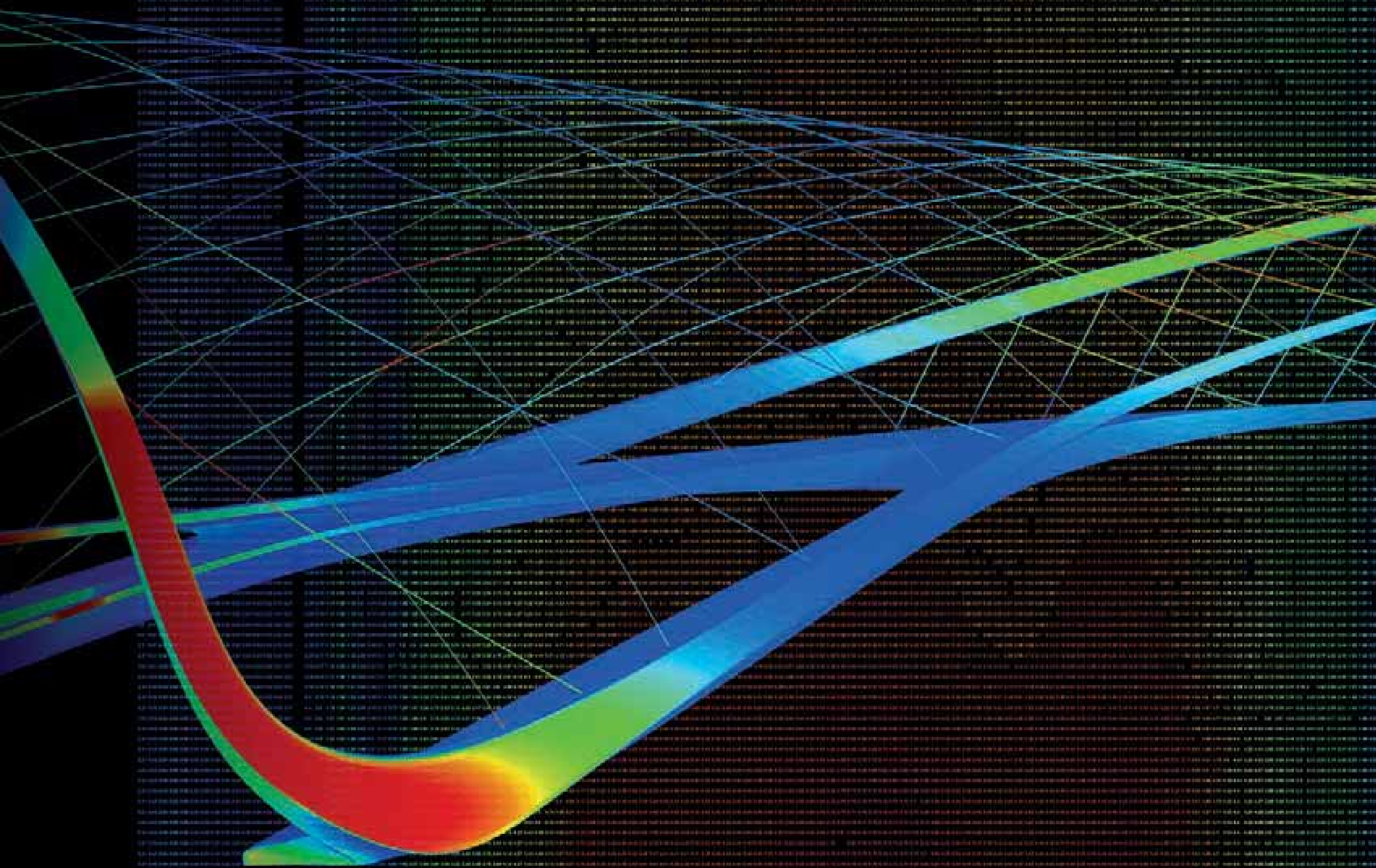
‘Lighting Powers of 10’ pivots at the level of 10^{0}, corresponding to actual size of (1:1) relating to architectural surfaces that are readily seen and touched. The exhibition takes a journey through thirteen powers of 10, aligning closely with the realities of architecture and lighting design work: from 10^{+5}—applying lighting master planning strategies to the size of a metropolitan area (1:100000), down to 10^{-7}—modifying the spectral wavelength of light (1:0.0000001).

