

Session

Arrester Systems, Declared Distances and Runway Excursion Prevention

Runway Excursion

Toronto, Canada August 2, 2005

*200 meters from
end of runway*



American Airlines
Flight 331,
Norman Manley
International
Airport, Kingston,
Jamaica
December 22,
2009



? How can you reduce
the damage ?

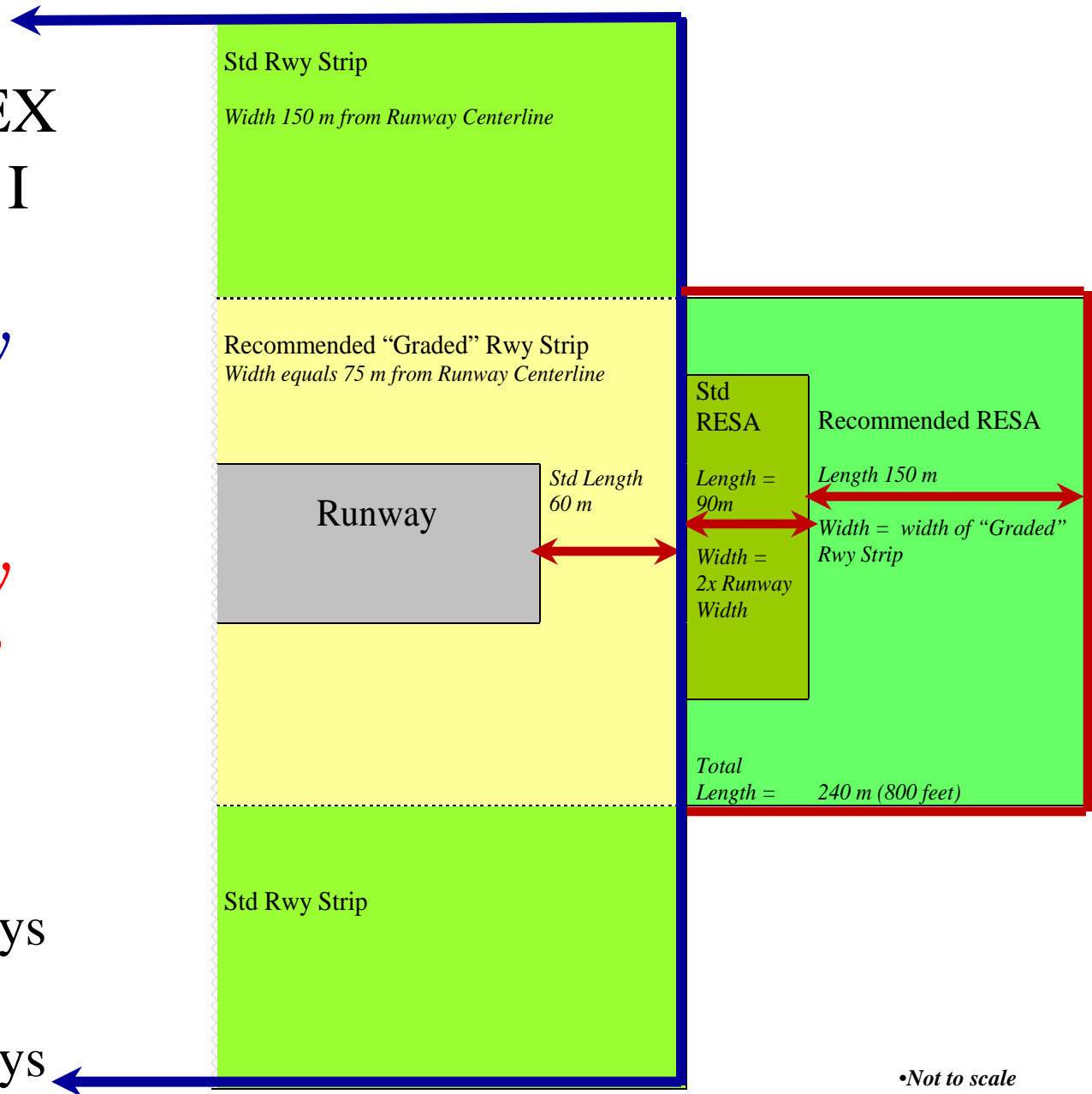


ICAO ANNEX 14, Volume I

(1) *Runway Strip*

(2) *Runway End Safety Area*

Case for
Code 3 Runways
and
Code 4 Runways



•Not to scale

Runway Strip

- 3.4.1 A runway and any associated **stopways** shall be included in a strip.
- 3.4.2 A *strip shall extend* before the threshold and beyond the end of the runway or stopway for a distance of at least:
 - **60 m** where the code number is 2, 3 or 4;
 - **60 m** where the code number is 1 and the runway is an instrument one; and
 - **30 m** where the code number is 1 and the runway is a non-instrument one.

*?Where does the Runway Strip
Begin?*

before a threshold
beyond a runway end
beyond a STOPWAY



Runway End Safety Area (RESA)

- 3.5.1 A runway end safety area **shall** be provided at each **end of a runway strip** where:
 - the code number is 3 or 4; and
 - the code number is 1 or 2 and the runway is an instrument one.

