STAINED GLASS

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ON THE COVER:

The Book Tower in Detroit, Michigan. Femenella & Associates Inc.'s in-shop 1:1 scale model of the book tower atrium. Performing the job in this fashion gave them the opportunity to get every panel, "just-right". This one small photo shows 6 different types of jewels as well as the two shades of glass used in the field. Every tube-member, every glass-panel and every cover plate went through a rigorous test-fitment process before being deemed acceptable.

Photo: Femenella & Associates Inc.

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***Stained Glass* Quarterly is an exchange of ideas and knowledge among readers, a means of carrying information and inspiration of our craft to the world.**

EDITORIAL CHAIR
Tyler Kimball

MANAGING EDITOR
Nicole Deneve

DESIGN
Holly Norris

CONTRIBUTING WRITERS
Tyler Kimball, Ellen Mandelbaum, Richard Prigg, Jules Smith

CONTRIBUTING EDITORS
Nicole Deneve, Josephine A. Geiger, Tyler Kimball, Megan McElfresh, Jules Smith

PROOFREADERS
Nicole Deneve, Tyler Kimball, Megan McElfresh

BUSINESS MANAGER
Megan McElfresh

EDITORIAL AND ADMINISTRATIVE OFFICES
371 Delaware Avenue
Buffalo, NY 14202
800-438-9581 / 816-737-2090
stainedglass.org

PUBLISHER
Stained Glass Association of America
371 Delaware Avenue
Buffalo, NY 14202
800-438-9581 / 816-737-2090
info@stainedglass.org
stainedglass.org

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The Book Tower: Project of a Lifetime

By Tyler Kimball

Imagine walking into a 475-foot building shortly after its grand opening in 1926, to discover an entry atrium nestled inside that rises six floors to a crown of glass jewels and the age's finest glass. The dome and ceiling cresting the open court, spewing light and a natural glow throughout the cascading open floors.

The Book Tower in Detroit, Michigan was spared no expense during its creation and it showed it. Designed by Louis Kamper and directed by three brothers, J. Burgess Jr, Herbert, and Frank Book, the mid-1920s build set the tone for the burgeoning metropolis, and the glass-capped atrium was meant to be the crown jewel of the city.

"Below the rusted steel skylight and antique fire-rated wire-glass of the tower, housed one of the most unique glass installations ever performed in this country," Arthur Femenella Jr. of Femenella and Associates would declare upon investigation of the atrium.

"A giant elliptical egg-shaped dome adorned with one of the most exquisite installations of glass jewels and patterns sat atop a grand marquee-style cast-iron frame. Radiating down from the cast iron to the surrounding columns were waves of glass panels and jewelling that melded seamlessly into the interior space. From the untrained eye it would have looked as if the installation was comprised of leaded panels akin to traditional stained glass. The original installation must have been a sight to behold."

Femenella took a deep survey of the glass in the atrium, for it was in severe need of restoration. The recently purchased building by Bedrock Real Estate had seen a rapid decline over 50 years, not receiving proper maintenance and care since sometime in the 1960s. A 317-million-dollar restoration was called into action and Femenella and Associates would take the task of recreating the original brilliance that was the Book Atrium glass ceiling.

Left: The scale and frequency of the jeweling is exceptional. Over 4,000 jewel replications from 12 different jewel-types were necessary to complete the restoration of the existing as well as the fabrication of 100% of the undercroft panels (all panels between the cast iron frame and the surrounding columns.) which all were made from scratch. The project was about 60/40 in terms of new fabrication to restoration; respectively. We had to make more new panels than were existing. Photo: Femenella & Associates Inc.

Right: To our knowledge this is the only surviving photograph containing the original undercroft panels, all of which were missing at the start of this project. The photograph was then translated into a rendering by ODA (AE, Manhattan, NY) as well as a working sketch. The sketch did not contain any sizes and was not drawn to scale. One can start to see how tall of a mountain we were about to climb. Those two pieces of paper were all we used to complete the entire project. Photo: Femenella & Associates Inc.

SCOPE OF THE PROJECT

A single historical photograph, depicting the original glory of the ceiling would serve as the main guide for Femenella's re-creation, but much would develop as he pulled out the old glass and matrix.