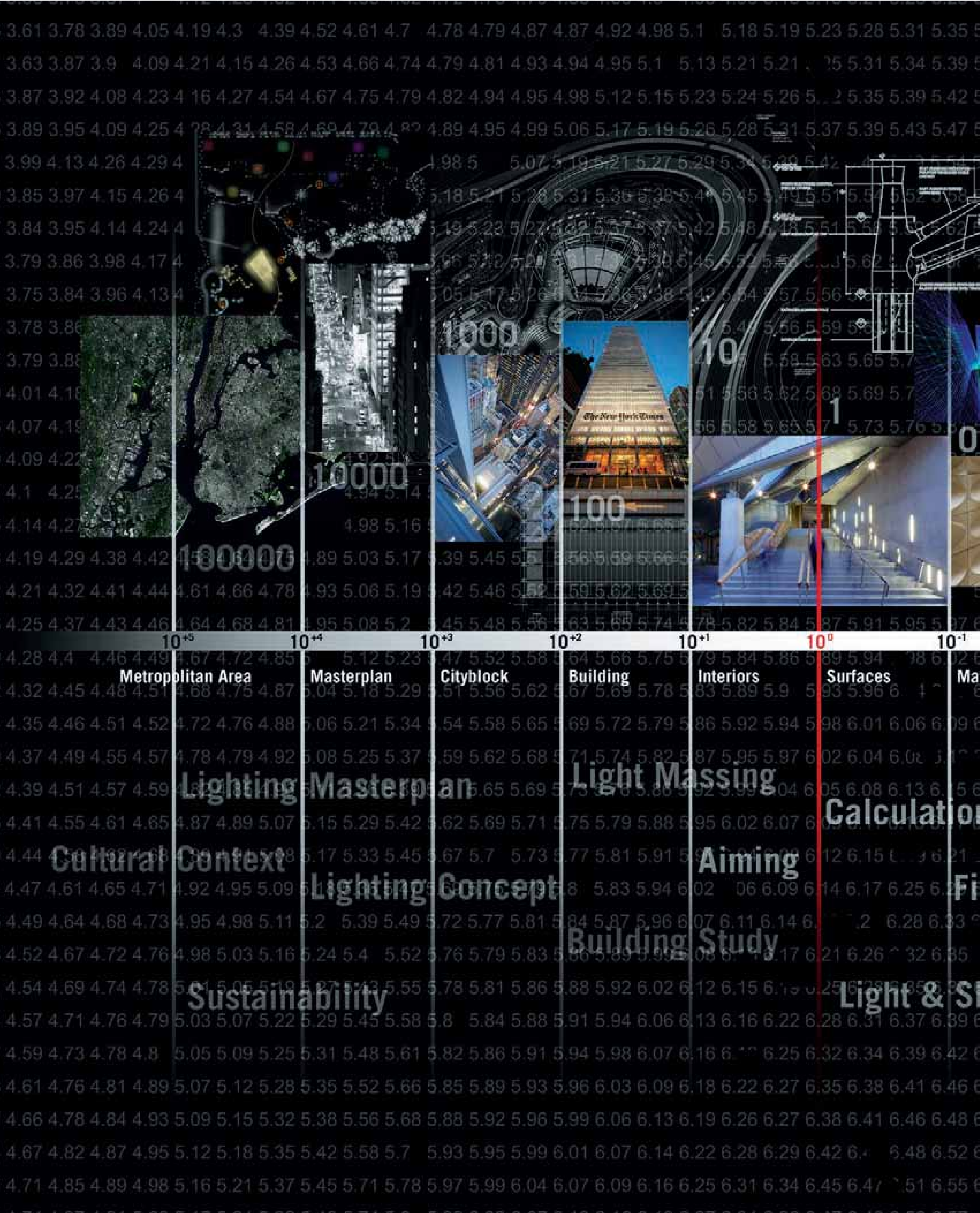
Working strategically at many scales, OVI approaches each project by looking at the overall picture or masterplan—the spirit of a city, the narrative of a building—and translating it into a corresponding lighting concept. Step by step and scale by scale, these ideas are developed from their largest conceptual aspirations to their tiniest details.

