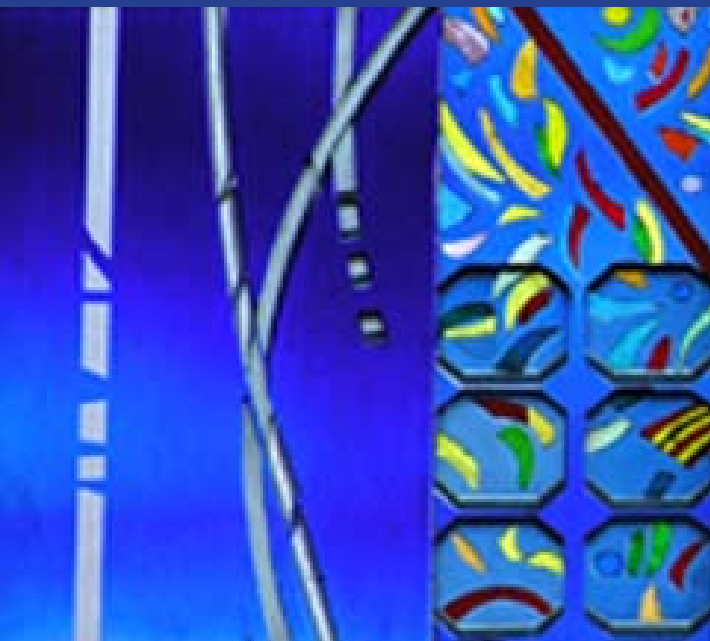




# CONTEMPORARY TECHNIQUES IN ARCHITECTURAL GLASS



**Lindy Sando and Vaughan Taylor**

National ISS Institute Overseas Fellowship

Fellowship supported by the  
Department of Education, Employment  
and Workplace Relations  
Commonwealth Government



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# Executive Summary

Glass is increasingly becoming a part of the Australian psyche. A more relaxed lifestyle and an appreciation of our climate and environment has led to a more open concept of building design. The new philosophy is to merge the exterior with the interior and to minimize the physical barriers. Glass is the perfect solution. It emits light and heat and acts as a translucent shield between the two areas. There is now a need for new technology and innovative ideas in architectural stained glass to complement this style. The large expanses of glass being used create huge opportunities for integrated glass designs but the development of new skills and a new glass language is necessary. In addition, stringent building and safety codes have also contributed to the need for new innovations.

Glass has become a major component in the built environment. New buildings feature walls of glass. The commercial glass industry is booming, but the possibilities of architectural glass art are not being realized. Australia is lagging behind overseas countries in this area. Presently, there is a great opportunity to advance the glass industry through utilising glass as a vehicle for both design and detail. The breadth of such activity can move from meeting a simple function such as obscuring a view or adding signage to a corporate building or it can be an outstanding artwork in its own right.

Internationally, glass is used to create huge integrated artworks on building facades as well as free-standing public sculptures. Architectural stained glass design has progressed from purely decorative, such as the church windows of the past, to being an integral part of the building design. This transformation requires new thought processes and new technology. A more seamless, free flowing approach is now appropriate. New technology has freed the artist from the constraints of traditional leaded glass. It allows a greater freedom of design and structural strength. While art in architecture is a cultural tradition in Europe that gives each country a unique identity, Australia is still developing its artistic language. There currently exists a misconception within Australia that glass is too fragile to be used in the public arena as artwork despite the prevalence of its use in the construction of high rise buildings. Developing comprehensive information on the latest innovative glass technology will lead to greater awareness of the suitability of glass in public art and design.

European countries have developed and successfully applied new technologies and processes from which much can be learnt. These countries have demonstrated an ability to transpose and interpret artworks into glass with no compromise. Several projects have involved designing for large scale site specific installations and require both a depth and breadth of understanding on a series of levels. Form and function of the building are considerations, in addition to choice of structural materials, design elements, the play of light and the consideration of safety. It is at this practical coalface that invaluable knowledge of experience has been developed.

For the past decade or more, European glass artisans have utilized the techniques of glass lamination to integrate major artworks into public buildings. Knowledge of innovative techniques such as this is not generally available in Australia. It is envisaged that knowledge obtained from this overseas study will assist in facilitating the development of leading edge technology that will benefit the Australian glass industry while having significant benefits for both the economy and broader community.

Given the primary objective of the fellowship was to undertake an overseas study tour of the best Architectural Glass Studios and to visit major installations, the following destinations were identified as yielding the most significant benefit: Barcelona, Wales, London and Germany. The study was designed to develop knowledge and understanding of the following key areas:

# Executive Summary

- Contemporary techniques in Architectural Glass production
- Glass lamination - design and manufacture
- Complementary techniques and innovations
- Integration of art into major architectural projects
- The collaboration process, from concept to installation
- The European culture of art in architecture

With regard to specific skill development, the fellows sought to acquire knowledge on glass surface techniques and workshop practices, including use of new products and machinery, health and safety issues and handling, storage, transport and installation of large scale artworks.

In order to optimise the outcomes of this fellowship and revitalize the Architectural glass industry, the fellows recognise the importance of ensuring that the knowledge obtained is shared with others. Following an overview of the international experience, a series of recommendations have been made regarding a range of initiatives and activities that the fellows identify as central to knowledge transfer and furthering opportunities for the built environment. The report then concludes with a series of recommendations for government bodies, professional associations, education and training providers, industry, business and the community.

# Acronyms & Abbreviations

**AGDA:** Architectural Glass Design

**AUSGLASS:** The Australian Association of Glass Artists

**CNC:** Computer numerical control

**DEEWR:** Department of Education, Employment and Workplace Relations

**Glasstec:** International Trade Fair of Glass Technology

**ISSI:** International Specialised Skills Institute

**LED:** Light Emitting Diode

**PPE:** Personal Protective Equipment

**RAIA:** Royal Australian Institute of Architects

**TAFE:** Technical and Further Education

**UV:** Ultra violet

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Lindy Sando and Vaughan Taylor would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide them throughout the Fellowship program.

## **1.1 Awarding Body - International Specialised Skills Institute (ISS Institute)**

**We know that Australia's economic future is reliant upon high level skills and knowledge, underpinned by design and innovation.**

The International Specialised Skills Institute Inc (ISS Institute) is an independent, national organisation, which has a record of nearly twenty years of working with Australian industry and commerce to gain best-in-the-world skills and experience in traditional and leading-edge technology, design, innovation and management. The Institute has worked extensively with Government and non-Government organisations, firms, industry bodies, professional associations and education and training institutions.

The Patron in Chief is Sir James Gobbo AC, CVO. The ISS Institute Board of Management is Chaired by Noel Waite AO. The Board comprises Franco Fiorentini, John Iacovangelo, Lady Primrose Potter AC and David Wittner.

Through its CEO, Carolynne Bourne AM, the ISS Institute identifies and researches skill deficiencies and then meets the deficiency needs through its *Overseas Skill Acquisition Plan (Fellowship Program)*, its education and training activities, professional development events and consultancy services.

Under the Overseas Skill Acquisition Plan (Fellowship Program) Australians travel overseas or international experts travel to Australia. Participants then pass on what they have learnt through reports, education and training activities such as workshops, conferences, lectures, forums, seminars and events, therein ensuring that for each Fellowship undertaken many benefit.

As an outcome of its work, ISS Institute has gained a deep understanding of the nature and scope of a number of issues. Four clearly defined economic forces have emerged out of our nearly twenty years of research. The drivers have arisen out of research that has been induced rather than deduced and innovative, practical solutions created - it is about thinking and working differently.

### **A Global Perspective. 'Skills Deficiencies' + 'Skills Shortages'**

Skill deficiencies address future needs. Skill shortages replicate the past and are focused on immediate needs.

Skill deficiency is where a demand for labour has not been recognised and where accredited courses are not available through Australian higher education institutions. This demand is met where skills and knowledge are acquired on-the-job, gleaned from published material, or from working and/or study overseas. This is the focus of the work of ISS Institute.

There may be individuals or firms that have these capabilities. However, individuals in the main do not share their capabilities, but rather keep the IP to themselves; and over time they retire and pass way. Firms likewise come and go. If Australia is to create, build and sustain Industries, knowledge/skills/understandings must be accessible trans-generationally through nationally accredited courses and not be reliant on individuals.

Our international competitors have these capabilities as well as the education and training infrastructure to underpin them.

Addressing skill shortages, however, is merely delivering more of what we already know and can do to meet current market demands. Australia needs to address the **dual** challenge – skill deficiencies and skill shortages.

Identifying and closing skills deficiencies is vital to long-term economic prospects in order to sustain sectors that are at risk of disappearing, not being developed or leaving our shores to be taken up by our competitors. The only prudent option is to achieve a high skill, high value-added economy in order to build a significant future in the local and international marketplace.

## **The Trades**

The ISS Institute views the trades as the backbone of our economy. Yet, they are often unseen and, in the main, have no direct voice as to issues which are in their domain of expertise. The trades are equal, but different to professions.

The ISS Institute has the way forward through its 'Master Artisan Framework for Excellence. A New Model for Skilling the Trades', December 2004. The Federal Government, DEEWR commissioned ISS Institute to write an Australian Master Artisan School, Feasibility Plan.

In 2006, ISS Institute Inc. set up a new ISS advisory body, the **Trades Advisory Council**. Members are Ivan Deveson AO; Martin Ferguson AM, MP, Federal Labor Member for Batman; Geoff Masters, CEO, Australian Council of Educational Research; Simon McKeon, Executive Chairman, Macquarie Bank, Melbourne Office; Richard Pratt, Chairman, Visy Industries and Julius Roe, National President Australian Manufacturing Workers' Union.

## **Think and Work in an Holistic Approach along the Supply Chain - Collaboration and Communication**

Our experience has shown that most perceive that lack of skills is the principal factor related to quality and productivity. We believe that attitudes are often the constraint to turning ideas into product and a successful business; the ability to think laterally, to work and communicate across disciplines and industry sectors, to be able to take risks and think outside the familiar, to share – to turn competitors into partners.

Australia needs to change to thinking and working holistically along the entire Supply Chain; to collaborate and communicate across industries and occupations - designers with master artisans, trades men and women, Government agencies, manufacturers, engineers, farmers, retailers, suppliers to name a few in the Chain.

## **'Design' has to be seen as more than 'Art' discipline – it is a fundamental economic and business tool for the 21st Century**

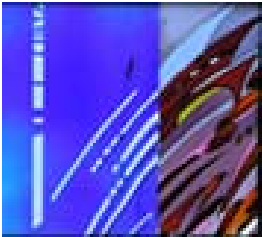
Design is crucial to the economic future of our nation. Australia needs to understand and learn the value of design, the benefits of good design and for it to become part of everyday language, decision making and choice.

Design is as important to the child exploring the possibilities of the world, as it is to the architect developing new concepts, and as it is to the electrician placing power points or the furniture designer working with a cabinet-maker and manufacturer. As such, design is vested in every member of our community and touches every aspect of our lives.

Our holistic approach takes us to working across occupations and industry sectors and building bridges along the way. The result has been highly effective in the creation of new business, the development of existing business and the return of lost skills and knowledge to our workforce, thus creating jobs - whereby individuals gain; industry and business gain; the Australian community gains economically, educationally and culturally.

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## 1.2 Fellowship Sponsor - DEEWR Federal Government

DEEWR provides national leadership and works in collaboration with the States and Territories, industry, other agencies and the community in support of the Government's objectives. They develop and implement policies to ensure the continuing relevance of education, science and training to contemporary needs and the growing requirement for lifelong learning. They also ensure high quality and value for money in delivering Government funded programs.

## 1.3 Professionals Who Endorsed the Fellowship Application

### Stephen Loo

Program Director Architecture, Louis Laybourne Smith School of Architecture and Design University of South Australia. Stephen verified the potential for large scale architectural glass installations to incorporate design elements. He recognized the "obvious gap in skills for innovative techniques to satisfy large scale applications."

### Bronwyn Hughes

Stained glass consultant and lecturer. ISS Fellow 1993. Bronwyn endorsed the application and encouraged the recipients to "look at the latest innovations overseas, with the expectation of gaining new skills and knowledge appropriate for Australian conditions and markets"

### Amber Hiscott

International architectural glass designer, Wales. Amber conducted an ISS Institute workshop in Architectural Glass, at Holmesglen TAFE in 2005, which was the impetus for the fellowship application. Amber made the students aware of the possibilities of glass design both in scale and technique and encouraged them to further their skills and widen their horizons.

### Frank Kos

Director, Profile Glass Pty Ltd. Frank gave his encouragement towards an investigation of overseas trends in glass lamination which would be of benefit to the decorative glass industry. He is willing to assist with future developments.

### Peter Pribetic

Managing Director, Pribetic Architectural Glazing & Glass. Peter has collaborated with the applicants on several architectural glass projects and supports their endeavours to gain technical information which will be of benefit to the building and glazing trades.

## 1.4 Overseas Contacts

The following individuals and organizations assisted in developing the overseas study program.

### UNITED KINGDOM

Andrew Moor - Architectural glass expert, lecturer and author

Amber Hiscott - Professional glass designer and collaborator

Rodney Bender - Head of Glass Studies, Swansea College, Wales

### SPAIN

Jose Fernandez Castrillo - Renowned architectural glass artist

### GERMANY

Barbara Derix - of the prestigious Derix Architectural Glass Studio



## 1.5 About the Fellows

### Names

Lindy Sando and Vaughan Taylor

### Contact Details

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[www.artglassdesign.com.au](http://www.artglassdesign.com.au)

Lindy Sando and Vaughan Taylor began their careers in architectural glass after training with master stained glass artisan Leonard Mathews. In 1976 they established the Art Glass studio together. They continue to work together fulltime and have completed hundreds of commissions for homes, churches and public buildings.

