



Building Maintenance and Rehabilitation Management

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المخلص :

مع نمو حجم أعمال التشييد والبناء أدى ذلك بدوره إلى زيادة أعمال صيانة وإعادة تأهيل المنشآت .. و تعد تكلفة إعادة تأهيل المنشآت وصيانتها من أعلي التكاليف ، حيث إنها تمثل ما يقرب من ثلاثين في المائة من قيمة صناعة التشييد والبناء و تعتمد غالبا قيمة المباني على نوعية الصيانة التي تحدث لها من حيث الجودة و الكفاءة حيث بدورها تعمل على الحفاظ على قيمة المبنى و تقليل التكلفة .. ولذلك يتوجب علينا العمل في مجال إعادة تأهيل المنشآت وصيانتها وفق خطة تقوم على دراسة الحلول المتاحة من حيث الوقت و التكلفة بحيث تحقق الحصول على أقصى فائدة من الاستثمار المحرز في أنشطة الصيانة .. و سنقوم من خلال البحث الحالي باستعراض الفكرة العامة حول صيانة المباني و كيفية التحكم في التكلفة و توضيح بعض العوامل التي تؤثر على صانع القرار و تؤثر على التكلفة أيضا...

Abstract:

A growth of construction and building appears as a part of the country development. As a result, more maintenance work is required to ensure the serviceability safety of the constructed building. Investment in building maintenance is huge all over the world. In most countries, it represents almost 30 per cent of the total turnover of the construction industry. The value of buildings depends on the quality of the maintenance invested in them, as maintenance assists retaining economic life of building, Maintenance management involves obtaining maximum benefit from the investment made on the maintenance activities. In this index we explain the general concept of building maintenance costs, how to control the maintenance costs and the factors affecting the decision making and costs.

Keywords:

Building, maintenance, management, factors, controlling, cost and optimization.

1. Introduction:

According to the British Standard 3811, building maintenance is defined as the work undertaken to keep, restore or improve every part of a building, its services and surrounds. It is expected to restore the building to its original design level and not to fall below the acceptable level. It may be more than to extend the life cycle of building. A more functional definition is that "Maintenance is synonymous with controlling the condition of a building so that its pattern lies within specified regions", (Shear, 1983). Moreover, building maintenance cost can be defined as the cost of any actions carried out to retain an item in, or restore it to an acceptable condition but excluding any improvements other than those necessitated by inability to replace obsolete materials or

components. Building maintenance is necessary even if building is large or small, simple or complex. However, it is suggested to have maintenance free building or adapt approaches with deferred maintenance strategy to buildings (El-Haram and Horner, 2002 ; Wood, 2003a). Over the past, building maintenance has been given a very low priority and building maintenance performance has been criticized as inefficient and unsatisfactory.

The objectives of building maintenance are therefore (Alner and Fellows, 1990):

- To ensure that buildings and their associated services are in a safe condition.
- To ensure that the buildings are fit for use.
- To ensure that the condition of the building meets all statutory requirements.
- To carry out the maintenance work necessary to maintain the value of the physical assets of the building stock.
- To carry out the work necessary to maintain the quality of the building.

Maintenance can be achieved in different stages those stages are:

- Planning and Design Stage: the planning and designing of the facility should be based on the identified function and be as maintenance free as possible. In this stage a lot of money can be saved with the proper plan and design.
- Construction Stage: in order to achieve minimum level of maintenance during the building life, work performed during the construction phase must be done with the highest quality in term of workmanship
- Maintenance Stage: in this stage, maintenance is performed after the building has been constructed and occupied.

2. Building Maintenance Cost Concept:

Building maintenance can contribute to reducing building cost through a continuous effort of cost reduction in maintenance operations. Moreover, the reduction of building maintenance cost can be done through deep understanding of the building maintenance cost concepts. The four categories of the cost elements associated with building rehabilitation have been developed and can be seen in more details in Figure 1.1. These all cost elements need to be included whilst calculating life cycle cost analysis.

2.1 Classifying Maintenance Cost:

Maintenance cost should be classified in alternative ways to indicate the nature of the work done, the reason for carrying out the work, the frequency at which the work becomes necessary, the method of execution and any other appropriate location reference.

Building elements: it is the major component common to most buildings. Building elemental analysis can be used for:

- To determine the high maintenance cost area in order to assist the decision-maker as to whether renew the component or continue to repair it.
- To determine the level of expenditures on maintaining of each part of building.
- To control and predict future expenditure.
- To compare the cost of maintaining of similar location and element both without the organization.

