# ADVISORY CIRCULAR

**SLCAA-AC-AGA035-Rev.00**

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**SIERRA LEONE CIVIL AVIATION AUTHORITY**

# Guidance on Aerodrome Compatibility Study

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# 1 GENERAL

The Sierra Leone Civil Aviation Authority's Advisory Circulars contains information about standards, practices and procedures that the Authority has found to be an Acceptable Means of Compliance (AMC) with the associated Regulations.

An AMC is not intended to be the only means of compliance with a Regulation, and consideration will be given to other methods of compliance that may be presented to the Authority

Information considered directive in nature is described in this AC in terms such as "shall" and "must", indicating the actions are mandatory. Guidance information is described in terms such as "should" and "may" indicating the actions are desirable or permissive, but not mandatory.

## 1.1 Purpose

This AC provides guidance on methodologies and procedures used to assess the compatibility between aircraft operations and aerodrome infrastructure and operations when an aerodrome accommodates an aircraft that exceeds the certificated characteristics of that aerodrome. It also establishes factors to be considered in the study and highlight conditions for safe operations at an aerodrome.

## 1.2 Applicability

The material contained herein applies to applicants seeking approval to establish and operate aerodromes as well as Aerodrome Operators intending to transfer, amend or surrender Aerodrome Certificates or modify their aerodrome facilities.

## 1.3 Description of Change

This AC is the first to be issued on this subject

## 1.4 Reference

(a) SLCAR, Part 14A - Aerodromes Design and Operations
(b) SLCAR Part 14C – Certification of Aerodromes
(c) SLCAA-AC-AGA016-Rev.01 - Guidance on Aeronautical Studies/Safety Assessment
(d) SLCAA-AC-AGA043-Rev00 - Guidance Material Supplementary to SLCAR Part 14A
(e) ICAO Doc 9981 - PANS Aerodromes

## 1.5 Cancelled Documents

Not Applicable

# 2 INTRODUCTION

(a) A compatibility study should be performed collaboratively between affected stakeholders, which include the aerodrome operator, the aircraft operator, and ground handling agencies as well as the various air navigation service providers (ANSPs).

(b) The following steps describe the arrangements to be appropriately documented between the aircraft and aerodrome operator, for the introduction of an aircraft type/sub-type new to the aerodrome:
   (i) the aircraft operator submits a request to the aerodrome operator to operate an aircraft type/subtype, new to the aerodrome;
   (ii) the aerodrome operator identifies possible means of accommodating the aircraft type/subtype including access to movement areas and, if necessary, considers the feasibility and economic viability of upgrading the aerodrome infrastructure; and
   (iii) the aerodrome operator and aircraft operator discuss the aerodrome operator's assessment, and whether operations of the aircraft type/subtype can be accommodated and if permitted, under what conditions.

(c) The following procedures should be included in the aerodrome compatibility study:
   (i) identify the aircraft physical and operational characteristics (see 3.0 of this AC)
   (ii) identify the applicable regulatory requirements;
   (iii) establish the adequacy of the aerodrome infrastructure and facilities vis-à-vis the requirements of the new aircraft (see Appendix 1 of this AC);
   (iv) identify the changes required to the aerodrome;
   (v) document the compatibility study; and
   (vi) perform the required safety assessments identified during the compatibility study (See SLCAA-AC-AGA016-Rev.01 - Guidance on Aeronautical Studies and Safety Assessment).

***Note 1 - A compatibility study may require a review of the obstacle limitation surfaces at an aerodrome as specified in 4.1 of SLCAR Part 14A. Further guidance on the function of these surfaces is given in SLCAA-AC-AGA011 Rev01 (Control of Obstacles).***

***Note 2 - For aerodrome operations in low visibility conditions, additional procedures may be implemented in order to safeguard the operations of aircraft. Guidance on operations in low visibility conditions are available in the SLCAA-AC-AGA007-Rev01 - Surface Movement Guidance and Control System. Further guidance can be found in ICAO Doc 9137 - Airport Services Manual, Part 8 - Airport Operational Services, ICAO Doc 9476 - Manual of Surface Movement Guidance and Control Systems (SMGCS); and ICAO Doc 9830 - Advanced Surface Movement Guidance and Control Systems (A-SMGCS) Manual.***

***Note 3 - Additional processes that ensure suitable measures are in place to protect the signal produced by the ground-based radio navigation equipment may be necessary at aerodromes with precision instrument approaches.***

(d) The result of the compatibility study should enable decisions to be made and should provide:
   (i) the aerodrome operator with the necessary information in order to make a decision on allowing the operations of the specific aircraft at the given aerodrome;
   (ii) the aerodrome operator with the necessary information in order to make a decision on the changes required to the aerodrome infrastructure and facilities to ensure safe operations at the aerodrome with due consideration to the harmonious future development of the aerodrome; and
   (iii) the Authority with the information which is necessary for its safety oversight and the continued monitoring of the conditions specified in the aerodrome certificate.

# 3 IMPACT OF AIRCRAFT CHARACTERISTICS ON THE AERODROME INFRASTRUCTURE.

## 3.1 Overview

(a) Introducing new types of aircraft into existing aerodromes may have an impact on the aerodrome facilities and services, in particular, when the aircraft characteristics exceed the parameters that were used for planning the aerodrome.

(b) The parameters used in aerodrome planning are defined in SLCAR Part 14A, which specifies the use of the aerodrome reference code determined in accordance with the characteristics of the aircraft for which an aerodrome facility is intended. The aerodrome reference code provides a starting point for the compatibility study and may not be the sole means used to conduct the analysis and to substantiate the aerodrome operator’s decisions and the SLCAA’s safety oversight actions.

## 3.2 Consideration of the aircraft’s physical characteristics

The aircraft physical characteristics may influence the aerodrome dimensions, facilities and services in the movement area. These characteristics are detailed in Chapter 4 of this AC.

## 3.3 Consideration of the aircraft’s operational characteristics

In order to adequately assess the aerodrome compatibility, aircraft operational characteristics should be included in the evaluation process. The operational characteristics can include the infrastructure requirements of the aircraft as well as ground servicing requirements. These characteristics are detailed in Chapter 4 of this AC.

## 3.4 Physical Characteristics of Aerodromes

In order to adequately assess the aircraft’s compatibility, aerodrome physical characteristics should be included in the evaluation process. These characteristics are detailed in the Appendix 2 of this AC.

# 4 AIRCRAFT CHARACTERISTICS

## 4.1 Physical

The lists of aircraft characteristics that may have an impact on the relevant aerodrome characteristics, facilities and services in the movement area are given as follows;

### *4.1.1 Fuselage Length*

The fuselage length may have an impact on:

(a) the dimensions of the movement area (taxiway, holding bays and aprons), passenger gates and terminal areas;
(b) the aerodrome category for RFF;
(c) ground movement and control (e.g. reduced clearance behind a longer aircraft holding at an apron or a runway/intermediate holding position to permit the passing of another aircraft);
(d) clearances at the aircraft stand.

### *4.1.2 Fuselage Width*

The fuselage width is used to determine the aerodrome category for RFF.

### *4.1.3 Door Sill Height*

(a) The door sill height may have an impact on:
(b) the operational limits of the air bridges;
(c) mobile steps;
(d) catering trucks;
(e) persons with reduced mobility; and
(f) dimensions of the apron.

### *4.1.4 Aircraft Nose Characteristics*

The aircraft nose characteristics may have an impact on the location of the runway-holding position of the aircraft which should not infringe the OFZ.

### *4.1.5 Tail Height*

The tail height may have an impact on:

(a) the location of the runway-holding position;
(b) ILS critical and sensitive areas: In addition to the tail height of the critical aircraft, tail composition, tail position, fuselage height and length can have an effect on ILS critical and sensitive areas;
(c) the dimensions of aircraft maintenance services;
(d) aircraft parking position (in relation to aerodrome OLS);
(e) runway/parallel taxiway separation distances; and
(f) the clearance of any aerodrome infrastructure or facilities built over stationary or moving aircrafts.

### *4.1.6 Wingspan*

The wingspan may have an impact on:

(a) taxiway/taxilane separation distances (including runway/taxiway separation distances);
(b) the dimensions of the OFZ;
(c) the location of the runway-holding position (due to the impact of the wingspan on OFZ dimensions);
(d) the dimensions of aprons and holding bays;
(e) wake turbulence;
(f) gate selection;
(g) aerodrome maintenance services around the aircraft;
(h) equipment for disabled aircraft removal

### *4.1.7 Wing Tip Vertical Clearance*

(a) The wing tip vertical clearance may have an impact on:
(b) taxiway separation distances with height-limited objects;
(c) apron and holding bay clearances with height-limited objects;
(d) aerodrome maintenance services (e.g cleaning of the airside)
(e) airfield signage clearances; and
(f) service road locations.

### *4.1.8 Cockpit View*

The relevant geometric parameters to assess the cockpit view are cockpit height, cockpit cut-off angle and the corresponding obscured segment. The cockpit view may have an impact on:

(a) runway visual references (aiming point);
(b) runway sight distance;
(c) taxiing operations on straight and curved sections;
(d) markings and signs on runways, turn pads, taxiways, aprons and holding bays;
(e) lights: in low visibility conditions, the number and spacing of visible lights when taxiing may depend on the cockpit view; and
(f) calibration of PAPI (pilot eye height above wheel height on approach).

### *4.1.9 Distance from the Pilot's Eye Position to the Nose Landing Gear*

The design of taxiway curves is based on the cockpit-over-centre-line concept. The distance from the pilot's eye position to the nose landing gear is relevant for:

(a) taxiway fillets (wheel track);
(b) the dimensions of aprons and holding bays; and
(c) the dimensions of turn pads.

### *4.1.10 Landing Gear Design*

The aircraft landing gear design is such that the overall mass of the aircraft is distributed so that the stresses transferred to the soil through a well-designed pavement are within the bearing capacity of the soil. The landing gear layout also has an effect on the manoeuvrability of the aircraft and the aerodrome pavement system.

### *4.1.11 Outer Main Gear Wheel Span*

The outer main gear wheel span may have an impact on:

(a) runway width;
(b) the dimensions of turn pads;
(c) taxiway width;
(d) taxiway fillets;
(e) the dimensions of aprons and holding bays; and
(f) the dimension of the OFZ.

