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CONSOLIDATED VULTEE

MODEL XB-36

REPORT FZS-36-242

DATE May 1948

TITLE

STRESS ANALYSIS OF WING CENTER SECTION

PART III

INTERSPAR BULKHEADS

LEADING AND TRAILING EDGE STRUCTURE

SUBMITTED UNDER

Contract W535-ac-22352

and

ACA 269A

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GROUP: STRUCTURES

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ANALYSIS Wing, Part III
PREPARED BY Mefford
CHECKED BY
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

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MODEL XB-36
DATE 5-28-48

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CONSOLIDATED VULTEE AIRCRAFT CORP., FORT WORTH DIV., TEX. (REPORT NO. FZS-36-242)

STRESS ANALYSIS OF WING CENTER SECTION - PART III - INTERSPAR BULKHEADS - LEADING AND TRAILING EDGE STRUCTURE - MODEL XB-36

N.S. MEFFORD; B.C. VOSS; A.B. CANFIELD AND OTHERS
MAY '48 306PP. TABLES, GRAPHS

USAF CONTR. NO. W535-AC-22352

STRUCTURES (7) WINGS - STRESS ANALYSIS
DESIGN AND DETAILS (3) B-36 - STRESS ANALYSIS
B-36

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ANALYSIS OF WING INTERSPAR BULKHEADS

LEADING EDGE, AND TRAILING EDGE

GENERAL INTRODUCTION

The purpose of this report is to analyze the center section wing box bulkheads, the trailing edge and the leading edge of the XB-36 Airplane. Due to the similarity of the B-36 and the XB-36 wing the YB-36 and B-36A Bulkhead Analysis, Report FZS-36-142 will be used as a guide in the preparation of many sections of this report.

The design conditions are based on the XB-36 with the one wheel main landing gear except for the landing gear bulkheads (5, 7, 8, and 9) and the inboard section of the wing trailing edge which are analyzed using loads obtained with the XB-36 four wheel main landing gear. Ref. ACA 269A.

The minimum margins of safety for the structure (wing bulkheads, trailing edge and leading edge) analyzed in this report appear on page 2.

TABLE OF MINIMUM MARGINS OF SAFTEY

TABLE I

MEMBER	DESCRIPTION AND LOCATION	MIN M.S.	PAGE
BLKHD 0	-11 STIFFENER	+.003	16
BLKHD 10	NO MARGINS OF SAFETY SHOWN		22
BLKHD 3	CENTER DIAGONAL TUBE (MN)	+.32	47
BLKHD 13	RIVET ATTACHMENT FWD VERTICAL TRUSS TUBE (NO)	+.06	88
BLKHD 19	END CONNECTION CENTER DIAGONAL TUBE (OP)	+.03	129
BLKHD 11	-15 STIFFENER	+.06	166
BLKHD 18	UPPER CHORD	+.10	191
BLKHD 16	UPPER CHORD	+.83	199
BLKHD 22	SECOND STIFFENER ~~WEB PANEL FORWARD~~ REAR SPAR	+.55	214
BLKHD 23	FWD VERTICAL TRUSS TUBE (NO)	.00	261
BLKHD 5	-59 WEB	+.05	286
BLKHD 7	STIFFENERS	+.01	286
BLKHD 8	DIAGONAL TRUSS TUBE END CONNECTION (3CW4108-118)	+.055	287
BLKHD 9	-7 WEB	+.032	287
T.E. INB'D CTR NAC.	WEB SPLICE 52½% BEAM	+.035	293
T.E. OUTB'D CTR NAC.	MEMBER C-1 T.E. RIB #13	0	305
LEADING EDGE	DIAGONAL TUBE STA 127.16	+.045	306

WING CENTER SECTION

BULKHEAD ANALYSIS

INTRODUCTION

The wing center section bulkheads are of the following type of construction:

1. Web type (semi-tension field)
2. Truss type
3. Combined web-truss type

Typical critical bulkheads of all types are analyzed either completely or by comparison with the B-36A analysis. Bulkheads #3 and #13 are typical truss type airload bulkheads. Bulkhead #19 is a typical truss type flap load bulkhead. Bulkheads #11, #16, #18, #22 and #23 are typical fuel wall, engine mount support and jack point bulkheads. Bulkheads #5, #7, #8 and #9 are landing gear support bulkheads. Bulkhead #0 and #10 require a special analysis due to the nature of their loading.

The chordwise airload distribution for bulkheads 3, 13, 19, 22 and 23 are tabulated on pages 6 through 10, while air loads for bulkheads 10, 11 and 18 are obtained from B-36A data. The upper and lower surface chordwise pressure distribution values are obtained from Figures 1.1 through 1.8, pages I-12 FZS-36-142. A detailed explanation of the chordwise pressure distribution calculations is given on page I-7 of FZS-36-142.

The properties of the various materials used in the wing structure are obtained from C.V.A.C. Structures Bulletins B-1, B-2, B-3, and from ANC-5.

The column allowables for truss tubes are obtained from page I-61, FZS-36-142.

The bulkhead loads due to the LAA and ILAA minimum flying weight conditions will be larger for the XB-36 than for the B-36A. The gust criteria used in the two airplanes is not the same.

$$\text{B-36A, } n_{(LAA)} = 1 + \frac{5K_1 aV \sigma^{1/2}}{W/S}$$

$$\text{XB-36, } n_{(LAA)} = 1 + \frac{3KaV \sigma}{W/S}$$

where $K = 2K_1$

at the 5,000' level

$\sigma = .8616$, $\sigma^{1/2} = .9285$

then

$$\text{B-36A, } n_{(LAA)} = 1 + \frac{5K_1 aV \times .9285}{W/S}$$

$$\text{XB-36, } n_{(LAA)} = 1 + \frac{6K_1 aV \times .8616}{W/S}$$

This gives an increase of factor for the XB-36 in the LAA condition of approximately 8% for the same speed and G.W.

Bulkhead loads imposed by landing loads are directly proportional to the landing gross weight, therefore, the bulkhead loads for the XB-36 DGW landing condition will be $\left(\frac{255,000}{268,000}\right) = .95$ of the B-36 loads.

TABLE II DATA FOR CHORDWISE AIR LOAD DISTRIBUTION XB-36 AIRPLANE

1	2.	3	4	5	6	7	8	9	10	11
BLKH'D	STATION	DESIGN CONDITION	M	V	LIMIT q	C_L	$C_{l_{a_1}}$	C_{l_b}	$C_L \times C_{l_{a_1}}$	C_l
			MACH NO	(REF: FZS-36	- 126)		(REF: FZS-36-138)		⑦ × ⑧	⑨ + ⑩
3	113.25	DGW ILAA @ 5000'	.416	311	213.1	-.424	.939	.0258	-.398	-.3722
		AGW (72-1000#B) HAA @ 5000'	.287	214.8	101.7	1.500	.939	.0258	1.408	1.4338
		AGW (72-1000#B) LAA @ 5000'	.416	311	213.1	.752	.939	.0258	.706	.7318
13	412	DGW LAA @ 5000'	.416	311	213.1	.7531	.995	.0180	.749	.767
		DGW ILAA @ 5000'	.416	311	213.1	-.4240	.995	.0180	-.422	-.404
		RGW (72-1000#B) LAA @ 5000'	.416	311	213.1	.7058	.995	.0180	.703	.721
19	615.38	DGW FDLGE @ SEA LEVEL	.247	188	90.41	1.3395	1.027	.3440	1.374	1.718
		RGW (72-1000#B) FDLGE @ S.L.	.247	188	90.41	1.2369	1.027	.3440	1.270	1.614
22	732	DGW FDLGE @ SEA LEVEL	.247	188	90.41	1.3395	1.042	.3280	1.395	1.723
23	766	MFW LAA @ 5000'	.416	311	213.1	.5690	1.048	-.0065	.596	.5895
		MFW ILAA @ 5000'	.416	311	213.1	-.2732	1.048	-.0065	-.286	-.2425
		DGW LAA @ 35000'	.597	396	124.27	1.1857	1.048	-.0065	1.242	1.2335

CALCULATED BY [signature] CLIFTON	TABLE II	DOC NO FZS-36-242 XB-36

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FORT WORTH DIVISION FORT WORTH TEXAS
FW 455 ... 11-43

TABLE III CHORDWISE AIRLOAD DISTRIBUTION XB-36 WING BULKHEAD #3

X/C	DESIGN GROSS WEIGHT / LAA @ 5000' *C_L = -.3722 $(\Delta P/q)_U$ FZS-36-142 FIG 1.5	$(\Delta P/q)_L$ FIG 1.6	*LIMIT q = 213.1 ΔP_U	ΔP_L	P_{NET}	AGW (73-1000# BOMBS) HAA @ 5000' *C_L = 1.4338 $(\Delta P/q)_U$ FZS-36-142 FIG. 1.1	$(\Delta P/q)_L$ FIG 1.2	*LIMIT q = 101.7 ΔP_U	ΔP_L	P_{NET}	AGW (72-1000# BOMBS) LAA @ 5000' *C_L = .7318 $(\Delta P/q)_U$ FZS-36-142 FIG 1.5	$(\Delta P/q)_L$ FIG 1.6	*LIMIT q = 213.1 ΔP_U	ΔP_L	P_{NET}
0	1.03	1.03	219	219	0	1.00	+1.00	+101.7	+101.7	0	+1.03	1.03	+219	+219	0
.005	.97	-.73	207	-156	+363	-3.02	+1.00	-307	+101.7	-409	-.49	.83	-104	+177	-281
.010	.88	-1.06	188	-226	+414	-3.02	+1.00	-307	+101.7	-409	-.59	.74	-126	158	-284
.025	.68	-1.36	145	-290	+435	-3.00	+.96	-305	+98	-403	-.82	.48	-175	102	-277
.050	.44	-1.36	94	-290	+384	-2.73	+.87	-278	+88	-366	-1.03	.24	-219	+51	-270
.10	.08	-1.23	17	-262	+279	-2.32	+.64	-236	+65	-301	-1.24	-.01	-264	-2	-262
.20	-.35	-1.12	-75	-239	+164	-2.04	+.30	-208	+31	-239	-1.37	-.24	-292	-51	-241
.30	-.54	-.975	-115	-208	+93	-1.77	+.13	-180	+13	-193	-1.34	-.36	-286	-77	-209
.40	-.57	-.77	-121	-164	+43	-1.38	+.07	-140	+7	-147	-1.15	-.30	-245	-64	-181
.50	-.485	-.50	-103	-107	+4	-1.03	+.08	-105	+8	-113	-.90	-.18	-192	-38	-154
.60	-.35	-.28	-75	-60	-15	-.68	+.10	-69	+10	-79	-.63	-.04	-134	-9	-125
.70	-.19	-.11	-40	-23	-17	-.41	+.13	-42	+13	-55	-.39	+.04	-83	+9	-92
.80	-.045	+.04	-10	+9	-19	-.18	+.22	-18	+22	-40	-.14	+.16	-30	34	-64
.90	+.10	+.24	+21	+51	-30	+.03	+.32	+3	+33	-30	+.10	+.29	+21	+62	-41
1.00	+.24	+.24	+51	+51	0	+.21	+.21	+21	+21	0	+.24	+.24	+51	+51	0

* REF: TABLE II R-5

BY: [illegible]
CHECKED: [illegible]

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FORT WORTH DIVISION FORT WORTH, TEXAS
FW 312 125 PADS 11-43

TABLE IV CHORDWISE AIRLOAD DISTRIBUTION - BLKD #13

X/C	DESIGN GROSS WEIGHT @ 5000' L.A.A.					DESIGN GROSS WEIGHT @ 5000' I.L.A.A.					R.G.W. (72-1000# BOMBS) @ 5000' L.A.A.				
	*Cℓ = +.767		*LIMIT q = 213.1 #/□'			*Cℓ = -.404		LIMIT q = 213.1 #/□'			*Cℓ = +.721		LIMIT q = 213.1 #/□'		
	$(\Delta p/q)_U$ FZS-36-142 P.I-16	$(\Delta p/q)_L$ P.I-17	Δp_U	Δp_L	p_{NET}	$(\Delta p/q)_U$ FZS-36-142 P.I-16	$(\Delta p/q)_L$ P.I-17	Δp_U	Δp_L	p_{NET}	$(\Delta p/q)_U$ FZS-36-142 P.I-16	$(\Delta p/q)_L$ P.I-17	Δp_U	Δp_L	p_{NET}
0	+1.03	+1.03	+219.5	+219.5	0	+1.03	+1.03	+219.5	+219.5	0	+1.03	+1.03	+219.5	+219.5	0
.005	-.565	+.860	-120.4	+183.3	-303.7	+.980	-.810	+208.7	-172.5	+381.2	-.445	+.820	-94.8	+174.7	-269.5
.010	-.660	+.770	-140.6	+164.1	-304.7	+.894	-1.150	+190.4	-245.0	+435.4	-.555	+.720	-118.3	+153.4	-271.7
.025	-.880	+.515	-187.5	+109.7	-297.2	+.707	-1.430	+150.6	-304.6	+455.2	-.790	+.455	-168.3	+97.0	-265.3
.050	-1.090	+.280	-232.3	+59.7	-292.0	+.475	-1.410	+101.1	-300.5	+401.6	-1.000	+.225	-213.1	+47.9	-261.0
.10	-1.285	+.015	-273.8	+3.2	-277.0	+.100	-1.265	+21.3	-269.6	+290.9	-1.210	-.025	-257.8	-5.3	-252.5
.20	-1.420	-.220	-302.6	-46.9	-255.7	-.330	-1.140	-70.3	-242.8	+172.5	-1.360	-.250	-289.8	-53.3	-236.5
.30	-1.370	-.340	-291.9	-72.5	-219.4	-.515	-.990	-109.7	-211.0	+101.3	-1.330	-.365	-283.4	-77.8	-205.6
.40	-1.170	-.280	-249.3	-59.7	-189.6	-.550	-.780	-117.1	-166.2	+49.1	-1.140	-.305	-242.9	-65.0	-177.9
.50	-.905	-.165	-192.9	-35.2	-157.7	-.475	-.510	-101.2	-108.7	+7.5	-.885	-.183	-188.6	-39.0	-149.6
.60	-.635	-.035	-135.3	-7.5	-127.8	-.340	-.290	-72.5	-61.8	-10.7	-.625	-.042	-133.2	-8.9	-124.3
.70	-.390	+.045	-83.1	+9.6	-92.7	-.190	-.114	-40.5	-24.3	-16.2	-.384	+.035	-81.8	+7.5	-89.3
.80	-.140	+.160	-29.8	+34.1	-63.9	-.040	+.035	-8.5	+7.5	-16.0	-.140	+.160	-29.8	+34.1	-63.9
.90	+.075	+.290	+16.0	+61.8	-45.8	+.108	+.240	+22.4	+51.1	-28.7	+.080	+.286	+17.0	+60.9	-43.9
1.00	+.240	+.240	+51.1	+51.1	0	+.240	+.240	+51.1	+51.1	0	+.240	+.240	+51.1	+51.1	0

*REF: TABLE II P-5

CALC. BY: B.C. Hey
CHKD. BY: Mefford

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FORT WORTH DIVISION — FORT WORTH, TEXAS
FW 833 125 PADS 11-43

TABLE V CHORDWISE AIRLOAD DISTRIBUTION - BLKHD. #19

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Model XB-36
Date 10-47

X/C	DESIGN GROSS WEIGHT, FDLGE @ SEA LEVEL — *C_L = 1.718		*LIMIT q = 90.41 #/□'			R.G.W. - (72-1000# BOMBS), FDLGE @ SEA LEVEL — *C_L = 1.614		*LIMIT q = 90.41 #/□'		
	$(\Delta p/q)_u$	$(\Delta p/q)_L$	Δp_u	Δp_L	p_{NET} #/□'	$(\Delta p/q)_u$	$(\Delta p/q)_L$	Δp_u	Δp_L	p_{NET} #/□'
	FBS-36-142 PI-18	PI-19				PI-8	PI-1?			
0	+.98	+1.00	+89	+90	-1	+1.00	+1.00	+90	+90	0
.005	-1.20	+1.00	-108	+90	-198	-.82	+1.00	-74	+90	-164
.01	-1.28	+1.00	-116	+90	-206	-.93	+.98	-84	+89	-173
.025	-1.45	+.74	-131	+67	-198	-1.15	+.64	-104	+58	-162
.05	-1.65	+.56	-149	+51	-200	-1.41	+.45	-128	+41	-169
.10	-1.60	+.30	-145	+27	-172	-1.42	+.22	-128	+20	-148
.20	-1.84	+.14	-166	+13	-179	-1.71	+.08	-155	+7	-162
.30	-1.82	+.08	-164	+7	-171	-1.72	+.02	-155	+2	-157
.40	-1.64	+.13	-148	+12	-160	-1.56	+.10	-141	+9	-150
.50	-1.41	+.25	-127	+23	-150	-1.36	+.22	-123	+20	-143
.60	-1.22	+.36	-110	+33	-143	-1.18	+.34	-107	+31	-138
.70	-.98	+.42	-89	+38	-127	-.96	+.42	-87	+38	-125
.80	-.36	+.48	-33	+43	-76	-.37	+.48	-33	+43	-76
.835	+.25	+.22	+23	+20	+3	+.24	+.20	+22	+18	+4

* REF: TABLE II P-5

By: [illegible]
Chkd By: [illegible]

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS

FW 033 125 PADS

TABLE VI

CHORDWISE AIRLOAD DISTRIBUTION
WING BULKHEAD # 22

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DESIGN GROSS WEIGHT - FLAPS DOWN - LANDING GEAR EXTENDED

$\frac{X}{C}$	* $C_L = 1.723$		* LIMIT q = 90.41		
	$(\Delta P/q)_U$	$(\Delta P/q)_L$	ΔP_U	ΔP_L	$P_{NET.}$
0	+.98	+1.10	+88.6	+99.5	-10.9
.005	-1.22	+1.10	-110.3	+99.5	-209.8
.01	-1.30	+1.00	-117.5	+90.4	-207.9
.025	1.47	+0.75	-132.9	-67.8	-200.7
.05	-1.66	+0.56	-150.1	+50.6	-200.7
.10	-1.61	+0.31	-145.6	+28.0	-173.6
.20	-1.85	+0.14	-167.3	+12.7	-180.0
.30	-1.83	+0.08	-165.5	+7.2	-172.7
.40	-1.64	+0.14	-148.3	+12.7	-161.0
.50	-1.41	+0.25	127.5	22.6	-150.1
.60	-1.22	+0.35	-110.3	+31.6	-141.9
.70	-0.98	+0.42	-88.6	+38.0	-126.6
.80	-0.36	+0.48	-32.5	+43.4	-75.9
.835	+0.25	+0.22	+22.6	+19.9	+2.7
.90					
.100					

* REF: TABLE II P. 5

CALCULATED BY Grabtaw
CHECKED BY Canfield

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FORT WORTH DIVISION
FW 833 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

WING BULKHEAD #23

TABLE VII CHORDWISE AIRLOAD PRESSURE DISTRIBUTION

% CHORD (X/C)	MFW-LAA @ 5000 FEET					MFW-IL9A @ 5000 FEET				
	*C_L = .5895, *q = 213.1 (LIMIT), *M = .416					*C_L = -.2925, *q = 213.1 (LIMIT), *M = .416				
	$\Delta P/q_U$	$\Delta P/q_L$	ΔP_U	ΔP_L	P_{NET}	$\Delta P/q_U$	$\Delta P/q_L$	ΔP_U	ΔP_L	P_{NET}
1	2	3	4	5	6	7	8	9	10	11
			q × 1	q × 2				q × 7	q × 8	
0	+1.03	+1.03	+220	+220	0	+1.03	+1.03	+220	+220	0
.005	-.14	+.64	-30	+136	-166	+.94	-.52	+200	-111	+311
.010	-.28	+.52	-60	+111	-176	+.83	-.83	+177	-177	+354
.025	-.56	+.28	-119	+60	-179	+.61	-1.18	+130	-251	+381
.050	-.76	+.07	-162	+15	-177	+.37	-1.21	+79	-258	+337
.100	-1.00	-.15	-213	-32	-181	+.01	-1.12	+2	-238	+240
.200	-1.20	-.36	-256	-77	-179	-.41	-1.05	-87	-224	+137
.300	-1.23	-.45	-262	-96	-176	-.58	-.93	-124	-198	+74
.400	-1.01	-.37	[illegible]	-79	-147	-.60	-.74	-128	-158	[illegible]
.500	-.84	-.24	-179	-51	-128	-.51	-.48	-109	-102	-7
.600	-.59	-.08	-126	-17	-109	-.37	-.26	-79	-55	-24
.700	-.36	+.02	-77	+4	-81	-.21	-.10	-45	-21	-24
.800	-.12	+.14	-26	+30	-56	-.05	+.06	-11	+13	-24
.900	+.08	+.28	+17	+60	-43	+.10	+.24	+21	+51	-30
1.000	+.24	+.24	+51	+51	0	+.24	+.24	+51	+51	0

* REF: TABLE II P-5

PREPARED BY: RUSSELL 11/3/47
CHECKED BY: Canfield 11/21/47

WING BULKHEAD #0.0
(36W100)

INDEX

TITLE PAGE

WING BULKHEAD #0.0
(36W100)

INTRODUCTION

The structure of Bulkhead #0.0 for the XB-36 is identical to that used for the B-36A. All design loads for both airplanes are determined from wing stresses and bending moments. The distribution of these loads is similar for corresponding XB and B-36 conditions. Since the bulkhead web shears and flange loads are proportional to the wing bending stresses for corresponding conditions, it is expected that web shears and flange loads will increase by the average percentage difference of the XB-36 over the B-36A stresses. Table VIII , page 14 will show 10% to be a conservative estimate of this increase.

All webs, flanges, web splices and web flange attachments have margins appreciably in excess of 10% and it is therefore felt to be unnecessary to reanalyze these items for the XB-36 Airplane.

Some of the vertical stiffeners have low margins and inasmuch as a portion of their loading is a function of crushing loads, a quantity that varies as the square of the wing bending moment, all the stiffeners will be checked for the higher XB-36 loads. The methods and assumptions used will be the same as for Bulkhead #0.0 on the B-36A Airplane. (Ref. FZS-36-142).

The following condition imparts critical stiffener loading:

R.G.W. 226,730# (72-1000# Bombs) L.A.A. @ 5000'

Note: This airplane configuration also produces critical stiffener loads for the B-36A Airplane.

ANALYSIS Wing, Part III
PREPARED BY Russell
CHECKED BY [illegible]
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

VERTICAL STIFFENER ANALYSIS — WING BLKD. # 0.0

ALL SECTION PROPERTIES, ALLOWABLES, AND ASSUMPTIONS ARE THE SAME AS FOR THE B-36A ANALYSIS. SEE REPORT No. FZS-36-142, PAGE I-71.

CRUSHING LOADS

$M'_x = 151,000,000''^{\#}$ (REPT. FZS-36-241, P. 63)
$I_x = 162,647''^4$
$h = 81.2'' = (I/Q)_x$
$L = 41.025''$
$w = M^2/EIh$ #/"

NET CRUSH. LOAD ON BLKD $= wL = \dfrac{(M'_x)^2 L}{EI_x (I/Q)_x}$

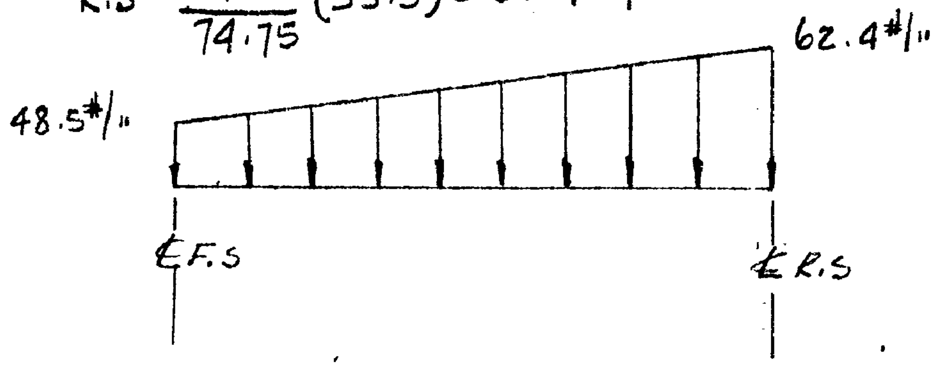
$$P_{CR} = \frac{(151\times 10^6)^2\, 41.025}{(10.3\times 10^6)\,162,647\times 81.2} = 6875^{\#}$$

$$\text{AVERAGE } P_{CR} = \frac{6875}{124} = 55.5 \text{ \#/"}$$

AV SPAR DEPTH = 74.75"

$$w_{F.S} = \frac{65.46}{74.75}(55.5) = 48.5 \text{ \#/"}$$

$$w_{R.S} = \frac{84.03}{74.75}(55.5) = 62.4 \text{ \#/"}$$



FW 444 6-46 UTILITY REPORT SHEET

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS

FW 833 125 PADS 11-45

REPT No. FZS-36-2[illegible]
MODEL XB-36
DATE 10-23-4[illegible]
BY: [illegible] Russell
CHK: B. [illegible]

TABLE VIII
BLKD *0.0 - WING O.S. - VERTICAL STIFFENER
LOADS DUE TO SKIN-STRINGER STRESSES
L.A.A. - H.S. @ 500' - R.G.W. =

ELEMENT No.	STR. STRESS B-36A	STR. STRESS XB-36	RATIO OF STRESS	V * B-36A	V * XB-36
1	2	3	4	5	6
	FZS-36-142 PAGE I-73	FZS-36-241 PAGE 37	③/②	FZS-36-142 PAGE I-78	④ x ⑤
	LOWER SURFACE				
1	34 820	37 340	1.072	19 023	20 400
2	34 800	37 370	1.076	21,686	23 400
3	34 424	37 [illegible]	1.080	22081	23 800
4	33 740	36 500	1.082	21885	23 700
5	32 582	35 230	1.082	21047	22 800
6	31 178	33 870	1.087	20395	22 200
7	[illegible]	31 770	1.092	19309	21 100
8	[illegible]	29 010	1.105	17737	19 500
9	23 560	26 050	1.105	16928	18 700
10	20 930	23 230	1.110	9663	10 700
	UPPER SURFACE				
11	-34 750	-37,440	1.072	-1901	-2040
12	[illegible]	-39,450	1.075	+2014	+2160
13	-38 072	-40,960	1.078	1825	1970
14	-38 900	-41,890	1.078	1707	1840
15	-38 148	-42 950	1.106	1034	1140
16	-40 350	-43 850	1.084	1799	1950
17	-40,852	-44370	1.085	500	540
18	-41 478	-44910	1.082	244	264
19	-41186	-44730	1.086	0	0
20	-41 007	-44630	1.090	-260	-284
21	-40 727	-44330	1.090	-573	-625
22	[illegible]	-43 870	1.092	-747	-815
23	-39 520	-43 250	1.095	-1026	-1123
24	[illegible]	-42 470	1.095	-1372	-1502
25	-37 180	-41150	1.096	-1004	-1100
26	-35 [illegible]	-39100	1.100	-1858	-2040

* POSITIVE LOADS ACT UP

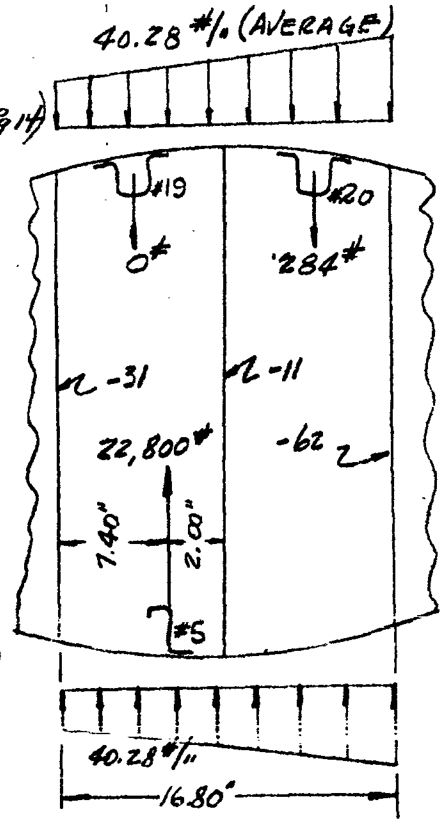
✓

VERTICAL STIFFENER ANALYSIS (CONT'D) WING BLKD. #0.0

CALCULATION OF STIFFENER END LOADS (EXAMPLE)

STIFFENER -11 (FWD):
CRUSHING = 49.28 #/"
#19 = 0#
#20 = 284# (DOWN)
#5 = 22,800# (UP)

(REF. PG 14)



CRUSHING:

$P_u = \frac{49.28(16.80)}{2} = 415^{\#}$ (DOWN)

$P_L = \quad 415^{\#}$ (UP)

ELEMENT:

$P_u = \frac{0+284}{2} = 142^{\#}$ (DOWN)

$P_L = \frac{7.40}{9.40}(22,800) = 17,960^{\#}$ (UP)

TOTAL STIFF. LOADS:

$P_{u(TOTAL)} = 415 + 142 = 557^{\#}$ (DOWN)

$P_{L(TOTAL)} = 415 + 17960 = 18,375^{\#}$ (UP)

THE STIFFENER END LOADS AS LISTED IN TABLE COL. 8 AND 9 WERE COMPUTED IN A SIMILAR MANNER.

CONSOLIDATED VULTEE AIRCRAFT CORPORATION TABLE IX BLKD #0.0 - WING C.S. - VERT. STIFFENER DESIGN PAGE 16

FORT WORTH DIVISION FORT WORTH, TEXAS

FW 655 125 PADS 11-43

L.A.A. - H.S. @ 5000' - R.G.W. = 226730#

REPORT No: FZS-36-242
MODEL : XB-36
DATE : 10-23-47
BY : [illegible]
CHK : [illegible]

STIFF DASH No.	A_S (STIFF. AREA)	A_P (WEB AREA)	A_T (TOTAL AREA)	L	ρ	L/ρ	I_{S-P}	P_U	P_L	$P_{AVE.}$ *	$f_{c\ AVE}$ *	σ_S	f_c	$f_{c\ MAX}$	F_c	M.S. CRIP.	M.S. COL.
	1	2	3 2①+②	4	5	6 ④/⑤	7	8	9	10 (⑧+⑨)/2	11 ⑩/③	12 CVAC #1 R7.437	13 ⑪+⑫	14 ⑨/③	15	16 62,800/⑫ -	17 ⑮/⑬-1
-18	.2298	.0566	.5162	65.70	1.204	54.5	.7486	+1610	-9685	4843	9380	45	9425	18,760	34600	+2.35	+2.67
-17	.2298	.0566	.5162	69.20	1.204	57.4	.7486	+1542	-9843	4922	9530	990	10520	19060	31100	+2.29	+1.96
-16	.2298	.0566	.5162	72.37	1.204	60.0	.7486	+1072	-13268	6634	12850	3550	16400	25700	28500	+1.45	+.74
-15	.2298	.0566	.5162	75.20	1.204	62.4	.7486	+1115	-13240	6620	12800	6870	19670	25600	26300	+1.45	+.34
-14	.2872	.1430	.7174	77.65	1.149	67.6	.9458	+851	-15344	7672	10,700	2075	12775	21400	22500	+1.94	+.76
-13	.2872	.1430	.7174	79.55	1.149	69.3	.9458	-18	-14150	7069	9870	3450	13320	19700	2150[illegible]	+2.19	+.67
-31	.2872	.1430	.7174	80.95	1.149	70.5	.9458	-310	-13782	7046	9830	4630	14460	19200	20900	+2.27	+.45
-11	.2872	.1430	.7174	81.97	1.149	71.4	.9458	-557	-18375	9466	13200	6280	19480	25600	20000	+1.4[illegible]	+.03
-6	.2872	.1430	.7174	82.1[illegible]	1.149	71.7	.9458	-860	-13305	7083	9870	7090	16960	18600	19800	+2.[illegible]	+.17
-12	.2872	.2268	.8012	82.48	1.108	74.4	.9838	-1220	-15590	8405	10500	4300	14800	19500	18400	+2.22	+.24
-11	.2872	.2268	.8012	82.14	1.108	74.3	.9838	-1390	-19971	10681	13350	5070	18420	25000	18500	+1.51	+.003
-10	.2872	.2268	.8012	81.44	1.108	73.5	.9838	-1693	-5330	3512	4380	4040	3620	6650	18800	+8.42	+1.18
-9	.2872	.2268	.8012	80.46	1.108	72.6	.9838	-1776	-18925	10351	12900	5450	18350	23600	19300	+1.66	+.05

POSITIVE LOADS, [illegible] TENSION IN STIFFENERS

* TENSION LOADS ARE CONSERVATIVELY NEGLECTED.

SEE TABLE I-XL, REPORT FZS-36-[illegible], PAGE I-111 FOR [illegible] PROPERTIES

WING BULKHEAD STA. 10
(36W110)

DISCUSSION

The bulkhead structure at wing Sta. 10 is the same on the B-36A and XB-36. This bulkhead is designed by the stiffness required to stabilize the plate stringers. (Ref. FZS-36-142, P. I-125).

The critical conditions are, those giving maximum stringer loads "P" Cond. I; Alternate Gross Weight, 265,000#, (72-1000# Bombs) H.A.A. @ 5000' and, Cond. II; Design Gross Weight, 265,192#, L.A.A., H.S. @ 5000'.

The values for "P" (stringer load in lbs), crushing loads, and airloads will be ratioed from the loads on the B-36A. P_{cr} (Critical stringer load for two bay length) remains unchanged for the XB-36 since it is a function of stringer stiffeness and column length. "P" is ratioed in proportion to the respective bending moments. The crushing loads are directly proportional as the square of the bending stress, therefore, will be ratioed in proportion to the square of the bending moment ratios. The air load will be ratioed in proportion to the total airload.

WING BULKHEAD STA 10.

THE CRITICAL "P" FOR THE B-36A WILL BE RATIOED, IN PROPORTION TO THEIR RESPECTIVE BENDING MOMENTS, TO OBTAIN THE "P" VALUES FOR THE XB-36. (P = STRINGER LOAD, LBS)

B-36A BEND. MOM. (REF. FZS-36-192, PG. I-133)

CONDITIONS:

I. D.G.W., H.A.A. @ 5000 FT.
II. D.G.W., L.A.A. @ 5000 FT.

STA. 10

COND. I B.M. = 98,260,000 "#
COND. II B.M. = 99,205,000 "#

STA. 11

COND. I B.M. = 95,740,000 "#
COND. II B.M. = 96,547,000 "#

XB-36 BEND. MOM. (REF. FZS-36-240, PGS. 234 + 235)

CONDITIONS:

I. A.G.W. 265,000# (72-1000# BOMBS) HAA @ 5000 FT.
II. D.G.W. L.A.A. @ 5000 FT.

STA. 10

COND. I B.M. = 95,400,000 "#
COND. II B.M. = 99,000,000 "#

STA. 11

COND. I B.M. = 91,200,000 "#
COND. II B.M. = 95,400,000 "#

WING BULKHEAD STA. 10

BENDING MOMENT RATIOS

STA. 10

COND. I, $R_1 = \frac{95,400,000}{98,260,000} = .97$

COND. II, $R_2 = \frac{99,500,000}{99,205,000} = 1.003$

STA. 11

COND. I, $R_1 = \frac{91,200,000}{95,740,000} = .952$

COND. II, $R_2 = \frac{95,400,000}{96,547,000} = .989$

AVERAGE RATIO FOR COND. I $= \frac{.97 + .952}{2} = \underline{.961}$

AVERAGE RATIO FOR COND. II $= \frac{1.003 + .989}{2} = \underline{.996}$

CRITICAL P (B-36A) = 151,200#, COND. I
= 113,000#, COND. II
(REF. FZS-36-142 PG. I-133)

P (XB-36):

COND. I = 151,200 X .961 = 146,200#

COND. II = 113,000 X .996 = 112,500#

P_{CR} (XB-36):
COND I = 125,100#
COND II = 97,200#
(REF FZS-36-142 PG I-133)

$P - P_{CR}$ (XB-36):

COND. I = 146,200 − 125,100 = 21,100#

COND. II = 112,500 − 97,200 = 15,300#

WING BULKHEAD STA. 10

THE AIRLOAD TO THE BULKHEAD FOR THE B-36A WILL BE RATIOED FOR THE XB-36 IN PROPORTION TO THEIR RESPECTIVE TOTAL AIRLOAD VALUES. CONDITIONS ARE THE SAME AS SHOWN ON PG.

B-36A

COND. I , $\frac{Z}{W} = +2.691$ (REF FZS-36-136 PG. 30) GW = 278,000#

COND II , $\frac{Z}{W} = +2.745$ ″

COND. I , $Z = 2.691 \times 278{,}000 = 747{,}000^{\#}$

COND. II , $Z = 2.745 \times 278{,}000 = 763{,}000^{\#}$

XB-36

COND. I , $\frac{Z}{W} = +2.697$ (REF FZS-36-126 PG. 45) GW = 265,000#

COND II , $\frac{Z}{W} = +2.887$ GW = 265,192#

COND. I , $Z = 2.697 \times 265{,}000 = 715{,}000^{\#}$

COND II , $Z = 2.887 \times 265{,}192 = 765{,}000^{\#}$

AIRLOAD RATIOS

COND I , $K_1 = \frac{715\,000}{747\,000} = .957$

COND II , $K_2 = \frac{765\,000}{763\,000} = 1.002$

AIRLOAD (B-36A), COND. I = −56.1 #/IN. ; COND. II = −72.2 #/IN. (REF FZS-36-142 PG. I-136)

AIRLOAD (XB-36), COND I = −56.1 × .957 = −53.6 #/IN.

COND II = −72.2 × 1.002 = −72.4 #/IN.

WING BULKHEAD STA 10

THE CRUSHING LOADS WILL BE RATIOED ACCORDING TO THE SQUARES OF THE BEND. MOM. RATIOS. CONDITIONS ARE SAME AS ON PG.

$$\text{RATIO (COND. I)} = (.961)^2 = .924$$

$$\text{RATIO (COND II)} = (.996)^2 = .992$$

CRUSHING LOADS (B-36A):

COND. I = 50.3 #/IN.
COND. II = 49.2 #/IN

{ REF FZS-36-142 PG I-136 }

CRUSHING LOADS (XB-36):

COND. I = .924 × 50.3 = 46.5 #/IN.
COND. II = .992 × 49.2 = 48.8 #/IN.

SUMMARY

COND. I:

CRITICAL P-PCR = 21,100#
ω_0 = 53.6 − 46.5 = 7.1 #/IN.

COND. II:

CRITICAL P-PCR = 15,300#
ω_0 = 72.4 − 48.8 = 23.6 #/IN.

WING BULKHEAD STA 10

CONCLUSION :

COMPARISON OF LOADS ON
B-36A AND XB-36

ITEM	B-36A (FZS-36-142) (PG I-36)	XB-36	COND.
$P-P_{CR}$	26,100#	21,100#	I
$P-P_{CR}$	15,900#	15,300#	II
ω_o*	5.8 #/IN	7.1 #/IN	I
ω_o	23.0 #/IN	23.6 #/IN	II

*ω_o = NET LOAD #/IN.

THE COMPARISON OF THE DEFLECTION OF THE THEORETICAL BEAM AND THE ACTUAL CROSS-BEAM SYSTEM FOR THE B-36A, IS MADE FOR CONDITION II, THE CONDITION HAVING THE LARGER W_o (REF. FZS-36-142, PG. I-150). A DEFLECTION OF THE CROSS BEAM SYSTEM UNDER A 23#/IN LOADING AS COMPARED TO THE DEFLECTION OF THE FICTICIOUS BEAM WITH THE REQUIRED I ($33.4 IN^4$) FOR STABILITY UNDER A CHORDWISE LOADING OF 23#/IN INDICATES A LARGE MARGIN OF SAFETY.

THE SLIGHT INCREASE IN LOADING FOR THE XB-36 SYSTEM - ω_o = 23.6#/IN VERSUS 23#/IN (B-36A) WILL BE MORE THAN OFFSET BY THE EXCESS STIFFENESS SUPPLIED BY VIRTUE OF THE DECREASE IN ($P-P_{CR}$).

WING BULKHEAD #3

INDEX

INDEX (CONT'D)

BULKHEAD #3 (36W4103)

INTRODUCTION

Wing bulkhead #3 of the XB-36 is structurally similar to bulkhead #3 of the B-36A; therefore, the description of the bulkhead and the method of analysis given on page I-154 of FZS-36-142 applies to the XB-36 bulkhead.

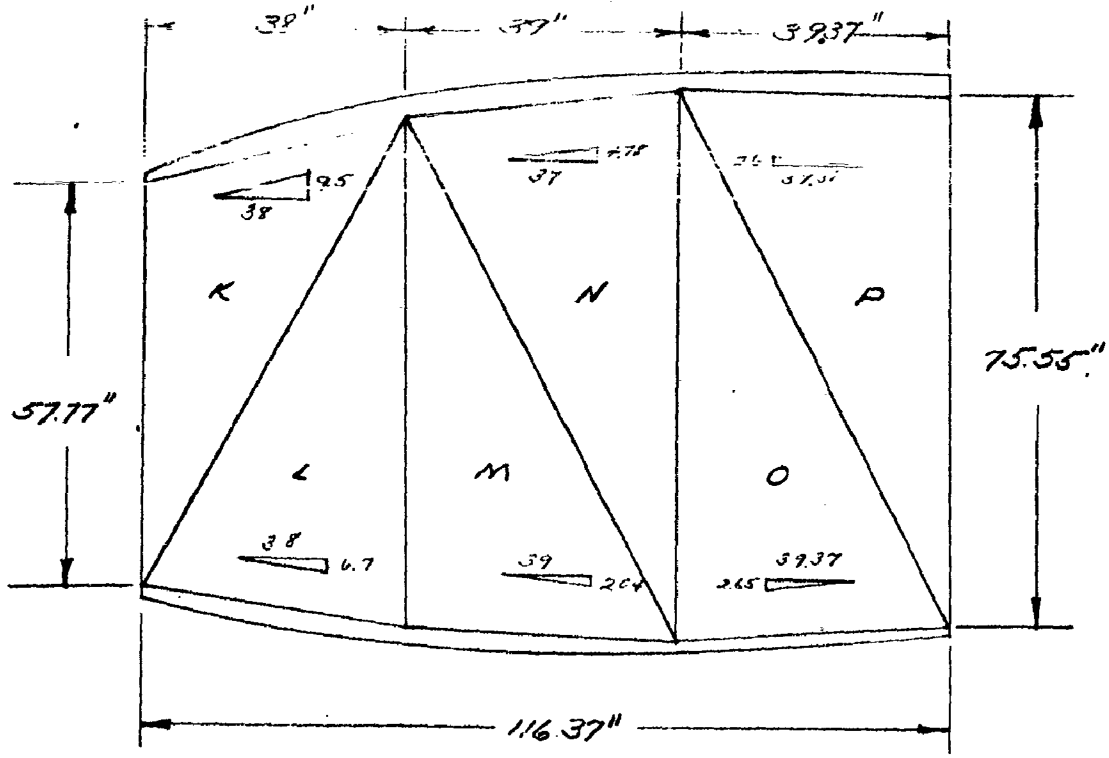
The critical loading conditions for bulkhead #3 of the XB-36 Airplane are:

I. D.G.W. (265,192#) ILAA @ 5000'

II. A.G.W. (72-1000# Bombs) HAA @ 5000'

III. A.G.W. (72-1000# Bombs) LAA A 5000'

SKETCH OF BULKHEAD #3



CHORDWISE AIR LOAD DISTRIBUTION
BULKHEAD 3
(SEE TABLE III)

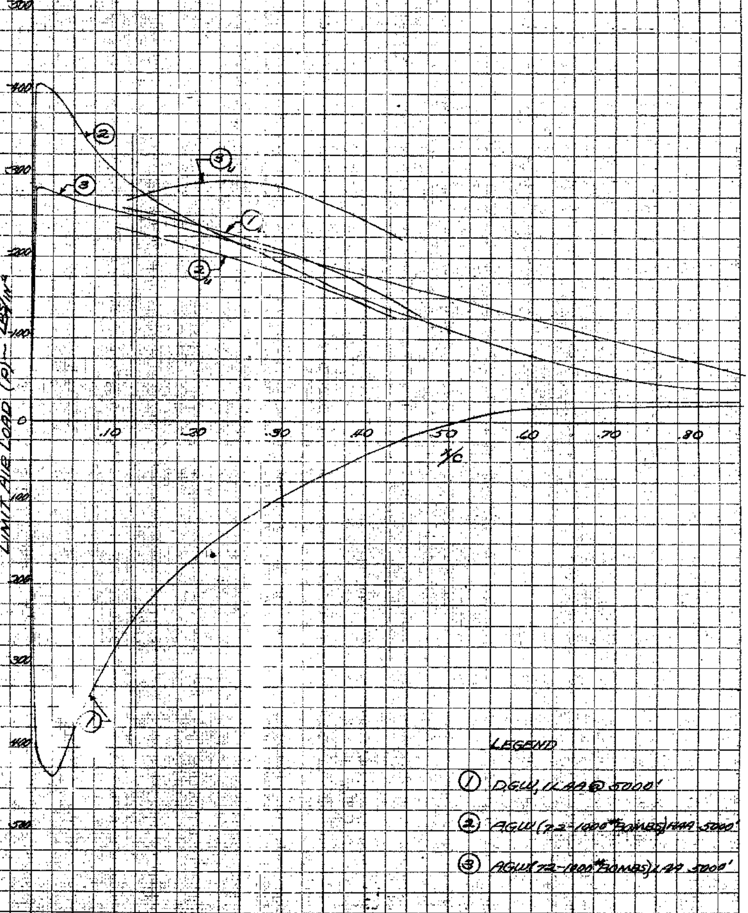


FIGURE 1

CALCULATED BY	[illegible]	10/47
DRAWN BY	[illegible]	10/47
CHECKED BY	[illegible]	10/47
APPROVED BY		

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS

DOC. NO. FZS-36-242
MODEL XB-36

CONSOLIDATED VULTEE AIRCRAFT CORPORATION T.A.S. XI
FORT WORTH DIVISION FORT WORTH, TEXAS
FW 833 125 PADS 11-43

COMPUTATION OF *N_L, N_{IS}, N_{LS}, M_L, M_{IS} & M_{LS} FOR AIR LOADS
XB-36 SIKHS #3 DGW 265192# (L.A.) @ 5000'

PAGE
REPORT No FZ[illegible]
XB-36
DATE 5-49

LEADING EDGE AIR LOAD

1 Distance from L.E. % Chord	2 Limit P #/in' (Fig 1)	3 Average P	4 Load Increment ③×.01	5 Distance to C.G. from 12%	6 Δ Moment about 12% Line ④×⑤
0	0				
		375	3.75	.114	.428
1	414				
		422	4.22	.105	.444
2	430				
		430	4.30	.095	.409
3	430				
		420	4.20	.085	.357
4	410				
			16.47		1.638

	P #/in' (Fig. 1)	SM	②×③	Moment Multiplier	④×⑤
4	410	1	410	4	1640
6	351	4	1403	3	[illegible]
8	315	2	630	2	1260
10	279	4	1116	1	1116
12	247	1	247	0	0
			5131		[illegible]

COMPOSITE INTERSPAR AIR LOADS

7 Distance from L.E. % Chord	8 P #/in' Limit (Figure 1)	9 SM	10 ⑧×⑨	11 Moment Multiplier	12 ⑩×⑪
43.000	30	1	30	8	240
39.125	45	4	180	7	1260
35.250	65	2	130	6	780
31.375	86	4	344	5	1720
27.500	109	2	218	4	872
23.625	137	4	548	3	1644
19.750	167	2	334	2	668
15.875	[illegible]	4	[illegible]	1	[illegible]
12.000	[illegible]	1	[illegible]	0	0
			2843		7776

LOWER SURFACE INTERSPAR AIR LOADS

13 Distance from L.E. % Chord	14 P #/in' Limit (Fig 1)	15 S.M.	16 ⑭×⑮	17 Moment Multiplier	18 ⑯×⑰
43.000	149	1	-149	8	-1192
39.125	-170	4	-680	7	-4760
35.250	-187	2	-374	6	-2244
31.375	-205	4	-820	5	-4100
27.500	-217	2	-434	4	-1736
23.625	-230	4	-920	3	-2760
19.750	-240	2	-480	2	-960
[illegible]	-249	4	-996	1	-996
[illegible]	-258	1	-258	0	0
			-5111		-18748

$N_L = \frac{12.2C}{144}\left[\frac{5131 \times [illegible]}{3} + 16.47\right] = 5450\#\downarrow$

$M_L = \frac{12.2C^2}{144}\left[\frac{[illegible]}{3} + [illegible]\right] = 134000''\#$

L.E. = [illegible] [illegible]

$N_{IS} = \frac{15.6C}{144}\left[\frac{.03875 \times 2843}{3}\right] = 4780\#\downarrow$

$M_{IS} = \frac{15.6C^2}{144}\left[\frac{(.03875)^2 \times 7996}{3}\right] = 195{,}000''\#$

$\bar{X} = \frac{195000}{4780} = 40.8''$

$N_{LS} = \frac{15.6C}{144}\left[\frac{.03875 \times (-5111)}{3}\right] = -8580\#\downarrow$

$M_{LS} = \frac{15.6C^2}{144}\left[\frac{(.03875)^2 \times -18748}{3}\right] = -458{,}000''\#$

$\bar{X} = \frac{458000}{8580} = [illegible]$ AFT F.S.

* DEFINITION OF TERMS:

N_L - LEADING EDGE AIRLOAD SHEAR
M_L - LEADING EDGE AIRLOAD MOMENT
N_T - TRAILING EDGE AIRLOAD SHEAR
M_T - TRAILING EDGE AIRLOAD MOMENT
N_U - UPPER SURFACE INTERSPAR AIRLOAD SHEAR
M_U - UPPER SURFACE INTERSPAR AIRLOAD MOMENT
N_{IS} - TOTAL (UPPER & LOWER) SURFACE INTERSPAR AIRLOAD SHEAR
M_{IS} - TOTAL (UPPER & LOWER) SURFACE INTERSPAR AIRLOAD MOMENT

BY: [illegible]
CHECKED: [illegible]

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS
FW 632 125 PADS 11-45

TABLE XII COMPUTATION OF *N_L, N_{IS}, N_U, M_L, M_{IS}, & M_U FOR AIR LOADS
BULKHEAD #3 AGW 72-1000# BOMBS HAA @ 5000'

PAGE
REPORT NO.
DATE 5-

1	2	3	4	5	6
DISTANCE FROM L.E. % CHORD	P #/□' LIMIT	AVERAGE P	LOAD INCREMENT	DISTANCE TO CG FROM 12%	Δ MOMENT ABOUT 12% LINE
	FIG. 1		③ × .01		④ × ⑤
LEADING EDGE AIR LOADS					
0	0				
		-350	-3.50	.114	-.399
1	-410				
		-408	-4.08	.105	-.429
2	-406				
		-400	-4.00	.095	-.380
3	-394				
		-388	-3.88	.085	-.330
4	-382				
			-15.46		-1.538

	P #/□'	SM	② × ③	MOMENT MULTIPLIER	④ × ⑤
	FIG. 1				
4	-382	1	-382	4	-1528
6	-350	4	-1400	3	-4200
8	-325	2	-650	2	-1300
10	-301	4	-1204	1	-1204
12	-288	1	-288	0	0
			-3924		-8232

7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	P #/□' LIMIT	S.M.	⑧ × ⑨	MOMENT MULTIPLIER	⑩ × ⑪
	FIG. 1				
COMPOSITE INTERSPAR AIR LOADS					
43.000	-136	1	-136	8	-1088
39.125	-151	4	-604	7	-4228
35.250	-167	2	-334	6	-2004
31.375	-186	4	-744	5	-3720
27.500	-204	2	-408	4	-1632
23.625	-223	4	-892	3	-2676
19.750	-240	2	-480	2	-960
15.875	-262	4	-1048	1	-1048
12.000	-288	1	-288	0	0
			-4934		-17356

13	14	15	16	17	18
DISTANCE FROM L.E. % CHORD	P #/□' LIMIT	S.M.	⑭ × ⑮	MOMENT MULTIPLIER	⑯ × ⑰
	FIG. 1				
UPPER SURFACE INTERSPAR AIR LOADS					
43.000	-130	1	-130	8	-1040
39.125	-144	4	-576	7	-4032
35.250	-160	2	-320	6	-1920
31.375	-175	4	-700	5	-3500
27.500	-187	2	-374	4	-1496
23.625	-200	4	-800	3	-2400
19.750	-210	2	-420	2	-840
15.875	-222	4	-888	1	-888
12.000	-231	1	-231	0	0
			-4439		-16116

$$N_L = \frac{1.5bc}{144}\left[\frac{(.02)(-3924)}{3} - 15.46\right] = -5420\ \#/''$$

$$M_L = \frac{1.5bc^2}{144}\left[\frac{(.02)^2(8232)}{3} - 1.538\right] = 128700\ ''\#/''$$

$$N_{IS} = \frac{1.5bc}{144}\left[\frac{.03875 \times -4934}{3}\right] = -8287\ \#/''$$

$$M_{IS} = \frac{1.5bc^2}{144}\left[\frac{(.03875)^2 \times (-17356)}{3}\right] = -404000\ ''\#/''$$

$$\bar{X} = \frac{424000}{8287} = 51.1''\ \text{AFT F.S.}$$

$$N_U = \frac{1.5bc}{144}\left[\frac{.03875 \times (-4439)}{3}\right] = -7456\ \#/''$$

$$M_U = \frac{1.5bc^2}{144}\left[\frac{(.03875)^2 \times (-16116)}{3}\right] = 394000\ ''\#/''$$

$$\bar{X} = \frac{394000}{7456} = 52.8''\ \text{AFT F.S.}$$

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*FOR DEFINITION OF TERMS SEE PAGE

CONSOLIDATED VULTEE AIRCRAFT CORPORATION — FORT WORTH DIVISION — FORT WORTH, TEXAS

FW 839 125 PADS 11-45

TABLE XIII COMPUTATION OF *N_L, N_S, N_W, M_L, M_S & M_W FOR AIR LOADS

BULKHEAD #3 AGW (72-1000# BOMBS) LAA @ 5000'

1	2	3	4	5	6
Distance From L.E. % Chord	p #/□' Limit	Average p	Load Increment	Distance to CG From 12%	Δ Moment About 12% Line
	Fig 1		③ x .01		
LEADING EDGE AIR LOAD					
0	0				
		-200	-2.00	.114	.228
1	-284				
		-282	-2.82	.105	.296
2	-280				
		-278	-2.78	.095	.264
3	-276				
		-274	-2.74	.085	.233
4	-272				
			-10.34		1.021

	p #/□' Fig. 1	S.M.	②×③	Moment Multiplier	④×⑤
4	-272	1	-272	4	1088
6	-266	4	-1064	3	3192
8	-262	2	-524	2	1048
10	-257	4	-1028	1	1028
12	-252	1	-252	0	0
			-3140		6356

$$N_L = \frac{1.56C}{144}\left[\frac{.02 \times (-3140)}{3} - 10.34\right] = -4060\ \#$$

$$M_L = \frac{1.56C^2}{144}\left[\frac{(.02)^2 \times 6356}{3} + 1.021\right] = 91,550\ ''\#$$

7	8	9	10	11	12
Distance From L.E. % Chord	p #/□' Limit	S.M.	⑧×⑨	Moment Multiplier	⑩×⑪
	Fig 1				
COMPOSITE INTERSPAR AIR LOADS					
43.000	-170	1	-170	8	-1360
39.125	-180	4	-720	7	-5040
35.250	-190	2	-380	6	-2280
31.375	-200	4	-800	5	-4000
27.500	-210	2	-420	4	-1680
23.425	-222	4	-888	3	-2664
19.750	-231	2	-462	2	-924
15.875	-241	4	-964	1	-964
12.000	-252	1	-252	0	0
			-5056		-18712

$$N_S = \frac{1.56C}{144}\left[\frac{.03875 \times (-5056)}{3}\right] = -8500\ \#$$

$$M_S = \frac{1.56C^2}{144}\left[\frac{(.03875)^2 \times (-18712)}{3}\right] = 461,500\ ''\#$$

$$\bar{X} = \frac{461,500}{8500} = 54.3''\ \text{AFT F.S.}$$

13	14	15	16	17	18
Distance From L.E. % Chord	p #/□' Limit	S.M.	⑧×⑨	Moment Multiplier	
	Fig 1				
UPPER SURFACE INTERSPAR AIR LOADS					
43.000	-230	1	-230	8	-1840
39.125	-248	4	-992	7	-6944
35.250	-266	2	-532	6	-3192
31.375	-281	4	-1124	5	-5620
27.500	-290	2	-580	4	-2320
23.425	-295	4	-1180	3	-3540
19.750	-291	2	-582	2	-1164
15.875	-283	4	-1132	1	-1132
12.000	-270	1	-270	0	0
			-6622		-25752

$$N_W = \frac{1.56C}{144}\left[\frac{.03875 \times (-6622)}{3}\right] = -11,100\ \#$$

$$M_W = \frac{1.56C^2}{144}\left[\frac{(.03875)^2 \times (-25752)}{3}\right] = 628300\ ''\#$$

$$\bar{X} = \frac{628,300}{11,100} = 56.6''\ \text{AFT F.S.}$$

* FOR DEFINITION OF TERMS SEE PAGE

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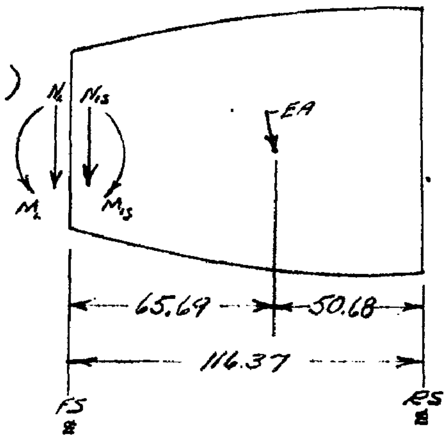
BULKHEAD #3

CONDITION I - DGW (265192#) ILAA @ 5000'

$N_L = 5450^{\#}$ (REF: TABLE XI)
$M_L = 134000''^{\#}$
$N_{IS} = 4780^{\#}$
$M_{IS} = 195000''^{\#}$
$N_{LS} = 8580^{\#}$
$M_{LS} = 458000''^{\#}$



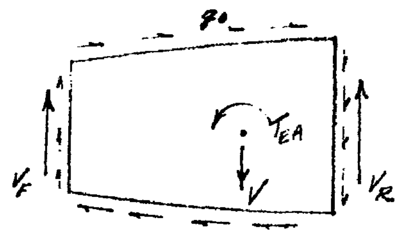
REACTIONS ON BULKHEAD

TRANSFERRING ALL EXTERNAL FORCES TO EA

$V = N_L + N_{IS} = \underline{10230^{\#}}$

$T_{EA} = M_L + M_{IS} + 65.69 \times V = \underline{611000''^{\#}}$

REACTIONS ON FS & RS DUE TO V



$V_R = \frac{65.69}{116.37} \times 10230 = \underline{5770^{\#}}$

$V_F = 10230 - 5770 = \underline{4460^{\#}}$

SHEAR FLOW DUE TO T_{EA}

$q_0 = \frac{611000}{*17830} = \underline{34.2}\ ^{\#}/_{IN}$

$*2A = 17830\ \square''$ (REF: FZS-36-141 P.206)

BULKHEAD #3

D.G.W. 265,192# ILAA @ 5000' (CONT'D)

CRUSHING LOADS

$$P = \frac{(M_x')^2 L}{I_x/Q_x \, E I}$$

$L = 33.25$

$M_x' = -66.70 \times 10^6$ (REF FZS-36-240)

$I_x/Q_x = 75.75''$

$P = 1405\#$

$I = 134,500 \text{ IN}^4$

$E = 10.3 \times 10^6$

REPLACE "P" WITH EQUIVALENT TRAPEZOID SUCH THAT $\frac{h_F}{h_R} = \frac{w_F}{w_R}$ WHERE h_F & h_R ARE CONTOUR DEPTHS OF FRONT & REAR SPAR RESPECTIVELY.

$w_F = \underline{10.54}$

$w_R = \underline{13.61}$

AIR LOADS

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPIZOIDS.

COMPOSITE INTERSPAR LOAD (N_{IS})

$w_{FC} = 77.8 \downarrow$

$w_{RC} = 4.3 \downarrow$

LOWER SURFACE LOAD (N_{LS})

$w_{FL} = 91.6 \downarrow$

$w_{RL} = 55.9 \downarrow$

UPPER SURFACE LOAD

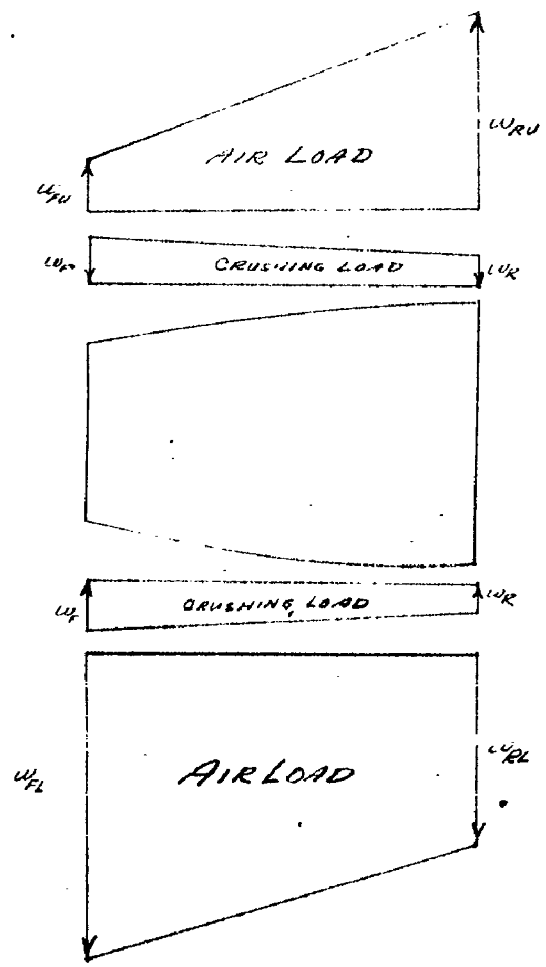
$w_{FU} = w_{FC} - w_{FL} = 13.8 \uparrow$

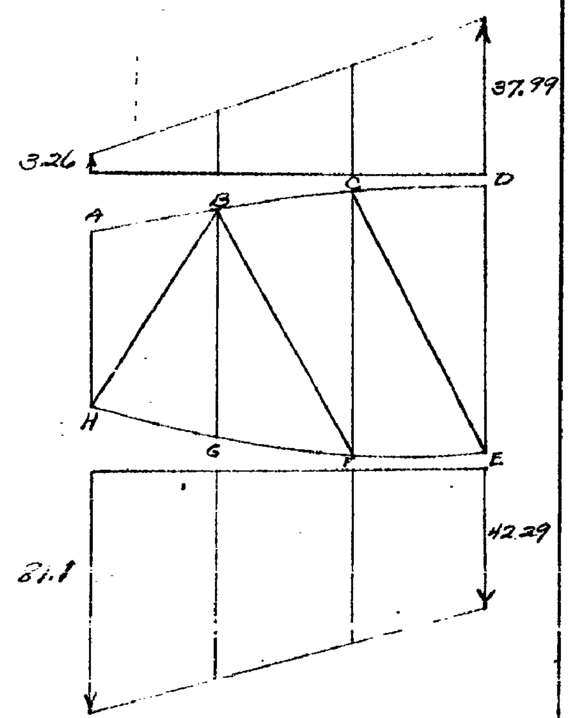
$w_{RU} = w_{RC} - w_{RL} = 51.6 \uparrow$

BULKHEAD #3

D.G.W. 265,192# 1LAA @ 5000' (CONT'D)

COMBINED AIR & CRUSHING LOADS





COMBINED LOADS

BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS

P_A = 133# ↑
P_B = 564# ↑
P_C = 1028# ↑
P_D = 670# ↑

P_E = 915# ↓
P_F = 2165# ↓
P_G = 2630# ↓
P_H = 1465# ↓

BULKHEAD #3.

D.G.W. 265192# ILAA @ 5000' (CONT'D).

CORRECTION LOADS

CORRECTING LOADS ON FRONT & REAR SPAR TO ACCOUNT FOR TRANSFER OF THE SHEAR FLOW FROM THE CONTOUR TO THE CENTROID OF THE STRAIGHT LINE CHORD MEMBER.

$$T_u = 2A_u q_o = 20{,}450''^{\#}$$

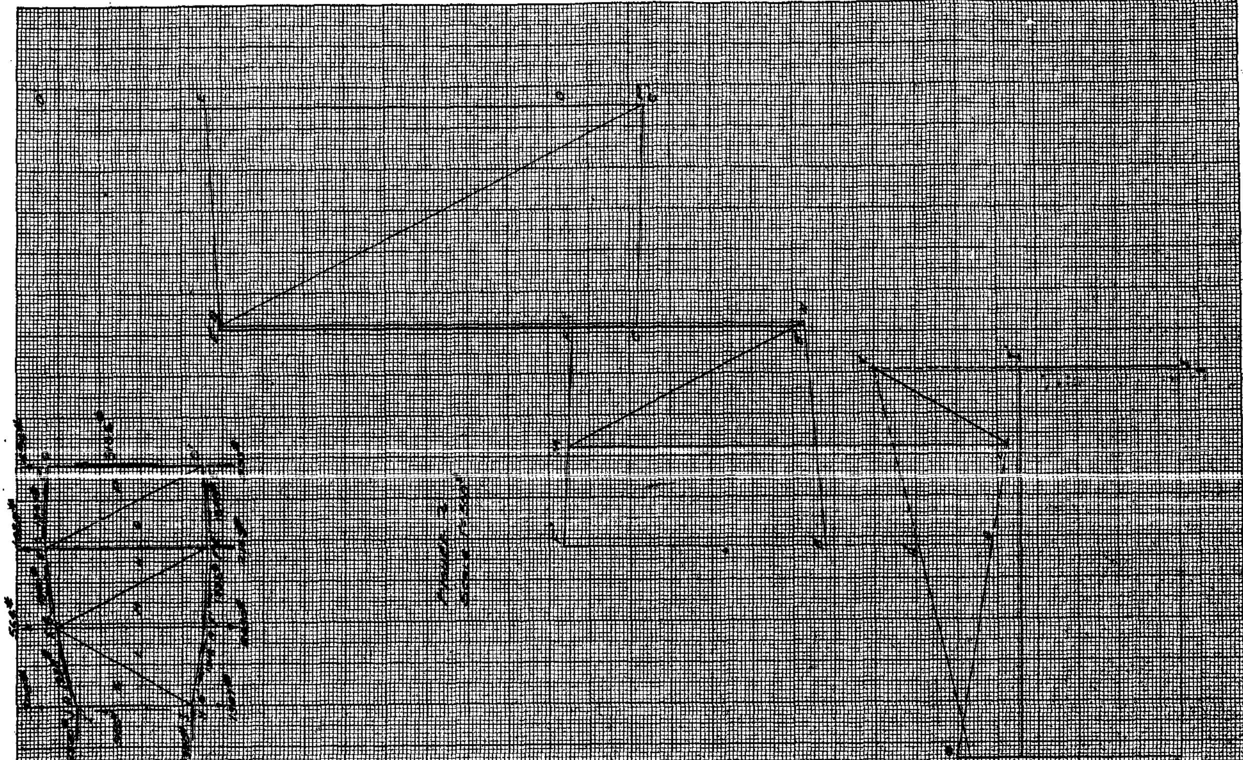
$$R_u = \frac{20450}{116.37} = \underline{175.5}^{\#}$$

$$T_L = 2A_L q_o = 9{,}050''^{\#}$$

$$R_L = \frac{9050}{116.37} = 77.7^{\#}$$

CORRECTED PANEL POINT LOADS

$P_A = 308^{\#}\downarrow$
$P_D = 494^{\#}\downarrow$
$P_E = 993^{\#}\downarrow$
$P_H = 1387^{\#}\downarrow$

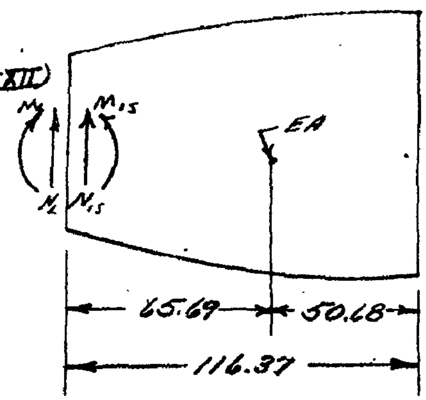


FORCE DIAGRAM

BULKHEAD #3

CONDITION II - AGW (72-1000# BOMBS) HAA @ 5000'

$N_L = 5420^{\#}\uparrow$ (REF: TABLE XII)
$M_L = 128700''^{\#}$
$N_{IS} = 8287^{\#}\uparrow$
$M_{IS} = 424000''^{\#}$
$N_W = 7456^{\#}\uparrow$
$M_W = 394000''^{\#}$



REACTIONS ON BULKHEAD

TRANSFERRING ALL EXTERNAL FORCES TO E.A.

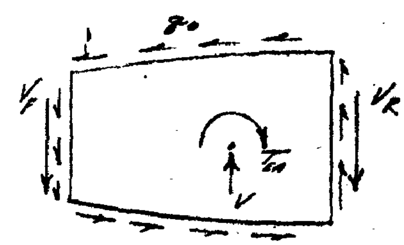
$V = N_L + N_{IS} = \underline{13707}^{\#}\uparrow$

$T_{EA} = M_L + M_{IS} + 65.69 \times V = \underline{604700}''^{\#}$

REACTIONS ON F.S. & R.S. DUE TO V

$V_R = \frac{65.69}{116.37} \times 13707 = \underline{7730}^{\#}\downarrow$

$V_F = 13707 - 7730 = \underline{5977}^{\#}\downarrow$



SHEAR FLOW DUE TO T_{EA}

$q_0 = \frac{T_{EA}}{2A} = \frac{604700}{17830} = \underline{33.9}^{\#}/\text{IN.}$

A.G.W. (72-1000# BOMBS) HAA @ 5000' (CONT'D) BULKHEAD #3

CRUSHING LOAD

$$P = \frac{(M_x')^2 L}{I_x/Q_x \, EI}$$

$M_x' = 126.20 \times 10^6$ (REF: TABLE 27, PG. 102, FZS-36-240)

$L = 33.25''$

$P = 5{,}040$

$I/Q = 75.75$

$E = 10.3 \times 10^6$

$I = 134{,}500 \text{ in}^4$

REPLACE P WITH EQUIVALENT TRAPEZOID SUCH THAT $\frac{h_F}{h_R} = \frac{w_F}{w_R}$ WHERE h_F & h_R ARE CONTOUR DEPTHS OF FRONT & REAR SPAR RESPECTIVELY.

$w_F = 37.8$
$w_R = 48.9$

AIR LOADS

REPLACING AIR LOADS WITH EQUIVALENT TRAPEZOID.

COMPOSITE INTERSPAR LOAD (N_{1S})

$w_{FC} = 97.3 \uparrow$
$w_{RC} = 45.2 \uparrow$

UPPER SURFACE LOAD

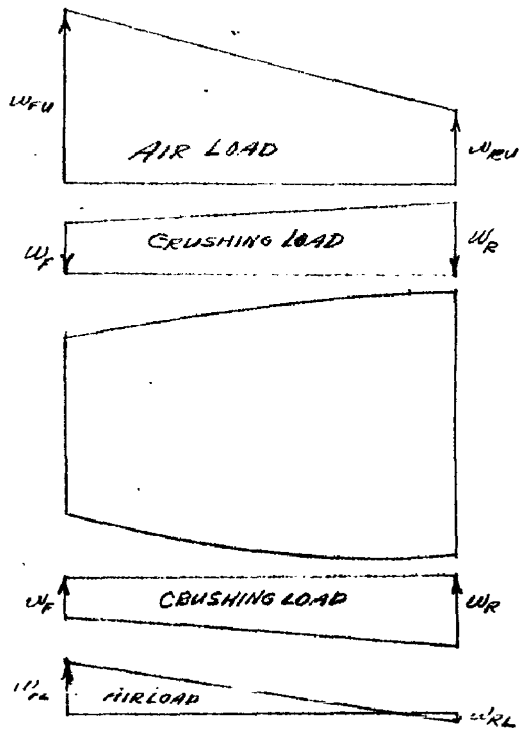
$w_{FU} = 81.7 \uparrow$
$w_{RU} = 46.6 \uparrow$

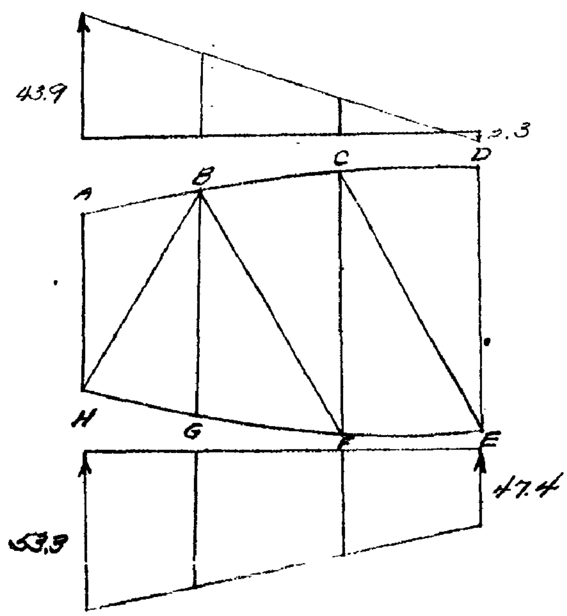
LOWER SURFACE LOADS.

$w_{FL} = 15.6 \uparrow$
$w_{RL} = -1.4 \downarrow$

A.G.W. (72-1000# BOMBS), HAA @ 5000' (CONT'D)

COMBINED AIR & CRUSHING LOADS:





COMBINED LOADS

BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS

$P_A = 775^{\#}\uparrow$	$P_E = 942^{\#}\uparrow$
$P_B = 1044^{\#}\uparrow$	$P_F = 1933^{\#}\uparrow$
$P_C = 542^{\#}\uparrow$	$P_G = 1976^{\#}\uparrow$
$P_D = 59^{\#}\uparrow$	$P_H = 1002^{\#}\uparrow$

BULKHEAD #3

A.G.W. (72-1000# BOMBS), H.A.A. @ 5000' (CONT'D)

CORRECTION LOADS

CORRECTING LOADS ON FRONT AND REAR SPAR TO ACCOUNT FOR TRANSFER OF THE SHEAR FLOW FROM THE CONTOUR TO THE CENTROID OF THE STRAIGHT LINE CHORD MEMBER.

$T_u = 2A_u q_0 = 20200''^{\#}$

$R_u = \frac{20200}{116.37} = \underline{173.5^{\#}}$

$T_L = 2A_L q_0 = 8950''^{\#}$

$R_L = \frac{8950}{116.37} = \underline{76.9^{\#}}$

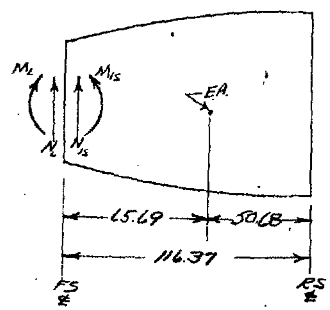
CORRECTED PANEL POINT LOADS

$P_A = 601^{\#}\uparrow$
$P_D = 233^{\#}\uparrow$
$P_E = 1019^{\#}\uparrow$
$P_H = 925^{\#}\uparrow$

BULKHEAD #3

CONDITION III. AGU! (72-1000# BOMBS) LAA @ 5000'

$N_L = 4060^{\#}\uparrow$ (REF TABLE XIII)
$M_L = 91{,}250^{"\#}$
$N_{IS} = 8{,}500^{\#}\uparrow$
$M_{IS} = 461{,}500^{"\#}$
$N_U = 11{,}100^{\#}\uparrow$



REACTION ON BULKHEAD

TRANSFERRING ALL EXTERNAL FORCES TO E.A.

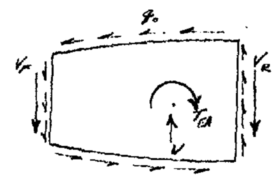
$V = N + N_u =$ [illegible] $^{\#}\uparrow$

$T_{EA} = M_L + M_{IS} + 65.69 \times V = 454{,}750^{"\#}$

REACTIONS ON F.S. & R.S. DUE TO V

$V_R = \frac{65.69}{116.37} \times 12560 = 7080^{\#}\downarrow$

$V_F = 12560 - 7080 = 5480^{\#}\downarrow$



SHEAR FLOW DUE TO T_{EA}

$q_o = \frac{T_{EA}}{2A}$
$= \frac{454{,}750}{17{,}830} = 25.5^{\#/IN}$

BULKHEAD #3

A.G.W. (72-1000# BOMBS) LAA @ 5000' (CONT'D)

CRUSHING LOAD

$$P = \frac{(M_x')^2 L}{\frac{I}{Q} EI}$$

$M_x' = 132.41 \times 10^6$ (FZS-36-240)
$L = 33.25$

$P = 5530\#$

REPLACE P WITH EQUIVALENT TRAPIZOID SUCH THAT $\frac{h_F}{h_R} = \frac{\omega_F}{\omega_R}$ WHERE h_F & h_R ARE THE CONTOUR DEPTHS OF FRONT & REAR SPARS RESPECIVELY.

$\omega_F = 41.4$
$\omega_R = 53.6$

AIR LOAD

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPIZOIDS.

