Keeping Great Performances "Under Cover" at the Kennedy Center

Required: The Best Materials and a Well-Orchestrated Effort to Apply Them

By Swen E. Swenson III, CSI

AS THE JOHN F. KENNEDY CENTER FOR THE Performing Arts in Washington, D.C. was celebrating its 25th anniversary, work was beginning to replace the entire roof of the nation's most visible showcase for music, theater and dance. It was a project that would require sensitivity to the very special nature of this facility as well as close coordination among several organizations.

Those organizations included the architectural firm, the general contractor, the roofing contractor, the manufacturer of the roofing system, the U.S. Army Corps of Engineers, and the Kennedy Center management itself. All agreed on one thing: They did not want to repeat the process again anytime in the near future.

The right roofing system

So the starting point was to select the appropriate roofing system. After an exhaustive analysis of six possible roofing technologies, the Chicago-based architectural firm of Wiss, Janney, Elstner Associates, Inc. (WJE) selected coal tar built-up roofing (BUR). They specified a four-ply coal tar built up roofing system over insulation with a top flood coat of coal tar and aggregate surfacing. Larry Meyers, the architectural firm's consultant on this project put it succinctly: "I wanted to be able to retire without having to worry about this roof again."

For a level or low-sloped roof, coal tar has two important characteristics that make it inherently superior to other commonly-used materials. First, coal tar's tight molecular structure gives it naturally superior resistance to water, air and water vapor penetration. And secondly, a coal tar roof is "self-healing" due to a property known as "cold flow." That simply means that hairline cracks that may develop due to changes in temperature will periodically fill in as the temperature rises and the coal tar reaches its "cold flow" point. This process will occur over the life of the roof.

The built-up aspect of the roofing system specified by WJE called for four plies of organic felt saturated with coal tar. "We wanted a four-ply built-up system," Meyers explained, "for the redundancy, and thus additional layers of confidence—if you will—that it would give us."

The roofing contractor, Prospect Waterproofing Company, a Sterling, Va.-based firm specializing in built-up roofing installations, chose a system from Koppers Industries (Pittsburgh, PA).

The biggest initial challenge: being invisible.

The biggest challenge, from a project management perspective, was presented by the nature of the Kennedy Center itself. Not only does the Kennedy Center host world-renowned performers and performances, but it also boasts an audience that on any given day might include dignitaries and heads of state from the U.S. and around the world.

The Kennedy Center is also the nation's busiest center for the arts, presenting more than 2,800 performances each year for audiences approaching 2 million people. Activity at the facility, from major performances to classes, is virtually constant. The Kennedy Center houses six theaters and several major public spaces ranging from the Hall of Nations to rooftop restaurants, to a 24,720 square foot Grand Foyer with a 63-foot high ceiling. This architectural gem is also situated

Day or night, the Kennedy Center is the nation's busiest center for the arts.

next door to one of the world's most exclusive urban apartment complexes, the Watergate.

Thus, two things were understood by everyone involved in the project: The work must be invisible to patrons and neighbors, and it must not interfere with any of the Kennedy Center's performances or other activities.

"A pretty good lesson in cooperation"

Roofing is not necessarily clean, quiet or odorless work. So the first challenge, identified by the Kennedy Center's Vice President of Facilities, Clifton Jeter, was to set up a system of communications and procedures between Prospect and the Kennedy Center's staff to schedule work to avoid interfering with the almost continuous flow of performances and activities.

Phase One began in June of 1996 with the removal of the old roof right down to the concrete deck. But because the existing roof already had numerous active leaks, this had to be done in manageable sections and would require the immediate application of a temporary, watertight covering. Prospect and WJE jointly decided on the application of two-ply vapor retarder directly onto the concrete as it was uncovered. Not only would the two-ply vapor retarder provide temporary roofing as demolition continued, but it would be left in place as a permanent vapor barrier under succeeding layers of insulation and the built-up coal tar roof in Phase Two.

An external elevator was installed outside the south end of the Kennedy Center, where there were no adjacent buildings. That elevator was used throughout the project to carry crews, material, equipment and debris unseen by patrons or neighbors.

Initially, to avoid interference with performances, Prospect worked only at night. But they soon realized that the frequency of thunderstorms and rain showers was much higher at night, increasing the risk of leakage as sections of roof were uncovered. Work then shifted to early morning hours, usually beginning before 7 a.m. but often needing to conclude by early afternoon to accommodate matinee performances.

