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REEL—C

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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 119 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)
Stress Analysis of Specific Aircraft (6) (25869.4); XB-36 (99409)
Control surfaces - Stress analysis

USAF C. N. W535-ac-22352

TITLE

[illegible]

E/R
[illegible] WITH
LETTER # 2015
DATED 5-7-48

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

FORT WORTH DIVISION • FORT WORTH 1, TEXAS

GS-50

MODEL XB-36

REPORT FZ8-36-246

DATE 12-16-47

TITLE

STRESS ANALYSIS OF HORIZONTAL TAIL SURFACES

SUBMITTED UNDER

Contract W535-ac-22352

PREPARED BY: [illegible] R. DVORAK [illegible] THOMSON

GROUP: STRUCTURES

REFERENCE:

CHECKED BY: [illegible]

APPROVED BY: [illegible] [illegible]

NO. OF PAGES 114

NO. OF DIAGRAMS 33

REVISIONS

NO.	DATE	BY	CHANGE	PAGES AFFECTED

FW 618 1M 10-44

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Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

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TABLE OF CONTENTS (CONT'D)

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.

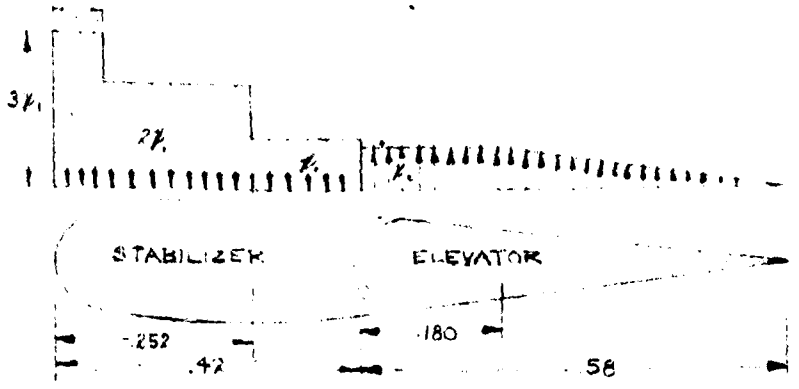
For all basic data such as planform and interior structure, reference is made to the B-36A Horizontal Tail Surface Analysis, Report FZS-36-146. Wherever possible, reference to loads and margins of safety in this report are made, and direct comparisons are taken.

BALANCING CONDITION

MOST AFT C.G. (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 = -41,100 #(LIMIT)

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

AVG. STAB. PRESS = $\frac{41100}{978}$ = -50.5 #/I' (ON SURFACE AREA)

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

$\ell_1[.137 + .378 + .163] = -50.5$

$\ell_1 = 69.1$ #/I'

$2\ell_1 = 138.2$ #/I'

$3\ell_1 = 207.3$ #/I'

$\ell_2[.180 + .20] = 14.5$

$\ell_2 = 39.2$ #/I'

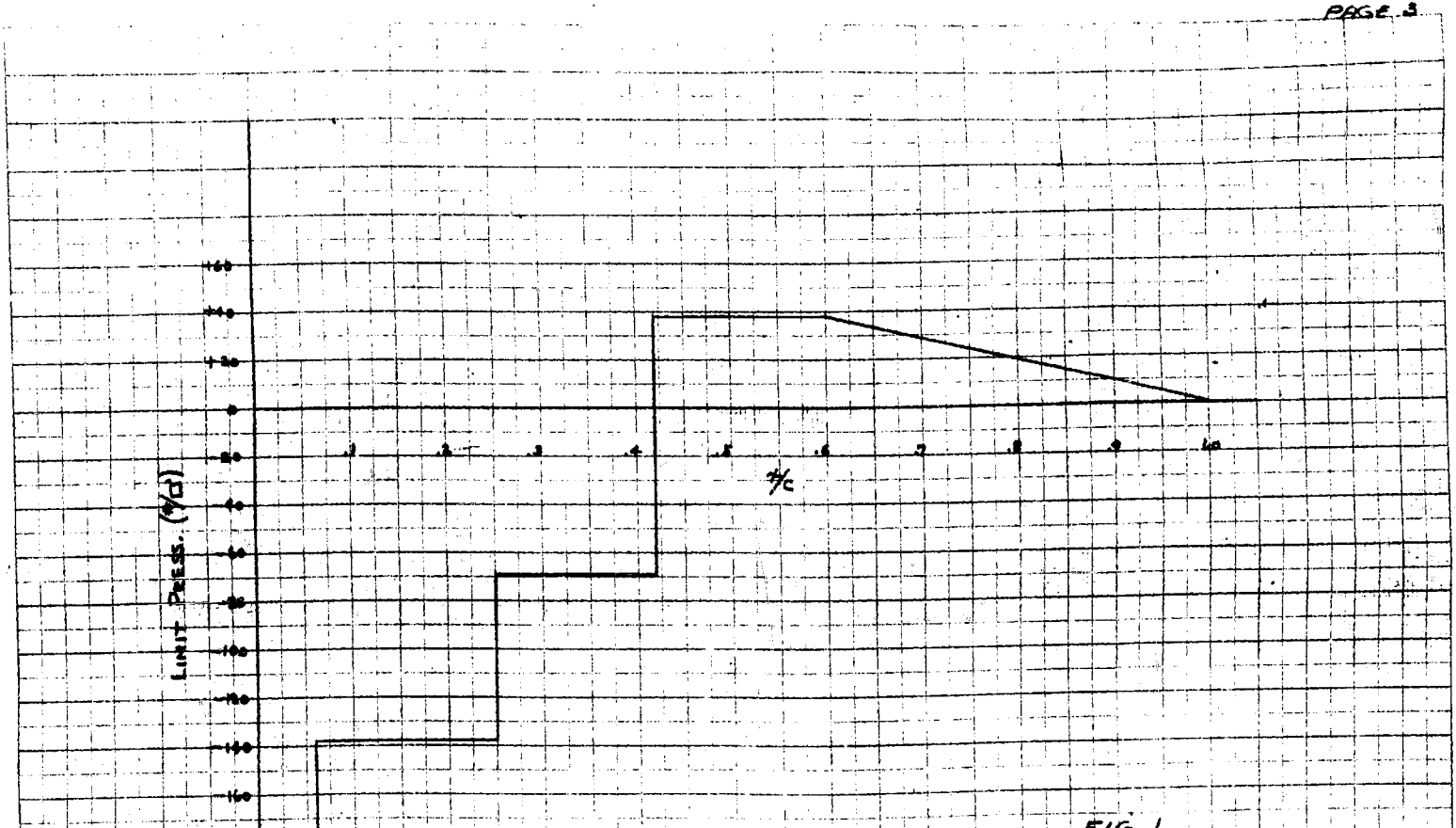


FIG. 1

CALCULATED BY	KOSIAK 3-17-41	PRESSURE DISTRIBUTION BALANCING CONDITION	DWG. NO. FB3-36-246
DRAWN BY	KOSIAK 3-17-41	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB-36
CHECKED BY	ZIMMERMAN		
APPROVED BY			

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

DETERMINATION OF BALANCING TAIL LOADS

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

$W = 261352$ #
$S_W = 4772$ SQ. FT.
$V_H = 311$ M.P.H. (FZS-36-126 P4.)
$J = .3616$

$$C_{WA} = \frac{391 W}{V^2 J S_W}$$

$$= \frac{311 \times 261352}{(311)^2 \times .3616 \times 4772}$$

$$= 0.257$$

$C_L = 0.281$ (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 = SLOPE OF LIFT CURVE $= \frac{.294}{\sqrt{1-(.414)^2}} = .1033$

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

$$\alpha_W = \frac{C_L}{m} - 2.60 = \frac{.231}{.1033} - 2.60 = +.12^\circ$$

$\theta = +.12 - 3.00 = -2.88^\circ$ $\sin\theta = -.05034$ $\cos\theta = .9987$

$C_Z = C_L \cos\theta + C_D \sin\theta = +.2801$
$C_X = C_D \cos\theta - C_L \sin\theta = +.0241$

$$C_T = \left(C_Z \frac{X'}{M.A.C.} + C_X \frac{-1}{M.A.C.} + C_{MO}\right) \frac{M.A.C.}{dt}$$

$= -.0231$

$\frac{X'}{MAC} = -.056$, $\frac{-1}{MAC} = -.0079$, $\frac{MAC}{d\alpha} = +.3617$ } REFER. FZS-36-126 P3.

CHECK $C_{NA} = C_T + C_Z$
$= -.0231 + .2801 = 0.257$

TAIL LOAD $= C_T \frac{1}{2} \rho V^2 S_W J$
$= (-.0231) \times .002558 \times (311)^2 \times 4772 \times .3616 =$ **-23497 # LIMIT**

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

USING METHOD AND REFERENCES SHOWN ABOVE
$W = 139209$ # $V = 311$ MPH
$C_{NA} = +.136$, $C_L = .151$, $C_{DW} = +.0080$
$\alpha_W = -.24^\circ$ $\theta = -4.14^\circ$ $\sin\theta = -.07220$ $\cos\theta = .9974$
$C_X = +.0189$, $C_Z = +.1500$
$\frac{X'}{M.A.C.} = +.0979$ $\frac{-1}{M.A.C.} = -.0109$ $\frac{M.A.C.}{d\alpha} = +.3394$
$C_T = -.0140$ CHECK $C_{NA} = -.0140 + .150 = +.136$
TAIL LOAD $= (-.0140) \times .002558 \times (311)^2 \times 4772 \times .3616 =$ **$-14,246$ # LIMIT**

DETERMINATION OF SHOCK LOAD ON HORIZONTAL TAIL

REFERENCE 2813-6A

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

$$\Delta_{FH} = \frac{57.3U}{V_H} S_H \gamma \left(1 - \frac{32 \times \lambda_H \times \Lambda_P \times K_T \times \Lambda_S}{A}\right) P \left(\frac{\pi \times A_H \times a_{OH}}{\pi \times A_H + 57.3 \times a_{OH}}\right)$$

$W = 121,350$ # $S_H = 47.5$ SQ. FT.

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

$\gamma = .9616$ $\sigma^{\frac{1}{2}} = 0.9232$

$U = \frac{50K}{\sigma^{\frac{1}{2}}} = 30.3$ FT/SEC

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

$S_H = 97.5$ SQ. FT.

$q = \frac{1}{2} \rho V^2 \gamma = .002378 \times \overline{311}^2 \times .9616 = 218.17$ #/SQ. FT.

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

$A = 1.14$, $A_H = 5.51$, $a_{OH} = .0995$

$K_P = .555$
$K_T = 2.34$
$K_S = .920$
$P = .992$

} REFER FES-36-146 P12

SUBSTITUTING VALUES IN ABOVE EQUATION GIVES

$\Delta_{FH} = 30993$ # LIMIT

MOST AFT FLIGHT C.G. - HIGH SPEED @ 5,000 FT.

USING METHOD AND REFERENCES SHOWN ABOVE

$W = 133,508$ #

$\frac{W}{S} = 29.96$ $K = .555$

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

ALL OTHER VALUES ARE AS SHOWN ABOVE

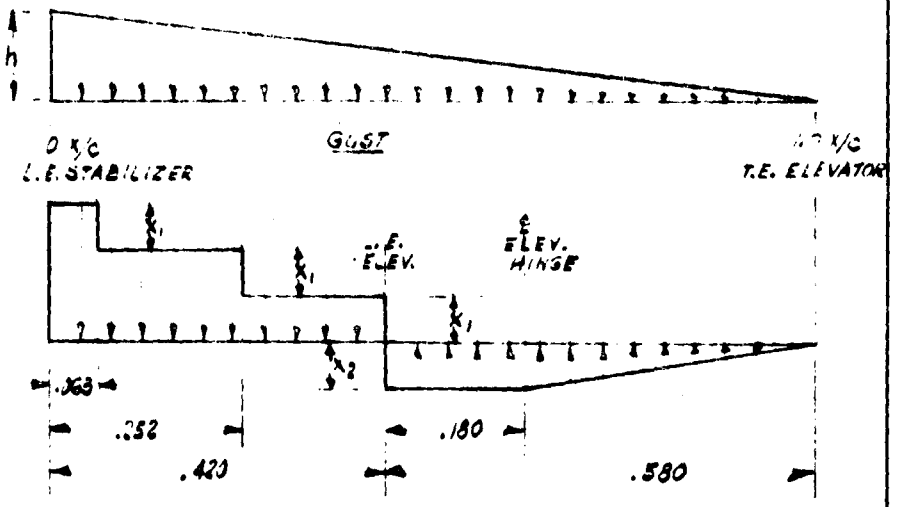
SUBSTITUTING VALUES IN ABOVE EQUATION GIVES

$\Delta_{FH} = 28592$ # LIMIT

LG 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 C-1913-GA



BALANCE

$h = \frac{32990}{999} \times 2 = 63.19$ #/SQ. FT.

ELEV. LOAD = [illegible]
STAB. LOAD = -23499 x 1.40 = -32899# = -33.04 #/SQ. FT.

$X_1 [3(.0630) + 2(.1890) + .1680] = -33.04$

$.7350 X_1 = -33.04$

$X_1 = -45.77$ #/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.

$h = \frac{29592}{999} \times 2 = 59.47$ #/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.

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS

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

FW 631 125 PADS 11-43

TABLE I

X/C (1)	BALANCING LOAD (2)	1 - X/C (3)	GUST LOAD [illegible] (4)	TOTAL LOAD (2) + (4) (5)	INTEGRATION OF CURVE: AVERAGE LOAD (6)	ORDINATE (7)	AREA (6) x (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 x 978 = -53407* LIMIT
ELEV. LOAD = -1.020 x 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 x 978 = -38916* LIMIT
ELEV. LOAD = -4.006 x 978 = -3918* LIMIT

BY - W. KOSIAK
CHECK - R. DVORAK

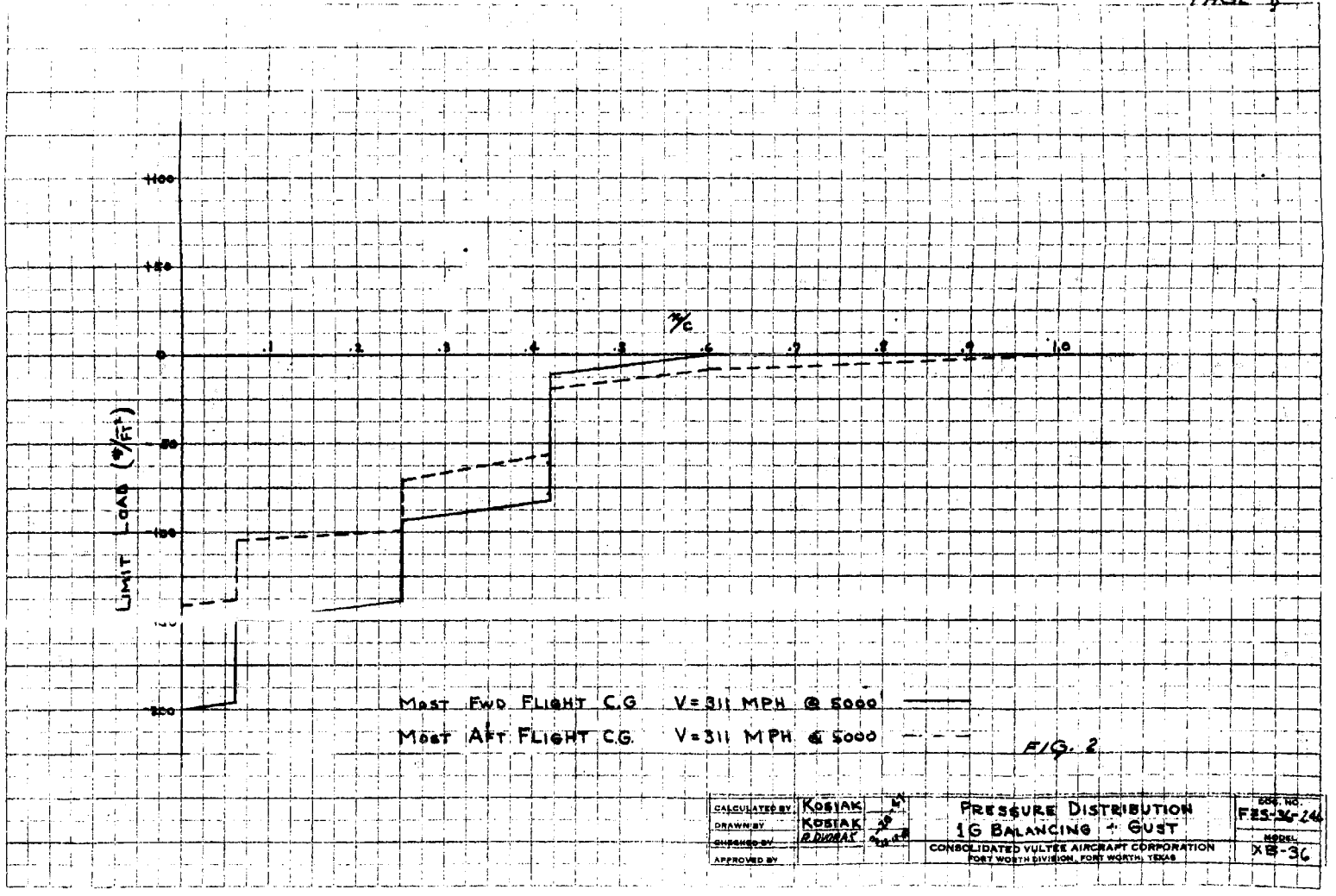


FIG. 2

CALCULATED BY	KOSIAK	PRESSURE DISTRIBUTION 1G BALANCING + GUST	ENG. NO. FZS-36-24
DRAWN BY	KOSIAK		
CHECKED BY	R DUDAS	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	-20900	-34550
MOST AFT C.G. L.A.A.*	+40450	-23700	+16750
IG BALANCE PULL OUT	-115	-53407	-54405
BALANCING†	-4000	-47700	-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

[illegible]

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

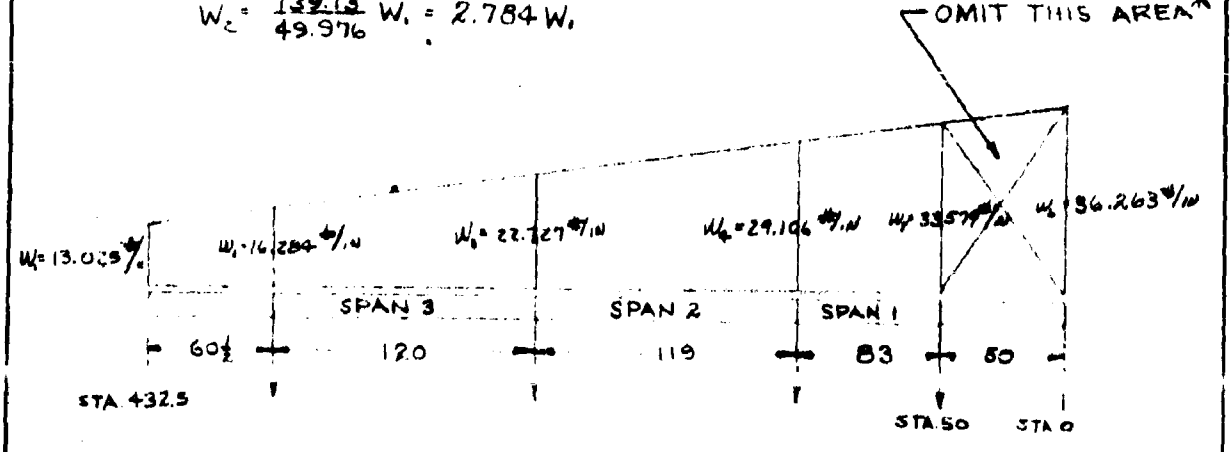
ROOT CHORD (STA 0) = 139.13"

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

[illegible] CONDITION

FIXED END MOMENTS - AIRLOADS

F.E.M. = K.WL² FOR K VALUE REF [illegible] Pgs 38 & 39

SPAN ①

UM_5 = .0803 × 29.106 × $\overline{83}^2$ = 16019.6
VM_5 = .0318 × 4.473 × $\overline{83}^2$ = 979.6
17079.2 "#

UM_4 = .0803 × 29.106 × $\overline{83}^2$ = 17308.8
VM_4 = .0515 × 4.473 × $\overline{83}^2$ = 1587.2
18891.0 "#

SPAN ②

UM_4 = .0910 × 22.727 × $\overline{119}^2$ = 29287.8
VM_4 = .0535 × 6.379 × $\overline{119}^2$ = 1853.1
31120.9 "#

UM_3 = .0762 × 22.727 × $\overline{119}^2$ = 24524.0
VM_3 = .0296 × 6.379 × $\overline{119}^2$ = 2673.6
27197.6 "#

SPAN ③

UM_3 = .1010 × 16.284 × $\overline{125}^2$ = 23682.1
VM = [illegible]
21046.3 "#

UM_2 = .0678 × 16.284 × $\overline{120}^2$ = 15899.0
VM_2 = .0255 × 6.443 × $\overline{120}^2$ = 2365.1
18264.1 "#

CANTILEVER MOMENT

UM_2 = [illegible] = 23850
VM_2 = $\frac{6.257 \times \overline{60.5}^2}{6}$ = 1988
25838 "#

BALANCED CONDITION.

