China Airlines

MD-11 Accident, August 22,1999

At Hong Kong International Airport,

Hong Kong

Comments on the draft final report

By the

Aviation Safety Council

Taiwan

Submitted June 2002

TABLE OF CONTENTS

REFERENCES

Reference A **- CAD Aircraft Accident Report 1/2002** (Final Draft) dated April 2002.

Reference B **- ICAO ISRPs Annex 13** to the Convention on International Civil Aviation **- Aircraft Accident and Incident Investigation** Section 6.3.

Reference C **- ICAO ISRPs Annex 3** to the Convention on International Civil Aviation – **Meteorological Service for International Air Navigation**, Section 5.6.

Reference D **-CAD Aircraft Accident Report 1/2001** dated June 2001

Reference E -Fujita, T.T. **Manual of downburst identification for project NIMROD", University of Chicago, SMRP research Paper No.156,** 104pp.dated 1978

Reference F –Technical Note No.102, Hong Kong Observatory

Part 1

An Overview of the Comments from the ASC to the CAD on the Confidential Draft Final report Concerning the China Airlines Boeing MD-11 Accident at Hong Kong Airport, August 22nd 1999

ASC Comments

The ASC, Accredited Representative team on CI642 accident investigation has carefully studied and reviewed the CAD draft Final Report.

The sole purpose of the ASC's comments is to provide constructive feedback to Hong Kong on the draft Final Report. Our aim is to achieve a Final Report of the highest possible quality, and one that will make a significant contribution to the enhancement of international aviation safety.

The Guiding Principles of the ASC's review of the Hong Kong Draft Final Report

In accordance with the principles and spirit of Annex 13, our aim is to ensure that the Draft Final Report of the CI-642 investigation is accurate, objective and balanced, and does not apportion blame or liability.

We have considered the Hong Kong draft Final Report in the light of established and proven air safety investigation methodology. We have considered whether all of the relevant factual material gathered in the investigation has been included in the Hong Kong draft Final Report. We have also assessed the degree to which the analysis and conclusions are based upon sound investigation procedures and factual evidence.

Both CAD, Hong Kong and ASC, Taiwan share the common goal of pursuing excellence in aviation safety. Notwithstanding the difficulties that have been encountered, ASC hopes that the valuable lessons learned by both Hong Kong and Taiwan from the experience of the CI-642 investigation will enhance aviation safety.

The Hong Kong draft Final Report

The ASC considers that:

a) The Hong Kong draft Final Report minimizes the significance of the absence of high capability wind shear warning detection system at Chap-Lap-Kok Airport. The improvement of wind shear detecting system is a major challenge confronting the world aviation industry.

b) The Hong Kong draft Final Report also minimizes the finding of the three very valuable simulator lessons tested at Boeing facility, Long Beach, California.

c) The Hong Kong draft Final Report does not adequately address the RWY 25L and 25R wind difference analysis attributed from passenger terminal building. It should be considered in that context. See Figure 1 below.

