THE PROJECT OF ADAPTATION OF AIRPORT TO EXECUTING THE IRREGULAR SERVICE OF AIRPLANE AIRBUS 380

Anna Kwasiborska, Anna Stelmach

Warsaw University of Technology
Faculty of Transport
Koszykowa Street 75, 00-662 Warsaw, Poland
tel.: +48 22 2347339
e-mail: akw@it.pw.edu.pl, ast@it.pw.edu.pl

Abstract

The aircraft Airbus A380 is the biggest aircraft in present time. Many airports need to adapt their airside infrastructure. The main duties concerns upgrading runways, and taxiways, relocating taxiways and even relocating aircraft stands and buildings to provide sufficient wings clearance. There are many hubs in the world, which must rebuild elements of infrastructures for A380. Besides these large hub and main base airports, there are other airports around the world that will experience A380 operations. The operating frequency could be either on regular basis, such as one or two scheduled arrivals a day, but also may be a much lower frequency such as for a flight diversion. Such diversions could be either due to the unavailability of the destination airport (because of weather or operational issues) or because of an in-flight emergency. It is in the interest of in-flight safety to have a reasonable number of alternate airports and runways available in addition to the scheduled ones. Aircraft operations regulations make a distinction between destination alternate aerodromes, other alternate aerodromes required to be adequate (e.g. in JAR-OPS 1) and in-flight diversion aerodromes. For those alternate airports, large-scale changes to their existing airside infrastructure would be financially excessive and never be economical. On the other hand, especially in the case of a filed alternate, a minimum should be done to properly handle the aircraft and its passengers. In paper is presented necessary requirements to service of airplane the Airbus A380. It is presented on examples of Chopin's airport in Warsaw. Service of this type of airplane requires adaptation of parameters of runway, taxiway and ground operations.

Keywords: *air transport, ground operation, infrastructure of airport*

1. Introduction

The first Airbus A380 aircraft was presented in Toulouse on January 18, 2005. The same year saw the first flight. The first aircraft was delivered to Singapore Airlines on 15 October 2007, and the first commercial flight on the route from Singapore to Sydney took place on October 25, 2007. An increasingly higher number of these aircraft operating in airports involves the issue of determining which airports can accommodate them. Airbus A380 is currently the world's largest passenger airliner.

The aircraft's dimensions (Fig. 1) affect the rescue and firefighting index that an airport has to have to accommodate this particular type of aircraft.

The index determines the minimum required quantity of extinguishing media and the minimum number of rescue and firefighting vehicles that should be available to an airport's rescue services (Tab. 1).

Another parameter is the runway length required for takeoff. It is not the only determining factor, however. The value is affected by the altitude of the airport above sea level, temperature, and longitudinal slope of the runway. Aircraft manufacturers publish International Standard Atmosphere (ISA) nomograms to exactly calculate the required value. The same applies for another parameter, which is the runway length, required for landing. Fig. 2 shows the runway lengths required for takeoff and landing of the A380 aircraft.

