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53460

Stress Analysis of Horizontal Tail Surfaces - Model XB-36 53460

(None)

Dvorak, R.; Kosiak, W.; Lanzara, A. and others
Consolidated Vultee Aircraft Corp., Fort Worth Division, Tex. FZS-36-246

USAF Contr. No. W535-ac-22352

(None)

Dec '47 Unclass. U.S. ± English 140 tables, diagrs, graphs

A stress analysis is made of the horizontal tail surfaces of the XB-36 bomber. This analysis covers stabilizer and elevator loads, elevator and tab (servo and trim), and stabilizer. Results of the analysis are shown in tables, diagrams, graphs, and computations. The minimum margins of safety are included wherever practical.

Copies of this report obtainable from CADO. (1)

Structures (7) Control surfaces - Stress analysis

Stress Analysis of Specific Aircraft (6) (25899.4); XB-36 (99409)

USAF C. N. W535-ac-22352

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CONSOLIDATED VULTEE AIRCRAFT CORPORATION

FORT WORTH DIVISION • FORT WORTH 1, TEXAS

GS-50

MODEL XB-36

REPORT FZS-36-246

DATE 12-16-47

TITLE

STRESS ANALYSIS OF HORIZONTAL TAIL SURFACES

SUBMITTED UNDER

Contract W535-ac-22352

PREPARED BY: A. Lanzara, R. Dvorak, W. Kosiak, L. Thomson

GROUP: STRUCTURES

REFERENCE:

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INTRODUCTION

This report contains the stress analysis of the Horizontal Tail Surfaces for the XB-36 Airplane.

The planform, internal structure, elevator hinge line, and tab arrangement of the XB-36 horizontal tail surfaces is identical to that of the B-36A type airplane. The only difference between the two surfaces is in the amount of incidence built into them. The XB-36 has -4° incidence, while the B-36A has -1° incidence. In addition, the speeds and C.G.'s of the two airplanes vary somewhat from each other. Due to the incidence, speed, and C.G. differences, a different set of design conditions exist for the two airplanes. Maneuver tail loads for the XB-36 are found in Report FZS-36-133, and are found to be different from those of FZS-36-134 (B-36A Airplane). It is also found that Balancing, and 1g Balance plus Gust Conditions for the two airplanes are different.

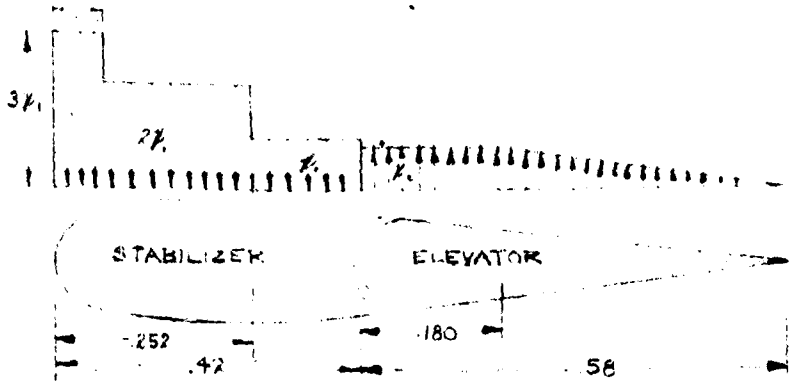
For all basic data such as planform and interior structure, reference is made to the B-36A Horizontal Tail Surface Analysis, Report FZS-36-146. Wherever possible, reference to loads and margins of safety in this report are made, and direct comparisons are taken.

BALANCING CONDITION

MOST [illegible] (REFER FZS-36-126, PAGE 85)

TOTAL TAIL LOAD - 35,500# (LIMIT)

LOAD DISTRIBUTED PER C1803-6 PAR. E-2A



STABILIZER LOAD = 1.4 X 35500 = - 49,700 # (LIMIT)

ELEVATOR LOAD = .4 X 35500 = + 14,200 # (LIMIT)

AVG. STAB. PRESS = $\frac{-49700}{978}$ = - 50.8 #/□' (ON SURFACE AREA)

AVG. ELEV. PRESS = $\frac{14200}{978}$ = 14.5 #/□' (ON SURFACE AREA)

$\lambda_1[.252 + .378 + .168] = -50.8$

$\lambda_1 = 69.1$ #/□'

$2\lambda_1 = 138.2$ #/□'

$3\lambda_1 = 207.3$ #/□'

$\lambda_2[.180 + .20] = 14.5$

$\lambda_2 = 38.6$ #/□'

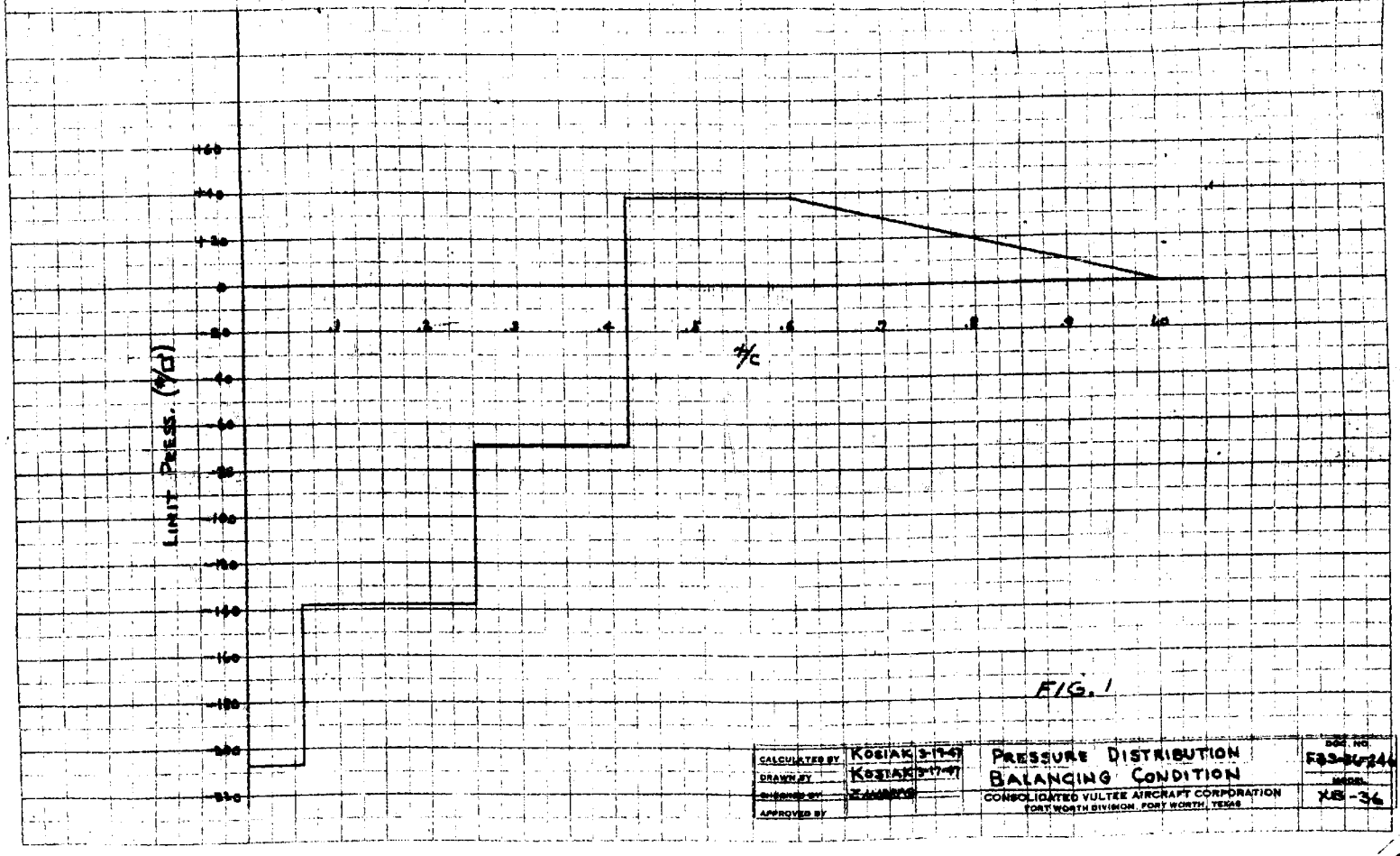


FIG. 1

CALCULATED BY	KOSIAK 3-17-47	PRESSURE DISTRIBUTION BALANCING CONDITION	DOC. NO. F23-BU-246
DRAWN BY	KOSIAK 3-17-47	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB-36
DESIGNED BY	[illegible]		
APPROVED BY			

DETERMINATION OF [illegible] BALANCING TAIL LOADS

MOST FWD. FLIGHT C.G. HIGH SPEED @ 5000 FT.

$W = 261332$ #

$S_W = 4772$ SQ. FT.

$V_H = 311$ M.P.H. (FZS-36-126 P4.)

$\tau = .8616$

$$C_{NA} = \frac{391 W}{V^2 \tau S_W}$$

$$= \frac{391 \times 261332}{(311)^2 \times .8616 \times 4772}$$

$$= 0.257$$

$C_L = 0.281$ (BY TRIAL & ERROR) FOR $C_L = 0.281$ $C_{DW} = +.0100$ (FZS-36-126 P16)

MACH NUMBER = .414

$$C_{MO(WING)} = \frac{-.051}{\sqrt{1-(.414)^2}} = -.056$$

$$m = \text{SLOPE OF LIFT CURVE} = \frac{.094}{\sqrt{1-(.414)^2}} = .1033$$

$\alpha_{CL=0} = -2.60$

$$\alpha_W = \frac{C_L}{m} - 2.60 = \frac{.281}{.1033} - 2.60 = +.12^\circ$$

$\theta = +.12 - 3.00 = -2.88^\circ$ $\sin\theta = -.05024$ $\cos\theta = .9987$

$C_Z = C_L \cos\theta + C_D \sin\theta = +.2801$

$C_X = C_D \cos\theta - C_L \sin\theta = +.0241$

$$C_T = \left(C_Z \frac{X'}{M.A.C.} + C_X \frac{Z'}{M.A.C.} + C_{MO}\right) \frac{M.A.C.}{dt}$$

$= -.0231$

$\frac{X'}{MAC} = -.056$, $\frac{Z'}{MAC} = -.0079$, $\frac{MAC}{dt} = +.3217$ } REFER. FZS-36-126 P32

CHECK $C_{NA} = C_T + C_Z$

$= -.0231 + .2801 = 0.257$

TAIL LOAD $= C_T \frac{1}{2} \rho V^2 S_W \tau$

$= (-.0231) \times .002558 \times (311)^2 \times 4772 \times .8616 =$ -23497 # LIMIT

MOST AFT FLIGHT C.G. HIGH SPEED @ 5000 FT.

USING METHOD AND REFERENCES SHOWN ABOVE

$W = 138209$ # $V = 311$ MPH

$C_{NA} = +.136$, $C_L = .151$, $C_{DW} = -.0080$

$\alpha_W = -1.14^\circ$ $\theta = -4.14^\circ$ $\sin\theta = -.07220$ $\cos\theta = .9974$

$C_X = +.0189$, $C_Z = +.1500$

$\frac{X'}{M.A.C.} = +.0979$ $\frac{Z'}{M.A.C.} = -.0109$ $\frac{M.A.C.}{dt} = +.3384$

$C_T = -.0140$ CHECK $C_{NA} = -.0140 + .150 = +.136$

TAIL LOAD $= (-.0140) \times .002558 \times (311)^2 \times 4772 \times .8616 =$ $-14[illegible]$ # LIMIT

DETERMINATION OF GUST LOADS ON HORIZONTAL TAIL

REFERENCE [illegible]-6A

MOST FWD. FLIGHT C.G. - HIGH SPEED @ 5000 FT.

$$\Delta_{FH} = \frac{57.3U}{V_H} S_H q \left(1 - \frac{52 \times a_W \times K_P \times K_T \times K_S}{A}\right) P \left(\frac{\pi \times A_H \times a_{OH}}{\pi \times A_H + 57.3 \times a_{OH}}\right)$$

$W = 261\,392\#$ $\quad S_W = 4772$ SQ. FT.

$\frac{W}{S} = 54.77$ $\quad K = 0.6$

$\sigma = .8616$ $\quad \sigma^{\frac{1}{2}} = 0.9282$

$U = \frac{50K}{\sigma^{\frac{1}{2}}} = 32.3$ FT/SEC

$V_H = 311$ M.P.H $= 456$ FT/SEC

$S_H = 975$ SQ. FT.

$q = \frac{1}{2}\rho v^2 \sigma = .002558 \times \overline{311}^2 \times .8616 = 213.17$ #/SQ. FT

$a_W = .094 \frac{1}{\sqrt{1-M^2}} = .1033$

$A = 1.08$, $A_H = 5.51$, $a_{OH} = .0995$

$K_P = .555$
$K_T = 2.04$
$K_S = .920$
$P = .982$
REFER FZS-36-146 P12

SUBSTITUTING VALUES IN ABOVE EQUATION GIVES

$\Delta_{FH} = 30893\#$ LIMIT

MOST AFT FLIGHT C.G. - HIGH SPEED @ 5000 FT.

USING METHOD AND REFERENCES SHOWN ABOVE

$W = 133\,208\#$

$\frac{W}{S} = 28.96$ $\quad K = .555$

$U = \frac{50K}{\sigma^{\frac{1}{2}}} = 29.9$ FT./SEC.

ALL OTHER VALUES ARE AS SHOWN ABOVE

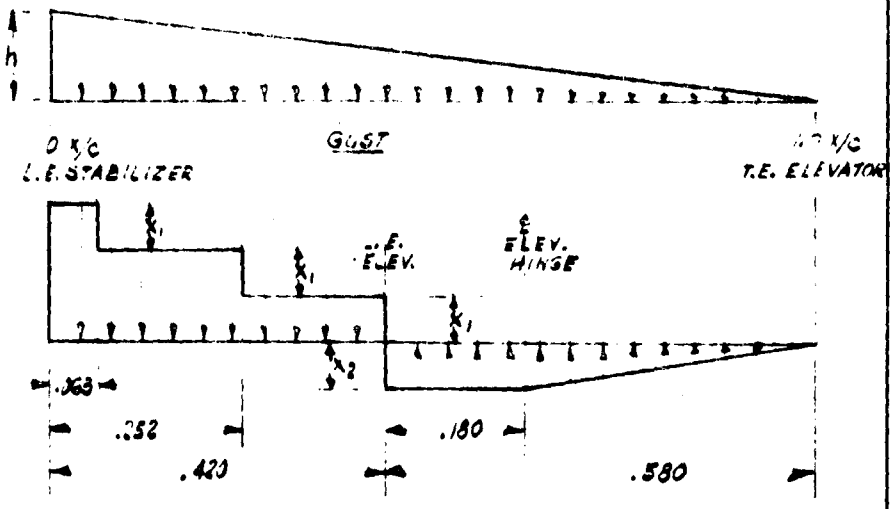
SUBSTITUTING VALUES IN ABOVE EQUATION GIVES

$\Delta_{FH} = 28592\#$ LIMIT

1G BALANCE + GUST - PRESSURE DISTRIBUTION

MOST FWD. FLIGHT C.G. - HIGH SPEED @ 5000 FT.

BALANCING LOAD = -23499 # LIMIT
GUST LOAD = -30933 # LIMIT
LOADS ARE DISTRIBUTED AS OUTLINED IN [illegible]-1913-GA



BALANCE

$h = \frac{33990}{999} \times 2 = 68.19$ #/SQ. FT.

ELEV. LOAD = [illegible] # = [illegible] #/SQ. FT.
STAB. LOAD = -23499 x 1.40 = -32899# = -33.64 #/SQ. FT.

$X_1 [3(.0630) + 2(.1890) + .1680] = -33.64$

$.7350 X_1 = -33.64$

$X_1 = -45.77$ #/SQ. FT., $2X_1 = -91.54$ #/SQ. FT., $3X_1 = -137.31$ #/SQ. FT.

$X_2 (.180 + \frac{.400}{2}) = 9.61$

$.380 X_2 = 9.61$

$X_2 = 25.29$ #/SQ. FT.

MOST AFT C.G. - HIGH SPEED @ 5000 FT.

$h = \frac{28592}{999} \times 2 = 58.47$ #/SQ. FT.

ELEV. LOAD = +14242 x .040 = 5697# = 5.83 #/SQ. FT.
STAB. LOAD = -14242 x 1.40 = -19939# = -20.39 #/SQ. FT.
$X_1 = -27.74$ #/SQ. FT. $2X_1 = -55.48$ #/SQ. FT $3X_1 = -83.22$ #/SQ. FT
$X_2 = 15.34$ #/SQ. FT.

PRESSURE DISTRIBUTION
1G BALANCE + GUST
I MOST FWD. C.G. HIGH SPEED @ 5000 Ft.
TABLE I

X/C	BALANCING LOAD	1 - X/C	GUST LOAD (Σ -63.19 × ③ / Σ -58.47 × ③)	TOTAL LOAD ② + ④	INTEGRATION OF CURVE: AVERAGE LOAD	ORDINATE	AREA ⑥ × ⑦
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
0	-137.31	1.000	-63.19	-200.50			
					-198.51	.063	-12.506
.0630	-137.31	.937	-59.21	-196.52			
.0630	-91.54	.937	-59.21	-150.75			
					-144.78	.189	-27.363
.2520	-91.54	.748	-47.27	-138.81			
.2520	-45.77	.748	-47.27	-93.04			
					-87.73	.168	-14.739
.4200	-45.77	.580	-36.65	-82.42			
.4200	+25.29	.580	-36.65	-11.36			
					-5.675	.180	-1.022
.6000	+25.29	.400	-25.28	+0.01			
					+0.005	.400	+0.002
1.0000	0	0	0	0			
						Σ	-55.628

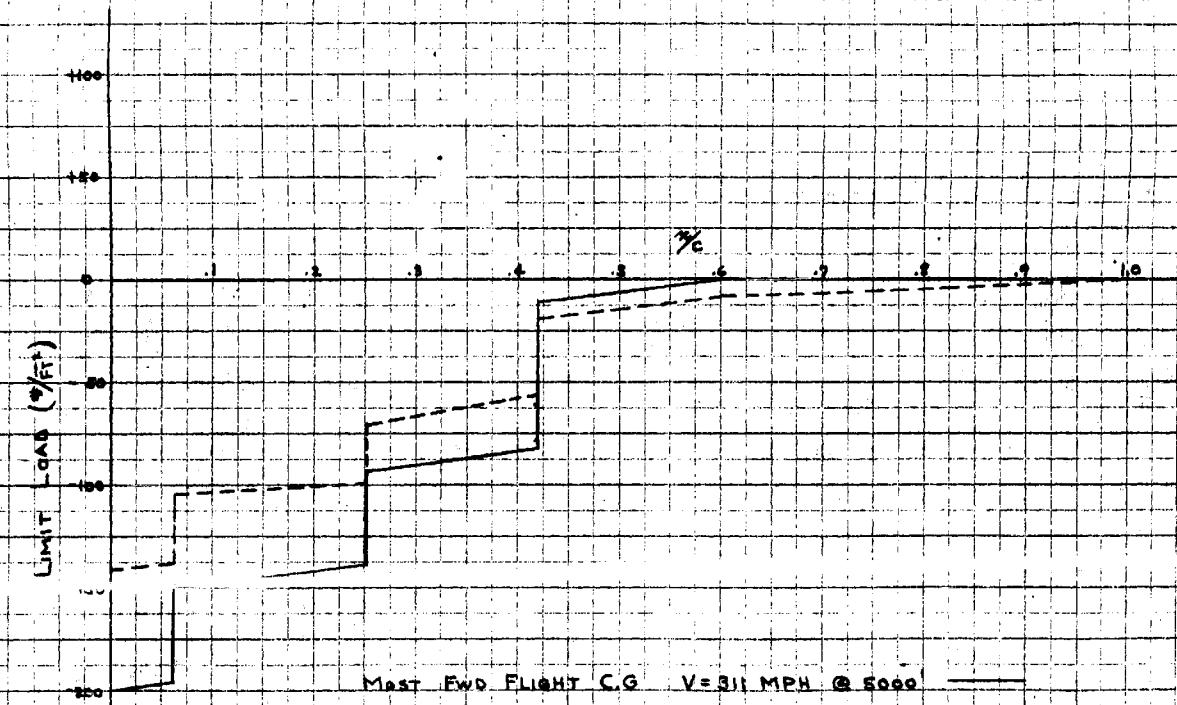
STAB. LOAD = -54.608 × 978 = -53407# LIMIT
ELEV. LOAD = -1.020 × 978 = -998# LIMIT

II MOST AFT C.G. HIGH SPEED @ 5000 Ft.

0	-83.22	1.000	-58.47	-141.69			
					-139.850	.063	-8.811
.0630	-83.22	.937	-54.79	-138.01			
.0630	-55.48	.937	-54.79	-110.27			
					-104.745	.189	-19.797
.2520	-55.48	.748	-43.74	-99.22			
.2520	-27.74	.748	-43.74	-71.48			
					-66.565	.168	-11.183
.4200	-27.74	.580	-33.91	-61.65			
.4200	+15.34	.580	-33.91	-18.57			
					-13.310	.180	-2.396
.6000	+15.34	.400	-23.39	-8.05			
					-4.025	.400	-1.610
1.0000	0	0	0	0			
						Σ	-43.797

STAB. LOAD = -39.791 × 978 = -38916# LIMIT
ELEV. LOAD = -4.006 × 978 = -3918# LIMIT

BY - W. KOSIAK
CHECK - R. DVORAK



MOST FWD FLIGHT C.G V=311 MPH @ 5000 ———

MOST AFT FLIGHT C.G. V=311 MPH @ 5000 - - -

FIG. 2

CALCULATED BY KOSIAK	PRESSURE DISTRIBUTION 1G BALANCING + GUST		ESS. NO. FZS-36-24
DRAWN BY KOSIAK			
CHECKED BY R. DUDRAS	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS		MODEL XB-36
APPROVED BY			

SUMMARY OF DESIGN LOADS

THE FOLLOWING TABLE SHOWS A SUMMARY OF LOADS FOR WHICH THE HORIZONTAL TAIL IS INVESTIGATED.

TABLE 2

CONDITION	ELEVATOR LOAD (LIMIT)	STABILIZER LOAD (LIMIT)	TOTAL SURFACE LOAD (LIMIT)
MOST FWD. C.G. H.A.A. *	-13650	-25900	-39550
MOST AFT C.G. L.A.A. *	+40450	-23700	+16750
1G BALANCE DIVE GUST	-115	-53407	-54405
BALANCING †	-4000	-41700	-35500

* REFER. FZS-36-133 (MANEUVER TAIL LOADS)
† REFER. FZS-36-128 P35

ELEVATOR SHEARS & BENDING MOMENTS

The calculation of elevator shears and bending moments are shown herein. The elevator is taken as a continuous beam over four supports. Variation of spanwise moment of inertia, and effects of support deflection are taken into account. The method used is described in Report FZS-36-146. All structural constants, such as stiffness and carry-over factors, are also taken from that report.

A complete solution of shears and moments is shown for the Balancing Condition, while only final curves, computed in a similar manner, are shown for all other conditions.

ELEVATOR SPAR

BASIC LOADING

ULT. ELEVATOR LOAD / SIDE = 14200 X 1.5/2 = 10650 #/SIDE

ULT. STABILIZER LOAD / SIDE = -49700 X 1.5/2 = -37275 #/SIDE

DISTRIBUTE LOAD IN PROPORTION TO CHORD LENGTHS

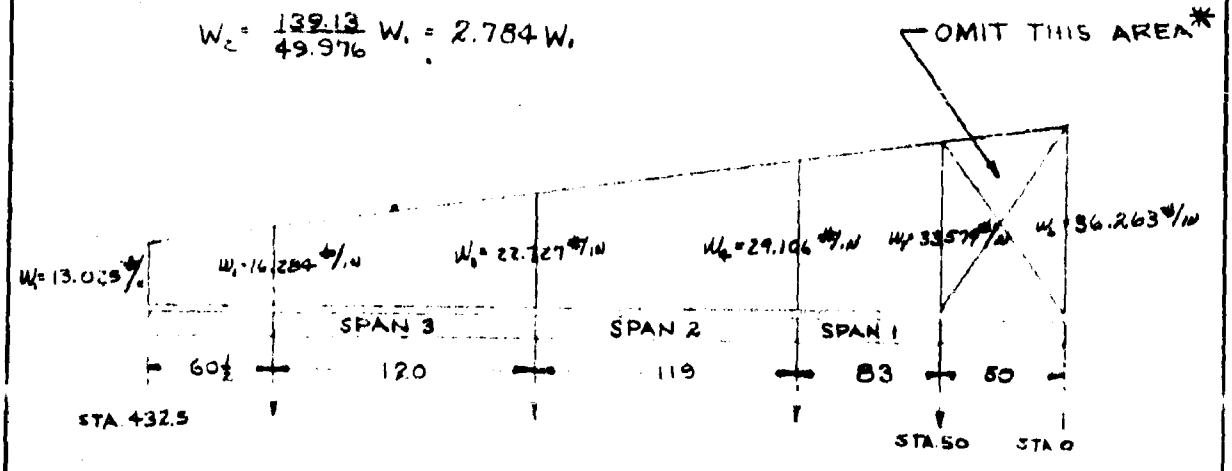
ROOT CHORD (STA. 0) = 139.13"

TIP CHORD (STA. 432.5) = 49.976"

W_1 = LOADING AT TIP

W_2 = LOADING AT ROOT

$$W_2 = \frac{139.13}{49.976} W_1 = 2.784 W_1$$



$$\frac{W_1 + 2.784 W_1}{2} \times 432.5 = 10650$$

$W_1 = 13.025$ #/IN

$W_2 = 36.263$ #/IN

NET LOAD ON ELEVATOR

$$= \frac{13.025 + 33.579}{2} \times 382.5 = 8913 \#$$

* OMITTED AS ELEVATOR BEGINS AT STA. 50

ELEVATOR SPAR

BALANCING CONDITION

FIXED END MOMENTS - AIRLOADS

$F.E.M. = K.WL^2$ FOR K VALUE REF [illegible] Pgs 38 & 39

SPAN 1

$UM_5 = .0803 \times 29.106 \times \overline{83}^2 = 16099.6$

$VM_5 = .0318 \times 4.473 \times \overline{83}^2 = 979.6$

17079.2 "#

$UM_4 = .0803 \times 29.106 \times \overline{83}^2 = 17303.8$

$VM_4 = .0515 \times 4.473 \times \overline{83}^2 = 1587.2$

18891.0 "#

SPAN ②

$UM_4 = .0910 \times 22.727 \times \overline{119}^2 = 29287.8$

$VM_4 = .0535 \times 6.379 \times \overline{119}^2 = 4853.1$

34120.9 "#

$UM_3 = .0762 \times 22.727 \times \overline{119}^2 = 24524.0$

$VM_3 = .0296 \times 6.379 \times \overline{119}^2 = 2673.6$

27197.6 "#

SPAN ③

$UM_3 = .1010 \times 16.284 \times \overline{120}^2 = 23683.7$

$VM_3 = [illegible]$

29046.3 "#

$UM_2 = .0678 \times 16.284 \times \overline{120}^2 = 15899.0$

$VM_2 = .0255 \times 6.443 \times \overline{120}^2 = 2365.9$

18264.1 "#

CANTILEVER MOMENT

$UM_2 = \frac{13.025 \times \overline{60.5}^2}{2} = 23850$

$VM_2 = \frac{6.259 \times \overline{60.5}^2}{6} = 1988$

25838 "#

BALANCED CONDITION.

