## PART II. OPERATIONAL RESTICTIONS

Nearly all of U.S. airports identified in figures 3 and 4 were built to less demanding airport design criteria than that appropriate for NLA service, namely ADG VI criteria. Although ADG VI criteria fully accommodate the operational requirements of NLA, some existing airfield infrastructure built to the lesser ADG V criteria can accommodate certain operational demands. The following paragraphs describe the negative consequences of this situation on airfield infrastructure and terminals on the basis of the (1) physical dimensions of existing airfield components, (2) clearance of fixed/movable objects from taxiing NLA, and (3) separations between taxiing NLA. To recapitulate the discussion on design features, table 1 summarizes the numerical differences between ADG V and VI standards and the percentage increase to physical design features and reduction to safety margins.

### 1. Physical Dimensions of Airfield Infrastructure.

#### a. Unaffected ADG V Airfield Infrastructure.

**(1) Runway Length**. The improved high lift wing designs in combination with the proposed engine trust ratings allow NLA continual usage of existing runways serving Boeing 747. Hence, runways do not require an increase in length.

**(2) Runway Blast Pad Length**. The proposed engines for NLA have comparable trust ratings to engines used on current wide-bodied aircraft. Hence, blast pads beyond the ends of ADG V runways do not require an increase in length.

#### b. Effected ADG V Airfield Infrastructure.

**(1) Runway and Shoulder Widths**. The widths for runways and shoulders are increased from 150 feet (45 m) to 200 feet (60 m) for runways and from 35 feet (10.5 m) to 40 feet (12 m) for runway shoulders. The items were included in the survey.

**(2) Runway Blast Pad Width**. The width of the blast pad, which equals the width of the runway and its shoulders, is increased from 220 feet (66 m) to 280 feet (84 m). The item was included in the survey.

**(3) Runway/Taxiway Bridges and Culverts**. The proposed maximum design taxiing weight for NLA is in the neighborhood of 1.4 million pounds (635,000 kg). The value represents an approximate 60 percent increase from the certified maximum design taxi weight for the Boeing 747-400 of 877,000 pounds (397,800 kg). Clearly, reinforcement is necessary for existing bridges and culverts not built to support the significant increase. The items were included in the survey.

**(4) Taxiway and Shoulder Widths.** The widths for taxiways and shoulders are increased from 75 feet (23 m) to 100 feet (30 m) for taxiways and from 15 feet (4.5 m) to 20 feet (6 m) for taxiway shoulders. The items were included in the survey.

**(5) Taxiway Fillets**. An airport safety design feature used in the design of taxiway fillets (including straight taxing sections) is the provision for a taxiway edge safety margin (TESM). Its function is to provide actual pavement for aircraft main gears during straight taxiing and turning operations. The TESM standard is increased from 15 feet (4.5 m) to 20 feet (6 m). The item was included in the survey.

2. **Clearances**.

**a. Unaffected ADG V Airfield Facilities**.

**(1) Runway Safety Area (RSA)**. At this time, the dimensions of the RSA for ADG V runways do not require an increase in length or width.

**(2) Runway Object Free Areas (ROFA)**. The dimensions of the ROFA for ADG V runways do not require an increase in length or width.

**b**. **Effected ADG V Airfield Facilities**.

**(1) Taxiway Safety Area (TSA) Width**. Widths of TSAs are based on the wingspan of the design airplane being accommodated. Since NLA have significantly wider wingspans, TSA width is increased from 214 feet (65 m) to 262 feet (80 m). The item was included in the survey.

**(2) Taxiway and Taxilane Object Free Area (OFA) Width**. Taxiing airplanes require a cleared area free from fixed or movable objects. The cleared area, termed the OFA, has a width based on the wingspan of the airplane design group being accommodated and whether air traffic controls or does not control taxiing aircraft. In terms of airport design, taxiway design criteria are used for the former operation were as, taxilane design criteria are used for the latter. Regardless of the design approach, both approaches contain a built in minimum wingtip clearance safety margin, that is, a distance between the wingtip of the airplane and the nearest object. The key difference between the two taxi design approaches is that taxilane operations allow smaller wingtip clearances than taxiway operations due to slower taxiing operations or extra safety measures. Taxiway OFA criteria are generally applicable to the airfield while taxilane criteria are commonly applied in the terminal gate areas of airports. For taxiways, the OFA width is increased from 320 feet (97 m) to 386 feet (118 m). For taxilanes, the OFA width is increased from 276 feet (84 m) to 334 feet (102 m).

