Dr Charlie Turner

exhibits 4-9

11/24/81

Lytha

U R G E N T

ATTN: CHEN LEWIS, ESQ.

JOHN FRICKER, ESQ.

RE: FRAC V. LOCKHEED AIRCRAFT CORPORATION

OUR FILE 2041-1278-29

OUR TELEX NO. 81/11-29/CEL

WE HAVE JUST BEEN ADVISED BY DR. TURNER AT HIS DEPOSITION THAT HE PROVIDED YOU WITH A DRAFT REPORT WHICH HE BELIEVES IS STILL IN YOUR POSSESSION. WE FULLY EXPECT THAT YOU WILL PRESERVE THIS REPORT AND ANY OTHER MATERIALS PROVIDED TO YOU BY DR. TURNER (OR ANY OTHER WITNESS) AND PRODUCE THEM TO US IMMEDIATELY SO THAT WE CAN DEPOSE DR. TURNER ON THEM. PLEASE ARRANGE TO HAVE THESE DELIVERED TO OUR OFFICES IMMEDIATELY.

HAIGHT GARDNER POOR AND HAVENS

CARROLL E. DUBUC

DEFT. EX. ~~BD~~-Turner Feb. 4

DATE:

Accident Report

On April 4, 1975 a Lockheed C-5A aft ramp together with the attached pressure door failed at approximately 23,000 ft. The structural failure resulted in a sudden decompression of the aircraft, and partial loss of control by the cutting of the number 1 and 2 hydraulic lines, the control cables to the tail, and the alternate electric trim and rudder yaw, Even though number three hydraulic system was not damaged, primary pitch and yaw control were lost due to damage to the control cables to the tail. Using the remaining controls available to them, right aileron, spoilers, and engine thrust; the pilots were able to maintain control of the aircraft by a combination of banking aircraft and thrusting the engines in order to keep a quasi-level descent for an emergency landing. A quasi-level descent being a series of dives and pull-ups until the aircraft was at landing altitide. The aircraft approached its first touch down point on the east side of the Saigon River. Just before touch down the engines were at full throttle to reduce the descent rate and the aircraft was at a slight roll angle. As the aircraft was touching down the engines were retarded to idle. The velocity of the aircraft as recorded by the MADAR DATA was approximately 270 knots (456 ft./sec.) approximately 3-4 seconds. The average wind velocity recorded at Saigon Airport at the time of the crash was 15 knots. The direction of the wind was approximately to the west, therefore the ground airspeed of the C-5A was about 283 knots (478 ft./sec.). The velocity is about 2-1/2 times the aircraft's normal landing velocity. It will be demonstrated later that the C-5A came to a complete stop in a shorter distance (~1900 ft.).

DEFT. EX. ~~DD-~~ Turner Exh. 5
DATE: 11/24/81
REPORTER: A. J. GASDOR

than it does when it lands at its normal landing velocity (~2300 ft.) Therefore the aircraft impacted at 283 knots, and stopped in approximately 1900 ft.. A normal landing would be at approximately 110 knots. (190 ft./sec.) and would stop in about 2300 ft.

Impacts on the East Side of the Saigon River

As the C-5A approached its first impact point it had a velocity of 283 knots and the pilots had limited control of the aircraft. There was no record of the descent speed. The initial impact occurred when the aft landing gear struck a dike. The aircraft still lofting above the ground struck another dike this time more severely than the first. The landing gear dug into the soil for a short distance. The aircraft bounced up again and then settled back down hitting a third dike. The landing gear again dug into the soil. It is probable that two complete sets of landing gear were lost during or shortly after this impact. Photographs show wheels and pieces of the landing gear spread throughout this area. The C-5A bounced up again and made several small ruts with its engines or wing tips. The aircraft then hit another dike. Finally the C-5A became airborne again slicing several treetops off with its starboard wing. From the films it appears that there were at least eight or more distinct impact points east of the Saigon River. These multiple impacts all occurred in a distance of about 350 yards. The impacts were of sufficient magnitude (snapped off several pieces of landing gear) to have weakened part or all of the C-5A structure.

Impacts on the West Side of the Saigon River

The C-5A crossed the Saigon River at a probable velocity of 283 knots. This velocity may not be precisely relied upon and is believed to somewhat less because of the series of impacts encountered on the east side. The angle of attack of the aircraft (nose up or down) also cannot be estimated because of the lack of in-flight data. It is to be emphasized that the pilots had no control of the C-5A during any of the impacts.

The aircraft impacted on the west side of the Saigon River breaking the remainder of its landing gear off. The C-5A went into a sliding skid for about 175 yards. After this point the skid marks disappeared indicating that the aircraft may have lifted off the ground. The C-5A traveled about 150 yards and broke into four separate sections: the T-tail, the aft troop compartment, the flight deck and the complete wing structure. At this point of impact, large amounts of debris were found and a large section of the cargo floor was located. This is also the area where almost all of the dead were located. North-west and about 100 yards away from the last impact point, the T-tail was found. The T-tail had a clean fracture indicating a sudden separation from the fuselage. It appears the tail was thrown over to its location as a result of the impact. The flight deck moved in a south-west direction and traveled approximately 400 yards from the impact. It appears that the flight deck traveled about 150 yards in the air and skidded to a stop in the remaining 250 yards. The wing structure also detached during the impact and through a combination of inertial (96,000 lbs. fuel) and lift forces was propelled approximately

525 yards from the point of last impact. The aft troop compartment became detached from between the wing section and the T-tail, and was propelled from the impact primarily by inertial forces and possibly some lift force. The troop compartment began digging into the ground approximately 175 yds. from the point of last impact. The aft troop compartment then came to a sudden stop after hitting an elevation. The total distance the troop compartment dug into the ground was approximately 2 lengths of the structure or about 40 yards.

The velocity of the four major sections were equal at the point of break-up. The velocity at this point has been estimated (see Appendix I) as 200 knots, (338 ft./sec.). The estimated "G" forces for the aft troop compartment, flight deck and the T-tail are summarized below (see Appendix I for details):

1. <u>T-tail</u>: After close examination of the photographs, it was concluded that the T-tail had been sheared off during the last impact. The <u>minimum</u> "G" force range required to break the tail off according to our engineering analysis with data from Lockheed reports is 11 to 15.

2. <u>Flight Deck</u>: Given the initial velocity as 200 knots, and the measured slide path of the flight deck, an <u>average</u> "G" force range of 6-8 has been estimated.

3. <u>Aft Troop Compartment</u>: The aft troop compartment had an initial height at the point of breakup. The height combined with a velocity of 200 knots turned the aft troop compartment into a projectile. The troop compartment was airborne as indicated by the photographs for approximately 175 yards, and smashed down onto the ground at the end of its trajectory. The <u>average</u> vertical "G" force range was estimated to be 10_6-30_6. The aft troop compartment then started digging into the ground and came to a sudden stop by hitting a small hill. The <u>average</u> estimated horizontal "G" force range during the deceleration was 7-13. At the point of impact with the hill, the estimated horizontal "G" force range was 220 to 480. It is obvious from the engineering analysis that the "G" force environment in the aft troop compartment was extremely complex and severe.

Summary

In conclusion the C-5A had an approach speed of 2-1/2 times its normal landing speed. The pilot only had limited control of the aircraft before the crash and no control during the crash landing. The C-5A structure experienced a series of 8-12 impacts, some sufficiently severe to break off landing gear, on the east side of the Saigon River. Approaching the west side of the river the aircraft had a velocity of approximately 270 knots. The C-5A impacted and slid for a short time and bounced into the air again and impacted again about 400 feet away, breaking up into four major sections, each moving at a velocity of approximately 200 knots. The aft troop compartment experienced a severe and extremely complex "G" force environment. The engineering analysis of Appendix I demonstrates the complexity involved in attempting to calculate the "G" force environment. The assumption of constant deceleration over the complete crash site cannot be used. The average "G" force ranges in Appendix I are all based on conservative assumptions. Peak "G" forces, greater than what is calculated, undoubtly exist; but cannot be calculated.

Appendix I

Estimation of Deceleration Levels

In order for some of the passengers and crew to survive the crash, the airframe and ground had to absorb the energy of the airframe/passengers/crew in a manner that made their survival possible while removing the danger of a post landing fire. This energy absorbtion was accomplished over several definable periods of time/distances. One method of characterizing the events that occurred during the time from aircraft touchdown to points where the various parts came to rest would be to develop the deceleration time history. As indicated by the location of the major parts in the photographs of the crash site, the aircraft was subjected to complex set aerodynamic, inertia, and frictional forces. These complex forces thus would yield an equally complex deceleration time history. Since only the final position and an estimation of the initial conditions are known, it is not possible to evaluate but the simplest assumptions (constant deceleration) without some additional data. Even though not valid, the assumption of a constant deceleration for both the flight deck and aft troop compartment may be made after the aircraft breaks up. This assumption will yield a lower bound on the estimated maximum "G" load. Since only the initial conditions are known, additional data (structural failure) is needed to determine the intermediate conditions. Use of structural failures will only yield a lower bound on the applied loads/maximum "G's" since the rate of failure is not known.

The first step is to determine the form of the deceleration while the aircraft is intact, thus developing lift. The deceleration force is given by:

$$F = \mu (W-L) + D - T - D_p$$

Where: μ = Coefficient friction

W = Weight

L = Lift = $1/2\rho V^2 C_L S$

D = Drag = $1/2\rho V^2 C_d S$

T = Thrust

D_p = Drag of landing gear post

ρ = Density of air

v = Velocity

C_L = Coefficient of lift

C_d = Coefficient of drag

S = Wing area.

The deceleration is given by:

$$a = 1/m\left\{F\right\} = 1/m \left\{\mu(W-L) + D - T - D_p\right\}$$

where : m = mass of aircraft

The deceleration can be written as:

$$\frac{dv}{dt} = a$$

or :

$$\frac{m \cdot dv}{\mu (W-L) + D - T - D_p} = dt$$

since L, D and D_p will be a function of velocity. The aircraft may be pitching, therefore both C_L and C_d may be a function of time, but they are assumed to change much slower than the velocity. Intergrating the above will allow an estimation of the form of deceleration versus time. A cubic variation of deceleration with time would be a good approximation for the above equation using the stated assumptions:

$$\frac{dv}{dt} = a = ct^3$$

where c = constant

yielding:

$$V_F - V_I = \frac{ct^4}{4}$$

where V_F = final velocity
V_I = Initial

and,

$$S_F - S_I = \frac{ct^5}{20} + V_I t.$$

where S_F = final position
S_I = Initial position

Next, the equations can be developed for the region in which a constant deceleration is to be assumed, as with the structural failure which is to be used with the above equation, this assumption will yield a lower bound on the maximum "G" estimate. For this assumption:

$$\frac{dv}{dt} = a$$

yielding:

$$V_F - V_I = at$$

and,

$$S_F - S_I = \frac{at^2}{2} + V_I t.$$

For the above formulations the distances are obtained from the referenced reports, velocities from referenced reports and calculations. The calculation of an intermediate velocity is made by assuming a minimum deceleration to fail parts of the structure. This must be done since there is one more unknown than equations available. The tail failure was selected because the normal flight loads on the tail are seen as bending movements/axial loads on the fuselage. The deceleration loads are also seen as bending movements/axial loads on the fuselage, thus, the loads needed to fail the fuselage are known (Figure I and Lockheed Reports). Since the axial force is now higher, several calculations on the magnitude of the failure load were made. The calculated "G's" for the failure load is 13 plus or minus 2. For the estimate "G" an intermediate velocity of 360 ft./sec. plus or minus 20 ft./sec. is obtained (Figure II). The aft troop compartment will require about one and a half seconds to travel from the break up point to its final touch down point, about the same time to travel from its break up height to the ground. At the point of final impact the aft troop compartment will experience 10-30 vertical maximum "G's". The horizontal maximum "G's" will depend on the method used. If it is assumed that the aft troop compartment would have gone as far as the forward flight deck if the hill had not been present, then the average "G's" would have been about 7 (Figure III) with a much higher "G" level when the hill is impacted, (Figure IV). If the average "G" is calculated then the "G" is about 13. Since some of the seats containing children failed, it is possible to estimate a level of horizontal "G" loading in the aft troop compartment. Depending on the weight of the children, the horizontal loading would range from 60-85 "G's", (Figure V).

Summary

Within the assumptions made, the following maximum "G" loadings have been calculated, these would be mimimum values since the time rate of failure is not known.

Horizontal

11 - 15 before break-up (use of structural failure)

7 - 13 after break-up (integration)

60 - 80 after break-up (use of structural failure)

Within the assumptions made, the following "G" loadings has been estimated for various impacts.

