ICAO Asia/Pacific Workshop – Implementation of New ICAO Annex 14 Volume I SARPs on Obstacle Limitation Surfaces

Session II

Why aircraft performance matters for aerodromes

Objectives

At the end of this session, participants will be able to

- Differentiate between ARC and ADG
- Describe the relationship between ADG and OLS dimensions
- Use ADG to select OFS and OES
- Analyze the surfaces of an aerodrome based on the selected ADG

Background

In 1978, the Aerodrome Reference Code Panel (ARCP) adopted the Aerodrome Reference Code (ARC) classification for Annex 14, Vol. 1.

In reaching to this decision, the use of **approach speed** and aeroplane reference field length were considered as possible elements of the ARC.

Aerodrome Reference Code (ARC)

Code Element 1		Code Element 2	
Code Number	Aeroplane reference field length	Code Letter	Wingspan
1	Less than 800m	A	Up to but not including 15 m
2	800m up to but not including 1200m	B	15 m up to but not including 24 m
3	1200m up to but not including 1800m	C	24 m up to but not including 36 m
4	1800m and over	D	36 m up to but not including 52 m
		E	52 m up to but not including 65 m
		F	65 m up to but not including 80 m

Challenges with ARC

ARC does not accurately reflect the OLS criteria

Airborne Performance

Aircraft with vastly different **approach speeds** (e.g., <50 kt to 120+ kt) are grouped under the same Code.

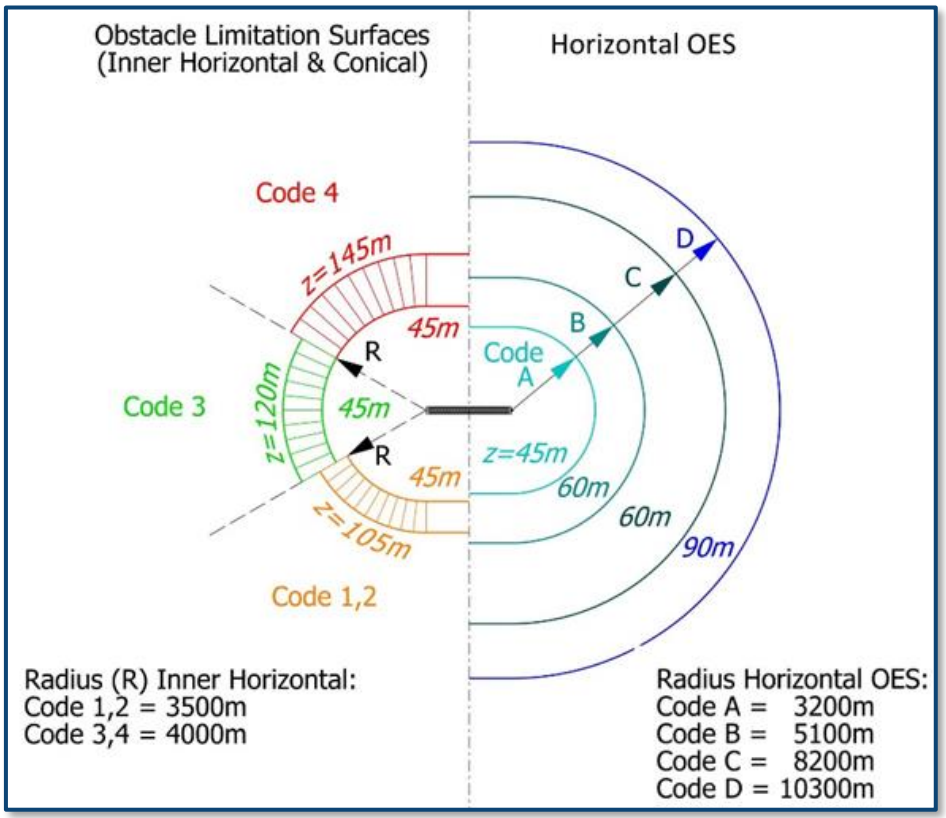
- Approach speed is a more suitable criterion to define airborne performance
- Already used in instrument flight procedure design.

Aircraft size

Runways serving aircraft with different **wingspans** (e.g., A380-800 vs. Learjet 45) may still have the same OLS and dimensional requirements, despite significant size differences.

Challenge with ARC

ARC is not aligned with criteria used in designing OES.



ADG

The Aeroplane Design Group of an aeroplane depends on both its

indicated airspeed at threshold and wingspan

Aeroplane design group	Indicated airspeed at threshold		Wingspan
I	Less than 169 km/h (91 kt)	and	Up to but not including 24 m
IIA	Less than 169 km/h (91 kt)	and	24 m up to but not including 36 m
IIB	169 km/h (91 kt) up to but not including 224 km/h (121 kt)	and	Up to but not including 36 m
IIC	224 km/h (121 kt) up to but not including 307 km/h (166 kt)	and	Up to but not including 36 m
III	Less than 307 km/h (166 kt)	and	36 m up to but not including 52 m
IV	Less than 307 km/h (166 kt)	and	52 m up to but not including 65 m
V	Less than 307 km/h (166 kt)	and	65 m up to but not including 80 m

ADG: Indicated airspeed

Indicated airspeed corresponds with the categories of aircraft defined in Doc 8168, Vol I, Part II — Section 5, Chapter 1

Used in the design of Horizontal OES

Category	
A	Less than 169 km/h (91 kt) indicated airspeed (IAS)
B	169 km/h (91 kt) or more but less than 224 km/h (121 kt) IAS
C	224 km/h (121 kt) or more but less than 261 km/h (141 kt) IAS
D	261 km/h (141 kt) or more but less than 307 km/h (166 kt) IAS.

At present, there are no category E civil aircraft with approach speed above 166 kt (other than military aircraft).
Category H refers to helicopter operations which are covered in Annex 14 Vol II.

ADG: Wingspan

Wingspan corresponds with the Aerodrome Reference Code letter as described in Annex 14 Vol 1 Chapter 1 para 1.6

Used in the determination of OFS dimensions.

Code Letter	Wingspan
A	Up to but not including 15 m
B	15 m up to but not including 24 m
C	24 m up to but not including 36 m
D	36 m up to but not including 52 m
E	52 m up to but not including 65 m
F	65 m up to but not including 80 m

Correlation between aircraft category and ADG

The aircraft categories have the following correlation with the aeroplane design groups.

