The Historic Dimension Series

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Brightening the 20th Century:
The Influence of Prismatic Glass

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Prismatic glass was developed to increase the amount of light entering a room without adding more windows.

Walking down Elm Street in Greensboro, North Carolina, one can view many phases in storefront transom designs beginning in the late nineteenth and early twentieth century. In fact, many twentieth century Main Streets across the U.S. illustrate the phases in commercial storefronts. Storefronts have been a very significant part of commercial architecture history. Commercial storefronts are particularly valuable because they continue to play a critical role in advertising and increasing business sales (Jandl, 1982).

In the 1870s, a new advancement in storefront design occurred. During this time period, commercial buildings began using large display windows on the ground floor (Gelbloom, 1978). Previously, storefronts resembled residential buildings with residentially scaled windows and doors. But with the use of display windows, the desire to have storefronts that appeared light and open distinguished the commercial building from the residential building.

Two technological innovations occurred during the 1800s that led to the evolution of storefront designs. These technological advances included the development of cast iron and new advances that led to the production of large panes of glass. By the late nineteenth century, storefronts consisted of a recessed entryway with two display windows on either side. By the early twentieth century, the use of transom lights with prismatic glass panes became prevalent. These transom lights sometimes incorporated moveable vents to increase air circulation.

Storefront Limitations and Designs

Main Street storefronts are one of the best and most abundant examples of the utilization of prismatic glass in America. Storefronts are also the best location to find remaining prismatic glass. Glass used in storefronts has seen several evolutions. Windows in storefronts began by resembling residential windows then cylinder and bent glass became popular. After cylinder and bent glass, there was plate glass and prismatic glass (Marinelli, 1988). Prismatic glass allowed for light to reach spaces of interiors that previously could not be lit. Not only did this allow for more business employment and use, but it also allowed stores to have longer business hours, which made them more profitable.

The use of prismatic glass in storefronts had a huge impact on the design and appearance of commercial buildings. In the nineteenth century, no interior point could be more than 25 feet from a window or there would be an inadequate amount of daylighting. The measurement of 25 feet applied not only for lighting needs but for ventilation needs as well. The desire for plentiful daylighting and ventilation restricted the configurations of architecture during this time. Buildings that were designed resembled alphabet characters of L, U, and E in plan. These shapes were used in order to maximize exposure to light as well as maximize ventilation. Before the widespread use of electric-

Fig. 2: Detail photograph of a prismatic glass tile. Courtesy, National Park Service, Chad Randl

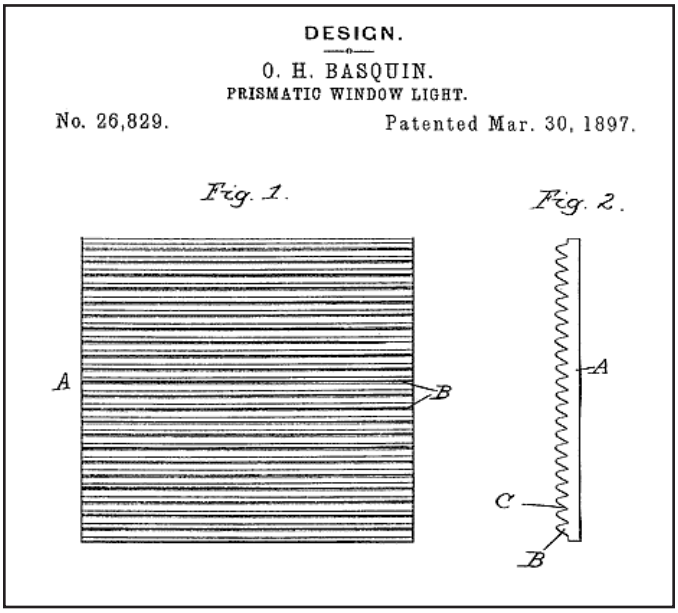

Fig. 3: The Luxfer Prism Company patent. In Olin H. Basquin's patent, he writes that this is a patent for a new and improved design for window-glass.

ity, the new invention of prismatic glass allowed new ways to light buildings in the late nineteenth century. The focus on providing the most amount of natural light possible was extremely important because natural light was one of the only ways a building could be lit. Architects and contractors were very focused on daylighting due to this necessity.