**(i) Safety Margin for Airfield Taxiway OFA.** During airfield taxiing operations, the taxiway OFA design standard maintains a minimum wingtip clearance safety margin of 62 feet (19m) between the wingtip and any object, whether fixed or movable. It is worth noting that the safety margin assumes no deviation from the

centerline by an airplane during taxiing. When NLA taxi on taxiways built to the lesser ADG V standards, the safety margin is reduced approximately 54 percent. That is, the 62-foot (19m) safety margin is lowered to a 29-foot (9 m) wingtip clearance.

**(ii) Safety Margin for Terminal Taxilane OFA**. For non-ATCT controlled terminal gate operations, the taxilane OFA design standard maintains a minimum wingtip clearance safety margin of 36 feet (11m) between the wingtip and any object, whether fixed or movable. Figure 5 illustrates the separation standard for ADG VI. In similar fashion to taxiway design, the safety margin assumes no deviation from the centerline by the airplane during taxiing. Figure 6 illustrates the significant reduction to the safety margin when NLA taxi at airports built to the lesser ADG V standard. It distinctly shows an 81 percent reduction to the safety margin from 36 feet (11m) down to only a 7-foot (2m) wingtip clearance. Clearly, NLA taxiing operations in the terminal gate and apron areas will experience severe taxiing restrictions. An operational restriction imposed on the terminal gate area may be restricting certain gates to aircraft having short fuselage lengths as a mean to provide adequate wingtip clearance for the passage of NLA. If this or another option does not overcome the less than standard clearance problem, then parking of NLA will most likely be at designated hard stands away from the terminal.

