MAINTENANCE OF SCHOOLS VS. OTHER TYPES OF FACILITIES

Maintenance professionals bring to school facilities a vast array of talents, many of which will be challenged in the K-12 school in ways that can be both rewarding and sometimes frustrating. Without a reliable system in place, maintaining a school can cause personal, budgetary, and administrative stress. The alternative is implementing the processes outlined in this book with professionalism, diligence, and a genuine interest in the important work that school maintenance professionals perform. It is these individuals who make the process succeed or fail, and who are instrumental in preserving a valuable asset for future generations.

Part One of this book reviews how and why K-12 schools differ from other types of facilities, highlights some building components that warrant special attention, and addresses special maintenance considerations.

Basic Assumptions

All elements of life, including buildings, are affected by time. As building materials age, they weaken, deteriorate, and collapse prematurely unless they are supported by maintenance. The forces of nature corrupt much more quickly when human caretakers fail in their diligence to maintain.

Discipline and administrative care are essential for long life of the K-12 asset. Too often school leadership cries “lack of funding” when the root cause is more accurately a lack of maintenance discipline. Maintenance promptly addressed is a fraction of the cost of deferred maintenance.

Immediacy is critical in the life of a school building. An administrative policy of “zero tolerance” for maintenance defects is a must. Some easy problems, such as asbestos exposure, would never exist if appropriate routine maintenance had been performed throughout the life of the school.

A key role of any institution is to sustain its facilities and grounds so that current and future generations can enjoy the educational process in a setting of adequate function and physical appearance. Tied to that mission, there should be enforced parameters of individual performance, detailed descriptions of staff positions, routine performance reviews, daily supervision, and communicated expectations. Maintenance personnel also have a responsibility to document, report, and make recommendations when they see issues that merit executive attention.

An organized preventive maintenance (PM) system and effective communication are both critical to proper school maintenance. A comprehensive PM program is essential to prevent decay. (Part Two presents the elements of a PM program.) Communication between maintenance personnel and teachers, students, and administrators is paramount. Observed problems should be communicated and addressed promptly. Students should be informed routinely of their importance in keeping the school functioning properly. Technology such as e-mail is a helpful tool in quickly identifying, reporting, and solving problems.

Whenever possible, maintenance personnel should be involved in planning and design for new schools. During the design process, the maintenance department and school system have the greatest opportunity to affect future maintenance costs for the building. Once construction begins, it is possible to make changes that effect maintainability, but at a higher cost. Once the building is occupied, few, if any, opportunities exist. During construction, maintenance personnel should have access to the site so that they can view items that will later be concealed, such as conduit and piping.

School maintenance is no different than any other school function in the sense that it is time-sensitive and must be approached aggressively using the professional, intellectual, and physical tools available.

K-12 Facilities

K-12 schools differ from other buildings because they feature a unique combination of intense usage and abuse, young occupants, and certain characteristic design and construction features. The main occupants are children and adolescents, making safety paramount. Extra precautions and rigorous standards must be implemented to ensure life safety. Seasonal usage also sets K-12 schools apart, as they are usually occupied from September through June, with minimal or significantly reduced summer usage. School

building users—students, faculty, administrators, and staff—are predominantly united in the pursuit of one unified goal—to sustain a safe and efficient learning environment.

The pursuit of learning can actually limit maintenance work and often requires flexible solutions. For example, as school learning environments call for an atmosphere conducive to activities such as listening to instructions, reading, taking exams, and studying, maintenance tasks that interrupt concentration by producing noise or debris must be scheduled when certain areas of the building are not in use. Large construction projects may have to take place during summer months or after hours. Preventive maintenance tasks, such as cleaning surfaces or changing lighting fixtures, may be scheduled after school hours or when students are involved in activities in other parts of the facility. Maintenance personnel must be thoroughly attuned to school routines, and must plan ahead for special events.

The preventive maintenance process must be thorough, timely, and routinely followed up in order to be successful. Special attention must be given to the unique features of each room and area. Classrooms, locker rooms, cafeteria areas, restrooms, and outdoor play areas each have unique demands and wear cycles, which are further influenced by the volume of students using them and the associated wear and tear. The following sections detail the maintenance considerations of traditional public and private K-12 schools and other types of schools.

