



Federal Aviation Administration

Memorandum

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To: All Regional Airport Division Managers

A handwritten signature in green ink that reads "Khalil Kodsi".

From: Khalil E. Kodsi, P.E. PMP, Manager, Airport Engineering, AAS-100

Prepared by: Steven Debban, Civil Engineer, Airport Engineering, AAS-100, x78664

Subject: Engineering Brief No. 94, Accommodating the Boeing B-777 Folding
Wingtip Airplane on Airports Built to ADG-V or Lower

This Engineering Brief (EB) discusses the results of analyzing the potential effect of accommodating the new Boeing B-777 Folding Wingtip Airplane (777 Folding Wingtip Airplane) on airport geometry and the application of existing FAA airport design standards.

Attachments



ENGINEERING BRIEF #94

Accommodating the Boeing B-777 Folding Wingtip Airplane onto Airports

1.0 Introduction.

This Engineering Brief (EB) discusses the results of analyzing the potential effect of accommodating the new Boeing B-777 Folding Wingtip Airplane (777 Folding Wingtip Airplane) on airport geometry and the recommended application of existing FAA airport design standards.

The Federal Aviation Administration has developed standards for airport geometry that ensure adequate clearance between airplane wingtips and other objects, including other airplanes. The clear space needed to taxi an airplane is determined mainly by its wingspan. Airplanes have grown in size to have unprecedented wingspans, and few airports have been built to accommodate the largest airplanes. Folding wingtip designs allow for the proper use of existing airfield infrastructure designed for Airplane Design Group (ADG) V.

2.0 Background.

To enable the B-777 Folding Wingtip Airplane to operate at airports designed for airplanes with narrower wingspans, technology was introduced that is common in military airplanes, but new to the civil fleet – the folding wingtip. The success of this design feature will likely result in its application to future airplane models.

The Federal Aviation Administration designs approach procedures for “families” of airplanes. The two characteristics of airplanes that determine the airspace requirements for procedures are Aircraft Approach Category (AAC), based on the landing approach speed, and the Airplane Design Group (ADG), based on the wingspan and tail height of the airframe. FAA standards for airport design are also based on these factors, but the movement of airplanes on the ground are only partially governed by them. The ability to fold the wingtips of the 777 Folding Wingtip Airplane while on the ground results in the unique ability to reduce the ADG of this airplane from ADG-VI to ADG-V while taxiing. FAA taxiway design standards also include Taxiway Design Group (TDG), based on the configuration of an airplane’s landing gear, but as the TDG and the AAC of the 777 Folding Wingtip Airplane are constant, this paper discusses only the effects of the Boeing 777 Folding Wingtip Airplane’s variable ADG on airport operations.

3.0 Application.

The Federal Aviation Administration (FAA) recommends this EB for all civil airports built to ADG-V or lower that anticipate accommodating the Boeing 777 Folding Wingtip Airplane. See also Advisory Circular [\(AC\) 150/5300-13A](#), *Airport Design*, for more information and guidance on airport geometry standards.

4.0 Airplane Design Group.

The dimensions that determine the ADG of the 777 Folding Wingtip Airplane are its tail height of 64.1 feet and wingspan of either 235.4 feet or 212.7 feet. As the limits for tail height and wingspan of ADG-V are 66 feet and 214 feet respectively, the 777 Folding Wingtip Airplane falls into ADG-VI with wingtips extended, and ADG-V with wingtips folded.

5.0 Standards Affected.

Other than those standards discussed below, runway design standards are either the same for ADG-V and ADG-VI, or the differences have no operational significance.

