This dissertation will consider the materials and processes suitable for the production of large scale three dimensional glass as exemplified in the work of Tomasz Urbanowicz

David Jones Llewellyn

p114253

Submitted in partial fulfilment of the requirements for the degree of BA(Hons) in Glass (Contemporary Practice), University of Wales Trinity St. David, Swansea.
March 2016

Table of Contents

Word Count 5780

Summary

My intension in this dissertation is to investigate the method of casting and fixing of large scale sculptural glass as exemplified in the work of Tomasz Urbanowicz, to look at the availability of large sheets of textured glass and to examine the work of other glass artists who produce similarly large cast textured glass artifacts.

INTRODUCTION

In this dissertation my intention is to examine the methods of casting and fixing large sculptural glass artwork, similar to that of the Polish architect turned glass artist Tomasz Urbanowicz, and to research his method of casting, together with that of similar artists and commercial companies that produce large scale cast glass pieces and also to examine the problems associated with the fixing of these large scale glass artefacts.

In his book 'Colours of Architecture', Andrew Moor states that 'Slumped glass still has the potential to awe people, perhaps because the process of heating float glass over a mould suddenly turns a totally artificial and manufactured product into a wonderfully organic and unmechanized one.' (Moor, 2006:148). He goes on to say that 'Glass as a material has become synonymous with a lack of texture, flaws and incident. The material has become in a sense the perfect absence. Nothing is happening, and light passes through uninterrupted - a most unnatural product. However, slumped glass resembles something that has been washed by the sea for centuries and eroded into a more bumpy surface that holds light and allows all sorts of sparkles to form in its crevices and undulations'. (Moor, 2006:148). In my opinion this is the effect that Tomasz Urbanowicz achieves in his work, transforming float glass into something totally different, alive and awe inspiring and in a quote from a Polish film made about his work by Camera Nera 'Glass is like a living creature.' (*850°C The Glass of Tomasz Urbanowicz.* 2013)

The film tells how Tomasz began in glass 'I studied architecture in Poland during the communist era. After graduation the only opportunities were to work for an architectural office and design ordinary blocks of flats. I felt I had an artistic talent and wanted to do something different.' He then went on to study glass and won a competition. He goes on to say 'It was then that I decided I wanted to work in glass. At first it was just an adventure, an attempt to do something on my own, and then I started feeling more and more attracted to it and I still am.' (*850°C The Glass of Tomasz Urbanowicz.* 2013)

Fig.1. The artistic glass sphere 'ARCHIKULA - THE UNITED EARTH', diam. 180cm/6ft, a gift from city of Wroclaw, is in the main agora of the European Parliament building in Strasbourg. (2004) © Tomasz Urbanowicz

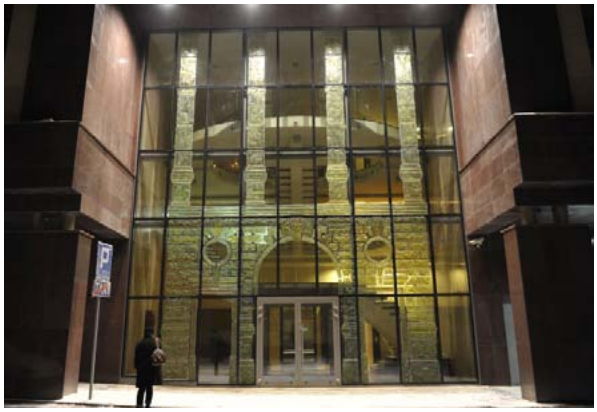


Fig.2. 'Justin Centre' - Wroclaw. Before WWII a magnificent building, the Post Office stood on this site. Now a glass facade on the new building evokes the 'good old days'. (2008/2009). © Tomasz Urbanowicz

Fig.3. The glass sculpture 'The Soul of the Piano' as the main artistic element in the interior of Polish Pavilion at EXPO 2005 in Aichi, Japan. (2005)
© Tomasz Urbanowicz

It was in 1987 that together with his wife, architect Beata Urbanowicz began their own studio Archiglass. In the film he goes on to say that 'I was lucky that times in Poland changed, communism ended and capitalism began. New modern buildings were being built..... I started creating much larger glass pieces. Also for private clients, some people managed to earn their fortunes in a short period of time so money wasn't a problem and people wanted to show off.' (*850°C The Glass of Tomasz Urbanowicz.* 2013).

Urbanowicz's work is almost always large scale glass cast on the kiln bed by making hand crafted marks into a thick layer of 'powder'. The result is a textural surface on one side and a smooth surface on the other.

Fig.4. Tomasz Urbanowicz making marks in ‘powder’ on the kiln bed. © Tomasz Urbanowicz

Fig.5. Some glass produced for private clients © Tomasz Urbanowicz

He describes glass in the film commentary as ‘... a material that still hasn’t been fully discovered. It’s mysterious and truly incredible due to its transparency and depth. It’s alive unlike other materials in my opinion, wood, stone a wall don’t have depth. ...I never polish or cut the edges. It’s sort of a life form for me already. Polishing the edges is unacceptable to me. It seems like interfering with a separate unique identity that lives on it’s own, life with edges as they came out to be. I really feel it has it’s own identity now, a glass form of life. I cannot imagine cutting it with a chainsaw or a diamond blade, it would feel like hurting it’ (*850°C The Glass of Tomasz Urbanowicz.* 2013).

THE CASTING PROCESS

By looking into the history of glass, Urbanowicz's method of using a 'powder' mould dates back to the beginning of the use of glass. 'The place and date of origin of manufactured glass is not completely known. According to Pliny the Elder, ancient Roman historian, Phoenician merchants deserve the credit for the discovery of glass in the region of Syria. The oldest specimens of glass are from Egypt and date back to 2000 B.C. In 1500BC the industry was well established in Egypt. After 1200BC the Egyptians learned to press glass into moulds. In the 1st century glassblowing was discovered by Syrian craftsmen. Thanks to this development, everyone could afford glass not only to the wealthy.' (History of Glass 2016). 'The first known methods used for shaping moulten glass into objects were drawing and casting. Glass drawing - A metal hook is used to pull moulten glass out of a tank while it is a very thick, red-hot liquid. Glass casting - Moulten glass is poured into a form and allowed to harden. The earliest glass moulds were probably made out of sand. These methods are believed to have been first used by Sumerians in ancient Mesopotamia (Iraq and Syria) more than 5,000 years ago.' (Neatorama 2012).

The surface texture produced by casting the handmade marks made in the powder base of the kiln is called in the world of sculpture relief. "Any work in which the figures project from a supporting background, usually a plane surface. Reliefs are classified according to the height of the figures' projection or detachment from the background. In a low relief, or bas-relief, the design projects only slightly from the ground and there is little or no undercutting of outlines. In a high relief, or alto-relievo, the forms project at least half or more of their natural circumference from the background and may in parts be completely disengaged from the ground, thus approximating sculpture in the round. Middle relief, or mezzo-relievo, falls roughly between the high and low forms.' (Encyclopædia Britannica, Inc. 2016).

Fig.6. Left. Commercial textured glass. Right. Closeup of a Tomasz Urbanowicz piece of glass © Author

Textured glass is available from the major glass manufactures. This is a very low profile texture and could be described as low or bas relief, whereas the bolder deeper marks created in the work of Tomasz Urbanowicz could be described as middle relief, if not bordering on high relief as in some of his works the thickness of the glass can in places be between 33 - 50% thicker than the main body of glass.

