JAMES M. ESTABROOK
EDWARD H. MAHLA
JOHN C. MOORE
MacDONALD DEMING
GORDON W. PAULSEN
M. E. DeORCHIS
DAVID P. H. WATSON
RICHARD G. ASHWORTH
EDWARD L. JOHNSON
RICHARD B. BARNETT
MAURICE L. NOYER
SANFORD C. MILLER
FRANCIS X. BYRN
THOMAS R. H. HOWARTH
STEPHEN K. CARR
WALTER E. RUTHERFORD
R. GLENN BAUER
THEODORE M. SYSOL
CARROLL E. DUBUC
THOMAS F. MOLANPHY
LENNARD K. RAMBUSCH
JAMES J. SENTNER, JR.
RANDAL R. CRAFT, JR.
WILLIAM J. HONAN III
CHESTER D. HOOPER
EMIL A. KRATOVIL, JR.
JOHN J. REILLY
BARTON T. JONES
RICHARD D. BELFORD
BRIAN D. STARER
ROBERT B. HASEROT
JOHN K. WEIR
JUAN A. ANDUIZA
DONALD J. KENNEDY
RICHARD L. JARASHOW
WILLIAM F. PAN

HAIGHT, GARDNER, POOR & HAVENS
FEDERAL BAR BUILDING
1819 H STREET, N.W.
WASHINGTON, D.C. 20006
CABLE: MOTOR WASHINGTON
WU: TELEX 892598
TELEPHONE (202) 737-7847

BERNARD D. ATWOOD
SPECIAL PARTNER

J. WARD O'NEILL
COUNSEL

NEW YORK OFFICE
ONE STATE STREET PLAZA
NEW YORK, N.Y. 10004
TEL. (212) 344-6800
CABLE: MOTOR NEW YORK
RCA TELEX: 222974
WUI TELEX: 620362
ITT TELEX: 424674
WU TELEX: 127683

PARIS AFFILIATE
FRANCOIS LEGREZ
34, AVENUE GEORGE V
75008 PARIS, FRANCE
TELEPHONE 720-8202
CABLE: MOTOR PARIS
TELEX: 640669

CARROLL E. DUBUC*
RESIDENT PARTNER WASHINGTON

RALPH E. CASEY*
JOHN W. McCONNELL, JR.*
OF COUNSEL WASHINGTON

*ADMITTED TO D.C. BAR

August 7, 1981

Mr. James Turnbow
[redacted]
Pheonix, Arizona 85018

FFAC v. Lockheed Aircraft Corporation
Our file 2041-1278-2S

Dear Dr. Turnbow:

Please find enclosed a copy of John Edwards' most recent calculations relating to vertical G-forces felt by the C-5A survivors.

Very truly yours,

HAIGHT, GARDNER, POOR & HAVENS

By

Thomas B. Almy

/dh

Enclosure

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED CORPORATION
INTERDEPARTMENTAL COMMUNICATION

TO R. P. Barton DEPT. 85-03 ZONE 35 DATE 29 July 1981

E-05-665-81

FROM J. W. Edwards DEPT. 72-05 ZONE 240 EXT. 4004

SUBJECT: C-5A SIAGON ACCIDENT FIRST IMPACT G LOADS

An analysis of all available data relevant to subject impact loads resulted in a range of loads based on the following data:

a) Engineering Analysis of Data From AF 68-218 - Second page states "The MADAR data for a period of 3.6 seconds prior to initial impact was lost due to power interruption at impact. At this point the airspeed was approximately 270 knots and the altitude trend information available indicates a probable sink rate at initial touchdown on the order of 16 ft/sec, however, it must be emphasized that no data exists for approximately 3.6 seconds prior to touchdown and ground effect should have produced a reduction in sink rate prior to ground contact."

b) Captain Harp's Court Testimony - Page 174, "The first landing, I would classify as a relatively smooth landing under the conditions, quite honestly. I have made firmer landings since then on a normal runway, I have seen firmer landings, both by military and commercial aircraft. I was prepared for a much firmer impact than what we had on the first landing."

c) Page 2141, "The first landing, I would describe as relatively smooth, considering the conditions we were landing in. I guess some people would probably call it a firm landing or something. I have seen worse landings. I personally have made worse landings."

