



**EASA**  
European Aviation Safety Agency

# Description of Operations – a cross-domain perspective on AWO

Andrew McKechnie  
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An agency of the European Union 

TE.GEN.00409-001



**Context**

**Classification of Operations**

**Operational Credits**

**Hazard Identification**



**Context** **Technology-**  
**Cross-domain** **independent**

**Performance-**  
**based**

**Systems**  
**Approach**



**Context** **Technology-**  
**Cross-domain** **independent**

**Performance-**  
**based**

**Systems**  
**Approach**



## Context

**Methods**

**Cross-domain**

**Systems  
Approach**

**To develop**

**Technology-  
independent  
Performance-  
based**

**Regulations**



## **Classification of Operations**



# Description of Operations

## Classification of Operations

Type of operation	Classification	Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach			
Taxiing			
Take-off			



## Definition:

***‘instrument approach operations’** means an approach and landing using instruments for navigation guidance based on an instrument approach procedure. There are two methods for executing instrument approach operations:*

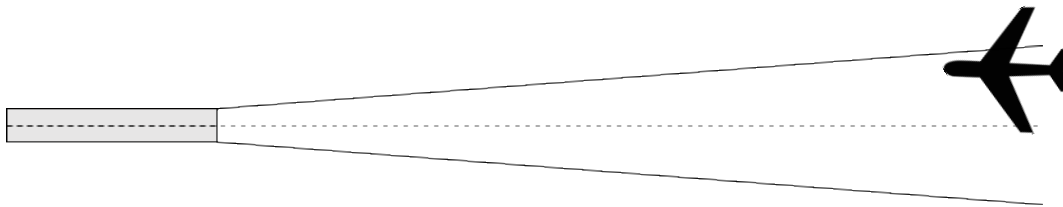
- (a) 2D instrument approach operation, using lateral navigation guidance only; and*
- (b) 3D instrument approach operation, using both lateral and vertical navigation guidance;*





# Description of Operations

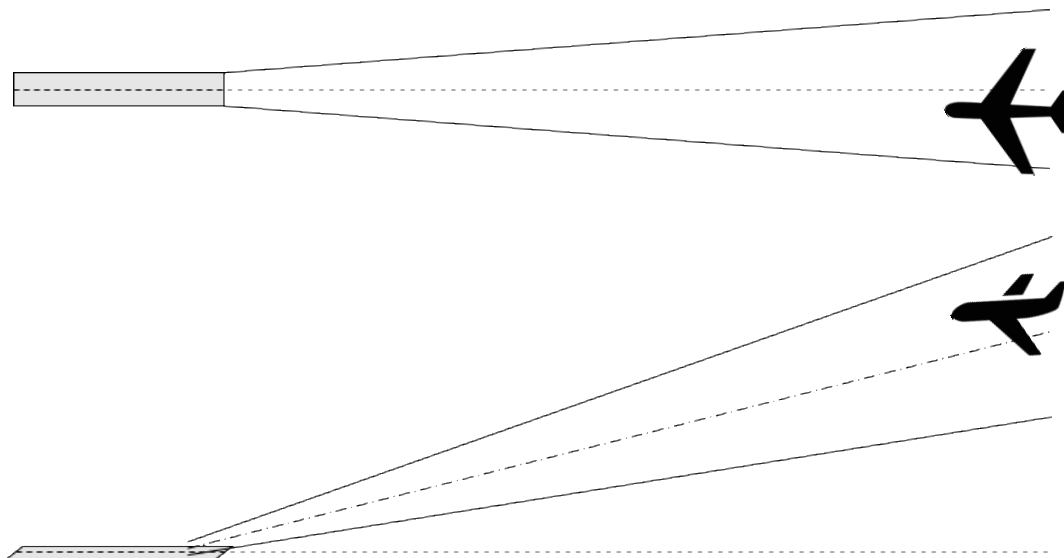
*(a) 2D instrument approach operation, using lateral navigation guidance only;*





# Description of Operations

*(b) 3D instrument approach operation, using both lateral and vertical navigation guidance;*

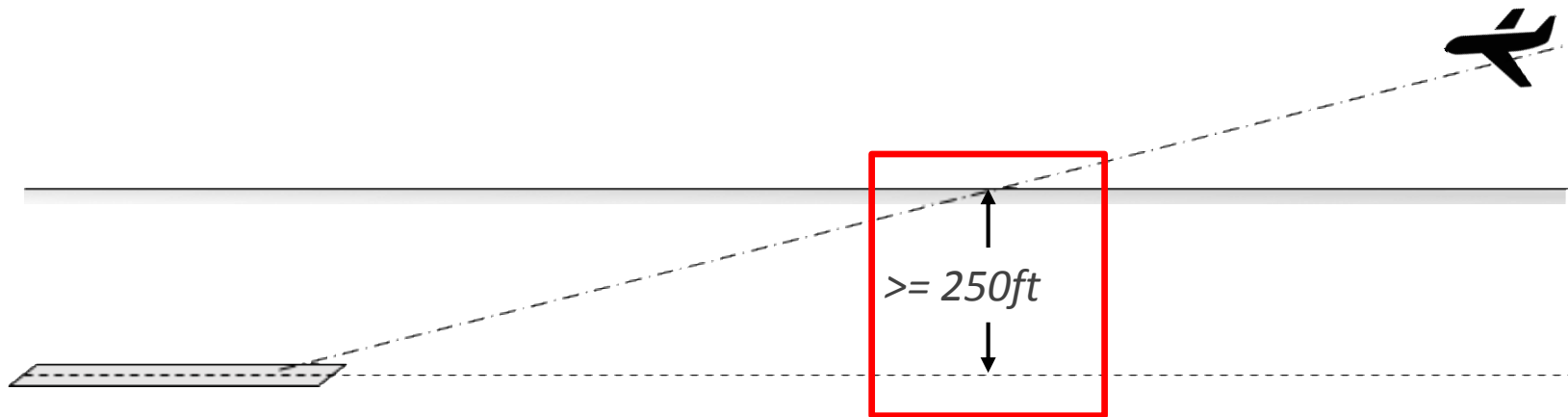




# Description of Operations

## Definition:

***‘Type A instrument approach operation’ means an operation with a minimum DA/H or MDA/H at or above 250 ft;***





# Description of Operations

## Classification of Operations

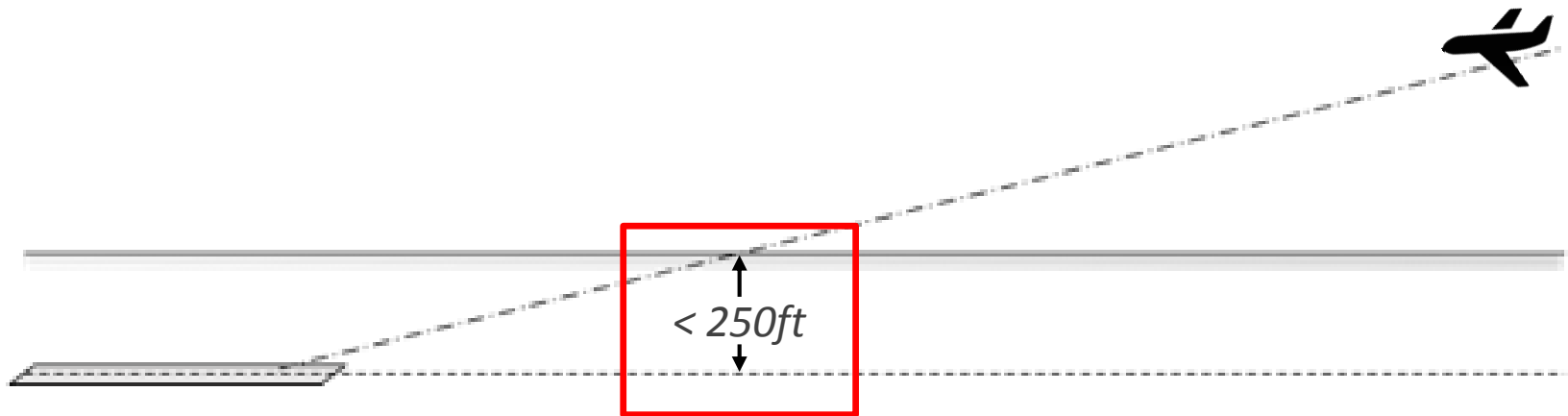
Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
<b>Approach</b>	Type A		250	600
Taxiing (see Note)				
Take-off				



