Significant Parts of my life

"40 Years Helping Crews to Navigate Vertically so Reduce Fuel Consumption, Noise on the Ground and Approach Accidents – with Mixed Success."

Hugh DIBLEY FRAeS, FRIN, CMILT
formerly BOAC/BAW Airbus Toulouse
Chairman Royal Aeronautical Society Toulouse Branch

1959-72 Involved motor racing as well as flying.

1973 - Started work in BOAC for fuel conservation

1974 – Developed Circular Descent Calculator, patented 1976

1975 - Instrumental in starting quiet and fuel efficient Constant Descent Approaches into LHR.

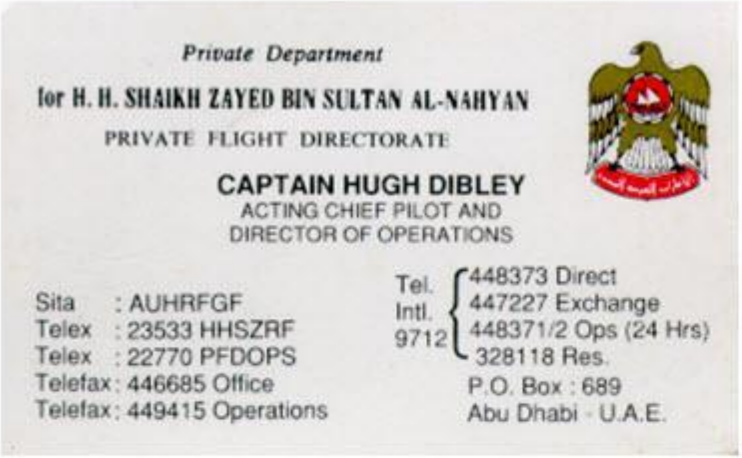
1975 - After TWA 727 CFIT accident into Washington the FAA mandated GPWS - surprised did not require airlines to fly Constant Angle Approaches when DME available.

2014 – Frustrated that CAAs not implemented in the US – Accident to DHL A300-600F in August 2013. FAA Human Factors expert – "Crews must not use Vertical Speed mode as they don't understand it."

***Accident Reports may not always find improvements in procedures and/or training that could have assisted the crew*.**

1958-92
FO Pilot Navigator
DC-7C
Britannia
Comet 4
Training Captain
Flight Manager
B707
B747
TriStar

1989-91
A/Chief Pilot
Director Operations
B747 SP
707



1991-94
Chief Pilot
Flt Tech Advisor
B747

1994-95 Airbus A340
Director Flight Operations

1995-2002 Airbus A320/A330/A340
Flight Instructor/Training Captain
Technical Pilot, Support / Flight Data Monitoring

2002 – Aviation Consultant
JAA Simulator Flight Instructor / Examiner
Airbus Training UK Ltd, and other TRTOs
Member RAeS Flight Simulation Group Committee
Chairman RAeS Toulouse Branch

Hugh Dibley's Main Aviation Activities

HPK Dibley's Motor Racing Background

1959–1962 Raced own cars and **mainly** did own maintenance

1959-60 AC Aceca Bristol

1960 Lola Formula Junior

1961 Lola Formula Junior & 1st Lola Formula 1!

1962 Lola Formula Junior

1964–1965 Raced own cars under Stirling Moss Automobile Racing Team

1964 Brabham BT8 2.5 litre Climax Sports Racing Car

1965 Lola T70 Chevrolet 6 litre / 489 bhp

1967 Raced own Camaro

1967 Chevrolet Camaro Modified Saloon

Possible to break even – on miniscule budget by current standards!

1964-74 drove

BRM, Camaro, Ferrari, Howmet, Lola, Lotus, Porsche

mainly in long distance sports car races:

Brands Hatch, Daytona, Kyalami, Le Mans, Lydden Hill, Nurburgring, Oulton Park, Rheims, Sebring, Targa Florio, Watkins Glenn

for private owners and works teams

& own Palliser single seater Formula Atlantic

1967 Targa Florio
Jackie Epstein's Lola T70GT

1967 BOAC 500 Brands Hatch
David Piper's Ferrari 275LM

1968 Brands Hatch, Le Mans, Oulton Park, Watkins Glenn
Howmet TX Gas Turbine

BOAC Boeing 707 First Officer Hugh Dibley in the cockpit of the Howmet TX jet car at Heathrow Airport London. With him is American dentist Dick Thompson. The drivers and their car travelled from the USA by BOAC Boeing 707 freighter to take part in the 1968 BOAC International 500 Race at Brands Hatch.

1970 Equalling Lydden Hill circuit record in his own Pallser Racing Design Ltd company works Formula Atlantic

1974 BA 1000 Brands Hatch
Gulf GR6 reserve driver

Drove against International competitors

366

Autosport 4 Sept 1964
Goodwood
Tourist Trophy
STARTING GRID

Graham Hill (Ferrari 330P) 1 m. 24.6 s.

Jim Clark (Lotus-Ford 30) 1 m. 23.8 s.

Bruce McLaren (Cooper-Oldsmobile) 1 m. 23.2 s.

Denis Hulme (Brabham-Climax BT8) 1 m. 25.2 s.

Hugh Dibley (Brabham-Climax BT8) 1 m. 24.6 s.

David Piper (Ferrari 250LM) 1 m. 26.6 s.

Frank Gardner (Elva-B.M.W. Mk. 7) 1 m. 26.6 s.

Trevor Taylor (Elva-B.M.W. Mk. 7) 1 m. 26.0 s.

5 F1 World Champions

John Coundley (Lotus-Climax 19) 1 m. 26.8 s.

Roger [illegible] (Brabham-Climax BT8) 1 m. 26.6 s.

Tony Lanfranchi (Elva-B.M.W. Mk.7) 1 m. 28.0 s.

Phil Hill (Shelby Cobra) 1 m. 27.4 s.

Dan Gurney (Shelby Cobra) 1 m. 27.2 s.

Roy Salvadori (Shelby Cobra) 1 m. 28.0 s.

Jack Sears (Shelby Cobra) 1 m. 28.0 s.

Innes Ireland (Ferrari GTO) 1 m. 28.4 s.

John Surtees (Ferrari GTO) 1 m. 28.4 s.

Bob Olthoff (Shelby Cobra) 1 m. 28.4 s.

Tony Maggs (Ferrari GTO) 1 m. 29.6 s.

Mike Salmon (Aston Martin DB4GT) 1 m. 28.6 s.

Peter Lumsden (Jaguar E) 1 m. 30.6 s.

Peter Sutcliffe (Jaguar E) 1 m. 30.6 s.

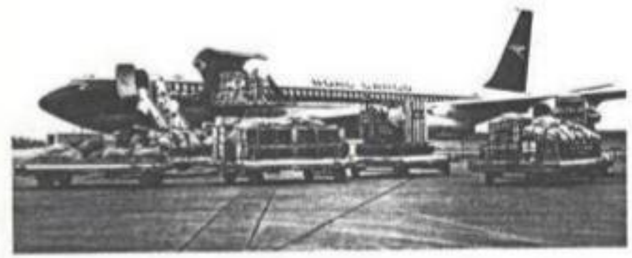
Richie Ginther (Ferrari GTO) 1 m. 30.2 s.

Roger Mac (Jaguar E) 1 m. 34.6 s.

David Hobbs (Lotus-Ford 23) 1 m. 31.8 s.

And did win some races!

Motor Racing fitted well with BOAC. 1967-1974 entered in all BOAC International Sports Car Races at Brands Hatch

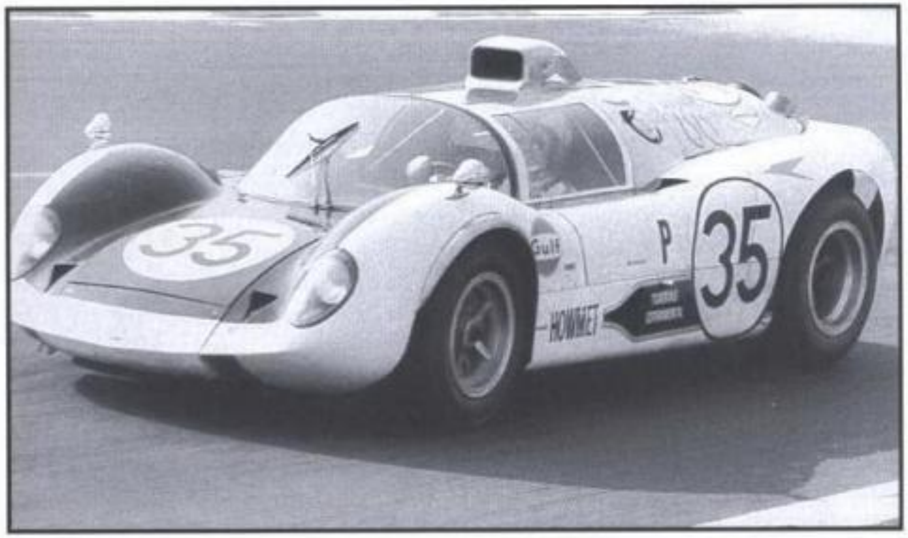


A large consignment of drilling rig equipment for Teheran being loaded onto a BOAC Boeing 707-336C freighter. The load, which left on 1 April was one of the largest single consignments to be carried by BOAC and filled the aircraft to its capacity of nearly 40 tons.

BOAC Boeing 707 First Officer Hugh Dibley in the cockpit of the Howmet TX jet car at Heathrow Airport London. With him is American dentist Dick Thompson. The drivers and their car travelled from the USA by BOAC Boeing 707 freighter to take part in the 1968 BOAC International 500 Race at Brands Hatch.

Motor Racing fitted well with BOAC. 1967-1974 entered in all BOAC International Sports Car Races at Brands Hatch

Including the Howmet TX Gas Turbine car at the BOAC 500 at Brands Hatch, then at Oulton Park, Watkins Glenn & in September 1968 Le Mans



The Howmet TX of Dick Thompson and Hugh Dibley at Brands Hatch in 1968
Photo: Ferret Fotographics

Formation of Palliser Racing Design 1967-72

Bob Winkelmann, San Francisco in 1968 bought and paid for 3 US Formula B Cars

In 1969 Bob Winkelmann ordered 20 Formula Fords

Marketing strategy was to export cars to one outlet in the US

UK market supplied when US demand disappeared

Factory set up at North Street, Clapham, Central London

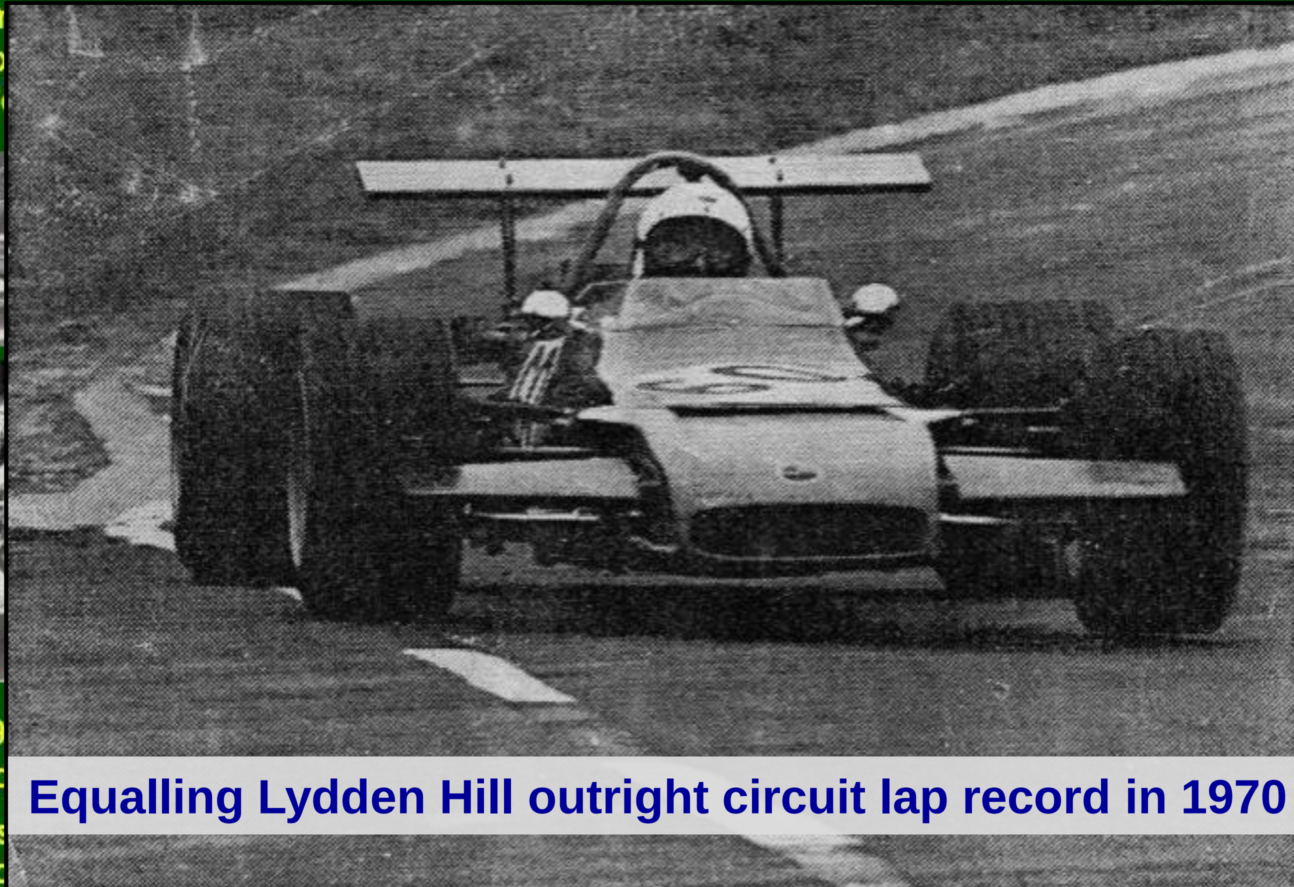
Nearly 100 cars produced. Championships won in UK, USA and South Africa. Wound up in 1972

H Dibley concentrated on aircraft fuel conservation and environmental noise reduction

Formation of Palliser Racing Design 1967-72

Factory set up at North Street, Clapham, Central London

Bob Winkeln
in 1968 bo
3 US F



Hugh Dibley's Palliser cars have been achieving numerous successes in Formula Ford events this season. Here "the boss" is seen practising what he preaches in his Formula Atlantic prototype (See Editorial) *Equalling Lydden Hill outright circuit record in1970*

In 1969
ordered

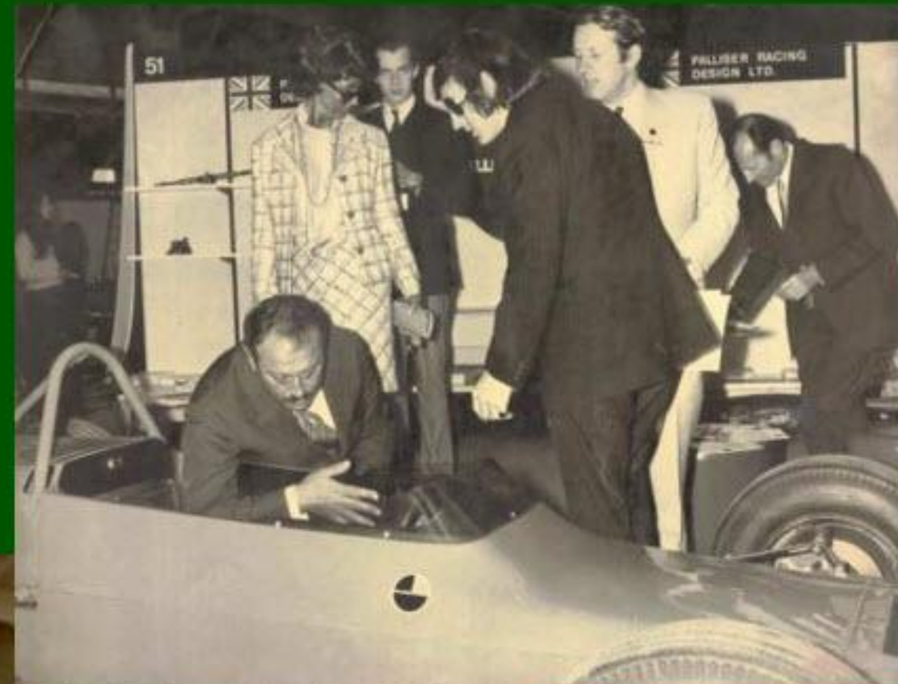
Marketing s
cars to c

UK marke
dema

Nearly 10 ... in 1972

H Dibley concentrated on aircraft fuel conservation and environmental noise reduction

1970 Nice Racing Car Show



As bilingual in French assisted with Palliser sales at Nice Racing Car Show

But the domestic situation changed – Especially after our twins were born in 1971

But after became pregnant became unacceptably nervous for me to continue driving.

Swedish drivers Ronnie Pedersen & Jo Bonnier killed

After the first “Fuel Crisis” in 1973
assisted in BOAC’s Fuel Conservation Campaign
(helped BOAC to remain profitable until 1977!)

Changed from Fixed to variable Long Range Cruise Speeds, etc
Pre-Flight Management Systems – produced manual Flight Data Cards:

TriStar

FL 330

MAXIMUM — CONTINUOUS IAS	EPR	Max TAT	NORM CLIMB M	EPR	
300 KN	581	-3°	·84	582	-3°
250 KN	605	-11°	·81	574	-6°
200 KN	621	-15°	·78	581	-7°

A/C Weight (1000kg)	SPEED M	SPEED IAS (kts)	CRZ EPR	LEVEL OFF FL 2ENG	LEVEL OFF FL 1ENG	LOW SPEED BUFFET
190	0·84	300	535	152		267
185	0·835	298	519	162		262
180	0·83	296	508	173		257
175	〃	〃	499	183		252
Climb FL 350 (Opt 174000 kg; Max 182000 kg)						
170	〃	〃	489	192		247
165	〃	〃	476	202		242
160	〃	〃	469	212	20	238
Climb FL 370 (Opt 159000 kg; Max 167000 kg)						
155	〃	〃	460	222	37	232
150	↓	↓	451	231	52	227
145	0·80	285	430	240	68	222
140	0·79	281	418	250	83	216
135	0·78	277	406	260	97	212
130	0·77	273	394	270	111	205
125	0·76	269	381	280	127	201
120	0·75	265	369	290	142	196

707

British airways 707-336 90,000KGS **DESCENT/APPROACH FUEL**

DISTANCE TO TOUCHDOWN	STANDARD DESCENT/APPROACH CONFIGURATION	STANDARD DESCENT/APPROACH FUEL (TIME)	200KN FLAP 0° 6000 FT CONFIGURATION	200KN FLAP 0° 6000 FT FUEL (TIME)	170KN FLAP 14° 4500 FT CONFIGURATION	170KN FLAP 14° 4500 FT FUEL (TIME)
150 NM	FL390 M·80	1200 KG (28)	6000 FT 200 KN FLAP UP	3300 KG (42)	4500 FT 170 KN FLAP 14°	5100 KG (51)
125 NM	FL330 280 KN	1100 KG (25)		2700 KG (36)		4200 KG (47)
100 NM	FL270 280 KN	1000 KG (22)		2200 KG (29)		3400 KG (34)
80 NM	FL220 280 KN	900 KG (18)		1800 KG (23)		2700 KG (27)
60 NM	FL160 280 KN	850 KG (15)		1400 KG (18)		2100 KG (21)
50 NM	FL130 280 KN	800 KG (13)		1200 KG (15)		1700 KG (18)
40 NM	FL100 280 KN	750 KG (11)		1000 KG (12)		1400 KG (14)
30 NM	8000 FT 250 KN	700 KG (10)	↓	800 KG (10)		1100 KG (11)
20 NM	6000 FT 200 KN FLAP 0 GEAR UP	600 KG (7)	6000 FT 200 KN FLAP 0 GEAR UP	600 KG (7)	↓	700 KG (8)
15 NM	4500 FT 170 KN FLAP 14° GEAR UP	550 KG (6)	4500 FT 170 KN FLAP 14° GEAR UP	550 KG (6)	4500 FT 170 KN FLAP 14° GEAR UP	550 KG (6)
10 NM	3000 FT 160 KN FLAP 25° GEAR UP	400 KG (5)	3000 FT 160 KN FLAP 25° GEAR UP	400 KG (5)	3000 FT 160 KN FLAP 25° GEAR UP	400 KG (5)
5 NM	1500 FT 150 KN FLAP 50° GEAR DOWN	250 KG (2)	1500 FT 150 KN FLAP 50° GEAR DOWN	250 KG (2)	1500 FT 150 KN FLAP 50° GEAR DOWN	250 KG (2)

707

B707 -336 **APPROACH / HOLD**

FUEL BURN WT. CORRN	V_{REF} FLAP 50°	MIN. SPEED FLAP 14°	MIN. SPEED FLAP 0°	AIRCRAFT WEIGHT '000 KGS	CRUISE SPEED FL150	HOLDING MIN. DRAG SPEED	HOLDING OPT. ALT	HOLDING F/F ISA KG/HR
+6%	143	173	203	120	335	236	FL260	5400
+3%	141	171	201	115	328	232	FL260	5200
0	138	168	198	110	322	226	FL260	4900
-3%	134	164	194	105	315	221	FL270	4600
-6%	131	161	191	100	308	216	FL270	4400
-10%	128	158	188	95	301	211	FL280	4200
-13%	125	155	185	90	293	205	FL280	4000
-17%	121	151	181	85	285	199	FL290	3700
-20%	118	148	178	80	277	193	FL300	3500

FUEL SAVING BY ALTITUDE DIVERSION	
FROM FL400	2500 KG
FL350	2200 KG
FL300	1900 KG
FL250	1600 KG
FL200	1300 KG
FL150	1000 KG
FL100	600 KG

DIVERSION FUEL

FUEL TO ALTERNATE ______		KG
+ RESERVE (MIN. 3200 KG)	+	KG
DIVERSION FUEL FROM OVERSHOOT	=	KG
FUEL FOR APPROACH (NM)	+	KG
APPROACH & DIVERT FUEL FROM HOLD	=	KG
SAVING FROM OVERSHOOT FUEL BY ALTITUDE DIVERSION —		KG
ALTITUDE DIVERSION FROM FL__	=	KG

Word Processors & Colour printers allowed total performance on 1 sheet

Air Hong Kong B747-249F JT9D-7Q 2 Packs On

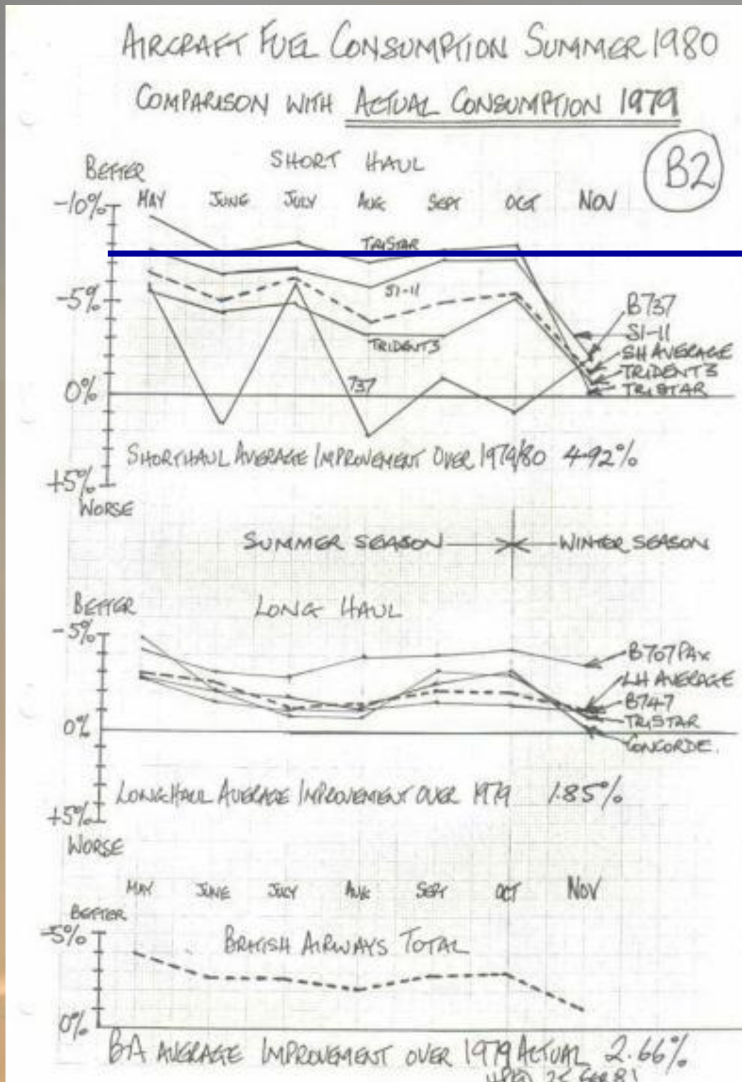
Long Range Cruise

Mach/IAS
EPR 1.3g Buf

Dump 6 pmp	37 min	31 min	27 min	23 min	19 min	15 min	10 min	6 min	2 min	2 min	6 min	10 min	-	-	-	-	-	2.4T / min	6 pmp Dump
Time 4 pmp	54 min	48 min	42 min	35 min	29 min	22 min	16 min	10 min	3 min M	LW 3min	10 min	16 min	22 min	29 min	35 min	42 min	48 min	1.6T / min	4 pmp Time
2 eng Max	Nett Perf MCT	FL32 05	FL47 22	FL61 38 07	FL75 53 25	FL91 69 43	FL106 84 61	FL121 100 79	FL137 115 98	FL152 132 112	FL166 148 129	FL181 164 145	FL195 180 162	FL211 197 179	FL225 213 197	FL241 228 213	Nett Perf	Add FL30 for Gross	2 eng Max
3 eng Max	<ISA+10° +15° +20°	FL213 186 152	FL227 201 168	FL240 216 186	FL254 230 208	FL268 244 216	FL281 258 232	FL294 272 247	FL307 287 263	FL320 302 279	FL333 317 294	FL344 332 310	FL354 346 327	FL363 356 343	FL372 366 356	FL381 374 366	3 Eng LRC	Add FL10 for DDwn	3 eng Max
Weight	**370.0**	**360.0**	**350.0**	**340.0**	**330.0**	**320.0**	**310.0**	**300.0**	**290.0**	**280.0**	**270.0**	**260.0**	**250.0**	**240.0**	**230.0**	**220.0**	**210.0**	**200.0**	**Tonnes**
Flap 10	175/185	172/182	168/179	164/176	160/172	156/169	152/166	147/162	143/159	139/156	136/154	132/152	130/150	130/150	130/150	130/150	130/150	Flap 10	VR/V2
Flap 20	168/178	165/175	161/172	157/169	153/165	149/162	146/159	141/155	137/152	133/149	130/147	130/145	130/143	130/143	130/143	130/143	130/143	Flap 20	VR/V2
Climb	349 350	347 295	344 290	341 285	338 280	336 275	333 270	330 264	327 258	324 252	322 247	319 242	316 237	314 233	311 228	308 224	Climb:	Normal	Max Gradient
Vmd	311	307	303	299	295	291	286	282	277	272	267	263	257	253	248	243	Vmd & Max Rate Climb Speed		
4 eng Max	<ISA+10°/bft +15° +20°	FL328 bft 321 303	FL334 bft 330 315	FL341 bft 338 324	FL348 bft 347 333	FL353 bft 353 342	FL361 bft 361 351	FL367 bft 367 359	FL374 bft 374 367	FL382 bft 382 375	FL389 bft 389 382	FL397 bft 397 390	FL405 bft 405 398	FL412 bft 412 406	FL422 bft 422 414	FL431 bft 431 422	FL441 bft 441 432	FL450 bft 450 442	4 eng Max
4 eng Opt	4 eng Max	Optimum	FL303	FL309	FL316	FL323	FL329	FL337	FL344	FL351	FL359	FL367	FL376	FL384	FL393	FL404	FL414	FL424	4 eng Opt
FL450 Opt 180.0	1.3g 200.0 + 15° 200.0 +20° 192.0	200.0 Step FL40																.847/230 1.55 228	FL450 ISA -57°C
FL430 Opt 196.0	1.3g 221.0 + 15° 221.0 +20° 212.0	215.0 Step FL40														.847/241 1.55 240	.847/241 1.48 230	199.0 1.8g Buffet	FL430 ISA -57°C
FL410 Opt 215.0	1.3g 244.0 + 15° 244.0 +20° 235.0	232.0 Step FL40											.846/252 1.59 ---	.847/252 1.53 247	.847/252 1.47 237	.848/253 1.42 230	.847/244 1.53 222	220.0 1.8g Buffet	FL410 ISA -57°C
FL390 Opt 234.0	1.3g 269.0 +15° 269.0 +20° 260.0	255.0 Step FL40									.847/264 1.56 265	.847/264 1.51 255	.848/264 1.46 245	.848/264 1.41 238	.847/264 1.37 231	.846/264 1.33 224	.843/263 1.30 218	241.0 1.8g Buffet	FL390 ISA -57°C
FL370 Opt 257.0	1.3g 296.0 +15° 296.0 +20° 287.0	281.0 Step FL40						.846/277 1.58 280	.847/277 1.53 268	.847/277 1.48 261	.848/277 1.43 254	.847/277 1.39 247	.847/277 1.39 240	.845/276 1.33 233	.843/276 1.29 227	.840/275 1.27 221	.835/273 1.24 215	267.0 1.8g Buffet	FL370 ISA -57°C
FL350 Opt 283.0	1.3g 326.0 +15° 326.0 +20° 312.0	308.0 Step FL40			.846/290 1.58 ---	.847/290 1.53 283	.847/290 1.49 275	.848/290 1.45 267	.848/290 1.41 262	.847/290 1.37 255	.846/290 1.34 249	.845/289 1.31 243	.842/288 1.29 236	.839/287 1.26 230	.835/286 1.24 224	.829/284 1.21 218	.823/282 1.19 213	293.0 1.8g Buffet	FL350 ISA -55°C
FL330 Opt 310.0	1.3g 358.0 +15° 350.0 +20° 334.0	338.0 Step FL40	.847/303 1.53 294	.847/303 1.49 287	.848/303 1.45 262	.848/303 1.41 275	.847/303 1.38 268	.847/303 1.35 262	.845/303 1.33 256	.844/302 1.30 250	.841/301 1.27 245	.838/300 1.25 239	.834/299 1.23 233	.828/297 1.21 227	.822/294 1.19 222	.815/292 1.17 216	.806/288 1.15 210	324.0 1.8g Buffet	FL330 ISA -51°C
FL310 Opt 339.0	1.3g 383.0 +15° 373.0 +20° 356.0	.848/317 1.44 292	.848/317 1.42 288	.847/317 1.38 281	.847/317 1.35 275	.846/316 1.33 269	.844/316 1.31 263	.842/315 1.28 2	.839/314	.836/313	.832/311	.827/309	.821/307	.814/304	.806/301	.797/298	.786/294 1.12 209	351.0 1.8g Buffet	FL310 ISA -47°C
FL290 Opt 372.0	.847/331 1.37 294	.847/331 1.35 287	.846/330 1.33 281	.844/330 1.31 276	.842/329 1.29 271	.840/328 1.27 265	.837/327 1.25 260	.833/3 1.23 2									.764/297 1.09 208	366.0 1.8g Buffet	FL290 ISA -43°C
FL280	.846/337 1.34 292	.845/337 1.32 285	.843/336 1.30 279	.841/336 1.28 274	.839/335 1.26 269	.836/334 1.24 264	.832/332 1.22 258	.828/3 1.21 2									.752/299 1.08 207	.739/293 1.06 203	FL280 ISA -41°C
FL270	.844/344 1.30 289	.842/343 1.28 283	.840/342 1.27 277	.837/341 1.25 273	.834/340 1.23 267	.830/338 1.22 262	.826/337 1.20 257	.821/3 1.19 2									.740/300 1.07 207	.727/294 1.06 203	FL270 ISA -39°C
FL260	.841/350 1.27 287	.839/349 1.26 281	.836/348 1.24 276	.832/346 1.23 271	.829/345 1.21 266	.824/343 1.20 261	.819/341 1.18 256	.814/3 1.17 2									.728/301 1.06 206	.714/295 1.05 202	FL260 ISA -37°C
FL250	.837/356 1.25 285	.834/354 1.23 279	.831/353 1.22 274	.827/351 1.20 270	.822/349 1.19 265	.817/347 1.17 260	.812/345 1.16 255	.805/3 1.15 2									.715/302 1.05 206	Copyright HPKD	FL250 ISA -35°C
FL150	.750/386 1.08 272	.749/385 1.07 267	.741/381 1.07 263	.733/377 1.06 259	.725/372 1.05 255	.716/368 1.05 250	.707/363 1.04 246	.697/358 1.03 242	.687/352 1.03 238	.676/347 1.02 234	.665/341 1.02 231	.654/335 1.01 226	.642/328 1.01 221	.629/322 1.01 217	.617/315 1.00 213	.603/308 1.00 209	.589/300 1.00 204	74-249-7Q hp310 960529	FL150 ISA - 15°C
Weight	**370.0**	**360.0**	**350.0**	**340.0**	**330.0**	**320.0**	**310.0**	**300.0**	**290.0**	**280.0**	**270.0**	**260.0**	**250.0**	**240.0**	**230.0**	**220.0**	**210.0**	**200.0**	**Tonnes**
Vref	185/ -	182/ -	178/ -	176/ -	172/ -	169/(163)	166/1(59)	163/(156)	160/(153)	157/150	154/146	150/143	147/140	143/137	140/134	136/130	133/127	129/124	Flap 25/30
Auto Brake	Distance from touch-down in zero wind at Flap 25 Vref + 5	Brake Setting	MINimum	Wet or Dry		3000m	2900m	2850m	2700m	2550m	2450m	2300m	2200m	2100m	2000m	1900m	1800m	MIN wet/dry	Auto Brake
			MEDium	Wet or Dry		2150m	2050m	2000m	1900m	1850m	1750m	1650m	1600m	1500m	1450m	1400m	1300m	MED wet/dry	
			MAXimum	WET r/w		1950m	1900m	1850m	1750m	1700m	1600m	1500m	1450m	1400m	1300m	1250m	1200m	MAX WET	
			MAXimum	DRY r/w		1500m	1450m	1400m	1350m	1300m	1250m	1150m	1100m	1050m	1000m	950m	900m	MAX DRY	
Descent	Normal (Gradient 315 ft/nmile) Econ (Gradient 300ft/nmile) *Still Air*								305 280	300 275	295 266	285 260	285 260	280 256	270 251	260 246	250 243	245 240	Descent

Data taken from aircraft flight manuals displayed clearly to crews provided most of the savings claimed by Flight Management Systems

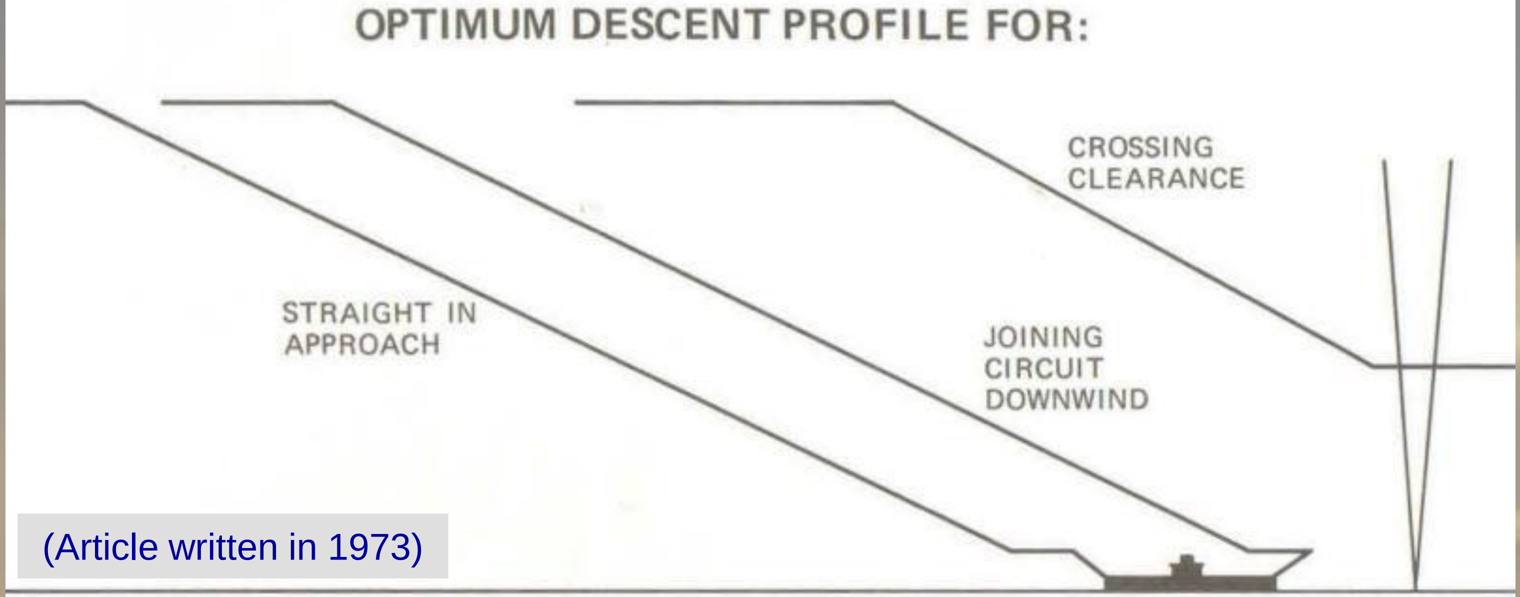
After re-merger with BEA to form BA – in 1979 became Head of Operational Fuel Conservation – these measures instantly saved 8% on similar types



Immediate fuel saving of 8% on short-haul TriStars

(Rolls-Rolls spends approximately 1B€ per year on research for a 1% improvement in fuel efficiency.)