d) Major Traynor's Court Testimony - Page 2213, "And the cushioning affect of the wings, against the ground made the airplane flare. And I remember looking at the vertical velocity and it was reading about 500 feet per minute, which is even less than a normal touchdown. So, I touched down the first time and was quite releived because of the non-severity of the touchdown."

e) Page 89, "The ground effect flared the airplane. We touched down in normal, or less than normal, rate of descent, so it was a very smooth initial touch." "One of the standard cross-check items is your rate of descent indicator, and I did notice that it was right at 500 to 600 feet per minute, which is the preferred normal rate of descent for touchdown."

f) My own personal observation at the accident site was that the aircraft initial touchdown caused failure of both aft main gears due to aft drag loads caused by the gears plowing into the soft dirt. There was no evidence of failure of the aft main gears due to vertical loads which indicates a normal descent rate and since the forward main gears and the nose gear stayed with the airplane until after the second touchdown, the initial touchdown was probably made at a tail down angle.

Attached is a graph of C-5A C.G. LOAD FACTOR VS LANDING SINK RATE prepared by the structures department. Given a sink rate of 600 fpm (10 fps) and a tail down angle of 4°, the g loading at the airplane CG is 1.025 which is considered to be the highest probable go force. Given a sink rate of 500 fpm (8.33 fps) and a tail down angle of 8°, the g loading at the airplane CG is .7. The g force on a person would be one plus the airplane g force or 2.025 and 1.7 respectively.

Therefore, the vertical g forces were either equal to or less than 1.7 g's or 2.025 g's depending on the tail down angle and these values would have been reduced further by the ground effects.

The vertical g loads at the second impact were essentially negligible since the aircraft crossed the river and dragged the two forward main gear through the vegetation (with the nose gear above the vegetation since no nose gear track was evident) for some fifty feet indicating a very level trajectory.

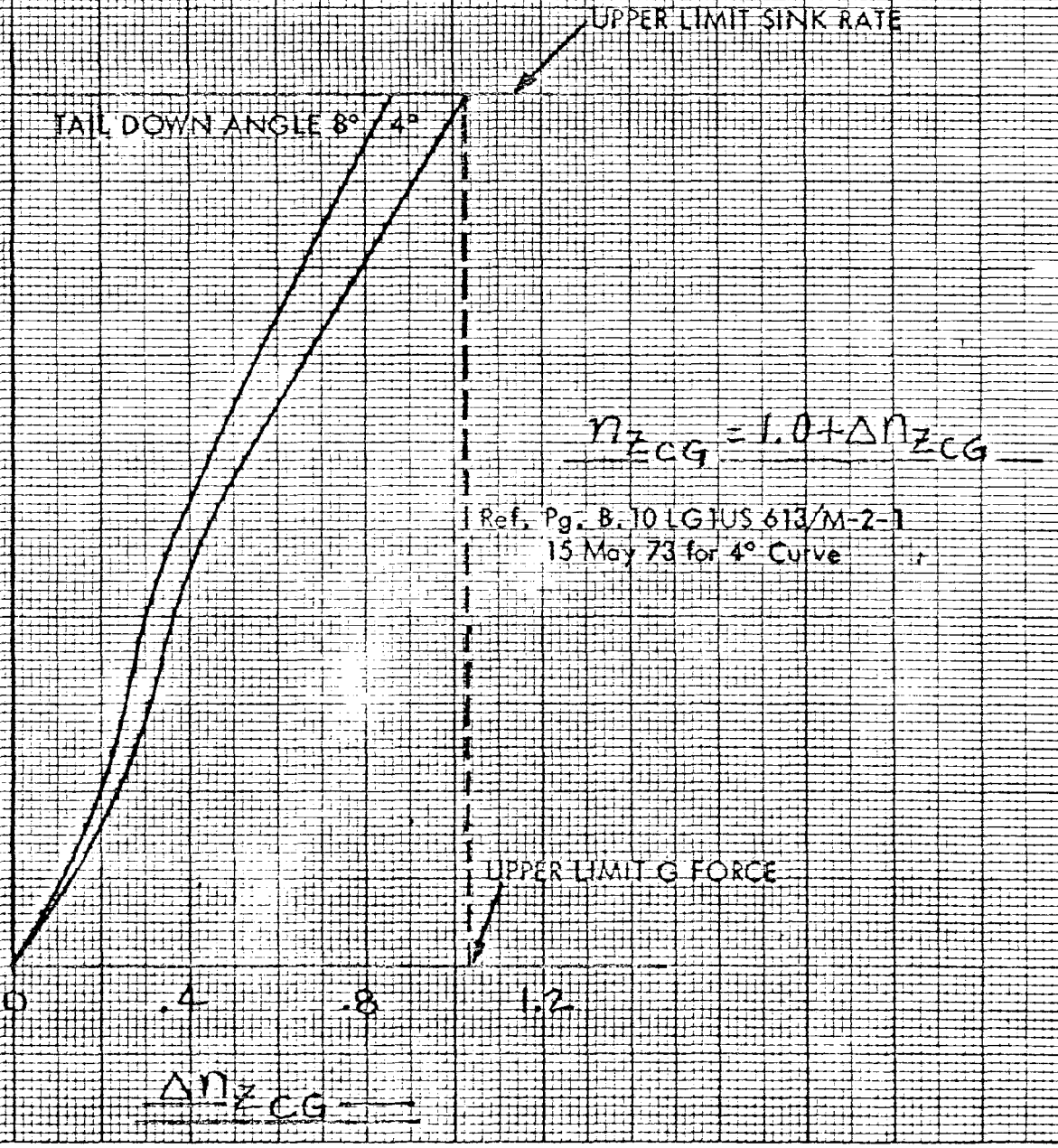
J. W. Edwards
Chief Project Engineer
Project Engineering Division