Note: Aircraft category - based on approach speed at threshold as referred in PANS-OPS

ADG	Aircraft categories (PANS-OPS)	Indicated airspeed at threshold km/h (knots) (Annex 14 Vol 1)	Wingspan
I	A	Less than 169 (91)	Less than 24 m
IIA	A	Less than 169 (91)	24 m to less than 36 m
IIB	B	169 (91) to less than 224 (121)	Up to but less than 36 m
IIC	C, D	224 (121) to less than 307 (166)	Up to but less than 36 m
III	A, B, C, D	Less than 307 (166)	36 m to less than 52 m
IV	A, B, C, D	Less than 307 (166)	52 m to less than 65 m
V	A, B, C, D	Less than 307 (166)	65 m to less than 80 m

Correlation between ADG and runway operations

A runway of a given ADG typically accommodates different aircraft categories

ADG of runway	Possible aircraft categories on the runway (Indicated Air Speed at threshold)			
	A	B	C	D
I	✓	X	X	X
IIA	✓	X	X	X
IIB	✓	✓	X	X
IIC	✓	✓	✓	✓
III	✓	✓	✓	✓
IV	✓	✓	✓	✓
V	✓	✓	✓	✓

ADG to ARC Conversion

The following ARC to ADG conversion may be used for implementing the provisions in chapter 4 of Annex 14, Volume I

Code number	**1**	**2**		**3-4**			
Aeroplane design group	I	IIA	IIB	IIC	III	IV	V

Caution:

The above conversion provides a broad overview of the relation between ARC and ADG methodology. Caution is required while applying it to specific aircraft types as they may fall under a different category.

Applying ADG: Wingspans

- A runway is designed to accommodate various aircraft, including those with wingspans at or above 36 m (For example 38 m, 43 m, 52 m, 60 m, and 68 m.)
- These aircraft belong to ADG II, III, IV, IV, and V, respectively.
- Since the most demanding aircraft falls under ADG V, the runway is classified as ADG V to ensure compatibility

Applying ADG: Indicated Airspeed

2

The runway is designed for aircraft with wingspans below 36 m.

These aircraft have the following wingspans and threshold speeds:

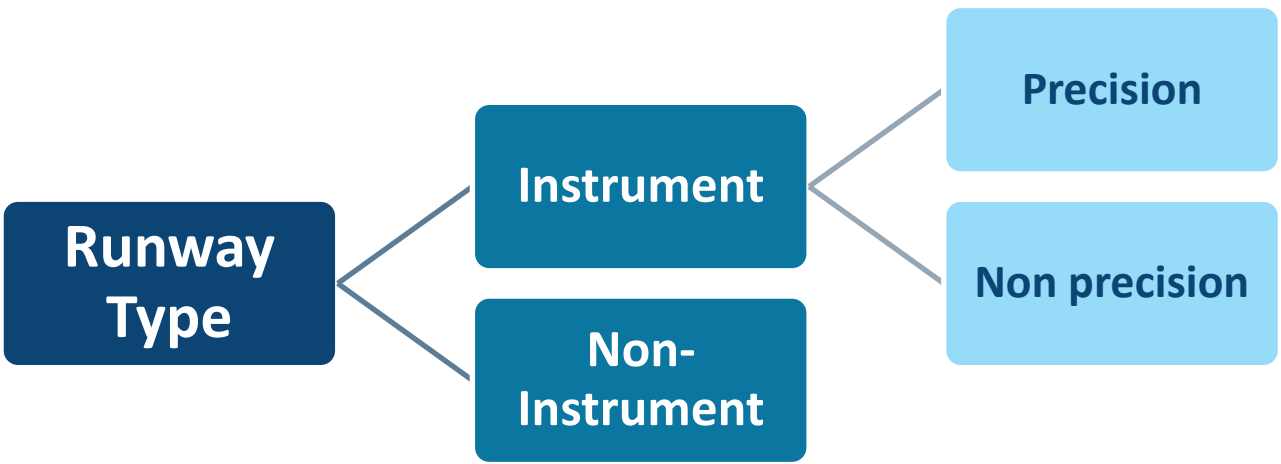
Threshold speeds	Wingspan	ADG
60 kts	9 m	I
55 kts	10 m	I
98 kts	13 m	II B
104 kts	26 m	II B
83 kts	28 m	II A

Since the most demanding aircraft belongs to ADG IIB, the runway is classified as ADG IIB.

Selecting Surfaces

- **Surface selection depends** on the approach runway type and type of operations conducted at the runway.
- **Surface dimensions** are determined by the Aeroplane Design Group (ADG) assigned to the runway.
- At aerodromes with **multiple runways**, each runway may have a different ADG classification.

Selecting Surfaces – Runway Type



Selecting Surfaces: OFS

Surfaces	Instrument (Precision)	Instrument (Non-Precision)	Non-Instrument
Approach	✓	✓	✓
Transitional	✓	✓	✓
Inner Approach	✓	✓	✓
Inner Transitional	✓	✓	✓
Balked Landing	✓	X	X