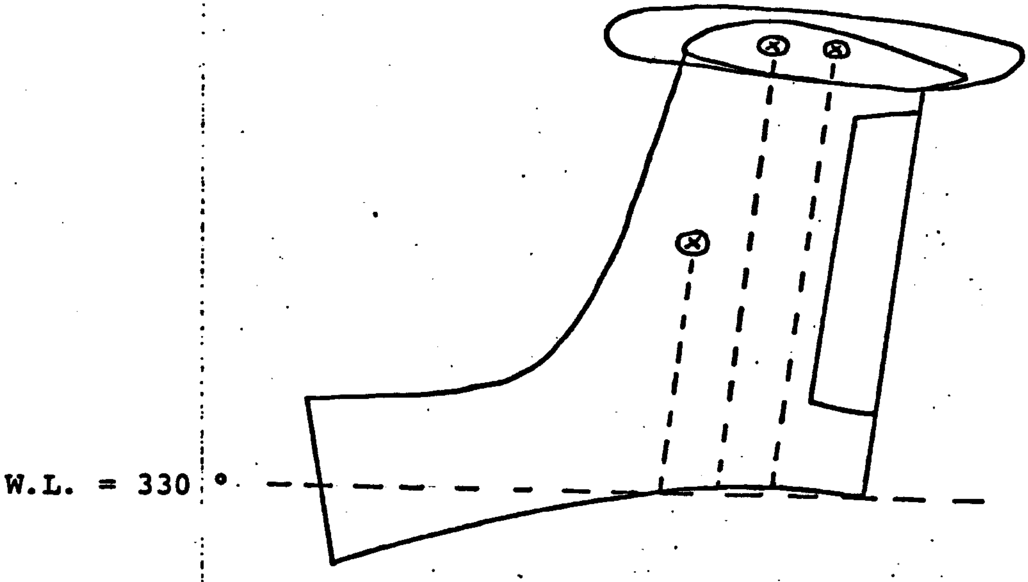
Horizontal

60 - 80 after break-up (use of structural failure)

220 - 480 after break-up (integration)

Vertical

10 - 30 after break-up (integration)



Item	Weight	$\bar{X}$	$\bar{Y}$	$\bar{Z}$	Mass
Bullet	769.4	2895.6	0.0	786.6	23.9
H.S.	3275.4	2921.3	140.1	787.5	101.7
V.S.	6151.0	2786.6	-0.1	633.1	191.02

$F = m(a) = [\ 23.9 + 203.4 + 196]\ a = 428.3(a)$ 15.

$M = 23.9\ (456.6)\ a + (2)\ (101.7)\ (457.5)\ a + (191.02)\ (303.1) a$

$\dot{M} = 1.619 \times 10^5\ (a)$

Figure I - Sample Calculation

Deceleration given by

$$a = ct^3$$

where a = -13 "G's" = -416 ft./sec^2

$$V_F - V_I = \frac{ct^4}{4} = \frac{-416t}{4} = -104t$$

$$V_F = V_I + \frac{ct^4}{4}$$

$$S_F - S_I = V_I t + \frac{ct^5}{20} = V_I t - \frac{416t^2}{20}$$

$$-20.8t^2 + V_I t - (S_F - S_I) = 0$$

$$t = \frac{-V_I \pm \sqrt{(V_I)^2 - (4)(20.8)(S_F - S_I)}}{(-20.8)(2)}$$, where $S_I = 0$

$S_F \approx 500$ ft.

$V_I \approx 463$ ft./sec

$$t = \frac{V_I \pm \sqrt{(V_I)^2 - (4)(20.8)(S_F)}}{41.6}$$

$t \approx 1.2$ sec. $V_F \approx 360$ ft./sec.

Figure II - Sample Collections

$$"G" = \frac{(V_I)^2}{64.4(\Delta X)}$$

ΔX = penetration into hill

ΔX = 2, 3, 4 ft.

then $"G_2" = 460 \pm 20$

$"G_3" = 320 \pm 20$

$"G_4" = 240 \pm 20$

$$t_2 = \frac{V_I}{(32.2)\ "G_2"} =$$

$$t_3 = \frac{V_I}{(32.2)\ "G_3"} =$$

$$t_4 = \frac{V_I}{(32.2)\ "G_4"} =$$

<u>Figure IV - Sample Calculations</u>

Seat is designed to transfer:

2500 lb horizontal

1250 lb vertical

375 lb lateral

to the floor beam without failing. For seat to fail in the horizontal direction with children, the "G" would be given by

$$G = \frac{2500}{(N)W_c}$$

N = number of children

W_c = Weight per child.

$$G = 60 - 85,$$

actual value would depend on the weight of the children. Note: the moment arm has not been adjusted for the children so the above estimates would be less than the actual values.

Figure V - Sample Calculations

Appendix II

Review of Reports by J.W. Turnbow and John W. Edwards

- Turnbow indicated that all seats remained attached and were facing rearward. Not all the seats in the aft troop compartment were facing rearward, and evidence presented indicated that some seats failed, but remained partially attached.

- The density of the wreckage and its location does not agree with the concept of many successive failures that Turnbow and Edwards hold to. In fact the wreckage diagram indicates that the aircraft parts were not always in contact with the ground.

- Structural failures in the aft troop compartment and the T-tail are inconsistent with the "G" forces they calculate.

- Photographs of the crash site and their description of the site are inconsistent. Example: rise the aft troop compartment is resting against.

- The amusement ride comparison with the C-5A crash analogy given by R.D. Jablonsky, Inc. cannot be compared. An amusement ride is a controlled uni-directional recreational vehicle. It produces constant accelerations and decelerations and is designed for safety. The C-5A crash was an uncontrollable large mass moving at 270 knots on inconsistent terrain. Multiple directional "G" forces were experienced with extremely high and uneven peaks.

Material Review

- USAF Collateral Report, Vol. I, II, III.
- Photographic documentation (still and motion picture) of the accident site and wreckage.

- John Edwards
  * Trial Testimony - 5-21-80
  * Trial Testimony - 3-11-80
  * Deposition
  * Report - Crash of AF68-218 C-5A on 4 April 1975

- James Turnbow
  * Deposition - 8 October 1981
  * Report - Analysis of "G" Levels Associated with the C-5A accident near Saigon - April 4, 1975.

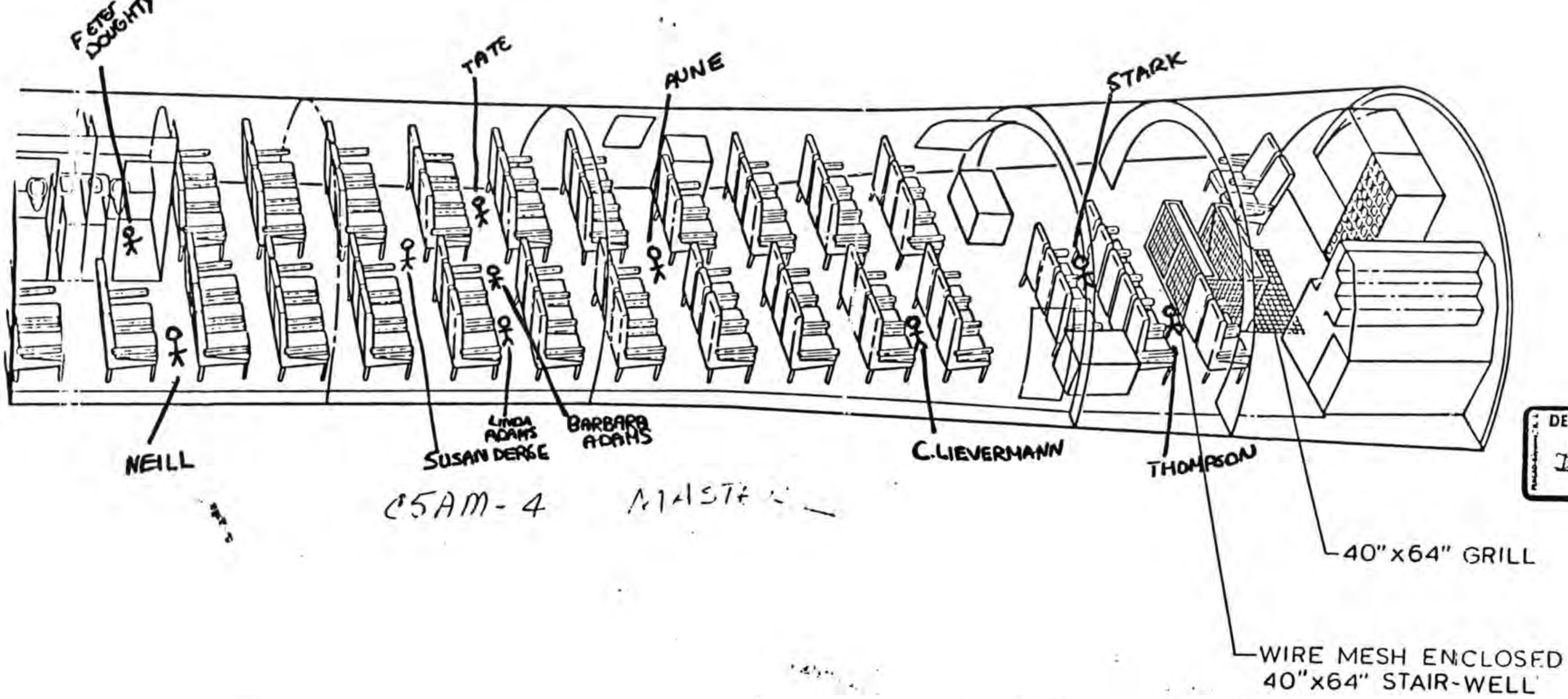
- William Timm
  * Trial Testimony 3-18-80
  * Trial Testimony 5-12-80

  Personnel Location Defendant's Exhibit D1210

- <u>Lockheed Reports</u>

* Report LG1US-46-2-2
* Report LG1US-54-12-1
* Report LG1US-44-1-2

- Article by Jane's - C-5A aircraft
- Photogrammetric Measurements and Soil/Vegetation Interpretations Related to the C-5A Incident by Dr. Stanley A. Morain.
- Failure of the C-5A Aft Pressure Closure by Joseph F. Tilson.