# Description of Operations

## Definition:

***'Type B instrument approach operation'** means an operation with a minimum DA/H below 250 ft.*





# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
<b>Approach</b>	Type A		250	600
	Type B			
Taxiing (see Note)				
Take-off				



## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
<b>Approach</b>	Type A		250	600
	Type B			
Taxiing (see Note)				
Take-off				



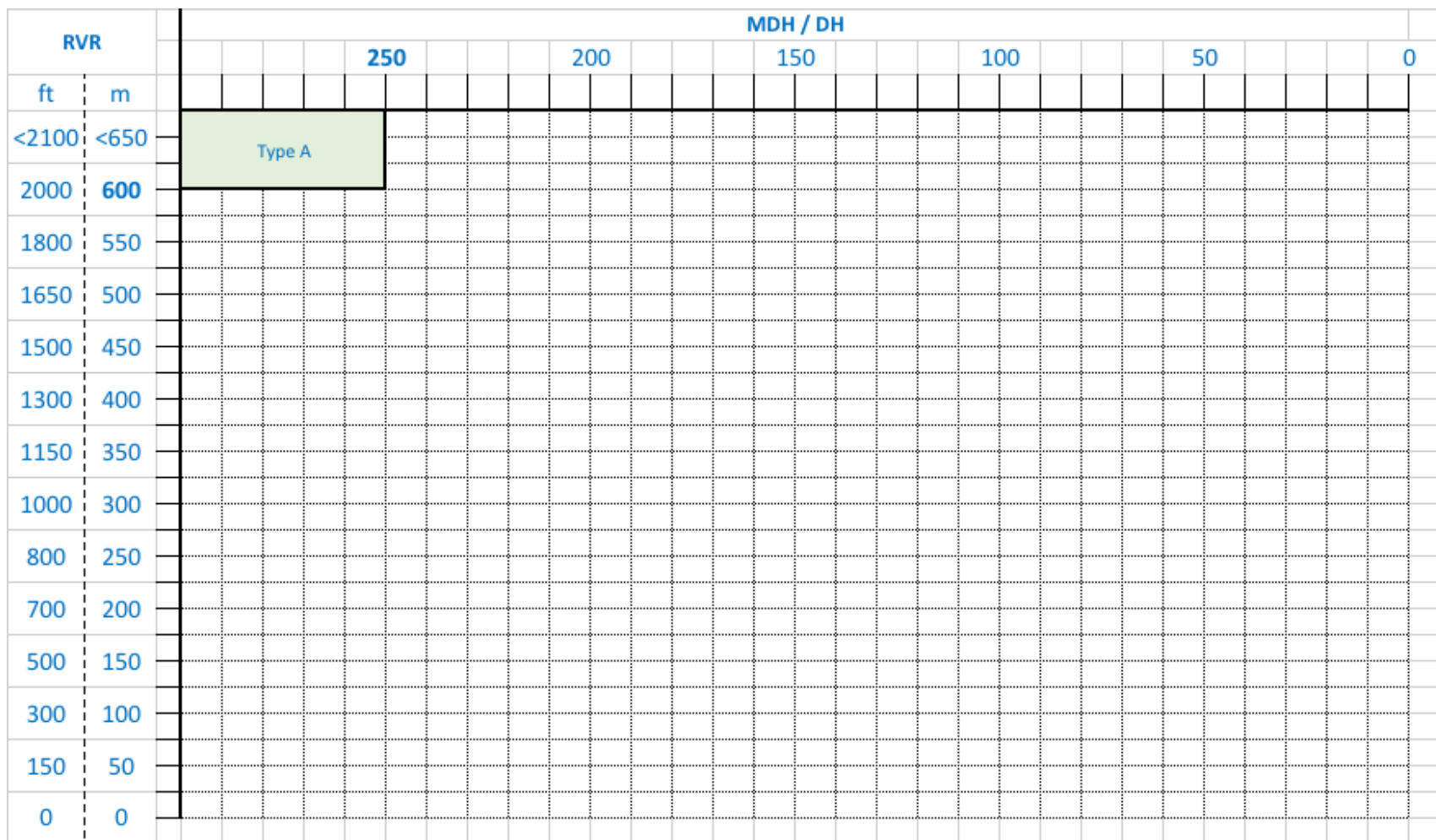
## Classification of Approach Operations

RVR		MDH / DH																			
		250				200				150				100				50			
ft	m																				
<2100	<650																				
2000	600																				
1800	550																				
1650	500																				
1500	450																				
1300	400																				
1150	350																				
1000	300																				
800	250																				
700	200																				
500	150																				
300	100																				
150	50																				
0	0																				



