

THE MATERIAL AND THE EPHEMERAL

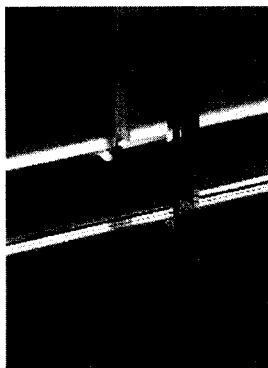
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Abstract

There has been a huge effort in recent years to reduce structural support of glass in buildings to the absolute minimum. The use of glass as a structural element itself is a further development of this idea. Ostensibly the goal is maximum transparency, which seems to serve the notion of openness and the metaphorical idea of lightness. However glass as a material remains resolutely massive and the sense of lightness requires contrast, with weight and with darkness, in order to be appreciated in context. I would like to examine these ideas through the exploration of a series of projects from the studio of James Carpenter Design Associates with whom I have been a primary collaborator for nine years.

I would like to present in particular three projects on quite different scales: a small post-tensioned vertical cantilever glass screen that was installed in a house by Richard Meier and Partners; a cable-net facade for the extension to the German Foreign Ministry in Berlin; and the ongoing development work to design post-tensioned tubular glass struts for a building in London being designed by Sir Norman Foster and Partners.

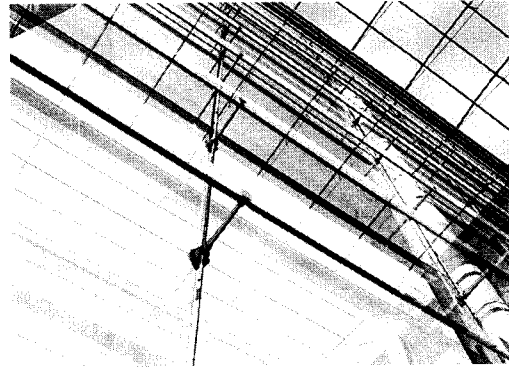
The three projects explore the use of glass, not only as a structural material, in order to reduce the visual weight of the structure, but also as a medium for the exploration of light itself and as a material with a mass and density of its own. The relationship between the goals of the building architects, the knowledge of the engineers, the development of visual and structural ideas within our studio, the means to fabricate and install, and the final result will be explored.



Rachofsky screen (detail)

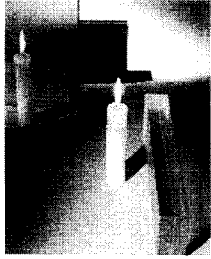


Tower Place (view)



Lichthof, Berlin (view)

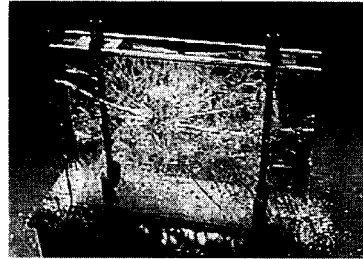
Rachofsky Screen, Dallas - (completed summer 1996)



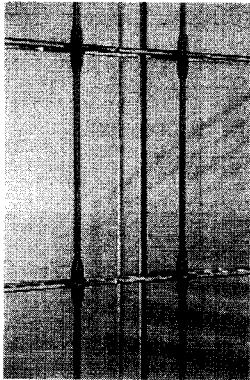
Visual test of reflectivity and translucency



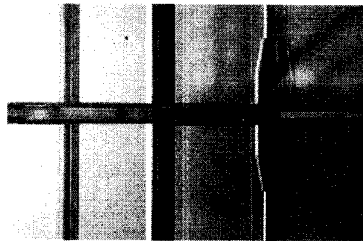
"Soft body" test



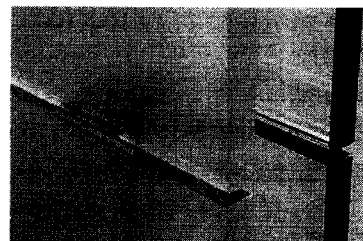
Impact test



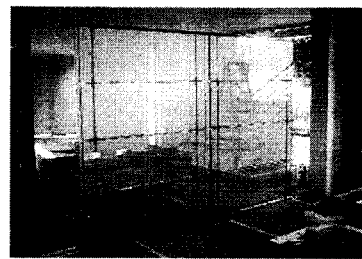
A pair of tension rods



Bearing pad/connector and rod



Panel corners showing bearing pads



The screen in raised position immediately after installation

This moving glass screen in a house for an art collector by Richard Meier and Partners has within it all the aspects of the material and the ephemeral that I would like to address. The commission was to provide a screen that would divide the dining area of the house from the art gallery, but which could also be sunk into a specially built basement room if the division of space were not desired.

