

CHAPTER 3

GUIDELINES FOR A PREVENTIVE MAINTENANCE PROGRAM

3-1 General This chapter outlines basic procedures used to manage, implement, and evaluate systematic PM programs. The scope includes planning, scheduling, and daily operations to maintain a consistent level of maintenance and reduce the costs of repair in buildings and structures.

a. Purpose of Program. The goal of the PM program is to reduce the number of service orders to a point where buildings and structures are being maintained by scheduled work as much as possible.

b. Developing a Management Plan. The management plan is a tool which enables the Facilities Engineer to systematize PM and orient personnel working within the system toward results. Management plans encompass policy, planning, accomplishment of work, and evaluation of effectiveness. Guidelines provided in this chapter address each of these in the development of a management plan for PM. Facilities Engineers should adopt those guidelines which apply to their own programs' needs.

3-2. Directions and Regulations Directions and Regulations relating to PM in buildings and structures are drawn from a number of sources, including Army regulations, pamphlets and other technical manuals of the 600 series. Each source provides valuable guidance for establishing programs, and should be reviewed to develop a PM program from the broadest possible range of information.

a. Regulations. Department of the Army regulations, orders, and pamphlets applicable to the establishment and operation of PM program are listed in Appendix A.

b. Standard Operating Plan for Preventive Maintenance. The Facilities Engineer should develop, document, and maintain a standard operating plan for PM. This procedural plan should be developed along guidelines found in this technical manual, adapting to meet local needs.

3-3. Planning a Preventive Maintenance Program PM is most effective when the work is accomplished on a cyclic basis. The length of the cycle must be determined, PM Areas must be properly sized, similar facilities grouped accordingly, and adequate manpower levels calculated. Each factor is important in planning to achieve cyclic PM and is dealt with separately here.

a. Basic Requirements to Maintain the Cycle. Selecting an appropriate cycle length is important; however, planning, priorities, procedures, and standards should also be considered.

(1) *Priorities.* Cyclic PM should be accomplished according to the following priorities:

(a) Priority 1: Family Quarters

(b) Priority 2: Other Permanent Facilities

(c) Priority 3: Temporary Facilities

(2) *Performance Cycles.* PM cycles vary among facilities and should be performed as follows:

(a) Family housing: scheduled cycle and/or between occupancies

(b) Other Permanent Facilities: scheduled cycle

(c) Temporary facilities: scheduled cycle

(3) *Length of Preventive Maintenance Cycle.* The recommended length of an effective PM cycle is between 90 and 180 days. Under 90 days is considered uneconomical; over 180 days is considered inefficient and significantly less effective.

(a) Optimum Cycle. In the absence of specific installation requirements and experience which dictate length of PM cycles, a 120-day cycle should be adopted. This length has been proven to be effective by experience.

(b) Cycle Determination for New Programs. Installations establishing cyclic PM programs in Areas where regular maintenance or PM has not previously been accomplished will probably not be able to complete all required work in 120-day cycles initially, due to the backlog of maintenance and the volume of additional Service Order Requests being generated. A longer initial cycle may have to be used and shortened as the backlog is reduced.

(c) Cycle Variance. The cycle is expected to vary for each team and each repetition since time is of secondary importance to accomplishment of all identified work.

(4) *Structuring Preventive Maintenance Areas.* Planning to accomplish PM at most Army installations, because of physical size, type and location of buildings, can be simplified by subdividing into Areas. Figure 3-1 shows an Army installation subdivided into PM Areas.