Elementary Schools (Grades K-5)

Elementary schools require age- and size-specific play areas, workstations, and restroom facilities. This translates into smaller desks, tables, and chairs; lower sinks, toilets, and door handles; and size-appropriate play equipment. These schools often feature large, carpeted areas for floor activities and workstations for computer usage. As the students are so young, elementary schools require a high degree of safety precautions.

The grounds of elementary schools are also unique, as physical educators recommend that they incorporate specialized outdoor play accommodations, including confined areas, surfaced areas for games and toys, sandboxes, and small field areas. Playground equipment may include swing sets, slides, bars, and so forth, some of which will suffer occasional damage.

Although there are currently no required standards regulating playground equipment, the U.S. Consumer Product Safety Commission has established suggested guidelines for the manufacture and installation of equipment and play area surfaces in its *Handbook for Public Playground Safety*. Resilient surfaces, such as sand, mulch, and commercially prepared materials, are recommended to provide effective cushioning against falls beneath playground equipment. Maintenance personnel in schools must monitor the wear of equipment and durability of surfaces, check fences frequently, remove safety hazards such as debris and deteriorated equipment, and attend to exterior and interior problems as quickly as possible. It is recommended that schools work with insurance providers to limit liability. (The Playground checklist in Part Five and the Appendix provide more information on playground safety and maintenance guidelines.)

Elementary schools often benefit from strong, active parent organizations, which means the activities and conditions of these schools are often closely monitored by involved parents.

Middle Schools (Grades 6-8)

Middle and Junior High schools represent the transition from self-contained classrooms to departmentalized instructors. They house pupils embarking on the sometimes-volatile stage of adolescence. These schools also feature diverse classrooms for home economics, wood shop, and art, as well as laboratory areas. Like elementary schools, middle schools typically have computer equipment within both classrooms and computer labs. While the computers themselves may be maintained by teachers, these areas may involve specialized equipment, electrical power requirements, and modified classroom design that necessitate additional maintenance procedures or call for specialty contractor input.

Middle schools also require more locker and changing areas, as well as larger grounds and physical activity accommodations, including surfaced courts for individual and team games such as volleyball, tetherball, or tennis, and larger field areas with grass or stabilized soil for baseball, soccer, lacrosse, hockey, track and field, and other sports. Larger areas and more equipment mean more maintenance, as personnel must monitor the wear of ground surfaces, bleacher systems, goal posts, fences, and other equipment.

High Schools (Grades 9-12)

High school students often show evidence of mature adulthood, but are also capable of exhibiting quite immature behavior. This is a time when they exercise self-assertion, determination, and independence. Depending on their prior educational and personal experiences, students at this stage may cause serious and costly challenges for maintenance personnel in the form of vandalism.

Like middle schools, high schools feature more diverse classrooms and equipment requirements, such as carpentry rooms and laboratories. High schools often house community events such as adult education courses, extracurricular activities, and sporting events. This extra usage accelerates wear of building components. Maintenance personnel must frequently monitor all areas and equipment exposed to this extra use.

The grounds of high schools tend to be larger than those of elementary and middle schools, with more sporting fields and courts. Maintenance personnel must maintain field and track conditions, equipment, and fencing, as well as outside area lighting systems. Most high schools have full-sized gymnasiums with bleacher systems for sporting events and other assemblies, and many have Olympic-sized swimming pools.

Other Types of Schools

In addition to traditional public and private K-12 schools, there are many specialty schools, including vocational, technical, art, military, and religious institutions, as well as those designed to meet the needs of physically challenged students. Each has unique requirements in terms of design, equipment, and maintenance. Vocational schools offer courses such as automotive repair, computer technology, culinary arts, electrical, landscaping, medical technician, plumbing, radio and television broadcasting, and welding. These schools may mandate unique ventilation systems and extensive loading dock areas, for example. Other schools, such as many private schools, feature dormitories to house students throughout the school year.

However, these institutions are not so unique that their requirements dictate extensively different maintenance procedures. A preventive maintenance program has broad application and can accommodate learning facilities of all kinds.

K-12 Student Populations and Maintenance Challenges

The K-12 population requires attention to detail in maintenance. Students of all ages often exhibit behavior—intentional or otherwise—that jeopardizes the well-being of the school facility. For example, students may find it amusing to plug up sinks or toilets, scratch or write on surfaces, kick buildings, or throw balls at windows. They may carelessly, but accidentally, damage furniture surfaces and wall finishes. In some circumstances, behavior can be more serious, such as significant vandalism, theft, or property damage. Once these situations are observed, they must be addressed immediately—both by damage repair and by communication of the harmful nature of the behavior. Maintenance personnel may even request an opportunity to personally address students as a group to explain the ramifications of their actions.

