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# THE STUDY ON THE MASTER PLAN OF AIRPORT MAINTENANCE AND REHABILITATION IN THE REPUBLIC OF INDONESIA

## FINAL REPORT

## VOL. 3

## AIRPORT MAINTENANCE MANUAL

MARCH 1991

JAPAN INTERNATIONAL COOPERATION AGENCY



THE STUDY ON THE MASTER PLAN OF AIRPORT MAINTENANCE AND REHABILITATION IN THE REPUBLIC OF INDONESIA
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# GENERAL

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## 1. Objectives

This manual is prepared for standardization of maintenance activities for airport civil and building facilities, and airport maintenance equipment, by providing Airport Authorities with guidance for their maintenance activities.

Personnel in charge of the maintenance of these facilities and equipment shall execute proper maintenance corresponding to special local conditions, operational conditions, etc., with full understanding of the context of this manual.

## 2. Definition of Terms

In this manual, the following words have the meanings assigned to them as hereinafter defined.

"Maintenance" means any activities to keep or restore the operational functions as well as to check and evaluate the present functions of facilities and equipment. The basic components of maintenance are;

- Inspection,
- Routine maintenance, and
- Repair

"Inspection" means any measures to check and evaluate the operating conditions including spontaneous and scheduled checks.

"Routine maintenance" means any preventive measures to maintain a facility or an equipment to its required operating condition in accordance with a plan specifying the time and sort of maintenance. This maintenance intends to prevent the occurrence of deficiency or malfunctioning of facilities and equipment, and is therefore classified into preventive maintenance.

"Repair" means any works to correct local deficiency of a facility or an equipment which still functions over the minimum service level required. This is required when inspection or routine maintenance discovers such deficiency, and therefore classified into corrective maintenance. Repair intends also to prevent or retard further occurrence of such deficiency.

"Rehabilitation" means any works to restore the capacity or performance of a facility or an equipment which has deteriorated beyond certain service level. As the rehabilitation differs from the maintenance in its nature, and usually in budgeting system, it is precluded from this manual.

## 3. Limitation of the Manual

Maintenance activities in this manual refer to not only inspection but also routine maintenance and repair which call for specific requirements on work methods and materials to be used.
Since airport design, construction and maintenance are all interrelated activities, a maintenance manual should refer design standards and technical specifications in evaluating the functional soundness of facilities and in conducting routine maintenance and repair.

However, such standards and specifications are not established in Indonesia, and provision of those documents is far beyond the objectives and scope of this manual.

Therefore, specifications on work method and materials to be used are only outlined and their details are not mentioned in this manual.

It will be required that this manual be given reference to design standards and technical specifications, when provision of those documents is completed, in order that it will constitute one part of systematic provision of guidance on airport design, construction and maintenance.

# PART I CIVIL FACILITIES

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## Chapter 1 General

### 1.1 Facilities Covered by this Manual

This manual covers the following civil facilities:

1) Airport pavements intended for use of aircraft, consisting of runways, taxiways and aprons
2) Unpaved areas in airside consisting of runway strip, runway end safety area, taxiway strip and apron surrounding area
3) Drainage facilities in airside

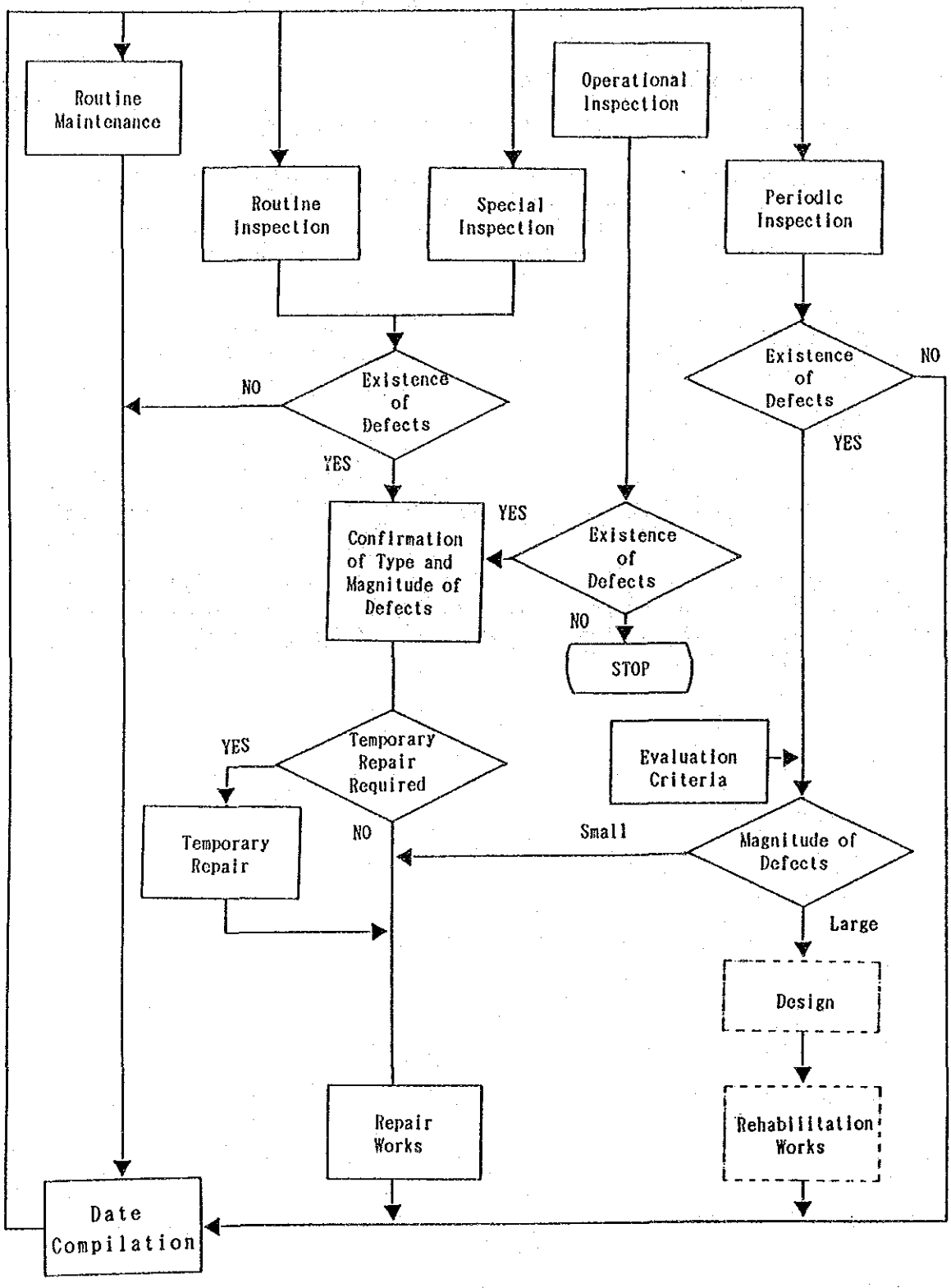
Civil facilities in land side, roads in air side, and miscellaneous civil facilities such as fences, gates, etc., are not subject to this manual.

### 1.2 Maintenance Work Flow

Figure 1.1 indicates the sequential flow of the maintenance activity for airport civil facilities, which basically comprises inspection, routine maintenance and repairs.

Data compilation, situated at the bottom of the flowchart as the result of every kind of maintenance activity, is an important administrative measure for airport maintenance as it will be the basis of the next maintenance activity.

FIGURE 1.1 Maintenance Work Flow for Airport Civil Facilities



# Chapter 2 Inspection

## 2.1 Type of Inspection

### 2.1.1 Operational Inspection

The purpose of operational inspection is to check the existence of unusual changes or foreign objects on pavement surfaces and unpaved areas which may hinder safe aircraft operations.

This inspection differs from the other inspections described later in that this is conducted for securing safe aircraft takeoff and landing operations, while the others aim at maintaining facilities.

The operational inspection shall be executed daily by visual observation.

### 2.1.2 Routine Inspection

The purpose of this inspection is to check the existence of failures or malfunctioning of facilities.

The routine inspection shall be conducted at scheduled time intervals mainly by visual observation.

### 2.1.3 Special Inspection

Special inspection shall be conducted after receipt of complaints or when an unusual condition or unusual event occurs on the airport, such as disaster or accident.

This inspection can be conducted by visual observation, or by means of measuring equipment as necessary.

### 2.1.4 Periodic Inspection

The purpose of periodic inspection is to examine the condition of primary airport facilities such as runway, taxiway, apron, etc., for evaluating its functional soundness.

The periodic inspection shall be executed at longer time intervals than routine inspection using measuring equipment.

Inspection items and frequency of operational, routine, special and periodic inspections are summarized in Table 2.1.

Table 2.1 Summary of Inspections for Civil Facilities

| Facilities | Inspection Items | | Operational Inspection (Daily) | Routine Inspection 0.5M | Routine Inspection M | Routine Inspection 2M | Routine Inspection 6M | Special Inspection ( As Necessary) | Periodic Inspection ( Every 3 Years ) |
|---|---|---|---|---|---|---|---|---|---|
| Runway | Existence of Foreign Objects | | ○ | | | | | | |
| | Distresses on Surface | | | ○ | | | | | |
| | Markings | | | | ○ | | | | |
| | Rubber Deposits | | | | ○ | | | | |
| | Fuel and Oil Spillage | | | ○ | | | ○ | | |
| | | | | ↑ (Flex) | | | ↑ (Rigid) | | |
| | Profile and Trans Slope | | | | | | | | ○ |
| Taxiway | Existence of Foreign Objects | | ○ | | | | | | |
| | Distresses on Surface | | | | ○ | | | | |
| | Markings | | | | | ○ | | | |
| | Fuel and Oil Spillage | | | ○ | | | ○ | | |
| | | | | ↑ (Flex) | | | ↑ (Rigid) | | |
| | Profile and Trans Slope | | | | | | | | ○ |
| Apron | Existence of Foreign Objects | | ○ | | | | | | |
| | Distresses on Surface | | | | ○ | | | | |
| | Markings | | | | | ○ | | | |
| | Fuel and Oil Spillage | | | ○ | | | ○ | | |
| | | | | ↑ (Flex) | | | ↑ (Rigid) | | |
| | | | | | | | | | |
| Unpaved Areas | Existence of Foreign Objects | | ○ | | | | | | |
| | Grass Growth | | | ○ | | | | | |
| | Surface Condition | | | | ○ | | | | |
| | Surface Drainage | | | | ○ | | | | |
| | Transverse Slope | | | | | | | | ○ |
| Drainage Facilities | Sodded Drains | Structural Drainage | | | | ○ | | | |
| | | Sedimentation of Sand | | | | ○ | | | |
| | Other | Structural Drainage | | | | | ○ | | |
| | | Sedimentation of Sand | | | | | ○ | | |

Note : "○" indicates facilities to be covered by inspections.
Special inspection should be executed when complaint arises or unusual event occurs.

## 2.2 Operational Inspection

### 2.2.1 Areas and Items for Inspection

Runway, taxiway, apron and the surroundings thereof shall be inspected daily for the existence of foreign objects such as debris, stones, metal or plastic parts, sand and soil, paper, dead birds, etc., and unusual changes on pavement which may be potential hazard to aircraft operations.

### 2.2.2 Inspection Procedures

Operational inspection shall be conducted before the airport operation hour.

Time of inspection shall be informed to Aerodrome Control Tower in advance.

Two-way radio shall be equipped during inspection for continuous communication with the Tower.

Inspection shall be conducted for the above-mentioned facilities and items and through the routes reported to the Tower in advance.

### 2.2.3 Actions to be Taken after Inspection

Immediately after the inspection, inspector shall report the inspection results to the Tower and other relevant personnel for further actions.

An example of operational inspection checklist of civil facilities is shown in Appendix-1 of this manual.

## 2.3 Routine Inspection

### 2.3.1 Items and Frequencies of Inspection

(1) Pavement Area

Airport pavements including runway, taxiway and apron shall regularly be inspected for the following items. The standard frequency of inspection is described below for each of inspection items.

a) Distresses on Flexible Pavements

Item to be inspected : Cracking, rutting, pothole, corrugation, ravelling, depression, bleeding, weathering, etc.

Frequency of inspection : Twice monthly for runway.
: Monthly for taxiway and apron.

b) Distresses on Rigid Pavements

Item to be inspected : Cracking, joint faulting, scaling, joint seal damage, blowup, etc.

Frequency of inspection : Twice monthly for runway.
: Monthly for taxiway and apron.

c) Markings

Item to be inspected : Fading and discoloration.

Frequency of inspection : Monthly for runway.
: Bimonthly for taxiway and apron.

d) Rubber Deposits

Item to be inspected : Build-up condition of rubber deposits on runway surface.

Frequency of inspection : Monthly.

e) Fuel and Oil Spillage

Item to be inspected : Contaminating condition of fuels, lubricants and oils on apron surface.

Frequency of inspection : Twice monthly for bituminous pavement.
Twice annually for rigid pavement.

(2) Unpaved Area

Unpaved areas in airport including runway strip, taxiway strip, apron surrounding area and runway end safety area shall regularly be inspected for the following items. The standard frequency of inspection is described below for different inspection items.

a) Surface condition

Item to be inspected : Existence of rutting, undulation, depression, erosion, etc.

Frequency of inspection : Monthly.

b) Surface Drainage

Item to be inspected : Condition of surface drainage, existence of water stands etc.

Frequency of inspection : Monthly.

c) Grass

Item to be inspected : Growing condition.
Frequency of inspection : Twice monthly.

(3) Drainage Facilities

Drainage facilities in airports shall regularly be inspected for the following items. The standard frequency of inspection is described below.

a) Structural Damage

Item to be inspected : Existence of damages on drainage facilities.

Frequency of inspection : Bimonthly for sodded drains.
: Twice annually for other open drains, culverts and manholes.

b) Sedimentation of Sand

Item to be inspected : Existence of sedimentation with sand, soil, debris and other loose objects.

Frequency of inspection : Bimonthly for sodded drains.
: Twice annually for other open drains, culverts and manholes.

Examples of routine inspection checklists of civil facilities are shown in Appendix-1 of this manual.

2.3.2 Inspection Procedures

(1) Preparatory works

Prior to the inspection, previous inspection checklist and other relevant records shall be reviewed.