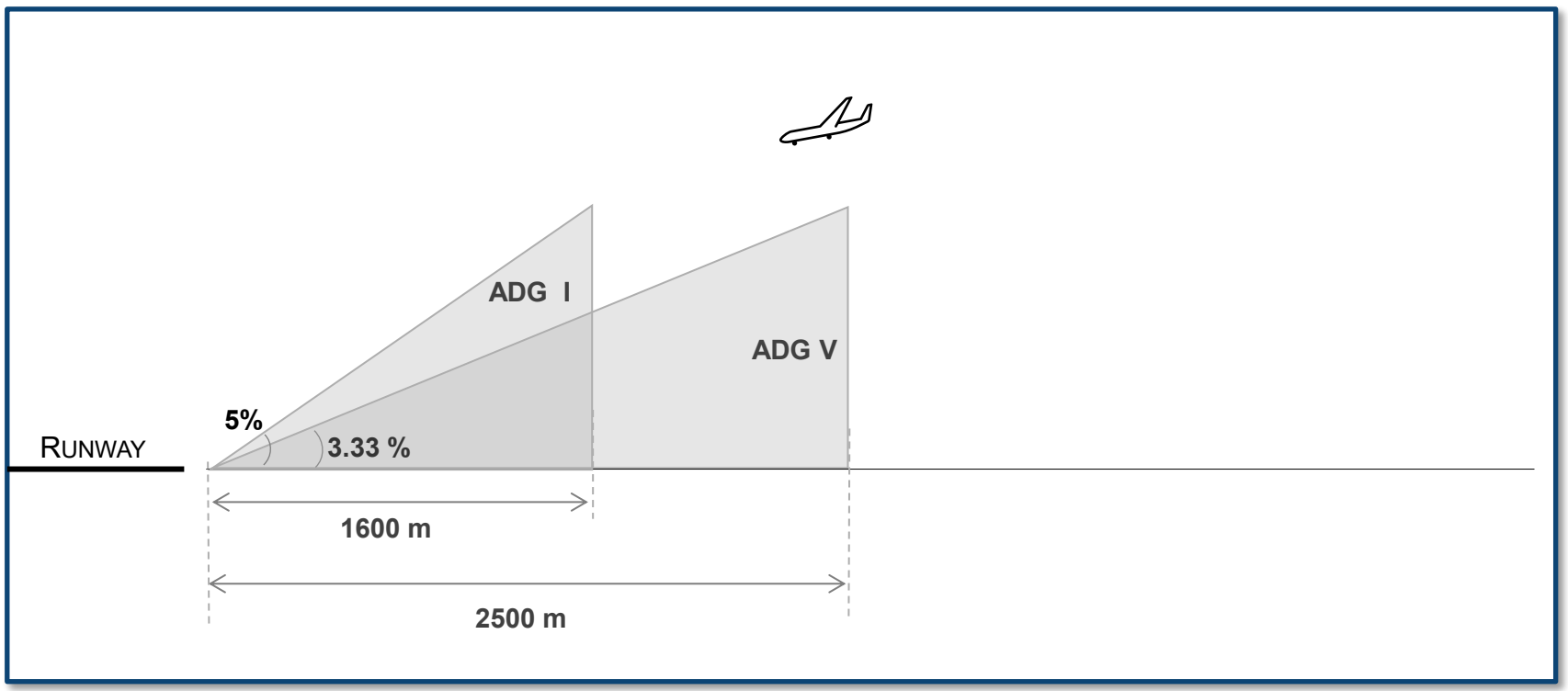
Selecting Surfaces: OFS

Table 4-1. Dimensions and slopes of approach surface — Non-instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Distance from threshold	30 m	60 m	60 m	60 m	60 m	60 m
Length of inner edge	60 m[a b]	80 m[c d]	100 m[d]	125 m	135 m	150 m
Divergence	10 %	10 %	10 %	10 %	10 %	10 %
Length	1 600 m[e]	2 500 m[e]	2 500 m[e]	2 500 m[e]	2 500 m[e]	2 500 m[e]
Slope	5 %[f]	4 %[f]	3.33 %[f]	3.33 %[f]	3.33 %[f]	3.33 %[f]

Selecting Surfaces: OFS

Approach surface **Non instrument runway**



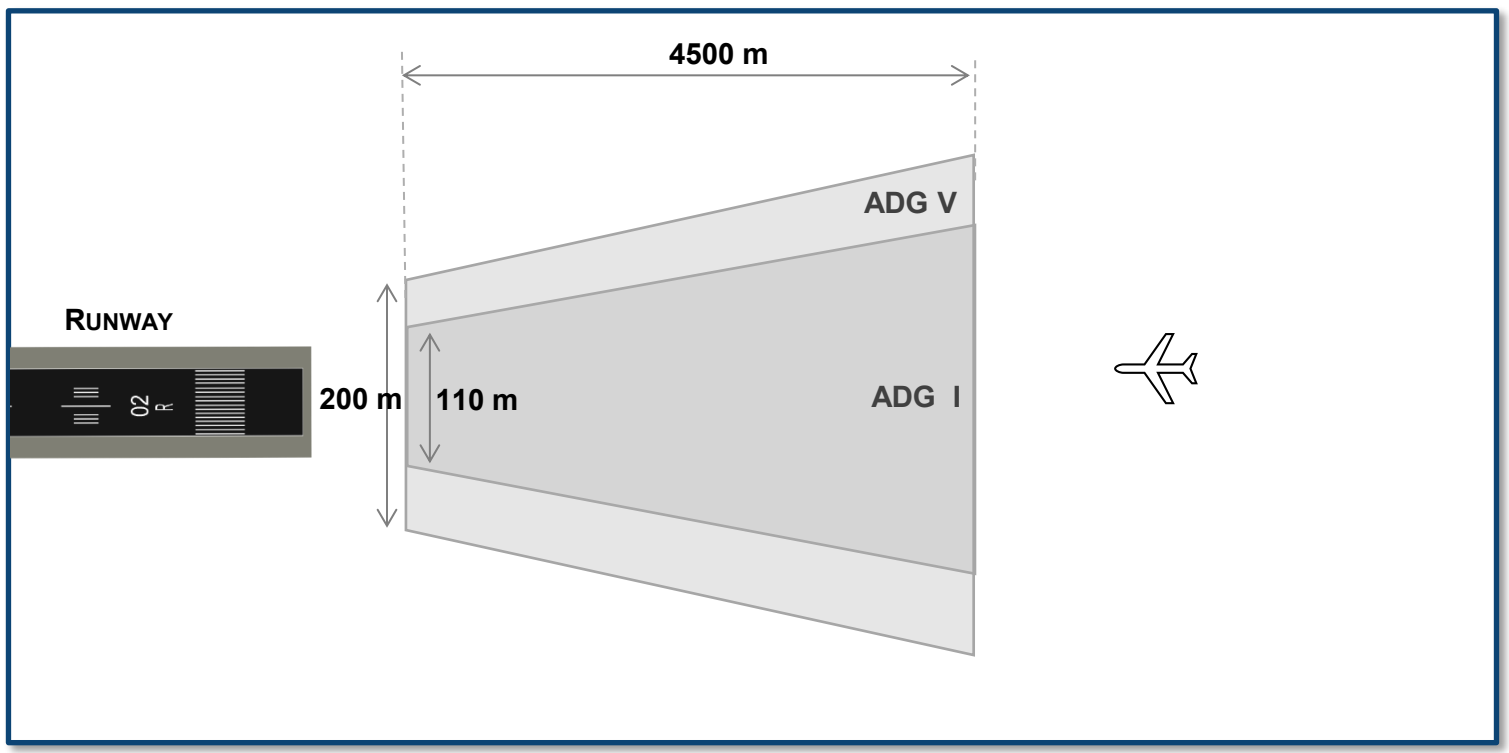
Selecting Surfaces: OFS

Table 4-2. Dimensions and slopes of approach surface — Instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Distance from threshold	60 m	60 m	60 m	60 m	60 m	60 m
Length of inner edge	110 m[a]	125 m[b]	155 m[c]	175 m	185 m	200 m
Divergence	10%	10%	10%	10 %	10%	10%
Length	4 500 m[d]	4 500 m[d]	4 500 m[d]	4 500 m[d]	4 500 m[d]	4 500 m[d]
Slope	3.33%[e]	3.33%[e]	3.33%[e]	3.33%[e]	3.33%[e]	3.33%[e]

