Federal Aviation Administration

Memorandum

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To: All Airports Regional Division Managers

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Subject: Engineering Brief No. 94B, Accommodating the Boeing B-777 Folding Wingtip Airplane onto Airports

This Engineering Brief provides guidance for the design and planning of airports to accommodate the Boeing B-777 Folding Wingtip aircraft and is an update to Engineering Brief 94A. This update removes the reference for the standard width for Aircraft Design Group (ADG) VI to be 200 feet, as the standard width is now 150 feet, per the publication of Change 1 to Advisory Circular (AC) 150/5300-13B, Airport Design.

Attachment

FAA
Airports

ENGINEERING BRIEF #94B

Accommodating the Boeing B-777 Folding Wingtip Airplane onto Airports

1.0 Introduction.

This Engineering Brief (EB) discusses methods to accommodate the new Boeing B-777 Folding Wingtip Airplane (777 FWT Airplane) on airport geometry and the recommended application of existing FAA airport design standards. The ICAO aircraft identifier for the 777 FWT Airplane is the B778 or B779.

The Federal Aviation Administration (FAA) develops standards for airport geometry ensuring adequate clearance between airplane wingtips and other objects, including other airplanes. Wingspan primarily determines clear space needed to taxi an airplane. Airplane wingspans have increased over time to improve efficiency, and only certain runways and taxiways are built to accommodate the largest airplanes. This folding wingtip design allows for use of existing airfield infrastructure designed for Airplane Design Group (ADG) V without special airport operating procedures (SAOP) for the aircraft type, or infrastructure alterations.

2.0 Background.

To enable the 777 FWT Airplane to operate at airports designed for airplanes with shorter wingspans, folding wingtip technology was introduced that is common in military airplanes, but new to the civil fleet.

The critical aircraft using the runway is a key component to instrument approach procedure designs, as well as other elements. The two characteristics of the critical aircraft determining the airspace requirements for these procedures are:

- Aircraft Approach Category (AAC), based on the landing approach speed, and
- ADG, based on the wingspan and tail height of the airframe.

FAA standards for airport design are also based on AAC and ADG, which also inform SAOP for the movement of airplanes on the ground. The ability of the 777 FWT Airplane to fold the wingtips while on the ground results in the unique benefit 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 since the TDG and the AAC of the 777

FWT Airplane are consistent with the other airplanes in the B-777 class, this EB discusses only the effects of the 777 FWT Airplane's variable ADG on airport operations.

3.0 Application.

FAA recommends this EB for all civil airports built to ADG-V or lower that anticipate accommodating the 777 FWT Airplane. See the latest version of Advisory Circular (AC) 150/5300-13, *Airport Design*, for more information and guidance on airport geometry standards.

4.0 Airplane Design Group (ADG).

The dimensions that determine the ADG of the 777 FWT Airplane are its tail height of 64.1 feet (19.5 m) and wingspan of either 235.4 feet (71.7 m) (extended) or 212.7 feet (64.8 m) (folded). As the limits for tail height and wingspan of ADG-V are 66 feet (20.1 m) and 214 feet (65.2 m) respectively, the 777 FWT 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 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 present at the time of operation.