In this method of working, the marks on the kiln bed are actually replicated on the surface of the glass. The majority of warm glass artists however go to great lengths to ensure that the glass placed on the bed of the kiln does not pick up any marks and remains as smooth after firing as before. The Bullseye Glass Company from America produce a variety of educational articles, primarily based around their products, which include 'TechNotes', 'TipSheets', 'Studio Tips' and 'Product Use Sheets'. These articles provide information such as TechNotes 6 - 'Preparing the shelf system for a large kiln' . In this article they state that "An ideal shelf system for a large kiln must have a continuous, seamless surface and be level, stable, smooth, durable, flat and able to transfer heat uniformly." (Bullseye Glass Co. 2008a.) Bullseye Shelf Primer instruction sheet explains how "Hot glass will stick to most ceramic or metal surfaces and crack as it cools, unless prevented by a separator like Bullseye shelf primer." (Bullseye Glass Co. 2011). Also the instruction sheet for their 'Thinfire Shelf Paper' they state that the advantage to using this product "ThinFire is a ceramic-impregnated shelf paper that provides excellent separation between glass and kiln shelf. Compared to other ceramic fibre materials, ThinFire is lightweight,

creates less binder burnout odour, and produces a glossier finish on the shelf side of your project. As an alternative to kiln wash, ThinFire reduces shelf preparation time and improves surface release." (Bullseye Glass Co. 2008b). Besides having a level kiln bed smoothness is not a feature which Urbanowicz is particularly concerned about.

TEXTURED GLASS (Multi-national glass manufacturers)

Textured float glass however is a product which is in demand by the public. Describing its qualities the glass manufacturer Pilkington UK describe it as 'translucent, transmitting diffused light whilst maintaining privacy. It offers a wide selection of alternatives, meeting both functional and aesthetic requirements and may be used for privacy in commercial, industrial and residential buildings. It may also be used for decorative purposes in applications such as doors, partitions and balustrades.' (Pilkington 2016a). The same obscurity is found in the glass of Tomasz Urbanowicz, this is partially caused by the thickness of the glass and also the greater relief texture increasing the reflection and refraction of the light passing through.

Pilkington UK, the company which invented the float glass process, now a part of the Nippon Sheet Glass Co., Ltd. of Tokyo, Japan markets its Decorative Glass Range which comprises of "18 different designs, from traditional to contemporary" (Pilkington UK, 2016b:2). They give their glass "Privacy Levels' from 1 to 5 depending on the obscurity (5 being the most obscure) produced by the textured pattern. All their patterns are low relief and the obscurity or privacy is achieved by the decorative pattern.

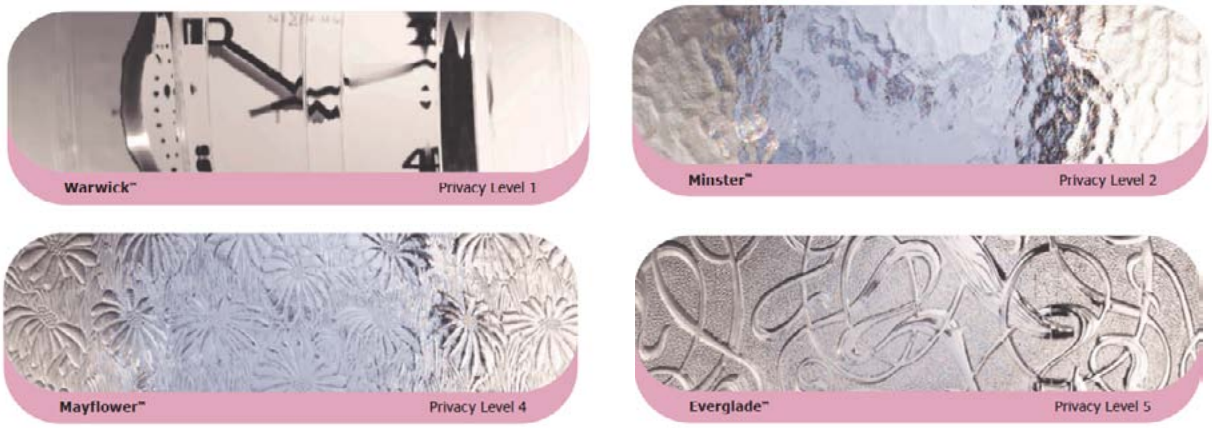


Fig.7. Samples of Pilkington Texture glass with privicy levels © Pilkington Glass UK

Another of the major float glass manufactures Saint-Gobain market 'Decorglass' their patterned glass range. Saint-Gobain describe their range as "The translucent patterned glasses are produced by casting and rolling the glass between two cylinders, one of which is embossed with a pattern. Saint-Gobain has developed

an exclusive product criterion: SGG Vision Control Factor. It assigns each Decorglass a factor of 1 to 10.

- Class 1 indicates maximum vision obstruction, i.e. an object is barely visible behind the glass.
- Class 10 indicates minimal vision obstruction with respect to the visibility of an object." (Saint-Gobain Glass UK Ltd. 2014)

Fig.8. Samples of Saint Gobain Decorglass Patterned glass with vision obstruction © Saint-Gobain Glass UK

Unlike Urbanowicz the glass manufactures produce their textures by casting and rolling the glass between two cylinders, one of which is embossed with a pattern. Both Pilkingtons and Saint-Gobain supply their patterned glass in 4mm thick sheets. Pilkington however also supplies it in 6, 8 and 10mm. Should the glass be used in a position that UK Building Regulations require it be toughened this has to be done by the client.

TEXTURED GLASS (Independent textured glass suppliers)

Independent companies also market textured float glass using their own patterns and also specialize in producing bespoke patterns for customers. One such company based in South Wales is Hot Glass Designs from Bridgend in Mid Glamorgan. In their brochure they state that “Kiln formed glass has gained a strong popularity in recent years among architects and interior designers being used as an alternative to standard, flat obscured, sandblasted or stained glass. Kiln formed glass is a different, new way to enhance and beautify any interior or exterior location. Hot Glass Design provides a full design and installation service if required, along with a range of fittings to assist installation. A variety of hinges, stand-off wall panel fittings and shower channels are available in a range of finishes.” (Hotglassdesign 2006). They offer 20 ‘standard’ designs and will create bespoke patterns to the clients requirements.

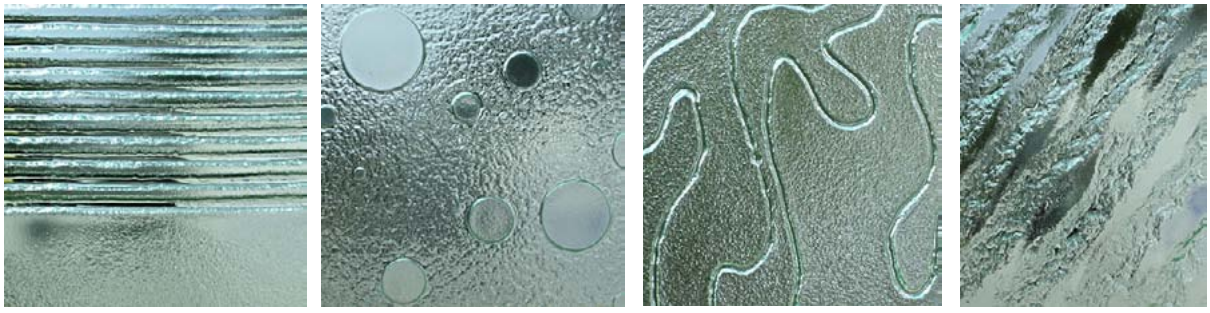


Fig.9. Samples of hot glass design’s textured glass © Hotglassdesign.

During a visit to Hot Glass Design’s studios I spoke in depth to the owner Rhodri Jones, and started by asking him where he first saw this method of texturing glass being used. He stated that after finishing a contract as a mine surveyor in Australia, he took a job at an Australian glass studio - Ozone Glass Design, their main business was producing large sheets of bespoke textured glass. After returning to the UK, Rhodri purchased a kiln and using similar techniques to those used in Australia began producing textured glass and Hot Glass Design was born.
The techniques used in Hot Glass Designs is to lay a level thickness of a mixture of kiln dried brick paviour sand and casting plaster onto the kiln bed, then for the ‘standard range’ of textures use a roller with the pattern raised on its surface, and roll this over the powder base to form the relief texture in the powder. Glass is then

placed on this texture and fired to replicate the texture onto one surface of the glass. If required to conform with building regulations as stated in ‘Glazing - safety in relation to impact, opening and cleaning N’ published by HM Government, the glass is sent out for toughening before being supplied to the customer.