Functional system: maintenance cost can be related to functional system. This will make the purpose of the work more feasible to assess the effect on user activities of

different levels of maintenance expenditures. A possible classification on these lines would (Lee, 1987):

- **Safety:** this includes structural stability, fire precautions, and hazards of all types.
- **Weather:** this would include the external envelope (i.e. roof covering, wall cladding, etc.).

Purpose: the purposes of maintenance work should be known because it will assist in better interpretation of cost data. Some of the purposes are (Lee, 1987).

- **Repair:** to maintain the building to the required standard.
- **Renewals:** the decision to renew a component before the end of its life cycle instead of continue in repairing is influenced by the economic circumstances or aesthetic consideration.
- **Modification:** it allows a more effective use of the building.
- **Protection:** it would cover all items that necessary to protect the base materials (i.e. external painting and thin coating).

2.2 Controlling Maintenance Cost:

Upper level management often views maintenance costs as an uncontrollable cost. Contrary to this view, maintenance costs are highly controllable when an accurate strategy for estimating maintenance cost is established. The maintenance cost estimation accuracy depends upon the amount of information available on the nature and extent of the work, condition under which will be executed, the mode of execution, and the costs of employing labors and prices of materials (Lee, 1987).

Maintenance costs can be expressed as a percentage of (Lee, 1987):

Construction cost: maintenance costs as a percentage of construction costs will vary based on the building age, type of the construction and the amount of increment in the maintenance and construction cost.

Production cost: the greater use of mechanization in the maintenance work in attempting to reduce the production cost may cause the maintenance costs to be raised.

Occupation cost: the reduction in the occupation costs may increase the maintenance costs. For example, the improvement in the thermal efficiency of the building will reduce the energy consumption cost and may increase the cost of maintaining and monitoring the system to ensure its effectiveness.

Profitability: buildings maintenance policies have long-term effects on the condition of buildings and indirectly determine the profit.

2.3 Ineffective Maintenance Cost:

There are many sources of ineffective maintenance cost, these sources are:

Unnecessary Work: It includes the following:

- Work above the required standards.
- Improper maintenance work.
- Misuse of the building.
- Design defects and faulty workmanship in the initial construction stage.

Uneconomic Work: This is resulting form:

- Non-productive time caused by excessive traveling from job to job, waiting for instruction and materials
- Improper work methods.
- Lack of motivation on the part of the operatives.
- Lack of appropriate maintenance contracts.
- Changes to the nature and scope of the work after commencement.
- Lack of an efficient system of recording and controlling costs.

Inadequate Work: This is also resulting from:

- Failure to identify the true causes of defects and specifies the correct remedial work.
- Improper execution of the work.
- Lack of adequate rules in the correct documents to ensure that the work will be performed in accordance with specification.

2.4 Types of Maintenance Contracts:

Maintenance contract is a contract under which one party promise to furnish services, manpower, material and money to maintain or to improve real property for another party who promises to pay for the work performed (Al-Hazmi, 1995). There are various types of maintenance contracts, which used to explain the type agreement between two parties to carry out the maintenance work. They are namely: Unit Price Contract, Lump-Sum Contract, Cost Plus a Fixed Fee Contract, Cost Plus Percentage Fee Contract, Cost Plus a Fixed Fee with a Guaranteed Maximum, Term Contract, Purchased Labor Contract, and Schedule Contract.

3. Factors Affect Building Maintenance:

3.1 Engineering factors:

- **Design Complexity:**

Building should be designed in such a way to be simple in maintenance. Design complexity will prevent maintenance work to be carried out easily, quickly and economically. Major replacement can often be avoided if regular cleaning and minor repair can be carried out without difficulty.

- **Faulty Design:**

It includes all defects that were caused during the early stage of design and particularly in the structural design such as: when designer ignores the spacing for contraction and expansion movement. Such movement causes cracking of the structure, which will result in fractures in pipes or joint failure.

- **Life Cycle Cost Techniques (LCC):**

Life cycle cost (LCC) is the total relevant costs over the life of a system including cost of acquisition, operation, maintenance, modification, and disposal for the purpose of making decision (Shear, 1993). LCC takes into account initial and other running costs (total cost of operation and maintenance of a system) over a life of the buildings. It can

help in determining how the owner's money is distributed during the life period of the facility. It is used to determine the most economical way of meeting a need of space.