FIXED END MOMENTS - DEFLECTION

RELATIVE DEFLECTIONS $\Delta_{50} = 0$
$\Delta'_{158} = 1.00$
$\Delta'_{252} = 1.24$
$\Delta'_{372} = 0$

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

WHERE $V = \Delta_{50}$ etc.
$I = \frac{I_1 + I_2}{2}$

SPAN (1)

$M_5 = \frac{.2573 \times 10.3 \times 10^6 \times 33.74 \times 1.06 \times 100}{83^2} = 306,398$ "

$M_4 = \frac{.0618 \times 10.3 \times 10^6 \times 33.74 \times 1.06 \times 100}{83^2} = 328,858$ "

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)

$M_3 = \frac{[illegible]}{126^2} = 86,794$ "

$M_2 = \frac{.0452 \times 10.3 \times 10^6 \times 15.055 \times 1.24 \times 100}{126^2} = 60,356$ "

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

ELEVATOR SPAR

BALANCING CONDITION

MOMENT DISTRIBUTION

SPAN	①		②		③	
CARRY OVER FACTORS	[illegible]	.475 | .442		.565 | [illegible]		.647	
STIFFNESS FACTORS	1.0	.613	.391	.601	.399	1.0	
AIRLOAD MOMENT	17.1	18.9	34.1	27.2	29.1	18.3	25.8
DEFLECTION MOMENT	306.4	-328.9	25.1	-21.1	-86.8	60.4	0
Σ MOM.	323.5	-310.0	54.2	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	9.8	
	42.7	-55.9	-0.7	-26.3	-6.3	0.8	
	-42.7	33.3	-21.9	12.0	-8.0	-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	
	2.0	1.7	1.1	1.1	[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

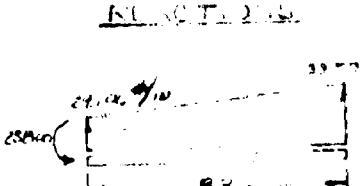
Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE
REPORT NO. [illegible]
MODEL XB-36
DATE 10-20-41

ELEVATOR SPAN

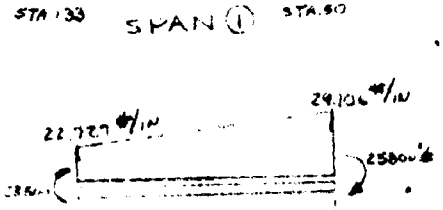
BALANCED CONDITION

REACTIONS



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

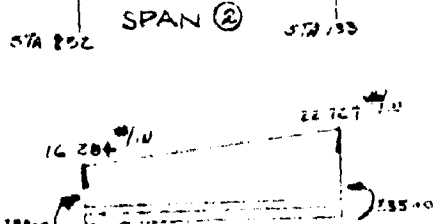
$$R_{133R} = \frac{29.106 \times 83}{2} + \frac{4.473 \times 83}{6} - \frac{25800}{83} = 958.7\#$$



$$R_{133L} = \frac{22.727 \times 119}{2} + \frac{6.379 \times 119}{3} - \frac{495000}{119} = 1191.7\#$$

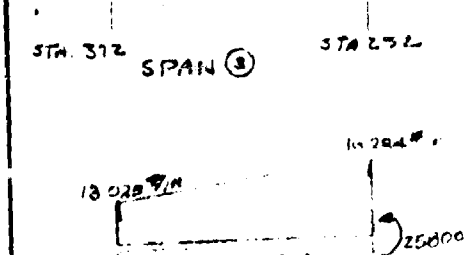
$$R_{252R} = \frac{22.727 \times 119}{2} + \frac{6.379 \times 119}{6} + \frac{495000}{119} = 1548.6\#$$

$$R_{252L} = \frac{16.284 \times 120}{2} + \frac{6.443 \times 120}{3} - \frac{2300}{120} = 815.1\#$$



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

$$R_{372L} = (13.02 + 16.284) \times 60.5 = 884.1\#$$



$R_{50} = 1042.0\#$

$R_{133} = 2150.4\#$

$R_{252} = 3108.7\#$

$R_{372} = 2011.8\#$

$8912.9\#$ vs 8913

ELEVATOR LOAD

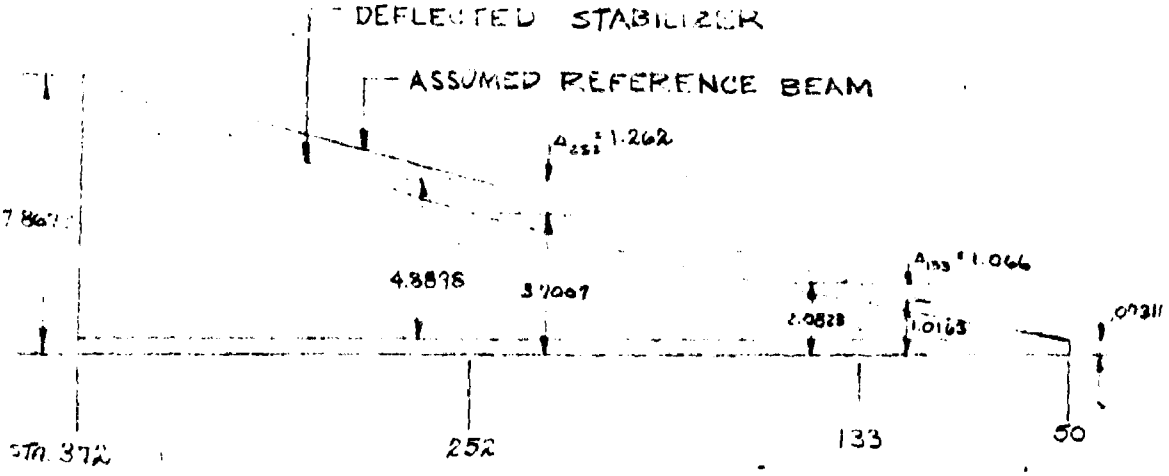
BALANCING CONDITION

CHECK OF ASSUMED RELATIVE DEFLECTIONS

ITEM	RATIO	STA 50		STA 133		STA 252		STA 372	
		RATIO	Δ	RATIO	Δ	RATIO	Δ	RATIO	Δ
W_s	-3.7275	.027611	-.10292	.385524	-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

$W_s = \frac{2 \times 37275}{20000} = 3.7275$

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



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

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

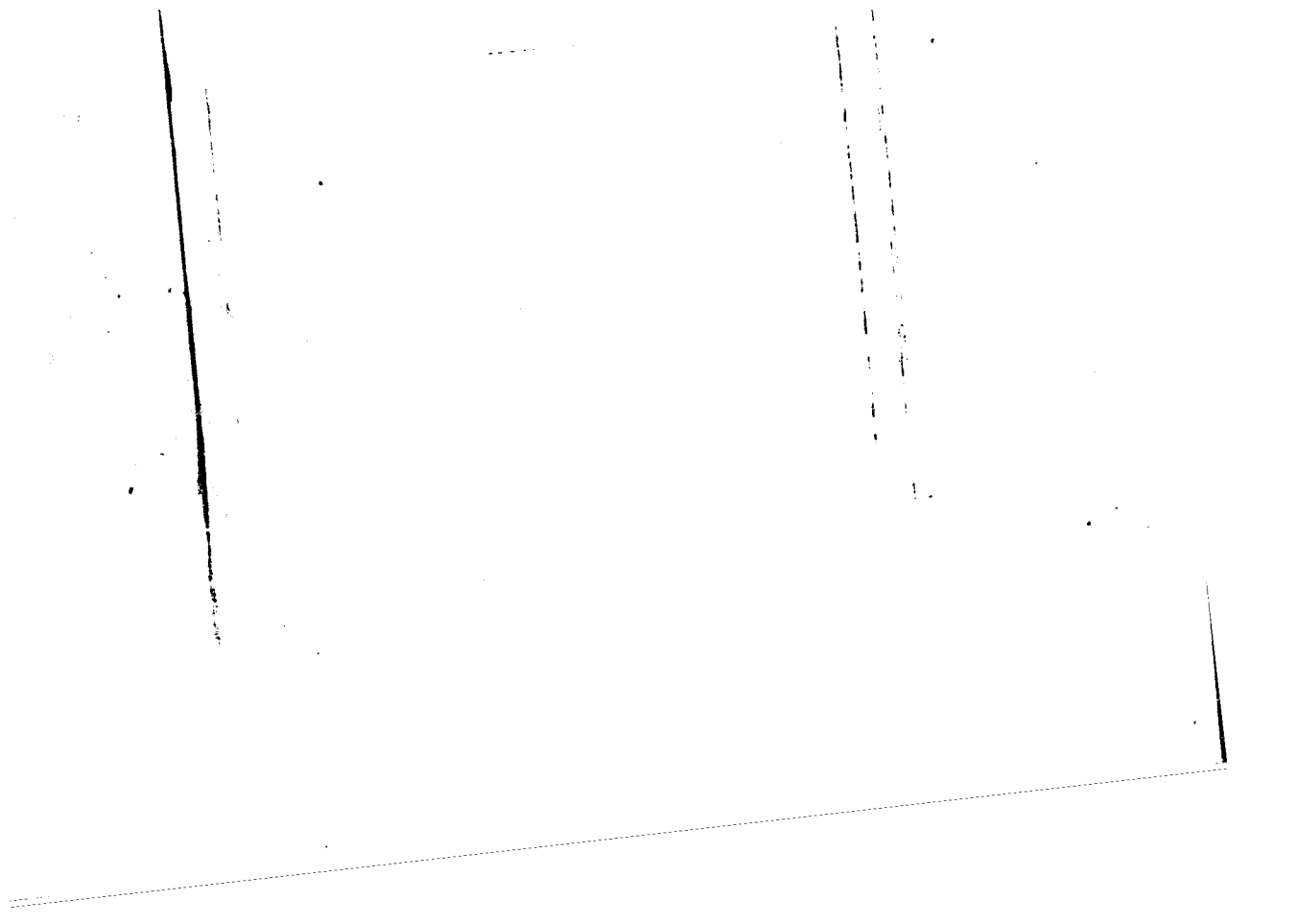
ASSUMED RELATIVE DEFLECTION $\Delta_{133} = 1.06$" VS 1.066" ACTUAL

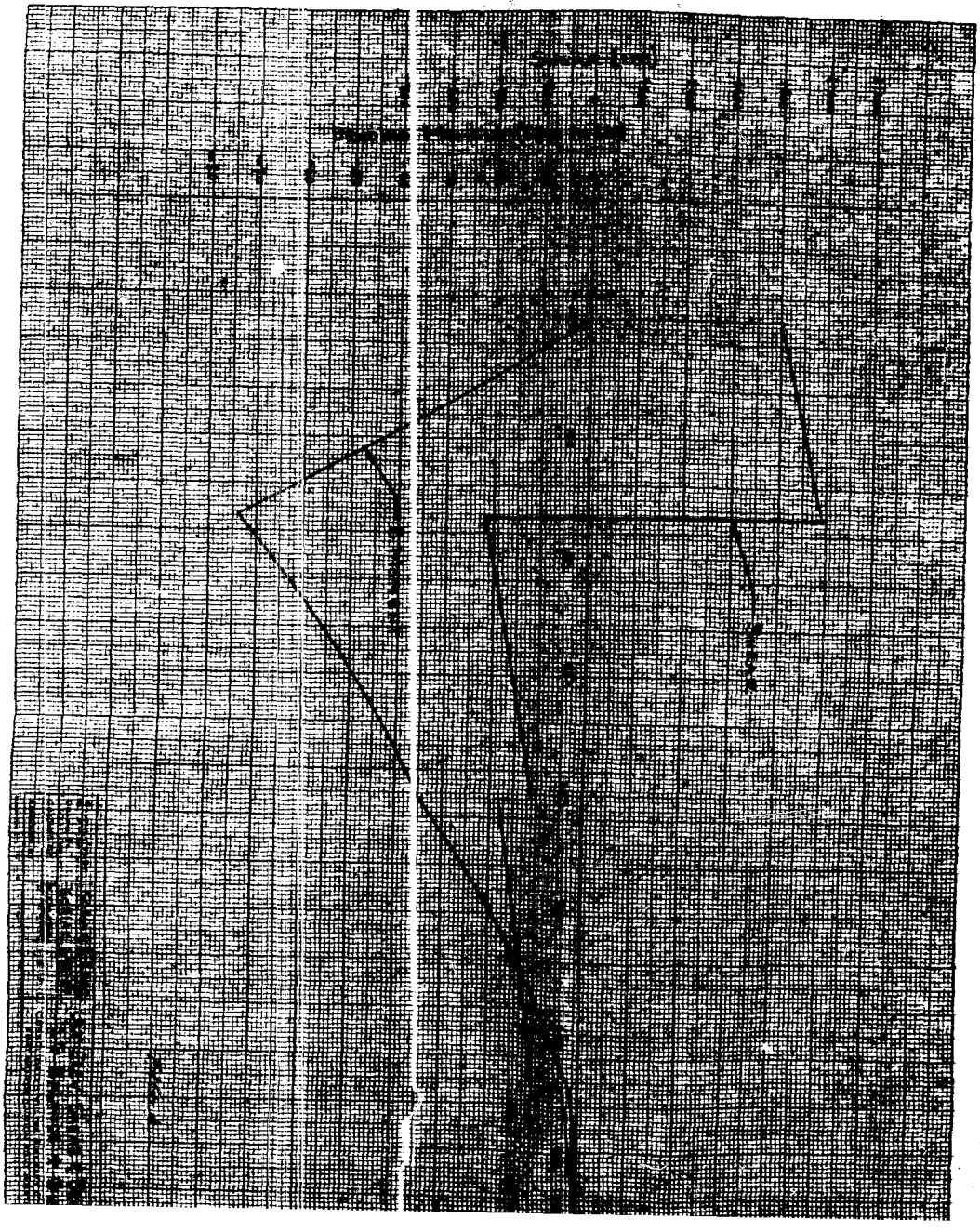
ASSUMED RELATIVE DEFLECTION $\Delta_{252} = 1.24$" VS 1.262" ACTUAL

STATION	DISTANCE BETWEEN STATIONS X	LOAD PER INCH	AVERAGE LOAD	LOAD BETWEEN STATIONS F	ARM TO CENTROID ω	MOMENT M'=Fω	SHEAR S=ΣF	MOMENT M''=SX	MOMENT AT STATION M'+M''
432.5		[illegible]					0	0	0
	20.5		[illegible]	273.3	[illegible]	2514			
412		14.1[illegible]					273.3		2514
	20		14.66[illegible]	293.3	9.5[illegible]	2[illegible]93		5500	
392		15.205					571.6		11275
	20		15.715	311.7	9.[illegible]33	3114		11[illegible]	
372		1[illegible].234					886.5		25[illegible]24
	—		—	-2011.3	—	—			
372		16.234					-1125.[illegible]		2[illegible]4
	20		16.924	336.5	9.[illegible]16	3380		-22[illegible]	
352		17.30[illegible]					-752.8		6645
	20		17.311	353.[illegible]	9.[illegible]	3516		-15776	
332		18.434					-4[illegible].9		-5592
	20		18.964	379.4	9.[illegible]	3758		-8616	
312		19.504					-[illegible]1.4		-10440
	20		20.039	400.8	9.112	[illegible]173		-1029	
292		20.574					341.4		-7415
	20		21.109	422.2	9.1[illegible]	4138		6933	
272		21.644					771.6		3651
	20		22.186	443.7	9.120	4402		15432	
252		22.727					1215.3		23515
	—		—	[illegible].7					
252		22.727					-1343.4		23515
	20		23.264	46[illegible].3	9.123	4614		-37969	
232		23.8[illegible]					-14[illegible]		-9734
	20		24.3[illegible]	486.7	9.125	4332		-23562	
212		24.373					-941.[illegible]		-33404
	20		25.410	508.[illegible]	9.119	5043		-19[illegible]68	
192		25.946					-[illegible]		-47247
	20		26.133	527.7	9.[illegible]	5263		8664	
172		27.014					1[illegible]		-5[illegible]

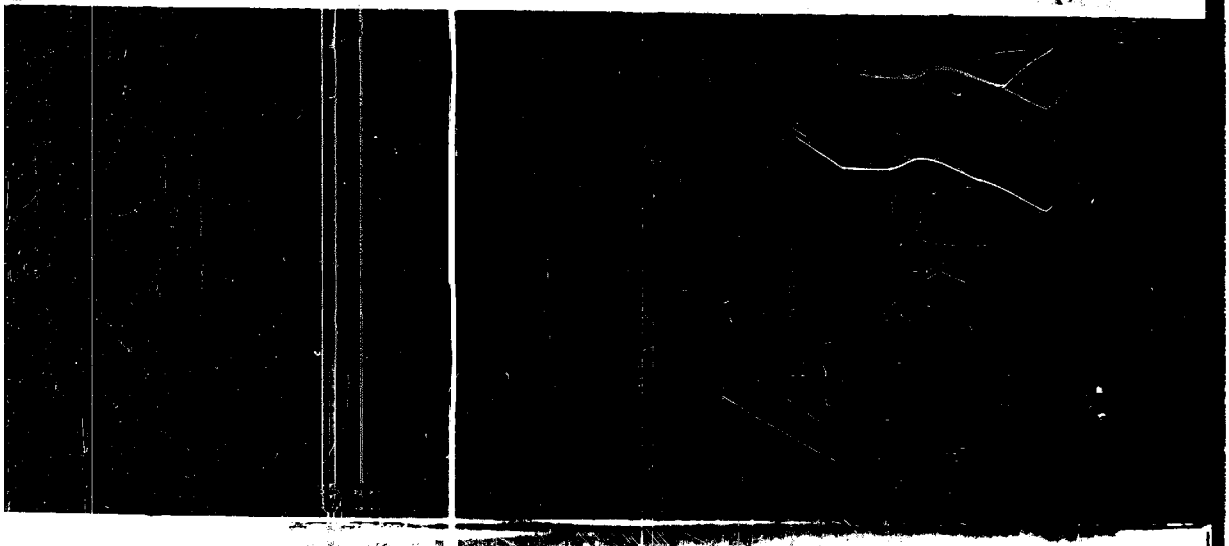
STATION	DISTANCE BETWEEN STATIONS X	LOAD PER INCH	AVERAGE LOAD	LOAD BETWEEN STATIONS F	ARM TO CENTROID ω	MOMENT M'=Fω	SHEAR S=ΣF	MOMENT M''=SX	MOMENT AT STATION M'+M''
1[illegible]2		27.[illegible]19					96.5		-50648
	20		27.552	551.0	9.950	54[illegible]		1930	
152		28.085					647.5		-43243
	19		28.576	543.3	9.44[illegible]	51[illegible]		128[illegible]3	
133		29.106					1190.9		-25802
	—		—	-2150.4					
133		29.106					-959.6		-25803
	20		29.646	592.9	9.1[illegible]	54[illegible]		-11112	
113		30.186					-366.7		-39104
	20		30.72[illegible]	614.5	9.944	6111		-7334	
93		31.266					247.8		-40327
	20		31.806	636.1	9.944	6325		4956	
73		32.346					883.9		-2[illegible]6
	11		32.642	359.1	5.432	1969		9723	
62		32.937					1243.0		-17354
	12		33.258	399.1	5.481	2337		14916	
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: FZ[illegible]-36-24[illegible]
MODEL: XB-36
BY: LANCHAY
CHECK:
DATE:





Bending Moment
Shear



FW 444 6-46 UTILITY REPORT SHEET

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	-2108.2	-2011.8		
1G BALANCE + GUST	-799.2	+1421.9	+142.2	-138.2	1227.3	1523.9

NOTE: Negative Sign Indicates Down REACTION

ANALYSIS HORIZ. TAIL
PREPARED BY LANZATA
CHECKED BY ZIMMERS
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

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MODEL XB-36
DATE 10-20-47

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.

ANALYSIS HORIZ. TAIL
PREPARED BY LANGER
CHECKED BY ZINBERG
REVISED BY

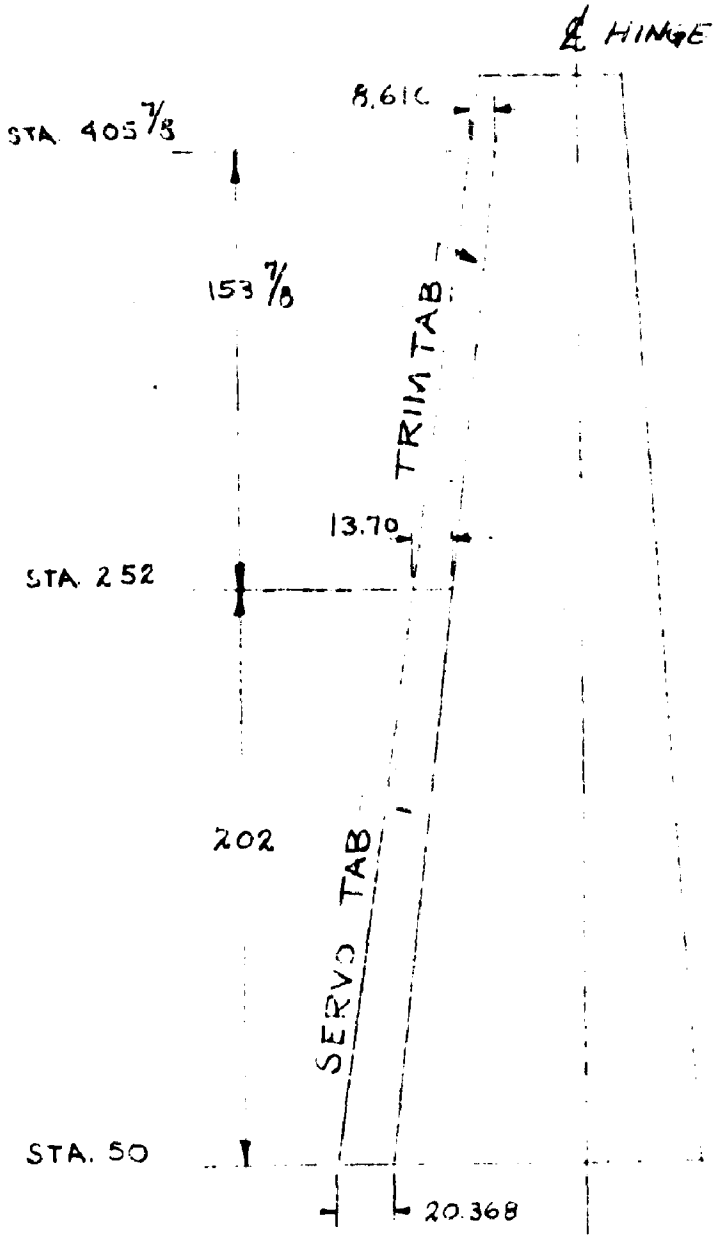
Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE
REPORT NO. FW-36-240
MODEL XB-38
DATE 10-23-41

ELEVATOR

SERVO AND TRIM TABS PLANFORM

REFERENCE DWGS. SERVO TAB 38T4830
TRIM TAB 38T4790



TRIM TAB
AREA = 11.92 SQ.FT.

SERVO TAB
AREA = 23.89 SQ.FT

ELEVATOR

BALANCE [illegible]

TRIM JACK LOADS

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

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

.3098 = DENSITY CORRECTION @ 35000'

A = 11.92 SQ FT

= .0012 × 396² × .3098 × 15

= 87.45 #/0' (ULTIMATE)

= 87.45 × 11.92

= 1042.4# (ULTIMATE)

[illegible]

BA[illegible] CONT[illegible]

AVERAGE UNIFORM LOAD FOR [illegible] TAB [illegible]
AND TRIM TAB [illegible]

STA 432.5 TO 405 ⅞

NET ELEVATOR LOAD = 8913# (REF. P 11)

AV. UNIFORM LOAD = $\frac{8913}{231.47 \times 144}$ = .260647 #/SQ. IN.

AVERAGE UNIFORM LOAD FOR TRIM TAB [illegible]

STA 405 ⅞ TO 252

TRIM TAB LOAD = $\frac{87.45}{144}$ = 0.00[illegible]727 #/□"

AV. TRIM TAB AIR LOAD = .0[illegible]727 X .1562 = .014356 #/□"

FROM PRESSURE DISTRIBUTION AV.
TRIM TAB [illegible] (REF P44) = $\frac{15}{2}$ X .1562 X $\frac{1}{144}$ = .008135 #/□"

NET AV. LOAD ON ELEV. = .260647 - (.014856 [illegible])

= .173426 #/SQ IN.