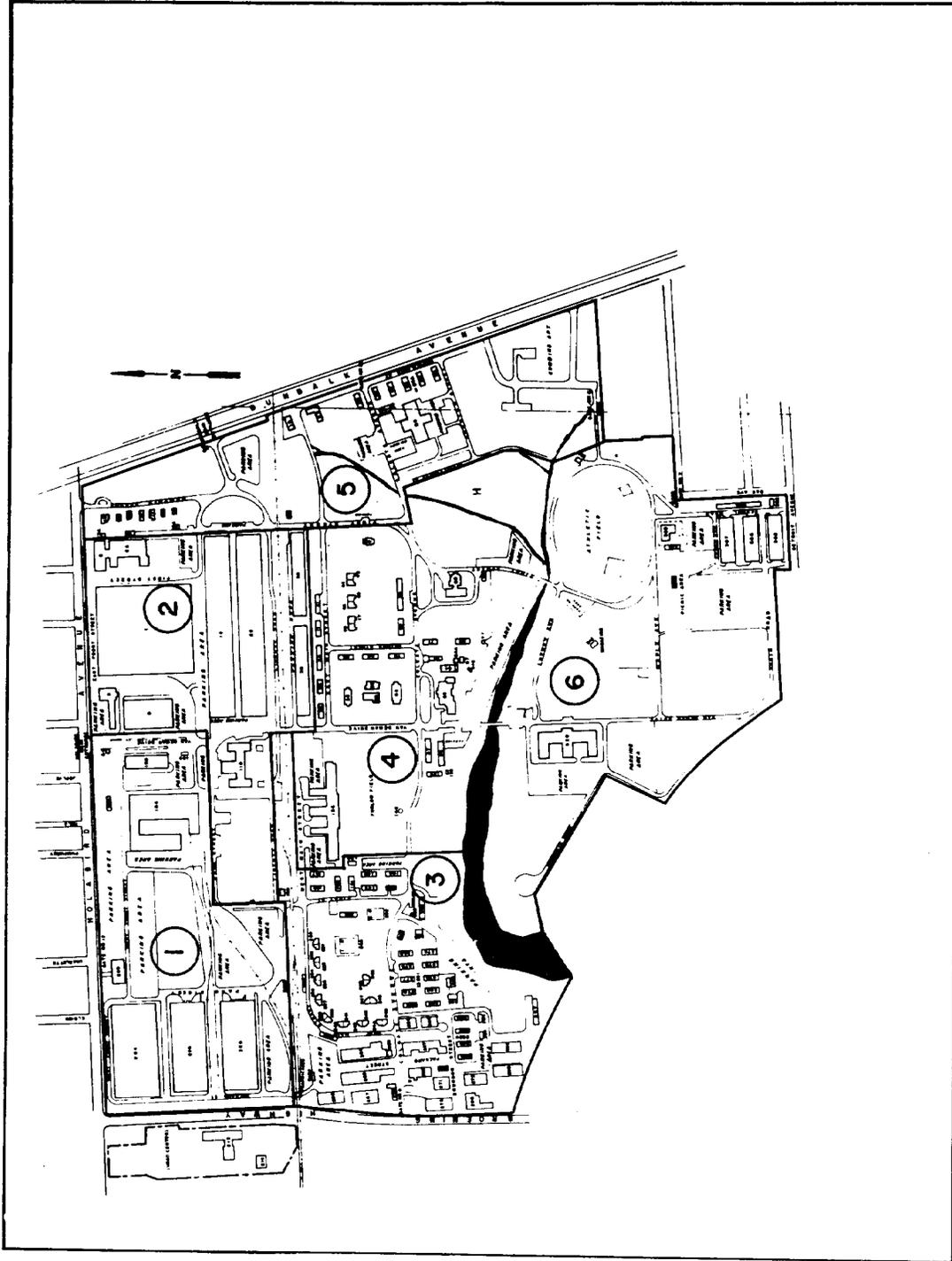


Figure 3-1. Army Installation Sub-divided into PM Areas

(a) *Geographic Closeness.* Travel distances are important in establishing PM Areas on installations. Excessive travel distances within the same PM area should be avoided. For example, training buildings, located at opposite ends of an installation would not normally be included in the same area.

(b) *Similar Buildings.* Buildings and structures with similar maintenance requirements should be located in common Areas, unless other factors such as travel distance would make establishment of the area inadvisable. If possible, Family Housing should constitute a separate PM area.

(5) *Diverting Preventive Maintenance Workers to other Duties.* Diverting workers assigned to PM to other duties disrupts planning and scheduling to maintain the cycle and is not recommended.