Ozone Glass Design as a company is no longer in existence having been taken over by another Australian company Axolotl.

‘For 20 years Axolotl has been the pioneer of innovative and creative metal, concrete, glass and timber products.’ (Axolotl 2016). ‘Axolotl and Ozone Glass Design, both pioneers in their field, joined forces in September [2005] to create a new division, Axolotl Ozone. ‘Axolotl Ozone’ will offer everything in architectural glass, including formed and textured, deep carved, etched, sandblasted, colour backed and the new ‘Lustre’ range. The acquisition of Ozone in Australia by Axolotl heralds a new chapter in its ten years of operating as a leader of innovative Australian design.” This was how Spec-Net Building Index an Australian building directory who’s “Audience demographics are architects, designers, engineers, contractors, building companies, building manufacturers both commercial and domestic.” (spec-net.2015) announced the news.

In their glass catalogue Axolotl Ozone, amongst the variety of textures and processes they use with glass, describe their texture range ‘Formed’ as “Formed is a range of textured glass where one face has been formed over a pattern or mould to create a unique finish to every panel of glass. Formed is the ideal product to apply transparent coloured finishes and a wonderful medium for corporate logos and text.” (Axolotl 2013).

Fig.10. Images from Axolotl’s Glass Brochure 2013 © Axoloti.

Having traced one of the owners of Ozone Glass Design, Warren Langley, I explained the nature of my dissertation and he outlined his experiences with casting into a powder base. In his email to the author he states that "The procedure used by Tomasz Urbanowicz is the same procedure I pioneered in the period 1979 to 1986 and which I taught in numerous workshops worldwide (Pilchuck, Sars Poteries, Northlands etc etc) for most of the 1980's and is a procedure now widespread throughout the world. Many of the people using this technology, because it is so simple it defies thinking, tend to exaggerate the process in order to give it an aura of mystique. It can be no more complex than a level bed of sand into which patterns are drawn, printed, pressed, rolled or whatever. The surface of the sand is then sprinkled with plaster, whiting, talc, aluminium hydrate or whatever you feel like to release the glass from the sand and stop it from sticking. Our company OZONE glass operated in 4 or 5 locations around the world and used nothing more than plaster sprinkled on the sand. In 2000 I left the company to return to my studio public art practice but I continue to see this simple technology used worldwide for architectural application." He then adds "I very rarely use this technique anymore but just completed a project "for old times sake". Images attached. All the best, WARREN LANGLEY". (*Langley.W*. 2015) Below are some of the images attached to his email for his project entitled 'Caernarvon'.

Fig.11. Photographs of the complete screen and close ups. © Warren Langley

Another company that specialise in the design and bespoke production of textured glass for interiors and architectural projects is Float Glass Design of Brighton. Describing their 20 textured glass patterns as “From clean, sharp geometrics to complement the urban office interior to organic, fluid textures that look great in contemporary living spaces you can design your glass to fit your environment.”

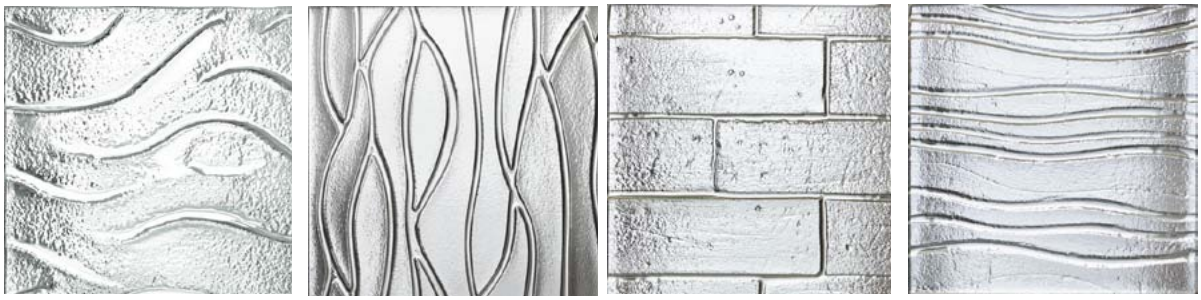


Fig.12. A sample from the 20 textures in Float Glass Design’s range of textured glass © Float Glass Design.

Float Glass Design also offer a bespoke service claiming that “If you can’t find what you are looking for in our glass ranges we can produce a bespoke design for you and work in collaboration with you to create this. We can produce bespoke textures and designs, and emboss or gild vector graphics/logos into the glass. Textured glass can also be gilded with for a reflective finish.” (Float Glass Design 2016)

In a telephone conversation with Canadian Managing Director Michael Johansson he stated that although the process of creating the texture on the glass, by creating impressions in the powder base of the kiln was simple and straight forward, many modifications have been made during the twelve years life of Float Glass Design and so as to keep ahead in the commercial world these were quite rightly being kept a company secret. On the subject of colouring the glass, many issues have occurred with accuracy of specifying colours that as far as the sheets of textured glass is concerned they offer only the coloured float which the manufacturers supply.

Both of the British companies that I contacted can supply textured glass in varying thickness from 6 to 19mm. In their bespoke range they will try to accommodate the client by producing glass to a specified thickness by fusing multiple

layers of glass of the manufactures standard float glass thickness to produce the required thickness.

The majority of the glass produced by both the glass manufactures and the independent companies producing their own ‘standard’ range of textured glass and bespoke designs are used for partitioning, shower cubicles or kitchen splash backs and tend to conform to standard thickness. The handling and location of the installation can have weight implications regarding both the structural integrity of the building and manual handling. Installation and transportation necessitate the use of the thinnest glass possible and Building Regulations usually require such thin glass to be tempered before installation. Off the shelf fixings are available for Shower screens, Glass Balustrades, Glass Doors and Structural Glass Fixings in a variety designs and finishes. These fittings can be used for most applications needed for this type of installations and fitted by commercial glass fitters. This is another reason for limiting the thickness of the glass. Below are some typical installations by Hot Glass Design from Bridgend and Float Glass Designs of Brighton. These installations use standard commercially sourced glass fixings.

Fig.13. Installations using typical commercial fixings for a balustrade and shower cubicle by Hot Glass Design © Hot Glass Design

Fig.14. Installations using typical commercial fixings for a frameless door, screens for a champagne bar, a retail desplay for a jewellery shop and shower cubicle by Float Glass Design © Float Glass Design .

SIMILAR GLASS ARTISTS

The ‘powder’ method of casting has its advantages and disadvantages. The marks if made by hand are unique and cannot be exactly replicated however where the pattern is rolled into the powder it will virtually be the same time and again. Tomasz Urbanowicz comments in the film that ‘I believe I’ve never repeated any idea twice. In most cases it wouldn’t even be possible because I create casting forms manually and they are destroyed when I extract the glass. It’s just not possible to make the exact same glass again.’

This could be a disadvantage if the design is to be repeated exactly but has the advantage of being a one off individual piece. It is a cheap and easy method for the production of textured glass. The cost of producing large plaster moulds as an alternative would not only be more expensive but would present problems in the handling of the mould in both it’s wet and dry state. However the main disadvantage of the ‘powder mould’ is that it can only be used once.

I have been having difficulties in finding many artists who actually use this technique. Looking at images in publications, online and members gallery of the Contemporary Glass Society it appears that most artists choose to make plaster moulds and those whose effects are similar to those of Tomasz Urbanowicz tend to core cast their work and therefore use casting glass as opposed to float.