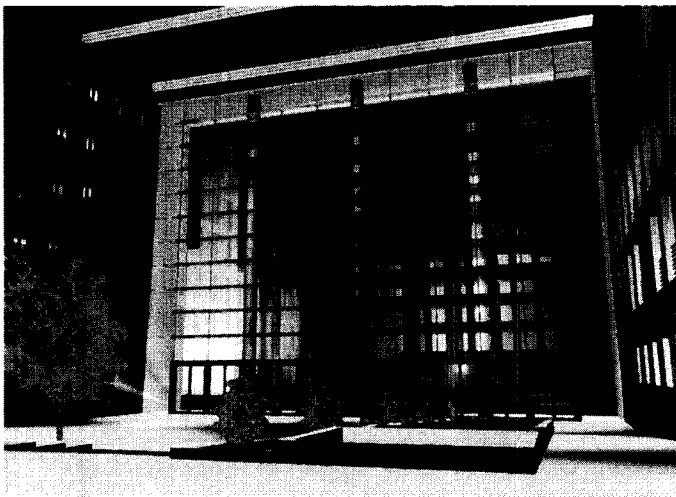
I was interested in using a semi-reflective glass with a translucent glass that in combination would change significantly under different lighting conditions. The particular colorless semi-reflective glass that I was interested in is produced in sheets no larger than 5' x 2'. I did not want to build a frame to hold them as this would be visually heavy in such a small screen and would make the space between the sheets inaccessible - "dead". I therefore proposed that the screen be made of four stacks of glass sheets on edge, in compression, clamped in place by four post-tensioned stainless steel rods between a top bar of stainless steel, and a beam in the structure below the floor. In this way the structure was minimized and the subtle visual effect of the glass heightened. Initial discussions with Tim Macfarlane of Dewhurst Macfarlane, indicated that the idea was viable and that a glass thickness of an inch in each stack, would

Visual tests were performed on glasses of varying reflectivity and translucency to get the right balance of reflected and transmitted image under different light conditions. Structural tests to destruction were also performed under the direction of Tony Broomhead of Ove Arup and Partners. The counterbalanced mechanism that lowered and raised the screen was completely assembled and tested prior to installation. All the work was carried out under the direct control of the studio.

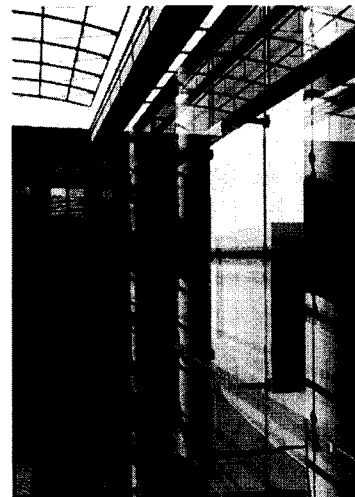
The physical presence of the glass is emphasized by exposing the edges and corners of each sheet, by making both the inside and outside of the glass panels accessible and because the thickness of the glass is essential to the structural stability of the screen. The physicality of the glass itself contrasts with the reflected images of people in the gallery and the insubstantial presence of shadows and silhouettes seen through the translucent surface. This contrast between material and image is intended to convey an awareness of the fleeting nature of perception and memory, and their roots in the physical world.

This project gave us the chance to explore some very simple and subtle effects that hopefully have a profound effect on their surroundings over time. The great level of control afforded by a small studio that also installs the work, allows the application of the high levels of commitment required to complete experimental work successfully. The ideas that developed in this project have found application in two other recent projects, on a very different scale.

Lichthof facade and roof, Berlin - (completion summer 1999).