(6) *Manpower Requirements.* Adequate manpower is essential to accomplish work and maintain PM cycles. To ensure that manpower requirements for PM are accurately identified and properly documented, the following procedures should be followed:

(a) *Calculation of Standard Hours.* Using the PM performance standards in Figure 3-2 calculate the standard hours required for the total square footage of all facilities in each building category by PM area. MI elements of work, including travel, are accounted for in these performance standards, expressed in manhours. The local adjustment factor(L.A.F.) should be expressed as a decimal, such as 1.1 or 0.92. Its use must be fully substantiated by the results of a work sampling study or other acceptable technique.

Item	Unit	PM Performance Standards (Ref DA PAM 420-5)	L.A.F.	Local Standard
Type of building				
Training	1,000 sq. ft.	1.116		
Maintenance and production	1,000 sq. ft.	0.900		
Research, development and test	1,000 sq. ft.	0.966		
Storage	1,000 sq. ft.	0.750		
Hospital and medical	1,000 sq. ft.	2.000		
Administration	1,000 sq. ft.	1.116		
Family housing	1,000 sq. ft.	1.666		
Troop	1,000 sq. ft.	1.116		
Other	1,000 sq. ft.	1.333		

Figure 3-2. Building PM Performance Standards

Figure 3-3 is a sample calculation of standard hours using square footage found on an Army installation.

A simple illustration format, illustration 3-1, is included at the end of this chapter.

Type of Buildings	Size of Building In Square Feet	PM Performance Standards by hour, per 1000 sq. ft. (REF DA PAM 420-5)	Hours Required for Yearly Cycle	Hours Required for Quarterly Cycle
Training	143,000	1.116	159.59	638.35
Maintenance and Production	83,000	0.900	74.70	298.80
Research, Development and Testing	63,000	0.996	60.86	243.43
Storage	127,000	0.750	95.25	381
Hospital and Medical	627,000	2.000	1,254.00	5,016
Administration	255,000	1.116	284.58	1,138.32
Family Housing	448,000	1.666	746.37	2,985.47
Troop Housing	396,000	1.116	441.94	1,767.74
Other	413,000	1.333	550.53	2,202.12
Total	2,555,000		3,667.82	14,671.23

Personnel Required	$\frac{14,672 \text{ hours per year}}{1,760 \text{ manhours, employee per year}^*}$
	= 8.34 required personnel

*This Figure will vary from installation to installation depending on the local adjustment factor.

Figure 3-3. Sample Calculation of Standard Hours

(b) *Hours for Between-Occupancy Preventive Maintenance of Family Housing Units.* Using past performance or the best possible initial estimate, identify the hours required, including travel, to provide between-occupancy PM to family housing units. This work must be documented for each housing unit visited and should cover a period equivalent to the selected cycle. Travel time must be documented and standards developed.

(c) *Determination of Manpower Requirements for Off-Post Facilities.* Manpower requirements for providing PM to off-post facilities, such as reserve centers, should be determined separately. In some cases excessive travel time is involved and the requirement may exist for personnel to remain at the station full time. Documentation must be provided to support the need for this work and the associated manpower. At some sites, studies may indicate economic justification for contracting out maintenance services including PM.

(d) *Calculation of Required Manpower for Each Preventive Maintenance Area Per Cycle.* Using the standard hours calculated using paragraph (6) (a) above, determine the number of personnel required to complete a cycle in each PM area. First, divided the total hours above by the number of available work hours during the cycle. Second, multiply this figure by the leave factor for the installation and round up to the nearest whole number.

(e) *Preparation of an Individual Job Order (I.J.O.) for Preventive Maintenance Areas.* An Individual Job Order should be written for each area that will identify the hours required to provide services as determined in the above paragraphs. As each I.J.O. is completed, the actual expended hours should be documented. In addition, the standard hours and actual hours should be noted on the PM Checklist/Record for each facility. (The Checklist/Record is discussed later in this chapter.) Work accomplished under an I.J.O. for family housing, between occupancies, must reflect maintenance and repair costs separately.

