CLEAR & PRESENT DAYLIGHT

It's now possible to design almost any structure in glass. And the results can be spectacular, says Nicole Swengley.

Glass, when used imaginatively, adds drama and glamour to a home. And now that technological advances allow walls, beams, girders and staircases to be made in glass, homeowners are demanding increasingly adventurous designs when renovating or building anew.

"Structurally, the sky's the limit once you take into account local planning laws, aesthetics and economics," says Tim Macfarlane, design partner of structural engineers Dewhurst Macfarlane, the company that designed the stunning façade and specialist laminated glass cantilever canopy for the architect Rafael Viñoly's Tokyo International Forum. "It's now possible to design almost any structure in glass and designers are able to realise exploratory ideas in beautiful, sensuous shapes."

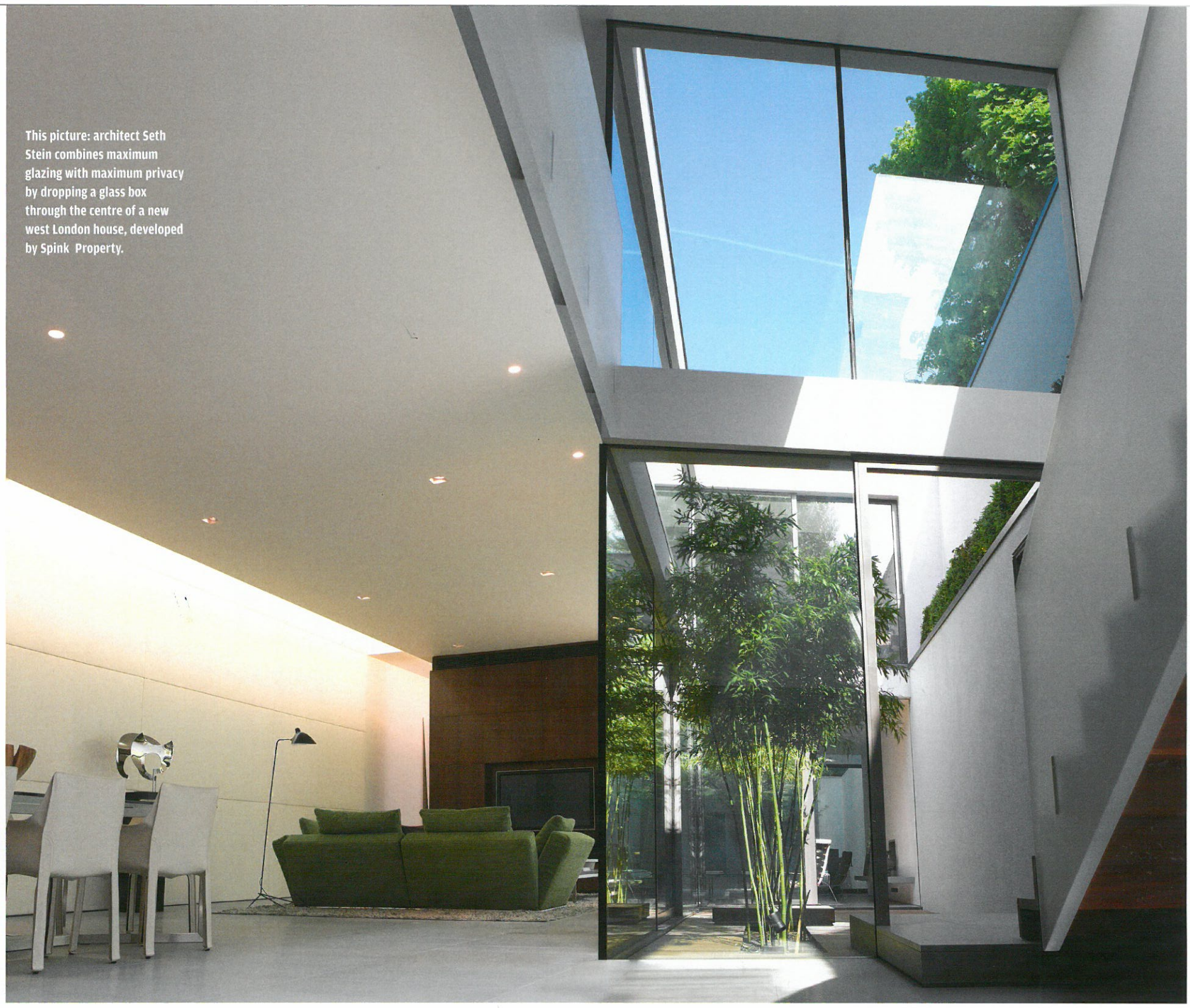
Nor are these imaginative designs confined to public and corporate buildings. "Homeowners want to create visually exciting structures and extensions using glass," confirms the architect David Mikhail. Why? "Because people increasingly want a seamless connection between the interior and exterior of their homes," says architect Alan Crawford. "They want natural daylight and sunshine to penetrate the inner core of their properties and to create spaces with a magical sparkle at night."