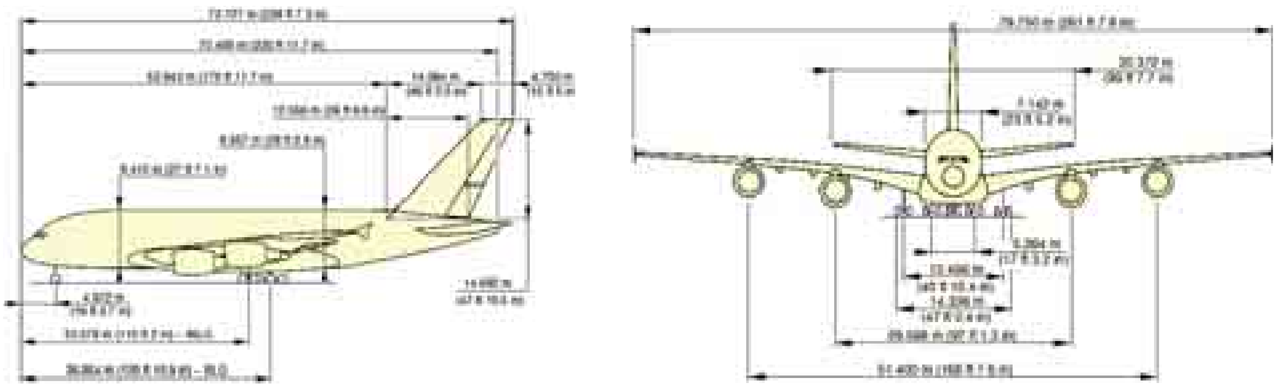

Fig. 1. Airbus A38 aircraft's dimensions. Sources: www.airbus.com

Tab. 1. Airport's rescue and firefighting index

Airport category	Aircraft length	Max width of fuselage
1	From 0 m to 9 m excluding	2 m
2	From 9 m to 12 m excluding	2 m
3	From 12 m to 18 m excluding	3 m
4	From 18 m to 24 m excluding	4 m
5	From 24 m to 28 m excluding	4 m
6	From 28 m to 39 m excluding	5 m
7	From 39 m to 49 m excluding	5 m
8	From 49 m to 61 m excluding	7 m
9	From 61 m to 76 m excluding	7 m
10	From 76 m to 90 m excluding	8 m

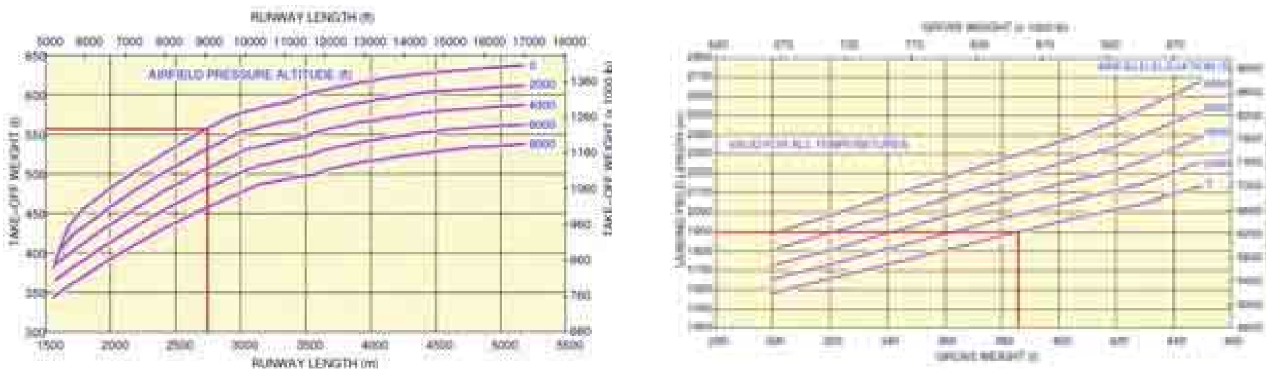

Fig. 2. Runway lengths required for takeoff and landing of the A380 aircraft. Sources: www.airbus.com

2. Requirements of Annex 14 to the Convention of International Civil Aviation

The introduced airport reference code systematizes the correlations between numerous technical requirements of the airport infrastructure components to define the airport equipment suitable for aircrafts to be accommodated. The reference code can be used to determine the value of many airport infrastructure requirements (Tab. 2). It consists of two elements related to the aircraft's performance and dimensions. Individual technical conditions are determined by the decisive element selected from two code elements or their appropriate combination. The component's code letter and digit selected for design purposes relate to the critical characteristics of the aircraft for which the specific equipment is to be provided (annex 14 to the Convention of International Civil Aviation. Airports. Vol. 1. Designing and Operating Airports. Issue 4, 2004).

Tab. 2. Airport reference code

Aerodrome Reference Code				
Code element 1		Code element 2		
Code number	Aeroplane reference field length	Code letter	Wing span	Outer main gear wheel span@
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 1200 m	B	15 m up to but not including 24 m	4.5 m up to but not including 6 m
3	1200 m up to but not including 1800 m	C	24 m up to but not including 36 m	6 m up to but not including 9 m
4	1800 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

@ distance between the outside edges of the main gear wheel

Source: Based on: Annex 14 to the Convention of International Civil Aviation. Airports. Vol. 1. Designing and Operating Airports. Issue 4, 2004.

