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CASE STUDY

ZHANGJIAJIE GLASS BRIDGE, CHINA

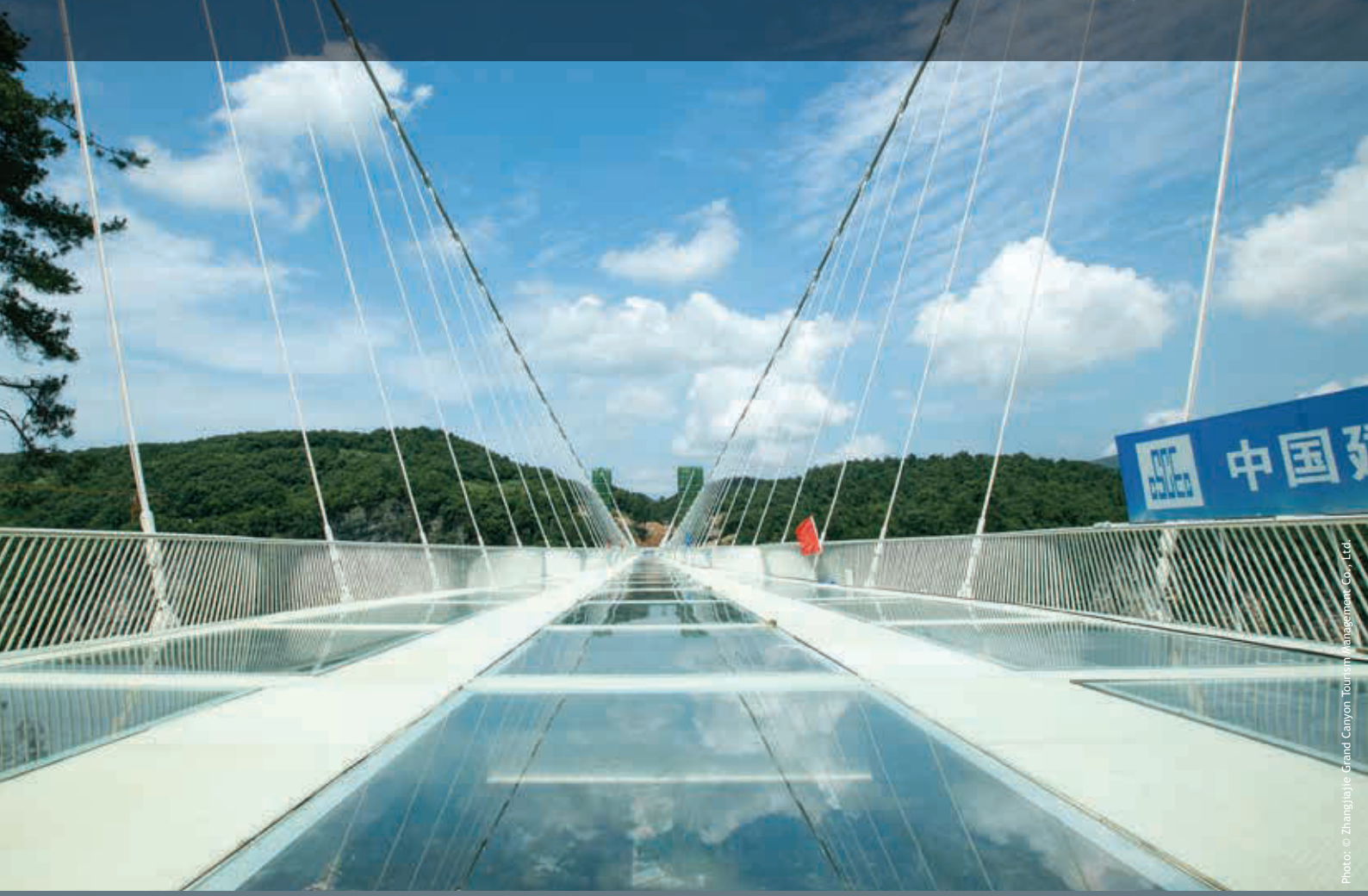

Photo: © Zhangjiajie Grand Canyon Tourism Management Co., Ltd.