AVERAGE UNIFORM LOAD FOR TRIM TAB AGAINST

STA 405 ⅞ TO 252

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

TRIM TAB REACTIONS

STATION	UNIF. LOAD REACTION	RATIO	REACTIONS TAB AGAINST	RATIO	REACTIONS TAB WITH
405.875	94.[illegible] #	1042.4 / 100[illegible]	98.2 #	.086721 / .094856	89.8 #
36[illegible]	287.[illegible] #	↑	299.4 #	↑	273.7 #
324.000	201.[illegible] #		210.0 #		192.0 #
288.000	306.4 #	↓	319.8 #	↓	292.4 #
252.000	1[illegible] #	1042.4 / 100[illegible]	115.0 #	.086721 / .094856	105.1 #

ELEVATOR

BALANCING CONDITION

SERVO TAB REACTIONS

SERVO TAB LOAD - TRIM TAB WITH 1365.6# (REF P 28)

SERVO TAB LOAD - TRIM TAB AGAINST 41.6# (REF P 30)

STATION	UNIT REACTIONS 1000# LOAD	SERVO TAB REACTION TRIM TAB WITH	SERVO TAB REACTIONS TRIM TAB AGAINST
252.0	97.4	133.0	4.05
192 3/8	286.1	390.7	11.90
145 1/8	204.5	279.3	8.51
100 3/8	254.1	347.0	10.57
60 1/8	158.3	216.2	6.59

[illegible] (1) TABLES 4 TO 7
PAGES 28 TO 31

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

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

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

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

$= \frac{86.39 - 31.00}{100}$

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

TABLE 4

STATION	DISTANCE FROM TIP	CHORD	K	LOAD AT STATION	AVERAGE LOAD BETWEEN STATIONS	% OF INTERVAL TO C.P.	DISTANCE BETWEEN STATIONS	$\bar{X}$	LOAD FROM ELEVATOR	ARM	TORQUE FROM ELEVATOR	EFFECTIVE TAB LOAD	ARM	TORQUE FROM TAB	STICK FORCE ABOUT HINGE
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			(REF P16)	3 × 4				7 × 8	6 × 8	-.0478 · 3 (REF. P27)	10 × 11		75537×③ (REF. P27)	13 × 14	
432.5	0	47.976	.260647	13.026											0
	6.557	51.323	↓		13.376	.5044	13.[illegible]	6.551	173.4	-2.45	-426				
419.5	13.000	52.656		13.725											-426
	19.872	54.072	↓		14.091	.5044	13.625	6.872	192.0	-2.58	-495				
405.875	26.625	55.464	.260647 .173426	14.457 9.617								89.8	-30.722	-2759	-921 -3680
	34.702	57.151	↓		9.434	.5048	16.000	8.077	153.4	-2.73	-434				
389.875	42.625	58.762		10.220											-4114
	51.645	60.622			10.541	.5048	17.875	9.023	188.4	-2.90	-546				
372.0	60.500	62.447		10.861											-4660
	66.475	63.673			11.074	.5032	11.875	5.975	131.5	-3.04	-400				
360.125	72.375	64.395		11.237								273.7	-35.945	-9838	-5060 -14898
	81.461	66.768			11.610	.5048	18.000	9.086	209.0	-3.19	-667				
342.125	90.375	68.606		11.932											-15565
	99.510	70.433			12.257	.5040	18.125	9.135	222.2	-3.37	-749				
324.0	108.500	72.341		12.582								192.0	-40.070	-7693	-16314 -24007
	117.572	74.211			12.905	.5040	18.000	9.072	232.3	-3.55	-825				
306.0	126.500	76.051		[illegible]											-24832
	135.572	77.921			13.550	.5040	18.000	9.072	243.7	-3.72	-907				
288.0	144.500	79.762		13.873								[illegible]2.4	-44.180	-12913	[illegible] -18027
	153.572	81.632			14.196	.5040	18.[illegible]	9.072	255.5	-3.90	-996				
	171.[illegible]	85.337	↑		14.841	.5[illegible]	18.000	9.058	267.1	-4.[illegible]	-1090				
252.0	180.500	87.152	.173426	15.163								105.1	-48.290	-5075	[illegible]
252.0	180.500	87.152	.260647 + K₂	22.724											
	236.302	98.685	↕		25.074 + [illegible]	.5187	[illegible]	55.8[illegible]	[illegible]	4.76	[illegible]				
144.42	292.088	109.358		28.504								-[illegible]	-[illegible]	[illegible]	-58[illegible] + 2.[illegible] .3324 + 58.275 K
	336.583	119.356			31.041 + [illegible]	.5187	14.470	[illegible]	[illegible]	[illegible]	[illegible]				
50.0	382.500	128.321	.260647 + K₂	[illegible]											-15551 + 55.324 K

K₂ = .000.4582

Σ F = [illegible] + 55.[illegible] K = 0

K = 75554 / 55.324 = 1365.6#

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

DETERMINATION OF ELEVATOR HINGE MOMENTS
BALANCING CONDITION – TRIM TAB LOAD IN DIRECTION OF AIRLOAD

TABLE 5

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	Σ 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 8	.0478 3	10 x 11		+5539.3	13 x 14	10 + 15
252	0	87.136	.323187	28.16								-133.0	-45.293	6423	-45818 / -39395
	10.076	89.659			28.85	.5035	20	10.076	577.0	-4.27	-2464				
232	20.000	91.304		29.51											-41859
	30.072	93.381			30.13	.5036	20	10.072	603.6	-4.46	-2692				
212	40.000	95.427		30.84											-44551
	49.153	97.438			31.41	.5034	19.375	9.753	612.1	-4.66	-2843				
192.625	59.375	99.421		32.13								-390.7	-55.069	21515	-47394 / -25879
	67.417	101.079			32.67	.5026	16	8.042	522.7	-4.83	-2525				
176.625	75.375	102.719		33.20											-28404
	83.417	104.377			33.73	.5026	16	8.042	539.7	-4.99	-2693				
160.625	91.375	106.017		34.26											-31097
	99.162	107.622			34.78	.5024	15.5	7.737	539.1	-5.14	-2771				
145.125	106.875	109.212		35.30								-274.3	-60.493	16596	-33869 / -16972
	112.959	110.466			35.70	.5018	12.125	6.094	432.9	-5.28	-2286				
133	119.000	111.711		36.10											-19258
	127.984	113.563			36.70	.5026	17.875	8.984	656.0	-5.43	-3562				
115.125	136.875	115.396		37.29											-22820
	[illegible]	[illegible]			[illegible]	[illegible]	14.5	7.290	547.8	-5.59	-3002				
100.625	151.375	118.358		38.26								-341.0	-65.573	22154	[illegible] / -3123
	157.893	119.230			38.64	.5018	13	6.523	503.0	-5.72	-2877				
[illegible]		[illegible]		[illegible]											-6005
	170.599	122.409			[illegible]	[illegible]	[illegible]	[illegible]							
74.625	177.575	123.744		39.79											-9014
	184.653	125.244			40.48	.5017	14.5	7.275	567.0	-5.99	-3516				
60.125	191.875	126.733		40.96								-216.2	-70.197	15177	-12530 / 2647
	196.951	127.731			41.29	.5013	10.125	5.076	418.1	-6.11	-2555				
50	202.0??	128.526	.323187	41.63											92
															v.
															0

[illegible] 0.00458 (355.6) = .323187

CONSOLIDATED-VULTEE AIRCRAFT CORP.
FT. WORTH DIV. FT. WORTH, TEX.
REPORT: FZS-36-[illegible]
PREPARED BY: LANZARA
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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	X/I OF INTERVAL TO C.P.	DISTANCE BETWEEN STATIONS	X̄	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 8	.0478 x 3 (REF. P27)	10 x 11		.5531 x 3 (REF. P27)	13 x 14	16 + 15	
432.5	0	49.976	.260647	13.03											0	
	6.557	51.325	↓		13.55	.5044	13.[illegible]	6.557	173.9	-2.45	-426					
419.5	13.000	52.050		13.92											-426	
	19.872	54.072	↓		14.09	.5044	13.625	6.872	192.0	-2.59	-495					
405.875	26.625	55.464	.260647 / .355503	14.46 / 19.72								-78.2	-30.722	3017	-921 / 2096	
	34.70%	57.129			[illegible]	.5048	16.[illegible]	8.077	325.0	-2.73	-887					
389.875	42.625	58.762		20.59											1201	
	51.648	60.622			21.55	.5048	17.875	9.023	385.2	-2.90	-1117					
372.0	60.500	62.447		22.20											92	
	66.475	63.678			22.64	.5032	11.875	5.975	268.1	-3.04	-817					
360.125	76.575	64.895		23.07								-244.4	-35.945	10762	-725 / 10037	
	81.461	66.768			23.73	.5048	18.000	9.086	427.1	-3.19	-1362					
342.125	90.375	68.605		24.39											8675	
	99.510	70.438			25.06	.5040	18.125	9.135	454.2	-3.37	-1531					
324.0	108.500	72.341		25.72								-210.0	-40.070	8415	7144 / 15559	
	117.572	74.211			26.38	.5040	18.000	9.072	474.8	-3.55	-1686					
306.0	126.500	76.051		27.04											13873	
	135.572	77.921			27.70	.5040	18.000	9.072	498.6	-3.77	-1880					
288.0	144.500	79.766		28.36								-319.8	-44.180	14129	[illegible]	
	153.572	81.032			27.92	.5040	18.000	9.072	522.4	-3.40	[illegible]					
270.0	162.500	83.472		29.09											24110	
	[illegible]	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
252.0	180.500	87.182	.355503	30.99								115.0	48.290	5553	21383 / 27436	
252.0	180.500	97.182	.260647 - K_L	25.77 / [illegible]												
	236.3[illegible]	98.655	↓		25.67 / -[illegible]450ℓ	.5187	107.5[illegible]	55.8[illegible]	[illegible]	4.12	[illegible]					
144.125	255.000	107.358		28.[illegible] / [illegible]								[illegible]	-60.573	-60.573ℓ	19732 + 2.297ℓ / 14162	-53.284ℓ
	336.505	111.356	↓		31.4 / [illegible]	.5159	14.400	48.[illegible]	[illegible]	-5.71	[illegible]					
50.0	[illegible]	123.[illegible]	.260649 - K_L	[illegible]											-[illegible]	55.343ℓ

K_L = .0000453 ℓ

[illegible] + [illegible] + 55.343ℓ = 0

ℓ = [illegible] / 55.343

REPORT: FZS-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	$\bar{x}$	LOAD FROM ELEVATOR	ARM	TORQUE FROM ELEVATOR	SERVO TAB REACTION	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
				3 × 4				7 × 8	6 × 8	[illegible]	10 × 11		+5539×(3)		
252	0	87.182	.2627	22.90								-4.05	-48.290	196	27486 27[illegible]
	10.076	89.251			23.45	.5039	20	10.076	469	-4.27	-2003				
232	20.000	91.304		23.99											25624
	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	-55.061	655	21125 21153
	67.417	101.071			26.55	.5026	16	8.042	425	-4.83	-2053				
176.625	75.375	102.719		26.98											14730
	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	-2[illegible]57				
145.125	106.875	[illegible]		28.69								-8.51	-60.493	515	15283 15805
	114.159	110.466			29.07	.5018	12.125	6.084	352	-5.28	-1859				
133	119.000	111.711		29.35											13944
	127.484	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	-5.57	-2498				
100.625	151.375	118.385		31.10								-10.57	-65.573	698	8562 7255
	157.913	119.730			31.45	.5018	13	6.523	404	-5.72	-2339				
87.625	164.375	121.065		31.80											6916
	170.893	122.401			32.16	.5018	13	6.523	415	-5.85	-2443				
[illegible]	177.375	[illegible]		[illegible]											4411
	184.653	125.244			32.90	.5019	14.5	7.278	477	-5.99	-2857				
60.125	191.875	126.735		33.29								-6.59	-70.177	463	1614 2077
	196.931	127.735			33.57	.5015	10.125	5.076	340	-6.11	-2077				
50	202.000	128.320	.2627	33.84											0 vs 0

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

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

[illegible] BALANCING [illegible] LOAD [illegible] TORQUE [illegible] AIR [illegible]

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
		Σ COL ⑩	Σ COL. 13		3+4+5	16 × ② (STA 50 TO 372 ONLY)		6 × 7	8 + 9
		REF. P28&29	REF. P28&29	REF. P15					
432.5	49.976				0	2.5	0	0	0
		173.4							
419.5	52.656				173.4	2.5	-426	435	9
		192.0							
405.875	55.464		89.8		368.4 / 455.7	2.5	-921 / -3680	915 / 1139	-6 / -2541
		159.9							
389.875	58.762				614.6	2.5	-4114	1537	-2577
		188.4							
372.0	62.447			-2011.8	803.0 / -1208.8	2.5 / -9.992	-4660	2008 / 12078	-2652 / 7418
		131.5							
360.125	64.895		273.7		-1077.3 / -803.6	-10.383	-5060 / -14649	11186 / 8343	6126 / -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	-16314 / -14007	4311 / 2088	-12003 / -21919
		232.3							
306.0	76.051				51.9	-12.168	-24832	-632	-25464
		243.9							
288.0	79.762		292.4		295.8 / 588.2	-12.762	-25739 / -38657	-3775 / -7506	-29514 / -46163
		255.5							
270.0	83.472				843.7	-13.356	-39153	-11268	-50421
		[illegible]							
252.0	87.182		[illegible] / -133.0	-3108.7	1215.4 / -2025.8	-13.94	-40743 / -39395	-16961 / 28257	-57704 / -11138
		577.0							
232.0	91.304				-1448.8	-14.609	-41859	21166	-20693
		603.6							
212.0	95.427				-845.2	-15.268	-44551	12905	31646
		610.1							
192.625	99.421		-340.7		-235.1 / -625.8	-15.907	-47594 / -25879	3740 / 9955	-43654 / -15924
		522.7							
176.625	102.719				-103.1	-16.435	-28404	1694	-26710

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
		Σ COL ⑩	Σ COL ⑬		3+4+5	16×②		6 × 7	8 + 9
		REF. P28&29	REF. P28&29	REF. P15					
176.625	102.719				-103.1	-16.435	-28404	1694	-26710
		531.7							
160.625	106.017				436.6	-16.963	-31097	-7406	-38503
		539.1							
145.125	109.212		-279.3		975.7 / 696.4	-17.474	-33869 / -16972	-17049 / -12169	-50918 / -29141
		432.9							
133.0	111.711			-2150.4	1129.3 / -1021.1	-17.874	-19258	-20185 / 18251	-39443 / -1007
		656.0							
115.125	115.396				-365.1	-18.463	-22820	6741	-16079
		547.9							
100.625	118.385		-347.0		182.7 / -164.3	-18.942	-25882 / -3128	-3461 / 3112	-29343 / -16
		503.0							
87.625	121.065				338.7	-19.370	-6005	-6561	-12566
		514.3							
74.625	123.744				853.0	-19.799	-9014	-16889	-25903
		587.0							
60.125	126.753		-216.2		1440.0 / 1223.8	-20.277	-12830 / 2647	-29199 / -24815	-41729 / -22168
		418.1							
50	128.560			-1642.0	1641.9 / -.1	-20.611	92	-33841 / 0	-33749 / 0
					VS 0				

REPORT: FZS-36-246
PREPARED BY: LANZARA
CHECKED BY: ZINBERG
MODEL: XB-36
DATE: 10-20-47

DETERMINATION OF ELEVATOR [illegible]

[illegible]

TABLE 9 — PAGE 33

STATION	TORQUE	2A	q_t	SPAR DEPTH	SHEAR	q_s	SPAR SHEAR FLOW Σq
1	2 REF. COL. ⑩ P 32	3	4 2/3	5 REF. [illegible]	6	7 6/5	8 7 − 4
432.5	0	0	[illegible]	0	0	0	[illegible]
419.5	4	218	0	8.05	173.9	21.6	[illegible]
405.875	-6 -2541	255	-0 -8.8	9.50	365.4 155.1	38.5 42.0	38.5 56.8
384.875	-2577	370	-7.0	11.25	614.0	54.6	61.6
372.0	2652 7418	46.2 104.52	-5.7 71.0	12.00 9.25	863.0 -1260.8	71.9 -130.6	66.7 [illegible]
360.125	6126 -6555	114	-53.7 -57.5	9.65	-1077.8 -803.0	-111.6 -83.2	[illegible] -22.8
342.125	-9038	[illegible]	-64.5	10.2	-594.6	-58.3	11.2
324.0	-12003 -21919	[illegible]	-67.2 -150.1	10.75	-342.1 -180.4	-34.6 -16.8	37.6 33.3
306.0	-25454	[illegible]	-151.2	11.3	51.9	4.6	155.8
288.0	-29514 -46165	177	-166.7 -260.8	11.8	475.8 588.2	25.1 44.6	191.8 305.6
270.0	50421	194	-262.5	12.4	843.7	68.0	330.5
252.0	-57714 -11130	210.96	-274.0 -52.8	12.95	1013.4 -2025.[illegible]	78.9 -156.4	352.7 -103.6
232.0	-20095	230	-40.0	13.55	-1445.[illegible]	-106.7	-66.7
212.0	-31646	251	-126.1	14.2	[illegible]	-54.5	61.6
192.625	-43054 -15924	272	[illegible]	14.8	[illegible]	-17.9 -12.3	144.0 16.2
170.25	-20110	271	-71.8	15.3	[illegible]	-6.7	[illegible]

STATION	TORQUE	2A	q_t	SPAR DEPTH	SHEAR	q_s	SPAR SHEAR FLOW Σq
1	(2) REF. COL. ⑩ P 32	3	4 2/3	5	6	7 6/5	8 7 − 4
160.625	-88503	311	-123.8	15.15	430.6	27.7	151.5
145.125	-50418 -29141	330	-152.8 -88.3	16.25	975.7 696.4	60.0 42.9	214.3 131.2
133.0	-39442 -1007	346.6	-113.7 -2.9	16.65	1129.3 -1021.1	67.8 -61.3	181.5 -58.4
118.125	-16079	372	-43.2	17.2	-365.1	-21.2	22.0
100.625	-29443 -16	392	-74.4 0	17.6	182.7 -164.3	10.4 -9.3	85.8 -9.3
87.625	-12566	410	-30.6	18.05	338.7	18.8	49.4
74.625	-25103	425	-60.5	18.45	853.0	46.2	106.7
60.125	-41729 -22168	450	-92.7 -49.3	18.4	1440.[illegible] 1223.5	76.2 64.8	168.9 114.1
50.0	-33749 0	465.12	-72.6 0	17.75	1641.9 0	85.3 0	157.9 0

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

DETERMINATION OF ELEVATOR TORSION [illegible]
BALANCING [illegible] 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
1	2	3	4	(5)	6	7	8	9	10
		Σ COL. 10 REF. P30(3)	Σ COL. 13 REF. P30(3)		3 + 4 + 5	.16 × (2) (STA. 50 TO 372 ONLY)		6 × 7	8 + 9
432.5	49.976				0	2.5	0	0	0
		174							
419.5	52.656				174	2.5	-426	435	9
		192							
405.875	55.469		-98		366 / 268	2.5	-921 / 2096	915 / 670	-6 / 2766
		325							
389.875	58.762				593	2.5	1209	1483	2692
		385							
372.0	62.447			-2012	978 / -1034	2.5 / -9.992	92	2445 / 10332	2537 / 10424
		269							
360.125	64.895		-299		-765 / -1064	-10.883	-725 / 10037	7942 / 11048	7217 / 21085
		427							
342.125	68.605				-637	-10.977	8675	6992	15667
		454							
324.0	72.341		-210		-183 / -393	-11.575	7144 / 13559	2118 / 4549	9262 / 20108
		475							
306.0	76.051				82	-12.168	13873	-998	12875
		499							
288.0	79.762		-320		581 / 261	-12.762	12613 / 26147	-7415 / -3331	+4603 / 22816
		522							
270.0	83.472				783	-13.356	24110	-10458	13652
		546							
252.0	87.182		-115 / -4	-3109	1329 / -1899	-13.949	21833 / 27692	-18535 / 26459	3345 / 54121
		469							
232.0	91.304				-1430	-14.609	25621	20891	46520
		491							
212.0	95.427				-939	-15.268	23431	14336	37715
		496							
192.625	99.421		-12		-448 / -455	-15.907	21128 / 21783	7047 / 7238	28175 / 29021
		425							
176.625	102.714				-30	-16.435	19730	493	20223

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
								6 × 7	(8) + 9
176.625	102.719				-30	-16.435	19730	493	20223
		439							
160.625	106.017				409	-16.963	17539	-6938	10601
		438							
145.125	109.212		-8		847 / 839	-17.474	15289 / 15803	-14805 / -14661	483 / 1142
		352							
133.0	111.711			-2150	1191 / -959	-17.874	13944	-21288 / 17141	-7344 / 31085
		533							
115.125	115.346				426	-16.463	11050	7865	18915
		445							
100.625	118.385		-11		19 / 8	-18.942	8562 / 9255	-360 / -152	8202 / 9103
		409							
87.625	121.065				417	-19.370	6916	-8077	-1161
		418							
74.625	123.744				835	-19.799	4471	-16532	-12061
		471							
60.125	126.733		-7		1312 / 1305	-20.277	1614 / 2677	-26603 / -26461	-24989 / -24384
		340							
50	128.825			-1642	1645 / 3 vs 0	-20.611	0	-33905 / -62	-33906 / 0

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

STATION	TORQUE	2A	q_T	SPAR DEPTH	SHEAR	q_s	SPAR SHEAR FLOW Σq
1	2 REF. COL. [illegible] P. 34	3	4 2/3	5 REF. [illegible]	6 REF. [illegible]	7 6/5	8 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	6 2766	288	0 9.6	9.50	366 269	38.5 25.2	38.5 16.6
384.875	2692	370	7.3	11.25	593	52.7	45.4
372.0	2337 10424	402 404.52	5.5 49.7	13.20 9.25	475 -1034	74.1 -111.7	68.6 -211.4
360.125	7219 21035	114	63.3 185.0	9.65	-705 -1064	-79.3 -111.3	-142.6 -245.3
342.125	15667	130	120.5	10.2	-637	-62.5	-183.0
324.0	9262 20108	146	63.4 137.7	10.75	-183 -393	-17.0 -36.6	-80.4 -174.3
306.0	12875	160	80.5	11.3	82	7.3	-73.2
288.0	4607 22616	177	26.0 128.9	11.8	537 261	47.2 22.1	23.2 -106.8
270.0	18652	194	70.4	12.2	793	63.1	-7.3
252.0	3345 54121	210.96	15.9 256.5	12.75	1329 1777	[illegible] -140.6	86.9 -403.1
232.0	46920	230	202.3	13.35	-1430	[illegible]	-307.8
212.0	37775	251	150.5	[illegible]	-737	-66.1	-216.6
190.625	28175 39021	272	103.6 [illegible]	14.5	-443 -457	[illegible]	-136.2 -174.4
176.625	20223	291	69.5	[illegible]	-30	[illegible]	-71.5

STATION	TORQUE	2A	q_T	SPAR DEPTH	SHEAR	q_s	SPAR SHEAR FLOW Σq
1	2	3	4 2/3	5	6	7 6/5	8 7 − 4
160.625	10601	311	34.1	15.15	409	26.0	-8.1
145.125	458 1142	330	1.5 3.5	16.25	841 834	53.1 51.6	50.6 48.1
133.0	7344 31095	346.8	-21.2 89.6	16.05	1191 -939	71.5 -57.6	92.7 -147.2
115.125	13915	372	50.3	17.2	-426	-24.9	-75.6
100.625	8202 9103	392	20.9 23.2	17.6	19 3	1.1 .5	-19.8 -22.7
[illegible]	-1161	410	-2.8	18.05	417	23.1	25.9
74.625	-12061	428	-29.2	18.45	835	45.2	73.4
[illegible].125	-24989 -24384	[illegible]	-55.5 -54.2	18.9	1312 1306	69.4 69.0	124.9 123.2
50	-33905 0	465.12	-72.9 0	19.25	1645 0	85.5 0	158.4 0

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

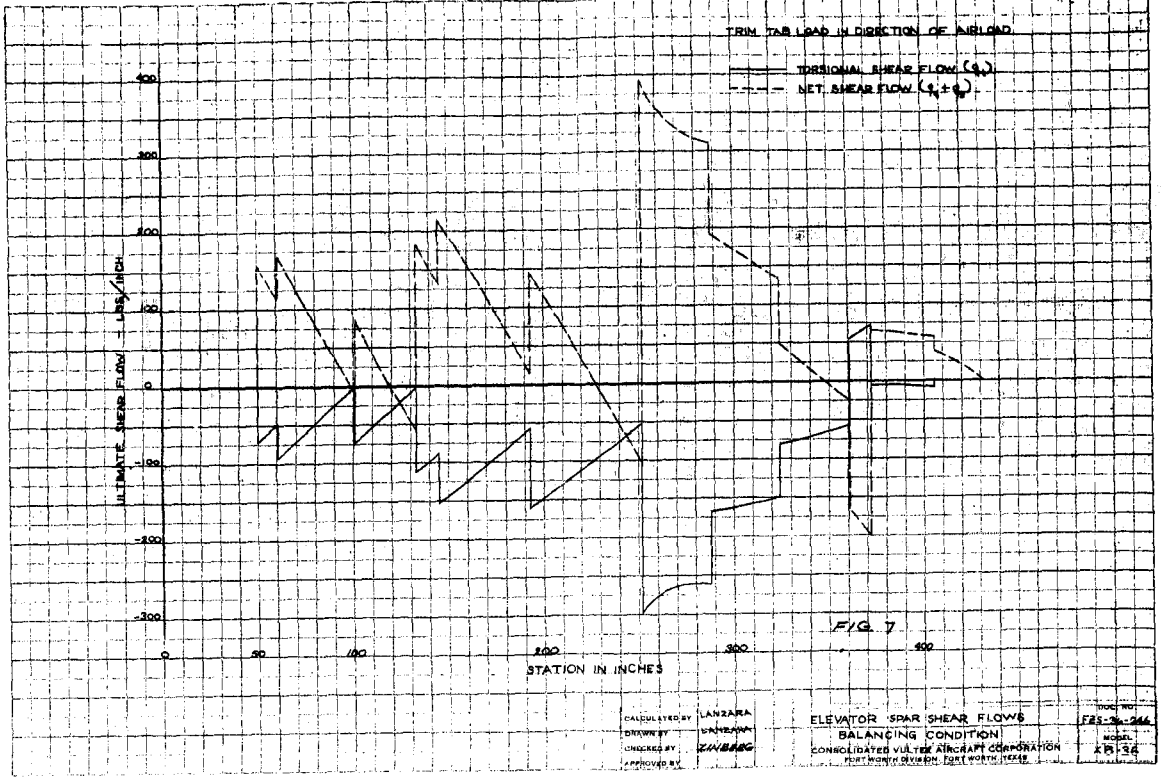
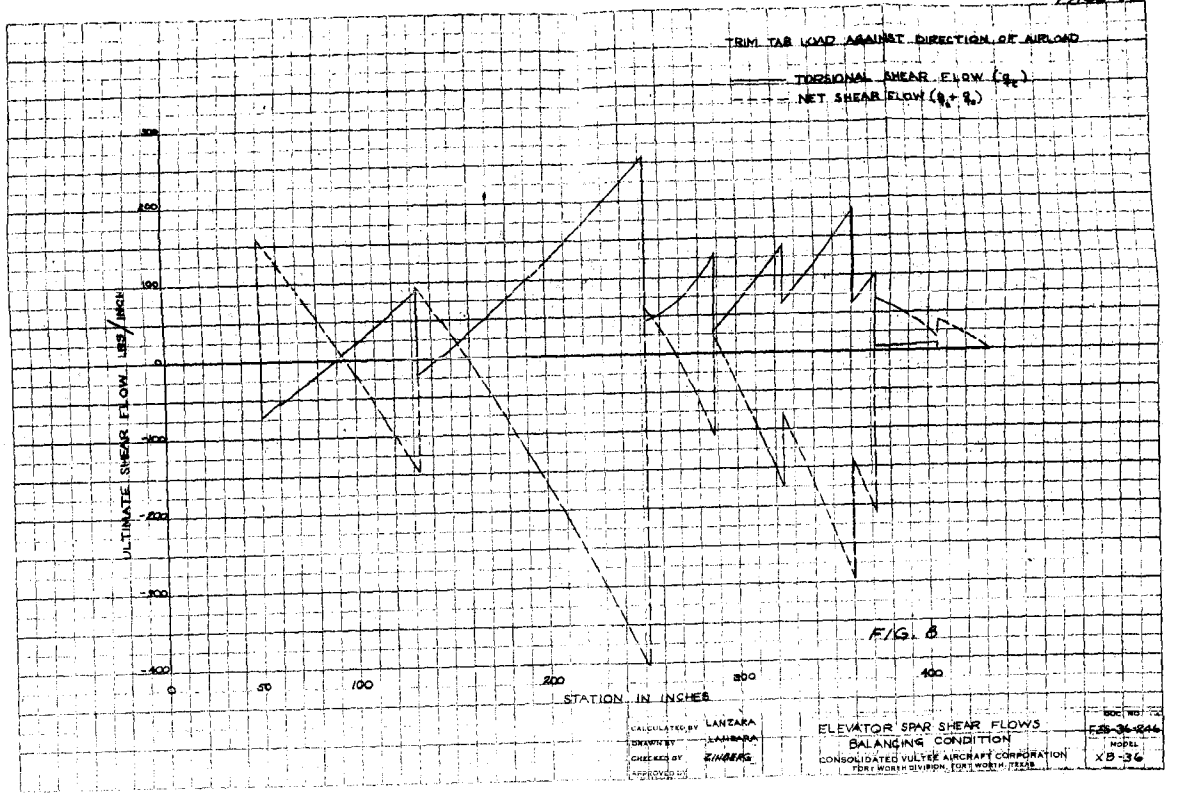


