U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

Subject: AIRPORT PAVEMENT DESIGN AND EVALUATION

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AC No: 150/5320-6D
Change: 4

1. PURPOSE. Advisory Circular (AC) 150/5320-6D, Airport Pavement Design and Evaluation, has been revised to provide design guidance for paved airfield shoulders.

2. PRINCIPAL CHANGES. Change 4 includes the following:

a. A new Chapter 8, Pavement Design for Airfield Shoulders, provides design guidance for paved runway, taxiway, and apron shoulders. Guidance is intended for application on airports accommodating Design Group III or larger aircraft.

b. Revised guidance on required design flexural strength for rigid pavement design.

c. New guidance for rubblization of existing Portland Cement Concrete (PCC) pavements prior to asphalt overlay.

d. Minor corrections to various text and figures.

PAGE CONTROL CHART

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CHAPTER 7. LAYERED ELASTIC PAVEMENT DESIGN

CHAPTER 8. PAVEMENT DESIGN FOR AIRFIELD SHOULDERS

(1) Total Pavement Thickness Unstabilized. Enter Figure 3-4 with the subgrade CBR value of 7 and read a total pavement thickness of 37.5 inches (953 mm). This thickness includes surfacing, granular base (P-209) and granular subbase (P-154)

(2) Thickness of Base and Surface Unstabilized. Re-enter Figure 3-4 with the assumed subbase CBR (P-154) of 20 (see paragraph 321 b.) and read a thickness of 17.0 inches (432 mm). This thickness includes surfacing and granular base (P-209). The note on Figure 3-4 states that the thickness of surfacing for critical areas is 4 inches (100 mm).

(3) Unstabilized Section. The unstabilized section would thus consist of 4 inches (100 mm) of surfacing, 13 inches (330 mm) of granular base (P-209) and 20 l/2 inches (520 mm) of granular subbase (P-154). (4) Stabilized Base Thickness. Assume the equivalency factor for P-401 base material to be 1.4. The required thickness of stabilized base is determined by dividing the thickness of granular base calculated in step (3) above by the equivalency factor. In this example 13 inches (330 mm) would be divided by 1.4 yielding 9 inches (230 mm).

(5) Stabilized Subbase Thickness. Referring to Table 3-7, assume the equivalency factor for P-401 used as subbase is 2.0. Divide the thickness of granular subbase 20 l/2 inches (520 mm) by 2.0 which yields 10 inches (255 mm) of P-401 subbase.

(6) Stabilized Section. The stabilized section would be 4 inches (100 mm) of surfacing, 9 inches (230 mm) of stabilized base (P-401) and 10 inches (255 mm) of stabilized subbase (P-401).

(7) Check Minimum Thickness. The total pavement thickness given above 4 + 9 + 10 = 23 inches (585 mm) is then compared to the total pavement thickness required for a CBR of 20. This was done in step (2) above and gave a thickness of 17.0 inches (430 mm). Since the calculated thickness of 23 inches (585 mm) is larger than the CBR=20 minimum thickness of 17 inches (430 mm), the design is adequate. Had the CBR=20 thickness exceeded the calculated thickness, the subbase thickness would have been increased to make up the difference.

322. FULL-DEPTH ASPHALT PAVEMENTS. Full-depth asphalt pavements contain asphaltic cement in all components above the prepared subgrade. The design of full-depth asphalt pavements can be accomplished using the equivalency factors presented in paragraph 321 and illustrated in paragraph 321f. Manual Series No. 11 prepared by the Asphalt Institute, dated January 1973, can also be used to design full-depth asphalt pavements when approved by the FAA.

323. FROST EFFECTS. Frost protection should be provided in areas where conditions conductive to detrimental frost action exist. Levels of frost protection are given in paragraph 308b of this document. Frost considerations may result in thicker subbase courses than the thicknesses needed for structural support.

a. Example. An example of pavement design for seasonal frost follows. Assume the same design conditions as in paragraph 321f above.

(1) Structural Requirements. The structural requirements for the example are: 4 inches (100 mm) of surfacing, 9 inches (230 mm) of stabilized base, and 10 inches (255 mm) of stabilized subbase. This section provides a total pavement thickness of 23 inches (585 mm).

(2) Determine Soil Frost Group. Assume the subgrade soil is a clayey sand SC with 10% of the material finer than 0.02 mm. The unit dry weight of the subgrade soil is 115 pcf (184 kg/cu m). The soil frost group is found in Table 2-4 and in this example is FG-2.

