Appendix 1

ATIS

\# to be included when appropriate
* Tick or delete as appropriate.

ATMD – 7 (Revised 6/99)

1. Hong Kong International Airport Information W at time 0940

2. Runway in use : ☑ 25L RWY 25R AVBL ON REQ
   ☐ ________ for Arrival, ________ for Departure

3. Expect : (type of Approach/Departure)*
   - ☑ ILS-DME Approach
   - ☐ LLZ-DME Approach
   - ☐ Others ________ (specify)
   - ☐ Arriving cargo flights expect RWY 07R/25L* ILS-DME/LLZ-DME Approach*

4. Significant runway surface conditions, NAVAIDS status and other essential information*#
   - ☑ Runway surface wet / ~~damp~~
   - ☐ Others BRAKING ACTION REPORTED AS GOOD ________ (specify)

5. Surface Wind — Degrees 320 Knots 30 MAX 45 kts
   Maximum/Gusts — Degrees ________ Knots ________

6. Visibility 1400 ~~Km~~/m* (IN) RVR 07L / 25R* ________ m#
   07R / 25L* ________ m#

7. Present weather#*
   - ☐ Thunderstorm/Heavy Rain/Rain/Light Rain/Drizzle/Passing Showers/Fog/Haze/
     Others ________ (specify)

8. Cloud below 5000ft AMSL FEW 1000 SCT 1600

9. Surface wind/visibility/cloud base changing rapidly due ________

10. Temperature 25 Dew point 24 QNH 986 hPa

11. Significant Met. phenomena in approach, take-off & climb-out areas*#
    - ☑ Expect significant wind shear/~~moderate~~/severe turbulence/~~in vicinity of CB~~ on APP/DEP
    - ☐ Others ________ (specify)

12. Trend-type landing forecast TEMPO VIS 1000 M

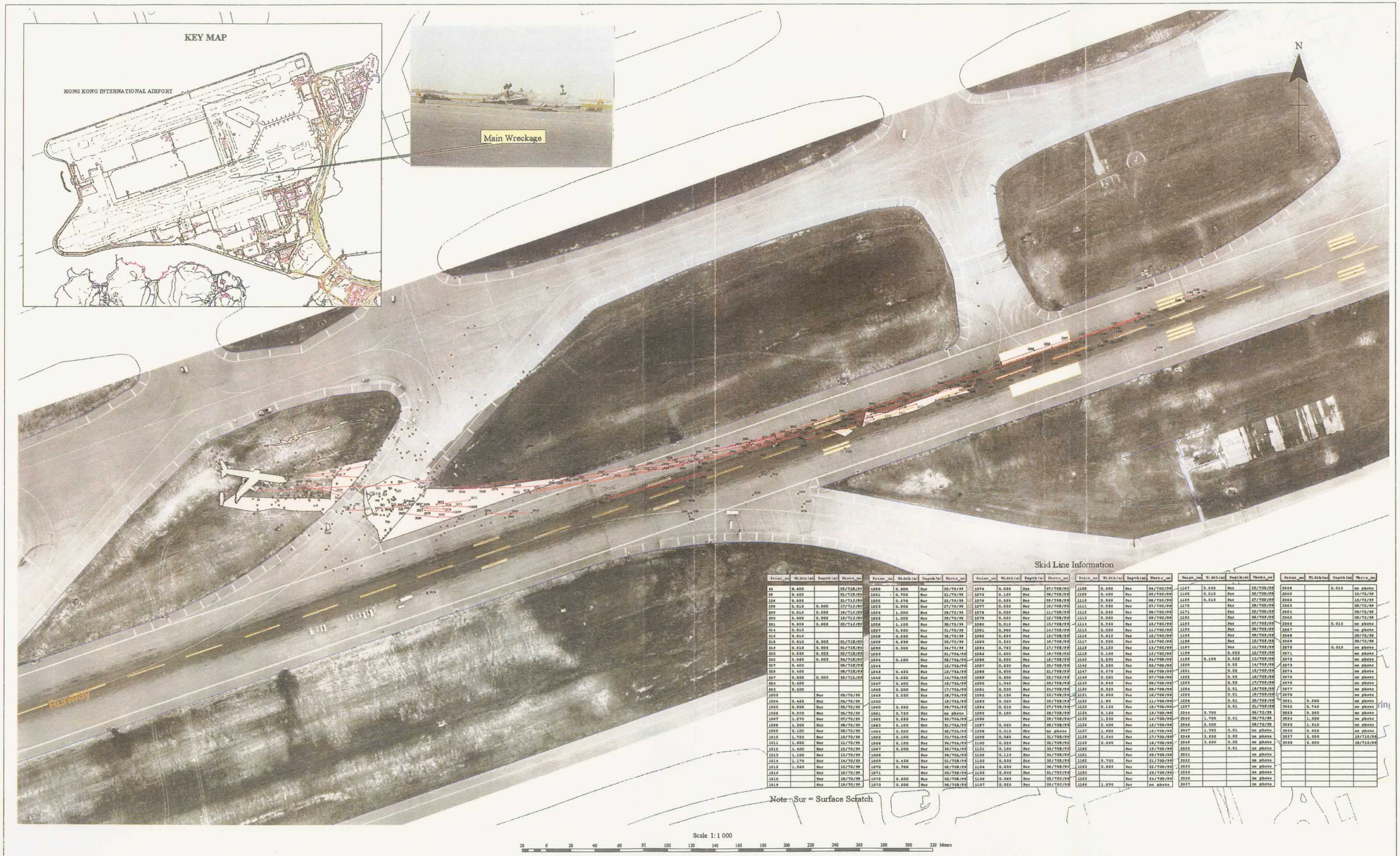
13. Acknowledge information W on freq. 119.1/119.35* for Arrival & 129.9/124.65/122.55* for Departure

ATIS

\# to be included when appropriate
* Tick or delete as appropriate

ATMD – 7 (Revised 6/99)

1. Hong Kong International Airport Information X at time 1006
2. Runway in use : ☑ 25L RWY 25R AVBL ON RZQ
   ☐ ________ for Arrival, ________ for Departure
3. Expect : (type of Approach/Departure)*
   - ☑ ILS-DME Approach
   - ☐ LLZ-DME Approach
   - ☐ Others ________________________________(specify)
   - ☐ Arriving cargo flights expect RWY 07R/25L* ILS-DME/LLZ-DME Approach*
4. Significant runway surface conditions, NAVAIDS status and other essential information*#
   - ☑ Runway surface (wet)/ ~~damp~~*
   - ☐ Others BRAKING ACTION REPORTED AS GOOD ________________(specify)
5. Surface Wind — Degrees 300 Knots 35
   Maximum/Gusts — Degrees ________ Knots ________
6. Visibility 800 ~~Km~~/m* IN — (RVR) ~~07L/25R*~~ ________ m#
   ~~07R~~/(25L*) 650 m#
7. Present weather*#
   - ☐ Thunderstorm/(Heavy Rain)/Rain/Light Rain/Drizzle/Passing Showers/Fog/Haze/
     Others ________________________________(specify)
8. Cloud below 5000ft AMSL FEW 1000 SCT 1600
9. Surface wind/visibility/cloud base changing rapidly due ________________
10. Temperature 25 Dew point 24 QNH 986 hPa
11. Significant Met. phenomena in approach, take-off & climb-out areas*#
    - ☑ Expect significant wind shear/~~moderate~~/severe turbulence/~~in vicinity of CB~~ on APP/DEP
    - ☐ Others ________________________________(specify)
12. Trend-type landing forecast ________________________________
13. Acknowledge information X on freq. 119.1/(119.35*) for Arrival & (129.9)/124.65/122.55* for Departure



Skid Line Information

Point_no	Width(m)	Depth(m)	Photo_no
44	0.400		05/71B/99
89	0.400		01/71D/99
108	0.005		21/71J/99
298	0.010	0.005	17/71J/99
299	0.010	0.005	18/71J/99
300	0.008	0.005	19/71J/99
301	0.008	0.005	20/71J/99
314	0.010		
315	0.010		
318	0.010	0.005	01/71K/99
319	0.010	0.005	01/71K/99
320	0.050	0.003	02/71K/99
322	0.060	0.003	04/71K/99
327	0.400		08/71K/99
328	0.400		08/71K/99
547	0.050	0.003	26/71L/99
624	0.400		
625	0.400		
1003		Sur	03/70/99
1004	0.460	Sur	04/70/99
1005	0.900	Sur	05/70/99
1006	0.300	Sur	06/70/99
1007	1.270	Sur	07/70/99
1008	1.300	Sur	08/70/99
1009	2.100	Sur	09/70/99
1010	1.720	Sur	10/70/99
1011	1.600	Sur	11/70/99
1012	1.400	Sur	12/70/99
1013	1.100	Sur	13/70/99
1014	1.170	Sur	14/70/99
1015	1.060	Sur	15/70/99
1016		Sur	16/70/99
1018		Sur	18/70/99
1019		Sur	19/70/99

Point_no	Width(m)	Depth(m)	Photo_no
1020	0.300	Sur	20/70/99
1021	0.700	Sur	21/70/99
1022	0.570	Sur	22/70/99
1023	0.900	Sur	27/70/99
1024	1.000	Sur	28/70/99
1025	1.000	Sur	29/70/99
1026	1.100	Sur	30/70/99
1027	0.950	Sur	31/70/99
1028	0.650	Sur	32/70/99
1029	0.630	Sur	33/70/99
1030	0.300	Sur	34/70/99
1033		Sur	01/70A/99
1034	0.100	Sur	02/70A/99
1044		Sur	12/70A/99
1045	0.450	Sur	13/70A/99
1046	0.650	Sur	14/70A/99
1047	0.400	Sur	15/70A/99
1048	0.200	Sur	17/70A/99
1049	0.050	Sur	18/70A/99
1050		Sur	19/70A/99
1060	0.590	Sur	29/70A/99
1061	0.750	Sur	no photo
1062	0.650	Sur	30/70A/99
1063	0.100	Sur	31/70A/99
1064	0.200	Sur	32/70A/99
1065	0.100	Sur	33/70A/99
1066	0.100	Sur	34/70A/99
1067	0.200	Sur	35/70A/99
1068		Sur	36/70A/99
1069	0.450	Sur	01/70B/99
1070	0.700	Sur	02/70B/99
1071		Sur	03/70B/99
1072	0.200	Sur	05/70B/99
1073	0.500	Sur	06/70B/99

Point_no	Width(m)	Depth(m)	Photo_no
1074	0.050	Sur	07/70B/99
1075	0.150	Sur	08/70B/99
1076	0.050	Sur	09/70B/99
1077	0.030	Sur	10/70B/99
1078	0.030	Sur	11/70B/99
1079	0.050	Sur	12/70B/99
1080	0.010	Sur	13/70B/99
1081	0.900	Sur	14/70B/99
1082	0.650	Sur	15/70B/99
1083	0.550	Sur	16/70B/99
1084	0.760	Sur	17/70B/99
1085	0.600	Sur	18/70B/99
1086	0.800	Sur	19/70B/99
1087	0.650	Sur	20/70B/99
1088	0.600	Sur	21/70B/99
1089	0.600	Sur	22/70B/99
1090	1.040	Sur	23/70B/99
1091	0.030	Sur	24/70B/99
1092	0.130	Sur	25/70B/99
1093	0.020	Sur	26/70B/99
1094	0.010	Sur	27/70B/99
1095	0.100	Sur	28/70B/99
1096		Sur	29/70B/99
1097	0.020	Sur	30/70B/99
1098	0.010	Sur	no photo
1099	0.060	Sur	31/70B/99
1100	0.020	Sur	32/70B/99
1101	0.100	Sur	33/70B/99
1102	0.110	Sur	34/70B/99
1103	0.030	Sur	35/70B/99
1104	0.030	Sur	36/70B/99
1105	0.040	Sur	01/70C/99
1106	0.060	Sur	02/70C/99
1107	0.020	Sur	03/70C/99

Point_no	Width(m)	Depth(m)	Photo_no
1108	0.400	Sur	04/70C/99
1109	0.400	Sur	05/70C/99
1110	0.350	Sur	06/70C/99
1111	0.030	Sur	07/70C/99
1112	0.030	Sur	08/70C/99
1113	0.060	Sur	09/70C/99
1114	0.050	Sur	10/70C/99
1115	0.030	Sur	11/70C/99
1116	0.010	Sur	12/70C/99
1117	0.200	Sur	13/70C/99
1118	0.120	Sur	14/70C/99
1119	0.100	Sur	15/70C/99
1145	0.230	Sur	04/70D/99
1146	0.200	Sur	05/70D/99
1147	0.370	Sur	06/70D/99
1148	0.260	Sur	07/70D/99
1149	0.940	Sur	08/70D/99
1150	0.320	Sur	09/70D/99
1151	0.600	Sur	10/70D/99
1152	1.80	Sur	11/70D/99
1153	0.150	Sur	12/70D/99
1154	0.150	Sur	13/70D/99
1155	1.530	Sur	14/70D/99
1156	2.400	Sur	15/70D/99
1157	1.900	Sur	16/70D/99
1158	2.540	Sur	17/70D/99
1159	0.050	Sur	18/70D/99
1160		Sur	19/70D/99
1161		Sur	20/70D/99
1162	0.700	Sur	21/70D/99
1163	0.800	Sur	22/70D/99
1164		Sur	23/70D/99
1165		Sur	24/70D/99
1166	1.630	Sur	no photo

Point_no	Width(m)	Depth(m)	Photo_no
1167	0.240	Sur	25/70D/99
1168	0.010	Sur	26/70D/99
1169	0.010	Sur	27/70D/99
1170		Sur	28/70D/99
1171		Sur	29/70D/99
1192		Sur	06/70F/99
1193		Sur	07/70F/99
1194		Sur	08/70F/99
1195		Sur	09/70F/99
1196		Sur	10/70F/99
1197		Sur	11/70F/99
1198		0.025	12/70F/99
1199	0.100	0.025	13/70F/99
1200		0.02	14/70F/99
1201		0.02	15/70F/99
1202		0.03	16/70F/99
1203		0.03	17/70F/99
1204		0.01	18/70F/99
1205		0.01	19/70F/99
1206		0.01	20/70F/99
1207		0.01	21/70F/99
2044	0.700		06/72/99
2045	1.700	0.01	06/72/99
2046	2.200		06/72/99
2047	1.300	0.01	no photo
2048	3.500	0.02	no photo
2049	3.600	0.02	no photo
2050		0.01	no photo
2051			no photo
2052			no photo
2053			no photo
2055			no photo
2056			no photo
2057			no photo

Point_no	Width(m)	Depth(m)	Photo_no
2058		0.015	no photo
2059			10/72/99
2060			10/72/99
2063			09/72/99
2064			09/72/99
2065			09/72/99
2066		0.015	no photo
2067			no photo
2068			09/72/99
2069			09/72/99
2070		0.015	no photo
2071			no photo
2072			no photo
2073			no photo
2074			no photo
2075			no photo
2076			no photo
2077			no photo
2078			no photo
3051	0.280		no photo
3052	0.740		no photo
3053	0.360		no photo
3054	1.330		no photo
3055	1.310		no photo
3056	0.920		no photo
3057	5.500		13/710/99
3058	6.000		18/710/99

Note : Sur = Surface Scratch

Legend

Large Wreckage
Scattered Wreckage
Small Wreckage
Burn Mark
Skid Line
Point Number

Note:

Use the point number to locate the photograph taken on the ground of the features. The photographs are kept in the Annex to this plan.

Survey of the Aircraft Accident to McDonnell Douglas MD-11 at Hong Kong International Airport at Chek Lap Kok on 22 August 1999

Plan No.: M590-1

Geodetic Survey Section
Survey and Mapping Office
Lands Department

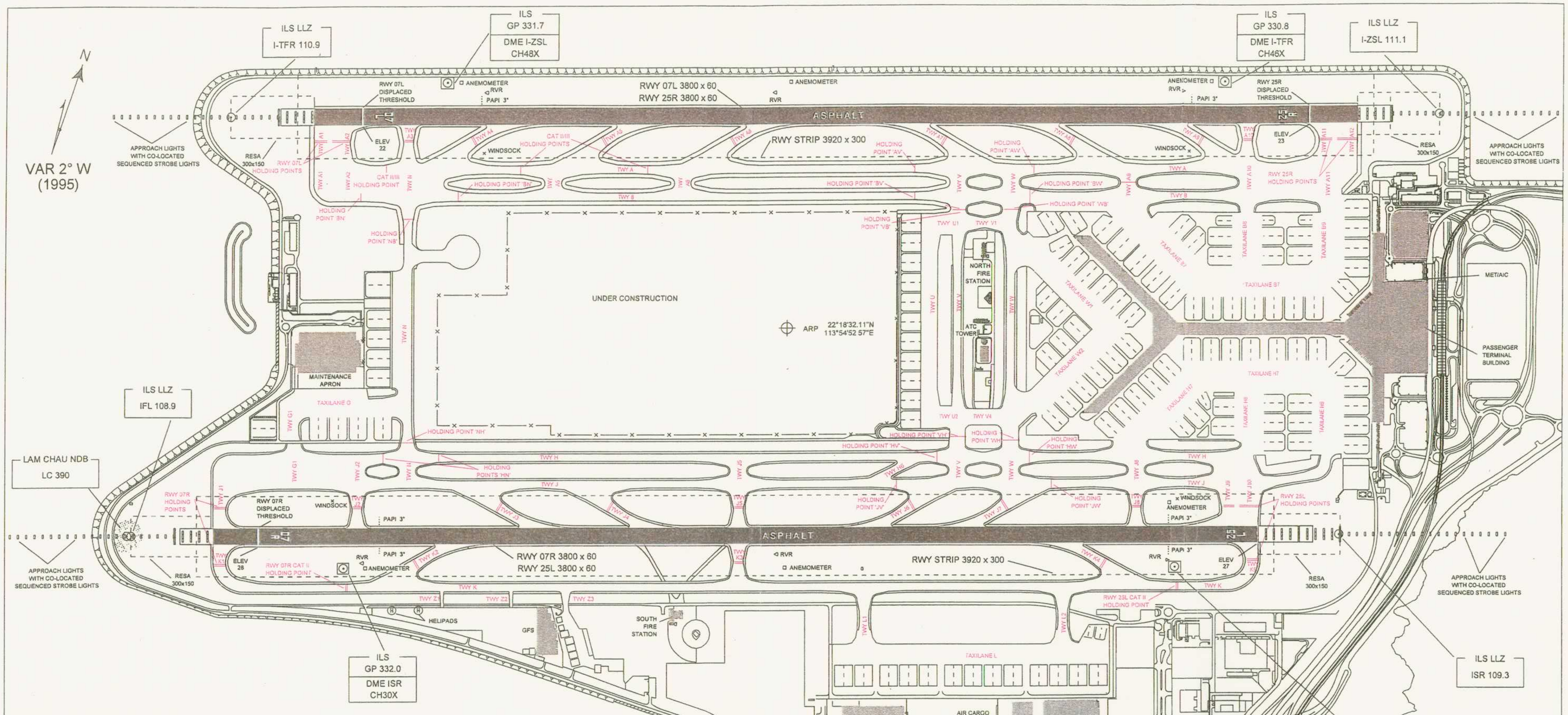
AERODROME CHART (AERODROME LAYOUT)

22° 18'32.11"N
113° 54'52.57"E

ELEVATION 19 FT AMSL

TWR	118.4 / 118.2
GMC	121.6 / 122.55

HONG KONG INTERNATIONAL AIRPORT



TAXIWAY HOLDING POSITION RUNWAY HOLDING POSITION			
RUNWAY 07L THRESHOLD DISPLACED RUNWAY 07L THRESHOLD ELEVATION			173 m 22 ft
RUNWAY 07R THRESHOLD DISPLACED RUNWAY 07R THRESHOLD ELEVATION			160 m 28 ft
RUNWAY 25L THRESHOLD ELEVATION			27 ft
RUNWAY 25R THRESHOLD DISPLACED RUNWAY 25R THRESHOLD ELEVATION			174 m 23 ft
RWY	DIRECTION	THRESHOLD	BEARING STRENGTH
07L	073°M	22°18.7'N 113°53.9'E	PCN 72/F/B/W/T
07R	073°M	22°17 8'N 113°54 0'E	
25L	253°M	22°18 5'N 113°56 0'E	
25R	253°M	22°19.3'N 113°55 8'E	
TAXIWAY			PCN 72/F/B/W/T
PASSENGER TERMINAL / CARGO TERMINAL APRON			PCN 80/R/C/W/T
MAINTENANCE APRON			PCN 53/R/C/W/T

CIVIL AVIATION DEPARTMENT, HONG KONG
Cartography by Survey and Mapping Office, Lands Department

One-minute mean RVR data – RW 25L/25R

Ending-time (hh:mm:sec)	RW 25L Touchdown (m)	RW 25L Mid-point (m)	RW 25L Roll-out (m)	RW 25R Touchdown (m)	RW 25R Mid-point (m)	RW 25R Roll-out (m)
10:25:00	1000	900	900	600	800	1000
10:25:10	1000	900	900	650	800	1000
10:25:20	1000	900	900	650	800	1000
10:25:30	1100	900	1000	650	800	1000
10:25:40	1100	900	1000	650	800	1100
10:25:50	1100	1000	1000	650	800	1100
10:26:00	1100	1000	1000	600	900	1100
10:26:10	1100	1000	1000	600	900	1100
10:26:20	1100	1000	1000	600	800	1100
10:26:30	1100	1000	1000	600	900	1000
10:26:40	1100	1000	1100	600	800	1000
10:26:50	1000	1000	1100	600	800	1000
10:27:00	1000	1100	1100	650	800	1000
10:27:10	1000	1100	1100	650	800	1000
10:27:20	1000	1200	1100	650	800	1000
10:27:30	1000	1300	1100	650	800	1100
10:27:40	1000	1300	1100	650	900	1100
10:27:50	1100	1200	1100	650	900	1100
10:28:00	1100	1200	1100	650	900	1100
10:28:10	1200	1200	1100	650	900	1100
10:28:20	1200	1200	1100	650	800	1100
10:28:30	1200	1200	1100	650	800	1100
10:28:40	1200	1200	1100	600	800	1100
10:28:50	1200	1300	1100	600	800	1100
10:29:00	1200	1300	1100	600	800	1200
10:29:10	1200	1300	1100	600	800	1200
10:29:20	1300	1400	1100	600	900	1200
10:29:30	1300	1400	1100	600	900	1200
10:29:40	1300	1400	1100	650	900	1200
10:29:50	1300	1400	1100	650	900	1200
10:30:00	1300	1500	1100	700	900	1200
10:30:10	1300	1500	1100	700	900	1100
10:30:20	1300	1500	1100	700	900	1100
10:30:30	1300	1500	1200	700	900	1100
10:30:40	1200	1500	1200	700	900	1100
10:30:50	1300	1400	1200	700	900	1000
10:31:00	1300	1300	1200	750	900	1000
10:31:10	1300	1300	1300	750	900	1000
10:31:20	1400	1300	1300	750	900	1000
10:31:30	1400	1300	1300	750	900	1000
10:31:40	1400	1400	1300	750	900	1000
10:31:50	1500	1500	1200	750	900	1000
10:32:00	1500	1600	1200	750	900	1100
10:32:10	1500	1600	1200	750	900	1100

One-minute mean RVR data – RW 25L/25R

	RW 25L			RW 25R		
Ending-time (hh:mm:sec)	Touchdown (m)	Mid-point (m)	Roll-out (m)	Touchdown (m)	Mid-point (m)	Roll-out (m)
10:32:20	1500	1500	1200	750	900	1100
10:32:30	1500	1500	1200	750	900	1100
10:32:40	1500	1400	1200	750	900	1100
10:32:50	1500	1400	1200	750	900	1100
10:33:00	1600	1400	1200	750	900	1100
10:33:10	1600	1500	1200	700	1000	1200
10:33:20	1600	1500	1200	700	1000	1200
10:33:30	1600	1600	1200	700	1000	1200
10:33:40	1600	1700	1300	700	1000	1200
10:33:50	1700	1700	1300	650	1000	1200
10:34:00	1700	1600	1300	650	1000	1200
10:34:10	1700	1600	1300	650	1000	1200
10:34:20	1700	1600	1300	650	1000	1200
10:34:30	1700	1600	1300	700	1000	1200
10:34:40	1700	1600	1300	700	1000	1200
10:34:50	1700	1600	1400	700	1000	1100
10:35:00	1600	1600	1400	750	1000	1100
10:35:10	1600	1600	1400	750	1000	1100
10:35:20	1600	1600	1400	750	1000	1100
10:35:30	1700	1600	1500	750	1000	1100
10:35:40	1700	1600	1500	750	1100	1100
10:35:50	1700	1600	1600	750	1100	1200
10:36:00	1700	1600	1600	750	1100	1200
10:36:10	1700	1700	1600	800	1100	1300
10:36:20	1700	1700	1600	800	1100	1300
10:36:30	1600	1700	1600	800	1100	1400
10:36:40	1600	1700	1600	800	1100	1500
10:36:50	1600	1700	1600	800	1100	1500
10:37:00	1800	1600	1600	800	1100	1500
10:37:10	1800	1700	1600	900	1100	1500
10:37:20	1800	1600	1600	900	1100	1500
10:37:30	1800	1600	1700	900	1100	1500
10:37:40	1600	1500	1700	900	1100	1500
10:37:50	1500	1500	1700	900	1100	1500
10:38:00	1500	1500	1700	900	1100	1500
10:38:10	1500	1500	1700	900	1100	1500
10:38:20	1600	1600	1700	900	1200	1500
10:38:30	1700	1600	1700	900	1200	1500
10:38:40	1800	1800	1700	900	1200	1500
10:38:50	1800	1800	1700	900	1200	1500
10:39:00	1900	1900	1700	900	1300	1500
10:39:10	1900	1900	1700	900	1300	1500
10:39:20	1900	2000	1700	900	1300	1400
10:39:30	1800	2000	1700	900	1300	1400

One-minute mean RVR data – RW 25L/25R

Ending-time (hh:mm:sec)	RW 25L Touchdown (m)	RW 25L Mid-point (m)	RW 25L Roll-out (m)	RW 25R Touchdown (m)	RW 25R Mid-point (m)	RW 25R Roll-out (m)
10:39:40	1800	2000	1700	900	1300	1400
10:39:50	1800	2100	1700	800	1300	1400
10:40:00	1800	2100	1700	800	1300	1400
10:40:10	1800	2100	1700	800	1300	1400
10:40:20	1800	2100	1800	800	1200	1400
10:40:30	1700	2200	1800	800	1200	1400
10:40:40	1600	2200	1800	800	1200	1400
10:40:50	1600	2000	1800	800	1200	1400
10:41:00	1600	1900	1700	900	1200	1500
10:41:10	1600	1900	1700	900	1200	1500
10:41:20	1600	1900	1700	900	1300	1500
10:41:30	1600	1900	1600	900	1300	1500
10:41:40	1700	1900	1600	900	1300	1500
10:41:50	1800	2200	1600	900	1300	1500
10:42:00	1800	2300	1700	900	1300	1400
10:42:10	1800	2300	1700	900	1300	1400
10:42:20	1800	2200	1700	900	1300	1400
10:42:30	1800	2200	1800	900	1300	1400
10:42:40	1900	2200	1800	900	1300	1400
10:42:50	1900	2200	1800	900	1300	1500
10:43:00	1900	2200	1800	900	1400	1500
10:43:10	1900	2200	1800	900	1400	1500
10:43:20	1900	2200	1800	900	1400	1600
10:43:30	1900	2200	1800	1000	1500	1600
10:43:40	2000	2300	1800	1000	1500	1700
10:43:50	2000	2300	1800	1000	1500	1700
10:44:00	1800	2400	1900	1000	1500	1700
10:44:10	1700	2300	1900	1000	1500	1700
10:44:20	1600	2300	1900	1000	1500	1600
10:44:30	1600	2300	1900	1000	1500	1600
10:44:40	1600	2300	1900	1000	1400	1600
10:44:50	1600	2300	1800	1000	1400	1600
10:45:00	1700	2300	1800	1000	1400	1600

Two-minute mean wind data – RW 07L/07R touchdown zones

		RW 07L			RW 07R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:25:00	317	34	50	306	30	36
10:25:10	317	34	50	306	31	36
10:25:20	317	34	50	308	31	36
10:25:30	316	35	50	308	31	36
10:25:40	317	36	50	309	31	40
10:25:50	316	36	50	310	32	40
10:26:00	315	36	50	311	33	40
10:26:10	314	36	49	311	33	40
10:26:20	315	36	49	312	32	40
10:26:30	315	37	49	314	32	40
10:26:40	314	37	49	315	31	40
10:26:50	315	38	49	315	29	40
10:27:00	315	38	49	315	29	40
10:27:10	315	39	49	314	29	40
10:27:20	316	40	49	314	29	40
10:27:30	317	40	50	313	29	39
10:27:40	316	40	50	313	29	39
10:27:50	317	40	50	313	29	38
10:28:00	317	40	50	313	29	38
10:28:10	317	39	50	313	28	38
10:28:20	316	39	50	310	29	38
10:28:30	315	39	50	310	29	38
10:28:40	315	39	50	308	30	38
10:28:50	315	38	50	308	31	40
10:29:00	315	38	50	308	32	40
10:29:10	315	39	50	308	32	40
10:29:20	315	38	50	307	31	40
10:29:30	315	38	44	307	31	40
10:29:40	316	38	44	307	31	40
10:29:50	316	38	44	306	31	40
10:30:00	316	38	44	306	31	40
10:30:10	317	39	46	306	30	40
10:30:20	317	39	46	305	30	40
10:30:30	317	39	46	307	31	40
10:30:40	317	39	46	307	31	40
10:30:50	317	40	46	307	30	38
10:31:00	318	41	46	307	30	35
10:31:10	318	41	46	307	30	35
10:31:20	318	41	47	307	30	35
10:31:30	317	41	47	308	30	35
10:31:40	317	41	47	308	30	35
10:31:50	317	41	47	308	30	36

Two-minute mean wind data – RW 07L/07R touchdown zones

		RW 07L			RW 07R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:32:00	317	42	47	308	31	36
10:32:10	317	41	47	309	32	40
10:32:20	317	40	47	309	32	40
10:32:30	317	40	47	309	32	40
10:32:40	317	39	47	309	32	40
10:32:50	317	39	47	309	32	40
10:33:00	317	39	47	309	32	40
10:33:10	317	38	47	309	32	40
10:33:20	317	37	45	310	32	40
10:33:30	317	37	45	310	31	40
10:33:40	316	37	45	310	31	40
10:33:50	316	37	45	310	30	40
10:34:00	317	36	45	310	30	40
10:34:10	316	37	45	309	28	35
10:34:20	316	37	45	309	28	35
10:34:30	317	37	45	309	28	35
10:34:40	317	38	47	309	27	35
10:34:50	317	38	47	310	27	33
10:35:00	316	38	47	310	27	33
10:35:10	316	38	47	311	26	31
10:35:20	317	38	47	312	26	31
10:35:30	316	37	47	314	25	31
10:35:40	316	37	47	315	25	31
10:35:50	315	36	47	315	25	31
10:36:00	315	36	47	315	25	31
10:36:10	316	36	47	316	25	31
10:36:20	316	36	47	317	25	31
10:36:30	316	36	47	317	25	31
10:36:40	316	35	45	317	25	31
10:36:50	316	35	45	318	25	31
10:37:00	316	34	40	318	25	31
10:37:10	317	35	46	316	26	31
10:37:20	317	36	46	316	26	31
10:37:30	317	36	46	315	26	31
10:37:40	317	37	46	314	27	31
10:37:50	318	37	46	313	27	31
10:38:00	317	37	46	313	27	31
10:38:10	317	37	46	313	27	35
10:38:20	316	37	46	312	28	35
10:38:30	316	37	46	311	28	35
10:38:40	315	37	46	311	28	35
10:38:50	315	37	46	311	28	35

Two-minute mean wind data – RW 07L/07R touchdown zones

		RW 07L			RW 07R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:39:00	314	38	46	311	29	35
10:39:10	314	37	42	310	29	35
10:39:20	313	37	44	310	29	35
10:39:30	313	37	44	310	29	35
10:39:40	313	38	44	311	29	35
10:39:50	313	38	46	311	29	36
10:40:00	313	38	46	311	29	36
10:40:10	313	39	46	312	30	39
10:40:20	314	39	46	312	30	39
10:40:30	314	38	46	312	30	39
10:40:40	314	38	46	311	30	39
10:40:50	313	38	46	310	31	39
10:41:00	313	37	46	310	31	39
10:41:10	313	37	46	309	31	39
10:41:20	313	37	46	309	31	39
10:41:30	312	36	46	309	32	39
10:41:40	312	36	46	308	32	39
10:41:50	312	36	45	308	32	39
10:42:00	312	35	44	308	32	39
10:42:10	312	35	43	308	31	37
10:42:20	312	35	44	308	31	37
10:42:30	312	36	44	308	31	37
10:42:40	312	36	44	308	30	36
10:42:50	312	36	44	309	30	36
10:43:00	313	36	44	310	29	35
10:43:10	313	36	44	311	28	33
10:43:20	314	35	44	311	28	33
10:43:30	315	35	44	310	28	33
10:43:40	315	34	44	310	28	33
10:43:50	315	34	44	311	27	33
10:44:00	315	33	44	311	27	33
10:44:10	314	32	44	311	27	34
10:44:20	315	32	42	312	27	34
10:44:30	315	32	42	311	27	35
10:44:40	316	32	41	310	28	36
10:44:50	316	32	39	310	28	36
10:45:00	317	32	39	310	29	36

Two-minute mean wind data – RW 07L/25R and RW 07R/25L mid-points

		RW 07L/25R			RW 07R/25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:25:00	324	38	47	305	33	40
10:25:10	324	37	44	305	34	40
10:25:20	324	38	47	306	33	40
10:25:30	325	39	47	308	33	40
10:25:40	325	39	47	308	34	43
10:25:50	325	39	47	309	34	43
10:26:00	324	40	47	309	35	43
10:26:10	324	40	47	310	35	43
10:26:20	324	40	47	309	36	43
10:26:30	323	40	47	309	36	43
10:26:40	323	40	47	309	36	43
10:26:50	323	40	47	309	36	43
10:27:00	323	40	47	309	36	43
10:27:10	324	41	47	311	35	43
10:27:20	324	40	47	310	35	43
10:27:30	324	40	48	310	35	43
10:27:40	324	39	48	310	35	42
10:27:50	324	39	48	310	35	42
10:28:00	323	40	48	310	35	42
10:28:10	323	40	48	310	35	42
10:28:20	324	40	48	311	35	42
10:28:30	324	40	48	311	35	42
10:28:40	324	40	48	310	35	42
10:28:50	324	40	48	309	35	42
10:29:00	323	40	48	309	35	42
10:29:10	324	40	48	309	36	42
10:29:20	324	40	48	310	36	42
10:29:30	324	40	45	310	36	42
10:29:40	324	39	45	310	36	42
10:29:50	324	40	47	309	36	42
10:30:00	324	40	47	308	36	42
10:30:10	323	39	47	307	35	42
10:30:20	323	40	51	307	35	42
10:30:30	324	40	51	307	35	42
10:30:40	324	40	51	307	35	42
10:30:50	323	41	51	307	36	44
10:31:00	323	41	51	307	36	44
10:31:10	323	42	51	307	36	44
10:31:20	322	42	51	307	37	44
10:31:30	322	42	51	307	37	44
10:31:40	322	42	51	308	36	44
10:31:50	322	42	51	307	36	44

Two-minute mean wind data – RW 07L/25R and RW 07R/25L mid-points

	RW 07L/25R			RW 07R/25L		
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:32:00	322	42	51	308	35	44
10:32:10	322	42	51	309	35	44
10:32:20	322	42	51	309	34	44
10:32:30	321	42	51	310	34	44
10:32:40	321	41	51	310	34	44
10:32:50	321	40	48	310	34	44
10:33:00	321	40	48	310	33	42
10:33:10	321	40	48	309	33	42
10:33:20	321	40	48	309	33	42
10:33:30	321	41	48	309	32	42
10:33:40	321	41	48	307	33	42
10:33:50	321	40	48	307	33	42
10:34:00	321	40	46	306	34	42
10:34:10	321	40	46	306	35	42
10:34:20	322	40	46	306	35	42
10:34:30	322	40	46	306	35	42
10:34:40	322	40	46	306	35	41
10:34:50	323	40	46	306	35	42
10:35:00	324	39	46	306	36	46
10:35:10	324	39	46	307	37	46
10:35:20	324	39	46	307	37	46
10:35:30	324	39	46	307	37	46
10:35:40	324	39	46	307	37	46
10:35:50	324	38	46	308	37	46
10:36:00	324	38	46	309	37	46
10:36:10	324	38	44	309	36	46
10:36:20	324	38	44	309	36	46
10:36:30	324	38	44	309	36	46
10:36:40	324	38	44	309	35	46
10:36:50	323	37	44	309	34	46
10:37:00	322	37	44	309	33	44
10:37:10	321	37	44	308	32	41
10:37:20	321	37	44	308	32	40
10:37:30	321	38	44	308	32	40
10:37:40	321	38	44	308	32	40
10:37:50	321	38	45	308	32	40
10:38:00	322	38	45	308	32	40
10:38:10	322	38	45	308	32	40
10:38:20	321	37	45	308	32	40
10:38:30	321	37	45	308	32	40
10:38:40	321	37	45	308	32	40
10:38:50	321	37	45	309	33	40

Two-minute mean wind data – RW 07L/25R and RW 07R/25L mid-points

	RW 07L/25R			RW 07R/25L		
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:39:00	321	37	45	309	33	40
10:39:10	322	37	45	309	33	40
10:39:20	322	37	45	309	33	40
10:39:30	323	36	45	310	33	39
10:39:40	323	36	45	310	33	39
10:39:50	323	36	44	309	33	39
10:40:00	323	37	44	310	33	39
10:40:10	322	38	47	310	33	39
10:40:20	322	38	47	309	33	39
10:40:30	323	38	47	309	33	39
10:40:40	322	38	47	310	34	39
10:40:50	322	38	47	310	33	39
10:41:00	322	38	47	310	33	39
10:41:10	322	38	47	310	32	39
10:41:20	321	38	47	309	31	39
10:41:30	321	39	47	308	31	39
10:41:40	320	39	47	309	32	40
10:41:50	320	39	47	309	32	40
10:42:00	319	39	47	309	32	40
10:42:10	319	39	47	309	32	41
10:42:20	318	38	45	309	32	41
10:42:30	318	38	45	308	32	41
10:42:40	318	38	45	307	32	41
10:42:50	317	38	45	306	32	41
10:43:00	317	38	45	306	33	41
10:43:10	317	39	45	306	33	41
10:43:20	318	39	45	306	33	41
10:43:30	318	38	45	306	33	41
10:43:40	319	38	45	305	33	41
10:43:50	319	38	42	306	32	41
10:44:00	320	37	42	306	32	41
10:44:10	320	37	42	307	32	37
10:44:20	320	37	42	308	31	37
10:44:30	321	37	42	308	31	37
10:44:40	322	37	42	309	31	37
10:44:50	322	37	42	309	31	37
10:45:00	322	37	42	309	31	37

Two-minute mean wind data – RW 25L/25R touchdown zones

Ending-time (hh:mm:sec)	RW 25L Direction (degrees)	RW 25L Speed (knots)	RW 25L Gust (knots)	RW 25R Direction (degrees)	RW 25R Speed (knots)	RW 25R Gust (knots)
10:25:00	316	30	42	325	39	48
10:25:10	317	29	39	324	39	48
10:25:20	318	29	39	324	39	48
10:25:30	318	29	39	325	40	48
10:25:40	318	30	39	325	40	48
10:25:50	316	29	37	324	40	48
10:26:00	317	29	37	325	40	46
10:26:10	317	28	36	325	40	47
10:26:20	318	27	36	325	40	47
10:26:30	318	27	36	324	40	47
10:26:40	318	28	42	324	40	47
10:26:50	317	28	42	325	41	47
10:27:00	316	28	42	325	41	47
10:27:10	316	29	42	326	40	47
10:27:20	315	29	42	326	40	47
10:27:30	316	29	42	326	41	47
10:27:40	317	30	42	325	41	47
10:27:50	319	29	42	326	41	47
10:28:00	319	30	42	325	41	47
10:28:10	319	31	42	325	41	49
10:28:20	320	31	42	324	41	49
10:28:30	320	31	42	324	41	49
10:28:40	320	31	40	324	41	49
10:28:50	320	31	40	323	41	49
10:29:00	320	31	40	322	41	49
10:29:10	320	31	40	320	42	49
10:29:20	320	31	40	319	42	49
10:29:30	319	31	40	318	44	55
10:29:40	318	32	42	319	44	55
10:29:50	318	32	42	319	44	55
10:30:00	319	32	42	321	44	52
10:30:10	319	32	42	321	46	56
10:30:20	319	32	42	323	47	56
10:30:30	319	32	42	324	44	56
10:30:40	320	31	42	325	39	51
10:30:50	320	31	42	325	38	48
10:31:00	320	31	42	325	39	48
10:31:10	320	30	42	325	40	48
10:31:20	321	31	42	325	40	47
10:31:30	322	31	42	325	41	47
10:31:40	322	31	40	325	41	47
10:31:50	322	30	39	324	41	49