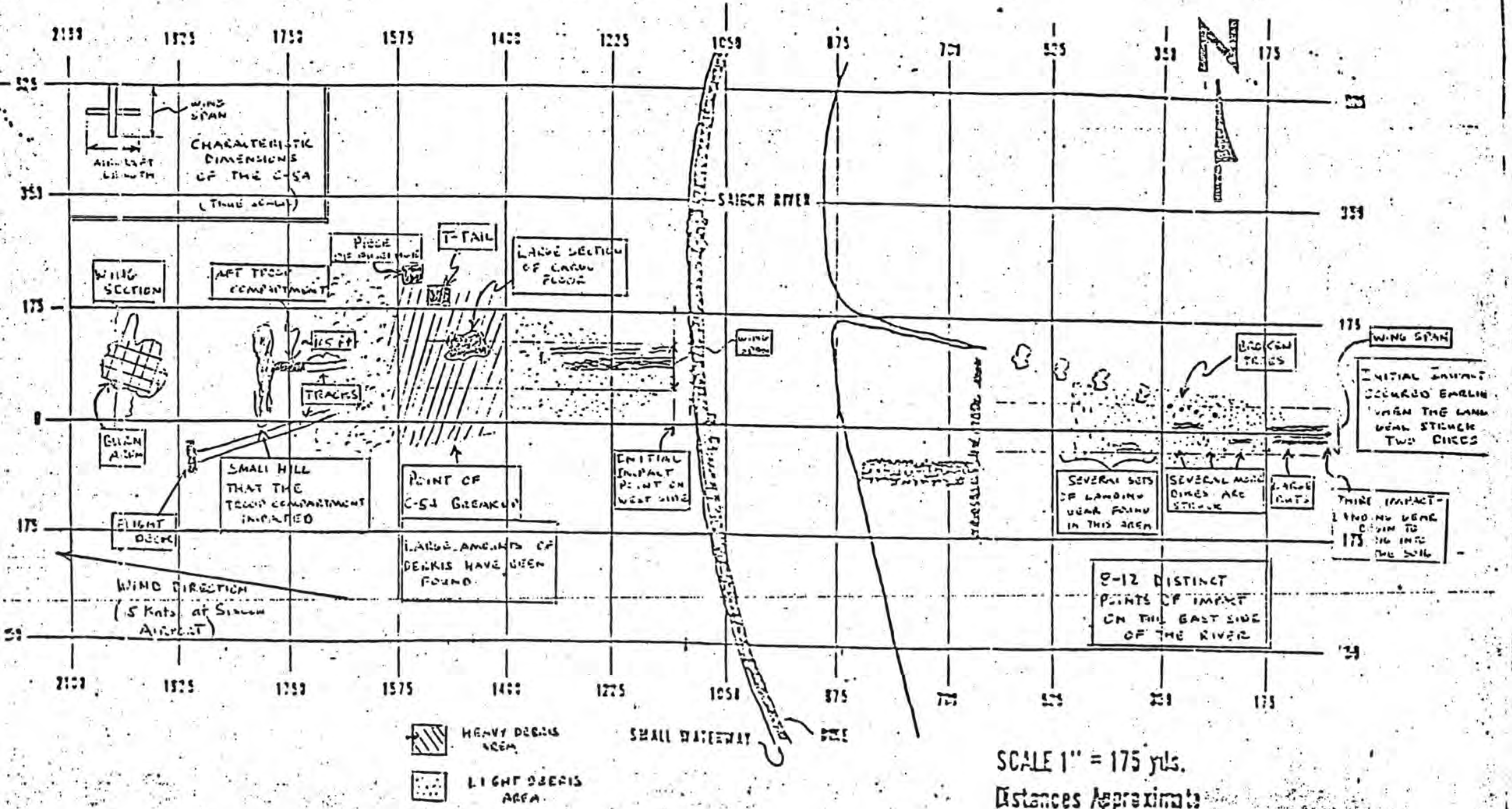
DEFENDANT'S EXHIBIT D1210

C5AM-4 MASTER

DEFT. EX. ~~DD~~-Turner Exh. 6
DATE: 11/24/81
REPORTER: A. J. GASDOR

WRECKAGE DIAGRAM

C-5A SN 68-218 4 APRIL 1975



TROOP COMPARTMENT LOCATIONS

	Reference:
NEILL, HARRIET GOFFINET:	
Forwardmost by latrine, left side facing latrine between the 2d and 3rd last row of seats, braced well between the seats, facing the babies; Thrown; Hit the forward bulkhead; found one baby who had come out of its seat	Collateral Statement Deposition testimony Schneider, Marchetti, Zimmerly trial testimony
TATE, MARCIA WIRTZ:	
4-5 rows in front of latrine; on right side facing flight deck; Held hand of Barbara Adams	Collateral Statement Schneider, Marchetti Trial Testimony
AUNE, REGINA:	
Mid-troop compartment, braced by sitting tailor-fashion in aisle, facing forward; slid all the way down aisle past latrines	Collateral Statement Deposition testimony Schneider trial testimony
GMEREK, GREGORY:	
Exact location unknown Braced in aisle, bounced over seats, ended up by latrines	Collateral Statement
BOUTWELL, OLEN:	
Exact location unknown Sitting in aisle	Collateral statement
DOUGHTY, PETER:	
In aft latrine, holding crippled child	Collateral Statement
HADLEY, JAMES:	
Exact location unknown, in aisle	
PARKER, WILLIAM:	
Unknown	
PERKINS, HOWARD:	
Unknown	

TROOP COMPARTMENT LOCATIONS CON'T

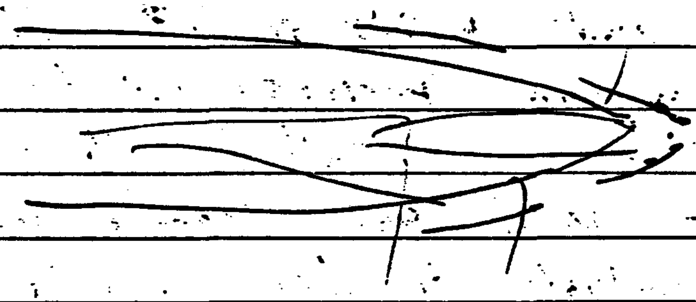
(CIVILIANS)	Reference:
ADAMS, BARBARA:	
2 rows in front of emergency doors, half between seats and aisle Thrown down aisle; fatally injured	Collateral Statements of Linda Adams, Marcia Tate
ADAMS, LINDA:	
Next to mother, nearer to wall Between seats	Collateral Statement
THOMPSON, THELMA:	
Behind the 1st row of seats on the floor, holding on to where the seats were anchored to the floor was pulled out of that section, managed to pull back into next row by emergency doors	Collateral Statement
DERGE, SUSAN:	
One-third of the way from the front, closer to latrine than gally or stairway; braced in aisle holding armrests	Collateral Statement. Aimmerly, Marchetti trial testimony
STARK, MERRITT:	
Forward of ladder by cargo hatch Between seats	Marchetti trial testimony
LIEVERMANN, CHRISTINE:	
Between rows 1 and 2 in front of stairwell Between seats	Collateral Statement

of train. – Calculate the forcing function – will be time dependent due to velocity changes –

Picture showing the depression and rise.

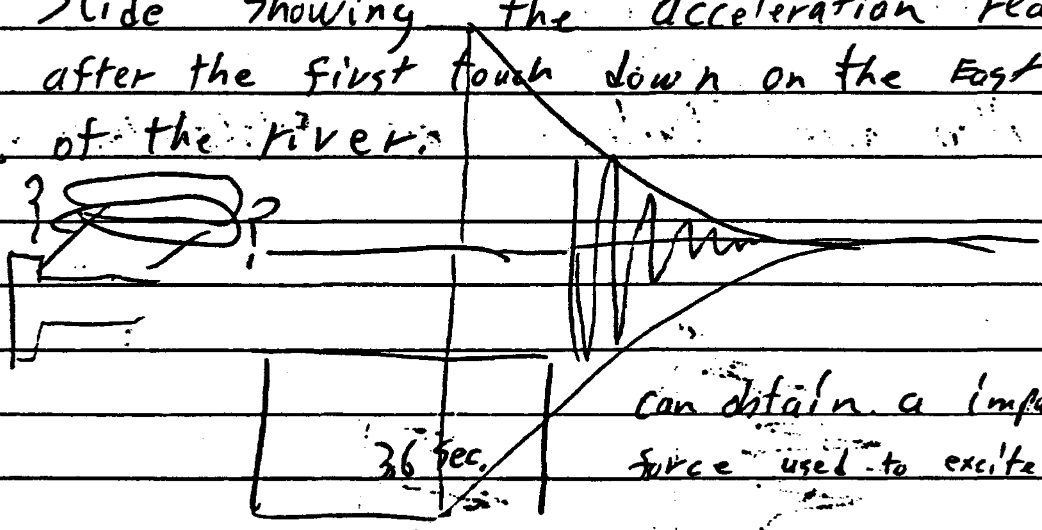
Need to do a rebound analysis on the seats — foam – seat deflection for various loadings

Talk to an aero on the effect of the base pressure on the cabin pressure. – at best will be cabin pressure – could be much lower at worst.



Aerodynamic report on the fuselage pressure distribution – May contain all data needed to calculate cabin pressure with door out – If not could use a higher order panelling method to obtain the pressure distribution.

Slide showing the acceleration readouts after the first touch down on the East side of the river.



can obtain a impulse "g" force used to excite structure

have velocity so can figure a time for the last impact –

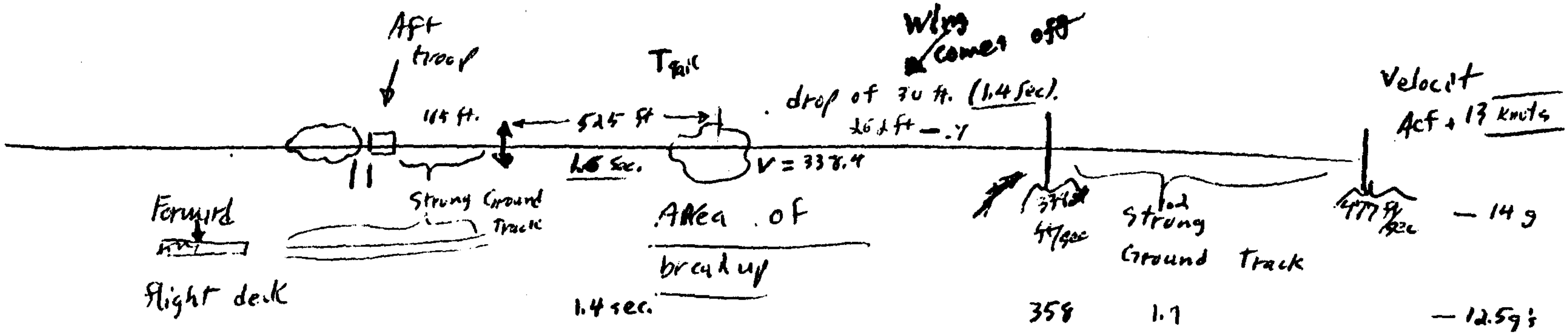
Use of the wing in estimating the possible aircraft velocities at the time of break-up. Complex motion (three dimensional with rotations) thus complex forces — both initial {failure of structure not being symmetric — as noted by the initial velocity/Acc. both linear and rotational given to the forward fligh deck} and while airborne.

Possible use of noted failure on forward flight deck — Aft troop compartment as an Indication of lower bound on maximum "g" loading.

Complete a NASTRAN model of aft troop compartment for use in determining the dynamic response node and maximum response points — why some seats failed others did not — will get Lockheed Report on modal analysis to check initial inputs.

Pylon failures may be of interest — one seemed to have failed at or pryor to wing separation — worth looking into —

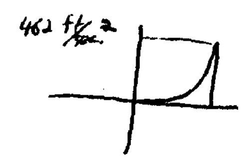
Also have structural failure of flight instruments — ?



structural Failures in troop compartment are due to ~~due to~~ the impact of compartment with hill, At this point the use of constant deceleration even though ~~still~~ not valid would be of some value in estimating minimum level of deleleration,

Failure of aircraft occurs at this time. Failure of Tail is due to inertia loads. Failure of wing is due to combined aerodynamic and inertia loads. Seperation of wing starts the sequence of the final break-up of the aircraft.

Use structural failure of tail as an estimation of the deceleration loads on aircraft at this point. Due to the complexity of the loading at this time the ~~use of~~ assumption of constant deceleration would be impractical and would yield little ~~no~~ information of value.



$a = ct^3$

DEFT. EX. ~~DD~~- Turner Exh. 8
DATE: 11/24/81
REPORTER: A. J. GASDOR

CRASH OF AF68-218 C-5A ON 4 APRIL 1975

By: John W. Edwards

Supervisor: LAC Technical Team
Serving Aircraft
Accident Board

AF 68-218 departed Ton Son Nhut Airport Siagon S. Viet Nam on 4 April 1975 and crash landed approximately 28 minutes later in a rice paddy while approaching the runway from which it had just de-parted.

At the time of the decompression the aircraft had climbed to an altitude of 23,200 feet approximately. The aircraft continued its climb for an additional nine (9) seconds to a maximum altitude of 23,424 feet at which time it began a descent. According to the on board data recording system, MADAR, the aircraft first reached 10,000 feet altitude approximately seven ( ) minutes and 51 seconds later. Attachment 5 dipicts the altitude time history.

1.0 The g'loads on the occupants at the decompression were essentially negligible as substantiated by the following information:

1.1 The Engineering analysis exhibit D-2 page 90 fifth paragraph indicates structural responses rather than airplane motions.

1.2 All crew statements described the decompression in terms of noise only. i.e., "Loud Pop" rather than airplane motion. Example: Harriett Mary Neill court testimony page 174 (Aimmerly case) last paragraph. "I remember the first thing I was aware of was that there was a loud pop and ---".

DEFT. EX. ~~DD~~- Turner Exh. 9
DATE: 11/24/81
REPORTER: A. J. GASDOR

DEFENDANT'S EXHIBIT D1298

2.0 Regarding the effects of Hypoxia, it should be noted that the altitude of 68-218 at 23,424 feet was more than a mile lower than Mt. Everest which has been climbed by man many times.

2.1 Chanute AFB in Illinois has a Physiological Training Unit which publishes an Atmospheric Pressure Table which advises that the time to parachute from 20,000 feet to 10,000 feet is 6 minutes and 30 seconds whereas the time of useful consciousness is over twice that or 15 minutes for a working crew member. A person at rest would consume less oxygen. Attachment 5 shows that the time from rapid decompression until the aircraft descended to 10,000 feet was 7' 45" approximately. This table is repeated below for convenience.

U. S. STANDARD

ATMOSPHERIC PRESSURE TABLE

PREPARED BY THE PHYSIOLOGICAL TRAINING UNIT · CHANUTE AFB, ILLINOIS

DO

1. Get annual physical within 60 days of birthday. (AFR 160-10)
2. Have base line ECG in records. (AFR 160-121)
3. Get physiological training refresher course every 3 years. (AFR 50-27)
4. Hand carry medical and dental records to new station. (ATC Sup 1 to AFM 160-5)
5. Eat before flying -- prevents hypoglycemia.
6. Pilots should not eat at same facility to avoid food poisoning.