Annex 14 specifies which airport data should be provided to Airport Information Services (AIS). They include, but are not limited to, airport reference point (it should be located near the geometrical centre of the airport and expressed in degrees, minutes, and seconds), airport reference temperature (monthly mean of maximum daily temperatures in the warmest month of the year, given in Celsius), and airport and runway elevation (altitude above sea level). Among other things, the following airport infrastructure components should also be dimensioned:

– runway: actual geographical direction with an accuracy of one-hundredth of a degree, runway threshold identity, length, width, displaced threshold location with an accuracy of one meter or foot, slope, type of pavement, type of runway ends, and, for runways with a category I instrumental landing system, the existence of an obstacle free zone, if any,
– runway strip, runway end protection, stopway – length and width with an accuracy of one meter or feet, type of pavement,
– taxiway – identification, width, type of pavement,
– apron – type of pavement, aircraft parking lots,
– boundaries of the area controlled by air traffic control services,
– clearway – length with an accuracy of one meter or feet, terrain profile,
– location and identification of standard taxiways.

It is also important to know pavement capacity. For aircrafts with apron masses exceeding 5700 kg, it should be given using the ACN-PCN method (aircraft classification number – pavement classification number). This helps airport administrators make sure that the airport apron is not subject to excessive wear and extends the life of the pavement. The essence of the ACN/PCN method is that for ACNs equal or lower than PCNs aircraft can perform an unlimited number of operations without detriment to the existing pavements of the airport's manoeuvring area. Aircraft operations (takeoff, landing, taxiing, and parking) can be performed with an ACN higher than the PCN specified for the pavement, but this involves faster wear. The ACN is specified by aircraft manufacturers. If you know the ACN limits, you can calculate the ACN value for any aircraft mass M using the following formula:

$$ACN = ACN_{min} + (ACN_{max} - ACN_{min}) \cdot \frac{M - M_{min}}{M_{max} - M_{min}}. \tag{1}$$

The ACN does not have to be lower than the PCN, but it involves faster wear of the runway. To introduce some pavement preservation guidelines in such cases, the ICAO has created the P/P0 ratio, which expresses a relation between the current aircraft mass and the mass at which the ACN is equal to the PCN of a specific pavement.

By rewriting formula [1] into the following form, you can calculate the mass that an aircraft has to have if its ACN is to be equal to the available PCN:

$$M = M_{min} + (ACN_M - ACN_{min}) \cdot \frac{M_{max} - M_{min}}{ACN_{max} - ACN_{min}} . \tag{2}$$

Annex 14 also imposes an obligation to report declared lengths. This applies for the following lengths, which have to be specified with an accuracy of one meter or foot:
- TORA (Take-Off Run Available),
- TODA (Take-Off Distance Available),
- ASDA (Accelerate-Stop Distance Available),
- LDA (Landing Distance Available).

SWY stands for stopway and CWY for clearway. The most important from the point of view of my paper will be TORA and LDA because these are the values that have to meet the requirements of the A380 aircraft.

Furthermore, Annex 14 specifies airport requirements including, but not limited to:
- physical characteristics (runways, taxiways, aprons, deciding stations),
- prevention and removal of aircraft obstacles,
- visual navigation aids,
- airport operational services.

These requirements depend on the airport reference code, however.

The actual length of the main runway is recommended to be sufficient enough to meet the operational requirements of the aircrafts for which such a runway is designed. This length should not be less than the shortest length obtained by making an allowance for operations performed under local conditions and the performance characteristics of the relevant aircrafts. This does not mean, however, that the runway should be designed on the assumption that it will be used by a critical aircraft with a maximum weight.

The method of calculating the lengths required for takeoff and landing is described in the airport design manual. An example of this method is as follows:

Data:
- Runway length required for takeoff with zero slope, at sea level, and under International Standard Atmosphere conditions – 2500 m,
- Runway length required for landing at sea level and under International Standard Atmosphere conditions – 2100 m,
- Airport elevation above sea level – 150 m,
- Airport reference temperature – 24°C,
- International Standard Atmosphere temperature at an altitude of 150 m above sea level – 14.025°C,
- Runway longitudinal slope – 0.5%.