JWE:bg

C5A C.G. LOAD FACTOR vs LANDING SINK RATE

GW = 450000 LBS

68-218



$n_{zCG} = 1.0 + \Delta n_{zCG}$

Ref. Pg. B.10 LG1US 613/M-2-1
15 May 73 for 4° Curve

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED CORPORATION
MARIETTA, GEORGIA 30063

21 August 1981

Mr. John Conners
Haight, Gardner, Poor & Havens
Federal Bar Building
1819 H Street N.W.
Washington, D. C. 20006

SUBJECT: PEAK g LOADS vs AVERAGE g LOADS

Dear Mr. Conners:

During the meeting 15 August, a great deal of discussion centered around the possible peak g loads that could have been experienced during the deceleration of the aft troop compartment 68-218 on the 4th of April 1970.

I took the liberty of referencing John Paul Stapp's technical report 5915 part 2 dated 12-51.

The attached data was taken from these reports and plotted on the attached curves.

The following are pertinent points and worthy of remembering.

1. The calculated average g load 68-218 was 1.6 over a period of 8.6 seconds.

2. When the highest peak of 27 different runs was calculated and brought to the same baseline, the peak was 3.91.

3. The average high peak of these 27 runs was 2.8g.

Very truly yours,

LOCKHEED-GEORGIA COMPANY

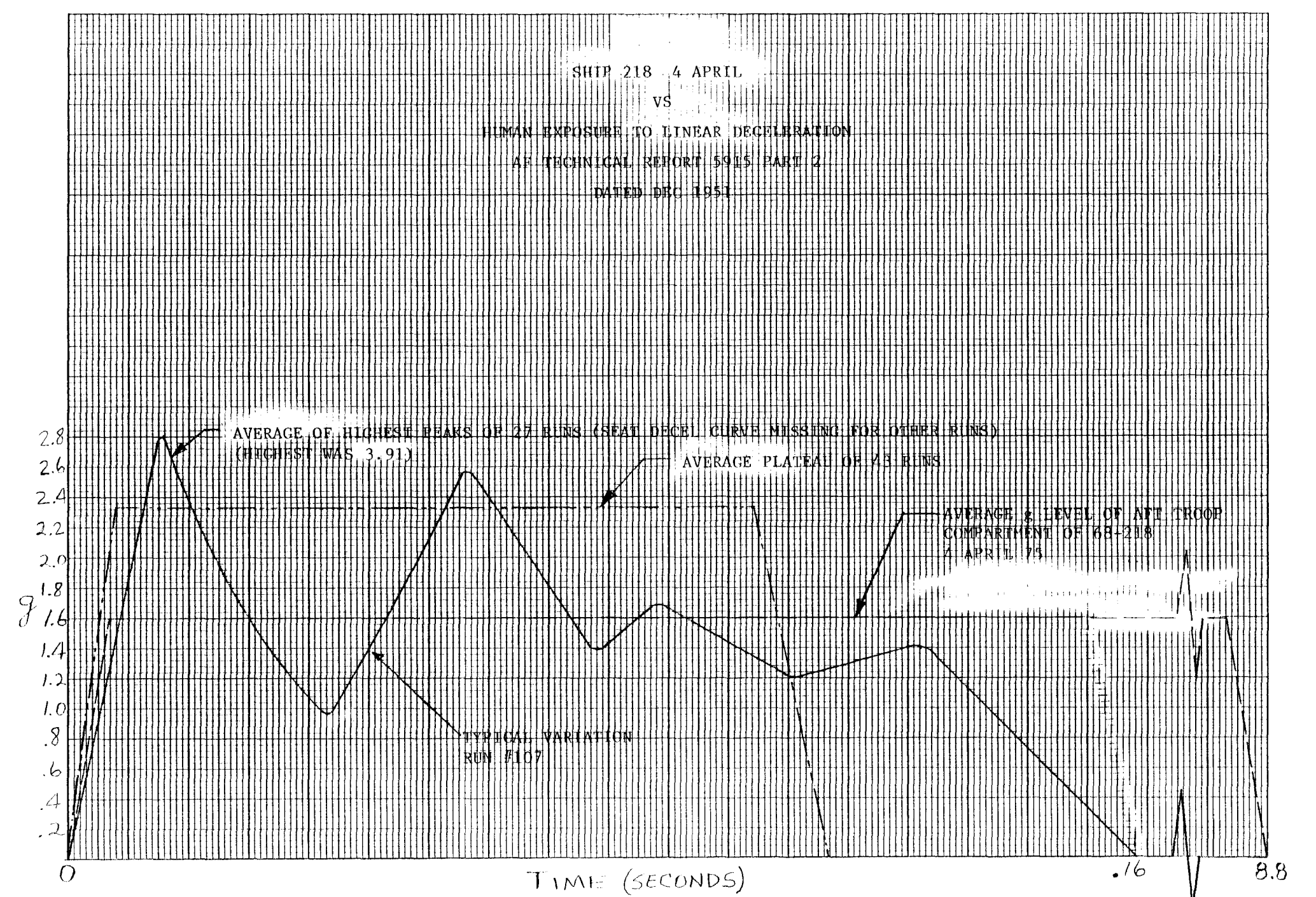
J. W. Edwards
Chief Project Engineer

JWE/mm

Attachment

cc: Dr. James W. Turnbow
[redacted]
Phoenix, Arizona 85018

Dr. J. G. Gaume
[redacted]
Palos Verdes Estate, Ca. 90274


SHIP 218 4 APRIL
VS
HUMAN EXPOSURE TO LINEAR DECELERATION
AF TECHNICAL REPORT 5915 PART 2
DATED DEC 1951
AVERAGE OF HIGHEST PEAKS OF 27 RUNS (SEAT DECEL CURVE MISSING FOR OTHER RUNS)
(HIGHEST WAS 3.91)
AVERAGE PLATEAU OF 43 RUNS
AVERAGE g LEVEL OF AFT TROOP COMPARTMENT OF 68-218 4 APRIL 75
TYPICAL VARIATION RUN #107
2.8
2.6
2.4
2.2
2.0
1.8
g 1.6
1.4
1.2
1.0
.8
.6
.4
.2
0
TIME (SECONDS)
.16
8.8