Note.— Guidance on runway end safety areas is given in Attachment A, Section 10.

- 3.5.2 Recommendation.— A runway end safety area **should** be provided at each end of a runway strip where the code number is 1 or 2 and the runway is a non-instrument one.

- 3.5.3 A runway end safety area shall extend from the end of a runway strip to a distance of **at least 90 m** where:
 - the code number is 3 or 4; and
 - the code number is 1 or 2 and the runway is an instrument one.
- If an **arresting system** is installed, the above length may be reduced, based on the design specification of the system, subject to acceptance by the State.

Note.— Guidance on **arresting systems** is given in Attachment A, Section 10 of Annex 14.

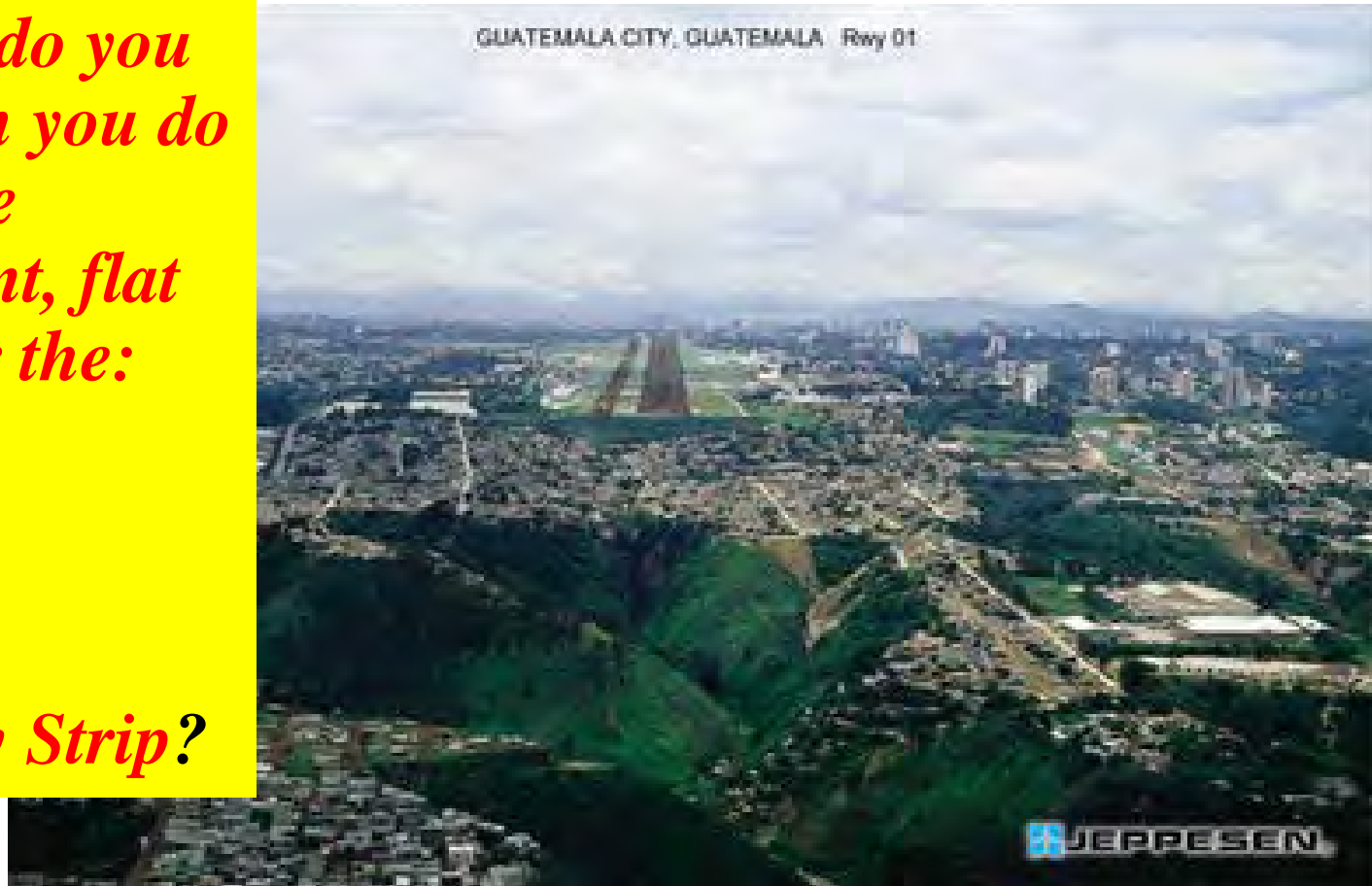
- 3.5.4 Recommendation.— A runway end safety area should, as far as practicable, extend from the end of a runway strip to a distance of at least:
 - **240 m** where the code number is 3 or 4; or a reduced length when an arresting system is installed;
 - **120 m** where the code number is 1 or 2 and the runway is an instrument one; or a reduced length when an arresting system is installed; and
 - **30 m** where the code number is 1 or 2 and the runway is a non-instrument one.