Opposite: Cover of exhibition catalogue
Following spread: ‘Lighting Powers of 10’ visual graphic

OFFICE FOR VISUAL INTERACTION
LIGHTING DESIGN

LIGHTING POWERS OF 10





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Light Massing
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Cultural Context
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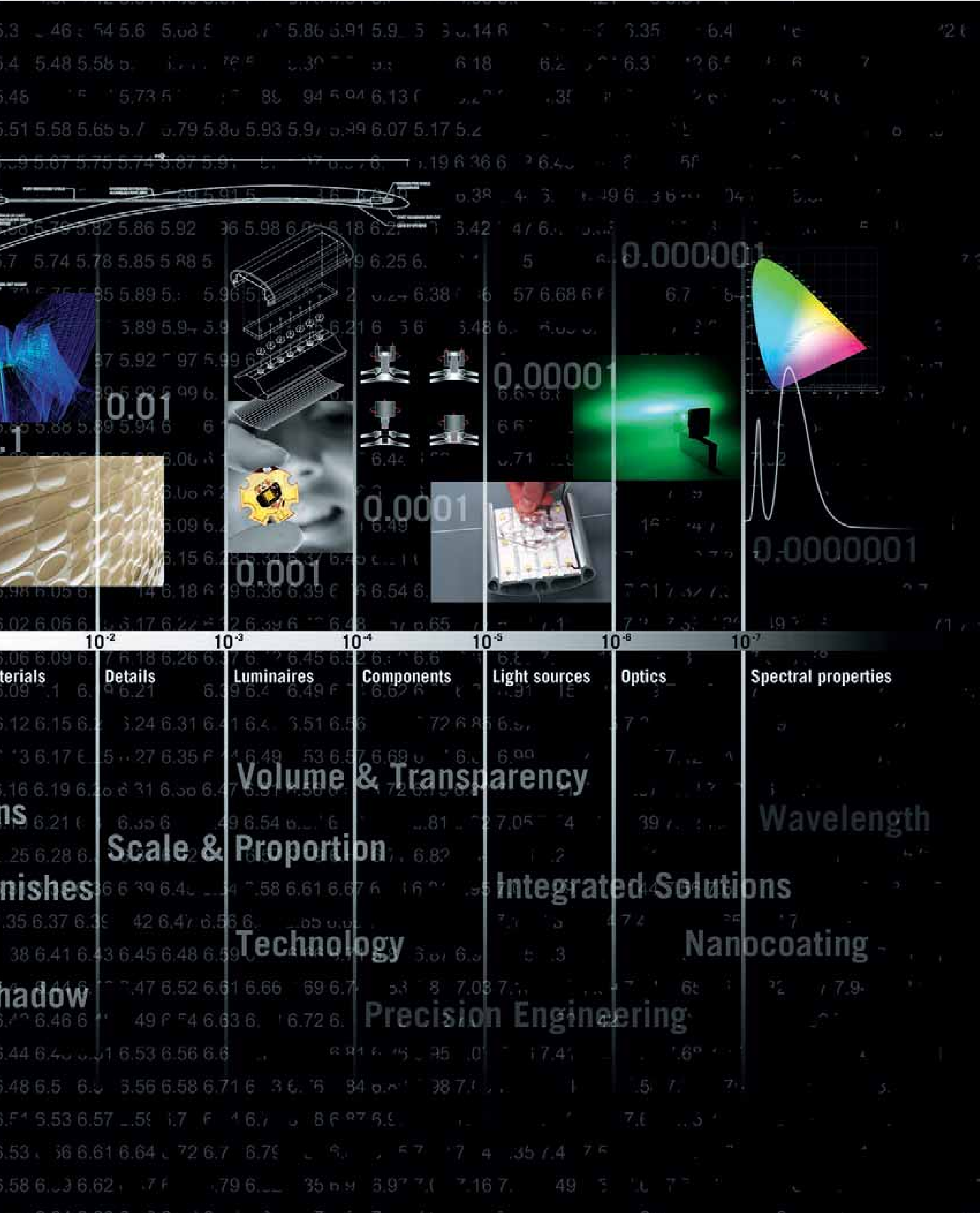
Lighting Concept
Building Study
Sustainability



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Light sources
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Integrated Solutions
Technology
Nanocoating
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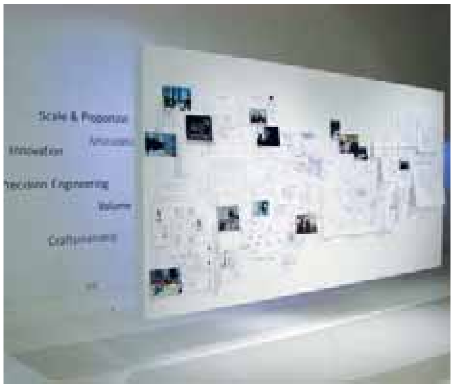
Precision Engineering

‘Lighting Powers of 10’ showcased four of OVI’s award-winning projects: the LED streetlight for New York City, lighting for the Scottish Parliament Building complex, the New York Times Building and the United States Air Force Memorial. A mix of photos, sketches, diagrams, photometric calculations, lighting renderings and working drawings traced the lighting development of each project through a full range of scales—from regional considerations spanning hundreds of kilometers (10^{+5}), to nano-scale wavelength modifications (10^{-7}). The exhibition provided a unique behind the scenes view of the lighting design work and process that demonstrates inventive concepts and precision design engineering at every scale.

