

BEST PRACTICES MAINTENANCE PLAN FOR SCHOOL BUILDINGS

State Department of Education

September 2006
(Reviewed April 2018)



Acknowledgement

We want to acknowledge and thank staff at the Division of Building Safety who spent time helping compile and review this manual. Much of the information in this manual was taken from *Preventive Maintenance for Local Government Buildings*, April 2000, published by the Minnesota Office of the Legislative Auditor, Program Evaluation Division.

Table of Contents

1.0	General.....	1
2.0	Legislative Authority	1
3.0	Purpose.....	1
4.0	Best Practices and Actions For Preventative Maintenance.....	2
4.1	Inventory Building Components and Assess Their Conditions.....	2
4.2	Build the Capacity for Ranking Maintenance Projects and Evaluating Their Costs	4
4.3	Plan Strategically for Preventive Maintenance in the Long- and Short-Term.....	6
4.4	Structure a Framework for Operating a Preventive Maintenance Program.....	8
4.5	Use Tools to Optimize the Preventive Maintenance Program.....	12
4.6	Advance the Competence of Maintenance Workers and Managers	14
4.7	Involve Appropriate Maintenance Personnel in Decision Making and in Communicating Building Needs	15
5.0	Summary.....	16
Appendix A Sample Inventory Lists		
Appendix B Sample Inspection Lists		
Appendix C Building Evaluation Form		
Appendix D Additional Recourses List		

1.0 General

The following guidelines are designed to assist Idaho's school districts in developing and maintaining facility preventative maintenance plans.

2.0 Legislative Authority

The School Facilities Improvement Act (House Bill 743) was approved by the 2006 Legislature and signed into law by Governor Dirk Kempthorne on March 31, 2006 with a July 1, 2006 effective date.

Idaho Code Section 39-8006A of this act provided a requirement for the administrator of the Division of Building Safety and the State Department of Education to consult and prepare a best practices maintenance plan for school buildings that shall in turn be supplied to superintendents of each of Idaho's school districts. Based on the best practices maintenance plan, each school district is required to develop a ten-year plan for submittal to and approval by the State Department of Education. Annually thereafter, school districts are required to submit reports to the State Department of Education detailing the work completed pursuant to their maintenance plans including any revisions made to those plans.

3.0 Purpose

The purpose of an effective preventative maintenance plan is to achieve the following five key goals:

- **Preserve taxpayers' investments in public buildings.** Preventive maintenance can extend the life of building components, thus sustaining buildings' value and the significant tax dollars they represent.
- **Help buildings function as they were intended and operate at peak efficiency, including minimizing energy consumption.** Because preventive maintenance keeps equipment functioning as designed, it reduces inefficiencies in operations and energy usage.
- **Prevent failures of building systems that would interrupt occupants' activities and the delivery of public services.** Buildings that operate trouble-free allow public employees to do their jobs and serve the public. Because preventive maintenance includes regular inspections and replacement of equipment crucial to operating a building, maintenance staff reduce the problems that might otherwise lead to a breakdown in operations.
- **Sustain a safe and healthful environment by keeping buildings and their components in good repair and structurally sound.** Protecting the physical

integrity of building components through preventive maintenance preserves a safe environment for employees and the public.

- **Provide maintenance in ways that are cost-effective.** Preventive maintenance can prevent minor problems from escalating into major system and equipment failures that result in costly repairs. In avoiding costs of major repairs, preventive maintenance creates efficiencies. Increasing preventive maintenance can reduce time spent reacting to crises, which is a more cost-effective way to operate buildings. Deferring preventive maintenance can generate higher costs over the long term.