Adjustment of the runway length required for takeoff:
- Runway length required for takeoff adjusted according to altitude above sea level (increase by 7% per 300 m above sea level):

$$\left(2500 \cdot 0.07 \cdot \frac{150}{300}\right) + 2500 = 2587 \text{ m}.$$

- Runway length required for takeoff adjusted according to height and temperature (increase by 1% per 1°C of the difference between the reference temperature and the International Standard

Atmosphere temperature at airport height):

$$[2587 \cdot (24 - 14.025) \cdot 0.01] + 2587 = 2845\,\text{m}.$$

– Runway length required for takeoff adjusted according to height, temperature, and slope (adjustment by 10% per 1% of runway longitudinal slope):

$$(2845 \cdot 0.5 \cdot 0.1) + 2845 = 2987\,\text{m}.$$

Runway length required for landing according to height (increase by 7% per 300 m above sea level):

$$\left(2100 \cdot 0.7 \cdot \frac{150}{300}\right) + 2100 = 2174\,\text{m}.$$

Actual required runway length – 2987 m.

If the runway is provided with a clearway or stopway, the actual runway length shorter than that calculated using the method described above can be considered to be sufficient, but then the runway/clearway and runway/stopway combinations have to make it possible to meet the operational requirements of the takeoffs and landings of those aircrafts for which the runway is designed.

The first requirement, which depends on the airport reference code, is runway width (Tab. 3). It is recommended to be not less than the dimensions shown in the table below.

Tab. 1. Runway widths

Code number	Code letter					
	A	B	C	D	E	F
1	18m	18m	23m	-	-	-
2	23m	23m	30m	-	-	-
3	30m	30m	30m	45m	-	-
4	-	-	45m	45m	45m	60m

Source: Own compilation based on: Annex 14 to the Convention of International Civil Aviation. Airports. Vol. 1. Designing and Operating Airports. Issue 4, 2004.

Additional factors to be considered when selecting a runway width should be:

– Aircraft deviation from the runway centreline when landing,
– Occurrence of crosswinds,
– Runway pavement condition,
– Visibility,
– Approach speed,
– Human factor.

Annex XIV also regulates allowable runway longitudinal and transverse slopes. For longitudinal slope, it should not exceed, respectively:

– 1% if the code digit is 3 or 4,
– 2% if the code digit is 1 or 2.

This slope is equal to the product of the maximum differential height of the runway centreline divided by its length:

$$i = \frac{H_{\max} - H_{\min}}{L_{DS}}, \tag{3}$$

i – runway longitudinal slope,
H_{max} – highest point of the runway,
H_{min} – lowest point of the runway,
L_{DS} – runway length.

To ensure the fastest possible outflow of water, the runway pavement should be, if possible,

pitched, except where fast water outflow can be ensured by one-sided crossfall in the direction of the most frequent winds accompanied by rain. The most favourable cross falls are as follows:
- 1.5% if the code letter is C, D, E, or F,
- 2% if the code letter is A or B.

This slope is also recommended to be approximately identical along the whole length of the runway, except for intersections with other runways.

A significant component of the runway is its shoulders. They are created to ensure the passage from a paved runway to an unpaved runway strip. They also protect runway edges against erosion caused by jet blast and prevent foreign objects from being sucked into jet engines. In addition, runway shoulders prevent the aircraft from being stopped should it run out of the runway. Shoulders of the runway should run symmetrically on both its sides so that the total width of the runway and both shoulders is not less than:
- 60 m when the code letter is D or E,
- 75 m when the code letter is F.

The transverse slope of shoulders should not exceed 2.5%, and their capacity should be high enough to carry the weight of an aircraft without damaging its structure in case it runs out of the runway.

When the runway end is not served by a taxiway or taxiway turnaround and the code letter is D, E, or F, a turnaround plane should be provided on the runway. It should be structured so that the distance between any wheel of the aircraft's landing gear and the edge of the turnaround plane cannot be less than the values shown in the table below when the crew cockpit of the aircraft for which this plane is designed remains above the horizontal marking of the turnaround plane:

Tab. 2. Turnaround plane requirements

Code number	Length
A	1.5m
B	2.25m
C	3m if the plane is designed for turnaround for aircraft wheel base greater than or equal to 18m 4.5m if the plane is designed for turnaround for aircraft wheel base greater than or equal to 18m
D	4.5m
E	4.5m
F	4.5m

Source: Own compilation based on: Annex 14 to the Convention of International Civil Aviation. Airports. Vol. 1. Designing and Operating Airports. Issue 4, 2004.