### *4.1.12 Wheelbase*

The wheelbase may have an impact on:

(a) the dimensions of turn pads;
(b) taxiway fillets;
(c) the dimensions of aprons and holding bays; and
(d) terminal areas and aircraft stands.

### *4.1.13 Gear Steering System*

The gear steering system may have an impact on the dimensions of turn pads and the dimensions of aprons and holding bays.

### *4.1.14 Maximum Aircraft Mass*

The maximum mass may have an impact on:

(a) the mass limitation on existing bridges, tunnels, culverts and other structures under runways and taxiways;
(b) disabled aircraft removal;
(c) wake turbulence; and
(d) arresting systems when provided as an element of kinetic energy.

### *4.1.15 Landing Gear Geometry, Tire Pressure and Aircraft Classification Number (ACN) Values (Applicable until 27 November 2024)*

Until 27 November 2024, landing gear geometry, tire pressure and ACN values may have an impact on the airfield pavement and associated shoulders.

### *4.1.16 Landing Gear Geometry, Tire Pressure and Aircraft Classification Rating (ACR) Values*

### *(Applicable as Of 28 November 2024)*

As of 28 November 2024, landing gear geometry, tire pressure and ACR values may have an impact on the airfield pavement and associated shoulders.

### *4.1.17 Engine Characteristics*

a. The engine characteristics include engine geometry and engine airflow characteristics, which may affect aerodrome infrastructure as well as ground handling of the aircraft and operations in adjacent areas which are likely to become affected by jet blast.
b. The engine geometry aspects are:
   (i) the number of engines;
   (ii) the location of engines (span and length);

(iii)the vertical clearance of engines; and
(iv)the vertical and horizontal extent of possible jet blast or propeller wash.

c. The engine airflow characteristics are:
   (i) idle, breakaway and take-off thrust exhaust velocities;
   (ii) thrust reverser fitment and flow patterns; and
   (iii)inlet suction effects at ground level.

d. The engine characteristics may be relevant for the following aerodrome infrastructure and operational aspects:
   (i) runway shoulder width and composition (jet blast and ingestion issues during take-off and landing);
   (ii) shoulder width and composition of runway turn pads;
   (iii) taxiway shoulder width and composition (jet blast and ingestion issues during taxiing);
   (iv) bridge width (jet blast under the bridge);
   (v) the dimensions and location of blast protection fences;
   (vi) the location and structural strength of signs;
   (vii) the characteristics of runway and taxiway edge lights;
   (viii) the separation between aircrafts and adjacent ground service personnel, vehicles or passengers;
   (ix) the design of engine run-up areas and holding bays;
   (x) the design and use of functional areas adjacent to the manoeuvring area;
   (xi) the design of air bridges; and
   (xii) the location of refuelling pits on the aircraft stand.

### *4.1.18 Maximum Passenger- and Fuel-Carrying Capacity*

(a) Maximum passenger- and fuel-carrying capacity may have an impact on:
(b) terminal facilities;
(c) fuel storage and distribution;
(d) aerodrome emergency planning;
(e) aerodrome rescue and fire fighting; and
(f) air bridge loading configuration.

### *4.1.19 Flight Performance*

(a) Flight performance may have an impact on:
(b) runway width;
(c) runway length;
(d) the OFZ;
(e) runway/taxiway separation;
(f) wake turbulence;
(g) noise; and
(h) aiming point marking.

## 4.2 Ground Servicing Requirements

The following list of aircraft ground servicing characteristics and requirements may affect the available aerodrome infrastructure. This list is not exhaustive; additional items may be identified by the stakeholders involved in the compatibility assessment process:

(a) ground power;
(b) passengers embarking and disembarking;
(c) cargo loading and unloading;
(d) fuelling;
(e) pushback and towing;
(f) taxiing and marshalling;
(g) aircraft maintenance;
(h) RFF;
(i) equipment areas;
(j) stand allocation; and
(k) disabled aircraft removal.

## APPENDIX 1 SELECTED AIRCRAFT CHARACTERISTICS

Data are provided for convenience, are subject to change and should be used only as a guide. Accurate data should be obtained from the aircraft manufacturer's documentation. Many aircraft types have optional weights and different engine models and engine thrusts; therefore pavement aspects and reference field lengths will vary, in some cases enough to change the aircraft category. Reference field length should not be used for the design of aerodrome runway length, as the required length will vary depending on various factors such as aerodrome elevation, reference temperature and runway slope.

| *Aircraft model* | *Take-off weight (kg)* | *Code* | *Reference field length (m)** | *Wingspan (m)* | *Outer main gear wheel span (m)* | *Nose gear to main gear distance (wheel base) (m)* | *Cockpit to main gear distance (m)* | *Fuselage length (m)* | *Overall (maximum) length (m)* | *Maximum tail height (m)* | *Approach speed (1.3×Vs) (kt)* | *Maximum evacuation slide length (m)****** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AIRBUS A318-100 | 68 000 | 3C | 1 789 | 34.1 | 8.9 | 10.3 | 15.3 | 31.5 | 31.5 | 12.9 | 124 | 7.2 |
| A319-100 | 75 500 | 4C | 1 800 | 34.1 | 8.9 | 11.4 | 16.5 | 33.5 | 33.5 | 12.2 | 128 | 7.2 |
| A320-200 | 77 000 | 4C | 2 025 | 34.1 | 8.9 | 12.6 | 17.7 | 37.6 | 37.6 | 12.2 | 136 | 7.5 |
| A321-200 | 93 500 | 4C | 2 533 | 34.1 | 8.9 | 16.9 | 22.0 | 44.5 | 44.5 | 12.1 | 142 | 6.2 |
| A300B4-200 | 165 000 | 4D | 2 727 | 44.8 | 11.1 | 18.6 | 25.3 | 53.2 | 54.1 | 16.7 | 137 | 9.0 |
| A300-600R | 170 500 | 4D | 2 279 | 44.8 | 11.1 | 18.6 | 25.3 | 53.2 | 54.1 | 16.7 | 135 | 9.0 |
| A310-300 | 164 000 | 4D | 2 350 | 43.9 | 11.0 | 15.2 | 21.9 | 45.9 | 46.7 | 16.0 | 139 | 6.9 |
| A330-200 | 233 000 | 4E | 2 479 | 60.3 | 12.6 | 22.2 | 28.9 | 57.3 | 58.4 | 18.2 | 136 | 11.5 |
| A330-300 | 233 000 | 4E | 2 490 | 60.3 | 12.6 | 25.4 | 32.0 | 62.6 | 63.7 | 17.2 | 137 | 11.5 |
| A340-200 | 275 000 | 4E | 2 906 | 60.3 | 12.6 | 22.2 | 28.9 | 58.3 | 59.4 | 17.0 | 136 | 11.0 |
| A340-300 | 276 500 | 4E | 2 993 | 60.3 | 12.6 | 25.4 | 32.0 | 62.6 | 63.7 | 17.0 | 139 | 11.0 |
| A340-500 | 380 000 | 4E | 3 023 | 63.4 | 12.6 | 28.0 | 34.5 | 66.0 | 67.9 | 17.5 | 142 | 10.9 |
| A340-600 | 380 000 | 4E | 2 864 | 63.4 | 12.6 | 33.1 | 39.8 | 73.5 | 75.4 | 17.9 | 148 | 10.5 |
| A380-800 | 560 000 | 4F | 2 779 | 79.8 | 14.3 | 29.7 | 36.4 | 70.4 | 72.7 | 24.4 | 138 | 15.2 |
| ANTONOV An-2 | 5 500 | 1B | 500 | 18.2 | 3.4 | 8.3 | –0.6 | 12.7 | 12.4 | 4.1 | 62 | |
| An-3 | 5 800 | 1B | 390 | 18.2 | 3.5 | 8.3 | –0.6 | 14.0 | 13.9 | 4.9 | 65 | |
| An-28 | 6 500 | 1B | 585 | 22.1 | 3.4 | 4.4 | 3.1 | 12.7 | 13.1 | 4.9 | 89 | |
| An-38-100 | 9 500 | 2B | 965 | 22.1 | 3.4 | 6.2 | 4.9 | 15.3 | 15.7 | 5.5 | 108 | |
| An-38-200 | 9 930 | 2B | 1 125 | 22.1 | 3.4 | 6.2 | 4.9 | 15.3 | 15.7 | 5.5 | 119 | |