4.0 Best Practices and Actions For Preventative Maintenance

Seven best practices are necessary for successful preventive maintenance. Without these practices, a preventive maintenance program may not fulfill its goals. The seven best practices are:

- 4.1 Inventory building components and assess their conditions.
- 4.2 Build the capacity for ranking maintenance projects and evaluating their costs.
- 4.3 Plan strategically for preventive maintenance in the long-and-short-term.
- 4.4 Structure a framework for operating a preventive maintenance program.
- 4.5 Use tools to optimize the preventive maintenance program.
- 4.6 Advance the competence of maintenance workers and managers.
- 4.7 Involve appropriate maintenance personnel in decision-making and in communicating buildings' needs.

4.1 Inventory Building Components and Assess Their Conditions

A program of preventive maintenance begins with an inventory of a school district's facilities and basic information on their conditions. Collecting building-condition information is necessary to help building managers identify maintenance needs and quantify deferred maintenance. Inventory and condition data also provide managers with the information needed to plan maintenance projects, set priorities among them, and estimate their costs.

Recommendation

As a prelude to preventive maintenance, building managers should oversee periodic inspections of buildings' conditions and create an inventory of buildings' components and equipment.

Keep an Accurate Inventory of Building Components and Equipment

An inventory is a reliable count of the various building components and equipment comprising a school district's facilities. A complete inventory, periodically updated, offers an information base with which building managers can plan condition assessments and needed preventive maintenance. Typically, information in the inventory should include the building components' condition

and functional performance, as well as the equipment's age, usage, location, warranty information, and model type.

Plan Building Inspections

Before inspecting buildings, building managers need to plan the inspection program. Because a building-condition assessment potentially involves substantial time and personnel, it can be costly. Proper planning of the inspection is the best way to control its costs.

Building managers should determine in advance the scope of the program, that is, which buildings and components to inspect, if not all of them. They should know what information to record, including maintenance deficiencies such as building and other school safety code violations. In addition, managers need to decide whether in-house employees can conduct the inspections or whether certain building systems require specialized knowledge that extends beyond in-house expertise. For example, to adequately assess a building's structural condition, a structural engineer should participate in the inspection process.

Deciding how to store and manage the volume of data collected during the inspections is also important in the planning stage. Without this step, staff may find it difficult to use the inspection information and as a result, derive little value from it.

As part of the planning, a timetable for the inspections is necessary. Building managers should coordinate inspections in ways that avoid disrupting teachers, students and other staff. To do this, the schedule could include inspection times when there are fewer building occupants, such as after normal business hours or during breaks in the school-year calendar.

Conduct the Inspections Methodically

A methodical approach to building audits improves data consistency from building to building and over time. Using standardized methods, condition data collected one year can be reliably compared to data collected in subsequent years. Written guidelines can also help provide consistency in inspection methods, particularly when multiple inspectors are involved.

In addition, building managers should design inspection forms to help inspectors observe building components logically and record data uniformly. With standardized checklists of the components, inspectors are more likely to collect consistent information and complete thorough inspections.

By themselves, however, standard checklists are insufficient unless they are used by personnel with the knowledge to identify the root causes of building deficiencies. Training inspectors on the use of standard checklists helps improve accuracy and diminish the subjectivity of individuals' judgments.

Although visual inspection is the primary way to conduct building audits, inspectors may need diagnostic tools to supplement their observations. For

instance, infrared scanning equipment helps detect wet insulation, air leaks in roofing systems, and loose electrical connections. The need for diagnostic tools may require hiring specialists with expertise in using the tools and interpreting their results. In more sophisticated building systems, built-in sensors collect data beyond what can be obtained via human observation.

Assign Condition Ratings

Using information from the inspection, building managers should assign condition ratings to the inspected items. The ratings should be objective and based on a standardized scale that reflects condition changes. A scale may be a simple one, such as a good-fair-poor ranking. Or, depending on local needs, it may be more sophisticated, using a numerical index with many gradations. Ratings should indicate whether some corrective action is warranted. Over time, the condition ratings reveal rates of deterioration or, if used in combination with ongoing maintenance, show how well maintenance efforts have sustained the components' condition.

