A cursory glance at Frank Matero’s Conservation Science class might make you scratch your head and wonder if you’ve mistakenly wandered into the medical school. His lab-coated students, hunched over microscopes, look as though they could be scrutinizing tissue samples or culturing bacteria. But the blocks of stone and bits of crushed brick arranged throughout the room set the record straight: This is the School of Design’s Graduate Program in Historic Preservation, and while its Architectural Conservation Laboratory (ACL) is a highly sophisticated operation, the expertise here has more to do with brick and mortar than flesh and blood.

Penn’s Architectural Conservation Laboratory takes a rigorous approach to historic preservation.
Years of water infiltration had badly weakened the interior plaster, threatening to turn a series of historic mural paintings into a pile of rubble. The Penn team and its partners quickly arrested and repaired the damage by injecting special grouts and adhesives into the weakened areas, ensuring the survival of the plaster—and paintings—for generations to come.

A question then arose—what had caused the roof to leak in the first place? The answer proved pretty decisively that new does not necessarily equal improved. As Matero and his students began to examine the layers of protective coating on the dome’s exterior, they made an interesting discovery:

Later layers were white; earlier layers, red. Laboratory analysis showed the white to be portland cement, a British invention of the early 19th century that is now the world’s most commonly used cement. The red layers, though, were something entirely different.

“It turned out to be lime mortar mixed with brick dust,” Matero explains. “The brick dust made the mortar hydraulic, which is to say waterproof, and it’s a perfect material to use in the humid soffit. The medical analogy isn’t lost on Matero, the architecture professor who chairs the Department of Historic Preservation.

“Students in historic preservation need to learn basic techniques in much the same way a doctor would learn about the human body,” he says, scanning the room with a supervisory eye. “This is the all-purpose lab, the very beginning, where they’re learning the necessary skills to diagnose and treat pathology in structures.”

The purpose of today’s lesson is to investigate the properties of limestone as a building material, especially its behavior when exposed to water. The students are examining samples from the ACL’s historic-building-materials library: limestone from Europe, from the American Southwest, from Asian temples … name a kind of limestone and it’s probably represented. But the point isn’t variety for its own sake; it’s to facilitate comparative examination.

“This is one of the many laboratory exercises we go through,” explains Matero. “The focus here in the conservation lab is on studying materials in a very direct and physical way, comparing them, learning standard testing methods, learning the quantification for how you determine the properties of materials.

“Franklin, the ultimate pragmatist, always saw the value of applying academic knowledge in the field, so it’s especially appropriate,” he adds. “Theory and practice is the mantra here. That’s what conservation is all about.”

The Iglesia de San José in San Juan, Puerto Rico, is one of the oldest and most architecturally significant structures in the Americas. Built by Dominican friars in 1532, the church—which housed the remains of Ponce de Leon for some 300 years—is widely considered a masterpiece of Spanish Colonial architecture.

“It’s a huge Gothic and post-Gothic masonry church; a very significant building given that it’s one of the earliest expressions of this style in the New World,” says Matero. Despite its rich history, the church had fallen into such disrepair that it was closed to the public and placed on a watch list of endangered historic sites. Decisive action was needed.

At the behest of the World Monuments Fund, and in collaboration with the Polytechnic University of Puerto Rico, the National Park Service, and other institutions, the ACL responded with a campaign of emergency stabilization measures.

“A whole series of our summer and post-graduate interns have been involved with this project and have had an opportunity to bring their training to it,” says Matero.

One of the most distressed parts of the church was a domed chapel dating from the 17th century, the Capilla del Nuestra Virgen de Rosario. "The Iglesia de San José’s Rosario Chapel before it was stabilized by the ACL (above left); the chapel’s dome murals during treatment (center); a digital reconstruction of the chapel in the 17th century (right)."
The American preservation movement first began to enjoy widespread public support in the early 1970s—thanks in part to the approaching bicentennial, which had begun to focus the nation's attention on issues of heritage, and also in response to an architectural tragedy, the 1963 demolition of McKim, Mead and White's monumental Pennsylvania Station in New York. Contemporary theories of urban renewal, which had so drastically altered America's cities after World War II, were increasingly viewed as agents of destruction, forces that were seeking to replace traditional environments with alien ones. The public had had enough.

"There was a real malaise and dissatisfaction with what had been going on, and this helped to prompt a rediscovery of the historic environment," says Matero. "Today the public is more and more concerned with issues related to preservation. Just turn on the television or the radio—lots of money is being spent on these kinds of projects. There's also no question that they have been a major boon for economic development."