Two-minute mean wind data – RW 25L/25R touchdown zones

Ending-time (hh:mm:sec)	RW 25L Direction (degrees)	RW 25L Speed (knots)	RW 25L Gust (knots)	RW 25R Direction (degrees)	RW 25R Speed (knots)	RW 25R Gust (knots)
10:32:00	322	30	39	322	41	49
10:32:10	322	30	39	321	42	49
10:32:20	322	29	39	322	42	48
10:32:30	322	29	39	322	42	48
10:32:40	322	29	39	322	41	45
10:32:50	321	29	39	321	39	45
10:33:00	321	29	39	320	40	52
10:33:10	321	28	39	320	41	52
10:33:20	321	28	39	320	41	52
10:33:30	320	27	35	320	41	52
10:33:40	320	27	36	320	41	52
10:33:50	319	27	36	320	41	52
10:34:00	319	27	36	320	41	52
10:34:10	318	28	44	320	41	52
10:34:20	317	29	44	320	41	52
10:34:30	317	29	44	320	41	52
10:34:40	317	29	44	320	40	52
10:34:50	318	29	44	320	39	48
10:35:00	318	29	44	320	39	47
10:35:10	319	29	44	321	39	47
10:35:20	319	29	44	321	38	47
10:35:30	320	29	44	321	38	47
10:35:40	320	29	44	320	37	45
10:35:50	320	29	44	320	36	45
10:36:00	321	29	44	320	36	45
10:36:10	321	29	39	320	37	46
10:36:20	321	29	39	321	37	46
10:36:30	321	29	39	321	37	46
10:36:40	320	29	42	321	37	46
10:36:50	320	30	42	321	37	46
10:37:00	321	30	42	321	37	46
10:37:10	320	30	42	321	38	46
10:37:20	319	30	42	320	39	46
10:37:30	319	29	42	320	39	46
10:37:40	319	29	42	321	40	46
10:37:50	319	29	42	321	40	46
10:38:00	319	29	42	321	39	46
10:38:10	320	29	42	321	39	46
10:38:20	319	29	42	321	39	46
10:38:30	320	28	42	321	39	46
10:38:40	320	27	36	321	39	46
10:38:50	319	26	36	321	39	46

Two-minute mean wind data – RW 25L/25R touchdown zones

		RW 25L			RW 25R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Gust (knots)	Direction (degrees)	Speed (knots)	Gust (knots)
10:39:00	318	26	36	321	39	46
10:39:10	318	26	36	322	38	46
10:39:20	318	26	36	322	37	44
10:39:30	318	26	36	322	37	45
10:39:40	318	26	36	322	37	45
10:39:50	318	26	35	322	37	45
10:40:00	319	25	34	322	38	45
10:40:10	318	24	32	322	38	45
10:40:20	318	23	32	322	38	45
10:40:30	318	23	32	322	38	45
10:40:40	318	24	32	322	39	45
10:40:50	318	24	32	322	39	45
10:41:00	318	25	33	321	39	45
10:41:10	319	25	33	322	39	45
10:41:20	319	25	33	322	39	45
10:41:30	319	25	33	321	39	45
10:41:40	319	25	33	321	38	45
10:41:50	319	25	33	321	38	45
10:42:00	317	26	36	321	38	45
10:42:10	318	26	36	320	38	45
10:42:20	318	27	36	320	37	45
10:42:30	318	27	36	320	36	44
10:42:40	317	28	36	320	36	42
10:42:50	317	28	36	319	35	41
10:43:00	317	27	36	318	36	41
10:43:10	316	26	36	318	36	42
10:43:20	317	26	36	318	36	43
10:43:30	316	25	36	318	37	43
10:43:40	317	24	36	318	37	43
10:43:50	317	25	36	318	37	43
10:44:00	318	24	35	318	37	43
10:44:10	318	24	35	318	37	43
10:44:20	318	25	39	318	37	43
10:44:30	319	25	39	318	38	43
10:44:40	319	25	39	318	38	43
10:44:50	319	26	39	319	38	43
10:45:00	320	26	39	319	38	43

Note : Gust figures evaluated from running 3 – second mean wind sequence

Ten-second mean wind data – RW 07L/07R touchdown zones

	RW 07L		RW 07R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:25:00	310	28	312	34
10:25:10	312	32	315	32
10:25:20	308	31	313	28
10:25:30	313	42	313	28
10:25:40	317	42	312	37
10:25:50	313	36	313	38
10:26:00	311	38	315	33
10:26:10	318	46	315	33
10:26:20	322	41	322	26
10:26:30	318	40	322	24
10:26:40	317	39	319	22
10:26:50	318	39	308	27
10:27:00	312	35	308	27
10:27:10	313	38	305	32
10:27:20	320	44	315	31
10:27:30	320	48	304	33
10:27:40	315	39	304	33
10:27:50	316	40	315	31
10:28:00	316	34	313	31
10:28:10	314	31	308	31
10:28:20	311	38	304	29
10:28:30	314	42	304	29
10:28:40	311	37	300	28
10:28:50	315	36	305	36
10:29:00	314	35	307	30
10:29:10	314	39	307	30
10:29:20	317	39	309	27
10:29:30	323	41	302	28
10:29:40	323	42	308	30
10:29:50	320	41	305	33
10:30:00	318	35	305	29
10:30:10	318	42	306	28
10:30:20	316	42	301	31
10:30:30	313	37	315	29
10:30:40	316	44	315	29
10:30:50	313	43	310	31
10:31:00	321	43	308	31
10:31:10	316	39	309	30
10:31:20	316	45	308	28
10:31:30	316	40	307	30
10:31:40	322	42	311	32
10:31:50	324	44	312	35

Ten-second mean wind data – RW 07L/07R touchdown zones

	RW 07L		RW 07R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:32:00	316	40	306	32
10:32:10	313	31	307	37
10:32:20	314	30	312	34
10:32:30	314	37	309	32
10:32:40	316	33	311	31
10:32:50	320	41	312	28
10:33:00	319	40	309	31
10:33:10	315	34	308	31
10:33:20	314	33	312	29
10:33:30	317	40	311	24
10:33:40	318	41	309	24
10:33:50	324	40	308	27
10:34:00	317	36	307	26
10:34:10	311	34	306	27
10:34:20	314	36	306	27
10:34:30	319	39	308	28
10:34:40	317	43	308	28
10:34:50	317	40	318	27
10:35:00	317	42	318	27
10:35:10	315	34	324	24
10:35:20	315	31	325	21
10:35:30	313	31	326	21
10:35:40	314	33	319	28
10:35:50	313	35	319	28
10:36:00	316	36	309	26
10:36:10	317	34	313	27
10:36:20	318	35	317	24
10:36:30	316	36	309	29
10:36:40	324	38	314	24
10:36:50	316	36	317	28
10:37:00	318	35	320	27
10:37:10	318	45	313	27
10:37:20	319	41	313	27
10:37:30	316	34	308	29
10:37:40	316	38	313	26
10:37:50	316	37	309	25
10:38:00	313	37	310	26
10:38:10	312	38	308	31
10:38:20	310	33	305	33
10:38:30	310	36	311	38
10:38:40	315	39	315	32
10:38:50	313	35	315	32

Ten-second mean wind data – RW 07L/07R touchdown zones

	RW 07L		RW 07R	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:39:00	315	38	315	30
10:39:10	312	39	309	30
10:39:20	309	39	314	27
10:39:30	312	42	314	27
10:39:40	315	39	315	25
10:39:50	314	39	309	31
10:40:00	318	40	310	33
10:40:10	318	43	310	36
10:40:20	315	34	310	36
10:40:30	310	33	308	34
10:40:40	310	32	305	31
10:40:50	310	33	303	34
10:41:00	311	35	303	34
10:41:10	309	36	308	33
10:41:20	308	34	316	29
10:41:30	309	35	316	28
10:41:40	312	35	304	29
10:41:50	315	37	304	29
10:42:00	316	40	307	30
10:42:10	316	38	307	29
10:42:20	313	39	308	26
10:42:30	311	34	308	26
10:42:40	315	35	313	28
10:42:50	313	36	316	27
10:43:00	315	35	311	27
10:43:10	315	30	316	28
10:43:20	316	30	316	28
10:43:30	316	30	308	26
10:43:40	312	28	309	28
10:43:50	319	29	317	24
10:44:00	315	27	317	24
10:44:10	313	32	310	30
10:44:20	317	36	308	27
10:44:30	317	38	301	31
10:44:40	319	35	307	34
10:44:50	321	35	307	34
10:45:00	321	38	313	31

Ten-second mean wind data – RW 07L/25R and RW 07R/25L mid-points

	RW 07L/25R		RW 07R/25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:25:00	325	34	310	35
10:25:10	320	35	298	34
10:25:20	320	45	311	32
10:25:30	326	43	314	32
10:25:40	326	43	308	40
10:25:50	324	40	312	40
10:26:00	324	40	313	38
10:26:10	318	36	312	39
10:26:20	318	36	302	37
10:26:30	316	42	305	35
10:26:40	324	40	314	33
10:26:50	327	34	315	33
10:27:00	329	40	311	32
10:27:10	325	42	311	31
10:27:20	323	37	304	34
10:27:30	327	44	308	33
10:27:40	321	37	310	39
10:27:50	321	37	315	37
10:28:00	320	42	316	39
10:28:10	324	43	311	35
10:28:20	324	40	306	36
10:28:30	322	40	305	36
10:28:40	321	37	306	34
10:28:50	324	42	307	33
10:29:00	325	39	306	37
10:29:10	327	38	310	40
10:29:20	327	38	315	35
10:29:30	327	40	312	34
10:29:40	323	35	311	38
10:29:50	321	44	309	36
10:30:00	321	44	301	32
10:30:10	321	38	302	34
10:30:20	323	46	305	33
10:30:30	326	42	302	32
10:30:40	321	43	306	38
10:30:50	322	48	301	42
10:31:00	320	45	310	41
10:31:10	324	40	312	40
10:31:20	319	36	312	39
10:31:30	319	36	315	37
10:31:40	321	35	313	32
10:31:50	320	45	307	28

Ten-second mean wind data – RW 07L/25R and RW 07R/25L mid-points

	RW 07L/25R		RW 07R/25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:32:00	321	44	310	25
10:32:10	321	44	309	28
10:32:20	319	40	314	28
10:32:30	319	42	306	29
10:32:40	323	37	305	40
10:32:50	321	38	310	36
10:33:00	321	38	306	35
10:33:10	321	37	304	35
10:33:20	324	42	310	37
10:33:30	317	43	308	36
10:33:40	317	43	300	35
10:33:50	322	39	303	34
10:34:00	324	38	302	34
10:34:10	325	44	307	35
10:34:20	322	40	307	32
10:34:30	322	40	309	34
10:34:40	326	36	306	37
10:34:50	330	39	310	39
10:35:00	324	34	310	42
10:35:10	324	34	313	42
10:35:20	324	40	311	38
10:35:30	322	38	303	35
10:35:40	318	38	308	37
10:35:50	324	37	309	34
10:36:00	324	37	312	34
10:36:10	322	39	308	30
10:36:20	324	37	308	28
10:36:30	321	37	307	29
10:36:40	321	37	309	30
10:36:50	320	37	307	30
10:37:00	321	33	309	32
10:37:10	318	40	311	31
10:37:20	318	40	304	32
10:37:30	321	42	303	35
10:37:40	324	40	313	36
10:37:50	322	40	309	32
10:38:00	327	37	311	35
10:38:10	323	33	303	30
10:38:20	322	33	308	32
10:38:30	320	38	312	31
10:38:40	322	37	309	32
10:38:50	321	36	312	33

Ten-second mean wind data – RW 07L/25R and RW 07R/25L mid-points

	RW 07L/25R		RW 07R/25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:39:00	320	36	309	33
10:39:10	325	36	312	37
10:39:20	323	35	313	35
10:39:30	324	39	313	35
10:39:40	324	39	306	29
10:39:50	320	42	305	34
10:40:00	327	42	313	31
10:40:10	325	45	306	30
10:40:20	325	45	302	33
10:40:30	320	37	312	36
10:40:40	319	34	313	35
10:40:50	323	34	314	28
10:41:00	318	36	310	27
10:41:10	318	36	309	29
10:41:20	315	39	305	30
10:41:30	323	42	308	33
10:41:40	319	43	312	38
10:41:50	319	43	311	35
10:42:00	315	39	305	31
10:42:10	315	40	303	33
10:42:20	314	37	303	33
10:42:30	319	35	302	35
10:42:40	319	35	299	32
10:42:50	315	33	305	32
10:43:00	320	39	309	32
10:43:10	321	39	307	34
10:43:20	324	40	303	31
10:43:30	325	38	311	31
10:43:40	322	37	307	30
10:43:50	321	38	319	29
10:44:00	320	36	309	31
10:44:10	320	36	312	29
10:44:20	318	33	309	29
10:44:30	323	35	308	32
10:44:40	320	38	306	35
10:44:50	320	38	306	35
10:45:00	321	37	312	32

Ten-second mean wind data – RW 25L/25R touchdown zones

	RW 25R		RW 25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:25:00	325	41	328	30
10:25:10	322	42	324	26
10:25:20	325	39	323	28
10:25:30	326	37	319	26
10:25:40	326	40	309	25
10:25:50	321	40	300	28
10:26:00	325	40	315	28
10:26:10	325	44	318	23
10:26:20	323	42	319	23
10:26:30	324	41	317	31
10:26:40	329	40	318	36
10:26:50	328	41	310	36
10:27:00	331	41	319	32
10:27:10	323	36	320	31
10:27:20	327	43	317	29
10:27:30	326	41	329	30
10:27:40	323	40	327	30
10:27:50	322	41	319	26
10:28:00	321	39	312	29
10:28:10	319	47	326	35
10:28:20	320	44	326	30
10:28:30	320	41	315	31
10:28:40	322	39	318	32
10:28:50	319	45	314	31
10:29:00	322	42	320	32
10:29:10	321	44	320	36
10:29:20	321	46	317	31
10:29:30	317	45	314	27
10:29:40	320	41	313	38
10:29:50	320	45	322	34
10:30:00	322	49	320	29
10:30:10	323	52	326	33
10:30:20	327	38	327	25
10:30:30	323	35	319	31
10:30:40	324	37	326	28
10:30:50	324	42	320	31
10:31:00	325	41	320	27
10:31:10	326	40	321	31
10:31:20	323	42	322	33
10:31:30	331	41	323	36
10:31:40	323	40	323	32
10:31:50	320	44	320	31

Ten-second mean wind data – RW 25L/25R touchdown zones

	RW 25R		RW 25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:32:00	322	42	320	29
10:32:10	324	42	325	23
10:32:20	321	43	320	24
10:32:30	323	39	319	28
10:32:40	322	42	327	31
10:32:50	322	36	311	24
10:33:00	321	40	317	28
10:33:10	318	37	322	25
10:33:20	319	39	322	27
10:33:30	320	39	314	29
10:33:40	326	43	320	33
10:33:50	323	41	315	28
10:34:00	316	39	311	28
10:34:10	319	39	312	35
10:34:20	319	40	317	34
10:34:30	320	38	320	31
10:34:40	321	38	326	29
10:34:50	318	37	325	25
10:35:00	321	36	315	27
10:35:10	325	35	331	26
10:35:20	322	33	328	26
10:35:30	320	35	314	30
10:35:40	318	33	323	31
10:35:50	322	37	321	32
10:36:00	319	35	314	28
10:36:10	323	43	317	31
10:36:20	323	40	324	28
10:36:30	319	40	316	30
10:36:40	320	41	318	34
10:36:50	322	40	325	33
10:37:00	322	37	320	31
10:37:10	319	40	323	25
10:37:20	320	43	316	24
10:37:30	318	42	319	19
10:37:40	326	38	318	28
10:37:50	321	36	320	33
10:38:00	321	33	314	34
10:38:10	322	37	324	32
10:38:20	322	40	317	24
10:38:30	323	41	325	21
10:38:40	321	41	313	21
10:38:50	323	35	321	24

Ten-second mean wind data – RW 25L/25R touchdown zones

	RW 25R		RW 25L	
Ending-time (hh:mm:sec)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
10:39:00	321	37	311	24
10:39:10	322	31	319	29
10:39:20	322	33	313	22
10:39:30	324	43	322	26
10:39:40	326	39	315	27
10:39:50	322	38	323	26
10:40:00	320	37	328	20
10:40:10	321	38	316	21
10:40:20	319	44	314	19
10:40:30	321	45	317	22
10:40:40	319	42	322	24
10:40:50	322	40	318	26
10:41:00	319	35	314	31
10:41:10	323	33	324	29
10:41:20	324	38	317	27
10:41:30	321	36	321	29
10:41:40	317	30	320	29
10:41:50	320	38	316	24
10:42:00	320	38	307	29
10:42:10	319	38	325	28
10:42:20	316	37	315	25
10:42:30	317	31	319	26
10:42:40	318	37	310	31
10:42:50	314	36	319	27
10:43:00	312	37	311	19
10:43:10	317	40	317	21
10:43:20	319	41	321	22
10:43:30	322	39	319	21
10:43:40	320	35	322	22
10:43:50	318	37	321	27
10:44:00	321	36	317	21
10:44:10	319	38	323	28
10:44:20	318	39	320	35
10:44:30	320	39	325	29
10:44:40	317	36	312	32
10:44:50	321	38	323	33
10:45:00	317	41	319	24

1-second wind direction and speed recorded at 25L/25R TDZ anemometers

Date	Time (UTC)	RW 25L Direction (degrees)	RW 25L Speed (knots)	RW 25R Direction (degrees)	RW 25R Speed (knots)
22-Aug-99	10:42:00	310	28	319	34
22-Aug-99	10:42:01	334	31	321	36
22-Aug-99	10:42:02	328	28	320	37
22-Aug-99	10:42:03	324	28	319	37
22-Aug-99	10:42:04	339	25	319	37
22-Aug-99	10:42:05	329	27	321	40
22-Aug-99	10:42:06	324	31	319	39
22-Aug-99	10:42:07	326	31	319	38
22-Aug-99	10:42:08	323	29	315	37
22-Aug-99	10:42:09	310	26	318	36
22-Aug-99	10:42:10	311	23	319	39
22-Aug-99	10:42:11	311	23	318	39
22-Aug-99	10:42:12	311	26	318	40
22-Aug-99	10:42:13	311	24	315	39
22-Aug-99	10:42:14	320	23	315	38
22-Aug-99	10:42:15	319	25	316	36
22-Aug-99	10:42:16	326	24	319	37
22-Aug-99	10:42:17	330	24	319	36
22-Aug-99	10:42:18	314	26	315	36
22-Aug-99	10:42:19	299	26	315	34
22-Aug-99	10:42:20	310	25	314	31
22-Aug-99	10:42:21	314	27	315	28
22-Aug-99	10:42:22	313	26	315	29
22-Aug-99	10:42:23	313	28	314	29
22-Aug-99	10:42:24	299	28	319	30
22-Aug-99	10:42:25	314	31	316	30
22-Aug-99	10:42:26	314	27	314	33
22-Aug-99	10:42:27	340	22	319	31
22-Aug-99	10:42:28	321	21	318	33
22-Aug-99	10:42:29	326	21	320	33
22-Aug-99	10:42:30	334	27	321	35
22-Aug-99	10:42:31	323	34	320	33
22-Aug-99	10:42:32	320	36	313	32
22-Aug-99	10:42:33	320	35	321	34
22-Aug-99	10:42:34	311	30	318	38
22-Aug-99	10:42:35	300	29	318	38
22-Aug-99	10:42:36	293	29	319	37
22-Aug-99	10:42:37	308	26	318	40
22-Aug-99	10:42:38	303	31	318	41
22-Aug-99	10:42:39	323	31	320	40
22-Aug-99	10:42:40	303	28	321	41
22-Aug-99	10:42:41	318	25	318	42
22-Aug-99	10:42:42	318	26	315	42
22-Aug-99	10:42:43	331	26	318	39

1-second wind direction and speed recorded at 25L/25R TDZ anemometers

Date	Time (UTC)	RW 25L Direction (degrees)	RW 25L Speed (knots)	RW 25R Direction (degrees)	RW 25R Speed (knots)
22-Aug-99	10:42:44	326	29	318	36
22-Aug-99	10:42:45	318	29	315	39
22-Aug-99	10:42:46	313	29	314	37
22-Aug-99	10:42:47	311	28	313	30
22-Aug-99	10:42:48	314	27	309	29
22-Aug-99	10:42:49	324	24	314	30
22-Aug-99	10:42:50	316	23	309	33
22-Aug-99	10:42:51	314	23	304	31
22-Aug-99	10:42:52	319	21	299	30
22-Aug-99	10:42:53	318	20	318	35
22-Aug-99	10:42:54	309	19	310	40
22-Aug-99	10:42:55	311	18	313	38
22-Aug-99	10:42:56	310	19	314	37
22-Aug-99	10:42:57	309	18	318	38
22-Aug-99	10:42:58	299	18	314	37
22-Aug-99	10:42:59	301	18	313	40
22-Aug-99	10:43:00	323	20	316	39
22-Aug-99	10:43:01	320	21	314	40
22-Aug-99	10:43:02	320	23	320	41
22-Aug-99	10:43:03	321	23	314	38
22-Aug-99	10:43:04	319	20	321	39
22-Aug-99	10:43:05	324	20	318	35
22-Aug-99	10:43:06	308	19	314	37
22-Aug-99	10:43:07	283	19	318	41
22-Aug-99	10:43:08	320	18	321	43
22-Aug-99	10:43:09	345	22	316	43
22-Aug-99	10:43:10	306	20	319	41
22-Aug-99	10:43:11	335	20	314	41
22-Aug-99	10:43:12	339	17	318	39
22-Aug-99	10:43:13	294	14	320	42
22-Aug-99	10:43:14	303	15	321	43
22-Aug-99	10:43:15	311	21	319	42
22-Aug-99	10:43:16	320	24	318	41
22-Aug-99	10:43:17	331	28	321	40
22-Aug-99	10:43:18	324	28	320	39
22-Aug-99	10:43:19	325	26	316	39
22-Aug-99	10:43:20	325	24	319	41
22-Aug-99	10:43:21	319	25	320	39
22-Aug-99	10:43:22	323	24	326	40
22-Aug-99	10:43:23	309	22	324	39
22-Aug-99	10:43:24	328	22	320	39
22-Aug-99	10:43:25	325	21	325	39
22-Aug-99	10:43:26	314	22	320	40
22-Aug-99	10:43:27	321	21	320	41

1-second wind direction and speed recorded at 25L/25R TDZ anemometers

Date	Time (UTC)	RW 25L Direction (degrees)	RW 25L Speed (knots)	RW 25R Direction (degrees)	RW 25R Speed (knots)
22-Aug-99	10:43:28	318	20	320	37
22-Aug-99	10:43:29	315	19	320	35
22-Aug-99	10:43:30	321	18	320	38
22-Aug-99	10:43:31	323	17	320	37
22-Aug-99	10:43:32	316	19	321	34
22-Aug-99	10:43:33	315	20	319	34
22-Aug-99	10:43:34	318	21	320	31
22-Aug-99	10:43:35	330	19	325	34
22-Aug-99	10:43:36	333	19	321	38
22-Aug-99	10:43:37	320	25	318	37
22-Aug-99	10:43:38	318	29	316	38
22-Aug-99	10:43:39	330	26	320	36
22-Aug-99	10:43:40	315	24	321	35
22-Aug-99	10:43:41	309	27	318	31
22-Aug-99	10:43:42	316	30	318	32
22-Aug-99	10:43:43	319	29	320	36
22-Aug-99	10:43:44	320	26	318	37
22-Aug-99	10:43:45	319	26	318	35
22-Aug-99	10:43:46	330	26	316	38
22-Aug-99	10:43:47	329	26	318	39
22-Aug-99	10:43:48	329	26	319	40
22-Aug-99	10:43:49	325	25	321	40
22-Aug-99	10:43:50	316	24	318	39
22-Aug-99	10:43:51	311	23	324	37
22-Aug-99	10:43:52	328	23	321	36
22-Aug-99	10:43:53	334	21	321	36
22-Aug-99	10:43:54	329	22	326	37
22-Aug-99	10:43:55	334	24	324	38
22-Aug-99	10:43:56	314	23	320	35
22-Aug-99	10:43:57	301	19	316	35
22-Aug-99	10:43:58	305	17	318	37
22-Aug-99	10:43:59	305	17	320	34
22-Aug-99	10:44:00	305	19	319	30

1-second wind direction and speed recorded at 07L/07R TDZ anemometers

Date	Time	RW 07L		RW 07R	
	(UTC)	Direction (degrees)	Speed (knots)	Direction (degrees)	Speed (knots)
22-Aug-99	10:42:00	315	43	304	31
22-Aug-99	10:42:01	316	43	310	31
22-Aug-99	10:42:02	324	42	310	30
22-Aug-99	10:42:03	316	43	303	31
22-Aug-99	10:42:04	316	38	308	31
22-Aug-99	10:42:05	311	37	313	31
22-Aug-99	10:42:06	319	37	309	29
22-Aug-99	10:42:07	316	35	303	27
22-Aug-99	10:42:08	309	32	301	28
22-Aug-99	10:42:09	320	33	308	27
22-Aug-99	10:42:10	314	36	303	27
22-Aug-99	10:42:11	314	36		
22-Aug-99	10:42:12	316	37		
22-Aug-99	10:42:13	313	36		
22-Aug-99	10:42:14	314	36		
22-Aug-99	10:42:15	318	41		
22-Aug-99	10:42:16	314	43		
22-Aug-99	10:42:17	315	45		
22-Aug-99	10:42:18	310	45		
22-Aug-99	10:42:19	310	38		
22-Aug-99	10:42:20	309	35		
22-Aug-99	10:42:21	315	35	305	28
22-Aug-99	10:42:22	311	38	308	26
22-Aug-99	10:42:23	313	34	303	24
22-Aug-99	10:42:24	313	34	300	26
22-Aug-99	10:42:25	313	36	310	25
22-Aug-99	10:42:26	306	33	314	25
22-Aug-99	10:42:27	304	33	309	27
22-Aug-99	10:42:28	310	32	309	27
22-Aug-99	10:42:29	313	31	308	29
22-Aug-99	10:42:30	316	31	313	27
22-Aug-99	10:42:31	323	32	305	26
22-Aug-99	10:42:32	313	29	311	27
22-Aug-99	10:42:33	313	30	309	27
22-Aug-99	10:42:34	310	28	311	28
22-Aug-99	10:42:35	309	33	313	29
22-Aug-99	10:42:36	315	37	310	29
22-Aug-99	10:42:37	320	37	315	27
22-Aug-99	10:42:38	316	40	318	30
22-Aug-99	10:42:39	320	42	316	31
22-Aug-99	10:42:40	315	44	319	28
22-Aug-99	10:42:41	319	43	329	29
22-Aug-99	10:42:42	313	40	309	29
22-Aug-99	10:42:43	316	39	304	27

1-second wind direction and speed recorded at 07L/07R TDZ anemometers

Date	Time (UTC)	RW 07L Direction (degrees)	RW 07L Speed (knots)	RW 07R Direction (degrees)	RW 07R Speed (knots)
22-Aug-99	10:42:44	316	39	310	27
22-Aug-99	10:42:45	314	38	310	28
22-Aug-99	10:42:46	308	30	311	28
22-Aug-99	10:42:47	314	31	326	27
22-Aug-99	10:42:48	311	31	326	25
22-Aug-99	10:42:49	309	34	319	25
22-Aug-99	10:42:50	313	32	316	24
22-Aug-99	10:42:51	310	34	311	24
22-Aug-99	10:42:52	315	35	310	23
22-Aug-99	10:42:53	319	35	306	25
22-Aug-99	10:42:54	315	36	306	26
22-Aug-99	10:42:55	314	36	315	30
22-Aug-99	10:42:56	313	35	304	28
22-Aug-99	10:42:57	315	33	314	27
22-Aug-99	10:42:58	315	35	318	27
22-Aug-99	10:42:59	319	34	311	28
22-Aug-99	10:43:00	315	33	311	28
22-Aug-99	10:43:01	313	32		
22-Aug-99	10:43:02	311	33		
22-Aug-99	10:43:03	310	29		
22-Aug-99	10:43:04	316	31		
22-Aug-99	10:43:05	315	31		
22-Aug-99	10:43:06	321	30		
22-Aug-99	10:43:07	315	29		
22-Aug-99	10:43:08	316	27		
22-Aug-99	10:43:09	315	29		
22-Aug-99	10:43:10	319	33		
22-Aug-99	10:43:11	321	31	313	28
22-Aug-99	10:43:12	314	32	316	29
22-Aug-99	10:43:13	315	33	320	30
22-Aug-99	10:43:14	309	32	319	28
22-Aug-99	10:43:15	314	30	306	27
22-Aug-99	10:43:16	314	28	316	29
22-Aug-99	10:43:17	319	28	315	28
22-Aug-99	10:43:18	321	27	314	28
22-Aug-99	10:43:19	318	28	315	28
22-Aug-99	10:43:20	316	29	321	29
22-Aug-99	10:43:21	319	29	306	27
22-Aug-99	10:43:22	318	32	310	24
22-Aug-99	10:43:23	320	33	308	26
22-Aug-99	10:43:24	318	33	308	26
22-Aug-99	10:43:25	319	32	313	26
22-Aug-99	10:43:26	315	30	304	25
22-Aug-99	10:43:27	318	31	306	23

1-second wind direction and speed recorded at 07L/07R TDZ anemometers

Date	Time (UTC)	RW 07L Direction (degrees)	RW 07L Speed (knots)	RW 07R Direction (degrees)	RW 07R Speed (knots)
22-Aug-99	10:43:28	309	30	301	25
22-Aug-99	10:43:29	310	27	306	29
22-Aug-99	10:43:30	311	26	314	29
22-Aug-99	10:43:31	313	28	303	29
22-Aug-99	10:43:32	314	28	305	29
22-Aug-99	10:43:33	311	26	305	31
22-Aug-99	10:43:34	311	26	316	30
22-Aug-99	10:43:35	314	27	304	28
22-Aug-99	10:43:36	310	28	308	30
22-Aug-99	10:43:37	314	28	309	27
22-Aug-99	10:43:38	311	31	313	26
22-Aug-99	10:43:39	311	31	313	26
22-Aug-99	10:43:40	311	29	315	25
22-Aug-99	10:43:41	314	31	305	28
22-Aug-99	10:43:42	320	31	315	27
22-Aug-99	10:43:43	319	30	311	25
22-Aug-99	10:43:44	324	30	324	26
22-Aug-99	10:43:45	320	29	318	25
22-Aug-99	10:43:46	318	29	324	24
22-Aug-99	10:43:47	320	28	320	23
22-Aug-99	10:43:48	315	28	319	21
22-Aug-99	10:43:49	318	27	311	22
22-Aug-99	10:43:50	319	28	320	24
22-Aug-99	10:43:51	320	26		
22-Aug-99	10:43:52	320	26		
22-Aug-99	10:43:53	316	24		
22-Aug-99	10:43:54	316	24		
22-Aug-99	10:43:55	310	24		
22-Aug-99	10:43:56	311	25		
22-Aug-99	10:43:57	315	28		
22-Aug-99	10:43:58	318	29		
22-Aug-99	10:43:59	315	29		
22-Aug-99	10:44:00	313	30		

One-minute mean cloud base heights

Ending-time (hh:mm:ss)	Cloud base (feet)
10:41:00	1300
10:41:10	1300
10:41:20	900
10:41:30	900
10:41:40	1200
10:41:50	800
10:42:00	900
10:42:10	900
10:42:20	1100
10:42:30	2300
10:42:40	2300
10:42:50	2300
10:43:00	1400
10:43:10	1400
10:43:20	1300
10:43:30	1200
10:43:40	1200
10:43:50	1400
10:44:00	1400

Notes :
i) Cloud base height (feet above mean sea level) measured by ceilometer at meteorological enclosure

ii) Touchdown elevation of RW25L ≡ 27 feet

iii) Aerodrome elevation is 19 feet above mean sea level.

Five-minute cumulative rainfall data

Ending-time (hh:mm:ss)	Rainfall (mm)
10:41:00	0.2
10:41:10	0.2
10:41:20	0.2
10:41:30	0.2
10:41:40	0.2
10:41:50	0.2
10:42:00	0.2
10:42:10	0.2
10:42:20	0.1
10:42:30	0.1
10:42:40	0.1
10:42:50	0.1
10:43:00	0.1
10:43:10	0.1
10:43:20	0.1
10:43:30	0.1
10:43:40	0.1
10:43:50	0.1
10:44:00	0.1

Notes : i) Rainfall recorded by rain gauge at meteorological enclosure

WTWS Alerts

ISSUE TIME: 22/08/1999 10:05

07RA	MOD	TURB	ARR
07RD	WSA	15K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	15K+	3MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:06

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	20K+	3MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:07

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	20K+	3MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:08

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	20K+	3MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:09

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	20K+	2MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:10

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	20K+	2MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:11

07RA	MOD	TURB	ARR
07RD	WSA	15K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	15K+	2MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:12

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	WSA	15K+	RWY
25RA	WSA	15K+	3MF
25RD	MOD	TURB	DEP
25LA	WSA	20K+	3MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:13

07RA	MOD	TURB	ARR
07RD	WSA	15K+	1MD
07LA	MOD	TURB	ARR
07LD	WSA	15K+	RWY
25RA	WSA	15K+	2MF
25RD	MOD	TURB	DEP
25LA	WSA	15K+	2MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:14

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	WSA	15K+	RWY
25RA	WSA	15K+	2MF
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:15

07RA	MOD	TURB	ARR
07RD	WSA	20K+	1MD
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	WSA	20K+	2MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:16

07RA	MOD	TURB	ARR
07RD	WSA	15K+	1MD
07LA	MOD	TURB	ARR
07LD	WSA	15K+	1MD
25RA	WSA	15K+	1MF
25RD	MOD	TURB	DEP
25LA	WSA	15K+	2MF
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:17

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	WSA	15K+	RWY
25RA	WSA	15K+	2MF
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:18

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:19

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:20

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:21

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:22

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:23

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:24

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:25

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:26

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:27

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:28

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA	MOD	TURB	ARR
07LD	SVR	TURB	DEP
25RA	SVR	TURB	ARR
25RD	MOD	TURB	DEP
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

ISSUE TIME: 22/08/1999 10:29

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:30

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:31

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:32

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:33

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:34

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:35

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:36

07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:37
07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:38
07RA MOD TURB ARR
07RD MOD TURB DEP
07LA MOD TURB ARR
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD MOD TURB DEP
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:39
07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:40
07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

ISSUE TIME: 22/08/1999 10:41
07RA
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD

ISSUE TIME: 22/08/1999 10:42
07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

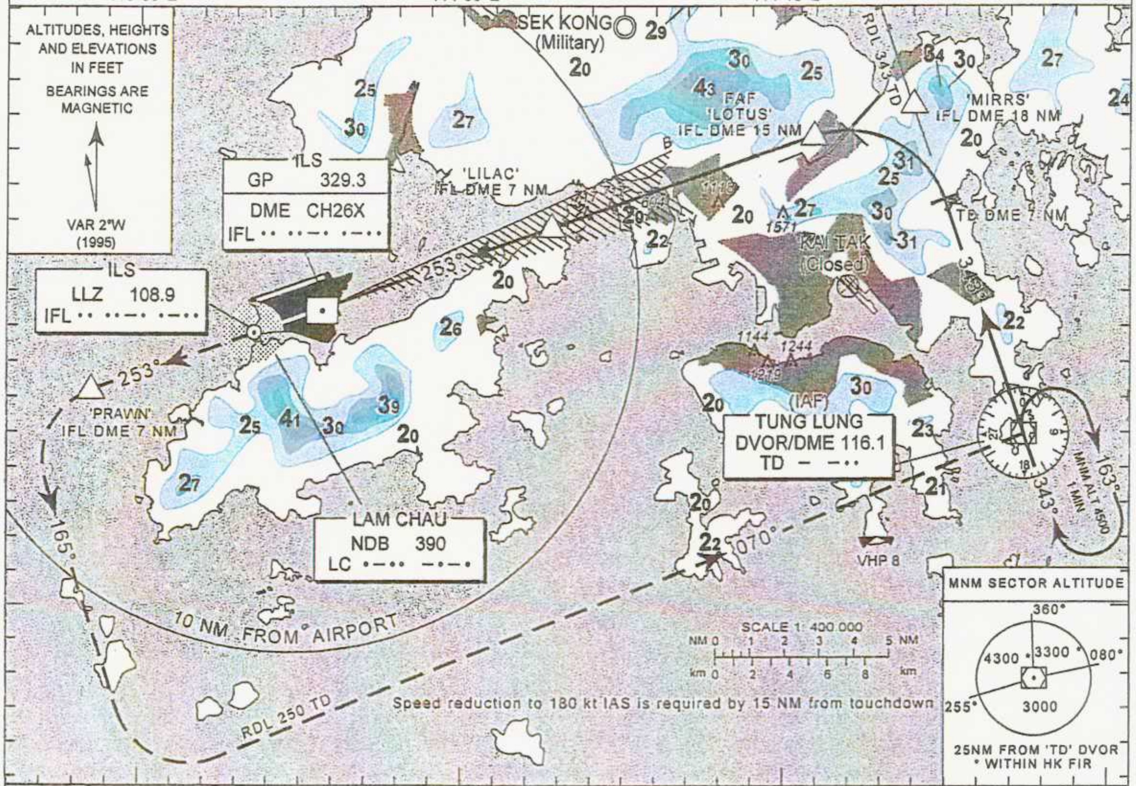
ISSUE TIME: 22/08/1999 10:43
07RA
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD

ISSUE TIME: 22/08/1999 10:44
07RA MOD TURB ARR
07RD MOD TURB DEP
07LA
07LD MOD TURB DEP
25RA MOD TURB ARR
25RD
25LA MOD TURB ARR
25LD MOD TURB DEP

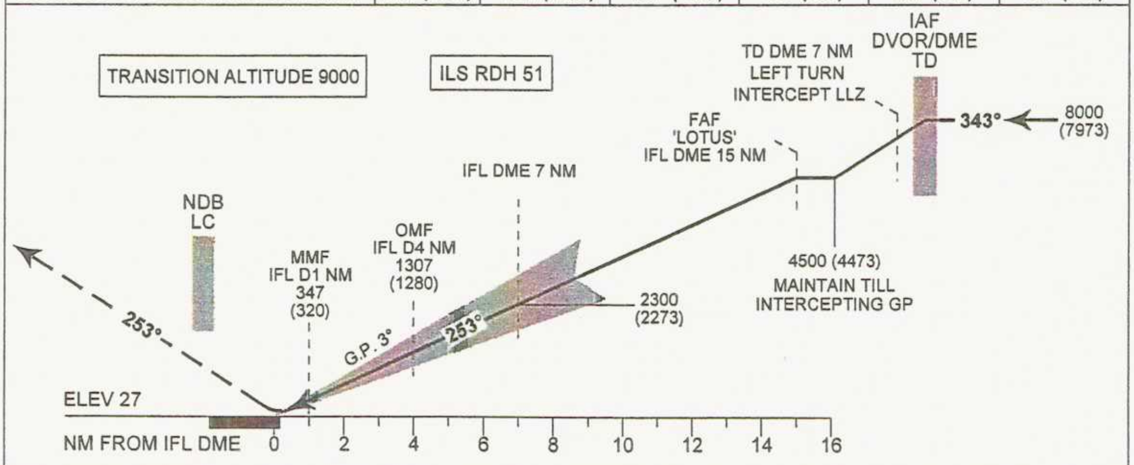
ISSUE TIME: 22/08/1999 10:45

07RA	MOD	TURB	ARR
07RD	MOD	TURB	DEP
07LA			
07LD	MOD	TURB	DEP
25RA	MOD	TURB	ARR
25RD			
25LA	MOD	TURB	ARR
25LD	MOD	TURB	DEP

INSTRUMENT APPROACH CHART	AERODROME ELEV 19 FT HEIGHTS RELATED TO THR RWY 25L - ELEV 27 FT	TWR 118.4 APP 119.1	**HONG KONG INTERNATIONAL ILS / DME RWY 25L (TD FEED-IN)**



Recommended Profile	DME IFL	5	4	3	2	1
Nominal 3° GP Descent Rate 320 FT/NM	ALT (HGT)	1627 (1600)	1307 (1280)	987 (960)	667 (640)	347 (320)



	Climb gradient	
	2.5% (152 ft/NM)	**3.2% (195 ft/NM)***
CAT I OCA (OCH)	437 ft (410 ft)	227 ft (200 ft)
CAT II OCA (OCH) (approved operators)	367 ft (340 ft)	127 ft (100 ft)

*** This climb gradient must be achieved until passing 1,800 ft AMSL**

MISSED APPROACH

Climb to 2,000 ft. Remain on the extended runway centreline tracking 253°M (or bearing 253°M to/from LC NDB). At IFL DME 3 NM (west of airport) climb to 4,500 ft. At PRAWN (IFL DME 7 NM) turn left to track 165°M to intercept RDL 250 TD DVOR and join the TD holding pattern or as directed by ATC.

NOTE 1 A speed restriction of 185 kt IAS or less is required until established on track 165°M.