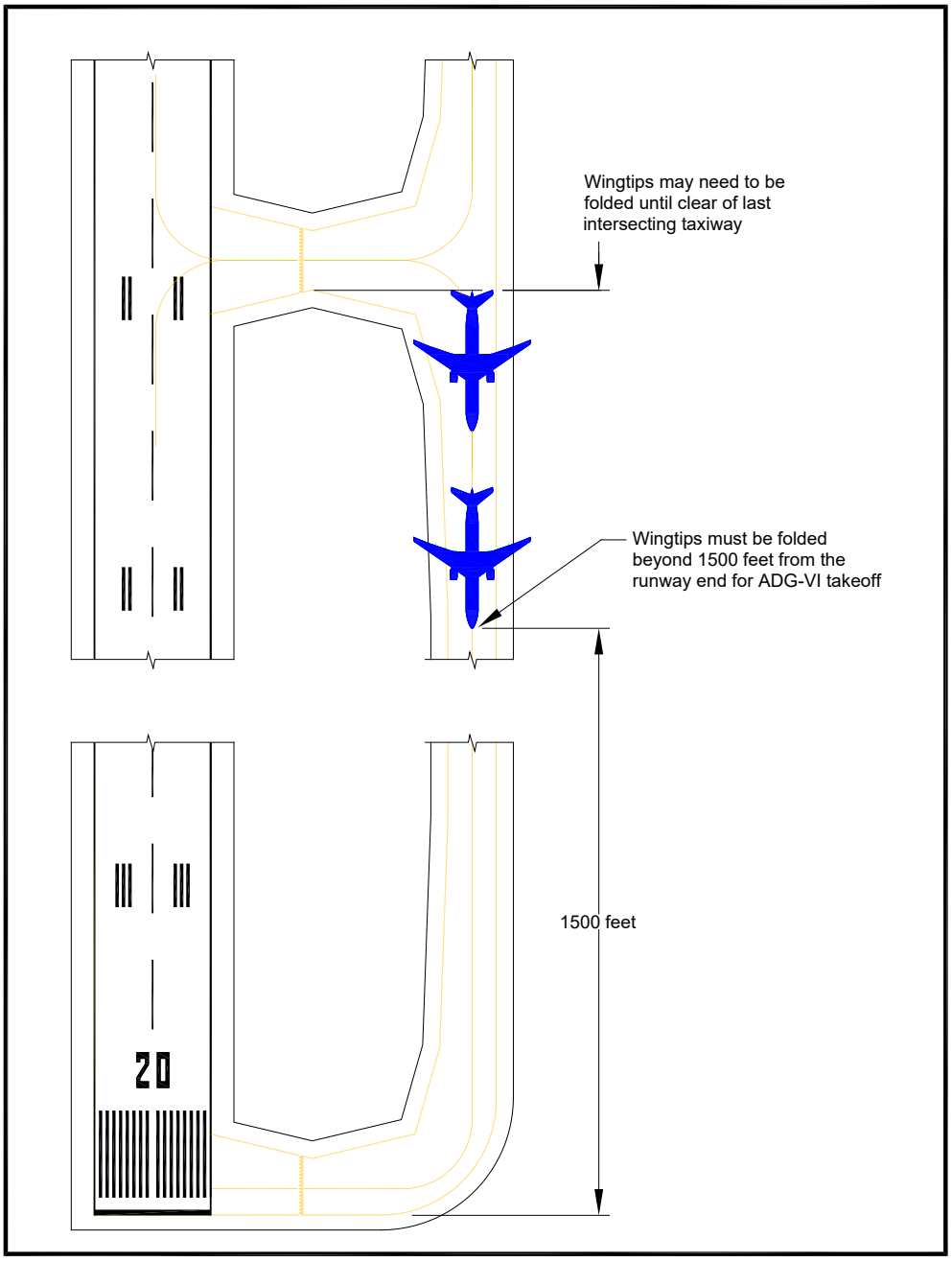
These requirements are summarized in Tables L-1, Approach Reference Code, and L-2, Departure Reference Code in AC 150/5300-13. A note in Table L-1 states "For ADG-VI aircraft with tail heights of less than 66 feet, ADG-V separation standards apply." The 777 FWT Airplane is always ADG-VI on the runway, and ADG-V standards sometimes apply, depending on the position of the wingtips, when it is on the parallel taxiway since its tail height is below 66 feet.

- For landing operations, the folding wingtip design has no impact to runway to taxiway separation.
- For departure operations, Table L-2 states "ADG-VI airplanes may depart with aircraft on the parallel taxiway where the runway to taxiway separation is as little as 400 feet (122 m) as long as:
    - No ADG-VI aircraft occupy the parallel taxiway beyond 1500 feet (457 m) of the point of the start of takeoff roll. (Figure 1 assumes this is the runway threshold, but this is not always true.)

- No aircraft, regardless of size, is occupying the parallel taxiway beyond 1,500 feet) of the point of the start of takeoff roll when there is snow, ice, or other contamination on the runway.