Once work shifted to daylight hours, Kennedy Center staff and Prospect established a communications system and planning schedule that allowed Prospect to plan manageable breaks in the work around scheduled performances. The system permitted emergency communications in case of unanticipated problems. Prospect generally planned its work to conclude at least several hours before any performance. They also provided a supervisor whose job it was to remain on-site and in communication both with Kennedy Center staff and Prospect staff throughout the performance.

"As far as our patrons were concerned, no construction was underway," explained Jeter. "That's quite an accomplishment, when you consider the amount of work that was actually being done directly overhead. It was a pretty good lesson in cooperation for all of us," he added.

Fumes—an even bigger challenge

Working unseen and unheard. Scheduling work around performances and activities. Ensuring that no work shift ended with a totally uncovered section of roof. Planning clean-up to make sure that no equipment or debris were visible. These challenges were all manageable through close coordination and good communications. However, the odor of asphalt or coal tar fumes was another challenge entirely. It was one that required more than good management.

"Initially," explained Jeter, "we coordinated to ensure that the appropriate intake vents were closed as the kettles were moved about on the roof." That, however, did not solve the problem of disturbing nearby residents, particularly those living at the Watergate.

The solution developed by Prospect and WJE was to acquire an FRS-6000® Fume Recovery System. This unique piece of technology (for which Koppers is national sales agent) is manufactured by Aercology, Inc. (Old Saybrook, CT) and distributed by NTE, Inc. (Boardman, OH). The FRS-6000 is a portable unit that consists of a hood, plenum and propane-powered blowers to recover fumes from tar and asphalt kettles and then "clean" them by pulling them through a series of filters and media. The system not only removes fumes and particulates (down to 0.3 microns), but it also removes gases, vapors and, most important to the Kennedy Center's neighbors, odors. Its use virtually eliminated the possibility that neighbors or passers by could detect the presence of coal tar or asphalt fumes.

According to James Newcomer, Prospect's project manager on the Kennedy Center job, workers eventually had two kettles in continuous use—one for coal tar and the other for asphalt. (The asphalt was used to attach the insulation and flashings and during demolition as the temporary roof). They were able to connect one FRS 6000 system to recover fumes at both kettles and at the points where coal tar or asphalt were placed into luggers for distribution to roofing areas.

Out of sight (and of smell) is not out of mind.

Just under the 140,000-plus square foot main roof, but hidden from view from within, was a system of pans, hoses and pumps that was catching and draining away water that would continuously work its way through the old roof during, and for some time after, rain storms or rapid snow melts.

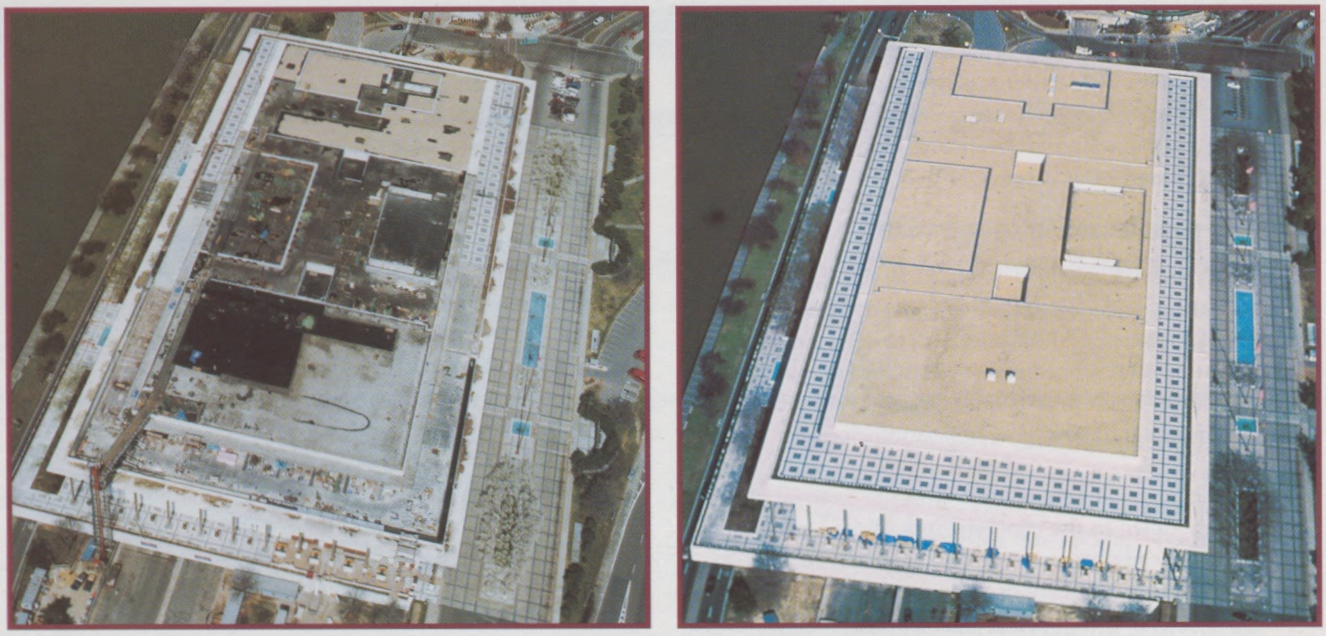
All agreed that two serious problems had diminished the performance of the old roof: its flatness and inadequate drainage.