(f) *Automatic Costing of PM Under I.F.S.* Installations operating under the Integrated Facilities System (I.F.S.) may use the automated technique, to assign document (work order) numbers to work designated as PM. This eliminates the cumbersome task of preparing lengthy I.J.O's and the necessity for recording work performed against the proper cost accounting code.

b. *Scheduling Work and Notification of Visits.* Work scheduling is based on building-by-building time requirements calculated from established maintenance standards for types of buildings and known square footage. An example of this calculation is provided in Figure 3-4. Also see Illustration 3-2.

Building Number	Square Feet	Building Use	PM Performance Standards (Ref DA PAM 420-5)	Allocated Man Hours
4000	11,500	Storage	.750	8.6 hours
4001	16,000	Administration	1.116	17.8 hours
4002	40,000	Training	1.116	44.6 hours
5000	7,500	Housing, Bach.	1.116	8.4 hours
5001	15,000	Utility	1.333	20 hours

Figure 3-4. Calculation of allocated PM per building.

Effective scheduling to complete PM cycles requires full cooperation and assistance from building occupants. Meeting schedules will depend on prior notification of regular visits by the PM Unit. The following methods are recommended for notifying personnel of upcoming visits:

(1) announcements placed in the installation newspaper or bulletin.

(2) notices delivered to buildings in advance of the visit (Illustration 3-3).

(3) schedules available from work receptionist.

(4) use of community and command organizations.

3-4. Work Reception Desk Control System The general responsibilities of the Work Receptionist as they relate to PM activities as follows:

a. *Preventive Maintenance Visit Schedules.* Prior to issuing a Service Order, the Work Receptionist should determine the priority of each request and check the schedule of PM visits. If a request is determined to be routine and a visit is scheduled within the next 30 days, the Work Receptionist should inform the requestor to note the work requirement on the Preventive Maintenance Reminder Sheet.

b. *Self-Help.* The request should be reviewed to determine if the work should be accomplished by the requestor as self-help. Authorized self-help work lists should be available from the Work Receptionist. (See DA PAM 210-2)

3-5. Daily Operation of the Preventive Maintenance Unit

a. *Job Preparation.* The unit leader should obtain the current "Building & Structures PM Checklist"Record" (Illustration 3-5) from the shop files for each building to be serviced in the area assigned for that day. The unit leader should make certain that the unit has the proper supplies and equipment. Basic supply and equipment lists are provided in Chapter 5 of this Technical Manual; these may be modified to suit the needs of specific facilities. The unit leader should also check the service order file for service orders located within the assigned area that can be routinely accomplished.

b. *Inspector—Team Concept of Operations.* A system using an inspector who operates in advance of the PM Unit has been found to be effective in reducing the actual time spent to accomplish PM, particularly for 3-man units or larger. This allows building condition to be readily determined, maintenance needs outlined, and work identified.

(1) Each area leader inspector has a master list of buildings for the assigned area. It contains the building number, the designated use of the building, the size of the building and the allocated time for PM. A sample master list is shown in illustration 3-4, at the end of this chapter.

(2) The inspector enters each building or quarters prior to the PM workers to determine what PM work is needed. The inspector prepares a list of individual work requirements and breaks them down into one of 3 categories: PM, self-help, or work request (when the maintenance work falls beyond the scope of PM).

(3) After receiving the list, the PM workers should begin the actual maintenance work. Supplies used are shown on the list. Upon completion of PM in the given building or quarters, the actual time spent in each building is shown on the list, along with the workers name. The completed list is returned to the inspector and the workers move to the next assigned buildings or quarters.

3-6. Work Guidelines for Preventive Maintenance

PM work is accomplished in two ways: by PM units operating on scheduled visits and by occupants performing self-help.

a. *Preventive Maintenance Unit.* PM units accomplish a series of basic tasks in every building visited. Performance of these tasks ensures that PM needs are being fully met. The procedures in this section outline the basic tasks.

(1) *Question Occupant/User.* A member of the PM unit will review the building occupant's Preventive Maintenance Reminder Sheet and ask the occupant about possible maintenance problems.

(2) *Inspect.* The senior member of the PM unit will inspect the building or structure using the Preventive Maintenance Checklist Record. References are made on the checklist to inspection guides included in Chapter 8 of this technical manual.