Colin Reed, world renowned glass artist from Stroud in Gloustershire, is famous for his cast glass artefacts produced by the lost wax method of casting and casts using optical glass. The lost wax method involves making a wax model of what is to be cast, this is then placed in a suitable container and covered with casting plaster. When the plaster has set the wax is removed by steaming leaving a plaster mould into which glass can be cast. After casting the plaster cast is removed leaving a glass replica of the wax. He has a series of sculptures and tables which are cast from moulds of leaves from Kew Gardens, The National Garden of Wales and The Eden Project. From these casts he has made a series of tables. Urbanowicz has also made similar glass tables using handmade marks by the ‘powder’ method of casting.

Fig.15. Left the Musa Cavendishii Table and Right the Monstera table both kiln-cast and polished optical glass © Colin Ried

Fig.16. Table in Tomasz Urbanowicz workshop cast with handmade marks in a 'powder' base, float glass © Author

Rena Holford of Hagg Hill Glass near Newcastle on Tyne is an artist who uses the same technique as Tomasz Urbanowicz. On her web site she describes her work as 'Based on images from cave paintings and my own horses, I create equine figures in kiln formed glass which are given colour and texture using various techniques. Both wall mounted and free standing sculptures are available in a variety of sizes.' (Hagg Hill Glass. 2015). During a telephone conversation with Rena she confirmed that she casts onto a 'powder' base on the kiln bed using both hand marks and impressions made by templates, working with float glass she has some of her glass waterjet cut to shape. She first started experimenting with this method of casting whilst studying for a BA Hons in Glass at the University of Sunderland and uses both frits and enamels to colour her work.

Fig.17. Images of Rena Holford's work showing detail and scale of her work
© Rena Holford

Atelier 70 is a Dutch company based in Amsterdam producing a variety of architectural glass artifacts including casting large pieces similar to that of Tomasz Urbanowicz. The details on their website http://www.atelier70.nl are very limited they have some images of their work.

Fig.18. Images of cast glass by Atelier 70 © Atelier 70

FIXING METHODS FOR LARGE SCALE WORKS

Tomasz Urbanowicz's work is nearly always large but unlike most artists he is approached by architects and designers, who commission him at an early stage of their projects, to create glass pieces for their current projects. In the film Tomasz states that 'Having studied architecture I know construction techniques and I understand building plans, so when I design my pieces I already know how to install them. I think this is why I stand out. Even if I don't know how, I'm sure I will eventually know how to solve it.' (*850°C The Glass of Tomasz Urbanowicz.* 2013).
Andrew Moor concurs with this in his book by stating that 'In his work it is often the details that the eye fails to perceive easily that are the secret ingredient that gives his work that indefinable quality of excellence.' (Moor 2006:158). Going on to describing some of his work he says ' In the Holstein Brewery it is the way the bar glass appears to hang in front of the base unsupported. In the screen called "Catch the Wind", the glass appears to stand on the polished floor, the two surfaces meeting seamlessly. Such detailing reveals the architectural training of the artist.' (Moor 2006:158). Andrew Moor also describes the balustrades in a Palace near Warsaw as 'Thick chunks of glass have been sunk into deep channels to create a continuous frame less balustrade.' (Moor 2006:158). Although Urbanowicz sometimes makes pieces with no predetermined location in mind, however most of his work is commissioned as installations in either large public building schemes or prestigious domestic houses.

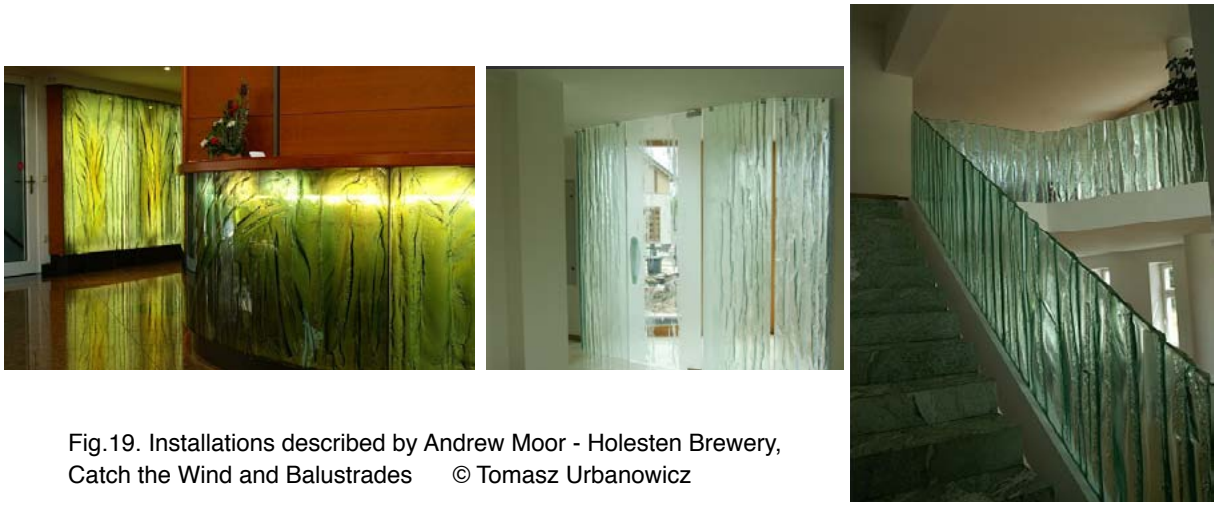


Fig.19. Installations described by Andrew Moor - Holesten Brewery, Catch the Wind and Balustrades © Tomasz Urbanowicz

Although not all of his work is created by hand made marks in 'powder', he also casts through laser cut fibreboard, fuses and sandblasts glass. All his work however is not only large horizontally and vertically but also in thickness, most of the cast pieces are 24 to 32mm thick. With 8mm float glass weighing 20kg/m^2 and pieces measuring up to 3x2m the weight could be up to 480kg fixing these pieces presents problems. Unlike the textured glass made by the commercial companies of glass up to 10mm and being able to use various purpose made fixings these art pieces need to have specially designed fixings. This is where his training as an architect and his thought process are an advantage thinking out the method of fixing early in the design stage.

One of his large installations using a combination of handmade marks, laser cut fibreboard and slumping is in the new Podlasie Opera and Philharmonic European Arts Centre in Białystok, Poland. The glass replicates the handwritten notes and the music scores of a Polish composer. Tomasz was brought in to the project at an early stage enabling fixing points to be designed into the construction of the building to accommodate the weight of the glass as demonstrated above and along the stairs.

Fig.20. Images of the foyer, closeup of the glass and the fixings for suspended glass at the Podlasie Opera and Philharmonic European Arts Centre
© Tomasz Urbanowicz

Fig.21. Images of the specially designed fixings for the wall and column panels at the Podlasie Opera and Philharmonic European Arts Centre © Tomasz Urbanowicz

In the design, glass panels were wrapped around the red steelwork columns in an upward spiralling direction, this required more bespoke designed fixings. In the interior specially designed and powder coated steel fixing were designed to hold the glass away from the wall and columns, together with stainless steel designed fixing to hold the suspended glass above the stairs.

Fig.22. Specially designed brackets with adjustable angles holding the top pieces onto the red steelwork.

Two of Urbanowicz's work are spheres although they are not constructed in the same manner and use totally different methods of fixing.

The first is a sphere entitled 'Archikula - The United Earth'' is a sphere of 180cm/6ft diameter and was a gift from the Polish city of Wroclaw to the European Parliament building in Strasbourg. It is situated in the main forecourt and is illuminated at night.

Fig.23. The sphere in the main forecourt by day and night. © Tomasz Urbanowicz

A complex shaped structure had to be specially designed to support the sphere. This was made from steel and calculated to support the weight of the glass, however after several years it had to be replaced after two people sat on the top to have their photograph taken. A new internal frame had to be constructed, this time out of stronger stainless steel, the sphere dismantled and reconstructed around the new steel structure.