DON'T

1. Fly while you have a cold or are fatigued.
2. Donate blood unless emergency -- no flying for 72 hours after donation. (AFR 160-92)
3. Fly without flight clearance from Flight Surgeon when reporting to new station. Time will not be logged. (ATC Sup 1 to AFM 160-5)
4. Fly for 24 hours following ingestion of drugs such as antihistamines (PBZ, benadryl, etc), narcotics or alcohol, etc. (Check with Flight Surgeon.).
5. Fly after injection treatment or drugs from Dentist.

PREVENT BURNS: Always wear coverall and gloves. Do not wear nylon undergarments or socks. Wear helmet and oxygen mask at all times in jet aircraft.

DON'T DOCTOR YOURSELF: Don't take any medicine unless your Flight Surgeon advises it. If you are sick, see your Flight Surgeon -- he is interested in your health.

OXYGEN LACK AND BAIL-OUT

ALTITUDE (feet)	TIME OF USEFUL CONSCIOUSNESS	TIME TO FREE FALL TO 10,000 FT	TIME (MIN) TO FALL TO 10,000 FT WITH 28 FT CANOPY OPEN	SYMPTOMS OF OXYGEN LACK
10,000	Many hrs	0:00	0:00	Fatigue, headache, drowsiness.
20,000	15 min	0:49	5:50	No sense of time, over-confidence, poor judgment, impared vision, faulty reasoning, unconsciousness.
30,000	1 1/2 min	1:31	12:28	
40,000	15 sec	2:05	16:54	If any of these symptoms appear, use 100% O_2 or Pressure. Check "P. D. McCripe" for oxygen leak!
50,000	9 sec	2:32	22:08	
60,000	9 sec	3:02	over 28:00	
				P - Pressure; R - Regulator
				D - Diaphragm Reg.; I - Indicator
				M - Mask; P - Portable eqpmt
				c - Clamps; E - Emergency eqpmt
				C - Connections

1. Standard bail-out bottle lasts 6 - 12 minutes.
2. Temperature - 67° F at 40,000 ft and above.
3. Free fall mandatory above 30,000 ft, due to extreme opening shock of parachute, temperature and oxygen lack.

382-8127

Altitude (Feet)	Pressure mm. Hg.	Pressure p.s.i.
38000	154.8	2.99
38500	151.2	2.92
39000	147.5	2.85
39500	144.1	2.79
40000	140.7	2.72
40500	137.4	2.66
41000	134.1	2.59
41500	131.0	2.53
42000	127.9	2.47
42500	124.8	2.42
43000	121.9	2.36
43500	119.0	2.30
44000	116.2	2.25
44500	113.5	2.19
45000	110.9	2.14
45500	108.2	2.09
46000	105.6	2.04
46500	103.1	1.99
47000	100.7	1.95
47500	98.3	1.90
48000	96.0	1.86
48500	93.7	1.81
49000	91.5	1.77
49500	89.4	1.73
50000	87.3	1.69
50500	85.2	1.65
51000	83.2	1.61
51500	81.2	1.57
52000	79.3	1.53
52500	77.4	1.50
53000	75.6	1.46
53500	73.8	1.43
54000	72.1	1.39
54500	70.4	1.36
55000	68.8	1.33
55500	67.1	1.30
56000	65.5	1.27
56500	64.0	1.24

Altitude (Feet)	Pressure mm. Hg.	Pressure p.s.i.
19000	364.0	7.04
19500	356.5	6.89
20000	349.1	6.75
20500	341.8	6.61
21000	334.6	6.47
21500	327.6	6.33
22000	320.8	6.20
22500	314.0	6.07
23000	307.4	5.94
23500	300.8	5.82
24000	294.4	5.70
24500	288.0	5.57
25000	281.8	5.45
25500	275.6	5.33
26000	269.6	5.22
26500	263.8	5.10
27000	258.0	4.99
27500	252.4	4.88
28000	246.8	4.77
28500	241.4	4.67
29000	236.0	4.56
29500	230.6	4.46
30000	225.6	4.36
30500	220.4	4.26
31000	215.4	4.17
31500	210.4	4.07
32000	205.6	3.98
32500	201.0	3.89
33000	196.3	3.80
33500	191.8	3.71
34000	187.3	3.62
34500	183.0	3.54
35000	178.7	3.46
35500	174.4	3.37
36000	170.3	3.29
36500	166.3	3.22
37000	162.4	3.14
37500	158.6	3.07

Altitude (Feet)	Pressure mm. Hg.	Pressure p.s.i.
0	760.0	14.70
500	746.4	14.43
1000	732.9	14.17
1500	719.7	13.92
2000	706.6	13.66
2500	693.8	13.42
3000	681.1	13.17
3500	668.6	12.93
4000	656.3	12.69
4500	644.2	12.46
5000	632.3	12.23
5500	620.6	12.00
6000	609.0	11.78
6500	597.6	11.55
7000	586.4	11.34
7500	575.3	11.13
8000	564.4	10.91
8500	553.7	10.71
9000	543.2	10.50
9500	532.8	10.30
10000	522.6	10.11
10500	512.5	9.91
11000	502.6	9.72
11500	492.8	9.53
12000	483.3	9.35
12500	473.8	9.16
13000	464.5	8.98
13500	455.4	8.81
14000	446.4	8.63
14500	437.5	8.46
15000	428.8	8.29
15500	420.2	8.13
16000	411.8	7.96
16500	403.5	7.80
17000	395.3	7.64
17500	387.3	7.49
18000	379.4	7.34
18500	371.7	7.19

Altitude (Feet)	Pressure mm. Hg.	Pressure p.s.i.
57000	62.4	1.21
57500	61.0	1.18
58000	59.6	1.15
58500	58.1	1.12
59000	56.8	1.10
59500	55.4	1.07
60000	54.1	1.05
60500	52.8	1.02
61000	51.6	0.998
61500	50.4	0.975
62000	49.2	0.951
62500	48.0	0.928
63000	46.9	0.907
63500	45.8	0.886
64000	44.7	0.864
66000	40.6	0.7861
68000	36.9	0.7149
70000	33.6	0.6494
72000	30.4	0.5903
74000	27.7	0.5366
76000	25.2	0.4876
78000	22.9	0.4430
80000	20.8	0.4028
82000	18.9	0.3661
84000	17.2	0.3327
86000	15.6	0.3024
88000	14.2	0.2749
90000	12.9	0.2498
92000	11.7	0.2270
94000	10.7	0.2063
96000	9.7	0.1875
98000	8.8	0.1704
100000	8.0	0.1549
120000	3.24	0.0628
140000	1.51	0.0293
160000	0.787	0.0152
180000	0.433	0.0083
200000	0.236	0.0046

CONVERSION FACTORS

I. PRESSURE:

1 atmosphere = 14.696 psi = 760 mm Hg = ~~[illegible]~~ 29.92 in Hg = 1013.3 mb.

1 mm Hg = 13.595 mm H_2O = 0.535 in. H_2O = 0.0193 psi

1 psi = 51.715 mm Hg

1 in. H_2O = 1.868 mm Hg

II. ALTITUDE:

1 foot = 0.3048 meter

1 meter = 3.2808

1 mile (US) = 1.6093 kilometer

1 kilometer = 0.62137 miles

III. VOLUME:

1 cu ft = 28.316 liters

1 liter = 0.03532 cu ft = 61.025 cu in

1 cubic meter = 35.314 cu ft

IV. TEMPERATURE:

Deg. Centigrade (°C) for Deg. Fahrenheit (°F)

$°C = 5/9\,(T°F - 32)$

Deg. Fahrenheit for Deg. Centigrade

$°F = (9/5\,T°C) + 32$

Temp. absolute (K) from Centigrade

$K = T°C + 273.16$

2.2 The medical attendants in the aft troop compartment reported no signs of Hypoxia. Example: Court testimony of Mary Neill (formerly Ms Goffenett) page 178 (Zimmerly case).

3.0 The vertical g' loads at the first impact were essentially negligible as substantiated by the following data.

3.1 Capt Traynor noted that the sink rate was between 500 and 600 feet per minute as documented in his court testimony page 90 (Marchetti case) second answer.

3.2 The engineering analysis section of the Accident Report notes that the landing gear would have failed at 11 to 16 feet per second rate of sink at the gross weight of 450,000 pounds due to the high vertical load which did not happen since only the two aft main gears failed at the first impact and broke in a drag load direction as a pencil would when held tightly in the fist and thrust across the table striking a heavy object.

3.3 The marks in the soil showed indentations of only the aft gear which broke and the stubs of these broken gear then plowed into the soft farm land digging up furrows too narrow for the entire gear. Reference Photograph 3G.

3.4 The remaining forward main gear and the nose gear were carried by the aircraft to the second impact point across the river.

3.5 Capt Traynor's court testimony on page 89 (Marchetti case) describes the first impact as "--- normal or less than normal rate of descent ---".

3.6 Harriett Mary Neill (Goeffenett) court testimony on page 180 (Zimmerly case) describes the first impact as "--- a firm commercial airliner landing ---".

4.0 The longitudinal decelerations at the first impact were essentially negligible as substantiated by the following data.

4.1 The engineering analysis, exhibit D-2, on page 90 third paragraph, shows the airpseed 3.6 seconds prior to first impact as 270 knots or 455 feet per second. On the fifth paragraph of the same page, the airpseed just prior to the second impact is listed as the identical 270 knots (455 feet per second), therefore, the speed did not reduce noticeably.

(?)

4.2 The crew statements as summarized in 3.5, 3.6 above also pertain to the absence of longitudinal deceleration since no sudden "bumps" were discussed.

4.3 Calculations of the change in aircraft velocity due the energy absorbed by breaking one of the aft mair gear as detailed in attachment #1 show that the aircraft would slow down by .2 feet per second from its initial velocity of 455 feet per second. The second aft main gear would have broken later with an additional .2 feet per second slow down.

4.4 Exhibit 3g which is a color photograph of the first impact point clearly shows:

A. The left aft gear striking the ground first - rolling a few feet and breaking off at about the same time the right aft gear strikes the ground rolls for a short distance and also breaks off as evidenced by a discontinuation of the tire marks. The aircraft in a left wing low attitude, continues to settle and the broken stub of the aft main gear starts plowing through the soft farm land. At the same time the two left engines come close enough to the ground to "vacuum" up the soft dust and rice straw as evidenced by the two clean streaks widely spaced at the same spacing as the two left engines on the C-5. The inboard door of the left aft gear, now being free to swing downward because of the broken gear strikes the ground just to the right of the deep darker plow mark and scrapes the surface of the soil resulting in a wider mark but less dark in color due to the lesser penetration of the soil. At this time the aircraft starts to gain altitude since no engine "vacuum" marks are in evidence. The aircraft still being close to the ground continues to blow away surface dust and straw.

The left aft gear tumbles free and stops to the left of the flight path near the vegetation that runs lateral to the flight path. The right aft gear ends up near the line of palm trees just to the right of the line of flight. The aircraft continues on toward the river with the right wing cutting off four (4) small palm trees in an ascending manner.

5.0 The vertical g loads on the occupants at the second impact were essentially negligible as shown by the following data.

5.1 The aircraft was very close to the ground as shown by color photograph exhibit 3F which shows the effects of the broken stubs of the aft main gear plowing through the vegetation on the river side of the dike. It is very noteworthy that the nose gear was above this vegetation on the river side of the dike since no middle plow mark was left by the nose gear. This nose up attitude of the aircraft allowed the main fuselage to clear the dike therefore the aircraft literally flew onto the rice paddy severing the nose gear and then the remaining two forward main gear at the dike. Again the color photograph indicates the aircraft was in contact with the rice paddy very shortly after crossing the dike.

5.2 The plow marks on the river side of the dike are essentially uniform from the river to the dike as shown by exhibit 3F indicating that the aircraft was not descending rapidly. An appreciable descent rate would have shown a widening and deepening of these plow marks.

5.3 The pilot of the aircraft, Capt Traynor, in his court testimony on page 2215 (Schneider case) describes the second impact as "This time it shook the aircraft a little bit more" and "well, it was a vibration like I had blown a tire or run off a runway."

5.4 Neither pilot nor co-pilot mentions being bounced up and down which would be indicative of vertical g loads.

5.5 In the aft crew compartment all adult occupants were in positions other than normal seats. Mrs Neill (formerly Goffenett) was in between two rows of seats with her arms spread over the seats she was facing. None of these occupants were dislodged from their position despite the lack of normal seat belt restraints except Mrs. Neill who was between rows of seats 2 and 3 from the front, as evidenced by her court testimony on page 87 (Marchetti case). Mrs. Neill stated that after the first impact she " must have let loose", "and the second impact, I was thrown forward against the forward bulkhead".