REF: HUMAN EXPOSURE TO LINEAR DECELERATION
AF 5915 PART 2 DATED DECEMBER 1951
TABLE II, PAGE 20

RUN #	A AVERAGE g (1)	B PLATEAU (TABLE II)	C PLATEAU 218 (2)	D PEAK g-SEAT (3)	E PEAK g-SEAT 218 (4)
96	10.56	11.3	1.71	11.0	1.67
119	10.12	10.9	1.72	13.5	2.13
121	10.79	11.9	1.76	15.5	2.30
94	13.01	15.0	1.84	27.8	5.42
97	11.39	15.0	2.11	*	*
98	14.48	16.8	1.86	*	*
102	14.08	16.7	1.90	21.5	2.44
106	13.90	16.6	1.91	24.5	2.82
117	11.06	13.9	2.01	19.0	2.75
118	12.49	14.3	.83	*	*
149	12.22	17.5	2.29	*	*
150	11.65	16.9	2.32	*	*
164	14.54	15.0	1.65	*	*
99	17.51	21.2	1.94	25.5	2.33
100	17.57	20.4	1.86	26.5	2.41
142	16.89	21.2	2.01	*	*
143	17.66	23.5	2.13	*	*
146	17.27	23.3	2.16	*	*
147	18.10	24.1	2.13	*	*
163	17.82	32.1	2.87	*	*
165	14.61	18.0	1.97	*	*
166	15.97	19.4	1.94	*	*
103	16.30	25.8	2.53	35.0	3.44
104	16.77	24.3	2.32	34.0	3.24
122	15.14	25.0	2.64	18.0	1.90
107	16.30	27.0	2.65	35.0	3.44
108	17.18	28.9	2.69	28.5	2.65
109	16.03	28.2	2.81	35.3	3.52
110	17.39	31.8	2.93	38.0	3.50
111	21.74	34.6	2.55	44.5	3.28
123	17.78	28.5	2.56	22.0	1.98
124	14.75	26.7	2.90	36.0	3.91
130	14.95	24.8	2.65	*	*
113	22.52	35.0	2.49	38.5	2.74
114	21.74	34.8	2.56	29.9	2.20
133	25.25	38.6	2.51	*	*
135	22.22	38.1	2.74	*	*
210	12.32	13.9	1.81	19.9	2.58
211	13.72	20.6	2.40	23.0	2.68
212	17.25	32.7	3.03	31.0	2.88
213	17.76	36.5	3.29	36.0	3.24
214	19.92	38.6	3.10	38.5	3.09
215	23.95	45.4	3.03	47.0	3.14
TOTAL	694.67		100.11		75.68
AVERAGE	16.16		2.33		2.80

* CURVE FOR SEAT DECEL NOT GIVEN IN REF REPORT

(1) VELOCITY CHANGE DIVIDED BY DURATION DIVIDED BY 32.2
(2) DIVIDE COLUMN B BY COLUMN A AND MULTIPLY BY 1.6 IN ORDER TO RATIO THE SLED DECELS TO THE AIRPLANE AVERAGE DECEL. 2.33 (AVERAGE PLATEAU FOR THE AIRPLANE) IS USED TO CONSTRUCT THE CURVE.
(3) SCALED FROM SEAT DECEL CURVES IN REF REPORT
(4) DIVIDE COLUMN D BY COLUMN A AND MULTIPLY BY 1.6 IN ORDER TO RATIO THE SLED SEAT DECELS TO THE AIRPLANE AVERAGE DECEL. THE 2.80 AVERAGE WAS USED FOR THE HIGHEST PEAK ON THE VARIABLE CURVE WHICH WAS PATTERNED TO RESEMBLE RUN #107 SEAT CURVE WHOSE AVERAGE DECEL IS CLOSE TO COLUMN A AVERAGE

HAIGHT, GARDNER, POOR & HAVENS
FEDERAL BAR BUILDING
1819 H STREET, N.W.
WASHINGTON, D.C. 20006
CABLE: MOTOR WASHINGTON
WU: TELEX 892598
TELEPHONE (202) 737-7847

175-1340

August 7, 1981

Mr. James Turnbow
[redacted]
Pheonix, Arizona 85018

FFAC v. Lockheed Aircraft Corporation
Our file 2041-1278-2S

Dear Dr. Turnbow:

Please find enclosed a copy of John Edwards' most recent calculations relating to vertical G-forces felt by the C-5A survivors.

Very truly yours,

HAIGHT, GARDNER, POOR & HAVENS

By

Thomas B. Almy

/dh

Enclosure

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED CORPORATION
INTERDEPARTMENTAL COMMUNICATION

TO R. P. Barton DEPT. 85-03 ZONE 35 DATE 29 July 1981

E-05-665-81

FROM J. W. Edwards DEPT. 72-05 ZONE 240 EXT. 4004

SUBJECT: C-5A SIAGON ACCIDENT FIRST IMPACT G LOADS

An analysis of all available data relevant to subject impact loads resulted in a range of loads based on the following data:

a) Engineering Analysis of Data From AF 68-218 - Second page states "The MADAR data for a period of 3.6 seconds prior to initial impact was lost due to power interruption at impact. At this point the airspeed was approximately 270 knots and the altitude trend information available indicates a probable sink rate at initial touchdown on the order of 16 ft/sec, however, it must be emphasized that no data exists for approximately 3.6 seconds prior to touchdown and ground effect should have produced a reduction in sink rate prior to ground contact."