FIG. 7

CALCULATED BY LANZARA
DRAWN BY LANZARA
CHECKED BY ZWIBACK
APPROVED BY

ELEVATOR SPAR SHEAR FLOWS
BALANCING CONDITION
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS

DOC. NO. FBS-5-246
MODEL XB-36



F/G. 8

CALCULATED BY LANZARA
DRAWN BY LANZARA
CHECKED BY ZIMBERG
APPROVED BY

ELEVATOR SPAR SHEAR FLOWS
BALANCING CONDITION
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS

DOC. NO. FDS-36-1246
MODEL XB-36

FIG. 9

ULT. TERMINAL SHEAR FLOW (kips)
STATION (INCHES)
TRIM TAB LOAD AGAINST DIRECTION OF AIRLOAD
TERMINAL SHEAR FLOW (kips)
NET SHEAR FLOW (kips)

FIG. 10

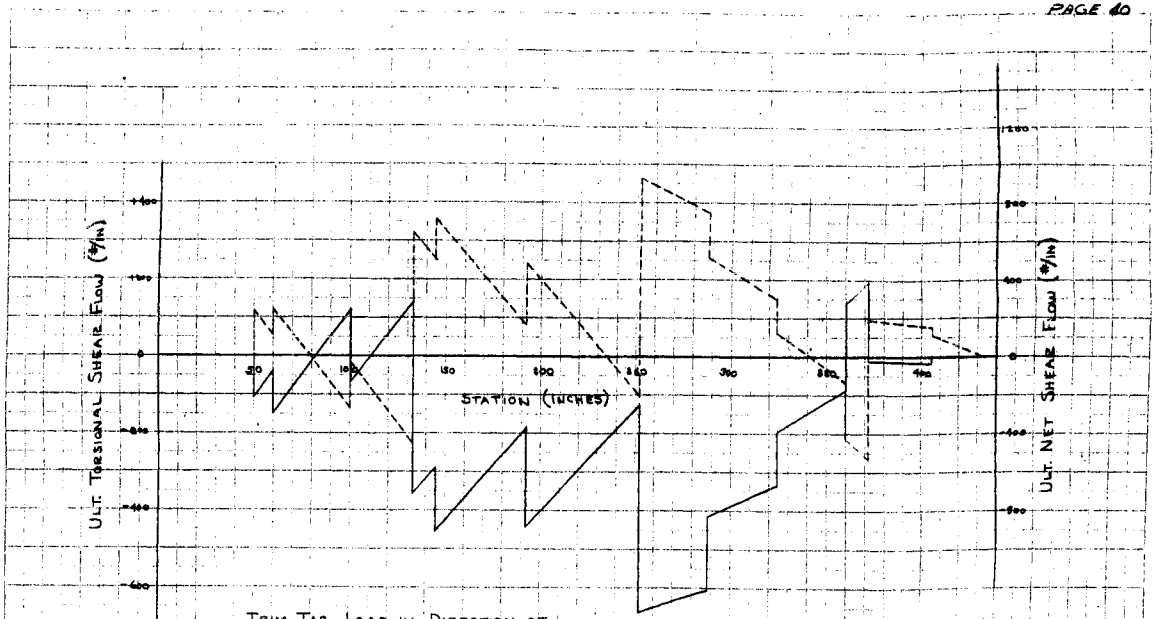
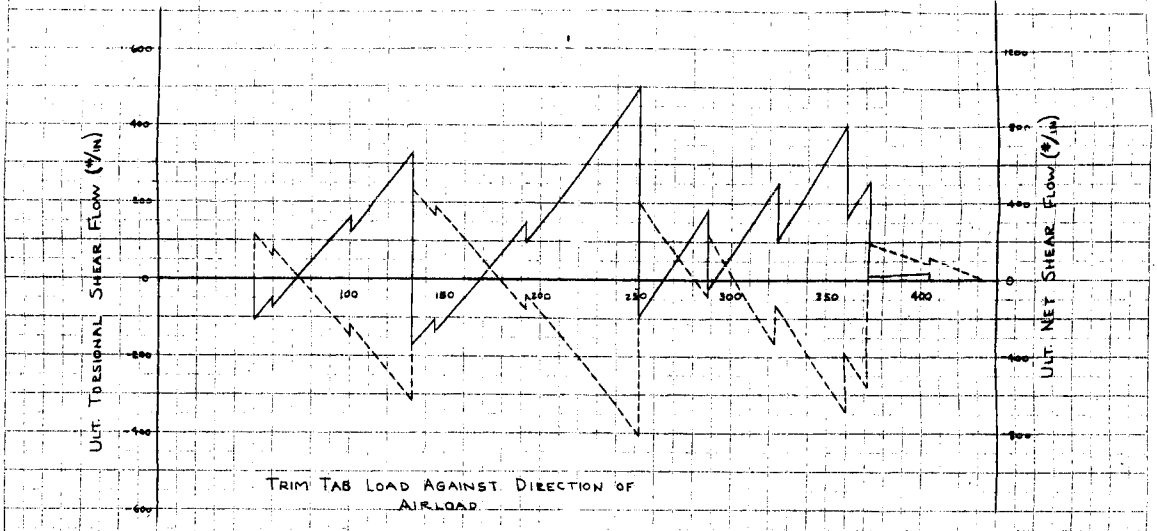


FIG. 11

CALCULATED BY	KOSIAK 4-16-47	ELEV. SPAR SHEAR FLOWS	DOC. NO. FZS-34-246
CHECKED BY	KOSIAK 4-17-47	MOST AFT CG - HS	MODEL XB-36
APPROVED BY	EMBERG	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION FORT WORTH, TEXAS	



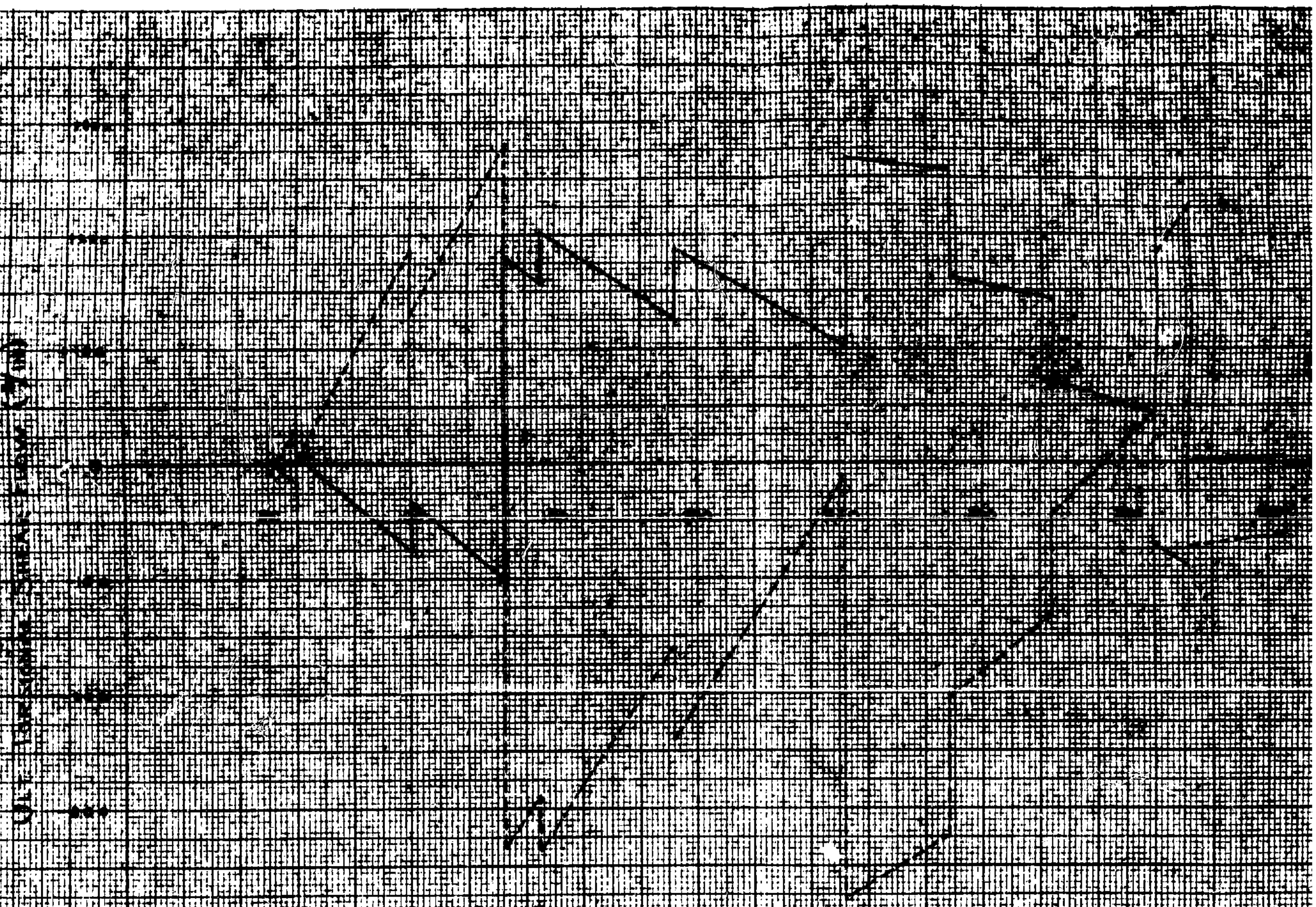
TRIM TAB LOAD AGAINST DIRECTION OF AIRLOAD

——TORSIONAL SHEAR FLOW (q_t)

– – – –NET SHEAR FLOW ($q_t + q_s$)

FIG 12

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



TRIM TAIL LOAD IN DIRECTION OF AIRLOAD

——— TORSIONAL SHEAR FLOW (q_t)

– – – NET SHEAR FLOW $(q_t + q_s)$

FIG. 18

ULT. TORSIONAL SHEAR FLOW (#/IN)
ULT. NET SHEAR FLOW (#/IN)
TRIM TAB LOAD AGAINST DIRECTION OF AIR LOAD
TORSIONAL SHEAR FLOW
NET SHEAR FLOW
ELEV. SPAR SHEAR FLOWS
MOST FWD C.G. - MAX

FIG. 14

ELEVATOR LOADS

1. TRIM TAB NEUTRAL .260647 X CHORD X SPAN
2. TRIM TAB WITH .178936 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 .6627 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 1.60788 X CHORD X SPAN~~

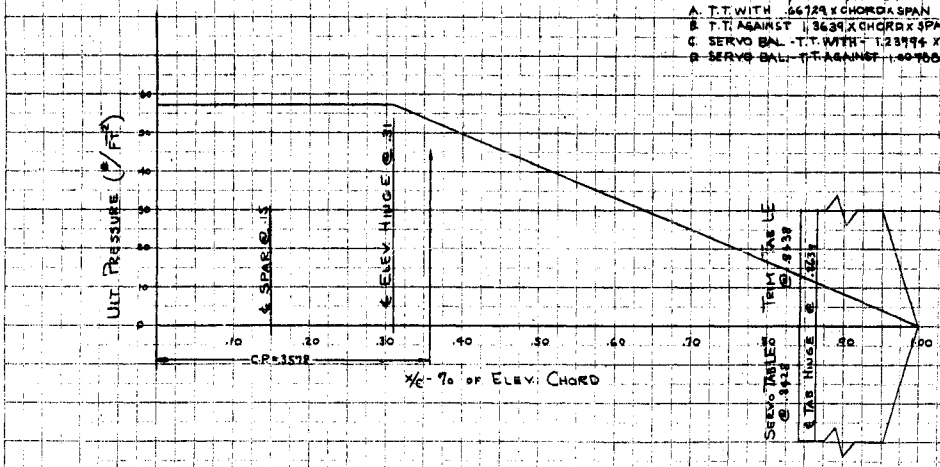


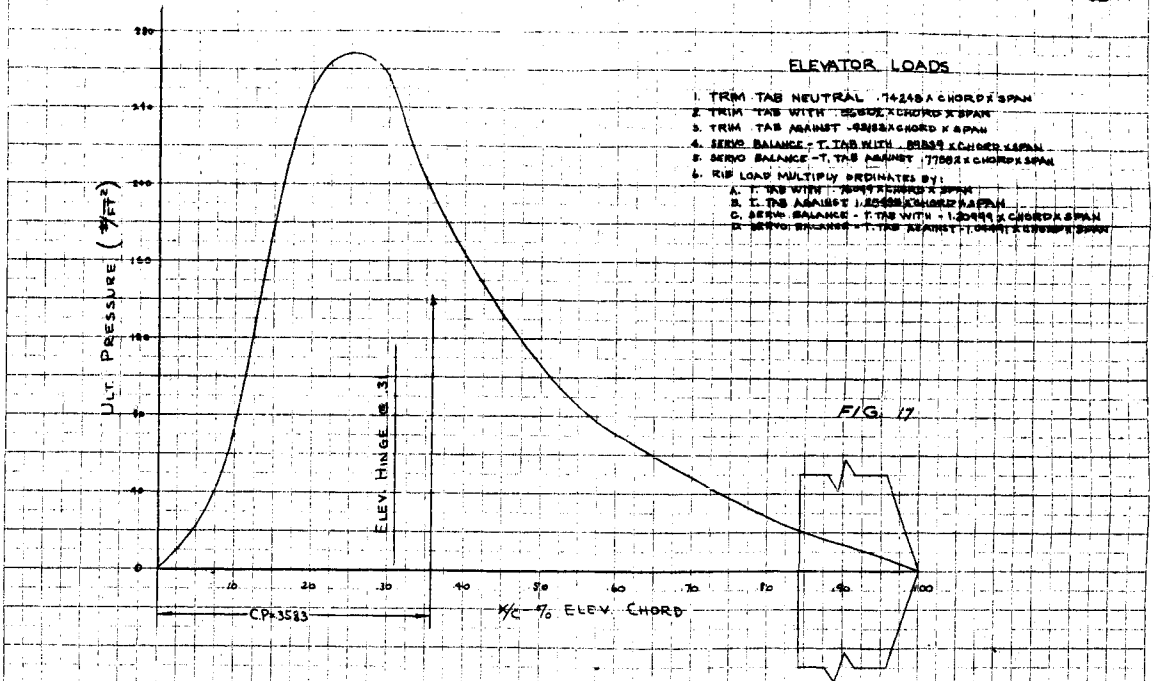
FIG. 15

ACCEPTED BY	KOSIAK 4-17-42	ELEV. PRESSURE DISTRIBUTION BALANCING CONDITION	DOC. NO. FES-36-216
DRAWN BY	KOSIAK 4-17-42	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB-36
CHECKED BY	[illegible]		
APPROVED BY			

ELEVATOR LOADS
ULTIMATE LOAD (#/sq. ft.)
% ELEVATOR CHORD
FIG. 12

ELEVATOR LOADS

1. TRIM TAB NEUTRAL .74218 x CHORD x SPAN
2. TRIM TAB WITH .65602 x CHORD x SPAN
3. TRIM TAB AGAINST -.49163 x CHORD x SPAN
4. SERVO BALANCE - T. TAB WITH .89339 x CHORD x SPAN
5. SERVO BALANCE - T. TAB AGAINST .77562 x CHORD x SPAN
6. RIB LOAD MULTIPLY ORDINATES BY:
   - A. T. TAB WITH .89339 x CHORD x SPAN
   - B. T. TAB AGAINST 1.20499 x CHORD x SPAN
   - C. SERVO BALANCE - T. TAB WITH 1.20999 x CHORD x SPAN
   - D. SERVO BALANCE - T. TAB AGAINST 1.04981 x CHORD x SPAN



CALCULATED BY	KOSIAK	ELEV. PRESSURE DISTRIBUTION MOST AFT C.G. - H.S.	DOC. NO. FTS36-246
DRAWN BY	KOSIAK	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB-36
CHECKED BY			
APPROVED BY			

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
PREPARED BY
CHECKED BY
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE
REPORT NO
MODEL
DATE

[illegible] SPAR

SUMMARY OF MAX. FLANGE LOADS & MARGINS OF SAFETY.

CONDITION I BALANCING CONDITION

II - [illegible]

III - MOST AFT [illegible] - H.S.

IV - MOST FWD. C.G. - 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		2947	I	7047	
88	1371	IV	7047		3545	II	7047	
16	2445	III	7295		5830	IV	7295	
107	9527	III	7295	+.32	8485	IV	11745	
114	10750	III	14735		11960	IV	11745	-.016
			HINGE OUTBOT					
147	15770	III	15685	-.006	12520	IV	13745	+.10
159	12552	III	13815	+.31	9965	IV	11955	
171	6226	III	7415	+.19	9415	II	11955	
183	1973	III	7415		5760	II	11955	
190	97	II	7415		8177	II	11955	
202	4990	III	7415		11750	II	11955	+.014
214	10053	III	7415		11590	II	11955	
220	7642	III	13015		11670	II	11955	
238	11725	III	16335		10990	II	14171	
			HINGE OUTBOT					
260	16570	III	17600	+.06	11140	II	12150	
279	12080	III	15420	+.22	11176	II	12150	
290	6720	III	12860		7720	II	12150	
302	3720	III	7700		7320	II	12150	
314	3513	III	7700		7257	II	7700	+.06
326	1771	III	7700		4641	II	7700	
334	2155	III	7700		4625	II	7700	
346	5283	III	7700		4544	II	7700	
358	11405	III	12150	+.06	5430	II	7700	

ELEVATOR [illegible]

WEB ANALYSIS

[illegible] 30 [illegible]

COND [illegible] I - BALANCING CONDITION
II - 1G BALANCE + GUST
III - MOST AFT C.G. - H.S.
IV - MOST FWD C.G. - H.R.K.

STATION	$q_s + q_e$	CRITICAL CONDITION	WEB t	f_s (PSI)
73	135	II	.020	64[illegible]
83	140	II	.020	70[illegible]
96	240	III	.025	96[illegible]
107	320	III	↓	12[illegible]
119	460	III		1[illegible]
147	680	III		272[illegible]
15[illegible]	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	147[illegible]
238	[illegible]30	III	.040	[illegible]750
266	960	III	.032	26[illegible]50
275	[illegible]00	III	↑	25000
290	500	III		15625
302	[illegible]	III		13450
314	43[illegible]	II		136[illegible]
326	230	II		5750
334	302	II		[illegible]440
340	470	III	↓	14100
3[illegible]	660	III	.032	20[illegible]

KEFER DWG 36T48

WEB ANALYSIS

WEB t = .025 (75ST) F_{tu} = 74000 #/in² F_s = 45000 #/in²

PANEL SIZE = 5.25" x 14.5

I_{UR} = .0776 in⁴

I_{UR} = .0764 in⁴

A_S = .0614 in² (FAM-45-250) STIFF

$$\lambda = bt\left[\frac{b^3}{72h}\left(\frac{1}{I_{tc}}+\frac{1}{I_{tt}}\right)+\frac{1}{A_s}\right]$$

λ = 2.17

τ = /25000 = .05

= 0.76 = 37°14'

.605 .796

τ_{cu} = 23500 #/in²

τ_{su} = 0.90 (1 -) F_s

τ_{su} = 37000 #/in²

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

STIFFENER

FAM-45-250

I_s = .00461 in⁴

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

I = .0049 in⁴

ANALYSIS ... PREPARED BY ... CHECKED BY ZINBERG REVISED BY

Consolidated Vultee Aircraft Corporation, FORT WORTH DIVISION, FORT WORTH, TEXAS

PAGE ... REPORT NO. FZ...-56... MODEL XB-36 DATE 10-29-47

ELEVATOR SPAR

REFER. DWG 36T4801

FLANGE RIVETS

PANEL STA $145\frac{3}{8}$ - STA $151\frac{1}{16}$

$N = 12 \;\; \frac{1}{8}$" RIVETS

S_{R} = 2 - $\frac{1}{8}$" RIVETS

$A_{...}/A_{R}$ = 2.0

S_{R} = ...

= 331 #/RIV.

$\frac{1}{8}$" RIV. ... BEARING ... = 321 #/RIV

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

= -.03

ELEVATOR SPAR
REFER [illegible], [illegible]

WEB ANALYS[illegible] STA. 266

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

WEB t = .032 (75ST) F_{tu} = 740[illegible] #/☐" F_{su} = 43000 #/☐"

PAN[illegible] [illegible] 5 X [illegible]

f_s = [illegible] #/☐"

f_{s_c} = 2360 #/☐"

I_{U} = .01052 IN⁴ (VS-72 ANGLE + 1¼ X .1275 SLOT)

I_{L} = [illegible] IN⁴ (VS 72 ANGLE + 1½ X .064 SLOT)

A_s = .043 IN² (FXK-45-X55) STIFF. BN 5 @ 1⅛"

I_s = .0004 IN⁴

$$\lambda = bt \left| \frac{b^3}{720h} \left(\frac{1}{I_{tc}} + \frac{1}{I_{t}} + \frac{1}{A_s} \right) \right|$$

λ = 1.795

f = f_s / 25000 = .0445

$\tan \alpha$ = 0.75 α = 37°53'

$\sin \alpha$ = .61520 [illegible] = .78839

$C_r = 1 - (A/R) \sin (90 - \alpha) + \frac{1}{4} \cos^2 (/ - \alpha)$

C_r 1.0 R_r = 0.80 R = 1.01

f_{s_u} = ($KE_r C_r$ [illegible] + f_s) [illegible]

f_{s_u} = 30,200 #/☐"

F_{s_u} = 0.90(1 − [illegible]) F_{su}

F_{su} = 34,100 #/☐"

M.S. = $\frac{302[illegible]}{26[illegible]}$ − 1

= +0.12

ELEVATOR SPAR

REFER DWG 36T4801

FLANGE RIVETS

PANEL STA. 264 TO STA 270

N = 10 5/32 RIVETS

S_{ec} = 2 1/8" RIVETS

$A_{5/32} / A_{1/8}$ = 2 × .01227 / .01915 = 1.28

S_{fl} = 5 × .032 × 3027

= 485 #/RIV

5/32" RIV. [illegible] ON .032 WEB (TEST) = 509#

M.S. = 509 / 485 − 1

= +0.05

STIFFENER

FXM-45-255

I_s = .00641 in⁴

S = hq = 10.5 × 300 = 1040 #

h = 10.5" D 5.0" t = .032

$I_{s(REQ)}$ REFER CURVE [illegible]

= .0035 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.