COMPOSITE INTERSPAR LOAD

$\omega_{FC} = 87.3\#/in$
$\omega_{RC} = 58.9\#/in$

UPPER SURFACE LOAD

$\omega_{FU} = 102.5\#/in \uparrow$
$\omega_{RU} = 88.1\#/in \uparrow$

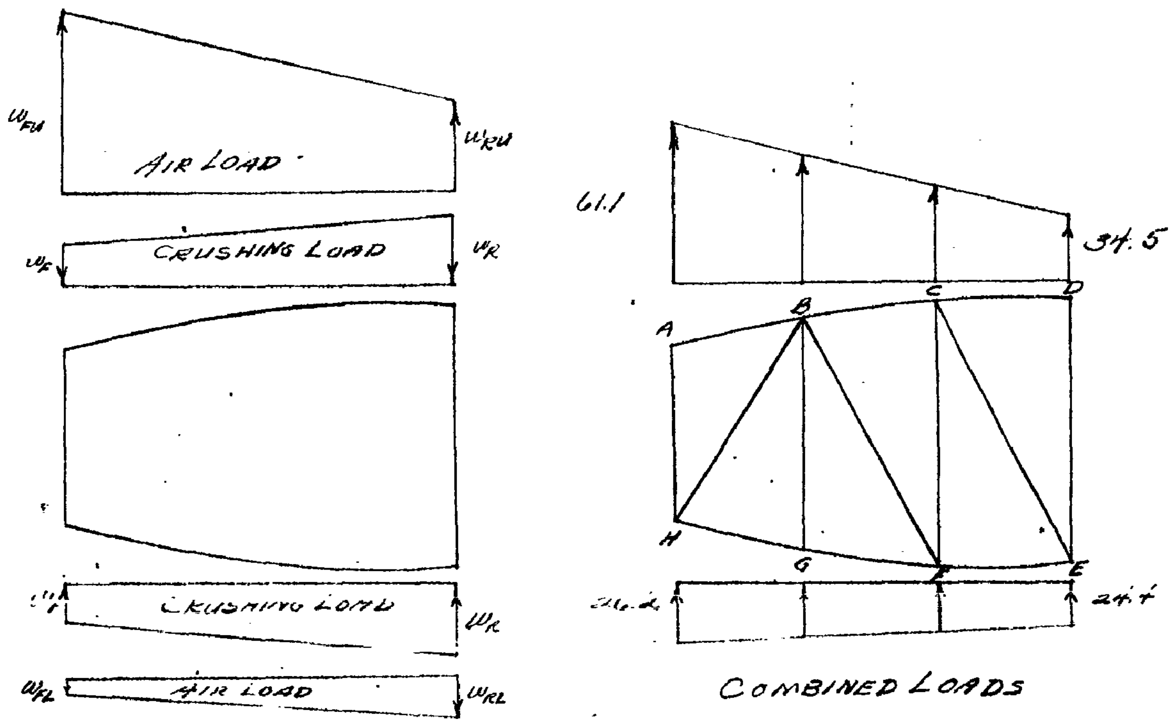
LOWER SURFACE

$\omega_{FL} = 15.2\#/in \downarrow$
$\omega_{RL} = 29.2\#/in \downarrow$

BULKHEAD #3

AGW (72-1000 # BOMBS) LAA @ 5000' (CONT'D)

COMBINED AIR & CRUSHING LOADS



BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS

$P_A = 1110^{\#}\uparrow$ $P_E = 485^{\#}\uparrow$
$P_B = 2015^{\#}\uparrow$ $P_F = 978^{\#}\uparrow$
$P_C = 1706^{\#}\uparrow$ $P_G = 984^{\#}\uparrow$
$P_D = 739^{\#}\uparrow$ $P_H = 493^{\#}\uparrow$

BULKHEAD #3

A.G.W. (72-1000# BOMBS) LAA @ 5000' (CONT'D)

CORRECTION LOADS

CORRECTING LOADS ON FRONT AND REAR SPAR TO ACCOUNT FOR TRANSFER OF THE SHEAR FLOW FROM THE CONTOUR TO THE CENTROID OF THE STRAIGHT LINE CHORD MEMBER.

$$T_U = 2A_u q_0 = 15{,}200''\#$$

$$R_U' = \frac{}{116.37} = 130.5\#$$

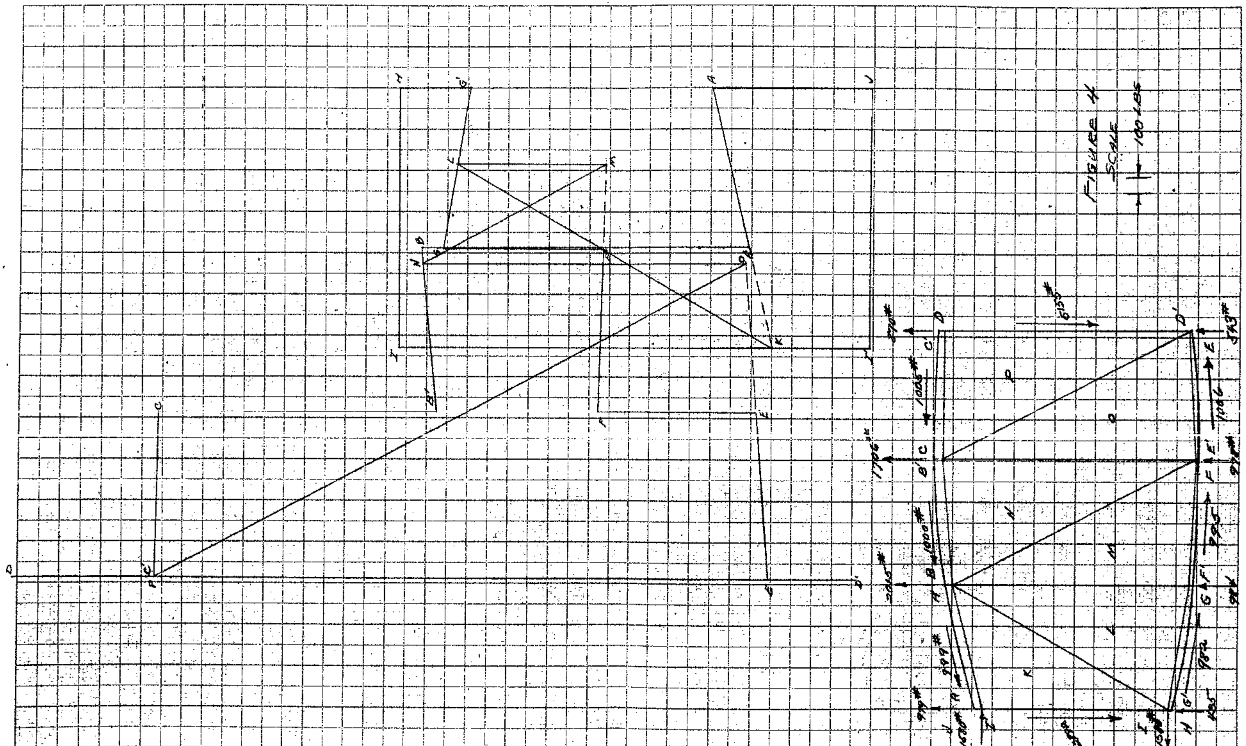
$$T_L = 2A_L q_0 = 6740''\#$$

$$R_L = \frac{}{116.37} = 57.8\#$$

CORRECTED PANEL POINT LOADS.

$P_A = 979\# \uparrow$
$P_D = 870\# \uparrow$
$P_E = 543\# \uparrow$
$P_H = 435\# \uparrow$

KEUFFEL & ESSER CO.

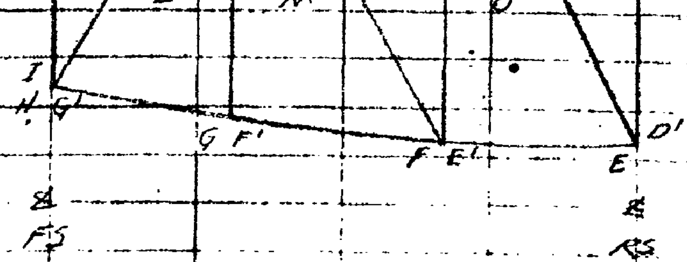


CALCULATED BY	M. Hill	FORCE DIAGRAM BULKHEAD #3	DOC. NO.	FZS-36-242
DRAWN BY	M. Hill	AGW (72-1000# BOMBS) LAA @ 5000'	MODEL	XB-36
CHECKED BY	M. Hill	CONSOLIDATED VULTEE AIRCRAFT CORPORATION		
APPROVED BY		FORT WORTH DIVISION, FORT WORTH, TEXAS		

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS
FW 833 125 PADS 11-43

TABLE XIV SUMMARY OF MEMBER LOADS

MEMBER	CONDITION DGW ILAA FIG 2	AGW HAA FIG 3	AGW LAA FIG 4	CRITICAL LOAD TEN	COMP.
AK	+2440	-2300	-624	2440	2300
A'K	+1105	-970	-625	1105	970
BN	+1365	-685	-100	1365	685
B'N	+25	+640	+900	900	—
CP	+1350	-1330	-1005	1350	1330
C'P	0	0	0	0	0
DP	+439	+233	+870	870	—
D'P	+3679	-4935	+4320	3679	4935
EO	+1325	-1980	-1916	1325	1980
E'O	-25	-640	-910	—	910
FM	+730	-1373	-1510	730	1510
F'M	-610	-50	-515	—	610
GL	-615	-55	-520	0	615
G'L	-1928	+1255	+462	1255	-1928
IK	+1875	-2475	-2292	1875	2475
I'K	+635	+35	+600	635	—
KL	-940	+2030	+2235	2235	940
LM	+2710	-1970	-915	2710	1970
MN	-1640	+1595	+275	1595	1640
NO	+3590	-3250	-1215	3590	3250
OP	-2920	+4270	+4215	4270	2920



BY: Mufford
CHECKED BY: Yielpom

WING BULKHEAD #3 DETAIL ANALYSIS

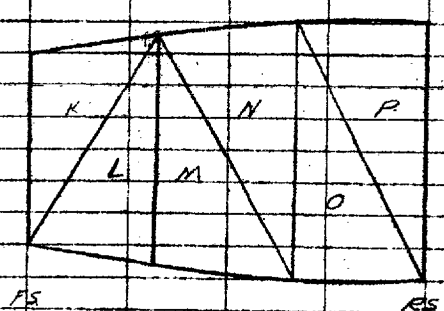
THE DETAIL ANALYSIS OF THE XB-36 BULKHEAD #3 WILL BE ACCOMPLISHED IN THE SAME MANNER AS THE YB-36 & B-36A ANALYSIS, REF FZS-36-142. DUE TO THE SIMILARITY OF THE TWO BULKHEADS THE ONLY DIFFERENCE BEING IN THE TRUSS TUBE END CHANNELS AND CONNECTIONS, THE SAME MEMBERS ARE CRITICAL FOR THE XB-36 THAT WERE CRITICAL FOR THE B-36A (REF: P-I181 FZS-36-141) AND WILL BE CHECKED IN THIS ANALYSIS.

CONSOLIDATED VULTEE AIRCRAFT CORPORATION TABLE XX MARGINS OF SAFETY OF TRUSS TUBES IN COMPRESSION

FORT WORTH DIVISION FORT WORTH, TEXAS

FW 655 125 PADS 11-43

1	2	3	4	5	6	7	8	9	10	11
MEMBER	SIZE of TUBE	MAX COMP LOAD	AREA □"	f_c #/□"	L (INCHES)	I	ρ	$L/\sqrt{c}\,\rho$	* F_c	M.S.
		TAB. XII		③/④			⑦/④			⑩/⑤ -1
KL	.037 1¼ x 1½	-940	.366	-2,570	72.000	.1586	.658	109.5	7200	+1.80
LM	.037 2 x 1½	-1970	.404	-4,880	68.00	.2627	.806	82.7	12,700	+1.60
MN	.040 1¾ x 1½	-1640	.2895	-5,670	77.75	.1519	.725	107.2	7,500	+.32
NO	.040 2¼ x 2	-3250	.388	-8380	74.00	.3436	.941	78.5	14000	+.67
OP	.040 2¼ x 2	-2920	.388	-7520	80.06	.3436	.941	85.1	12000	+.59



* TRUSS TUBE COLUMN ALLOWABLES FROM FIG. I-10 P-I-62 FZS-36-142

BY Mufford

CHECKED BY: Simpson

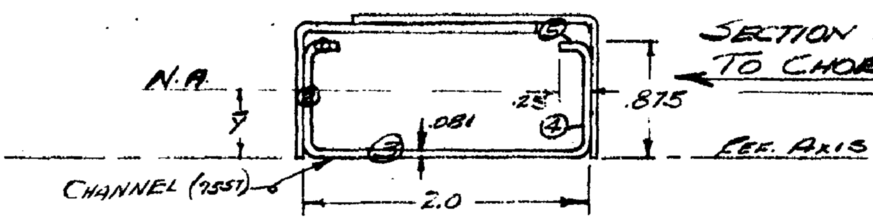
BLKHD #3

DETAIL ANALYSIS

ANALYSIS OF MEMBER "NO" END ATTACHMENT

ITEM	AREA	Y	AY	AY^2	I_o
①	.0138	.834	.0115	.0096	0
②	.0580	.438	.0234	.0111	.0024
③	.1489	.040	.0059	.0002	0
④	.0580	.438	.0254	.0111	.0024
⑤	.0138	.838	.0115	.0096	0
TUBE	.1850		.1540	.1470	.0040
	.4775		.2337	.1886	.0088

REF. FZS-36-142 p I-183



SECTION AT ATTACHM'T TO CHORD MEMBER

$$\bar{Y} = \frac{\Sigma AY}{\Sigma A} = \frac{.2337}{.4775} = .489 \text{ IN.}$$

$$\bar{Y}_t = .489 \text{ IN.} \qquad Y_c = .637 \text{ IN.}$$

$$I = \Sigma AY^2 + I_o - \Sigma A \bar{Y}^2 = .1886 + .0088 - (.4775)(.489)^2$$
$$= .0834 \text{ IN.}^4$$

THE MAXIMUM LOAD "P" IS 3,590# (REF. p. 45)

$$f_t = \frac{P}{A} + \frac{(Pe)\,Y_t}{I} = \frac{3590}{.4775} + \frac{(3590 \times .489)(.489)}{.0834}$$

$$= 17\,810 \text{ \#/IN}^2$$

$$F_t = .70(70\,000) = 49\,000 \text{ \#/IN}^2 \text{ (REF. FZS-36-142, p I-184)}$$

$$M.S. = \frac{49000}{17810} - 1 = \qquad +1.75$$

BLKHD #3

END ATTACHMENT OF "NO"

THE ATTACHMENT OF THE CHANNEL INSERT (-9 CHANNEL) TO THE CHORD MEMBER IS CRITICAL, AND THE (8) 3/16" A17ST RIVETS ARE CRITICAL IN SHEAR.

$$M.S. = \frac{8 \times 860}{3590} - 1 = \quad +.92$$

ANALYSIS OF MEMBER "OP"

SINCE MEMBER "OP" OF THE XB-36 AIRPLANE IS OF THE SAME MATERIAL AND THE SAME SIZE AS THE CORRESPONDING MEMBER ON THE B36A AIRPLANE, THIS ANALYSIS WILL BE DONE BY A RATIO OF THE TWO LOADS.

$P_{B\text{-}36} = 4560^{*}$

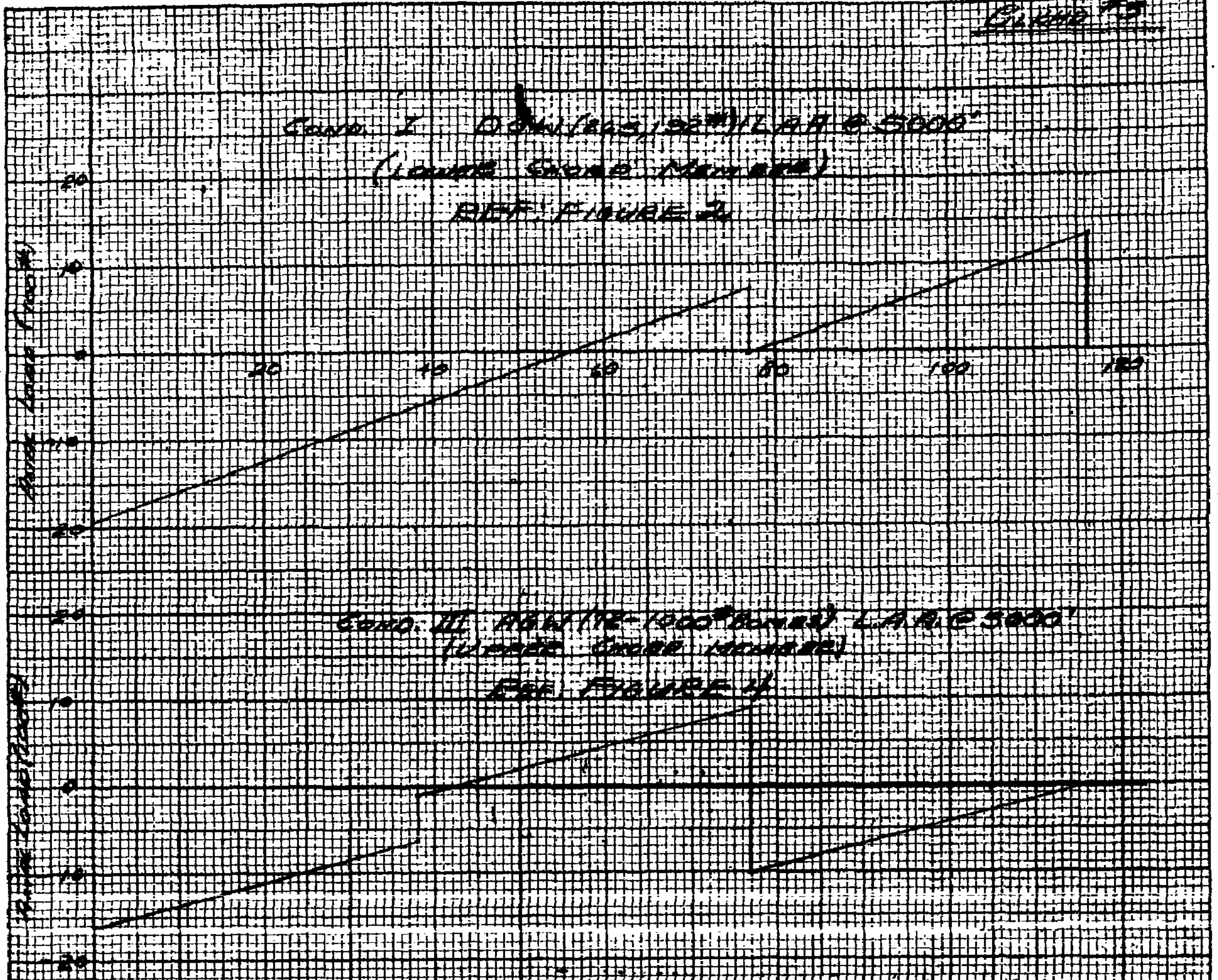
$P_{XB\text{-}36} = 4270$ (REF. p 45)

$$f_t = \frac{4270}{4560} \times 24\,730^{*} = 23,200 \text{ \#/IN}^2$$

$$F_t = .7 \times 70,000 = 49\,000 \text{ \#/IN}^{2\,*}$$

$$M.S. = \frac{49000}{23200} - 1 = \quad +1.11$$

*REF. FZS-36-142 p. I-184 & I-185



CRITICAL AXIAL LOADS FOR UPPER AND LOWER CHORD MEMBERS

CALCULATED BY	[illegible]	FIGURE 5	DOC. NO. FZS-36-242
DRAWN BY			
CHECKED BY	[illegible]		MODEL
APPROVED BY		CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION FORT WORTH, TEXAS	XB-36

ANALYSIS: WING
PREPARED BY: Canfield
CHECKED BY: [illegible]
REVISED BY:

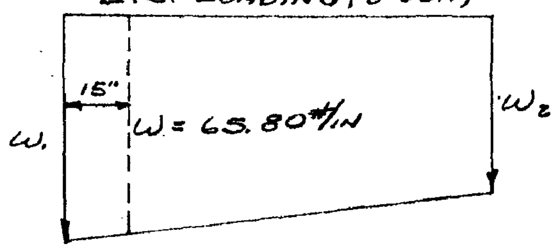
Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

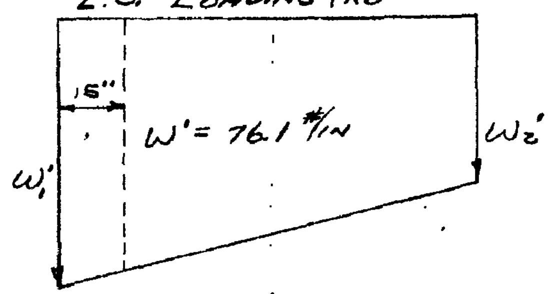
PAGE: 51
REPORT NO. FZS-36-242
MODEL: XB-36
DATE: 12/47

BLKHD #3

ANALYSIS OF LOWER CHORD MEMBER

DGW ILAA @ 5,000' CONDITION





$w_1 = 71.29$ #/IN
$w_2 = 28.73$ #/IN

$w_1' = 81.10$ #/IN
$w_2' = 42.29$ #/IN

CRITICAL SECTION OCCURS AT 15" AFT. OF F.S. (REF. FZS-36-142 p I-197)
AXIAL LOAD = 1460# (REF. p.50)
$M_{(B\text{-}36A)} = 7600$ IN# (REF. FZS-36-142 p I-196)

$$M = \frac{w'}{w} \times M_{B\text{-}36A} = \frac{76.1}{65.8} \times 7600 = 8800 \text{ IN\#}$$

$A = 2.586 \text{ IN}^2$; $Y_c = 5.83$ IN; $I = 7.36 \text{ IN}^4$
(REF. FZS-36-142, p I-192)

$$f_c = \frac{P}{A} + \frac{MY_c}{I} = \frac{1460}{2.586} + \frac{8800 \times 5.83}{7.36}$$
$$= 7525 \text{ \#/IN}^2$$

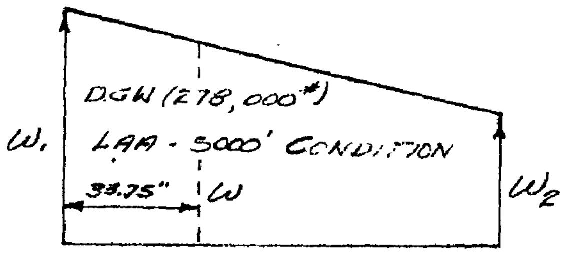
$F_c = 25,000 \text{ \#/IN}^2$ (REF. FZS-36-142, p. I-197)

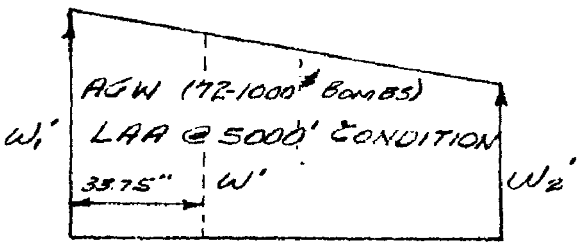
$$M.S. = \frac{25000}{7525} - 1 = \qquad +2.32$$

ANALYSIS OF UPPER INTERCOSTAL

FROM FZS-36-142 (P. I-98) IT WAS FOUND THAT THE INTERCOSTAL JUST FORWARD OF THE FIRST PANEL POINT TO BE CRITICAL FOR THE COMBINED EFFECTS OF TRANSVERSE SHEAR AND AXIAL LOAD.

BLKHD #3





U.S. LOADING (B-36A)

$w_1 = 66.59$ #/IN

$w_2 = 31.14$ #/IN

$w = 56.30$ #/IN

U.S. LOADING (XB-36)

$w_1' = 61.1$ #/IN

$w_2' = 34.5$ #/IN

$w' = 53.9$ #/IN

$$\text{AVERAGE TRANSVERSE SHEAR} = \frac{w'}{w} \times V_{AVE\,(B\text{-}36A)}$$

$$= \frac{53.9}{56.3} \times 1108^{*}$$

$$= 1060^{\#}$$

THE INTERCOSTAL LOAD DUE TO TRANSVERSE

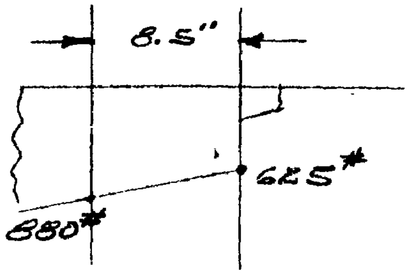
$$\text{SHEAR} = \frac{VQ}{I}\,8.5^{*} = \frac{1060 \times 1.014 \times 8.5}{5.45} = 1680^{\#}$$

THE INTERCOSTAL LOAD DUE TO THE CHORD MEMBER AXIAL LOAD IS THE DIFFERENCE BETWEEN P_{1L} AND P_{2L} AS SHOWN ON THE ACCOMPANYING SKETCH, WHERE:

$$P_{1L} = P_1 \frac{A_L}{A_{TOTAL}} = 880\,\frac{.374}{.874} = 376^{\#}$$

$$P_{2L} = P_2 \frac{A_L}{A_{TOTAL}} = 625\,\frac{.374}{.874} = 268^{\#}$$

$$P_{1L} - P_{2L} = 376 - 268 = 108^{\#}$$



$$\text{TOTAL INTERCOSTAL LOAD} = 1680^{\#} + 108^{\#}$$

$$= 1788^{\#}$$

$$f_s = \frac{1788}{bt} = \frac{1788}{[3.3 - 3(3/16)]\,.051} = 12800\ \#/\text{IN}^2$$

*(REF. FZS-36-142, p I-199)

BLKHD #9

$F_{S_{CR}} = 28\,000\ \#/in^2$ (REF. FZS-36-142, p I-201)

$M.S._{BUCKLING} = \frac{28000}{12800} - 1 =$ +1.18

BULKHEAD NO. 13 (36W113)

INDEX

WING BULKHEAD #13
(36W113)

INTRODUCTION

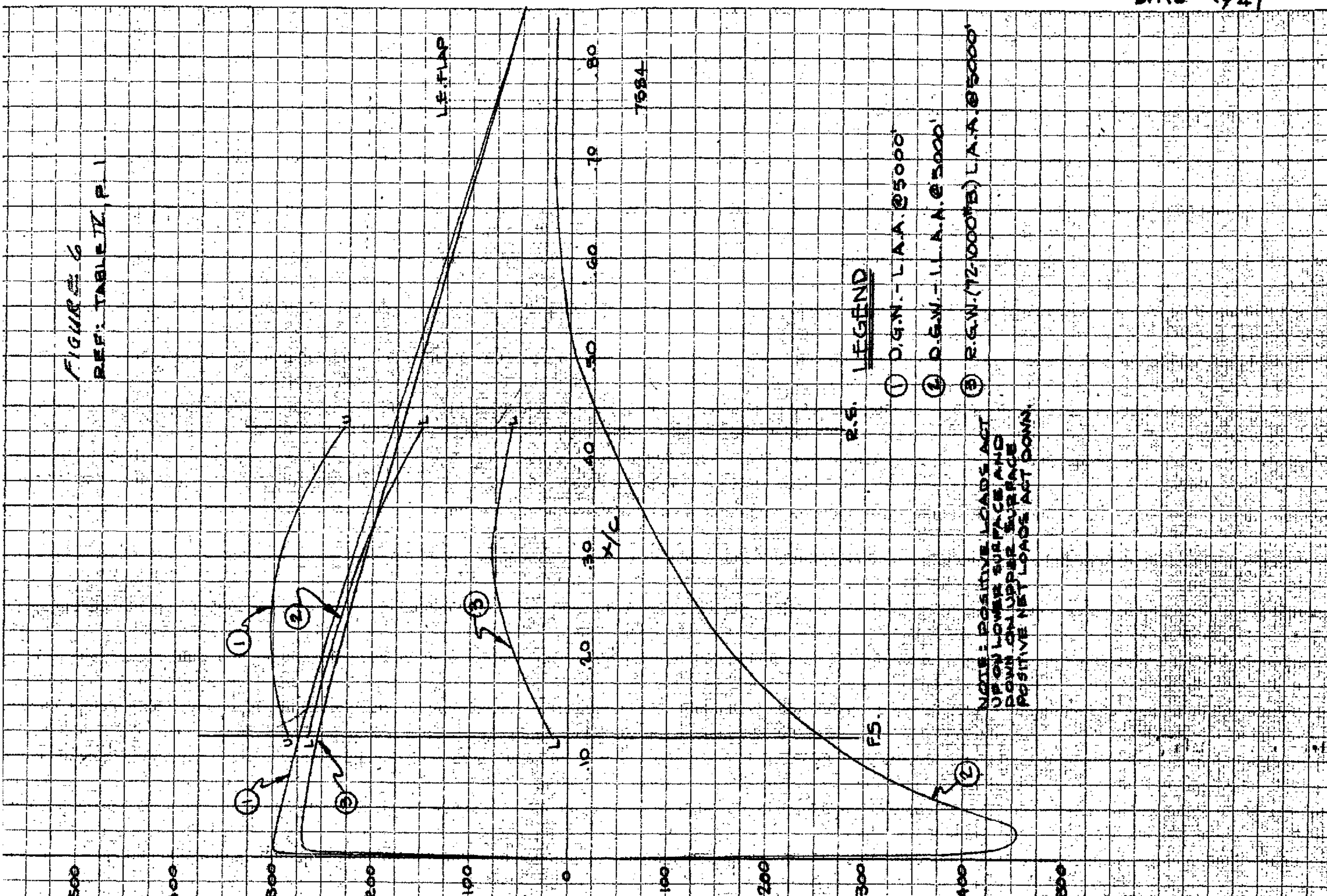
For all practical purposes Bulkhead #13 of the XB-36 is the same as Bulkhead #13 of the B-36A. A detailed discussion of the location, purpose, and method of analyzing Bulkhead #13 is given on page I-206 of FZS-36-142.

A survey of design conditions resulted in the selection of three flight conditions as critical conditions for the design of this bulkhead:

1. D.G.W. LAA @ 5000'
2. D.G.W. ILAA @ 5000'
3. R.G.W. (72-1000# Bombs) LAA @ 5000'

This analysis includes:

1. Analysis of truss & their end attachments, Ref. page 56
2. Chord member analysis, which is accomplished by comparison with B-36A data.
3. Intercostal analysis; by use of B-36A data.



CALCULATED BY		FIG. 6	DOC. NO. FZS-36-242
DRAWN BY		BULKHEAD # 13	
CHECKED BY		CONSOLIDATED VULTEE AIRCRAFT CORPORATION	MODEL
APPROVED BY		FORT WORTH DIVISION, FORT WORTH, TEXAS	XB36

TABLE XVI $b = 36.375"$, $C = 310.471"$

COMPUTATION OF * N_L, N_T, M_L & M_T FOR AIR LOADS
STATION 13 D.G.W. - 265,152# - L.A.A. @ 5000'

1	2	3	4	5	6
DISTANCE FROM L.E. % CHORD	p #/□' (LIMIT)	AVERAGE p	Δ AREA	DISTANCE TO C.G. FROM 12% LINE	Δ MOMENT ABOUT 12% LINE
	FIG. 6		(3) × .01		(4) × (5)
	LEADING EDGE AIR LOADS				
0	0				
		-200	-2.00	.1135	-.2270
1	-300				
		-299	-2.99	.105	-.3140
2	-298				
		-296.5	-2.97	.095	-.2820
3	-295				
		-294	-2.94	.085	-.2500
4	-293				
Σ			-10.90		-10.730

	p #/□' FIG. 6	S.M.s	(2) × (3)	MOMENT MULTIPLIER	(4) × (5)
4	-293	1	-293	4	-1172
6	-288	4	-1152	3	-3456
8	-283	2	-566	2	-1132
10	-277	4	-1108	1	-1108
12	-273	1	-273	0	0
Σ			-3392		-6868

$$N_L = \frac{1.5bc}{144}\left[\frac{-3392(.02)}{3} - 10.90\right] = -3939\#$$

$$M_L = \frac{1.5bc^2}{144}\left[\frac{-6868(.02)^2}{3} - 10.730\right] = -72600''\#$$

$\bar{X} = \frac{72600}{3939} = 18.43"$ FWD F.S.

7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	p #/□' (LIMIT)	S.M.s	(8) × (10)	MOMENT MULTIPLIER	(10) × (11)
	FIG. 6				
	TRAILING EDGE AIR LOADS				
75.840	-77	1	-77	8	-616
71.735	-90	4	-360	7	-2520
67.630	-103	2	-206	6	-1236
63.525	-115	4	-460	5	-2300
59.420	-128	2	-256	4	-1024
55.35	-141	4	-564	3	-1692
51.210	-154	2	-308	2	-616
47.105	-166	4	-664	1	-664
43.000	-179	1	-179	0	0
Σ			-3074		-10668

$$N_T = \frac{1.5bc}{144}\left[\frac{-3074(.04105)}{3}\right] = -4948\#$$

$$M_T = \frac{1.5bc^2}{144}\left[\frac{-10668(.04105)^2}{3}\right] = -219,014''\#$$

$$\bar{X} = \frac{219014}{4948} = 44.263" \text{ AFT. R.S.}$$

*** DEFINITION OF TERMS**

N_L - LEADING EDGE AIRLOAD SHEAR.
M_L - LEADING EDGE AIRLOAD MOMENT ABOUT F.S.
N_T - TRAILING EDGE AIRLOAD SHEAR.
M_T - TRAILING EDGE AIRLOAD MOMENT ABOUT R.S.

NOTE: SIGNS (+ OR -) FOLLOW THOSE USED FOR PRESSURE DISTRIBUTION AND HAVE NO CONSISTENT MEANING WITH RESPECT TO FORCES. THEREFORE, DIRECTION OF FORCES IS INDICATED BY ARROWS, NOT BY SIGNS.

CALC. BY: B. C[illegible]
CHKD. BY: Mafford

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS
FW 613 125 PADS 11-43

TABLE XVII b = 36.375", C = 310.471"

COMPUTATION OF N_{IS}, N_U, M_{IS} & M_U FOR AIRLOADS

STATION 13 - DGW - 265,192# - L.A.A. @ 5000'

PAGE 57
REPORT NO FZA-36-242
MODEL XB36
DATE 11/47

COMPOSITE INTERSPAR AIR LOADS

1	2	3	4	5	6
DISTANCE FROM L.E. % CHORD	p "/q" (LIMIT) FIG. 6	S. M.s	(2) x (3)	MOMENT MULTIPLIER	(4) x (5)
43.000	-179	1	-179	8	-1432
39.125	-192	4	-768	7	-5376
35.250	-204	2	-408	6	-2448
31.375	-216	4	-864	5	-4320
27.500	-228	2	-456	4	-1824
23.625	-240	4	-960	3	-2880
19.750	-251	2	-502	2	-1004
15.875	-262	4	-1048	1	-1048
12.000	-273	1	-273	0	0
Σ			5458		-20332

UPPER SURFACE INTERSPAR AIRLOADS

7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	p "/q" (LIMIT) FIG. 6	S. M.s	(8) x (9)	MOMENT MULTIPLIER	(10) x (11)
43.000	-229	1	-229	8	-1832
39.125	-254	4	-1016	7	-7.12
35.250	-274	2	-548	6	-3288
31.375	-289	4	-1156	5	-5780
27.500	-298	2	-596	4	-2384
23.625	-303	4	-1212	3	-3636
19.750	-301	2	-602	2	-1204
15.875	-295	4	-1180	1	-1180
12.000	-285	1	-285	0	0
Σ			-6824		-26416

$$N_{I.S.} = \frac{1.5bc}{144}\left[\frac{.03875(-5458)}{3}\right] = +8293^{\#}\uparrow$$

$$N_U = \frac{1.5bc}{144}\left[\frac{.03875(-6824)}{3}\right] = -10{,}460^{\#}\uparrow$$

$$M_{I.S._{F.S.}} = \frac{1.5bc^2}{144}\left[\frac{.03875^2(-20332)}{3}\right] = -371{,}936''^{\#}$$

$$M_{U_{F.S.}} = \frac{1.5bc^2}{144}\left[\frac{.03875^2(-26416)}{3}\right] = -484{,}000''^{\#}$$

$$\bar{X} = \frac{371936}{8293} = 44.843'' \text{ AFT F.S.}$$

$$\bar{X} = \frac{484000}{10460} = 46.200'' \text{ AFT F.S.}$$

* DEFINITION OF TERMS

N_{IS} - TOTAL (UPPER & LOWER SURFACE) INTERSPAR AIR LOAD SHEAR.
M_{IS} - TOTAL (UPPER & LOWER SURFACE) INTERSPAR AIR LOAD MOMENT.
N_U - INTERSPAR AIRLOAD SHEAR (UPPER SURFACE AIRLOAD)
M_U - INTERSPAR AIRLOAD MOMENT (UPPER SURFACE AIRLOAD)

NOTE: SIGNS (+ OR -) FOLLOW THOSE USED FOR PRESSURE DISTRIBUTION AND HAVE NO CONSISTENT MEANING WITH RESPECT TO FORCES, THEREFORE, DIRECTION OF FORCES IS INDICATED BY ARROWS, NOT BY SIGNS.

CALC. BY: [signature]
CHKD. BY: [signature]

CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION FORT WORTH, TEXAS

FW 833 125 PADS 11-43

TABLE XVIII $b = 36.375''$, $C = 310.47''$

COMPUTATION OF* N_L, N_T, M_L & M_T FOR AIRLOADS

STATION 13 D.G.W. - 205,192# - I.L.AA. @ 5000'

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

LEADING EDGE AIRLOADS

1 DISTANCE FROM L.E. % CHORD	2 p #/□" (LIMIT)	3 AVERAGE p	4 Δ AREA	5 DIST. TO C.G. FROM 12% LINE	6 Δ MOMENT ABOUT 12% LINE
	FIG. 6		(3)×.01		(4)×(5)
0	0				
		+300	3.00	.1137	.3411
1	+435				
		+445	4.45	.105	.4672
2	+454				
		+454	4.54	.095	.4313
3	+454				
		+444	4.44	.085	.3774
4	+433				
Σ			16.43		1.6170

	p #/□"	S.M.s	(2)×(3)	MOMENT MULTIPLIER	(4)×(5)
	FIG. 6				
4	+433	1	433	4	1732
6	+370	4	1480	3	4440
8	+325	2	650	2	1300
10	+291	4	1164	1	1164
12	+259	1	259	0	0
Σ			3986		8636

$$N_L = \frac{1.5bc}{144}\left[\frac{3986(.02)}{3} + 16.43\right] = +5058\#$$

$$M_L = \frac{1.5bc^2}{144}\left[\frac{8636(.02)^2}{3} + 1.6170\right] = +101,192''\#$$

$$\bar{X} = \frac{101,192}{5058} = 20.006 \text{ FWD F.S.}$$

TRAILING EDGE AIRLOADS

7 DISTANCE FROM L.E. % CHORD	8 p #/□" (LIMIT)	9 S.M.s	10 (8)×(9)	11 MOMENT MULTIPLIER	12 (10)×(11)
	FIG. 6				
75.840	-16	1	-16	8	-128
71.735	-16	4	-64	7	-448
67.630	-15	2	-30	6	-180
63.525	-14	4	-56	5	-280
59.420	-10	2	-20	4	-80
55.315	-4	4	-16	3	-48
51.210	+4	2	8	2	16
47.105	+18	4	72	1	72
43.000	+35	1	35	0	0
Σ			-87		-1076

$$N_T = \frac{1.5bc}{144}\left[\frac{-87(.04105)}{3}\right] = -140.0\#$$

$$M_T = \frac{1.5bc^2}{144}\left[\frac{-1076(.04105)^2}{3}\right] = -22,111''\#$$

$$\bar{X} = \frac{22,111}{140.0} = 157.94'' \text{ AFT R.S.}$$

* FOR DEFINITION OF TERMS SEE PAGE 57

NOTE: SIGNS (+ OR -) FOLLOW THOSE USED FOR PRESSURE DISTRIBUTION AND HAVE NO CONSISTENT MEANING WITH RESPECT TO FORCES, THEREFORE, DIRECTION OF FORCES IS INDICATED BY ARROWS, NOT BY SIGNS.

CALC. BY: [illegible signature]
CHKD. BY: [illegible signature]

TABLE XIX COMPUTATIONS OF *N_{IS}, N_L, M_{IS} & M_L FOR AIR LOADS

b = 36.375", c = 310.471"

STATION 13 DGW - 265,132# - I.L.A.A @ 5000'

1	2	3	4	5	6
DISTANCE FROM L.E. % CHORD	$p^{\#}/\square'$ (LIMIT) FIG. 6	S.M.s	② × ③	MOMENT MULTIPLIER	④ × ⑤
COMPOSITE INTERSPAR AIR LOADS					
43.000	+35	1	35	8	280
39.125	+53	4	212	7	1484
35.250	+73	2	146	6	876
31.375	+93	4	372	5	1860
27.500	+116	2	232	4	928
23.625	+142	4	568	3	1704
19.750	+174	2	348	2	696
15.875	+212	4	848	1	848
12.000	+259	1	259	0	0
Σ			3020		8676

7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	$p^{\#}/\square'$ (LIMIT) FIG. 6	S.M.s	⑧ × ⑨	MOMENT MULTIPLIER	⑩ × ⑪
LOWER SURFACE INTERSPAR AIR LOADS					
43.000	-149	1	-149	8	-1192
39.125	-171	4	-684	7	-4788
35.250	-190	2	-380	6	-2280
31.375	-206	4	-824	5	-4120
27.500	-220	2	-440	4	-1760
23.625	-232	4	-928	3	-2784
19.750	-244	2	-488	2	-976
15.875	-255	4	-1020	1	-1020
12.000	-264	1	-264	0	0
Σ			-5177		-18920

$$N_{IS} = \frac{1.5bc}{144}\left[\frac{.03875(3020)}{3}\right] = +4604^{\#}\downarrow$$

$$N_{L\,(\text{LOWER SURF.})} = \frac{1.5bc}{144}\left[\frac{.03875(-5177)}{3}\right] = -7866^{\#}\downarrow$$

$$M_{IS} = \frac{1.5bc^2}{144}\left[\frac{.03875^2(8676)}{3}\right] = +158,719''^{\#}$$

$$M_{L\,(\text{LOWER SURF.})} = \frac{1.5bc^2}{144}\left[\frac{.03875^2(-18920)}{3}\right] = -346,141''^{\#}$$

* FOR DEFINITION OF TERMS SEE P. 57

$$\bar{X} = \frac{158,719}{4604} = 34.476'' \text{ AFT F.S.}$$

$$\bar{X} = \frac{-346,141}{-7866} = 44.005'' \text{ AFT F.S.}$$

NOTE: SIGNS (+ OR -) FOLLOW THOSE USED FOR PRESSURE DISTRIBUTION AND HAVE NO CONSISTENT MEANING WITH RESPECT TO FORCES, THEREFORE, DIRECTION OF FORCES IS INDICATED BY ARROWS, NOT BY SIGNS.

CALC. BY: [illegible signature]
CHKD. BY: [illegible signature]

TABLE XX

$b = 36.375"$, $C = 310.471"$

COMPUTATION OF * N_L, N_T, M_L & M_T FOR AIR LOADS

STATION 13, R.G.W. (72-1000# BOMBS) L.A.A. @ 5000'

LEADING EDGE AIR LOADS

1 DISTANCE FROM L.E. % CHORD	2 p#/□" (LIMIT) FIG. 6	3 AVERAGE p	4 Δ AREA (3)x.01	5 DIST. TO C.G. FROM 12% LINE	6 Δ MOMENT ABOUT 12% LINE (4)x(5)
0	0				
		-180	-1.80	.1138	-.2048
1	-268				
		-269	-2.69	.105	-.2824
2	-270				
		-270	-2.70	.095	-.2564
3	-269				
		-269	-2.69	.085	-.2286
4	-268				
Σ			-9.88		-.9722

	p#/□" FIG 6	S.M.s	(2)x(3)	MOMENT MULTIPLIER	(4)x(5)
4	-268	1	-268	4	-1072
6	-265	4	-1060	3	-3180
8	-262	2	-524	2	-1048
10	-258	4	-1032	1	-1032
12	-253	1	-253	0	0
Σ			-3137		-6332

$$N_L = \frac{1.5bc}{144}\left[\frac{-3137(.02)}{3} - 9.88\right] = +3622^{\#}\uparrow$$

$$M_L = \frac{1.5bc^2}{144}\left[\frac{-6332(.02)^2}{3} - .9722\right] = -66396"^{\#}$$

$$\bar{X} = \frac{66396}{3622} = 18.34" \text{ FWD F.S.}$$

TRAILING EDGE AIR LOADS

7 DISTANCE FROM L.E. % CHORD	8 p#/□" (LIMIT) FIG. 6	9 S.Ms	10 (8)x(9)	11 MOMENT MULTIPLIER	12 (10)x(11)
75.840	-75	1	-75	8	-600
71.735	-87	4	-348	7	-2436
67.630	-99	2	-198	6	-1188
63.525	-111	4	-444	5	-2220
59.420	-123	2	-246	4	-984
55.315	-135	4	-540	3	-1620
51.210	-147	2	-294	2	-588
47.105	-158	4	-632	1	-632
43.000	-170	1	-170	0	0
Σ			-2947		-10268

$$N_T = \frac{1.5bc}{144}\left[\frac{-2947(.04105)}{3}\right] = -4741^{\#}\uparrow$$

$$M_T = \frac{1.5bc^2}{144}\left[\frac{-10268(.04105)^2}{3}\right] = -210,824"^{\#}$$

$$\bar{X} = \frac{210824}{4741} = 44.472 \text{ AFT R.S.}$$

* FOR DEFINITION OF TERMS SEE P. 57

NOTE: SIGNS (+ OR -) FOLLOW THOSE USED FOR PRESSURE DISTRIBUTION AND HAVE NO CONSISTENT MEANING WITH RESPECT TO FORCES, THEREFORE, DIRECTION OF FORCES IS INDICATED BY ARROWS, NOT BY SIGNS.

CALC. BY: R. Chapman
CHKD. BY: Mulford

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION — FORT WORTH, TEXAS
FW 833 125 PADS 11-43

TABLE XXI — $b = 36.375'$, $c = 310.471''$

COMPUTATION OF * N_{IS}, N_L, M_{IS} & M_L FOR AIRLOADS
STATION 13 R.G.W. (72-1000# BOMBS) L.A.A. @5000'

REPORT Nº
MODEL
DATE 1/47

COMPOSITE INTERSPAR AIR LOADS

1	2	3	4	5	6
DISTANCE FROM L.E. % CHORD	p #/□' (LIMIT) FIG. 6	S.M.s	(2)×(3)	MOMENT MULTIPLIER	(4)×(5)
43.000	-170	1	-170	8	-1360
39.125	-181	4	-724	7	-5068
35.250	-192	2	-384	6	-2304
31.375	-203	4	-812	5	-4060
27.500	-214	2	-428	4	-1712
23.625	-225	4	-900	3	-2700
19.750	-235	2	-470	2	-940
15.875	-245	4	-980	1	-980
12.000	-253	1	-253	0	0
Σ			-5121		-19124

LOWER SURFACE INTERSPAR AIRLOADS

7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	p #/□' FIG. 6	S.M.s	(8)×(9)	MOMENT MULTIPLIER	(10)×(11)
43.000	-58	1	-58	8	-464
39.125	-66	4	-264	7	-1848
35.250	-73	2	-146	6	-876
31.375	-78	4	-312	5	-1560
27.500	-75	2	-150	4	-600
23.625	-66	4	-264	3	-792
19.750	-52	2	-104	2	-208
15.875	-35	4	-140	1	-140
12.000	-15	1	-15	0	0
Σ			-1453		-6488

$$N_{IS} = \frac{1.5bc}{144}\left[\frac{.03875(5121)}{3}\right] = -7781\# \uparrow$$

$$N_{\text{LOWER SURF}} = \frac{1.5bc}{144}\left[\frac{.03875(-1453)}{3}\right] = -2208\# \downarrow$$

$$M_{IS} = \frac{1.5bc^2}{144}\left[\frac{.03875^2(-19124)}{3}\right] = -349{,}945''\#$$

$$M_{\text{LOWER SURF}} = \frac{1.5bc^2}{144}\left[\frac{.03875^2(-6488)}{3}\right] = -118{,}722''\#$$

$$\bar{X} = \frac{-349{,}945}{-7781} = 44.975'' \text{ AFT F.S.}$$

$$\bar{X} = \frac{-118{,}722}{-2208} = 53.777'' \text{ AFT F.S.}$$

* FOR DEFINITION OF TERMS SEE P. 57

NOTE: SIGNS (+ OR −) FOLLOW THOSE USED FOR PRESSURE DISTRIBUTION AND HAVE NO CONSISTENT MEANING WITH RESPECT TO FORCES. THEREFORE, DIRECTION OF FORCES IS INDICATED BY ARROWS — NOT BY SIGNS.

CALC. BY: [signature]
CHKD. BY: [signature]

CONDITION I - D.G.W. (265,192#) - L.A.A. @ 5000'
BULKHEAD #13

AIR LOADS (INTERSPAR)

(REF. SKETCHES P. 65)

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZOIDS,

COMPOSITE INTERSPAR LOAD = $N_{I.S.}$ = 8293# ↑

C.G. AFT OF F.S. = 44.849" (REF. P.58)

$W_{FC} = 103.50$ #/IN

$W_{RC} = 68.83$ #/IN

UPPER SURFACE INTERSPAR LOAD = N_U = 10,460# ↑

C.G. AFT OF F.S. = 46.200" (REF. P.58)

$W_{FU} = 120.70$ #/IN ↑

$W_{RU} = 96.55$ #/IN ↑

LOWER SURFACE INTERSPAR LOAD:

$W_{FL} = W_{FC} - W_{FU} = 103.50 - 120.70 = -17.20$ #/IN ↓

$W_{RL} = W_{RC} - W_{RU} = 68.83 - 96.55 = -27.72$ #/IN ↓

CRUSHING LOADS

CALCULATING THE CRUSHING LOAD,

$M'_x = 83.45 \times 10^6$ IN# REF. FZS-36-240, P. 81.

$E = 10.3 \times 10^6$

$L = 36.375$ IN. (BULKHEAD SPACING)

$I_x = 69,535$ IN^4 REF. FZS-36-141, P.39

$I_x/Q_x = 61.3$ IN REF. FZS-36-141, P.207

$$\text{CRUSHING LOAD} = \frac{(M'_x)^2 L}{(I_x/Q_x) E I} = \frac{(83.45 \times 10^6)^2\, 36.375}{61.3 \times 10.3 \times 10^6 \times 69,535} = 5770\#$$

BULKHEAD # 13 (DGW (265,192#) LAA @ 5000')

REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $\frac{H_R}{H_F} = \frac{W_R}{W_F}$ WHERE H_F = CONTOUR DEPTH OF FRONT SPAR.

$H_R = 63.789"$, $H_F = 49.353"$

$W_F = 52.29$ #/IN

$W_R = 67.61$ #/IN

(REF. P. 11)

FUEL LOAD

SINCE THE AIR LOADS OPERATE UPWARD, THE FUEL LOAD ACTS ON THE LOWER SURFACE

$P_{FUEL} = 5418.7 \times 3.969 = -21507\# \downarrow$

REF: LOAD - FZS-36-240, P. 52

$$*\frac{P_{FUEL}(XB36)}{P_{FUEL}(B36A)} = \frac{21507}{21703} = .991$$

INERTIA LOAD FACTOR - FZS-36-126, P. 84

$W_{F_{FUEL}(XB36)} = {}^{*}199.385(.991) = 197.59\# \downarrow$

$W_{R_{FUEL}}(XB36) = {}^{*}251.610(.991) = 249.35\# \downarrow$

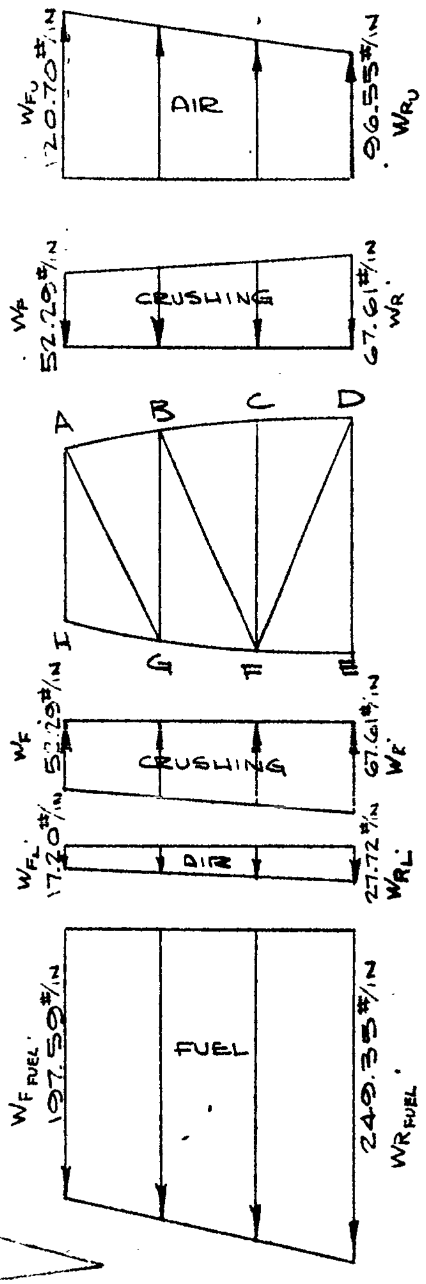
$\bar{X} = 49.98"$ *

(REF. P. 65)

* FUEL LOAD FOR B36A TAKEN FROM P. I-215 FZS-36-142.

BULKHEAD #13
D.G.W. (265,192#) L.A.A. @ 5000'

COMBINED AIR (INTERSPAR), CRUSHING AND FUEL LOADS ACTING ON BULKHEAD.



UPPER SURFACE

F.S. ORDINATE =
$W_{F_U} + W_F = -68.41$ #/IN ↑

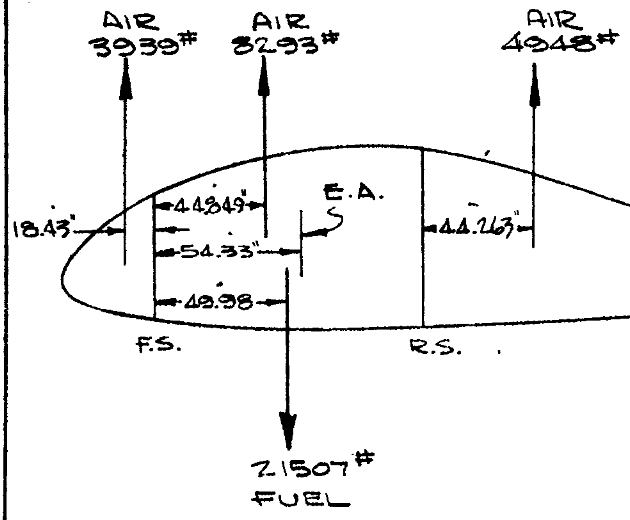
R.S. ORDINATE =
$W_{R_U} + W_R = -28.94$ #/IN ↑

LOWER SURFACE

F.S. ORDINATE =
$W_{F_L} + W_F + W_{F_{FUEL}} = 162.50$ #/IN ↓

R.S. ORDINATE =
$W_{R_L} + W_R + W_{R_{FUEL}} = 209.46$ #/IN ↓

WING STA. #13 FUEL AND AIR LOADING
(SEE FIG. BELOW)



BULKHEAD #13
D.G.W. (265,192#) - LAA @ 5000'

BREAKDOWN OF NET AIR, CRUSHING AND FUEL LOADS INTO PANEL POINT LOADS

UPPER SURFACE

$P_A = 1026\#$ ↑

$P_B = 1776\#$ ↑

$P_C = 1350\#$ ↑

$P_D = 535\#$ ↑

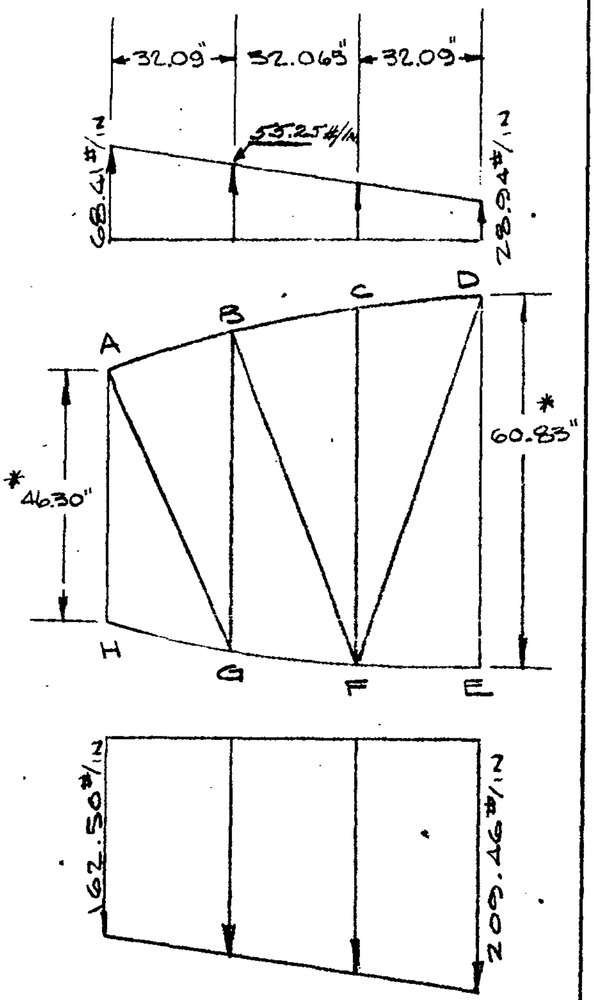
LOWER SURFACE

$P_E = 282\#$ ↓

$P_F = 6219\#$ ↓

$P_G = 5714\#$ ↓

$P_H = 2686\#$ ↓



COMBINED LOADS

COUPLE AT F.S. RESULTING FROM LEADING EDGE AIR LOAD

$$\frac{M_L}{*46.30} = \frac{72600}{46.30} = 1568\#$$ (REF. TABLE XVI P. 57)

COUPLE AT R.S. RESULTING FROM TRAILING EDGE AIRLOAD

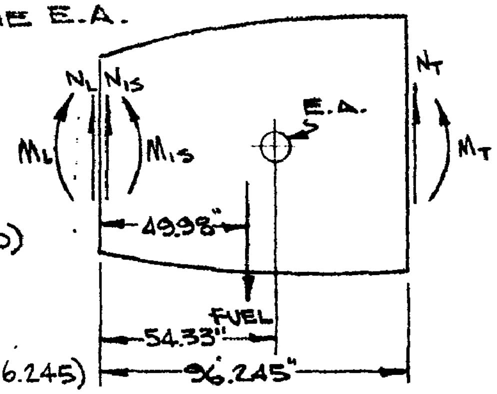
$$\frac{M_T}{*60.83} = \frac{219014}{60.83} = 3600\#$$ (REF. TABLE XVI P. 57)

*DEPTH OF SPAR BETWEEN TRUSS POINTS. SEE P. 69

BULKHEAD # 13
D.G.W. (265,192#) LAA @ 5000'

REACTIONS ON BULKHEAD

TRANSFERRING ALL FORCES TO THE E.A.



$V = N_L + N_{IS} + N_T + P_{FUEL}$
$= 3939 + 8293 + 4948 - 21507$
$= \underline{-4327}^{\#}\downarrow$

$T_{EA} = M_L + M_{IS_{FS}} + N_T(\bar{X}_{TE} + 1.S.\ CHORD)$
$+ P_{FUEL}(\bar{X}_{FUEL}) + 54.33V$
$= 72{,}600 - 371{,}936 - 4948(44.263 + 96.245)$
$+ 21507(49.98) + 54.33(-4327)$
$= \underline{154{,}740}''^{\#}$

(REF. TAB. XVI.)
TAB. XVII)

E.A. LOCATION =
0.175C AFT OF F.S.
$= .175 \times 310.471 = 54.33''$

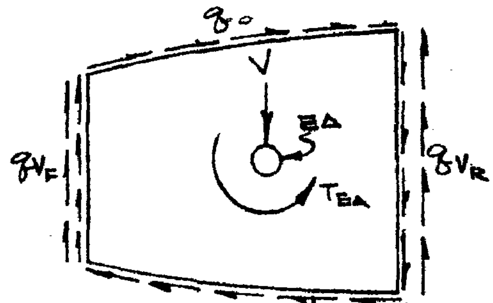
REACTIONS ON F.S. & R.S. DUE TO V

$V_{FS} = \dfrac{41.915}{96.245} \times 4327 = 1884^{\#}\uparrow$

$V_{RS} = V - V_{FS} = 4327 - 1884 = 2443^{\#}\uparrow$

$q_{V_{FS}} = \dfrac{1884}{*46.30} = 40.691\ ^{\#}/IN\uparrow$

$q_{V_{RS}} = \dfrac{2443}{*60.83} = 40.161\ ^{\#}/IN\uparrow$



REACTING FORCES ON BULKHEAD

REACTIONS DUE TO T_{EA}

$q_o = \dfrac{T_{EA}}{2A} = \dfrac{154740}{11840} = \underline{13.069\ ^{\#}/IN}$

($2A = 11840\square''$ REF. FZS-36-141, P. 206)

NET REACTIONS OF F.S. AND R.S.

$q_{F.S.} = 40.691 + 13.069 = 53.700\ ^{\#}/IN\uparrow\ (2486^{\#})$

$q_{R.S.} = 40.161 - 13.069 = 27.092\ ^{\#}/IN\uparrow\ (1648^{\#})$

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE PG. 69

BULKHEAD #13
D.G.W. (265,192#) LAA @ 5000'

CORRECTION LOADS

CORRECTING LOADS ON F.S. & R.S. TO ACCOUNT FOR THE TRANSFER OF THE SHEAR FLOW FROM THE CONTOURS TO THE CENTROIDS OF THE STRAIGHT LINE CHORD MEMBERS

UPPER SURFACE

$$T = 2A_U \overset{*}{q_o} = 2 \times 240.53 \times 13.069 = 6290''\#$$

$$R_{UF\&R} = \frac{6290}{96.245} = 65.35\#$$

LOWER SURFACE

$$T = 2A_L \overset{*}{q_o} = 2 \times 107.82 \times 13.069 = 2815''\#$$

$$R_{LF\&R} = \frac{2815}{96.245} = 29.25\#$$

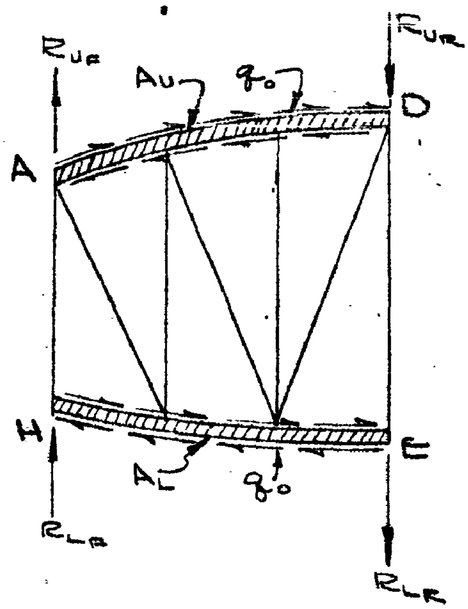
CORRECTED PANEL POINT LOADS AT F.S. AND R.S.

$P_A = 1026 + R_{UF} = 1091.35\#$ ↑

$P_D = 535 - R_{UR} = 469.65\#$ ↑

$P_E = 3282 + R_{LR} = 3311.25\#$ ↓

$P_H = 2686 - R_{LF} = 2656.75\#$ ↓



* SEE PAGE 67 FOR q_o.

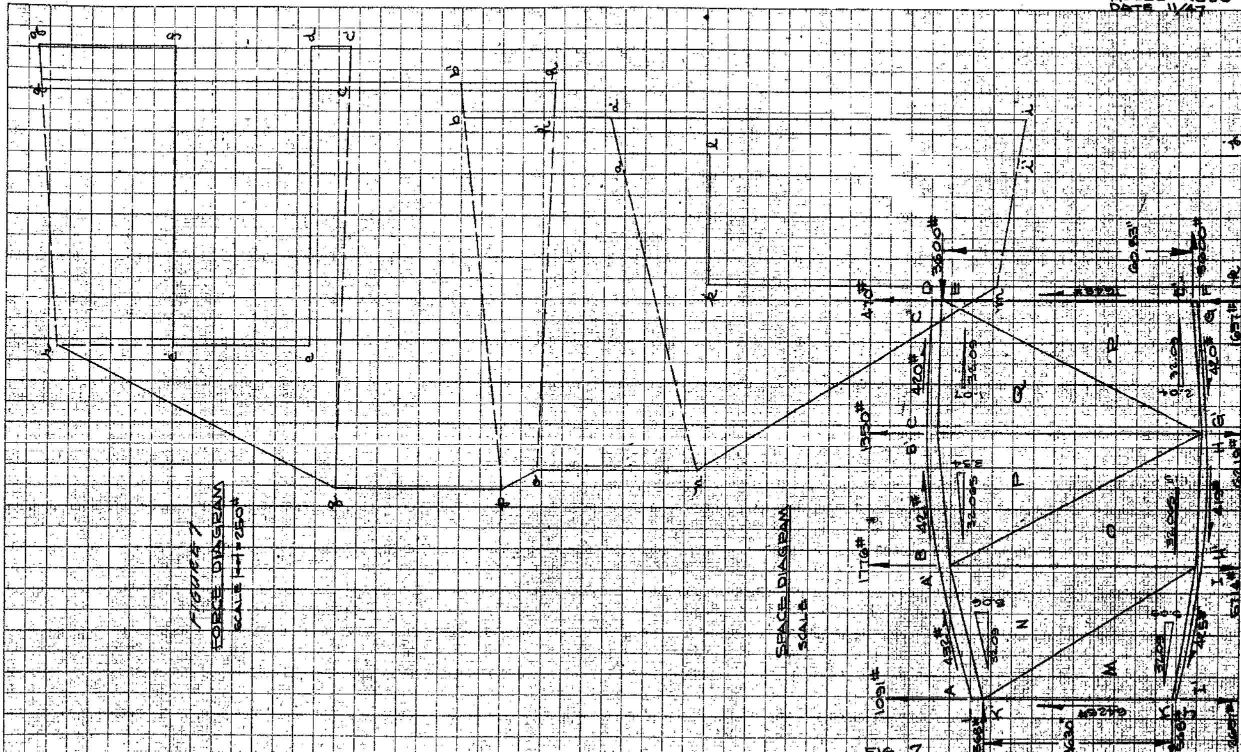


FIG. 7

CALCULATED BY	[signature]	SPACE & FORCE DIAGRAMS - BLKHD# 13	DOC. NO.
DRAWN BY	[signature]	DGW 265192 # LAA @ 5000'	
CHECKED BY	[signature]	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL XB36
APPROVED BY			

CONDITION II - D.G.W. (265,192#) ILAA @ 5000'
BULKHEAD #13

AIR LOADS (INTERSPAR) (REF. SKETCHES P. 72)

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZOIDS,

COMPOSITE INTERSPAR AIR LOAD = $N_{I.S.} = 4604^{\#}\downarrow$

C.G. AFT OF F.S. = 34.476" (REF. P. 60)

$W_{FC} = 88.50^{\#}/IN \downarrow$

$W_{RC} = 7.25^{\#}/IN \downarrow$

LOWER SURFACE INTERSPAR AIR LOAD = $N_{L.S.} = -7866^{\#}\downarrow$

C.G. AFT OF F.S. = 44.005" (REF. P. 60)

$W_{FL} = 102.40^{\#}/IN \downarrow$

$W_{RL} = 61.00^{\#}/IN \downarrow$

UPPER SURFACE INTERSPAR AIR LOAD

$$W_{FU} = W_{FC} - W_{FL} = 88.50 - 102.40 = -13.90^{\#}/IN \uparrow$$

$$W_{RU} = W_{RC} - W_{RL} = 7.25 - 61.00 = -53.75^{\#}/IN \uparrow$$

CRUSHING LOADS

CALCULATING THE CRUSHING LOAD,

$M'_x = -54.12 \times 10^6$ REF. FZS-36-240, P. 97

$E = 10.3 \times 10^6$

$L = 36.375$ IN (BULKHEAD SPACING)

$I_x = 69{,}535\ IN^4$ REF: FZS-36-141, P. 59

$I_x/Q_x = 61.3$ IN. REF. FZS-36-141, P. 207

$$\text{CRUSHING LOAD} = \frac{(M'_x)^2 L}{(I_x/Q_x) E I} = \frac{(-54.12 \times 10^6)^2 \times 36.375}{61.3 \times 10.3 \times 10^6 \times 69{,}535}$$

$$= 2427^{\#}$$

BULKHEAD # 13
D.G.W. (265,192#) ILAA @ 5000'

CRUSHING LOADS (CONT'D)

REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $\frac{H_R}{H_F} = \frac{W_R}{W_F}$ WHERE H_F = CONTOUR DEPTH OF FRONT SPAR.

$H_R = 63.789"$, $H_F = 49.353"$

$W_F = 22.00$ #/IN.

$W_R = 28.43$ #/IN. (REF. P. 72)

FUEL LOAD

SINCE THE AIR LOADS OPERATE DOWNWARD, THE FUEL LOAD ACTS ON THE UPPER SURFACE.

$P_{FUEL} = 5418.7 \times 1.675 \times 1.5 = 13617\# \uparrow$

REF: LOAD-FZS-36-240, P.52
INERTIA LOAD FACTOR-
FZS-36-126, P. 84

USING RATIO OF FUEL LOADS, B-36A & XB36.

$$\frac{P_{FUEL}(XB36)}{{}^*P_{FUEL}(B36A)} = \frac{13617}{{}^*13574.6} = 1.003$$

$W_{F_{FUEL}} = {}^*124.713(1.003) = 125.09$ #/IN $\uparrow$

$W_{R_{FUEL}} = {}^*157.379(1.003) = 157.85$ #/IN $\uparrow$ (REF. P. 72)

* FUEL LOAD FOR B36A TAKEN FROM P. I-222 FZS-36-142.

ANALYSIS WING
PREPARED BY B Clifton
CHECKED BY Heydrick
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

REPORT NO. FZS-36-242
MODEL XB36
DATE 11/47

BULKHEAD #13
D.G.W. (265,192#) ILAA @ 5000'

COMBINED AIR (INTERSPAR), CRUSHING AND FUEL LOADS ACTING ON BULKHEAD.

UPPER SURFACE

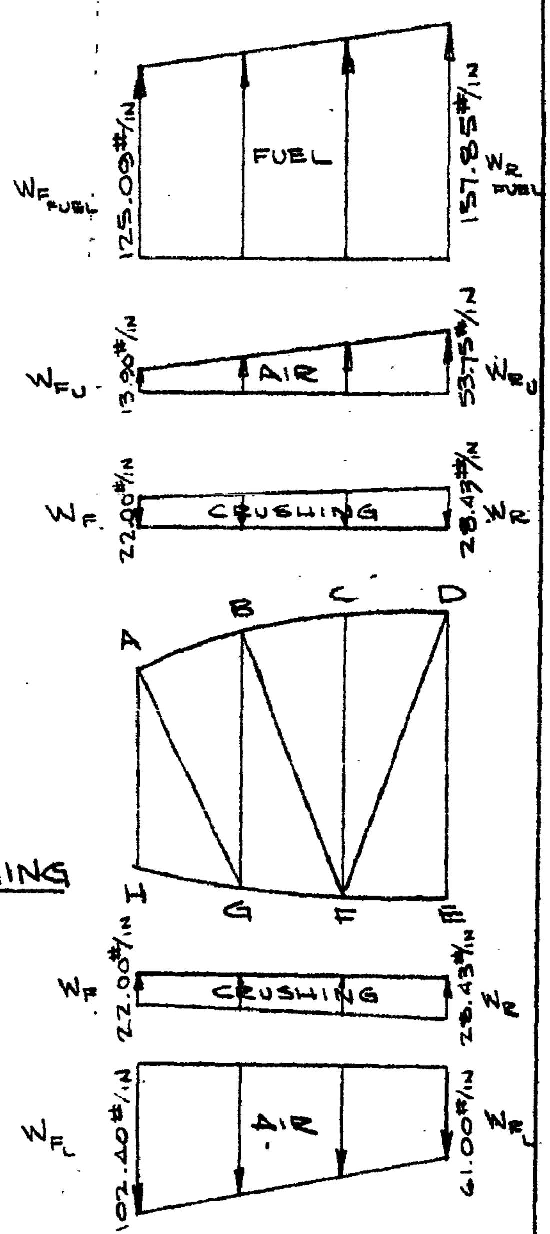
F.S. ORDINATE =
$W_{FU} + W_F + W_{F_{FUEL}} = 116.99$ #/IN ↑

R.S. ORDINATE =
$W_{RU} + W_R + W_{R_{FUEL}} = 183.17$ #/IN ↑

LOWER SURFACE

F.S. ORDINATE =
$W_{FL} + W_F = 80.40$ #/IN ↓

R.S. ORDINATE =
$W_{RL} + W_R = 32.57$ #/IN ↓



BREAK DOWN OF NET AIR, CRUSHING AND FUEL LOADS INTO PANEL POINT LOADS.

UPPER SURFACE

$P_A = 1994$# ↑

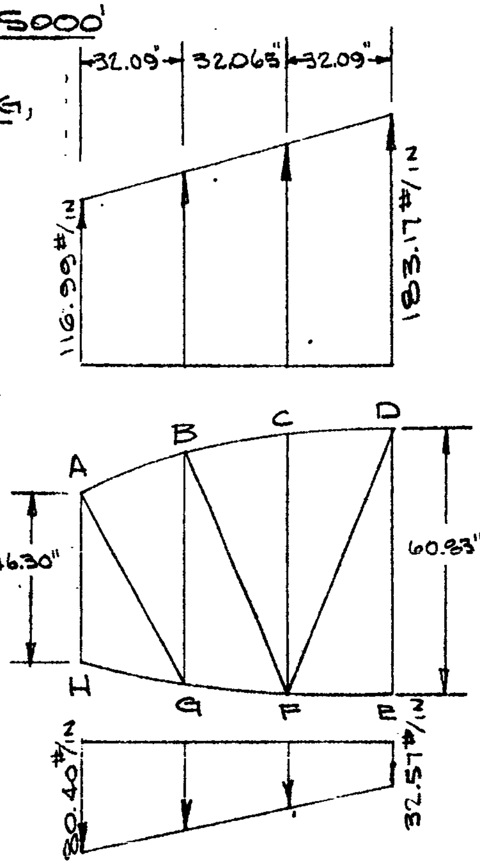
$P_B = 4459$# ↑

$P_C = 5168$# ↑

$P_D = 2824$# ↑

BULKHEAD #13

D.G.W. (265,192#) ILAA @ 5000'



COMBINED LOADS

BREAKDOWN OF NET AIR, CRUSHING, AND FUEL LOADS INTO PANEL POINT LOADS, (CONT'D)

LOWER SURFACE

$P_E = 606^{\#}$

$P_F = 1559^{\#}$

$P_G = 2069^{\#}$

$P_H = 1205^{\#}$

COUPLE AT F.S. RESULTING FROM LEADING EDGE AIR LOAD

$$\frac{M_L}{{}^{*}46.30} = \frac{101,192}{46.30} = 2185^{\#}$$ (REF: TABLE XVIII P.59)

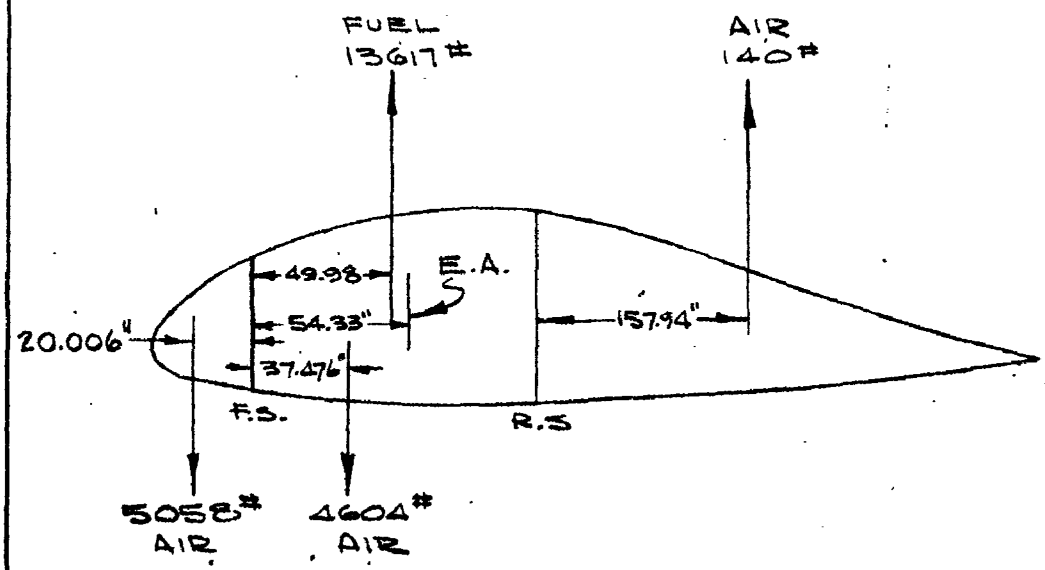
COUPLE AT R.S. RESULTING FROM TRAILING EDGE AIR LOAD

$$\frac{M_T}{{}^{*}60.83} = \frac{22111}{60.83} = 364^{\#}$$ (REF: TABLE XVIII P.59)

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE P. 77

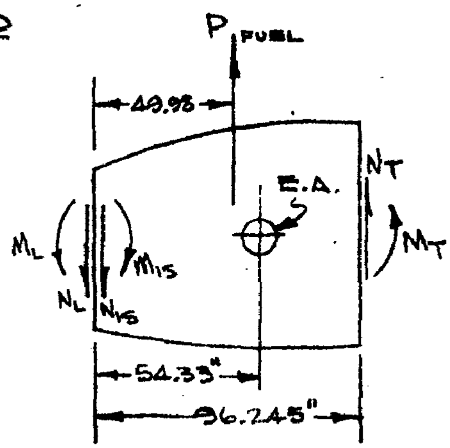
BULKHEAD #13
D.G.W. (265,192#) ILAA @ 5000'

WING STATION #13 FUEL AND AIR LOADING



REACTIONS ON BULKHEAD

TRANSFERRING ALL FORCES TO E.A.



$$V = N_L + N_{15} + N_T + P_{FUEL}$$

$$= 5058 + 4604 - 140 - 13617$$

$$= \underline{4095}\# \uparrow$$

REF: TABLE XVIII P.	59
TABLE XIX P.	60

$$T_{E.A.} = M_L + M_{15_{FS}} + N_T(\bar{X}_{TE} + \text{I.S. CHORD})$$

$$+ P_{FUEL}(\bar{X}_{FUEL}) + 54.33\,V$$

$$= -101{,}192 + 158719 - 140(157.94 + 96.245)$$

$$- 13617(49.98) + 54.33(4095)$$

$$= -\underline{436{,}156}''\#$$

BULKHEAD #13
D.G.W. (265,192#) ILAA @ 5000#

REACTIONS ON BULKHEAD (CONT'D)

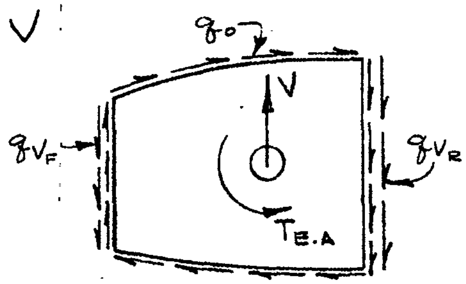
REACTIONS ON F.S. & R.S. DUE TO V

$V_{FS} = \frac{41.915}{96.245} \times 4095 = 1784^{\#} \downarrow$

$V_{RS} = 4095 - 1784 = 2311^{\#} \downarrow$

$q_{V_F} = \frac{1784}{*46.30} = 38.53^{\#}/\text{IN} \downarrow$

$q_{V_R} = \frac{2311}{*60.83} = 37.99^{\#}/\text{IN} \downarrow$



REACTING FORCES ON BULKHEAD

E.A. LOCATION = 0.175C AFT F.S. = .175 × 310.471 = 54.33"

REACTIONS DUE TO $T_{E.A.}$

$q_0 = \frac{T_{EA}}{2A} \quad \frac{436,156}{11840} = \underline{36.84}^{\#}/\text{IN}$

(2A = 11840 □" REF: FZS-36-141, P. 206)

NET REACTIONS OF F.S. AND R.S.

