

CONTEMPORARY ARCHITECTURAL GLASS: THE AUSTRALIAN CONTEXT



Elisabeth Coleman

ISS Institute/TAFE Fellowship

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Executive Summary

Architectural glass is defined as decorative glass that is specifically designed, constructed and integral to an architectural context. Designer/makers may use a range of appropriate methods: leadlight, kiln-forming, painting, staining, sandblasting and silk-screening, to name only a few. AGDA believes that there is wide scope for glass designers to work with architects and builders to bring innovation in design, materials and technique into mainstream use.

Glass in architecture is not only functional but is fast becoming a fundamental design element in our built environment. The Architectural Glass Industry must develop and adopt new skills in order to meet the ever-increasing technical demands associated with working with glass in architecture. There is wide scope for glass designers to work with architects and builders to bring innovation in design, materials and technique into mainstream use among interior designers, architects, glass practitioners, artists and designers.

A significant set of skill deficiencies holds back the pace of development of the Australian Architectural Glass Industry. These deficiencies can be identified across four areas: technical, educational, design and management.

Technical

Successful large-scale projects require materials and techniques that comply with building, OH&S and a raft of ever-increasing environmental regulations while still fulfilling a designer/artist's creative vision in glass.

Along with traditional techniques, a variety of technical innovations in contemporary architectural glass have been implemented overseas.

Australia has not kept pace with these new technologies and techniques applied to glass in architecture. The ISS Institute Report, *Contemporary Techniques in Architectural Glass*, by Lindy Sando and Vaughn Taylor points out a number of innovative technologies now in use overseas that either are not yet available in Australia, or have simply not been implemented.¹

Education

Although the glazing industry, the sector that manufactures and installs float glass, is keeping pace with technological advances, the architectural glass industry remains largely conservative and appears reluctant to embrace change. The development of training that delivers skills and knowledge outcomes that are relevant to current industry needs is paramount. The training should be aligned with direct pathways to careers in either the architectural glass industry or to furthering higher education.

New and innovative education pathways in contemporary architectural glass are crucial to the future growth of the architectural glass industry. There are currently very limited training opportunities in Australian educational institutes. The level of training available is presently at a base-level Certificate III in Furnishing, Lead Lighting and Stained Glass, which includes only basic training in techniques including lead light and stained glass. The reluctance of mentorship within small business has not encouraged participation in the exchange of skills and knowledge.

¹ Lindy Sando and Vaughan Taylor, *Contemporary Techniques in Architectural Glass*, National Overseas Fellowship, February 2008. Fellowship supported by DEST, Commonwealth of Australia. This report is available on request from the ISS Institute.

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University training is focussing on glass in its three dimensional form, namely, glass blowing and casting. There are minimal education opportunities available in the architectural glass industry, particularly in contemporary methods and techniques. These are generally confined to short courses, or self-education by individual practitioners.

Consequently, the Architectural Glass Industry in Australia remains relatively unsophisticated in the use of modern technologies. Basic equipment is often outdated and not easily accessible. Materials are expensive and limited and, although professional networking is developing gradually in Australia, it is still in its infancy and is nowhere near as extensive as the industry networks in place overseas. How we go about growing and maintaining an effective industry network remains an important challenge for the Australian Glass Industry.

Design

Design is problem setting and problem solving. It is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product – in business, government, education and training and in the community in general.²

Good design is at the heart of working with glass. To foster good design in a contemporary context requires the development of new and relevant training opportunities. Education in design must be at the centre of every aspect of education, as well as the way we all lead our daily lives.

Exploring overseas educational programs and specifically how they incorporate design at every level would be of value to the development of the Australian experience. Industry representatives and educators should identify successful overseas glass education programs to guide reforms and improve training content in Australia. In order to develop education and training to higher levels, improve course content and delivery will require commitment from industry and government as well as closer liaison with overseas institutes.

Advanced education providers should also play a role in researching overseas education models. Regular surveys that track the employment outcomes of students graduating from courses offered overseas may reveal information to assist in developing Australian programs that better reflect the needs of the participants in seeking successful employment outcomes.

Management

Sando and Taylor's Fellowship Report highlights significant differences between Australia and overseas industries in their respective approaches to contemporary architectural glass.³

Overseas studios utilise project management techniques to deliver desired artistic outcomes. They recognise that the artist or designer need not be the fabricator of a particular project. Collaboration between artist, designer, studio and relevant fabrication businesses is an accepted work practice.

Australian architecture is highly respected and evolving in response to current concerns around sustainability and climate change. The need to provide more enriching environments for living and working requires buildings that not only comply with safety standards, but

² *Sustainable Policies for a Dynamic Future*, Carolynne Bourne AM, ISS Institute 2007.

³ Op. cit. *Contemporary Techniques in Architectural Glass*

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also achieve measurable and significant outcomes in terms of these and other issues. The aesthetics of such spaces should reflect a modern, progressive nation. To that end, architects and designers are constantly seeking new ways to incorporate modern methods and materials into new, innovative settings. Regrettably, however, the glass industry in Australia still has a way to go in meeting these goals.

It is imperative that a national approach should continue through the further development of the National Training Package (NTP) that sets standards and goals for the TAFE sector in response from recommendations from industry. The NPT must respond positively to contemporary trends and new innovations in architectural glass design and construction, rather than simply reflect current activity in the industry that, as already noted, is often behind its overseas counterparts. In addition, many small or micro-businesses do not have industry representation and have limited advocacy resources compared to large industry and professional associations. Thus, some industry bodies may not be aware of the processes required to make recommendations or changes to the training models and, as a consequence, relevant and necessary modifications do not occur.

Bureaucracy and administrative requirements can also get in the way of innovation and progress. Funding is often distributed at the top end of the process, leaving little if any funding for developing useful teaching resources at the delivery end of the process.

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Abbreviations and Acronyms

AGDA	Architectural Glass Design Australia
AGGA	Australian Glass and Glazing Association
AIA	Australian Institute of Architects
AS1288	Australian Safety Standard for Glass and Glazing
AQTF	Australian Quality Training Framework
Ausglass	The Australian Association of Glass Artists
CNC	Computer Numerical Control
COE	Co-efficient of thermal expansion
GGAV	Glass and Glazing Association of Victoria
IGU	Insulated Glazing Unit
ISS Institute	International Specialised Skills Institute
LED	Light Emitting Diode
MSDS	Material Safety Data Sheet
PPE	Personal Protective Equipment
RTO	Registered Training Organization
TAFE	Technical and Further Education
UV	Ultra Violet

Definitions

Design	<p>Design is problem setting and problem solving.</p> <p>Design is a fundamental economic and business tool. It is embedded in every aspect of commerce and industry and adds high value to any service or product - in business, government, education and training and the community in general.</p> <p><i>Reference: 'Sustainable Policies for a Dynamic Future', Carolynne Bourne AM, ISS Institute 2007.</i></p>
Glasstec	International Trade Fair of Glass Technology
Innovation	<p>Creating and meeting new needs with new technical and design styles (new realities of lifestyle).</p> <p><i>Reference: 'Sustainable Policies for a Dynamic Future', Carolynne Bourne AM, ISS Institute 2007.</i></p>
Skills deficiency	<p>A 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.</p> <p>There may be individuals or individual 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 away. Firms likewise come and go.</p> <p><i>Reference: 'Directory of Opportunities. Specialised Courses with Italy. Part 1: Veneto Region', ISS Institute, 1991.</i></p>
Sustainability	<p>The ISS Institute follows the United Nations NGO on Sustainability, "Sustainable Development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"</p> <p><i>Reference: http://www.unngosustainability.org/CSD_Definitions%20SD.htm</i></p>
U-Value	The rate of transfer of heat-thermal transmittance.

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Elisabeth Coleman would like to thank the following individuals and organisations who gave generously of their time and their expertise to assist, advise and guide her throughout the Fellowship program.

Awarding Body – International Specialised Skills Institute (ISS Institute)

The International Specialised Skills Institute Inc is an independent, national organisation that for over two decades has worked with Australian governments, industry and education institutions to enable individuals to gain enhanced skills and experience in traditional trades, professions and leading-edge technologies.

At the heart of the Institute are our Fellows. Under the **Overseas Applied Research Fellowship Program** the Fellows travel overseas. Upon their return, they are required to pass on what they have learnt by:

1. Preparing a detailed report for distribution to government departments, industry and educational institutions.
2. Recommending improvements to accredited educational courses.
3. Delivering training activities including workshops, conferences and forums.

Over 180 Australians have received Fellowships, across many industry sectors. In addition, recognised experts from overseas conduct training activities and events. To date, 22 leaders in their field have shared their expertise in Australia.

According to Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010':

Australia requires a highly skilled population to maintain and improve our economic position in the face of increasing global competition, and to have the skills to adapt to the introduction of new technology and rapid change.

International and Australian research indicates we need a deeper level of skills than currently exists in the Australian labour market to lift productivity. We need a workforce in which more people have skills, but also multiple and higher level skills and qualifications. Deepening skills across all occupations is crucial to achieving long-term productivity growth. It also reflects the recent trend for jobs to become more complex and the consequent increased demand for higher level skills. This trend is projected to continue regardless of whether we experience strong or weak economic growth in the future. Future environmental challenges will also create demand for more sustainability related skills across a range of industries and occupations.

Skills Australia's 'Australian Workforce Futures: A National Workforce Development Strategy 2010', pp. 1-2. http://www.skillsaustralia.gov.au/PDFs_RTfS/WWF_strategy.pdf

In this context, the Institute works with Fellows, industry and government to identify specific skills in Australia that require enhancing, where accredited courses are not available through Australian higher education institutions or other Registered Training Organisations. The Fellows' overseas experience sees them broadening and deepening their own professional practice, which they then share with their peers, industry and government upon their return. This is the focus of the Institute's work.

For further information on our Fellows and our work see www.issinstitute.org.au.

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Acknowledgments

Fellowship Sponsor

The Victorian Government, Skills Victoria is responsible for the administration and coordination of programs for the provision of training and further education, adult community education and employment services in Victoria and is a valued sponsor of the ISS Institute. Coleman would like to thank them for providing funding support for this Fellowship

Supporters

- **Architectural Glass Design Australia (AGDA)**
Phillip Parker, President
- **Australian Association of Glass Artists (Ausglass)**
Merinda Young, 2009 Conference Convener
- **AXESS Glass Products Pty Ltd**
Tony Stafrace, Managing Director
- **Glass and Glazing Association of Victoria (GGAV)**
Stan Hawksworth, GGAV member
- **Holmesglen Institute of TAFE**
Bruce McKenzie, CEO
Henry Pook, Associate Director
Roger Mason, Teaching Centre Manager
- **Hughes and Hughes Associates**
Dr Bronwyn Hughes, Stained Glass Consultant
David Hughes, Associate
- **My Word**
Myrine Hawksworth, Director

Organisations and Individuals Impacted by the Lead Lighting, Stained Glass and Architectural Glass Industries

Australian Government

- CSIRO
- Department of the Environment, Heritage and the Arts
- Department of Innovation, Industry, Science and Research
- Department of Education, Employment and Workplace Relations
- Industry Skills Council of Australia (Manufacturing Industry Skills Council)
- Standards Australia

Victorian Government

- Arts Victoria
- Skills Victoria
- Sustainability Victoria

Acknowledgments

- Department of Education and Early Childhood Development
- Departments of Innovation, Industry and Regional Development
- Department of Planning and Community Development
- Department of Sustainability and Environment
- Equivalent organisations in all other states

Local Government and Shire Councils

- Departments of Planning
- Cultural Units

Industry

Firms across industry sectors related to glass include:

- Architects
- Designers such as interior and industrial designers
- Glass Designers
- Educators – TAFE, University
- Engineers
- Fabricators
- Glaziers
- Glass materials, equipment and service suppliers
- Installers
- Technologists
- Tradespeople
- Project managers

Architects

Firms such as:

- Architectural Design Group (ADG)
- Andrew Maynard Architects
- Biscoe Wilson Architects
- Buchan Group Architects
- Cox Howlett and Bailey Woodland
- Fender Katsalidis Architects
- Harris Designs and Communications Pty Ltd
- Hassell Ltd
- John Wardle Architects
- Metier3
- Mirvac Design
- PTW Architects
- Sutera Prior Cheney Architects
- Tompkins MDA Architects

Acknowledgments

Glaziers and Glass Suppliers

- Architectural Glassworks and Gallery
- ASG Safety Glass
- Axxess Glass Products Pty Ltd
- Bent and Curved Glass Pty. Ltd. (BCG)
- EuroGlass Australia
- Fingerprint Glass
- G.James Glass & Aluminium
- Glass Projects Pty Ltd
- Glasstech (Qld) Pty. Ltd.
- Hartley Williams & Co. Pty. Ltd.
- Hub Street Equipment Pty. Ltd.
- Nanovations Pty. Ltd. (glass coatings)
- Matrix Design Studio
- Ozone Glass Design Pty. Ltd.
- Toucan Forged Glass Studio
- Viridian New World Glass

Ancillary Suppliers

- Clear Glass Solutions
- Consolidated Alloys Australia
- George Fethers & Co. Pty. Ltd.
- Global Alloys

Professional Associations

- Architectural Glass Design Australia Inc. (AGDA)
- Association of Australian Glass Artists (Ausglass)
- Australian Institute of Architects (AIA)
- Australian Nanotechnology Alliance
- Design Institute of Australia (DIA)
- Glass and Glazing Association of Victoria (GGAV)
- Housing Industry Association (HIA)
- Master Builders Australia (MBA)
- Planning Institute of Australia

Education and Training

- Universities – Faculty of Art and Design
- TAFE institutes such as Holmesglen Institute of TAFE

About the Fellow

Name: Elisabeth Coleman

Employment: Holmesglen Institute of TAFE

- Senior Teacher, Glass Department
- Co-ordinator, Lead Lighting and Stained Glass
- Program Co-ordinator, Glass and Glazing Department

Qualifications

- Diploma in Food and Food Service Administration (RMIT), 1977
- Diploma in Applied Science (RMIT), 1978
- Graduate Diploma of Education (Hawthorn Teachers College), 1978
- Bachelor of Arts (Hons) (Monash University), 1983
- Workplace Assessor, Holmesglen Institute of TAFE, 1999
- Certificate IV in Workplace Training and Assessment, Holmesglen Vocational and Higher Education, 2002
- Certificate OH&S, Holmesglen Institute of TAFE, 2004
- Certificate Manual Handling, Holmesglen Institute of TAFE, 2004
- Level 2, First Aid, Holmesglen Institute of TAFE, 2009

Elisabeth Coleman began her career as a secondary teacher with the Victorian Department of Education and taught in secondary schools for 10 years. She later completed further studies and achieved a Bachelor of Arts Degree (Craft) with a major study in glass. Following the completion of her Honours degree, the Fellow worked full-time as an artist in glass and participated in numerous workshops to enhance her knowledge of, and expertise in, a variety of glass-related fields.

The Fellow's secondary school teaching and curricula writing experience, coupled with the high standard of her glass practice, led to her being employed to develop resources for a new training course proposed by industry and the Glass Department of Holmesglen TAFE. The opportunity to coordinate the apprenticeship level course in lead lighting and stained glass led to developing new relationships with various industry sectors and, in so doing, opened new career pathways.

Her current role of Program Co-ordinator in Glazing at Holmesglen TAFE has further deepened the Fellow's involvement with the wider glass and glazing industry and its related training development. The Fellow serves in an advisory capacity to the Glass and Glazing Association of Victoria (GGAV).

Her studio work has centred on private commissions and gallery pieces. More recently the Fellow has moved toward work on large-scale public installation art and architectural glass.

The principle underpinning all her work is the commitment to good design as it relates to contemporary architecture and construction, together with a passion for high quality materials and workmanship. She also recognises the importance of continual learning about new processes and techniques that will translate into good design in her glass commissions.

About the Fellow

Throughout her career, the Fellow has attended conferences and workshops to keep abreast of artistic and technological trends and to forge networks with artists and designers across the diverse glass sectors. In 2000, she was invited to speak at the National Ausglass Conference in Fremantle, Perth, on training trends and standards. In 2009, she was again invited to speak at the Ausglass Conference in Tasmania, highlighting current and future training issues that were an outcome of her ISS Institute Fellowship experience.

The history of glass and its conservation and restoration is an important focus of the Fellow's work. She is involved with research projects that include the history of the stained glass industry in Australia and she is currently deputy editor of a five-year project to document Australian stained glass makers 1850-2000. She is a consultant to industry glass groups and various associations.

The Fellow is also a foundation member of Architectural Glass Design Australia (AGDA) and undertakes a training advisory role within this organisation. As a founding member, the Fellow is committed to making a contribution to grow the Australian contemporary architectural glass sector.

As an artist and educator in architectural glass, the Fellow's professional development has been enhanced immeasurably by this Fellowship. The dissemination of new knowledge and skills generated by the Fellowship is being brought to the classroom, industry workshops and conferences, as well as initiating new opportunities for commissions and projects.

Aims of the Fellowship

The Fellowship involved an overseas research tour of architectural glass studios and educational facilities. The objective was to obtain the latest knowledge, insights and skills in:

- Contemporary techniques in architectural glass, including methods and materials employed as well as innovations in educational delivery of skills and knowledge
- Materials
- Collaboration and project management
- Sustainability
- Safety and industry standards
- Education

The Fellowship was undertaken with the goal of bringing back to Australia new knowledge, insights and skills that will add value to Australian innovative processes, resulting in new business opportunities throughout the glass industry.