Projected light model calculations from the Scottish Parliament, custom-designed luminaires from the New York Times Building, and prototype components from the New York City LED streetlight put visitors in direct contact with the materials and processes involved in OVI’s work.

Above and below: Photos of the exhibition



Left: Enrique Peiniger and Jean Sundin at the exhibition opening
Below: Exhibition photos

Jean Sundin and Enrique Peiniger founded Office for Visual Interaction (OVI) in 1997. Based in New York City, the office specializes in architectural lighting design for signature projects worldwide.

Born in the United States, Jean Sundin received her B.F.A. in Interior Design from Virginia Commonwealth University, where she studied under Han Schroeder and graduated magna cum laude. She later joined the lighting office of Claude and Danielle Engle, and as a project manager contributed to internationally acclaimed works including the Carée d'Art in Nîmes, France; Stansted Airport in Essex, UK and the Grand Louvre in Paris, France. Jean's lighting design experience and technical expertise allow her to use light as a technical extension of the architectural language to shape and transform space.

German-born Enrique Peiniger received his Diploma in Architecture and a Masters degree in Social Science from the Technical University in Berlin. He worked in the lighting design studio of Christian Bartenbach in Austria and later joined a lighting manufacturer to develop custom luminaires. Over the years he has cultivated an in-depth knowledge of luminaire manufacturing and technology, giving him the highest level of precision in designing lighting solutions that conform to narrow technical requirements. Enrique frequently spearheads collaborations with industry to develop custom luminaires, incorporating specialized finishes, innovative manufacturing techniques, and emerging light sources.

OVI's unique work process and holistic approach to lighting design were recognized early on, with major commissions including lighting for the Scottish Parliament in Edinburgh, Scotland. As principals of OVI, Jean and Enrique have been responsible for iconic lighting work around the globe, ranging from masterplans and cultural buildings to sophisticated interiors and product design.

Parallel to their lighting design practice, they are both active Professional Members of the International Association of Lighting Designers (IALD), the Illuminating Engineering Society of North America (IESNA) and the Professional Lighting Designers' Association (PLDA). During Jean's tenure as Director of Education for the PLDA, she established the *'Architectural Lighting Fundamentals',* a set of universal benchmarks for lighting education, and chaired the committee for the development of a syllabus for a Masters Degree in Lighting Design. She has been an invited judge for the IALD Lighting Design Awards, IES Lumen Awards and A|L Magazine Awards. Jean and Enrique are co-authors of the IALD *'Guidelines for Specification Integrity'* used by lighting designers worldwide. In 2004, Enrique was appointed a UNESCO expert and later served as Treasurer for the PLDA. In addition, he has served on the program advisory committee for the IALD – Enlighten America conference.

Jean and Enrique have been internationally recognized for their technologically and aesthetically inventive lighting design solutions. Their work has been honored with the industry's highest accolades, including the General Electric *Edison Award*, Architect Magazine's *R&D Award*, the Illuminating Engineering Society *International Award of Distinction* and multiple *Lumen Awards*, the IALD *Award of Merit,* the American Institute of Architects' *Project Merit Award*, the New York Arts Commission *Award for Excellence in Design*, the Illumni *Gold Infinity Award*, the LAMP *First Place Award for Architectural Outdoor Lighting* and the World Architecture News *Lighting Project of the Year*.

Their work has been featured on national television and in leading international architectural, design and lighting publications. In 2010, the work of OVI was showcased in the first solo lighting exhibition at the renowned Architecture Forum in Berlin, entitled 'Lighting Powers of 10'. Jean and Enrique have both led advanced courses in lighting design and are frequent lecturers worldwide. Presentations have included the keynote at Neocon in Toronto, the Richard Kelly Lighting Symposium at Yale University, Universidad Politécnica in Madrid, Lightfair, Light + Building in Frankfurt, PLDC conventions in Berlin, London, Madrid and the Euroluce in Milan.

