

What is Maintenance?



*This series of Building Asset Management bulletins form part of a 3-year research project for corporations and managers. The bulletins provide a common understanding of the language and terms that relate to the best practices of the maintenance, repair and long-term planning for the renewal of the common property and common assets. The bulletins are posted on the CHOA website for public access. The bulletins have been produced in partnership with **CHOA, RDH Building Engineering Ltd.** and the **Real Estate Foundation of BC.***

Definition of Maintenance

Maintenance is work that is carried out to preserve an asset (such as a roof or a heating boiler), in order to enable its continued use and function, above a minimum acceptable level of performance, over its design service life, without unforeseen renewal or major repair activities.

Reasons for Maintenance

Maintenance serves to protect the owners' real estate investment in a number of ways.

- **Physical Integrity.** To keep the assets in good working order so as to minimize disruptions and downtimes.
- **Risk Management.** To keep the assets in a state of good repair for the owners' health and safety.
- **Aesthetic Preservation.** To keep the assets from deteriorating in appearance and becoming unsightly.
- **Responsible Stewardship.** To ensure that the assets achieve their full potential service life.
- **Fiscal Responsibility.** To leverage efficiencies that can be reflected on the owners' balance sheet.
- **Duty of Care.** To satisfy a legislated duty that is owed to owners, occupants and guest on the property.
- **Duty to Mitigate.** To prevent unnecessary damage to assets that may result in their premature failure.

Three Types of Maintenance

In the maintenance literature it is generally recognized that maintenance philosophies can be grouped into three broad categories.

		Description	Example
1	Corrective Maintenance (CM)	Maintenance tasks are intentionally withheld until an asset stops working or starts failing. Maintenance is then performed as necessitated.	Lubricate motors when they become noisy or vibrations occur.
2	Preventative Maintenance (PM)	Maintenance tasks are performed at regular intervals, based on industry expected equipment life spans and failure patterns.	Lubricate pumps every 2,000 hours.
3	Predictive Maintenance (PdM)	Maintenance is conducted only when it is confirmed necessary through the use of non-destructive tests that detect potential failure conditions before their occurrence.	Conduct scans on pumps and panels to determine if and when work is required.

Each of these three maintenance strategies has their own merits and limitations. A robust maintenance program will therefore utilize an appropriate hybrid of the three approaches.

#1 Corrective Maintenance (CM)

A conscious decision is made to neglect an asset until it fails or until some type of problem emerges. This maintenance strategy is therefore also referred to as “Run to Failure” (RTF) or “Fit and Forget” (F&F). No routine maintenance tasks are performed and the only “planned” maintenance on the asset is corrective maintenance after a problem necessitates some action.



Many strata corporations do not intentionally allow their assets to run to failure. While they may find that they are neglecting some of their assets, this is not a conscious decision but rather an unfortunate consequence of other factors such as inadequate maintenance budgets, poor planning or ignorance.

There is a subtle, but very important, distinction that must be made between Corrective Maintenance (CM) and Reactive Maintenance (RM). In the case of CM, the owners anticipate the consequences of their planned inaction, they are ready for these consequences and they are therefore still in control. In the case of RM, however, the owners are unaware of the consequences of their neglect, they are ill-prepared and the assets are therefore in control of the owners.

The following table provides a summary of some of the merits and limitations of Corrective Maintenance (CM).

Some Advantages	Some Disadvantages
Lower short-term costs.	Increased long-term costs due to unplanned equipment downtime.
Requires less staff since less work is being done.	Possible secondary equipment or process damage.
	Prone to neglect of assets.

In young buildings with new assets, we can expect lower incidents of failure. During this stage in the life cycle of a building, corrective maintenance may appear (on the surface) to be a prudent and reasonable approach. However, this is

false economy and owners will find that attempts to defer costs until something breaks will often result in additional costs.

In order for a Corrective Maintenance (CM) strategy to be considered prudent (in some limited circumstances), assets must meet one or more of the following criteria:

- Assets that are not maintainable.
- Assets that are disposable and cheaper to replace than to fix.
- Small assets without significant financial value.
- Assets whose downtime is non-critical.
- Assets that are not subject to wear and tear.
- Assets that are unlikely to fail during the life of the building.
- Assets that are prone to technological obsolescence.