The knowledge and skills obtained through this Fellowship will be best put into practice through:

- Upgrading existing glass training packages
- Running workshops and lectures
- Disseminating web-based information through the ISS Institute and AGDA website to facilitate access to different learning tools

Participants in the Australian Glass Industry and related industry sectors have had limited communication channels available to them to enable timely knowledge sharing. Architectural Glass Design Australia (AGDA) aims to rectify this shortcoming as a matter of urgency and has developed a website to assist not only the membership, but also the public.⁴

⁴ www.agdavic.com.au

The Australian Context

The Australian Glass Industry comprises four sectors: the glazing industry, the art glass industry, the lead lighting and stained glass industry and the architectural glass industry.

Glazing

Glazing comprises tradespeople who cut, fit and install glass sheet and glazing units to architecture. The glazing sector includes window installations and the fitting of features such as kitchen splashbacks, shower screen doors, room dividers and partitions. With new types of safety glass it is possible to incorporate outdoor glass in the form of glass fencing, balustrades and conservatories. A glazier is trained as an apprentice to a glazing company and by completing 20 weeks off-site training at a Registered Training Organisation (RTO) such as Holmesglen Institute of TAFE. A National Training Package outlines the skills and knowledge necessary to be awarded the qualification. The apprenticeship period is four years inclusive of the off-site component.

AGGA is the recognised industry association. It has a large membership and provides its members with up-to-date information on product and technological innovations. There are approximately 3,500 registered glazing businesses in Australia who employ about 20,000 people. AGGA has state-based memberships in nearly all states. In Victoria AGGA have 75 accredited members and 50 non-accredited members. AGGA accreditation is obtained by companies that meet AS1288 compliance and certification standards.

Art Glass

Art glass is concerned principally with the design and manufacture of three-dimensional glass objects. This sector includes glass blowers and individual designers/artists who cast, slump and fuse glass into a variety of artistic forms. The principal means of training is through short courses, workshops or, more formally, through one of the university pathways. However, although many of the skills are transferable, few practitioners trained in this way work in architectural glass.

'Hot' glass workers are a small component within the Australian glazing industry and are more generally served by Ausglass, the 'hot' glass association. It runs an annual conference that brings together artists from across Australia and overseas to share knowledge, techniques and ideas.

Lead Lighting and Stained Glass

In Australia, this sector of the glass industry was at its zenith in the late nineteenth and early twentieth century when glass was used extensively in churches, public buildings and private residences. There was a deep pool of well-trained artists and manufacturers, many of whom were trained overseas. As no formal training programs were subsequently established skills and knowledge were lost gradually as artisans retired and died.

The late 1960s saw a revival in lead lighting and stained glass. By the late 1990s, the lead lighting and stained glass industry had recognised significant gaps in training. Consequently, with industry support, a Certificate III in Lead Lighting and Stained Glass Apprenticeship was established initially in Victoria and then adopted nationally as an endorsed Industry Training Package.

The lead lighting and stained glass industry is very small. It employs very few apprentices. Many who enrol in training programs tend to be interested in furthering their knowledge and skills in architectural glass.

The Australian Context

Holmesglen Institute of TAFE is the only Australian institute currently providing training using an endorsed national training package. The industry is struggling to grow and explore new initiatives and is constrained by an innate conservatism and the small size of the sector.

Architectural Glass

Glass in architecture is an integral component of the contemporary built environment. It embraces the use of exterior and interior spaces. Australia's climate and culture dictates the use of living spaces as places of entertainment as well as areas in which to live and work.

The use of light and the requirement for flexibility in the spaces we use, mandate the use of glass as a functional and expressive medium that can be used in a wide range of contexts. As glass is used increasingly as a structural element in the built environment, the need for high-quality engineered components becomes paramount. That such components also be designed aesthetically is equally important in an overall design concept.

The safety standard for glass in buildings is the AS 1288 – 2006 Glass in Buildings – Selection and Installation. Standards Australia is responsible for recommending and reviewing all such standards through its glass sub-committee, a group heavily represented by the major float glass and glazing companies within the industry.

Until recently the lead lighting, stained and architectural glass sectors were not represented on any relevant Standards Australia committee. After its formation in 2004, AGDA in conjunction with the Queensland leadlight group lobbied successfully for representation within Standards Australia – an important step towards ensuring the sector's survival. Without this consultative role and recognition of the smaller, high-value decorative glass, this sector could have disappeared entirely, as new specifications as initially proposed prohibited the use of their product in favour of industrially glazed options.

Standards Australia published AS 1288 on the 16 January 2006. It is periodically reviewed and regularly amended to maintain currency. It serves as a guideline for builders and architects to an agreed industry standard and is referenced in the Building Codes of Australia 2006. The code has a significant impact on project outcomes in architecture and in the glass and glazing industry.

Proposed new regulations that standardise building features with an energy rating code will impact significantly on the glass industry. Float glass producers are already addressing this situation with new and innovative glass products that meet these requirements, such as; coated and laminated specialty glass which complies with safety standards and meets heat insulation, soundproofing and self-cleaning requirements.

In countries such as Germany, Italy, France and the United Kingdom, art and design in architectural glass is an accepted part of the architectural culture. In Australia, however, glass is generally seen as purely functional rather than as a means of enhancing the aesthetic environment, while at the same time being functional. The concern that standards and codes will not be met through the use of artistic or decorative alternatives may have led to the perpetuation of more traditional materials and techniques and the rejection of any decorative elements in favour of an easier option: plain float glass. This conservative approach appears to be led by the larger corporations, who work to tried and tested mass glass applications.

The Australian Context

SWOT Analysis

A SWOT analysis provides a useful means of summarising the current situation and the implications of addressing, or not addressing, the need for ongoing skills associated with the contemporary Architectural Glass Industry.

Strengths

- Practitioners' ability to understand and use complex techniques and technology as appropriate to the task
- Practitioners' willingness to embrace technological advances.
- The Australian Quality Training Framework (AQTF)⁵
- TAFE sector support to continue to develop and deliver programs.
- Infrastructure to deliver training into the future
- Equipment and facilities suitable for glass training.
- TAFE training is continually being internally and externally quality audited by independent auditors to maintain training and delivery standards.
- TAFE training programs are supported by industry with technical advice and product donation making the programs viable and current.
- Trainers have a minimum of seven years industry experience and academic qualification requirements to qualify position.
- Excellence of the architectural profession with the design of projects using large-scale glass components
- Liaison and education with other industries including glass eg interior designers, builders, architects.
- Practitioners' ability to manage small and large-scale projects
- Education assists in the management of projects through professionalism.

Weaknesses

- Poor supply of specialist materials available locally.
- No coloured glass produced in Australia.
- A small and fragmented industry that's resistant to new concepts and ideas.
- Little or no research and development
- Micro glass businesses that are often time deficient.
- Inadequate professional development in contemporary design concepts and large-scale project management

⁵ AQTF is a national set of standards in training and assessment in vocational education and training systems. This structured framework of delivering training to industry using quality accredited government guidelines and standards, is assessed by independent auditors in the registered training institutes, who monitor delivery of the training packages. To issue nationally recognised qualifications, a training organisation must meet a set of requirements against quality indicators before registration can be approved as an RTO. By adherence to the set standards, the RTOs will comply with consistent quality training and assessment nationally. This form of consistent training allows for training to be transferable between one RTO and another through recognition of prior learning arrangement and credit transfer.

The Australian Context

- Training is costly in time and resources.
- Training package reviews are industry driven, but lack full support. Many individuals in the industry, who would have valuable input into reviews, are unaware of the process and procedures involved in the development of training packages and have little time to devote to reviewing training materials as they juggle the many tasks of running their businesses.
- Training levels are insufficient and are not articulated from one level to the next ie. Certificate III to Certificate IV, Diploma to Degree.
- Entry-level requirements for apprenticeships are low and this highlights a need to incorporate higher entry requirements to courses above basic levels. For example; Certificate III may need to be considered as a prerequisite for entry to Certificate IV and above level training.
- Inadequate studio space to undertake large-scale commissions
- High cost of and equipment for manufacturing and training
- Some training facilities face a need for urgent upgrade.
- Inherent lack of understanding of large scale design concepts.
- Few links between architectural professions and architectural glass industry
- Lack of expertise in the management of large-scale projects

Opportunities

- Importation of high quality, specialist materials to expand possibilities for the architectural glass industry.
- Increasing training, so that practitioners can tender for a wider variety of architectural projects.
- Increasing the confidence skills and knowledge of practitioners to develop architectural products using glass.
- Through appropriately targeted short courses increase the confidence, skills and knowledge of practitioners to develop architectural projects that use glass.
- Develop a dynamic product that appeals to a wide range of internal and external architectural settings.
- Management develop links between architectural professions and the architectural industry by using relevant examples from overseas studios.
- The visual impact of large-scale contemporary glass commissions will assist in promoting design concepts to Australian architects and builders.
- Targeting new ideas to larger industry-based sectors.
- Encouraging Australian architects and designers to incorporate glass in contemporary architectural design.

Threats

- Cost of raw materials
- Increasing overseas competition for local commissions.
- Loss of local artistic/design talent to superior training overseas

The Australian Context

- Australian Standards limit the possibilities of glass. Safety standards in a number of countries have exclusions for heritage glass and glass that is identified as art whereas in Australia, glass safety standards apply to all uses and applications of glass in buildings.
- Large float glass manufacturers have ample resources to ensure they are represented at standards groups and training groups. In this way, larger corporations are able to determine outcomes with which the remainder of the industry must comply.
- Legislative changes, especially legislation mandating energy ratings in building codes, can be forced on the entire industry by the developers of a specific technology. This technological determinism can create restrictive outcomes.

Skills and Knowledge Deficiencies

Research undertaken by the Fellow identified the following skill and knowledge deficiencies.

Design

Knowledge of quality contemporary design within the Australian Architectural Glass Industry is limited. This applies particularly in relation to large-scale work. Crucial to successful local project development is research into how successful studios in overseas markets are able to achieve high quality aesthetics and good design. It is also important to understand how overseas studios go about disseminating information and promoting excellence in contemporary design. Australian designers/artists need to be better informed about how their output can become more commercially viable without compromising their design and vision.

Design considerations for large-scale works include making sure such works conform to mandated safety standards and energy ratings. This is avoided or ignored at times by glass designers in Australia. Overseas studios deal with such issues and have processes in place to manage compliance without compromising design excellence. It is commonplace for studios to employ expert consultants to manage specialised components of a commission.

Construction

Modern construction methods being utilised overseas, but not yet taken up in Australia, can be seen in the following large-scale architectural projects by British artists.



Graeme Jones

SmithKline Beecham's Technical Headquarters in Harrow, Essex is an example of the designer solving a natural light deficit without compromising the artistic integrity of existing structure.

SmithKline Beecham's Technical Headquarters in Harrow, Essex. Image courtesy of www.graham-jones-glass.co.uk/corporate-artworks-glass-4.html

Amber Hiscott

The Cancer Treatment Centre at Glan Clwyd Hospital in North Wales illustrates how an artist working in collaboration with the local hospital staff, patients and community has been able to incorporate safe art glass. By using safety glass with enamels painted on the surface, good design was not compromised by the need for safety standards.



The Cancer Treatment Centre at Glan Clwyd Hospital, North Wales.



Images courtesy of www.amberhiscott.com/page001.htm

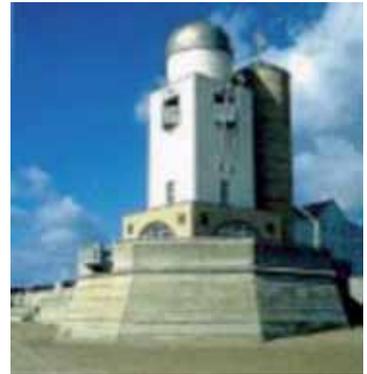
Skills and Knowledge Deficiencies

David Pearl

The Tower of the Ecliptic is a public observatory tower in Swansea showing how function and art can exist harmoniously.



*The Tower of the Ecliptic public observatory tower, Swansea
Image courtesy of www.david-pearl.com/page003.htm*



*Image courtesy of Stained Glass
Masterpieces of the Modern Era –
Xavier Barral I Altet*

IM Pei

The Louvre Pyramid in Paris is a classic example of glass in architecture that delivers both beauty and function.



The Louvre Pyramid in Paris. Image courtesy of <http://staff.washington.edu/jrterry/images/louvre.jpg>

Skills and Knowledge Deficiencies

Brian Clarke

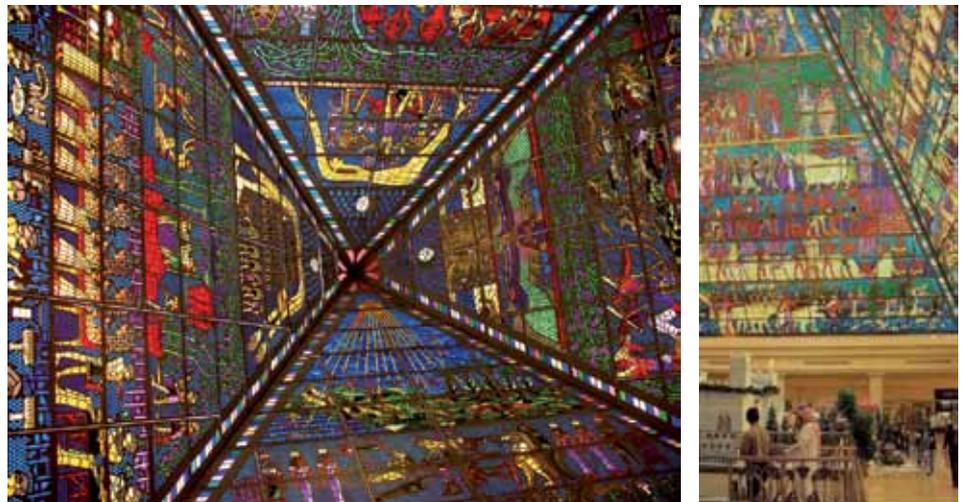
The glass roof for the Victorian Quarter in Leeds uses coloured glass in suspended ceilings that explore and stretch the boundaries of glass while maintaining architectural and structural integrity.



The glass roof for the Victorian Quarter in Leeds. Images courtesy of Stained Glass Masterpieces of the Modern Era – Xavier Barral I Altet

Wafi Mall, Dubai

The decorative stained-glass ceiling incorporates ancient Egyptian motifs on a pyramid ceiling that spans the central retail space. The light is captured brilliantly, thereby enhancing an otherwise empty space.



Wafi Mall, Dubai Image courtesy of www.flickr.com/photos/8118993@N04/2360373851/

Image courtesy of Stained Glass Masterpieces of the Modern Era – Xavier Barral I Altet

Skills and Knowledge Deficiencies

These examples serve to demonstrate that, while large-scale utilisation of glass is not a new phenomenon internationally, similar advances in contemporary architectural applications have not emerged as readily in Australia. Australian glass studios have been reluctant to embrace opportunities to expand their repertoire of techniques.

Expanding the skill sets and knowledge of Australian designers will enable them to better express contemporary designs in architectural glass. The industry needs to respond as the market becomes more comfortable with glass in architecture as a viable and desirable building material.

A number of the techniques used in Australian industry today may not suit the changing requirements of the built environment of the future. While there will always be an important place for traditional lead lighting and stained glass, more contemporary methods need to be embraced to ensure industry survival and growth.

State-of-the-art techniques and processes being used overseas include:

- Large-scale enamelling, lamination and screen printing on glass
- The use of colour, texture and form
- Photographic imaging on glass

In Australia, the preferred work model is for small studios to manage all aspects of a project in-house. As knowledge and skills are limited to small-scale work, many studios are reluctant to apply for larger commissions, because they do not have the necessary critical mass of human resources and equipment to deliver bigger projects. The largest single stained-glass window project in Australia to date is the *Creation* windows in the Cairns Cathedral, undertaken in 1999 by Jerry Cummins and Jill Stein. The commission was completed in the traditional manner with each component from conception to completion executed by the designers.

The Fellow found that overseas studios work on a completely different basis by creating a team of people with a variety of skills and putting them together in one location to work collaboratively on a project. Teams include the designer, architect, fabricator, engineer, business partners and studio practitioners, all collaborating as a single unit to ensure project objectives are achieved. Additional members are added as new and different skill needs arise in order to complete a project

In the United Kingdom and Europe, artists and designers with little or no knowledge or skills in working with glass, work with glass technology experts to help realise their artistic visions. Designers and artists may oversee the project, but do not necessarily need to learn new processes outside their area of expertise. This is project managed within the studio structure with each aspect of the job progressed using the best people available. All team members may be highly skilled in one or more areas, but they are not required to be the masters of all.

This symbiotic relationship between artists, engineers, fabricators, architects and business practitioners is unique to overseas studios. The methodology underlying this approach and its applicability to studio practices in Australia has the potential to deliver vastly improved artistic and architectural outcomes for local studios.

Skills and Knowledge Deficiencies

Training

The built environment is changing. New materials, methods and skills are being used to address increasing demands for greater sustainability and to reduce the environmental impact of structures. It is crucial to provide safe materials that take into account the long-term effect on the environment and the need for improved energy conservation. The timely acceptance of new technologies and skills in the Australian glass industry is essential if we are to continue to achieve best practice models of training that recognise the need for sustainability. Training models must be able to embrace new technologies and skills in a timely manner.

Glass in architecture is being adapted by many of the major glass industries to meet energy safety ratings. The art and architectural glass industries need to adapt to these changes while remaining economically viable as well as compliant with new Australian Standards and Building Codes.

Training in contemporary design, fabrication methods and project management techniques is essential. Skilled and well-trained educators need to deliver training to industry, so that identified knowledge and skills deficiencies can be addressed.

New training opportunities should incorporate workshops in contemporary architectural glass, including lamination on glass and large scale painting techniques. Screen-printing, airbrush painting and large-scale enamel applications on glass are areas also requiring further training through continual workshop programs.

