

Introduction

Maintenance Engineering is defined as the work done to keep the civil engineering structures and work in a condition so as to enable them to carry out the functions for which they are constructed.

1.1. Necessity of Maintenance

The maintenance of structure is done to meet the following objectives :

1. Prevention of damages and decay due to natural agencies and wear and tear and to keep them in good appearance and working condition.

2. Repair of the defects occurred in the structure and strengthen them, if necessary.

The maintenance work is broadly classified as :

- (i) Preventive maintenance.
- (ii) Remedial maintenance.
- (iii) Routine maintenance.
- (iv) Special Maintenance.

1.2. Preventive Maintenance

The maintenance work done before the defects occurred or damage developed in the structure is called 'Preventive Maintenance'.

It includes thorough inspection, planning the programme of maintenance and executing the same. It depends upon the specifications, condition and use of structures.

1.3. Remedial Maintenance

It is the maintenance done after the defects or damage occurs in the structure. It involves the following basic steps :

- (i) Finding the deterioration.
- (ii) Determining the causes.
- (iii) Evaluating the strength of the existing structures.

- (iv) Evaluating the need of the structure.
- (v) Selecting and implementing the repair procedure.

1.4. Routine Maintenance

It is the service maintenance attended to the structure periodically.

The nature of work done and interval of time at which it is done depends upon specifications and materials of structure, purpose, intensity and condition of use. It is done by the fund provided annually for the purpose which is normally $1\frac{1}{2}\%$ of the cost of construction. This is rendered to meet day to day problem of normal nature and includes the inspection, planning the programme and executing the same. It includes white washing, patch repair to plaster, replacement of fittings and fixtures, binding of road surface.

The periods for some of the repair is given in Table 1.1 as per P.W.D. Manual.

Table 1.1

Name of the periodical repair	Periods exposed surface on		Unexposed surface	Remarks
	Important building	Other building		
External white washing	Annually	Every two years and yearly in places	Every 2 to 3 years	The periods are given a guide but repairs must be done when required. Some building for various reasons require more frequent attention than others.
External colour washing	Every two years	Every 2 or 3 years	Every three years	
External painting	To be done according to need		—	
Internal painting	Every four years	Every 4 years	as required	
Internal painting	Every three years	Every 4 years	as required	
Renewal of approach road	3 to 10 years	(According to traffic and material used)	—	
Renewal of Tennis court	5 years	—	—	
Thatching	8 cm coat every year	3-4 years and 9 years renewal	—	

1.5. Special Maintenance

It is the work not covered in routine programme or the annual repair and is done under special condition and requires sanction and performed to rectify heavy damage. It may be done for strengthening and updating of the structure to meet the new condition of usage or to increase its serviceability. It may include particular or complete renewal occurring at long interval, such as renewal of floors, roofs etc.

1.6. Causes which Necessitate the Maintenance

The causes which necessitate the maintenance effects the service and durability of the structure are as follows :

- (a) Atmospheric Agencies : (i) Rain. (ii) Wind. (iii) Temperature.
- (b) Normal wear and tear.
- (c) Failure of structure.

Rain. It is the important source of water which affects the structure in the following ways :

Physical. (a) Dissolving and carrying away minerals as it is universal solvent.

(b) *Expansion and contraction.* The material is subjected to repetitive expansion and contraction while they become wet and dry and develops the stresses.

(c) *Expansion of water.* The variation of temperature causes the expansion and contraction of absorbed water and affects the micro-structures of the materials.

(d) *Errosion.* Transportation and attrition and abrasion of the material is quite evident effect of the water.

Chemical. (i) The water available in nature contains acids and alkali and other compound in dissolved form acts over the material to give rise which is known as chemical weathering.

(ii) *Wind.* It is the agent which transports the abrasive material and assist the physical weathering. Its action is aggravated during rains and when it is moving with high speed it may contain some acidic gases like CO₂ fumes which may act over the material and penetrates quite deeply in the material and structure.