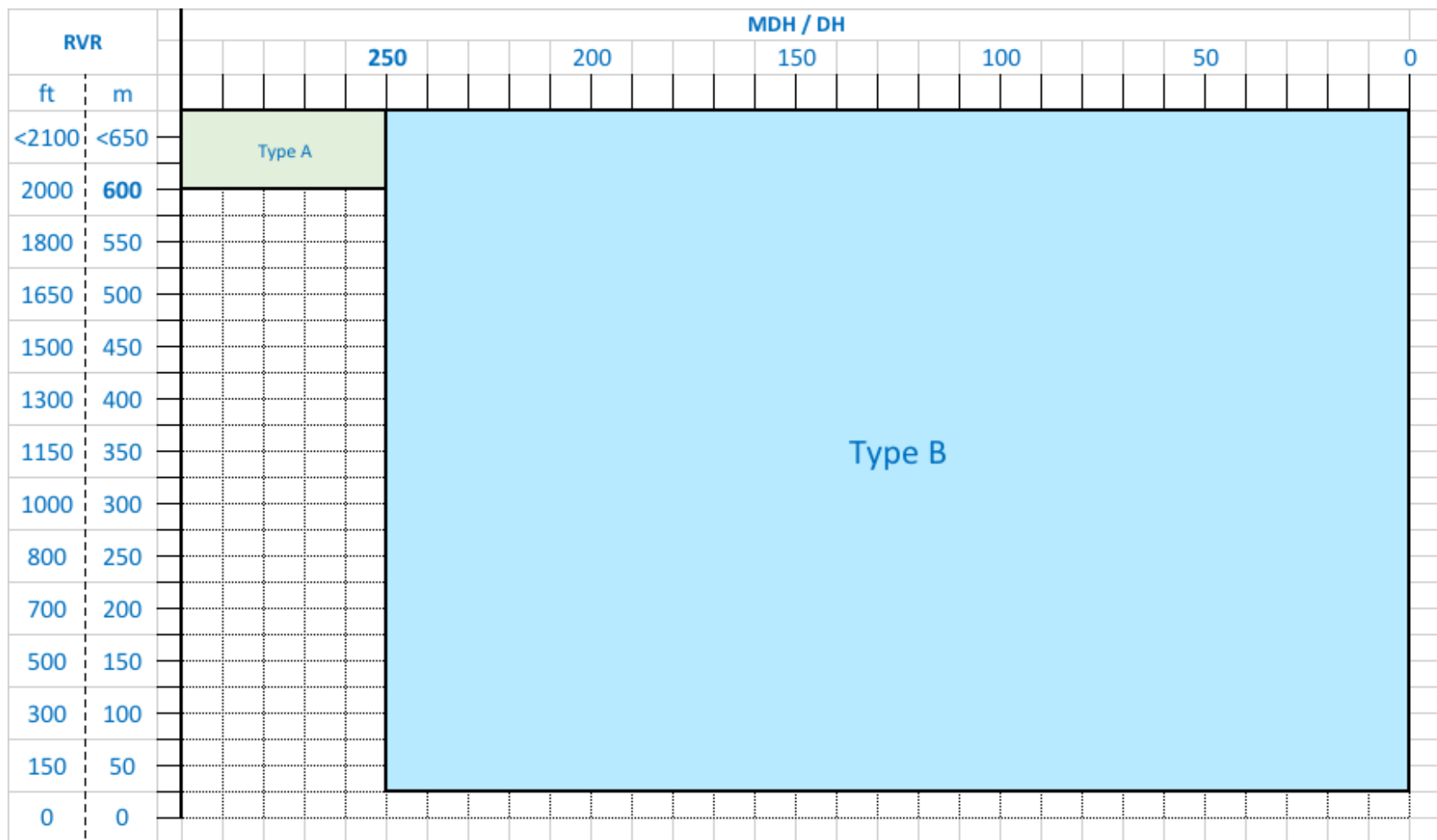


## Classification of Approach Operations



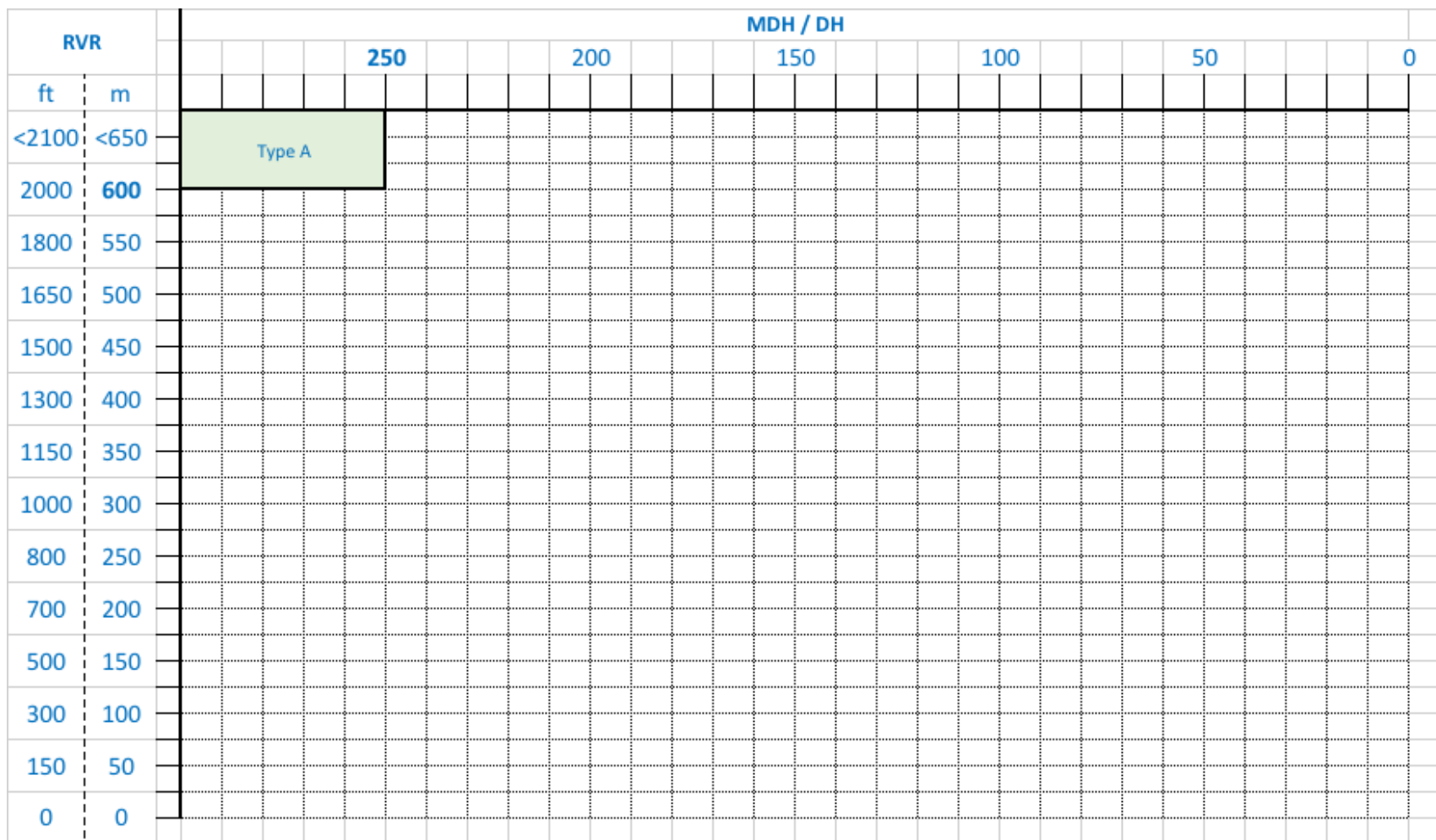


## Classification of Approach Operations



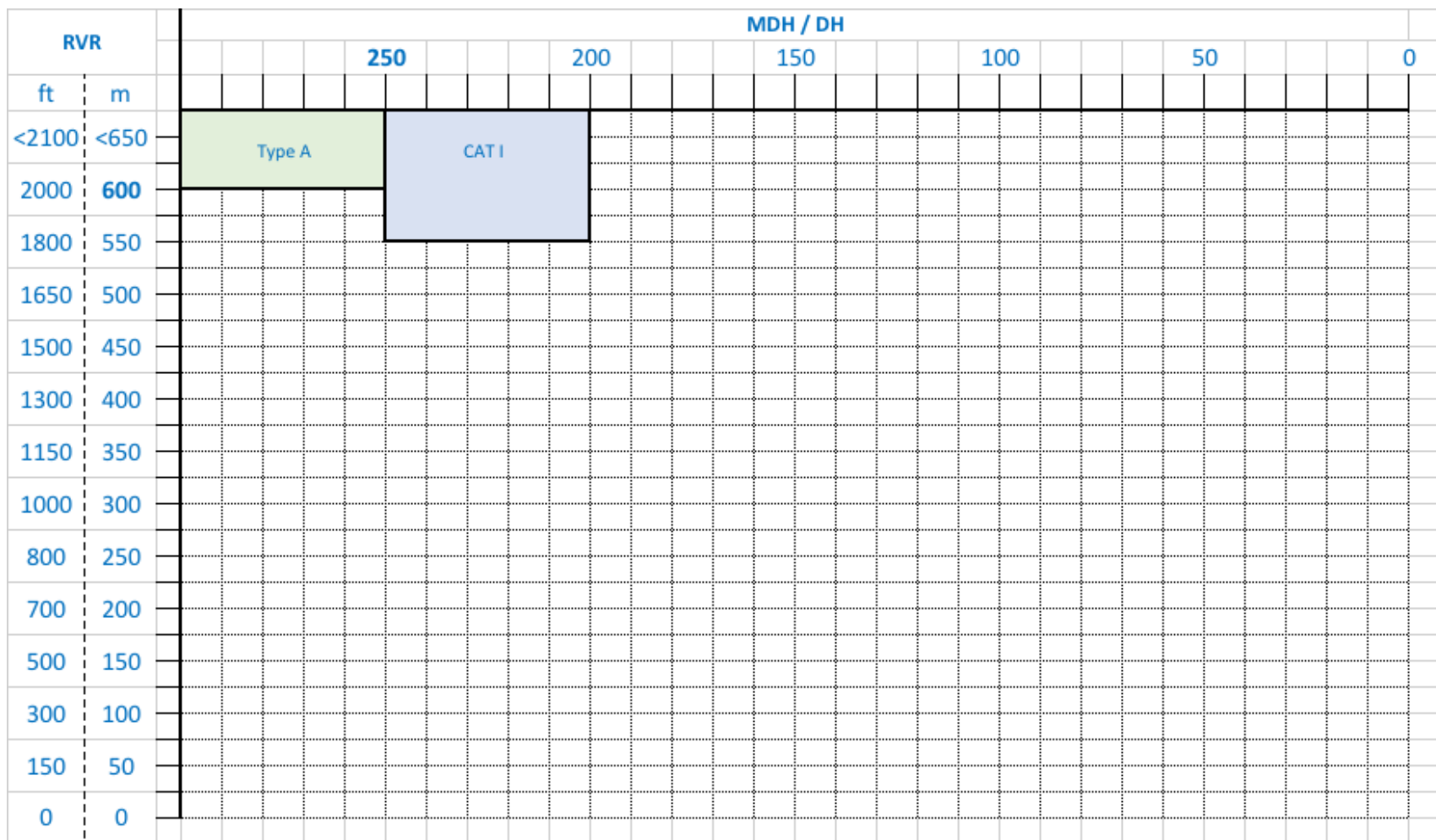