The International Experience



Davide Fassi, of the Milano Politecnico, in consultation with another teacher.

Italy: Milano Politecnico

Davide Fassi, Lecturer, Designer, Architect

In June 2008, renowned Italian architect and ISS Institute Fellow, Davide Fassi, conducted a series of design workshops at the Royal Melbourne Institute of Technology (RMIT) as part of the ISS Institute's *Milano in Melbourne* program.⁶ As an ISS Institute Fellow, Coleman was afforded the opportunity to attend a Davide Fassi workshop to broaden her understanding of design, innovation and implementation. Through their shared association with the ISS Institute Fellowship program, Fassi agreed to facilitate a visit by Coleman to the Milano Politecnico to study similarities and differences in Italian and Australian education models in design.

Industrial design has been taught for more than 50 years in universities and other institutes around the world. These have been situated primarily in industrialised nations in Europe, North America, and Japan. More recently, higher education institutions in India, China, Brazil, Argentina, Korea, and Taiwan have also introduced courses in industrial design.

With an approach to design-oriented manufacturing regarded internationally as cutting edge, Milano is recognised as the design capital of the world. The dual campus (Milano and Como) Design Faculty at Politecnico Milano boasts some 4000 students, more than 700 teachers, around 800 assistants and various subject specialists. It is the world's largest higher education design faculty.

Course Options

Milano Politecnico operates on a system of sequential study cycles.



Milano Politecnico photo board.

⁶ Davide Fassi is a 2008 'ISS Institute/Victorian Government' Design Fellow. He holds a PhD from Politecnico di Torino and has been associated with a number of prestigious international exhibitions, as well as being involved in large-scale architectural projects with a focus on environmentally friendly systems for interiors and temporary architecture. The ISS Institute Milano in Melbourne workshops enabled Fassi to share his design and innovation expertise through an Italian perspective. This was done through illustrated lectures, demonstrations, seminar, group and individual discussions and involving workshop participants in a practical 'hands-on' project.

The International Experience

Level 1

A three-year graduate degree gives the student a basic technical grounding. The degree provides the student with training that will enable them to enter the workforce or take up the option to proceed to a two-year master's degree.

Level 2

The master's degree specialises in high-level scientific training in a chosen speciality that has been preliminarily developed in the graduate degree. The option to pursue the master's degree provides students with an opportunity to broaden knowledge and maximise skills obtained in the graduate degree.

Assessment

The measurement applied to studies undertaken is called a university education credit. Each unit of measurement equates to a certain level of knowledge and skills acquired by work undertaken by the student. Each credit equates to 25 hours of work. This includes attendance in computer skills and workshops, study and set exercises. The credit is not a form of assessment of specific educational achievement. Rather, it serves as recognition of attendance requirements met. Assessment relies on a grade achieved throughout the course of study. A typical full time student should achieve on average 60 credits. The second level masters study averages 120 university education credits.

Courses

Degree level (3-year) courses (five options)

- Industrial Design (Milan Campus) Specialising in Product Design, Product Ergonomics
- Communication Design (Milan Campus)
- Fashion Design (Milan Campus)
- Interior Design (Milan Campus)
- Furniture Design (Como Campus)



Fashion Design students at work

The International Experience



Sign pointing to Fashion Design



Sign pointing to Model Making

All degree courses have the following core subjects across all disciplines:

- Mathematics
- Materials and Design
- History
- Drawing Studio
- Technology and Design Culture
- Communication – Visual – Society
- Environment studies (Culture)
- Design Studio (Industrial – Structures)
- Estimation
- Business Management
- Computer Graphics
- Technology and Production
- English

Master Degree (2-year) courses

- Industrial Design (Milan Campus)
- Communication Design (Milan Campus)
- Fashion Design (Milan Campus)
- Interior Design (Milan Campus)
- Furniture Design (Como Campus)
- Design and Engineering (Milan campus)
- Yacht Design (Spesia–Genova–Milan campus)
- Product Service System Design (Milan Campus)

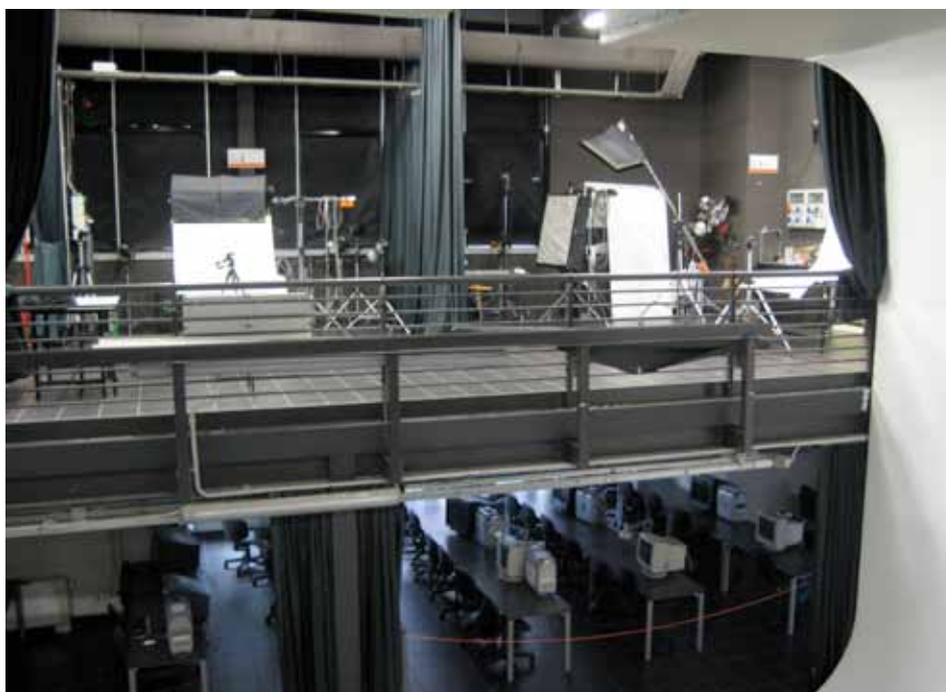
Subject areas include:

- Culture and History
- Project scenarios
- Systems of Cultural Productions
- Semiotics
- Representation and Visualisation
- Design and Process
- Materials and Technologies
- Concept Design Studio
- System product design
- Professional Practice
- History and Critical Analysis

The International Experience

PhD Program

The Politecnico also offers a PhD program to master degree graduates. PhD students undertake highly academic research in design, including: Industrial Design, Multimedia, Communication, Interior Architecture (in conjunction with the Department of Architectural Planning), Design and methods of product development (in conjunction with the Department of Mechanics).



The Milano Politecnico's photography lab

The Politecnico delivers an integrated and holistic design curriculum that undergoes regular content evaluation and delivery methodology. The courses offered are value added further through the regular inclusion of consultants from private companies and outside industry bodies as lecturers.

Italy: Site Visits

Galleria Vittorio Emanuel

The Fellow also visited various notable architectural sites, including the Galleria Vittorio Emanuel.

The use of early technological advances in glass ceilings showed the use of large expanses of glass supported by an engineered matrix of steel framework. Structural systems employed in glass installations, particularly in ceilings, is of significant interest as buildings are using glass and solar systems as a way of including natural light and harnessing thermal properties. The simplicity of the structure was enhanced by the well-designed and balanced classical architecture. Allowing light to permeate the space, the ceiling created a vaulted open extension of a gallery that would otherwise have required significant artificial lighting.

The International Experience



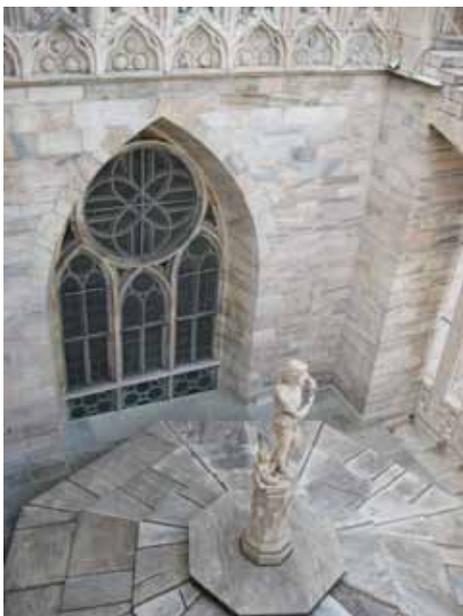
The view of the ceiling of the Galleria Vittorio Emanuele



View from the Milan Duomo of the Galleria Vittorio Emanuele

Milan Duomo

The Fellow visited the Milan Duomo to study the stained glass windows, as well as the conservation site on the roof. While photography of the stained glass was not allowed inside the church, observations on the use of protective glazing on outside windows showed similar practices to works in Australian situations.



A stained glass window of the Milan Duomo



Stained glass restoration work being completed on the outside of the Milan Duomo building

The windows are glazed with hinged and locked wire cage structures. This allows the protective frame to be opened for cleaning and repair work. Such systems are also in use in Australia.

The International Experience

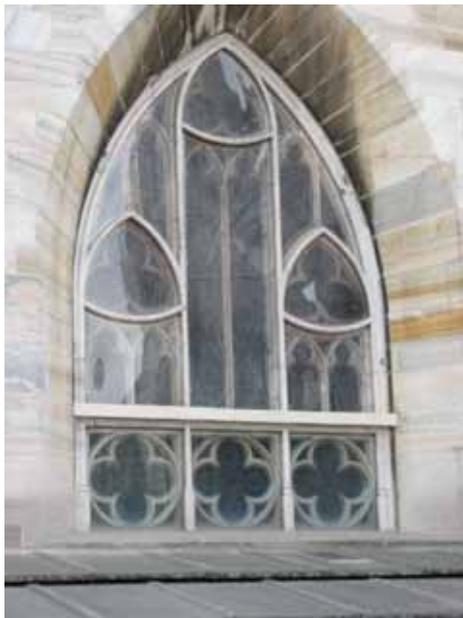


The view of restoration work from the roof of the Milan Duomo building



This photo shows the hinged, wire cages used to protect the stained glass windows of Milan Duomo.

Some of the larger lights were protected with polycarbonate sheet double-glaze on the exterior of the windows. These are fixed in place and require removal by skilled craftspeople in order to gain access. This method is common in Australia. While the type of material used domestically varies slightly, the results are similar. Although effective protection is provided to the window, it is prone to scratching, discoloration and exterior distortion thereby impacting on the window's aesthetics.



An example of double-glazing on exterior windows of Milan Duomo



An example of double-glazing on exterior windows of Milan Duomo

The International Experience

Window sections were strengthened with the use of reinforcement bars to brace portions of the stained glass. The bars were soldered on the edge for strength and made from brass for durability against rusting. Window reinforcements were applied on all windows at regular and frequent intervals. While this type of reinforcement is employed by some Australian studios, the extent of reinforcement work generally exceeds that found in Australian stained glass installations.

The Duomo employs a team of qualified conservation and restoration experts who work to a carefully planned maintenance schedule. This is time-consuming work and the Milan Duomo recognises the importance of providing ongoing staff training and apprenticeship opportunities. The Duomo operates as a business. The entry fee paid by students is an important source of funding for ongoing restoration and conservation work.

Castello Storzesco

The Fellow visited the gallery to observe stained glass and the use of enamel paint.

As enamel paint is used on glass using new methods outlined further in report, it was useful to examine the use of enamel on glass in its traditional context. The enamel had been applied in conjunction with traditional stained glass painting techniques and suffered paint degradation.

The enamel was applied to create small areas of colour in, on and around the surface areas to included hue within the stained glass. Close examination of the panels highlight the possible limitations that enamel paint on glass may present to the designer in architectural glass today.



The outside of the Castello Storzesco



A photo of a stained glass window in the Castello Storzesco highlighting the use of enamel paint

Paint loss and stability affects enamel paint on glass. The glass on display showed paint fading and peeling in sections where the enamel paint had been affected by either light, water or poor firing processes.

The International Experience



A close-up of a stained glass window in the Castello Storzeseo highlighting the use of enamel paint



A close-up of a stained glass window in the Castello Storzeseo highlighting the use of enamel paint

The use of silver nitrate on glass is referred to generally as silver stain. It has been a common application since its discovery in the fourteenth century. Silver stain is thought to be the only true stain. Anecdotally, it is believed by some people to be the origin of the term 'stained glass'.

When applied and fired to temperatures of 500 – 650 degrees celsius, the silver nitrate stains the glass surface, colouring it to a palette of hues ranging from soft pale yellow to deep yellow and gold to almost orange. The depth and intensity of colour varies with the concentration and type of silver nitrate, the method of application, the firing process and the receptivity of the glass. Through the firing process the silver nitrate undergoes a chemical reaction with the glass to colour, or stain the surface. No other stained glass paint changes in this manner.

Transparent in nature, unlike enamel, silver nitrate allows the light to be transmitted as if it were coloured glass. Enamels painted onto glass create a layer of colour on the surface. Enamel does not penetrate the glass surface. Rather, it is the colour of the enamel paint that alters the colour of the glass. When fired correctly, the enamel softens and fuses to the surface of the base glass. Over time, glass colour can fade or be compromised through exposure to factors including ultra violet (UV) light and atmospheric conditions.



These photos, of Castello Storzeseo's stained glass window, shows how the use of silver stain on glass adds depth of colour to the design without the encumbrances of extra lead work around glass pieces

The International Experience

The technical quality and skills involved in traditional stained glass painting are extensive. Of particular interest is the use of diapering. The technique is referred to usually as a matt process whereby stained glass paint is applied evenly over the glass surface ready for the artist to embellish with other tools and treatments. The pattern is scratched through the matt, enabling light to penetrate through the lace-like design.

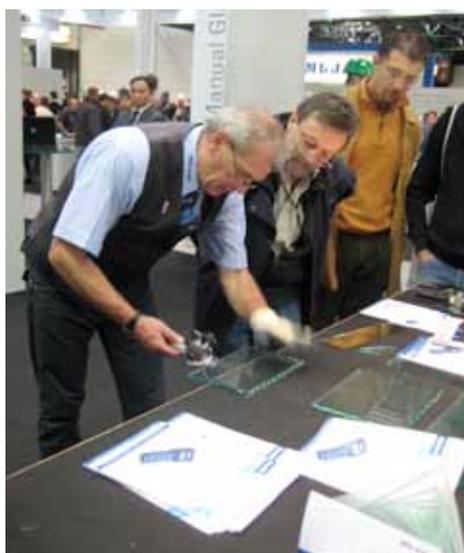


These photos, of Castello Storzese's stained glass window, show the technical quality and skills involved in traditional stained glass painting

The skills and knowledge obtained through traditional painting techniques can be the foundation to applications that evolve in modern or contemporary glass applications.

Germany: Dusseldorf

Glasstec International Trade Fair, 21–25 October, 2008



The Glasstec industry trade fair – demonstration of specialised glass cutting and shaping tools

With more than 1200 exhibitors, Glasstec is the pre-eminent international glass industry trade fair. Of particular value to the Fellow was the opportunity to meet exhibitors of modern glass design and learn about the latest developments and innovations in glass technologies. Exposure to the latest applications of glass, together with developments in environmental sustainability and related OH&S issues was invaluable.

The principal theme of Glasstec 2008 was sustainability. A program of lectures addressed climate protection and energy efficiency, including the potential of glass and glass products as contributors to climate control. The latest products, technologies and research results on topics like photovoltaic, solar thermal systems, thermal insulation, and solar protection were also showcased.

While there was a focus on thermal glazing systems, attention was also given to innovations in insulation glass, thin solar cells, coatings and films as energy conservers, integrative facades and building skins using glass products.

The International Experience

A symposium *Transparency! Glass and Façade Technologies* comprised papers and discussion on design and engineering working in harmony to maximise the potential of glass installations in large structures. Speakers included experts from the International Architects Congress. The symposium was organised in conjunction with the North Rhine – Westphalian Chamber of Architects and the Technical University of Delft.

Further information and resource materials are available on the post-conference website.⁷ Lecture papers on subjects relating to glass and solar technologies, photovoltaic principles and processes related to glass, architecture, machine building and other products are also available on the Glasstec website.

Demonstration of Lamination Processes at Glasstec Conducted by Lamberts Glass⁸ And Bohle⁹

The process of laminating glass on glass is fraught with difficulties. The quality and longevity of the finished product is questionable.

As the Architectural Glass Industry continues to develop, architects and designers are exploring new possibilities in using cost-effective large decorative glass in and around the built environment.

Laminating coloured glass onto safety glass produces designs and delivers transparent luminosity and light refractive qualities other applications cannot achieve.

How light behaves as it passes through coloured glass is different from light transmitted through coloured enamel on glass. Due to its refractive qualities, mouth blown glass is the material of choice of designers. The prohibitive factor, however, is its cost.

Recent improvements in adhesive technologies and lamination processes have advanced development of laminated glass. The Fellow observed a demonstration by Lamberts whereby two-part silicone adhesive was used to laminate mouth-blown antique glass to a base safety glass. Although costly, this method enables the designer to adhere coloured glass portions to a field of laminated safety glass. Compared to mouth-blown coloured glass, safety glass can be larger in surface area and relatively inexpensive. Technological advances in glass technology addresses both the safety and sustainability issues necessary to comply with current building codes and regulations.

Mouth-blown coloured glass sheets are limited in size to approximately 600 x 900mm. However, studios can work directly with the designers and the glass blowers to custom make not only colours, but textures and designs to suit any specific commission. This mouth-blown glass can be treated to produce the many laminated designs we see today on large plates of laminated safety glass and toughened glass products.

A designer can create a colour pallet covering a large space while maintaining the light capturing qualities of the far more expensive mouth-blown glass.

