U.S. Department of Transportation

Federal Aviation Administration

Advisory Circular

Subject: OFF-PEAK CONSTRUCTION OF AIRPORT PAVEMENTS USING HOT-MIX ASPHALT

Date: 9/29/2006 **AC No.:** 150/5370-13A

Initiated by: AAS-100 **Change:**

1. PURPOSE. This advisory circular (AC) provides guidance for the planning, coordination, management, design, testing, inspection, and execution of off-peak construction of airport pavements using hot-mix asphalt (HMA) paving materials. This circular focuses on HMA airfield pavement construction. The material contained herein also applies to other types of airfield improvements where off-peak construction is identified as the preferred delivery method.

2. EFFECTIVE DATE. The effective date is September 29, 2006.

3. CANCELLATION. AC 150/5370-13, *Offpeak Construction of Airport Pavements Using Hot-Mix Asphalt*, dated August 27, 1990, is canceled.

4. SELECTED READING MATERIAL. Appendix A lists publications that contain additional information on the subject matter.

5. APPLICATION. The guidelines contained herein are recommended by the Federal Aviation Administration (FAA) for applications at airports where closure of a pavement would create significant adverse impacts.

6. METRIC UNITS. To promote an orderly transition to metric units, the text and figures include both English and metric dimensions. The metric conversions are based on operational significance and may not be exact equivalents. Until there is an official changeover to the metric system, the English dimensions should be used.

7. COMMENTS OR SUGGESTIONS for improvements to this AC should be sent to:

Manager, Airport Engineering Division
Federal Aviation Administration
ATTN: AAS-100
800 Independence Avenue, S.W.
Washington, DC 20591

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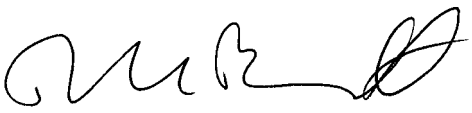

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1. JUSTIFICATION. As airport traffic increases and additional airport capacity becomes scarce, airport construction activities can cause severe disruptions to airport operations and contribute to flight delays, cancellations, and missed connections that are inconvenient to passengers, result in loss of schedule integrity, and are costly to aircraft operators. In addition to allowing aircraft operators to maintain scheduled air service to the community, paving airside pavements during off-peak periods may be an effective way to maintain airport construction schedules without loss of revenues, inconvenience to passengers or excessive air traffic system delays.

2. PURPOSE. Techniques for paving during off-peak periods have been applied successfully at airports throughout the United States for many years. This advisory circular describes the techniques that are available and the procedures that should be followed in the execution of off-peak construction projects in order to ensure safety, provide quality construction, and avoid excessive air traffic delays. Section 7, Operational Safety Procedures, provides further emphasis on the importance of safety during off-peak construction.

3. OFF-PEAK TIMES. In most cases, off-peak refers to the nighttime hours between 9:00 p.m. and 7:00 a.m. when scheduled passenger flight air service is at the lowest. Off-peak may also include particular days of low activity or periods of low usage through a continuous weekend period; for example, from 10:00 pm Friday until 2:00 p.m. Sunday. At some airports, such as those serving resort areas, off-peak may refer to particular seasons of the year; for example, Spring or Fall. Scheduling work periods of at least 8½ hours is recommended; however, shorter work periods may be acceptable at locations where 8½ or more hours is difficult to attain.

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SECTION 2. PROJECT PLANNING

4. POTENTIAL. The potential for off-peak paving should be identified early in the project planning stage and discussed in the predesign conference (see AC 150/5300-9, *Predesign, Prebid and Preconstruction Conferences for Airport Grant Projects*). After the need for a particular airport improvement has been identified, it should be determined if that project will necessitate the closing of any airside pavements. Pavements should be identified which, if closed, may cause disruption to the flow of air traffic at the facility. Pavements closed to accommodate construction activities should be fully addressed in the phasing plans of the project documents. Construction phasing plans should specifically identify alternate taxi routes for aircraft as well as service and construction vehicle routes. Alternate routes should be fully coordinated with airport operations, air traffic control, aircraft operators, and fixed base operators.

5. FEASIBILITY. If the project will involve the closing of critical airside pavements, it should be determined if it is advisable to construct the project during off-peak periods. The first step should be to identify the off-peak hours associated with the facility in question. For example, the off-peak period for a primary runway may be during the nighttime hours between 10:00 p.m. and 7:00 a.m. However, the off-peak period associated with a taxiway leading to an air cargo ramp may be during the daytime or normal airport operating hours.

6. STAGING. It is often possible to stage the project so that some elements may be accomplished during normal working hours, while other elements may be completed during off-peak periods. For example, a taxiway that crosses an active runway may be resurfaced during normal working hours if alternative taxi routes are available. However, the portions of the taxiway which abut or intersect the runway and would involve closing the runway to aircraft operations may be good candidates for completion during off-peak hours. In addition, work can be accomplished when wind or other weather conditions prevent aeronautical use of sections of airside pavements.

7. CONSIDERATIONS. The major factors that influence the decision to perform construction during off-peak hours should be identified and, if possible, quantified. These factors should include those listed below:

a. Cost of Off-peak Construction. In most cases the standard unit price items, e.g., cost/ton of hot-mix asphalt etc., will increase for off-peak construction to account for nighttime and weekend work periods outside the normal working hours. As described in paragraphs 18a and 20a, additional inspectors and standby equipment may be required, thus increasing the project cost. Nighttime construction requires portable lighting units, supplemental equipment lighting and night shift pay differentials for construction personnel which will also increase the project cost. In addition, the availability of a nighttime testing laboratory facility and personnel may increase costs.

b. Cost of Aircraft Delays. The cost of delayed or canceled flights can be very expensive and, therefore, may be the most important factor in determining whether to accomplish the construction during off-peak periods. This is particularly true of paving projects requiring the

closure of a runway, taxiway, or aircraft parking area. In such instances, the use of off-peak construction should be considered. Delayed flights, particularly arrivals, incur additional costs for operating the aircraft for the period of the delay. Extended periods of reduced flight schedules and canceled flights by aircraft operators as well as the reduction in passenger volume all account for lost revenues to the airport. When considering off-peak construction periods, the impact to the airport, aircraft operators, aircraft support services, and passenger support services should all be evaluated. Such impacts should be quantified and presented to all parties prior to commencement of construction to determine whether off-peak is feasible.

c. Quality of Construction. No additional material acceptance testing is required for off-peak construction projects. The laboratory acceptance testing should be performed at the specified intervals during each work period and field samples obtained from the work area prior to reopening for operations, when practical. The results of all available testing should be reviewed before the next work period begins. This condensed work schedule may require additional personnel to ensure that the tests are performed correctly and on time and to ensure that the construction is of acceptable quality. More detailed construction monitoring is recommended, particularly for construction performed during the hours of darkness. More detailed field monitoring, rapid acceptance testing, and the need to reopen the pavement for traffic at early ages will likely require an accelerated testing delivery schedule. Field sampling for acceptance testing may require previously constructed work areas to be closed during the next work period while obtaining samples.

d. Disruption to Specialized Operators. Construction during off-peak hours can be accomplished with minimal disruption to normal airport operations with few exceptions. Some specialized carriers operate primarily outside the normal operating hours for the airport. For example, air cargo aircraft usually operate at night or during the early morning when other airport operations are typically at a very low level. While an air cargo carrier's operation may be a very small portion of the airport's total operation, that airport could be a major revenue-generating point for that particular carrier. The nature and extent of these operations will vary from airport to airport, as will the procedures to accomplish the construction without negatively impacting the services of a specialized operator. In these cases, it is particularly important to discuss the proposed construction with the aircraft operators well in advance in order to minimize potential impacts and to develop mutually agreeable strategies, procedures, schedules, and financial arrangements.

8. COORDINATION. A coordination framework for the project should be prepared by the airport operator which includes planning, design, and construction phases. This framework should specify the individual organizations having interests in the project, which factors or events will be important to each group, and the time frame for involvement. Specific coordination procedures and organizations to be included are detailed in paragraph 10.

9. COST ESTIMATES. Cost estimates must be developed in sufficient detail to give an accurate indication of the finances necessary to accomplish the project. Estimates should specify all special pay items in order to maintain flexibility in project scheduling and to avoid unnecessarily inflated prices.

