DEPARTMENT OF THE NAVY
NAVAL FACILITIES ENGINEERING COMMAND
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IN REPLY REFER TO

23 Mar 00

From: Commander, Naval Facilities Engineering Command

Subj: NAVAL FACILITIES ENGINEERING COMMAND INTERIM POLICY AND TECHNICAL GUIDANCE FOR AIRFIELD PAVEMENT VOID DETECTION, REPAIR AND PREVENTION

Encl: (1) Amplification on NAVFAC Interim Technical Guidance for Airfield Pavements Void Detection, Repair and Prevention
(2) Naval Facilities Engineering Command Airfield Pavements Users Group

1. Purpose. To establish engineering policy and technical guidance to minimize the risk of subsurface voids to the structural integrity of airfield pavements, and reduce the probability of facility related hazards to aviation.

2. Policy. NAVFAC will maintain, and make available to aviation claimants, the best technology accessible through consultations and engineering services to facilitate the incorporation of void prevention and detection in airfield maintenance and renewal programs.

3. Background. Airfield pavements have failed under the load of taxing aircraft because of undetected subsurface voids from soil erosion in the vicinity of drainage pipes. Such mishaps are extremely hazardous to life and aircraft. NAVFAC Engineering Field Divisions and the Naval Facilities Engineering Service Center, together with Public Works personnel, conduct periodic condition surveys for Claimants in managing their pavements. The current structural capacity and surface pavement condition evaluation protocols do not include explicit and mandatory inspections for subsurface erosion and related drainage conditions that cause voids.

4. Technical Guidance. Periodic inspections, using best available tools and experienced engineers, must be conducted at intervals consistent with the local susceptibility of airfields to void formation. Broken drainage pipes and excessive water entry to pavement foundation soils must be repaired and prevented to reduce the likelihood of void formation. Advanced technology shall be screened for unsubstantiated claims. NAVFAC will accelerate development of appropriate technology. Enclosure (1) amplifies on methods, procedures, roles and responsibilities.

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5. Funding. Claimant Maintenance and Repair (M&R) resources shall be used for activity specific consultations, engineering services, and for Claimant wide condition and structural surveys extended to include void detection and prevention. NAVFAC components shall assist and coordinate with Claimants in planning and programming for void surveys.

6. Action. NAVFAC components will initiate actions to assist Claimants in: (a) identifying their operational and technical requirements, (b) planning for resources for airfield void detection, prevention and repair, (c) disseminating best available technology, and (d) selective development and validation of advanced technology.

7. Point of Contact. If you have questions, please call the local NAVFAC Engineering Field Division Pavement Team users group point of contact listed in enclosure (2). The NAVFAC Criteria Office Special Assistant for Pavement, Mr. Vince Donnally, can provide assistance in clarifying these policies and standards.

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Internal List 1

AMPLIFICATION ON NAVFAC INTERIM TECHNICAL GUIDANCE FOR AIRFIELD PAVEMENTS VOID DETECTION, REPAIR AND PREVENTION
23 March 2000

Ref: (a) "Airfield Pavement Void Detection, NAS Pensacola," Site Specific Report SSR-2534-SHR, Naval Facilities Engineering Service Center, Port Hueneme, CA, December 1999, by Malvar, L.J., Lesto, J., Cline, G., and Beverly, W.

Attachment: (1) Naval Facilities Engineering Command Airfield Pavements Users Group

Purpose. Provide methodology and technical guidance for determining the risk of pavement failure from undetected subsurface voids. The assessment is intended for application at all Navy and Marine Corps airfields. The objective is to provide cost-effective and reliable methods to minimize the potential for accidental airfield pavement failure due to subsurface voids.

Background. Pavement failure due to subsurface voids has resulted in aircraft accidents at Navy airfields, causing concerns for potential accident and threat to life safety in the future, as facilities age and resources for maintenance and repair become more scarce. Reference (a), available at http://intranet.nfesc.navy.mil/apvdt.htm, describes recent evaluation of available technology to detect such subsurface weaknesses. The approach used a combination of destructive and non-destructive testing. While the detection protocols that emerged are specifically addressed to pavements above drainpipe crossings, the methods can be applied elsewhere.

Technical Guidance.

1. Void Detection

a. Visual inspection of the airfield pavements should be performed with frequency sufficient to locate potential problem areas and satisfy the airfield manager of its operational safety. Such inspections shall monitor pavement for conditions that may affect aircraft movement (FOD, depressions, pavement deterioration, etc.). Frequency should be determined by local physical conditions and operational tempo as to minimize the hazards. In flexible pavements, depressions are evident after a rainfall or by the concentric marks left by the evaporated water. In rigid pavements, standard 12½ by 15-ft concrete slabs cracked into two or more pieces, as well as slabs that exhibit faulting at joints, may indicate underlying soft spots or voids. In particular, areas above drainpipe crossings should be carefully inspected, since most problems appear near these pipes. Problems observed in unpaved areas above a pipe are early warning signs of problems in nearby paved areas above the same pipe. Depressed pavement or shattered slabs surrounding drainage structures (catch basins) indicate infiltration of soil materials into the structure or pipe. Visual inspections can also follow Pavement Condition Index (PCI) guidelines, as detailed in NAVFAC MO-102 Manuals, and as detailed in ASTM Standards commonly available.

