Into the sky

The United States Air Force Memorial in Arlington/VA.

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Photos: Thomas Mayer, Erco USA

"The Memorial is rooted in the necessary symbolic transition of making the medium of the Air Force visible. The Navy has the medium of water, which can always be shown in fountains, and the Army has the medium of land, which can be referenced with mountains and plains; the Air Force has the medium of air, which is very difficult to show. The core of this effort lies in making air tangible, making technology felt."

James Ingo Freed, FAIA

The Memorial overlooks the Pentagon and 'monumental' Washington from the crest of a high-visibility promontory. It features three stainless steel spires that soar skyward and is 270 feet (82 meters) high at its highest point. Its array of arcs against the sky evokes a modern image of flight - and is reminiscent of the precision "bomb burst" maneuver performed by the United States Air Force Thunderbird Demonstration Team. The Memorial's design is truly representative of the Air Force and evokes flight and the flying spirit.

The number three has significant associations for the Air Force, including the three core values: Integrity first, Service before self, and Excellence in all we do. It is also the smallest number of elements needed to define and enclose a space. The spires are asymmetric, dynamic and each has a different height (270', 231' and 201') so that the view of the Memorial changes from every angle. The appearance of the arcs changes dynamically with the viewer's location, the weather, the season, and the time of day.

The lighting scheme is based on a concept that illumination appears to be emerging from within the memorial itself to enhance the architectural qualities, and provide an inspirational quality at night.

The challenge of illuminating the memorial is based on its unique design - the fact that the spire elements themselves are quite precise, relatively small surfaces. The spires are multi-faceted, triangulated forms and each has a different size in footprint and height. The spires all have a convex contour, which turns away from the light and can sway up to 18" on a windy day. In addition, lighting had to meet Federal Aviation Association (FAA) requirements due to its proximity and location on the flight path to Washington Reagan National Airport, as well as minimizing unnecessary glare for pilots. Approvals by the National Capital Planning Commission and other agencies were also part of the design process.

Light levels for the spires meet Federal Aviation Association (FAA) requirements and are an integral part of the overall effect. Initial lighting schemes provided sufficient brightness from an architectural point of view. However, in order to satisfy FAA regulations, red beacons would typically be required at the mid-point and top of each spire. After exploring numerous alternatives to the 'red beacons' OVI developed a lighting scheme in which the upper 1/3 of the spires are illuminated to an average of 15FC as required by FAA. The spires are articulated, using this light level as a starting point. This lighting is balanced to achieve the appropriate shaping and aesthetic appearance of the spires and is a fundamental setting out point for the lighting design.

The result is the upper portion of the spires illuminated more brilliantly via floodlights concealed behind the large granite inscription walls flanking the memorial, while the base of the spires have a gradation of light from the base of each spire. This project demonstrates that a technical solution can also be balanced appropriately with aesthetics. To verify the light levels, specialist 'climbers' from the UK made the readings with a handheld light meter device. Readings were taken at multiple reference points along the surfaces of each spire to ensure consistency of brightness and accuracy of the readings. It was clear the lighting elements had to be woven into the design, and are ultimately tucked away behind large granite inscription walls. This dramatically increases the distance between the luminaires and the spires.

To make this possible, extensive lighting calculations were carried out in several different lighting software applications, in order to determine the most suited aiming positions, lamping/wattage solutions and product selection. Each luminaire is given a designation, and precisely aimed to various positions along the contour of the spire. Very narrow beam, precise optics were key to generate this effect. The optical reflector design of each manufacturer is unique and performance varies considerably. Several manufacturers' luminaires with different photometric data were studied. The Erco "Beamer" series was chosen for its superior optical design and excellent glare

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shielding properties. Based on the photometric data and performance of the luminaire the positions and quantities were calculated and confirmed. The use of less efficient luminaire's could have required additional quantities or higher wattage luminaries' to meet the FAA light levels required. Increasing the number of luminaires would make them more visible, more costly and utilize more energy.

While the illumination for the spires is the central element, the granite inscription walls, glass contemplation panel, honor guard and luminous air force star are all key components balanced to create the overall lighting design.

The lamping logic considers maintenance cycles. The British Standards (CIBSE) have a phrase that inspires our maintenance and lamping choices, again and again. It states: "A project which is not maintained well looks like nobody cares about it." The project has to be user-friendly and work properly well after the opening date. The lamping logic was developed to utilize long life light sources and only one lamp type for all the FAA lighting to simplify future maintenance.

The luminaires have fully integrated, non-exposed cables as a standard design feature. This is good for the longevity of the memorial, as cables tend to deteriorate over time, causing maintenance problems and eventually lighting related problems of non-working luminaires. In addition, instead of the typical polyester powder coat finish which is customary in the industry, the luminaires for the memorial have a paint process which is used in the car industry. This provides an extremely durable, long lasting finish, allowing the project to age well over time.

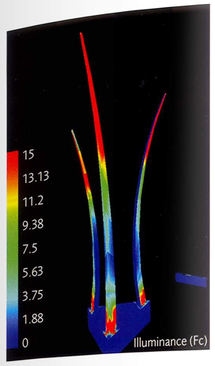
There are a lot of metal halide lamps to choose from. So, which one is the right one? Minimizing glare was nearly as important as achieving the proper light levels. Since the project is directly in the flight path for planes approaching National Airport in Washington DC - there is no use in achieving the light levels if every pilot flying by is blinded by 'glare cannons'. The T-lamp currently offers the smallest lamp envelope which, in turn, allows better optical control of the light beam, and high peak intensity cd based on the combination of lamp and reflector technology.