(3) Determine the Depth of Frost Penetration. The design air freezing index for the area is 350 degree days. Referring to figure 2-6 the depth of frost penetration is found to be 28 inches.

(4) Types of Frost protection. Several levels of frost protection are possible as follows:

(i) Complete Frost Protection. Complete frost protection would require the pavement section be increased from 23 inches (585 mm) to 28 inches (710 mm). This would require placing 5 inches (125 mm) of nonfrost susceptible material beneath the structural section.

(ii) Limited Frost Protection. Limited subgrade frost penetration provides nonfrost susceptible material to a depth of 65% of the depth of frost penetration. In this example, 65% of 28 inches (710 mm) equals 18 inches (460 mm). Since the structural design section provides a total pavement thickness of 23 inches (585 mm), no further protection is required. The structural section provides more than enough protection to satisfy the limited subgrade frost penetration requirements.

(iii) Reduced Subgrade Strength. The reduced subgrade strength rating for an FG-2 soil is found in paragraph 308a.(3) and is a CBR of 7. Since the design CBR used in the example was 7, the structural design is adequate for the reduced subgrade strength method of frost protection. As has been previously mentioned, this method is intended to provide adequate structural support when the frost is melting.

(5) Summary. In summary, for areas sensitive to pavement heave due to frost action the complete protection method should be used. This would add 4 inches (100 mm) of nonfrost susceptible material to the structural section. In areas where some degree of pavement heave due to frost action can be tolerated, the structural section will be adequate. The same is true for providing structural support during periods of frost melting, i.e. the structural section is adequate.

