WORKING TOGETHER TO ENHANCE AIRPORT OPERATIONAL SAFETY

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AERODROME COMPATIBILITY

Aerodrome compatibility

A methodology and procedure to assess the **compatibility between aeroplane operations and aerodrome infrastructure** and operations when an aerodrome accommodates an aeroplane that exceeds the certificated characteristics of the aerodrome.

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

Aerodrome compatibility

The following steps describe the **arrangement, to be appropriately documented, between the aeroplane operator and aerodrome operator** for the introduction of an aeroplane type/subtype new to the aerodrome:

a) the **aeroplane operator submits a request to the aerodrome operator** to operate an aeroplane type/subtype new to the aerodrome;

b) the **aerodrome operator identifies possible means of accommodating the aeroplane** type/subtype including access to movement areas and, if necessary, considers the feasibility and economic viability of upgrading the aerodrome infrastructure; and

c) the **aerodrome operator and aircraft operator discuss the aerodrome operator's assessment**, and whether operations of the aeroplane type/subtype can be accommodated and, if permitted, under what conditions.

Aerodrome compatibility

The following procedures should be included in the aerodrome compatibility study:

a) **identify the aeroplane's physical and operational characteristics**;

b) identify the **applicable regulatory requirements**;

c) establish the **adequacy of the aerodrome infrastructure and facilities** vis-à-vis the requirements of the new aeroplane;

d) identify the **changes required** to the aerodrome;

e) document the compatibility study; and

f) perform the required **safety assessments** identified during the compatibility study.

Aerodrome compatibility

The result of the compatibility study should enable decisions to be made and should provide:

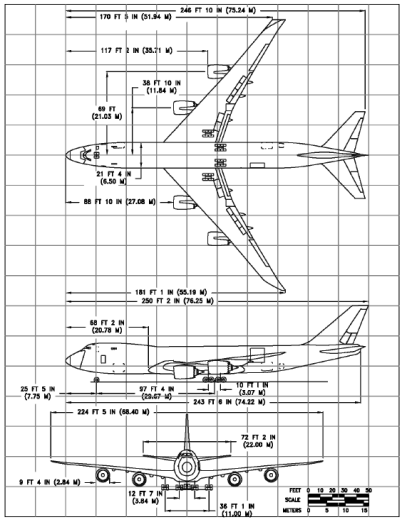
a) the aerodrome operator with the **necessary information in order to make a decision** on allowing the operation of the specific aeroplane at the given aerodrome;

b) 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

c) the State with the information which is necessary for **its safety oversight and the continued monitoring of the conditions** specified in the aerodrome certification.

Impact of aeroplane characteristics On the aerodrome infrastructure

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



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 State's safety oversight actions.

Table 1-1. Aerodrome reference code
(see 1.6.2 to 1.6.4)

Code element 1		Code element 2		
Code number (1)	Aeroplane reference field length (2)	Code letter (3)	Wingspan (4)	Outer main gear wheel span[a] (5)
1	Less than 800 m	A	Up to but not including 15 m	Up to but not including 4.5 m
2	800 m up to but not including 1 200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1 200 m up to but not including 1 800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1 800 m and over	D	36 m up to but not including 52 m	9 m up to but not including 14 m
		E	52 m up to but not including 65 m	9 m up to but not including 14 m
		F	65 m up to but not including 80 m	14 m up to but not including 16 m

a. Distance between the outside edges of the main gear wheels.

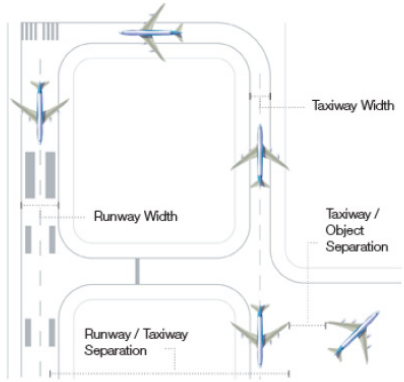
Note.— Guidance on planning for aeroplanes with wingspans greater than 80 m is given in the Aerodrome Design Manual *(Doc 9157), Parts 1 and 2.*

Impact of aeroplane characteristics on the aerodrome infrastructure

Consideration of the aeroplane's physical characteristics

The aeroplane's physical characteristics may influence the aerodrome **dimensions, facilities and services in the movement area**.

Airfield Characteristics	ICAO Code E / F	
	Meters	Feet
Runway Width	45 / 60	148 / 197
Runway + Shoulder Width	60 / 75	197 / 246
Taxiway Width	23 / 25	75 / 82
Taxiway + Shoulder Width	44 / 60	144 / 197
Runway – Taxiway Separation	182.5 / 190	599 / 623
Taxiway – Taxiway Separation	80 / 97.5	262 / 320
Taxiway – Object Separation	47.5 / 57.5	156 / 189
Taxilane – Object Separation	42.5 / 50.5	139 / 166



Consideration of the aeroplane's operational characteristics

In order to adequately assess aerodrome compatibility, aeroplane operational characteristics should be included in the evaluation process.