Inspection checklist and the drawings indicating the details of facilities shall be prepared for recording.

Route and procedure for inspection shall be determined in advance.

It is desirable to prepare a simple measuring equipment, camera, etc., for measurement and recording as necessary.

For the inspection of airside facilities, two-way radio shall be equipped for communicating with the Tower.

(2) Inspection

Inspection shall be done by 2 or 3 staff in principle.

The surface condition of pavement shall be checked for each of 5-10 m wide lanes, from the inspection vehicle with approximate speed of 10 km/h.
Touch down zone on the runway, taxi-holding position on the taxiway and aircraft stands on apron shall thoroughly be inspected.

Pavement distresses such as cracks, rutting, potholes, etc., shall be checked not only for their existence but also the condition of progression.

Drainage facilities shall be inspected by routes.

(3) Actions to be Taken after Inspection

Immediately after the inspection, inspectors shall report the inspection results to relevant personnel for further actions such as temporary repairs, permanent repairs, publication of NOTAM, etc.

Inspection results shall be recorded in the prepared inspection checklist and drawings.

## 2.4 Special Inspection

### 2.4.1 Timing of Inspection

Special inspection shall immediately be conducted upon;

1) the receipt of complaints or claims from airport users such as pilots and passengers,

2) the occurrence of unusual events such as earthquake, flood, etc., and

3) the occurrence of an accident or incident by aircraft or vehicles

### 2.4.2 Item of Inspection

The items of special inspection shall, in principle, conform to those of routine inspection.

### 2.4.3 Procedure of Inspection

The procedures of special inspection are basically the same as those of routine inspection. As temporary repairs may urgently be required in case of disaster, measuring equipment shall be equipped for the inspection.

## 2.5 Periodic Inspection

### 2.5.1 Inspection Items

Periodic inspection for runway, runway strip, taxiway and apron shall be carried out for the following items:

1) Pavement surface condition
2) Profile and transverse slope

### 2.5.2 Inspection of Pavement Surface Condition

(1) Inspection Items

The pavement surfaces of runway, taxiway and apron shall be inspected for the following items:

- For flexible pavement
  . Cracks
  . Rutting

- For rigid pavement
  . Cracks
  . Joint spalling and corner spalling
  . Settlement or faulting

(2) Procedures of Inspection

The inspection procedure and the method of evaluation for inspection results are described in Appendix-2 of this manual.

(3) Frequency of Inspection

The inspection of pavement surface condition shall be executed once every 3 years in principle.

### 2.5.3 Inspection of Profile and Transverse Slope

(1) Inspection Method

The profiles and transverse slopes of runway, taxiway and runway strip shall be inspected in the following manners:

| Inspection Item | Facility | Inspection Method |
|---|---|---|
| Profile | Runway | - Centerline survey<br>- Profile leveling at 100 m intervals |
| | Taxiway | - Centerline survey<br>- Profile leveling at 100 m intervals |
| Transverse Slope | Runway | - Cross-section survey at 100 m intervals along runway centerline and at 5 m intervals transversely |
| | Runway Strip | - Cross-section survey at 200 m intervals along runway centerline and 20 m intervals transversely |
| | Taxiway | - Cross-section survey at 100 m intervals along taxiway centerline and at 5 m intervals transversely |

Level, staff, transit, steel tape and all other equipment necessary for inspection shall be used for securing appropriate accuracy of inspection.

(2) Frequency of Inspection

Inspection of profile and transverse slope shall be conducted once every 3 years.

At the airport where settlement of pavement caused by weak foundation, reclamation, high embankment etc., is anticipated, the inspection shall be conducted more frequently until no more settlement is observed.

As-built drawing of pavement overlay works can substitute the inspection.

(3) Inspection Results

The inspection results shall be recorded in drawings.

# Chapter 3 Routine Maintenance

## 3.1 General

The objectives of routine maintenance are to keep facilities constantly in good working condition, and to prevent the occurrence of malfunctioning of facilities or aircraft accident by giving proper and regularly scheduled treatment in advance.

In this manual, following types of routine maintenance are covered.

- Pavement sweeping
- Repainting of marking
- Fuel and oil removal
- Mowing
- Clearing of drainage facilities

## 3.2 Pavement Sweeping

### 3.2.1 Objective

Aircraft engines can easily ingest loose material, and suffer severe compressor blade or propeller damage. There is also the risk that propeller or jet engine blast may cause loose objects to be shot against adjacent aircraft, vehicles or people.

The purpose of pavement sweeping is to clean the surface of sand, debris, stones or other loose objects from the surfaces of runway, taxiway and aprons for safety reasons.

### 3.2.2 Area for Sweeping

All the pavement surfaces of runway, taxiway, apron, paved shoulders and paved overruns shall be swept regularly.

### 3.2.3 Frequency of Sweeping

Runway, taxiway, apron, paved shoulder and paved overrun shall be swept bimonthly.

Apron area shall be swept monthly.

### 3.2.4 Method of Sweeping

Pavement sweeping shall be executed by use of pavement sweepers at airports served by jet aircraft. For the portion where sweeper is not accessible, pavement can be cleaned by means of brooms.

At the airports served by propeller aircraft or light aircraft, regular sweeping can be executed using brooms.

When sweeper is used, it shall be operated at a speed low enough to completely remove the loose objects.

Sweeping shall be executed before or after the airport operation hours in principle. When sweeping operation is conducted within the airport operation hours, due attention shall be paid not to disturb the normal airport operations.

Sweeping shall not be executed in rainy days.

3.2.5 Treatment of Swept Objects

Debris, stone, sand and soil, or other loose materials which are swept with sweepers shall be dumped at designated area. When swept by manual sweeping, these shall be collected at some locations and hauled to the designated area immediately.

3.3 Repainting of Markings

3.3.1 Objective

Airport markings provide important information to pilots during takeoff, landing and taxiing. The regular repainting of airport markings aims to keep the markings clearly visible.

3.3.2 Frequency of Repainting

Markings on runway, taxiway and apron shall regularly be repainted in accordance with the following frequencies:

| Facility | Kind of Markings | Frequency |
|---|---|---|
| Runway | Centerline Marking | Twice annually |
| | all other markings | Annually |
| Taxiway | all taxiway markings | Annually |
| Apron | all apron markings | Annually |

3.3.3 Materials to be used

Paint material to be used for marking shall be traffic paint.

3.3.4 Method of Repainting

The painting shall be performed only to the surface which is dry and when the weather is not foggy or windy.

The surface area to be painted shall be clean, dry, and free from loose particles.

The painting shall be executed using mechanical marker in principle. The mechanical marker shall be an atomizing spray-type suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage, and shall be designed so as to apply markings of uniform cross sections and clear-out edges without running or spattering.

Application of paint material shall basically be before or after the airport operation hours.

After application of the paint, all markings shall be protected from damage until the paint is dry. All surfaces shall be protected from disfiguration by spatter, splashes or drippings of paint.

## 3.4 Fuel and Oil Removal

### 3.4.1 Purpose

Repeated oil soaking of cement and/or bituminous concrete may deteriorate the surface material, and require surface repair or entire replacement. The most proper way to prevent the pavement from deterioration due to oil spillage is to remove the spilt fuels or oils immediately. This is of basic importance for flexible pavement as no effective methods to remove the fuel contaminants on the bituminous surfaces are available.

The purpose of regular removal of fuel and oil contaminants on rigid pavement surface is to retard the progress of pavement deterioration.

### 3.4.2 Frequency of Removal

Contaminated fuels and oils on rigid pavement shall be removed at least annually.

### 3.4.3 Method of Removal

Fuels or oils spilled accidentally on pavement shall immediately be covered with dry sand or oil-absorbing material which is a powder or granulate as developed by oil industry. These shall be removed later by sweeping.

Contaminants on rigid pavement surfaces shall be removed by spraying grease solvents followed by sweeping and water flushing. If necessary water jet cleaning may follow to achieve optimum results.

Whenever the grease solvents are used, due attention shall be paid to environmental protection.

The use of grease solvent for flexible pavement is not recommendable due to adverse affect to the pavement. A regular resurfacing with seal coat is a practical method for the fuel contamination on bituminous surfaces.

## 3.5 Mowing

### 3.5.1 Objective

The objective of mowing is to reduce the potential bird hazards to aircraft operations and to maintain the functions of navigational facilities.

### 3.5.2 Area to be Mown

Areas to be mown regularly consists of the following:

- Graded area in runway strip
- Runway end safety area
- Taxiway strip
- Apron surroundings
- Radio navigational facility sites

### 3.5.3 Frequency of Mowing

1 The time intervals of mowing depend on the climate and soil conditions of the area to be mown as well as the type of grass. Grass in the area to be maintained shall be cut with such intervals that the grass height does not exceed 20 cm.

### 3.5.4 Method of Mowing

Grass shall be mown down to a height of about 5 cm by means of mowers in principle. Mowing shall be made by blocks to facilitate the collection of cut grass.

For the areas within 1m of pavement edge, upper edge of open drainage facilities and of fence line, or the area where the mower is not accessible, the use of handy mower or manual mowing is practical.

Stones, paper, metal or plastic parts, and other loose objects shall be removed when observed during mowing operation.

Attention shall be paid so as not to disturb the normal airport operations and not to damage airfield lighting facilities, radio navigational aids, meteorological observation facilities, etc.

### 3.5.5 Treatment of Cut Grass

The cut grass shall be collected and picked up by machines or manually as immediately as practicable after mowing, since otherwise it might be sucked into jet engines, thus creating potential hazard to aircraft operation. The cut grass left without being picked up may also create detrimental choking effects to the remaining grass under a probably heavy hay coverage. Consequential composite effects may produce great number of microscopic organism, insects, worms, etc., and attract birds to the area.

The collected grass shall be dumped at designated area.

## 3.6 Cleaning of Drainage Facilities

### 3.6.1 Objective

The purpose of regular cleaning of the drainage facilities is to secure the original capacities and functions by removing the sedimentation of sand and soil, debris and other loose objects.

### 3.6.2 Frequency of Cleaning

Drainage facilities in airports shall regularly be cleaned at the following frequencies:

| | |
|---|---|
| Sodded channel | : Quarterly |
| Other open drains, culverts, manholes | : Twice annually |

### 3.6.3 Method of Cleaning

Drainage facilities shall be cleaned route by route and from upstream to downstream.

Sand and soil, debris and other loose materials in the drainage facilities shall be cleaned using scoops, brooms or other tools suitable for removal.

Drains with concrete or steel grate covers shall be cleaned by removing the covers.

The cleaning of culvert or slot drains can be accomplished by means of flushing water with high pressure.

### 3.6.4 Treatment of Soil and Others

Soil, sand, debris and other loose materials which are cleaned out of drainage facilities shall not be left around the drains. They shall be picked up and dumped at designated area using dump truck, etc.

# Chapter 4 Repair

## 4.1 General

The purposes of repair are not only to correct the damage but also to prevent or retard its further occurrence.

While deterioration of facility due to traffic and adverse weather conditions cannot completely be prevented, repair can reduce this deterioration to a minimum level.

This chapter focuses on the repairs of airfield pavement which are the major part of repair works in airports.

Repairs shall be made at early stage of distress, even when they may be considered minor. A delay in repairing may allow minor distresses to progress into major failures which require complete rehabilitation.

## 4.2 Type of Pavement Distresses

### 4.2.1 Distresses on Flexible Pavements

(1) Cracking

1) Longitudinal and Transverse Cracks

Longitudinal and transverse cracks are caused by shrinkage of the bituminous concrete surface. Longitudinal cracks are also caused by poorly constructed line joints.

2) Alligator Cracks

Alligator cracks are interconnected cracks which form a series of small blocks resembling an alligator skin. They may be caused by fatigue failure of the bituminous surface under repeated loading or by excessive deflection of the surface over an unstable foundation. The unstable support is usually the result of water saturation of the bases or subgrade.

3) Block Cracks

Block cracks are interconnected cracks which divide the pavement into approximately rectangular pieces. Block cracking generally occurs over large portion of the pavement area and may sometimes occur only in nontraffic areas. Block cracking is caused by shrinkage of the asphalt concrete and daily temperature cycling.

4) Slippage Cracks

Slippage cracks are caused by braking or turning wheels causing the pavement surface to slide and deform. This usually occurs when there is a low-strength surface mix or poor bond between the surface and the next layer of pavement structure.

5) Reflection Cracking

Reflection cracking is caused by vertical or horizontal movement in the pavement beneath an overlay, brought on by expansion and contraction with temperature and moisture changes. These cracks in asphalt overlays reflect the crack pattern in the underlying pavements.

(2) Disintegration

1) Ravelling

Ravelling is the wearing away of the pavement surface caused by the dislodging of aggregate particles and loss of asphalt binder.

(3) Distortion

1) Rutting

A rut is characterized as a surface depression in the wheel path. This type of distress is caused by a permanent deformation in any of pavement layers or subgrade and is caused by consolidation of the materials due to traffic load.

2) Corrugation and Shoving

Corrugation results from a form of plastic surface movement typified by ripples across the surface. Shoving is a form of plastic movement resulting in localized bulging of the pavement surface. Corrugation and shoving can be caused by lack of stability in the mix and poor bond between material layers.

3) Depression

Depressions are localized low areas of limited size. Depression can be caused by traffic heavier than that for which the pavement was designed, by localized settlement of the underlying pavement layers, or poor construction methods.

4) Swelling

Swelling is characterized by an upward bulge in the pavement surface. It may occur sharply over a small area or as a longer gradual wave. Both types of swell may be accompanied by surface cracking. A swell is usually caused by frost action in the subgrade or by swelling soil.

(4) Skid Resistance

1) Bleeding

Bleeding is characterized by a film of bituminous material on the pavement surface which resembles a shiny, glass-like, reflecting surface which usually becomes quite sticky. It is caused by excessive amounts of asphalt or tars in the mix and/or low air-void content.

2) Polished Aggregate

Aggregate polishing is caused by repeated traffic applications. It occurs when the aggregate extending above the asphalt is either very small, of poor quality, or contains no rough or angular particles.

3) Fuel Spillage

Continuous fuel spillage on a bituminous surface will soften the asphalt.

4) Contaminants

An accumulation of rubber over a period of time will reduce the skid resistance of a pavement.