FIXED END MOMENTS - DEFLECTION

RELATIVE DEFLECTIONS $\Delta_{50} = 0$
$\Delta'_{152} = 1.06$
$\Delta'_{252} = 1.24$
$\Delta'_{372} = 0$

$$F.E.M. = \frac{KEIU \times 10^6}{L^2}$$

WHERE $U = \Delta'_{50}$ etc.
$I = \frac{I_1 + I_2}{2}$

SPAN ①

$$M_5 = \frac{.0573 \times 10.3 \times 10^6 \times 33.74 \times 1.06 \times 100}{83^2} = 306{,}398''\#$$

$$M_4 = \frac{.0615 \times 10.3 \times 10^6 \times 33.74 \times 1.06 \times 100}{83^2} = 328{,}858''\#$$

SPAN ②

$$M_4 = \frac{.0632 \times 10.3 \times 10^6 \times 30.37 \times .18 \times 100}{119^2} = 25{,}129''\#$$

$$M_3 = \frac{.0532 \times 10.3 \times 10^6 \times 30.37 \times .18 \times 100}{119^2} = 21{,}153''\#$$

SPAN ③

$$M_3 = \frac{[illegible] \times 10.3 \times 10^6 \times [illegible] \times 100}{120^2} = 86{,}794''\#$$

$$M_2 = \frac{.0452 \times 10.3 \times 10^6 \times 15.055 \times 1.24 \times 100}{120^2} = 60{,}356''\#$$

FOR K & I VALUES REF. FES-36-146 P. 40

ELEVATOR SPAR

BALANCING CONDITION

MOMENT DISTRIBUTION

SPAN		(1)		(2)		(3)	
CARRY OVER FACTORS	[illegible]	[illegible]	.447	.565	[illegible]	.647	
STIFFNESS FACTORS	[illegible]	[illegible]	[illegible]	.601	.399	.60	
AIRLOAD MOMENT	17.1	18.9	34.1	27.2	27.1	18.3	25.8
DEFLECTION MOMENTS	306.4	-328.4	25.1	-21.1	-8.8	60.4	0
Σ MOM.	323.5	-310.0	59.2	6.1	-57.7	78.7	25.8
	-323.5	222.6	-146.6	-38.3	25.5	-104.5	
	-106.4	169.8	21.6	65.5	67.6	-9.8	
	106.4	-89.4	58.8	1.3	-0.8	7.8	
	42.7	-55.9	-0.7	-26.3	-6.3	0.8	
	-42.7	33.3	-21.9	12.0	-5.0	-0.3	
	-15.9	22.4	-6.8	9.8	.2	3.1	
	15.9	-17.6	11.6	-5.8	3.8	-3.1	
	8.4	-8.3	3.3	-5.2	2.0	-1.5	
	-8.4	7.0	-4.6	4.3	-2.9	1.5	
	-3.3	4.4	-2.4	2.1	-1.0	1.1	
	3.3	-4.1	2.7	-1.9	1.2	-1.1	
	2.0	-1.7	1.1	-1.2	.7	-.5	
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Σ	0	-25.8	-25.8	23.5	23.5	25.8	25.8

NOTE: MOMENT IN 1000'#

ANALYSIS [illegible]
PREPARED BY [illegible]
CHECKED BY [illegible]
REVISED BY

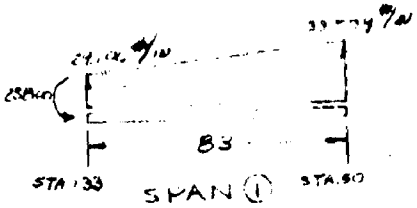
Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE
REPORT NO. [illegible]
MODEL XB-[illegible]
DATE 10-20-47

ELEVATOR SPAR

BALANCING CONDITION

REACTIONS

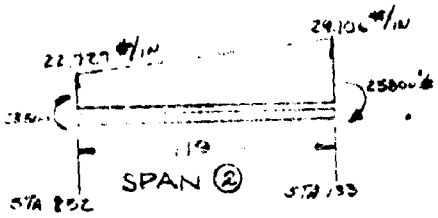


SPAN ①

$$R_{50} = \frac{29.106 \times 83}{2} + \frac{4.473 \times 83}{3} + \frac{25800}{83} = 1042.0^{\#}$$

$$R_{133R} = \frac{29.106 \times 83}{2} + \frac{4.473 \times 83}{6} - \frac{25800}{83} = 958.7^{\#}$$

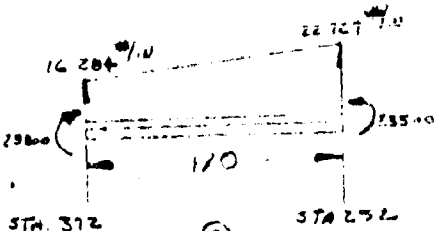
$$R_{133L} = \frac{22.727 \times 119}{2} + \frac{6.379 \times 119}{3} - \frac{49300}{119} = 1191.7^{\#}$$



SPAN ②

$$R_{252R} = \frac{22.727 \times 119}{2} + \frac{6.379 \times 119}{6} + \frac{49300}{119} = 1848.6^{\#}$$

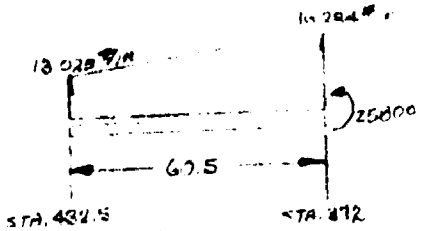
$$R_{252L} = \frac{16.284 \times 120}{2} + \frac{6.443 \times 120}{3} - \frac{2300}{120} = 215.1^{\#}$$



SPAN ③

$$R_{372R} = \frac{16.284 \times 120}{2} + \frac{6.443 \times 120}{6} + \frac{2300}{120} = 1124.7^{\#}$$

$$R_{372L} = (13.02 + 16.284) \times 60.5 = 887.1^{\#}$$



CANTILEVER

R_{50} = 1042.0# ↓

R_{133} = 2150.4# ↓

R_{252} = 3108.7# ↓

R_{372} = 2011.8# ↓

8912.9# vs 8913

ELEVATOR SPAR

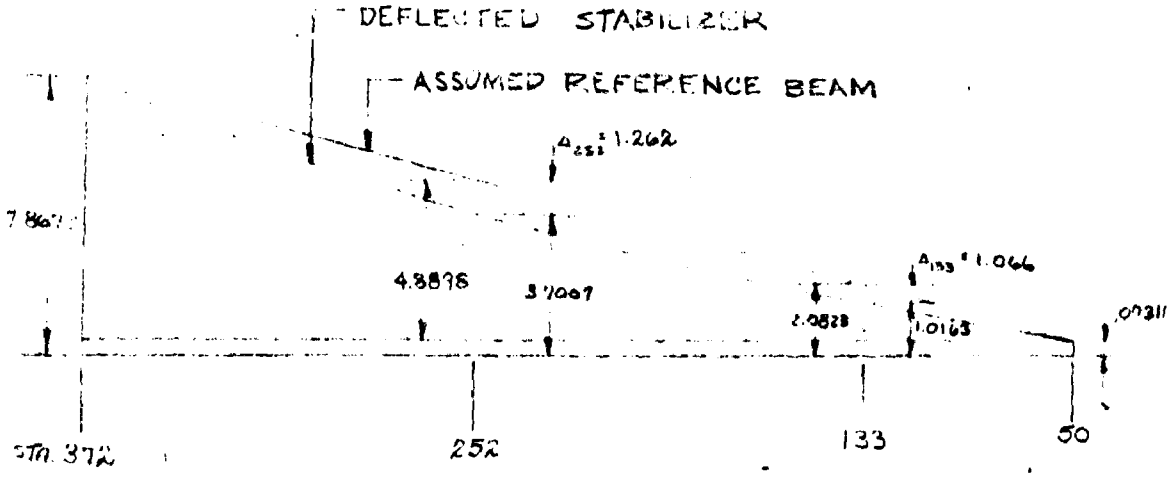
BALANCING CONDITION

CHECK OF ASSUMED RELATIVE DEFLECTIONS

ITEM	RATIO	STA 50		STA 133		STA 252		STA 372	
		RATIO	Δ	RATIO	Δ	RATIO	Δ	RATIO	Δ
W_5	-3.7275	.027611	-.10292	.38552	-1.4370	1.416518	-5.2801	3.038112	-11.3246
R_{133}	2.1504	.001831	.00394	.022742	.0489	.058256	.1253	.094067	.2023
R_{252}	3.1087	.004139	.01287	.058469	.1818	.211658	.6580	.394711	1.2270
R_{372}	2.0118	.006464	.01300	.094462	.1900	.395699	.7961	1.007775	2.0274
ΣΔ			+.07311		-1.0163		-3.7007		-7.8679

$$W_5 = \frac{2 \times 37275}{20000} = -3.7275$$

$$R_{133},\ R_{252},\ R_{372} = \frac{\text{REACTION}}{1000}$$



$$\left(\frac{7.8679 - .07311}{322}\right) \times 83 = 2.0042 + .0731 - 1.0163 = 1.066$$

$$\times 202 = 4.8898 + .0731 - 3.7007 = 1.262$$

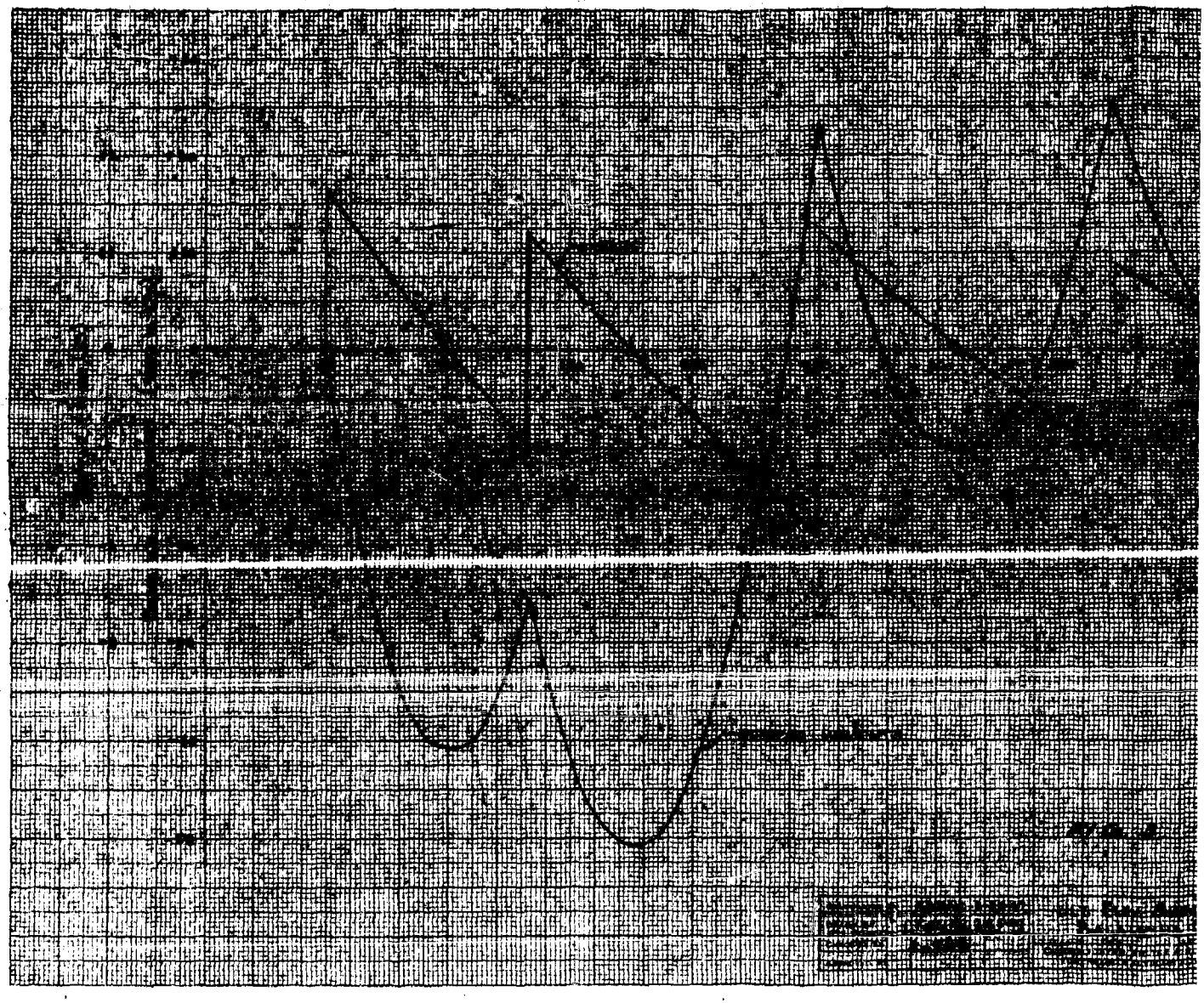
ASSUMED RELATIVE DEFLECTION Δ_{133} = 1.06" VS 1.066" ACTUAL

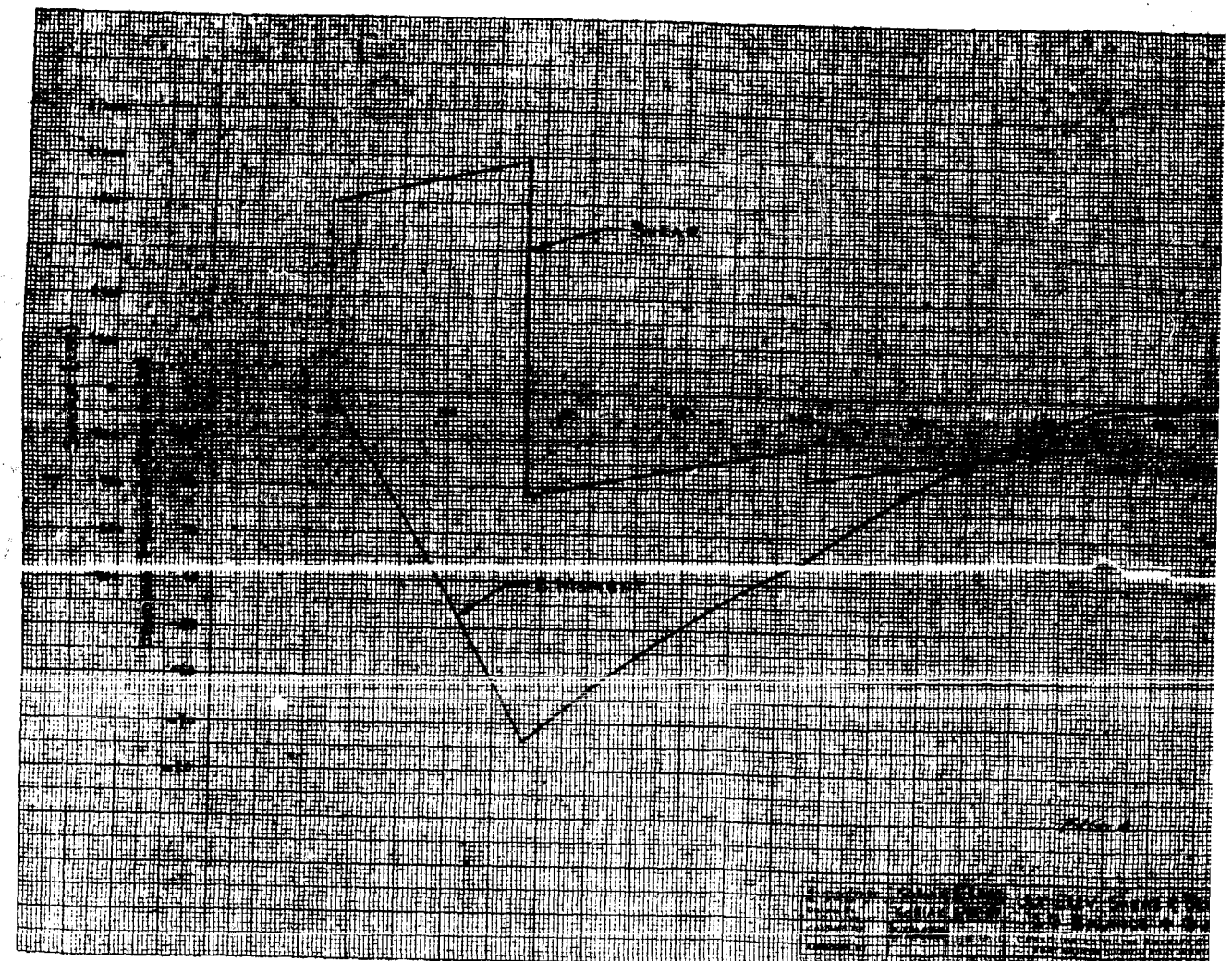
ASSUMED RELATIVE DEFLECTION Δ_{252} = 1.24" VS 1.262" ACTUAL

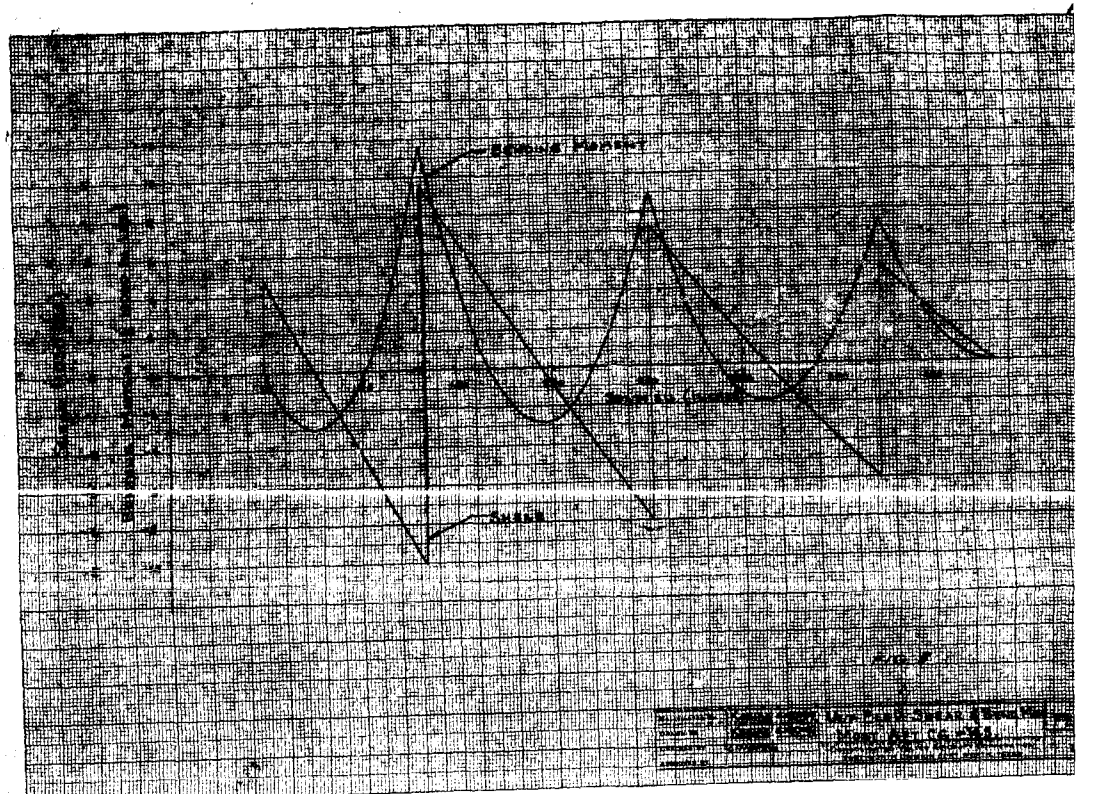
STATION	LOAD PER INCH	[illegible]	BEAM STATION F	[illegible]	MOMENT M'+Fw	SHEAR S 8F	MOMENT M'+Gy	MOMENT AT STATION M'+M
428	15.[illegible]					0	0	0
20.5		15.575	273.3	[illegible]	2514			
412	14.[illegible]					273.3		2514
20		14.[illegible]	293.3	[illegible]	2933		5866	
392	15.[illegible]					566.6		11278
20		15.[illegible]	311.7	[illegible]	3117		[illegible]	
372	[illegible]					856.3		25534
			-201.3					
372	16.234					1125.3		25534
20		16.824	336.5	9.016	3365		[illegible]	
352	17.3[illegible]					1461.8		6045
20		17.311	353.[illegible]	[illegible]	3516		-15776	
332	18.434					[illegible]		5552
20		18.969	377.4	9.[illegible]	3758		-8616	
312	19.5[illegible]					1[illegible]4		10440
20		20.039	400.8	9.[illegible]	[illegible]		-1023	
292	20.571					341.7		-1445
20		21.139	422.8	9.[illegible]	4138		6798	
272	21.6[illegible]					771.6		3631
20		22.120	443.7	[illegible]	4402		15432	
252	22.[illegible]					1215.3		23515
			[illegible]					
252	22.[illegible]					-1348.4		23515
20		23.264	465.3	9.[illegible]	4614		-37965	
232	23.8[illegible]					-1460.1		-9734
20		24.5[illegible]	486.7	9.[illegible]	4832		-23562	
212	24.57[illegible]					-1411.4		-33406
20		25.410	508.2	9.[illegible]	5045		-13565	
192	26.[illegible]					-[illegible]		-47247
20		26.132	529.7	9.[illegible]	5263		5664	
172	27.014					[illegible]		-[illegible]

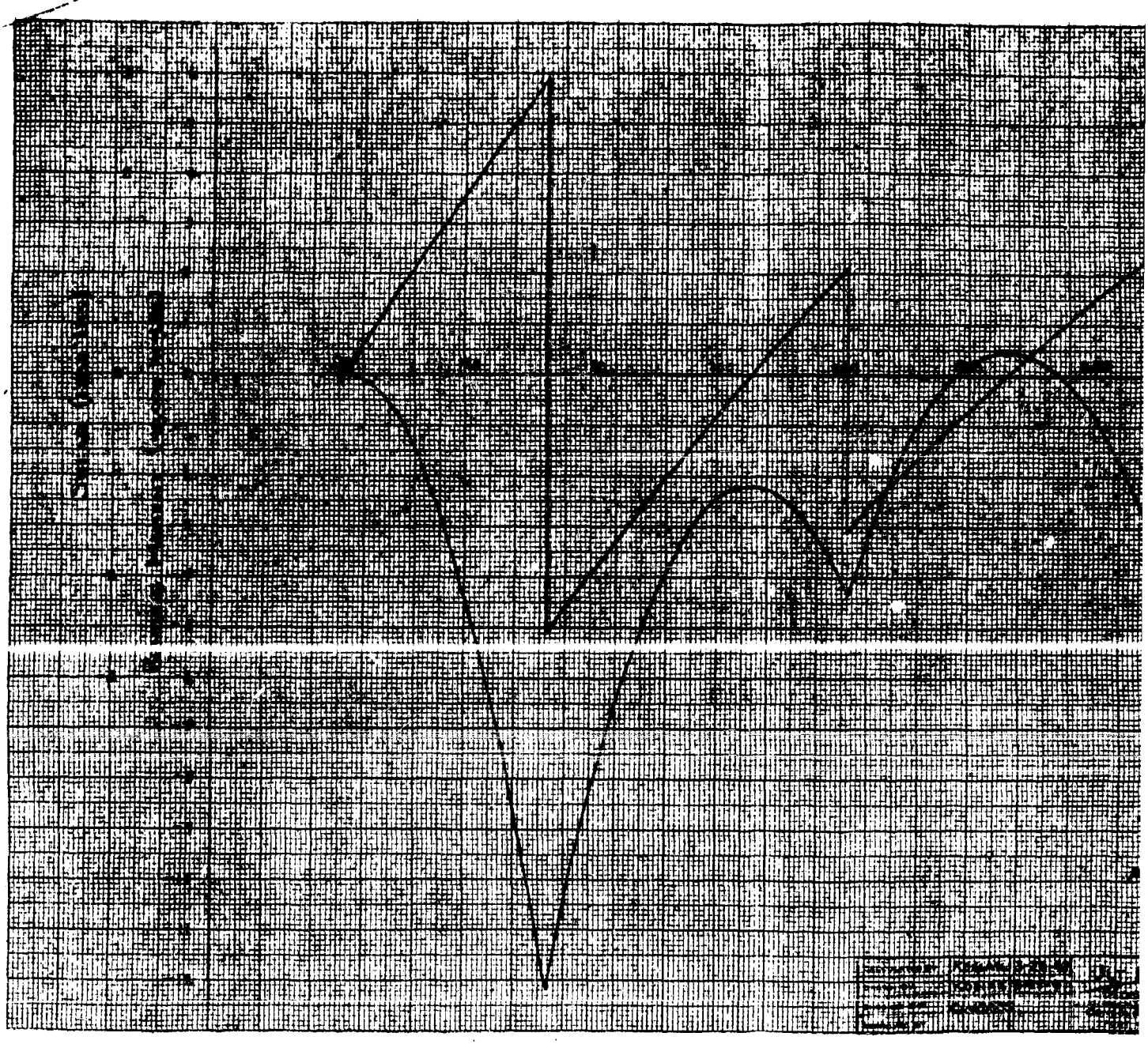
STATION	LOAD PER INCH	AVERAGE LOAD	LOAD BETWEEN STATIONS F	ARM TO CENTROID G	MOMENT M'+Fw	SHEAR S 2F	MOMENT M'+Gy	MOMENT AT STATION M'+M
172	27.[illegible]					96.5		50648
20		27.552	551.0	9.750	[illegible]		[illegible]	
152	28.085					647.5		-98243
20		28.576	571.3	9.[illegible]	[illegible]		12[illegible]	
132	29.066					1190.8		-25502
			-2150.4					
132	29.100					-959.6		25502
20		29.646	592.9	9.744	5[illegible]		-14172	
112	30.186					-367.7		-39104
20		30.726	614.5	9.944	6111		-7334	
92	31.266					246.8		-40327
20		31.806	636.1	9.944	6325		4956	
72	32.346					883.9		-21.9[illegible]
11		32.642	359.1	5.432	1[illegible]		9720	
62	32.937					1243.0		-17354
10		33.258	399.1	5.431	2337		14416	
50	33.579					1642.1		-51
			-1642.0					VS
50	33.579					0		0

CONSOLIDATED-VULTEE AIRCRAFT CORP.
FT. WORTH DIVISION FT. WORTH, TEX.
REPORT: FZS-36-240
MODEL: XB-36
BY: LANDAU
CHECKED:
DATE:






BENDING MOMENT
SHEAR



ELEVATOR

SUMMARY OF ELEVATOR REACTIONS & SERVO TAB LOADS

CONDITION	ELEVATOR REACTIONS				SERVO TAB LOAD	
	STA. 50	STA. 133	STA. 252	STA. 372	TRIM TAB WITH	TRIM TAB AGAINST
MOST AFT CG - H.S.	-2401.8	-9747.5	-7648.2	-5541.9	3404.2	728
MOST FWD CG - H.A.A.	93.4	5500.4	2627.2	2229.7	844.1	457.0
BALANCING	-1642.0	-2150.4	-3108.2	-2011.8		
1G BALANCE + GUST	-799.2	+1421.9	+142.2	-138.2	1227.3	1523.9

NOTE: Negative Sign Indicates Down REACTION

DETERMINATION OF ELEVATOR HINGE MOMENTS, SERVO TAB LOADS, AND NOSE BOX TORSIONS

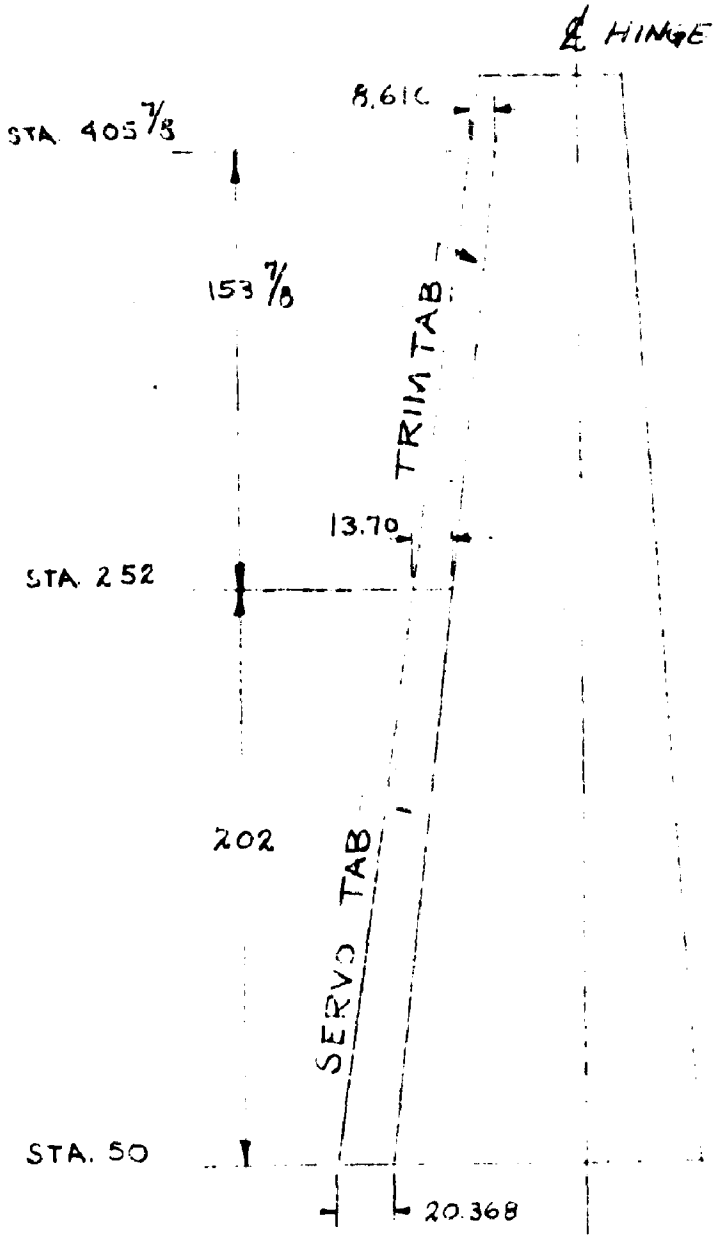
This section of the report contains the determination of the elevator torsions. Essentially, the method consists of summing up elevator hinge moments, and reacting these moments by loads on the servo tab. Hinge moments and shears are then transferred to the spar, and the torsion reacted as T/2A shear flow around the nose box. In computing hinge moments it is assumed that the trim tab may act either to increase or decrease the moments. Corresponding changes in chordwise pressure distributions are made to account for tab effects. The method is completely outlined in Report FZS-36-140.

A complete set of computations are shown for the Balancing Condition, and only final curves are shown for all other conditions.

ELEVATOR

SERVO AND TRIM TABS PLAN FORM

REFERENCE DWGS. SERVO TAB 38T4830
TRIM TAB 36T4790



TRIM TAB
AREA = 11.92 SQ.FT.

SERVO TAB
AREA = 23.89 SQ.FT

ELEVATOR

BALANCE [illegible]

TRIM TAB [illegible]

.0012 V^2 (LIMIT) REFER C-1803-6

V = 396 M.P.H. @ 35000'

.3098 = DENSITY CORRECTION @ 35000'

A = 11.92 [illegible]

= .0012 × 396² × .3098 × 1.5

= 87.45 #/□' (ULTIMATE)

= 87.45 × 11.92

= 1042.4# (ULTIMATE)

[illegible]

[illegible]

AVERAGE UNIFORM LOAD FOR TRIM TAB [illegible]

AND TRIM TAB AGAINST

STA 432.5 TO 405 7/8

NET ELEVATOR LOAD = 8913# (REF. P11)

AV. UNIFORM LOAD = $\frac{8913}{237.47 \times 144}$ = .260647 #/SQ. IN.

AVERAGE UNIFORM LOAD FOR TRIM TAB [illegible]

STA. 405 7/8 TO 252

TRIM TAB LOAD = $\frac{87.45}{144}$ = 0.00727 #/□"

AV. TRIM TAB AIR LOAD = .00727 X .1562 = .094856 #/□"

FROM PRESSURE DISTRIBUTION AV.

TRIM TAB [illegible] (REF P44) = $\frac{13}{2}$ X .1562 X $\frac{1}{144}$ = .008135 #/□"

NET AV. LOAD ON [illegible] = [illegible] - (.094856 [illegible])

= .173926 #/SQ. IN.

AVERAGE UNIFORM LOAD FOR TRIM TAB AGAINST

STA. 405 7/8 TO 252

AV. UNIFORM LOAD = 0.260647 + 0.094856 = 0.355503 #/SQ. IN.