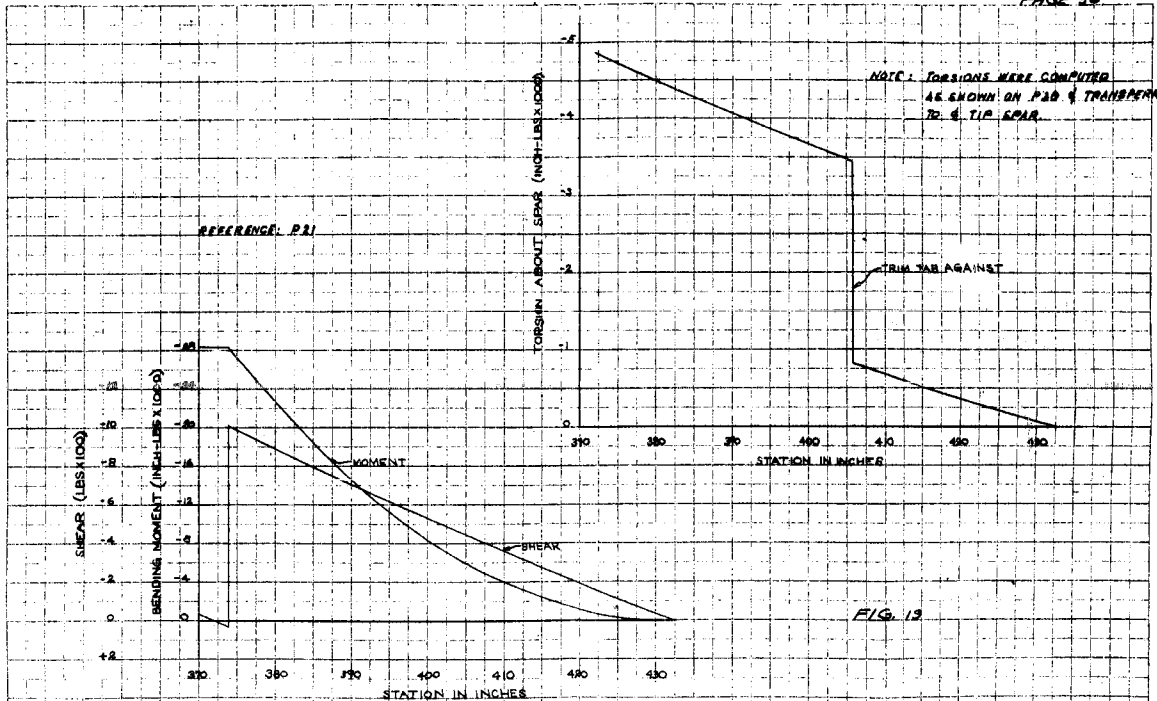


FIG. 13

CALCULATED BY	LANZARA	ELEVATOR TIP SPAR SHEAR, BENDING MOMENTS & TORSIONS M.G.T. FWD CG - HAA	DOC. NO. FZS-34-246
DRAWN BY	LANZARA		
CHECKED BY	ZIMBERG	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB-36
APPROVED BY			

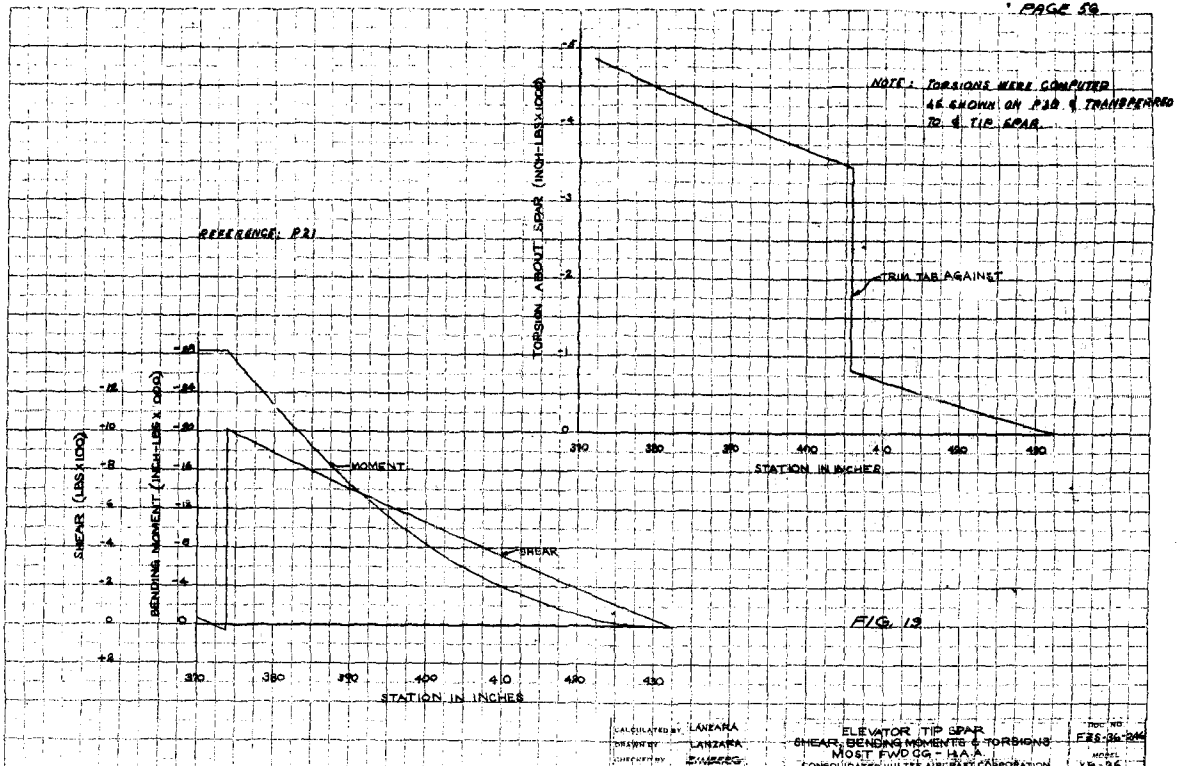

NOTE: TORSIONS WERE COMPUTED AS SHOWN ON P38 & TRANSFERRED TO ℄ TIP SPAR
REFERENCE: P21
TRIM TAB AGAINST
MOMENT
SHEAR
SHEAR (LBS X 100)
BENDING MOMENT (INCH-LBS X 1000)
TORSION ABOUT SPAR (INCH-LBS X 1000)
STATION IN INCHES
STATION, IN INCHES
CALCULATED BY LANZARA
DRAWN BY LANZARA
CHECKED BY
APPROVED BY
ELEVATOR TIP SPAR
SHEAR, BENDING MOMENTS & TORSIONS
MOST FWD CG - HAA
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS
MODEL
XB-36

FIG. 12

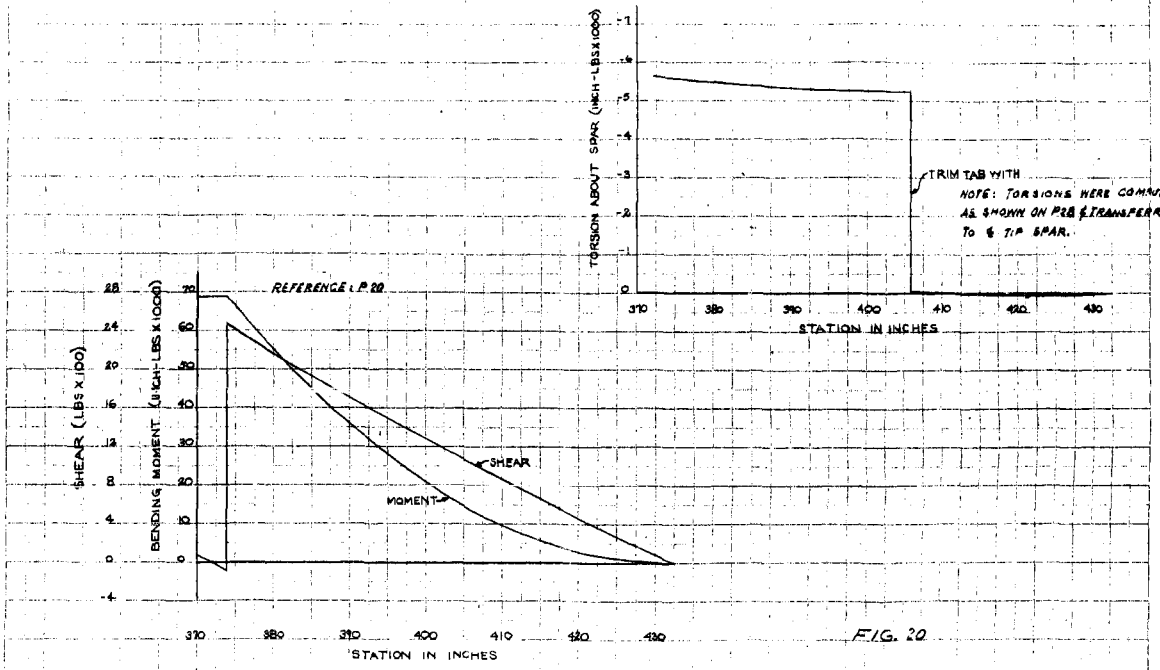


FIG. 20

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 FORT WORTH, TEXAS	DOC. NO. FZS-36-24 MODEL XB-36

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

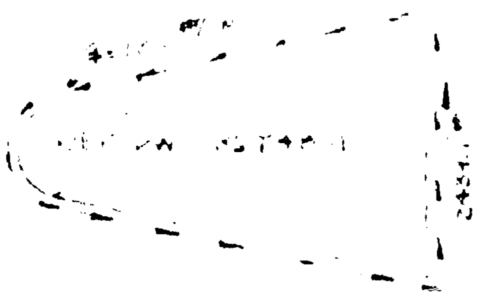
Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

REPORT NO. FZS-36-246
MODEL XB-36
DATE 10-20-47

[illegible]

[illegible]

STA [illegible] WEB AREAS



= [illegible] (REF [illegible] 57)

[illegible]

$q = \frac{[illegible]}{10.2}$

[illegible]

[illegible] SHEAR = 2434.0 #

SHEAR IN SPAR OUTBOARD STA 373 7/8
= 2434.1 + 11.5 x [illegible] = 2574.3 #

SHEAR IN SPAR INBOARD STA 373 7/8
= 2574.3 − 2521.1 = 53.2 #

SPAR PANEL OUTBOARD OF STA 373 7/8 IS CRITICAL

$q = \frac{2574.3}{10.2} = 252.2$ #/in

WEB t = .032 (75ST) F_{tu} = 74000 #/in² F_{su} = 43000 #/in²

PANEL SIZE = 4.3" x 10.2"

τ = 7390 #/in²

τ_{cr} = 3140 #/in²

$I_{UP} = I_{L}$ = .0044 in⁴ (EXTR 22544)

A_U = .0754 in² [illegible]

[illegible] $\left[\frac{4.3^3}{[illegible]} - \frac{1}{754} \right]$

λ = 2.2

k = [illegible]/25 [illegible]

[illegible] = [illegible] 15 [illegible]

[illegible] 71335

[illegible]

FW 444 6-46 UTILITY REPORT SHEET

ANALYSIS HORIZ. TAIL	**Consolidated Vultee Aircraft Corporation**	PAGE	71
PREPARED BY [illegible]	FORT WORTH DIVISION	REPORT NO.	[illegible]
CHECKED BY [illegible]	FORT WORTH, TEXAS	MODEL	XB-36
REVISED BY		DATE	10-22-47

EL[illegible] [illegible]

MOST [illegible]

[illegible] ANALYSIS [illegible] STA [illegible]

$[illegible]_K = [illegible] ([illegible]) + [illegible] (161)^2$

$[illegible] = .130 \quad [illegible] = .152 \quad [illegible] = 530$

$[illegible] \quad (42 \times .152 \times .85 \times [illegible] + 3[illegible]) [illegible] 779$

$[illegible] = 23[illegible] \ \#/[illegible]$

$[illegible] = 0.[illegible] (1 - [illegible]) + [illegible]$

$[illegible] = 3[illegible] \ \#/[illegible]$

M.S. = HIGH

FLANGE [illegible]

$$[illegible] = 4.3 \times .032 \sqrt{ \left(\frac{-7390}{9+2} [illegible] \right)^2 + \left(\frac{-7310 \times .767 - 3142}{1} \right)^2 }$$

$[illegible] = 1[illegible] \ \#/RIVET$

ALLOWABLE OF ½ RIVET ON .032 = 381#

M.S. = HIGH

[illegible]

[illegible] 42 [illegible]

$I_S = .00[illegible] IN^4$

$I_S (REQ) = [illegible] 0[illegible]5 IN^4$

STIFFENER IS [illegible] [illegible]TACTORY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

[illegible]

[illegible]

STATION [illegible]

[illegible] H = [illegible]

SHEAR = 2431 #

MOMENT = 68117 #

S_a = [illegible] + 1152 × [illegible] = 2579.2 #

S_b = [illegible] × [illegible] × [illegible] = 1025 #

[illegible] #

[illegible]

[illegible] #

F_{cy} = 44,200 #/in² (FZS-36-14 P105)

A = 19.2 in²

$f_c = \frac{792.1}{.1790}$ = 41,200 #/in²

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

= +.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 [illegible]	**Consolidated Vultee Aircraft Corporation**	PAGE	[illegible]2
PREPARED BY [illegible]	FORT WORTH DIVISION	REPORT NO.	FZS-36-24[illegible]
CHECKED BY ZINBERG	FORT WORTH, TEXAS	MODEL	XB-36
REVISED BY		DATE	10-14-47

ANALYSIS OF ELEVATOR CUTOUT AT STA [illegible]

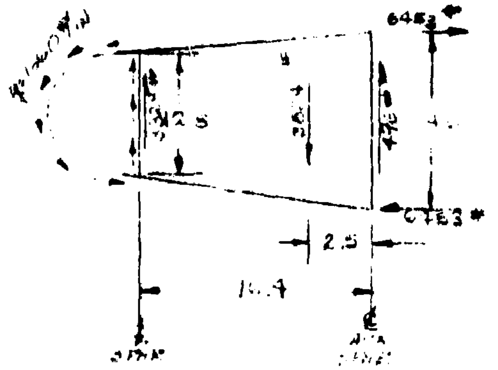
CRITICAL CONDITIONS

MOST AFT [illegible]

TRIM TAB WITH q_t = 660 #/in (REF. P40), 2A = 210.76 in², T = 210.76 × 660 = 13[illegible]34"#

ELEV[illegible] REACTION = 7648.2# (REF. P22), q - q_t = 260 #/in (REF. P42)

SPAR SHEAR = 260 × 12.8 = 3328#



Σ MOM. ABOUT AUX SP.

TORQUE [illegible] 131234

3328 × 16.4 = 54579

− 3-24 × 2.5 = − 9[illegible]

94215

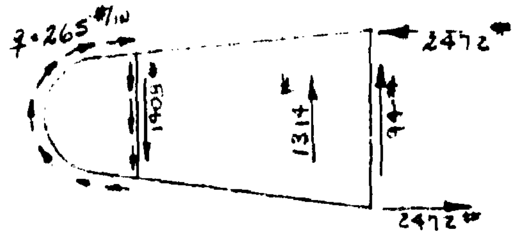
$\frac{94215}{14.6}$ = 6453#

MOST FWD [illegible] HAR

TRIM TAB WITH q = 265# (REF. P42), T = 265 × 210.76 = 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 25[illegible]

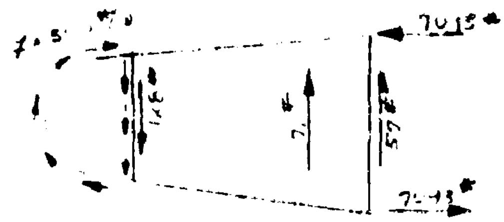
[illegible]

[illegible] CONDITION

TRIM TAB [illegible] q = [illegible] #/in [illegible] X 210 [illegible] #

ELEV[illegible] RE[illegible] [illegible] # (P 22) q_e = 10 #/in (P [illegible])

SPAR SHEAR = [illegible] X 12.8 = 12[illegible] #



Σ MOM. ABOUT AUX SPAR

TORQUE = 1054[illegible] #
− 12[illegible] X 16.4 = [illegible]
71 X 2.5 = [illegible]
10[illegible] #

$$\frac{102552}{14.6} = 7015^{\#}$$

BALANCING CONDITION

TRIM TAB WITH q = −240 #/in (P 36) T = 240 X 210.76 = −61178 #

ELEVATOR REACTION = 3105.7 # (P 22) q_e = 95 #/in (P 36)

SPAR SHEAR = 95 X 12.8 = 1216 #

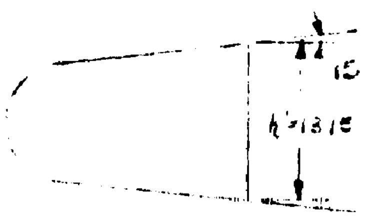
Σ MOM. ABOUT AUX SPAR

TORQUE = −61178
1216 X 16.4 = 19942
1554 X 2.5 = −3885
−45121

$$\frac{45121}{14.6} = 3040^{\#}$$

PANEL b

W. B.



$\frac{M}{h} = \frac{139234}{13.15}$ = 15670# (HORIZ. COMP.)

VERT. COMP. = 10600 x .265 = 2840#

SHEAR INDUCED INTO THE WEB DUE TO BENDING $\frac{M}{2A} = \frac{82320}{256}$ = 320#/"

SHEAR = 320 x 12.8 = 4100#

TOTAL SHEAR = 3528 + 2 x 2840 - 4100 = 4408#

CRIT. 15" = 1059
CRIT. 15" = 2650

τ = 4408 / (12.15 x .050) = 7140 #/□"

PANEL IS SHEAR RESISTANT

M.S. - HIGH

CRITICAL COMP. LOAD IN LOWER FLANGE

P = 10950#

f = 10950 / .3505 = 31,200 #/□"

M.S. = +.025

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[illegible] COMP [illegible]

[illegible] B [illegible] TRIM TAB WITH [illegible]

$\frac{M}{h} = \frac{105430}{13.15} = 80[illegible]^{\#}$ ([illegible] COMP)

VERT. COMP [illegible] .244 x 8[illegible] = 20[illegible]#

SHEAR = [illegible] 125 - 2 x 2[illegible] + $\frac{35500 \times 1[illegible]}{2[illegible]}$ = 285[illegible]#

FLANGE LOAD = $\frac{8[illegible]}{[illegible]}$ = 5[illegible]#

$f_c = \frac{5275}{[illegible]} = 31[illegible]$ #/□"

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

= **+.01**

[illegible] RING [illegible]

SHEAR [illegible] = [illegible]#

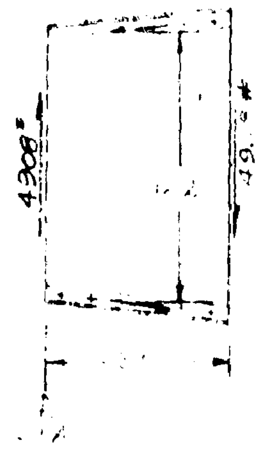
[illegible]

BZ [illegible] = 71[illegible]#

[illegible] = [illegible]#

[illegible]#

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



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

= 1.[illegible]+

CUTOUT RIB (STA [illegible])

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 = .2590 IN² I = .0632 IN⁴ F_c = 31550 #/□"

LOWER FLANGE: A = .3271 IN² I = .0526 IN⁴ F_c = 32000 #/□"

CRITICAL SHEAR

MOST AFT CG - H.S. TRIM TAB [illegible]

SHEAR = 3325 - 3284 - 41 0 = 4596#

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

τ_{cr} = 21700 #/□"
τ_{cu} = 20400 #/□" } REF FZS-36-146 P 142
τ_{cr} = 1935 #/□"

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

= LARGE

LOWER FLANGE

CRITICAL COMP LOAD (MOST AFT CG [illegible])

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

S_{cr} = 1935 x 15.45 x .032 = 95[illegible]#

S_{tu} = 4596 - 950 = 3640#

$\frac{S_{tu} \cot \alpha}{2} = \frac{3640 \times 1.212}{2} = 2210$#

AXIAL LOAD = 5730 + 2210 = 7940#

$f_c = \frac{7940}{.3271} = 24200$ #/□"

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

= .32

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[illegible]

[illegible]

[illegible] LOAD ([illegible])

$P = \frac{M}{h} = \frac{[illegible]}{10.[illegible]} = 630[illegible]\#$

SHEAR = $\frac{[illegible] \times 12.5}{250}$ [illegible] = 1718#

$S = 150\#$

$S = 1718 - 150 = 762\#$

$\frac{[illegible]}{2} = \frac{762 \times [illegible]}{2} = 403\#$

AXIAL LOAD = 6300 + 403 = 6703#

$f_c = \frac{6703}{.2390} = 28300 \#/\square''$

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

= .11

[illegible]

[illegible] $\sqrt{\left(\frac{[illegible]}{N + [illegible]}\right)^2 + \left(\frac{[illegible]}{N}\right)^2}$

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

= 1711 × .855

= 152 #/RIV

5/32" RIV. BR [illegible] = 500#
SH [illegible] = 590#

M.S. HIGH

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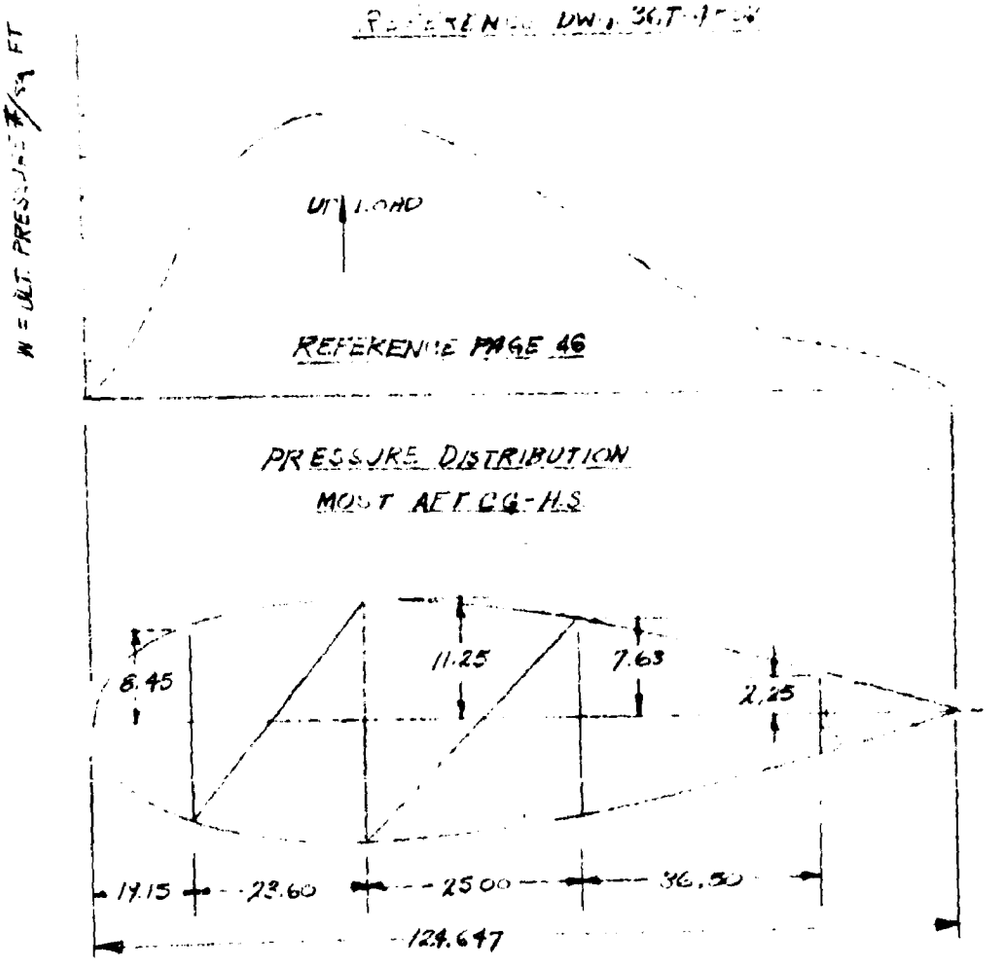
ELEVATOR

TYPICAL AIRLOAD RIB STA 70

REFERENCE DWG 36T-1[illegible]



RIB DIMENSIONS

SPANWISE RIB SPACING = 10 1/2

PRESSURE DISTRIBUTION CORRECTION FACTOR* [illegible]

CHORDWISE LOADING #/INCH = $\frac{W \times 10.125 \times .2099}{144} = .0185 W$

NOTE:

THE MAX. UP LOAD (30,337#) IS CAUSED BY THE MOST AFT CG-HS CONDITION. THE MAX. DOWN LOAD (-12,178#) IS CAUSED BY THE MOST FWD CG-HAA.

