PROJECT PROFILE

SarnaProof

John Hancock Tower
Boston, MA
Building Owner:
John Hancock Insurance Company
Roofing Contractor:
Titan Roofing Company
Chicopee, MA
Roofing Designer:
Simpson Gumpertz & Heger
Manufacturer:
Sarnafil Roofing Systems
Roof Area: *31,500 sq. ft.*
Date Installed: *1987*
System: *Mechanically Attached Linear*
Membrane: *S327 60 mil feltback*

By the time the John Hancock Insurance Company decided to re-roof its well-known Hancock Tower in Boston, Massachusetts, it had accumulated a wealth of experience in studying the effects of wind on the building.

The striking, innovative building, erected in 1972, has become a Boston landmark. The triumph of the building's design won architect I. M. Pei an A.I.A. national honor award and an award from the Boston Society of Architects for "the city's most beautiful piece of architecture" for the year 1972.

The Challenge:

Years of exposure to high winds, sun, rain, snow, and hail had taken their toll on the original liquid-applied roofing. The original 1-inch polyurethane insulation had become saturated in some areas. By the mid 1980's, Hancock building officials recognized that a new roofing system, with a complete tear off of the old system, was needed.

"We did not have any leaks into the building," said Hancock's Jim Bell, director of building operations, "but the roof insulation was soaked due to the deterioration of the old roofing."

Bell wanted a durable membrane that could withstand high wind uplift

BUILDING TYPE: OFFICE HIGHRISE

pressures and foot traffic. The use and maintenance of heavy window washing equipment and other equipment means that high rates of foot traffic are experienced.

The Choice:

Hancock engineers selected the Sarnafil thermoplastic roofing system, and contracted the consulting engineering firm of Simpson Gumpertz & Heger of Arlington, Massachusetts to manage the job.

Several factors influenced Hancock's selection of the Sarnafil system. First, Sarnafil membranes built an enviable track record of over 25 years of exposure history around the world under extreme conditions. It was particularly important that the company's hot-air weldable, single-ply roofing membranes had been manufactured with the same formulation for that entire period - far longer than any other system.

A strong manufacturer's warranty was also a requirement in the decision. "Sarnafil guaranteed the roof for us, and that certainly influenced our decision," Bell said.

Weight was another consideration. "We needed a roof that was wind-resistant, but we did not want to add a lot of weight up there," Bell said.

The new membrane also allows easy inspection and repair. The membrane is hot-air welded on the roof, and the seams may be checked easily - an important factor for Bell.

The single-ply membrane also is unusually resistant to the destructive effects of ozone, sunlight, chemicals, and industrial pollutants.

The Solution:

To assure that the new roof would successfully resist the high wind uplift pressures generated at the top of the 63-story, 797-foot fully glazed landmark, Hancock commissioned a thorough wind-tunnel model testing program at the Wright Brothers Facility (WBF) in nearby Massachusetts Institute of Technology.

Previous pressure data had been acquired at the WBF on the facades of the John Hancock Tower, but did not include pressures from the roof.

The WBF roofing uplift pressure tests were conducted on a 1:600 scale model of the tower, along with all buildings within a 2,400-foot radius. The roof of the tower model was instrumented with 46 pressure taps for sampling purposes. (See the accompanying diagram, which shows maximum wind uplift pressures in pounds per square foot measured by each of the taps.)

Based on the test data, the system was designed to resist wind uplift pressures of 111 pounds per square foot at the corners of the building, 98 psf at the perimeter, and 77 psf in the interior field area. The roof was designed to withstand uplift pressures of 168 psf in "hot spots" (defined as zones having greater than 120 psf uplift pressure under conditions of the worst storm that had occurred during the previous 100 years).

The Sarnafil mechanically attached roofing system utilizes a linear attachment method, based on the use of 14-gauge galvanized steel Sarnabars. The bars can accommodate high loads without deformation, distributing the loads uniformly to the fasteners and to the structural deck. The bar's torsional and bending strength enables the membrane to resist deformation under high wind uplift forces.

The Sarnafil linear attachment method enabled Sarnafil to directly apply the wind uplift research data to calculate what the actual wind uplift pressures would be on the Sarnabars in the various areas of the roof.

The precision with which bar and fastener spacing could be calculated was particularly valuable in designing the roofing in hot spot areas.

The spacing between Sarnabars was precisely determined to accommodate variations in uplift pressures. The bars were spaced at 2-foot O.C. intervals at the perimeter, corners, and hot spots, and at 3 1/2 feet O.C. in the interior to assure that the elongation/elasticity limit of the membrane would not be exceeded.

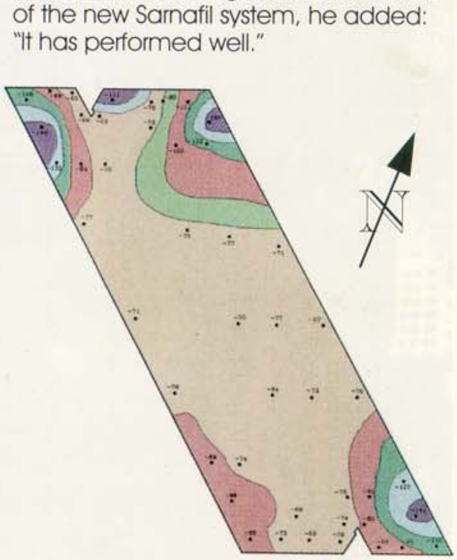
After defining bar spacing, considering anticipated forces on the bars, and factoring in the pullout resistance of the fasteners in the poured-in-place structural concrete deck, Sarnafil technicians precisely determined the required fastener spacing. The bars are pre-punched 1-in. O.C. Special masonry fasteners were driven through every 12th hole to produce a uniform fastener spacing of 12-in. O.C., embedded a minimum of 1 1/2 inches into the structural concrete deck.

A safety factor of 4 was included in the final design calculation. Because pullout values for fasteners are based on static rather than dynamic tests, this safety factor was deemed necessary to accommodate the dynamic movement of the membrane under episodes of high wind uplift.

The new system was based on Sarnafil S327 60-mil feltback membrane. This heavy-gauge felt-backed membrane offered the high puncture resistance that was needed on this roof. S327 has an integral, fully encapsulated, woven polyester scrim with the high tensile strength needed to resist deformation and tearing due to high wind uplift forces.

Throughout the job, Sarnafil technicians worked closely with the roofing contractor, Titan Roofing Company of Chicopee, Massachusetts, to assure the success of each roofing detail. "Sarnafil's technical people were readily available to answer questions, and were supportive throughout the project," said Arthur Grodd, president of Titan Roofing. "This complex job went very smoothly," said Saul Shanit, project coordinator for Titan.

Hancock management is very satisfied with the installation and the performance of the roofing system. "Sarnafil was responsive to our needs and provided excellent technical support during the job," said Bell. Succinctly, summing up his assessment of the new Sarnafil system, he added: "It has performed well."



Wind uplift pressure contour map of the roof of the John Hancock Tower in Boston, Massachusetts for 100-year storm conditions. The computer-generated data points represent wind tunnel test readings taken at 46 sampling pressure taps on a model of the roof. Then contour lines were drawn to show the shape of zones of equal uplift pressure on the 30,000 square foot, trapezoidal roof.

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