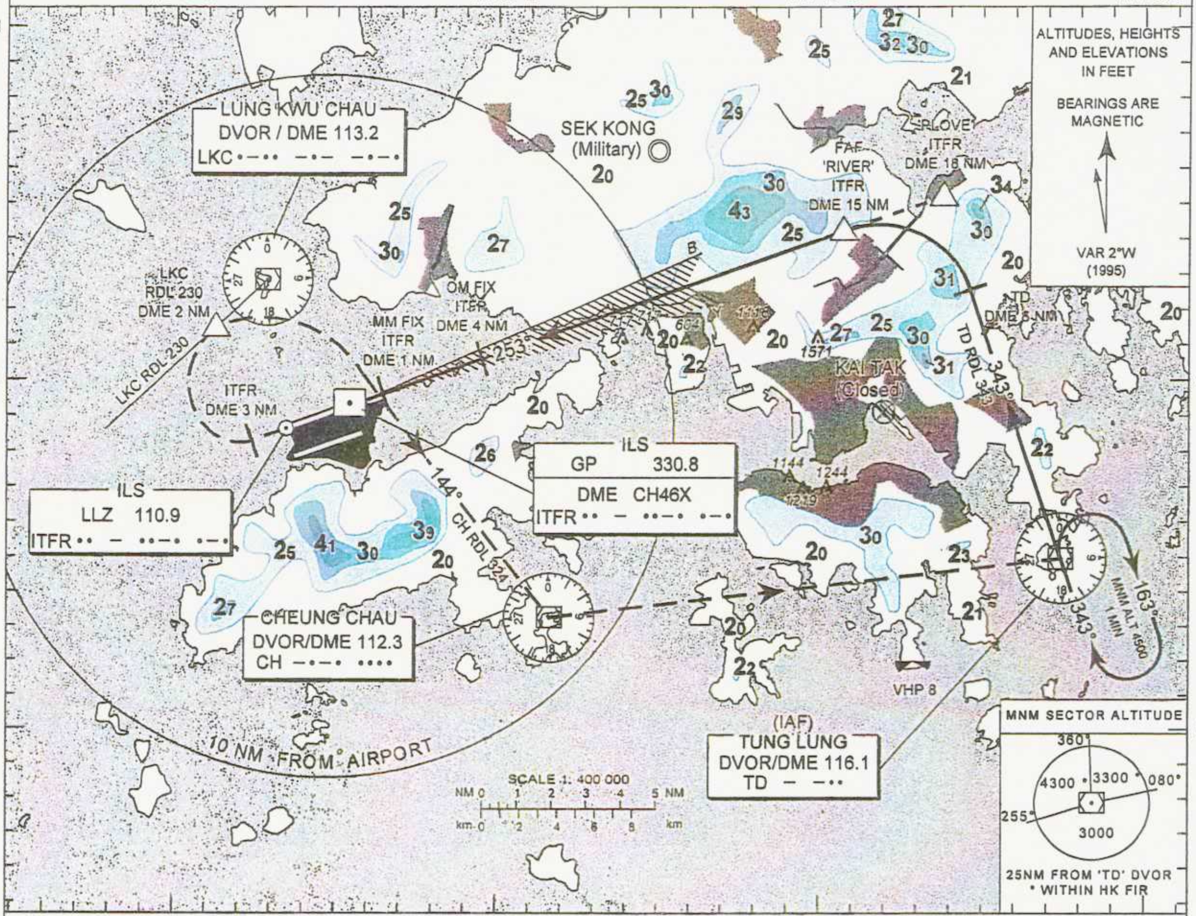
NOTE 2 Aircraft discontinuing an approach at or above 2,000 ft must continue on the glidepath to 2,000 ft and maintain until IFL DME 3 NM west of the airport.

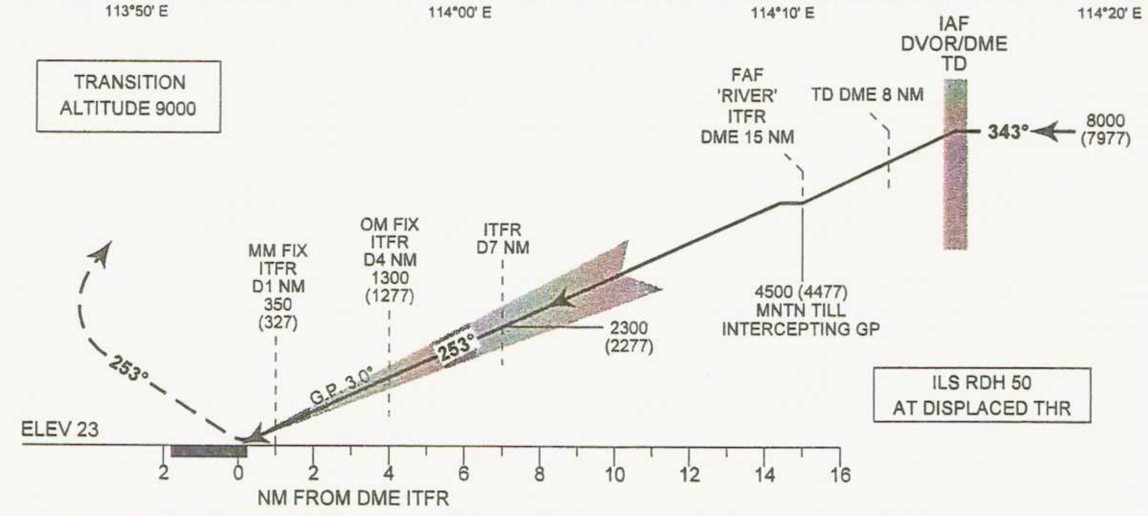
INSTRUMENT APPROACH CHART

AERODROME ELEV 19 FT
HEIGHTS RELATED TO
THR RWY 25R - ELEV 23 FT

TWR 118.2
APP 119.1

HONG KONG INTERNATIONAL
ILS / DME
RWY 25R (TD FEED-IN)





	Climb gradient			
	2.5% (152 ft/NM)	**3% (183 ft/NM)***	**4% (243 ft/NM)***	**4.3% (262 ft/NM)***
CAT I OCA (OCH)	934 ft (911 ft)	694 ft (671 ft)	292 ft (269 ft)	223 ft (200 ft)
CAT II OCA (OCH) (approved operators)	858 ft (835 ft)	618 ft (595 ft)	216 ft (193 ft)	123 ft (100 ft)

*** These climb gradients must be achieved until passing 3,000 ft AMSL**

MISSED APPROACH

Climb to 2,000 ft. Remain on the extended runway centreline tracking 253°M. At ITFR DME 3 NM (west of airport), climb to 3,000 ft and turn right to establish LKC DVOR RDL 230 inbound. At LKC DME 2 NM, climb to maintain 4,500 ft and turn right to establish inbound on CH DVOR RDL 324. At CH turn left direct to TD DVOR and hold or proceed as directed by ATC.

NOTE 1 For ILS CAT III approach, aircraft must achieve a missed approach climb gradient of 4.3% (262 ft/NM) or greater until passing 3,000 ft AMSL.

NOTE 2 A speed restriction of 185 kt or less is required until established on CH RDL 324.

NOTE 3 Aircraft discontinuing the approach at or above 2,000 ft must continue on the glidepath to 2,000 ft. Maintain 2,000 ft on the extended runway centreline until ITFR DME 3 NM (west of airport).

RELEVANT CVR TRANSCRIPTS
DESCENT AND FINAL APPROACH

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:13:08	10:14:03	Radar	CI642	*DYNASTY 642, when ready descend to FL260.*			
10:13:13	10:14:08	CI642	Radar	*When ready descend FL260, DYNASTY 642.*			
10:13:28	10:14:23	Radar	CI642	*DYNASTY 642, contact Radar 126.3.*			
10:13:32	10:14:27	CI642	Radar	*Say again.*			
10:13:33	10:14:28	Radar	CI642	*DYNASTY 642, contact Radar 126.3.*			
10:13:38	10:14:33	CI642	Radar	*126.3, good day.*			
10:13:45	10:14:40	CI642	Radar	*Radar, DYNASTY 642 FL370.*			
10:13:50	10:14:45	Radar	CI642	*DYNASTY 642, Roger, when ready recleared FL130, reach by MANGO.*			
10:13:56	10:14:51	CI642	Radar	*Recleared FL130, reach by MANGO, 642.*			
10:14:06	10:15:01				P1	*We go to BAKER and hold, what is the last weather?*	
10:14:14	10:15:09				P2	*Latest wind?*	
10:14:15	10:15:10	ATIS	-	*Acknowledge information X-ray on frequency 119.35 for arrival, 129.9 for departure. This is Hong Kong International Airport information X-ray at time 1008. Runway in use 25L, runway 25R available on request, expect ILS, DME approach, runway ……*			Remainder of ATIS broadcast overlayed by other RTF broadcasts but still audible at times.

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:14:55	10:15:50				P2	*Are you avoiding weather? Shall we request?*	
10:15:03	10:15:58	CI642	Radar	*DYNASTY 642, request heading 360 due to weather.*			
10:15:08	10:16:03	Radar	CI642	*360 DYNASTY 642 approved.*			
10:15:11	10:16:06	CI642	Radar	*Thank you.*			
10:15:29	10:16:24				P1	*We can make it, wind 300, 35 at 255 is 45, 25 knots, 25 knots crosswind.*	
10:15:51	10:16:46				P2	*Are we going down now?*	
10:15:52	10:16:47				P1	*Yes, you told the heading?*	
10:15:55	10:16:50				P2	*Yes*	
10:15:57	10:16:52				P1	*Let's go down, X-ray, we are only clear ……*	
10:16:01	10:16:56	CI642	Radar	*DYNASTY 642, leaving 370 for 130 now.*			
10:16:06	10:17:01				P1	*OK, we try it.*	
10:16:10	10:17:05	Radar	CI642	*Roger, DYNASTY 642, when clear weather, track direct to MANGO.*			
10:16:14	10:17:09	CI642	Radar	*When clear weather, direct to MANGO.*			
10:16:19	10:17:14				P2	*When clear weather, direct to MANGO.*	
10:16:21	10:17:16				P1	*Ah?*	
10:16:22	10:17:17				P2	*When clear weather, direct to MANGO.*	
10:16:24	10:17:19				P1	*We are leaving for 130.*	

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
							Non-pertinent cockpit conversation
10:17:08	10:18:03				P1	*OK. Which runway 25? Left, ILS25L, 8000, TD, to 4500, minimum 227, 227, go-around down 2000, or up 2000 until 3 miles, then PRAWN, maintain 165 to 4500 TD.*	Approach briefing for RW25L.
10:18:16	10:19:11				P1	*If we are at 300, 35 that's OK.*	
10:18:19	10:19:14				P2	*We are, we are using runway 25, 25 Right? Minima is 223, minima 223.*	
10:18:30	10:19:25				P1	*223, 25L.*	
10:18:36	10:19:31				P2	*25 Right.*	
10:18:39	10:19:34				P1	*Who said 25R, the control?*	
10:18:42	10:19:37				P2	*Yes.*	
10:18:51	10:19:46				P1	*223.*	
10:19:00	10:19:55				P2	*Are we clear of weather?*	
10:19:02	10:19:57				P1	*MANGO.*	
10:19:04	10:19:59	CI642	Radar	*DYNASTY 642 clear of weather, now direct to MANGO.*			
10:19:09	10:20:04	Radar	CI642	*DYNASTY 642, thank you.*			

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:19:28	10:20:23				P1	*OK. 227, from TD to 4500 then go down 2000 on glide, cross 7 miles, 2300, 4 miles 1300, minimum 223, go-around 2000, 3 miles then turning right, and leaving 3000 to 4500, intercept 270, turn to the right, 185, otherwise its too complicated, speed 185 eh, right?*	Approach briefing for RW25R.
10:20:27	10:21:22				P1	*If you land, haven't, please be sure, people going out, very important.*	
10:21:16	10:22:11				P1	*Is that correct 25L, recognise?*	
10:23:16	10:24:11				P2	*We need visibility 800 metres or RVR 550.*	
10:23:38	10:24:33				P1	*How much is now?*	
10:23:39	10:24:34				P2	*Now is 800.*	
10:23:44	10:24:39				P1	*Cat II, we have Cat II?*	
10:23:46	10:24:41				P2	*No.*	
10:23:47	10:24:42				P1	*We can make for the wind, we can make Cat II for the wind, we must take Cat I we need.*	
10:24:05	10:25:00				P2	*Yes, Cat I, Cat I we need 800 metres.*	
10:24:12	10:25:07	Radar	CI642	*DYNASTY 642, contact Approach 119.35.*			
10:24:17	10;25:12	CI642	Radar	*119.35, DYNASTY 642, good day.*			
10:24:34	10:25:29	CI642	Appr	*Hong Kong, DYNASTY 642 passing 150 for 130 and we have information X-ray.*			
10:24:43	10:25:38	Appr	CI642	*DYNASTY 642, good evening and Roger, descend 8000 feet, QNH 986.*			

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:24:49	10:25:44	CI642	Appr	*8000 feet and 896.*			
10:24:52	10:25:47				P1	*986.*	
10:24:54	10:25:49	CI642	Appr	*986, DYNASTY 642.*			
10:24:58	10:25:53	Appr	CI642	*That's correct, QNH 986 is current.*			
10:25:01	10:25:56	CI642	Appr	*Roger.*			
10:25:20	10:26:15				P1	*Anti-ice for the water.*	
10:25:46	10:26:41				P1	*What speed be addable for landing? 157, we need 20 more that means 17, 170 correct?*	
10:26:14	10:27:09				P1	*And the medium for the braking action, eh?*	
10:26:21	10:27:16				P1	*Now is clean, we need now is the spray for the water but the China Airline has no spray, very effective with the heavy rain.*	
10:26:35	10:27:30				P2	*If we cannot see, we just go-around.*	
10:26:38	10:27:33				P1	*Yes, yes.*	
10:26:41	10:27:36	Appr	-	*This is Approach transmitting, just landed traffic reported the lightning strike at 400 feet approach height.*			
10:26:49	10:27:44				P1	*See the light at 400 feet.*	
10:27:45	10:28:40				P1	*Why are they requesting 25L? Should be a reason.*	Preceding traffic requested approach to 25L.
10:27:54	10:28:49				P2	*For us?*	
10:27:55	10:28:50				P1	*No, I mean Cathay requesting 25L.*	
10:28:00	10:28:55				P2	*Parking gate?*	
10:28:01	10:28:56				P1	*Ah, no.*	
10:28:02	10:28:57	CI642	CI Ops	*Operations, DYNASTY 642.*			

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:28:06	10:29:01	CI Ops	CI642	*642 go-ahead.*			
10:28:08	10:29:03	CI642	CI Ops	*Parking gate?*			
10:28:10	10:29:05	CI Ops	CI642	*Gate is S29.*			
10:28:18	10:29:13	CI642	CI Ops	*Our parking gate is 29.*			
10:29:01	10:29:56				Area	*'Altitude'.*	1000 feet before assigned altitude.
10:29:55	10:30:50				P1	*Wind is pushing ……*	
10:30:15	10:31:10	Appr	CI642	*DYNASTY 642, turn right by the heading of 010, descend 6000 feet.*			
10:30:21	10:31:16	CI642	Appr	*Heading 010, descend 6000 feet, DYNASTY 642.*			
10:30:42	10:31:37	Appr	CI642	*DYNASTY 642, reduce speed 220 knots.*			
10:30:47	10:31:42				P1	*220 knots.*	
10:30:48	10:31:43	CI642	Appr	*Speed 220 knots, DYNASTY 642.*			
10:31:35	10:32:30				Area	*'Altitude'.*	1000 feet before assigned altitude.
10:32:47	10:33:42	Appr	CI642	*DYNASTY 642, turn left heading 340, descend 4500 feet, DYNASTY 642.*			
10:32:53	10:33:48	CI642	Appr	*Heading 340, descend 4500 feet, DYNASTY 642.*			
							Non-pertinent cockpit conversation
10:34:20	10:35:15				P1	*Slat extend.*	
10:34:22	10:35:17				P2	*Slat extend.*	

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:34:31	10:35:26	Appr	CI642	*DYNASTY 642, confirm your speed?*			
10:34:34	10:35:29				P1	*220 reducing.*	
10:34:34	10:35:29	CI642	Appr	*220.*			
10:34:35	10:35:30	Appr	CI642	*Roger reduce to 180 knots, I will take your slightly through the localiser for spacing.*			
10:34:41	10:35:36	CI642	Appr	*Roger reducing to 180 knots.*			
10:34:44	10:35:39				P1	*Flap 15.*	
10:34:55	10:35:50				P1	*We are down to Foxtrot Romeo ILS.*	
10:35:00	10:35:55	Appr	CI642	*DYNASTY 642, turn left on heading 230 to intercept the localiser from the right side, clear ILS approach runway 25L.*			
10:35:09	10:36:04	CI642	Appr	*Heading 230, confirm clear for ILS 25L?*			
10:35:13	10:36:08	Appr	CI642	*DYNASTY 642, heading 230 to intercept the localiser from the right side, clear ILS 25L.*			
10:35:21	10:36:16	CI642	Appr	*Roger, heading 230, clear for ILS25L, what RVR now?*			
10:35:26	10:36:21	Appr	CI642	*RVR is showing on runway 25L at the touchdown point 1300, at the midpoint 1600, at the stop end 1700 metre.*			
10:35:42	10:36:37	CI642	Appr	*Thank you sir.*			
10:35:44	10:36:39				P2	*25L, yes.*	

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:35:55	10:36:50				P1	*IFL, 25L, APPROACH/LAND so then go-around in sequence.*	Push of 'Approach/Land' control button to intercept ILS.
10:36:01	10:36:56				P2	*25L minimum is 22, 227 right? 25L minimum is 227.*	
10:36:17	10:37:12				P1	*2000, then go to PRAWN, climb 4500, turn left 165.*	
10:36:26	10:37:21				P1	*Speed is 185?*	
10:36:29	10:37:24				P2	*180.*	
10:36:31	10:37:26				P1	*180.*	
10:36:35	10:37:30				P2	*Sorry 180 …… max 185 when establish on 165.*	
10:36:46	10:37:41				P1	*LOC is alive, do we have the new …… yes 25R, we still have the 25R……*	Remainder blotted out by incoming transmission at 10:37:07.
10:37:07	10:38:02	Appr	CI642	*DYNASTY 642, you coming up the localiser now, maintain your speed 180 knots until 7 DME.*			
10:37:15	10:38:10	CI642	Appr	*Speed 180 knots until 7 DME, DYNASTY 642.*			
10:37:19	10:38:14				P1	*For the go-around please ……*	
10:37:21	10:38:16				P2	*Yes, standby.*	
10:38:23	10:39:18				P1	*14 miles leaving 4500, correct.*	
10:38:28	10:39:23	Appr	CI642	*DYNASTY 642, reduce speed now to 160 knots, contact Hong Kong Tower 118.4.*			
10:38:35	10:39:30	CI642	Appr	*160 knots, 118.4, DYNASTY 642.*			

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:38:48	10:39:43	CI642	Tower	*Tower, DYNASTY 642 with you on ILS 25L, 13 DME.*			
10:38:56	10:39:51	Tower	CI642	*DYNASTY 642, Hong Kong Tower, good evening, continue the approach 25L, number two, touchdown wind 230 degrees 26 knots gusting 36.*			
10:39:04	10:39:59	CI642	Tower	*Continue approach 25L, DYNASTY 642.*			
10:39:36	10:40:31	Tower	CI642	*Wind check acknowledge, 330 degrees 26 knots gusting 36 now.*			
10:39:59	10:40:54				P1	*We can't do it, another wind check below 1000 feet.*	
10:40:04	10:40:59				P2	*OK.*	
10:40:07	10:41:02				P1	*Gear down.*	
10:40:08	10:41:03				P2	*Gear down.*	
10:40:22	10:41:17				P1	*Go-around ready?*	
10:40:23	10:41:18				P2	*Yes.*	
10:40:24	10:41:19				P1	*2000.*	Discussion re missed approach procedure initial altitude.
10:40:34	10:41:29				P2	*Actually 4500.*	
10:40:36	10:41:31				P1	*2000 until 3 mile.*	
10:40:38	10:41:33				P2	*2000 until 3 mile.*	
10:40:50	10:41:45				P1	*Now is 330, OK flap 35.*	
10:40:54	10:41:49				P2	*Flap 35, medium.*	
10:41:10	10:42:05				P1	*Final checklist.*	
10:41:12	10:42:07				P2	*Final checklist, gear?*	
10:41:13	10:42:08	Tower	CI642	*DYNASTY 642, copy?*			
10:41:14	10:42:09				P1	*Negative.*	
10:41:15	10:42:10	CI642	Tower	*Negative.*			

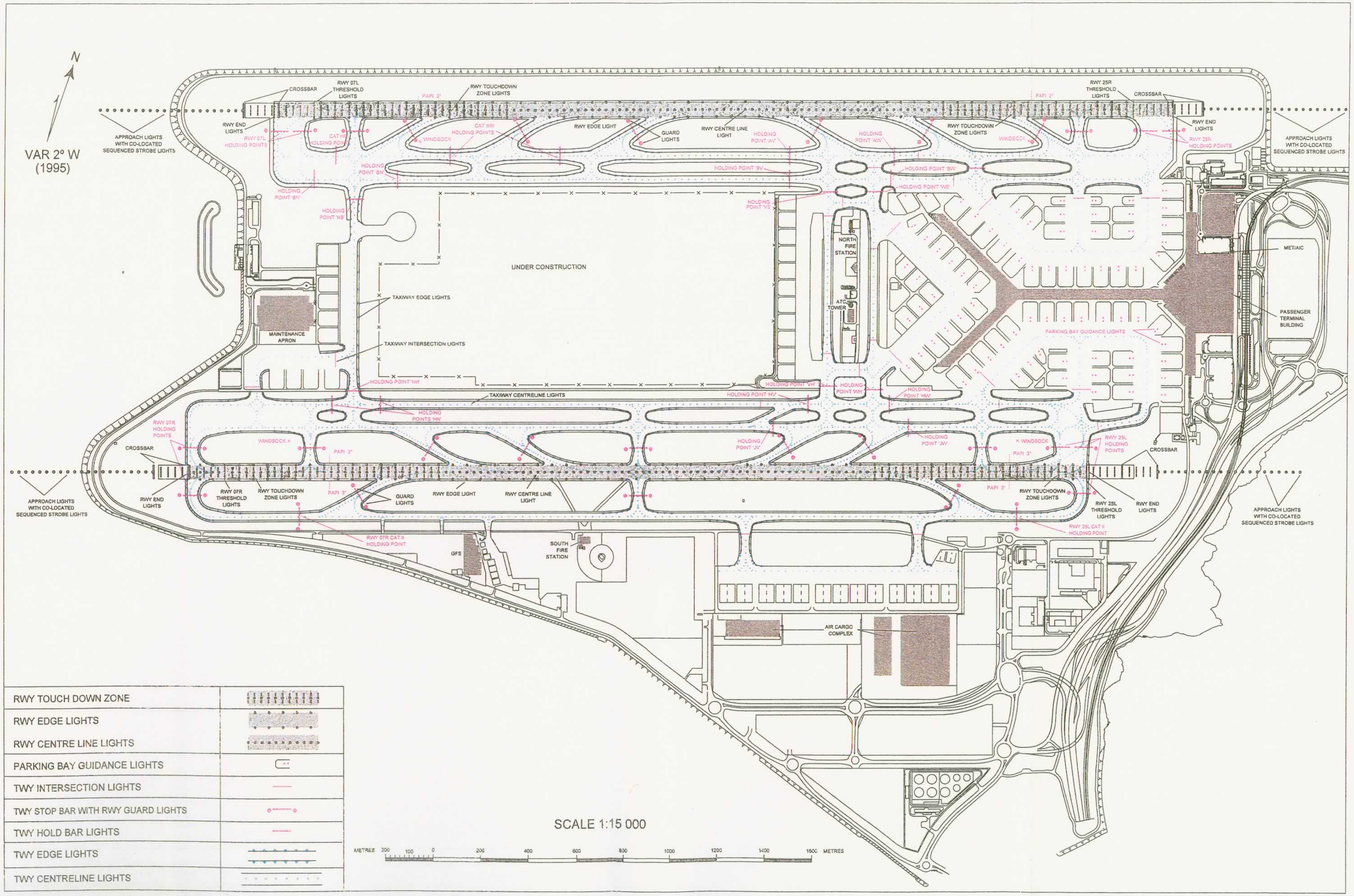
TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:41:17	10:42:12	Tower	CI642	*DYNASTY 642, braking action is good.*			
10:41:20	10:42:15	CI642	Tower	*Thank you.*			
10:41:22	10:42:17				P2	*Gear, 4 green, autobrake medium, spoiler arm, flap 35, ENA standby, final checklist standby ……*	Final word(s) blotted out by incoming RTF at 10:41:31.
10:41:31	10:42:26	Tower	CI642	*DYNASTY 642, the visibility at touchdown 1600 metre, touchdown wind 320 degrees at 25 knots, gust 33 knots, run way 25L clear to land.*			
10:41:44	10:42:39	CI642	Tower	*Clear to land runway 25L, thank you.*			
10:41:53	10:42:48				P2	*Dual land.*	
10:41:56	10:42:51				P1	*Check list?*	
10:41:57	10:42:52				P2	*Completed.*	
10:42:10	10:43:05				P2	*Speed.*	
10:42:15	10:43:10				Area	*'1,000'.*	
10:42:18	10:43:13			*Approach light, approach light ahead, do you need the wind again?*			
10:42:31	10:43:26				P1	*No, yes, wind check, wind check.*	
10:42:37	10:43:32				P2	*OK, now in sight 6 ……*	
10:42:40	10:43:35	CI 642	Tower	*DYNASTY 642, wind check again?*			
10:42:44	10:43:39	Tower	CI642	*DYNASTY 642, just about to give you that, 320 degrees 28 knots gusting 36 knots.*			
10:42:48	10:43:43	CI642	Tower	*Thank you and we have the runway in sight around 700 feet.*			
10:42:51	10:43:46				Area	*'500'.*	

TIME UTC		RTF COMMUNICATION			FLIGHT DECK COMMUNICATION		REMARKS
ATC	FDR	FROM	TO		ORIGIN		
10:42:52	10:43:47	Tower	CI642	*DYNASTY 642.*			
10:42:53	10:43:48				Area		Warning sound for autopilot disengage.
10:42:57	10:43:52				P2	*Go-around speed 185.*	
10:43:08	10:44:03				P2	*Left of course.*	
10:43:15	10:44:10				P2	*Speed.*	
10:43:19	10:44:14				Area	*'100'.*	
10:43:23	10:44:18				Area	*'50, 40, 30, 20, 10'.*	
10:43:26	10:44:21				Area		Sound of touchdown.
10:43:30	10:44:25						End of recording.

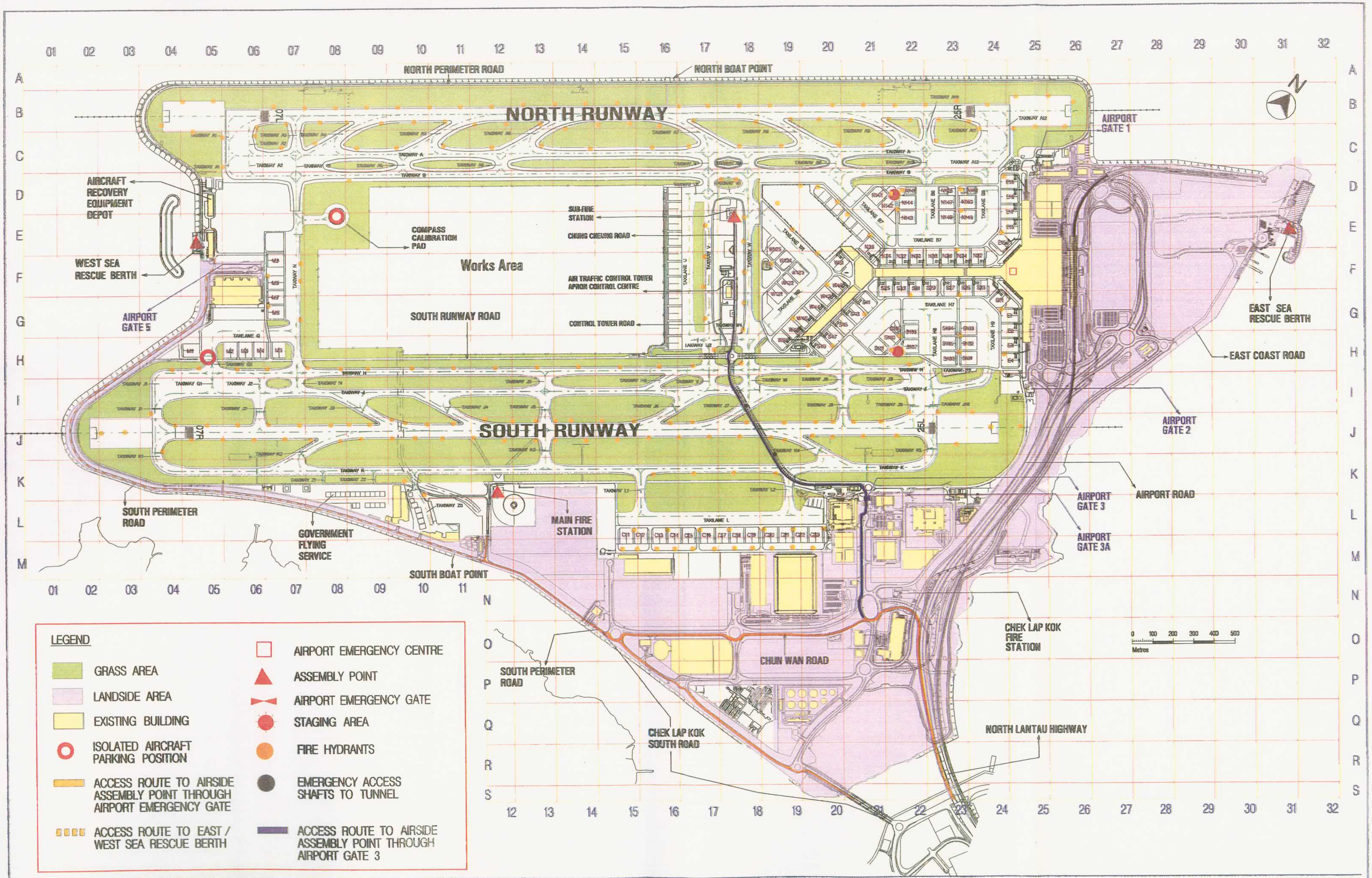
AERODROME CHART
(LIGHTING PLAN)

TWR	118.4 / 118.2
GMC	121.6 / 122.55

HONG KONG
INTERNATIONAL AIRPORT



CIVIL AVIATION DEPARTMENT, HONG KONG
Cartography by Survey and Mapping Office, Lands Department



A12-1

PLAN 10 - AIRPORT GRID MAP

Plot Date: 03/08/99
Filename: 151CA700.AOM

Tabulated FDR Data - 500 feet RA to Touchdown

subframe count	ALT (FEET)	RALT (FEET)	CAS (KTS)	TAT (DEG)	AOA (DEG)	ROLL (DEG)	PITCH (DEG)	HDG (DEG)	LONG G (G)	LATG (G)	NORMG (G)	AIL LO (DEG)	AIL LI (DEG)	AIL RI (DEG)	AIL RO (DEG)	ELEV (DEG)
					4.74609	0.70312	3.16406				1.02547					0.175781
91616.125		507	167						-1.08364	0.020414	1.06438			1.66992		
91616.25							3.16406	268.945			1.07812					1.93359
91616.375									-1.08364	0.014303	1.11474				1.31836	
91616.5					6.67969	1.05468	3.16406				1.13763					-1.75781
91616.625	1230								-1.08364	0.002081	1.12161	-1.8457				
91616.75							3.16406				1.05294					0.263672
91616.875									-1.08364	-0.016252	0.952224		-1.05469			
91617					5.09766	1.05468	3.16406				0.945357					-3.86719
91617.125		490	168.5						-1.08364	-0.026437	0.927045			-1.66992		
91617.25							2.8125	268.945			0.952224					-2.02148
91617.375									-1.08364	-0.042733	0.981981				-2.19727	
91617.5					5.27344	0.70312	2.8125				1.00487					-1.58203
91617.625	1212								-1.08364	-0.018289	0.956802	2.02148				
91617.75				26.25			2.8125				0.945357					0.527344
91617.875									-1.08364	-0.014215	0.988848		0.791015			
91618					5.09766	0.70312	2.8125				0.954513					-2.10937
91618.125		481	168						-1.08364	-0.020326	0.977403			-0.615234		
91618.25							2.8125	268.945			0.986559					-0.351562
91618.375									-1.06734	-0.016252	0.981981				-0.703125	
91618.5					4.92188	0.35156	2.8125				0.970536					0.966797
91618.625	1201								-1.07345	0.002081	0.998004	-1.49414				
91618.75							2.8125				0.991137					1.05469
91618.875									-1.08364	0.004118	1.01403		1.93359			
91619					4.92188	0	2.8125				1.04607					-0.703125
91619.125		466	166						-1.08364	0.002081	1.04149			-2.10937		
91619.25							2.8125	268.945			0.993426					0.263672
91619.375									-1.08364	0.004118	1.03005				-7.64648	
91619.5					5.97656	-0.35156	3.16406				0.995715					1.14258
91619.625	1190								-1.0816	4.40E-05	0.931623	-0.087891				
91619.75				26.375			3.16406				1.00716					0.878906
91619.875									-1.08364	0.004118	1.02089		4.74609			
91620					5.97656	-0.70312	3.16406				0.986559					0.175781
91620.125		455	166.5						-1.08364	-0.008104	1.01403			-5.18555		
91620.25							3.16406	268.945			0.970536					0.175781
91620.375									-1.08364	-0.010141	0.981981				-9.14062	
91620.5					5.44922	-1.40624	3.16406				0.952224					0.791015
91620.625	1166								-1.08364	0.024488	0.945357	2.90039				
91620.75							3.16406				0.975114					0.703125
91620.875									-1.08364	0.014303	0.93849		8.34961			
91621					5.09766	-2.81248	3.16406				0.979692					0.351562
91621.125		438	166.5						-1.08364	4.40E-05	0.931623			-4.48242		
91621.25							3.16406	268.242			0.963669					0.263672
91621.375									-1.08364	0.008192	1.0186				2.90039	
91621.5					6.32812	-1.7578	3.16406				1.03463					6.15234
91621.625	1164								-1.08364	0.022451	1.02547	-10.9863				
91621.75				26.375			3.51562				1.07354					5.36133
91621.875									-1.07753	-0.008104	1.16739		-14.5898			
91622					6.15234	0.70312	3.86719				1.08041					2.63672
91622.125		427	164.5						-1.08364	0.010229	1.02547			-2.98828		
91622.25							4.21875	266.484			0.979692					2.46094
91622.375									-1.08364	-0.010141	0.988848				-4.39453	
91622.5					5.80078	1.05468	4.21875				1.00258					2.63672
91622.625	1147								-1.08364	-0.034585	0.98427	-3.95508				
91622.75							4.21875				0.959091					0
91622.875									-1.08364	-0.063103	1.04149		-0.966797			
91623					6.15234	-0.35156	4.57031				1.05981					-0.527344
91623.125		413	166						-1.06938	-0.077362	1.05294			-0.263672		
91623.25							4.57031	263.672			1.06438					-0.439453
91623.375									-1.08364	-0.069214	1.03234				-5.97656	
91623.5					5.625	-2.10936	4.57031				1.03234					0.263672
91623.625	1140								-1.08364	-0.095695	1.07812	-9.58008				
91623.75				26.375			4.57031				1.01403					0
91623.875									-1.08364	-0.08551	1.02776		-6.32812			
91624					5.625	-3.16404	4.21875				0.991137					-0.966797
91624.125		404	164						-1.08364	-0.14662	0.949935			4.39453		
91624.25							4.21875	261.562			1.01174					-1.05469
91624.375									-1.08364	-0.128287	0.931623				9.14062	
91624.5					8.08594	-1.7578	4.21875				0.936201					-0.263672
91624.625	1135								-1.08364	-0.073288	0.968247	-17.4902				
91624.75							4.21875				1.03463					-0.615234
91624.875									-1.08364	-0.056992	1.05294		-3.7793			
91625					8.08594	0.70312	3.86719				1.04149					-1.05469
91625.125		391	164.5						-1.08364	-0.032548	1.00029			1.66992		
91625.25							3.86719	261.914			0.968247					-0.527344
91625.375									-1.08364	-0.030511	0.98427				2.72461	
91625.5					6.15234	0	3.86719				0.995715					0.439453
91625.625	1106								-1.08364	-0.056992	1.05294	4.48242				
91625.75				26.5			3.86719				1.07812					1.05469
91625.875									-1.08364	-0.050881	1.08727		9.3164			
91626					5.80078	-3.86716	3.51562				1.05981					0.966797
91626.125		381	167.5						-1.08364	-0.079399	1.11474			-5.53711		
91626.25							3.51562	261.562			1.05294					0.439453
91626.375									-1.08364	-0.050881	1.00945				-2.8125	
91626.5					7.73438	-7.0312	3.51562				1.05981					1.93359
91626.625	1101								-1.08364	-0.054955	1.05523	-7.38281				
91626.75							3.51562				0.979692					1.66992
91626.875									-1.08364	-0.056992	0.991137		-5.80078			
91627					7.03125	-9.14056	3.16406				1.01632					-0.878906
91627.125		370	165.5						-1.08364	-0.048844	0.970536			10.459		
91627.25							3.16406	261.914			0.977403					-0.878906
91627.375									-1.08364	-0.034585	0.968247				3.95508	
91627.5					4.92188	-8.43744	3.16406				0.975114					0.351562
91627.625	1099								-1.08364	0.01634	1.03005	-11.6016				
91627.75				26.5			3.16406				1.03005					2.10937
91627.875									-1.08364	-0.010141	1.04836		-1.58203			
91628					6.50391	-7.0312	3.51562				1.02776					0.703125
91628.125		361	161.5						-1.07549	-0.056992	0.975114			1.66992		
91628.25							3.51562	261.914			0.979692					1.14258
91628.375									-1.08364	-0.06514	0.920178				-1.66992	
91628.5					6.32812	-5.97652	3.51562				0.911022					0.0878906
91628.625	1081								-1.08364	-0.036622	0.920178	-11.25				
91628.75							3.51562				0.933912					0.527344
91628.875									-1.06327	-0.048844	0.945357		-9.58008			
91629					6.15234	-3.86716	3.51562				0.913311					0
91629.125		347	164						-1.08364	-0.022363	1.00258			7.38281		
91629.25							3.51562	262.265								
91629.375																
91629.5					5.625	-2.10936	3.86719									
91629.625	1080															
91629.75				26.5			3.86719									
91629.875																
91630					6.50391	0.35156	3.86719									
91630.125		338	162.5													
91630.25							3.86719	262.968								
91630.375																
91630.5					6.50391	2.10936	3.86719									
91630.625	1070															
91630.75							3.51562									
91630.875																
91631					6.95547	2.46092	3.16406									
91631.125		325	169													
91631.25							2.46094	263.672								
91631.375																
91631.5					5.44922	2.46092	2.10938									
91631.625	1054															
91631.75				26.5			1.40625									
91631.875																
91632					5.27344	3.86716	1.40625									
91632.125		316	168.5													
91632.25							1.05469	264.375								
91632.375																
91632.5					4.57031	3.5156	1.40625									
91632.625	1036															
91632.75							1.40625									
91632.875																
91633					3.69141	2.46092	1.40625									
91633.125		300	167.5													
91633.25							1.75781	264.375								
91633.375																
91633.5					4.39453	4.21872	1.75781									
91633.625	1029															
91633.75				26.625			2.10938									
91633.875																
91634					4.39453	6.32604	2.10938									
91634.125		282	166.5													
91634.25							2.10938	264.726								
91634.375																
91634.5					4.92188	7.0312	2.46094									
91634.625	1005															
91634.75							2.46094									
91634.875																
91635					5.625	7.73432	2.46094									
91635.125		263	166													
91635.25							2.8125	265.781								
91635.375																
91635.5																