Helping Students Respect School Property

Maintenance personnel can play a valuable role in helping students respect their school and its property. Students should realize that the school in many ways belongs to them and is reflective of their collective identity. Students should treat the school as they would their own property. Maintenance personnel should share with them the value of honoring their asset. One creative approach might be a contest for the neatest classroom, restroom, or common area, with appropriate rewards. Maintenance personnel should take the initiative to establish a rapport with students and become a visible presence on campus, so that students understand that the school and its property are not maintained by invisible, nameless entities, but by very real individuals.

School Building Materials, Wear Factors, and Maintenance Requirements

Many schools in the United States were built within three general time periods: the 1920s and 30s, the 1950s and 60s, and the 1980s to the present. Schools were primarily built:[1]

1. During the 1930s as part of the government work project (WPA).
2. During the Baby Boom, starting when the GIs came home from World War II and continuing through the 1950s and 60s. The increasing number of families caused educational facilities to expand during the late 1950s until the early 1970s.
3. During the Second Baby Boom as Baby Boomers had children of their own. As a result, schools have expanded from the late 1980s to the present.

After 20 years of use, school facilities often reveal visible signs of wear and experience substantial maintenance deficiencies, including deterioration of roofing or other building components. Older schools have had to comply with more recent ADA and building code requirements, update equipment, and abate hazardous materials such as lead paint and asbestos.

School building materials each have a certain life span, which is naturally affected by care or lack thereof. (See Figure 1.1.) Proper maintenance, barring accidents, yields a long life span, while minimal or negligent care brings premature failure. The K-12 facility must be understood in terms of projected life span and potential causes of decay.

It is important to note that the construction date of a building does not determine or influence the potential for asset failure. A school building's functional age is determined by the length of time since the most recent major renovation, or, if no major repair project has taken place, the original date of construction. The facility should, in fact, never fail over many generations of students if there is a continuous commitment to diligence and professionalism.

Maintenance personnel should ideally have available the needed funds at critical life points to sustain the asset with major improvements, such as a new roof. If the maintenance philosophy is to fully correct problems (as opposed to "Band Aid" temporary repairs), the asset should live well beyond its projected life.

Certain factors contribute to material failure and the physical deterioration of the school facility. In addition to wear and tear of campus structures and grounds from facility users, exposure to the following elements reduces asset integrity:

- Organic solvents
- Oxygen
- Ozone
- Carbon dioxide
- Sulfur dioxide
- Hydrogen sulfide
- Acids, alkalis, salts (airborne or in solution)
- Cleaning solutions
- Radiant energy: sunlight, ultraviolet, infrared
- Heat
- Cold (frost, snow, ice)
- Cycles of heat and cold