(iii) *Temperature.* The diurnal, seasonal and annual variation of the temperature, difference in temperature in two parts of the material and the surface of material causes expansion and contraction. By this movement of the material bond and adhesion between them is lost when it is repeated. This is responsible for the development of cracks and the rock may break away into small units.

Exploitation or peeling off the shell takes place if exterior layer are heated externally with respect to internal layers.

The temperature variation may also cause change in the structure and chemical composition of the material.

(b) *Normal wear and tear.* During the use of structure it is subjected to abrasion and thereby it loses appearance and serviceability.

(c) **Failure of structure.** Failure is defined as a behaviour of structure not in agreement with expected condition of stability or lacking freedom from necessary repair or non-compliance with desired use of and occupancy of the completed structure. In field it may result in visual collapse of the structure or even suspension of the services e.g. the collapse of towers, sliding or over-turning of dam, settlement of foundation, crushing of columns etc.

The causes of failure may be broadly grouped as :

(i) *Improper design* – due to incorrect, insufficient data regarding use, loading and environmental conditions, selection of material and poor detailing.

(ii) *Defective construction* – poor materials, poor workmanship, lack of quality control and supervision.

(iii) *Improper use of structure* – overloading, selecting the structure for the use for which they are not designed such as deteriorating environment due to impurities from industrial fuel burning, sea water minerals, chemicals, storage of chemicals for which they are not designed.

(iv) *Lack of maintenance* — Lack of upkeep, proper protection, precaution and preservation, deteriorates the structure, which may result in the failure.

1.7. Pre-monsoon and Post-monsoon Inspection

The maintenance programme is normally drawn taking climatic conditions under consideration and in Bharat (India) the year is divided into the following periods :

(i) *Pre-monsoon period.* Two months before rainy season.

(ii) *Monsoon period.* Four months in the rainy season normally commencing from 15th June.

(iii) *Post-monsoon period.* Six months after the monsoon.

For drawing up the maintenance programme, it is very essential to inspect the structure to get first-hand information regarding defects and their causes. Emergency of works to enable to decide the procedure of maintenance.

Pre-monsoon inspection is made to decide the maintenance programme to be done before monsoon such as cleaning of drains, checking of roof leakage, collection of material and equipment require during monsoon repairs, bridges and other structure which are not

easily approachable during the monsoon are inspected fully and repaired, if necessary.

1.8. Post-monsoon Inspection

It is made to repair the damage caused by water and draw up the programme of repair according to the priorities. All replacement renewal and rehabilitation work are carried out. It is needless to mention that the maintenance engineering should also be on toe to meet the emergency work during the monsoon, *e.g.* canal or dam breach, washing away of roads, railways tracks, collapse of roof, failure of walls. They must have a vigilant eye over the structure and should take note of meteorological forecasts. The complete team should be kept alert to meet the situation due to unfavourable rains and its deteriorating effect.

QUESTIONS

1. The main aim of maintaining any structures is to :
 - (a) Improve its appearance.
 - (b) Utilise the funds provided.
 - (c) Stabilise the structure so as to enable it to carry the functions for which it is constructed.
 - (d) Utilise services of incharge maintenance.
2. Which one of the following is preventive maintenance.
 - (a) Filling up cracks in masonry.
 - (b) Repair of pot holes on road.
 - (c) Painting of doors and windows.
 - (d) Renewal of flooring.
3. Which of the following jobs will you classify as special maintenance ?
 - (a) Replacing door frame damaged by white ants.
 - (b) Renewal coat to W.B.M. road surface.
 - (c) White washing and colour washing of buildings.
 - (d) Painting of steel roof trusses of a workshop.
4. State the causes which necessitate maintenance of civil engineering works.
5. State two examples each for routine, special, pre-monsoon, post-monsoon, preventive and remedial maintenance works.
6. Tile turning of tiled roof in the month of May is the example of :
 - (a) Special repair

- (b) Pre-monsoon repair
 - (c) Remedial repair
 - (d) Post-monsoon repair.
- 7.** A roof has fallen in rainy season. Its maintenance will be classified under which of the following maintenance :
- (a) Special repairs
 - (b) Routine
 - (c) Pre-monsoon
 - (d) None of the above.