



Case Study:

Creating a scene at the Marina Bay Sands Hotel and SkyPark in Singapore

SentryGlas® ionoplast interlayer helped create wide-open views and an opening day spectacle at the Marina Bay Sands Hotel and SkyPark.

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The Marina Bay Sands SkyPark in Singapore is a cantilevered 340-meter(1115-foot)-long tropical oasis spanning three hotel towers and 2,500 guest rooms, crowning state-of-the-art convention and exhibition facilities, theaters, world-class casino entertainment and some of the best shopping and dining in the region.

The gravity-defying structure is one of the largest of its kind, anywhere. Its length exceeds the height of the Eiffel Tower. Its area (1.2 hectares/2,420 ac) is big enough to park four jumbo jets. The SkyPark's goal is to attract and delight visitors to the Marina Bay Sands Hotel, and to help lift Singapore as a leading travel destination and meeting-place. To do that, architect Moshe Rasdie and owner Las Vegas Sands Corp. decided to literally "create a scene."

Approached from sea, the innovative Marina Bay Sands SkyPark looks like a giant ship, berthed in the sky. From the skyship's wooden-planked observation deck, 200 meters (656 feet) up in the air, hundreds of people at a time can take in the surrounding Singapore views. Those views ... and the people who come to see them ... are protected by a clear glass windscreen and safety railing made stronger and lighter using SentryGlas® ionoplast interlayers.

Marina Bay Sands President and CEO Thomas Arasi calls the SkyPark "one of the greatest architectural feats of modern times. Sands SkyPark will be a must-visit destination and will certainly put Singapore on the global map."

Bigger, Clearer Views ... Made Safer

Rooftop views require attention to detail. For people to feel comfortable, and less exposed to buffeting winds, a windscreen is often helpful. And when visitors walk around on a roof, all reasonable care must be taken to protect them from falling off the building, or causing objects to fall on people below. Glass balustrades, or railings, made with SentryGlas® interlayers are being used with increasing frequency on rooftops, as well as observation towers, oceanfront housing and cruise ship decks where designers want to maximize available viewscape assets by applying the latest generation of laminated glass.

Glass fins and balustrades laminated with SentryGlas® help Las Vegas Sands Corp. redefine the Singapore skyline.

- The Sands SkyPark sits atop three hotel towers, 200 meters (656 feet) in the air, using a gravity-defying cantilevered structural design.
- Compared with traditional interlayers, extra-stiff SentryGlas® ionoplast offers greater resistance to weathering and deflection from oceanfront winds.
- Using SentryGlas® with low-iron glass adds to color clarity, while strengthening safety performance.
- Open edges on laminated glass panels are more weather-durable using SentryGlas®, compared with those using PVB.

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Compared with traditional PVB interlayers, SentryGlas® ionoplast interlayers are 5 times tougher and up to 100 times stiffer, helping withstand greater wind loads using thinner, clearer glass.

The interlayer's post-glass-breakage strength helps maintain barrier and safety properties even after a glass panel has been broken. This adds an extra measure of human safety. And with SentryGlas®, architects have discovered a perfect companion for low-iron glass. The ionoplast-based laminating sheet emphasizes low-iron glass clarity, helping let more natural light come through.

Weather Durable Open-Edge Laminates

The railing with SentryGlas® also protects against obstructed views. Architect Moshe Safdie chose low-iron laminated glass with open edges, a style of glass that's rapidly gaining attention for its elegant combination of appearance and structural performance, enabling wider views with fewer interruptions by framing and fixturing elements.

Glass Technique Asia Pte., Ltd., supplied the laminated glass panels, typically consisting of two 10 mm (3/8") layers of tempered or heat-strengthened low-iron glass, with a 1.52-mm-(60-mil)-thick SentryGlas® interlayer. Structural support for the panels included 2-sided and 3-sided framing, leaving long, open edges along the glass panels to enhance the scenic views. Open edges on laminated glass panels are more weather-durable using SentryGlas®, compared with those using PVB.

With such a magnificent vista and so many Singapore attractions to see, SkyPark visitors care assisted by audio touchpoints along the edge of the glass-protected roof deck, identifying local landscape features, commercial zones and historical areas. The SkyPark is open daily from 10 a.m. to 10 p.m.

Fins Add to Facade Flair

Also incorporating SentryGlas® structural interlayers are the long, narrow laminated glass fins that climb the three

Lighter façade panels enable more subtle supporting structures

For decades, interlayers made of polyvinyl butyral (PVB) have been the industry standard when producing laminated safety glass. Architects are well aware of the possibilities and limitations of such glass when used extensively in façade engineering, for roofing and window panels. In contrast, SentryGlas® enables an entirely new approach because the interlayer is over 100 times stiffer and five times stronger than PVB. As a consequence, there is an almost perfect transmission of load between two laminated sheets of glass, even at high temperatures, leading to the excellent flexural behavior of the glass when under load - also under direct sunlight in high summer. Accordingly, laminates with SentryGlas® show less than half the rate of deflection when compared to laminates with PVB, when under the same load, and thus almost the same behavior as monolithic glass of the same thickness.

55-story hotel towers. Using SentryGlas® helped thinner glass meet anticipated design loads, resulting in lighter-weight glass that was easier to source with the desired properties. The metal framing used for the fins became a handy footing and grasping aid for an opening-day climbing contest that sent 21 athletes scrambling up the glass towers, a first-of-its-kind World Championship Climb to the Sands SkyPark. Seven 3-person teams representing climbers from 10 different countries speed-scaled each 200 m (656 ft) tower in a team relay race, finishing with a sprint across the Marina Bay Sands SkyPark.

"The opening of the Sands SkyPark signifies an important milestone for Marina Bay Sands," said Thomas Adelson, CEO of Las Vegas Sands, the project owner. "This has been the single, most challenging engineering component of our unique integrated resort and to see it materialize is an incredibly proud moment for us. Marina Bay Sands along with its signature Sands SkyPark will be a truly impressive icon and we are excited to present this bold architecture to not only Singapore but to the rest of the world."



Lighter, stronger laminated glass allows for long, vertical glass fins that help sculpt and define the Marina Bay Sands hotel tower facades, well worth an adventurer's climb!

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As well as improved strength and stiffness, other benefits of SentryGlas® include:

- **Safety:** In the event of breakage, glass fragments remain firmly bonded to the interlayer, reducing the chance for injury
- **Security:** SentryGlas® can be used in glazing that withstands bullets, hurricane-force winds and even bomb blasts
- **Durability:** SentryGlas® is extremely durable and resistant to clouding, even after years of exposure
- **Design Versatility:** SentryGlas® can be used in glass manufactured flat or curved, including annealed, toughened, heat-strengthened, spandrel, wired, patterned and color tinted glass
- **UV control:** SentryGlas® is available with or without UV transmittance

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