## Classification of Approach Operations



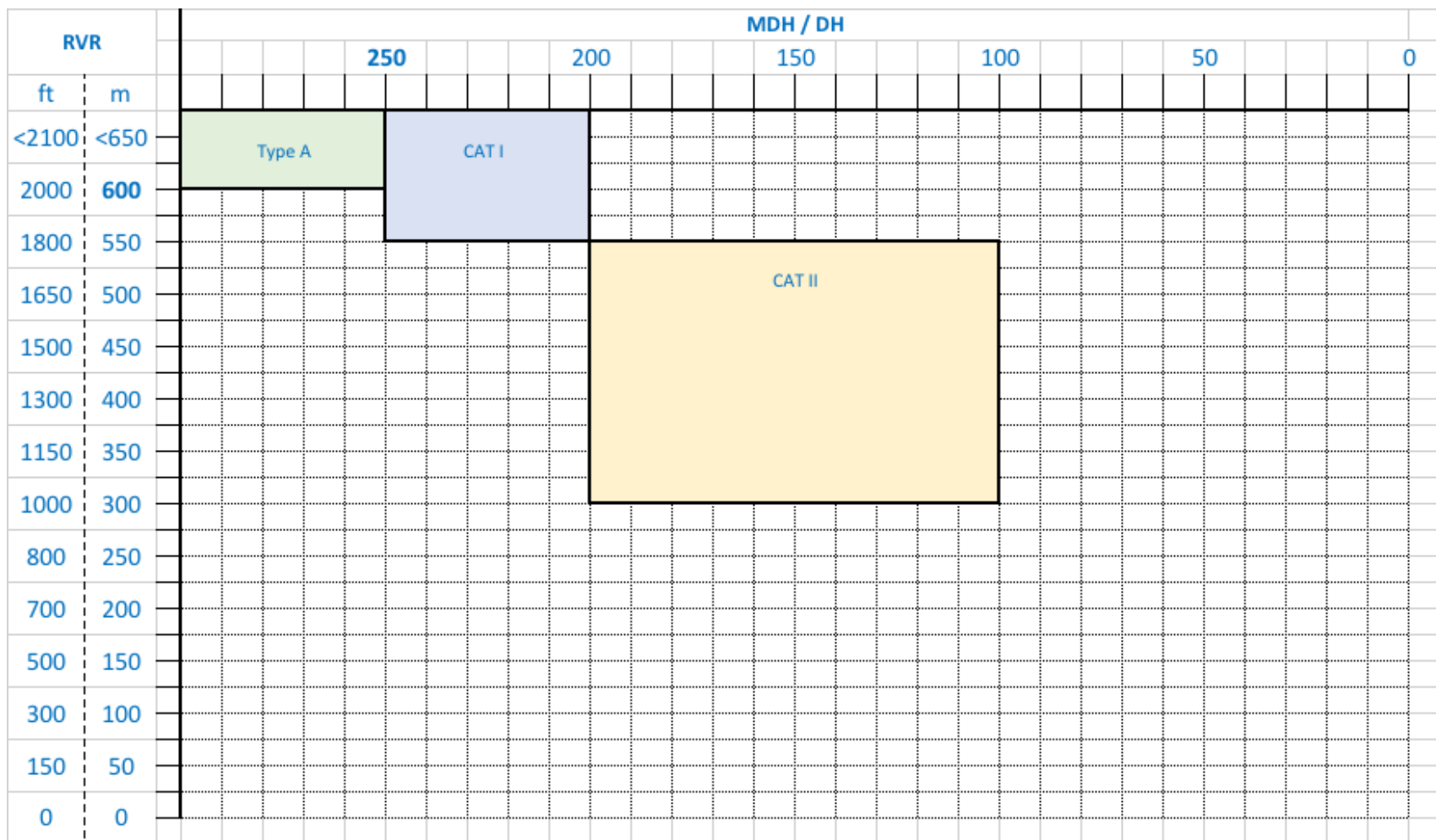


## Classification of Approach Operations



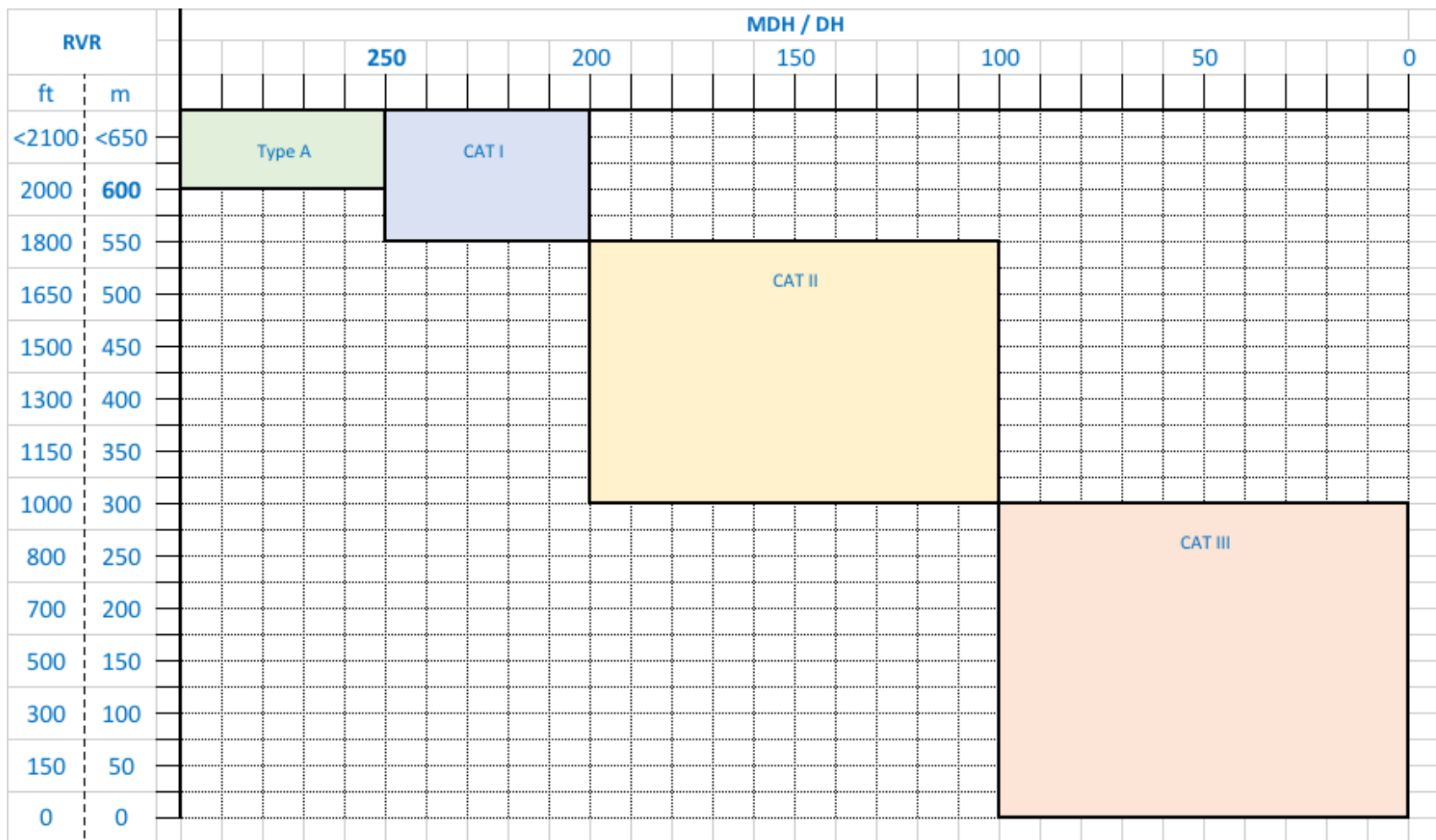