TRIM TAB REACTIONS

STATION	UNIF. 1000# REACTION	RATIO	REACTIONS TAB AGAINST	RATIO	REACTIONS TAB WITH
405.875	94.2#	1042.4 / 1000.3	98.2#	.086721 / .094856	89.8#
360.125	287.8#	↓	299.4#	↓	273.7#
324.000	201.3#		210.0#		192.0#
288.000	306.9#		319.8#		292.4#
252.000	110.9#	1042.4 / 1000.3	115.0#	.086721 / .094856	105.1#

ELEVATOR

BALANCING CONDITION

SERVO TAB REACTIONS

SERVO TAB TRIM TAB WITH 1365.6# (REF. P 28)

SERVO TAB TRIM TAB AGAINST 41.6# (REF. P 30)

STATION	UNIT REACTIONS 1000# LOAD	SERVO TAB REACTIONS TRIM TAB WITH	SERVO TAB REACTIONS TRIM TAB AGAINST
252.0	97.4	133.0	4.05
192 5/8	286.1	390.7	11.90
145 1/8	204.5	279.3	8.51
100 5/8	254.1	347.0	10.57
60 1/8	158.3	216.2	6.54

MOMENT ARM CONSTANT VOL. (11) TABLES 4 TO 7
PAGES 28 TO 31

$$.0478 = \frac{\%\ \text{CHORD}}{100}$$ (DISTANCE BETWEEN C.P. PRESSURE [illegible])

$$= \frac{35.78 - 31.00}{100}$$

MOMENT ARM CONSTANT VOL. (14) TABLES 4 TO 7
PAGES 28 TO 31

$$.5539 = \frac{\%\ \text{CHORD}}{100}$$ (DISTANCE BETWEEN SERVO OR TRIM TAB HINGE LINE & 31% HINGE LINE)

$$= \frac{86.34 - 31.00}{100}$$

DETERMINATION OF [illegible] HINGE MOMENTS AND SERVO [illegible]
BALANCING CONDITION TRIM TABS [illegible] AIRFOIL

TABLE 4

STATION	DISTANCE FROM TIP	CHORD	K	LOAD AT STATION	AVERAGE LOAD BETWEEN STATIONS	% OF INTERVAL TO C.P.	DISTANCE TO STATION	$\bar{X}$	LOAD FROM ELEVATOR	ARM	TORQUE FROM ELEVATOR	EFFECTIVE TAB CHORD	ARM	TORQUE FROM TAB	STORQUE ABOUT SIT. HINGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			(REF PG)	3 × 4				7 × 8	6 × 8	-0.478 3 (REF. P.27)	10 × 11		7.553 7.28 (REF. P27)	13 × 14	
432.5	0	47.970	260647	13.086											0
	6.557	51.023			13.376	.5044	13.000	6.557	173.7	-2.45	-426				
419.5	13.100	52.076		13.765											-426
	19.578	53.072			14.091	.5044	13.625	6.876	192.0	-2.58	-495				
405.875	20.605	53.904	260647 93226	14.439 9.611								89.8	-30.722	-2759	-921 -3680
	34.704	54.737			9.934	.5048	16.000	8.077	155.4	-2.73	-434				
389.875	42.625	55.762		10.220											-4114
	51.045	56.622			10.541	.5048	13.875	9.023	185.4	-2.90	-540				
372.0	60.500	62.447		10.861											-4660
	66.415	63.073			11.077	.5032	11.875	5.975	131.5	-3.04	400				
360.125	72.375	64.346		11.237								273.7	-35.445	-9838	5000 -14838
	81.461	66.768			11.610	.5048	18.000	7.086	209.0	-3.19	-667				
342.125	90.375	69.609		11.932											-15505 CONSOLIDATED-VULTEE AIRCRAFT CORP.
	99.510	70.433			12.257	.5040	18.125	9.135	222.2	-3.37	-749				-16254 FT. WORTH DIV. FT. WORTH, TEX. REPORT: FZ2-36-246
324.0	108.500	72.341		12.582								192.0	-40.070	-7693	-24947 PREPARED BY: LANZARA
	117.578	74.211			12.925	.5040	18.000	9.078	232.3	-3.58	-825				-24972 CHECKED BY: ZINDARG
306.0	126.500	76.051		13.277											-24972 MODEL : XB-36
	135.578	77.921			13.550	.5040	18.000	7.072	245.7	-3.76	-907				DATE : 10-20-47
288.0	144.500	79.762		13.823								172.4	-44.180	-7613	-18.287
	153.578	81.632			14.196	.5040	18.000	7.072	255.5	-3.90	-996				
	171.578	85.337			14.841	.5040	18.000	7.058	267.1	-4.05	-1090				
252.0	180.500	87.172	173426	15.163								100.1	-48.690	-5075	[illegible]
252.0	180.500	87.172	260647 + K2	22.744											
	236.302	98.685			23.074 [illegible]	.5157	16.750	15.8[illegible]	[illegible]	4.16	[illegible]				
144.42	292.080	109.358		29.504								- 8	[illegible]	[illegible]	-[illegible] 28.978 [illegible] +58.475
	350.583	114.356	260647		31.941 [illegible]	.5157	14.440	[illegible]	[illegible]	[illegible]	[illegible]				
50.0	387.500	123.321	+ K2	[illegible]											-[illegible] + 52.321 K
			K2 = [illegible] .4062 K												= 75554 / 58.321 = 1300.0"

DETERMINATION OF ELEVATOR HINGE MOMENTS
BALANCING CONDITION - TRIM TAB LOAD IN DIRECTION OF AIRCRAFT

TABLE 5

STATION	DISTANCE FROM STA 252	CHORD	K	LOAD AT STATION	AVERAGE LOAD BETWEEN STATIONS	% OF INTERVAL TO C.P.	DISTANCE BETWEEN STATIONS	X	LOAD FROM ELEVATOR	ARM	TORQUE FROM ELEVATOR	SERVO TAB FRACTION	ARM	TORQUE FROM TAB	TORQUE ABOUT 51% HINGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				3 x 4				7 x 8	6 x 5	0.478 3	10 x 11		-5539.3	13 x 14	10 + 15
252	0	87.136	.323187	28.16								-133.0	-45.283	6423	-38618 -39395
	10.076	87.459			28.85	.5085	20	10.076	577.1	-4.27	-2464				
232	20.000	91.794		29.51											-41859
	30.076	93.381			32.13	.5085	20	10.076	633.6	-4.46	-2092				
212	40.000	95.427		30.84											-44551
	49.753	97.435			31.71	.5084	17.375	9.753	611.1	-4.66	-2843				
192.625	59.375	99.421		32.13								-390.7	-55.069	21515	-47394 -25879
	69.417	101.079			32.07	.5086	16	8.042	522.7	-4.83	-2525				
176.625	75.375	102.719		33.20											-28404
	83.417	104.377			33.73	.5086	16	8.042	539.7	-4.99	-2693				
160.625	91.375	106.017		34.26											-31097
	99.167	107.622			34.73	.5087	15.5	7.737	537.1	-5.14	-2771				
145.125	106.875	109.212		35.30								-274.3	-60.495	16596	-33869 -16972
	112.954	110.466			35.71	.5088	12.125	6.054	432.9	-5.28	-2286				
133	119.000	111.711		36.10											-19258
	127.984	113.563			36.70	.5086	17.375	8.784	656.0	-5.43	-3562				
115.125	136.875	115.396		37.29											-22820
	[illegible]	[illegible]			[illegible]	[illegible]	14.5	7.250	547.4	-5.59	-3057				
100.625	151.375	117.335		38.26								-344.0	-65.573	22554	-25866 -3128
	157.849	119.230			38.64	.5088	13	6.523	503.0	-5.72	-2877				
															-6002
	170.375	122.409			[illegible]	[illegible]	[illegible]								
74.625	177.515	123.744		39.79											-9014
	189.653	125.244			40.48	.5087	14.5	7.273	557.0	-5.99	-3516				
60.125	191.875	126.733		40.96								-216.2	-70.197	15177	-12530 2647
	196.951	127.759			41.39	.5088	10.125	5.176	418.1	-6.11	-2555				
50	202.000	128.820	.323187	41.83											92 0 0

.323187 (0.20755 (30.00)) = .323187

CONSOLIDATED-VULTEE AIRCRAFT CORP.
FT. WORTH DIV. FT. WORTH, TEX.
REPORT: FZS-36-246
PREPARED BY: LANZARA
CHECKED BY: ZIMBERO
MODEL: XB-36
DATE: 10-20-47

DETERMINATION OF ELEVATOR HINGE MOMENTS AND SERVO TAB LOAD — TABLE 6

BALANCING CONDITION — TRIM TAB LOAD AGAINST DIRECTION OF AIR LOAD

STATION	DISTANCE FROM TIP	CHORD	K	LOAD AT STATION	AVERAGE LOAD BETWEEN STATIONS	DISTANCE OF INTERVAL TO C.P.	DISTANCE BETWEEN STATIONS	Σ	LOAD FROM ELEVATOR	ARM	TORQUE FROM ELEVATOR	EFFECTIVE TAB LOAD	ARM	TORQUE FROM TAB	Σ TORQUE ABOUT 31% HINGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			(REF. P.26)	3 x 4				7 x 8	6 x 9	-.1478 x 3 (REF. P27)	10 x 11		+.5537 x 3 (REF. P27)	13 x 14	12 + 15
432.5	0	49.916	.260697	13.03											0
	6.557	51.323			13.32	.5044	13.000	6.557	173.9	-2.45	-426				
419.5	13.00	52.730		13.72											-426
	19.872	54.072			11.94	.5044	13.625	6.876	142.0	-1.55	-445				
405.875	26.625	55.464	.260697 355503	14.46								-78.2	-30.722	3017	-981 2096
	34.707	57.127		15.31	8.31	.5043	16.750	8.082	325.0	-2.73	-887				
389.875	42.625	58.762		22.39											1201
	51.693	60.622			21.55	.5043	17.875	7.023	395.2	-3.10	-1117				
372.0	60.503	62.497		22.20											92
	66.475	63.678			22.04	.5032	11.875	5.175	268.1	-3.04	-817				
360.125	76.513	64.895		23.07								-277.4	-35.445	10762	-135 10627
	81.461	66.768			23.73	.5043	18.000	7.086	427.1	-3.17	-1362				
342.125	90.375	68.605		24.37											8675
	99.510	70.438			25.00	.5040	18.125	7.135	454.2	-3.37	-1531				
324.0	108.504	72.341		25.70								-212.0	-40.070	8415	7124 15539
	117.516	74.211			26.38	.5040	18.000	7.072	474.8	-3.55	-1686				
306.0	126.503	76.051		27.04											13573
	135.512	77.921			27.70	.5040	18.000	7.072	448.6	-3.77	-1692				
288.0	144.500	79.766		28.36								-319.8	-44.180	14124	26697
	153.512	81.632			27.72	.5040	18.000	7.072	522.4	3.90	[illegible]				
270.0	162.503	83.472		27.07											39410
	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				
252.0	180.503	87.182	355503	30.49								115.0	48.279	5553	21933 29936
252.0	180.503	87.182	.260697 - K	33.77 [illegible]											
	186.34	88.655			28.61 [illegible]	.5187	107.375	5.53	[illegible]	4.72	[illegible]		-60.578	-60.578	[illegible] 12.2697 [illegible] -55.2942
144.125	233.000	107.353		[illegible]											
	236.503	111.376			31.4 [illegible]	.5121	14.400	4.0 [illegible]	[illegible]	-5.71	[illegible]				
50.0	[illegible]	123.221	.260697 - K	[illegible]											[illegible] 55.343 ℓ

[illegible] = 0

ℓ = [illegible] = 11.6

REPORT: F25-36-246

PREPARED BY: LANZARA

CHECKED BY: ZINBERG

MODEL: XB-36

DATE: 10-20-47

DETERMINATION OF ELEVATOR HINGE MOMENTS TABLE 7
BALANCING CONDITION TRIM TAB LOAD AGAINST DIRECTION OF AIR LOAD

STATION	DISTANCE FROM STA 252	CHORD	K *	LOAD AT STATION	AVERAGE LOAD BETWEEN STATIONS	X% OF INTERVAL TO C.P.	DISTANCE BETWEEN STATIONS	X̄	LOAD FROM ELEVATOR	ARM	TORQUE FROM ELEVATOR	SERVO TAB REACTION	ARM	TORQUE FROM TAB	# TORQUE ABOUT 31% HINGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				3 x 4				7 x 8	6 x 9	[illegible]	[illegible]		+5539x13		
252	0	37.182	.2627	22.90								-4.05	48.290	196	27486 27635
	10.076	39.254			23.45	.5039	20	10.076	469	-4.25	-2003				
232	20.000	91.504		23.99											25629
	30.072	93.381			24.53	.5036	20	10.072	491	-4.46	-2190				
212	40.000	95.427		25.07											23439
	49.753	97.438			25.60	.5034	19.375	9.753	496	-4.66	-2311				
192.625	59.375	99.421		26.12								-11.90	-55.069	655	21125 21733
	67.417	101.079			26.55	.5026	16	8.042	425	-4.83	-2053				
176.625	75.375	102.719		26.98											19730
	83.417	104.377			27.42	.5026	16	8.042	439	-4.99	-2191				
160.625	91.375	106.017		27.85											17539
	99.162	107.622			28.27	.5024	15.5	7.787	433	-5.14	-2251				
145.125	106.875	109.212		28.69								-8.51	-60.493	515	13283 15803
	112.759	110.466			29.02	.5018	12.125	6.034	352	-5.28	-1859				
133	119.000	111.711		29.35											13944
	127.984	113.563			29.83	.5026	17.875	8.984	533	-5.43	-2894				
115.125	136.874	115.396		30.31											11050
	144.155	116.897			30.71	.5021	14.5	7.280	445	-5.59	-2488				
100.625	151.375	118.385		31.10								-10.57	-65.573	693	8562 9255
	157.898	119.730			31.45	.5018	13	6.523	409	-5.72	-2339				
87.625	164.375	121.065		31.80											6916
	170.898	122.409			32.16	.5018	13	6.523	415	-5.85	-2445				
[illegible]	[illegible]	[illegible]		[illegible]											[illegible]
	184.653	125.244			32.90	.5019	14.5	7.278	477	-5.79	-2857				
60.125	191.875	126.733		33.29								-6.59	-70.177	463	1614 2077
	196.931	127.733			33.57	.5018	10.125	5.076	340	-6.11	-2077				
50	200.000	128.820	.2627	33.84											0 vs 0

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MODEL: XB-36
DATE: 10-20-47

* .260647 - .0000458 (-45.1) = .262713

TABLE 8

STATION	SLOPE	DISTRIBUTED LOAD SPAN	TAB REACTION SPAN	ELEVATOR HINGE SPAN	Σ SHEAR	DISTANCE HINGE TO SPAN	HINGE MOMENT AT STATION	CHANGE IN MOMENT	Σ TORQUE ABOUT SPAR
1	2	3	4	5	6	7	8	9	10
		Σ COL 10	Σ COL 13		Σ 3+4+5	16 X (GTA 50 TO 372 ONLY)		6 X 7	8 + 9
		REF. P 2824	REF. P 2824	REF. P 15					
432.5	49.976				0	2.5	0	0	0
		173.9							
419.5	52.656				173.9	2.5	-426	435	9
		192.0							
403.875	55.464		89.8		365.9 455.7	2.5	-921 -3680	915 1139	-6 -2541
		159.9							
389.875	58.762				614.6	2.5	-4114	1537	-2577
		180.4							
372.0	62.447			-2011.8	803.0 -1208.8	2.5 -9.992	-7660	2008 12078	-2052 7418
		131.5							
360.125	64.895		273.7		-1077.3 -803.6	10.383	-5000 -15643	11186 8842	6186 -6555
		209.0							
342.125	68.605				-594.6	-10.477	-15565	6527	-9035
		222.2							
324.0	72.341		192.0		-372.4 -180.4	-11.575	-16614 -24917	4311 2006	-12303 -21919
		232.3							
306.0	76.051				51.9	-12.166	-24832	-632	-25464
		249.9							
288.0	79.762		292.4		243.8 542.2	-12.766	-25739 -38457	-3775 -7506	-29514 -45963
		255.5							
270.0	83.472				843.7	-13.356	-37053	-11268	-50421
		207.1							
252.0	87.182		169.1 -135.0	-3108.7	1213.7 -2025.8	-13.94	-50743 -39375	-16961 28257	-67704 -11118
		577.0							
232.0	91.304				-1448.8	-14.607	-41359	21166	-20193
		603.6							
212.0	95.427				-845.2	-15.268	-44551	12405	31646
		670.1							
192.625	99.421		-340.7		-235.1 -575.8	-15.907	-49394 -29874	3140 7955	-46254 -19919
		522.7							
176.625	102.719				-103.1	-16.435	-28404	1694	-26710

STATION	CHORD	DISTRIBUTED LOAD SPAN	TAB REACTION SPAN	ELEVATOR HINGE SPAN	Σ SHEAR	DISTANCE HINGE TO SPAN	HINGE MOMENT AT STATION	CHANGE IN MOMENT	Σ TORQUE ABOUT SPAR
1	2	3	4	5	6	7	8	9	10
		Σ COL 10	Σ COL 13		Σ 3+4+5	16 X 2		6 X 7	8 + 9
		REF. P 2824	REF. P 2824	REF. P 15					
176.625	102.719				-103.1	-16.435	-28404	1694	-26710
		531.7							
163.625	106.017				436.6	-16.963	-31097	-7406	-38503
		533.1							
145.125	109.212		-279.3		975.7 696.4	-17.474	-35869 -46972	-17049 -12169	-52918 -29141
		432.9							
133.0	111.711			-2150.4	1129.5 -1021.1	-17.874	-20185 18291	-39343 -1007	
		656.0							
115.125	115.334				-365.1	-18.463	-22820	6741	-16079
		549.3							
100.625	118.385		-347.0		182.7 -164.3	-18.947	-23882 -31210	-3461 3112	-27343 -16
		503.0							
87.625	121.005				338.7	-19.370	-6005	-6561	-12566
		514.3							
74.625	123.944				853.0	-19.799	-9014	-16889	-25903
		587.0							
60.125	126.933		-216.2		1440.0 1223.8	-20.277	-12830 2647	-29199 -26815	-41729 -22168
		+18.1							
50	128.360			-1642.0	1641.9 vs 0	-20.611	92	-33841 0	-33749 0

REPORT: FZS-50-246

PREPARED BY: LANZHAN

CHECKED BY: ZIMBERG

MODEL: XB-36

DATE: 10-20-47

DETERMINATION OF ELEVATOR [illegible]

STAT. (1)	TORQUE (2) REF. CON. P 32	2A (3)	q_c (4) 2/3	SPAR DEPTH (5) REF. 30T4801	SHEAR (6)	q_s (7) 6/5	AIR SHEAR FLOW (8) 7 - 4
432.5	0	0	[illegible]	0	0	0	[illegible]
419.5	9	218	0	8.05	173.9	21.5	[illegible]
405.875	-2541	255	-8.8	9.50	305.7 / 1054	30.5 / 45.0	39.5 / 56.8
384.875	-2577	377	-7.0	11.25	614.0	54.6	61.6
372.0	2652 / 7418	414.6 / 1434.54	-5.7 / 77.0	12.00 / 9.25	863.0 / 1210.0	75.8 / -130.0	66.5 / -206.0
360.125	6120 / -2395	114	-29.7 / 77.5	9.65	-1772.5 / 8.30	-111.6 / -53.3	-70.3 / -225.8
342.125	-9038	151	-64.5	10.2	-594.6	-52.3	11.2
324.0	-14003 / -21919	310	-92.2 / -120.1	10.75	-2721.4 / -1804	-34.0 / -36.2	77.6 / 83.8
306.0	-25346.4	1[illegible]	-151.2	11.3	314	4.6	163.0
288.0	-29548 / -46163	171	-100.7 / -200.2	11.8	2705.8 / 3660.2	29.1 / 44.6	171.6 / 210.6
270.0	50421	191	-262.5	12.4	3437	63.0	325.5
252.0	-57114 / -11150	210.96	-271.0 / -52.8	12.95	1613.9 / -2025.0	43.9 / -126.4	360.7 / -[illegible]
234.0	-20695	230	-10.0	13.55	-1445.4	-106.7	-10.7
216.0	-31646	271	-126.1	14.2	[illegible]	-54.5	66.0
192.625	-43054 / -15924	272	[illegible] / -[illegible]	14.8	-[illegible] / [illegible]	-17.9 / 12.3	144.6 / 16.2
178.25	-20710	271	-91.8	15.3	[illegible]	-6.7	[illegible]

STATION (1)	TORQUE (2) REF. CON. P 32	2A (3)	q_c (4) 2/3	SPAR DEPTH (5)	SHEAR (6)	q_s (7) 6/5	AIR SHEAR FLOW (8) 7 - 4
160.625	-88803	311	-123.8	15.75	432.6	27.7	151.5
145.125	-50418 / -29191	330	[illegible] / 85.3	16.25	773.7 / 696.4	60.0 / 42.7	217.3 / 131.2
133.0	-39442 / -1009	346.8	-113.7 / 2.9	16.65	1129.3 / -1021.1	67.8 / -61.3	181.5 / -58.4
115.625	-16379	372	-43.2	17.2	-365.1	-21.2	22.0
100.625	-29449 / 16	372	-79.4 / 0	17.6	182.7 / -149.8	10.4 / 7.3	[illegible] / 7.3
87.625	-12566	410	-30.6	18.05	323.7	18.8	49.4
74.625	-25103	428	-60.5	18.45	853.0	46.2	106.7
60.125	-41729 / -22102	450	-92.7 / 49.3	18.9	1944.2 / 1227.5	76.2 / 64.5	169.9 / 114.1
50.0	-23749 / 0	466.12	-72.6 / 0	19.25	1041.9 / 0	45.3 / 0	157.9 / 0

CONSOLIDATED-VULTEE AIRCRAFT CORP.
FT. WORTH DIVISION. FT. WORTH, TEX.
REPORT: FZS-96-296
PREPARED BY: CANTARA
CHECKED BY: ZINBERG
MODEL: XB-36
DATE: 10-20-47

DETERMINATION OF ELEVATOR TORSIONS BALANCING CONDITIONS DUE TO LOAD AGAINST DIRECTION OF AIR LOAD

TABLE 10

STATION	CHORD	DISTRIBUTED LOAD SHEAR	TAB REACTION SHEAR	ELEVATOR HINGE SHEAR	Σ SHEAR	DISTANCE HINGE TO SPAR	HINGE MOMENT AT STATION	CHANGE IN MOMENT	Σ TORQUE ABOUT SPAR	STATION	CHORD	DISTRIBUTED LOAD SHEAR	TAB REACTION SHEAR	ELEVATOR HINGE SHEAR	Σ SHEAR	DISTANCE HINGE TO SPAR	HINGE MOMENT AT STATION	CHANGE IN MOMENT	Σ TORQUE ABOUT SPAR
1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
		Σ COL. 10 REF. P30431	Σ COL. 13 REF. P30431		3+4+5	16 x (2 (STA. 50 TO 372 ONLY)		6 x 7	8+9									6 x 7	8+9
432.5	49.976				0	2.5	0	0	0	176.625	102.714				-30	-16.435	19730	493	20223
		174										439							
419.5	52.656				174	2.5	-426	435	9	160.625	106.014				409	-16.963	17539	-6935	10601
		192										438							
405.875	55.469		-98		366 268	2.5	-921 2296	915 670	-6 2966	145.175	109.212		-8		847 839	-17.414	15289 15805	-14800 -14661	488 1142
		325										352							
389.875	55.762				593	2.5	1209	1483	2692	133.0	111.711			-2150	1141 -959	-17.874	13944	-21288 17161	-7344 31051
		385										533							
372.0	62.447			-2012	972 -1234	2.5 -9.996	92	2445 10332	2537 10424	115.125	115.344				426	-10.463	11050	7865	18915
		269										445							
360.125	64.895		-299		-765 -1064	-10.388	-725 10037	7442 11048	7217 21085	100.625	118.385		-11		19 8	-18.942	8562 8255	-300 -132	8262 8123
		427										409							
342.125	68.605				-637	-10.977	8675	6992	15667	87.625	121.085				417	-19.370	6916	-8077	-1161
		454										418							
324.0	72.341		-210		-183 -393	-11.575	9164 13559	2118 4549	9362 20108	74.625	123.744				835	-19.799	4471	-16332	-12061
		475										471							
306.0	76.051				82	-12.168	13873	-998	12875	60.125	126.733		-7		1312 1305	-20.277	1614 2677	-26608 -26461	-24939 -24384
		499										340							
288.0	79.762		-320		587 267	-12.762	12018 26147	-7418 -9331	+7603 22816	50	128.827			-1642	1645 3	-20.611	0	-33905 62	-33906 -0
		522													vs 0				
270.0	83.472				783	-13.356	24110	-10458	13652										
		546																	
252.0	87.184		-115 -4	-3109	1329 -1899	-13.949	21833 27692	-18535 26459	3345 54121										
		469																	
232.0	91.304				-1430	-14.609	25021	20841	46520										
		491																	
212.0	95.427				-939	-15.268	29437	14336	43773										
		496																	
192.625	99.421		-12		-448 -455	-15.907	21128 27583	7047 7238	28175 34821										
		425																	
176.625	102.714				-30	-16.435	19730	493	20223										

CONSOLIDATED-VULTEE AIRCRAFT CORP.
FT. WORTH DIV. FT. WORTH, TEX.

REPORT: FZS-36-246
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MODEL: XB-36
DATE: 10-20-47

STATION	TORQUE	2A	q_t	SPAR DEPTH	SHEAR	q_s	SPAR SHEAR
1	2	3	4	5	6	7	8
	REF COL 10 P. 34		2/3	REF 36T9501		4/5	7 - 4
432.5	0	0	0	0	0	0	0
419.5	9	213	0	8.05	174	21.6	21.6
405.875	2766	288	9.6	9.50	366 269	38.5 28.2	38.5 18.6
384.875	2072	370	7.3	11.25	573	52.9	45.4
372.0	2589 10924	402 1248.82	5.5 49.7	13.25 9.25	975 -1034	74.1 -111.7	68.6 -211.4
360.125	7217 21095	114	63.3 185.0	9.65	-905 -1064	-79.3 -117.2	-142.6 -245.3
342.125	15667	130	120.5	10.2	-637	-62.5	-183.0
324.0	9266 20108	140	67.4 137.7	10.75	-183 -373	-17.0 -34.6	-84.4 -174.3
306.0	12875	150	80.5	11.3	82	7.3	-73.2
288.0	6608 22616	171	38.6 128.9	11.5	537 261	47.2 22.1	28.2 -106.8
270.0	18652	191	70.4	12.6	783	63.1	-7.3
252.0	3340 27127	210.70	15.9 258.5	12.75	1329 1777	[illegible] -[illegible]	86.9 -408.1
232.0	20320	230	302.3	13.55	-1430	[illegible]	-87.8
212.0	37775	247	150.5	14.2	-737	-44.1	-216.6
192.025	28175 29661	272	103.6 109.0	14.5	-443 -455	-29.9 -30.4	-130.2 -139.4
170.025	20223	241	67.5	15.0	-30	[illegible]	-71.5

STATION	TORQUE	2A	q_t	SPAR DEPTH	SHEAR	q_s	SPAR SHEAR
1	2	3	4	5	6	7	8
			2/3			4/5	7 - 4
160.025	10661	311	34.1	15.75	409	26.0	-8.1
145.125	4068 1142	330	1.5 3.5	16.25	847 334	52.1 20.6	50.6 48.1
133.0	7344 3035	346.8	21.2 8.7.6	16.05	-1196 -939	-74.5 -57.6	-92.7 -149.2
115.125	13915	372	50.3	17.2	-426	-24.8	-75.6
100.025	8202 9103	372	22.4 23.2	17.6	19 9	1.1 1.5	-19.3 -22.7
87.025	-1161	410	-2.8	18.05	417	23.1	25.9
74.025	12061	428	[illegible]	18.15	535	45.2	13.4
[illegible]	-24343 -24334	450	-55.5 -54.2	18.9	1312 1336	69.4 69.0	124.9 123.2
[illegible]	-83905	465.12	-72.9	19.25	[illegible]	85.5	158.4

CONSOLIDATED-VULTEE AIRCRAFT CORP.
FT. WORTH DIV. FT. WORTH, TEX.
REPORT: FZS-36-246
PREPARED BY: LANZAFA
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MODEL: XB-36
DATE: 10-20-47

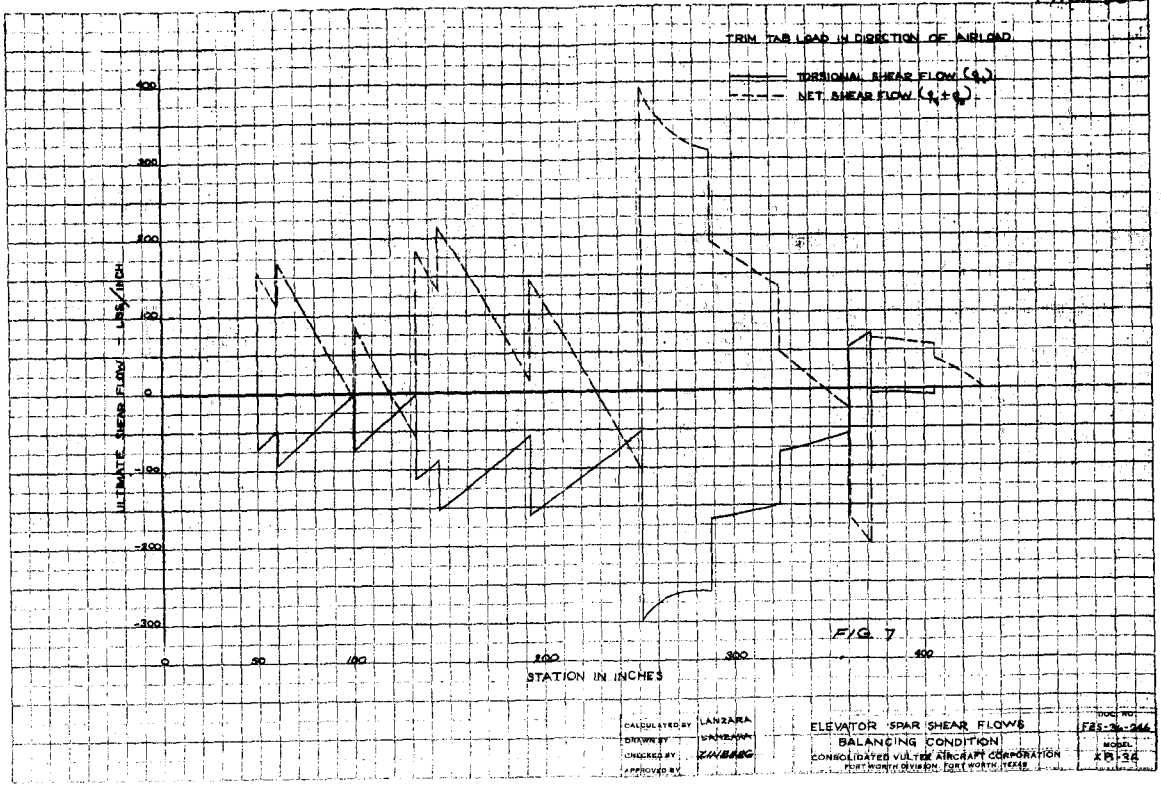
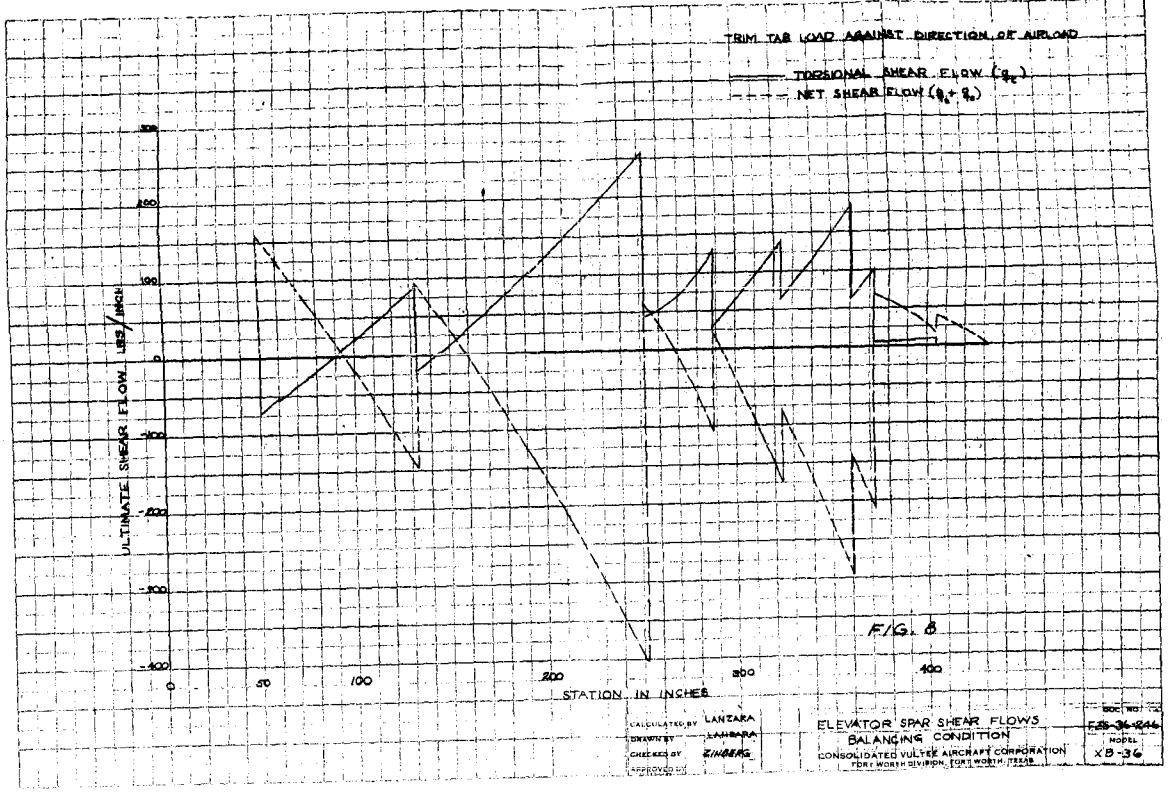


FIG. 7

CALCULATED BY LANZARA	ELEVATOR SPAR SHEAR FLOWS	DOC. NO.	
DRAWN BY LANZARA	BALANCING CONDITION	FZS-%-244	
CHECKED BY ZIMBERG	CONSOLIDATED VULTEE AIRCRAFT CORPORATION	MODEL	
APPROVED BY	FORT WORTH DIVISION, FORT WORTH, TEXAS	XB-36	


TRIM TAB LOAD AGAINST DIRECTION OF AIRLOAD
TORSIONAL SHEAR FLOW (q_t)
NET SHEAR FLOW ($q_b + q_t$)
ULTIMATE SHEAR FLOW LBS/INCH
300
200
100
0
-100
-200
-300
-400
0
50
100
200
300
400
STATION IN INCHES
F/G. 8
CALCULATED BY LANZARA
DRAWN BY LANZARA
CHECKED BY ZINBERG
APPROVED BY
ELEVATOR SPAR SHEAR FLOWS
BALANCING CONDITION
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS
DOC. NO.
FZS-36-246
MODEL
XB-36