$q_{F.S.} = -38.53 + 36.84 = -1.69^{\#}/\text{IN} \downarrow (78.25^{\#})$

$q_{R.S.} = -37.99 - 36.84 = -74.83^{\#}/\text{IN} \downarrow (4552^{\#})$

CORRECTION LOADS

CORRECTING LOADS ON F.S. & R.S. TO ACCOUNT FOR THE TRANSFER OF THE SHEAR FLOW FROM THE CONTOURS TO THE CENTROIDS OF THE STRAIGHT LINE CHORD MEMBER

UPPER SURFACE

$T = 2A_U q_0 = 2 \times 240.53 \times 36.84 = 17,722''^{\#}$

$R_{UF\&R} = \frac{17722}{96.245} = 184.1^{\#}$

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE P. 69

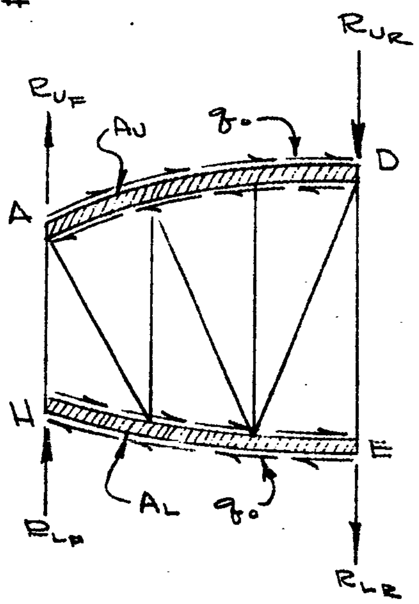
BULKHEAD #13
D.G.W. (265,192#) ILAA @ 5000'

CORRECTION LOADS (CONT'D)

LOWER SURFACE

$$T = 2A_L q_o = 2 \times 107.82 \times 36.84 = 7944''\#$$

$$R_{LF\&R} = \frac{7944}{96.245} = 82.54\#$$



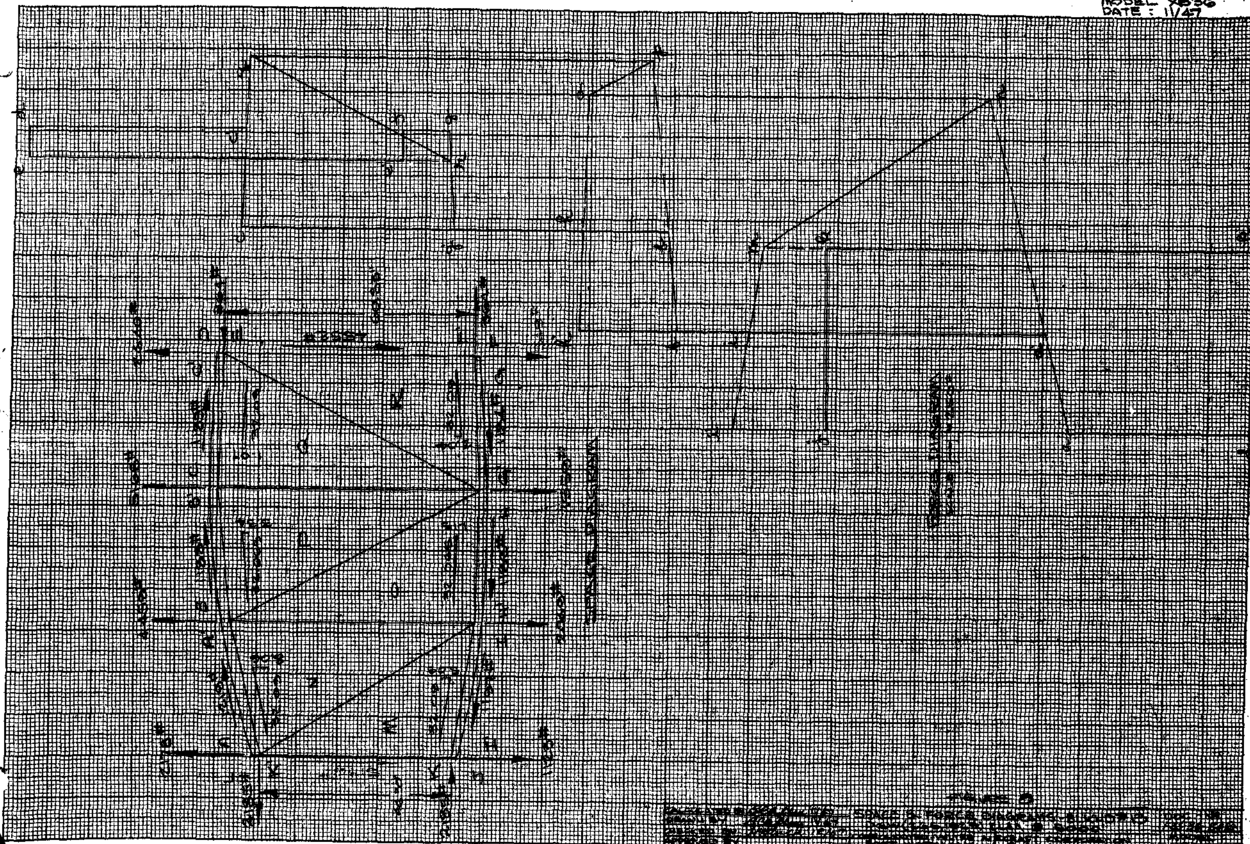
CORRECTED PANEL POINT LOADS AT F.S. AND R.S.

$$P_A = 1994 + 184 = 2178\# \uparrow$$

$$P_D = 2824 - 184 = 2640\# \uparrow$$

$$P_E = 606 + 82.5 = 688.5\# \downarrow$$

$$P_H = 1205 - 82.5 = 1122.5\# \downarrow$$


SPACE & FORCE DIAGRAMS

CONDITION III - R.G.W. (72-1000# BOMBS) LAA @ 5000'

BULKHEAD #13

AIR LOADS (INTERSPAR) (REF. SKETCHES P. 81)

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZOIDS,

COMPOSITE INTERSPAR AIR LOAD $= N_{IS} = 7781^{\#}$

C.G. AFT OF F.S. = 44.975" (REF. P. 62)

$W_{FC} = 96.59\ \#/\mathrm{IN}$

$W_{RC} = 65.10\ \#/\mathrm{IN}$

LOWER SURFACE INTERSPAR AIR LOAD $= N_{LS} = 2208^{\#}$

C.G. AFT OF F.S. = 53.777" (REF. P. 62)

$W_{FL} = 14.97\ \#/\mathrm{IN}$

$W_{RL} = 30.92\ \#/\mathrm{IN}$

UPPER SURFACE INTERSPAR AIR LOAD

$W_{FU} = W_{FC} - W_{FL} = 96.59 + 14.97 = 111.56\ \#/\mathrm{IN}$

$W_{RU} = W_{RC} - W_{RL} = 65.10 + 30.92 = 96.02\ \#/\mathrm{IN}$

CRUSHING LOADS

CALCULATING THE CRUSHING LOAD

$M'_x = 79.6 \times 10^6$ REF: FZS-36-240, P. 153

$E = 10.3 \times 10^6$

$L = 36.375$ IN (BULKHEAD SPACING)

$I_x = 69.535\ \mathrm{IN}^4$ REF: FZS-36-141, P. 59

$I_x/Q_x = 61.3$ IN REF: FZS-36-141, P. 207

$$\text{CRUSHING LOAD} = \frac{(M'_x)^2 L}{(I_x/Q_x) E I} = \frac{(79.6 \times 10^6)^2\, 36.375}{61.3 \times 10.3 \times 10^6 \times 69.535}$$

$$= 5250^{\#}$$

BULKHEAD #13

R.G.W. (72-1000# BOMBS) LAA@5000'

CRUSHING LOADS (CONT'D)

REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $\frac{H_R}{H_F} = \frac{W_R}{W_F}$ WHERE H_F = CONTOUR DEPTH OF F.S.

$H_R = 63.789''$, $H_F = 49.353''$

$W_F = 47.58$ #/IN.

$W_R = 61.51$ #/IN. (REF. FIG. BELOW)

COMBINED AIR (INTERSPAR) AND CRUSHING LOADS ON BULKHEAD.

UPPER SURFACE

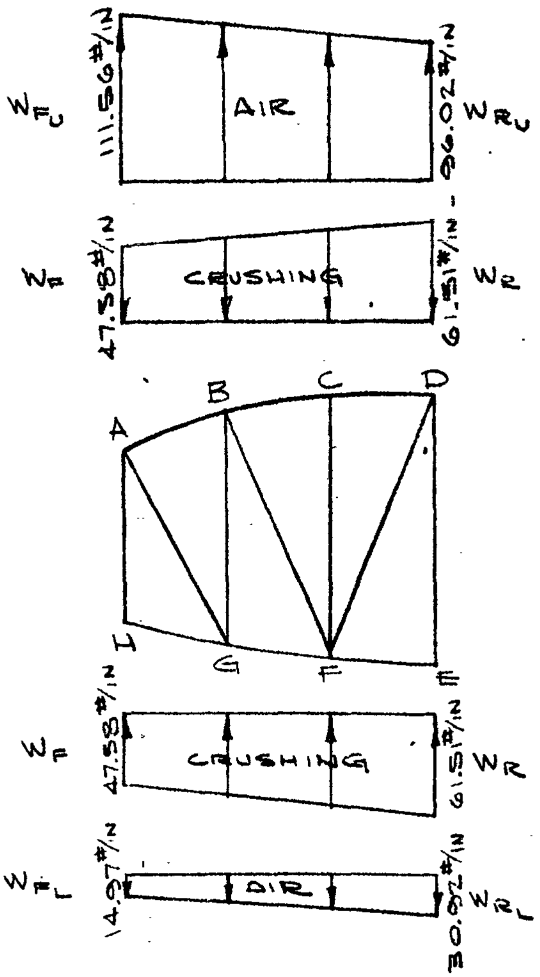
F.S. ORDINATE =
$W_{F_U} + W_F = 63.98$ #/IN

R.S. ORDINATE =
$W_{R_U} + W_R = 34.51$ #/IN

LOWER SURFACE

F.S. ORDINATE =
$W_{F_L} + W_F = 32.61$ #/IN

R.S. ORDINATE =
$W_{R_L} + W_R = 30.59$ #/IN



BULKHEAD #13
R.G.W. (72-1000# BOMBS) LAA@5000'

BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS

UPPER SURFACE

$P_A = 974^{\#}$

$P_B = 1737^{\#}$

$P_{C'} = 1422^{\#}$

$P_D = 606^{\#}$

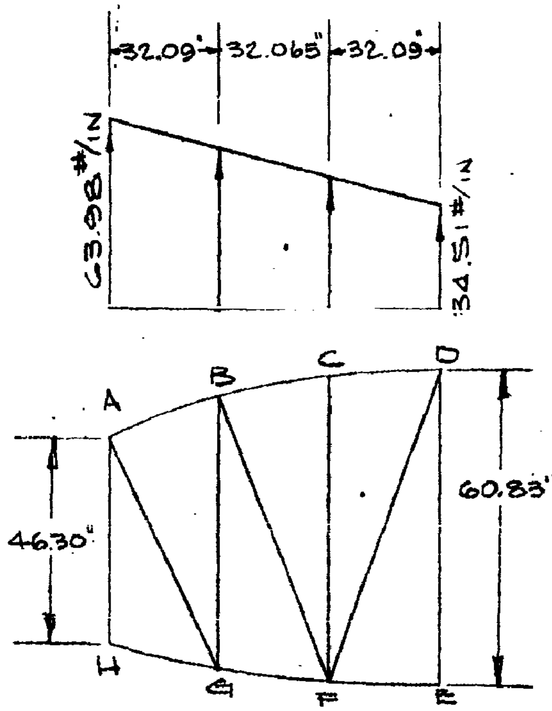
LOWER SURFACE

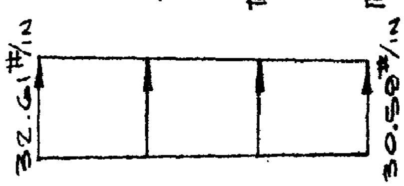
$P_E = 494^{\#}$

$P_F = 1004^{\#}$

$P_G = 1023^{\#}$

$P_H = 521^{\#}$





COMBINED LOADS

COUPLE AT FRONT SPAR RESULTING FROM L.E. AIR LOAD

$$\frac{M_L}{*46.30} = \frac{66396}{46.30} = 1434^{\#} \quad (\text{REF: TAB. XX P. 61})$$

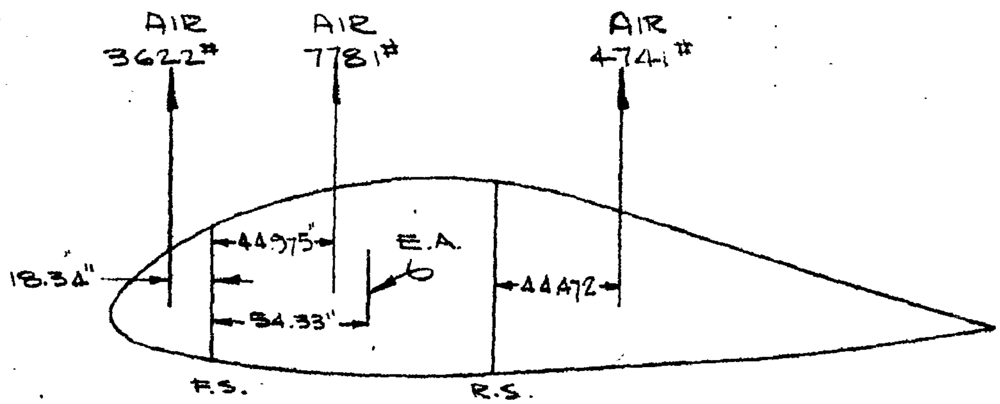
COUPLE AT REAR SPAR RESULTING FROM T.E. AIR LOAD

$$\frac{M_T}{60.83} = \frac{210824}{60.83} = 3466^{\#} \quad (\text{REF: TAB. XX P. 61})$$

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE P. 84

BULKHEAD #13
R.G.W. (72-1000# BOMBS) LAA@5000'

WING STATION #13 AIR LOADING



REACTIONS ON BULKHEAD

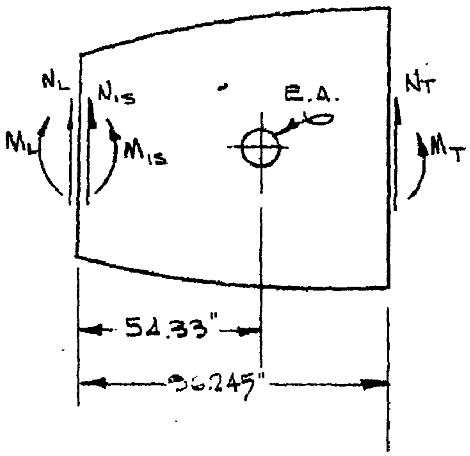
TRANSFERRING ALL FORCES TO E.A.

$V = N_L + N_{IS} + N_T$

$= 3622 + 7781 + 4741$

$= \underline{16,144}\#$

REF:	TABLE XX P. 61
	TABLE XXI P. 62



E.A. LOCATION =
0.175 C AFT F.S.
$= .175 \times 310.471 = 54.33"$

$T_{EA} = M_L + M_{IS_{FS}} + N_T(\bar{X}_{TE} + I.S.\ CHORD) + 54.33V$

$= 66,396 - 349,945 - 4741(44.472 + 96.245) + 54.33(16,144)$

$= \underline{73,584}\ ''\#$

BULKHEAD #13
R.G.W. (72-1000# BOMBS) LAA@5000'

REACTIONS ON BULKHEAD (CONT'D.)

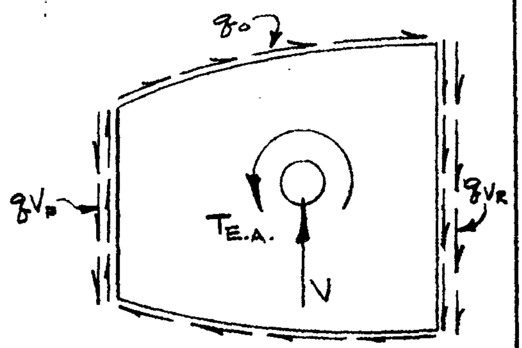
REACTIONS ON F.S. & R.S. DUE TO V

$$V_{FS} = \frac{41.915}{96.245} \times 16144 = 7031^{\#} \downarrow$$

$$V_{RS} = 16144 - 7031 = 9113^{\#} \downarrow$$

$$q_{V_F} = \frac{7031}{*46.30} = 151.87^{\#}/IN \downarrow$$

$$q_{V_R} = \frac{9113}{*60.83} = 149.81^{\#}/IN \downarrow$$



REACTIONS DUE TO T_{EA}

$$q_0 = \frac{T_{EA}}{2A} = \frac{73584}{11840} = 6.21^{\#}/IN$$

(2A = 11840□" REF: FZS-36-141, P. 206)

NET REACTIONS OF F.S. & R.S.

$$q_{F.S.} = 151.87 - 6.21 = 145.66^{\#}/IN \downarrow \quad (6744^{\#})$$

$$q_{R.S.} = 149.81 + 6.21 = 156.02^{\#}/IN \downarrow \quad (9491^{\#})$$

CORRECTION LOADS

CORRECTING LOADS ON F.S. & R.S. TO ACCOUNT FOR THE TRANSFER OF THE SHEAR FLOW FROM THE CONTOURS TO THE CENTROIDS OF THE STRAIGHT LINE CHORD MEMBER.

UPPER SURFACE

$$T = 2A_U q_0^{\ddagger} = 2 \times 240.53 \times 6.21 = 2987''^{\#}$$

$$R_{U_{F\&R}} = \frac{2987}{96.245} = 31^{\#}$$

‡ SEE P. 82 FOR q_0.

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE P. 84

BULKHEAD # 13

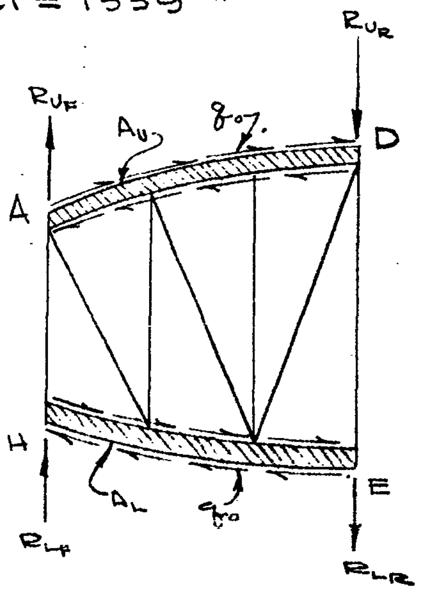
R.G.W. (72-1000# BOMBS) LAA @ 5000'

CORRECTED LOADS (CONT'D)

LOWER SURFACE

$$T = 2A_L q_o = 2 \times 107.82 \times 6.21 = 1339''\#$$

$$R_{LF\&R} = \frac{1339}{96.245} = 14\#$$



CORRECTED PANEL POINT LOADS AT F.S. AND R.S.

$$P_A = 974 + 31 = 943\#$$

$$P_D = 606 - 31 = 575\#$$

$$P_B = 494 - 14 = 480\#$$

$$P_H = 521 + 14 = 535\#$$

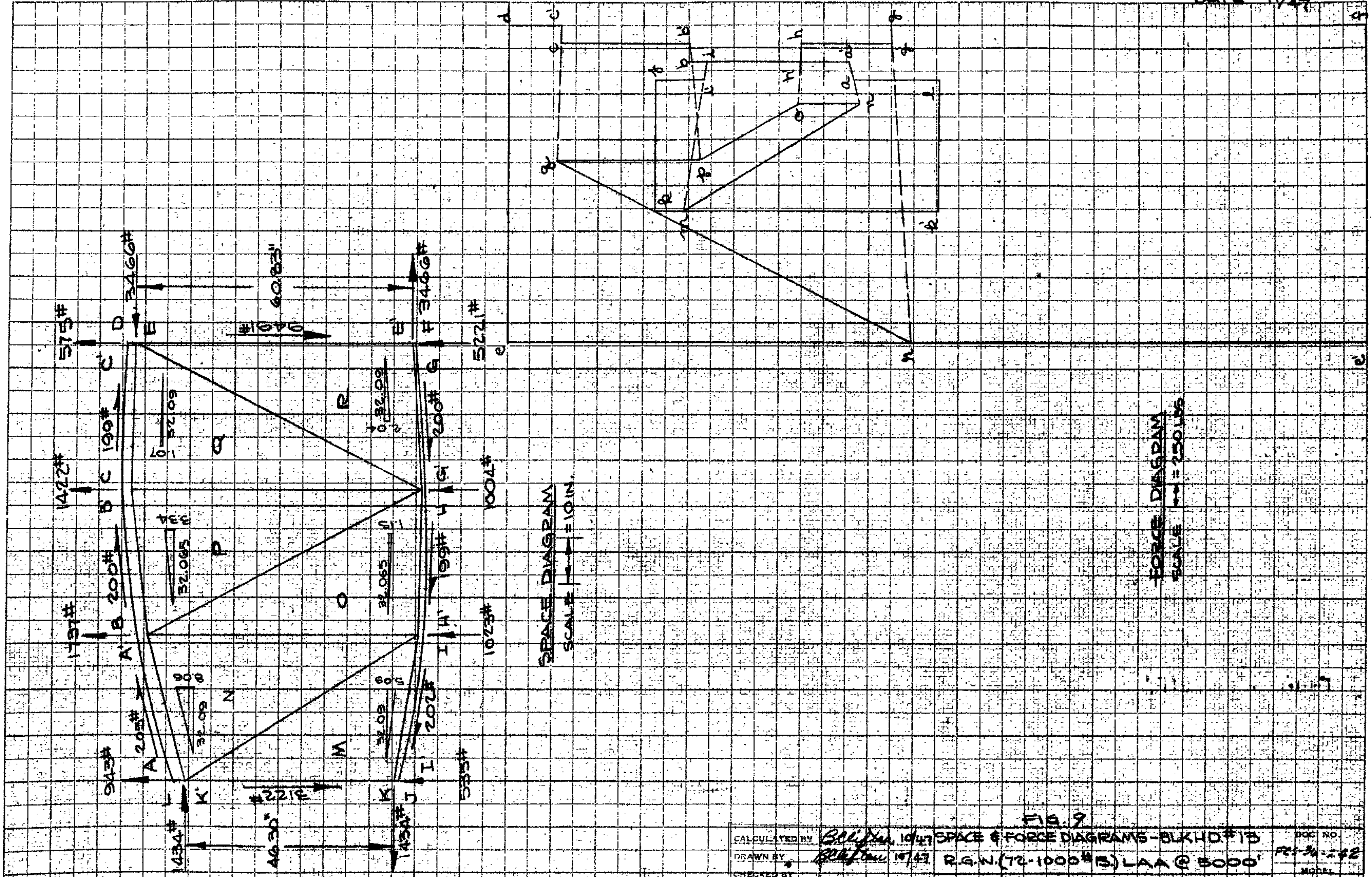


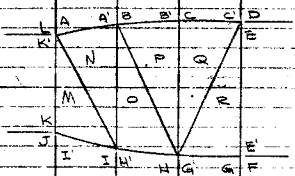
FIG. 9

CALCULATED BY	B.Clifton 10/47	SPACE & FORCE DIAGRAMS - BLKHD. #13	DOC. NO. FZ5-36-242
DRAWN BY	B.Clifton 10/47	R.G.W. (72-1000 # B.) L.A.A. @ 5000'	MODEL
CHECKED BY		CONSOLIDATED VULTEE AIRCRAFT CORPORATION	XB36
APPROVED BY		FORT WORTH DIVISION, FORT WORTH, TEXAS	

TABLE XXII SUMMARY OF AXIAL LOADS IN TRUSS MEMBERS & COMPARISON XB36 & YB36

BULKHEAD #13

MEMBER	CONDITION: D.G.W. L.A.A. @5000'	D.G.W. L.L.A.A @5000'	RGW-LAA 72-1000# B. 1/3 F & O.J. @5000'	MAXIMUM LOAD XB36 TEN.	MAXIMUM LOAD XB36 COMP.	MAXIMUM LOAD YB36 TEN.	MAXIMUM LOAD YB36 COMP.
	FIG. 7	FIG. 8	FIG. 7			P. I-230 FZS-36-142	
AN	-3928	+4130	-270	+4130	-3928	3940	-4300
A'N	-4360	+2911	-475	+2911	-4360	2890	-4385
BP	-4489	+3270	-1075	+3270	-4489	3240	-4620
B'P	-4910	+2082	-1275	+2082	-4910	2220	-4700
CQ	-4900	+2050	-1285	+2050	-4900	2240	-4700
C'Q	-5320	+867	-1484	+867	-5320	1220	-4780
ER	-3060	+5140	+4450	+5140	-3060	4420	-3200
E'R	-2412	+588	-5041	+588	-5041	3210	-3350
GR	+3610	+365	+3480	+3610	——	3150	-225
GR	+3190	-819	+3280	+3280	-819	3070	-1240
HO	+4660	-1640	+660	+4660	-1640	4335	-1795
H'O	+4241	-2822	+461	+4241	-2822	4250	-2810
IM	+2040	-1030	+1650	+2040	-1030	2000	-1190
I'M	+1615	-2227	+1448	+1615	-2227	1915	-2220
KM	+2930	+770	-325	+2930	-325	2600	-520
K'M	-3495	+5906	+2797	+5906	-3495	5575	-3900
MN	+4270	-3255	-2270	+4270	-3255	4300	-3040
NO	+1350	+4860	+680	+4860	——	4300	-370
OP	+500	-875	+1250	+1250	-875	1280	-920
PQ	+2025	+4900	+1580	+4900	——	4145	—
QR	+3790	-2740	-4400	+3730	-4400	3620	-3640



CALC. BY: R. Cip[illegible]

CHKD. BY: [illegible]

BULKHEAD # 13

DETAIL ANALYSIS OF:

TUBULAR MEMBERS IN COMPRESSION AND TENSION, TUBE END ATTACHMENTS AND CHORD MEMBERS.

THE CRITICAL SECTION OF ALL TUBES WHEN LOADED IN TENSION IS AT THE JUNCTURE OF THE REDUCED END SECTION AND THE FULL CROSS SECTION AS SHOWN IN THE ACCOMPANYING SKETCH.

A COMPARISON WAS MADE OF THE TRUSS MEMBERS AND THEIR AXIAL LOADS FOR THE YB36 & THE XB36. FROM THIS COMPARISON & A STUDY OF THE YB36 ANALYSIS (FZS-36-142 P. I-237), IT WAS FOUND THAT THE UPPER ENDS OF TUBES <u>NO</u> & <u>PQ</u> WERE CRITICAL IN COMBINED BENDING & TENSION IN THE END SECTION, & FOR THE RIVET ATTACHMENT TO THE CHORD MEMBER.
THE ANALYSES OF THESE JOINTS ARE, THEREFORE, MADE.

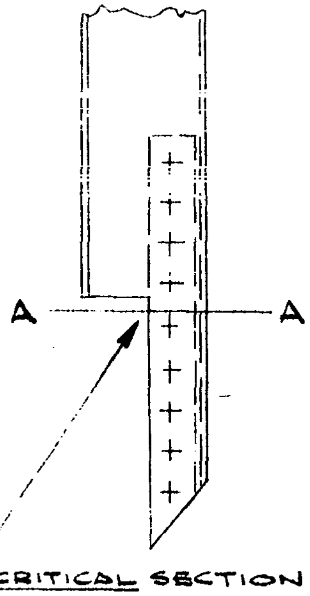


TABLE XXIII.

TUBULAR MEMBERS IN COMPRESSION & TENSION
STATION #13

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
MEMBER	MAX. COMP LOAD #	TUBE NUMBER	SIZE OF TUBE	AREA OF TUBE □"	f_c #/□"	* L "	I	$\rho = \sqrt{I/A}$	$L/\sqrt{c}\,\rho$ c=1	‡ F_c	M.S.$_c$	MAX. TEN. LOAD	f_t #/□"	‡ F_t	M.S.$_t$
	TABLE XXII PAGE 85				(2)/(5)			(8)/(5)	(7)/(9)			TAB. XXII PAGE 85	(13)/(5)		
MN	-3255	36W113-53	1.5"×1.75"×.040	.2895	11,240	53	.1519	.7244	73.2	16,100	+.43	4270	14,750	49,000	+2.32
NO	——	36W113-37 & 43	1.5"×1.5"×.040	.2695	——	55	.1080	.6330	86.9	11,450	——	4860	18,050		+1.72
OP	-875	36W113-54	1.5"×1.5"×.032	.2149	4070	62	.0846	.6274	98.8	6,900	+.69	1250	5,810		+7.43
PQ	——	36W113-41 & 49	1.5"×2.0"×.040	.3095	——	59	.2049	.8137	72.5	16,600	——	4900	15,850		+2.09
QR	-4400	36W113-55	2.0"×2.0"×.051	.4733	9,300	62.5	.3453	.8541	73.2	16,100	+.73	3790	8,010	49,000	+5.11

NOTE: * DISTANCE BETWEEN C.G.'S OF ATTACHING RIVETS
‡ FOR ALLOWABLE STRESSES, REFER TO PAGE I-62, FZS-36-142.

CALC. BY: B C [illegible]
CHKD. BY: Mufford

BULKHEAD # 13

TUBE "NO" IN TENSION (AND RIVET ATTACHMENT)

SINCE THE TUBE, END CHANNELS AND RIVETS ARE THE SAME FOR BOTH THE YB36 AND XB36, THE RATIO OF THE AXIAL LOADS IN THE MEMBER IS USED TO DETERMINE THE M.S. FOR THE XB36

LOAD IN YB36 = 4300# (P. I-240, FZS-36-142)

LOAD IN XB36 = 4860# (P. 85, TABLE XXII)

$M.S._t\,(YB36) = +.32$ (P. I-240, FZS-36-142)

$$M.S._t\,(XB36) = (+.32+1)\left(\frac{4300}{4860}\right)-1 = \quad +.17$$

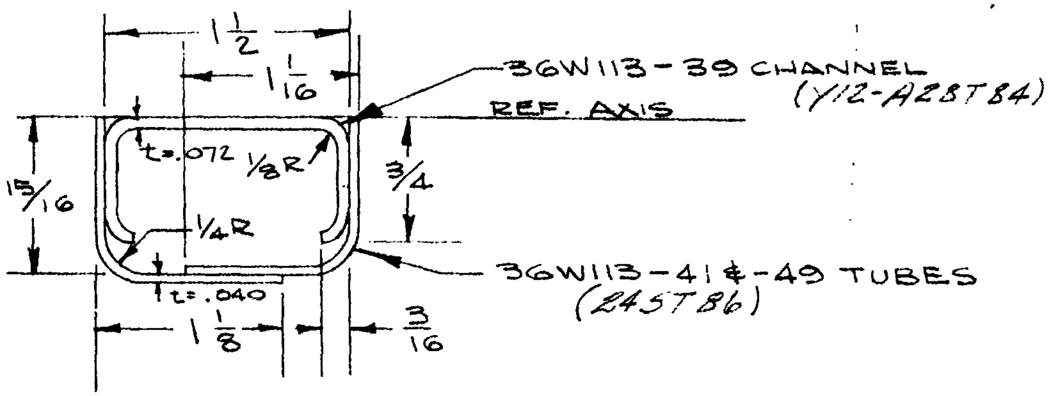
RIVETED ATTACHMENT

$M.S._{RIVETS}\,(YB36) = +.20$ (P. I-240, FZS-36-142)

$$M.S._{RIVETS}\,(XB36) = (+.20+1)\left(\frac{4300}{4860}\right)-1 = \quad +.06$$

BULKHEAD #13

ANALYSIS OF TUBE "PQ" AND RIVET ATTACHMENT IN TENSION



CRITICAL SECTION

$\bar{y} = .4512''$ $\quad$ $A = .3616\ \square''$

$y_t = .4512''$ $\quad$ $e = .4512''$

$y_c = .5263''$

$I = .04691\ \text{IN}^4$

THE MAXIMUM LOAD IS 4900# TENSION (P. 3)

$$f_t = \frac{P}{A} + \frac{Pey_t}{I} = \frac{4900}{.3616} + \frac{4900 \times .4512 \times .4512}{.04691}$$

$$= 13{,}550 + 21{,}270 = 34{,}820\ \#/\text{IN}^2$$

$$f_c = \frac{P}{A} - \frac{Pey_c}{I} = 13{,}550 - \frac{4900 \times .4512 \times .5263}{.04691}$$

$$= 13550 - 24800 = -11{,}250\ \#/\text{IN}^2$$

CONSERVATIVELY ASSUMING A COMBINED CONCENTRATION & RIVET FACTOR $R \times C_R = 0.70$

$F_{tu} = 70{,}000\ \#/\square''$ (STRUCTURES BULLETIN B-1)

$$M.S._t = \frac{0.70 \times 70{,}000}{34820} - 1 = \boxed{+.41}$$

BULKHEAD # 13

ANALYSIS OF TUBE "PQ" (CONT'D)

RIVETED ATTACHMENT

THE ATTACHMENT OF THE CHANNEL INSERT 36W113-39 TO THE UPPER CHORD MEMBER IS CRITICAL. THE (6) RIVETS (Q4305-D8) ARE CRITICAL IN SHEAR.

ALLOWABLE SINGLE SHEAR = 1764#
(STRUCTURES BULLETIN B-6)

$$M.S._{RIVETS} = \frac{6 \times 1764}{4900} - 1 = \quad +1.16$$

CHORD MEMBERS

THE XB36 CHORD MEMBERS FOR THIS BULKHEAD ARE THE SAME AS THOSE OF THE YB36; THEREFORE A REASONABLY CLOSE CHECK CAN BE MADE OF THE XB36 THROUGH A COMPARISON OF THE APPLIED LOADS ON THE CHORD MEMBERS. THIS TYPE OF CHECK IS FURTHER JUSTIFIED BY THE VERY HIGH M.S. FOUND IN THE YB36 ANALYSIS. FROM A STUDY OF THE DESIGN CONDITIONS, IT IS FOUND THAT THE XB36 AND YB36 CHORD MEMBERS ARE CRITICAL FOR THE SAME CONDITIONS. THE CRITICAL POINTS USED IN THE YB36 ANALYSIS ARE USED HERE FOR THE XB36 FOR A COMPLETE EXPLANATION OF THE CHORD MEMBER ANALYSIS PROCEDURE SEE REPORT FZS-36-142 (PAGES I-241 THRU I-256).

BULKHEAD #13

CHORD MEMBERS (CONT'D)

UPPER CHORD MEMBER (ABCD) (36W113-7)

THE UPPER CHORD MEMBER IS CRITICAL FOR TWO CONDITIONS. FOR CONDITION I, DGW-LAA@5000', THE CRITICAL COMPRESSIVE STRESS OCCURS IN THE SKIN AT THE FIRST PANEL POINT AND FOR CONDITION II, DGW-ILAA@5000', THE CRITICAL STRESS OCCURS IN THE LIPPED FLANGE 13 IN. FORWARD OF THE REAR SPAR.

CONDITION I
(DGW-LAA @ 5000')

AXIAL LOAD, $P_1 = -4489$# (P. 85) COMP.

THE BENDING MOMENT, M_1 IS OBTAINED BY THE COMPARISON OF THE ORDINATES (AT THE CRITICAL POINT) OF THE NET LOAD DISTRIBUTION TRAPEZOIDS OF THE TWO MODELS.

$B_{ORDINATE}(YB36) = 38.106$#/IN.*

$B_{ORDINATE}(XB36) = 55.25$#/IN. (P. 66)

$M_{(YB36)} = 4471$"# *

$$M_{(XB36)} = \frac{4471(55.25)}{38.106} = 6490\text{"\#}$$

* (REF: FZS-36-142, P. I-216
I-252)

BULKHEAD # 13

CHORD MEMBERS (CONT'D)

UPPER CHORD MEMBER (ABCD)

CONDITION I

$$f_c = \frac{P}{A} + \frac{M}{I/c} = \frac{4489}{.9058} + \frac{6490}{2.472} = 7585\#/\square''$$

A & I/c TAKEN FROM YB36 REPORT FZS-36-142 - CHORD MEMBERS SAME.

$F_c = 27{,}900\#/\square''$ (FZS-36-142)

$$M.S._{COMP.} = \frac{27900}{7585} - 1 = \boxed{+2.68}$$

CONDITION II
(DGW - ILAA @ 5000')

AXIAL LOAD, P, = 1340# (P. 85) TENSION
(CRITICAL POINT, X, IS 13" FWD R.S.)

$X_{ORDINATE}$ (YB36) $= 160.394 - .6237 \times 13$ *
$= 152.286\#/IN.$

$X_{ORDINATE}$ (XB36) $= 183.17 - .6876 \times 13$ (P. 73)
$= 174.231\#/IN.$

$M_{(YB36)} = 12612''\#$ *

$$M_{(XB36)} = 12612\left(\frac{174.231}{152.286}\right) = 14530''\#$$

* (REF: FZS-36-142, P. I-223
P. I-251)

BULKHEAD # 13

CHORD MEMBERS (CONT'D)

UPPER CHORD MEMBER (ABCD)

CONDITION II

$$f_c = \frac{P}{A} + \frac{M}{I/c} = \frac{1340}{.9058} - \frac{14530}{1.294} = -9731\text{\#/□"}$$

$$F_c = 25000\text{\#/□"} \quad (\text{FZS-36-142 P-I-251})$$

$$M.S._{COMP.} = \frac{25000}{9731} - 1 = \qquad \boxed{+1.57}$$

LOWER CHORD MEMBER (EFGH)(36W113-6)

THE LOWER CHORD MEMBER IS CRITICAL FOR CONDITION I, DGW-LAA @ 5000'. THE CRITICAL COMPRESSIVE STRESS OCCURS IN THE LIPPED FLANGE 13" FORWARD OF THE REAR SPAR.

AXIAL LOAD, $P_1 = 3440$# (P. 85) TENSION

$$X_{ORDINATE\,(YB36)} = 193.360 - \frac{57.498}{96.245} \times 13 \; * $$
$$= 185.594\text{ \#/"}$$

$$X_{ORDINATE\,(XB36)} = 209.460 - .4879 \times 13 \quad (\text{P. 66})$$
$$= 203.117\text{ \#/"}$$

* (REF : FZS-36-142, P. I-216)

BULKHEAD #13

CHORD MEMBERS (CONT'D)

LOWER CHORD MEMBER (EFGH)

$$M_{(YB36)} = 15360''\# \quad (FZS\text{-}36\text{-}142,\ P.\ I\text{-}256)$$

$$M_{(XB36)} = 15360\left(\frac{203.117}{185.594}\right) = 16800''\#$$

$$f_c = \frac{P}{{*}A} + \frac{M}{{*}I/c} = \frac{3440}{2.612} - \frac{16800}{1.332}$$

$$= -11282\ \#/\square''$$

$$F_c = {}^{*}25{,}000\ \#/\square''$$

$$M.S._c \geq \frac{25000}{11282} - 1 \geq$$ $\boxed{+1.22}$

*(REF: FZS-36-142, P. I-256)

BULKHEAD #13.

INTERCOSTAL ANALYSIS

ANALYSIS OF UPPER INTERCOSTALS

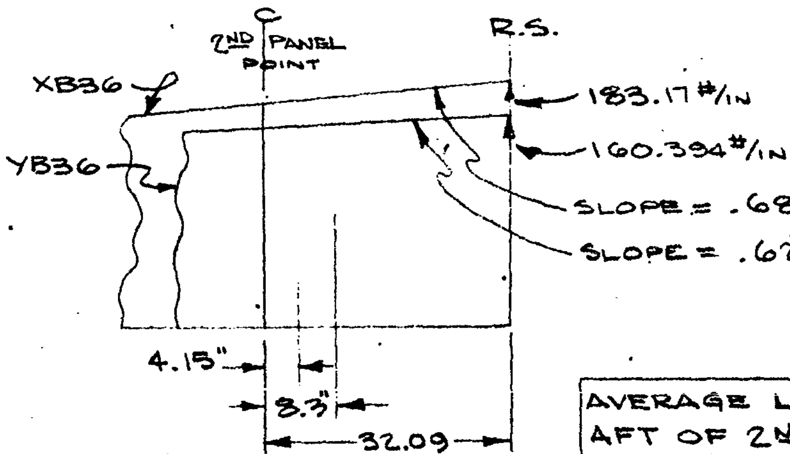
THE UPPER INTERCOSTALS, AS WERE THE CHORD MEMBERS, FOR THE XB36 ARE IDENTICAL TO THOSE OF THE YB36; THEREFORE, THE ONLY CHANGE WILL OCCUR IN THE APPLIED LOADS. A SURVEY OF THE DESIGN CONDITIONS OF THE XB36 PRODUCED THE SAME CRITICAL CONDITION AND INTERCOSTAL THAT WERE CRITICAL FOR THE YB36. THE CRITICAL CONDITION IS DGW-ILAA @ 5000' AND THE INTERCOSTAL JUST AFT OF THE SECOND PANEL POINT IS FOUND TO BE CRITICAL FOR THE COMBINED EFFECTS OF TRANSVERSE SHEAR AND AXIAL LOAD.

THE AVERAGE TRANSVERSE SHEAR FOR THE YB36 WAS TAKEN AS THE AVERAGE SHEAR OVER A DISTANCE OF 8.3", USING THE SHEAR CURVE DEVELOPED (REF: FZS-36-142, P.I-257). IN THIS ANALYSIS THE AVERAGE TRANSVERSE SHEAR IS CONSIDERED PROPORTIONAL TO THE AVERAGE LOADING OVER THE SAME DISTANCE. THE AVERAGE TRANSVERSE SHEAR FOR THE XB36 IS THEN COMPUTED USING THE RATIO OF THE XB36 LOADING TO THE YB36.

BULKHEAD #13

INTERCOSTAL ANALYSIS

ANALYSIS OF UPPER INTERCOSTALS (CONT'D).



AVERAGE LOADING IS 4.15" AFT OF 2ND PANEL POINT OR 27.94" FWD. R.S.

NET LOADING ON UPPER SURFACE

REF: FZS-36-142 P. I-223
P. 72 THIS REPORT

LOADING FOR YB36 = 160.394 − .6237(27.94) = 142.968#/IN
(27.94" FWD R.S.)

LOADING FOR XB36 = 183.17 − .6876(27.94) = 163.958#/IN
(27.94" FWD R.S.)

AVERAGE TRANSVERSE SHEAR (YB36) = 2240#
(P. I-257 FZS-36-142)

AVERAGE TRANSVERSE SHEAR (XB36) =

$$2240\left(\frac{163.958}{142.968}\right) = 2569^{\#}$$

THE INTERCOSTAL LOAD DUE TO TRANSVERSE SHEAR

$$= \frac{VQ}{I}\ 8.3$$

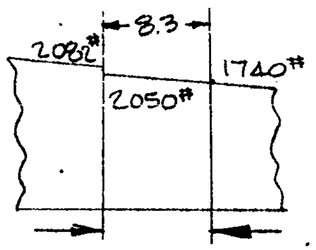
$$= \frac{2569 \times 1.025 \times 8.3}{5.223} = 4180^{\#}$$

BULKHEAD # 13

INTERCOSTAL ANALYSIS

ANALYSIS OF UPPER INTERCOSTALS (CONT'D)

THE INTERCOSTAL LOAD DUE TO THE CHORD MEMBER AXIAL LOAD IS THE DIFFERENCE OF P_{1L} & P_{2L} AS SHOWN ON THE ACCOMPANYING SKETCH, WHERE



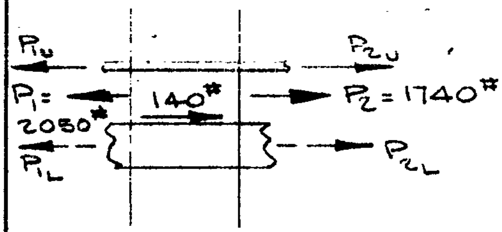
(REF: P. 96)

$$P_{1L} = P_1 \frac{A_L}{A_{TOTAL}} = 2050 \frac{.4058}{.9058} = 920^{\#}$$

$$P_{2L} = P_2 \frac{A_L}{A_{TOTAL}} = 1740 \frac{.4058}{.9058} = 780^{\#}$$

$$P_{1L} - P_{2L} = 920 - 780 = 140^{\#}$$

(REF: FZS-36-142, P. I-259)



TOTAL INTERCOSTAL LOAD = 4180 + 140 = 4320#

$$f_s = \frac{4320}{bt} = \frac{4320}{[4.1-3(1/4)].064} = 20{,}150 \ \#/\square''$$

THE ALLOWABLE SHEAR STRENGTH OF THE INTERCOSTAL WILL BE TAKEN AS THE CRITICAL BUCKLING STRESS OF THE INTERCOSTAL ELEMENT — $F_{S_{cr}} = 39{,}000 \ \#/\square''$
(FZS-36-142, P. I-260)

$$M.S._{CR.} = \frac{39000}{20150} - 1 = \boxed{+.94}$$

BULKHEAD #13

INTERCOSTAL ANALYSIS

ANALYSIS OF UPPER INTERCOSTALS (CONT'D)

T-SECTION

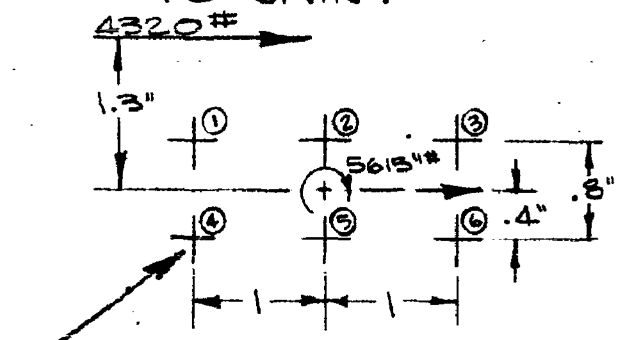
CHECK OF CRITICAL SECTION OF TEE.

$f_s = \dfrac{4320}{[3-3(\frac{1}{4})].080} = 24000$ #/□" REF: P.I-258 FZS-36-142

F_{su} (GUST ELIM) = 37000 #/□"

$M.S. = \dfrac{37000}{24000} =$ +.54

CHECK OF RIVET PATTERN TYING T-SECTION TO SKIN.



RIVET PATTERN
(1/4 IN. 17ST RIVETS)

RIVET	A	x	y	Ax^2	Ay^2
1	—	−1	.4	1	.16
2	—	0	.4	0	.16
3	—	1	.4	1	.16
4	—	−1	−.4	1	.16
5	—	0	−.4	0	.16
6	—	1	−.4	1	.16
Σ				4	.96

J = 4.96

CRITICAL RIVETS 1 & 3
CONSIDER 1

$H_D = \dfrac{4320}{6} = 720\#\rightarrow$

$H_M = \dfrac{5615}{4.96} \times .4 = 453\#\rightarrow$

$H = 1173\#\rightarrow$

$V_M = \dfrac{5615}{4.96} \times 1 = 1132\#\uparrow$

$P = \sqrt{(1173)^2 + (1132)^2} = 1632\#$

RIVET ALLOWABLE IN SHEAR = 1764#

$M.S._{RIVET} = \dfrac{1764}{1632} - 1 =$ +.08

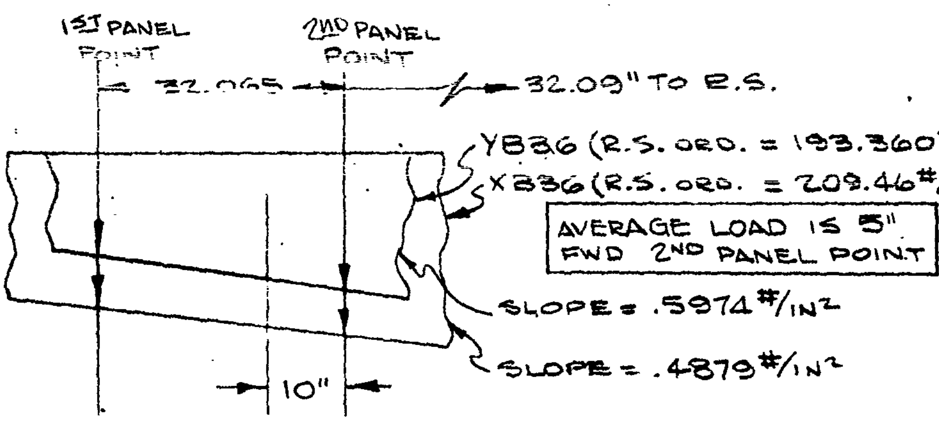
BULKHEAD # 13

INTERCOSTAL ANALYSIS

ANALYSIS OF LOWER INTERCOSTALS

THE LOWER INTERCOSTALS FOR THE XB36 ARE IDENTICAL TO THOSE OF THE YB36 FOR THIS BULKHEAD. THE CRITICAL CONDITION IS DGW-LAA @ 5000' AND THE INTERCOSTAL JUST FORWARD OF THE 2ND PANEL POINT IS CRITICAL (AS IN THE YB36 ANALYSIS).

THE TRANSVERSE SHEAR IS OBTAINED BY THE SAME METHOD USED IN THE UPPER INTERCOSTAL ANALYSIS.



NET LOADING ON LOWER SURFACE

REF: FZS-36-142, P. I-216
P. 65, THIS REPORT

LOADING FOR YB36 = 193.360 − 37.09(.5974) = 171.208 #/IN

LOADING FOR XB36 = 209.46 − 37.09(.4879) = 191.364 #/IN

AVERAGE TRANSVERSE SHEAR (YB36) = 2100#
(FZS-36-142, P. I-261)

BULKHEAD # 13

INTERCOSTAL ANALYSIS

ANALYSIS OF LOWER INTERCOSTALS (CONT'D)

$$\text{AVERAGE TRANSVERSE SHEAR (XB36)} = 2100\left(\frac{191.364}{171.208}\right)$$

$$= 2347^{\#}$$

THE INTERCOSTAL LOAD DUE TO TRANSVERSE SHEAR

$$= \frac{VQ}{I} \times 10$$

$$= \frac{2347 \times 1.47825 \times 10}{7.466} = 4645$$

THE INTERCOSTAL LOAD DUE TO THE CHORD MEMBER AXIAL LOAD WAS FOUND TO BE NEGLIGIBLE.

$$f_s = \frac{4645}{.bt} = \frac{4645}{8.4 \times .051} = 10{,}830\ \#/\square''$$

THE ALLOWABLE SHEAR STRENGTH OF THE INTERCOSTAL WILL BE TAKEN AS THE CRITICAL BUCKLING STRESS OF THE INTERCOSTAL ELEMENT — $F_{s_{CR}} = 12{,}100\ \#/\square''$
(FZS-36-142, P. I-263)

$$M.S._{cr.} = \frac{12100}{10830} - 1 = \boxed{+.12}$$

WING BULKHEAD #19
(36W 119)

INDEX

BULKHEAD #19 (36W119)

Bulkhead #19 is a truss type bulkhead located 615.375 inches from the airplane center line. It is similar to Bulkhead #19 in the B-36A analysis except for slight differences in the truss tube end connections, truss tubes, and Rear Spar Vertical. The method of analysis is the same as that used for the B-36A (Ref. FZS-36-142, p. I-264 to I-342).

A study of the B-36A critical conditions shows that a check of two conditions for the XB-36 analysis will be adequate.

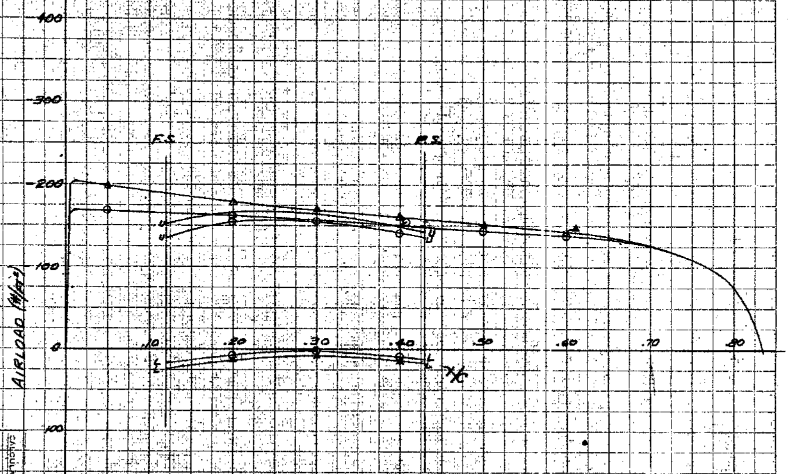
I. DGW - FDLGE (Flaps Down Landing Gear Extended) @ Sea Level

II. RGW - 72-1000# Bombs - FDLGE @ Sea Level

The third and fourth conditions used in the B-36A analysis (Ref. above), RGW-12(4000# Bombs) - LAA_{HS} @ 5000 ft. and RGW-12(4000# Bombs) - $ILAA_{HS}$ @ 5000 ft., design the lower chord and intercostals; since the M.S. are high on these members the B-36A analysis will be referred to for this portion of the analysis.

This analysis consists of a tube analysis; check of the critical tube end and critical tube end tie; analysis of upper chord; and an analysis of the rear spar vertical member.

CHORDWISE AIRLOAD DISTRIBUTION
STATION 19



NOTE: POSITIVE LOADS ACT UP ON LOWER SURFACE AND DOWN ON UPPER SURFACE. POSITIVE NET LOADS ACT DOWN.

LEGEND

△ D.G.W.– F.D.L.G.E. @ SEA LEVEL
◎ R.G.W.– F.D.L.G.E. (72-1000# BOMBS) @ SEA LEVEL

(REF. TABLE V PG. 2)

CALCULATED BY	Canfield	10/47
DRAWN BY	Canfield	10/47
CHECKED BY	Hooper	10/47
APPROVED BY		

FIG. 10

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS

DOC. NO. FZS-36-248
MODEL XB-36

KEUFFEL & ESSER CO. N. Y.

TABLE XXIV COMPUTATION OF * N_L, N_T, M_L & M_T FOR ULT. AIR LOADS

STATION 19 — D.G.W. - F.D.L.G.E @SEA LEVEL C=266.277" T.E. @ 80.47% CHORD b=36.875"

LEADING EDGE

CHORDWISE STATION %CHORD ①	p_L #/□' FIG. 10 ②	AVE. p_L ③	Δ AREA ③×.01 ④	DISTANCE TO C.G. FROM 12% LINE ⑤	Δ MOMENT ABOUT 12% LINE ⑥
0	0				
		-150	-1.50	.114	-.171
1	-203				
		-203	-2.03	.105	-.213
2	-203				
		-203	-2.03	.095	-.193
3	-202				
		-201	-2.01	.085	-.171
4	-200				
			-7.57		-.748

CHORDWISE STATION %CHORD	p_L #/□' FIG 10	S.M.s	②×③	MOMENT MULTIPLIER	④×⑤
4	-200	1	-200	4	-800
6	-197	4	-788	3	-2364
8	-195	2	-390	2	-780
10	-192	4	-768	1	-768
12	-190	1	-190	0	0
			-2336		-4712

TRAILING EDGE

CHORDWISE STATION % CHORD ⑦	p_L #/□' FIG. 10 ⑧	S.M.s ⑨	⑧×⑨ ⑩	MOMENT MULTIPLIER ⑪	⑩×⑪ ⑫
80.47	-70	1	-70	6	-420
74.225	-113	4	-452	5	-2260
67.98	-131	2	-262	4	-1048
61.735	-141	4	-564	3	-1692
55.49	-146	2	-292	2	-584
49.245	-152	4	-608	1	-608
43.0	-158	1	-158	0	0
			-2406		-6612

BY: Canfield
CHKD. BY: Simpson

* DEFINITION OF TERMS:
N_L = LEADING EDGE AIRLOAD SHEAR
M_L = LEADING EDGE AIRLOAD MOMENT ABOUT F.S.
N_T = TRAILING EDGE AIRLOAD SHEAR
M_T = TRAILING EDGE AIRLOAD MOMENT ABOUT R.S.

$$ULT.\ N_L = \frac{1.5bc}{144}\left[\frac{-2336(.02)}{3} - 7.57\right] = -2,496^{\#}\uparrow \qquad ULT.\ N_T = \frac{1.5(.06245)bc}{144}\left[\frac{-2406}{3}\right] = -5,400^{\#}\uparrow$$

$$ULT.\ M_L = \frac{1.5bc^2}{144}\left[\frac{-4712(.02)^2}{3} - .748\right] = -39,520''^{\#} \qquad ULT.\ M_T = \frac{1.5(.06245)^2bc^2}{144}\left[\frac{-6612}{3}\right] = -246,797''^{\#}$$

TABLE XXI COMPUTATION OF *N_{IS}, N_U, M_{IS} & M_U FOR AIRLOADS
STATION 19 D.G.W, F.D.L.G.E. @ SEA LEVEL b=38.915"; C=266.277"

1	2	3	4	5	6	7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	p #/□' (LIMIT)	S.M.$_5$	(2) x (3)	MOMENT MULTIPLIER	(4) x (5)	DISTANCE FROM L.E. % CHORD	p #/□' (LIMIT)	S.M.$_5$	(8) x (9)	MOMENT MULTIPLIER	(10) x (11)
	FIG. 10						FIG. 10				
COMPOSITE INTERSPAR AIR LOADS						UPPER SURFACE INTERSPAR AIR LOADS					
43.000	-158	1	-158	8	-1264	43.000	-143	1	-143	8	-1144
39.125	-161	4	-644	7	-4508	39.125	-150	4	-600	7	-4200
35.250	-165	2	-330	6	-1980	35.250	-157	2	-314	6	-1884
31.375	-168	4	-672	5	-3360	31.375	-162	4	-648	5	-3240
27.500	-172	2	-344	4	-1376	27.500	-166	2	-332	4	-1328
23.625	-175	4	-700	3	-2100	23.625	-167	4	-668	3	-2004
19.750	-180	2	-360	2	-720	19.750	-166	2	-332	2	-662
15.875	-185	4	-740	1	-740	15.875	-160	4	-640	1	-640
12.000	-190	1	-190	0	0	12.000	-152	1	-152	0	0
			-4,138		-16,048				-3,829		-15,102

*DEFINITION OF TERMS:
N_{IS} - TOTAL (UPPER & LOWER) INTERSPAR AIRLOAD SHEAR
M_{IS} - TOTAL (UPPER & LOWER) INTERSPAR AIRLOAD MOMENT
N_U - INTERSPAR AIRLOAD SHEAR (UPPER SURFACE AIRLOAD)
M_U - INTERSPAR AIRLOAD MOMENT (UPPER SURFACE)

BY: Cofield
CHKD BY: Wilkinson

$$N_{IS} = \frac{1.56b}{144}\left[\frac{(-4{,}138)\,.03875}{3}\right] = -5{,}763^{\#}\uparrow \qquad N_U = \frac{1.56b}{144}\left[\frac{(-3829)(.03875)}{3}\right] = -5{,}333^{\#}\uparrow$$

$$M_{IS_{F.S.}} = \frac{1.56c^2}{144}\left[\frac{(-16{,}048)(.03875)^2}{3}\right] = -230{,}611''^{\#} \qquad M_{U_{F.S.}} = \frac{1.56c^2}{144}\left[\frac{(-15{,}102)(.03875)^2}{3}\right] = -217{,}030''^{\#}$$

$\bar{X}$ = 40.02" AFT F.S. $\bar{X}$ = 40.70 AFT F.S.

TABLE XXVI COMPUTATIONS OF * N_L, N_T, M_L & M_T FOR ULT. AIR LOADS

STATION 19 R.G.W. (72-1000# BOMBS) F.D.L.G.E @ SEA LEVEL C = 266.277 TE @ 80.47% CHORD
6 = 58.875

LEADING EDGE

CHORDWISE STATION % CHORD ①	p_L #/□' FIG. 10 ②	AVE. p_L ③	Δ AREA ③ x .01 ④	DISTANCE TO C.G. FROM 12% LINE ⑤	Δ MOMENT ABOUT 12% LINE ⑥
0	0				
		-140	-1.40	.113	-.158
1	-169				
		-169	-1.69	.105	-.177
2	-169				
		-169	-1.69	.095	-.161
3	-169				
		-168	-1.68	.085	-.143
4	-168				
			-6.46		-.639

CHORDWISE STATION % CHORD	p_L #/□' FIG. 10	S.M.$_s$	② x ③	MOMENT MULTIPLIER	④ x ⑤
4	-168	1	-168	4	-672
6	-167	4	-668	3	-2004
8	-166	2	-332	2	-664
10	-165	4	-660	1	-660
12	-165	1	-165	0	0
			-1,993		-4,000

TRAILING EDGE

CHORDWISE STATION % CHORD ⑦	p_L #/□' FIG. 10 ⑧	S.M.$_s$ ⑨	⑧ x ⑨ ⑩	MOMENT MULTIPLIER ⑪	⑩ x ⑪ ⑫
80.41	-70	1	-70	6	-420
74.225	-112	4	-448	5	-2240
67.98	-130	2	-260	4	-1040
61.735	-137	4	-548	3	-1644
55.49	-140	2	-280	2	-560
49.745	-145	4	-580	1	-580
43.00	-148	1	-148	0	0
			-2334		-6484

BY: CANFIELD
CHKD BY: [illegible]

*DEFINITION OF TERMS:
N_L - LEADING EDGE AIRLOAD SHEAR
M_L - LEADING EDGE AIRLOAD MOMENT ABOUT C.S.
N_T - TRAILING EDGE AIRLOAD SHEAR
M_T - TRAILING EDGE AIRLOAD MOMENT ABOUT C.S.

$$\text{ULT. } N_L = \frac{1.5 \cdot 6^2}{144}\left[\frac{-1993(.02)}{3} - 6.46\right] = -2{,}128^{\#} \uparrow$$

$$\text{ULT. } M_L = \frac{1.5\, 6^2}{144}\left[\frac{-4000(.02)^2}{3} + .639\right] = -33{,}[illegible]^{\prime\prime\#}$$

$$\text{ULT. } N_T = \frac{1.5\, 6^2(.06245)}{144}\left[\frac{-2334}{3}\right] = -5{,}237^{\#} \uparrow$$

$$\text{ULT. } M_T = \frac{1.5\, 6^2 \cdot (.06245)^2}{144}\left[\frac{-6484}{3}\right] = -241{,}593^{\prime\prime\#}$$

TABLE XXVII COMPUTATION OF *N_{IS}, N_U, M_{IS} & M_U FOR AIRLOADS

STATION 19 P.G.W (72-1000# BOMBS) F.D.L. G.E. @ SEA LEVEL b = 38.875" ; c = 266.277"
T.E. @ 80.47% CHORD

1	2	3	4	5	6	7	8	9	10	11	12
DISTANCE FROM L.E. % CHORD	-p #/□" (LIMIT) FIG 10	S. M.s	(2) × (3)	MOMENT MULTIPLIER	(4) × (5)	DISTANCE FROM L.E. % CHORD	p #/□" (LIMIT) FIG 10	S. M.s	(8) × (9)	MOMENT MULTIPLIER	(10) × (11)
COMPOSITE INTERSPAR AIR LOADS						UPPER SURFACE INTERSPAR AIR LOADS					
43.000	-148	1	-148	8	-1184	43.000	-136	1	-136	8	-1088
39.125	-150	4	-600	7	-4200	39.125	-143	4	-572	7	-4004
35.250	-153	2	-306	6	-1836	35.250	-149	2	-298	6	-1788
31.375	-155	4	-620	5	-3100	31.375	-153	4	-612	5	-3060
27.500	-158	2	-316	4	-1264	27.500	-155	2	-310	4	-1240
23.625	-160	4	-640	3	-1920	23.625	-156	4	-624	3	-1872
19.750	-162	2	-324	2	-648	19.750	-155	2	-310	2	-620
15.875	-164	4	-656	1	-656	15.875	-146	4	-584	1	-584
12.000	-165	1	-165	0	0	12.000	-135	1	-135	0	0
			-3,775		-14,808				-3,581		-14,256

*DEFINITION OF TERMS:

N_{IS} - TOTAL (UPPER & LOWER) INTERSPAR AIRLOAD SHEAR

M_{IS} - TOTAL (UPPER & LOWER) INTERSPAR AIRLOAD MOMENT

N_U - INTERSPAR AIRLOAD SHEAR (UPPER SURFACE AIRLOAD)

M_U - INTERSPAR AIRLOAD MOMENT (UPPER SURFACE)

BY: Canfield
CHKD. BY: [illegible]

$$N_{IS} = \frac{1.5\,b_c}{144}\left[\frac{-3775(.03875)}{3}\right] = -[illegible]^{\#}\uparrow \qquad N_U = \frac{1.5\,b_c}{144}\left[\frac{-3581(.03875)}{3}\right] = -4,5[illegible]7^{\#}\uparrow$$

$$M_{IS_{F.S.}} = \frac{1.5\,b_c^2}{144}\left[\frac{-14,808(.03875)^2}{3}\right] = -21[illegible],805''^{\#} \qquad M_{U_{F.S.}} = \frac{1.5\,b_c^2}{144}\left[\frac{-14,256(.03875)^2}{3}\right] = -204,872''^{\#}$$

$\bar{X}$ = 40.30 IN. AFT F.S. $\qquad$ $\bar{X}$ = 41.03 IN. AFT F.S.

BLKHD. #19

CONDITION I - D.G.W. - F.D. L.G.E. @SEA LEVEL

AIR LOADS (INTERSPAR)

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZOIDS:

COMPOSITE INTERSPAR LOAD = N_{IS} = 5763# ↑ (REF.: Pg. 105)
C.G. AFT OF F.S. = 40.02"
W_{FC} = 76.0 #/IN ↑
W_{RC} = 63.9 #/IN ↑

UPPER SURFACE INTERSPAR LOAD = N_U = 5,333# ↑ (REF.: pg. 105)
C.G. AFT OF F.S. = 40.70"
W_{FU} = 66.8 #/IN ↑
W_{RU} = 62.4 #/IN ↑

LOWER SURFACE INTERSPAR LOADS
$W_{FL} = W_{FC} - W_{FU} = 76.0 - 66.8 = 9.2$ #/IN ↑
$W_{RL} = W_{RC} - W_{RU} = 63.9 - 62.4 = 1.5$ #/IN ↑

AIR LOADS (FLAP - 40° DEFLECTION)

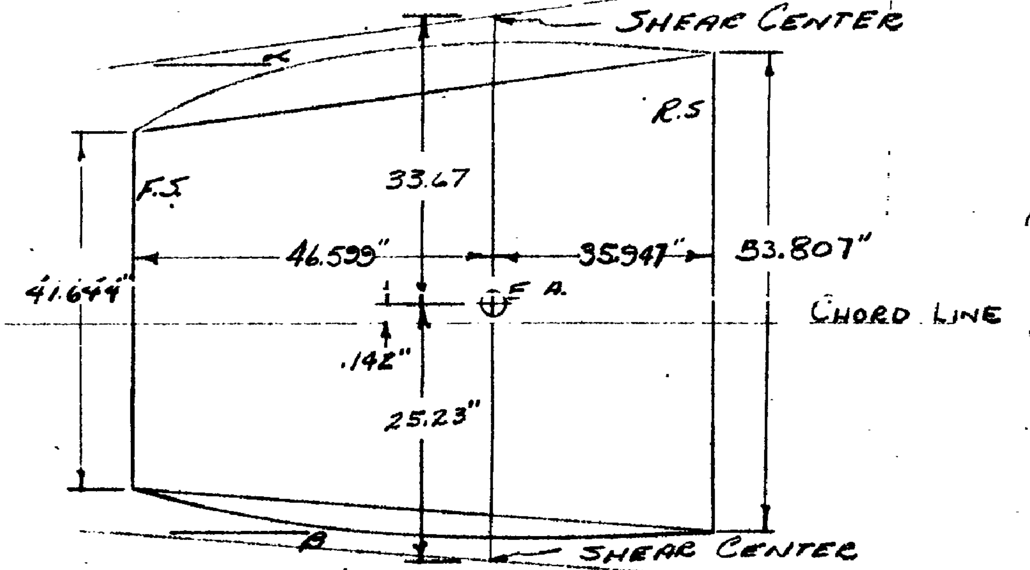
FOR 50K F.P.S. GUST
(REF.: FZS-36-148, page 48)
R_{19N} = 9700# ↙ (ACTING AT C.P. OF FLAPS)
R_{19C} = -669# ↘

THE MAXIMUM PERMISSIBLE SPEED WITH FLAPS DEFLECTED 40° IS THE SAME FOR BOTH THE YB-36 AND THE XB-36. SINCE THE MAXIMUM POSSIBLE C_{N_f} HAS BEEN USED TO DETERMINE THE YB-36 FLAP LOADS, THESE LOADS (REF.: FZS-36-142, pg. I-279) ARE CONSERVATIVELY USED FOR THE XB-36 BULKHEAD ANALYSIS.

V_{RS} = 7861# ↑
P_U = 882# → (AT UPPER TRUSS PT.)
P_L = 4841# → (AT LOWER TRUSS PT.)

BLK NO. #19
COND. I

SURFACE LOADS IN THE PLANES OF THE SHEAR CENTERS OF THE UPPER AND LOWER SURFACES OF THE INTERSPAR BOX:



$\alpha = TAN^{-1} .10811$

$\beta = TAN^{-1} .03924$

FROM FLAP LOADS: (REF.: FZS-36-142, pg. I-281)

UPPER SURFACE CONTOUR LOAD = 2,466 #

HORIZONTAL COMPONENT = 2451 #

LOWER SURFACE CONTOUR LOAD = 3274 #

HORIZONTAL COMPONENT = 3271 #

CRUSHING LOADS

FROM PRELIMINARY CALCULATIONS $M_X = 28.85 \times 10^6$ IN.#, AND SINCE $M'_X \cong M_X$, THIS VALUE WILL BE USED FOR COMPUTING THE CRUSHING LOADS.

$E = 10.3 \times 10^6$

$L = 38.875$

$I_x = 41,174 \text{ IN}^4$

$I_x / Q_x = 51.5 \text{ IN}$

$$\text{CRUSHING LOAD} = \frac{(M'_x)^2 L}{(I_x/Q_x) E I} = \frac{(28.85 \times 10^6)^2 (38.875)}{(51.5)(10.3 \times 10^6)(41174)}$$

$$= 1481 \#$$

BLK HD. #19
COND. I

REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $\frac{H_R}{H_F} = \frac{W_R}{W_F}$ WHERE H_F = CONTOUR DEPTH OF FRONT SPAR AND H_R = CONTOUR DEPTH OF REAR SPAR.

$H_R = 53.807''$; $H_F = 41.644''$

$W_F = 15.7$ #/IN.

$W_R = 20.6$ #/IN.

FUEL LOAD

SINCE THIS IS A NORMAL FLIGHT CONDITION THE FUEL LOAD ACTS ON THE LOWER SURFACE.

$P_{FUEL} = 4186.5 \times 1.5 \times 2.090 = 13{,}125$ # (REF: FZS-36-240, PG. 52)

$\bar{X}_{FUEL} = 77.4 - 31.95 = 45.45''$ (AFT F.S.)

$W_{F_{FUEL}} = 112$ #/IN. ↓

$W_{R_{FUEL}} = 206$ #/IN. ↓

COMBINED AIR (INTERSPAR), CRUSHING AND FUEL LOADS ACTING ON BULKHEAD

UPPER SURFACE

F.S. ORDINATE $= W_{F_{AIR}} + W_{F_{CRUSH}}$
$= 66.8 - 15.7 = 51.1$ #/IN ↑

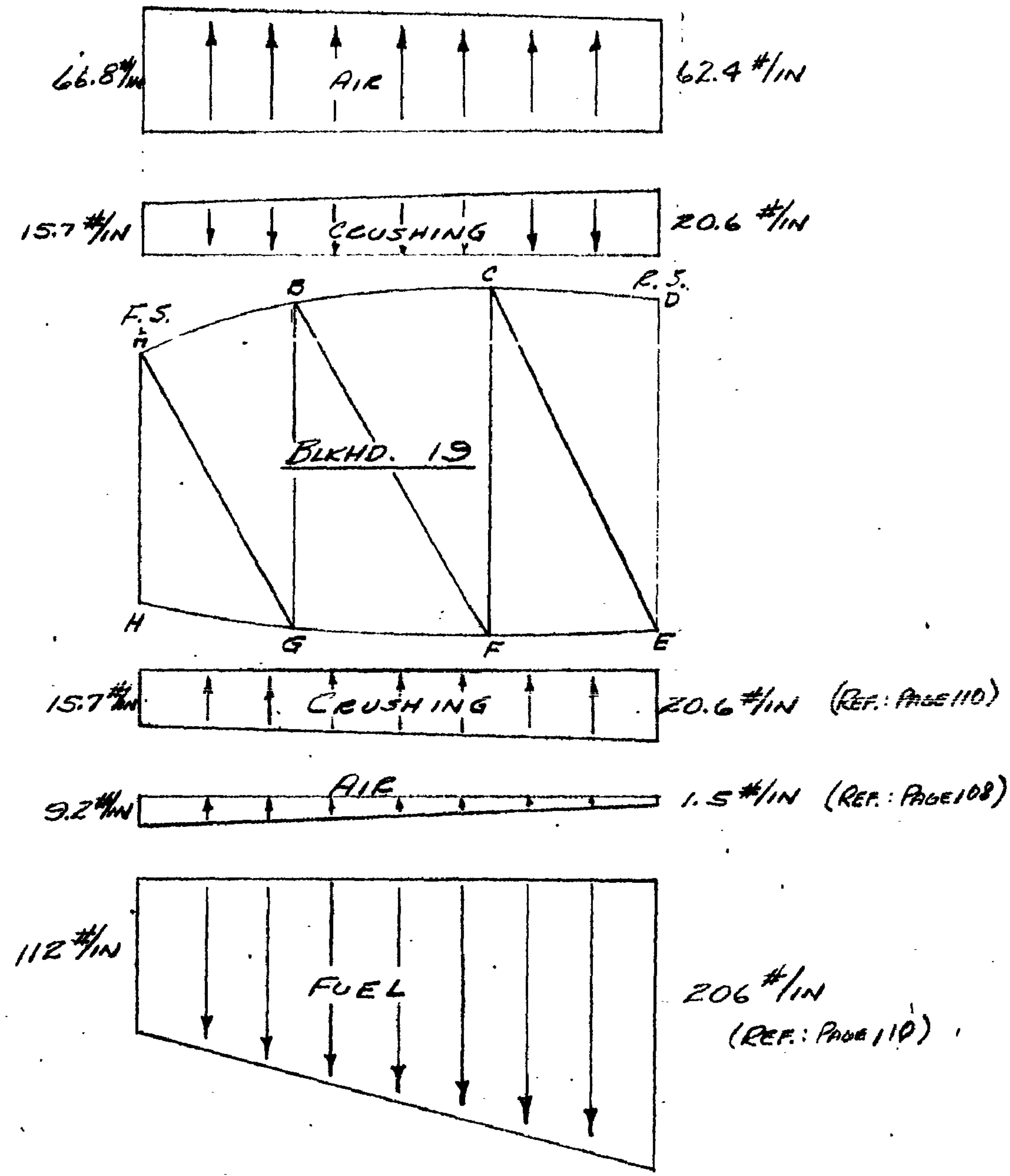
R.S. ORDINATE $= W_{R_{AIR}} + W_{R_{CRUSH}}$
$= 62.4 - 20.6 = 41.8$ #/IN ↑

LOWER SURFACE

F.S. ORDINATE $= W_{F_{AIR}} + W_{F_{CRUSH}} + W_{F_{FUEL}}$
$= 15.7 + 9.2 - 112 = -87.1$ #/IN ↓

R.S. ORDINATE $= W_{R_{AIR}} + W_{R_{CRUSH}} + W_{R_{FUEL}}$
$= 20.6 + 1.5 - 206 = -183.9$ #/IN ↓

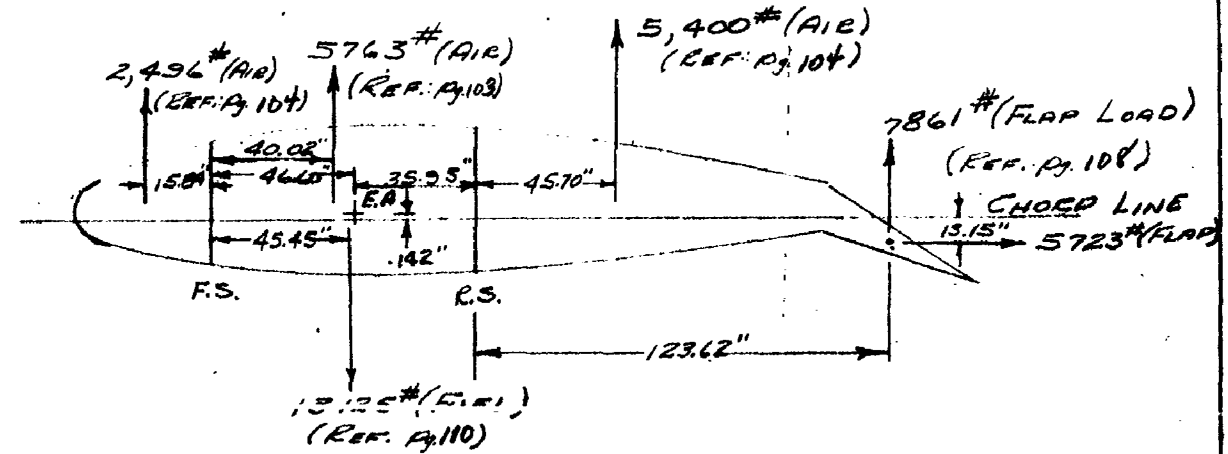
BLKHD. #19
COND. I



INTERSPAR LOADING DIAGRAM
BLKHD. #19 (D.G.W. - F.O.L.G.E. @ SEA LEVEL)

BLKHD. #13
COND. I

WING STATION LOADING



APPLIED LOADS ON BULKHEAD

TRANSFERRING ALL FORCES TO THE E.A.