## Classification of Approach Operations



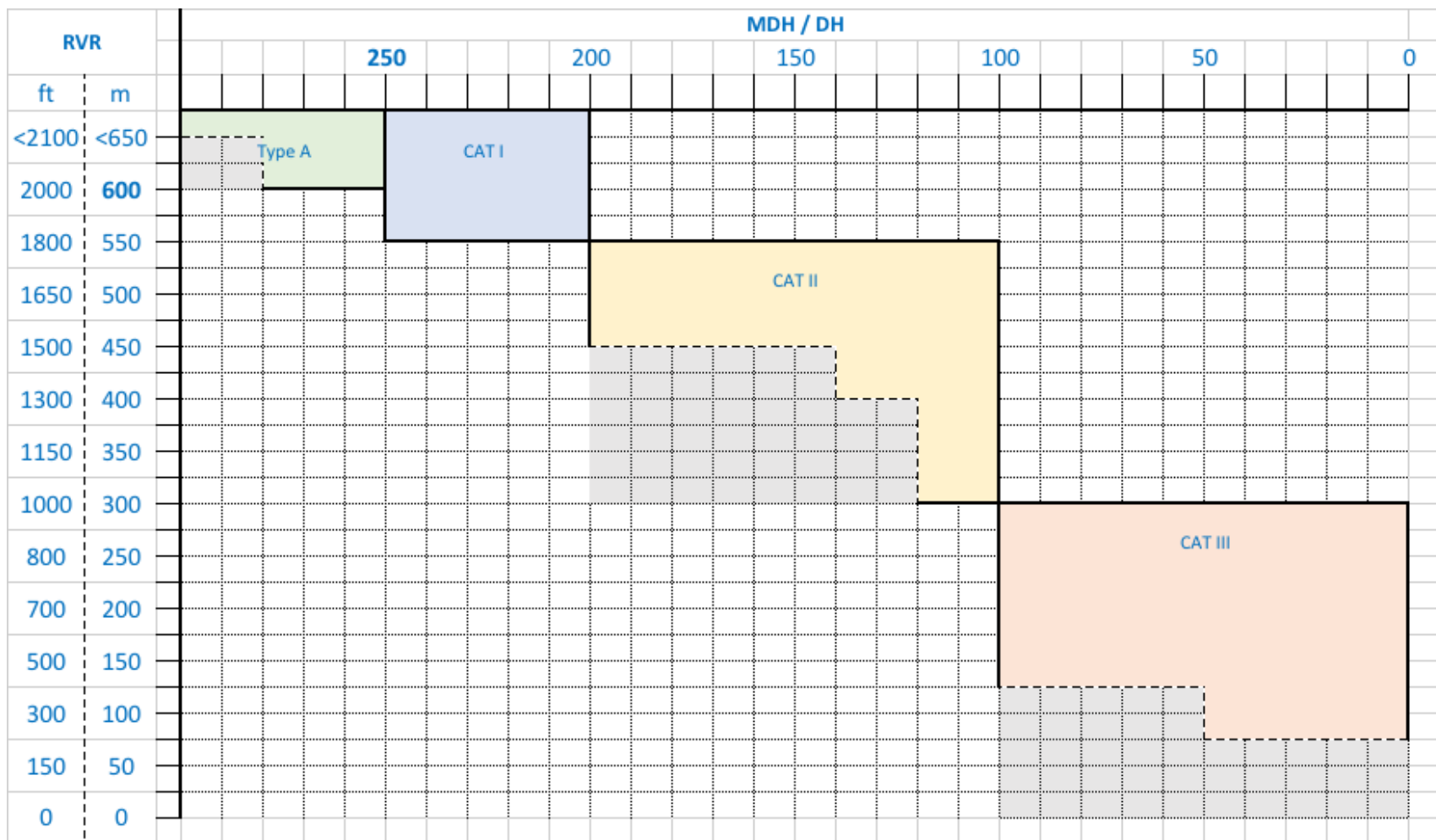


## Classification of Approach Operations





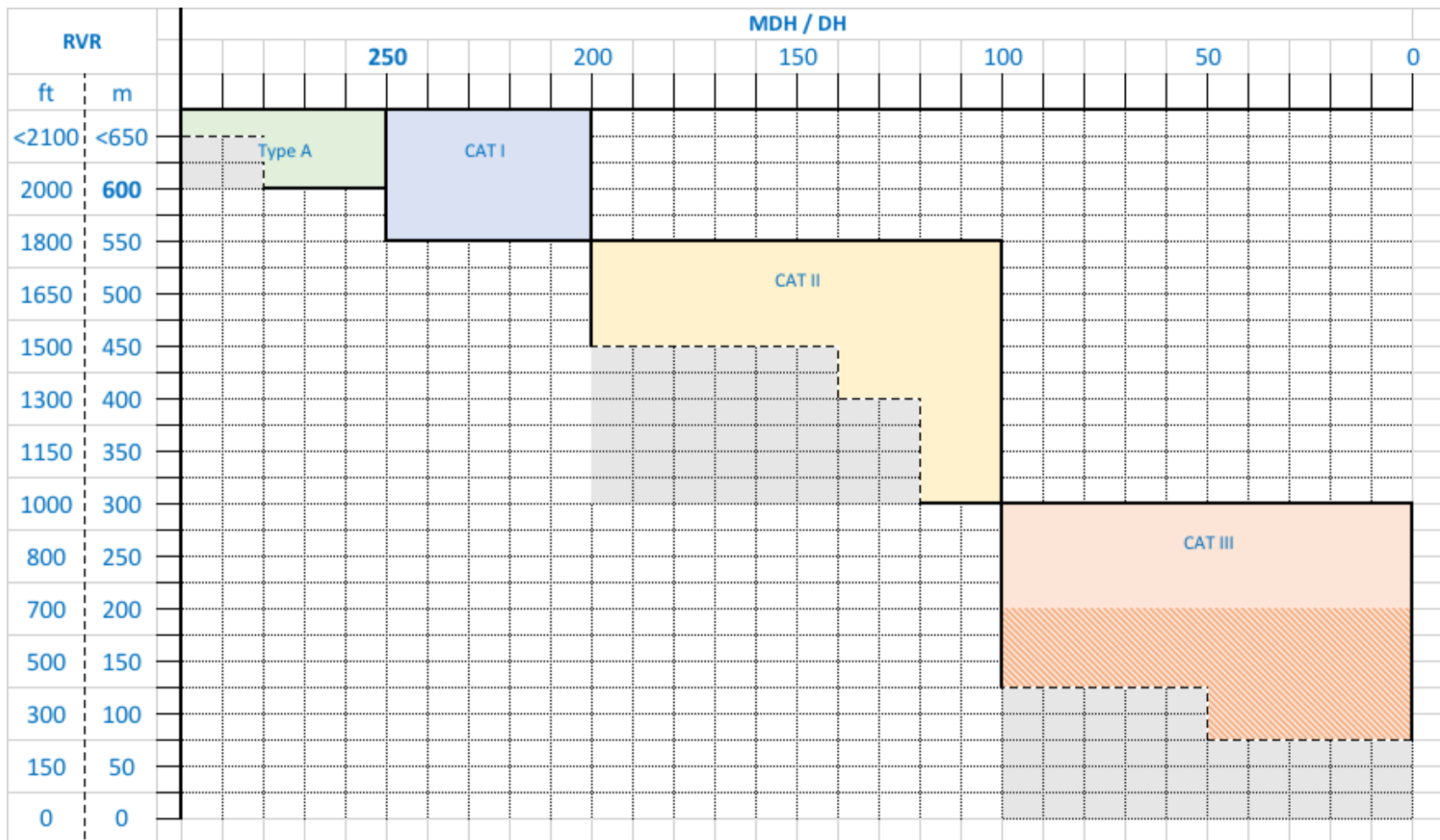
## Classification of Approach Operations