Corrective maintenance has a legitimate role to play in the overall maintenance program, albeit a limited one. The advantages of corrective maintenance can be viewed as a double-edged sword and therefore skill and care is required when determining which assets should be allowed to run to failure. These concepts will be explored further in an upcoming information bulletin.

#2 Preventative Maintenance (PM)

In this strategy, the assets are subjected to a regular schedule of maintenance tasks, such as inspections, cleaning, lubrication, adjustments and calibration. The work is performed on a routine basis regardless of whether functionality or performance of the asset is degraded. The frequency of the maintenance is generally constant and is usually based on the expected life of the components being maintained.



The maintenance is carried out at predefined intervals in an attempt to reduce equipment failures or to ensure a consistent appearance of the assets. As the assets age, the frequency and number of checkpoints may need to be re-evaluated. These tasks are usually done frequently and require a relatively constant amount of labour and materials.

Preventive Maintenance (PM) has several advantages over that of a Corrective Maintenance (CM) program. As a result of PM activities (such as lubrication, filter change, etc) the equipment will run more efficiently and will also extend the life of the equipment closer to the intended design life, which translates into dollar savings. While PM will not prevent equipment catastrophic failures, it will decrease the number of failures.

Some Advantages	Some Disadvantages
Increased component lifecycle.	It can be labour intensive.
Reduced asset failure.	Failures are still likely to occur despite PM work being carried out.
Some potential energy savings.	It may include the performance of unnecessary maintenance required by the preset maintenance schedule.
Estimated 12-18% cost savings over Corrective Maintenance (CM).	

A Preventative Maintenance (PM) strategy is most appropriate when assets meet one or more of the following criteria:

- Assets that are subject to predictable wear-out and consumable replacement.
- Assets whose failure patterns are known and can be modeled.
- Assets that are highly regulated for health and safety reasons (Examples: elevators and fire protection equipment).
- Assets that can be effectively captured under a service contract (Examples: HVAC, landscaping, janitorial).

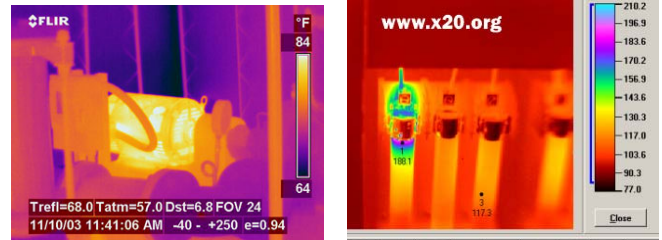
Strategies for aligning maintenance to different assets will be addressed in a future information bulletin.

#3 Predictive Maintenance (PdM)

This maintenance strategy is based on monitoring and measuring the condition of the assets to determine whether they will fail during some future period and then taking appropriate action to avoid the consequences of that failure. Monitoring includes, for example, looking out for excessive vibration, temperature changes, lubrication degradation, or by observing any other unhealthy trends that occur over time.

This philosophy consists of scheduling maintenance activities only if and when conditions warrant. When the condition gets

to a predetermined unacceptable level, the equipment is shut down to repair or replace damaged components so as to prevent a more costly failure from occurring.



A variety of technologies are used to help monitor the condition of assets. The process begins with the sampling of physical data over time, such as vibrations or particulate matter in oil. Measurements detect the onset of a degradation mechanism, thereby allowing causal stressors to be eliminated or controlled prior to any significant deterioration in the asset. Analysis is then performed on the collected data to develop an appropriate maintenance schedule that is tailored to the assets and its condition.

Predictive Maintenance (PdM) differs from Preventative Maintenance (PM) in that it bases maintenance needs on the actual condition of the assets rather than on some preset schedule. This approach offers cost savings over time-based preventative maintenance because tasks are performed only when warranted.

Some Advantages	Some Disadvantages
Increased component lifecycle.	An upfront capital cost associated with an increased investment in diagnostic equipment.
Decrease in equipment downtime.	Increased investment in staff training.
Estimated 6% to 15% cost savings over Preventive Maintenance (PM) program.	

