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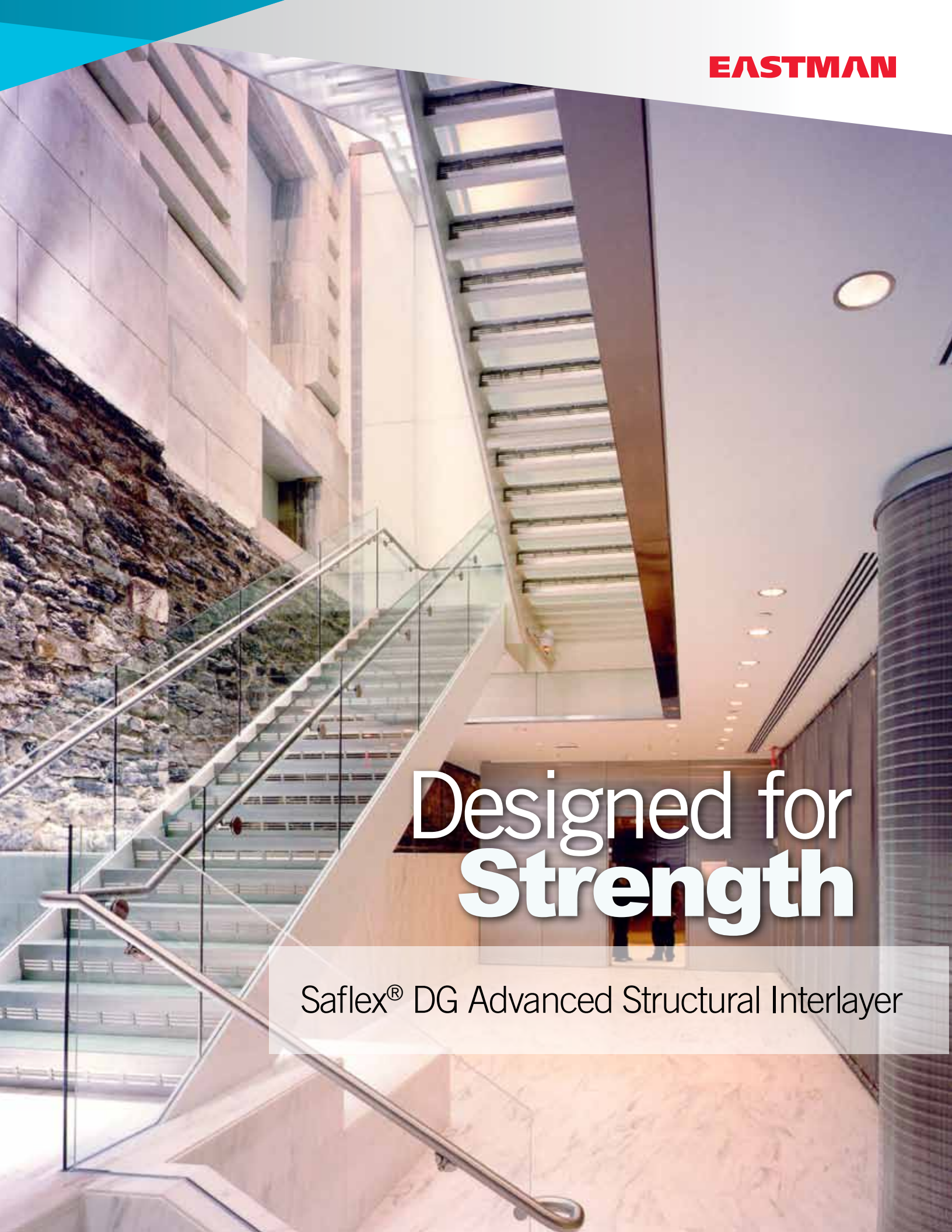

Designed for **Strength**

Saflex® DG Advanced Structural Interlayer

Explore the High-Performance Benefits of Laminated Glass

Whether protecting people and property from mother nature or man made threats, Saflex® interlayer technology brings strength, safety and security to glazing design.

Glass laminated with Saflex DG structural interlayer, provides around the clock protection, helping to maintain the integrity of the building envelope and prevent injury and damage from glass fallout in the case of natural disasters, terrorist threats and more. This advantage over traditional monolithic safety glass solutions is contained in the tough, plastic interlayer that adheres to the glass, and upon breakage, remains intact, holding the glass fragments in place.

Saflex DG interlayer can provide significant protection over standard PVB products. With its stiffer formulation, laminates can withstand higher loads without compromise.

