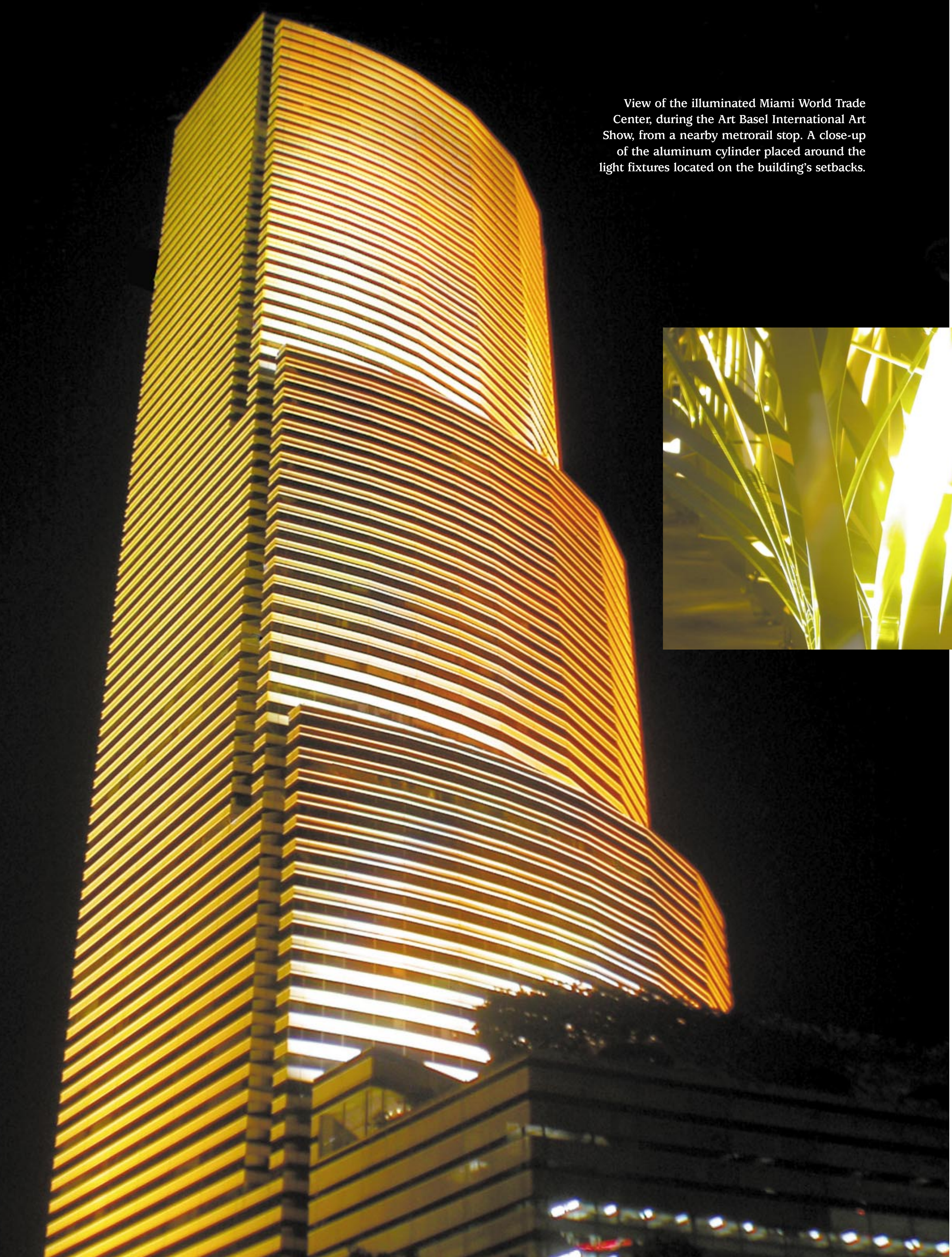


View of the illuminated Miami World Trade Center, during the Art Basel International Art Show, from a nearby metrorail stop. A close-up of the aluminum cylinder placed around the light fixtures located on the building's setbacks.