This improved flexibility delivers better outcomes in terms of safety, energy efficiency and costs without compromising design integrity and architectural aesthetics.

⁷ www.lamberts.de

⁸ www.lamberts.de

⁹ www.bohle-group.com

The International Experience

New Techniques in Lamination

Until recently, practitioners have struggled to find a product that will laminate glass to glass and meet a variety of restrictions. At Lamberts and other studios, the Fellow observed the latest techniques in lamination processing.

Adhesives

Glass adhesives require extensive research and testing in order to meet stringent criteria. Features of a good adhesive are:

- Does not discolour over time
- Has a refractory index close to the glass so that light is not diffused by the adhesive
- Retains its structural integrity over time to withstand UV light and extreme climatic conditions
- Is easy to use in studio settings
- Is cost effective and meets OH&S standards
- Leaves no residue or smear on areas not requiring adhesive application
- Is able to fill gaps (particularly when using textured glass on a flat surface) and has self-levelling properties
- Does not cause compatibility stress within the glass structures being joined

While the adhesives used in different studios vary slightly, the overwhelming preference was for two-part silicone adhesive that delivers clarity, colour stability and strength. In some applications a primer was first applied to the specific areas covered by the adhesive. This technique resolved clean-up issues arising from adhesive overflow. Any area not primed would not accept the adhesive and would peel off the surface readily.

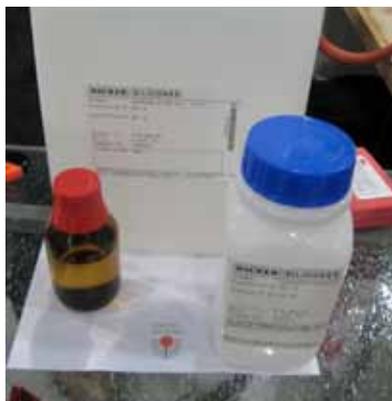
Appropriate personal protective equipment must be worn and adequate ventilation provided.

Outline of Laminating Process

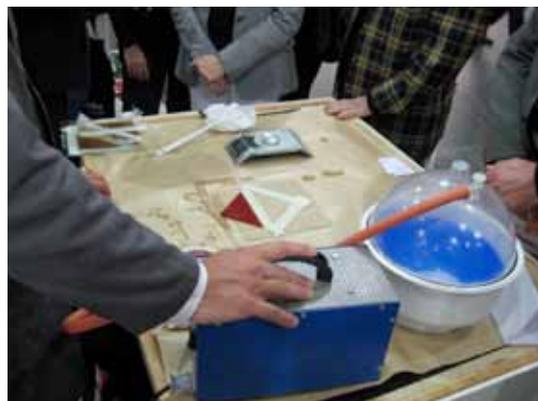
- Check Material Safety Data Sheet (MSDS) for safety requirements.
- It is vital to work in a clean environment free from airborne dust and contaminants.
- All glass pieces for lamination should be cut to shape and size as accurately and cleanly as possible. Any glass that is tight fitting, or butt joined should be checked carefully before gluing begins to ensure a tight, close fit and adjusted to suit the designed pattern.
- Glass needs to be cleaned thoroughly using a cleaner that leaves no residue.
- Clean both surfaces of the glass to be bonded. Isopropyl alcohol is a suitable product.
- Use lint free paper products so that no lint, paper residue or flock remains on the glass surface. A commercial glass cleaning machine can be used for large scale work.
- The lamination area should be carefully masked to create a dam. Adhesive tape can be used to create a working boundary and to prevent overflow of excess adhesive.
- A two-part silicone adhesive with a primer was used in the demonstration (silicone plus catalyst and primer).

The International Experience

- The adhesive used was VERIFIX. This is a two-part silicone that polymerises into an elastic, non-ageing, weatherproof and UV-resistant elastomer without shrinking, regardless of the layer's thickness. This adhesive is specifically designed for joining glass surfaces – VERIFIX is used with a primer to promote adhesion.
- Area to be laminated is treated with primer. Any area not prepared with primer resists the action of the silicone adhesive and, therefore, will not require cleaning.
- Accurate volumetric measurement of the two parts as per the product instructions is imperative. In this instance the ratio is 50:50.



The VERIFIX glues that are used in the laminating process



Silicone adhesive is placed in vacuum bowl to remove any bubbles

- Silicone adhesive when mixed is prone to trapping air bubbles. To overcome this, the combined mixture was placed in a vacuum bowl (an apparatus used in laboratories to remove bubbles). Correct timing is vital to ensure the adhesive does not begin to cure and harden during this process.
- The silicone is poured carefully onto the prepared surface, ensuring that the adhesive is kept close to the glass and the stream of adhesive is continuous. It must be decanted evenly from the container to prevent air bubbles in the silicone.
- A generous amount of adhesive is required to cover the lamination surface evenly without any gaps.
- The silicone must be allowed to settle and level out before the next step.
- Glass pieces are placed carefully in position, leading with one edge at a time to push the air bubbles out as the glass is levelled.
- Any excess adhesive oozing beyond the perimeter is left to cure.
- Once cured, excess silicone is peeled away. The clean up was simple.

The resulting lamination has outstanding optical clarity. The lamination process is strong and does not discolour over time.

The demonstration was conducted on a suction table similar to those used in screen-printing. This ensured the glass was held firmly to the table surface.

The International Experience



Image showing a piece of coloured glass being placed carefully in position on top of the safety glass (once the safety glass has had adhesive applied to it)



A finished piece of Lamberts Studio glass that has undergone the lamination process.

A low-grade heating mat underneath the glass provided tepid heat. This assists in curing the silicone. The heating mat should not be turned on before all glass has been applied and positioned correctly. This measure may not be necessary in warmer climates. The cured silicone does not set hard. It remains flexible and can accommodate the range of thermal expansion properties of different glasses that may be combined on a sheet.

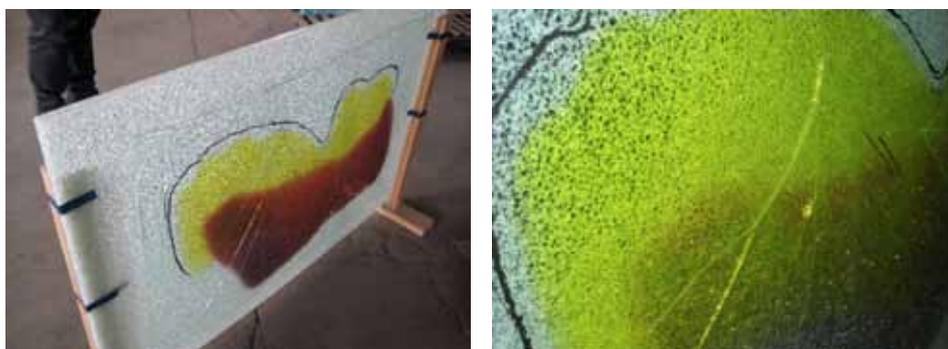
Compared to the refractory index of most glass, tests indicate that this silicone delivers excellent optical outcomes. This is important when assessing the optical quality of the finished laminated glass. The minimal shrinkage properties and flexibility of the cured silicone enables lamination to a variety of glass surfaces. The cured silicone also appears to retain its stability and does not discolour or opacify over time when exposed to UV light.

As this is a new application technology, the test of time will determine its viability. Various lamination silicones and resin adhesives have been used with glass over many years. Results have been varied. Many silicones have opacified, yellowed, bubbled, cracked the glass, or been difficult to apply and clean. It has always been difficult to achieve good results using large pieces of glass. Most success has been achieved with small mosaic-like pieces where it is easier to avoid trapping air bubbles. The refractive qualities of other silicones have been poor and the end product disappointing.

The industry is enthusiastic about this new product and the related application techniques as it enables lamination of large glass pieces. It, therefore, opens up new and exciting design possibilities for architectural multi-layered glass while still being capable of complying with accepted safety standards as well as energy and noise ratings.

The International Experience

Laminated mouth-blown, antique, coloured glass can be held together, using this technology, when laminated onto the sheet of toughened safety glass. Although the safety glass has shattered, the sheet of laminated glass with the annealed mouth-blown antique glass laminated onto its surface holds together. This strength of the sheet suggests this glass would be compliant with the current AS-1288.



Laminated mouth-blown, antique, coloured glass has been laminated onto the sheet of toughened safety glass

In collaboration with Hartley Williams, a wholesale glass supplier in Queensland, Lamberts Glass conducted an industry demonstration workshop on this new technology in August 2009. A proposed training activity in glass lamination will be undertaken in 2010.

Germany: Studio Site Visits

The German taxation system provides various incentives to encourage art and conservation projects. A significant component of large-scale commission work is generated through this system. A number of new developments have a component mandated in their design and construction budgets for arts related works. There are three major glass studios in Germany with similar levels of experience, expertise and facilities to undertake big projects. The Fellow visited all three studios. While competition for large-scale commissions is fierce, these studios display mutual respect for their professional rivals.

Derix Studio, Taunusstein



Art glass on display at Derix Studio

Derix Studio is one of the leading architectural glass studios in the world. It houses a number of highly technically trained artisans working in various fields within the glass industry.

Derix Studio was established in Goch Neiderrheim in 1866 by Wilhelm Derix (1837–1919). A restoration workshop was set up at the Cologne Cathedral in 1945, and in 1946 another studio was established in Rottweil followed in 1952 by a studio in Weisbaden.

The International Experience

The Weisbaden studio has collaborated with renowned artists including Johannes Beek, Albert Bickle, Otto Dix, Wilhel Geyer, Professor Greishaber, Ida Kervovious, Emil Kiess, George Meisterman, Jochem Poensgen, Ludwig Schaffrath, and Johannes Schreiter. In 1974, the studio moved to Taunusstein. The company is headed by Wilhelm Derix IV.

During the 1990s, Derix Studios developed large-scale contemporary art glass projects for artists worldwide including Leifur Breidford, Brian Clarke, Graeme Jones and Patrick Reyntiens. In 1991, the company celebrated its 125th anniversary with the opening of a new art glass gallery that showcases the work of national and international glass artists. In 1999, Derix Glass Art Consultants was established in Oakland California.

Anywhere between 35 and 70 expert glass practitioners, master craftsmen, glaziers and apprentices are currently employed to bring the glass artists vision to reality using a multitude of practical applications.



The application of lead to a glass design at the Derix Studios



An example in the Derix Studios Gallery of a finished glass piece displaying the use of screen-printing methods

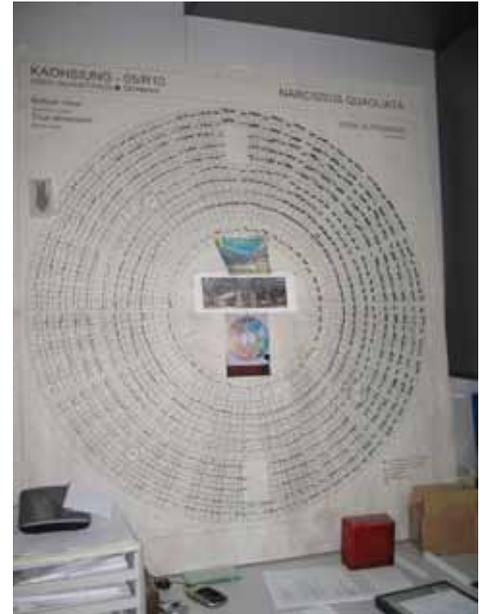
The Fellow received a conducted tour of the studio as well as tours of installations completed by the Derix studio. Full access to the studio and staff was provided.

Questions about the work being undertaken were answered willingly and in detail. There was great camaraderie and interaction among studio workers, many of whom were not only professional co-workers, but also relatives. Family members had a strong presence among the studio workforce.

The International Experience



Example of a sandblasted project in development



Example of scale design for Narcissus Quagliata project. Ceiling in Taiwan.



Staff preparing enamel paints for screen-printing



Example of a sandblasted project in development

Derix has a culture of in-house training and mentoring that ensures a stable and highly skilled studio workforce.

The International Experience

The studio faithfully reproduces the artworks of designers without seeking to exert any artistic influence. The company works in collaboration with the designer and other specialists to project manage commissions from start to completion. The Derix network of architects, engineers, designers and specialists is extensive.



One of the design areas of Derix Studios



Small pieces of glass that have been used for testing out different techniques

The Fellow was fortunate to witness the work of a master craftsman who was Johannes Schreiter's personal fabricator who has worked at Derix for many years as a specialist in the rendering of Johannes Schreiter designs. The precision and technical expertise displayed by this craftsman reflects the great sensitivity and understanding he has for the design concept laid out by the artist.

While the Fellow was at the studio, the craftsman (introduced only as Andreas) was working on an original design concept of a Johannes Schreiter commission. The Fellow observed the accuracy of the lead shaping, placement and construction, executed with specialist hand tools to replicate the subtle changes of line and the shapes of the design.



Andreas working on an original design concept of a Johannes Schreiter commission



A completed Johannes Schreiter design rendered by the master craftsman

The International Experience

The Fellow also observed cutting-edge glass lamination techniques that enable coloured glass installations in large-scale settings. Glass lamination has overcome many previous design restrictions.



An example of the lamination processes. Derix Studios craftsmen demonstrate lamination process onto larger areas of safety glass.



Examples of larger scale section of coloured glass that has gone through the lamination process



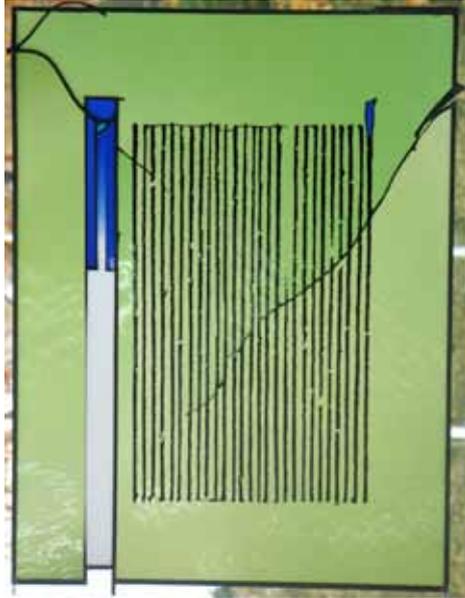
A finished glass piece by Derix Studios

Technological advancement in glass manufacture and lamination glues has improved innovative possibilities to laminate large format sheets of coloured glass. These new processes now comply with sustainability and safety requirements in architectural settings. Architects working on large scale projects are increasingly utilising art glass and lamination techniques.

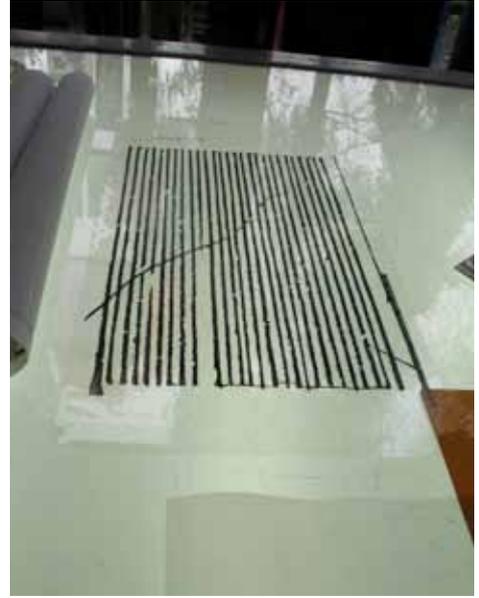
While traditional lead work is still used, contemporary works are taking on new shapes. A glass designer is no longer restricted to smaller scale versions of coloured glass.

Derix studio uses state-of-the-art technologies for screen printing on glass, sandblasting, acid etching and warm glass slumping and fusing. These processes all expand the glass designers' creative options. The studio also has the added advantage of being able to access a ready supply of locally produced antique glass and related materials. It is also possible for the artist or designer to work directly with glassmakers in producing glass to specific requirements.

The International Experience

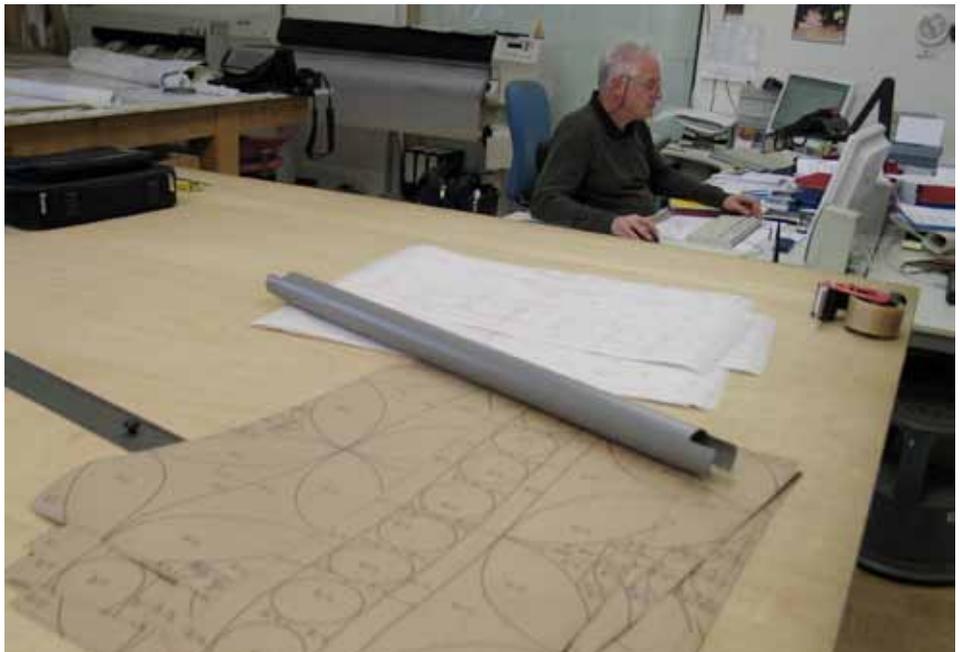


A completed Johannes Schreiter design rendered by Johannes Schreiter's personal lead-lighter



A Johannes Schreiter design

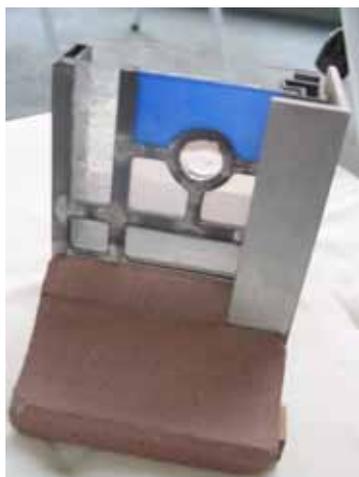
An area requiring significant improvement in Australia is in project management. The Fellow was able to discuss this issue at length with Wilhelm Derix. His studio has significant project management experience and expertise. When undertaking a commission, studios like Derix are able to access a large pool of available expertise, both internally and externally.