Fig.24. Left - the old frame now hanging in the studio © Author and
Right - a close up of the new frame during installation © Tomasz Urbanowicz

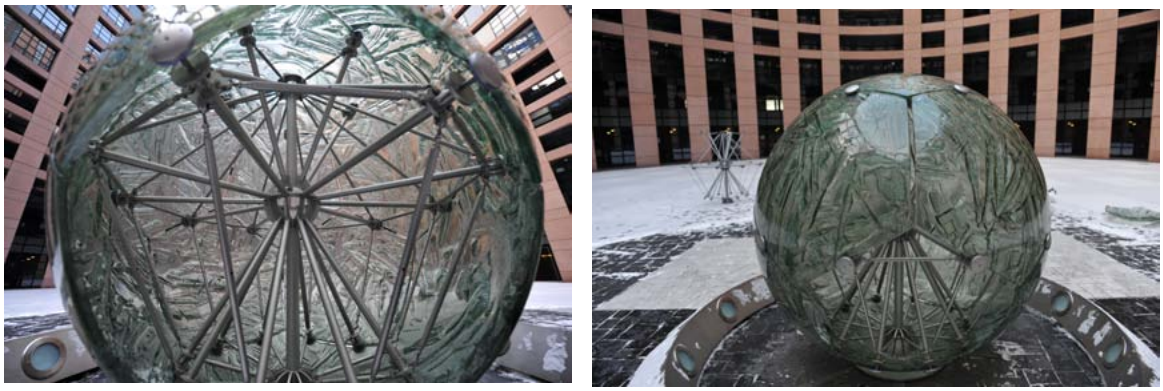


Fig.25. Left - the new frame with some glass attached Right - one more section of glass to attach with the old frame in the background © Tomasz Urbanowicz

The second sphere 3-meter tall is the central element of the newly built University of Bialystok Campus in North East Poland. It represents the beginning of the Universe. The small blue glass sphere in its centre symbolizes a “God particle” and chaotically arranged network of numerous stainless steel thin rods refers to the Big Bang.

This time the supporting steelwork is an integral part of the design. From the initial drawings and a full size maquette the construction of the steel framework was made at the same time as the glass panels. I was fortunate to be present at Tomasz’s studio whilst some of the early manufacturing and fixing of this piece was taking place. I also visited the engineering fabrication workshop and saw the steel work being assembled and how some aesthetical and structural problems were being solved together with some of the experimental fixings.

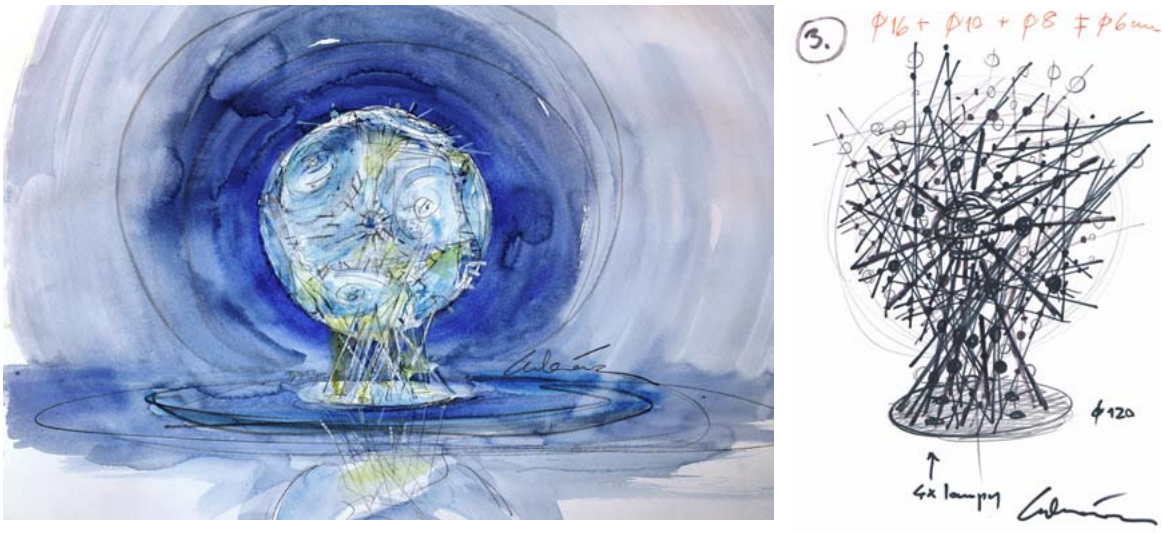
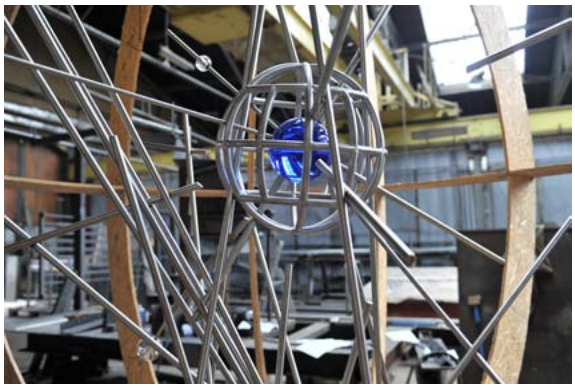


Fig.26. Watercolour sketch and drawing of the steelwork supporting structure. © Tomasz Urbanowicz



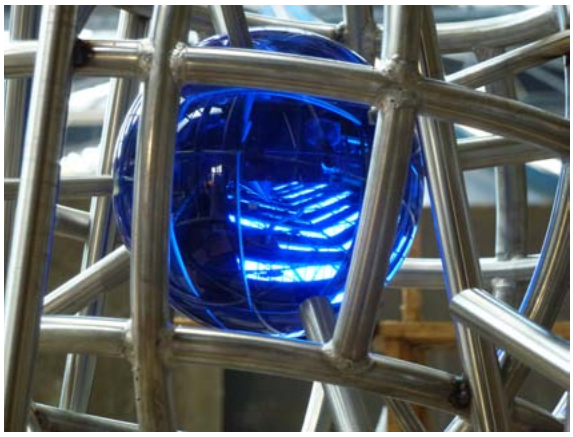


Fig.27. Shows the full size maquette outside the studio with the glass shapes drawn onto a cling film 'cover', some of the glass sections and the steelwork being constructed within the maquette. © Tomasz Urbanowicz

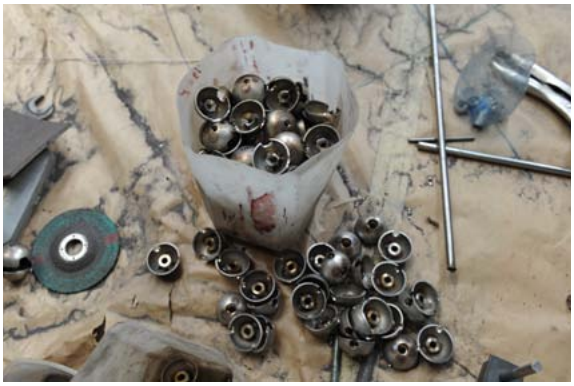


Fig.28. The manufacturing of specially designed clamps and problem solving fixing to hold small glass spheres © Tomasz Urbanowicz