Despite Aircraft being most efficient at Altitude Guidance for Fuel Efficient Descents was lacking Relying on the Crews' Mental Arithmetic -



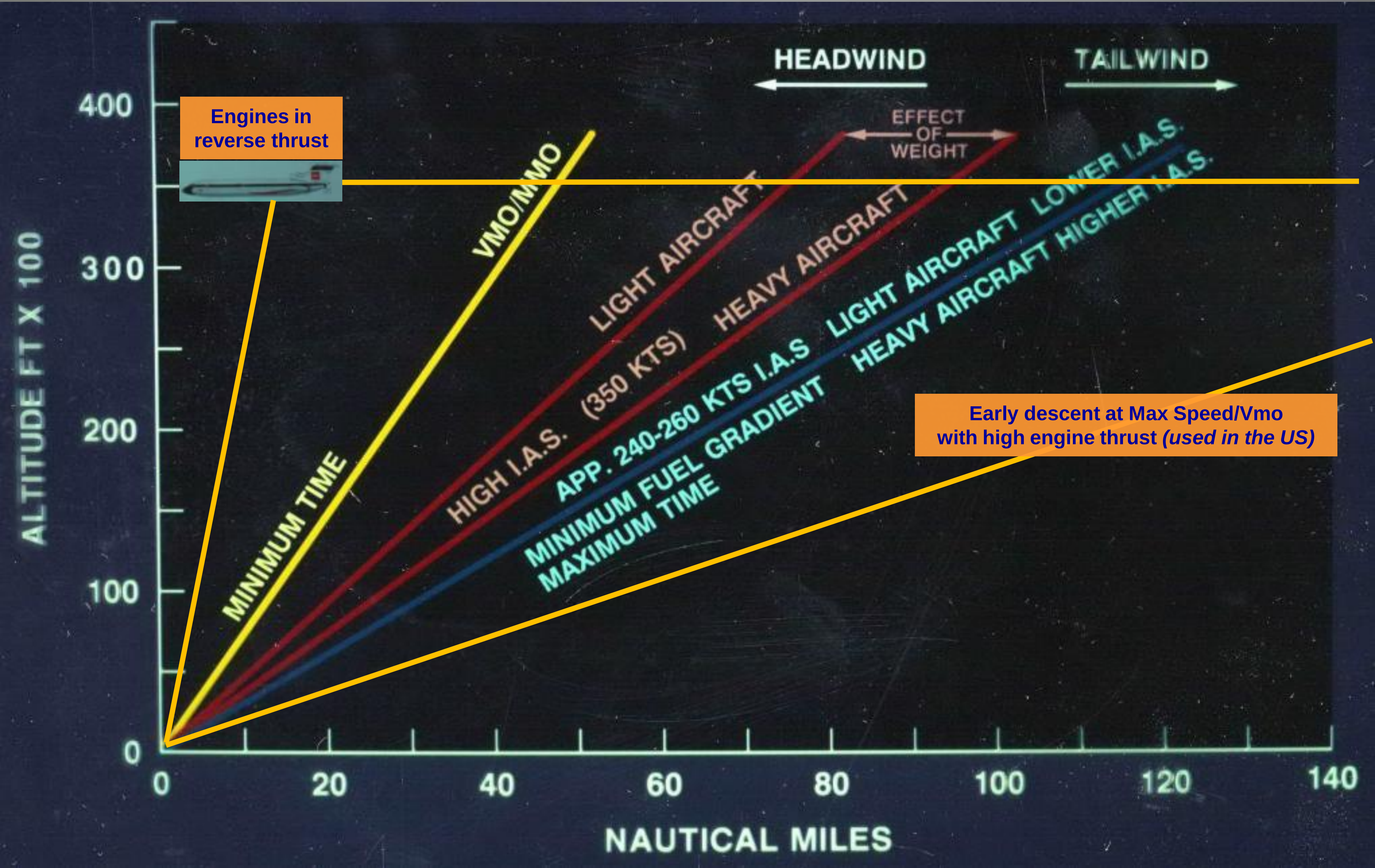
(Article written in 1973)

THERE IS NO TRADE BETWEEN FUEL/TIME ON A POOR DESCENT

EFFECTS OF OPERATION AWAY FROM OPTIMUM:

1. WASTE OF FUEL = £ + (POLLUTION) ETC. (£n00,000 PER ANNUM)
2. WASTE OF TIME = £ (COMPONENT TIME) + PAX. RELATIONS
3. EXCESS NOISE = PUBLIC NUISANCE = RESTRICTION OF OPERATIONS
4. LACK OF EFFICIENCY IN ATC SYSTEM
5. PAX COMFORT (POWER/ATTITUDE CHANGES, SPOILER RUMBLE, ETC.)

Crews' Profiles Could be Grossly Inefficient -



Education - Best Descents at Optimum Speed & Idle Thrust

ALTITUDE/CONFIGURATION FUEL BURN COMPARISON (330,000 LB/150,000 KG AIRCRAFT)

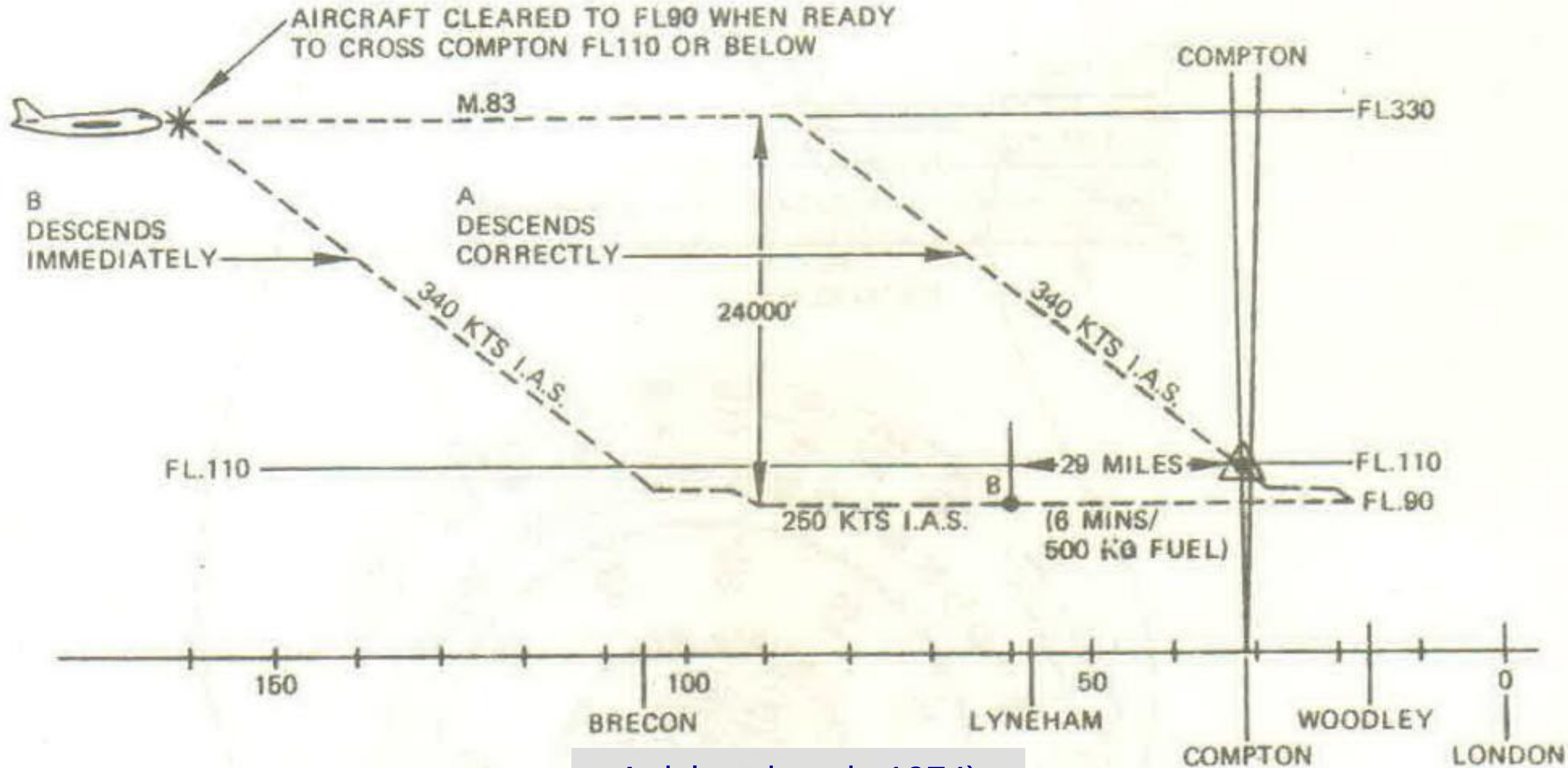
ALT:	AIRSPEED NM/TONNE % FROM 23% FL 370	CONFIGURATION	FUEL AND TIME FOR 10 NMS	FUEL AND DISTANCE FOR 1 MIN
FL370	.83/270 KNS 72 NMS - - -	LEVEL CLEAN	300 LBS/ 140 KGS 75 SECS	250 LBS/ 110 KGS 8 NMS
LF100	300 KNS 47 NMS + 150%	LEVEL CLEAN	450 LBS/ 210 KGS 105 SECS	270 LBS/ 120 KGS 6 NMS
FL50	210 KNS 40 NMS + 180%	LEVEL CLEAN	550 LBS/ 250 KGS 160 SECS	210 KGS 100 KGS 4 NMS
FL50	210 KNS 31 NMS + 230%	LEVEL FLAP 4°	700 LBS/ 320 KGS 160 SECS	260 LBS/ 120 KGS 4 NMS
FL50	160 KNS 18 NMS + 400%	LEVEL FLAP 22° GEAR DOWN	1200 LBS/ 550 KGS 220 SECS	330 LBS/ 150 KGS 3 NMS
FL200 DESCENDING	320 KNS 210 NMS - 65%	DESCENT CLEAN FLIGHT IDLE	100 LBS/ 50 KGS 85 SECS	70 LBS 33 KGS 7 NMS
FL30 DESCENDING	170 KNS 90 NMS - 20%	3° GLIDESLOPE FLAP 10 FLT IDLE	250 LBS/ 110 KGS 140 SECS	70 LBS/ 33 KG 3 NMS
FL30 DESCENDING	150 KNS 20 NMS + 350%	3° GLIDESLOPE FLAP 42° GEAR DOWN	1000 LBS/ 480 KGS 230 SECS	300 LBS/ 130 KGS 2.5 NMS

Baseline Cruising at 37,000ft

Maximum Fuel Consumption

Minimum Fuel Consumption

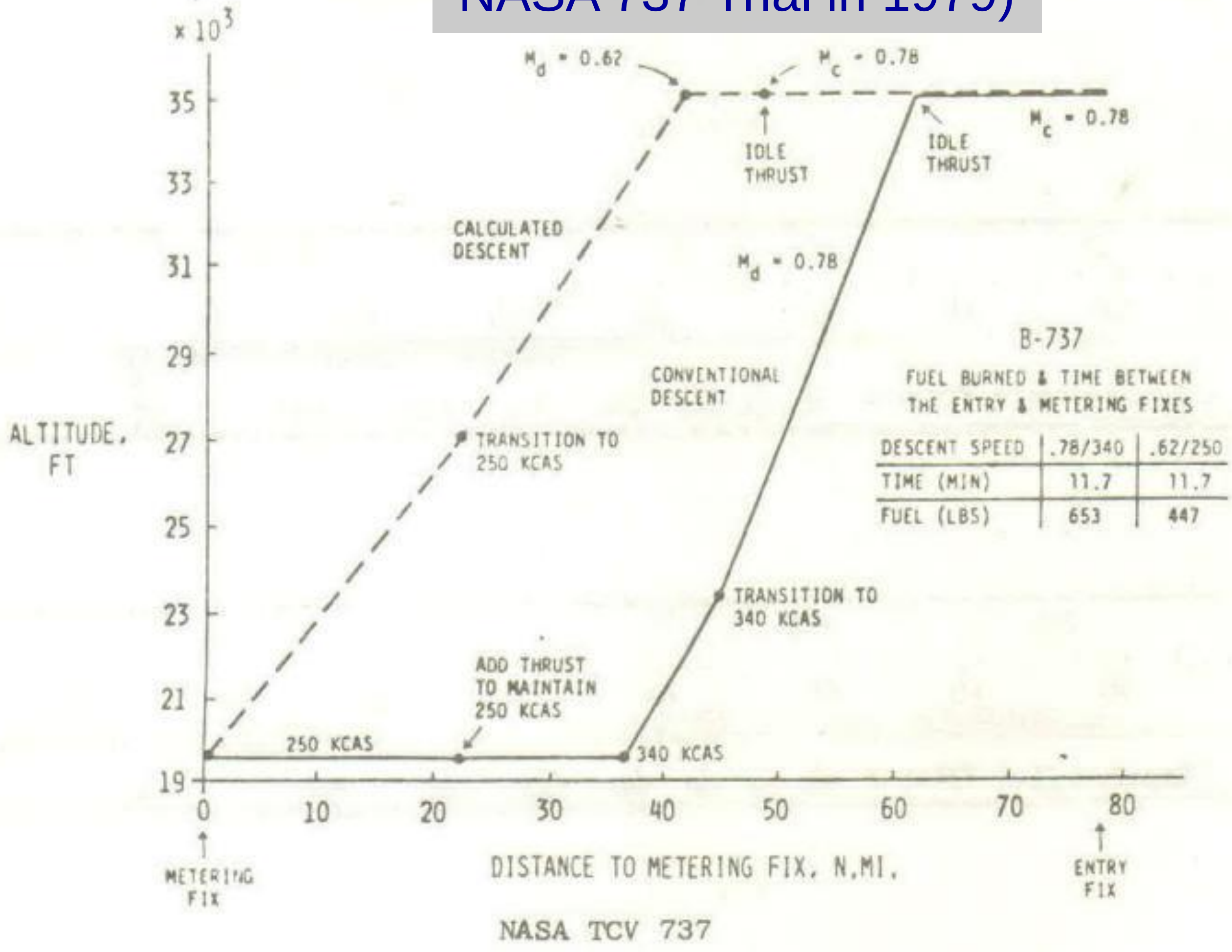
Crews' Technique for Following the Correct Profile Using Mental Arithmetic was Usually Inefficient – Descending Early when cleared to be Sure of Compliance



Article written in 1974)

Confirmed by NASA when Introducing Profile Descents

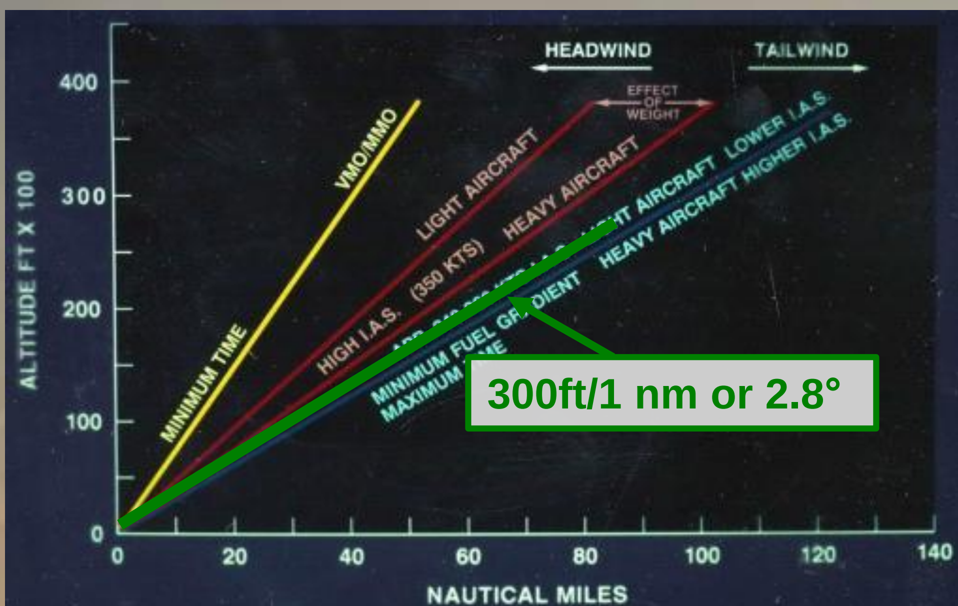
NASA 737 Trial in 1979)

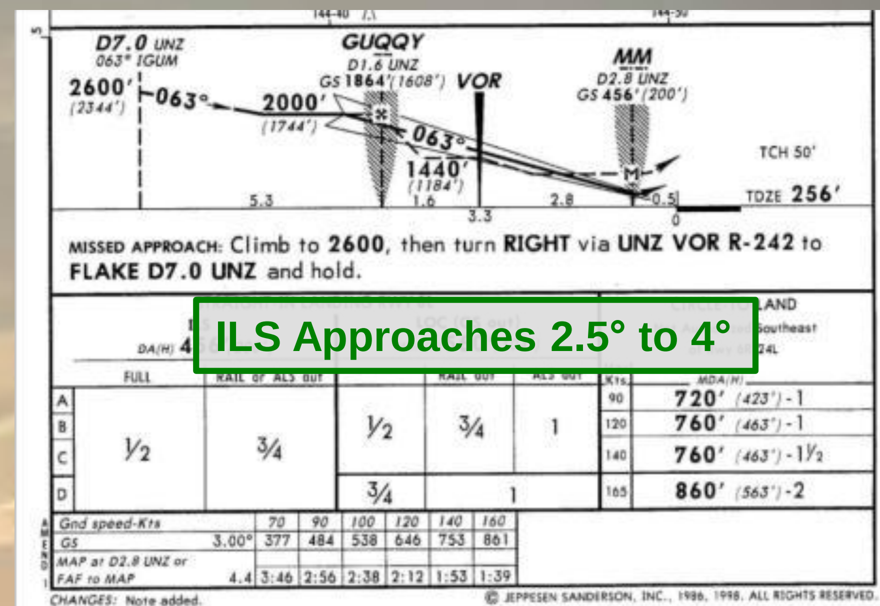


A Comparison of a Conventional Descent Profile Typically Flown and a Descent Profile Calculated by the Flight Management Descent Algorithm.

Most Aircrafts' Optimum Descent Gradient is about 3° From Altitude and During Final Instrument Approach

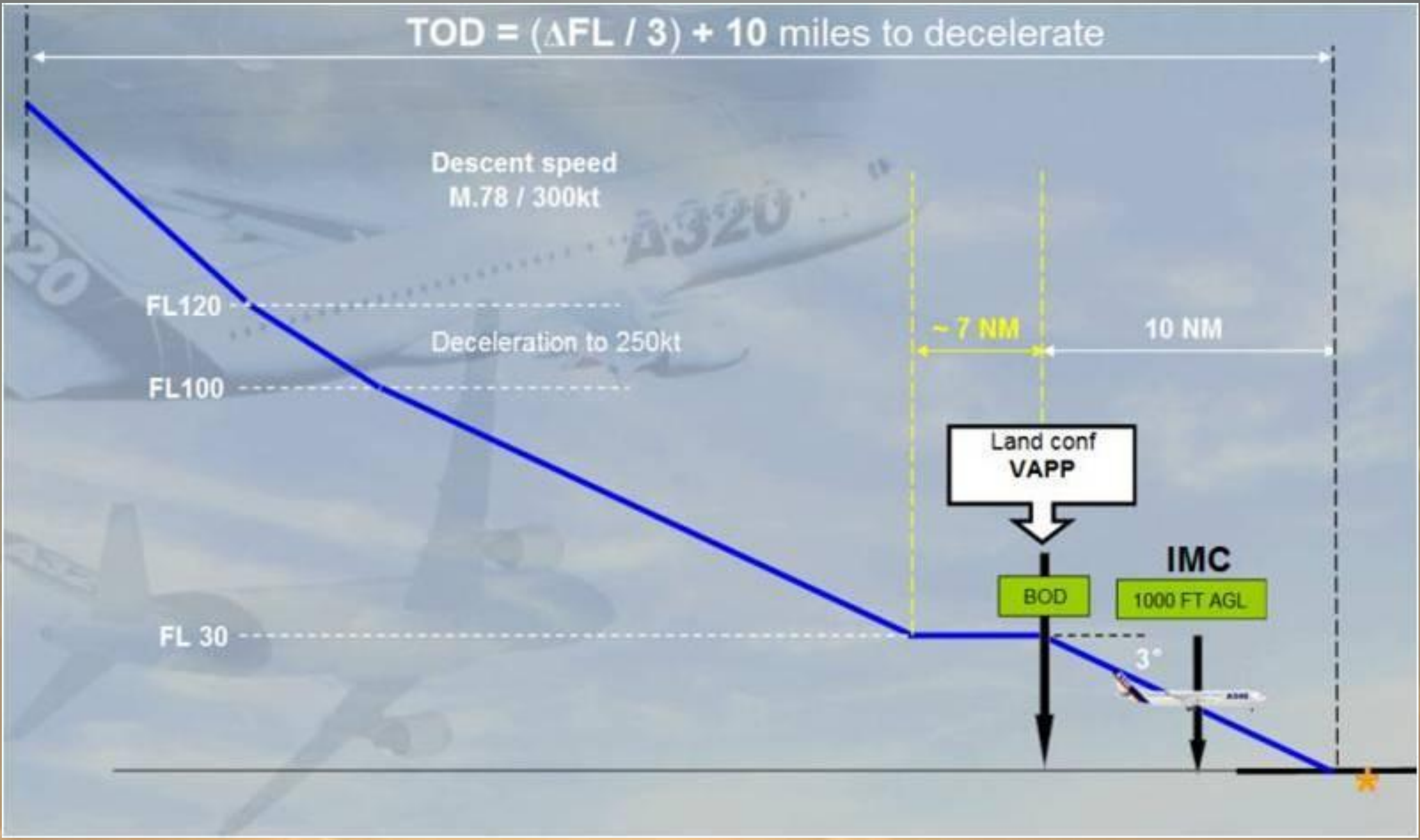
Due to Anglo-Saxon Units – Distance in Nautical miles and Height in Feet Height (feet) on approx 3° Profile = Distance (nm) x 300





3 Times Table used mentally for Rough Descent Guidance "I can do that in my head"

Airbus Training slide - Entry Level Training Pilots' Course

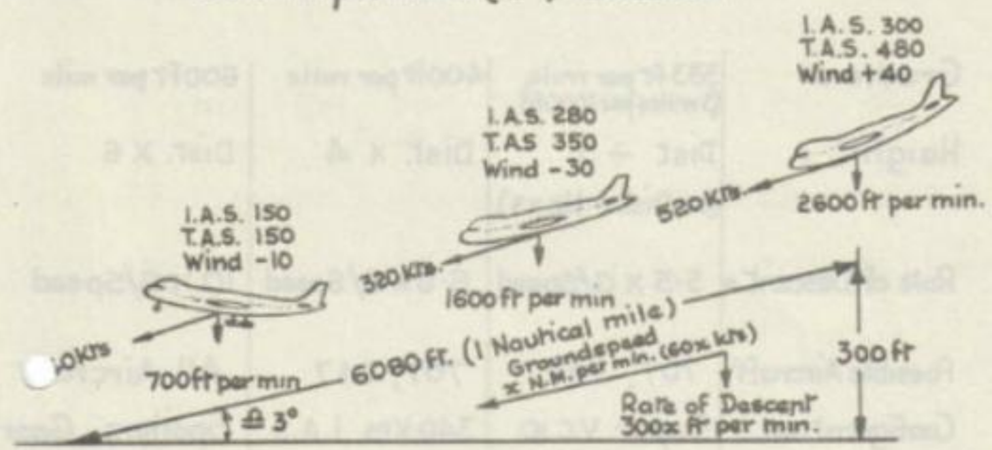


BOAC Safety Digest

AUGUST 1973
Issue 127

(Article written in 1973)

300 Ft. per mile (3°) Gradient



Height to lose (00 feet) = Distance to run (N. Miles) × 3.

Rate of Descent (ft. per min.) ALWAYS = 5 × Groundspeed (Knots)

(or ½ Groundspeed × 10)

Examples of other suitable Gradients.

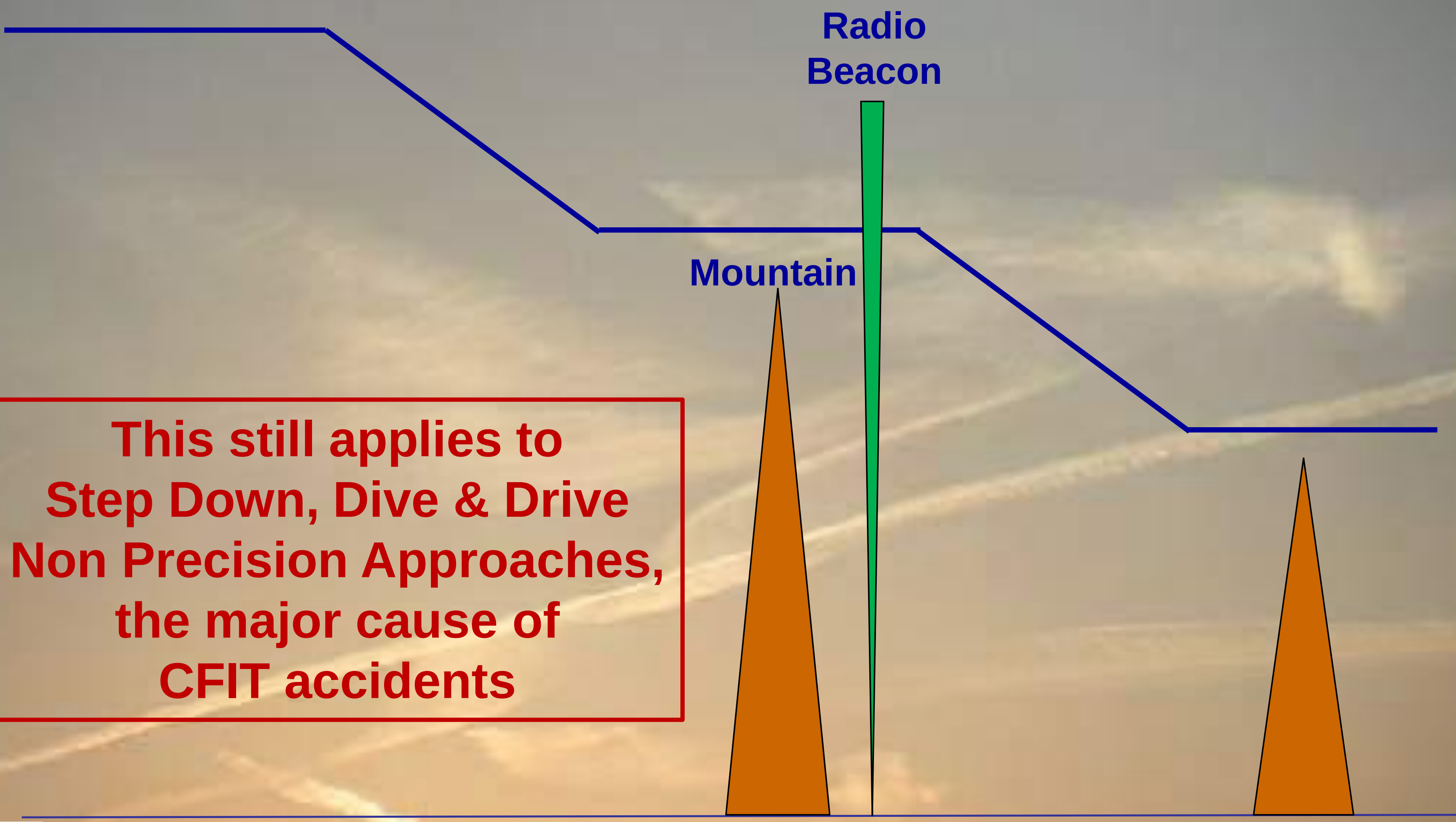
Gradient	333 ft per mile (3 miles per 1000 ft)	400 ft per mile	600 ft per mile
Height =	Dist. ÷ 3 (or Dist. = Ht. x3)	Dist. x 4	Dist. x 6
Rate of Descent =	5·5 x G/Speed	6·6 x G/Speed	10 x G/Speed
Possible Aircraft Configuration	707, 747 Super V.C.10 300 Kts I.A.S. Clean.	707, 747 340 Kts I.A.S. Standard VC10 290 Kts I.A.S. Super VC.10 with spoilers	All Aircraft Spoilers, Gear or Flaps. Required in New York T.M.A.

On 3° Slope: Height (Feet) = Distance nm x 300

Vertical Speed fpm = 5 x Groundspeed Knots

Should always know VS for aircraft configurations

Many crews still descended on Steps as before distance information available - when could now navigate to 30ft using distance shown to 0.1nm



This still applies to Step Down, Dive & Drive Non Precision Approaches, the major cause of CFIT accidents

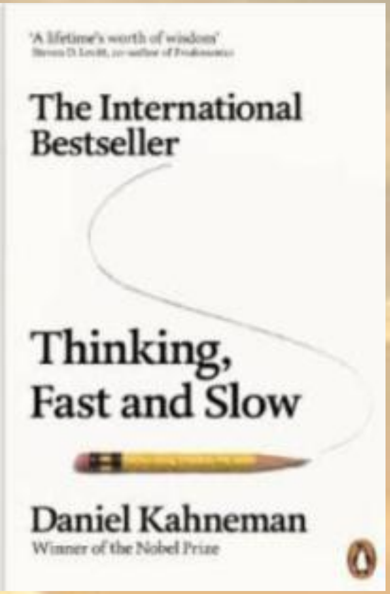
Descents Flown Accurately with Mental Arithmetic

Distance to Start Descent at 340kts at 400ft per mile gradient =
(Height to Descend / 4) + Distance to Decelerate + Distance at Bottom of Descent
Example: From 35,000ft descend to cross 23 nm at 8,000ft at 250kts
(27000/400) + 9 + 23 = 68 + 32 = 100

Start descent at 100 nm, with Vertical Speed for actual Groundspeed

Make regular checks to confirm on the profile
Example at 75 nm: (75-9-23) x 400 + 8000 = 43 x 400 + 8,000 = 25,200ft
Example at 50 nm: (50-9-23) x 400 + 8000 = 18 x 400 + 8,000 = 15,200ft

I CAN DO THAT IN MY HEAD!
While still flying the aircraft, etc??



Nobel Prize winner Daniel Kahneman disagrees

Ask someone walking for
2 + 2
Instant reply 4

Ask for 17 x 24
To think will stop walking,
or flying the aircraft?

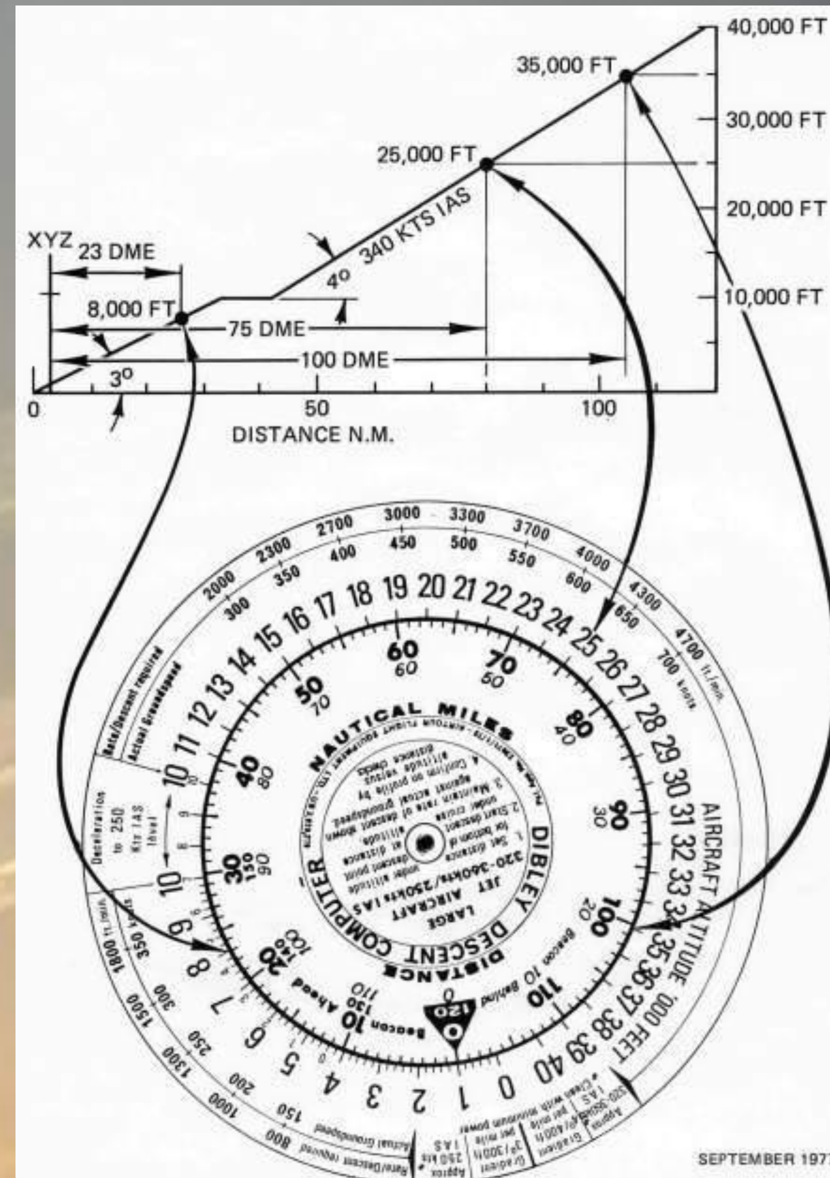
Crews could easily fly efficient descents with simple aids

Descent from 35,000ft to 8,000ft at 23nm Start at:
(27000/400) + 9 + 23 = 68 + 32 = 100 nm
If groundspeed 500kts - Vertical Speed 3300fpm,
Similar to flying Inertial Flight Path Angle

Crosschecks:
75 nm: (75-9-23) x 400 + 8000 = 43 x 400 + 8,000 = 25,200ft

50 nm: (50-9-23) x 400 + 8000 = 18 x 400 + 8,000 = 15,200ft

Pierre Baud agreed –
"This is very good. I know the formulae I should use – but I can never do them in my head….
Why haven't you marketed this properly!"

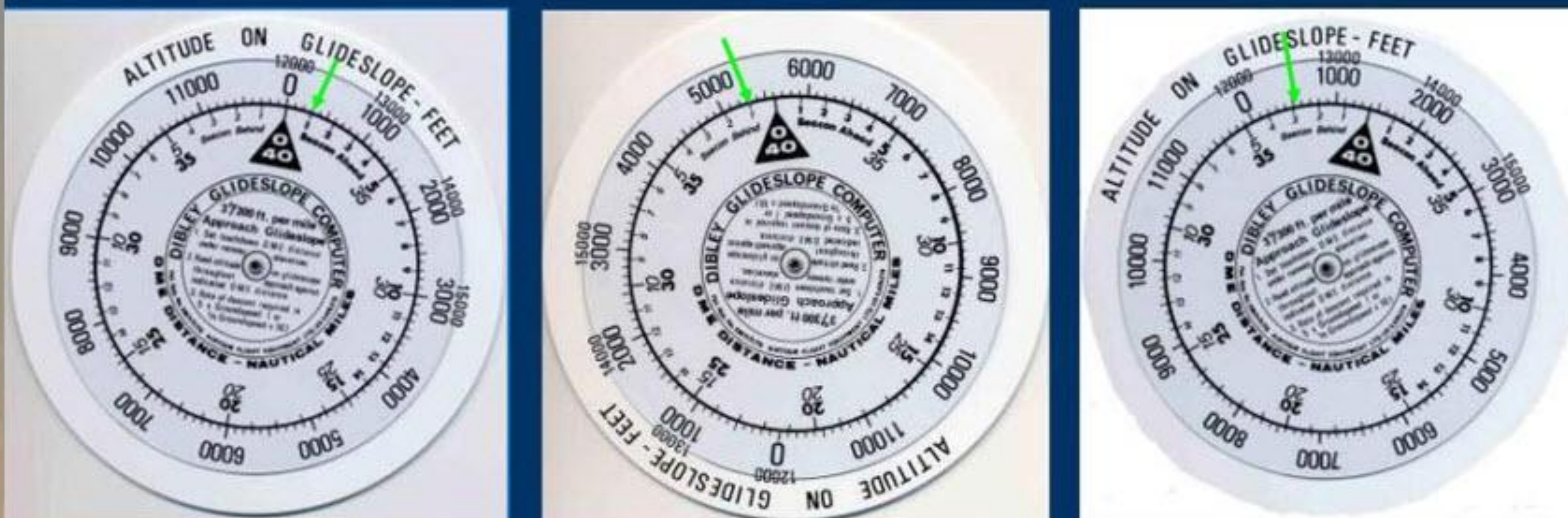


Such devices now overtaken by FMGC Managed Descents

But Captain Tom Gasparalo, Training Committee Chairman, Southwest Airlines – original Low Cost operator of 814 B737s who attends our RAeS operations conferences -
Took my penultimate copy,
Doesn't want to give it back,
Thinks I should make/market some more!

The Reverse Side Showed Expanded Scale to Fly Non-Precision Constant Angle Final Approaches with Direct Distance to Altitude Checks To accuracy of about 30ft

Approach Slide Rule Set for Washington, Nairobi and Toulouse / Guam



IAD 12 – set ahead 1.2 DME at 360 ft

NBO 24 – set behind 1.0 DME at 5,300 ft

TLS 14R – set behind 2.7 DME at 550 ft or Guam 06 – set behind 3.3 at 310 ft

Principle still valid today using Distance-Altitude Tables

United Airlines Evaluated the Descent Approach Calculator in 1977-78

UNITED AIRLINES

Nov. 18, 1977

Capt. Hugh Dibley
British Airways, TBA
Heathrow Airport
London, England

Dear Hugh:

This will acknowledge receipt of the descent approach calculators for our evaluation. I will be distributing these to a number of our line managers and regular line captains for their use over the next six weeks. I would expect a decision shortly after the first of the year and will advise you at that time of what our decision is. Thank you very much.