A draftsman at work in Derix Studios

The International Experience

Double Glazing



A sample of a double-glazing system A sample of a double-glazing system

Historically, the Australian Glass Industry has produced single glazed (single sheet) glass for the architectural market.

A number of small companies have produced double and triple-glazed units, primarily for the commercial market. However, local production of double and triple-glazed units for both domestic and commercial buildings is now growing rapidly in response to higher energy rating compliance requirements and more stringent building codes and regulations.

Peters Glass Studio, Paderborn

Peters Glass Studio was established in 1912 by Otto Peters. The company was passed on to his son, Emil, who in turn handed over the management to his son, Wilhelm, in 1981. Peters is one of Europe's largest studios and is located across two sites in Paderborn. Peters has an impressive record of quality restoration of significant works in heritage glass.



Peters Glass Studio's restoration equipment



Conservation and restoration of historical glass at Peters Glass Studio

The International Experience

The Fellow examined the company's protective glazing techniques, as well as its work in conservation and restoration of historical glass. The Fellow was able to tour the restoration studio. Peter's staff is highly trained and skilled in the specialisation of restoration work. As such their qualifications include a minimum of an undergraduate degree from universities specialising in conservation restoration studies. The methodologies employed Peters are current and recognised internationally and are monitored by regulatory bodies and heritage legislation. Their studio facilities are essentially technical laboratories. They are equipped with magnification equipment linked to computerised systems. The detailed analysis, recording and archiving of data is paramount to the process as many of the projects involved date back to the earliest centuries of medieval stained glass. Peters were working on a window at the time of the Fellow's visit that dated back to the 12th century from Spain.

Peters Studio also has an impressive reputation for its work with photovoltaics.¹⁰ This technology is at the cutting edge of contemporary glass in architecture. The photovoltaic components used in glass are microcrystalline silicon cells that collect and redirect energy. They are used in glass designs as components that are incorporated within the glass. Artists and studio consultants collaborate to deliver on a variety of domestic and international commissions. Because of its reputation, Peters is able to call on an extensive network of architects, artists, designers, engineers and developers. The studio operates from two sites that are furnished with state-of-the-art equipment including kilns, sandblasters, laminating facilities, air brushing and screen printing booths, computer-generated systems, painting and fabrication facilities.

Project management of large-scale commissions is the studio's core business. The studio employs graduates who have specialised in areas of glass-related research or study. For example, some graduates may specialise in computer-generated design where others may specialise in the scientific analysis or research and documentation related to conservation of materials. Emphasis is given to finding appropriate solutions to energy conservation issues with the use of photovoltaic components in the glass designs. Peters Studio has successfully project managed installations of this nature, including a children's kindergarten in Dresden and a 'rathaus' (which translates to 'city hall' or a government building) in Antwerp-Deurne.

Projects such as these demonstrate how art and architectural design in glass can combine beauty with function in storing and generating solar power. The studio has an uncompromising commitment to engineering excellence and safety while maintaining the aesthetic integrity of commissions in their care.

Product Development

Peters Studio's laboratory has developed an advanced cold colour painting application marketed under the name *Condecora*. The product is versatile and can be applied to glass (interior, curved, insulation and laminated), wood, acrylic and metal, using a variety of applications such as screen-printing and airbrushing. It is available in a wide pallet of translucent and transparent colours, as well as a colourless application that simulates acid etching or sandblasting.

It has an excellent optical quality similar to glass enamels that are currently kiln fired onto glass. The firing of enamels onto glass is a difficult process that requires access to expensive equipment and facilities. Enamels are often unstable in UV light. Unless protected by another layer of glass, they are prone also to destabilisation from solvents and cleaning.

¹⁰ Photovoltaics is the field of technology and research related to the application of solar cells in producing electricity.

The International Experience

Condecora is UV-stable and scratch resistant. It is also resistant to seawater, acid and a variety of benzene and nitro thinners. It has low flammability, is suitable for use on fire protection glazing, including fire doors and can be certified with a compliance certificate. It can be cleaned with standard disinfectant and liquid cleaners and removed completely from glass surfaces. *Condecora* may well be the solution to some of the technical issues many glass designers face in endeavouring to comply with safety standards and integrity issues when using coloured applications on large glass surfaces.

Energy conservation is being enhanced through new glass surface coatings and glazing systems. These incorporate low energy products to improve and control heat loss and gain. Glass with energy-saving properties is being produced by glass manufacturers; including coating the surface of the glass with metallic oxides and heat baking to make it relatively permanent, thereby enabling the glass to reflect heat. The coatings are prone to damage and do require special handling during processing and installation. Emissivity is measured on a scale from 0 to 1, with 1 representing the highest emissivity. Low emissivity-rated glass means that some radiation, particularly shortwave radiation which comes from the sun, is reflected rather than absorbed and therefore keeps buildings cooler. The same glass offers high reflection of long-wave infrared energy that greatly reduces heat loss in cold conditions.

When these glasses are installed in Insulated Glazed Units (IGUs) the insulating properties are improved and can be calculated to be compliant with building codes. Glass and glazing systems can be given a U-rating that is identified by mathematical calculations and is determined by the statistics offered from the glass thickness and type used in conjunction with the glazing system to which it is applied. Although double and triple-glazed systems are not new in cold weather climates such as Europe or Britain, the benefits of incorporating more energy-efficient glass into these systems is being increasingly recognised.

Building an IGU requires a process to prevent condensation being trapped between the sealed glass sheets. Different methods are used to achieve this, including the injection of gases, with variable levels of success and the resulting U-values (thermal transmittance) are indicated on the finished products. Certification is available on all glass products and some systems are stamped or labelled to that effect.



Example of external protective double-glazing used in stained glass windows of Milan Duomo building



Double glaze system using a forged or slumped section of glass

The International Experience

The Australian lead lighting and stained glass industry sectors have been slow in addressing energy conservation. The sectors' conservative approach has been driven by concerns about the impact on aesthetics of new methodologies and technologies. Resistance has revolved around two issues. First, this type of glass had never been glazed in such a way in Australia. Second, there are concerns about the cost effectiveness of new glazing systems.

Double and triple glazing has been used for decades in Europe for both general and decorative architectural glass components. Greater energy efficiency was historically not a principal factor governing double and triple glazing. Rather, the motivation in providing thermal IGUs was to provide protection during European winters. Significant heritage work – including medieval restorations – have been increasingly conserved and restored with protective glazing.

The photo on the right on the previous page shows a double glaze system using a forged or slumped section of glass with a simplified mirror image of the lead light design lines that mirror the structure of the window. The stained glass is double glazed in front of the clear, slumped float glass. This type of glazing option is one method to enhance safety standards and energy conservation. Double-glazing with non-reflective glass is another method. It has the advantages of other glazing options without the reflected glare that can affect the exterior aesthetic of an installation.

In Australia, polycarbonate sheet products often become compromised visually due to the propensity of the product to become cloudy and opaque, as well as being prone to scratching and buckling due to the effects of UV light. Very little energy conservation is achieved through the use of polycarbonate.

When used as protective glazing safety glass provides clarity without the distortion of polycarbonate, while also delivering good energy conservation outcomes. The types of coating used determine the choice of glass. Low emissivity (Low E) hard-coated glass products dramatically improve the insulation properties of glass. The U value of windows can be determined and energy ratings provided to architects and contractors. The inclusion of Low E glass improves energy efficiency by reducing power needs for heating, cooling and lighting, thereby reducing greenhouse gas emissions and energy bills.

While multi-glazing systems are common in Germany, they are not as popular in Britain where debate continues into appropriate use and development of these applications. Multi-glazing systems need to take into account the requirements of existing structures as well as the maintenance of the original fabric. IGUs must also be compliant with strict conservation guidelines. In some instances the injection of mixed gases produces a higher U-value than argon gas-filled units. The mixed gas option reduces the air space size required, thereby allowing for thinner IGUs to be installed into delicate heritage frames.

A company developing this technology in the United Kingdom is Slimlite Double Glazing Ltd.¹¹ This company's 'slimlite' IGUs have been used in heritage buildings, as seen on the 'Grand Designs' television program. The units are slim and thus able to be installed into window frames with smaller rebates.

The Australian glass and glazing industry needs to adapt rapidly to double and triple glazing of glass structures in architecture in order to comply with energy conservation standards and regulations. New technologies and access to quality materials are a crucial component of any successful transition.

¹¹ www.slimliteglass.co.uk

The International Experience

Franz Mayer of Munich Inc Mayer'sche Hofkunstanstalt GmbH¹²

(Glass studio since 1847)

The Franz Mayer Studio marked its 160th anniversary in 2007 with a new 30,000 square foot studio space to service large-scale float glass painting commissions.



Franz Mayer



Wilfred Jäkel and the Fellow investigating the vast store of ancient Smalti glass used in exquisite mosaic production

With state-of-the-art equipment, the latest available materials and a highly skilled workforce, the studio provides artists, architects and designers with a place where they can experiment, develop design ideas, and work in collaboration with others and studio staff to take a vision or design from the concept stage through to fabrication.

This ultra-modern studio is highly organised and efficient, yet its work and its people remain true to the Mayer culture and traditions established over more than one and a half centuries. It has an extensive library of materials and provides a range of technical, project management, archival and consultancy services. The studio has a long and extensive experience and a rich historical background that includes large-scale mosaic projects and restorations. Mosaic commissions are a major component of the studio's portfolio.

Studio Equipment

A stainless steel flat bed spray booth is fitted with extraction vents around the edge lip: this ensures all residue paint is drawn away from the surface of the glass. This system allows the designer to view the work full size and apply materials safely without the need to wear respirator masks and shields.

The studio also uses computer-aided design application techniques for glass painting. The Fellow witnessed this technique being used on a 5 square metre float glass.

¹² info@mayer-of-munich.com

The International Experience

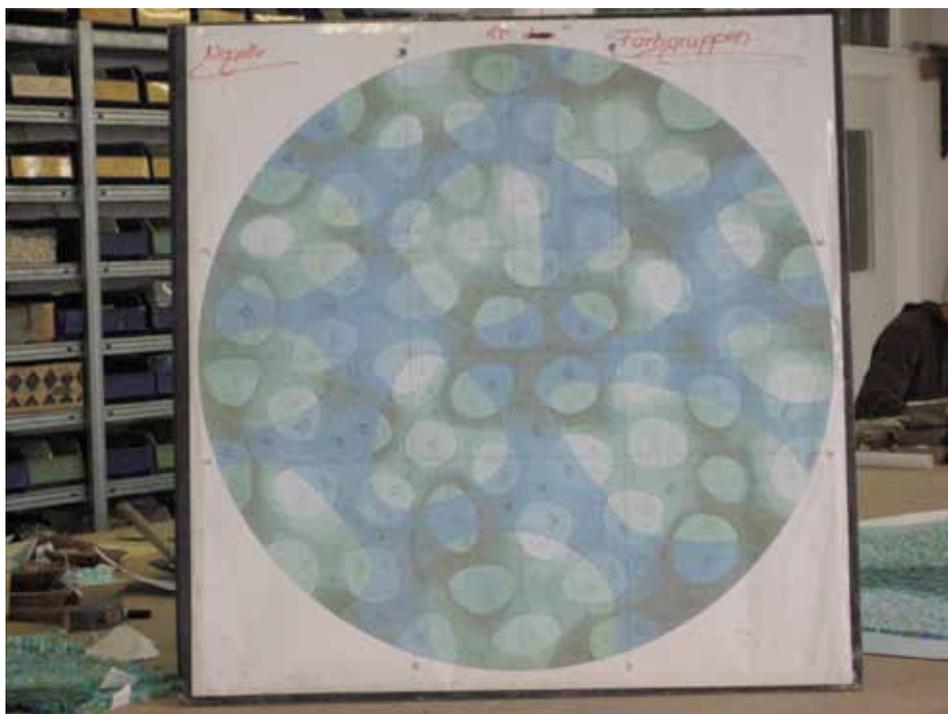
The glass remains stationary while a spray nozzle mounted on a moving arm applies even amounts of glass paint to the glass prior to kiln firing. The firing process fixes the paint permanently as the glass is toughened to become safety glass. After the firing process the glass can then be laminated if required.



Mosaic studio at work



Mosaic studio at work



Close-up of a design for the project

The Fellow met Mayer trainees as well as an employee who had recently graduated from the apprenticeship program at the Mayer studios. All apprentices are individually mentored by a master within the workshop and attend formal schooling usually at an advanced technical school similar to the Australian TAFE system, or attend university. Ongoing staff training is a studio priority. While basic elements of the apprentice training are consistent with apprentice training in Australia, apprentices must also study and successfully complete a range of core subjects including history, mathematics, politics, languages, management and professional practices. Fine art and design are also part of the curriculum.

The International Experience

A significant training component is mentoring by people with master artisan qualifications.¹³ The mentoring program is steeped in tradition. The mentor must have completed a significant apprenticeship and have been working for a considerable number of years within the realms of the craft to be deemed worthy of the responsibility of mentoring an apprentice.

The Herz Jesu Kirche (Church)



The front of the Herz Jusu Kirche's outer glass skin by Alexander Beleschenko



The inside of the Herz Jusu Kirche's outer glass skin by Alexander Beleschenko

Construction of the Herz Jesu Kirche was completed in November 2000. Fire destroyed the previous church in 1994. The renowned English architectural glass artist, Alexander Beleschenko, was commissioned to create the outer glass skin that envelops the internal wooden structure.

The design concept for the glass skin was inspired by passages from St John's Gospel. The 224 square metre glass skin comprises 432 panels, each 78cm x 77cm. Each panel has a raised blue silkscreen print with an arrangement of nails that when viewed from a distance, form a satin-like pattern. This allows light to permeate the interior of the church during the day and enables an illuminated light show at night. The patterning is screen printed on two inner surfaces of toughened double-glazed glass, thereby providing better visitor safety and improved energy savings. The entire front facade comprises two spectacular 14-metre high doors.

¹³ Through its research in Australia and overseas, ISS Institute has identified the way forward through its report: *Master Artisan Framework for Excellence - A New Model for Skilling the Trades*. ISS Institute, December 2004. ISS Institute reports: "the trades are the economic backbone of our economy. Yet, they are often unseen and, in the main, have no direct voice on issues that are within their domain of expertise. The Trades are equal, but different to Professions. They are, however, educationally, economically and socially disadvantaged against those in professional disciplines. This has a direct flow-on effect to our economy". The Australian Government, through the Department of Employment and Workplace Relations, commissioned ISS Institute to prepare an *Australian Master Artisan School. Program and Courses. Feasibility Implementation Plan*. May 2007.

The International Experience



A close-up of one the glass panels that make up the Herz Jesu Kirche's outer glass skin

The structure is essentially a glass box made up of a rectilinear form of grids within grids. The artist has used opaque white glass at the easterly aspect (rear) of the church, which progressively becomes translucent approaching the westerly aspect (front) front of the church where the glass skin becomes fully transparent.

This monumental work complied with all the safety standards/requirements and the architect's brief. The Fellow noted that one glass panel at the front of the church had been broken by vandals.

Although it had fragmented into small pieces, because it was toughened and laminated, the panel held together as one sheet. The Mayer studio has been engaged to replace the damaged section.

Augsburg Cathedral, Augsburg

As a student of stained glass and architectural glass, the Fellow identified a selection of historically significant windows for detailed examination. The Prophet Windows in the Augsburg Cathedral were glazed towards the end of the eleventh century. Texts such as 'Stained Glass' by Laurence Lee, George Seddon and Francis Stephens¹⁴ suggests that the five Old Testament figures remain in their original frames in the clerestory of the nave. The figures are eight feet high and proportionally exaggerated to create strong, bold figures. It is believed skilled artisans from the Abbey of Tegerneseesee created these stylised designs.

Lamberts Glass, Waldsassen

Lamberts Glass is a third generation family owned company. It prides itself on its commitment to sustainability and care for the environment. It has an outstanding international reputation as a maker of quality antique glass.

The Fellow visited the Lamberts Glass factory in Waldsassen to obtain new insights into glass making techniques, in particular the range of materials and colour palettes used.

The company began investing in green technologies in the 1970s – well before Germany introduced industry-wide environmental protection regulations. Lamberts Glass boasts a sophisticated filtration system to reduce air pollution during the melting of heavy metals. The company is investing in water recycling systems and photovoltaic cells to supplement the factory's electrical requirements. While glass making is a resource-hungry process, Lamberts Glass is an industry leader in green manufacturing technology.