Daylighting Needs & A New Invention

Daylighting remains an influence in architecture because it provides a free illumination source and affects people and how they work. Daylighting can affect people in positive and negative ways. Researchers studied poor exposure to natural lighting compared with abundant exposure of natural lighting. The study showed that students and workers perform better when natural light is more abundant (Blatner, 1948). The affects of natural light, the direct influence of saving money, and the need to light space, drove inventors of the nineteenth century to develop the idea of prismatic glass. While other types of glass allowed rays to pass directly through the pane, inventors developed prismatic glass to increase the amount of light entering a room without adding more windows. As seen in Figure 2, prismatic glass was achieved through texturizing, which increased the depth that refracted light reached. Careful consideration was given to the texture of the glass in order to reach the desired amount of lighting in a building. The lighting method was ideal for commercial architecture, and saved room and money spent on electricity, as well as lit basements with natural light.

Prismatically shaped glass can be traced to the early eighteenth century. It was first used to direct light into the interiors of ships. By the second half of the nineteenth century, prismatic glass was being used for skylights in pavements to allow light in the basements of commercial buildings (Jester, 1995). The prismatic skylights would bounce sunlight underneath buildings where, before prismatic glass's invention, natural lighting could not reach.

Prismatic glass was widely used in pre-electric commercial buildings (Jester, 1995). Prismatic glass transoms were introduced to the architecture of commercial buildings in the 1890s as a way to direct daylight to the rear of a building. By expanding the amounts of space that could receive light, businesses could expand, thereby increasing revenue. Prismatic glass was also used in the United States as an energy-saving mechanism at the turn of the twentieth century.

Even though prismatic glass was used in ships and commercial buildings before the late nineteenth century, the real breakthrough came in 1897, when "a group of Chicago businessmen joined forces with the inventor, James Pennycuick, to found the Luxfer Prism Company" (Prismatishes Glass = Prismatic Glass, 1995, p. 24). Chicago's Luxfer Prism Company was the most influential manufacturer of prismatic glass. The company worked to develop a very specific formula to calculate individual prescriptions for lighting buildings. The formula was very similar to how optometrists prescribed certain lenses for patients (Jester, 1995). The calculations were used to find the right type of prism, combination, and placement for each building. For some architects who thought the calculations were too complicated, the Luxfer Prism Company suggested an average textured

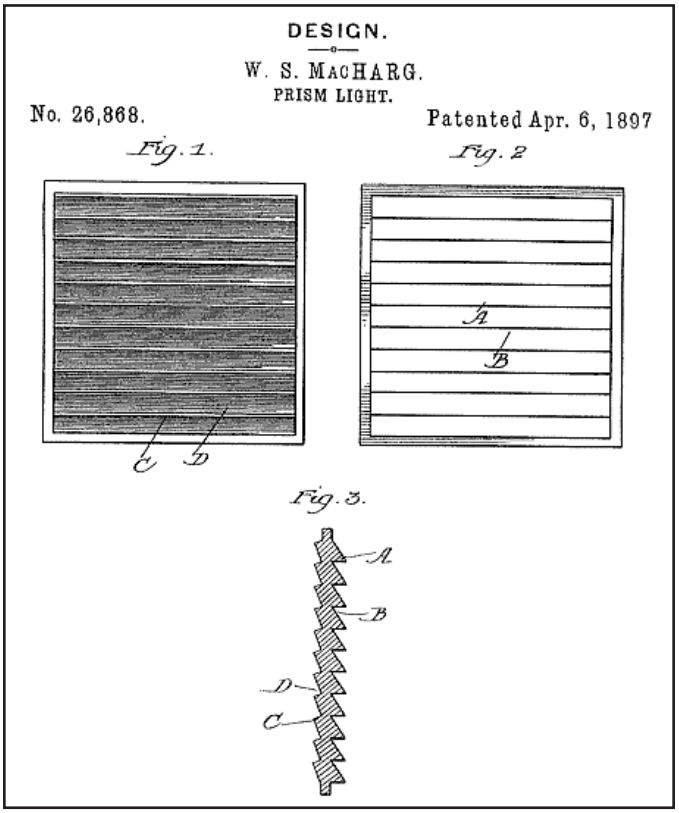

Fig. 4: The Luxfer Prism Company patent. In William S. MacHarg's design, he uses both sides of the glass for parallel prisms and grooves.