Steep terrain off Runway 01 at Guatemala City La Aurora International Airport

? What do you do when you do not have sufficient, flat land for the:

RESA?

Runway Strip?



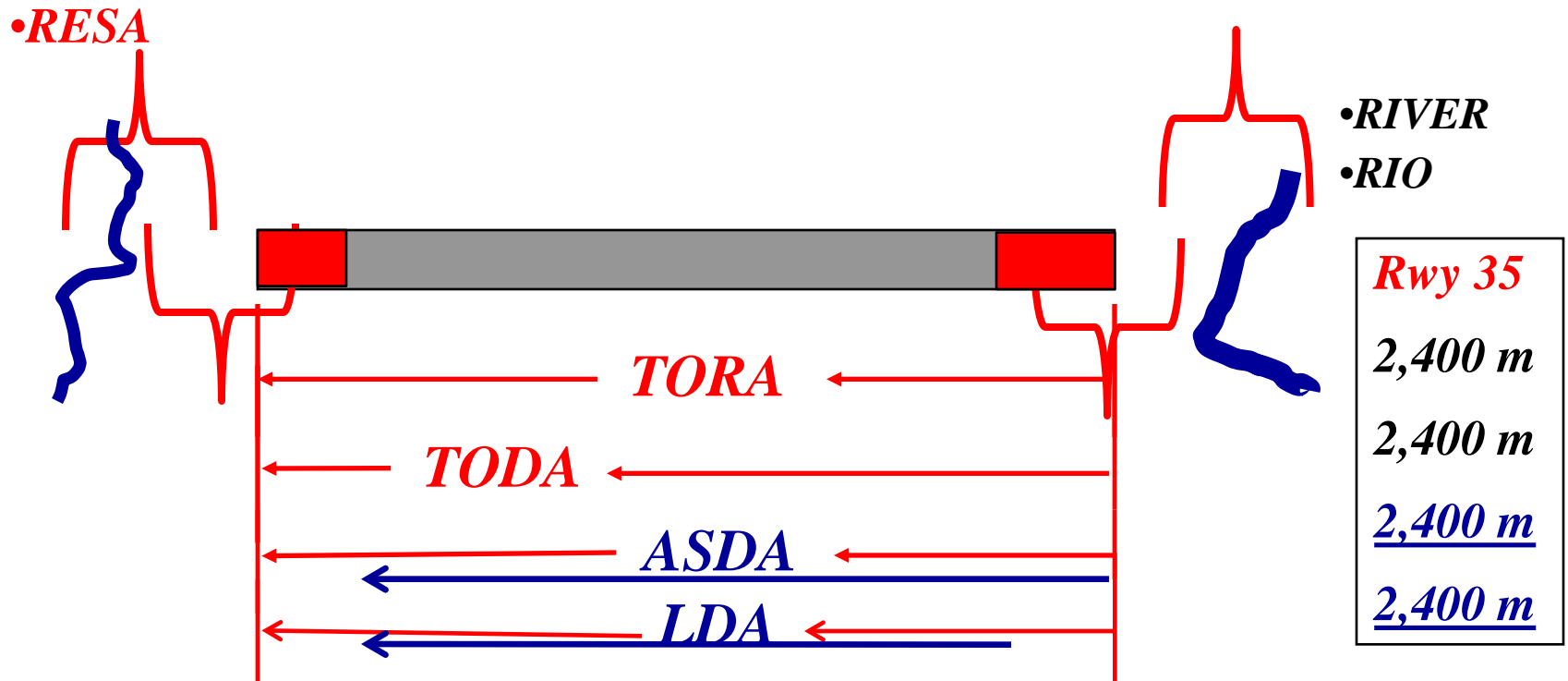
ANNEX 14, Volume I

- *ICAO recognizes the use of declared distances to obtain Runway Strip and Runway End Safety Areas when you DO NOT HAVE sufficient, acceptable land beyond the runway end.*
- *Benefits – Compliance with:*
 - *Standard RESA lengths*
 - *Recommended RESA lengths*
- *How ?*
- *Reduce ASDA and LDA*
 - *Not TORA*
 - *Not TODA*

One Process to get Standard RESA beyond Rwy 17

RWY 17/35 = 2,400 m

A Code 4 runway (over 1800 m)