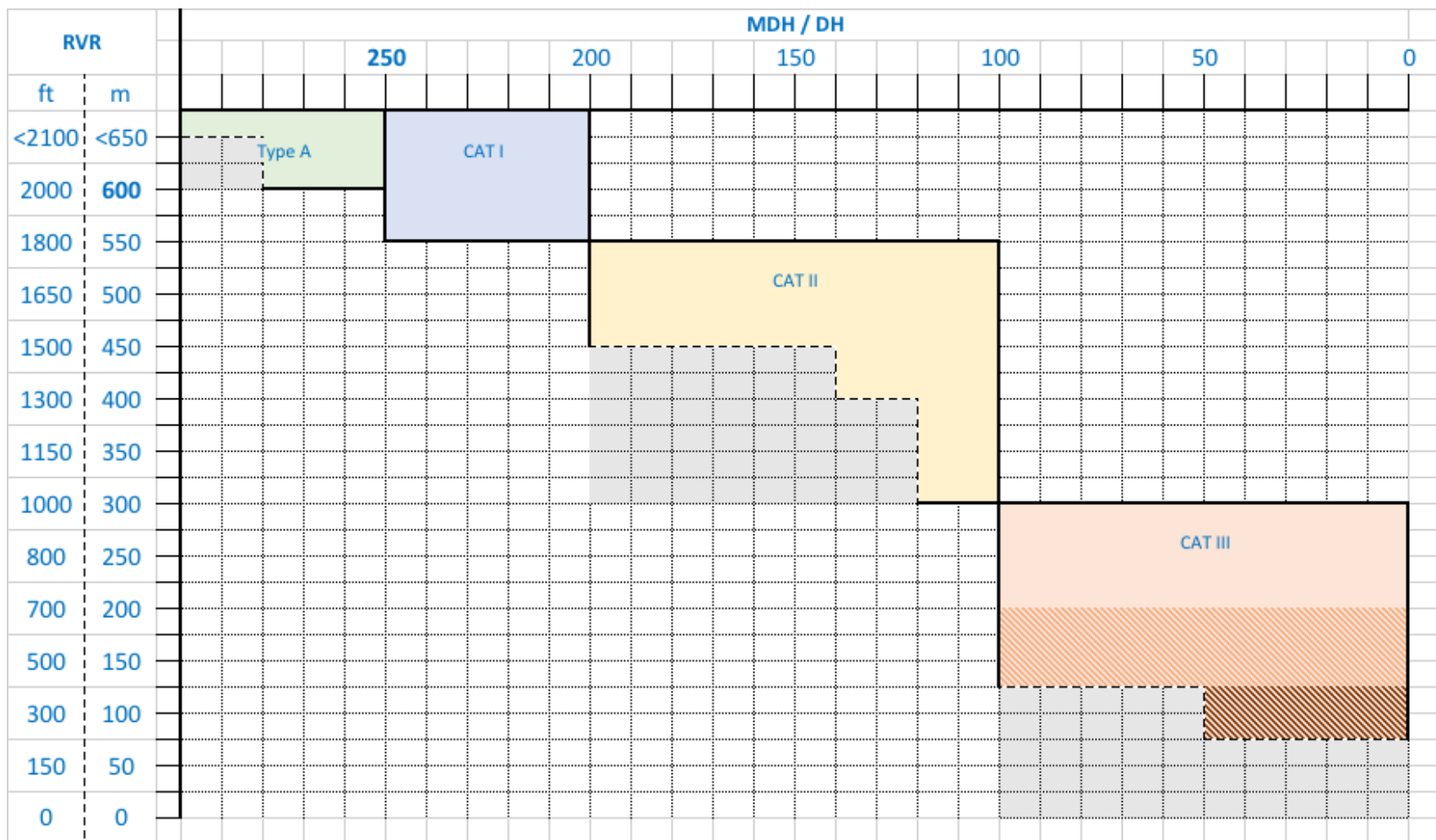
## Classification of Approach Operations







## Classification of Approach Operations





# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
<b>Approach</b>	Type A		250	600
	Type B			
Taxiing (see Note)				
Take-off				



# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
<b>Approach</b>	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
Taxiing (see Note)				
Take-off				



## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
<b>Taxiing (see Note)</b>				
Take-off				



## Definition:

*'low-visibility operation (LVO)' means an approach or take-off operations with an RVR less than 550m.*



## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
<b>Taxiing</b> (see Note)	Normal taxiing		N/A	550
	Low-visibility taxiing		N/A	0
Take-off				

Note: RVR is measured only on a runway and is, therefore, not directly relevant to taxiing.

The minimum value stated will be required on the runway to be used for take-off/approach to ensure that aircraft can safely taxi on and off the runway.



## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
Taxiing (see Note)	Normal taxiing		N/A	550
	Low-visibility taxiing		N/A	0
Take-off	Take-off		N/A	

Note: RVR is measured only on a runway and is, therefore, not directly relevant to taxiing.

The minimum value stated will be required on the runway to be used for take-off/approach to ensure that aircraft can safely taxi on and off the runway.



# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
Taxiing (see Note)	Normal taxiing		N/A	550
	Low-visibility taxiing		N/A	0
Take-off	Take-off		N/A	550

Note: RVR is measured only on a runway and is, therefore, not directly relevant to taxiing.

The minimum value stated will be required on the runway to be used for take-off/approach to ensure that aircraft can safely taxi on and off the runway.





# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
Taxiing (see Note)	Normal taxiing		N/A	550
	Low-visibility taxiing		N/A	0
Take-off	Take-off		N/A	550
	LVTO I		N/A	400

Note: RVR is measured only on a runway and is, therefore, not directly relevant to taxiing.

The minimum value stated will be required on the runway to be used for take-off/approach to ensure that aircraft can safely taxi on and off the runway.



# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
Taxiing (see Note)	Normal taxiing		N/A	550
	Low-visibility taxiing		N/A	0
Take-off	Take-off		N/A	550
	LVTO I		N/A	400
	LVTO II		N/A	0

Note: RVR is measured only on a runway and is, therefore, not directly relevant to taxiing.