The operational characteristics can include the infrastructure requirements of the aeroplane as well as ground servicing requirements.

Runway end safety area (RESA)

A RESA is primarily intended to **reduce the risk of damage to an aeroplane undershooting or overrunning the runway**.

Consequently, a RESA will **enable an aeroplane overrunning to decelerate, and an aeroplane undershooting to continue its landing**.

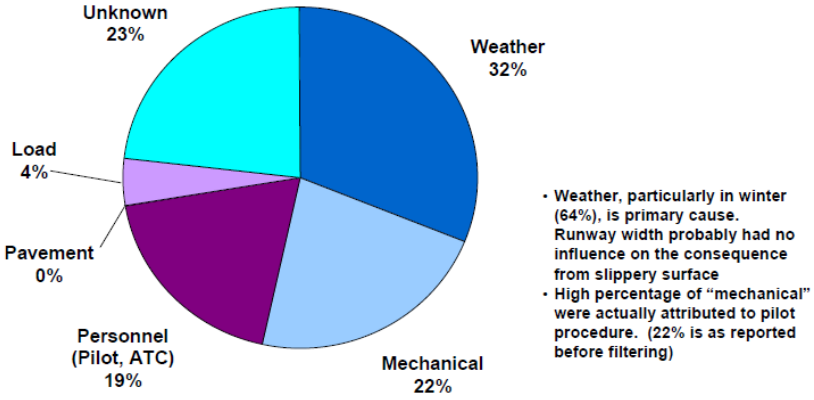
Physical characteristics of aerodromes

Challenges

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:

- meteorological conditions;
- type of aeroplane;
- load factor;
- available landing aids;
- runway characteristics;
- overall environment,
- human factors.



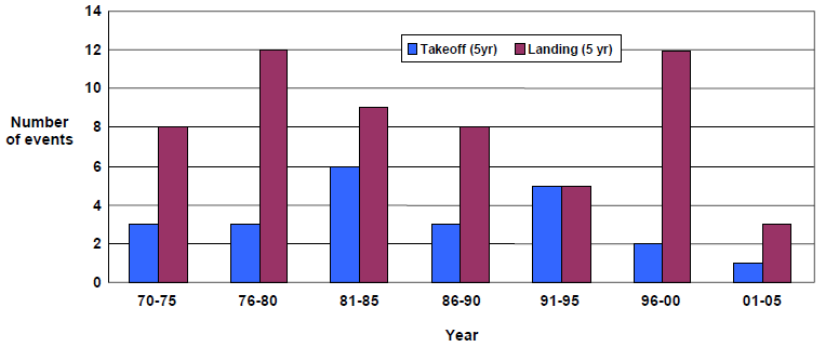
Physical characteristics of aerodromes

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

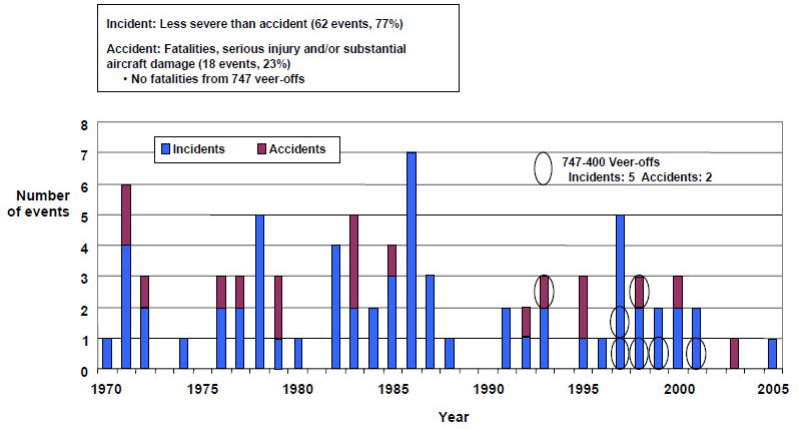
a) the nature and **location of any hazard** beyond the runway end;
b) the **topography and obstruction** environment beyond the RESA;
c) the **type of aeroplanes** and level of traffic at the aerodrome and actual or proposed changes to either;
d) overrun/undershoot causal factors;
e) friction and drainage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

Physical characteristics of aerodromes

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**.

Physical characteristics of aerodromes

Potential solutions

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

b) **defining**, in cooperation with aeroplane 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;

Physical characteristics of aerodromes

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;

Physical characteristics of aerodromes

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 aeroplane 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;

Physical characteristics of aerodromes

j) installing suitably positioned and designed **arresting systems** as a supplement or as an alternative to standard RESA dimensions when necessary;

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.