Doctor Stark in his court testimony (Marchetti case) on page 25 stated that none of the adults had seats. Because of his concern for the impending landing, Doctor

Stark had sat down between two rows of seats (page 30) and braced himself against the seat at his back and was not dislodged from this position during the entire sequence. Also, on page 30 he describes the sequence "--- and there was certainly a very definite impact but everything remained pretty much as it was." On page 34 he refers to the condition of the children as "---essentially, unchanged from the time they were aboard the plane, as near as I could determine."

Capt Marcia Gray Tate was on her knees between two rows of seats leaning forward over the seats in front of her as discussed in her court testimony (Marchetti case) on page 33. On page 35 she testified that she stayed in that position until the aircraft came to a complete stop. Also, on page 35 she described the landing as "--- bumpy but it was not particularly violent", and compared the landing on page 36 as "yes, there was -- very similar to me -- to a rough landing in a commercial aircraft that I had been in previous to that."

Lieutenant Aune was sitting in the aisle with her legs crossed and bracing herself with the seats according to her court testimony (Marchetti case) on page 1914. Also on page 1915 it is noted that she was not dislodged except as a result of turning loose to grab someone's ankle who was standing. At this time she went sliding along the floor to the front.

These statements together with the physical evidence and photographs indicate that the vertical g loads were negligible.

6.0 The longitudinal decelerations were fairly uniform and of a relatively low magnitude for an airplane crash.

6.1 The g loads as computed by using velocity and distance were 1.6 average for the occupants of the aft troop compartment and 1.46 for occupants of the flight deck. Refer to Attachment 2.

6.2 The expected variation in this average would be a peak of 3.91 g's as scaled from 27 different tests of rocket sled test by the Air Force in 1951 used to develo restraint systems. The cover sheet and tabular data sheet is listed as Attachment

6.3 The terrain was flat, wet, grassy and free of any obstructions (such as trees or rocks. — ? forgot the hill - rise - ?

6.4 The aircraft sliding in essentially a straight line stayed in contact with the ground at all times as shown by photographs 3E, 3F, and 3B. ?

6.5 The occupants were seated in rear-ward facing seats which means that the occupant is pressed into the seat cushions by the decelerations.
Not all

6.6 The occupants are seated approximately 20 feet above the bottom of the fuselage which means that the soft aluminum structure absorbs and cushions the shock loads in a manner similar to the soft body structure of a racing car which is termed " deformable" by race car drivers.

The errosion of this structure by the scrubbing action of the rice paddy would be felt as vibration and noise rather than a shock due to the cushioning action of the structure between the occupant and the ground.

6.7 The average g' load of 1.6 would be only one-tenth that of the average of the 43 rocket sled test in the attachment 3 report. In all these cases the deceleration distance was from 24.6 feet to 47.1 feet with a velocity change of ranging from 77 feet per second to 181.5 feet per second.

6.8 The peak deceleration of 3.91 g's is about one-half of what one experiences in an amusement part ride which range from 1.53 g's to 6.2 g's.

?

6.9 The aircraft skidded through the wet rice paddy in a slightly nose up attitude as indicated by the front end of the aircraft being more intact - that is the entire circumference of the nose section, although severely damaged was with the crew compartment as shown in photo 3C. The crew compartment actually skidded on the lower portion - and after coming to a stop - rolled over on the right side since no mud is noted on the cab top.

6.10 The copilot, Capt Harp, actually described the stopping of the aircraft in his court testimony on page 2143 (Schneider case) as "It seemed like we were sliding through a bog. The slide itself was relatively smooth."

7.0 As the aircraft slide through the rice paddy, the errosion of the lower fuselage up to the cargo floor severely diminished the structural integrity of the aircraft. This scrubbing action tore off pieces of structure - absorbing the speed of the aircraft and opening up cracks in the structure.

7.1 When the errosion penetrated the cargo floor at about 800 feet from the dike the cracks opened up the sides of the fuselage and the wing - still having lifting power due to the remaining velocity, actual broke free from the flight deck in front of the wing and the aft troop compartment aft of the wing, and literally flew off separately. The wing landed a football field and a half in front of the aft troop compartment where a fire broke out consuming most of the wing.

7.2 At about the same time the empennage, due to the structural cracks formed by the scrubbing away of the aft fuselage, and having lifting power also, broke loose and flew separately off to the right side.

7.3 The flight deck, with the lower portion more intact, continued to slide through the wet rice paddy and curved off to the left. At the end of the slide the flight deck turned over on its right side. The total distance traveled by the flight deck was scaled from the wreckage diagram attachment 7 as 2,209 feet which computes to an average g load of 1.46 in the longitudinal or X axis and the lateral movement was scaled as 607.89 feet from the time of separation. This computes to 1.07 g's in the lateral or Y axis as shown in attachment 4.

7.4 The aft troop compartment, at the time of separation from the wing and empennage, continued to slide through the rice paddy. Since the lower portion of the fuselage under this troop compartment was not intact, the friction was greater and the distance traveled was less - actually scaled as 2,012 feet computing 1.60 g's in the X axis. The lateral movement was also less - actually scaling at 121.58 feet which computes at .29 g's in the Y axis.

and hill

7.5 The aft troop compartment was now open at the front end due to the departure of the wing. This opening allowed relatively warm 100°F airto enter this compartment which was previously cooled at about 70°F. This sudden inrush of warm air would have been noticed by the occupants. The aft troop compartment came to a rest about 150 yards from the burning wing, pointing almost directly at the fire area. Although the wind was blowing in a direction to carry the smoke and fumes away from the aft troop compartment, undoubtedly some fire oder would have been noticed even 150 yards away.

7.6 There was no fire in the area of the aft troop compartment as evidenced by color photograph 3B and my own personal observations at the site.

Discorloration of area ?

7.7 There was no fire in the area of the crew compartment as evidenced by photographs 3C and my own personal observations at the site.

7.8 The only fire was in the wing area as shown by 3A.

The foregoing opinion is based on a total assessment of all the available evidence and information and includes; actual on the site participation in the search for pertinent aircraft parts, an examination of the wreckage, evaluation of recorded data on the on-board recording system MADAR, evaluation of all crew statements made to the Collateral Board, evaluation of statements made by crew members in depositions, evaluation of statements made by some crew members in court testimony, evaluation of aerial photographs, and on the site knowledge of the type of terrain. ?

The preponderance of evidence leads to a reasonable engineering conclusion that the occupants of this aircraft were not harmed by the g' loads at either the Rapid Decompression or the impacts with the ground.

{deaths in troop compartment}

Further it is a considered engineering opinion that the occupants were subjected to far less severe conditions of "thin" air than that which is expected to be harmful. an M.D. also

J.E. Edwards

John W. Edwards
Chief Project Engineer
Lockheed-Georgia Company

Determine Aircraft Velocity Change due to breaking of main gear strut due to drag loads:

KE_1 = before 1st impact

$$KE_1 = 1/2\ MV_1^2 = 1/2\ \frac{451000}{32.2} \times 455^2$$

$$KE_1 = 1.4498 \times 10^9$$

Energy absorbed by breaking one gear:

Assume gear picked up drag load for 10 feet starting at 0 drag and increasing to 250000 at 10 feet

$\therefore$ Average distance is 5 feet

$\therefore$ $Fxd = 250000 \times 5 = 1.250 \times 10^6$ foot pounds

KE_2 = energy left after breaking first gear.

$$KE_2 = KE_1 - 1.25 \times 10^6$$

$$KE_2 = 1449.8 \times 10^6 - 1.25 \times 10^6$$

$$KE_2 = 1448.55 \times 10^6$$

Velocity after 1st impact:

$$KE_2 = 1/2\ MV_2^2 \quad \text{or}$$

$$V_2^2 = \frac{2 \times KE_2}{M}$$

$$= \frac{2 \times 1.44855 \times 10^9}{\frac{451000}{32.2}}$$

$$= 2.89710 \times 10^9 = \frac{2.8971}{1.40062 \times 10^4} \times 10^9$$

$$V_2^2 = 2.068441 \times 10^5$$

$$V_2 = 454.80 \text{ feet per sec*}$$

The aircraft would travel this 10 feet in $\frac{10}{455}$ or .022 sec., therefore, Velocity change .2 feet sec. in .022 sec.

$$V = AT \text{ or } A = \frac{.2}{.022} = 9.09$$

$$g's = \frac{A}{32.2} \qquad g's = .28$$

*This is for one gear - the second gear would impart a similar .2 ft decel at a later time.

AF TECHNICAL REPORT No. 5915, Part 2 December 1951

HUMAN EXPOSURES TO LINEAR DECELERATION

Part 2. The Forward-Facing Position and the Development of a Crash Harness

John Paul Stapp, Major, USAF (MC)

[redacted]

United States Air Force
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Wright-Patterson Air Force Base, Dayton, Ohio

Run No.	Subject	Initial Velocity (A)	Final Velocity (B)	Velocity Change (C)		Duration (D)	Equivalent Stopping Distance (E)	Calculated Slope (F)	Calculated Plateau (G)	Weight of Subject (H)	Force G x H (I)	Harness Area (J)	Harness Pressure (K)
		(ft/sec)	(ft/sec)	ft/sec	mph	(Seconds)	(Feet)	(g/sec)	(g)	(Pounds)	(Pounds)	(sq. in)	(PSI)
		Configuration No. 1 Deceleration Distance, 47.1 feet. Active Brake Units, 1,2, — 12, 13, — 23, 24.											
96	JFB	217	115	102	69.5	.30	12.6	1170	11.3	172	1940	137.5	14.1
101	JFS	No displacement record											
119	JFS	202.5	95	107.5	72.6	.33	15.6	1060	10.9	174	1893	217.5	8.7
120	DIM	No displacement record											
121	WAR	200.5	72	128.5	87.6	.37	20.5	575	11.9	152.5	1814	207.5	8.7
		Configuration No. 2 Deceleration Distance 35.4 feet. Active Brake Units 1,2,3, — 12, 13 14, — 23, 24											
94	JFB	216	128	88	61	.21	8.5	1055	15.0	172	2575	261	9.9
95	JPP	No displacement record											
97	WAR	226	149	77	52.3	.21	4.1	1079	15.0	155	2310	244.5	9.5
98	WAR	214	116.1	97.9	66.5	.21	11.0	1150	16.8	154	2586	207.5	12.5
102	RHA	216.2	121	95.2	65	.21	10.0	1165	16.7	170	2840	265.5	10.7
106	DIM	220	126	94	64.2	.21	9.0	1170	16.6	176	2920	271.0	10.8
117	RHA	220	145.5	74.5	50.7	.21	4.9	980	13.9	170	2366	204.0	11.6
118	RL	202	113.5	88.5	60.4	.22	10.6	923	14.3	177	2522	238.0	10.6
149	FMB	215.5	123	92.5	63.2	.235	16.5	970	17.5	197	3445	198.2	17.4
150	ED	223.5	141	82.5	56.3	.22	4.4	935	16.9	208	3500	198.7	17.6
164	WJAM	195	92	103	70	.22	15.2	940	15.0	(142+21)	2445	168.0	14.2
		Configuration No 3. Deceleration Distance 26.7 feet. Active Brake Units, 1,2,3,4 — 12,13,14,15											
99	JPP	216.2	126	90.2	61.5	.16	6.5	1101	21.2	149	3160	201.3	15.7
100	WAR	220	129.5	90.5	61.8	.16	6.0	1080	20.4	155	3225	244.5	13.2
142	WAR	222	135	87.0	59.4	.16	5.1	1150	21.2	155	3280	176.5	18.6
143	JPP	219	128	91.0	62.2	.16	6.2	1015	23.5	149	3500	170.3	20.6
146	WAR	220	131	89.0	60.8	.16	5.7	1022	23.3	155	3610	176.3	20.5
147	JPP	210	108	102	69.6	.175	7.8	1000	24.1	149	3590	170.3	21.2
148	WAR	No displacement record											
162	JFS	No displacement record											
163	JFB	132	0	132	[illegible]	.23	18.5	894	32.0	(170+21)	6112	186.0	32.9
165	JFS	206	126	80	54.4	.17	5.3	934	18.0	(170+21)	3438	186.0	18.5
166	JFS	200	107	90	63.2	.175	8.0		19.4	170	3298	186.0	17.7
		Configuration No 4 Deceleration Distance 25.7 feet. Active Brake Units, 1,2,3,4,5 — 12,13,14											
103	JPP	224	140	84	57.3	.16	3.3	1110	25.8	155	4000	210.3	16.7
124	WAR	208.6	122.2	86.4	59.	.16	6.2	975	24.3	152	3695	207.5	17.8
125	RHA	No displacement record											
122	JPP	204	126	78	53.2	.16	5.6	980	25.0	152	3800	201.3	18.9
		Configuration No. 5 Deceleration Distance 24.6 feet. Active Brake Units, 1.2.3.4.5.6 — 12.13											
107	JPP	218	134	84	57.3	.16	3.2	946	27.0	149	4030	210.3	16.8
108	WAR	212	129	83	56.7	.15	4.0	980	28.9	153	4422	207.5	18.1
109	RHA	213	133	80	54.6	.155	2.4	990	28.2	170	4800	204.0	26.9
110	JFS	226	142	84	57.4	.15	2.0	1150	31.8	172.5	5490	217.5	25.2
111	JPP	211	104	107	73.0	.15	8.0	1170	34.6	152	5255	210.3	21.8
123	RHA	197.6	106	91.6	62.0	.16	7.7	910	28.5	170.5	4859	204.0	23.8
124	JFS	210	134	76	51.7	.16	3.2	900	26.7	174.5	4659	217.5	21.4
129	WAR	No displacement record											
130	JPP	201	124	77	52.5	.16	4.8	796	24.8	153	3792	210.3	15.8
		Backward Facing, Seated Position *											
113	WAR	206	90	116	72.1	.16	8.2	1156	35.0	152	5320	260	20.5
134	JPP	208	96	112	76.4	.16	9.2	1160	34.8	153	5324	252	21.1
		Configuration No. 6. Deceleration Distance 24.6 feet											
133	RL	213	87	126	86	.155	11.1	1370	38.6	177	6839	238	28.7
135	JFB	220	105.5	114.5	78.9	.16	7.7	1344	38.1	172	6553	217.5	30.2
		Configuration No. 7 Reduced Brake Pressure											
		Deceleration Distance, 39.5 feet. 38 consecutive brakes at 150 to 200 p.s.i. closing pressure											
210	FMB	210	116	94	64.2	.237	12.0	281	13.9	206	2864	280	10.2
		Deceleration Distance, 36.4 feet 35 consecutive brakes at 200 to 250 p.s.i. closing pressure											
211	JFB	218	123	95	64.8	.215	9.9	288	20.6	175	3604	217.5	16.6
		Deceleration Distance, 34.3 feet 33 consecutive brakes at 250 to 300 p.s.i. closing pressure											
212	FMB	210	89.5	120.5	82.2	.217	14.9	300	32.7	206	6738	280	24.1
		Deceleration Distance, 36.4 35 consecutive brakes at 250 to 300 p.s.i. closing pressure											
213	JFB	224	71.0	143	97.5	.250	18.7	314.5	36.5	175	6386	217.5	29.4
		Deceleration Distance, 36.4 35 consecutive brakes at 300 to 350 p.s.i. closing pressure											
214	FMB	222.5	41.0	181.5	123.8	.283	24.8	331	38.62	206	7938	290	28.35
		Deceleration Distance 31.2 feet 30 consecutive brakes at 350 to 400 p.s.i. closing pressure											
215	JFB	226	50.2	175.8	120.	.228	19.7	493.5	45.4	175	7942	217.5	36.5