b) Captain Harp's Court Testimony - Page 174, "The first landing, I would classify as a relatively smooth landing under the conditions, quite honestly. I have made firmer landings since then on a normal runway, I have seen firmer landings, both by military and commercial aircraft. I was prepared for a much firmer impact than what we had on the first landing."

c) Page 2141, "The first landing, I would describe as relatively smooth, considering the conditions we were landing in. I guess some people would probably call it a firm landing or something. I have seen worse landings. I personally have made worse landings."

d) Major Traynor's Court Testimony - Page 2213, "And the cushioning affect of the wings, against the ground made the airplane flare. And I remember looking at the vertical velocity and it was reading about 500 feet per minute, which is even less than a normal touchdown. So, I touched down the first time and was quite releived because of the non-severity of the touchdown."

e) Page 89, "The ground effect flared the airplane. We touched down in normal, or less than normal, rate of descent, so it was a very smooth initial touch." "One of the standard cross-check items is your rate of descent indicator, and I did notice that it was right at 500 to 600 feet per minute, which is the preferred normal rate of descent for touchdown."

f) My own personal observation at the accident site was that the aircraft initial touchdown caused failure of both aft main gears due to aft drag loads caused by the gears plowing into the soft dirt. There was no evidence of failure of the aft main gears due to vertical loads which indicates a normal descent rate and since the forward main gears and the nose gear stayed with the airplane until after the second touchdown, the initial touchdown was probably made at a tail down angle.

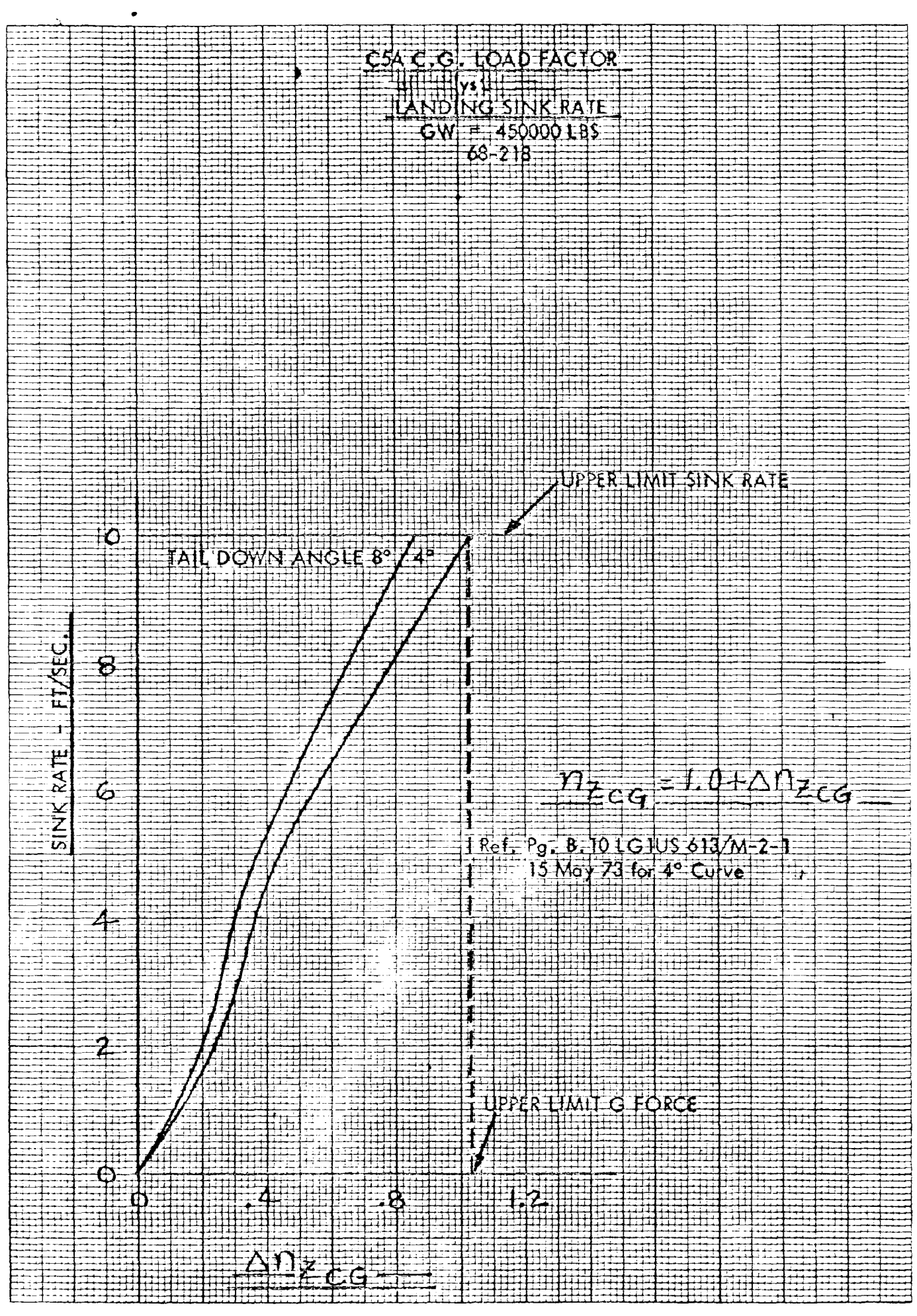
Attached is a graph of C-5A C.G. LOAD FACTOR VS LANDING SINK RATE prepared by the structures department. Given a sink rate of 600 fpm (10 fps) and a tail down angle of 4°, the g loading at the airplane CG is 1.025 which is considered to be the highest probable go force. Given a sink rate of 500 fpm (8.33 fps) and a tail down angle of 8°, the g loading at the airplane CG is .7. The g force on a person would be one plus the airplane g force or 2.025 and 1.7 respectively.