English

STRUCTURAL & SECURITY

ZHANGJIAJIE, CHINA

ZHANGJIAJIE GLASS BRIDGE, CHINA

The glass bridge over the Grand Canyon of Zhangjiajie, China, shows sympathy for nature and incredible fortitude in the face of demanding winds, foot traffic and operating conditions.

At 300 m (984 ft) above the canyon floor, the 385 m (1,263 ft) long and six meters (19.7 ft) wide bridge over the Grand Canyon of Zhangjiajie is the world's tallest and longest pedestrian glass bridge.

The thin horizontal bridge, which incorporates a transparent glass floor and side suspension cables, has been designed to accommodate up to 800 visitors, so the glazing solution deployed by the architects and engineers had to be incredibly robust. For such a demanding application, there was only one real option – the use of laminated glass panels incorporating SentryGlas® ionoplast interlayers from Trosifol®.

Offering outstanding immersion within the surrounding canyon and mountains – which were the inspiration for some of the breath-taking scenes in the movie Avatar – as well as an unparalleled view of the canyon floor for walk-on visitors, the bridge also features the world's highest bungee jump and will serve as a stage for dances, fashion shows and cultural events.

According to the architect, Professor Haim Dotan, founder of Haim Dotan Ltd. Architects and Urban Designers: "Out of respect for the beauty of nature, the bridge had to disappear… this was my challenge in the design process. We therefore put our heart, vision and love of nature into creating a bridge, which had the least impact on the surrounding natural beauty."

"We immediately conceived the glass floor," he continues, "in order to make the bridge transparent. A structural girder design, suspended from cables, was devised to eliminate the need for bulky three or four meter (9.8 to 13.1 ft) bridge beams and to create a slim profile with a girder beam depth of just 60 cm (23.6 in) for a 400-meter (1,312 ft) span length – a record in Chinese engineering and bridge technology. In order to further integrate the bridge into the surrounding nature, the four suspension towers are covered with trees and plants, assimilating them into the green canyon cliffs beyond."

The project, which was developed by the Zhangjiajie Grand Canyon Tourism Management Co. Ltd. in collaboration with the architects and structural engineering firm BRDI – China Railway Major Bridge Reconnaissance & Design Institute Co. Ltd., incorporates glazed elements comprising large 3 x 4 m laminated glass panels. At 50 mm (1.97 in) thick, the panels are made of three layers of 16 mm (0.63 in) low iron glass, with two layers of SentryGlas® interlayer sandwiched between them.

The structure of the bridge and the panels were subjected to incredibly rigorous testing prior to fabrica-

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tion and construction. Six months' worth of wind tests were performed in the Wind Testing Laboratory at Hunan University in Changsha, with wind velocities reaching 56 m/s (183.7 ft/s), or 201.6 km/h (125.3 mph). Furthermore, the glass sections were subjected to extremely demanding load and deflection tests. As well as experiencing extreme loads up to 40 tons, the 3 x 4 m panels showed a deflection of just 2.16 cm (0.85 in) under a 20 ton load.

Extensive engineering studies and tests were also conducted to determine aero elasticity, fluttering effects, gravitational stiffness, vibrations, structural dynamics and pedestrian effects. As a result of these tests, special measures were devised to ensure that structural designs for wind resistance, safety and pedestrian vibration requirements were met through the use of various shock-absorbing technologies coupled to damping and anti-vibration mechanisms. This was helped in part by the stiffness exhibited by panels incorporating SentryGlas® interlayers.

The panels in the bridge were installed by He'nan Chengjian Decoration Engineer Co. Ltd having been laminated by He'nan Fuxin Glass Co., Ltd. The General Manager at He'nan Fuxin Glass Co., Ltd explains: "The decision to use SentryGlas® was made jointly by the developer, architect, engineer and us, the laminators. We considered a number of different interlayers, but after significant testing and comparison studies SentryGlas® simply offered us better performance in terms of its glass-post-breakage capabilities, high light transmittance and its enhanced durability versus any other interlayer."