The minimum value stated will be required on the runway to be used for take-off/approach to ensure that aircraft can safely taxi on and off the runway.



# Description of Operations

## Classification of Operations

Type of operation	Classification		Lowest MDA/H, DA/H (ft)	Lowest RVR (m)
Approach	Type A		250	600
	Type B	CAT I	200	550
		CAT II	100	300
		CAT III	0 or no DA/H	0
Taxiing (see Note)	Normal taxiing		N/A	550
	Low-visibility taxiing		N/A	0
Take-off	Take-off		N/A	550
	LVTO I		N/A	400
	LVTO II		N/A	0

Note: RVR is measured only on a runway and is, therefore, not directly relevant to taxiing.

The minimum value stated will be required on the runway to be used for take-off/approach to ensure that aircraft can safely taxi on and off the runway.



## Operational Credits




## Operational Credits: Definition:

**‘operation with an operational credit’** means an operation using specific airborne or ground equipment, or a combination of airborne and ground equipment, such that lower than standard operating minima can be applied for a particular classification of operation;



## Operational Credits:

- Lower than standard CAT I (LTS CAT I);
- Special Approval Category I (SA CAT I); 
- Other than standard CAT II (OTS CAT II);
- Special Approval Category II (SA CAT II); 
- Enhanced Flight Vision System / Combined Vision System (EFVS/CVS).



## Operational Credits

Operational Credit	System Element(s) providing Enhanced performance	Applies to (classification of operation)	Credit to (instrument or visual segment)		
				DA/H	RVR



# Description of Operations

## Lower than standard CAT I (LTS CAT I);

Operational Credit	System Element(s) providing Enhanced performance	Applies to (classification of operation)	Credit to (instrument or visual segment)		
				DA/H	RVR
LTS CAT I	Enhanced Performance of Approach Aid  Aircraft Flight Guidance System (e.g. HUD, SVS, Autoland)	CAT I approach	Instrument	200	450





# Description of Operations

## Lower than standard CAT I (LTS CAT I);

RVR		MDH / DH															
		250				200				150				100			
ft	m																
<2100	<650	Type A				CAT I											
2000	600																
1800	550									CAT II							
1650	500																
1500	450																
1300	400																
1150	350																
1000	300																



## Special Approval CAT I (SA CAT I);



Operational Credit	System Element(s) providing Enhanced performance	Applies to (classification of operation)	Credit to (instrument or visual segment)		
				DA/H	RVR
SA CAT I	Aircraft Flight Guidance System (e.g. HUD, SVS, Autoland)	CAT I approach	Instrument	150	400



# Description of Operations

## Special Approval CAT I (SA CAT I);



RVR		MDH / DH															
		250				200				150				100			
ft	m																
<2100	<650	Type A				CAT I											
2000	600																
1800	550					SA CAT I				CAT II							
1650	500																
1500	450																
1300	400																
1150	350																
1000	300																



## Other than standard CAT II (OTS CAT II);

Operational Credit	System Element(s) providing Enhanced performance	Applies to (classification of operation)	Credit to (instrument or visual segment)		
				DA/H	RVR
OTS CAT II	Autoland or approved HUD to touchdown	CAT II approach with reduced lighting	Visual	100	350



# Description of Operations

## Other than standard CAT II (OTS CAT II);

RVR		MDH / DH															
		250				200				150				100			
ft	m																
<2100	<650	Type A				CAT I											
2000	600																
1800	550									OTS CAT II							
1650	500																
1500	450																
1300	400																
1150	350																
1000	300									CAT II							



# Description of Operations

## Special Approval CAT II (SA CAT II);



Operational Credit	System Element(s) providing Enhanced performance	Applies to (classification of operation)	Credit to (instrument or visual segment)		
				DA/H	RVR
SA CAT II	Aircraft Flight Guidance System (e.g. HUD, SVS, Autoland)	CAT II approach with reduced lighting	Visual	150	350*

\* 1200ft in FAA regs.



## Special Approval CAT II (SA CAT II);



RVR		MDH / DH															
		250				200				150				100			
ft	m																
<2100	<650	Type A				CAT I				CAT II							
2000	600																
1800	550																
1650	500																
1500	450																
1300	400																
1150	350																
1000	300																



# Description of Operations

## Definition:

**‘head-up display (HUD) or equivalent systems’** means a display system which presents flight information to the pilot’s forward external field of view and which does not significantly restrict the external view;







# Description of Operations

## Definition:



**‘enhanced vision system (EVS)’** is an electronic means to provide the flight crew with a real-time sensor-derived or enhanced display of the external scene topography (...) through the use of imaging sensors; an EVS does not have an integrated flight guidance system.



# Description of Operations

## Definition:



## Enhanced flight vision

**system:** an EFVS is integrated with a flight guidance system and is implemented on a head-up display (or an equivalent display) on which the imagery and symbology is visible to the pilot flying in his or her normal position with the line of vision looking forward along the flight path;



# Description of Operations

## Definition:

**‘combined vision system (CVS)’** combines a real-time imaging sensor and display with a synthetic image generated using a terrain and obstacle database utilising a precision navigation position. CVS can include either; an EFVS or EVS and a SVGS or SVS;





## Enhanced Flight Vision Systems / Combined Vision Systems

Operational Credit	System Element(s) providing Enhanced performance	Applies to (classification of operation)	Credit to (instrument or visual segment)		
				DA/H	RVR
EFVS/CVS	EVS/CVS on HUD or equivalent system	3D instrument approach	Visual	No credit	credit



**Context**

**Classification of Operations**

**Operational Credits**

**Hazard Identification**



## Systems-Theoretic Process Analysis (STPA)

### Terminology:

***Accident:*** Any event resulting to injuries and/or damages to property and/or equipment

***Hazard:*** A system state or set of conditions that, together with a particular set of worst-case environmental conditions, will lead to an accident.



## AWO System Hazards

- **H1:** Uncontrolled aircraft when airborne;
- **H2:** Inadequate separation of the aircraft from terrain or obstacles before landing;
- **H3:** Inadequate separation of the aircraft from flying objects when airborne;
- **H4:** Inadequate separation of the aircraft from objects on the ground;
- **H5:** Uncontrolled landing and roll-out;
- **H6:** Uncontrolled taxiing;
- **H7:** Movement outside the movement areas (manoeuvring areas and apron);
- **H8:** Uncontrolled take-off.



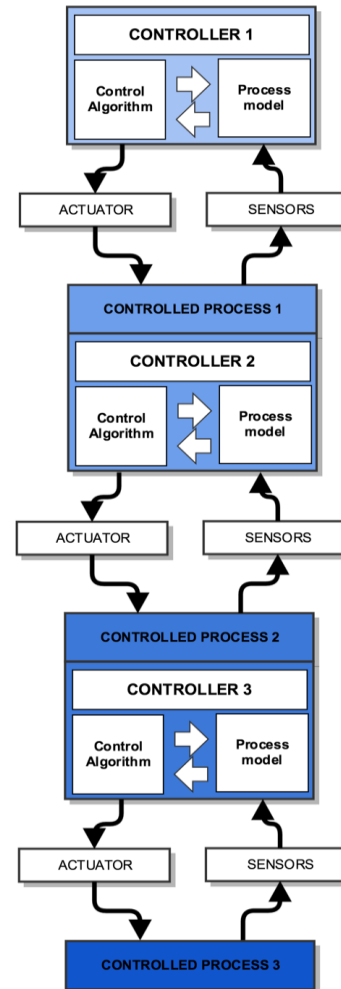
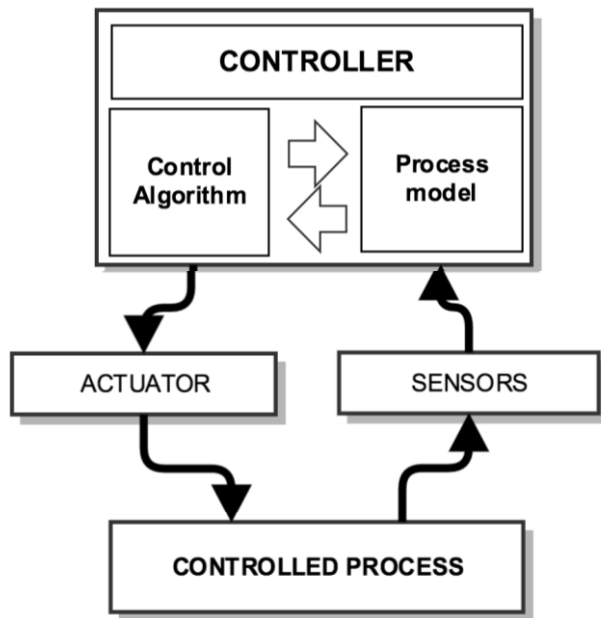
## AWO System Hazards