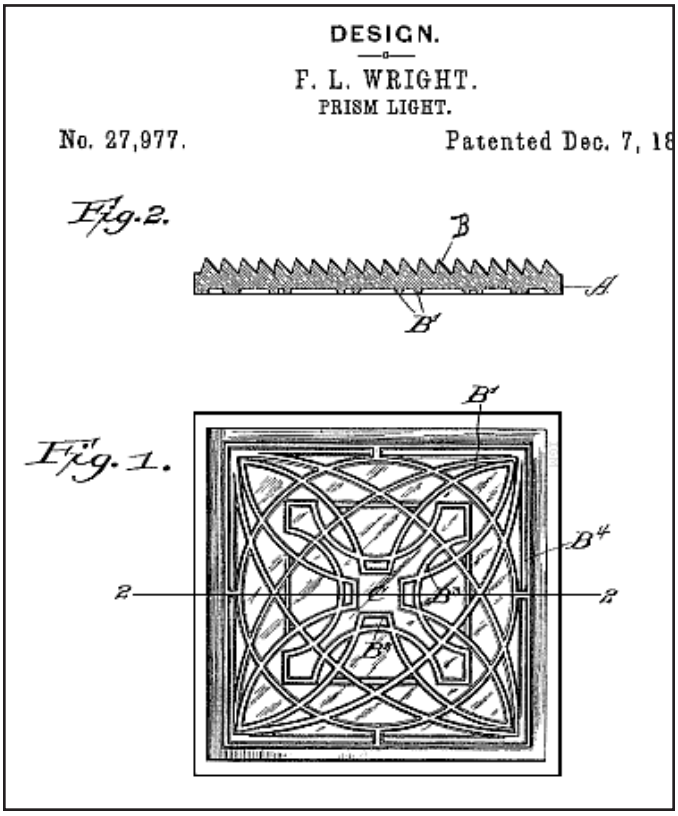

Fig. 5: The Luxfer Prism Company patent. Frank Lloyd Wright's design illustrates the more intricate of the patents that The Luxfer Company submitted.

angle of 57 degrees. In 1897, the Luxfer Prism Company had submitted 162 patents for designs, frames, and machinery to create their prismatic glass. Figures 3 and 4 are from the Luxfer Prism Company. The company was such a success that within one year after opening, they had already installed prismatic glass into 296 buildings. By 1906, the number of buildings with the Luxfer Prism Company's prismatic glass had reached to over 12,000. As Luxfer and their prismatic glass gained popularity, many competitors developed. By 1905, some of Luxfer's competitors included Luminous Prism, American 3-Way Prism, Searchlight Prism, Daylight Prism, and Solar Prism, but Luxfer Prism Company remained the most successful seller.

Manufacturing, Designing and Installing

The development of prismatic glass was a unique process. The glass was pressed into iron molds to produce the textures in the glass. In order to create the various rib forms, manufacturers created and used special dies. The exterior prisms on the glass would catch near vertical sunrays and refract them horizontally into the store or building while the interior side of the glass would collect ambient light and filter it throughout the room (Marinelli, 1988). The Luxfer Prism Company began by developing small 10x10 cm glass tiles that were 3 mm thick (Prismatishes Glass = Prismatic Glass, 1995). The glass originally could not be created in larger sheets because they tended to crack. The small tiles would then be assembled in a frame of 60-120 cm high. The frames would then be installed into the building.

Several architects used prismatic glass while some even helped design some of the glass textures. Several of the well-known architects to use the material included Frank Lloyd Wright, William Le Baron Jenney, and Louis Sullivan. Frank Lloyd Wright was one of the architects that worked with the Luxfer Prism Company to create special designs. He designed 41 prismatic glass textures. Figure 5 is Wright's most famous design out of the 41.

Prismatic glass tile had ridges and other raised patterns on the inside surface that directed sunlight. The tiles were joined together using zinc or lead. The original color of the glass was clear, but after World War I, manganese was added which eventually made the glass turn green. Also, after years and years of exposure, UV rays could make the manganese turn a purple color.

"Prismatic glass was the most sophisticated and complex development among the many attempts in the last decades of the nineteenth century to bring more daylight into the dark interiors of factories and densely built urban centers" (Neumann, 1995, p. 24). The Luxfer

Fig. 6: South Elm Street, Greensboro, North Carolina. Storefront with prismatic glass transoms.