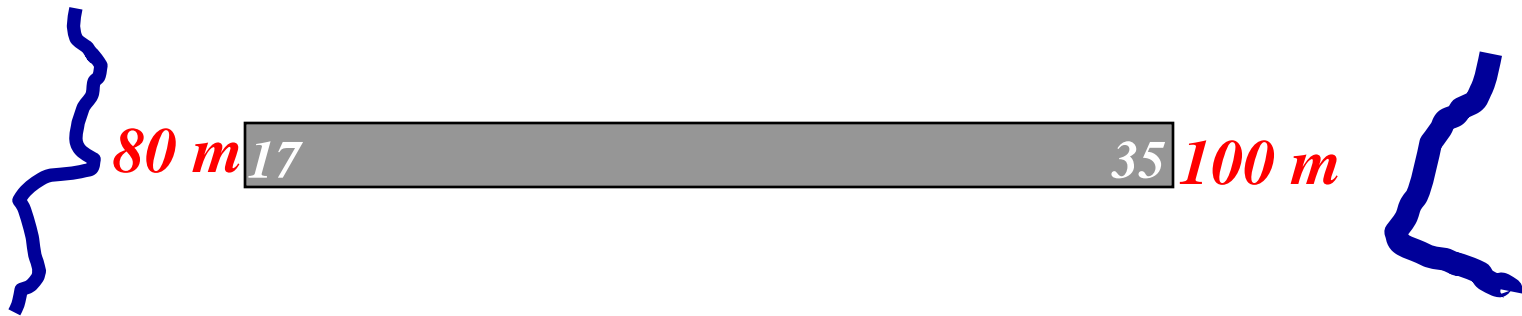
One Process to Get Standard RESA Length

- Step 1: Determine the length of the **standard Runway Strip (para. 3.4.2)** Answer: 60 meters
- Step 2: Determine the length of the **standard RESA (para. 3.5.3)**. Answer: 90 meters
 - Note: for Recommended length use **para. 3.5.4**
- Step 3: Add these numbers. Answer: $60 + 90 = \underline{\underline{150 \text{ meters}}}$. This is the length of suitable, flat ground you need to meet the standard RESA and Standard Runway Strip.

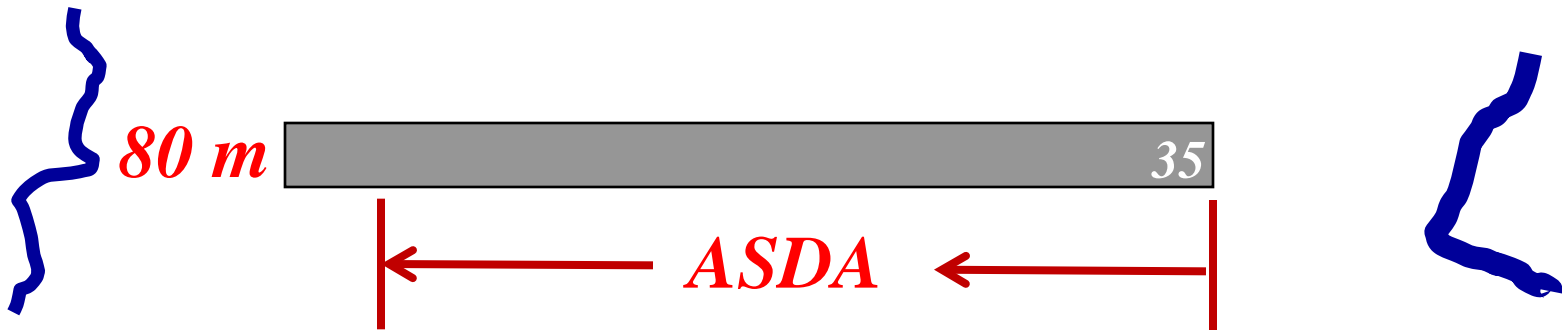
Step 4: Determine how much acceptable, flat ground you have. Answer: for this example assume:

Rwy 17 - you walked **80 m** (before the River)

Rwy 35 - you walked **100 m** (before the River)



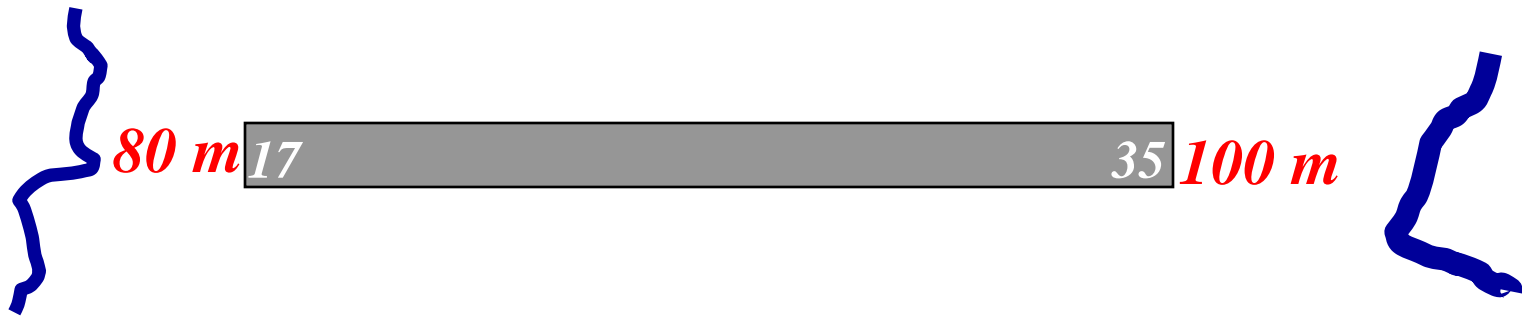
- Step 5: Find ASDA (only 1 case)
- Step 6: Subtract $150\text{m} - 80\text{m} = 70\text{ m missing off Rwy 17}$.
 - *This is the amount you reduce ASDA.*
- Step 7: Reduce $2400 - 70 = \underline{\text{NEW ASDA} = 2330\text{ m}}$