The Predictive Maintenance (PdM) maintenance strategy lends itself well to some electrical and mechanical systems and assets with the following attributes:

- Assets with random failure patterns.
- Assets that are not subject to straight-line wear.
- Assets that will significantly impact the owners' operations if there is any downtime.
- Assets with measurable performance thresholds.

Strategies for aligning maintenance to different assets will be addressed in a future information bulletin.

Finding the Right Maintenance Mix

A “Maintenance Mix” is the degree to which a strata corporation has adopted each of the three types of maintenance strategies and distributed these across the many different assets in the building. For example:

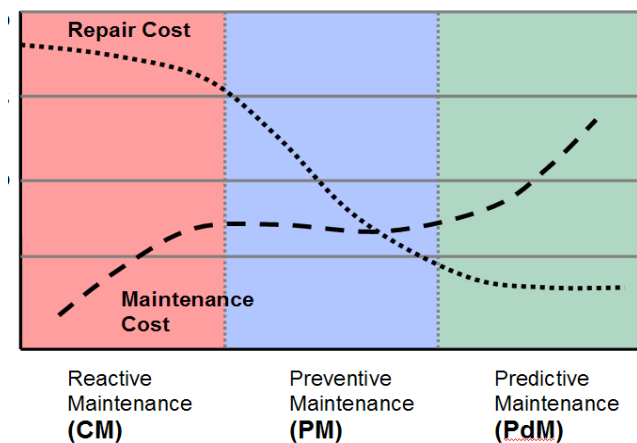
- Corrective Maintenance (CM) **40%** of the assets
- Preventative Maintenance (PM) **50%** of the assets
- Predictive Maintenance (PdM) **10%** of the assets

In the preceding scenario, the strata corporation has not yet optimized its maintenance program to take advantage of the benefits of Predictive Maintenance (PdM) and limit the risks of Corrective Maintenance (CM).

A well-orchestrated program will include a prudent and reasonable mix of the different maintenance strategies. Independent maintenance studies have indicated the following average savings can be achieved by carefully leveraging the advantages of each the three maintenance philosophies:

- Return on investment: up to 3 times
- Reduction in maintenance costs: up to 30%
- Elimination of breakdowns: up to 75%
- Reduction in downtime: up to 45%
- Increase in production: up to 25%

The figure below provides a correlation between the maintenance costs and repair costs associated with the three different maintenance strategies.



While Predictive Maintenance (PdM) generally has the highest maintenance cost, it will result in the lowest repair costs. CM, on the other hand, has the lowest maintenance cost but the highest corresponding costs associated with asset repairs.

Finally, the following table compares how the different maintenance strategies may approach the same maintenance objective of cleaning roof drains.

Description	Maintenance Strategy
Clean the roof drains when water starts leaking into the building.	Reactive Maintenance
Clean the roof drains when there is ponded water on the roof.	Corrective Maintenance (CM)
Clean the roof drains quarterly.	Preventative Maintenance (PM) on a fixed-interval
Clean the roof drains after each rainfall and more frequently during the fall season.	Preventative Maintenance (PM) on variable-interval
Inspect the roof drains quarterly to determine the extent of vegetative debris and clean as required	Condition-based maintenance
Review data from the roof leak detection system and clean the drains as required.	Predictive maintenance (PdM)

The procedures for aligning maintenance strategies to the different types of assets will be addressed in a future bulletin.

Information Bulletins

Listed below is a summary of some of the information bulletins that form part of this series.

- **What is asset management?**
- **What is an asset inventory?**
- **What happens over the life of a building?**
- **What causes our assets to deteriorate?**
- **What happens when our assets deteriorate?**
- **What is obsolescence and how does it affect us?**
- **How do we identify our short-term, mid-range and long-range needs?**
- **What is a condition assessment?**
- **What is a warranty review?**
- **What is a maintenance plan?**
- **What is a maintenance review?**
- **What is a maintenance policy?**
- **What is a maintenance backlog and how do we deal with it?**
- **What is a reserve fund study?**