Sincerely yours,

Dale E. Cavanagh
Director of Flight Standards
and Procedures

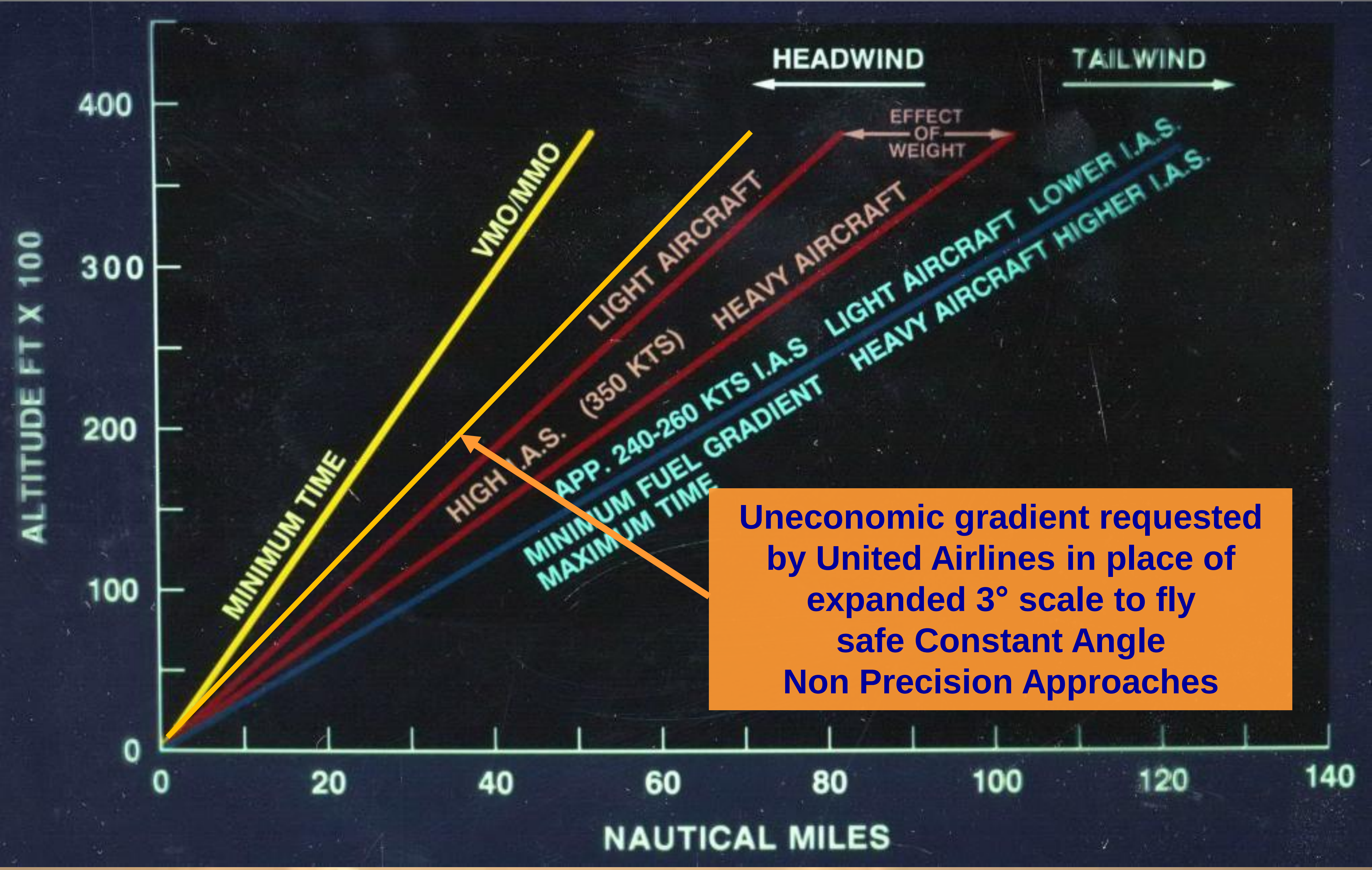
UAL Requested Removal of Expanded Final Approach Scale Allowing Constant Angle rather than Dive & Drive NPAs Replaced by Scale for 4000-4500fm Vertical Speed at 500kts

> In our telephone conversation several weeks ago you indicated the ability to modify your calculator, if necessary, in order to better match our requirements. Would it be possible to use the reverse side of your calculator (altitude on glide slope) to provide a descent calculation based on a descent rate of about 4000-4500 feet per minute at 500 knots?

4000-4500 fpm at 500kts gives a descent gradient of over 500 ft per nm which could only be achieved at uneconomically high speeds and thus was not produced.

Made device with variable gradient for high & low speeds.

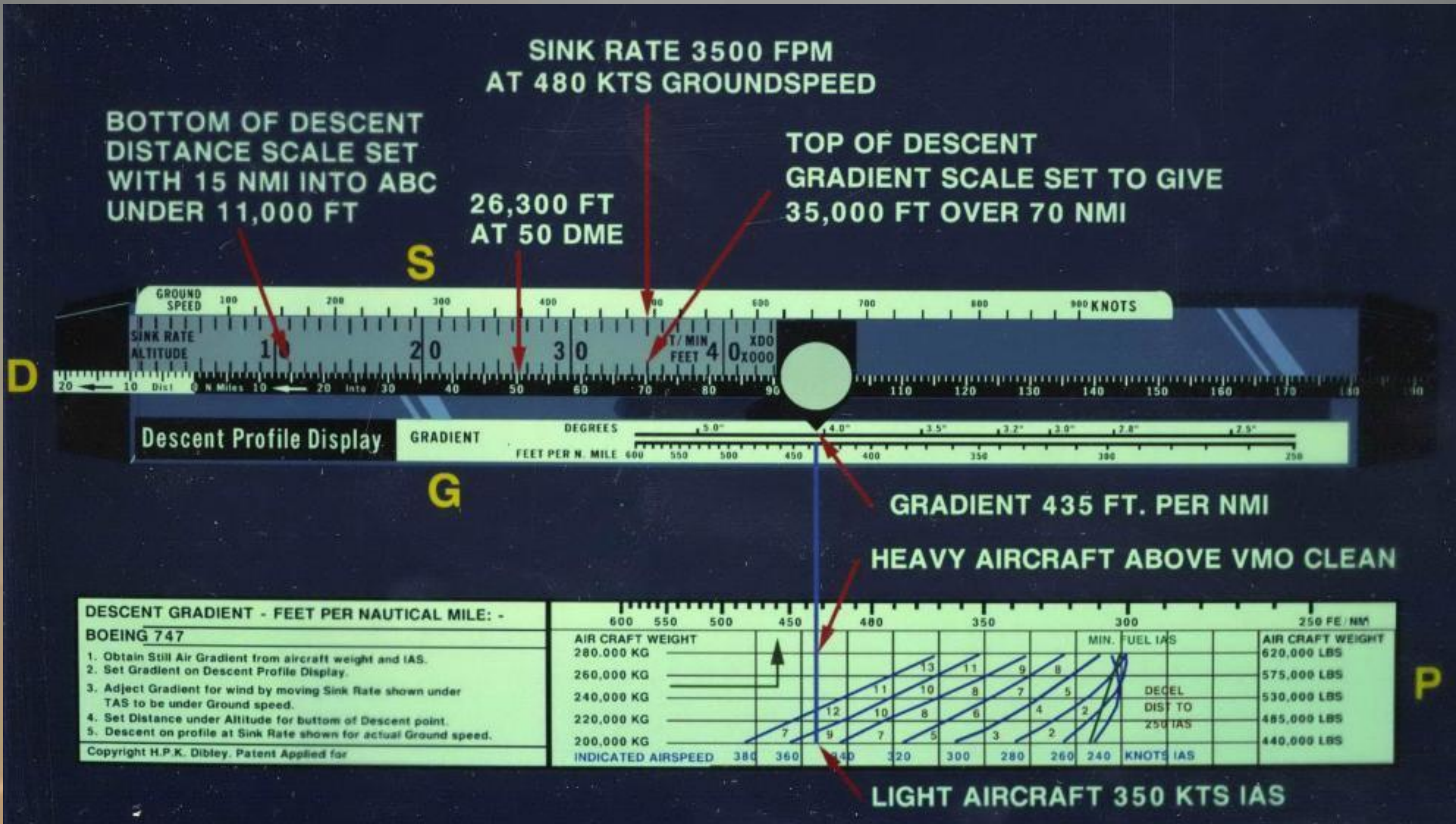
UAL Request for High Speed Scale (727s?) Not Implemented



Uneconomic gradient requested by United Airlines in place of expanded 3° scale to fly safe Constant Angle Non Precision Approaches

Variable Gradient on Elastic Scale – Labour intensive to produce

Descent gradient set for aircraft weight & Indicated Air Speed, adjusted for wind - Upper scale gave Vertical Speed for Groundspeed, Lower moveable Distance scale checks v Altitude. ***Extremely effective with light aircraft in strong head winds.***



United Airlines saw No Value in the Expanded 3 degree Scale to fly accurate Constant Angle Non Precision Approaches

Set for 5000ft – UAL's Denver Base

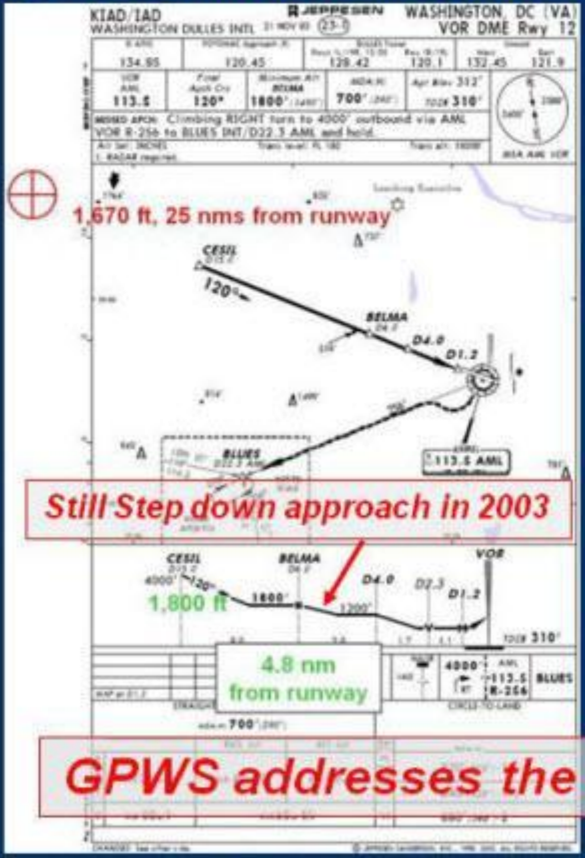
UAL was flying Step-Down / Dive & Drive NPAs 30 years later

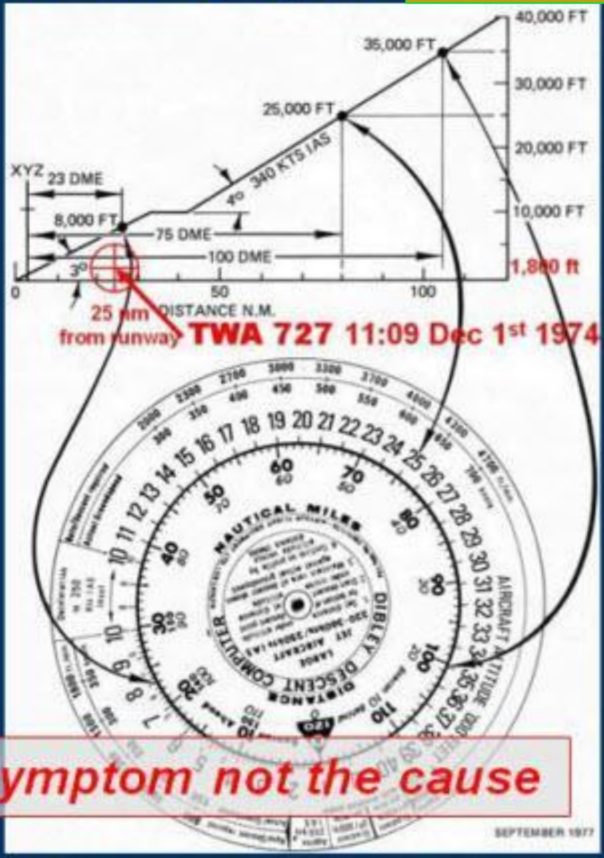
(Hong Kong radar warned a 747 which missed a step and was flying into a hill.)

Use of such a device could have saved many CFITs

- **TWA B727 Accident into Washington Dulles in 1974**
  - Hit hill at 1,700ft at 25 nm when should have crossed 1,800ft at 4.8 nm
  - FAA mandated all US carriers to fit GPWS
  - No comment about better use of DME during descent and approach?
  - *If the FAA had also mandated that DME approaches must be Constant Angle – Many lives could have been saved in the following 30 years*

Make that 40 years





GPWS addresses the symptom not the cause

Similar Profiles followed with unfortunate effects

A320 at 3000ft 30nm from runway
Crew armed the ILS approach

3000ft

30 nm from runway

Similar Profiles followed with unfortunate effects

A320 at 3000ft 30nm from runway
Crew armed the ILS approach
Aircraft pitched up to capture false glideslope
(as any aircraft will do)
Speed fell to near low speed protection

Why was the aircraft at 3000ft & 30nm?
Should have been close to 10 000ft

Why did the crew Arm the Approach so far out?

What about the noise over the ground?

Indicates lack of Vertical Navigation knowledge and competence all round….

3000ft

30 nm from runway

Example of poor Vertical Navigation at High Altitude

14 Oct 2004 Pinnacle Bombardier CL-600-2B19

Ferry flight – only 2 pilots on board

Failed to monitor autopilot Vertical Speed Mode climbing to FL410,

Speed reduced to stall which was not recovered.

Should have been prevented by improved knowledge of aerodynamics and thus use of automatics –

(There is an official view that crews must not VS mode as the mode not understood. This indicates a failure in training.

VS has to be used routinely when climbing fast in busy airspace to avoid unnecessary ACAS/collision avoidance warnings, etc.)

Could have been recovered by better knowledge of aerodynamics and if had been given proper stall/stick pusher training.

Avoided by proper crew discipline.

Approaches Flying at Low Level can cause Major Noise Nuisance affecting aviation and the whole community

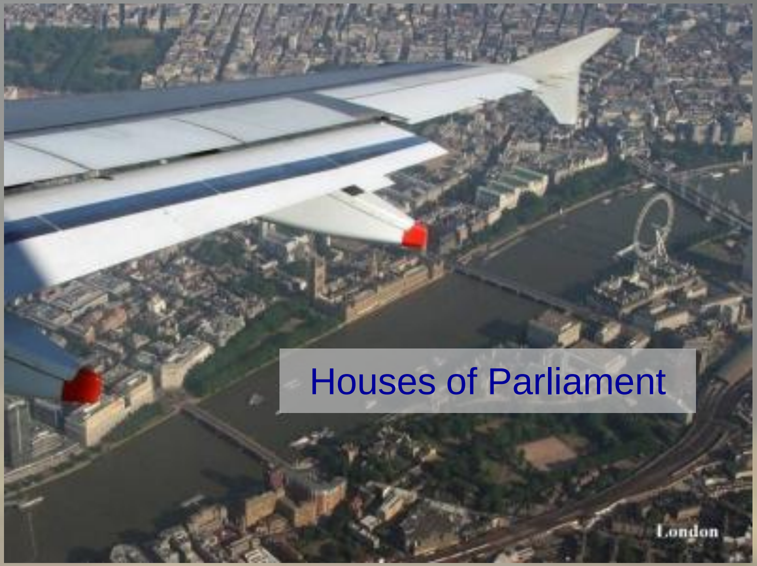
In 1960s-70s the inhabitants of central London were greatly disrupted by aircraft on approach to LHR – ***At times normal speech could be impossible.***

Because:

1. **The route is over central London**

The main route is over central London

City – Tower Bridge



Houses of Parliament


Buckingham Palace / Hyde Park


South Kensington /
Lycée Charles de Gaulle

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The largest operator flew in a high drag configuration

DRILLS 4

INITIAL APPROACH

1. Altimeters ———— Check/set all to QNH at Trans. Level (cross-check alt.)
2. Speedbrake lever ———— In. Check lights out.
3. Flaps ———— Flaps 4°. Check slats. Flaps 10°.
4. Fuel .... Set for landing.
5. Notices .... On.
6. Seat and harnesses ———— Adjusted.
7. APFDS ———— Set. PVD arm.
8. Radar .... STBY.
9. Altimeters ———— Set left QFE (cross-check elevation).
10. Flight Purser's report
11. Crossbleeds .... Latch in.
12. Continuous ignition and engine anti-ice ———— As required.
13. Gear ———— Down. Anti-skid-test. 3 greens.

FINAL APPROACH

1. Altimeters ———— Set right QFE (cross-check readings) except for QNH SRA.
2. Flaps ———— 42°. Check DLC.
3. AFCS ———— Check modes and flags.
4. Flight directors .... As required.
5. Cabin Staff .... Signal.
6. Wing anti-icing .... OFF at 500 ft.

LANDING

1. AGS .... Check.
2. Reverse Thrust .... Select.
3. Brakes .... Apply.

Initial Approach Drills were completed leaving the Holding fix at the **start of the approach** with **approach flap and gear/wheels extended** could fly like this for ***60 nms / 20 minutes***

Similar Approaches Flying at Low Level can cause Major Noise Nuisance affecting aviation and the whole community

In 1960s-70s the inhabitants of central London were greatly disrupted by aircraft on approach to LHR – ***At times normal speech could be impossible.***

Because:

1. **The route is over central London**
2. **The largest operator flew in a high drag configuration**
3. **ATC would clear aircraft down to 2500ft at 170kts**
4. **Causing a stream of the noisiest turbojet aircraft to fly overhead a large population at high thrust and low level.**

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4. **Causing a stream of noisey turbojet aircraft to fly overhead a large population at high thrust at low level.**

Pressure to move LHR to the coast Northeast of London

SOMETHING HAD TO BE DONE!

JOURNAL OF THE GUILD OF
AIR PILOTS AND AIR NAVIGATORS

March 1974

How to Reduce Noise and Save Fuel - Now

By Senior First Officer Hugh Dibley *

(Liveryman and Vice-Chairman, Technical Committee, who is expressing a purely personal view)

FUEL conservation has always been a major factor in efficient airline operations but it is being highlighted by the present crisis *(1974)*. During climb and cruise it is relatively simple for a pilot to extract the best performance from the aircraft, mainly by flying at the correct speeds and at the optimum altitude for the aircraft weight. But during descent and approach practical information may not be so readily available which can lead to a considerable drop away from optimum efficiency.

Poor descent and/or approach operation dramatically increases the amount of fuel burnt – at least 20 per cent on a short sector – besides making life under the approach path unnecessarily noisy.

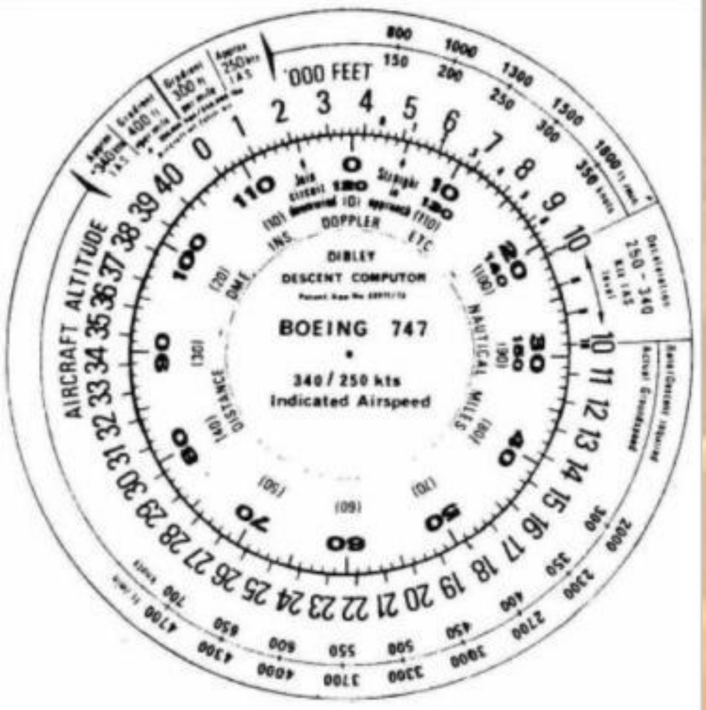
Air Traffic Control obviously largely governs an aircraft's navigation in a complex terminal area such as London. It is important that the profile prescribed by ATC should be as close to the aircraft's optimum descent and approach path as possible.
(An ideal profile for minimum fuel burn - but not minimum noise - is shown in Figure 1)

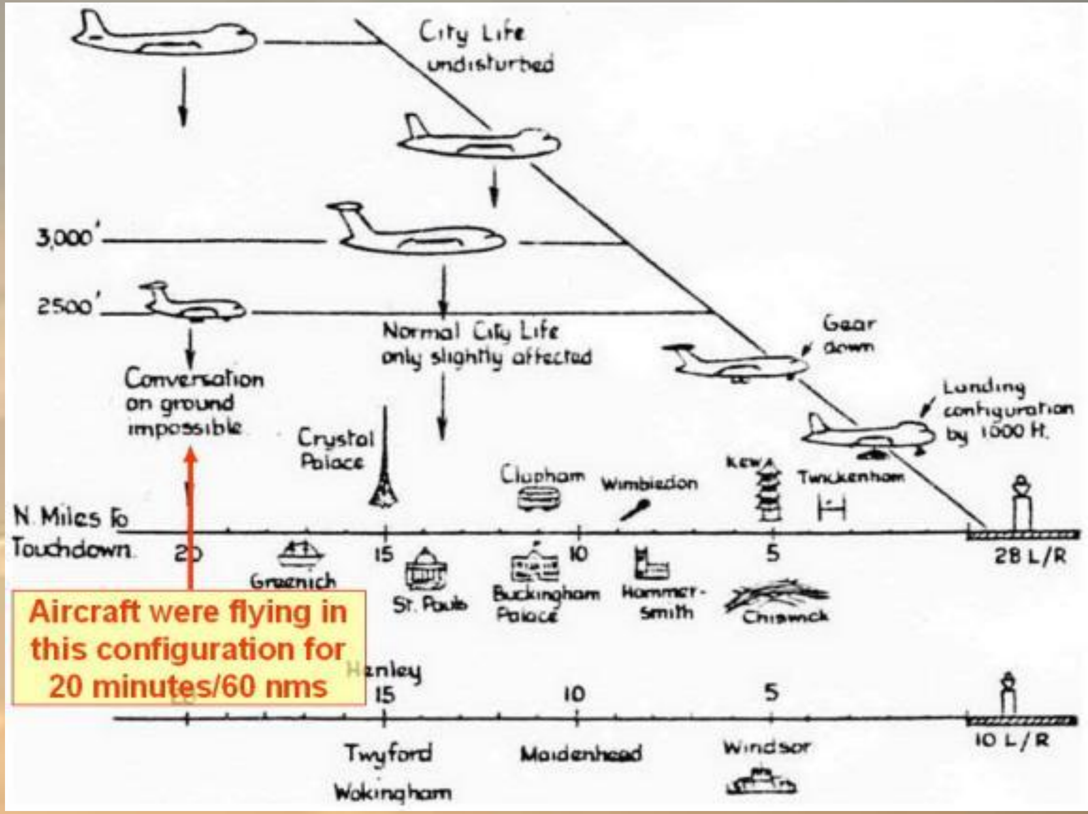
The aircraft descends from the cruise altitude at point A with minimum power to Point B at circuit height, and then decelerates to approach speed before starting its final approach at point C to land at D.

A good approach is a prerequisite for a safe landing, so it is vital that the aircraft is properly stabilised at the correct speed in the landing configuration (gear down, landing flap) in the last 1,000 ft or 3 miles of the approach to land.

Article in the Journal of the Guild of Air Pilots and Air Navigators in March 1974

Suggested that crews be provided with some form of Vertical Guidance to permit them to fly Quiet, Fuel Efficient Descending Approaches.





National Air Traffic Services

FROM: Air Commodore Ian Pedder, OBE, DFC, MBIM, RAF,
Director of Control (Operations)

The Adelphi,
John Adam Street,
London WC2N 6BQ

Telephone 01 836 1207

NATS

H P K Dibley, Esq,
Guild of Air Pilots and Air Navigators,
163 Holland Park Avenue,
LONDON W11

Our Ref: 8M/52/03 S
7 May 1974

Dear Mr Dibley,

FUEL SAVING

It is with considerable interest that I read your article "How to reduce Noise and Save Fuel – Now" in the March edition of the Journal of the Guild of Air Pilots and Air Navigators.

We are, of course, very conscious of the need to afford operators the opportunity to conserve fuel whenever possible, and we have recently extended the period of operation on the White Airways that we introduced at the beginning of the fuel crisis. These specifically arranged direct routes have enabled significant fuel savings to be made in the en route phase.

The TMA phase has proved to be a more complex problem. I am sure that you are aware that UK controlled airspace is designed to affect the minimum amount of airspace commensurate with flight safety, and this very tight configuration does restrict the room for manoeuvring if we are to avoid any adverse effects upon the expeditious flow of traffic. Even the smallest revisions to procedures can have considerable impact upon other parts of the system. We are currently coming across difficulties in this area and, so far, have not found a solution which could be practically implemented. Nevertheless we shall keep on trying.

Finally, I should like to express my appreciation of your contribution to the problem and reaffirm that NATS is very much concerned to do what it possibly can to offer, to all operators, opportunities to conserve fuel.

Yours sincerely,
Ian Pedder

The suggestions in the Article were recommended to operators in May 1974 by the head of NATS Air Marshal Sir Ivor Broom RAF

The main local airline replied that such procedures were not possible or worthwhile because:

High thrust and thus high drag was needed for aircraft air-conditioning and for option use of autothrust,

Long stable approaches needed for autoland,

The fuel savings by flying clean at a higher speeds would be minimal,

The extra noise generated was not considered as an operational factor.

No immediate action was taken

In September 1975 DLH proposed their Managed Drag Approach to NATS, were almost exactly the same as the GAPAN article recommendations. Using similar graphics, these were publicised in the national press.

NATS introduced Continuous Descent Approaches into LHR in late 1975.

OBSERVER 21st September 1975

'Gliding' Jets halve the noise

By ANDREW WILSON

BRITISH AIRWAYS and the Civil Aviation Authority are resisting introduction of a landing technique that could cut London and other cities airport noise by half.

The technique, known as 'low drag, low power,' has been safely and successfully used by the German airline Lufthansa for more than four years.

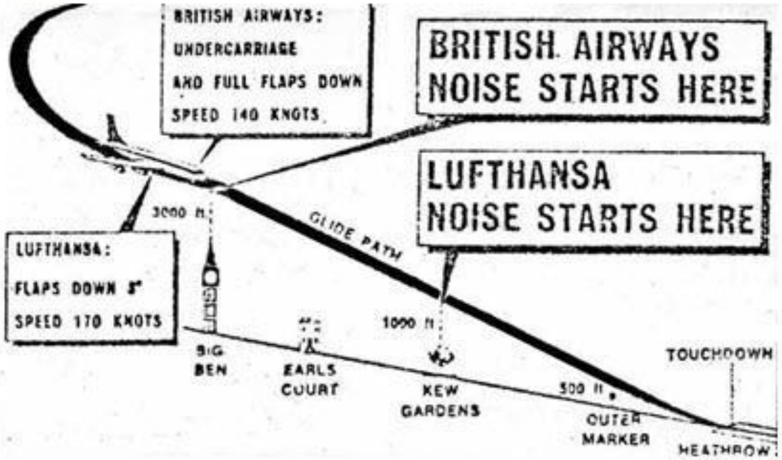
Instead of putting out flaps and landing gear 12 miles from the runway, and having to increase power and noise to overcome the extra drag (the conventional British Airways method), Lufthansa pilots fly 'clean' down the three degree glide-slope until they are near the airport.

At 1,000 feet they still have 40-50 seconds to extend flaps and gear and (stabilise for the touch-down. If that were allowed when approaching Heathrow, thousands of people living along the Thames would be spared ear-splitting noise.

At a discussion in London last week CAA officials alluded to air traffic control problems with the German system. But the real reason for Britain's reluctance is that British Airways Tridents, already among the noisiest jets in the world, are equipped with an automatic landing system which requires that flaps be extended at conventional height.

The British planes descend at 140 knots (161 m.p.h.), spreading a carpet of noise over a wide area, whereas Lufthansa's Boeing 727s descend at 170 knots, with engines nearly idling, almost like gliders. Even at Kew, where noise would begin, (see diagram) it would be much reduced.

Lufthansa's technique has been recommended to member airlines by the International Air Transport Association.



THE ECONOMIST SEPTEMBER 20 1975 BUSINESS BRITAIN Page 95

Airport noise

The German way

A technique which could halve aircraft noise for people living under the landing route more than 3-4 miles, from London's Heathrow airport (say Westminster to Chiswick) is being given the cold shoulder by the Civil Aviation Authority. The technique, called "low-drag-low-noise", was developed by the West German airline, Lufthansa, to get round a problem with a small village directly in line with the runway at Frankfurt airport, where the residents were objecting to having their eardrums blasted. What it adds up to is that Lufthansa is leaving the noisy, final, bit of the landing process until its aeroplanes are nearer the airport and (don't get alarmed) nearer the ground.

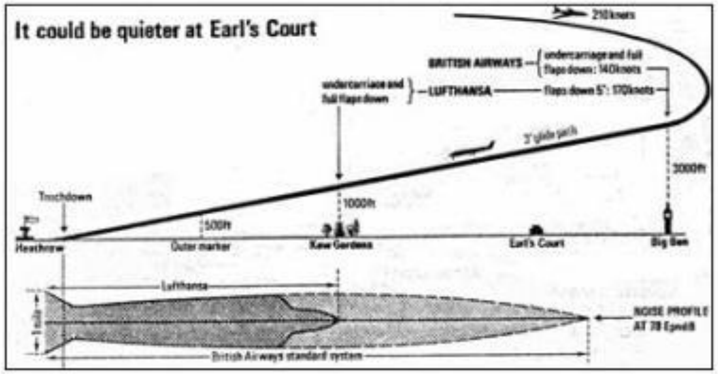
Under both the Lufthansa and the standard systems, air traffic controllers direct the aircraft, flying at about 210 knots, towards a point about 14 miles from the runway to intercept a theoretical glide path which points up from the end of the runway at 3°. Using the conventional landing approach, at about 12 miles from the runway the undercarriage and flaps are put down, which means that power and noise are created. The aircraft flies in, slowing down to about 140 knots in this configuration, until it lands. On a fine day Lufthansa aircraft, by contrast, come in on minimum power at 170 knots all the way, no flaps, no wheels: these are then put out in time for the aircraft to be stabilised before reaching 1,000 feet (or higher if the weather is less good).

As well as making less-noise Lufthansa, reckons that it is now saving an average of 30 gallons of fuel on each landing by its Boeing 727 aircraft and on reduced maintenance. Less throttle is needed to push the aeroplane along when it does not have the wheels down and all those flaps (wing extensions which give more lift) hanging about.

The British concern about the new technique is said to centre on safety—in particular, whether the system increases the pilot's workload during landing, the most dangerous part of the flight. Yet British Airways pilots helped devise the new technique and it has been welcomed by the pilots' international association, Ifalpa. (The pilots are less happy about an American development, called the two-segment approach, where the aircraft first descends down a 6° slope, to intercept the 3° glide path not far from the outer marker.)

Your special correspondent can vouch that the crew seemed to have more than adequate time during a recent low-noise approach to Heathrow in a Lufthansa 727. The- three minutes or so between putting out the undercarriage and flaps and landing were more than adequate for the crew to go through its final checks that all was well (and for the captain to double-check).

The real reason for British official apathy may be a clash with the automatic landing system used on British Airways Tridents. This requires the undercarriage and flaps to be lowered miles out as in the standard technique. This is fine when the weather is foul (BA can land at Heathrow when most others cannot). But people who live from Westminster to Chiswick (and similar places around other airports) deserve better treatment when the weather is better, which is most of the time.



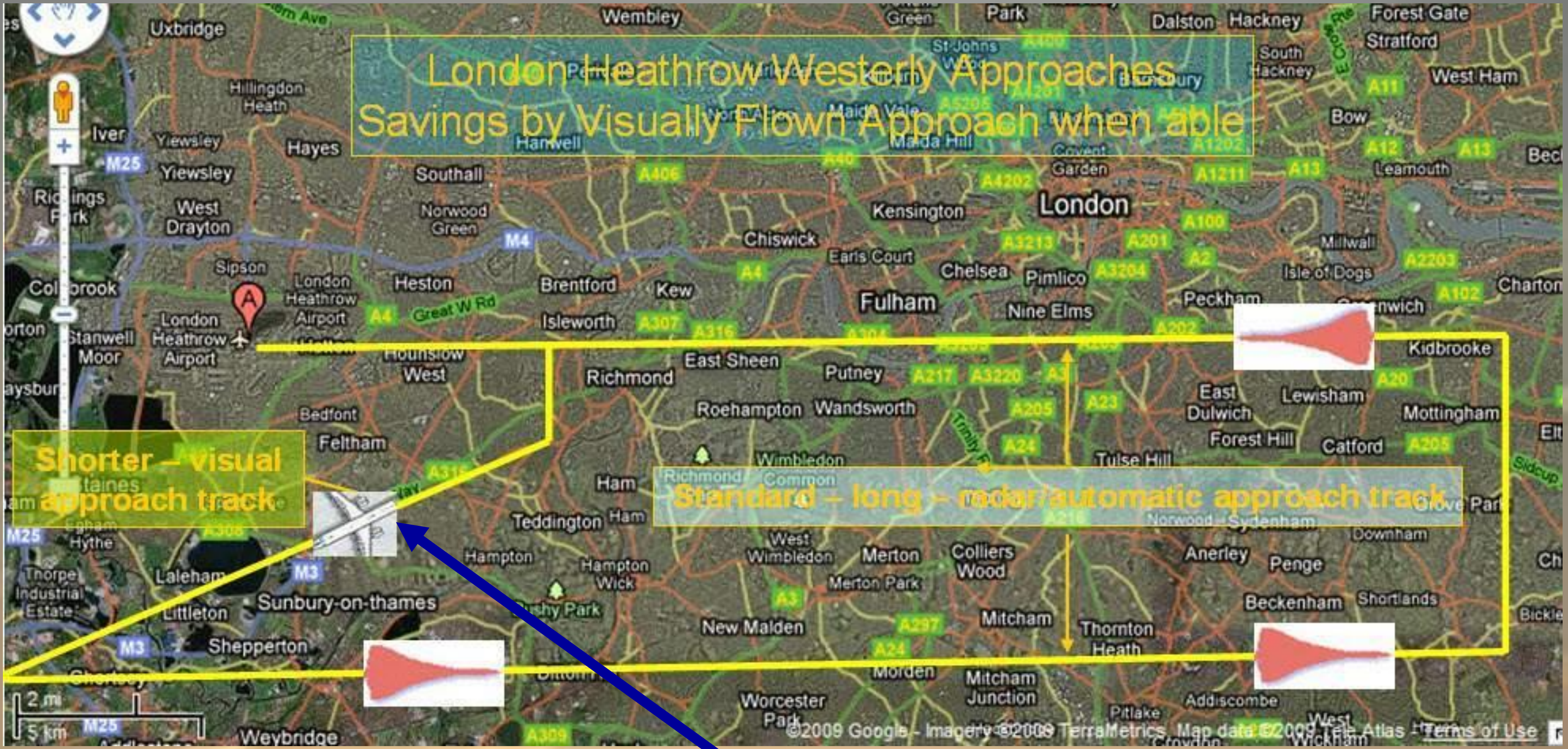
Recommendations of Hugh Dibley's March 1974 GAPAN Journal Article

1. Airlines should be encouraged if not actually required to adopt some form of vertical navigation aid as soon as possible.
2. ATC should give the point where lowest altitude is to be crossed. Whenever possible likely crossing clearances to be published with standard routings

(NB: The US plans to introduce vertical navigation in 1977-82. New York already has routes tentatively drawn up.)

3. Intermediate approach speed for radar vectoring to be 200 kts minimum.
4. Whenever possible pilots should be allowed to control their own navigation - including speed - for an approach.

Whenever possible pilots should be allowed to control their own navigation - including speed - for an approach.



Like when traffic and weather permits, flying shorter visual approaches

Recommendations of Hugh Dibley's March 1974 GAPAN Journal Article

1. **Airlines should be encouraged if not actually required to adopt some form of vertical navigation aid as soon as possible.**
2. **ATC should give the point where lowest altitude is to be crossed. Whenever possible likely crossing clearances to be published with standard routings**

(NB: The US plans to introduce vertical navigation in 1977-82. New York already has routes tentatively drawn up.)

3. **Intermediate approach speed for radar vectoring to be 200 kts minimum.**
4. **Whenever possible pilots should be allowed to control their own navigation - including speed - for an approach.**
5. **Minimum height for intercepting the glideslope, especially over London. to be 3,000 ft preferably higher.**
6. **DMEs to radiate from all ILS. Pilots to be encouraged to keep aircraft clean for as long as possible, and not to lower gear before about 5 miles DME unless precluded by weather.**

Continuous Descent Approaches (CDA) from stack level of FL 70 were introduced into LHR in 1975, initial approach speed 210 kts. ATC gave track miles to runway.

DMEs were installed on the ILS in 1978 - funded by the Department of the Environment for noise abatement.

UK CAA Paper for the Department of Trade in 1978
Showed average Reduction of 3 to 4 DB
with up to 15 DB Reduction at 15 nm from runway

CAA Paper 78006

The Noise Benefits Associated With Use of Continuous Descent Approach and Low Power/Low Drag Approach Procedures at Heathrow Airport

A report prepared for the Department of Trade

SUMMARY

The Directorate of Operational Research and Analysis (DORA) measured the approach noise levels and observed the aircraft configurations and flight paths of some 700 westerly approaches during two periods in 1976 and 1977. From these data the average reductions in peak noise level resulting from use of the Low Power/Low Drag (LP/LD) and Continuous Descent Approach (CDA) procedures have been estimated and the areas over which the reductions apply, inferred.