¹⁴ *Stained Glass* 1976, Lee, L, Seddon, G & Stephens, F, London

The International Experience



Glass blower in Lamberts Glass



Glass samples in Lamberts Glass



Glass samples in Lamberts Glass

Lamberts Glass supplies many of the major glass studios that work on international commissions. In addition to its more than 3000 regular lines of glass, Lamberts Glass also makes glass to order and often works with glass artists to design and custom-make glass product to specification. The company invests in research and development. It is currently working in partnership with the Bohle Group testing laminating adhesives to further improve the lamination of Lamberts' antique glass to a base safety glass. This research is nearing completion and, to date, results have been positive.

Findings

Laminating coloured glass onto safety glass is one of the new techniques that meet the design standards of architects as well as safety and energy rating regulations. Only a small number of companies make mouth-blown glass, the two major ones being St Just (France) and Lamberts Glass (Germany). Although there is a market for this glass in restoration and conservation projects, it is also in demand for use in contemporary architectural work. While material costs are high; the results can be spectacular.



Australian manufactured glass is limited to clear float glass, tints (such as grey or soft ambers), mirror glass, safety glass and solar-coated float products. All coloured glass – art glass, stained glass or lead lighting glass – is imported. Mouth-blown glasses from companies such as Lamberts Glass constitute the high end of this market.

The photo to the left (a larger version is shown on page 31) shows mouth-blown antique glass laminated onto a clear sheet of glass. The glass has been acid etched and painted with glass enamels. The pieces have been joined without the use of the usual lead matrix, thereby giving the piece a delicate lightness while simultaneously providing the strength of a laminated product, without compromising the aesthetics.

The International Experience

Discussions with Lamberts Glass representatives at the Glasstec Conference and the subsequent visit to the company has given the Fellow a greater understanding of what Lamberts Glass had to offer the industry in Australia. Lamberts Glass is able to supply mouth-blown glass through its distributor in Australia, which is Hartley Williams in Queensland.

The company is also keen and willing to assist in training Australia's industry in the use of laminating adhesives. Using adhesives allows the designer to use smaller sheets of mouth-blown glass and attach them to larger sheets of safety glass produced by the float glass industry, thus enabling the use of artistic glass without compromising safety standard requirements.

United Kingdom: England

Central Saint Martins College of Art & Design, Southampton

The Fellow was intending to visit Central Saint Martins College of Art and Design in Southampton. The college was established in 1989 by the merger of the Central School of Arts and Crafts (founded 1896) and St Martin's School of Art (founded 1854).

Internationally recognised for the work of their students and staff, Central St Martins provides a range of courses, including theatre design, industrial design and graphic design. Unfortunately, circumstances beyond her control meant the Fellow was unable to confirm a suitable time to visit the College. The Fellow utilised the subsequent gap in her schedule to visit the Victoria and Albert Museum, to gain a more comprehensive understanding of the historical context of glass and its development.

The Victoria and Albert Museum, Kensington

In its dedicated glass gallery – The Marit Rausing Gallery – the Victoria and Albert Museum houses a world class collection showcasing the history of glass from the beginning of glass making to contemporary examples of architectural glass panels.

The visit to the Victoria and Albert provided the opportunity to experience the use of float glass components that formed an architectural structure, a staircase of glass, made by studio art glass designer Danny Lane.



Front of the Victoria and Albert Museum showing stained glass panels



A staircase of glass made by studio art glass designer Danny Lane

The International Experience

Danny Lane studied with Patrick Reyntiens, painting at Byam Shaw School of Art and the Central School of Art. Lane's work is often monumental. He works in both sculptural architectural and functional art in glass. His use of stacked and fractured glass and metals relies on the refractive and reflective qualities of glass to engage the viewer and exploit its strength as a structural material in architectural setting and components. He overcomes design and engineering issues to produce work that is both compliant with regulations and breathtaking in its apparent simplicity. His London studio is equipped to create works of considerable scale in glass, wood and steel. Working nationally and internationally on commissions, Lane's work is represented in museums, private and corporate collections worldwide.

The Fellow concluded that glass practitioners working successfully in large commissions are generally formally educated in the arts usually at the university level.

Westminster Abbey,¹⁵ Westminster

The Westminster windows of greatest interest to the Fellow were the contemporary additions designed by Graeme Jones¹⁶ and dedicated to the Abbey in 1994. The use of contemporary glass installed within historic architecture has always presented unique challenges. To see modern work installed into such a historic building highlights the need for the artist to have sensitivity to the relationship between the historical windows *in situ* and the new work presented within the same visual space. The windows were uniquely modern at the time of production and today have a contemporary edge that belies their age.



The Westminster windows

These modern windows set in this historically significant cathedral highlight the compatibility of old and new work sitting comfortably within one context. The plated, etched and enamelled antique glass lights are constructed using the ancient stained-glass techniques with a modern concept. The design is based on the English gardens and their seasons. The windows are 10 metres by 3.5 metres.

The windows commemorate the architectural historian, Edward Horton Hubbard (1937 – 1989) who championed the conservation of Liverpool's heritage.

The twelve small diamond-shaped panes were designed in antique glass and are memorials to poets and writers. The window is installed above Geoffrey Chaucer's tomb in Poets' Corner.

While the designs are reminiscent of designs produced in traditional thirteenth century stained glass, they are abstract geometrical designs interrelated into a series of roundels.

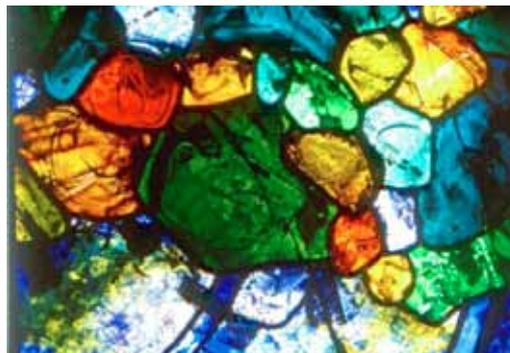
¹⁵ www.heritage.westminster-abbey.org

¹⁶ www.grahamjones.org.uk

The International Experience



Close up of the Westminster windows



Close up of the Westminster windows

AS Handover Ltd,¹⁷ Leeds

AS Handover has been manufacturing quality artists' and signwriters' brushes for more than 50 years. The company's comprehensive range of products meets the needs of artists, sign writers, specialist and traditional decorators, gilders, pin strippers and stained glass artists.

Badger hair brushes are an important tool for painting on glass. The brushes are usually hand made and are expensive. The Fellow was privileged to meet an employee of AS Handover who is believed by the company to be the last of the brush makers, and establish a contact for purchasing such equipment in Australia in the future.



The brush maker working on new orders at AS Handover

Brush making is a dying craft. AS Handover do not have a replacement for their current brush maker. Finding a suitable apprentice brush maker is proving difficult. Sadly, the skill of handmade brush making may be lost completely. This highlights the need to protect and foster small crafts. Once the skills are lost they may never be regained.

Australia and overseas studios may find it difficult to obtain suitable brushes and tools in the future. Stained glass painting, particularly restoration and conservation work rely on specific styles and types of brushes to achieve quality reproduction outcomes.

Coventry Cathedral, Coventry

Coventry Cathedral is a cutting-edge building project incorporating glass in architecture. Artists, designers and architects collaborated to produce a symbolic reminder of the devastation caused by war. It was the only British cathedral destroyed by German bombing during World War II. The old ruins were retained and a new cathedral created to symbolise indestructibility of place and faith.

¹⁷ www.handover.co.uk

The International Experience

Initially, the design created controversy. It is now acknowledged, however, as the progenitor of Britain's progression from conservatism to modernism in ecclesiastical architecture. Coventry Cathedral provides a valuable example of what can be achieved through collaborative approaches to construction. Today's practitioners in glass can only gain inspiration from artists such as Patrick Reyntiens, John Piper, Lawrence Lee, Geoffrey New and John Hutton who contributed to the rebirth of Coventry Cathedral.

Of particular note is the sculpture, *Christ Crucified*, by Helen Jennings. The artist has used material taken from car wrecks, symbolising regeneration and transfiguration.



Coventry Cathedral



The sculpture, Christ Crucified

York Minster Cathedral,¹⁸ York

York Minster – the largest Gothic cathedral in northern Europe – contains stained glass dating back to the twelfth century. The 130 windows are the largest collection of medieval stained glass in England.

York Minster houses the famous Grisaille glass in the form of five light windows known as the Five Sisters. The windows are approximately 24 metres tall and 10 metres wide. Restoration work is ongoing.

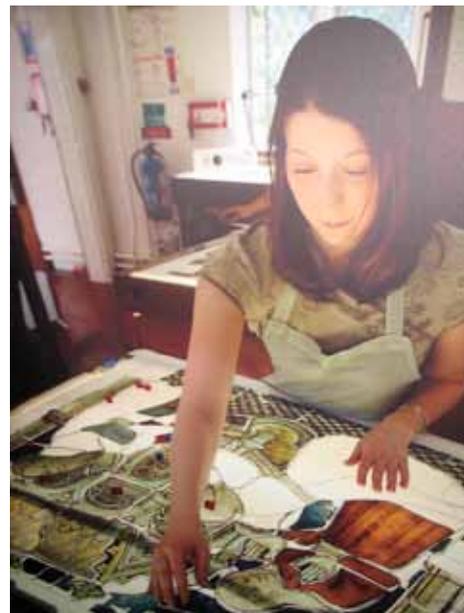
When undertaking a close examination of the windows, the Fellow noted the structural matrix that has held these lights in place for centuries. York Minster has an on site restoration studio working to a cyclical maintenance program. For large cathedrals an onsite studio makes good economic sense as a way of maintaining significant works and training new students in glass conservation. In addition, to its in-house work, the York Minster studio also undertakes selected outside commissions.

¹⁸ www.yorkminster.org

The International Experience



Conservation work on the Great East Window at York Minster Cathedral



An apprentice prepares glass for cleaning as part of the restoration process at the studios of York Minster Cathedral

The conservation and restoration work will completely restore the stonework and the Apocalypse section of the Great East Window. State-of-the-art glass conservation techniques being used include microscopic analysis, computer imaging and x-rays.

Sunderland University, Sunderland – Faculty of Arts, Design and Media



Sunderland University

The faculty of Arts, Design and Media is based in the National Glass Centre located on the Sir Tom Cowie Campus at Sunderland University. The university facilitates an interface between glass artists/designers, practitioners, and students through the use of the gallery and the modern glass facilities provided. The symbiotic relationship between the faculty and the National Glass Centre keeps the students, gallery and industry connected in the real business of exhibiting, marketing and selling work.

Institute for International Research in Glass (IIRG)

The university incorporates the Institute for International Research in Glass (IIRG). The IIRG was established in 1998 to promote and facilitate research in glass. Through contemporary glass practice, IIRG disseminates information through exhibitions, residencies, master classes, workshops, publications and projects.

The university also facilitates an interface between glass designers/artists, practitioners, students and the public through its *Gateway to Glass*¹⁹ – a web-based resource in glass research and practice.

¹⁹ <http://www.gatewaytoglass.org>

The International Experience

The Fellow received a briefing from Dr Kevin Petrie²⁰ on the facility, equipment and curriculum. The programs offered in the United Kingdom are similar to those available to students studying glass in Australia at university level. An important difference, however, is that entrants in the UK are often introduced to Bachelor of Arts courses through a foundation year of study to give them a basic grounding prior to moving to specialised subjects.

The facilities are modern. Studio spaces provide full glass-blowing facilities, casting glass sandblasting and computerised waterjet cutting machinery. Significant numbers of staff are also practicing designers/artists with particular specialised skills.



A 5-axis waterjet cutting head. Attribution: <http://www.wardjet.com/copyright.asp> One of Sunderland University's studio spaces

The university is highly regarded internationally. Many of the students completing masters programs are from overseas. Masters students came from many disciplines and do not necessarily have a background in glass. Studio space is freely available to students and the gallery almost exclusively houses student work.

The National Glass Centre is part of the same complex. It connects educational disciplines with gallery business issues such as the real marketing, advertising and exhibition management. It hosts exhibitions and master classes by internationally renowned designers/artists.

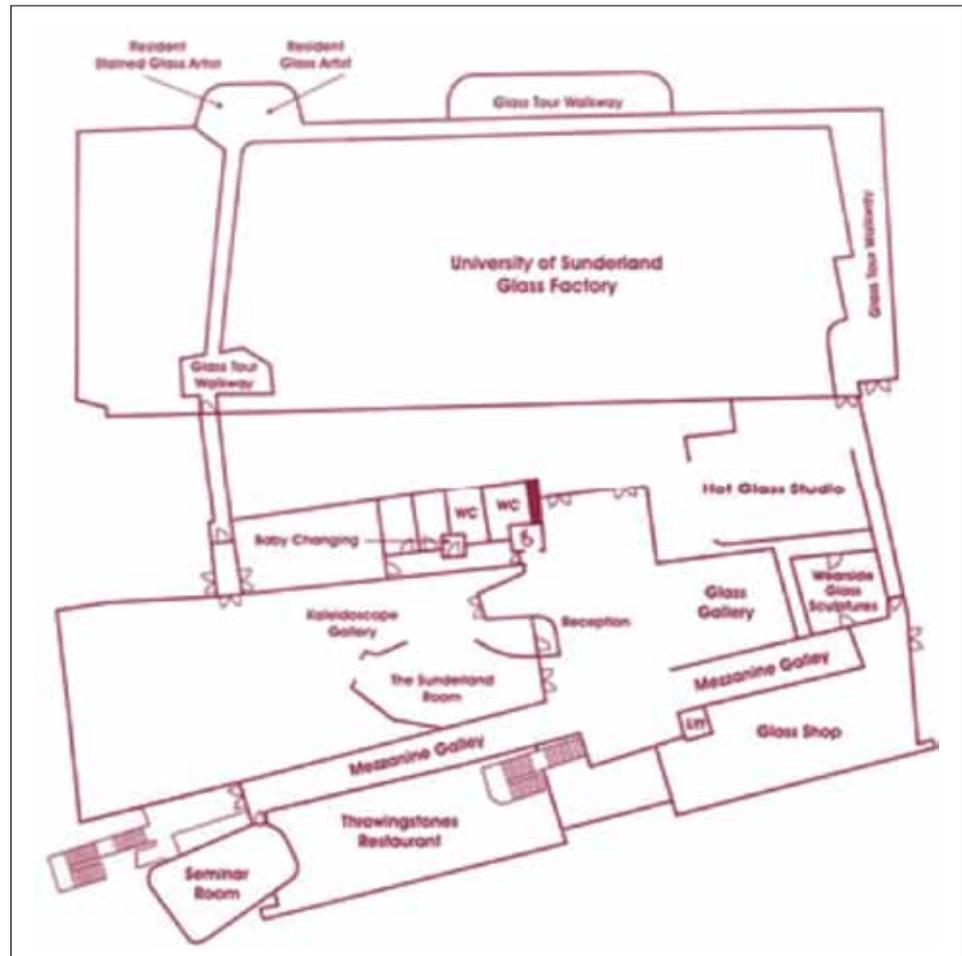
Students are involved in all aspects of working with glass through to the presentation for sale or display. Mentoring and artist-in-residence programs further enrich the student experience. The university prides itself on the diversity of its programs and excellence in program delivery. The programs are:

- BA (Hons) Glass, Architectural Glass and Ceramics
- MA Glass
- MA Ceramics
- PhD – Practice and Theory

Staff members are also supported with professional development opportunities such as fellowships and sabbaticals.

²⁰Dr Petrie is program leader for the Master of Arts at the University. He studied illustration at the University of Westminster and ceramics at the Royal College of Art, London. He has a PhD in printmaking from the centre for Fine Print Research at the University of West England, Bristol. His book, *Glass and Print – Glass Handbook* documents the various methods of printing applications on glass including screen printing, relief printing, printing using plates, photographic print processes on glass, including digital and laser technologies, and sandblasting.

The International Experience



This floor plan illustrates the physical connection between the university and the gallery. It attracts many visitors, including tourists and professionals working in glass.

Salisbury Cathedral, Salisbury

The Cathedral's Prisoners of Conscience windows were commissioned from Loire Studios in 1979 and installed in 1980. Loire Studios is located near Chartres in France and was chosen because of its extensive experience in medieval glass and modern application. The commission was done by Gabriel Loire and his son, Jacques.

These five lancet windows replaced the lancets installed originally in an early gothic style church around 1220 and subsequently removed during the Reformation. The removal of the original lancets had denuded colour from the church interior. The colour loss was compounded because of the Chilmark stone used for the church interior and the Purbeck marble shafts. The studios created a design using a variety of blue glasses in a medieval style.

Many stained glass painters work on a light box and assemble the glass pieces as they paint. Alternatively, glass is adhered to a clear glass plate on an easel prior to the painting stage. For this commission however, a unique construction method pioneered by Loire Studios was used.

The International Experience

The work was first leaded together prior to painting the stained glass. The panels were then placed on easels and stained glass paint applied to each piece. This allowed the artist to see his work in its entirety while he worked on the panel's tonal values. Although this painting method is costly, the accuracy achieved in transition from one panel to the next is faultless. The panels are then dissembled and the glass fired. After firing the pieces are then reassembled.