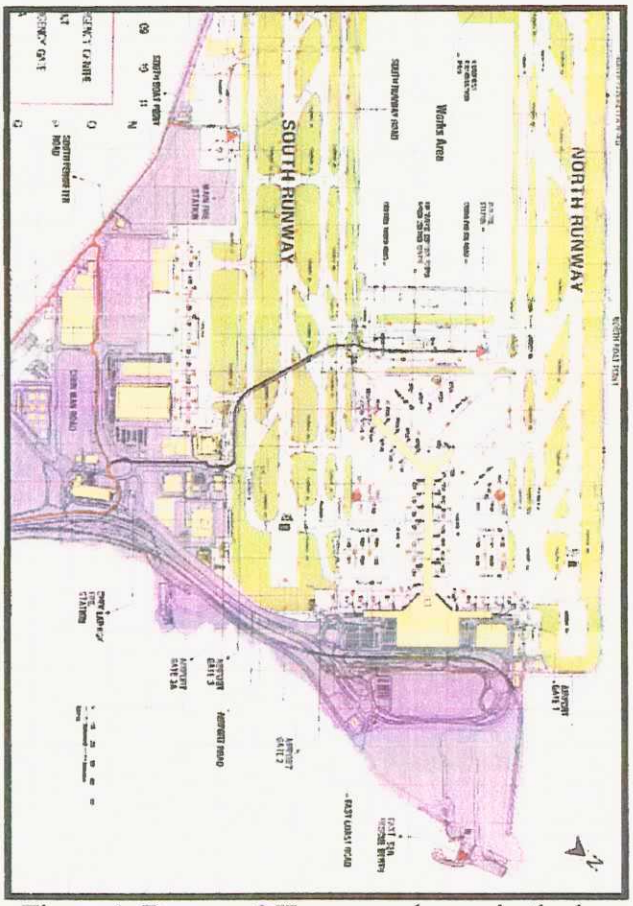


Figure 1. Runway 25L approach area in the lee of the Passenger Terminal Building

Part 2

Comments on Section 1, Factual Information

Reference A, Section 1.1. History of the flight Pg. 6 Para 3

ASC issues and Discussion

This paragraph contains: "…and exited through L1 door and began…" which does not reflect the actual fact, since the crew exited through a hole in the fuselage.

ASC proposed changes

Change Page 6, Para 3 of Ref. A Section 1.1 to read: "…and exited through a hole in the fuselage and began…"

Part 3

Comments on Section 2, Analysis

ASC proposes the following paragraphs and figures to support the findings as a result of analysis that based on recorded data and known aircraft characteristics.

(A) Wind derived from FDR data

According to FDR parameters, ASC interpolated the horizontal wind direction, wind speed, vertical wind speed and derived the following data as shown in Table 1.

	UTC_Time	CAS	RALT	sink rate (DRA)	sinkrate VG	MHEading	ROLL	PITCH	GSPD	DRIFT	AOA#1	AOA#2	ELEV RIB	ELEV ROB	flight path angle	WSPD (Boeing)	WINDIR (Boeing)	Vert.WSPD (Boeing)
	(hh:mm:ss.s)	(knots)	(feet)	(ft/s)	(ft/s)	(deg)	(deg)	(deg)	(knots)	(deg)	(deg)	(deg)	(DEG)	(DEG)	(deg)	(Kts)	(deg)	(Kts)
	10:44:01.0	169.0	325	-13	-8.89	264	2.46	3.16	154	-14.42	6.86	5.45	-4.83	-1.76	-3.7	46.15	323.20	4.02
	10:44:02.0	168.5	316	-9	-11.68	264	3.87	1.41	154	-14.77	5.27	4.57	4.31	5.89	-3.86	42.05	317.70	0.13
	10:44:03.0	167.5	300	-16	-16.20	264	2.46	1.41	154	-14.42	3.69	4.39	0.26	1.32	-2.28	46.15	322.80	4.16
	10:44:04.0	166.5	282	-18	-18.29	265	6.33	2.11	154	-14.42	4.39	4.92	-0.53	0.44	-2.28	47.86	326.10	1.80
	10:44:05.0	166.0	263	-19	-19.91	266	7.74	2.46	152	-14.42	5.62	5.27	0.79	1.76	-3.16	43.27	320.60	0.28