They have exhibited in Australia and Japan. In 1986 they were recipients of a shared grant to mount an exhibition of architectural stained glass at the Jam Factory in Adelaide. They continue to forge new ground and endeavour to take the glass industry to a higher level of expression. They are currently working from their studio in the Adelaide hills.

Sando has studied many art related courses including commercial art, design, life drawing, printmaking and sculpture. She has also participated in numerous glass workshops with international designers including Ludwig Schaffrath, Johannes Schreiter, Lutz Haufschild and Amber Hiscott. She designs all of the glassworks that the studio produces and is responsible for surface treatments including painting and etching. Sando is keen to develop new techniques and solutions in her work. She is currently experimenting with contemporary painted techniques on commercial glass. She was a founding member of Ausglass and was a member of CraftSouth for many years.

Taylor fabricates all of the windows and glassworks made by the Art Glass Studio. He comes from a practical background and has a very hands on approach. He is constantly developing new ideas and building the equipment to produce them. He has been experimenting with glass lamination techniques for many years and was very interested to see what was happening in this area overseas. The utilization of commercial glazing technology to achieve glass designs is another area he is developing. Taylor is a member of the Glass and Glazing Guild of S.A.

Apart from their glass work Sando and Taylor are kept busy on their 20 acre property. They have a huge native garden which includes a large hedge maze.



## 2.1 Aim of the Fellowship

The aim of the fellowship was to undertake an overseas study tour of the best Architectural Glass Studios and to visit major installations in the quest to gain knowledge and understanding in:

- Contemporary techniques in Architectural Glass production
- Glass lamination - design and manufacture
- Complementary techniques and innovations
- Integration of art into major architectural projects
- The collaboration process, from concept to installation
- The European culture of art in architecture

The intention was to increase their own skills and understanding and then disseminate the information to related industry and teaching institutions in Australia, with the hope of revitalizing the Architectural Glass industry and offering new possibilities for the built environment.

The desired achievements can be summarized by the ISS Institute philosophy - skills + knowledge + innovation + communication + good design = good business



## 2.2 Skills and Knowledge Gaps

With the evolution of contemporary architecture into a more minimalist style, glass has become a key element in the design and construction of the built environment.

There is now a need for new technology and innovative ideas in architectural stained glass to complement this style. The large expanses of glass being used create huge opportunities for integrated glass designs but the development of new skills and a new glass language is necessary. Stringent building and safety codes have also contributed to the need for new innovations.

Architectural stained glass design has progressed from purely decorative, such as the church windows of the past, to being an integral part of the building design. This transformation requires new thought processes and new technology. A more seamless, free flowing approach is now appropriate. New technology has freed the artist from the constraints of traditional leaded glass. It allows a greater freedom of design and structural strength.

European countries have adopted these guidelines and have many examples from which we can learn. They have the ability to transpose and interpret artworks into glass with no compromise. Designing for large scale site specific installations involves an understanding on many levels. The form and function of the building are considerations. The structural materials, the design elements, the play of light, the safety aspects are all areas that must be addressed.

This is where the knowledge of experience is invaluable. For the past decade or more European glass artisans have utilized the techniques of glass lamination to integrate major artworks into public buildings.

Architectural glass lamination involves the bonding of coloured glass designs and other details to the interior surface of the specified structural glass using clear resins and silicones. Advanced technology in cold pour resin is being developed overseas to meet the needs of contemporary architecture. This technology is vital to the continuity of the architectural glass design industry.

Information on these innovative techniques is not generally available in Australia. Knowledge obtained from the overseas study will assist in facilitating the development of leading edge technology that will be of benefit across the whole spectrum from teaching institutions to glass practitioners and architects.

## **Related Skills**

**To realize the full potential of the new technology, related skills also need to be learnt.**

## **Glass Surface Techniques**

These can be revamped traditional skills such as etching, polishing and painting or new ideas involving computer generated imagery. There are many factors that go into the successful translation of an artist's design into glass. European studios utilize skills, knowledge, new ideas and technology in a way that is rarely seen in Australia. Some of the work being produced by these studios could not be made in Australia at present.

## **Workshop Practices**

The introduction of new technology necessitates changes in manufacturing operations. The methods of working are very different to those used in traditional stained glass and studios need to be redesigned to suit. As larger and heavier individual panels can now be made the handling, storage, transport and fitting of these become part of the new studio operation. Glass lamination results in the cut edge of the bonded glass being visible. How the glass is cut, the treatment of the edges and the machines used all need to be considered. Computerized machines are being used in studios to cut, polish and apply surface finishes.

A willingness to experiment, technical innovation and modern equipment and facilities are necessary to make a successful studio. Some of the materials and processes used are potentially dangerous to workers' health and the environment. How the studios address this issue is also an important part of the studio operation. Information gained from visiting large manufacturing studios overseas will help facilitate necessary changes.

The philosophy of art in architecture has long been established and accepted in European countries. Art works are incorporated into most of their public buildings. The skills of integrating art and architecture have not been developed sufficiently in Australia. Documentation of the best examples from the study tour will help create an awareness and hopefully act as a catalyst towards the acceptance and promotion of public art works. More specifically the possibilities of integrated art works in architectural glass will be realized.

There is a need for more collaboration between architects, glass artisans and clients and for a network of professional skills to be developed to enable all factions to work together with confidence and ability.

**The overseas study concentrated on addressing the following skills and knowledge gaps.**

### **Contemporary Architectural Glass Practices**

- The design and construction of integrated architectural glass artworks
- Logistics of large scale projects and compliance with building standards
- Collaborations with architects and clients

### **New Techniques**

- Contemporary techniques including screen printing and lamination
- New applications for traditional techniques e.g. sandblasting, painting, polishing
- The latest developments in glass bonding
- Interpreting designs into glass using innovative solutions

### **Workshop Operations**

- Use of new products and machinery
- Handling, storage, transport and installation of large scale artworks



## 2.3 The Australian Context

Glass is increasingly becoming a part of the Australian psyche. A more relaxed lifestyle and an appreciation of our climate and environment has led to a more open concept of building design. The new philosophy is to merge the exterior with the interior and to minimize the physical barriers. Glass is the perfect solution. It emits light and heat and acts as a translucent shield between the two areas.

Glass has become a major component in the built environment. New buildings feature walls of glass. The commercial glass industry is booming, but the possibilities of architectural glass art are not being realized. Australia is lagging behind overseas countries in this area.

There is a great opportunity at the moment to take the glass industry another step further and use glass as a vehicle for design and detail. This can be simple and functional to meet a need such as obscuring a view or adding signage to a corporate building or it can be an outstanding artwork in its own right.

In overseas countries glass is used to create huge integrated artworks on building facades as well as free-standing public sculptures. In Australia there is a misconception that glass is too fragile to be used in the public arena as an artwork even though it is used to construct high rise buildings.

Art in architecture is a cultural tradition in Europe that gives each country a unique identity. Australia is still developing its artistic language.

More information on the latest innovative glass technology will lead to greater awareness of the suitability of glass in public art and design.

New skills development in contemporary techniques for Architectural Glass would benefit Australia in the following areas:

### Industry

- Revitalize stained glass industry
- Offer new solutions to building design
- Create possibilities for integrated glass design
- Keep abreast with overseas trends
- Establish links with overseas industry

### Economy

- More employment opportunities

### Community

- Enhance lifestyle
- Add to cultural tradition
- Increase public art options
- Develop a unique Australian style
- Strengthen intercultural exchange

## 2.4 Benefits to Associates

The knowledge acquired from an overseas study of leading edge technology in architectural glass practices will be of benefit to all those involved in the related building trades.

**Architects** require information on new technology to specify in their building designs. They also need to be confident that the work can be carried out professionally with no detriment to the strength, aesthetics and longevity of their buildings.

**Glass Designers** need to be aware of the latest techniques and innovations to allow them to design with a contemporary palette. Inspiration from overseas work will lead to new solutions.

**Tradespeople** need the appropriate new skills to fabricate the work. Workshop practices will change to accommodate the new technology.

**Glaziers** will benefit from information on installation techniques for integrated art works.

**TAFE Colleges** are currently reassessing their trade courses and looking for new input and ideas. Dissemination of information from an overseas study of contemporary glass practices would revitalize the glazing course.

**University** Architecture and Design courses can introduce new innovations at a grass roots level that will lead to an evolution of architectural glass.

More specifically the following organizations will benefit from the study:

**AUSGLASS** - The Australian Association of Glass Artists

**AGDA** - Architectural Glass Design

**Glass & Glazing Association of South Australia**

**Arts SA**

**Craftsouth:** Centre for Contemporary Craft & Design



## **Revitalizing the Architectural Glass Industry in Australia**

In the past the architectural glass industry in Australia has focused on the design and construction of stained glass and leadlight windows using traditional techniques. These ranged from exquisite handpainted stained glass windows in churches through to simple domestic leadlights and more recently architecturally integrated contemporary works.

In the 1970's - 80's there was a renaissance in the industry coinciding with a renewed interest in period style architecture, particularly in houses. This resulted in hundreds of autonomous studios opening up throughout the country. Most were small establishments with mainly self-taught artisans. It became a "cottage industry". As there was no formal training available within the industry and no accreditation there were no guidelines to be met.

The standard of work being produced was variable and the artisans ranged from hobbyists to master craftsmen. This has been to the detriment of the industry which is sometimes regarded as unskilled and unprofessional. This situation doesn't seem to occur overseas as there are tertiary courses and traineeships available and the workers are highly skilled and held in high regard.

The current situation in Australia is that the leadlight industry is experiencing a down turn. Contemporary building designs and safety standards are not compatible with traditional techniques. However there is now great scope for new contemporary innovations in glass. The professional glass artisans and designers need to be able to offer new solutions and embrace new technology.

By following overseas examples glass designs can now be incorporated into large scale applications. The techniques being used to add detail to architectural glass can be used in Australia to great effect.

A new approach is needed and a new skills base needs to be developed. The first step is to create an awareness of what can be done and this will generate interest which in turn will create new opportunities. Essential to ensuring that opportunities are maximized, collaboration across the industries must be encouraged.

## **The Fellows' Perspective**

As long term architectural glass artisans Lindy Sando and Vaughan Taylor identified the need to develop and upgrade their skills to remain viable. They were aware of architectural glass trends overseas and felt the time was right to introduce new ideas to the Australian market. An understanding of new techniques was necessary to achieve this. Sando and Taylor's fellowship study concentrated on gaining information relevant to contemporary architectural glass practices which would complement the Australian built environment. These included techniques suitable for large scale applications in particular lamination, screen printing and painting. They can now offer new ideas to the industry and incorporate new technology. By working more closely with glaziers and building designers a knowledge transfer is being developed which will lead to future innovations. They feel that further developments in tertiary training and traineeships would now be beneficial to the industry.

## **Developing an Australian Style**

Another area which is well developed overseas but lacking in Australia is the culture of art in architecture. Architectural glass is the perfect medium to incorporate and develop a unique Australian style. Rather than looking to Europe for design inspiration, glass artisans could draw on the wealth of artistic talent within their own country.

A recent collaboration between France and Australia resulted in a major installation of Australian aboriginal art being incorporated into the architectural fabric of the new Musee du quai Branly in Paris. This is a stunning example of what can be achieved and should be an inspiration to Australian architects and designers. It would appear that Australian indigenous design is more valued overseas than in its country of origin. There is huge potential for its use in architectural glass.

## **The Australian Glass Industry**

The Australian glass industry is at a very exciting stage. The glazing industry is very competitive and always looking for a leading edge or a value adding product. Likewise architects and building designers are looking for new directions and innovations. The architectural glass industry can benefit from this environment by offering unique solutions.

The future is very promising for those who are prepared to adopt new ideas.

The key to revitalizing the industry depends on vision, education and collaboration.

## 3.1 International Context

### Barcelona

Meeting with Jose Fernandez Castrillo, master glass artisan

Visit to Fundacio Centre Del Vidre De Barcelona, university of glass studies

Workshop inspection

Site visits

Tours of cultural centres

### Wales

Meeting with Rodney Bender, lecturer and practitioner

Visit to Swansea College, school of glass studies

Studio visit and discussion, Alexander Beleschenko, architectural glass artisan

Studio visit and discussion, Catrin Jones, glass designer and artisan

Site visits, glass as public art

### London

Visit to Goddard & Gibbs, large architectural glass studio

Meeting with Yorgos Papadopoulos, innovative glass designer

Visit to John Reyntiens workshop

Discussion with Kirsty Brooks, designer

Meeting with Julian Stocks, architectural glass designer and collaborator

Discussion with Andrew Moor, author and art consultant

Site visits, glass as corporate art, Canary Wharf and London CBD

### Germany

Taunusstein

One week as guests of the Derix studio, renowned architectural glass fabricators

Study of workshop practices, techniques, innovations and collaborations

Site visits with Andrea McKay, project consultant

In house discussions with Guy Kemper, collaborating artist from USA

Visit to Eberhard Munch studio and site visit to view his work

## Dusseldorf

Two days at Glasstec, International Trade Fair of Glass Technology

## Program Information

### 3.2 Barcelona

It was a privilege for the Fellows to spend time with Jose Fernandez Castrillo, a prominent and highly regarded Catalan glass artisan. As his English is very limited a graduate of the glass college was employed as an interpreter. The study began with a visit to the Fundacio Centre Del Vidre De Barcelona, the school of glass studies. Jose gave a lecture and slide presentation for the students and visitors.