PHOTOS: POONAM WORLIKAR

FORCE OF NATURE

Designers used light, wind and other natural elements—rather than automation—to turn the Miami World Trade Center Tower into a giant work of art

The Art Basel International Art Show is one of the largest events the city of Miami Beach, FL, hosts throughout the year. The event attracts over 50,000 art collectors, art dealers, artists, curators, journalists and art lovers from around the world. The show's artists and galleries continually compete for a piece of the spotlight and jockey for a high profile exhibit location. Last year, however, one artist quite literally had a towering assignment.

The marketing team from Miami's World Trade Center Tower approached Paul Deeb just five weeks before the start of the Art Basel event and requested that he turn the entire tower into an eye-catching illumination art work for the week of the show. Deeb is a light and sound designer and the principal of Vox, an environmental arts company based in Baltimore, MD. Aside from the obvious issue of time, Deeb and his team faced a battery of challenges in the design, prototyping, field testing, delivery and installation processes up until just a few hours before the project's unveiling.

The Miami World Trade Center Tower, also known as the Bank of America Tower, is an I.M. Pei-designed skyscraper that was completed in 1986. It comprises 47 floors perched atop a 10-story parking garage. The parking garage roof features a garden from which the curved façade of the building rises in three setbacks. Each setback conceals between 30 and 51 1000 watt metal halide fixtures (a total of 173) which are actuated by an astronomic timer and function from dusk to dawn. The remaining three sides of the building are illuminated with similar arrays of fixtures positioned on rooftops of adjacent two story buildings. All totaled, approximately 400 fixtures illuminate the tower from the setbacks and adjacent buildings.

A different color palette for the tower was created for each night of the Art Basel event.

The concept for the illumination was "light in motion." Although he has used computer technology for his designs in the past, Deeb wanted the design for the Art Basel event to rely on the properties of natural forces—light, wind and physics—to paint changing reflective patterns onto the building. "I wanted this illumination to be different. When you use computers and automation to move light you get results that are arbitrary since they are not grounded in the natural environment. The light shares nothing with the viewer. By using natural elements you are moving light according to the environment that is shared by both the illumination and the viewer. They experience the same atmospheric changes and therefore become connected," explained Deeb.

A more high-tech system would have been easier to develop since the designer would have had a greater amount of control over the final results. The natural route he chose was in essence more difficult because Deeb only had control of the parameters and not the resulting effect. In the end, he chose science over simplicity because, "natural forces are more inherently interesting, more subtle, more nuanced and in general, less arbitrary."

Convector Device

Upon initial inspection of the fixtures, which date to the original construction of the building, the design team found substantial corrosion on the bolts securing the fixtures to their adjustable aiming bases. This discovery along with the generally weathered condition of the fixtures had to be accounted for in the design. Faced with the static nature of the existing fixture placement, Deeb needed to design a way to move the light without moving the fixture.

Deeb's solution was to create a device he later named an "optical convector" (**Figure 1**). The name was derived from the various functions the unit accomplished: optical alignment and aiming, convection and reflection. The industrial design staff at Vox manufactured the convectors from Alanod's Miro 27 optical grade aluminum which has a 94 percent reflectivity rating and can be worked like conventional sheet aluminum.

The team cut and shaped the metal into cylinders with a diameter of 20 in., to match the diameter of the light fixtures, and a height varying between 24 and 48 in. Then they cut the top of each cylinder into flexible "fronds" with widths varying from half an inch to an inch-and-a-half. The top of the cylinder also included a bracket assembly from which internal elements of the convector were suspended. The cylinder's base attached to the halide fixture's lens shroud through the aid of built-in brackets. The reflective surface of the aluminum faced the inside of the mechanism.