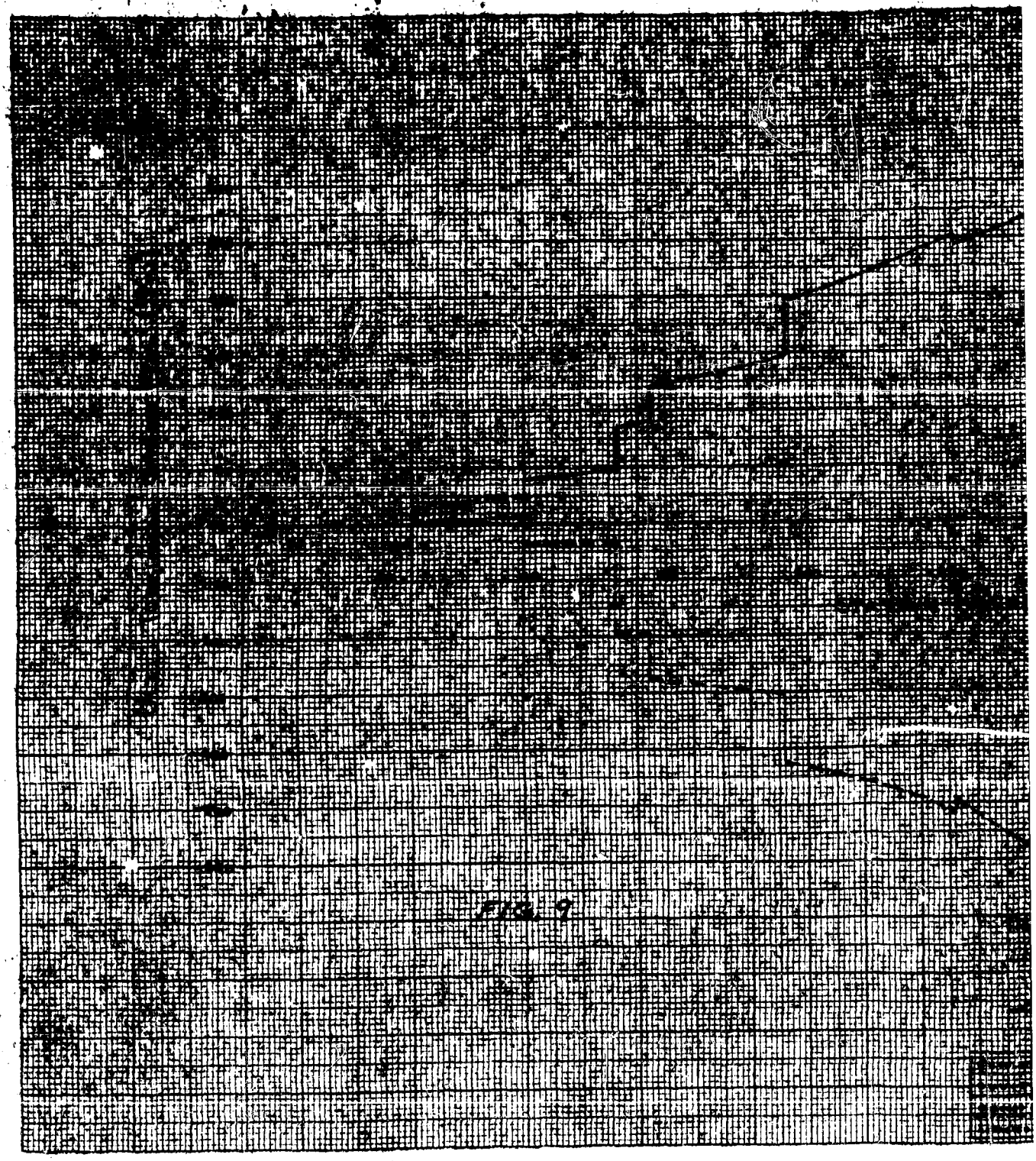


FIG. 9

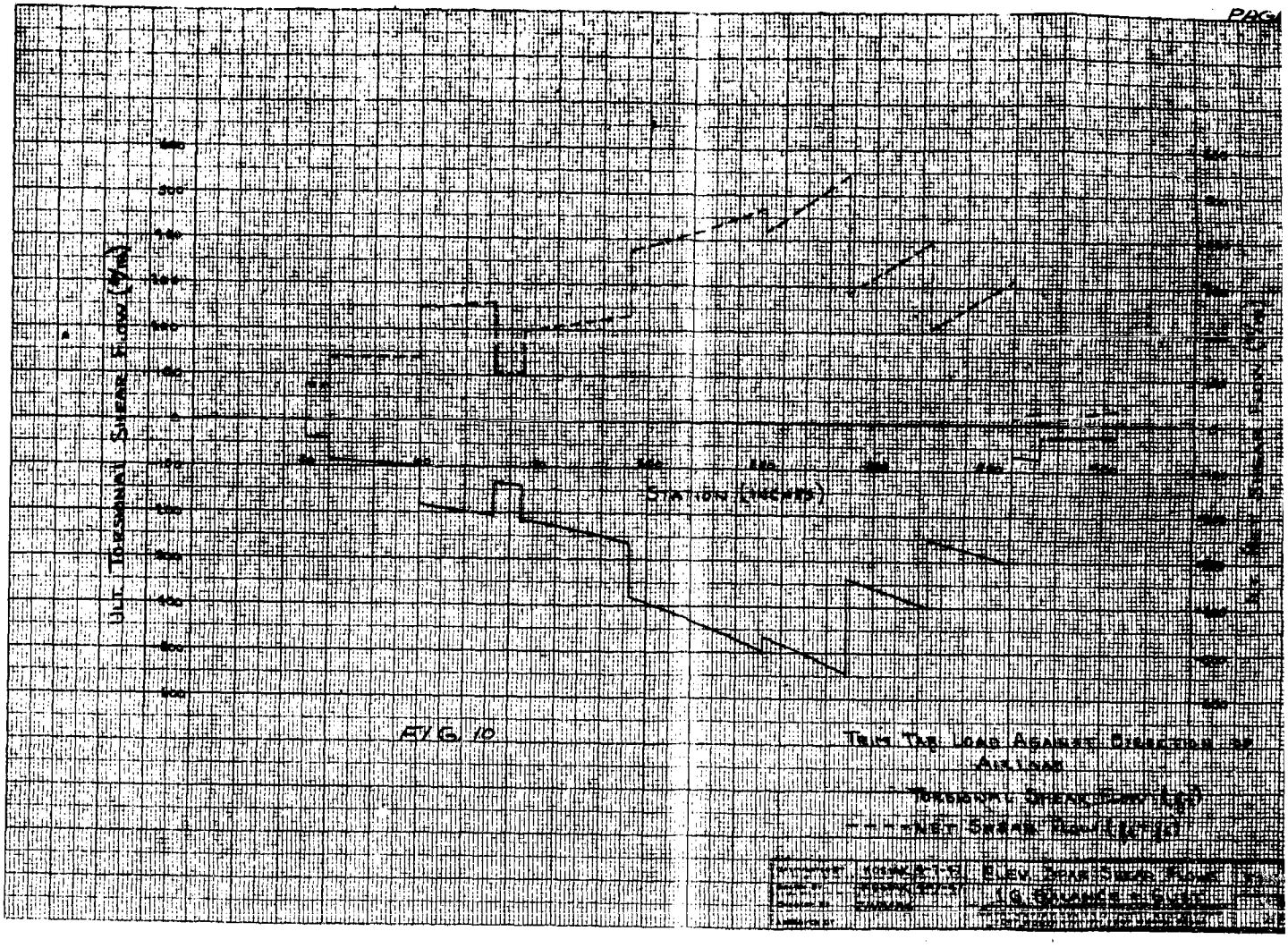

ULT. TORSIONAL SHEAR FLOW
STATION (INCHES)
TRIM TAB LOAD AGAINST DIRECTION OF AIRLOAD
TORSIONAL SHEAR FLOW
NET SHEAR FLOW
ELEV. SPAR SHEAR FLOW

FIG. 10

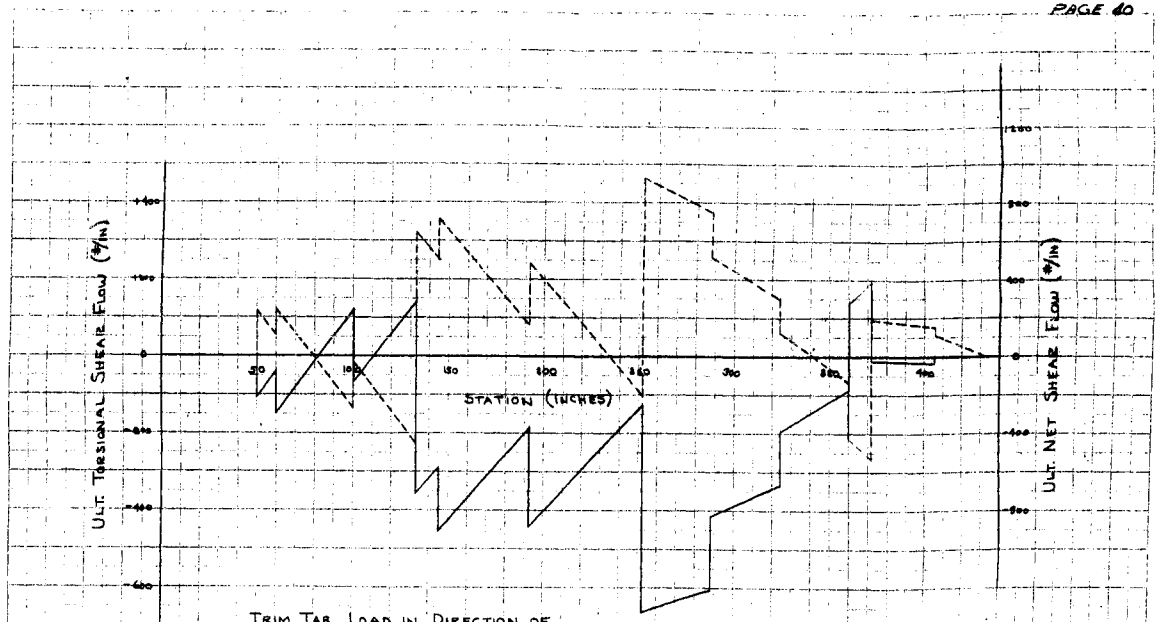
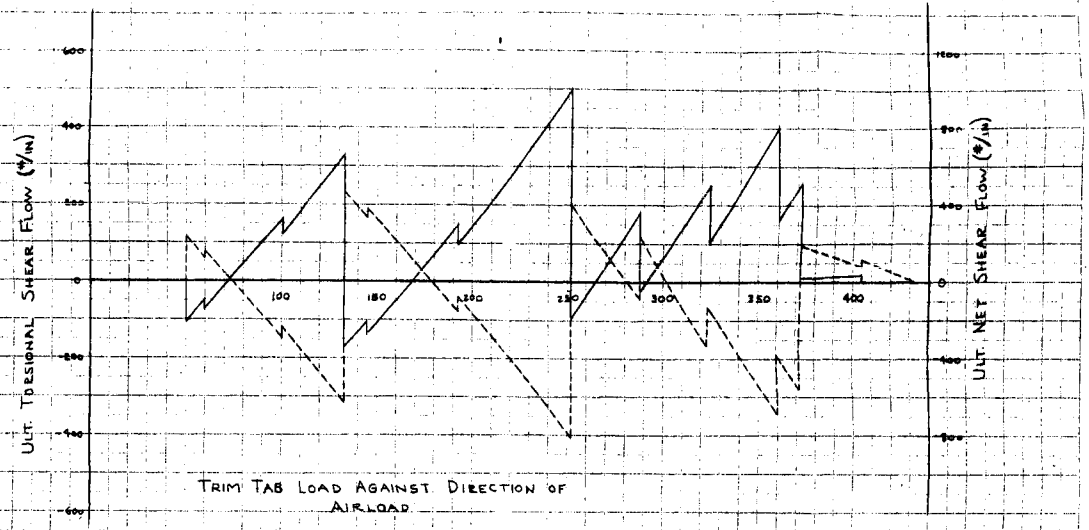


FIG. 11

CALCULATED BY: KOSIAK 4-16-47 CHECKED BY: KOSIAK 4-17-47 APPROVED BY: ENGERG.	ELEV. SPAR SHEAR FLOWS MOST AFT CG - HS CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION FORT WORTH, TEXAS	DOC. NO. FZS-36-246 MODEL XB-36	



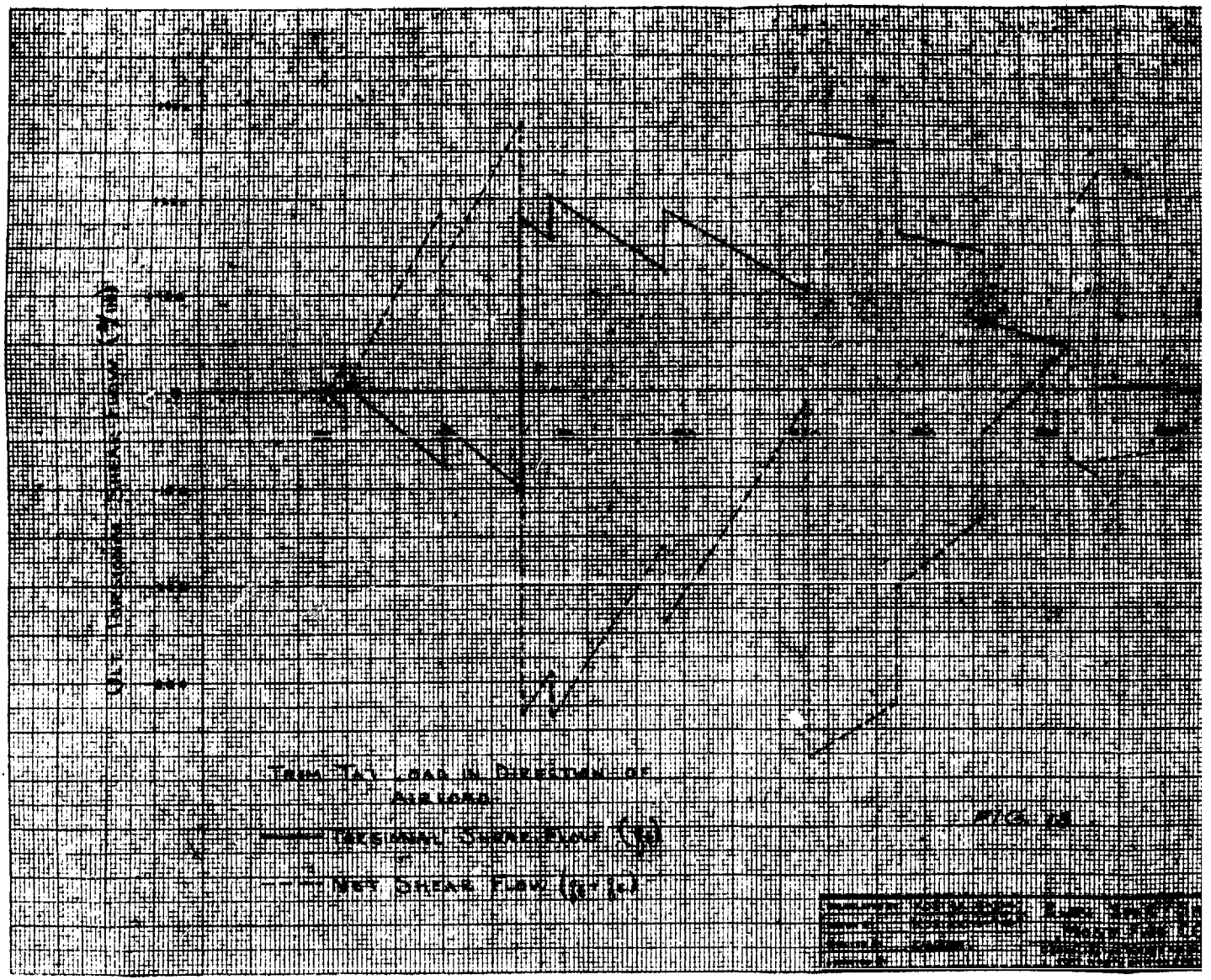
TRIM TAB LOAD AGAINST DIRECTION OF AIRLOAD

—— TORSIONAL SHEAR FLOW (q_t)

- - - - NET SHEAR FLOW ($q_t + q_s$)

FIG. 12

CALCULATED BY	KOSIAK 4-16-47	ELEV. SPAR SHEAR FLOWS MOST AFT CG - H.S.	LOG NO. FZS-36-246
DRAWN BY	KOSIAK 4-17-48		
CHECKED BY	ZINBERG	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION FORT WORTH, TEXAS	MODEL XB-36
APPROVED BY			


TRIM TAB LOAD IN DIRECTION OF AIRLOAD
TORSIONAL SHEAR FLOW
NET SHEAR FLOW

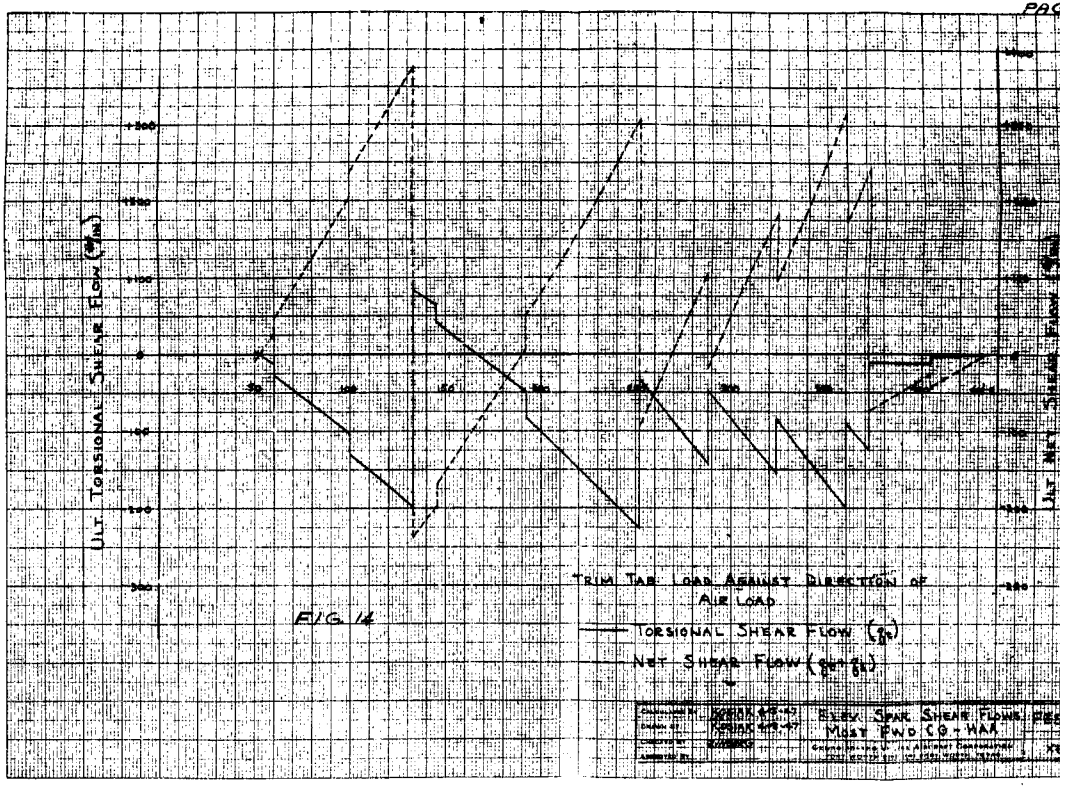

ULT TORSIONAL SHEAR FLOW (#/IN)
+300
+200
+100
0
-100
-200
-300
TRIM TAB LOAD AGAINST DIRECTION OF AIR LOAD
TORSIONAL SHEAR FLOW
NET SHEAR FLOW
ELEV. SPAR SHEAR FLOWS
MOST FWD CG - MAX

FIG. 14

ELEVATOR LOADS

1. TRIM TAB NEUTRAL .260947 X CHORD X SPAN
2. TRIM TAB WITH .178926 X CHORD X SPAN
3. TRIM TAB AGAINST .335503 X CHORD X SPAN
4. SERVO BAL. - T.T. WITH .323187 X CHORD X SPAN
5. ~~SERVO BAL. - T.T. AGAINST .6621 X CHORD X SPAN~~
6. RIB LOAD - MULTIPLY ORDINATE BY:
   - A. T.T. WITH .66729 X CHORD X SPAN
   - B. T.T. AGAINST 1.3639 X CHORD X SPAN
   - C. SERVO BAL. - T.T. WITH - 1.23994 X CHORD X SPAN
   - ~~D. SERVO BAL. - T.T. AGAINST 1.60765 X CHORD X SPAN~~

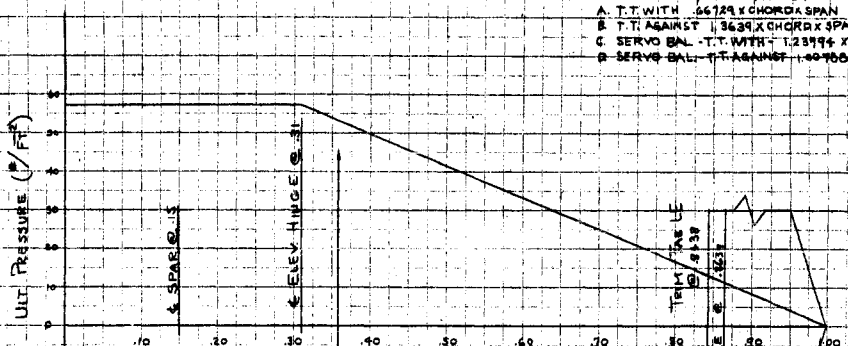


FIG. 15

ACCEPTED BY		ELEV. PRESSURE DISTRIBUTION BALANCING CONDITION	DOC. NO. FES-36-216
DRAWN BY	KOSIAK 4-17-47		
CHECKED BY	KOSIAK 4-17-47		
APPROVED BY	[illegible]	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB-36

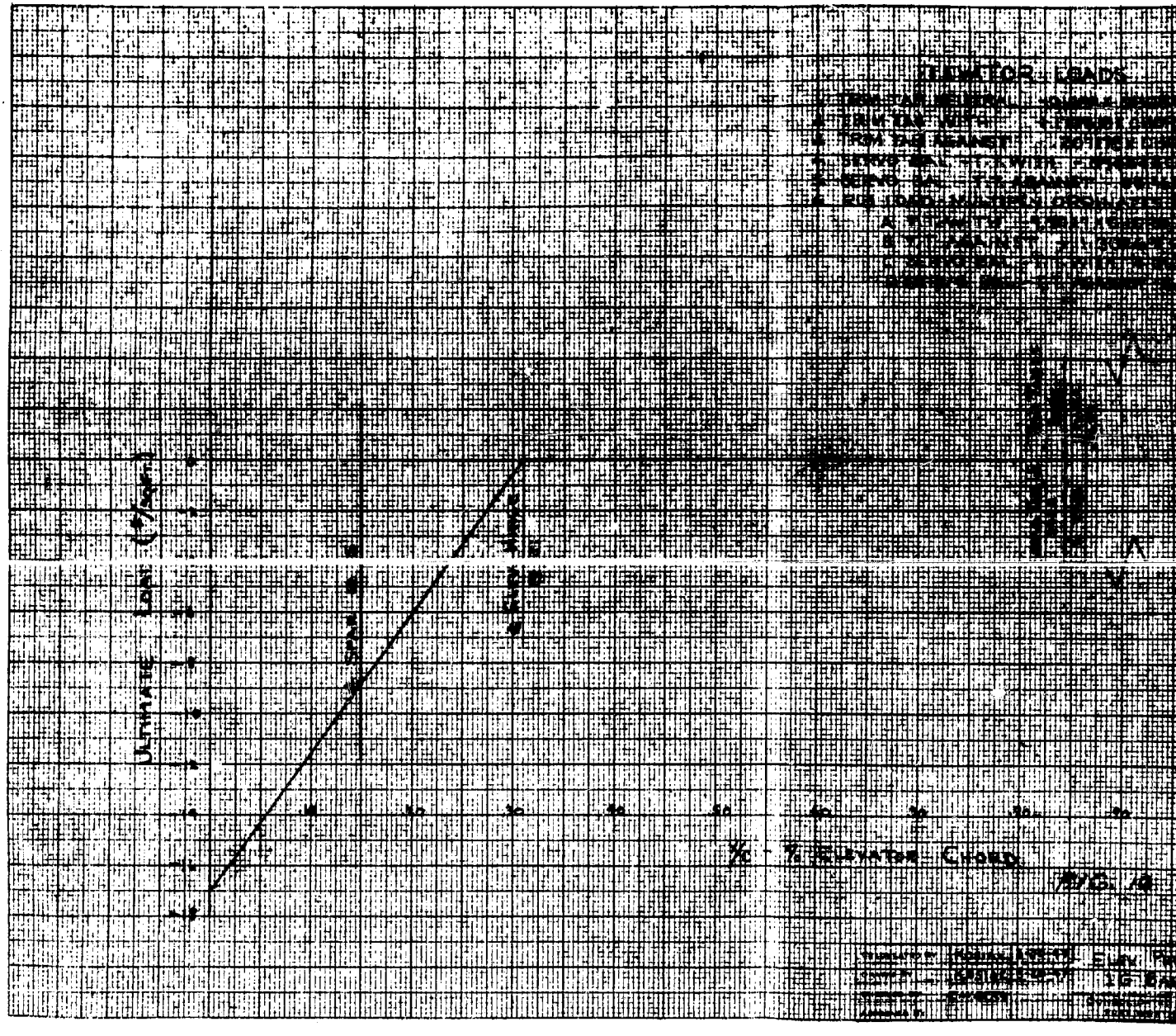


FIG. 10

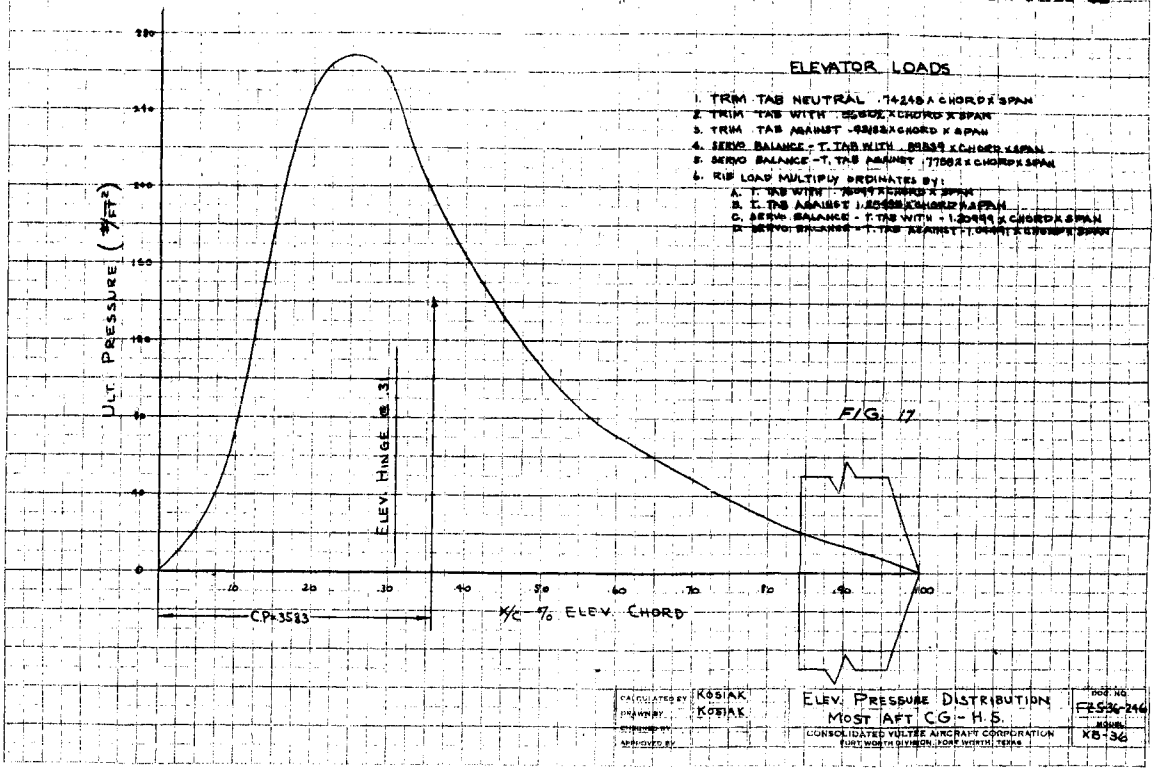
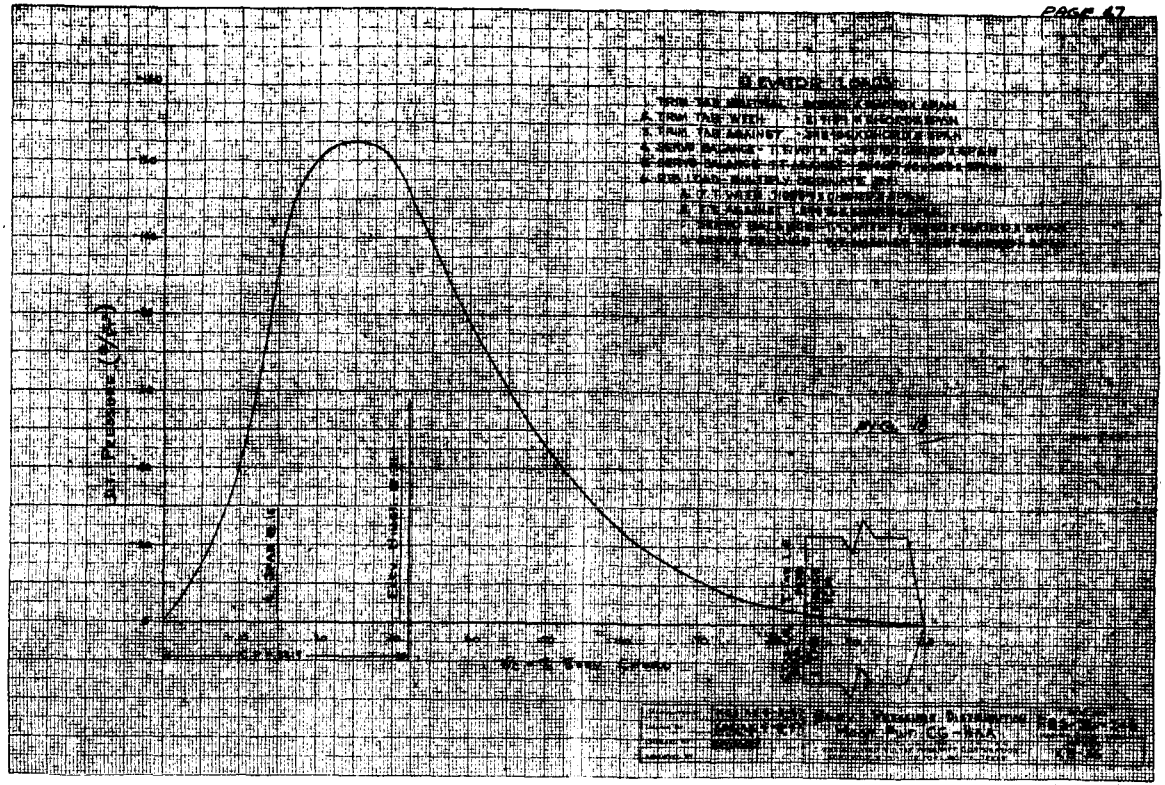

ELEVATOR LOADS
1. TRIM TAB NEUTRAL .74248 X CHORD X SPAN
2. TRIM TAB WITH .56602 X CHORD X SPAN
3. TRIM TAB AGAINST .93183 X CHORD X SPAN
4. SERVO BALANCE - T. TAB WITH .89839 X CHORD X SPAN
5. SERVO BALANCE - T. TAB AGAINST .77582 X CHORD X SPAN
6. RIB LOAD MULTIPLY ORDINATES BY:
A. T. TAB WITH .76099 X CHORD X SPAN
B. T. TAB AGAINST 1.25438 X CHORD X SPAN
C. SERVO BALANCE - T. TAB WITH - 1.20999 X CHORD X SPAN
D. SERVO BALANCE - T. TAB AGAINST - 1.04441 X CHORD X SPAN
ULT. PRESSURE (#/FT²)
ELEV. HINGE @ .3
X/C % ELEV. CHORD
C.P. 3583
0
.10
.20
.30
.40
.50
.60
.70
.80
.90
1.00
CALCULATED BY KOSIAK
DRAWN BY KOSIAK
CHECKED BY
APPROVED BY
ELEV. PRESSURE DISTRIBUTION
MOST AFT CG - H.S.
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS
DOC. NO. FZS-36-246
MODEL XB-36

FIG. 17


ELEVATOR LOADS
TRIM TAB WITH
TRIM TAB AGAINST
FIG. 8

ELEVATOR SPAR

The XB-36 elevator spar is the same as the B-36A elevator spar and is described in FZS-36-146 on page 85. The method of analysis of the spar flanges and web was carried out in a similar manner to the B-36A. Allowable flange loads and other pertinent data not shown herein was obtained from the B-36A Analysis.