*Jose Castrillo in front of one of his laminated windows at the Bayer Laboratories*



*Taylor, Sando, Jose Castrillo and Jordi Dou at the glass college*

Sando and Taylor reciprocated by showing slides of their own work and that of a colleague. The director of the college, Jordi Dou, then conducted a tour of the facilities. The college offers courses in most aspects of glass studies except glass blowing.

These include grisaille, fusing, kiln casting, photographic imagery, pate de verre and resin techniques. Practicing artisans are employed as lecturers. Most of the full time students were participating as part of a retraining program. Short, intensive courses and workshops are also offered to the public. The web site for the college is [www.fcv-bcn.org](http://www.fcv-bcn.org)

Jose personally escorted the fellows on a tour of some of his major works. His windows are magnificent as well as technically brilliant. His style is unique. Perhaps because of his "isolation" in Barcelona or because of the language barrier, his work isn't promoted internationally to the extent it deserves.

This has the benefit that he is not generally copied by other artisans, although that could also be because few have the skills, vision and patience required. It was only by seeing his work in reality that its quality could be appreciated.

Rather than rely on colour to make an impact he subdues the coloured glass by frosting the surfaces and rounding the edges to produce a soft velvety haze of coloured light. He tends to use a fine white acid etched glass as the background and adds to that with lamination and sandblasting and then cuts back the surface with grinding and polishing.

The work is very 3 dimensional. He uses resin to adhere stacks of glass up to 40mm high which are then laminated to the surface of the window. Quite often the stacks are of clear float glass with a single layer of handmade coloured glass on top. The clear stacks are angled and polished with bevelled edges which protrude beyond the colour, creating a halo effect and giving the appearance of floating coloured shapes.



*Jose explaining the symbolism of his window  
which uses light as a design element*

As most of the glass is obscure any clear or translucent sections have greater radiance. In this way he manipulates the light and glass to create lyrical works of art which at the same time are architecturally compatible.

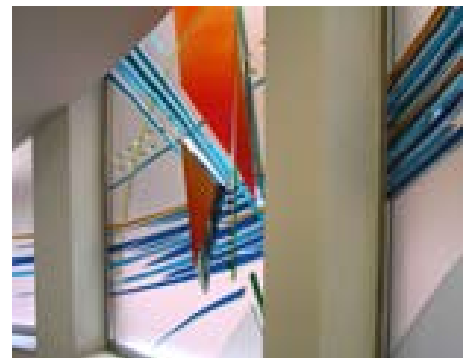
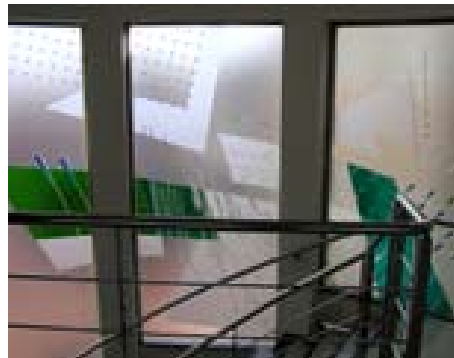
The workshop where most of his windows are fabricated was visited. The facilities are very basic but the artisans are highly skilled in polishing and etching. Jose is now also using a computerized CNC machine in another factory to cut and grind some of the long thin pieces that are incorporated into his work.

The relevance of the design is also of great importance to Jose. Rather than just produce a beautiful window every line and shape has meaning that relates to the function of the building. He explained the symbolism when viewing the following works.



### **Bayer Laboratory Offices**

Seven story high ( 20 m.) windows incorporate symbols of science, nature & healing.



### **Basilica of Santa Maria del Mar**

Contemporary Gothic window commemorates the Barcelona Olympic Games



### **Capilla del Colegio Scala Dei, Catholic School**

Chapel windows rich with religious symbolism



*Outstanding examples of laminated glass techniques by Castrillo*

## Barcelona Hospital

Large mirrored piece above entrance with design based on the heartbeat



**Jose Fernandez Castrillo** is passionate about every detail of his projects from concept to completion. He combines traditional skills with new technology to produce beautiful contemporary architectural glass.

### Summary of his Techniques:

- Manipulating light to create effects.
- Use of bright ( highly polished ) etched glass as background. Resin cleans off easier.
- Minimalist use of colour. Using and exploiting the inherent qualities of glass.
- Use of basic machinery e.g. belt finisher, glass lathe, diamond saw, sand blaster
- Emphasis on grinding, polishing, chipping, etching

### Key Issues

Use of traditional skills with new techniques to produce contemporary glass installations. Incorporating contemporary glass into historic architecture. Having uncompromising vision i.e. finding solutions to extend boundaries.

Another window of interest in Barcelona was designed by architect and glass artist Antonio Sainz-Keshava. It is a 22 x 25 metre area of glass which forms part of the facade of the Casa Madrid office building. The work is called The Awakening Planet and incorporates sandblasting with laminated coloured glass. Within the building atrium and directly in front of this window is a three dimensional, suspended sculpture, The Permanent Eclipse. It is computer programmed to follow the movement of the sun and cast a shadow on the reception desk, shielding it from the intense light of the window. It is thus a functional as well as aesthetic public art work.

## Casa Madrid Office Building Barcelona



*Laminated & etched structural glass building facade by Antonio Sainz-Keshava*

The remainder of the study tour of Barcelona concentrated on the rich cultural identity that has been created by its wealth of art and architecture. The work of designers such as Gaudi have added great value and pride to the city.

### 3.3 Wales

The study tour of Wales was assisted by former colleague Rodney Bender. He began his glass career in Adelaide some 30 years ago and shortly afterwards was awarded a Arts Council Grant to study at Swansea College of Higher Education where he is now Head of Architectural Glass Studies.

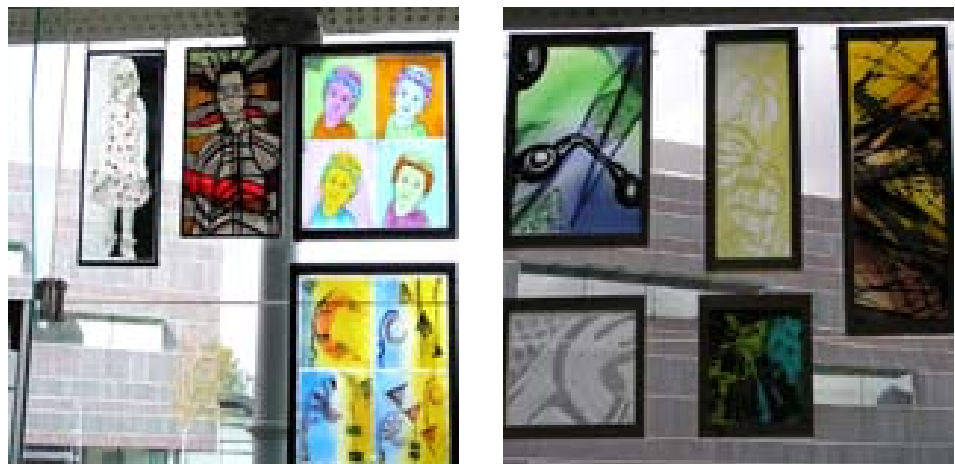
Rodney also runs an independent business, "Innovative Glass", where he fabricates his own work as well as that of other designers including Alexander Beleschenko. The studio also serves as an access workshop and was partly funded by the College to provide facilities for students to produce their own work. It is equipped with large kilns as well as an industrial size sandblaster. The College also gives ongoing assistance to help the students research and develop new ideas.

Rodney is expert in most architectural glass techniques and is currently writing a book on the subject. As he is involved in both education and business he appreciates the big picture and understands the value of collaboration. With his technical expertise he is highly regarded as a problem solver.

Rodney arranged a visit to the Swansea Cultural centre where there was an exhibition of work by the recent graduates of the College. The work was of a very high standard and it would appear that the College will continue to produce successful artisans. Former students are among the most highly regarded in the field of architectural glass and include, Amber Hiscott, Alexander Beleschenko and Graham Jones.

Sando and Taylor visited the college and gave a short presentation before meeting the students and discussing the courses. Traditional as well as innovative techniques are taught.

## Students' Work Swansea College



## Alexander Beleschenko studio visit

Alexander is a major force in the architectural glass movement. He is based in Swansea near the Architectural Glass centre where he completed his studies. Although, due to the immensity of their scale, his work is often fabricated in one of the large studios in Germany, his approach is very hands on. Rather than just presenting a design to be interpreted he first develops the techniques to realize his vision. Maintaining and exploiting the intrinsic qualities of glass is an integral part of his work. He likes to reveal the cut edge with its tiny chips that sparkle in the light. He then gouges, engraves, etches, paints and manipulates the glass into an architectural artwork. His style is not predictable and he approaches each commission with fresh ideas and energy, coming up with a unique and innovative solution for each new environment.

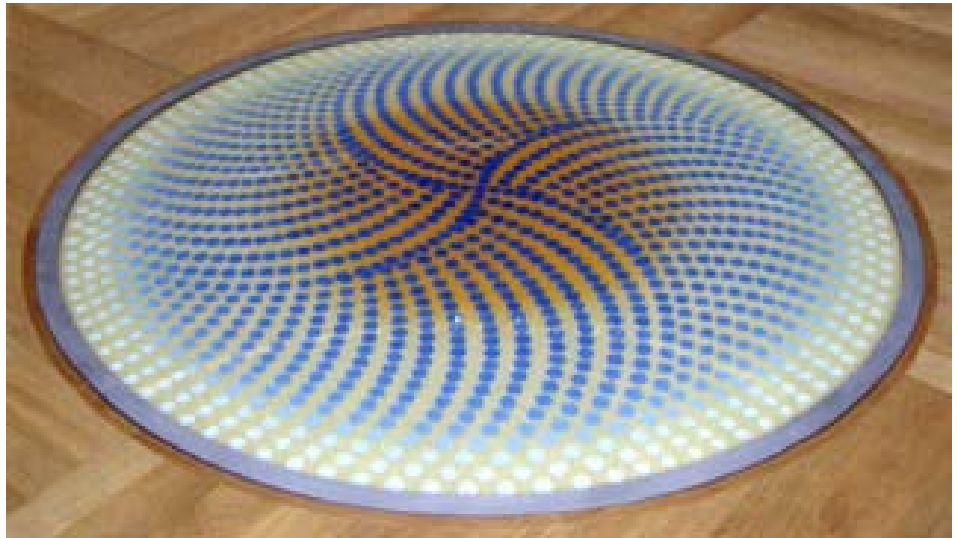
His approach and attention to detail is inspirational. His philosophy is to think outside the square and widen the technical horizons, rather than producing more of the same. He is true to his ideals and will only accept a commission if he believes he can do it justice. He has gained the respect of leading architects and his work appears in public buildings in many countries.

His work is sourced from three main avenues; competitions where artists are invited to submit proposals, architects who are familiar with his work and developers who are obliged to include artwork in new buildings.

Alex was interviewed in his studio and his installations visited at the following locations.

## **Senedd Building, Cardiff Bay**

Domed panel in floor of debating chamber. Constructed by screen printing toughened glass which was then shattered and set with resin over a mould to achieve a domed shape.



Alexander Beleschenko's web site : [www.beleschenko.com](http://www.beleschenko.com)

## **Ewenny Priory, Bridgend**

Translucent internal screen incorporating lamination, etching and fired enamels. A good example of contemporary glass in a historic building.



## Catrin Jones Studio Visit



*Sample panels of painted glass with etched details*

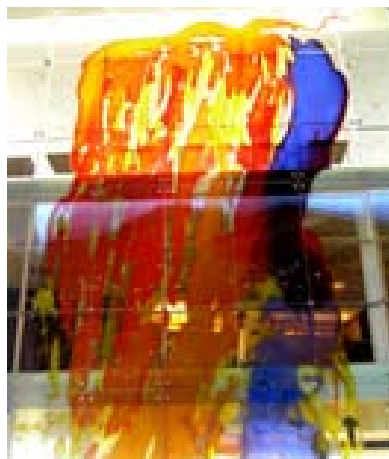
Catrin works from her studio in Swansea and is one of the most successful and innovative of the many glass artists in Wales. She combines kiln work with etching to create tactile pieces based on natural imagery. She has completed many large projects and benefits from the Artworks Wales' Commissions Programme. Although Catrin maintains a hands on approach it is necessary for her to out source work to larger studios. She says it is important to keep control and not let the fabricating studio reinterpret the design. She sends digital designs and has sample panels produced before going ahead. She is currently utilizing screen printed effects and has a good relationship with Proto Studios. The necessity for safety glass is being addressed by first painting, then slumping or texturing and finally toughening the glass. When double glazed units are specified both sides of the glass can be worked on to create a sense of movement.

Catrin Jones web site: [www.catrinjones.co.uk](http://www.catrinjones.co.uk)

## Site Visits of Glass Installations, Wales

### Cardiff Bay Millennium Centre

Large internal wall of glass, by Amber Hiscott, with screen printed coloured design on toughened glass.





Rodney Bender wall panels of mirror with intricate design etched onto both sides. Also kiln formed glass bricks that are structural elements of the building.