Step 8: Find LDA (2 Cases) Land Long; Land Short

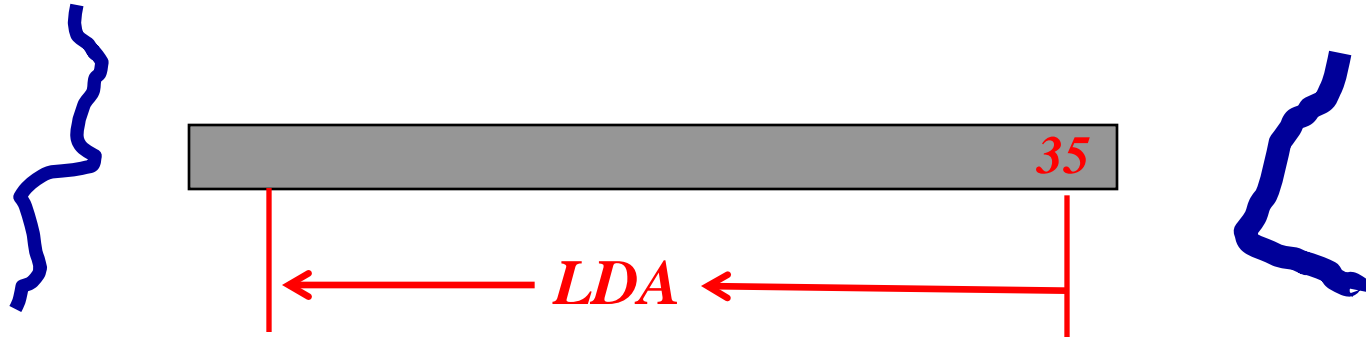
Rwy 17 - you walked 80 m

Rwy 35 - you walked 100 m




- Step 9: First case **Land Long** (beyond Rwy 17)
 - This is the 1st amount you reduce LDA
- Step 10: Subtract 150 m - 80 m = **70 m**
 - Reduce 2400 - 70 = 2330 m
- Step 11: Second case **Land Short** (before Rwy 35)
 - This is the 2nd amount you reduce the revised LDA
- Step 12: Subtract 150m - 100m = **50 m**
 - Reduce 2330 - 50 = **NEW LDA = 2280 m**

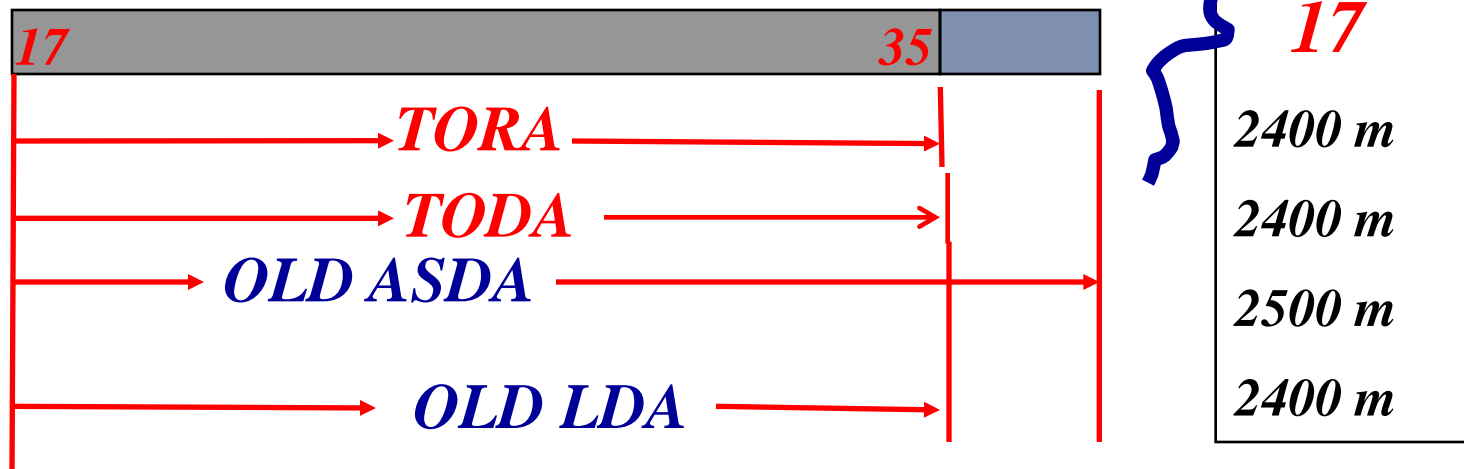
New LDA = 2280 m



Exercise #2 Determine the reduced ASDA and reduced LDA for Rwy 17 to obtain

**Recommended 240 meter RESA
Standard Runway Strip = 60 m**

- **RWY 17/35 = 2,400 meters**
 - **Stopway off Rwy 35 = 100 m** 
 - **River is 240 m from the End of Rwy 35**
 - **No River off Rwy 17 flat ground = 400 meters**