$V = N_{LE} + N_{IS} + N_{TE} + V_{FLAP} + P_{FUEL}$
$= 2496 + 5763 + 5400 + 7861 - 13125$
$= 8,395\# \uparrow$

$D = D_{FLAP} = 5723\# \rightarrow$

$T_{EA} = (2496)(15.84 + 46.60) + (5763)(46.60 - 40.02)$
$- (5400)(35.95 + 45.70) - (7861)(35.95 + 123.62)$
$- (13125)(46.60 - 45.45) - (5723)(13.15 + .14)$

$= -1,592,672 \text{ "}\#$

SHEAR FLOW ON F.S. AND R.S. DUE TO V

$V_{F.S.} = \frac{35.95}{82.55}(8,395) = 3656\# \downarrow$

$V_{RS} = V - V_{F.S.} = 8396 - 3656 = 4739\# \downarrow$

$q_{V_{F.S.}} = \frac{3656}{*41.64} = 87.8\#/\text{IN.} \downarrow$ (* F.S. & R.S. DEPTHS)

$q_{V_{RS}} = \frac{4739}{*53.81} = 88.1\#/\text{IN.} \downarrow$

BLKHD. #19
COND. I

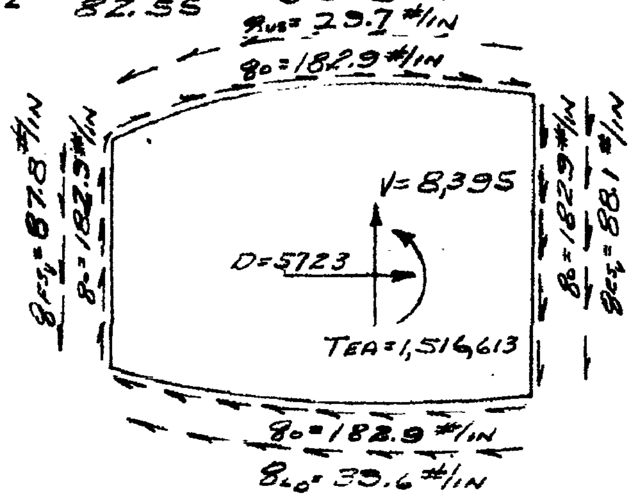
SHEAR FLOW DUE TO TEA:

$$q_0 = \frac{TEA}{2A} = \frac{1,592,672}{8707} = 182.9 \ \#/in$$

SHEAR FLOW DUE TO DRAG LOAD

$$q_u = \frac{2451}{82.55} = 29.7 \ \#/in \leftarrow$$ (REF.: pg. 109)

$$q_L = \frac{3271}{82.55} = 39.6 \ \#/in \leftarrow$$ (REF.: pg. 109)



BLKH'D. #19 APPLIED SHEAR FLOWS
(D.G.W. - F.O. L.G.E. @ SEA LEVEL)

NET SHEAR FLOW

$$q_{FS} = 182.9 - 87.8 = 95.1 \ \#/in \uparrow$$

$$q_{RS} = 182.9 + 88.1 = 271.0 \ \#/in \downarrow$$

$$q_{U.S.} = 182.9 - 29.7 = 153.2 \ \#/in \rightarrow$$

$$q_{L.S.} = 182.9 + 39.6 = 222.5 \ \#/in \leftarrow$$

BLKHD. #19
COND. I

REACTIONS AT F.S. AND R.S. DUE TO VERTICAL COMPONENTS OF SURFACE LOADS.

$V_{8_{US}} = (29.7)(\overset{*}{8.92}) = 266\#\downarrow$

$V_{8_{LS}} = (39.6)(\overset{*}{3.24}) = 129\#\uparrow$

* DIFFERENCE BETWEEN F.S. & R.S ABOVE AND BELOW THE CHORD LINE.

$V_{8_R} = 266 - 129 = 137\#\downarrow$ (ACTING AT E.A.)

$V_{RS} = \frac{46.60}{82.55} \times 137 = 77\#\uparrow$

$V_{FS} = 137 - 77 = 60\#\uparrow$

NET APPLIED SHEAR ON FRONT & REAR SPAR

$F.S. = (95.1)(41.64) + 60$

$= 4020\#\uparrow$

$R.S. = (271.0)(53.81) - 77$

$= 14{,}506\#\downarrow$

BLKHD. #19
COND. I

BREAKDOWN OF NET AIR, CRUSHING, AND FUEL LOADS INTO PANEL POINT LOADS.

UPPER SURFACE

$P_A = 770^{\#} \uparrow$

$P_B = 1342^{\#} \uparrow$

$P_C = 1168^{\#} \uparrow$

$P_D = 562^{\#} \uparrow$

(REF.: Pg. 111 FOR LOCATION OF PANEL POINTS)

LOWER SURFACE

$P_E = 2327^{\#} \downarrow$

$P_F = 4000^{\#} \downarrow$

$P_G = 3409^{\#} \downarrow$

$P_H = 1456^{\#} \downarrow$

CORRECTION LOADS

CORRECTION LOADS ARE APPLIED TO THE FRONT AND REAR SPARS TO ACCOUNT FOR THE TRANSFER OF THE SHEAR FLOW FROM THE CONTOURS TO THE CENTROIDS OF THE STRAIGHT LINE CHORD MEMBERS.

UPPER SURFACE

$$T = 2A_U\,q_U^* - q_U y_U c = [2(202) - (2.13)(82.55)]\,153.2$$
$$= 34884^{\,IN\#}$$

$$R_{U_{F\&R}} = \frac{34884}{82.55} = 423^{\#} \uparrow\downarrow$$

* REF.: pg. 113

LOWER SURFACE

$$T = 2A_L\,q_L^* - q_L y_L c = [2(89) - (.79)(82.55)]\,222.5$$
$$= 25{,}143$$

$$R_{L_{F\&R}} = \frac{25143}{82.55} = 305^{\#} \uparrow\downarrow$$

CORRECTED PANEL POINT LOADS AT F.S. & R.S.

UPPER SURFACE

$P_A = 770^{\#} + 423 = 1193^{\#} \uparrow$

$P_D = 562 - 423 = 139^{\#} \uparrow$

BLKHD. #19
COND. I

LOWER SURFACE

$P_H = 1456 - 305 = 1151^{\#} \downarrow$

$P_E = 2327 + 305 = 2632^{\#} \downarrow$

COUPLE AT FRONT SPAR RESULTING FROM LEADING EDGE AIR LOAD:

$$\frac{M_L}{38.72} = \frac{39520}{38.72} = 1020^{\#} \rightleftarrows$$

COUPLE AT REAR SPAR RESULTING FROM TRAILING EDGE AIR LOAD:

$$\frac{M_T}{50.88} = \frac{246797}{50.88} = 4850^{\#} \leftrightarrows$$

COUPLE AT REAR SPAR RESULTING FROM VERTICAL COMPONENT OF FLAP LOAD (40° DEFLECTION)

$$\frac{M_{VFBS}}{50.88} = \frac{7861 \times 123.62}{50.88} = 19100^{\#} \leftrightarrows$$

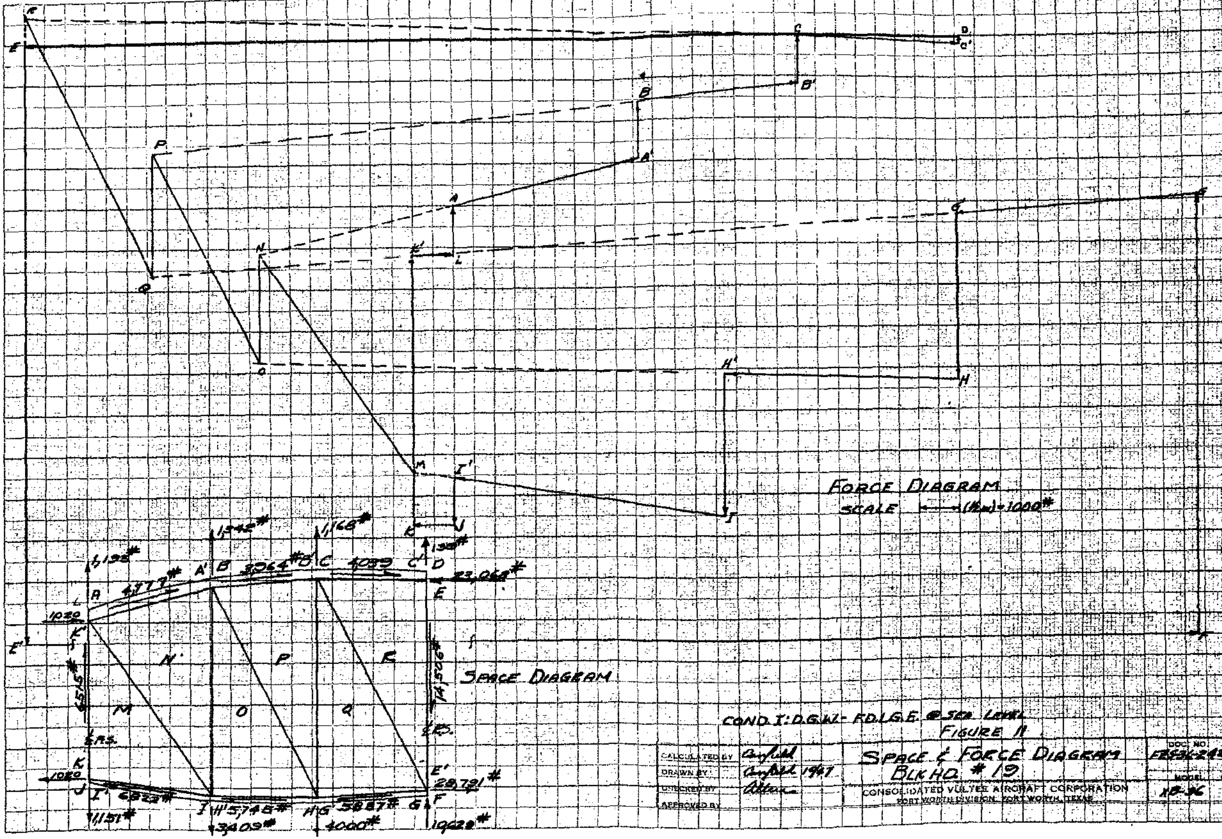
NET HORIZONTAL LOADS AT TRUSS PTS. OF REAR SPAR

$P_{D_H} = 4850 + 19100 - 882 = 23,068^{\#} \leftarrow$

$P_{E_H} = 4850 + 19100 + 4841 = 28,791^{\#} \rightarrow$

VERTICAL LOAD AT R.S. LOWER PANEL POINT

$P_E = 5400 + 7861 - 2632$
$= 10,629^{\#} \uparrow$



COND. I: D.G.W. - F.D.L.G.E. @ SEA LEVEL

FIGURE 11

CALCULATED BY	Canfield	SPACE & FORCE DIAGRAM BLK HD. # 19	DOC. NO. FZS-36-242
DRAWN BY	Canfield 1947		MODEL XB-36
CHECKED BY	Allen	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	
APPROVED BY			

BLKHD. #19

CONDITION II - R.G.W. (72-1000# BOMBS), F.D.L.G.E. @ SEA LEVEL

AIR LOADS (INTERSPAR)

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZOIDS:

COMPOSITE INTERSPAR LOAD = N_{IS} = 5,255# ↑

C.G. AFT. OF F.S. = 40.50 IN.

W_{FC} = 67.4 #/IN. ↑ (REF.: PG. 107)

W_{RC} = 60.0 #/IN. ↑

UPPER SURFACE INTERSPAR LOAD = N_U = 4,987# ↑

C.G. AFT. OF F.S. = 41.08 IN.

W_{FU} = 61.0 #/IN. ↑ (REF.: PG. 107)

W_{RU} = 59.8 #/IN. ↑

LOWER SURFACE INTERSPAR LOAD:

$W_{FL} = W_{FU} - W_{FC}$ = 6.4 #/IN ↑

$W_{RL} = W_{RU} - W_{RC}$ = .2 #/IN ↑

AIR LOADS (FLAP)

SINCE THE DESIGN FLAPS DOWN SPEED FOR THIS CONDITION & THE DGW-FDLGE CONDITION ARE THE SAME, THE FLAP LOADS FOR THE TWO CONDITIONS ARE TAKEN TO BE THE SAME. REF. COND. I.

NET VERTICAL LOAD = 7861# ↑ C.G. IS 123.62" AFT OF R.S.

NET HORIZONTAL LOAD = 5723# →

P_U = 882# ← (REF.: PG. 108)

P_L = 4841# →

AIR LOADS (COMBINED TR. EDGE & FLAP AT TRUSS PTS. OF REAR SPAR)

$$H_{RS_{UPPER}} = \frac{(7861)(123.62)}{50.88} + \frac{241,983}{50.88} - 882$$

$$= 22,974\# \leftarrow$$

BLKHD. #19
COND. II

$H_{R.S._{LOWER}} = 19100 + 4756 + 4841$
$= 28,697^{\#} \rightarrow$

$V_{R.S._{LOWER}} = 5237 + 7861 = 13,098^{\#} \uparrow$

CRUSHING LOADS

FROM PRELIMINARY CALCULATIONS $M_x = 24.55 \times 10^6$ IN.#
AND SINCE $M'_x \cong M_x$ THIS VALUE WILL BE USED FOR COMPUTING THE CRUSHING LOADS.

$E = 10.3 \times 10^6$
$L = 38.875$
$I_x = 41174 \text{ IN}^4$

$I_x/Q_x = 51.5 \text{ IN}$

$$\text{CRUSHING LOAD} = \frac{(M'_x)^2 L}{(I_x/Q_x) E I} = \frac{(24.55 \times 10^6)^2 (38.875)}{(51.5)(10.3 \times 10^6)(41174)}$$
$$= 1,070^{\#}$$

REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $\frac{H_R}{H_F} = \frac{W_R}{W_F}$

WHERE H_F = CONTOUR DEPTH OF FRONT SPAR AND H_R = CONTOUR DEPTH OF REAR SPAR.

$H_R = 53.807''$; $H_F = 41.644''$
$W_F = 11.32$ #/IN
$W_R = 14.61$ #/IN

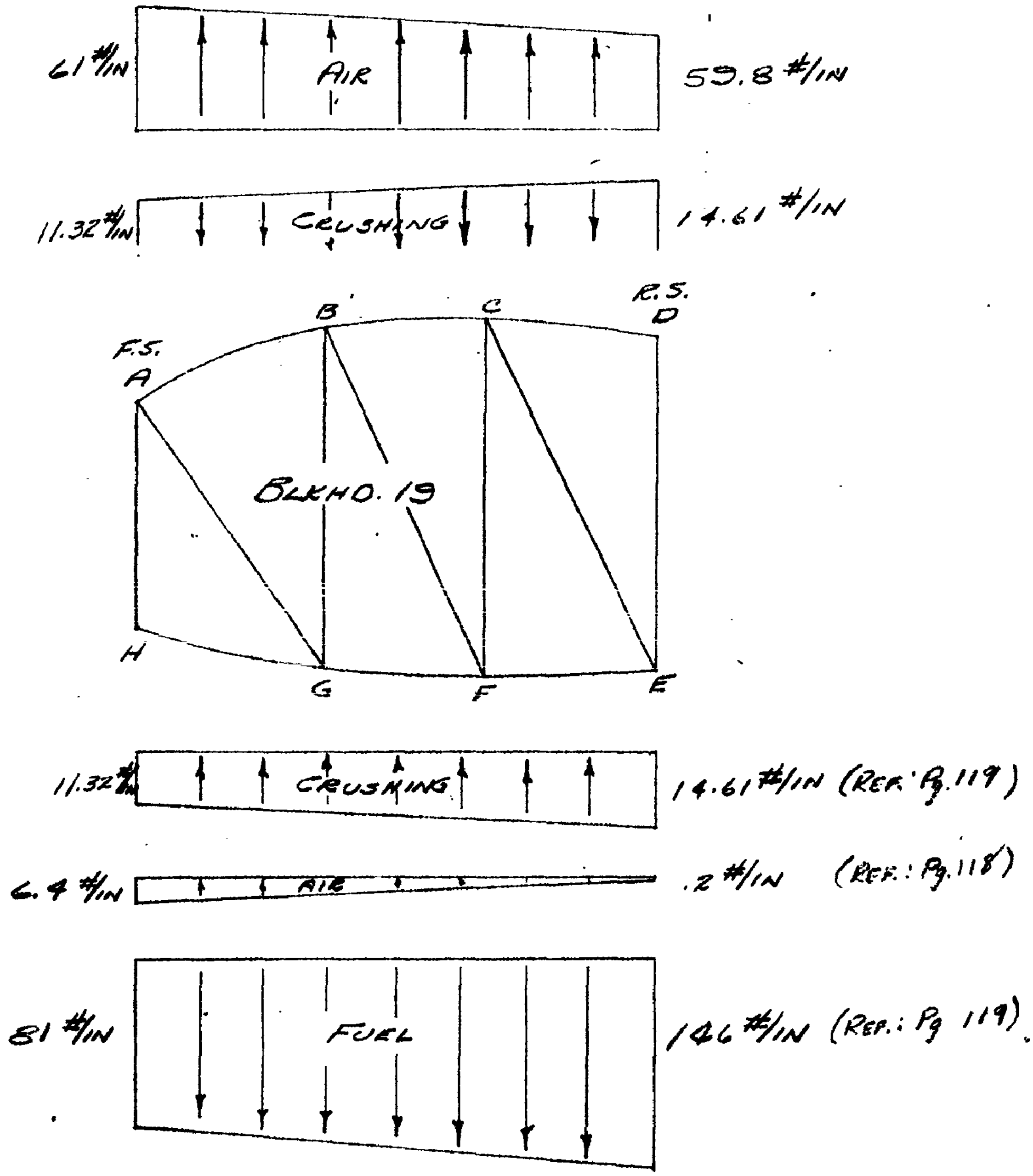
FUEL LOAD

SINCE THIS IS A NORMAL FLIGHT CONDITION THE FUEL LOAD ACTS ON THE LOWER SURFACE.

$P_{FUEL} = 1.5 \times 2.259 \times 2761 \cong 9,356^{\#} \downarrow$
(REF.: FZ5-36-240, pg. 58)

$\bar{x}_{FUEL} = 77.2 - 31.95 = 45.25$ IN. (AFT. F.S.)
$W_{F_{FUEL}} = 81$ #/IN. $\downarrow$
$W_{R_{FUEL}} = 146$ #/IN. $\downarrow$

BLKHD #19
COND. II



INTERSPAR LOADING DIAGRAM
BLKHD. #19
R.G.W. (72-1000# BOMBS), F.D.L.G.E. @ SEA LEVEL

BLKHD. #19
COND. II

COMBINED AIR (INTERSPAR), CRUSHING AND FUEL LOADS ACTING ON BULKHEAD

UPPER SURFACE:

F.S. ORDINATE = $W_{F_{AIR}} + W_{F_{CRUSH}}$
$= 61.0 - 11.32 = 49.68$ #/IN ↑

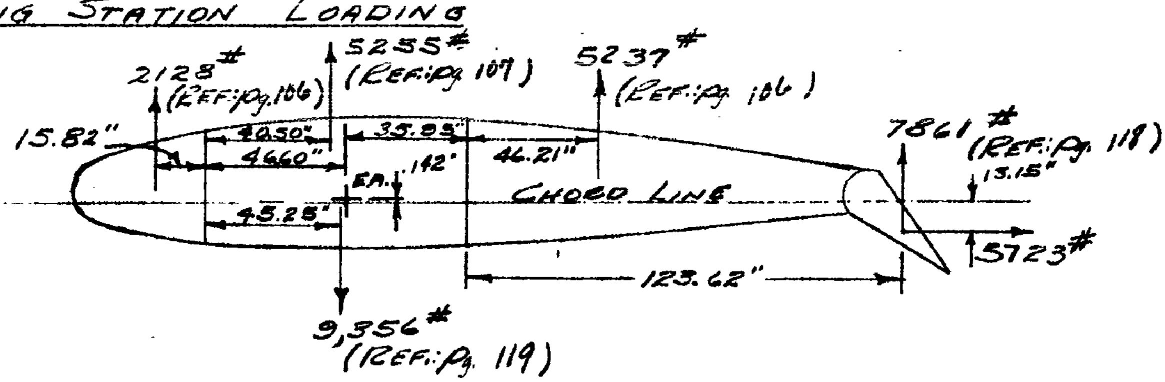
R.S. ORDINATE = $W_{R_{AIR}} + W_{R_{CRUSH}}$
$= 59.8 - 14.61 = 45.19$ #/IN ↑

LOWER SURFACE

F.S. ORDINATE = $W_{F_{AIR}} + W_{F_{CRUSH}} + W_{F_{FUEL}}$
$= 6.4 + 11.32 - 81.0 = -63.28$ #/IN ↓

R.S. ORDINATE = $W_{R_{AIR}} + W_{R_{CRUSH}} + W_{R_{FUEL}}$
$= .2 + 14.61 - 146 = -131.19$ #/IN ↓

WING STATION LOADING



APPLIED LOADS ON BULKHEAD

TRANSFERRING ALL FORCES TO THE E.A.

$V = 2128 + 5255 + 5237 + 7860 - 9356 = 11,124$ # ↑

$D = D_{FLAP} = 5,723$ # →

$T_{EA} = (2128)(15.82 + 46.60) + 5255(46.60 - 40.50)$
$- (5237)(35.95 + 46.21) - (7860)(35.95 + 123.62)$
$- (5723)(.142 + 13.15) - (9356)(46.60 - 45.25)$
$= -1,608,296$ "#

BLKHD. #19
COND. II

SHEAR FLOW ON F.S. AND R.S. DUE TO V

$V_{F.S.} = \frac{35.95}{82.55}(11{,}124) = 4{,}845^{\#}\downarrow$

$V_{R.S.} = V - V_{F.S.} = 6{,}279^{\#}\downarrow$

$q_{V_{FS}} = \frac{4845}{{}^{*}41.64} = 116.4\ ^{\#}/_{IN}\downarrow$ *(F.S. & R.S. DEPTHS)

$q_{V_{RS}} = \frac{6279}{{}^{*}53.81} = 116.7\ ^{\#}/_{IN}\downarrow$

SHEAR FLOW DUE TO TEA:

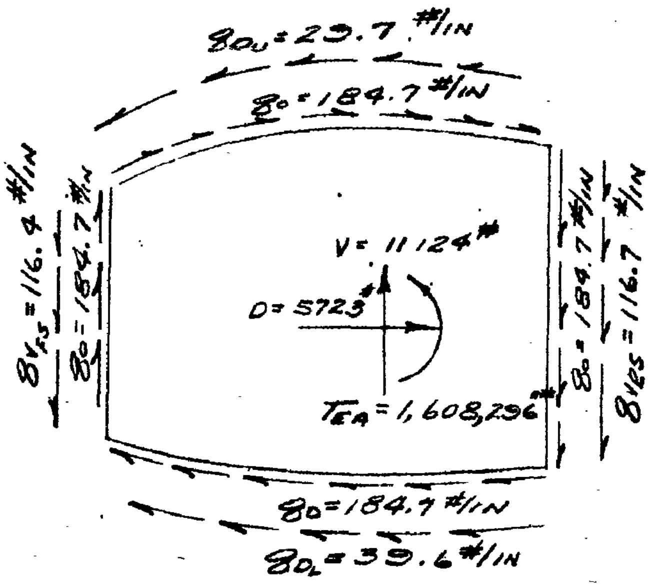
$q_0 = \frac{TEA}{2A} = \frac{1\,608\,296}{8707} = 184.7\ ^{\#}/_{IN}$

SHEAR FLOW DUE TO DRAG LOAD

$q_U = 29.7\ ^{\#}/_{IN} \leftarrow$

(REF: pg. 113)

$q_L = 39.6\ ^{\#}/_{IN} \leftarrow$



BLKHD. 19 - APPLIED SHEAR FLOWS
R.G.W. (72-1000# BOMBS), F.D.L.G.E. @ SEA LEVEL

BULKHD. #19
COND. II

NET SHEAR FLOWS

$q_{FS} = 184.7 - 116.4 = 68.3$ #/in ↑

$q_{RS} = 184.7 + 116.7 = 301.4$ #/in ↓

$q_U = 184.7 - 29.7 = 155.0$ #/in →

$q_L = 184.7 + 39.6 = 224.3$ #/in ←

REACTIONS AT F.S. AND R.S. DUE TO VERTICAL COMPONENTS OF SURFACE LOADS.

$V_{RS} = 77$ # ↑
$V_{FS} = 60$ # ↑ (REF.: Pg. 114)

NET APPLIED SHEAR ON FRONT & REAR SPAR

F.S.
$V = (68.3)(41.64) + 60 = 2{,}904$ # ↑

R.S.
$V = (301.4)(53.81) - 77 = 16{,}141$ # ↓

BREAKDOWN OF NET AIR, CRUSHING, AND FUEL LOADS INTO PANEL POINT LOADS.

UPPER SURFACE
$P_A = 748$ # ↑
$P_B = 1350$ # ↑
$P_C = 1216$ # ↑
$P_D = 601$ # ↑

(REF.: Pg. 111 FOR LOCATION OF PANEL POINTS)

LOWER SURFACE
$P_E = 1660$ # ↓
$P_F = 2859$ # ↓
$P_G = 2452$ # ↓
$P_H = 1055$ # ↓

BLKHD. #19
COND. II

CORRECTION LOADS

CORRECTION LOADS ARE APPLIED TO THE FRONT AND REAR SPARS TO ACCOUNT FOR THE TRANSFER OF THE SHEAR FLOW FROM THE CONTOURS TO THE CENTROIDS OF THE STRAIGHT LINE CHORD MEMBERS.

UPPER SURFACE

$$T = 2A_u q_u - q_u y_u c = [2(202) - 2.13(82.55)]155$$
$$= 35,340''^{\#}$$

$$R_{U_{F\&R}} = \frac{35340}{82.55} = 428^{\#} \uparrow\downarrow$$

LOWER SURFACE

$$T = 2A_L q_L - q_L y_L c = [2(89) - (.79)(82.55)]224.3$$
$$= 25,346''^{\#}$$

$$R_{L_{F\&R}} = \frac{25346}{82.55} = 307^{\#} \uparrow\downarrow$$

CORRECTED PANEL POINT LOADS AT F.S. & R.S.

UPPER SURFACE

$$P_A = 748 + 428 = 1176^{\#} \uparrow$$
$$P_D = 601 - 428 = 173^{\#} \uparrow$$

LOWER SURFACE

$$P_H = 1055 - 307 = 748^{\#} \downarrow$$
$$P_E = 1660 + 307 = 1967^{\#} \downarrow$$

COUPLE AT F.S. RESULTING FROM LEADING EDGE AIR LOAD

$$\frac{M_L}{38.72} = \frac{33656}{38.72} = 869^{\#} \rightleftarrows$$

COUPLE AT R.S. RESULTING FROM TRAILING EDGE AIR LOAD

$$\frac{M_T}{50.88} = \frac{241,983}{50.88} = 4756^{\#} \leftrightarrows$$

BLKHD. #13
COND. II

COUPLE AT R.S. RESULTING FROM VERTICAL COMPONENT OF FLAP LOAD (40° DEFLECTION)

$$\frac{M_{V_{FRS}}}{50.88} = \frac{7861 \times 123.62}{50.88} = 19,100^{\#} \rightleftarrows$$

NET HORIZONTAL LOADS AT TRUSS PTS. OF REAR SPAR

$$P_{D_H} = 4756 + 19100 - 882 = 22,974^{\#} \leftarrow$$

$$P_{E_H} = 4756 + 19100 + 4841 = 28,697^{\#} \rightarrow$$

VERTICAL LOAD AT R.S. LOWER PANEL POINT

$$P_E = 7861 - 1967 + 5237$$
$$= 11,131^{\#} \uparrow$$

KEUFFEL & ESSER CO.

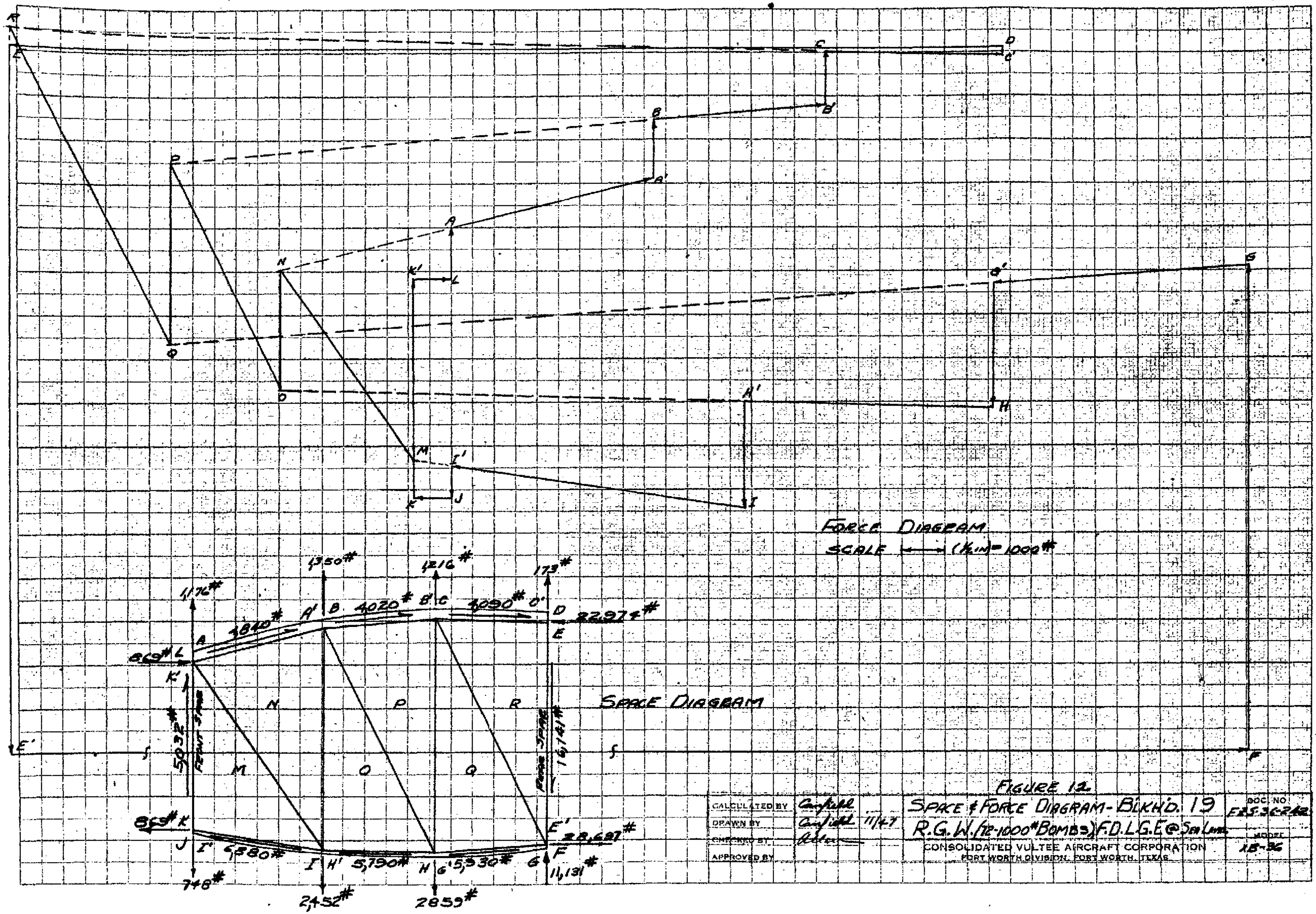


FIGURE 12

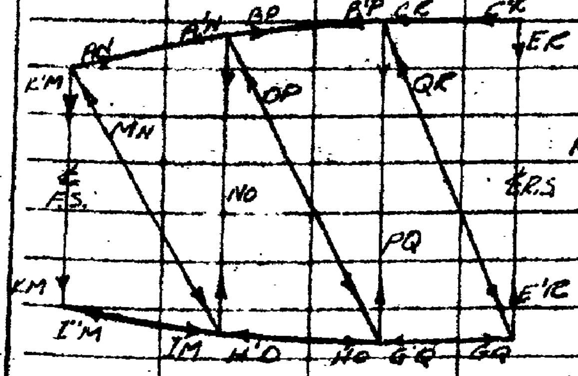
CALCULATED BY	Canfield		SPACE & FORCE DIAGRAM - BLKHD. 19
DRAWN BY	Canfield	11/47	R.G.W. (12-1000# BOMBS) F.D.L.G.E @ SEA LEVEL
CHECKED BY	Allen		CONSOLIDATED VULTEE AIRCRAFT CORPORATION, FORT WORTH DIVISION, FORT WORTH, TEXAS
APPROVED BY			

DOC. NO. FZS-36-242

MODEL XB-36

BLKHD. #19 - MEMBER LOAD SUMMARY & COMPARISON - XB-36 & B-36A

MEMBER	XB-36 D.G.W., FDLGE, @SEA LEVEL REF.: FIG. 11 PAGE 117	XB-36 R.G.W. (72-1000# BOMBS), FDLGE, @SEA LEVEL REF.: FIG. 12 PAGE 126	B-36A D.G.W., FDLGE, @SEA LEVEL REF.: FZS-36-142, PAGE I-315	B-36A R.G.W. (72-1000# BOMBS), FDLGE, @SEA LEVEL	MAXIMUM LOADS TEN.	MAXIMUM LOADS COMP.
AN	-4,890	-4,070	-4,340	-3,560		
A'N	-9,620	-8,900	-9,360	-8,580		
BP	-12,000	-11,250	-11,535	-10,800		
B'P	-15,980	-15,290	-15,700	-14,965		
CR	-19,000	-18,890	-18,750	-18,600		
C'R	-23,050	-22,960	-23,000	-22,840		
ER	-690	-400	-1,200	-1,070		
E'R	-15,200	-16,560	-15,860	-17,330		
GQ	+25,730	+25,100	+25,690	+24,935		
G'Q	+19,850	+19,170	+19,600	+18,855		
HO	+17,200	+16,560	+17,140	+16,405		
H'O	+11,420	+10,790	+11,200	+10,465		
IM	+7,790	+7,780	+7,930	+7,790		
I'M	+1,020	+890	+870	+740		
KM	+1,230	+880	+935	+400		
K'M	-5,270	-4,170	-4,785	-3,645		
MN	+6,480	+5,360	+6,040	+4,950	+6,480	* -1,800
NO	-2,630	-2,750	-3,200	-3,260	* +3,135	-2,750
OP	+5,710	+5800	+5,665	+5,665	+5,800	* -500
PQ	-2,970	-4,150	-4,100	-5,245	* +2,610	-4,150
QR	+7,020	+8,050	+7,300	+8,600	+8,050	—



*USED B-36A VALUES FROM FZS-36-142, PAGE I-315

REPORT NO: FZS-36-242
MODEL: XB-36
BY: Canfield
CHKD BY: Allen
DATE: 11-47

TABLE XXIX TUBULAR MEMBERS IN COMPRESSION & TENSION
BULKHEAD 19

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
MEMBER	MAX. COMP. LOAD (LBS) REF: TABLE XXVIII PAGE 131	TUBE No	SIZE OF TUBE	AREA OF TUBE	f_c (#/in²) (2)/(5)	* L (IN)	I	$\rho = \sqrt{I/A}$	$L/\sqrt{c}\rho$ c=1	F_c REF: FZS-36-142, Fig I-C2	$M.S._c$ (11)/(6)-1	MAX. TEN. LOAD REF: TAB XVIII	f_t (#/□") (13)/(5)	$M.S._t$ F_t=49,000#/□"
MN	1800	36R1966-6	1.5 x 1.5 x .032	.2149	8,376	46	.0846	.6274	73.3	12,600	+.51	6480	30,200	+.62
NO	2750	36W119-43 -34	1.5 x 1.5 x .040	.2660	10,340	46	.1058	.6310	72.9	16,500	+.60	3135	11,800	+3.15
OP	500	36R1966-6	1.5 x 1.5 x .032	.2149	2,327	50	.0846	.6274	79.6	10,600	+3.55	5800	26,950	+.82
PQ	4150	36W119-38 -42	2 x 1.5 x .040	.3180	13,050	50	.1884	.7710	64.8	20,000	+.53	2610	8,210	+4.96
QR	—	36R1966-8	1.5 x 1.5 x .040	.2784	—	51	.1152	.6434	73.3	13,100	—	8050	28,900	+.70

* DISTANCE BETWEEN C.G.'s OF ATTACHING RIVETS

BY: Canfield
CHKD. BY: Allen

BLKHD. #19

TUBE END OP IN TENSION

THE CRITICAL BENDING STRESSES IN AN END CONNECTION OCCUR IN MEMBER OP:

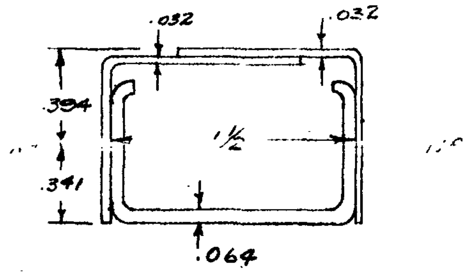
$P = +5800$ # (REF.: pg. 121) FOR R.G.W. (72-1000# BOMBS), F.DL.G.E., SEA LEVEL.

AREA OF CHANNEL-TUBE END SECTION = .2850 □"

$I = .0216$ IN^4

$\bar{y} = .341$ IN

$y_t = .394$ IN



$$f_t = \frac{P}{A} + \frac{P e y_t}{I} = \frac{5800}{.2850} + \frac{(5800)(.341)^2}{.0216}$$

$$= 51{,}550 \text{ \#/□"}$$

ASSUME $C_E = .8$ AND A RIVET CONCENTRATION FACTOR OF $K_R = .9$

$F_t = .8 \times .9 \times 74\,000 = 53\,280$ #/□" FOR 75ST

$$M.S. = \frac{53\,280}{51\,550} - 1 = \quad +.03$$

RIVET ATTACHMENT OF TUBE END QR

$P_{MAX} = 8{,}050$# (REF. pg. 127) FOR R.G.W. (72-1000# BOMBS), F.DL.G.E., SEA LEVEL.

THE TUBE IS ATTACHED TO THE CHANNEL BY 18 - 5/32 AD RIVETS. THE RIVETS ARE CRITICAL IN SHEAR.

THE RIVET ALLOWABLE FOR 18 - 5/32 RIVETS

$= 18 \times 596 = 10{,}730$ #

$$M.S. = \frac{10730}{8050} - 1 = \quad +.33$$

BLKHD. #19

UPPER CHORD

FROM A STUDY OF THE B-36A ANALYSIS (REF.: FZS-36-142, pg. I-321) IT IS FOUND THAT THE CRITICAL STRESSES IN THE UPPER CHORD OCCUR AT THE REAR SPAR. THE CRITICAL CONDITION IS D.G.W. F.D. LGE AT SEA LEVEL AND SINCE THE CHORD MEMBERS ON BOTH SHIPS ARE THE SAME THE ANALYSIS FOR THE XB-36 IS AS FOLLOWS:

COMPRESSION IN LIPPED FLANGE AT REAR SPAR

$P = -23{,}050$ # (REF.: pg. 127)

$A = 1.065$ in² (REF.: FZS-36-142, pg. I-319)

$$f_c = \frac{P}{A} + \frac{Mc}{I} = \frac{23050}{1.065} + 0 = 21{,}650 \ \#/in^2$$

$F_c = 25{,}000 \ \#/in^2$ (REF.: FZS-36-142, pg. I-322)

$$M.S. = \frac{25000}{21650} - 1 = \qquad +.15$$

LOWER CHORD

FROM A STUDY OF THE B-36A ANALYSIS (REF.: FZS-36-142, pg. I-325) IT IS FOUND THAT THE R.G.W., L.A.A.$_{H.S.}$ @ 5000', (12-4000# BOMBS), PRODUCED THE CRITICAL STRESSES IN THIS MEMBER WITH A M.S. = +2.20. SINCE THE M.S. IS HIGH AND THE LOWER CHORD ON BOTH AIRPLANES IS THE SAME, AN ANALYSIS OF THIS MEMBER IS CONSIDERED UNNECESSARY.

INTERCOSTAL ANALYSIS

THE MEMBERS ON BOTH AIRPLANES ARE THE SAME AND THE M.S.'s ARE HIGH, (REF.: FZS-36-142, pg. I-333) THEREFORE AN

BLKHD. #19

INTERCOSTAL ANALYSIS IS CONSIDERED UNNECESSARY FOR THE XB-36 AIRPLANE. REFER TO THE ABOVE REFERENCED REPORT FOR THE INTERCOSTAL ANALYSIS AND M.S.

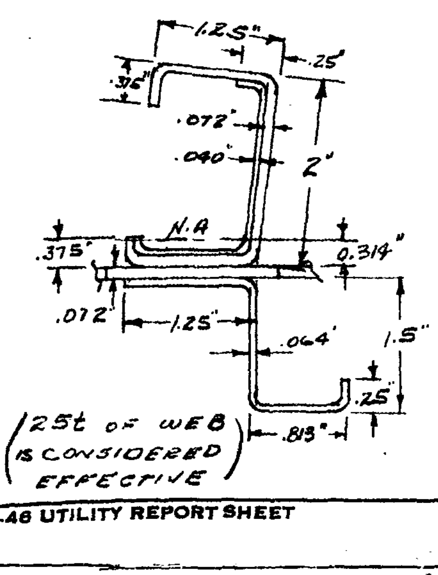
ANALYSIS OF REAR SPAR MEMBER

THE REAR SPAR MEMBER IS ANALYZED FOR COMBINED AXIAL AND BENDING (FUEL) STRESSES.

COND. 1, U.G.W., F.U.L.G.E., SEA LEVEL, IS THE CRITICAL COND. FOR THE DESIGN OF THIS MEMBER.

1. A CHECK IS MADE AT THE LOWER END OF THE MEMBER FOR THE COMBINATION OF THE MAXIMUM AXIAL COMPRESSIVE LOAD IN THE MEMBER COMBINED WITH BENDING FROM THE FUEL PRESSURE.
2. A CHECK IS MADE AT 57.74 % OF THE MEMBER LENGTH MEASURED FROM THE UPPER END OF THE MEMBER AT WHICH POINT THE MAXIMUM BENDING MOMENT OCCURS FOR THE TRIANGULAR LOADING RESULTING FROM FUEL PRESSURE IN THE O.G.W., FDLGE @ SEA LEVEL, CONDITION.

CHECK JUST ABOVE LOWER CHORD MEMBER



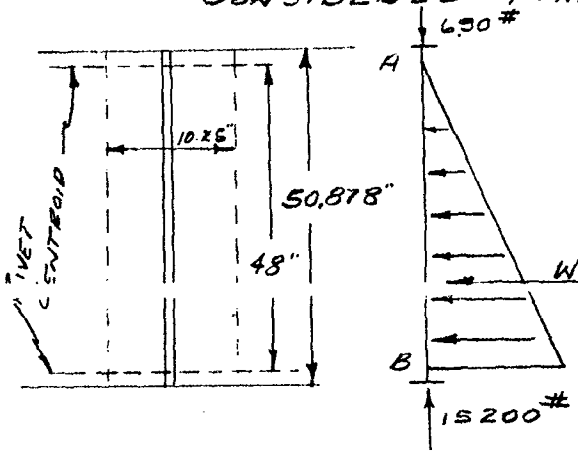
$A = 0.8137\ \square''$

$I_{NA} = 0.7814\ in^4$

$I/C_c = \frac{0.7814}{1.886} = 0.415\ in.^3$

BLKHD. #19

FOR THIS CHECK THE ENDS OF THE MEMBER ARE CONSERVATIVELY CONSIDERED FIXED.



$-\frac{N_A}{W} = -2.090$ (REF.; FZS-36-126, pg.85)

$P_{MAX} = \frac{6}{231} \times 50.878 \times 2.09 \times 1.5$

$= 4.14 \ \#/in^2$

$W = \frac{4.14(10.25)(48)}{2} = 1020^{\#}$

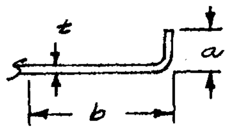
$M_B = \frac{WL}{10} = \frac{1020 \times 48}{10}$

$= 4900 \ in.\#$

$f_c = \frac{P}{A} + \frac{MC}{I} = \frac{15200}{0.8137} + \frac{4900}{.415}$

$= 30,490 \ \#/in^2$

THE ALLOWABLE IS THAT OF THE LIPPED ELEMENT OF THE ZCC



$a = .25$
$b = .635$
$t = .064$

$a/t = .25/.064 = 3.91$

$1/\sqrt{K} = .635$

$b/t\sqrt{K} = 6.3$

(REF.: C.V.A.C. STRUCT. HANDBOOK #1, pg. 2.224)

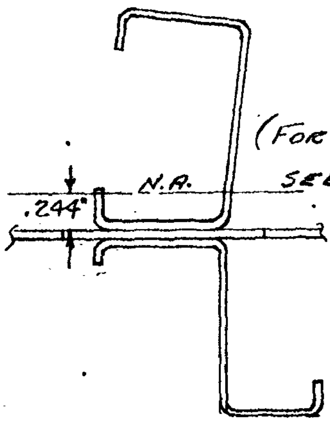
FOR 24ST 84
$F_{cy} = 64000$ psi

$F_{cr} = 70,000$ psi (REF.: C.V.A.C. STRUCT. HDBOOK #1, pg. 2.232)

$M.S. = \frac{70000}{30490} - 1 =$ $\boxed{+1.29}$

BLKHD. #19

SECTION AT 57.74% OF STIFFENER FROM TOP



(FOR DIMENSIONS SEE pg. ")

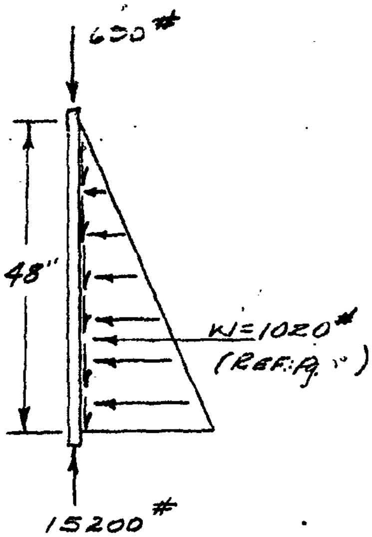
$A = .6857 \text{ in}^2$

$I_{NA} = .7101 \text{ in}^4$

$I/C_c = \frac{.7101}{1.756} = .404 \text{ in}^3$

$\sigma_{CR} = 57{,}500 \text{ \#/}\square''$
(REF.: FZS-36-142, pg. I-341)

FOR THIS CHECK THE ENDS OF THE MEMBER ARE CONSERVATIVELY ASSUMED SIMPLY SUPPORTED.



$q = \frac{15200 - 690}{48} = 303 \text{ \#/in.}$

AXIAL LOAD AT 57.74 %L
$= 690 + (.5774)(48)(303)$
$= 9090\#$

$M_{MAX} = .128\,WL = .128(1020)(48)$
$= 6260 \text{ in\#}$

$f_c = \frac{P}{A} + \frac{MC}{I} = \frac{9090}{.6857} + \frac{6260}{.404}$

$= 13{,}250 + 15{,}500$

$= 28{,}750 \text{ \#/in}^2$

$M.S. = \frac{57{,}500}{28{,}750} - 1 =$ +1.00

WING BULKHEAD #11
(36 W 111)

INDEX

WING BULKHEAD #11

DISCUSSION:

BULKHEAD #11 IS LOCATED 339.5 INCHES FROM THE CENTERLINE OF THE AIRPLANE. THE PRIMARY FUNCTION OF THE BULKHEAD IS TO INTRODUCE AIR, INERTIA, AND ENGINE MOUNT FITTING LOADS INTO THE WING, RESIST CRUSHING LOADS, AND STABILIZE THE PLATE-STRINGER COMBINATIONS. IT ALSO SERVES AS THE INBOARD END OF THE CENTER FUEL TANK. IT IS OF THE WEB TYPE, CONSTRUCTED ENTIRELY OF ALUMINUM ALLOYS. THE CONDITIONS THAT HAVE BEEN DETERMINED AS CRITICAL ARE:

(I) TWO-WHEEL LANDING, NOSE DOWN, INCLINED REACTIONS, D.G.W. (255,272#) LESS BOMBS, FULL FUEL AND OIL.
(II) MIN. FLYING WT. (136,018#) ILAA, H.S @ 5000 FT.
(III) SIDE DRIFT LANDING, A.G.W. (112-500# BOMBS)

THESE CONDITIONS ARE SIMILAR TO THOSE FOUND TO BE CRITICAL FOR THE B-36A AIRPLANE (FZS-36-142, PG. II-3). DUE TO THE FACT THAT DIFFERENT CRITERIA IS USED FOR DETERMINING GUST FACTORS ON THE XB-36 AIRPLANE, THE LOADING FOR CONDITION (II), SHOWN ABOVE, WILL BE HIGHER FOR THE XB-36.

WING BULKHEAD #11

DISCUSSION (CONT'D.)

THE ENGINE MOUNT FITTING LOADS ARE CALCULATED WITH THE AID OF THE UNIT LOAD TABLES OF REPORT NO. FZS-36-243 (STRESS ANALYSIS OF ENGINE MOUNT AND NACELLE). THE LOADS IN THE EXTENSION MOUNT TRUSS MEMBERS ARE CALCULATED FOR COND'S (I) AND (II) AND ARE RESOLVED AT THE FITTING POINTS INTO VERTICAL, DRAG, AND SIDE COMPONENTS ACTING ON THE BULKHEAD FITTINGS.

THE XB-36 BULKHEAD LOADS DUE TO AIRLOADS, CRUSHING LOADS, AND FUEL LOADS FOR CONDITION (II) ARE OBTAINED FROM THE B-36A LOADS AS SHOWN ON PGS 155.

CALCULATION OF EFFECT OF LOAD FACTORS FOR CONDITIONS I AND II.

THE LOAD FACTORS ACTING ON THE ENGINE & NACELLE CONTENTS MUST BE RESOLVED INTO PLANES PERPENDICULAR & PARALLEL TO THE THRUST LINE TO MAKE USE OF THE UNIT LOADS OF FZS-36-153, P. 137 TO 139.

[illegible] FACTORS FOR CONDITION I - DGW (255,272*) - TWO WHEEL LANDING - I.R. - N.D.

$n_V = -4.00$ ULTIMATE (DOWN)

$n_d = 1.32$ ULTIMATE (FWD.) (REF. ANC-2)

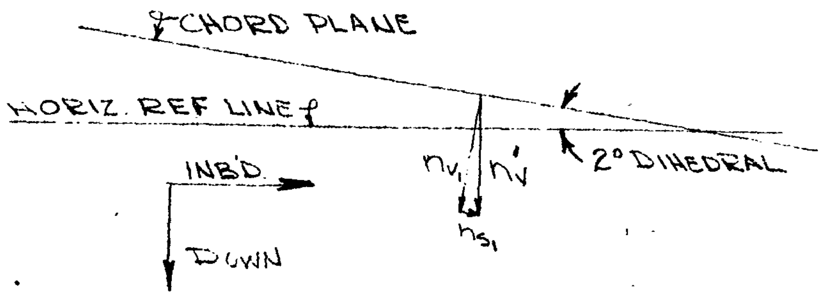
BECAUSE OF THE PITCHING ACCELERATION IN LANDING THE VERTICAL LOAD FACTOR IS INCREASED.

$\frac{\alpha}{12g} = -.006516$ (REF. FZS-36-240 P. 174)

DISTANCE OF C.G. OF INBD. ENGINE AFT. OF C.G. OF AIRPLANE = 154.3"

$n_V' = -4.00 + (-.006516)(154.3) = -5.00$

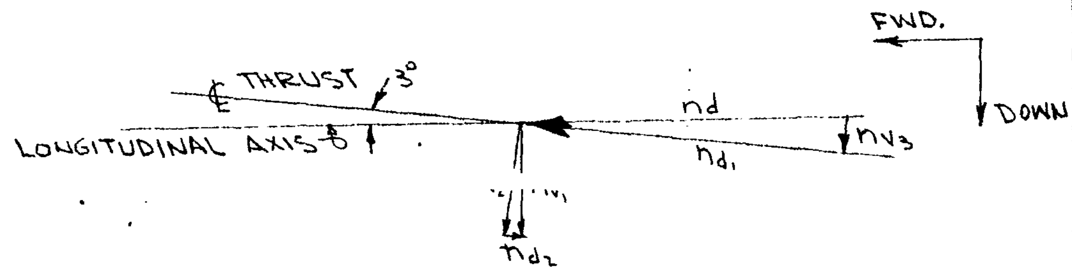
RESOLVING THE LOAD FACTORS INTO PLANES PERPENDICULAR & PARALLEL TO THE THRUST LINE:



COND. I LOAD FACTORS CONT'D.

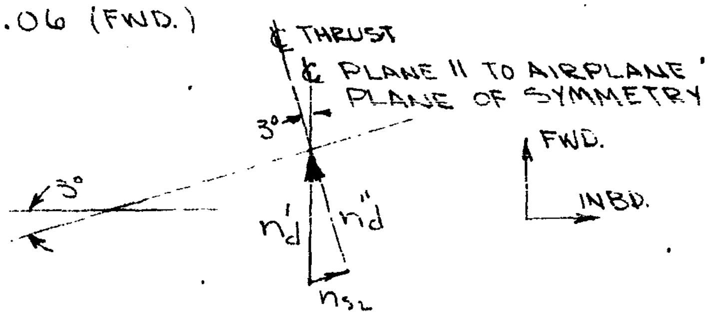
$n_{V_1} = 5.00 \cos 2° = 5.00 (.99939) = 5.00$ (DOWN)

$n_{S_1} = 5.00 \sin 2° = 5.00 (.0349) = .17$ (INB'D.)



$n_V'' = 5.00 \cos 3° + 1.32 \sin 3° = 5.00 (.99863) + 1.32 (.05234)$
$= 5.06$ (DOWN)

$n_d' = 1.32 \cos 3° - 5.00 \sin 3° = 1.32 (.99863) - 5.00 (.05234)$
$= 1.06$ (FWD.)



$n_d'' = 1.06 \cos 3° = 1.06 (.99863) = 1.06$ (FWD.)

$n_S'' = n_{S_1} + n_{S_2} = .17 + 1.06 \sin 3° = .23$ (INBD.)

SUMMARY OF LOAD FACTORS FOR USE IN OBTAINING FITTING LOADS IN THE DGW-2WL-IR-ND CONDITION.

$$\left.\begin{aligned} n_V'' &= 5.06 \text{ (DOWN)} \\ n_d'' &= 1.06 \text{ (FWD.)} \\ n_S'' &= .23 \text{ (INBD.)} \end{aligned}\right\} \text{ULTIMATE}$$

CALCULATION & RESOLUTION OF LOAD FACTORS FOR CONDITION II MIN. FLYING WT. = 136,018# - ILAA @ 5000'

$$\frac{-N_A}{W} \doteq 2.236 \text{ (LIMIT)}$$

$$\frac{X_M}{W} = -.012 \text{ (LIMIT)} \quad \text{(REF. FZS-36-126-P. 84)}$$

RESOLVING THE LOAD FACTORS INTO PLANES PARALLEL & PERPENDICULAR TO THE THRUST LINE:

$$n_y = \frac{N_A}{W} \cos 2^\circ (1.5) = 2.236 \times .99939 \times 1.5 = 3.35 \text{ (UP)}$$

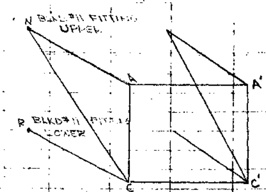
$$n_d = \frac{X_M}{W} \cos 3^\circ (1.5) = -.012 \times .99863 \times 1.5 = -.018 \text{ (FWD.)}$$

$$n_s = \left(\frac{N_A}{W} \sin 2^\circ + \frac{X_M}{W} \sin 3^\circ\right) 1.5 = (2.236 \times .0394 - .012 \times .0523) \times 1.5$$

$$= .1312 \text{ (OUTBD)}$$

TABLE XXI ULTIMATE LOADS APPLIED TO INBD. EXTENSION MOUNT FOR DESIGN CONDITIONS (INERTIA EFFECTS ONLY)

EXTENSION MOUNT POINTS (REF. FIG.)	UNIT LOADS FROM BALANCE MOUNT 1g DOWN V	D	S	1g INBD. V	D	S	1g AFT V	D	S	UNIT LOADS FROM EXTENSION MOUNT INERTIA ITEMS 1g DOWN V	1g INBD. V	S	1g AFT V	D
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
	REF. TAB. 18									TAB. 35	TAB. 37		TAB. 36	
A	+19.[illegible]	+[illegible]	-[illegible]	-9[illegible]	[illegible]	+7.[illegible]	-13.5	[illegible]	-19.[illegible]	+18.9	—	+18.9	—	+18.[illegible]
A'	+[illegible]	+[illegible]	+[illegible]	-9[illegible]	[illegible]	+7.[illegible]	[illegible]	[illegible]	+19.[illegible]	+18.9	—	+18.9	—	+18.[illegible]
C	[illegible]	[illegible]	[illegible]	[illegible]	+5[illegible]	-2[illegible]	[illegible]	[illegible]	-2[illegible]	+580	+2[illegible]	+5[illegible]	-5.9	+[illegible]
C'	[illegible]	[illegible]	-8.[illegible]	+[illegible]	+15.[illegible]	[illegible]	[illegible]	+2252	+2[illegible]	+58[illegible]	-2[illegible]	+[illegible]	-5.9	+[illegible]



SKETCH OF INBD. EXTENSION MOUNT

ULTIMATE LOADS DOWN-SIDE TRAN. LOAD FACTORS VERT. 5.06 DOWN, DRAG 1.06 FWD. SIDE .23 INBD. (REF. P.[illegible])

POINT	V	D	S	V	D	S	V	D	S	V	V	S	V	D	ΣV	ΣD	ΣS
	5.06 x 1	5.06 x 2	5.06 x 3	.23 x 4	.23 x 5	.23 x 6	-1.06 x 7	-1.06 x 8	-1.06 x 9	5.06 x 10	.23 x 11	.23 x 12	-1.06 x 13	-1.06 x 14	15+18+21 +24+25+27	16+19+22 +28	17+20 +23+26
	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
A	9,150	31,5[illegible]	-4,3[illegible]	[illegible]	1[illegible]	164	143	-1320	204	96	—	4	—	-20	9,176	30,310	-3,973
A'	9,150	3[illegible]53	4,3[illegible]	[illegible]	-1[illegible]	164	143	-1320	-204	96	—	4	—	-20	9,602	30,110	4,319
C	8,440	-[illegible]57[illegible]	4,[illegible]	-5[illegible]	[illegible]	6[illegible]	-151	-2,390	313	294	5	13	+6	-61	8,542	-30,551	5,315
C'	[illegible]	[illegible]	4,[illegible]5	[illegible]	-[illegible]420	[illegible]	-151	-2390	-313	294	-5	13	+6	-61	8,[illegible]	-31,451	-4021

ULTIMATE LOADS MAX. FLYING ATT. [illegible] LOAD FACTORS VERT. -3.35 UP DRAG -.015 FWD. SIDE .1312 OUTBD. (REF. P.139)

POINT	V	D	S	V	D	S	V	D	S	V	V	S	V	D	ΣV	ΣD	ΣS
	-3.35 x 1	-3.35 x 2	-3.35 x 3	-.1312 x 4	-.1312 x 5	-.1312 x 6	.015 x 7	.015 x 8	.015 x 9	-3.35 x 10	-.1312 x 11	-.1312 x 12	.015 x 13	.015 x 14	29+32+35 +38+39+41	30+33 +36+42	31+34 +37+40
	29	30	31	32	33	34	35	36	37	38	39	40	41	42			
A	-6,050	-20,900	2,870	121	-57	-96	2	-22	3	-63	—	-2	—	—	-5,990	-20,979	2,775
A'	-6,050	-20,900	-2,870	-121	57	-96	2	-22	-3	-63	—	-2	—	—	-6,232	-20,865	-2,971
C	-5580	20,900	-2,890	29	-1970	-362	-3	-40	5	-194	-3	-8	—	-1	-5,751	18,889	-3,245
C'	-5580	20,900	2,890	-29	1970	-362	-3	-40	-5	-194	3	-8	—	-1	-5,803	22,879	2,505

SIGN CONVENTION:

+ VERTICAL LOADS DOWN
+ SIDE LOADS INBD.
+ DRAG LOADS AFT.

CALC. BY: NOAH
CK. BY: LOONEY

TABLE XXXI

MEMBER	MEMBER LOAD DUE TO 1000# DOWN AT A	MEMBER LOAD DUE TO 1000# DOWN AT C	MEMBER LOAD DUE TO 1000# AFT. AT A	MEMBER LOAD DUE TO 1000# AFT. AT C
	(1)	(2)	(3)	(4)
AW	0	0	1010T	0
CW	1422T	1422T	196C	913T
CR	[illegible]	[illegible]	[illegible]	[illegible]

(REF. FZS-36-53 TABLE XXXI)

ULTIMATE MEMBER LOADS DGW-2WL-IR-ND

MEMBER	$\frac{\Sigma V_A^*}{1000} \times (1)$	$\frac{\Sigma V_C^*}{1000} \times (2)$	$\frac{\Sigma D_A^*}{1000} \times (3)$	$\frac{\Sigma D_C^*}{1000} \times (4)$
	(5)	(6)	(7)	(8)
AW	0	0	30,600T	0
CW	13,060T	12,150T	5940 C	2790C
CR	9910C	9220C	4560T	28,600C

*REF. TABLE [illegible] FOR ΣV & ΣD

ULTIMATE MEMBER LOADS MIN. FLYING WT. ILAA @ 5000'

MEMBER	$\frac{\Sigma V_A^*}{1000} \times (1)$	$\frac{\Sigma V_C^*}{1000} \times (2)$	$\frac{\Sigma D_A^*}{1000} \times (3)$	$\frac{\Sigma D_C^*}{1000} \times (4)$
	(9)	(10)	(11)	(12)
AW	0	0	21,100 C	0
CW	8,530C	8,170C	4,100 T	1,730T
CR	6,4[illegible]T	6,[illegible] T	3,1[illegible] C	17,730T

CALC. BY: Voss
CK. BY: Johnson

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS
FW 855 125 PADS 11-43

TABLE XXXIII

SUMMARY OF SIDE LOAD COMPONENTS @A, A', C & C' DUE TO 1000# VERTICAL & 1000# DRAG LOADS

PAGE: 142
FZS-36-242
DATE: 11-47

POINT	FROM VERT. LOAD OF 1000# DOWN @ A	FROM DRAG LOAD OF 1000# AFT. @ A	FROM VERT. LOAD OF 1000# DOWN @ A'	FROM DRAG LOAD OF 1000# AFT. @ A'	FROM VERT. LOAD OF 1000# DOWN @ C	FROM DRAG LOAD OF 1000# AFT. @ C	FROM VERT. LOAD OF 1000# DOWN @ C'	FROM DRAG LOAD OF 1000# AFT. @ C'
	1	2	3	4	5	6	7	8
A		-36.8						
A'				+81.1				
C	-2.9	+.4			-2.9	-34.3		
C'			-47.9	+5.55			-47.9	+120

+ COMPONENT INBD.

(REF FZS-36-153 TABLE XXXIV.)

CALC. BY: Voss
CK. BY: Johnson

SUMMARY OF SIDE LOADS ON INBOARD ENGINE MOUNT, POINTS A, A', C & C'

CONDITION OF LOADING				DGW-2WL-IR-ND A	DGW-2WL-IR-ND A'	DGW-2WL-IR-ND C	DGW-2WL-IR-ND C'	MIN. FLYING WT.-ILAA @ 5000' A	MIN. FLYING WT.-ILAA @ 5000' A'	MIN. FLYING WT.-ILAA @ 5000' C	MIN. FLYING WT.-ILAA @ 5000' C'
LOADS DUE TO AIRPLANE ACCELERATION	SIDE COMPONENT	* [illegible]	[illegible] A OR A'	0	0	-27	-42[illegible]	0	[illegible]	+17	+2[illegible]8
			[illegible] C OR C'	0	0	-25	-413	0	[illegible]	+11	+277
		† [illegible] DRAG LOAD	[illegible] A OR A'	-1,115	+2440	+[illegible]2	+[illegible]1	+770	-[illegible]	-8	-115
			[illegible] C OR C'	0	0	+1048	-4490	[illegible]	[illegible]	-653	+2750
	SIDE LOAD FROM BASIC MOUNT & INERTIA ITEMS			-3,973	+4319	+5315	-4021	+[illegible]75	-[illegible]71	-3,[illegible]43	+2,505
LOADS DUE TO [illegible] TORQUE (REF. FZS-[illegible])	SIDE COMPONENT	FROM VERT. LOAD	ACTING @ A OR A'	0	0	+14L -14R	+228L -228R	0	0	+14L -14R	+228L -228R
			ACTING @ C OR C'	0	0	+13L -13R	+193L -193R	0	0	+13L -13R	+193L -193R
		FROM DRAG LOAD	[illegible]	[illegible]	[illegible]	-5[illegible]	+70[illegible]	+459	+1010[illegible]	-54	+70L
			ACTING @ C OR C'	0	0	-427L +427R	-1494L +1494R	[illegible]	0	-427L +427R	-1494L +1494R
	SIDE LOAD FROM BASIC MOUNT & INERTIA ITEMS			+1322L -1322R	+1322L -1322R	-1298L +1298R	-1298L +1298R	+1322L -1322R	+1322L -1322R	-1298L +1298R	-1298L +1298R
LOADS DUE TO THRUST (REF. FZS-[illegible] TAB. [illegible])	SIDE COMPONENT	FROM VERT. LOAD	ACTING @ A OR A'	0	0	—	-3	0	[illegible]	—	-3
			ACTING @ C OR C'	0	0	—	[illegible]	[illegible]	[illegible]	—	+3
		FROM DRAG LOAD	ACTING @ A OR A'	+42	-92	—	-6	+42	[illegible]	[illegible]	-6
			ACTING @ C OR C'	0	0	+55	-192	[illegible]	[illegible]	+55	-192
	SIDE LOAD FROM BASIC MOUNT & INERTIA ITEMS			+158	-158	+221	-221	+158	-158	+221	-221
[illegible] (COMBINATION R.H. WING + TORQUE + THRUST)				-6,[illegible]68	+4177	6,810 / 8,3[illegible]	-5544 / -6,736				
(FOR MIN. FLYING WT.-ILAA, COMBINATION L.H. WING + TORQUE + THRUST)								+5,519	-2,575	-[illegible] / -5,[illegible]	[illegible] / +25[illegible]

* UNIT SIDE LOAD COMPONENT ON ENGINE MOUNT POINT UNDER INVESTIGATION, DUE TO [illegible] UNIT VERTICAL LOAD. (REF. TAB. XXXII)

$X \dfrac{\Sigma V}{1000}$ WHERE ΣV CORRESPONDS TO ENGINE MOUNT POINT WHERE UNIT VERTICAL LOAD IS APPLIED. (REF. TABLE XXX)

† UNIT SIDE LOAD COMPONENT ON ENGINE MOUNT POINT UNDER INVESTIGATION, DUE TO [illegible] UNIT DRAG [illegible]. REF. TABLE XXXII

$X \dfrac{\Sigma D}{1000}$ WHERE ΣD [illegible] TO ENGINE MOUNT POINT WHERE UNIT DRAG LOAD IS APPLIED. (REF. TAB. XXX)

SIGN CONVENTION
+ SIDE LOADS INBOARD

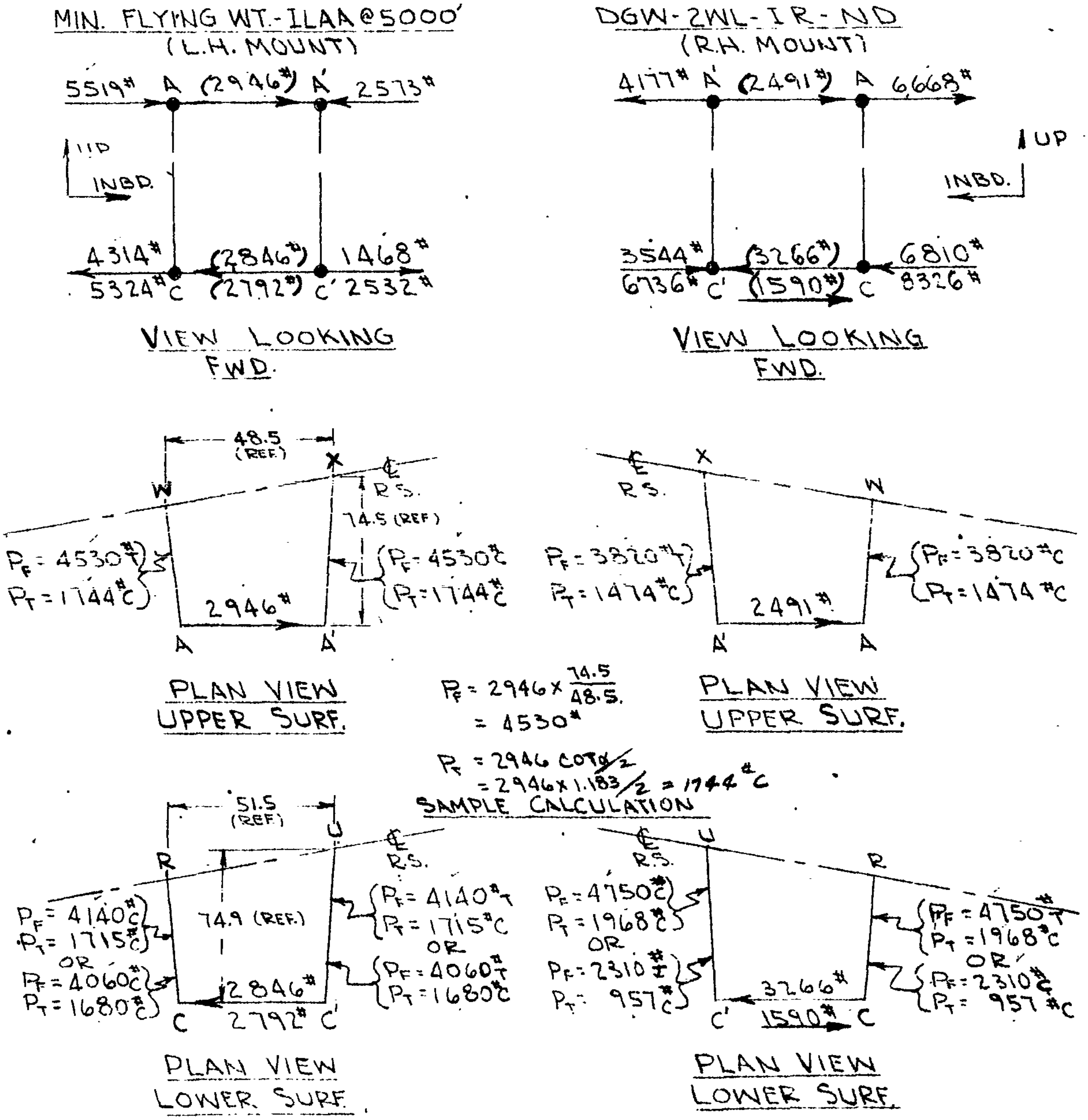
L - L.H. WING
R - R.H. WING

CALC. BY: [illegible]
CK. BY: Johnson

DETERMINATION OF FLANGE LOADS IN UPPER & LOWER SHEAR BEAMS OF INBOARD EXTENSION MOUNT.

P_F = FLANGE LOAD = NET SHEAR × 74.5/48.5 FOR UPPER SURF; 74.9/51.5 FOR LOWER SURF
(REF. FZS-36-153 TABLE L)

P_T = TENSION FIELD FACTOR = NET SHEAR × $\frac{\cot\alpha}{2}$ $\cot\alpha = 1.183$ FOR UPPER SURF; $\cot\alpha = 1.205$ FOR LOWER SURF



$P_F = 2946 \times \frac{74.5}{48.5}$
$= 4530^{\#}$

$P_T = 2946 \cot\alpha/2$
$= 2946 \times 1.183/2 = 1744^{\#}C$

SAMPLE CALCULATION

FIG. 13

TABLE XXXIV SUMMARY OF EXTENSION MT. MEMBER LOADS

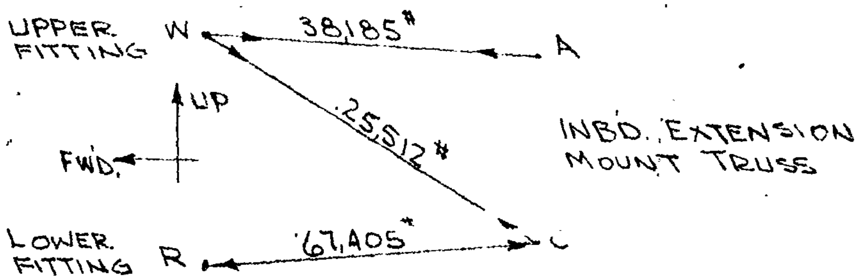
CONDITION		MEMBER	INERTIA LOADS	THRUST LOADS	TORQUE LOADS	FLANGE LOADS	$\frac{V \cot\alpha}{2}$* LOADS	TOTAL
			TABLE XXXI	(REF. FZS-36-253 TABLE XL)		FIG. 13	FIG. 13	Σ① + Σ② + Σ③ + ④ + ⑤
			①	②	③	④	⑤	⑥
DGW-2WL-IR-ND		AW	30,600T	1,145C	12550T	3,820C	—	38,185T
		CW	13,060T	91T	6790T			
			12,150T	223T	2,440C			
			[illegible]	98C	5750T			
			2790C	147C	1,137C			
		ΣCW	16,480T	69T	8,963T			25,512T
		CR	9,410C	69C	5,150C			
			9,220C	169C	1,855T			
			4560T	75T	4,360C			
			28,600C	1500C	11,650C			
		ΣCR	43,170C	1663C	19,305C	2310C	957C	67,405C
MIN FLYING WT.		AW	21,100C	1145C	12,550C	4530T	1744C	32,009C
-ILAA	@5000'							
		CW	8,520C	91T	6,790C			
			8,170C	223T	2,440T			
			4,100T	[illegible]	5,750C			
			1730T	147C	1,137T			
		ΣCW	10,870C	69T	8,963C			19,764C
		CR	6,470T	69C	5,150T			
			6,200T	169C	1,855C			
			3,120C	75T	4,360T			
			17,730T	1500C	11,650T			
		ΣCR	27,280T	1663C	19,305T	1060C	—	40,862T

*LOADS DUE TO $\frac{V \cot\alpha}{2}$ ARE USED ONLY IF THEY INCREASE MEMBER LOAD

CALC. BY: [illegible]
CK. BY: Lowrey

CONDITION: I D.G.W. = 255,272# - (LESS BOMBS) - FULL FUEL & OIL - 2 WL - IR - ND

ENGINE MOUNT FITTING LOADS (REF. PG. 145)

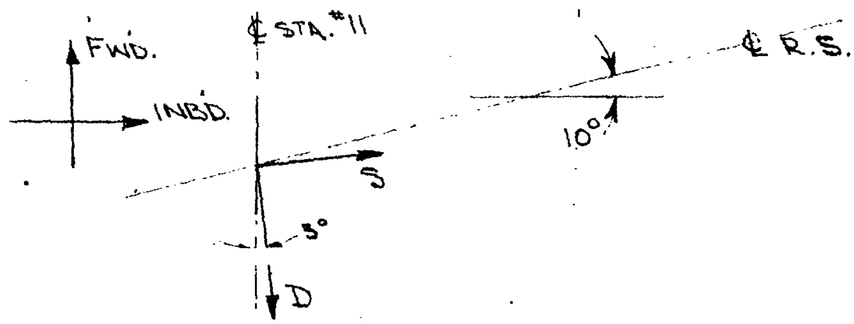


①	②	③	④	⑤	⑥	⑦	⑧
MEMBER	LOAD #	(REF. FZS-36-153 P. 130) DIRECTION COSINE			UPPER FITTING (POINT W)		
		V/L	D/L	S/L	V_W = ③ x ②	D_W = ④ x ②	S_W = ⑤ x ②
AW	38,185 (T)	.1367	.9900	.0364	5,210	37,800	1,390
CW	25,512 (T)	.6560	.7560	.0278	16,740	19,300	710
CR	67,405 (C)	.0640	.9970	.0340	---	---	---
					ΣV_W = 21,950# (DOWN)	ΣD_W = 57,100# (AFT)	ΣS_W = 2,100#

	⑨	⑩	⑪
MEMBER	LOWER FITTING (POINT R)		
	V_R = ③ x ②	D_R = ④ x ②	S_R = ⑤ x ②
AW	---	---	---
CW	---	---	---
CR	4300	67,000	2,290
	ΣV_R = 4,300# (DOWN)	ΣD_R = 67,000# (FWD.)	ΣS_R = 2,290# (OUTBD.)

