Public Works

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■ ***Featuring Roadside Maintenance***

surface materials range from sealers to hot and cold liquid-applied membranes. These membranes range from various polymers, thermal plastics, or asphaltic materials to preformed elastomeric sheets and elastomeric traffic-bearing membranes. Often these materials are used in combination with roofing felts, glass or polyester mats, fabrics, or fibers.

Sealers represent the simplest way to waterproof a deck surface. They are used to seal micropores and prevent absorption of water and waterborne chlorides. Usually they do not impede the passage of water vapor and allow the slab to breathe and dry out when it becomes wetted.

There are many sealers, but they usually perform either by penetrating the surface and reacting with the cementitous materials or by adhering as a film to the surface. While sealers can greatly reduce water absorption, no sealer provides complete waterproofing protection—and none against cracking.

Cold liquid-applied elastomeric membranes and traffic deck coating systems have better adhesion, are less prone to reflective cracking, and can stand direct traffic when used in new parking structures or in rehabilitating old ones. Most are based on urethane or modified urethane polymers. They are lightweight and when fully cured require little or no protection during construction from sun or pedestrian and wheel traffic.

Elastomeric sheet membranes are factory-manufactured sheet goods that are shipped to the job site and laid ln place. They require less deck preparation and the installation is less sensitive to site conditions. However, because sheet membranes usually are not adhered to the deck surface, water can move laterally beneath the membrane if it is punctured.

Historically, owners have come to expect leaks and leak-related problems ln concrete decks. However, a properly designed, constructed, and effective waterproofing system is completely feasible. □□□

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that five percent of the steel shelf angles behind the facade had been omitted at the time of construction.

The 12- by 18- by 4-in. terra cotta blocks were to be vertically carried at each floor by 4- by 6-in. steel shelf angles. Horizontal support was provided by Z-shaped steel straps anchored into slots in each block and running the full width of the floors.

"None of the supports extended all the way to the building corners," noted Sven Thomasen, affiliated consultant with Wiss, Janney, Elstner Associates of Emeryville, California, engineers for the restoration project. "This caused vertical displacement cracks between the supported and unsupported sections. Some of these cracks extended through 15 stories—from the ground through the roof."

In turn, the cracks allowed significant amounts of moisture to enter the wall, corroding the shelf angles and terra cotta anchors and damaging the building interior. The rust build-up resulted in more cracking and bulging of the terra cotta. This was particularly evident at the toe of the shelf angles where the deformation of the wall caused instability and localized collapses.

Restore or Replace?

As the deterioration accelerated and crumbling terra cotta fell to the plaza below, Atlanta city officials pondered the situation. The city's growth had long outpaced the building's facilities, which were sorely outdated and did not meet Atlanta city building codes. The question was whether to salvage the building or tear it down and build anew. The answer to their dilemma turned out to be a combination of solutions.

A $31-million facilities improvement project was planned that included new construction as well as restoration of the deteriorating landmark. The new construction phase, a massive U-shaped annex built behind the old City Hall, was completed in spring 1989. The five-story structure, designed by the joint venture team of Muldawer-Jova/Daniels/Busby-Harris, features a wrap-around atrium and neo-gothic details that echo the older building.

With the annex completed, the old City Hall was completely vacated, and the restoration phase began. Western Waterproofing Company's Atlanta branch performed the exterior renovation as part of a $7.3 million cleaning, restoration, and remodeling program under general contractor Holder/Russell, also of Atlanta. Western's affiliate company, Brisk Waterproofing Company, had performed the exterior restoration of the Woolworth Building in New York City and brought extensive expertise in terra cotta work to the project.

Western addressed the building from the top down. Rigging for the project was complex. Crews had to punch through the tile roof, already slated for replacement, to tie outriggers for supporting the 32-ft wide scaffolding.

Full-height expansion joints were cut into each corner and soft, Hypalon rubber strips were installed under the shelf angles at each floor. Built-up stress in the walls had reached an average of 300 psi. As the expansion joints relieved the stress, new cracks appeared on the lower floors and some ashlar virtually exploded as the strain was relieved.

Western drilled 55, 3-in. diameter cores to identify corroded steel support angles and anchors. At this point, the original contractor's omission of shelf angles at the building corners was discovered. Eventually, an additional 1,200 ft of ASTM 36 steel shelf angles were needed—nearly four times the amount originally estimated. Weepholes were also specified every 48 in. on center along the supporting angles.

Western essentially offset the additional cost with a suggestion based on previous terra cotta restoration experience. The company recommended high-strength polymer concrete (Silikal) as an economical substitute for replacing the terra cotta ashlar on the tower.

With a finish and color to match the original terra cotta, the 1,501 polymer concrete replications were cost-effective: roughly half the cost per unit of terra cotta. Because of the short cure time, the polymer units for the tower could be cast nearby and installed with little delay.

Real terra cotta was used to repair the three-story building base. The 466 replacement units were cast by Gladding, McBean of Lincoln, California and shipped to the job site.

The final phase of the restoration involved repointing the entire building and infilling the expansion joints at the corners with two-part polyurethane sealant.

A Job Well Done

Complete interior restoration was concurrent with the exterior work. In October 1990, city personnel moved back into the building. With the additional space provided by the annex, most city offices are consolidated at one site for the first time in nearly 40 years.