Tabulated FDR Data - 500 feet RA to Touchdown

Row	subframe count	ALT (FEET)	RALT (FEET)	CAS (KTS)	TAT (DEG)	AOA (DEG)	ROLL (DEG)	PITCH (DEG)	HDG (DEG)	LONG G (G)	LATG (G)	NORMG (G)	AIL LO (DEG)	AIL LI (DEG)	AIL RI (DEG)	AIL RO (DEG)	ELEV (DEG)	RUD UP (DEG)	RUD LO (DEG)
159	91635.625	990				5.27344	7.0312	2.8125				1.01174					1.75781		
160	91635.75				26.75					-1.08364	-0.001993	1.01174	5.44922						
161	91635.875							3.16406				1.05981					-0.087891		-3.07617
162	91636									-1.08364	-0.018289	1.13077		11.1621					
163	91636.125		245	157		6.32812	5.62496	3.16406				1.10788					-0.351562		
164	91636.25									-1.08364	0.010229	1.13305			-7.55859				
165	91636.375							3.16406	266.836			1.10101					-0.615234	-1.05469	
166	91636.5									-1.0816	0.01634	1.03005				0.966797			
167	91636.625	978				7.91016	7.73432	3.16406				1.05523					-0.703125		
168	91636.75									-1.08364	0.030599	1.01403	-11.0742						
169	91636.875							2.8125				0.968247					-0.527344		-3.33984
170	91637									-1.08364	4.40E-05	0.93849		-11.7773					
171	91637.125		225	161.5		7.20703	11.2499	2.8125				1.00258					0.439453		
172	91637.25									-1.05308	0.01634	1.00029			0.615234				
173	91637.375							2.46094	267.187			1.0621					-0.087891	-4.21875	
174	91637.5									-1.08364	0.002081	1.00029				-2.10937			
175	91637.625	944				8.08594	14.0624	2.46094				0.96138					2.37305		
176	91637.75				26.75					-1.08364	4.40E-05	0.908733	-6.15234						
177	91637.875							2.46094				0.89271					1.05469		-8.52539
178	91638									-1.08364	-0.028474	0.897288		6.5039					
179	91638.125		206	161.5		5.27344	14.414	2.46094				0.888132					1.23047		
180	91638.25									-1.08364	-0.04477	0.917889			-5.44922				
181	91638.375							2.46094	266.132			0.901866					0.175781	-7.91015	
182	91638.5									-1.05716	-0.046807	0.904155				-8.87695			
183	91638.625	932				6.15234	13.0077	2.46094				0.931623					4.13086		
184	91638.75									-1.08364	-0.050881	0.927045	0.527344						
185	91638.875							2.8125				0.931623					3.42773		-8.70117
186	91639									-1.08364	-0.095695	0.96138		5.00976					
187	91639.125		186	157.5		6.15234	9.49212	3.16406				1.01403					1.93359		
188	91639.25									-1.0816	-0.073288	1.03692			-3.60351				
189	91639.375							3.51562	265.078			1.07354					7.20703	-5.71289	
190	91639.5									-1.08364	-0.040696	1.07812				-4.6582			
191	91639.625	938				7.91016	7.0312	4.21875				1.1239					6.32812		
192	91639.75				26.75					-1.08364	0.004118	1.13992	-5.44922						
193	91639.875							4.92188				1.18112					5.71289		-6.41601
194	91640									-1.08364	-0.014215	1.19486		-1.14258					
195	91640.125		150	159.5		5.80078	4.57028	5.27344				1.1445					2.8125		
196	91640.25									-1.0816	-0.036622	1.08727			0.966797				
197	91640.375							5.625	265.078			1.04149					2.72461	-4.04297	
198	91640.5									-1.06734	-0.038659	1.07125				-3.7793			
199	91640.625	914				7.91016	2.81248	5.625				1.19486					3.33984		
200	91640.75									-1.08364	-0.052918	1.24522	-4.92187						
201	91640.875							5.625				1.26124					-4.30664		-8.08594
202	91641									-1.08364	0.010229	1.291		-0.878906					
203	91641.125		131	163.5		8.96484	1.7578	5.625				1.19486					-3.95508		
204	91641.25									-1.08364	-0.032548	1.15137			0.175781				
205	91641.375							5.27344	265.429			1.13763					-5.88867	-9.40429	
206	91641.5									-1.08364	0.01634	1.14908				-11.25			
207	91641.625	904				8.4375	0	4.92188				1.12161					-7.82226		
208	91641.75				26.875					-1.08364	-0.056992	1.19715	4.21875						
209	91641.875							4.21875				1.1445					-7.55859		-11.7773
210	91642									-1.08364	-0.018289	1.03463		9.75586					
211	91642.125		129	171		4.74609	-2.46092	3.51562				0.993426					-1.58203		
212	91642.25									-1.0816	-0.06514	0.988848			2.98828				
213	91642.375							2.8125	264.023			0.876687					-0.527344	-8.4375	
214	91642.5									-1.08364	-0.101806	0.867531				-5.53711			
215	91642.625	879				7.20703	-3.86716	2.10938				0.771393					0.175781		
216	91642.75									-1.08364	-0.048844	0.75537	-4.13086						
217	91642.875							2.10938				0.881265					8.96484		-11.7773
218	91643									-1.08364	-0.101806	0.931623		-11.4258					
219	91643.125		117	175		5.09766	-3.5156	2.10938				0.98427					7.99804		
220	91643.25									-1.08364	-0.036622	1.03005			8.78906				
221	91643.375							2.46094	262.265			1.00716					9.3164	-11.1621	
222	91643.5									-1.0816	-0.154768	1.00258				4.21875			
223	91643.625	872				3.51562	-3.86716	2.46094				1.05065					-0.439453		
224	91643.75				27.25					-1.08364	-0.109954	0.96138	-11.5137						
225	91643.875							2.8125				0.998004					0.527344		-7.29492
226	91644									-1.08364	-0.118102	0.954513		-12.3926					
227	91644.125		104	170		2.98828	-1.05468	2.8125				1.00716					1.23047		
228	91644.25									-1.08364	-0.054955	1.00487			10.6348				
229	91644.375							3.16406	261.562			1.03692					-2.90039	-11.3379	
230	91644.5									-1.08364	-0.054955	1.03463				-2.28516			
231	91644.625	855				6.67969	-0.70312	2.8125				0.98427					-4.74609		
232	91644.75									-1.08364	-0.052918	0.965958	-7.55859						
233	91644.875							2.8125				0.897288					-3.86719		-11.9531
234	91645									-1.08364	-0.018289	0.93849		9.58008					
235	91645.125		83	166.5		6.32812	-3.5156	2.8125				1.02776					-1.49414		
236	91645.25									-1.06938	-0.067177	1.06438			-6.5039				
237	91645.375							2.8125	260.859			1.06896					-1.23047	-12.5684	
238	91645.5									-1.08364	-0.008104	1.08499				-10.3711			
239	91645.625	845				3.69141	-6.32808	2.46094				1.00716					-2.37305		
240	91645.75				27.375					-1.08364	-0.056992	0.968247	-6.76758						
241	91645.875							2.10938				0.954513					1.05469		-13.7109
242	91646									-1.08364	-0.059029	0.954513		-7.64648					
243	91646.125		73	167.5		4.92188	-6.67964	2.10938				0.927045					-1.40625		
244	91646.25									-1.08364	-0.118102	0.876687			6.67969				
245	91646.375							2.10938	259.101			0.84693					-0.439453	-13.3594	
246	91646.5									-1.06327	-0.142546	0.860664				11.6895			
247	91646.625	820				6.32812	-2.10936	2.10938				0.862953					0.878906		
248	91646.75									-1.08364	-0.097732	0.899577	-19.6875						
249	91646.875							2.46094				0.945357					1.40625		-11.8652
250	91647									-1.08364	-0.099769	0.979692		-18.3691					
251	91647.125		59	165		6.50391	2.46092	2.46094				0.860664					2.63672		
252	91647.25									-1.08364	-0.059029	0.933912			-2.63672				
253	91647.375							2.46094	258.398			0.929334					3.33984	-12.2168	
254	91647.5									-1.0592	-0.048844	0.853797				-1.58203			
255	91647.625	790				3.86719	2.46092	2.46094				0.993426					1.58203		
256	91647.75				27.5					-1.08364	0.018377	1.00258	-4.6582						
257	91647.875							2.8125				0.979692					12.041		-19.0723
258	91648									-1.08364	-0.016252	1.0827		5.44922					
259	91648.125		45	172		4.39453	-0.35156	3.51562				1.08727					10.5469		
260	91648.25									-1.08364	-0.012178	1.10101			-4.74609				
261	91648.375							3.86719	256.992			1.26124					10.6348	-19.4238	
262	91648.5									-1.08364	-0.075325	1.21546				-10.3711			
263	91648.625	768				7.20703	-1.7578	4.21875				1.16968					-8.52539		
264	91648.75									-1.05512	-0.079399	1.12848	-10.2832						
265	91648.875							4.21875				1.03463					-7.73437		-20.3027
266	91649									-1.08364	-0.097732	0.927045		-13.7988					
267	91649.125		32	164.5		7.03125	-0.35156	3.86719				0.991137					-5.44922		
268	91649.25									-1.08364	-0.069214	0.965958			12.3926				
269	91649.375							3.51562	254.882			0.93849					-5.44922	-15.4687	
270	91649.5									-1.08364	-0.083473	1.00258				10.7227			
271	91649.625	775				6.32812	4.21872	3.51562				0.993426					-3.42773		
272	91649.75				27.625					-1.08364	-0.08551	0.885843	-19.5117						
273	91649.875							3.16406				0.963669					-2.72461		-15.9961
274	91650									-1.08364	-0.069214	1.00716		4.57031					
275	91650.125		21	166		2.8125	4.57028	3.16406				0.933912					5.53711		
276	91650.25									-1.08364	-0.173101	0.943068			-0.966797				
277	91650.375							3.16406	252.773			0.959091					5.00976	-19.5996	
278	91650.5									-1.08364	-0.120139	0.9156				-4.39453			
279	91650.625	750				7.91016	1.05468	2.8125				0.874398					3.69141		
280	91650.75									-1.08364	-0.209767	0.904155	-13.5352						
281	91650.875							3.16406				0.803439					11.3379		-16.6992
282	91651									-1.08364	-0.195508	0.771393		-16.9629					
283	91651.125		7	153		7.91016	0	3.51562				0.844641					5.88867		
284	91651.25									-1.06327	-0.162916	0.849219			13.1836				
285	91651.375							4.21875	251.367			0.924756					6.67969	-16.3477	
286	91651.5									-1.08364	-0.116065	1.0186				12.3926			
287	91651.625	703				3.51562	3.5156	4.92188				2.29358					15.7324		
288	91651.75				27.75					-1.08364	-0.081436	2.63006	-19.5996						
289	91651.875							4.92188				2.60488					13.7988		-13.8867
290	91652									-1.08364	-0.494947	2.10359		-19.9512					
291	91652.125		-1	151.5		2.10938	3.86716	5.625				1.00487					7.4707		
292	91652.25									-1.08364	0.01634	0.576828			7.91015				
293	91652.375							5.97656	252.07			0.597429					4.21875	-11.4258	
294	91652.5									-1.08364	-0.395134	0.93849				2.90039			
295	91652.625	714				7.20703	0	2.8125				0.560805					0		
296	91652.75									-1.08364	-1.08364	-3.37399	0						
297	91652.875							0				-3.37399					0		0

subframe count	STAB (DEG)	FLAP DEG	SPL 5L DEG	SPL 3L DEG	SPL 3R DEG	SPL 5R DEG	LAT (DEGS)	LON (DEGS)	GSPD (KTS)	DRIFT DEG	MINS	DME 1 NM	DME 2 NM	LOC (DOT)	GLIDE (DOT)	G WT	C of G	T FUEL
91635.625							22.325592											
91635.75						1.8457		113.9296										
91635.875		33.75																
91636																		
91636.125																		
91636.25			6.24023						152	-14.4141								
91636.375	-8.96484																	
91636.5														0.635081	0.0534194			
91636.625							22.325592											
91636.75					3.60352			113.9296										
91636.875		34.9805																
91637																		
91637.125																		
91637.25				1.58203					150	-14.0625								
91637.375	-9.00879																	
91637.5														0.614919	-0.017806			
91637.625							22.325592											
91637.75						6.50391		113.9296										
91637.875		34.9805																
91638											44.1							
91638.125																		
91638.25			1.8457						150	-12.3047								
91638.375	-8.9209																	
91638.5														0.594758	-0.427355			
91638.625							22.325592											
91638.75					0.878906			113.92685										
91638.875		33.3984																
91639																		
91639.125																		
91639.25				1.93359					150	-9.49219								
91639.375	-8.9209																	
91639.5														0.544355	-0.658839			
91639.625							22.325592											
91639.75						1.8457		113.92685										
91639.875		33.75																
91640																		
91640.125																		
91640.25			0.703125						152	-8.4375								
91640.375	-8.87695																	
91640.5														0.493952	-1.05058			
91640.625							22.325592											
91640.75					0.878906			113.92685										
91640.875		34.9805																
91641																		
91641.125																		
91641.25				1.66992					154	-8.4375								
91641.375	-9.00879																	
91641.5														0.403226	-1.104			
91641.625							22.325592											
91641.75						1.93359		113.92685										
91641.875		34.9805																
91642											44.2							
91642.125																		
91642.25			2.63672						156	-7.38281								
91642.375	-8.87695																	
91642.5														0.302419	-1.21084			
91642.625							22.324219											
91642.75					0.966797			113.9241										
91642.875		33.75																
91643																		
91643.125																		
91643.25				1.58203					158	-6.67969								
91643.375	-8.96484																	
91643.5														0.201613	-0.979355			
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91643.875		33.75																
91644																		
91644.125																		
91644.25			0.878906						158	-5.97656								
91644.375	-8.87695																	
91644.5														0.131048	-1.15742			
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91644.75					4.48242			113.9241										
91644.875		34.9805																
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91645.125																		
91645.25				5.88867					160	-5.97656								
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91645.75						2.90039		113.9241										
91645.875		34.9805																
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91646.125																		
91646.25			1.23047						160	-5.625								
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91647.125																		
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91647.375	-9.00879																	
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91648.125																		
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91648.5														-0.010081	-1.86968			
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91648.875		34.9805																
91649																		
91649.125																		
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91649.875		34.9805																
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91650.125																		
91650.25			0.439453						158	-1.05469								
91650.375	-8.87695																	
91650.5														-0.100806	-3.75716			
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91650.75					7.03125			113.91724										
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91651																		
91651.125																		
91651.25				1.58203					156	0.351562								
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91652.5														-0.080645	6.83768			
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91652.875		0																

subframe count	EPR 1	EPR 2	EPR 3	N1 1	N1 2	N1 3	N2 1	N2 2	N2 3	EGT E1 DEG C	EGT E2 DEG C	EGT E3 DEG C	FF E1 LB H	FF E2 LB H	FF E3 LB H	TLA 1 (DEG)	TLA 2 (DEG)	TLA 3 (DEG)	FCOUNT	SYNC
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91648.25																				4
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91649.625																				1
91649.75									75.625									37.2656		1
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91651.625																				3
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91652																38.3203			1914	4
91652.125	1																			4
91652.25																				4
91652.375																	37.6172			4
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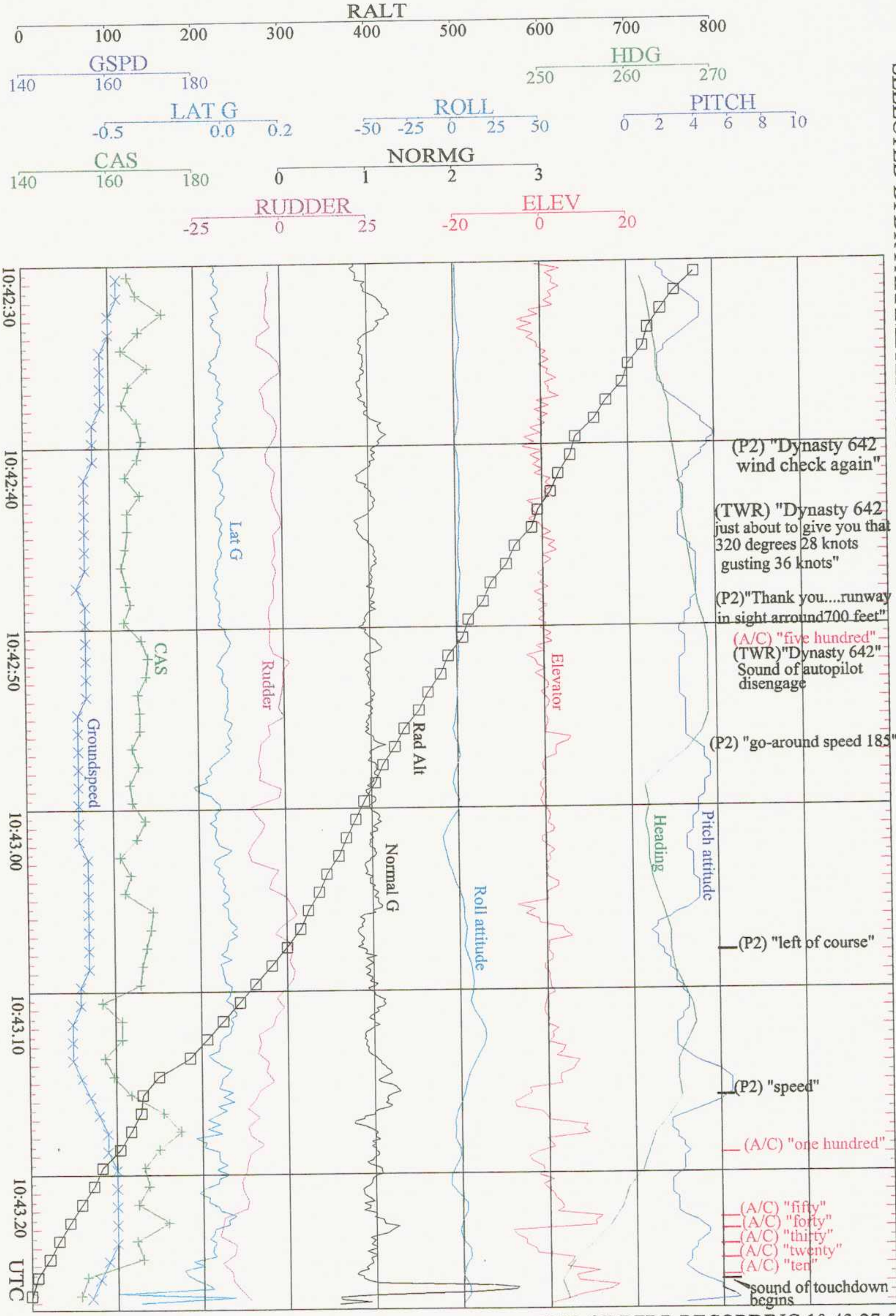
SELECTED DFDR PARAMETERS SYNCHRONISED WITH CVR INFORMATION - FINAL APPROACH AND LANDING



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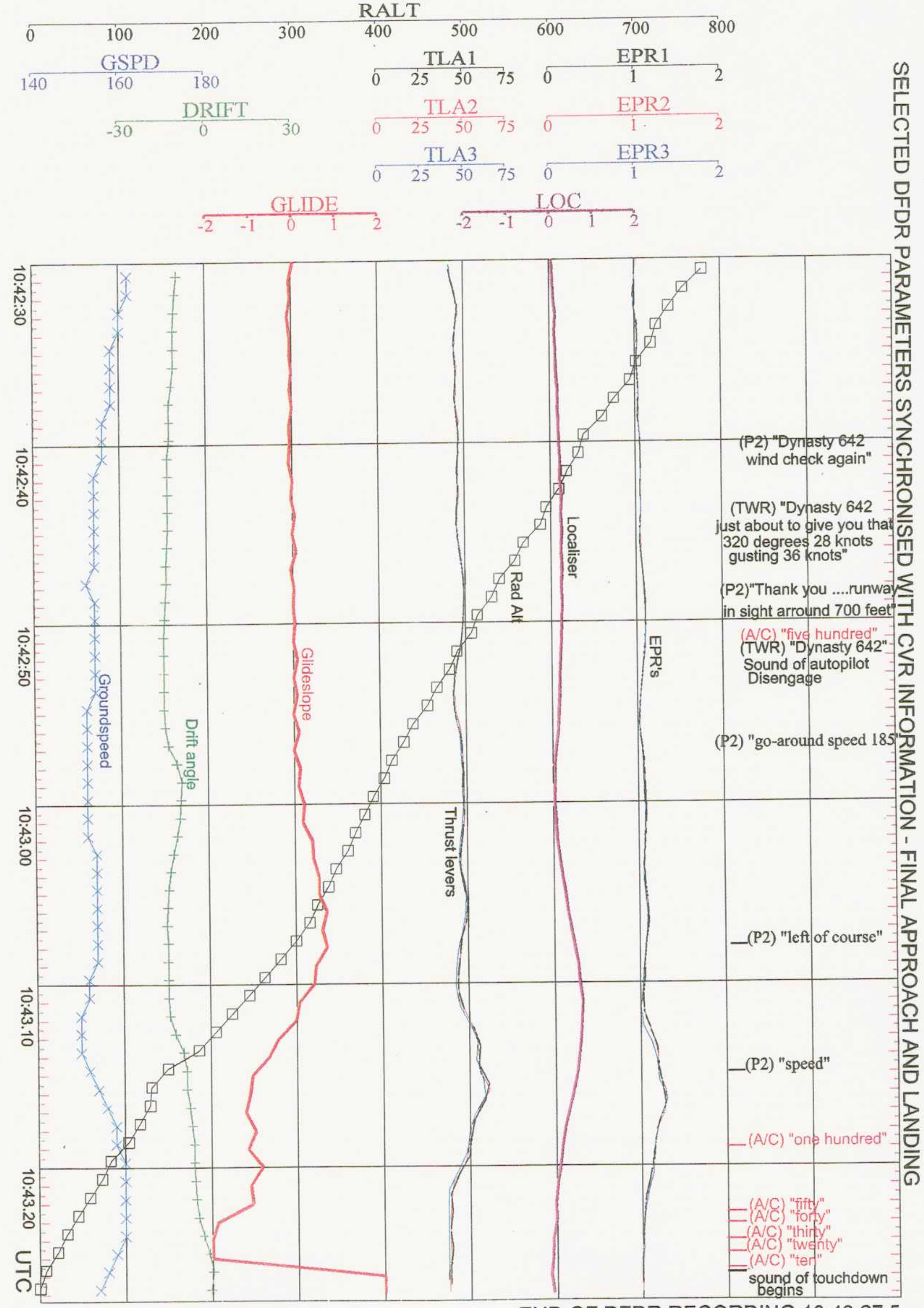
END OF CVR RECORDING 10:43:30



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END OF CVR RECORDING 10:43:30

The Boeing Company
P.O. Box 3707
Seattle, WA 98124-2207

13 October 2000
B-H200-17074-ASI

FILE B-150
19 OCT 2000

Mr. Y. K Leung
Civil Aviation Department
10/F Commercial Building
Airport Freight Forwarding Centre
2 Chun Wan Road
Chek Lap Kok
Hong Kong

BOEING

Subject: Sink Rate Calculations - China Airlines MD11 B-150 Accident Hong Kong – 23 September 1999

Reference: E-mail Jim Adams to Rick Howes, item ii, 25 September 2000

Dear Mr. Leung:

Per the reference request, the following provides the methodology used to calculate the sink rate of the subject airplane. The sink rate calculation uses an Adams-Bashforth 2-integration scheme, starting 35 seconds before the airplane contact with the runway. The initial sink rate is determined by using the change in radio altitude over one second. When the initial sink rate has been established, the vertical acceleration is integrated using the following equations from the Adams-Bashforth 2-integration scheme:

$$Vz(1) = radalt(2) - radalt(1)$$
$$Vz(i) = vz(i-1) + (1.5 * nz(i) * g - 0.5 * nz(i) * g) * dt$$

Where vz is the sink rate, nz is the vertical acceleration – 1, g is the gravitational acceleration of 32.2 ft/s^2, and dt is the time difference between samples.

A script was created to loop through these calculations to develop a time history of the sink rate for the final 35 seconds of the flight. Since the impact (right main landing gear contact with runway surface) sink rate is dependent on the value used for the starting sink rate, the starting point is moved forward by one second and the sink rate is recalculated using the new starting point.

To verify the calculated sink rate is accurate, it is integrated to calculate the radio altitude. This calculated radio altitude is then compared with the radio altitude recorded on the DFDR. Any difference in these values is corrected by adding a bias to the vertical acceleration and recalculating the sink rate and radio altitude.

A calculated sink rate of approximately 18 feet per second was determined using the above methods for this accident. The attached plots show the sink rate calculations for each of the starting points, which is approximately 18 feet per second. The second plot shows the radio altitude calculations with the recorded radio altitude (raw and adjusted for terrain height).

If you have any further questions, please do not hesitate to contact me.

BOEING

Very truly yours,

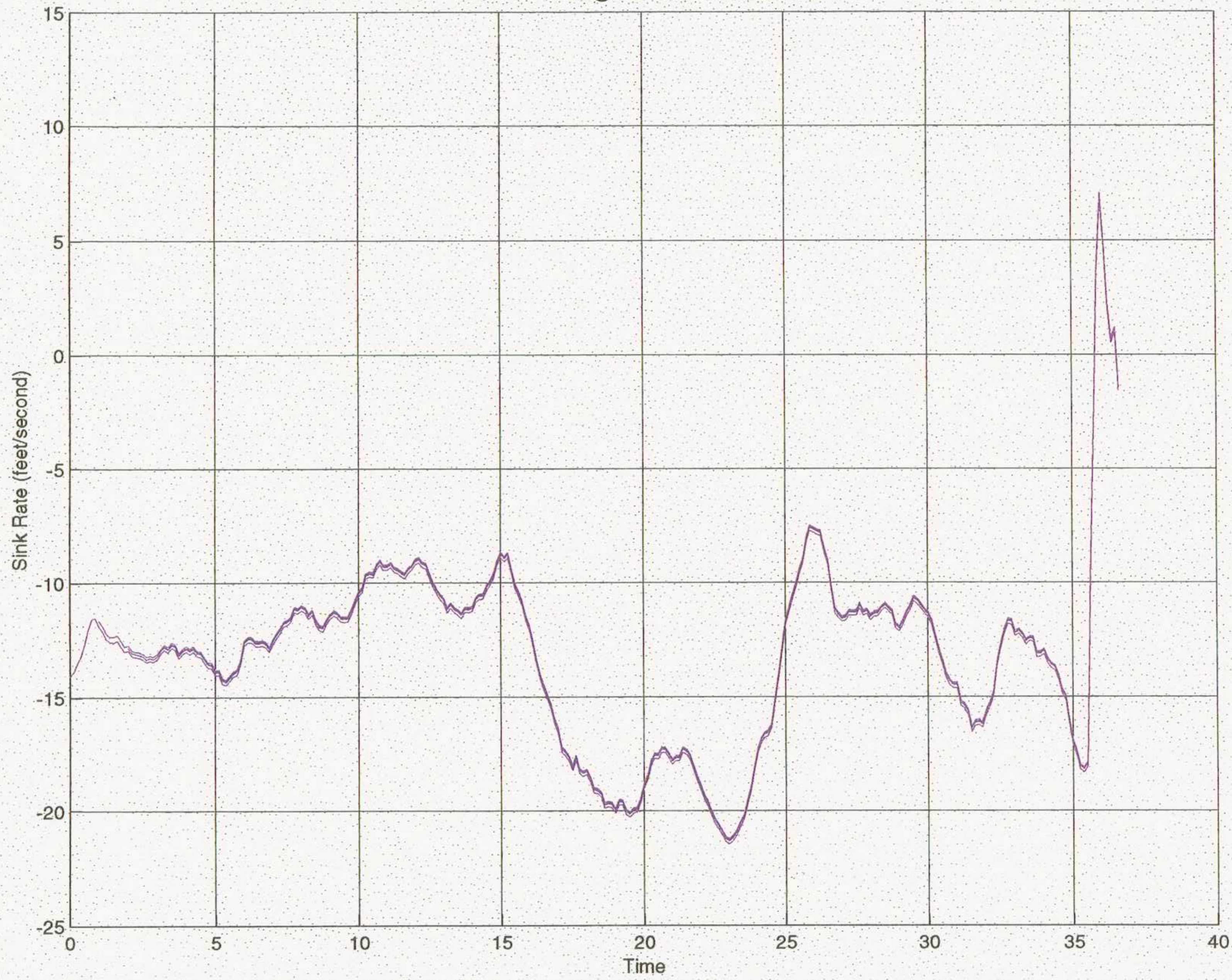
for: Ronald J. Hinderberger
Director, Airplane Safety
Org. B-H200, MC 67-PR
Telex 32-9430, STA DIR AS
Phone (425) 237-8525
Fax (425) 237-8188

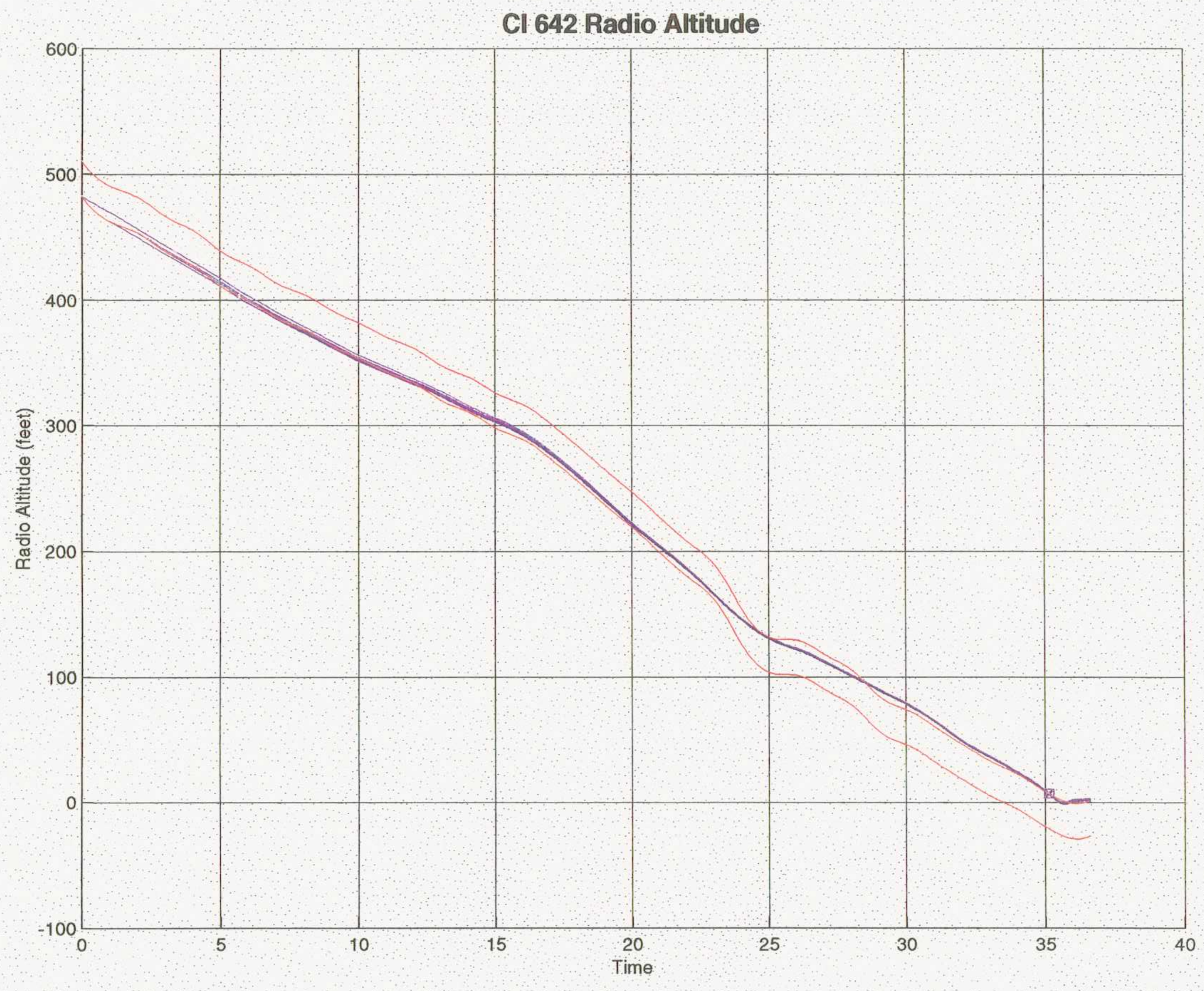
Encl:

- Boeing Figure 1, *CHI 642 Integrated Sink Rates*, and Figure 2, *CHI 642 Radio Altitude*

cc: Mr. Bob Benzon, NTSB, AS-10 (for Mr. John O'Callaghan)
Dr. Kay Yong, Taiwan ASC,
Captain Samson Yeh, China Airlines

CI 642 Integrated Sink Rates




CI 642 Radio Altitude
Radio Altitude (feet)
600
500
400
300
200
100
0
-100
0
5
10
15
20
25
30
35
40
Time

WRECKAGE INFORMATION

1. Fuselage

The fuselage was found inverted at the main wreckage with severe impact damage and fire damage (Figure 1). The crown of the fuselage was crushed downward for the entire length (nose to tail). The pilot and co-pilot's windows were cracked and the side windows were pulled out and were lying outside the cockpit. There was no evidence of any bird strike or foreign object damage on the cockpit windows. The right side of the fuselage suffered slight impact damage just aft of the R1 entry door. The skin at this location was torn in the vertical direction (Figure 2).

The remaining fuselage on the right side was intact and suffered no impact damage. There was evidence of heavy external soot and fire damage on the skin and right wing fairing just forward of the right wing front spar. The lower wing fairing aft of the right main landing gear wheel well exhibited severe scrape/grind marks. These scrape marks were at 30 degrees angle (nose left orientation).

About a 10-feet section of the right wing upper and lower skins with front and rear spars remained attached to the fuselage (Figure 3). The trapezoid fitting which connects the fixed and folding retractable side brace of the right main landing gear remained attached to the fuselage. This fitting suffered no fire damage and was fractured in tension at the brace connection. The fractured surface exhibited overload features. This fracture surface area was cut from the fitting for detailed metallurgical examination. The right main landing gear had separated from the wing and fuselage point and was found near the aft right side of the fuselage under the right horizontal stabilizer (Figure 4).

The left fuselage suffered crushing damage just aft and forward of the L1 entry door. A large section of the fuselage common to L2 door from Station 735 to Station 1059 was pushed out (Figure 5). The remaining portion of the fuselage remained intact with minor impact damage. The aft section of fuselage suffered external fire damage and soot damage on left and right sides.

2. Wings

2.1. Left wing

The left wing remained attached to the fuselage and was found at the main wreckage (Figure 6). The inboard section of the wing exhibited evidence of sooting. There was evidence of scrape marks on the upper wing skin in a span-wise direction outboard of no.1 engine location. The leading edge at the inboard section was slightly damaged and suffered fire damage. The leading edge at the no.1 engine location was crushed aft and slightly upwards. The inboard slats remained attached to the wing and were found in extended position (approximately 30 degrees position). The leading edge outboard of the no.1 engine suffered severe impact and fire damage at various locations. The slats outboard of the no. 1 engine remained attached to the wing and were in the extended position. The outboard end of the slat suffered fire damage. The wing structure outboard from Station 855 suffered severe fire damage with the structure exhibiting melting. The front and the rear spars of the outboard section suffered severe fire damage and had sagged. The wing tip suffered severe fire damage. The outboard aileron and the wing-lets were consumed by fire. The spoilers remained intact with no apparent damage.

The inboard flap and the inboard aileron remained attached to the wing structure. There was evidence of slight scrape marks on the upper surface of the flap. The outboard flap remained attached with minimum damage. The left main landing gear remained attached to the attachment fitting on the wing. There was no damage to the attachment fitting.

2.2. Right Wing

The right wing fractured between the no. 3 engine nacelle and the right side fuselage at Station 163 on the leading edge and Station 197 at the rear spar (Figure 3). About a 15-feet section of the front spar and a six-feet section of the rear spar remained attached to the fuselage. The upper and the lower skins between the front and the rear spar of the inboard section remained attached to the fuselage and exhibited upwards bending. About a six-feet section of the outboard front spar separated from the upper skin near the fractured end and the spar cap was cracked. The remaining nine-feet section remained attached to the upper skin and exhibited no bending. The stringers between the front and rear spar exhibited upward bending. The fractured surface exhibited overload features. There was evidence of slight fire damage and soot damage on the front spar and associated structure. Some of the fractured surfaces were sooted. The soot/fire damage was not very significant as compared to the outboard section of the wing.

The wing outboard from the fracture was in one section and was found about 300 feet from the nose of the airplane in the main wreckage (Figure 7). The upper skin exhibited sooting from the fracture to Station 772 and was consumed by fire from Station 772 to the tip. There was a crack of about 30 inches long at the middle of the upper skin in a span-wise direction. The fractured surface on this crack was sooted. The upper skin was bulged upward 12 inches forward of the rear spar on the upper skin and the side rib. The upper skin bulge was 38x46 inches in area and bulged up for about two inches. The leading edge suffered severe impact damage and fire damage. The inboard slat was detached and recovered at the site. The middle and outboard slats suffered severe fire damage and remained attached to the leading edge. The leading edge from the fracture to Station 538 suffered fire damage. The inboard end of the leading edge suffered severe impact damage and was dented at various locations. The leading edge outboard of Station 538 was consumed by fire. There was no evidence of heavy scrape marks on the upper skin. Only light scrape marks were observed at the inboard end on the upper skin in a fore and aft direction. The wing tip suffered severe fire damage on the upper skin. The strobe lens reflector and the case with the bulb remained intact and suffered fire damage. There was no evidence of any scrape marks on the wing tip structure on the lower skin. The right wing lower skin was intact from the inboard fracture location to the tip and suffered severe fire damage. There was no evidence of any heavy scrape marks on the lower skin.

The inboard fractured end of the lower skin exhibited severe scrape marks and grinding on the edge of the skin at a 45-degree angle.

The inboard flap was missing and was found on the left side of the runway in the vicinity of the main wreckage. The inboard aileron and the outboard flap suffered severe fire damage and were separated from the wing. These control surfaces were found at close proximity to the right wing. The outboard aileron was consumed by fire along with the outboard section of the wing.

The engine pylon forward attachment fitting (tombstone fitting) that attached to the engine pylon remained attached to the front spar and was fractured across the middle. The fractured end exhibited evidence of bending aft. The forward wing pylon mount fitting was pulled downward at the forward end and was slightly bent inboard. The aft pylon mount fitting remained attached to the lower skin with no bending. The aft pylon mount remained attached to the lower skin and was slightly bent aft. All the fasteners on the aft mount bulkhead sheared.

The forward and aft main landing gear attach fitting suffered severe damage. The aft lug of the forward mount fractured between 4 o'clock to 10 o'clock position (view looking forward - see Figure 8). The fractured surface exhibited soot accumulation and slight discoloration. The forward mount was cracked and exhibited impact damage in an upward direction. The forward mount shear pin was sheared off and a portion of the shear pin remained with the forward lug (Figure 9). The remaining piece was attached to the landing gear. The fractured surface on the shear pin was heavily sooted. The aft mount was fractured, and both the lugs along with a large piece of fitting remained attached to the landing gear including the shear pin (Figure 10). The entire area of the main landing gear fitting and fractured surfaces exhibited evidence of sooting. The piece of the head-end of the main landing gear actuator remained attached to the fitting.

3. Landing Gears

3.1. Right Main Landing Gear

The right main landing gear was separated from its mount. The forward shear pin was sheared off from the forward mount and half of the shear pin remained in the forward lug of the forward mount. This section of the shear pin was pushed out and exhibited severe soot damage on the fracture surface. The remaining portion of the shear pin remained on the forward lug of the landing gear and exhibited some bending. The fractured surface on this portion exhibited surface rust and the fractured surfaces could not be examined. The aft lug of the forward mount fractured between the 4 o'clock and 10 o'clock positions. This section of the lug fractured into two pieces and was found on the runway between the touchdown point and the main wreckage. The mating fractured surface on the wing forward mount aft lug exhibited some discoloration but the mating fractured surface of the lug that was found on the runway did not exhibit any discoloration. All surfaces on the aft lug exhibited evidence of overload features. There was no evidence of fire or soot on the pieces of lug found on the runway. The forward fitting that remained attached to the landing gear fitting suffered soot damage. The forward mount fractured in the middle and exhibited impact damage in an upward direction (Figure 8).

The landing gear fitting between the forward and aft mount fractured and a portion of the fitting was missing. This section was attached to the landing gear with the aft pin still in place. This piece also exhibited impact damage between the forward and aft mount. The landing gear fitting between the forward and aft mounts suffered severe soot damage and the soot was evident on the fracture surfaces.

The right main landing gear strut remained intact and was fully extended at the main wreckage site. The strut was deflated later for safe handling. The folding side brace remained attached to the gear. The upper rib of the folding side brace was fractured and twisted near the end that attached to the fuselage. A small section of the fixed brace remained attached to the trapezoidal fitting along with the folding side brace (Figure 11). The trapezoidal fitting fractured from the trapezoidal panel that attached to the fuselage (Figure 12). The trapezoidal panel pillow block remained attached to the fixed and folding brace. The fractured surface exhibited evidence of overload features. There was no evidence of fire damage or soot damage to the right main landing gear.

The truck beam suffered impact damage and was cracked at the aft stop location on the upper surface. The forward stop exhibited severe impact damage on the upper surface. All four tyres remained attached to the truck beam. The outboard tyres remained inflated and the pressures in the tyres were 200 psi each. The inboard tyres were deflated. The inboard side-wall of the inboard tyres exhibited severe scuff marks generally in radial direction. There was no evidence of any fire damage to the landing gear tyres.

3.2. Centre Landing Gear

The centre landing gear fractured at the bottom of the cylinder (oleo) near the axle (Figure 13). The fractured surface exhibited overload features with a 45-degree shear lip and was severely rusted. The wheel truck with tyres was found on the runway near the main wreckage. There was evidence of heavy impact damage on the right hydraulic brake reservoir that attached on the wheel. The heavy impact mark was a 3/8-inch wide indentation and ranged up to 1/2 inch deep. There was no evidence of any fire damage or soot damage to the centre gear truck assembly. Only one tyre was inflated and did not exhibit any scuff mark on the inner or outer side. The other tyre was deflated and suffered severe sharp cuts on its side.

The strut remained attached to the fuselage with the inner cylinder (oleo) compressed all the way in. The lower end of the strut exhibited grinding consistent with runway contact. These grind marks was approximately at 45 degrees with respect to airplane centreline and about 30 degrees nose left. These grind marks covered about 50% of the circumferential surface. The body gear remained attached to the fuselage. There was no evidence of any damage to the gear-to-fuselage attachment point. There was no evidence of any fire damage on the centre landing gear.