Fig. 7: South Elm Street, Greensboro, North Carolina. Detailed photograph of a prismatic glass transom utilizing different colors and textures.

Company described the glass as not only a way to light up a dark space, but a design and safety feature as well. The glass could increase the amount of light in a room between 5 to 50 times that of ordinary glass, but its success depended on the specific circumstances of the building (Jester, 1995). The product was a great success and was introduced to almost every Main Street across the United States, including Greensboro. Figures 6 and 7 are photographs of prismatic glass utilized in storefronts along Greensboro's South Elm Street.

The invention of prismatic glass was a major breakthrough for daylighting but it did have some drawbacks, including its expense and difficulty to keep clean. In 1903, plate glass cost five cents per square foot while prismatic glass cost up to fifty cents per square foot. Business owners were required to weigh the options of the cost of installation to the proposed increase in sales after the installation. Due to the success of the product, it is not difficult to determine which side business owners leaned towards.

Prismatic glass was commonly installed in three ways, in a window sash, separate frames in front of existing windows, or as a transom. Towards the waning of the glass as a popular building material, prismatic glass was even used for glass blocks. The introduction of prismatic glass changed the architecture of commercial buildings of the early twentieth century. The new glass was usually placed at a prominent position on the storefronts of commercial buildings as seen in the historic 1920s photograph of Figure 8. It was placed in the upper section of the store's first and/or second floors. The placement of the prismatic glass windows influenced floor plan designs when existing light shafts could be converted into floor space once the prismatic glass was installed. Along with storefronts and floor plans, ceiling heights could be reduced because light could reach farther into spaces, which eliminated the need for high ceilings. Prismatic glass was most frequently used in commercial buildings, but residences, schools, and hospitals of the early twentieth century would sometimes install the material as well (Jester, 1995).

Prismatic Glass Block

After the development of prismatic glass, another advancement for daylighting occurred. This advancement was in the utilization of prismatic glass for developing prismatic glass blocks. An example is illustrated in Figure 11. In the late 1930s, the arrival of light-diffusing glass block created a series of improvements in daylighting (Boyd, 1951). The first prismatic glass blocks were manufactured by the Owens-Illinois Glass Company in 1937. Once developed, scientists began studying the glass block's potential affects on daylighting. Around the same time that the prismatic glass block was manufactured, scientists had begun to study the effects of natural light on human activity. Before prismatic glass, daylighting was almost entirely achieved by the use of nonfunctional light-transmitting materials like clear sheet glass. Unlike prismatic glass, clear sheet glass does not control the direction or the amount of sunlight that is coming into a space.

The prismatic glass block was developed in order to maximize the amount of daylight. The four surfaces allowed "light-controlling designs [to] be impressed in contrast to the two surfaces available in the case of sheet glass" (Boyd, 1951, p. 5). The developers of the prismatic glass block believed that the increased number of planes in the glass block on which prismatic glass could be placed, would allow for an increase in the amount of daylighting available for a building. By the time of development, the making of prismatic glass had come down to a science. Scientists could mathematically cal-

Fig. 8: Late 1920s photograph taken in Delphi, Indiana. In the photograph are storefronts with prismatic glass transoms. Gerard Collection, Courtesy Delphi Preservation Society, Delphi, Indiana.

culate the average amount of lighting available with the angle of the sun to determine the potential foot-candles the material could produce. In order to achieve the most illumination possible, manufacturers suggested reflective surfaces positioned on the ceiling and upper portions of the walls because the glass block would direct most of the light to these surfaces first. If the upper portions of the room were reflective, light would hit those surfaces and then bounce off to other areas of the room. The use of prismatic glass blocks was seen in both institutional and commercial settings.

Fading Away

Unless there are remnants of the original glass, prismatic glass has largely been abandoned. By the 1930s, the demand for electricity caused the prismatic glass transoms to become obsolete (Chad, 2001). The most abundant use of prismatic transoms was for display windows and doorways of Main Street buildings. Prismatic glass saw a renewed interest during the 1940s and 1950s. Today, many original prismatic transoms have been covered or replaced with other glasses. But as the interest in sustainability increases, scientists are beginning to study the ways prismatic glass can be utilized again.

