Overview on Aircraft Pavement Maintenance

References

a. International Civil Aviation Organisation (ICAO) Annex 14, Document 9157-AN/901- *Aerodrome Design Manual*, Part 3 – *Pavements*, Chapter 2 – *Guidance on Overload Operations*

b. ADF - Aircraft Pavement Strength Evaluation Manual (previously known as *RAAFE*), Infrastructure Division

c. AAP 3400.004, *Aircraft Movement Strength Rating,* RAAF, 14 Oct 96

d. *Flight Information Handbook Australia*, RAAF AIS

e. Department of Defence, *Aircraft Pavement Maintenance Manual*, 1997

Introduction

1. The following chapter provides the Defence civil engineer with an overview of the principles involved in the effective management of Defence's aircraft pavements to optimise their life whilst minimising their maintenance costs. This chapter is intended to provide the user with an appreciation of how aircraft loads affect the life of an aircraft pavement, how the overloading of pavements is managed, how Defence aircraft pavements' condition is assessed, how maintenance works are programmed and where information can be found on pavement defects and repair techniques.

Pavement Concession Management System

2. When the aircraft pavements for an airfield are designed, they are usually designed to provide sufficient strength to support a finite number of aircraft operations of a specific aircraft at a specific weight over a finite period of time. This is more often the case with flexible aircraft pavements such as asphaltic concrete as opposed to rigid aircraft pavements such as concrete. Those aircraft that are lighter than the aircraft in which the pavement was designed for can operate continuously without affecting the design life of the pavement. In pavement strength terms these types of aircraft operations are termed `continuous operations'. In order to monitor the remaining life of a pavement when subjected to aircraft loads which affect its design life, airport managers often implement `pavement concession' management systems. Such systems require aircraft operators to submit requests for approval to the airport management whenever they propose to undertake aircraft operations which may reduce the life of the pavement. Such operations occur when the Aircraft Classification Number (ACN) exceeds the Pavement Classification Number (PCN). The approvals provided by the airport management are usually referred to as `aircraft pavement concessions'. This system allows the airfield manager to keep reasonably accurate records of the aircraft operations that are reducing the pavements life and use this information to schedule pavement maintenance.

3. The life of a pavement can be optimised by ensuring aircraft operations that may affect the life of a pavement are minimised and are evenly distributed throughout the pavement's life. Generally, those operations that only just exceed the PCN rating are permitted in greater numbers and frequency than those operations that significantly exceed the pavement's PCN. A rule of thumb for the allowable number, frequency and associated conditions of pavement concessions is provided below in Table 1. This approach is based upon a UK method detailed in reference A.

ACN/PCN Ratio	Conditions
1.0 – 1.1	- pavement age > 12 months - no signs of pav't load distress - no. of overload ops < 5% of annual operations
1.1 – 1.25	- as above - regular insp'n of pavement by pav't engineer
1.25 – 1.5	- as above - requires scrutiny of pav't construction records and test data by qualified pavement engineer - requires inspection of pav't for distress before and after operation
> 1.5	- only undertaken in emergencies

Table 1 – Rules of Thumb for Pavement Concessions

4. Smaller regional airfields generally tend not to actively manage aircraft pavement concessions. These airfield managers tend to exercise a `physical damage' approach to managing the maintenance of a pavement. Effectively this allows the aircraft operator to use the pavement at their own risk and if any physical damage to the pavement is apparent at the completion of the operation the operator becomes responsible for the repairs to the pavement. Such management systems pass a considerable amount of risk to the operator. In order to manage this risk it is in the interests of the operator to conduct and photographically document the condition of the subject pavement before and after the aircraft operation.

Defence Pavement Concession System

5. The pavement concession management system used on Defence airfields in Australia tends to be more carefully controlled than on civil airfields. This concession system is formalised in a document known as the Aircraft Pavement Strength Evaluation Manual at reference B. The system converts the ACN/PCN system into a format that is more easily understood by those involved in day-to-day aircraft operations planning. The ACN/PCN values are converted to actual aircraft loads for each aircraft type likely to use the subject pavement throughout its life. The use of aircraft weights as opposed to ACNs makes it clearer to the aircraft operator when a request for an aircraft pavement concession is required to be submitted. Reference B is distributed only to Corporate Services and Infrastructure Group (CSIG) Infrastructure Division's (ID's) Facilities Civil Engineering (FCE) personnel for pavement maintenance management purposes. A simplified version of reference B is distributed to Defence aircraft operators and operations planners, senior air traffic control personnel and ID's regional offices in the form of reference C. A very simplified version is also contained in reference D.

Biennial Inspection Process

6. The maintenance of airfield pavements is an essential and continuing activity to ensure that pavements are not only kept in a condition for safe use at all times, but also preserved to perform the functions for which they were intended. It is a primary responsibility of those involved in the management of airfield pavements to accomplish this aim in the most practical and economical manner using the resources available.