From the reductions in noise level and the observed numbers of approaches implementing the procedures a tentative estimate of the reduction in Noise and Number Index (NNI) in areas under westerly approaches, resulting from use of the procedures, has been made.

Civil Aviation Authority London April 1978

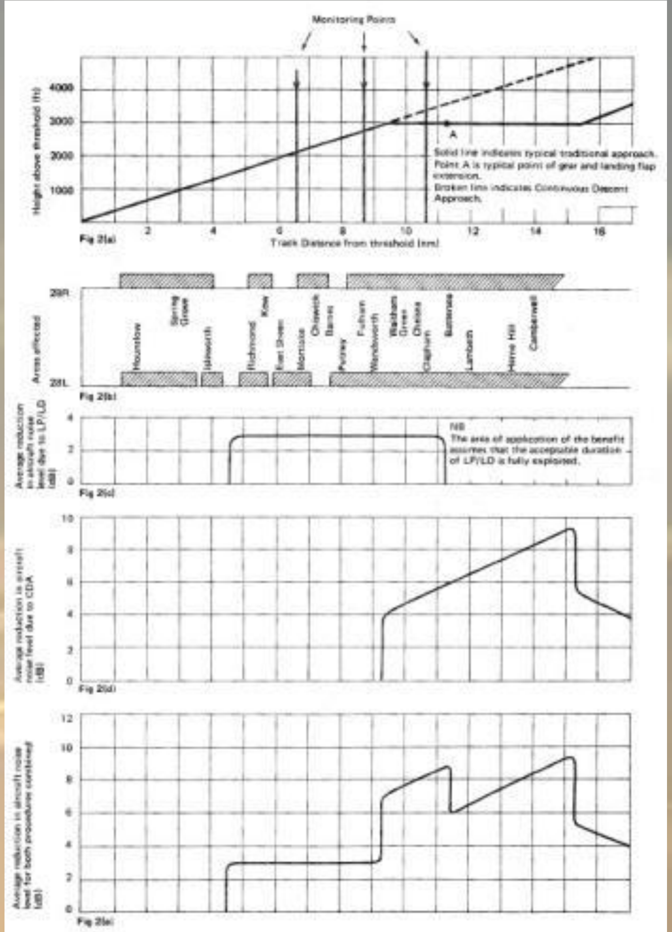


Fig 2 Average noise benefits resulting from LP/LD and CDA procedures for a single westerly approach at Heathrow

NB All reduction in aircraft noise level shown are those directly below the flight path.

Continuous Descent Approaches are often Re-Invented and Introduced to many other airports worldwide

AIR TRANSPORT

NAVIGATION

EC plans two agencies to share Galileo responsibility

Two operational agencies have been proposed to oversee crucial parts of the European Galileo global navigation satellite system, including one to work on interoperability with rival systems.

The European Commission, which handles the administration in the joint undertaking with the European Space Agency, is keen to spin off responsibility for tender applications and security to help the month-old project meet its strict deadline.

The EC's proposal centres on the creation of two bodies – a supervisory authority to oversee the tender for the concession to deploy and operate Galileo; and a centre for safety and reliability, which will handle security aspects associated with the system.

EC vice-president Loyola de Palacio says the plan is "fundamental" because it establishes the crucial legal and institutional framework for managing the Galileo programme from 2006 onwards.

Galileo's deployment and operation will be handled by a private contractor, to be appointed by the end of this year, and a call for tenders will be issued in the next few weeks. The proposed supervisory authority would act as a licensing body, ensuring that service obligations are met, and would also be controller of the radio frequencies.

The centre for safety and reliability's task would also be to ensure that the satellite system is adequately defended against "hostile intentions", says the EC. The team would also have to be capable of taking signal-scrambling or interruption measures in an emergency, it adds.

The integral security of Galileo has long been a thorny issue between Europe and the USA, whose rival global positioning system is military-led.

OPERATIONS DAVID KAMINSKI-MORROW / LONDON

BA tests precision area navigation at Heathrow

Aim is for quieter, more accurate approaches that simplify air traffic management

British Airways has begun trials of high-accuracy, continuous-descent approach techniques at London Heathrow airport. Working with the Civil Aviation Authority's Directorate of Airspace Policy and National Air Traffic Services (NATS), its aim is to make approaches quieter, more accurate, simpler in terms, and

During Boeing 74 tween 05:

August 2003

sion area navigation (P-RNAV) flightpaths using a continuous-descent approach. Virgin Atlantic is also preparing to take part.

P-RNAV requires a lateral accuracy of 1nm (1.85km) compared with the existing basic RNAV (B-RNAV) allowance of 5nm

Eurocontrol is also keen to drive the introduction of P-RNAV procedures in terminal airspace because it will generate consistency in procedure design and execution, and has the potential to improve safety.

Use of P-RNAV at Heathrow will be combined with the increasing use of continuous-descent

a higher altitude during the earlier segments of their approach, and use lower power during descent, cutting down noise.

NATS, which is helping to manage the trial, says: "It will reduce the fuel and noise penalty – but also the radio communication workload. In traffic capacity terms, you can be constrained as much by the amount of instruction time on the radio as by the airspace itself."

The trial will involve BA flights arriving via the Lambourne holding point to the north-east of Heathrow. This is the normal routing for long-haul services arriving from the Middle East and Asia-Pacific regions. BA says its 747s and 777s are already equipped with flight management systems (FMS) that can carry out the procedure, so the only investment being made is in preparatory simulation and procedural training.

BA's air traffic management project manager for area navigation, Kevin O'Sullivan, says procedures for the P-RNAV approach have been drawn up by the CAA. "These are coded into the normal navigation database as a procedure – like the standard arrivals and standard departures – using the FMS." P-RNAV normally relies on DME/DME fixes for navigation, but this can be aided by VOR/DME, satellite navigation or inertial navigation, says O'Sullivan. He adds that BA and NATS want to examine reducing the navigation tolerance to 0.3nm.

LONDON HEATHROW P-RNAV APPROACH TRIAL

LEASING NICHOLAS IONIDES / SINGAPORE

India drags feet on Airbus purchase

Indian Airlines is being forced to lease more aircraft in a bid to hang on to its dwindling market share, as its government continues to delay approving the proposed purchase of 43 Airbus narrowbodies.

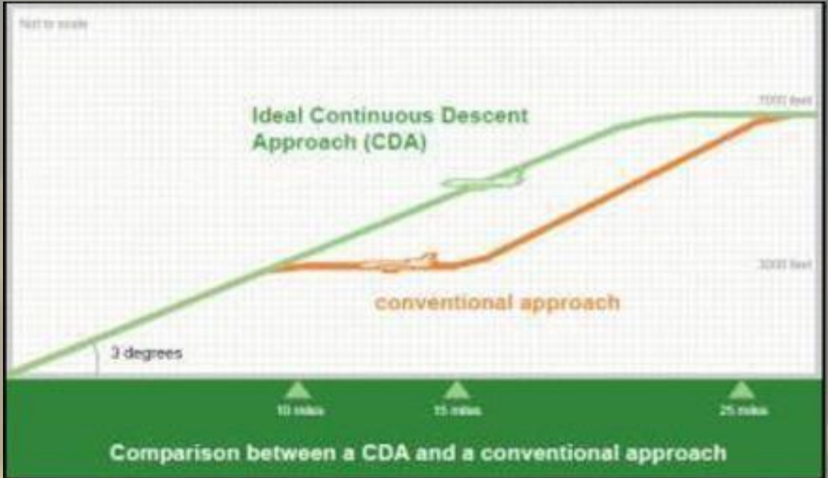
State-owned Indian says it will soon launch a search to lease five more Airbus A320s, with deliveries expected by early next year.

In March last year, Indian selected the A320 family over the Boeing 737 for a fleet modernisation and applied for government approval to conclude a deal for 43 aircraft – 20 A321s, 19 A319s and four A320s. The application for approval to buy new aircraft has remained stalled at government level for nearly 18 months, and there is no indication as to when a decision will be taken.

Indian operates 38 owned and leased A320s and three more leased aircraft are due for delivery this year. The airline's board recently approved a proposal to lease the five additional twinjets to help it compete better with privately owned domestic carriers Air Sahara and Jet Airways. Indian Airlines' domestic market share was estimated at 39.5% in the first four months of this year – down from 42.5% in 2002, while Jet Airways' share increased to 49.8% and Air Sahara's share rose to 10.7%, say local reports.

Indian Airlines says additional aircraft are needed because "we are not in a position to increase our market share on high-density routes" like the private airlines, which have been boosting services and cutting fares.

12 12-18 AUGUST 2003 FLIGHT INTERNATIONAL www.flightinternational.com



Comparison between a CDA and a conventional approach

SACRAMENTO COUNTY AIRPORT SYSTEM

2009

Continuous Descent Approach (CDA) Fact Sheet

- CDA is the approach recommended by the Mather Airport Aircraft Overflight Noise Working Group.

Now I just monitor progress from where we live in London

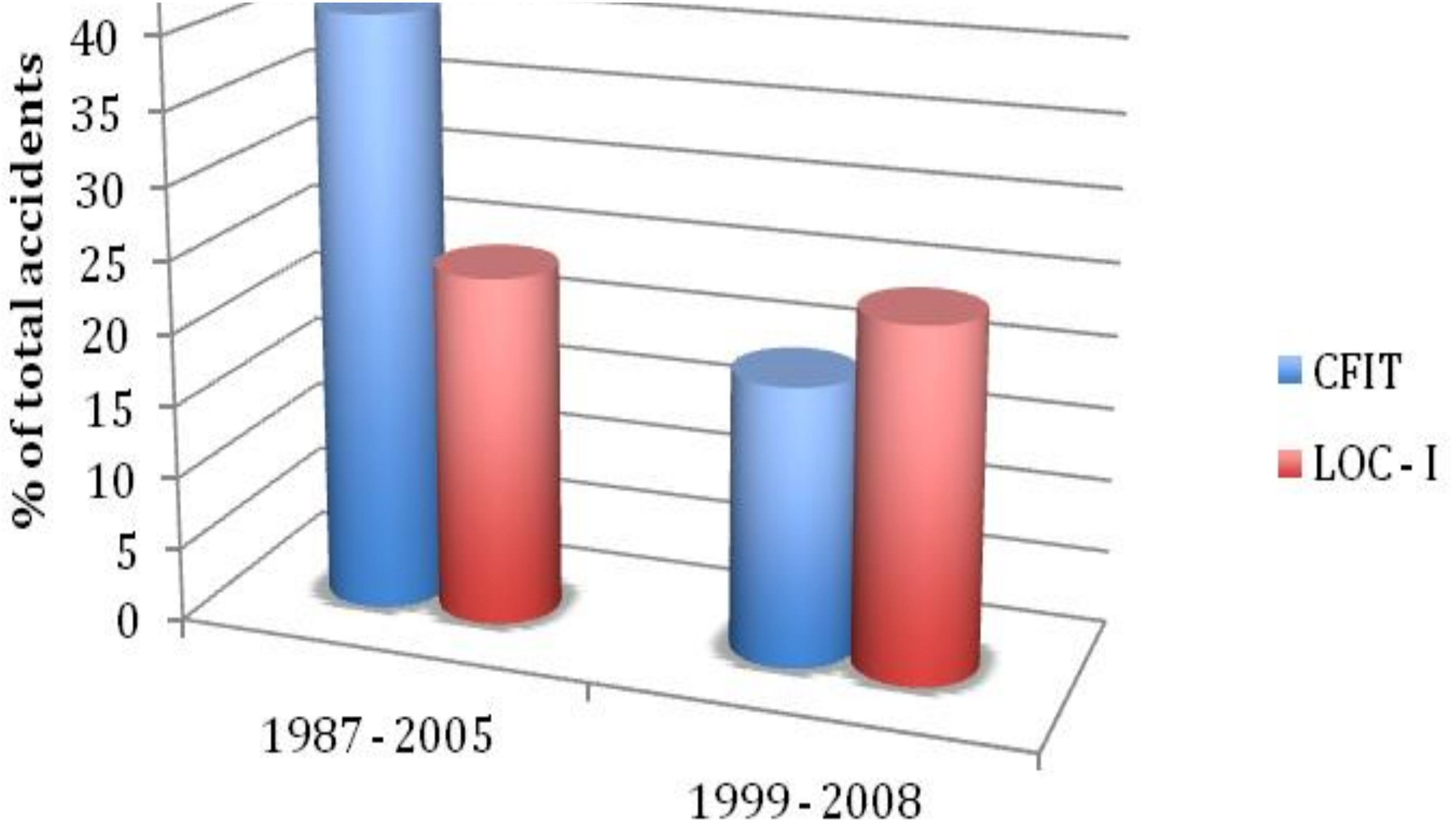
Emirates A380 with wheels down early

BA 747 flying level, not on a Continuous Descent

Reggie (Registration) Spotters Now Take Videos!
Can show crews' performance in Continuous Descents

Considerable Variation – Room for improvement - In Training – *none at present*, Technology / Guidance?

Reminder that Controlled Flight Into Terrain is still a major accident cause



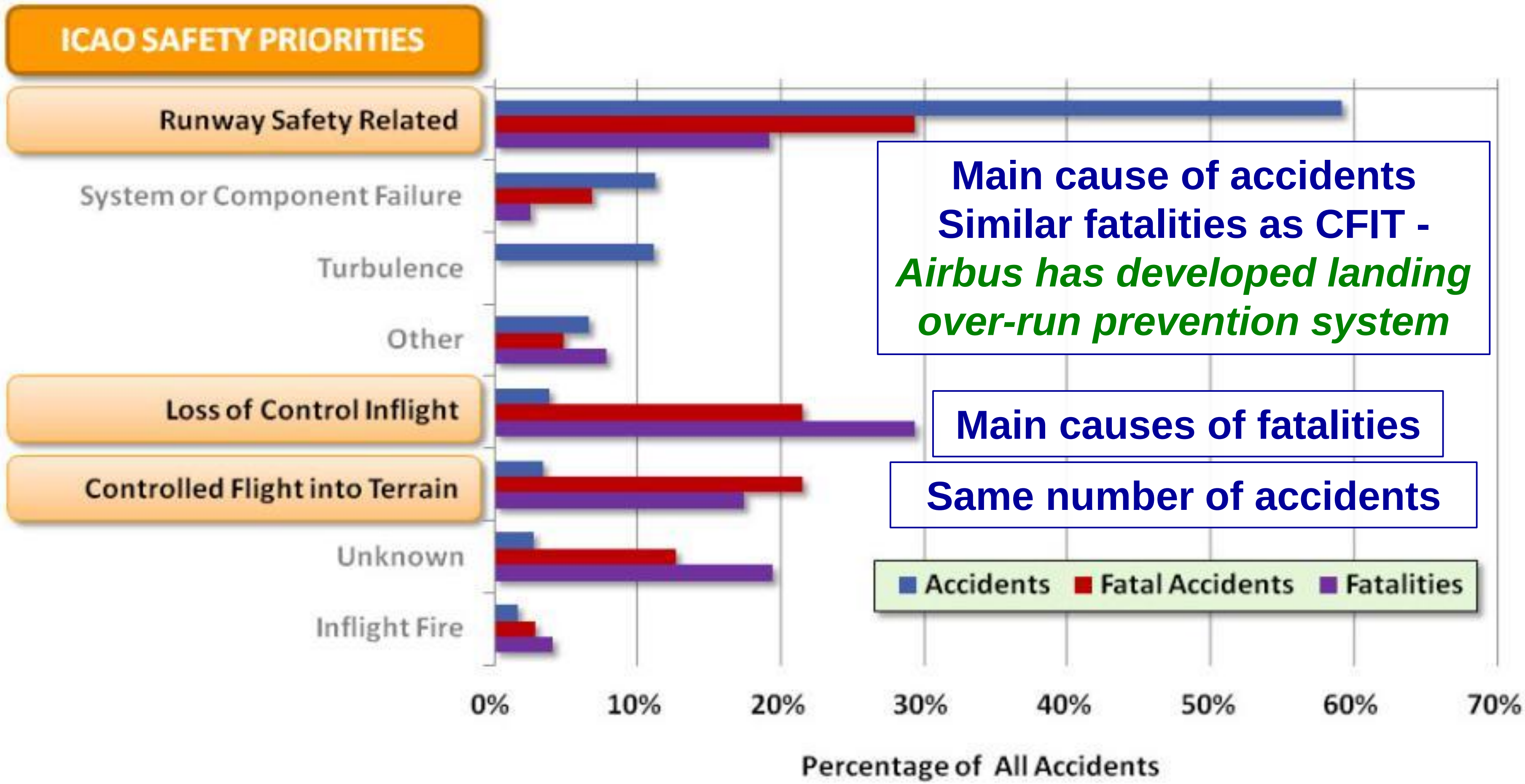
Although LOC-I (Loss of Control – Inflight) currently main accident cause

Figure 1

Safety Performance – the main killers

Accidents & Related Fatalities by Occurrence Categories

Scheduled Commercial Traffic – MTOW > 2 250 kg (Yrs 2006- 2010)



The Majority of CFIT Accidents have involved Non Precision Approaches

CFIT was involved in 37% 0f 76 approach and landing accidents and incidents and that 57% of CFIT accidents and incidents occurred during Non Precision Approaches

Flight Safety Foundation

Reasons for CFIT Now Well Understood?
NO! Some airlines are still flying
Step-Down / Dive & Drive Non Precision Approaches

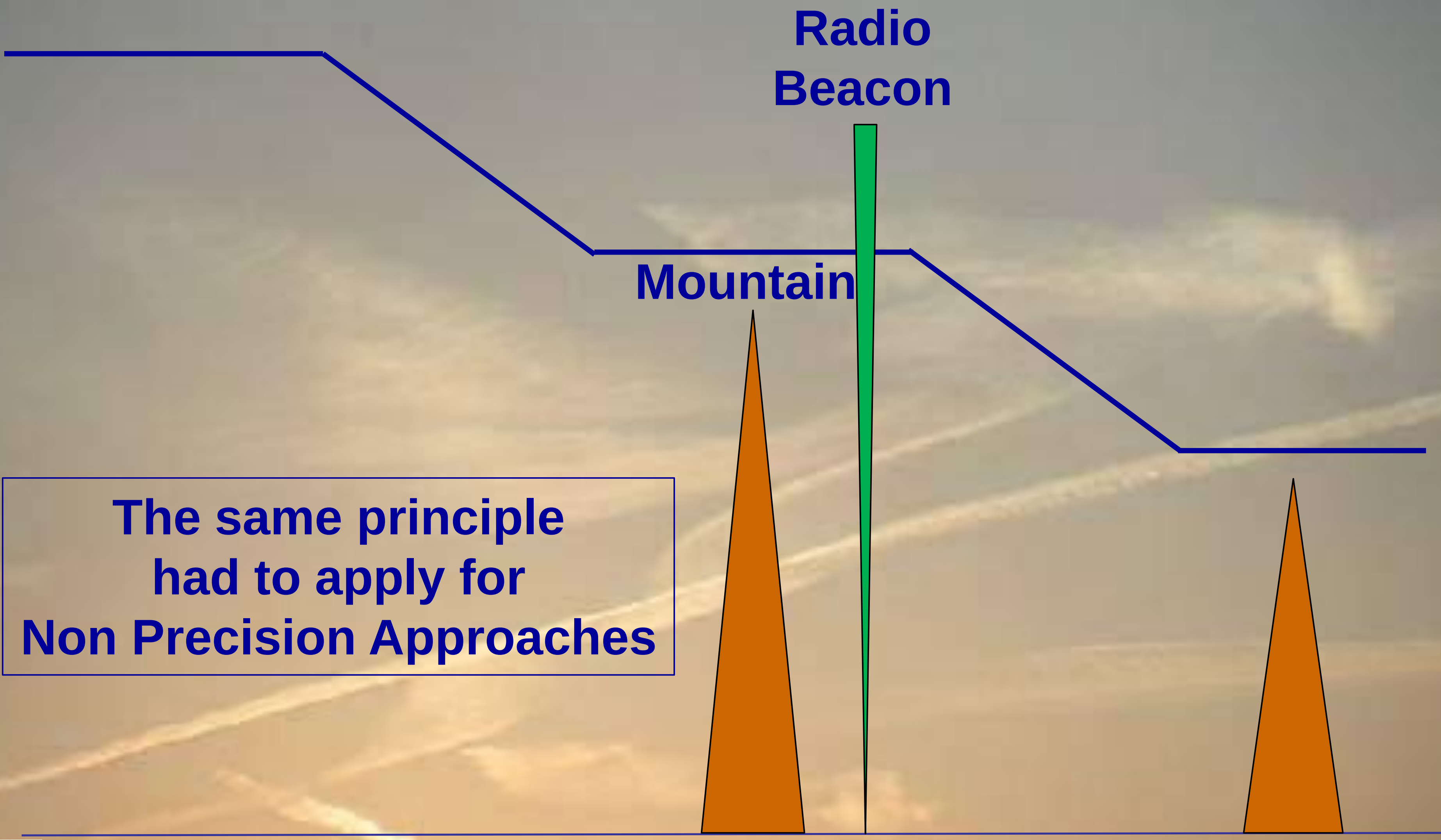
(Discouraged if not banned for UK operators)

Saudia Crew on A320 Transition Course June 2011

After flying 2 Airbus standard CDAs "This is very easy!"

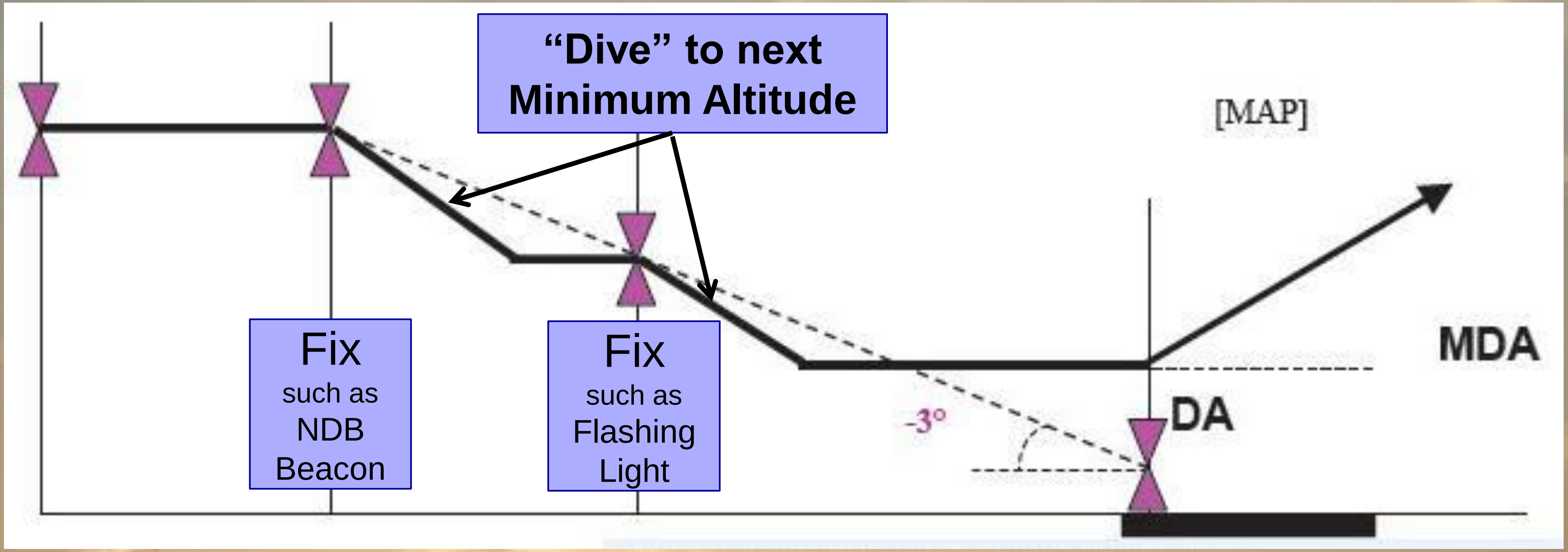
Therefore asked to give presentation at WATS 2013
Modified after UPS A300-600F CFIT accident 4 months later

Reason for Frequent CFIT Accidents up to 1970s - Where No Ground Radar, Descents Made in Steps, Continuing Descent Passing Radio Beacons

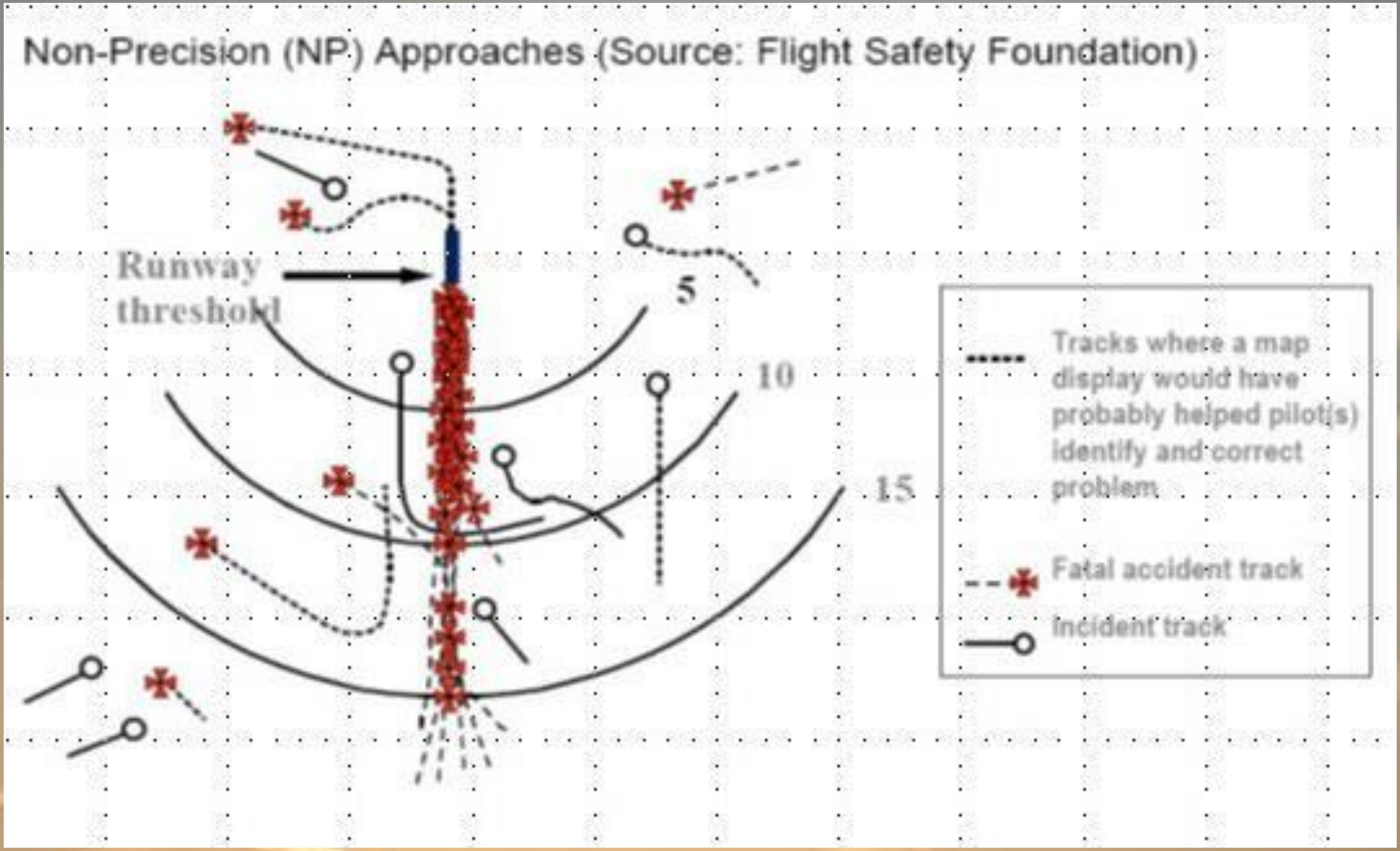


**The same principle
had to apply for
Non Precision Approaches**

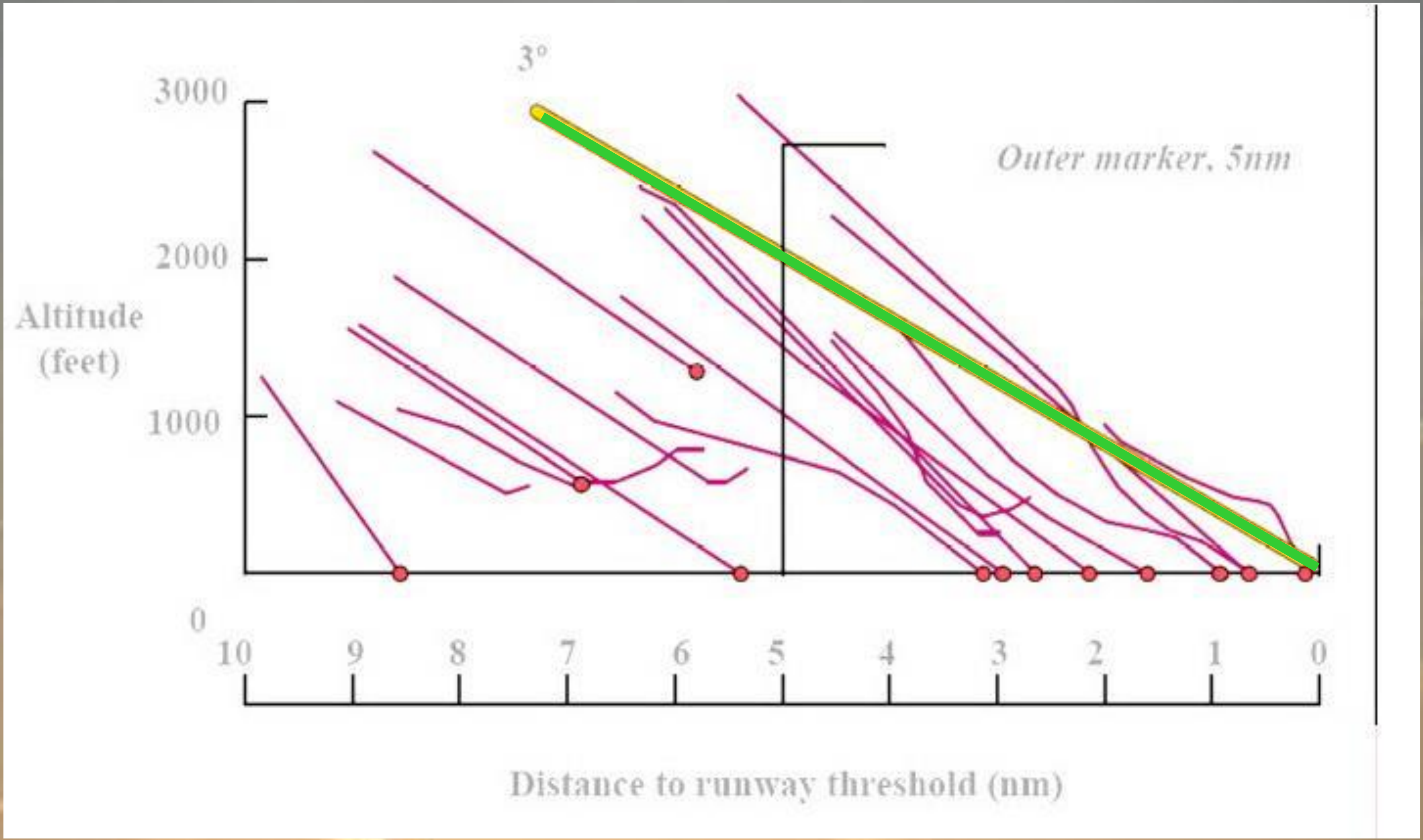
Before DME / reliable distance information NPAs Had to be Step Down or "Dive and Drive



Lateral Navigation was not the Main Problem
Accidents sites were mainly in line with runway

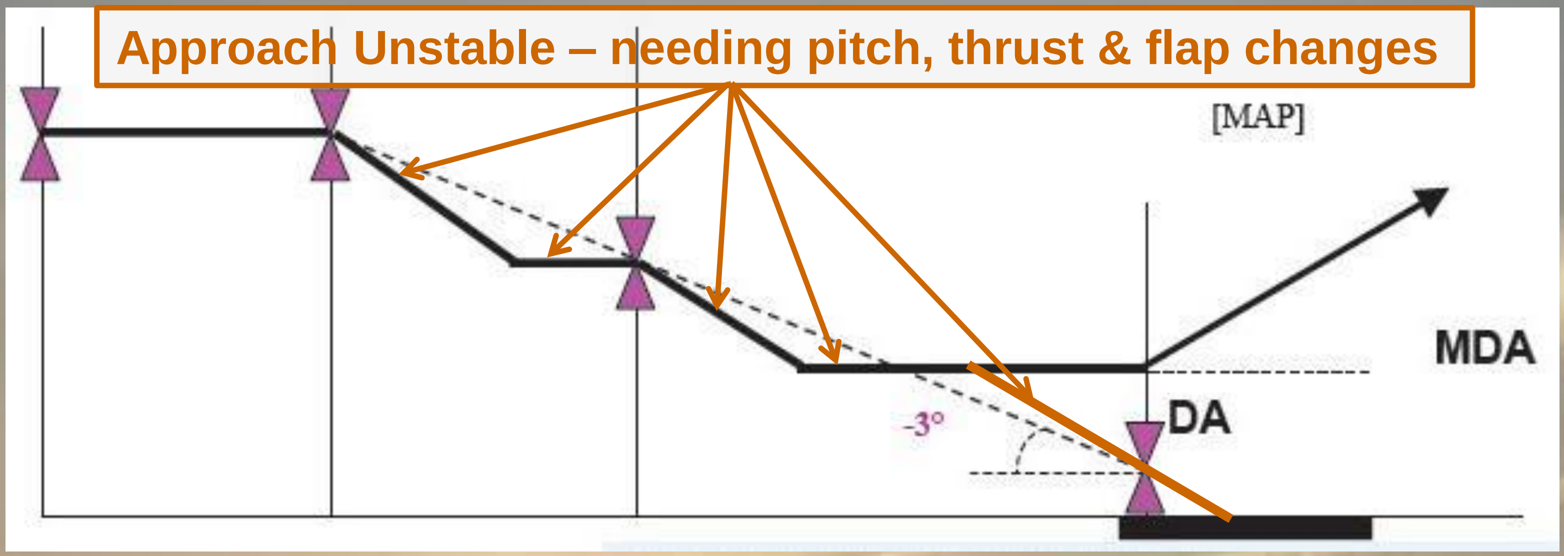


The Difficulty was in Vertical Navigation - Flying below the 3º glide path to crash short of the runway



Hazards of a “Dive & Drive” NPA Profile

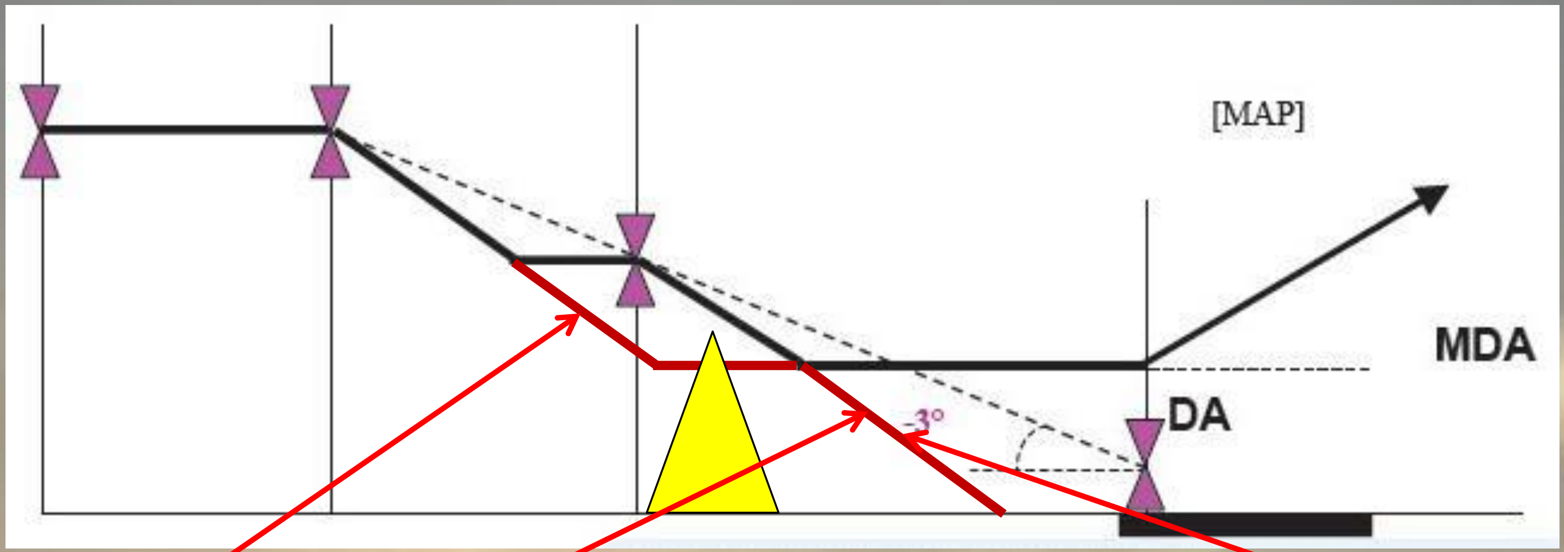
Unstable profile



Unstable profile leading to unstable approaches

Hazards of a "Dive & Drive" NPA Profile

Missed step or late stabilisation causes accidents



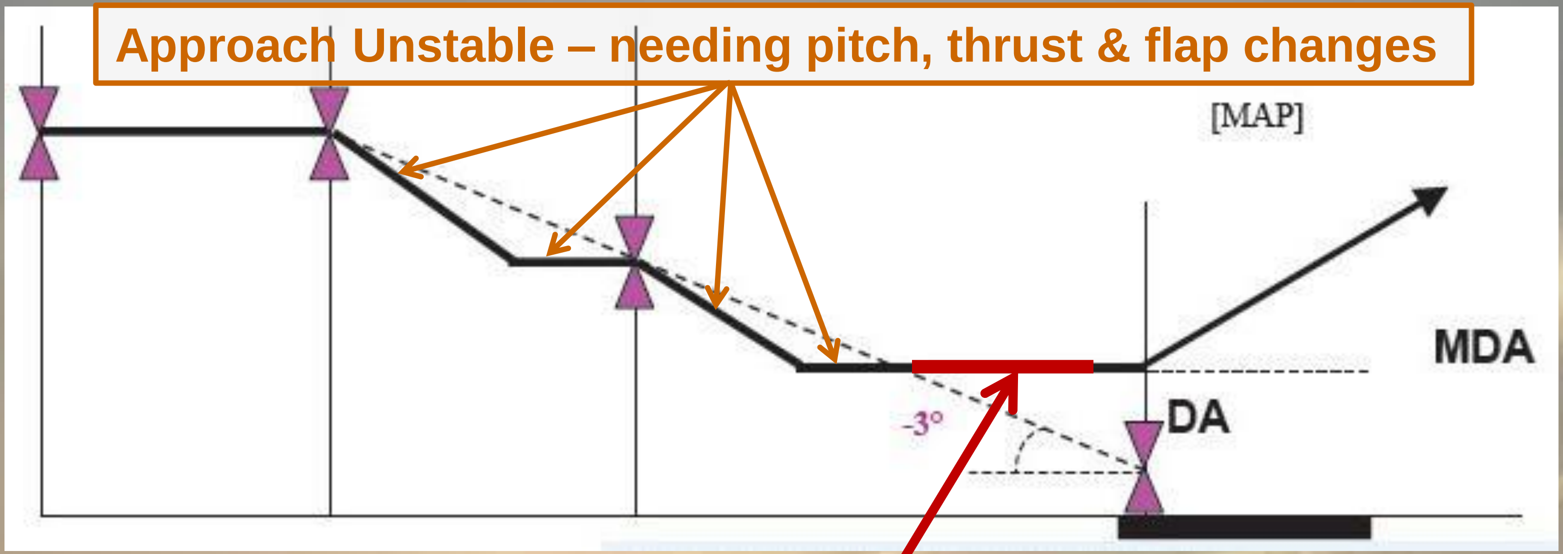
Crew missed a step, stabilised late, or failed to monitor DME-Altitude glideslope

01 Dec 1974 TWA 727 VOR DME approach into Washington Dulles
08 Feb 1989 Flying Tigers 747 VOR DME approach accident into Kuala Lumpur
12 Nov 1995 American MD82 VOR DME approach into Windsor Locks Conn, USA
06 Aug 1997 Korean 747 LOC No Glidepath DME approach accident into Guam
24 Nov 2001 Crossair RJ 100 VOR DME approach accident into Zurich R/W 28
14 Aug 2013 UPS A300-600F LOC-DME into Birmingham Alabama?