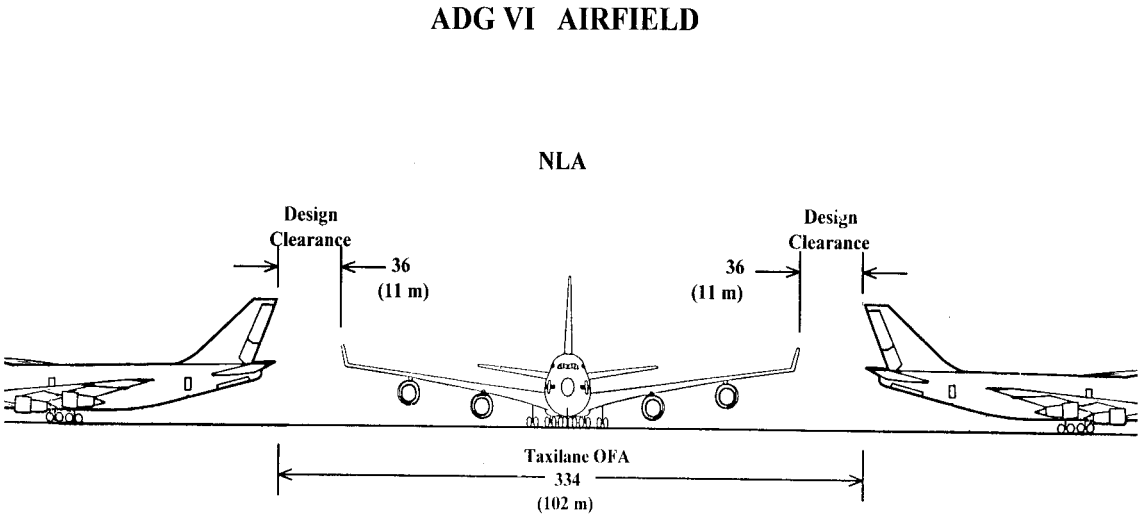


**Figure 5. Terminal Taxilane with Full Wingtip Safety Margin .**

**ADG V AIRFIELD**

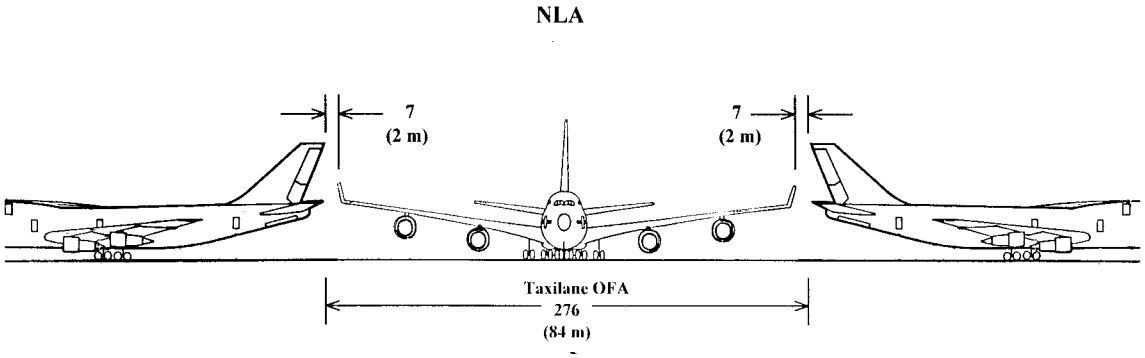


**Figure 6. Terminal Taxilane with Reduced Wingtip Safety Margin.**

**3. Separations.**

**a. Unaffected ADG V Airfield Facilities**.

**(1) Holdline Location on Taxiway Entrance.** Before taxiing onto a departure runway, airplanes hold on an entrance taxiway at a specified distance away from the runway centerline, i.e., the holdline. Figure 7 illustrates that when a NLA is on approach, NLA can simultaneously hold perpendicular to a precision runway under the applicable holdline criterion for ADG V runways at sea level.

**(2) Parallel Runways**. At this time, the current separation standards between the centerlines of parallel runways remain the same under visual and instrument flight rules.

**ADG V AIRFIELD**

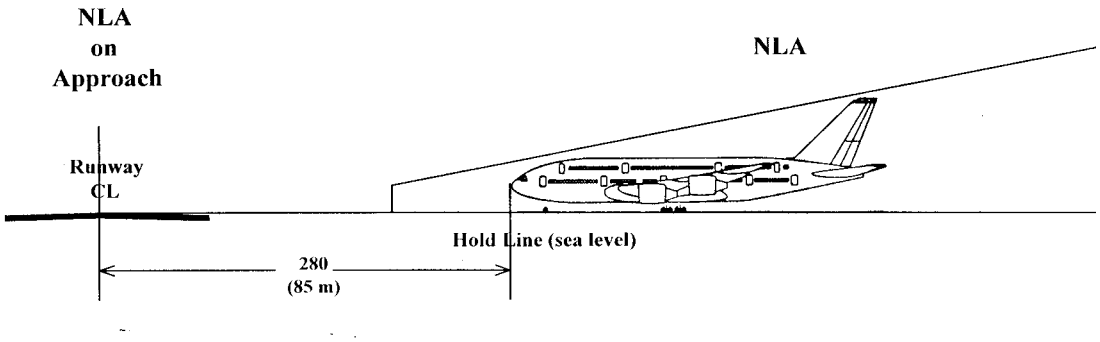


**Figure 7. NLA Holding Safely Under the Obstacle Free Zone (OFZ).**

**b. Effected ADG V Airfield Facilities**.

**(1) Parallel Runway/Taxiway and the Obstacle Free Zone (OFZ)**. Insufficient separation between a runway and a parallel taxiway will impose one of the more restrictive operational restrictions to the airplane or airport. Runways require a volume of airspace, termed the OFZ, to provide an object free protected airspace. By definition the OFZ is the volume of airspace below 150 feet (45 m) above the established airport elevation and along the runway and the extended runway centerline that is required to be clear of objects in order to provide clearance protection for aircraft landings or takeoffs from the runway and for missed approaches. Figure 8 illustrates the 3-dimensional OFZ protected airspace off to one side of a precision runway and inclined over a parallel taxiway. The illustrated parallel taxiway is separated in accordance with the ADG VI separation standard of 600 feet (180 m). The significance of the 600-foot standard is that it allows the simultaneous operations of NLA landings/takeoffs while another NLA safely taxis underneath the inclined portion of the OFZ. Furthermore, the 600-foot standard allows airframe manufacturers the flexibility to design future NLA derivatives without airport authorities having to reconstruct airfields or impose additional operational restrictions. That is, airport design standards consider longevity of design. Violations to the OFZ protected airspace and the available operational restrictions to overcome inadequate taxiing separations are discussed in the following subparagraphs. The item was included in the survey.