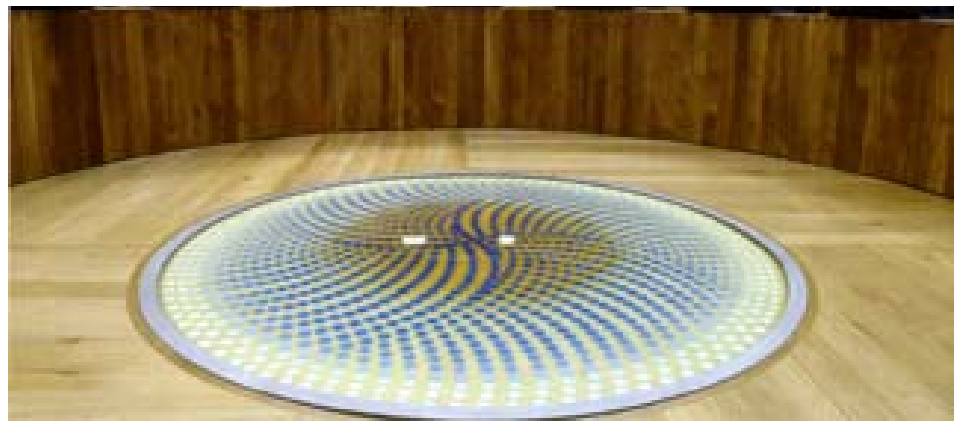


## Assembly Senedd Building Cardiff Bay

Danny Lane glass sculpture, the "assembly field", consists of 32 vertical glass elements of varying height made of 3.4cm thick laminated toughened glass. It is functional as well as aesthetic as it creates a wind break for the entrance steps.



Alexander Beleschenko sculpture of 2m wide domed glass composition which stands slightly proud of the floor at the centre of the debating chamber. The design is of radiating dots which converge back to the centre representing the working of the Assembly.



## Office Building, Bridgend



Martin Donlin large commission of laminated coloured glass windows. Good example of precision cutting and laminating as well as excellent design. The budget would have been substantial and presumably was a result of the percentage for the arts policy which applies to new developments.

## Bridgend Offices, Interior





*Excellent example of precision cutting & laminating of flashed glass with etched details.  
The work is installed in double glazed units*

### Summary of Techniques

- Use of safety glass as the structural component
- Applying detail with screen printing and lamination
- Firing enamels and toughening in one process for large pieces
- Utilizing double glazed units for extra dimension

### Key Issues

Wales has an abundance of high quality public art installations. This is mainly due to “Artworks Wales”, the national organization for public art in Wales, which was established in 1981 to encourage the placing of art in the environment. This policy has nurtured the careers of many artisans and with the influence of the Swansea glass centre there is an emphasis on glass. All new public buildings are required to incorporate artworks to a proportional value. This provides the opportunity for really great works to be realized. It also establishes a philosophy of art in architecture so that it is accepted and appreciated. In answer to the question “Is public art worth the money?” Artworks Wales reply is “Of course, yes. A nation discusses its history and sets its aspirations through its art. Access to that art should be accepted as a right and not a luxury”. Funding + awareness = opportunity. The web site for Artwork Wales is: [www.cywaithcymru.org](http://www.cywaithcymru.org)



*Sculptural installation in central Swansea by Amber Hiscott combining metal with glass*

## 3.4 London

### Studio Tour Goddard and Gibbs

A studio tour and interview with head artist Harry Cardross still went ahead although the business had gone into liquidation the day before, the reason being unclear. There appeared to be plenty of ongoing work including commissions for the middle east.

Goddard and Gibbs was established in 1868 and was the largest stained glass studio in the UK, with up to 40 employees. The studio facilities were large and catered for all aspects of architectural glass from traditional through to contemporary. There was an emphasis on screen printing and kiln work. They were well equipped with large mechanical screens and stencil making facilities including vacuum presses. The kilns could accommodate large pieces of structural glass.

One of their specialty techniques involved double glazed units. They would kiln-form (slump) a design onto one piece of clear structural glass and then match the pattern with fired paints onto the other. The gap between the two pieces of glass meant that the image would misalign when viewed from different angles creating a sense of movement.



*Large kiln with roll away top for firing  
and slumping architectural glass*

It is possible that as the business had evolved over so many years it was too reliant on manpower. There was little evidence of labour saving technology which could have made them more competitive.

There may also have been a conflict of interest as the studio employed its own in house designer as well as fabricating work for outside designers. The successful German studios only fabricate and interpret designs provided by outside artists and are therefore not in competition with them. Or perhaps there isn't enough work to support all of the large studios. Another UK based company Proto Studios which specializes in similar techniques seems to remain viable and is used by local designers including Amber Hiscott, David Pearl and Catrin Jones.

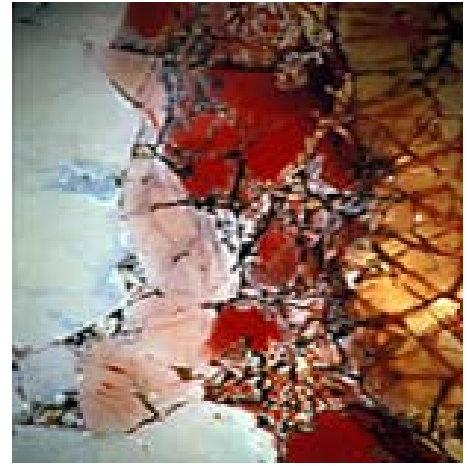
### George Papadopoulos

George is a young, flamboyant and innovative designer who has a fresh approach to glass techniques. He says he knows little about architectural glass which seems to work to his advantage.

He completed an MA course in ceramics and glass at the Royal College of Arts, London. He claims to have been an impatient student with many resultant breakages which is how he discovered the beauty of cracked glass. He has developed his own unique techniques



*Lindy Sando with George Papadopoulos  
in his home studio*



*Detail of cracked technique*

of breaking laminated glass, applying colour, sandblasting, sealing and then re-laminating the “artwork” between sheets of toughened float glass using silicon or resin. He explores the inherent qualities of glass and highlights its fragility and spontaneity to produce uniquely beautiful and sensitive designs. The pieces work well in most light situations and are suitable for external glazing as well as interior feature panels. George has produced a handbook which explains his process. He is happy to share his knowledge as he is already looking for new challenges and new directions with glass.

His work is admired world wide and has been commissioned by Heathrow Airport, Luxury cruise ships and a dance studio in San Francisco to name a few. His success has been rapid and he has quickly progressed from making his panels on the kitchen table to owning his own studio and now having the work produced by Derix studio in Germany under his supervision. He is a good example of someone who thinks outside the square and dares to be different rather than producing more of the same. He promotes his work through “100% design” trade exhibitions which are aimed at architects and interior designers.

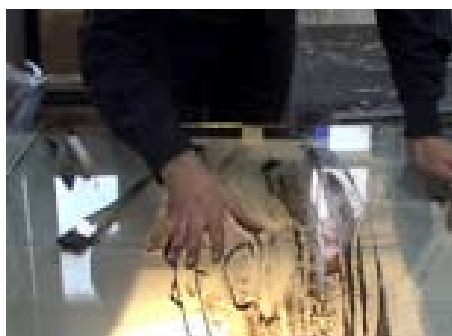


*Backlit installation of cracked glass by Papadopoulos*

Glass Handbooks: Lamination by George Papadopoulos (A & C Black, London)  
Website: [www.yogosglass.com](http://www.yogosglass.com)

## John Reyntiens

John is one of the few remaining “hands on” artisans. He runs a small studio with one or two casual assistants and fabricates his own designs as well as those of his father.



*John Reyntiens demonstrating painting techniques*

He is the son of one of Britain's leading stained glass artists, Patrick Reyntiens. John is a specialist glass painter and as well as using traditional techniques he explores new ideas and applications. He demonstrated a few ideas including rubbing the glass with a candle before painting to achieve a watery effect or spraying with hair spray etc. to create texture.

He also has developed a technique to imitate acid etched flashed glass on large areas. He makes a sample piece by painting a wash of coloured enamel onto clear glass. He then takes a digital photograph of this and transfers the image to a computer to produce a stencil for screen printing. This is a cost effective technique and one of the many ways that colour is being applied to commercial glass.

Kirsty Brooks was assisting in the studio during the visit. She is a highly regarded glass artisan in her own right and has completed several important commissions. Her work often incorporates her own large scale photography. She is an expert in computer graphics, from creating digital imagery for screens through to presenting designs realistically. The computer has fast become the most important tool for the glass artist and this is an area where more education would be very beneficial.

John Reyntiens web site: [www.johnreyntiens.com](http://www.johnreyntiens.com)

Kirsty Brooks web site: [www.kirstybrooks.co.uk](http://www.kirstybrooks.co.uk)



*Design presentation by Kirsty Brooks*

## Andrew Moor

Andrew Moor is a glass art consultant, lecturer and author. His books are the definitive guide to architectural glass and where it is at the moment. He has spent the last two decades profiling glass artists and documenting contemporary trends and techniques. His three books map the changes that have occurred in that time. He keeps abreast with what is happening throughout the world and although he is not a glass artisan himself he possibly knows more about architectural glass and where it is heading than anyone else. He gives an informed overview. The interview was conducted in his office and his advice was sought on procuring large commissions. As an art consultant he liaises between client and artist. He matches artists and studios to architectural briefs to produce the best solutions.

He suggested keeping in touch with art consultants who are either freelance or employed by large corporations. He advised that artists/designers should promote themselves under their own name e.g. "Lindy Sando " rather than under a company name. When organizations tender for an expression of interest in a proposed public artwork they are looking for individual artists to come up with design concepts rather than a studio to fabricate the work, so it is best to separate the two. He is passionate about architectural glass and his books and lecture tours have been instrumental in creating awareness and stimulating interest.

His three books in chronological order:

Contemporary Stained Glass

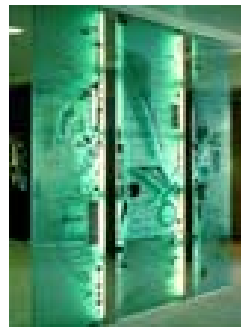
Architectural Glass Art

Colour In Architecture

Andrew Moor's website: [www.andrewmoor.co.uk](http://www.andrewmoor.co.uk)

## Julian Stocks

Julian combines graphic design with glass. His main tool of trade is the computer. His work often incorporates computer generated imagery which is etched and sand carved onto float glass. He outsources his work to contract studios such as Proto but often incorporates small handmade pieces that he has produced himself. Using commercial studios to fabricate as well as address the safety and structural aspects gives him more flexibility. He also feels that it could be advantageous if artisans worked together and shared facilities. He collaborates with architects to come up with design solutions which he feels add a human scale and sense of history to buildings. His designs are relevant as well as decorative. His work is sourced from Art Consultants, Corporate Art Agencies and Developers as well as the percentage for the arts schemes. Julian Stocks web site: [www.julianstocks.com](http://www.julianstocks.com)



*Internally illuminated sculpture combining mirror, acid etching and enamels*

## 3.5 Site Visits London

### Canary Wharf

Canary wharf is a reclaimed dock land area of London. It is a new corporate city with high rise headquarters dominating the skyline. Public art has been used to give a human element to an otherwise austere environment. Some of the major works are in glass which is fitting as the predominant building material for the facades is also structural glass. The following installations were viewed.



### Cabot Square

#### Jeff Bell

Four round drums of cast glass placed in an outdoor plaza. They have the appearance of corroded metal.



## Morgan Stanley Building Foyer

**Danny Lane**

Hanging glass sculpture of triangular shaped pieces of clear float glass threaded onto metal spikes.



**Kirsty Brooks**

Corridor walls and reception desk. Deep carved sandblasted float glass panels depicting text and graphics.



## McGraw-Hill Foyer

### Danny Lane

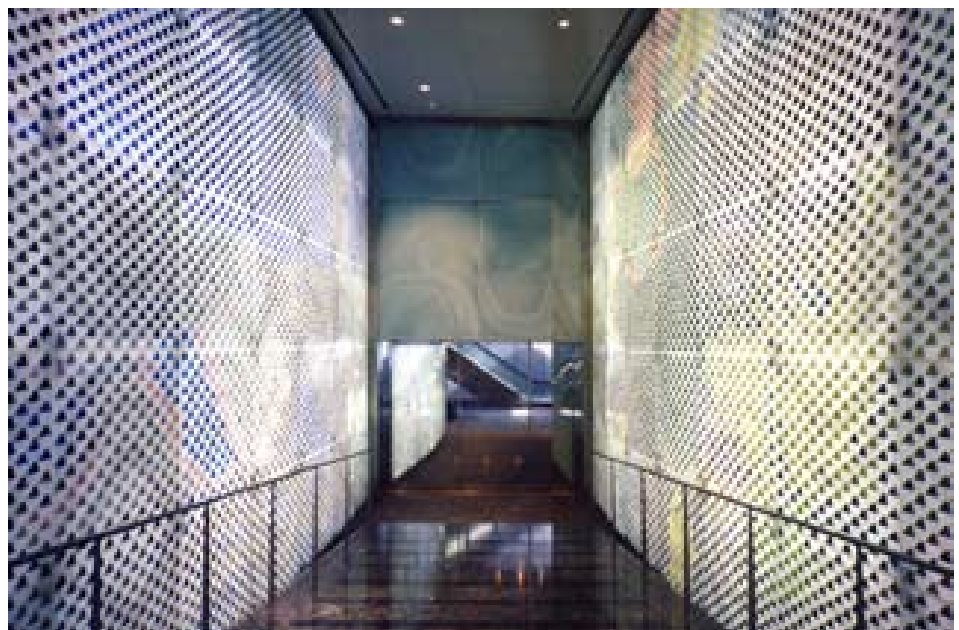
Huge sculpture of stacked glass forming a wave. Hundreds of pieces of float glass have been cut into long curved shapes and placed vertically to form a continuous shape.