The optical convector functioned in the following way:

- Heat generated by the metal halide lamp initiated airflow through the convector's cylindrical body. Cool air entered through a gap between the convector base and the fixture shroud. Warm air exited through the top of the mechanism.
- As the air column moved, it rotated a series of suspended reflectors. The reflectors were attached to a monofilament using snap swivel pins which allowed a full 360 deg of rotation. The reflectors were shaped to distribute light on both the vertical and horizontal axis.
- Light from the fixture face passed through arrangements of glass prisms. The prisms directed their portion

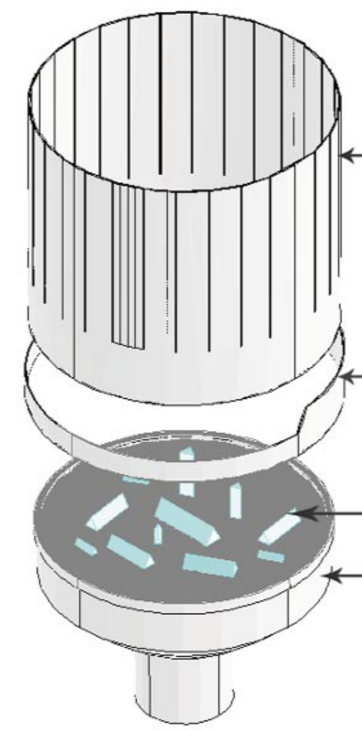
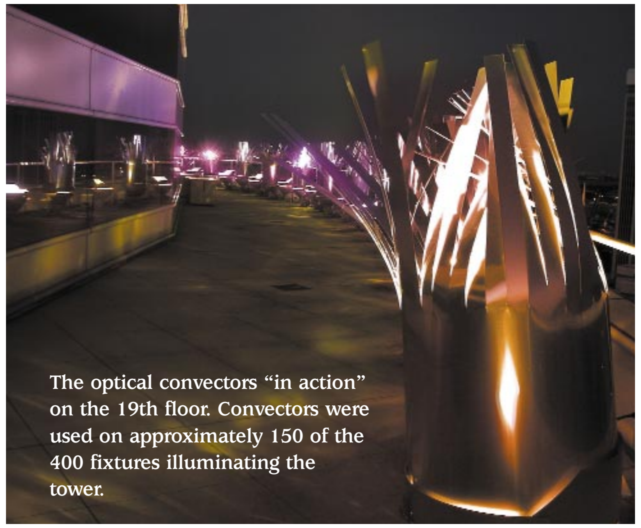


FIGURE 1



The optical convectors "in action" on the 19th floor. Convectors were used on approximately 150 of the 400 fixtures illuminating the tower.

The view from inside the Sky Lounge of the World Trade Center.

of the light at angles such that the light reached the reflective fronds at the top of the convector.

- The reflective fronds moved in response to wind and air currents. As the fronds moved they reflected light onto the surface of the building in a constantly shifting pattern.
- Since the light fixtures were not color changing they had to be manually fitted with colored gel filters each day. As colors from adjacent fixtures overlapped, mixed colors were obtained. A different color palate was created for each night of the Art Basel event.

The final convector design was fairly straightforward, however it was the result of an extensive, albeit rushed, prototyping and field testing process. The initial prototypes for the convector design were successful in shop testing, but proved to be flawed when field tested at the site. The problems involved in the design included: 1) The variability of wind strength on location, 2) determining appropriate length and width dimensions for the "fronds," and 3) getting the reflected light to the fronds via the prisms.

During the design and manufacturing of the original convector prototypes the VOX team used high speed fans to simulate the effects wind would have on the convector. When the team took 12 units down to Miami for the first field test they discovered that wind strength along

the building's three setbacks could vary wildly. The final project design utilized two different convector types to prevent the convectors from being inert in a calm breeze or manic in high wind conditions. A "short stack" unit was used on the lowest setback (floor 13) and a "tall stack unit" was used on the higher setbacks (floors 20 and 31).