Tour of the Salisbury Cathedral Restoration Workshop with the Verger

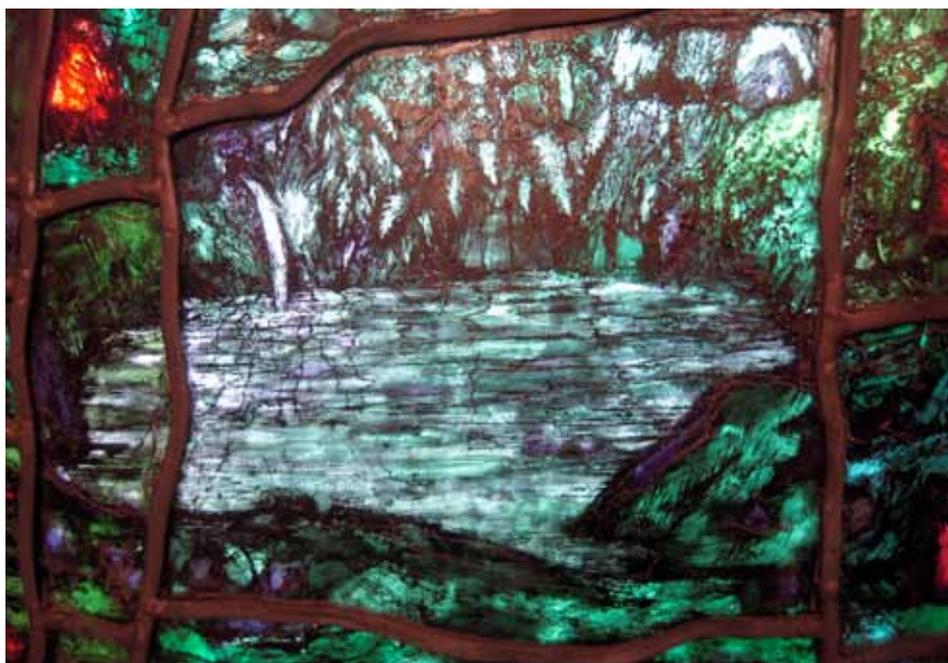
During this visit the Fellow met a number of skilled craftspeople and apprentices. The apprenticeship training regime is very similar to Australia where apprentices are attached to a studio and attend college on block release several times a year for three years.

Hereford Cathedral, Herefordshire

The *Traherne Windows* in Hereford Cathedral were commissioned from a local stained glass artist, Tom Denny.²¹

The windows were constructed using glass enamels painted and fired onto the glass. Situated in a small chapel on the outer rim of the church, the lighting from the windows was subdued and did not illuminate the space.

While the photographs shown below and on the next page are excellent representations of the work, it was darker in situ. This lack of illumination highlights the importance of considering the lighting parameters of any work while still at the planning stages.



A section of the Traherne Windows

²¹ www.protostudios.com

The International Experience



A section of the Traherne Windows

Proto Studios,²² Wiltshire

Proto Studios has been operating for 25 years. David Proto is the owner. The studio provides a range of facilities to artists working in glass.

Proto Studios laminates glass onsite and trains apprentices. The studio also works with other facilities to handle kiln firing and has managed to overcome the challenges associated with transporting glass coated with unfired enamels. It is also producing large-scale works involving screen printing and sandblasting.

At the time of the Fellow's visit, two apprentices were undergoing onsite assessment by an assessor from a local trade school. The Fellow had an opportunity to discuss assessment models.

Much of the training competency in Australia can be delivered onsite through the training mentor and assessed onsite by a qualified assessor.

This model enables apprentices to be observed and assessed in their work place or on a building site. The apprentice does not have to leave the work site and can be trained and assessed on equipment used in the work place and in a real working environment rather than being assessed on simulated experiences and models. The mentor/employer takes part in the training plan and develops an understanding of the expected outcomes for that particular training module.

²² www.protostudios.com

The International Experience

On the other hand, one drawback is that the apprentice only has exposure to limited applications and processes in one place of employment. He, or she, may not get the benefit of experiential learning that can be imparted in the formality of a training institute.

This onsite assessment model, therefore, is reliant on the quality of the training assessor and his or her capacity to assess an apprentice or trainee with the appropriate rigour in order to identify and recommend any necessary supplementary training.

The photo below left shows an apprentice mixing stained glass enamel paint. This particular batch is a premixed preparation sold off the shelf. The enamel paint is mixed with a screen medium that, when fired onto glass, does not leave a residue. The studio undertakes numerous firing tests to determine the best mixtures and colours to apply to achieve the best results.



An apprentice mixing stained glass enamel paint



Proto Studios works with screen-printing to apply the paint to the glass

Screen-printing on glass has become the standard technique used by European and British studios to cover large sheets of float glass with coloured designs.

Proto Studios works with screen-printing to apply the paint to the glass. The usual application method is to apply a photosensitive film to the screen. The screen is then exposed to direct UV light to develop the image. The screen is then cleaned by high-pressure water to remove areas of resistance before proceeding to the printing stage.



This screen is being cleaned with high-pressure water to remove areas of resistance before proceeding to the printing stage



Flat bed dryer – drying enamels on glass

The International Experience

Once the enamel is on the glass, it is semi-dried in a flat bed dryer at 100 degrees celsius. This stage of the process dries the enamel on the surface. A layer of plain smooth paper is sandwiched between the sheets of glass. The paper protects the enamel from scratching and prevents the sheets sticking together. The stacked block is then packed for transport to the location where the glass is to be toughened.

Toughening and re-firing of the enamel is achieved in the one process.

United Kingdom: Wales

Hay on Wye

The Fellow was able to obtain a number of resource materials from Hay on Wye to add to the teaching library. Difficult-to-find books now available in Australia because of this Fellowship include: Italian Stained Glass Windows by Marchini, Thames and Hudson London 1957 and a range of Italian printed art plates.

Swansea

The Fellow was hosted by the artist and 2005 'ISS Institute/OTTE (Design) Fellow', Amber Hiscott,²³ and visited various locations to examine her commissioned work. The Fellow held detailed discussions with the artist on techniques and applications, including large scale sandblasting, screen printing, acid etching, painting on glass and lamination techniques.

Amber Hiscott has used new techniques for painting on glass in many of her contemporary architectural commissions.

While painting on glass is by no means new, paint application techniques for glass have developed rapidly. The various requirements for architectural glass to comply with safety and energy conservation standards led to improved surface paint application processes and technologies.

The application of coloured enamel paints suitable for glass has been an integral part of stained glass painting for many years. Over time, enamel paints fired onto glass can become fragile and fade if exposed to natural light. Many enamel-painted windows have been lost forever for those reasons.

Traditional glass stainer paints remain stable if applied and fired correctly. Enamel glass paints have tended to be prone to deterioration. The result is that preservation can be difficult, although recent advances in materials and techniques have improved the quality of new enamels.

²³ Amber Hiscott is a graduate of the Swansea College of Art in Architectural Glass. Hiscott also works in collaboration with a fellow artist, David Pearl. While Hiscott's work has been produced in studios including Derix and Peters, her preferred studio is Proto Studio in Wales (www.swansea.ac.uk).

In 2005 she was awarded the prestigious 'ISS Institute/OTTE (Design) Fellowship' sponsored by OTTE, Victorian Government. Hiscott conducted a series of 'Architectural Glass Workshops' that introduced participants to creating innovative solutions using glass in architectural settings. Participants were from the Value/Supply Chain such as: architects, interior designers and decorators, builders, glass artists, glaziers, stained glassworkers, product suppliers, and worked in teams over two days. Sessions covered the history, context and theories of the use of glass. Hiscott also was the speaker at the public lecture, 'Architectural Glass Art'. Coleman's Fellowship builds further depth into Hiscott's, as well as Sando and Taylor's, and Bronwyn Hughes' Fellowships in the field of architectural glass. Hughes was awarded the 1993 'Specialised Skills Training' Fellowship sponsored by Monash University, the Australian Multicultural Foundation and the Palladio Foundation.

The International Experience

The application of enamels on large glass panels is much sought after by designers in glass looking to create areas of colour, light and translucency in architectural settings. These relatively new applications are proving to be a more cost-effective method of achieving results for glass designers than other traditional painting techniques. Enamels are regularly being air brushed, screen printed and hand painted on glass in large format designs. Due to the vast areas of glass that can be designed and produced economically, this application is being used in larger commissions in contemporary glass installations around the world.

Enamels are also being used for direct printing on glass or interlayer materials used for lamination with printers connected to computers. This is revolutionising coloured glass in architecture.

As buildings evolve, so do their decorative elements. Decorative glass is now used in the fabric of buildings in ways beyond just window treatments. Glass is being used in partition and solid walls, sculptures, screens, fences, ceilings, cladding, lighting, water features and artwork.

UV degradation issues have been overcome through improvements in the quality of specific purpose enamels. The mediums used to mix the paints vary as to the requirements of the application. Chemicals used are minimising health risks and, by law, are supplied with material safety data sheets (MSDS). Advances in kiln firing technology are delivering consistent, even glass.

Enamels have traditionally been applied to glass by hand. Some artists still use some hand painting techniques, but brushes are being replaced increasingly with large brooms, spray guns, and various screen printing processes that can cover large areas of glass surfaces.

Instead of mouth-blown or traditional glass, today's designers often use large sheets of float glass. Float glass is available in various thicknesses and is often toughened contemporaneously with the firing of the enamels, thereby eliminating the need to fire the glass twice. The glass can also be laminated to other sheets of float glass to meet safety, noise and energy conservation standards

Glass by Amber Hiscott

Great Western Hospital, Swinden



Great Western Hospital



Great Western Hospital



Great Western Hospital

The International Experience

Millennium Centre, Cardiff Bay



Close up of Millennium Centre windows



Close up of Millennium Centre windows



Close up of Millennium Centre windows

Amber Hiscott Studio, Swansea

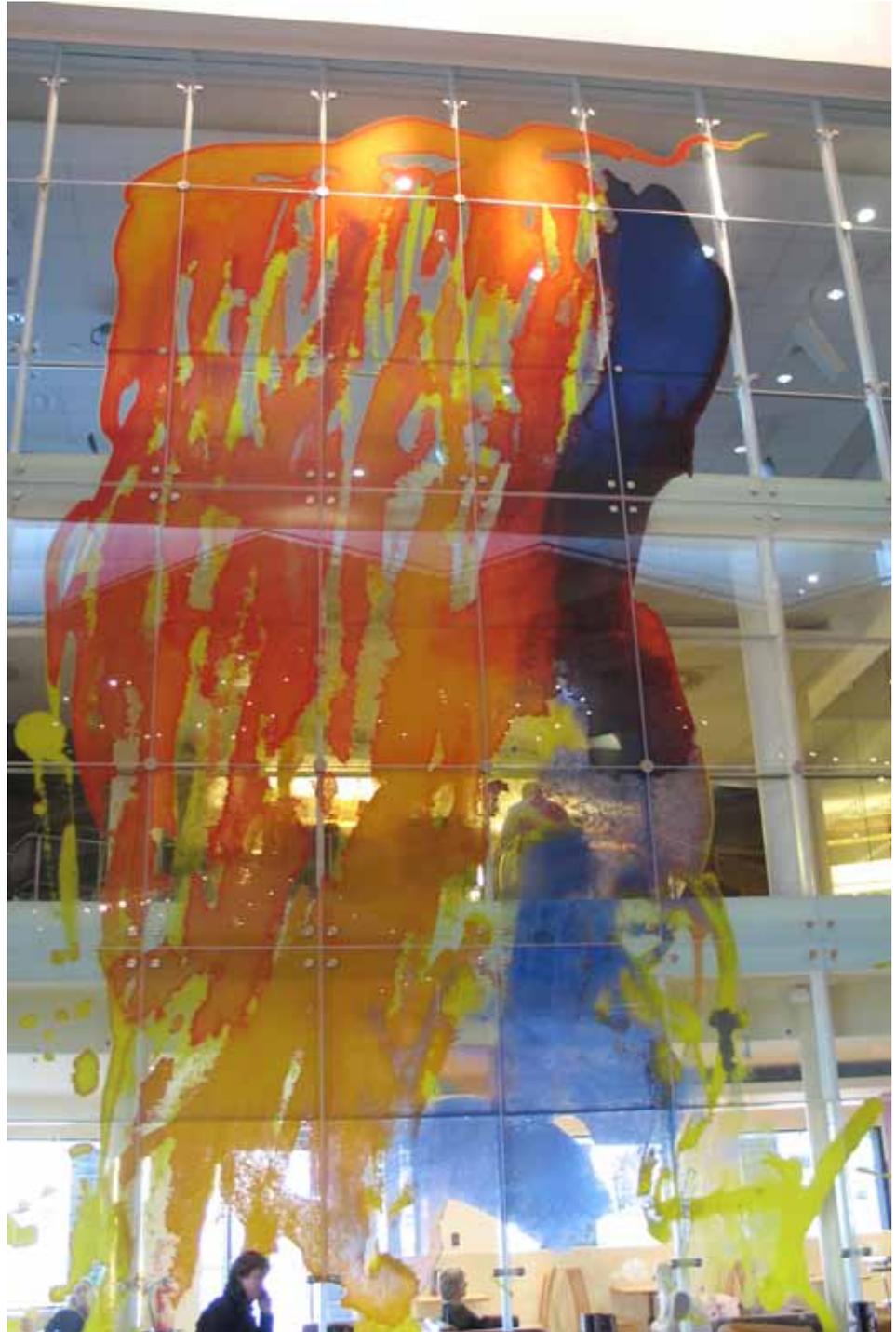
Photo on page 59: Artwork on display at Amber Hiscott's studio, entitled Colourfalls.

Callagan Square, Cardiff Bay

Photo on page 60: Water Towers by Amber Hiscott and David Pearl at night.

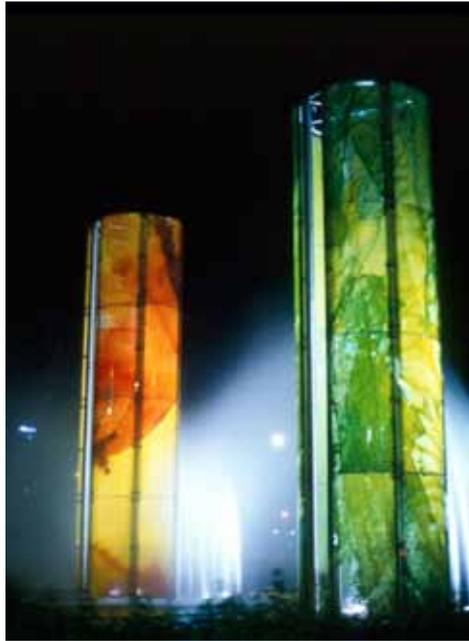
Photo on page 60: Water Towers by Amber Hiscott and David Pearl.

The International Experience



Colourfalls

The International Experience



Water Towers



Water Towers

Alexander Beleschenko

Glass Domed Sculpture, Assembly Sened Building, Millennium Centre, Cardiff Bay



Glass Domed Sculpture by Alexander Beleschenko

The International Experience

Danny Lane

Glass Sculpture 'Assembly Field', The National Assembly for Wales, Millennium Centre Cardiff Bay



Assembly Field by Danny Lane

Swansea University, School of Architectural Glass

The School offers a variety of courses. Its practical program has similar subject outlines to the Australian TAFE system. However, higher-level theoretical components of history, art and design, and drawing at the degree level are also part of the course requirements.

Situated in a heritage building, the glass workshops have recently relocated to improved facilities within the same building. Included in the upgraded equipment is a computerised waterjet cutter capable of cutting with precision and minimum waste any glass shape imaginable.

Cutting machinery such as this has enabled glass designers to explore new and exciting aspects of glass for use in both art and architecture. Nonetheless, such equipment is prohibitively expensive and costly to run.



Just some of the shapes produced by the computerised waterjet cutter at Swansea University

The International Experience

Gateshead

The Fellow visited a shopping precinct at Gateshead in Swansea to view the landmark sculptural glass feature, 'Lookout', by Cate Watkinson.²⁴ Situated on top of the Debenhams retail store, Lookout is inspired by old fashioned 'sweetie jars' and people who enjoy the experience of shopping. It takes the form of a glass and metal basket filled with five metal spheres. Each sphere measures two metres in diameter. One of the spheres contains a time capsule with contents created by local school children.

The sculpture explores how glass can be used in contemporary installations in the built environment, and includes a variety of glass components and mixed media such as stone and metal. Watkinson uses glass as an artist would use paint, to explore light and colour in various settings in and around the building, not just in the framework where we usually see glass.



Metro Centre – 'Lookout' by Cate Watkinson



'Lookout' at night

Ireland

The Fellow visited Ireland to assess educational standards in glass and examine some of the stained glass windows made by renowned artist Harry Clarke.

Harry Clarke (1889–1931) is considered Ireland's greatest stained glass artist and arguably was the finest of his time worldwide. He was prolific in his brief 42-year life. Clarke's windows are outstanding examples of a modernist approach in the art of glass including symbolism, decadence, Celtic mysticism, romanticism and the art nouveau period.

Clarke's work can be found in England, Ireland, Wales and Scotland, as well as in one church in New Jersey in the United States and one in Queensland, Australia.