We were invited to a meeting with ODA in Manhattan; the lead architects for the project," Femenella explained about the first steps in learning about what was needed for the reproduction job. "They had a sample of a surviving corner panel from within the cast iron frame. This was our first look into what we would be dealing with. No encapsulating leads, cames or foiling. All vertical members with a copperish tinge; with seemingly nothing holding the glass itself. On further inspection you can see that the delicate soldering was the lone material holding the glass in pane on both sides." He added, "After Art Sr. and I left the initial meeting (a year prior to the project), I shared a thought with him: 'I have been puttying Tiffany windows since I was 7 years old and working with the firm ever since—I have never seen anything quite like this.' His response was a bit surprising to me: 'That makes two of us.' In his half-century of specialization, if it was news to him, it was truly 'unique.'"

A single solder bead was all that had held each individual piece of glass in the ceiling and dome for nearly a century. Femenella and his team were learning that a huge amount of precision was used in the original fabrication and would again need to be replicated with that kind of perfection.

"The skill at which this glass was cut. It's almost like they used a scalpel. The glass is edge to edge with the vertical brass members the full 360° around the perimeter of lite. Just amazing," Femenella would say. "We had confidence we could make it happen, but to say that this was going to be an automatic, "slam-dunk" was light years from the truth. Just looking at this project, one can spot about 100 very legitimate pitfalls that could be a death sentence for the completion. It was surely a risk, as we had never done something quite like this before."

In order to go into the project without getting overwhelmed, Femenella came up with a plan to divide the work into two sections. The project bifurcation would point out two very different paths for the two areas that were defined as the dome and the undercroft portions of the ceiling.

The dome had seen 80 percent of the glass survive and would become a hybrid of restoration and replication. The undercroft was in need of a fully new fabrication. The undercroft would need to blend seamlessly with the restored and replicated dome though, so much was needed in the way of creating a new matrix that would work with the old cast iron structure.

"The blend of three-dimensional tubing structures, the delicate means and methods of the glass, the massive jeweling sections, the replication in kind and stress of matching colors, opacities, textures, thicknesses, OA footprints of new jewels being within thousandths of an inch for proper fit; it was a myriad of madness,' Femenella would state. But into the madness his team and he went.

THE DOME

Beginning with the reclaiming of the existing glass and cleaning, decades of grime was required to be taken off. "For a very long-time people were able to stand under the glass and marvel at it while enjoying a cigar or cigarette in one hand," Femenella began about the depth of cleaning that was needed. "The tar and nicotine that a burning cigarette is constantly vaporizing into the interior space, combined with the heat given off makes the contaminants rise in the air until they are corralled by this monstrous glass installation. The smoke begins to develop a thin film over each square inch of the glass surfaces as well as the surrounding structure. Once the film dries- it becomes stronger and hardens over time. But not before the polymer chains within deposited chemicals begin to build on one another until it becomes a tacky residue. This residue will attract and adhere to every particle of dust and dirt that ever encounters its surface. The entire surface top and bottom were absolutely caked in resin, dirt, and debris. In fact, they were so dirty that it made the entire installation look opalescent! Having seen the cleaned sample prior to our removal- we know we would eventually see this level of clarity from all the surviving panels."

Using a wide array of cleaning tactics, Femenella and his team found each piece begin to show its true brilliance and original coloration and opacity. And as each piece revealed itself, the substrate of required repairs also appeared. The staging of the glass and how many pieces would need to be replicated began to take form in the studio.

With every glass and jewel needing a very exact edge to fit 1/8" into overlapping solder joints at every corner while holding each piece into place, any slight differential from what was needed would deem the original glass unusable.

"A single solder bead on the edge of each side of the glass is all that holds each piece in place," Femenella stated.

"It's almost like the prongs of a wedding ring, personally grasping and holding each lite and panel in perfect position. All with tricked out, hidden attachment points to lend a seamless look to the installation."

The matrix in which the glass was housed would also undergo scrutiny for repair and reconstruction. The copper-plated-brass-retaining-matrix, or CPBRM as it was referred to by Femenella and Associates throughout the project, needed some major corrections and in some instances full replacements. All repairs of bent and warped sections were done in mating with the original design.