4.2.2 Distresses on Rigid Pavements

(1) Cracking

1) Longitudinal, Transverse and Diagonal Cracks

These types of distress are characterized by cracks which divide the slab into two or more pieces and are usually caused by a combination of repeated loads and shrinkage stresses.

2) Corner cracks

This type of break is characterized by a crack which intersects the joints at a distance less than or equal to one-half of the slab length on both sides, measured from the corner of the slab. Corner cracks are usually caused by load repetitions combined with loss of support and curling stresses. The lack of support may be caused by pumping or loss of load transfer at the joint.

3) Joint Seal Damage

Joint seal damage is any condition which enables soil or rocks to accumulate in the joints or allows infiltration of water. Typical types of joint seal damage include stripping of joint sealant, extrusion of joint sealant, hardening of filler, loss of bond to the slab edges and absence of sealant in the joint. Joint seal damage is caused by improper joint width, use of the wrong type of sealant, incorrect application, and/or not cleaning properly the joint before sealing.

(2) Disintegration

1) Scaling, Map Cracking and Crazing

Map cracking or crazing refers to a network of shallow hairline cracks which extend only through the upper surface of the concrete. Crazing usually results from improper curing and/or finishing of the concrete and may lead to the scaling of the surface. Scaling is the integration and loss of the wearing surface. Scaling also be caused by a weakened surface caused by improper curing or finishing, and unsuitable aggregate.

2) Joint Spalling

Joint spalling is the breakdown of the slab edges within 60 cm of the side of the joint. A joint spall usually does not extend vertically through the slab but intersects the joint at an angle. Joint spalling often results from excessive stresses at the joint or crack caused by infiltration of incompressible materials.

3) Corner Spalling

Corner spalling is the raveling or breakdown of the slab within 60 cm of the corner. Corner spall usually angles downward to intersect the joint.

4) Blowups

Blowups normally occur at a transverse crack or joint in thin pavement sections. It usually occurs at a transverse crack or joint that is not wide enough to permit expansion of the concrete slabs. Insufficient width is usually caused by infiltration of incompressible materials into the joint space.

5) Shattered Slab

A shattered slab is defined as a slab where intersecting cracks break the slab into four or more pieces. This is caused by overloading and/or inadequate foundation support.

(3) Distortion

1) Pumping

Pumping is characterized by the ejection of material by water through joints or cracks, caused by deflection of the slab under passing load. Surface staining and base or subbase material on the pavement close to the joint or crack are evidence of pumping. As the water is ejected, it carries particles of gravel, sand, clay or silt resulting in a progressive loss of pavement support which can lead to cracking.

2) Settlement or Faulting

Settlement or faulting is a difference in elevation at a joint or crack caused by upheaval or differential consolidation.

(4) Skid Resistance

1) Polishing Aggregate

Some aggregate will become polished quickly under traffic. Others are naturally polished and will be a skid hazard if used in the pavement without crushing.

2) Contaminants

An accumulation of rubber over a period of time will reduce the skid resistance of a pavement.

4.3 Materials to be Used

(1) Bituminous Concrete

Bituminous concrete is a mixture of asphalt and well-graded, high-quality aggregates. The materials are mixed in a plant and placed and compacted while hot. Bituminous concrete is used for patching and overlay of airport pavements.

(2) Tack Coat

A tack coat is applied to an existing pavement to provide a bond with an overlying course such as a bituminous overlay. A tack coat is also used on the sides of an existing pavement which has been cut vertically prior to patching. Asphalt emulsion is commonly used for tack coat.

(3) Prime Coat

A prime coat is applied to a nonbituminous base course for the following purposes:

1) To waterproof the surface of the base
2) To plug capillary voids, and
3) To promote adhesion between the base and the surface course.

(4) Fog Seal

A fog seal is a light application of emulsified asphalt for the purpose of rejuvenating the surface of the bituminous pavement. Asphalt emulsions are used as fog seal.

(5) Aggregate Seal

Aggregate seals consist of sprayed asphalts which are immediately covered with aggregate and rolled, and are used to seal the surface of weathered pavements.

(6) Slurry Seal

A slurry seal is a mixture of a slow setting asphalt emulsion, fine aggregate, mineral filler and water. The mixture is prepared in the form of a slurry and applied in a film approximately 3 mm thick. Slurry seals are used to seal small cracks, to correct surface conditions, and to improve the skid resistance of pavement surfaces.

(7) Portland Cement Concrete

Portland cement concrete is a blend of portland cement, fine and coarse aggregate, and water, with or without additives. Concrete is used to repair a distressed cement concrete pavement so that it may be used at its original designed capacity.

(8) Joint Sealant

Material for sealing joints in portland cement concrete pavement is usually a hot or cold applied compound such as;

1) Jet fuel-resistant concrete joint sealer, hot-poured elastic type
2) Hot-poured, elastomeric type joint sealants
3) Hot-poured, elastomeric, jet fuel-resistant type joint sealants
4) Elastomeric, polymer type, jet-fuel resistant sealing compounds, cold applied

(9) Epoxy Grouts

There are many types of epoxy resins; the type to be used depends on the application being considered. Under normal conditions, mixed resins may be workable up to one hour after mixing. Repairs with epoxy materials are costly and their use shall be limited to small areas and application by experienced personnel.

## 4.4 Repair Method for Flexible Pavements

### 4.4.1 Cracking

(1) Longitudinal, Transverse, Reflection and Block Cracks

Narrow cracks (less than 3 mm ) shall be repaired by applying seal coat, slurry seal or fog coat to the area where the narrow cracks are present.

Wide cracks (greater than 3 mm) shall be repaired using following procedures:

- Clean out cracks with compressed air to remove all loose objects.
- Fill cracks with a prepared joint sealer.

(2) Alligator Cracks

Alligator cracks shall be repaired by permanent patching using the

following procedures:

- Cut the pavement area to be repaired vertically with power saw in rectangular shape.
- Remove the surface and base, or if necessary, the subbase to reach firm foundation.
- Replace base material with the same materials as that removed.
- Apply prime coat to base material and vertical faces of the existing pavement.
- Place bituminous concrete and compact.

Temporary repairs can be made by applying a seal coat.

(3) Slippage Cracks

Slippage cracks shall be repaired by patching as follows:

- Remove the slipping area and at least 30 cm into the surrounding area.
- Clean the surface of the exposed underlying layers with brooms and compressed air.
- Apply a light tack coat.
- Place a hot-mixed asphalt and compact.

4.4.2 Disintegration

(1) Ravelling

Ravelling shall be repaired by following procedures:

- Sweep the surface free of all dirt and loose aggregate material.
- Apply a fog seal diluted with equal parts of water.
- Apply a surface treatment such as an aggregate seal coat when the fog seal has cured.

A paving machine, such as heater-planer, may be used to soften the face of pavement and then applying a seal coat or bituminous concrete overlay.

4.4.3 Distortion

(1) Rutting

Repair for rutting shall be executed as follows:

- Determine the severity of the rutting with a straightedge or straightline. Outline the area to be filled.
- Apply a light tack coat of asphalt emulsion diluted with equal parts of water.
- Spread dense-graded asphalt concrete with a paver and compact.
- Place a thin overlay of asphalt concrete over the entire area.

(2) Corrugation and Shoving

Repair procedure for this distress shall be the same as for patching of alligator cracks.

(3) Depressions

Repair procedures are as follows:

- Determine the limits of depression with a straightedge or straight-line. Outline the area to be repaired.
- Clean the entire area to at least 25 cm beyond the limits.
- Apply a light tack coat of asphalt emulsion diluted with equal parts of water.
- Allow the tack coat to cure.
- Spread enough asphalt concrete in the depression to bring it to the original grade when compacted. For deep depression, spreading shall be done in layers.
- Compact thoroughly the patch with a vibratory compactor, roller or hand tamps.

(4) Swelling

The repair method is the same as for patching of alligator cracks.

4.4.4 Skid Resistance

(1) Bleeding

Repair procedures using hot sand or aggregate are as follows:

- Apply slag screenings, sand, or rock screenings to the affected area.
- Roll with a rubber tire-roller immediately after spreading.
- When the aggregate has cooled, broom off loose particles.

A paving machine, such as heater-planer, may be used for removing the excess asphalt in following manners:

- Remove the asphalt film with heater-planer.
- Leave the surface as planed; or
- Apply a seal coat.

(2) Polished Aggregate

This condition can be repaired by covering the surface with an aggregate seal coat.

(3) Fuel Spillage

The area subjected to continuous fuel spillage shall be removed and replaced with portland cement concrete or overlay with a tar emulsion seal coat for permanent repairs.

(4) Contaminants

Rubber deposits may be removed by use of high-pressure water or biodegradable chemicals.

## 4.5 Repair Methods for Rigid Pavements

### 4.5.1 Cracking

(1) Longitudinal, Transverse and Diagonal Cracks

Crack sealing shall be made by following procedures:

- A groove about 10 mm wide and 20 mm deep shall be made along the crack.
- Clean out with compressed air.
- Fill the crack with sealant materials.

(2) Corner Cracks

For low severity cracks, the same methods as for crack sealing shall be applied. For high severity cracks accompanied by loss of subgrade support shall be repaired by following procedures:

- Cut vertically with a concrete saw and break out the broken corner.
- Add subbase material, if necessary, and compact.
- Clean the vertical face of remainder of the slab with a high pressure water jet or compressed air.
- Coat the face of the adjacent slabs with bond-breaking medium to prevent bonding with the new concrete.
- Maintain the existing joint by using temporary inserts.
- Coat the clean surface with sand-cement grout or epoxy grout.
- Place the portland cement concrete in the patched area while the grout is still sticky.
- After the concrete has cured, remove the joint inserts.
- Seal joints.

Repair for high severity cracks can also be made by bituminous patching as an interim measure. The bituminous patching shall be done using the following procedures:

- Make a vertical cut with a concrete saw completely through the slab.
- Break out the concrete with pneumatic tools and remove broken concrete.
- Add subbase material if required and compact.
- Apply prime coat to subbase material.
- Apply tack coat to the sides of the slab.
- Place bituminous concrete in layers.
- Compact each layer with a vibratory compactor, roller or mechanical rammers.

(3) Joint Seal Damage

Joint seal damage shall be resealed as follows:

- Use joint router to remove the joint sealing material to a depth of at least 25 mm.
- Reface the side of the joint to expose sound concrete which is free of old sealer.
- Use power wire brush to remove debris.
- Blow out the joints with compressed air.
- Seal joints with hot or cold compounds.

4.5.2 Disintegration

(1) Scaling, Map Cracking and Crazing

- Cut vertically the scaled area with a concrete saw about 25 mm to 50 mm deep at the perimeter of the scaled area.
- Break out the broken concrete with pneumatic tools until sound concrete is exposed.
- Clean the area with compressed air or high-pressure water jet.
- Dampen surface with water.
- Coat the surface of the old concrete with thin coat of sand-cement grout.
- Place the portland cement concrete while the grout is still tacky.

(2) Joint Spalling and Corner Spalling

The repairs of spall shall be made as follows:

- Make a vertical cut with a concrete saw 25 mm in depth and about 50 mm back of the spalled area.
- Break out the unsound concrete with air hammers or pneumatic drills and blow out the area with compressed air.
- Pressure rinse the area to be repaired.
- Treat the surface with a grout mixture to ensure good bond between the existing pavement and new concrete. Apply the grout immediately before placing the patch mixture and spread with a stiff broom or brush to a depth of 2 mm.
- Place a thin wood or metal coated with bond-breaking material in the joint groove and tamp the new mixture into the old surface.
- After edging the patch has been completed, it shall be finished to a texture matching the adjacent area.
- After curing, the open joint shall be filled with joint material prior to opening to traffic.

Bituminous patching for high severity corner cracks is also applicable for repairing the spalls as an interim measure.

(3) Crack spalling

The procedure is the same as for joint spalling except for the joint repair.

(4) Blowups

- Make a vertical cut with a concrete saw approximately 15 cm outside of each end of the broken area.
- Break out the concrete with pneumatic tools and remove concrete down to the subbase/subgrade material.
- Add subbase material, if necessary, and compact.
- Dampen the subgrade and edges of the old concrete.
- Place concrete on the area to be patched.
- Finish the concrete so that the surface texture approximates that of the existing pavement.
- Immediately after the completion of finishing operations, the surface shall be properly cured.

Bituminous patching can also be applied as an interim measure.

(5) Shattered Slab

Follow the same procedure for blowup repairs except that subgrade materials shall be removed to a minimum depth of 30 cm and replaced with the selected material.

4.5.3 Distortion

(1) Pumping and Settlement

Slabjacking procedures may be used to correct this type of distress. In slabjacking, a grout is pumped under pressure through holes cored in the pavement into the void under the pavement.

4.5.4 Skid Resistance

(1) Polished Aggregate

This condition can be repaired by grooving or milling of the pavement surface, or by concrete or asphalt resurfacing.

(2) Contaminants

Rubber deposits may be removed by use of high-pressure water or biodegradable chemicals.

## Appendix-1 Examples of Inspection Checklists for Civil Facilities

Appendix-1.1 Operational Inspection Checklist

Appendix-1.2 Routine Inspection Checklist (1) - Twice Monthly Sheet -

Appendix-1.3 Routine Inspection Checklist (2) - Monthly Sheet -

Appendix-1.4 Routine Inspection Checklist (3) - Bimonthly Sheet -

Appendix-1.5 Routine Inspection Checklist (4) - Twice Annual Sheet -

## Appendix-1.1 Operational Inspection Checklist

Airport : V : Satisfactory

Date : Inspector:

| Facilities | Check | Remarks |
|---|---|---|
| Runway | | |
| Taxiway | | |
| Apron | | |
| Other Area | | |

Additional Comments:

## Appendix-1.2 Routine Inspection Checklist (1) - Twice Monthly Sheet -

Airport : Inspector:

Date :

| Facilities | Inspection Items | Degree of Defects A | B | C | Location | Size of Defects | Actions Taken |
|---|---|---|---|---|---|---|---|
| Runway (Flexible Pavement) | Cracking | | | | | | |
| | Rutting | | | | | | |
| | Pothole | | | | | | |
| | Corrugation | | | | | | |
| | Raveling | | | | | | |
| | Depression | | | | | | |
| | Bleeding | | | | | | |
| | Weathering | | | | | | |
| | Other | | | | | | |
| Runway (Rigid Pavement) | Cracking | | | | | | |
| | Joint Faulting | | | | | | |
| | Scaling | | | | | | |
| | Joint Seal Damage | | | | | | |
| | Blowup | | | | | | |
| | Other | | | | | | |
| Bituminous Pavement | Fuel & Oil Spillage | | | | | | |
| Unpaved Area | Grass Growth Condition | | | | | | |

A:Repair or temporary repair is urgently required as problem occurs if operations are continued.
B:Repair or temporary repair is desirable, but no problem for operations.
C:Requires attention, but no problem for operations.