The spires are made of stainless steel, therefore, a cool color temperature of 4000K was selected to enhance this material in the best way.

The luminaires are all provided with integral glare baffles that minimize glare. It is an integral element which does not get lost or broken and is not an external component which can add to the overall dimensions of the luminaire. The overall dimension is important when aiming multiple luminaires in a series, so that they do not interfere or occlude the beam of the adjacent luminaire. Simply, the larger the luminaire is, the more space it requires for proper pivoting and rotation, done during aiming.

The spacing and layout of the luminaires determined the size and location of the steel mounting frame structures. This coordination was key. The frames were coordinated with the setback and height of the granite walls and root ball of the adjacent trees to minimize their appearance.

By night the United States Air Force Memorial appears to glow from within.



FAA light level simulation (above).

250 watt HIT floodlights are installed at the base of the three spires (below) and concealed behind the large granite inscription walls (above).

The Air Force Star is located in the central paving area and consists of five luminous glass pavers.

The glass contemplation panel is made from five layers of glass, laminated together. The assembled wall is 9'-0" wide and 11'-0" high inscribed with images.

The luminous glass contemplation panel is illuminated via LED technology approximately 20" below the surface of the paving. High flux LEDs on 2" o.c. spacings with 5000K color temperature and narrow beam distribution are used. One sees only lighting "effect" and absolutely no hardware at this feature - providing a glare free, maintenance friendly and magical effect. The granite pavers can be removed for initial installation and later access to the lighting hardware, if required.

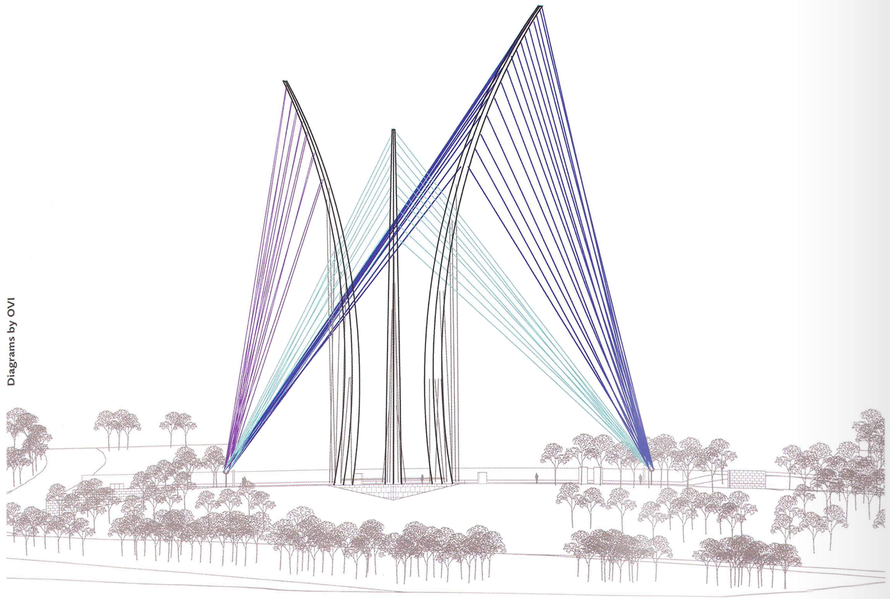
The polished granite inscription walls float on a matte finished granite background and are illuminated by custom stainless steel in-grade wallwash luminaires. This configuration of materials (matte finish near grade level for example) minimizes the reflected light when viewing the wall from various angles. The luminaire is designed to provide a wide even distribution of light on a vertical surface, while its hood design minimizes its "aperture" – for example in lieu of typical round apertures that tend to be glary for visitors and easily scratched. Standard products available did not meet the finish and material requirements. Therefore, a limited quantity of luminaires was specially fabricated of stainless steel only for this project - to match the material used for the spires. The luminaires are finished with a special coating to resist damage and corrosion from salt and other substances that are used to keep walkways free of snow and ice. A memorial is a very special type of project that lasts many generations - a good and timeless design should support that fact.

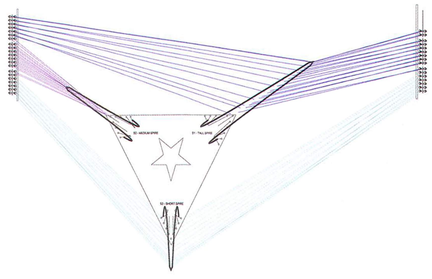
The Air Force Star has had a long tradition of gracing Air Force aircraft and missiles, and is central to the rank insignia of every enlisted member of the Air Force. This 'logo' is embedded in granite and luminous glass pavers located in the central paving area beneath the spires – which overlooks all of Washington DC. The luminous pavers are illuminated with small LEDs to provide a soft, ambient glow of light within this unique viewing area.

Project: United States Air Force Memorial
Location: Arlington, Virginia/USA
Completion: October 2006
Total Project Cost: $37 Million US Dollars
Site: 3 acres

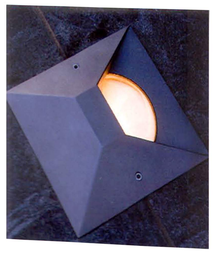
Architect: Pei Cobb Freed & Partners
Lighting Consultant: Office for Visual Interaction, Inc. (OVI) Jean Sundin, Enrique Peiniger
Structural Engineer: Ove Arup and Partners
Landscape Consultants: Olin Partnership

Diagrams by OVI





Light level aiming diagram for multiple spires in section view – tallest spire 270 ft.
Light level aiming diagram for all spires in plan view indicating position and throw distance.



The granite inscription walls and the honor guard are illuminated by custom stainless steel in-grade wallwash luminaires (left).