| *Aircraft model* | *Take-off weight (kg)* | *Code* | *Reference field length (m)** | *Wingspan (m)* | *Outer main gear wheel span (m)* | *Nose gear to main gear distance (wheel base) (m)* | *Cockpit to main gear distance (m)* | *Fuselage length (m)* | *Overall (maximum) length (m)* | *Maximum tail height (m)* | *Approach speed (1.3×Vs) (kt)* | *Maximum evacuation slide length (m)******* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| An-24 | 21 000 | 3C | 1 350 | 29.2 | 7.9 | 7.9 | 7.6 | 23.8 | 23.8 | 8.6 | 119 | |
| An-24PB | 22 500 | 3C | 1 600 | 29.2 | 7.9 | 7.9 | 7.6 | 23.8 | 23.8 | 8.6 | 119 | |
| An-30 | 22 100 | 3C | 1 550 | 29.2 | 7.9 | 7.4 | 7.6 | 24.3 | 24.3 | 8.6 | 113 | |
| An-32 | 27 000 | 3C | 1 600 | 29.2 | 7.9 | 7.9 | 7.6 | 23.7 | 23.7 | 8.8 | 124 | |
| An-72 | 31 200 | 3C | 1 250 | 31.9 | 4.1 | 8.0 | 8.5 | 28.1 | 28.1 | 8.7 | 108 | |
| An-148-100A | 38 950 | 3C | 1 740 | 28.9 | 4.6 | 10.6 | 10.6 | 26.1 | 29.1 | 8.2 | 124 | |
| An-70 | 139 000 | 3D | 1 610 | 44.1 | 5.9 | 14.0 | 14.9 | 39.7 | 40.6 | 16.4 | 151 | |
| An-26 | 24 000 | 4C | 1 850 | 29.2 | 7.9 | 7.7 | 7.6 | 23.8 | 23.8 | 8.8 | 124 | |
| An-26B | 25 000 | 4C | 2 200 | 29.2 | 7.9 | 7.7 | 7.6 | 23.8 | 23.8 | 8.8 | 124 | |
| An-32B-100 | 28 500 | 4C | 2 080 | 29.2 | 7.9 | 7.9 | 7.6 | 23.7 | 23.7 | 8.8 | 127 | |
| An-74 | 34 800 | 4C | 1 920 | 31.9 | 4.1 | 8.0 | 8.5 | 28.1 | 28.1 | 8.7 | 108 | |
| An-74TK-100 | 36 500 | 4C | 1 920 | 31.9 | 4.1 | 8.0 | 8.5 | 28.1 | 28.1 | 8.8 | 108 | |
| An-74T-200 | 36 500 | 4C | 2 130 | 31.9 | 4.1 | 8.0 | 8.5 | 28.1 | 28.1 | 8.8 | 108 | |
| An-74TK-300 | 37 500 | 4C | 2 200 | 31.9 | 4.1 | 8.0 | 8.5 | 28.1 | 28.1 | 8.7 | 116 | |
| An-140 | 21 000 | 4C | 1 880 | 24.5 | 3.7 | 8.1 | 7.8 | 21.6 | 22.6 | 8.2 | 124 | |
| An-140-100 | 21 500 | 4C | 1 970 | 25.5 | 3.7 | 8.1 | 7.8 | 21.6 | 22.6 | 8.2 | 124 | |
| An-148-100B | 41 950 | 4C | 2 020 | 28.9 | 4.6 | 10.6 | 10.6 | 26.1 | 29.1 | 8.2 | 124 | |
| An-148-100E | 43 700 | 4C | 2 060 | 28.9 | 4.6 | 10.6 | 10.6 | 26.1 | 29.1 | 8.2 | 124 | |
| An-158*** | 43 700 | 4C | 2 060 | 28.6 | 4.6 | 11.7 | 11.8 | 27.8 | 30.8 | 8.2 | 126 | |
| An-168*** | 43 700 | 4C | 2 060 | 28.9 | 4.6 | 10.6 | 10.6 | 26.1 | 29.1 | 8.2 | 124 | |
| An-12 | 61 000 | 4D | 1 900 | 38.0 | 5.4 | 9.6 | 11.1 | 33.1 | 33.1 | 10.5 | 151 | |
| An-22 | 225 000 | 4E | 3 120 | 64.4 | 7.4 | 17.3 | 21.7 | 57.8 | 57.8 | 12.4 | 153 | |
| An-124-100 | 392 000 | 4F | 3 000 | 73.3 | 9.0 | 22.8 | 25.6 | 69.1 | 69.1 | 21.1 | 154 | |
| An-225 | 640 000 | 4F | 3 430 | 88.40 | 9.01 | 29.30 | 16.27 | 76.62 | 84.00 | 18.10 | 167 | |
| BOEING 707-320C | 152 407 | 4D | 3 079 | 44.4 | 8.0 | 18.0 | 20.9 | 44.4 | 46.6 | 13.0 | 137 | 6.6 |
| 717-200 | 54 885 | 3C | 1 670 | 28.4 | 5.9 | 17.6 | 17.0 | 34.3 | 37.8 | 9.1 | 139 | 5.3 |
| 727-200 | 95 254 | 4C | 3 176 | 32.9 | 7.1 | 19.3 | 21.4 | 41.5 | 46.7 | 10.6 | 136 | 6.1 |
| 727-200/W | 95 254 | 4C | 3 176 | 33.3** | 7.1 | 19.3 | 21.4 | 41.5 | 46.7 | 10.6 | 136 | 6.1 |
| 737-200 | 58 332 | 4C | 2 295 | 28.4 | 6.4 | 11.4 | 13.0 | 29.5 | 30.5 | 11.2 | 133 | 5.8 |
| 737-300 | 62 823 | 4C | 2 170 | 28.9 | 6.4 | 12.4 | 14.0 | 32.2 | 33.4 | 11.2 | 133 | 7.0 |
| 737-300/W | 62 823 | 4C | 2 550 | 31.2** | 6.4 | 12.4 | 14.0 | 32.2 | 33.4 | 11.2 | 133 | 7.0 |

| *Aircraft model* | *Take-off weight (kg)* | *Code* | *Reference field length (m)** | *Wingspan (m)* | *Outer main gear wheel span (m)* | *Nose gear to main gear distance (wheel base) (m)* | *Cockpit to main gear distance (m)* | *Fuselage length (m)* | *Overall (maximum) length (m)* | *Maximum tail height (m)* | *Approach speed (1.3×Vs) (kt)* | *Maximum evacuation slide length (m)****** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 737-400 | 68 039 | 4C | 2 550 | 28.9 | 6.4 | 12.4 | 15.9 | 35.2 | 36.4 | 11.2 | 139 | 7.0 |
| 737-500 | 60 555 | 4C | 2 470 | 28.9 | 6.4 | 11.1 | 12.7 | 29.8 | 31.0 | 11.2 | 128 | 7.0 |
| 737-500/W | 60 555 | 4C | 2 454 | 31.1** | 6.4 | 11.1 | 12.7 | 29.8 | 31.0 | 11.2 | 128 | 7.0 |
| 737-600 | 65 091 | 3C | 1 690 | 34.3 | 7.0 | 11.2 | 12.8 | 29.8 | 31.2 | 12.7 | 125 | 7.0 |
| 737-600/W | 65 544 | 3C | 1 640 | 35.8** | 7.0 | 11.2 | 12.9 | 29.8 | 31.2 | 12.7 | 125 | 7.0 |
| 737-700 | 70 080 | 3C | 1 600 | 34.3 | 7.0 | 12.6 | 14.2 | 32.2 | 33.6 | 12.7 | 130 | 7.0 |
| 737-700/W | 70 080 | 3C | 1 610 | 35.8** | 7.0 | 12.6 | 14.2 | 32.2 | 33.6 | 12.7 | 130 | 7.0 |
| 737-800 | 79 016 | 4C | 2 090 | 34.3 | 7.0 | 15.6 | 17.2 | 38.0 | 39.5 | 12.6 | 142 | 7.0 |
| 737-800/W | 79 016 | 4C | 2 010 | 35.8** | 7.0 | 15.6 | 17.2 | 38.0 | 39.5 | 12.6 | 142 | 7.0 |
| 737-900 | 79 016 | 4C | 2 240 | 34.3 | 7.0 | 17.2 | 18.8 | 40.7 | 42.1 | 12.6 | 141 | 7.0 |
| 737-900ER/W | 84 912 | 4C | 2 470 | 35.8** | 7.0 | 17.2 | 18.8 | 40.7 | 42.1 | 12.6 | 141 | 7.0 |
| 747-SP | 318 875 | 4E | 2 710 | 59.6 | 12.4 | 20.5 | 22.9 | 53.9 | 56.3 | 20.1 | 140 | 14.3 |
| 747-100 | 341 555 | 4E | 3 060 | 59.6 | 12.4 | 25.6 | 28.0 | 68.6 | 70.4 | 19.6 | 144 | 11.8 |
| 747-200 | 379 203 | 4E | 3 150 | 59.6 | 12.4 | 25.6 | 28.0 | 68.6 | 70.4 | 19.6 | 150 | 11.8 |
| 747-300 | 379 203 | 4E | 3 292 | 59.6 | 12.4 | 25.6 | 28.0 | 68.6 | 70.4 | 19.6 | 152 | 14.3 |
| 747-400ER | 414 130 | 4E | 3 094 | 64.9 | 12.6 | 25.6 | 27.9 | 68.6 | 70.7 | 19.6 | 157 | 14.3 |
| 747-400 | 396 893 | 4E | 3 048 | 64.9 | 12.6 | 25.6 | 27.9 | 68.6 | 70.7 | 19.5 | 157 | 14.3 |
| 747-8 | 442 253 | 4F | 3 070 | 68.4 | 12.7 | 29.7 | 32.0 | 74.2 | 78.0 | 19.2 | 150*** | 15.7 |
| 747-8F | 442 253 | 4F | 3 070 | 68.4 | 12.7 | 29.7 | 32.0 | 74.2 | 78.0 | 19.2 | 159*** | 11.7 |
| 757-200 | 115 666 | 4D | 1 980 | 38.1 | 8.6 | 18.3 | 22.0 | 47.0 | 47.3 | 13.7 | 137 | 9.3 |
| 757-200/W | 115 666 | 4D | 1 980 | 41.1** | 8.6 | 18.3 | 22.0 | 47.0 | 47.3 | 13.7 | 137 | 9.3 |
| 757-300 | 122 470 | 4D | 2 400 | 38.1 | 8.6 | 22.3 | 26.0 | 54.4 | 54.4 | 13.7 | 143 | 9.3 |
| 767-200 | 163 747 | 4D | 1 981 | 47.6 | 10.8 | 19.7 | 24.3 | 47.2 | 48.5 | 16.1 | 135 | 8.7 |
| 767-200ER | 179 623 | 4D | 2 743 | 47.6 | 10.8 | 19.7 | 24.3 | 47.2 | 48.5 | 16.1 | 142 | 8.7 |
| 767-300 | 163 747 | 4D | 1 981 | 47.6 | 10.9 | 22.8 | 27.4 | 53.7 | 54.9 | 16.0 | 140 | 8.7 |
| 767-300ER | 186 880 | 4D | 2 540 | 47.6 | 10.9 | 22.8 | 27.4 | 53.7 | 54.9 | 16.0 | 145 | 8.7 |
| 767-300ER/W | 186 880 | 4D | 2 540 | 50.9** | 10.9 | 22.8 | 27.4 | 53.7 | 54.9 | 16.0 | 145 | 8.7 |
| 767-400ER | 204 117 | 4D | 3 140 | 51.9 | 11.0 | 26.2 | 30.7 | 60.1 | 61.4 | 17.0 | 150 | 9.7 |
| 777-200 | 247 208 | 4E | 2 380 | 60.9 | 12.9 | 25.9 | 28.9 | 62.9 | 63.7 | 18.7 | 136 | 12.0 |
| 777-200ER | 297 557 | 4E | 2 890 | 60.9 | 12.9 | 25.9 | 28.9 | 62.9 | 63.7 | 18.7 | 139 | 12.0 |
| 777-200LR | 347 815 | 4E | 3 390 | 64.8 | 12.9 | 25.9 | 28.9 | 62.9 | 63.7 | 18.7 | 140 | 12.0 |
| 777-300 | 299 371 | 4E | 3 140 | 60.9 | 12.9 | 31.2 | 32.3 | 73.1 | 73.9 | 18.7 | 149 | 12.6 |