The crest of the upper-dome's glass was seated in a top-loaded cast iron t-bar matrix that needed nine of the 69 panels replaced. The nine panels were recreated using a 3-D template that Femenella created in order to find the exact curvature and size of each panel.

The remaining portion of the dome required 68 panels of glass to be replicated. Each piece was matched to a corresponding glass within the design to achieve the exact color and opacity.

"Several types of glass needed to be sourced," Femenella explained. "Two shades of flat glass for the field as well as 11 different variations of jewels. Ranging from 2" x 2" weighing only ounces; to ones larger than a large closed fist weighing several pounds. Most of them being crystal clear, while one of them is a deep amber color, in the shape of a 12oz soda can. All being held in by the same, "jewelers-prong" means of retention."

Left: The finished product. Photo: Bedrock Management Services LLC.

Right: This is a historic photo of the building. Based on the automobiles and the Detroit trolley, the photo was taken in the 1940s. Photo: Detroit Free Press archives

It isn't stained glass; it isn't leaded glass; it isn't even copper foil. The original means and methods of the installation consists of a copper-plated-bronze-retaining-matrix. Sort of a mouthful. If not for the oversized solder joints at each verticy, each piece of glass could simply fall out of its setting. Once all of the glass is installed the entire panel gets dipped in a copper plating solution where a thin layer of copper envelopes only the bronze matrix itself. The glass' lack of conduction ensures this. Photo: Femenella & Associates Inc.

Femenella sourced the field amber glass for this project from Kokomo and Rainbow glass, but needed some help from Savoy Studios for the very specific jewels and more unique textured glass.

"In the crown panels there was also a third type of textured glass with a heavy embossing that resembled flowing water, Femenella continued about matching glass. "We refer to it as river-glass. This glass was only found in the very top crown of the installation. Two panels consisting of only river style glass were missing and needed to be made from scratch."

After each portion of glass was fitted to the correct curvature and fabricated within the slight tolerances of the matrix, each panel was handled with extreme care. The assembled panels weighing up to 60 pounds and without a flat edge to sit on were often at risk when simply placed on a worktable. "Just moving these panels around the shop needed to be thought through in a very complete way," Femenella recalled. "Not only were they very fragile and heavy- just being able to put them down to rest was a bit tricky. Usually when you place a panel on the bench, it isn't trying to break itself in half once at rest. If these panels aren't properly supported in a 3-Dimensional manner—they attempt to tear themselves apart by their own mass and leverage. For a rigid alloy matrix such as this with a zero-tolerance install as well as the glass making contact with metal on all sides, placing the panels under any sort of strain or torque will result in breakage. Typical stained or leaded panels have the luxury of resting in soft linseed-oil putty enveloped with the soft alloy of lead. These materials act as a buffer to breakage and stress in a traditional setting."

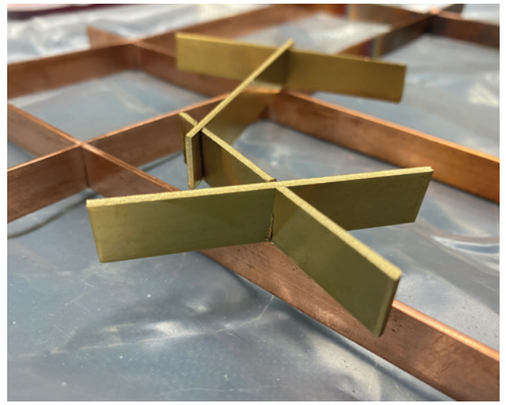
Once the panels had the glass fully inserted and soldered on both sides, the panels were then treated with a copper plating and patina application to match the finish of the original panels.

THE UNDERCROFT

Working from the existing original photo, Femenella created a digital rendering that would then lend itself the scaled design drawing that would be his guide for the entire reconstruction of the undercroft. The 68 glass panels made from glimmering bevels and jewels were made to fit into the structure that would best replicate the look of the original ceiling. Along with every single glass panel, the original framing was lost without a single surviving aspect. Due to this loss, a completely new structure needed to be formed by Femenella and Associates to house the glass panels.