b. If visual inspection suggests concern, further evaluation using a Heavy Weight Deflectometer (HWD) should be performed. The HWD investigation would cover all pipe crossings and additional suspect areas, following the procedure indicated in SP-2534-SHR. It can be found on the website http://intranet.nfesc.navy.mil/apvdt.htm. The HWD will establish the effect of any subgrade weakness (or void) on the load-carrying capacity of the pavement. HWD evaluations can be performed by the cognizant NAVFAC Engineering Field Division Pavement Design/Evaluation Team listed in enclosure (2). Periodic testing with a HWD is recommended at all pipe crossings. This HWD testing can best be done at the time of the standard Pavement Classification Number (PCN) structural evaluation cycle, as described in Headquarters, Department of the Army, Air Force and Navy, "Airfield Pavement Evaluation" Technical Manual, TM 5-826-1/AFJMAN 32-1121/DM 21.7, Washington, DC, December 1998.

c. Weak areas revealed by the HWD should be further tested to determine the depth of the weakness in order to determine the type of repair needed. This testing can be completed using either a Dynamic Cone Penetrometer (DCP), Electronic Cone Penetrometer (ECP), or Standard Penetration Test (SPT). Videotaping the interior of pipe crossings is recommended when testing and/or visible failure is evident in or around pipe crossings. It will help pinpoint the location of potential problem areas and define the need for maintenance and repair. Special attention should be paid to assessing pipe crossings and joints. Accumulations of fines near joints or other penetrations are a good indicator of a loss of subgrade material and possibly subgrade strength. Naval Facilities Engineering Command "Design Manual 21.06 – Airfield Pavement Design for Frost Conditions and Subsurface Drainage" draft August 1999 (final expected to be issued by May 2000) provides discussion on video inspection of subsurface drainage utilities. POC for this design manual is Mr. Vincent Donnally (see enclosure (2)). In some cases, coring of the pavement may be required to confirm presence of voids directly below the pavement surface.

d. Alternate non-destructive techniques are currently being evaluated, but are not believed to be as effective as the aforementioned tools in determining the existence of voids. Ground Penetrating Radar (GPR) cannot be used as a reliable tool to predict weak areas. GPR should not be used for void detection at this time. However, GPR appears successful in pinpointing the actual location of drainpipes and thickness of pavement layers, and potentially could be used to verify the extent of known voids.

e. Based on experience to date, and in the absence of more specific information, approximately $75,000 should be used for programming purposes for a one-time evaluation of all drainage pipe crossings of typical air stations.

2. Void Repair and Prevention

a. Repair methods are now available from the cognizant NAVFAC Engineering Field Division Pavement Design/Evaluation Team. Methods include pressures grouting, excavation, filter materials, compaction, and quality control.

b. Designs and practices to prevent the onset or growth of voids are also available from the cognizant NAVFAC Engineering Field Division Pavement Design/Evaluation Team.

c. Because of the complex nature of the hydrologic and geotechnical aspects of subsurface erosion and the threat of undetected voids to high value manned aircraft, work of void prevention, detection and repair should be considered Type 1 (as per NAVFAC Policy document dated 31 December 1998) in order to draw from the cumulative experiences of several EFD/NFESC specialists.

NAVFAC components will:

(1) Make available expert technical assistance to air stations in implementing visual inspections and interpretation procedures.
(2) Make available to air stations the EFD/NFESC combined HWD and DCP capability to detect the location and severity of voids/soft conditions in the pavement foundation soils when needed.
(3) Make available to air stations consulting services for the development of a risk and cost based plan for inspection, prevention and repairs to reduce hazards from undetected conditions.
(4) Recommend, in the absence of other compelling reasons, the conduct of complete evaluation of all pavements, at drainage pipe crossings when performing (every 8 years) the PCN structural evaluation survey. This will establish the risk prioritization and requirements for funding.
(5) Periodically validate claims of advanced technology, demonstrate suitability for adoption and use, and collaborate with research and development organizations for selective and focused development - generally in concert with the Tri-Service Pavements Group.
(6) Maintain appropriate cost data and provide to stations economic basis for actions.
(7) Pursue the maintenance of reciprocal, interdependent and sharing practices to optimize the accumulation of experience (for core competence learning) and the distributed availability of knowledge for use----minimally within the DON and ultimately among public airfield operators and engineers.
(8) Maintain an effective, easily accessible database of knowledge and criteria along with other airfield engineering information.
(9) Report all conditions suggesting water entry, erosion, softness, loss of load capacity, and voids to air station and EFD authorities for Type 1 response action.
(10) Disseminate this guidance document to all aviation claimant commands and their activity level pavement engineers.

Points of Contact. If you have questions, enclosure (2) provides the NAVFAC Engineering Field Division Pavement Design/Evaluation Team.

NAVAL FACILITIES ENGINEERING COMMAND
AIRFIELD PAVEMENT USERS GROUP POINTS OF CONTACT
23 March 2000

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