Neither the Luxfer Prism Company nor any of their competitors are still in business, but the look and use of prismatic glass remains appropriate for the 21st century. After the 1930s, when prismatic glass became obsolete, many storefronts' prismatic glass was either covered with signboards or new facades, or covered in paint (Marinelli, 1988). If the restoration of prismatic glass to a storefront is desired, it could be as easy as removing panels that conceal it. If the glass has been removed but the desire for prismatic glass remains, there

Fig. 9: Opera House in Delphi, Indiana, undergoing restoration. Courtesy Delphi Preservation Society, Delphi, Indiana.

are three options to choose from: custom cast new glass tiles, used textured glass, or salvaged historic material. The National Park Service lists four possible sources to replace the prismatic glass. These include: The Architectural Glass, Inc., of Beacon, New York, which can cast new prismatic tiles using historic steel molds purchased from an original manufacturer; the Rambusch Studios of Jersey City, New Jersey, who sell original prismatic tiles acquired from the Canadian Luxfer Prism Company (their collection offers several patterns); Pilkington/ Libbey-Owens-Ford in Toledo, Ohio, has a 1/4" reeded glass that has been used as a substitute for historic prismatic tiles; and the Hollander Glass Central, Inc., of Downers Grove, Illinois, that manufactures cross-reeded and double reeded textured glass that resembles prismatic tile patterns (Chad, 2001).

Conclusion

The development of prismatic glass had a profound impact on commercial storefronts in the early twentieth century. Most commonly used in transoms located in the upper portions of the facade, prismatic glass influenced the design and appearance of Main Streets across America. The utilization of prismatic glass can be seen locally on South Elm Street in Greensboro, North Carolina.

Since prismatic tiles are difficult to locate, the best option for existing prismatic glass in historic buildings is to maintain them. Challenges may arise as prismatic glass panels can bulge over time, which is caused by the failing of the lead cames. The metal can be repaired without damaging the glass tiles and therefore the prismatic glass transoms should always be kept in place. If proper maintenance is given, historic prismatic glass can be upheld and the character of the building can be main-

Fig. 10: Restoration of the Opera House's prismatic glass transoms. Courtesy Delphi Preservation Society, Delphi, Indiana.

tained. Figures 6 and 7 illustrate the aesthetic beauty of prismatic glass that has been properly maintained. The continued use and upkeeping of this building material is important because it represents a significant time in building design, construction materials, and daylighting. As the quest for renewable energy in the twenty-first century continues, it is possible that the use of prismatic glass, or a material of the like, will see resurgence again. There is much to be learned from previous generations; all we have to do is look at what they have left us.

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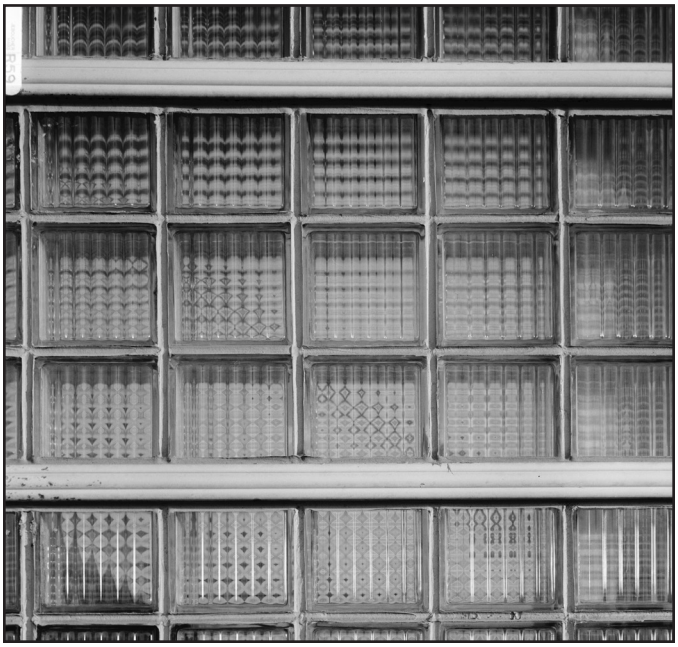

Fig. 11: Example of prismatic glass block.

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Images

Figure 2: National Park Service, Chad Randl
Figure 3, 4, 5: U.S. Patent Office
Figure 6, 7: Author
Figure 1, 8, 9, 10: Delphi Preservation Society, Delphi, Indiana
Figure 11: HABS

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