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Mori art centre Museum cone

The Amazing Glass Cone

The project has been a long time coming. Now that it's complete, the Roppongi Hills Mori Arts Center in Tokyo will provide a place for the creative juices to flow.

Yoshinori Nito and Yumi Fujikawa, structural & façade designers/engineers, Satoru Wakui, Saburo Iseya and Tsutomu Funaoka façade contractors and suppliers are proud of their Museum Cone, which enriches the entrance of the Mori Art Museum. They tell all about it here....



Tokyo city view: Observation gallery on the 52nd floor of the Mori Tower (Photo by Hiroshi Ueda)

Mori Arts Center, Museum Cone One of the largest redevelopment projects in the history of Tokyo, Roppongi Hills, opened in April 2003 after 18 years of tremendous effort and work done by the biggest Japanese developer, Mori Building Co., Ltd (MBC).

The entire area occupies 89,400m²; the total floor area is 759,700m², including four residential buildings, two office towers, a cinema complex, hotel, TV broadcasting headquarters, shopping center, public arena and The Mori Arts Center.

The Mori Arts Center is the primary cultural component of the entire development.

MBC have a clear vision to make the Mori Arts Center a new type of cultural complex, where open-minded people may stimulate each other, and inspire the creation of new ideas and concepts that may form our future.

The Mori Art Museum is a part of the Mori Arts Center, a world-class contemporary art institution located at the top of the Mori Tower. It is an innovative new museum with an exhibition programme that includes a wide range of contemporary art, architecture, design, fashion, photography film and more.

The museum cone is the entrance of

the Mori Art Museum, located in front of the Mori Tower. This cone is the main focal point in the design and circulation of the Museum, which corresponds to a major axis of symmetry of the Mori Tower. It allows visitors arriving from any of four levels – the traditional Japanese garden at B2F, retail at B1F, vehicular drop off at 1F, and the main office plaza at 2F – to ascend to 3F and cross the glass-clad bridge to enter the dedicated museum lobby in the base of the tower, and to take the high-speed elevator to reach the Mori Art Museum and the observation deck.

Gluckman Mayner Architects (GMA), the architects for the museum, designed the museum cone to be an elliptical, conical shape as the symbol of cultural components, which gives different appearances from the adjacent commercial buildings.

Our role was to make the museum cone an iconic element on the landscape of Roppongi Hills.

The museum cone embodies the extreme integration of architectural and structural elements. At its centre, a glass-fiber, reinforced, 30m-high steel structure called the funnel contains passenger elevators and provides the primary vertical support for the building. The spiral stairs

gently coiling around are supported by brackets from each column location of the funnel, giving views out to the Japanese garden as it rises to the bridge level.