- **Poor Quality Control:**

During the construction and maintenance stages, quality control program should be set out. It is used to control, inspect and test record of activities in accordance with the contract requirement and construction procedures. A facility with the presence of an effective QC program has fewer defects and therefore requires less maintenance than a facility where no QC program has been considered.

- **Unfamiliarity with Maintenance Methods:**

The effect of adoption of inappropriate method is not limited to increase the cost of the particular work, but may also have an adverse effect on the long-term durability of the building and the cost of subsequent maintenance.

- **Unfamiliarity with Site Conditions:**

Designer should be familiar with buildings site condition such as soil condition. Ignoring variation in soil condition will cause setting, which will cause cracking of structural elements.

3.2 Contractors and Labors:

- **Unavailability of Maintenance Contractor:**

Most small and medium-sized maintenance contractors in the local market carry out new construction in addition to maintenance and usually prefer new work because it is more straightforward and offers potentially higher profit. In addition, the number of well-experienced maintenance contractors is countable; thereby it will limit the competition in the field with a likelihood of higher price.

- **Unqualified Maintenance Contractor and Labors:**

The specialized and well-experienced maintenance contractors and labors are important to perform maintenance work effectively. A good maintenance contractor is a solid performer who knows the costs and knows what he can or cannot do, and realizes that his regulations are built upon his past performance.

- **Unavailability of Skilled Labors:**

Skilled labors are important for maintenance work and they should be available to perform job and utilize equipment. It is because they perform work according to their past experience and their skills. Employing labor with the requisite skills will assist to improve the quality of work, minimizing cost and reduce work time span.

- **Defects and Faulty Workmanship in the Initial Construction:**

Some building defects have their origin in the building process itself. Due to inaccuracies during construction, the fixing and bearings cannot tolerate the differential movements leading to structural defects.

3.3 Management and Administration:

- **Poor Management of Maintenance Group:**

Maintenance management is an effective tool for achieving a high standard of maintenance work. In absence of such management, it will lead to a time consuming, and most likely fail maintenance work. Maintenance management's responsibility needs to formulate long term strategic plans to meet those needs are required.

- **Lack of Building Maintenance:**

The objective of the manual is to provide all building users with a common system of maintenance information recording and retrieval for the proper guidance of maintenance operatives, building owners, maintenance involving operatives, costing, and general maintenance.

- **Not Using Building for a Long Time:**

Facilities which have not been used for a long time could be needed urgently. However, if no maintenance has been performed on idle components and items, they may require emergency maintenance which will cost more and require more manpower. Hence, if facilities are not in use, they should be maintained in order to avoid future unplanned maintenance (Mahmoud, 1994).

3.4 Budget of Maintenance Work:

- **Poor Financial Support for Maintenance Work:**

It is very important that building owners, when they prepare the annual budgets, include enough financial allocation for maintenance work, as it is a critical and needed function. In the absence of financial support for maintenance work required, the building will not be maintained properly.

- **Poor Financial Control:**

Labor productivity, material availability, materials waste, good and effective maintenance methods, using effective tools and equipment, and good maintenance planning should be financially controlled on site.

4. Building Maintenance Management:

In maintaining a building, there are usually several strategic options available to management, and many alternative decisions to be considered, and to select the strategy we have to identify the significant and non-significant items. Building maintenance can be divided into three strategies as shown in fig1.

- Corrective Maintenance.
- Preventive Maintenance.
- Condition Based Maintenance