	10:44:06.0	157.0	245	-18	-19.21	267	5.63	3.16	152	-14.42	6.33	7.91	-0.62	-0.70	-3.17	39.66	322.10	-0.53
	10:44:07.0	161.5	225	-20	-17.76	267	11.25	2.81	150	-14.06	7.21	8.09	-0.09	2.37	-4.4	37.33	321.00	2.11
	10:44:08.0	161.5	206	-19	-18.82	266	14.42	2.46	150	-12.31	5.27	6.15	0.18	4.13	-2.81	36.70	317.00	3.01
	10:44:09.0	157.5	186	-20	-21.33	265	9.49	3.16	150	-9.49	6.15	7.91	7.21	6.33	-2.99	35.74	325.00	0.96
	10:44:10.0	159.5	150	-36	-17.89	265	4.57	5.27	152	-8.44	5.80	7.91	2.72	3.34	-0.53	27.67	315.40	-4.81
	10:44:11.0	163.5	131	-19	-12.47	265	1.76	5.63	154	-8.44	8.96	8.44	-5.89	-7.82	-3.33	26.86	308.30	1.51
	10:44:12.0	171.0	129	-2	-7.88	264	-2.46	3.52	156	-7.38	4.75	7.21	-0.53	0.18	-1.23	33.30	304.00	2.70
	10:44:13.0	175.0	117	-12	-11.58	262	-3.52	2.11	158	-6.68	5.10	3.52	9.32	-0.44	-2.99	36.42	301.80	7.22
	10:44:14.0	170.0	104	-13	-11.58	262	-1.05	2.81	158	-5.98	2.99	6.68	-2.90	-4.75	-0.18	31.58	307.60	0.92
	10:44:15.0	166.5	88	-21	-12.06	261	-3.52	2.81	160	-5.98	6.33	3.69	-1.23	-2.37	-3.52	24.48	307.40	4.78
	10:44:16.0	167.5	73	-10	-11.48	259	-6.68	2.11	160	-5.63	4.92	6.33	-0.44	0.88	-2.81	29.13	314.90	1.72
	10:44:17.0	165.0	59	-14	-14.65	258	2.46	2.46	160	-5.27	6.50	3.87	3.34	1.58	-4.04	21.65	316.50	5.29
	10:44:18.0	172.0	46	-14	-16.07	257	-0.35	3.52	160	-4.57	4.39	7.21	10.63	-8.53	-0.87	20.58	271.60	0.79
	10:44:19.0	164.5	32	-13	-12.30	255	-0.35	3.87	160	-2.81	7.03	6.33	-5.45	-3.43	-3.16	17.81	301.10	0.46
	10:44:20.0	166.0	21	-11	-13.27	253	4.57	3.16	158	-1.05	2.81	7.91	5.01	3.69	0.35	18.49	298.00	-0.22
	10:44:21.0	153.0	7	-14	-16.82	251	0.00	3.52	156	0.35	7.91	3.52	6.68	15.73	-4.39	20.87	341.60	4.14
T/	10:44:22.0	151.5	-1	-8	4.43	252	3.87	5.63	154	-0.35	2.11	-4.57	4.22	-10.37	3.52	20.87	343.90	6.8[illegible]