Suggested Average Useful Life of Building Components

Item	Years
I. Major Construction	
A. Reinforced Concrete Frame	
1. Masonry Exterior	
a. Heavy	45
b. Light & Medium	40
B. Steel Frame	
1. Masonry Exterior	
a. Heavy	45
b. Medium	35
c. Light	30
2. Metal Exterior	
a. Heavy	45
b. Medium	35
c. Light	30
C. Wood Frame	
1. Masonry Exterior	
a. Heavy	35
b. Medium	25
2. Metal Exterior	
a. Heavy	30
b. Medium	25
c. Light	20
3. Wood Exterior	
a. Heavy	25
b. Light & Medium	20
II. Electrical & Mechanical Equipment	
A. Electrical Systems	
1. Lighting Systems	
a. Conduit & Wire	20
b. Fixtures	15
c. Flood Lighting	15
2. Power Feed Wiring	
a. Bus Duct	25
b. Capacitor	20
c. Power Feed Wiring Maine	25
d. Switch Boards	20
e. Switch Units	20
3. Transformers	
a. Wet Type	20
b. Dry Type	15
B. HVAC Systems	
1. Air Conditioning Systems	
a. Central including ducts & piping	15
b. Window Type	10
c. Cooloing Towers	15
2. Heating Systems	
a. Furnaces & Boilers	20
b. Radiators, Convectors, Piping	25
c. Unit Heaters, gas & steam piping	20
d. Unit Heaters — Electrical	15
3. Ventilating Systems including fans & exhausters	15
C. Plumbing Systems	
1. Drinking Water Systems	
2. Fixtures	
3. Piping	
a. Cast Iron Waste	35
b. Concrete	30
c. Copper	30
d. Plastic	20
e. Steel	30
f. Vitified Tile	
4. Sprinkler Systems	
a. Wet & Dry Systems	30
b. Fire Pumps	20
c. Hose Housings	
1) Wood	15
2) Steel	20
3) Masonry	30
5. Sump Pumps	
a. Small	10
b. Large	15
6. Water Heaters — gas & electric	10
7. Water Wells	25
D. Service Systems	
1. Elevators (all types)	20
2. Fire Alarm	20
3. Intercom	15
4. Telephone	15
III. Miscellaneous Items	
A. Bulkheads	
1. Concrete	30
2. Steel	25
3. Timber	20
B. Chimneys	
1. Brick or concrete	35
2. Steel-lined	25
3. Steel-unlined	20
C. Culverts	
1. Concrete	30
2. Galvanized Steel	20
D. Curbing	
1. Concrete	25
E. Fencing	
1. Brick or Stone	30
2. Chain Link	20
3. Concrete	30
4. Wire	10
5. Wood	10
F. Flag Poles	25
G. Incinerators	
1. Commercial Type, steel fire brick lined	20
2. Concrete block or brick	20
3. Steel	15
H. Paving and Walks	
1. Asphalt on gravel or stone	15
2. Brick	20
3. Concrete	20
4. Gravel, stone, cinders	10
5. Parking area guard rails	10
I. Platforms	
1. Reinforced Concrete	35
2. Wood frame on concrete piers	20
3. Wood frame on wood posts	15
J. Railroad sidings	25
K. Resevoirs, concrete	35
L. Retaining Walls	
1. Brick	30
2. Concrete	40
3. Steel	25
4. Stone	40
5. Wood	15
M. Sheds	
1. Brick, tile or concrete block with wood frame	25
2. Brick, tile or concrete block with steel frame	35
3. Metal clad, steel frame	27
4. Metla clad, steel frame	20
5. Wood siding and frame	20

FIGURE 1.1 Excerpted from *Means Facilities Maintenance Standards*. Copyright R.S. Means Co., Inc.

- Cycles of relative humidity
- Abrasives: dirt particles, airborne dust, smoke
- Water
- Matter in motion: mechanical stress, impact shock, vibration
- Vegetation: algae, bacteria, fungi, lichens, plant roots
- Insects: ants, moths, silverfish, termites, wood beetles
- Rodents

It is important to note that water is particularly damaging, as it can dissolve building materials over time, and fosters rot and insect intrusion. As a universal solvent, water is a catalyst for chemical reactions. It can consume wood, erode masonry, corrode metal, peel paint, expand when frozen, and permeate everywhere when it evaporates. It warps, swells, discolors, rusts, loosens, mildews, and causes odor. Since buildings today are airtight and well insulated, they can generate high levels of destructive internal moisture, which corrodes as it penetrates.

Architectural Materials

Most schools are composed of traditional architectural fabrics consisting of two broad types: *monolithic mass masonry* and *skeletal* or *composite* structures. The primary materials used in schools are:

- Wood
- Metals: cast iron, wrought iron, modern steels, copper, and sheet metal
- Masonry: stone, brick, ceramics, concrete, and terra cotta
- Plastics

For decorative or protective purposes, many schools contain the following materials:

- Floors: wood, tile, brick, or stone
- Walls and ceilings: plaster or gypsum board (painted, papered), wood, glass, masonry, tile, acoustic tile, or painted concrete block
- Roofs: shingles (asphalt, wood, tile), sheet metal, steel, or built-up membranes (felt, asphalt, plastic)

Each of these materials has its own physical and chemical characteristics and repair and maintenance requirements. Restorative or preservation tactics are often called for. (It should be noted that deterioration is not always visible to even the trained eye.) Generally, maintenance personnel would encounter the following conditions.

Wood[2] Wood is often used in schools for both structural and aesthetic purposes. Maintenance personnel will deal with a wide variety of wood structures in various states of physical deterioration. Major causes of wood deterioration include decay-causing fungi, marine borers, insects, and fire damage. Maintenance personnel often encounter instances of splitting or excessive deflection. Exactly how to preserve wood—i.e., the extent of intervention—depends on two considerations: aesthetic and structural. Focusing on only one can actually cause confusion about the other. For example, painting a wooden beam for cosmetic reasons might conceal structural weaknesses caused by fungi or insect attack, whereas an ill-appearing wood-paneled wall may in fact be structurally sound, needing only a coat of paint.