Selecting Surfaces – OFS

Approach surface **Instrument runway**



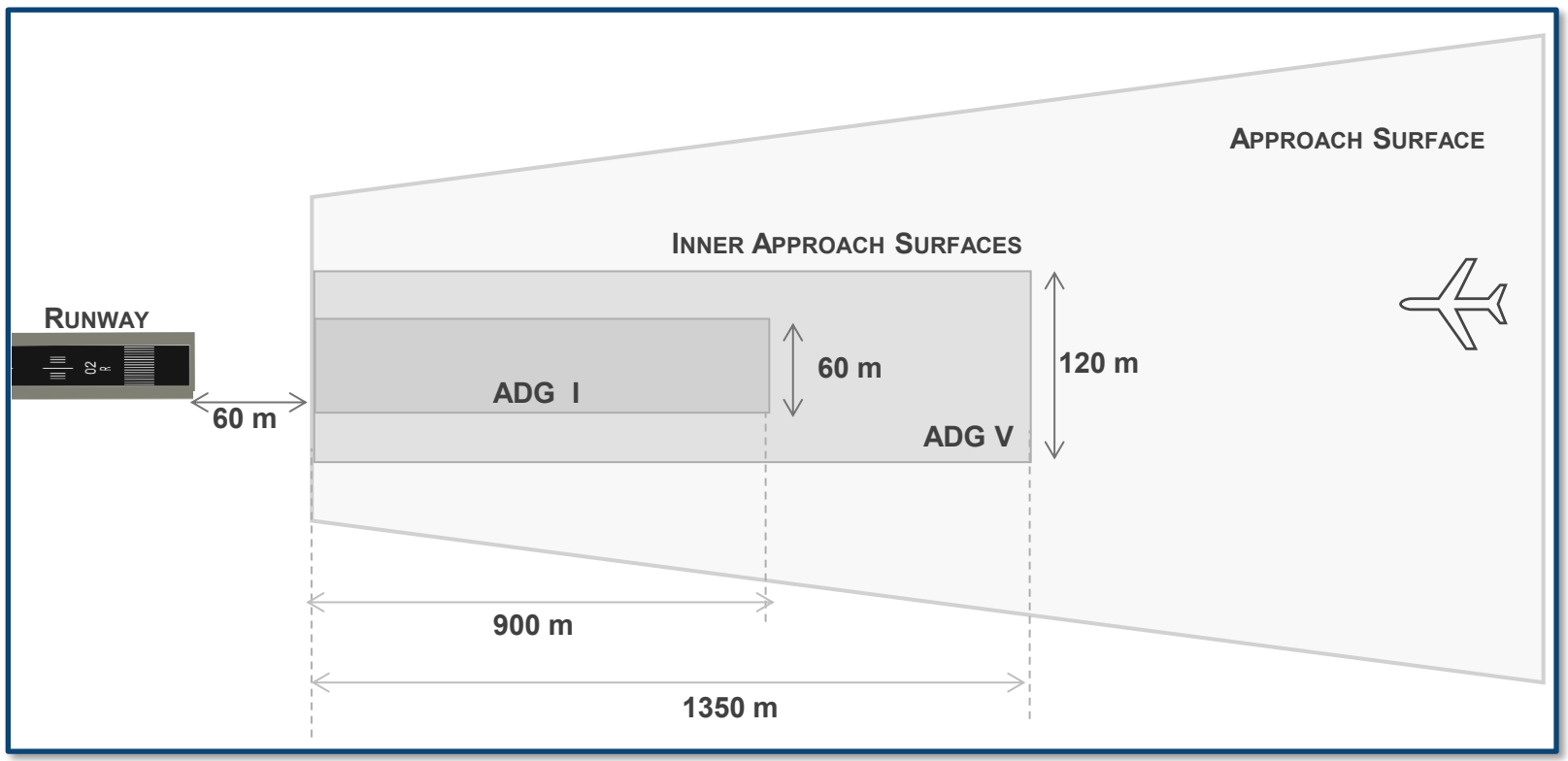
Selecting Surfaces: OFS

Table 4-3. Dimensions of inner approach surface — Non-instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Length of inner edge	60 m	80 m	100 m	110 m	120 m	120 m[a]
Length	900 m[b]	1 125 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]

Selecting Surfaces: OFS

Inner Approach surface **Non-Instrument runway**



Selecting Surfaces: OFS

Table 4-4. Dimensions of inner approach surface — Non-precision approach runways

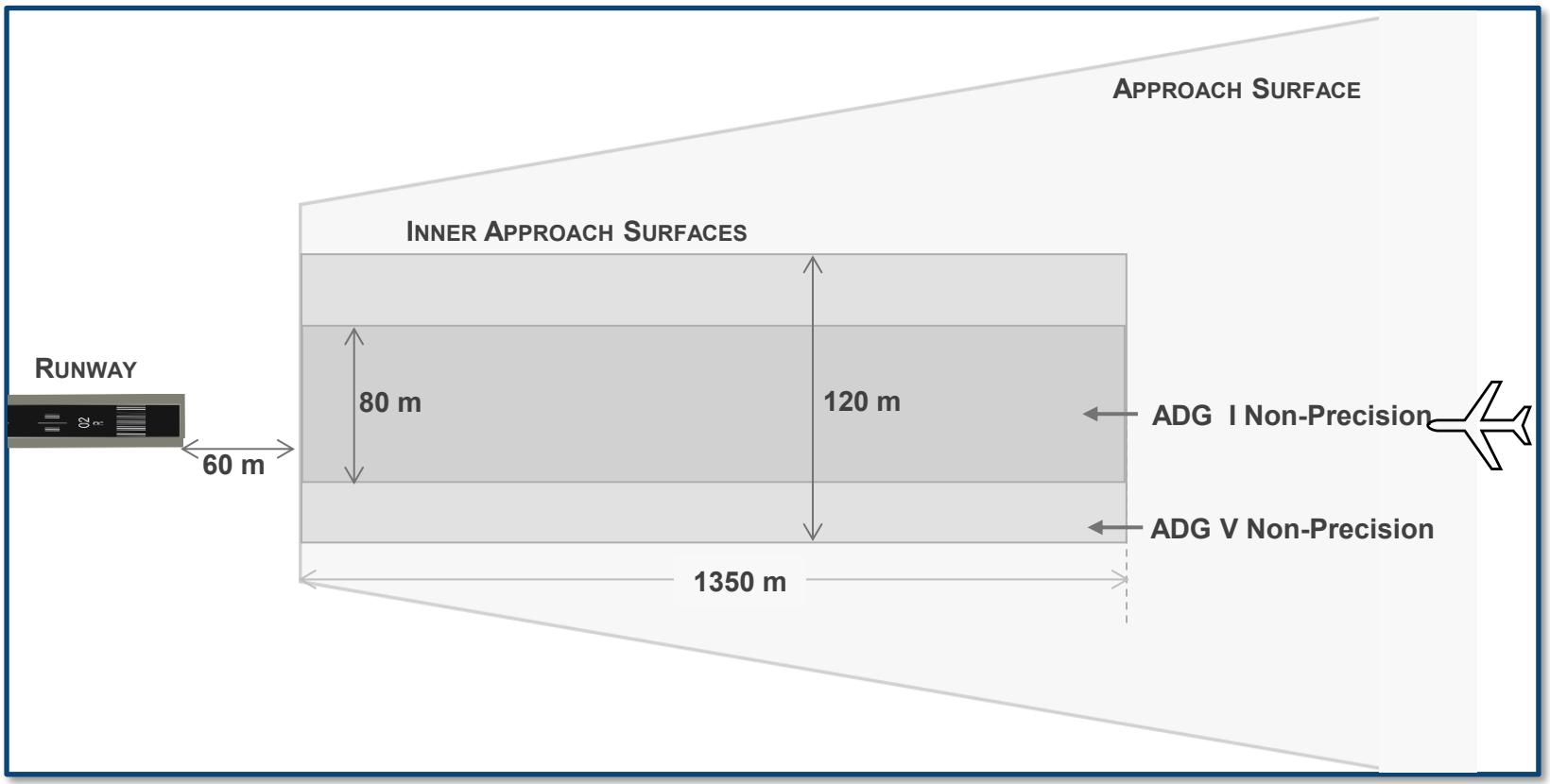
Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Length of inner edge	80 m	80 m	120 m	120 m	120 m	120 m[a]
Length	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]