A small section of the base of the oleo (lower cylinder) of about five inches long with torque link was separated from the centre gear. The fractured surfaces on both sides exhibited overload and were rusted.

3.3. Left Main Landing Gear

The left main landing gear remained attached to the wing and fuselage with its attachment point. There was no evidence of any impact damage or fire damage to the left main landing gear. The gear cylinder was extended and the gear was in the lock position with the folding and fixed side braces intact. The tyres remained attached to the truck beam assembly and suffered no damage.

3.4. Nose Landing Gear

The nose landing gear remained attached to the nose fuselage with minimum structural damage. The strut was in an extended position. The right tyre separated from the hub and was found near the main wreckage. The tyre exhibited heavy cut damage in the bead area of the tyre. The hub fractured circumferentially. The left tyre remained attached to the axle and was scuffed on the inboard side-wall. There was no evidence of fire damage to the nose landing gear.

4. Engine Pylons

4.1. No. 1 Engine Pylon

The no. 1 engine remained attached to the left wing at its forward attachment point. The forward attachment point is the tombstone fitting and remained fully attached to the upper and lower spar of the pylon. This tombstone fitting was bent forward about 60 degrees. The pylon separated at the rear mount fitting. The fitting fractured in the middle of the lug. The fractured surface exhibited evidence of overload failure. There was no evidence of any fire damage to the pylon-wing attachment structure.

4.2. No. 2 Engine Pylon

The no.2 engine pylon was separated from the empennage and was found intact. The front portion of the inlet duct was separated from the engine and the vertical stabilizer broke off at the manufacturing joint on the top of the pylon.

4.3. Engine No. 3 Pylon

The no. 3 engine separated from the wing at its pylon attachment points and was found in the grassy area near the right wing (Figure 14). The front (tombstone fitting) pylon mount fractured about 24 inches from the upper wing skin. This fitting suffered severe fire damage and the web and the cap was bent aft at the fractured end. The tombstone fitting was attached to the wing front spar and pulled out of the pylon about five inches below the pylon upper spar. The upper spar that the front links were attached, was broken out of the pylon and attached to the wing mount. A large section of the tombstone fitting remained with the engine pylon. The web and the cap were bent forward with slight twisting. The rear engine mount and bulkhead separated from the pylon in one piece and remained attached to the wing. The rear engine mount separated from the left and right pylon skin and all the fasteners were pulled out of the skin. The upper spar cap at the outboard side of the pylon was bent in a "U" shape and the web/ skin separated from the cap indicating that the pylon was experiencing loads in the inboard direction. The upper spar cap at the inboard side remained attached to the web with no noticeable bending. The inboard pylon skin was bent inboard.

5. Empennage

The right horizontal stabilizer remained attached to the empennage with severe impact damage (Figure 4). The section outboard of Station 292 was bent down. The inboard section remained attached to the empennage. The right stabilizer suffered soot damage on the leading edge, upper and lower skins. The leading edge and lower skin exhibited severe scrape marks and these scrape marks were on top of the sooted leading edge and skin. The scrape marks were in three distinct directions. One set of scrape marks near the leading edge ran in span-wise direction. The second set was about 30 degrees anti-clockwise from the span-wise direction (view looking down), while the third one was about 70 degrees anti-clockwise from the span-wise direction (view looking down). There were other scrape marks in various directions. These scrape marks are indication of runway contact. The leading edge of the stabilizer was dented and crushed at various locations. The outboard end of the leading edge was crushed aft. The inboard and outboard elevators remained attached to the horizontal stabilizer and suffered severe fire damage.

The left horizontal stabilizer fractured at Station 290 (Figure 15). The inboard section remained attached to the empennage with upper skin. This section exhibited upward bending. The lower skin was fractured at the root in a jagged fracture pattern. The front spar and the associated structure at the fractured location were bent aft. The upper and lower skin suffered soot damage. The inboard elevator remained attached with no impact damage but exhibited severe soot damage. The outboard elevator fractured at Station 290. There was no scrape marks observed on the inboard section of the horizontal stabilizer.

The vertical stabilizer right skin fractured approximately at Station 525 and at Station 426 on the left side (Figure 16). The left skin and the associated structure were bent to the left. The front spar fractured at Station 525 and the lower section of the front spar web was missing. The front spar at the fracture was bent slightly to the left. The rear spar fractured at Station 525 and was bent aft. The second fracture on the rear spar was at Station 444. At this location the spar was bent aft. The left skin from Station 525 was still attached to the upper vertical stabilizer but the right skin was missing. The upper forward and aft rudders remained attached to the vertical. The lower forward and aft rudders fractured at approximately Station 426. The rudder section below this station suffered severe fire damage. A portion of the lower vertical stabilizer (lower from Station 426) remained with the lower rudder and suffered fire damage. The vertical stabilizer fractured at the base just above the no.2 engine. The rear spar and aft centre spar fractured about 10 inches above the base and was bent aft The forward centre and front spar attachment point fractured six inches above the base and exhibited no bending. All the fractured surfaces exhibited evidence of overload.

6. Powerplants

The accident aircraft was powered by three Pratt & Whitney model PW4460 engines. All three engines were found at the crash site. None of the engines displayed signs of engine fire or non-contained events. All of the engine cowling and nacelle hardware was found forward of the aircraft touchdown area. The Full Authority Digital Engine Control (FADEC) was removed from each engine for analysis of engine fault information by the FADEC manufacturer. No further engine disassembly was required for investigation.

6.1. No. 1 engine; s/n: 723907 (Figure 17)

After the accident, no. 1 engine remained attached to the pylon structure. The engine and pylon had separated from the left wing at the front and rear pylon mounts. The engine was inverted, along with the wing, with the 12 o'clock position of the fan case resting on the ground. The inlet structure was separated from the engine forward of A-flange. The fan rotor and fan blades were intact. Fifteen of the fan blades were slightly bent opposite the direction of rotation. The other 21 fan blades were not significantly bent while two fan blades were slightly bent in the direction of rotation. The fan case showed signs of fan blade tip contact with the fan case attrition material. The Low Pressure Compressor (LPC) inlet vanes were intact and did not show signs of distress. No significant damage was found to the LPC blades and vanes that could be seen from the LPC inlet. The fan exit guide vanes were intact. The fan cowl doors were separated from the nacelle. The thrust reverser doors were found in the stowed position. The rear stages of the low-pressure turbine were intact and showed no indication of distress. No indication of engine failure or debris was found in the turbine exhaust case. The exhaust nozzle and tail cone remained intact and were not significantly distressed. There were no indications of any scrape marks on the engine nacelle.

6.2. No. 2 engine; s/n: 723968 (Figure 18)

After the accident, no. 2 engine remained attached to the inlet and engine mounting structure. The engine, inlet, and mounting structure separated from the aircraft along the diverter structure of the vertical stabilizer. The inlet duct was breached radially inward and forward of the fan face. Debris was found in the inlet duct in front of the fan face. The fan rotor and fan blades were intact. Foreign object impact damage was observed on the fan blades in the form of nicks and local deformations of the fan blade leading edges. The inlet, fan section, LPC, and bypass air surfaces were thinly covered in soot, consistent with the external, post-accident fire. No damage beyond slight foreign object damage was observed on the LPC inlet vanes or blades. The fan exit guide vanes remained intact. The fan cowl doors were separated from the fan case, one of which was found on the side of the runway. The bypass and core cowl doors remained on the engine and showed impact damage from external directions. The thrust reverser doors were found in the stowed position. No indication of engine distress was found on the 6th stage LPC blades or in the turbine exhaust case. The exhaust tail cone and nozzle remained attached to the engine.

6.3. No. 3 engine; s/n: 723952 (Figure 19)

After the accident, no. 3 engine remained attached to the pylon structure. The engine and pylon structure was separated from the right wing at both the front and rear pylon mounts. The engine mounts did not exhibit any signs of distress. The inlet duct separated from the engine immediately forward of A-flange. The inlet exhibited abrasion marks at the 6 o'clock position. The fan case separated from the engine at C-flange, just behind the fan exit guide vane outer platform mounts. The separated fan case structure showed no signs of non-containment. Engine externals mounted near the 6 o'clock position of the fan case exhibited abrasion marks. The fan containment belt, yellow in color, displayed heavy fraying in the 6 o'clock region. Fragments of the belt material were found on the runway. The fan hub was intact and contained all 38 fan blade attachments. Three fan blades were fractured at roughly 50% span while 25 fan blades were fractured at the part-span shroud location. The remaining 10 fan blades were of full length and bent opposite the direction of fan rotation. The LPC shroud was intact, with the 1st stage LPC stators showing signs of foreign object damage. Ground debris was found throughout the bypass ducts and the LPC.

The upper intermediate case struts were deformed rearward, while the lower struts were crushed into the engine core cowl. The outer structure of the bypass duct, including the thrust reverser, was collapsed radially inward on both the left and right sides of the nacelle. Scuff marks consisting of gray paint were found at the 10 & 11 o'clock positions. Two pieces were removed for further examination. The right thrust reverser door was in the stowed position. The left thrust reverser door was separated from the engine, along with the thrust reverser cascades. The thrust reverser cascades were in place on the right side of the engine. The lowest external region of the thrust reverser doors exhibited two distinct patterns of abrasion or grinding. One of the patterns of abrasion was oriented roughly along the engine centreline in the fore to aft direction. The second pattern of abrasion was oriented approximately 35 degrees right of engine centreline, also in the fore to aft direction. The 6th stage low-pressure turbine blades showed no signs of distress. The lower third of the turbine exhaust case was crushed radially inward at T-flange; however, P-flange was only slightly deformed. No engine debris was found in the turbine exhaust case. The exhaust nozzle was separated from T-flange. The exhaust tail cone suffered radial impact at the 6 o'clock position, but remained attached to the turbine exhaust case.

GENERAL COMMENTS

All station numbers are approximate
Conventional sign orientation with the aeroplane on gear
No evidence of any inflight collision or fire

Main Wreckage (Figure 1)

Right-hand Forward Fuselage (Figure 2)

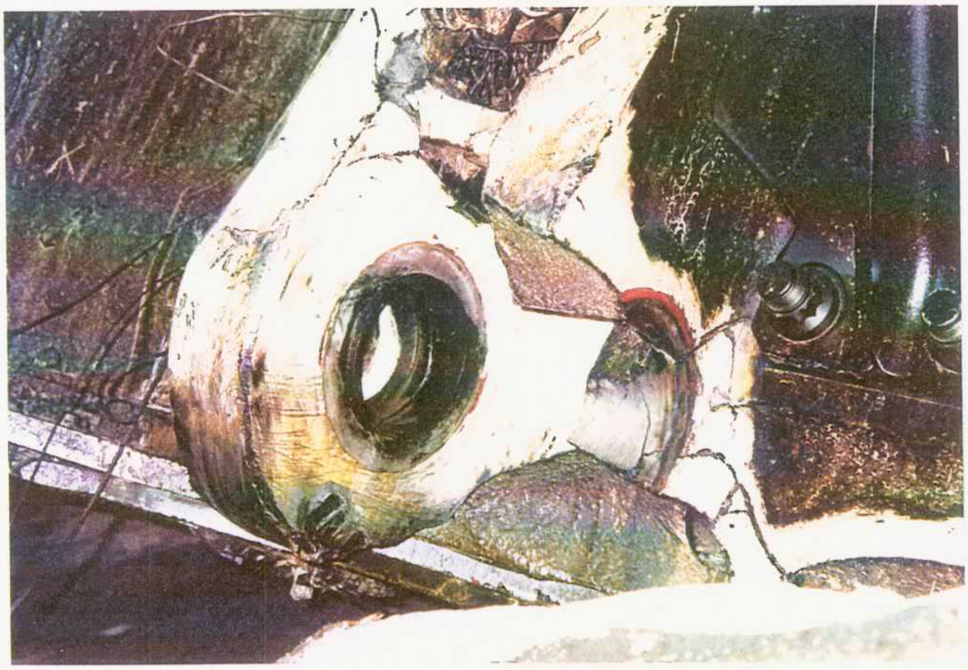
Right Wing Root Section (Figure 3)

Right Main Landing Gear and Right Horizontal Stabilizer (Figure 4)

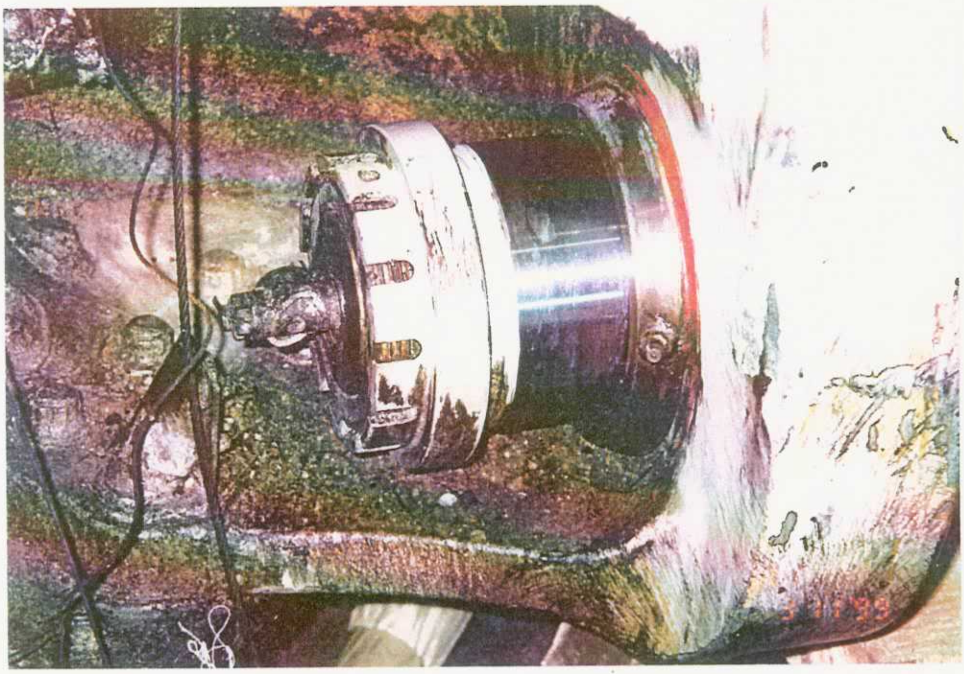
Left Forward Fuselage (Figure 5)

Left Wing (Figure 6)

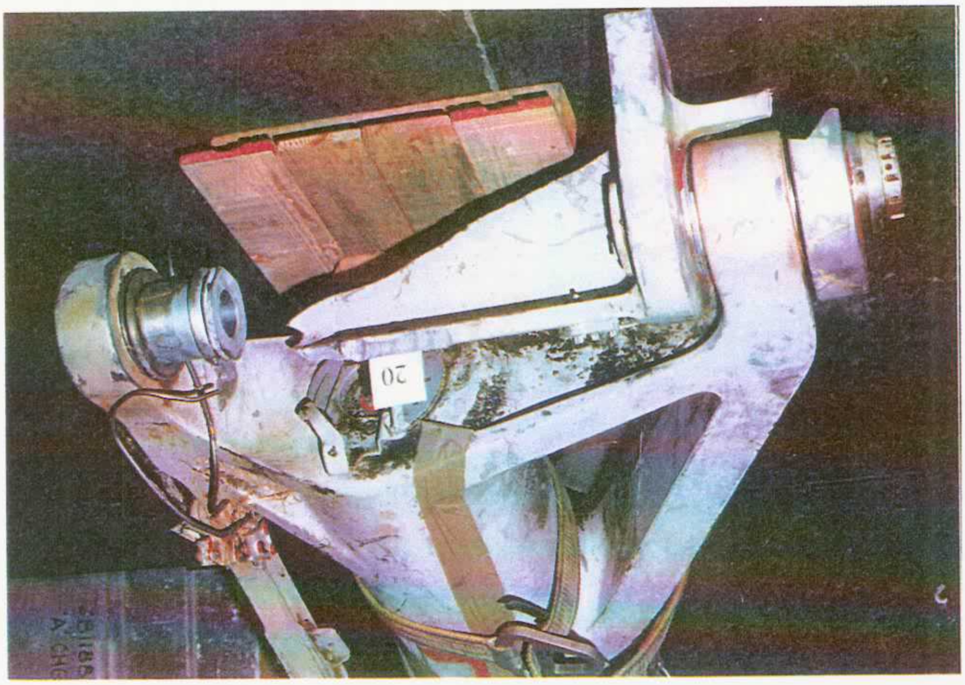
Right Wing Detached from Main Fuselage (Figure 7)



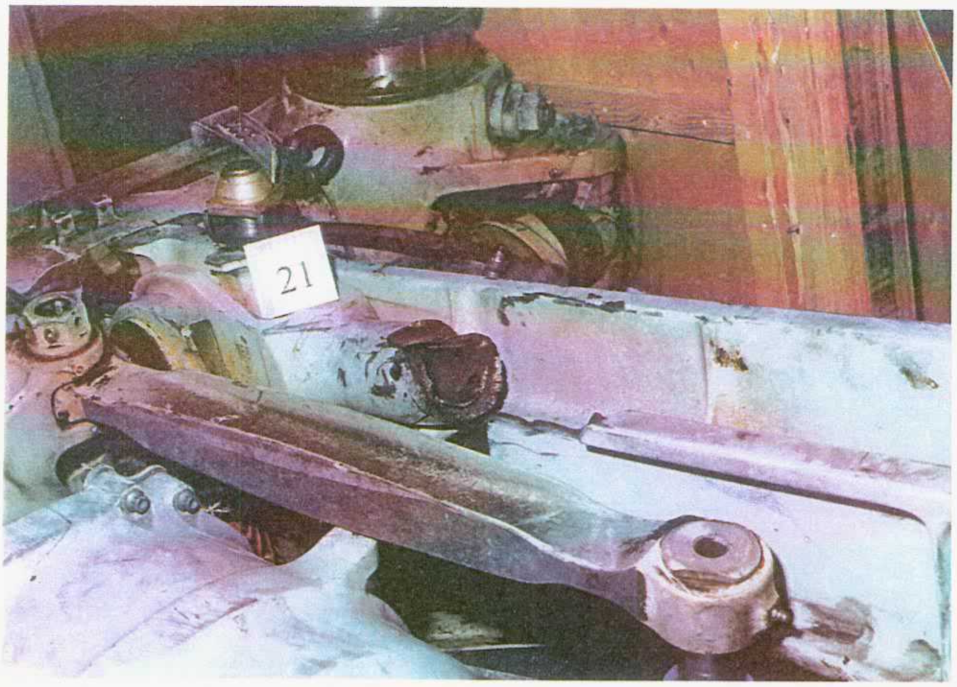
Right Main Landing Gear (RMLG) Forward Attachment Fitting (Figure 8)



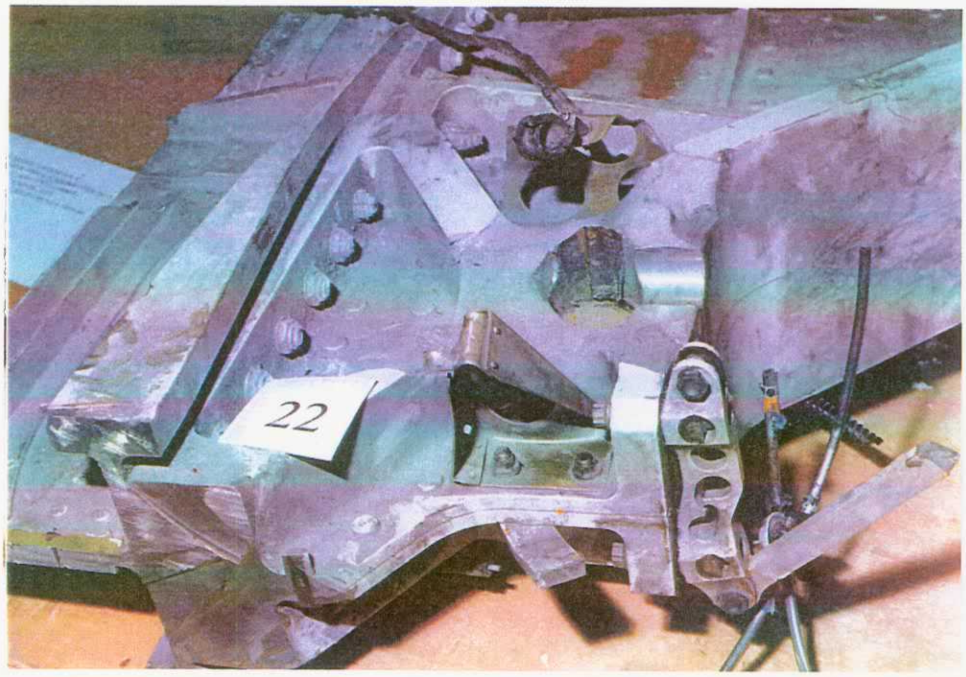
Forward Shear Pin (Trunnion Bolt) (Figure 9)



Fractured RMLG Aft Attachment Fitting with Aft Shear Pin (Trunnion Bolt) (Figure 10)



Fractured Fixed Side-Brace (Figure 11)



Fractured Trapezoidal Panel (Figure 12)

Fractured Center Landing Gear Oleo (Figure 13)

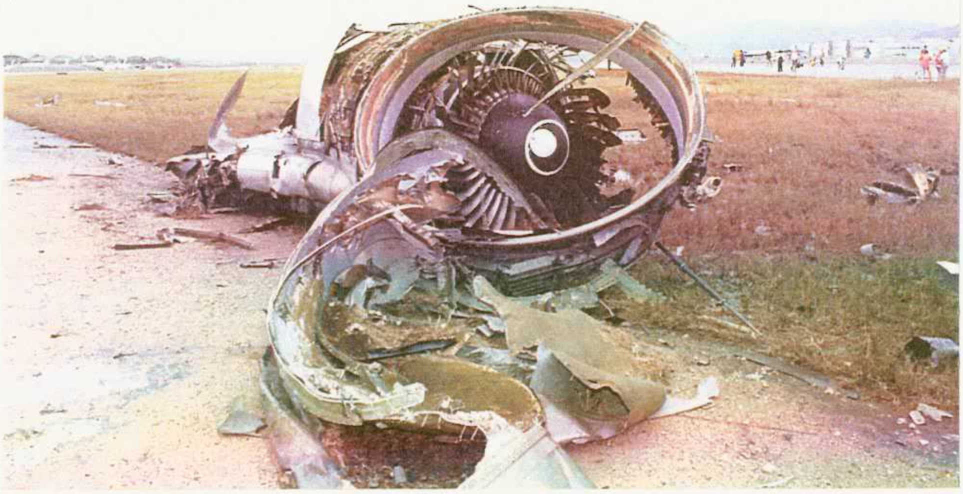
No. 3 Engine Pylon to Wing Forward Attachment Structure (Figure 14)

Left Horizontal Stabilizer (Figure 15)

Vertical Stabilizer (Figure 16)

No.1 Engine (Figure 17)

No.2 Engine (Figure 18)

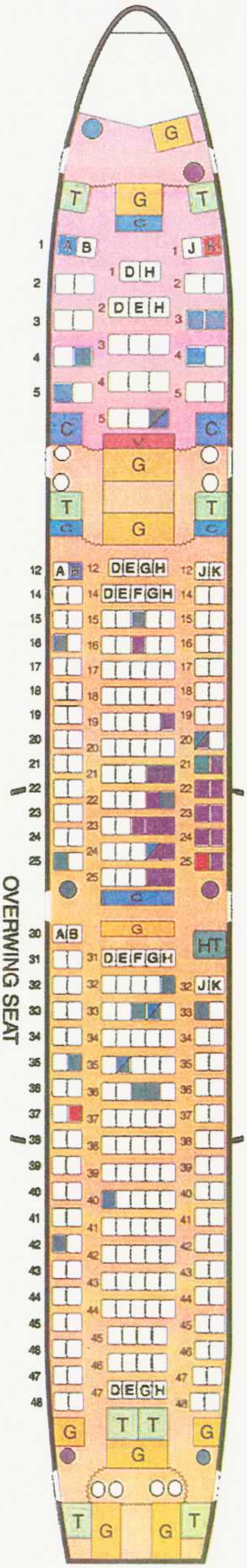


No.3 Engine (Figure 19)

SEAT LOCATIONS OF SERIOUSLY INJURED PERSONS

圖示説明 KEY TO AMENITIES

- 華夏商務客艙 Dynasty Business Class
- 經濟客艙 Economy Class
- V 影音控制室 Video Control Center
- HT 殘障設備盥洗室 Handicap Toilet
- T 盥洗室 Toilet
- G 機上廚房 Galley
- C 衣帽間 Coat Closet



LEGEND

- Dead (3 pax)
- Burn or Scald (21 pax, 3 F/A)
- Head Injury (10 pax, 1 F/A)
- Other Injuries (18 pax, 2 F/A)

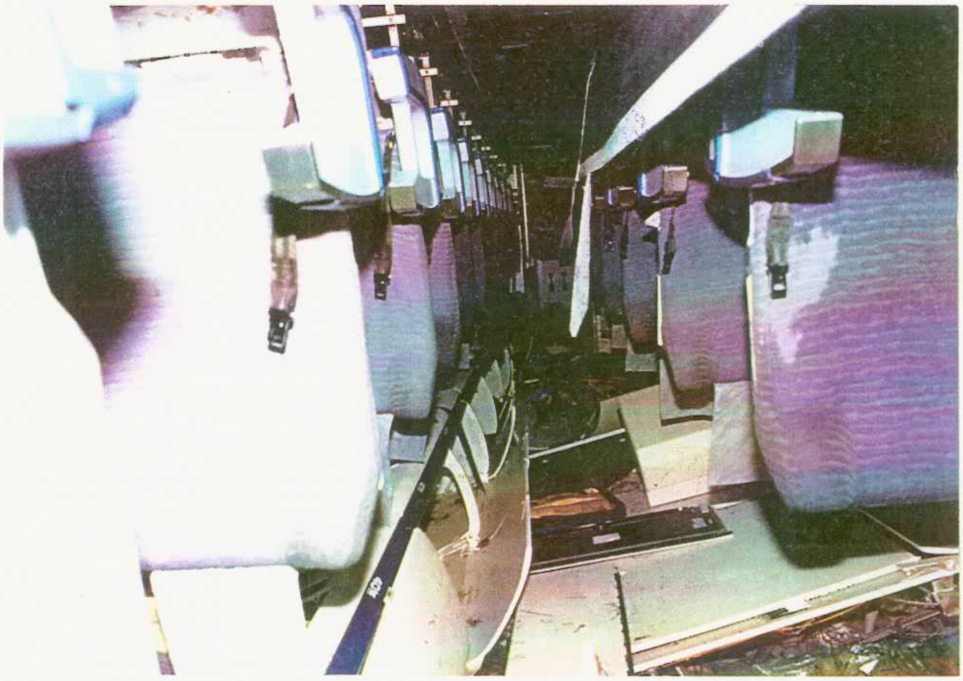
Photographs of Damaged Fuselage

1. General view of main wreckage.

2. View of seats 1J and 1K.

3. View of the lavatory just inside Door 3R.

4. View of the Business Class section of the cabin.



5. View of the Economy Class section of the cabin.

6. View of right side of fuselage including Door 1R.

7. View of left side of fuselage including Door 3L.

8. View of crack in right fuselage (forward) including Door 2R.

9. View of crack in right fuselage (aft).

Enclosure to: B-H200-17041-ASI

MDC-00K1121

Sequence and Characteristics of the Structural Failure of the Mandarin Airlines (China Airlines) MD-11 Fuselage Number 518 – August 22,1999 Accident at Hong Kong International Airport

REVISION: NEW

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Reference 1 China Air Accident "Performance Group Report"

Reference 2 MDC-00K1008, "Materials and Process Engineering Report on Mandarin Airlines (China Airlines) MD-11 Fuselage Number 518 Accident at Hong Kong International Airport, Hong Kong, China"

1.0 DESCRIPTION OF STRUCTURAL ARRANGEMENT

A rendering of the MD-11 structural arrangement in the vicinity of the main landing gear is included as Figure 1. Note that the rendering is "artistic" in character and incorrectly shows some structure which should (from the view depicted) be hidden.

The MD-11 main landing gear is cantilevered off the rear spar of the wing. Two trunnion bolts attach the main landing gear strut (blue) to the wing fitting (green). The wing fitting attaches to the rear spar (yellow). Vertical, drag and side loads applied to the landing gear are reacted through the trunnion bolts into the wing fitting and from there into the main torque box of the wing.

The forward of the two main landing gear trunnion bolts is a designed "fuse". For very high drag loads (as might be encountered during an off-runway excursion, or if the landing gear struck an obstruction) the forward bolt is designed to shear as the forward main landing gear trunnion moves downward.

Loads about the main landing gear pivot axis (gear sideloads) are reacted via a trusslike structure made up of the folding side brace (magenta), the fixed brace (light blue), and the strut. This arrangement results in loads which are primarily up and down (vertical) at the joint where the truss attaches to the fuselage. The loads at this joint are primarily up when an inboard acting sideload is applied to the landing gear, and down when the sideload is outboard.

The fuselage attach point for the truss is on a machined beam referred to as the "trap panel" because of its trapezoidal shape. The trap panel is shown in red in Figure 1.

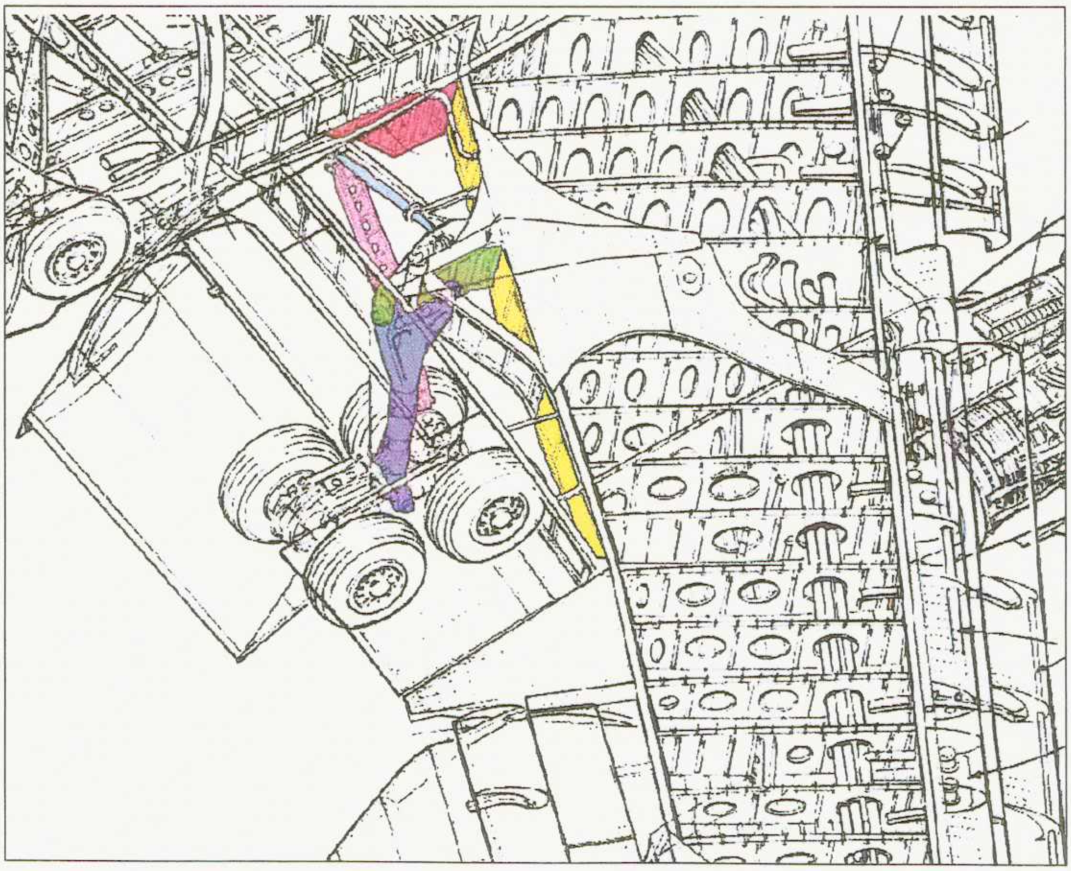


Figure 1. MD-11 Structural Arrangement in the vicinity of the MLG-to-Wing attachment

2.0 LANDING CONDITIONS

The attitude of the accident aircraft, along with the velocity and acceleration components were estimated from data obtained from the flight data recorder. More detail is available in the report published by the Performance Group of the accident investigation team (Reference 1). From a structural loads perspective the most significant of these parameters is the sink rate (velocity towards the ground) which has been estimated to be in the vicinity of 18-20 feet-per-second. The next most significant parameter is the roll attitude (approximately 3 degrees right-wing-down).

It should be noted that the design sink rate for a symmetric landing (zero degrees roll) is 10 feet-per-second. Recognizing that the kinetic energy which must be absorbed to decelerate an aircraft moving towards the ground is a function of the velocity *squared*, it is observed that the energy from a 20 foot-per-second sink rate is four times (not double) that from a 10 foot-per-second sink rate. And since the aircraft was rolled right at touchdown, most of the load was taken by the right-hand main landing gear.

3.0 LANDING SIMULATION

MD-11 crash landing simulation analyses were run using initial conditions consistent with the accident aircraft at touchdown. The aircraft was rolled right-wing-down 3 degrees, pitched nose-up 4.5 degrees, and was descending at nearly 20 feet-per-second. There was no perceptible roll rate and the lift on the airplane was roughly equal to its weight. The high sink rate combined with the rolled attitude caused

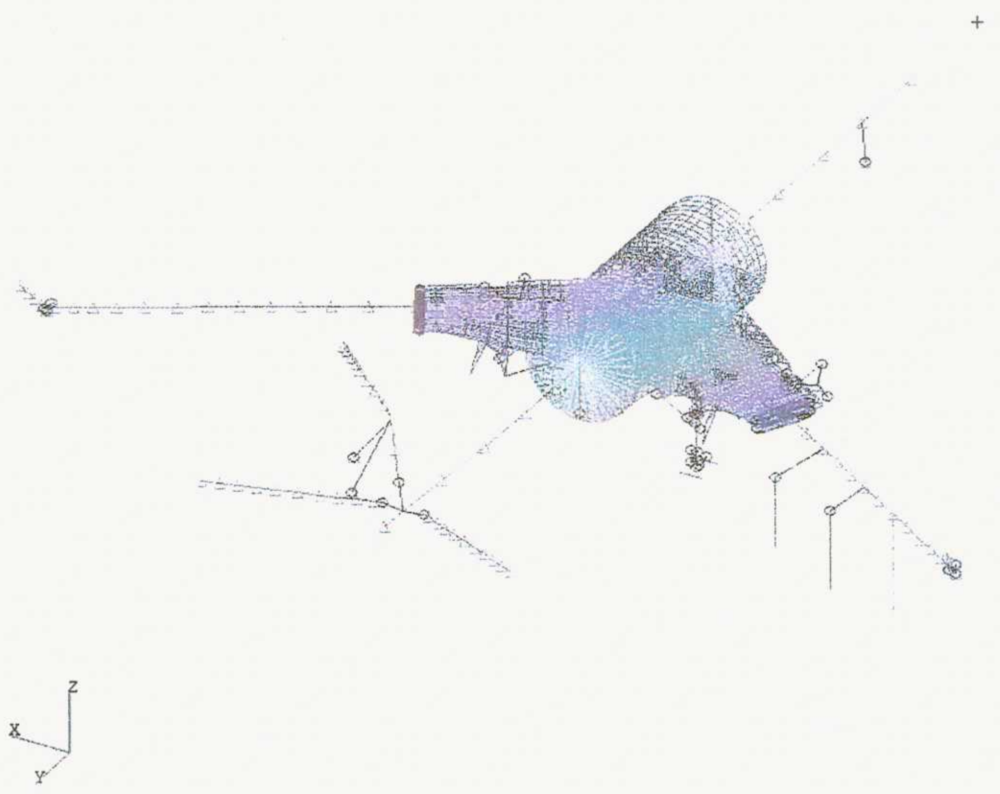


Figure 2. MD-11 Dynamic Landing FE Model

bottoming of the right main landing gear strut and generated a vertical load "spike" which failed structure in the area where the right main landing gear attaches to the right wing.

The structural failures (of the right wing rear spar in particular) which were observed in this accident bore notable similarities to those that were observed for a FedEx MD-11 that was involved in a crash landing at Newark, New Jersey on July 31st, 1997. A significant amount of analysis was conducted to simulate the FedEx accident and estimate structural loads on the right main landing gear, the right MLG-to-wing attach fitting, the right wing rear spar, and the right landing-gear-side-brace-fitting-to-trap-panel joint. These analyses were conducted using an in-house aircraft dynamic landing program (B7DC), a commercially available finite element program (MSC NASTRAN), and a commercially available nonlinear kinematics code (ADAMS).

Based on knowledge and experience gained in analyzing the FedEx accident a simplified analysis technique was developed for studying the effects of very high sink rate landings on aircraft structure. The crash landing analyses performed for this accident utilized MSC NASTRAN. A transient nonlinear solution was run using a detailed finite element model of the MD-11 inboard wing and center fuselage, combined with a coarser idealization of the remaining structure. (See Figure 2). The main landing gear was idealized using the BUSH1D element, which allowed the gear nonlinear spring and damping characteristics to be input in table form. The results from this model were compared and correlated with certification analyses (for cases within the design limits of the aircraft) and with the FedEx ADAMS analysis and were shown to be satisfactory.

The most significant differences in the structural loads applied to the aircraft during the FedEx and the China Airlines accidents lay in the drag loads applied to the right main landing gear. Landing gear drag loads were not significant for the FedEx accident. This is because the aircraft touched down, bounced, then landed a second time at a high sink rate and sink acceleration, and at a significantly rolled attitude. Since the high vertical loads occurred on the second touchdown, the wheels were already spinning and drag loads were minimal. The high vertical loads for the China Air accident occurred at the initial touchdown so "spin-up" and "spring-back" (plus and minus drag) loads were significant.

The existence of significant drag loads for the China Air accident required an adjustment to the simplified NASTRAN analysis technique. Spin-up and spring-back loads (essentially a time history of the main landing gear drag loads) were estimated using B7DC (the certification landing gear loads analysis program) and the time history was manually input into the NASTRAN solution. The peak load from the B7DC time history was phased to correspond with the peak right main landing gear vertical load.

Figure 3 displays the landing gear strut and tire loads for the China Airlines baseline case (Case 4.010). The structure responds linearly for this case and it is assumed that all of the lift on the right-hand wing is lost when the right main landing gear load reaches 600,000 lbs. (This assumption is consistent with analyses that were run for the FedEx crash simulations, which used ADAMS to dynamically calculate wing lift as a function of local angle of twist). For the China Airlines analysis, both the left main landing gear and the center landing gear pick up load well before the right main landing gear reaches its peak load.

The strut and total-tire load time histories should be equal for a given gear (note that the right main landing gear strut load oscillates near its peak and separates after the peak due to NASTRAN convergence problems). These convergence problems do not have a significant effect on the time history of the other gear loads or the peak value of the right main landing gear total-tire load.

Time histories of key loads from Case 4.010 are plotted in Figure 4. From the figure, the right main landing gear strut load peaks at 1.4 million pounds, the peak rear spar shear flow is 35,000 lbs/in, and the peak load on the right main landing gear forward trunnion bolt is 1.2 million pounds. The rear spar shear flow is well in excess of what is required to fail the rear spar shear web and the forward trunnion bolt load is roughly that which is required to fail it.