SECTION 3. COORDINATION

10. BACKGROUND. Off-peak construction projects involving hot-mix asphalt (HMA) pavements within aircraft operational areas are highly visible and have the potential to cause aircraft delays. Therefore, close coordination with all elements of the airport is essential throughout the planning, design, and construction phases. Figure 1 shows the organizations that should participate in the coordination of off-peak construction projects. As soon as an airfield paving project has been identified by the airport operator, the operator should meet with airport users and the FAA to discuss the manner in which the project will be implemented. Personnel representing the groups and organizations identified in Figure 1 should attend all planning and coordination meetings. Special coordination consideration must be given to those airports that do not have an Air Traffic Control Tower (ATCT) or that have limited ATCT hours.

a. Airport Operator. The airport operator should be represented by the operator's project manager as well as in-house representatives of the planning, engineering, operations, security, and maintenance sections. If the airport operator has retained the services of outside design consultants and construction management firms to oversee the project, the respective managers and field personnel should also attend all meetings related to the project.

b. Airport Users. Airport users that operate in the areas affected by the project, either regularly or on an occasional basis, should actively participate in the project coordination process. Airlines should be represented by the airport technical committee, the Air Transport Association Regional Office, and the station managers. Air cargo facilities managers, fixed-base operators (FBOs) and other users of airside facilities such as fuel suppliers, flight catering services, and pilot organizations should also be represented.

c. FAA. The FAA should be involved in the coordination process through representatives of the local ATCT, National Airspace System Implementation Program Office (ANI), the airports district office, the flight standards district office, and the airway facilities division. The airport operator should also maintain close coordination with the FAA regional airport certification inspector through the airport's district office.

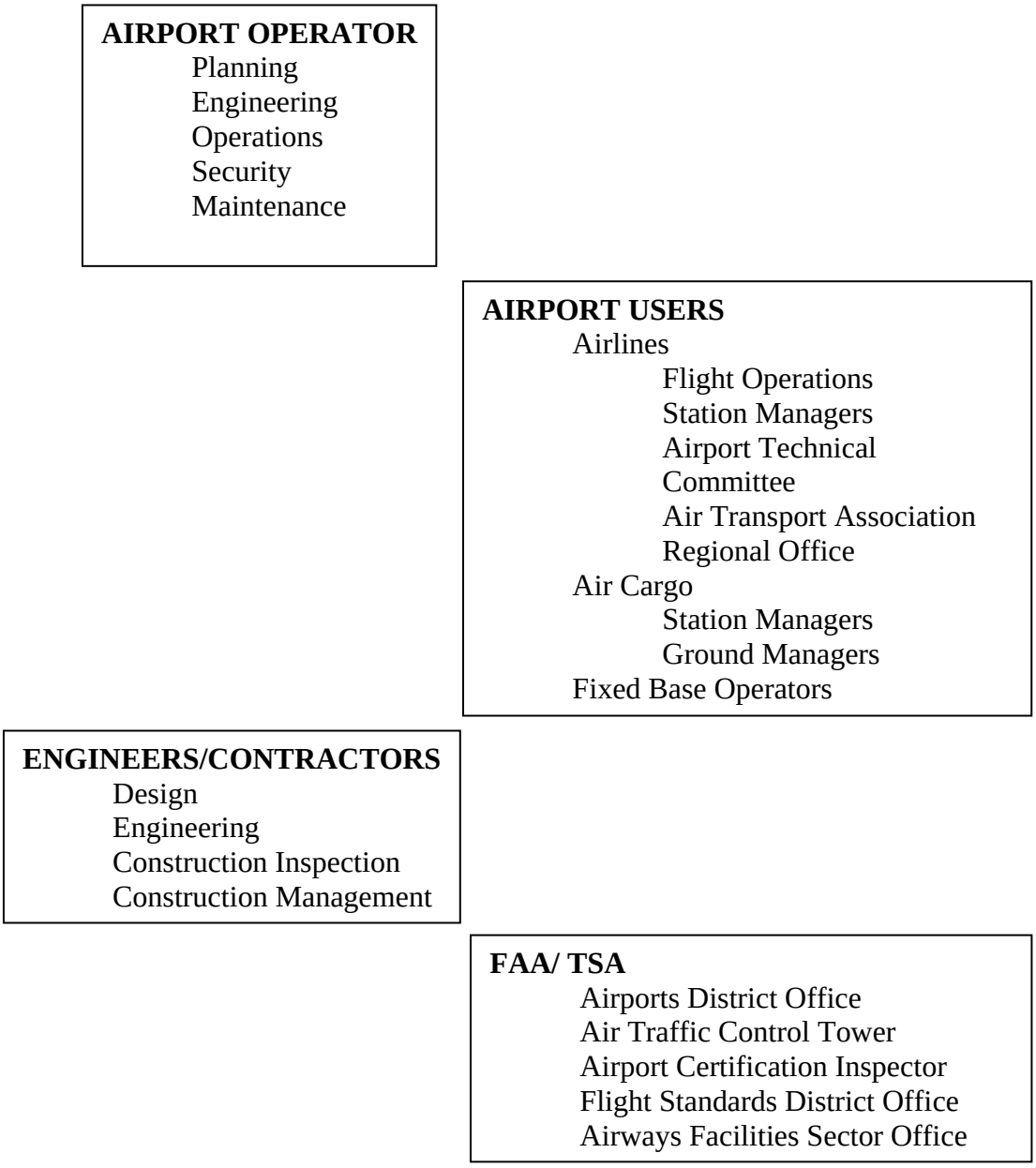

Figure 1. Coordination - Participating Organizations

11. INITIAL COORDINATION. The initial coordination meeting in the project planning phase should identify the coordination framework and process for the entire project and set forth the ground rules under which the project will be accomplished. The meeting agenda should include the following items:

a. Construction Work Periods. Off-peak working hours and extended daily or weekly work periods should be identified as soon as possible in the planning process. Since time is a critical factor in off-peak construction, the contractor should be given as much time as possible for HMA paving operations during each work period. A minimum of 8½ hours is recommended for efficiency during construction. The work should be scheduled during a time period that will

displace the least number of scheduled flights. A specific work period timeframe and extended length work period timeframes should be identified, based on input from all participating organizations, as soon as possible in the planning phase. Work periods should be selected and agreed upon early enough to allow airlines to adjust their flight schedules as required for the project's scheduled construction period. Runways and other airside pavements crucial to maintaining aircraft operations should be opened and closed at the agreed upon times without exception. Airline flight schedules and the contractor's work schedules are predicated upon the availability of the affected airport pavements at the designated times.

b. Operational Criteria. Mutually agreeable operational criteria for each critical phase or sub-phase should be developed for those factors and procedures that will be in use during the construction process. These items include, but are not necessarily limited to, those listed below:

(1) Issuance of Notices to Airmen (NOTAMs) and advisories.

(2) Aircraft operations, performance, and taxi routes.

(3) Navigation aids and visual landing aids.

(4) Truck haul routes and airfield access security requirements.

(5) Testing, inspection, access, protocol, and procedures.

(6) Requirements and safety inspections for reopening areas for operational use.

(7) Designation of equipment staging area(s).

(8) Placement and removal of construction safety barricades and runway closure markers.

(9) Designation of secure storage site for construction materials.

(10) Temporary airfield pavement marking, signing, and lighting.

(11) Days of the week and detailed scheduled timeframe upon which construction will take place.

(12) Proper vehicle identification, security clearances, and airfield maneuvering (e.g. lights, flags, when radio equipped escorts are needed, etc.).

(13) Contingency plans for construction interruptions due to equipment breakdowns or weather events. Large operations may require standby paving equipment for key areas like intersections.

(14) Emergency pavement reopening plan.

(15) Temporary parking and service plan for aircraft during scheduled pavement closures.

(16) Detailed contractor safety plan.

c. Communication. Lines of communication (see checklists below) should be established by the airport operator to maintain coordination and control of pavement closures and reopenings through all phases of the project. Proper communication procedures will ensure that the necessary organizations and individuals will be kept informed of the project schedule and will provide necessary input at critical points throughout the project. It is particularly important to establish methods and lines of communication for determining if the project work area is available to start work at the beginning of each work period and if the work area is in acceptable condition prior to its reopening for aircraft operations.