Update Condition Assessments Regularly

To reflect changes in square footage, value, building condition, and maintenance practices, building managers should regularly update information on building conditions. Some authorities suggest annual re-inspections. This may not be realistic for all jurisdictions, however. Inspection frequency will depend on the type and use of the building, type and condition of building systems and materials, rate of deterioration, and costs of the jurisdiction's inspection program. With ongoing inspections, and a system for keeping good records, building managers can document building conditions over time.

4.2 Build the Capacity for Ranking Maintenance Projects and Evaluating Their Costs

To operate buildings as they were intended and in a cost-effective manner, active planning of building maintenance is necessary. Adequate planning involves setting project priorities to target resources toward the highest needs. It also requires analytical tools to determine components' full costs—including expected maintenance—over their projected lifetimes.

Recommendation

As building managers determine what maintenance projects are needed, they should use an objective process for setting priorities among them. For cost-effectiveness, building managers should calculate total costs over the expected lifetime of equipment and facilities.

Set Project Priorities

Because maintenance needs can outpace available resources, good planning requires a process for ranking maintenance projects—including preventive maintenance, general maintenance, and projects necessary to correct deficiencies. A ranking process recognizes that not all projects share equal importance. For instance, some projects left undone would involve too great a risk to building occupants' safety or could result in premature and expensive equipment failure.

The danger in assigning lower priorities lies in the risk that less important projects left unattended eventually grow in urgency. Because delayed projects may pose larger future problems, building managers should understand and inform decision makers of the negative consequences of continually putting off the projects. They should also assign a time when work should start on the lower-priority projects.

To set priorities, building managers should use objective criteria to sort out the relative importance of each project. Objective criteria not only help methodically select projects, they also make apparent to building occupants why certain projects precede others.

The criteria should indicate the urgency of each project. For instance, conditions that pose no immediate threat but may endanger the future integrity of other building components could receive somewhat lower priority than those that threaten occupants' safety. A project's cost, environmental concerns, and the need to comply with building and safety codes and standards are other factors that may influence project priorities. Depending on buildings' uses, a district may have multiple priority systems for ranking projects.

Use Life-Cycle Costing or Other Tools to Evaluate Total Costs

Building managers should use an evaluation tool, such as life-cycle costing, to make cost-effective decisions on whether to replace or maintain building systems and equipment. Estimating life-cycle costs involves determining a building system's total cost—not only its initial purchase price, but also the annual maintenance, repair, and energy costs over its expected life span, and its salvage value. The calculation requires some method of accounting for the time value of money, that is, estimating the present value of future dollars.

Other evaluation tools are also useful. Methods such as calculating a benefit-to-cost ratio help measure the economic performance of investments in building systems.

With estimates of life-cycle costs, building managers can compare a range of alternatives and decide whether continuing to repair a component, deferring its maintenance, or replacing it is more economical. Such comparisons also help in choosing replacement equipment. Life-cycle costs allow building managers to time repairs knowing the overall costs of completing certain projects ahead of others.

When determining life-cycle costs it is important to use standardized cost data for reliable estimates. Contractors' estimates and published cost guides prepared by professional organizations are useful for accurate cost estimates. A district's own historical maintenance and repair data can also help, if such data has been kept over time.

4.3 Plan Strategically for Preventive Maintenance in the Long- and Short-Term

To get optimum benefits from preventive maintenance, school districts need to plan for it. Absent planning, maintenance tends to occur when the need for repair arises—typically a more costly arrangement leading to premature equipment failure.

Recommendation

Districts should include preventive maintenance along with other maintenance projects in long- and short-term maintenance plans that are tied to capital improvement programs, capital budgets, reserved accounts, and operating budgets.

Active planning for preventive maintenance should occur at the same time as planning for other maintenance; it is needed both for the long-term (at least a three-year outlook) and the short-term (the upcoming year). Long-term planning includes a long-range facility plan and a capital improvement program. Short-term planning includes annual work plans and annual budgets.