Table 1. FDR Parameters and Derived Wind Data

From table 1 ASC identified the following information:

(1) At altitude of 325 ft ~ 150 ft RA, the wind speed varied from 46.2 knots to 27.7 knots, and wind direction varied from 315 degree to 326 degree. This wind condition is consistent with the data of ground measurement.

(2) Sinking rate was integrated from vertical acceleration and found varied with parameters of the vertical acceleration and angle of attack.

(3) The vertical wind was found varied at different altitude till touch down.

(4) This high sinking rate was found affected by wind. At 117 ft RA and 32 ft the wind speed indicated 36 knots and 17.8 knots,

(B) Downdraft Analysis

Professor Fujita of University of Chicago stated the wind change in convective mode, with wind speed over 34 knots, is called downdraft. Fujita also pointed out that the over 12 ft/sec wind change rate could also be defined as a downdraft. (Reference E)

Wind shear refers to a change in the headwind or tailwind for more than a few seconds, resulting in changes in the lift to an aircraft. A decreased lift will cause the aircraft to go below the intended flight path. In the presence of significant windshear, a pilot has to take corrective action in a very short time. Turbulence is caused by rapid irregular motion of air. It brings about bumps or jolts. In severe cases, the aircraft might go momentarily out of control. (1.1 pp1 , Reference F)

Refer to Table 1; there are two major findings as below:

(1) The significant delta CAS or unsteady horizontal wind:

Between 300 ft ~ 186 ft, the CAS varied from 167.5 to 157.5kts (-10.0 kts).

Between 186 ft ~ 117 ft, the CAS varied from 157.5 to 175 (+17.5 kts).

Between 117 ft ~ 7 ft, the CAS varied from 175.0 to 153.7 (-21.3 kts).

(2) The significant vertical wind changed:

During passing 316 ft ~ 245 ft, the vertical wind speed varied from +8.13 to –0.53

During passing 206 ft ~ 150 ft, the vertical wind speed varied from +3.01 to –4.81.

During passing 59 ft ~ 21 ft, the vertical wind speed varied from +5.29 to –0.22.