Pavement Closure Communication Checklist:

Contractor Superintendent	**Resident Engineer**	**Airport Operator Project/Operations Manager**
Request Pavement	Confirm Contractor's work time, area, & safety measures	Notify ATCT
Closure time & work annex to Resident Engineer	Request Pavement closure from Project/Operations Manager	Issue NOTAMs
		Confirm closure with ATCT
		Notify Resident Engineer & Contractor to proceed with closure

Pavement Reopening Communication Checklist:

Contractor Superintendent	**Resident Engineer**	**Project/Operations Manager**
Request Reopening	Inspect work area	Inspect work area
	Request reopening to Project/Operations Manager	Notify ATCT, Resident Engineer, & Contractor
		Reopen pavement

d. Special Considerations. Particular aspects of construction that will require special coordination or communication procedures should be identified. These items are discussed in sections 5 and 7 and include pavement transitions and runway closings.

SECTION 4. PROJECT MANAGEMENT

12. PROJECT MANAGER. The airport operator must select a qualified project manager(s) to oversee all phases of the project, from planning through final inspection of the completed work. The individual(s) selected should be experienced in the design and management of airfield pavement construction projects as well as HMA placement during off-peak hours. The individual should also be familiar with the airport operations, airport security requirements, aircraft operator schedules, and overall airport layout. The project manager should be the final authority on all technical aspects of the project and must be responsible for coordination with airport operations. All contact with the airport operator, the weather service, or the FAA should be made through the project manager or designated representative (i.e., resident engineer) to ensure continuity and proper coordination with all elements of the operation of the airport. Any changes resulting from discussions with the airport operator, airport security, the weather service, or the FAA should be processed through the project manager to maintain continuity and coordination. All such communications should be documented in writing by the project manager. The project manager's specific responsibilities are detailed below:

a. Planning and Design.

(1) Establish clear and concise lines of communication.

(2) Participate as a member of the selection team for the design engineer, if allowed by local policy.

(3) Monitor and review the project design to ensure that it meets budget constraints.

(4) Coordinate the design review with other elements of the airport operator, the airlines, the Air Transport Association Regional Office, Transportation Security Administration (TSA), and the FAA, including designated working hours, aircraft and operational requirements, technical reviews, and establishment of coordination procedures.

(5) Chair all meetings pertaining to the project.

b. Construction.

(1) Have the ATCT manager brief construction personnel on basic ATCT procedures for the facility, proper communications with ATCT, hazards of jet blast, familiarization with the airport layout, and avoidance of runway incursions.

(2) Manage the overall construction effort with an adequate number of qualified resident engineers and inspectors to observe and document the work done by the contractor.

(3) Contact the weather service, airport operations, the air traffic control tower, local Airway Facilities sector office, airport operators, and field maintenance personnel prior to starting the next off-peak construction work shift, and confer with the contractor's project superintendent to verify that weather and air traffic conditions will allow work to proceed as scheduled.

(4) Confer with the contractor's project superintendent daily and agree on the limits of construction scheduled for the next work period to ensure that the selected work areas will be reopened to aircraft operations at the specified time for pavement reopening. This is especially important in situations where pavement repair and replacement are to take place.

(5) Participate in post-construction inspections of the work areas prior to reopening for aircraft operations. Figure 2 shows a sample checklist to aid the project manager in participating in the inspection.

13. CONSTRUCTION MANAGER. Some airport operators may choose to retain the services of a construction management firm to oversee the accomplishment of the construction project. If the construction management firm is to assume the full responsibility for the management of the project, the firm's project manager should be responsible for those items detailed in paragraphs 12a and 12b and be familiar with the operating procedures of the airport. A division of responsibilities between the project managers for the construction management firm and the airport operator should be clear-cut and understood by all parties throughout all phases of the project. A division of responsibility between project managers is not recommended in the construction phase. In any case, the construction manager should be involved in the project as soon as possible before the construction phase begins.

14. RESIDENT ENGINEER. A resident engineer, preferably a civil engineer or senior construction inspection professional, with experience working within an airport environment, should be designated to assist the project manager during the construction phases of the project. The resident engineer may be a member of the airport operator, the design engineering firm, or the construction management firm, but in any case should report directly to the project manager. In order to be of maximum benefit to the project, the resident engineer should be responsible for the items listed below:

a. Prepare documentation for all quantities constructed during each work period.

b. Ensure that all tests are performed and results obtained from each work period.

c. Schedule the inspections and surveys that must be performed during each work period.

d. Observe compliance with contract specifications and report any discrepancies to the project manager and the contractor.

e. Maintain a construction diary and prepare daily inspection reports.

f. Facilitate communication between the contractor, airport operations, affected airlines or FBOs, control tower, quality assurance testing personnel, and the project manager.

ITEM	COMPLETED	REMARKS
1. Have all paving and rolling operations planned for the work period been completed?		
2. Are all transition ramps properly constructed and safe for aircraft operations?		
3. Have all field quality assurance tests been conducted for the work period?		
4. Have all temporary markings been applied to all appropriate newly paved surfaces?		
5. Have all lighting units, construction equipment, and safety devices been removed to a remote storage location?		
6. Have all construction materials that are to remain on site been properly secured from dislodgement by wind or jet blast?		
7. Have all excavations been properly backfilled, plated, or appropriately marked for safe aircraft operations?		
8. Has all construction debris been cleaned up and removed from the airport's construction site, access pavements, and haul routes? Has any necessary pavement sweeping been completed?		
9. Have all obstruction lights and barricades been removed from areas that are to be opened to aircraft operations?		
10. Has all lighting and/or temporary lighting been returned to service and tested?		
11. Have all visual aids been returned to service and tested?		
12. Have proper NOTAMs been issued for the runway/taxiway/apron operating conditions?		
13. Have all pavement "lips" greater than 3 inches (75mm) in height been removed?		
14. Has the hot-mix asphalt cooled enough to be opened to aircraft operations?		

Figure 2. Inspection Checklist

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SECTION 5. DESIGN CONSIDERATIONS

15. PLANS AND SPECIFICATIONS. Plans and specifications for pavement repair and overlay during off-peak periods should be presented in sufficient detail to allow ready and accurate determination of the limits of pavement repair, finish grades (in accordance with standards in AC 150/5300-13, *Airport Design*) and depths of overlay. They should be used by the contractor and the inspectors for each work period and should, therefore, be clear and precise in every detail.

16. PAVEMENT SURVEY. Accurate surveys and proper grade control are critical to the successful accomplishment of a quality off-peak paving job, particularly if the paving is done during the hours of darkness. Survey control should be established and maintained in areas that are accessible and that will not be disturbed during construction activities. The following factors should be used as a guide to surveying for off-peak paving projects:

a. Cross-sectioning. A complete system of benchmarks should be set on the side of the runway, taxiway, or apron area to permit a ready reference during cross-sectioning operations. The benchmarks should be set at approximately 400-foot (120M) intervals. Pavement cross-sectioning should be performed, at a minimum, on a 25 feet (7.5M) grid system both longitudinally and transversely. All breakpoints (high, low, and crown) should be added to the grid system to supplement the survey. Where paving lane widths are less than 25 feet (7.5M), the transverse grid component layout should be adjusted relative to the width of the proposed paving lane.

b. Elevations. Extreme care should be exercised in level operations because the elevations will be used in determining the depth of the HMA pavement for meeting design grades. The design engineer should not use grade information from previous as-built drawings or surveys that were performed during potential frost conditions because these elevations will vary seasonally. This is particularly critical for single-lift HMA overlays where pavement depths are varied by design.

c. Grades. After the design finish grades, transverse slopes and break points of the pavement are determined, a tabulation of grades and a finish grade grid should be included in the plans the contractors use in preparing bids for the project. The finish grade grid system will be used for the establishment of the erected stringline during the paving operations. The tabulation of grades should include the existing pavement elevations, design finish grades, depth of pavement millings (if required) and depth of overlay. Grades should be shown longitudinally every 25 feet (7.5M) and transversely every 12.5 feet (3.75M) on a grid system with all break points included. This level of topographic survey information is considered essential in the preparation of plans which are sufficiently accurate for contracting for off-peak construction services.