Develop a Long-Term Ten-Year Facility Plan

Long-term plans establish goals that guide maintenance activities and help allocate resources strategically. The plans also provide common objectives for employees by defining goals for the district toward which individual staff members strive. They chart a future for a district's facilities and help building managers identify those maintenance projects that best meet the overall needs of the district. Long-term plans make building needs explicit to elected officials and the community at large.

As a goal-setting document, a ten-year plan takes a much broader view of facilities than an annual plan. Although the contents of a ten-year plan will differ from district to district, the plans typically contain four important elements.

- (1) A description of the district and how it is organized, and the communities it serves.
- (2) An explanation of the overall mission and purposes of the district and how facilities fit into fulfilling those purposes.
- (3) An account of the facilities operated by the district and appraisal of their adequacy for meeting overall goals. This element includes a building-by-building assessment of improvements listing expected years of completion; projects are ranked by need and based on the expected remaining life of building systems. Districts with deferred maintenance should include plans for reducing the backlog.
- (4) An assessment of the financial resources required to fund desired improvements. Projections of operating and capital costs give school

boards and other policymakers information to anticipate upcoming financial needs. In cases of major improvements, it is prudent to include a range of project alternatives, instead of a single value, listing each option's estimated costs and level of service. This planning becomes the basis for a capital improvement program (described below.)

Although long term by nature, the ten-year plan requires annual review and updating. Those involved in the planning should recalculate cost estimates based on updated condition levels and current costs of equipment and labor. Updating is also necessary because projections of deferred maintenance may decrease due to completed projects, or increase from ongoing deterioration. Plus, the general uncertainty involved with any long-range forecast requires building administration to revise costs and building information with its best professional estimates.

Develop a Capital Improvement Program

Information in the long-term plan provides a base for a capital improvement program. Simply put, a capital improvement program is a schedule of capital improvements, listed in priority order, over a number of years (usually five or more). The capital improvement program's time span typically coincides with the long-range plan. In contrast to the long-range plan, the capital improvement program is a set of proposed actions. It proposes specific projects to meet the needs identified in the long-range plan. If the long-range plan offers a range of alternatives, the capital improvement program identifies a specific course of action the school district intends to take. Capital improvement programs typically include remodeling and new construction, as well as major maintenance projects.

All school districts that own facilities should develop capital improvement programs to accurately prepare for the future needs and costs of their physical plant.

When estimating costs for the capital improvement program, building managers should base their estimates on building components' remaining useful life. This is important because components that have been neglected will have an older "effective" age requiring earlier replacement than those that have been well maintained.

Unless the capital improvement program's estimated costs are based on the best available data, its projections could substantially over or underestimate actual costs. Therefore, it is necessary to use standard cost data when estimating project costs.

Officials that develop the capital program should update its cost estimates annually to account for inflation and changes that occur to the buildings.

Establish a Reserved Account

Maintenance and planned replacements vary from year to year. Some years require larger expenditures for major projects, such as reroofing, tuckpointing

brick exteriors, and replacing a boiler or cooling tower. Consequently, districts should reserve an amount of money each year to provide funding for the renewal of building components. Defined simply, reserved accounts spread out over many years the payments for replacing building components.

Establishing reserved funds requires a district to place high priority on renewing building components when setting budgets. With reserved funds, districts affirm the importance of an ongoing investment in preserving their physical plant. Planning adequate reserved funds depends on needs identified from building condition assessments, calculations of components' useful remaining life, and accurate estimates of project costs.

Develop an Annual Work Plan

An annual work plan and budget should flow from the strategic long-term goals and objectives developed for a district's buildings. Some annual plans are more complete than others, however.

The work plan should list all expected maintenance projects for the year: preventive maintenance, general maintenance, major and minor repairs, custodial operations, alterations, and construction. It should also include projects needed to reduce backlogs of deferred maintenance.