Below 50 ft RA, according to Table 2, the sinking rate of CI642 varied from 16.1 ft/sec to 12.0 ft/sec. There were significant vertical accelerations data recorded in FDR. During this period, the ground speed indication was stable at 158 knots and the angle of attack (AOA) varied. ASC believes that below 50 ft RA, the aircraft encountered a downdraft that affected the descent rate.

UTC_Time (hh:mm:ss.s)	CAS (knots)	RALT (feet)	sink rate (DRA) (ft/s)	sinkrate VG (ft/s)	M Heading (deg)	ROLL (deg)	PITCH (deg)	GSPD (knots)	DRIFT (deg)	AOA (deg)	flight path angle (deg)	WSPD (Boeing) (Kts)	WINDIR (Boeing) (deg)	VERT ACC (g)	ELEV LIB (deg)	ELEV RIB (deg)	ELEV ROB (deg)	ELEV LOB (deg)
10:44:18.0	172	45	-14	-16.1	257.02	-0.35	3.52	160	-4.57	4.39	-0.87	20.38	271.60	1.083	10.55			
10:44:18.1				-15.7										1.087				
10:44:18.2				-15.3			3.87							1.101		10.63		
10:44:18.4				-14.2										1.261				
10:44:18.5				-13.4		-1.76	4.22			7.21	-2.99			1.215			-8.53	
10:44:18.6				-12.7										1.170				
10:44:18.7				-12.2			4.22							1.128				-7.73
10:44:18.9				-12.0										1.035				
10:44:19.0	164.5	32	-13	-12.3	254.91	-0.35	3.87	160	-2.31	7.03	-3.16	17.81	301.10	0.927	-5.45			
10:44:19.1				-12.3										0.991				
10:44:19.2				-12.5			3.52							0.966		-5.45		
10:44:19.4				-12.7										0.938				
10:44:19.5				-12.7		4.22	3.52			6.33	-2.81			1.003			-3.43	
10:44:19.6				-12.7										0.993				
10:44:19.7				-13.2			3.16							0.286				-2.72
10:44:19.9				-13.3										0.964				
10:44:20.0	166	21	-11	-13.3	252.8	4.5	3.16	158	-1.0	2.81	0.35	18.49	290.00	1.007	5.54			
10:44:20.1				-13.5										0.934				
10:44:20.2				-13.7			3.16							0.943		5.01		
10:44:20.4				-13.9										0.959				
10:44:20.5				-14.2		1.0	2.81			7.91	-5.1			0.916			3.69	
10:44:20.6				-14.7										0.874				
10:44:20.7				-15.1			3.16							0.904				11.34
10:44:20.9				-15.9										0.803				
10:44:21.0	153	7	-14	-16.8	251.39	0	3.52	156	0.3	7.91	-4.39	20.87	341.60	0.771	5.89			
10:44:21.1				-17.4										0.815				
10:44:21.2				-18.0			4.22							0.849		6.68		
10:44:21.4				-18.3										0.925				
10:44:21.5				-18.3		3.5	4.92			3.52	1.4			1.019			15.73	
10:44:21.6				-13.0										2.294				
10:44:21.7				-6.5			4.92							2.630				13.8
10:44:21.9				0.0										2.496				
10:44:22.0	151.5	-1	-8	4.4	252.1	3.87	5.63	154	-0.3	2.11	3.52	20.87	343.90	2.104	7.47			
10:44:22.1				4.5										1.005				
10:44:22.2				2.8			5.98							0.577		4.22		
10:44:22.4				1.1										0.497				
10:44:22.5										-4.57	4.57			0.938			-10.37	
10:44:22.6														0.403				
10:44:22.7														0.385				-9.49
10:44:22.9														0.316				