17. SPECIAL DETAILS. Details pertaining to the following items should be included in the plans for the project.

a. Transition Ramps. At the end of each work period, it will be necessary to provide a transition ramp from the completed course of an HMA overlay to the existing pavement. The construction of this ramp is one of the most important tasks in each work period. Details on transition ramp construction techniques are presented in paragraph 36.

b. In-Pavement Lighting. If the paving project involves in-pavement lighting fixtures, the plans should depict the removal and reinstallation of the fixtures in detail. Construction techniques for in-pavement lighting are discussed in paragraph 37.

c. Temporary Pavement Markings. During the course of off-peak construction projects, temporary pavement markings are often required to allow for aircraft operations between work periods. During the design phase of the project, the designer should coordinate with the project manager, airport operations, airport users and the FAA Airports project manager to determine minimum temporary markings. The FAA Airports project manager should, in turn, coordinate with the appropriate FAA Flight Standards Office and disseminate his findings to all parties. Where possible, the temporary markings on finish grade pavements should be placed to mirror the dimensions of the final markings. Further details on temporary markings are presented in paragraph 38.

d. Skid Resistance. If a special skid resistant surface or grooving is required, the guidance published in AC 150/5320-12, *Measurement, Construction, and Maintenance of Skid Resistant Airport Pavement Surfaces*, should be used to ensure adequate aircraft braking action. Grooving should not be used until the pavement has cured for 30 days, per the guidance provided in AC 150/5320-12.

18. SPECIFICATIONS. In addition to the typical specifications required for any pavement project, the following items should be included in the specifications for off-peak paving projects:

a. Standby Equipment.

(1) Construction Equipment. When operationally critical pavements are involved, the contract should require the contractor to maintain standby equipment at the construction site for all construction work performed during off-peak periods. The specific type and amount of equipment should be that which is necessary to complete the work planned for that work period should any piece of equipment break down. This includes equipment such as paving machines, milling machines, rollers, trenching machines, core drills, backhoes, graders, tack trucks, and any equipment necessary to remove disabled equipment. In addition, standby cleanup equipment such as sweepers, brooms, etc., should be available to ensure timely reopening of the pavement at the end of the work period. Standby equipment may be used for construction to improve productivity, but the contractor should be required to properly repair or replace any broken equipment before being allowed to proceed with the next work period. Standby equipment should be listed on the daily equipment log which is usually required by the contract's specifications. To minimize the chances of equipment failure, the contractor should be required to furnish proof that the equipment has been well maintained and is in good working condition. In addition, if at all possible, the

contractor should be required to prearrange for alternate equivalent equipment to permit completion of the project in a timely fashion in the event of a major breakdown.

(2) Asphalt Plant. Provision should also be made for a standby asphalt production plant or for sufficient hot storage bins to provide enough material to reopen the construction work area to aircraft operations should the primary plant break down. While it is preferred that the standby plant be capable of producing HMA that meets the project specifications for FAA asphalt mix (P-401), it is often impractical and cost prohibitive to do so on short notice when the pavement must be reopened for use. In these instances the emergency use of HMA meeting state requirements is acceptable for use in the event of a primary plant breakdown and to allow the affected work area to be reopened. Once the primary plant problem is resolved, the state HMA must be removed and the area repaved with material as specified in the contract documents. The project manager and the contractor must agree prior to construction commencement on the exact HMA state mix that will be allowed in the case of an emergency.

b. Obstruction Lighting and Barricades. Drawings and specifications applicable to the work should show the details of the construction-related obstruction lighting and safety barricades to be used. The types of construction lights and barricades to be used and the procedures for marking construction areas should be consistent with AC 150/5370-2, *Operational Safety on Airports During Construction*. Some airports have used portable self-contained elevated tower-style lighted X's to indicate closure of runways at night, and during reduced visibility conditions for daytime off-peak construction.

c. Construction Lighting.

(1) Construction Area. Lighting equipment must be sufficient to adequately illuminate the work area in order to ensure a quality HMA overlay if the construction is to be performed during nighttime hours. Additionally, it is recommended that all paving machines, rollers, milling machines, distributor trucks, and other support equipment, except haul trucks, be equipped with artificial illumination to safely illuminate the area immediately surrounding their work areas. The lights should be positioned to provide the most natural color illumination and contrast with a minimum of shadows. The spacing for each individual project will have to be determined by trial. Light towers should be positioned and adjusted to aim away from ATCT cabs and active runways to prevent blinding effects. Lighting the pavement from both sides is considered preferable as lighting from only one side can result in objectionable shadows. Light towers should be removed from the construction site when the pavement is reopened to aircraft operations. Construction lighting units should be identified and generally located on the construction phasing plans in relationship to the ATCT and active runways and taxiways. A separate bid item for the number of portable light plants per day should be included in the bid schedule.

The project manager should strictly enforce lighting requirements because sufficient light is necessary to properly observe the placement and compaction of material, and thus ensure the satisfactory construction of overlays. Pay items should be established in the contract to ensure that the contractor is willing and able to provide adequate temporary construction lighting on a per-unit basis.

(2) Vehicular Lighting. All construction vehicles and equipment should be properly marked with flashing amber lights in accordance with AC 150/5370-2, *Operational Safety on Airports During Construction*. Flags may be used to supplement vehicle markings also in accordance with the circular. Additionally, all paving machines, rollers, milling machines distributor trucks, and other support equipment, except haul trucks, should be equipped with artificial illumination to safely illuminate the area immediately surrounding their work areas. Refer to Figure 3.

Figure 3. Pavement Spreader in Nighttime Construction

d. Special Pay Items. Special pay items or allowances pertaining to lost time experienced by the contractor due to wind/weather conditions, airline schedule requirements and other airport operational requirements or needs beyond the contractor's control should be established in the contract specifications. This will maintain maximum flexibility in the scheduling of work and will avoid unnecessarily inflated prices. By having these times defined as pay items, the

contractor will not have to anticipate in his bid, the full risk of such lost time by increasing other bid items to cover these delay-associated costs. One typical method for addressing these special pay items is to provide for owner-estimated dollar amount allowances in the bid schedule that all contractors will carry in their bids. The actual costs of lost time events would then be calculated on a time and materials basis as specified and paid out of the allowance amounts. These lost time pay items should include suspension time, standby time and down time, as described below:

(1) Suspension Time. The suspension of the entire work period, with advance notice of at least two hours prior to the scheduled start time.

(2) Standby Time. The time when a contractor's forces are mobilized for work and waiting to start. This condition may last for a maximum of two hours after the scheduled start time.

(3) Down Time. The period between the end of the standby time and normal quitting time.

e. Liquidated Damages. It is imperative that the runway, taxiway, and other airside pavements crucial to maintaining aircraft operations and schedule integrity be opened on time following the completion of each work period. Scheduled airlines and the air traffic control system usually have aircraft en route to coincide with the opening. If the opening is delayed, diversions and cancellations costing thousands of dollars may be incurred. One way of calling the contractor's attention to the importance of opening on time is to include a liquidated damage clause in the contract. The liquidated damage assessed should reflect the revenue lost and additional expenses incurred by the airport sponsor and aircraft operators when the pavement is not usable. Liquidated damages for hourly, daily, and total project completion are often used. The method used to calculate the amount of liquidated damages should be shown in the design report or other appropriate documents. At very busy airports, liquidated damages have been assessed in time increments as short as 15 minutes. It is important to keep in mind that the liquidated damages established for a project must be based on reasonable and realistic estimates of the costs incurred to the owner and the airport users as a result of contractor's failure to complete on time. In order to be fully enforceable, liquidated damages cannot be established in an arbitrary and capricious manner. The assessed liquidated damages should reflect and not exceed the lost revenue and additional expenses incurred due to unusable pavement. Limits to liquidated damage clauses may vary by political jurisdiction, but some sort of motivating pressure should be put on the contractor to open on time. Liquidated damages should be identified by the airport operator's construction representative project manager, construction manager, and resident engineer, and tracked accordingly whether hourly, daily, or total contract time. The airport's representative should notify the contractor's superintendent as soon as the scheduled opening time has not been met and that liquidated damages for delays to airport operations are in effect. The assessment of liquidated damages should be held for possible review until the project is complete.