COND: I DGW-2WL-IR-ND

THE DRAG & SIDE LOADS ARE RESOLVED INTO THE PLANE OF THE BULKHEAD & THE PLANE OF THE REAR SPAR.



UPPER FITTING

$D' = D \cos 3° - S \sin 3° = 57{,}100 \times .999 - 2100 \times .052 = 56{,}900^{\#}$ (AFT.)

$S' = D \sin 3° + S \cos 3° = 57{,}100 \times .052 + 2100 \times .999 = 5{,}070^{\#}$ (INBD.)

$D'' = S' \tan 10° = 5070 \times .176 = 890^{\#}$ (FWD.)

$D_{TOTAL} = D' + D'' = 56{,}900 - 890 = 56{,}010^{\#}$ (AFT.)

LOWER FITTING

$D' = D \cos 3° - S \sin 3° = 67{,}000 \times .999 - 2290 \times .052 = 66{,}880^{\#}$ (FWD.)

$S' = D \sin 3° + S \cos 3° = 67{,}000 \times .052 + 2290 \times .999 = 5770^{\#}$ (OUTBD.)

$D'' = S' \tan 10° = 5770 \times .176 = 1020^{\#}$ (AFT.)

$D_{TOTAL} = 66{,}880 - 1{,}020 = 65{,}860^{\#}$ (FWD.)

ADDITIONAL VERTICAL & DRAG LOADS MUST BE INCLUDED AT POINTS W & R DUE TO INERTIA ITEMS OF THE EXTENSION MOUNT BEAMED TO THESE POINTS.

POINT W

$V = 85^{\#}$ (DOWN)
$D = 17^{\#}$ (FWD.) (REF. FZS-36-142 P. II-43)

POINT R

$V = 111^{\#}$ (DOWN)
$D = 24^{\#}$ (FWD.)

NOTE: B-36A LOADS FROM INERTIA ITEMS ARE USED IN PLACE OF XB-36 LOADS, SINCE THE LATTER ARE UNAVAILABLE AT THIS TIME. THIS IS DONE WITH NEGLIGIBLE ERROR AS THIS ASSUMPTION HAS ONLY A SLIGHT EFFECT ON THE NET ULTIMATE FITTING LOADS.

COND. IDGW-2WL-IR-ND

SUMMARY OF FITTING LOADS

UPPER FITTING

V = 21,950 + 85 = 22,035# (DOWN)

D = 56,010 - 17 = 55,993# (AFT.)

LOWER FITTING

V = 4,300 + 111 = 4411# (DOWN)

D = 65,860 + 74 = 65,884# (FWD)

FUEL LOADS

THE CENTER FUEL TANK IS FULL OF FUEL FOR THIS CONDITION.

1g FUEL LOAD AT BLKH'D. #11 = 3008.2#

C.G. FUEL IS 54.81" AFT. OF F.S. (REF. FZS-36-240 P. 13 & P. 52)

THE VERTICAL LOAD FACTOR AT THE FUEL C.G. IS:

$n_V = -4.00 - .006516 \times (-44.86) = -3.708$

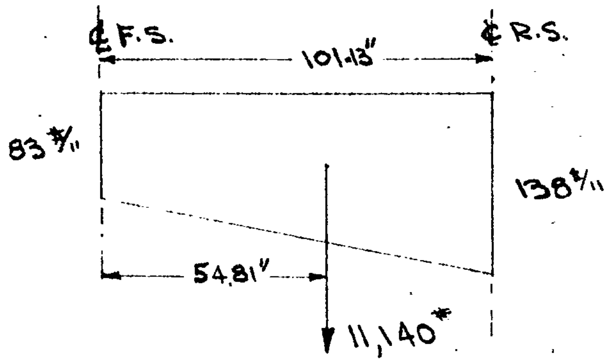
(REF. ANC-2 & FZS-36-240 P. 174)

WHERE -44.86" IS THE DISTANCE OF THE FUEL C.G. FWD. OF THE AIRPLANE C.G. (REF. FZS-36-237 P. 14 & 31)

THE ULTIMATE FUEL LOAD IS:

$P_{ULT.} = 3,008.2 \times 3.708 = 11,140$#

THE FUEL IS ASSUMED DISTRIBUTED AS A TRAPEZOID



COND: I · DGW - 2WL - IR - ND

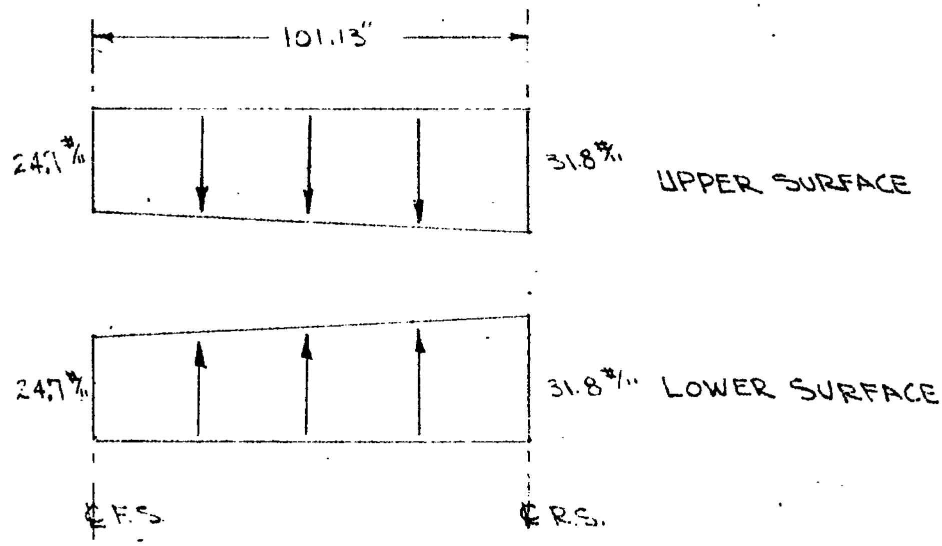
CRUSHING LOAD

$$P_{(CRUSHING)} = \frac{(M'_x)^2 L}{\left(\frac{I}{Q}\right)_x EI}$$

$M'_x = -71.48 \times 10^6$ (REF FZS-36-240 P. 219)
$I_x = 86{,}385$ (REF FZS-36-141 P. 54)
$Q_x = 1{,}338$ (REF FZS-36-141 P. 144)
$L = \frac{36.5 + 27.5}{2} = 32.0$

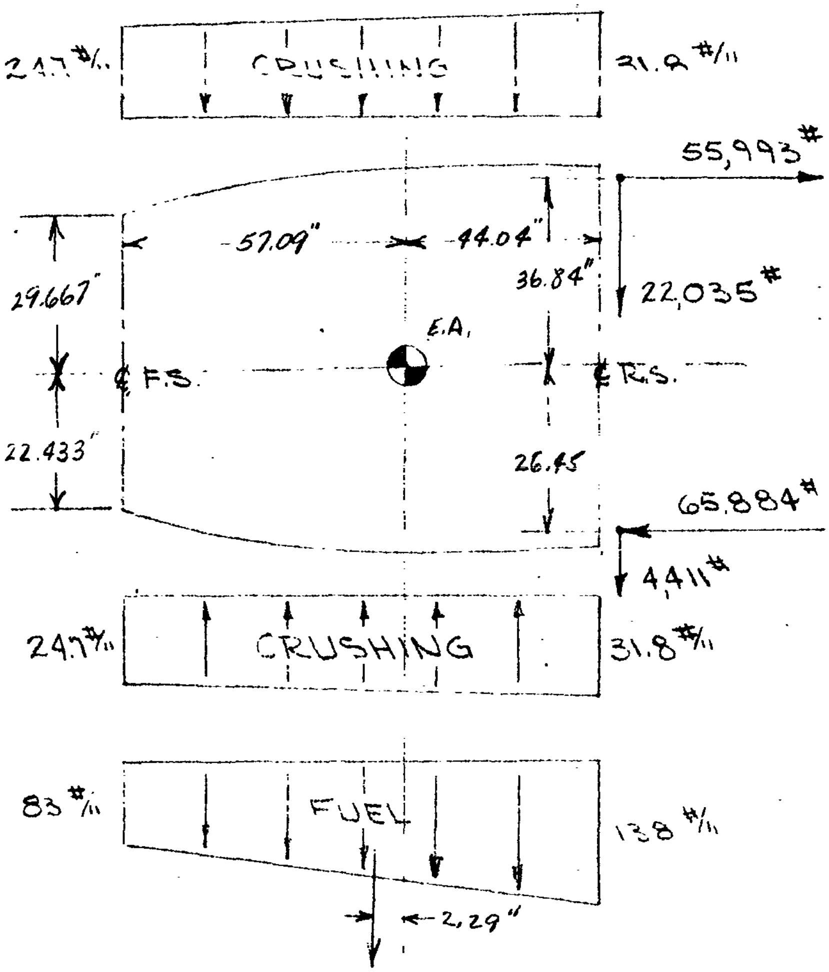
$$P_{(CRUSHING)} = \frac{(-71.48 \times 10^6)^2 (32.0)}{\left(\frac{86{,}385}{1338}\right)(10.3 \times 10^6)(86{,}385)} = \text{[illegible]}^{\#}$$

THE CRUSHING LOAD IS APPLIED SYMMETRICALLY TO THE UPPER & LOWER SURFACE OF THE BULKHEAD & THE DISTRIBUTION IS ASSUMED TO BE TRAPEZOIDAL WITH THE MAGNITUDE OF THE BASES PROPORTIONAL TO THE SPAR DEPTHS.



COND: I DGW-2WL-IR-ND

APPLIED LOADS ON THE BULKHEAD



COND: I DGW - 2WL - IR - ND

TRANSFERRING LOADS TO THE ELASTIC AXIS OF THE BULKHEAD:

$D = +55{,}993 - 65{,}884 = -9{,}891^{\#}$ (FWD)

$V = 22{,}035 + 4{,}411 + 11{,}140 = -37586^{\#}$ (DOWN)

$T_{EA} = 22{,}035 \times 44.04 + 4{,}411 \times 44.04 + 55{,}993 \times 36.84 + 65{,}884 \times 26.45 - 11{,}140 \times 2.29 = 4{,}944{,}590^{''\#}$

REACTING THE DRAG LOAD AT THE UPPER & LOWER SURFACE SHEAR CENTERS: REF. FZS-36-142, P. II-3

$R_U = 9891 \times \frac{32.44}{73.92} = 4{,}350^{\#}$ (AFT.)

$R_L = 9891 \times \frac{41.48}{73.92} = 5{,}550^{\#}$ (AFT.)

REACTING R_U & R_L AS SHEAR FLOWS IN THE UPPER & LOWER SURFACES: REF. FZS-36-142, P. II-3

$q_U = \frac{4350}{101.13} = 43^{\#/''}$

$q_L = \frac{5550}{101.13} = 55^{\#/''}$

THE NET VERTICAL COMPONENT DUE TO SHEAR FLOW IS $= 43 \times 10.714 - 55 \times 4.534 = 212^{\#}$ (UP). & IS REACTED AT THE FRONT & REAR SPARS.

$P_{F.S.} = 212 \times \frac{44.04}{101.13} = 92^{\#}$ (DOWN)

$P_{R.S.} = 212 \times \frac{57.09}{101.13} = 120^{\#}$ (DOWN)

THE VERTICAL SHEAR LOAD ON THE BULKHEAD IS REACTED AT THE FRONT & REAR SPARS.

$P_{F.S.} = 37{,}586 \times \frac{44.04}{101.13} = 16{,}350^{\#}$ (UP)

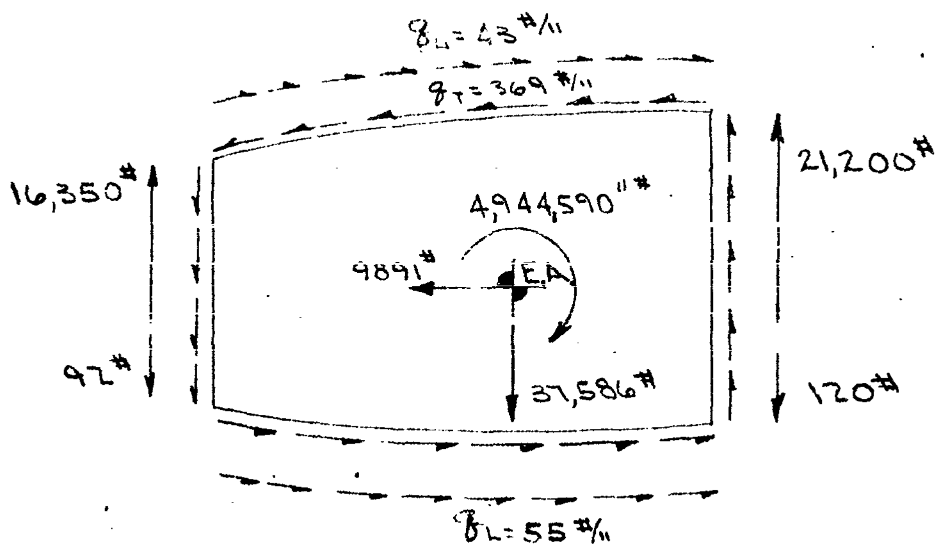
$P_{R.S.} = 37{,}586 \times \frac{57.09}{101.13} = 21{,}200^{\#}$ (UP)

COND: I DGW-2WL-IR-ND

TRANSFERR OF LOADS TO E.A. CONT'D.

THE TORSION ABOUT THE ELASTIC AXIS (TEA) IS REACTED BY A SHEAR FLOW AROUND THE ENTIRE BULKHEAD:

$$q_T = \frac{T_{EA}}{2A} = \frac{4{,}944{,}590}{2 \times 6699} = 369\ \#/"$$



CONSOLIDATED VULTEE AIRCRAFT CORPORATION

FORT WORTH DIVISION FORT WORTH, TEXAS

FW 633 125 PADS 11-43

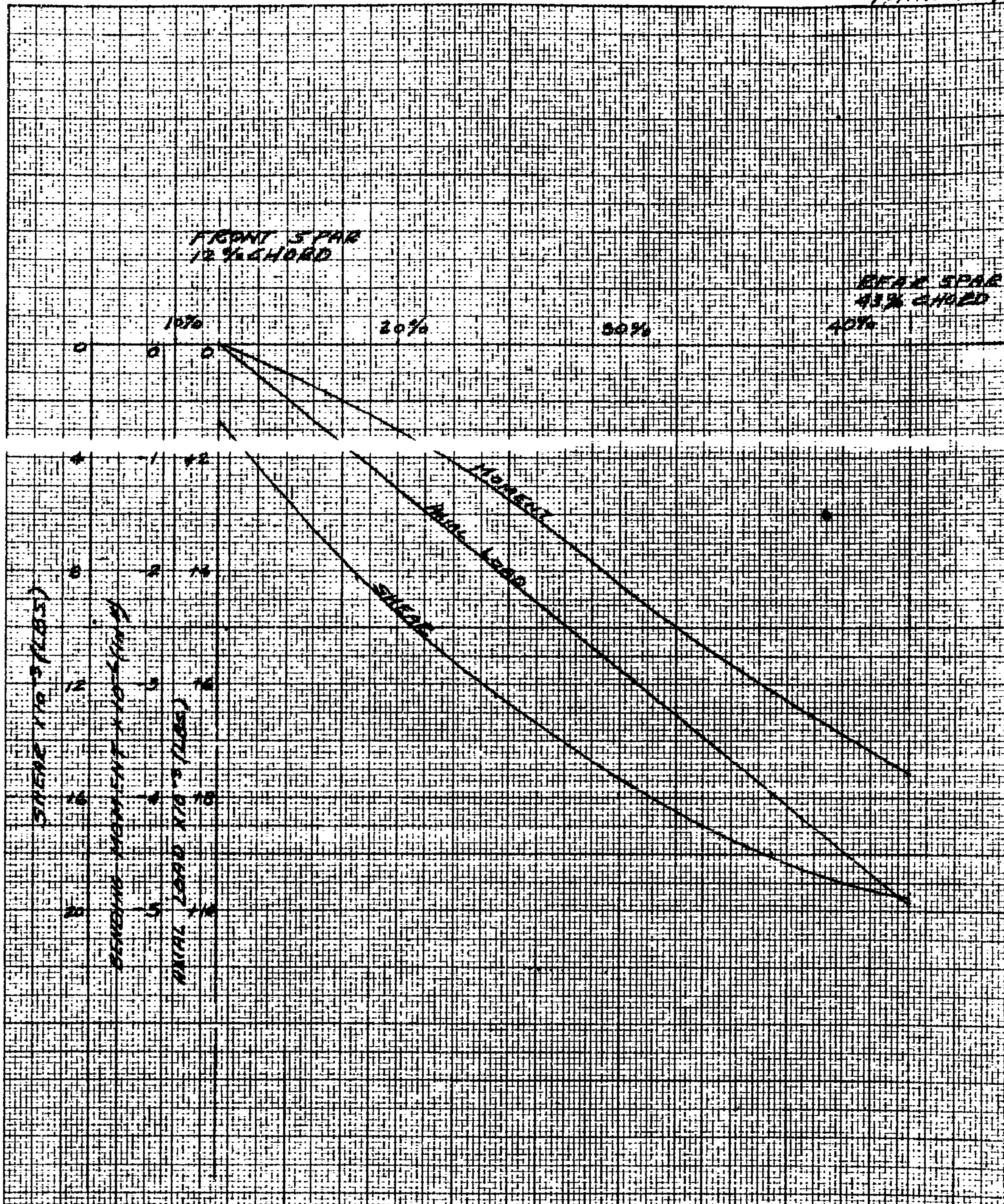


FIGURE 48

CALCULATED BY Canfield 3/4/48	SHEAR, MOMENT & AXIAL LOAD CURVE	DOC. NO.
DRAWN BY Canfield 3/4/48	FOR BULKHEAD #11	FZS-36-242
CHECKED BY Lowrey 3/5/48	COND. I D.G.W. 2WL I.F. ND	MODEL
APPROVED BY	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	XB-36

KEUFFEL & ESSER CO., N.Y. NO. 359-14
Millimeters, 5 mm. lines accented, cm. lines heavy.
MADE IN U.S.A.

CONDITION: II MINIMUM FLYING WEIGHT = 136,018# - II.A.A (H.S.) @ 5000'

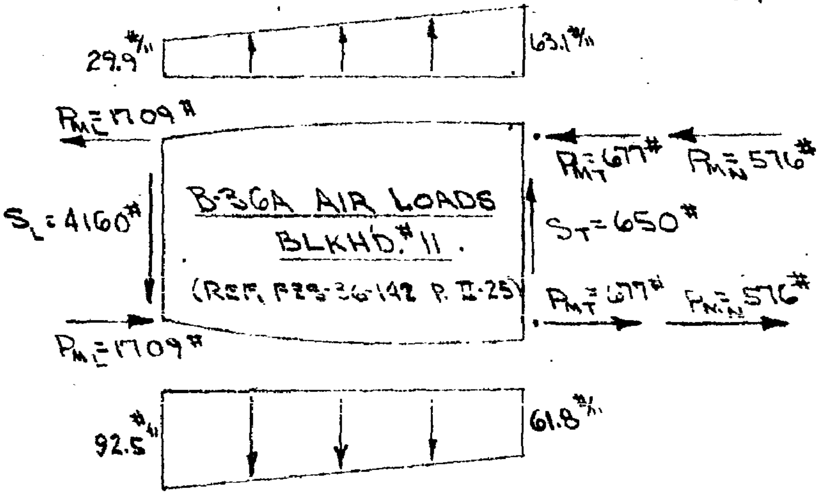
AIR LOADS

AIR LOADS FOR THE XB-36 AIRPLANE WERE OBTAINED FROM B-36A AIR LOADS BY ASSUMING THE SAME DISTRIBUTION IN THE MANNER SHOWN BELOW:

$\frac{Z}{W}$ (XB-36) = -2.043 (REF. FZS-36-126 P. 40)

$\frac{Z}{W}$ [illegible]

$\frac{-2.043}{-1.494} \times 29.9 = 40.9$ #/" (SINCE W FOR THE XB-36 AND B-36A IS ALMOST THE SAME, THIS RATIO WILL BE USED.)



AIR LOAD DESIGNATIONS

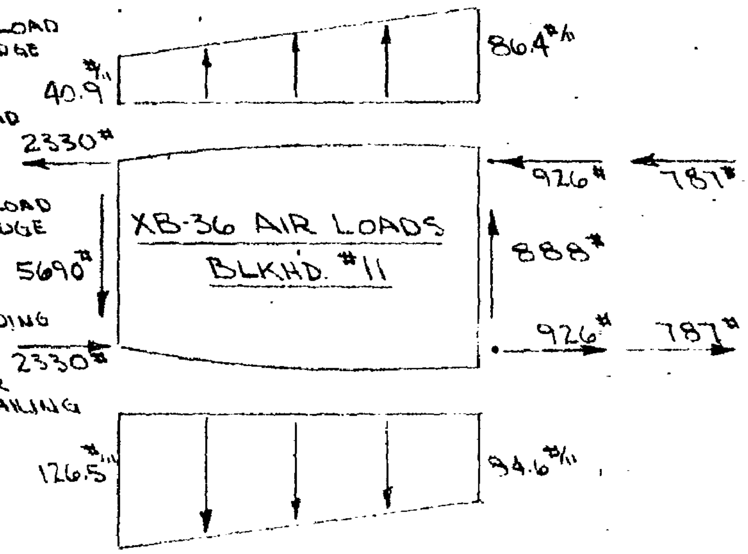
P_{M_L} = FLANGE COUPLE LOAD FROM LEADING EDGE MOMENT.

P_{M_N} = FITTING COUPLE LOAD FROM NACELLE MOMENT.

P_{M_T} = FITTING COUPLE LOAD FROM TRAILING EDGE MOMENT.

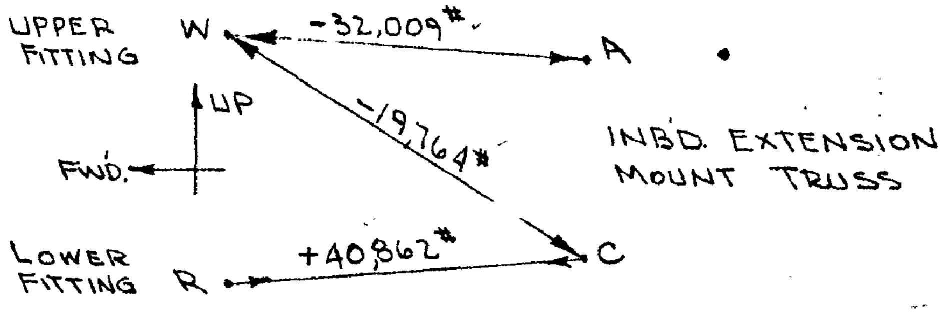
S_L = SHEAR AT FRONT SPAR FROM LEADING EDGE.

S_T = SHEAR AT REAR SPAR FROM TRAILING EDGE.



CONDITION: II MINIMUM FLYING WEIGHT = 136,018# - ILAA (H.S.) @ 5000'

ENGINE MOUNT FITTING LOADS



①	②	③	④	⑤	⑥	⑦	⑧
MEMBER	LOAD #	DIRECTION COSINE (REF. FZS-36-153, P. 130)			UPPER FITTING (POINT W)		
		V/L	D/L	S/L	V_W = ③ × ②	D_W = ④ × ②	S_W = ⑤ × ②
AW	32,009 (C)	.1367	.9900	.0364	4,370	31,700	1,170
CW	19,764 (C)	.6560	.7560	.0278	12,970	14,950	550
CR	40,862 (T)	.0640	.9970	.0340	— — —	— — —	— — —
					ΣV_W = 17340# (UP)	ΣD_W = 46,650# (FWD)	ΣS_W = 1,720# (OUTB'D)

	⑨	⑩	⑪
MEMBER	LOWER FITTING (POINT R)		
	V_R = 3 × 2	D_R = 4 × 2	S_R = 5 × 2
AW	— — —	— — —	— — —
CW	— — —	— — —	— — —
CR	2,620	40,700	1,390
	ΣV_R = 2,620# (UP)	ΣD_R = 40,700# (AFT.)	ΣS_R = 1,390# (INB'D.)

TOTAL OF VERTICAL LOAD

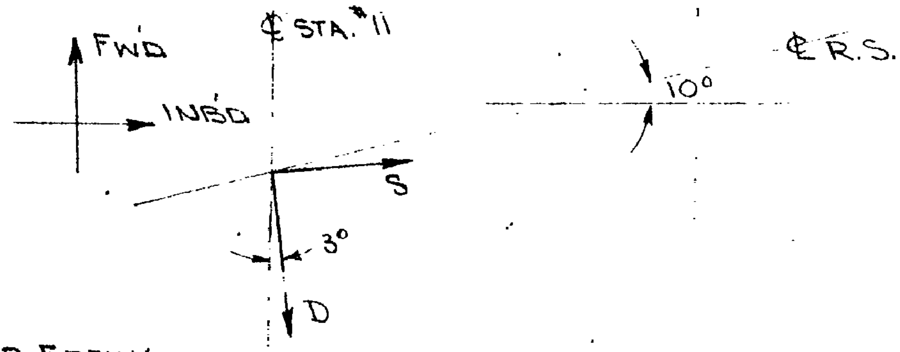
UPPER FITTING (POINT W)
$V_W = 17340 + 42 = 17382^{\#}$ (UP)

LOWER FITTING (POINT R)
$V_R = 2620 + 59 = 2679^{\#}$ (UP)

(FOR $\Delta V_W = 42^{\#}$ & $\Delta V_R = 59^{\#}$ SEE P/157)

COND. II MFW-ILAA (H.S.) @ 5000

THE DRAG & SIDE LOADS ARE RESOLVED INTO THE PLANE OF THE BULKHEAD & THE PLANE OF THE REAR SPAR.



UPPER FITTING

$D' = D\cos 3° - S\sin 3° = 46650 \times .999 - 1720 \times .052 = 46{,}510^{\#}$ (FWD)

$S' = D\sin 3° + S\cos 3° = 46{,}650 \times .052 + 1720 \times .999 = 4{,}150^{\#}$ (OUTB'D)

$D'' = S'\tan 10° = 4{,}150 \times .176 = 730^{\#}$ (AFT.)

$D_{TOTAL} = D' + D'' = 46{,}510 - 730 = 45{,}780^{\#}$ (FWD.)

LOWER FITTING

$D' = D\cos 3° - S\sin 3° = 40{,}700 \times .999 - 1390 \times .052 = 40{,}630^{\#}$ (AFT.)

$S' = D\sin 3° + S\cos 3° = 40{,}700 \times .052 + 1390 \times .999 = 3{,}510^{\#}$ (INBD)

$D'' = S'\tan 10° = 3510 \times .176 = 620^{\#}$ (FWD.)

$D_{TOTAL} = 40{,}630 - 620 = 40{,}000^{\#}$ (AFT.)

ADDITIONAL VERTICAL & DRAG LOADS MUST BE INCLUDED AT POINTS, W & R DUE TO INERTIA ITEMS OF THE EXTENSION MOUNT BEAMED TO THESE POINTS.

POINT W

$V = 42^{\#}$ (UP) (REF. FZS-36-142 P.II-25)

POINT R

$V = 59^{\#}$ (UP)

THE ADDITIONAL DRAG LOADS ARE NEGLIGIBLE

NOTE: B-36A LOADS FROM INERTIA ITEMS ARE USED IN PLACE OF XB-36 LOADS, SINCE THE LATTER ARE UNAVAILABLE AT THIS TIME. THIS IS DONE WITH NEGLIGIBLE ERROR, AS THIS ASSUMPTION HAS ONLY A SLIGHT EFFECT ON THE NET ULTIMATE FITTING LOADS.

CONDITION: II MINIMUM FLYING WEIGHT = 136,018# - ILAA (H.S.) @ 5000'

CRUSHING LOADS

M'_x FOR THIS CONDITION IS NOT CONTAINED IN ANY REPORT; M_x HAS BEEN CALCULATED INDEPENDENTLY & IS CONSIDERED SUFFICIENTLY CLOSE TO M'_x FOR USE.

$M'_x \sim M_x =$ [illegible] IN#

$I_x = 86{,}385$ IN⁴ (REF. FZS-36-141 P.54)

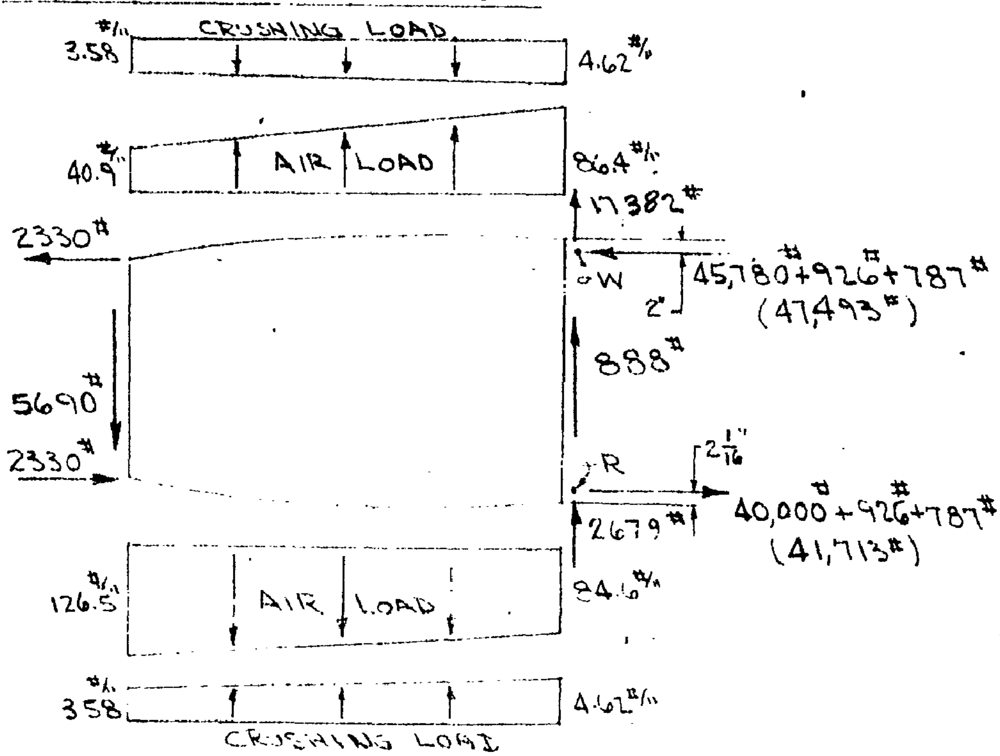
$Q_x = 1338$ IN³ (REF. FZS-36-141 P.144)

$L = 32.0''$

$$P_{(CRUSHING)} = \frac{(27.5 \times 10^6)^2 \; 32.0}{\frac{86{,}385}{1338} \times 10.5 \times 10^6 \times 86{,}385} = 414^{\#}$$

THE DISTRIBUTION IS TAKEN AS A TRAPEZOID WITH THE BASES EQUAL TO 3.58 #/" AT THE FRONT SPAR & 4.62 #/" AT THE REAR SPAR.

APPLIED LOADS ON THE BULKHEAD



COND: II MFW-ILAA (H.S.) @ 5000'

TRANSFERRING LOADS TO THE ELASTIC AXIS OF THE BULKHEAD:

$D = -45,780 + 40,000 = -5780^{\#}$ (FWD)

$V = 5690 + 10,670 - 17,332 - 888 - 2679 - 6430 = -11,019$ (UP)

$T_{EA} = (6430 \times .49) - (2330 \times 52.1) - (5690 \times 57.09) - (17,332 + 888 + 2679) \times 44.04 - (926 + 787) \times 63.285 - (45,780 \times 36.84) - (40,000 \times 26.45) - (10,670 \times 9.59) = -4,318,000''^{\#}$

(COUNTERCLOCKWISE)

REACTING THE DRAG LOAD AT THE UPPER & LOWER SURFACE SHEAR CENTERS: REF. FZS-36-142, P. II-3 FOR DIMENSIONS.

$R_U = 5780 \ \dfrac{32.44}{73.92} = 2540^{\#}$

$R_L = 5780 \ \dfrac{41.48}{73.92} = 3240^{\#}$

REACTING R_U & R_L AS SHEAR FLOWS IN THE UPPER & LOWER SURFACES:

$q_U = \dfrac{2540}{101.13} = 25.1^{\#}/''$

$q_L = \dfrac{3240}{101.13} = 32.1^{\#}/''$

THE VERTICAL COMPONENT OF UPPER & LOWER SURFACE SHEAR IS:

$R_{V_U} = 25.1 \times 10.714 = 269^{\#}$ (UP)

$R_{V_L} = 32.1 \times 4.534 = 145^{\#}$ (DOWN)

THE NET VERTICAL COMPONENT IS $124^{\#}$ (UP) & IS REACTED AT THE FRONT & REAR SPARS.

$P_{FS} = 54^{\#}$ (DOWN)

$P_{RS} = 70^{\#}$ (DOWN)

COND: II MFW-ILAA (H.S.) @ 5000'

THE VERTICAL SHEAR LOAD ON THE BULKHEAD IS REACTED AT THE FRONT & REAR SPARS:

$$R_{FS} = 11{,}019 \ \frac{44.04}{101.13} = 4780^{\#} \text{ (DOWN)}$$

$$R_{RS} = 11{,}019 \ \frac{57.09}{101.13} = 6200^{\#} \text{ (DOWN)}$$

THE TORSION ABOUT THE ELASTIC AXIS (T_{EA}) IS REACTED BY A SHEAR FLOW AROUND THE ENTIRE BULKHEAD:

$$q_0 = \frac{T}{2A} = \frac{4{,}318{,}000}{2 \times 6699} = 323^{\#/"}$$

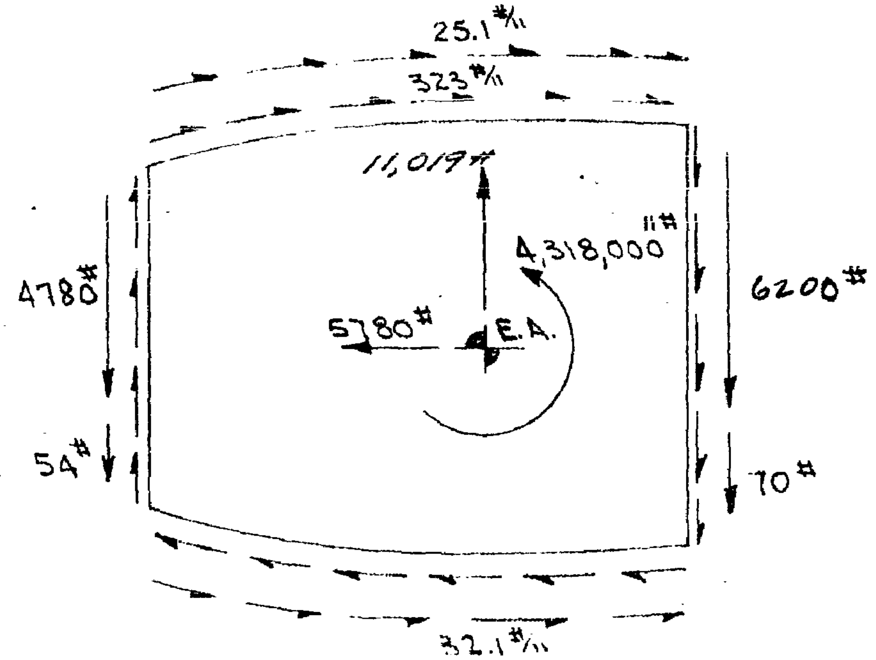
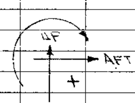
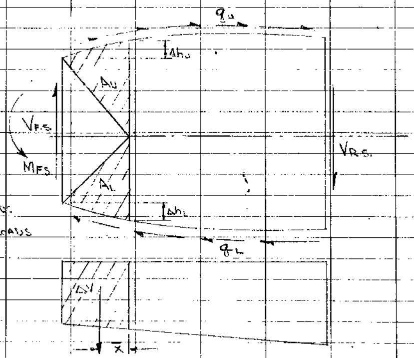


TABLE XXXVI

SUMMATION OF DRAG & VERTICAL FORCES & MOMENTS OVER INTERSPAR AREA OF BULKHEAD AT STA. #11. COND: II MFW=136,018# - I.L.A.A. (H.S.) @ 5000'

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	STATION INCHES FROM F.S.	A_u	A_L	Δh_u	Δh_L	ΔV_a*	$\bar{X}_a$	ΔV_f*	$\bar{X}_f$	$\Delta V_u = \Delta h_u \cdot q_u$	$\Delta V_L = \Delta h_L \cdot q_L$	$V_{STA.} = V_{F.S.} + \Sigma\Delta V_a + \Sigma\Delta V_f + \Sigma\Delta V_u + \Sigma\Delta V_L$	$\Delta M_u = 2 \cdot q_u \cdot A_u$	$\Delta M_L = 2 q_L \cdot A_L$	$\Delta M_{Va} = \Delta V_a \cdot \bar{X}_a$	$\Delta M_{Vf} = \Delta V_f \cdot \bar{X}_f$	$\Delta M_{F.S.} = V_{F.S.} \cdot X$	$M_{STA.} = M_{F.S.} + \Delta M_u + \Delta M_L + \Delta M_{Va} + \Delta M_{Vf} + \Delta M_{V_{F.S.}}$	AXIAL LOAD = $(q_L - q_u) X$
		← (REF. FZS-36-142 P. II-46) →								$\Delta h_u \cdot 348$	$\Delta h_L \cdot 591$		696 × (2)	582 × (3)	(6) × (7)		6306 × (1)		57 · X
F.S.	0	0	0	0	0	0	0	0	0	0	0	6,306	0	0	0	0	0	-121,500	0
	20.226	372	282	5.9	3.8	-1554	10.48	—	—	2050	1105	7,907	259,000	164,200	-16,300	—	127,800	413,200	1,152
	40.452	875	620	9.5	6.1	-2756	21.2	—	—	3310	1775	8,635	608,000	361,000	-58,400	—	255,000	1,049,100	2,305
	60.678	1559	1011	11.5	6.9	-3605	32.4	—	—	4010	2010	8,721	1,085,000	588,000	-116,800	—	382,500	1,817,200	3,460
	80.904	2013	1423	11.8	6.3	-4100	45.3	—		4110	1843	9,154	1,400,000	829,000	-185,900	—	510,000	2,431,700	4,610
R.S.	101.130	2399	1679	10.5	4.5	-4250	68.0		—	3650	1310	7,016	1,670,000	977,000	-289,000	—	639,000	2,875,500	5,760





*SUBSCRIPT "a" DENOTES AIR LOADS
"f" DENOTES FUEL LOADS

MOMENT AT FRONT SPAR ($M_{F.S.}$) = 2330 x 521 = 121,500"#

VERTICAL LOAD AT FRONT SPAR ($V_{F.S.}$)
= -5690 - 4770 - 54 + (322 x 52.1) = +6,306# (UP)

CALC. BY: Vogel
CKD. BY: Lowrey 5/4/43

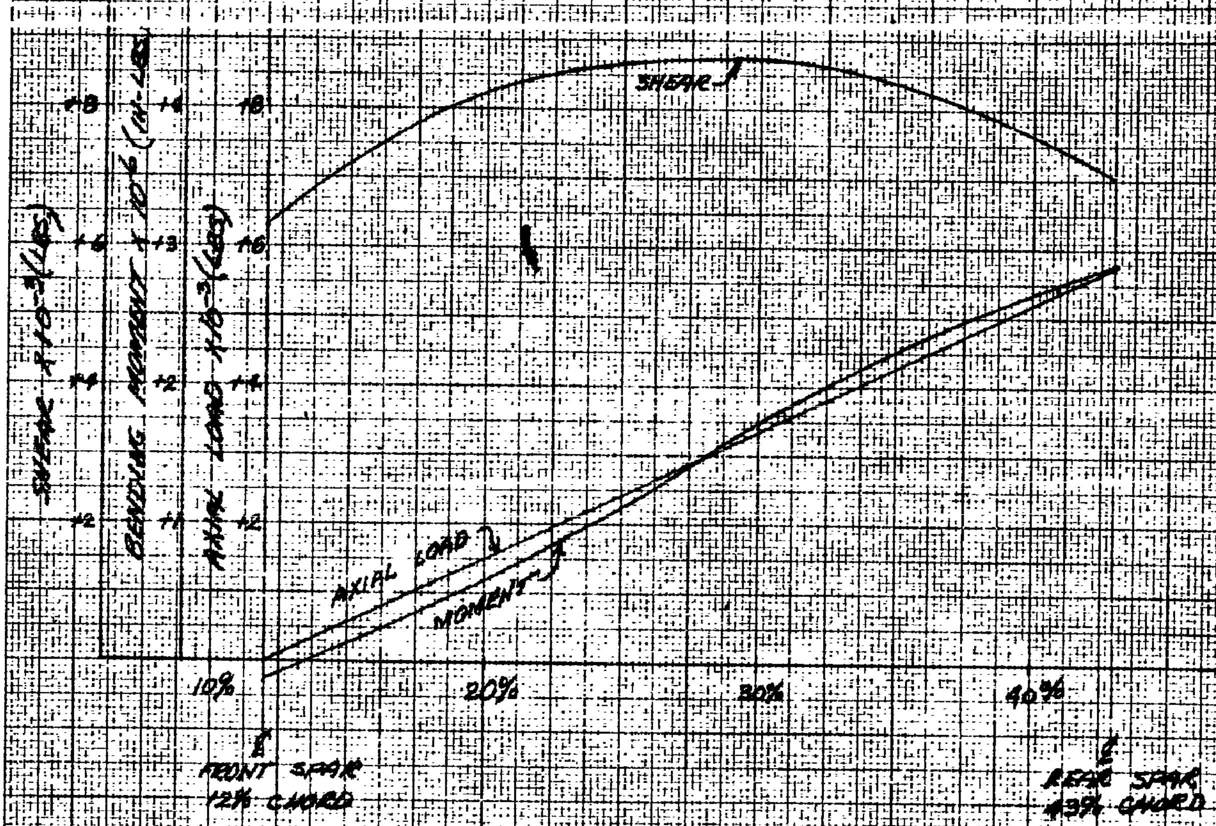


FIGURE 16

VOSS	4/13/48	BLK'D #11 - ULTIMATE SHEAR MOMENT & AXIAL LOAD COMP. MKN-11AA @ 5000 FT.	FZS-36-242
LOWREY	5/25/48		
VOSS	5/26/48		XB-36

ANALYSIS OF MEMBERS

WEB ANALYSIS

THE MAXIMUM SHEAR OCCURS IN CONDITION I IN THE PORTION OF THE WEB ADJACENT TO THE REAR SPAR. THIS IS THE -8 WEB.

$$\tau = \frac{S}{h't}$$

$S = 19{,}392^{\#}$

$h' = 66.47''$ (REF FZS-36-142 P.II-31)

$t = .032''$

$$\tau = \frac{19{,}392}{66.47 \times .032} = 9{,}120^{\#/\square''}$$

$\tau_{su} = 21{,}000^{\#/\square''}$ (REF. FZS-36-142 P.II-32)

$$M.S. = \frac{21{,}000}{9120} - 1 = \boxed{+1.30}$$

FLANGE ANALYSIS

COMPRESSIVE STRESS IN THE LOWER FLANGE:

$M = -3{,}790{,}000''^{\#}$ (COND: DGW 2WL-IP-ND)

$h' = 66.74''$ *   *(REF. FZS-36-142 P.II-34)

$S_a = 19{,}392$

$h = 56''$ *

$I = 6721 \text{ IN.}^4$ *

$Q = 100.8 \text{ IN.}^4$ *

$S_{CR} = 3{,}140^{\#}$ *

$$P_c = \frac{M}{h'} + \frac{S_{tu} \cot\alpha}{2} \quad \text{(REF. AAF TR \#4313, P. 257 EQ. 11-38)}$$

$$S_{tu} = \frac{S_a}{K_g} - S_{CR} \; ; \quad K_g = \frac{I}{Qh} = \frac{6721}{100.8 \times 56} = 1.191$$

$$S_{tu} = \frac{19{,}392}{1.191} - 3140 = 13{,}160^{\#}$$

$$P_c = \frac{3{,}790{,}000}{66.74} + \frac{13{,}160}{2}(1.086)$$

$P_c = 63{,}940^{\#}$

THE AXIAL LOAD ON THE BULKHEAD IS BEAMED TO THE FLANGE CENTROIDS:

$$P_c' = 9890 \times \frac{39.651}{66.738} = 5{,}880^{\#}$$

TOTAL COMPRESSIVE STRESS IN THE LOWER FLANGE:

$$P_{c_{TOTAL}} = 63{,}940 + 5880 = 69{,}820^{\#}$$

$$f_c = \frac{69{,}820}{3.40^{*}} = 20{,}500^{\#/\square''}$$ *(REF. FZS-36-242 P.II-31)

ALLOWABLE COMPRESSIVE STRESS:

$F_c = 36{,}500^{\#/\square''}$ (REF. FZS-36-142 P.II-35)

$$M.S. = \frac{36{,}500}{20{,}500} - 1 = \boxed{+.78}$$

TENSILE STRESS IN THE UPPER FLANGE (COND: DGW-2WL-IR-ND)

$$P_T = \frac{M}{h} - \frac{s t \dot{u} \cot\alpha}{2}$$

$$= 56{,}800 - 7{,}140 = 49{,}660^{\#}$$

$$P_c' = 9890 \times \frac{27.087}{66.738} = 4010^{\#}$$

$$P_{T(TOTAL)} = 49{,}660 - 4010 = 45{,}650^{\#}$$

$$f_t = \frac{45{,}650}{2.718^{*}} = 16{,}800^{\#/\square''}$$ *(REF. FZS-36-142 PII-31)

$F_t = 45{,}600^{\#/\square''}$ (REF. FZS-36-142 P.II-35)

$$M.S. = \frac{45{,}600}{16{,}800} - 1 = \boxed{+1.72}$$

WING BULKHEAD #11

THE MINIMUM FLYING WEIGHT - I.L.A.A @ 5000' CONDITION GIVES THE MAXIMUM COMPRESSIVE STRESS IN THE UPPER FLANGE:

$$M = 2{,}875{,}500\ '\#$$
$$S_a = 7016\#$$
$$S_{CR} = 3140\#$$

$$S_{tu} = \frac{7016}{1.191} - 3140 = 2760\#$$

$$P_c = \frac{2875500}{66.74} + \frac{2760}{2}(1.086)$$

$$P_c = 44{,}590\#$$

AXIAL LOAD:

$$P_c' = 5760 \times \frac{27.087}{66.738} = 2340\#$$

TOTAL FLANGE LOAD:

$$P_{c(TOTAL)} = 44{,}590 + 2340 = 46{,}930\#$$

$$f_c = \frac{46930}{2.718} = 17{,}300\ \#/\square''$$

$$M.S. = \frac{36{,}500}{17{,}300} - 1 = \boxed{+1.11}$$

STIFFENER ANALYSIS:

THE STIFFENERS ARE DESIGNED PRIMARILY BY FUEL PRESSURE FROM THE SIDE DRIFT LANDING CONDITION AND SINCE THE SIDE INERTIA FACTOR HAS BEEN REDUCED FROM 1.437 A.G.W (112 - 500# BOMBS), SIDE DRIFT LANDING, FOR THE B-36A (REF. FZS-36-141, P. 284) TO 1.408, AGW (112 - 500# BOMBS), SIDE DRIFT LANDING FOR THE XB-36 (REF. FZS-36-243, P143) THE VALUES OF THE TABLE II-XI P. II-39 (REF. FZS-36-142) WILL BE $\frac{1.437}{1.408}$ OR 2% CONSERVATIVE FOR THE XB-36.

WING BULKHEAD #11

CONDITION: III AGW (112,500# BOMBS); SIDE DRIFT LANDING

STIFFNER ANALYSIS

TABLE XXXVII

STIFFENER	B-36A (REF FZS-36-142 P II-39) TENSILE STRESS	B-36A COMPRESSIVE STRESS	XB-36 TENSILE STRESS	XB-36 COMPRESSIVE STRESS	$F_T = 56{,}000$ M.S. (TEN.)	$F_C = 61{,}000$ M.S. (COMP.)
① REF. 36W111	②	③	④ $\frac{1.408}{1.434} \times ②$	⑤ $\frac{1.408}{1.434} \times ③$	⑥ $\frac{F_T}{④} - 1$	⑦ $\frac{F_C}{⑤} - 1$
-13	42,100	41,500	41,400	40,700	+.35	+.50
-14	51,300	50,700	50,400	49,700	+.11	+.23
-15	53,500	52,900	52,500	51,900	+.06	+.17
-16	48,300	47,600	47,400	46,700	+.18	+.30
-17	51,400	50,800	50,500	49,900	+.11	+.22
-18	49,900	49,200	49,000	48,300	+.14	+.26
-19	47,200	46,600	46,300	45,800	+.21	+.33
-20	43,800	44,100	43,000	43,300	+.30	+.41
-21	41,600	41,800	40,800	41,100	+.37	+.48
-22	42,800	43,900	42,000	43,100	+.33	+.41
-23	38,600	39,400	37,900	38,700	+.47	+.57

WING BULKHEAD #18

INDEX

WING BULKHEAD #18

DISCUSSION:

BULKHEAD #18 IS LOCATED 576.5 INCHES FROM THE AIRPLANE CENTER LINE. IT IS OF THE TENSION FIELD TYPE, CONSTRUCTED ENTIRELY OF ALUMINUM ALLOYS. THE FOUR CONDITIONS THAT HAVE BEEN DETERMINED AS BEING CRITICAL, ARE:

(1) MIN. FLYING WT. (136,018#), L.A.A., UNSYM. GUST, H.S. @ 5000 FT. – REF. P. 170

(2) MIN. FLYING WT. (136,018#) ILAA, UNSYM. GUST, H.S @ 5000 FT. – REF. P. 179

(3) JACKING COND. – D.G.W. (265,192#)

(4) SIDE DRIFT LANDING, ALT. G.W. (112-500# BOMBS)

THESE CONDITIONS ARE THE SAME AS THOSE FOUND TO BE CRITICAL FOR THE B-36A AIRPLANE (REF. FZS-36-192, PG. II-98). DUE TO THE FACT THAT DIFFERENT CRITERIA WAS USED FOR DETERMINING GUST FACTORS ON THE XB-36 AIRPLANE, THE LOADINGS FOR CONDITIONS (1) AND (2), SHOWN ABOVE WILL BE HIGHER FOR THE XB-36 AIRPLANE.

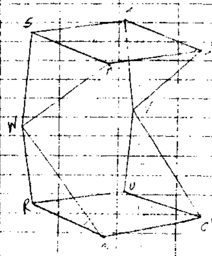
ENGINE MOUNT FITTING LOADS INTRODUCED INTO THE WING BOX AT BULKHEAD #18 ARE OBTAINED FROM REPORT FZS-36-253 AND ARE TABULATED ON PG. 169.

THE XB-36 BULKHEAD LOADS DUE TO AIRLOADS, CRUSHING LOADS, AND GAS LOADS FOR CONDS. (1) AND (2) ARE OBTAINED FROM THE B-36A LOADS AS SHOWN ON THE FOLLOWING PAGES. THE MEMBERS THAT ARE CRITICAL FOR CONDS. (3) + (4) WILL NOT BE ANALYZED HERE BECAUSE THE XB-36 LOADS ARE SMALLER THAN THE B-36A LOADS AND IT WILL BE CONSIDERED CONSERVATIVE TO USE MARGINS SHOWN FOR B-36A (REF. FZS-36-242, PGS. II-141 TO II-147)

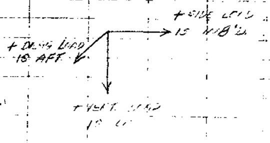
TABLE XXXIII BLKHD. #18 - WING C.S. - RESOLUTION OF ENG. EXT. MOUNT MEMBER LOADS
SHEET 1 OF 1

FITTING PANEL POINT	MEMBER CK.	MEMBER LOAD	V/L	?/L	?/L	V	L	?	L''	D'''	S''	S'''	D'	S'
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
FZS [illegible]	[illegible]	FZS [illegible]	←	FZS [illegible]		[illegible]	[illegible]	[illegible]	[illegible]	9 + 10	.0532 × 9	.0532 × 11	1.01 × 11	12 + 13
← [illegible] →														
S	A-S	76429	.365	-.494	[illegible]	[illegible]	[illegible]	9.35	11.?	.0778	42.0	3,770	71,400	12,940
W	A-W	-20,295	-.2[illegible]	-.809	.171	-2,4[illegible]	-7,[illegible]	3,4[illegible]	-4.17	11,657	-[illegible]	-940	-12,9[illegible]	-4,[illegible]
	C-W	25,2[illegible]	[illegible]	[illegible]	.169	[illegible]	4,[illegible]	4,2[illegible]	5[illegible]	12,6[illegible]	4,250	1,0[illegible]	20,2[illegible]	5[illegible]
NET W						27,25[illegible]							3,770	727
R	C-R	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-72,131	[illegible]	[illegible]	[illegible]	[illegible]
← [illegible] →														
S	A-S	-16,1[illegible]	[illegible]	[illegible]	[illegible]	6,0[illegible]	-2,6[illegible]	[illegible]	1,740	4,240	-4,010	-1,2[illegible]	-472	8,550
W	A-W	13,757	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42[illegible]	7.91	11,422	2,380	608	11,537	2,988
	C-W	-16,2[illegible]	[illegible]	[illegible]	[illegible]	9,[illegible]	[illegible]	[illegible]	[illegible]	-13,238	-2,770	-706	-13,410	-3,476
NET W						17,700							-1,850	-488
R	C-R	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	44,361	9,430	2,300	44,8[illegible]	[illegible]

CALC. BY: VOSS
CK. BY: LOWREY



S, W + R ATTACH. TO T.E. OF BLKD #18
T, V + U ATTACH TO T.E. OF BLKD #16

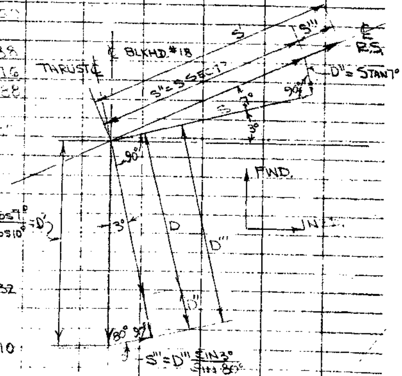


$\text{SEC } 7^\circ = 1.008$

$\frac{\sin 3^\circ}{\sin 80^\circ} = \frac{.05234}{.9848} = .0532$

$\tan 7^\circ = .1228$

$\frac{\cos 7^\circ}{\cos 10^\circ} = \frac{.9926}{.98481} = 1.010$



WING BULKHEAD #18

AIRLOADS

CONDITION: MIN FLYING WT., L.A.A., H.S. @ 5000 FT.

THE B-36A AND XB-36 AIRLOAD PRESSURE DISTRIBUTION WILL BE ASSUMED THE SAME. THE B-36A AIRLOADS, (REF. FZS-36-142, PG. I-111) WILL BE RATIOED IN PROPORTION TO THE TOTAL WING AIRLOADS OF THE TWO AIRPLANES TO OBTAIN THE AIRLOADS FOR THE XB-36 BULKHEAD.

B-36A:

$$\left.\begin{array}{l} \frac{Z}{W} = +3.597 \\ W = 136{,}713^{\#} \end{array}\right\} \text{FZS-36-136 PG. 71}$$

$$Z = 492{,}000^{\#}$$

XB-36:

$$\left.\begin{array}{l} \frac{Z}{W} = +4.256 \\ W = 136{,}018^{\#} \end{array}\right\} \text{FZS-36-126 PG. 84}$$

$$Z = 579{,}000^{\#}$$

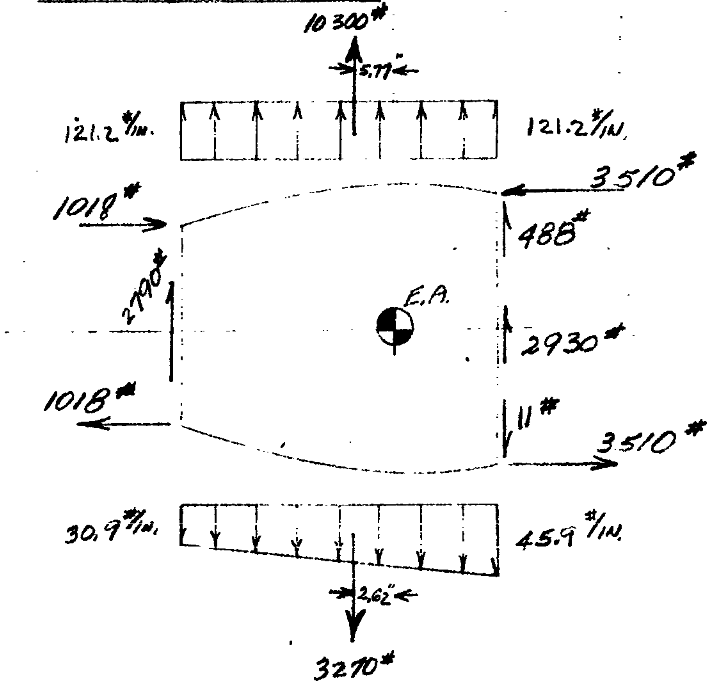
$$RATIO = \frac{579{,}000}{492{,}000} = 1.178$$

XB-36 AIRLOADS = B-36A AIRLOADS × 1.178

WING BULKHEAD #18

AIRLOADS (CONT'D)

XB-36 AIRLOADS



FOR B-36A AIRLOADS SEE FZS-36-142, PG. II-111

CRUSHING LOADS

COND.: MIN. FLYING WT., L.A.A., H.S. AT 5000 FT.

THE B-36A CRUSHING LOADS, (REF. FZS-36-142, PG. II-111), WILL BE RATIOED IN PROPORTION TO THE SQUARE OF THE BENDING MOMENTS TO OBTAIN THE XB-36 CRUSHING LOADS.

WING BULKHEAD # 18

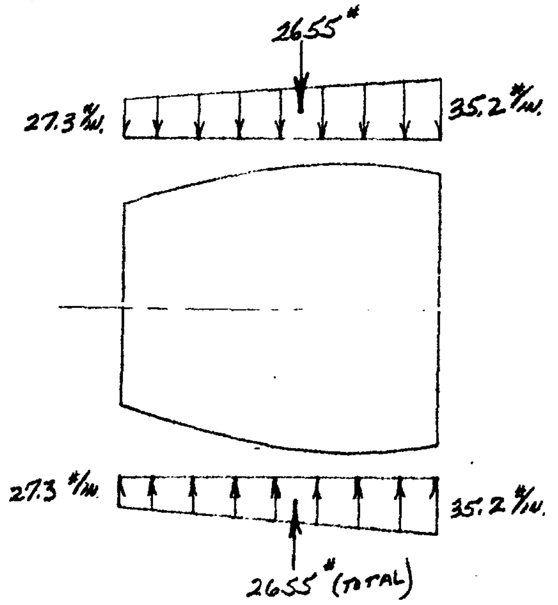
CRUSHING LOADS (CONT'D)

B-36A: B.M = 32,266,000 "# (REF. FZS-36-142, PG. II-110)

XB-36 : B.M. = 37,550,000 "# (PRELIMINARY CALCULATIONS)

$$RATIO = \frac{(37\,550\,000)^2}{(32\,266\,000)^2} = 1.352$$

XB 36 CRUSHING LOADS = B-36A CRUSHING LOADS X 1.352



FOR B-36A CRUSHING LOADS SEE FZS-36-142, PG. II-111

FUEL LOADS

COND. : MIN. FLYING WT., L.A.A., UNSYM. GUST @ 5,000'

THE FUEL LOADS WILL BE RATIOED FROM THE B-36A FUEL LOADS, IN PROPORTION TO THE VERTICAL LOAD FACTORS. SEE REF. FZS-36-142, PG. II-111 FOR B-36A FUEL LOADS.

WING BULKHEAD # 18

FUEL LOADS (CONT'D)

B-36A:

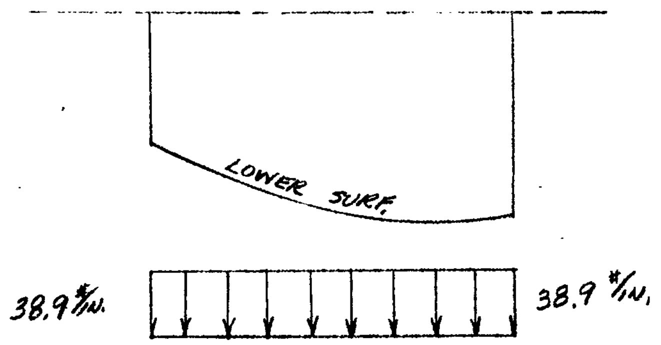
$n_v = -5.64$ (REF. FZS-36-153, PG. 10)

XB-36:

$n_v = -6.572$ (REF. FZS-36-253, PG. 8)

$$RATIO = \frac{6.572}{5.64} = 1.168$$

XB-36 FUEL LOADS = B-36A FUEL LOADS × 1.168



FOR B-36A FUEL LOADS SEE FZS-36-142, PG II-111

ANALYSIS WING
PREPARED BY LOWREY
CHECKED BY Johnson
REVISED BY

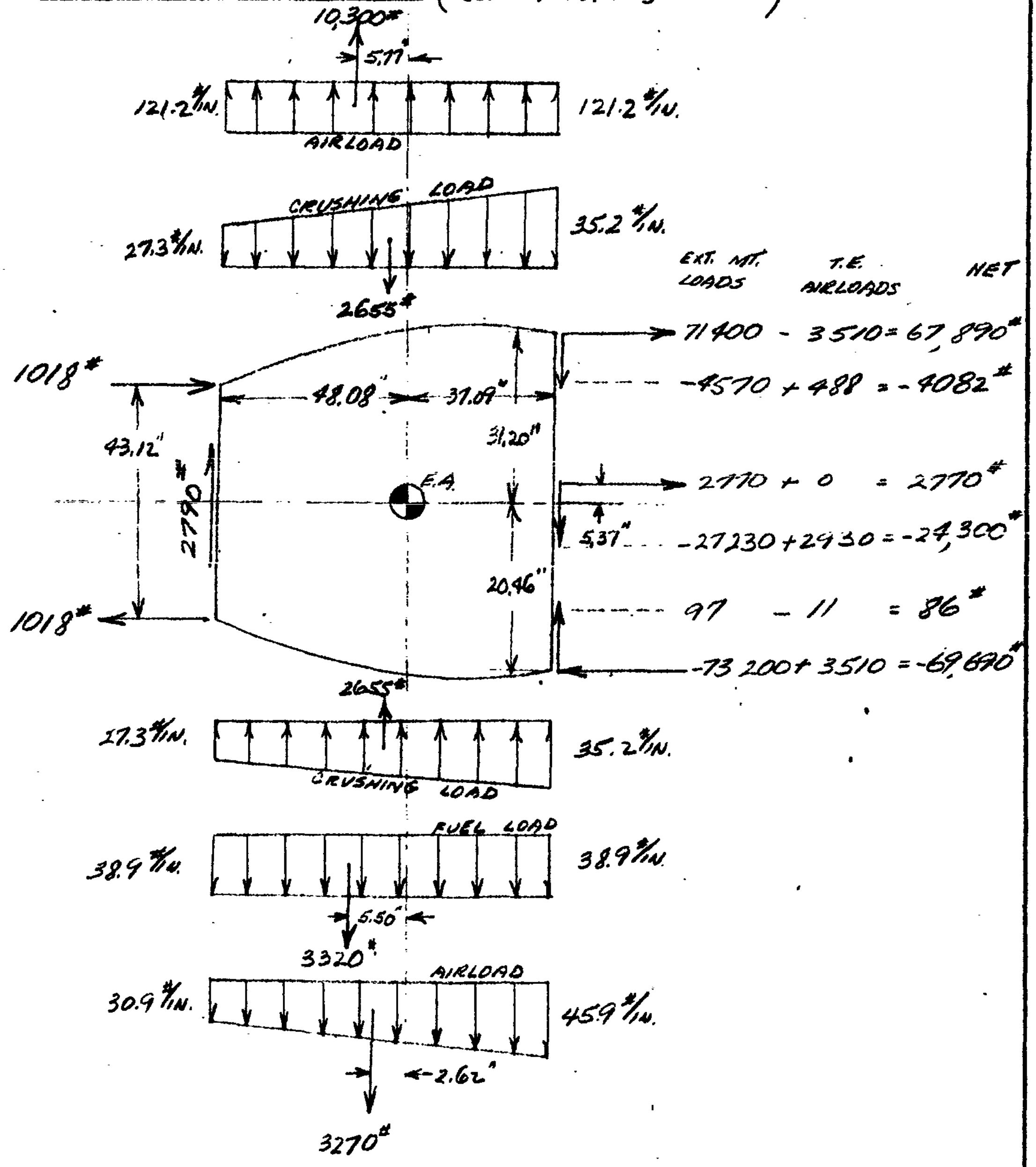
Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

REPORT NO. FZS-36-242
MODEL XB-36
DATE 5/13/48

WING BULKHEAD #18

CONDITION – M.F.W., L.A.A., U. GUST @ 5000 FT.

SUMMARY OF LOADS (REF. PGS. 171, 172 & 173)



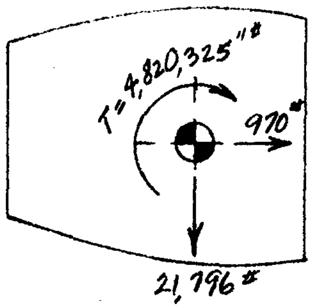
WING BULKHEAD #18

Σ LOADS ABOUT E.A.

$$\Sigma_V = 10{,}300 - 4082 - 24{,}300 + 86 - 3270 - 3320 + 2790$$
$$= \underline{-21{,}796}^{\#}$$

$$\Sigma_D = 67{,}890 + 2770 - 69{,}690 = \underline{970}^{\#}$$

$$T_{E.A.} = (1018 \times 43.12) + (2790 \times 48.08) + (10{,}300 \times 5.77)$$
$$-(3320 \times 5.50) - (3270 \times 2.62) + (28{,}296 \times 37.09)$$
$$+(67890 \times 31.2) + (2770 \times 5.37) + (69{,}690 \times 20.46)$$
$$= \underline{4{,}820{,}325}''^{\#}$$



APPLIED LOADS ARE REACTED BY SHEAR FLOWS:

$$q_T = \frac{T}{2A} = \frac{4820325}{2 \times 4665} = 517\ {}^{\#}/_{IN.}$$

WING BULKHEAD #18

Σ LOADS ABOUT E.A. (CONT'D.)

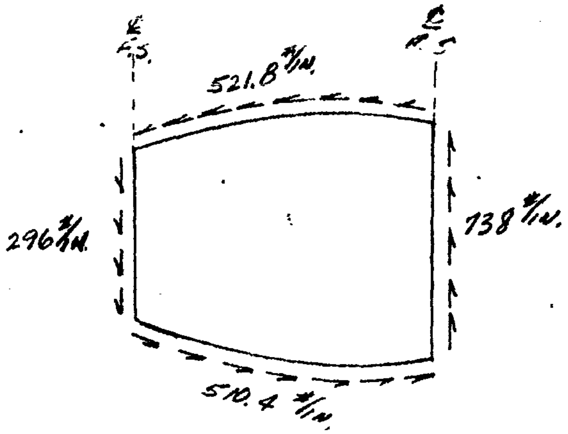
$$q_{F.S.} = 21{,}796\left(\frac{37.09}{85.17}\right)\frac{1}{43.12} = 221 \text{ \#/IN.}$$

$$q_{R.S.} = 21{,}796\left(\frac{48.08}{85.17}\right)\frac{1}{55.72} = 221 \text{ \#/IN.}$$

$$q_U = 970\left(\frac{25.79}{60.84}\right)\frac{1}{85.17} = 4.8 \text{ \#/IN.}$$

$$q_L = 970\left(\frac{35.05}{60.84}\right)\frac{1}{85.17} = 6.6 \text{ \#/IN.}$$

NET BALANCING SHEAR FLOWS



SUMMATION OF "V", "P" + "M" FOR SECTIONS

$$V_{F.S.} = -12780 + 2790 = -9990 \text{ \#}$$

$$M_{F.S.} = M_L' = 43{,}900 \text{ ''\#}$$

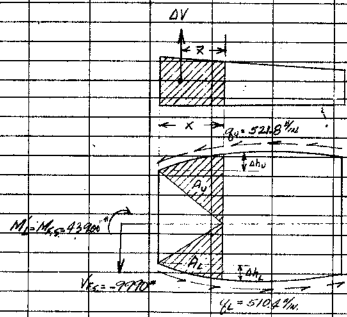
$$P = 0$$

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE XXXIX

WING BULKHEAD # 18
ULT. SHEARS, BENDING MOMENT AND AXIAL LOADS
M.F.W. (136,018) L.A.B. UNSYM. GUST @ 5,000'

	STATION INCHES FROM F.S.	A_U	A_L	Δh_U	Δh_L	ΔV_a *	$\bar{X}_a$	ΔV_f *	$\bar{X}_f$	$\Delta V_U = \Delta h_U \times q_U$	$\Delta V_L = \Delta h_L \times q_L$	$V_{STA} = V_{FS}+\Delta V_a+\Delta V_f+\Delta V_U+\Delta V_L$	$\Delta M_U = 2 q_U A_U$	$\Delta M_L = 2 q_L A_L$	$\Delta M_a = \Delta V_a \bar{X}_a$	$\Delta M_f = \Delta V_f \bar{X}_f$	$\Delta M_{V_{FS}} = V_{FS} X$	$M_{STA} = M_{FS}+\Delta M_U+\Delta M_L+\Delta M_a+\Delta M_f+\Delta M_{V_{FS}}$	AXIAL LOAD = $(q_L+q_U)X$
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
		(REF. FZS-36-142, PG. II-115)					FZS-36-142 PG. II-115		FZS-36-142 PG. II-115	4 X -521.8	5 X -510.4	-9990 X 6	2 X -521.8 X 2	2 X 510.4 X 3	6 X 7	8 X 9	-9990 X 1	43900 + 13 + 14 + 15 + 16 + 17	-11.4 X 1
F.S.	0	0	0	0	0	0	0	0	0	0	0	-9990	0	0	0	0	0	43900	0
	17.03	250.1	191.8	4.9	3.1	1512	8.57	-662	8.51	-2550	-1582	-13,272	-261,000	-195,800	12,980	-5630	-170,100	-575,650	-194
	34.07	565.1	424.7	7.9	4.9	2960	17.23	-1328	17.03	-4120	-2500	-14978	-591,000	-433,000	50,100	-22,600	-340,000	-1,291,300	-388
	51.10	922.1	677.5	9.8	5.4	4380	26.00	-1990	25.55	-5110	-2755	-15465	-964,000	-692,000	114,000	-50,900	-510,600	-2,057,400	-582
	68.14	1296.4	929.5	10.0	4.9	5750	34.70	-2655	34.07	-5218	-2500	-14,613	-1352,000	-949,000	200,500	-70,000	-680,000	-2,826,100	-776
R.S.	85.17	1664.6	1163.8	9.2	3.4	7030	43.70	-3320	42.52	-4790	-1735	-12,805	-1,740,000	-1,188,000	307,000	-141,000	-851,000	-3,567,300	-970



* SUBSCRIPT "a" DENOTES AIR LOADS.
"f" DENOTES FUEL LOADS.

PREPARED BY: LOWREY 5/14/48
CHECKED BY: [illegible] 5/25/48

WING BULKHEAD #18

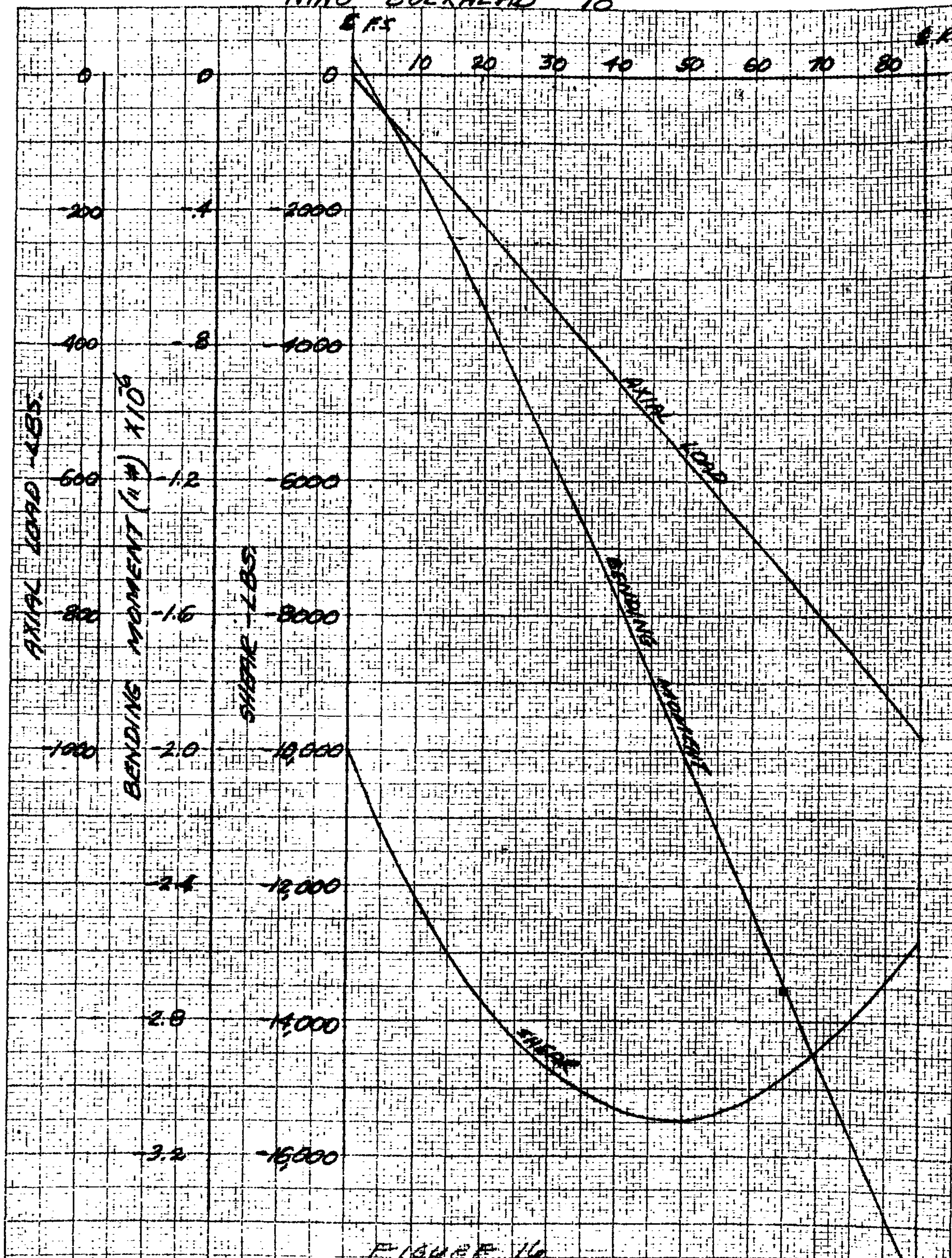


FIGURE 16

LOWREY	5/14/48	SHEARS, MOMENTS + AXIAL LOADS	DWG NO.
LOWREY	5/14/48	M.F.W. - LAA - N.S @ 5000 FT (CONSTANT COURSE)	FZS-36-242
[illegible]			XB-36

WING BULKHEAD #18

AIRLOADS

CONDITION: MIN. FLYING WT, I.L.A.A., H.S. @ 5000 FT.

THE B-36A AND XB-36 AIRLOAD PRESSURE DISTRIBUTION WILL BE ASSUMED THE SAME. THE B-36A AIRLOADS (REF. FZS-36-142, PG. II-124) WILL BE RATIOED IN PROPORTION TO THE TOTAL WING AIRLOADS OF THE TWO AIRPLANES TO OBTAIN THE AIRLOADS FOR THE XB-36 BULKHEAD.