## Link Glass

### Alexander Beleschenko

Three walls of glass in a linking corridor between skyscrapers with computer controlled backlighting. Thousands of pieces of coloured glass cut to the same small shape have been laminated to toughened glass in a repetitive pattern with the change of colours creating a digital image.



## Heron Quay corridor

### Graham Jones

Front lit panels in an underground rail corridor. Float glass panels with hand painted kiln fired enamels.



Also visited :

## Blackfriars Church London

### Julian Stock

Backlit panels in crypt. Deep carved sandblasting and etching on thick float glass

## Holmes Place, Bunhill Row

### Jose Castrillo

Glass screen and wall panels with polished and bevelled glass laminated to acid etched backing glass.

## Summary of Techniques

- Although the techniques varied most of the artists and studios visited were experimenting with innovative ways to use float glass.
- Some were screen printing it to imitate hand painting.
- Some were laminating handmade details to it.
- Others were smashing it and sticking it back together.
- But, whatever the technique the common goal was to end up with a structurally sound artwork that would enhance the architecture and become an integral part of it.

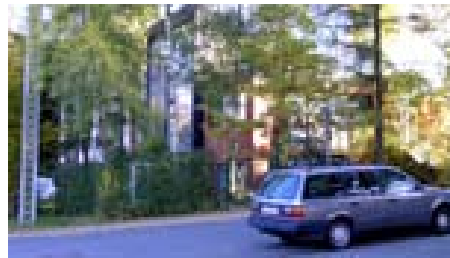
## Key Issues

- Designing artworks to comply with safety standards.
- Keeping in touch with architectural trends.
- Collaborating
- Promoting
- Outsourcing

## 3.6 Germany

### Derix Studio, Taunusstein

The fellows were privileged to spend a week as guests of the Derix Studio. Accommodation was on site in an apartment which is available for visiting artists. Visitors are allowed to observe all aspects of the studio. Derix Studio is one of the largest architectural glass studios in the world.

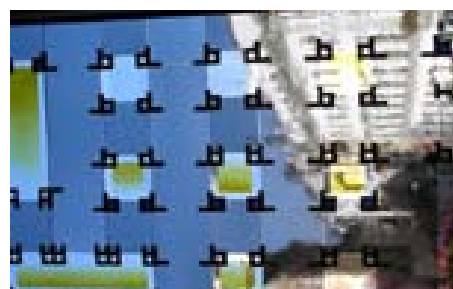
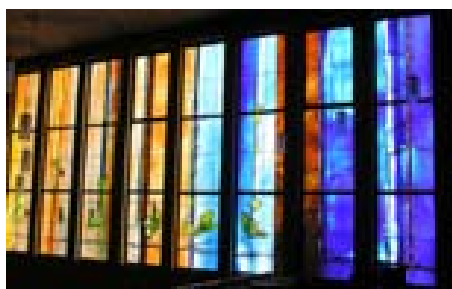


They fabricate work designed by other artists. They do not design work themselves but employ artisans who are highly skilled in interpreting designs into glass. They are absolute perfectionists and are able to achieve the best possible results. They manufacture huge commissions world wide for a diverse range of clients and in very diverse styles. It is an arrangement that works well.

The artists could not possibly fabricate the work themselves but they have the confidence when designing that the work will be realized in the most professional way. Derix employ approximately 65 artisans. They offer a three year apprenticeship and most of their employees are long term. They are all very dedicated and take great pride in their work. At any time they can be working



on several major commissions with an individual project manager for each one. Derix is a fifth generation business with the next generation also very much involved.



They maintain a very strong family atmosphere. Wilhelm Derix is the current director and two of his daughters work for the company.

As well as providing accommodation, Wilhelm and wife, Brigette, invite all of their guests to lunch in their house every day. In this way they keep in touch with what is happening and forge ongoing friendships and working relationships. It is a great opportunity for everyone to exchange ideas and discuss projects.

On their first day at the studio Sando and Taylor were escorted on a tour of significant works. These included installations by Karl Heinz Traut, Lutz Haufschild, Graham Jones, Ludwig Schaffrath, Jochem Poensgen, Johannes Schreiter, Joachim Klos and John Clark.

There is a remarkable abundance of architectural glass art in the area, including many commissions by overseas artists. This is partly due to funding for the arts. A proportion of the Government tax revenue goes to the churches which explains why there is such a wealth of excellent ecclesiastical art, in particular glass.



*Derix Studio*

Most of the study time at Derix was spent in the studio observing techniques and talking to visiting artists. Several prominent artists called in to supervise their window fabrications.

These included :

**Guy Kemper** from USA who has designed major installations for airports as well as the Catholic Chapel at “ground zero” New York. His designs are very free-flowing and give the impression of large watery brush strokes. This is achieved by combining laminated hand blown “ antique” glass, which is acid etched in up to 4 layers, with hand painted and air-brushed vitreous enamels onto security glass.



*Section of airport window designed by Kemper*

**Johannes Schreiter** who is one of the best known and highly regarded contemporary stained glass artists from Germany. At the age of 77 he is still designing in his minimalist style with very subdued colour palette. It was obvious by the attention that he received that he is still considered to be the master. Although his work appears to be simple there is great attention to detail. The glass, which is hand blown opaque, is made especially for him by Lamberts glassworks. The airbrushed shading is done to his exacting standards before being fired. He uses the lead lines to express the design in the same way that a pen would draw on paper. The result is very powerful as well as contemplative.



*Derix artisans working on a Hartmann design*

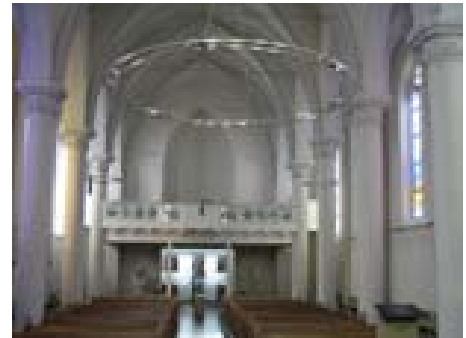
**Karl-Martin Hartmann** is another German artist who continues to use the leaded glass technique but in a very different way. His designs are very intricate with thousands of tiny pieces fitted together into a brightly coloured “floral” design. His work is incredibly labour

intensive and made even more so by the fact that the studio cuts a cardboard template for each piece of glass to ensure accuracy. There must be an easier way of doing this.

There were also artists who normally work in different mediums having their designs translated into glass by the studio. This is a great concept which has enormous potential. It means that established artists can be commissioned to create an artwork in glass without being constrained by a lack of technical skills. It gives them flexibility and generates more work for the studio.



*Eberhard Munch in his studio*



*St. Martin church, Rhaunen, Germany*

**Eberhard Munch** in Wiesbaden was also visited. He is a multi talented artisan who began his career painting traditional ecclesiastical frescoes. He now works in a painterly abstract style and is commissioned to design the whole interior of churches including stained glass, frescoes, lighting, altar and furniture. The result is a beautiful harmonious environment. His windows are mainly fabricated by Derix apart from some etched clear glass pieces that he works on in his studio. He is a painter and designer rather than specifically a glass artisan but his output is immense.



*Stained glass windows by Eberhard Munch in St. Martin church, Rhaunen*

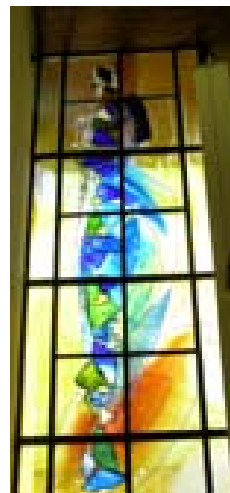
His work at St. Martin, Rhaunen was visited. His windows incorporate large pieces of hand painted glass with minimal lead lines and work well with his frescoes. It was a unique experience to walk into an ancient building and find a completely unified contemporary interior. A good example to show to church committees in Australia.

Another day was spent on a tour of church windows, fabricated by Derix studio, in the Mainz area. These included recent works by Graham Jones and Tobias Kammerer. Both artists have

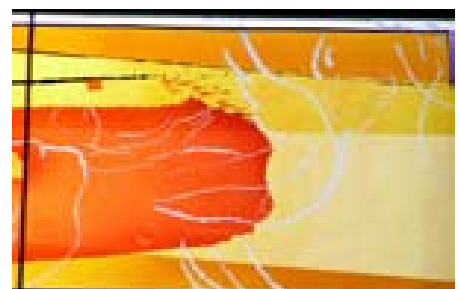
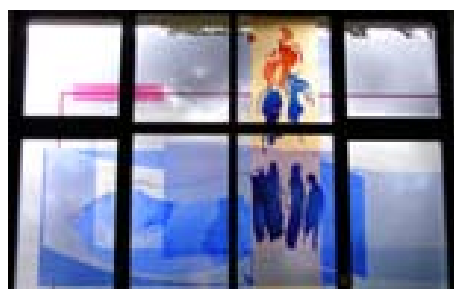
a painterly style which is interpreted with enamel paints that are hand painted or airbrushed onto the glass and then fired. Some areas incorporate hand made glass which is laminated onto the surface. It is obvious that the church has been a very important patron for the Derix studio, but as many of the available windows in the area have now been completed they need to look further afield for commissions. This is why it is so important for Derix to develop working relationships with glass designers from overseas.



*Graham Jones window in Mainz, Germany*



*Detail of Graham Jones window in Mainz, Germany*



*Tobias Kammerer windows in Mainz, Germany*

## Summary of Techniques

The Derix Studio are expert in all styles of architectural glass, from traditional painted stained glass through to computer generated designs. They are very skilled in the processes of free-hand etching and painting as well as airbrushing. Most of their contemporary work uses these techniques rather than screen printing which requires a separate screen for each colour and is less painterly. Because the studio workers are so skilled they can interpret an artist's design perfectly.

As safety glass is being specified for new buildings the artwork needs to meet these standards. This is achieved by painting the design onto structural glass which is then toughened and also by laminating pieces onto the surface. Derix use silicon for laminating. They often incorporate sections of laminated hand made glass onto larger sections that are painted to imitate the same effect. It is hard to tell the difference and is a cost effective solution. As Derix have a large work force they tend to opt for the hands on approach rather than use new labour saving machinery. The end result is still perfect and as machinery is constantly needing upgrading it is probably better to rely on the adaptability of human skills where possible.

## Key Issues

Derix does not have its own designer and only fabricates work by outside designers. In this way they remain unbiased and are not competing for the same job. They also have the security of knowing that the work has already been commissioned when the artist contacts them. They are not chasing the jobs only the artists. Another advantage of this arrangement is that the work is very diverse and they are therefore not associated with a particular style. It means that they keep up with the latest techniques and are continually developing new skills. It also means that the work must be of the highest possible standard as they rely on their reputation to maintain the loyalty of their clients. Glass artists from all over the world have their work fabricated at Derix. Derix handles everything from quotation through to transportation and installation.

## Glasstec

### Dusseldorf

Two intensive days were spent at Glasstec, the international trade fair for glass technology. This is the showcase for the latest machinery and innovations for the glass industry. It is mainly aimed at the commercial sector but there is now an overlapping with architectural glass design. As large expanses of glass can now incorporate imagery the designer and glazier are working together more and combining expertise. The clever designer is making use of state of the art glazing machinery to cut, polish, apply inter layer films, print digital imagery, temper glass, etc.

Some products of particular interest were:

- Ivlack glass paints [www.ivlack.it](http://www.ivlack.it)  
Unfired paints from Italy in either water or solvent base.
- Schott glass [www.schott.com/architecture](http://www.schott.com/architecture)  
Fusible coloured glass and frits that can be tempered into safety glass.
- PMI Digital Imaging [www.pmi.com.tw](http://www.pmi.com.tw)  
Digital designs printed directly onto glass.
- Tampo Print [www.tampoprint.com](http://www.tampoprint.com)  
Ink-Jet printing system and laser engraving

- Nanogate  
Permanent, wipe on colouring solution for etched glass.
- Vetro [www.vetrosuit.it](http://www.vetrosuit.it)  
Hand-made fused glass tiles, using Murano glass, for laminating onto architectural glass.

### 3.7 Outcomes of the Fellowship Program

The fellowship program gave the opportunity to see first hand the scope of architectural glass overseas and the techniques used for design and fabrication. Prominent artists/designers were interviewed to discuss the process from concept to completion.

#### Key Issues are:

##### Commissioning

There is a lot more opportunity for the glass artisan overseas. Funding policies such as Artworks Wales and “percentage for the arts schemes” means that there is a substantial amount of money available for major installations. This leads to a philosophy of art in architecture where it is now expected that a major artwork will be incorporated into a new building. Artists usually have to compete for commissions with a fee being paid to several artists to produce a design concept which then goes to a selection committee. Most large corporations employ art consultants to oversee the process. They are responsible for commissioning artists so it is important that they are provided with up to date portfolios. Art Consultancy is an area that needs to be developed in Australia.

##### Collaborations

Glass artists provide the vision for a project. They then become part of a network collaborating with architects, art consultants, clients and fabricators.

##### Computer Technology

Computers have become the most important tool of the trade. They are used for designing, presentation, digital imaging, glass cutting etc. They are responsible for rapid change and advancement in the design and manufacturing industry. Good computer skills are essential. Training in this area would be advantageous.

##### Techniques

The techniques used in architectural glass have changed dramatically in the last few years and are continuing to advance rapidly. This is due to changing building styles and new technology that is being developed for the glazing industry. Artwork is being incorporated into and onto structural glass as part of the fabric of the building. Techniques for large scale applications are now essential.