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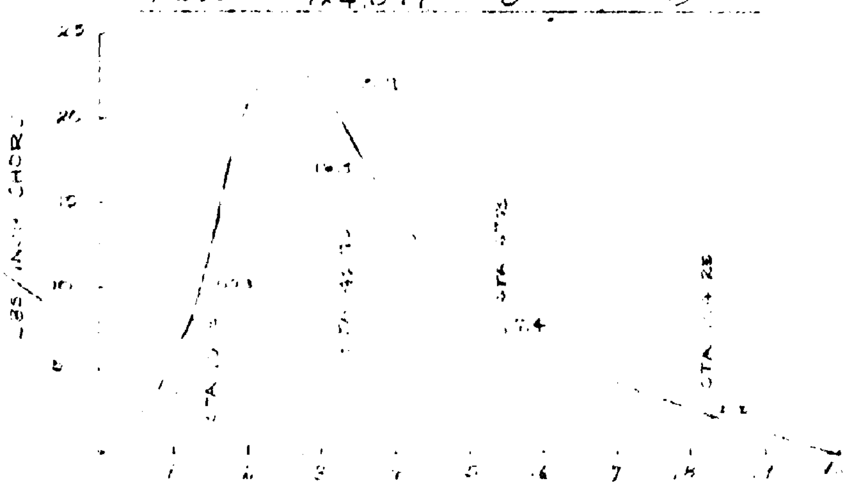
ELEVATOR

TYPICAL [illegible]

TABLE OF PRESSURE DISTRIBUTION ORDINATES
[illegible]

X/C	R.H. STATION	W	.085 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	28.0[illegible]	264	22.5
.250	31.10	268	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



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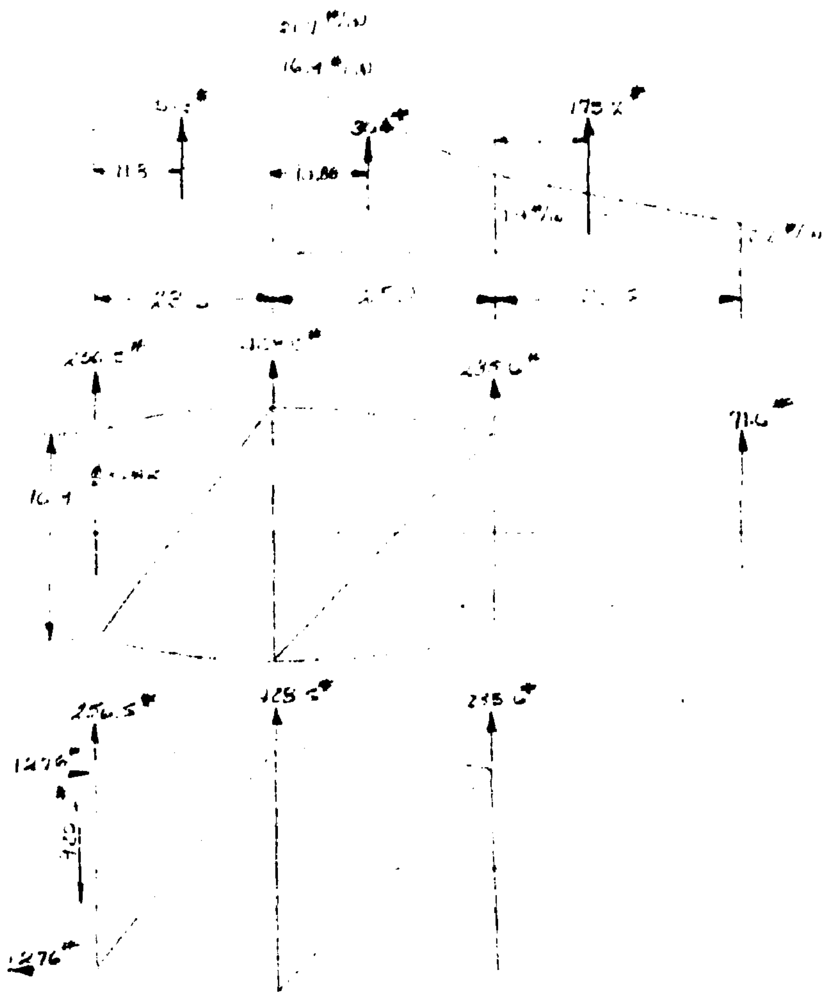

[illegible] = $\frac{428.5 \times 25.6 + 235.6 \times 4[illegible]}{16.4}$ = 1276#

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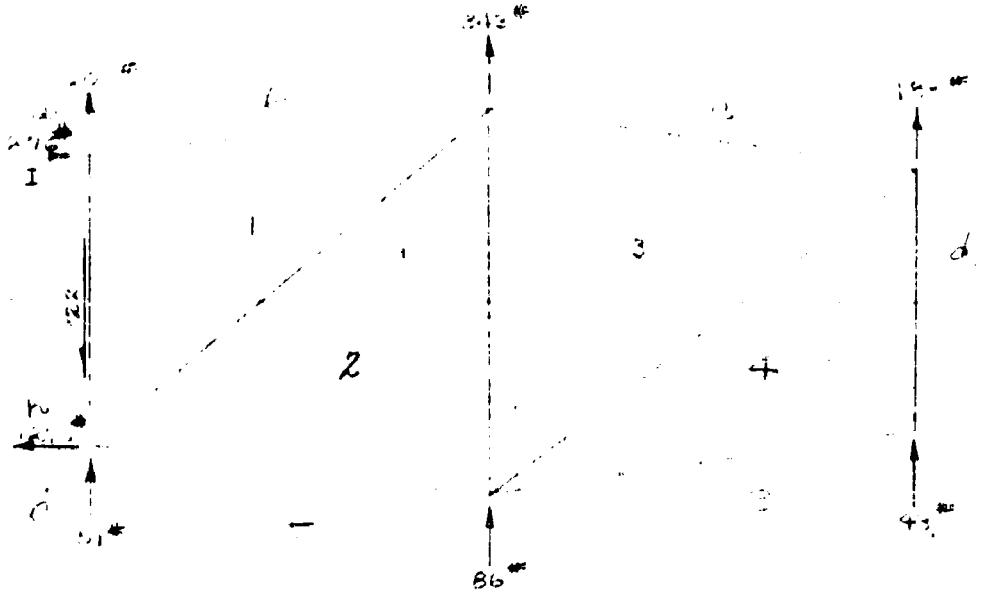

MEMBER	LOAD
2-1	-1480
1-4	+1328
2-4	- 322
3-4	- 205
3 4	+ 325
1 4	- 49
2 4	0
4 4	+ 228
4-1	- 870
1 1	+ 52

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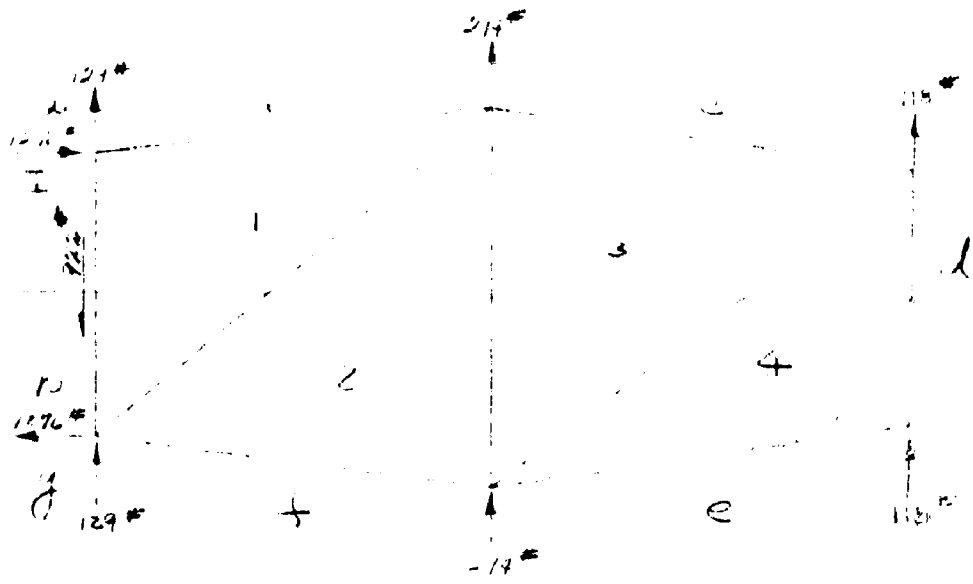

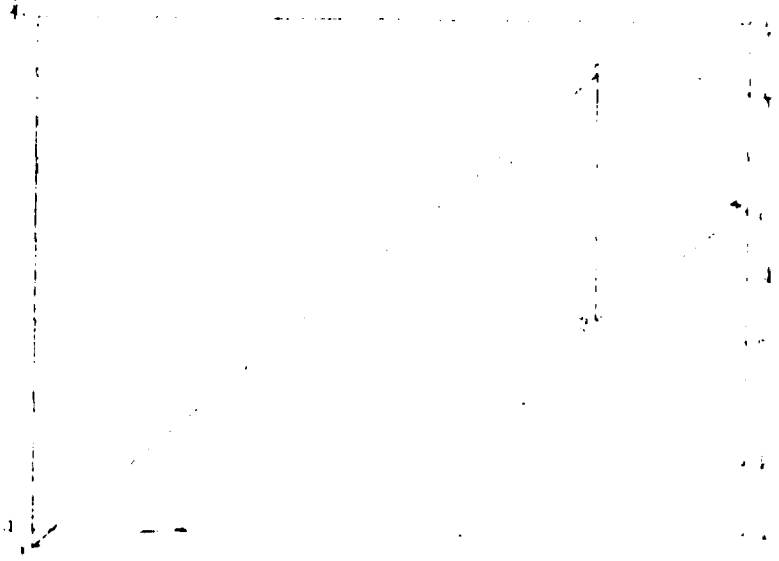

MEMBER	LOAD
A-1	- 1280
C-3	- 272
d-4	- 118
e-4	0
f-2	+ 275
h-1	- 945
I-1	- 30
1-2	+1315
2-3	- 440
3-4	+ 338

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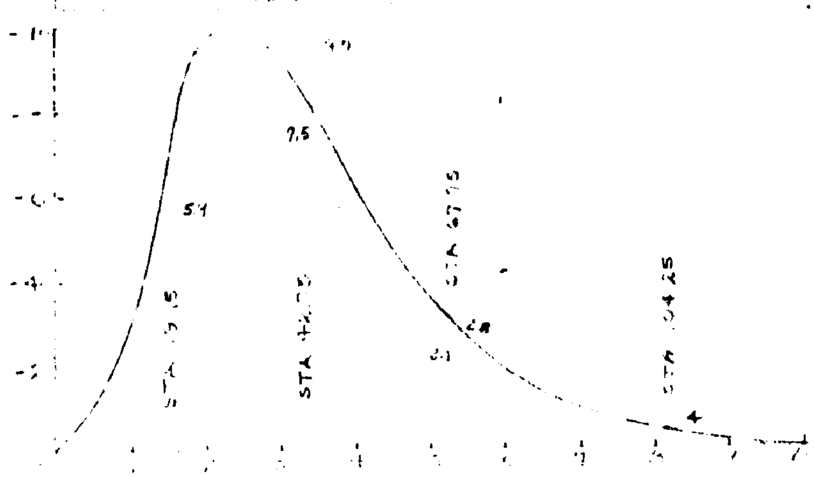
ELEVATOR

[illegible]

X/C	[illegible] STA	W	[illegible] W
0		0	0
.05	[illegible]	[illegible]	- [illegible]
.10	[illegible]	[illegible]	- [illegible]
.15	[illegible]	24.[illegible]	- [illegible]
[illegible]	[illegible]	.3[illegible]	- [illegible]
.250	[illegible]	[illegible]5	- 11
.275	[illegible]	[illegible]	- 1[illegible]
.300	[illegible]	114.0	- 7.4
.350	[illegible]	10[illegible]	- 7.5
.4[illegible]	[illegible]	77[illegible]	- [illegible]
.500	[illegible]	45	- 3.0
.600	[illegible]	24	- 1.1
.700	97.27	11.5	- .4
[illegible]	[illegible]	4.5	4
.900	112.[illegible]	[illegible]5	.1
1.00	121.0[illegible]	0	0



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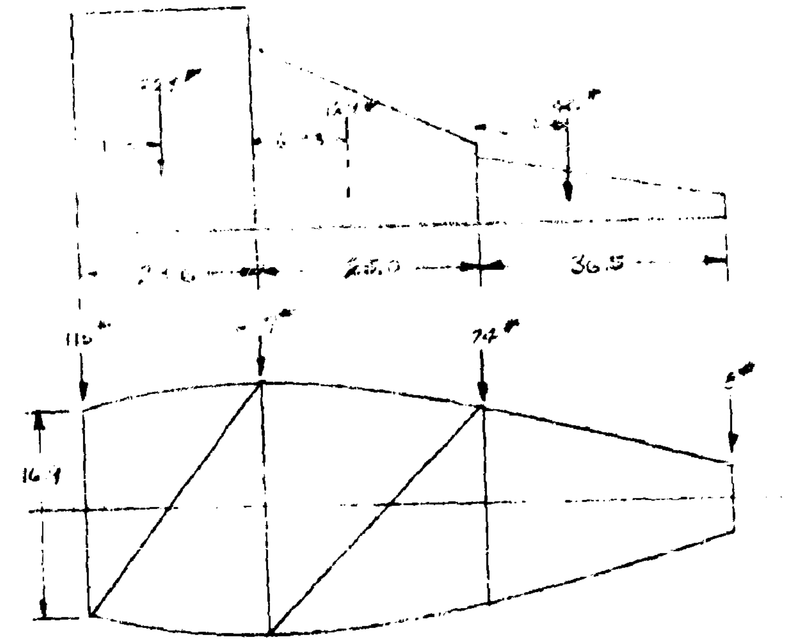
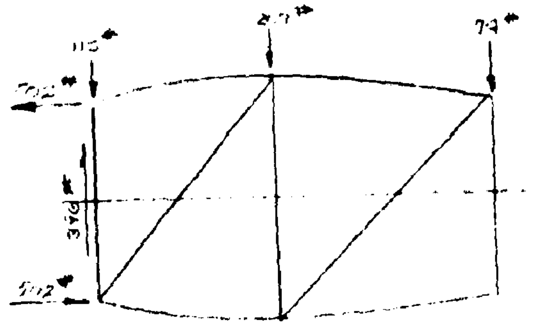
ELEVATOR

[illegible] A[illegible] STA [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 25[illegible], IT CAN BE ASSUMED THAT [illegible] NOT CRITICAL [illegible] FURTHER [illegible] FOR [illegible]

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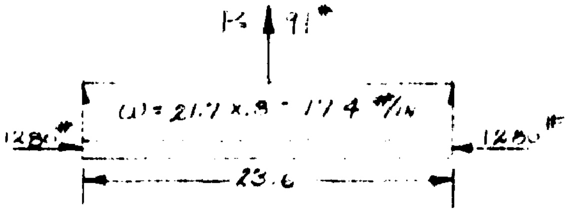
[illegible]

[illegible]
[illegible] 25[illegible]

I [illegible] MAX [illegible] 34 IN⁴ $\bar{y}$ [illegible] A = .1445 IN²
I [illegible] MIN [illegible] .2 IN⁴ $\bar{y}$ [illegible] A = [illegible]
I LATERAL [illegible] 30 [illegible] IN⁴
[illegible] 1280 [illegible] 535 #
VERTICAL [illegible] TO PRODUCE THIS MOMENT [illegible]
[illegible] R [illegible] $\frac{[illegible]}{23.6}$ = 10.8 #



SECTION - FXM 45-252 + INTERCOSTAL

F_b = 48000 #/□"
F_c = 30800 #/□"
j^2 = 511
$\frac{L}{j}$ = 1.045

$$j = \sqrt{\frac{10.3 \times 10^6 \times .0636}{1280}} = 22.6$$

$$C_1 = \frac{w j^2 \left(\cos \frac{L}{j} - 1\right)}{\sin \frac{L}{j}} + \frac{P j}{2} \cos \frac{L}{j} \sec \frac{L}{2j}$$

$\cos \frac{L}{j}$ = .50159 $\sin \frac{L}{j}$ = .86411

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

$$C_1 = \frac{17.4 \times 511 ([illegible] - 1)}{.86411} + \frac{11 \times 22.6 \times .50159}{2 \times .86782}$$

= -4[illegible]

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TYPICAL ... RIB ...

$M = C_1 \sin \frac{x}{j} + C_2 \cos \frac{x}{j} + f(x)$

$= -4550 \times .41685 - 1121 \times .90782 + 8900$

$= -1163$ "#

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

$\sin \frac{x}{j} = .41685$

$\cos \frac{x}{j} = .90782$

$f_b = \frac{1163 \times 1.191}{.10058} = 23,100$ #/□"

$f_c = \frac{1283}{.14751} = 8680$ #/□"

$M.S. = \frac{1}{\frac{8680}{3...} + \frac{23100}{45000}} - 1$

$= \underline{+.31}$

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[illegible]

[illegible] RIB [illegible]

VERT. MEMBER 2-3
REF [illegible]

SECT [illegible]

LENGTH - 22 in.

[illegible] - [illegible] in

AREA - .1036 in²

L/ρ - 68.0

LOAD - 440 #

P/A = $\frac{440}{.1036}$ = 4250 #/□"

F_c = 5000 #/□"

$M.S. = \frac{5000}{4250} - 1$

= +.17

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ELEVATOR TRIM AND SERVO TABS

The XB-36 tabs are the same as the B-36A tabs which are described in FDS-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.

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ELEVATOR TRIM TAB

DESIGN LOADS

TRIM TAB LOAD (B-36) 2040# (FZS-36-146 P192)

TRIM TAB LOAD (XB-36)

LOAD = .0012 V_D^2 (LIMIT) (C-1103-A, APP D)

V_D = 311 MPH A = 11.92 sq ft

LOAD = .0012 (311)^2 X 1.5 X 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 P202)

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

Y = 1.10 IN $I = .128\ IN^4$

$f_b = \frac{1782 \times 1.1}{.128} = 15320$ #/"

$F_b = 15300$ #/" (REF FZS-36-146 P202)

M.S. = $\frac{15300}{15320} - 1$

= -.013

ELEVATOR TRAILING EDGE

DESIGN LOADS

STA. 280 (WEB CRITICAL)

$F = 1411 \times \frac{2075}{2040} = 1321^{\#}$

$2A = 10.76\ IN^2 \qquad h = 3.0\ IN$

$D.CELL\ SHEAR = 219 \times \frac{2075}{2040} = 223^{\#}$

$NET\ SPAR\ SHEAR = \frac{1321}{10.76} + \frac{223}{3} = 165.4^{\#}$

WEB t = .032 IN

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

$F_{s,u} = 5510\ \#/\square''$ (FZS-36-146)

$M.S. = \frac{5510}{5175} - 1$

$= +0.08$

STA 354.5 (NOSE SKIN CRITICAL)

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

SKIN - .025 FS-1H MAG. AN-M-24 ...

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

$F_{ST} = \frac{KE}{(P/t)^{3/4}\ (L/D)^{1/2}}$

$F_{ST} = \frac{8 \times 6.5 \times 10^6}{\left(\frac{4.0}{.025}\right)^{3/4} \left(\frac{1.75}{2.65}\right)^{1/2}} = 18,750\ \#/\square''$

M.S. = HIGH

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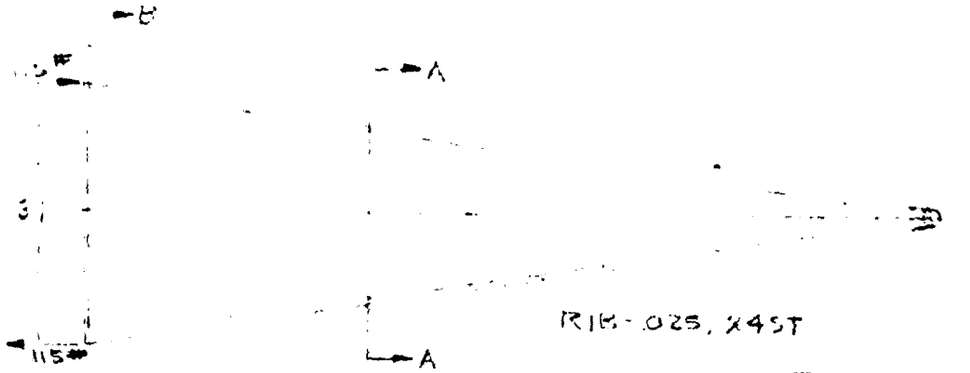
ELEVATOR TRIM TAB

ATTACHED RIB



$P = \frac{350}{3.1} \times 1.015 = 115\#$

SECTION A-A

FROM FZS-36-146

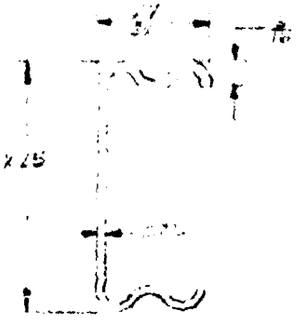
$M_{MOMENT} = 118 \times \frac{2075}{2040}$

$M = 120\ "\#$

$f_L = \frac{120 \times .125}{.0761} = 1195\ \#/\square"$

$F_L = 21{,}500\ \#/\square"$

M.S. - HIGH



SECTION A-A
I = .0761 in⁴

SECTION B-B

FROM FZS 36-146

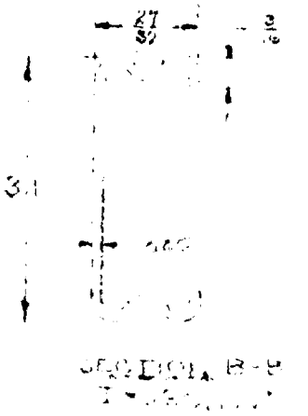
$M = 350 \times \frac{2075}{2040}$

$M = 356\ "\#$

$f_L = \frac{356 \times .155}{.1300} = 4250\ \#/\square"$

$F_L = 21{,}500\ \#/\square"$

M.S. - HIGH



SECTION B-B
I = .1300 in⁴

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 = .028 x 55000 x .125

= 172 #/RIV.