View from the rear of the Lichthof at night showing the reflections



Side view of the facade (rendering)

The Lichthof will be the public space of the new German Foreign Office in Berlin, designed by Müller Reimann Architekten. The space was conceived as a light-filled, open-sided courtyard and the intention of the architects was to make the space visually accessible, even if the security arrangements make it impossible for the courtyard to

be always physically open. The structure of the facade wall, which was engineered by Schlaich Bergermann and Partners of Stuttgart, is a two-way post-tensioned cable-net, based on their previous experience, which relies upon horizontal deflection to provide a reaction against wind loads. The elegance and delicacy of this structure opened up the possibility of a play with the reflectivity of the glass itself.

The courtyard faces north and sun-studies made clear the practicality of reflecting light into the shaded area at the back of the courtyard. So we took the parallel planes of the deep roof beams and the facade and used specular metal reflectors and various glass coatings to reflect light back into the shadow. In the facade we use three glass coatings to reflect heat, sunlight, and color. The glass is a single laminated sheet 24mm thick, of two layers of water-clear glass. The first coating is to reflect energy to avoid condensation of the inside of glass. Light will be reflected by the second colorless semi-reflective coating, which occurs only in the central area of the facade. This is very similar in reflectivity to the one used in the Rachofsky Screen and is intended to create the impression of a semi-reflective mirror floating in the facade. Special dichroic coatings will be applied to horizontal bands of glass cantilevered from the facade. This coating divides sunlight into two halves, reflecting and transmitting opposite ends of the spectrum. This will project two constantly changing fields of colour either side of the facade, within the Lichthof and out into the street.

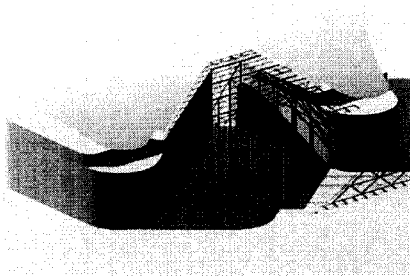
The facade structure is two parallel planes of cables that are separated by about 450mm in order for the wall to have depth within which there can be a play of light. The horizontal cables and their dichroic-coated glass bands are cantilevered from the vertical cables. The very high levels of pre-stress make the vertical cables very stiff and the small internal strip of glass at the end of the cantilever arm counterbalances the large pane of glass close to the cable. The glass panes are 2.7m by 1.8m and are restrained at their corners only by cast stainless steel patch plates. The movement of the wall is about 300mm either side of vertical in the centre under extreme conditions. This movement occurs rarely and is gradual, but it is emphasized by the semi-reflective coating on the glass. This will enhance the viewers' awareness of the fragility of the reflected image and the delicacy of the membrane.

At night, just as in the Rachofsky screen, the artificial lighting is intended to light the surroundings rather than the wall itself. The garden within the Lichthof, the roof structure, and the portal which forms the frame for the facade, will all be lit, and will be seen in reflection overlaid with incidental light from the Foreign Office, from other buildings, streetlights, and even the light of the city itself projected onto clouds. The relative darkness outside the Lichthof at night will increase the apparent reflectivity of the facade from the inside creating the appearance of a second Lichthof superimposed on the real buildings beyond the facade.

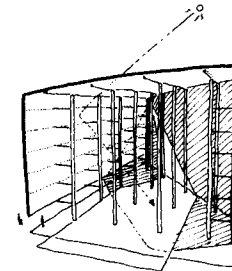
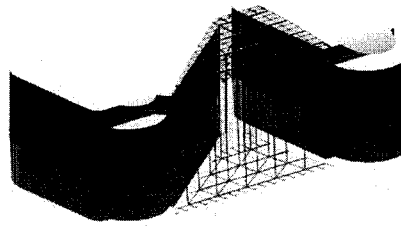
There is a literal boundary between the inside and the outside, and normally the use of glass is an attempt to minimize this. The boundary, though one can see through it, is real. This confusion can even assume a symbolic political dimension when it occurs in the facade of the Foreign Office. The superimposition of transmitted and reflected

images afforded by the use of a semi-reflective glass in a defined area of the facade is intended to increase one's awareness of the contradiction, and in so doing, clarify the reality.