Above a small sample – many other accidents/near misses, eg at old HKG Kai Tak IGS Glidepath out approach, a 747 missed a step and descended early towards a hill, but error advised by Hong Kong Approach Radar.

Hazards of a "Dive & Drive" NPA Profile

Chance of hard landing or runway over-run



Flying level pitched up at MDA obtaining visual reference causes late "dive" at the runway with hard or deep landing and runway over-run.

Runway safety related accidents are ICAO's highest accident cause

Late final configuration means checklists being read at low altitude

Start of 747 in 1971 BOAC’s Policy was Constant Angle NPA*
In 1976 Close Call to BAOD 747 flying NPA with 1.5º glidepath

Chart instruction – Descend to Minima. “Black Hole” approach with no visual reference, aircraft brushed palm trees on a small hill during Go Around.

Published Approach started at 2000ft at 12.5nm, 2000ft below 3º glide path

***Using vertical speed & time to runway, but not always practicable.**

A colleague kindly requested to the 747 Flight Management that Dibley Descent Computers be issued to 747 Crews

(1 computer had been on each BOAC aircraft for descent guidance.)

COPY LETTER

From: Captain G.D. Chainey

18 Sherbourne Drive
Windsor
Berkshire

23 August 1976

To: Captain John Hayward,
Flight Manager Technical, B747s

Dear John,

I have read with alarm the latest Accident Summary, specifically re KL.

Now, if a Dibley Descent Computer had been used then I am positive this accident would not have happened. I say this even though a stupidly fast approach was flown, and other undesirable factors came into this one.

Consequently, I now urgently request you to consider making the D.D.C. a personal issue to all 747 Technical Crew, as apart from the total cost being less than 1 enforced night-stop it has the following advantages:

full descend.

3. Ensures never too high, and thus prevents a last minute steep dive-bombing approach as sometimes happens (evidenced by the event markers on the AIDS).

4. Saves fuel on almost every approach and this alone must be enormous in 1 year.

5. Makes a more relaxed and efficient operation all round with it immediately in front of you, stuck on the control column with Bostik Blue Tack or whatever.

In the case of KL Runway 15 it can be seen from the D.D.C. that 3700' Is the ideal height at the VOR/DME for a 3° Glide Slope, or if 2,000' is flown overhead then it should be maintained until approximately 6 DME when a normal descent profile should be set up.

I await your comments on this matter, particularly as to making it a personal issue all around.
I'm sure Hugh would always explain it to you if you so desire.

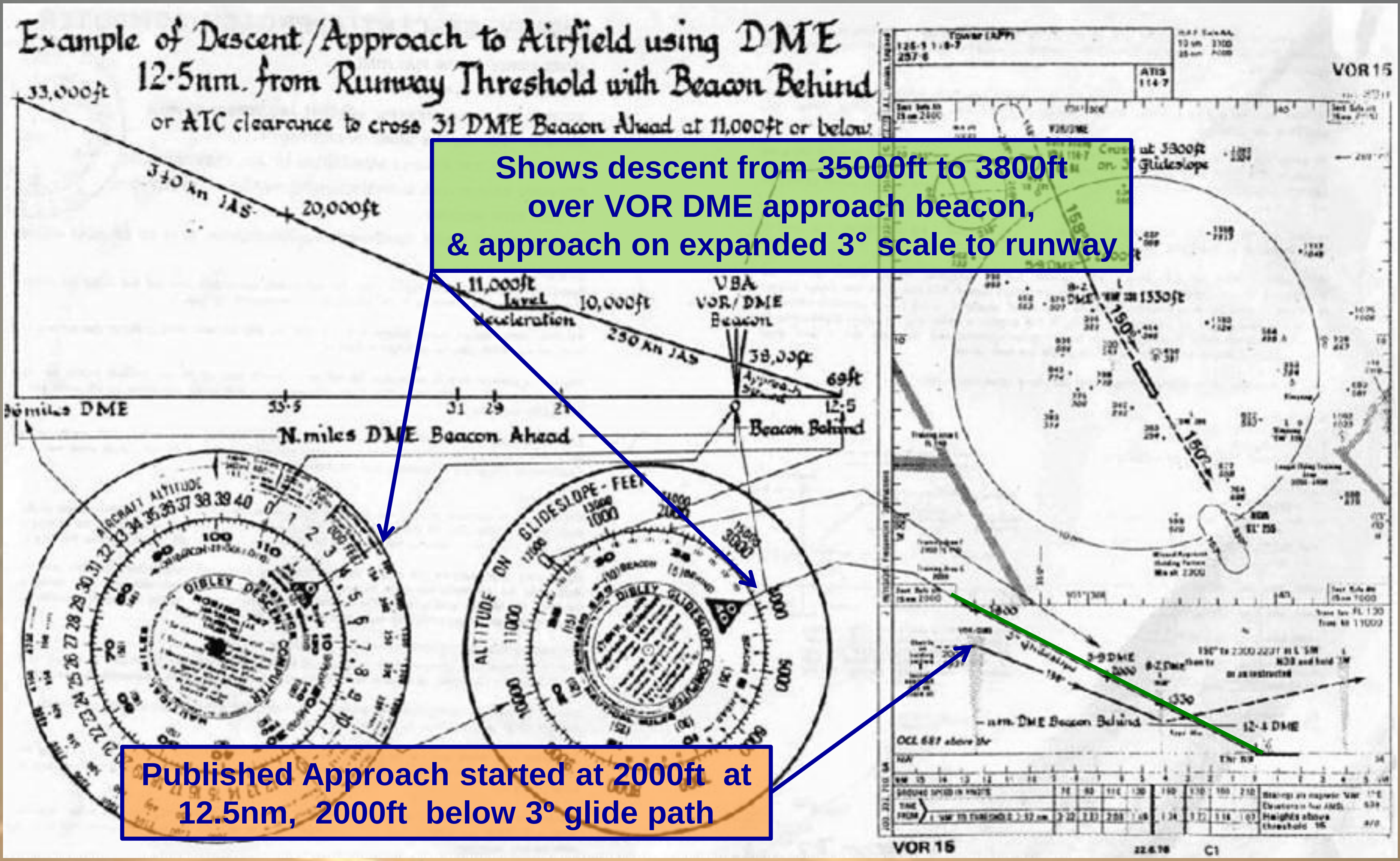
Regards,

(signed)

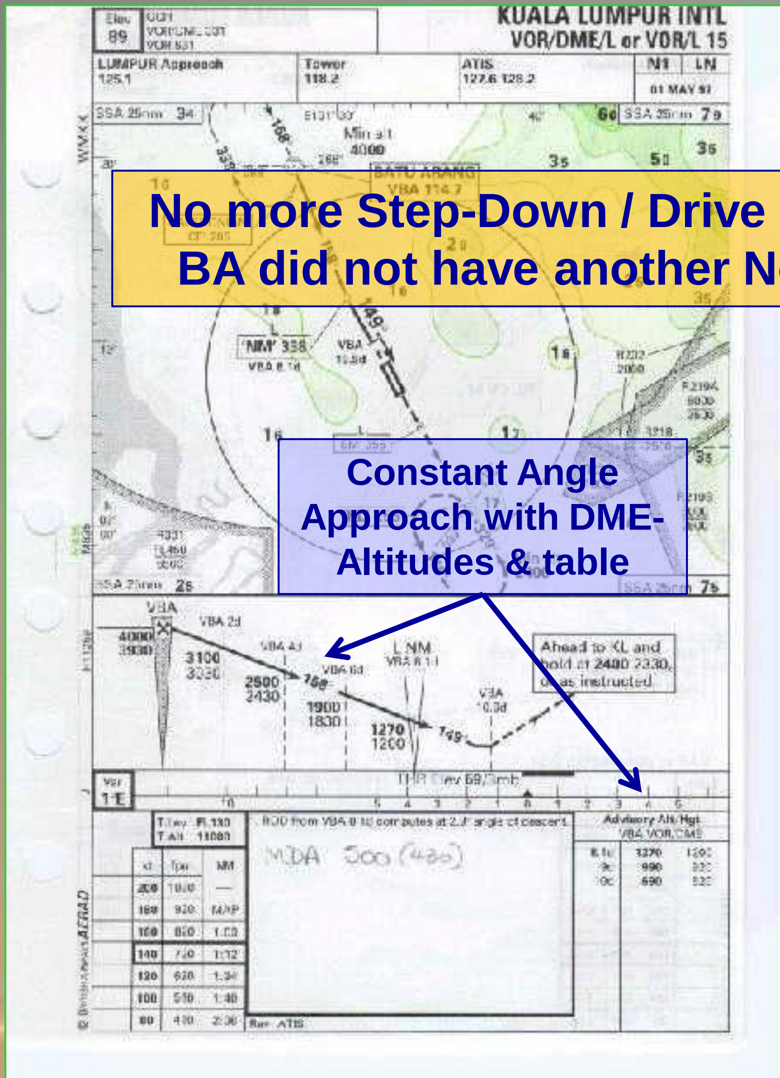
Graham Chainey

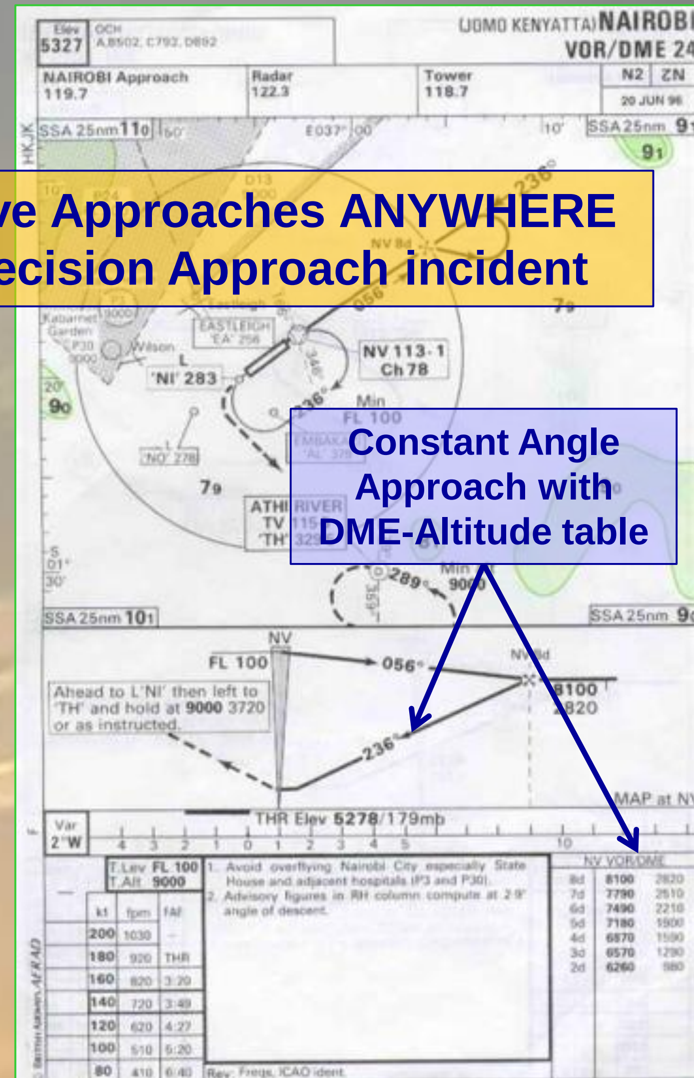
This request was based on the publicity showing the event.

(Was not actioned due to the BOAC-BEA operational re-merger)



The Approach was Re-Drawn Starting at 4000ft BA/Aerad Provided DME-Altitude Tables in 1975 which gave similar information as the slide-rule.



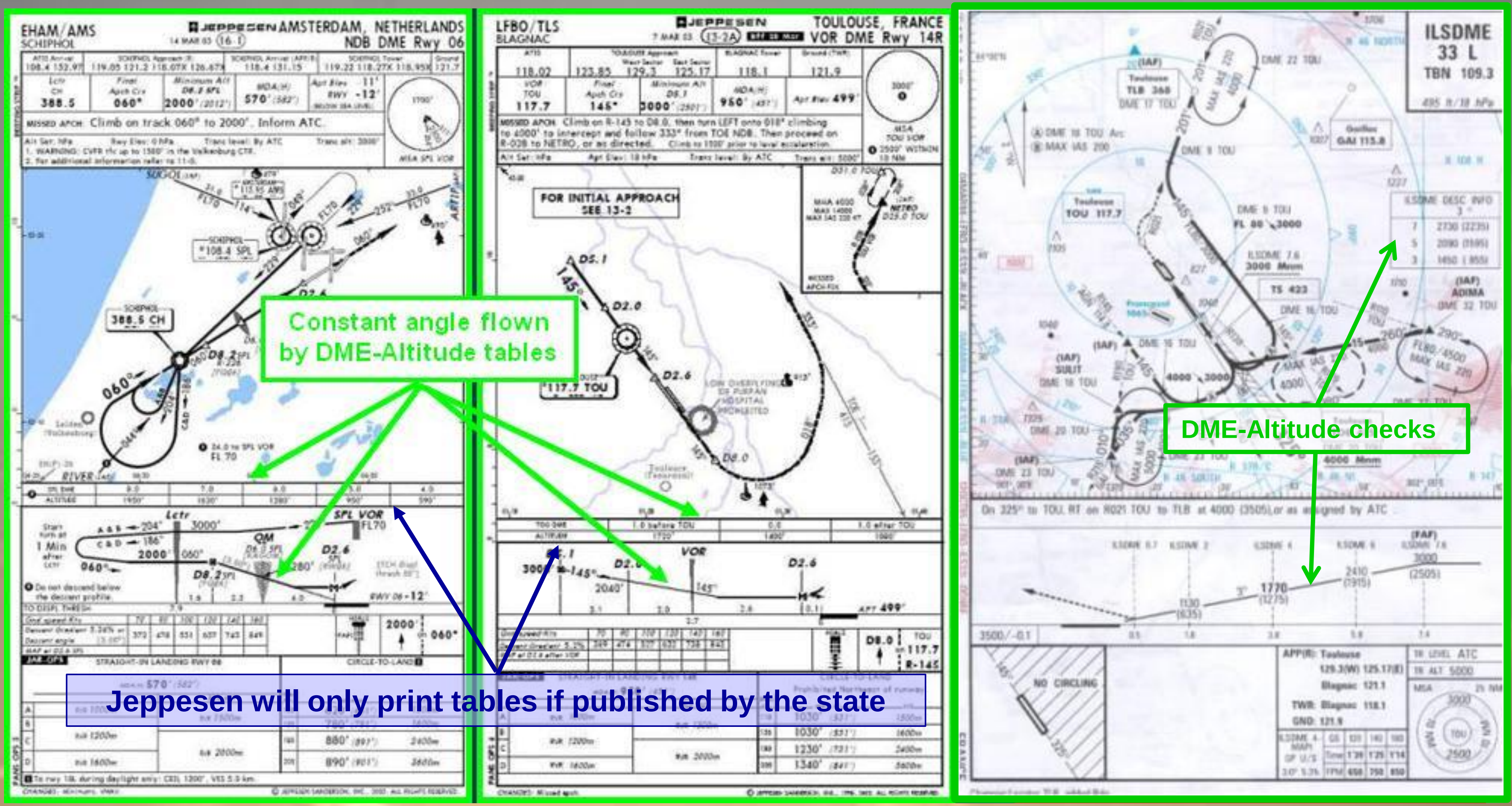


No more Step-Down / Drive & Drive Approaches ANYWHERE
BA did not have another Non Precision Approach incident

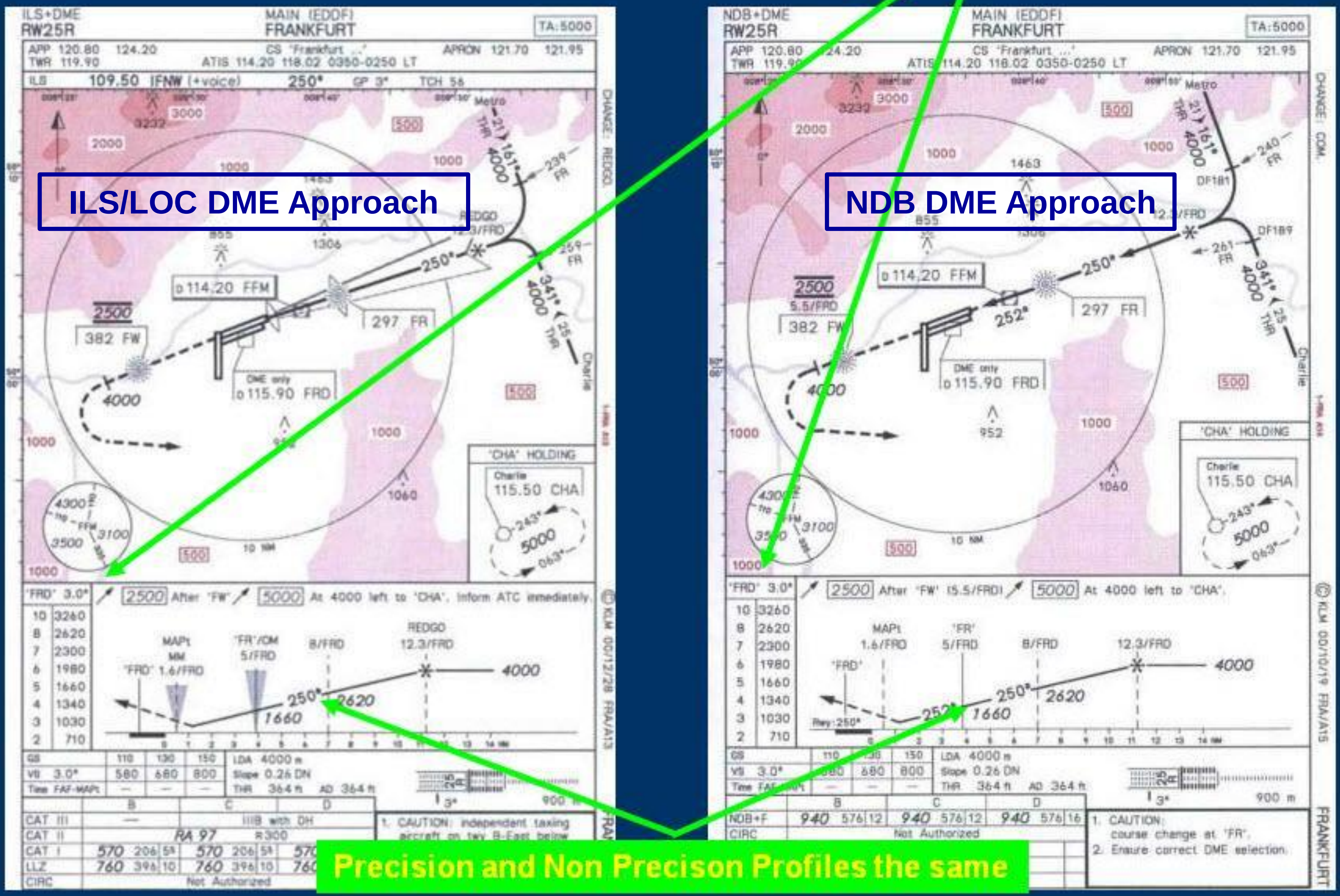
Constant Angle Approach with DME-Altitudes & table

Constant Angle Approach with DME-Altitude table

By the 1980s Most European Authorities provided DME-Altitude Information for Constant Angle NPAs,



KLM ILS and NDB Approach Charts with DME-Altitude Tables



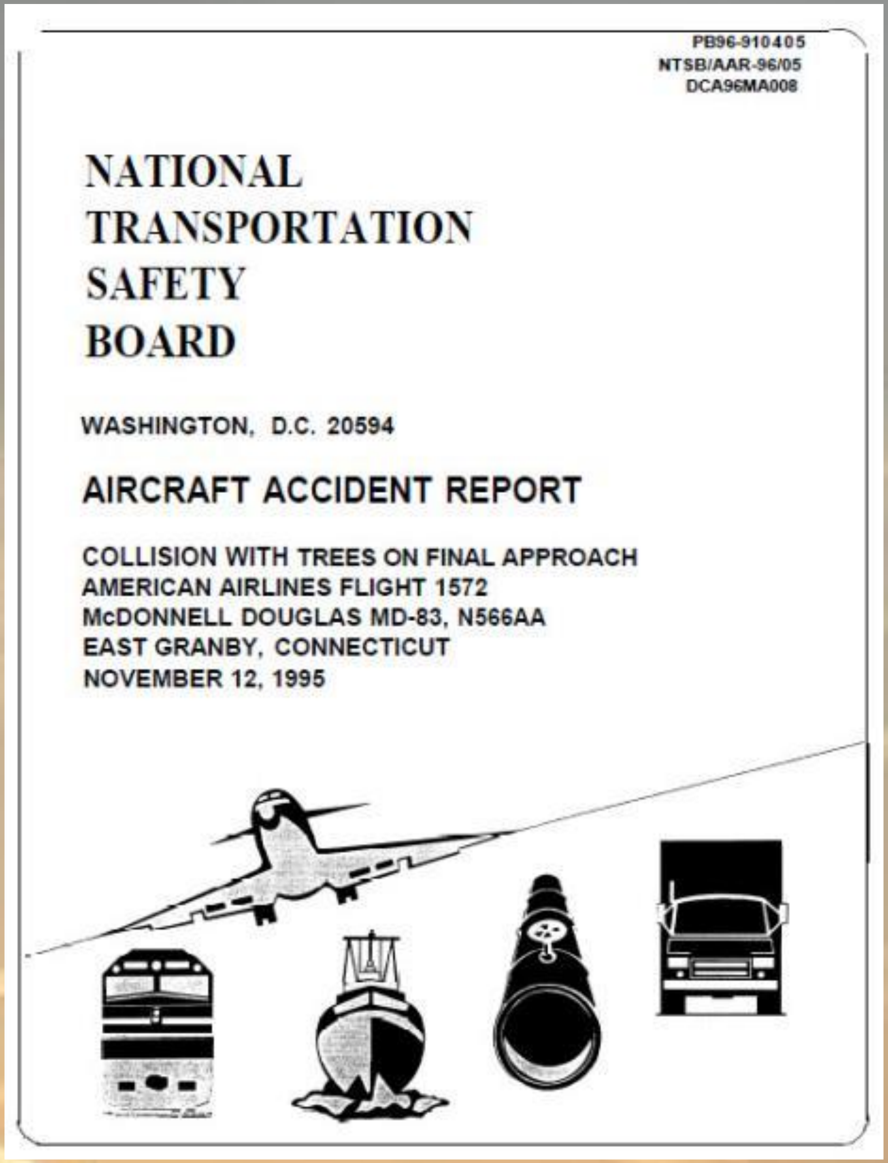
In 1989 Flying Tigers B747 Crashed with the FO flying a VOR-DME Approach in to Kuala Lumpur

Hit hill at 427ft - Final Approach Fix Altitude 2400ft

GPWS "Pull Up, Pull Up" ignored for 25 seconds

(13 years after BAOD's close call into same airfield)

12 November 1995 American Airlines 1572 MD 82
Hit trees on VOR DME Approach into Bradley Connecticut



PB96-910405
NTSB/AAR-96/05
DCA96MA008

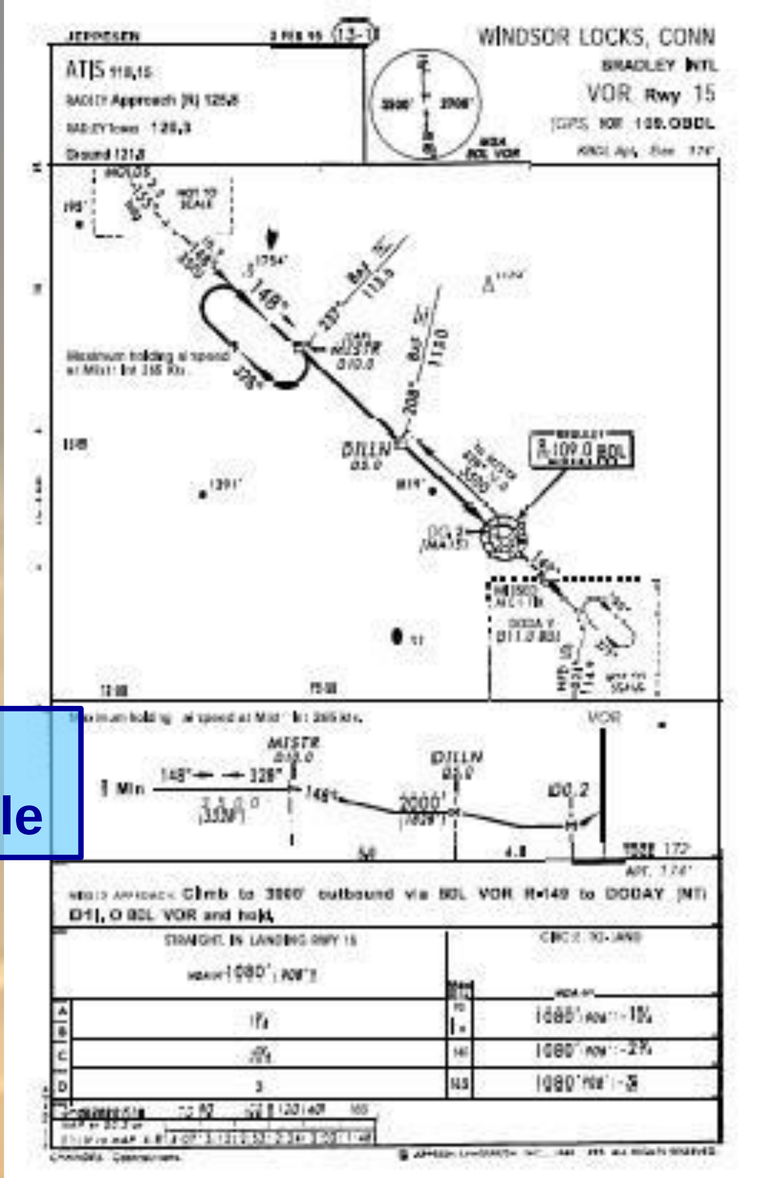
NATIONAL
TRANSPORTATION
SAFETY
BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

COLLISION WITH TREES ON FINAL APPROACH
AMERICAN AIRLINES FLIGHT 1572
McDONNELL DOUGLAS MD-83, N566AA
EAST GRANBY, CONNECTICUT
NOVEMBER 12, 1995

12 November 1995 American Airlines 1572 MD 82
Hit trees on VOR DME Approach into Bradley Connecticut

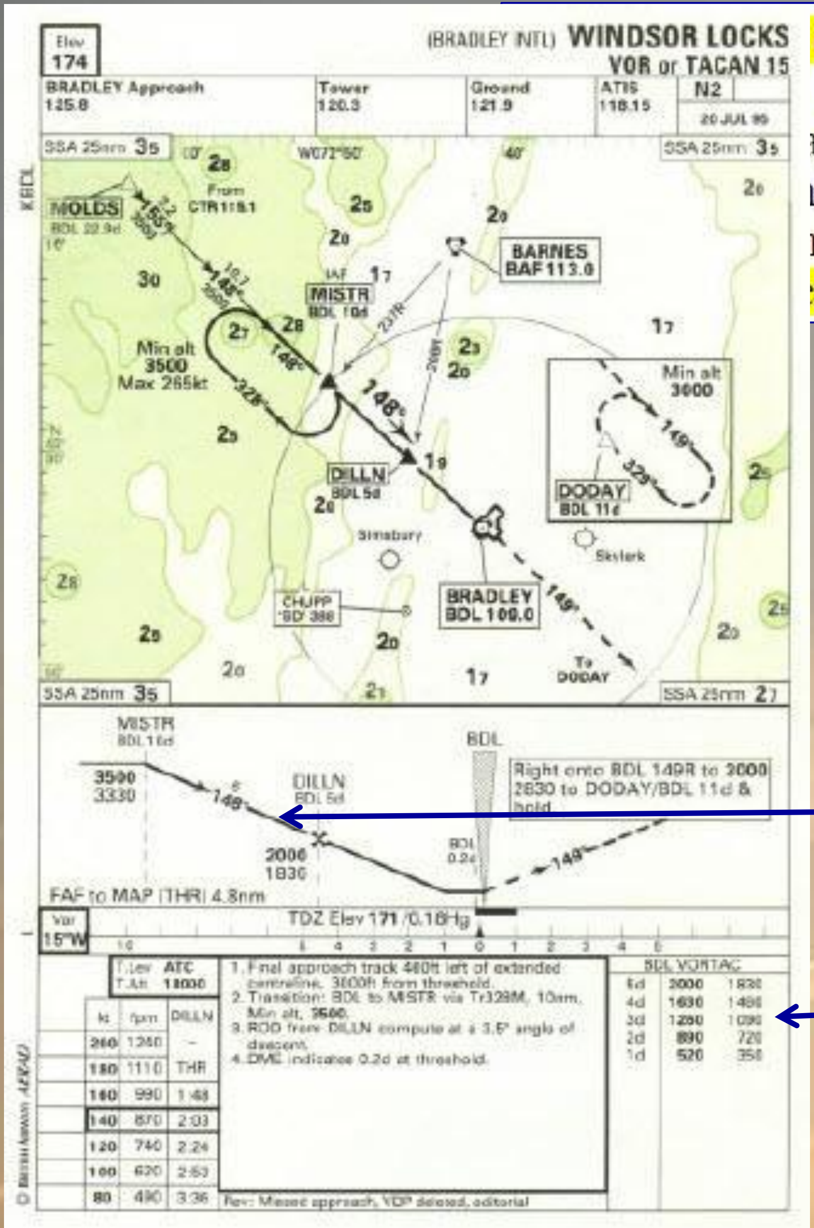


Step Down Profile
No DME Altitude table

NTSB Analysis AA 1572 MD82 12 Nov 95

terrain close to other airports should be fully depicted on the appropriate approach charts. As an example, see Figure 4, the BDL approach plate used by British Airways. The Safety Board continues to believe, as reflected in Safety Recommendation A-96-102, following the accident near Buga, Colombia, that the FAA should require that all approach and navigation charts graphically present terrain information.

NTSB Analysis AA 1572 MD82 12 Nov 95



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As an example, see Figure 4, the BDL approach plate used
ays. The Safety Board continues to believe, as reflected in
endation A-96-102, following the accident near Buga,
e FAA should require that all approach and navigation charts
ent terrain information.

Example given of British Airways chart showing terrain information –
But why no emphasis given to the Constant Angle Approach checked by DME-Altitude table which keeps the aircraft above terrain?

Constant Angle Approach

DME –Altitude Tables to fly Constant Angle Approach of primary assistance

NTSB Conclusions AA 1572 MD82 12 Nov 95

3. CONCLUSIONS

3.1 Findings

17. There is great value in flying non-precision approaches with a constant rate or angle of descent until the airport environment can be visually acquired, if the avionics aboard the airplane can safely support such a procedure.

No additional avionics required.
Just DME-Altitude Cross checks on 3º profile
by tables or slide rule –
as used on hand flown CANPAs since 1970s
on aircraft such as B707s with no FD or autopilot.

NTSB Recommendations - 13 Nov 1996

4. RECOMMENDATIONS

As a result of the investigation of this accident, the National Transportation Safety Board makes the following recommendations:

--to the Federal Aviation Administration:

Evaluate Terminal Instrument Procedures (TERPS) design criteria for non-precision approaches to consider the incorporation of a constant rate or constant angle of descent to minimum descent altitude in lieu of step-down criteria. (A-96-128)

Required descent angle can be followed by flying sink rate for indicated groundspeed – allowing for airspeed wind component changes – adjusted if checks show deviation from profile.

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

B747 Guam August 1997

AIR TRANSPORT

Guam Crash Underscores Navaid, Training Concerns

NTSB culls CVR, FDR for clues to Korean Air crew's familiarity with and execution of approach procedures

LOC GS Out Approach but DME on VOR 3.3 nm short of r/w

Step down / Dive & Drive Approach

No clear DME-Altitude Tables for VNAV checks

Glideslope flag was occasionally cleared by local FM radio station to indicate on the glideslope.

Crash site on hill 660 ft was above MDA of 560 ft for LOC (GS out) approach

AIRBUS

1 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

B747 Guam August 1997
Airbus proposal

The profile is identical to
TLS VOR 14/R
flown successfully by thousands of students of all nationalities, managed or selected approaches.

Airbus policy is to fly Constant Angle Approaches

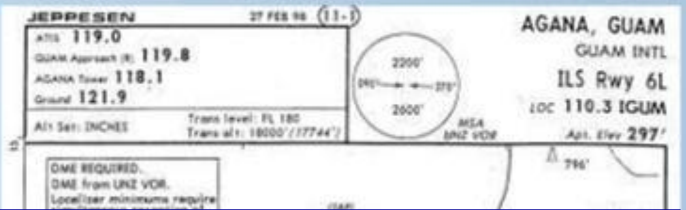
Providing clear DME-Altitude tables, so profile can be cross-checked by crew and easily flown accurately

NTSB report recommendation No 9 erroneously suggests tables showing Altitude - Distance to Runway.	
*** Altitude - Distance to DME ***	
is essential for instant cross-checks	

2 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

B747 Guam August 1997
Airbus proposal



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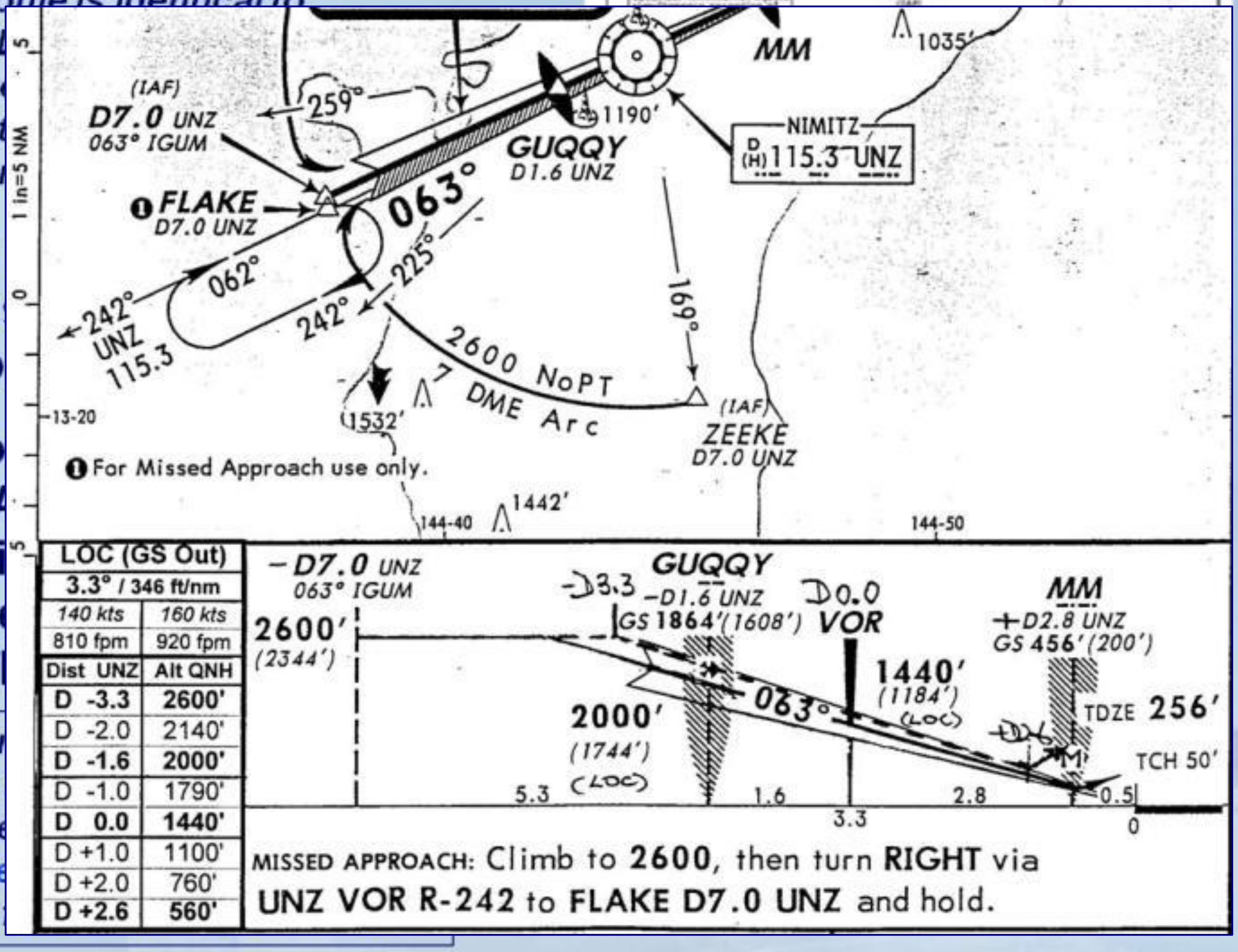

NTSB repo...
erroneously ...
Altitude...
*** Altitude...*
is essential...

