Well worth noticing at the DuPont Benedictus Awards 2000 was the trend among professional architects to use technology in order to simplify structures, while exploiting both the functional and aesthetic qualities of laminated glass. Students, on the other hand, used the transparency of laminated glass to invite nature and the outdoors into their projects. Some of the designs are detailed here.
Spring 2000 marked the eighth year of the DuPont Benedictus Awards, a programme designed to honour enterprising architectural applications of laminated glass by both professional and student architects. The programme is organized by DuPont in collaboration with the American Institute of Architects (AIA) and with the support of the Union Internationale des Architectes (UIA).

**PROFESSIONAL CATEGORY**

The professional competition last year attracted a record number of entries from architectural firms all over the world. Winners were selected by three judges according to fixed DuPont Benedictus criteria which include the functional and innovative use of laminated glass in architectural design. They were presented an original glass sculpture at the annual awards luncheon held on 5 May in Philadelphia, Pennsylvania, United States. Winners in the professional category were as follows:

**First Prizes**

- Fink + Jocher Architects won the Commercial Award for the Audi Development Centre in Ingolstadt, Germany.
- The Residential Award was given to Fougeron Architects for a private residence in Palo Alto, California, United States.

**Special Recognition**

The following architects were honoured with awards of special recognition:

- Eric Owen Moss for the “Umbrella” in Culver City, California, United States;
- Rafael Viñoly Architects PC for the Samsung Jong-Ro Building in Seoul, Korea;
- Arup Façade Engineering for the Corporation Street Bridge in Manchester, United Kingdom;
- Marks Baffield Architects for the Millennium Wheel in London, United Kingdom;
- Jutta Schürmann and Peter Schürmann for the Pavilion Domshof in Bremen, Germany;
Studens

The 2000 student competition attracted over 1,000 participants from 125 schools in 33 countries. Their challenge was to design a new, freestanding medical retreat for the treatment and research of cancer patients, chosen to encourage students to explore the various uses and applications of laminated glass as a building material.

Winning Projects

Glazed hall on the south side of the Audi Development Centre

- Ingenhoven Overdiek and Partner for the Audi AG Messestand first seen in Frankfurt, Germany;
- Ray King Studio Ltd. for “Light Wave”, a sculpture in the Library Reading Room of Rowan College in Glassboro, New Jersey, United States;

Students

The student winners were as follows:

First prize
- Robbie Forslund, Oklahoma State University, United States.

Second prize
- Cheong Michael Chan, Kwok Leung Lai, Che Wai Ng, Minqu Deng, University of Hong Kong.

Honourable mentions
- Scott Sundrop, Oklahoma State University, United States;
- Corey Graham, Oklahoma State University, United States;
- Peter Kwan Man Lok and Peggy Lau Pi Ki, University of Hong Kong.

Winning Projects

Climatic glass

Fink + Jocher Architects won the 2000 DuPont Benedictus Commercial Award for Innovation in Architectural Laminated Glass for the Audi Development Centre in Ingolstadt, Germany. Their design was based on continuous discussion among architects, planners and engineers, which resulted in a linear form, an energy efficiency scheme and a flexible layout. Designed for up to fifty Audi AG subcontractors, the centre was completed in 1999 after only seven months of construction and at 80 per cent the cost of a standard office building.

The aim of the design was to create a flexible structure that would not only permit future modifications required by eventual changes in occupancy or in occupants’ needs, but that would also allow for alterations to the building’s infrastructure. Through the use of glass and energy-saving technology, the architects were able to create a foyer which works as a thermic chimney, an underground duct which heats air in the winter and cools it in the summer, a circulation system of natural light and air through-
out the building and a facility for heat recovery.

The glazed hall on the south side serves as a climate buffer and forms an integral part of the building’s energy concept, collecting and transporting heat. Between the two layers of the glazing are electronically operated sunscreen ventilation flaps to create a stack effect in the hall for heated air in the summer. This wall is transformed into a striking patchwork of shades of light by occupants in the building; tenants who prefer more light and heat let the louvres open, while those who prefer a cooler environment close them at varying degrees to create a tapestry of transparency and obscurity. An infrared reflective coating on the inner layer of the glass protects the internal space from becoming too warm and room-height single-glazed walls separate the offices and gallery spaces in order to provide 14-metre deep offices with daylight from both sides. The laminated glass used by Fink + Jocher was supplied by Flachglas AG in Gelsenkirchen, Germany.

This development center represents a positive trend in architecture to approach design holistically, taking into account the form, structure and glass façades of the building, as well as the climatic concept. Architecturally it is very simple, in response to modern aesthetics which demand a certain degree of minimalistic linearity and to modern technology which necessitates environmental friendliness. Both light and air were taken into consideration, exploiting the laminated glass used in the interior partition and in the roof glazing. The judges said they were most impressed with the simplicity, which
Glass projects

was clean and simple and yet technologically accomplished.