Globally, architects and designers have relied on Saflex interlayer technology for more than 80 years. We invite you to explore the safety, security and structural glazing benefits of our newest PVB technology: Saflex DG.

For more than 80 years, Saflex® has been the world's leading brand of protective interlayer for laminated glass. Trusted and proven in the most critical applications, Saflex can be found in nearly 40 percent of all architectural laminated glazing worldwide.

Saflex®

Structural Performance

A New Option in Structural Glazing: Saflex® DG Interlayer

Saflex® DG structural interlayer is a tough, resilient film produced from plasticized polyvinyl butyral (PVB). It is designed specifically as an interlayer for applications where increased interlayer rigidity and high glass adhesion are required relative to standard glazing interlayers. Saflex DG provides superior structural capacity versus standard PVB interlayers and is designed with ease of processing in mind. Saflex DG also offers design flexibility as it is compatible with other Saflex and Vanceva® products.

Laminated glass as a building material has experienced a striking upsurge in recent years as increased glass use in facades and interiors has become increasingly en vogue. Tempered glass produced to meet the human impact requirements has been used for years. The awareness and risk of sudden rupture, failure and fall-out caused by nickel sulfide inclusions, processing or installation has been heightened by coverage in glazing industry trade journals. Although tempered glass has been traditionally used for its load strength and safe break characteristic, the fragmentation upon breakage that showers from tall buildings can become dangerous and affect pedestrian well being, cause vehicular damage and even close down passageways and roadways for long durations. In recent years, the use of heat-strengthened glass has become more prevalent for multiple benefits, including improved optics. When used in combination with heat-strengthend glass, Saflex DG combines the benefits of a rigid interlayer with the features of glass containment, UV screening, edge stability, clarity and noise abatement.

Implementing long standing technology from the aeronautical market, and built upon the performance specific attributes of cyclone/hurricane and typhoon resistant PVB interlayers, Saflex DG interlayer is unlike standard PVB interlayer and is significantly more rigid. As such, Saflex DG interlayer in a properly designed system, is capable of keeping glass intact at high and low temperatures, even after impact and under load. Saflex DG is unique in that it combines the meaningful performance and processing characteristics while allowing for balanced engineering practices which can lead to more efficient whole building design.

Assembly and lamination properties that have come to be expected from other Saflex brand PVB interlayer products are applicable to Saflex DG. Laminated glass made with Saflex DG intelrayer can also be fabricated post lamination using standard laminate cutting techniques (scoring and cracking, heating or water-jet). This can provide opportunities for increased opimization and processability. Information regarding the safe handling and storage of Saflex DG can be found in the Material Safety Data Sheet that is available from the Advanced Interlayers Sales organization or at www.eastman.com/saflex.

Making Glass Strong

Specific applications of Saflex® DG include structural glass applications, exposed edge laminates, floors, stairs, balconies, canopies, point glazing systems, clip systems, captured systems, curtain wall, sloped and overhead glazing and essentially anywhere glazing is used and glass is needed to remain intact after breakage. More specialized areas such as adherence of glass to the spall layer in bullet resistant glazing or in mass transit (train) applications can also benefit from the use of Saflex DG.

Due to the stiffness of the Saflex DG interlayer, laminates can either sustain higher uniform loads with the same glass thickness, or the glass thickness can be reduced and still achieve the same loading. Saflex DG is ideally suited for use with annealed and heat-strengthened glass – providing the opportunity to design with less optical distortion, reduce the potential for spontaneous breakage, allow for view through capability after breakage and design for applications where thermal stress may come into consideration.

Saflex DG has been tested in single side balcony and canopy applications with one or both sides of glass broken. When using annealed or heat-strengthened (semi-toughened) glass, the laminate is able to stand even after breakage. Saflex DG structural interlayer has a unique rheology when compared to standard PVB interlayers. It exhibits very high shear modulus at common temperatures and this modulus extends well past that of standard PVB. In fact, Saflex DG is one hundred times stiffer than standard Saflex R series interlayer whereas Saflex R series has a shear modulus of 3 MPa, Saflex DG has a Shear modulus of 300 MPa at the same temperature.