Additional Comments:

Location Map of Defects:

## Appendix-1.3 Routine Inspection Checklist (2) - Monthly Sheet -

Airport : Inspector:

Date :

| Facilities | Inspection Items | Degree of Defects A | B | C | Location | Size of Defects | Actions Taken |
|---|---|---|---|---|---|---|---|
| Runway Marking | Fading Discoloration | | | | | | |
| Taxiway and Apron (Flexible Pavement) | Cracking | | | | | | |
| | Rutting | | | | | | |
| | Pothole | | | | | | |
| | Corrugation | | | | | | |
| | Raveling | | | | | | |
| | Depression | | | | | | |
| | Bleeding | | | | | | |
| | Weathering | | | | | | |
| | Other | | | | | | |
| Taxiway and Apron (Rigid Pavement) | Cracking | | | | | | |
| | Joint Faulting | | | | | | |
| | Scaling | | | | | | |
| | Joint Seal Damage | | | | | | |
| | Blowup | | | | | | |
| | Other | | | | | | |
| Unpaved Area (Surface Conditions) | Rutting | | | | | | |
| | Undulation | | | | | | |
| | Depression | | | | | | |
| | Erosion | | | | | | |
| | Other | | | | | | |
| Unpaved Area (Surface Drainage) | Condition of Drainage | | | | | | |
| | Standing Water | | | | | | |
| | Other | | | | | | |

A:Repair or temporary repair is urgently required as problem occurs if operations are continued.
B:Repair or temporary repair is desirable, but no problem for operations.
C:Requires attention, but no problem for operations.

Additional Comments:

Location Map of Defects:

## Appendix-1.4 Routine Inspection Checklist (3) - Bimonthly Sheet -

Airport : Inspector:

Date :

| Facilities | Inspection Items | Degree of Defects | | | Location | Size of Defects | Actions Taken |
|---|---|---|---|---|---|---|---|
| | | A | B | C | | | |
| Taxiway Marking | Fading Discoloration | | | | | | |
| Apron Marking | Fading Discoloration | | | | | | |
| Drainage (Sodded Drains) | Structural Drainage | | | | | | |
| | Sedimentation of Sand | | | | | | |
| | Other | | | | | | |

A:Repair or temporary repair is urgently required as problem occurs if operations are continued.
B:Repair or temporary repair is desirable, but no problem for operations.
C:Requires attention, but no problem for operations.

Additional Comments:

Location Map of Defects:

## Appendix-1.5 Routine Inspection Checklist (4) - Twice Annual Sheet -

Airport : ..... Inspector: .....

Date :

| Facilities | Inspection Items | Degree of Defects | | | Location | Size of Defects | Actions Taken |
|---|---|---|---|---|---|---|---|
| | | A | B | C | | | |
| Rigid Pavement | Fuel & Oil Spillage | | | | | | |
| Drainage (Other than Sodded Drains) | Structural Drainage | | | | | | |
| | Sedimentation of Sand | | | | | | |
| | Other | | | | | | |

A:Repair or temporary repair is urgently required as problem occurs if operations are continued.
B:Repair or temporary repair is desirable, but no problem for operations.
C:Requires attention, but no problem for operations.

Additional Comments: .....

Location Map of Defects:

## Appendix-2 Survey and Evaluation Method for Pavement Surface Conditions

### 1. General

Surface conditions of airport pavement facilities shall regularly be inspected for securing safe aircraft operation and riding comfort for passengers, and for evaluating the conditions for its soundness.

The items for periodic inspection of pavement surface conditions shall comprise the followings:

(1) Flexible pavement

- Cracks
- Rutting

(2) Rigid pavement

- Cracks
- Joint spalling and corner spalling
- Settlement or faulting

### 2. Size of Unit Area for Inspection

The pavement surface conditions shall be inspected and evaluated by data units. The data units for runways and taxiways shall continuously be taken along their centerlines. Size of a data unit shall be as follows:

TABLE 2.1 Size of Unit Area for Runways

| Runway Width | Flexible Pavement (Width) (Length) | Rigid Pavement (Width) (Length) |
|---|---|---|
| 60 m | 21 m x 30 m | 21 m x 20 m |
| 30 m - 45 m | 14 m x 45 m | 14 m x 30 m |
| 23 m | 7 m x 90 m | 7 m x 60 m |

TABLE 2.2 Size of Unit Area for Taxiways and Aprons

| Taxiway Width | Flexible Pavement (Width) (Length) | Rigid Pavement (Width) (Length) |
|---|---|---|
| 30 m | 21 m x 30 m | 21 m x 20 m |
| 18 m - 23 m | 14 m x 45 m | 14 m x 30 m |
| 9 m | 7 m x 90 m | 7 m x 60 m |

## 3. Methods of Inspections

### 3.1 Inspection for Flexible Pavements

#### 3.1.1 Inspection of Cracks

Longitudinal cracks, transverse cracks, alligator cracks, reflection cracks and other cracks in a data unit shall be measured with steel tapes for the lengths and areas, and be recorded in an inspection sheet.

A crack ratio for a certain data unit shall be calculated based on the following formula:

$$CR = (0.3CL + AC) \times 100 / UA$$

where,
- CR: Crack ratio (%)
- CL: Total length of linear cracks including longitudinal, transverse and reflection cracks (m)
- AC: Area of alligator cracks (sq.m)
- UA: Area of data unit (sq.m)

As an example, a crack ratio for the data unit shown in FIGURE 3.1 can be calculated as:

$$CR = [\ 0.3 \times (12+14+5+3+6.5+8+4+14.5) + 6 \times 2\ ] \times 100 / (21 \times 30)$$
$$= 5.1\ \%$$

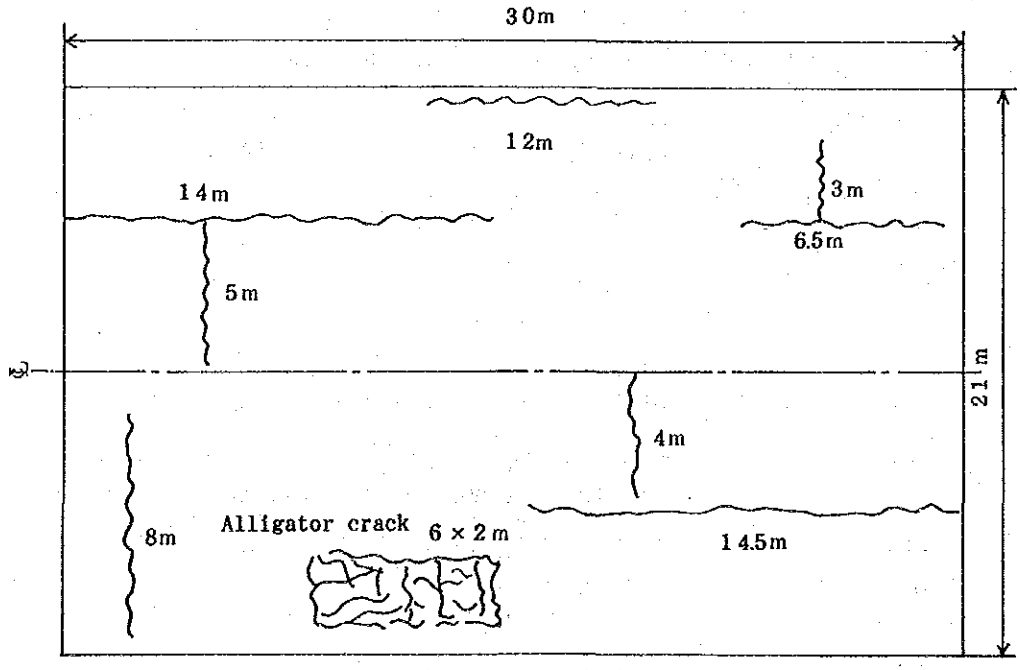



FIGURE 3.1 Example of Crack Inspection for Flexible Pavement

### 3.1.2 Inspection of Rutting

Rutting shall be inspected at the section where the maximum rut depth is observed in a data unit. A maximum rut depth in millimetres in the section shall be measured by use of 5 m straightedge or straightline.

## 3.2 Inspection for Rigid Pavements

### 3.2.1 Inspection of Cracks

Longitudinal, transverse, diagonal and corner cracks in a data unit shall be measured with steel tapes for the lengths and areas.

These shall be recorded in a prepared inspection sheet.

A crack ratio for a certain data unit shall be calculated based on the following formula:

$$CI = CL/UA$$

Where, CI: Crack index (cm/sq.m)
CL: Total length of longitudinal, transverse, diagonal and corner cracks (cm)
UA: Area of data unit (sq.m)

As an example, a crack index for the data unit shown in FIGURE 3.2 can be calculated as:

$$CI = (300+1200+750+350+350+350)/ (21 \times 30)$$
$$= 7.9 \text{ (cm/sq.m)}$$

FIGURE 3.2 Example of Crack Inspection for Rigid Pavement

### 3.2.2 Inspection of Joint Spalling and Corner Spalling

Joint spalls and corner spalls on cement concrete slab shall be measured with steel tapes for the lengths.

A spall ratio in a certain data unit shall be calculated based on the following formula:

$$SR = (JS + CS) \times 100 / JL$$

Where, SR: Spall ratio (%)
JS: Total length of joint spalls (m)
CS: Total length of corner spalls (m)
JL: Total joint length in the data unit (m)

Length of the joints included in a data unit shall be double counted, while that of the joints on the border of the data unit be single counted. The joints in patched area are not included in the calculation of total joint length.

A spall ratio for the example shown in FIGURE 3.3 can be calculated as follows:

$$SR = (0.3+ 0.7+1.9+6.0+2.4+0.9) \times 100 / (21+42+42+32+10+40+40+38+36+38)$$
$$= 12.2/329$$
$$= 3.7\ (\%)$$

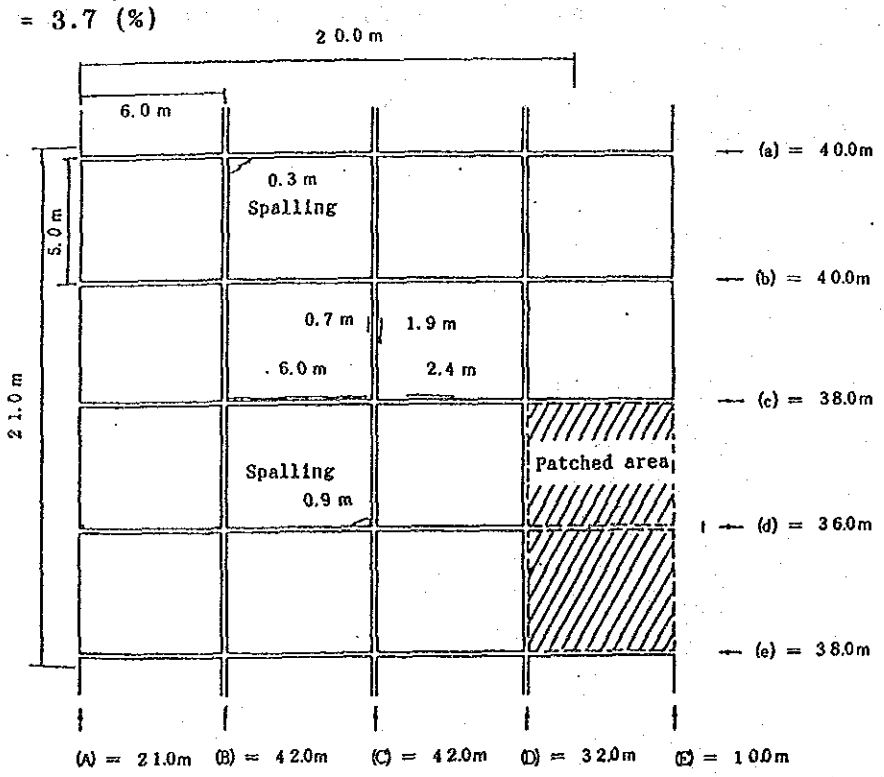



FIGURE 3.3 Example of Spall inspection for Rigid Pavement

### 3.2.3 Inspection of Settlement or Faulting

The maximum level difference at a joint or crack in a data unit shall be measured with steel tapes.

## 4. Evaluation Methods

### 4.1 Evaluation for Flexible Pavements

The surface conditions of flexible pavement shall be evaluated based on the crack ratio and maximum rut depth in a data unit.

Evaluation shall be made in accordance with the evaluation criteria in TABLE 4.1.

TABLE 4.1 Evaluation Criteria for Flexible Pavements

| Item | Facility | Evaluation Rank A | B | C |
|---|---|---|---|---|
| Crack Ratio (CR) | Runway | CR≧7 | 7>CR≧0.1 | 0.1>CR |
| | Taxiway | CR≧13 | 13>CR≧1 | 1>CR |
| | Apron | CR≧17 | 17>CR≧2 | 2>CR |
| Maximum Rut Depth (RD) | Runway | RD≧40 | 40>RD≧10 | 10>RD |
| | Taxiway | RD≧60 | 60>RD≧20 | 20>RD |
| | Apron | RD≧70 | 70>RD≧25 | 25>RD |

In the above table, the following meanings are assigned to A,B and C respectively:

A: Rehabilitation required immediately
B: Rehabilitation desirable in near future
C: Rehabilitation not required

When either a crack ratio or maximum rut depth ranks "A" above, the data unit shall be regarded as "A".

### 4.2 Evaluation for Rigid Pavements

The surface condition of rigid pavement shall be evaluated in accordance with the evaluation criteria indicated in TABLE 4.2.

A, B and C in the table have the same meanings as for flexible pavement.