7. Timely and appropriate maintenance of airfield pavements not only permits expensive aircraft to operate from them with a minimum of risk of damage but also allows the full design lives of pavements to be achieved. Allowing pavements to achieve their full design lives delays closures of airfields for resurfacing or

reconstruction for as long as possible. Pavements that are regularly maintained can have their life extended in order to carefully schedule major maintenance to minimise disruption to aircraft operations. Pavements that are irregularly maintained tend not to have failure identified until it is too late. Late identification of pavement failure often requires urgent and extensive maintenance in order to avoid aircraft operational safety problems. The urgency of such maintenance usually does not allow disruptions to aircraft operations to be minimised by forward planning. Such disruptions result in degradation of ADF *airpower* capabilities and loss of profit to civil aircraft operations where the pavements are jointly used.

8. The performance of aircraft pavements throughout their life, particular flexible pavements, could be likened to one's own skin. When the pavement is young it has a lot of ductility but is susceptible to damage by harsh substances such as heat, fuels and solvents. In these early years the pavement must be protected from these substances to avoid severe damage. As the pavement ages it loses some of its volatiles, hardens and becomes more resistant to the above aggressive agents. As flexible pavements become older they need to be regularly conditioned to extend their life.

9. The process of conditioning flexible pavements usually takes place in the form of a Surface Enrichment Spray Treatments (SEST) or Coal Tar Rejuvenator treatments. These treatments involve the spraying of the pavement with a *50:50 Cutback* (50% Bitumen/50% Kerosene) solution or a *coal tar based conditioning solution* respectively. These treatments are usually undertaken midway through the life of the pavement and then every three years after until the pavement reaches the end of its life.

10. The ability to identify the aging signs of an aircraft pavement is quite a specialised skill and this skill is not available at every Defence airfield location in Australia. The responsibility for the monitoring of Defence's aircraft pavement's condition rests with ID's Facilities Civil Engineering (FCE) section. FCE along with its specialist aircraft pavement consultants, inspect each of Defence's airfields once every two years. These inspections not only report on the condition of the aircraft pavements but they make recommendations on the type and extent of repair and maintenance works that are required on the subject pavement in order to maximise its life. The reports deliberate do not attempt to provide a specification for each maintenance recommendation. Minor maintenance work can be performed using the techniques and products recommended in reference E. Larger maintenance works will require a separate specification to be developed by FCE's aircraft pavement consultants once the works are identified in the upcoming FY's maintenance program.

11. These inspections of the pavement condition usually take between one and two days per airfield and involve recording and describing the following.

a. photographs of typical defects found
b. photographs of specific defects found
c. photographs of typical condition(s)
d. photographic log and plan
e. assessment of longitudinal shape (usually confirmed by driving vehicle at 100kph along runway and 40kph along taxiways)
f. assessment of traverse shape (quantified using string line and digital spirit level)
g. assessment of drainage adequacy
h. surface integrity and FOD potential
i. roughness and frictional characteristics

j. condition of concrete slabs
    1. integrity
    2. degree of cracking
    3. stepping, faulting
    4. structural distress indications
k. condition of joints in asphalt surfacings and concrete pavements
l. presence of weeds growing through cracks
m. pavement markings
n. condition of ancillary equipment
    1. distance to run markers
    2. interface of cable arresters with pavement
    3. integrity of lighting cables cut into pavement surface
    4. aircraft tie-down points
    5. physical condition of earthing points (electrical resistance checks are conducted by others)
o. approach conditions
p. condition of RESA, stopways and clearways
q. condition of stabilised, graded and vegetated horizontal areas of flight strip

12. Immediately following the inspection FCE personnel debrief the regional personnel responsible for maintenance and the Senior Air Traffic Control Officer (SATCO) on any issues that require immediate attention to maintain aircraft operational safety. The debrief also provides these personnel with an overall indication of the pavement's condition and some insight into how the pavement has performed since the last inspection.

13. Upon completion of the inspections a report is produced that serves as a *report card* on the condition of the pavement and on how well the regional ID office has implemented the works recommended the last time the pavements were inspected. At the front of the report is an executive summary of the pavement's condition and immediately following this summary is a list of works that are recommended to be undertaken immediately, in the next financial year and in the next five years. Each of these recommended works items is presented with an indicative cost. Upon receipt of the report the regional ID office is required to undertake the works recommended for immediate attention and to submit bids for funding of those works recommended for completion in the next financial year.

14. Some of Defence's airfields (eg. Darwin and Townsville) are jointly used and funded by civilian aviation organisations. In order to ensure the civilian organisations are financing their use of the airfield facilities, *Joint-User Agreements* have been developed between Defence and the non-Defence users of the airfield. These agreements contain mathematical models that are used to determine what portion of the maintenance costs the non-Defence organisation should finance. In order to avoid disagreement with respect to the extent and cost of maintenance works required to be undertaken at a jointly-used airfield, it is beneficial to have the non-Defence users participate in the biennial inspection process. This participation includes: agreeing on the nominated specialist pavement consultant who will undertake the inspection, providing a representative on the inspection party itself, and even working with Defence to agree on the products to be used in the repair process and the timeframes in which the works can be undertaken.

Further Guidance

15. Should clarification or further information be sought on any of the guidance presented in this instruction, DDA section can be contacted on 62668183. DDA is ID's authority for aircraft pavement concessions, inspections and maintenance.