B-36A:

$$\left.\begin{aligned} \frac{Z}{W} &= -1.494 \\ W &= 136{,}712^{\#} \end{aligned}\right\} \text{FZS-36-136, PG. 72}$$

$$Z = 204{,}500^{\#}$$

XB-36:

$$\left.\begin{aligned} \frac{Z}{W} &= -2.043 \\ W &= 136{,}018^{\#} \end{aligned}\right\} \text{FZS-36-126, PG. 84}$$

$$Z = 278{,}000^{\#}$$

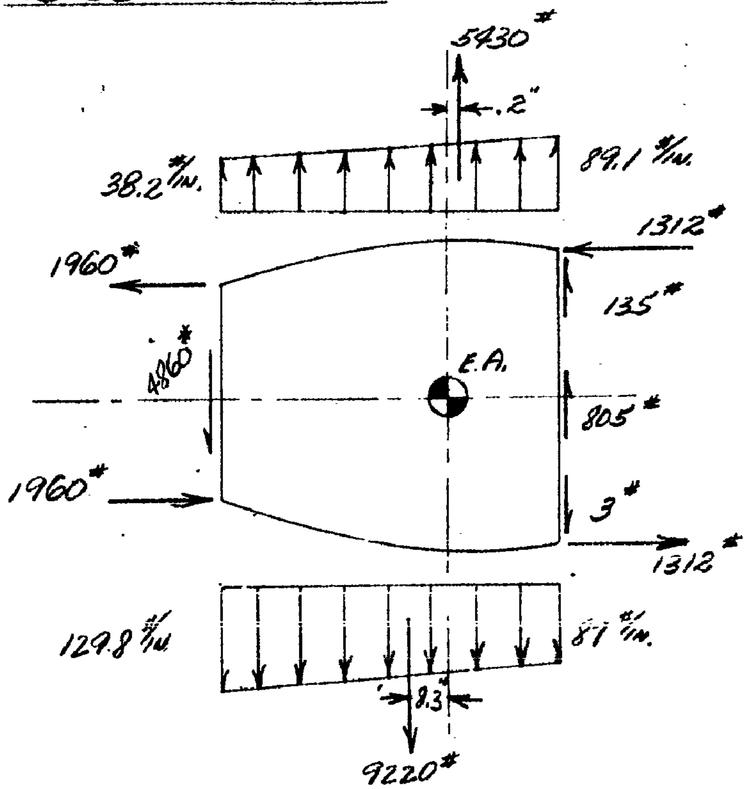
$$RATIO = \frac{278\,000}{204\,500} = 1.36$$

XB-36 AIRLOADS = B-36A AIRLOADS X 1.36

WING BULKHEAD # 18

AIRLOADS (CONT'D)

XB-36 AIRLOADS



FOR B-36A AIRLOADS SEE FZS-36-142, PG. II-124

CRUSHING LOADS

COND.: MIN. FLYING WT., I.L.A.A., N.S. @ 5000 FT.

THE B-36A CRUSHING LOADS (REF. FZS-36-142, PG II-124), WILL BE RATIOED IN PROPORTION TO THE SQUARE OF THE BENDING MOMENTS TO OBTAIN THE XB-36 CRUSHING LOADS.

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

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

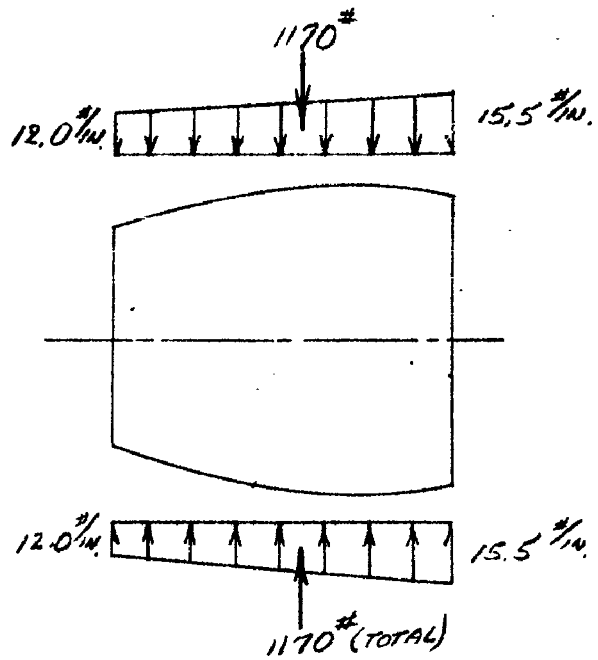
WING BULKHEAD #18

CRUSHING LOADS (CONT'D)

B-36A: B.M. = 18,911,000"# (FZS-36-142, PG. II-123)
XB-36: B.M. = 37,550,000"# (PRELIMINARY CALCULATIONS)

$$RATIO = \frac{(24\ 990\ 000)^2}{(18\ 911\ 000)^2} = 1.74$$

XB-36 CRUSHING LOADS = B-36A CRUSHING LOADS X 1.74



FOR B-36A CRUSHING LOADS SEE FZS-36-142, PG. II-124

FUEL LOADS

COND.: MIN. FLYING WT., I LAA, UNSYM. GUST @ 5,000'

THE FUEL LOADS WILL BE RATIOED FROM THE B-36A FUEL LOADS, IN PROPORTION TO THE VERTICAL LOAD FACTORS. SEE FZS-36-142, PG. II-124, FOR B-36A FUEL LOADS.

WING BULKHEAD #18

FUEL LOADS (CONT'D)

B-36A:

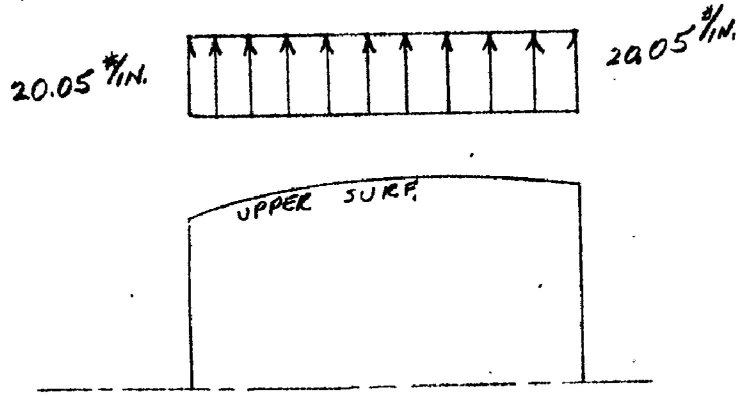
$n_v = 2.60$ (REF. FZS-36-153, PG. 11)

XB-36:

$n_v = 3.40$ (REF. FZS-36-253, PG. 11)

$$RATIO = \frac{3.40}{2.60} = 1.31$$

XB-36 FUEL LOADS = B-36A FUEL LOADS x 1.31

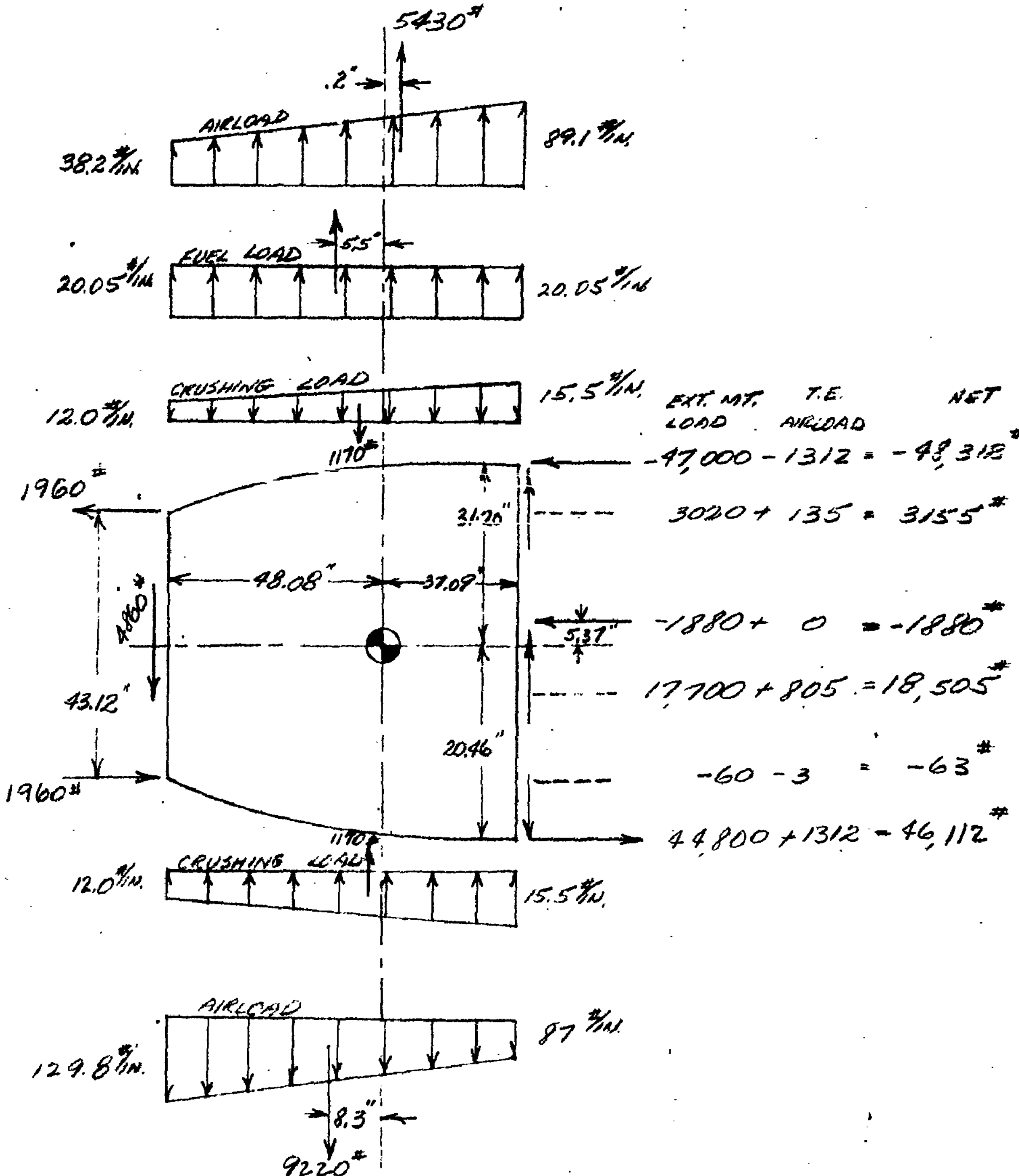


FOR B-36A FUEL LOADS SEE FZS-36-142, PG. 124.

WING BULKHEAD # 18

CONDITION - M.F.W., I.L.A.A., UNSYM. GUST @ 5,000'

SUMMARY OF LOADS (REF. PGS. 180, 181, & 182)



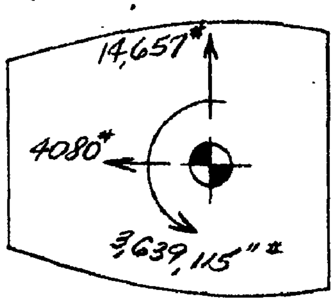
WING BULKHEAD # 18

Σ LOADS ABOUT E.A.

$$\Sigma V = -4860 + 5430 + 3155 + 18{,}505 - 63 + 1710 - 9220$$
$$= \underline{14{,}659^{\#}}$$

$$\Sigma D = -48{,}312 - 1880 + 46{,}112 = \underline{-4080^{\#}}$$

$$T_{E.A.} = -(1960 \times 43.12) - (4860 \times 48.08) - (5430 \times .2) - (21{,}379 \times 37.09) + (1710 \times 5.5) - (9220 \times 8.3) - (48{,}312 \times 31.2) - (1880 \times 5.37) - (46{,}112 \times 20.46)$$
$$= \underline{3{,}639{,}115}\ ''^{\#}$$



APPLIED LOADS ARE REACTED BY SHEAR FLOWS:

$$q_T = \frac{T}{2A} = \frac{3\,639\,115}{2 \times 4665} = 390^{\#}/\text{IN.}$$

WING BULKHEAD #18

Σ LOADS ABOUT E.A. (CONT'D.)

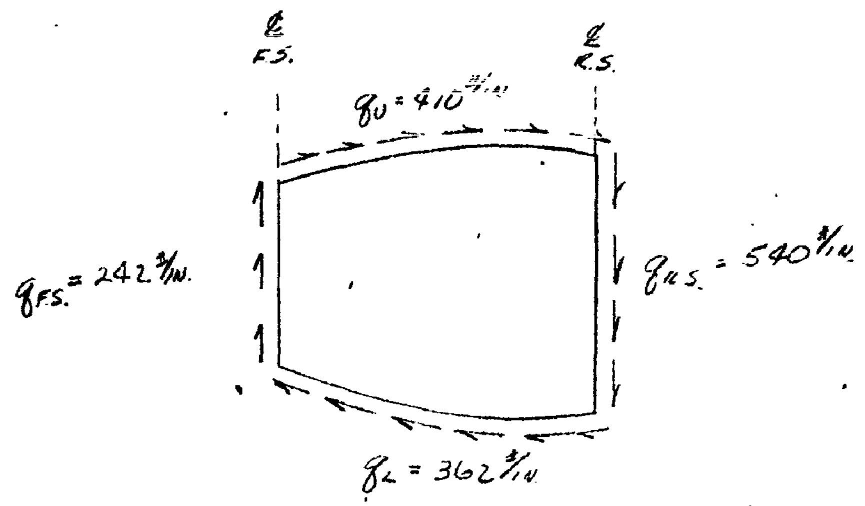
$$q'_{F.S.} = 14{,}657\left(\frac{37.09}{85.17}\right)\frac{1}{43.12} = 148\ \#/\text{in}$$

$$q'_{R.S.} = 14{,}657\left(\frac{48.08}{85.17}\right)\frac{1}{55.72} = 150\ \#/\text{in}$$

$$q'_{U} = 4080\left(\frac{25.79}{60.84}\right)\frac{1}{85.17} = 20\ \#/\text{in}$$

$$q'_{L} = 4080\left(\frac{35.05}{60.84}\right)\frac{1}{85.17} = 28\ \#/\text{in}$$

NET BALANCING SHEAR FLOWS.



SUMMATION OF "V", "P" AND "M" FOR SECTIONS

$$V_{F.S.} = 10{,}520 - 4860 = 5660\ \#$$

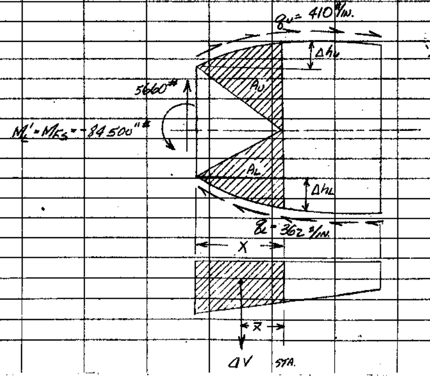
$$M_{F.S.} = M_4' = -84{,}500\ ''\#$$

$$P = 0$$

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE XI — WING BULKHEAD #18 ULT. SHEARS, BENDING MOMENTS, AND AXIAL LOADS
MIN FLYING WT - I.L.A.A, UNSYM. GUST @ 5000'

	STATION INCHES FROM F.S.	A_U	A_L	Δh_U	Δh_L	ΔV_a *	$\bar{X}_a$	ΔV_f *	$\bar{X}_f$	$\Delta V_U = \Delta h_U \times q_U$	$\Delta V_L = \Delta h_L \times q_L$	$V_{STA} = V_{FS} + \Delta V_a + \Delta V_f + \Delta V_U + \Delta V_L$	$\Delta M_U = 2 q_U A_U$	$\Delta M_L = 2 q_L A_L$	$\Delta M_a = \Delta V_a \bar{X}_a$	$\Delta M_f = \Delta V_f \bar{X}_f$	$\Delta M_{V_{FS}} = V_{FS} X$	$M_{STA} = M_{FS} + \Delta M_U + \Delta M_L + \Delta M_a + \Delta M_f + \Delta M_{V_{FS}}$	AXIAL LOAD $(q_L + q_U) \times$
	1	2	3	4	5	6	7	8	1	10	11	12	13	14	15	16	17	18	19
		(REF. FZS-36-142, PG. II-115)					FZS-36-142 PG. II-115		FZS-36-142 PG. II-115	4 × 410	5 × 362	5660 + 6 + 8 + 10 + 11	2 × 410 × 2	2 × 362 × 3	6 × 7	8 × 9	5660 × 1	-84500 + 13 + 14 + 15 + 16 + 17	48 × 1
F.S.	0	0	0	0	0	0	0	0	0	0	0	5660	0	0	0	0	0	-84,500	0
	17.03	250.1	191.8	4.9	3.1	-1365	8.84	341	8.51	2010	1122	7769	205,000	138,600	-12,050	2900	96,400	-346,550	820
	34.07	565.8	424.7	7.9	4.9	-2430	18.95	690	17.03	3240	1775	8935	464000	307,500	-44,800	11730	192,800	-846,730	1635
	51.10	922.1	677.5	9.8	5.4	-3185	29.20	1035	25.55	4020	1955	9485	756,000	491,000	-93,000	26,450	289000	-1,389,950	2450
	68.14	1296.4	929.5	10.0	4.9	-3650	41.60	1384	34.07	4100	1775	9269	1,063,000	673,000	-151,800	47200	386,000	-1,932,900	3270
R.S.	85.17	1664.6	1163.8	9.2	3.4	-3790	56.80	1710	42.58	3770	1230	8600	1365000	842,600	-215,000	72,800	482,000	-2,462,900	4090



* SUBSCRIPT "a" DENOTES AIRLOADS
"f" DENOTES FUEL LOADS

PREPARED BY: LOWKEY 5/14/48
CHECKED BY: Vaughn 5/18/48

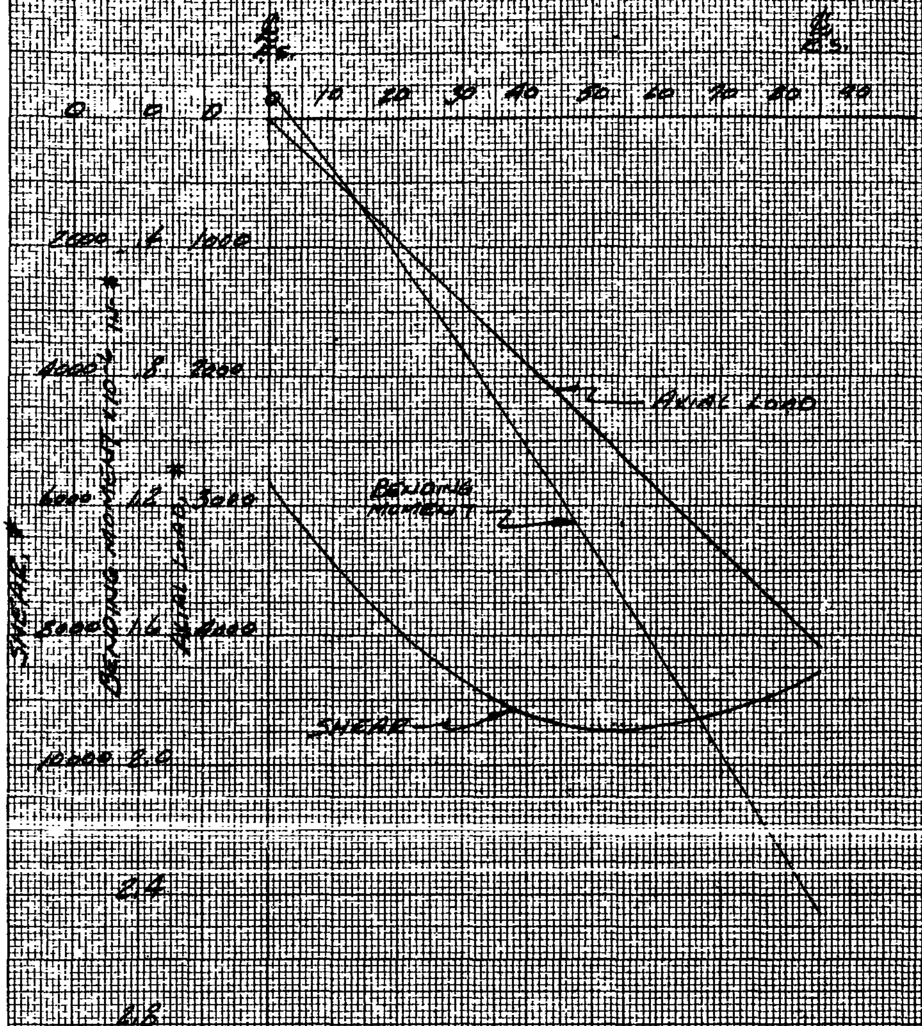


FIG. 17

LOWREY 5/14/41 COND II. 11AB NEG UNSYMM FZS-36-2
[illegible] 5/29/41 GUST MIN. FLYING WT. (1
LOWREY 5/-/41
XB-36

WING BULKHEAD #18

JACKING CONDITION - D.G.W. (265,000#)

NO ANALYSIS WILL BE SHOWN FOR MEMBERS CRITICAL FOR THIS CONDITION, BECAUSE THE DESIGN GROSS WT. HAS BEEN REDUCED FROM 278,000# ON THE B-36A TO 265,000# ON THE XB-36. THE B-36A ANALYSIS WILL BE USED AND CONSIDERED CONSERVATIVE. (REF. FZS-36-142, PG. II-129). THIS CONDITION IS CRITICAL FOR THE WEB AND HOR. STIFFENERS.

SIDE DRIFT LANDING COND. [A.G.W. (112-500# BOMBS)]

THE SIDE DRIFT LANDING CONDITION IS CRITICAL FOR THE BULKHEAD VERTICAL STIFFENERS, AS A RESULT OF FUEL PRESSURES PRODUCED BY THE SIDE INERTIA FACTOR IN THE A.G.W. - S.D.L. CONDITION.

$$P = \frac{6}{231} \times n_s \times h$$

WHERE:

$n_s = 1.408$ = ULT. AIRPLANE SIDE LOAD FACTOR (REF. FZS-36-243, PG. 143)

h = SPANWISE LENGTH OF FUEL CELL. (STA. #18 TO STA. #22 = 155.5")

$$P = \frac{6}{231} \times 1.408 \times 155.5 = \underline{\underline{5.68}}\ \#/\text{IN}^2$$

$P(B\text{-}36A) = 5.81\ \#/\text{IN}^2$ (REF. FZS-36-142, PG II-138)

THE SIDE DRIFT LANDING COND. LOADING IS SLIGHTLY SMALLER THAN THE B-36A LOADS, SO THE B-36A ANALYSIS WILL BE CONSERVATIVELY USED, FOR THE XB-36, FOR MEMBERS CRITICAL FOR THIS CONDITION.

WING BULKHEAD # 18

DETAIL ANALYSIS

THE DETAIL ANALYSIS OF THIS BULKHEAD MAY BE DIVIDED INTO THE FOLLOWING PARTS.

(1.) BULKHEAD WEB AND ATTACHMENTS.

(2) BULKHEAD WEB STIFFENERS.

(3) BULKHEAD CHORD MEMBERS

PART	CRITICAL CONDITION
(1) - - - - - -	D.G.W. - JACKING CONDITION. (FOR DISCUSSION SEE PG. 168)
(2) - - - - - - -	A.G.W. - SIDE DRIFT LANDING. (FOR DISCUSSION SEE PG. 168)
(3) - - - - - - -	M.F.W (136,018#) I.L.A.A. AND L.A.A UNSYM. GUST, H.S. @ 5000 FT. (SEE FOLLOWING PAGES)

WING BULKHEAD #18

CHORD MEMBER ANALYSIS

UPPER CHORD

THIS MEMBER WILL BE CHECKED AT THE POINT OF MAX. MOMENT FOR THE MIN. SECTION, WHICH IS 57.2" AFT OF THE FRONT SPAR. ILAA CONDITION PRODUCES THE CRITICAL COMPRESSIVE STRESS IN THIS MEMBER. THIS CHORD MEMBER IS THE SAME AS THE B-36A CHORD MEMBER.

$$\left.\begin{array}{l} h_U' = 33.7'' \\ h_L' = 24.2'' \\ h' = h_U' + h_L' = 57.9'' \\ A_{UC} = 1.247 \text{ sq. in.} \end{array}\right\} \text{REF. FZ5-36-142 PG. II-139 } \text{\& 36W118}$$

$$\left.\begin{array}{l} V = 9480^{\#} \\ M_1 = 1,580,000''^{\#} \\ P = 2750^{\#} \end{array}\right\} \text{PG. 187}$$

FLANGE LOAD, $P_U = \frac{M_1}{h'} + P\left(\frac{h_L'}{h'}\right) + \frac{V \cot\alpha}{2}$

$\cot\alpha = 1.15$ (REF. FZ5-36-142, PG. II-141)
ASSUMED SAME $\cot\alpha$

$$P_C = \frac{1580\ 000}{57.9} + 2750\left(\frac{24.2}{57.9}\right) + \frac{9480 \times 1.15}{2}$$

$$= 33{,}910^{\#}$$

WING BULKHEAD #18

UPPER CHORD (CONT'D)

$$f_{cu} = \frac{33\,910}{1.247} = 27{,}200 \text{ \#/sq. in.}$$

$F_c = 30{,}000$ #/sq.in (REF. FZ5-36-142, PG. II-149)

$$M.S. = \frac{30\,000}{27\,200} - 1 = +.10$$

THE CRITICAL TENSION STRESSES IN THIS MEMBER ARE PRODUCED BY L.A.A. COND., AT THE POINT OF MAX. MOMENT FOR THE MIN. SECTION AT 57.2" AFT OF THE FRONT SPAR. THE EFFECTIVE AREA IS ASSUMED AS EQUAL TO THAT USED IN THE COMPRESSION ANALYSIS, WHERE THE ENTIRE EXTRUDED "T" WAS NOT USED.

$$\left.\begin{array}{l} V = -15{,}300\# \\ M = -2{,}370{,}000''\# \\ P = -655\# \end{array}\right\} \text{REF. PG. 178}$$

$$P_{Tu} = \frac{M}{h} + P\left(\frac{h_u}{h}\right) = \frac{-2\,370\,000}{57.9} + (-655)\left(\frac{24.2}{57.9}\right)$$

$$= -41{,}174\#$$

$$f_{tu} = \frac{41174}{1.247} = 33{,}000 \text{ \#/sq. in.}$$

$F_{tu} = 45{,}600$ #/sq. in. (REF. FZ5-36-142, PG II-149)

$$M.S. = \frac{45600}{33\,000} - 1 = +.38$$

WING BULKHEAD #18

LOWER CHORD

THIS MEMBER IS CRITICAL IN COMPRESSION, FOR L.A.A. CONDITION, AT THE POINT OF MAX. MOMENT FOR THE MIN. SECTION, WHICH IS 73.2" AFT OF FRONT SPAR. THIS MEMBER IS THE SAME AS THE B-36A LOWER CHORD.

$$\left.\begin{array}{l} h_U' = 33.4'' \\ h_L' = 23.0'' \\ h' = h_U' + h_L' = 56.4'' \\ A_{L_e} = 2.965 \text{ SQ. IN.} \end{array}\right\} \begin{array}{l} \text{REF. FZS-36-142} \\ \text{PG. II-139} \\ ⊈ \text{ 36W118} \end{array}$$

$$\left.\begin{array}{l} V = -14{,}100^{\#} \\ M = -3{,}100{,}000''^{\#} \\ P = 1690^{\#} \end{array}\right\} \text{REF. PG. 178}$$

$\cot\alpha = 1.15$ (REF. FZS-36-142, PG. II-14 ASSUMED SAME $\cot\alpha$)

FLANGE LOAD, $P_L = \dfrac{M}{h'} + P\left(\dfrac{h_L}{h'}\right) + \dfrac{V\cot\alpha}{2}$

$$P_L = \frac{3\,100\,000}{56.4} + (-1690)\frac{23}{56.4} + \frac{14100(1.15)}{2} = 64{,}600^{\#}$$

$$f_{c_L} = \frac{64600}{2.965} = 21{,}800^{\#}/\text{SQ. IN.}$$

$F_c = 44{,}500^{\#}/\text{SQ. IN.}$ (REF. FZS-36-142, PG. II-151)

$$M.S. = \frac{44500}{21800} - 1 = +\underline{\underline{1.04}}$$

WING BULKHEAD # 16

INDEX

WING BULKHEAD #16

DISCUSSION:

BULKHEAD #16 IS LOCATED 521.5 INCHES FROM THE CENTERLINE OF THE AIRPLANE. IT IS OF THE TENSION FIELD TYPE, CONSTRUCTED ENTIRELY OF ALUMINUM ALLOYS. THE FOUR CONDITIONS THAT HAVE BEEN DETERMINED AS BEING CRITICAL ARE:

(1) MIN FLYING WT (136,018#), L.A.A, UNSYM. GUST, @ 5000'
(2) MIN. FLYING WT. (136,018#), I.L.A.A, UNSYM. GUST @ 5000'
(3) JACKING CONDITION - D.G.W. (265,192#)
(4) SIDE DRIFT LANDING, ALT. G.W (112-500# BOMBS)

IN ADDITION THE STIFFENERS IN THE OIL TANK REGION ARE CHECKED FOR A TEST PRESSURE OF 7.5#/sq. in.

THIS BULKHEAD IS CRITICAL FOR THE SAME CONDITIONS AS BULKHEAD #18. BY COMPARISON OF BULKHEAD #18 LOADS FOR CONDS. (1) AND (2) FOR XB-36 AND B-36A, IT WAS FOUND THAT THERE IS APPROXIMATELY a 35% INCREASE IN LOADS FOR THE XB-36 OVER THE B-36A. THIS SAME PER CENT INCREASE IN LOADS WILL BE ASSUMED FOR BULKHEAD #16 AND THE MARGINS OF SAFETY FOR THESE CONDITIONS WILL BE REDUCED IN

WING BULKHEAD # 16

DISCUSSION (CONT'D.)

PROPORTION TO THE 35% INCREASE IN LOADS. THE CHORD MEMBERS ARE CRITICAL FOR CONDITIONS (1) AND (2).

MEMBERS CRITICAL FOR CONDITIONS (3) + (4) WILL NOT BE ANALYZED HERE BECAUSE THE XB-36 LOADS ARE SMALLER THAN THE B-36A LOADS AND IT WILL BE CONSERVATIVE TO USE THE B-36A ANALYSIS. THE WEB AND STIFFENERS ARE CRITICAL FOR THESE CONDITIONS.

WING BULKHEAD #16

FLIGHT CONDITIONS:

(1) MIN. FLYING WT. (136,018#), L.A.A, UNSYM. GUST, H.S @ 5000 FT.

(2) MIN. FLYING WT. (136,018#), I.L.A.A., UNSYM. GUST, H.S @ 5000 FT.

WING BULKHEAD #16 IS CRITICAL FOR THE SAME FLIGHT CONDITIONS AS BULKHEAD #18. BY COMPARISON OF THE SHEARS, BENDING MOMENTS, AND AXIAL LOADS ON BULKHEAD #18 FOR THE B-36A AND XB-36, IT WAS FOUND THAT THERE IS AN INCREASE OF 35% IN LOADS FOR THE XB-36 OVER THE B-36A, FOR M.F.W. (136,018#) I.L.A.A. UNSYM. GUST, @ 5000 FT. THIS INCREASE IS DUE PRIMARILY TO THE HIGHER GUST LOAD FACTOR USED IN THE DESIGN OF THE XB-36. THE INCREASE FOR M.F.W (136,018#) L.A.A, UNSYM. GUST @ 5000 FT IS SLIGHTLY LESS, BUT WILL BE CONSERVATIVELY ASSUMED TO BE THE SAME, AS THE MARGINS OF SAFETY ARE LARGE. THEREFORE THE LOADS FOR BULKHEAD #16 ON THE XB-36 WILL BE ASSUMED TO INCREASE THE SAME AMOUNT (35%) OVER THE B-36A LOADS.

WING BULKHEAD #16

JACKING CONDITION - D.G.W. (265,192#)

NO ANALYSIS WILL BE SHOWN FOR MEMBERS CRITICAL FOR THIS CONDITION, BECAUSE THE DESIGN GROSS WT. HAS BEEN REDUCED FROM 278,000# ON THE B-36A TO 265,192# ON THE XB-36. THE B-36A ANALYSIS WILL BE USED AND CONSIDERED CONSERVATIVE (REF. FZS-36-142 PG. II-70). THIS CONDITION IS CRITICAL FOR THE WEB AND HORIZONTAL STIFFENERS.

SIDE DRIFT LANDING COND [A.G.W. (112-500# BOMBS)]

THE SIDE DRIFT LANDING CONDITION IS CRITICAL FOR THE BULKHEAD VERTICAL STIFFENERS, AS A RESULT OF FUEL PRESSURES PRODUCED BY THE SIDE INERTIA FACTOR IN THE A.G.W. (112-500# BOMBS) S.D.L. COND.

$$P = \frac{6}{231} \times n_s \times h$$

WHERE:

$n_s = 1.408$ = ULT. AIRPLANE SIDE LOAD FACTOR. (REF. FZS-36-243, PG. 193)

h = SPANWISE LENGTH OF FUEL CELL. (STA. #11 TO STA. #22) = 182"

$$P = \frac{6}{231} \times 1.408 \times 182 = \underline{6.65}\ \#/\text{IN}$$

$P(B\text{-}36A) = \underline{6.79}\ \#/\text{IN.}$ (REF. FZS-36-142, PG. II-79)

WING BULKHEAD #16

SIDE DRIFT LANDING COND. (CONT'D)

THE XB-36 SIDE DRIFT LANDING CONDITION LOADING IS LESS CRITICAL THAN THE B-36A LOADING, FOR THE CORRESPONDING CONDITION. SO THE B-36A ANALYSIS WILL BE CONSERVATIVELY USED FOR THE XB-36, FOR MEMBERS CRITICAL FOR THIS CONDITION. (REF. FZS-36-142, PG. II-89)

OIL TANK TEST PRESSURE

THE PORTION OF THE BULKHEAD IN THE OIL TANK REGION IS SUBJECTED TO A TEST PRESSURE OF 7.5 #/SQ.IN. THIS TEST PRESSURE IS THE SAME AS USED ON THE B-36A, THEREFORE THE B-36A ANALYSIS WILL BE USED FOR THE OIL TANK REGION OF THE BULKHEAD (REF. FZS-36-142, PG II-87)

DETAIL ANALYSIS

THE DETAIL ANALYSIS OF THIS BULKHEAD MAY BE DIVIDED INTO THE FOLLOWING PARTS.

(1.) BULKHEAD WEB AND ATTACHMENTS.

(2) BULKHEAD WEB STIFFENERS.

(3) BULKHEAD CHORD MEMBERS.

WING BULKHEAD #16

DETAIL ANALYSIS (CONT'D)

PART	CRITICAL CONDITION
(1)	D.G.W. JACKING COND. (FOR DISCUSSION SEE PG. 195)
(2)	A.G.W. SIDE DRIFT LANDING COND. (112-500# BOMBS) (FOR DISCUSSION SEE PG. 195)
(3)	M.F.W. (136,018#) ILAA, AND L.A.A., UNSYM. GUST @ 5000 FT. (SEE FOLLOWING CALCULATIONS)

CHORD MEMBER ANALYSIS

UPPER CHORD

THE XB-36 UPPER CHORD MEMBER IS THE SAME AS THE B-36A UPPER CHORD MEMBER AND IS CRITICAL AT THE SAME LOCATION. THEREFORE B-36A MARGINS OF SAFETY WILL BE RATIOED DOWN FOR THE 35% INCREASE IN LOADS FOR THE XB-36 OVER THE B-36A.

(A) MFW. (136018#) L.A.A. UNSYM. GUST @ 5000 FT IS CRITICAL FOR TENSION.

M.S. (B-36A) = +1.47 (FZS-36-142, PG. II-93)

$$M.S.\,(XB\text{-}36) = \frac{(1.47+1)}{1.35} - 1 = \underline{\underline{+.83}}$$

(B) M.F.W. (136,018#) I.L.A.A. UNSYM. GUST @ 5000 FT. IS CRITICAL FOR COMPRESSION.

M.S. (B-36A) = +1.83 (FZS-36-142, PG. II-94)

$$M.S.\,(XB\text{-}36) = \frac{(1.83+1.)}{1.35} - 1 = \underline{\underline{+1.09}}$$

WING BULKHEAD #16

CHORD MEMBER ANALYSIS (CONT'D)

LOWER CHORD

THE XB-36 LOWER CHORD MEMBER IS THE SAME AS THE LOWER CHORD MEMBER ON THE B-36A AND IS CRITICAL AT THE SAME LOCATIONS. THEREFORE B-36A MARGINS OF SAFETY WILL RATIOED TO THE 35% INCREASE IN LOADS FOR THE XB-36 OVER THE B-36A.

(A) M.F.W. (136,018#) L.A.A. UNSYM. GUST @ 5000 FT. IS CRITICAL FOR COMPRESSION.

$$M.S.(B\text{-}36A) = +1.54 \text{ (FZS-36-142, PG. II-95)}$$

$$M.S.(XB\text{-}36) = \frac{1.54+1}{1.35} - 1 = +\underline{.88}$$

(B) M.F.W. (136,018#) I L.A.A. UNSYM. GUST @ 5000 FT IS CRITICAL FOR TENSION.

$$M.S.(B\text{-}36A) = +4.41 \text{ (FZS-36-142, PG. II-95)}$$

$$M.S.(XB\text{-}36) = \frac{4.41+1}{1.35} - 1 = +\underline{3.01}$$

BULKHEAD #22 (36W122)

TABLE OF CONTENTS

BULKHEAD #22 (36W122)

GENERAL DISCUSSION

Bulkhead #22, located at 732.00" from the centerline of the airplane, serves the function of introducing air, inertia, flap fitting, and jack fitting loads into the wing. The bulkhead also acts to stabilize the plate-stringer combination; and serves as the outboard end of the outboard fuel and oil tanks. It is of the web type, and is constructed entirely of aluminum alloys.

Bulkhead #22 (Ref. 36W122) for the XB-36 is essentially the same structurally as Bulkhead #22 (36W4122) for the B-36A. The same conditions that were found critical for the B-36A bulkhead are also critical for the XB-36 bulkhead.

Condition: I - DGW - Flaps Down - Landing Gear Extended

Condition: II- DGW - Jacking Condition

Condition: III-AGW (112-500# Bombs) - Side Drift Landing.

BULKHEAD No. 22 GEOMETRY

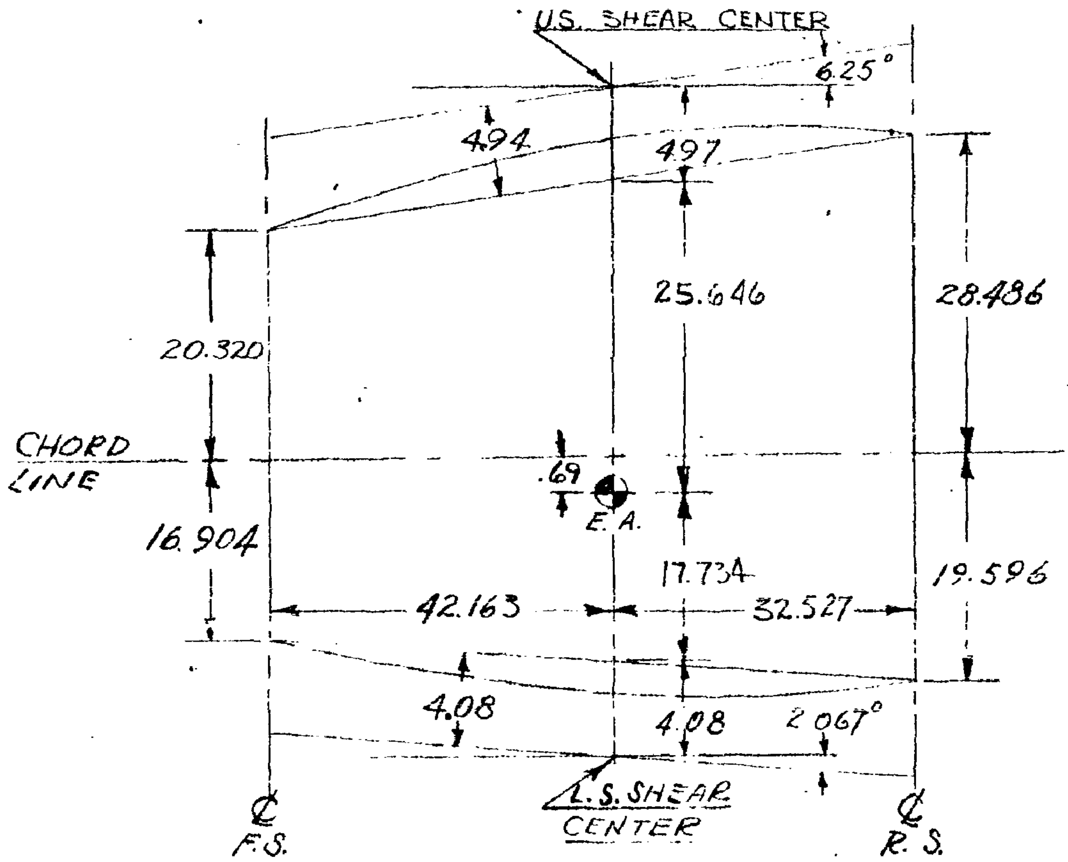


FIGURE 18

CONDITION: I DGW-FD-LGE

LEADING & TRAILING EDGE MOMENTS & SHEARS, & FLAP FITTING LOADS ARE CALCULATED IN THE SAME MANNER AS FOR THE B-36A. (REF. FZS-36-142, P.II-157)

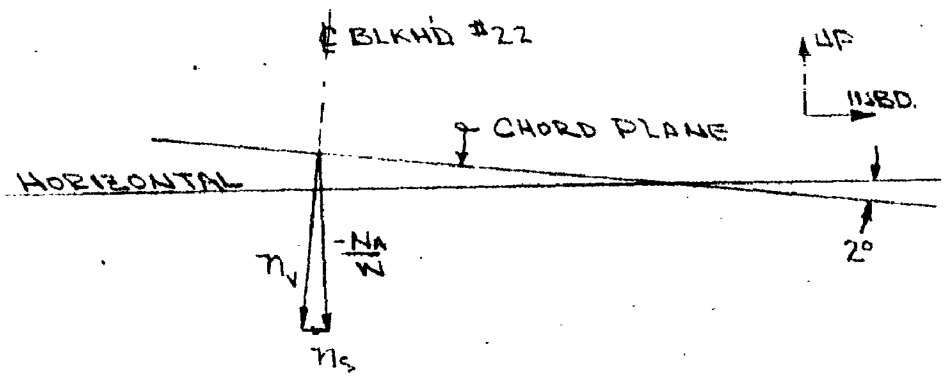
LOAD FACTORS ARE TAKEN FROM FZS-36-126 P. 85.

LOAD FACTORS

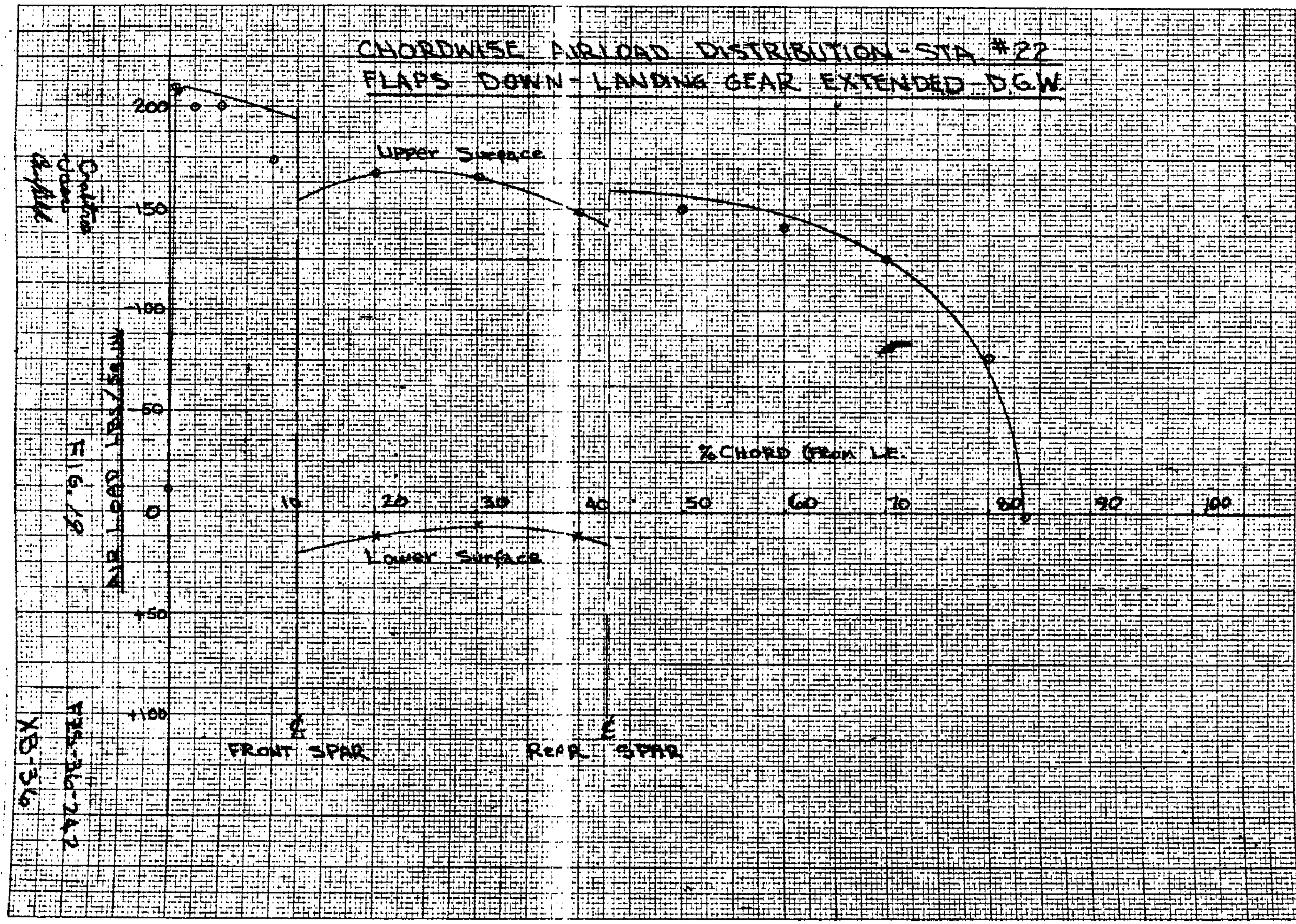
$$-\frac{N_A}{W} = -2.090 \text{ (}\perp\text{ TO ROOT CHORD)}$$

$$\frac{X_M}{W} = -.031 \text{ (}\parallel\text{ TO ROOT CHORD)}$$

RESOLVING VERTICAL LOAD FACTOR INTO THE PLANE OF THE BULKHEAD:



$n_v = -2.09 \cos 2° = -2.0775$
$n_s = -2.09 \sin 2° = -.0718$
$n_d = -.031$


CHORDWISE AIRLOAD DISTRIBUTION - STA #22
FLAPS DOWN - LANDING GEAR EXTENDED - D.G.W.
Upper Surface
Lower Surface
% CHORD FROM L.E.
AIR LOAD LBS/SQ.IN.
200
150
100
50
0
+50
+100
10
20
30
40
50
60
70
80
90
100
℄ FRONT SPAR
℄ REAR SPAR
FIG. 18
FZS-36-242
XB-36

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH TEXAS
FW 833 125 PADS 11-43

COMPUTATION OF * N_L, N_T, M_L & M_T FOR ULT. AIRLOADS

TABLE XXI

D.G.W. - F.D.▲ - L.G.E. $b = 36.44$; $C = 240.934$; L.E. FLAP @ 78.44%

LEADING EDGE						TRAILING EDGE					
STATION % CHORD	P #/□ FIG.	S.M.	② × ③	MOMENT MULTIPLIER	$\overline{\Delta M}$	STATION % CHORD	P #/□ FIG.	S.M.	⑧ × ⑨	MOMENT MULTIPLIER	$\overline{\Delta M}$
1	2	3	4	5	6	7	8	9	10	11	12
0	-200	1	-200	6	-1200	78.42	-90	1	-90	6	-540
2	-209	4	-836	5	-4180	72.52	-118	4	-472	5	-2360
4	-205	2	-410	4	-1640	66.61	-135	2	-270	4	-1080
6	-201	4	-804	3	-2412	60.71	-144	4	-576	3	-1668
8	-196	2	-392	2	-784	54.81	-150	2	-300	2	-600
10	-190	4	-760	1	-760	48.90	-154	4	-616	1	-616
12	-185	1	-185	0	0	43.00	-156	1	-156	0	0
			-3587		-10976				-2480		-6864

$$\text{ULT. } N_L = \frac{1.5\,bc}{144}\left(\frac{-3587 \times .02}{3}\right) = -2184^{\#}$$

$$\text{ULT. } N_T = \frac{1.5\,bc}{144}\left(\frac{-2480 \times .05903}{3}\right) = -4470^{\#}$$

$$\text{ULT. } M_L = \frac{1.5\,bc^2}{144}\left(\frac{-10976 \times .02^2}{3}\right) = -32{,}200^{\#\#}$$

$$\text{ULT. } M_T = \frac{1.5\,bc^2}{144}\left(\frac{-6864 \times .05903^2}{3}\right) = -175{,}000^{\#\#}$$

* DEFINITION OF TERMS:

N_L - LEADING EDGE AIRLOAD SHEAR
M_L - LEADING EDGE AIRLOAD MOMENT ABOUT F.S.
N_T - TRAILING EDGE AIRLOAD SHEAR
M_T - TRAILING EDGE AIRLOAD MOMENT ABOUT R.S.

▲ FLAP DOWN 40°

CALCULATED BY: Crabtree
CHECKED BY: Canfield

TABLE XLII INTERSPAR AIRLOAD-SHEARS & MOMENTS
D.G.W. - F.D. - L.G.E.

UPPER SURFACE

STATION % CHORD	ORDINATE FIG.	SIMPSON'S MULTIPLIER	② × ③	MOMENT MULTIPLIER	④ × ⑤
1	2	3	4	5	6
12	155	1	155	6	930
17.17	164	4	656	5	3280
22.33	167	2	334	4	1336
27.50	165	4	660	3	198
32.66	160	2	320	2	640
37.83	152	4	608	1	608
43	142	1	142	0	0
		$\Sigma_4 =$	2875	Σ_6	8774

LOWER SURFACE

STATION % CHORD	ORDINATE FIG.	SIMPSON'S MULTIPLIER	⑧ × ⑨	MOMENT MULTIPLIER	⑩ × ⑪
7	8	9	10	11	12
12	35	1	35	6	210
17.17	20	4	80	5	400
22.33	10	2	20	4	80
27.50	7	4	28	3	84
32.66	8	2	16	2	32
37.83	11	4	44	1	44
43	17	1	17	0	
		$\Sigma_{10} =$	240	$\Sigma_{12} =$	850

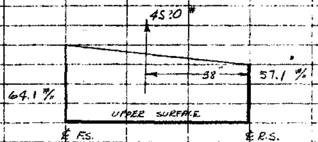
$N = \frac{[illegible]}{144}\left(\Sigma_4 \times \frac{.31}{6} \times \frac{1}{3}\right) =$ [illegible] # (ULTIMATE)

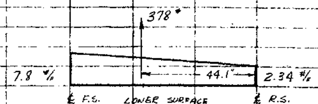
$N =$ 378 # (ULTIMATE)

$M_{R.S.} = \frac{1.5\,bC^2}{144}\left[\Sigma_6 \times \left(\frac{.31}{6}\right)^2 \times \frac{1}{3}\right] = 171{,}800$ #" (ULTIMATE)

$M_{RS} =$ 16,680 #" (ULTIMATE)

EQUIVALENT TRAPEZOIDS





CALCULATED BY: Crabtree
CHECKED BY: [illegible]

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

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE 208
REPORT NO. FZS-36-242
MODEL XB-36
DATE 4-48

CONDITION: I DGW-FD-LGE

AIR LOADS

LEADING EDGE

$N_L = 2184^{\#}$

$M_L = 32,200''^{\#}$

"M_L" AS A COUPLE AT UPPER & LOWER SURFACES $= \frac{32,200}{37.224} = 865^{\#}$

TRAILING EDGE

$N_T = 4,470^{\#}$

$M_T = 175,000''^{\#}$

"M_T" AS A COUPLE AT UPPER & LOWER FITTINGS $= \frac{175,000}{43.925} = 3980^{\#}$

INTERSPAR AIR LOAD

UPPER SURFACE $= 4,520^{\#}$

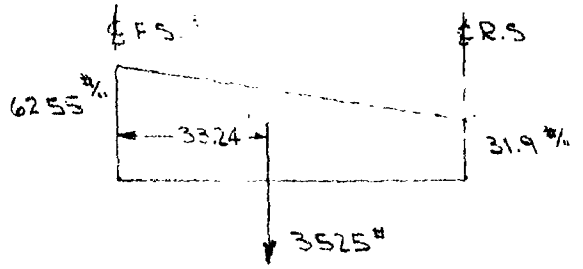
LOWER SURFACE $= 378^{\#}$

FUEL & OIL LOADS

1G LOAD = 1132.8 AT 25.75% CHORD
(REF. TABLE 16, P. 52, FZS-36-240)

ULTIMATE LOAD = 1132.8 × 2.0775 × 1.5 = 3,525#

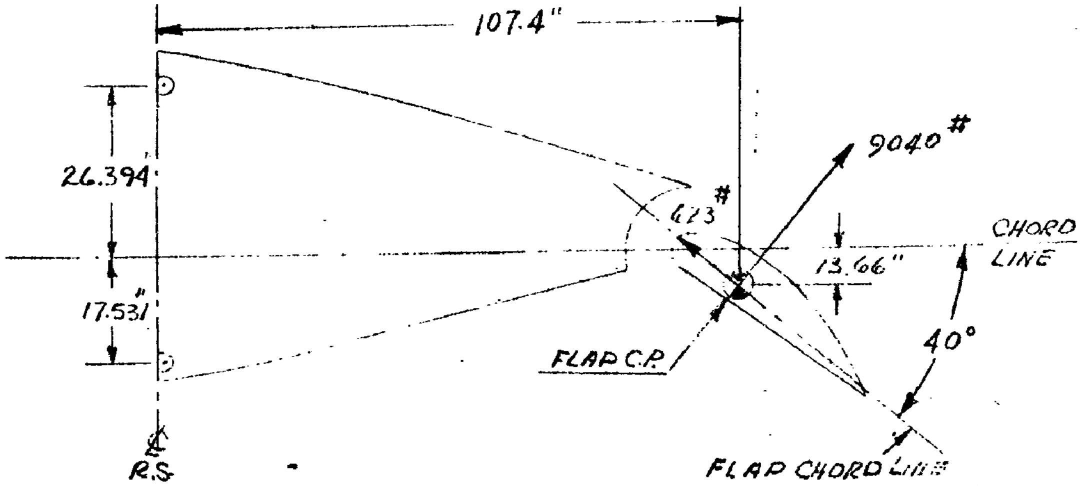
A TRAPEZOIDAL DISTRIBUTION OF COMBINED FUEL & OIL LOADS IS ASSUMED.



COND: I DGW-FD-LGE

FLAP LOADS ARE THE SAME AS FOR THE B-36A

(FLAP LOADS TAKEN FROM FZS-36-148, P 36)



RESOLVING LOADS OF FIG. ABOVE INTO VERTICAL & HORIZONTAL COMPONENTS

$V = 9040 \cos 40° + 623 \sin 40° = 7325^{\#}$

$D = 9040 \sin 40° - 623 \cos 40° = 5333^{\#}$

$M_{RS} = 7325 \times 107.4 = 787{,}000''^{\#}$

"M" AS A COUPLE AT UPPER & LOWER FITTINGS:

$\frac{787{,}000}{43.925} = 17{,}900^{\#}$

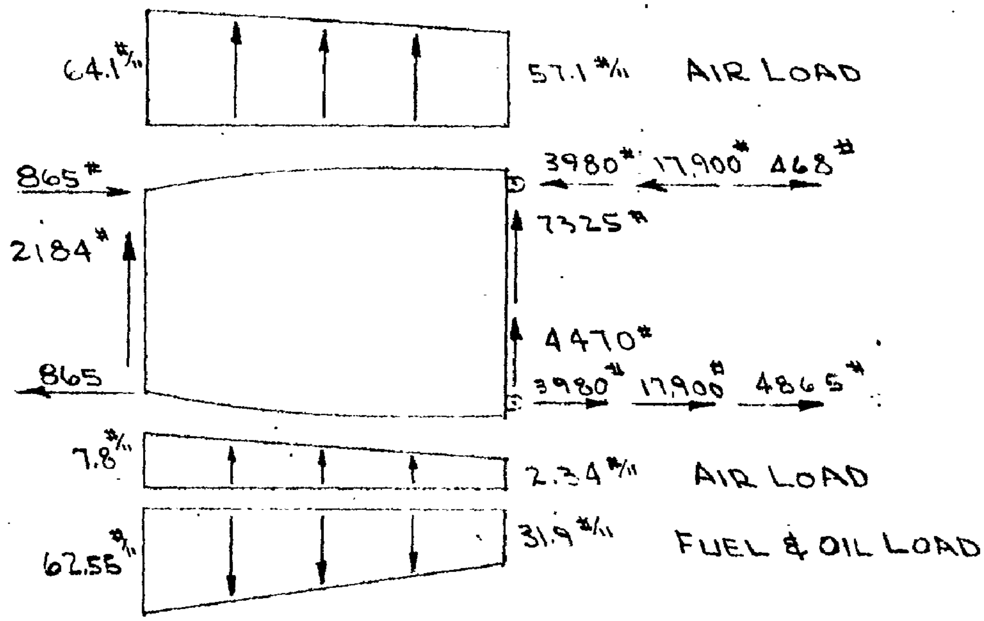
DRAG LOAD BEAMED TO UPPER & LOWER FITTG'S.

$D_u = \frac{3.871 \times 5333}{43.925} = 468^{\#}$

$D_L = \frac{40.054 \times 5333}{43.925} = 4865^{\#}$

COND: I DGW-FD-LGE

SUMMARY OF APPLIED LOADS ON BULKHEAD



TRANSFERRING LOADS TO THE E.A. OF THE BLKHD.

$$D = 4865 + 468 \quad \text{(AFT.)}$$

$$V = 2184 + 378 + 4250 + 7325 - 3525 + 4470 = 15{,}352^{\#} \text{ (UP)}$$

$$T_{E.A.} = 32{,}200 + 2184(42.163) - 175{,}000 - 4470(32.527) - 5333(12.97) - 7325(139.927) - 3525(8.923) + 4520(5.473) + 378(11.573)$$

$$= -1{,}292{,}205 \text{ ''}^{\#}$$

REACTING THE TORSION ABOUT THE ELASTIC AXIS AS A SHEAR FLOW AROUND THE BLKHD:

$$q = \frac{T}{2A} = \frac{1{,}292{,}205}{2(3526.2)} = 183.2 \ ^{\#}/_{''}$$

COND: I DGW - FD - LGE

REACTING DRAG FORCE AT UPPER & LOWER SHEAR CENTERS:

$$R_U = 5333 \times \frac{21.814}{52.430} = 2220^{\#}$$

$$R_L = 5333 \times \frac{30.616}{52.430} = 3113^{\#}$$

$$q_U = \frac{2220}{74.69} = 29.7 \ ^{\#}/'' \quad (FWD.)$$

$$q_L = \frac{3113}{74.69} = 41.6 \ ^{\#}/'' \quad (FWD.)$$

THE VERTICAL COMPONENT OF UPPER & LOWER SURFACE SHEAR IS:

$$V_U = 2220 \times \tan 6.25° = 2220 \times .1093 = 242^{\#} \ (UP)$$

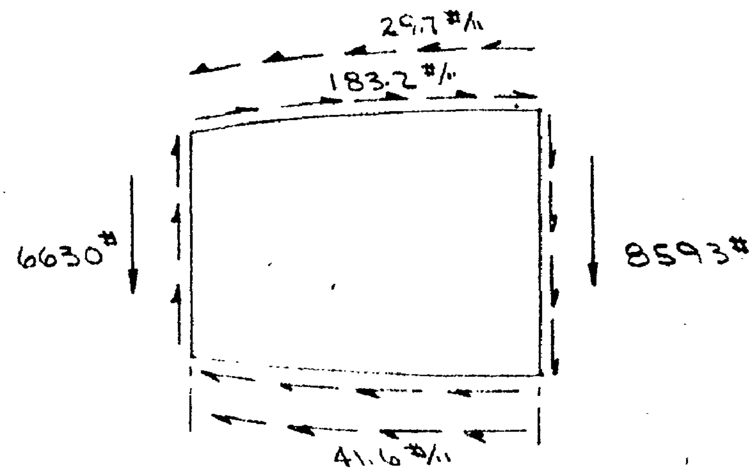
$$V_L = 3113 \times \tan 2.067° = 3113 \times .0361 = 112.5^{\#} \ (DOWN)$$

REACTING VERTICAL SHEAR AT FRONT & REAR SPARS:

$$R_{F.S.} = (-15,352 + 242 - 112.5) \ \frac{32.527}{\text{[illegible]}} = -6630^{\#} \ (DOWN)$$

$$R_{R.S.} = (-15,352 + 242 - 112.5) \ \frac{42.163}{74.690} = 8593^{\#} \ (DOWN)$$

SUMMARY OF BULKHEAD REACTIONS:

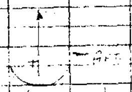


CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS

FW 855 125 PADS 11-43

TABLE XLIII [illegible] VERTICAL FORCES & MOMENTS [illegible] STATION 2 [illegible]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	DISTANCE FROM F.S. X	A_u	A_L	Δh_u	Δh_L	ΔV_L^*	$\bar{X}_L$	ΔV_f^*	$\bar{X}_f$	$\Delta V_u = \Delta h_u \cdot g_u$	$\Delta V_L = \Delta h_L \cdot g_L$	$V_{STA} = V_{FS} + \Delta V_u + \Delta V_L + \Delta V_f$	$\Delta M_u = \Sigma g_u \cdot A_u$	$\Delta M_L = \Sigma g_L \cdot A_L$	$\Delta M_{\bar{L}} = \Delta V_L \cdot \bar{X}_L$	$\Delta M_f = \Delta V_f \cdot \bar{X}_f$	$\Delta M_{V_{FS}} = V_{FS} \cdot X$	$M_{STA} = M_{FS} + \Delta M_u + \Delta M_L + \Delta M_{\bar{L}} + \Delta M_f$	AXIAL LOAD $(g_L - g_u) X$
		(Ref. FZS-36-142 p I-15)				(Ref. p. 210)		(Ref. p. 210)		4 × .535	5 × [illegible]	[illegible] + 6 + 8 + 10 + 11	207 · 2	4436 · 3	6 × 7	8 × 9	2,384 · 1	54,200 + 13 + 14 + 15 + 16 + 17	-71.3 × 1
F.S. 12%	0	0	0	0	0	0	0	0	0	0	0	[illegible]	0	0	0	0	0	52,200	0
18.?%	14.94	[illegible]	[illegible]	4.0	[illegible]	[illegible]57	7.41	-[illegible]	7.32	614	[illegible]85	2,151	52,300	74,500	[illegible]	-[illegible]	25,100	[illegible]	-1,065
24.4%	29.9[illegible]	[illegible]	[illegible]	7.0	4.1	[illegible]	14.72	-[illegible]	14.40	1073	[illegible]	4,771	117,300	163,100	[illegible]	-[illegible]	71,500	[illegible]	-2,130
30.6%	44.81	[illegible]	[illegible]75	[illegible]	4.6	3,0[illegible]5	[illegible]0	-[illegible]	21.1	1272	1033	5,3[illegible]	199,000	[illegible]52,500	[illegible]	-50,[illegible]	107,00[illegible]	[illegible]	-3,195
[illegible].8%	59.75	[illegible]	774.0	[illegible]	4.0	[illegible]5	29.1	-[illegible]000	[illegible]4	1320	900	5,599	[illegible]78,400	348,00[illegible]	11[illegible]	[illegible]	[illegible]	[illegible]	-4,260
F.S. [illegible]%	71.69	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	-3325	[illegible]	[illegible]	[illegible]	7,247	355,000	448,000	[illegible]	[illegible]	113,2[illegible]	[illegible]	-5,330



BY [illegible]
CHECKED [illegible]

* SUBSCRIPT "L" [illegible] LIMIT
"f" [illegible] FULL LIMIT

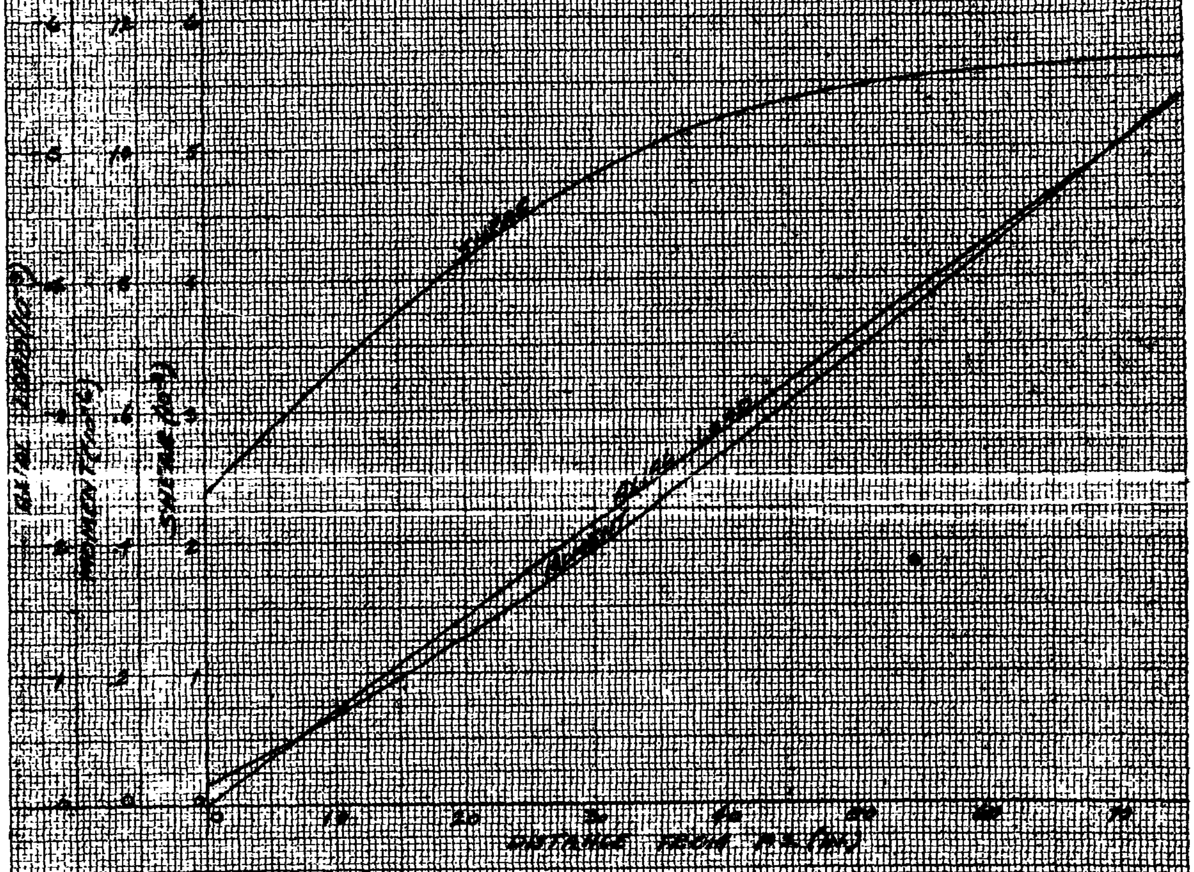


FIGURE 20

BULKHEAD #22
COND. I-FD-LEG-DOWN

CALCULATED BY	[illegible] 1948	SHEAR, MOMENT & AXIAL LOAD CURVE	REPORT NO. FZS-36-242
CHECKED BY	[illegible] 1948		
CHECKED BY	[illegible]	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION FORT WORTH, TEXAS	MODEL B-36
APPROVED BY			

KEUFFEL & ESSER CO., N. Y. NO. 359-14 Millimeters, 5 mm. lines accented, cm. lines heavy. MADE IN U.S.A.

BULKHEAD #22

DETAIL ANALYSIS

Web Analysis

The critical bulkhead shear occurs in Condition: II - D.G.W. - Jacking

The jacking loads vary directly with the weight of the airplane, assuming no appreciable change in airplane c.g., and as the DGW for the XB-36 is less than the DGW for the B-36A, the jacking loads will be less for the XB-36. Margins of safety for the bulkhead web, web attachments, and web splice are all greater than 100% for the B-36A. (Ref. FZS-36-142, P. II-177 to II-180). XB-36 margins of safety for the web, web attachments, and web splice may be conservatively obtained from the foregoing reference.

Stiffener Analysis

Stiffeners in Engine Oil Tank Area

XB-36 bulkhead stiffeners in the engine oil tank area are designed to the same test pressure as B-36A stiffeners. See FZS-36-142, P. II-182 for margins of safety.

Vertical Stiffeners in Fuel Tank Area

The vertical stiffeners in the fuel tank area are designed primarily by fuel pressure from the AGW-Side Drift Landing Condition. The side inertia factor has been reduced from 1.434 AGW-(112-500# Bombs) Side Drift Landing for the B-36A (Ref. FZS-36-141 P. 284) to 1.408 AGW (112-500# Bombs) Side Drift Landing for the XB-36 (Ref. FZS-36-243 P.143). The values of the stiffener stresses in Table II-XL, P. II-191 (Ref. FZS-36-142) will be 1.437/1.408 or 2% conservative for the XB-36. The minimum stiffener margin of safety for the B-36A is +55%. Margins of safety for the XB-36 will exceed this value.

Stiffener Analysis (Cont'd.)

Horizontal Stiffeners in Panel Adjacent To Front Spar

These stiffeners are loaded by the tension field action of the bulkhead web and are critical for DGW-Jacking. Margins of safety for B-36A stiffeners are conservatively taken for XB-36 stiffeners by the same analogy made for the bulkhead web analysis. (Ref. FZS-36-142, P. II-180).

ANALYSIS OF CHORD MEMBERS

Upper Chord Member

The maximum moment occurs at the R.S. in the DGW-Flaps Down-Landing Gear Extended Condition.

The compressive load is:

$$P_c = \frac{M}{h'} + \frac{S_{tu} \operatorname{Cot} \alpha}{2} + P_A \quad \text{(Ref. AAF TR 4313; P. 257 EQ. 11-38)}$$

$$S_{tu} = S - S_{cR}$$

Comparing loads for B-36A and XB-36 Airplanes:

B-36A Ref. FZS-36-142 P. II-167	XB-36
$S = 5431\#$	$S = 5647\#$
$M = 1{,}044{,}250''\#$	$M = 1{,}073{,}300''\#$
$P_A = -5333\#$	$P_A = -5330\#$

The comparison indicates very little increase in stress for the upper chord member. The margin of safety for the B-36A upper chord is greater than 100%. The margin of safety for the XB-36 upper chord can be taken as that of the B-36A.

Lower Chord Member

Since the B-36A lower chord member has a high margin of safety its margin of safety can be said to apply to the XB-36.

WING BULKHEAD #23
(36W 123)

INDEX

WING BULKHEAD #23

DISCUSSION

Wing Bulkhead #23 is located 766" from the center line of the airplane. The bulkhead introduces airload, inertia loads, and engine mount fitting loads into the wing; it also resists crushing loads and stabilizes the plate stringer combinations. The bulkhead is of combined web and truss type construction, made entirely of aluminum alloys.

Two conditions are critical for the bulkhead members.

1. Min. Flying Wt. (136,018#) LAA, Positive Unsymmetrical Gust @ 5,000'

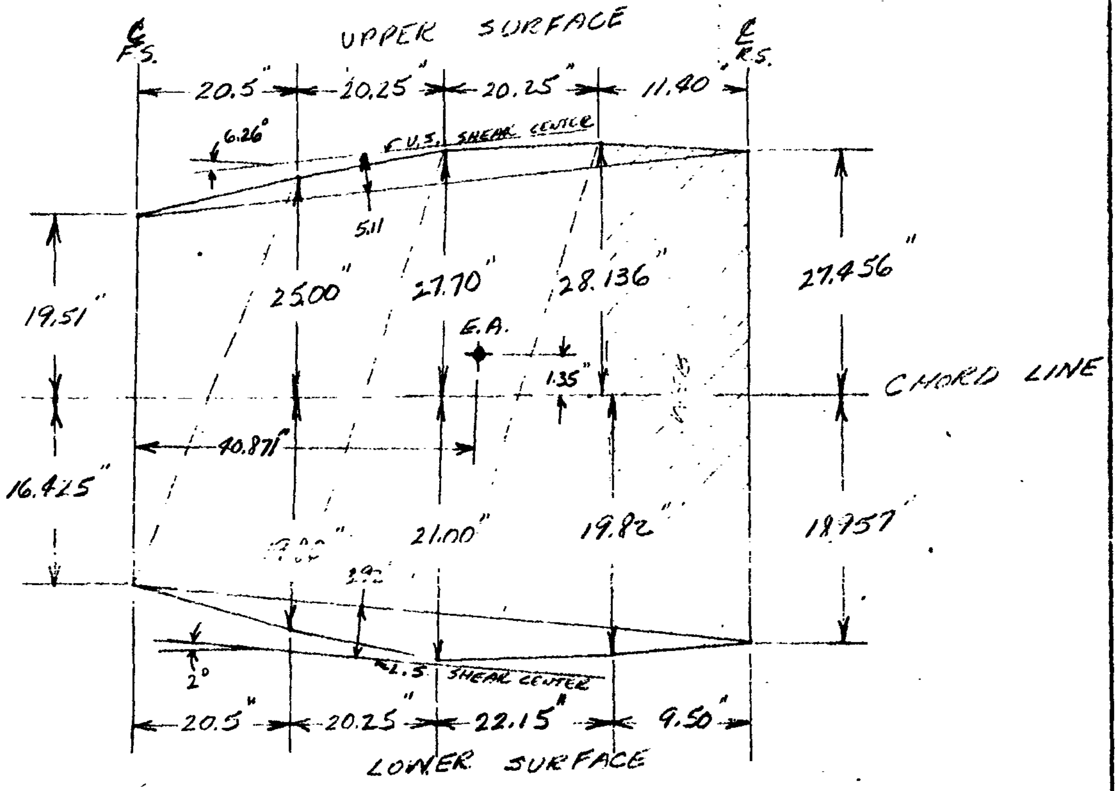
2. Minimum Flying Wt. (136,018#) ILAA, Negative Unsymmetrical Gust @ 5,000'

All loads applied to the bulkhead other than air loads are based on the factors produced by the unsymmetrical loading condition, Ref. FZS-36-253, page 4. The air load is the same as for the symmetrical gust condition since it is necessary to have 100% of the [illegible] factors increased by the rolling moment.

The rear spar vertical is critical for the AGW (72-1,000# Bomb) LAA @ 35,000' condition. The applied bulkhead loads for this condition are obtained as shown on page 270.

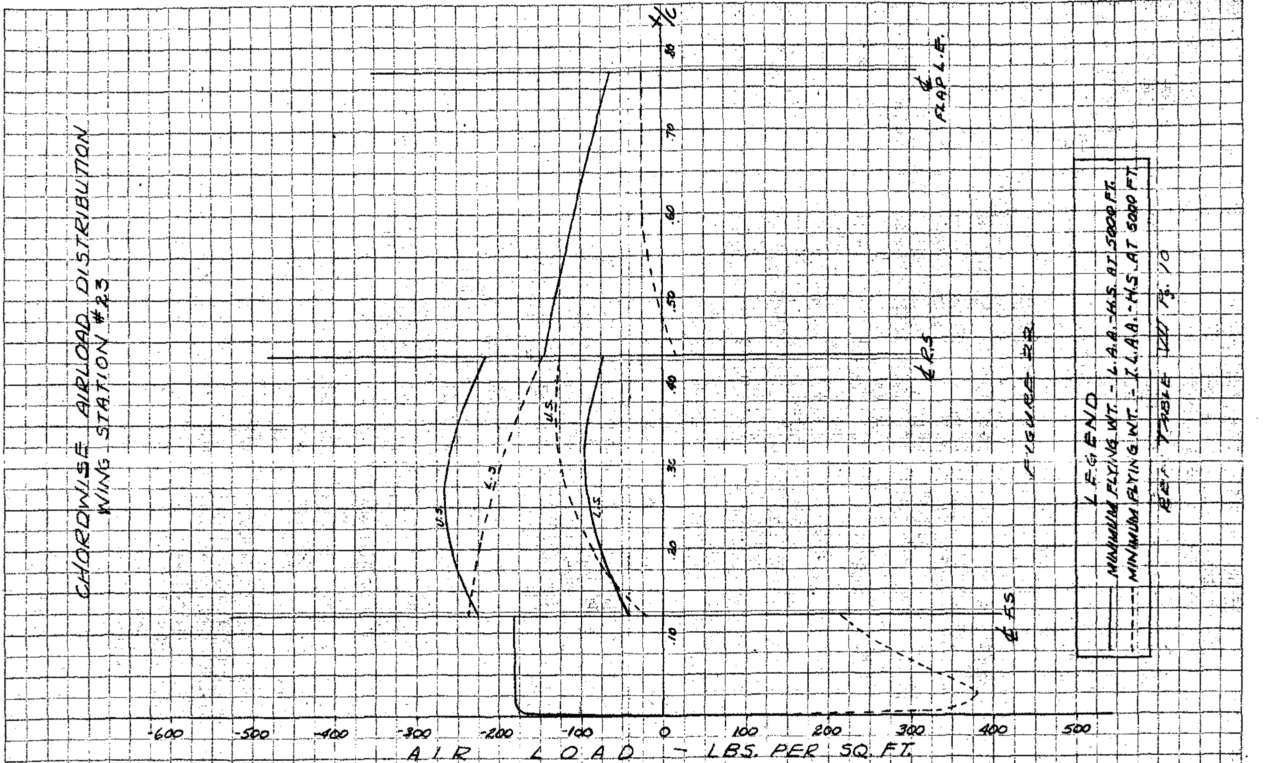
WING BULKHEAD #23

BULKHEAD DIMENSIONS



TOTAL ENCLOSED AREA = 6616 sq. IN.

