CHALLENGES OF A HISTORIC RENOVATION

Converting the Bank Building at Chestnut Street presents difficulties for the design/build team.

by Stephen Ziga, CPD, CET

Philadelphia is one of the oldest and most historically significant cities in the United States. Founded in the 17th century, Philadelphia was a major center of the independence movement during the American Revolution. The Declaration of Independence and U.S. Constitution were drafted in Philadelphia and signed in the city's Independence Hall. Today tourists can stop by Independence Mall and visit the Liberty Bell Center and the new National Constitution Center.

Philadelphia is also home of the Mummers, cheese steaks, the United States' oldest zoo, and four major sports teams. Dubbed "The City of Brotherly Love," Philadelphia is rich with culture and history and offers much as a major travel destination.

Recently the city has experienced a boom in the residential redevelopment market. The local government has been successful in its push for neighborhood revitalization due to an increase in demand for urban living space after years of resident exodus. Because of this call for more housing, residential developers are eyeing abandoned factories, warehouses, and commercial facilities for conversion to multitenant condominium buildings. With this increase in construction demand comes an increase in need for engineering services.

Many engineers who work outside the city don't know that Philadelphia is home of the Philadelphia Plumbing Code, also known as the single-stack system. Adopted by the city in 1961, this code varies greatly from more recognized plumbing codes. Two of the most noticeable items to outsiders are the dense fixture quantity requirements for commercial facilities and the use of large pipe sizes for venting and drainage systems. The city code also sanctions the use of combination storm and sewer systems. It takes much time for an outsider to become familiar with the diverse requirements set forth by the Philadelphia Plumbing Code.

The Department of Licenses and Inspections (L&I) enforces city code ordinances. Each construction discipline has its own thorough permit review process by a city sub-code official. There also exists the Philadelphia Water Department, Philadelphia Gas Works Co., and Exelon Corp., the electric company. Each of these utilities also has its specific guidelines for utility installation. (You must take much care when working within any metropolitan or municipal area to create a design that hopefully will be reviewed and installed in accordance to established regulations. Proper utility installation regulation awareness should lead to a swift passage through permit review and construction.)

Figure 1 Turn-of-the-century photo of Banker's Row

Photo: Bryn Mawr College

This historic renovation story begins in 1857. In the mid-to-late 19th century many trust and banking companies came together in the central section of Philadelphia now known as Banker's Row (see Figure 1).

This central location for financial institutions created an environment with a healthy sense of competition. Firms of comparable size vied for the same clients and presumably kept their operations lean and responsive because an alternative for business was only a few steps away.

The Bank Building at Chestnut Street (see Figure 2) was designed by John M. Gries in an at-the-time modern classical style. Constructed for the Bank of

Pennsylvania, this building was one of several designed by Gries in Philadelphia. Each of these new buildings featured a rich and distinctive architectural face. The buildings were designed in a new pattern of street architecture, with contiguous elaborate stone fronts. The area was the first to truly fulfill this image of a shoulder-to-shoulder gathering of the city's financial citizens in distinctive façades. These connected buildings became the notable buildings on Banker's Row.

The Bank Building is a masonry construction, six-story building with two basement levels. The project involved converting this historic structure into a mixed-use, multitenant condominium/commercial building. The ground floor would remain commercial space; the second through fifth floors would have four residential units each; and the sixth floor would be a single penthouse unit. A tunnel was to be created at one basement level to connect the Bank Building with an adjacent hotel. The reason behind the connecting tunnel was to provide condominium residents with the hotel's amenities: concierge service, pool and spa, and room service. This was to be the jet-set style of condominium living.

The project seemed straightforward at the beginning. It was a simple "gut job." We were to identify any infrastructure deficiencies and develop a preliminary scheme for the new tenant fit-out. The developer was intending to provide bidding contractors with a minimal level of information for pricing and then move toward a design/build construction phase. However, once we started to unravel the string of old as-built documents, survey notes, and proposed floor layouts, it quickly became apparent that this project had a lot more underlying issues.

Figure 2 The Bank Building

As details of the project became clearer, we found that many significant hurdles needed to be addressed. We reported our findings in our feasibility report and issued a set of schematic documents showing the required infrastructure upgrades. In this report, we cited the major challenges that would be faced in the design of the plumbing systems. Those challenges included the following:

Figure 3 In the existing historic area, the cement open structure with plaster architectural details limited the amount of pipes passing though open areas.