A conversation with Macfarlane leaves you wondering why Cinderella's fairy godmother provided only glass slippers. He murmurs lyrically about glass beams, lintels, columns, girders and canopies. He conjures images of 180-degree views through glass walls supporting glass roofs. And he admits his own fantasy is to build a glass house with coloured walls in the style of a Mondrian painting.

It's clear from this that glass has an emotional and aesthetic pull that goes beyond its functionality. And you quickly realise that rapid advances in glass manufacturing are altering the nature of the material itself. Interior or exterior glass walls that change colour via embedded light-emitting diodes, introduced last year, are now finding their way into properties. Similarly, laminated panels that switch at the flick of a button from transparent to opaque are becoming more widespread as prices come down. As for high drama, forget back-lighting: fibre optics, invisibly set within interior or exterior glazing, will create the necessary wow factor.

Meanwhile, environmental concerns are being addressed by solar and thermal developments such as photovoltaic glass that converts solar energy into electricity, ultraviolet sun-filtering coatings and insulated glass containing Cabot's translucent Nanogel (a hydrophobic aerogel comprising 95 per cent air in nano-sized pores to inhibit heat transfer).

Main picture: Belsize Architects' triple-height glass atrium in a London new-build. Above: Rick Mather's four-storey glass stairs below a sliding roof light.



This picture: architect Seth Stein combines maximum glazing with maximum privacy by dropping a glass box through the centre of a new west London house, developed by Spink Property.

In one 1770s restoration in Virginia, US, "Everything that isn't original - every beam and lintel - is made of glass."

These developments will soon be followed by vacuum-glazing that improves insulation by pulling air out from between the panels to keep heat in – or out – depending on geographical location.

A special type of insulated glass was used to great effect three years ago in the redevelopment of a Grade II listed 18th century house in London, where architect Eva Jiricna installed huge, glazed roof lights to unite the historic part with new additions. The kitchen courtyard's roof light has a raised central section fitted with translucent insulating material whose capillary action reflects unwanted heat in summer, retains heat in winter and diffuses natural light. Meanwhile, a bespoke spiral glass staircase with curved glass balustrade draws light through the property and allows views through to the garden via annealed low-iron glass treads (a very clear type of glass). "Bonding sheets of glass with new types of glue under ultraviolet light now makes joins invisible," explains Mikhail.

A historic property's original masonry and woodwork can even be captured for posterity within glass panels, as if suspended in space. Macfarlane is working on just such a house – a 1770s restoration in Virginia, USA – to the delight of conservationists. "We're replacing rafters and joists with glass beams and girders of the same size and building a glass roof incorporating photovoltaic panels to generate power," he says. "Everything that isn't original – every beam and lintel – is made of glass." The restoration will cost about $15m (about £7.4m).

Crawford Partnership, meanwhile, has added a 10m-long all-glass extension to the back of a locally listed 1930s house in Harpenden, Hertfordshire. Full-height glass panels and glass roof truss beams avoid employing a metal support structure – a local conservation planning requirement – and provide a visual connection between the original building and the garden, which is accessed by frameless glass doors with spider hinge fittings (a relatively new advance in glass technology). The new extension has opened up the living space in the narrow-plan house, linking a new living/dining area and other family rooms. Below, a new basement area with gym and children's play area is lit by walk-on, toughened glass panels suspended in the floor above.