| *Aircraft model* | *Take-off weight (kg)* | *Code* | *Reference field length (m)** | *Wingspan (m)* | *Outer main gear wheel span (m)* | *Nose gear to main gear distance (wheel base) (m)* | *Cockpit to main gear distance (m)* | *Fuselage length (m)* | *Overall (maximum) length (m)* | *Maximum tail height (m)* | *Approach speed (1.3×Vs) (kt)* | *Maximum evacuation slide length (m)****** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 777-300ER | 351 534 | 4E | 3 060 | 64.8 | 12.9 | 31.2 | 32.3 | 73.1 | 73.9 | 18.8 | 149 | 12.6 |
| B787-8 | 219 539 | 4E | 2 660 | 60.1 | 11.6 | 22.8 | 25.5 | 55.9 | 56.7 | 16.9 | 140*** | 11.1 |
| MD-81 | 64 410 | 4C | 2 290 | 32.9 | 6.2 | 22.1 | 21.5 | 41.6 | 45.0 | 9.2 | 134 | 5.3 |
| MD-82 | 67 812 | 4C | 2 280 | 32.9 | 6.2 | 22.1 | 21.5 | 41.6 | 45.0 | 9.2 | 134 | 5.3 |
| MD-83 | 72 575 | 4C | 2 470 | 32.9 | 6.2 | 22.1 | 21.5 | 41.6 | 45.0 | 9.2 | 144 | 5.3 |
| MD-87 | 67 812 | 4C | 2 260 | 32.9 | 6.2 | 19.2 | 21.5 | 36.3 | 39.8 | 9.5 | 134 | 5.3 |
| MD-88 | 72 575 | 4C | 2 470 | 32.9 | 6.2 | 22.1 | 21.5 | 41.6 | 45.0 | 9.2 | 144 | 5.3 |
| MD-90 | 70 760 | 3C | 1 800 | 32.9 | 6.2 | 23.5 | 22.9 | 43.0 | 46.5 | 9.5 | 138 | 5.3 |
| MD-11 | 285 990 | 4D | 3 130 | 51.97 | 12.6 | 24.6 | 31.0 | 58.6 | 61.6 | 17.9 | 153 | 9.8 |
| DC8-62 | 158 757 | 4D | 3 100 | 45.2 | 7.6 | 18.5 | 20.5 | 46.6 | 48.0 | 13.2 | 138 | 6.7 |
| DC9-15 | 41 504 | 4C | 1 990 | 27.3 | 6.0 | 13.3 | 12.7 | 28.1 | 31.8 | 8.4 | 132 | 5.3 |
| DC9-20 | 45 813 | 3C | 1 560 | 28.4 | 6.0 | 13.3 | 12.7 | 28.1 | 31.8 | 8.4 | 126 | 5.3 |
| DC9-50 | 55 338 | 4C | 2 451 | 28.5 | 5.9 | 18.6 | 18.0 | 37.0 | 40.7 | 8.8 | 135 | 5.3 |
| BOMBARDIER CS100**** | 54 930 | 3C | 1 509 | 35.1 | 8.0 | 12.9 | 13.7 | 34.9 | 34.9 | 11.5 | 127 | |
| CS100 ER**** | 58 151 | 3C | 1 509 | 35.1 | 8.0 | 12.9 | 13.7 | 34.9 | 34.9 | 11.5 | 127 | |
| CS300**** | 59 783 | 4C | 1 902 | 35.1 | 8.0 | 14.5 | 15.3 | 38.1 | 38.1 | 11.5 | 133 | |
| CS300 XT**** | 59 783 | 3C | 1 661 | 35.1 | 8.0 | 14.5 | 15.3 | 38.1 | 38.1 | 11.5 | 133 | |
| CS300 ER**** | 63 321 | 4C | 1 890 | 35.1 | 8.0 | 14.5 | 15.3 | 38.1 | 38.1 | 11.5 | 133 | |
| CRJ200ER | 23 133 | 3B | 1 680 | 21.2 | 4.0 | 11.4 | 10.8 | 24.4 | 26.8 | 6.3 | 140 | |
| CRJ200R | 24 040 | 4B | 1 835 | 21.2 | 4.0 | 11.4 | 10.8 | 24.4 | 26.8 | 6.3 | 140 | |
| CRJ700 | 32 999 | 3B | 1 606 | 23.3 | 5.0 | 15.0 | 14.4 | 29.7 | 32.3 | 7.6 | 135 | |
| CRJ700ER | 34 019 | 3B | 1 724 | 23.3 | 5.0 | 15.0 | 14.4 | 29.7 | 32.3 | 7.6 | 135 | |
| CRJ700R**** | 34 927 | 4B | 1 851 | 23.3 | 5.0 | 15.0 | 14.4 | 29.7 | 32.3 | 7.6 | 136 | |
| CRJ900 | 36 514 | 3B | 1 778 | 23.3 | 5.0 | 17.3 | 16.8 | 33.5 | 36.2 | 7.4 | 136 | |
| CRJ900ER | 37 421 | 4C | 1 862 | 24.9 | 5.0 | 17.3 | 16.8 | 33.5 | 36.2 | 7.4 | 136 | |
| CRJ900R | 38 329 | 4C | 1 954 | 24.9 | 5.0 | 17.3 | 16.8 | 33.5 | 36.2 | 7.4 | 137 | |
| CRJ1000**** | 40 823 | 4C | 1 996 | 26.2 | 5.1 | 18.8 | 18.3 | 36.2 | 39.1 | 7.5 | 138 | |
| CRJ1000ER**** | 41 640 | 4C | 2 079 | 26.2 | 5.1 | 18.8 | 18.3 | 36.2 | 39.1 | 7.5 | 138 | |
| DHC-8-100 | 15 650 | 2C | 890 | 25.9 | 7.9 | 8.0 | 6.1 | 20.8 | 22.3 | 7.5 | 101 | |
| DHC-8-200 | 16 465 | 2C | 1 020 | 25.9 | 8.5 | 8.0 | 6.1 | 20.8 | 22.3 | 7.5 | 102 | |
| DHC-8-300 | 18 643 | 2C | 1 063 | 27.4 | 8.5 | 10.0 | 8.2 | 24.2 | 25.7 | 7.5 | 107 | |
| DHC-8-400 | 27 987 | 3C | 1 288 | 28.4 | 8.8 | 14.0 | 12.2 | 31.0 | 32.8 | 8.3 | 125 | |

| *Aircraft model* | *Take-off weight (kg)* | *Code* | *Reference field length (m)** | *Wingspan (m)* | *Outer main gear wheel span (m)* | *Nose gear to main gear distance (wheel base) (m)* | *Cockpit to main gear distance (m)* | *Fuselage length (m)* | *Overall (maximum) length (m)* | *Maximum tail height (m)* | *Approach speed (1.3×Vs) (kt)* | *Maximum evacuation slide length (m)******* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EMBRAER ERJ 170-100 STD | 35 990 | 3C | 1 439 | 26.0 | 6.2 | 10.6 | 11.5 | 29.9 | 29.9 | 9.7 | 124 | |
| ERJ 170-100 LR, SU and SE | 37 200 | 3C | 1 532 | 26.0 | 6.2 | 10.6 | 11.5 | 29.9 | 29.9 | 9.7 | 124 | |
| ERJ 170-100 + SB 170-00-0016 | 38 600 | 3C | 1 644 | 26.0 | 6.2 | 10.6 | 11.5 | 29.9 | 29.9 | 9.7 | 125 | |
| ERJ 170-200 STD | 37 500 | 3C | 1 562 | 26.0 | 6.2 | 11.4 | 12.3 | 31.7 | 31.7 | 9.7 | 126 | |
| ER 170-200 LR and SU | 38 790 | 3C | 1 667 | 26.0 | 6.2 | 11.4 | 12.3 | 31.7 | 31.7 | 9.7 | 126 | |
| ERJ 170-200 + SB 170-00-0016 | 40 370 | 4C | 2 244 | 26.0 | 6.2 | 11.4 | 12.3 | 31.7 | 31.7 | 9.7 | 126 | |
| ERJ 190-100 STD | 47 790 | 3C | 1 476 | 28.7 | 7.1 | 13.8 | 14.8 | 36.3 | 36.3 | 10.6 | 124 | |
| ERJ 190-100 LR | 50 300 | 3C | 1 616 | 28.7 | 7.1 | 13.8 | 14.8 | 36.3 | 36.3 | 10.6 | 124 | |
| ERJ 190-100 IGW | 51 800 | 3C | 1 704 | 28.7 | 7.1 | 13.8 | 14.8 | 36.3 | 36.3 | 10.6 | 125 | |
| ERJ 190-200 STD | 48 790 | 3C | 1 597 | 28.7 | 7.1 | 14.6 | 15.6 | 38.7 | 38.7 | 10.5 | 126 | |
| ERJ 190-200 LR | 50 790 | 3C | 1 721 | 28.7 | 7.1 | 14.6 | 15.6 | 38.7 | 38.7 | 10.5 | 126 | |
| ERJ 190-200 IGW | 52 290 | 4C | 1 818 | 28.7 | 7.1 | 14.6 | 15.6 | 38.7 | 38.7 | 10.5 | 128 | |

* Reference field length reflects the model/engine combination that provides the shortest field length and the standard conditions (maximum weight, sea level, std day, A/C off, runway dry with no slope).

** Span includes optional wiinglets.

*** Preliminary data.

**** Preliminary data — aircraft not yet certified.

***** Longest deployed slide lengths, including upper deck slides, referenced from aircraft centre line as measured horizontally. Data are based primarily on aircraft rescue fire fighting charts.