Table 4-5. Dimensions of inner approach surface — Precision approach runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Length of inner edge	90 m	90 m	120 m	120 m	120 m	120 m[a]
Length	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]	1 350 m[b]

Selecting Surfaces: OFS

Inner Approach surface **Non-Precision and Precision runways**



Selecting Surfaces: OFS

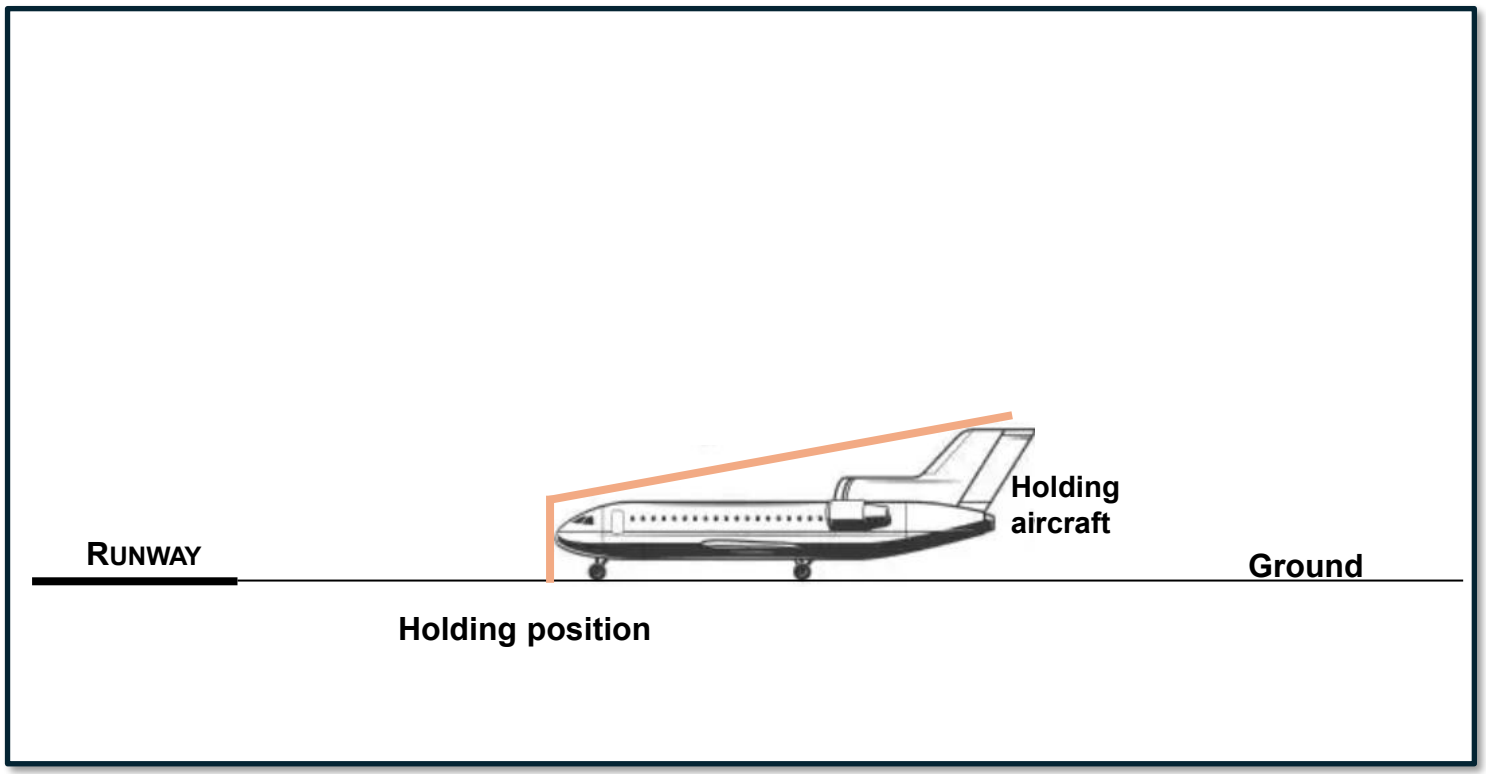
Table 4-6. Dimensions of inner transitional surfaces — Non-instrument runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Height of the vertical section	6 m	6 m	8.4 m	10 m	5 m	5 m
Slope of the inclined section	40 %	40 %	33.3%	33.3%	33.3%	33.3%
Length	a	a	1 800 m[b]	1 800 m[b]	1 800 m[b]	1 800 m[b]

Table 4-7. Dimensions of inner transitional surfaces — Non-precision approach runways

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Height of the vertical section	6 m	6 m	5 m	5 m	5 m	5 m
Slope of the inclined section	40 %	40 %	33.3%	33.3%	33.3%	33.3%
Length	a	a	1 800 m[b]	1 800 m[b]	1 800 m[b]	1 800 m[b]