We fabricated over 4,000 individual jewels stratified into a dozen shapes, sizes and colors that repeated throughout the design. Some being the size of a small dinner plate and each weighing close to 5 pounds. All 4,190 jewels need to be polished by hand at the base to adjust for proper fitment into the matrix.

Photos: Femenella & Associates Inc.



The original means and methods of fabrication have been reemployed. Bronze members receive a series of plunging cuts that relieve material sufficient enough to allow each element to systematically interlock with one another.

Photo: Femenella & Associates Inc.

"No doubt, the shimmering panels of glass speckled with light altering jewels steal the show every single time. However, it might interest people to know that the panels themselves took just as long to make as the structure that would hold them in place," Femenella began about the structure. "If you can believe it... The tubing structure that we had to contemplate, engineer, fabricate and eventually install- was just as big of a hurdle, if not even more challenging than fabricating the 70 panels through a completely foreign set of means and methods! That's how difficult this was to accomplish. Eight columns, a cast-iron frame, and a massive hole in the floor that extends six stories to the marble floors. The most important part to understand about the consistencies that exist between all of these elements that support this structure is that there are none. Not a one!"

Femenella would work around these inconsistencies found in the supports under and around undercroft at great length. The columns that the structure rose from were not equidistant from one another, nor were they square to one another on the same plane. Additionally, the dome that the undercroft was to line up with was not centered to the undercroft's structure and off five degrees parallel with its complementary undercarriage.

"Each one of the dimensional facts above all compound each other at the same time" Femenella explained. "It's not a matter of just dealing with each issue one at a time. We had to deal with all of them on a constant basis. We needed to contemplate a holistic approach to the way this structure was A. going to come to life and B. was going to fit perfectly within the space of the 6th floor Detroit Atrium over 600 miles away."

Shortly after contracts were signed for the project, Femenella took very exact measurements off the ceiling needing restoration in Detroit. He did this with a string and bob running six floors from the work area down to the dance floor six floors below. He then took the measurements back with him to his studio in New Jersey to create a 1:6 scale model of the ceiling needing a new structure. The in-house model would serve as their map to creating what was needed to align to the atrium in the Book Tower.

"Have you ever seen the movie, *Oceans 11*," Femenella inquired. "The movie is about a vault robbery that takes place at a casino in Las Vegas. A large part of the heist was to make an exact scale replica of the casino-vault in their offsite shop where they could stage the robbery. Well, no robbery here! The only thing we stole was this scaled-model-idea from the movie. That's exactly what we did."

The floor drawings and 1:6 scale model was soon traded for a life size 1:1 model that Femenella and his team could easily report to when needing measurements for panels or structure fabrication.

With scale models in place, as well as renderings and design drafts, the team could then fabricate the structure that would hold the glass in place as well as leading together the faceted panels, weighing up to 60 pounds each.

The party piece of this original installation leaves nothing to be desired. 8 massive jewels the size of ostrich eggs serve as the apex that sets the tone for the down-flowing design. The cylindrical amber jewels that create a solid ring at the base of the dome; they are the size of 12 oz beverage cans.

Photo: Femenella & Associates Inc.

"The goal was to fabricate an engineered structure that would safely hold all the panels and offer the installation details that we thought were most advantageous to the client. Because of the extra dimension (3D), DOM tubing was an obvious choice for our main structural supports," Femenella said about the structure's engineering. "The finished product is a very strong material with the memory and bending characteristics that the project required. Because this tubing is produced by welding; naturally, the material is also very cooperative during the cutting and welding steps of the process. The bulk of the design is based on a DOM tube with an OD of 1 ½" and a wall thickness of ⅛".

INSTALLATION

Working off the scale model to recreate in full the structure and glass of the undercroft, and mirror exactness to replicate existing glass after a full clean to the pieces making up the dome, it was time to install the work.