A. Velocity at entry to brakes
B. Velocity at exit from brakes
C. Velocity change in miles per hour and feet per second
D. Duration of deceleration
E. Calculated equivalent stopping distance for the observed deceleration if final velocity were zero
F. Initial slope of deceleration-time curve calculated from displacement-time record.
G. Plateau of trapezoidal deceleration-time curve calculated from displacement-time record.
H. Weight in pounds of subject just prior to run.
I. The product of calculated plateau g-times the weight of the subject , from columns F and G.
J. Measured area of harness webbing impinging on the subject in the forward seated position.
K. The force in column H, divided by the harness area column I, to give average harness pressure

* Measured back area of subject against seat.

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	3.42
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	1.83	*	*
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

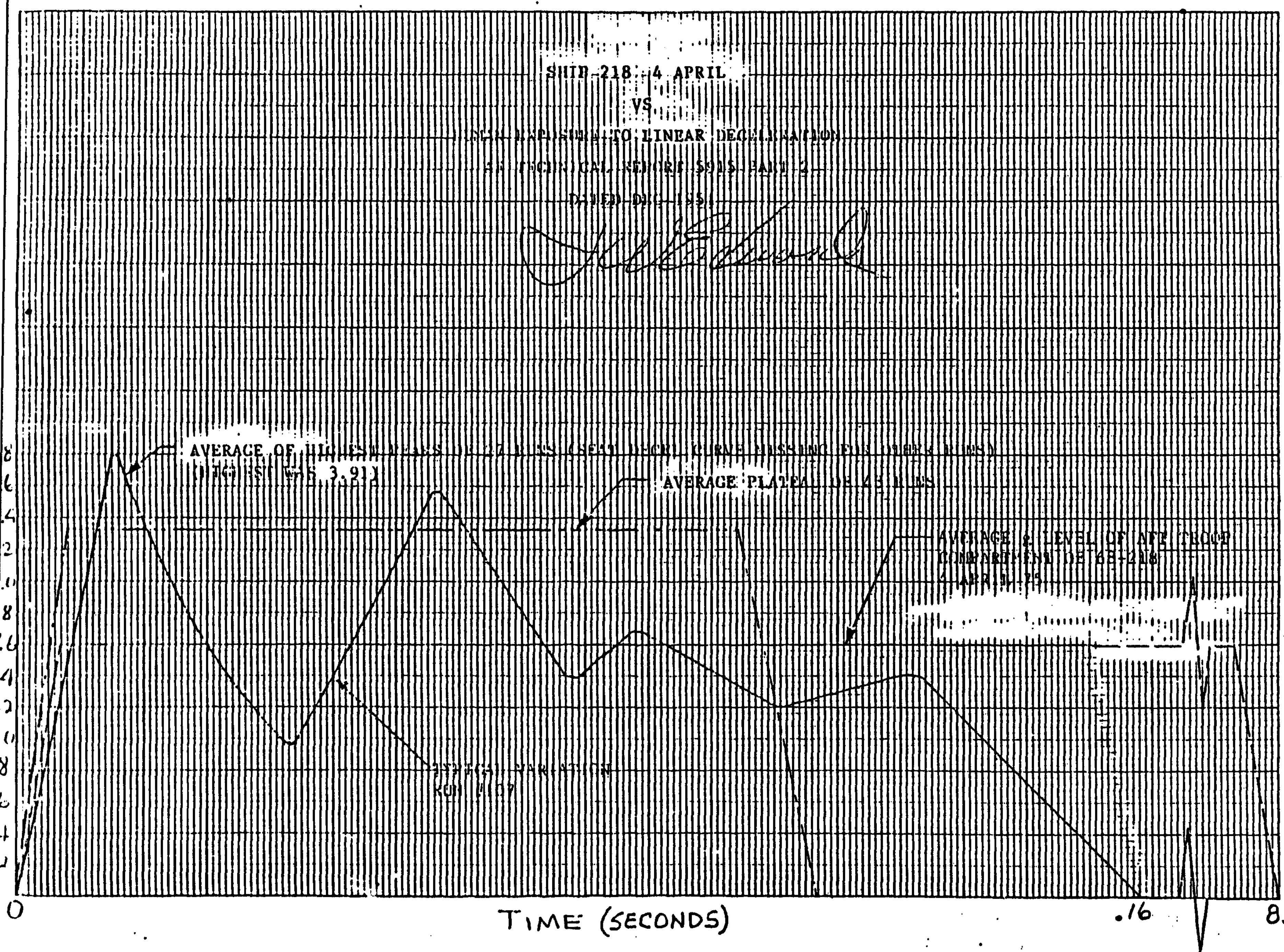
REF: HUMAN EXPOSURE TO LINEAR DECELERATION AF 5915 PART 2 DATED DECEMBER 1951
TABLE II, PAGE 20

△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 referenced 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.



ATTACHMENT #3

"Y" AXIS g LOADS ON PASSENGER COMPARTMENTS

Note (1) Troop compartment traveled 121.58 feet in the "y" axis after separation from the aircraft.

- Total travel time $\frac{455}{51.56} = 8.82$

  T = 5.083 for 1159 feet

- $d = 1/2\ AT^2$ or $A = \frac{2d}{T^2}$

- $A = \frac{2 \times 121.58}{(5.083)^2} = 9.41$

  $g's = \frac{9.41}{32.2} = .29$

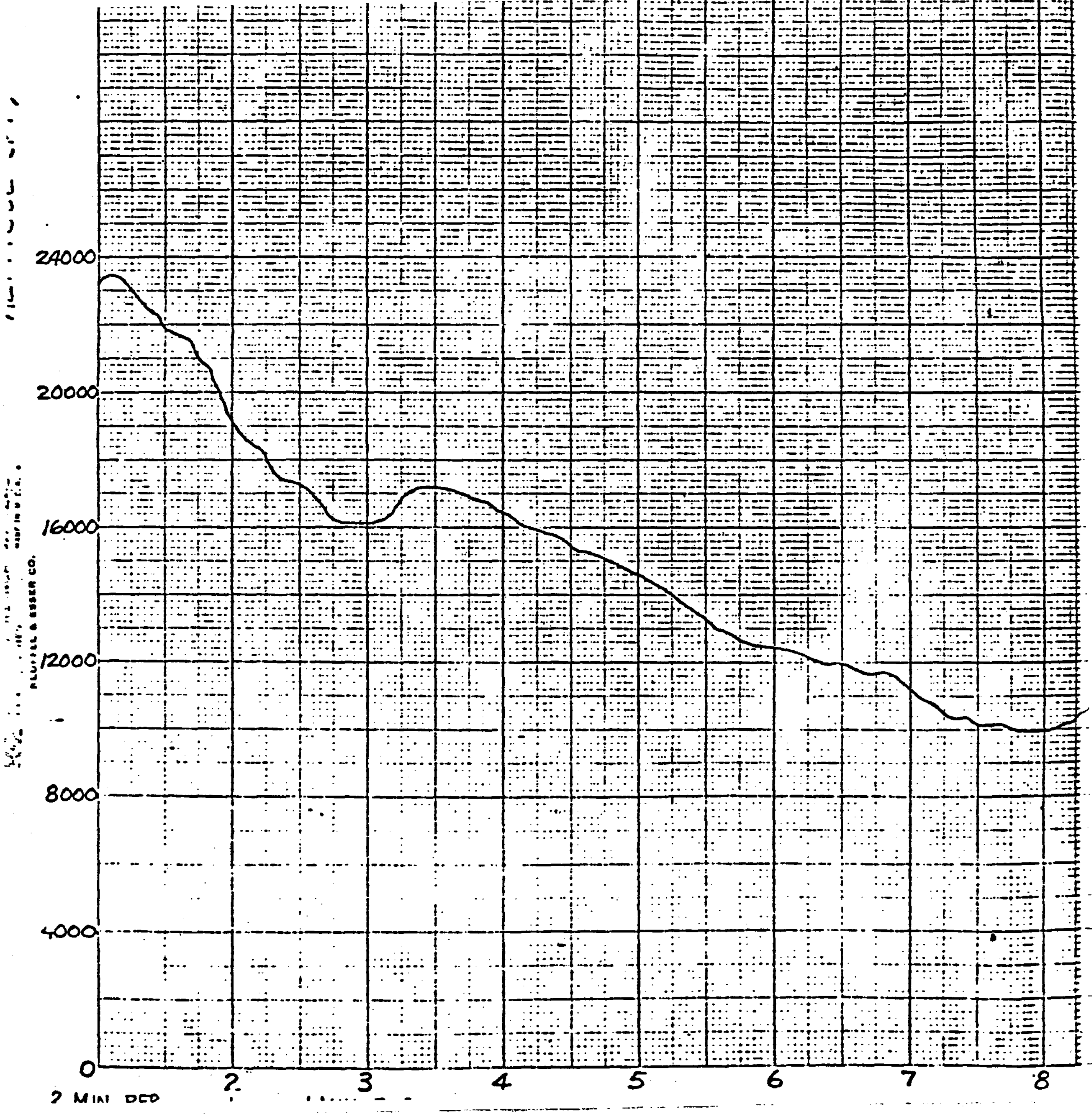
(2) Flight Deck traveled 607.89 feet in the "y" axis after separation from the aircraft.