Inevitably, this preservation groundswell created an enormous demand for expertise, and it was in that context that Penn launched the ACL in 1990. Matero, then teaching historic preservation at Columbia, joined the Penn faculty and took charge of the new venture.

The Roman's actual invented this technology," Matero explains. "It came to the New World by way of the Spanish because it had been used extensively on the Iberian Peninsula. So now this masonry tradition hybridizes into something completely New World."

As it turned out, the red mortar didn't just look better, it worked better. "We know now that the artificial cement was largely responsible for the water damage," Matero says. "Such materials have wreaked havoc on these types of buildings. They've caused leakage from cracking and water entrapment; they've changed the historic appearance; and they perform totally unlike the traditional masonry that comprises the structural aspects of the buildings."

Having arrived at this conclusion, Matero and his colleagues learned all they could about the composition of the mortar, and even found ways to improve it slightly. Then, working with a group of local masons, they set about reproducing it. "It's been the input of many, and we're finding it's really working," says Matero. "So we're about to—hopefully—change the face of San Juan by reintroducing this material that has been lost for many years. It will make the domes red and white again in an ornamental way, but it also has to do with function."

Furthermore, it provided an environmentally friendly solution—at a reasonable price. "Everyone is talking about sustainability, with respect to food, in terms of local produce," says Matero. "Well, the costs of restorations are often skyrocketed by the need to import materials from very select places. That is not true in this case, given that we're using local materials. This technique introduces a new notion of sustainability, using traditional technology based on recycled materials such as used bricks for waterproofing, which had been abandoned with the advent of cement, and even later, membrane coatings, which are based on the oil industry."

In addition, the ACL's work on the Iglesia de San José should spark new research. Matero outlined his findings in a paper given in Lisbon last September, and hopes to conduct further research in conjunction with the Getty Conservation Institute.

"When something like this happens, I realize that it's really why I do this," he says. "History showed the way."
“I brought my background in archaeology, art history, and architecture, and my interest in the technical aspects of how buildings as form and fabric are preserved and interpreted,” he recalls. “I knew from my experiences at Columbia that in order for the program to grow and to really move into first place, we would have to have a practice-based approach that not only provided research—which is greatly needed in the field—but also could give the students on-site training. The idea from the beginning was to get them out into the field with mentors—or, better yet, practicing professionals.”

The Graduate Program in Historic Preservation offers a two-year degree and admits 25 applicants per class. Students spend half their time taking core courses and half studying one of five concentrations—site management, preservation planning, landscape preservation, preservation design, and building conservation. It’s generally students in that last group who spend the most time doing research at the ACL. Many, in fact, compete to stay on for a third-year residency, which presents an opportunity to conduct an independent research project. “They have to design the scope of work, make the budget, set a schedule, and work with other professionals,” explains Matero. “We, or whoever their mentor is, are the safety net, but they’re responsible for delivering. It can be full-blown research involving a lot of technical data.”

For the Guggenheim, the Architectural Conservation Lab (ACL) helped evaluate a body of research seeking to understand the deterioration landmark, widely considered an important work of Pop Art. “Wright and the client wanted to design a building that would be like no other, that would represent the principles of the non-objective paintings that it held, so he insisted upon a continuous, absolutely seamless surface.”

After sorting through the extensive recommendations that a cadre of consultants had already made, the Penn team helped nudge the conservation efforts in the right direction, backed up by ample historical and technical data. “In the end we recommended an approach and a series of products that would allow the cracks to open and close without visual distortion,” says Matero. “Technically I think the [now-completed] restoration has succeeded, but there are still aesthetic issues—the present color is unfortunately not what Wright chose, for instance. For a building of this significance, this is no small matter.”

In the case of the pavilion, conservation efforts targeted the floor—a football-field-sized terrazzo roadmap of New York State (“All Things Ornamental,” Sept|Oct 2006). Working in partnership with the New York City Department of Parks and Recreation and the National Endowment for the Arts, the ACL staged an exhibition at the Queens Museum of Art and began efforts to stabilize the deteriorating landmark, widely considered an important work of Pop Art.

These Modernist projects “challenge many of the principles and tenets that define conservation, because those all predate Modernism by quite some time,” says Matero. “One of the main difficulties is that both the original appearance of these buildings and their technology is often difficult to sustain. So it’s been a really interesting ride for conservators and preservationists. How do you save design intent and physical fabric when the building displays obsolescence or unproven technologies? It’s not to say that earlier buildings were not ephemeral, but you didn’t necessarily have such a strong functional manifesto attached to them, as is the case with much Modernist architecture.”