The load capacity of the runway turnaround plane should be at least equal to that of the adjacent runway. In addition, the turnaround plane is recommended to have a shoulder that should be wide enough to comprise the area under the external engine of a critical aircraft.

The runway together with a stopway should be included in the runway strip, i.e. a designated area supposed to reduce the risk of damaging the aircraft should it run out of the runway and to ensure the safety of the aircraft over this area during takeoff or landing operations. The runway strip should extend before the runway threshold and beyond the runway end or stopway to a distance of at least:
- 60 m if the code digit is 2, 3, or 4,
- 60 m if the code digit is 1 and the runway is instrumental,
- 30 m if the code digit is 1 and the runway is non-instrumental.

In addition, it should extend crosswise, where possible, to a distance of not less than:
- 150 m if the code digit is 3 or 4,
- 75 m if the code digit is 1 or 2,

on each side of the runway centreline and its extended centreline along the whole length of the runway.

Every object on the runway that might pose a hazard to aircrafts should be considered an obstacle to be removed if possible. In addition, no solid object, except for visual aids necessary for aircraft navigation, should not find itself on the runway strip within a distance:

- Less than 77.5 m from the centreline of the runway with category I, II, or III precise approach if the code digit is 4 and the code letter F,
- Less than 60 m from the centreline of the runway with category I, II, or III precise approach if the code digit is 3 or 4,
- Less than 45 m from the centreline of the runway with category I precise approach if the code digit is 1 or 2.

It is also recommended that some part of the instrument runway strip within a distance of at least:

- 75 m if the code digit is 3 or 4,
- 40 m if the code digit is 1 or 2.

From the runway, centreline or its extension be adapted or structured so as to minimize, for the aircrafts for which a specific runway is designed, the risk caused by differences in pavement capacity when the aircraft runs out of the runway.

To find out which requirements and recommendations of Annex 14 will apply for the Airbus A380 aircraft, it should be determined which reference code the airport that will accommodate it should have. For this purpose, we will need details of the aircraft's length and the total wheelbase of the main landing gear. For the A380 aircraft, these values are 72.727 m and 14.336 m respectively. According to Tab. 1, it can be accommodated only by airports with reference code 4F. Tab. 5 provides a summary of the requirements for 4F airports.

Tab. 5. Summary of Annex 14's requirements for airports with reference code 4F

Infrastructure Component	*ICAO Requirement*
Runway width	60 m
Runway longitudinal slope	≤1%
RWY shoulder width	7.5 m
Turnaround plane: distance between any wheel of the aircraft's landing gear and the edge of the turnaround plane cannot be less than	4.5 m
Precise approach runway strip width on both runway sides	150 m from the runway centreline
Obstacle free zone on both runway sides	77.5 m from the runway centreline
Taxiway width	25 m
TWY shoulder width	17.5
Minimum distance between the outer wheels of the aircraft's main landing gear and the runway edge should not be less than	4.5 m
Distance between the taxiway centreline and the instrument runway centreline	190 m
Distance between the taxiway centreline and the non-instrument runway centreline	115 m
Distance between the taxiway centreline and the centreline of another taxiway	97.5 m
Distance between the centreline of a taxiway other than that leading to the parking lot and an object	57.5 m
Distance between the centreline of the taxiway to the parking lot and an object	50.5 m
Minimum distance between the parking aircraft and the adjacent building, neighbouring aircraft, and any other object	7.5 m
Minimum distance between the runway centreline and the waiting bay, holding point before the runway or holding point on the motor road	107.5 m from the runway centreline

Source: Own compilation based on: Annex 14 to the Convention of International Civil Aviation. Airports. Vol. 1. Designing and Operating Airports. Issue 4, 2004.