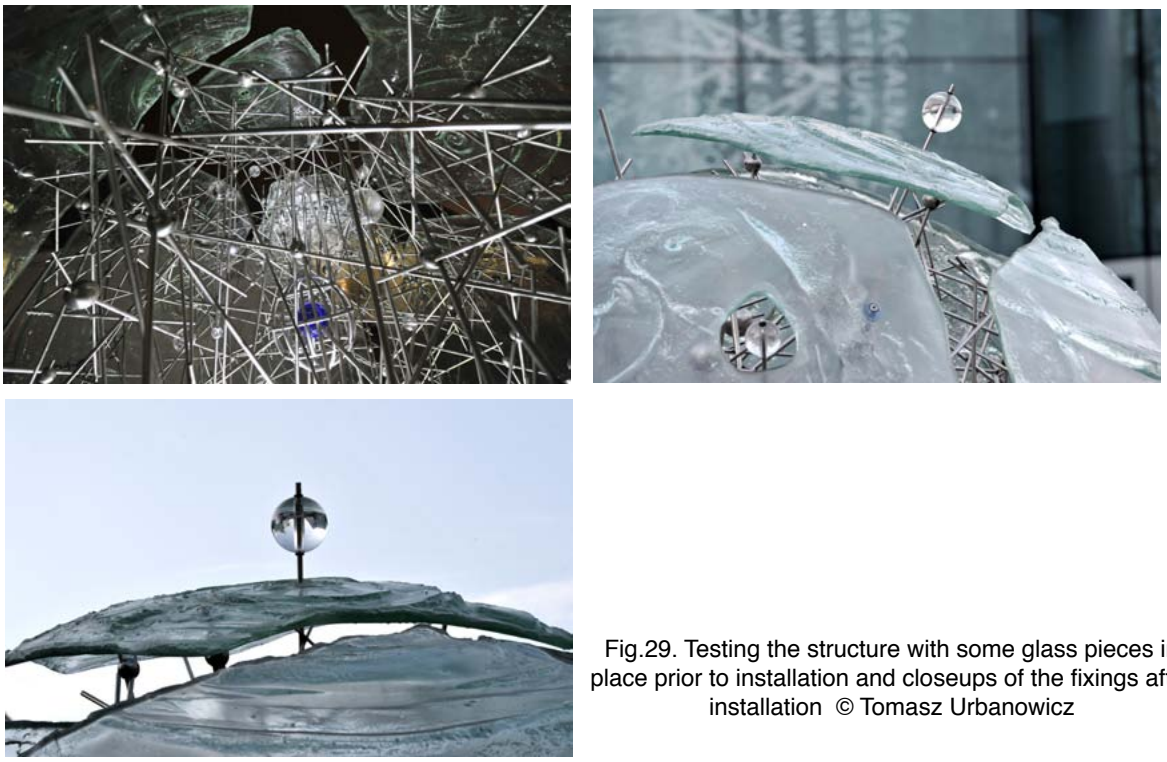


Fig.29. Testing the structure with some glass pieces in place prior to installation and closeups of the fixings after installation © Tomasz Urbanowicz

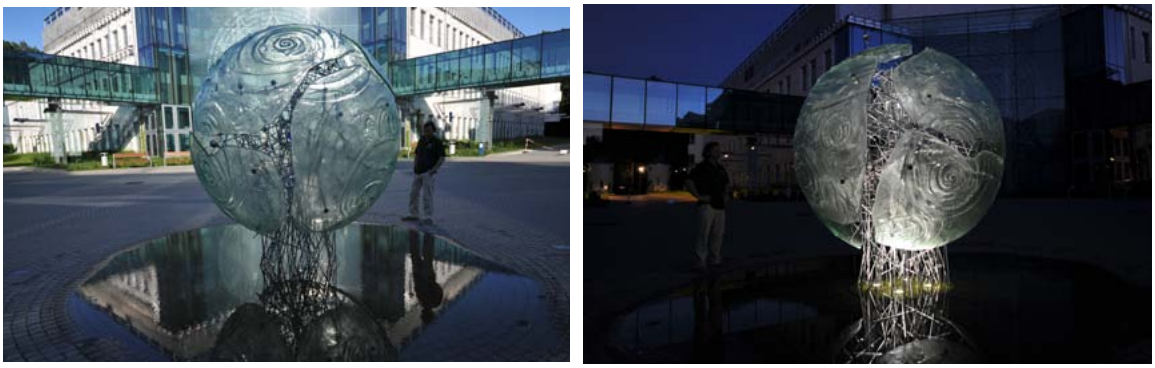


Fig.30. Day and night photographs of the sphere installed in a pool of water at the University © Tomasz Urbanowicz

With each new project a different set of problems with regards to fixings present themselves. The commission for The European Cooperation Centre in Olawa - Poland was to create an artistic glass and stainless steel composition inspired by the European Union's flag. The composition was a balustrade in which the number of glass elements reflects the number of member countries in the European Union. With Tomasz designing the complete project it meant that the design of the steelwork would seamlessly include the fixings for the glass. Commercially bought screws are used to screw into the frames which are part of the balustrade design. A scale model was made so that the correct positions for all the elements could be

accurately calculated prior to manufacture. Again in this project the installation was commissioned early in early stages of building and could therefore be structurally incorporated into the building's design.

Fig.31. From left to right The concept drawing, the scale model (looking up towards the ceiling) © Tomasz Urbanowicz and comparing the model with the finished project © Author.

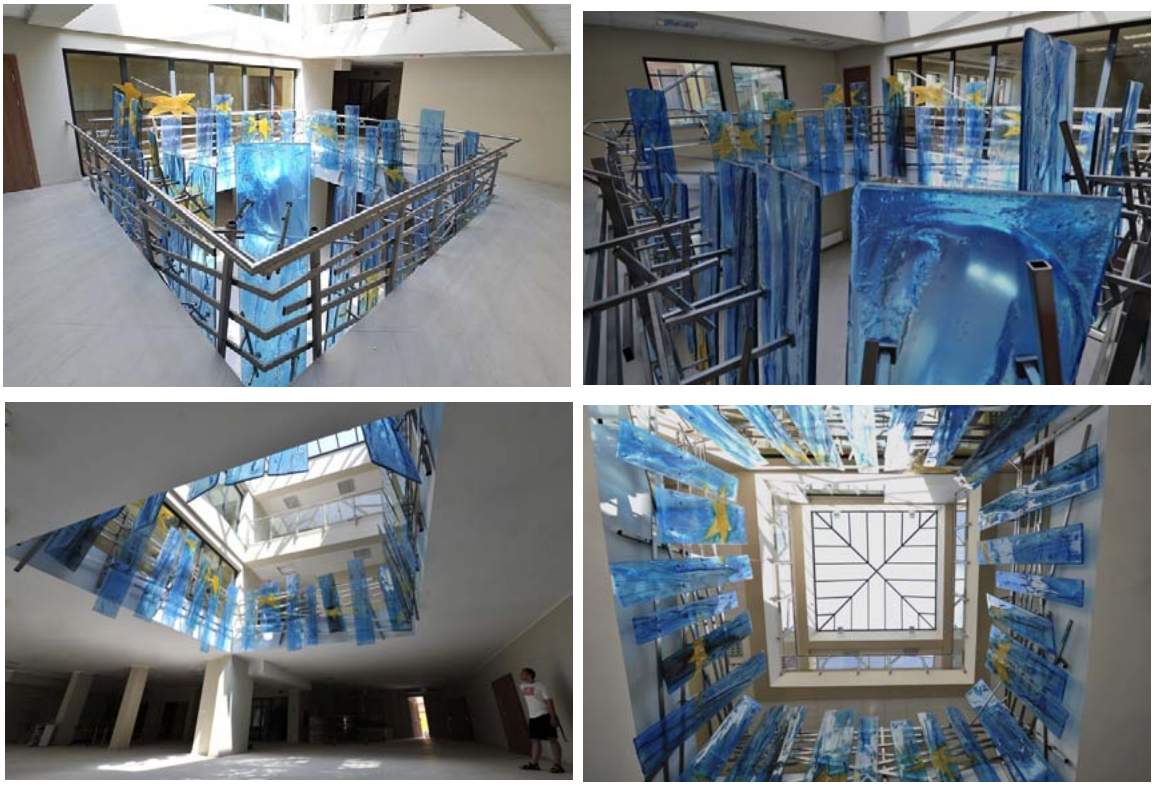


Fig.32. The finished project showing from floor level, close up and views looking up. © Tomasz Urbanowicz

In the church at Przedbórz, Poland, glass panels of Psalm 1 in Hebrew and a translation in old Polish are fixed with sympathetic fixings to that of Christ. Again having to be specially manufactured, this time from wrought iron.