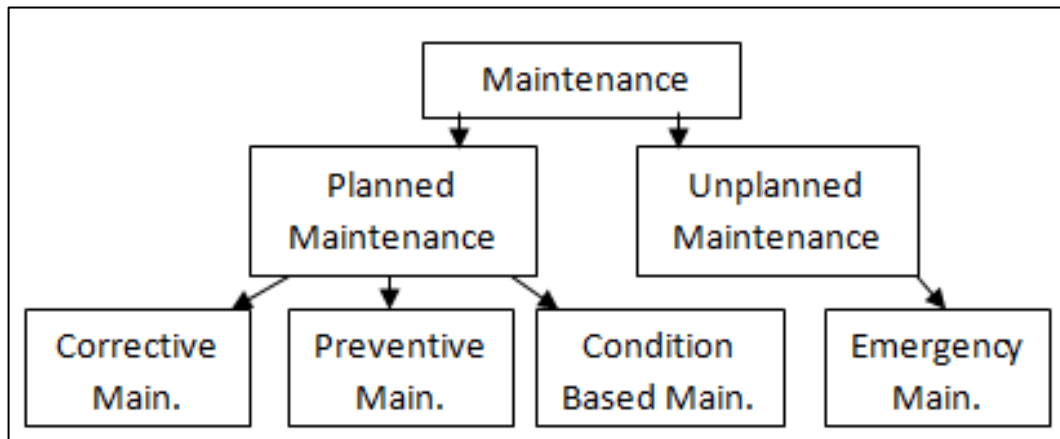


Fig.1 Four Categories of the Cost Elements

4.1 Corrective Maintenance:

Corrective maintenance is the simplest type of maintenance strategy, where an element in a building is used until it breaks down or defects. It covers all activities, including replacement or repair of an element that has failed to a point at which it cannot perform its required function. Corrective maintenance is sometimes referred to as failure-based or unplanned maintenance. Thus, corrective maintenance can be extremely expensive for two reasons:

- The failure of an item can cause a large amount of consequential damage to other elements in the building. For example, failure of the roof could cause damage to the ceiling and the interior of the building.
- Failure of an item can occur at a time which is inconvenient to both the user and the maintaining authority. This can make manpower and spare parts planning extremely difficult.

However, corrective maintenance is still an important part of any maintenance management strategy. It is from such work that we can gather vital predictive information.

Corrective maintenance is most likely to be the appropriate maintenance strategy for:

- Non-significant items.
- Utility significant items whose condition cannot be monitored and for which the cost of applying time-based preventive maintenance is less than the cost of applying corrective maintenance.

4.2 Preventive Maintenance:

Preventive maintenance was introduced to overcome the disadvantages of corrective maintenance, by reducing the probability of occurrence of failure and avoiding sudden failure. The following are the advantages of preventive over corrective maintenance:

- Maintenance can be planned ahead and performed when it is convenient to the building's user.
- Maintenance costs can be reduced by avoiding the cost of consequential damage.
- Downtime, the time that an element of the building or the whole building is out of service, can be minimized so the habitability of the building can be increased.

Preventive maintenance has some disadvantages which must be minimized (El-Haram, 1995):

- Planned maintenance is performed irrespective of the condition of the building elements. Consequently, a large number of unnecessary tasks will be carried out on elements that could have remained in a safe and acceptable operating condition for a much longer time.
- As a result of human error during the execution of the maintenance task, the condition of an element may end up worse than it was before.
- Planned maintenance tasks are usually very demanding in terms of spare parts and labor.

Preventive maintenance is most likely to be the appropriate maintenance strategy for:

- Health, safety and environmentally significant items whose condition cannot be monitored.
- Health, safety and environmentally significant items whose condition can be monitored, but for which the online condition monitoring techniques either are not available or are not cost effective.

4.3 Condition Based Maintenance:

The condition-based maintenance concept recognizes that a change in condition and/or performance of an item is the principal reason for carrying out maintenance. Thus, the optimal time to perform maintenance is determined from a condition survey used to determine the actual state of each constituent item in a building. In this strategy, maintenance tasks are determined and planned by efficiently monitoring the building's elements such as walls, floors, roof and service equipment such as boilers, pumps, and heating system, to identify which element or piece of equipment requires maintenance before a major failure.

Condition-based maintenance is most likely to be the appropriate maintenance strategy for:

- Health, safety and environmentally significant items whose condition can be monitored and for which on-line condition monitoring techniques are available and cost-effective.
- Utility significant items whose condition can be monitored and for which condition-based monitoring techniques are available and cost-effective.

4.4 New Approach of Maintenance Management:

Current building maintenance strategies, whether based on planned or unplanned maintenance, are most likely to be budget driven. This means that maintenance is not carried out according to actual need, but is dictated by financial priorities decided at the time or during the previous year. Three methods are currently used for constructing a budget for estate-based management organizations; none is entirely satisfactory and each produces a different budget (Lee, 1987):

- Base this year's budget on last year's expenditure with an allowance for inflation.
- Use the Department of Environment or other formula for calculating the maintenance element of the estate budget.
- Use a stock condition survey to quantify the size of the maintenance task.

The new maintenance management approach is based on the failure consequences of each item in a building. Thus, the objective of maintenance management is to prevent, to minimize and to repair building defects by enhanced planning and implementation using appropriate materials and tools at the right time and minimum total life-cycle cost.