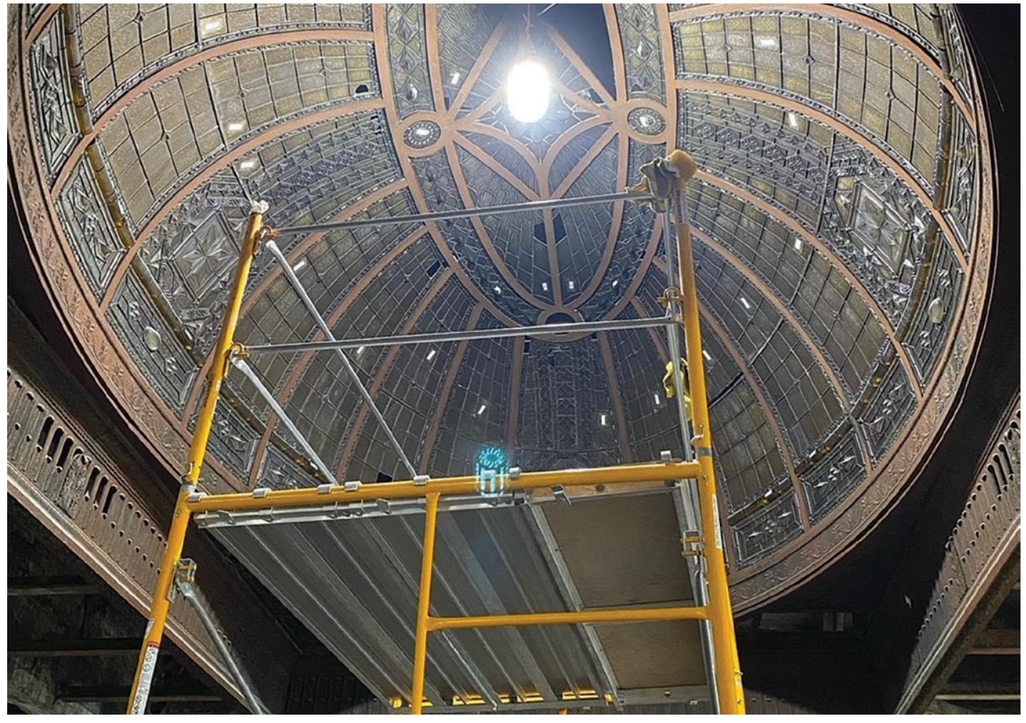
"The shop model was built down to the 1/16" from the site conditions," Femenella proudly exhibited. "All of the columns are out of line, the cast iron frame is twisted in the same direction, everything was made exactly as it is at the site in Detroit 600 miles away." And the model to work off needed to be that way for a flawless installation. "If I had to choose one fact as a badge of honor to take away from this project, it would be our install tolerance," Femenella continued. "The longest side of the installation is over 40 feet long. Over this long span, our installation was only off its mark by a quarter inch. A light persuasion of the end tube, and the final fasteners threaded in like butter. It was a very proud moment for my team and I."

Clockwise from top left: The level of difficulty regarding the removal of the surviving panels cannot be understated enough. Their rigidity was their lone saving grace. Overly cumbersome, massively heavy and full of compounding curves- the panels were not cooperative. The majority of the panels could not even be set to rest once removed; some of them do not possess flat edges to rest upon!

A shot of my family and I visiting the final install without my father. My dad was diagnosed with cancer shortly before the project started. He isn't pictured in this photo because he had already passed. I am ever thankful for the teachings, wisdom and the restoration paradigms that he has instilled in me.

If you can believe it, the relationship between the columns and the central cast iron frame in which we needed to bridge the gap; there are a lot of words that can be used to describe this relationship; however, "symmetrical" is not one of them. Not one dimension was mirrored on the opposite side. We required all of this information down to the nearest mm. Bringing our shop to Detroit was not a cost effective option for the project. So, we made an in shop model just as in the movie, "Ocean's 11" where an exact replica of a bank vault was replicated. The model was a verbatim match complete with all of the inconsistencies of the elements on site, over 600 miles away.

Photos: Femenella & Associates Inc.



Clockwise from top left:

Only this portion of the installation that we had to work with. Bent panels, broken glass, entire panels missing, broken joints. The big take-a-way is that none of the undercroft panels are pictured; Why? Because they were long gone. All of the remaining panels not in this photo were made from scratch.

The shape, alignment, pattern, soldering, miter-cuts; all of these had to be within extremely fine margins of error. Having the materials line up and seamlessly meld together as one cohesive unit was paramount. Some of the jewels can weigh up to ~4 pounds, and are only held in place at the corner vertices of the matrix. Over 4,000 individual jewels had to be replicated to complete the project. Every one of them was put together just as you see here.