(3) *Work Guides.* Detailed inspection/work guides contained in Chapter 8 of this manual describe typical PM requirements found in buildings and structures. As a guide, it is recommended that, in the initial establishment of a PM program, a detailed list of all specific building components and elements listed in sub-paragraphs of Chapter 8 be prepared and utilized for the first few cycles in addition to the PM checklist/record described in paragraph 3-7b below. Thereafter, only the PM checklist/record need be maintained.

(4) *Repair of Minor Work Requirements.* PM units will repair any maintenance requirements discovered during inspections and accomplish all work within their capabilities. The Unit Leader will determine which requirements fall within the scope of PM.

(5) *Reporting of work requirements beyond the Scope of Preventive Maintenance.* In order to complete the scheduled cycle within a reasonable time frame, PM units should not undertake any maintenance or repair tasks beyond their capability. Work beyond the scope of PM should be reported to the PM Foreman. (Note: Primary objective is to accomplish all work within PM capability; time is of secondary importance.)

(6) *Self-Help Items.* PM units should refer minor maintenance and repair items to the Occupant for accomplishment by self-help.

b. *Self-Help.* Guidelines for accomplishing minor maintenance and repair by self-help are contained in Chapter 4. Self-help is a valuable and essential supplement to preventive maintenance and should be given full command support.

3-7. Formats, Records, and Costs Accounting

This section describes the administrative aspects of

PM programs, including flow of documents, recording of work requirements, and accounting for costs.

a. *General Principles.* One principle for a successful PM program is to minimize documentation, but still fully document PM work for all labor, materials and expenses. Accurate accounting, will allow the Facilities Engineer to analyze the costs and results of his program and substantiate manpower requirements.

b. *Buildings and Structures PM Checklist/Record.* One main tool available to the PM unit in the performance of its duties is the Buildings and Structures PM Checklist/Record. Use of the "Buildings & Structures PM Checklist/Record Format" (Illustration 3-5) is recommended. It is both a guide to work performance and a record of its accomplishment.

(1) The checklist/record lists building components, applicable inspection items, date, coded action-taken symbols, remarks, and number of man hours used for the building.

(2) This format should be used in conjunction with inspection/work guides in Chapter 8, which is a training guide for PM personnel. For example, personnel assigned to the electrical component in a particular building may use a list of work guides in paragraph 8-13 for inspection. Designated in-

spection items would include conservation of energy, lighting and sockets, lamps, security alarms, wiring, electric heaters, motors, fans, fuse boxes, ductwork, switches and outlets and general electric safety items.

(3) Minor maintenance and repair tasks, as well as major items, that are corrected or reported, should be documented under the action column using one of the five symbols shown.

(4) The PM unit uses the checklist/record each time it visits a building or structure. Completed forms are filed in the PM shop at the end of the day, when all job order requests have been submitted. The format covers three visits 50 PM units can insure that follow-up actions have been taken and continuity is maintained.

(5) Installations may modify this format to suit local conditions.

c. *Preventive Maintenance Reminder Sheet.* Repair requirements discovered by the occupant between regularly scheduled PM visits other than emergencies or self-help should be listed on the Preventive Maintenance Reminder Sheet (Figure 3-5) and given to the PM Team upon arrival at the building or quarters. This record will enable the PM unit to expedite the required service. A sample illustration format, illustration 3-6, is included at the end of this chapter.

Preventive Maintenance Reminder Sheet		Building No.		
Date	Deficiency	Occupant	P.M. Worker	Action Taken

Figure 3-5. Preventive Maintenance Reminder Sheet

The spaces of the Preventive Maintenance Reminder Sheet will be identified by the titles as shown on Figure 3-5 and data will be entered as follows:

(1) "Building Number." Enter number of building for which sheet is prepared.

(2) "Date." Responsible building occupants will enter the date when they first observe any particular deficiencies.

(3) "Deficiency." Enter a brief description of the deficiency.

(4) "Occupant." Occupant to enter his/her initials or apt./office number.

(5) "P.M. Worker." PM worker to enter his/her initials.