**(i) Violations to Obstacle Free Zones (OFZ).** The determining factors for the shape of the OFZ are the (1) wingspan of the approach airplane, (2) airport elevation, and (3) approach capability of the runway, such as, CAT I or CAT II/III. Once the OFZ geometry is defined, the separation between the centerlines of the parallel taxiway and the runway is determined. The determination is based primarily on the physical characteristics of the taxiing airplane instead of the airplane on approach. The key factors are the height of tail section and the width of wingspan for the airplane design group being accommodated. Figure 9 illustrates that when a NLA is landing and a Boeing 747-400 is taxiing parallel to a runway separated in accordance with the lesser ADG V separation standard of 400 feet (122 m), a violation to the OFZ protected airspace results. As stated above, airport elevation effects the geometry of the OFZ. At rather high elevations above sea level, current models of the Boeing 747 landing at runways/parallel taxiways separated in accordance with the 400-foot separation standard will sustain OFZ violations when another Boeing 747 airplane taxis. In other words, FAA design standards further note additional separation at higher elevation airports.

**ADG VI AIRFIELD**

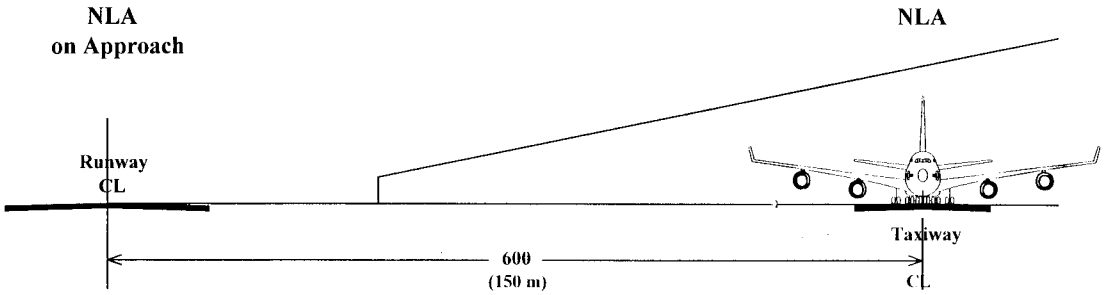


**Figure 8. Runway/Parallel Taxiway at Full Separation Standard .**

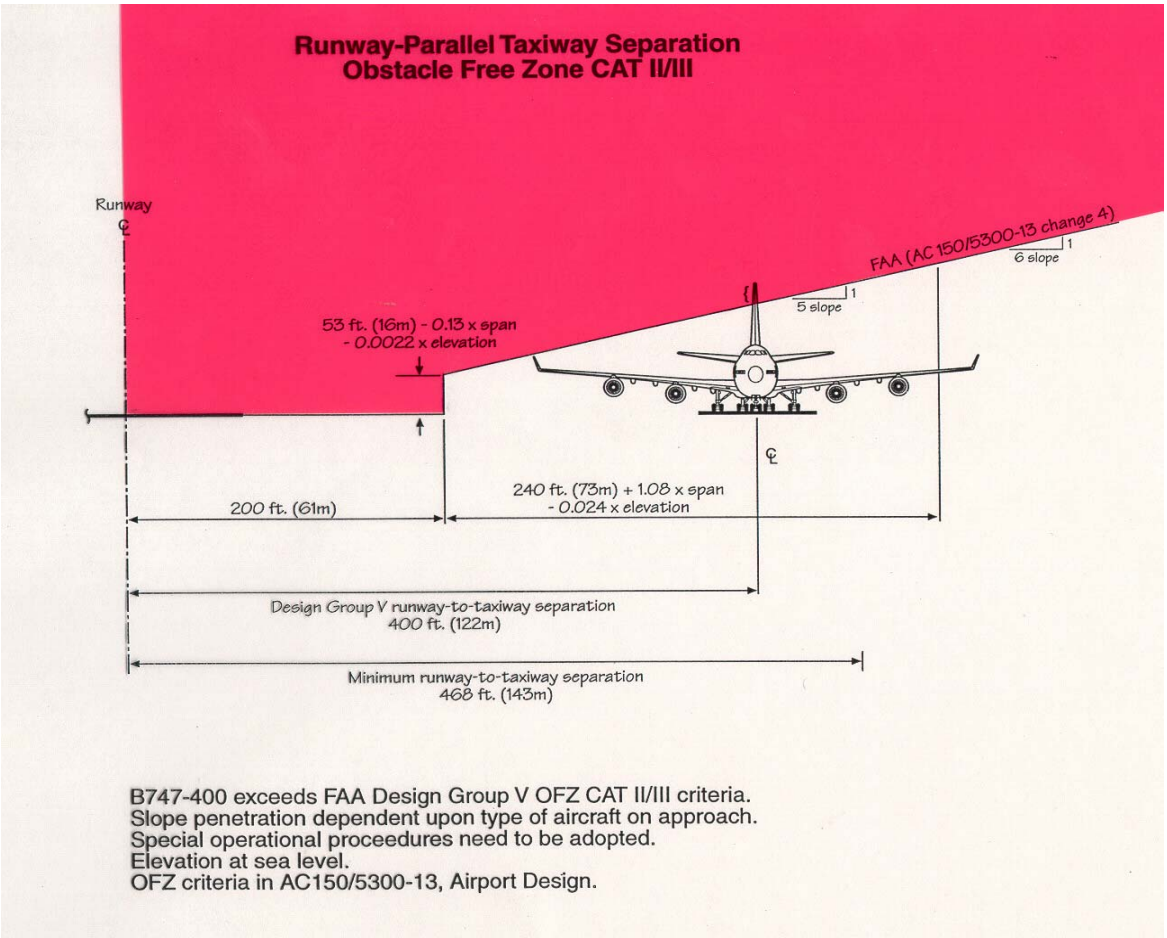


**Figure 9. Violation of the Obstacle Free Zone during NLA Approach.**

**(ii) Operational Restrictions**. Airport authorities have two means at their disposal to retain the safety function of the OFZ. They can either operationally restrict the usage of the taxiway or the runway. In other words, restrict the size of the taxiing airplane or the airplane on approach.

**(1) Taxiing Restriction.