This ceiling is a cross-vault. This occurs when there are two barrel vaults that intersect at right angles. 97% of the surfaces of this installation are bent. Not only that, some of them are bent several directions at once! This panel has a single bend at the exact radius of 5'6". The sibling vault is slightly smaller at 4'6". All of these panels need to be constructed, safely stored, and installed in the exact same position. This means for traveling across the country from NJ to MI as well.

The partial cleaning reveals just how much debris and contaminants were present on the glass surface. The entire installation and palate were much more "clear" in appearance than we originally thought. The original thinking being that the colors would reveal a higher level of "amber" to the field.

For the restoration panels (surviving / existing) the first half of the scope prior to performing repairs was a very thorough cleaning. Because of retired smoking laws- the panels were caked in a layer of nicotine and carbon deposits from the combustion. The cleaning was done gently by hand using a non-ionic-surfactant mixed with warm water in concert with hand agitation using soft brushes.

Photos: Femenella & Associates Inc.

Each panel fitted to work with the dome needed careful placement and each setting caused concern by the team while installing into the rebate framing. Other obstacles also presented themselves as the installation team made their way through the 89 panels needing to be fit into the dome.

"Seems simple enough, just lift them into place, right? Not exactly," Femenella explained. "It's very tricky to get these large, heavy and delicate panels back into their resting places. The setting forces the installer to place the panels in complete peril for a temporary amount of time while the maneuvering is being performed. The entire panel needs to be supported in a very even way by very trained hands, all while suspending the panel in mid-air under pure arm strength. The final fun-factor of this task was the fact that there was undocumented encumbrance behind the glass that lessened the workspace greatly. Steel pipes and cut-off raw beams were in random locations, blocking movement in unpredictable ways. It's a nervous moment, to put it lightly."

The undercroft structure engineered and fabricated by Femenella and his team gave him the ability to plan a more intelligent installation process. Due to the heavier weights of the panels in the undercroft, Femenella devised a system of bronze mechanical connections that would lock each panel into place after lifting into their setting. "

Instead of lifting, contorting, adjusting and setting the panels into a rebate- what if we could face-mount them from the bottom," Femenella recollected his thoughts about his engineering. "Two people would lift and hold the panel in place while two others inserted machine screws treated with blue thread-locker into drilled and tapped corresponding tabs that mirrored the attachment points on each panel. Once the fasteners were installed, the panels were as happy as well fitted ceiling-tiles."

PROJECT OF A LIFETIME

The project is one of note simply for its historic importance but gains more prominence for its aesthetic of design and aim at grandeur. But more than its historic value or sheer beauty is its extreme in engineering. For Femenella and his team to delve into the mind of the Book brothers and pick apart a complex matrix of minuscule tolerances, recreate it and work within it is marvel over all things. And then to put this project

Arthur (Art) J. Femenella Sr., pictured with his son, Arthur J. Femenella Jr. Photo: Femenella & Associates Inc.

into one for the ages like no other, a to-scale model that represents all the off-parallels and inconsistencies of the 1926 build, to work off and then find every measurement spot on in a breath-holding installation on site in Detroit.

Femenella stated, "If I'm ever able to work on something this fantastic ever again, I'd be really surprised. Every single aspect of the project was something new. Everything. This is not stained glass. This is not leaded glass. This is a copper-plated-brass-retaining-matrix. The glass is both full-size and sight-size simultaneously, which is an amazing feat in itself. The entire thing is nothing short of amazing."

He continued, "Although he was very sick, sharing progress photos with my father brought him a lot of joy at the end of his life. My only wish is that he could be here with us to see it complete for himself. All that I am—I owe to him."

The final installation occurred at the Book Tower in Detroit in September of 2022, after two years of work on the project. After the careful re-imagination of structural supports and glass panel restorations, the ceiling is set to last another 100 years, if not more.

Known to the stained glass community as 'The Rondel King,' Tyler joined the SGAA Board and put his English degree and experience as a newspaper reporter to good use as the SGQ Chair of the editorial committee in the summer of 2022. His passion for working in glass has led him down many different avenues over the years and his favorite work is always just around the next turn. ■