TABLE 4.2 Evaluation Criteria for Rigid Pavements

| Item | Facility | Evaluation Rank A | B | C |
|---|---|---|---|---|
| Crack Index (CI) | Runway | CI≧6 | 6>CI≧0.2 | 0.2>CI |
| | Taxiway | CI≧8 | 8>CI≧0.6 | 0.6>CI |
| | Apron | CI≧11 | 11>CI≧1 | 1>CI |
| Spall Ratio (SR) | Runway | SR≧1 | 1>SR≧0.1 | 0.1>SR |
| | Taxiway | SR≧3 | 3>SR≧0.1 | 0.1>SR |
| | Apron | SR≧6 | 6>SR≧0.1 | 0.1>SR |
| Faulting (F) | Runway | F≧10 | 10>F≧5 | 5>F |
| | Taxiway | F≧12 | 12>F≧5 | 5>F |
| | Apron | F≧14 | 14>F≧5 | 5>F |

## Appendix-3 Testing Equipment for Inspection of Civil Facilities

| | | |
|---|---|---|
| 1. | Straightedge ..... | Measurement for rutting and undulation |
| 2. | Level, theodolite and other survey equipment ..... | Measurement for slopes, undulation, location of deterioration |
| 3. | Camera ..... | Recording of defects |

# PART II BUILDING FACILITIES AND ANCILLARY EQUIPMENT

# PART II BUILDING FACILITIES AND ANCILLARY EQUIPMENT

## II-1 Building Facilities

### Chapter 1 General

#### 1.1 Facilities Covered by this Manual

This manual shall apply to passenger terminal buildings, aerodrome control towers, and administration and operation buildings in the airports.

Maintenance for other buildings in the airport can be executed by referring to and properly understanding the implications of this manual.

#### 1.2 Activities Covered by this Manual

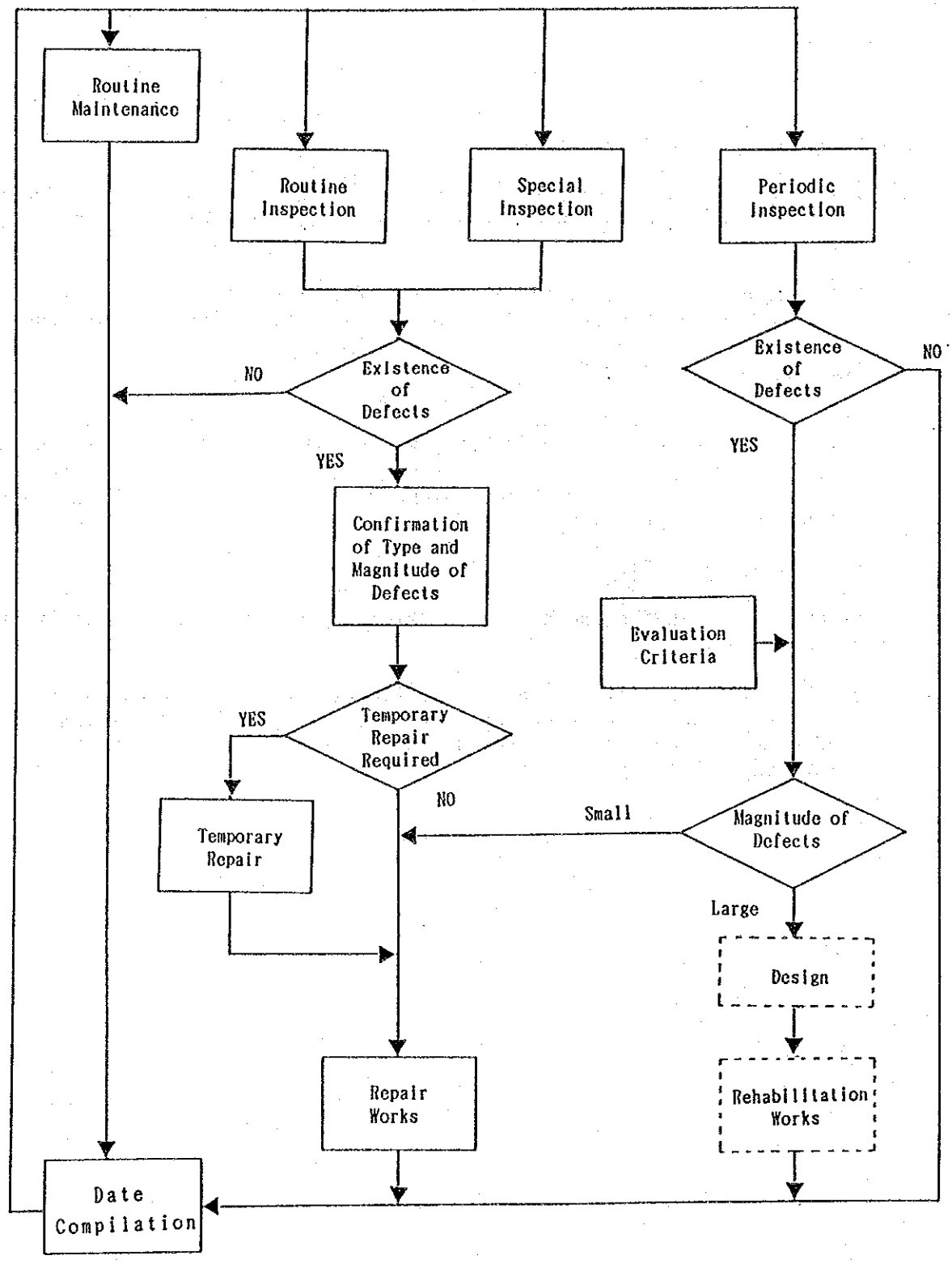
This maintenance manual for buildings comprises inspection, routine maintenance and evaluation method. The repairs for building components is precluded from this manual because of the wide variety of repair methods corresponding to various kinds of defects, material used and the components to be repaired.

#### 1.3 Maintenance Work Flow

Figure 1.1 indicates the sequential flow of the maintenance activity for building facilities.

Data compilation, situated at the bottom of the flowchart as the result of every kind of maintenance activity, is an important administrative measure for airport maintenance as it will be the basis of the next maintenance activity.

FIGURE 2.1 Maintenance Flow for Building Facilities



# Chapter 2 Inspection

## 2.1 Type of Inspections

### 2.1.1 Routine Inspection

The routine inspection of building facilities aims to check the existence of failures and defects on finishing materials which may require local treatment.

The routine inspection shall be conducted at scheduled time intervals mainly by visual observations.

### 2.1.2 Special Inspection

Special inspection shall be executed when disaster attacks buildings, such as fire, earthquake, heavy rain or flood.

### 2.1.3 Periodic Inspection

The purpose of periodic inspection for building facilities is to examine the overall conditions of building components in order to evaluate the soundness of building from a long-term viewpoint.

The periodic inspection shall be executed at scheduled time intervals but less frequently than the routine inspection.

Facilities to be inspected and frequency of inspections are summarized in TABLE 2.1.

## 2.2 Routine Inspection

### 2.2.1 General

Finishings of passenger terminal buildings, control tower, administration and operation buildings in airports shall be inspected at regularly scheduled time intervals for the existence of defects and failures.

Routine inspection shall be conducted by visual observation in principle.

Examples of routine inspection checklists for building facilities are shown in Appendix - 1 of this manual.

TABLE 2.1 Summary of Inspections for Building Facilities

| Facility | | Routine Inspection | | | Special Inspection as Required | Periodic Inspection | |
|---|---|---|---|---|---|---|---|
| | | Daily | 0.5m | Monthly | | Annually | Every 3 Years |
| Foundation | | | | | | | ○ |
| Super Structures | - RC Structures | | | | | | ○ |
| | - Steel Structures | | | | | | ○ |
| | - Wooden Structures | | | | | ○ | |
| Building Finishing | - Floors | ○ | | | | ○ | |
| | - Interior Walls | ○ | | | | | ○ |
| | - Exterior Walls | ○ | | | | ○ | |
| Doors | | ○ | | | | ○ | |
| Windows | | ○ | | | | ○ | |
| Ceilings | - Interior Ceilings | ○ | | | | | ○ |
| | - Exterior Ceilings | ○ | | | | ○ | |
| Roofs | - Flat Roofs | | ○ Wet Season | ○ Dry Season | | | ○ |
| | - Clad Roofs | | ○ Wet Season | ○ Dry Season | | | ○ |
| | - Roof Drains | | ○ Wet Season | ○ Dry Season | | ○ | |
| Handrails | | ○ | | | | ○ | |

Note: "○" indicates facilities to be covered by inspections.
Special inspection shpuld be executed when complaint aries or unusual event occurs.

### 2.2.2 Items and Frequencies of Inspection

(1) Floor

Items to be inspected : Cracking, rusting, corrosion, abrasion, floating and deterioration

Frequency : Daily

(2) Interior Walls

Items to be inspected : Cracking, swelling, floating and deterioration

Frequency : Daily

(3) Exterior Walls

Items to be inspected : Cracking, swelling, spall, floating and deterioration

Frequency : Daily

(4) Doors and Windows

Items to be inspected : Condition of installation, difficulty of operation, water leakage and deterioration

Frequency : Daily

(5) Ceiling

Items to be inspected : Cracking, deformation, rusting, corrosion, leakage, deterioration, and damage of curtain or blind box

Frequency : Daily

(6) Flat Roof

Items to be inspected : Leakage, cracking, floating,deterioration, damage of parapet, damage of coping, damage of expansion filler, damage of joint covers and metal fittings

Frequency : Monthly in dry season and twice monthly in rainy season

(7) Clad Roof

Items to be inspected : Leakage, deterioration, deformation, corrosion, rusting, damage of sealant

Frequency : Monthly in dry season and twice monthly in rainy season

(8) Roof Drains

Items to be inspected : Damages, sedimentation of debris and condition of drainage and gutters.

Frequency : Monthly in dry season and twice monthly in rainy season

(9) Handrails

Items to be inspected : Damages such as rusting, deterioration, etc.

Frequency : Daily

## 2.3 Special Inspection

### 2.3.1 General

The purpose of special inspection is to check the existence of damage caused by disasters such as fire, earthquake or heavy rain, etc., and to identify necessary repairs or rehabilitation works.

### 2.3.2 Items and Method of Special Inspection

Items for special inspection vary depending on the type of disaster.

Special inspection can be conducted by visual observation or, if necessary, by use of measuring equipment.

In case of structural damages by fire or earthquake, the inspection shall be made by structural specialist.

## 2.4 Periodic Inspection

### 2.4.1 General

The purpose of periodic inspection is to inspect comprehensively and thoroughly the existence and magnitude of defects on building structure and finishing for evaluating building condition, then judging the necessity of repairs or renovation works.

### 2.4.2 Items and Frequencies of Inspection

Items and frequencies of periodic inspection shall be in accordance with the following standards:

(1) Building Structures

1) Foundations

Items to be inspected : - Level line difference from adjacent buildings
- Inclination of building
- Cracks, deformation or damages on foundations and exterior walls

Frequency : Once in 3 years

2) Superstructures

a) RC Structures

Items to be inspected : - Cracks on structural members
- Discoloration or swelling of concrete surface due to rusting of reinforcing bars
- Deflection of beams and floor slabs
- Spalling of concrete in structural members

Frequency : Once in 3 years

b) Steel Structures

Items to be inspected : - Deformation of frames, loss of bolts or looseness of joints
- Holes or thinning by rusting
- Scaling of anti-rust paint
- Deformation of beams or floor slabs

Frequency : Once in 3 years

c) Wooden Structures

Items to be inspected : - Deformation of frames or looseness of joints
- Corrosion in main frames by termite infestation or other factors

Frequency : Annually

(2) Building Finishing

1) Floors

Items to be inspected : - Cracks
- Rusting
- Corrosion
- Abrasion

- Floating
- Deterioration

Frequency : Annually

2) Walls

a) Interior Walls

Items to be inspected :
- Cracks
- Swelling
- Floating
- Deterioration

Frequency : Once in 3 years

b) Exterior Walls

Items to be inspected :
- Cracks
- Swelling
- Spalling
- Floating
- Deterioration

Frequency : Annually

3) Doors and Windows

Items to be inspected :
- Condition of installation
- Difficulty of open-shut operation due to deformation
- Leakage from frames
- Deterioration

Frequency : Annually

4) Ceilings

Items to be inspected :
- Cracks
- Deformation
- Rusting
- Corrosion
- Leakage
- Deterioration
- Damages on curtain or blind box

Frequency :
- Annually for exterior ceilings
- Once in 3 years for interior ceilings

5) Roofs

a) Flat Roofs

Items to be inspected :
- Leakage

- Cracks on water-proof materials
- Floating of water-proof materials
- Deterioration of water-proof materials
- Damages on parapets
- Damages on coping
- Damages on expansion filler
- Damages on joint covers and metal fittings

Frequency : Once in 3 years

b) Clad Roofs

Items to be inspected :
- Leakage
- Deterioration of finishing materials
- Deformation, corrosion or rusting in roof sheetings
- Damages on sealant

Frequency : Once in 3 years

c) Roof Drains and Gutters

Items to be inspected : Structural damages

Frequency : Annually

6) Handrails

Items to be inspected : Damages such as rusting, deformation, etc.

Frequency : Annually

2.4.3 Inspection Procedures

(1) Preparatory Work

Previous inspection record and drawings shall be reviewed prior to inspection.

Items and route for inspection shall be determined.

Inspection checklist and detailed drawings of building shall be prepared.

Equipment necessary for inspection shall be prepared.

These are
* Level, transit, plumb
* Crack gauge
* Steel tape
* Test hammer
* Camera and others

(2) Inspection

Inspection of foundation and superstructure of building shall be conducted for each structural system.

Inspection of floors and ceilings shall be made by rooms, if the building is divided into rooms.

Interior walls and exterior walls shall be inspected for each wall.

Clad roof and flat roof shall be inspected as a whole.

Doors, windows, roof drains, gutters and hand rails shall be inspected part by part.

(3) Actions to be Taken after Inspection

All the inspection results shall be recorded in prepared checklist, and the details such as location, area, dimensions, etc., shall be given in drawings. If necessary, photographs shall be attached for recording.

The results of the periodic inspection shall be evaluated by applying criteria in Appendix - 2 of this manual in order to judge the necessity of rehabilitations or repairs.

## Chapter 3 Routine Maintenance

### 3.1 Cleaning of Buildings

A proper cleaning method and frequency varies depending on the area to be cleaned and materials used. These shall be selected from TABLE 3.1.