** When a NLA is on approach, restricting the tail height (and wingspan) of the taxing aircraft eliminates violations to the OFZ.

**(2) Approach Restriction.** Figure 10 illustrates that when a NLA is taxiing, restricting the wingspan width of the airplane on approach to greater than 100 ft (30 m) eliminates a violation to the OFZ.

**(2) Parallel Taxiways/Taxilanes Separations.** The separation between parallel taxiways is based on the wingspan of the airplane design group being accommodated. Figure 11 illustrates the design separation standard between parallel taxiways to accommodate simultaneous NLA operations. The design standard maintains a minimum wingtip safety margin of 62 feet (19m) between taxiing airplanes. This safety margin is achieved by the construction of parallel taxiways having centerlines spaced at a minimum distance of 324 feet (99m). It is worth mentioning that the safety margin assumes no taxing deviation from either centerline by taxing airplanes. Figure 12 illustrates the significant impact to the safety margin when NLA taxi at airports built to the lesser ADG V standard of 267 feet (81 m). It shows an approximate 92 percent reduction to the 62-foot (19m) safety margin down to a 5-foot (1 1/2m) wingtip separation. Figure 13 illustrates the operational restriction of limiting the wingspan of the smaller airplane as a means to retain the full safety standard. Since the wingspans of the illustrated DC-8-62/63 equal 148 feet (45 m), narrow-bodied airplanes are able to taxi unrestricted. In terms of taxilane design as compared to taxiway design, the design approach is not available since the 262-foot (80 m) wingspan of ADG VI exceeds the actual available physical centerline separation by 17 feet (5.5 m). The separation between the centerlines of parallel taxilanes is only 245 feet (74.5 m).