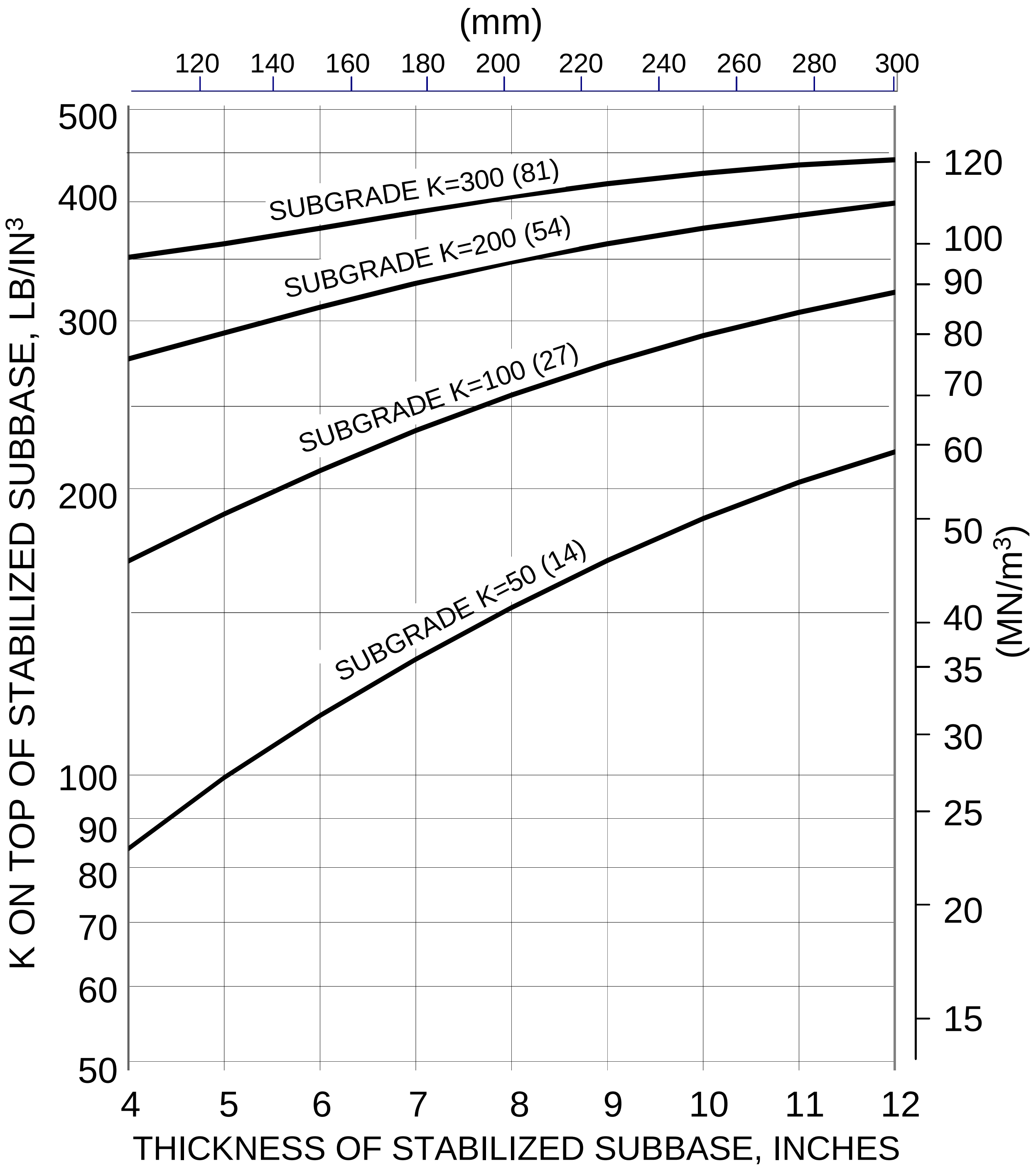


FIGURE 3-16 EFFECT OF STABILIZED SUBBASE ON SUBGRADE MODULUS

331. DETERMINATION OF CONCRETE SLAB THICKNESS. Design curves have been prepared for rigid pavements similar to those for flexible pavements; i.e., separate curves for a variety of landing gear types and aircraft. See Figures 3-17 through 3-29. These curves are based on a jointed edge loading assumption where the load is located either tangent or perpendicular to the joint. Use of the design curves requires four design input parameters: concrete flexural strength, subgrade modulus, gross weight of the design aircraft, and annual departure of the design aircraft. The rigid pavement design curves indicate the thickness of concrete only. Thicknesses of other components of the rigid pavement structure must be determined separately.

a. Concrete Flexural Strength. The required thickness of concrete pavement is related to the strength of the concrete used in the pavement. Concrete strength is assessed by the flexural strength, as the primary action of a concrete pavement slab is flexure. Concrete flexural strength should be determined by ASTM C 78 test method. The design flexural strength of the concrete should be based on the age and strength the concrete will be required to have when it is scheduled to be opened to traffic. Thickness design strength of 600 to 650 psi is recommended for most airfield applications. Unless expedited construction is required, the strength specified for material acceptance during construction should be specified as a 28 day strength and be 5 percent less than the strength used for thickness design.

b. k Value. The k value is in effect, a spring constant for the material supporting the rigid pavement and is indicative of the bearing capacity of the supporting material.

c. Gross Weight of Design Aircraft. The gross weight of the design aircraft is shown on each design curve. The design curves are grouped in accordance with either main landing gear assembly type or as separate curves for individual aircraft. A wide range of gross weights is shown on all curves to assist in any interpolations which may be required. In all cases, the range of gross weights shown is adequate to cover weights of the aircraft represented.

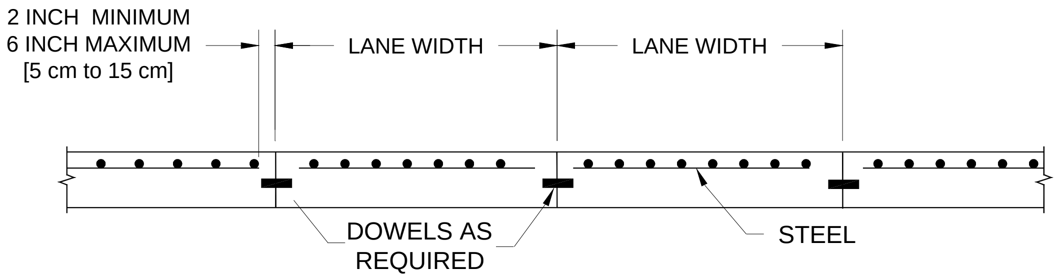
d. Annual Departures of Design Aircraft. The fourth input parameter is annual departures of the design aircraft. The departures should be computed using the procedure explained in paragraph 305.