To determine an optimal maintenance strategy for a building, it is necessary to integrate the three types of maintenance strategy because:

- Not all items are significant.
- Not all significant items can be condition monitored.
- Condition monitoring techniques are not always available.
- The application of condition monitoring techniques is not always cost-effective.

5. Conclusion:

According to the British Standard 3811, building maintenance is defined as the work undertaken to keep, restore or improve every part of a building, its services and surrounds. It is expected to restore the building to its original design level and not to fall below the acceptable level. It may be more than to extend the life cycle of building. This report is about building maintenance management we explain the general concept of building maintenance costs, The four categories of the cost elements associated with building rehabilitation have been developed and can be seen in more details in Figure 2. These all cost elements need to be included whilst calculating life cycle cost analysis. how to control the maintenance costs and the factors affecting the decision making and costs, the different strategies for managing the building maintenance costs and how to select the strategy.

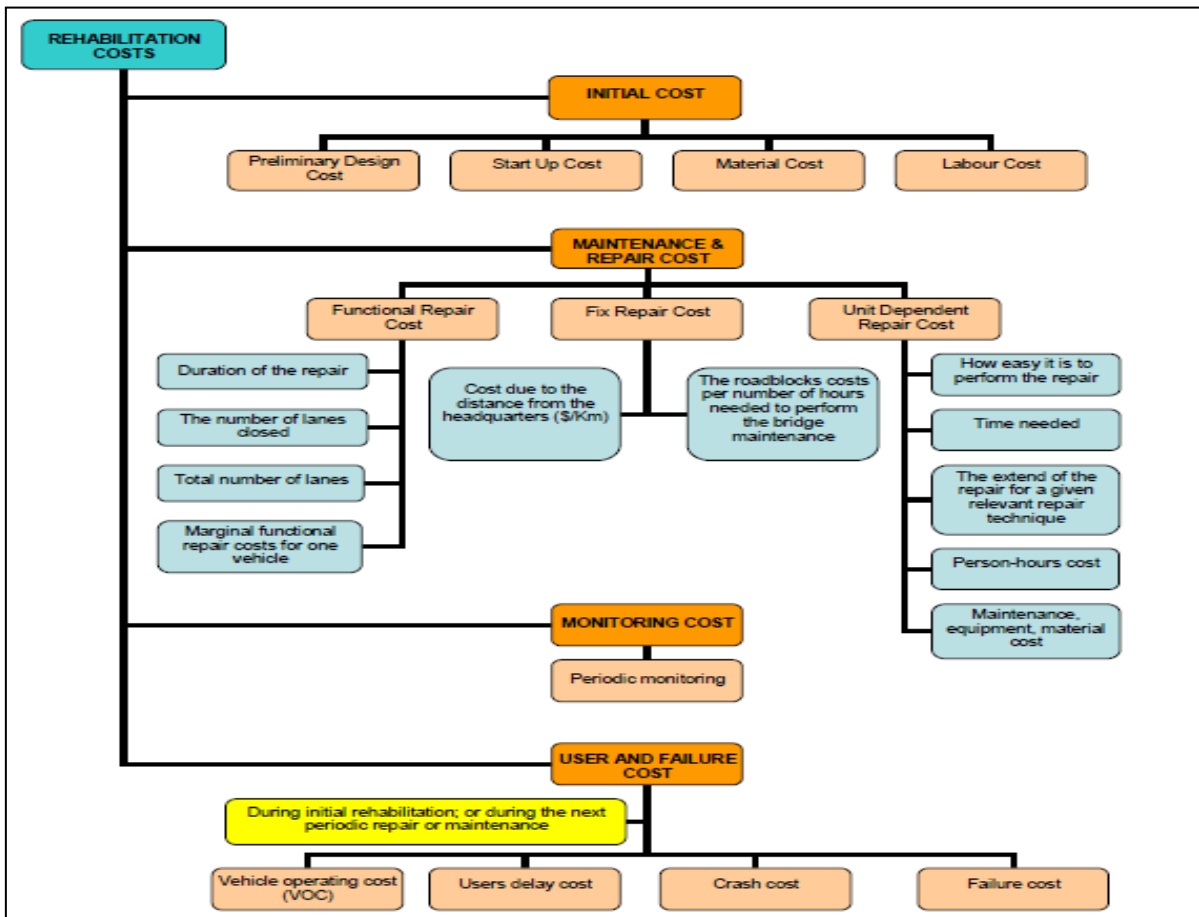


Fig. 2 Rehabilitation Cost

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