# APPENDIX 2 – PHYSICAL CHARACTERISTICS OF AERODROMES

## 1. INTRODUCTION

Each paragraph within this appendix is structured as follows:

*Introduction*

This section provides the rationale, including the basis and objectives for the various elements of the physical infrastructure required in Chapter 3 of SLCAR Part 14A. References are made, where necessary, to other SLCARs and ICAO documents.

*Challenges*

This section identifies possible challenges based on experience, operational judgment and analysis of hazards linked to an infrastructure item in relation to the SLCAR provisions. Each compatibility study should determine the challenges relevant for the accommodation of the planned aircraft at the existing aerodrome.

*Potential solutions*

This section presents possible solutions related to the identified problems. Where it is impracticable to adapt the existing aerodrome infrastructure or operations in accordance with the applicable regulations, the compatibility study or, where necessary, safety assessment, determines the appropriate solutions or possible risk mitigation measures to be implemented.

***Note 1 - where possible solutions have been developed, these should be reviewed periodically to assess their continued validity. These possible solutions do not substitute or circumvent the provisions contained in SLCAR Part 14A.***

***Note 2 - Procedures on the conduct of a safety assessment can be found in the SLCAA-AC-AGA016 Rev01 (Aeronautical Studies and Safety Assessment).***

## 2. RUNWAYS

### 2.1 Runway length

***Note 1 - Runway length is a limiting factor on aircraft operations and should be assessed in collaboration with the aircraft operator. Information on aircraft reference field length can be found in Appendix 1 of this AC.***

***Note 2 - Longitudinal slopes can have an effect on aircraft performance.***

### 2.2 Runway width

*Introduction*

2.2.1 For a given runway width, factors affecting aircraft operations include the characteristics, handling qualities and performance demonstrated by the aircraft. It may be advisable to consider other factors of operational significance in order to have a safety margin for factors such as wet or contaminated runway pavement, crosswind conditions, crab angle approaches to landing, aircraft controllability during aborted take-off, and engine failure procedures.

***Note - Guidance is given in the Aerodrome Design Manual (ICAO Doc 9157), Part 1 - Runways.***

*Challenges*

2.2.2 The main issue associated with available runway width is the risk of aircraft damage and fatalities associated with an aircraft veering off the runway during take-off, rejected take-off or during the landing.

2.2.3 The main causes and accident factors are:

a. for take-off/rejected take-off:
   - (i) aircraft (asymmetric spin-up and/or reverse thrust, malfunctioning of control surfaces, hydraulic system, tires, brakes, nose-gear steering, centre of gravity and power plant (engine failure, foreign object ingestion));
   - (ii) temporary surface conditions (standing water, dust, residuals (rubber), FOD, damage to the pavement and runway friction coefficient);
   - (iii) permanent surface conditions (horizontal and vertical slopes and runway friction characteristics);
   - (iv) meteorological conditions (e.g. heavy rain, crosswind, strong/gusty winds, reduced visibility); and
   - (v) Human Factors (crew, maintenance, balance, payload security);

b. for landing:
   - (i) aircraft/airframe (malfunction of the landing gear, control surfaces, hydraulic system, brakes, tires, nose gear steering and power plant (reverse and thrust lever linkage));
   - (ii) temporary surface conditions (standing water, dust, residuals (e.g. rubber), FOD, damage to the pavement and applying runway friction coefficient);
   - (iii) permanent surface conditions (horizontal and vertical slopes and runway friction characteristics);
   - (iv) prevailing meteorological conditions (heavy rain, crosswind, strong/gusty winds, thunderstorms/wind shear, reduced visibility);
   - (v) Human Factors (i.e. hard landings, crew, maintenance);
   - (vi) ILS localizer signal quality/interference, where auto-land procedures are used;
   - (vii) any other localizer signal quality/interference of approach aid equipment;
   - (viii) lack of approach path guidance such as VASIS or PAPI; and
   - (ix) approach type and speed.

***Note - An analysis of lateral runway excursion reports shows that the causal factor in aircraft accidents/incidents is not the same for take-off and landing. Mechanical failure is, for instance, a frequent accident factor for runway excursions during take-off, while hazardous meteorological conditions such as thunderstorms are more often associated with landing accidents/incidents. Engine reverse thrust system malfunction and/or***

***contaminated runway surfaces have also been a factor in a significant number of veer-offs during landing (other subjects are relevant to the aircraft, such as brake failures and high crosswinds).***

*Potential solutions*

2.2.4 The lateral runway excursion is linked to specific aircraft characteristics, performance/handling qualities, controllability in response to such events as aircraft mechanical failures, pavement contamination and crosswind conditions. Runway width is not a required specific certification limitation. However, indirectly related is the determination of minimum control speed on the ground (Vmcg) and the maximum demonstrated crosswind. These additional factors should be considered as key factors in order to ensure that this kind of hazard is adequately addressed.

2.2.5 For a specific aircraft, it may be permissible to operate on a runway with a narrower width if approved by the appropriate authorities for such operations.

***Note - The maximum demonstrated crosswind is included in the aircraft flight manual.***

2.2.6 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. paved inner shoulders of adequate bearing strength to provide an overall width of the runway and its (inner) shoulders of the recommended runway width according to the reference code;
b. paved/unpaved outer shoulders with adequate bearing strength to provide an overall width of the runway and its shoulder according to the reference code;
c. additional runway centreline guidance and runway edge markings; and
d. increased full runway length FOD inspection, when required or requested.

2.2.7 Aerodrome operators should also take into account the possibility that certain aircrafts are not able to make a 180-degree turn on narrower runways. When there is no proper taxiway at the end of the runway, providing a suitable runway turn pad is recommended.

***Note - Particular care should be given while manoeuvring on runways having a width less than recommended to prevent the wheels of the aircraft from leaving the pavement, while avoiding the use of large amounts of thrust that could damage runway lights and signs and cause erosion of the runway strip. For affected runways a close inspection, as appropriate, is generally considered to detect the presence of debris that may be deposited during 180-degree turns on the runway after landing.***

***Note - further guidance is given in Doc 9137, Part 2 - Pavement Surface Conditions.***

2.2.8 Aerodromes which use embedded (inset) runway edge lights should take into account additional consequences such as more frequent cleaning intervals for the embedded lights, as dirt will affect the function more quickly compared to elevated runway edge lights;

2.2.9 Location and specifications for runway signs should be considered due to the increased size of the aircraft's wingspan (engine location) as well as the increased thrust rating from the aircraft's engines.

## 2.3 Runway shoulders

*Introduction*

2.3.1 The shoulders of a runway should be capable of minimizing any damage to an aircraft veering off the runway. In some cases, the bearing strength of the natural ground may be sufficient without additional preparation to meet the requirements for shoulders. The prevention of ingestion of objects from jet engines should always be taken into account particularly for the design and construction of the shoulders. In case of specific preparation of the shoulders, visual contrast, such as the use of runway side-stripe markings, between runway and runway shoulders, may be required.

***Note – further guidance is given in ICAO Doc 9157, Part 1.***

*Challenges*

2.3.2 Runway shoulders have three main functions:

a. to minimize any damage to an aircraft running off the runway ;
b. to provide jet blast protection and to prevent engine FOD ingestion; and
c. to support ground vehicle traffic, RFF vehicles and maintenance vehicles.

2.3.3 Potential issues associated with runway shoulder characteristics (width, soil type, bearing strength) are:

a. aircraft damage that could occur after excursion onto the runway shoulder due to inadequate bearing capacity;
b. shoulder erosion causing ingestion of foreign objects by jet engines due to unsealed surfaces; consideration should be given to the impact of FOD on aircraft tires and engines as a potentially major hazard; and
c. difficulties for RFF services to access a damaged aircraft on the runway due to inadequate bearing strength.

2.3.4 Factors to be considered are:

a. runway centre line deviations;
b. powerplant characteristics (engine height, location and power); and
c. soil type and bearing strength (aircraft mass, tire pressure, gear design).

*Potential solutions*

2.3.5 Possible solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. Excursion onto the runway shoulder. Provide the suitable shoulder as detailed in 2.3 of this

Appendix;

b. Jet blast. Information about outer engine position, jet blast velocity contour and jet blast directions at take-off is needed to calculate the required width of shoulders that has to be enhanced for protection against jet blast. Lateral deviation from the runway centreline should also be taken into account;

***Note 1 - Jet blast velocity data may be available from the aircraft manufacturers.***

***Note 2 - Relevant information is typically available in the aircraft characteristics for airport planning manual of aircraft manufacturers.***

c. RFF vehicles. Operational experience with aircrafts currently operating on existing runways suggests that an overall width of the runway and its shoulders which is compliant with the requirements is adequate to permit intervention on aircrafts by occasional RFF vehicle traffic. However, longer upper-deck escape chutes may reduce the margin between the shoulder edge and the extension of escape slides and reduce the supporting surface available to rescue vehicles; and

d. Additional surface inspections. It may be necessary to adapt the inspection programme for FOD detection.

## 2.4 Runway turn pads

*Introduction*

2.4.1 Turn pads are generally provided when an exit taxiway is not available at the runway end. A turn pad allows an aircraft to turn back after landing and before take-off and to position itself correctly on the runway.

***Note - Guidance on typical turn pads is given in ICAO Doc 9157, Part 1 Appendix 4. In particular, the design of the total width of the turn pad should be such that the nose-wheel steering angle of the aircraft for which the turn pad is intended will not exceed 45 degrees.***

*Challenges*

2.4.2 For minimizing the risk of a turn pad excursion, the turn pad should be designed sufficiently wide to permit the 180-degree turn of the most demanding aircraft that will be operated. The design of the turn pad generally assumes a maximum nose landing gear steering angle of 45 degrees, which should be used unless some other condition applies for the particular type of aircraft, and considers clearances between the gears and the turn pad edge, as for a taxiway.

2.4.3 The main causes and accident factors of the aircraft veering off the turn pad pavement are:

a. aircraft characteristics that are not adequate and aircraft failure (ground manoeuvring capabilities, especially long aircrafts, malfunctioning of nose-gear steering, engine, brakes);

b. adverse surface conditions (standing water, friction coefficient);

c. loss of the turn pad visual guidance (markings and lights inadequately maintained); and

d. Human Factors, including incorrect application of the 180-degree procedure (nose-wheel steering, asymmetric thrust, differential breaking).