Playing with light

The DuPont 2000 Benedictus Residential Award was given to Fougeron Architecture of San Francisco, United States, for the design of a private home in Palo Alto, California. The architects said “The use of laminated glass was an integral part to our design concept, as it allowed us to create a translucent floor plane which acts as a beautiful light filter for the rooms around it.”

Glass was used extensively throughout the 5,000-square-foot house in both horizontal and vertical applications. Laminated glass, for example, was used to build the floor, which allows light to penetrate into the dining and family room spaces. Laminated glass was also used in a bridge on the second floor, which overlooks the living room; its upper surface was sandblasted for safety, but the underside was left smooth. Together, the laminated glass floor and the bridge illuminate and extend a glass staircase tower built of channel glass, which has been manufactured in Germany since the 1920s and is incorporated in the Palo Alto residence in modular units 10 inches wide by as much as 15 feet long.

Organized around a central living area, the house pulls views of the front and back gardens in through the glass, while overhead a circulation spine draws the various levels and spaces together. Polished black granite, pear wood, plaster hand-rubbed to a satiny texture, white marble, Panama granite, stainless steel and woven metal accentuate the transparent quality of the laminated glass. The overall effect of this design is a blend of space and light and a fusion of solidity and transparency.

Thanks to the glass, this project excels in the use of light, both by day and by night, so much that one judge said “light was what the house was all about”. The glass is functional rather than superfluous, much like its use in the Audi Centre. Fougeron’s glazing firm for this project was NGA Glass of San Leandro, California. Tempglass of Freemont, California was the glazing laminator.

HONOURABLE MENTIONS

Glass canopy

Eric Owen Moss of Culver City, California was honoured with an award of Special Recognition for his outdoor amphitheatre space. The “Umbrella” is an experimental structure, located above two contiguous warehouses in Culver City.

The warehouses date back to the 1940s and had fallen into disrepair, calling for massive remodelling. On their roof an outdoor seating, lounging, music-making amphitheatre space was constructed. It is covered overhead by a structure which cantilevers over the entry ramp. Seventeen pieces of slumped, laminated, overlapping glass panels held up on a steel pipe framework

Suspended bridge through the living room of the Palo Alto residence in California, United States

Photo credit: Richard Barnes
create a canopy over the stairway and seating area. The Umbrella gets its name from its intense curvature, made possible by the strength of the glass, laminated by *California Glass Bending*. The slump glass process minimizes the risk of breakage and, given that the glass forms a canopy, laminated glass was also necessary to ensure safety in the building. The Umbrella is basically a “conceptual bowl” whose slope is determined by the curving top chord of two inverted wood trusses. Its edge is defined by a curved steel pipe 14 inches in diameter that ends the vaulted bowstring roof and begins the new Umbrella. In this way, the use of glass solves both practical and aesthetic problems in the design.

**Elements of glass**

The Samsung Jong-Ro building design by Rafael Viñoly Architects PC of New York City, United States, was also honoured for special merit. The architects’ plan involved the renovation and architectural reconfiguration of a very large and complex office building into a translucent, open structure with views out onto the city of Seoul, Korea. Their aim was to restructure the building to be more in line with the needs of the client, Samsung Life Insurance.

The building is divided into four main zones supported on three restructured towers. Each zone, or element of the project is designed differently, and its design is defined through the use of laminated glass. The first zone takes up a three-storey retail atrium

*The Samsung Jong-Ro building in Seoul, Korea*
The second zone, nine floors of retail space, is made up of horizontal laminated glass beams supporting insulated units suspended by stainless steel rods from the eleventh floor. Defined by vertical laminated glass blades spanning from floor to floor, the third zone is spread out over eight floors of office space. The glass blades stiffen the aluminium mullions, reducing their dimensions and controlling the deflections. The fourth zone, called “The Cloud”, is a restaurant sheathed in laminated glass both above and below.

Laminated glass was used in this project for safety, aesthetics and functionality. The architects explored its strength and transparency in order to take such a large complex project and use technology to simplify it.

The second zone of the building is the most innovative for its use of laminated glass. In this part of the project, the laminated glass actually encloses the building, shading spaces and receiving all the external forces applied to its façade. Horizontal fritted glass louvres allow natural light to enter the building while blocking damaging ultraviolet rays with minimal obstruction of the city views. Using laminated glass for the 11-metre horizontal beams was an ideal solution because it added stiffness to them.

Stainless steel bezels had to be developed in order to accommodate alignment differentials between the laminated sheets for the suspension of the glass curtain wall from the eleventh floor in this second zone. This guarantees uniform load transfer. Additionally, horizontal load transfer joints were designed to accommodate vertical movements generated from imposed loads on the horizontal blades and temperature differentials among the rods.