The bridge, which opened to the public on August 20th 2016, has proved incredibly popular, so much so that it had to be closed for a while in order that the owners could improve the parking and ticketing infrastructure to cope with the influx of visitors. In terms of sheer adrenalin, visitors' concerns about the use of glass in the structure have been allayed by some very public demonstrations of robustness. Press representatives and visitors have being invited to

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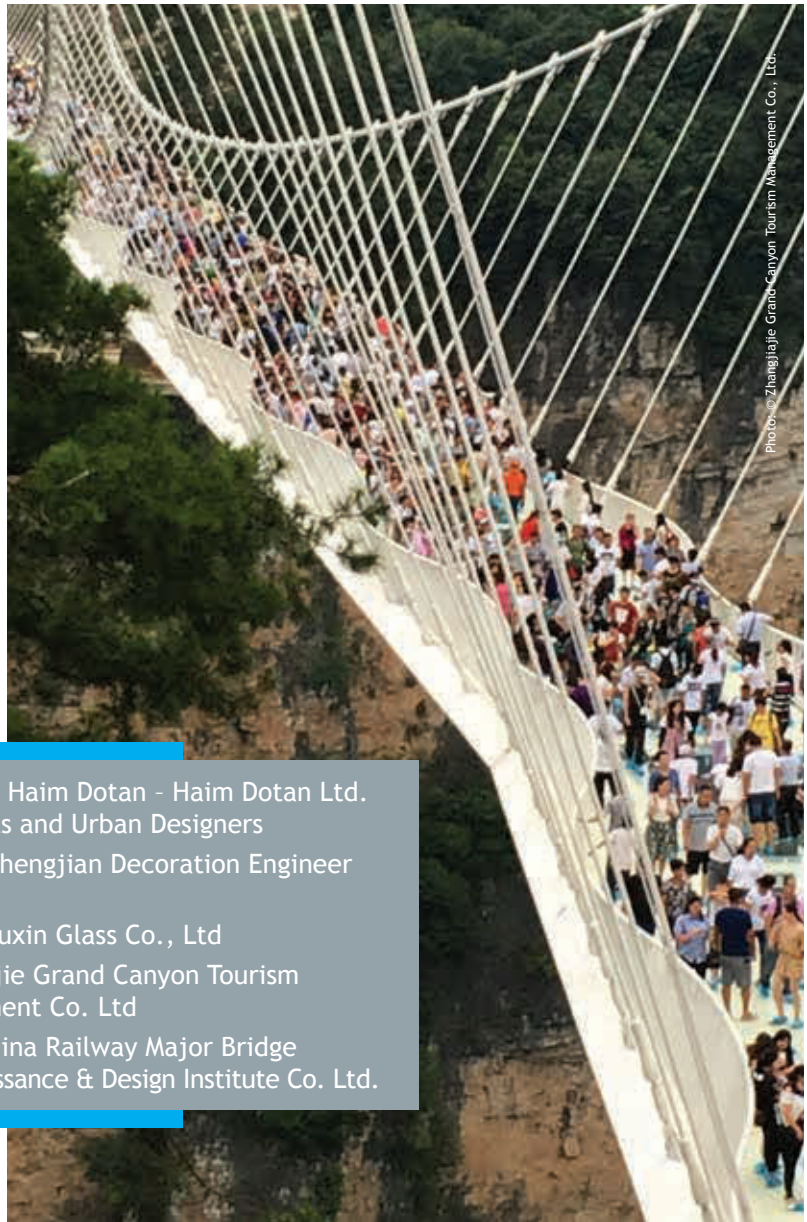
- **Structural:** Trosifol® Extra Stiff (ES) PVB and SentryGlas® ionoplast interlayer
- **Acoustic:** Trosifol® SC Monolayer and Multilayer for sound insulation
- **UV Control:** from full UV protection to natural UV transmission
- **UltraClear:** Lowest Yellowness Index in industry
- **Decorative & Design:** opaque black & white, colored & printed interlayers

repeatedly strike examples of the panels with sledge hammers, then to walk and jump on them to demonstrate the interlayer's capability to absorb shocks and to maintain the structural integrity of the panel – even under extreme duress. Such demonstrations of capability really do highlight why SentryGlas® interlayers are the number one choice for incredibly demanding structural applications.



Architect	Professor Haim Dotan – Haim Dotan Ltd. Architects and Urban Designers
Installer	He'nan Chengjian Decoration Engineer Co.,Ltd
Laminators	He'nan Fuxin Glass Co., Ltd
Developer/Owner	Zhangjiajie Grand Canyon Tourism Management Co. Ltd
Structural Engineer	BRDI - China Railway Major Bridge Reconnaissance & Design Institute Co. Ltd.

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