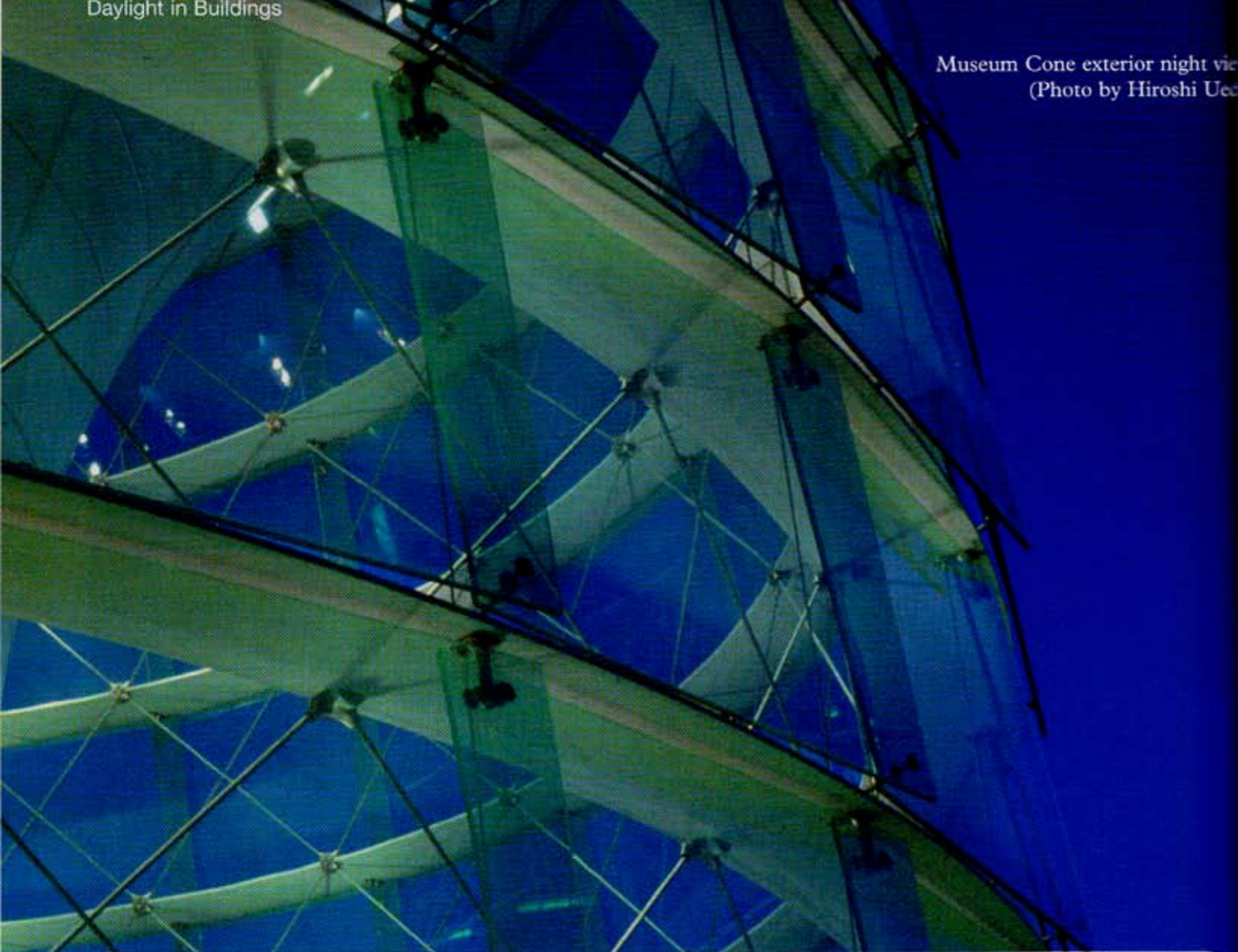
The 20m-high innovative, lightweight steel and glass façade operates on the principle of the cable net shell: a single layer of diagonal net consists of 17.5mm galvanized cables for tension, and 12 stabilising 22mm-thick horizontal steel rings (maximum 20m x 16m in diameter) in compression, which hold the elliptical conical form of the façade. The main compression loads imposed by the cable net are resolved into the funnel. The cable net shell and the funnel work compositely to maintain its stability and resist external forces such as the strong wind load from the Mori Tower behind.

We have fulfilled the design goal, making the cone one of the stiffest and most efficient structures, due to its own shell effect.

From the structural design point of view, we have achieved a powerful vertical line with the funnel, and conversely horizontal lines using parallel ring plates.

The exterior façade glass is 10+10mm laminated tempered safety glass, point supported by the stainless

Museum Cone exterior night view
(Photo by Hiroshi Ueda)



steel fittings at four corners with printed a translucent ceramic frit dot-pattern, overlapping each other to provide a rain screen.

The appearance of the façade dramatically changes throughout the course of the day. During the day, it appears to be a green shell. At night, it almost disappears (but the floating rings glow strongly).

The upper glass holder is hung from the ring above and comes down between the overlapped glasses to hang with integrated point-support fittings. The lower glass holder is a horizontal strut for the glasses, connected to the ring with an articulated, inside ball-bearing joint detail to avoid some local twisting effects at the supporting holes, and to accommodate differential movements among the two laminated glasses and the ring.

In order to emphasise the continuity of the horizontal rings, we designed all the stainless steel fittings to be small and scarce. It was a challenge to design each fitting to accommodate construction tolerances and the complexity of the geometry.

After making numerous prototypes, we achieved our desired shapes, with required structural performance.

The great design achievement is the result of an unusually productive collaboration with façade contractors Mr. Iseya, Mr. Funaoka and Mr. Wakui from Asahi Glass.