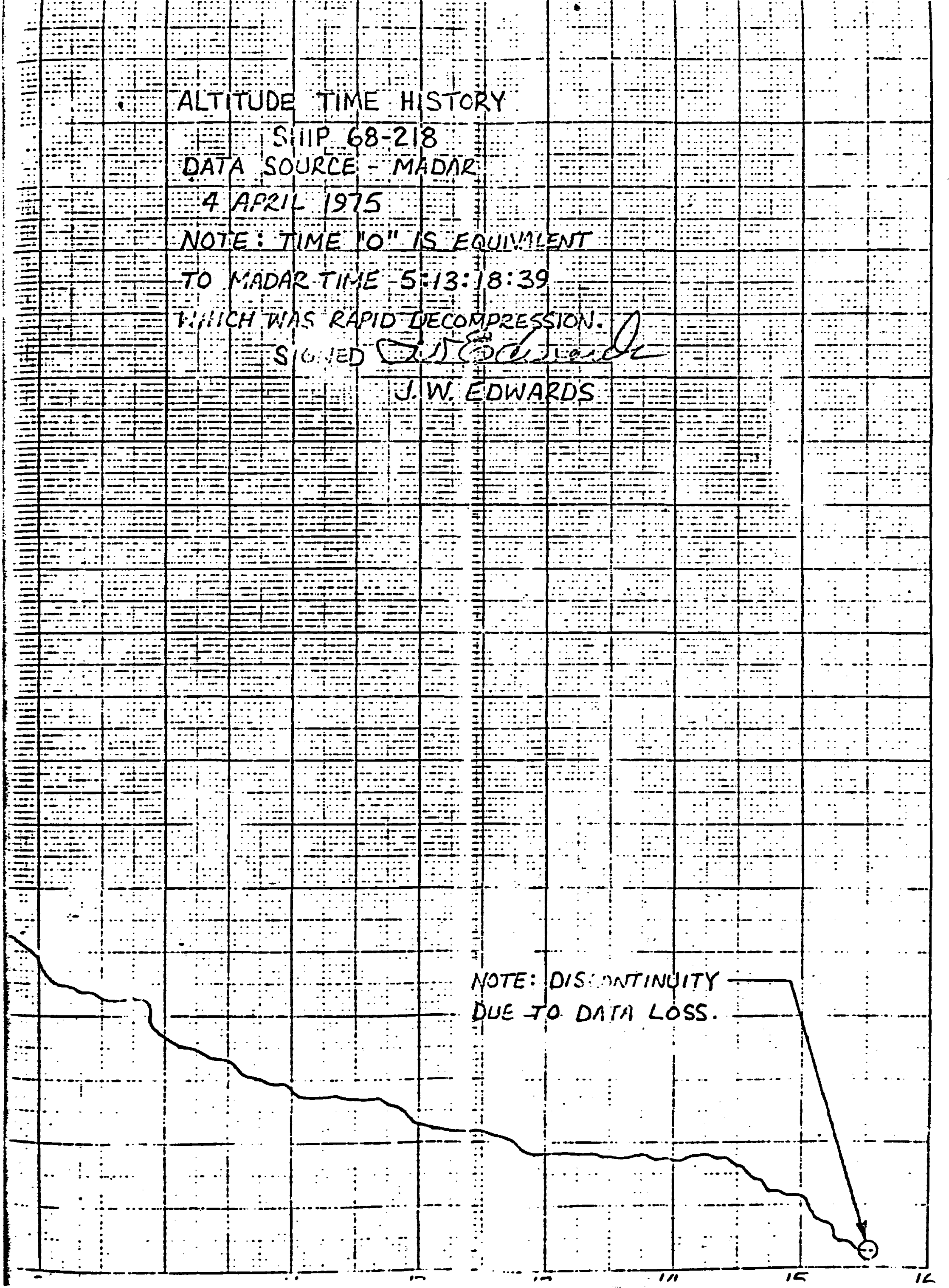
- Total travel time $\frac{455}{46.96} = 9.69$

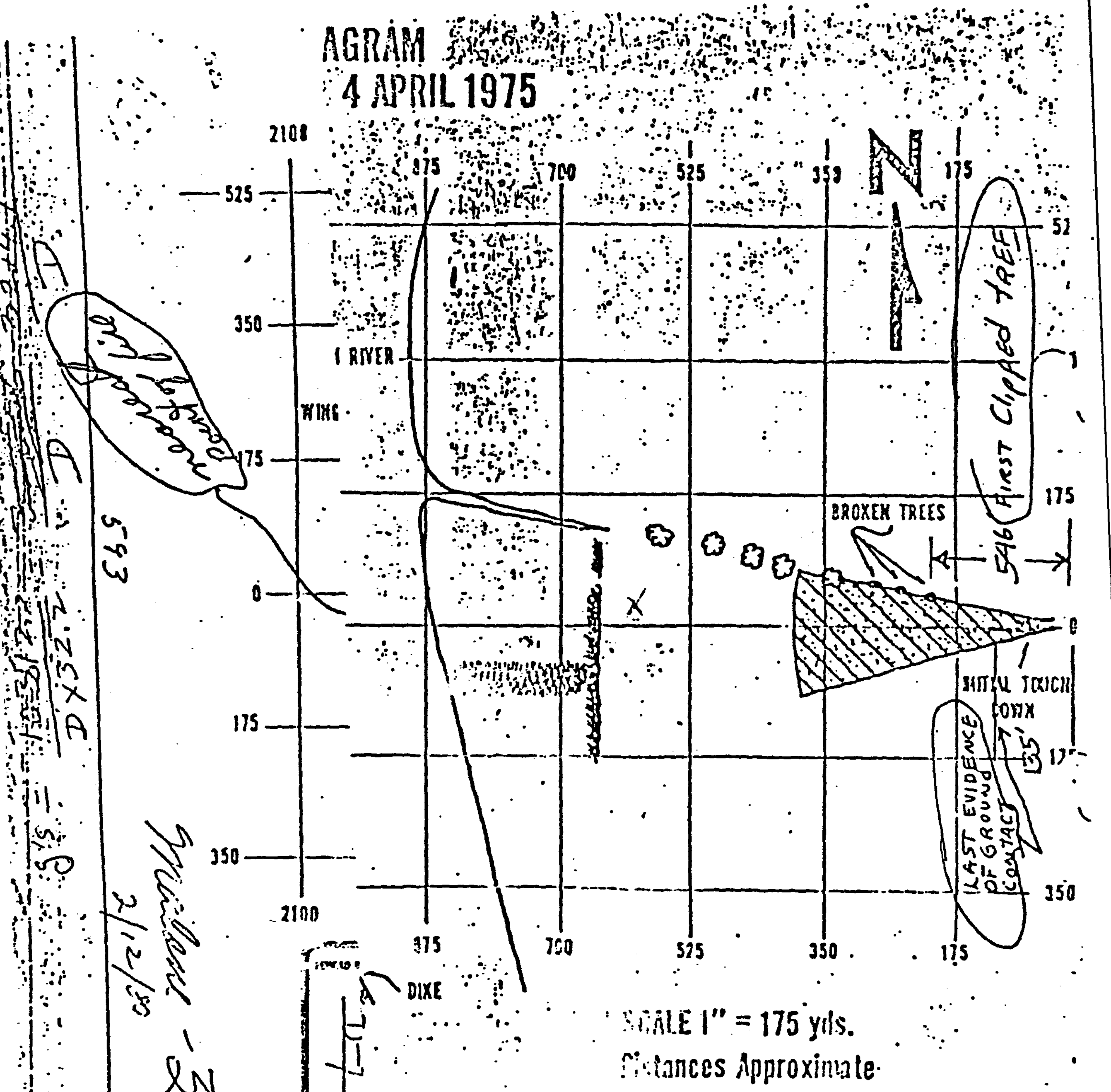
  T = 5.94 sec for 1356 feet

  $A = \frac{2 \times 607.89}{(5.94)^2} = 34.45$

  $g^1 = \frac{34.45}{32.2} = 1.07$


24000
20000
16000
12000
8000
4000
0
2
3
4
5
6
7
8
2 MIN PER


ALTITUDE TIME HISTORY
SHIP 68-218
DATA SOURCE - MADAR
4 APRIL 1975
NOTE: TIME "O" IS EQUIVALENT
TO MADAR TIME 5:13:18:39
WHICH WAS RAPID DECOMPRESSION.
SIGNED
J. W. EDWARDS
NOTE: DISCONTINUITY
DUE TO DATA LOSS.



ATTACHMENT 6

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"Army Aviation Safety," Final Report U.S. Army TRECOM Contract DA-44-177-T6-624 (with other authors), Dec. 30, 1960.

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"Military Troop Seat Design Criteria," Turnbow, J.W., Rothe, V.E., Bruggink, G.M. and Roegner, H.R., TRECOM Technical Report 62-79, U.S. Army Transportation Research Command, Fort Eustis, Virginia, November 1962.

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"Crew Seat Design Criteria for Army Aircraft," Roegner, H.F. and Turnbow, J.W., TRECOM Technical Report 63-4, AvCIR 62-20, U.S. Army Transportation Research Command, Fort Eustis, Virginia, February 1963.

"Dynamic Test of an Aircraft Litter Installation," Weinberg, L.W.T. and Turnbow, J.W., TRECOM Technical Report 63-3, AvCIR 62-63, U.S. Army Transportation Research Command, Fort Eustis, Virginia, March 1963.