3. Project

Warsaw Okęcie Airport (IATA code: WAW, ICAO code: EPWA) is situated 8 km to the south-west of downtown Warsaw. It was put into service in 1934. Two instrument runways 11/29 and 15/33 are available here. Due to its length, it is runway 15/33 that has been taken for review and consideration.

Tab. 6. Warsaw Okęcie Airport's technical data

Reference code	4E
Airport's rescue and firefighting index	9
Reference temperature	27°C
Airport elevation	110.3m
Apron capacity	Apron 1 – PCN 41/R/B/W/T Apron 2 – PCN 44/R/B/X/T Apron 3 – PCN 58/R/B/W/T Apron 4 – PCN 40/R/B/X/T Apron 5A – PCN 58/R/B/W/T Apron 5B – PCN 58/R/B/W/T Apron 5C – PCN 58/R/B/W/T Apron 6 – PCN 67/R/C/W/U Apron 9 – PCN 70/R/C/W/T Apron 10 – PCN 57/R/B/X/T Apron 11 – PCN 39/R/B/X/T
The width and strength of taxiways	TWY A0 – 23m, PCN 60/F/B/X/T TWY A1 – 23m, PCN 57/F/B/X/T TWY A2 – 23m, PCN 62/F/B/X/T TWY A3 – 23m, PCN 57/F/B/X/T TWY A4 – 23m, PCN 57/F/B/X/T TWY A5 – 23m, PCN 59/F/B/W/T TWY A6 – 23m, PCN 59/F/B/W/T TWY A7 – 23m, PCN 59/F/B/W/T TWY A8 – 23m, PCN 67/R/C/W/U TWY B6 – 23m, PCN 59/F/B/W/T TWY B7 – 23m, PCN 59/F/B/W/T TWY B8 – 23m, PCN 59/F/B/W/T TWY C1 – 23m, PCN 50/F/B/X/T TWY D1 – 23m, PCN 54/R/B/X/T TWY D2 – 23m, PCN 39/F/B/X/T TWY D3 – 23m, PCN 39/F/B/X/T TWY D4 – 23m, PCN 48/F/B/X/T TWY E1 – 23m, PCN 58/R/B/W/T TWY E2 – 23m, PCN 59/F/B/X/T TWY E3 – 23m, PCN 59/F/B/X/T TWY F – 23m, PCN 58/R/B/W/T TWY H1 – 23m, PCN 59/F/B/W/T TWY H2 – 23m, PCN 59/F/B/W/T TWY J – 23m, PCN 57/F/B/X/T TWY K – 15m, PCN 39/F/B/X/T TWY L – 23m, PCN 57/F/C/X/U TWY N – 23m, PCN 59/F/B/X/T TWY O1 – 23m, PCN 46/F/B/X/T TWY O2 – 23m, PCN 58/R/B/W/T TWY R1 – 23m, PCN 52/F/B/X/T TWY R2 – 23m, PCN 52/F/B/X/T TWY S – 23m, PCN 52/F/B/X/T TWY Z1 – >25m, PCN 70/R/B/W/T

Tab. 6. Warsaw Okęcie Airport's technical data (cont.)

TWY shoulder width	7.5m
Distance between the centreline of a taxiway other than that leading to the parking lot and an object	TWY A0 – 57.5m TWY A1 – 47.5m TWY A2 – > 57.5m TWY A3 – 47.5m TWY A4 – 47.5m TWY A5 – > 57.5m TWY A6 – 50m TWY A7 – > 57.5m TWY A8 – > 57.5m TWY B6 – > 57.5m TWY B7 – > 57.5m TWY B8 – > 57.5m TWY H1 – > 57.5m TWY H2 – > 57.5m TWY O1 – > 57.5m TWY R1 – > 57.5m TWY R2 – > 57.5m TWY Z1 – > 57.5m
Runway	
Runway length	3690m
Runway width	60m
RWY shoulder width	7.5m
Pavement capacity	PCN 57/R/B/W/T
The highest point runway	107.9m
The lowest point runway	104.2m
Runway longitudinal slope	$\frac{107.9-104.2}{3690}=0.001=0.1\%$
Runway strip length	3810 m
Runway strip width	300 m
RWY 15	
TORA	3690 m
TODA	3690 m
ASDA	3690 m
LDA	3690 m
RWY 33	
TORA	3690 m
TODA	3690 m
ASDA	3690 m
LDA	3690 m
Other data	
Distance between the taxiway (A1, A3, A4, A5, A6) centreline and the instrument runway centreline	TWY A1, A3, A4, A5, A6, B6 – 240m
Minimum distance between the runway centreline and the holding point	TWY A0, H1, H2 – 95m TWY B7 – 160m TWY B8 – 150m TWY O1 – 142m TWY R1 – 120m