M.S. - HIGH

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[illegible] TAB

[illegible]

SERVO TAB LOAD (B-36) = 2861# (REF FZS-36-146 P222)
SERVO TAB LOAD (XB-36) = 3404# (MOST AFT [illegible] TAB WITH)

ALL DIMENSIONS OF B-36 & XB-36 SERVO TAB 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 OCCURS AT STA. 192.625 (REF FZS-36-146 P224)

$$M = 4191 \times \frac{3404}{2861} = 4910 \text{ "\#}$$

$$Y = 1.85 \text{ IN} \qquad I = 1.216 \text{ IN}^4$$

$$f_t = \frac{4910 \times 1.85}{1.216} = 7490 \text{ \#/□"}$$

$$F_t = 11{,}800 \text{ \#/□"} \text{ (REFER. FZS-36-146 P233)}$$

$$M.S. = \frac{11800}{7490} - 1$$

$$= +.57$$

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[illegible]

NOSE SKIN

STATION 90

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

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

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

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

ASSUME K = .8

D = 4.85 IN

L = 4.25 IN

F_{st} = 7650 \#/IN^2

M.S. - LARGE

STATION 192.625

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

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

$$f_s = \frac{134}{.025} = 5560 \text{ \#/}\square''$$

ASSUME K = .8

D = 4 IN

L = 2 IN

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

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

M.S. - HIGH

ELEVATOR SERVO TAB

SPAR WEB

STATION 190.5

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

$t = .040\ in$

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

$F_s = 6730\ \#/in^2$ (FZS-36-116 P. 233)

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

$= +.15$

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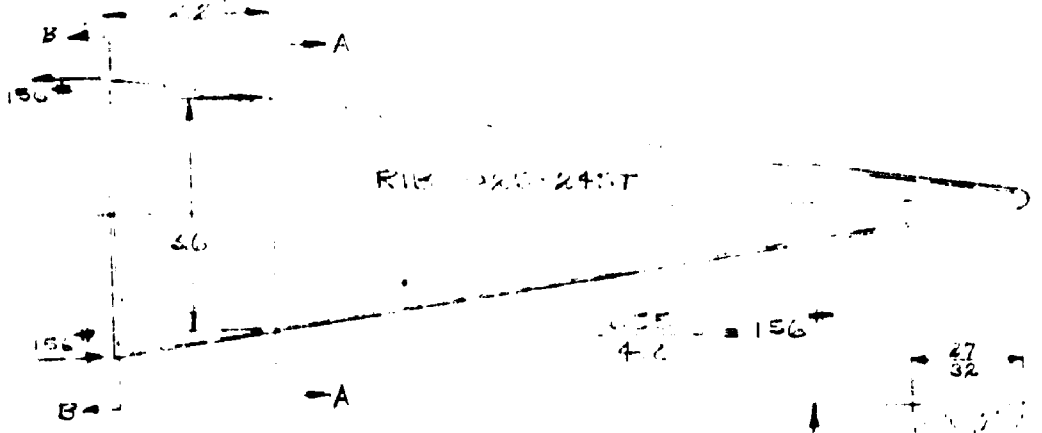
[illegible]

[illegible]



SECTION A-A

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

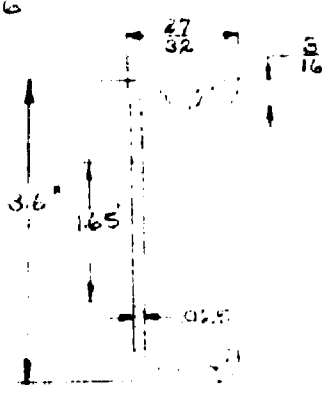
$\frac{M}{h} = \frac{392}{3.08} = 127\#$

$f_c = \frac{127}{.0484} = 2625\ \#/IN^2$

ALLOW. STRESS

[illegible]

M [illegible]



SECT. A A
$A = .0484\ IN^2$
$I = .2374\ IN^4$
$n = 3.05\ IN$

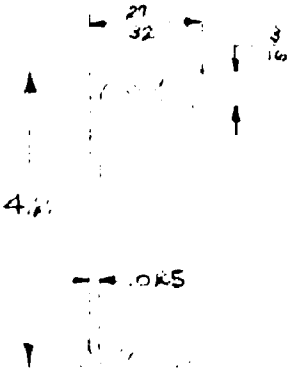
SECTION B-B

$M = 350 \times \frac{3404}{2861} = 650''\#$

$f_b = \frac{650 \times 2.1}{.0627} = 3790\ \#/IN^2$

[illegible]

M.S. HIGH



SECT B-B
[illegible]

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

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

REPORT NO. [illegible]
MODEL [illegible]
DATE [illegible]

[illegible] TAB

[illegible]

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

LOAD = 156#

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

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

M.S. - LARGE

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

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE 87
REPORT NO. [illegible]
MODEL [illegible]
DATE [illegible]

[illegible] TAB

[illegible]

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

LOAD = 150#

LOAD/RIVET = 156/[illegible] = 75 #/RIVET

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

M.S. – LARGE

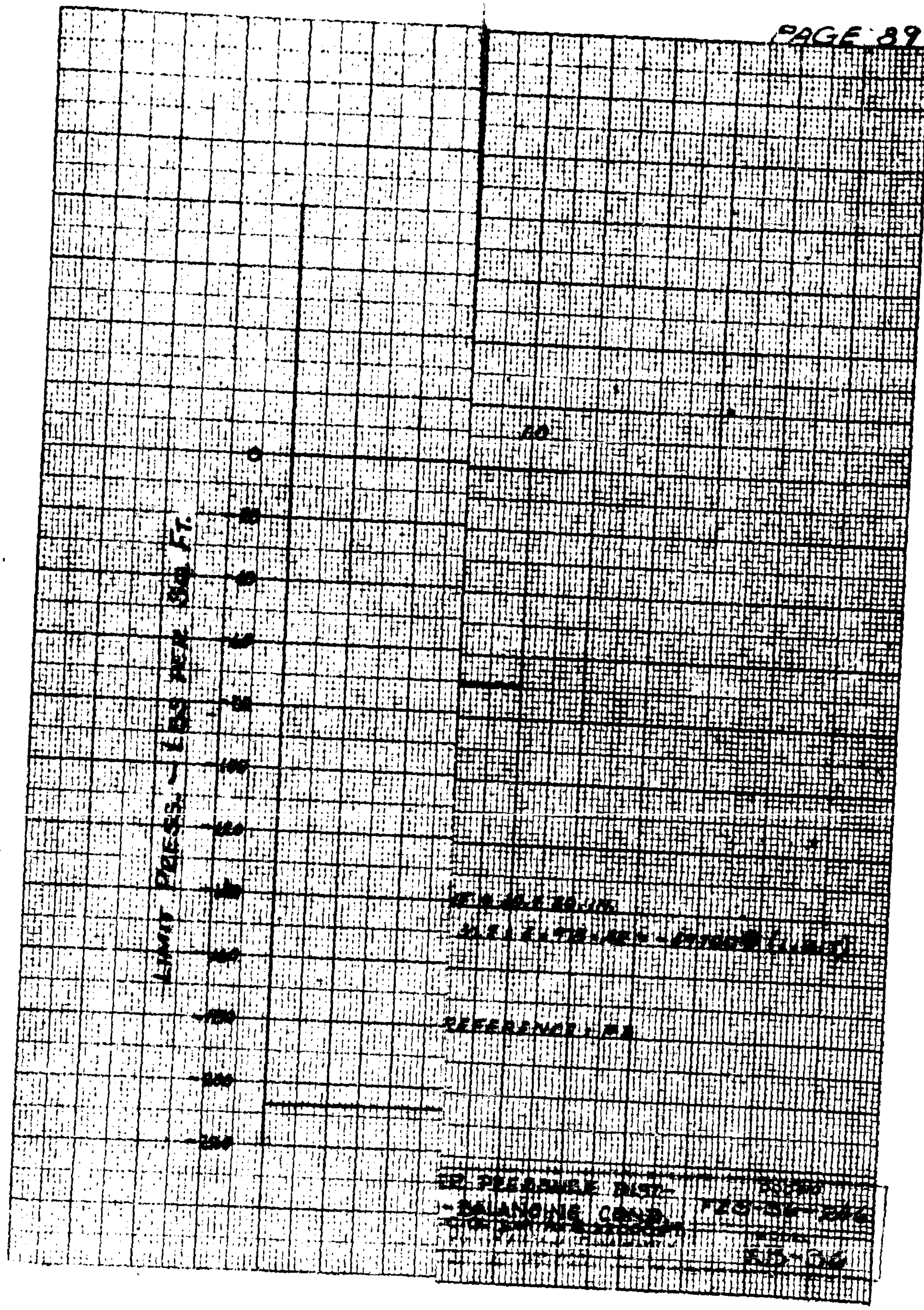
FW 444 6-46 UTILITY REPORT SHEET

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 [illegible], 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.

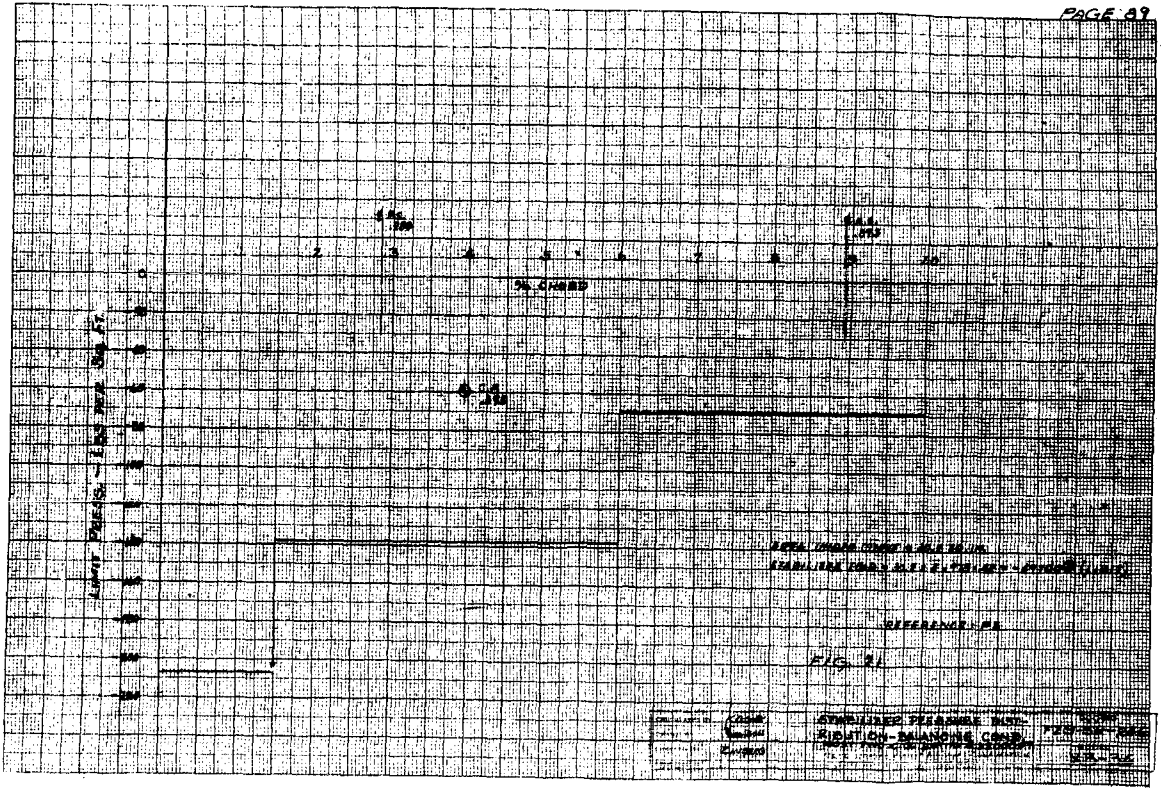

% CHORD
LIMIT PRESS. – LBS. PER SQ. FT.
C.G.
REFERENCE
STABILIZER PRESSURE DISTRIBUTION-BALANCING COND.

FIG. 21

LIMIT LOAD — Load Peak Sub Pt
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FIG 22

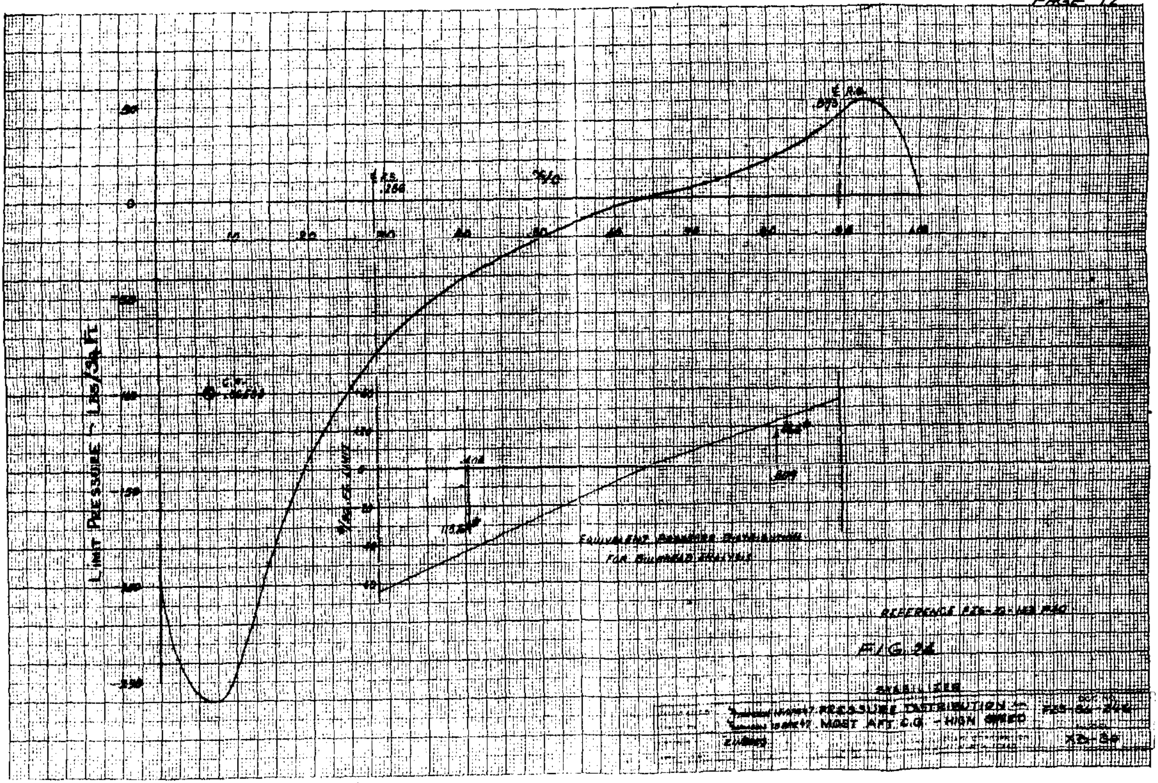


FIG. 24

STABILIZER
PRESSURE DISTRIBUTION
MOST AFT C.G. - HIGH SPEED
XB-36

STAB. & ELEV. – ULTIMATE BENDING MOMENTS & SHEARS
MOST AFT C.G. HIGH SPEED (L.A.A.)

TABLE 12

STA.	MOMENT FOR UNIT STAB. LOAD	MOMENT FOR -17,775 STAB. LOAD	MOMENT FOR UNIT LOAD AT STA 133	MOMENT FOR 9797.3 LOAD AT STA 133	MOMENT FOR UNIT LOAD AT STA 232	MOMENT FOR 7648.2 LOAD AT STA 232	MOMENT FOR UNIT LOAD AT STA 372	MOMENT FOR 5541 LOAD AT STA 372	TOTAL BENDING MOMENT (MX)	SHEAR FOR UNIT STAB. LOAD	SHEAR FOR -17,775 STAB. LOAD	SHEAR FOR LOADS AT STA 133, 232, 372	STABILIZER SHEAR
1	2	3	4	5	6	7	8	9	10	11	12	13	14
	REF. FZS-36-146	-17775 × (2)	REF. FZS-36-146	9797.5 × (4)	REF. FZS-36-146	7648.2 × (6)	REF. FZS-36-146	5541 × (8)	(3)+(5)+(7)+(9)	REF. FZS-36-146	-17775 × (11)		(12)+(13)
[illegible]	[illegible]	-2521668	[illegible]	930763	2140	1636715	[illegible]	1850115	1898805	0	0	0	0
[illegible]	[illegible]	-2522840							1895633	-263	467	0	467
[illegible]	[illegible]	-2530550							1887923	-604	1074	0	1074
27	[illegible]	-2543460							1875013	-942	1671	0	1671
[illegible]	[illegible]	-2564095							1854378	-1285	2284	0	2284
[illegible]	[illegible]	-2564095	[illegible]	930763	214	1636715	[illegible]	1852896	1854378	8715	-15491	22498	7497
[illegible]	[illegible]	-2381239	[illegible]	813193	[illegible]	1544936	[illegible]	1784492	1761732	8325	-14798		8190
[illegible]	[illegible]	-2236177	[illegible]	715218	[illegible]	1468454	[illegible]	1721873	1676565	8007	-14232		8756
[illegible]	[illegible]	-1963293	[illegible]	519268	[illegible]	1315490	[illegible]	1618135	1489700	7387	-13130		9858
100	762829	-1711446	[illegible]	323318	[illegible]	1162526	[illegible]	1507897	1281795	6788	-12066		10922
120	832664	-1480042	[illegible]	127368	[illegible]	1001562	[illegible]	1391655	1053447	6211	-11040		11948
[illegible]	[illegible]	-1341127	[illegible]	0	[illegible]	910136	[illegible]	1324514	893523	5848	-10395	22988	12593
133	[illegible]	-1341127			[illegible]	910136	[illegible]	1324514	893523	5848	-10395	13190	2795
142	[illegible]	-1261368			[illegible]	856598	[illegible]	1285721	872951	5655	-10052		3138
[illegible]	[illegible]	-1078386			[illegible]	703634	[illegible]	1174833	800131	5122	-9104		4086
[illegible]	504426	-905505			[illegible]	550670	[illegible]	1064845	791210	4609	-8192		4998
[illegible]	[illegible]	-750476			[illegible]	397706	[illegible]	953207	600437	4119	-7322		5868
[illegible]	344426	-612217			[illegible]	244742	[illegible]	842369	474894	3652	-6499		6702
240	275955	-490510			[illegible]	91779	[illegible]	731331	332790	3201	-5690		7500
[illegible]	239176	-425135				0	[illegible]	665928	239893	2944	-5233	13190	7957
[illegible]	239176	-425135					[illegible]	665928	239893	2944	-5233	5542	309
[illegible]	[illegible]	-384409					[illegible]	620693	236284	2776	-4934		608
[illegible]	[illegible]	-292123					[illegible]	509155	216932	2371	-4214		1328
[illegible]	121324	-215653					[illegible]	399017	183364	1989	-3535		2007
[illegible]	85177	-151402					[illegible]	288179	136777	1628	-2894		2649
[illegible]	[illegible]	-91574					[illegible]	177341	77767	1289	-2291		3251
[illegible]	[illegible]	-59511					[illegible]	66303	6492	971	-1726		3816
372	22911	-40724					[illegible]	0	-40724	790	-1404	5542	4138
372	22911	-40724							-40724	790	-1404	0	-1404
[illegible]	[illegible]	-30326							-30326	675	-1200	0	-1200
400	[illegible]	-11280							-11280	400	-711	0	-711
[illegible]	[illegible]	-1619							-1619	147	-261	0	-261
[illegible]	[illegible]	-0							0	0	0	0	0

ANALYSIS: [illegible]
REPORT: FZS-36-246
MODEL: XB-36
BY [illegible]
CHECKED BY [illegible]

STABILIZER — ULTIMATE BENDING MOMENTS & TORSIONS

MOST AFT C.G. HIGH SPEED (L.A.A.) NORMAL & PARALLEL TO DIRECTIONS OF STRINGERS

TABLE 13

STATION	SHEAR FOR STABILIZER LOAD	x	d = 19.728 +.08618x	S·L	MOMENT FOR -17,775 STABILIZER LOAD	Mt = .21412 M	TORSION FOR -17775 STABILIZER LOAD	SHEAR LOADS AT STAS. 133, 252, 372	e = 27.364 +.12794x	TORSION FOR LOADS AT STA. 133, 252, 372	NET TORSION T_{EA}	STABILIZER BENDING MOMENT M_s	$M_s \cos\beta$	$T_{EA} \sin\beta$	$M_s \sin\beta$	$T_{EA} \cos\beta$	M'_y	T'_{EA}
(1)	(2) col. 12 P93	(3)	(4) Ref P	(5) (2)×(4)	(6) col. 15 P93	(7) .21412×(6)	(8) (5)-(7)	(9) col. 15 93	(10)	(11) (9)×(10)	(12) (8)+(11)	(13) col. 10 P93	(14) .99625×(13)	(15) .0865×(12)	(16) .0865×(13)	(17) .99625×(12)	(18) (14)-(15)	(19) (16)+(17)
432.5	0	0	19.728	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	-5083	0	-28.963	0	-5083	-1619	-1613	-440	-14[illegible]	-5064	-1173	-5204
400	-711	32.5	22.529	-16018	-11280	-2415	-13603	0	-31.522	0	-13603	-11280	-11238	-1177	-976	-13552	-10061	-14528
380	-1200	52.5	24.253	-29104	-30326	-6493	-22611	0	-34.081	0	-22611	-30326	-30212	-1956	-2623	-22526	-28256	-25149
372	-1404	60.5	24.942	-35019	-40724	-8720	-26299	0	-35.104	0	-26299	-40724	-40571	-2275	-3523	-26200	-38296	-29723
372	-1404	[illegible]	24.942	-35019	-40724	-8720	-26299	5542	-35.104	-194546	-220845	-40724	-40571	-19103	-3523	-220017	-21468	-223540
360	-1726	72.5	25.976	-44835	-59511	-12742	-32093		-36.640	-203057	-235152	6992	6966	-20341	605	-234270	+27307	-233665
340	-2291	92.5	27.700	-63461	-99574	-21321	-42140		-37.198	-217241	-251381	77767	77475	-22436	6727	-258408	99911	-251681
320	-2894	112.5	29.423	-85150	-151402	-32418	-52732		-41.757	-231417	-284149	136777	136264	-24579	11831	-283083	160843	-271252
300	-3535	132.5	31.147	-110105	-215653	-46176	-63929		-44.316	-245599	-309528	183364	182676	-26774	15861	-308367	209450	-292506
280	-4214	152.5	32.871	-138518	-292923	-62721	-75797		-46.875	-259781	-335578	216132	216119	-29027	18765	-334320	245146	-315555
260	-4934	172.5	34.594	-170687	-384[illegible]	-82310	-88377		-49.434	-273963	-362340	236284	235398	-31342	20439	-360981	266740	-340542
252	-5233	180.5	35.283	-184636	-425135	-91030	-93606	5542	-50.547	-280131	-373737	239893	238993	-32328	20751	-372335	271321	-351584
252	-5233	180.5	35.283	-184636	-425[illegible]	-91[illegible]	-93606	13190	-50.547	-666715	-760321	239893	238993	-65768	20751	-757470	304761	-736719
240	-5690	192.5	36.318	-206649	-440510	-[illegible]028	-101621		-51.993	-685788	-787409	332799	331551	-68111	28787	-784456	399662	-755669
220	-6488	212.5	38.041	-246810	-612217	-131088	-115722		-54.551	-719528	-835250	474894	473113	-72249	41078	-832118	545362	-791040
200	-7322	232.5	39.765	-291159	-750476	-160692	-130467		-57.110	-753281	-883748	600437	598185	-76444	51938	-880434	674629	-828496
180	-8192	252.5	41.489	-339878	-905509	-193887	-145991		-59.669	-787034	-933025	709210	706550	-80707	61347	-929526	787257	-868179
160	-9104	272.5	43.212	-393402	-1078386	-230904	-162498		-62.228	-820787	-983285	800131	797131	-85054	69211	-979598	882185	-910387
140	-10052	292.5	44.936	-451697	-1269368	-271797	-179900		-64.787	-854541	-1034441	872751	869477	-89479	75510	-1030562	959156	-955052
133	-10395	299.5	45.539	-473378	-1341127	-287162	-186216	13190	-65.682	-866346	-1052562	893523	890172	-91047	77290	-1048615	981219	-971325
133	-10395	299.5	45.539	-473378	-1341127	-287162	-186216	22988	-65.682	-1509898	-1696114	893523	890172	-146714	77296	-1689754	1,036,886	-1,612,464
120	-11040	312.5	46.657	-515115	-1480042	-316907	-198208		-67.345	-1548127	-1746335	1053497	1049497	-151058	91123	-1739786	1,200,555	-1,648,663
100	-12066	332.5	48.383	-583787	-1711446	-366455	-217334		-69.904	-1606953	-1824287	1281795	1276988	-157801	110875	-1817446	1,434,789	-1,706,571
80	-13130	352.5	50.107	-657905	-1963293	-420380	-237525		-72.463	-1665779	-1903304	1489700	1484114	-164636	128859	-1896167	1,648,750	-1,767,308
60	-14232	372.5	51.830	-737645	-2236177	-478810	-257835		-75.022	-1724606	-1983441	1676568	1670281	-171568	145023	-1976003	1,841,849	-1,830,980
50	-14798	382.5	52.692	-779736	-2381239	-509871	-267865	22988	-76.301	-1754007	-2023872	1761382	1754777	-175065	152360	-2016282	1,929,842	-1,863,922

ANALYSIS: HORIZ. TAIL SURF.
REPORT: FZ2-36-246
BY L. E. THOMSON
CHECKED BY W. KOSIAK
MODEL: XB 36

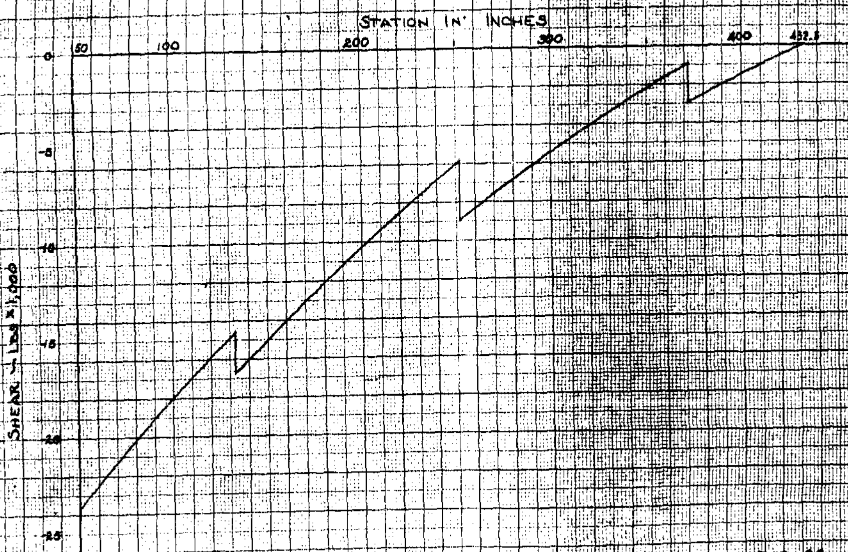


FIG. 25

MOST FWD. C.G. L.A.A. @ 15000 FT.