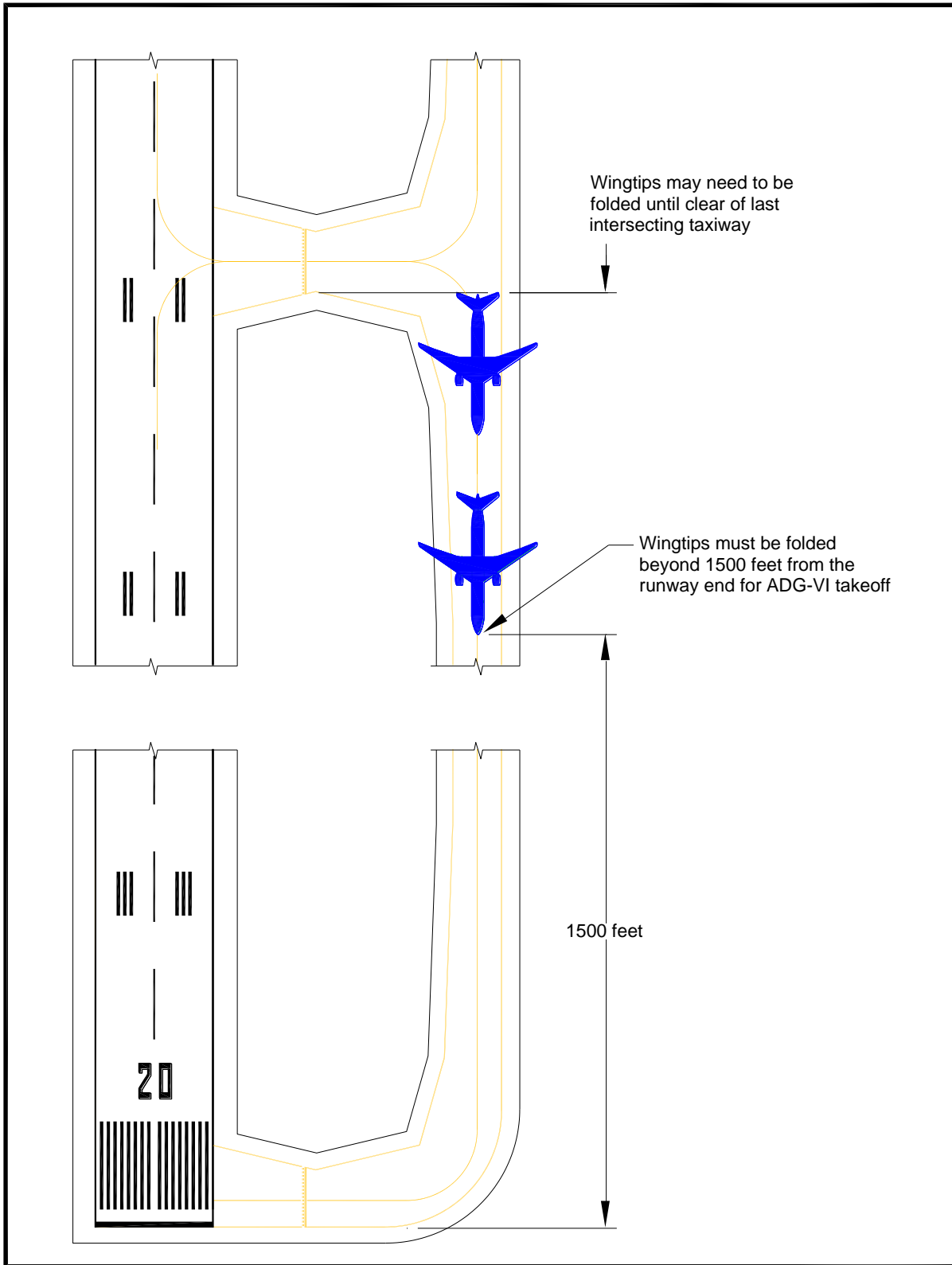
5.1 Runway Width.

The FAA standard for runway width for ADG-VI is 200 feet. However, the FAA Flight Standards Service determines the runway width required for the takeoff and landing of particular airplanes, and allows the operations of other ADG-VI airplanes on runways as narrow as 150 feet based on demonstrated capabilities of those airplanes.

5.2 Runway to Taxiway Separation.

The required distance between the centerline of a runway and the associated parallel taxiway is dependent on the ADG of airplanes on the parallel taxiway, the AAC and ADG of the airplane using the runway, and for landing operations, the visibility conditions under which the operation is being conducted. These requirements are summarized in Tables 3-7, Approach Reference Code, and 3-8, Departure Reference Code, in [AC 150/5300-13A](#), *Airport Design*. A note in Table 3-7 states “For ADG-VI aircraft with tail heights of less than 66 feet (20 m), ADG-V separation standards may be used.” The 777 Folding Wingtip Airplane is always an ADG-VI airplane when it is in flight or on the runway, and ADG-V standards sometimes apply when it is on the parallel taxiway, since its tail height is below 66 feet. Thus, runway to taxiway separation with respect to landing operations is not affected by the folding wingtip design. For departure operations, Table 3-8 states “ADG-VI airplanes may depart with aircraft on the parallel taxiway where the runway to taxiway separation is as little as 400 feet as long as **no ADG-VI aircraft** occupy the parallel taxiway beyond 1500 feet of the point of the start of takeoff roll. Operational plans should include provisions for extension of wingtips only within 1500 feet of the point of the start of the takeoff roll. See Figure 1.