The main techniques being used overseas are :

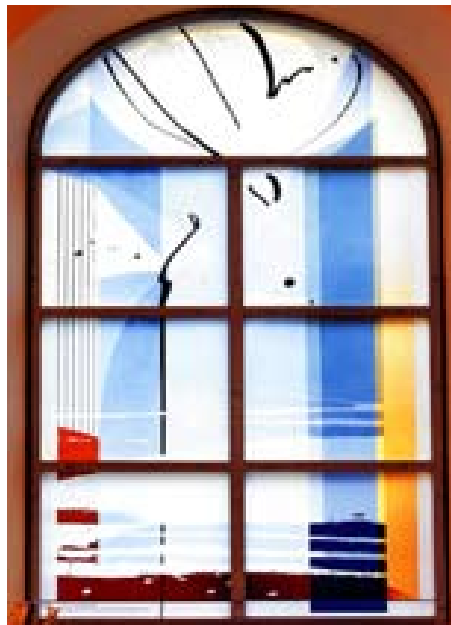
##### Glass Painting

Large designs are applied to commercial glass using screen printing, freehand painting and airbrushing. The paints can be fired into the glass during the toughening process. There is also state of the art machinery being used in the glazing industry that will print ceramic paint directly onto glass before tempering. These techniques are being widely used overseas to

great effect but there is little evidence of their use in Australia. The glass artist would benefit from working more closely with the glazing industry as this is where the advancements are taking place.

### Glass Lamination

This is the process of bonding glass to glass using clear structural silicon or resin. This has the advantage that delicate handmade glass that was previously used in stained glass windows can now be bonded onto safety glass to produce structural works. There is great



*Painted window designed by Tobias Kammerer and fabricated by Derix studio*



*Laminated window by Martin Donlin*

scope for this technique and when used in conjunction with painting it is more cost effective. It is widely used overseas for ecclesiastical as well as corporate applications. There are great possibilities for its use in Australia.

### Promotion

All of the artists, studios and schools visited had high quality and up to date promotional material. They appreciated the value of advertising and used it to their advantage to generate work and interest. This is another area that hasn't been developed in Australia. It is vital to keep in touch with commissioning bodies and keep them informed with visuals of techniques.

### Outsourcing

Very few overseas artists fabricate their own work as commissions become larger and more structural. The days of the artisan working alone in a cottage industry are gone. To keep up with building and glazing trends the artisan requires access to the latest machinery and techniques. It is not feasible for every studio to have their own facilities. Most of the artists

spoken to overseas have their work fabricated in one of the large architectural glass studios, Derix or Mayer studios in Germany, or Proto Studio in Britain.

In Australia there is no such studio. At the moment one solution is for the artisan/designer to work with a large glazing company and either hire their equipment or out source the work to them and oversee the project. Another solution would be the establishment of an access studio where artisans could share facilities. Probably the best solution would be the development of a specialist manufacturing studio that employed skilled artisans and had suitable machinery to fabricate the work. They could then offer training and apprenticeship schemes.

### **Manpower Versus Machinery**

The Derix studio has evolved over many generations and has maintained a large and highly skilled work force. They therefore specialize in hand techniques and tend to use manpower where possible.

Newer studios without the inherited workforce would be more efficient using new technology in combination with skilled workers. Training in the use of machinery would be essential and ongoing. These are areas to be addressed in Australia.

## Knowledge Transfer

The knowledge gained from the overseas study has already been of benefit to the fellows. They have been able to utilize new techniques and offer new ideas to clients. They have actively promoted new solutions to architects and designers and generated interest within the industry.

In conjunction with the Australian Glass and Glazing Association Sando and Taylor held a seminar in 2007 where they outlined the fellowship program and its outcomes. They gave a power-point presentation showing many examples of overseas work and talked about the techniques used. This was attended by glaziers, architects, glass designers and representatives of the government public arts department. The event was held in a Building Information centre and coincided with a three month display of new techniques in glass which was mounted by the fellows. It was well received and has resulted in further enquiries. More presentations of this kind to targeted groups would help sustain an interest in glass design.

An article has also been written for the Adelaide Catholic Cathedral Magazine outlining the evolution of stained glass from traditional to contemporary as seen in overseas churches. The church has long been a patron of the arts, in particular stained glass and many churches, especially in Germany have excellent examples of new works that have been funded. The purpose of the article was to create an interest in contemporary glass and show that it can exist harmoniously with traditional styles.

Other areas where knowledge transfer would be beneficial are in the trade and higher education institutions. The fellows could be involved with course development as well as giving presentations. Information at this level would lead to future vision.

Workshops for established glass artisans would help disseminate knowledge to the actual practitioners and keep them informed of world trends. These could be organised by Ausglass or ISSI and run as intensive courses. Alternatively they could be instigated by the new Canberra glass facility. Another possibility is to bring renowned glass designers to Australia. Several of those met overseas were interested in giving lectures.

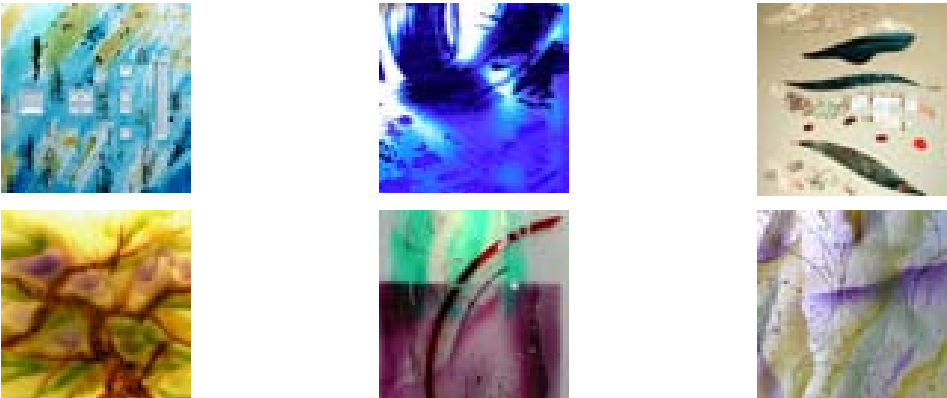
Sando and Taylor are now working more closely with glaziers and sharing their information as well as taking advantage of glazing technology. Since returning from their overseas study they have completed several public commissions involving some of the new techniques that they gained information on whilst overseas. These include :

- Cracked, painted and laminated glass panels for a winery counter using techniques similar to those of George Papadopoulos.
- Reception panel and signage using airbrushed paints on toughened glass for a new electronics company.
- Large door panels for a dental clinic featuring coloured glass lamination and sandblasting.
- Painted wall panels plus a large sculpture for the foyer of a new resort hotel. In this case the wall panels were spray painted in a free flowing style onto toughened glass. The sculpture consists of large pieces of 15mm thick float glass cut to shape in a glazing factory using computer operated machinery. It was mounted on a wooden plinth and lit from below with I.e.d. lighting. The project involved glaziers, glass designers, cabinet makers and lighting experts and offers an example of how collaboration can provide effective opportunities for knowledge transfer.

Recent Works by Sando and Taylor Displaying New Techniques



"Cracked", laminated & painted glass for winery counter front



Details of contemporary techniques



Airbrushed wall panels & faceted glass sculpture in resort foyer

## Recommendations

TAFE Institutes need to reassess their glazing trade courses. Rather than teaching traditional techniques such as lead light they should be offering training in new innovations including computer technology for the design and fabrication of architectural glass. Other speciality areas that should be included are screen printing, airbrushing, lamination, sandblasting and glass polishing. These are skills that are more relevant today and are lacking in the work force.

Tradespeople need ongoing training to keep up with technology. Some of the new computerized machinery is very complex and requires new skills to be able to realize its potential. They must be prepared to develop these skills (basic and high level) so as to develop innovative solutions for architectural settings.

The following skills which are highly developed overseas need to be addressed in Australia:

### Paint Application and Firing Techniques

This is the area with the most potential for applying artwork and designs to glass. The designer presents a scale concept to the glass fabricating studio which then determines the best way to interpret the design onto glass. With large scale works there are three main considerations; representation of the artwork, cost effectiveness and structural strength. Using vitreous enamels is often the best solution. It can be handpainted as well as airbrushed or screen printed to achieve a painterly effect. The skills required to apply the paint need to be highly developed. This is an area where tuition from overseas experts would be very beneficial. It could then be included into a specialised glazing skills course for vitreous enamel paints onto structural float glass, including airbrushing and screen printing.

### Printing onto Glass

The methods of printing on glass are rapidly evolving with new technology. The techniques range from hand cut stencils, UV sensitive films, computer generated resists using digital imagery through to direct printing on glass using state of the art machinery. There is a place for each technique depending on the size and nature of the job. It is an area where skills need to be regularly updated to take advantage of new developments.

Printing on glass is a growth area which is being used for signage and mass production as well as one off designs.

### Techniques of Lamination

This is the process of adhering glass to glass. All of the products available have advantages and disadvantages so it is best to make a choice based on each situation. Skills in handling the products and understanding their qualities is necessary.

As well as being used to create innovative designs in glass, lamination is becoming essential to meet safety standards in the glazing industry. For example sheets of coloured glass are being laminated to toughened glass using silicones, resin and epoxy.

## **Techniques of Etching Flashed Glass (Within Health and Safety Standards)**

Hydrofluoric acid has been used in the past to shade and add detail to handmade “flashed” glass (glass with two or more layers of colour). The use of acid is now being discouraged for health and environmental reasons and mechanical sandblasting is being used instead. The skilled tradesperson can achieve similar effects with sandblasting eg. shading, carving etc. It is a traditional skill with contemporary relevance that should be revived.

## **Cutting, Grinding, Polishing and Face Working Thick Glass**

There are many techniques that can be employed to add detail to thick float glass from hand bevelling, chipping, scalloping and engraving through to precision cutting and polishing using water-jet and computerised machinery. As well as adding interest to architectural glass, large sculptural pieces can be manufactured. There are many possibilities to be explored.

## **Use of Commercial Glass Processing Machinery in Architectural Glass Fabrication**

This is definitely the way of the future. As architectural glass installations become larger and glazing machinery becomes more adaptable it makes sense for the glass designer to take advantage of new technology. An understanding of what can be achieved and associated skills need to be developed.

## **Designing for Contemporary Architectural Glass**

The designer should have an understanding of glass and its possibilities but doesn't necessarily need the skills to fabricate the work themselves. Designing for architectural glass could be introduced to architectural, interior design, graphic design and art related courses. In this way the best designs would be produced and a greater awareness would be generated.

## **Interpreting and Fabricating Artists Designs Into Glass**

This is the most important area for skills development. Very few of the leading glass designers overseas fabricate the work themselves. Instead they produce a design or concept which they take to a specialist company for manufacture. Being able to interpret the design into glass requires specialist skills. This is an area which is completely lacking in Australia and is the main reason why it is being left behind in the architectural glass field. A comprehensive knowledge of techniques is necessary to be able to choose the most suitable process to achieve the best results.

## **Relevant Computer Skills**

Computer skills are becoming essential in all areas of architectural glass production from design through to manufacture. Most designers use a computer as their main tool of trade for design and presentation. The manufacturers have computerised state of the art machinery available. To realize the full potential of this equipment associated computer skills are necessary. Higher level training in this area would be beneficial to the glazing industry.

## **Co-operation**

Glaziers are becoming involved in glass design and fabrication. As architectural glass becomes more structural, particularly in large scale work, there is an overlapping of skills and a need for designer and glazier to work together. In this way both will benefit - glaziers have the machinery and ability to work with large scale architectural glass; designers have the vision.

## Areas for Development are:

- Knowledge sharing. Glaziers could offer advice on glass selection, safety codes and installation requirements
- Specialized products. The ability to make customized products e.g. double glazed units, would be beneficial
- Diversity. Having the knowledge and confidence to think outside the square and produce unique, value adding, glass products
- Embracing new technology. Having the ability to utilize machinery to its full potential

Architects need to be informed of the latest technologies and design applications in architectural glass.

There needs to be opportunities for information transfer along the Supply Chain. For example, as glass designers and glaziers update their technical expertise and new technologies arise, they can pass on their capabilities to architects, urban planners, builders and engineers so as to incorporate current technologies into buildings. These may be short courses in the above areas conducted by TAFE institutes, information sessions held by professional associations such as the RAIA and through digital listings such as on websites and through e-newsletters.

Glass designers also need to keep in touch with the latest design trends and associated technology, so that they keep in pace with the building industry in Australia and overseas.

## 4.1 Government

The amount of public art overseas is very impressive. This has been made possible by funding of various kinds. In Wales, "Artwork Wales", the national organization for public art encourages the placing of art in the environment. In Britain a proportion of the lottery money is available for special projects. In Germany some of the tax revenue goes to the churches who are the main patrons for glass art.

It would be very beneficial if the Australian Government had a policy for funding artworks in new public buildings. If a fixed percentage of the value of the building was allocated for art some very substantial work could be incorporated. This would add to the culture and identity of Australia.

The Federal government could assist with funding for Australian artisans to study overseas and sponsorship of visits to Australia by skilled workers. State governments could further assist by enabling TAFE and higher education institutions to offer courses in architectural glass and skills based training to apprentices and casual students. Encouraging art installations in buildings and providing assistance via state arts organizations for visiting artists and exhibitions are also possibilities.

Funding to assist studio development would be a big help to the industry. Local government could encourage art in building via planning regulations and by having an arts adviser to help ensure quality work. They could also commission art works from local artists including temporary works and help sponsor exhibitions.