Physical characteristics of aerodromes

Runway strips

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 aeroplane 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 aeroplane 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.

Critical model shown in red	747-8	747-400ER	777-300ER	A340-600	A380-800
Wingspan	224.4ft (68.4 m)	213.0 ft (64.9 m)	212.6 ft (64.8 m)	208.0 ft (63.4 m)	261.8 ft (79.8 m)
Length	250.2 ft (76.3 m)	231.8 ft (70.7 m)	242.4 ft (73.9 m)	247.4 ft (75.4 m)	238.7 ft (72.7 m)
Tail height (max)	64.2 ft (19.6 m)	64.0 ft (19.5 m)	61.4 ft (18.7 m)	58.7 ft (17.9 m)	80.2 ft (24.4 m)
Wheelbase (to turning centroid)	92.3 ft (28.1 m)	79.1 ft (24.1 m)	100.4 ft (30.6 m)	108.9 ft (33.2 m)	97.8 ft (29.8 m)
Cockpit-to-main gear	100.0 ft (30.5 m)	86.6 ft (26.4 m)	112.2 ft (34.2 m)	122.7 ft (37.4 m)	104.6 ft (31.9 m)
Main gear span (to outer tire edges)	41.7 ft (12.7 m)	41.3 ft (12.6 m)	42.3 ft (12.9 m)	41.3 ft (12.6 m)	46.9 ft (14.3 m)
Outer engine span	136.7 ft (41.7 m)	136.7 ft (41.7 m)	63.0 ft (19.2 m)	126.3 ft (38.5 m)	168.6 ft (51.4 m)
Wingtip height (min)	19.7 ft (est) (6.0 m)	16.7 ft (5.1 m)	23.6 ft (7.2 m)	19.4 ft (5.9 m)	17.1 ft (5.2 m)
Max taxi weight	978,000 lb (443,610 kg)	913,000 lb (414,130 kg)	777,000 lb (352,440 kg)	840,400 lb (381,200 kg)	1,258,000 lb (571,000 kg)

Physical characteristics of aerodromes

Particularly, the graded portion of the runway strip is provided to **minimize the damage to an aeroplane 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 frangible mounted.

Challenges

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 aeroplane and the level of traffic at the aerodrome should be reviewed**.

Physical characteristics of aerodromes

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.

An **analysis of lateral runway excursion reports** shows that the causal factor in aeroplane accidents/incidents is not the same for take-off and for landing.

Therefore, **take-off and landing events may need to be considered separately**.

Physical characteristics of aerodromes

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 aeroplanes is contained within the OFZ**.

The lateral runway excursion hazard is clearly linked to **specific aeroplane characteristics, performance/ handling qualities and controllability** in response to such events as aeroplane 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/aeroplane performance and handling qualities**.

Certified limitations of the specific aeroplane is one of the key factors to be considered in order to ensure that this hazard is under control.

Physical characteristics of aerodromes

Potential solutions

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;

Physical characteristics of aerodromes

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 aeroplane delivery at the correct landing position on runways; and

e) in consultation with aeroplane operators, formulating any **other relevant aerodrome operating procedures or restrictions and promulgating such information appropriately**.

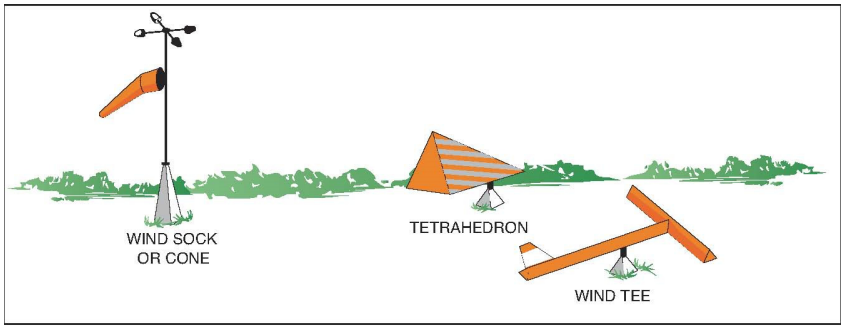


Figure 12-11. Wind direction indicators.

Physical characteristics of aerodromes

Runway and taxiway minimum separation distances

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.

Challenges

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

a) the **possible collision between an aeroplane running off a taxiway and an object** (fixed or mobile) on the aerodrome;

b) the possible collision between an aeroplane leaving the runway and an object (fixed or mobile) on the aerodrome or the **risk of a collision of an aeroplane on the taxiway** that infringes on the runway strip; and

c) **possible ILS signal interference due to a taxiing or stopped aeroplane**.