In addition, there are two areas of the main roof that are unique: Directly over several small theaters that are in constant use, are floating acoustic "slabs" to protect those theaters from airplane noise. These slabs are actually areas of concrete roof poured directly on top of insulation. It was believed that the slabs might already have absorbed water.

These three challenges—flatness, poor drainage and the possibility that the acoustic slabs might have absorbed water—would require joint creative solutions.

Flatness and poor drainage—creative solution number one.

According to Meyers, the architects' initial challenges were how to design enough slope into the roof to allow proper



All phases of the job can be viewed in the photograph at the left. At the bottom (south end) is the external elevator that was used throughout the job. The south third of roof shows bare concrete slab and a section of the installed vapor barrier. The rectangular area on the east (right) side of the middle section contains the acoustic slabs that were left in place under the concrete in a creative solution that avoided the additional work of removing concrete deck. New 2-ply, insulation board, built-up roofing and gravel top coat were installed over the concrete, leaving the old insulation undisturbed. The tan areas on the north end of the building show finished roof with top coat of tar and river gravel. The photograph at the right shows the completed roof. Installation took 19 months.

drainage, and then how to direct that water and control run-off to within D.C. code limitations.

"We knew from the outset," explained Meyers, "that a lot of ponding had occurred over the years and that had contributed to the active leaks in the old roof." The original roof simply did not have enough drains. In fact, Prospect's Newcomer said he could actually see the algae blooms in dry weather. "Those are created only when water stands for extremely long periods of time."

Putting slope into the new roof presented its own special aesthetic and physical challenges. According to Meyers, the old roof had a top surfacing of white marble chips, which actually carried forward the white appearance of the Italian marble on the building's facade. Now the architects were calling for a river gravel top surfacing to eliminate the potential of piercing the top ply presented by the sharpness of marble chips. And they were faced with the need to create elevation to facilitate drainage and accommodate base flashings.

WJE's solution was to design a modification that increased the height of the parapet wall around the entire perimeter of the main roof by eight inches to maintain the design intent of the original sight line. They specified marble to match the blocks in the original facade. "We were able to show the client that we could change the wall height enough to accommodate necessary drainage without significantly changing the building's original ground-level site lines," Meyers explained. "And we believed that the river gravel would lighten over time, providing visual continuity in more elevated views from across the river or from the Watergate."

But getting marble to match was another challenge. According to Douglas Winger, project manager for Rockville, MD-based Grunley Construction Company, Inc. (the general contractor), the original marble was Carrera Ultisimo, found only in the Carrera Mountains of Italy. After some research, Pagliaro Brothers Stone Contractors were not only able to locate the marble, but the original quarry from which it was cut.

Grunley then raised the parapet walls using marble mined from the original quarry and then reinstalled the original marble coving atop the parapet wall.

The additional eight inches enabled the architects to design in about 1/4-inch per foot of slope and create a more than adequate system of 63 drains. The slope was executed via a system of "crickets," or peaks and valleys to catch water and carry it to the 63 drains. Over the initial vapor retarder, and directly beneath the four-ply built-up coal tar roof, was isocyanurate insulation with a one-inch thick overlay board. The system of crickets and valleys was created by varying the thickness of the isocyanurate from two inches to 12 inches. And the additional eight inches of elevation around the external wall allowed for the necessary additional insulation and base flashing.

Runoff was then controlled to within code limits through the use of "flow preventers" at all 63 drainage points.

"Having standing water at these points for a few hours when necessary will present no problem because of the built-up coal tar roof," explained Newcomer.

"As we completed sections, you could literally see them drain like sink bowls," Newcomer added. "And you could watch the catch pans under the roof dry up."

Creative solution number two: the acoustical slabs.

The floating acoustic slabs presented a different kind of problem. While the ponding and leakage could be seen, the condition of these slabs, because they were installed directly under poured concrete, could not.