332. USE OF DESIGN CURVES.

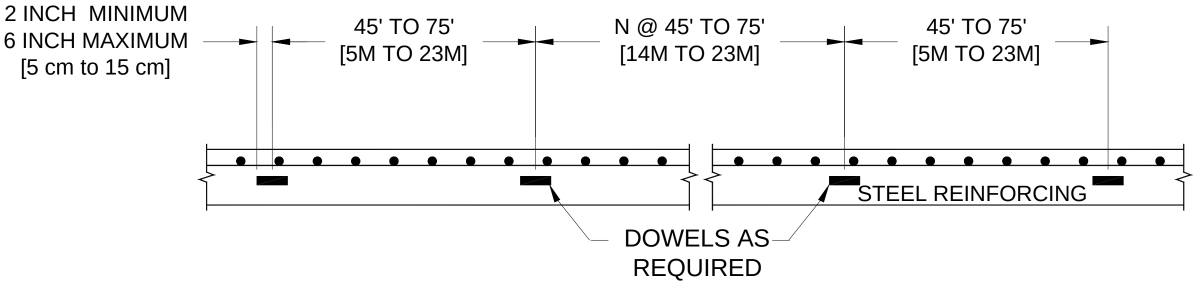
a. Rigid Pavement Design Curves. The rigid pavement design curves are constructed such that the design inputs are entered in the same order as they are discussed in paragraph 331. Dashed “chase around lines” are shown on the curves to indicate the order of progression through the curves. Concrete flexural strength is the first input. The left ordinate of the design curve is entered with concrete flexural strength. A horizontal projection is made until it intersects with the appropriate foundation modulus line. A vertical projection is made from the intersection point to the appropriate gross weight of the design aircraft. A horizontal projection is made to the right ordinate showing annual departures. The pavement thickness is read from the appropriate annual departure line. The pavement thickness shown refers to the thickness of the concrete pavement only, exclusive of the subbase. This thickness is that shown as “T” in Figure 3-1, referred to as the critical thickness.

b. Optional Design Curves. When aircraft loadings are applied to a jointed edge, the angle of the landing gear relative to the jointed edge influences the magnitude of the stress in the slab. Single wheel and dual wheel landing gear assemblies produce the maximum stress when the gear is located parallel or perpendicular to the joint. Dual tandem assemblies often produce the maximum stress when positioned at an acute angle to the jointed edge. Figures 3-30 through 3-41, have been prepared for dual tandem gears located tangent to the jointed edge but rotated to the angle causing the maximum stress. These design curves can be used to design pavement in areas where aircraft are likely to cross the pavement joints at acute angles such as runway holding aprons, runway ends, runway-taxiway intersections, aprons, etc. Use of Figures 3-30 through 3-41 is optional and should only be applied in areas where aircraft are likely to cross pavement joints at an acute angle and at low speeds.

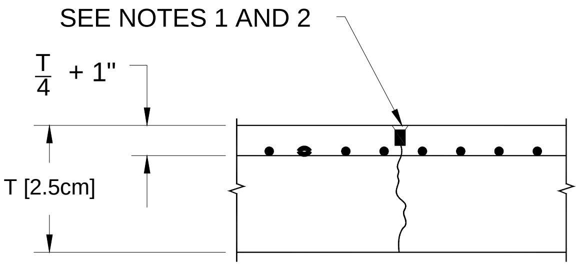
333. CRITICAL AND NONCRITICAL AREAS. The design curves, Figures 3-17 through 3-41, are used to determine the concrete slab thickness for the critical pavement areas shown as “T” in Figure 3-l. The 0.9T thickness for noncritical areas applies to the concrete slab thickness. For the variable thickness section of the thinned edge and transition section, the reduction applies to the concrete slab thickness. The change in thickness for the transitions should be accomplished over an entire slab length or width. In areas of variable slab thickness, the subbase thickness must be adjusted as necessary to provide surface drainage from the entire subgrade surface. For fractions of an inch of 0.5 or more, use the next higher whole number; for less than 0.5, use the next lower number.



TRANSVERSE CROSS SECTION OF PAVING LANES



LONGITUDINAL CROSS SECTION



LONGITUDINAL CONTRACTION JOINT

(SEE NOTE 3)

NOTES:

1. SEE FIGURES 3-42 AND 3-43 FOR GROOVE DETAILS
2. JOINT DETAILS ARE SIMULAR TO FIGURES 3-42 AND 3-42A EXCEPT FOR STEEL REINFORCING
3. USE THIS JOINT WHEN THE SLAB THICKNESS IS 10 INCHES [25 CM] OR LESS AND PAVING EXCEEDS 12 $\frac{1}{2}$ FEET [4 M].