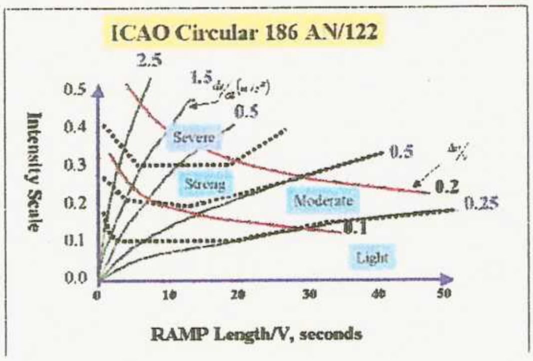
Downdraft

T/D

Table 2 Vertical Acceleration Variations Below 50 ft RA

(C) Wind Shear Identification from Flight Data Record

In 1987, ICAO proposed a method to measure the wind shear hazard (ICAO, 1987). This method categorizes the wind shear into four levels: light, moderate, strong and severe. The wind shear identification depends on two parameters, i.e. the air speed change and the proportion of air speed, as shown in Figure 3.



Wind Shear identification method - airspeed variation, published by ICAO. Source: Prof. Fujita, Univ. of Chicago, USA, 1985

Figure 3: Wind Shear Intensity classification

CI642 FDR Analysis
[Wind Shear Intensity Vs. CAS/TLA/Wind speed]

	UTC Time	CAS	delta CAS	dt	Dv/v	dv/dt	windshear level	delta YWSPD	delta WSPD	RA	AOA	Vert. Wind	WSPD (Boeing)	WINDIR (Boeing)	GSPD	TLA1	TLA2	TLA3	HEADING	PITCH1
	hh:mm:ss	kts	kts			(m/s^2)		(kts)	(kts)	ft	deg	(kts)	(Kts)	(deg)	KTS	(deg)	(deg)	(deg)	Deg	deg
	18:43:46	167.0								507.0	5.10				154.0	48.2	48.2	47.8	268.9	3.2
	18:43:47	168.5								490.0	5.10	4.1	50.4	327	154.0	46.8	46.1	45.0	268.9	3.2
	18:43:48	168.0								481.0	4.90	4.3	48.9	323	154.0	44.6	43.9	43.2	268.9	2.8
	18:43:49	166.0	-1.0	3.0	0.01	0.17	below light	-0.2	-4.7	466.0	4.90	3.9	45.8	328	154.0	43.2	43.2	42.9	268.9	2.8
	18:43:50	166.5								455.0	5.10	4.3	47.0	328	152.0	42.9	43.6	43.6	268.9	3.2
	18:43:51	166.5								438.0	5.10	3.3	44.4	324	152.0	44.3	46.1	46.1	268.2	3.2
	18:43:52	164.5								427.0	6.20	4.6	40.4	323	152.0	47.1	47.5	46.8	266.5	3.9
	18:43:53	166.0	-0.5	3.0	0.00	0.09	below light	-2.3	-3.6	413.0	6.20	2.0	43.4	323	152.0	47.5	47.5	47.5	263.7	4.6
	18:43:54	164.0								404.0	8.10	-0.4	46.0	326	152.0	48.2	47.8	47.5	261.6	4.2
	18:43:55	164.5								391.0	8.10	4.1	34.5	320	152.0	48.2	48.5	47.8	261.9	3.9
	18:43:56	167.5	1.5	3.0	0.01	0.26	below light	1.3	-4.0	381.0	7.00	3.3	39.4	316	152.0	48.5	48.2	47.1	261.6	3.5
	18:43:57	165.5								370.0	7.00	6.0	41.7	318	152.0	47.5	46.8	45.7	261.9	3.2
	18:43:58	161.5								361.0	6.20	6.0	39.0	325	154.0	46.1	45.7	45.0	261.9	3.5
	18:43:59	164.0								347.0	6.20	4.1	43.2	328	154.0	45.7	46.4	46.8	262.3	3.5
	18:44:00	162.5								338.0	6.90	2.4	42.4	325	154.0	48.2	48.5	48.9	263.0	3.9
	18:44:01	169.0	7.5	3.0	0.04	1.29	below light	-2.0	7.2	325.0	6.90	4.0	46.2	323	154.0	49.9	49.9	48.5	263.7	3.2
	18:44:02	168.5								316.0	3.70	8.1	42.1	318	154.0	48.9	48.2	46.4	264.4	1.4
	18:44:03	167.5								300.0	3.70	4.2	46.2	323	154.0	46.1	45.0	43.9	264.4	1.4
a	18:44:04	166.5								282.0	5.60	1.9	47.9	326	154.0	45.0	45.0	42.9	264.7	2.1
	18:44:05	166.0								263.0	5.60	0.4	43.3	321	152.0	43.9	43.6	42.5	265.8	2.5
	18:44:06	157.0	-11.5	4.0	0.07	1.38	moderate	-8.7	-2.4	245.0	7.20	-0.5	39.7	332	152.0	43.9	43.9	44.6	266.8	3.2
b	18:44:07	161.5								225.0	7.20	2.1	37.3	321	150.0	47.1	48.9	50.3	267.2	2.8
	18:44:08	161.5								206.0	6.20	3.0	36.8	31[illegible]	150.0	52.7	54.5	54.8	266.1	2.5
	18:44:09	157.5	-10.0	4.0	0.06	0.86	light	-3.2	-10.4	186.0	6.20	1.0	35.7	325	150.0	56.2	55.2	54.1	265.1	3.2
	18:44:10	159.5								150.0	9.00	-4.8	27.7	315	152.0	55.5	56.2	58.0	265.1	5.3
	18:44:11	163.5								131.0	9.00	1.5	26.6	308	154.0	61.2	61.9	59.1	265.4	5.6
c	18:44:12	171.0								129.0	5.10	2.7	33.3	304	156.0	58.7	55.5	52.7	264.0	3.5
	18:44:13	175.0	17.5	4.0	0.10	2.25	strong	6.3	0.7	117.0	5.10	7.2	36.4	302	158.0	52.7	50.6	49.6	262.3	2.1
	18:44:14	170.0								104.0	6.30	1.0	31.6	308	158.0	50.6	49.6	48.5	261.6	2.8
	18:44:15	166.5								83.0	6.30	4.8	24.5	307	160.0	49.6	47.1	43.2	260.9	2.8
d	18:44:16	167.5								73.0	6.50	1.7	29.1	315	160.0	43.2	40.1	37.6	259.1	2.1
IDLE	18:44:17	165.0	-10.0	4.0	0.06	1.29	moderate	-1.9	-14.6	59.0	6.50	5.3	21.9	317	160.0	38.7	38.7	37.3	258.4	2.5
	18:44:18	172.0								45.0	7.00	0.8	20.4	272	160.0	39.4	38.0	37.3	257.0	3.5
	18:44:19	164.5								32	7.00	0.5	17.8	301	160.0	38.0	38.9	37.3	254.9	3.9
e	18:44:20	166								21	7.90	-0.2	18.5	298	158.0	39.4	38.3	37.3	252.8	3.2
	18:44:21	153								7	7.90	4.1	20.9	342	156.0	38.2	37.6	37.3	251.4	3.5
	18:44:22	151.5	-20.5	4.0	0.14	2.64	severe	5.3	0.5	-1	0.00	6.0	20.9	344	154.0	38.3	37.6	26.0	252.1	5.6