2 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

AIRBUS

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

B747 Guam August 1997
Airbus proposal

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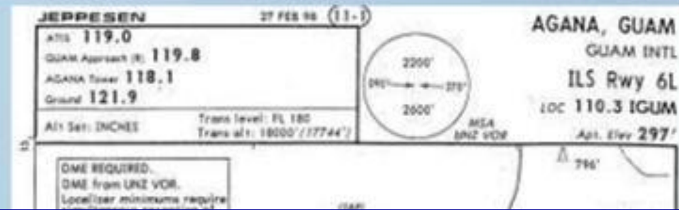

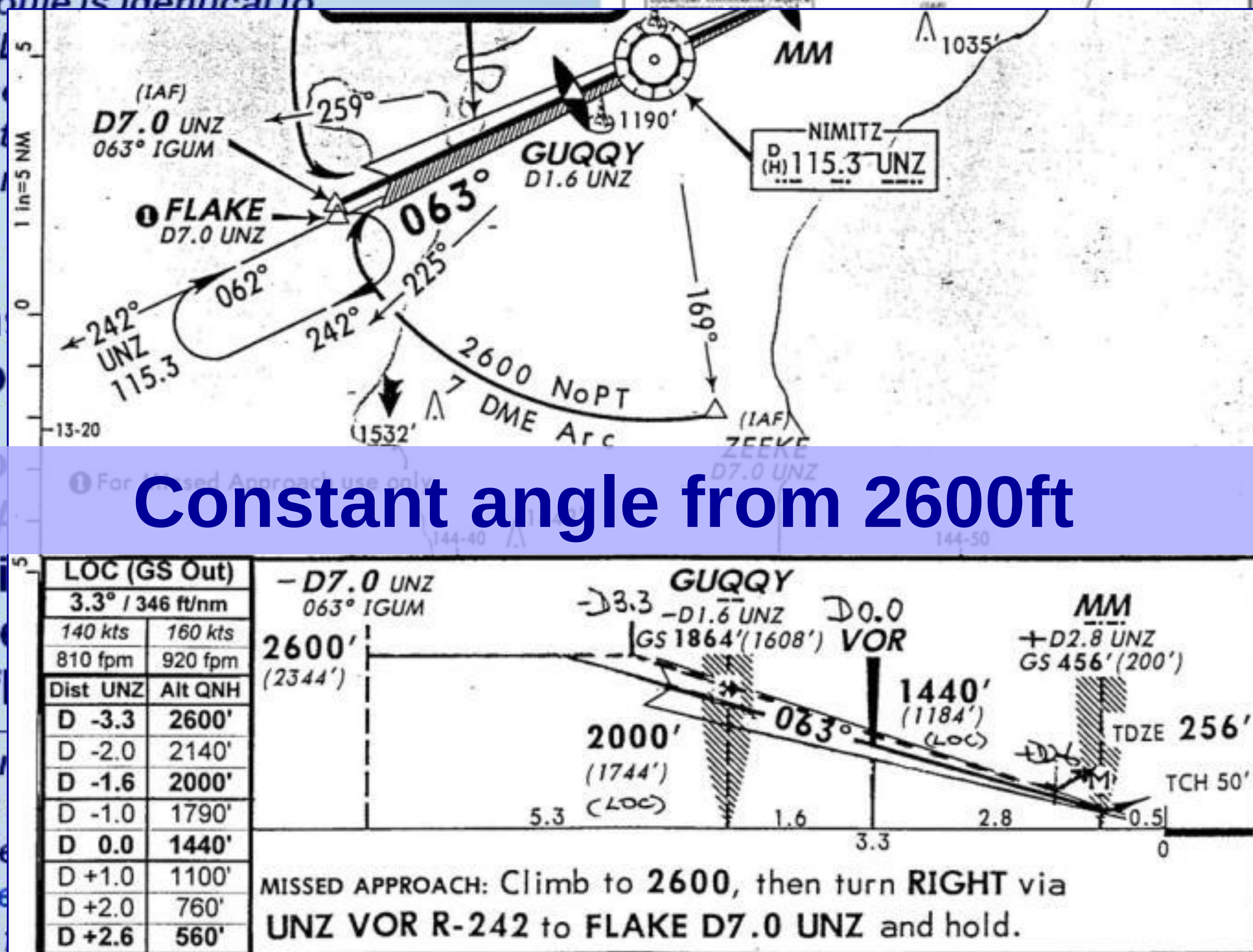

Constant angle from 2600ft

AIRBUS

2 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

B747 Guam August 1997

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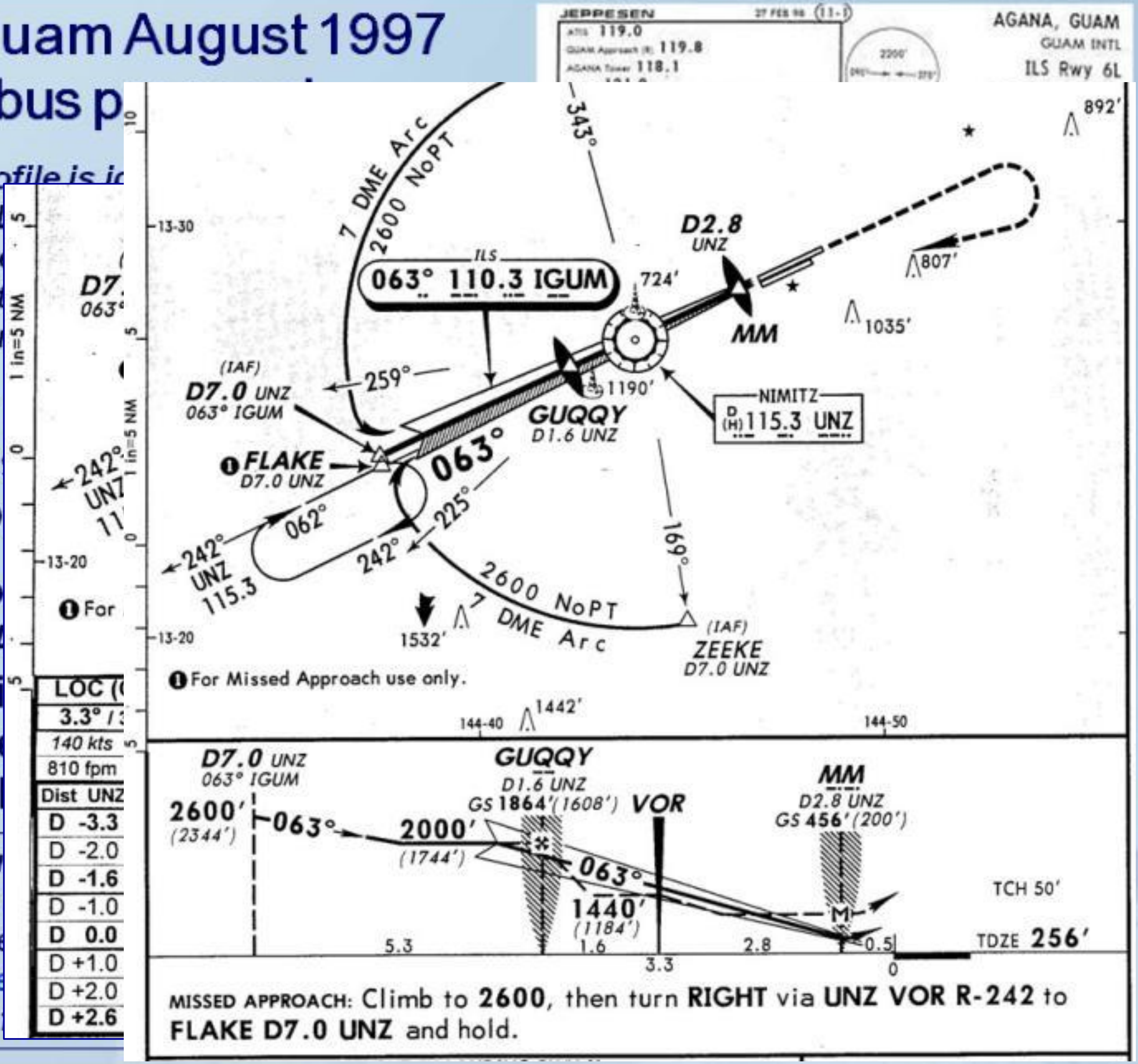
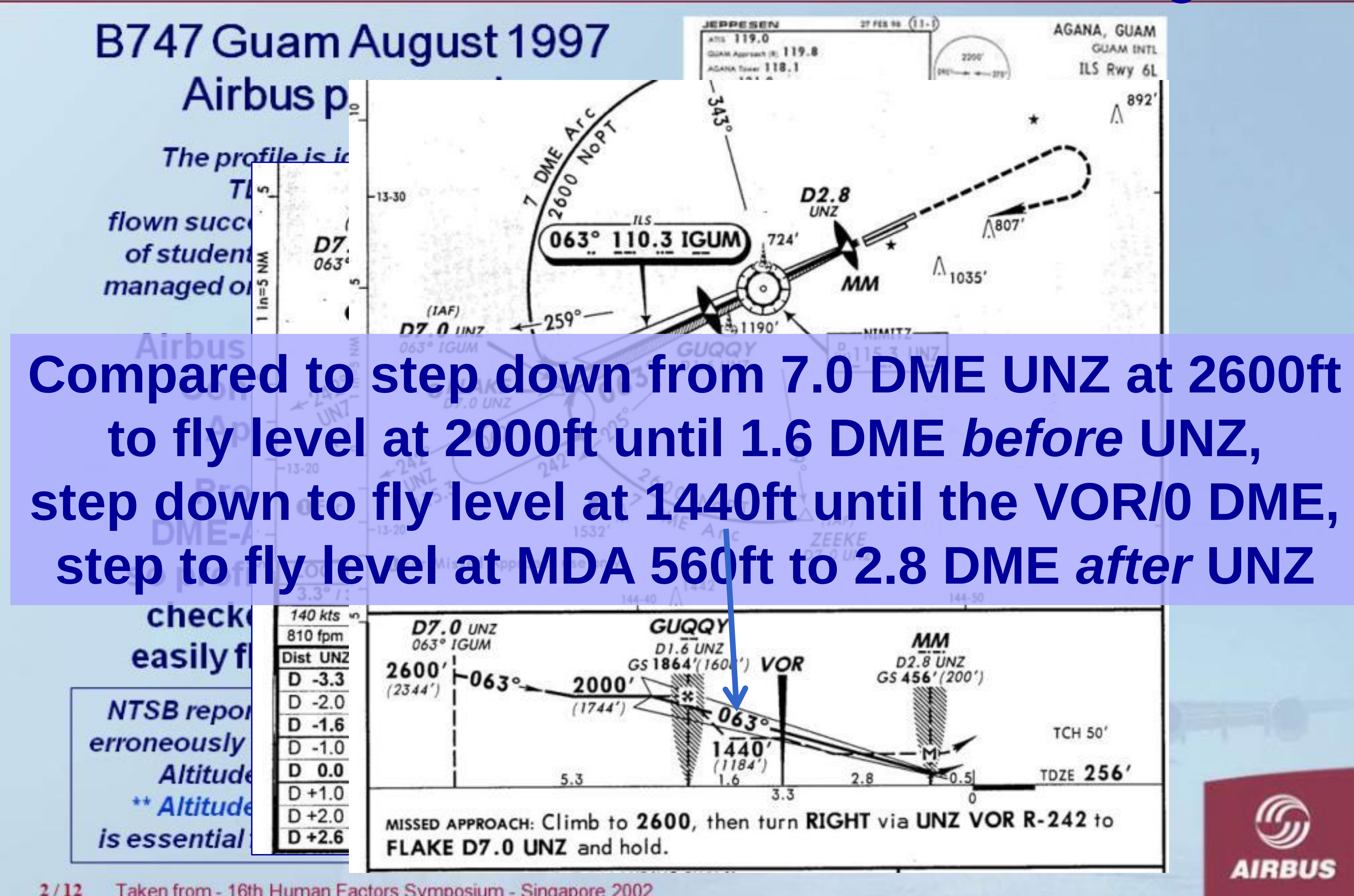


AIRBUS

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

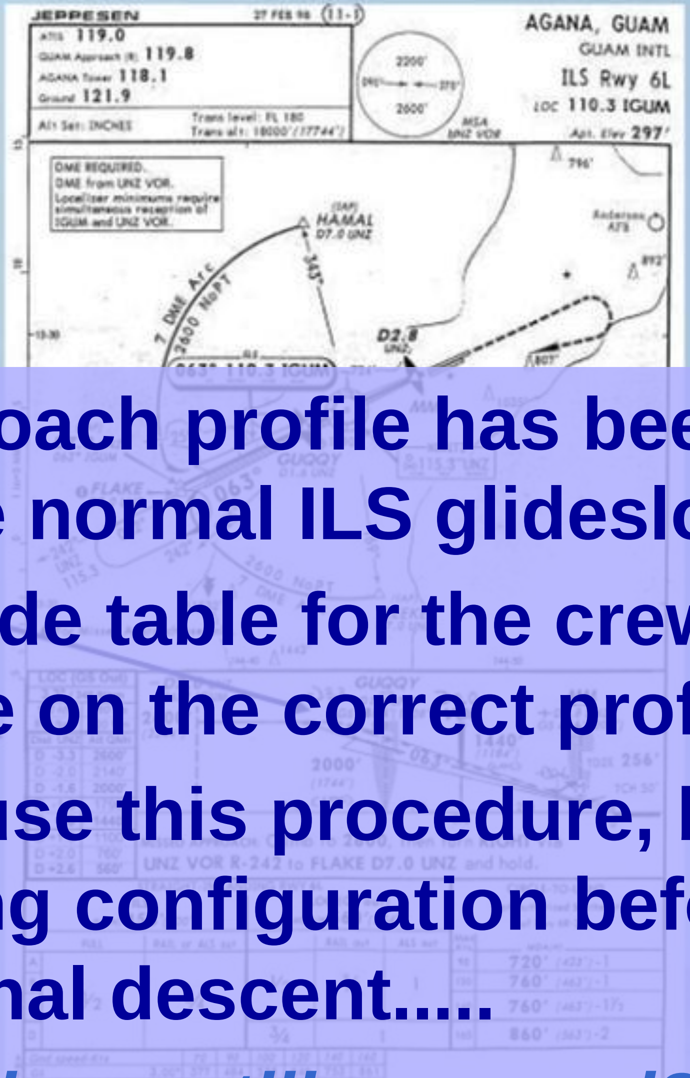


Compared to step down from 7.0 DME UNZ at 2600ft to fly level at 2000ft until 1.6 DME *before* UNZ, step down to fly level at 1440ft until the VOR/0 DME, step to fly level at MDA 560ft to 2.8 DME *after* UNZ

KAL B747-300 CFIT Accident into Guam 6 Aug 1997

B747 Guam August 1997 Airbus proposal

The profile is identical to TLS VOR 14/R flown successfully by thousands of students of all nationalities, managed or selected approaches.



If the LOC GS out approach profile has been a Constant Angle like the normal ILS glideslope, with a clear DME-Altitude table for the crew to check the aircraft to be on the correct profile, and the crew trained to use this procedure, being stabilised in the landing configuration before starting the final descent.....

would the accident have still occurred?

2 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

AIRBUS

NTSB Report of KAL 747 Accident Guam 8 Aug 1997

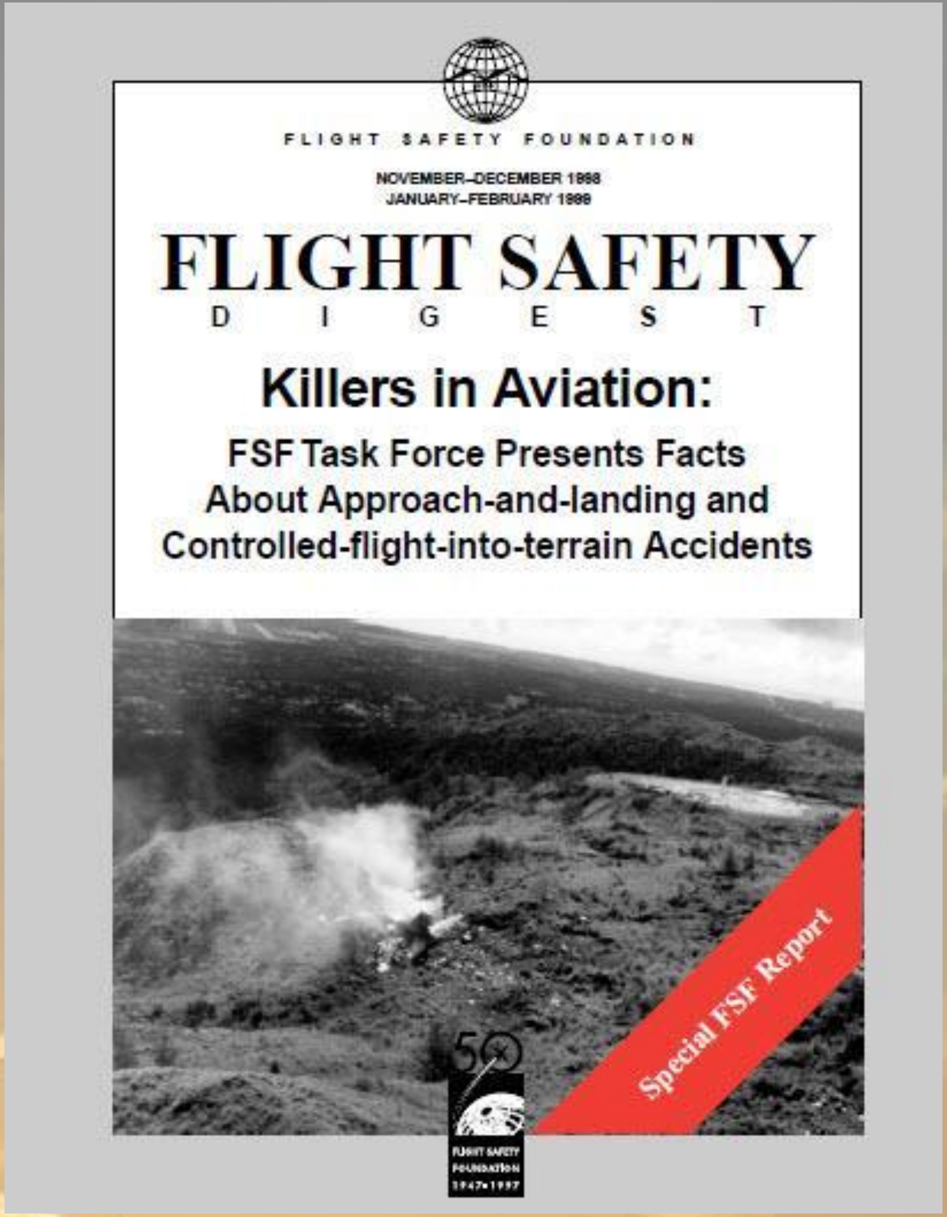
NTSB Report of KAL 747 Accident Guam 8 Aug 1997

NTSB report in FSF May-Jul 2000 FS Digest made 12 recommendations – Aircraft with suitable systems required to provide vertical flightpath guidance for constant angle nonprecision approaches, and all air carriers' aircraft to be so equipped in 10 years.

– **"Tabular information to allow Constant Angle of Descent by cross referencing distance from the airport and barometric altitude."**

But distance from airport is only available from FMS/GPS equipped aircraft so the distance reference must be the local DME when FMS/GPS is not available.

Ability to fly DME-Altitude CANPAs not stressed



Ability to fly DME-Altitude CANPAs not stressed

FSF 278 page **Nov-Dec 1998 CFIT Task Force Report** *only reference?*

Aircraft Equipment Working Group Page 93

"Operators should furnish crews with charts depicting constant-angle profiles and recommended altitudes along the glide path for nonprecision approaches;"

CFIT NPA Accidents Continued – In 2002 Don Bateman, father of GPWS/EGPWS, published 9 NPA CFIT accidents which could have been saved if EGPWS had been fitted

SOME RECENT CFIT ACCIDENT EXAMPLES
SUMMER 2001 TO SUMMER 2002 (ONE YEAR)
IATA SAC 12/13 AND IATA SAC 14

This booklet is an incomplete brief of nine large civil aircraft accidents suspected to be CFIT that have occurred over the last year:

24 Nov 2001	Zurich, SR	RJ-100	24 F of 23
27 Nov 2001	Port Harcourt, Nigeria	B747	1 F of 14
18 Jan 2002	Nr. Ipiales, Colombia	FH-227	26 F
28 Jan 2002	Tulcan, Ecuador	B-727	92 F
12 Feb 2002	Khoramabad, Iran	Tu-154	117 F
15 Apr 2002	Pusan, Korea	B767	130 F of 167
07 May 2002	Tunis, Tunisia	B737	18 F of 62
01 June 2002	George, South Africa	HS-748	3 F of 3
26 July 2002	Tallahassee, Florida	B727	0 of 3

Described on following slides

DME Available for Approach – but No DME-Altitude table to show Constant Descent Approach Angle.

But 5 had DME available but no DME-Altitude tables on the charts which could have avoided an accident.

Crossair RJ 100 CFIT Accident Zurich 24 Nov 2001

RJ100 Zurich November 2001

SAFETY DAVID LEARMOUNT/LONDON

Swiss crash puts noise rules in spotlight

Crossair's fatal crash during final approach to Zurich Kloten airport on 24 November came just a month after a new noise abatement procedure began forcing pilots to use a non-precision approach to the airport at night.

Instrument landing system (ILS) precision approaches were available at Kloten on the night of the crash, when the visibility was poor in light snow, but only on runways affected by the new noise-abatement rules.

Crossair says that its BAE Systems Avro RJ100 (HB-IXM) was "too low" for that stage of its approach, though the airline does not yet know why. Inbound to Zurich from Berlin, it hit the ground in a wooded area 2nm (3km) from the threshold of runway 28. The airline confirms that 21 of the 28 passengers and three out of the crew of five died.

The pilots originally briefed for an ILS approach to runway 14, but were told the approach would be a VOR/DME approach to runway 28. This entails flying on range and bearing information from a navigation beacon on the airfield, but it does not give the glidepath guidance that an ILS provides.

The radio altimeter warned the crew when they reached 500ft (150m) and then 300ft above ground level (AGL), but the crew had still not reported the airfield in sight. Just after that, say investigators, the captain – who was the pilot flying – told the co-pilot he was going-around (abandoning the approach), but it was too late and the aircraft hit tree tops.

The new noise abatement procedures, agreed between Germany and Switzerland, rule out all except essential use of the two main ILS runways (14 and 16) after 22:00 because an approach from the north means the aircraft flies low over southern Germany. The accident occurred at 22:06. Switzerland's aviation authority says that Zurich has been planning to install an ILS for runway 28, but the authority says that it would be more than a year before it could be operational.

The big difference

The Flight Safety Foundation (FSF) says that studies by its Approach and Landing Accident Reduction (ALAR) working group have established that the use of non-precision approaches raises the risk of serious accidents by a multiple of between five and seven compared with statistics for precision approaches. Before the initial ALAR study was published five years ago, it was tacitly accepted by the industry that precision approaches were better, but no-one had established what the difference was. It was also assumed that divergence between performance probably resulted from the fact that small operators at remote airfields usually used non-precision aids. But the ALAR found that, since the crews of large airlines carry out proportionately fewer non-precision approaches than pilots in small aircraft, they are worse at them. Since then the FSF has been campaigning for phasing-out approaches like that used by the RJ100 at Zurich.

12 4-10 DECEMBER 2001 FLIGHT INTERNATIONAL www.flightinternational.com

What was the main threat that caused the accident ?

AIRBUS

3 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

Crossair RJ 100 CFIT Accident Zurich 24 Nov 2001

VOR DME Rwy 28 Chart in use

Threats?

No DME-Altitude Table.

Crew cannot cross-check profile continuously during approach.

PNF unable to monitor properly.

(Aircraft descended below profile and hit hill. Captain remarks having visual contact.)

Dual Segment NPA

Start Approach at 8 DME - 4,000 ft

On 5.3% [3.0°] gradient to 6 DME - 3,360 ft

Continue on 5.3% gradient,

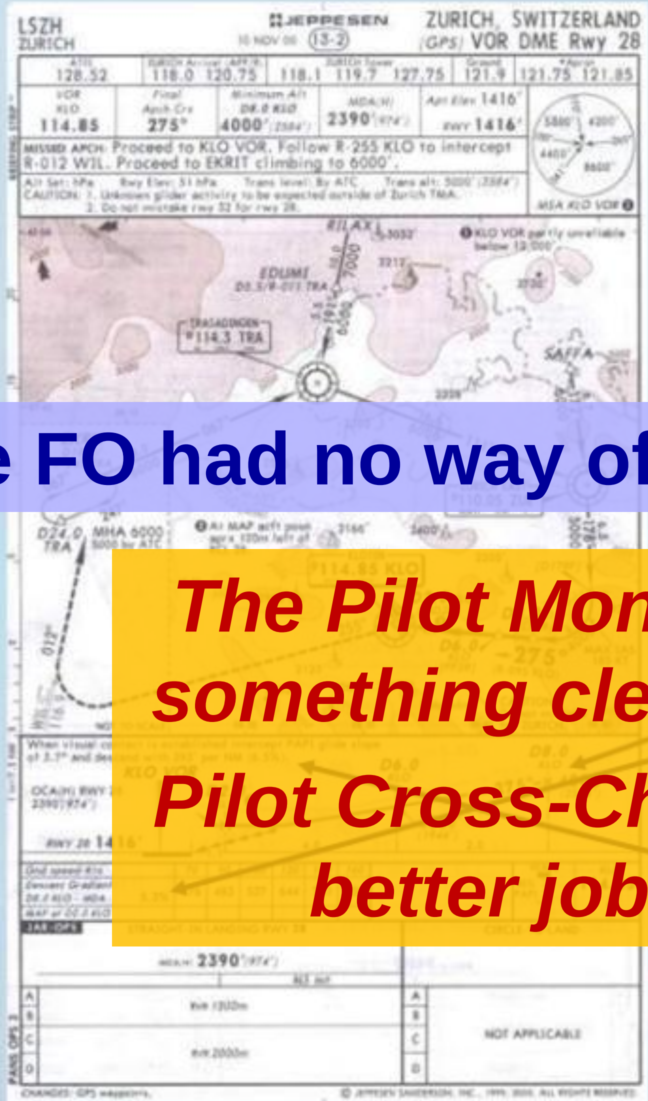
'When in Visual contact with 3.7° PAPIs Descend with 394 ft/nm (6.5%)'

4 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

AIRBUS

Crossair RJ 100 CFIT Accident Zurich 24 Nov 2001

VOR DME Rwy 28 Chart in use



Threats?

No DME-Altitude Table.

Crew cannot cross-check profile continuously during approach.

PNF unable to monitor properly.

(Aircraft descended below profile and hit hill. Captain remarks having visual contact.)

The FO had no way of monitoring the descent path.

Start Approach

0 ft

ient to

6 DME - 3,360 ft

radient,

'When in Visual contact with 3.7° PAPIs

Descend with 394 ft/nm (6.5%)'

The Pilot Monitoring must have something clear to monitor with.

Pilot Cross-Checking might be a better job requirement?

4 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

AIRBUS

Crossair RJ 100 CFIT Accident Zurich 24 Nov 2001

Airbus chart with 3.7° DME-Altitude Table

Threat Reduction :
Constant Angle NPAs are now recommended by ICAO.
Should not also standardised DME-Altitude tables required to be shown on all charts?

Airbus FMGC Database contains ZRH 28 VOR DME Approach with 3.7° Profile, which can be flown 'managed', automatically to MDA.

The same 3.7° approach can easily be flown selected, using a DME – Altitude Table.
Providing a simple monitoring task, even for inexperienced crew members.

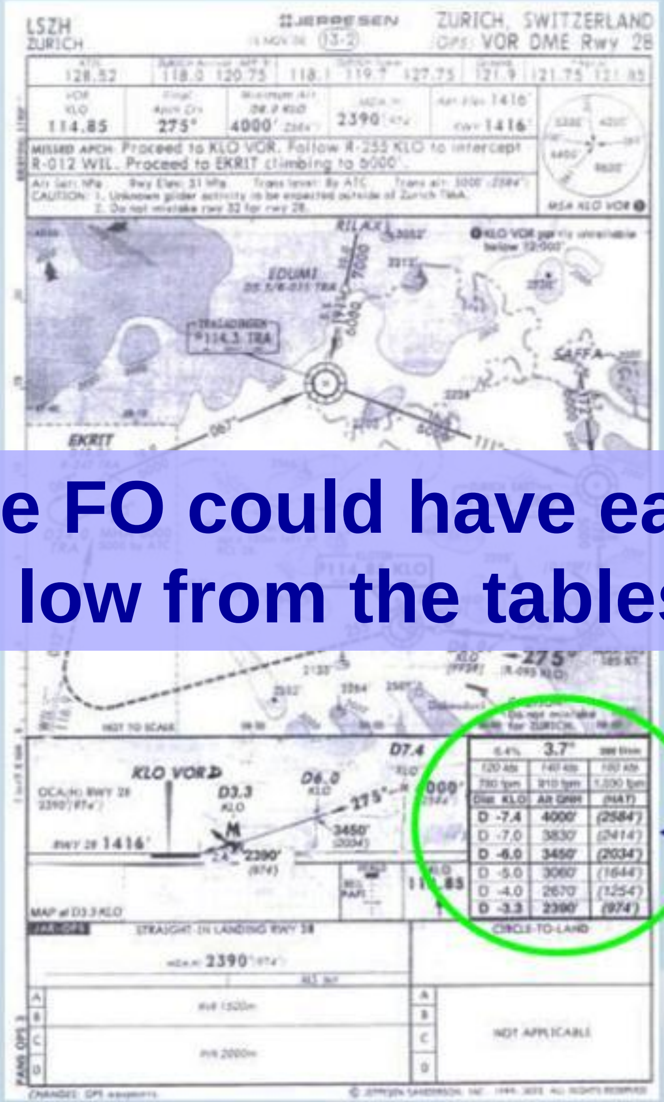
max 3.15° GS only applies to Cat 3

AIRBUS

5 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

Crossair RJ 100 CFIT Accident Zurich 24 Nov 2001

Airbus chart with 3.7° DME-Altitude Table



Threat Reduction :
Constant Angle NPAs are now recommended by ICAO.
Should not also standardised DME-Altitude tables required to be shown on all charts?

Airbus FMGC Database contains ZRH 28 VOR DME Approach with 3.7° Profile which can be flown 'managed',

The FO could have easily checked the aircraft was low from the tables and advised the captain.