Glass Tube Field, Tower Place, London - (completion date uncertain)



Sun studies of the atrium space at Tower Place (Sept 21st 10am and 3pm)



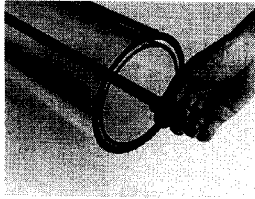
Concept sketch

Tower Place, designed by Norman Foster and Partners, is the proposed headquarters of an insurance company adjacent to the Tower of London. The two independent buildings form a common triangular space that is open to the public at all times and which is sheltered by a glass roof and two suspended glass curtain walls. The glass walls, designed by Ove Arup and Partners facade group, do not reach the ground. Each 2m x 3.8m glass sheet is hung from the one above, each 26m high chain being held in place by a single bolt at the top. The wind restraint is achieved by a pre-stressed cable that runs the length of the wall (about 63m), similar in concept to that used in the project in Berlin), and the deflections are kept within reasonable limits by horizontal props (4.5m) back to the columns at intervals of 12m.

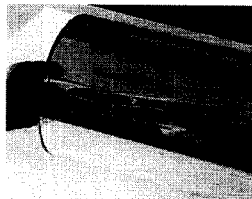
An initial study of the effects of the sun on the north facing space indicated that for long periods of time the public space would be in shadow. The orientation of the facade led us to propose a similar solution to that used in Berlin. The basic idea was again to reflect light back into the shaded areas of the public space and simultaneously to present to the viewer with the superimposition of reflected and transmitted images floating within the facade. In this case however we were able to propose a more integrated visual concept. We suggested substituting pre-stressed glass tubes for the steel props that help restrain the facade. In this way the floating field will appear to be supported by the almost transparent props. The concept of expanding the threshold of the space that we were able to develop to only a very limited degree in the Lichthof is brought to fruition in this project. The whole 4.5m length of the tubes defines the boundary of the public space.

The props were initially proposed as two concentric glass tubes (od 150mm) with a resin laminate between, and a stainless steel rod of approximately 10 mm diameter in the centre pre-stressed to avoid load reversal under tension. A course of testing was undertaken to determine the feasibility of this approach. In every case the shrinkage

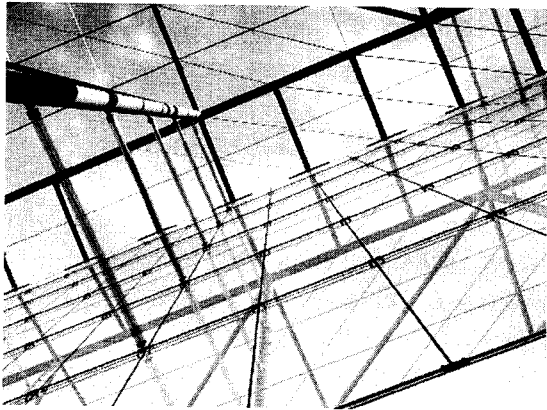
of the resin laminate broke one of the tubes and usually delaminated at the same time. At the time of writing a simpler approach is being tried in co-operation with Du Pont Butacite and Schott glass and samples are being prepared.



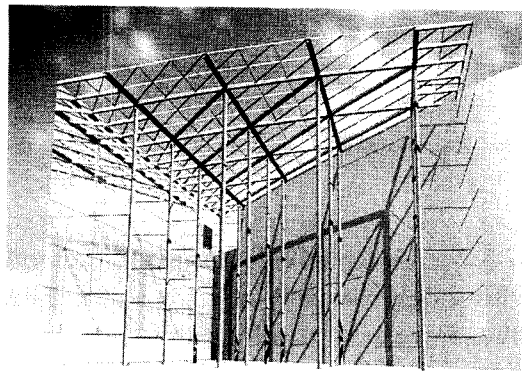
Concentric glass tubes and stainless rod



Tubes with dichroic coated film



Rendering of facade from below



Rendering of sectional perspective

Conclusion

All of these projects have attempted to take the design of the glass wall, in different forms and at different scales, beyond a simplistic notion of transparency. The development of glass facades, even at its most technical, is inevitably part of an ongoing process of artistic and architectural exploration, and these projects have attempted to make that exploration conscious. They attempt to manifest the contrast between the material world and its representation, within the material itself.

The development on a large scale of these ideas was, I believe, only possible because of the understanding and knowledge gained in the smaller project. I believe that this kind of small-scale exploration by committed groups of individuals is essential for the development of a synthetic relationship of technology to culture.