FIGURE 3-44 JOINTING OF REINFORCED RIGID PAVEMENTS

348. CONTINUOUSLY REINFORCED CONCRETE PAVEMENT. A continuously reinforce concrete pavement (CRCP) is a Portland cement concrete pavement with continuous longitudinal steel reinforcement and no intermediate transverse expansion or contraction joints. Continuously reinforced concrete pavements normally contain from 0.5 to 1.0 percent longitudinal steel reinforcement. The main advantage of continuously reinforced concrete pavement is the elimination of transverse joints which are costly to construct, require periodic resealing, and are often a source of maintenance problems. Continuously reinforced concrete pavements usually provide a very smooth riding surface. A properly designed CRCP will develop random transverse cracks at 2 to 10 feet (0.6 to 3 m) intervals. The resultant pavement is composed of a series of articulated short slabs held tightly together by the longitudinal reinforcing steel. A high degree of shear transfer across the cracks can be achieved because the cracks are held tightly closed.

a. Foundation Support. The reinforcing steel in a CRCP provides continuity of load transfer however good uniform foundation support must still be provided for satisfactory performance. The embankment and subbase requirements given earlier in this Chapter for plain concrete pavements also apply to CRCP.

b. Thickness Design. The thickness requirements for CRCP are the same as plain concrete and are determined from the appropriate design curves, Figures 3-17 through 3-41. Design inputs are the same for concrete strength, foundation strength, aircraft weight and departure level.

c. Longitudinal Steel Design. The design of steel reinforcement for CRCP is critical to providing a satisfactory pavement. The steel percentage must be properly selected to provide optimum crack spacing and crack width. Crack widths must be small to provide a high degree of shear transfer across the crack and to prevent the ingress of water through the crack. The design of longitudinal steel reinforcement must satisfy three conditions. The maximum steel percentage determined by any of the three following requirements should be selected as the design value. In no case should the longitudinal steel percentage be less than 0.5 percent.

(1) Steel to Resist Subgrade Restraint. The longitudinal steel reinforcement required to resist the forces generated by the frictional restraint between the CRCP and the subbase should be determined by using the nomograph shown on Figure 3-45. Use of the nomograph requires three parameters: allowable working stress for steel, tensile strength of concrete and a friction factor for the subbase. The recommended working stress for steel is 75 percent of the specified minimum yield strength. The tensile strength of concrete may be estimated as 67 percent of the flexural strength. The recommended friction factor for stabilized subbase is 1.8. While not recommended as subbase for CRCP, friction factors for unbound fine-grained soils and coarse-grained soils are usually assumed to be 1.0 and 1.5 respectively.

(2) Steel to Resist Temperature Effects. The longitudinal steel reinforcement must be capable of withstanding the forces generated by the expansion and contraction of the pavement due to temperature changes. The following formula is used to compute the temperature reinforcement requirements.

$$P_S = \frac{50f_S}{f_S - 195T}$$

where:

P_s = steel reinforcement in percent
f_t = tensile strength of concrete
f_s = working stress for steel usually taken as 75% of specified minimum yield strength
T = maximum seasonal temperature differential for pavement in degrees Fahrenheit

Reinforcing steel should be specified on the basis of minimum yield strength. All deformed reinforcing steel bars should conform to ASTM A 615, A 616 or A 617. Deformed welded wire fabric should conform to ASTM A 497.

(2) Increasing C_b Factor. A value of C_b lower than 0.75 represents a severely cracked base slab, which would not be advisable to overlay without modification due to the likelihood of severe reflection cracking. See paragraph 406 f. In some instances it may be advantageous to replace several slabs and restore load transfer along inadequate joints to raise the C_b value. Increasing the C_b value will decrease the required overlay thickness. A detailed condition survey of the existing pavement which examines the subsurface drainage conditions, structural capacity of the slabs, foundation strength, flexural strength of the concrete, load transfer along joints and thickness of the component layers is strongly encouraged to properly design a hot mix asphalt overlay.

c. Example. An example of the hot mix asphalt overlay design method is given below:

(1) Assumptions. Assume an existing rigid pavement 12 inches (305 mm) thick is to be strengthened to accommodate 3000 departures of a dual wheel aircraft weighing 180,000 pounds (81,800 kg). The flexural strength of the existing concrete is 725 psi (5.00 MN/m’) and the foundation modulus is 300 pci (81.6 MN/m’). The condition factor of the existing pavement is 0.95.