Left: Lynn Davis's double-height, split-level glazed new-build in Kent. Below: Steve Marshall's 4m swivelling rear-wall glass doors.

So great are advances in technology that it is now possible to build houses entirely of glass. Architect Odile Decq has designed three houses in Brittany, working with structural engineers Malishev Wilson, at which Nanogel-filled glass roofs and façades supplied by bespoke installation specialists FA Firman will form cloudlike enclosures (Nanogel can be made to allow different levels of light diffusion) with thermal insulation which is superior to triple-glazing. "As long as great care is taken with a design and with the manufacturing tolerances and on-site assembly, glass can now be used to full capacity in withstanding vertical and lateral loads, creating self-stable, all-glass houses," says Philip Wilson.

Parallel developments in bonding materials are also pushing designs forward. "There's been a revolution in the way glass is bonded to glass," says Mikhail. He cites a

This picture and below left: at a house in Stockwell, London, David Mikhail used three 4.5m glass panels within a sliding door frame to link a one-and-a-half storey room with the garden.

The potential to build double- or triple-height glass structures using sliding glass roofs offers yet more design scope.

Grade II listed house in north London that he extended into a rear garden over two floors, opening up the views and bringing light deep into the property. "We built a big, structural glass box in which the glass walls carried the weight of the glass roof, which itself was one huge panel of a new type of glass [Pilkington's Suncool] that won't overheat in summer," he says. And even where an aluminium frame is built to create an industrial-style glass roof – like the one Mikhail added to a new, double-height family room at the rear of a house in Richmond – larger, flatter sheets of glass can now be used for greater effect. The same goes for vertical panels like the impressive 4m-tall glass doors that architect Steve Marshall installed at his north London house. The four giant doors each swivel through 90 degrees to access a courtyard garden and form the property's new rear wall. The use of structural silicon also creates a much sleeker look when bonding glass to timber as Mikhail demonstrated at a Grade II listed Victorian house in south London where he installed three 4.5m toughened, double-glazed panels within a full-height, sliding, cedar door-frame linking a one-and-a-half-storey family room with the garden. "The glass sits completely flush with the timber door frame and was much more affordable than one big panel as it was brought in by hand," he says.

And there is no need to limit imaginative glazing to a property's façade or rear. Shahriar Nasser of Belsize Architects clad a triple-height, steel-framed atrium rising through the centre of a modern, six-bedroom new-build in London with toughened, double-glazed panels bonded to the frame with structural silicon. "The cascading glass atrium brings light right into the heart of the building, with Pilkington's Suncool glass reducing heat gain by around 30 per cent," explains Nasser. The property's basement swimming pool, located in a sunken courtyard extending into the rear garden, is also glass-roofed, providing intriguing views from the house and garden.

The potential to build double- or triple-height glass structures using massive glass sheets and vast, automatic sliding glass roofs offers yet more design scope, as architect Rick Mather showed when redeveloping a period property in west London. He removed the rear and flank walls, roof and most floors to insert a four-storey glass staircase below a very large, automatic, sliding roof light to bring daylight into the whole house, right down to a basement swimming pool, and inserted a double-height glazed structure to create a seamless link between the living space and rear garden. The result is stunning.

Even at more modest properties, such as Victorian terraced houses, glass is being used imaginatively. Architect Paul Archer cites a Victorian house in Islington, north London in which a glass box acts as an external lantern above a new dining room that he created by glazing over the original basement light well. And it seems that designers just can't resist playing with glass boxes these days: take the double-height, frameless glass cube that architect Seth Stein added to the exterior of a tall, narrow, Grade II listed terraced house in west London. Here, a glass balcony forms the ceiling of the family room below – handy for keeping an eye on the children downstairs – while sleek, sliding glass doors provide access to a terrace overlooking the garden.

Or check out a modernist new-build in Kent created by architect Lynn Davis.

Below: Paul Archer glazed over a basement light well to make a dining room in this Victorian house in Islington, then placed an external glass box above.