### 3.2 Repainting of Buildings

#### 3.2.1 General

Repainting of building shall be conducted at regularly scheduled time intervals to prevent the existing paint from weathering, discoloration, fading or peeling.

#### 3.2.2 Frequency of Repainting

| Finishing Material | Exterior | Interior |
|---|---|---|
| Steel | Annually | Once in 2 years |
| Wood and others | Once in 2 years | Once in 3 years |

#### 3.3.3 Materials to be Used

Paint material shall, in principle, be same as the existing one.

#### 3.3.4 Method of Repainting

Existing paint shall be removed with abrasives, and the surface to be painted shall be cleaned and smoothened before applying the paint.

Repainting can be executed by means of spray-type painting machines or with brushes.

After application, all paints shall be protected from damage until the paint is dry.

Anti-corrosive paint shall be applied for the steel surfaces prior to the application of finishing paint.

TABLE 3.1 Frequency and Method of Cleaning

| Part | Material | Method of cleaning | Public area | Office | Toilet & Kitchen | Storage | Exterior |
|---|---|---|---|---|---|---|---|
| Floors | Tile, Terrazzo, Stone & Vinyl | Sweeping | A | A | A | B | |
| | | Scrubbing | A | B | A | | |
| | | Polishing | B | B | B | | |
| | Carpet | Cleaning by Vacuum cleaner | | A | | | |
| | | Washing | | C | | | |
| Interior Walls | Cement plaster | Dusting | A | B | A | C | |
| | Wood, tile stone | Scrubbing | A | B | A | C | |
| Exterior Walls | Cement Plaster | Dusting | | | | | C |
| | Tile, stone | Scrubbing | | | | | C |
| Doors & Windows | Glass | Scrubbing | A | B | A | C | |
| | Wood, metal | Scrubbing | A | B | A | C | |
| | Seal | Dusting | A | C | B | C | |
| Ceilings | Board | Dusting | C | C | C | C | |
| | Wood, metal | Scrubbing | C | C | C | C | |
| Roofs | Cement mortar | Sweeping | | | | | B |
| Roof Drains & Gutter | | | | | | | * |

Note : 1) A: Daily B: Monthly C: Annually
2) *: Monthly for dry season and twice monthly for rainy season

## Appendix-1 Examples of Routine Inspection Checklist for Building Facilities

Appendix-1.1 Routine Inspection Checklist - Daily Sheet -

Appendix-1.2 Routine Inspection Chechlist - Monthly Sheet -

## Appendix-1.1 Routine Inspection Checklist - Daily Sheet -

Airport : V : Satisfactory

Date : Inspector:

| Facilities | Check | Remarks |
|---|---|---|
| Floor | | |
| Interior Walls | | |
| Exterior Walls | | |
| Doors and Windows | | |
| Ceiling | | |
| Handrails | | |

Additional Comments:

Appendix-1.2 Routine Inspection Checklist - Monthly Sheet -
(to be executed twice monthly in rainy season)

Airport : V : Satisfactory

Date : Inspector:

| Facilities | Check | Remarks |
|---|---|---|
| Flat Roof | | |
| Clad Roof | | |
| Roof Drains | | |

Additional Comments:

## Appendix - 2 Evaluation Method for Building Structures and Finishings

1. General

TABLES 1.1 and 1.2 are prepared to evaluate objectively the deteriorated conditions of building structures and finishings, and then to judge the necessity of rehabilitations or repairs.

Based on the results of periodic inspection, building structures and finishings shall be evaluated by applying the evaluation criteria shown in the tables.

2. Building Structures

In TABLE 1.1, the following meanings are assigned to each of A, B and C:

A : Rehabilitation or reconstruction urgently required
B : Rehabilitation desirable in near future
C : Rehabilitation not required

In the actual evaluation process, the foundation or superstructure shall, when any one of the evaluation items evaluated "A", be judged totally as "A", i.e., rehabilitation or reconstruction urgently required.

TABLE 1.1 Evaluation Criteria for Building Structure

Y: Deflection ratio= D/L D: Depth in mm
L: Span length in mm
K: Percentage of damaged area or members
W: Width in mm

| Evaluation Items | A | B | C |
|---|---|---|---|
| 1. Foundations | | | |
| 1) Level line difference from adjacent buildings | Easy to find out | By measurement only | Normal condition |
| 2) Inclination of building | Ditto | Ditto | Ditto |
| 3) Cracks, deformation or damages on foundations and exterior walls | Ditto | Ditto | Ditto |
| 2. Super Structures<br>2.1 R.C. Structures | | | |
| 1) Cracks on structural members<br>(Max. width of crack and percentage of number of cracked members) | $W \geqq 0.3$ and $K \geqq 30$ | $W \geqq 0.3$ and $K < 30$ | $W < 0.3$ |
| 2) Discoloration or swelling of concrete surface due to rusting of reinforcing bar | In part of main bars | In sub bars only | Almost normal condition |
| 3) Deflection of beams and floor slabs | $Y \geqq 1/200$ | $1/200 > Y \geqq 1/300$ | $1/300 > Y$ |
| 4) Spall ratio in sectional area of structural members | $K \geqq 5$ | $5 > K \geqq 2$ | $K < 2$ |
| 2.2 Steel Structures | | | |
| 1) Deformation of frames, loss of bolts or looseness of joints | In main frame | In sub frame only | Almost normal condition |
| 2) Holes or thinning by rusting | Ditto | Ditto | Ditto |

TABLE 1.1 (Cont'd)

| Evaluation Items | A | B | C |
|---|---|---|---|
| 3) Scaling of anti-rust paint | K≧50 | 50>K≧10 | K<10 |
| 4) Deformation of beams and floor slabs | Y≧1/150 | 1/150>Y≧1/300 | Y<1/300 |
| 2.3 Wooden Structure | | | |
| 1) Deformation of frames and looseness of joints | Easy to find out | By measure-ment only | Normal condition |
| 2) Corroded area in main frame by termite infes-tation or other factors | K≧3 | 30>K≧5 | K<5 |

3. Building Finishings

In TABLE 1.2, A, B and C have following meanings respectively:

A: Rehabilitation urgently required
B: Repairs required
C: Rehabilitation not required

Evaluation of building finishings shall be made in the same manner as for the periodic inspection. Namely, floors and ceilings shall be evaluated by rooms; interior and exterior walls be evaluated for each wall; clad and flat roof be evaluated as a whole; while door, windows and others be evaluated by parts.

In actual evaluation process, any one of evaluation items which falls into "A" shall be regarded as "A", and necessary action for the urgent rehabilitation shall be taken.

TABLE 1.2 Evaluation Criteria for Building Finishings

K: Percentage of damaged area or members
L: Percentage of damaged length

| Evaluation Items | A | B | C |
|---|---|---|---|
| 1. Floor | | | |
| 1) Cracked area to total area | K≧50 | 50>K>0 | 0 |
| 2) Rusted area to total area | K≧50 | 50>K>0 | 0 |
| 3) Corroded area to total area | K≧50 | 50>K>0 | 0 |
| 4) Abraded area to total area | K≧50 | 50>K>0 | 0 |
| 5) Floated area to total area | K≧50 | 50>K>0 | 0 |
| 6) Deteriorated area to total area | K≧50 | 50>K>0 | 0 |
| 2. Walls<br>2.1 Interior Walls | | | |
| 1) Cracked area to total area | K≧50 | 50>K>0 | 0 |
| 2) Swelled area to total area | K≧2 | 20>K>0 | 0 |
| 3) Floated area to total area | K≧50 | 50>K>0 | 0 |
| 4) Deteriorated area to total area | K≧50 | 50>K>0 | 0 |
| 2.2 Exterior Walls | | | |
| 1) Cracked area to total area | K≧50 | 50>K>0 | 0 |
| 2) Swelled area to total area | K≧20 | 20>K>0 | 0 |
| 3) Spalled area to total area | K≧10 | 10>K>0 | 0 |
| 4) Floated area to total area | K≧50 | 50>K>0 | 0 |
| 5) Deteriorated area to total area | K≧50 | 50>K>0 | 0 |
| 3. Doors & Windows | | | |
| 1) Condition of installation | Dangerous | Not so dangerous | No problem |

TABLE 1.2 (Cont'd)

| Evaluation Items | A | B | C |
|---|---|---|---|
| 2) Difficulty of open shut operation due to deformation | Difficult | Still possible | No problems |
| 3) Leakage from frames | Much leakage | Few leakage | No problems |
| 4) Deteriorated numbers to total numbers | K≧50 | 50>K>0 | 0 |
| 4. Ceiling | | | |
| 1) Cracked area to total area | K≧30 | 30>K>0 | 0 |
| 2) Deformed area to total area | K≧50 | 50>K>0 | 0 |
| 3) Rusted area to total area | K≧50 | 50>K>0 | 0 |
| 4) Corroded area to total area | K≧5 | 50>K>0 | 0 |
| 5) Damaged by leaks over total area | K≧30 | 30>K>0 | 0 |
| 6) Deterioration in finishing materials to total area | K≧50 | 50>K>0 | 0 |
| 7) Damages of curtain or blind box to total length | K≧50 | 50>K>0 | 0 |
| 5. Roof<br>5.1 Flat Roof | | | |
| 1) Leakage | Leakage | - | No leakage |
| 2) Cracked area of water-proof material to total area | K≧50 | 50>K>0 | 0 |
| 3) Floated area of water-proof material to total area | K≧50 | 50>K>0 | 0 |
| 4) Deterioration of water-proof material to total area | K≧50 | 50>K>0 | 0 |
| 5) Damages on parapets to total length | L≧20 | 20>L>0 | 0 |
| 6) Damages on coping and flashings to total length | L≧30 | 30>L>0 | 0 |

TABLE 1.2 (Cont'd)

| Evaluation Items | A | B | C |
|---|---|---|---|
| 7) Damages on expansion filler to total length | L≧30 | 30>L>0 | 0 |
| 8) Damages of joint covers and metal fittings to total length | L≧30 | 30>L>0 | 0 |
| 5.2 Clad Roof | | | |
| 1) Leakage | Leakage | - | No leakage |
| 2) Deterioration in finishing materials to total area | K≧50 | 50>K>0 | 0 |
| 3) Deformation, corrosion or rusting in roof sheeting to total area | K≧50 | 50>K>0 | 0 |
| 4) Damages on sealant to total length | L≧30 | 30>L>0 | 0 |
| 5.3 Roof Drains and Gutters | | | |
| 1) Damages | Serious damages to be replaced with new | Slightly damaged possible to repair | No problems |
| 6. Handrails | | | |
| 1) Damages such as rusting, deterioration, etc. | Ditto | Ditto | No problems |

## Appendix-3 Testing Equipment for Inspection of Building Facilities

| | | |
|---|---|---|
| 1. | Level ..... | Measuring level of building, deflection of beams and floor slabs |
| 2. | Transit and plumb ..... | Measuring the inclination of walls or columns |
| 3. | Inspection hammer ..... | Floating of floors, or walls |
| 4. | Crack gauge ..... | Measurement of cracks |
| 5. | Steel tape ..... | Measurement of defect area or length |
| 6. | Camera ..... | Recording of defects |

## II-2 Building Ancillary Equipment

### Chapter 1 General

1.1 Equipment Covered by this Manual

This maintenance manual shall apply to the equipment ancillary to buildings in airport, covering X-ray baggage screening units, walk-through metal detectors, baggage claim devices and air-conditioning units.

1.2 Activities Covered by this Manual

The maintenance activities for the equipment vary depending on the type of equipment to be maintained. However, the activities can roughly divided into inspection, routine maintenance and repairs.

The inspection including the succeeding adjustment and servicing shall regularly be conducted at scheduled time intervals, while routine maintenance such as periodic replacement of expendable supplies is necessary for preventing the occurrence of malfunction.

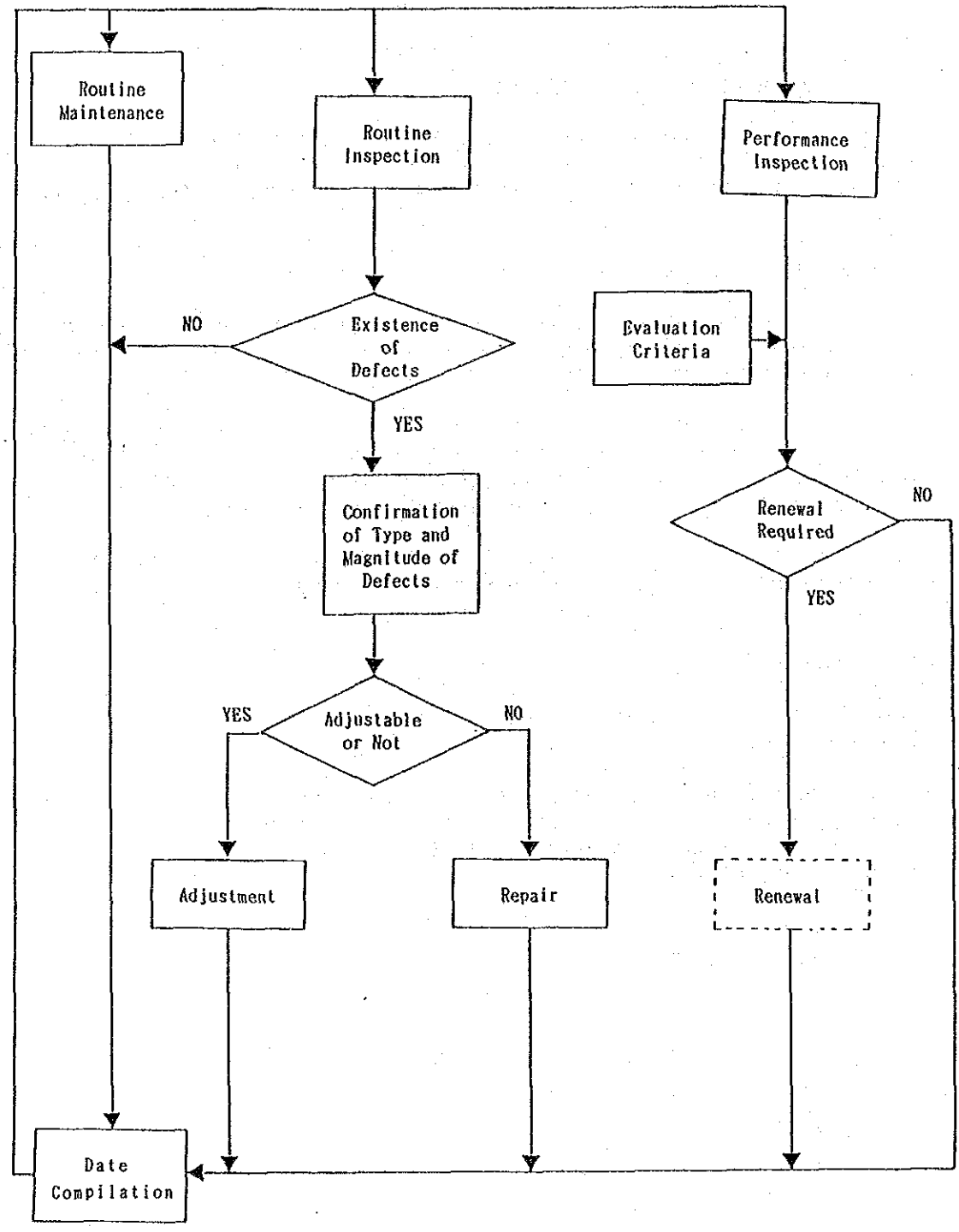
This manual covers the above-mentioned activities, while repairs of equipment are precluded from this manual because of the wide variety of types and causes of the breakdown.