(2) Single Slab Thickness. Compute the single slab thickness required to satisfy the design conditions given in (1) above. Using Figure 3-17 the slab thickness is found to be 13.9 inches (353 mm). The F factor is determined from Figure 4-3 and equals 0.93. Applying the overlay formula given in paragraph 406 yields:

$$t = 2.5\ (0.93 \times 13.9 - 0.95 \times 12)$$

$$t = 3.82 \text{ inches (97 mm)}$$

This thickness would be rounded up to 4 inches (100 mm) for practicality of construction.

d. Previously Overlaid Rigid Pavement. The design of a hot mix asphalt overlay for a rigid pavement which already has an existing hot mix asphalt overlay is slightly different. The designer should treat the problem as if the existing hot mix asphalt overlay were not present, calculate the overlay thickness required, and then adjust the calculated thickness to compensate for the existing overlay. If this procedure is not used, inconsistent results will often be produced.

e. Example. An example of a hot mix asphalt overlay design for a rigid pavement which already has an existing hot mix asphalt overlay is given below:

(1) Assumptions. An example of the procedure follows. Assume an existing pavement consists of a 10-inch (255 mm) rigid pavement with a 3-inch (75 mm) hot mix asphalt overlay. The existing pavement is to be strengthened to be equivalent to a single rigid pavement thickness of 14 inches (355 mm). Assume an “F” factor of 0.9 and “C_b” of 0.9 are appropriate for the existing conditions.

(2) Ignore Existing Overlay. Calculate the required thickness of hot mix asphalt overlay as if the existing 3-inch (75 mm) overlay were not present.

$$t = 2.5\ (0.9 \times l4 - 0.9 \times 10)$$

$$t = 9 \text{ inches (230 mm)}$$

(3) Thickness Allowance For Existing Overlay. An allowance is then made for the existing hot mix asphalt overlay. In this example assume the existing overlay is in such a condition that its effective thickness is only 2.5 inches (64 mm). The required overlay thickness would then be 9 - 2.5 = 6.5 inches (165 mm). The determination of the effective thickness of the existing overlay is a matter of engineering judgment.

f. Limitations. The formula for hot mix asphalt overlay thickness assumes the existing rigid pavement will support load through flexural action. As the overlay thickness becomes greater, at some point the existing rigid pavement will tend to act more like a high quality base material. When this condition is reached, the overlay should be designed as a flexible pavement with the existing pavement treated as a high quality base course.

407. NONSTRUCTURAL HOT MIX ASPHALT OVERLAYS. In some instances overlays are required to correct nonstructural problems such as restoration of crown, improve rideability, etc. Thickness calculations are not required in these situations, as thickness is controlled by other design considerations or minimum practical overlay thickness. Information concerning runway roughness correction can be found in FAA Report No. FAA-RD-75-110, Methodology for Determining, Isolating and Correcting Runway Roughness. See Appendix 4.

408. REFLECTION CRACKING IN HOT MIX ASPHALT OVERLAYS. Reflection cracking is often a problem in hot mix asphalt overlays particularly overlays of rigid pavement. Numerous materials and techniques have been tried attempting to solve the problem with varying degrees of success. The following methods have met with some success:

a. Coarse Aggregate Binders. The use of coarse aggregate binder course is recommended where economically feasible. Use of the largest practical size coarse aggregate in the hot mix asphalt layer immediately above the existing pavement is recommended. This practice provides some measure of protection against reflection cracking.

b. Rubblization of Existing PCC Pavement. If the condition of the existing rigid pavement is very poor (i.e., extensive structural cracking, joint faulting, “D” cracking, etc.), consideration may be given to using the “rubblization” technique. Subgrade support conditions must be considered, as weak subgrade support can cause difficulties in rubblizing the existing pavement and cause premature failures in the completed pavement. Rubblization involves purposely breaking the existing rigid pavement into small pieces and then rolling the broken pieces to firmly seat them in the foundation. A hot mix asphalt layer is then placed over the pavement. This type of section is designed as a flexible pavement, treating the broken rigid pavement as base course. Reflective cracking is reduced or eliminated with this type of construction.

c. Engineering Fabrics. Research studies and field performance have shown that fabric membranes are effective in retarding reflection cracking. While fabrics will not eliminate reflection cracking all together, they do provide some degree of water-proofing beneath reflection cracks thus protecting the existing pavement and foundation. At present, the water-proofing capability of fabrics, assuming the capacity of the asphalt impregnated fabric to resist rupture is not lost, appears to be the most significant contribution fabrics provide in a hot mix asphalt overlay system. Existing pavements, whether flexible or rigid, that show evidence of excessive deflections, substantial thermal stresses, and/or poor drainage, probably will exhibit no improvement by including a fabric in a structural overlay. The following conditions are recommended for fabric usage:

(1) Fabric Properties. The fabric should have a minimum tensile strength of 90 lbs (41 kg) when tested in accordance with ASTM D 4632 and a density in the range of 3 to 5.5 ounces per square yard (70 to 130 grams per square meter).