Accordingly, develop airport operational plans that 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



5.2 Taxiway Design Standards.

There are several FAA taxiway design standards based on ADG. None of these standards are operational requirements. Where an airplane of a higher ADG than for which a taxiway system is designed operates on that taxiway system, safe operations are conducted by using SAOP. Such SAOP, 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 do not collide. Where a 777 FWT Airplane taxis with its wingtips folded on a taxiway system designed for ADG-V, no SAOP are necessary. Information from Boeing states for departure that wingtips are extended as soon as feasible prior to entering the runway along a taxiway parallel to a runway for takeoff; and folded prior to exiting the runway and entering the taxiway system upon landing. Airport operators should coordinate an operational plan detailing compatible wingtip extension and retraction locations with airlines, the Flight Standards Certificate Management Office overseeing the airline, the appropriate FAA Airports District or Regional Office, and local Air Traffic Service. Document the operational plan with the SAOP in the airport's Airport Certification Manual (ACM), airline surface operating procedures used by pilots, and a Letter of Agreement between the airport operator and the Airport Traffic Control Tower.

a. **Single taxiways.**

Where a taxiway does not parallel another taxiway, the extension of the wingtips of a 777 FWT Airplane between any intersecting taxiways and the runway end may not need an SAOP to ensure adequate separation from other airplanes. Evaluate the geometry and note the Taxiway Centerline to Fixed Object or Movable Objects standards still apply (See AC 150-5300-13, Table 4-1). See paragraph 3 below.

b. **Parallel Taxiways.**

Where two (or more) taxiways designed for ADG-V or lower are parallel, use SAOP to maintain wingtip to wingtip separation for those portions beyond the point of wingtip extension. If full ADG-V and/or ADG-VI standards, as appropriate, cannot be met for the 777 FWT operations, develop SAOP in an Airport Compatibility Assessment. This assessment shall ensure a clearance of 35.5 feet (10.8 m) when wingtips are folded, and 36.5 feet (11.1 m) when wingtips are extended, between the wingtips of airplanes on the parallel taxiway(s) (see AC 150/5300-13 and the latest version of FAA Order 5300.1 - *Modifications to Agency Airport Design, Construction, and Equipment Standards*). These standard separations may be achieved, for example, by restricting the operations on the other taxiway to airplanes with shorter wingspans If this is operationally undesirable, another option is to extend the wingtips of a 777 FWT Airplane just prior to crossing the runway hold line for takeoff; or on the runway itself if sufficient runway occupancy time is available. If multiple entrances serve the runway end, consider the taxiway-to-taxiway separation to

identify the appropriate entrance(s) where the 777 FWT Airplane operates as ADG-VI with extended wingtips.

2. **Taxiway/Taxiway Intersections.**
Where a taxiway intersects a taxiway in use by a 777 FWT Airplane with wingtips extended, locate any taxiway/taxiway intersection intermediate holding position markings in accordance with ADG-VI criteria (i.e., half the ADG VI TOFA width of 167.5 feet (51.1 m) from the taxiway centerline; or at least to provide a wingtip clearance of 36.5 feet with an Airport Compatibility Assessment). 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. Assess all objects close to taxiways to maintain proper wingtip clearance. For example, provide a solid roadway stop line (bar) located in accordance with ADG-VI separation criteria on every roadway lane feeding vehicle traffic onto or across a taxi route where the 777 FWT Airplane operates with wingtips extended (i.e., 167.5 feet from the taxiway centerline, or provide a minimum wingtip clearance of 36.5 feet with an Airport Compatibility Assessment).

6.0 Conclusions.

1. The folding wingtip design of the 777 FWT Airplane will have no effect on runway operations when the wingtips are extended no further than 1,500 feet from the departure point during departure operations. Any SAOP applicable to other ADG-VI airplanes also apply to the 777 FWT Airplane.

2. For taxiway operations, SAOP like 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 FWT Airplane is taxiing with its wingtips extended. In addition, the SAOP indicates where on the airport to extend the wingtips for takeoff.

3. The FAA recommends operational plans include non-nominal provisions for taxiing the 777 FWT Airplane with wingtips extended, to accommodate the rare occurrence of the inability to fold the wingtips.