***Note - an aircraft disabled on a turn pad can have an impact on runway closure.***

*Potential solutions*

2.4.4 The ground maneuvering capabilities available from aircraft manufacturers are one of the key factors to be considered in order to determine whether an existing turn pad is suitable for a particular aircraft. The speed of the manoeuvring aircraft is also a factor.

2.4.5 For a specific aircraft, it may be permissible to operate on a runway turn pad not provided in accordance with SLCAR Part 14A, specifications, considering:

a. the specific ground manoeuvring capability of the specific aircraft (notably the maximum effective steering angle of the nose landing gear);
b. the provision for adequate clearances;
c. the provision for appropriate marking and lighting;
d. the provision of shoulders;
e. the protection from jet blast; and
f. if relevant, protection of the ILS.

In this case, the turn pad can have a different shape. The objective is to enable the aircraft to align on the runway while losing the least runway length as possible. The aircraft is supposed to taxi at slow speed.

## 2.5 RUNWAY STRIPS

### 2.5.1 Runway strip dimensions

*Introduction*

2.5.1.1 A runway strip is an area enclosing a runway and any associated stopway. Its purpose is to:

a. reduce the risk of damage to an aircraft running off the runway by providing a cleared and graded area which meets specific longitudinal and transverse slopes, and bearing strength requirements; and
b. protect an aircraft flying over it during landing, balked landing or take-off by providing an area which is cleared of obstacles, except for permitted aids to air navigation.

2.5.1.2 Particularly, the graded portion of the runway strip is provided to minimize the damage to an aircraft in the event of a veer-off during a landing or take-off operation. It is for this reason that objects should be located away from this portion of the runway strip unless they are needed for air navigation purposes and are frangibly mounted.

***Note - The dimensions and characteristics of the runway strip are detailed in section 3.4 of SLCAR Part 14A and SLCAA-AC-AGA043 Rev00 (Supplementary Guidance to the SLCAR Part 14A).***

*Challenges*

2.5.1.3 Where the requirements on runway strips cannot be achieved, the available distances, the nature and location of any hazard beyond the available runway strip, the type of aircraft and the level of traffic at the aerodrome should be reviewed. Operational restrictions may be applied to the type of approach and low visibility operations that fit the available ground dimensions, while also taking into account:

a. runway excursion history;
b. friction and drainage characteristics of the runway;
c. runway width, length and transverse slopes;
d. navigation and visual aids available;
e. relevance in respect of take-off or aborted take-off and landing;
f. scope for procedural mitigation measures; and
g. accident report.

2.5.1.4 An analysis of lateral runway excursion reports shows that the causal factor in aircraft accidents/incidents is not the same for take-off and for landing. Therefore, take-off and landing events may need to be considered separately.

***Note - Mechanical failure is a frequent accident factor in runway excursions during take-off, while hazardous meteorological conditions such as thunderstorms are more often present with landing accident/incidents. Brake failures or engine reverse thrust system malfunctions have also been factors in a significant number of landing veer-offs.***

2.5.1.5 Lateral deviation from the runway centre line during a balked landing with the use of the digital autopilot as well as manual flight with a flight director for guidance have shown that the risk associated with the deviation of specific aircrafts is contained within the OFZ.

***Note - Provisions on OFZ are given in SLCAR Part 14A, and in ICAO Cir 301, New Larger Aircrafts - Infringement of the Obstacle Free Zone: Operational Measures and Aeronautical Study and ICAO Cir 345, New Larger Aircrafts - Infringement of the Obstacle Free Zone: Collision Risk Model and Aeronautical Study****.*

2.5.1.6 The lateral runway excursion hazard is clearly linked to specific aircraft characteristics, performance/ handling qualities and controllability in response to such events as aircraft mechanical failures, pavement contamination and crosswind conditions. This type of hazard comes under the category for which risk assessment is mainly based on flight crew/aircraft performance and handling qualities. Certified limitations of the specific aircraft is one of the key factors to be considered in order to ensure that this hazard is under control.

*Potential solutions*

2.5.1.7 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. improving runway surface conditions and/or the means of recording and indicating rectification action, particularly for contaminated runways, having knowledge of runways and their condition and characteristics in precipitation;
b. ensuring that accurate and up-to-date meteorological information is available and that information on runway conditions and characteristics is passed to flight crews in a timely manner, particularly when flight crews need to make operational adjustments;
c. improving the aerodrome operator's knowledge of recording, prediction and dissemination of wind data, including wind shear, and any other relevant meteorological information, particularly when it is a significant feature of an aerodrome's climatology;
d. upgrading the visual and instrument landing aids to improve the accuracy of aircraft delivery at the correct landing position on runways; and
e. in consultation with aircraft operators, formulating any other relevant aerodrome operating procedures or restrictions and promulgating such information appropriately.

### 2.5.2 Obstacles on runway strips

*Introduction*

2.5.2.1 An object located on a runway strip which may endanger aircrafts is regarded as an obstacle, and should be removed, as far as practicable. Obstacles may be either naturally occurring or deliberately provided for the purpose of air navigation.

*Challenges*

2.5.2.2 An obstacle on the runway strip may represent either:

a. a collision risk for an aircraft in flight or for an aircraft on the ground that has veered off the runway; and
b. a source of interference to navigation aids.

***Note 1 - mobile objects that are beyond the OFZ (inner transitional surface) but still within the runway strip, such as vehicles and holding aircrafts at runway-holding positions, or wing tips of aircrafts taxiing on a parallel taxiway to the runway, should be considered.***

***Note - Provisions on OFZ are given in SLCAR Part 14A, and in ICAO Cir 301, New Larger Aircrafts - Infringement of the Obstacle Free Zone: Operational Measures and Aeronautical Study and ICAO Cir 345, New Larger Aircrafts - Infringement of the Obstacle Free Zone: Collision Risk Model and Aeronautical Study***

*Potential solutions*

2.5.2.3 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. a natural obstacle should be removed or reduced in size wherever possible; alternatively, grading of the area allows reduction of the severity of damage to the aircraft;
b. other fixed obstacles should be removed unless they are necessary for air navigation, in which case they should be frangible and should be so constructed as to minimize the severity of damage to the aircraft;
c. an aircraft considered to be a moving obstacle within the runway strip should respect the requirement on the sensitive areas installed to protect the integrity of the ILS and should be subject to a separate safety assessment; and

   ***Note - Provisions on ILS critical and sensitive areas are given in SLCAR Part 10A – Aeronautical Telecommunications - Radio Navigation Aids.***

d. visual and instrument landing aids may be upgraded to improve the accuracy of aircraft delivery at the correct landing position on runways, and in consultation with aircraft operators, any other relevant aerodrome operating procedures or restrictions may be formulated and such information promulgated appropriately.

## 3. RUNWAY END SAFETY AREA (RESA)

*Introduction*

3.1 A RESA is primarily intended to reduce the risk of damage to an aircraft undershooting or overrunning the runway. Consequently, a RESA will enable an aircraft overrunning to decelerate, and an aircraft undershooting to continue its landing.

*Challenges*

3.2 Identification of specific issues related to runway overruns and undershoots is complex. There are a number of variables that have to be taken into account, such as prevailing meteorological conditions, the type of aircraft, the load factor, the available landing aids, runway characteristics, the overall environment, as well as Human Factors.

3.3 When reviewing the RESA, the following aspects have to be taken into account:

a. the nature and location of any hazard beyond the runway end;
b. the topography and obstruction environment beyond the RESA;
c. the type of aircrafts and level of traffic at the aerodrome and actual or proposed changes to either;
d. overrun/undershoot causal factors;
e. friction and drainage characteristics of the runway which have an impact on runway susceptibility to surface contamination and aircraft braking action;
f. navigation and visual aids available;

g. type of approach;

h. runway length and slope, in particular, the general operating length required for take-off and landing versus the runway distances available, including the excess of available length over that required;

i. the location of the taxiways and runways;

j. aerodrome climatology, including predominant wind speed and direction and likelihood of wind shear; and

k. aerodrome overrun/undershoot and veer-off history.

*Potential solutions*

3.4 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. restricting the operations during adverse hazardous meteorological conditions (such as thunderstorms);

b. defining, in cooperation with aircraft operators, hazardous meteorological conditions and other factors relevant to aerodrome operating procedures and publishing such information appropriately;

c. improving an aerodrome's database of operational data, detection of wind data, including wind shear and other relevant meteorological information, particularly when it is a significant change from an aerodrome's climatology;

d. ensuring that accurate and up-to-date meteorological information, current runway conditions and other characteristics are detected and notified to flight crews in time, particularly when flight crews need to make operational adjustments;

e. improving runway surfaces in a timely manner and/or the means of recording and indicating necessary action for runway improvement and maintenance (e.g. friction measurement and drainage system), particularly when the runway is contaminated;

f. removing rubber build-up on runways according to a scheduled time frame;

g. repainting faded runway markings and replacing inoperative runway surface lighting identified during daily runway inspections;

h. upgrading visual and instrument landing aids to improve the accuracy of aircraft delivery at the correct landing position on runways (including the provision of ILSs);

i. reducing declared runway distances in order to provide the necessary RESA;

j. installing suitably positioned and designed arresting systems as a supplement or as an alternative to standard RESA dimensions when necessary (see Note 1 below);

k. increasing the length of a RESA and/or minimizing the potential obstruction in the area beyond the RESA; and

l. publishing provisions, including the provision of an arresting system, in the AIP.