The same 3.7° approach can easily be flown selected, using a DME – Altitude Table.
Providing a simple monitoring task, even for inexperienced crew members.

max 3.15° GS only applies to Cat 3

AIRBUS

5 / 12 Taken from - 16th Human Factors Symposium - Singapore 2002

In a recent accident crew responded to EGPWS but then lost control during the Go Around

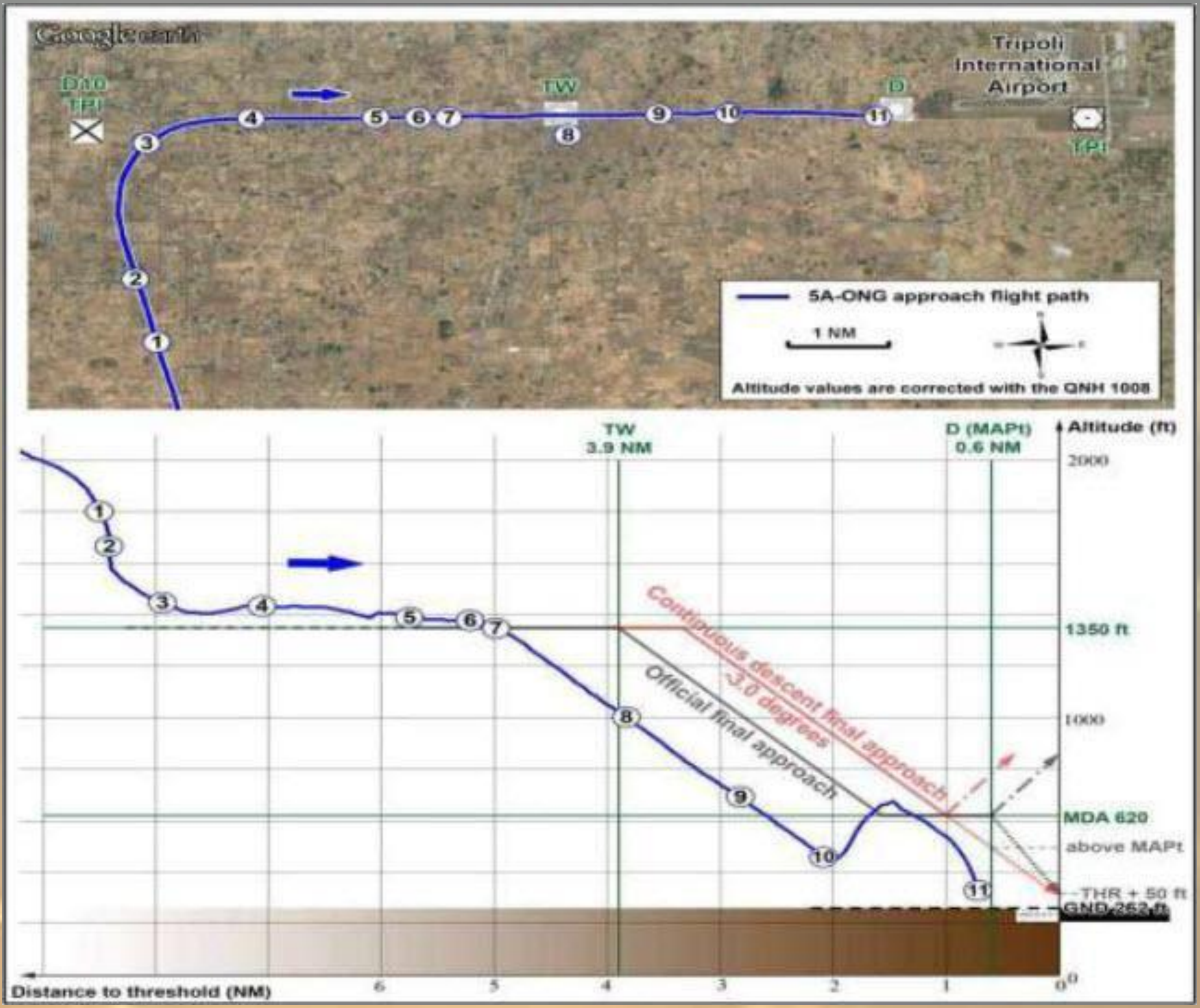
On 12 May 2010 Afriqiyah A330 Crashed during Go Around after an incorrectly flown NDB Approach


Libyan Civil Aviation Authority

Final Report

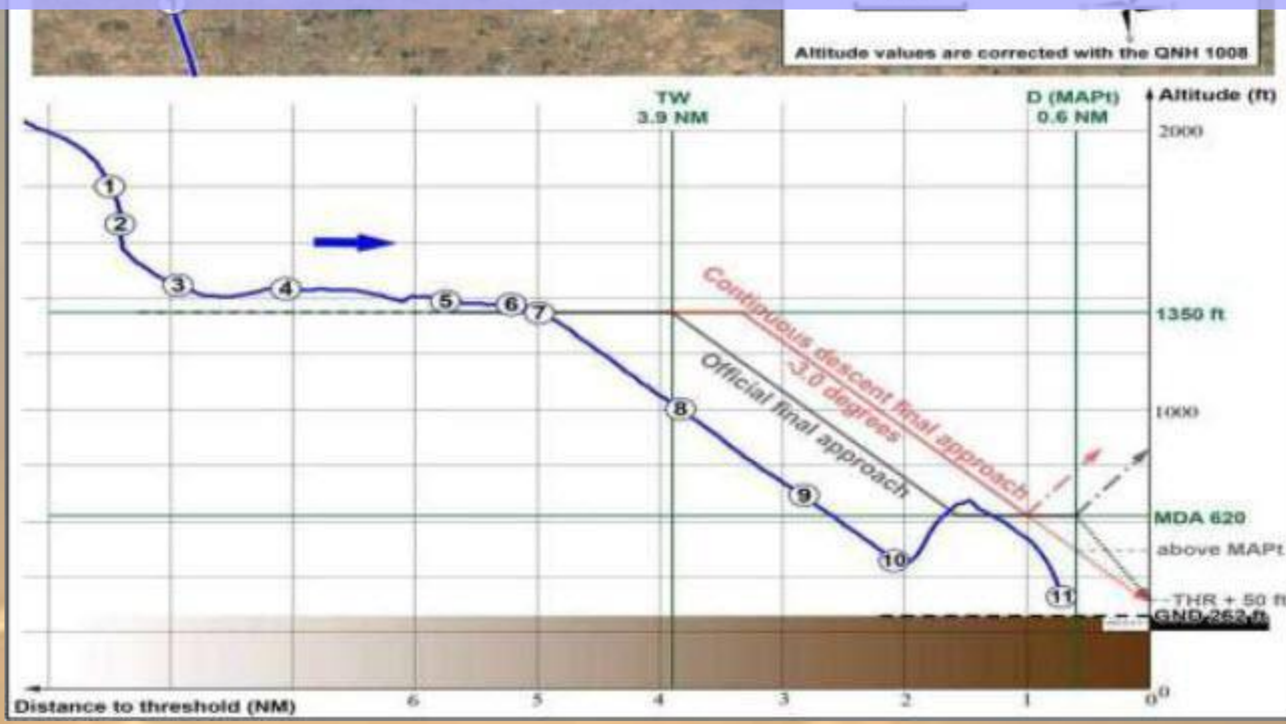
of AFRIQIYAH Airways Aircraft
Airbus A330-202, 5A-ONG Crash
Occurred at Tripoli (LIBYA)
on 12/05/2010

On 12 May 2010 Afriqiyah A330 Crashed during Go Around after an incorrectly flown NDB Approach

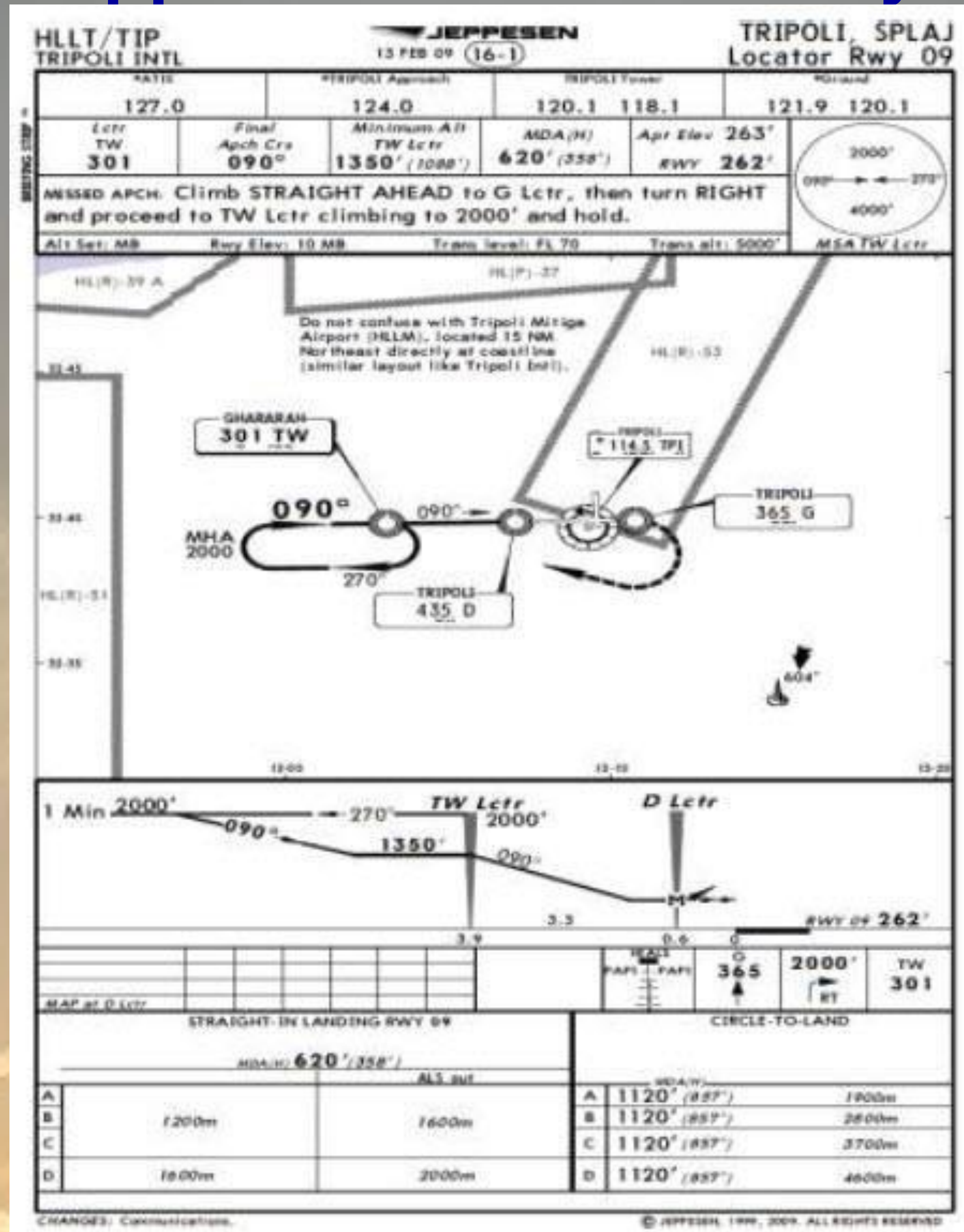


On 12 May 2010 Afriqiyah A330 Crashed during Go Around after an incorrectly flown NDB Approach

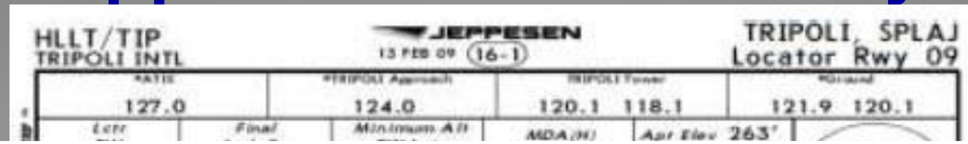
The FO selected the correct Flight Path Angle for the final approach but about 1.8 nm early. Perhaps because confused with the DME distance to descend on a separate VOR DME approach.



NDB Approach Chart Used by crew



NDB Approach Chart Used by crew



Final Report
of AFRIQIYAH Airways Aircraft
Airbus A330-202, 5A-ONG Crash
Occurred at Tripoli (LIBYA) on 12/05/2010
1.17.2.1.5 Documentation on board
"The Jeppesen chart did not provide any glide path after the FAF and did not include the table in the official map identifying crossing altitudes in relation the distance to the runway threshold 09 and rates of descent in relation the speed of the aircraft."

Need for Distance-Altitude Tables in Future Aircraft

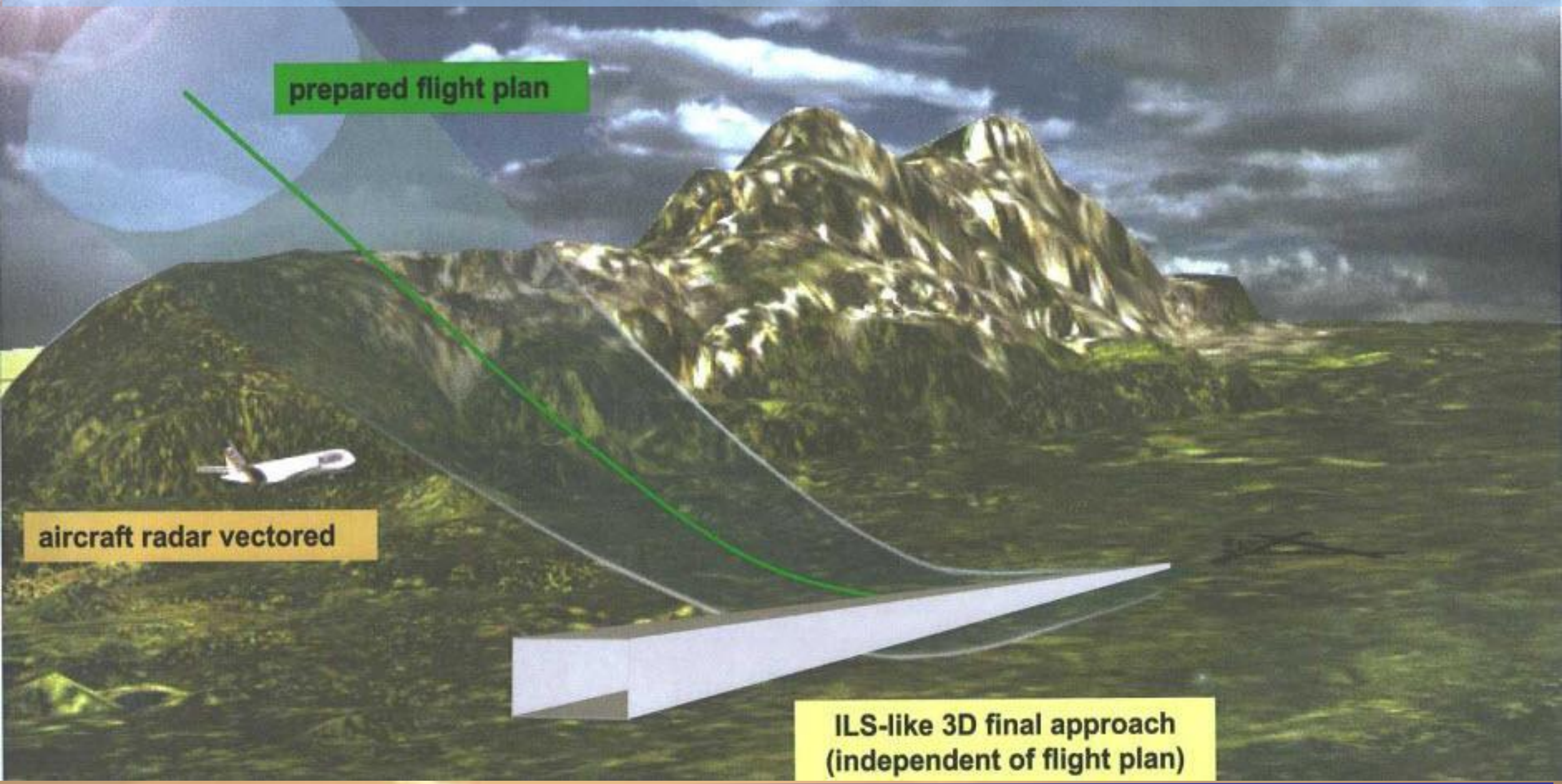
Need for Distance-Altitude Tables in Future Aircraft

Need for Distance-Altitude Tables in Future Aircraft

Latest Airbus aircraft can fly FLS – ILS Look-alike

Fms generated **L**anding **S**ystem

(other manufacturers have similar systems)



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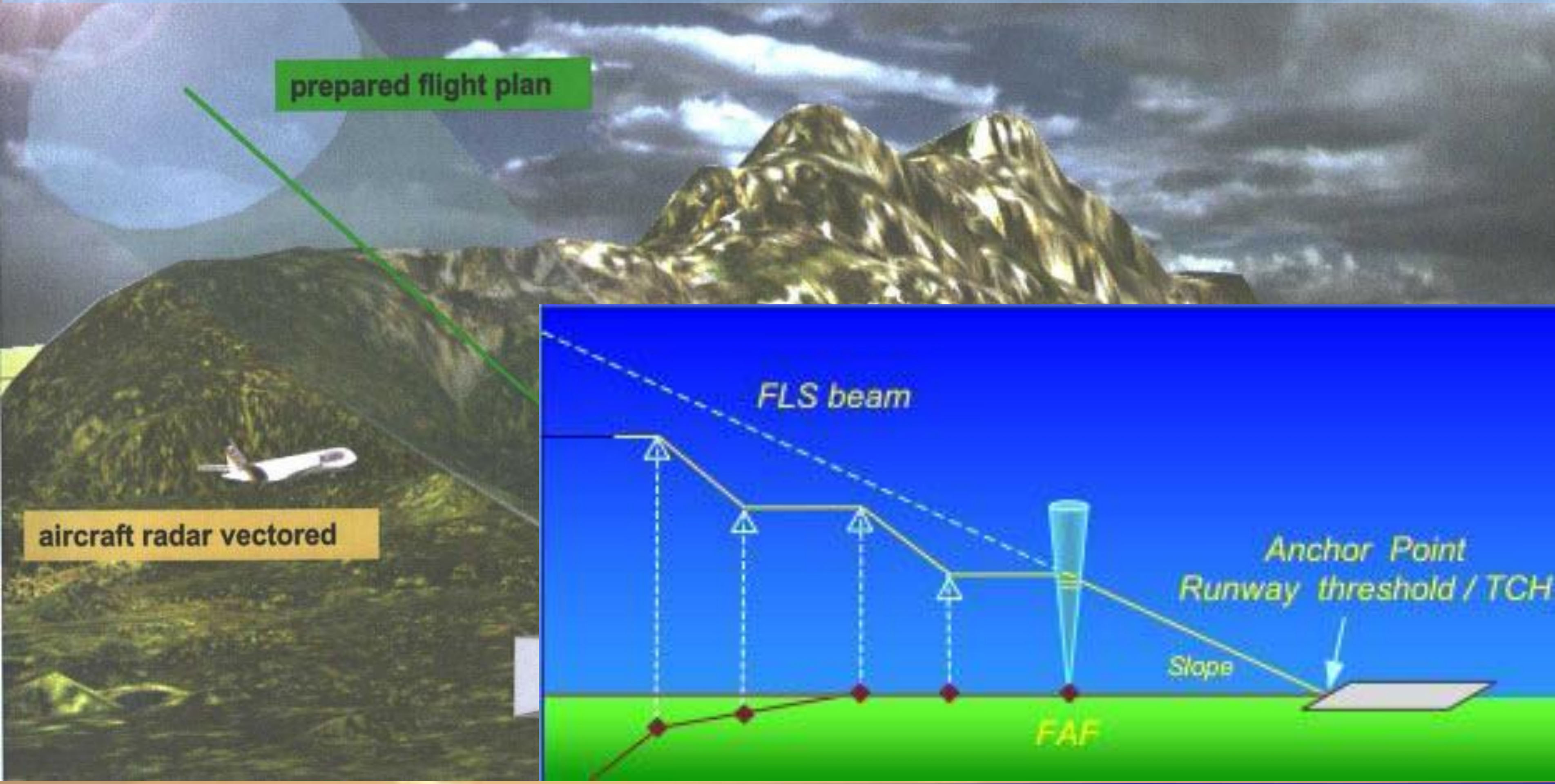
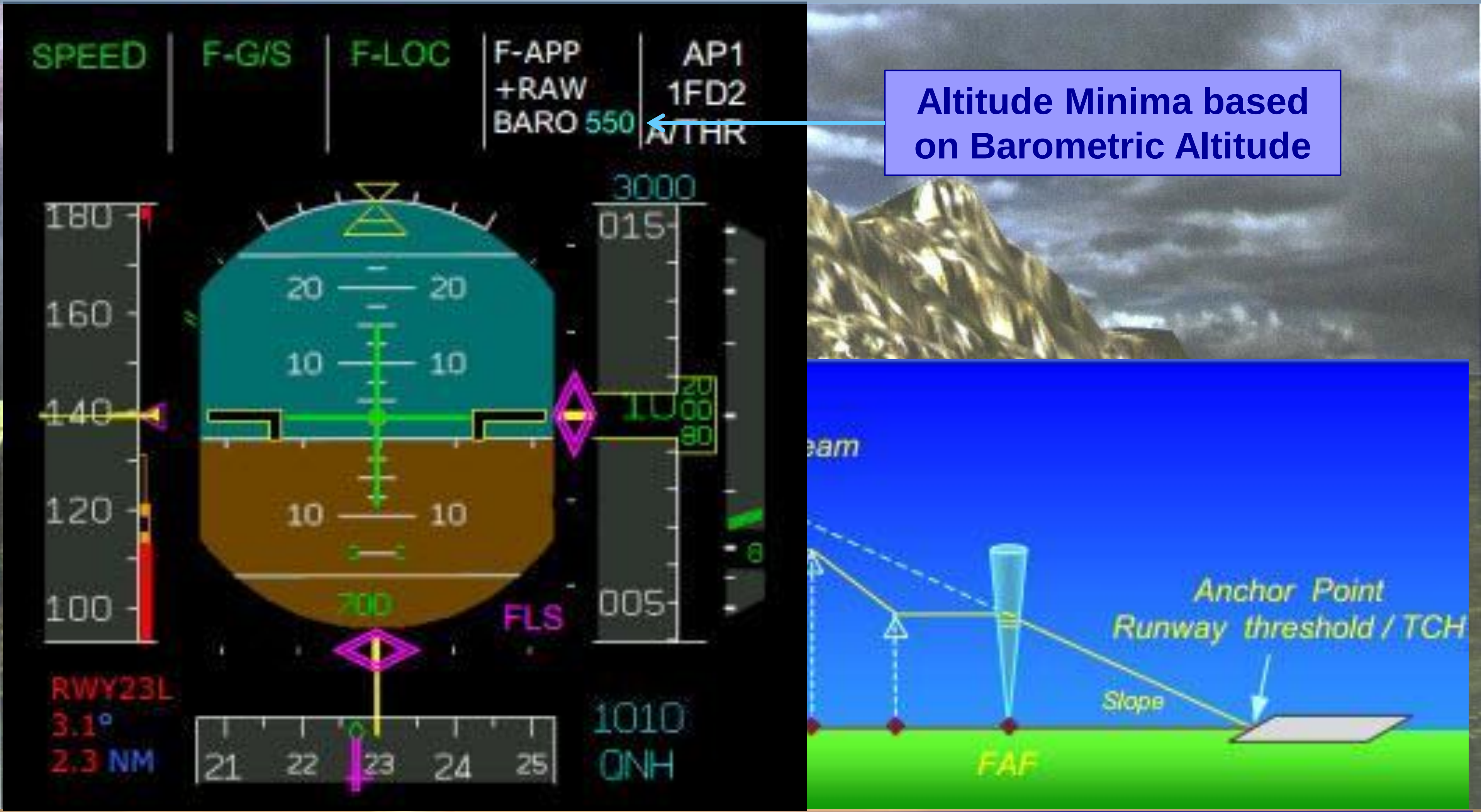


Need for Distance-Altitude Tables in Future Aircraft

Latest Airbus aircraft can fly FLS – ILS Look-alike

(**F**ms generated **L**anding **S**ystem)



Need for Distance-Altitude Tables in Future Aircraft

Latest Airbus aircraft can fly FLS – ILS Look-alike
(**F**ms generated **L**anding **S**ystem)

Based on GPS and independent of any ground aid.
If "GPS Primary" no accuracy checks required. ***But***

As Minima based on Barometric Altitude a Distance-Altitude check required on the glideslope to confirm the correct QNH/altimeter setting has been set....remember
Events show incorrect QNH values are still passed by ATC

therefore Distance to Runway-Altitude info required.

If systems are downgraded due to aircraft or GPS failures navigation may revert to raw data, ***therefore***

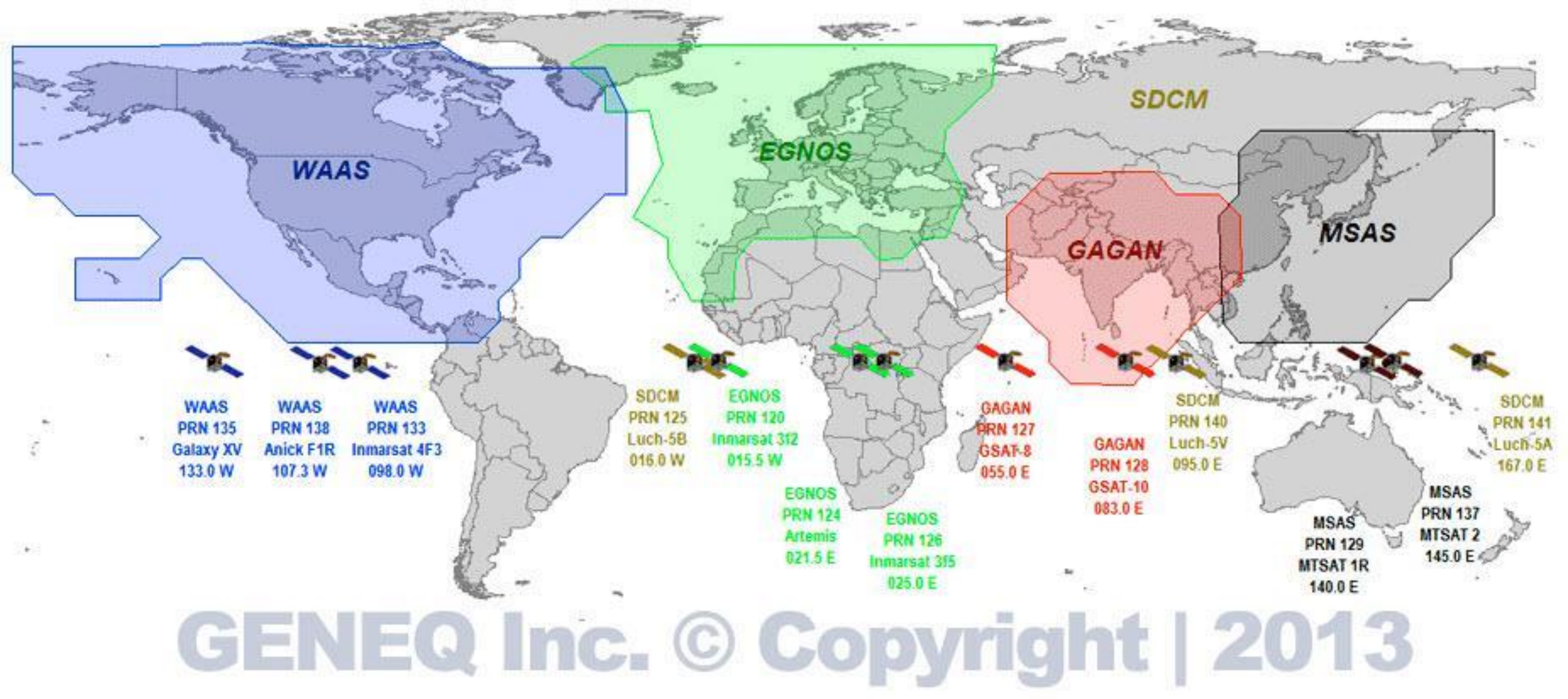
DME-Altitude distance info may occasionally be required.

Chart tables will be required for the foreseeable future!

Need for Distance-Altitude Tables in Future Aircraft

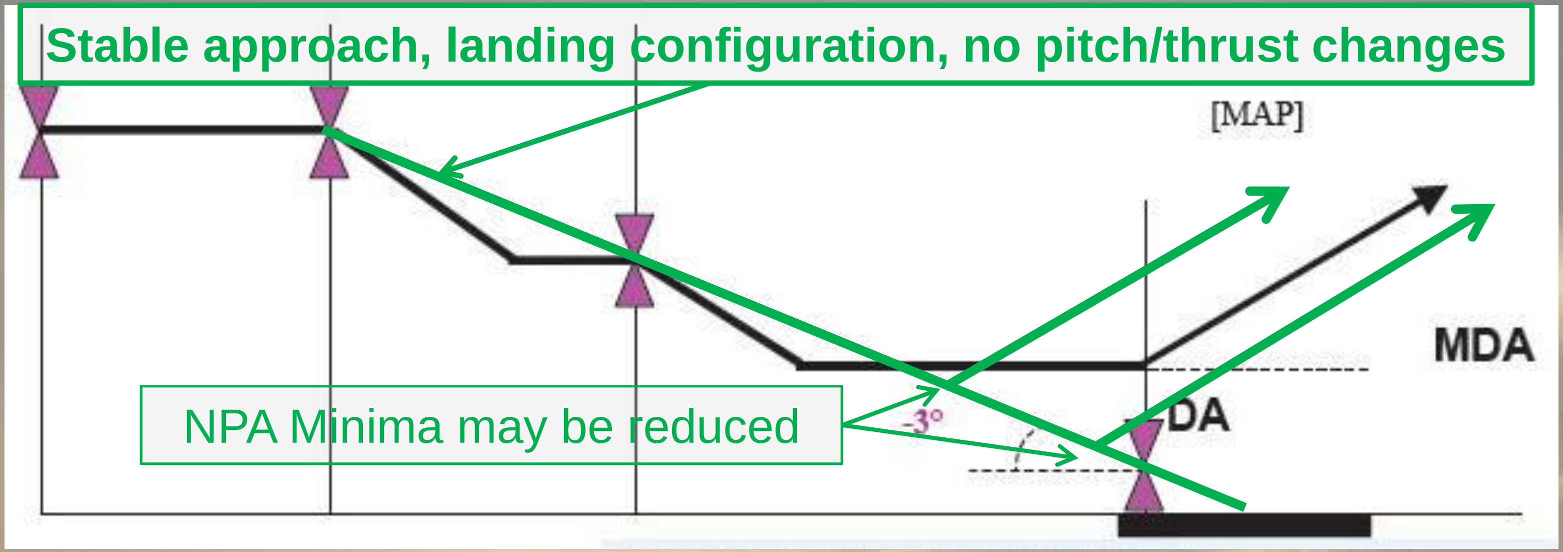
All aircraft should progressively be equipped with SBAS (Space Based Augmented System) to fly CAT1 precision approaches and eliminate Non Precision Approaches, but altitudes will still be based on Barometric Altitude.

This will take time so current NPAs will continue...



Back to Benefits of a Constant Angle NPA Profile

Stable Approach – established as many orders safer



6.5%	3.7°	393 f/nm
120 kts	*140 kts*	*160 kts*
790 fpm	920 fpm	1,050 fpm
Dist KLO	**Alt QNH**	***(HAT)***
D -7.4	**4000'**	***(2584')***
D -7.0	3860'	*(2444')*
D -6.0	**3470'**	***(2054')***
D -5.0	3080'	*(1664')*
D -4.0	2680'	*(1264')*
D -3.3	**2390'**	***(974')***
D -2.0	1900'	*(484')*
D -1.0	1510'	*(94')*
D -0.9	1470'	*(54')*

DME-Altitude Tables can provide regular checks to confirm aircraft on the correct profile to 30ft accuracy. Rather than checks at single points which might be interrupted by ATC request, crew action etc.

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: Continuous Descent Final Approach

Date: 1/20/11

Initiated by: AFS-400

AC No: 120-108

Change:

1. PURPOSE. This advisory circular (AC) provides guidance for all operators using the continuous descent final approach (CDFA) technique while conducting a Nonprecision Approach (NPA) procedure. It describes the rationale for using the CDFA technique, as well as recommended general procedures and training guidelines for implementing CDFA as a standard operating procedure (SOP). While the use of CDFA is beneficial to all aircraft operators, we intend this AC for those operators governed by Title 14 of the Code of Federal Regulations (14 CFR) parts 91 subpart K (91K), 121, 125, and 135. This guidance and information describes an acceptable means, but not the only means, of implementing the use of CDFA during NPAs and does not constitute a regulation.

2. RELATED TITLE 14 CFR REGULATIONS.

- Part 91, General Operating and Flight Rules.
- Part 97, Standard Instrument Procedures.
- Part 119, Certification: Air Carriers and Commercial Operators.
- Part 121, Operating Requirements: Domestic, Flag and Supplemental Operations.
- Part 125, Certification and Operations: Airplanes Having a Seating Capacity of 20 or More Passengers or a Maximum Payload Capacity of 6,000 Pounds or More; and Rules Governing Persons On Board Such Aircraft.
- Part 135, Operating Requirements: Commuter and On Demand Operations and Rules Governing Persons On Board Such Aircraft.

3. RELATED READING MATERIAL (current editions).

- AC 120-71, Standard Operating Procedures for Flight Deck Crewmembers.
- Federal Aviation Administration (FAA) Aeronautical Information Manual (AIM).
- FAA Instrument Procedures Handbook (FAA-H-8261-1A).

4. BACKGROUND. Controlled flight into terrain (CFIT) is a primary cause of worldwide commercial aviation fatal accidents. Unstabilized approaches are a key contributor to CFIT

FAA AC 120-108 January 20th 2011

Introduced the CDFA

Continuous Descent Final Approach,

flown using sink rate calculated from the published glideslope angle and current groundspeed, or by Flight Path Angle.

Examples starting from FAF 1900ft & 1500ft aal.

But when possible should be CAFA

Constant Angle Final Approach using Distance-Altitude Tables

(DME or FMS distance to runway)

to monitor final glideslope like an ILS.

Charts must incorporate Distance-Altitude tables.

To allow early stabilisation profiles should include CAFA from at least 2500ft with option to intercept the glideslope from a lower altitude if required.

Advisory Circular

Date: 1/20/11 AC No: 120-108

Initiated by: AFS-400 Change:

DME-Altitude Constant Angle NPAs remain a good backup

The new RNP Approaches generally require an accuracy of 0.1 n mile…..

DME (Distance Measuring Equipment) reads to 0.1 n mile, therefore:
Altitudes on a 3 degree glidepath can be checked / flown to within 30ft (300 x .1)
(It is important to use the correct DME - ILS or VOR if both are available!)

A DME in line with a runway can show an accurate glidepath on a Non Precision Approach by a simple DME-Altitude table for a Constant Descent Angle approach.
Many Step Down NPAs accidents could have been avoided over the past 30 years.

DME-Altitude Constant Angle NPAs remain a good backup

The new RNP Approach ... **acy of 0.1 n mile…..**

DME (Distance Meas ... **1 n mile,** therefore:
Altitudes on a 3 degree gl ... to within 30ft (300 x .1)
(It is important to use t ... both are available!)

DME-Altitude Table for LOC-DME R/W 18 Birmingham Alabama

BHM LOC-DME 18		
Gradient:	3.2°	342 ft/nm
120 kts	140 kts	160 kts
680 fpm	800 fpm	910 fpm
D I-BXO	Alt QNH	(HAT)
D -14.1	5070'	(4426')
D -9.5	3500'	(2856')
D -8.0	2980'	(2336')
D -7.0	2640'	(1996')
D -6.0	2300'	(1656')
D -5.0	1960'	(1316')
D -4.0	1620'	(976')
D -3.3	1380'	(736')
D -2.0	930'	(286')

A DME in line with a runwa ... **path on a Non Precision Approach by a simple DME-** ... **Descent Angle approach.**
Many Step Down NPAs accidents could have been avoided over the past 30 years.

Let us never have to say –

that accident need not have happened.

............but

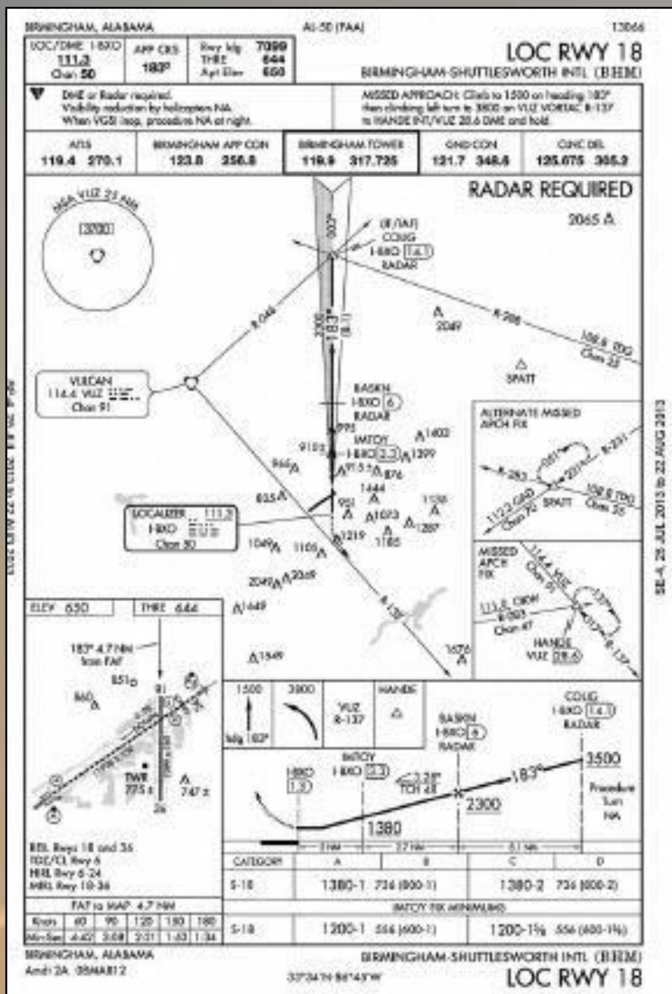
Let us never have to say –

that accident need not have happened.

............but only 4 months later...

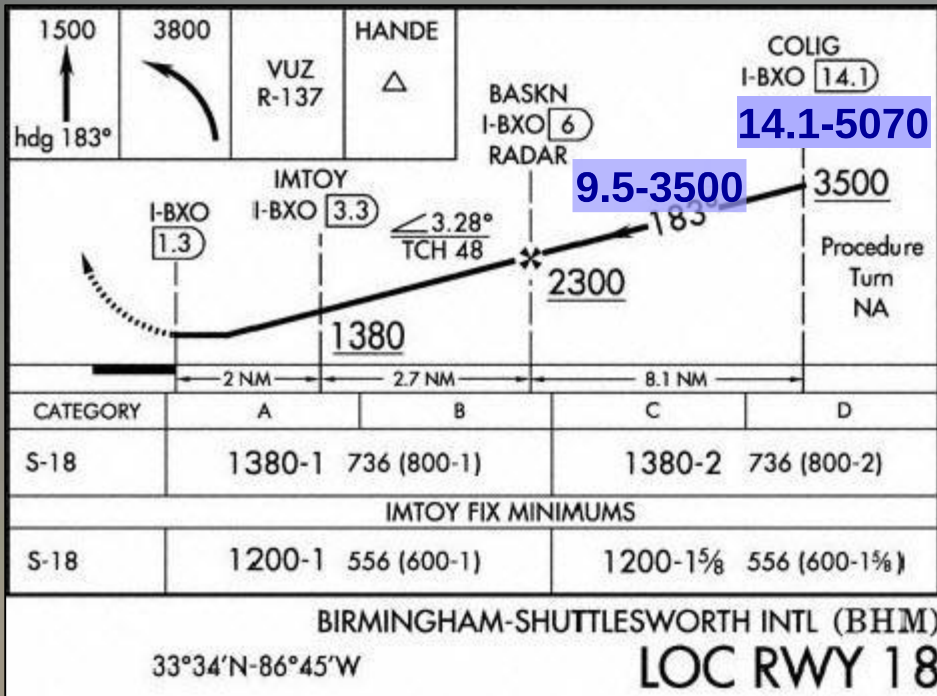
Crash: UPS A306 at Birmingham on Aug 14th 2013, contacted trees and touched down outside airport

On 14 Aug 2013 UPS 5X-1354 Airbus A300-600F N155UP freighter crashed short of the runway on a LOC-DME approach to R/W 18 Birmingham AL.



The FAA approach chart shows a straight line approach profile from 3500ft which is not coherent with the DME distances shown

FAA LOC-DME Chart without table & Possible Table



The chart profile is a linear path from 3500ft at 14.1D.

The table shows on a 3.2º GS 5070' at 14.1D & 3500' at 9.5D.

The profile is not realistic.