(6) "Action Taken." Enter the date and the type of action taken.

d. *Typical Flow of Documents.* This technical manual provides a system to collect information on building requirements and account for the allocation of manpower and resources to meet

those requirements. Figure 3-6 shows the basic flow of information between the Occupant, PM Shop, and Work Coordinating Office.

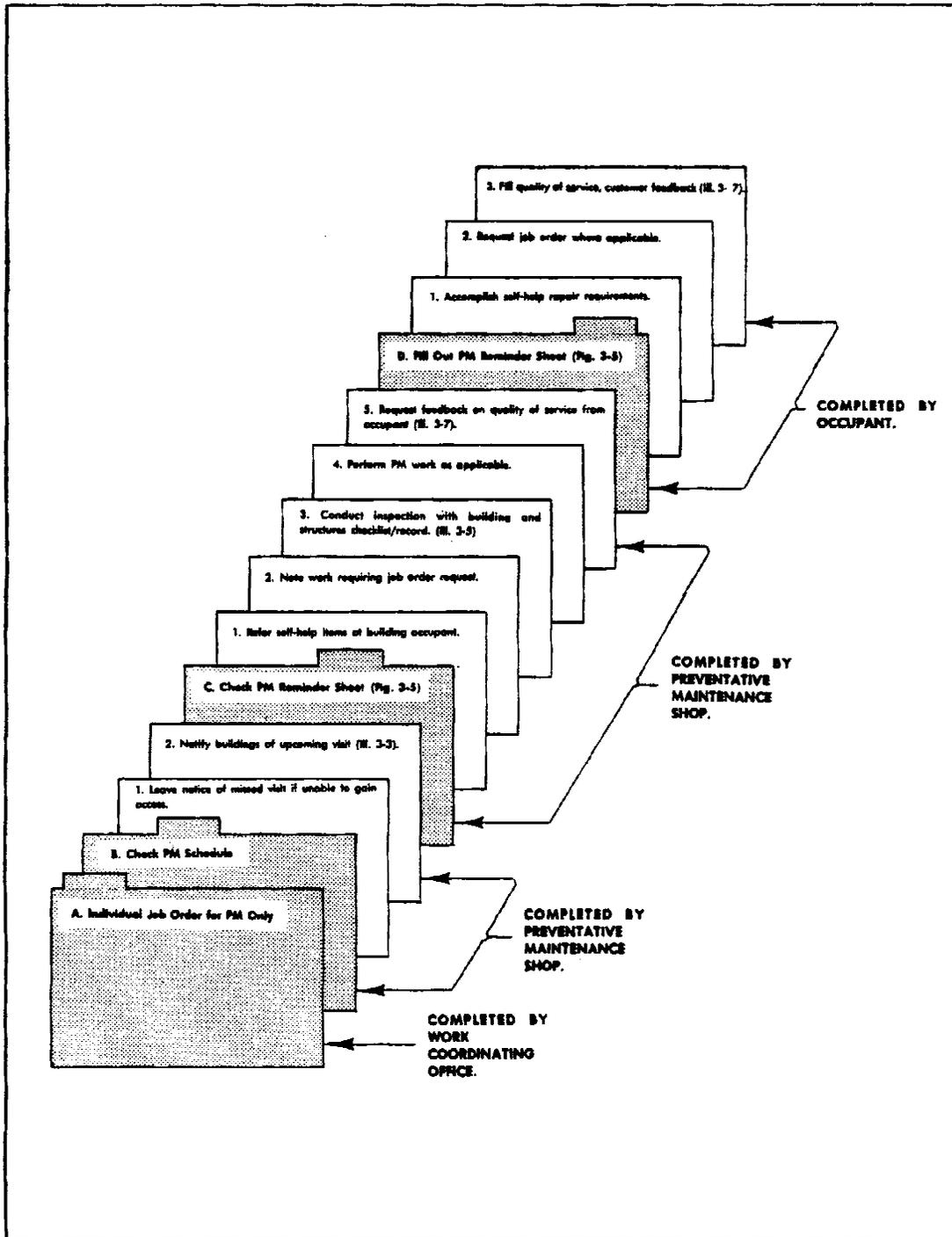


Figure 3-6. Flow of Information in PM

e. *Cost Accounting and Budgeting.* Individual job orders are written for each PM area to cover each cycle. All workers' time and materials are charged against the appropriate work order as defined above.