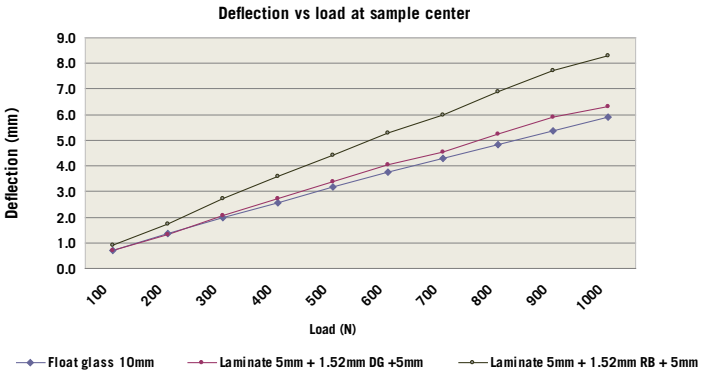

Figure 2: Canopy Test - Broken Laminate - Saflex® DG - 34 kg (75 lbs) HS glass

Glass strength calculations in many European communities set the interlayer contribution at zero. The interlayer contribution to glazing strength, or lack thereof, is not a concern for any temperature, including high temperature applications as the glass must be designed to carry the load. Glass strength charts included in ASTM E 1300 allow PVB interlayers to be used without further restriction in accordance with the standard.

It is only when effective thickness calculations are invoked in an attempt to reduce overall glass thickness that shear modulus becomes a varying factor in design.

Saflex DG interlayers respond to load in a more aggressive manner than standard Saflex PVB interlayers. Due to the rigidity of the interlayer and tenacious adhesion to the glass surface, the coupling effect of the interlayer to the laminate is significantly higher than standard PVB and can in turn be translated into the ability to handle higher loads – even at higher temperatures.

Most glass is designed for uniform loads with safety factors. Taking these factors into account and coupling them with the unlikely potential of full loading acting on the glazing while at elevated temperatures, the use of laminated glass with Saflex DG in most structural applications is an excellent choice.

Keeping Glass Safe

Saflex® DG interlayer tends to hold glass shards together after breakage and to stop penetration from typical handheld objects. With proper glazing design, laminated glass with Saflex DG interlayer has been demonstrated to withstand the load even after the glass has been broken.

For example, laminated glass lites containing Saflex DG interlayer were placed in a single side support, steel frame mechanism in vertical position for balcony testing and in a horizontal position for canopy testing. Glass was broken with a prick punch in several locations on one lite and then the other. The ability of the laminate to remain vertical (balcony) or horizontal (canopy) with one and two lites broken was assessed. The laminated constructions with Saflex DG structural interlayer remained upright or horizontal after the glass was broken on one and two sides. Laminates with Saflex DG were subjected to additional testing after breakage to induce failure.

Laminated glass with Saflex DG interlayer and heat-strengthened glass is capable of remaining both rigid and upright after glass cracking in as thin a construction as 3 mm HS – 1.52 mm Saflex DG – 3 mm HS in a single side support structure. (1/8" HS -- .060in Saflex DG -- 1/8") (Figure 2) The configuration is even capable of withstanding additional horizontal load applied to it after the glass is cracked on one or both sides. The same is true for glass installed in a canopy with a single side support. The glass has also demonstrated durability and stability with continued loading after breakage in the horizontal position.

Laminated glass with Saflex DG and heat strengthened glass can be specified for balcony applications in single side support structures. This can and should be recommended over the use of fully tempered lites when used with this interlayer to reduce the risk of spontaneous breakage yet still achieve the impact, structural and thermal stress performance desired as well as maintaining the glass shards after impact and all the other benefits of the laminated glass. Although single side support canopy glazing is controversial, the laminated glass used in this test shows that with proper design and framing, the Saflex DG interlayers can also be used successfully in these applications.

Saflex DG, when properly laminated and installed, can meet architectural safety glazing codes as tested according to the prescribed methods, including ANSI Z 97.1-2009, AS 1288, CPSC 16 CFR 1201, EN 12600, GB 15763-3 and other similarly administered and rated test protocols.

Saflex DG structural interlayer has been successfully tested for performance in security glazing applications in accordance with EN 356. Security glazing is designed accounting for several variables. For specific security applications, Saflex DG structural interlayer should be tested in the desired configuration to ascertain acceptability.

Figure 3: Static Load Test - 2 Hours after Breakage - Saflex DG interlayer (1.52 mm) FT glass

Edge Stability and Laminate Durability

Saflex® DG structural interlayer is specifically formulated to provide robust resistance to delamination, excellent edge stability, and compatibility with most visibly reflective, low emissivity and ceramic frit coatings.

Saflex DG can be used in exposed edge applications. A key performance requirement for exposed edge glazing is the ability to maintain defect-free edges in the presence of mechanical and environmental stresses. Although this is an aesthetic issue only, it is desirable to minimize the potential of formation. There are many variables associated with visual edge effects, some are processing related while others may be induced by the installation and glazing. Weathering and assessment testing conducted by Eastman examines the stability of the significant interlayer properties. These tests are conducted on laminated glass with exposed edges and minimal support to ensure proper orientation throughout the exposure duration.