Project Credits

The Scottish Parliament
Edinburgh / Scotland
Architects: Enric Miralles-Benedetta Tagliabue with RMJM
Structural Engineer: Arup
Electrical Engineer: RMJM Building Services

Lois and Richard Rosenthal Center for Contemporary Art
Cincinnati, Ohio / USA
Architects: Zaha Hadid with KZF Design
Structural Engineer: THP
Electrical Engineer: Heapy Engineering

Bergisel Ski Jump
Innsbruck / Austria
Architects: Zaha Hadid
Structural Engineer: Aste Konstruktion
Electrical Engineer: TB Pürcher

Experimental Media and Performing Arts Center (EMPAC) at Rensselaer Polytechnic Institute
Troy, New York / USA
Architects: GRIMSHAW with Davis Brody Bond
Structural Engineer: Buro Happold
Electrical Engineer: Lazslo Bodak Engineers

The New York Times Building
New York, New York / USA
Architects: Renzo Piano Building Workshop with FXFOWLE
Structural Engineer: Thornton Tomasetti
Electrical Engineer: Flack + Kurtz

The TimesCenter
New York, New York / USA
Architects: Renzo Piano Building Workshop with FXFOWLE
Structural Engineer: Thornton Tomasetti
Electrical Engineer: Flack + Kurtz

The United States Air Force Memorial
Arlington, Virginia / USA
Architects: Pei Cobb Freed & Partners
Structural and Electrical Engineer: Arup

Museum of Modern Art (MoMA) Design Store
New York, New York / USA
Architects: Gluckman Mayner
Structural Engineer: Severud Associates
Electrical Engineer: Altieri Sebor Wieber

C.V. Starr East Asian Library at the University of California, Berkeley
Berkeley, California / USA
Architects: Todd Williams Billie Tsien with Tom Eliot Fisch
Structural Engineer: Rutherford & Chekene
Electrical Engineer: Flack + Kurtz

New York City Streetlight
New York, New York / USA
Architects: Thomas Phifer and Partners
Structural Engineer: Werner Sobek
Electrical Engineer: Lazslo Bodak Engineers

Museo del Acero - Museum of Steel
Monterrey, Nuevo Leon / Mexico
Architects: GRIMSHAW with Oficina de Arquitectura
Structural Engineer: Werner Sobek
Electrical Engineer: Buro Happold

Al Hamra Firdous Tower
Kuwait City / Kuwait
Architects: Skidmore Owings & Merrill with Al-Jazera Consultants
Structural and Electrical Engineer: Skidmore Owings & Merrill

Canadian Museum for Human Rights
Winnipeg, Manitoba / Canada
Architects: Antoine Predock with Smith Carter
Structural Engineer: Halcrow Yolles
Electrical Engineer: Mulvey + Banani

Perot Museum of Nature and Science
Dallas, Texas / USA
Architects: Morphosis with Good Fulton & Farrell
Structural Engineers: Datum Engineers with John A. Martin & Associates
Electrical Engineer: Buro Happold

King Abdullah Petroleum Studies and Research Center (KAPSARC)
Riyadh / Saudi Arabia
Architects: Zaha Hadid
Structural and Electrical Engineer: Arup

Canadian Parliament - West Block
Ottawa / Canada
Architects: ARCOP with Fournier Gersovitz Moss Drolet & Associates
Structural Engineer: Ojdrovic + Cooke
Electrical Engineer: Crossey Engineering

New Istanbul Iconic Tower
New Istanbul / Turkey
Architects: Foster + Partners
Structural Engineer: Halcrow Yolles
Electrical Engineer: Samay Muhendislik

The Rookery
Chicago, Illinois / USA
Architects: Daniel Burnham and John Wellborn Root
Structural Engineer: Klein and Hoffman
Electrical Engineer: Environmental Systems Design

Presidential Library of Kazakhstan
Astana / Kazakhstan
Architects: Foster + Partners
Structural Engineer: Buro Happold
Electrical Engineer: DEC Kazakhstan

Dancing Dragons
Seoul / Korea
Architects: Adrian Smith + Gordon Gill Architecture
Structural Engineer: Werner Sobek
Electrical Engineer: PositivEnergy Practice

OVI Exhibition - Lighting Powers of 10
Berlin / Germany
Exhibition Design: Office for Visual Interaction, Inc. - OVI
Graphic Design and Catalog: Office for Visual Interaction, Inc. - OVI

Photo Credits

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