Therefore, the vertical g forces were either equal to or less than 1.7 g's or 2.025 g's depending on the tail down angle and these values would have been reduced further by the ground effects.

The vertical g loads at the second impact were essentially negligible since the aircraft crossed the river and dragged the two forward main gear through the vegetation (with the nose gear above the vegetation since no nose gear track was evident) for some fifty feet indicating a very level trajectory.

J. W. Edwards
Chief Project Engineer
Project Engineering Division

JWE:bg


C5A C.G. LOAD FACTOR
vs
LANDING SINK RATE
GW = 450000 LBS
68-218
UPPER LIMIT SINK RATE
TAIL DOWN ANGLE 8° / 4°
SINK RATE - FT/SEC.
0
2
4
6
8
10
$n_{z_{CG}} = 1.0 + \Delta n_{z_{CG}}$
Ref. Pg. B. 10 LG1US 613/M-2-1
15 May 73 for 4° Curve
UPPER LIMIT G FORCE
0
.4
.8
1.2
$\Delta n_{z_{CG}}$

JAMES M. ESTABROOK
EDWARD H. MAHLA
JOHN C. MOORE
MacDONALD DEMING
GORDON W. PAULSEN
M. E. DeORCHIS
DAVID P. H. WATSON
RICHARD G. ASHWORTH
EDWARD L. JOHNSON
RICHARD B. BARNETT
MAURICE L. NOYER
SANFORD C. MILLER
FRANCIS X. BYRN
THOMAS R. H. HOWARTH
STEPHEN K. CARR
WALTER E. RUTHERFORD
R. GLENN BAUER
THEODORE M. SYSOL
CARROLL E. DUBUC
THOMAS F. MOLANPHY
LENNARD K. RAMBUSCH
JAMES J. SENTNER, JR.
RANDAL R. CRAFT, JR.
WILLIAM J. HONAN III
CHESTER D. HOOPER
EMIL A. KRATOVIL, JR.
JOHN J. REILLY
BARTON T. JONES
RICHARD D. BELFORD
BRIAN D. STARER
ROBERT B. HASEROT
JOHN K. WEIR
JUAN A. ANDUIZA
DONALD J. KENNEDY
RICHARD L. JARASHOW
WILLIAM F. PAN

HAIGHT, GARDNER, POOR & HAVENS
FEDERAL BAR BUILDING
1819 H STREET, N.W.
WASHINGTON, D.C. 20006
CABLE: MOTOR WASHINGTON
WU: TELEX 892598
TELEPHONE (202) 737-7847

BERNARD D. ATWOOD
SPECIAL PARTNER
J. WARD O'NEILL
COUNSEL
NEW YORK OFFICE
ONE STATE STREET PLAZA
NEW YORK, N.Y. 10004
TEL. (212) 344-6800
CABLE: MOTOR NEW YORK
RCA TELEX: 222974
WUI TELEX: 620362
ITT TELEX: 424674
WU TELEX: 127683
PARIS AFFILIATE
FRANCOIS LEGREZ
34, AVENUE GEORGE V
75008 PARIS, FRANCE
TELEPHONE 720-8202
CABLE: MOTOR PARIS
TELEX: 640669
CARROLL E. DUBUC*
RESIDENT PARTNER WASHINGTON
RALPH E. CASEY*
JOHN W. McCONNELL, JR.*
OF COUNSEL WASHINGTON
*ADMITTED TO D.C. BAR