What to do if: Runway is too short and the REDUCED ASDA or LDA is too significant? Install Arrestor System



Aerial photo showing Hollywood Blvd. off Runway 26 at Burbank Airport, Burbank, California. **EMAS** installed for runway excursions

ANNEX 14, Volume I

- *ICAO recognizes the use of arrestor systems to obtain Runway End Safety Areas (RESA)*
- *Benefits – Compliance with:*
 - *Standard RESA and Runway Strip Lengths*
 - *Recommended RESA lengths*
- *How ? Use “proven” arrestor systems.*
- *May combine with Reduced ASDA and LDA*
 - *Not TODA*
 - *Not TORA*

United States, Charleston Yeager Airport West Virginia



Successful Aircraft Arrestment by EMAS

US Airways Flight 2495, Charleston Yeager Airport

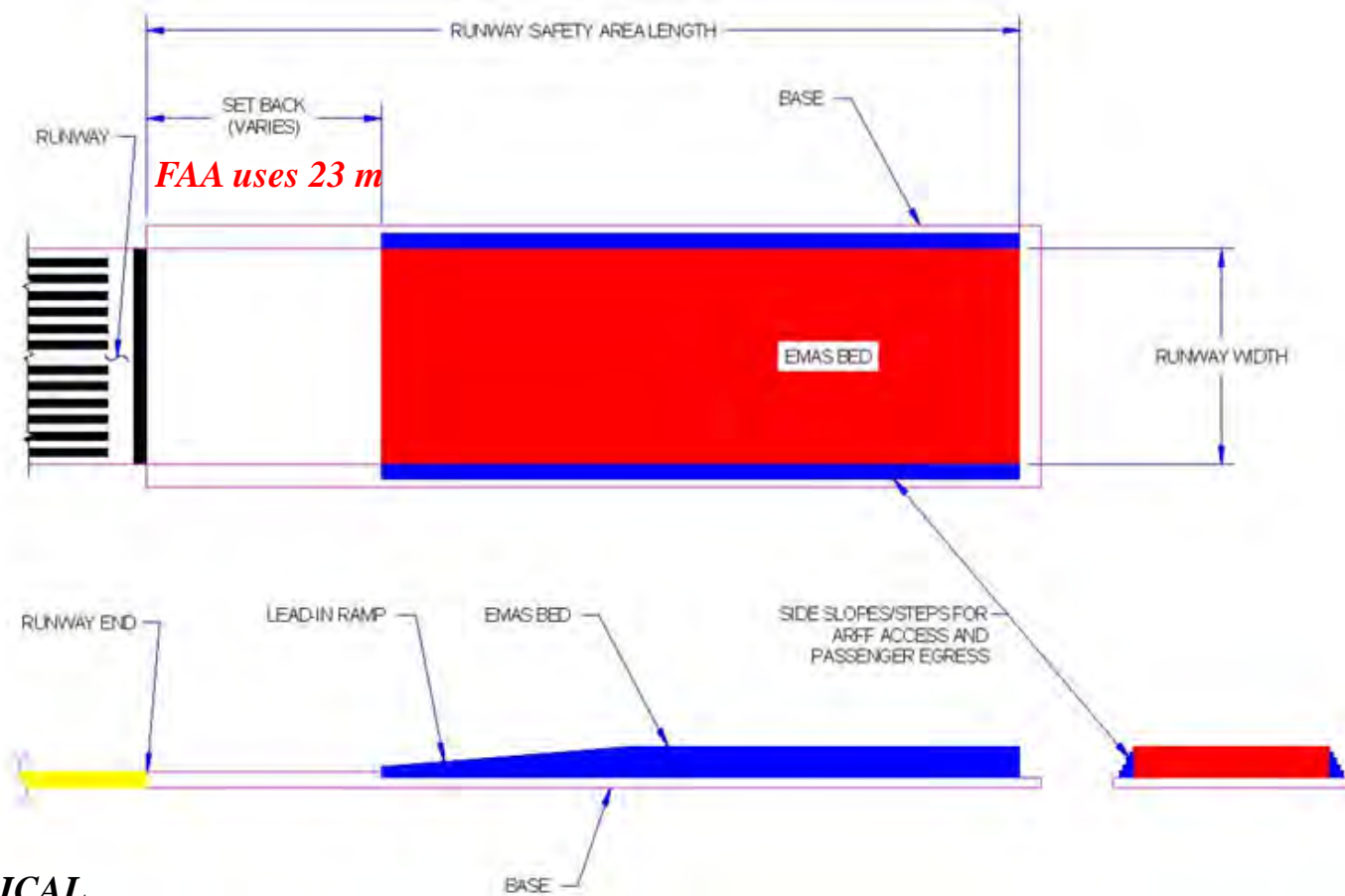
January 19, 2010



US FAA Advisory Circular 150/5220-22

Engineered Materials Arresting Systems (EMAS)