Figure 1



5.3 Taxiway Design Standards.

There are several FAA taxiway design standards that are based on ADG. None of these standards, however, are operational requirements. Where an airplane of a higher ADG than that for which a taxiway system is designed operates on that taxiway system, safe operations can be conducted by the use of special procedures. Such procedures, as used where ADG-VI airplanes currently operate on taxiway systems designed for ADG-V, are discussed below.

1. Taxiway to Taxiway Separation.

The requirement for a minimum distance between the centerlines of parallel taxiways ensures that wingtips of airplanes on those respective taxiways will not collide. Where a 777 Folding Wingtip Airplane is taxied with its wingtips folded on a taxiway system designed for ADG-V, no special procedures are required. Information from Boeing states that wingtips will be extended as soon as feasible prior to the runway end along a taxiway parallel to a runway for takeoff, and prior to entering the taxiway system on landing. Airport operators should coordinate an operational plan detailing these procedures with airlines, the appropriate FAA Airports District or Regional Office, and local Air Traffic Service in developing operational plans to accommodate the 777 Folding Wingtip Airplane and designate points of wingtip extension prior to runway entrances.

a. Single taxiways.

Where a taxiway does not parallel another taxiway, the extension of the wingtips of a 777 Folding Wingtip Airplane between any intersecting taxiways and the runway end requires no special procedures to ensure adequate separation from other airplanes. Taxiway to Fixed Object standards still apply. See paragraph 3 below.

b. Parallel Taxiways.

Where two (or more) taxiways designed for ADG-V or lower are parallel, special procedures to maintain wingtip to wingtip separation should be used for those portions beyond the point of wingtip extension. If full ADG-V and/or ADG-VI standards, as appropriate, cannot be met, such procedures will require an FAA approved Modification to Standards (MOS). An MOS should ensure a clearance of 53 feet when wingtips are folded, and 62 feet when wingtips are extended, between the wingtips of airplanes on the parallel taxiway(s) (see [AC 150/5300-13, Airport Design](#) and [FAA Order 5300.1F - Modifications to Agency Airport Design, Construction, and Equipment Standards](#)). This may be achieved, for example, by restricting the other taxiway during such operations to airplanes with shorter wingspans (no greater than 174.6 feet for taxiways built to ADG-V separation standards). If this is operationally undesirable, the extension of the wingtips of a 777 Folding Wingtip Airplane can be delayed until just prior crossing the runway hold line for takeoff. This, however, may not be applicable to multiple entrances at a runway end.

2. **Taxiway/Taxiway Intersections.**

Where a taxiway intersects a taxiway in use by a 777 Folding Wingtip Airplane with wingtips extended, any taxiway/taxiway intersection intermediate holding position markings should be located in accordance with ADG-VI criteria (i.e. 193 feet from the taxiway centerline, or at least to provide a wingtip clearance of 62 feet with an FAA approved MOS. (See AC 150/5340-1, *Standards for Airport Markings*).

3. **Taxiway to Fixed or Movable Objects.**

Fixed objects (e.g. glide slope) or movable objects (e.g. vehicles) are often located adjacent to taxiways. All objects close to taxiways must be properly assessed to ensure proper wingtip clearance is maintained. For example, every roadway lane that feeds vehicle traffic onto or across a taxi route where the 777 Folding Wingtip Airplane wingtips will be extended must have a solid roadway stop line (bar) located in accordance with ADG-VI separation criteria (i.e. 193 feet from the taxiway centerline, or provide a minimum wingtip clearance of 62 feet with an FAA approved Modification to Standards).

6.0 Conclusions.

1. The folding wingtip design of the 777 Folding Wingtip Airplane will have no effect on runway operations as long as wingtips are not extended farther than 1,500 feet from the departure point during departure operations. Any procedures applicable to other ADG-VI airplanes also apply to the 777 Folding Wingtip Airplane.
2. For taxiway operations, procedures similar to those currently used where ADG-VI airplanes operate on taxiway systems designed for ADG-V or lower may be used. Such procedures are necessary only where a 777 Folding Wingtip Airplane is being taxied with its wingtips extended. In addition, procedures will often include restricting where the 777 Folding Wingtip Airplane's wingtips may be extended.
3. It is advisable for operational plans to include provisions for taxiing the 777 Folding Wing Airplane with wingtips extended to plan for the rare occurrence of the inability to fold the wingtips.