ANALYSIS [illegible]
PREPARED BY [illegible]
CHECKED BY ZINBERG
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE [illegible]
REPORT NO [illegible]
MODEL [illegible]
DATE [illegible]

[illegible]

SUMMARY OF MIN. FLANGE LOAD & MARGINS OF SAFETY.

CONDITION I - BALANCING CONDITION
II - [illegible] GUST
III - MOST AFT. [illegible] - H.S.
IV - MOST FWD. CG - H.A.A.

STATION	UPPER FLANGE LOAD COMPRESSION	CRITICAL CONDITION	ALLOWABLE FLANGE LOAD COMPRESSION	MINIMUM M.S. UPPER FLANGE	LOWER FLANGE LOAD COMPRESSION	CRITICAL CONDITION	ALLOWABLE FLANGE LOAD COMPRESSION	MINIMUM M.S. LOWER FLANGE
1	2	3	4	5	6	7	8	9
73	1012	IV	7047		2997	I	7047	
83	1379	IV	7047		3545	II	7047	
96	2445	III	7295		5830	IV	7295	
107	5527	III	7295	+.32	8985	IV	11745	
119	10730	III	14735		11960	IV	11745	-.016
HINGE CUTOUT								
147	15790	III	15685	-.006	12520	IV	13745	+.10
159	10553	III	13815	+.31	9965	IV	11955	
171	6226	III	7415	+.19	9415	II	11955	
183	1973	III	7415		8760	II	11955	
190	97	II	7415		8177	II	11955	
202	4930	III	7415		11750	II	11955	+.015
214	4625	III	7415		11580	II	11955	
226	7642	III	13015		11620	II	11955	
238	11725	III	16385		10940	II	14171	
HINGE CUTOUT								
266	16570	III	17600	+.06	11140	II	12150	
278	12680	III	15420	+.22	11176	II	12150	
290	6570	III	12860		7320	II	12150	
302	3920	III	7700		7320	II	12150	
314	3813	II	7700		7257	II	7700	+.06
326	1771	II	7700		4641	II	7700	
334	2155	III	7700		4625	II	7700	
346	5683	III	7700		4544	II	7700	
358	11405	III	12150	+.06	5430	IV	7700	

FW 444 6-46 UTILITY REPORT SHEET

ANALYSIS [illegible]
PREPARED BY [illegible]
CHECKED BY ZIMBERG
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE [illegible]
REPORT NO [illegible]
MODEL [illegible]
DATE [illegible]

ELEVATOR [illegible]

WEB [illegible]

[illegible] 36 [illegible]

CONDITIONS I - BALANCING CONDITION
II - 1G BALANCE + GUST
III - MOST AFT CG - H.S.
IV - MOST [illegible] - H.R.L.

STATION	$q_s + q_t$	CRITICAL CONDITION	WEB t	f_s (PSI)
73	138	II	.020	[illegible]
83	140	II	.020	7000
96	240	III	.025	96[illegible]
107	320	III	↓	12[illegible]
119	460	III		[illegible]
147	680	III		272[illegible]
159	540	III		21[illegible]
171	410	III		164[illegible]
183	300	II		12[illegible]
190	302	II		12[illegible]
202	435	II		17400
214	450	II	↓	[illegible]
226	480	III	.025	19[illegible]
238	630	III	.040	[illegible]
266	860	III	.032	26[illegible]50
278	[illegible]	III	↑	25000
290	500	III		15620
302	[illegible]	III		13450
314	435	II		13600
326	280	II		5750
334	302	II		[illegible]440
346	470	III	↓	14700
358	660	III	.032	20[illegible]

[illegible]

REFER DWG 36T48-1

WEB ANALYSIS [illegible]

q = [illegible] #/in [illegible] 50

WEB t = [illegible] (75ST) F_{tu} = 74000 #/in² F_{cu} = 45000 #/in²

PANEL SIZE = 5.25" x 14.5

τ = 27200 #/in²

τ_{cr} = 12.50 #/in²

I_{UR} = .0776 in⁴ (YS-32 + 1 3/8 x .025 WEB + 1 1/4 x [illegible])

I_{LR} = .0764 in⁴ (FXM-46-250 + 1 3/8 x .025 WEB + 1 1/4 x .04 [illegible])

A_s = .0614 in² (FXM-45-250) STIFF RIV @ 1"

$\lambda = bt\left[\frac{b^3}{720H}\left(\frac{1}{I_{tc}}+\frac{1}{I_{tt}}\right)+\frac{1}{A_s}\right]$

λ = 2.17

$\tau = \tau_{cr}/25000$ = .05

$\tan\alpha$ = 0.76 α = 37°14'

$\sin\alpha$ = .605 $\cos\alpha$ = .796

$C_R = 1 - (d_t/R_t)\sin(\alpha + \alpha) + \frac{1}{4}\tan^2(\alpha + \alpha)$

C_R = 1.0 R_R = [illegible] R = [illegible]

$\tau_{tu} = (RR_t C_R F_{tu} + \tau_R)\sin\alpha$ [illegible]

τ_{tu} = 2350 #/in²

$\tau_{su} = 0.90(1 - d_t/R_t)F_{su}$

τ_{su} = 3300 #/in²

$M.S. = \frac{23500}{27200} - 1 =$ +0.045

STIFFENER

FXM-45-250

I_s = .00461 in⁴

$s = nq$ = 14.5 x 6[illegible] = 7800#

t = .025, h = 14.5 in, b = 5.25 in

$I_{(REQ)}$ = .0049 in⁴

ELEVATOR SPAR

REFER, DWG 36T4801

FLANGE RIVETS

PANEL STA 145 1/8 - STA 151 1/16

N = 12 1/8" RIVETS

S_{cr} = 2 - 1/8" RIVETS

A_{scr}/A_{ft} = 2.0

$$S_{cr} = bt \sqrt{\left(\frac{\tau}{N + A_{scr}/A_{ft}}\right)^2 + \left(\frac{2\sigma_{max} - \sigma_{cr}}{N}\right)}$$

= 331 #/IN.

1/8" RIV. ARE CRITICAL IN BEARING ON [illegible] = 321 #/IN

$$M.S. = \frac{321}{331} - 1$$

= -0.03

ELEVATOR SPAR

REFER DWG. 36[illegible]

WEB ANALYS[illegible] STA. 266

$q = 50$ #/in REF R. 50

WEB $t = .32$ (75ST) $F_{tu} = 740$[illegible] #/□" $F_{su} = 430$[illegible] #/□"

PAN [illegible] 5 [illegible]

Σ [illegible] #/□"

$\Sigma_{tu} = 2360$ #/□"

I_{yr} = .07652 in⁴ (YS-72 ANGLE + 1¼ × .1275 SLUG)

I_{ch} = .07475 in⁴ (YS 72 ANGLE + 1¼ × .004 SLUG)

A_s = .093 in² (FXM-45-255) STIFF RIV 5 @ 1⅛"

I_s = [illegible] in⁴

$$\lambda = bt\left|\frac{p^2}{720h}\left(\frac{1}{I_{tu}} + \frac{1}{I_{ch}} + \frac{1}{A_s}\right)\right|$$

λ = 1.795

$p = \Sigma_{tu}/25000$ = .0945

$\tan\alpha$ = 0.75 α = 37°53'

$\sin\alpha$ = .61520 $\cos\alpha$ = 7.8837

$C_r = 1 - (d_1/R_1)\cos(90-\alpha) + \frac{1}{4}\tan^2(90-\alpha)$

C_r 1.0 R_r = 0.80 R = 1.01

$\Sigma_{tu} = (KE_R C_r F_t + \Sigma_{tu})\sin\alpha\cos\alpha$

Σ_{tu} = 30,200 #/□"

$\Sigma_{su} = 0.90(1 - d_1/R_1)F_{su}$

Σ_{su} = 34,200 #/□"

M.S. = $\frac{30200}{26850}$ − 1

= +0.12

ELEVATOR SPAR

REFER DW 36T4801

FLANGE RIVETS

PANEL STA. 264 TO STA. 270

N = 10 5/32 RIVETS

S_{cu} = 2 1/8" RIVETS

A_{sca}/A_{sc} $\frac{2 \times .01227}{.01415}$ = 1.25

S_{tu} = 5 x .032 x 3022

= 485 #/RIV

5/32" RIV. BEARING ON .032 WEB (75ST) = 509#

$M.S. = \frac{509}{485} - 1$

= +0.05

STIFFENER

FXM-45-255

I_s = .00641 in⁴

S = hq = 10.5 x 800 = 9040#

h = 10.5" b = 5.0" t = .032

$I_{s(req)}$ [illegible] CVAC #1 [illegible] 1.934

= .0055 in⁴

STIFFENER IS SATISFACTORY

ELEVATOR TIP SPAR

The XB-36 elevator tip spar is the same as the B-36A elevator tip spar and is described in FZS-36-146 on P. 100. XB-36 shears, bending moments and torsions were determined in a similar manner to the B-36A but only the curves for the two conditions investigated are shown herein. An analysis of the tip spar caps and web completes this portion of the report.

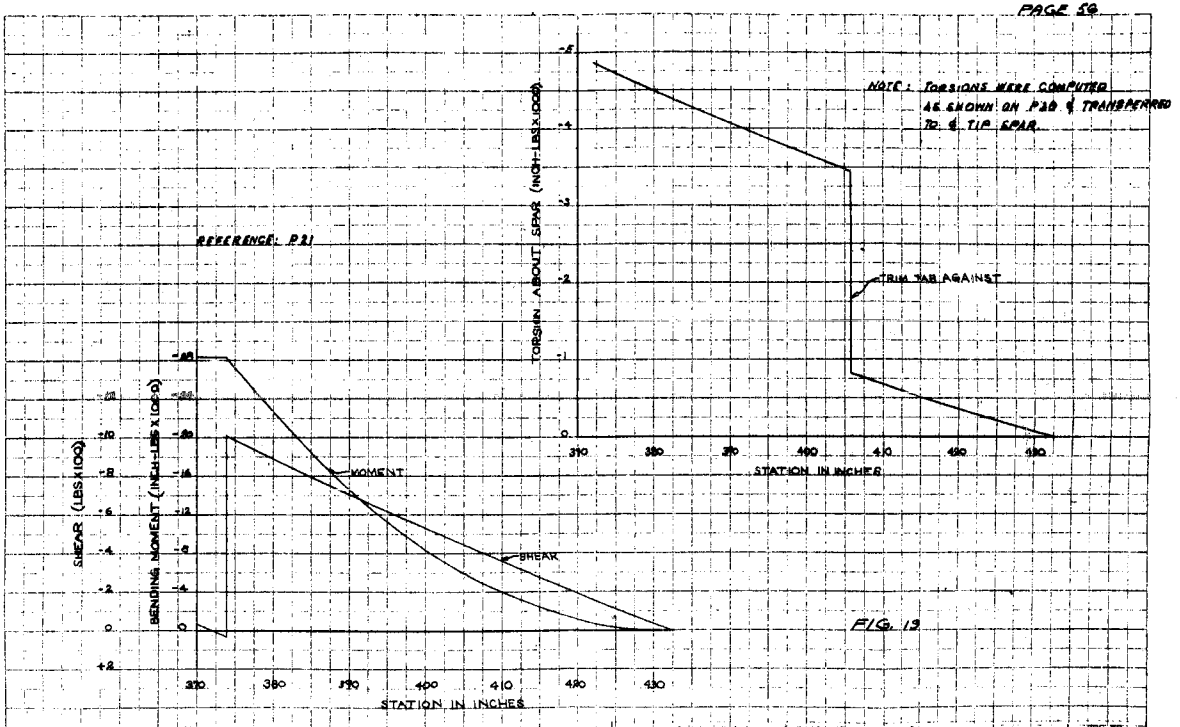


FIG. 13

CALCULATED BY LANZARA	ELEVATOR TIP SPAR		DOC NO. FZS-36-246
DRAWN BY LANZARA	SHEAR, BENDING MOMENTS & TORSIONS		
CHECKED BY ZINBERG	MOST FWD CG - H.A.A.		MODEL XB-36
APPROVED BY	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS		

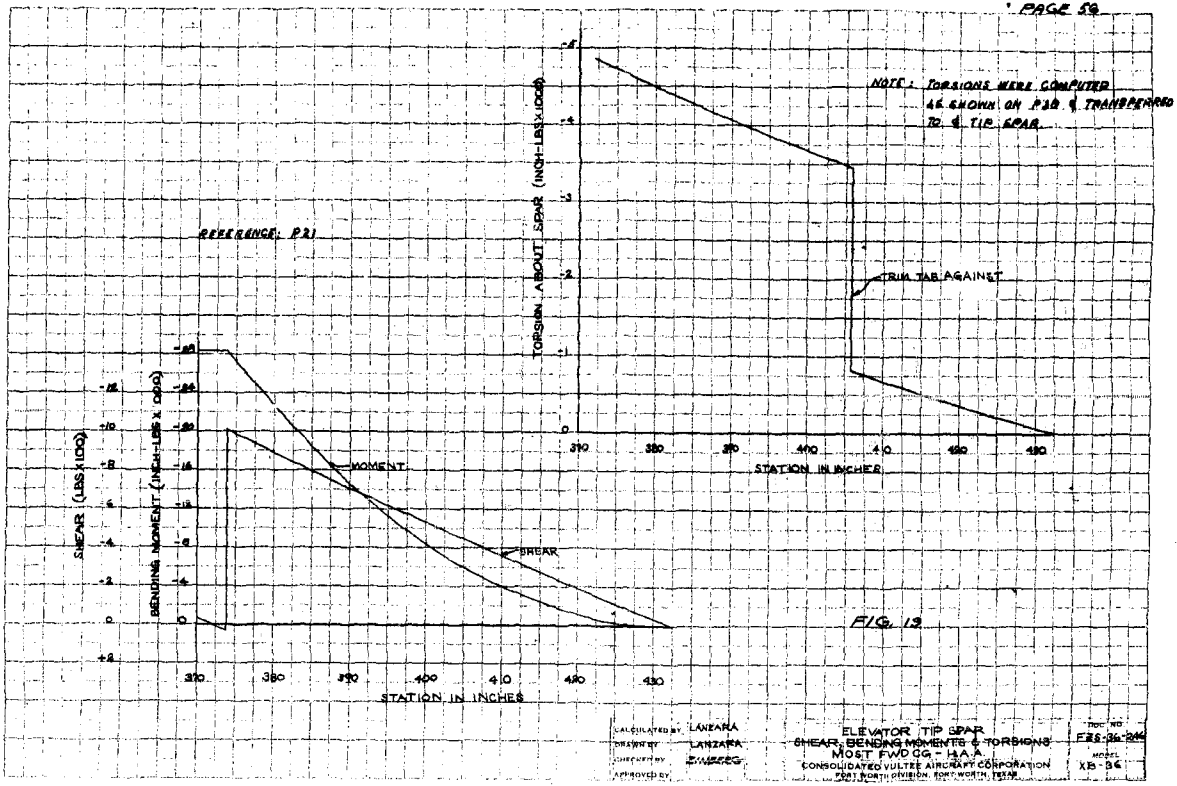

NOTE: TORSIONS WERE COMPUTED AS SHOWN ON P38 & TRANSFERRED TO ℄ TIP SPAR
REFERENCE: P21
TRIM TAB AGAINST
TORSION ABOUT SPAR (INCH-LBS X 1000)
STATION IN INCHES
MOMENT
SHEAR
SHEAR (LBS X 100)
BENDING MOMENT (INCH-LBS X 1000)
STATION, IN INCHES
CALCULATED BY LANZARA
DRAWN BY LANZARA
CHECKED BY
APPROVED BY
ELEVATOR TIP SPAR
SHEAR, BENDING MOMENTS & TORSIONS
MOST FWD CG - 1.4 A.A.
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS
DOC. NO. FZS-36-246
MODEL XB-36

FIG. 12

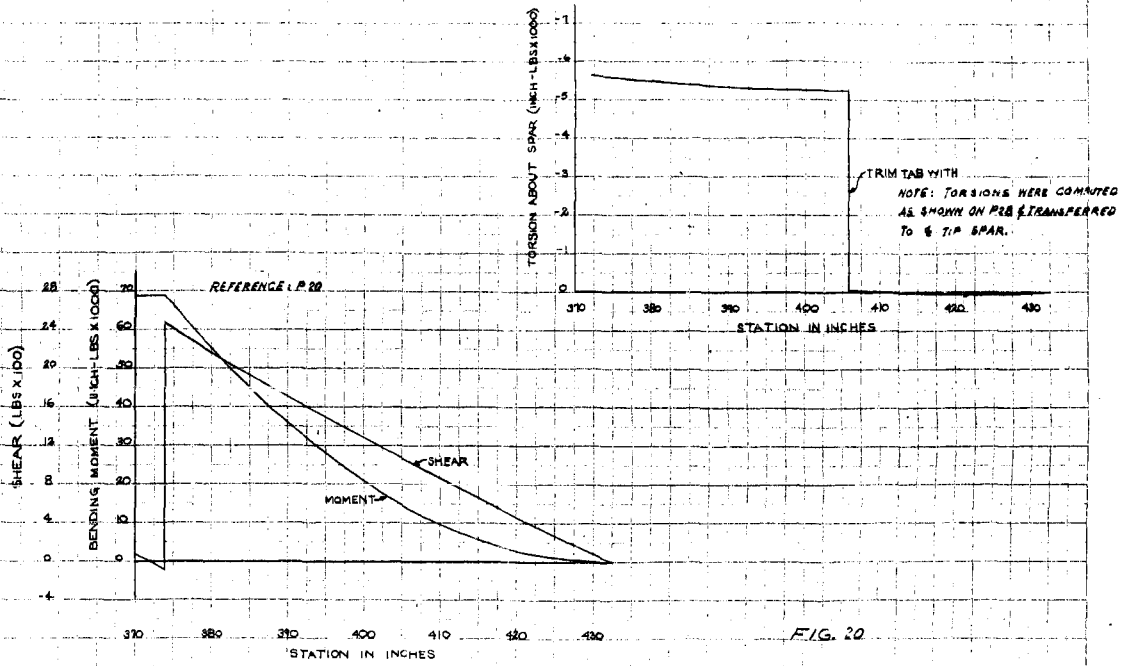


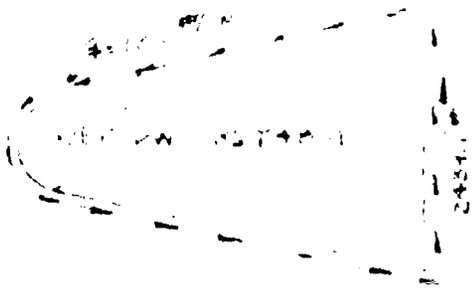
FIG. 20

CALCULATED BY LANZARA DRAWN BY LANZARA CHECKED BY EINBERG APPROVED BY	ELEVATOR TIP SPAR SHEAR, BENDING MOMENTS & TORSIONS MOST AFT CG - HIGH SPEED CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION N. FORT WORTH, TEXAS	DOC. NO. FZS-36-246 MODEL XB-36

[illegible]

[illegible]

STA [illegible] WEB ANALYSIS



[illegible] # (KIP [illegible] 57)

[illegible]

$q = \frac{[illegible]}{41.2} = [illegible]$ #/IN

[illegible]

DIRECT SHEAR = 2434.1 #

SHEAR IN SPAR OUTBOARD STA 373 7/8

= 2434.1 + 11.5 x 12.2 = 2579.3 #

SHEAR IN SPAR INBOARD STA 373 7/8

= 2579.3 - 2527.1 = 52.2 #

SPAR PANEL OUTBOARD OF STA 373 7/8 IS CRITICAL

$q = \frac{2579.3}{10.2} = 252.2$ #/IN

WEB t = .032 (75ST) F_{tu} = 74000 #/IN² F_{su} = 43000 #/IN²

PANEL SIZE = 4.3" x 10.2"

τ = 7890 #/IN²

τ_{cr} = 3140 #/IN²

$I_{up} = I_{lo}$ = .0099 IN⁴ (EXTR 22844)

M_c = .0754 IN² [illegible]

[illegible] $\left[\frac{[illegible]}{[illegible]} - \frac{1}{.754}\right]$

λ = 2.12

[illegible]

[illegible]

[illegible] 77335

[illegible]

[illegible]

[illegible]

[illegible]

$S_R = [illegible] \left(\frac{1}{[illegible]}\right) + \frac{1}{4}(767)^2$

$S_1 = .930$ [illegible] $= .952$ [illegible] $= .530$

$S_2 = (.93 \times .952 \times .85 \times 740 [illegible] + 3140) [illegible] \times .775$

$S_2 = 2[illegible]$ #/□"

$S_3 = 0.96 \left(1 - \frac{125}{[illegible]}\right) + [illegible]$

$S_3 = 3[illegible]$ #/□"

M.S. [illegible] HIGH

FLANGE [illegible]

$$S_{14} = 4.3 \times .032 \sqrt{\left(\frac{7890}{9+2}\right)^2 + \left(\frac{7890 \times 767 - 3140}{1}\right)^2}$$

$S_{14} = [illegible]$ #/□"

ALLOWABLE OF 1/8 RIVET ON .032 [illegible] #

M.S. = HIGH

STIFFENER

[illegible]

$I_s = .0054$ [illegible]

$I_{s(REQ)} = [illegible] .005$ IN^4

STIFFENER IS [illegible] SATISFACTORY

[illegible]

[illegible]

SPAR [illegible]

$h = [illegible]$ $H = 1.02$

SHEAR = 24[illegible]#

MOMENT = 68117 #

$S_a = 24[illegible] + 11.5 \times 1.22 = 2579.8$#

$S_b = [illegible] \times [illegible] \times [illegible] = 1025$#

[illegible] = 1[illegible]4#

$P_c = \frac{[illegible]}{[illegible]} + \frac{[illegible]}{[illegible]}$

$P_c = [illegible]$#

$P_c = 44,000$ #/in² (FZS-36-14: P108)

$A = .19[illegible]$ in²

$f = \frac{[illegible]}{.1790} = 41,200$ #/□"

$MS = \frac{44000}{41200} - 1$

$= +.06$

ANALYSIS OF ELEVATOR HINGE CUTOUTS

The XB-36 cutout structure is similar to the B-36A cutout structure except that the XB-36 top and bottom skins are heavier than the B-36A. Since the type of structure and method of analysis involved is the same as for the rudder, reference is made to FZS-36-147, page 130 for a description of the detailed method of analysis.

Two representative portions of the cutout structure at Sta. 252 are analyzed in this section of the report.

ANALYSIS OF ELEVATOR CUTOUT AT STA 252

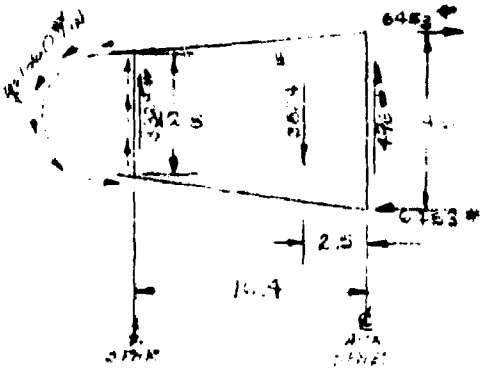
CRITICAL CONDITIONS

MOST AFT C.G. HS

TRIM TAB WITH q_t = 660 #/in (REF P40), 210-210.96 in² T = 210.96 × 660 = 73[illegible]#

ELEVATOR REACTION = -7648.2# (REF P22), $q - q_t$ = 260 #/in (REF P40)

SPAR SHEAR = 260 × 2.8 = 3328#



Σ MOM ABOUT AUX SP

TORQUE = 73[illegible]
3328 × 16.4 = 54579
-3-241 × 2.5 = -9560
942.15

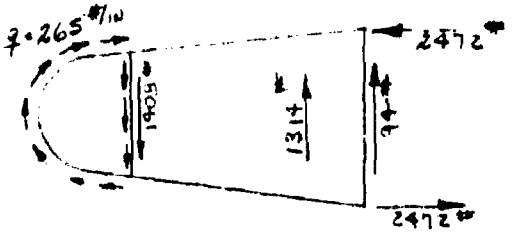
$\frac{942.15}{14.6}$ = 6453#

MOST FWD C.G. - HAA

TRIM TAB WITH q = 265# (REF P42), T = 265 × 210.96 = 55904#

ELEVATOR REACTION = 2627.2# (REF P22), $q - q_t$ = 110 #/in (REF. P42)

SPAR SHEAR = 110 × 12.8 = 1408#



Σ MOM ABOUT AUX SPAR

TORQUE = 55904
1408 × 16.4 = -23091
1314 × 2.5 = 3285
36098

$\frac{36098}{14.6}$ = 2472#

ANALYSIS OF ELEVATOR [illegible] AT STA 252

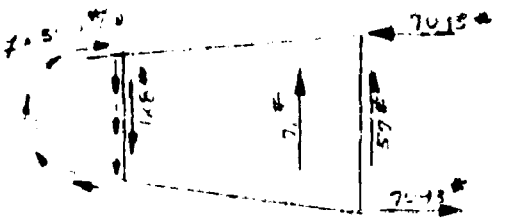
[illegible]

[illegible]

[illegible] q [illegible] #/in [illegible] $T = 5$ [illegible] $\times 210$ [illegible] #

ELEVATOR [illegible] #(P 22) $q = q_t = 10$ #/in (P [illegible])

SPAR SHEAR [illegible] $\times 12.8 = 128$ #



2 MOM. ABOUT AUX SPAR

TORQUE = 10549[illegible] "#
$-128 \times 16.4 =$ [illegible]
$71 \times 2.5 =$ [illegible]
[illegible] "#

$$\frac{103559}{14.6} = 7093\#$$

BALANCING CONDITION

TRIM TAB WITH $q = -290$ #/in (P 36) $T = -290 \times 210.96 = -61178$ "#

ELEVATOR REACTION = 3105.7 #(P22) $q = q_t = 95$ #/in (P 36)

SPAR SHEAR = $95 \times 12.8 = 1216$ #

2 MOM. ABOUT AUX SPAR

TORQUE = -61178
$1216 \times 16.4 = 19942$
$1554 \times 2.5 = -3885$
-45121

$$\frac{45121}{14.6} = 3090\#$$

[illegible]

[illegible]

PANEL b [illegible]

WEB [illegible]

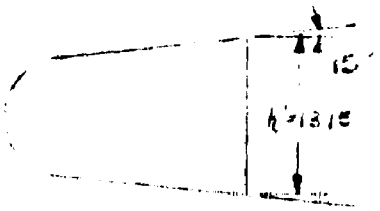
STIFFENER [illegible]

UPPER FLANGE A = .2652 [illegible] F = 31550 #/in² I = .0[illegible]

LOWER FLANGE A = .3505 [illegible] F = [illegible] #/in I = [illegible]

W. B.

MOST [illegible] TRIM TAB [illegible]



$\frac{M}{h} = \frac{139234}{13.15} = -10600$ # (NOR. COMP.)

VERT COMP = 10600 × 265 = 2840 #

SHEAR INDUCED INTO RIB DUE TO BENDING $\frac{M}{2A} = \frac{82000}{256} = 320$ #/in

SHEAR = 320 × 12.8 = 4100 #

TOTAL SHEAR = 3328 + 2 × 2840 = 4100
= 4908 #

Cos 15° = .9659

Tan 15° = .2680

$\tau = \frac{4908}{12.15 \times .05} = 7940$ #/in²

$\tau_{cr} = 5.11 \times 10^{6} \times 10^{-6} \left(\frac{.051}{34}\right)^2 = 1188$ #/in²

PANEL IS SHEAR RESISTANT

M.S. - HIGH

CRITICAL COMP. LOAD IN LOWER FLANGE

$P = \frac{10600}{97} = 10,950$ #

$f_c = \frac{10950}{.3505} = 31,200$ #/in²

M.S. = $\frac{32000}{31200} - 1 = +.025$

[illegible] COMP [illegible]

[illegible] TRIM [illegible]

$\frac{M}{R} = \frac{[illegible]}{[illegible]} = 8[illegible]^{\#}$ (H[illegible] COMP)

VERT COMP [illegible] $= 20[illegible]^{\#}$

SHEAR $= -125 - 2 \times 2[illegible] + \frac{35500 \times 12[illegible]}{[illegible]} = 2[illegible]^{\#}$

FLANGE LOAD $= \frac{8[illegible]}{[illegible]} = [illegible]^{\#}$

$f_c = \frac{[illegible]}{[illegible]} = 31[illegible]$ #/□"

$M_{[illegible]} = \frac{[illegible]}{[illegible]} - 1$

$= \underline{+.01}$

FLANGE RIVETS

SHEAR LOAD $= [illegible]^{\#}$

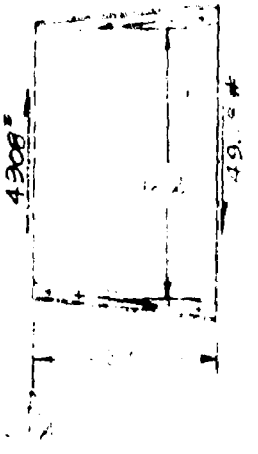
[illegible]

BR [illegible] $= 77[illegible]^{\#}$

[illegible] $= [illegible]^{\#}$

[illegible] $= [illegible]^{\#}$

[illegible] $= \frac{4908 \times 35}{12.2} = 1410^{\#}$



$M = \frac{[illegible]}{1410} - 1$

$= \underline{1[illegible]}$

CUTOUT RIB (STA 202)

PANEL FORWARD OF AUX SPAR

PANEL: b = 5.35" h = 15.45" h' = 16.45"

WEB: .032 - 24ST

STIFFENER: Y2-55 75ST

UPPER FLANGE: A = .2390 IN² I = .0632 IN⁴ F_c = 31550 #/□"

LOWER FLANGE: A = .3277 IN² I = .0826 IN⁴ F_c = 32000 #/□"

CRITICAL SHEAR

MOST AFT CG - H.S. TRIM TAB WITH

SHEAR = 3328 - 3284 - 41.0 = -4596#

$\tau = \frac{4596}{15.45 \times .032} = 9240$ #/□"

τ_{cu} = 21700 #/□" } REF FZS-36-146 P 142
τ_{su} = 20400 #/□" }

τ_{cc} = 1935 #/□"

$M.S._{(web)} = \frac{20400}{9240} - 1$

= LARGE

LOWER FLANGE

CRITICAL COMP LOAD (MOST AFT CG - H.S.)