Link Work Plan to Annual Budgets

The annual work plan should link directly to the yearly maintenance budgets. Projects in the work plan transform from ideas into reality only when they are included in operating or capital budgets. In the budget, building managers balance maintenance needs against available funding.

The annual budget shows for the coming year what money is needed for each project in the annual work plan, including projects intended to reduce maintenance backlogs. Budget development requires preparing cost estimates for annual operations, such as personnel and supplies costs, as well as for capital costs, such as making major repairs. Each year's capital budget should flow from the longer-range capital improvement program described earlier.

The amount of spending needed for facility maintenance depends on the costs of buildings' identified needs, the extent of deferred maintenance, and the planned period over which the district hopes to reduce building deficiencies. Higher spending any given year will bring conditions to their desired level faster; lower spending lengthens the time. No single rate of maintenance spending applies to all buildings.

4.4 Structure a Framework for Operating a Preventive Maintenance Program

By definition, preventive maintenance means inspecting, adjusting, lubricating, testing, and replacing on a regular, ongoing basis. To do this effectively, building managers need a framework that supports the preventive maintenance program.

Recommendation

Building managers should (1) coordinate preventive maintenance with other maintenance projects, (2) prepare a checklist of preventive maintenance tasks, (3) schedule a timeline for the tasks, (4) prepare procedures for managing the program, and (5) include preventive maintenance among activities for controlling the quality of air inside buildings.

Coordinate the Program with Other Maintenance

In most districts, preventive maintenance projects will be performed among many other maintenance requests. Therefore, the overall maintenance program requires coordination to ensure work is assigned to the appropriate personnel and performed when it is supposed to be.

This means designating responsibility for coordination with a specific individual or department. A coordinator should be responsible for synchronizing all maintenance jobs—including preventive, general, and emergency maintenance. This lodges accountability for managing maintenance with specific staff. It also helps ensure that maintenance projects of one type do not interfere with others, such as repainting a wall that is soon to be modified as part of a remodeling project.

Develop Checklists of Tasks and Their Frequency

Including every piece of every building system in a preventive maintenance program is unnecessary and prohibitively expensive. The time involved with such an effort would be enormous and the outcomes unlikely to justify the expense. Building managers should exclude from a preventive maintenance program equipment that is inexpensive and easy to replace.

Consequently, building managers must determine in advance which equipment is critical to the continued safe operation of the building, carries high repair or replacement costs, or is difficult to purchase “off the shelf.” Equipment of this type should be part of the preventive maintenance program.

After deciding which items to include in the program, building managers should develop a checklist of preventive maintenance tasks. The checklist should specify for each type of equipment what inspections, calibrations, lubrications, or replacements are needed. Using a specific checklist with detailed activities helps ensure that needed servicing is not inadvertently neglected.

The checklist should also indicate the frequency of the preventive maintenance task. This timetable for servicing equipment should specify whether the task is to be performed weekly, monthly, annually, or at some other interval.

To produce the checklist, building managers should rely to the extent possible on recommendations by manufacturers of the specific equipment. Manufacturers’ guidance will indicate which preventive maintenance tasks are necessary and their frequency. This is especially important because some manufacturers’ warranties remain in effect only if owners conduct the required preventive maintenance.

Realistically, however, manufacturers' recommendations are not always available. Other sources are also helpful for the checklist, including records of the equipment's own maintenance history, employees' experience, preventive maintenance guides prepared by industry groups and trade associations, and building or other safety codes or standards.

Schedule Timelines to Perform Tasks

As part of the annual work plan, building managers should prepare one-year schedules of the preventive maintenance tasks to be performed. The timelines should depend on equipment manufacturers' recommendations or other predetermined intervals.

The schedule should detail when the tasks are to be completed and estimate the amount of time needed for each activity. For each week in the year, it should list all activities that need to be completed.

When setting the schedule, building managers should time projects to minimize disruptions to building users and take advantage of equipment down times. For instance, districts should conduct preventive maintenance on cooling equipment while it is shut down in the winter. Similarly, consolidating multiple tasks within a single building or scheduling similar types of work together, to the extent possible, helps maximize efficiency.