- maintaining the integrity of the building exterior while creating useful interior floor layouts;
- creating vertical shafts and riser locations for heating, ventilation, and air conditioning, electrical, and plumbing utilities;
- changing the use and occupancy classification of the building;
- accounting for additional utility requirements on existing systems;
- planning and designing for an adaptable design for possible tenant fit-out variations;
- providing dedicated utilities to each tenant unit; and
- minimizing the amount of interruption to existing tenant space.

We wanted to keep the appearance that the building was historically preserved—even though it changed from commercial to mixed use—by preserving the building façade as well as many architectural features within the ground-floor tenant space. The upper floors were to be treated as totally renovated areas within the historic envelope.

The project's historic preservation goals adhered to the following principals:

- Preserve the architectural and historic integrity of the exterior.
- Preserve the historically significant areas in commercial and public spaces.
- Maintain distinctive original features such as the building entranceway and placard.
- Recognize the building as a product of its own time.
- Treat sensitively such distinctive stylistic features or examples of skilled craftwork as original millwork, sculpture, plasterwork, and specialty glazing.
- Repair rather than replace worn architectural features when possible. When replacement is necessary, new material should match the old in design, composition, and color.
- Clean façades using the gentlest methods possible.
- Use compatible contemporary alterations only if they do not destroy significant historical or architectural fabric.
- Build new additions so they can be removed without impairing the underlying structure.

After the initial pricing came back, the owner decided to keep my team on board as consulting engineers and move forward toward construction documents. The complicated infrastructure upgrades could have become more costly if the project went out as design/build. The owner wanted a complete engineered construction document package to clearly define the project scope and control construction costs. In this phase we had to confront and solve all problems outlined in our feasibility study. It also was decided that it would be more cost effective to separate the infrastructure work from the tenant fit-out work and issue separate design packages. By separating the construction packages, the owner would

Figure 4 Sanitary piping installed below a raised floor application

be able to fit out the tenant areas as sales progressed and also have an infrastructure in place for any unit customizations.

The first conflict to deal with was the minimal impact requirement for the ground floor. The tenant and landlord wanted no additional piping exposed. The ground floor was originally the lobby and teller area for the Bank of Pennsylvania. The tenant kept much of the architectural millwork and plasterwork intact (see Figure 3). This area was historically significant to the building and could not be compromised by any new utility passing though the space. The floor's brick and masonry construction made this issue difficult. Running our new services in existing shafts was not feasible, since the few existing shafts didn't line up with the required locations on the floors above.

To our luck, an architectural firm was the ground-floor tenant. The architects spoke our language and were helpful in the planning process. We agreed to provide one central shaft location in a closed-off area where we could run all new plumbing and electrical utilities.

The original sanitary drainage design had only provided for a central toilet core at each floor level. Only one 4-inch sanitary stack existed. Since no sanitary drainage piping was to run horizontally on the first floor, we decided to raise the second floor level and provide the new sanitary service beneath it. We designed the new sanitary system to reuse the existing service and provided a new 6-inch horizontal main that was to be routed beneath the raised floor (see Figure 4). This new main would pick up the additional sanitary risers that were required for the fixtures on the floor above. (When working with residential design, it is important to tell the architects where you are running any piping larger than 3 inches so they can provide walls deep enough to contain the piping.)

This building was originally a combined sanitary and storm drainage system. After we recalculated the drainage demand and added the existing storm water demand, we realized that the existing sewer main exiting the building was not the proper size. Because of the additional demand the project required, the sanitary service for the building needed to be upgraded to a 6-inch service (at 1 percent slope), and the combined system was required to be upgraded to an 8-inch service (at 2 percent slope).

Because this system was designed around the Philadelphia Plumbing Code, the pipe sizing was much larger than what would be required using a code such as the International Plumbing Code. The Philadelphia Plumbing Code places a much higher drainage fixture unit (DFU) value on each fixture. The allowable DFU rate on a pipe size is also much less in comparison to the IPC. See Figure 5 for an example comparison between the two codes.

The redesign of the sanitary service and storm water service added great expense to the project due to the need to route through existing concrete and masonry conditions and relocate piping to provide proper head clearances (see Figure 6). This might have become a much larger issue had it not been identified early in the project. (It is important to understand the head clearance of the piping and what impact the slope may have on the area beneath the pipe. It is also important to consider how large piping or equipment will be brought into the building. Can you easily get the piping to the area of construction?)