$P = \frac{M}{h'} = \frac{94215}{16.45} = 5730$#

S_{cu} = 1935 x 15.45 x .032 = 956#

S_{su} = 4596 - 956 = 3640#

$\frac{S_{su}\ cut}{2} = \frac{3640 \times 1.212}{2} = 2210$#

AXIAL LOAD = 5730 + 2210 = 7940#

$f_c = \frac{7940}{.3277} = 24200$ #/□"

$M.S. = \frac{32000}{24200} - 1$

= .32

[illegible]

UPPER FLANGE

CRITICAL COMP LOAD (1 G BAL FGUST - T.F WITH)

$P = \frac{M}{H} = \frac{1.3550}{16.45} = 6300\#$

$SHEAR = \frac{35500 \times 128}{256} + 71 - 128 = 1718\#$

$S_{cr} = 956\#$

$S_{tu} = 1718 - 956 = 762\#$

$\frac{S_{tu}\, st\, t}{2} = \frac{762 \times 1.212}{2} = 463\#$

AXIAL LOAD = 6300 + 463 = 6763#

$f_c = \frac{6763}{.2390} = 28300\ \#/\square''$

$M.S. = \frac{31550}{28300} - 1$

$= .11$

FLANGE RIVETS

$S_{tu} = bt\sqrt{\left(\frac{2}{N + \frac{A_{sec}}{H_{tu}}}\right)^2 + \left(\frac{2 \tan \frac{\theta}{2}}{N}\right)^2}$

$= 5.35 \times .032\sqrt{\left(\frac{9240}{11+2}\right)^2 + \left(\frac{9240 \times .825 - 1135}{11}\right)^2}$

$= 1711 \times .855$

$= 152\ \#/RIV$

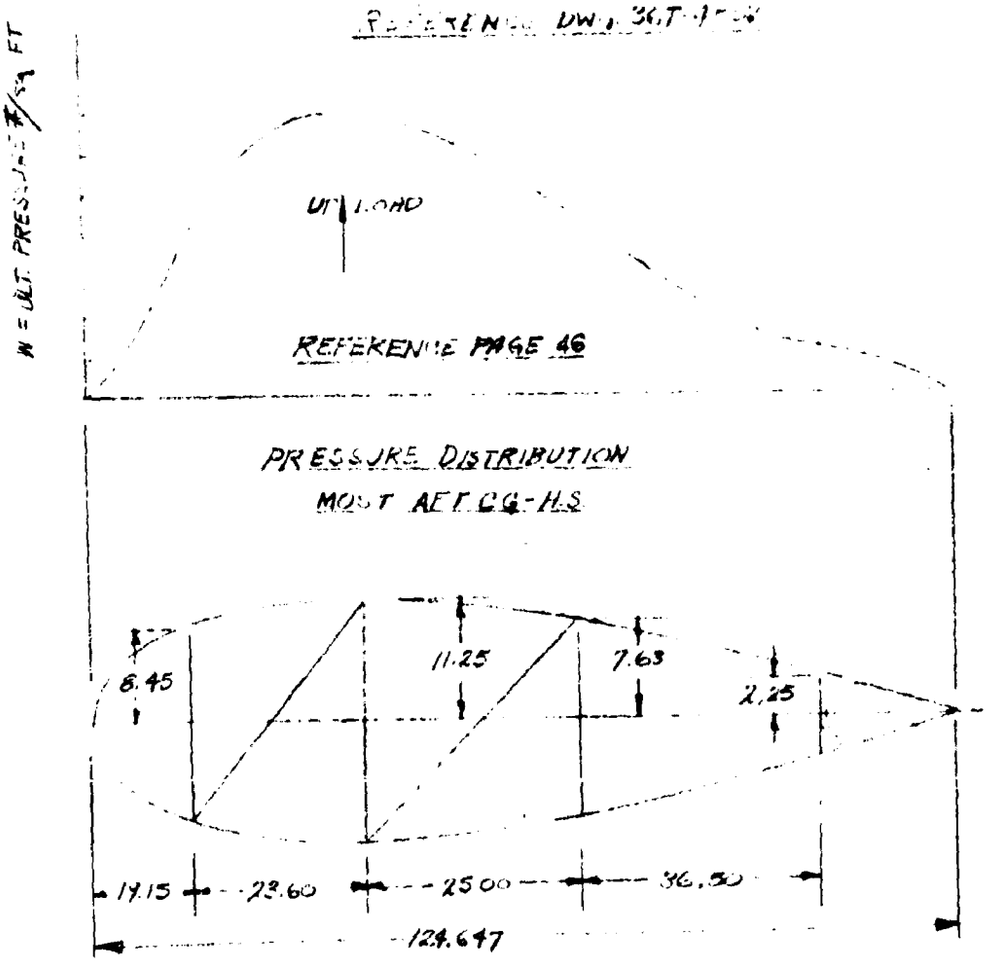
5/32" RIV. BR [illegible] .032 × .056 × [illegible] = 500#
SH = 596#

M.S. = HIGH

ELEVATOR

TYPICAL AIRLOAD RIB STA 7[illegible]

REFERENCE DWG 36T-[illegible]



RIB DIMENSIONS

SPANWISE RIB SPACING = 10 $\frac{1}{3}$

PRESSURE DISTRIBUTION CORRECTION FACTOR =

CHORDWISE LOADING #/INCH = $\frac{W \times 10.125 \times 1.2099}{144}$ = .0851W

NOTE:

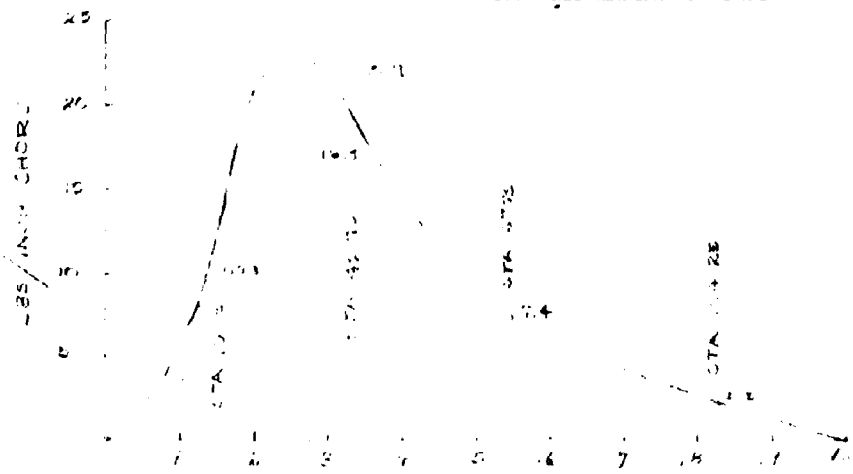
THE MAX. UP LOAD (30,337#) IS CAUSED BY THE MOST FWD CG-HS CONDITION. THE MAX. DOWN LOAD (-12,[illegible]8#) IS CAUSED BY THE MOST FWD CG-HAA.

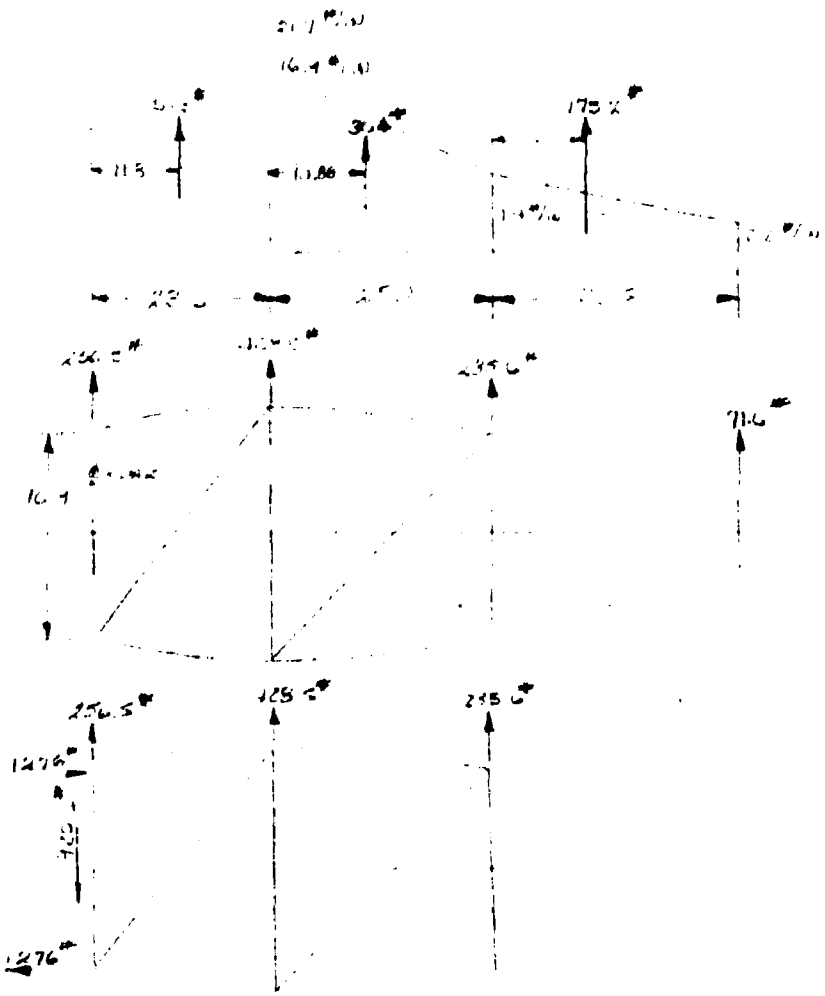
ELEVATOR

TYPICAL AIRLOAD [illegible]

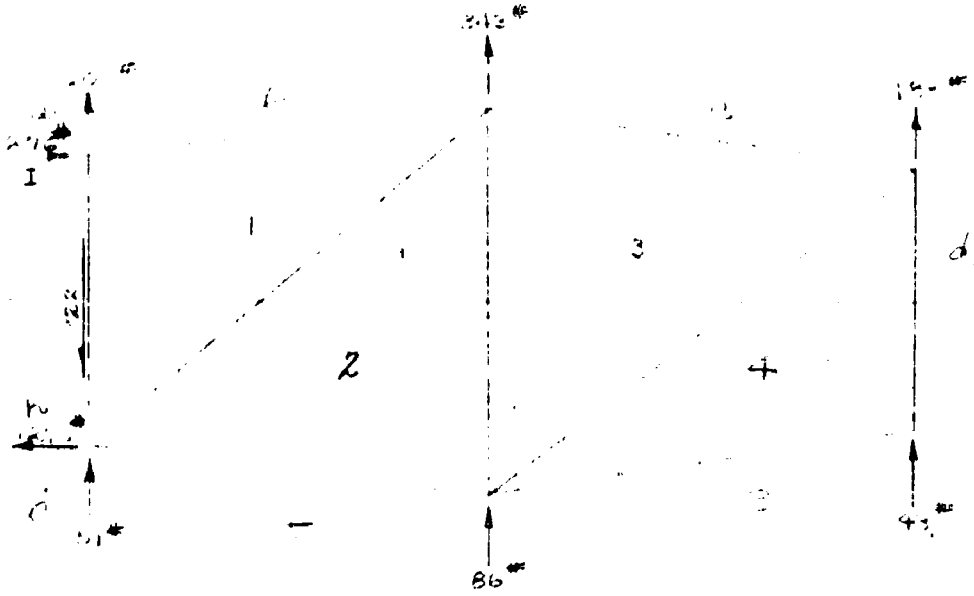
TABLE OF PRESSURE DISTRIBUTION ORDINATES
[illegible]

X/C	R.B. STATION	W	.0851 W
0	0	0	0
.05	6.23	23	[illegible]
.10	12.46	74	[illegible]
.15	18.69	180	[illegible]
.175	21.80	220	[illegible]
.200	24.92	250	21.3
.225	28.00	264	22.5
.250	31.10	260	22.8
.275	34.20	266	22.6
.300	37.30	255	21.7
.350	[illegible]	200	17.0
.400	49.80	164	14.0
.500	62.32	100	9.0
.600	74.78	70	6.0
.700	87.24	48	4.1
.800	99.70	28	2.4
.900	112.16	14	1.2
1.000	124.047	0	0





16.4

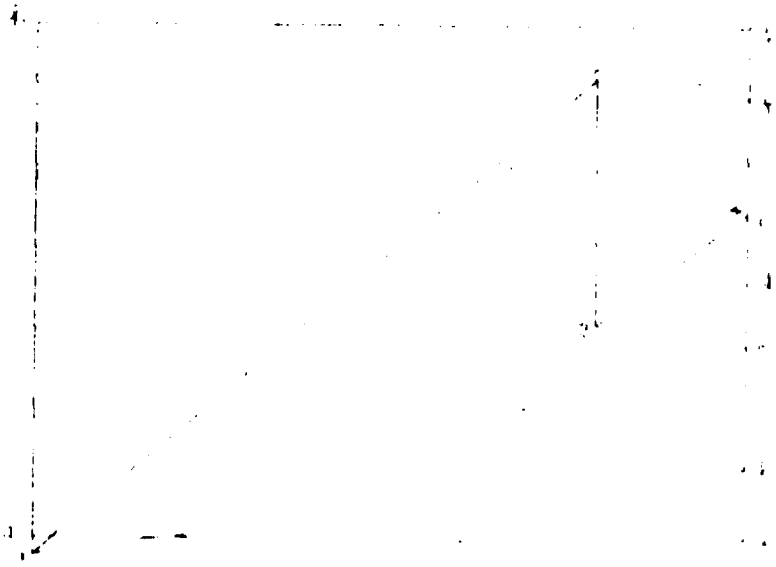


MEMBER	LOAD
2-1	-1280
1-2	+1328
2-3	-322
3-5	-255
3-4	+325
1-4	-49
2-4	0
f-2	+222
h-1	-870
I-1	+52

[illegible]

[illegible]

[illegible]

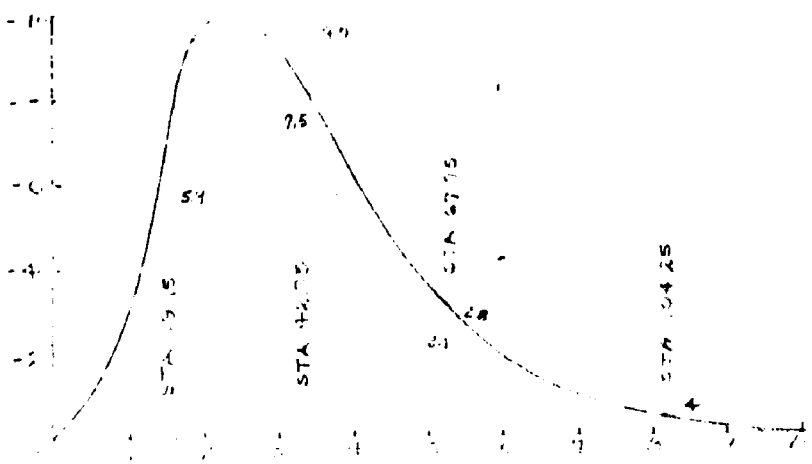


MEMBER	LOAD
b-1	-1280
c-3	-272
d-4	-118
e-4	0
f-2	+275
h-1	-945
I-1	-30
1-2	+1315
2-3	-440
3-4	+338

ELEVATOR

[illegible]

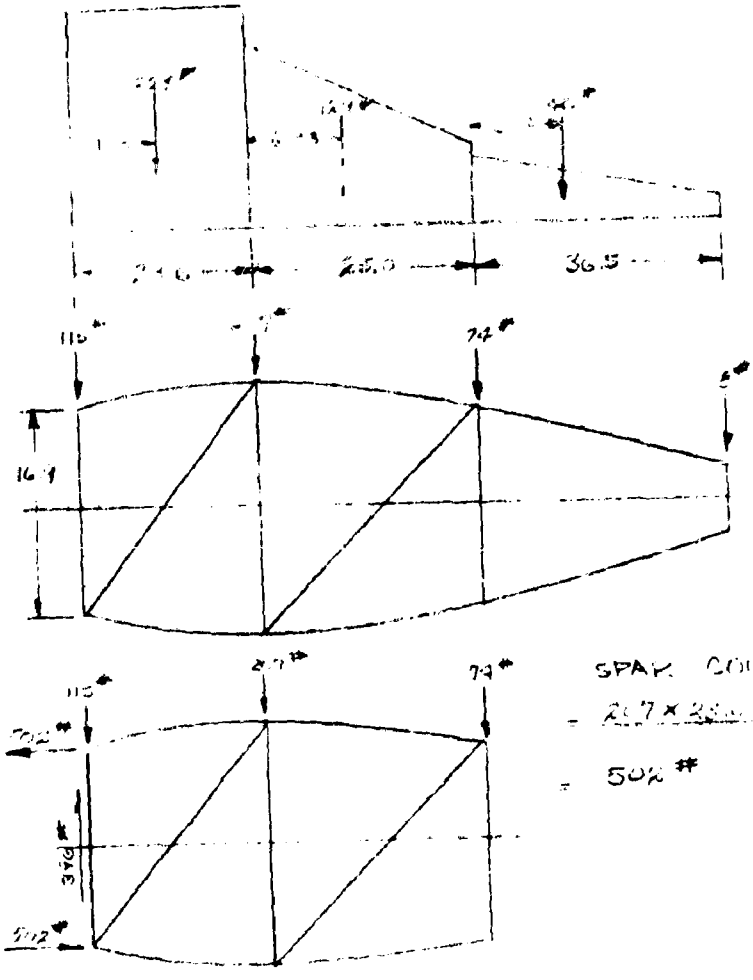
X/C	RIB STATION	W	[illegible]
[illegible]		[illegible]	[illegible]
.05	[illegible]	[illegible]	[illegible]
.10	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
250	[illegible]	1[illegible]5	- 1.4
275	[illegible]	12[illegible]	- 9.5
[illegible]	[illegible]	114.0	- 9.4
350	[illegible]	10[illegible]	- 7.3
[illegible]	[illegible]	77.5	- [illegible]
[illegible]	[illegible]	45[illegible]	- 3.0
[illegible]	[illegible]	24[illegible]	- 1.9
700	97.24	11.5	- .4
[illegible]	[illegible]	4.5	- .4
[illegible]	[illegible]	[illegible]	- .1
[illegible]	[illegible]	[illegible]	0



ELEVATOR

[illegible]

[illegible]



SPAR COUPLE

$= \frac{207 \times 25.0 + 74 \times 48.6}{16.9}$

$= 502\#$

BECAUSE THE LOADS [illegible] ARE SMALLER THAN [illegible] SHOWN IN [illegible] 36 [illegible] PAGE 250, IT CAN BE ASSUMED [illegible] FWD [illegible] NOT [illegible] THE [illegible] FURTHER [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

I = MAX [illegible] $\bar{y}$ = [illegible] A = .14751 in²

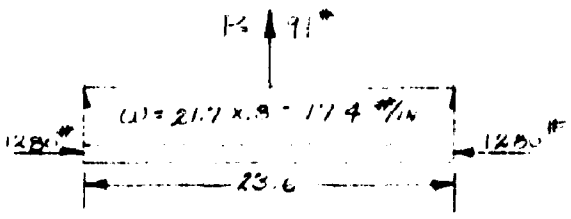
I = MIN [illegible] $\bar{y}$ = [illegible] A = [illegible]

I CAVERN [illegible] = 30[illegible] in⁴

[illegible] 1280 × [illegible] = 535 #

[illegible] TO PRODUCE THIS MOMENT [illegible]

[illegible] = $\frac{535[illegible]}{23.6}$ = 10.8 #



SECTION - FXM 45-252 + INTERCOSTAL

F_b = 48000 #/□"

F_c = 30500 #/□"

j^2 = 511

$\frac{1}{j}$ = 1.045

$$j = \sqrt{\frac{10.3 \times 10^{11} \times .0636}{1280}} = 22.6$$

$$C_1 = \frac{\omega j^2 (\cos \frac{L}{j} - 1)}{\sin \frac{L}{j}} + \frac{Pj}{2} \cos \frac{L}{j} \sec \frac{L}{2j}$$

$\cos \frac{L}{j}$ = .50189 $\sin \frac{L}{j}$ = .86411

$\frac{L}{2j}$ = .52 $\cos \frac{L}{2j}$ = .86782 $\sin \frac{L}{2j}$ = .49688

$$C_1 = \frac{17.4 \times 511 (.50189 - 1)}{.86411} + \frac{11 \times 22.6 \times .50189}{2 \times .86782}$$

= -4.5[illegible]

[illegible]

TYPICAL [illegible] PIE [illegible] 7 1/4

[illegible]

$C_2 = -[illegible] - [illegible] \sin \frac{x}{y}$

$= 11.4 \times 511 - 91 \times 22.6 \times .49688$

$= -9921$

$f_{(b)} = [illegible]$

$= 8900$

M IS MAX WHEN X = [illegible]

$M = C_1 \sin \frac{x}{y} + C_2 \cos \frac{x}{y} + f_{(c)}$

$= -4550 \times .49688 - 9921 \times .86782 + 8900$

$= -1900$ "#

$\frac{x}{y} = .52$

$\sin \frac{x}{y} = .49688$

$\cos \frac{x}{y} = .86782$

$f_b = \frac{1900 \times 1.191}{.10058} = 23{,}100$ #/□"

$f_c = \frac{1280}{.14751} = 8680$ #/□"

$$M.S. = \frac{1}{\frac{8680}{30500} + \frac{23100}{49000}} - 1$$

$= \underline{+31}$

[illegible]

[illegible] RIB [illegible]

VERT. [illegible] 2-3
REF [illegible]

SECTION = [illegible]

LENGTH = 22 in.

ℓ = [illegible] in.

AREA = 1036 in²

l/ρ = 68.0

LOAD = 440 #

$P/A = \frac{440}{.1036} = 4250$ #/□"

F_c = 5000 #/□"

$MS = \frac{5000}{4250} - 1$

$= \underline{+.17}$

ELEVATOR TRIM AND SERVO TABS

The XB-36 tabs are the same as the B-36A tabs which are described in FZS-36-146 on pages 184 and 215.

The B-36A bending moments, shears and torsions are proportional to the tab loads. The XB-36 bending moments, shears and torsions were found by direct ratio from the respective tab loads. Points of minimum margins were rechecked and new margins of safety were computed.

ELEVATOR TRIM TAB

DESIGN LOADS

TRIM TAB LOAD (B-36) 2040# (FZS-36-146 P.192)

TRIM TAB LOAD (XB-36)

LOAD = .0012 V_D^2 (LIMIT) (C-1403-A, APPD)

V_D = 311 MPH A = 11.92 SQ. FT.

LOAD = .0012 $(311)^2 \times 1.5 \times 11.92$

= 2075#

ALL DIMENSIONS OF TRIM TAB REMAIN CONSTANT THEREFORE THE MOMENT AT THE CRITICAL POINT OF THE SPAR WILL BE RATIOED DIRECTLY AS THE LOAD

THE CRITICAL POINT ON THE SPAR OCCURS AT STA 390 (REF FZS-36-146 P.202)

$M = 1751 \times \frac{2075}{2040} = 1782$ "#

Y = 1.10 IN I = .128 IN^4

$f_b = \frac{1782 \times 1.10}{.128} = 15320$ #/□"

F_b = 15300 #/□" (REF FZS-36-146 P.202)

$M.S. = \frac{15300}{15300} - 1$

= +.015

ELEVATOR TRIM TAB

DESIGN LOADS

STA 280 (WEB [illegible])

$F = .1991 \times \frac{2075}{2040} = 1521\#$

$RA = 16.76\ in^2 \qquad h = 3.0\ in$

DIRECT SHEAR $= 219 \times \frac{2075}{2040} = 223\#$

NET SPAR SHEAR $= \frac{1521}{16.76} + \frac{223}{3} = 165.4\#$

WEB $t = .032\ in$

$f_s = \frac{165.4}{.032} = 5175\ \#/\square''$

$F_{s_{cr}} = 6540\ \#/\square''$ (FZS-36-146)

$M.S. = \frac{6540}{5175} - 1$

$= +0.08$

STA 354.5 (NOSE SKIN CRITICAL)

$q = 139 \times \frac{2075}{2040} = 141.2\ \#/in$

SKIN - .025 FS-1h MAG. AN-M-24 [illegible]

$f_s = \frac{141.2}{.025} = 5650\ \#/\square''$

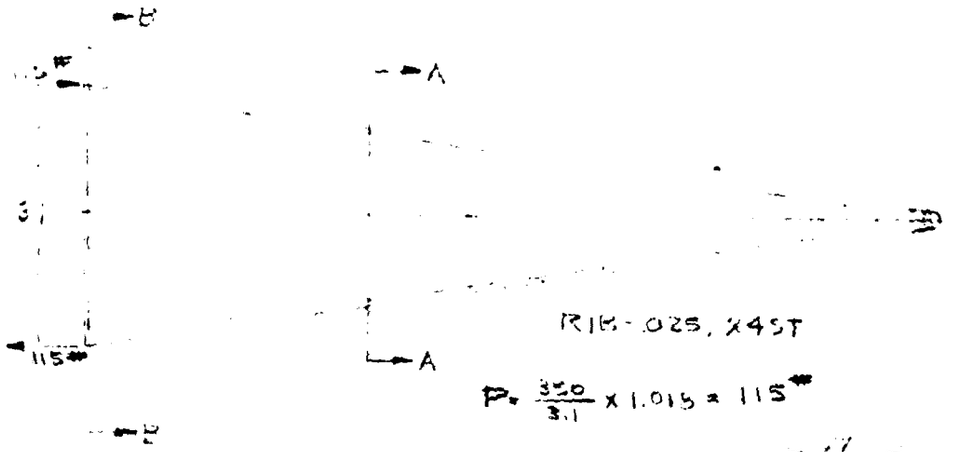
$F_{st} = \frac{KE}{(P/t)^{5/4}(L/D)^{1/2}}$

$F_{st} = \frac{8 \times 6.5 \times 10^6}{\left(\frac{2.65}{.025}\right)^{5/4}\left(\frac{1.75}{2.65}\right)^{1/2}} = 18{,}750\ \#/\square''$

M.S. - HIGH

ELEVATOR TRIM TAB

ALCLAD RIB



SECTION A-A

FROM FZS-36-146

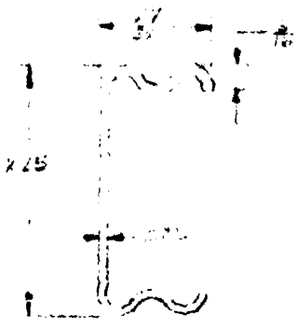
$M = M_{CONST} = 118 \times \frac{2075}{2040}$

$M = 120$ "#

$f_b = \frac{120 \times 1.125}{.0961} = 1795$ #/□"

$F_b = 24{,}000$ #/□"

M.S. - HIGH



SECTION A-A
I = .0961 in⁴

SECTION B-B

FROM FZS 36-146

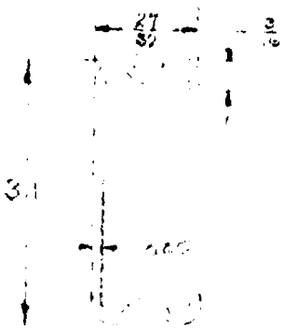
$M = 350 \times \frac{2075}{2040}$

$M = 356$ "#

$f_b = \frac{356 \times 1.55}{.1250} = 4420$ #/□"

$F_b = 24{,}000$ #/□"

M.S. - HIGH



SECTION B-B
I = [illegible]

ELEVATOR TRIM TAB

AIRLOAD RIB

RIB CAP ATTACHMENT TO SPAR CAP IS MADE BY TWO AN 426-B3 RIVETS

LOAD = 115.#

LOAD/RIVET = $\frac{115}{2}$ = 57.5 #/RIV.

ALLOW RIVET LOAD = .025 x 55000 x .125

= 172 #/RIV.

M.S. - HIGH

[illegible]

[illegible]

[illegible] TAIL LOAD (B-36) = 2361# (REF FZS-36-146 P222)
SERVO TAIL LOAD (XB-36) = 3404# (MOST AFT [illegible] TAIL WITH)

ALL DIMENSIONS OF B-36 & XB-36 SERVO TAIL REMAIN CONSTANT, THEREFORE CRITICAL POINTS ON THE SPAR FLANGES, NOSE SKIN, & WEB WILL BE CHECKED BY THE RATIO OF THE MAX. XB-36 SERVO LOAD TO THE B-36 DESIGN SERVO LOAD.