Adopt Written Procedures to Manage the Program

To adequately manage a preventive maintenance program, procedures are needed to guide how the program is planned and budgeted and how the actual work will be coordinated. This requires a written procedures manual. Following a procedures manual brings consistency to the program. It also offers some control over activities that might otherwise be done haphazardly or not at all.

Written procedures will vary by district but should typically address certain elements. Procedures should establish who is responsible for controlling work orders and administering staff. To aid in budget preparation, procedures should specify a cost-accounting system as well as the format for reporting the budget.

For managing maintenance projects, procedures should define responsibilities expected of each trade represented on staff. The procedures should make explicit what work is expected from each trade and help coordinate multiple tradespeople who may be involved in a single project. Written procedures also help employees understand what is expected of them.

Districts that employ outside help to perform maintenance should follow procedures on when to use contractors as well as how to bid for them and supervise them while on the job. The procedures should specify the services for which contractors will be used. For instance, services that are performed infrequently or that require special equipment or expertise, such as roof repairs, are often good candidates for contracting.

Building managers should have procedures for good contracts. Historical practice shows that effective contracts explicitly state (1) the quality and quantity of the needed service, (2) specific measures to determine service quality, and (3) steps to take if service is inadequate. Contracts that lack criteria for defining satisfactory work prevent local jurisdictions from verifying proper completion of the job.

Written procedures are needed to control the inventories of a maintenance department's materials and equipment. They should designate who is responsible for monitoring and requisitioning parts and equipment to ensure adequate supplies of materials are on hand when needed without overburdening available storage space.

Building managers should also have procedures on how to manage emergency situations, should they occur. With formal procedures designed in advance, staff will know their responsibilities and appropriate roles when emergencies, such as storms or electrical failures, occur. If staff have no plan to react, a minor emergency could quickly escalate into a major one.

Follow Indoor Air Quality Program

Maintaining the quality of indoor air has become increasingly important due to the large amount of time people tend to spend indoors and because of the environmental threats that poor air can pose to public health, according to the U.S. Environmental Protection Agency. Many factors, such as building construction, affect the condition of inside air. One of the important factors is how management operates and maintains buildings, particularly the HVAC systems. Some buildings' HVAC systems are designed to maximize energy savings instead of providing adequate outside air for ventilation; inadequate ventilation can contribute to indoor air problems and serious health problems for building users.

Water damage to building materials or furnishings is another contributing factor. It is a prime source of microbial contamination that affects indoor air, posing potentially serious health risks.

Usage of ozone generators within school facilities is not recommended as an air quality enhancement process.

Certain preventive maintenance can help meet recommended ventilation rates and manage the quality of inside air. Periodic cleaning of ventilating ducts, air plenums, cooling coils, and condensate pans minimizes the opportunity for the growth of microorganisms that would otherwise disseminate through ventilation systems. In addition, inspecting and cleaning other HVAC components, such as outdoor-air intakes, air filters, and fan belts, can make the HVAC operate more efficiently while providing good indoor air quality. Periodically testing and balancing HVAC systems keeps them operating in line with design specifications. Other recommended actions include planning building operations and maintenance in ways to prevent indoor air problems, such as managing airborne

particulates from construction activities, and training employees on issues related to indoor air quality.

Together with other federal agencies, the Environmental Protection Agency has prepared a list of steps that building owners may take to reduce the risks of poor indoor air. (U.S. EPA, *Building Air Quality*, 13-106) In addition, the agency provides information specific to schools' air quality issues and management practices. (U.S. EPA, *Indoor Air Quality Tools for Schools* - Washington D.C.: U.S. Government Printing Office, 1998 - <http://www.epa.gov/iaq/schools>; accessed December 2, 1999.)