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SECTION 6. TESTING AND INSPECTION

19. TESTING. Off-peak construction does not require any additional types of material testing other than that required under standard construction procedures and specifications. The major difference between off-peak construction and standard construction is that, usually, not all acceptance testing can be performed prior to reopening the area to aircraft operations. For example, cores for the determination of hot-mix asphalt density should not be taken until the pavement has cooled to ambient temperature. The field core samples required for density testing for a given work period may have to be taken during the following work period. Laboratory testing of HMA material may require additional personnel to perform the required number of tests during a reduced work period. Nuclear density tests, while not allowed as acceptance tests for FAA funded projects, can be valuable as immediate on-site density indicators to control and monitor rolling patterns and to help ensure that the specified density for acceptance testing is being achieved. These procedures may require additional personnel to ensure that the tests are performed correctly and on time.

20. INSPECTION. High quality inspection performed in a timely manner contributes significantly to the success of any paving project. The number of inspectors required for any given paving project will depend on a number of factors (project size, complexity, production rates, etc.). The resident engineer should be responsible for overall inspection and reporting. Adequate inspection can be achieved with (in addition to the project manager and the resident engineer) an asphalt plant inspector, with one or two helpers, for each plant, and one paving inspector, with an adequate number of helpers, at the paving site. The number of helpers required depends on several factors such as, number of paving machines, production rates, complexity of the project, etc. Areas requiring particular attention typically include: pavement milling; pavement repair inspection; HMA plant production and field laydown; electrical inspection; and surveying.

a. Asphalt Plant Inspector(s). The asphalt plant inspector(s) should be primarily responsible for sampling and testing of the HMA, as produced, to assure the product is within specifications. The asphalt plant inspector(s) must maintain records and prepare reports as required by the specifications. The inspector(s) should maintain open communications with the contractor's testing personnel as well as the resident engineer for any potential HMA or plant problems during the work period.

b. Paving Inspector(s). The paving inspector(s) should be primarily responsible for proper laydown of the HMA, as placed, to assure conformance with the specifications. The paving inspector(s) must maintain records and prepare reports as required by the specifications. The paving inspector should also calculate the random sampling locations for layout of core samples.

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SECTION 7. OPERATIONAL SAFETY PROCEDURES

21. GENERAL. Off-peak construction, or any construction, should never derogate the level of safety or security of aircraft operations or construction operations. In order to provide for safety and security during off-peak construction, the topics in this section are emphasized. Nighttime construction on a closed pavement system, when other areas of the airport are open, is inherently more dangerous than nighttime work.

22. SAFETY PLAN. A construction safety/phasing plan that addresses work area security, access, lighting, and barricades, and emergency contacts should be prepared to guide activities in the construction phase. Refer to paragraph 11b for additional requirements to cover in the safety plan. Once the safety plan is developed for construction, coordinate with the FAA's Airport District Office. A contingency plan should be prepared to address cases of abnormal failures or unexpected disasters. These plans should be updated weekly as the project schedule progresses. Refer to AC 150/5370-2, *Operational Safety on Airports During Construction*, for further guidance on safety related issues. Safety plans need to be adjusted as the project progresses. Weekly construction meetings need to be held to discuss how effective the plan is and what adjustments are needed to keep it realistic.

23. CONSTRUCTION ACTIVITIES.

a. NOTAMs. NOTAMs should be issued as early as possible advising users of any construction activity which will require the shutdown of airside pavements and/or navigational aids for more than 24 hours or in excess of 4 hours daily on consecutive days. NOTAMs should be prepared daily by the airport operator and issued by the airport operator to reflect current construction activities.

b. Safety Meetings. Regularly scheduled safety meetings should be held to discuss safety issues. Personnel should be reminded that nighttime and off-peak construction offers some unique safety concerns such as the need to lock out electrical switches to prevent accidentally or prematurely energizing electrical systems, the need to wear reflective vests and hats to increase visibility, etc. Safety meetings should address airfield environment awareness and stress the serious consequences of runway/taxiway incursions. Keeping contractor and subcontractor personnel up to date on the changing work areas and changing active airfield areas is critical.

c. Truck Haul Routes. Truck haul routes should be located to avoid the use of airside airport pavements (unless there is no cost-effective alternative), minimize hauling operations within aircraft operating areas, and to avoid truck traffic in close proximity to navigational aids. Truck haul routes should be clearly marked. The use of radio equipped escort vehicles to guide truck traffic to and from the work area is highly recommended.

d. Construction Lighting and Barricades. The contractor should be required to have sufficient construction lighting and barricades (as indicated in the construction safety/phasing plans and specifications) to block off any intersecting runways and taxiways and to delineate haul routes to the work site.

e. Staging Areas. To facilitate construction equipment, staging area(s) should be as close to the work site as possible in a location that will not interfere with aircraft operations or navigational aids. The staging area(s) should be fenced and secured where practicable.

f. Storage of Construction Materials. Storage of construction materials should be located within or near the equipment staging area(s), if practical. However, if this is not practical, stored material should be covered and located to preclude wind, jet blast, prop wash and/or rain from blowing or washing materials into aircraft operating areas. Stored materials should not encroach on aircraft operating areas or otherwise violate criteria in Title 14 Code of Federal Regulation (CFR) Part 77 *Objects Affecting Navigable Airspace,* or the airport hazard criteria contained in AC 150/5300-13, *Airport Design*, unless the location and heights of the stored material have been approved by an FAA airspace study.

24. POST-CONSTRUCTION INSPECTION. Prior to reopening pavements to aircraft operations, an inspection of the work area must be performed by the project manager. The project manager (or project manager's designated representative) should conduct an inspection of the work area with airport operations personnel and the project superintendent. The project manager should ensure that all construction materials have been secured, all pavement surfaces have been swept clean, all transition ramps have been properly constructed, and that surfaces have been appropriately marked for aircraft to operate safely [see paragraph 12b(5) and Figure 2]. Only if all items on the list meet with the airport operator and project manager's (or project manager's designated representative) approval should the air traffic control tower be notified to open the area to aircraft operations. The contractor's superintendent should be required to retain a suitable workforce and the necessary equipment at the work area for any last minute cleanup which may be requested by the airport's project manager prior to opening the pavement.

SECTION 8. CONSTRUCTION PRACTICES

25. PRECONSTRUCTION CONFERENCE. The requirements and procedures to be followed during the off-peak construction process should be set forth in detail and discussed with all parties involved in or affected by the construction at a preconstruction conference. The format, agenda and timing of preconstruction conferences are described in AC 150/5300-9, *Predesign, Prebid, and Preconstruction Conferences for Airport Grant Projects*. The overall purpose of these conferences is to ensure that all parties understand the construction procedures, as well as potential problems and possible solutions. The conference should be convened and conducted by the project manager as soon as practicable after the construction contract has been awarded and before the notice to proceed has been issued. The agenda should include items such as operational safety, testing, quality control, security, labor requirements and environmental factors. The items discussed below are particularly important and should be emphasized at preconstruction conferences for off-peak paving projects.

26. PROJECT SUBMITTALS. Prior to beginning work on the project, the contractor must be required to file the following items with the project manager for approval:

a. Progress Schedule. A detailed progress schedule showing the proposed schedule of work in the areas to be constructed each period.

b. Equipment and Personnel. A complete list of contractors, equipment, and personnel to be used, including standby equipment, as required by the specifications.

c. Asphalt Plant. Evidence that the hot-mix asphalt plant or plants meet the requirements of the specifications.

d. Quantity. Evidence that the amount of hot-mix asphalt that the contractor proposes to place each work period can be supplied to the construction site in the time required.

e. Project Superintendent. The experience record of the project superintendent that the contractor proposes to place in charge of the project. The experience record should list the superintendent's experience on hot-mix asphalt overlays, including nighttime or off-peak construction.

f. Safety/Phasing Plan. A detailed safety plan that addresses airfield security requirements, construction safety barricade locations, haul routes, etc. All safety plans must be coordinated with the FAA's Airports District Office and updated weekly as required in section 7, paragraph 22.

g. Other Requirements. Other requirements identified in the contract documents.