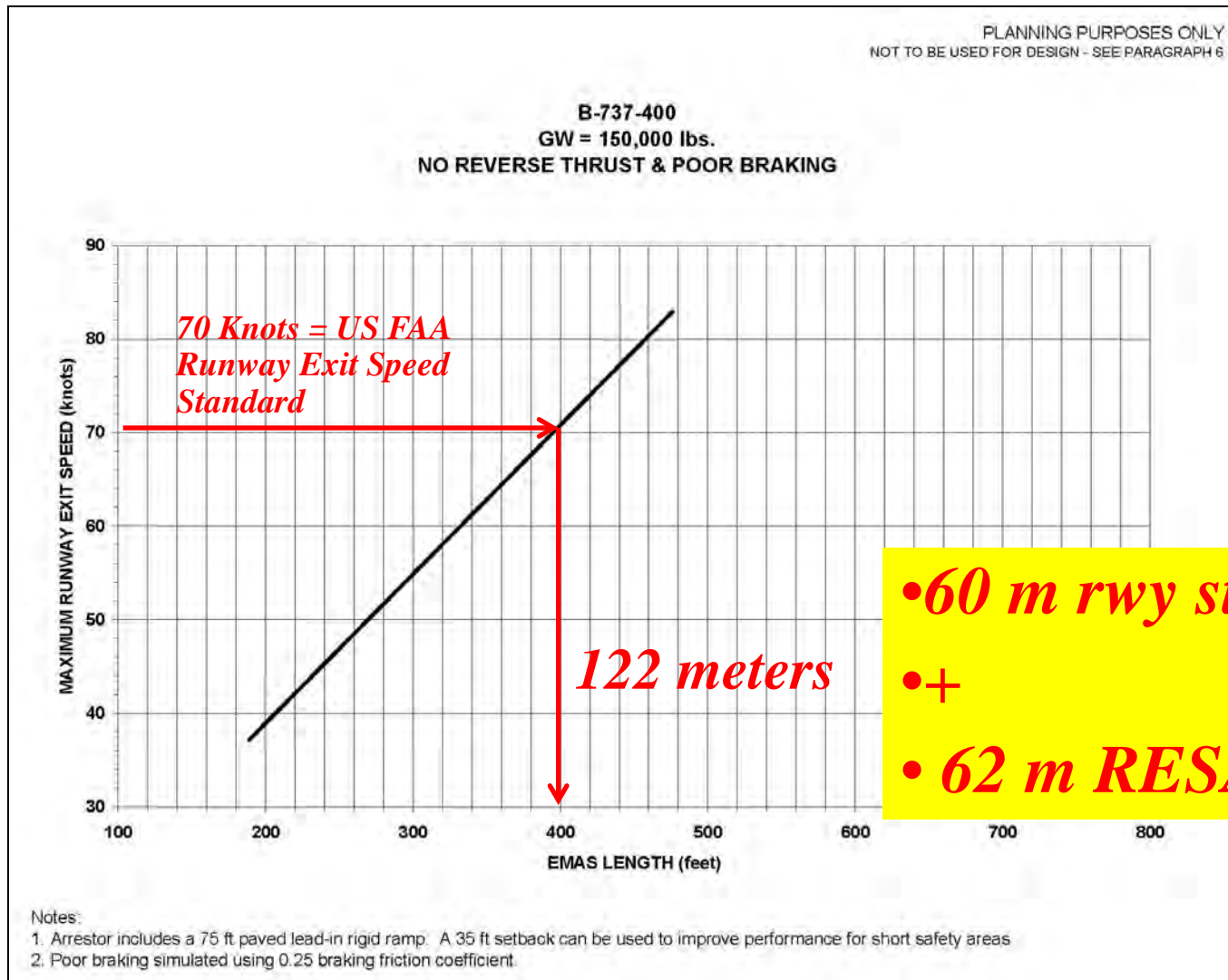
for Aircraft Overruns



•EMAS TYPICAL SECTION



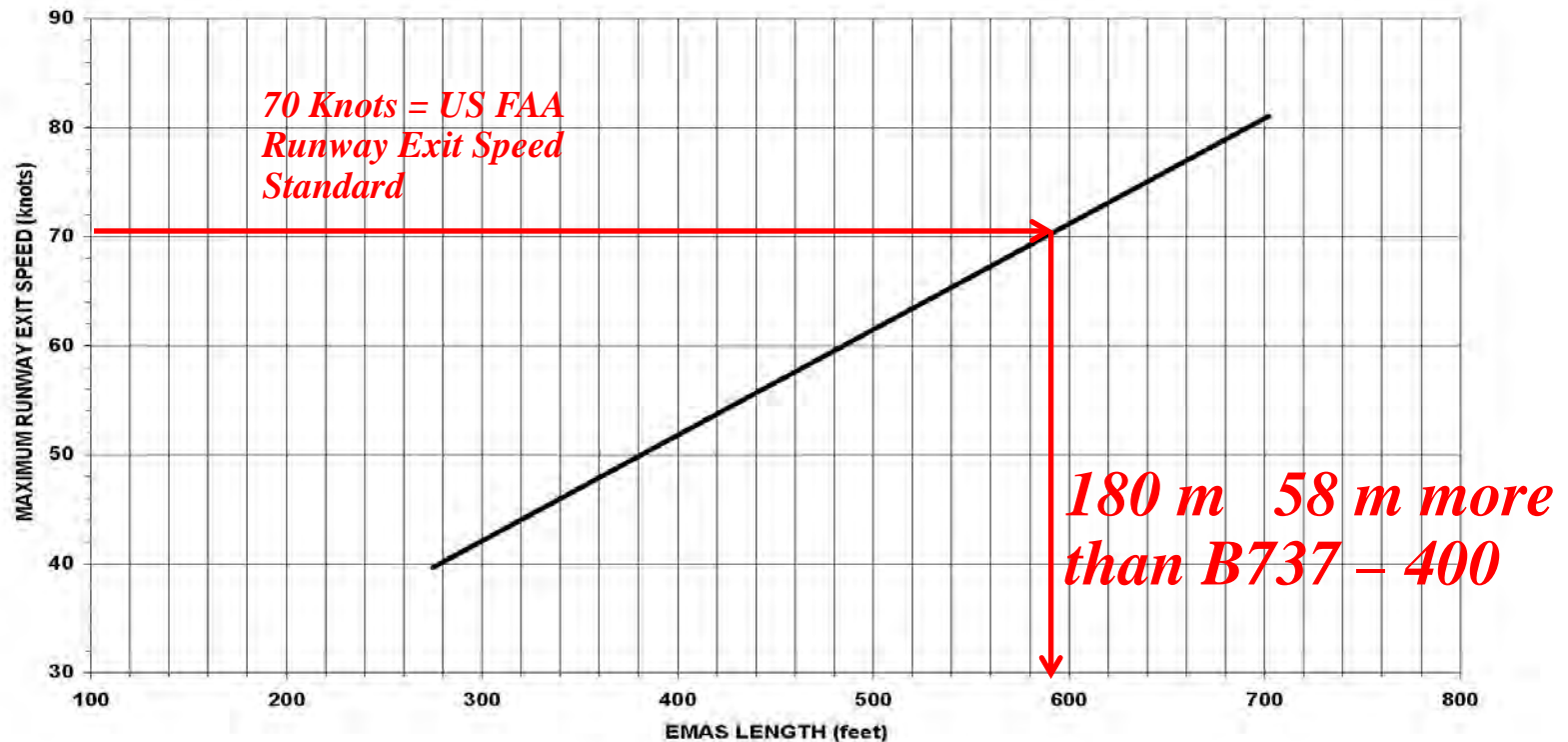
US FAA Advisory Circular 150/5220-22 - The figure illustrates the estimated EMAS stopping distance capabilities for the **Boeing 737-400**



US FAA AC 150/5220-22 - The figure illustrates the estimated EMAS stopping distance capabilities for the **Boeing 747**

PLANNING PURPOSES ONLY
NOT TO BE USED FOR DESIGN - SEE PARAGRAPH 6

B-747
GW = 875,000 lbs.
NO REVERSE THRUST & POOR BRAKING




Notes:

1. Arrestor includes a 75 ft paved lead-in rigid ramp. A 35 ft setback can be used to improve performance for short safety areas.
2. Poor braking simulated using 0.25 braking friction coefficient.

Example Group Exercise:

Install a Standard Arrestor Bed (70 Knot Exit Speed) to obtain a Standard 90 meter RESA off Rwy End 09

- Assume:
 - Runway 9/27 is 1,600 meters
 - Design airplane Boeing 737-400
 - A 75-meter Stopway is beyond Rwy 9 
 - Suitable, Flat ground beyond the stopway measures 75 m and 400 m off Rwy 27



- Step 1: How much flat land is needed for a std runway strip and a std RESA? Answer: $60 + 90 = 150$ meters.
- Step 2: How much suitable flat land do you have? Answer: **75 meters (missing 75m)**
 - Go to airlines and say ***“There is NO Stopway!!!”***
- Step 3: Because you have a Stopway, is there enough land for LDA? Answer: yes
 - Stopway is not used by LDA, hence you have 75 m. Also you have another 75 m beyond the Stopway for a total of 150 meters.
 - ***You do not reduce LDA for Rwy 27.***

- Step 4: Use EMAS chart (B737-400) to determine the length of Std EMAS. Answer: previous slide = 122 meters
- Step 5: Install the Std EMAS and START at the farthest point from the rwy.
 - Part of the EMAS is on the Stopway (45 meters)
 - $122\text{m (EMAS)} - 75\text{ m(ground)} = 47\text{m on Stopway}$
- Final Step: Reduce ASDA by 47 m
 - Old ASDA = $1600 + \text{Stopway (75)} = 1675\text{m}$
 - *New ASDA = $1675 - 47 = 1633\text{m}$*
 - *New Stopway = 33 meters*

End of Session