4.5 Use Tools to Optimize the Preventive Maintenance Program

Recommendation

To gain optimum benefits from preventive maintenance, building managers should incorporate preventive maintenance tasks into a work-order system and keep systematic maintenance records, either by computer or manually. Managers should evaluate the preventive maintenance program to improve it over time. For added efficiencies, building managers should look for opportunities to share preventive maintenance.

Use a Work-Order System

A work-order system is a standard way of processing maintenance work, whether the job originates as a problem communicated by building users or as part of planned maintenance projects. It controls the large numbers of job requests that maintenance personnel typically face. A work-order system provides uniformity in planning maintenance jobs. Using work orders for upcoming preventive maintenance tasks helps ensure that this work does not get abandoned amidst multiple maintenance jobs.

By analyzing completed work orders, building managers can track recurring problems in a piece of equipment. Work orders may also provide a written record of actual work done each day, as well as the number of hours to complete tasks, parts needed for the job, and feedback on the completed work. More sophisticated work-order systems provide information for measuring worker productivity.

Keep Systematic Records

All the actions discussed above, from assessing the condition of buildings to scheduling preventive maintenance tasks, require keeping data. For many districts, particularly those with multiple buildings, keeping accurate records means having a system for retaining and managing their maintenance information. The purpose of a "management information system" is to make sure that building managers have sufficient information to properly oversee maintenance work.

An information system allows managers to compare budgeted to actual costs and evaluate department performance. Information on maintenance histories can help determine equipment's expected remaining life spans. Trend data on maintenance and repair costs provide useful information for estimating budget items.

Together with preventive maintenance inspections, an information system allows building managers to efficiently identify building problems before major failures occur. When analysis of records shows problems, such as noisy bearings that recur over a number of inspections, maintenance personnel can take corrective steps.

Some districts will require more sophisticated information systems than others. At one end of the spectrum are computerized maintenance management systems. These systems automate many management features such as generating and analyzing work orders, storing building condition information, and tracking preventive maintenance tasks. Some also integrate programs for financial management and energy management control systems. Some help determine what staffing levels and contract-labor hours are necessary based on estimates of maintenance projects' hours and costs.

At the other end of the spectrum, jurisdictions with a limited number of facilities may find it impractical to invest in a computerized management information system. For them, a systematic way of manually recording information can suffice, such as using simple index cards to list the frequency of preventive maintenance tasks.

Evaluate the Program

To improve the quality of preventive maintenance, building managers should periodically evaluate the maintenance work. Planned, ongoing evaluations help identify what aspects of the program need improvement. They also identify what is working successfully and should continue into the future. Data collected through evaluations help determine the costs and benefits of preventive maintenance practices.

Building managers may evaluate preventive maintenance in any of several ways, some of which are described below.

- Set measurable, formal goals for the program and measure progress toward meeting them. This usually involves “benchmarking,” or comparing measures of performance (such as the percentage of work orders completed within three days) against a base line in the school district or top performers elsewhere. Comparing the preventive maintenance program's results in a given year to earlier years yields information on the program's progress.
- Analyze work orders to mark progress in the preventive maintenance program. As the ratio of preventive maintenance work orders to emergency orders improves, building managers may be able to measure a shift toward planned maintenance and away from crisis maintenance.
- Analyze how closely the department adhered to the schedule of preventive maintenance tasks for the year.

- Survey building users with questionnaires that elicit their levels of satisfaction with building conditions.
- Track how frequently equipment breaks down or malfunctions; equipment that is routinely maintained should have a better maintenance history.
- Set standards for various tasks performed by employees. Once employees understand the standards, managers periodically inspect employees' completed work to measure how well it meets the standards.

Explore Efficiencies of Shared Arrangements

Some districts may gain efficiencies in sharing maintenance expertise or equipment with other districts. Sharing services is most conducive in situations where districts have compatible needs or serve similar enrollment capacities. It may produce more or improved services, avoid duplication, get maximum use out of facilities, and save money through joint use of infrequently used equipment. Equally important, sharing preventive maintenance information improves the knowledge and abilities of maintenance personnel, which can lead to better service.