STABILIZER ULTIMATE SHEAR
BALANCE CONDITION

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

MODEL XB-36

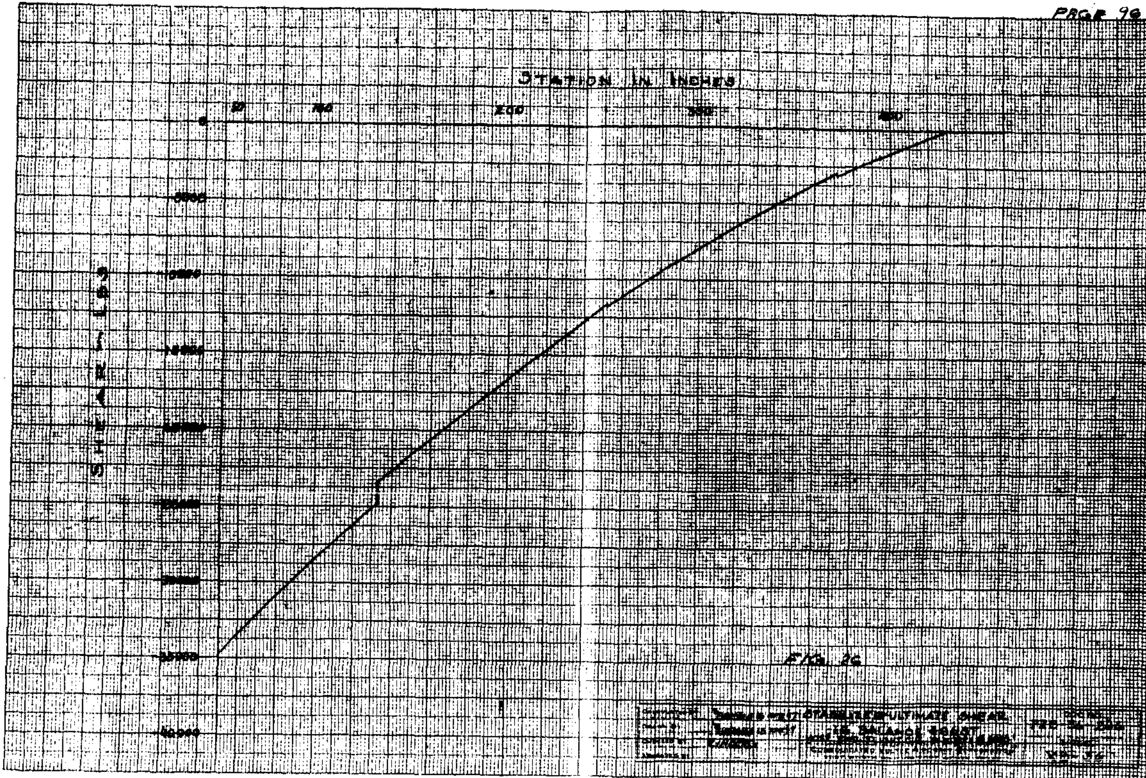


FIG. 26

STATION IN INCHES
80
160
240
320
400
Shear - Lbs x 1000
4
-8
-16
-24
-32

FIG. 27

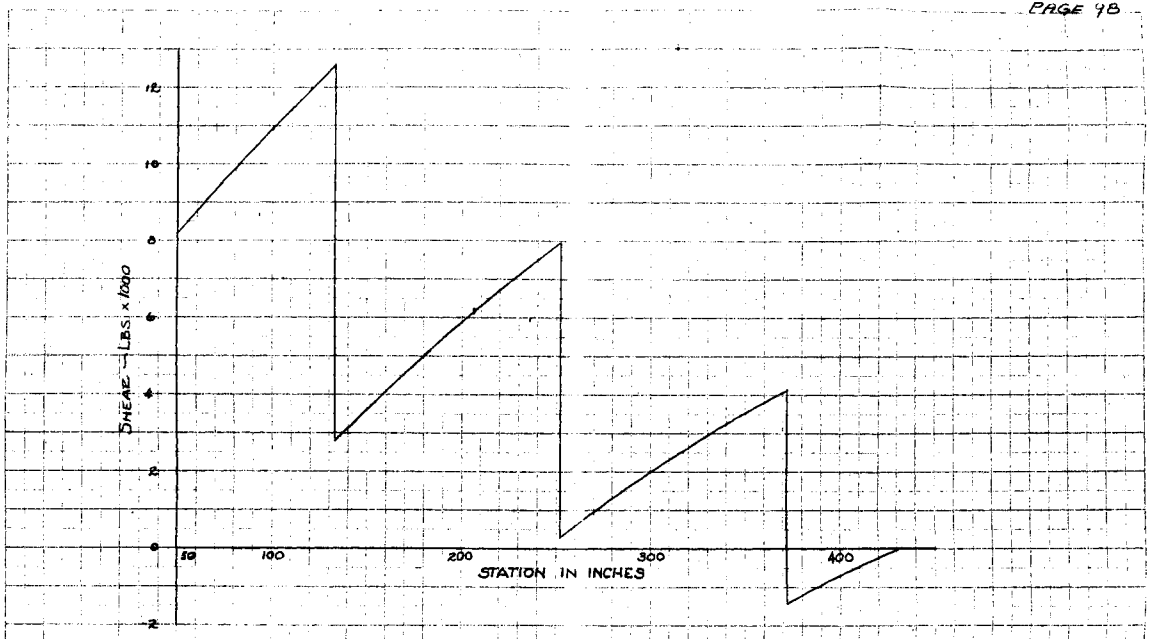
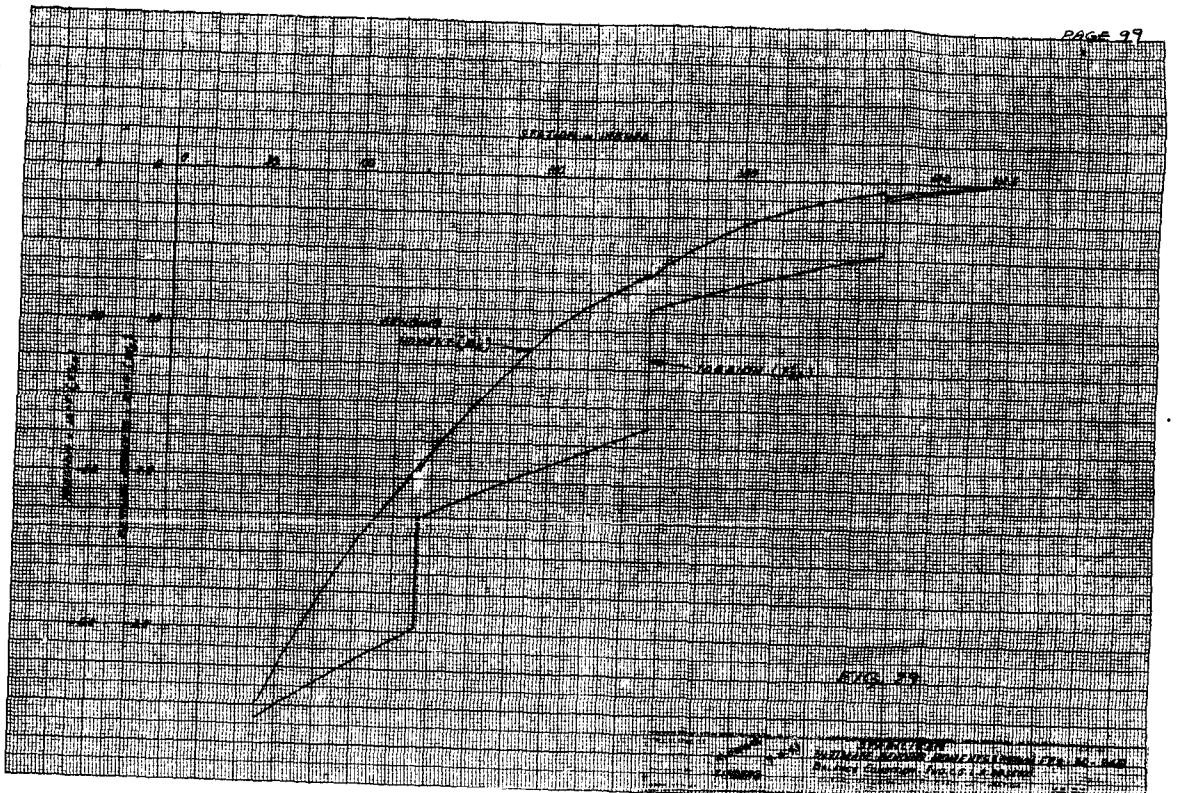


FIG. 28

THOMSEN 14 APEXT STABILIZER - ULTIMATE SHEAR
THOMSEN 11 APEXT MOST AFT C.G. — HI SPEED
ZIMMERS

DWG. NO. FZS-36-246
MODEL XB-36



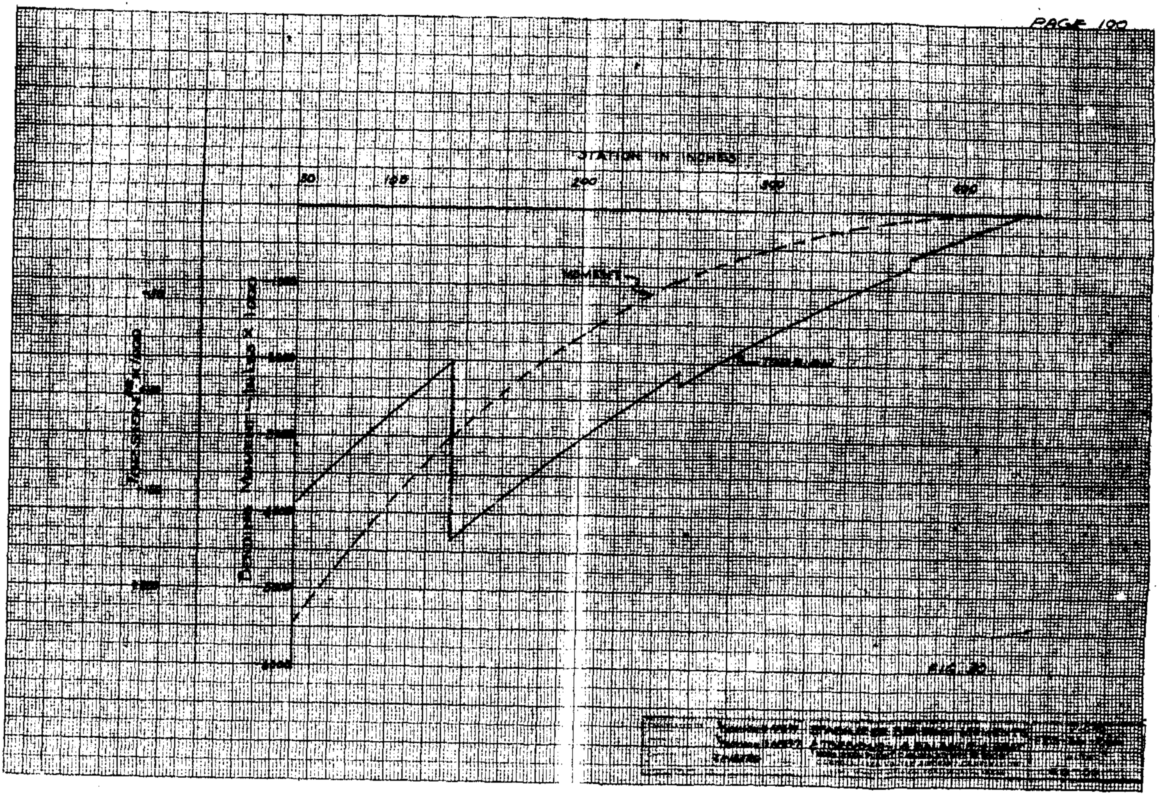


FIG. 30

Torsion — in Lbs × 1000
Bending Moment — in Lbs × 1000
TORSION
MOMENT

FIG. 11

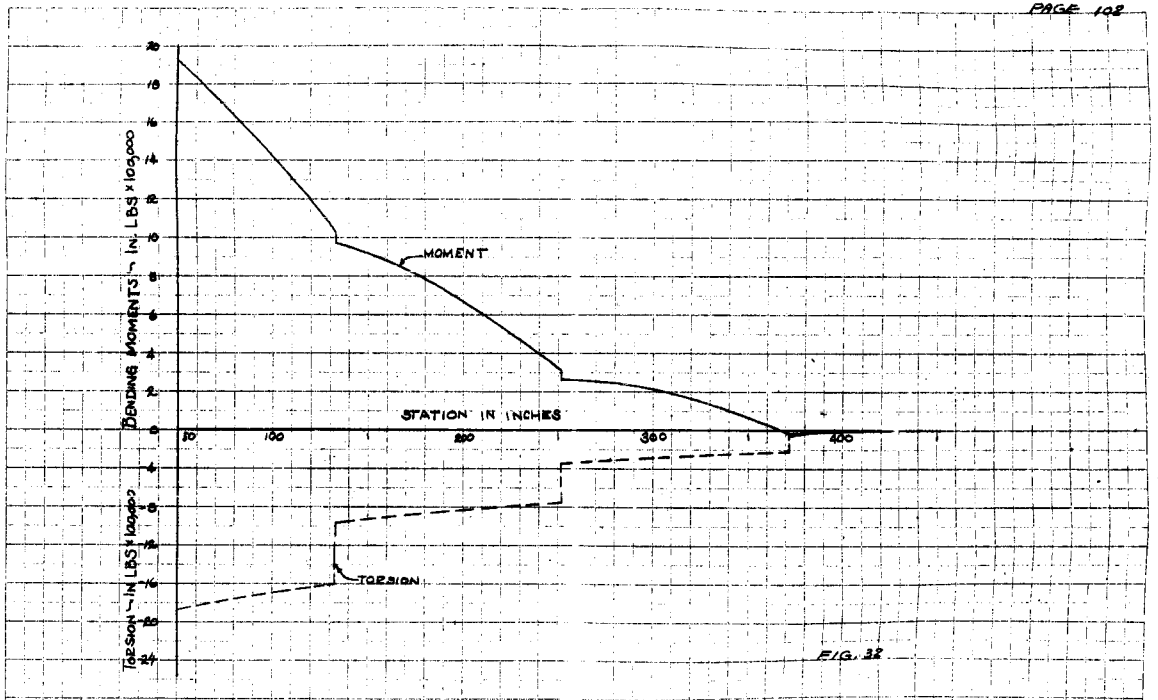


FIG. 32

STABILIZER BENDING MOMENTS & TORSIONS-MOST AFT C.G.-H.S.

FZS-36-246

XB-36-

ANALYSIS HORIZ. TAIL
PREPARED BY BEARD
CHECKED BY ZINBERG
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

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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-36-166	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	+1,087,000	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. W.T. 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	—	—		

ANALYSIS HORIZ. TAIL
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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 24ST 86	F_s (p.s.i.)	B-36A			XB-36		
				CRIT. q #/in.	f_s (p.s.i.)	M.S.	CRIT. q #/in.	f_s (p.s.i.)	M.S.
50	W15	.051	30,750	418	8,200	+2.75	-607	11,910	+1.58
	W3	.040	30,400	-403	10,070	+2.02	-458	11,630	+1.66
	W1	.051	30,750	418	8,200	+2.75	-612	12,000	+1.56
	W4	.040	29,950	-400	10,000	+1.95	-457	11,630	+1.62
	W16	.040	30,400	-338	8,450	+2.59	-479	12,000	+1.53
90	W15	.051	30,800	457	8,960	+2.44	-660	12,930	+1.38
	W16	.032	30,300	-333	10,400	+1.92	-469	14,650	+1.07
	W1	.051	31,050	456	8,920	+2.48	-666	13,080	+1.37
	W4	.032	30,400	-373	11,660	+1.61	-436	13,640	+1.23
133	W15	.051	30,050	453	8,880	+2.38	-764	14,950	+1.01
	W4	.032	30,600	-322	10,060	+2.04	-472	14,750	+1.07
	W1	.051	30,700	446	8,750	+2.46	-774	15,180	+1.99
204	W4	.025	29,950	-290	11,600	+1.56	-343	13,720	+1.18
	W1	.025	30,000	-289	11,560	+1.60	-503	20,100	+ .49
252	W15	.025	29,150	-322	12,900	+1.26	-589	23,500	+ .24
	W1	.025	29,400	-333	13,300	+1.21	-602	24,100	+ .22
300	W4	.020	29,100	-182	9,100	+2.20	-391	19,550	+ .49
	W4	.020	29,100	-181	9,050	+2.20	-389	19,950	+ .46
	W1	.020	29,100	-155	7,750	HIGH	-447	22,350	+ .30
372	W15	.020	28,700	-198	9,900	+1.90	-375	18,750	+ .53
	W1	.020	28,700	-200	10,000	+1.87	-380	19,000	+ .51

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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

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COMPARISON OF B36A & XB36 MAXIMUM ELEVATOR HINGE REACT.

STATION	XB36 +	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.

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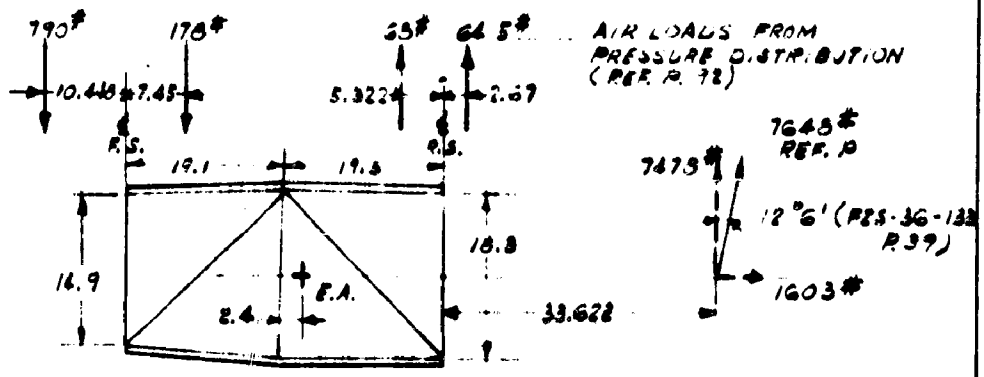
FORT WORTH, TEXAS

STABILIZER BULKHEAD

STA. 252

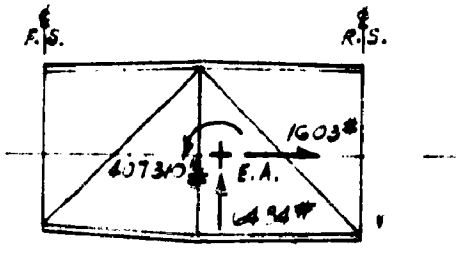
CONDITION :- MOST AFT C.G. HIGH SPEED



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"
2 x 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

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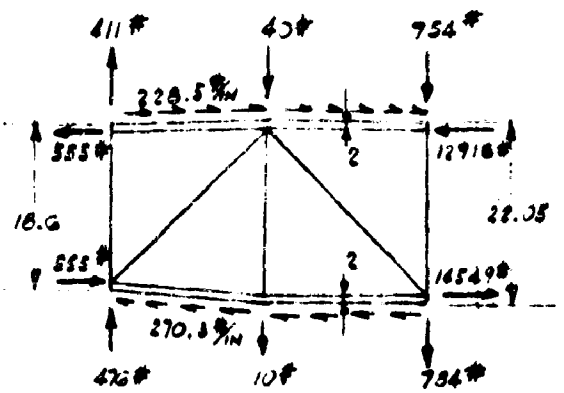
FORT WORTH, TEXAS

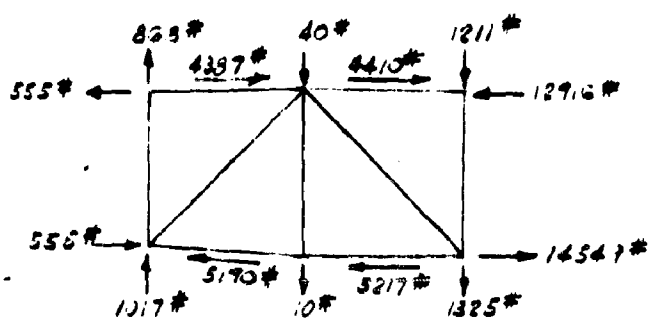
STABILIZER BULKHEAD
STA. 252



APPLIED LOADS PLUS REACTIONS

NOTE:

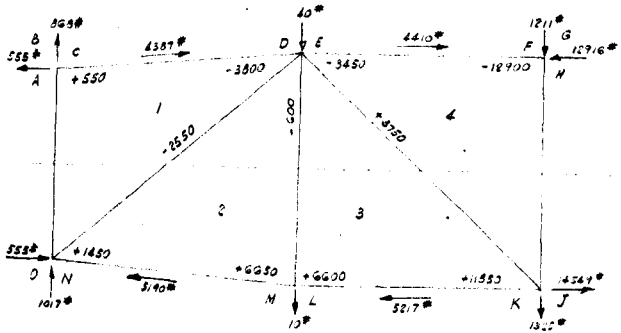
INTERSPAR AIR LOAD DISTRIBUTION 30-20
UPPER AND LOWER SURFACE REACTIONS ARE ON SKIN LINE



APPLIED LOADS PLUS REACTIONS

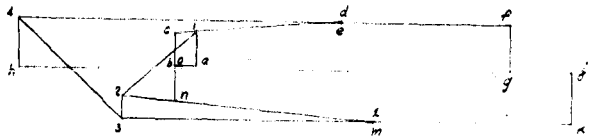
NOTE:

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



TRUSS LAYOUT

SCALE 1" = 6"



STRESS DIAGRAM

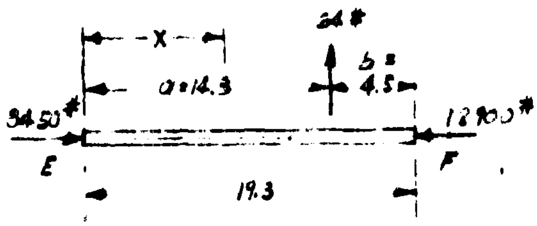
SCALE 1" = 2000#

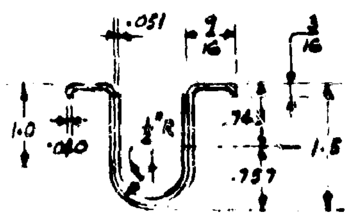
FIG. 33

	R. DIXON	STABILIZER BLKHD. STA. 858 MOST AFT C.G. HIGH SPEED	SCALE	FBS-36-246
	R. DIXON 10-1-47		SCALE	XB-36
	R. DIXON			

STABILIZER BULKHEAD
STA. 552

CHECK OF UPPER CHORD MEMBER E-F





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

REFER. FZS-36-146 P432, 433

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

LET $P = \frac{3450 + 12900}{[illegible]} = 10675\#$

$j = 9.9$

MOMENT IS MAX. WHEN $x = 13.8$

WHEN $x < a$ $\quad C_1 = -Wj \frac{\sin \frac{b}{j}}{\sin \frac{L}{j}} = -389$

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

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

$M = -389''\#$

BENDING $f_b = \frac{389 \times .757}{.0799} = 2690$ P.S.I.

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

$R_1 = \frac{2690}{62000} = .043$, $\quad R_2 = \frac{31000}{46900} = .66$

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

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

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FORT WORTH, TEXAS

STABILIZER SULLAHEAD

STA. 250

CHECK OF FWD. DIAGONAL 1-2

LOAD = -2550 # (REF. P

A = .1710 SQ. IN. — REF. AZ-30-146 P432

F_c = 18200 P.S.I.

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

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

STAB BULK HEAD STA. 133

B-36A CRITICAL HINGE LD. = 5517 #↑ (REF FZS-36-146 P53)
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 $\quad F_c = 25,000$ p.s.i

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

STAB BULK HEAD 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 $\quad F_a = 55,500$ 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, $\quad F_c = 49,800$ 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

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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

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

ATI- 53460

REVISION (None)

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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.

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

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