Figure 6 shows the exit point for the combined sanitary and storm drainage system. The piping passes though an existing coal storage area. The depth of the piping and passage though the existing brick foundation made the installation more challenging.

Figure 5 **Code comparison example**

Example: New apartment building with 20 units with 20 bathroom groups plus a kitchen sink

Philadelphia Plumbing Code

- Single bathroom group = 6 dfu
- Kitchen sink = 3 dfu
- Total drainage fixture count = 180
- Minimum service size = 6 inches (⅛-inch slope)

House Drain or Horizontal Branch					Vertical Soil or Waste Stack
Pipe size (inches)	1/16-inch fall	⅛-inch fall	¼-inch fall	½-inch fall	
1¼			2	2	
1½			4	6	6
2			10	18	20
2½			27	36	36
3			48	65	75
4		50	100	200	225
5		130	225	420	480
6		330	480	875	1,015
8	500	850	1,100	2,000	2,320
10	1,050	1,650	2,320	3,800	4,500
12	1,800	3,000	4,500	6,500	8,100
15	3,600	6,000	8,100	10,000	13,600

Source: Philadelphia Plumbing Code

International Plumbing Code

- Single bathroom group = 5 dfu
- Kitchen sink = 2 dfu
- Total drainage fixture count = 140
- Minimum service size = 4 inches (⅛-inch slope)

Maximum Number of Drainage Fixture Units Connected to any Portion of the Building Drain or the Building Sewer, Including Branches of the Building Drain				
Pipe size (inches)	1/16-inch slope per foot	⅛-inch slope per foot	¼-inch slope per foot	½-inch slope per foot
1¼	—	—	1	1
1½	—	—	3	3
2	—	—	21	26
2½	—	—	24	31
3	—	36	42	50
4	—	180	216	250
5	—	390	480	575
6	—	700	840	1,000
8	1,400	1,600	1,920	2,300
10	2,500	2,900	3,500	4,200
12	3,900	4,600	5,600	6,700
15	7,000	8,300	10,000	12,000

Source: International Plumbing Code

One of the positives about the single-stack method when designing a bathroom is that you typically only need to vent branches that have more than two connected fixtures or are greater than 12 feet from the stack.

Figure 6 Sanitary drainage piping

The cold water source was via a new constant-pressure booster pump system and 3-inch cold water riser. The existing water meter and backflow assembly needed to be relocated as part of the infrastructure upgrade. It was required to perform all the domestic water modifications during off-peak times, so the ground-floor tenant could operate during normal business hours. Each unit then was provided with a dedicated cold water service with a sub-meter for landlord monitoring and billing. Hot water would be generated locally at each dwelling unit via an electric water heater.

A new natural gas service was brought to the building to satisfy the appliance demands for the converted residential units. Each unit was provided with a separate meter and pipe main. Philadelphia Gas Works only provided a guaranteed 3 inches water column (wc) of gas pressure to the building. Since the connected appliances have a minimal demand of 7 inches wc, a gas pressure booster was provided to supplement the additional pressure need. A piping network of 21 gas mains then was routed via the new chase to each of their respective units. (It is important to remember when sizing for single units such as this type of application that the upper floor may require a different size service than the lower floors if you are sizing the pipeline using the equivalent length method.)

The final snag that carried on for some time was the fire protection system. The building was partially sprinklered by a wet-based sprinkler system powered by an existing 250-gallon-per-minute diesel-driven fire pump. A dedicated sprinkler riser located in an exit stair supported the sprinkler system. The exit stair towers also were provided with fire department connections at each floor landing by means of manual dry standpipes. The Philadelphia Fire Code has since mandated that all high-rise buildings with dry-type standpipes be converted to automatic wet-type standpipes. We recommended the upgrade of the fire pump service to accommodate the new mandate. The required fire flow would need to be increased to 750 gpm for an automatic combined standpipe system. However, in an attempt to save cost, the owner requested from the city fire department a variance to convert the dry standpipes to manual wet standpipes. The city accepted the variance request after much time. We then provided the performance requirements for the modifications to the standpipe systems and sprinkler system coverage.

Figure 7 The new Bank Building, circa 2006

What appeared to be a straightforward renovation actually turned out to be one of our most difficult and involved projects (see Figure 7). We encountered challenges for each system. The building construction type, age, and condition led to a more intensive survey and findings report and ultimately a more defined construction document package. Since we took the time to properly coordinate the mechanical, electrical, plumbing, and fire protection systems, field issues during construction were only minor clarifications, not major design revisions. PSD

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