As a result of two significant mock-up tests they produced, we were convinced that our structure will remain intact under factored design forces, and we had a clear vision of how to construct this delicate structure with the pre-tensioning the cable net.

Since the project was completed, we have, together with Asahi Glass, continued to inspect the structural behavior and relaxation of the cable to ensure this unprecedented structure functions properly.

TriPyramid were the stainless steel fittings and cable suppliers who worked closely with us to develop and create elegant and sophisticated solutions.

The outcome of these excellent collaborations shows how we can benefit from bridging the occupational barriers that exists between designers and contractors.

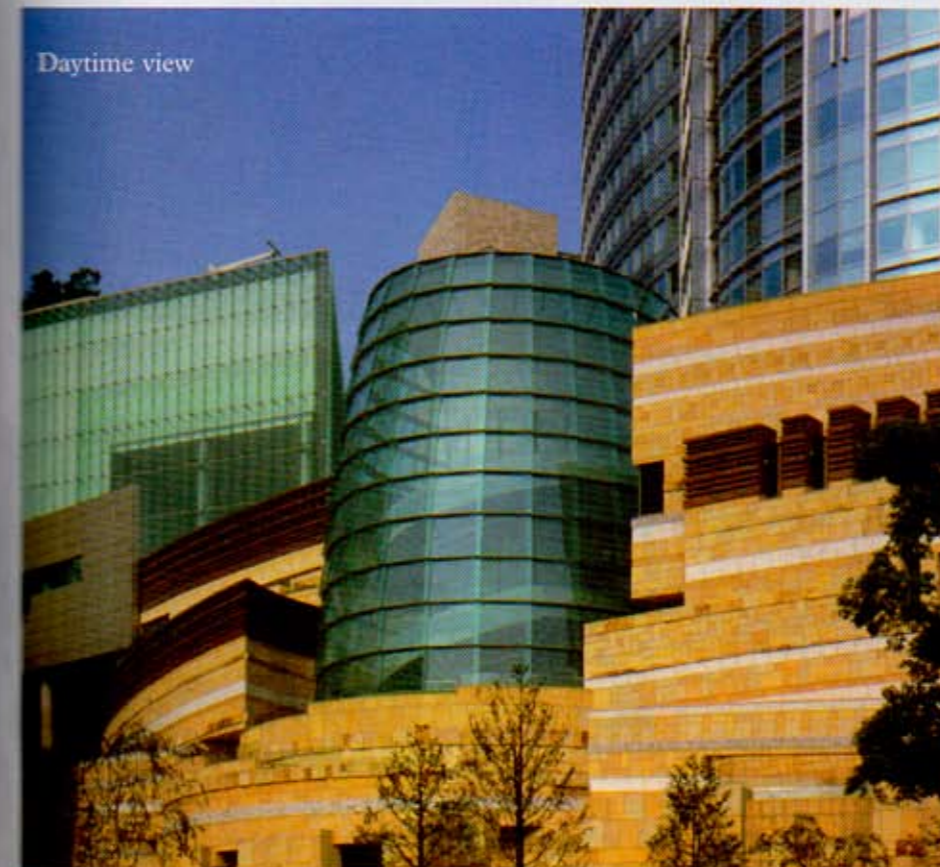
As the structural designer / engineer, who has considered our role, task and responsibility, we hope that people feel the Museum cone serve pragmatic functions and safety as well as experience of structural art. (Yoshinori Nito, Yumi Fujikawa)



Roppongi Hills
around the
Museum Cone



Cable clamp & glass fittings



Daytime view

All Those involved in the cone:

**Structural & Façade Designers/
Engineers:**
Yoshinori Nito, Yumi Fujikawa +
Dewhurst Macfarlane and
Partners

Architects:
Gluckman Mayner Architects

Owner:
Mori Building Co., Ltd.

General Contractor:
Kajima + Ovayashi Joint Venture

Curtain Wall Contractor:
Asahi Glass Building Component
Engineering Co., Ltd.

Structural Steel Fabricator:
Toa Tekko Construction Co., Ltd.

Steel Fittings and Cable:
TriPyramid Structures, Inc.