FIGURE 21



CALCULATED BY		FIGURE CHORDWISE AIRLOAD DISTR. STATION #23
DRAWN BY	Russell 11/4/47	
CHECKED BY	Lowrey 4/7/48	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS
APPROVED BY		

DOC NO. FZS-36-242

MODEL XB-36

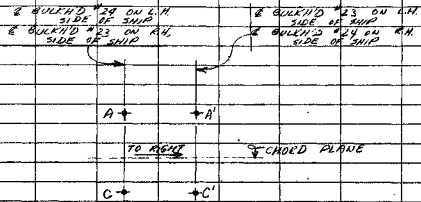
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE XLIV

WING BULKHEAD #23
SUMMARY OF 1-G INERTIA LOADS OF MOST FORWARD POINTS OF BASIC ENGINE MOUNT, L.H. SIDE & R.H. SIDE

BASIC MT. POINT	1-G VERTICAL LOAD* ON BASIC MOUNT (ACTING DOWN)			1-G SIDE LOAD* ON BASIC MOUNT (ACTING INBOARD)			1-G DRAG LOAD* ON BASIC MOUNT (ACTING AFT)		
	V (1)	D (2)	S (3)	V (4)	D (5)	S (6)	V (7)	D (8)	S (9)
A	+1807	+6227	∓858	∓925	±434	+734	-135	+1244	∓193
A'	+1807	+6227	±858	±925	∓434	+734	-135	+1244	±193
C	+1666	-6233	±860	∓224	±15012	+2756	+142	+2252	∓295
C'	+1666	-6233	∓860	±224	∓15012	+2756	+142	+2252	±295

* REF. FZS-36-253 ADD.
TABLE XVIII, PG. 69



DETAIL SHOWING LETTER DESIGNATION OF BASIC ENG. MT. POINTS

VIEW LOOKING FWD. NORMAL TO ENGINE MOUNT FITTING FACE

SIGN CONVENTION & DIRECTION OF LOADS

VERTICAL LOADS ARE NORMAL TO THE CHORD PLANE & (+) WHEN DIRECTED DOWN.

DRAG LOADS ARE PARALLEL TO THE ℄ OF THRUST & (+) WHEN DIRECTED AFT.

SIDE LOADS ARE PARALLEL TO THE CHORD PLANE & NORMAL TO THE ℄ THRUST & ARE (+) WHEN DIRECTED INBOARD.

IN THE COLUMNS WHERE THE LOADS APPEAR WITH BOTH (+) & (-) SIGNS THE TOP SIGNS ARE FOR LOADS THAT OCCUR ON THE L.H. SIDE OF THE AIRPLANE; BOTTOM SIGNS, FOR THOSE OCCURING ON THE R.H. SIDE. SINGLE SIGNS ARE FOR LOADS THAT OCCUR ON BOTH SIDES.

PREPARED BY: VOSS 10/20/47
CHECKED BY: JOHNSON 11/3/47

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

WING BULKHEAD #23

TABLE XLV — ULT. LOADS AT MOST TWD. POINTS OF OUTB'D. BASIC ENG. MT., L.H. & R.H. SIDES

COND.: MIN. FLYING WT. = 136,018# - UNSYM. GUST - I.L.A.A. @ 5000 FT.

BASIC MT. POINTS	‡N_V = 6.872 DOWN			‡N_S = .241 INBD.			‡N_D = .0135 AFT			ULTIMATE TORQUE ON BASIC MOUNT *			ULTIMATE THRUST ON BASIC MOUNT			TOTAL LOADS		
	V	D	S	V	D	S	V	D	S	V	D	S	V	D	S	ΣV	ΣD	ΣS
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	N_V x (COL. 1 TAB. XLIV)	N_V x (COL. 2 TAB. XLIV)	N_V x (COL. 3 TAB. XLIV)	N_S x (COL. 4 TAB. XLIV)	N_S x (COL. 5 TAB. XLIV)	N_S x (COL. 6 TAB. XLIV)	N_D x (COL. 7 TAB. XLIV)	N_D x (COL. 8 TAB. XLIV)	N_D x (COL. 9 TAB. XLIV)	REF. FZS-36-253 TABLE XVII, PG. 68			REF. FZS-36-253 TABLE XVII PG. 68					
A	+12,410	+42,700	-5890 L	-223 L	+104 L	+177	-2	+14	-2 L	-4773 L	-12,436 L	+1322 L	+64	-1135	+158 L	+12,185 L	+42,818 L	-5715 L
			+5890 R	+223 R	-104 R				+2 R	-4773 R	-12,436 R	-1322 R			-158 R	+12,631 R	+42,610 R	+6069 R
A'	+12,410	+42,700	+5890 L	+223 L	-104 L	+177	-2	+14	+2 L	+4773 L	+12,436 L	+1322 L	+64	-1135	-158 L	+17,468 L	+53,911 L	+7233 L
			-5890 R	-223 R	+104 R				-2 R	+4773 R	+12,436 R	-1322 R			+158 R	+17,022 R	+54,119 R	-6879 R
C	+11,430	-42,700	+5910 L	-54 L	+3620 L	+664	+2	+26	-3 L	-4032 L	+12,445 L	-1298 L	-69	-1605	+221 L	+11,378 L	-39,054 L	+6571 L
			-5910 R	+54 R	-3620 R				+3 R	-4032 R	+12,445 R	+1298 R			-221 R	+11,486 R	-46,294 R	-5243 R
C'	+11,430	-42,700	-5910 L	+54 L	-3620 L	+664	+2	+26	+3 L	+4032 L	-12,445 L	-1298 L	-69	-1605	-221 L	+15,499 L	-60,344 L	-6762 L
			+5910 R	-54 R	+3620 R				-3 R	+4032 R	-12,445 R	+1298 R			+221 R	+15,341 R	-53,104 R	+8070 R

CONDITION: MIN. FLYING WT. = 136,018# - UNSYM. GUST - I.L.A.A. @ 5000'

	N_V = -3.587 UP			N_S = -.083 OUTB'D			N_D = .01925 AFT											
A	-6490	-22,350	+3080 L	+77 L	-36 L	-61	-3	+24	-4 L	-4773 L	-12,436 L	+1322 L	+64	-1135	+158 L	-11,135 L	-35,933 L	+4495 L
			-3080 R	-77 R	+36 R				+4 R	-4773 R	-12,436 R	-1322 R			-158 R	-11,279 R	-35,861 R	-4617 R
A'	-6490	-22,350	-3080 L	-77 L	+36 L	-61	-3	+24	+4 L	+4773 L	+12,436 L	+1322 L	+64	-1135	-158 L	-6570 L	-22,290 L	-3137 L
			+3080 R	+77 R	-36 R				-4 R	+4773 R	+12,436 R	-1322 R			+158 R	-6416 R	-22,362 R	+3015 R
C	-5980	+22,400	-3085 L	+19 L	-1245 L	-228	+3	+43	-6 L	-4032 L	+12,445 L	-1298 L	-69	-1605	+221 L	-10,059 L	+32,038 L	-4396 L
			+3085 R	-19 R	+1245 R				+6 R	-4032 R	+12,445 R	+1298 R			-221 R	-10,097 R	+34,528 R	+3940 R
C'	-5980	+22,400	+3085 L	-19 L	+1245 L	-228	+3	+43	+6 L	+4032 L	-12,445 L	-1298 L	-69	-1605	-221 L	-5996 L	+23,688 L	+2863 L
			-3085 R	+19 R	-1245 R				-6 R	+4032 R	-12,495 R	+1298 R			+221 R	-5958 R	+21,198 R	-3319 R

SIGN CONVENTION
(+) VERTICAL LOADS, DOWN
(+) DRAG LOADS, AFT
(+) SIDE LOADS, INB'D.

L - DESIGNATES L.H. MOUNT
R - DESIGNATES R.H. MOUNT

PREPARED BY: VOSS 10/30/47
CHECKED BY: JOHNSON 11/3/47

* THESE LOADS DUE TO TORQUE ARE FOR A .29 GEAR RATIO INSTEAD OF A .38 GEAR RATIO, AND ARE THEREFORE CONSERVATIVE.

‡ REF: FZS-36-253

WING BULKHEAD #23

ENGINE MOUNT FITTING LOADS

THESE ARE APPLIED LOADS TO THE ENGINE MOUNT FITTINGS. (REF. PG. 222)

MIN. FLYING WT. (136,018#) L.A.A. UNSYM. GUST 5000'

	V	D	S
UPPER FITTING	-17,468	53,911	7233
LOWER FITTING	-15,449	-60,344	-6762

MIN. FLYING WT. (136,018#) ILAA UNSYM. GUST 5000'

	V	D	S
UPPER FITTING	11,279	-35,861	-4617
LOWER FITTING	10,097	34,528	3940

VERTICAL; POSITIVE WHEN UP - NORMAL TO THE CHORD PLANE.

DRAG; POSITIVE WHEN AFT - PARALLEL TO THE ℄ OF THRUST AND IN THE CHORD PLANE.

SIDE; POSITIVE WHEN INBOARD - PARALLEL TO THE CHORD PLANE & NORMAL TO THE ℄ OF THRUST.

WING BULKHEAD # 23

CONDITION

MIN. FLYING WT (136,018#) L.A.A. UNSYM.
GUST @ 5000'

WING BULKHEAD #23

CRUSHING LOADS (M.F.W., L.A.A. UNSYM GUST @ 5000')

M'_X ASSUMED EQUAL TO M_X

$M_X = 23,760,000$ "# (OBTAINED FROM PRELIMINARY CALCULATIONS)

$$P_{CR} = \frac{(M_x)^2 L}{\left(\frac{I}{\varphi}\right)_x E I}$$

$I_X = 22,660$ IN.^{4}
$\varphi_X = 515.24$ IN.^{3}
$L = 37.0$ IN.
$E = 10,300,000$

FZS-36-142 PG. II-201

$$P_{CR} = \frac{(23,760,000)^2 (37)}{\left(\frac{22,660}{515.24}\right) 10.3 \times 10^6 \times 22,660} = 2030^{\#}$$

CRUSHING LOAD WILL BE DISTRIBUTED IN PROPORTION TO SPAR DEPTHS.

F.S. = 35.935
R.S. = 46.413
2) 82.348
41.174 AVERAGE SPAR DEPTH.

$$\frac{2030}{72.4} = 28.05 \ {}^{\#}/_{IN}$$ AV. LOADING OVER CHORD

AT F.S., $w = \frac{35.935}{41.174}(28.05) = 24.5\ {}^{\#}/_{IN}$

AT R.S., $w = \frac{46.413}{41.174}(28.05) = 31.6\ {}^{\#}/_{IN}$

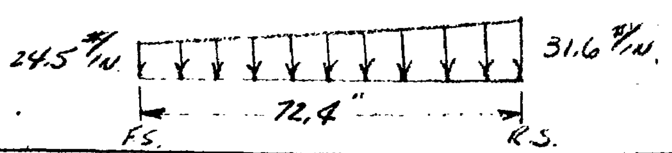


TABLE XLVI

WING BULKHEAD #23

SHEARS & BENDING MOMENT AT REAR SPAR FROM T.E. AIRLOAD

COND. : M.F.W. , LA A. UNSYM GUST @ 5000 FT.

% CHORD (X/C)	DIST. FROM R.S.	DIST. BETWEEN STA.	P(STA)	P(AU)	ΔS WHERE b=37	S (LIMIT)	DIST FROM STA TO CENTROID	ΔM₁	ΔM₂	M_T (LIMIT)	S (ULT)	M (ULT)
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬
					$\frac{37 \times ⑤ \times ③}{144}$	Σ⑥		⑧×⑨	③×⑦	Σ⑨+⑩	1.5 ⑦	1.5 ⑪
.619	58.16		-88			0		0	0	0	0	0
		6.77		-92	-160		3.35					
.650	51.39		-95			-160		-536	0	-536	-240	-805
		5.84		-99	-149		2.89					
.625	45.55		-102			-309		-431	-935	-1902	-463	-2850
		5.84		-105	-158		2.89					
.600	39.71		-108			-467		-457	-1810	-4169	-700	-6240
		5.84		-111	-167		2.89					
.575	33.87		-113			-634		-487	-2730	-7386	-950	-11100
		5.84		-116	-174		2.90					
.550	28.03		-118			-808		-505	-3700	-11591	-1210	-17400
		5.84		-122	-183		2.89					
.525	22.19		-125			-991		-529	-4720	-16840	-1490	-25200
		5.84		-128	-192		2.90					
.500	16.35		-130			-1183		-557	-5790	-23187	-1780	-34700
		5.84		-133	-200		2.90					
.475	10.51		-135			-1383		-580	-6990	-30707	-2070	-46000
		5.84		-138	-207		2.90					
.450	4.67		-140			-1590		-600	-8100	-39407	-2340	-59100
		4.67		-142	-170		2.33					
.430	0		-143			-1760		-396	-7420	-47223	-2640	-70,800

C = 233.546 IN.
b = 37.00 IN.

PREPARED BY: RUSSELL
CHECKED BY: Canfield

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE XLVII

WING BULKHEAD # 23
SHEARS AND BENDING MOMENT AT FRONT SPAR FROM L.E. AIRLOAD
COND. M.F.W. L.A.A. UNSYM. GUST @ 5000 FT.

% CHORD (X/C)	DIST. FROM F.S.	DIST. BETW. STA	P (STA)	P (AV)	ΔS b=37.00"	S (LIMIT)	DIST. FROM STA TO CENTROID	ΔM_1	ΔM_2	M_T (LIMIT)	S. (ULT.)	M_T (ULT.)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
					$\frac{37 \times (5) \times (3)}{144}$	Σ (6)		(8) x (6)	(7) x (3)	Σ (9) + (10)	1.5 (7)	1.5 (11)
0	28.12		0			0		0	0	0	0	0
		4.67		-90	-120		2.26					
.02	23.45		-180			-120		-187	0	-187	-180	-280
		4.67		-181	-217		2.34					
.04	18.78		-182			-337		-508	-560	-1255	-506	-1880
		4.67		-182	-219		2.34					
.06	14.11		-182			-556		-512	-1575	-3342	-834	-5020
		4.67		-182	-219		2.34					
.08	9.34		-182			-775		-512	-2600	-6554	-1163	-9840
		4.67		-182	-219		2.34					
.10	4.67		-182			-994		-512	-3620	-10,586	-1493	-16,000
		4.67		-182	-219		2.34					
.12	0		-182			-1213		-512	-4620	-15,738	-1821	-23,600

C = 233.546"
b = 37.00"

PREPARED BY: RUSSELL
CHECKED BY: Canfield

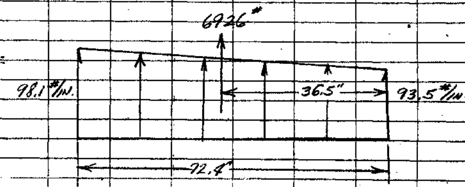
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE XLVIII

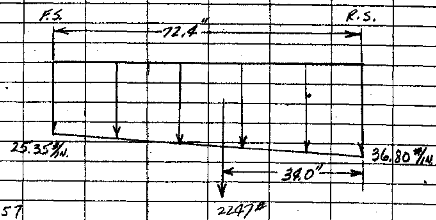
WING BULKHEAD #23
INTERSPAR AIRLOAD
COND.; M.F.W. L.A.A. UNSYM GUST @ 6000'

	% CHORD (X/c)	DIST. BETW. STA.	P (STA)	P (AV)	ΔS b=37'	S (LIMIT)	DIST. FROM STA. TO C.G.	ΔM₁	ΔM₂	MT (LIMIT)	S (ULT)	M (ULT)
	1	2	3	4	5	6	7	8	9	10	11	12
					37×2×4/144	Σ5		5×7	2×6	Σ8+9		
UPPER SURFACE	.12		-225			0			0	0		
		7.00		-232	-418		3.47	-1450				
	.15		-238			-418			0	-1450		
		11.68		-248	-744		5.76	-4280				
	.20		-257			-1162			-4890	-10,620		
		11.68		-262	-786		5.80	-4560				
	.25		-266			-1948			-13,600	-28,780		
		11.68		-264	-792		5.85	-4630				
	.30		-262			-2740			-22,700	-56,110		
		11.68		-255	-763		5.89	-4510				
	.35		-248			-3505			-32,000	-92,620		
		18.68		-232	-1112		9.55	-10,620				
	.43		-215			-4617			-65,500	-168,740	-6926	-253,110
LOWER SURFACE	.12		-43			0			0	0		
		7.00		-50	-90		3.34	-301				
	.15		-57			-90			0	-301		
		11.68		-67	-201		5.56	-1120				
	.20		-77			-291			-1050	-2471		
		11.68		-84	-252		5.69	-1440				
	.25		-90			-543			-3400	-7311		
		11.68		-93	-279		5.79	-1620				
	.30		-95			-822			-6350	-15,281		
		11.68		-94	-282		5.88	-1660				
	.35		-92			-1104			-9600	-26,541		
		18.68		-82	-394		9.72	-3830				
	.43		-72			-1498			-20,600	-50,971	-2247	-76,457

EQUIV. TRAPEZOIDAL LOADING



EQUIV. TRAPEZOIDAL LOADING

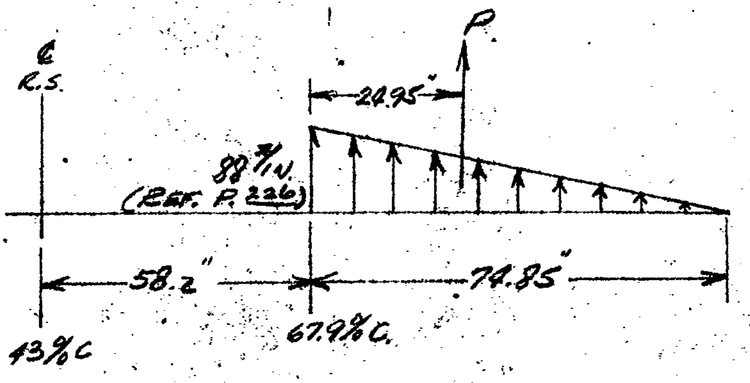


PREPARED BY: RUSSELL
CHECKED BY: Canfield

WING BULKHEAD #23

NACELLE AIR LOAD

SEE DISCUSSION ON PG II-97, FZS-36-142.



$$P_{(ULT)} = 1.5\left(\frac{88}{2} \times \frac{74.85}{12} \times \frac{37}{12}\right) = 1270^{\#}$$

THIS LOAD IS INTRODUCED AS A COUPLE AT THE ENGINE MT. FITTINGS AND AN EQUAL SHEAR ON EACH FITTING.

$$\text{COUPLE} = 1270 \times \frac{77.925}{49.5} = 1990^{\#} \rightleftarrows$$

$$\text{SHEAR} = \frac{1270}{2} = 635^{\#}\ (\text{UP})$$

WING BULKHEAD #23

L.E + T.E. AIRLOADS

L.E. SHEAR = 1821# (UP)
L.E. $MOM_{F.S.}$ = 23600"# (CLOCKWISE)
T.E. SHEAR = 2640# (UP)
T.E. $MOM_{R.S.}$ = -70,800"# (C-CLOCKWISE)

REF PG. 227

THE L.E. SHEAR IS APPLIED TO THE F.S. THE L.E. MOMENT IS APPLIED AS A COUPLE TO THE F.S. FLANGES.

$$\text{COUPLE} = \frac{23{,}600}{35.935} = 662^{\#} \rightleftarrows$$

THE T.E. SHEAR IS APPLIED EQUALLY TO THE ENGINE MT. FITTINGS.

$$\frac{2640}{2} = 1320^{\#} (\text{UP})$$

THE T.E. MOMENT IS APPLIED AS A COUPLE TO THE ENGINE MT. FITTINGS.

$$\text{COUPLE} = \frac{70{,}800 - 2640(5.725)}{49.5} = 1120^{\#} \leftrightarrows$$

WING BULKHEAD #23

ENGINE MT. FITTING LOADS

M.F.W. - L.A.A. UNSYM GUST @ 5000', REF. P. 222

UPPER FITTING

D = 53,911# (AFT)

V = 17,468# (DOWN)

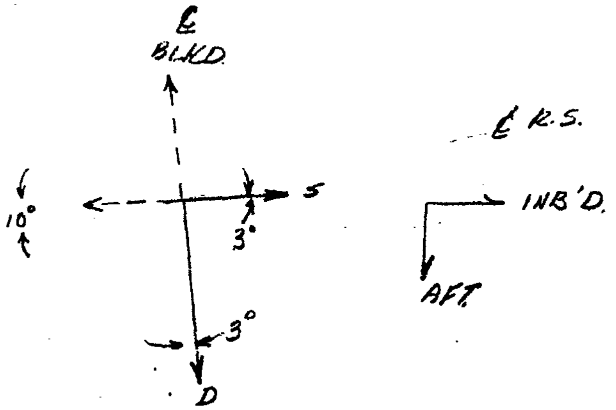
S = 7,233# (INB'D.)

LOWER FITTING

D = 60,344# (FWD)

V = 15,449# (DOWN)

S = 6,762# (OUTB'D.)



ENGINE MT. LOADS ARE RESOLVED INTO PLANE OF BLK'D AND R.S.

UPPER

$D' = D\cos 3^\circ - S\sin 3^\circ = 53{,}911 \times .9986 - 7233 \times .0523 = 53{,}458^\#$

$S' = D\sin 3^\circ + S\cos 3^\circ = 53{,}911 \times .0523 + 7233 \times .9986 = 10{,}043^\#$

$D'' = S'\tan 10^\circ = 10{,}043 \times .1763 = 1771^\#$

$D_{TOTAL} = 53{,}458 + 1771 = \underline{55{,}229}^\#$

LOWER

$D' = -60{,}344 \times .9986 + 6762 \times .0523 = -59{,}906^\#$

$S' = -60{,}344 \times .0523 - 6762 \times .9986 = -9909^\#$

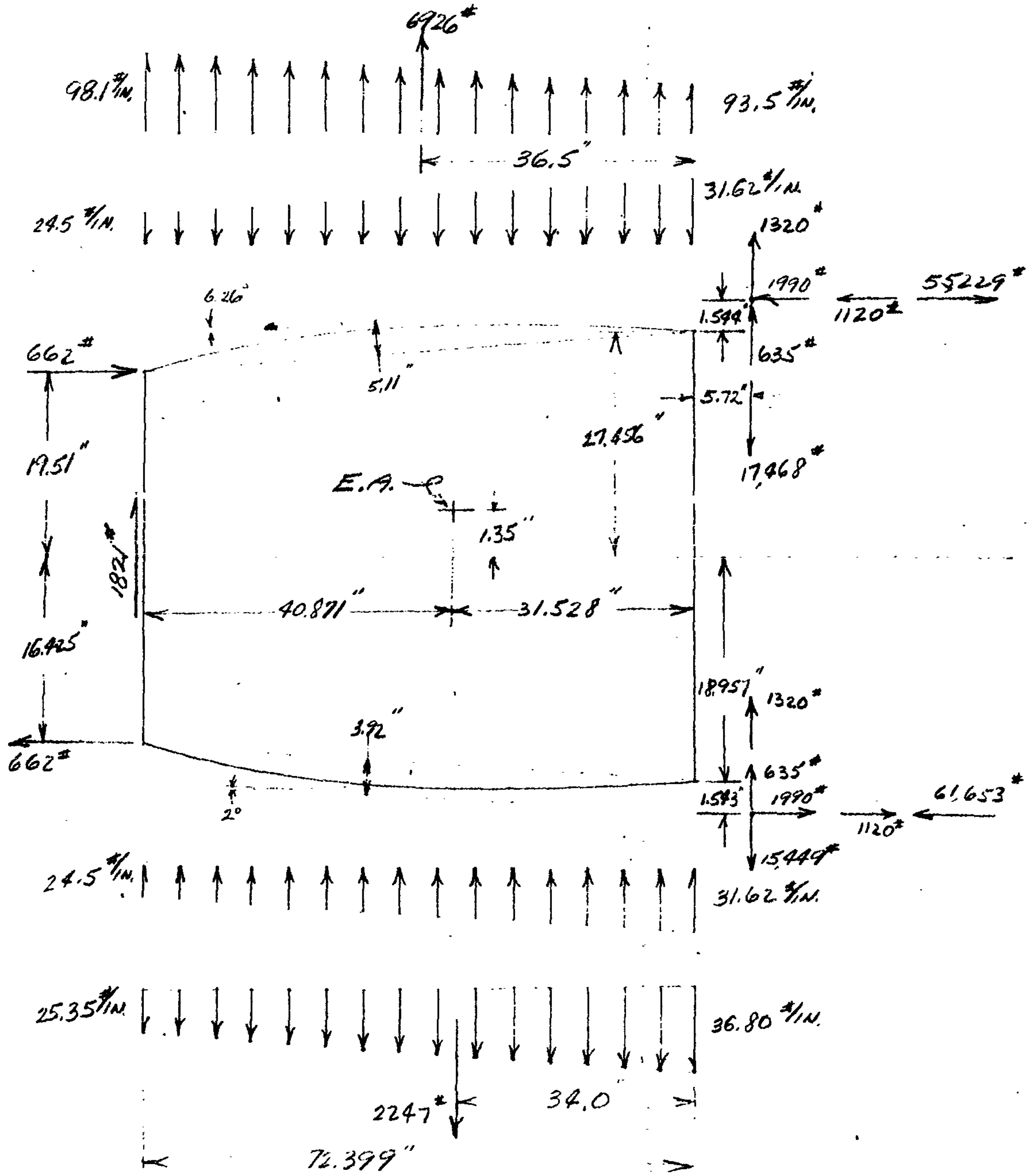
$D'' = -9909 \times .1763 = -1747^\#$

$D_{TOTAL} = -59{,}906 - 1747 = -61{,}653^\#$

WING BULKHEAD #23

APPLIED LOADS

M.F.W. - L.A.A. UNSYM GUST @ 5000'



WING BULKHEAD #23

Σ LOADS ABOUT ELASTIC AXIS

DRAG

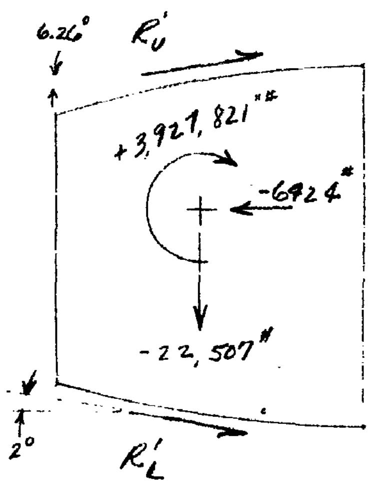
$D = 55{,}229 - 61{,}653 = -6424^{\#}$ (FWD)

VERT.

$V = 6926 - 2247 - 17{,}468 - 15{,}449 + 2(635) + 2(1320) + 1821$
$= -22{,}507^{\#}$ (DOWN)

ΣM_{EA} (+CLOCKWISE)

$MOM. = +662(35.935) + 1821(40.871) + 6926(4.972)$
$-2247(2.472) - 1990(49.50) - 1120(49.50) + 55{,}229(21.65)$
$+61{,}653(21.85) - 1320(2) \times 37.253 - 2(635) \times 37.253$
$+17{,}468(37.253) + 15{,}449 \times 37.253$
$= +3{,}927{,}821''^{\#}$



WING BULKHEAD # 23

Σ LOADS ABOUT E.A. (CONT'D.)

THE DRAG IS REACTED AT THE UPPER AND LOWER SURFACE SHEAR CENTERS.

$$R_U = 6424\left(\frac{23.25}{50.90}\right) = +2934^{\#}\ (AFT)$$

$$R_L = 6424\left(\frac{27.65}{50.90}\right) = +3490^{\#}\ (AFT)$$

RESOLVE $R_U + R_L$ PARALLEL TO THE SHEAR CENTER.

$$R_U' = \frac{2934}{\cos 6.26^\circ} = \frac{2934}{.992} = 2958^{\#}$$

$$R_L' = \frac{3490}{\cos 2^\circ} = \frac{3490}{.999} = 3493^{\#}$$

REACTING $R_U' + R_L'$ AS SHEAR FLOWS.

$$q_U = \frac{2958}{72.4} = 40.8^{\#}/_{IN}, \quad q_L = \frac{3493}{72.4} = 48.2^{\#}/_{IN}$$

RESOLVE $R_U + R_L \perp$ TO CHORD LINE.

$$R_{VU} = 2934 \tan 6.26^\circ = 322^{\#}\ (UP)$$

$$R_{VL} = 3493 \tan 2^\circ = 122^{\#}\ (DOWN)$$

$$TOTAL = 200^{\#}\ (UP)$$

REACT. AT FRONT AND REAR SPAR.

$$F.S. = 200\left(\frac{31.528}{72.399}\right) = -87^{\#}\ (DOWN)$$

$$R.S. = 200 - 87 = 113^{\#}\ (DOWN$$

WING BULKHEAD #23

Σ LOADS ABOUT E.A (CONT'D)

REACT. VERT. UNBALANCE AT F.S. + R.S.

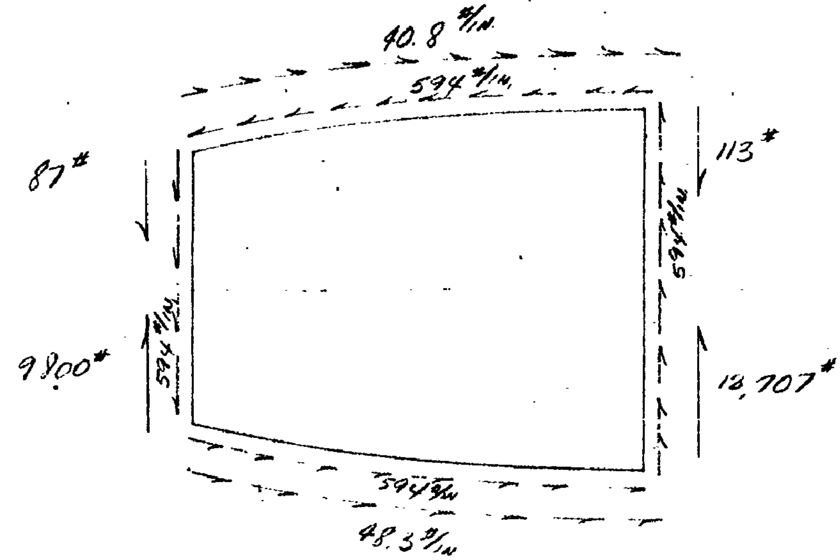
$$R_{F.S.} = 22,507\left(\frac{31.578}{72.399}\right) = +9,800^{\#}(UP)$$

$$R_{R.S.} = 22,507\left(\frac{40.871}{72.399}\right) = +12,707^{\#}$$

REACT. TORQUE AS SHEAR AROUND BLK'D

$$q_T = \frac{T}{2A} = \frac{3,927,821}{6616} = -594^{\#/IN}$$

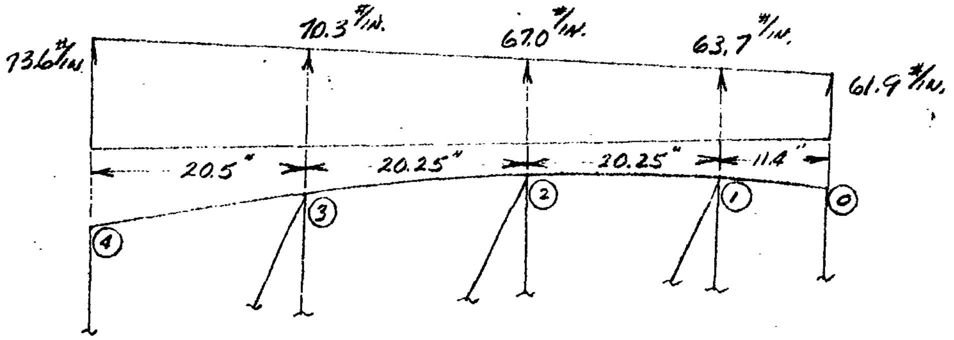
REACTIONS TO BULKHEAD



WING BULKHEAD #23

PANEL POINT LOADS (UPPER SURF)

CALCULATION OF PANEL POINT LOADS DUE TO CRUSHING + AIRLOADS. (REF. FOR APPLIED LOADS PG. 232)



$$\frac{73.6-61.9}{72.4} = \frac{w}{X} \quad ; \quad w = \frac{11.7X}{72.4}$$

$$w_1 = \frac{11.7(11.4)}{72.4} = 1.84 \quad , \quad w_2 = \frac{11.7(31.65)}{72.4} = 5.11$$

$$w_3 = \frac{11.7(51.90)}{72.4} = 8.38$$

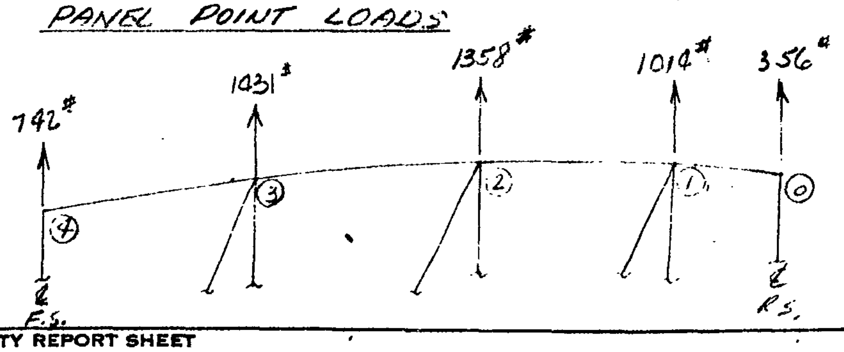
ORDINATES

AT, 1 = 61.9 + 1.84 = 63.7

2 = 61.9 + 5.11 = 67.0

3 = 61.9 + 8.38 = 70.3

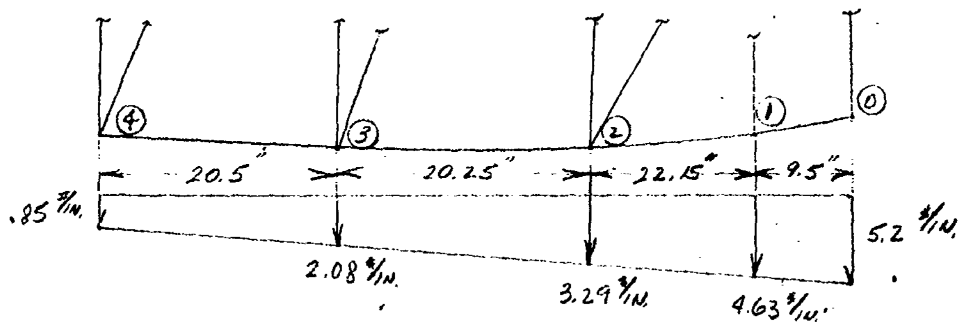
PANEL POINT LOADS



WING BULKHEAD #23

PANEL POINT LOADS (LOWER SURF.)

CALCULATION OF PANEL POINT LOADS DUE TO CRUSHING + AIRLOADS. (REF. FOR APPLIED LOADS PG. 232)



$$\frac{5.2-.85}{72.4} = \frac{w}{x} \quad ; \quad w = \frac{4.35x}{72.4}$$

$$w_1 = \frac{62.9 \times 4.35}{72.4} = 3.78 \text{ \#/in.} \quad , \quad W_2 = \frac{40.75 \times 4.35}{72.4} = 1.77 \text{ \#/in.}$$

$$w_3 = \frac{20.5 \times 4.35}{72.4} = 1.23 \text{ \#/in.}$$

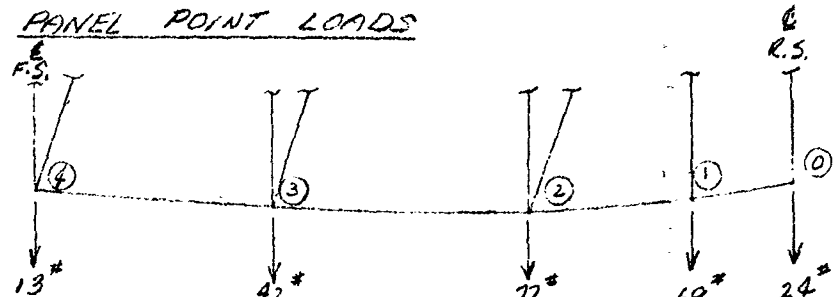
ORDINATES

AT, $1 = .85 + 3.78 = 4.63$ #/in

$2 = .85 + 2.44 = 3.29$ #/in.

$3 = .85 + 1.23 = 2.08$ #/in

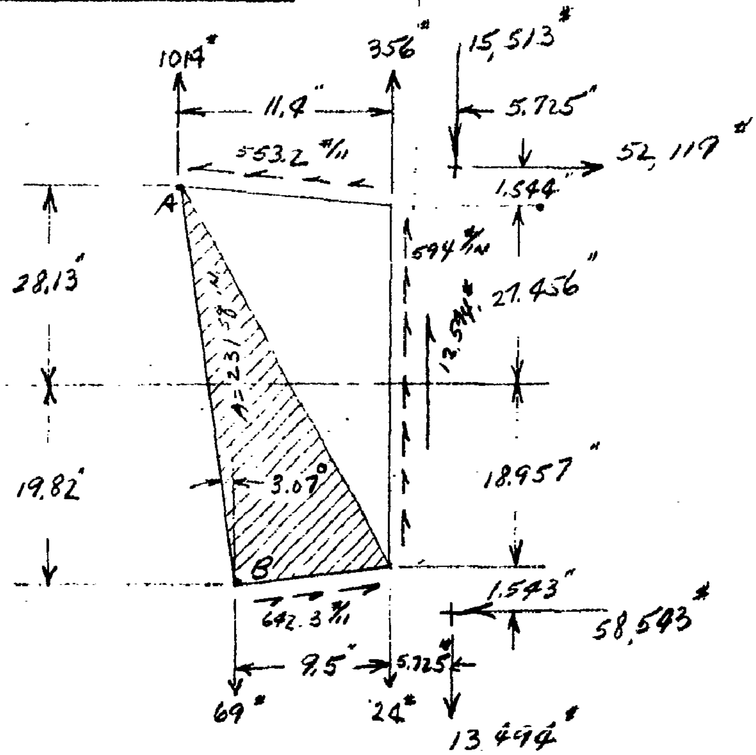
PANEL POINT LOADS



WING BULKHEAD #23

WEB REACTIONS TO TRUSS

FOR LOADS SEE PGS. 232, 236 & 237



$\Sigma M_A = 0$

$$47.95\,R_B = -(356 + 46.413(594) + 12{,}594 - 24)\,11.4$$
$$+ (15{,}513 + 13{,}494)\,17.125 + 58{,}593(48.63)$$
$$+ 52{,}119(.87) + 69(1.9) - 642.3 \times 2(231)$$
$$= +2{,}622{,}670''^{\#} \text{ (CLOCKWISE)}$$

$$R_{B_H} = \frac{2{,}622{,}670}{47.95} = +55{,}006^{\#} \text{ (AFT)}$$

WING BULKHEAD #23

WEB REACTIONS TO TRUSS (CONT'D)

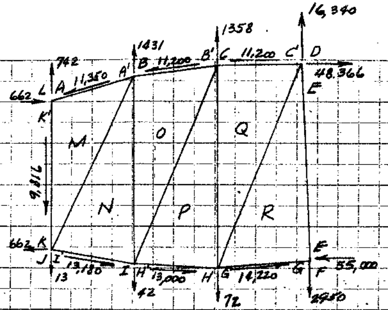
$\Sigma_H = 52{,}119 - 553.2(11.4) - 58{,}543 + 692.3(9.5)$
$= -6634^{\#}$ (FWD)

$R_{AH} = R_{BH} - 6634^{\#}$
$= 55{,}000 - 6634 = 48{,}376$ (FWD)

$R_{BV} = 55{,}000 \times \tan 3.07° = 2950^{\#}$ (UP)

$\Sigma_V = 356 - 15{,}513 + 594(46.413) + 12{,}594 - 24 + 1014$
$- 13{,}494 - 69 + 553.2(.674) + 692.3(.863)$
$= +13{,}390^{\#}$

$R_{AV} + R_{BV} = -13{,}390$
$R_{AV} = -13{,}390 - 2950$
$= -16{,}340^{\#}$



AM = − 280	KM = − 9600
A'M = + 11,000	K'M = + 600
BO = + 14,900	MN = + 10,000
B'O = + 26,100	NO = − 8,800
CQ = + 30,100	OP = + 11,200
C'Q = + 41,300	PQ = − 11,600
	QR = + 18,100
GR = − 55,100	
G'R = − 40,800	
HP = − 33,800	
H'P = − 20,800	
IN = − 16,800	
I'N = − 3,600	

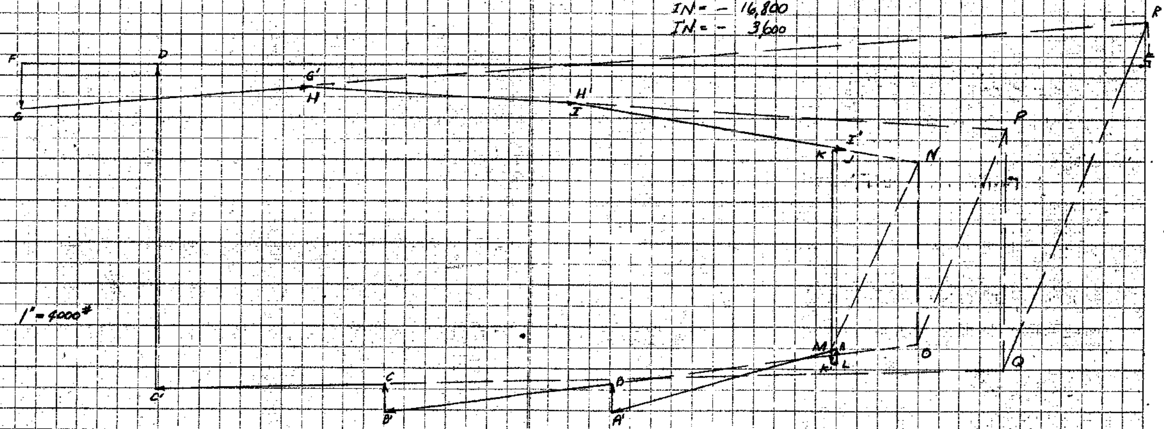


FIGURE 23

CALCULATED BY		TRUSS MEMBER LOADS	DOC. NO.
DRAWN BY	RUSSELL	MFW – L.A.A. Unsym Gust @ 5000 FT.	[illegible]
CHECKED BY	[illegible]	CONSOLIDATED VULTEE AIRCRAFT CORPORATION FORT WORTH DIVISION, FORT WORTH, TEXAS	MODEL
APPROVED BY			XB-36

WING BULKHEAD #23

CONDITION

MIN. FLYING WT. (136,018#) I.L.A.A. UNSYM. GUST
@ 5000'

WING BULKHEAD #23

CRUSHING LOADS (M.F.W - I.L.A.A. UNSYM GUST @ 5000')

M'_x IS ASSUMED EQUAL TO M_x

$M_x = 16,200,000$ "# (OBTAINED FROM PRELIMINARY CALCULATIONS.)

$$P_{CR} = \frac{(M_x)^2 L}{\left(\frac{I}{Q}\right)_x E I}$$

$I_x = 22,660$ IN.^{4}
$Q_x = 515.24$ IN.^{3}
$L = 37.0$ (BLKD. SPACING)
$E = 10,300,000$

FZS-36-142 PG. II-201

$$P_{CR} = \frac{(16,200,000)^2 (37)}{\left(\frac{22660}{515.24}\right) 10.3 \times 10^6 \times 22660} = 943^{\#}$$

CRUSHING LOAD WILL BE DISTRIBUTED TRAPEZOIDALLY IN PROPORTION TO SPAR DEPTHS.

F.S. = 35.935
R.S. = 46.413
2) 82.348
41.174 AVERAGE SPAR DEPTH

$\frac{943}{72.4} = 13.03$ #/IN AVERAGE LOADING OVER CHORD

AT F.S., $w = \frac{35.75}{41.174} \times 13.03 = \underline{11.38}$ #/IN

AT R.S., $w = \frac{46.413}{41.174} \times 13.03 = \underline{14.70}$ #/IN

TABLE XLIX

WING BULKHEAD #23

SHEAR AND BEND MOM. OF AIRLOAD ABOUT F.S. (L.E. AIRLOAD)
M.F.W. - 1LAA @ 5000'

% CHORD (x/c)	DIST. FROM F.S.	DIST. BETW. STA.	$P_{(STA)}$	$P_{(AVE)}$	ΔS b = 37	S (LIMIT)	DIST. TO CENTROID	ΔM_1	ΔM_2	M_T (LIMIT)	S (ULT)	M (ULT)
1	2	3	4	5	6	7	8	9	10	11	12	13
					$\frac{37 \times 5 \times 3}{144}$	Σ 6		8 × 9	7 × 3	Σ 9 + 10	1.5 7	1.5 11
0	28.12		0			0		0	0	0		
		4.67		351	421		2.31					
.02	23.45		377			421		971	0	971		
		4.67		366	439		2.36					
.04	18.78		355			860		1038	1962	3971		
		4.67		332.5	399		2.39					
.06	14.11		310			1259		953	4010	8934		
		4.67		290	348		2.39					
.08	9.34		270			1607		832	5880	15,646		
		4.67		255	306		2.39					
.10	4.67		240			1913		728	7500	23,874		
		4.67		227.5	273		2.38					
.12	0		215			2186		650	8930	33,454	3280	50200

PREPARED BY: RUSSELL 11/14/47
CHECKED BY: [illegible signature]

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

WING BULKHEAD #23
SHEAR AND BENDING MOMENT OF AIRLOAD ABOUT R.S. (T.E. AIRLOAD)
TABLE I M.F.W.-I.L.A.A. @ 5800'

% CHORD (X/C)	DIST. FROM R.S.	DIST. BETW. STA.	P (STA)	P (AVE)	ΔS (b=37)	S (LIMIT)	DIST TO CENTROID	ΔM_1	ΔM_2	M_T (LIMIT)	S (ULT)	M (ULT.)
1	2	3	4	5	6	7	8	9	10	11	12	13
					$\frac{37 \times 3 \times 5}{144}$	Σ 6		8 × 6	3 × 7	Σ 9 + 10	1.5 (7)	1.5 (11)
.679	58.16		-25			0		0	0.	0		
		6.77		-25	-44		3.39					
.650	51.39		-25			-44		-149	0	-149		
		5.84		-25	-38		2.92					
.625	45.55		-25			-82		-111	-257	-517		
		5.84		-25	-38		2.92					
.600	39.71		-25			-120		-111	-479	-1107		
		5.84		-23.5	-35		2.86					
.575	33.87		-22			-155		-100	-702	-1909		
		5.84		-20	-30		2.83					
.550	28.03		-18			-185		-85	-907	-2901		
		5.84		-15.5	-23		2.76					
.525	22.19		-13			-208		-64	-1080	-4045		
		5.84		-10	-15		2.63					
.500	16.35		-7			-223		-37	-1215	-5299		
		5.84		-3.5	-5		1.93					
.475	10.51		0			-228		-10	-1304	-6613		
		5.84		+4	+6		3.86					
.450	4.67		+8			-222		+23	-1332	-7922		
		4.67		+12	+18		2.59					
.430	0		+16			-204		+47	-1038	-8913	-306	-13,380

TRANSFER SHEAR TO AFT FITTINGS

REDUCED MOM. = 13,380 − 306(5.725) = 11,630"#

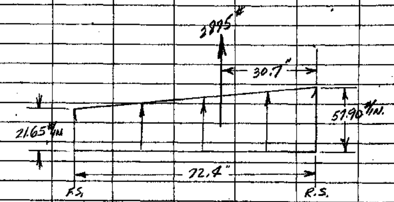
PREPARED BY: RUSSELL 11/14/47
CHECKED BY: [signature] 11/25/47

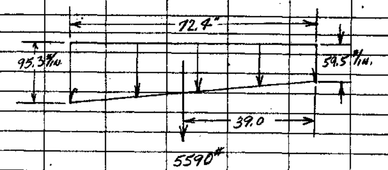
CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE 21

WING BULKHEAD #23
INTERSPAR AIRLOAD
M.F.W. - I.L.A.A. - @ 5000'

	% CHORD (X/C)	DIST. BETW. STA.	$P_{(STA)}$	$P_{(AVE)}$	ΔS b=37	S (LIMIT)	DIST. TO CENTROID	ΔM_1	ΔM_2	M_T (LIMIT)	S (ULT)	M (ULT)
	1	2	3	4	5	6	7	8	9	10	11	12
					$\frac{37 \times (2) \times (4)}{144}$	Σ5		7×5	2×6	Σ8+9	Σ6	Σ10
UPPER SURFACE	.12		22			0		0	0	0		
		7.00		37.5	67		3.02					
	.15		53			67		200	0	200		
		11.68		70	210		5.37					
	.20		87			277		1130	780	2110		
		11.68		98.5	296		5.60					
	.25		110			573		1660	3240	7010		
		11.68		117.5	353		5.71					
	.30		125			926		2020	6710	15,790		
		11.68		127.5	382		5.79					
	.35		130			1308		2210	10,850	28,800		
		18.68		126.5	607		9.26					
	.43		123			1915		5620	24,450	58,870	2875	88,310
LOWER SURFACE	.12		237			0		0	0	0		
		7.00		235	423		3.51					
	.15		233			423		1490	0	1490		
		11.68		228.5	685		5.89					
	.20		224			1108		4030	4960	10,480		
		11.68		218.5	655		5.90					
	.25		213			1763		3870	12,930	27,280		
		11.68		205.5	616		5.93					
	.30		198			2379		3660	20,600	51,590		
		11.68		189	567		5.94					
	.35		180			2946		3370	27,800	86,710		
		18.68		163	782		7.65					
	.43		146			3728		7550	35,000	145,260	5590	219,040



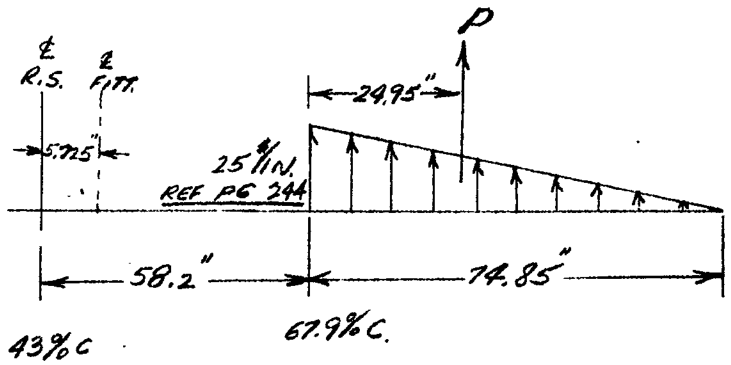


PREPARED BY: RUSSELL 11/24/47
CHECKED BY: [illegible]

WING BULKHEAD #23

NACELLE AIR LOAD

SEE DISCUSSION ON PG II-97, FZS-36-142



$$P_{(ULT)} = 1.5\left(\frac{25}{2} \times \frac{74.85}{2} \times \frac{37}{12}\right) = 361^{\#}$$

THIS LOAD IS INTRODUCED AS A COUPLE AT THE ENGINE MT FITTINGS AND AN EQUAL SHEAR ON EACH FITTING.

$$\text{COUPLE} = \frac{361 \times 77.425}{49.5} = 565^{\#} \leftrightarrows$$

$$\text{SHEAR} = \frac{361}{2} = 180.5\ ^{\#}/\text{FITTING (UP)}$$

WING BULKHEAD #23

L.E + T.E AIRLOADS

L.E SHEAR = $-3280^{\#}$ (DOWN)
L.E $MOM_{F.S.} = -50200''^{\#}$ (C-CLOCKWISE)
T.E SHEAR = $306^{\#}$ (UP)
T.E $MOM_{R.S.} = 11,630''^{\#}$ (C-CLOCKWISE)

REF. PG 243

THE L.E SHEAR IS APPLIED AT THE F.S.. THE L.E MOMENT IS APPLIED AS A COUPLE TO THE F.S. FLANGES.

$$COUPLE = \frac{50200}{35.935} = 1396^{\#} \leftrightarrows$$

THE T.E SHEAR IS APPLIED EQUALLY TO THE ENGINE MT. FITTINGS

$$\frac{306}{2} = 153^{\#}/\text{FITTING (UP)}$$

THE T.E MOMENT IS APPLIED AS A COUPLE TO THE ENGINE MT. FITTINGS.

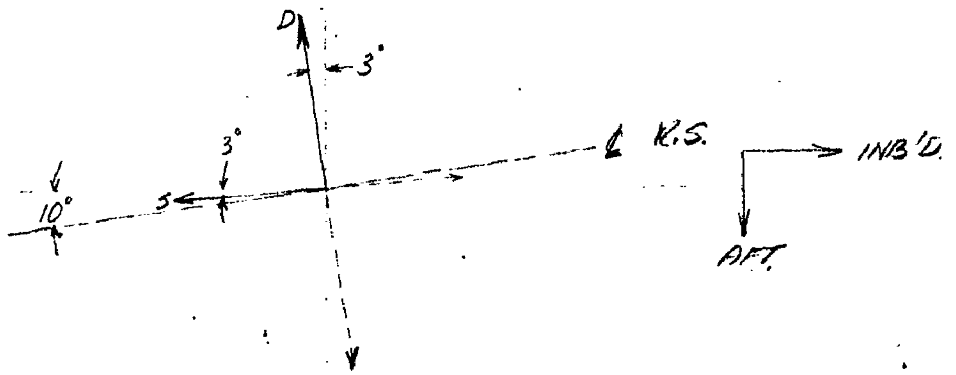
$$COUPLE = \frac{11630}{49.5} = 235^{\#} \leftrightarrows$$

WING BULKHEAD #23

ENGINE MT FITTING LOADS

M.F.W. - ILAA - UNSYM GUST @ 5,000' REF. P. 222

UPPER FITTING	LOWER FITTING
V = +11,279#	V = +10,097#
D = -35,861#	D = +34,528#
S = -4,617#	S = +3940#



ENGINE MT. LOADS ARE RESOLVED INTO PLANE OF B'LK'D AND R.S.

UPPER

$D' = -D \cos 3° + S \sin 3° = -35861(.9986) + 4617(.0523) = -35570^{\#}$

$S' = -D \sin 3° - S \cos 3° = -35861(.0523) - 4617(.9986) = -6490^{\#}$

$D'' = S \tan 10° = -6490(.1763) = -1140^{\#}$

$D_{TOTAL} = -35,570 + (-1140) = \underline{-36,710}^{\#}$

LOWER

$D' = D \cos 3° - S \sin 3° = 34528(.9986) - 3940(.0523) = +34,270^{\#}$

$S' = D \sin 3° + S \cos 3° = 34528(.0523) + 3940(.9986) = +5740^{\#}$

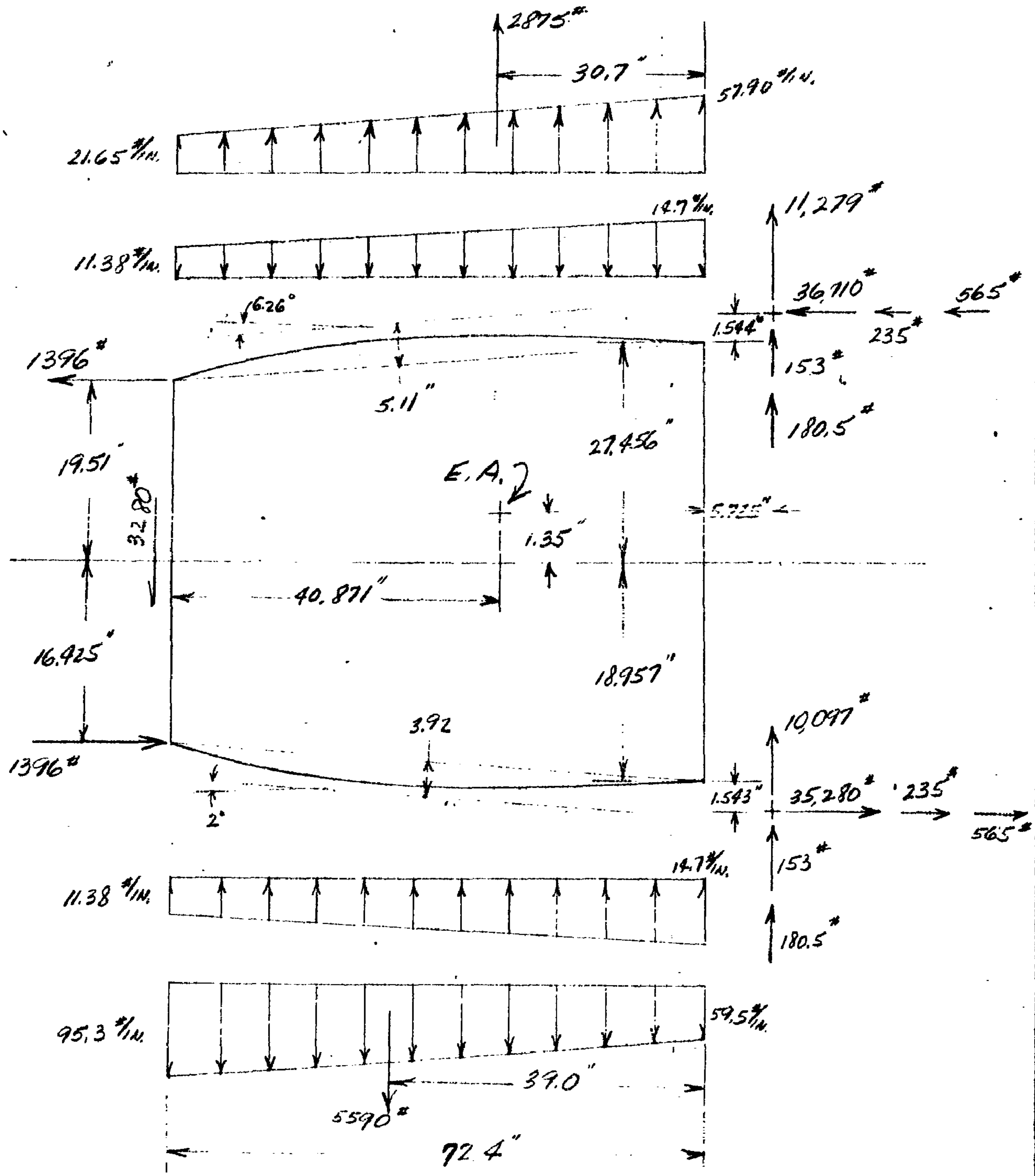
$D'' = S \tan 10° = +5740(.1763) = +1010^{\#}$

$D_{TOTAL} = 34,270 + 1010 = \underline{+35,280}^{\#}$

WING BULKHEAD #23

APPLIED LOADS

M.F.W. - I.L.A.A. - UNSYM GUST @ 5000'



WING BULKHEAD #23

Σ LOADS ABOUT ELASTIC AXIS

DRAG

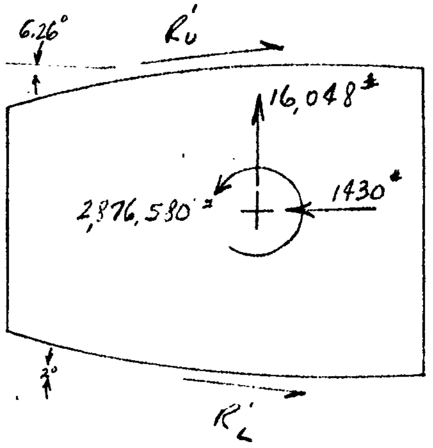
$D = -36{,}710 + 35{,}280 = \underline{-1430}$ (FWD.)

VERT.

$V = +2875 + 11279 + 333.5 + 10{,}097 + 333.5$
$-5590 - 3280$
$= +16{,}048^{\#}$ (UP)

ΣM_{EA} (+ CLOCKWISE)

$MOM. = -1396(35.935) - 3280(40.871) - 2875(.828)$
$-11{,}613(37.253) - 37{,}510(27.65) - 36{,}080(21.85)$
$-10{,}431(37.253) - 5590(1.472)$
$= -2{,}876{,}580''^{\#}$



WING BULKHEAD #23

Σ LOADS ABOUT E.A (CONT'D)

THE DRAG IS REACTED AT THE UPPER AND LOWER SURFACE SHEAR CENTERS.

$$R_U = 1430\left(\frac{23.25}{50.90}\right) = 653^{\#}$$

$$R_L = 1430\left(\frac{27.65}{50.90}\right) = 777^{\#}$$

RESOLVE $R_U + R_L$ PARALLEL TO SHEAR CENTERS.

$$R_U' = \frac{653}{\cos 6.26^\circ} = 658^{\#}$$

$$R_L' = \frac{777}{\cos 2^\circ} = 778^{\#}$$

REACT $R_U' + R_L'$ AS SHEAR FLOWS.

$$q_U = \frac{658}{72.4} = 9.1\ \#/in \quad , \quad q_L = \frac{778}{72.4} = 10.75\ \#/in$$

RESOLVE $R_U + R_L$ ⊥ TO CHORD LINE.

$$R_{V_U} = 653 \tan 6.26^\circ = 70.5^{\#}\ (UP)$$

$$R_{V_L} = 777 \tan 2^\circ = \underline{27.1^{\#}}\ (DOWN)$$

$$TOTAL = 43.4\ (UP)$$

REACT AT FRONT AND REAR SPAR

$$F.S. = 43.4\left(\frac{31.528}{72.399}\right) = 18.9^{\#}\ (DOWN)$$

$$R.S. = 43.4 - 18.9 = 24.5^{\#}\ (DOWN)$$

WING BULKHEAD #23

Σ LOADS ABOUT E.A. (CONT'D)

REACT VERT. UNBALANCE AT F.S. + R.S.

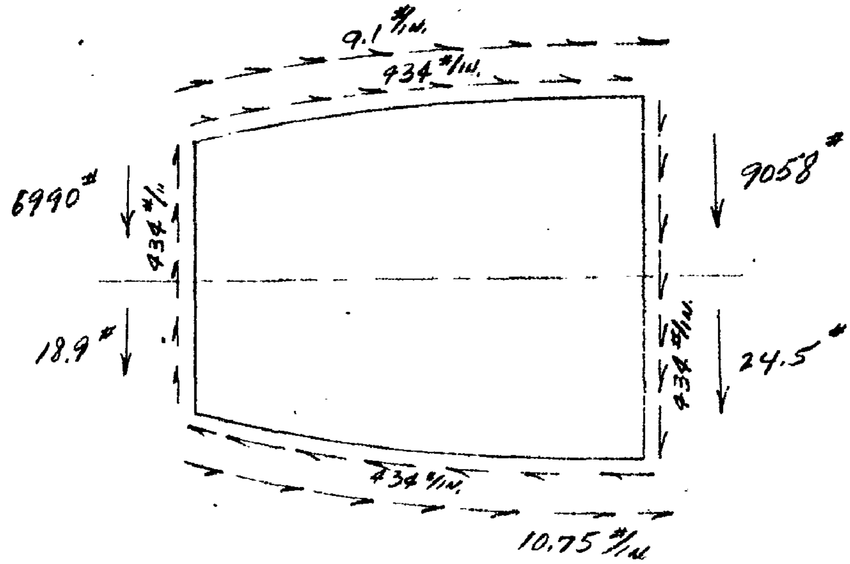
$$R_{F.S.} = 16048\left(\frac{31.528}{72.4}\right) = 6990^{\#}\ (\text{DOWN})$$

$$R_{R.S.} = 16048\left(\frac{40.871}{72.4}\right) = 9058^{\#}\ (\text{DOWN})$$

REACT TORQUE AS SHEAR AROUND BLK'D.

$$q_T = \frac{T}{2A} = \frac{2\,876\,580}{6616} = 434^{\#}/\text{IN.}$$

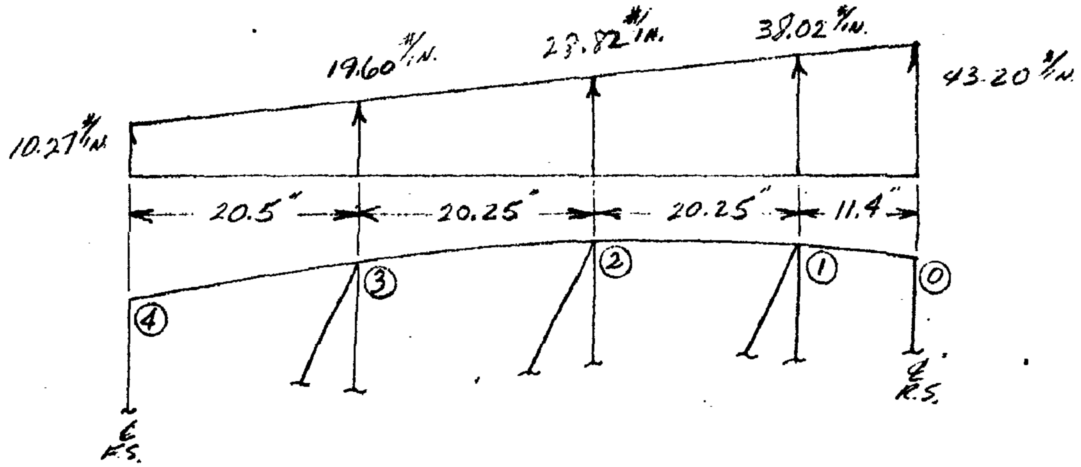
REACTIONS TO BULKHEAD



WING BULKHEAD #23

PANEL POINT LOADS (UPPER SURF.)

CALCULATION OF PANEL POINT LOADS DUE TO CRUSHING + AIR LOADS. (REF PG. 249 FOR APPLIED LOADS).



ORDINATES AT PANEL POINTS

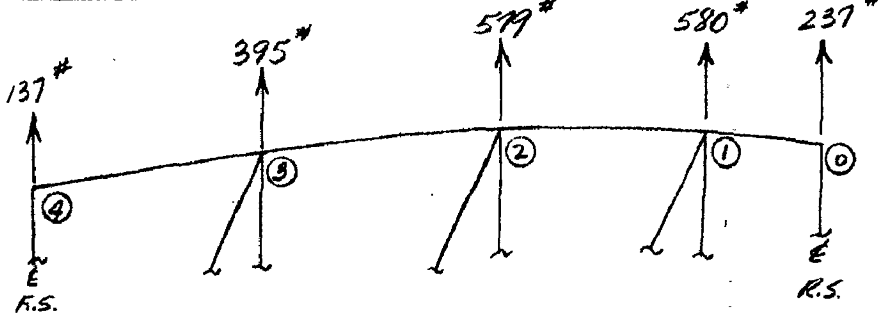
$$\frac{32.93}{72.4} = \frac{x}{L}, \quad \frac{32.93\,L}{72.4} = x, \quad x = .455\,L$$

AT ① $W = 10.27 + 61.0(.455) = 38.02$ #/IN.

② $W = 10.27 + 40.75(.455) = 28.82$ #/IN.

③ $W = 10.27 + 20.5(.455) = 19.60$ #/IN.

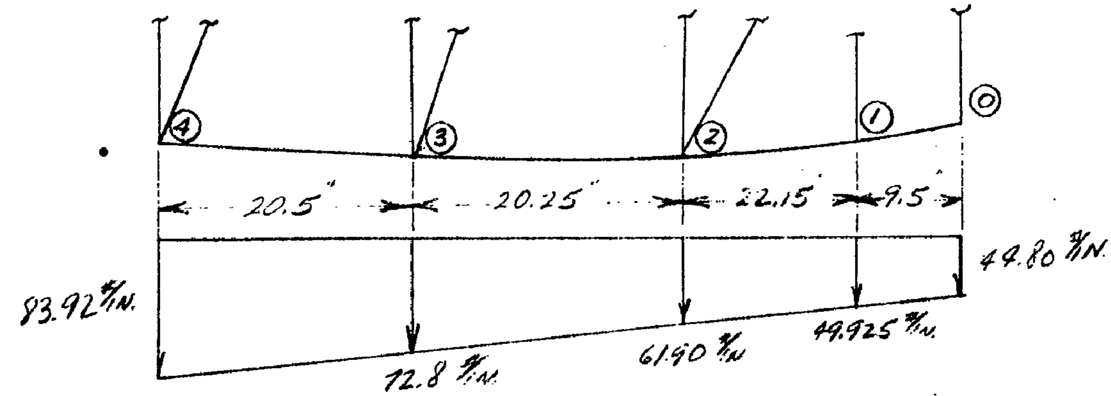
PANEL POINT LOADS



WING BULKHEAD #23

PANEL POINT LOADS (LOWER SURF.)

CALCULATION OF PANEL POINT LOADS DUE TO CRUSHING AND AIR LOADS.
(REF. PG 249 FOR APPLIED LOADS)



ORDINATES AT PANEL POINTS

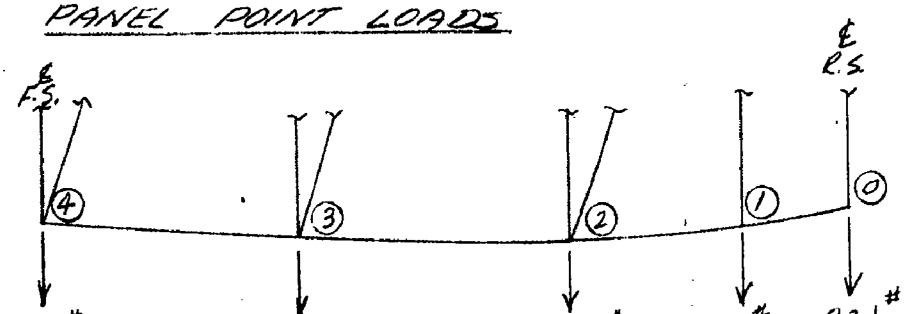
$$\frac{32.12}{72.4} = \frac{X}{L}, \quad \frac{39.12}{72.4} L = X, \quad X = .54(L)$$

AT. ① $w = 44.8 + 9.5(.54) = 49.925$ #/IN.

② $w = 44.8 + 31.65(.54) = 61.90$ #/IN.

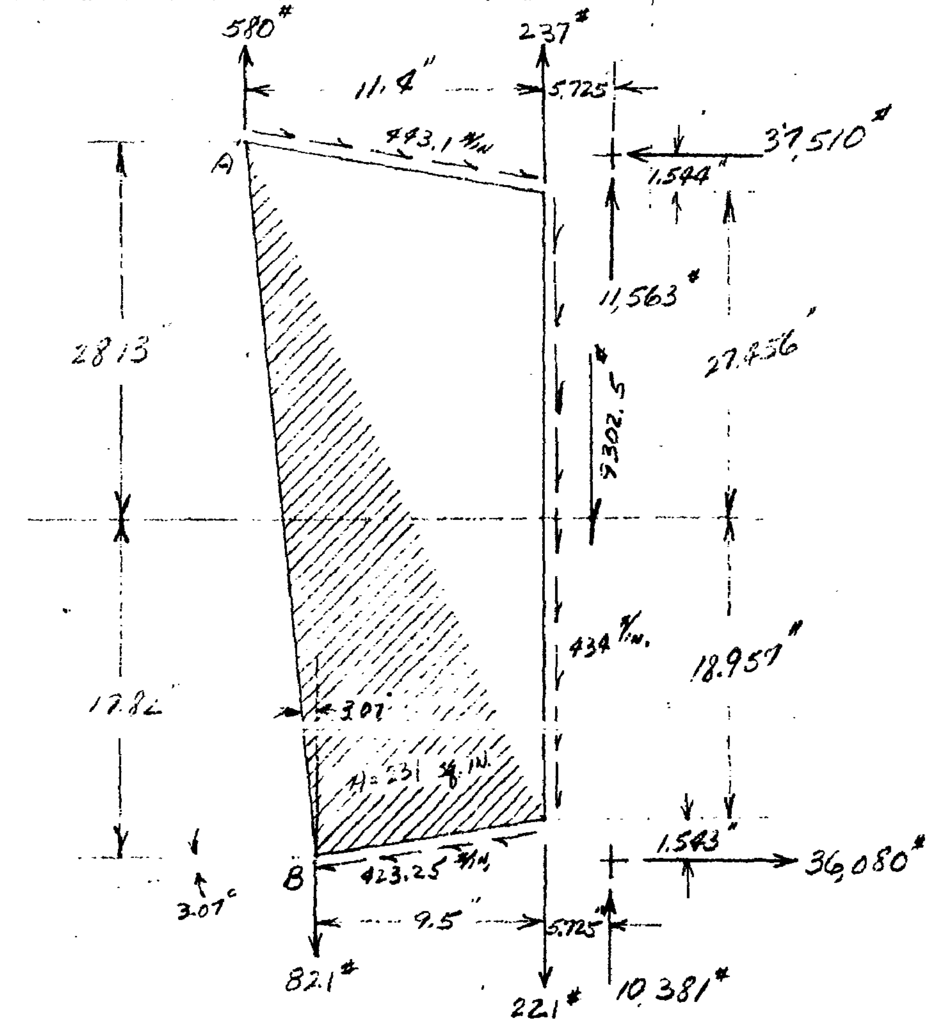
③ $w = 44.8 + 51.90(.54) = 72.8$ #/IN.

PANEL POINT LOADS



WING BULKHEAD #23

WEB REACTIONS TO TRUSS



$\Sigma M_A = 0$

$$
\begin{aligned}
47.95\, R_B = {} & -11.4(237) + 11.4(434 \times 46.413) + 11.4(9032.5) \\
& + 11.4(221) - 17.125(11{,}563) - 17.125(10{,}381) \\
& - .87(37510) - 48.63(36{,}080) + 2(231)(423.25) \\
& + 1.9(821) \\
= {} & -1{,}637{,}000 \text{ "\#}
\end{aligned}
$$

$$R_{B_H} = \frac{1637000}{47.95} = -34{,}100\#\ (\text{FWD})$$

WING BULKHEAD #23

WEB REACTIONS TO TRUSS (CONT'D.)

$\Sigma_H = 0$

$= +443.1(11.4) - 37,510 + 36,080 - 423.25(9.5)$
$-34,100 + R_{AH} = 0$

$R_{AH} = 34,510^{\#}$ (AFT)

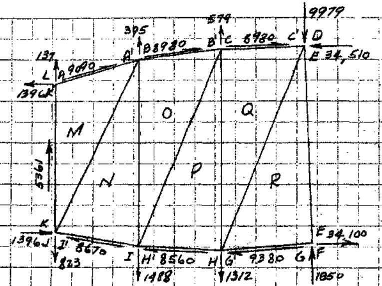
$R_{BV} = R_{BH}$ TAN $3.07° = -34,000(.0396) = \underline{-1850^{\#}}$ (DOWN)

$\Sigma_V = 0$

$= -443.1(.674) + 237 + 11,563 - 434(46.413) - 9032.5$
$+ 10,381 - 221 - 821 + 580 - 423.25(.863) - 1850 + R_{VA} = 0$

$R_{VA} = \underline{9974^{\#}}$

KEUFFEL & ESSER CO. N. Y.



AM = + 1360	H'P = + 12,300
A'M = − 8090	IN = + 9,800
BO = − 10,280	I'N = + 1100
B'O = − 19,200	KM = + 6000
CQ = − 21,700	K'M = + 500
C'Q = − 30,550	MN = − 5600
	NO = + 6400
GR = + 34,150	OP = − 6300
G'R = + 24,750	PQ = + 7730
HP = + 20,800	QR = − 10,320

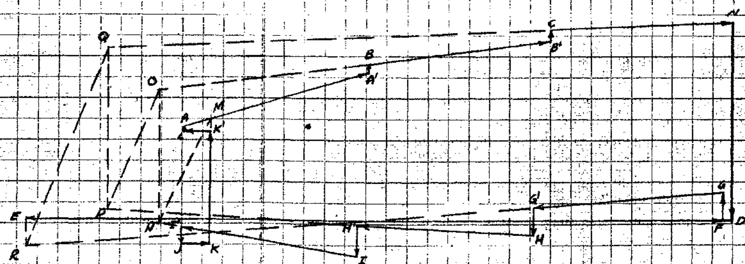


FIGURE 24

TRUSS MEMBER LOADS

M.F.W. - I.L.A.A.-Unsym Gust 5000 FT.