**A glass bridge**

The Corporation Street Pedestrian Bridge, built in Manchester, United Kingdom, by Arup Façade Engineering in order to replace the original footbridge destroyed in a terrorist bombing in the late 90s, was also honoured with an award of Special Merit. The essence of the bridge is transparency. That, coupled with the need to conceal the varying floor levels on each side, demanded the bridge’s regular, geometrical shape with a tapered and sloping deck within. The hyperbolic paraboloidal geometrical shape was achieved using a pre-stressed arrangement of CHS struts and solid rod ties between two circular lattice trusses. The glazing strategy had to have minimal actual glazing members to achieve the desired transparency and had to follow the geometry dictated by the steel exoskeletal structure. Design-A-Glass based in Derbyshire, United Kingdom, did the glazing lamination.

The glazing geometry was achieved through a method of panellization...
which involved 360 flat, triangular, laminated, heat-treated glass panels, of ten different sizes, positioned to create the three-dimensional curvature. The safety of those under the bridge was the primary consideration in selecting laminated interlayers for the area beneath the deck. Polyester PET interlayers were considered the best method for achieving the mechanical restraint at each corner of the panels. Specially designed and tested interlayer “tabs” were left to extend beyond each of the corners. This allowed the stainless steel casting to be designed to engage the six interlayer tabs which occur at each node while remaining as small as possible. The design supports an operative standing on the undercroft glazing and, should either one or both of the panes break for any reason, the operative will not fall through, nor will any items fall onto pedestrians on the street below.

A glass eye

Designed by Marks Barfield Architects, the Millennium Wheel in London, United Kingdom, is the largest observation wheel in the world. The design of its 32-passenger capsules calls for optically clear glass, an aerodynamic shape to shed wind load and specific safety features. Double curved glazing was especially designed for the 450-
feet “Eye” for a level of visual clarity found in car windshields, but with a greater degree of curve for a much larger unobstructed glass piece.

Initially it was apparent that no material could offer the optical clarity and longevity of glass. However, single-lay toughened glass was ruled out because failure would result in a shower of glass fragments falling from the capsule, leaving a gaping and unprotected hole. Toughening can also cause distortion in the glass that would be exacerbated by the curvature. Laminated glass was the answer, as the pane would stay intact and remain bonded to its frame if cracked or crazed.

The innovative double curved capsule glazing consists of two layers of 6 mm float glass laminated together with PVB and constructed to withstand a loading of six people per square metre. An Italian company, Sunglass, developed a process that involves bending three sheets of glass together and discarding the sheet closest to the mould. For the most double curved panels at the sharpest slope, a pin-hole enabled vacuum-assisted moulding without overheating the glass.

The glass panels were glued directly to the tube frames, providing in-plane stiffness to the capsule structure. The roof glazing has metallized coating fused onto the inner surface of the inner sheet to provide a degree of overhead shading. All the wall glazing is clear and the structure of the capsules consists of two ring beams supporting a space frame floor beam that transfers loads to the main wheel structure via the capsule support brackets, with the majority of the wall and roof sections formed from the double curved laminated glass panels.

**STUDENT PROJECTS**

**Glass care**

The winning project in the student category was the fruit of a holistic approach to designing a cancer treatment centre. Robbie Forslund

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*Photograph: Nick Wood*
of Oklahoma State University, United States, emphasized treating the patient rather than exclusively treating the disease. The project proposal states as follows: “The innovative use of glass is a response to the environmental context of this structure and the holistic philosophy of the comprehensive care centre. The glass membrane is created without the use of large columns to maximize the psychological and physical effect of the membrane and to heighten the connection to the exterior environment.

“There are more than 120 different laminated glass operable panels in this design proposal, each of which has different proportions. These panel systems are suspended above the titanium beams on a compression rod system. This crafting of space through holistic design would not have been possible without the use of laminated glass.”

**Light therapy**

Second place was awarded to a light-modulated cancer treatment centre made up of three main atriums designed by a group of students from the University of Hong Kong. Their proposal was based on light therapy using laminated glass to create outdoor views and light modulated spaces. The students wrote: “Light and ‘light treatment’ are key concepts of the plan for the Centre.” Laminated glass was used extensively throughout the building, especially in the façade, where it is a major element.

**Giving space to light**

One of the three entries which was awarded third place also used glass in an atrium to create a sense of space and an intimate relationship with the landscape around it. Part of Scott Sundrup’s proposal reads as follows: “Historically, glass has given light to space. With this design, most notably in the atrium space, there is an attempt to give space back to light. Opaque structure is kept at a minimum with open web tube steel trusses, transverse laminated glass beams and a system of thin tension reinforcement cables to tie the elements together. The peak of the atrium also rises well above the other roof planes, allowing it to catch natural light from all directions and, with its curved plane, refract it, filter it, focus it and gracefully deliver it to those who occupy the space. This degree of transparency creates space that is more completely connected to the landscape and distant views, and immersed in the luminous refractive symphony that is dynamic, kinetic and alive.”

**CONCLUDING COMMENTS**

Named after Edouard Benedictus, the French chemist who discovered the process for laminating glass, the DuPont Benedictus Awards are a tribute to its architectural applications. The winning projects last year proved that laminated glass is, and will remain, an important feature in architecture thanks to its strength, striking appearance, and technological possibilities.