3-8. Evaluation of Preventive Maintenance Programs. A major advantage of documented PM programs is the availability of data. This data includes facts concerning Service Order levels, actual manhours expended, occupant feedback, and amount of scheduled vs. unscheduled work. It allows the Facilities Engineer to provide the Installation Commander with objective reports on the physical condition of buildings and structures and the use of manpower and resources. Periodic evaluation of PM programs using available data will indicate whether desired system performance is being achieved, and if not, where changes should be made.

a. *Standards of Maintenance.* AR 420-70 prescribes criteria, standards, and procedures in connection with Facilities Engineering responsibilities for buildings and structures. PM programs are directed toward achieving these standards, and inspections should be made at random intervals to ascertain building conditions.

b. *Calculation of Actual vs. Projected Performance.* Use of manpower in productive work is the most essential evaluation standard in PM. It indicates manpower shortages or surpluses which have occurred because initial manpower determinations did not match work requirements. Facilities Engineers should compare actual vs. estimated manhours of effort for a 120-day PM cycle. (Figure 3-7) The figures are representative for installations where established PM programs have been operating for some time. In this example, an actual surplus of over 1.387 manhours was registered.

Area No.	Calculated Man-Hours ¹ for 120-day Cycle	² Actual Man-Hours avg. (1st Cycle)	Man-hours per quarter or Building (DA Pam 420-5)	Actual Man/Hr. per qtr/bldg worked
			Avg. Man/Hr. per sta. (DA Pam 420-5)	
1	1027	763	2.28	2.26
2	733	675	3.48	3.80
3	587	543	2.22	2.32
4	733	660	3.9	4.9
5	733	631	5.0	5.7
6	733	512	29.7	29.2
7	587	484	33.7	32.1
8	587	543	5.13	5.80
9	<u>587</u>	<u>587</u>	1.93	1.20
	6307	5456		
	<u>440³</u>			
	6747			

¹Man-Hours based on 1760 hours per employee year. This Figure will vary from installation to installation depending on the local adjustment factor.
²Difference from calculated due to sick leave, annual leave, retirement, hire lag, etc.
³Added to compensate for workers on leave pending retirement, etc.

Figure 3-7. Comparison of Actual vs. Calculated Performance

c. *Shortages in Manpower.* Calculations required to establish manpower levels are shown in figure 3-3. A comparison of allocated PM hours vs. Actual PM hours is shown in Figure 3-7. These provide documentation to be used as support for current or additional manpower requests.

d. *Volume of Service Orders.* Reduction of Service Orders is a primary goal of the PM program, and by comparing levels of Service Orders before and after PM will provide information for determining the effectiveness of the PM program.

e. *Occupant Feedback.* Effectiveness of PM may be measured by customer satisfaction. Facilities Engineers should encourage positive feedback by establishing simple methods for occupants to provide this information directly. Methods of soliciting customer feedback include the following:

(1) *Customer Checklists.* Comments regarding PM performance may be solicited via checklists or standard questionnaires distributed and collected by P.M. personnel. Illustration 3-7 shows a typical customer feedback request used to monitor FE Service, including PM.

(2) *Non-Commissioned Officer (NCO) Meetings.* Minutes of NCO meetings are another source of feedback on PM performance and should be reviewed by the Facilities Engineer.

(3) *Community Development Councils.* Community development councils may be approached to assist in providing feedback on PM in family

housing and community facilities.

f. *Performance of New Programs vs. Upgraded Programs.* PM work in some cases is accomplished too infrequently to affect the number of Service Order requests and major maintenance failures frequently occur. Long cycles contribute to the backlog of maintenance and repair since many building maintenance repair requirements go undetected over long periods. The conditions created by irregular maintenance have predictable effects on systematic, cyclic PM programs. Facilities Engineers instituting programs where effective maintenance has not been accomplished previously should expect an initial response which might include the following:

(1) *Initial Cycle Length.* Longer initial cycles should be expected and must be planned for.