Physical characteristics of aerodromes

Causes and accident factors can include:

a) **Human Factors** (crew, ATS);

b) **hazardous meteorological conditions** (such as thunderstorms and wind shear);

c) **aeroplane mechanical failure** (such as engine, hydraulic system, flight instruments, control surfaces and autopilot);

d) **surface conditions** (standing water, loss of control on ice-covered surfaces, friction coefficient);

e) **lateral veer-off distance**;

f) **aeroplane position relative to navigation aids**, especially ILS; and

g) **aeroplane size and characteristics** (especially wingspan).

Physical characteristics of aerodromes

Potential solutions

a) **place a restriction on the wingspan of aeroplanes** using the parallel taxiway or on the runway, if continued unrestricted taxiway or runway operation is desired;

b) **consider the most demanding length of aeroplane** 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 aeroplanes; and

d) **employ tactical control** of aerodrome movements.

Clearance distance on aircraft stands

Annex 14, Volume I, 3.13.6, recommends the **minimum distance between an aeroplane using the stand and an obstacle**.

The possible reasons for collision between an aeroplane 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, ice-covered surfaces, friction coefficient);

c) **loss of the visual taxi guidance system** (docking system out of service); and

d) **Human Factors** (directional control, orientation error).

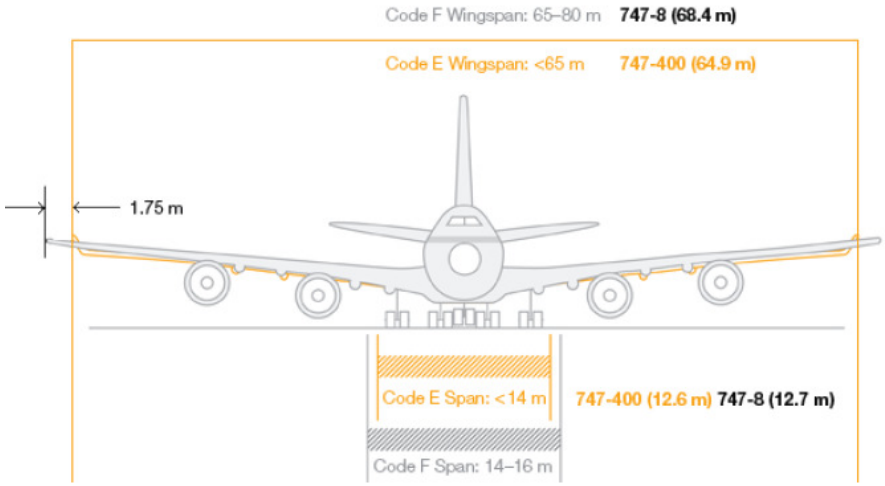
Physical characteristics of aerodromes

Clearance distance on aircraft stands

The probability of a collision during taxiing **depends more on Human Factors than on aeroplane performance**.

Unless technical failure occurs, aeroplanes will respond reliably to directional inputs from the pilot when taxiing at the usual ground speed.

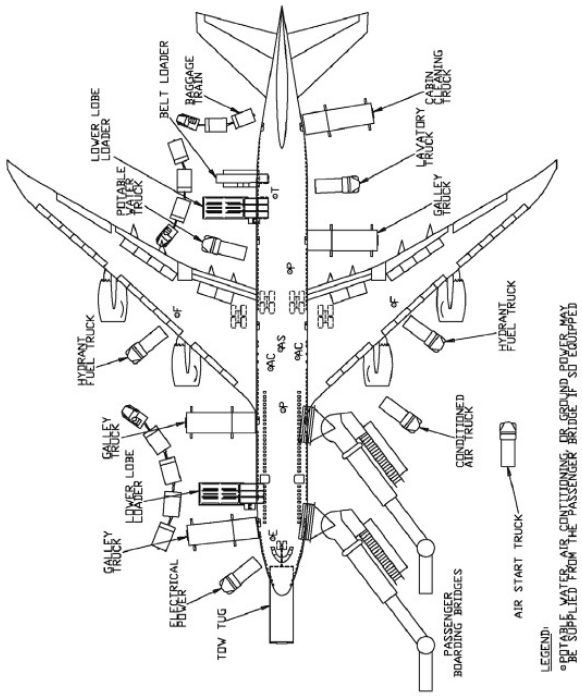
Nevertheless, **caution should be exercised with regard to the impact of aeroplanes with larger wingspans**.



Physical characteristics of aerodromes

Potential solutions

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 aeroplanes due to the increased length of aeroplanes);
f) temporarily downgraded adjacent aircraft stands;



5.1.1 AIRPLANE SERVICING ARRANGEMENT - TYPICAL TURNAROUND
MODEL 747-8

Physical characteristics of aerodromes

g) towing the aeroplane on/from the stand;
h) use of remote/cargo stands or “roll-through” parking positions for handling the aeroplane;
i) publication of procedures in the appropriate aeronautical documentation (i.e. closing or rerouting of taxilanes behind parked aeroplanes);
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.

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THANK YOU!