Fig.33. The glass panels mounted around the statue of Christ and a close up of the fixing
© Tomasz Urbanowicz

Another solution to a fixing problem, this time a silicon product was modified in the UK to fix glass blocks onto the exterior of a double glazed glass curtain wall. The original building, the main Post Office, was destroyed during World War II. The 'Justin Centre' in Wroclaw was built on the site but it was decided to create a reminder of the splendid building that once existed here.

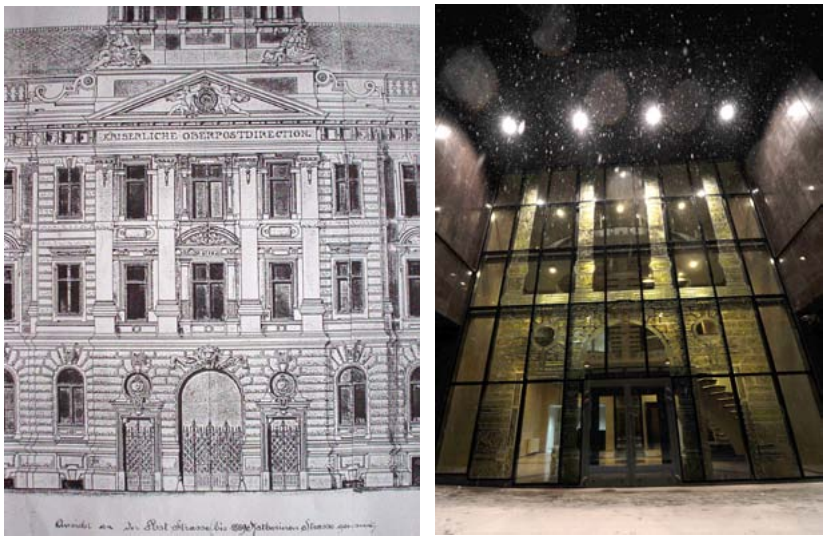


Fig.34. An original architectural drawing of the old building and the exterior of the new building with the glass 'stones' fixed to the double glazed curtain wall.
© Tomasz Urbanowicz

Fig.35. Close up photographs of the glass 'stones'. © Author

Wood has been used to stand a panel on together with stainless steel brackets.

Fig.36. Wooden blocks and metal fixings
© Tomasz Urbanowicz

The Grand Piano was a commission for the Polish Pavilion at the Expo 2005 Exhibition in Aichi, Japan. This was suspended using a combination of purpose designed fixings and fixings from a yachting chandelier.

Fig.37. Left to Right Close up of fixing bonded to the glass, Close up of the glass and the installation
© Tomasz Urbanowicz

Finally the mounting of a piece of glass through a metal frame and resting on a stone plinth. This was for a the headstone of military pastor Rev. Adam Pilch, who died in Smolensk air crash in Russia that killed the Polish president, Lech Kaczynski, and 95 others, titled ‘Monument to the Sky’. Not only did the fixings to hold the glass have to be specially designed but the glass had to be designed to fit through a metal structure and rest on an inscribed stone.

Fig.38. Left to Right Maquette built in the studio. The headstone in situ and a closeup © Tomasz Urbanowicz

CONCLUSION

Casting into various powders that are chemically inactive to glass is not a new process and has existed since the begins of man's use of glass up to the present day. Sand was probably the first powder that was used as a mould by the Sumerians in Mesopotamia 5000 years ago but over the years this has been modified to suit modern needs. From my investigations various people use various powders including plaster, various different types of sand including Mansfield Casting Sand, as was used by the now non existent company Fusion Glass Design UK according to Richard Johnson a former employee and Kiln Dried Block Paviour Sand as used by Hot Glass Designs. Float Glass Designs keeping a trade secret their additives to their powder base.

Commercially available textured glass, produced by rolling moulten glass through textured rollers gives a uniform repeated pattern. This is available in a selection of thicknesses and glass types and can be cut to size from standard sheet sizes. The manufacturers also offer a service of cutting to shape, drilling, edge polishing and tempering to suit specific customer requirements. This service is usually quick as stocks of the glass exists and merely needs to be finished and delivered. The glass is usually used in windows, glass partitions, shower cubicles etc. The weight of this type of glass is the same as the non textured standard float glass and is handled in the same manner. Standard fixings such as channels, bolts, handles, clips etc are readily available from specialist suppliers.

The independent companies producing textured glass, either their own standard designs or bespoke designs tend not to keep a stock of textured glass. It tends to be made to order and to the specific size and shape required by the client. As the requirement is usually more aesthetic and designed for a specific location, thickness can be part of the design. This then means that the finished glass pieces can be heavier than commercially available glass and that the fixing may need to be specially designed. The cost of these services tend to be far greater than using the more standard 'off the shelf' glass supplied by the large glass manufactures.

However the large three dimensional art glass pieces that are designed and

installed by glass artists such as Tomasz Urbanowicz are far more problematic. With no two projects being the same and the panels being very heavy due to the dimensions and thickness, most pieces are 24 to 32mm thick, a lot of planning needs to be done at the design stage. Problems such as how to fix, will the building support the installation and can the pieces be manoeuvred into position are paramount and need to be ascertained during the design stage, certainly before the production stage. In the case of a new build supporting structures, access and installation close cooperation with the architect and builders is essential.

The casting method using powder as the mould is very suitable for the making of large cast pieces provided exact replicas are not required. The making and handling of rigid plaster moulds in excess of 2 meters would be problematic, moving the fragile plaster mould after setting and placing into a kiln, also the weight of the mould would have to be taken into consideration. However if the design could be carved or milled with a five axis milling machine into a thick sheet of fibre board this could offer an alternative, but would require the computing knowledge to design using a 3d drawing package and the use of the milling machine. With the texture patterns that Tomasz Urbanowicz creates, although the mould is new each time, the patterns created seem to form a continuous pattern and as the mould is the base of the kiln it doesn't have to be moved after it's made. Although the mould is destroyed when the glass is removed, the powder can be levelled out on the kiln bed and reused.

The London based American glass artist Danny Lane's work is described by the Cass Sculpture Foundation as 'Lane's work combines monumental and brutal physicality, primarily using stacked and fractured glass' (Cass Sculpture Foundation 2016) In his current series of work Lane is using strips of float glass placed on their edges and fusing them to form sculptural pieces. This is produced by placing formers around the glass shaping it whilst in a softened state. The formers acting as a mould. Again this is a unique process where no two pieces would be exactly the same giving a handmake bespoke product.

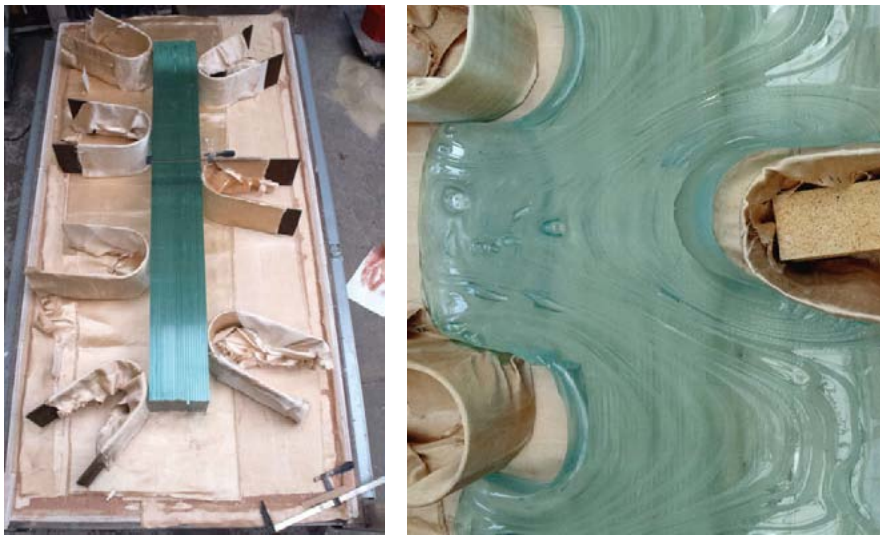


Fig.39. Strips of glass with formers before and after firing © Danny Lane

There is no option when making large three dimensional glass artwork out of single glass sheets other than to use either float glass or low iron float glass. The reason is the availability of large standard sheet sizes and that no other glass is available in such large sizes and at a comparatively low price. The same glass is also used by both the manufacturers and the independent companies to producing textured glass.