27. TESTING AND INSPECTION. It should be emphasized to the contractor that acceptance testing will take place each work period, and work will not be allowed to proceed in the next work period unless all tests have been reviewed, recorded, and approved. The daily inspection

reports should be made by the inspection team and testing laboratory. These reports should include the location and description of the work performed, the results of the inspections, and any comments on the specifications. Items considered to be critical are Marshall test results, in-place density results, pavement smoothness, and finished grade elevations.

a. Reporting Test Results. All laboratory test results, with the exception of field core densities, should be forwarded to the project manager as soon as practical during the work period. Open lines of communication from the laboratory to the field and back will allow for minor changes to be made at the plant to the HMA (if required) during production. These potential changes will promote a better quality product.

b. Reporting Field Cored Densities. The field cores for in-place density acceptance testing may have to be obtained during the following work period due to pavement temperatures or reopening times. The results of these tests may not be known over 24 hours.

28. CONSTRUCTION PROGRESS MEETINGS.

a. Daily. A daily progress meeting should be held between the project manager and the contractor's superintendent to discuss the work requirements for the next work period and to review the test results from the previous work period.

b. Weekly. A weekly progress meeting should be held with representatives of all elements of the airport and the airport user community. The agenda for this meeting should include the work schedule for the coming week, any operational problems that have been encountered or may be expected, and any other operational aspects of the project as necessary. The progress meeting should also address the updated safety/phasing plan with the associated changes for the following week.

29. WEATHER.

a. Permissible Weather Conditions. The project manager, the contractor, the local airway facilities sector office and field maintenance personnel, airport operations, and the air traffic control tower should establish procedures for determining the weather conditions under which work will not begin as scheduled or when work should be suspended due to inclement weather. It is particularly important to establish an adequate lead time for notifying the contractor if work is to be suspended for the period due to inclement weather.

b. Wind Conditions. Weather conditions that may affect construction include wind conditions, as well as precipitation and temperature. For example, a forecast of winds from a particular direction may preclude the use of a crosswind runway or other alternative. Off-peak construction during Instrument Flight Rule (IFR) conditions is not recommended because construction vehicles and markings may be difficult to see from the control tower as well as from an aircraft cockpit.

30. COMMUNICATION. It should be emphasized to the contractor that all communication with the air traffic control tower or any other element of the airport should be made through the project manager (or project manager's designated representative) or as agreed upon between the ATCT and the airport. This is important because the number of people having contact with the

various elements of the airport should be limited in order to prevent possible misunderstandings or conflicting information. The only exception should be radio-equipped escort vehicles controlling construction traffic through active airfield pavements or zones. The project manager should have direct contact with airport operations at all times. All requests for closing and/or opening the construction area to aircraft operations should be made only by the project manager (or the project manager's designated representative).

a. Radio Frequencies. On large paving projects, project managers, contractors, airport management, and security personnel must coordinate to ensure that the radio frequencies used for contact and control of day-to-day construction operations by radio do not conflict with existing frequencies used for air traffic, security, and emergency purposes. Airport communication requirements should be included in the contract documents and followed in their entirety over the life of the project.

31. SECURITY DURING CONSTRUCTION. In addition to the normal security requirements and operational procedures of the airport, all personnel and suppliers should be given a drawing showing haul routes, restricted areas, and any other details pertinent to the construction operation. The drawing should contain a notice that states that any unauthorized construction personnel found in restricted areas of the airport are subject to arrest for a punishable Federal offense and will be promptly and permanently removed from the job. At some airports, all vehicles are escorted to and from airside locations for safety and security reasons. Security requirements vary at individual airports and these requirements should be detailed in the project specifications.

32. ASSEMBLY OF EQUIPMENT. Prior to beginning work, the contractor should make certain that all equipment, including standby equipment, is in good operating condition and ready to begin work. After the project manager has checked with the weather service and airport operations, conferred with the contractor's superintendent, and agreed that work may proceed as scheduled, the contractor should assemble all personnel and equipment in the designated equipment staging area(s). All equipment must be fully operational and tested prior to mobilizing from the designated equipment staging area to the work site. Equipment and personnel should be organized so that they can proceed to the work area as soon as authorization is given. Also, all hot-mix plants should be operating and ready to produce the paving material when notified.

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SECTION 9. CONSTRUCTION TECHNIQUES

33. TEST SECTIONS. Prior to beginning full production of any pavement work on the project, a test strip should be placed, following the provisions of the P-401 specifications, to provide a trial run for all aspects of the paving operation as well as communications and acceptance testing. The test strip should be at least 150 feet (45M) long with a nominal thickness of two inches (50mm) and should include transition ramps, as detailed on the plans. The test strip should include pavement milling (to grade) if the project has profile milling and transverse passes for transitional ramps. The test strip paving operation should be set up to run on a reference line/laser for vertical control, and a reference line/laser and/or averaging device (ski) with design grades set.

NOTE: *Test strips for off-peak construction should be performed on "closed" pavement areas similar to existing construction conditions at the project work area, where it is not practical to close the actual work area for this limited amount of work.*

34. LIMITS OF OVERLAY OPERATIONS. When placing overlay pavement during off-peak periods, it is essential that the full width of the overlay be placed during each work period. Each work period should be as long as possible in order to limit the number of transverse joints for the entire project. When overlaying runways, the overlay operation should begin at one end of the runway and proceed in the primary direction of aircraft operations. The limits of HMA overlay may increase for each work shift once the project manager becomes comfortable with the capabilities of construction personnel and production rates.

35. PLACEMENT OF HOT-MIX ASPHALT.

a. Spreaders. The preferred method of placing hot-mix asphalt is to use 25-foot (7.5M) spreaders working in echelon. Paving spreaders of lesser widths may be used; however, wider spreaders will maximize the use of available time for paving and minimize paving joints. Spreaders working in echelon help to maintain a hot joint between adjacent paving lanes. The spreaders should start on the centerline and work their way outward in the sequence shown in Figure 4. It is important to overlay as much of the center portion of the runway as possible in the event that equipment failure or weather problems force the suspension of work. During the paving operation, the contractor should hold raking to a minimum and should be prohibited from casting raked material on the mat.