THE CRITICAL POINT ON THE SERVO SPAR CAP AT STA. 192.625 (REF FZS-36-146 P224)

$$M = 4910 \times \frac{3404}{2361} = 4910 \text{ "\#}$$

$$Y = 1.55 \text{ IN} \qquad I = 1.216 \text{ IN}^4$$

$$F_b = \frac{4910 \times 1.55}{1.216} = 7490 \text{ \#/□"}$$

$$F_b = 11{,}500 \text{ \#/□"} \quad \text{(REFER. FZS-36-146 P233)}$$

$$M.S. = \frac{11{,}500}{7490} - 1$$

$$= \underline{+.54}$$

[illegible]

NOSE SKIN

STATION 90

SKIN .025 MAG FS-1h AN-M-29 COND H

$$q = 77 \times \frac{3404}{2861} = 91.6 \ \#/IN$$

$$f_s = \frac{91.6}{.025} = 3660 \ \#/\square''$$

$$F_{sr} = \frac{KE}{(D/t)^{3/4}(L/D)^{1/2}} = \frac{.8 \times 6.5 \times 10^6}{\left(\frac{4.85}{.025}\right)^{3/4}\left(\frac{4.25}{4.85}\right)^{1/2}}$$

ASSUME K = .8

D = 4.85 IN

L = 4.25 IN

$F_{sr} = 7650 \ \#/IN^2$

M.S. - LARGE

STATION 192.625

SKIN - .025 MAG FS-1h AN-M-29 COND. H

$$q = 177 \times \frac{3404}{2861} = 134 \ \#/IN$$

$$f_s = \frac{134}{.025} = 5360 \ \#/\square''$$

ASSUME K = .8

D = 4 IN

L = 2 IN

$$F_{sr} = \frac{.8 \times 6.5 \times 10^6}{\left(4/.025\right)^{3/4}\left(\frac{2}{4}\right)^{1/2}}$$

$$= 12,950 \ \#/\square''$$

M.S. - HIGH

ELEVATOR SERVO TAB

SPAR WEB

STATION 190.5

$q = 196 \times \frac{3404}{2861} = 233\ \#/IN$

$t = .040\ IN$

$f_s = \frac{233}{.040} = 5830\ \#/IN^2$

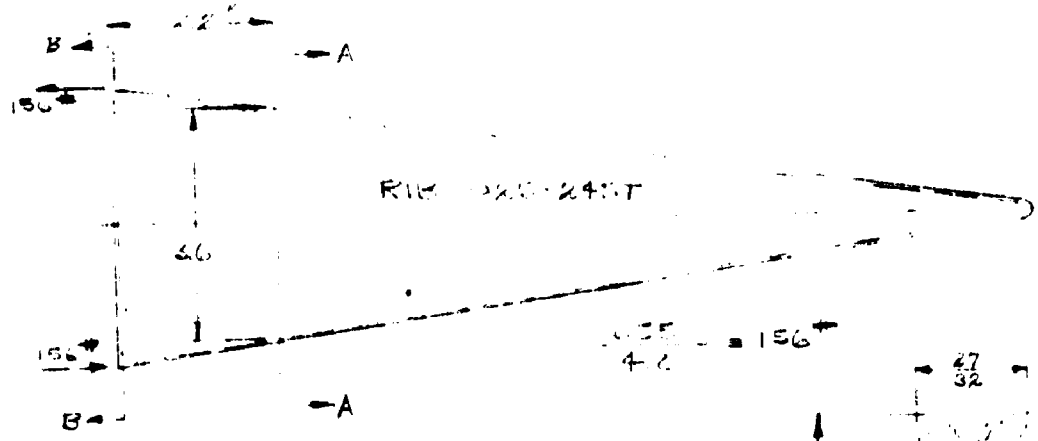
$F_s = 6730\ \#/\square''$ (FZS-36-146 P. 233)

$M.S. = \frac{6730}{5830} - 1$

$= \underline{+.15}$

[illegible]

[illegible]



SECTION A-A

$M = 330 \times \frac{3404}{2861} = 392''\#$

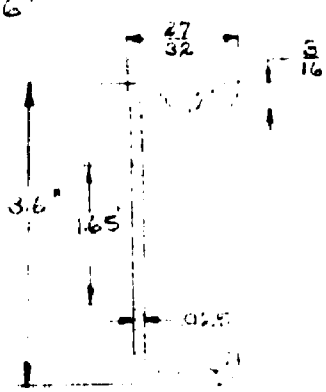
$\frac{M}{h} = \frac{392}{3.08} = 127\#$

$f_c = \frac{127}{.0484} = 26[illegible]\ \#/IN^2$

ALLOW. STRESS

[illegible] $\#/IN^2$ ([illegible])

M [illegible]



SECT. A-A

$A = .0968\ IN^2$

$I = 2374\ IN^4$

$n = 3.08\ IN$

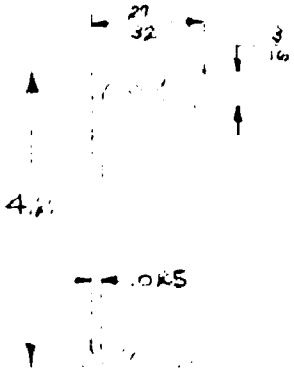
SECTION B-B

$M = 550 \times \frac{3404}{2861} = 655''\#$

$f_b = \frac{[illegible] \times 2.1}{.3627} = 3790\ \#/IN^2$

$F_b = [illegible]\ \#/IN^2$

M.S. HIGH



SECT. B-B

$I = [illegible]\ IN^4$

[illegible] TAB

[illegible] RIB

RIB TAB AT [illegible] TO [illegible] CAP IS MADE BY [illegible] AN [illegible]-3 RIVETS

LOAD = 156#

LOAD/RIVET = $\frac{156}{2}$ = 78 #/RIVET

RIVET ALLOW = [illegible] x [illegible] x [illegible]
= [illegible] #/[illegible]

M.S. - LARGE

[illegible] TAB

[illegible] RIB

[illegible] TAB AT [illegible] TO [illegible] CAP IS
MADE BY [illegible] AN [illegible]-3 RIVETS

LOAD = 156#

LOAD/RIVET $\frac{156}{2}$ = [illegible] #/RIVET

RIVET ALLOW = [illegible] × [illegible] × [illegible]
= [illegible] #/[illegible]

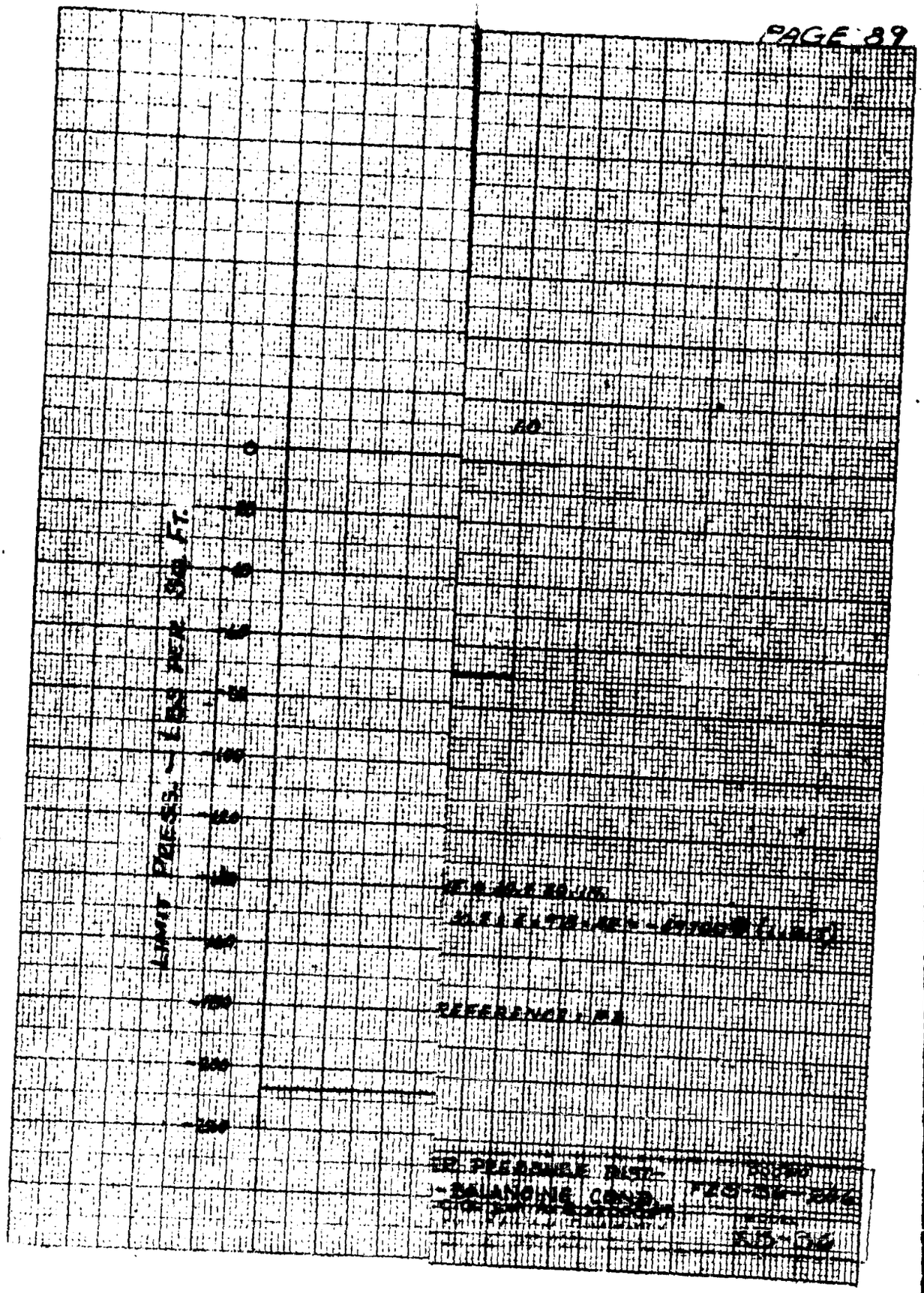
M.S. - LARGE

XB-36 STABILIZER

The XB-36 Stabilizer is the same as the B-36A Stabilizer which is analyzed in detail in Report No. FZS-36-146, Vol. II.

In this analysis no attempt is made to duplicate the entire B-36A Analysis (FZS-36-146, Vol. II) except for the loads which are determined in detail for all of the conditions investigated. The remaining portions of this analysis are covered by comparing the XB-36 loads to the B-36A loads and corresponding margins of safety. In places where the margins of safety are questionable a detailed investigation is made and new margins of safety computed.

The critical shear flows, shown on pages 104 to 115, were computed in the same manner and using the same section properties as in the "Cell Analysis" portion of FZS-36-146, pages 307 to 367.


LIMIT PRESS. - LBS PER SQ. FT.
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
-200
-220
REFERENCE: F2
PRESSURE DIST.
BALANCING COND.

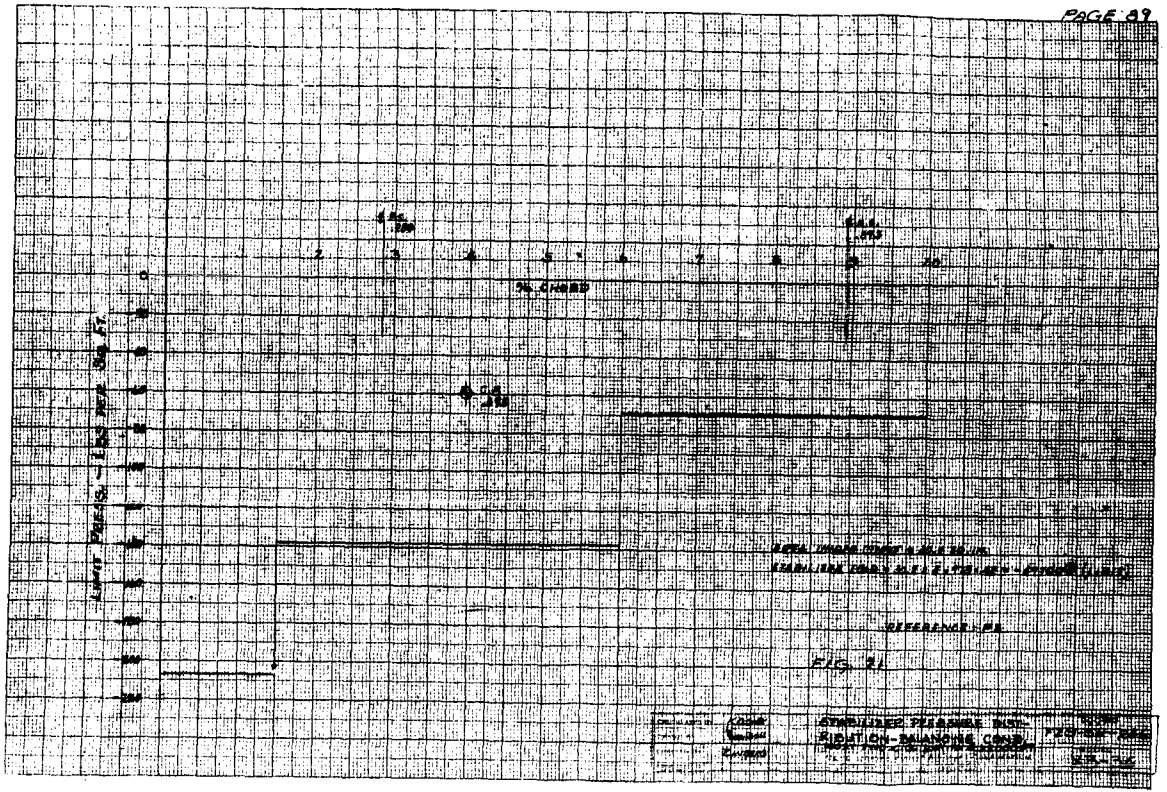

% CHORD
LIMIT PRESS. - LBS PER SQ. FT.
REFERENCE: PE
STABILIZER PRESSURE DISTRIBUTION-BALANCING COND.

FIG. 21

LIMIT LOAD — LBS PER SQ FT
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410

FIG. 2A

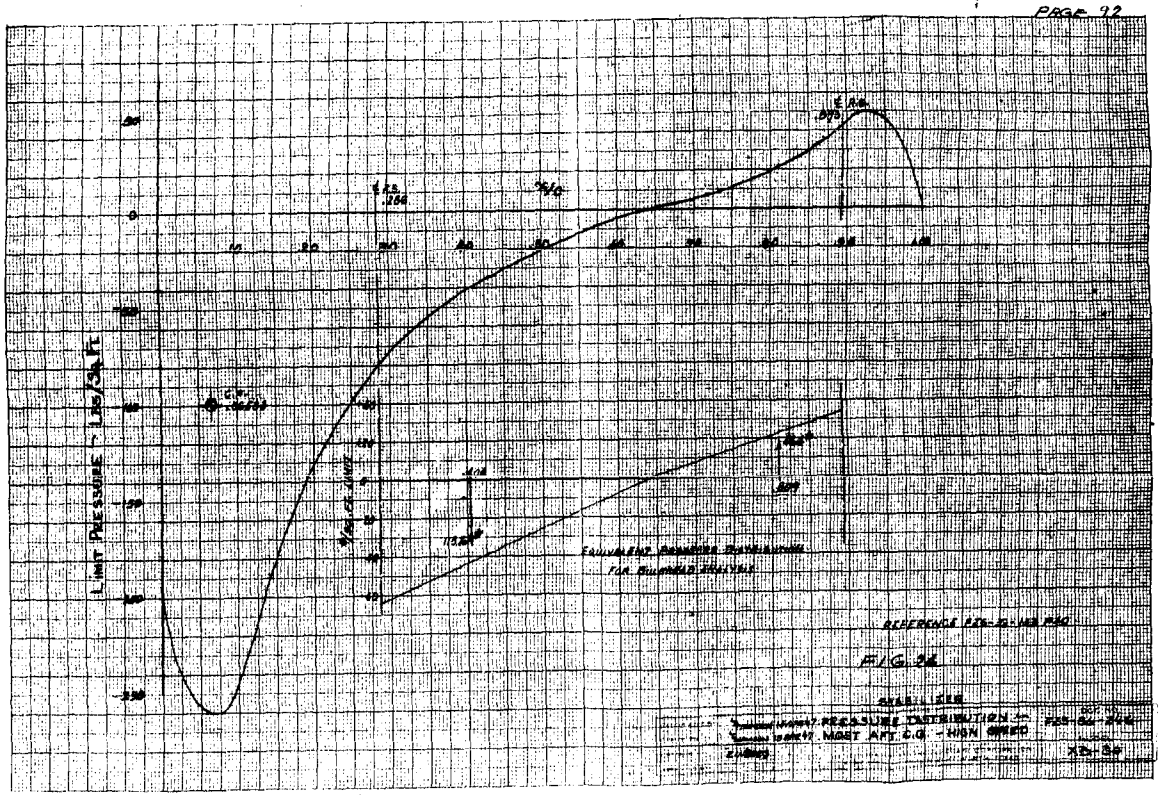

LIMIT PRESSURE - LBS/SQ FT
%/C
EQUIVALENT PRESSURE DISTRIBUTION
FOR BULKHEAD ANALYSIS
REFERENCE
PRESSURE DISTRIBUTION
MOST AFT C.G. - HIGH SPEED

FIG. 94

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS

STATIC REP — ULTIMATE BENDING MOMENTS & SHEARS
MOST AFT C.G. HIGH SPEED (L.A.A.)

TABLE 12 PAGE 92

Station	Moment	Moment	Moment	Moment	Moment	Moment	Moment (MX)	Shear	Shear	Shear	Stability Shear
								11	12	13	14
			9								
	-17775	9770		7648.2							
	4										
	-17775	97758		7648.2		5341			-17775		
	-2521668	1437763		1636715		1850115	1826805	0	0	0	0
	-2522840						1825453	-2643	-467	0	467
	-2530558						1817023	-2641	1074	0	1074
	-2543460						1815313	-1342	1671	0	1671
	-2564945						1814378	-1285	2284	0	2284
	-2564695	1430763		1636715		1821496	1814315	8715	-15491	22988	7497
	-2381239	813193				1784492		8543	-14798		8170
	-2234177	715218		1468854		1721973	1676569	8007	-14232		8756
	-1963293	519263		1315490		1618135	1497700	7387	-13130		9858
	-1711846	323318		1162526		1507397	1281795	6788	-12066		10922
	-1480042	127368		1001562		1376551	1053477	6211	-11040		11948
	-1341127	0		910136		1324514	893523	5848	-10345	22988	12593
	-1341127			910136		1324514	893563	5848	-10345	13190	2795
	-1269368			856598		1285721	872951	5685	-10052		3138
	-1078386			703634		1174853	800131	5122	-9104		4086
	-905505			550670		1064985	727210	4607	-8192		4998
	-750476			397706		953207	660437	4171	-7322		5868
	-612217			244742		842369	594844	3673	-6493		6702
	-470510			91778		731531	532797	3261	-5690		7500
	-425135			0		665028	232893	2944	-5233	13190	7957
	-425135					665028	239892	2944	-5233	5542	309
	-384409					620693	236284	2776	-4934		608
	-292122					509155	216932	2371	-4214		1328
	-215653					399017	183346	1989	-3535		2007
	-151402					288791	136777	1628	-2894		2649
	-91594					177641	77767	1281	-2291		3251
	-59511					66503	6492	171	-1726		3816
	-40724					0	-40724	790	-1404	5542	4138
	-40724						-40724	790	-1404	0	-1404
	-30326						-30326	675	-1200	0	-1200
	-11280						-11280	400	-711	0	-711
	-1619						-1619	147	-261	0	-261
	-0						0	0	0	0	0

ANALYSIS: MOUNTAIN SUB
REPORT: 123-SA-186
MODEL: XB-36
BY: L. E. Thomas
CHECKED BY: W. [illegible]

STABILIZER — ULTIMATE BENDING MOMENTS & TORSIONS NORMAL & PARALLEL TO ELEMENTS OF STRINGERS

TABLE IA

S_T	$B_{T_{IN}}$	SHEAR FOR STABILIZER LOAD	X	$\sin\theta$ 19.728 $+.086187X$	$\cos\theta$	$M_{T_{IN}}$	TORSION FOR 17.775 STABILIZER LOAD	$M_{T_{IN}}$ $.2162M$	SHEAR LOADS AT BNS 130, 222, 272	G_T 27.364 $+.127946X$	TORSION FOR LOADS AT BNS 130, 222, 272	NET TORSION T_{EA}	PARL. FOR BENDING MOMENT $M_{Y_{IN}}$	$M_{Y_{IN}}\cos\theta$	$T_{EA}\sin\theta$	$M_{Y_{IN}}\sin\theta$	$T_{EA}\cos\theta$	M'_Y	T'_{EA}
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
432.5	0	0	19.728	0	0	0	0	0	0	-27.364	0	0	0	0	0	0	0	0	0
420	-261	12.5	20.805	-5430	-1619	-347	-5193	0		-28.963	0	-5463	-1619	-1613	-440	-1314	-5206	-1173	-5206
400	-711	32.5	22.524	-16018	-11280	-2415	-13603	0		-31.523	0	-13603	-11280	-11238	-1177	-976	-13558	-10061	-14528
380	-1200	52.5	24.253	-29104	-30324	-6493	-22611	0		-34.081	0	-22611	-30324	-30212	-1956	-2623	-22526	-28256	-25149
372	-1464	60.5	24.942	-35091	-40724	-8720	-26499	0		-35.104	0	-26499	-40724	-40571	-2275	-3523	-26400	-38246	-29723
372	-1464		24.942	-35091	-40724	-8720	-26499		5442	-35.104	-194546	-22949	-40724	-40571	-4103	-3523	-220017	-21468	-223590
360	-1726	72.5	25.976	-44835	-59511	-12742	-32093			-36.640	-203057	-235152	6993	6966	-2031	605	-234270	+27307	-233468
340	-2231	92.5	27.700	-63461	-73576	-21331	-42140			-39.119	-217491	-251331	77767	77475	-2343	6727	-258408	99911	-251681
320	-2735	112.5	29.423	-85150	-151402	-32418	-52732			-41.757	-231917	-284149	136777	136264	-2459	11831	-283083	160893	-271252
300	-3235	132.5	31.147	-110105	-215453	-46176	-63329			-44.316	-245599	-309528	183344	182676	-2677	15841	-308867	209950	-292506
280	-4214	152.5	32.871	-138518	-292923	-62781	-75797			-46.875	-259281	-335577	216132	215117	-2907	18765	-334320	245146	-315555
260	-4934	172.5	34.594	-170687	-384[illegible]	-82310	-93372			-49.434	-273363	-362340	236284	235398	-3132	20439	-360921	266740	-340543
252	-5233	180.5	35.283	-184636	-425135	-91930	-13606	5542		-50.547	-280131	-373737	231813	230893	-3232	20751	-372335	271321	-351584
252	-5233	180.5	35.283	-184636	-425135	-91[illegible]	-13606		13190	-50.547	-666715	-760321	239893	238993	-6576	20751	-759470	304761	-738719
240	-5690	192.5	36.318	-206649	-490510	-[illegible]028	-101621			-51.993	-695788	-797409	332799	331551	-6811	28787	-784456	339662	-755669
220	-6488	212.5	38.041	-246810	-612217	-131068	-115722			-54.551	-719527	-833520	4746834	473113	-7239	41078	-821117	545362	-791040
200	-7322	232.5	39.765	-291159	-750476	-166072	-130467			-57.110	-753291	-883798	600437	598185	-7644	51938	-880434	674629	-828846
180	-8172	252.5	41.487	-338878	-905500	-193897	-145171			-59.669	-787036	-933025	709210	706550	-8070	61347	-929526	787257	-868179
160	-9104	272.5	43.212	-393402	-1078386	-220704	-162497			-62.227	-820787	-983285	800131	797131	-8505	69311	-979598	882186	-910387
140	-10052	292.5	44.936	-451647	-1263368	-247997	-179900			-64.787	-854541	-1033441	872751	869677	-8947	76510	-1030562	959136	-955052
132	-10398	299.5	45.534	-473378	-1341127	-287162	-186216		13190	-65.682	-866246	-1052562	893523	890172	-9107	77890	-1048615	981219	-977325
132	-10398	299.5	45.534	-473378	-1341127	-287162	-186216		22987	-65.682	-1509858	-1616114	893523	890172	-1467[illegible]	77890	-1[illegible]897[illegible]	1036[illegible]	-1612[illegible]
120	-11040	312.5	46.651	-515115	-1480042	-316707	-198208			-67.345	-1548127	-1746335	1053447	1049497	-1510598	91123	-1739786	1200558	-1649[illegible]
100	-12066	332.5	48.383	-583779	-1711446	-366555	-217334			-69.904	-1606953	-1824287	1287715	1279398	-1578011	110875	-1817476	1434[illegible]	-1706[illegible]
80	-13130	352.5	50.107	-657905	-1962433	-420380	-237525			-72.463	-1665774	-1903304	1489700	1484114	-1646436	128859	-1896167	1648[illegible]	-1767[illegible]
60	-14232	[illegible]	51.830	-737645	-2236177	-478810	-258735			-75.022	-1724606	-1983441	1676568	1670231	-1715[illegible]	145023	-1976003	1841[illegible]	-1830[illegible]
50	-14798	372.5	52.692	-779736	-2381234	-509871	-269365	22987		-76.301	-1754[illegible]	-2023872	1761382	1754777	-1756[illegible]	152360	-2016282	1929[illegible]	-1863[illegible]

HORIZONTAL HORIZ. TAIL SURF.
REPORT: FZ-36-[illegible]
CHECKED BY L.E. THOMSON
BY W. KOSIAK
MODEL: XB-36

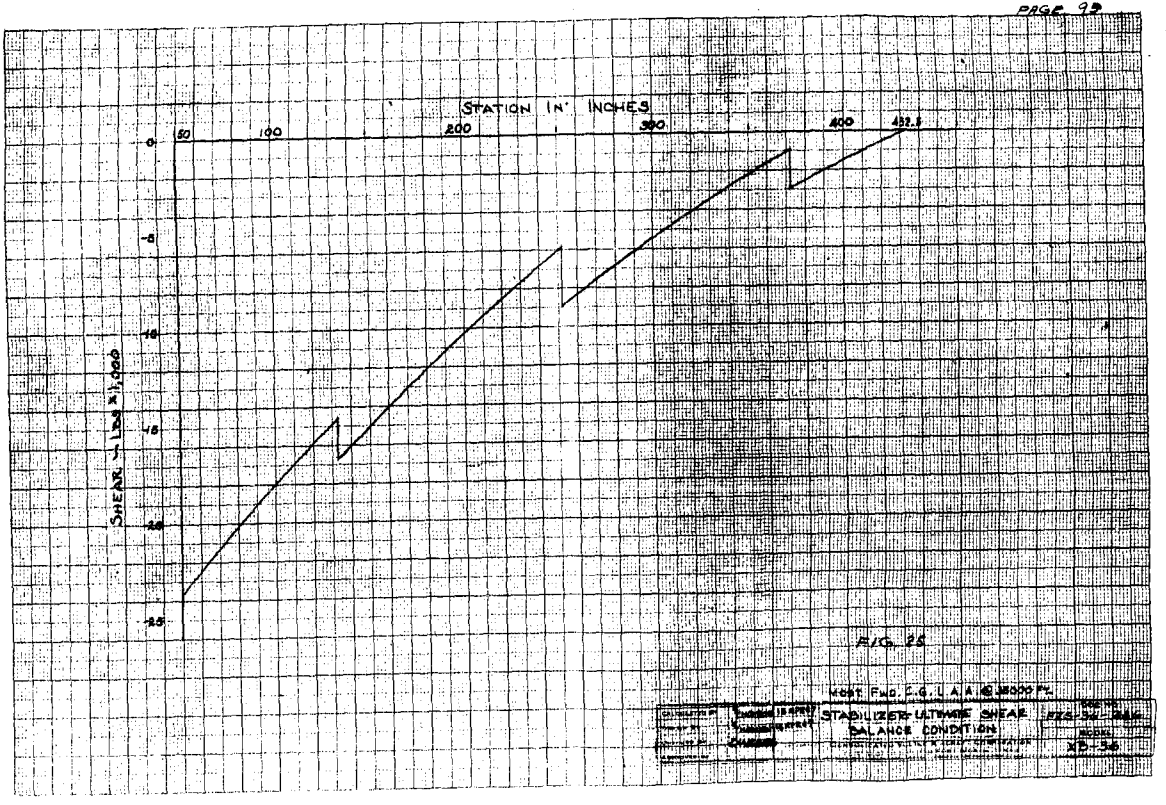

STATION IN INCHES
50
100
200
300
400
432.5
0
-5
-10
-15
-20
-25
SHEAR — LBS X 1,000
MOST FWD. C.G. L.A.A. @ 35000 FT.
STABILIZER ULTIMATE SHEAR
BALANCE CONDITION
XB-36

FIG. 25

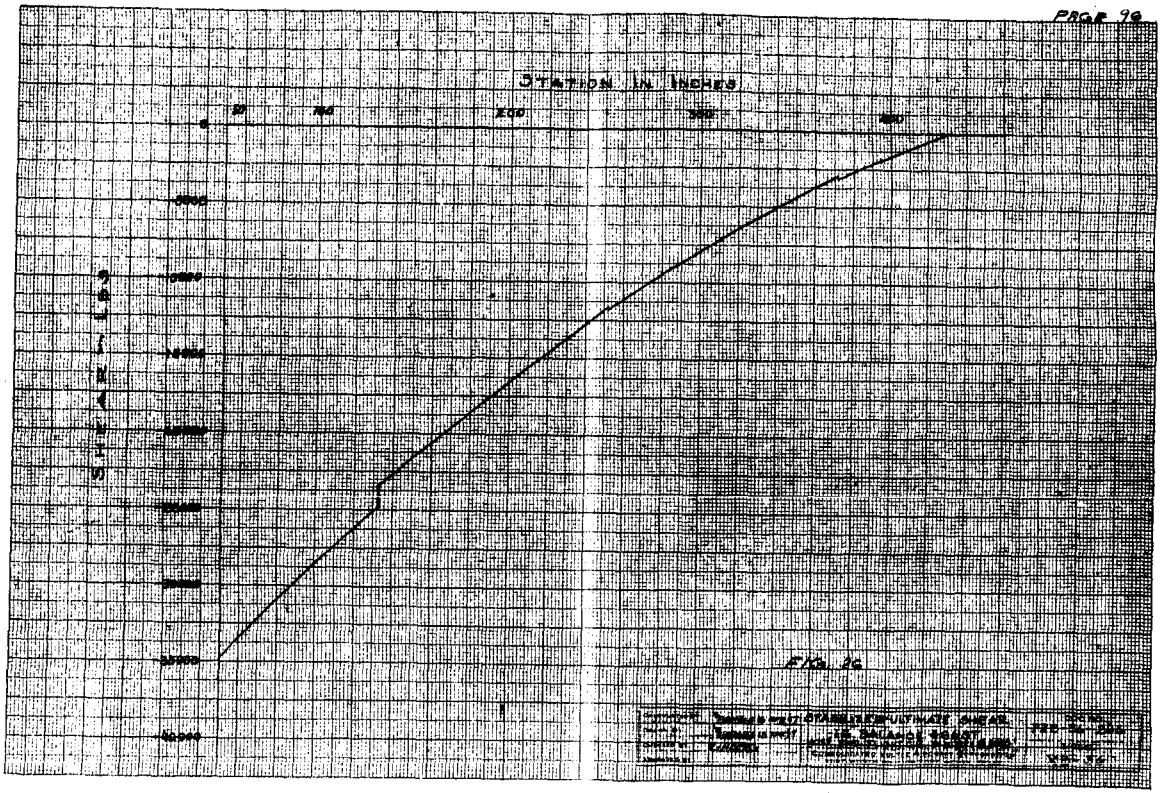

STATION IN INCHES
50
100
200
300
400
SHEAR IN LBS
0
-5000
-10000
-15000
-20000
-25000
-30000
-35000
-40000

FIG. 26

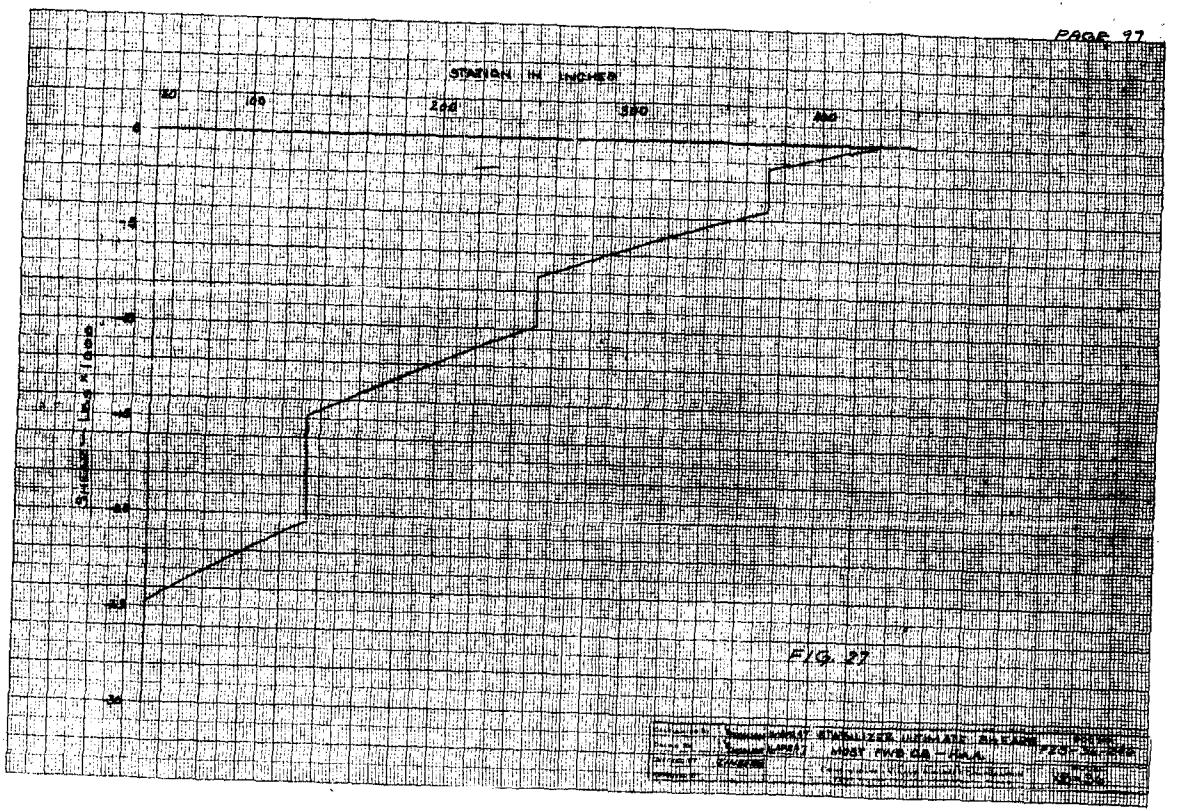

STATION IN INCHES
20
100
200
300
400
0
-5
-10
-15
-20
-25
-30
SHEAR — LBS × 1000
STABILIZER ULTIMATE SHEARS
MOST FWD OB — H.A.A.