***Note 1 - Further guidance on arresting systems can be found in SLCAA-AC-AGA043 Rev00 (Supplementary Guidance to the SLCAR Part 14A).***

***Note 2 - In addition to the AIP entry, information/instructions may be disseminated to local runway safety teams and others to promote awareness in the community.***

## 4. TAXIWAYS

### 4.1 General

*Introduction*

4.1.1 Taxiways are provided to permit the safe and expeditious surface movement of aircrafts.

4.1.2 A sufficiently wide taxiway permits smooth traffic flow while facilitating aircraft ground steering.

***Note 1 - Guidance material is given in Doc 9157, Part 2 - Taxiways, Aprons and Holding Bays; Section 1.2 and Table 1-1 provide the formula for determining the width of a taxiway.***

***Note 2 - Particular care should be taken while manoeuvring on taxiways having a width less than that specified in SLCAR Part 14A, to prevent the wheels of the aircraft from leaving the pavement, while avoiding the use of large amounts of thrust that could damage taxiway lights and signs and cause erosion of the taxiway strip. Affected taxiways should be closely inspected, as appropriate, for the presence of debris that may be deposited while taxiing into position for take-off.***

*Challenges*

4.1.3 The issue arises from a lateral taxiway excursion.

4.1.4 Causes and accident factors can include:

a. mechanical failure (hydraulic system, brakes, nose-gear steering);
b. adverse surface conditions (standing water, friction coefficient);
c. loss of the taxiway centreline visual guidance (markings and lights inadequately maintained);
d. Human Factors (including directional control, orientation error, pre-departure workload); and
e. aircraft taxi speed.

***Note - The consequences of a taxiway excursion are potentially disruptive. However, consideration should be given to the greater potential impact of deviation of a larger aircraft in terms of blocked taxiways or disabled aircraft removal.***

4.1.5 Pilot precision and attention are key issues since they are heavily related to the margin between the outer main gear wheel and the taxiway edge.

4.1.6 Compatibility studies related to taxiway width and potential deviations can include:

a. the use of taxiway deviation statistics to calculate the taxiway excursion probability of an aircraft depending on taxiway width. The impact of taxiway guidance systems and meteorological and surface conditions on taxiway excursion probability should be assessed whenever possible;
b. view of the taxiway from the cockpit, taking into account the visual reference cockpit cut-off angle and pilot eye height; and
c. the aircraft outer main gear wheel span.

*Potential solutions*

4.1.7 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. the provision of taxiway centre line lights;
b. conspicuous centre line marking;
c. the provision of on-board taxi camera systems to assist taxi guidance;
d. reduced taxi speed;
e. the provision of taxi side-stripe markings;
f. taxiway edge lights (inset or elevated);
g. reduced wheel-to-edge clearance, using taxiway deviation data;
h. enhanced snow bank clearance (engine positions);
i. the use of alternative taxi routes; and
j. the use of marshaller services (follow-me guidance).

***Note 1 - Taxi cameras are designed to ease the taxi and can assist the flight crew in preventing the wheels of the aircraft from leaving the full-strength pavement during normal ground manoeuvring.***

***Note 2 - Taxiways that are not provided with suitable shoulders may be restricted in operation.***

4.1.8 Location and specifications for taxiway signs should be considered due to the engine location as well as the increased thrust in the aircraft engines.

## 4.2 Taxiway curves

*Introduction*

4.2.1 Section 3.9.5 of SLCAR Part 14A, contains provisions on taxiway curves. Additional guidance is included in ICAO Doc 9157, Part 2.

*Challenges*

4.2.2 Any hazard will be the result of a lateral taxiway excursion on a curved section.

4.2.3 The main causes and accident factors are the same as for a taxiway excursion on a straight taxiway section. The use of the cockpit-over-centreline steering technique on a curved taxiway will result in track-in of the main landing gear from the centre line. The amount of track-in depends on the radius of the curved taxiway and the distance from the cockpit to the main landing gear.

4.2.4 The consequences are the same as for lateral taxiway excursions on straight sections.

4.2.5 The required width of the curved portions of taxiways is related to the clearance between the outer main wheel and the taxiway edge on the inner curve. The hazard is related to the combination of the outer main gear wheel span and the distance between the nose gear/cockpit and the main gear. Consideration should be given to the effect on airfield signs and other objects nearby of jet blast from a turning aircraft.

4.2.6 Certain aircrafts may require wider fillets on curved sections or taxiway junctions.

*Potential solutions*

4.2.7 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. the widening of existing fillets or the provision of new fillets;
b. reduced taxi speed;
c. the provision of taxiway centre line lights and taxi side-stripe markings (and inset taxiway edge lights);
d. reduced wheel-to-edge clearance, using taxiway deviation data;
e. pilot judgmental oversteering; and
f. publication of provisions in the appropriate aeronautical documentation.

***Note - Operations on taxiway curves that are not provided with suitable taxiway fillets should be restricted.***

4.2.8 Special attention should be given to the offset of centre line lights in relation to centre line markings.

4.2.9 Location and specifications for taxiway signs should be considered due to the increase in the size of aircrafts as well as the increased thrust in aircraft engines.

## 5. RUNWAY AND TAXIWAY MINIMUM SEPARATION DISTANCES

*Introduction*

5.1 A minimum distance is provided between the centre line of a runway and the centre line of the associated parallel taxiway for instrument runways and non-instrument runways.

***Note 1 - ICAO Doc 9157, Part 2, section 1.2, and Table 1-5, clarify that the runway/taxiway separation is based on the principle that the wing tip of an aircraft taxiing on a parallel taxiway should be clear of the runway strip.***

***Note 2 - It is permissible to operate with lower separation distances at an existing aerodrome if a safety assessment indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of operations of aircrafts.***

***Note 3 – ICAO Doc 9157, Part 2, has related guidance in 1.2.47 to 1.2.50. Furthermore, attention is drawn to the need to provide adequate clearance at an existing aerodrome in order to operate an aircraft with the minimum possible risk.***

*Challenges*

5.2 The potential issues associated with runway/parallel taxiway separation distances are:

a. the possible collision between an aircraft running off a taxiway and an object (fixed or mobile) on the aerodrome;
b. the possible collision between an aircraft leaving the runway and an object (fixed or mobile) on the aerodrome or the risk of a collision of an aircraft on the taxiway that infringes on the runway strip; and
c. possible ILS signal interference due to a taxiing or stopped aircraft.

5.3 Causes and accident factors can include:

a. Human Factors (crew, ATS);
b. hazardous meteorological conditions (such as thunderstorms and wind shear);
c. aircraft mechanical failure (such as engine, hydraulic system, flight instruments, control surfaces and autopilot);
d. surface conditions (standing water, friction coefficient);
e. lateral veer-off distance;
f. aircraft position relative to navigation aids, especially ILS; and
g. aircraft size and characteristics (especially wingspan).

*Potential solutions*

5.4 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. place a restriction on the wingspan of aircrafts using the parallel taxiway or on the runway, if continued unrestricted taxiway or runway operation is desired;
b. consider the most demanding length of aircraft that can have an impact on runway/taxiway separation and the location of holding positions (ILS);
c. change taxiway routing so that the required runway airspace is free of taxiing aircrafts; and
d. employ tactical control of aerodrome movements.

***Note - When A-SMGCS is available, it can be utilized as a supporting means to the proposed solutions especially in low visibility conditions.***

## 6. TAXIWAY AND TAXILANE MINIMUM SEPARATION DISTANCES

*Introduction*

**Taxiway to object separation**

6.1 The taxiway minimum separation distances provide an area clear of objects that may endanger an aircraft.

***Note 1 - See section 3.9 of SLCAR Part 14A.***

***Note 2 - Additional guidance material on minimum separation distances is included in ICAO Doc 9157, Part 2.***

**Parallel taxiway separation**

6.2 The minimum separation distance is equal to, the wingspan plus maximum lateral deviation, plus increment.

***Note 1 – further information is given in ICAO Doc 9157, Part 2.***

***Note 2 - If the minimum required distance between the centre-lines of two parallel taxiways is not provided, it is permissible to operate with lower separation distances at an existing aerodrome if a compatibility study, which may include a safety assessment, indicates that such lower separation distances would not adversely affect the safety or significantly affect the regularity of aircraft operations.***

*Challenges*

**Taxiway to object separation**

6.3 The separation distances during taxiing are intended to minimize the risk of a collision between an aircraft and an object (taxiway/object separation, taxilane/object separation).

***Note - Taxiway deviation statistics can be used to assess the risk of a collision between two aircrafts or between an aircraft and an object.***

6.4 The causes and accident factors can include:

a. mechanical failure (hydraulic system, brakes, nose-gear steering);
b. conditions (standing water, friction coefficient);
c. loss of the visual taxiway guidance system; and
d. Human Factors (directional control, temporary loss of orientation resulting in aircrafts being incorrectly positioned, etc.).

**Parallel taxiway separation**

6.5 The potential issues associated with parallel taxiway separation distances are:

a. the probable collision between an aircraft running off a taxiway and an object (aircraft on parallel taxiway); and
b. an aircraft running off the taxiway and infringing the opposite taxiway strip.

6.6 Causes and accident factors can include:

a. Human Factors (crew, ATS);
b. hazardous meteorological conditions (such as reduced visibility);
c. aircraft mechanical failure (such as engine, hydraulic system, flight instruments, control surfaces, autopilot);
d. surface conditions (standing water, friction coefficient);
e. lateral veer-off distance; and
f. aircraft size and characteristics (especially wingspan).

*Potential solutions*

**Taxiway to object separation**

6.7 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. the use of reduced taxiing speed;
b. the provision of taxiway centre line lights;

c. the provision of taxi side-stripe markings (and inset taxiway edge lights);
d. the provision of special taxi routing for larger aircrafts;
e. restrictions on aircrafts (wingspan) allowed to use parallel taxiways during the operation of a specific aircraft;
f. restrictions on vehicles using service roads adjacent to a designated aircraft taxi route;
g. the use of "follow-me" guidance;
h. the provision of reduced spacing between taxiway centre line lights; and
i. the provision of straightforward taxiway naming and ground routings with respect to the hazard of taxiway veer-offs.

***Note - Special attention should be given to the offset of centre line lights in relation to centre line markings.***

**Parallel taxiway separation**

6.8 Potential solutions can be developed by providing the following facilities, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. place a restriction on the wingspan of aircrafts using the parallel taxiway if continued unrestricted taxiway operation is desired;
b. consider the most demanding length of aircraft that can have an impact on a curved taxiway section;
c. change taxiway routing;
d. employ tactical control of aerodrome movements;
e. use of reduced taxiing speed;
f. provision of taxiway centre line lights;
g. provision of taxi side-stripe markings (and inset taxiway edge lights);
h. use of "follow-me" guidance;
i. provision of reduced spacing between taxiway centre line lights; and
j. provision of straightforward taxiway naming and ground routings with respect to the hazard of taxiway veer-offs.