Natural and accelerated exposure testing indicates exceptional durability and resistance to delamination when exposed to heat and humidity as well as color fastness.

Figure 4: Exposure testing conducted in Miami, Florida, USA.

Edge Stability Exposure Results

The Edge Stability Number (ESN) system is used which is based on the length and depth of delaminated or "let go" areas that occur at the laminate edges. The larger the ESN number, the poorer the interlayer performance. The maximum ESN number is 2500 with a minimum number being zero. Interlayer product exhibiting an ESN of less than 500 is considered exceptional.

Product	Duration (Months)	Edge Stability Number (ESN)
Saflex® DG 41 Interlayer	0	0
	6	0
	12	0
	15	0

Florida Exposure Results Edge Stability for Saflex® DG Structural Interlayer

The Beauty Unrolls

Available in roll form, Saflex DG structural interlayer has excellent clarity and lack of haze under normal conditions. The chemistry used in Saflex DG also eliminates the potential for crystallization with improper cooling.

Saflex DG structural interlayer can be used alone, layered with itself, or with Vanceva® colors to create varying degrees of transparent, translucent or opaque lites. Compared to other materials clear and colored laminates with reduced glass thickness can be designed due to the coupling and higher glass transition temperature of this interlayer.

Saflex DG structural interlayer is perfect for a variety of safety glass applications including furniture, flooring, wall cladding, partitions, signage, spandrel, aesthetic facades and other accent areas

Product Offering

Product Name	Color	Thickness	Roll Width	Roll Length	VLT%
Saflex® DG 41	Clear	0.76mm (0.030 in)	45 - 280 cm	250 m	88*

VLT value when laminated at 0.76 mm (0.030 inch) between two pieces of 3 mm (1/8 inch) clear glass.
Please contact your Saflex Sales Manager, Customer Service Representative or visit www.eastman.com/saflex for further information.

Sealant Compatibility and Properties

In most installations where the sealant is used as a weather seal, the sealant material rarely comes into contact with the glass edge. However, in butt joint glazing (structural glazing), in installations where a heel or toe bead is applied, and in organically sealed insulated glass units, the sealant will come into contact with the edge of the glass and possibly with the interlayer in laminated glass. It is in this area that questions about compatibility arise.

Sealant compatibility testing has been completed with some commonly used silicone sealants and Saflex® DG structural interlayer and show significant improvement versus standard PVB interlayer. Completed testing indicates excellent sealant compatibility with the neutral cure sealants and an acetoxy cure product. Additional sealant compatibility results as well as test procedure can be found at www.eastman.com/saflex.

Saflex® DG Sealant Compatibility Results

Total Exposure Time: 3000 hours accelerated

Sealant	Manufacturer	Average Depth (mm)	Maximum Depth (mm)
SCS 7000 (Hybrid)	Momentive (GE)	0	0
SCS 9000 (Silpruf NB)	Momentive (GE)	<1*	<1*
SSG 4600 (Ultra 2 part)	Momentive (GE)	<1*	<1*
SCS 1200 (Construction)	Momentive (GE)	<1*	<1*

*Depth not measurable

Architects and Designers Trust Saflex

Around the world, architects and designers trust Saflex when performance and safety are their most critical concerns.
The reason for their confidence is simple: no matter what the specifications or performance targets, Saflex interlayer technology delivers advanced glazing performance for demanding applications. That is why Saflex is the most trusted name in laminated glass interlayer technology -- delivering consistent performance, durability, reliable and knowledgeable service.

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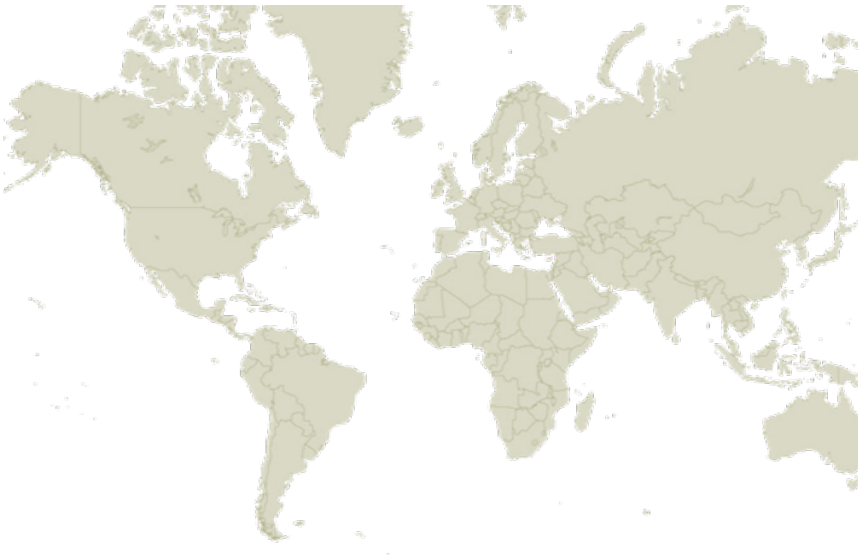