FIG. 27

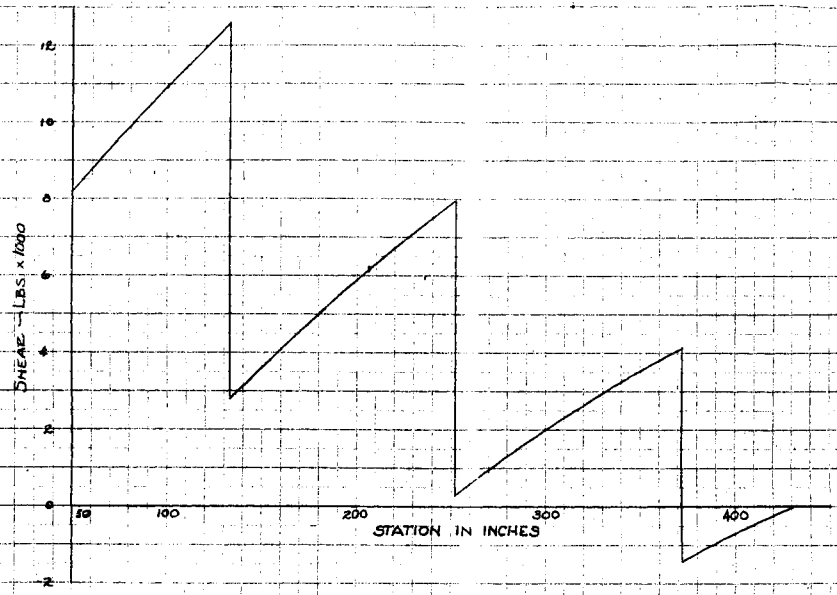


FIG. 28

THOMSON 16 APR 49 STABILIZER-ULTIMATE SHEAR
THOMSON 16 APR 49 MOST AFT C.G. — HI SPEED
ZIMBERG

CONSOLIDATED FZS-36-246
MODEL XB-36

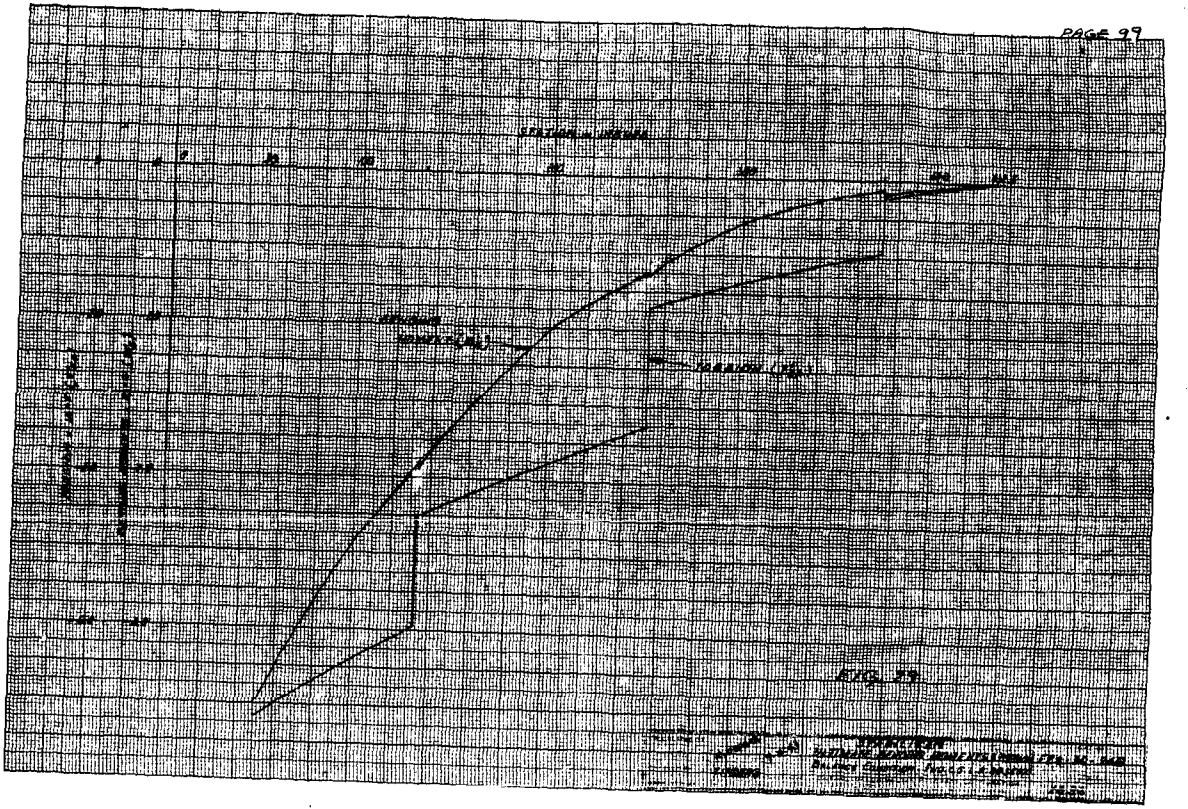


FIG. 39

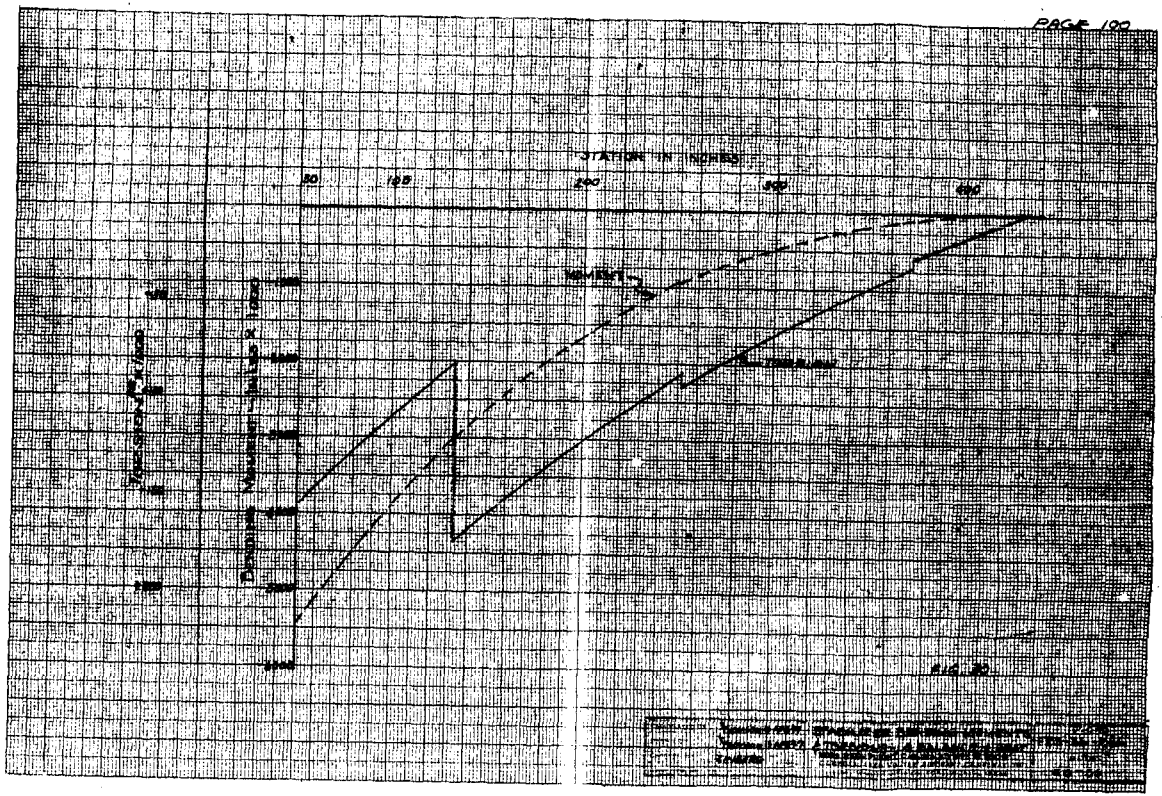


FIG. 30

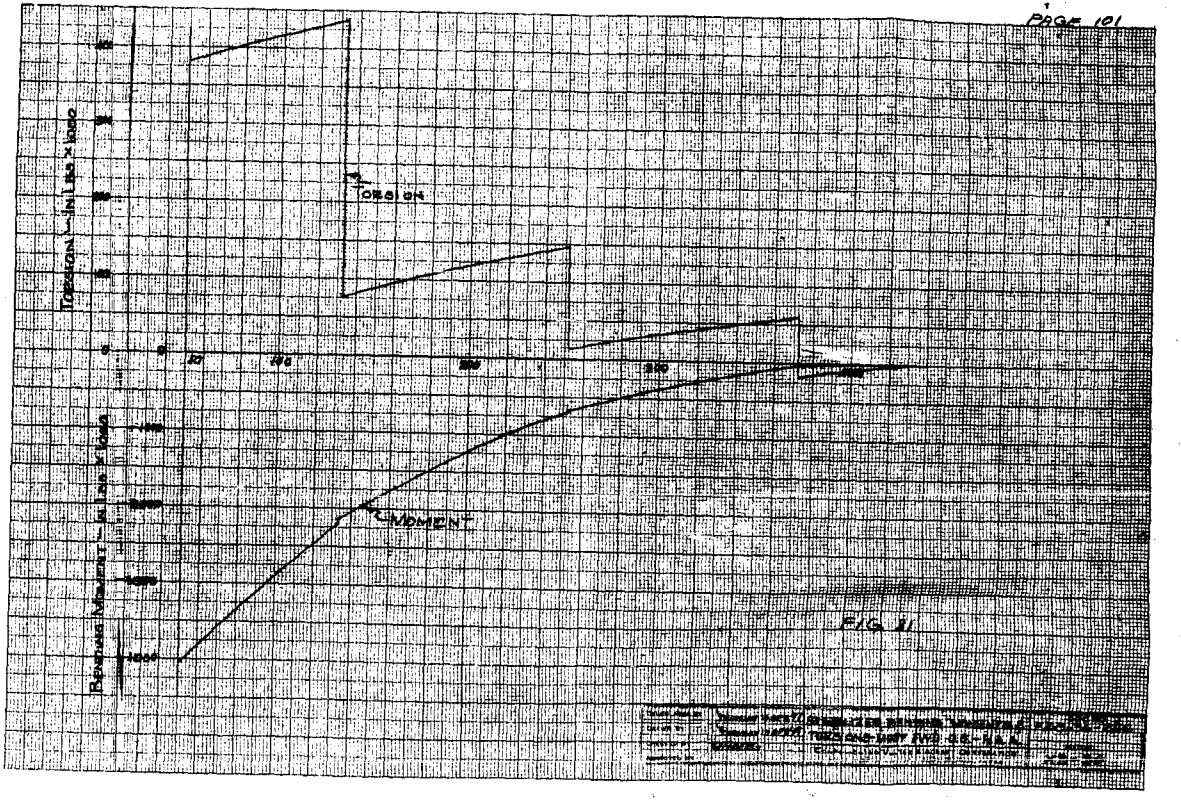

TORSION
MOMENT
TORSION — IN LBS × 1000
BENDING MOMENT — IN LBS × 1000
0
10
100
200
300
-1000

FIG. 21

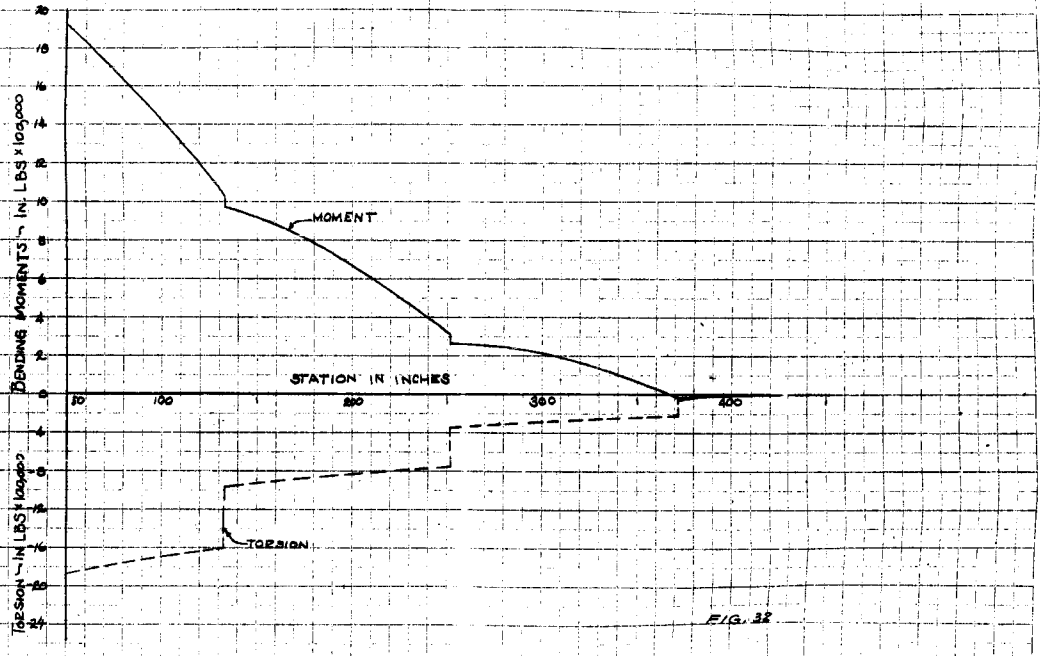


FIG. 32

THOMSON 17 APR 47 STABILIZER BENDING MOMENTS & TORSIONS-MOST AFT CG.-H.S.
THOMSON 17 APR 47
ZIMBERG

FZS-36-246

XB-36-

STABILIZER STRINGERS TABLE 14

MAXIMUM POSITIVE AND NEGATIVE BENDING MOMENTS, TOGETHER WITH CRITICAL STRINGER MARGINS OF SAFETY, FOR B-36A AND XB-36 STABILIZER

STATION	B-36A				XB-36			
	M_x'	COND.	CRITICAL STRINGER M.S.	REF. PAGE FZS-36-146	M_x'	COND.	REF. PAGE NO.	CRITICAL STRINGER M.S.
50	-4,950,000	DES. G.W. HIGH SPEED	+ .81	327	-5,475,000	1 G. BAL. + GUST	100	+ .65
	+3,240,000	MOST AFT C.G. H.A.A.	+ 1.53	330	+1,930,000	MOST AFT C.G. HI-SPEED	102	HIGH
90	-3,820,000	DES. G.W. HIGH SPEED	+ .98	333	-4,200,000	1 G. BAL. + GUST	100	+ .80
	+2,500,000	MOST AFT C.G. H.A.A.	HIGH	336	+1,530,000	MOST AFT C.G. HI-SPEED	102	HIGH
133	-2,750,000	1 G. BAL. + GUST	+ .70	339	-3,010,000	1 G. BAL. + GUST	100	+ .56
	+1,762,900	MOST AFT C.G. H.A.A.	HIGH	342	+1,037,000	MOST AFT C.G. HI-SPEED	102	HIGH
204	-1,328,000	1 G. BAL. + GUST	+ .52	345	-1,600,000	1 G. BAL. + GUST	100	+ .74
	+ 960,000	MOST AFT C.G. H.A.A.	+ 1.20	348	+ 640,000	MOST AFT C.G. HI-SPEED	102	HIGH
252	- 862,400	1 G. BAL. + GUST	HIGH	351	- 938,000	1 G. BAL + GUST	100	+ .90
	+ 538,800	MOST AFT C.G. HI-SPEED	HIGH	354	+ 305,000	MOST AFT C.G. HI-SPEED	102	HIGH
300	- 436,400	D.G. WT. HIGH SPEED	+ 1.44	357	- 472,000	1 G. BAL. + GUST	100	+ 1.26
	+ 289,900	MOST AFT C.G. H.A.A.	HIGH	360	+ 210,000	MOST AFT C.G. HI-SPEED	102	HIGH
372	- 80,000	1 G. BAL. + GUST	HIGH	363	- 90,000	1 G. BAL. + GUST	100	HIGH
	+ 35,500	MOST AFT C.G. H.A.A.	HIGH	366	—	—		

TABLE 15

STABILIZER SKIN PANELS

COMPARISON OF B-36A AND XB-36 CRITICAL PANEL SHEAR FLOWS AND MARGINS OF SAFETY

(REF. FZS-36-146 P. 369)

STA.	CRIT. PANEL	PANEL GAUGE 24ST86	F_s (p.s.i.)	B-36A CRIT. q #/IN.	B-36A f_s (p.s.i.)	B-36A M.S.	XB-36 CRIT. q #/IN.	XB-36 f_s (p.s.i.)	XB-36 M.S.
50	W_{15}	.051	30,750	418	8,200	+2.75	-607	11,910	+1.58
	W_9	.040	30,400	-403	10,070	+2.02	-458	11,430	+1.66
	W_1	.051	30,750	418	8,200	+2.75	-612	12,000	+1.56
	W_7	.040	29,950	-400	10,000	+1.95	-457	11,430	+1.62
	W_{10}	.040	30,400	-338	8,450	+2.59	-479	12,000	+1.53
90	W_{15}	.051	30,800	457	8,960	+2.44	-660	12,930	+1.38
	W_{10}	.032	30,300	-333	10,400	+1.92	-469	14,650	+1.07
	W_1	.051	31,050	455	8,920	+2.48	-666	13,080	+1.37
	W_7	.032	30,400	-373	11,660	+1.61	-436	13,640	+1.23
133	W_{15}	.051	30,050	453	8,880	+2.38	-764	14,950	+1.01
	W_9	.032	30,600	-322	10,060	+2.04	-472	14,750	+1.07
	W_1	.051	30,300	446	8,750	+2.46	-774	15,180	+1.99
204	W_9	.025	29,950	-290	11,600	+1.56	-343	13,720	+1.18
	W_1	.025	30,000	-289	11,560	+1.60	-503	20,100	+ .49
252	W_{15}	.025	29,150	-322	12,900	+1.26	-589	23,500	+ .24
	W_1	.025	29,400	-333	13,300	+1.21	-602	24,100	+ .22
300	W_9	.020	29,100	-182	9,100	+2.20	-391	19,550	+ .49
	W_4	.020	29,100	-181	9,050	+2.20	-389	19,950	+ .46
	W_1	.020	29,100	-155	7,750	HIGH	-447	22,350	+ .30
372	W_{15}	.020	28,700	-198	9,900	+1.90	-375	18,750	+ .53
	W_1	.020	28,700	-200	10,000	+1.87	-380	19,000	+ .51

STABILIZER SPAR WEBS

TABLE 16

FRONT SPAR WEB

STA.	t	CRITICAL q #/IN.	f_s (p.s.i.)	τ_u REF FZS-36-146 P. 372	M.S.
50	.040	-483	12,070	25,900	+1.15
90	.040	-420	10,500	25,100	+1.39
133	.040	-435	10,880	25,700	+1.36
204	.032	-359	11,220	25,660	+1.28
252	.025	-299	11,970	26,700	+1.23
300	.025	-378	15,130	25,150	+ .66
372	.020	-172	8,600	25,400	+1.96

REAR SPAR WEB

STA.	t	CRITICAL q #/IN.	f_s (p.s.i.)	τ FZS-36-146 P. 374	M.S.
50	.040	-633	15,810	28,050	+ .77
90	.040	-704	17,600	26,400	+ .50
133	.040	-840	21,000	26,900	+ .28
204	.025	-533	21,300	27,720	+ .30
252	.025	-657	26,300	28,850	+ .10
300	.020	-464	23,200	24,850	+ .07
372	.020	-458	22,900	26,350	+ .15

COMPARISON OF B36A & XB36 MAXIMUM ELEVATOR HINGE REACT.

STATION	XB 36 +	B36A *
50	-2402	-1371
133	-9798	-5517
252	-7648	-4071
372	-5542	-2881

*REF. FZS-36-146 P. 53
+ MOST AFT C.G. HIGH SPEED
NOTE: NEG. SIGN INDICATES DOWN REACT.

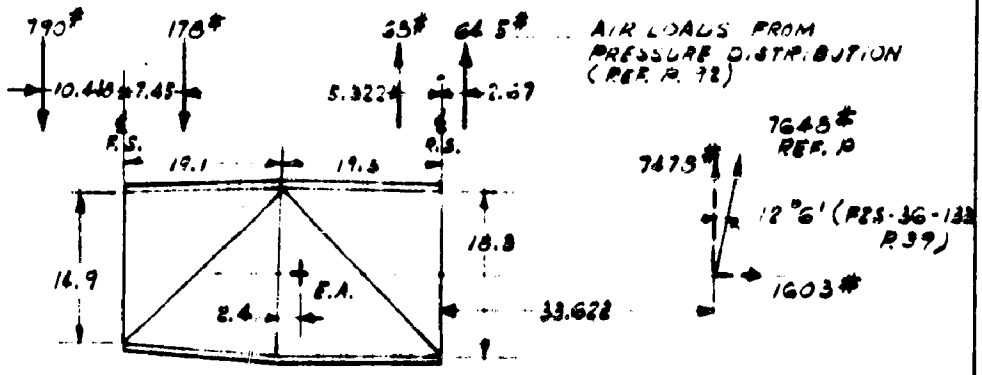
THE HIGHEST PERCENTAGE INCREASE IS AT STA. 252. A NEW STRESS DIAGRAM IS DRAWN, AND MEMBERS CHECKED FOR THIS BULKHEAD.

FOR STA. 133 AND 372, CRITICAL MEMBERS ARE COMPARED WITH B36A LOADS, AND MINIMUM MARGINS SHOWN ON P. 112.

STABILIZER BULKHEAD

STA. 252

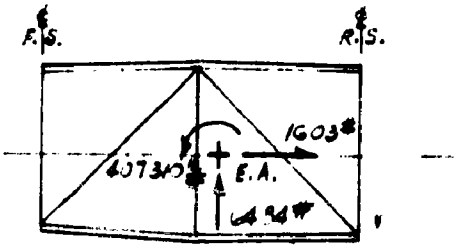
CONDITION :- MOST AFT C.G. HIGH SPEED



APPLIED BULKHEAD LOADS

NOTE:

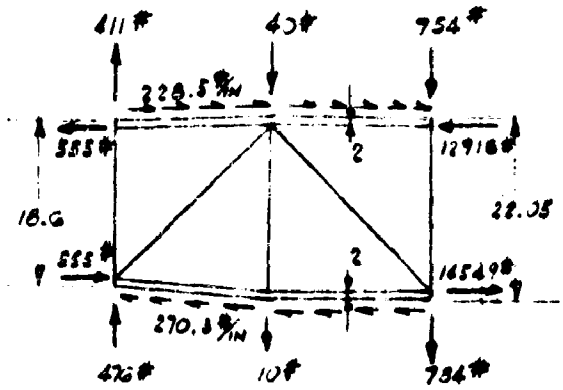
MOMENT OF LOAD FWD. OF F.S. IS APPLIED AS A COUPLE AT F.S.
MOMENT OF LOADS AFT OF R.S. IS APPLIED AS A COUPLE AT R.S.
BULKHEAD SPACING 24"
2x BOX AREA = 1633.3 SQ. IN.
CRUSHING LOADS ARE NEGLIGIBLE



Σ M-V & H ABOUT E.A.

CHORD SHEAR IS REACTED BY UPPER & LOWER SURFACE SKINS
VERTICAL SHEAR IS BEAMED TO FRONT & REAR SPARS
TORSION IS REACTED AS A RUNNING SHEAR AROUND THE BOX

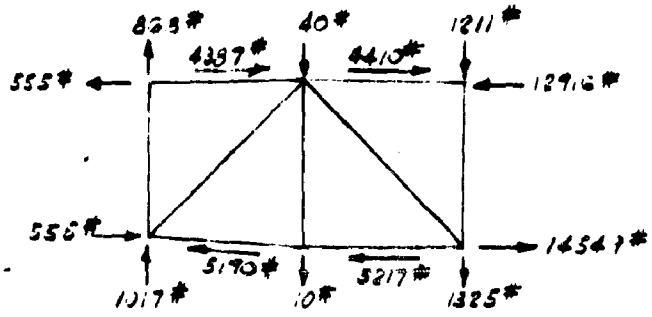
STABILIZER BULKHEAD
STA. 252



APPLIED LOADS PLUS REACTIONS

NOTE:

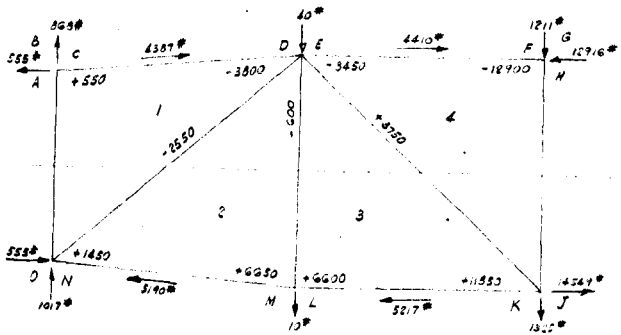
INTERSPAR AIR LOAD DISTRIBUTION 50-50
UPPER AND LOWER SURFACE REACTIONS ARE ON SKIN LINE



APPLIED LOADS PLUS REACTIONS

NOTE:

SKIN SHEAR FLOW TRANSFERRED TO C.G. OF UPPER & LOWER CHORD MEMBERS



TRUSS LAYOUT

SCALE 1" = 6"

STRESS DIAGRAM

SCALE 1" = 2000#

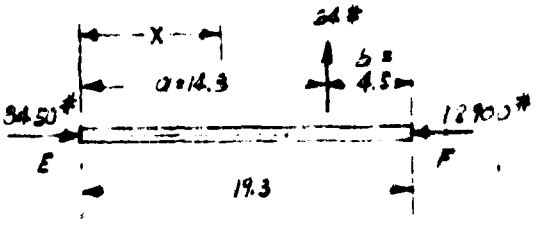
FIG. 33

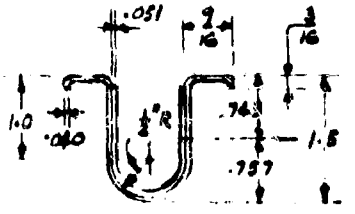
	R. DIJRAK		STABILIZER BLKHD. STA. 252 MOST AFT C.G. HIGH SPEED	FSS-36-246
	R. DIJRAK	10-1-47		
	ZINBERG			XB-36

STABILIZER BULKHEAD

STA. 252

CHECK OF UPPER CHORD MEMBER E-F





$A = .3453$ SQ. IN.
$I_{xx} = .0799$ IN^4
$\rho = .432$ IN
$L/\rho = 40.0$
$F_{CR} = 62000$ P.S.I.
$F_c = 46900$ P.S.I.

REFER. FZS-36-146 P432, 433

$$\gamma = \sqrt{\frac{EI}{P}}$$

LET $P = \frac{3450 + 12900}{6} = 10675$#

$\gamma = 9.9$

MOMENT IS MAX. WHEN $x = 13.8$

WHEN $x < a$ $C_1 = -W\gamma \frac{\sin \frac{b}{\gamma}}{\sin \frac{L}{\gamma}} = -388$

$\sin \frac{b}{\gamma} = .488$
$\sin \frac{L}{\gamma} = .814$
$\sin \frac{x}{\gamma} = 1.0$

$M = C_1 \sin \frac{x}{\gamma}$

$M = -388$ ''#

BENDING $f_c = \frac{388 \times .757}{.0799} = 3690$ P.S.I.

COLUMN $f_c = \frac{10675}{.3453} = 31000$ P.S.I.

$R_1 = \frac{3690}{62000} = .043$, $R_2 = \frac{31000}{46900} = .66$

$$M.S. = \frac{1}{R_1 + R_2} - 1$$

$$= \frac{1}{.043 + .66} - 1 = \text{- - - - - - - - - - - - - - - } \underline{+.42}$$

STABILIZER BULKHEAD

STA. 252

CHECK OF FWD. DIAGONAL 1-2

LOAD = -2550# (REF. P

$A = .1710$ SQ. IN.] REF. FZS-36-146 P432
$F_c = 18200$ P.S.I.]

$$f_c = \frac{2550}{.171} = 14900 \text{ P.S.I.}$$

$$M.S. = \frac{18200}{14900} - 1 = \text{- - - - - - - - - - - - - - - - - - - -} \underline{+.22}$$

STAB BULKHEAD STA. 133

B-36A CRITICAL HINGE LD. = 5517# ↑ (REF. FZS-36-146 P.53)
AFT C.G HIGH SPEED COND.
THE CRITICAL TRUSS MEMBER FOR THIS CONDITION IS MEMBER "1-2" M.S. = +1.88 (FZS-36-146 P. 414)

XB-36 CRITICAL HINGE LD. = 9798# ↑
ASSUMING INTERNAL STRESSES TO VARY DIRECTLY AS HINGE LOAD
LOAD IN TRUSS MEMBER "1-2" = $1780 \times \frac{9798}{5517} = 3,160$# C

$f_c = \frac{3160}{.2052} = 15,420$ p.s.i. $F_c = 25,000$ p.s.i.

$M.S. = \frac{25,000}{15,400} - 1 = \underline{+.62}$

STAB BULKHEAD STA. 372

B-36A AFT C.G. HIGH-SPEED
CRITICAL MEMBER IS "4-D"
CRUSHING LOAD = 4420# COMP. (FZS-36-146 P. 458)
HINGE LOAD = 2881 #↑ (FZS-36-146 P.53)

XB-36
CRITICAL HINGE LOAD = 5542#↑ (AFT C.G.-HI-SPEED)
MEMBER LD = $\frac{5542}{2881} \times 4420 = 8,500$# COMP.

$f_a = \frac{8500}{.2742} = 31,000$ p.s.i. $F_a = 55,500$ p.s.i.

$M.S. = \frac{55,500}{31,000} - 1 = \underline{+.79}$

CRITICAL COMBINED AXIAL + BENDING STRESS

$f_c = 14,070 \times \frac{5542}{2881} = 27,000$ p.s.i., $F_c = 49,800$ p.s.i.

$M.S. = \frac{49,800}{27,000} - 1 = \underline{+.84}$

TABLE OF MINIMUM MARGINS OF SAFETY

	Margins of Safety	Page No.
Elevator Spar		
Upper Flange Sta. 107	+ .32	49
Lower Flange Sta. 119	- .016	49
Upper Flange Sta. 147	- .006	49
Lower Flange Sta. 147	+ .10	49
Lower Flange Sta. 202	+ .018	49
Upper Flange Sta. 266	+ .06	49
Lower Flange Sta. 314	+ .06	49
Upper Flange Sta. 358	+ .06	49
Web Sta. 147	+ .048	51
Flange Rivets Sta. 145 - 151	- .03	52
Web Sta. 266	+ .12	53
Flange Rivets Sta. 264 - 270	+ .05	54
Elevator Tip Spar Flanges	+ .06	60
Elevator Cut-Out Rib Sta. 252		
Lower Flange	+ .025	64
Upper Flange	+ .01	65
Elevator Air Id. Rib Sta. 70 1/4		
Chord Member b-1	+ .31	76
Vert. Member 2-3	+ .17	77
Elevator Trim Tab		
Spar Flanges Sta. 390	+ .018	79
Web Sta. 280	+ .08	80
Elevator Servo Tab Spar Web Sta. 190.5	+ .15	85
Stabilizer Stringers		
Sta. 50	+ .63	103
Sta. 90	+ .80	103
Sta. 133	+ .56	103
Sta. 204	+ .74	103
Sta. 252	+ .90	103
Sta. 300	+1.26	103
Sta. 372	High	103
Stabilizer Skin Panels		
Sta. 204	+ .49	104
Sta. 252	+ .22	104
Sta. 300	+ .30	104
Sta. 372	+ .51	104

TABLE OF MINIMUM MARGINS OF SAFETY (CONT'D)

	Margins of Safety	Page No.
Stabilizer Spar Webs		
Front Spar Sta. 300	+ .66	105
Rear Spar Sta. 252	+ .10	105
Rear Spar Sta. 300	+ .07	105
Rear Spar Sta. 372	+ .15	105
Stabilizer Hinge Bulkheads		
Sta. 133 Fwd. Diagonal (1-2)	+ .62	112
Sta. 252 Upper Chord (E-F)	+ .42	110
Sta. 252 Fwd. Diagonal (1-2)	+ .22	111

REEL — C

2403

A.T.I.

53460

TITLE: Stress Analysis of Horizontal Tail Surfaces - Model XB-36

ATI- 53460

REVISION (None)

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DATE	DOC. CLASS.	COUNTRY	LANGUAGE	PAGES	ILLUSTRATIONS
Dec '47	Unclass.	U.S.	English	119	tables, diagrs, graphs

ABSTRACT:

A stress analysis is made of the horizontal tail surfaces of the XB-36 bomber. This analysis covers stabilizer and elevator loads, elevator and tab (servo and trim), and stabilizer. Results of the analysis are shown in tables, diagrams, graphs, and computations. The minimum margins of safety are included wherever practical.

DISTRIBUTION: Copies of this report obtainable from CADO. (1)

DIVISION: Structures (7)
SECTION: Stress Analysis of Specific Aircraft (6)

SUBJECT HEADINGS: Control surfaces - Stress analysis (25899.4); XB-36 (99409)

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