The short stack convector was 24 in. tall with narrow width fronds that provided greater sensitivity to lighter winds. At higher elevations wind strength increases, therefore the tall stack convector had fronds of greater thickness and length, making these units more stable in higher wind conditions. To counterbalance the wind load and weight of the longer fronds, a substantially taller cylinder body of 48 in. was employed.

Guaranteed Light

Neither design, however, would be responsive if the winds were calm. Deeb incorporated suspended internal reflectors into the optical convectors to address this problem. The reflectors were designed to guarantee the movement of light even during calm conditions. The individual reflectors were shaped vaguely like airplane propellers and moved easily with the convection created by the heat of the HID lamp.

By using a combination of both horizontal and vertical reflectors a subtle effect was produced of shifting light intensity. While not as dramatic as the painting effect of the fronds, it ensured that the motion would be present even in gusty or calm conditions. The design team later discovered that this mixing effect was one of the more intriguing aspects of the project and provided a nice aesthetic counterbalance to the more prominent painting effect.

The final problem involved making the light from the convector's cylindrical body interact with the fronds. Initial tests in the Vox workshop and another disappointing field trial revealed that the cylindrical body of the tall stack convector was effectively creating a spot type effect because the fronds were only picking up a marginal amount of reflected light. The testing showed that a four to six inch equilateral, non-silvered glass prism was able to direct the light at an angle such that upon escaping the cylinders' top it was aimed at an angle optimum for being captured and reflected by the painting action of the fronds. "We experimented with various positioning methods of the prism finding that placement directly overtop of the lamp with the prism axis perpendicular to the building worked in the most effective way," explained Deeb.

On to the Site

By the time the convector design was finalized Art Basel was less than a week away. The Vox team worked through the Thanksgiving holiday machining the 150 convector bodies from four foot by eight ft sheets of Alanod Miro. On November 26, three days before opening night, all of the materials were loaded onto a truck for the 20 hour non-stop drive from Baltimore to Miami.

The Vox team installed roughly one third of the convectors throughout the afternoon of November 27 and that evening began placing the prisms. As the sun dipped below the horizon the team witnessed the first blue green flickers of the metal halide lamps warming up and as the darkness intensified they saw, with astonishment, the prism effect was almost non-existent.

As they tried to fix the problem, the VOX team gradually understood that the problem lay in a disparity between the fixtures being used on site and the mock-up fixture used in the design and prototyping process. The mock-up metal halide fixture had a face size of 12 in. while the actual fixture was an aluminum bowl of almost twice that diameter. They collected the prisms from a dozen adjacent fixtures and installed them in a single unit. The relief of finding the solution was tempered by the realization that to recreate the effect on the rest of the fixtures they would need to find about 600 equilateral non-silvered glass prisms in 24 hours.

American Scientific Surplus then set out to round up and deliver the required prisms a scant four hours before the show began. Designers didn't even have time to do a full scale test of the installation before the unveiling. As Deeb prepared for the cocktail party that would inaugurate his work he realized that he still didn't know how grandiose the final illumination would appear. Upon exiting the hotel on his way to the opening gala, he saw a group of parking valets looking up at the building while pointing and exclaiming, "Look!"

"I looked up and saw patterns of white light shifting across red, with various pinks and magentas dancing in response to the evening's steady breeze. It worked," Deeb recounts.

The Vox team labored throughout each day of Art Basel changing the gel filters on the 400 light fixtures. At night, they would photograph the changing display of colors and revel in the obvious enjoyment of passersby—be it passengers in vehicles hanging out of windows to photograph and record video of the illumination, or pedestrians stopping on the street and looking skyward, mesmerized.

About the Designer: Paul A. Deeb, principal of Vox Environmental Arts, Baltimore, MD, Member IESNA (2001), has designed numerous sound and lighting installations throughout the Middle Atlantic region. Vox employs architects, industrial designers and lighting designers. With the recent addition of a metal working and wood working facility, it now manufactures custom lighting and acoustical fixtures.