The restoration, remodeling, and new construction were cost-effective as well. New, tenant-finished commercial office buildings in Atlanta can range from $100 to $180 per sq ft. The improvements on Atlanta City Hall cost approximately $60 per sq ft, with the new annex running about $100 per sq ft. Thus, Atlanta city government gained its much-needed office space for an average of $75 per sq. ft.

"The project was a bargain," said Paul Muldawer, architect with the joint venture design team.

The square block complex has also elicited praise for its architectural continuity and new construction that complements rather than overshadows the graceful older building. The Atlanta City Hall and Annex is certain to become a frequently referenced landmark, particularly when that city hosts the Summer Olympics in 1996. □□□

dered between the slabs. This can be accomplished with a drainage grid consisting of a three-dimensional polymeric material that has interconnected voids covered by a filter fabric. When placed between the membrane and insulation of inverted assemblies, the grid creates a space for drainage and collection of debris that penetrates through the wearing surface joints.

Another alternative is a layer of clean, coarse aggregate. A pea gravel aggregate is much better than sand, which tends to hold moisture and wash into drains.

Drain hardware used with double-slab systems must accept water at both the top and bottom slabs. One way of doing this is to add more drainage holes to standard drain hardware.

Leakage below the expansion joint seal element—between slabs and through expansion joints—is another problem. This can be avoided by detailing expansion joints at high points and draining away from them. A good practice is to curb the bottom joints at expansion joint lines and provide the sealing element at the wearing surface only, thus damming any potential for leakage at these points from between the slabs.

Flashing is critical at drains, rising walls, and expansion joints, particularly at corner transitions where two different "cross sections" are to be sealed.

Here are a few principles for handling flashings successfully:

- Flashings should be raised above the deck level and placed at high points of the drainage grade. Local slope should be away from the flashing.
- Make provision for movement between components of the waterproofing system, the building structure, and the traffic surface.
- Provide access for inspection and maintenance of flashing with the least possible demolition of structural components.

Successful surface protection depends on the design and execution of all the components already discussed. Available

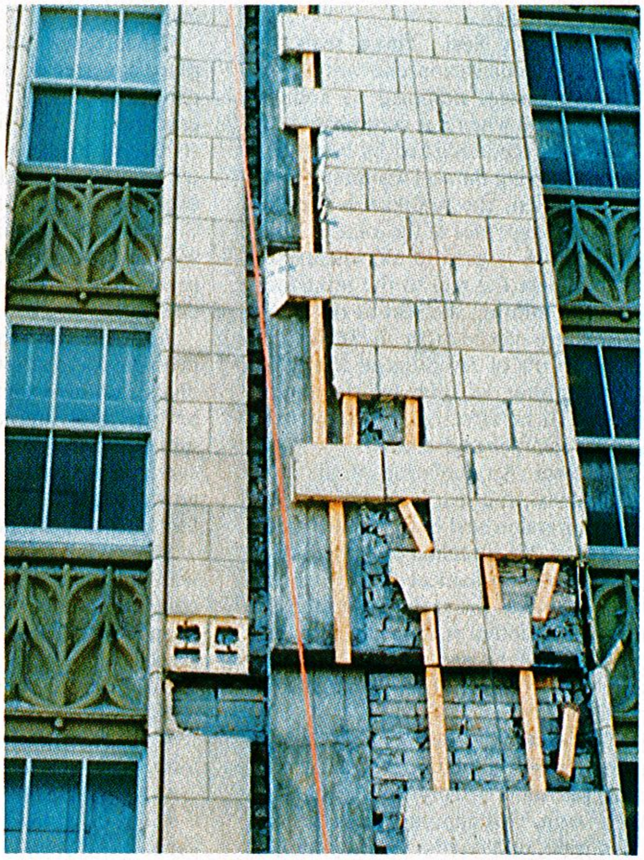
Restoring Atlanta's City Hall Corrects Design Flaws

AS part of a $31-million facilities improvement project, the total restoration of Atlanta City Hall was completed in October 1990. But in 1930, even as the ribbon was cut at the dedication ceremony, the stress factors that would nearly destroy the graceful, neo-gothic landmark were already in place.

Designed by G. Lloyd Preacher & Company, the 85,000-sq ft structure features a 12-story tower atop a three-story base. It has a cast-in-place concrete frame with buff-colored terra cotta cladding over a masonry backup. The building is finely detailed at various levels and capped with a distinctive, stepped-back clay tile roof.

However, as was common practice at the time, the original plans did not call for expansion joints, internal flashings, or weepholes. The cladding was set in place with narrow joints filled with cement-lime mortar. Over the next 60 years, the shrinkage of the concrete columns and the thermal and moisture expansion of the terra cotta created stress in the facade. Terra cotta blocks, particularly on the lower floors where the weight of the facade was greatest, were crushed and buckling under the strain.

Unfortunately, the building's structural problems did not end with the design practices of the day. When restoration began in April 1989, preliminary tests showed



■ **MAJOR repairs were needed at the building's corners, where steel shelf angles had been omitted by the original contractor. Above, workman removes a damaged terra cotta cladding block.**