Vertical section of the inner transitional surface



Selecting OES Surfaces based on operations

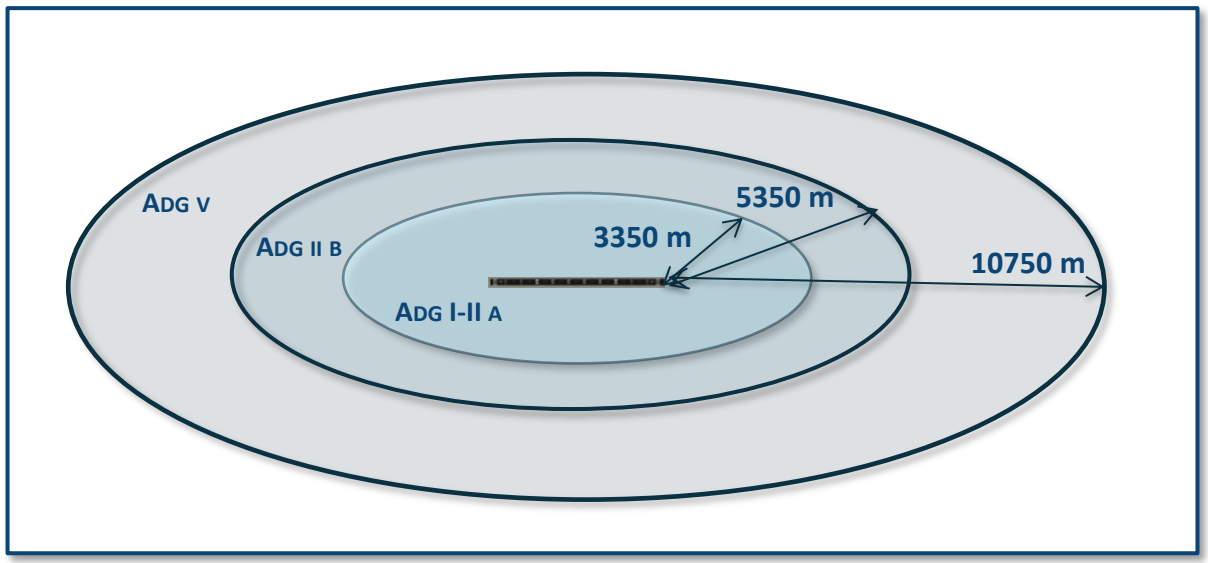
Surfaces	Take-off	Instrument Departures	Circling / visual circuits	Straight in Instrument Approaches (Non-precision)	Precision Approaches
Horizontal Surfaces	X	X	✓	*To be considered*	X
Surface for Straight In Instrument Approach	X	X	*To be considered*	✓	X
Surface for Precision Approaches	X	X	X	X	✓
Instrument Departure Surface	X	✓	X	X	X
Take-off Climb Surface	✓	✓	X	X	X

Selecting Surfaces: OES

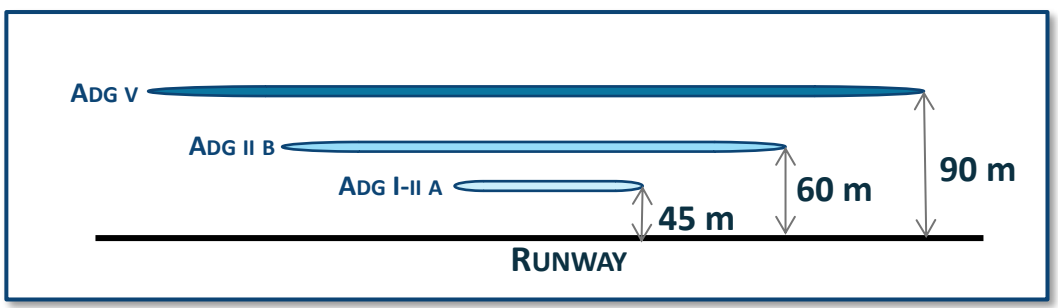
Table 4-10. Dimensions of horizontal surface

Aeroplane design group	I-IIA	IIB	IIC	III	IV	V
Radius	3 350 m	5 350 m	10 750 m	10 750 m	10 750 m	10 750 m
Height	45 m	60 m	90 m	90 m	90 m	90 m

Selecting Surfaces: OES



Horizontal Surfaces

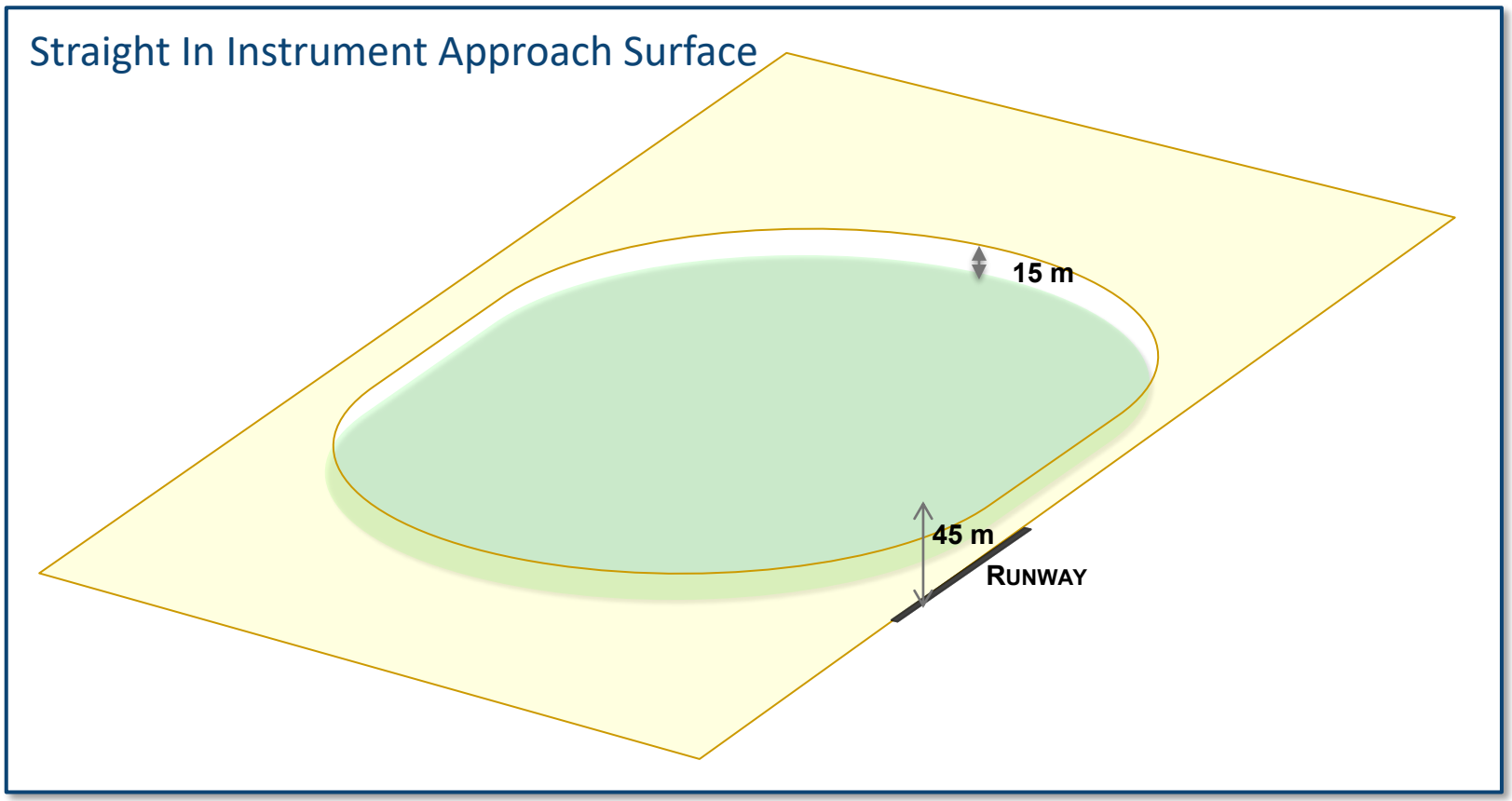


Selecting Surfaces: OES

Table 4-11. Dimensions of surface for straight-in instrument approaches

	Aeroplane design group	I to V
Lower section	**Height**	45 m
	Length	Horizontal OES as per ADG I
Upper section	**Height**	60 m
	Length of shorter side	7 410 m
	Length of longer side from the threshold or thresholds	5 350 m