1.3 Maintenance Work Flow

FIGURE 1.1 indicates the sequential flow of the maintenance activity for building ancillary equipment.

Data compilation, situated at the bottom of the flowchart as the results of every kinds of maintenance activity, is an important administrative measures for airport maintenance as it will be the basis of next maintenance activity.

FIGURE 1.1 Maintenance Flow for Building Ancillary Equipment



# Chapter 2 Inspection

## 2.1 Type of Inspection

### 2.1.1 Routine Inspection

The routine inspection of building ancillary equipment aims to check the existence of failure and defects and to judge the succeeding action, i.e., adjustment or repair.

This inspection shall be conducted regularly at scheduled intervals.

### 2.1.2 Performance Inspection

The purpose of performance inspection for building ancillary equipment is to check the necessity of renewal of an equipment in deteriorated condition.

This inspection shall be conducted at scheduled time intervals after a certain period from the installation of an equipment or when an equipment experiences a major breakdown.

## 2.2 Routine Inspection

### 2.2.1 X-Ray Baggage Screening Units

(1) Unit Proper

a) Outside Panels

<Daily Inspection>

- Inspect plates for damage, buckling or cracking. Repair as necessary.

<Bimonthly Inspection>

- Inspect for loose bolts on the outside body plates. Tighten loose bolts.

Note: The outside plates shall be securely fastened to prevent radiation outside the machine.

b) Conveyor Belt

<Daily Inspection>

- Inspect the degree of damage to the belt, the extent and depth.

Take the following steps when the conveyor belt is damaged:

i) If the edge of the belt is torn for several centimeters: Cut out and remove.

ii) Tear in the inner part of the belt. Repair with industrial tape.

iii) Large tears or holes: Repair by using special belt repair adhesive.

iv) Replace belt when repairs are not possible.

- Belt tracking: Adjust by moving idler rollers in small amounts.

- Power Drive Mechanism: When sounds are heard, check the cause of the belt malfunction.

- Unusual sounds generated from the rollers. Oil or grease bearings. If sound persists, replace parts.

(2) Other Miscellaneous Items

<Daily Inspection>

- Inspect the following items. If there are any malfunctions, check to see if the unit can be repaired and the best judgment shall be exercised.

i) Whether the display lamps light up. If the lamp is dead, replace the lamp. The photocell switch may be malfunctioning.

ii) When the test pattern displayed on the CRT monitor malfunctions request for specialists to make repairs.

iii) The display condition of the test chart. When any malfunctions are observed, request for repairs to be performed by specialists.

iv) The forward, reverse and stop mode of the conveyor belt. Confirm the condition of the switch, motor, and speed reducer.

v) Confirm whether the emergency stop apparatus functions. When a malfunction is found, request for specialists to make repairs.

2.2.2 Walk Through Metal Detectors

<Daily Inspection>

The equipment sensitivity will be inspected before it will be used to check passengers by using the test metal piece that will make the alarm

lamp to light up, and the metal piece that will not make the alarm light up.

- Using the Metal test piece that will make the metal detector sound an alarm; confirm that

  . the indicating lamp will light up

  . the alarm horns will actuate.

  When the alarm horn will not actuate, adjust the sensitivity.

- Using the metal test piece that that will not make the metal detector to not sound an alarm; confirm that

  . the indicating lamp will not light up

  . the alarm horn will not actuate

  If the alarm horn is actuated, adjust the sensitivity.

  When the adjustment cannot be made, request a specialist to make repairs.

2.2.3 Baggage Claim Device

(1) Belt Conveyor

a) External Panels, Frame

<Daily Inspection>

- Inspect for damage, buckling or cracking. When observed, repair damaged, buckled and cracked sections.

<Six-month Inspection>

- Check for corrosion, measure depth and extent. When corroded, remove rusted spots and repaint.

- Tighten loose bolts.

b) Belt

<Daily Inspection>

- Inspect belt for damage. Especially, check where panels are joined. Take the following measures when the belt if damaged:

  i) Any tear in the belt edge of several centimeters shall be cut out in circular shape and removed.

ii) Tears in the inner part of the belt shall repaired. If the belt cannot be repaired, replace with a new belt.

- Check belt for eccentric travel and snaking. When such travel or snaking is observed, adjust the belt by moving the take-up pulley to one side.

- Check surface of belt for soiled conditions. Soiled belt shall be cleaned with a waste rag. If excessively soiled, clean with detergent.

<Bimonthly Inspection>

- Check belt for slipping when loaded with baggage. Slipping belt hall be adjusted by moving take-up pulley on both sides.

c) Motor Drum, Roller, Pulley

<Daily Inspection>

- Check for noises when operating. When unusual sounds emit, check oil or grease bearings. If unusual noise persists, replace parts.

d) Control Box

<Bimonthly Inspection>

- Inspect NFB and electromagnetic switch for any deterioration. When the NFB and electromagnetic switches are damaged or deteriorated, replace with new parts.

- Check wiring in panelboard for breakage and damage, and loosing of wire end connection. Soiled wiring within the panelboard shall be cleaned or replaced. Tighten connections as required.

- Check emergency stop switch for proper operation. When operating improperly investigate any faulty wiring and replace as necessary.

<Six Month Inspection>

- Measure wire resistance values. Use a 500V Megger for testing. Wiring with more than 1 M Ohm is satisfactory.
Check faulty wiring and replace with new wiring as necessary.

- Measure amperage of wiring. Use a ampere meter. Refer manufacturer's manual for the proper amperage. Check any faults and replace with wiring as necessary.

(2) Gravity Roller Conveyor

<Daily Inspection>

- Inspect equipment for damage, dents, and improper operation. Adjust or replace with new parts as required.

<Bimonthly Inspection>

- Check for any unusual sounds while in operation. When unusual sounds emit, oil or grease moving parts. When unusual sounds persist, replace parts.

2.2.4 Package-Type Air Conditioning Units

(1) Unit Proper

<Trimonthly Inspection>

- Check that piping connections are not cracked, deformed or otherwise damaged. Minor dents in the compressor body should be monitored. Dents that cause refriger ant leaks will be repaired. Check in the connection of the refrigerant piping shall be repaired.

- Check the unit proper for rust. If rusty, examine its extent and depth. Small and medium rusts will be removed with sandpaper or file and repainted.

- Check that the compressor, fan, condensing unit, evaporator, and other electrical components in the unit proper are not damaged. If damaged, check the cause of faults and repair as required.

(2) Electrical System

<Annual Inspection>

- Check that wiring is not burnt or deteriorated. Check wiring for change in colour or loss of insulation. Replace deteriorated wiring.

- Check that terminal fitting screw, bolts or nuts are not loose. Tighten all loose connections.

- Measure insulation resistance and current parameters using a 500-volt insulation resistance tester and an ampere meter. Insulation resistance of over one mega-ohm is regarded as good. The cause of faults shall be checked and replaced as required.

(3) Coolant Refrigerant Piping

<Trimonthly Inspection>

- Check that the proper amount of refrigerant is charged. When air bubbles are noticed in the sight glass, the refrigerant will need to be replenished.

- Check that the coolant piping is not stained with oil. When stained with oil, repair refrigerant leaks.

(4) Lubrication System

<Trimonthly Inspection>

- Check oil level, and maintain proper oil level by adding lubricant as necessary.
- Check oil for contamination, and confirm that the color is within normal range. Change oil if it becomes black and dirty.

(5) Compressor, Supply Air System

<Trimonthly Inspection>

- Check to see that there are no unusual noise emanating from the equipment. Oil bearings if unusual noise is detected. If noise persists, replace bearing. Other faults shall be repaired by special repairmen.

(6) Coils

<Trimonthly Inspection>

- Inspect for damage, deformation or dents in the equipment. If coils can be used in spite of faults are as-is, and repair if refrigerant leaks are detected. Cracks in the pipe joints shall be repaired.

- Check the coil fins and filters by dust. Coils shall be clogging of cleaned with compressed air or water under pressure to remove dust and dirt. Repair where refrigerant leaks are detected.

(7) Safety Cutouts

<Annual Inspection>

- Inspect the high pressure, low pressure, oil pressure, cutout switches to see whether they are correctly set. If not correct, adjust at normal rating.

(8) Other Items

<Trimonthly Inspection>

- Check whether there are no unusual sounds or vibration when the equipment is operating. When such sounds or vibrations are detected, check cause of faults and repair as necessary.

2.2.5 Room-Type Air Conditioning Unit

(1) Unit Proper

<Trimonthly Inspection>

- Inspect for cracks in pipe joints and dents and damage to equipment casing. Repair joints in piping as required.

- Inspect for rust, their depths and extent. Surface corrosion not reaching base metal shall be removed and painted.

  . Small Rust : Remove with sandpaper and paint.

  . Medium Rust: Remove with file and paint.

- Check interior of the equipment for damage to compressor, fan, condenser evaporation, electrical apparatus, etc. Damaged parts shall be investigated for faults and repaired.

(2) Electrical System

<Annual Inspection>

- Check for burnt and deteriorated wiring. Replace burnt wiring and deteriorated insulation.

- Inspect wire terminal such as screws, bolts and nuts. Tighten loose connections.

- Test the insulation-resistance of wiring. Use a 500V resistance testing meter. A good general minimum value for wiring is 1 mega-ohm.

- Measure the amperage of wires. Use an ampere meter for this test. Refer to manufacturer's manual for proper amperage. Inspect cause of faults, and replace parts as required.

(3) Refrigerant System

<Trimonthly Inspection>

- Inspect to see if there is any oil on the refrigerant piping. When

leaks are detected, repair tubing by brazing or replace tubing. Confirm the connection in pipings and valves for leaks.

(4) Compressor, Supply Air System

<Trimonthly Inspection>

- Check if there are any unusual sounds compared to normal operation. Oil motor bearings when unusual sounds are detected. When sound persists, replace bearing.

(5) Coil

<Trimonthly Inspection>

- Inspect for corrosion, damage or dents in the fan. Clean coil fins. Repair faults when detected.

- Inspect coil fan and filter for dust or dirt in the equipment. Coils shall be cleaned with compressed air or water to remove dirt and dust, and shall be used as-is if faults do not affect function, and repair refrigerant leaks when detected by specialist.

(6) Other Items

<Trimonthly Inspection>

- Inspect for unusual sounds and vibration while equipment is in operation. Check any faults and repair as necessary.

Examples of checklists for routine inspection together with routine maintenance are shown in Appendix-1.

## 2.3 Performance Inspection

When equipment in a deteriorated condition can be further utilized only with costly repairs or whether the equipment shall be discarded and replaced, shall be determined by a performance inspection.

This inspection shall be conducted annually after 5 years from the installation of an equipment or when equipment has experienced a major breakdown.

A method to systematically evaluate the overall performance of the ancillary equipment is shown in Appendix - 2 of this manual.

## Chapter 3 Routine Maintenance

### 3.1 General

Routine maintenance for the ancillary equipment in buildings shall be executed at regularly scheduled time intervals to keep the equipment in good working condition and to prevent malfunctions.

The frequency and sort of routine maintenance are described hereinafter for each equipment

### 3.2 X-Ray Baggage Screening Units

#### 3.2.1 Unit Proper

(1) Outside Panels

<Daily Maintenance>

- Clean outside panels with a 3% solution of detergent (1 or 2 teaspoons to 200cc of water) using a gauze. After which clean with clear water and remove all traces of detergent. Wipe off water and dry off.

  Allow air to circulate and let dry. Remove all traces of oil using gauze immersed in benzine and lightly tamping oily spots.

(2) Conveyor Belt

<Daily Maintenance>

- Clean surface of conveyor belt. Normal cleaning can be performed with a rag, and when the soiled condition is excessive, apply the same as for outside panels.

#### 3.2.2 Monitor

<Daily Maintenance>

- Clean the surface of CRT. Normal cleaning can be performed with waste rags, but if the soiling is severe, clean with a 3% solution of detergent (1 to 2 tablespoons of detergent add to 200CC of water) using a gauze and wipe off.

### 3.3 Walk-Through Metal Detectors

<Daily Maintenance>

- Clean the surface of the control equipment and gate. Clean with a 3% solution detergent (1 to 2 tablespoon of detergent added to 200cc of water) using a gauze. Wipe off the soap solution with a cloth

air to circulate and let dry. Clean off oil with gauze immersed in benzine and tamp lightly oily spots.

3.4 Baggage Claim Devices

<Six-Month Maintenance>

- Add grease to bearings and other grease points of motor drum, roller and pulley of belt conveyor.

3.5 Package-Type Air Conditioning Units

3.5.1 Compressor, Air Supply System

<Annual Maintenance>

- Grease all grease points

3.5.2 Filter

<Trimonthly Maintenance>

- Clean filter

3.5.3 Drain System

<Trimonthly Maintenance>

- Clean drain pan.