## ADG V AIRFIELD

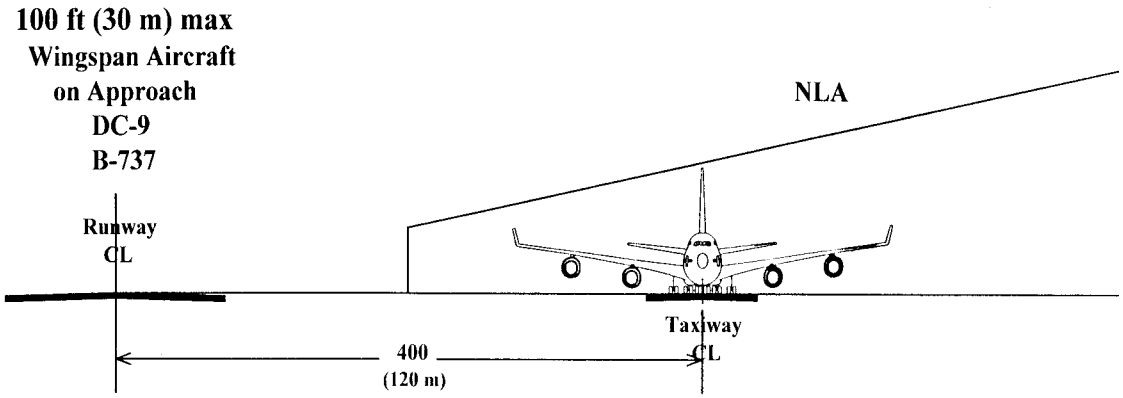


**Figure 10. Operational Restriction on the Wingspan of the Approach Airplane.**

## ADG VI AIRFIELD

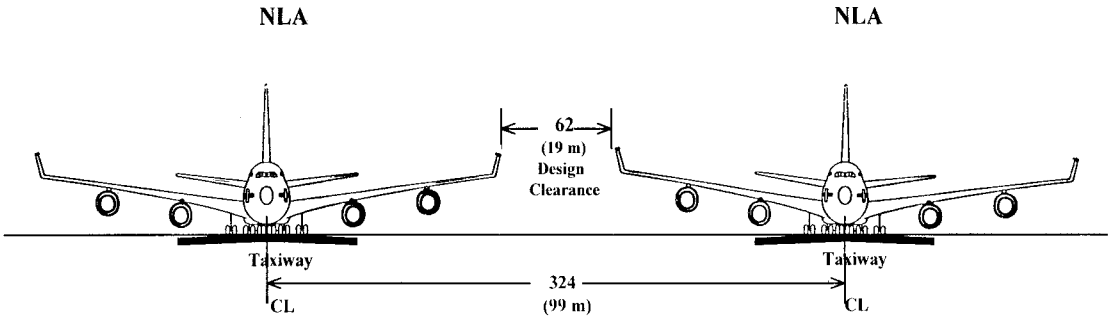


**Figure 11. Parallel Taxiways at Full Wingtip Safety Margin .**

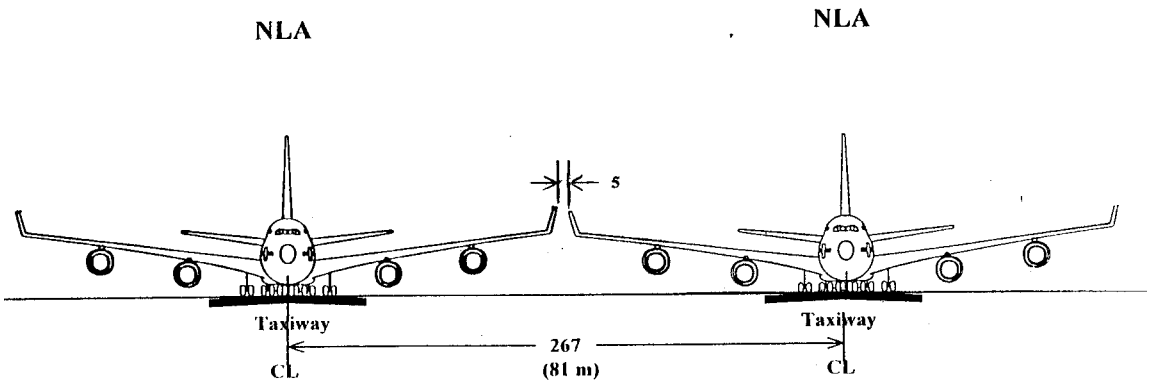


**Figure 12. Parallel Taxiways at Reduced Wingtip Safety Margin .**

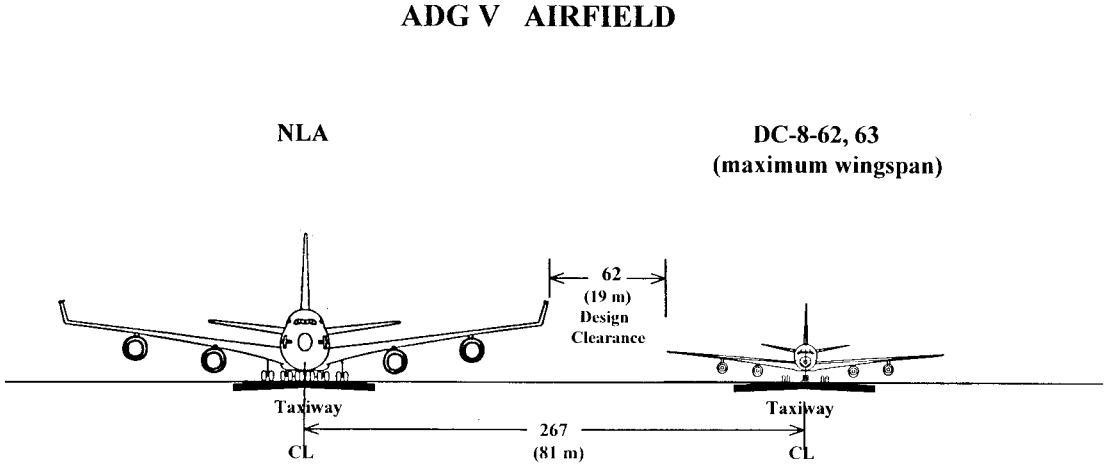


**Figure 13. Operational Restriction to the Wingspan of Non-NLA Airplane .**

**TABLE 1. Comparison of Airport Design Standards for Airplane Design Groups V and VI.**

| Design Feature | | Airplane Design Group V | Airplane Design Group VI | Percentage Increase & Safety Margin Reductions |
|---|---|---|---|---|
| Runway Environment | | | | |
| | Length | | | None |
| | Width | 150 ft | 200 ft | 33% |
| | Shoulder Width | 35 ft | 40 ft | 14% |
| | Blast Pad Length | 200 ft | 200 ft | None |
| | Blast Pad Width | 220 ft | 280 ft | 27% |
| | Runway Safety Area Length | 1000 ft | 1000 ft | None |
| | Runway Safety Area Width | 500 ft | 500 ft | None |
| | Runway Object Free Area Length | 1000 ft | 1000 ft | None |