4.6 Advance the Competence of Maintenance Workers and Managers

Recommendation

School districts should ensure that their maintenance employees have appropriate training to competently and safely complete the tasks expected of them.

Require Ongoing Training to Match Duties Performed

Regardless of the size of the maintenance workforce, ongoing training should be available to improve employees' technical skills and meet their individual training needs. Appropriate training represents an investment in helping a school district's employees reach their full potential. When targeted to an employee's individual needs, good training can improve competence and productivity.

Training is also necessary for job safety. The Occupational Safety and Health Administration (OSHA) requires safety-related training. Maintenance employees exposed to hazardous chemicals, for instance, must receive training, including information on methods of detecting the hazardous chemicals and measures they can take to protect themselves from the hazards.

Require Additional Training for Building Managers

Building managers, or those employees with specific responsibilities for managing or overseeing maintenance, may need additional training. Those in leadership roles need managerial skills in addition to their hands-on maintenance skills. Managerial training needs will vary according to each manager's abilities and assigned responsibilities.

Although we are unaware of any universally accepted set of skills for all building managers, degree programs in facilities management give an indication of the material about which managers should be knowledgeable. According to the content of one school's degree program in facilities management, building managers should be equipped to manage: (1) human relations and personnel needs; (2) budgeting, financing, and purchasing practices; (3) use of computers in maintaining buildings; (4) effective contract specifications; (5) compliance with legal requirements; (6) daily building operations; and (7) effective preventive maintenance programs for preserving physical assets.

4.7 Involve Appropriate Maintenance Personnel in Decision Making and in Communicating Building Needs

Recommendation

School districts should include appropriate maintenance personnel in decisions on facility matters, including purchasing major components or designing new square footage. Doing so can provide insight into future maintenance needs and avoid unnecessary costs. Building managers should develop a multiple-level education strategy to address the differing information needs of their various audiences.

Consider Maintenance Needs Prior to Purchasing or Designing Components

Attention to maintenance needs is as important before the design and construction of a building as it is once a building is erected. In considering options for replacing or adding equipment, knowing future maintenance costs for each option allows informed decision making. Adding the expected maintenance costs of equipment to the initial purchase price may reveal some options to be more economical than others over the long term.

Although the initial purchase price may be higher, future savings yielded by trouble-free service and lower rates of deterioration often outweigh the up-front cost. Low-maintenance items also reduce the chances that breakdowns will interrupt use of the building.

In addition, when designing new or altered space, using a design team that includes maintenance perspectives along with the design professionals can help control future costs. When potential maintenance problems are identified early, such as during the design phase, they can be easily corrected. Further, considering maintenance needs can prevent poor design, such as lack of access panels needed to gain access to HVAC components for servicing. As another example, certain plumbing fixtures made of stainless steel are sturdier than others made of porcelain. In some environments, where high use or abuse of a component is expected, the added durability may be justified.

Educate Decision Makers about Building Needs

School district superintendents and elected officials need information on maintenance projects and costs, albeit at a different level of detail than building managers. Superintendents need information on buildings' needs, alternatives to meet those needs, and costs. Similarly, those responsible for funding major

maintenance projects—school boards—need appropriate summary information to make cost-effective judgments. The appropriate level of information will differ from school district to school district.

5.0 SUMMARY

Preventive maintenance requires strategic actions for prolonging the life of building components. As a base line for planning, building managers should prepare and periodically update an inventory of building components and their conditions. Management can then better identify maintenance needs, determine their costs, and set priorities. Well-structured preventive maintenance, incorporated into ongoing maintenance programs, offers the best chance for achieving intended results. School districts have a responsibility to make sure their maintenance employees receive needed training beyond occupational licensure requirements. For cost-effective decisions, district management should include appropriate maintenance personnel in considering long-term maintenance needs in addition to initial project costs.