(2) *Increase in Service Orders.* The backlog in maintenance and repair uncovered by initial cycles will be accompanied by an increase in Service Orders. While this increase appears to contradict the goals of the program in reducing Service Orders, it is a necessary program effect and will diminish during successive cycles.

(3) *Succeeding Cycles.* PM cycles should generate fewer Service Orders as the work becomes systematized and long-standing maintenance requirements are reduced. Eventually, the number of service orders should follow a fairly constant pattern.

Type of Buildings	Size of Building In Square Feet	Labor Standards by hour, per 1000 sq. ft.	Hours Required for Yearly Cycle	Hours Required for Quarterly Cycle
TOTAL				

Illustration 3-1. Calculation for Standard PM Hours (Format)

Building Number	Square Feet	Building Use	PM Performance Standards (Ref. DA PAM 420-5)	Allocated Man Hours

Illustration 3-2. Calculation for Allocated PM Per Building (Format)

Office of the Director of Facilities Engineering

A unit of Engineer Preventive Maintenance personnel will visit your quarters on _____ to perform scheduled building maintenance. Team members may be identified by a special Government Identification Card which they will present upon your request.

Your cooperation will be appreciated in assuring that an adult person is home to grant these workers access. Request that you list those items needing repair on your Preventive Maintenance Reminder Sheet to expedite the visit for our personnel and to minimize your inconvenience. If an item of work is beyond the scope of this team, it will be referred to the appropriate shop for repair at a later time. Further, personnel of this team will advise you on any questions you may have on self-help maintenance in your quarters.

It is our intent through this scheduled maintenance to correct small deficiencies before major repairs develop and to provide better service for the occupant. Any questions or suggestions you may have to improve this service may be referred to the Preventive Maintenance Foreman. Extension _____.

Illustration 3-3. Sample Notification of Visit (Format)

Master Building List			P.M. Area
Building Number	Building Usage	Building Size (sq. ft.)	Allocated P.M. Time (man hours)

Illustration 3-4. Master Building List (Format)

Buildings & Structures PM Checklist / Record		Key to Symbols				Referred to Occupant as Self-help Adjusted as Required Repaired Replaced Part Forward Job Order Request	
		SH: A: R: RP: J:	Remarks	Date Action	Remarks	Date Action	Remarks
Component	Work Guide References (TM5-610)	Date Action	Remarks	Date Action	Remarks	Date Action	Remarks
Roofing	8-5						
Structural	8-6						
Floor Cover	8-7						
Ext. Paint	8-8						
Int. Paint	8-9						
Heating	8-10						
Air Cond.	8-11						
Plumbing	8-12						
Electrical	8-13						
Equipment	8-14						
Structures	8-15 through 8-19						
Area: Bldg: Unit:			Time In: Time Out: Total Man-Hr:		Time In: Time Out: Total Man-Hr:		Time In: Time Out: Total Man-Hr:
			Unit Leader		Unit Leader		Unit Leader

Illustration 3-5. Buildings and Structures PM Checklist/Record (Format)

Preventive Maintenance Reminder Sheet		Building No.		
Date	Deficiency	Occupant	P.M. Worker	Action Taken

Illustration 3-6. PM Reminder Sheet(Format)

Quality of Service, Customer Feedback Format

TO FE Customer FROM FE DATE

1. The Facilities Engineering organization desires to provide quality service to the troops and their dependents. You can help by giving us your evaluation of our performance on work which we recently performed for you. The lower portion of this form is provided for this purpose.

2. Please be specific if you desire to make a comment or to express appreciation to certain employees.

(FE Signature Block)

TO FE FROM DATE

Type of Work:

Preventive Maintenance Carpentry Pest Control	Contractor Air Conditioning Heating	Plumbing Electrical Other
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Bldg. No: _____ Date Performed: _____

Time Arrived _____ Time Completed: _____

Work Performed: _____

(Comments/Recommendations on Service, if any): _____

Signature (not valid unless signed)

Illustration 3-7. Quality of Service, Customer Feedback Format