"It was the Koppers people who first expressed concern that we may have moisture in the acoustic slabs," recalled Newcomer. After discussions among Grunley, the architects and the U.S. Army Corps of Engineers, it was decided to undertake a "fairly major" redesign in midstream to effectively isolate the acoustical areas—physically and drainage-wise—so they could be replaced much more easily if necessary in the future.

The solution involved surrounding both areas with a low, double masonry wall (like a room divider). Batt insulation was specified between the double walls, and they were to be capped by roll roofing (*See Figure 1*). Then, as a backup, Prospect was asked to mechanically fasten the first layer of insulation to the slab prior to installing additional layers of insulation and finally the built-up roof itself.

"It was agreed by all that we couldn't and shouldn't disturb the slabs," explained Meyers. "I could fax drawings back and forth to Koppers technical people and get some quick resolutions to this and several other problems and issues."

"It was a group effort," was Larry Meyer's conclusion—one that required good communication among all entities involved in the job.

Last December, just the week before Christmas, another well-coordinated group, the Joffrey Ballet of Chicago, performed its Nutcracker to full houses over a six-day run at the Kennedy Center. Not a person in the audience was aware that a well-orchestrated team of engineers, architects, builders and roofers had worked since June of 1996 to ensure that the management and board of the nation's premier performance facility would not have to think about the roof again at least until the grandchildren of the Joffrey's dancers were starting their careers.

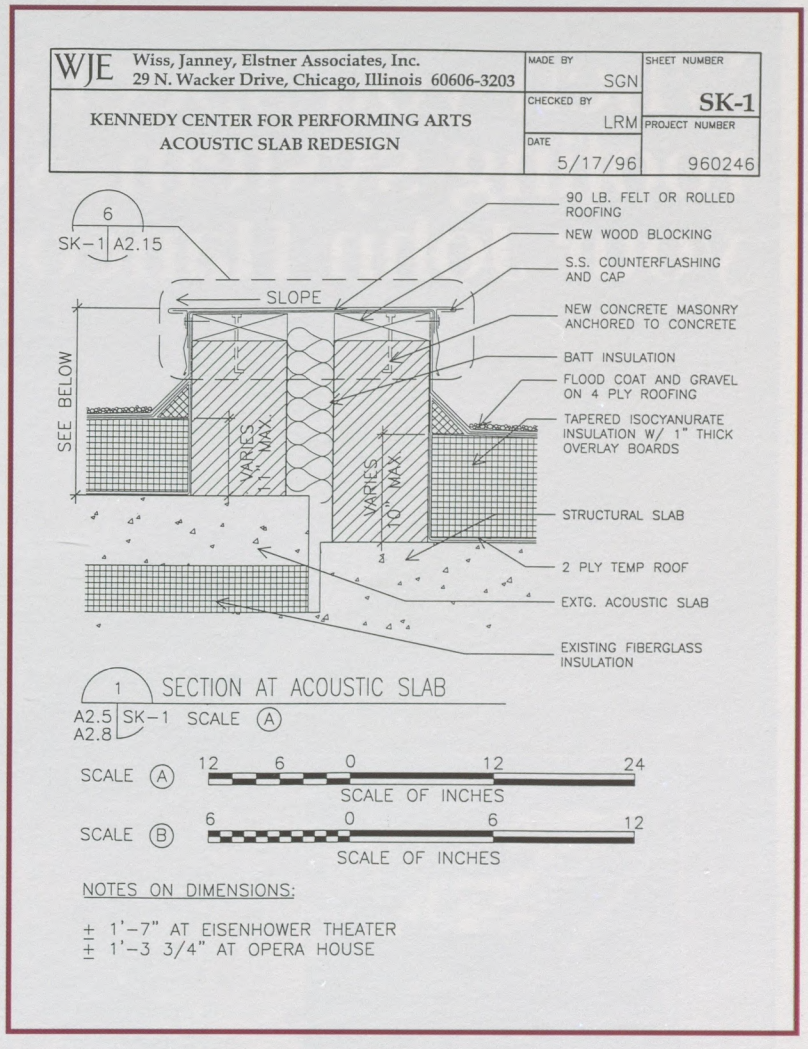


Figure 1

Swen E. Swenson III, *who is currently National Sales Manager of Koppers Industries Commercial Roofing Department, has held a variety of positions with the company over the past 28 years. He has served as Architectural Manager, District Manager, Regional Manager of Commercial Roofing and Product Manager for Roof Maintenance Products. He has held membership in CSI since 1977, and is a past Board Member of the Single Ply Roofing Institute (SPRI). Mr. Swenson also serves as a Municipal Planning Commissioner for the Borough of Leetsdale, PA, near Pittsburgh.*