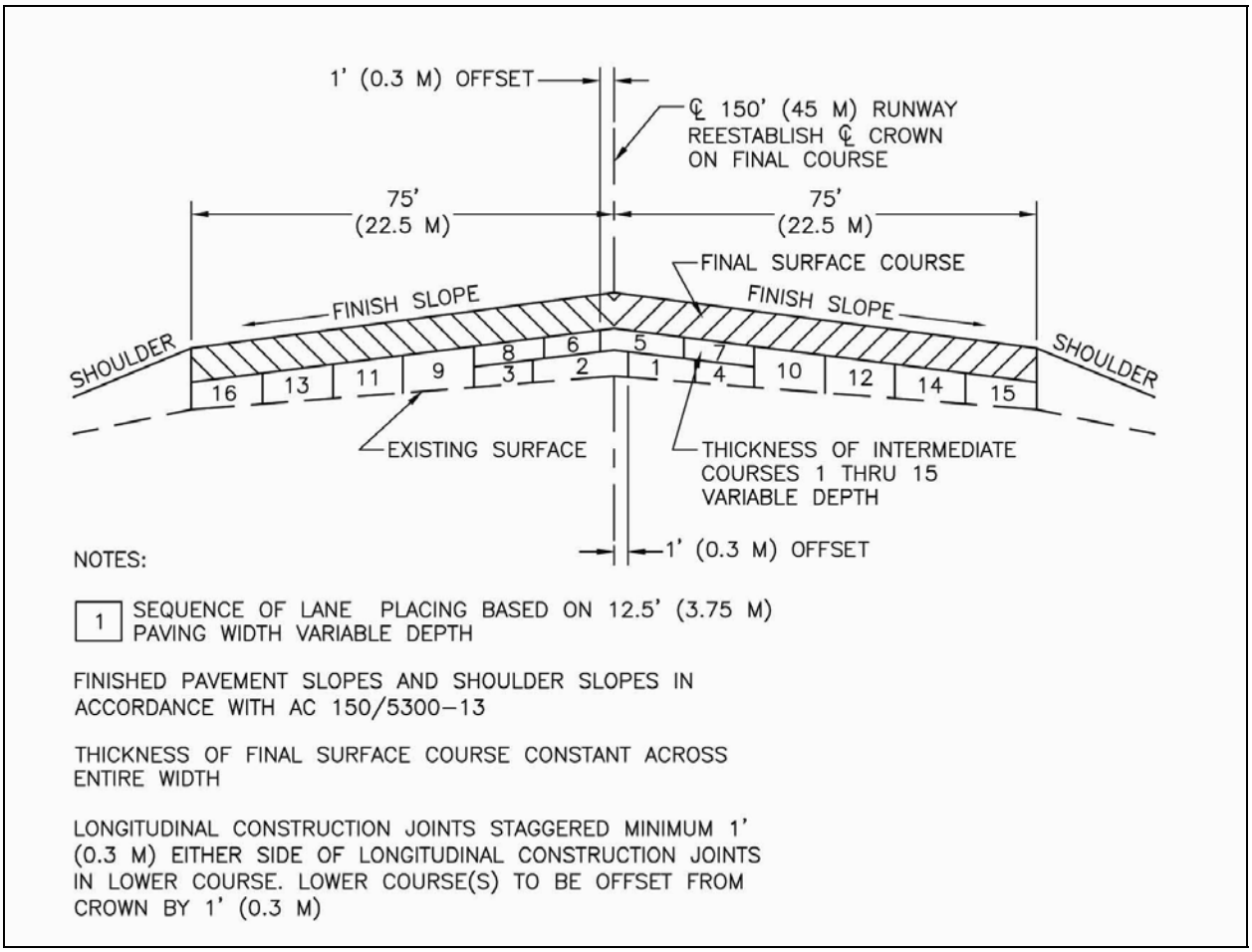

Figure 4. Typical Overlay Section – 150-foot (45M) Runway

b. Grade Control. If the runway is considered sufficiently smooth, the contractor may be permitted to place hot-mix asphalt using a traveling stringline. A slope control device should not be used under any circumstances because the cumulative error in multiple-lane paving may violate the grade control criteria. If the runway is not considered sufficiently smooth for the use of a traveling stringline, an erected stringline (Figure 5), digital control, Global Positioning System (GPS), or laser control should be required. In this case erected stringlines or laser controls should be used on both sides of the paver for the initial centerline pass. Subsequent passes may be controlled by a joint matcher on the newly overlaid side of the paver and laser control on the opposite side or a 30-foot (9M) averaging ski.

Figure 5. Setting an Erected Stringline

c. Opening to Traffic. The time required between the end of hot-mix asphalt placing and opening the pavement to aircraft traffic will vary depending on several factors. Asphalt placing can continue up to the time that will allow the newly placed surface to cool sufficiently to avoid rutting and the construction team, inspectors, and survey crew can complete their assigned tasks. These tasks include acceptance testing, pavement striping, cleaning up the construction area, and securing all materials which are to be left on the construction site. The potential for aircraft traffic to cause rutting of the newly placed mat is a function of the stability of the mix, which varies with temperature and asphalt content. As a general rule, aircraft traffic should not be allowed on the newly placed mat until it cools to 150°F (65.5°C) or lower. When it can be demonstrated that a specific HMA pavement material has shown that traffic will not adversely affect the pavement at higher temperatures, then higher pavement opening temperatures would be acceptable.

36. TRANSITION RAMPS.

a. Transverse Ramps. At the end of each work period a ramp should be constructed to provide a transition from the completed course of the overlay to the existing pavement. The construction of this transitional area is one of the most important tasks in the work period because a ramp that is too steep could cause structural damage to an operating aircraft or a malfunction of the aircraft's instruments. A ramp that is too long may result in raveling of the pavement and damage to aircraft engines if any of the loosened material is ingested. When practicable, it is recommended that the overlay proceed in the predominant direction of aircraft resulting in "down" transition ramps. This will further minimize the potential for damage to aircraft landing gear.

b. Multiple-lift Overlays. In multiple-lift overlays the transition ramps should not be constructed any closer than 500 feet (150M) to one another. The length of all longitudinal ramp slopes should be 15 feet (4.5M) for each inch (25mm) of depth of compacted overlay. Every effort should be made to pave the full width of the runway or taxiway during each work period. However, in cases where it is necessary to construct a transverse transition ramp, the ramp slope should be 5 feet (1.5M) in the transverse direction for each inch (25mm) of compacted overlay. Aircraft operations are sometimes allowed on very thin partial width overlays, such as porous friction course surfaces without transverse ramps. Abrupt drops of over 1 inch (25mm) should not be allowed on any airfield pavement where aircraft ground speeds may exceed 35 knots.

c. Construction Methods. Transition ramps are to be made with cold-planing equipment of suitable size for the work required.

d. Cold-planing Equipment. The most effective method of ramp construction is to use a cold-planing machine (Figure 6) to heel cut the pavement at the beginning and at the end of each work-period overlay. This method is shown in Figure 7. Millings and debris from cold-planing must be removed in their entirety before the application of tack coat or the placement of HMA pavements. When placing the final surface course of an overlay, the heel cut at the start of the second overlay period should be equal to the thickness of the overlay to ensure a smooth joint.

e. Other Requirements. Other requirements identified in the contract documents.

Figure 6. A Cold-Planer for Use in Removing Transition Ramp

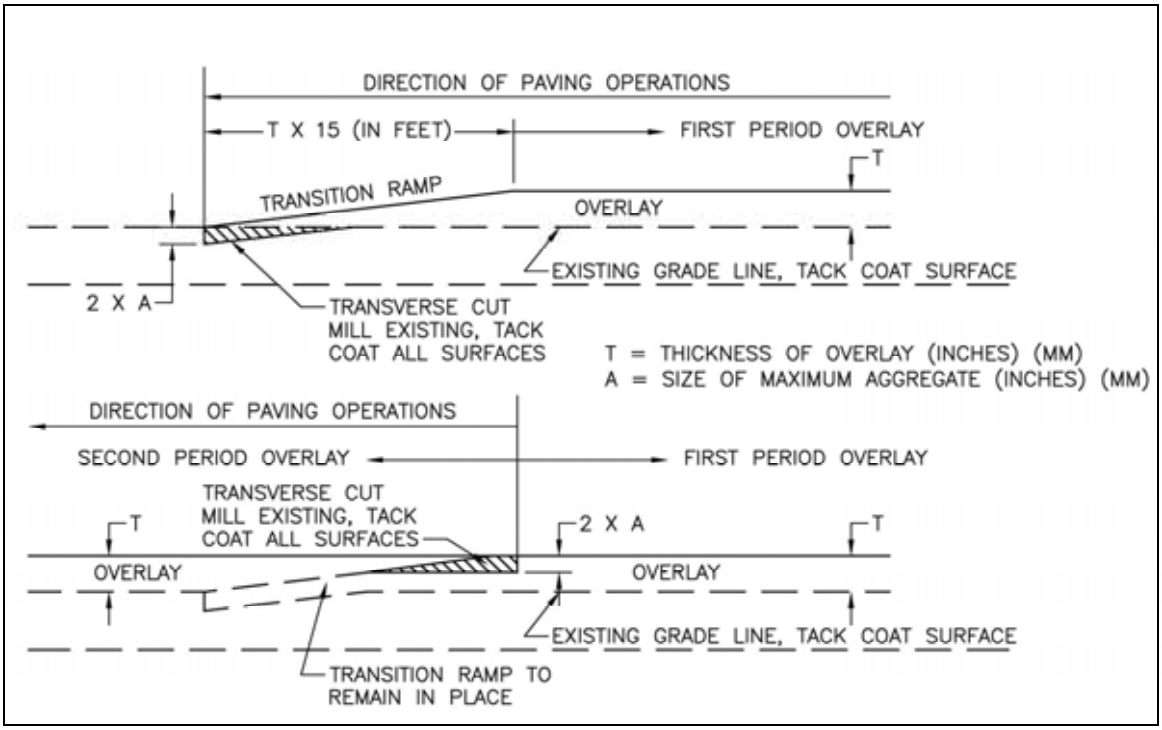

Figure 7. Transition Ramp Construction with Cold-Planing Equipment

37. IN-PAVEMENT LIGHTING. Details depicting the removal and reinstallation of in-pavement lighting should be included on the plans where applicable. The details should depict: removal of the light fixture and extension ring, placement of a target plate over the light base, filling the hole with hot-mix asphalt until overlay operations are complete, accurate survey location information, core drilling with a small (3-4 inch [75-100mm]) core to locate the center of the target plate, and final coring with an appropriate sized core machine (Figure 8). The light and new extension ring can then be installed to the proper elevation. When measuring and installing new extension rings after the overlay is in place, care should be taken to match each extension ring with the specific light fixture for which it was measured. Also, the compound used to seal around the light bases and to fill slots for conduits should be a type manufactured for that particular purpose and should be compatible with the hot-mix asphalt. For thin overlays, extension rings are sometimes added before overlaying. The removal and reinstallation process may require that certain lights be out of service for a period of time. The reinstallation process on overlays greater than 2 inches (50mm) requires lights to be cored to receive the extensions(s) and fixtures. Pavement overlay temperatures must be such that core holes do not distort. In-pavement lights should be installed in conformance with the manufacturers' written instructions and in conjunction with the contract documents. Details of in-pavement lighting installation should be specifically detailed and noted in the contract drawings and specifications.