Selecting Surfaces: OES



Selecting Surfaces: OES

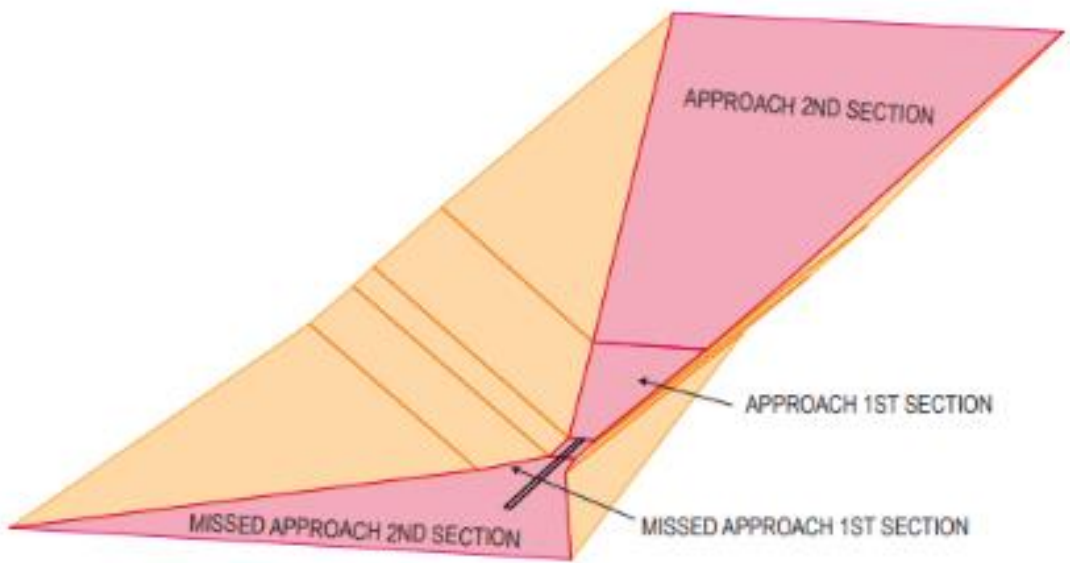
Table 4-12. Dimensions of surface for precision approaches

Aeroplane design group			I to V
Approach component		Distance from threshold	60 m
		Length of inner edge	300 m
	1st section	Length	3 000 m
		Divergence (each side)	15 %
		Slope	2 %
	2nd section	Length	9 600 m
		Divergence (each side)	15 %
		Slope	2.5 %
Missed approach component		Distance after threshold	900 m
		Length of inner edge	300 m

Aeroplane design group			I to V
	1st section	Length	1 800 m
		Divergence (each side)	17.48 %
		Slope	2.5 %
	2nd section	Length	10 200 m
		Divergence (each side)	25 %
		Slope	2.5 %
Transitional component		Slope	14.3 %

