



# Runway geometric design

Runway characteristics depend on technical criteria and determine airport operations.

The runway adapts to the predominant winds in the area

## AIR SIDE

The runway is the protagonist of the airfield; the aircraft that operate on it will determine its orientation and signage.

Learn more!



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## Orientation

### Climate

The main runway must be oriented in the direction of the predominant wind, avoiding cross winds. An aircraft, depending on its weight, aerodynamics and thrust of its engines, needs to reach a specific relative speed with respect to the air that sustains it in order to ascend in take-off. This means that for a given effort, the relative speed in relation to the ground will be different depending on the direction of the wind.



When planning a new airport, a study is made of the winds in the area and three fundamental characteristics are analysed: direction, intensity and frequency. The **predominant winds** are those which are present most of the time. The **prevailing winds** are the strongest at any given time.

WINDS	
DIRECTION	✓✓
INTENSITY	✓✓
FREQUENCY	✓✓

The maximum permissible crosswind depends on the size of the aircraft, the wing configuration and the condition of the runway.

## Dimensions

### Length and width

Critical aircraft is that which makes most frequent use of the airport, and which defines the length and width of the runway. The width depends on the wingspan and wheelbase of the landing gear (number of engines). A code D or E runway (wingspan greater than 52 m and less than 65 m) would be 60 m wide.

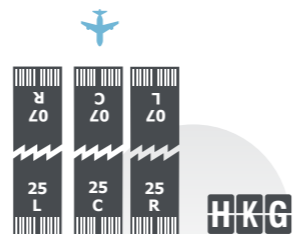
For type F aircraft (wingspan greater than or equal to 65m and up to 80m), and four engines or more, runway width and margins are...

75 metres

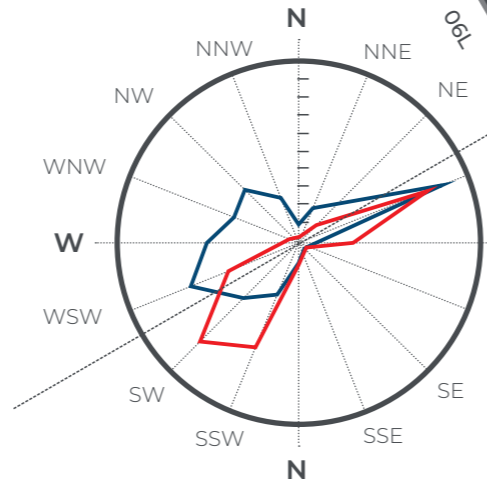
Altitude is inversely proportional to the density of the air. For a given aircraft model, the length required to operate is greater at greater altitude than at sea level, being that the higher the altitude, the lower the mass of air circulating through the aircraft's engine, and the lower the thrust. Low air density also affects lift.

### Designation

The designation of the runway is made according to its magnetic orientation in degrees, divided by 10 and rounded off. In the case of several runways with the same orientation, a letter is added: «R» (Right) y «L» (Left). And, in the case of a third runway «C» (Centre)



HKG  
Chek Lap Kok Airport (Hong Kong)



Other technical factors related to the runway to keep in mind are the type of surface (asphalt or concrete), the altitude and the longitudinal slope.

## Obstacles

### Site

The orientation of the runway will be determined by the topography, soil types, susceptibility to flooding and other geomorphological factors. The location of nearby towns or protected areas are also key factors to consider.

### Acoustic impact

The areas most exposed to acoustic impact are the head of the runway, underneath and on both sides of the approach and take-off paths. The noise footprint is calculated by measuring decibels, the number of times they are perceived and their duration.

At the Mallorca Airport (Spain) the orientation of the two runways (06L/24R y 06R/24L) is aligned with the direction of the predominant and prevailing winds. It corresponds to the compass rose of the winds **summer (red)** and **winter (blue)**.

### Slope

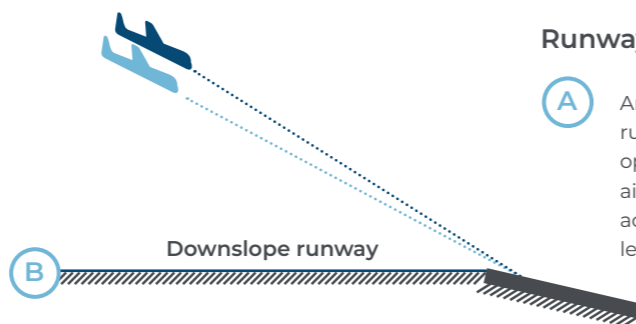
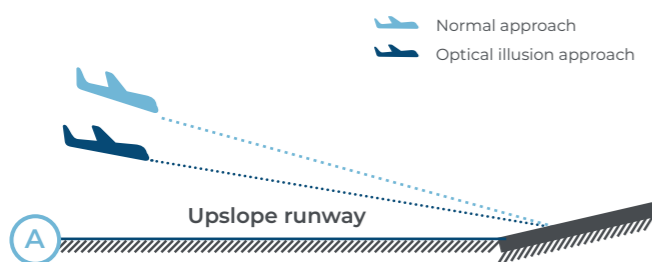
Another important factor to consider is the airport runway's longitudinal slope. The ideal design conditions foresee a slope of 0.0%, but geomorphological limitations often require runways to be built in areas where slope is very relevant. In these cases, according to predominant winds, if the slope is negative or positive the aircraft will need more or less runway to operate.

### Runway slope illusion

**A** An **upslope (positive slope)** runway can create the optical illusion that the aircraft is higher than its actual position, which can lead to a lower approach.

**B** A **downslope (negative slope)** runway can create the illusion that the aircraft is lower than its actual position, which leads to a higher approach.

The length of the runway must increase by 10% for every 1% increase in slope



## Unique runways

### Longest runway

#### ZIA Zhukovski International Airport (Russia)

This mixed-use runway (commercial/military) is the longest in the world (5,402 m). It began as an airfield assigned to the Flight Research Institute (1941) and has served as a test centre for aircraft. It was used as a test site for the Soviet Buran Spacecraft.

### Highest and longest (until 2013)

#### BPX Qamdo Bamda Airport (Changdu, Tibet)

Up to 2013 this was the longest runway in the world (5,500 m), later shortened to 4,507 m. Located in the easternmost part of Tibet, its great length is necessary due to the airfield's altitude (4,334 m). Altitude affects the functioning of engines and wings to acquire lift.

### Shortest runway

#### SAB Saba Airport (Caribbean)

The shortest useful commercial runway in the world (396 m), it is located in the Caribbean Sea at the Juancho E. Yrausquin Airport on the Island of Saba. Its short length determines the class of aircraft that can operate (type STOL in all cases) with the DHC-6 being the most widely used as it only needs 360 m to land.

### Second longest and... widest

#### ULY Ulyanovsk Vostochny Airport (Russia)

This is the second longest public-use runway in the world (5,000 m) long, and also the widest (105 m). This is due to the presence and requirements of the Aviarstar-SP aircraft company, manufacturer of the Antonov An-124 and the Tupolev Tu-204. This runway functions basically as a cargo airport.

### Steepest runway

#### GVF Courchevel Airport (France)

Located at the highest point of the Courchevel ski station (frequented by skiers) at 2,007 m with a very short runway (537 m) and a slope of 18.6%, used only by STOL (Dash 8) planes. This is an "altiport" with a complicated approach as it lacks an Instrument Landing System (ILS).