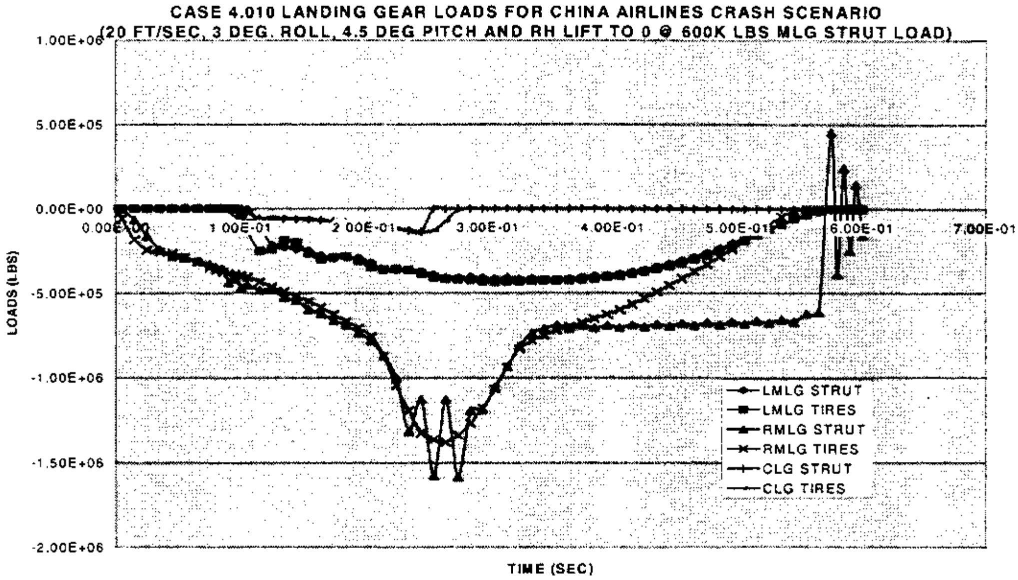


Figure 3. Case 4.010 Landing Gear Loads for China Airlines Crash Scenario

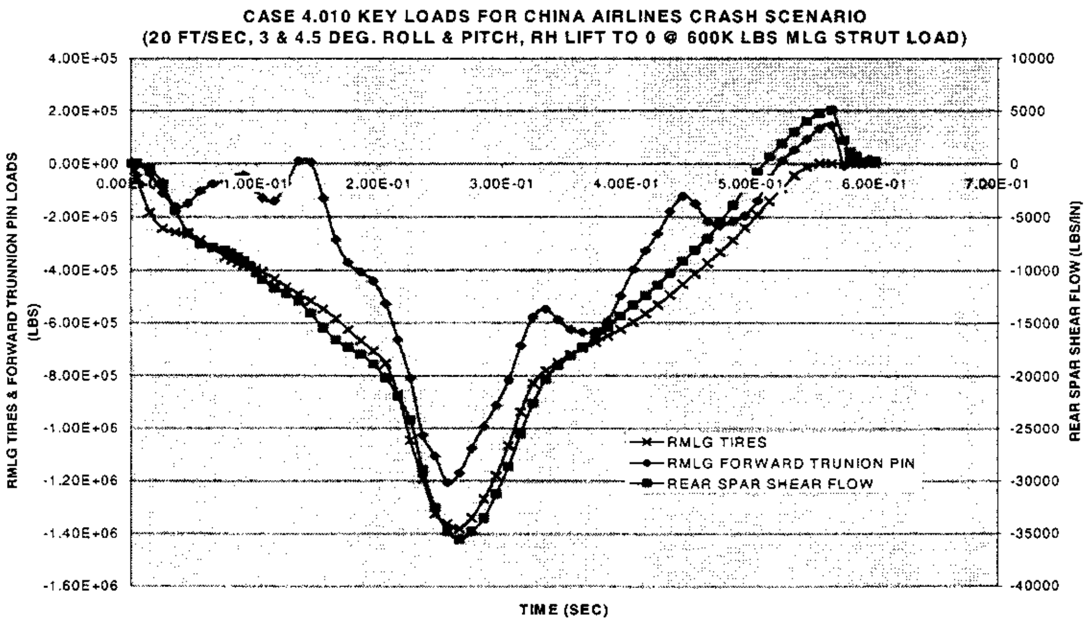


Figure 4. Case 4.010 Landing Gear Loads for China Airlines Crash Scenario

The results of this analysis, although not rigorous, confirm that loads high enough to fail the forward trunnion bolt and the rear spar shear web are feasible, and that the failure sequence described in the following sections is reasonable.

4.0 STRUCTURAL FAILURE SEQUENCE

The most likely sequence of structural failures is summarized below. Details and supporting evidence are included in the Sections 5.0 through 11.0.

- Due to the combination of a high sink rate and a right-wing-low rolled attitude, the right main landing gear shock strut bottomed and the vertical load on the right main gear "spiked".
- The forward trunnion bolt on the right main landing gear sheared upwards as a result of a very high vertical gear load combined with a large "springback" moment.
- The forward trunnion of the right main landing gear was driven upwards and contacted the MLG-to-wing attach fitting, damaging the fitting.
- The rear spar web and caps of the right wing fractured, inboard of the MLG-to-wing attach fitting.
- The inboard upper wing panel of the right wing began to collapse from back to front.
- The outboard (right) wing twisted significantly nose down which caused the MLG-to-wing attach fitting to move up, and the main landing gear tires to move aft and outboard.
- The track attached to the inboard flap on the right wing was pried off the rollers that support it at the fuselage side-of-body.
- The inboard flap on the right wing twisted off its outboard hinge support fitting and separated from the aircraft.
- Excessive movement of the right main landing gear and its wing attach fitting imparted large "prying" loads on the side-brace-fitting-to-trapezoidal-panel (S-B-F-T-T-P) joint.
- The right main landing gear fixed brace failed near the S-B-F-T-T-P joint.
- With the side brace failed, large sideloads were introduced to the S-B-F-T-T-P joint by the folding side brace.
- The S-B-F-T-T-P joint failed; first the inboard attach bolt fractured, then an outboard section of the outboard trapezoidal panel "split off" releasing the outboard attach bolt and its barrel nut.
- The right main landing gear strut, now released from the fuselage (trap panel), pivoted outboard; the trunnion arms contacted the MLG-to-wing attach fitting. The resulting "short couple" (prying) loads finished separating the landing gear from the attach fitting.
- The right nacelle contacted the runway (at about the same time as the inboard flap was separating the S-B-F-T-T-P joint was failing) and the right wing engine/pylon assembly was twisted off. (The pylon-wing separation appears to have been dominated by side loads applied to the nacelle rather than vertical loads).
- The aircraft began to roll clockwise having lost the integrity of the right wing, yet still carrying enough speed to generate meaningful lift on the left hand wing.
- Failures beyond this point were consequent, are not considered particularly relevant, and were not studied in detail.

5.0 FORWARD TRUNNION BOLT FAILURE

The first structural element thought to have failed in this accident is the forward trunnion bolt, also known as the "zero margin trunnion pin". This bolt is designed to reliably shear at a predetermined load (approximately 1.2 million lbs) and acts as a "fuse" when the main landing gear is subjected to excessive drag loads. Figure 5 shows the location of the zero margin trunnion pin.

When acting as a fuse against excessive drag load the zero margin trunnion pin fails by shearing downwards (i.e. the forward trunnion of the main landing gear moves downward relative to the wing attach fitting). In this accident this bolt failed in the *upwards* direction due to a combination of high landing gear vertical load, and a high "springback" moment. Both the high vertical load and the high "springback" moment were a result of the excessive (18-20 ft/sec) sink rate.

"Spin-up" and "springback" loads occur when an aircraft touches down and the tires are not yet spinning (a normal occurrence). First the runway exerts a drag force ("spin-up") on the tires which starts them spinning and bends the strut aft. As the tires spin up the drag force disappears and the strut "springs

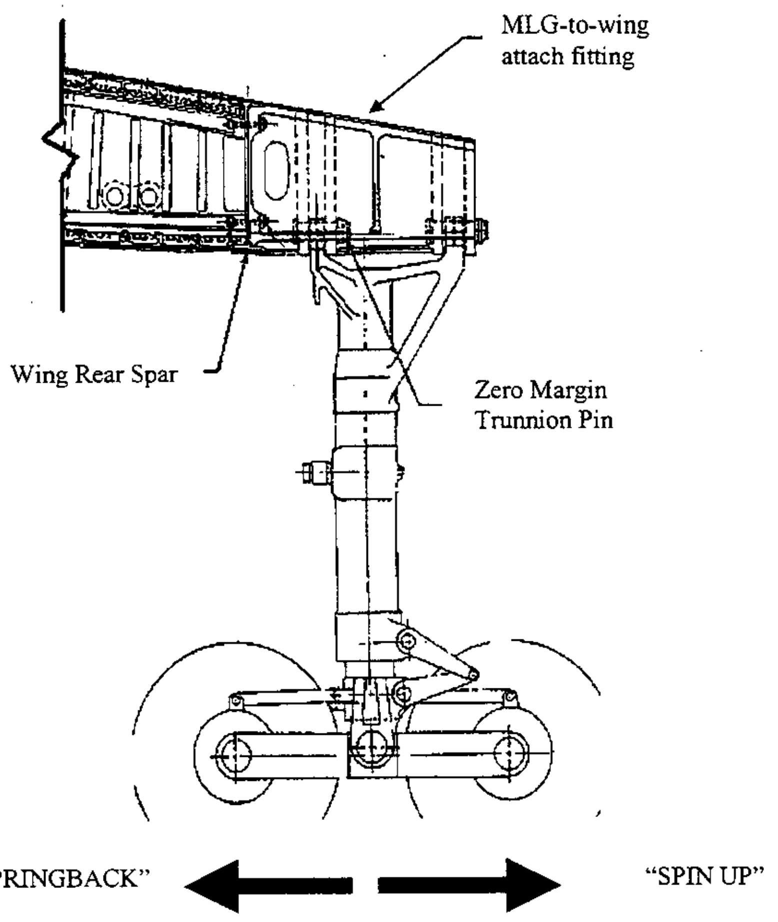


Figure 5. Main-Landing-Gear-to-Wing Attach Arrangement

back" (bending the strut forward). For conditions within the aircraft design range this phenomenon is well known and understood, and analytical tools are available to calculate the associated loads.

As described in Section 3 the spin-up and springback loads for this accident were estimated using B7DC (an in-house aircraft dynamic landing program). When the estimated springback loads were combined with the vertical loads predicted for a 20 ft/sec touchdown, it was shown that a 1.2 million lb load on the forward trunnion bolt was within the feasible range.

It should be noted that the structural loads presented in Section 3 are estimates and are based on analytical extrapolation in to a regime for which we have little or no data to establish correlation. In fact we believe the springback moment obtained from B7DC is probably underestimated.

The results of the metallurgical examination of the forward trunnion bolt are presented in the Boeing Materials and Process Engineering Report (Reference 2) in Section 4.5.2. The findings are consistent with the theory that the forward trunnion bolt failed as the forward trunnion of the main landing gear was moving upwards relative to the wing attach fitting. This relative motion is most evident in Figure 38 of Reference 2, which shows how the aft portion of the bolt is bent down.

Note that the bolt failed at the forward zero-margin groove. The bolt is loaded in double-shear; there are zero-margin grooves at both shear interfaces.

6.0 DAMAGE TO THE MAIN-LANDING-GEAR-TO-WING ATTACH FITTING

After shearing the forward trunnion bolt at the forward zero-margin groove, the forward trunnion of the right main landing gear was driven upwards and contacted the wing attach fitting, damaging the fitting. This is clearly evident in a photograph taken at the crash site (Figure 6) and in Figures 34 and 35 of the Materials and Process Engineering Report (Reference 2).

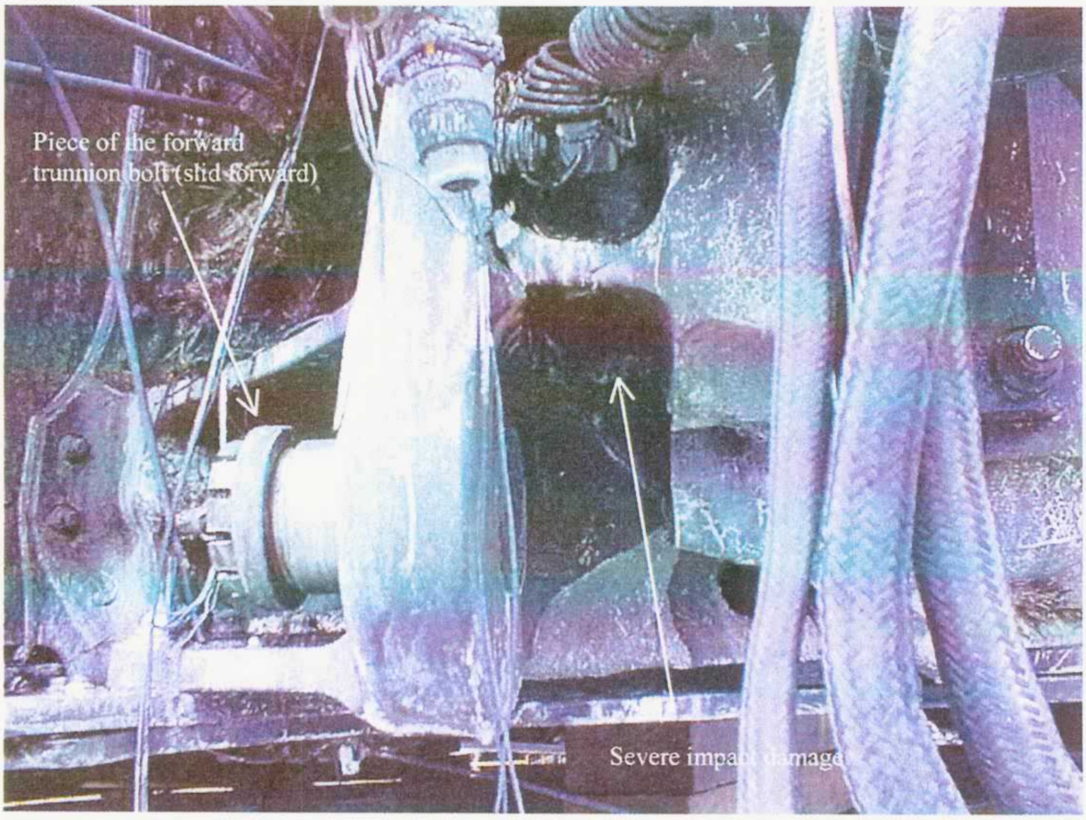


Figure 6. Damage to MLG-to-Wing Attach Fitting at the forward lugs

7.0 REAR SPAR FAILURE

With the forward trunnion bolt sheared, and the forward trunnion of the right main landing gear jammed upwards into the wing attach fitting, the vertical load on the gear was driven into the wing rear spar. Both rear spar webs fractured (in this area the web is doubled for failsafe reasons), along with the upper and lower rear spar caps. The rear spar web fractures were oriented roughly 45 degrees relative to the spar caps, as is typical of shear overload of a beam web.

The rear spar web was identified as the first structural element thought to have failed in the FedEx accident that occurred in Newark, New Jersey on August 31st, 1997. A significant amount of analysis was conducted to validate the FedEx failure sequence, so this failure mode was quickly recognized when the wreckage of the China Airlines aircraft was examined.

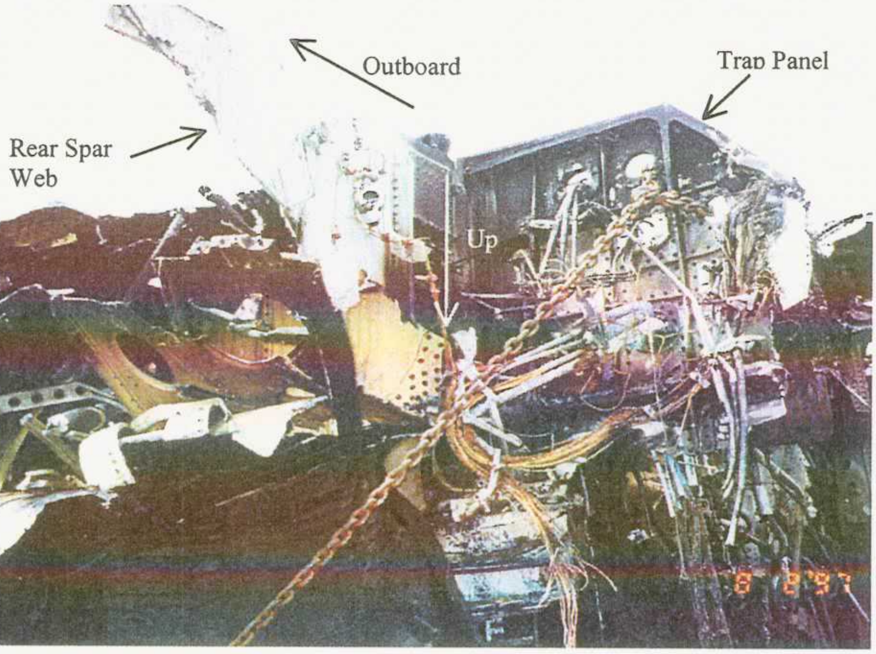


Figure 7. Right Wing Rear Spar Web Fracture from Ship 553 (FedEx - Newark)

A photograph of the FedEx aircraft showing the right wing rear spar web fracture is included as Figure 7. Note that the aircraft is inverted in this photograph.

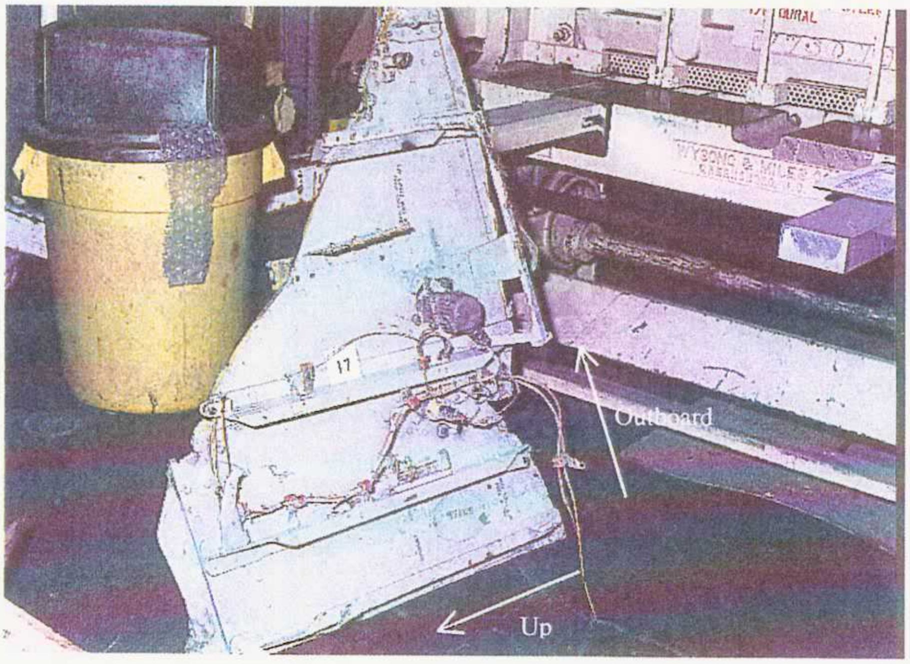


Figure 8. Right Wing Rear Spar Web Fracture from Ship 518 (China Airlines)

A lab photograph of the right wing rear spar web which was cut from the China Airlines aircraft is included as Figure 8. When examined closely it was observed that the rear spar web fractures from the two accidents occurred at almost identical locations.

8.0 INBOARD FLAP DEPARTURE

The inboard flap is located just aft of the main landing gear (Figure 9) and is supported at its inboard end by a track/roller arrangement (Figure 10) and at its outboard end by a simple hinge (Figure 11). The track is mounted on the flap and the rollers on the fuselage (Figures 12 and 13). The outboard hinge is supported off the wing rear spar.

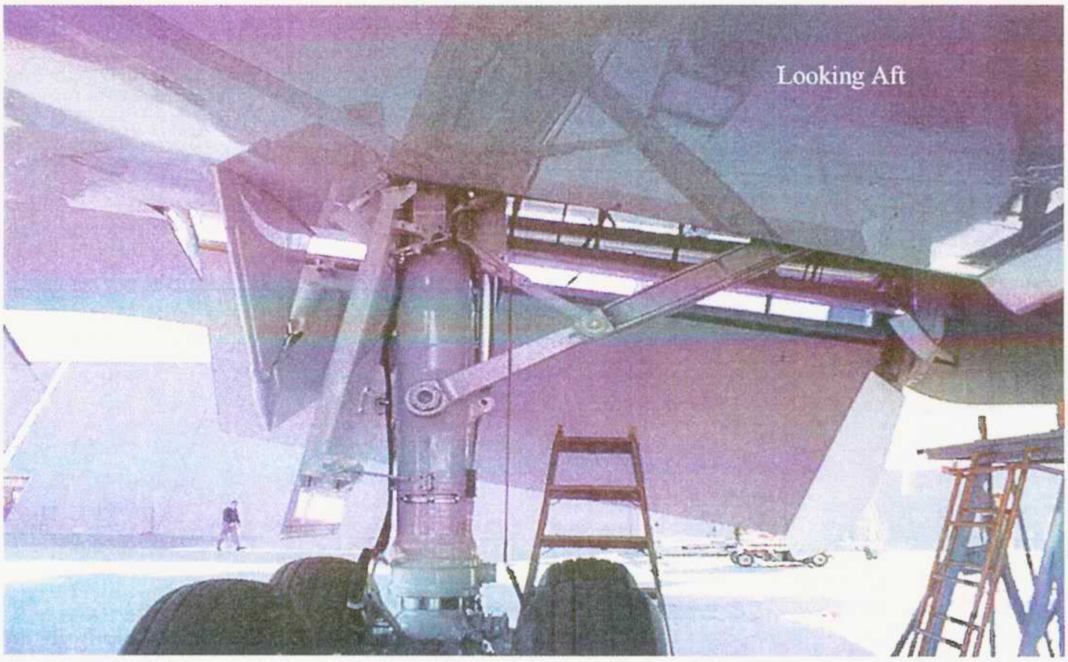


Figure 9. Inboard Flap (Location relative to MLG)

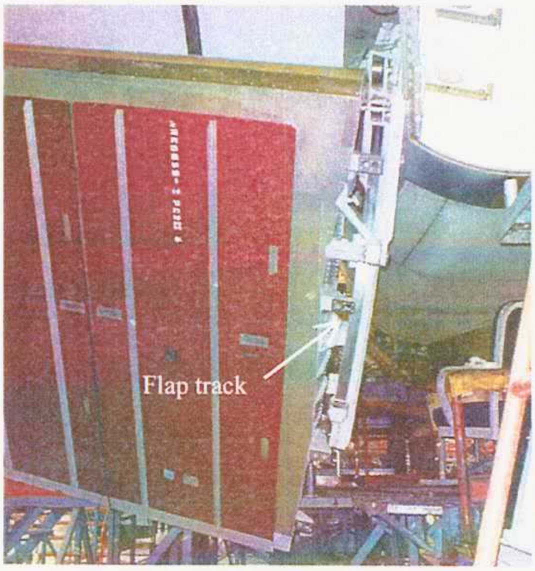


Figure 10. Inboard Flap inboard support

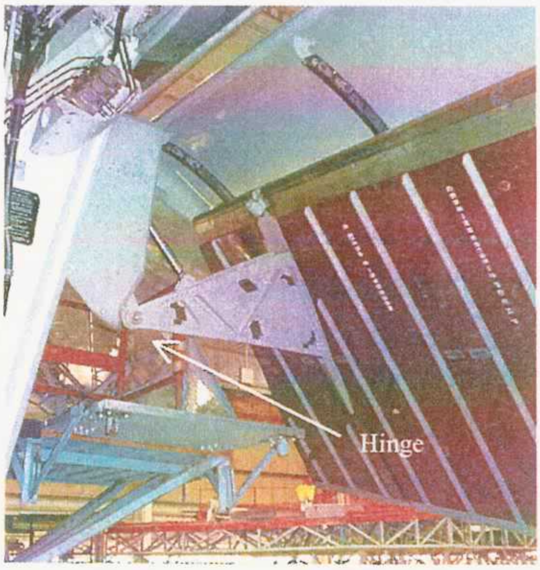


Figure 11. Inboard Flap outboard support

The flap track is an I-beam with return lips on the inboard legs of the two caps. The upper "lip" is captured by three side rollers which limit the outboard motion of the flap track (Figures 13 and 14).

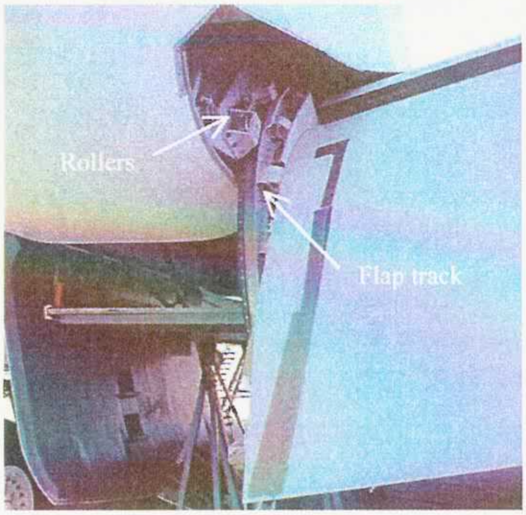


Figure 12. Inboard Flap track and rollers

Figure 13. Inboard Flap rollers (flap removed)

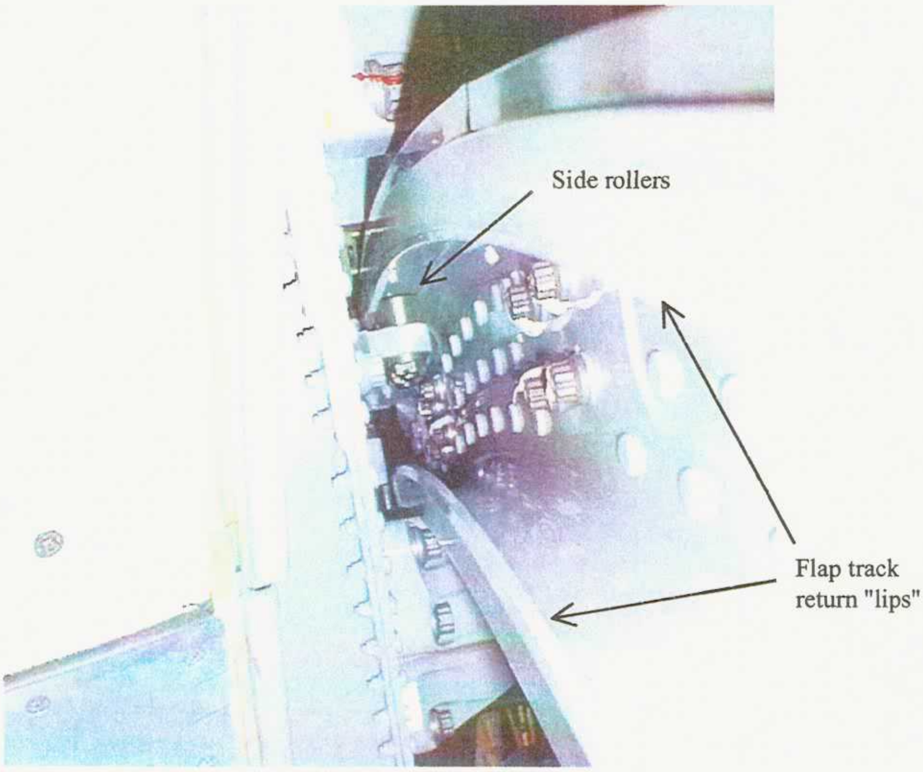


Figure 14. Inboard flap track and side rollers

With the aircraft structurally intact the nominal side loads (inboard-outboard) are small as is evident by the relative size of the side rollers.

Continuing the failure sequence of the China Airlines accident, fractures of the wing rear spar webs, and of the upper and lower spar caps destroyed the integrity of the right wing as a "box structure" resulting in very large relative displacements between the inboard flap's inboard support (mounted to the fuselage) and its outboard support (mounted to the wing, outboard of the landing gear). This relative movement effectively pried the flap track off its roller support system. Once the inboard end became unsupported, the flap easily twisted off its outboard hinge, separating at the tension bolts where the aft hinge attaches to the flap box.

As was the case for the wing rear spar failure mode, there are some observed similarities in the FedEx and China Airlines inboard flap failures. Both inboard flaps were found near the beginning of the debris field, were relatively intact (having almost no lower surface damage), and evidenced local shear-out failures of the flap track lips at the side roller locations.

The China Airlines inboard flap was found off to the left of the runway and is thought to have been carried there by the crosswind (which was blowing right-to-left) after it departed the aircraft. The flap, as it was found, is pictured in Figure 15. The FedEx inboard flap was found on a taxiway to the right of the runway (Figure 16); note there was little or no crosswind present when the FedEx accident occurred.

Figure 15. Right Inboard Flap from Ship 518 (China Airlines)

Figure 16. Right Inboard Flap from Ship 553 (FedEx - Newark)

It is viewed as significant that the lower surfaces of these flaps suffered no significant damage. The inboard flap would have been directly in the path of the main landing gear had the gear separated before the flap and would have been badly damaged. It is clear then, that the main landing gear did *not* "knock" the inboard flap off the aircraft.

The local shear-out failure of the flap track is evident in a photograph taken at the accident site (Figure 17). The location of this failure is consistent with the position of the side rollers for the reported flap setting of 35 degrees. The same type of failure is observed in the photograph of the inboard flap from the FedEx-Newark aircraft (Figure 18); in this case the failure location is consistent with the reported flap setting of 50 degrees.

Figure 17. Right Inboard Flap track from Ship 518 (China Airlines)

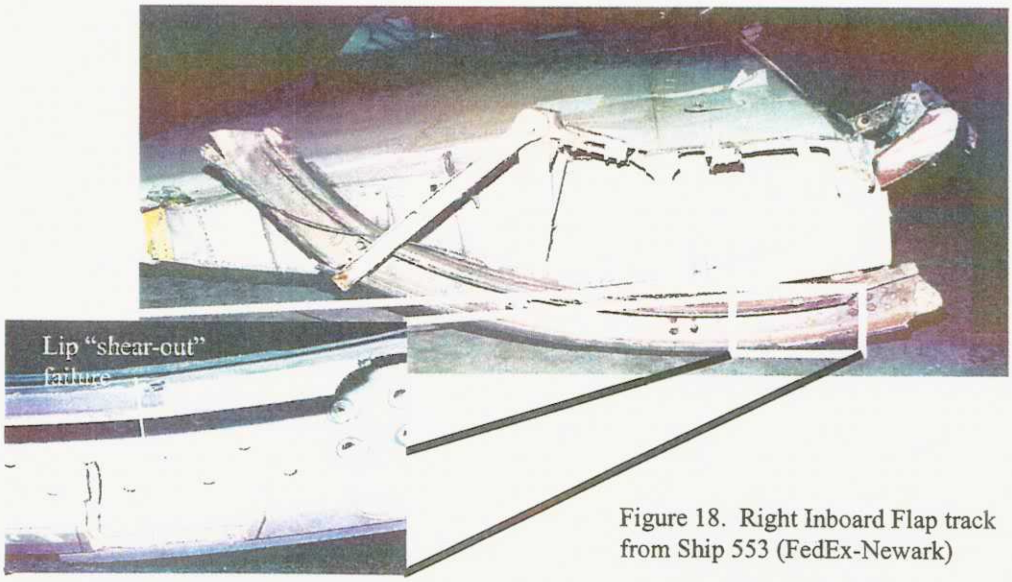


Figure 18. Right Inboard Flap track from Ship 553 (FedEx-Newark)

9.0 DAMAGE TO SIDE-BRACE-FITTING-TO-TRAP-PANEL JOINT AND TO THE FIXED AND FOLDING SIDE BRACES

The location of the side-brace-fitting-to-trap-panel (S-B-F-T-T-P) joint is highlighted in Figure 19. A photograph of a this area (taken from inside the landing gear wheel well) in included as Figure 20 along with a sketch of the joint (with the fixed and folding side braces removed).

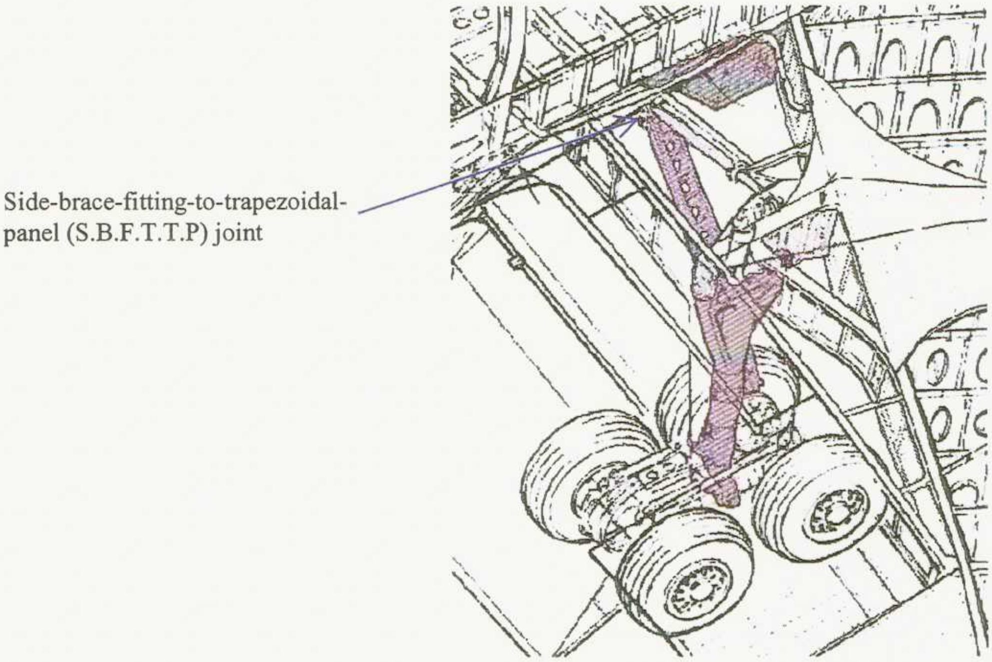


Figure 19. Location of the side-brace-fitting-to-trap-panel joint

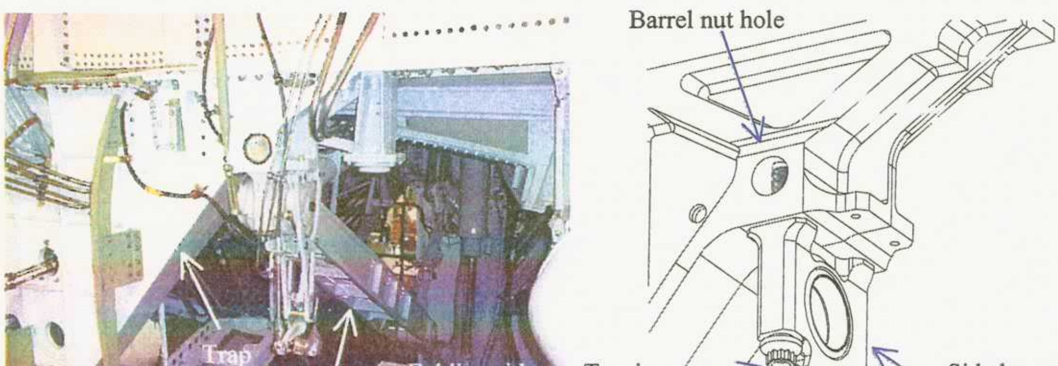


Figure 20. Side-brace-fitting-to-trap-panel joint (from inside the right wheel well)

The fixed brace and folding side brace are connected to one another and to the side brace fitting via a large pin. The side brace fitting is attached to the trap panel with two long tension bolts and mating barrel nuts. As discussed in Section 1.0 this joint is designed to take primarily vertical loads; the fore-and-aft and inboard/outboard loads are nominally small.

As was the case for the for inboard flap's departure, the damage to the S-B-F-T-T-P joint was the result of large relative displacements between attach points on the wing and on the fuselage. After the right wing rear spar failed, the MLG-to-wing attach fitting moved up (relative to the fuselage) and the outboard wing twisted severely nose-down. This motion effectively tilted the truss formed by the MLG strut, and the fixed and folding side braces, and applied a nose-down twist to the S-B-F-T-T-P joint. This applied twist rocked the side brace fitting (bottom-end-aft) and resulted in "impressions" on the lower surface of the trap panel (Figure 21). Similar impressions were observed on the underside of the trap panel from the FedEx-Newark accident aircraft.

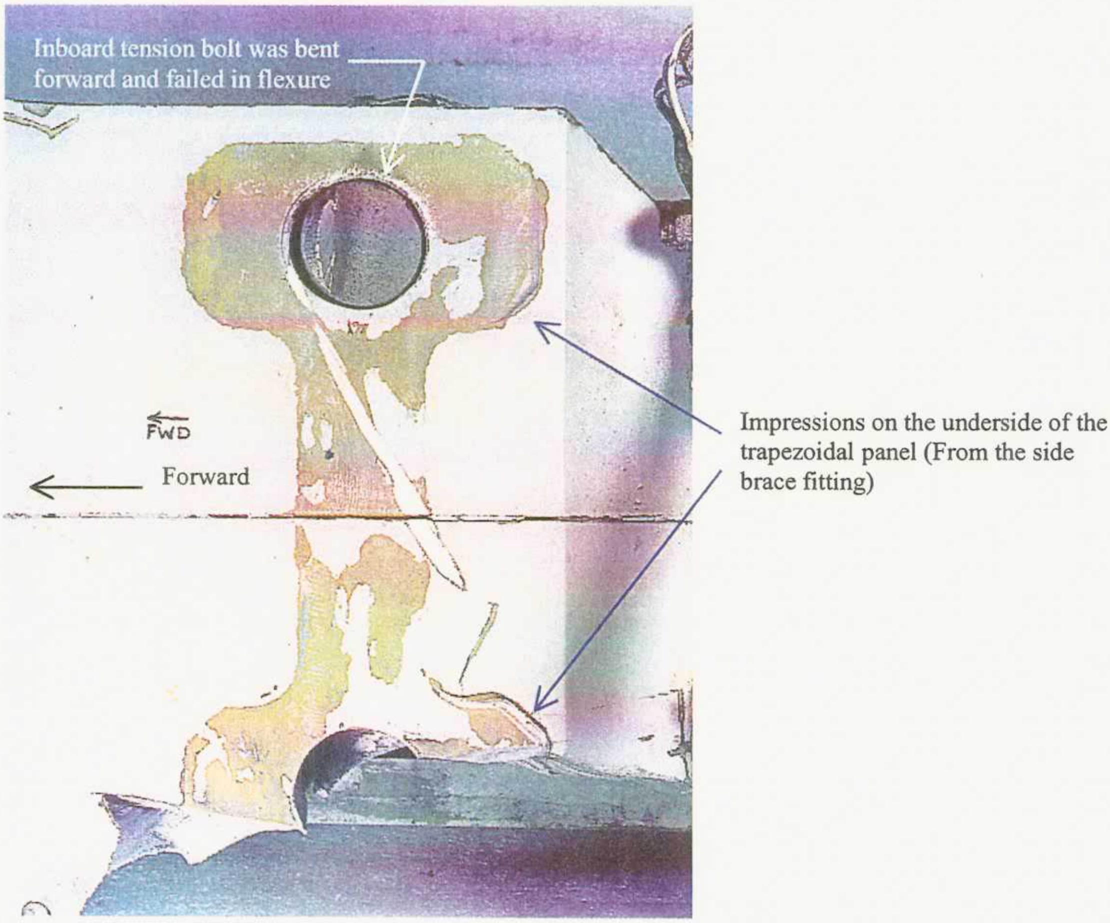


Figure 21. Underside of the right trapezoidal panel

Figure 22 is another photograph of the S-B-F-T-T-P joint area. The photograph is annotated to point out the limited clearance between the clevis end of the fixed brace and the side brace fitting. Excessive upward motion of the outboard end of the fixed brace (which is connected to the MLG-to-wing attach fitting) results in contact in the noted area, and creates a "short couple" prying load at the joint. Evidence of contact in this area for parts taken from the China Airlines accident aircraft is seen in Figure 23. Similar evidence was also noted for the FedEx-Newark accident aircraft.