***Note - When A-SMGCS is available, it can be utilized as a supporting means to the proposed solutions especially in low visibility conditions.***

## 7. TAXIWAYS ON BRIDGES

*Introduction*

7.1 The width of that portion of a taxiway bridge capable of supporting aircrafts, as measured perpendicularly to the taxiway centre line, is normally not less than the width of the graded area of the strip provided for that taxiway, unless a proven method of lateral restraint is provided which is not hazardous for aircrafts for which the taxiway is intended.

***Note - section 3.9 of SLCAR Part 14A and ICAO Doc 915 Part 2, provides information on taxiways on bridges*.**

7.2 Access is to be provided for RFF vehicles to intervene, in both directions within the specified response time, with the largest aircraft for which the taxiway is intended.

7.3 If aircraft engines overhang the bridge structure, it may be necessary to protect the adjacent areas, below the bridge, from engine blast.

*Challenges*

7.4 The following hazards are related to the width of taxiway bridges:

a. landing gear leaving the load-bearing surface;
b. deployment of an escape slide beyond the bridge, in case of an emergency evacuation;
c. lack of manoeuvring space for RFF vehicles around the aircraft;
d. jet blast to vehicles, objects or personnel below the bridge;
e. structural damage to the bridge due to the aircraft mass exceeding the bridge design load; and
f. damage to the aircraft due to insufficient clearance of engines, wings or fuselage from bridge rails, lights or signs**.**

7.5 The causes and accident factors can include:

a. mechanical failure (hydraulic system, brakes, nose-gear steering);
b. surface conditions (standing water, friction coefficient);
c. loss of the visual taxiway guidance system;
d. Human Factors (directional control, disorientation, pilot's workload);
e. the position of the extremity of the escape slides; and
f. Under-carriage design.

7.6 The main causes of and accident factors for jet blast effect below the bridge are:

a. powerplant characteristics (engine height, location and power);
b. bridge blast protection width; and
c. taxiway centre line deviation factors (see taxiway excursion hazard in 4.1.4 of this

Appendix).

7.7 In addition to the specifications on Safety Assessments for Aerodromes in SLCAA-AC-AGA016 Rev01 (Aeronautical Studies and Safety Assessment), hazard prevention mechanisms should be based on the critical dimensions of the aircraft in relation to the bridge's width.

*Potential solutions*

7.8 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. where feasible, strengthen existing bridges;
b. provide a proven method of lateral restraint to prevent the aircraft from veering off the full bearing strength of the taxiway bridge;
c. provide an alternative path/bridge for RFF vehicles or implement emergency procedures to taxi the aircraft away from such taxi bridges;
d. implement jet blast procedures to reduce the effects of jet blast on the undercroft; and
e. use the vertical clearance provided by high wings.

7.9 The RFF vehicles need to have access to both sides of the aircraft to fight any fire from the best position, allowing for wind direction as necessary. In case the wingspan of the considered aircraft exceeds the width of the bridge, another bridge nearby can be used for access to the "other" side of an aircraft rather than an increased bridge width; in this case the surface of the bypass routes are at least stabilized where it is unpaved.

***Note - The use of another bridge as mentioned in 7.9 is practicable only where bridges are paired (parallel taxiways) or when there is a service road in the surrounding area. In any case, the bridge strength is to be checked, depending on the aircraft planning to use it***.

7.10 The protection from jet blast of vehicular traffic under/near the bridge is to be studied, consistent with the overall width of the taxiway and its shoulders.

7.11 The bridge width should be compatible with the deployment of escape slides. If this is not the case, a safe and quick escape route should be ensured.

***Note - Curved centre lines should be avoided leading up to, on and when leaving the bridge***.

## 8. TAXIWAY SHOULDERS

*Introduction*

8.1 Taxiway shoulders are intended to protect an aircraft operating on the taxiway from FOD ingestion and to reduce the risk of damage to an aircraft running off the taxiway.

8.2 The taxiway shoulder dimensions are based on current information regarding the width of the inner engine exhaust plume for breakaway thrust. Furthermore, the surface of taxiway shoulders is prepared so as to resist erosion and ingestion of the surface material by aircraft engines.

*Challenges*

8.3 The factors leading to reported issues are:

a. powerplant characteristics (engine height, location and power);
b. taxiway shoulder width, the nature of the surface and its treatment; and
c. taxiway centre line deviation factors, both from the expected minor wander from tracking error and the effect of main gear track-in in the turn area while using the cockpit-over-centre line-steering technique**.**

*Potential solutions*

8.4 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. ***Excursion on the taxiway shoulder***. The thickness and composition of shoulder pavements should be such as to withstand the occasional passage of the aircraft operating at the aerodrome that has the most demanding impact on pavement loading, as well as the full load of the most demanding aerodrome emergency vehicle. The impact of an aircraft on pavements should be assessed and, if required, existing taxiway shoulders (if allowed to be used by these heavier aircrafts) may need to be strengthened by providing a suitable overlay.

***Note - Surface materials of an asphalt paved shoulder of 10 to 12.5 cm thick (the higher thickness where wide bodied aircraft jet blast exposure is likely) and firmly adhering to the underlying pavement layers (by way of a tack coat or other means that assures a well-bonded interface between the surface layer and the underlying strata) is generally a suitable solution.***

b. ***Jet blast***. Information on engine position and jet blast velocity contour at breakaway thrust mode is used to assess jet blast protection requirements during taxiing operations. A lateral deviation from the taxiway centreline should be taken into account, particularly in the case of a curved taxiway and the use of the cockpit-over centre-line steering technique. The effect of jet blast can also be managed by the use of thrust management of the engines (in particular for four-engine aircraft).

c. ***RFF vehicles*****.** Operational experience with current aircrafts on existing taxiways suggests that a compliant overall width of the taxiway and its shoulders permits the intervention of aircrafts by occasional RFF vehicle traffic.

***Note 1 - For NLA, the longer upper-deck escape chutes may reduce the margin between the shoulder edge and the extremity of these escape slides and reduce the supporting surface available to rescue vehicles.***

***Note 2 - In some cases, the bearing strength of the natural ground may be sufficient, without special preparation, to meet the requirements for shoulders. (Doc 9157, Part 1, provides further design criteria).***

## 9. CLEARANCE DISTANCE ON AIRCRAFT STANDS

*Introduction*

9.1 Section 3.13.6 of SLCAR Part 14A, recommends the minimum distance between an aircraft using the stand and an obstacle.

*Challenges*

9.2 The possible reasons for collision between an aircraft and an obstacle on the apron or holding bay can be listed as:

a. mechanical failure (e.g. hydraulic system, brakes, nose-gear steering);
b. surface conditions (e.g. standing water, friction coefficient);
c. loss of the visual taxi guidance system (docking system out of service); and
d. Human Factors (directional control, orientation error).

9.3 The probability of a collision during taxiing depends more on Human Factors than on aircraft performance. Unless technical failure occurs, aircrafts will respond reliably to directional inputs from the pilot when taxiing at the usual ground speed. Nevertheless, caution should be exercised with regard to the impact of aircrafts with larger wingspans.

*Potential solutions*

9.4 Potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. appropriate condition of marking and signage;
b. apron stand lead-in lights;
c. azimuth guidance as a visual docking system;
d. appropriate training of operating and ground personnel should be ensured by an aerodrome

operator;

e. operational restrictions (e.g. adequate clearances before and behind parked or holding aircrafts due to the increased length of aircrafts);

f. temporarily downgraded adjacent aircraft stands;

g. towing the aircraft on/from the stand;

h. use of remote/cargo stands or “roll-through” parking positions for handling the aircraft;

i. publication of procedures in the appropriate aeronautical documentation (i.e. closing or rerouting of taxilanes behind parked aircrafts);

j. advanced visual guidance system;

k. marshaller guidance;

l. enhancing apron lighting levels in low visibility conditions; and

m. use of the vertical clearances provided by high wings.

## 10. PAVEMENT DESIGN (Applicable until 27 November 2024)

*Introduction*

10.1 Until 27 November 2024, to facilitate flight planning, various aerodrome data are required to be published, such as data concerning the strength of pavements, which is one of the factors required to assess whether the aerodrome can be used by an aircraft of a specific all-up mass.

***Note - The aircraft classification number/pavement classification number (ACN/PCN) method is used for reporting pavement strength. Requirements are given in section 2.6 of SLCAR Part 14A and Chapter 19 of SLCAA-AC-AGA043 Rev00 (Guidance Material Supplementary to SLCAR Part 14A).***

10.2 Until 27 November 2024, the increased mass and/or gear load of the aircrafts may require additional pavement support. Existing pavements and their maintenance will need to be evaluated for adequacy due to differences in wheel loading, tire pressure, and undercarriage design. Bridge, tunnel and culvert load-bearing capacities are a limiting factor, requiring some operational procedures.

*Potential solutions*

10.3 Until 27 November 2024, potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. restrictions on aircrafts with higher ACNs on specific taxiways, runway bridges or aprons; or

b. adoption of adequate pavement maintenance programmes.

## 11 PAVEMENT DESIGN (Applicable as of 28 November 2024)

*Introduction*

11.1 As of 28 November 2024, to facilitate flight planning, various aerodrome data are required to be published, such as data concerning the strength of pavements, which is one of the factors required to assess whether the aerodrome can be used by an aircraft of a specific all-up mass.

***Note - The aircraft classification rating/pavement classification rating (ACR-PCR) method is used for reporting pavement strength. Requirements are given in section 2.6 of SLCAR Part 14A and Chapter 19 of SLCAA-AC-AGA043 Rev00 (Guidance Material Supplementary to SLCAR Part 14A).***

11.2 As of 28 November 2024, the increased mass and/or gear load of the aircrafts may require additional pavement support. Existing pavements and their maintenance will need to be evaluated for adequacy due to differences in wheel loading, tire pressure, and undercarriage design. Bridge, tunnel and culvert load-bearing capacities are a limiting factor, requiring some operational procedures.

*Potential solutions*

11.3 As of 28 November 2024, potential solutions can be developed by applying the following measures, alone or in combination with other measures. The following list is not in any particular order and is not exhaustive:

a. restrictions on aircrafts with higher ACRs on specific taxiways, runway bridges or aprons; or

b. adoption of adequate pavement maintenance programmes.