- **S11:** The aircraft shall be under control when airborne;
- **S12:** The aircraft separation of the aircraft separation from obstacles before landing; excluding the intended landing surface;
- **S13:** The aircraft separation of the aircraft separation from objects in the air;
- **S14:** The aircraft separation of the aircraft separation from objects on the ground;
- **S15:** The aircraft shall be under control; during landing and roll-out on the intended landing surface;
- **S16:** The aircraft shall be under control during taxiing;
- **S17:** The aircraft shall be under control when moving (manoeuvring) on the ground (apron);
- **S18:** The aircraft shall be under control during take-off.



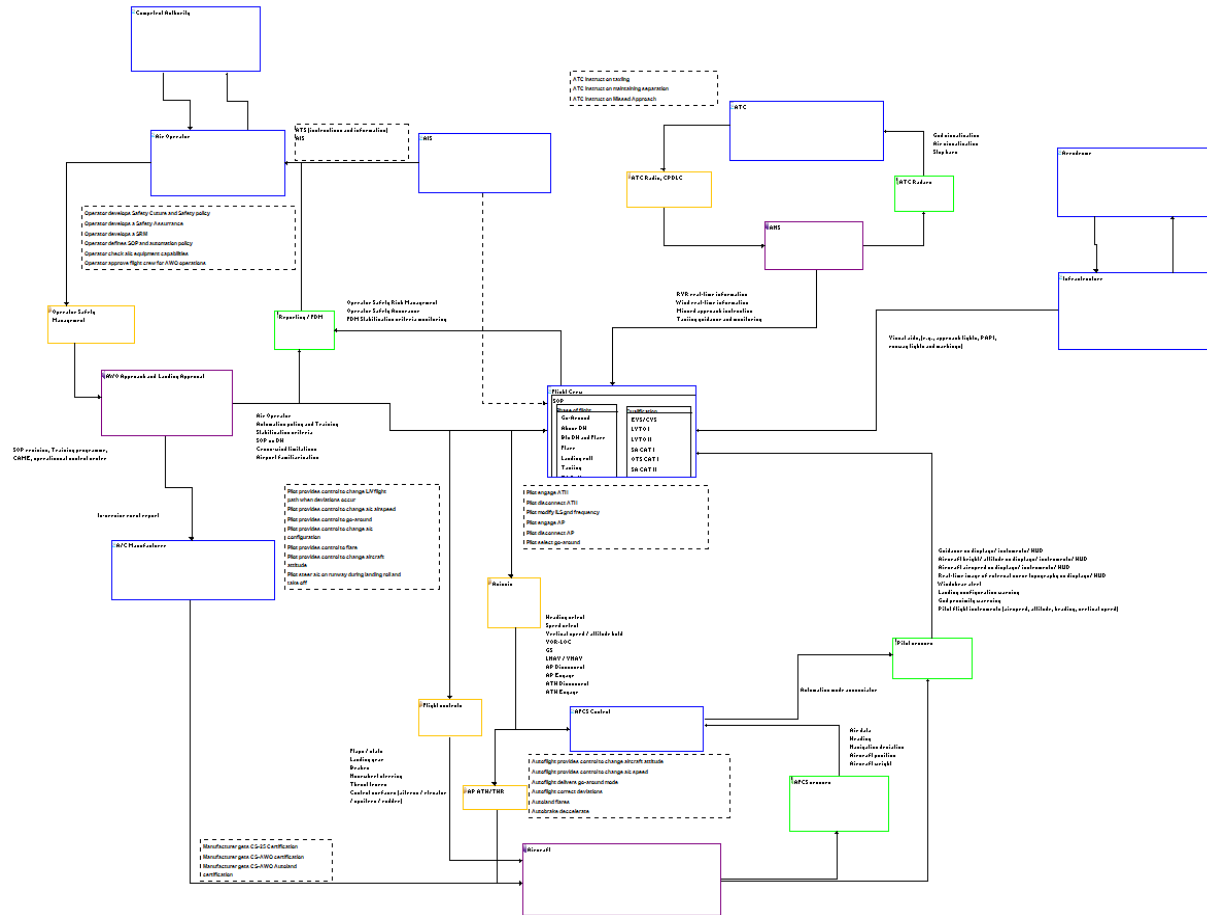


## Control structure



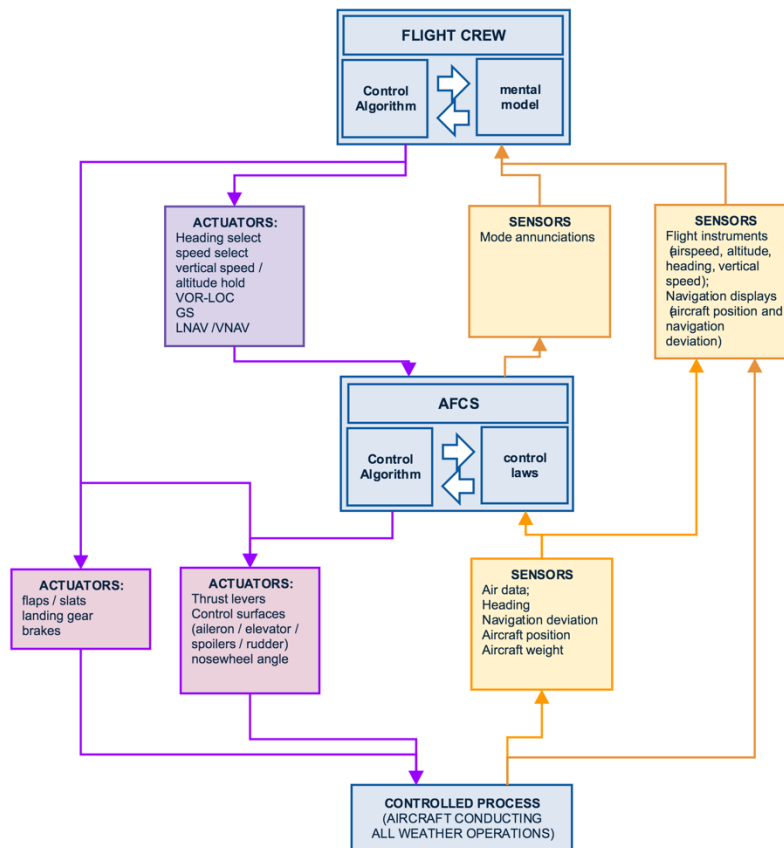


# Control structure





## Control structure





## Safety Requirements





**Context**

**Classification of Operations**

**Operational Credits**

**Hazard Identification**



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# Description of Operations – a cross-domain perspective on AWO

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