Hand crafted large glass artefacts are the most expensive option, as they are one off pieces of art as well as in some cases functional structural elements of a building. The timescale for this type of work is also the longest, not only due to the design time, but also having to be scheduled into the artist's workload. In some cases small test pieces have to be made this is also time consuming. In Tomasz's case the Podlasie Opera and Philharmonic European Arts Centre project took nearly two years to complete and was the only project undertaken during that time.

Having looked into the production methods that could be suitable for producing large scale three dimentional glass artifacts, I believe that using a mould created into a powder base of the kiln together with the use of either float or low iron float glass is the best, quickest and most cost effective method of producing this type of glass artwork.

Bibliography

Axolotl (2013) *Axolotl Glass Brochure* Available at: https://static.squarespace.com/static/50a4739ae4b000dda4d98149/t/51145f32e4b00dcd7b6d8008/1360289586484/AxolotlGlassBrochure2013%5B1%5D.pdf (Accessed 14 Jan 2016)

Axolotl (2016) *About the Company* Available at: http://axolotl.com.au/about/ (Accessed 14 Jan 2016)

Bullseye Glass Co. (2008a) *TechNote 6: Preparing the Shelf System for a Large Kiln* Available at: http:// http://www.bullseyeglass.com/methods-ideas/technote-6-preparing-the-shelf-system-for-a-large-kiln.html. (Accessed: 5 Jan. 2016)

Bullseye Glass Co. (2008b) *Thin fire Shelf Paper* Available at http://www.bullseyeglass.com/methods-ideas/bullseye-thinfire-instructions.html (Accessed: 5 Jan. 2016)

Bullseye Glass Co. (2011) *Using Bullseye Shelf Primer* Available at: https://www.bullseyeglass.com/methods-ideas/bullseye-shelf-primer-instructions.html (Accessed: 5 Jan. 2016)

Cass Sculpture Foundation (2016) *Danny Lane* Available at: http://www.sculpture.org.uk/artist/54/danny-lane (Accessed Feb 3 2016)

Encyclopædia Britannica. (2016) *Relief Sculpture* Available at: http:// http://www.britannica.com/art/relief-sculpture (Accessed: 9 Feb 2016)

Float Glass Design (2016) *Bespoke Glass* Available at: http://floatglassdesign.co.uk/bespoke-glass (Accessed 21 Jan 2016)

Hagg Hill Glass. (2015) *About my work* Available at: http://www.hagghillglass.co.uk (Accessed 20 Jan 2016)

History of Glass. (2015) *Who invented glass* Available at: http://www.historyofglass.com/glass-invention/who-invented-glass/ (Accessed: 1 Feb 2016)

Hot Glass Design (2006) *Hot Glass Design Brochure* Available at: http://www.hotglassdesign.co.uk/brochure.htm (Accessed: 10 Dec 2015)

Moor,A. (2006) *Colours in Architecture.* London: Mitchell Beazley.

Neatorama. (2009) *The History of Glass* Available at: http://www.neatorama.com/2012/09/10/The-History-of-Glass/ (Accessed: 1 Feb 2016)

Pilkington Glass UK. (2016a) *Pilkington Texture Glass* Available at: http://www.pilkington.com/products/bp/bybenefit/decoration/textureglass/ (Accessed: 15 Dec 2015)

Pilkington Glass UK. (2016b) *Pilkington Decorative Glass Range Brochure* Available at: http://www.pilkington.com/products/bp/downloads/byproduct/decoration/default.htm (Accessed: 15 Dec 2015)

Saint Gobain Glass Uk Ltd (2014) *SGG Decorglass Patterned Glass Range Brochure* Available at: http://ememento.saint-gobain-glass.com/app/webroot/img/assets/19/products/pdffiles/19_1406723583_1.pdf (Accessed: 15 Dec 2015)

Spec-net. (2015) *Axolotl and Ozone Glass Design create a new division, Axolotl Ozone.* Available at: http://www.spec-net.com.au/press/1005/axolotl.htm (Accessed 14 Jan 2016)

Film

850°C The Glass of Tomasz Urbanowicz. (2013) Directed by Łukasz Śródka [Film] Wroclaw, Poland. Camera Nera.

Personal Communication

Holford, R. (2016) Telephone conservation with D. Llewellyn, 20 Jan 2016.

Jackson, R. (2016) Telephone conservation with D. Llewellyn, 4 Feb 2016.

Johansson, M. (2016) Telephone conservation with D. Llewellyn, 20 Jan 2015.

Jones, R. (2015) Studio visit, D. Llewellyn, 16 Dec 2015.

Langley, W. (2015) Email communication with D. Llewellyn, 31 Dec 2015.

Urbanowicz, T. (2013) Studio visit, D. Llewellyn, 3 - 7 July 2013.

Urbanowicz, T. (2015) Studio visit, D. Llewellyn, 24-27 Jan 2015.

Further Reading

Beck, C. and Slater, K. (2013) *Glass Sculpture*, Farnham: Lund Humphries.

Beveridge, P. (2003) *Warm Glass*, New York: Lark Books.

Delpech. J-E. and Figueres, M-A. (2001) The Mouldmaker's Handbook, London: A&C Black.

HM Government (2010) *The Building Regulations 2010, N - Glazing,* London: HM Government.

Thwaites, A. (2011) *Mould Making for Glass*, London: A&C Black.

Williams, A. (1989) *Sculpture*, Worcester, Massachusetts: Davis Publications Inc.

Wurm, J. (2007) *Glass Structures - Design and Construction of Self-Supporting Glass Skins*, Basel, Switzerland: Birkhäuser GmbH.

List of Illustrations

Fig.24 Urbanowicz,T., Llewellyn,D. *Old and new steel frames,* 2012-2013, photographs.

Fig.25. Urbanowicz,T. *New frame being installed,* 2012, photographs.

Fig.26 Urbanowicz,T. *Sketches for sphere at University of Bialystok,* 2014, photographs.

Fig.27. Urbanowicz,T. *Maquette and steelwork for sphere at University of Bialystok,* 2014, photographs.

Fig.28. Urbanowicz,T. *Fixings for sphere at University of Bialystok,* 2014, photographs.

Fig.29. Urbanowicz,T. *Initial fitting of glass and close ups of fixings after installation,* 2014, photographs.

Fig.30. Urbanowicz,T. *Sphere in situ,* 2014, photographs.

Fig.31. Urbanowicz,T. *Concept drawing and model for European Cooperation Centre,* 2014, photographs.

Fig.32. Urbanowicz,T. *Finished installation at the European Cooperation Centre,* 2014, photographs.

Fig.33. Urbanowicz,T. *Fixings in a church at Przedbórz,* 2010, photographs.

Fig.34. Urbanowicz,T. *Original drawing and new building, Justin Centre, Wroclaw,* 2008, photographs.

Fig.35. Llewellyn,D. *Close up of glass blocks, Justin Centre, Wroclaw,* 2013, photographs.

Fig.36. Urbanowicz,T. *Use of wood and metal fixings,* 2006, photographs.

Fig.37. Urbanowicz,T. *The Soul of the Piano, fixings and installation,* 2005, photographs.

Fig.38. Urbanowicz,T. *Maquette,fixings and finished headstone in situ,* 2011, photographs.

Fig.38. Lane,D. *Kiln with formers and slumped artifact,* 2014, photographs.