When failure of a wood element is structural, radical intervention may be mandatory; the member must be either repaired or replaced. If the member is concealed and therefore difficult to regularly access for inspection and repair (behind a floor, paneled wall, or plaster ceiling), it might be preferable to replace it with a new one while it is exposed, rather than make repairs, which may require later follow-up. Wood members may be replaced or reinforced with steel.

Concrete and Masonry[3] Masonry materials consist of tilt-up concrete, brick, stone, and terra cotta, and are most often used for walkways and miscellaneous reinforcement areas. Masonry/concrete tends to be the dominant fabric of school facilities. Conservation of these materials depends on the maintenance staff's ability to recognize and address potential problems.

Terra cotta/concrete roofing materials are used extensively for their aesthetic, fireproofing, and historical qualities. They are, however, susceptible to the effects of heat, cold, wind, rain, earthquakes, and other environmental factors. A keen eye in the preventive maintenance process and attention to detail in remedial maintenance should sustain these materials and allow them to achieve a normal 45-50 year life span.

Water, as has been previously identified, is one of the greatest protagonists of demise in masonry. Cracks, eroded surfaces, efflorescence, and subterranean encroachment can all violate the integrity of masonry fabric. Weather conditions and pathogenic forces, such as environmental pollution by urbanization, industry, and transportation, can lead to failure.

The attrition of masonry is so widespread that the syndrome has been dubbed "stone disease," and scientists in several countries are attempting to isolate the specific pathogens and develop the appropriate therapies. Because of the relative infancy and simplicity of most American brick and stone masonry buildings, preservation often requires nothing more than cleaning, sealing, and sometimes re-painting for aesthetic rather than structural reasons. Where structural issues arise, an appropriate engineer should be consulted.

The extent and frequency of preventive maintenance of masonry components will often depend on the location, exposure, existing deterioration, and desired appearance of the materials. Cleaning methods such as dry or dry grit blasting, water washing, steam cleaning, and chemical cleaning with acid, alkaline, or organic cleaners all have their advantages, disadvantages, and relative effectiveness. Historic brickwork requires specialized, non-abrasive techniques such as high-pressure water treatment with mild detergents or hand scrubbing to prevent further deterioration. Depending on the funding source (such as certain grants or, for private schools, tax incentive programs), restoration methods for historic buildings may be limited to a prescribed few.

To aid in masonry maintenance, staff should take the following actions.

- Keep abreast of the technology for cleaning and waterproofing.
- Aggressively seek out and repair areas of suspected water intrusion.
- Pay close attention to signs of earth movement and subsequent cracks or displacement.

Metal[4] Metal in school buildings is used for both structural and aesthetic components, including fences, roofs, ports, and railings. Common exterior metal materials include aluminum, galvanized iron and steel, and prefabricated sheet metal. Metal, like wood and masonry, is subject to deterioration, particularly by oxidation, water, and atmospheric/environmental factors.

Exposed metal needs to be maintained by cleaning, painting, and polishing. Non-exposed metal must be protected from contact with water. Metal fences on school grounds must be appropriately coated to prevent rust and other damage. Generally, maintenance of fences involves painting to prevent rust; ensuring stability of posts, braces, and anchors; keeping the area free of vegetation and trash; and patching holes and gaps when necessary.

Maintaining Historic Materials

Although there are many new school facilities being constructed to meet expansion rates, there are still many older schools in operation (from as early as the early 1900s). As of the 1999 report published by the National Center for Educational Statistics (NCES), the average age of public schools was 40 years. The functional age of a school, however, differs from the date of its construction and is based on the amount of time that has elapsed since the date of the most recent major renovation project. The study found that, while most schools had a functional age of 5-34 years, 14% had a functional age of 35 years or more. Schools and other buildings that are 50 years or older and contribute significantly to national history, architecture, or culture are eligible for listing in the National Register of Historic Places.