Selecting Surfaces: OES

Surface for precision approaches

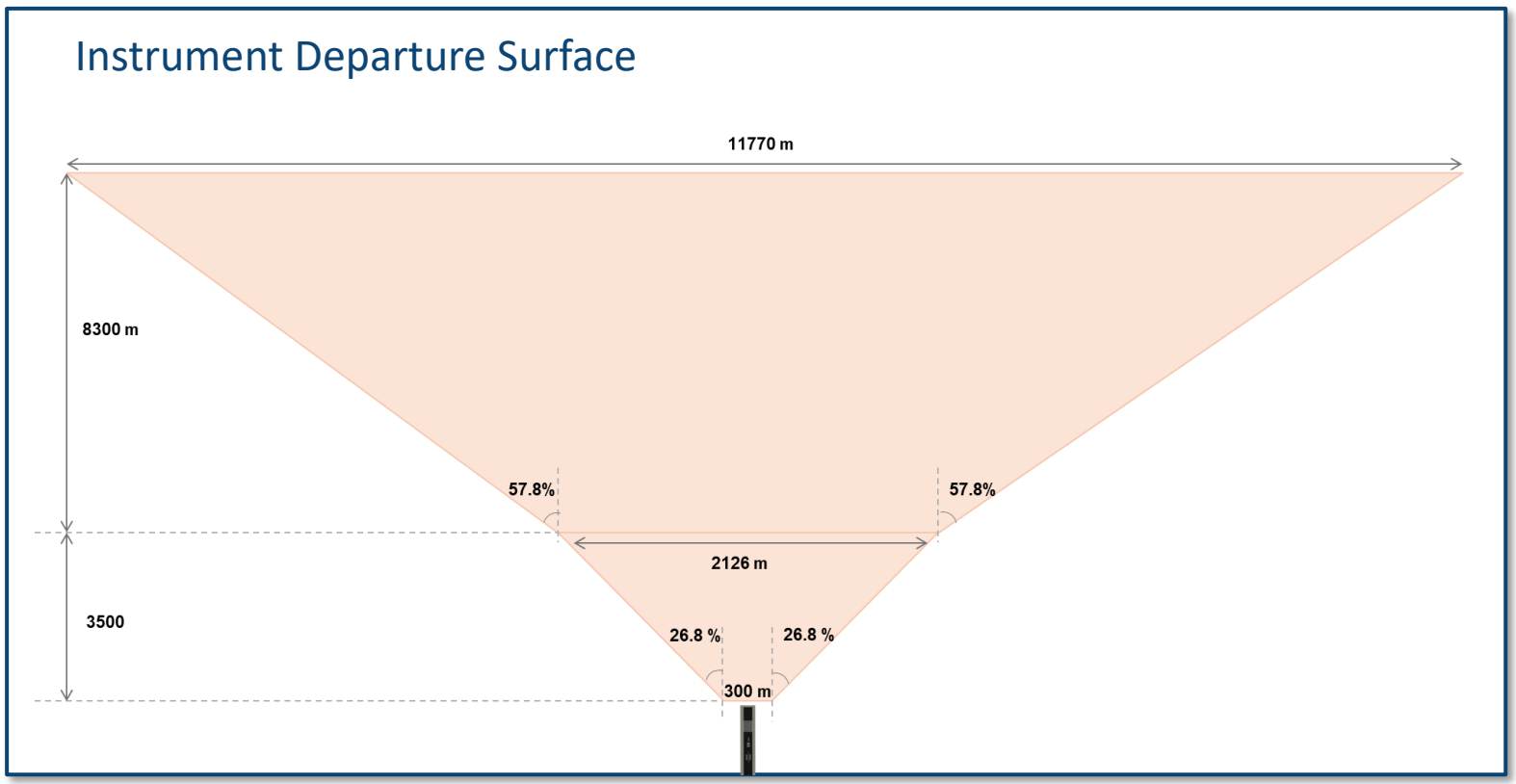


Selecting Surfaces: OES

Table 4-13. Dimensions of instrument departure surface

	Aeroplane design group	**I to V**
	Length of inner edge	300 m
	Slope	2.5 %
First section	**Length**	3 500 m
	Divergence	26.8 %
Second section	**Length**	8 300 m
	Divergence	57.8 %

Selecting Surfaces: OES



Selecting Surfaces: OES

Table 4-14. Dimensions of take-off climb surface – runways with operations of aeroplanes with a mass up to 5 700 kg

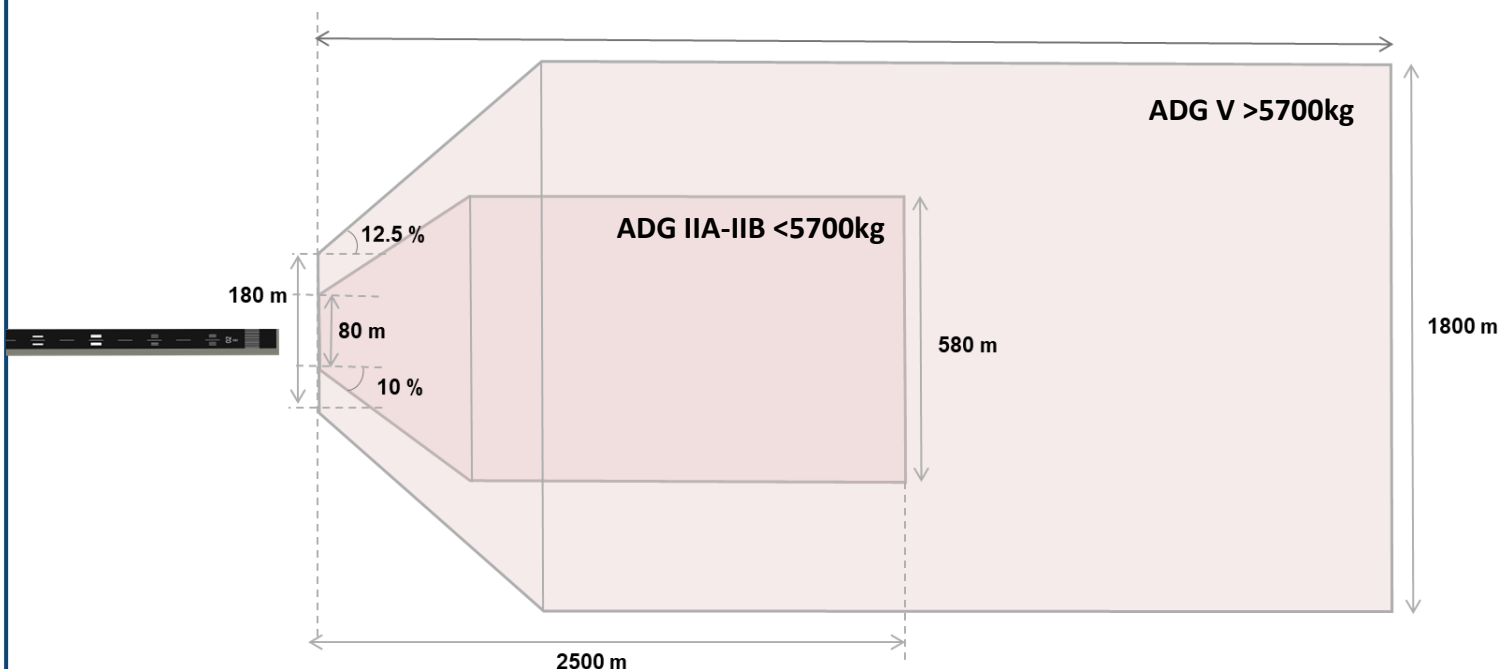
Aeroplane design group	I	IIA-IIB	IIC[a]	III[a]	IV[a]	V[a]
Distance from runway end[b]	30 m	60 m	-	-	-	-
Length of inner edge	60 m	80 m	-	-	-	-
Divergence (each side)	10%	10%	-	-	-	-
Final width	380 m	580 m	-	-	-	-
Length	1 600 m	2 500 m	-	-	-	-
Slope	5%	4%	-	-	-	-

Table 4-15. Dimensions of take-off climb surface – runways with operations of aeroplanes with a mass above 5 700 kg

Aeroplane design group	I	IIA-IIB	IIC	III	IV	V
Distance from TODA	-	-	-	-	-	-
Length of inner edge	144 m	156 m	156 m	172 m	180 m	180 m
Divergence (each side)	12.5%	12.5%	12.5%	12.5%	12.5%	12.5%
Final width	1 800 m[a]	1 800 m[a]	1 800 m[a]	1 800 m[a]	1 800 m[a]	1 800 m[a]
Length	10 000 m	10 000 m	10 000 m	10 000 m	10 000 m	10 000 m
Slope	5%	4%	2%	2%	2%	2%

Selecting Surfaces: OES

Take Off Climb surface

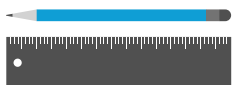


Selecting Surfaces - OES

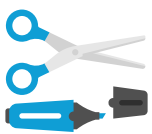
If the Standard OES stipulated in Annex 14, Vol 1 does NOT cover all type of operations conducted on the runway

Establish Specific OES

- **Adapted OES**



- **Tailored OES**



- Different OES may be established for each runway at an aerodrome
- The relevant authority shall ensure that the more limiting surface prevail

Summary

- Aeroplane Design Group is the more appropriate classification to be used for OLS
- The 2 parameters that make up the ADG are Aircraft speed at threshold and wingspan.
- The more stringent values of the 2 parameters shall be used when choosing the ADG for the runway.
- For aerodromes with multiple runways, different ADG can be identified for each runway.
- The dimensions for the OFS and OES are dependent on the ADG selected for the runway.