August 7, 1981

Mr. James Turnbow
[redacted]
Pheonix, Arizona 85018

FFAC v. Lockheed Aircraft Corporation
Our file 2041-1278-2S

Dear Dr. Turnbow:

Please find enclosed a copy of John Edwards' most recent calculations relating to vertical G-forces felt by the C-5A survivors.

Very truly yours,

HAIGHT, GARDNER, POOR & HAVENS

By

Thomas B. Almy

/dh

Enclosure

LOCKHEED-GEORGIA COMPANY
A DIVISION OF LOCKHEED CORPORATION
INTERDEPARTMENTAL COMMUNICATION

TO R. P. Barton DEPT. 85-03 ZONE 35 DATE 29 July 1981

E-05-665-81

FROM J. W. Edwards DEPT. 72-05 ZONE 240 EXT. 4004

SUBJECT: C-5A SIAGON ACCIDENT FIRST IMPACT G LOADS

An analysis of all available data relevant to subject impact loads resulted in a range of loads based on the following data:

a) Engineering Analysis of Data From AF 68-218 - Second page states "The MADAR data for a period of 3.6 seconds prior to initial impact was lost due to power interruption at impact. At this point the airspeed was approximately 270 knots and the altitude trend information available indicates a probable sink rate at initial touchdown on the order of 16 ft/sec, however, it must be emphasized that no data exists for approximately 3.6 seconds prior to touchdown and ground effect should have produced a reduction in sink rate prior to ground contact."

b) Captain Harp's Court Testimony - Page 174, "The first landing, I would classify as a relatively smooth landing under the conditions, quite honestly. I have made firmer landings since then on a normal runway, I have seen firmer landings, both by military and commercial aircraft. I was prepared for a much firmer impact than what we had on the first landing."

c) Page 2141, "The first landing, I would describe as relatively smooth, considering the conditions we were landing in. I guess some people would probably call it a firm landing or something. I have seen worse landings. I personally have made worse landings."

d) Major Traynor's Court Testimony - Page 2213, "And the cushioning affect of the wings, against the ground made the airplane flare. And I remember looking at the vertical velocity and it was reading about 500 feet per minute, which is even less than a normal touchdown. So, I touched down the first time and was quite releived because of the non-severity of the touchdown."

e) Page 89, "The ground effect flared the airplane. We touched down in normal, or less than normal, rate of descent, so it was a very smooth initial touch." "One of the standard cross-check items is your rate of descent indicator, and I did notice that it was right at 500 to 600 feet per minute, which is the preferred normal rate of descent for touchdown."

f) My own personal observation at the accident site was that the aircraft initial touchdown caused failure of both aft main gears due to aft drag loads caused by the gears plowing into the soft dirt. There was no evidence of failure of the aft main gears due to vertical loads which indicates a normal descent rate and since the forward main gears and the nose gear stayed with the airplane until after the second touchdown, the initial touchdown was probably made at a tail down angle.

Attached is a graph of C-5A C.G. LOAD FACTOR VS LANDING SINK RATE prepared by the structures department. Given a sink rate of 600 fpm (10 fps) and a tail down angle of 4°, the g loading at the airplane CG is 1.025 which is considered to be the highest probable go force. Given a sink rate of 500 fpm (8.33 fps) and a tail down angle of 8°, the g loading at the airplane CG is .7. The g force on a person would be one plus the airplane g force or 2.025 and 1.7 respectively.

Therefore, the vertical g forces were either equal to or less than 1.7 g's or 2.025 g's depending on the tail down angle and these values would have been reduced further by the ground effects.

The vertical g loads at the second impact were essentially negligible since the aircraft crossed the river and dragged the two forward main gear through the vegetation (with the nose gear above the vegetation since no nose gear track was evident) for some fifty feet indicating a very level trajectory.

J. W. Edwards
Chief Project Engineer
Project Engineering Division

JWE:bg

C5A C.G. LOAD FACTOR vs LANDING SINK RATE

GW = 450000 LBS

68-218