The National Trust for Historic Preservation has deemed historic neighborhood schools one of "America's 11 Most Endangered Places." According to the Trust's findings, historic schools are often victims of deferred maintenance, and the Trust is calling for "reform of state funding formulas to facilitate the maintenance and modernization of existing schools."[5]

As many existing school facilities were built earlier in the century, preventive maintenance procedures may need to be altered to protect historic materials. Archaic materials—historic components and assemblies that are essential to the integrity of the historic building—may require special handling and alternative preventive maintenance procedures. Wherever possible, according to the *Secretary of the Interior's Standards for the Treatment of Historic Properties,* historic materials should be preserved, and deteriorated material should be repaired.

These guidelines affect school facilities in several ways. Specialty contractors, qualified architects, engineers, and construction specialists may need to be consulted for technical expertise on the long-term performance of building products and the timed maintenance and repair they may require. Standard preventive maintenance procedures may harm historic materials such as masonry components, door and window hardware, or other functional or aesthetic details. Cleaning solvents in particular may further deteriorate archaic materials, calling for maintenance personnel to use non-abrasive cleaning techniques and mild detergents.

Maintaining Compliance with Codes and Standards

It is essential that school facilities routinely monitor compliance with building codes and standards, such as the requirements of The National Fire Protection Association (NFPA), The Americans with Disabilities Act (ADA), The Environmental Protection Agency (EPA), and Occupational Safety and Health Administration (OSHA).

According to the NFPA, schools must have a properly maintained egress system that includes panic hardware for releasing door latches, rescue and ventilation windows, emergency lighting, and other features. The *Life Safety Code*® mandates that schools be equipped with a fire alarm system that is regularly maintained according to the requirements of NFPA 72, the *National Fire Alarm Code*®, and NFPA 70, the *National Electric Code*®. Alarms must be both audible and visible to meet ADA requirements. Schools must conduct practice evacuation drills once a month, and accessible routes and evacuation plans must be established and updated regularly.

According to Title III of the ADA, the 1990 federal anti-discrimination civil rights act, educational and other public facilities must make accommodations for handicap accessibility. Spaces such as entrances, hallways, restrooms, dining areas, and auditoriums must provide accessibility for disabled users. Drinking fountains and sinks must not exceed certain height requirements, and must allow clearance for wheelchairs, for example.

Schools must feature special ramps, chair lifts or elevators, railings, seating, and emergency warning systems, as well as signage identified with the International Symbol of Accessibility, among other elements. Outside accommodations must include accessible parking areas, passenger loading zones, curb ramps, signage, walkways, and playground equipment. Indoor and outdoor surfaces must be accessible, firm, stable, and slip-resistant.

Current and Future Challenges in the K-12 Population

K-12 school facilities have undergone rapid expansion and technological advancements at the end of the 20th century and the beginning of the 21st. The majority of schools feature extensive computer equipment and alternative learning environments to house newly designed courses and collaborative learning techniques. For example, many schools have bilingual programs and are designed to allow student hands-on experiences with subject matters.

While the learning potential is being enhanced, American schools are also experiencing overcrowding as they face an increased student population. According to multiple U.S. Department of Education reports, many schools consistently enroll far more students than the number the building is designed to accommodate. This calls for administrators—and maintenance personnel—to develop creative solutions to the accelerated wear of building components, as well as the basic need for more classroom space. Schools are experimenting with staggered hours of operation, temporary portable classrooms, satellite campuses, and online courses. Remodeling and new construction projects are ongoing. All of these solutions have an impact on maintenance scheduling and logistics. With the heightened demand for space and increased wear from an often unplanned number of users, preventive maintenance becomes even more important as the key to sustaining the existing facility and ensuring student safety.

Summary

Part One explored some key considerations that differentiate school maintenance from the care of other types of facilities. Clearly, the safety of students and the extended life of the asset for multiple generations are priorities of school preventive maintenance. This section also highlighted the major categories of school building materials and types of deterioration to which they are susceptible.

Part Two outlines the basic requirements and components of a PM system, and Part Three provides guidelines on budgeting for PM within a school facility. Part Four offers guidance on estimating PM procedures, including material, equipment, and labor costs. Part Five comprises reproducible PM checklists, followed by an Appendix of repair considerations and additional resources.

1. Armstrong, James. "Educational Facilities." *Cost Planning and Estimating for Facilities Maintenance.* R.S. Means Co., Inc., 1996.
2. Fitch, James Marston. *Historic Preservation: Curatorial Management of the Built World.* UP of Virginia, 1990.
3. Ibid
4. Ibid
5. "America's 11 Most Endangered Historic Places." National Trust for Historic Preservation. Internet Web site: http://www.nhtp.org.