Table 3.Wind Shear Intensity in a,b,c,d,e zone at different altitude.

Based on table 3 data for calculating wind shear intensity, the result showed CI642 encountered a strong to severe wind shear below 200 feet. The intensity of wind shear varied with radio altitude is plotted in figure 3.

(1) a zone: 300 ft~ 245ft: Light to **moderate** wind shear [25 ~ 19sec. Prior to touch down]

(2) b zone: 245 ft~ 186ft: **Moderate** to Light wind shear [19 ~ 13sec. Prior to touch down]

(3) c zone: 186 ft~ 117 ft: Light to **Strong** wind shear [13 ~ 9sec. Prior to touch down]

(4) d zone :117 ft~ 59 ft: **Strong** to Moderate wind shear [9 ~ 6sec. Prior to touch down]

(5) e zone: 45 ft ~ -1 ft: Moderate to **Severe** wind shear [6 ~ 1sec. Prior to touch down]

(D) Summarized Comments of ASC's Analysis

1. During the final landing phase, the aircraft encountered unsteady airflow as downwash that was exacerbated to have a high descent rate at the 6 seconds and 2 seconds before touch down.
2. At the time of the six seconds and the two seconds before touchdown, the elevator position indicated increasing from+2 to +11degrees and +5.1 deg to +15.7 deg max respectively. ASC believes that the commander was working on the recovery to the high descent rate and provided large control column input. The pilots responded and recovered the first downdraft to have less descent rate. It took three seconds to recover the first downdraft.
3. The second downdraft happened at two seconds before touch down. The pilot did make his effort by pulling the column back and the elevators were moving up to a higher degree but no enough time for the pilot to recover.
4. The ASC believes that AOA is a significant parameter to the analysis in this accident. Angle of Attack in conjunction with normal acceleration and elevator deflection are of vital importance to differentiate between external forces acting on the aircraft and pilot-generated responses, was mentioned only in factual (paragraph 1.11.6.): "...fluctuated with increasing divergence between 3° and 8°..."and was not mentioned in the "Analysis" (Section 2. of Reference A).
5. Appendix A5-3-2 in Reference A shows a variation in TDZ wind direction of between 314° and 326° with speeds from 39kt to 43kt (Runway 25R) in comparison to a variation in TDZ wind direction of between 283° and 339° at 14kt to 28kt （Runway 25L）in the lee of the Passenger Terminal Building. This kind of wind change will affect the landing to a great extent.

Part 4 (continued)

Comments on Section 3, Conclusions

Cause Factors

Reference A, Section 3.2. Causal factor 3.2.1.

ASC issues and Discussion

According to the FDR data and ASC's analysis, the elevator was changed by the pilot's effort during final seconds of landing while the aircraft was encountering a downdraft and pouring rain on Runway 25L.It is in contrast with the statement that the pilot did not arrest the high sinking rate during landing.

ASC proposed changes

Change Causal Factor 3.2.1 to reflect the derivation from analysis of the data (Part 3, above), as follows:

3.2.1 **During the final two seconds before touchdown the aircraft encountered atmospheric conditions, which caused an increasing rate of descent, culminating in touchdown at a rate in excess of 18 fps.The existence of a downdraft condition at a point where landing aircraft normally flare for runway 25L was involved in this accident.**

Contributing factors to the downdraft condition were:

3.2.1.1 Rapidly changing strong wind and downdraft conditions resulting from an approaching tropical storm.

3.2.1.2 Large differences in wind velocity and direction between the approach path to runway 25L and that of runway 25R at Chep Lap Kok Airport, Hong Kong. (See Ref A appendix 5.3)

Reference A, Section 3.2. Causal factor 3.2.2.

ASC issues and Discussion

This Causal factor should be deleted in its entirety, for the following reasons:

(1) The FDR data show that the pilot flew the aircraft after passing the altitude of $21ft_{RA}$ fully configured for landing, on centerline, corrected for cross-wind and with a kinetic energy margin in excess of 15% for that gross weight and configuration. Additionally, the aircraft descent rate at that point (less than 2 seconds from touchdown) was less than that for a nominal 3° glide path (see Figure 4). Given the aircrafts excess energy at that time, the thrust was (and should have been) automatically retarding to idle, as designed by the manufacturer.

(2) The training manual contains no instructions or procedure for arresting rate of descent by adding thrust.

ASC proposed changes

Change Causal Factor 3.2.2 to reflect the derivation from analysis of the data (Part 3, above), as follows:

3.2.2.1 **Reduced visibility in heavy rain and dusk conditions which prevented visual detection of the increasing rate of descent until less than 1 second before touchdown, due to obscured peripheral vision and partially obscured forward vision in heavy rain.**

Reference A, Section 3.2. Causal factor 3.2.3.