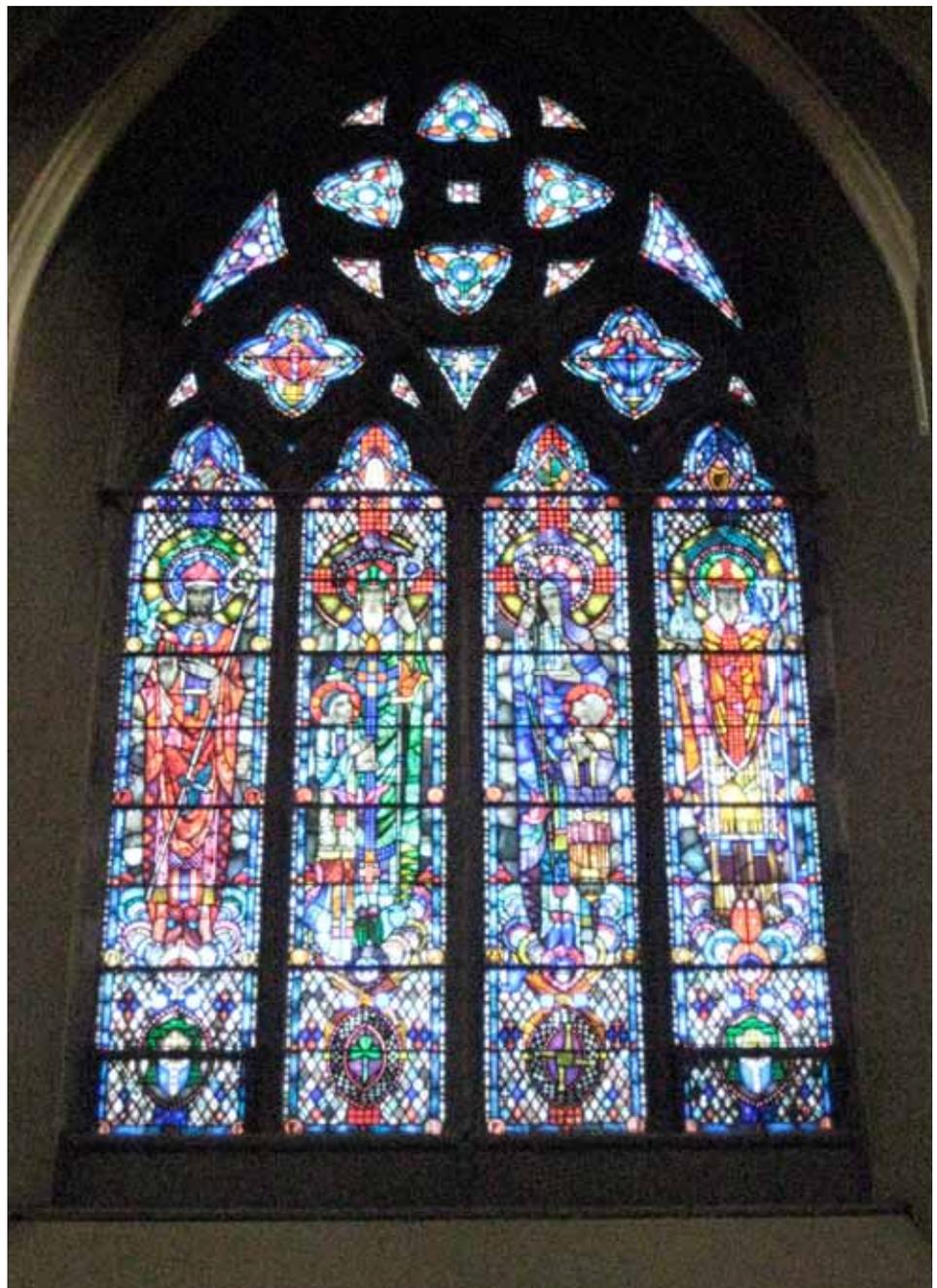
²⁴ www.watkinsonglass.com

The International Experience

Dublin

Basilica of St Patrick's, Harry Clarke Windows

Windows by Clayton and Bell and Kempe and Co, St Josephs



An example of a Harry Clarke window inside the Basilica of St Patrick's

The International Experience

Community College, Cork

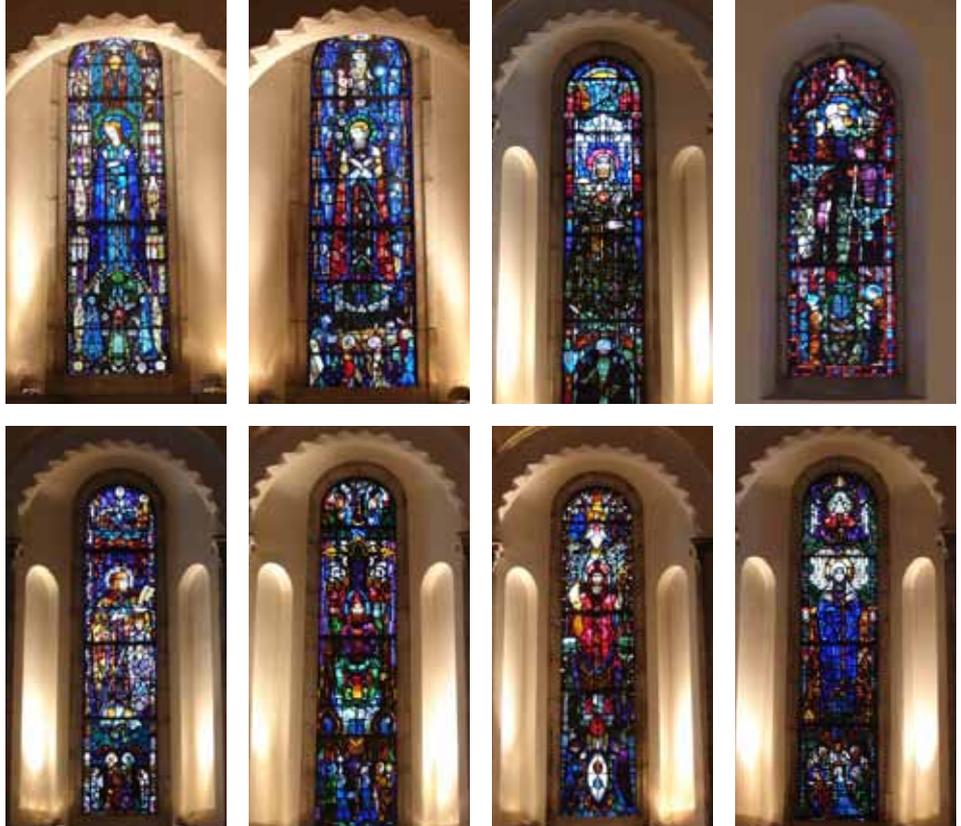


Una O'Sullivan with her students

The Fellow visited the Community College in Mallow and met with Una O'Sullivan, a teacher in glass, together with students at the institute. O'Sullivan is a graduate of Holmesglen Institute of TAFE in Melbourne, Australia. She has continued her art practice in Ireland. O'Sullivan relies on the internet to maintain her professional networks as well as to source materials and tools. She is a dedicated artist and educator, committed to passing on her skills to her students and, in so doing, growing the Irish glass-art skill base.

The Fellow's visit coincided with a glass class in progress. The students were engaged in preliminary projects and the tutor was working in rudimentary facilities with very little equipment.

University College Cork



Windows by Harry Clarke in the Honan Chapel at University College Cork

Knowledge Transfer: Applying the Outcomes

Glass workers in Australia and overseas face highly competitive markets for commissions. Large-scale contemporary commissions remain the domain of the few studios capable of project managing and delivering on a commission.

While apprenticeship and institutional training programs in Europe and the United Kingdom are similar in some basic respects to those in Australia, they differ in a significant way by having an added foundation requirement of a general arts-based course of study in subjects such as maths, politics, history and languages, undertaken in conjunction with art and design.

It is important to disseminate the experiences of the ISS Institute journey and share it with as many within the industry and its allied architectural professions as possible.

The primary means of doing this will be through the Fellow's apprenticeship teaching activities in the TAFE system as the coordinator of the Lead Lighting, Stained Glass and Glass and Glazing courses at Holmesglen Institute of TAFE. This 'ISS Institute/Skills Victoria Fellowship' has provided new insights on design and manufacturing techniques that are being passed on to the approximately 500 apprentices who pass through the relevant courses each year.

Post-travel knowledge transfer activities by the Fellow have included the following:

Conference Presentation

Ausglass Conference, Hobart, Tasmania

Topic: Contemporary Issues in Training Glass in Australia

Lectures

Holmesglen Institute of TAFE

Lectures dealt with contemporary issues in design and techniques. A slide presentation was given on contemporary glass arising from the ISS Institute Fellowship journey.

Powerpoint Presentation to AGDA members: Contemporary Glass in Architecture, May 2009.

Double and Triple Glazing Workshop

Glass and Glazing Department, Holmesglen Institute of TAFE

Proposed Laminating Workshop 2010

Holmesglen Institute of TAFE

Sponsors:

- Architectural Glass Design Australia (AGDA)
- Axxess Glass Products Australia
- Bolle
- Holmesglen Institute of TAFE

Other activities are yet to be determined in discussions with ISS Institute.

Recommendations

Australian Government

Government legislation and associated regulations relating to building codes affecting glass must include consultation with of all glass industry sectors. Too often regulatory changes are made without due consideration given to the economic consequences to small enterprises.

It is therefore recommended: that the Australian Government consults with all sectors of the Glass Industry including AGDA before implementing regulatory changes.

As part of the Henry Tax Review, relevant glass industry professional associations should call on the Australian Government to require the review to consider the efficiency of current tax treatment of art/design commissions undertaken as part of major building projects.

It is therefore recommended: that AGDA, Ausglass and AGGA submit a joint paper to the Henry Tax Review that addresses possible improvements to the current tax regime as it applies to art/design commissions associated with the built environment.

The need for enhancing the skills, knowledge and understandings of educationalists is an essential pre-requisite before progress can be made within future cohorts of students. It is therefore recommended:

- That respective State Governments fund professional development activities to educate university lecturers and TAFE teachers so that they can deliver the curriculum to the required knowledge and skill level. The professional development activities can be through courses eg: workshops or release to industry programs through their respective educational organisation.
- That funding of Master Artisan post-apprenticeship training in architectural glass is implemented as soon as possible, as recommended by the ISS Institute Trades Advisory Council.

Significant opportunities exist for the wider use of glass in architectural and urban environments at the municipal level. This has occurred overseas and some examples have met with success in Australia, for example the glass shards on the streets of Frankston, where fears that glass would be fragile or unsafe have been totally dispelled. It is therefore recommended:

- That Local Government consider incorporating architectural glass as an integral part of their urban planning projects.
- That local governments address the impact on building codes in heritage and contemporary constructions in relation to architectural glass.

Industry Skills Councils

The new endorsed national training package released in mid 2009 includes new competencies that have the potential to develop contemporary skills and knowledge in glass. The development of competency training that reflects contemporary design needs to focus on drawing and design, together with innovative principles and methodologies for the execution of concepts and ideas. It is therefore recommended:

- That Industry Skills Council recognises the specialised requirements for this sector of industry and implements an appropriate national training package in line with future trends as well as current needs.

Recommendations

- That the Industry Skills Council (ISC) recognises the specialist requirements of this micro-industry sector would be better served by collaboration across related ISCs, for example furnishing, building and construction.
- That the ISC develops a specific micro-industry package for the architectural glass sector.

Occupational Health and Safety

Occupational Health and Safety (OH&S) is a major concern of governments, educational institutions and industry. OH&S education and testing occurs as a matter of course in formal training at the TAFE level, but in this micro-industry it is rarely addressed comprehensively. It is therefore recommended:

- That state and government workplace safety agencies undertake an audit of OH&S information relevant to the glass industry and ensure up-to-date OH&S information is disseminated in a timely manner to all sectors of the industry and teaching institutions.
- That ISS Institute and AGDA provides relevant OH&S information through its website.

Industry Associations

AGDA is a relatively new initiative, run by individuals who volunteer their time and resources to the association. With its limited financial resources, the capacity of the AGDA to deliver a full suite of professional services to its membership is limited. It is therefore recommended:

- That greater financial support for AGDA by individuals and companies be sought from its current membership base.
- That AGDA undertakes to further expand its membership numbers, so as to enable the association to more effectively represent the interests of its membership to other professional associations, government and private sector forums.

The 2009 Ausglass conference included more information, speakers and entries related to architectural glass than previous conferences; however, Ausglass policies and memberships are largely oriented toward glass blowing and warm glass techniques. It is therefore recommended: that AGDA and Ausglass establish a strategic alliance to encourage the cross-fertilisation of ideas and technical expertise in order to foster the growing interest in architectural glass and promote architectural glass more positively at future Ausglass conferences.

There is also a need to promote architectural glass beyond its own industry boundaries. It is therefore recommended: that AGDA seeks strategic alliances with other professional associations, such as the Australian Institute of Architects and the Design Institute of Australia, to foster and strengthen positive change and development in the architectural glass industry.

Holmesglen TAFE continues to support AGDA and meetings are held there every month with Holmesglen TAFE representation on the committee. AGDA continue to be involved in training issues and are working with the state Industry Training Advisory Body representatives to consult in training development and changes to the training packages.

AGDA has forged forwards with its initiatives to promote contemporary architectural glass to architects and industry's in design and the built environment.

Recommendations

On October 21st 2009 an inaugural selected contemporary architectural glass exhibition, 'Glass 21' showcased an extensive selection of innovative work by an emerging contemporary industry. Three Holmesglen TAFE students exhibited.

An open member's exhibition called 'Glass off Chapel' followed in August to September 2010. Seven Holmesglen TAFE students exhibited. This exhibition has been extremely well attended and has highlighted the value of exposure of glass design through exhibition format.

The launch of a major selected exhibition in Federation square opening 13th September 2010 will expose the use of contemporary glass forward in a setting used for the display of art and arts related exhibitions drawing much of Melbourne's population into its arena. This launch includes two students from Holmesglen TAFE.

It is recommended that AGDA continues with its charter to pursue promotion of contemporary architectural glass and quality training initiatives into the future.

Education and Training

Training institutions need to review curricula to better reflect contemporary trends in glass and industry demand. There must be a willingness to be involved in the consultative and development processes at government level to advise appropriate changes. Training packages should be developed in conjunction with industry and the relevant registered training institutes.

After consultation in the development stages, training packages should then be offered to Registered Training Organisations (RTOs) to deliver these packages. It is therefore recommended: that new training packages are developed in consultation with relevant teaching staff and specialist practitioners, in addition to the current industry bodies.

New competencies²⁵ indicate a move towards additional training models that reflect greater emphasis on contemporary glass design. However, trainers will still be required to develop programs within the competencies included in these knowledge and skill areas. This can only occur if the Registered Training Organisation (RTO) supports the training with funding to equip departments with the necessary facilities. It is therefore recommended: that the RTO be appropriately funded to ensure that adequate equipment and materials are available to fully implement the national training package.

No clear articulation from TAFE training to becoming a university graduate currently exists: the vocational education and training sector could provide training with planned pathways for participants to advance to higher educational opportunities. Consultation with universities offering diploma and degree level training in glass studies should be formalised. The certificate training at TAFE level would be a particularly relevant hands-on pathway to further advance training at the diploma and degree levels at university. It is therefore recommended: That ISS Institute in consultation with the ISC, foster the introduction of qualifications beyond Certificate III level, aiming towards full implementation of the Master Artisan qualification.

²⁵ Certificate III in Furnishing, Lead Lighting and Stained Glass:

- LMFGG3008B Apply Patterns and Designs to Glass
- CUVCOR08B Produce Drawings to Represent and Communicate the Concept
- LMFGG3007B Form Glass
- LMFSL3006A Prepare and Install Architectural engineered Glass

Recommendations

While training in glass exists at the Certificate III level, it is not well supported by industry. Only a small number of businesses have employed apprentices in the 12 years of the apprentice training being available. Most of the student numbers in classes are supplemented by students who are working in glass independently, have an interest in obtaining employment or starting a small business in glass, want to extend a hobby level of training, or have a desire to start their interest in glass with formal training. Apprenticeship training is supported by students attending the Certificate III qualification. It is therefore recommended: that industry is encouraged to support the continuation of courses by the employment of apprentices and providing opportunities for employees to undertake higher-level qualifications as they become available.

ISS Institute

Practitioners who are not familiar with professional development opportunities often find it difficult to justify professional development as the businesses are very small and training is cost prohibitive. Cost-effective training funded by either government or industry associations can help address professional development gaps. It is therefore recommended: that government and relevant industry bodies use the expertise of the ISS Institute to conduct workshops on subjects such as screen-printing, lamination, double and triple-glazing and contemporary design.

References

Websites

- Andrew Moor: www.andrewmoor.co.au
- AGDA: www.agdavic.com.au
- AGGA: www.agga.com.au
- Swansea University,: Swansea: www.swansea.ac.uk
- Rodney Bender: www.innovativeglass.co.uk
- Amber Hiscott: www.amberhiscott.com
- Alexander Belishenco: www.belishenco.co.uk
- Danny Lane: www.dannylane.co.uk
- Derix Studio: www.derix.com
- Glasstec: www.messe-dusseldorf.de
- Lamberts: www.lamberts.de
- Mayer Studios: www.mayer-of-munich.com
- National Glass Center: www.nationalglasscentre.com
- NTIS: www.ntis.gov.au
- Peters Studios: www.glasmalerei.de
- Politecnico di Milano: www.polimi.it
- Faculty of design (Politecnico di Milano): www.designpolimi.it
- Proto Studios: www.protostudios.com
- Standards Australia: www.standards.org.au
- University of Sunderland: www.sunderland.ac.uk

Bibliography

- *Architectural Glass Art: Form and technique in contemporary glass*, Andrew Moor
- *Brian Clarke*, Martin Harrison
- *Capter la Lumie re: Gathering Light*, Suzanne Beth-Lustenberger
- *Colours of architecture: Coloured Glass in Contemporary Buildings*, Andrew Moor
- *Contemporary Stained Glass: A guide to the potential of modern stained glass in architecture*, Andrew Moor
- *Contemporary Stained Glass Artists*, Kate Baden Fuller
- *Glass and Print*, Kevin Petrie
- *John K Clark Glasspainter: Drawings designs and processes*, University of Strathclyde/ Collins Gallery
- *Lamination, Glass Hand Books*, George Papadopoulos
- *Light Fusions: Gateway into night and other works*, Narcissus Quagliata
- *Painting with Light*, Narcissus Quagliata, Borrell, Trapp & Mentasti/Museo Franz Mayer
- *Stained Glass: Masterpieces of the Modern Era*, Xavier Barral I Altet