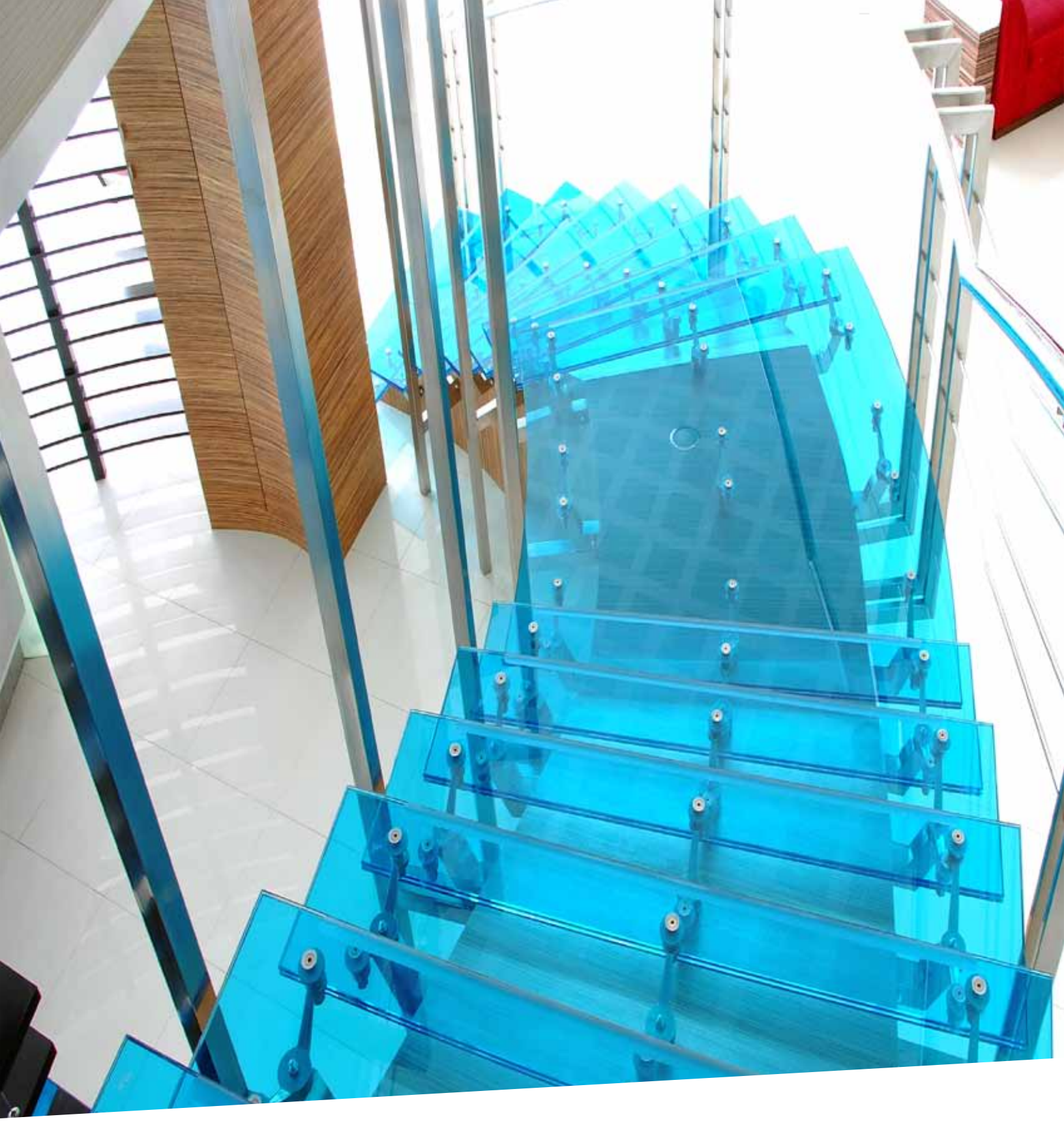

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