| | Runway Object Free Area Width | 800 ft | 800 ft | None |
| Bridges and Culverts: Taxiing Weights | | | | |
| | | Up to 877,000 pounds | Up to 1,400,000 pounds | 60% |
| Taxiway Environment | | | | |

| | | | | |
|---|---|---|---|---|
| | Width | 75 ft | 100 ft | 33% |
| | Shoulder Width | 35 ft | 40 ft | 14% |
| | Taxiway Edge Safety Margin | 15 ft | 20 ft | 33% |
| | Safety Area Width | 214 ft | 262 ft | 22% |
| | Airfield Taxiway Object Free Area & Safety Margin | 320 ft | 386 ft | 21%<br><br>54% Safety Reduction |
| | Terminal Taxilane Object Free Area & Safety Margin | 276 ft | 334 ft | 21%<br><br>81% Safety Reduction |
| Separations | | | | |
| | Holdline | 280 ft | 280 ft | None |
| | Parallel Runways | | | None |
| | Runway to Parallel Taxiway | 400 ft | 600 ft | 50% |
| | Parallel Taxiways & Safety Margin | 267 ft | 324 ft | 21%<br><br>92% Safety Reduction |
| | Parallel Taxilanes & Safety Margin | 245 ft<br><br>NLA Design Wingspan equals 262 ft | 298 ft | 22%<br><br>Wingtip Collision |

**Table 1. Continuation**

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