38. PAVEMENT MARKING. Several different types of paint have been successfully used for temporary markings. However, water emulsion-based paint (Federal Specification TT-P-1952) is generally preferred over solvent-based paint (Federal Specification A-A-2886) due to the lower cost of the paint and lower effort and maintenance cost associated with cleanup. When applying temporary markings at night, it is recommended that the fast drying, Type II paint be used to help offset the higher humidity and cooler temperatures often experienced at night. Temporary markings are generally applied at 50% of the application rate recommended for permanent markings. Diluting the paint is not recommended. Dry time will be increased substantially if paint is diluted. Drop-on glass beads are not required for temporary markings. The decreased paint thickness of temporary markings results in proper embedment of only a portion of drop-on glass beads. If a marginal increase in conspicuity is necessary, the smallest gradation for glass bead conforming to Federal Specification TT-B-1325, Type I, is recommended. Loose beads on the pavement are considered construction debris and must be removed. Striated markings may also be used for certain temporary markings. AC 150/5340-1, *Standards for Airport Markings*, has additional guidance on temporary markings.

a. Pavement Curing. If possible, it is recommended that temporary markings on the final surface be left in place until final curing of the surface is achieved (usually 30 days). Allowing the final surface to cure will usually result in better appearance and adherence of the permanent markings.

b. Marking Tape. Pavement marking tape is not recommended for the temporary marking of paved surfaces. If the temperature of the mat is too high when the tape is put down, the tape may melt into the pavement and will be very difficult and time-consuming to remove prior to the application of the next course of the overlay. Also, if the tape does not adhere properly, it can be blown loose by jet blast and possibly be ingested by an aircraft engine.

Figure 8. Core Drilling Above In-pavement Light Base (NOTE: *Drilling Rig is Plumb*)

39. WORK AREA CLEANUP. Sufficient time should be provided at the end of each work period to allow for cleanup and inspection of the work area before it is opened to aircraft operations. All construction debris should be totally removed from the work area. Suction/brush type sweepers should be in operation during most of the work period to minimize final work area cleanup time. Rotary broom and blower type sweepers have been found effective in cleaning milled pavement surfaces. Where additional courses of pavement raise the surface of the pavement to the point where the runway shoulders deviate from the standards set forth in 14 CFR Part 139, and AC 150/5300-13, *Airport Design*, the contractor should restore the shoulders to the proper grade before the pavement is reopened to air traffic. All construction materials that must be temporarily left onsite should be transported to a designated materials staging area. All such materials must be secured so that they cannot be dislodged by wind or jet blast. The contractor's superintendent should accompany the project manager, resident engineer, and a representative from airport operations on an inspection of the work area before it is opened to traffic. The contractor should have the necessary manpower and equipment standing by to perform any additional cleanup that may be identified during this inspection. Active work areas should be periodically monitored by airport operations personnel to ensure the area remains free of all debris. It is not recommended that airport owners assist in the cleanup of construction materials and debris as a joint effort with the contractor. A clear delineation of roles and responsibilities during construction projects is in the best interest of all parties.

40. MILLED SURFACES. The construction process can be made more efficient by milling off a greater area of the pavement surface than will be overlaid during the work period. On occasion, aircraft operators and the airport owner (airport operations officer) may agree to permit operations on runways which have partially milled surfaces. Operations on partially milled surfaces are generally allowed when milling requirements have not been extensive. On certificated airports, the partially milled surface must not violate any of the pavement requirements set forth in 14 CFR Part 139. Generally, a maximum length of 700 feet (215M) of milled surface is acceptable. In addition, the milled surface must not be so deep or of such a geometry as to impair directional control of the aircraft. Transition joints must also be adjusted to meet the specific needs of the airport. Milled surfaces must be thoroughly cleaned of all dust and loose particles prior to opening for aircraft traffic.

SECTION 10. SUMMARY

41. GENERAL. Off-peak construction can be an effective way to maintain and improve airports while avoiding excessive aircraft delays. However, as described in the preceding paragraphs, certain factors must be considered and procedures followed to ensure quality construction while maintaining a safe operating environment. The airport sponsor should conduct a cost-benefit analysis to determine the applicability of off-peak construction to any particular project. In summary, adequate lead times should be given for airport users to adjust their schedules and operating procedures where feasible and possible. Coordination should be maintained with all affected parties through all phases of the project. Construction plans and specifications should be detailed to show the unique aspects and construction phasing requirements of the project. Finally, specific construction practices and techniques should be followed to ensure that the construction is of acceptable quality, particularly if the work is to be done at night.

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APPENDIX A. RELATED READING MATERIAL

1. ADVISORY CIRCULARS. The latest issuance of the following advisory circulars may be obtained by downloading them from the FAA's website at www.faa.gov.

a. AC 00.2, *Advisory Circular Checklist and Status of Other FAA Publications*. Contains a listing of all current advisory circulars.

b. AC 150/5300-9, *Predesign, Prebid and Preconstruction Conferences for Airport Grant Projects*. Provides guidance for conducting predesign, prebid and preconstruction conferences for projects funded under the Federal Aviation Administration's airport grant program.

c. AC 150/5320-6, *Airport Pavement Design and Evaluation*. Provides guidance to the public for design and evaluation of pavements at civil airports.

d. AC 150/5320-12, *Measurement, Construction and Maintenance of Skid Resistant Airport Pavement Surfaces*. Contains guidance on determining runway surface friction characteristics, specifications for friction measuring equipment, and procedures for the construction and maintenance of skid resistant airport pavement surfaces.

e. AC 150/5340-1, *Standards for Airport Markings*. Describes the standards for marking paved runways, taxiways, and closed or hazardous areas on airports.

f. AC 150/5370-2, *Operational Safety on Airports During Construction*. Sets forth guidelines concerning the operational safety on airports during construction, to assist airport operators in complying with Part 139, *Certification and Operation: Land Airports Serving Certain Air Carriers*, of the Code of Federal Regulations, and with the requirements of federally funded construction projects.

g. AC 150/5300-13, *Airport Design*. Presents Federal aviation design standards for airports.

h. AC 150/5370-10, *Standards for Specifying Construction of Airports*. Provides construction standards and guide specifications to be used in specifying grading, drainage, paving, lighting, fencing, turfing, and other construction activities at civil airports

2. GOVERNMENT REPORTS. The following Government reports may be purchased from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, Virginia 22161 or from www.ntis.gov.

a. DOT/FAA/RD-80/121, *Current Practices on Nighttime Pavement Construction-Asphaltic Concrete*, July, 1982.

b. FAA/RD-76/221, *Study of Nighttime Pavement Construction Practices-Asphaltic Concrete*, December, 1987.

3. OTHER REPORTS. The following report may be obtained from Mr. Richard P. Raymond, T.Y. Lin International/HJ Ross, 201 Alhambra Circle, Suite 900, Miami, FL 33134.

a. Off-Peak Construction Practices for Airfield Pavements Utilizing Asphaltic Concrete, Richard P. Raymond, International Industry Working Group, April, 1988.