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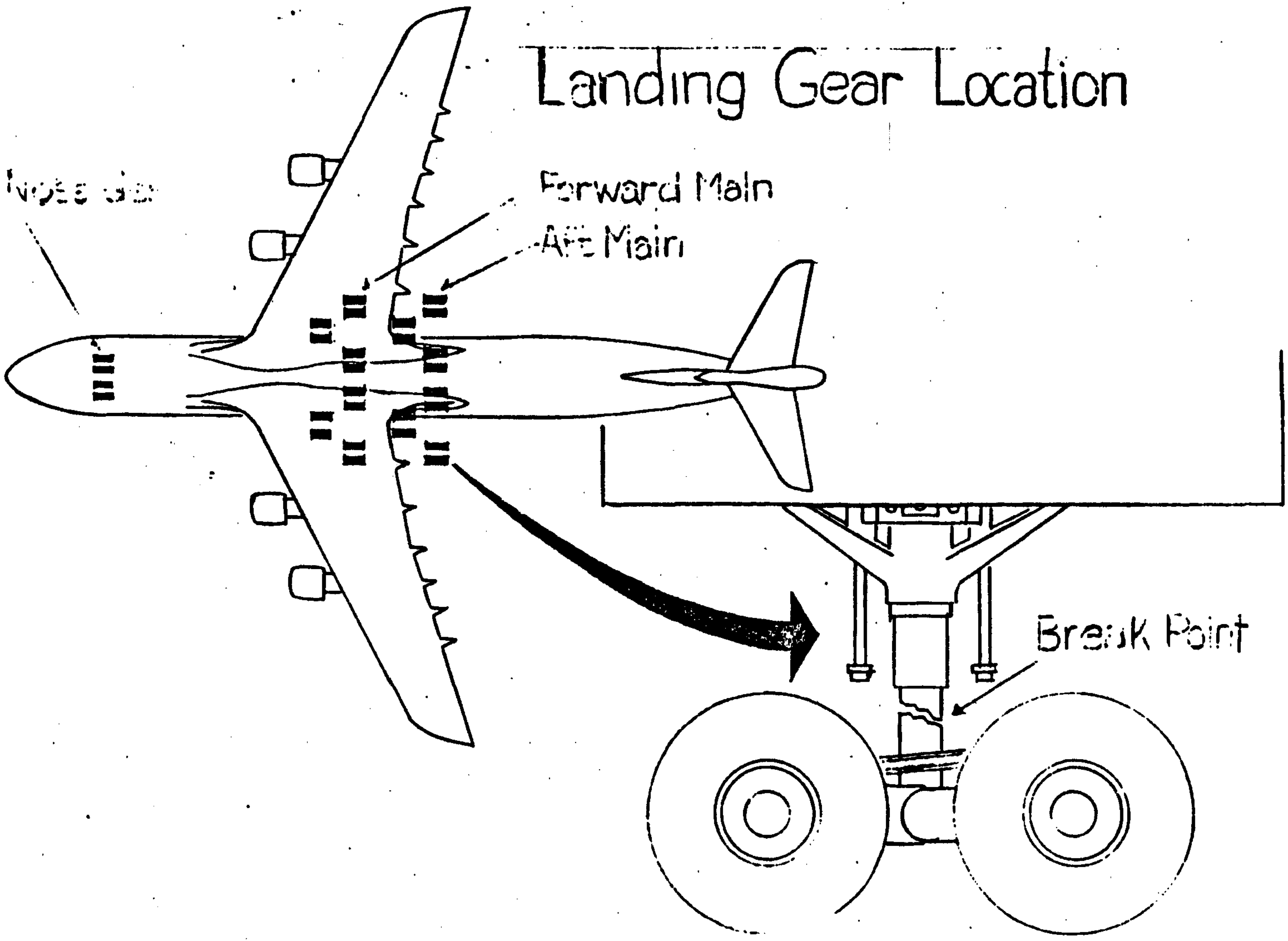
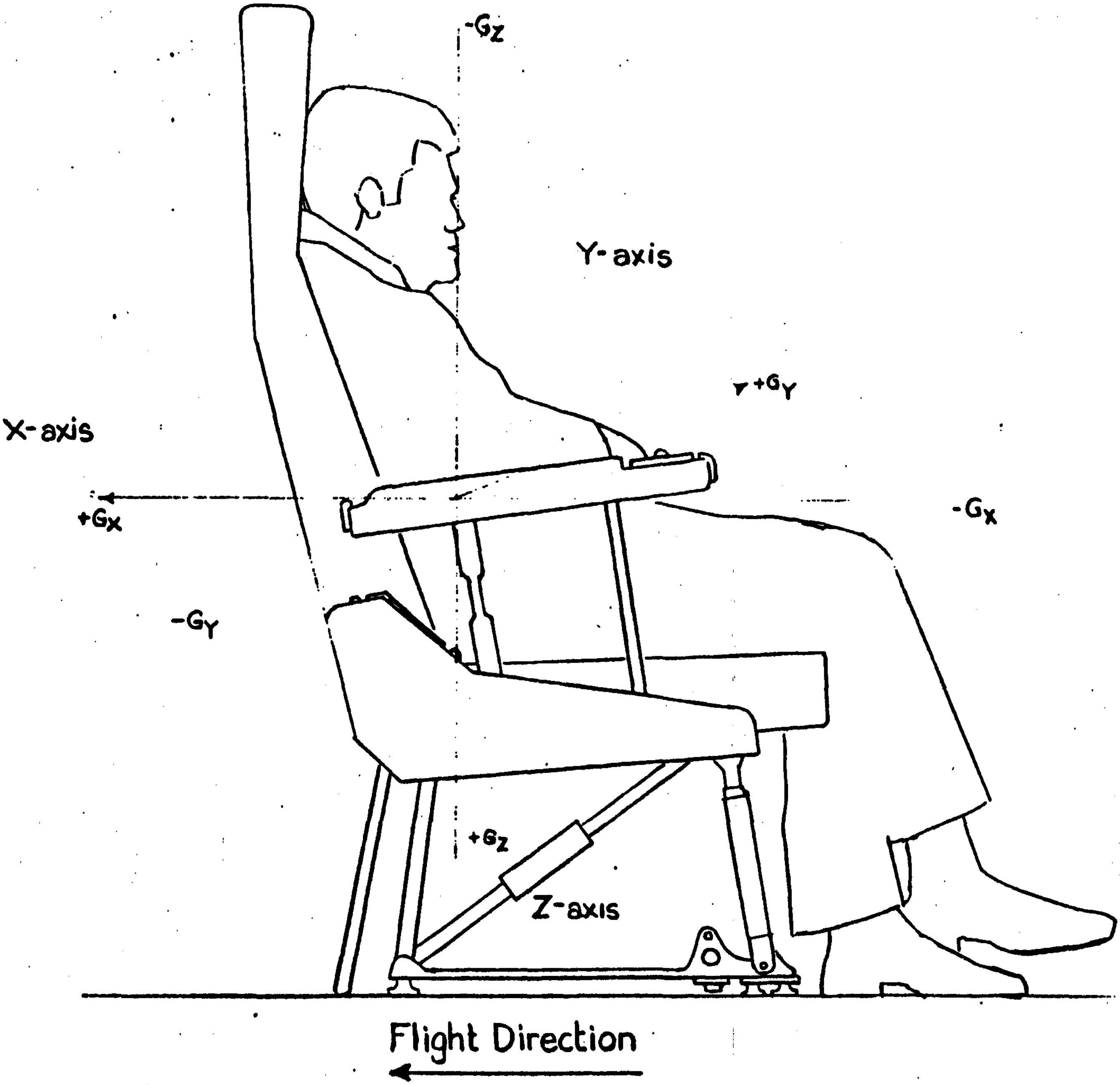
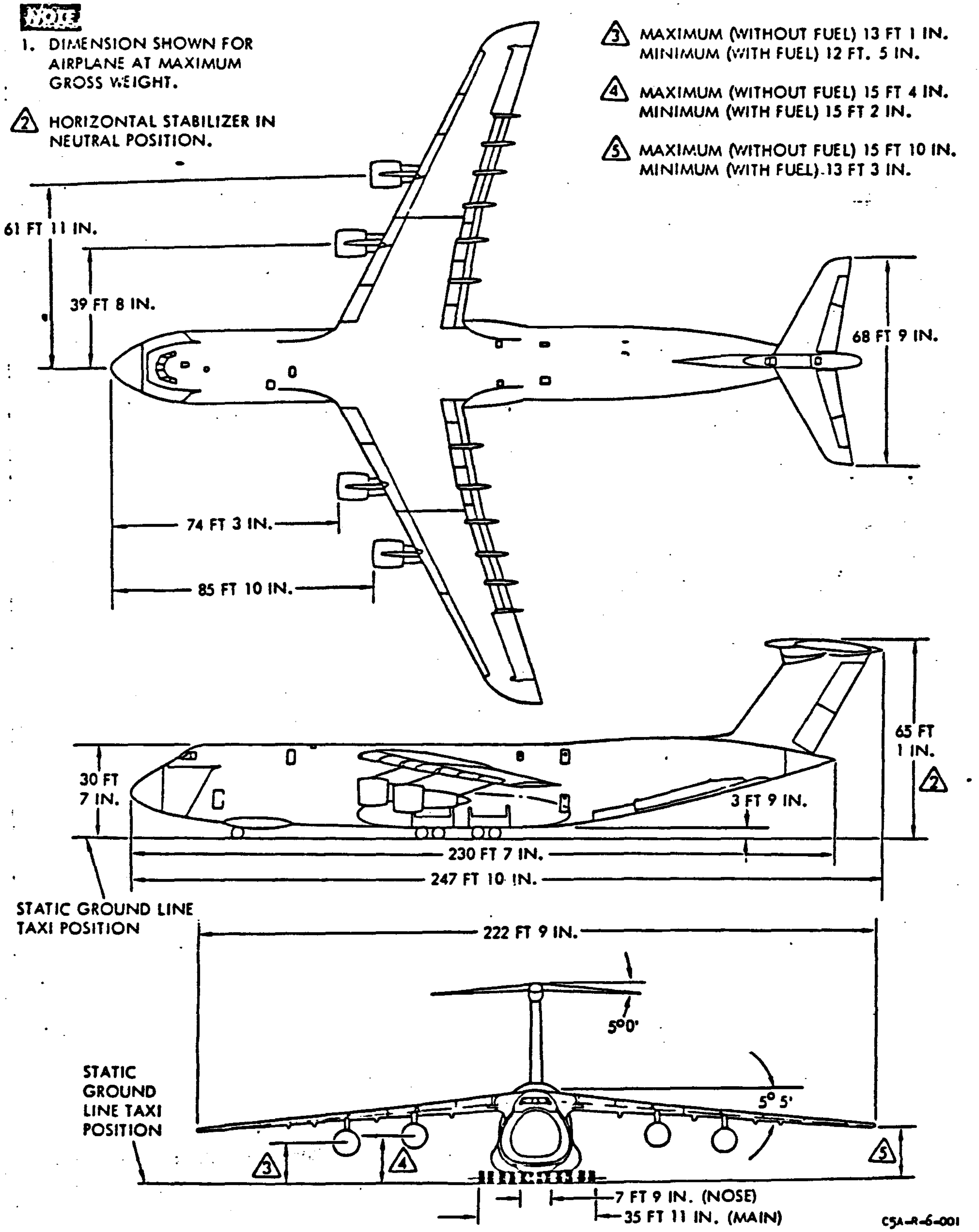

Landing Gear Location
Forward Main
Aft Main
Break Point

Acceleration Axes




NOTE
1. DIMENSION SHOWN FOR AIRPLANE AT MAXIMUM GROSS WEIGHT.
2 HORIZONTAL STABILIZER IN NEUTRAL POSITION.
3 MAXIMUM (WITHOUT FUEL) 13 FT 1 IN. MINIMUM (WITH FUEL) 12 FT. 5 IN.
4 MAXIMUM (WITHOUT FUEL) 15 FT 4 IN. MINIMUM (WITH FUEL) 15 FT 2 IN.
5 MAXIMUM (WITHOUT FUEL) 15 FT 10 IN. MINIMUM (WITH FUEL) 13 FT 3 IN.
61 FT 11 IN.
39 FT 8 IN.
68 FT 9 IN.
74 FT 3 IN.
85 FT 10 IN.
30 FT 7 IN.
65 FT 1 IN.
2
3 FT 9 IN.
230 FT 7 IN.
247 FT 10 IN.
STATIC GROUND LINE TAXI POSITION
222 FT 9 IN.
5°0'
5° 5'
STATIC GROUND LINE TAXI POSITION
3
4
5
7 FT 9 IN. (NOSE)
35 FT 11 IN. (MAIN)
C5A-R-6-001

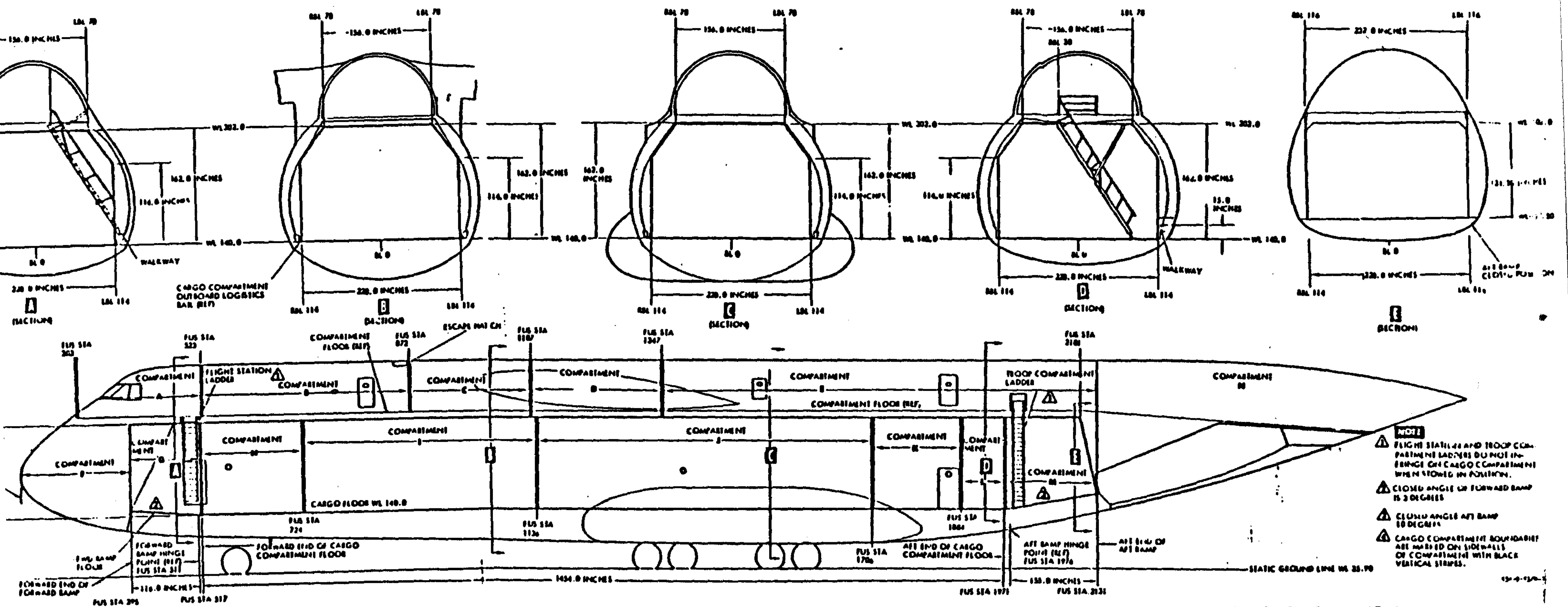


Figure 2-1. Cargo Compartment Envelope

CURRICULUM VITAE

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HOME:	1211 Timberland Drive Marietta, Georgia 30067

DEGREES, INTERNSHIP AND RESIDENCY:

Hadley Technical School (USN)	St. Louis Mo.	1943
Electrical Interior Communications (USN)		1943-44
B. S. - in EE Duke University		1948
Emory Lockheed Business School		1974

EMPLOYMENT

Hardy - Burlingham Mining Co.	1940-42
Arabian American Oil Company	1948-49
Boiler Equipment Service Co.	1949-51
Lockheed-Georgia Company	1951-Present (30 Years)