## 4.2 Industry

The Glazing Industry is becoming more involved with the manufacturing of artistic architectural glass. As artworks become larger and more structural the designer needs to utilize glazing technology such as toughening and laminating to meet safety requirements. The industry could help to develop standards for techniques such as lamination and double glazed units. Encouragement could be given to industry members such as glazing companies, designers and engineers to become aware of what can be done in glass and how it is being used in buildings here and overseas. Sponsorship of exhibitions and lecture tours by glass designers would help raise the profile of architectural glass.

Construction companies need to become aware of the benefits of incorporating architectural glass into their projects. Glass art can help to provide an identity add character and a human element to buildings. They need to be confident that glass can be successfully incorporated into their project and set a realistic budget.

## 4.3 Firms

Most of the glass designers interviewed overseas had a close working relationship with architects and building designers. They collaborated successfully to achieve an integration of art, design and structure. Architectural and interior design firms need to be aware of new ideas in glass design and be prepared to work with independent glass designers on projects. They need to appreciate the positive impact that architectural glass will have on the building. Developing relationships with local artisans would be beneficial.

Individual glazing companies should be encouraged to assist glass designers with the fabrication of their projects. Being flexible with use of machinery, providing technical help and accommodating the requirements of artisans would greatly assist fabrication of glass projects. Being aware of contemporary glass and local designers would enable glazing companies to offer clients the possibility of using architectural glass. This would help to generate more work.

Existing glass studios need to be aware of what is happening overseas, be prepared to learn new techniques and to encourage and work with artists who are new to glass.

## 4.4 Professional Associations

There are several organizations relevant to the architectural glass industry. These range from craft based through to professional industry. It is their responsibility to represent and promote the industry as a whole as well as assisting individual members. They give a professional status to members and provide a network base. They should keep members informed of the latest trends in design and technology. They should organize conferences, workshops and presentations to increase awareness, develop skills and disseminate information.

## 4.5 Training Providers

The study tour included higher education facilities offering glass studies in Barcelona, Spain and Swansea, Wales. Both institutions offer full time courses in architectural glass as well as short skills based courses. Swansea College provides training through to Ph.D. level as well as providing development assistance for research projects. Graduates of the college are highly regarded and many have gone on to successful international careers. This type of training needs to be developed in Australia to produce qualified glass designers and practitioners which would give the industry legitimacy and accreditation.

## How ISS Institute can Assist

Assistance could be given to more individuals to learn specific skills related to architectural glass design and fabrication. This overseas study provided an insight into what was happening overseas, what techniques were being used and what skills need to be developed in Australia.

The ISS Institute could assist with fellowships for local artisans to learn specific skills at overseas colleges or in glass studios such as Derix in Germany or Proto Glass in UK. Designers and artisans could be brought to Australia to run workshops and give lectures etc.,. These could be people such as Rodney Bender, Alex Beleschenko or Andrew Moor. Each have skills and knowledge in different aspects of glass.

It may also be possible to sponsor skilled workers from studios or colleges who would be interested in coming to Australia for short periods. Forums involving glass designers, practitioners, glaziers, architects and other interested parties could be organized. The forums could include an exhibition of glass and feature an overseas guest.

## Further Skills Gap

An area of recent development is in the use of unfired glass paints. Two-pack paints are being used extensively in commercial glazing to colour glass splashbacks. Australia is at the forefront in the use and development of these paints, which although aimed at the mass production market, have great potential for the glass design sector.

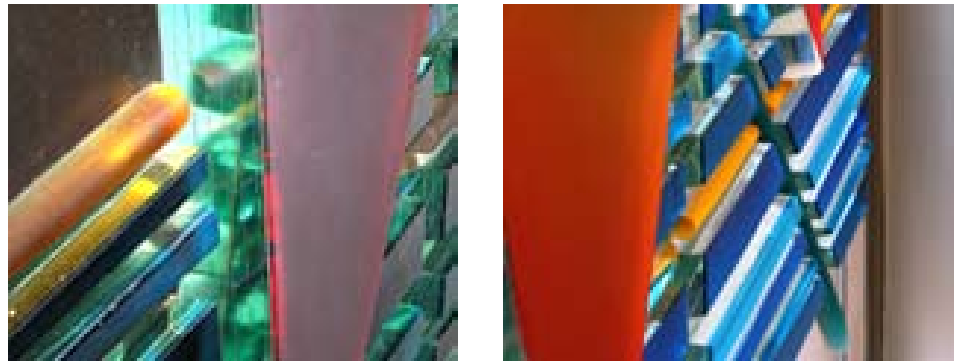
The overseas study highlighted the use of paint on glass but it was almost exclusively paint that needed to be fired in a kiln. Unfired paint has many advantages and is suitable for corporate signage, wall panels, internal screens, reception counters and a myriad of glass features. The possibilities are very exciting and this is an area where new skills could be developed in Australia that would put it ahead in architectural glass production and provide a new direction for designers and tradespeople.

## 4.6 Notes on Specific Skills and Techniques

The designing, fabrication and installation of an architectural glass work requires many skills and practices to be employed. While the artist does not have to be proficient in the techniques used there has to be someone able to translate their design to glass. While some of the skills used are generally employed in the glazing industry others are unique or a development of traditional skills.

Good artists are innovators and will push the boundaries of materials and techniques. The artisans who make the artist's designs a reality must have a sound understanding of the basics of their trade and be willing to experiment and develop new ideas and techniques. The specific technical skills gaps that the fellowship study concentrated on were: lamination, glass painting with enamel and traditional paint, grinding and polishing of glass, new uses for old skills and techniques and the operation of studios.

## Lamination



Jose Castrillo has been successfully laminating glass designs for about twenty years and said that he has not had any problems. Some of his windows have stacks of glass 40 mm thick laminated to the backing glass. He tends to use a bright finish acid etched glass, up to 20mm thick as the base glass. Jose said that he has had no problems with the resin that he uses, the weight of some of the pieces that he laminates would be an extreme test.

The Bayer building windows are more than ten years old and look to be in good condition. The thick backing glass would help to keep the panels stable and reduce the U.V. rays effect on the resin. The resin Jose uses is a commercial three part resin similar to those made by Glasslam and Siglam. These types of resin are made for commercial glass lamination and are therefore strong and relatively affordable. There are also U.V. set resins, however only the catalyst cure types seem to be used for this type of work. The resins have a strong odour and the fumes should not be inhaled. They should be used in a properly ventilated room and appropriate P.P.E. should be worn.

Unfortunately Jose did not have any projects currently under construction so it was not possible to see first hand how he used the resin. From what he said via the interpreter and from what was observed it seemed that he only props uneven pieces of glass prior to pouring the resin. The resin under the laminated pieces was certainly thin but was enough to hold them securely.

Derix studio uses silicone for laminating all their work. Wilhelm Derix the owner of the studio said that they changed to silicone after having problems with resin. He did not say what brand of resin they had been using or how it was used. They now use Wacker 612 Sil Gel for major jobs. There is also a silicone made by Bohle, a German glazing supply company. Both of these are two part silicones and are expensive. The Bohle product is sold as a glass bonding silicone where as the Wacker product is primarily used to protect electrical components.

For small lamination jobs Derix will use a clear silicone in a tube. This is spread with a spatula prior to attaching the top piece of glass. The Sil Gel is used where multiple pieces are being laminated. The silicone is mixed then needs to be de-aired in a vacuum chamber otherwise there will be air bubbles in the silicone bed. A dam is made with tape around the edge of the glass, the silicone is poured in and allowed to level. The top pieces are then set into the silicone ensuring that they do not touch the backing glass. When dry the excess silicone is removed and visible edges cut back. he only props uneven pieces of glass prior to pouring the resin.

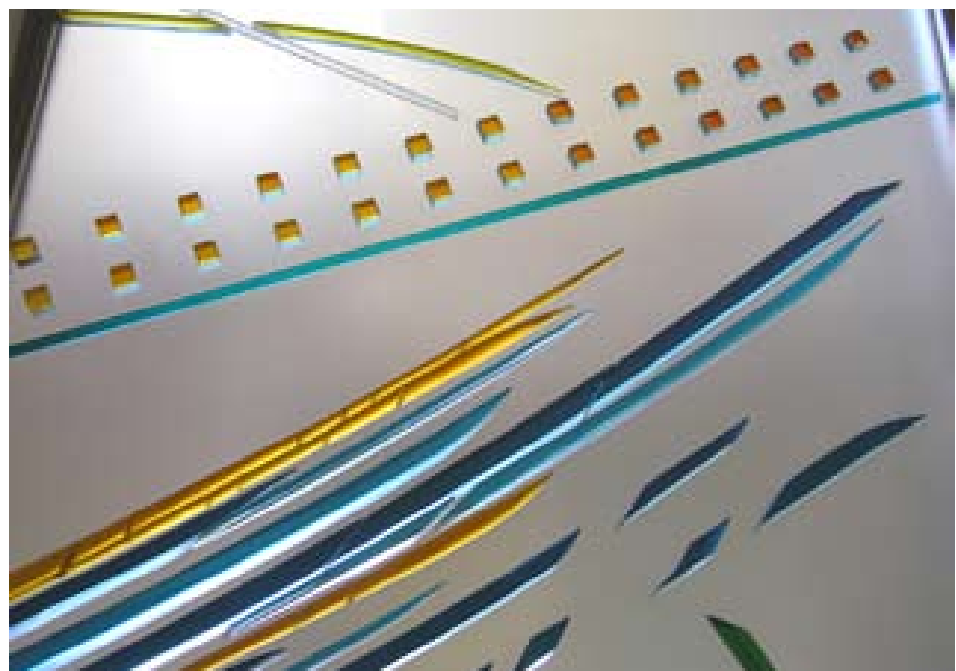
The silicone does not set hard, rather it stays jelly like, this gives good flexibility but makes cutting back and cleaning difficult. Silicones are safe to work with and have little odour.

There are also epoxy glues suitable for glass bonding. They are expensive but are made specifically for glass adhesion. Only one of the interviewed artists said that he had used epoxy. Most of the artists were happy to let the fabricating studio decide on the type of adhesive to use on their project.

The suitability of various adhesives for architectural glass use is an issue that requires further study. In Germany art works are exempt from safety standards, in Spain there seemed to be no guidelines and in England most lamination was inside double glazed units. It would be advantageous for an Australian artist if they could be sure that the adhesive method they were using was to an approved standard.

Edge finishing techniques for glass pieces to be laminated was also studied. Jose Castrillo grinds and polishes the glass as part of his design process. He indicated that this is mostly done by hand using a belt arising machine and horizontal shaft polishing machines. The precision of the work seen indicated a very high skill level. The basics of hand polishing can be learnt at trade school, but a lot of experience would be required to produce pieces to Jose's standard. Larger pieces can be edged on computer controlled machines e.g. Intermac. The operator would need to be skilled, the correct software and grinding heads also need to be available along with the knowledge to be able to program the desired profile into the machine.

The lamination process used at the Derix Studio showed a different approach to that of Jose. There were two basic styles of windows. One had all of the adhered pieces of glass touching together. Unless instructed otherwise by the artist the studio carefully grinds the edges by hand to ensure a near perfect fit. This is very hard to do on curves but can be done on straight pieces.



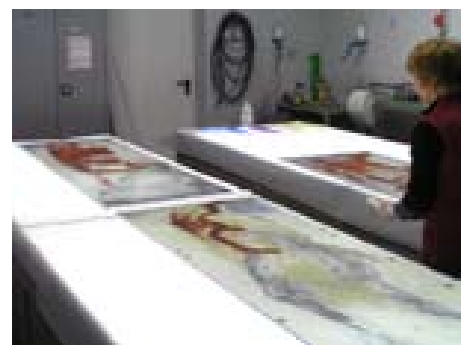
Some artists design their work such that the coloured glass, usually acid worked flashed antique, is laid out in a tile like grid. These pieces can be ground to fit together to the extent that there are no light gaps. This is done using a lead- lighting glass router, which is slow and finicky work. Any visible edges appeared to be unpolished, just left as a cut edge. The second style had isolated pieces of laminated glass. These pieces appeared to be clean cut with little grinding. As most of the background glass was painted the edges weren't really noticeable and most windows are well above eye height.



## Glass Painting

The process of colouring glass with fired paint is used extensively by overseas studios. Most artists that were interviewed stated that they preferred to use antique glass due to its clarity, life, colour range and versatility. However they were happy to use painted glass, especially as it is cost effective compared to hand made glass. Fired enamel, traditional tracing and shading paint as well as silver stain are all used to colour large pieces of glass, which may also incorporate smaller details in handmade and etched glass.

The paints are supplied in powder form and need to be mixed with a suitable medium. The paint can be applied via brush, screen, spray or printing. Heraeus, Keracolor and Degusa all make a range of translucent and opaque colours. Screen printing is used extensively especially on large pieces of glass and where a repetitive pattern is required.



The basic process used is the same as commercial decorative printing. Screens are costly to make so it is more economical if multiple pieces can be done using each screen. Computer design and digital output allows the artist and studio to design, copy, modify art work and produce the stencil for the screen. Examples are John Reyntien's screened enamel "acid etched" glass and Amber Hiscott's glass wall in the Millennium Centre. Goddard & Gibbs had two large screen printing machines and screen production facilities. Derix Studio had the

screens made and the printing done elsewhere although they did the artwork in house. Proto Studio in England do a lot of screen printing for various artists and would be an excellent studio to visit to learn more about the technique.

Brushing of paints is relatively straight forward but does need a sound knowledge of the paint and firing techniques. Spraying is also used to very good effect. Derix studio has highly skilled painters and two well set up painting rooms. The paints can be mixed with either water or oil based mediums.