Matero also questions the wisdom of maintaining Modernist buildings in a perpetual state of immaculate newness. “Why can’t we accept a 50-plus-year-old building looking its age the way we can with an 18th- or 19th-century building?” he asks. “The newness value is at the top of the list right now, but it seems to me that 50 years ago, people who were over 50 were quite comfortable in their skins. There should be more of that kind of thinking about these buildings.” —D.P.
The program attracts a surprising variety of applicants, Matero says. “They come with backgrounds in history, in design, in engineering, and in the social sciences, anthropology, archaeology. Some students double-degree in— for example—law and preservation; a good number will do the dual degree in [preservation plus] architecture, planning, or landscape architecture.”

Alumni of the program typically go on to take jobs with government agencies such as the National Park Service; organizations like the National Trust For Historic Preservation or the Getty Conservation Institute; any number of historic sites, museums, or foundations; or private-sector businesses that do building conservation.

John Milner AR’64, founder and principal of John Milner Architects in Chadds Ford, Pennsylvania, has been involved in Penn’s preservation program for the past 30 years. During that time, he has seen the curriculum expand dramatically, and he describes Matero’s contributions to that expansion as “extraordinary.”

“From my perspective, the preservation program offers a unique blend of theoretical and practical approaches to the preservation, restoration, and conservation of historic buildings, sites, and objects,” Milner says. “Our students tell me that what they appreciate most about the program is the opportunity to apply what they have learned in the classroom to real-life situations in the field. We are committed to providing multiple opportunities during the academic year and through summer programs, both domestic and international, for the hands-on investigation, documentation, and treatment of historic resources.”

“We take the practical problems and bring them back into the academy and intellectualize them,” Matero explains. “After we consider a problem almost from the realm of an art historian— Why did they build the building they built? Why did they use those materials? — we then consider the pathologies of buildings. How do they deteriorate and decay? What kinds of treatments or interventions must we do? The process is what’s interesting, and the facilities and equipment that we have here are specifically designed to help us address these issues.”

Students use research techniques drawn from a range of disciplines— chemistry, geology, physics, even biology—and investigative procedures run the gamut, from examining a sample through a microscope to x-ray diffraction and fluorescence. These kinds of techniques might help a researcher determine what color a building was painted originally, or the specific places where reinforcements are necessary in order to prevent a structural failure. And, since many site owners or operators frequently ask how lasting the interventions are likely to be, materials are often put (almost literally) through the wringer. They’re crushed, pulled apart, fatigued, and subjected to high-intensity simulations of the kinds of weather conditions they must withstand.

Sometimes the laboratory has to go into the field. “Buildings are not objects” that can be moved, Matero points out. “So we have to study them on-site fairly frequently. We use a lot of non-destructive techniques to examine them, like x-rays, ground-penetrating radar, and impact echo.”

Half the work of conservation is documenting the exact condition and appearance of a given structure or site, and the ACL uses an impressive array of technologies to create pictorial records of every project. Managed by supervising conservator John Hinchman GFA’01 GFA’02, this arm of the ACL uses sophisticated digital technology to create scale-photographs, drawings, and site plans. It recently acquired a device that was once the realm of science fiction: a laser scanner that can create highly accurate three-dimensional computer models of buildings.

“We’re drawing from a great many different approaches,” says Matero. “Traditional and historic building materials have not received in-depth analytical investigations, so all of this technology has helped create a gold mine for original research.”

Typically, the ACL takes on projects under the auspices of a sponsor.

“We’ve operated in accordance with this formula since the beginning, and it has been extremely successful,” Matero explains. “We are able to attract good funding, and that leads to some very interesting research. The sponsors can be a range of organizations, and what we have found to be really effective is to develop cooperative agreements with institutions. Then the channels are open to have a productive long-term relationship.” Among those institutions and organizations are the National Park Service, the Samuel H. Kress Foundation, the Aga Khan Trust for Culture, Middle East Technical University, and Cambridge University.

But to view the work of the program simply as turning back the clock for dilapidated buildings misses the mark. Conservation is fraught with nuanced issues: What is the past? Who gets to decide what it will look like? Can anyone really own it? In Matero’s view, the past must always interact with the present in a meaningful way. He is currently helping the State Department develop a national conservation-heritage training program for Iraq, as well as directing—with colleagues from the Penn Museum—a conservation management plan for the ancient site of Ur.

“Historic buildings and sites only have relevance today,” he explains. “Our goal is always to implement change that is responsive to the historic environment, but at the same time allows us to utilize those environments to their full potential. It is all about recognizing that change happens, but always honoring the historical values where they’re relevant.”

David Perrelli C’01 is a frequent contributor to the Gazette.