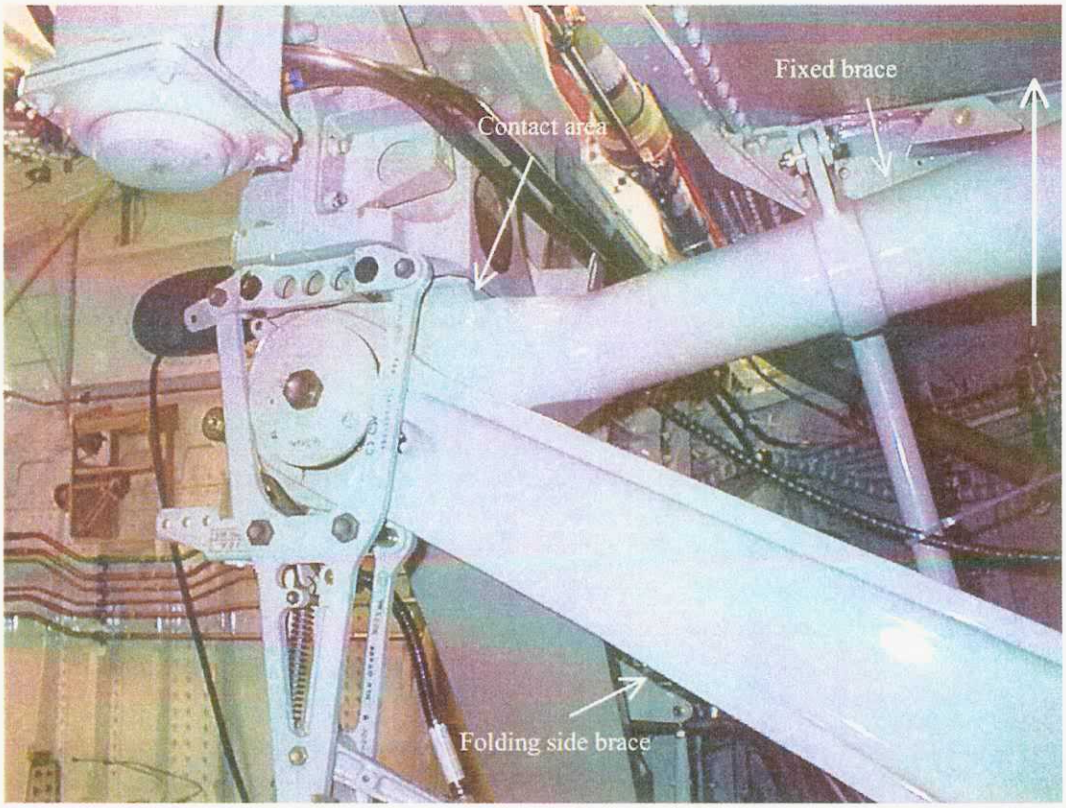


Figure 22. Side-brace-fitting-to-trap-panel joint (from aft and outside the right wheel well)

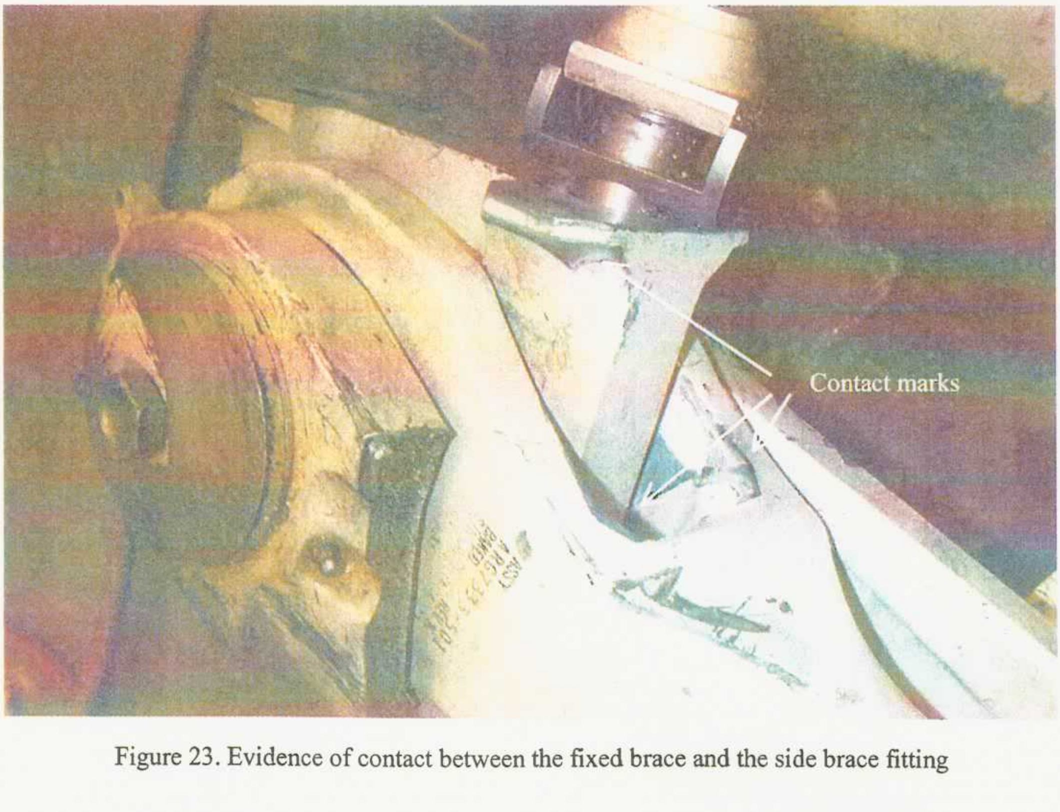


Figure 23. Evidence of contact between the fixed brace and the side brace fitting

The presence of a large prying load at the S-B-F-T-T-P joint results in severe distress to this joint. This manifests itself as localized high bending (flexure) at the outboard end of the fixed brace, and a large tension load on the inboard of the two tension bolts attaching the side brace fitting to the trap panel. Evidence of flexural distress of the fixed brace was observed in parts taken from both the China Airlines and FedEx-Newark accident aircraft. The fixed brace from the China Airlines aircraft failed completely (Figure 24). The fixed brace from the FedEx-Newark aircraft was bent and suffered a stress corrosion fracture (Figure 25). The stress corrosion fracture is attributed to residual stress resulting from a high flexural load. Note also in Figure 25 the evidence of local contact with the side brace fitting.

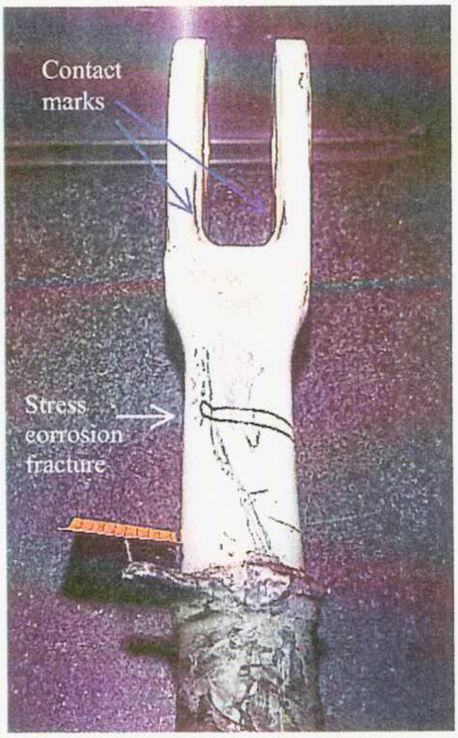


Figure 24. Outboard end of the fixed brace from Ship 518 (China Airlines) [left]
Figure 25. Outboard end of the fixed brace from Ship 553 (FedEx-Newark) [right]

Figure 24 also shows damage to the upper folding side brace. The upper folding side brace is an I-section "laid on its side" with lightening holes in the web (Figure 19). The fixed brace after it failed in flexure, appears to have dropped down into the upward facing "channel" of the I. Relative motion between the outboard wing and the fuselage then appears to have "punched" the inboard end of the fixed brace through the web and aft cap of the upper folding side brace.

The final two failures at the S-B-F-T-T-P joint involve the two tension bolts that attach the side brace fitting to the trap panel, and the trap panel itself. The inboard of the two tension bolts failed in flexure and was bent lower-end-forward (Figure 21 and also Figure 15 of Reference 2). This is thought to have been a consequence of the fixed brace having previously failed, coupled with the lower end of the main landing gear strut moving aft. The folding side brace, acting as a lever, would then apply a twist about the vertical axis of the S-B-F-T-T-P joint. Presuming the outboard tension bolt is acting as a pivot, this would tend to bend the inboard bolt forward.

The outboard tension bolt did not fail. Instead a portion of the outboard face of the trap panel appears to have "split off", releasing the outboard barrel nut and tension bolt (Figure 26). This is thought to have occurred *after* the inboard bolt had failed and appears to have been the result of a prying load applied by the outboard tension bolt, the prying load resulting from the folding side brace pulling outboard on the side brace fitting. (Note the photograph is upside-down relative to the normal position in the aircraft).

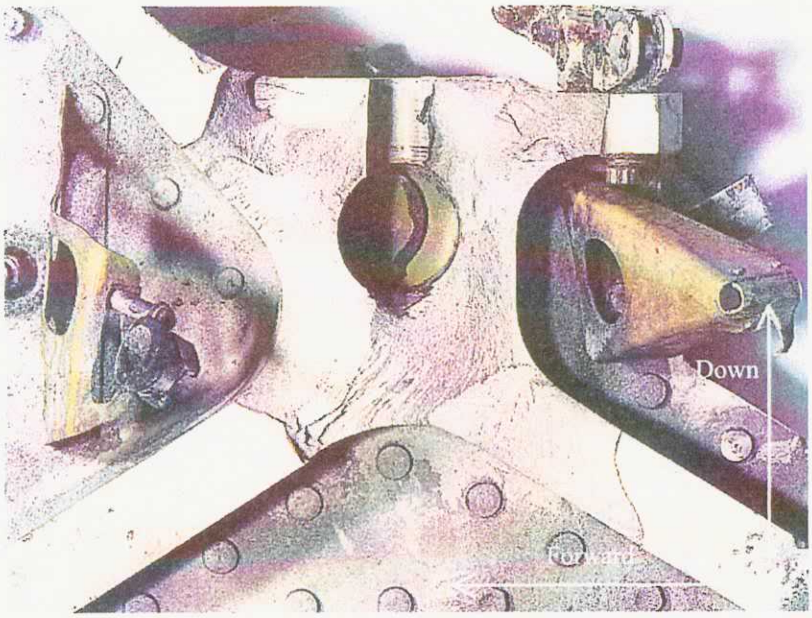


Figure 26. Outboard trap panel failure at the S-B-F-T-T-P joint

10.0 DAMAGE TO THE MAIN LANDING GEAR TRUNNION ARMS AND ADDITIONAL DAMAGE TO THE MLG-TO-WING ATTACH FITTING

There is clear evidence that the right main landing gear strut, once released at the S-B-F-T-T-P joint, rotated outboard and contacted its wing attach fitting. Similar observations were made for the parts from the FedEx-Newark accident aircraft (see Figures 27 and 28). This type of contact creates a "short couple" prying action that easily breaks the gear loose from the fitting.

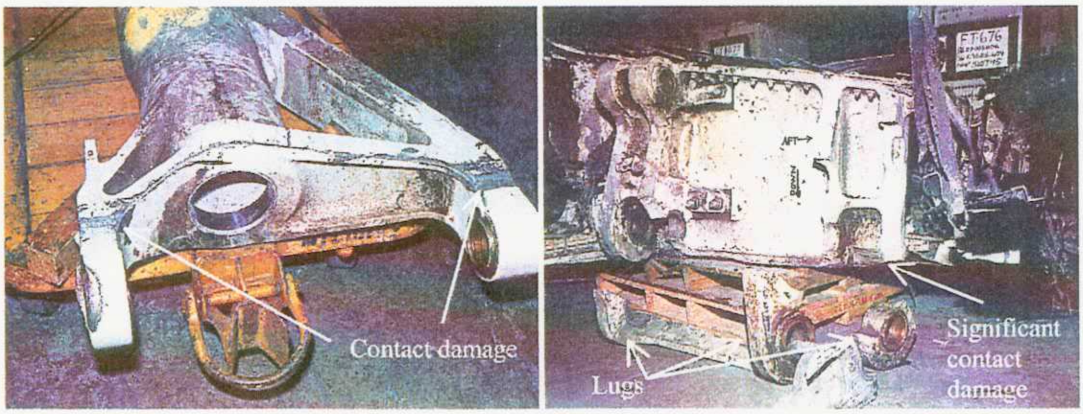


Figure 27. Right main landing gear strut from Ship 553 (FedEx-Newark) [left]
Figure 28. Right MLG-to-wing attach fitting from Ship 553 (FedEx-Newark) [right]

In the case of the China Airlines accident the markings indicating contact between the right main landing gear strut and the wing attach fitting are slightly different (and not quite as clear). This is primarily due to the fact that the forward trunnion connection was partially failed (See Section 5.0) before the strut rotated outboard. The contact area for the forward trunnion was therefore very localized, and quickly resulted in the fracture of the remaining connection (the aft lug). See Figures 29 and 30. The two lugs that support the *aft* trunnion, the fowardmost still connected to a large piece of the wing fitting, also

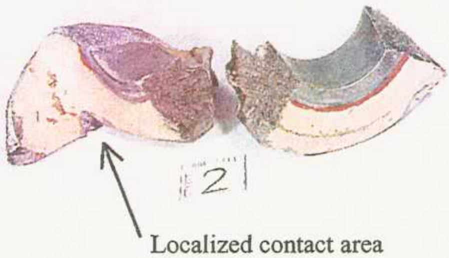


Figure 29. Wing fitting lugs that support the MLG forward trunnion [left]
Figure 30. Separated pieces of the aft wing fitting lugs that support the MLG forward trunnion [right]

cracked off as a result of the gear rotating outboard (Figure 31). This separated the right main landing gear from the aircraft. The contact area on the aft trunnion arm is shown in Figure 32. A photograph of the wing fitting, showing the mating area for the two aft trunnion support lugs, is included as Figure 33.

Figure 31. Right main landing gear assembly

Substantial sidewall abrasion was noted on the inboard sidewall of the aft inboard tire on the right main landing gear truck (Figure 34). This evidence further supports the theory that the gear rotated outboard putting the inboard sidewalls of the inboard tires in contact with the ground.

Figure 32. Aft trunnion arm of the right main landing gear strut [left]
Figure 33. Right MLG-to-wing attach fitting from Ship 518 (China Airlines) [right]

Figure 34. Inboard aft tire from the right main landing gear

11.0 RIGHT HAND WING PYLON FAILURE MODE

Figure 35 illustrates and describes the key elements of the attachment of the engine pylon to the wing. Figure 36 shows how the wing engine pylons are designed to "fuse" in the event of a wheels up landing to protect against rupture of the wing fuel tanks.

If the loads acting on the nacelle are primarily upwards, the engine pylon's aft attach bulkhead is designed to break at the top of the monoball housing, freeing the back end of the pylon and allowing the engine/nacelle to tilt up and act as a "ski". This failure mode has been verified by testing and validated in a number of in-service incidents. (As a point of reference, this *was* the observed failure mode for the right engine pylon from the FedEx-Newark accident).

Figure 37 shows that the right pylon failure mode was different for the China Airlines accident aircraft; the right engine pylon aft-attach bulkhead is still attached to the right wing. Figure 38 shows the right engine pylon. The observed failures suggest that the loads on the nacelle included a significant sideways component. This is thought to have occurred because the outboard wing, as the failure progressed, began to sweep further and further aft.

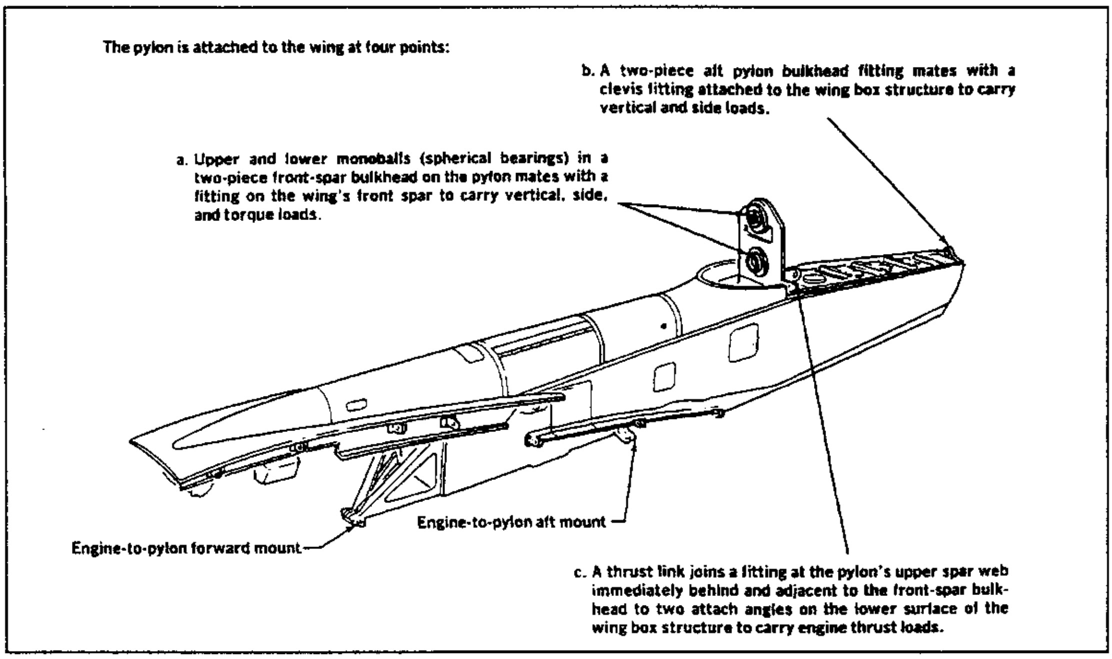


Figure 35. Pylon-to-wing attachment details

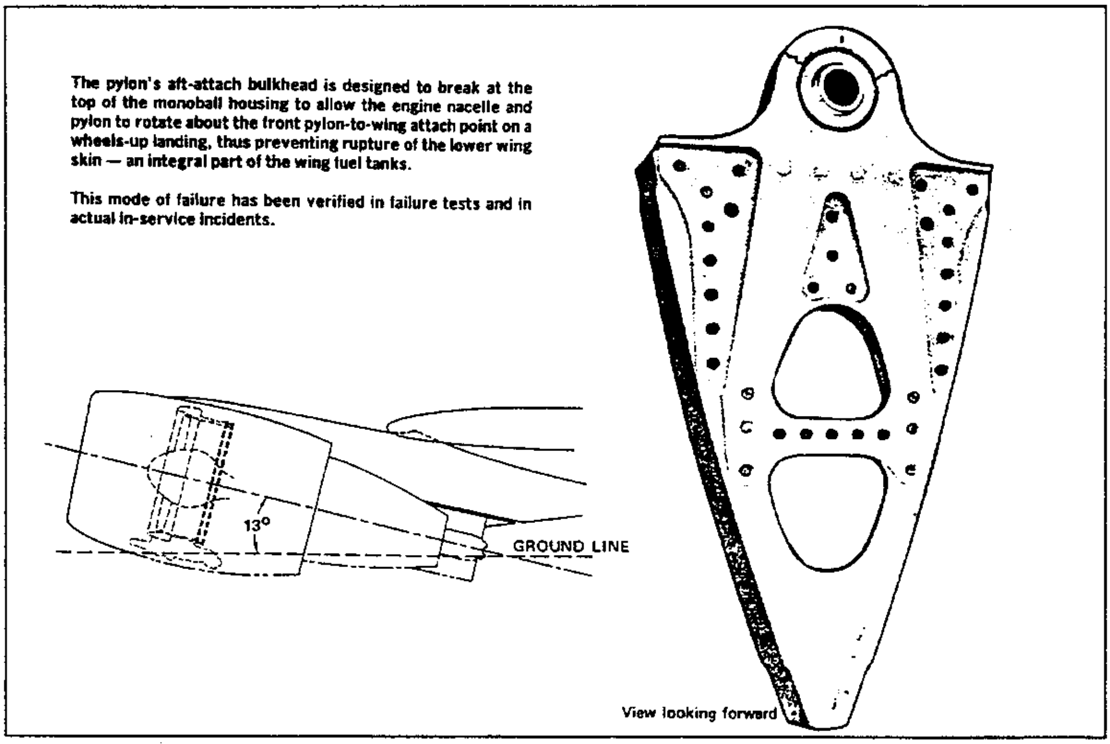


Figure 36. Wing pylon "fusing" mechanism

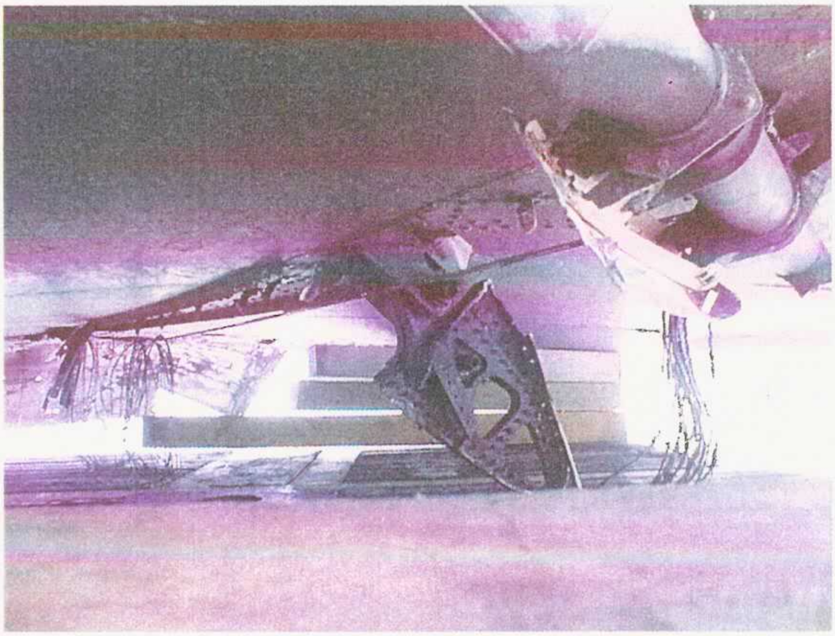


Figure 37. Right engine pylon aft-attach bulkhead still attached to the right wing

Figure 38. Right engine pylon

12.0 SUMMARY

Analysis was conducted to attempt to understand the structural failure sequence, failure modes, and failure characteristics of the accident aircraft. The analysis included primarily the review and examination of failed parts and photographs from the accident site, along with a limited amount of dynamic loads analysis using parameters taken from the Flight Data Recorder.

The analysis has produced a definition of a failure sequence that is reasonable and appears to have no significant inconsistencies with the accident observations.

The failure appears to have initiated with the forward trunnion bolt of the right hand landing gear (the trunnion shearing upwards) closely followed by failures of the inboard right wing rear spar webs and caps. These failures were the result of an extremely high vertical load and an associated "springback moment" applied to the right main landing gear. Both the high vertical load and the high "springback moment" were a result of the excessive (18-20 ft/sec) sink rate, and the slightly rolled (3 degrees right-wing-down) touchdown attitude.

民航處 *Civil Aviation Department*
飛行標準及適航部 Flight Standards and Airworthiness Division

香港赤鱲角駿運路 2 號機場空運中心商業大樓十樓
10/F Comm Bldg Airport Freight Forwarding Centre 2 Chun Wan Road Lantau Hong Kong

INVESTIGATION OF CAL 642 ACCIDENT ON 22 AUGUST 1999

TEST REPORT ON CAPTAIN'S WIPER MOTOR & ELECRICAL CIRCUIT COMPONENTS

Test Requirement:-	Minutes of Accident Investigation Team Meeting dated 11 January 2000 Meeting Note item 6. a.
Location of Test:-	Electrical Workshop 2110 at the HAECO Component Overhaul Facility at Tseung Kwan O (TKO)
Date of Test:-	17th February 2000
Test Witnesses:-	C M Lee – Inspector of Accident, HKCAD K W Lau – HAECO QA Head of Section, TKO
Items Tested:-	Wiper Motor and Drive Assembly (Captains Position) Vendor - Rosemount Aerospace Inc, USA P/N 2313M-537 S/N 00097
	15 AMP Main Power Supply Circuit Breaker (Captains wiper) Vendor – Jackson Inc, USA P/N 700-030-15, (700-066-15) (76374-9137) S/N None visible
	5 AMP Wiper Control Power Supply Circuit Breaker (Captains wiper) Vendor – Jackson Inc, USE P/N 8500-005-5 (76374-9151) S/N None visible
	Captain's Wiper Control Switch Vendor – Cole, USA P/N 200-3061 S/N None visible

1. Testing Method and Considerations

All components were checked for any obvious damage prior to testing, none was evident. All components had been removed from the subject aircraft by HAECO. The wiper motor had been removed intact, together with attachment hardware. However, the circuit breakers (CBs) and control switch had been removed by the release of the attachment feature and the cutting of the associated circuit wiring. Therefore, the testing which was possible was applied to each separate unit/item, and not the physical circuit installed upon the subject aircraft. Although HAECO was nominated and willing to accomplish the testing, they do not hold specific maintenance approval for the MD-11 Wiper Motor, which being classified as a rotable component, would normally be tested and serviced in accordance with an approved Component Maintenance Manual (CMM). On the other hand, the CBs and Control Switch being of a consumable design, would not normally be the subject of overhaul and repair. Therefore, the scope of the testing was done on the basis that HAECO were not approved for these components, but possessed enough experience and knowledge to apply basic testing techniques. In addition to this, consideration must be given to the fact that unit specifications or CMM's were not to hand. On this basis, best practice was applied to the rudimentary scope of the testing that was possible. All test power was applied in accordance with MD-11 wiring diagrams, reference 30-43-01 supplied by China Airlines.

2 Unit Testing and Results

2.1 Wiper Motor Assembly

2.1.1 This unit was tested to establish the correct operation of the following features:

i) Operation of the drive motor.
ii) Operation of drive brake.
iii) Functioning of parking switch circuit.

2.1.2 Witnessed operation of main drive motor:

i) The unit ran smoothly without undue noise or vibration.
ii) No load current draw at low speed was 5 amps.
iii) No load current draw at high speed was 7.5 amps.
iv) The output shaft to the wiper arm was witnessed to rotate back and forth in an arc of approximately 30 degrees.
v) The unit brake released when power was applied, and had a circuit resistance of 60 ohms.
vi) The wiper parking system interrupter switch was tested during motor operation and found to make and break as would be expected.

It was not possible to apply any representative working load to this unit while running due to the fact that no test bench is available at HAECO. Furthermore, the power and size of this unit is such that any additional testing could only be accomplished on a suitable test stand, or alternatively by the unit being temporarily installation upon another MD-11 aircraft. As no CMMs, or unit design specifications were available, we are unable to determine how this unit conforms to such data.

2.2 15 AMP Main Power Circuit Breaker

2.2.1 This unit was tested to establish the correct operation of the following features:

i) Ability to sustain a continuously applied current of 15 amps without tripping.
ii) Test the current overload protection of the unit.

2.2.2 Witnessed operation of the 15 amp CB:

i) This unit was able to carry a load of 15 amps for over 2 minutes without tripping.
ii) When tested in overload, a circuit trip occurred after 22 seconds with a load of 30 amps applied.

2.3 5 AMP Control System Power Circuit Breaker

2.3.1 This unit was tested to establish the correct operation of the following features:

i) Ability to sustain a continuously applied current of 5 amps without tripping.
ii) Test the current overload protection of the unit.

2.3.2 Witnessed operation of the 5 amp CB:

i) This unit was able to carry a load of 5 amps for over 2 minutes without tripping.
ii) When tested in overload, a circuit trip occurred after an average elapsed time of 6 to 8 seconds with a load of 10 amps applied.

2.4 Captains Wiper Control Switch

2.4.1 This unit was tested to establish the correct operation of the following features:

i) The switch rotated to all three detented positions.
ii) Basic circuit electrical resistance and continuity test across all six contact positions.
iii) Basic electrical insulation/leakage test of all terminal to switch the body (aircraft electrical grounding plane).

2.4.2 Witnessed results of the above switch tests:

i) The switch rotated with positive detents at three positions corresponding to OFF, LOW and HIGH.
ii) The resistance check applied to all switch contact positions produced the following results:

Across the "A" Contacts
C-1 = 1.2 ohms, C-2 = 2.2 ohms and C-3 = 1.5 ohms

Across the "B" Contacts
C-1 = 2.2 ohms, C-2 = 2.8 ohms and C-3 = 1.6 ohms

iii) The insulation tests applied to all of the "A" and "B" contacts to the unit body, resulted in an infinity ohmic resistance being achieved, indicating no circuit electrical breakdown.

3. Conclusion

In view of the limited amount of test and specification data to hand for these units, it is not possible to make comprehensive operation statements. However, from the witnessed rudimentary test results, and the condition of the subject components, there is nothing to suggest that they would not be able to operate and function, as designed.

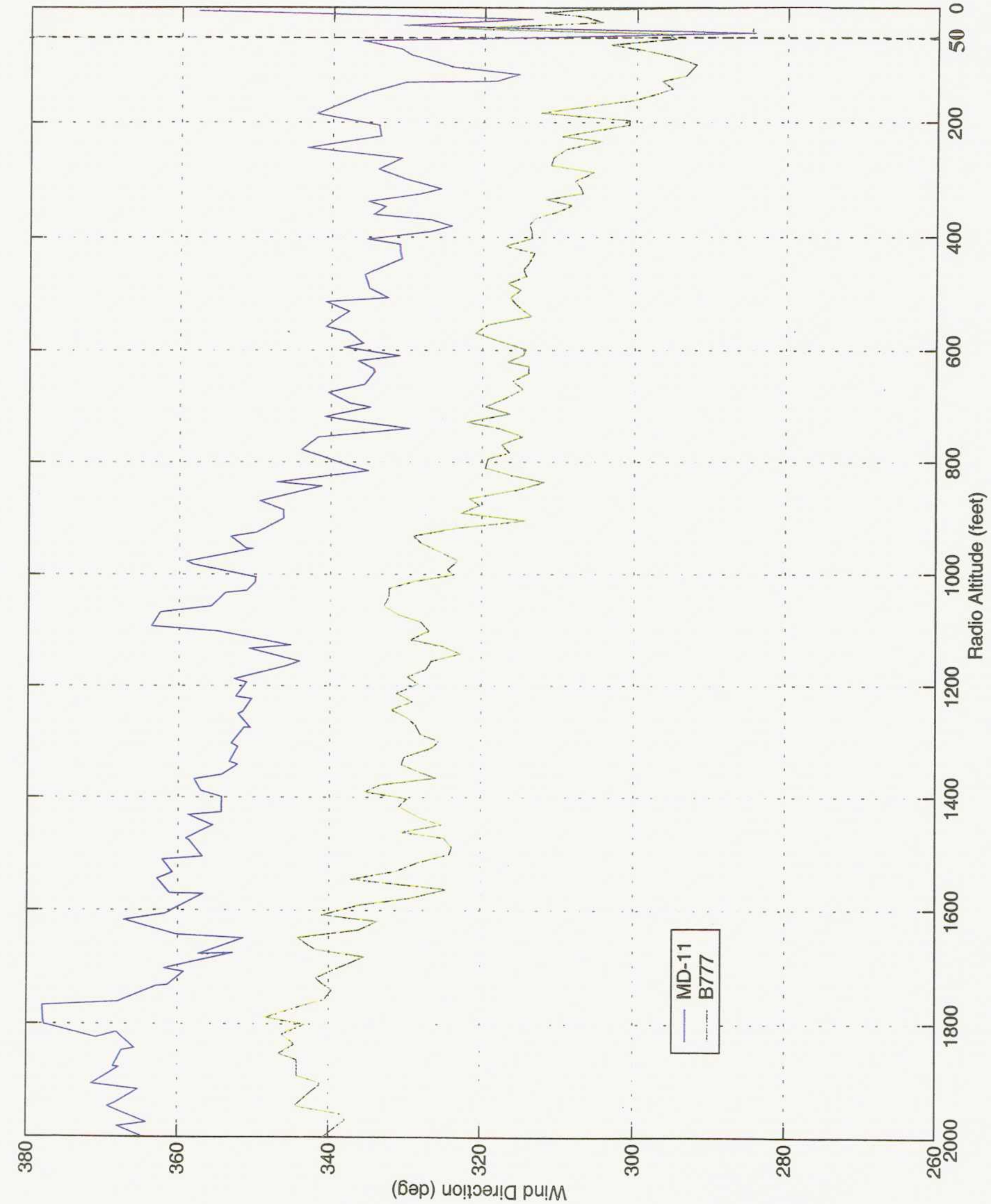
This witness test report was raised and presented by;

C M Lee - Inspector of Accident Signed:- [signature] Dated:- 18 February 2000

SUMMARY OF APPROACHES
HONG KONG INTERNATIONAL AIRPORT
0657 – 1044 Hours UTC, 22 August 1999

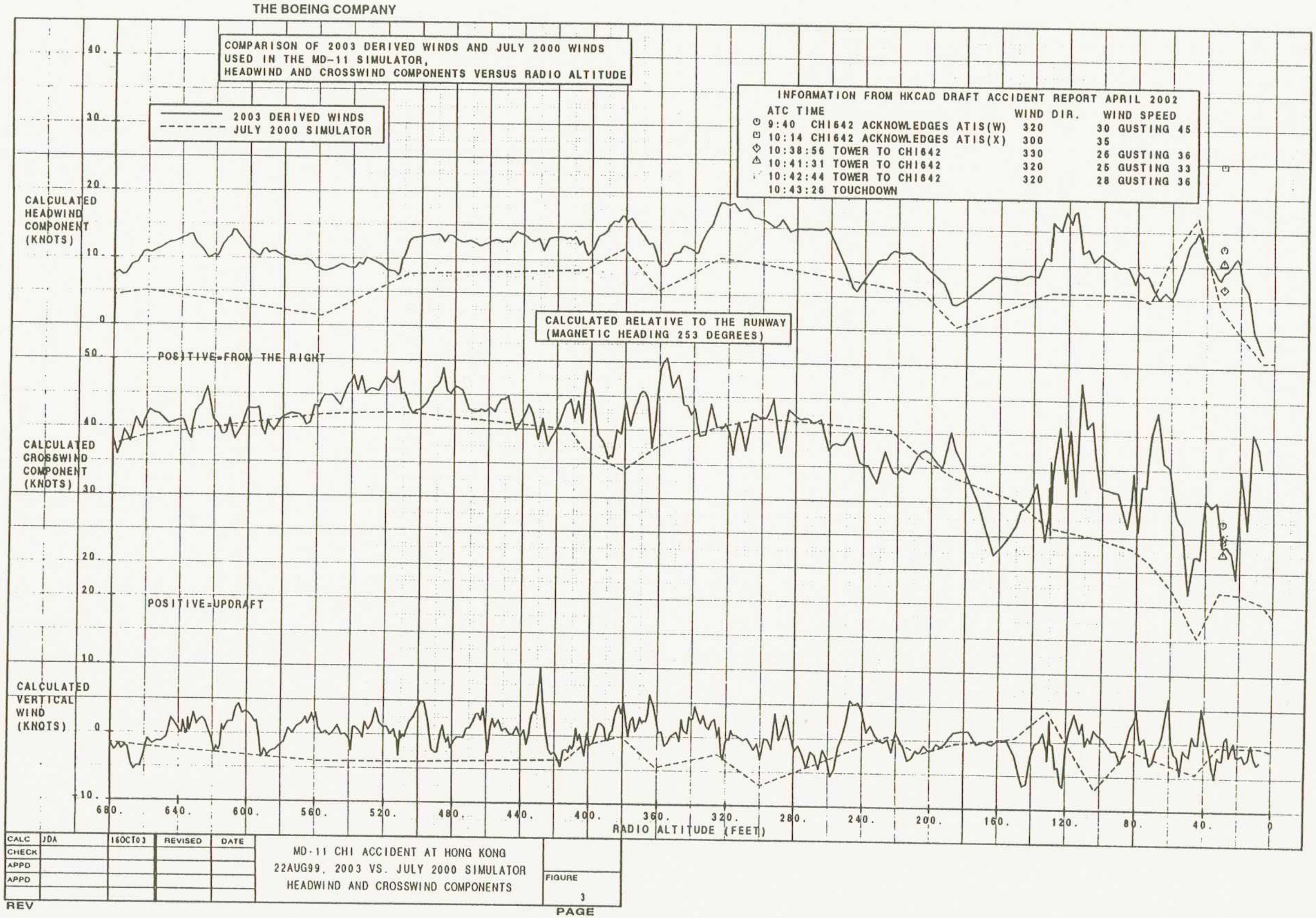
Aircraft type	Landed	Go-around	Comments
Runway in use 07R			
A330		0657	2nd go-around @ 0727
A330	0700		
MD82	0710		
MD11	0716		
A320	0721		
A330		0727	Diverted
A330		0735	Diverted
A330		0742	Diverted
Runway change to 25L			
A340		0818	Diverted
B742		0830	Diverted
B744	0849		
A340		0859	Diverted
B773	0915		
B744		0940	Diverted
A330		0945	2nd approach, landed 1019
B773	0947		
B772	0953		
A330	1002		
A330	1019		
B744	1024		
A340	1029		
B763	1031		
A330		1034	Diverted - airport closed due later accident
B744	1036		
B773	1040		
MD11	1043		Accident flight

COMPARATIVE WIND DATA – MD11 / B777 AIRCRAFT

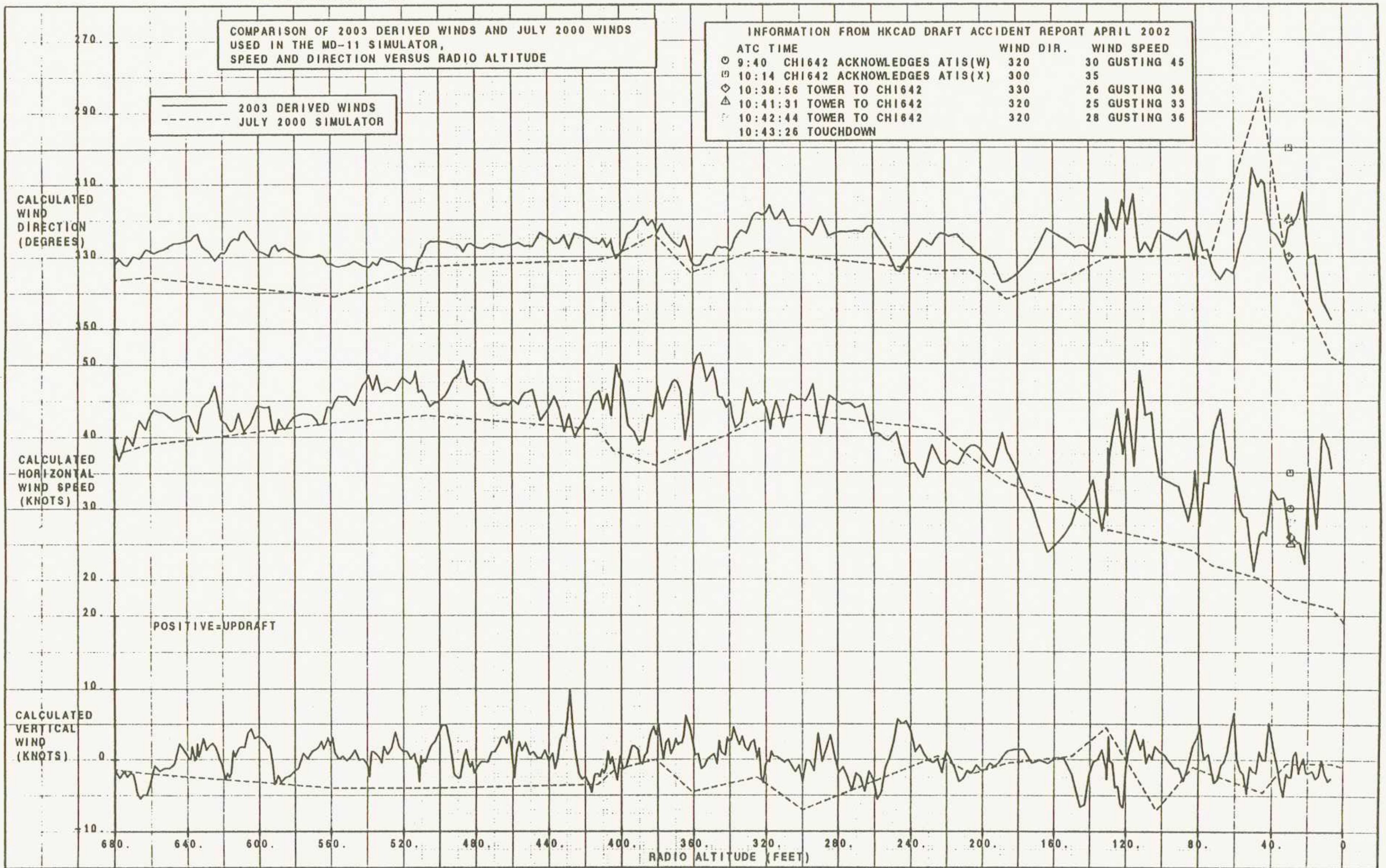


Note : See qualification at Paragraph 1.18.4 of the report regarding accuracy of MD11 wind data below 50 feet RA

Note : See qualification at Paragraph 1.18.4 of the report regarding accuracy of MD11 wind data below 50 feet RA