ASC issues and Discussion

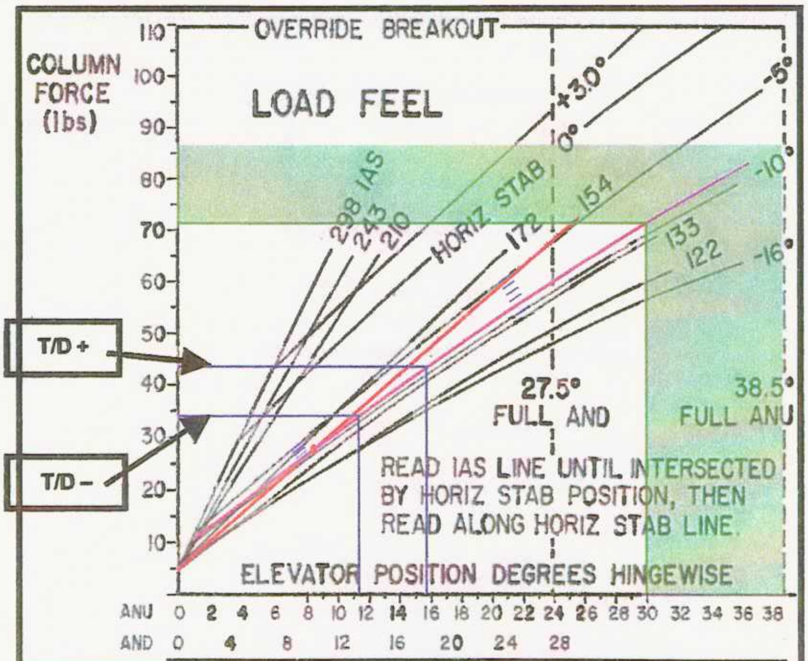
This conclusion is invalid and is included as cause factor 3.2.2.4, above; it may therefore be replaced.

ASC proposed changes

For completeness, in the interest of identifying all causes, which can pass the test of links of the accident chain, the following factors need to be included in the accident report.

3.2.3 The time critical location of the sudden onset of the severe downdraft, at a position and altitude less than two seconds prior to touchdown, which prevented pilot awareness of the phenomenon in sufficient time to effect corrective action prior to ground contact, was a contributing factor of the accident.

3.2.3.1 **Elevator control forces required achieving the large deflections necessary to arrest the descent rate in time, which were well in need of large input from the pilot (with one hand on the control wheel, See Figure.4 below).**



From CAL "MD-11 Lamm Schematics" McDonnell

Figure 4. MD-11 Elevator Load Feel force Gradient

3.2.4 Structural failure of the right main landing gear in such a fashion that fracture of the wing main spar rear web occurred, resulting in separation of the right wing followed by inversion of the fuselage was an important factor to this accident.

Contributing causes to the structural failure were:

3.2.4.1 Crosswind conditions that required asymmetric touch down.

3.2.4.2 Touch down sink rate in excess of design limit loads.

Design limit loads (12fps) such that a normal approach at maximum landing weight involves descent rates 40 to 50% in excess of limit loads. (13.9 to 15.2fps).

3.2.4.3 The absence of an energy absorbing landing gear structure which would dissipate excessive touch down loads without compromising the integrity of the wing main spar

Findings

General

Some of the Findings of Reference A exhibit in the absence of detailed analysis of the data of Flight Recorder.

Specific

Reference A, Section 3.1. Finding 3.1.16.

ASC issues and Discussion

It is normal for an aircraft to land at gross weights up to and including its published maximum landing weight, and since normal landing procedures require the choice of an approach speed (with additives as required for environmental conditions) predicated on landing weight, in no event can a loss of airspeed be attributed to the gross weight.

ASC proposed changes

Delete Finding 3.1.16.

Reference A, Section 3.1. Missing/Deleted Finding

ASC issues and Discussion

Finding 3.1.28, of the Reference D (Initial Draft Report dated June 2001):

> **3.1.28** During the final two seconds before touchdown the aircraft encountered atmospheric conditions, which caused an increasing rate of descent, culminating in touchdown at a rate in excess of 18fps.

was omitted from Reference A. **Since analysis of the data shows that this Finding accurately describes the primary causal factor of this accident, it should be included again.**

ASC proposed changes

Re-instate the Finding contained in paragraph 3.1.28 of Reference D (the Initial Draft report) into the final report.

Part 5

Comments on Section 4, Safety Recommendations

ASC considers Safety Recommendations **4.9** and **4.10** of **Reference A** to be of merit, and would like to add the following safety recommendations:

To Hong Kong International Airport

1. Enhance the capability of the WTWS system to enable detection of both vertical and horizontal components of wind shear on approach.

2. Enhance its emergency response planning in accordance with ICAO Document 9137 Part 7 Section 1.2 to provide a timely emergency shelter capability for survivors of an accident. (Reference A, Finding 3.1.28)