Source: Own on based: www.ais.pata.pl/aip

The runway lengths required for takeoff and landing have been determined one after another. The runway lengths for takeoff have been determined based on the maximum landing weight (MLW), while the runway length required for takeoff will be calculated for the MTOW.

Then, by reversing this method, the aircraft's maximum mass has been determined for a specific runway length.

Data:

– Runway length required for takeoff with zero slope, at sea level, and under International Standard Atmosphere conditions – 2750 m,

- Runway length required for landing at sea level and under International Standard Atmosphere conditions – 1900 m,
- Airport elevation above sea level – 110.3 m,
- Airport reference temperature – 27°C,
- International Standard Atmosphere temperature at an altitude of 149 m above sea level – 14.2831°C,
- Runway longitudinal slope – 0.1%.

Adjustment of the runway length required for takeoff for the MTOW:

- Runway length required for takeoff adjusted according to altitude above sea level (increase by 7% per 300 m above sea level):

$$\left(2750 \cdot 0.07 \cdot \frac{110.3}{300}\right) + 2750 = 2821\,\text{m}.$$

- Runway length required for takeoff adjusted according to height and temperature (increase by 1% per 1°C of the difference between the reference temperature and the International Standard Atmosphere temperature at airport height):

$$[2821 \cdot (27 - 14.2831) \cdot 0.01] + 2821 = 3179\,\text{m}.$$

- Runway length required for takeoff adjusted according to height, temperature, and slope (adjustment by 10% per 1% of runway longitudinal slope):

$$(3179 \cdot 0.1 \cdot 0.1) + 3179 = 3211\,\text{m}.$$

Runway length required for landing according to height for the MLW (increase by 7% per 300 m above sea level):

$$\left(1900 \cdot 0.07 \cdot \frac{110.3}{300}\right) + 1900 = 1949\,\text{m}.$$

Actual required runway length – 3211m.

Calculation of the maximum mass of the aircraft at which it can take off a 3690 m long runway and under specific airport conditions (x – sought runway length).

- Runway length without adjustment by slope:

$$(x \cdot 0.1 \cdot 0.1) + x = 3690\,\text{m},$$

$$1.01x = 3690\,\text{m},$$

$$x = 3653\,\text{m}.$$

- Runway length without adjustment by temperature:

$$[x \cdot (27 - 14.2831) \cdot 0.01] + x = 3653\,\text{m},$$

$$1.127169x = 3653\,\text{m},$$

$$x = 3240\,\text{m}.$$

- Runway length without adjustment by elevation above sea level:

$$\left(x \cdot 0.07 \cdot \frac{110.3}{300}\right) + x = 3240\,\text{m},$$

$$1.025737x = 3240\,\text{m},$$

$$x = 3159\,\text{m}.$$

The maximum mass that the aircraft can have to take off a 3690 m long runway is 606,000 kg, so the aircraft mass is not subject to any restrictions in this case.

4. Summary

Polish airports are not prepared for the irregular handling operations of the A380 aircraft. No airport has reference code 4F, and only one, Warsaw Okęcie, is coded 4E, i.e. it is acceptable according to the AACG guidelines. A major problem is also the lack of rescue and firefighting category compliance. Having a category lower than 9 bars the airport from handling the A380. The runways do not pose a big problem, however. The average allowable mass this aircraft can have to take off at these six Polish airports is 516,000 kg, which accounts for 92% of its MTOW. Each airport under review also has taxiways that allow manoeuvring the aircraft after landing and before takeoff. Most of them do not meet the recommendations of Annex 14, but are compliant with the AACG guidelines and the aircraft's manufacturer. Adapting infrastructure components to the handling of this type of aircraft is a challenge and often involves a massive airport upgrade.

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