(2) Application. Fabric membranes should not be used where the horizontal displacements exceed 0.05 inch (1.3 mm) or where vertical displacements will exceed 0.02 inch (0.5 mm). Fabric should not be used when the overlay thickness is less than 3 inches (75 mm) or more than 7 inches (178 mm).

(3) Tack Coat. The proper amount of tack coat applied to the fabric is critical. Emulsified asphalt applied at a rate of from 0.15 to 0.30 gallons per square yard (0.7 to 1.4 liters per square meter) is recommended. The optimum amount of tack coat will depend on the type of fabric and the surface on which the fabric is placed.

d. Asphalt Reinforcement. Destructive tensile stresses in asphalt pavements may be reduced by incorporating a reinforcement material. Reinforcement materials are similar to fabric membranes except the reinforcement is either a woven fabric or a grid- shaped material. These materials have very high tensile strength and very low strain capacity. Products with a combination of fabric materials and reinforcement grids have been developed and appear to be successful in retarding reflective cracking. Depending upon the material type and the intended purpose, reinforcing materials may be applied across the full width of the pavement or may be limited to the immediate area around joints and cracks.

409. DESIGN OF CONCRETE OVERLAYS. Concrete overlays can be constructed on existing rigid or flexible pavements. The minimum allowable thickness for concrete overlays is 5 inches (127 mm) when placed on a flexible pavement, directly on a rigid pavement, or on a leveling course. The minimum thickness of concrete overlay which is bonded to an existing rigid pavement is 3 inches (75 mm). The design of concrete overlays is based on a thickness deficiency approach. The existing base pavement and overlay section are equated to a single slab thickness. The empirical formulas presented were developed from research on test track pavements and observations of in-service pavements.

CHAPTER 8. PAVEMENT DESIGN FOR AIRFIELD SHOULDERS

801. PURPOSE. This chapter provides a design procedure for paved airfield shoulders.

802. APPLICATION. The design procedure for paved or surfaced shoulders applies to all airports that accommodate Design Group III or higher aircraft.

803. BACKGROUND. The need for paved or surfaced shoulders is created due to erosion and generation of debris from jet blast. As aircraft grew in size, so did the size of the aircraft engines and their respective increase in jet thrust or jet blast. Jet blast can cause problems with erosion of unprotected soil immediately adjacent to airfield pavements. To mitigate this problem, FAA recommends paved shoulders for runways, taxiway, and aprons that will accommodate Group III and higher aircraft. In addition to providing protection from jet blast, the shoulder must be capable of safely supporting "occasional" passage of the most demanding aircraft as well as emergency and maintenance vehicles.

804. PURPOSE OF DESIGN PROCEDURE. The procedure for shoulder pavement thickness design is intended to provide a minimum pavement structure to support limited operations of aircraft. The design is intended to provide sufficient support for unintentional or emergency operations of an aircraft on the shoulder pavement. Use standard airfield pavement design requirements to design all areas of pavement where aircraft regularly operate.

The minimum section provided by the shoulder pavement design procedure will not perform in the same fashion as full strength airfield pavements. The shoulder pavement is intended to allow safe operation of the aircraft across the paved area without damage to the aircraft. Flexible shoulder pavement sections may experience noticeable vertical movements with each passage of an aircraft and may require inspection and/or limited repair after each operation. Rigid shoulder pavement sections may experience cracking with each operation.

805. DESIGN PROCEDURE. The design procedure is based upon the FAA Layered Elastic pavement design software (LEDFAA) and utilizes a modified design procedure to determine the most demanding aircraft (MDA) for shoulder pavement design purposes. Several of the procedural assumptions in the standard pavement design (traffic distribution, pass-to-coverage ratios, etc,) are not valid and are not used for the shoulder pavement design procedure. The procedure determines the minimum pavement section required for the MDA, assuming a total of 10 departures. A composite traffic mixture is not considered for the shoulder design.

The shoulder pavement design procedure determines the MDA by calculating pavement thickness requirements for all aircraft utilizing or expected to utilize the airport. The aircraft requiring the thickest pavement section is considered the MDA. The following steps are used to complete the design procedure:

1 Use the LEDFAA software to create a new job file and proposed pavement section for the shoulder design. Include all desired pavement layers, e.g. surface course, base course, stabilized course, subbase course, etc. Adjust layer thickness to observe minimum thickness requirements for shoulder design.