3.6 Room-Type Air Conditioning Units

3.6.1 Filter

<Trimonthly Maintenance>

- Clean Filter

3.6.2 Drain System

<Trimonthly Maintenance>

- Clean drain pan

**Appendix-1 Examples of Routine Inspection and Maintenance Checklists for Building Ancillary Equipment**

| | | |
|---|---|---|
| Appendix-1.1 | X-Ray Baggage Screening Unit | - Daily Sheet - |
| Appendix-1.2 | X-Ray Baggage Screening Unit | - Bimonthly Sheet - |
| Appendix-1.3 | Walk Through Metal Detector | - Daily Sheet - |
| Appendix-1.4 | Baggage Claim Device | - Daily Sheet - |
| Appendix-1.5 | Baggage Claim Device | - Bimonthly Sheet - |
| Appendix-1.6 | Baggage Claim Device | - Six Month Sheet - |
| Appendix-1.7 | Package Type Air Conditioning Unit | - Trimonthly Sheet - |
| Appendix-1.8 | Package Type Air Conditioning Unit | - Annual Sheet - |
| Appendix-1.9 | Room Type Air Conditioning Unit | - Trimonthly Sheet - |
| Appendix-1.10 | Room Type Air Conditioning Unit | - Annual Sheet - |

## Appendix-1.1 X-Ray Baggage Screening Unit - Daily Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|---|
| Unit proper | Outside panels | Damage, backling, cracking | | |
| | | Clean | | |
| | Conveyerbelt | Damage | | |
| | | Belt climbs sideways | | |
| | | Unusual sounds emit from the power drive mechanism | | |
| | | Unusual sounds generate from the roller | | |
| | | Clean surface of conveyer belt | | |
| Monitor | | Clean surface of CRT | | |
| Other miscellaneous items | | Display lamps light up | | |
| | | Test pattern display | | |
| | | Display condition of the test chart | | |
| | | Confirm the condition of the | | |
| | | switch,motor,and speed reducer | | |
| | | Emergency stop apparatus function | | |

Check column should be filled as follows:

1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks

2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.2 X-Ray Baggage Screening Unit - Bimonthly Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|---|
| Unit proper | Outside panel | Looseness of bolts | | |

Check column should be filled as follows:
1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks
2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.3 Walk Through Metal Detector - Daily Sheet -

| | |
|---|---|
| Airport:<br>Date: | Equipment No.:<br>Inspector: |

| Part | Inspection & Routine Maintenance | Check | Remakrs |
|---|---|---|---|
| Control unit and Gate | Clean the surface control equipment and gate | | |
| Using the metal test piece that will make the metal detector sound an alarm | The indicating lamp light up | | |
| | The alarm horn actuate | | |
| Using the metal test piece that will not make the metal detector to not sound an alarm | The indicating lamp will not light up | | |
| | The alarm horn will not actuate | | |

Check column should be filled as follows:
1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks
2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.4 Baggage Claim Device - Daily Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | | Inspection & Routine Maintenance | Check | Remakrs |
|---|---|---|---|---|
| Belt Conveyor | External panel Frame | Damage, buckling, cracking | | |
| | Belt | Damage | | |
| | | Eccentric travel and snaking | | |
| | | Soiled condition | | |
| | Motor drum, Roller,and Pulley | Unusual sound | | |
| Gravity roller conveyor | | Damage | | |

Check column should be filled as follows:
1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks
2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.5 Baggage Claim Device - Bimonthly Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | | Inspection & Routine Maintenance | Check | Remakrs |
|---|---|---|---|---|
| Belt Conveyer | Belt | Slipping | | |
| | Control Box | Deterioration | | |
| | | Breakage, damage of wiring and looseness of wire and connection | | |
| | | Emergency stop switch | | |
| Gravity Roller Conveyor | | Unusual sound | | |

Check column should be filled as follows:

1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks

2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.6 Baggage Claim Device - Six Month Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|---|
| Belt Conveyor | External panel | Corrorsion | | |
| | Frame | Looseness of bolts | | |
| | Motor drum, Roller,and Pulley | Add grease | | |
| | Control box | Measure wire resistance | | |
| | | Measure current amperage | | |

Check column should be filled as follows:

1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks

2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.7 Package Type Air Conditioning Unit - Trimonthly Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|
| Unit proper | Piping connection, crack, deform, damage | | |
| | Rust | | |
| | Damage of compressor,fan, condensing unit, evaporator, and other electrical components | | |
| Coolant refrigerant piping | Proper amount of refrigerant | | |
| | Stained with oil | | |
| Lubrication system | Oil level | | |
| | Contamination, color of oil | | |
| Compressor, supply air system | Unusual sound | | |
| Coils | Damage, deformation | | |
| | Clogging with dust | | |
| Filter | Clean | | |
| Drain system | Clean | | |
| Other items | Unusual sound and vibration | | |

Check column should be filled as follows:
1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks
2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.8 Package Type Air Conditioning Unit - Annual Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|
| Electrical system | Wiring is not burnt or deteriorated | | |
| | Looseness of teminal fitting screws | | |
| | Measure insulation resistance | | |
| | Measure current parameters | | |
| Compressor, air supply system | Add grease | | |
| Safety cutouts | High pressure | | |
| | Low pressure | | |
| | Oil pressure | | |

Check column should be filled as follows:
1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks
2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.9 Room Type Air Conditioning Unit - Trimonthly Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|
| Unit proper | Crack in pipe joint | | |
| | Rust | | |
| | Damage of condenser, evaporator, and electrical parts | | |
| Refrigerant system | Oil on the refrigerant pipes | | |
| Compressor, supply air system | Unusual sound | | |
| Coil | Corrosion, damage, in the fin | | |
| | Dust in dirt for coil fan and filter | | |
| Filter | Clean | | |
| Drain system | Clean | | |
| Other items | Unusual sound and vibration | | |

Check column should be filled as follows:

1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks

2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-1.10 Room Type Air Conditioning Unit - Annual Sheet -

| | |
|---|---|
| Airport: | Equipment No.: |
| Date: | Inspector: |

| Part | Inspection & Routine Maintenance | Check | Remarks |
|---|---|---|---|
| Electrical system | Burnt and deteriorated wiring | | |
| | Looseness of teminal fitting screws | | |
| | Measure of insulation resistance | | |
| | Measure of current amperage | | |

Check column should be filled as follows:

1) Inspection···Check(V) if satisfactory
···Check(X) if unsatisfactory
Write details in remarks

2) Routine Maintenance···Check(V) if completed

Additional Remarks

## Appendix-2 Evaluation Method For Equipment Performance

### 1.General

This evaluation method and criteria are prepared for evaluating systematically the overall performance of the building ancillary equipment in airports, such as X-ray baggage screening units, walk-through metal detectors, etc.

### 2.Classification of Equipment

The equipment to be evaluated shall firstly be classified into one of the following types:

Type A: Relatively inexpensive equipment (Room type or package type air conditioning, etc.)

Type B: Other than Type A

### 3.Evaluation Items

The conditions of equipment shall be clarified for the following evaluation items by investigating operational conditions, checking previous inspection checklist, simple measurement, or by means of the five senses.

1) Operational performance

- Capacity

2) Reliability

- Operational conditions
- Energy consumption
- Frequency of replacement of parts
- Frequency of repairs

3) Economic value

- Availability of spare parts
- Deteriorated condition
- Comparison with new product
- Service year

4) Local failure

- Experience of overhaul
- Rusting
- Breakdown
- Leakage

- Looseness of joint or crack (by checking with test hammer)
- Abrasion
- Smell
- Noise
- Stain

Evaluation items vary depending on the type of equipment, and are as shown in TABLE 3.1 for respective equipment.

TABLE 3.1 Evaluation Items for Ancillary Equipment in Buildings

| Evaluation | Items | X-Ray Baggage Screening Units | Walk-through Metal Detectors | Baggage Claim Devices | Air Conditioning |
|---|---|---|---|---|---|
| 1. Operational Performance | 1.1 Capacity | x | x | x | x |
| 2. Reliability | 2.1 Operational Conditions | x | x | x | x |
| | 2.2 Energy Consumption | - | - | - | - |
| | 2.3 Frequency of Replacement of Parts | x | x | x | x |
| | 2.4 Frequency of Repairs | x | x | x | x |
| 3. Economic Value | 3.1 Availability of Spare Parts | x | x | x | x |
| | 3.2 Deteriorated Condition | x | x | x | x |
| | 3.3 Comparison with new product | x | x | x | x |
| | 3.4 Service Year | x | x | x | x |
| 4. Local Failure | 4.1 Experience of Overhaul | x | x | x | x |
| | 4.2 Rusting | x | x | x | x |
| | 4.3 Breakdown | x | x | x | x |

TABLE 3.1 (Cont'd)

| Evaluation | Items | X-Ray Baggage Screening Units | Walk-through Metal Detectors | Baggage Claim Devices | Air Conditioning |
|---|---|---|---|---|---|
| | 4.4 Leakage | - | - | - | X |
| | 4.5 Looseness of joint or cracks | - | - | X | - |
| | 4.6 Abrasion | X | - | X | - |
| | 4.7 Smell | X | X | X | X |
| | 4.8 Noise | X | - | X | X |
| | 4.9 Stain | X | X | X | X |

## 4. Evaluation Criteria

### 4.1 Evaluation for Each Item

The performance of equipment shall be inspected for each evaluation item, and any of the evaluation ranking of A, B or C shown in TABLE 4.1 shall be assigned based on the equipment conditions:

TABLE 4.1 Evaluation Criteria for Auxiliary Equipment in Buildings

| Evaluation Items | A | B | C |
|---|---|---|---|
| 1. Operational Performance | | | |
| 1.1 Capacity | - Original capacity at full power not able to be attained at any time | - Original capacity at full power not able to be attained at peak load | - No problems |
| 2. Reliability | | | |
| 2.1 Operational Conditions | - Unusual operation frequent due to various causes | - Unusual operation by single cause | - No problems |

TABLE 4.1 (Cont'd)

| Evaluation Items | A | B | C |
|---|---|---|---|
| 2.2 Energy Consumption | - Increase by 30% over previous year with no load increase | - Increase by 15% over previous year with no load increase | - No changes |
| 2.3 Frequency of replacement of parts | - Not operational due to no availability of spare parts | - Extraordinarily frequent | - Reasonable frequency |
| 2.4 Frequency of Repairs | - Increase by 30% over previous year | - Increase by 15% over previous year | - No changes |
| 3. Economic Value | | | |
| 3.1 Availability of Spare parts | - Impossible to procure due to discontinuation of production | - Production of spare parts scheduled to discontinue after 7 years, or<br>- Production of equipment already stopped 3 years ago | - No problems |
| 3.2 Deteriorated Condition | - Impossible to repair | - Repair by specialist necessary | - Able to be covered by maintenance |
| 3.3 Comparison with new product | - New product with higher efficiency available in market | - Comparable with new product by improvement | - New product not available |
| 3.4 Service year | - More than 10 years | - Between 5- 10 years | - Less than 5 years |
| 4. Local Failure | | | |
| 4.1 Experience of Overhaul | - More than twice in the past | - Once in the past | - No overhaul |
| 4.2 Rusting | - Heavy rusting: holes in surface of main body | - Possible to maintain by rubbing off the rust and repainting with a rust preventive | - No problems |
| 4.3 Breakdown | - Completely broken | - Possible to repair | - No problems |

TABLE 4.1 (Cont'd)

| Evaluation Items | A | B | C |
|---|---|---|---|
| 4.4 Leakage | - Leakage of water (or exhaust gas) | - Seepage of water (or exhaust gas) | - No problems |
| 4.5 Looseness of joint or crack | - Dull sound | - | - Normal sound |
| 4.6 Abrasion | - Already abraded | - | - No problems |
| 4.7 Smell | - Unusual smell | - | - No problems |
| 4.8 Noise | - Unusual sound | - Unusual sound is not so remarkable | - No problems |
| 4.9 Stain | - No possibility to clean up | - Possible to clean up | - No problems |

4.2 Scoring System

Assigning the following points to the respective evaluation ranks, total score (s) shall be calculated.

Rank A ..... 3 points
Rank B ..... 2 points
Rank C ..... 0 points

Total score (s) shall then be divided by number of evaluated items to enable objective evaluation.

$K = S/M$

where, S: Total score
M: Number of evaluated items

4.3 Overall Evaluation

The comprehensive evaluation shall be based on the following criteria.

TABLE 4.2 Comprehensive Evaluation Criteria

| | | |
|---|---|---|
| Equipment Type A | $K \geq 1.2$ | Complete renewal of equipment required |
| | $K < 1.2$ | Repair required |
| Equipment Type B | $K \geq 2.4$ | Replacement of major parts, or complete renewal of equipment required |
| | $K < 2.4$ | Repair required |

## Appendix-3 Testing Equipment for Inspection of Building Ancillary Equipment

| | | |
|---|---|---|
| 1. | Clamp ammeter ..... | Measuring electric current |
| 2. | Insulation resistance meter (500 V) ..... | Measuring insulation resistance |
| 3. | Freon gas detector ..... | Leakage of freon gas |
| 4. | Steel tape ..... | Deflection of belt |
| 5. | Volt meter ..... | Measuring electric voltage |
| 6. | Circuit tester ..... | Measuring current, voltage, resistance |
| 7. | Camera ..... | Recording of defects |

# PART III AIRPORT MAINTENANCE EQUIPMENT

# PART III AIRPORT MAINTENANCE EQUIPMENT

## Chapter 1 General

### 1.1 Equipment Covered by this Manual

This maintenance manual covers the activities for maintaining mowers,tractors, handy mowers, sweepers and dump trucks which are utilized for the maintenance of airport facilities.

### 1.2 Activities Covered by this Manual

The maintenance activities for the above equipment vary depending on the type of equipment to be maintained. However the activities can roughly be divided into inspection, routine maintenance and repairs.

The inspection including the succeeding adjustment and servicing shall be conducted at scheduled time intervals, while routine maintenance such as periodic replacement of expendable supplies is necessary for preventing the occurrence of malfunctioning.

This manual covers the above-mentioned activities, while repairs of equipment are precluded because of the wide variety of types and causes of the breakdown.

### 1.3 Maintenance Work Flow

FIGURE 1.1 indicates the sequential flow of the maintenance activity for airport maintenance equipment.

Data compilation situated at the bottom of the flowchart is the result of every kind of maintenance activity, is an important administrative measures for airport maintenance as it will be the basis of next maintenance activity.

FIGURE 1.1 Maintenance Flow for Airport Maintenance Equipment