The application should be done in a force ventilated booth or room. The paint can be artistically removed after firing by applying a suitable mask and sand blasting or acid etching. Paint must be fired to permanently fix it to the glass. The painted glass can be fired in a gas or electrical kiln at temperatures between approximately 550 - 650 degrees centigrade. The firing cycle

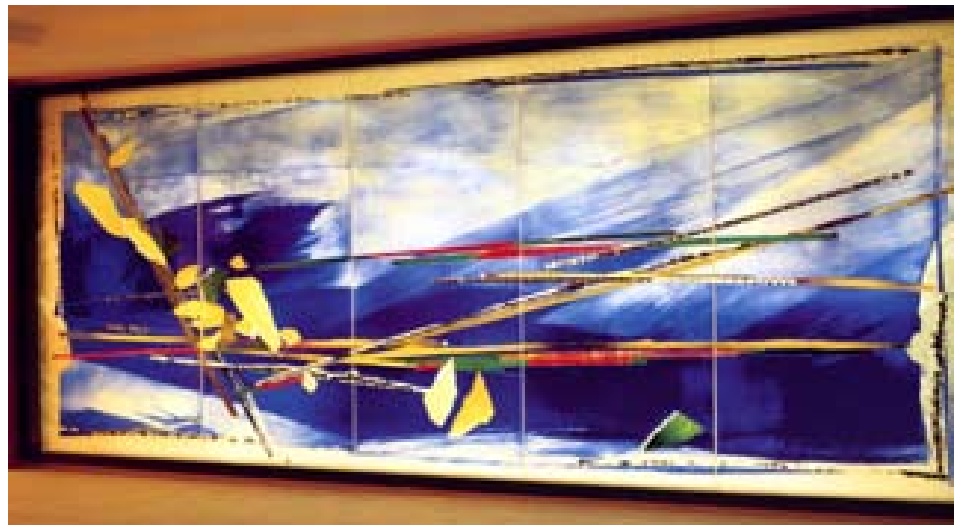


depends on many factors including the type of paint, colour, surface finish required and thickness of the glass. Commercial laminated glass cannot be fired. If safety glass is required the painted glass can be liquid laminated or toughened.

The painted glass can generally be fired and then toughened or can be fired and toughened in one process. The toughening process rapidly heats and cools the glass, this greatly strengthens the glass and if it does break it will shatter into tiny harmless fragments. Most enamel paints can be fired this way but care must be taken not to get paint on the rollers in the toughening plant. The plant operator needs to be experienced and be prepared to adjust the firing cycle to suit the glass - paint combination.

### Acid Etching and Sandblasting

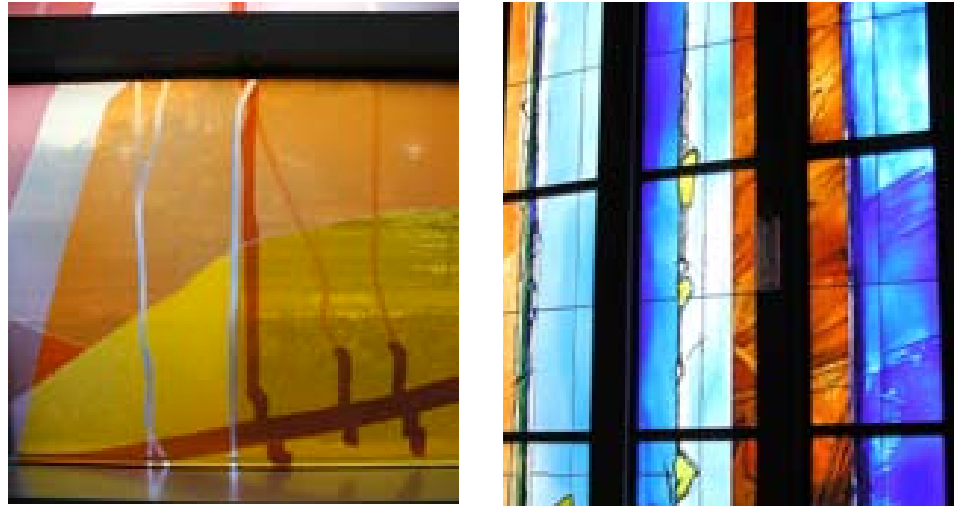
Goddard & Gibbs and Derix studios used hydrofluoric acid extensively for etching and polishing the surface of glass. Other acids and combinations can be used but hydrofluoric is the most common.



The acid eats away the surface of the glass and the resulting finish is dependant on the strength and temperature of the acid and the immersion time. Inert resists such as bitumen can be applied by brush or screen or the acid can be mixed into a paste and brushed onto the glass. These techniques allow for control of the acids effect on the glass. Flashed antique glass is a 2 or 3 layer glass, with a base colour overlaid with thin layers of different colour. The acid can be used to remove the top layers allowing the base colours to show.

This process can give results ranging from dramatic to very subtle and is used by many artists. Acid can also be used to etch clear glass. Hydrofloric acid is highly toxic and can cause severe burns and the fumes are damaging to the respiratory system.

Derix has a very well set up aciding room with tanks that remove the fumes from the surface of the liquid. The operators are highly skilled and produce outstanding results. The use of acid in studios is becoming harder due to the safety and environmental regulations and tight control on availability. Jose Castrillo said that it would not be long before he would only be able to use commercially produced acid etched glass.

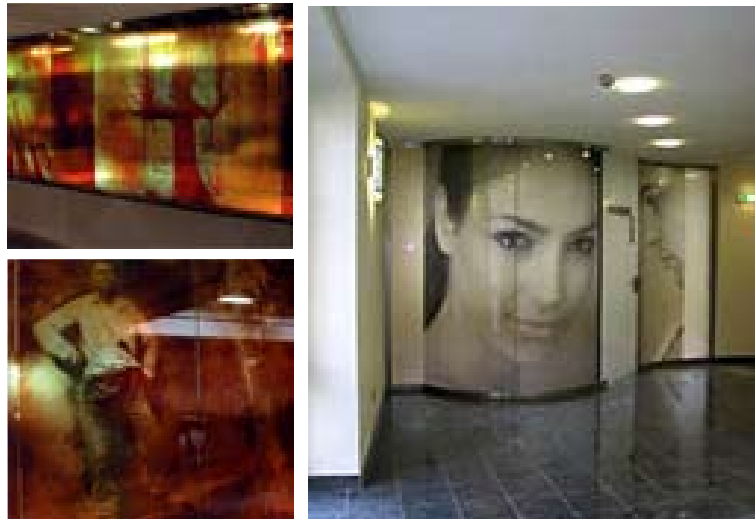


## Safe work practices are essential for acid etching

Similar results can be obtained on flashed glass using sandblasting. Sandblasting of glass is a process where an abrasive, usually aluminium oxide, silicon carbide or garnet is mixed with compressed air to abrade the glass surface. A resist is applied to the glass to protect the areas not to be blasted. Designs can be cut into vinyl resist either by hand or with computer controlled cutters. The ability to go directly from computer to cutter enables the artist to produce complicated designs.



These techniques are well established and it is up to the artists to be innovative and use sand blasting in new ways. Photo resists made using U.V. sensitive film is another way to mask glass to be sand blasted. At Derix there were examples of enamelled glass which had been sand blasted with a half tone photo image. The process is similar to printing images using very small dots. The result is highly detailed yet subtle. The availability of self adhesive light sensitive resists from companies such as PhotoBrasive Systems greatly assists artists to make use of this technique.



## Studio Operations

The way that the studios operated and the methods and equipment that they used were also looked at. The process of design through to fabrication and installation was investigated in each studio.

Jose Castrillo designs and makes amazing and intricate windows using quite basic methods. He said that he hand draws his designs and full size patterns.

The workshop where he currently makes most of his work was small and old. The main business seemed to be edge working and acid etching commercial glass. Jose indicated that his glass was cut ground and laminated in the general work space. It was hard to see how they manage to produce such high quality work. The workers must be very skilled. From what was seen and comments made by Jose it seems that he is responsible for the whole project and uses commercial glass companies to make and install the windows under his close supervision.



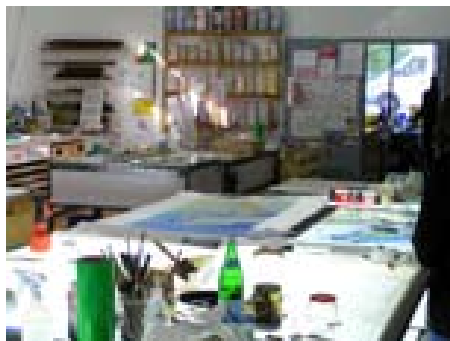
As Goddard & Gibbs were not operating it was only possible to get a feel for the way the studio would have worked. The studio was in rented industrial premises which were large and allowed each section separate areas. The only machinery appeared to be the screen printers and vacuum frames for the production of the stencilled screens.



There were also two large kilns. The studio made use of computers for designing and design presentation although there weren't any large format printers or plotters in view.

Derix is the worlds largest architectural glass studio. They operate from premises that have grown over time to three stories with multiple rooms. There are cutting and assembling rooms, a kiln and sand blasting area, an acid room, two spray painting rooms, a paint studio, a packing room, a large layout area, plan drawing and computing rooms, a gallery and administration rooms. There were only two hand edging machines, a large sand blasting cabinet and four kilns. All the glass cutting was done using the European method of cutting around hand cut cardboard patterns. Screen printing was done elsewhere as was any job involving large, heavy pieces of glass.

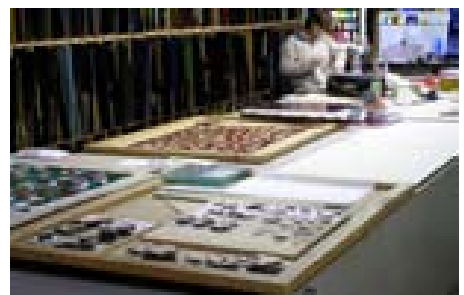
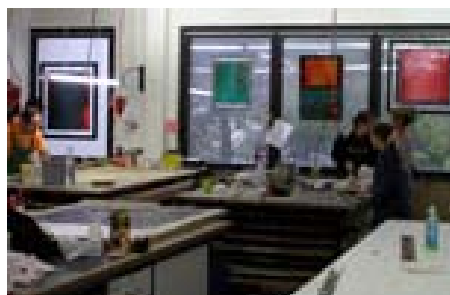
The number of workers, about sixty five, and the multiple projects requires the studio to be well organized. There is a studio head and each job has a project manager. They liaise to ensure smooth progress of each job through the various stages of fabrication. The whole operation appears well organized but labour intensive. Some artists will only visit the studio a few times



while their project is being fabricated while others prefer to stay and work on it themselves. The skill and experience of the Derix artisans enables them to advise the artists, suggest different techniques that could be tried and to make artistic decisions in the absence of the artist.

This appears to blur the line between artist and artisan but the artists seem happy to make use of these skills. The studio carries a large stock of glass and has a close relationship with the Lamberts glass factory. This enables the studio to provide coloured glass for smaller projects from their stock and order specific colours and quantities for larger jobs.

As most of the jobs need to be transported to distant locations there is a packing department. Most of the finished work is packed into custom made crates and this needs to be done with care as breakages would be costly for the studio. There can be no doubt that Derix works well and gets the results. It is a good model for such studio operations.



## Spain

Jose Fernandez Castrillo : [www.castrillovitro.com](http://www.castrillovitro.com)  
The fundacio centre del vidre : [www.fcv-bcn.org](http://www.fcv-bcn.org)  
Antonio Sainz-Keshava : [www.arquired.es/users/keshava](http://www.arquired.es/users/keshava)

## Wales

Swansea Institute of Higher Education : [www.sihe.ac.uk](http://www.sihe.ac.uk)  
Artworks Wales : [www.cywaithcymru.org](http://www.cywaithcymru.org)  
Rodney Bender : [www.innovativeglass.co.uk](http://www.innovativeglass.co.uk)  
Amber Hiscott : [www.amberhiscott.com](http://www.amberhiscott.com)  
Alexander Beleschenko : [www.beleschenko.co.uk](http://www.beleschenko.co.uk)  
Catrin Jones : [www.catrinjones.co.uk](http://www.catrinjones.co.uk)

## England

Andrew Moor : [www.andrewmoor.co.uk](http://www.andrewmoor.co.uk)  
George Papadopoulos : [www.yorgosglass.com](http://www.yorgosglass.com)  
Julian Stocks : [julianstocks.com](http://julianstocks.com)  
John Reyntiens : [www.johnreyntiens.com](http://www.johnreyntiens.com)  
Graham Jones : [www.grahamjones.org.uk](http://www.grahamjones.org.uk)  
Kirsty Brooks : [www.kirstybrooks.co.uk](http://www.kirstybrooks.co.uk)  
Proto Studio : [www.protostudios.com](http://www.protostudios.com)  
Martin Donlin : [www.martindonlin.com](http://www.martindonlin.com)  
Danny Lane : [www.dannylane.co.uk](http://www.dannylane.co.uk)  
National Glass Centre : [www.nationalglasscentre.com](http://www.nationalglasscentre.com)

## Germany

Derix Studio : [www.derix.com](http://www.derix.com)  
Tobias Kammerer : [tobias-kammerer.de](http://tobias-kammerer.de)  
Eberhard Munch : [www.atelier-muench.de](http://www.atelier-muench.de)  
Guy Kemper ( USA ) : [www.kemperstudio.com](http://www.kemperstudio.com)

## Books

Colours in Architecture, Andrew Moor  
Lamination, Glass Handbooks, George Papadopoulos  
Glass and Print, Glass Handbook, Kevin Petrie