NOTE: Due to minimum pavement layer requirements in the formal airfield pavement design procedure, it may be necessary to use the "undefined" pavement layer to represent the proposed shoulder pavement cross-section.

2 Input one aircraft from the traffic mixture for analysis.

a. Adjust aircraft operating weights as appropriate.

b. Change annual departures to 1.0 departure.

3 Return to the Structure screen and confirm that the design period is 10 years.

NOTE: The intent of this design procedure is to design a pavement for 10 total departures of the most demanding aircraft. By setting annual departures to 1 and the design period to 10, the total departures is 10.

4 Confirm the composition and thickness of pavement layers and that the correct layer is designated for thickness iteration. The iteration layer will be shown with a small arrow along the left side.

5 Click on the “Design Structure” button to establish the minimum pavement section for the individual aircraft.

6 Repeat steps 1 through 5 for all aircraft in the traffic mixture. The pavement section with the greatest thickness requirement is the design for the shoulder pavement.

EVALUATION AID: To reduce the list of individual aircraft requiring evaluation, include all aircraft from the airport traffic mixture and set annual departures of all aircraft to 1,200 annual departures. Create the proposed shoulder pavement section in the structure screen, then click the “Life” button instead of the “Design Structure” button. Return to the aircraft mixture, and scroll over to the column labeled “CDF Max for Aircraft”. The aircraft with the highest CDF Max value will be the most demanding aircraft in most instances and will control the shoulder design. However, the top few aircraft with the highest CDF Max values should be evaluated because the thickness of the pavement section being evaluated will influence which aircraft is the most demanding.

806. PAVEMENT LAYER THICKNESS AND MATERIAL REQUIREMENTS.

a. Asphalt Surface Course Materials. The minimum recommended thickness for asphalt surfacing material is 3 inches. The material should be of high quality, similar to FAA Item P-401, and compacted to an average target density of 94 percent of maximum theoretical density. Material produced for use with high traffic volume highway pavement is acceptable provided the compaction specified for the highway application is obtained.

b. Portland Cement Concrete Surface Course Materials. The minimum recommended thickness for rigid pavement design is 6 inches. Portland Cement Concrete (PCC) must be a high quality, durable material capable of resisting deterioration due to environmental factors. The PCC should be similar to FAA Item P-501, with a minimum design flexural strength of 600 psi. Material produced for use with high traffic volume highway pavement is acceptable provided that environmental durability is addressed.

b. Base Course Materials. Base course materials must be high quality crushed stone or stabilized materials similar to FAA Items P-208, P-209, P-301, or P-304. Materials produced for use with high traffic volume highway pavement may be acceptable provided they possess qualities similar to the FAA specification items. Crushed stone material must possess a minimum CBR value of 80. The recommended minimum thickness of the base course material is 6 inches. The minimum base course thickness may be reduced to 4 inches by increasing the minimum asphalt thickness by 1.0 inch. Place base course material in accordance with the appropriate standard from AC 150/5370-10 or in accordance with the applicable State Highway standard. Additional consideration should be given to frost heave susceptibility of the material when used in frost-susceptible zones.

c. Subbase Course Materials. Subbase course material must provide a minimum CBR value of 20. Materials produced by State Highway standards are acceptable provided the minimum CBR value is obtained. Place subbase course material in accordance with AC 150/5370-10, Item P-154 or in accordance with the applicable State Highway standard. Additional consideration should be given to frost heave susceptibility of the material when used in frost susceptible zones. The minimum recommended thickness is 4 inches. See paragraph 808 below.

d. Subgrade Materials. Preparation of subgrade materials should be in accordance with AC 150/5370-10, Item P-152.

807. EMERGENCY AND MAINTENANCE VEHICLE CONSIDERATIONS. In most cases, the pavement design selected by the shoulder design procedure should provide sufficient strength for unlimited operations of maintenance and emergency vehicles. If high operations of these vehicles are anticipated, the shoulder design should be verified for the anticipated service.

808. AREAS SUSCEPTIBLE TO FROST HEAVE. In areas prone to frost heave, it may be necessary to increase the thickness of the shoulder pavement to avoid differential frost heave. Additional thickness of the pavement beyond that necessary for structural design may be achieved with any material suitable for pavement construction. The material should possess a CBR value higher than the subgrade and have non-frost susceptible properties. Place the additional layer immediately on the subgrade surface below all base and subbase layers.

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