BHM LOC-DME 18		
Gradient:	3.2°	342 ft/nm
120 kts	*140 kts*	*160 kts*
680 fpm	800 fpm	910 fpm
D I-BXO	Alt QNH	*(HAT)*
D -14.1	5070'	(4426')
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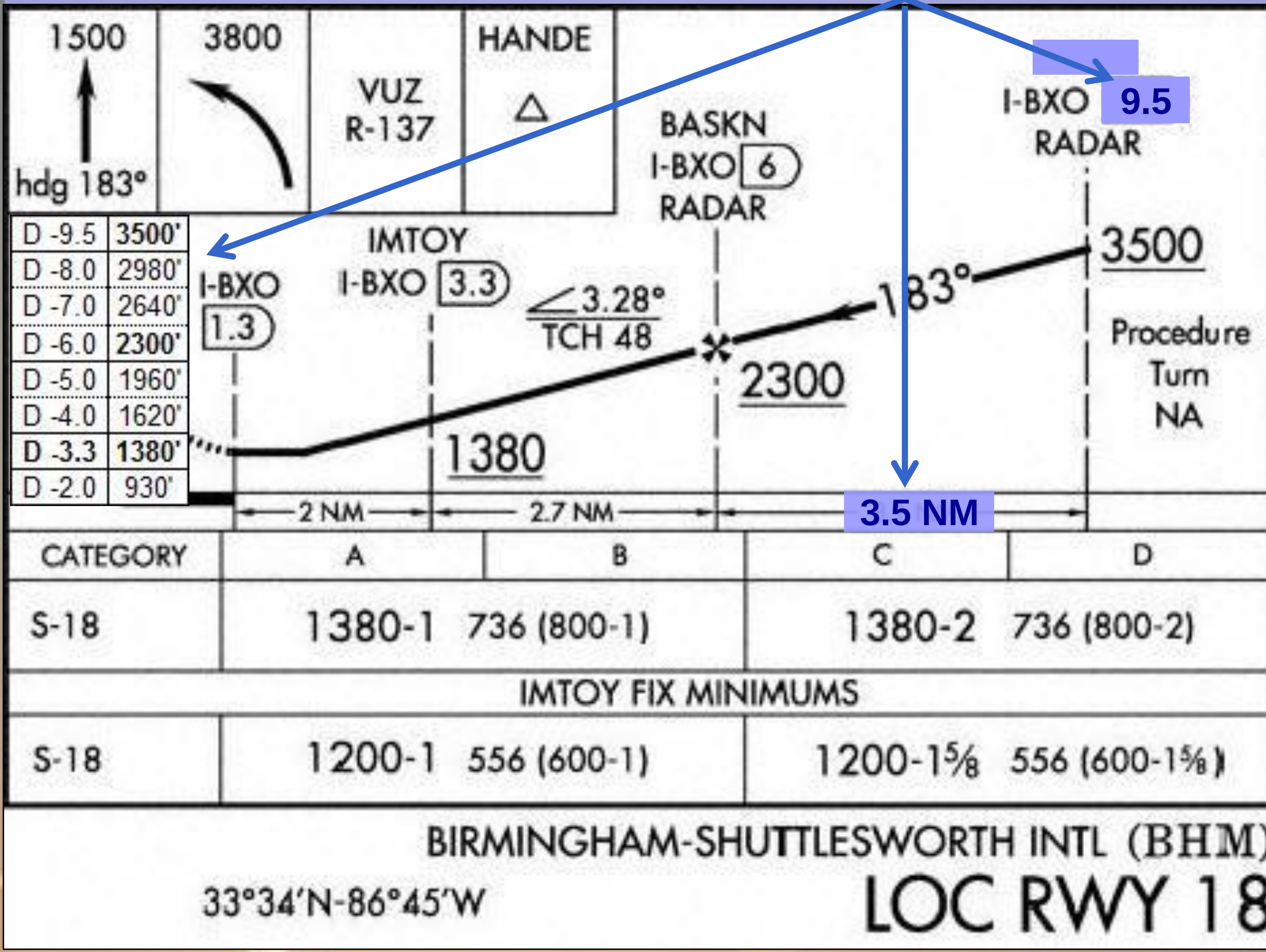
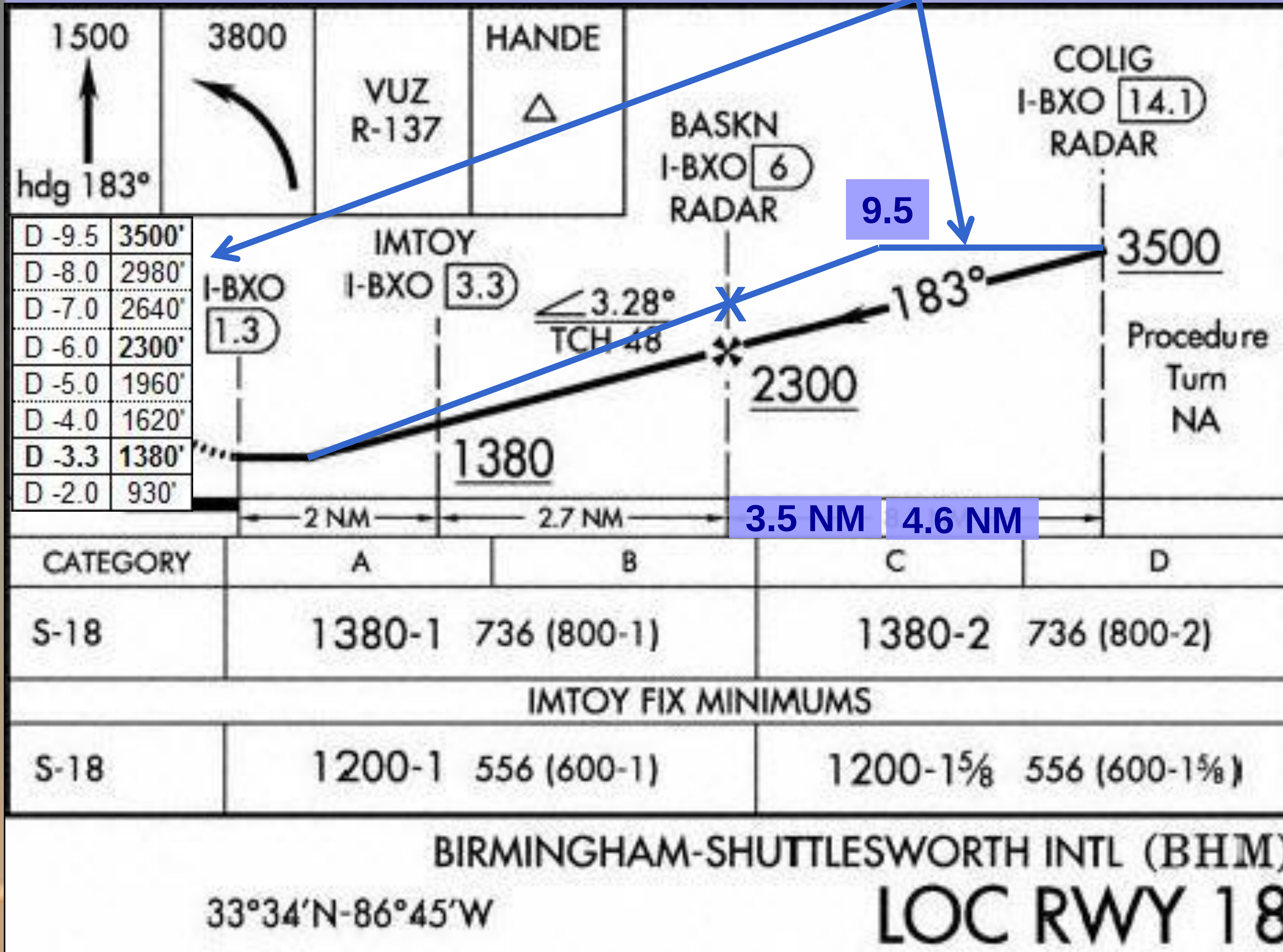
D -4.0	1620'	(976')
D -3.3	1380'	(736')
D -2.0	930'	(286')

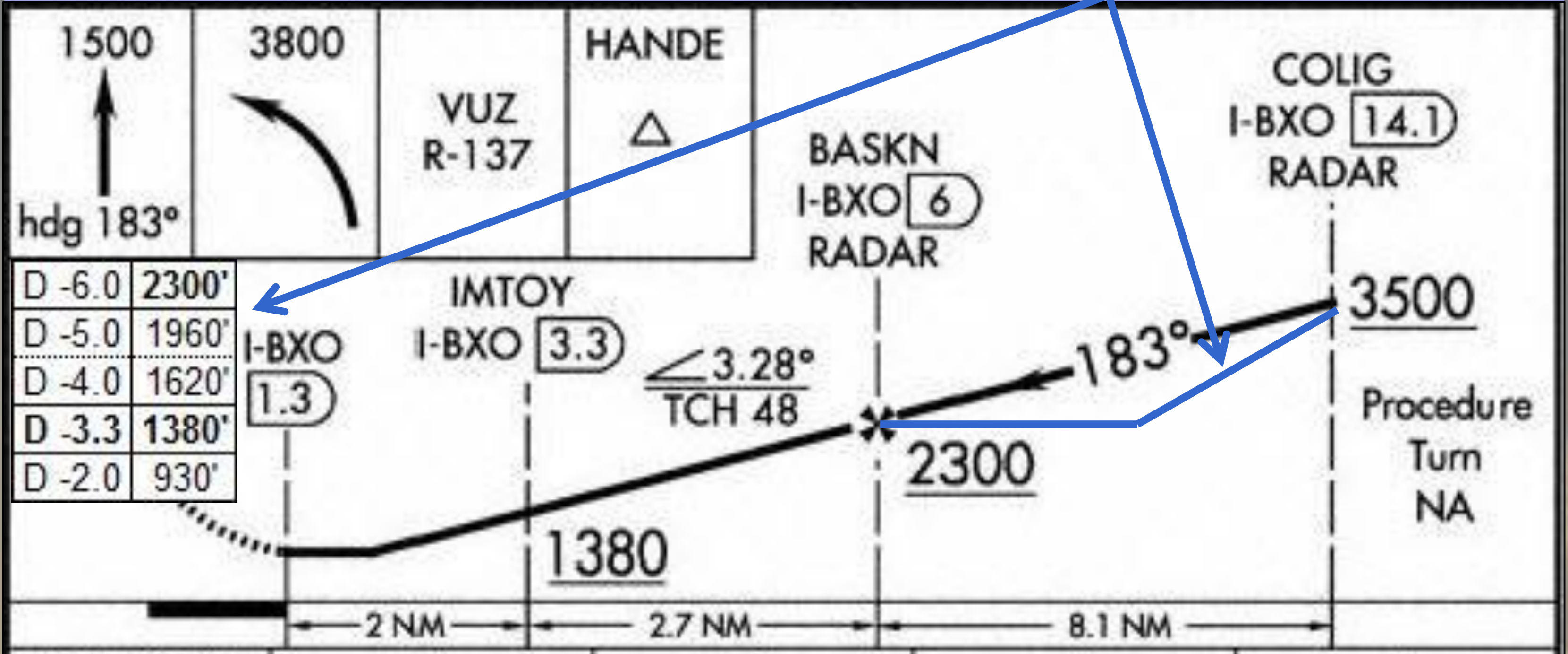
BHM LOC-DME Chart - *Correct Distances for Profile*



BHM LOC-DME Chart *Correct Profile for Distances 1*



BHM LOC-DME Chart *Correct Profile for Distances 2*



D -6.0	2300'
D -5.0	1960'
D -4.0	1620'
D -3.3	1380'
D -2.0	930'

CATEGORY	A	B	C	D
S-18	1380-1	736 (800-1)	1380-2	736 (800-2)
IMTOY FIX MINIMUMS				
S-18	1200-1	556 (600-1)	1200-1⅝	556 (600-1⅝)

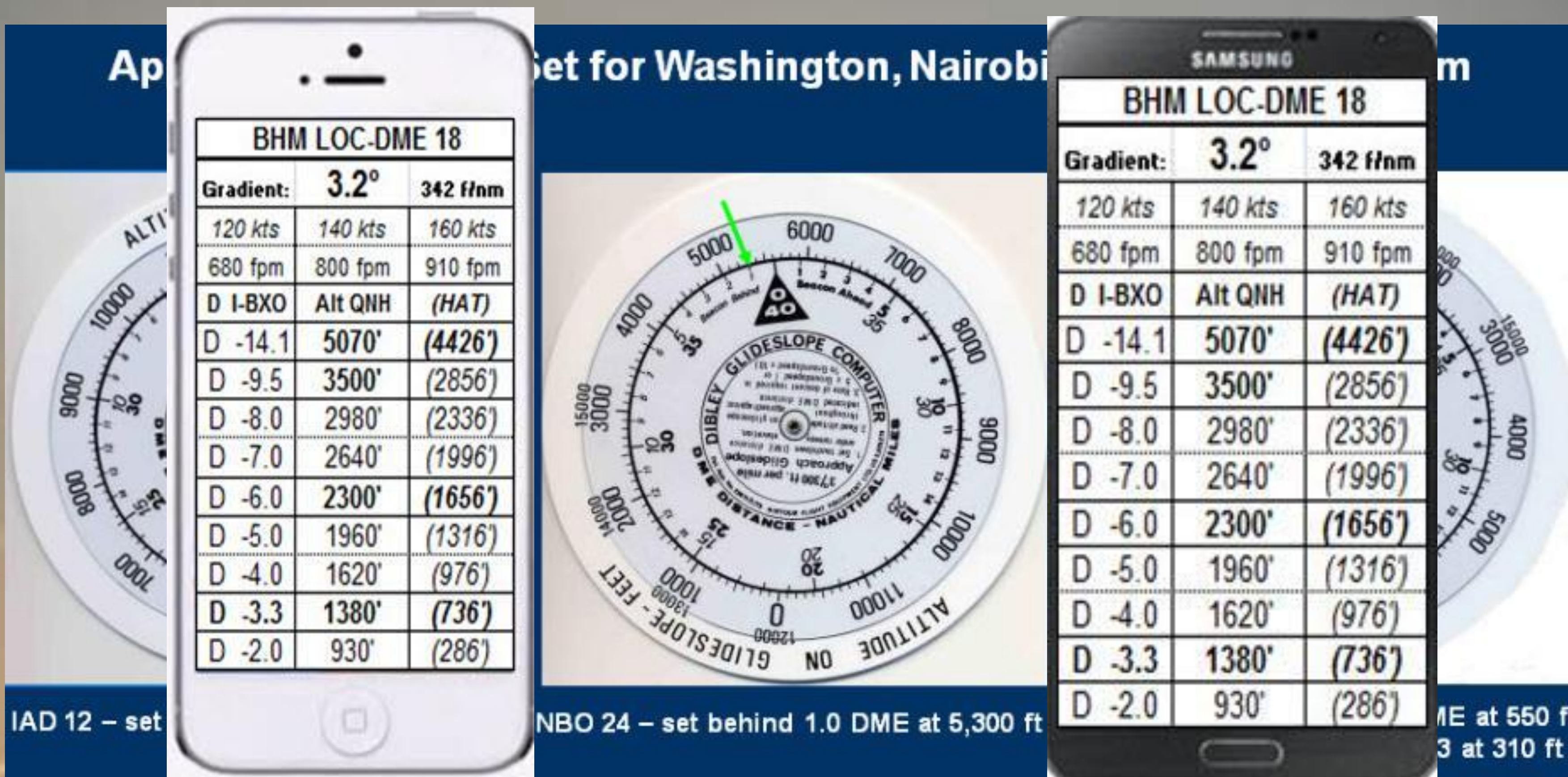
BIRMINGHAM-SHUTTLESWORTH INTL (BHM)

33°34'N-86°45'W

LOC RWY 18

Essential Info for Monitoring LOC-DME Approach

If no chart table available – Use another system



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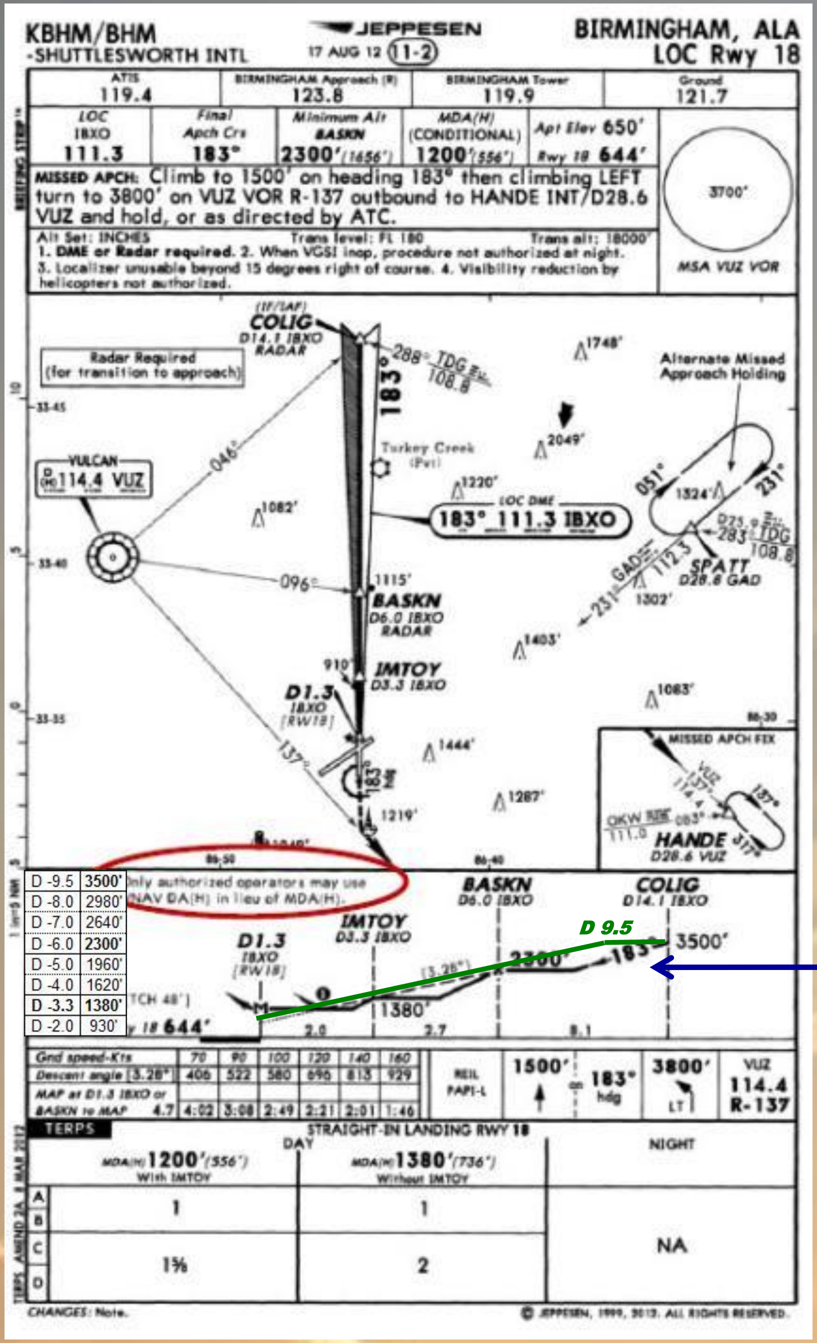
D -4.0	1620'	(976')
D -3.3	1380'	(736')
D -2.0	930'	(286')

The NTSB Report published the Jeppesen LOC Rwy 18 approach chart used by the UPS Crew, rather than the FAA chart in previous slides.

The Jeppesen chart tailored for UPS was an improvement on the FAA chart using the Step Down profile 2 in the modified FAA chart shown in the previous slide, however *without* the table recommended by many agencies – but not published by the state.

A recommended table would have allowed the First Officer easily to monitor the aircraft's position relative to the profile and advise the captain – helping to resolve the captain's apparent confusion that the aircraft was higher than it actually was.



A constant angle descent from 3500ft would give the crew more time to be stabilised on the profile besides reducing noise over the ground.

UPS Flight 1354's Actual Descent & Altitudes

**A constant angle descent from 3500ft would give the crew more time to be stabilised on the profile besides reducing noise over the ground.
Crew would not need to select high sink rates at low level.**

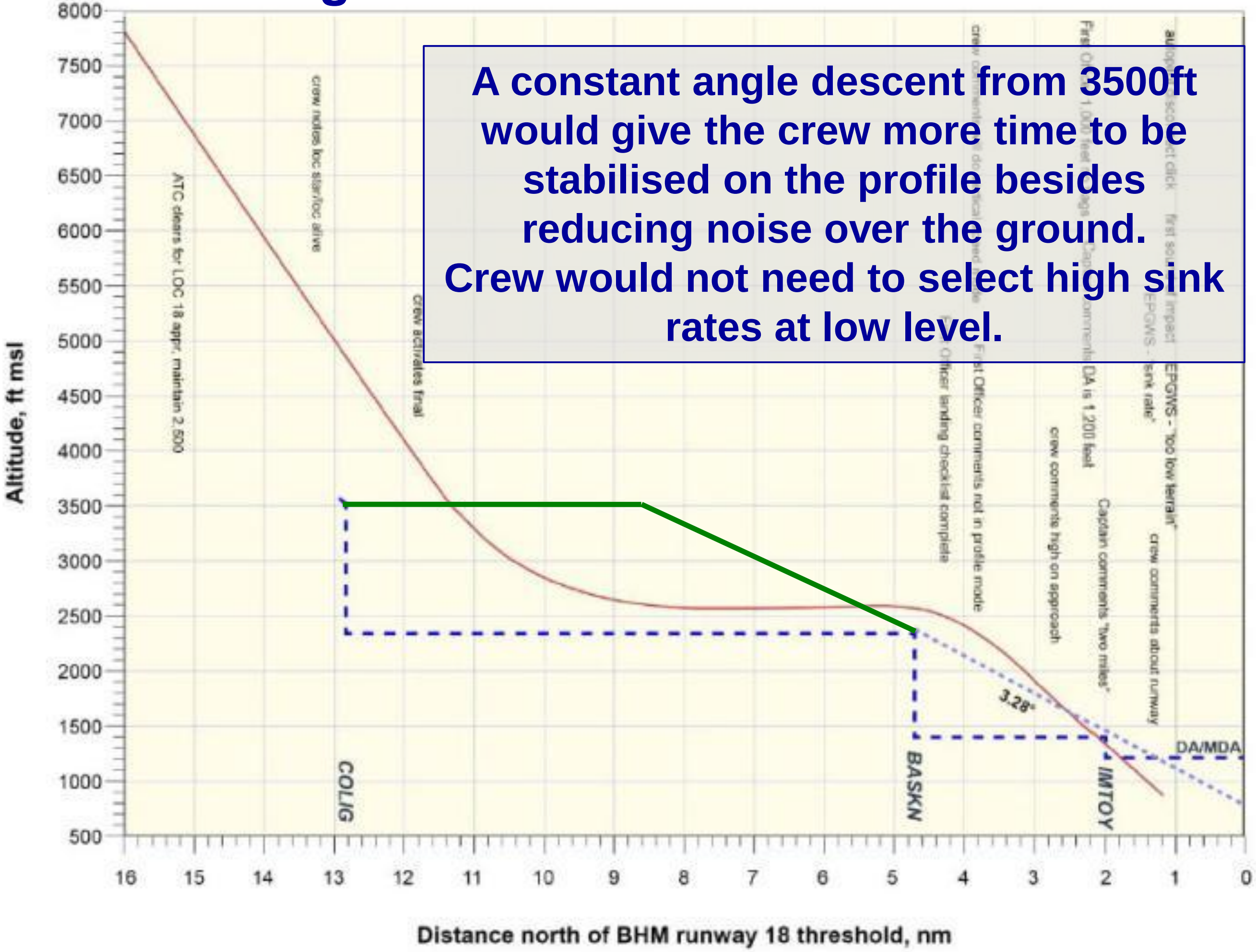
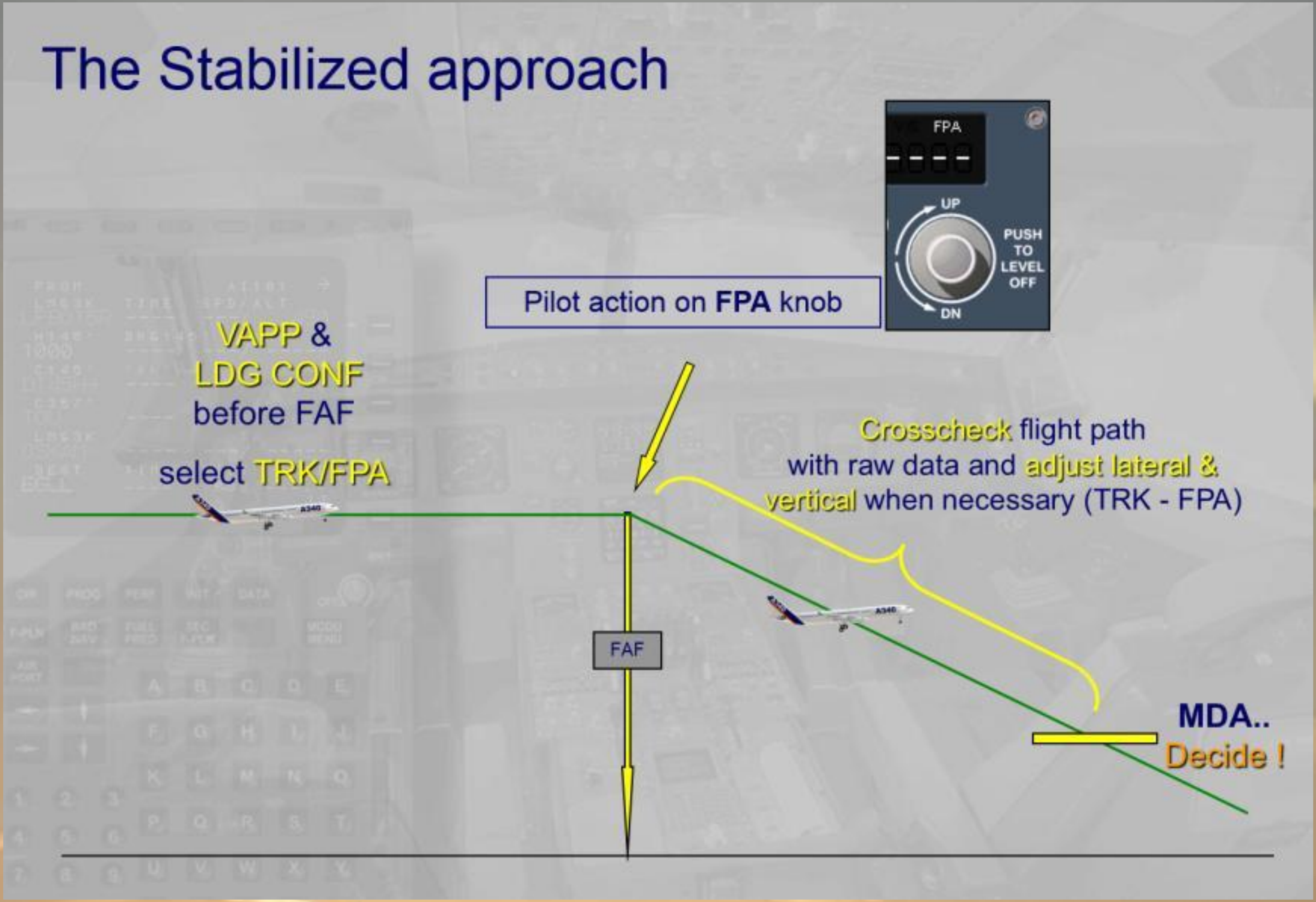


Figure 3. UPS flight 1354's actual descent and altitudes.

Training for Airbus Standard Constant Angle Non Precision Approach

Step-Down / Dive and Drive is not taught



Reversion from Automatic to Manually controlled approach is simple as both following the same Constant Angle profile

The Final Approach

FINAL APP mode engagement

Profile monitored using Distance-Altitude tables

- Flight path monitoring (Lateral & Vertical)

+

TOU DME	1.0 before TOU	0.0	1.0 after TOU
ALTITUDE *(HAA)*	1720' *(1221')*	1400' *(901')*	1080' *(581')*

In case of loss of ACCY or ACCY downgraded, revert to Selected

Airbus/airlines consider that Ground Based DME Distance gives some Vertical Flight Path Guidance/Fixes from Tables *but still not accepted in the US.*

NTSB report on UPS A300-600F Accident 14 Aug 13 – Page xiii

- **Use of continuous descent final approach technique.** Nonprecision approaches do not provide any ground-based vertical flightpath guidance to flight crews and therefore can be more challenging to fly than precision approaches. These factors may contribute to the higher occurrence of unstabilized nonprecision approaches

DME distance can give regular "Altitude Fixes" to accuracy of 30ft.
Using tables makes constant Angle approaches less challenging that Dive & Drive.
Reaction of Saudia Crew – "This is very easy!"

Long letter to FSF AeroSafety World June 2014 arguing for Dive & Drive

require for a CDA. The source noted that some nonprecision, straight-in IAPs provide a table showing distances vs. altitudes which, if followed, approximate the proper descent rate. For IAPs that do not, the pilot would have to calculate these numbers as the airplane descends or refer to another tool if available.

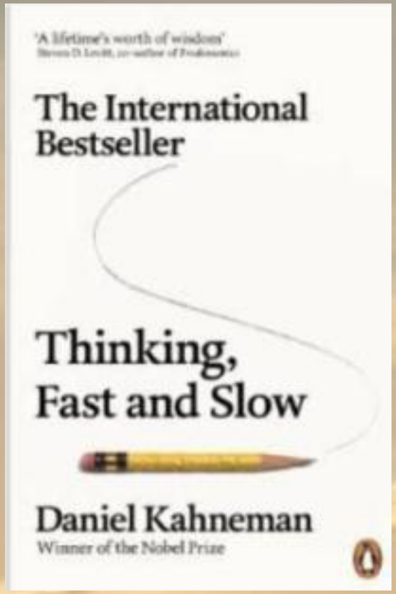
Enforce states to publish tables on all charts – as recommended by authorities

Airbus/airlines consider that Ground Based DME Distance gives Vertical Flight Path Guidance/Fixes from Tables *but still not accepted in the US.*

Comment by FAA official reference AC 120-08 Continuous Descent Approach

"I don't need Distance-Altitude Tables – I can do that in my head!"

Remember Daniel Kahneman



Nobel Prize winner Daniel Kahneman disagrees

Ask someone walking for 2 + 2
Instant reply 4

Ask for 17 x 24
To think will stop walking,
or flying the aircraft?

and Pierre Baud!

Final Comment re UPS A300-600F Accident at BHM

The crew made mistakes - not cleaning up the flight plan waypoints so the FMS could not capture the vertical profile for final approach nor indicate the Vertical Deviation on the flight instruments.

They were fatigued and at times it appears confused

However a Total Flight Safety System must try to allow for such errors if possible.

Having the unstable Dive & Drive as an option at the back of a crews' mind cannot help their wellbeing.

The FO might or might not have made use of a DME-Altitude table to alert the captain of his vertical deviation. But if the information did not exist there was no chance.

If the crew are trained to the standard Airbus procedure of a Constant Angle Approach whether automatic or manual cross checked by vertical distance-altitude fixes this type of accident is less likely to recur.

The challenge is to persuade the US pilots and establishment to accept this truth.

Looking back on my life -

The most important decision I never made - was my wife's to decide I needed looking after and to make a family, then giving me over 45 years of undeserved support. Sadly she is now in hospital.

It was gratifying to start the introduction of quieter approaches into LHR with the help of Lufthansa - more training is needed for consistency.

I failed to make use of the Anglo-Saxon link properly to export the European elimination of Dive and Drive Approaches to the US.

A most rewarding part of my life was certainly my 7 years with Airbus Training working for Pierre Baud.

Leading to being invited to become a Member of the Académie which one of the greatest honours I have been granted. I thank everyone who made this possible.

I hope to be able to make a contribution to justify your faith in me.

Most Significant LOC-I Accident

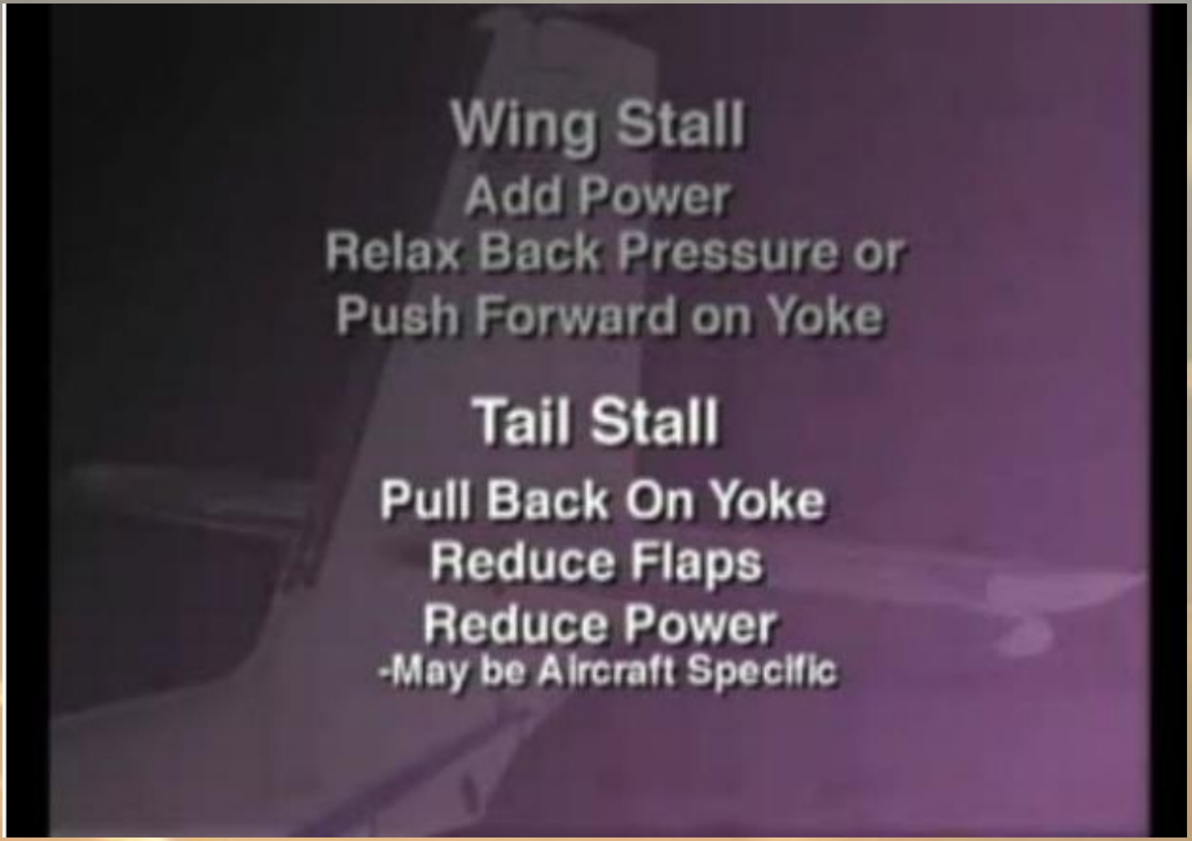
Colgan Air - Bombardier DHC-8-400
12th February 2009

Crew airspeed monitoring lapsed – due to fatigue?
Speed reduced after flap selected & stick shaker activated
FO had discussed icing several times during flight –
Had seen NASA tailplane icing video instructing flap retraction
Reacted as per training video to retract flaps & pull aft stick?
Should have been prevented by *type training on mainplane icing*
Could have been recovered by training/knowledge for type.

Most Significant LOC-I Accident

Colgan Air - Bombardier DHC-8-400
12th February 2009

NASA Tailplane Icing Video



Colgan Air Cockpit Voice Recorder

22:16:27.4
CAM [sound similar to stick shaker lasting 6.7 seconds]

22:16:27.7
HOT [sound similar to autopilot disconnect horn repeats until end of recording]

Captain pulled back on stick as per NASA video?

DCA09MA027
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TIME and SOURCE	INTRA-AIRCRAFT COMMUNICATION CONTENT	TIME and SOURCE	AIR-GROUND COMMUNICATION CONTENT
22:16:27.9 **CAM**	[sound of click]		
22:16:31.1 **CAM**	[sound similar to increase in engine power]		
22:16:34.8 **HOT-1**	Jesus Christ.		
22:16:35.4 **CAM**	[sound similar to stick shaker lasting until end of recording]		
22:16:37.1 **HOT-2**	I put the flaps up.		
22:16:40.2 **CAM**	[sound of two clicks]		

FO Retracted the flaps

Colgan Air Cockpit Voice Recorder

22:16:27.4
CAM [sound similar to stick shaker lasting 6.7 seconds]

22:16:27.7
HOT [sound similar to autopilot disconnect horn repeats until end of recording]

Captain pulled back on control wheel

DCA09MA027
CVR Factual Report
Page 12-62

INTRA- ... **D COMMUNICATION**

TIME and SOURCE ... **NTENT**

22:16:27.9
CAM [sound of click]

22:16:31.1
CAM [sound similar to increas

22:16:34.8
HOT-1 Jesus Christ.

Crew incompetence or lack of experience?
or
Reacting to what they believed to be the correct procedure having seen the NASA Tail Plane Icing Video?

22:16:35.4
CAM [sound similar to stick shaker lasting until end of recording]

22:16:37.1
HOT-2 I put the flaps up. ← **FO Retracted the flaps**

22:16:40.2
CAM [sound of two clicks]

Video of Colgan Air Bombardier Accident into Buffalo

Colgan Air Bombardier Accident into Buffalo

Colgan Air Bombardier Accident into Buffalo

Conclusion of NTSB –
Crew were Incompetent

Although known their training included the NASA tail-plane icing video which did not apply to their aircraft

NASA Icing Video showed aircraft with a similar configuration to Colgan Air – High wing turboprop with high T tailplane

Most Significant LOC-I Accident

Families of those lost formed a focus group & website


search...

Families of Continental Flight 3407

3407

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Aviation Safety Legislation

The Airline Safety and Federal Aviation Administration Extension Act of 2010 (PL 111-216) was signed into law on August 1, 2010. For a summary of the provisions included in this new law, please click here.

Who's Flying Your Plane?

Do you know who is really flying your plane? For more information on our campaign to raise awareness of the code-share practices exhibited by US airlines, click here

Safety Improvement Items

- Flight and Duty Time
- Safety Management Systems
- Crew Member Training Part N&O Final Rule
- Crew Member

Welcome to the Families of Continental Flight 3407 Webpage

Welcome to the website created and maintained by the family members of the victims of Flight 3407. Continental Flight 3407 departed Newark airport on Thursday, February 12 en route to Buffalo, New York. Approximately 5 miles from the airport, the airplane began experiencing problems and tragically crashed into the Clarence Center neighborhood just outside of Buffalo. 45 passengers, 4 crew members, 1 off-duty pilot, and 1 person on the ground perished in this horrible accident.

PL 111-216 Has Been Signed Into Law

On August 1, 2010, President Obama signed PL 111-216, The Airline Safety and Federal Aviation Administration Extension Act of 2010, into law. The passage of this law marked the culmination of over 15 months of tireless effort by the Families of Continental Flight 3407 and it includes many safety provisions that we are in support of.

PL 111-216 outlines numerous requirements for improving the safety of the American flying public. The key sections of the bill are summarized below and the full text of the bill can be found here:

- Section 202 - Requires the Secretary of Transportation to annually report to the Transportation and Infrastructure/Commerce Committees on the status of all NTSB safety recommendations related to Part 121 air carrier operations.

Major News Articles

- Balancing the Scales - Positive Changes That Can Come From Tragedy
- 2011 Person of the Year: Flight 3407 Families
- Ohio State Assistant's Higher Cause
- DOT Forces More Disclosure by Regional Airlines
- Flight 3407 families' work pays off
- Turning tragedy into triumph
- Loved ones complete Flight 3407 journey

Most Significant LOC-I Accident

Families of passengers killed
In the Colgan Airways Accident
into Buffalo
Lobbied congress to
Pass a Law
Requiring Stall Training
For All Airline Pilots
and more hours' experience.
(New president & administration)

Bill Wainwright's Advice

Prevention is Prime

If the AA 587, the Pinacle and the Colgan crews had been given the correct training in Knowledge Skills and Attitude …..