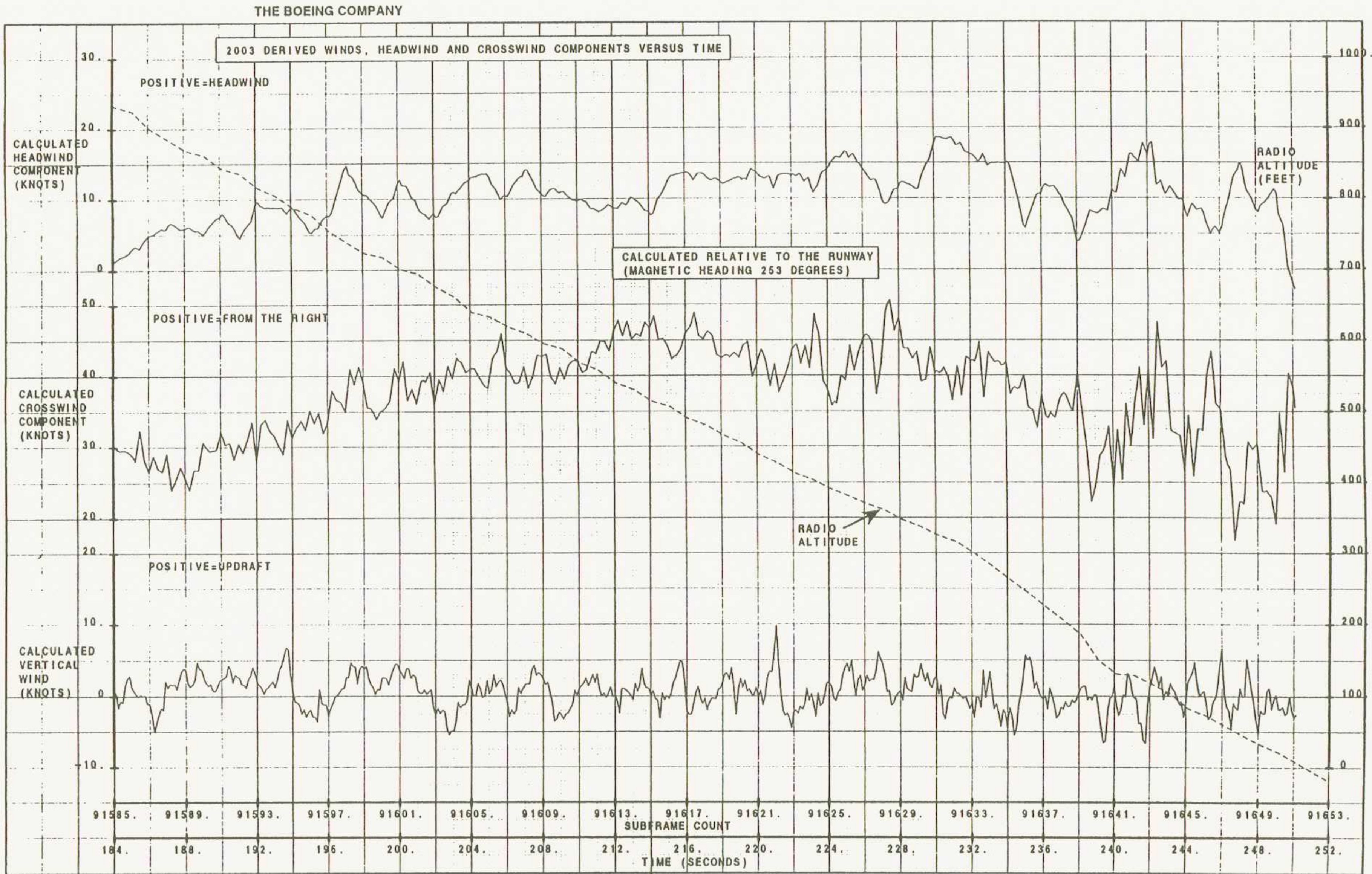

THE BOEING COMPANY
COMPARISON OF 2003 DERIVED WINDS AND JULY 2000 WINDS
USED IN THE MD-11 SIMULATOR,
HEADWIND AND CROSSWIND COMPONENTS VERSUS RADIO ALTITUDE
2003 DERIVED WINDS
JULY 2000 SIMULATOR
INFORMATION FROM HKCAD DRAFT ACCIDENT REPORT APRIL 2002
ATC TIME
WIND DIR.
WIND SPEED
9:40 CHI642 ACKNOWLEDGES ATIS(W) 320 30 GUSTING 45
10:14 CHI642 ACKNOWLEDGES ATIS(X) 300 35
10:38:56 TOWER TO CHI642 330 26 GUSTING 36
10:41:31 TOWER TO CHI642 320 25 GUSTING 33
10:42:44 TOWER TO CHI642 320 28 GUSTING 36
10:43:26 TOUCHDOWN
CALCULATED HEADWIND COMPONENT (KNOTS)
CALCULATED RELATIVE TO THE RUNWAY
(MAGNETIC HEADING 253 DEGREES)
POSITIVE=FROM THE RIGHT
CALCULATED CROSSWIND COMPONENT (KNOTS)
POSITIVE=UPDRAFT
CALCULATED VERTICAL WIND (KNOTS)
RADIO ALTITUDE (FEET)
CALC JDA 16OCT03
CHECK
APPD
APPD
REVISED
DATE
REV
MD-11 CHI ACCIDENT AT HONG KONG
22AUG99, 2003 VS. JULY 2000 SIMULATOR
HEADWIND AND CROSSWIND COMPONENTS
FIGURE
3
PAGE

THE BOEING COMPANY



CALC	JDA	22OCT03	REVISED	DATE	MD-11 CHI ACCIDENT AT HONG KONG 22AUG99, 2003 VS. JULY 2000 SIMULATOR WIND SPEED AND DIRECTION	FIGURE 2
CHECK						
APPD						
APPD						

REV PAGE



CALC	JDA	06OCT03	REVISED	DATE	MD-11 CHI ACCIDENT AT HONG KONG 22AUG99, 2003 DERIVED WINDS HEADWIND AND CROSSWIND VS. TIME	APPENDIX A
CHECK						FIGURE
APPD						A-1
APPD						

REV

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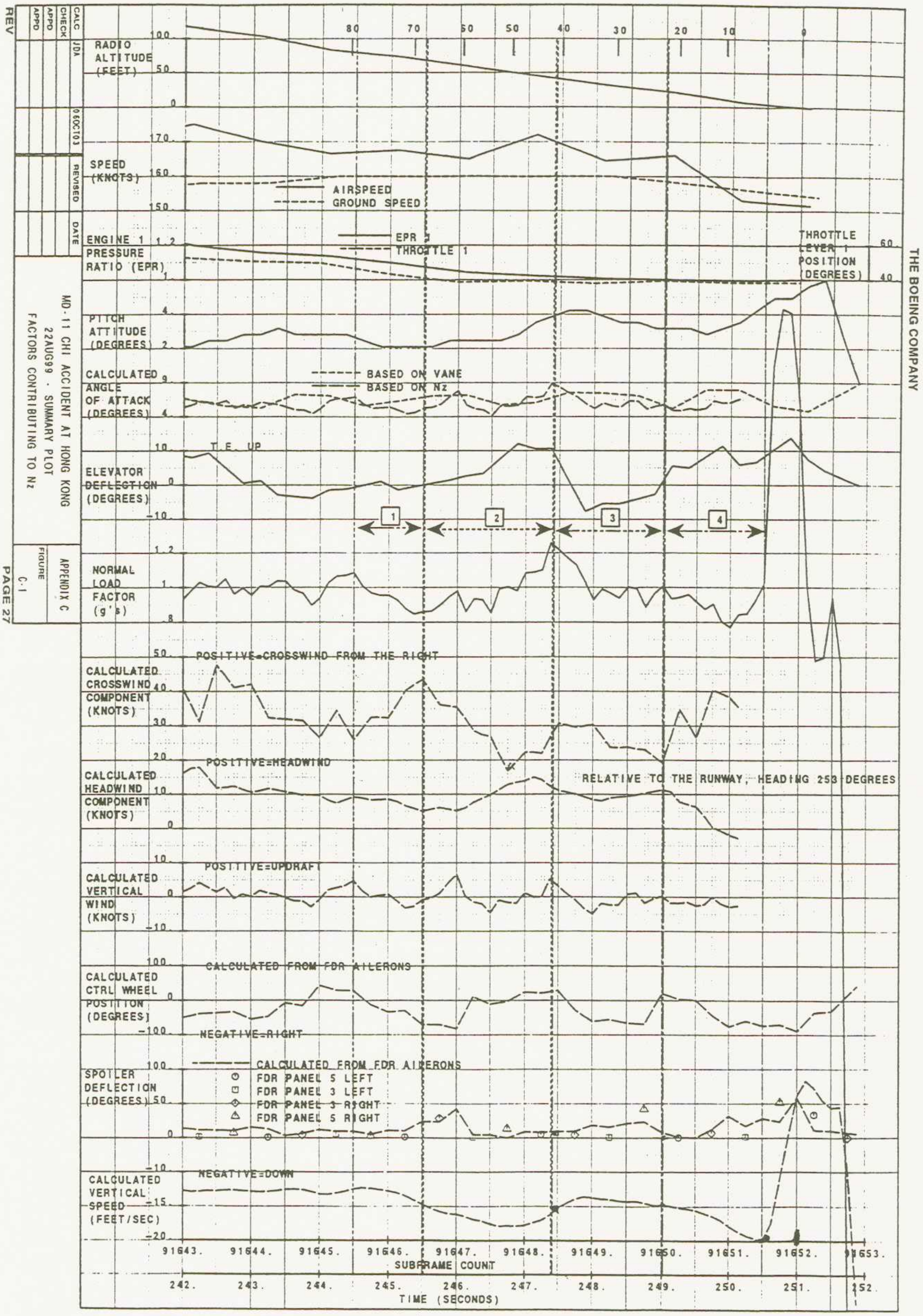

RADIO ALTITUDE (FEET)
SPEED (KNOTS)
AIRSPEED
GROUND SPEED
ENGINE 1 PRESSURE RATIO (EPR)
EPR
THROTTLE 1
THROTTLE LEVER 1 POSITION (DEGREES)
PITCH ATTITUDE (DEGREES)
CALCULATED ANGLE OF ATTACK (DEGREES)
BASED ON VANE
BASED ON Nz
ELEVATOR DEFLECTION (DEGREES)
T.E. UP
NORMAL LOAD FACTOR (g's)
CALCULATED CROSSWIND COMPONENT (KNOTS)
POSITIVE=CROSSWIND FROM THE RIGHT
CALCULATED HEADWIND COMPONENT (KNOTS)
POSITIVE=HEADWIND
RELATIVE TO THE RUNWAY, HEADING 253 DEGREES
CALCULATED VERTICAL WIND (KNOTS)
POSITIVE=UPDRAFT
CALCULATED CTRL WHEEL POSITION (DEGREES)
CALCULATED FROM FDR AILERONS
NEGATIVE=RIGHT
SPOILER DEFLECTION (DEGREES)
CALCULATED FROM FDR AILERONS
FDR PANEL 5 LEFT
FDR PANEL 3 LEFT
FDR PANEL 3 RIGHT
FDR PANEL 5 RIGHT
CALCULATED VERTICAL SPEED (FEET/SEC)
NEGATIVE=DOWN
SUBFRAME COUNT
TIME (SECONDS)
THE BOEING COMPANY
MD-11 CHI ACCIDENT AT HONG KONG
22AUG99 - SUMMARY PLOT
FACTORS CONTRIBUTING TO Nz
APPENDIX C
FIGURE C.1
PAGE 27
REV
CALC JDA
CHECK
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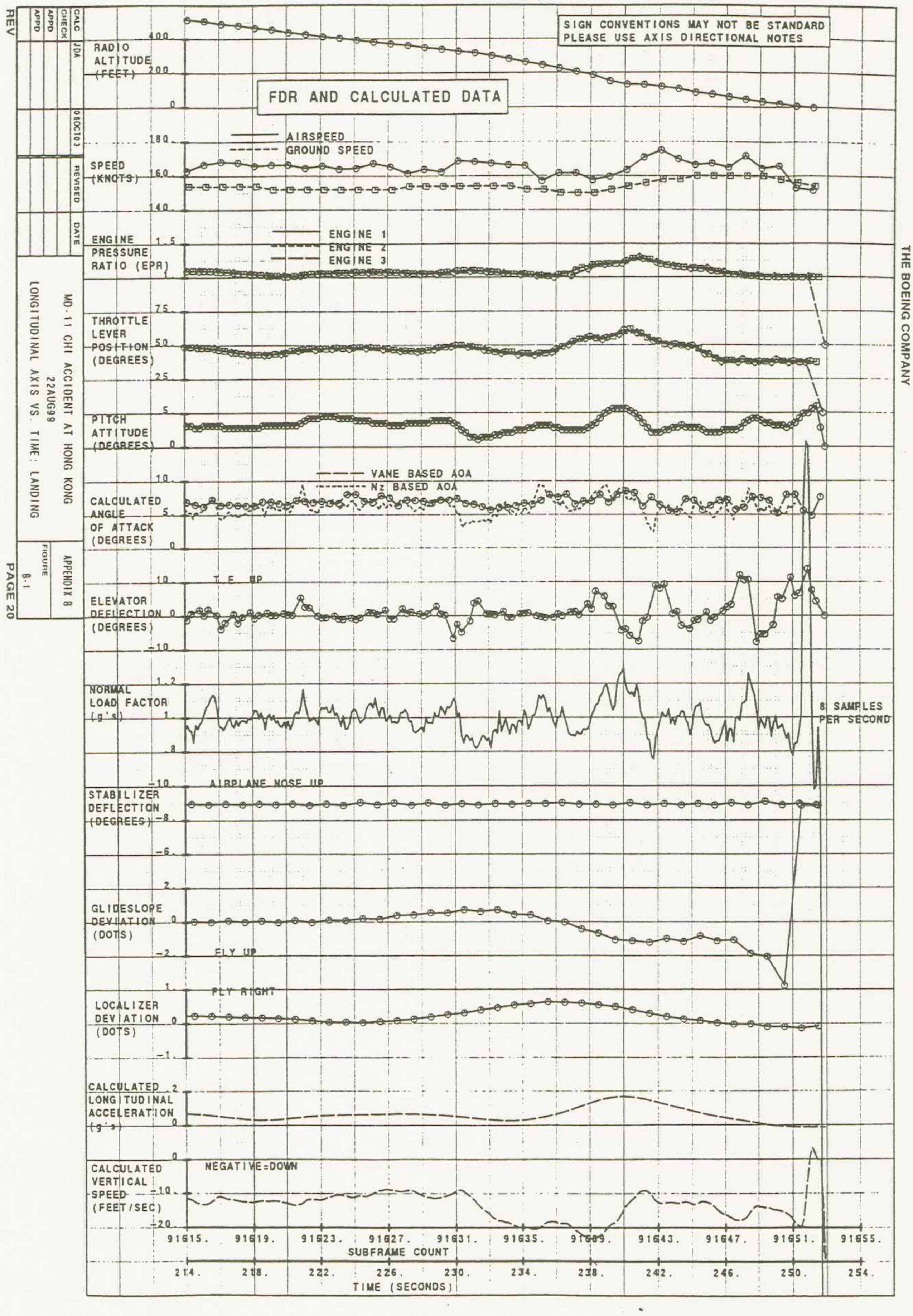
APPD
REVISED 06OCT03
DATE


SIGN CONVENTIONS MAY NOT BE STANDARD
PLEASE USE AXIS DIRECTIONAL NOTES
FDR AND CALCULATED DATA
RADIO ALTITUDE (FEET)
SPEED (KNOTS)
AIRSPEED
GROUND SPEED
ENGINE PRESSURE RATIO (EPR)
ENGINE 1
ENGINE 2
ENGINE 3
THROTTLE LEVER POSITION (DEGREES)
PITCH ATTITUDE (DEGREES)
CALCULATED ANGLE OF ATTACK (DEGREES)
VANE BASED AOA
Nz BASED AOA
ELEVATOR DEFLECTION (DEGREES)
T.E. UP
NORMAL LOAD FACTOR (g's)
8 SAMPLES PER SECOND
STABILIZER DEFLECTION (DEGREES)
AIRPLANE NOSE UP
GLIDESLOPE DEVIATION (DOTS)
FLY UP
LOCALIZER DEVIATION (DOTS)
FLY RIGHT
CALCULATED LONGITUDINAL ACCELERATION (g's)
CALCULATED VERTICAL SPEED (FEET/SEC)
NEGATIVE=DOWN
SUBFRAME COUNT
TIME (SECONDS)
MD-11 CHI ACCIDENT AT HONG KONG
22AUG99
LONGITUDINAL AXIS VS. TIME: LANDING
APPENDIX B
FIGURE B-1
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JDA
08OCT03
REVISED
DATE
THE BOEING COMPANY

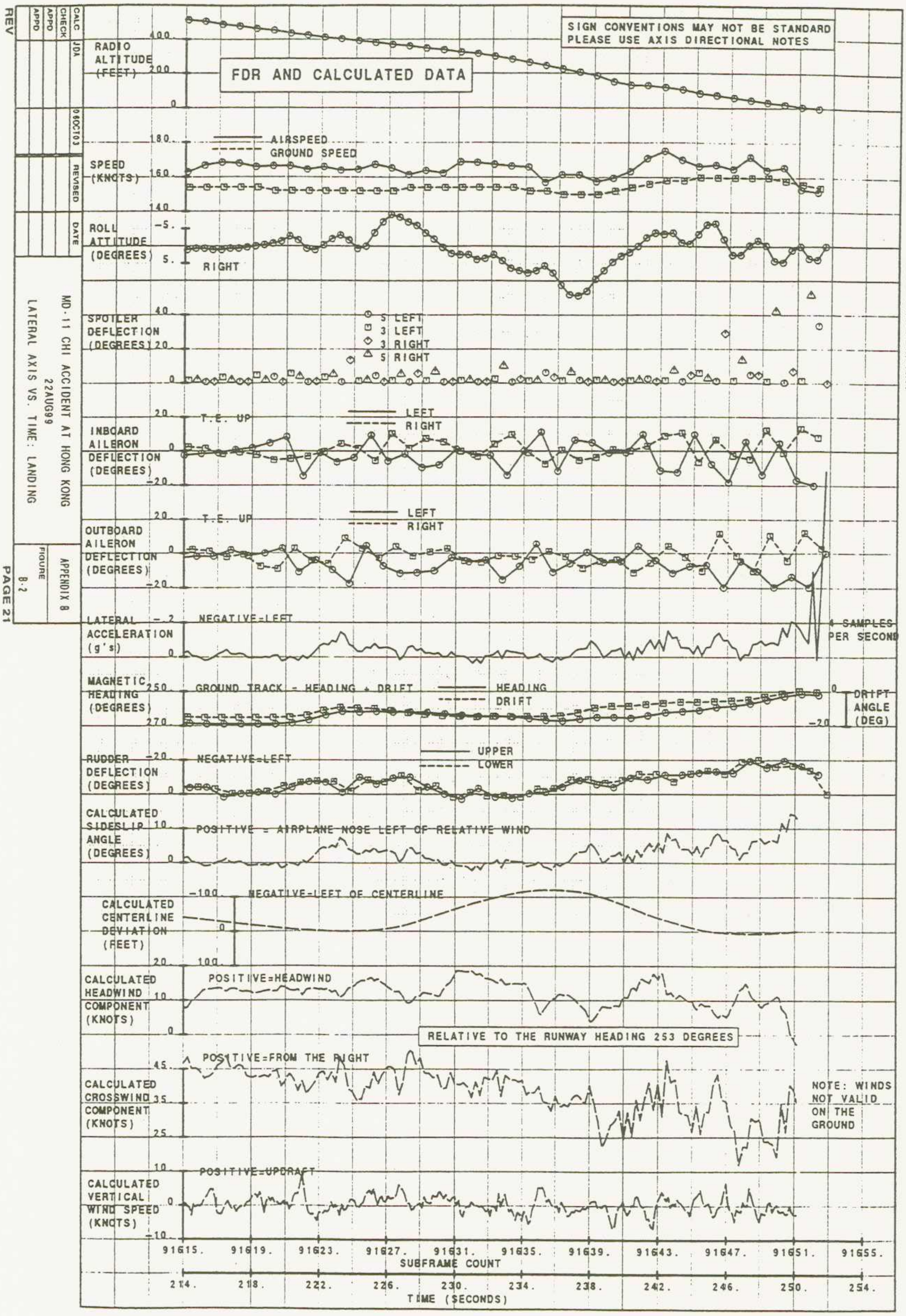
FDR AND CALCULATED DATA
SIGN CONVENTIONS MAY NOT BE STANDARD
PLEASE USE AXIS DIRECTIONAL NOTES
RADIO ALTITUDE (FEET)
SPEED (KNOTS)
AIRSPEED
GROUND SPEED
ROLL ATTITUDE (DEGREES)
RIGHT
SPOILER DEFLECTION (DEGREES)
5 LEFT
3 LEFT
3 RIGHT
5 RIGHT
INBOARD AILERON DEFLECTION (DEGREES)
T.E. UP
LEFT
RIGHT
OUTBOARD AILERON DEFLECTION (DEGREES)
LATERAL ACCELERATION (g's)
NEGATIVE=LEFT
4 SAMPLES PER SECOND
MAGNETIC HEADING (DEGREES)
GROUND TRACK = HEADING + DRIFT
HEADING
DRIFT
DRIFT ANGLE (DEG)
RUDDER DEFLECTION (DEGREES)
UPPER
LOWER
CALCULATED SIDESLIP ANGLE (DEGREES)
POSITIVE = AIRPLANE NOSE LEFT OF RELATIVE WIND
CALCULATED CENTERLINE DEVIATION (FEET)
NEGATIVE=LEFT OF CENTERLINE
CALCULATED HEADWIND COMPONENT (KNOTS)
POSITIVE=HEADWIND
RELATIVE TO THE RUNWAY HEADING 253 DEGREES
CALCULATED CROSSWIND COMPONENT (KNOTS)
POSITIVE=FROM THE RIGHT
NOTE: WINDS NOT VALID ON THE GROUND
CALCULATED VERTICAL WIND SPEED (KNOTS)
POSITIVE=UPDRAFT
SUBFRAME COUNT
TIME (SECONDS)
THE BOEING COMPANY
MD-11 CHI ACCIDENT AT HONG KONG
22AUG99
LATERAL AXIS VS. TIME: LANDING
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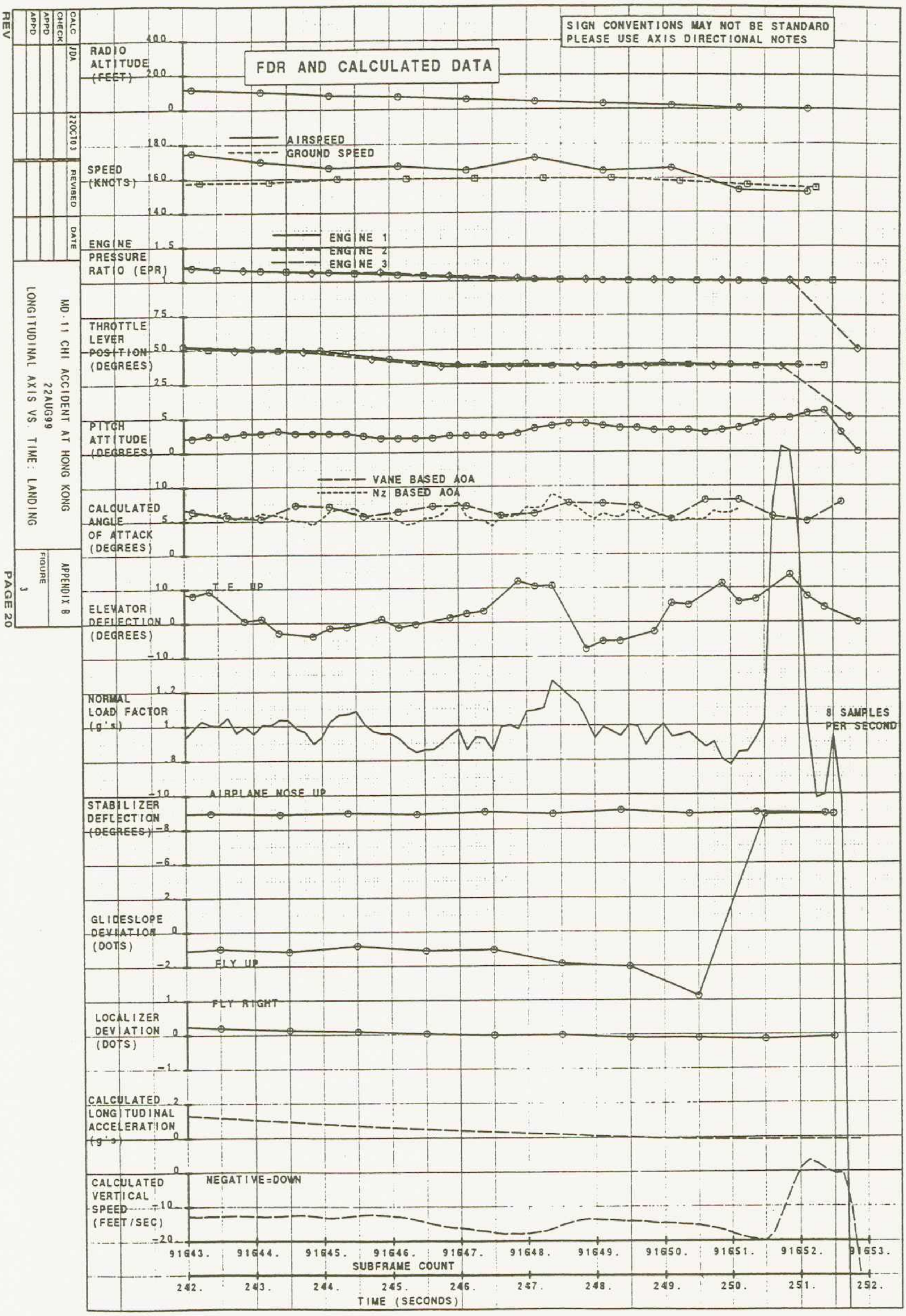
FIGURE B-2
PAGE 21
CALC JDA
CHECK
APPD
APPD
06OCT03
REVISED
DATE
REV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SIGN CONVENTIONS MAY NOT BE STANDARD
PLEASE USE AXIS DIRECTIONAL NOTES
RADIO ALTITUDE (FEET)
SPEED (KNOTS)
AIRSPEED
GROUND SPEED
ENGINE PRESSURE RATIO (EPR)
ENGINE 1
ENGINE 2
ENGINE 3
THROTTLE LEVER POSITION (DEGREES)
PITCH ATTITUDE (DEGREES)
CALCULATED ANGLE OF ATTACK (DEGREES)
VANE BASED AOA
Nz BASED AOA
ELEVATOR DEFLECTION (DEGREES)
T.E. UP
NORMAL LOAD FACTOR (g's)
8 SAMPLES PER SECOND
STABILIZER DEFLECTION (DEGREES)
AIRPLANE NOSE UP
GLIDESLOPE DEVIATION (DOTS)
FLY UP
LOCALIZER DEVIATION (DOTS)
FLY RIGHT
CALCULATED LONGITUDINAL ACCELERATION (g's)
CALCULATED VERTICAL SPEED (FEET/SEC)
NEGATIVE=DOWN
SUBFRAME COUNT
TIME (SECONDS)
MD-11 CHI ACCIDENT AT HONG KONG
22AUG99
LONGITUDINAL AXIS VS. TIME: LANDING
APPENDIX B
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PAGE 20
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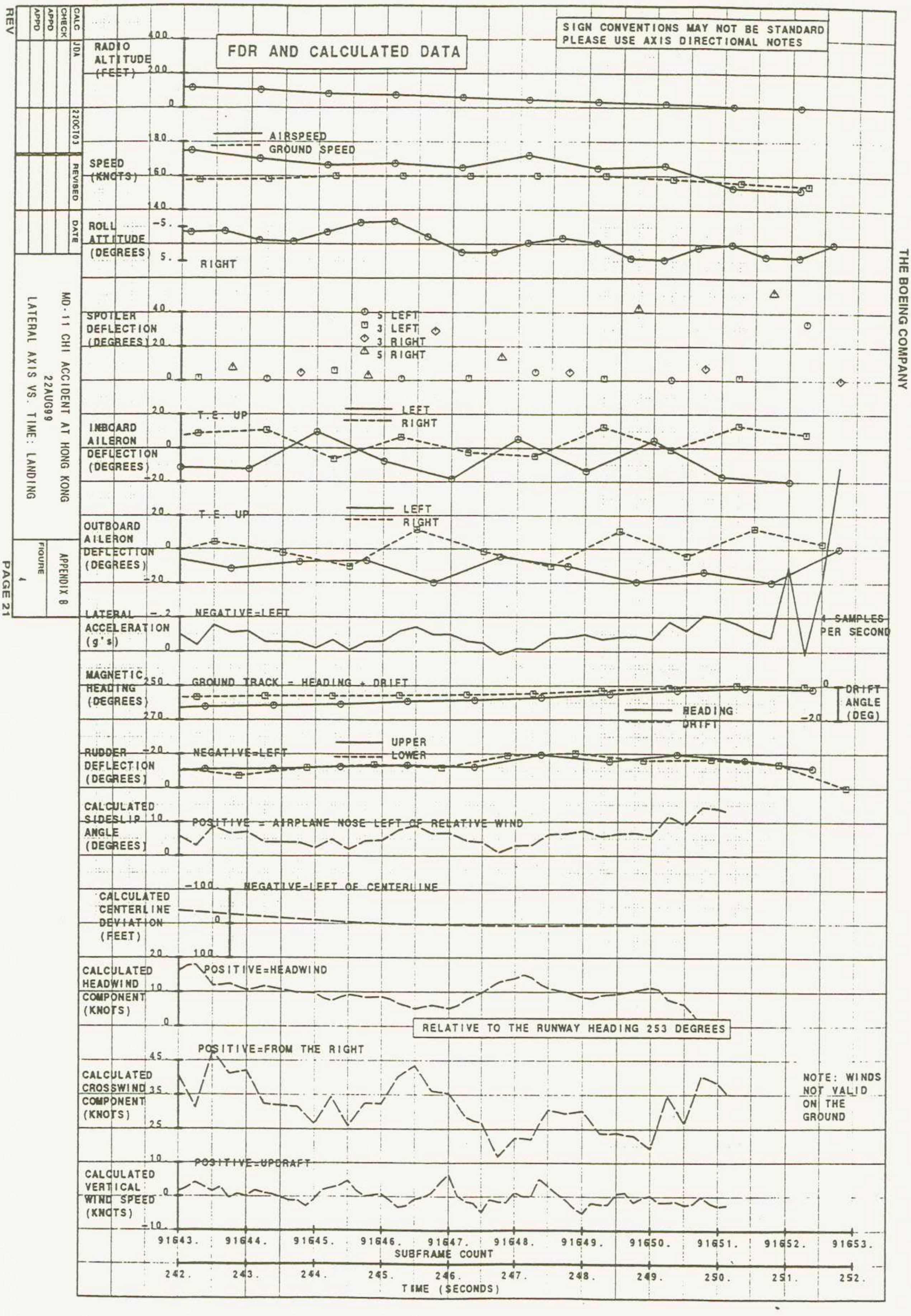
REVISED
DATE
22OCT03
REV
THE BOEING COMPANY


FDR AND CALCULATED DATA
SIGN CONVENTIONS MAY NOT BE STANDARD
PLEASE USE AXIS DIRECTIONAL NOTES
RADIO ALTITUDE (FEET)
SPEED (KNOTS)
AIRSPEED
GROUND SPEED
ROLL ATTITUDE (DEGREES)
RIGHT
SPOILER DEFLECTION (DEGREES)
5 LEFT
3 LEFT
3 RIGHT
5 RIGHT
INBOARD AILERON DEFLECTION (DEGREES)
T.E. UP
LEFT
RIGHT
OUTBOARD AILERON DEFLECTION (DEGREES)
LATERAL ACCELERATION (g's)
NEGATIVE=LEFT
4 SAMPLES PER SECOND
MAGNETIC HEADING (DEGREES)
GROUND TRACK = HEADING + DRIFT
HEADING
DRIFT
DRIFT ANGLE (DEG)
RUDDER DEFLECTION (DEGREES)
UPPER
LOWER
CALCULATED SIDESLIP ANGLE (DEGREES)
POSITIVE = AIRPLANE NOSE LEFT OF RELATIVE WIND
CALCULATED CENTERLINE DEVIATION (FEET)
NEGATIVE=LEFT OF CENTERLINE
CALCULATED HEADWIND COMPONENT (KNOTS)
POSITIVE=HEADWIND
RELATIVE TO THE RUNWAY HEADING 253 DEGREES
CALCULATED CROSSWIND COMPONENT (KNOTS)
POSITIVE=FROM THE RIGHT
NOTE: WINDS NOT VALID ON THE GROUND
CALCULATED VERTICAL WIND SPEED (KNOTS)
POSITIVE=UPDRAFT
SUBFRAME COUNT
TIME (SECONDS)
REV
CALC JDA
CHECK
APPD
APPD
22OCT03
REVISED
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MD-11 CHI ACCIDENT AT HONG KONG
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LATERAL AXIS VS. TIME: LANDING
APPENDIX B
FIGURE 4
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THE BOEING COMPANY

MD－11 S.O.P.	NORMAL PROCEDURE	REV.	PAGE 93 / 01-01-95

PREPARATION FOR DESCENT PROCEDURE

1. ATIS PNF

Acquire the destination weather information from destination ATIS or other appropriate source.

2. MCDU ACT F-PLN PAGE

(1) Select the ACT F-PLN page by pushing the F-PLN key. Page up with the ↑ key on the MCDU until the arrival airport is in view.

(2) Pushing the LS key adjacent to the waypoint prior to the destination selects the LAT REV page.

(3) To select the STAR page push LS key 1R.

(4) On the STAR page select the appropriate approach and landing runway on the right then select the appropriate STAR (if applicable) with the left LS keys. To return to the ACT F-PLN page push " * INSERT" (LS key 6L).

(5) If the approach selected has a transition option the MCDU will automatically display the options for pilot selection.

(6) After picking the appropriate transition push "*INSERT" line select key 6L or "ACT F-PLN" line select key 6R to return to the ACT F-PLN page.

3. MCDU APPROACH PAGE

Select the Approach Page, verify the landing field LENGTH and ELEV, select the desired flap setting for landing and crosscheck MCDUs for correct VREF speed.

NOTE

Landing field altitude is normally entered into the

MD－11 S.O.P.	NORMAL PROCEDURE	REV.	PAGE 94 / 01-01-95

pressurization controller by the FMS. In the event of an emergency return after climbing through 5000 feet above takeoff field altitude or diverting to an airport other than planned. Landing field altitude must be inserted by turning the MANUAL LDG ALT knob on the Cabin Pressurization Panel.

4. WINDSHIELD ANTI-ICE PNF

Use of windshield anti-ice when descending into high humidity conditions will prevent window fogging.

5. GLARESHIELD PF/PNF

On the EIS Control Panel rotate the RA/BARO Selector to RA or BARO as required and rotate the Minimums Control Knob to the correct Decision Height or Minimum Descent Altitude as appropriate for the approach being flown.

6. CREW BRIEFING PF

Please refer L/D briefing formats as followed:

FLIGHT CREW BEFORE L/D BRIEFING

(1) WX:
LANDING A/P________________
ALTERNATE A/P________________
(2) TIME OF DESCENT________________
(3) TRANSITION LEVEL________________
MSA________________
(4) RUNWAY IN USE________________
FIELD ELEVATION________________
(5) STAR & MISS APPROACH PROCEDURE
(6) GO-AROUND PROCEDURE

PREPARATION FOR DESCENT PROCEDURE (CONT'D)

PUSH G/A BUTTON, ADVANCE THROTTLES
FLAPS 28, POSITIVE RATE, GEAR-UP.
ALT____________LEVEL CHANGE
ALT____________SPEED SELECT
THEN FLAP SKJ & CONTINUE CLIMB.

(7) FMS & NAV RADIO SET UP
(8) REMARK:

MD11 FLIGHT CREW CAT II APPROACH BRIEFING

1. WX :
   LANDING AIRPORT ATIS ____________
   ALTERNATE AIRPORT ____________
2. TIME OF DESCENT ____________
3. TRANSITION LEVEL ____________
   MSA ____________
4. RUNWAY IN USE ____________
   FIELD ELEVATION ____________
   ILS FRQ & CRS ____________
   LANDING CAT Ⅱ OR Ⅲ. DH OR AH ____________
   AUTOLAND OR MANUAL LAND.
5. STAR & MISS APPROACH PROCEDURE. ____________
6. MINIMUM DIVERSION FUEL
7. GO-AROUND PROCEDURE.
   PUSH G/A BUTTON, ADVANCE THROTTLES.
   FLAPS 28, POSITIVE RATE, GEAR-UP.
   LEVEL CHANGE PROFILE
   HEADING SELECT OR NAV
   SPEED SELECT MAP
   MAP
   THEN FLAPS SKJ & CONTINUE CLIMB.
8. FMS & NAV RADIO SET-UP.
9. REMARK :

PREPARATION FOR DESCENT PROCEDURE (CONT'D)

7. SEAT BELTS SWITCHES PF
   Move SEAT BELTS switch to ON when beginning the descent from cruise altitude.
8. SHOULDER HARNESS PF/PNF
   PF and PNF should fasten their shoulder harness before descend.
9. DESCENT/APPROACH CHECKLIST PNF
   Begin the DESCENT/APPROACH checklist by accomplishing the check list through SEAT BELTS.

NOTE

Refer to supplemental procedures and procedures and techniques sections of the FCOM for operation of AUTO FLIGHT and MCDUs during descent phase of flight.

DESCENT TECHNIQUES

• STANDARD DESCENT PROCEDURE

1. The FMS will consider the optimum point to begin an unrestricted descent to a landing, however, in actual operations, when it is necessary to compute a TOD point, use the following rule-of-thumb:
   (1) Determine the altitude difference.
   (2) Drop the last three digits.
   (3) Multiply by three.
   (4) For an unrestricted descent to a landing, add 10 n.m.
   (5) For a descent to an intermediate altitude above 10000 feet, no additive required.
   (6) Adjust TOD point for wind (tailwind-earlier TOD headwind-later TOD):

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.

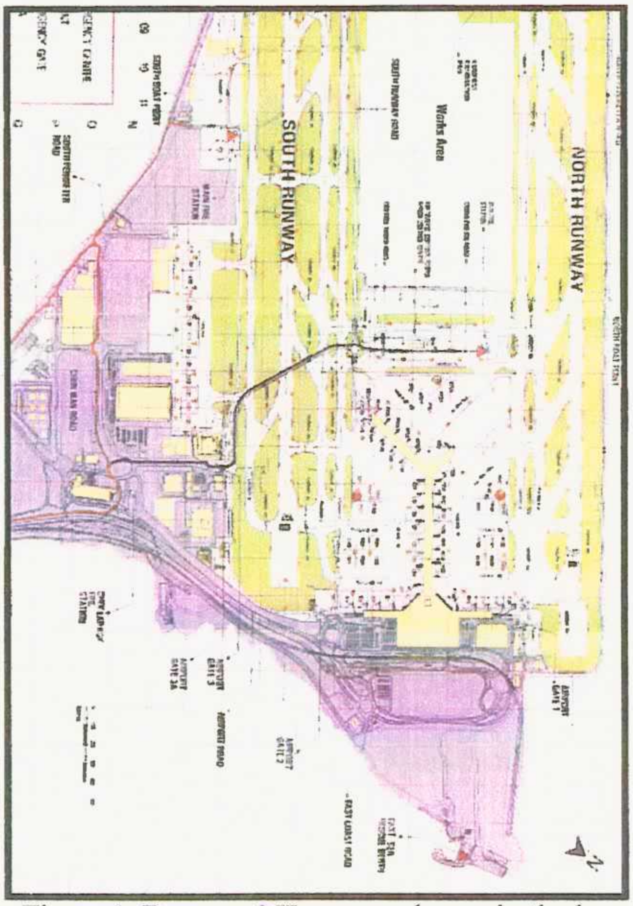


Figure 1. Runway 25L approach area in the lee of the Passenger Terminal Building

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 (hh:mm:ss.s)	CAS (knots)	RALT (feet)	sink rate (DRA) (ft/s)	sinkrate VG (ft/s)	MHEading (deg)	ROLL (deg)	PITCH (deg)	GSPD (knots)	DRIFT (deg)	AOA#1 (deg)	AOA#2 (deg)	ELEV RIB (DEG)	ELEV RCB (DEG)	flight path angle (deg)	WSPD (Boeing) (Kts)	WINDIR (Boeing) (deg)	Vert.WSPD (Boeing) (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	46.16	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	332.10	-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	26.70	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	-3.82	-3.33	26.56	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	0.93
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	314.50	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	45	-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	0.75
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	290.00	-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

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							0.886				-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										0.845				
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										2.406				
10:44:22.0	151.5	-1	-8	4.4	252.1	3.8	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				

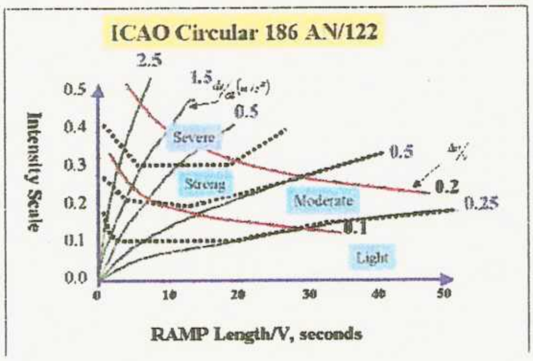
Downdraft

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

Zone	UTC Time	CAS	delta CAS	dt	Dv/h	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*f)		(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	327	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	326	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	326	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	0.06	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.[illegible]	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	329	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	99.1	265.4	5.6
c	18:44:12	171.0								129.0	5.10	2.7	33.3	30[illegible]	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	5.3	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	38.8	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	38.3	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).**

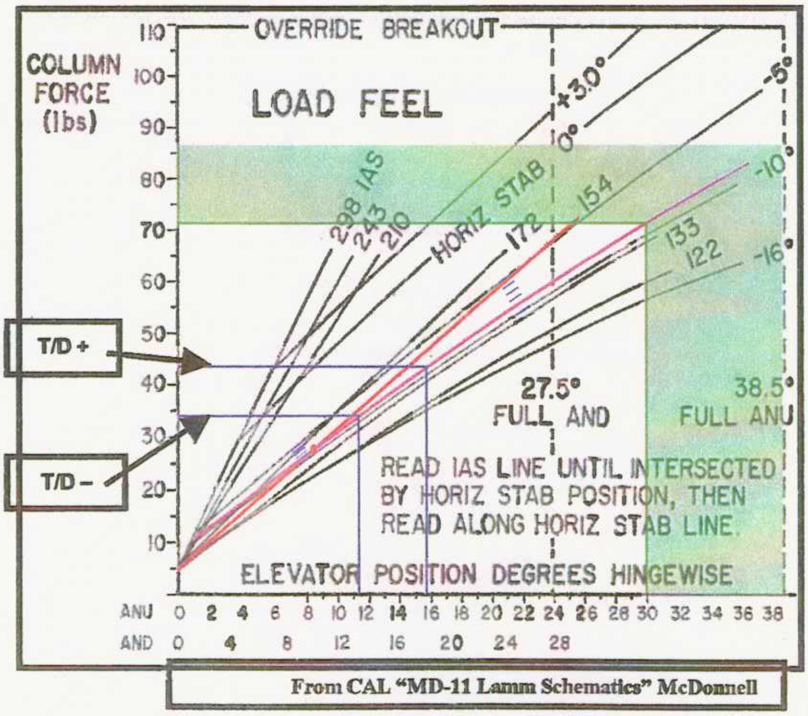


Figure 4. MD-11 Elevator Load Feel force Gradient

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)