CALCULATED BY	
DRAWN BY	RUSSELL
CHECKED BY	Claughton
APPROVED BY	

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION, FORT WORTH, TEXAS

DOC. NO. FZS-36-242

MODEL XB-36

WING BULKHEAD #23

MEMBER LOADS

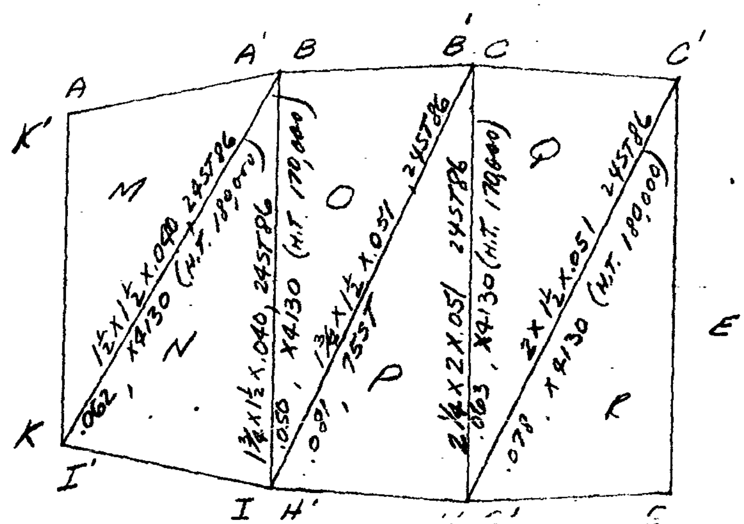
SUMMARY

TABLE III

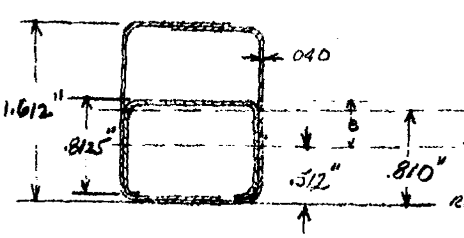
MEMBER	CONDITION (M.F.W. L.A.A.-Unsym Gust @5000' Ref P 240)	CONDITION (M.F.W.-I.L.A.A.-Unsym Gust @5000' Ref P 251)
AM	-280#	1360#
A'M	11,000#	-8090#
BO	14,900#	-10,280#
B'O	26,100#	-19,200#
CQ	30,100#	-21,700#
C'Q	41,300#	-30,550#
ER	———	———
GK	-55,100#	34,150#
G'R	-40,800#	24,750#
HP	-33,800#	20,800#
H'P	-20,800#	12,300#
IN	-16,800#	9800#
I'N	-3600#	1100#
KM	-9600#	6000#
K'M	600#	500#
MN	10,000#	-5600#
NO	-8800#	6400#
OP	11,200#	-6300#
PQ	-11,600#	7730#
QR	18,100#	-10,320#

WING BULKHEAD #23

VERTICAL + DIAGONAL MEMBERS



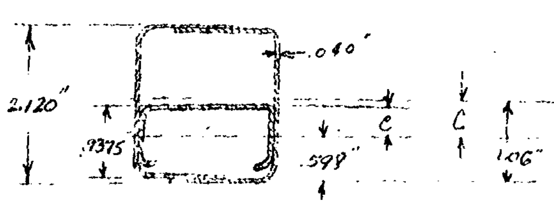
MEMBER MN



N.A TUBE $c = .810 - .512 = .298''$

N.A. END SEC. $c = (.8125 + .08) - .512 = .3805''$

MEMBER NO



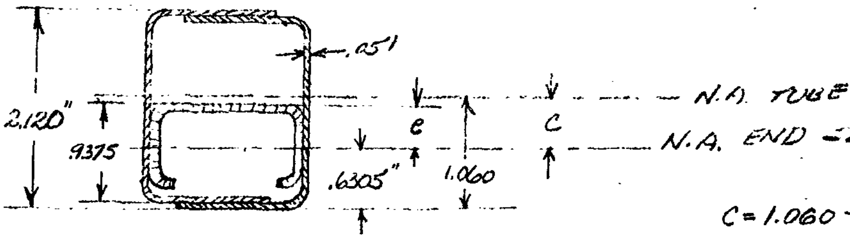
N.A TUBE $C = 1.060 - .598 = .462''$

N.A END SEC. $c = (.9375 + .04) - .598 = .3795''$

WING BULKHEAD # 23

VERTICAL + DIAGONAL MEMBERS

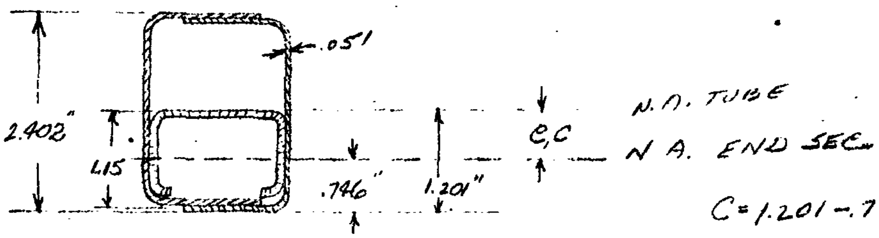
MEMBER OP



$C = 1.060 - .6305 = .4295"$

$e = (.9375 + .051) - .6305 = .3580"$

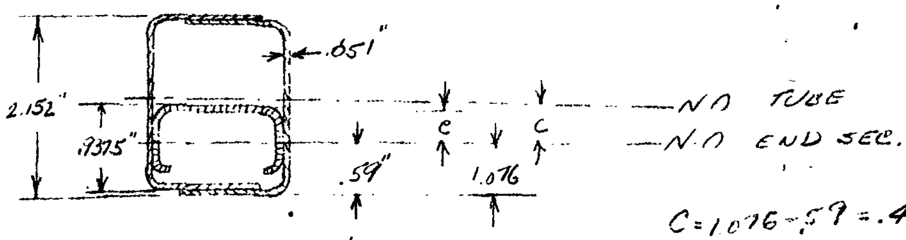
MEMBER PQ



$C = 1.201 - .746 = .455"$

$e = (1.15 + .051) - .746 = .455"$

MEMBER QR



$C = 1.076 - .59 = .486"$

$e = (.9375 + .051) - .59 = .3985"$

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 835 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE LIII

WING BULKHEAD #23
SUMMARY OF STRESSES & M.S.
FOR TRUSS VERT. & DIAGONAL MEMBERS.

	MEMBER	AREA	TENS. LOAD (P_T)	COMP. LOAD (P_C)	$f_T = P_T/A$	F_T	M.S. (TENS.)	$f_c = P_c/A$	COLUMN LENGTH	ρ_x	ℓ/ρ_x	F_c	M.S. (COL.)
	1	2	3	4	5	6	7	8	9	10	11	12	13
			Pg 258	Pg 258	3/2	FZS-36-142 P.II-220	6/5 -1	4/2	FZS-36-142 P.II-220	FZS-36-142 P.II-220	9/10	FZS-36-142 P.I-62	12/8 -1
WHOLE TUBES	MN	.2695	10,000	-5600	37,100	49000	+.32	20,800	36.5	.633	57.6	23,300	+.12
	NO	.3060	6400	-8800	20,900		+1.34	28,750	37.0	.808	45.8	28,800	+.00
	OP	.3060	11,200	-6300	36,600		+.34	20,600	42.62	.808	52.8	25,600	+.24
	PQ	.4804	7730	-11600	16,100		+2.04	24,200	41.25	.941	43.8	29,700	+.23
	QR	.3969	18,100	-10320	45,600	49000	+.07	26,000	43.375	.817	53.0	25,600	-.015

MEMBER	AREA	P_T	P_C	P_T/A	P_C/A	C	e	I	$P_T c e / I$	$P_C c e / I$	f_T(TOTAL)	f_T(STEEL)	M.S.	f_c(TOTAL)	f_c(STEEL)	M.S.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
				3/2	4/2				3×7×8/9	4×7×8/9	5+10	[illegible]	F_T/13 -1	6+11	[illegible]	F_c/16 -1
MN	.6978	10,000	-5600	14,350	-8020	.2980	.3805	.0825	13,750	-7700	28,100	79,300	+1.14	15,720	44,300	+2.50
NO	.5994	6400	-8800	10,780	-14,800	.4620	.3795	.0716	15,700	-21,600	26,480	74,600	+1.28	36,400	102,500	+.51
OP	.5778	11,200	-6300	19,400	-10,900	.4295	.3580	.0618	27,850	-15,700	47,250	133,200	+.28	26,600	75,000	+1.07
PQ	.9328	7730	-11,600	8300	-12,450	.4550	.4550	.1669	9600	-14,400	17,900	50,500	+2.37	26,850	75,800	+1.04
QR	.8848	18,100	-10,320	20,500	-11,700	.4860	.3985	.1028	34,100	-19,450	54,600	154,000	+.10	31,150	88,000	+.74

* RATIO OF E FOR STEEL AND ALUM.

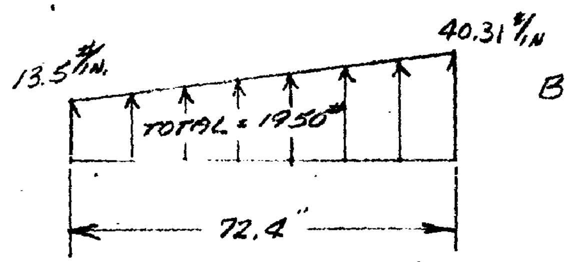
PREPARED BY: RUSSELL.
CHECKED BY: [illegible]

WING BULKHEAD #23

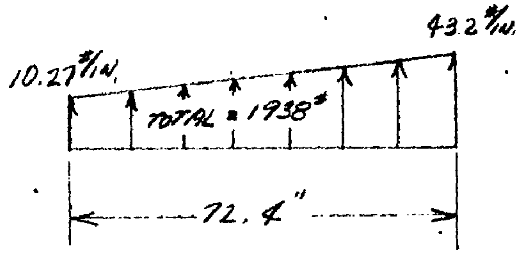
UPPER CHORD (AFT PORTION)

THE UPPER CHORD ANALYSIS WILL BE MADE SIMILIAR TO THE B-36A ANALYSIS (REF. FZS-36-142, PG. II-234) THE UNSUPPORTED SKIN BETWEEN HAT STRINGERS IS CRITICAL.

CHORD LOADING (I.L.A.A.)



B-36A (FZS-36-142 PG. II-213)



XB-36 (REF. PG. 253)

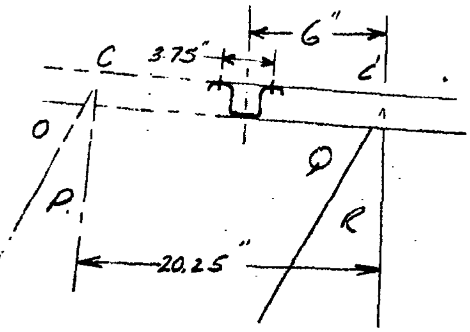
THE B-36A AND XB-36 CHORD LOADINGS (SEE ABOVE) ARE PRACTICALLY THE SAME, AND THE B-36A BEND. STRESSES ARE VERY SMALL (REF. FZS-36-142, PG. II-234). THEREFORE THE XB-36 CHORD B.M. WILL BE ASSUMED THE SAME AS THE B-36A.

WING BULKHEAD #23

UPPER CHORD (CONT'D)

AXIAL LOAD

$$\left.\begin{aligned} C'Q &= -30550^{\#} \\ CQ &= -21700^{\#} \end{aligned}\right\} \text{REF. P. 258}$$



$$P = -30550 + (30550 - 21700)\frac{6}{20.25}$$
$$= -27{,}900^{\#}$$

BEND MOM. = 1208"# (REF. FZ5-36-142, PG. II-234)

USE 6" WIDTH OF .102 SKIN.

$$\left.\begin{aligned} \text{AREA} &= 1.424 + 2(.102) = 1.632 \text{ IN}^2 \\ I &= 12.256 \text{ IN}^4 \\ C &= 4.11 \text{ IN} \end{aligned}\right\} \text{REF. FZ5-36-142 PG. II-222}$$

$$f_c = \frac{27900}{1.632} + \frac{1280 \times 4.11}{12.256}$$
$$= 17{,}500 \ ^{\#}/\text{SQ. IN.}$$

$F_c = 19{,}000\ ^{\#}/\text{SQ. IN}$ (REF. FZ5-36-142, PG. II-234)

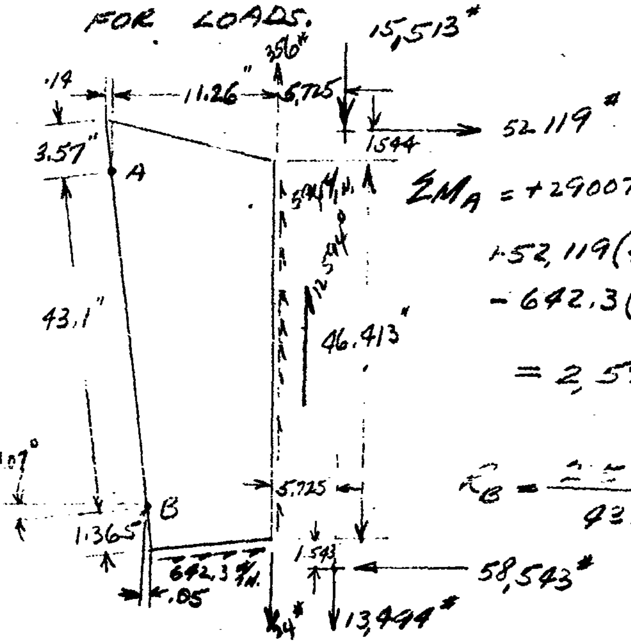
$$M.S. = \frac{19000}{17500} - 1 = +.08$$

WING BULKHEAD #23

WEB SECTION

M.F.W. - L.A.A. @ 5000 FT. IS CRITICAL

REWORK AFT SECTION WITH REACTIONS AT CENTROIDS OF CHORDS. REF PG 258 FOR LOADS.



$$\Sigma M_A = +29007(16.985) + 58{,}543(45.06) + 52{,}119(4.44) - 40{,}527(11.26) - 642.3(421)$$

$$= 2{,}595{,}100 \text{ "\#}$$

$$R_B = \frac{2{,}595{,}100}{43.1} = 60{,}250\#$$

$R_{B_H} = 60{,}250 \cos 3.07° = 60{,}000\#$ (AFT)

$R_{BV} = 60{,}250 \sin 3.07° = 3230\#$ (UP)

$\Sigma_V = 13{,}390\#$ (UP)

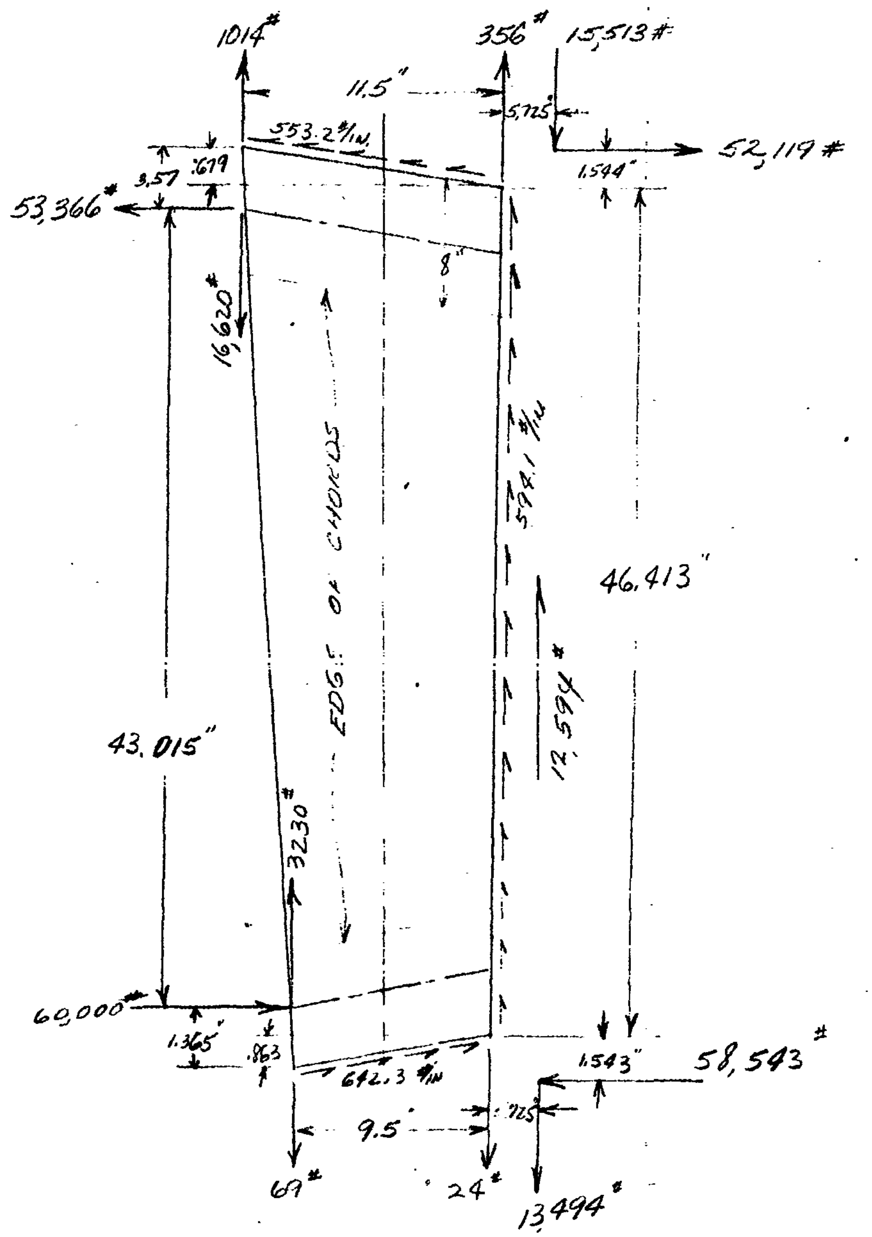
$R_{AV} = 13{,}390 + 3230 = 16{,}620\#$ (DOWN)

$\Sigma_H = -6634$ (FWD)

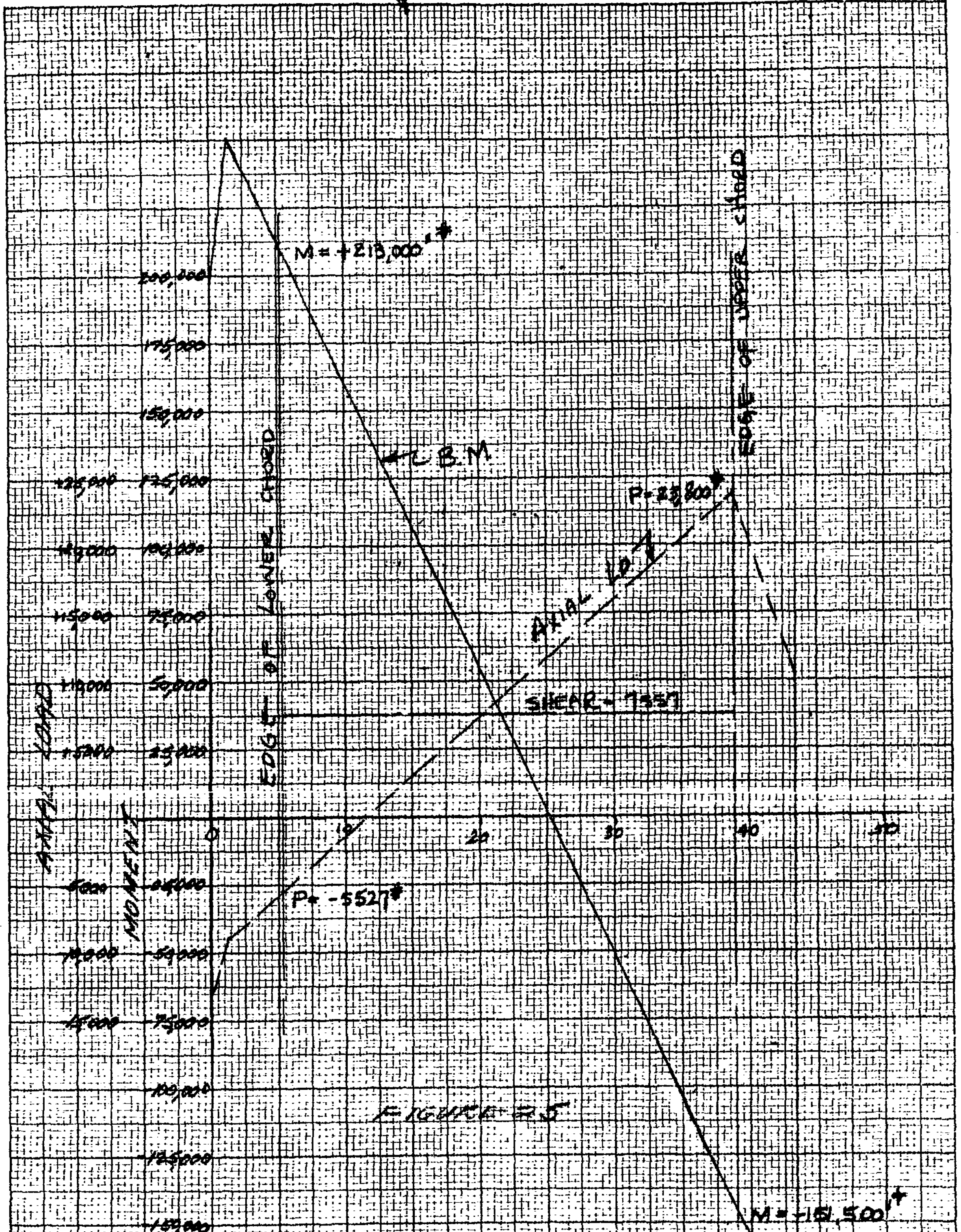
$R_{AH} = 60{,}000 - 6634 = 53{,}366$ (FWD)

WING BULKHEAD #23

SUMMARY OF LOADS



FOR BENDING MOMENTS, SHEARS, AND AXIAL LOADS ON WEB SECTION, SEE FOLLOWING PAGE.



CALCULATED BY
DRAWN BY
CHECKED BY
APPROVED BY

SHEARS, MOMENTS AND AXIAL LOADS ON WEB SECTION
MFW. LAA. UNSYM GUST @ 5000'

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION FORT WORTH, TEXAS

DOC. NO. FZS-36-242

MODEL XB-36

WING BULKHEAD #23

WEB SECTION (CONT'D.)

MEMBER ER

ADJACENT TO LOWER CHORD

$B.M. = +213{,}000$ (COMP. IN ER)

$P = -5527$ (TENS. IN ER)

$S = +7557$ (COMP. IN ER)

$5.25 \sin 2.27^\circ = .208$

$9.500 + .208 = 9.708$

$h' = 9.708 - .562 - .381 = 8.765$

$$P_c = \frac{213000}{8.765} + \frac{7557 \times 1.35}{2} - 5527\left(\frac{5.12}{9.708}\right)$$

$= 27{,}440^{\#}$ (comp)

ADJACENT TO UPPER CHORD

$B.M. = -151{,}500$ (TENS. IN ER)

$P = +23{,}800$ (COMP. IN ER)

$S = +7557$ (COMP. IN ER)

$h' = 9.62$

$$P_c = \frac{151500}{9.62} + 5100 + 23{,}800\left(\frac{3.46}{10.73}\right)$$

$= 2990^{\#}$ (TENS.)

WING BULKHEAD #23

WEB SECTION (CONT'D.)

MEMBER ER (CONT'D)

AVERAGE LD. IN $ER = \frac{27440 - 2990}{2} = 12{,}225^{\#}$ (comp.)

$$f_c = \frac{12{,}225}{.5928} = 20{,}600 \ \#/in^2$$

$F_c = 33{,}000 \ \#/sq.in.$ (REF. FZS-36-142, PG. II-245)

$$M.S. = \frac{33\,000}{20\,600} - 1 = +.60$$

WEB

$S = 7557^{\#}$ (Ref. P-266)

$h' = 10.3$

$t = .040$

$$\tau = \frac{7557}{10.3 \times .040} = 18{,}350 \ \#/sq.in.$$

$\tau_{CR} = 2880 \ \#/sq.in.$

$\tau_{SU} = 29{,}700 \ \#/sq.in.$

$\tau_{tU} = 24{,}300 \ \#/sq.in.$

FZS-36-142 PG. II-241

$$M.S. = \frac{24300}{18\,350} - 1 = +.325$$

THE WEB STIFFENERS WILL BE CONSIDERED SATISFACTORY, BECAUSE THE MARGIN OF SAFETY ON THE B-36A IS LARGE.

WING BULKHEAD #23

ANALYSIS OF REAR SPAR VERTICAL.

THE ANALYSIS OF THE REAR SPAR VERTICAL FOR THE XB-36 IS MADE BY OBTAINING A CLOSE APPROXIMATION OF THE LOADS AND COMPARING THEM WITH THE B-36A LOADS (REF. PAGES 272 AND 276). THE LOADS ARE APPROXIMATED BY RATIOING THE B-36A LOADS FOR THE XB-36.

THE CRITICAL CONDITION FOR THE XB-36 IS; ALT. GROSS WT. (72-1000# BOMBS) L.A.A. @ 35,000 FT. AND THE CRITICAL COND. FOR THE B-36A IS; DESIGN GROSS WT. L.A.A. @ 30,000 FT.

THE MINIMUM MARGIN OF SAFETY FOR THE REAR SPAR VERTICAL FOR THE B-36A IS +.39 (REF. FZS-36-192, PG. II-266 & 268.) A COMPARISON OF THE LOADS (PG. 272) WILL SHOW THAT THE XB-36 LOADS ARE APPROXIMATELY THE SAME AS THE B-36A, THEREFORE THE REAR SPAR VERTICAL WILL BE CONSIDERED SATISFACTORY AND THE B-36A M.S. WILL BE APPLICABLE.

WING BULKHEAD #23

FLIGHT INERTIA FACTORS

COND. = A.G.W. - L.A.A. (72-1000# BOMBS) @ 35,000 FT.

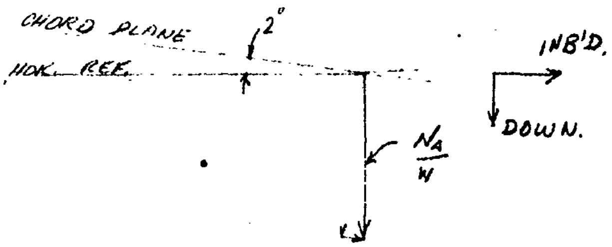
$$-\frac{N_A}{W} = -2.668 \quad \frac{X_M}{W} = .101 \quad \text{REF. F25-36-126, PG. 69.}$$

RESOLVE FACTORS INTO PLANE ⊥ AND PARALLEL TO THRUST LINE.

$$n_V = -\frac{N_A}{W}\cos 2°(1.5)$$

$$= -2.668 \times .99 \times 1.5$$

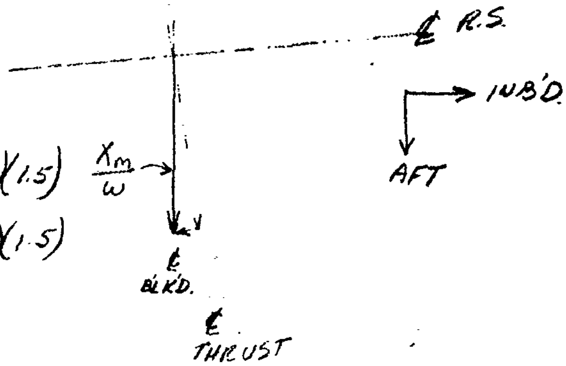
$$= -4.0 \text{ DOWN (ULT.)}$$



$$n_D = +\frac{X_m}{W}\cos 3°(1.5)$$

$$= +.101 \times .9986 \times 1.5$$

$$= +.1512 \text{ AFT (ULT.)}$$



$$n_S = -\left(-\frac{N_A}{W}\sin 2° + \frac{X_m}{W}\sin 3°\right)(1.5)$$

$$= -(-2.668 \times .0399 + .101 \times .0523)(1.5)$$

$$= +.1318 \text{ INBD (ULT.)}$$

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FW 633 7-46 ENGINEERING RULED TABULATION PAD—VELLUM

TABLE LV

ULT. LOADS AT MOST FWD. POINTS OF OUTBD. BASIC ENG. MT. L.H & R.H. SIDES

COND.: A.G.W. (72-1000# BOMBS), L.A.A @ 35,000 ft.

BASIC MT. POINTS	N_V = 4.0 DOWN			N_S = .1318 INBD.			N_D = .1512 AFT			ULTIMATE TORQUE ON BASIC MOUNT			ULTIMATE THRUST ON BASIC MOUNT			TOTAL LOADS		
	V	D	S	V	D	S	V	D	S	V	D	S	V	D	S	ΣV	ΣD	ΣS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
	N_V x COL. (1) TAB. XLIV	N_V x COL. (2) TAB. XLIV	N_V x COL. (3) TAB. XLIV	N_S x COL. (4) TAB. XLIV	N_S x COL. (5) TAB. XLIV	N_S x COL. (6) TAB. XLIV	N_D x COL. (7) TAB. XLIV	N_D x COL. (8) TAB. XLIV	N_D x COL. (9) TAB. XLIV	REF. FZS-36-253 PG. 57			REF. FZS-36-253 PG. 50					
A	+7228	+24,708	-3432 L	-122 L	+57 L	+97	-20	+188	-27 L	-3620 L	-9382 L	+977 L	+64	-1135	+158 L	+7150 L	+25,153 L	-3364 L
			+3432 R	+122 R	-57 R				+27 R	-3620 R	+9382 R	-977 R			-158 R	+7330 R	+25039 R	+3558 R
A'	+7228	+24,708	+3432 L	+122 L	-57 L	+97	-20	+188	+27 L	+3620 L	+9382 L	+977 L	+64	-1135	-158 L	+11,014 L	+34,421 L	+4535 L
			-3432 R	-122 R	+57 R				-27 R	+3620 R	+9382 R	-977 R			+158 R	+10,770 R	+34,535 R	-4341 R
C	+6664	-24,732	+3440 L	-30 L	+1978 L	+363	+22	+340	-45 L	-3078 L	+9451 L	-772 L	-61	-1605	+221 L	+6656 L	-22,614 L	+3758 L
			-3440 R	+30 R	-1978 R				+45 R	-3078 R	+9451 R	+772 R			-221 R	+6716 R	-26,570 R	-3032 R
C'	+6669	-24,732	-3440 L	+30 L	-1978 L	+363	+22	+340	+45 L	+3078 L	-9451 L	-772 L	-61	-1605	-221 L	+9794 L	-37,966 L	-4245 L
			+3440 R	-30 R	+1978 R				-45 R	+3078 R	-9451 R	+772 R			+221 R	+9734 R	-33,670 R	+4971 R

SIGN CONVENTION

(+) VERTICAL LOADS, DOWN
(+) DRAG LOADS AFT
(+) SIDE LOADS INB'D.

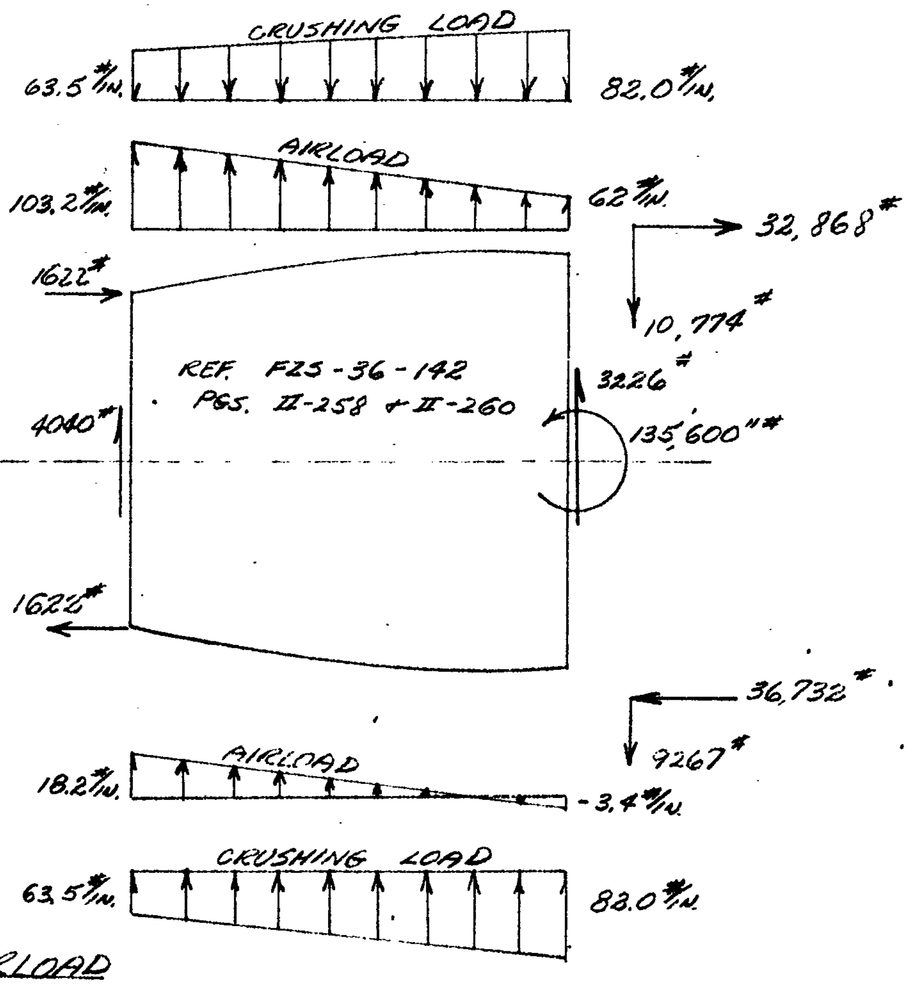
L- DESIGNATES L.H MOUNT.
R- DESIGNATES R.H MOUNT.

PREPARED BY: [illegible] 4/30/48
CHECKED BY: [illegible] 5/17/48

WING BULKHEAD #23

B-36 LOADING

D.G.W. L.A.A. @ 30,000 FT.



AIRLOAD

THE XB-36 AIR LOADS WILL BE OBTAINED BY MULTIPLYING THE B-36A AIRLOADS ON WING BULKHEAD #23 BY THE RATIO OF $\frac{Z\,(XB\text{-}36)}{Z\,(B\text{-}36A)}$, WHERE, Z = AIRLOAD ON WING NORMAL TO CHORD LINE.

THIS PROCEDURE ASSUMES THAT THERE IS NO CHANGE IN CHORDWISE PRESSURE DISTRIBUTION BETWEEN B-36 AND XB-36 CONDITIONS.

WING BULKHEAD #23

AIRLOADS (CONT'D)

B-36 A $\left\{ \begin{array}{l} \frac{Z}{W} = +2.758 \\ W = 268,213^{\#} \end{array} \right\}$ REF. FZS-36-136 PG. 50

XB-36 $\left\{ \begin{array}{l} \frac{Z}{W} = +2.779 \\ W = 254,793^{\#} \end{array} \right\}$ REF. FZS-36-126 PG. 69

B-36A; $Z = 738,000^{\#}$

XB-36; $Z = 708,000^{\#}$

$$R = \frac{708,000}{738,000} = .960$$

(L.E.) $4040 \times .960 = 3880^{\#}$

" $1622 \times .960 = 1560^{\#}$

(T.E.) $3226 \times .960 = 3100^{\#}$

" $135,600 \times .960 = 130,200''^{\#}$

(U. SURF) $103.2 \times .960 = 99\ ^{\#}/IN.$

" $62 \times .960 = 59.5\ ^{\#}/IN.$

(L. SURF) $18.2 \times .960 = 17.5\ ^{\#}/IN.$

" $-3.4 \times .960 = -3.2\ ^{\#}/IN.$

CRUSHING LOADS

THE XB-36 CRUSHING LOADS WILL BE OBTAINED BY MULTIPLYING THE B-36A CRUSHING LOADS ON WING BULKHEAD #23 BY THE RATIO OF $\frac{(\text{BEND MOM.})^2\ XB\text{-}36}{(\text{BEND MOM.})^2\ B\text{-}36}$.

WING BULKHEAD #23

CRUSHING LOADS (CONT'D)

B-36A ; BEND MOM = 38,500,000 "# (REF. FZS-36-140 PG. 115)

XB-36 ; BEND. MOM. = 35,750,000 "# (REF FZS-36-240 PG 121)

$$R = \frac{(35{,}750{,}000)^2}{(38{,}500{,}000)^2} = .882$$

$63.5 \times .882 = 56$ #/IN

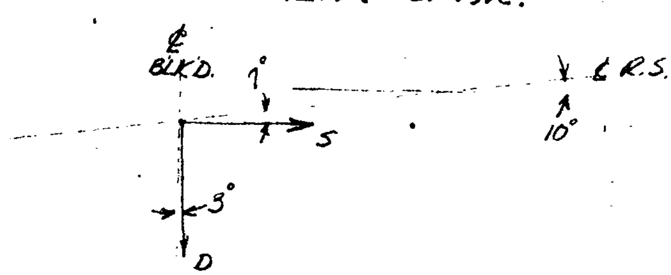
$82.0 \times .882 = 72.3$ #/IN.

ENGINE MOUNT FITTING LOADS

UPPER FITTING (A'):
V = 11,014#
D = 34,421#
S = 4535#
REF. PG. 222

LOWER FITTING (C'):
V = 9794#
D = -37,966#
S = -4245#
REF. PG. 222

THE DRAG AND SIDE LOADS ARE RESOLVED INTO THE PLANE OF THE BULKHEAD AND THE PLANE OF THE REAR SPAR.



WING BULKHEAD #23

ENGINE MOUNT FITTING LOADS (CONT'D)

UPPER FITTING (A'):

$D' = 34{,}421 \cos 3^\circ - 4535 \sin 3^\circ = 34{,}163^{\#}$

$S' = 34{,}421 \sin 3^\circ + 4535 \cos 3^\circ = 6325^{\#}$

$D'' = 6325 \tan 10^\circ = 1117^{\#}$

$D_{TOTAL} = 34\,163 + 1117 = 35{,}280^{\#}$

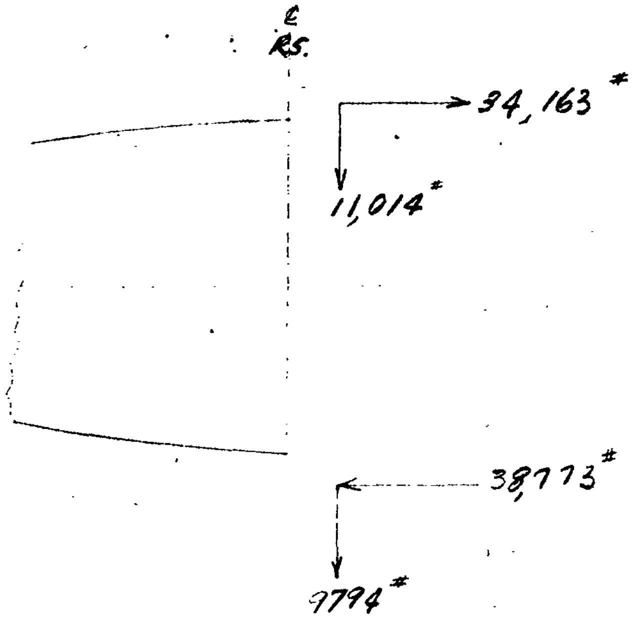
LOWER FITTING (C'):

$D' = -37{,}966 \cos 3^\circ + 4245 \sin 3^\circ = -37{,}678^{\#}$

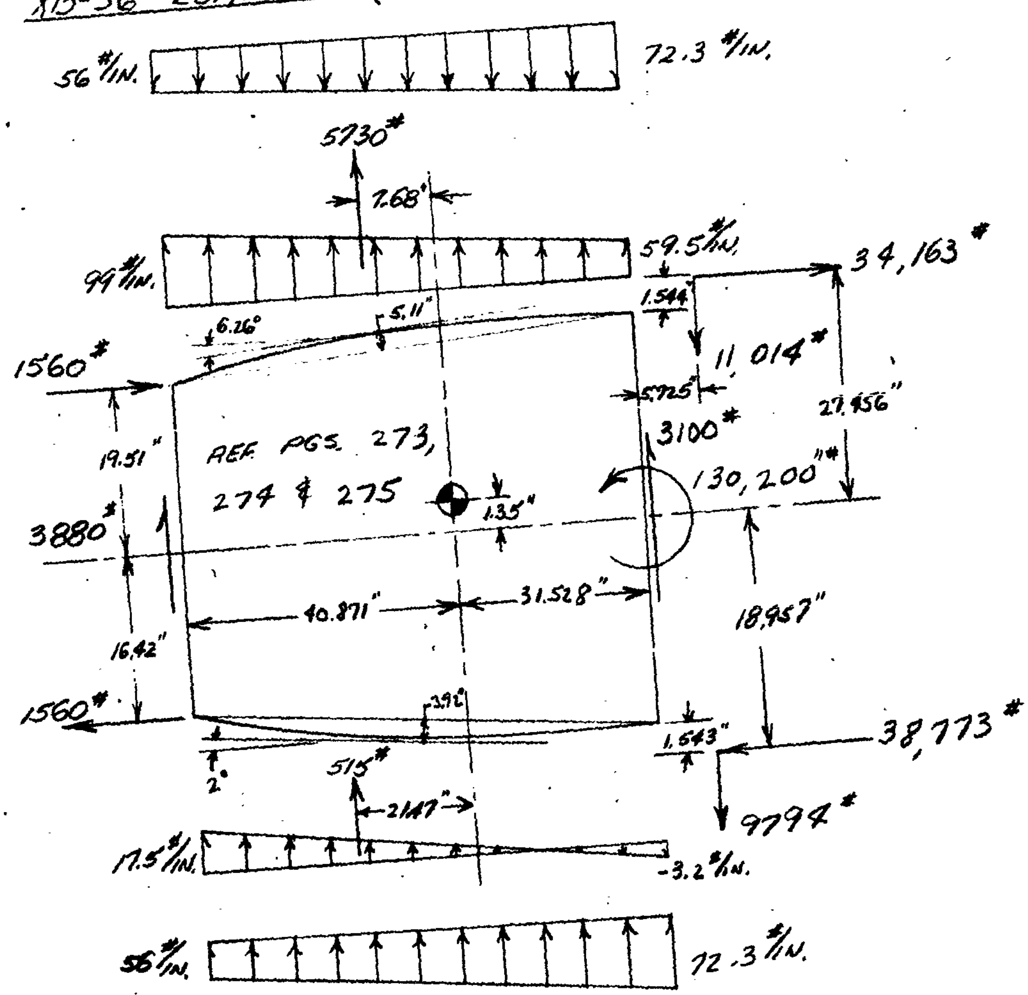
$S' = -37{,}966 \sin 3^\circ - 4245 \cos 3^\circ = -6215^{\#}$

$D'' = -6215 \tan 10^\circ = -1095^{\#}$

$D_{TOTAL} = -37{,}678 - 1095 = -38{,}773^{\#}$



WING BULKHEAD # 23



SUMMATION OF LOADS ABOUT E.A.

V = 7583# (DOWN)

D = 4610# (FWD.)

$T_{E.A} = 2,594,450$ "# (CLOCKWISE)

WING BULKHEAD #23

REACTIONS TO VERT. LOAD.

$$q_{F.S.} = \frac{7583 \times 31.53}{72.4 \times 35.94} = 92.0\ \#/\text{IN.}\ (\text{UP})$$

$$q_{R.S.} = \frac{7583 \times 40.87}{72.4 \times 46.41} = 92.2\ \#/\text{IN.}\ (\text{UP})$$

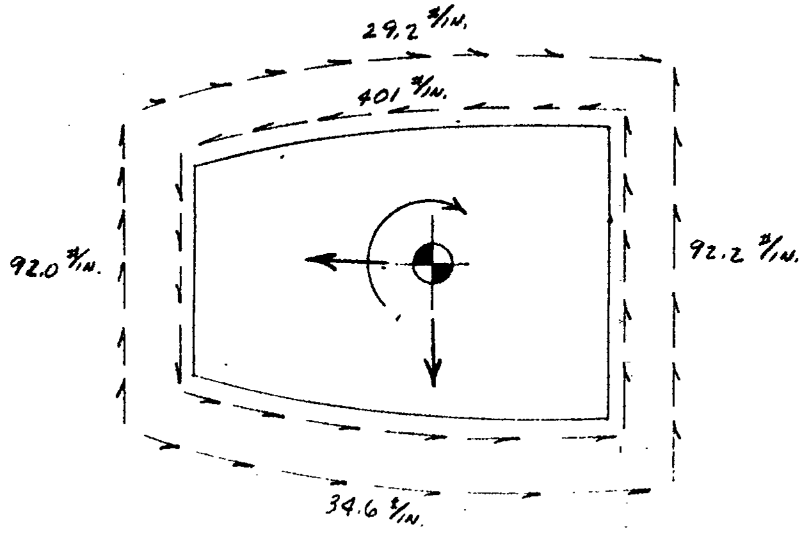
REACTIONS TO DRAG LOAD.

$$q_U = \frac{4610 \times 23.25}{50.90 \times 72.40} = 29.2\ \#/\text{IN.}\ (\text{AFT.})$$

$$q_L = \frac{4610 \times 27.65}{50.90 \times 72.40} = 34.6\ \#/\text{IN.}\ (\text{AFT.})$$

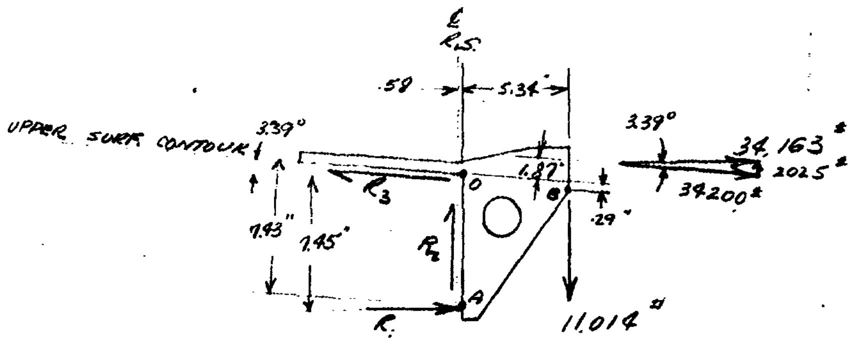
REACTION TO T_{EA}

$$q_0 = \frac{2\,594\,450}{6485.2} = 401\ \#/\text{IN.}$$



WING BULKHEAD #23

TRANSFER OF UPPER FITTING LOADS TO BULKHEAD



$\Sigma M_O = 0$

$$7.45\ R_1 = 34200 \times 1.87 + (11014 - 2025) \times 5.34$$

$$R_1 = 15{,}000^{\#} (\text{AFT})$$

$\Sigma M_A = 0$

$$7.43\ R_3 = 34200 \times (7.43 + 1.87) + (11014 - 2025) \times 5.34$$

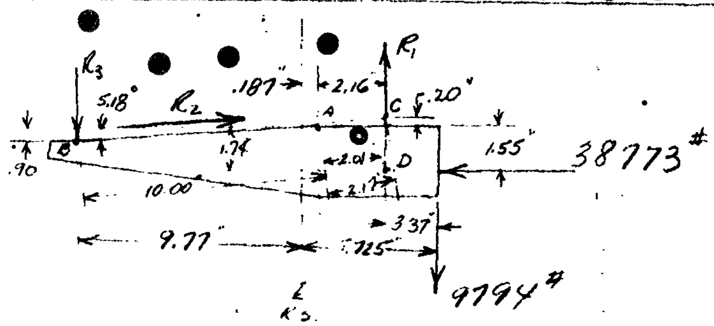
$$R_3 = 49{,}250^{\#} (\text{FWD})$$

$\Sigma M_B = 0$

$$5.34\ R_2 = -34200 \times 1.87 + 15000\,(7.45 - .29)$$

$$R_2 = 8160^{\#}\ (\text{UP})$$

TRANSFER OF LOWER FITTING LOADS TO BULKHEAD



WING BULKHEAD #23

TRANSFER OF LOWER FITTING LOADS TO BLK'D (CONT'D)

$\Sigma M_B = 0$

$12.12\ R_1 = 38{,}773(1.55 - .90) + 9794 \times 15.495$

$R_1 = 14{,}580^{\#}$ (UP)

$\Sigma M_C = 0$

$12.17\ R_3 = 38{,}773(1.55 + .20) + 9794 \times 3.37$

$R_3 = 8280^{\#}$ (DOWN)

$\Sigma M_D = 0$

$1.74\ R_2 = -9794 \times 3.37 + 8280(10.00 + 2.01)$

$R_2 = 38{,}200^{\#}$ (AFT)

LOADS IN R.S. VERTICAL FROM SPAR ANALYSIS

FROM FZS-36-241, PG. 105, THE SHEARS AT STA. #23 WERE CALCULATED AS 996 #/IN. INB'D. AND 1449 #/IN OUTB'D. THE REAR SPAR DEPTH IS 46.413", THEREFORE THE COMPRESSIVE END LOADS ON THE MEMBER ARE:

$P_U = 996 \times 46.413 = 46{,}200^{\#}$

℄ R.S.

INB'D →

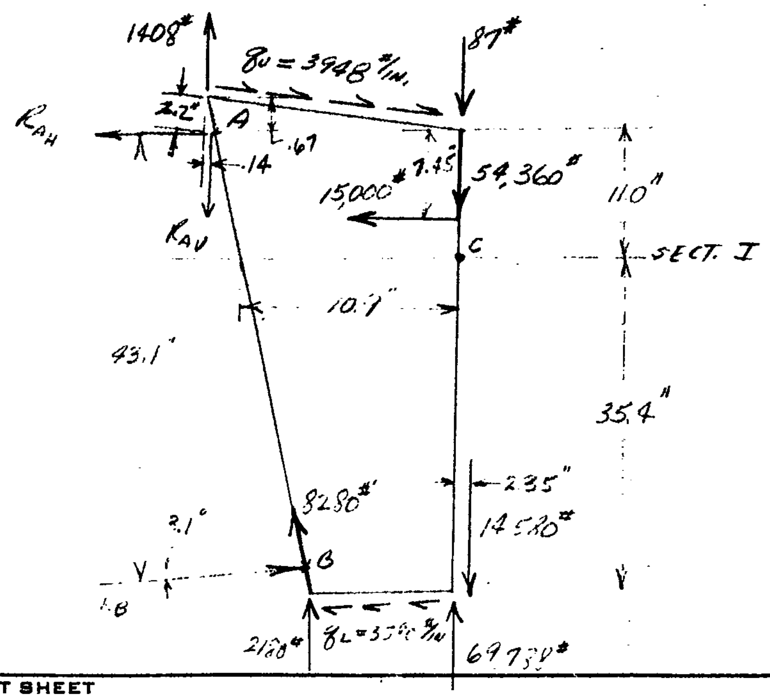
$P_L = 1449 \times$ [illegible] $= 67{,}$[illegible]$^{\#}$

WING BULKHEAD #23

LOAD IN R.S. VERT FROM SPAR ANALYSIS (CONT'D)

THE DIFFERENCE IN THE END LOADS (21,050#) SHOULD BE EQUAL TO THE NET BULKHEAD R.S. REACTION. FROM PG 279 THE SHEAR FLOW WAS CALCULATED TO BE 502.2 #/IN, OR A LOAD OF 502.2 X 46.413 = 23,350#. THE DISCREPANCY IN LOADS OF 2200# IS DUE TO THE SLIGHTLY DIFFERENT ASSUMPTIONS MADE IN THE BULKHEAD ANALYSIS AND SPAR ANALYSIS.

IN THE ANALYSIS OF THE R.S. VERTICAL THE SHEAR FLOW AT THE R.S. CALCULATED IN THE BULKHEAD ANALYSIS WILL BE REPLACED BY THE END LOADS FOR THE SPAR ANALYSIS. THE VALUE P_L WILL BE CORRECTED TO 67,450# TO BALANCE THE SHEAR FLOW FROM THE BULKHEAD ANALYSIS.



WING BULKHEAD # 23

WEB PORTION REACTIONS

$\Sigma MOM_A = 1,733,349''^{\#}$

$R_B \times 43.1 = 1,733,349$

$R_B = 40,200^{\#}$

$R_{BH} = 40200 \cos 3.1° = 40,000^{\#}$ (AFT)

$R_{BV} = 40200 \sin 3.1° = 2160^{\#}$ (UP)

$\Sigma_V = 7889^{\#}$ (UP)

$R_{AV} = -2160 - 7889 = -10,049^{\#}$ (DOWN)

$\Sigma_H = -4000^{\#}$ (FWD.)

$R_{AH} = -40,000 + 4000 = -36,000^{\#}$ (FWD)

SHEAR, MOMENT, & AXIAL LOAD AT SECT. I

$\Sigma\ MOM = 4,100''^{\#}$ (C'CLOCKWISE)

$\Sigma\ V = 65,828^{\#}$ (UP)

$\Sigma\ H = 6000^{\#}$ (AFT)

WING BULKHEAD # 23

BY COMPARISON OF THE XB-36 SHEAR, BENDING MOMENT, AND AXIAL LOAD, ON THE WEB PORTION OF THE BULKHEAD, (REF. PG. 246) WITH THE B-36A LOADS (REF. FZS-36-142, PG. II-266) IT IS SEEN THAT THE XB-36 LOADING IS LESS CRITICAL THAN THE B-36A LOADING. THEREFORE IT WILL BE CONSIDERED SATISFACTORY TO ASSUME THE B-36A R.S. VERTICAL ANALYSIS IS APPLICABLE TO THE XB-36.

LANDING GEAR SUPPORT BULKHEADS

INDEX

INTRODUCTION

Wing bulkheads 5, 7, 8 and 9 of the XB-36 Airplane equipped with the four wheel main landing gear are almost all designed by loads obtained from the Side Drift Landing or 2WL-IR-ND Landing Conditions.

It is the purpose of this section of the report to compare loads on bulkheads 5, 7, 8 and 9 for the XB-36 Airplane to those obtained for the B-36A Airplane and by means of this comparison prove that these bulkheads in the XB-36 Airplane are structurally satisfactory.

DETERMINATION OF LOADS FOR

LANDING GEAR BULKHEADS 5, 7, 8, AND 9

A study of Report FZS-36-142B shows that the critical conditions for the B-36A bulkheads 5, 7, 8, and 9 are:

DGW 268,000# Side Drift Landing
DGW 268,000# 2WL-1R-ND
AGW 255,030# (62-1000# Bombs) 2WL-IR-ND

The same conditions are critical for the XB-36 four wheel main landing gear airplane. The loads on the landing gear bulkheads are due almost entirely to the landing gear fitting loads; and the fitting loads vary directly with the weight of the airplane at landing.

CONDITION	WEIGHT AT LANDING B-36A	XB-36
DGW (No Bombs)	268,000#	255,272#
AGW (62-1000# Bombs)	255,030#	255,340#

Critical wing bulkhead loads in the landing gear region of the XB-36 four wheel gear airplane due to DGW conditions will be generally 5% less than for the B-36A since 255272/268000 = .95 (approx.). Critical loads in this region due to AGW condition will be slightly greater than for the B-36A since 255340/255030 = 1.001.

Because of the similarity and relatively small change in loads from the B-36A to the XB-36 four wheel gear airplane a detail analysis is not necessary, instead a comparative analysis based on the work shown in Report FZS-36-142 and 142B is made for each bulkhead.

BULKHEAD #5

The DGW - S.D.L. - 25% "V" into Wing Box condition is critical for bulkhead #5. The loads for the XB-36 four wheel landing gear airplane are approximately 5% less than for the B-36A, reference page 285. This bulkhead structure is identical for the B-36A and the XB-36 Airplanes; therefore, the margins of safety shown for the B-36A bulkhead, (ref. FZS-36-142B) will be increased approximately 5% for bulkhead #5 in the XB-36 Airplane.

The minimum margin of safety for bulkhead #5 of the XB-36 four wheel landing gear airplane exists in -59 web and is +5% based on the 0% margin of safety shown in FZS-36-142B, page 1.

BULKHEAD #7

The critical condition for bulkhead #7 is DGW-S.D.L. - 60% S.L. on forward wheels, 25% "V" into Wing Box. Since it has been shown that the bulkhead loads vary directly as the landing weights of the B-36A and the XB-36 Airplane, the loads on the XB-36 four wheel landing gear bulkhead #7 will decrease by the same ratio or approximately 5% from those of the B-36A shown in Report FZS-36-142B, page 19.

In the following table a comparison of the XB-36 and the B-36A minimum margins of safety for pertinent parts of the bulkhead #7 structure are shown.

TABLE LV

PART DESCRIPTION	M.S. B-36A REF: FZS-36-142B P.22	M.S. XB-36 4 WHL. G.
UPPER FLANGE	+.06	+.11
LOWER SURFACE INTERCOSTAL	+.34	+.39
LOWER FLANGE	+.04	+.09
WEBS (-8 WEB)	+.03	+.08
WEB SPLICES	+.21	+.26
STIFFENERS, #9	-.04	+.01

BULKHEAD #8

A.G.W. 2WL-IR-ND condition is critical for bulkhead #8. Since the difference in loads of the XB-36 and the B-36A is so small the margins of safety for the B-36A shown in FZS-36-142B page 24 will be used for the XB-36 four wheel landing gear airplane.

BULKHEAD #9

The critical condition for bulkhead #9 is DGW - Side Drift Landing - 60% S.L. on Forward Wheels - 25% "V" into Wing Box. Bulkhead loads will decrease about 5% when compared to those for the B-36A bulkhead, Ref. FZS-36-142B. The margins of safety for the XB-36 four wheel landing gear airplane bulkhead will increase an equal amount over those shown for the B-36A airplane bulkhead in the above reference.

The following table shows the minimum margins of safety for bulkhead #9 of the B-36A and the XB-36 equipped with the four wheel main landing gear.

TABLE LVI

PART DESCRIPTION	M.S. B-36A Ref.*	M. S. XB-36 4 W.G.
- 6 Web	-.004	+.046
-7 Web	-.018	+.032
-8 Web	+.003	+.053
-9 Web	-.008	+.042
Inter Flange Web of Lower Chord	+.005	+.055
Riveted Connections	+.22	+.27
Chord Members	+.16	+.21
Stiffeners	-.006	+.044

* FZS-36-142B, Page 31

WING TRAILING EDGE
CENTER NACELLE TO WING FUSELAGE INTERSECTION

INDEX

TRAILING EDGE INBOARD NACELLE TO WING FUSELAGE INTERSECTION

THE WING TRAILING EDGE STRUCTURE BETWEEN THE INBOARD NACELLE AND THE FUSELAGE FOR THE XB-36 IS IDENTICAL TO THE SAME STRUCTURE IN THE B-36A AIRPLANE. THIS IS THE CASE SINCE THE XB-36 AIRPLANE IS NOW EQUIPPED WITH THE FOUR WHEEL MAIN LANDING GEAR, REF A-H 263A. THIS ANALYSIS WILL PROVE THE STRUCTURAL STRENGTH OF THE XB-36 AIRPLANE WING TRAILING EDGE STRUCTURE BY COMPARING THE LOADS ON THE B-36A AIRPLANE TRAILING EDGE WITH THOSE FOR THE XB-36 AIRPLANE TRAILING EDGE.

SAMPLE COMPUTATIONS FOR DETERMINING THE CHORDWISE PRESSURE DISTRIBUTIONS ON THE XB-36 TRAILING EDGE ARE SHOWN ON THE FOLLOWING PAGE, AND A COMPARISON OF XB-36 AND B-36A CHORDWISE PRESSURE DISTRIBUTION OVER THE TRAILING EDGE PORTION OF THE WING ARE SHOWN BY FIGURE 26, PAGE 292.

NO CONSIDERATION IS MADE IN THIS ANALYSIS OF THE CHANGE IN PRESSURE DISTRIBUTION FOR THE AREAS WHICH CONTAIN PROTUBERANCES IN THE WING SURFACE, NECESSARY FOR FAIRING IN THE FOUR WHEEL GEAR IN RETRACTED POSITION. THIS IS LEGITIMATE SINCE THE INTENT IS TO COMPARE XB-36 AND

B-36 PRESSURE DISTRIBUTIONS AND THE RATIO OF THE COMPARATIVE PRESSURES FOR THE TWO AIRPLANES WILL REMAIN PRACTICALLY UNCHANGED IN THE AREAS CONTAINING PROTUBERANCES. REF: FZS-36-142 B, PAGES 38, 39, 40 & 42.

WING TRAILING EDGE BETWEEN
STA. #2 & STA. #8

DETERMINATION OF UPPER & LOWER SURFACE PRESSURES

- D.G.W. - C.H.H. - 25000'

$\beta_{z} = 0.7528$, $q = 213.1$ (REF. FZS-36-126, P35)
$M = .416$ USE $M = .40$

STA. #2 $C_{\ell a_1} = .928$ $C_{\ell b} = +0.026$ (REF. FZS-36-138 P. 14 & 15

$C_{n_w} = 0.928(.7528 + 0.026) = 0.725$

STA. #8 $C_{\ell a_1} = 0.964$ $C_{\ell b} = 0.023$

$C_{n_w} = 0.964(.7528) + .023 = 0.749$

AVG $C_{n_w} = {}^{+}0.737$, $\Delta P = \dfrac{1.5 \times 213.1}{144} \dfrac{\Delta P}{q} = 2.22 \dfrac{\Delta P}{q}$ #/in.² (ULT.)

FROM FZS-36-142 PP. I-16 & I-17

TABLE LVII

% C	$\Delta P/q$ (UPPER)	ΔP (UPPER)	$\Delta P/q$ (LOWER)	ΔP (LOWER)
(1)	(2)	(3)	(4)	(5)
40	-1.15	-2.555	-0.30	-.665
50	-0.895	-1.985	-0.18	-.40
60	-0.65	-1.40	-0.04	-.09
70	-0.385	-.855	+0.04	+.09
80	-0.14	-.31	+0.16	+.355
90	+0.075	+.165	+0.29	+.645
100	+0.24	+.535	+0.24	+.535

CHORDWISE PRESSURE DISTRIBUTION IS CALCULATED FOR ALL CONDITIONS IN [illegible] MANNER.

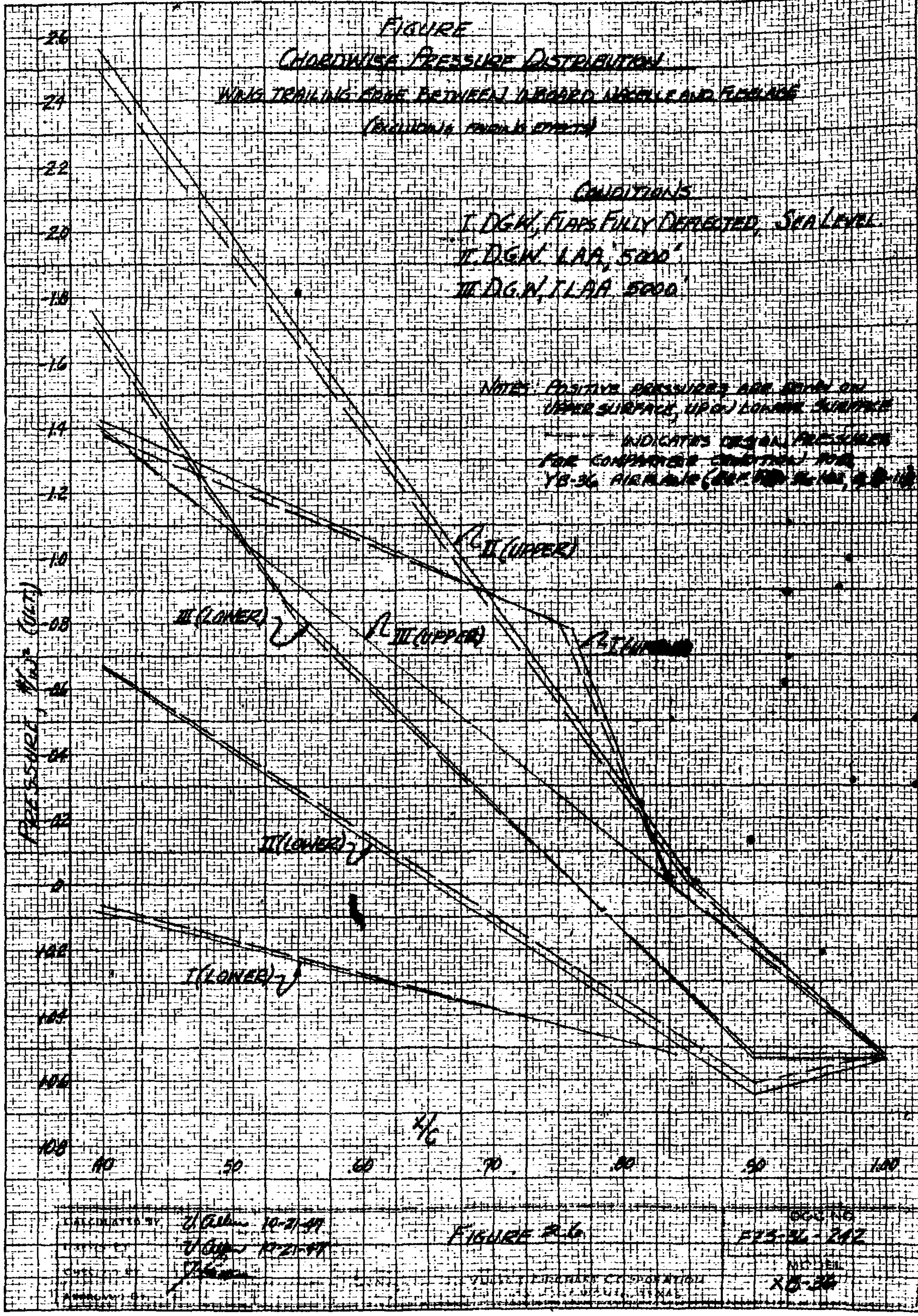


FIGURE
CHORDWISE PRESSURE DISTRIBUTION
WING TRAILING EDGE BETWEEN INBOARD NACELLE AND FUSELAGE
CONDITIONS
I DGW, FLAPS FULLY DEFLECTED, SEA LEVEL.
II D.G.W. LAA, 5000'
III D.G.W, I LAA 5000'
NOTES: POSITIVE PRESSURES ARE DOWN ON UPPER SURFACE, UP ON LOWER SURFACE
INDICATES DESIGN PRESSURES FOR COMPARABLE CONDITION FOR YB-36 AIRPLANE
II (UPPER)
III (LOWER)
III (UPPER)
II (LOWER)
I (LOWER)
PRESSURE, #/in² (ULT.)
x/c
-2.6
-2.4
-2.2
-2.0
-1.8
-1.6
-1.4
-1.2
-1.0
-0.8
-0.6
-0.4
-0.2
0
+0.2
+0.4
+0.6
+0.8
.40
.50
.60
.70
.80
.90
1.00
CALCULATED BY
10-21-47
10-21-47
FIGURE 2.6
MODEL
XB-36

THE 52 1/2 % BEAM (36W4273)

THE 52 1/2 % BEAM IN THE XB-36 IS IDENTICAL TO THE 52 1/2 % BEAM IN THE B-36A, (36W4273). FOR A DISCUSSION OF ITS FUNCTION AND STRUCTURAL DESIGN, REF. FZS-36-142B, PAGE III-14.

THE CRITICAL LOADING CONDITION FOR THE BEAM IS DGW-LAA-3 5000'. A STUDY OF FIG. 24 PAGE 242 SHOWS THAT THIS CONDITION YIELDS LOADS FOR THE XB-36 APPROXIMATELY 3% HIGHER THAN FOR THE B-36A.

A REVIEW OF LOW MARGINS OF SAFETY, SHOWN IN THE B-36A ANALYSIS IS MADE BASED ON THE INCREASE OF XB-36 OVER B-36A AIRLOADS.

(WEB ... -50 TO -6, STA 90.0)
B-36A M.S. = .065 REF. FZS-36-142B P. 76

M.S. (XB-36) = $\frac{(1+.065)}{1.03} - 1$ = +.035

(WEB TO FLANGE ATTACHMENT)
B-36A M.S. = +.065 REF. FZS-36-142B P. 77

M.S. (XB-36) = $\frac{(1+.065)}{1.03} - 1$ = +.035

XB-36 MARGINS OF SAFETY FOR OTHER PORTIONS OF THIS BEAM MAY BE OBTAINED BY REDUCING THE B-36A MARGINS BY 3% IN THE MANNER SHOWN ABOVE. REF. FZS-36-142B P. 73 TO 79

ANALYSIS Wing	**Consolidated Vultee Aircraft Corporation**	PAGE 294	
PREPARED BY [illegible]	FORT WORTH DIVISION	REPORT NO. FZS-36-242	
CHECKED BY J. Hansen	FORT WORTH, TEXAS	MODEL XB-36	
REVISED BY		DATE 5-10-48	

THE 65% BEAM (36W4874)

THE 65% BEAM IN THE XB-36 IS THE SAME MEMBER (36W4874) AS USED IN THE B-36A AIRPLANE. INFORMATION ON ITS STRUCTURAL PROPERTIES AND FUNCTIONS CAN BE FOUND IN FZS-36-142B, PAGES 81 & 83.

LOADINGS FROM DGW-LAA-@5000' CONDITION ARE CRITICAL FOR THE DESIGN OF THE BEAM AND A STUDY OF THIS CONDITION, REF FIG 26 PAGE 292 SHOWS THE XB-36 LOADING TO BE APPROXIMATELY 3% GREATER THAN FOR THE B-36A.

ALL MARGINS OF SAFETY OF THE BEAM ON THE B-36A ARE SUFFICIENTLY GREAT SO THAT INCREASING THE LOAD 3% WILL NOT CRITICALLY LOWER THE MARGINS. THE MINIMUM MARGIN OF SAFETY FOR THE B-36A 65% BEAM IS (.11) IN THE LOWER FLANGE. (REF. FZS-36-142B, PAGE 94) THE MARGIN OF SAFETY FOR THE SAME MEMBER IN THE XB-36 IS SHOWN BELOW.

$$M.S._{XB\text{-}36} = \frac{(1+.11)}{(1.03)} - 1 = +.08$$

REF. FZS-36-142B, PAGES 81 TO 96 TO OBTAIN DATA.

FW 444 6-46 UTILITY REPORT SHEET

THE DIAGONAL BEAM, 36W282

THE DIAGONAL BEAM (36W282) IN THE XB-36 WING TRAILING EDGE IS IDENTICAL TO THE SAME MEMBER IN THE B-36A AIRPLANE. THE DISCUSSION AND METHOD OF ANALYSIS OF THIS MEMBER IS GIVEN IN REPORT FZS-36-142 PAGE III-113.

THE CRITICAL CONDITION FOR THIS BEAM IS

<u>D.G.W. FLAPS DOWN @ SEA LEVEL</u>.

THIS CONDITION YIELDS LOADS WHICH AVERAGE LESS THAN 1% GREATER THAN FOR THE B-36A. AIRPLANE. REF. THE COMPARATIVE PRESSURE CURVES GIVEN ON PAGE 292.

SINCE THE INCREASE IN LOADS IS NO GREATER THAN INDICATED ABOVE, THE B-36A MARGINS OF SAFETY ARE CONSIDERED TO BE APPLICABLE FOR THE XB-36 AIRPLANE.

THE AUXILIARY SPAR, 36W275

THE AUXILIARY SPAR (36W275) USED IN THE XB-36 AIRPLANE IS IDENTICAL TO THAT IN THE B-36A AIRPLANE. A DISCUSSION AND METHOD OF ANALYSIS FOR THIS BEAM IS GIVEN IN REPORTS FZS-36-143 P III-154 AND FZS-36-143B P 118.

THE CRITICAL CONDITION FOR THE DESIGN OF THE AUXILIARY SPAR IS D.G.W.-FLAPS DOWN @ SEA LEVEL. A STUDY OF LOADS FROM FIG. 26 SHOWS THAT THE LOADS ON THIS MEMBER HAVE INCREASED LESS THAN 1% OVER THE B-36A LOADS.

SINCE THE INCREASE IN LOADS IS NO GREATER THAN INDICATED ABOVE THE B-36A MARGINS OF SAFETY ARE APPLICABLE TO THE XB-36 AIRPLANE.

ANALYSIS Vlins	**Consolidated Vultee Aircraft Corporation** FORT WORTH DIVISION FORT WORTH, TEXAS	PAGE	297
PREPARED BY [illegible]		REPORT NO.	FZS-36-242
CHECKED BY Johnson		MODEL	XB-36
REVISED BY		DATE	5-11-43

T.E. BULKHEAD NO. 8

TRAILING EDGE BULKHEAD NO. 8 (36W293) IS IDENTICAL TO TRAILING EDGE BULKHEAD NO. 8 ON THE B-36A AIRPLANE. A DISCUSSION OF ITS FUNCTION AND STRUCTURAL DESIGN IS FOUND IN REPORT FZS-36-143 PAGE III-252

THE APPLIED LOADS TO TRAILING EDGE BULKHEAD # 8 FOR THE B-36A AIRPLANE IN THE

D.G.W. FLAPS DOWN 3 SEA LEVEL COND.

ARE SHOWN ON PAGE 68 OF REPORT FZS-36-143B. THIS REFERENCE SHOWS THE NET VERTICAL LOAD ON THE BULKHEAD TO BE

$$\Sigma V = 11,901\ \#$$

AND THE MOMENT OF THE APPLIED LOADS ABOUT THE REAR SPAR

$$\Sigma M = -2,140,380\ ''\#$$

IN A SIMILAR MANNER THE APPLIED LOADS TO THE XB-36 AIRPLANE ARE FOUND TO GIVE

$$\Sigma V = 29,135\ \#$$
$$\Sigma M = -2,159,310\ ''\#$$

A [illegible] STATIC LOADS AT BULKHEAD # 8 FOR THE

D.G.W. FLAPS DOWN COND.

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T.E. BLKHD. #8

AND THE FOLLOWING LOAD COMPARISON MAY BE MADE.

	B-36A	XB-36
ΣV	20,409	21,152
$\Sigma M_{R.S.}$	-2,637,390	2,700,180

(REF. FZS-36-143, P. 68

THE CALCULATIONS OF REACTIONS FOR THE INBOARD TRAILING EDGE SECTION IS ACCOMPLISHED AS SHOWN ON PAGE 57 OF FZS-36-142, VOL. III. THE NET EFFECT OF THE APPLIED LOADS TO BULKHEADS #7 AND #8 WILL BE AN INCREASE OF LESS THAN 1% IN THE SHEAR AND MOMENT VALUES FOR THESE MEMBERS IN THE

U.G.W. FLAPS DOWN @ S.L. COND.

SINCE THE INCREASE IN APPLIED LOADS IS NO GREATER THAN INDICATED, THE B-36A ANALYSIS AND MARGINS OF SAFETY WILL BE APPLICABLE FOR THE XB-36 AIRPLANE, TRAILING EDGE BULKHEAD NO. 8.

T.E. BULKHEAD NO. 2 (36W291)

TRAILING EDGE BULKHEAD NO 2 IS THE SAME BULKHD AS IN THE B-36A AIRPLANE. REFERENCE REPORTS FZS-36-143, P. III-183 AND FZS-36-143B, P. 104 SHOWS THE GREATER PORTION OF THIS BULKHEAD IS CRITICAL FOR THE

D.G.W. FLAPS DOWN COND.

HOWEVER THE TRUSS PORTION AT THE FORWARD END OF THIS BULKHEAD IS [illegible] CRITICAL FOR THE

D.G.W.-ILAA. @5000' COND.

AND THE LOWER [illegible] CUT-OUT AFT OF THE T/E TO THE 62½% BEAM IS CRITICAL FOR THE

D.G.W.-LAA-@5000' COND.

A STUDY OF THE LOADS TO BULKHD NO. 2 TO DETERMINE THE EFFECT OF INCREASED [illegible] PRESSURES AS SHOWN [illegible], FIG. 26, P. 292 SHOWS FOR:

1. DGW-FLAPS DOWN @ SEA LEVEL COND. AN [illegible] SE [illegible] THAN 1%, SEE PAGE 298
2. DGW-ILAA @ 5000' COND. CHANGE IN BULKHEAD LOADING [illegible] SMALL REF PAGE 4
3. DGW-LAA-@5000' COND. AN [illegible] OF [illegible] IS INDICATED BY PRESENT [illegible] 4

THE [illegible] FOR [illegible] #2

T.E. BLKHD. #2

IS [illegible] FOR THE
D.G.W. LAND. 85000 COND.
THE B-36A ANALYSIS.
REF FZS-36-148B PP. 108-110 SHOWS
THIS MEMBER TO HAVE A MARGIN
OF SAFETY OF (+.13). SINCE THE
BULKHEAD SHEAR, BENDING MOMENT
AND AXIAL LOAD AT THIS POINT
FOR THE XB-36 BULKHEAD IS
INCREASED IN PROPORTION TO THE
INCREASE IN BULKHEAD LOADS, WHICH
ARE OBTAINED BY USE OF THE
PRESSURE DISTRIBUTION CURVE, P. 4.
MARGINS OF SAFETY FOR THE XB-36
MEMBERS MAY BE OBTAINED BY
REDUCING THE B-36A MARGINS OF
SAFETY BY THE RATIO OF B-36A
AIR LOADS TO XB-36 AIRLOADS.

THE XB-36 MARGIN OF SAFETY FOR
THE LOWER FLANGE AT A SECTION
15" AFT OF THE 52½ % BEAM IS
M.S. = (+.13), REF. FZS-36-148B PP. 110
THE MARGIN OF SAFETY FOR THE
SAME MEMBER IN THE XB-36 IS

$$\frac{(1.13+1)}{1.03} - 1 = \boxed{+.10}$$

SINCE THE INCREASE IN LOADS [illegible]
[illegible] ARE LESS
THAN [illegible], THE B-36A ANALYSIS
[illegible] ARE [illegible]

TRAILING EDGE, INBOARD TO CENTER NACELLE

T.E. BULKHEAD NO. 12

TRAILING EDGE BULKHEAD NO. 12 IS IDENTICAL TO THE SAME STRUCTURE IN THE B-36A. FOR A DISCUSSION OF ITS FUNCTION AND STRUCTURAL PROPERTIES REFER TO REPORT FZS-36-142.

THE CRITICAL DESIGN CONDITION FOR THE MAJOR PORTION OF THE BULKHEAD IS

D.G.W. FLAPS FULLY DEFLECTED @ S.L.

REFERENCE TO THE ANALYSIS OF LOADS ON T.E. BULKHEADS NO. 2 AND NO. 8 PAGE 297 SHOWS AN INCREASE OF LOADS OF LESS THAN 1%. THIS AMOUNT OF INCREASE MAY BE CONSIDERED TYPICAL FOR T.E. BULKHEAD #12.

MEMBERS WITH THE LOWEST MARGINS OF SAFETY IN THE B-36A ANALYSIS WILL BE GIVEN FURTHER CONSIDERATION IN THIS ANALYSIS.

MEMBER 7-I

(REF. SKETCH, PAGE 302)

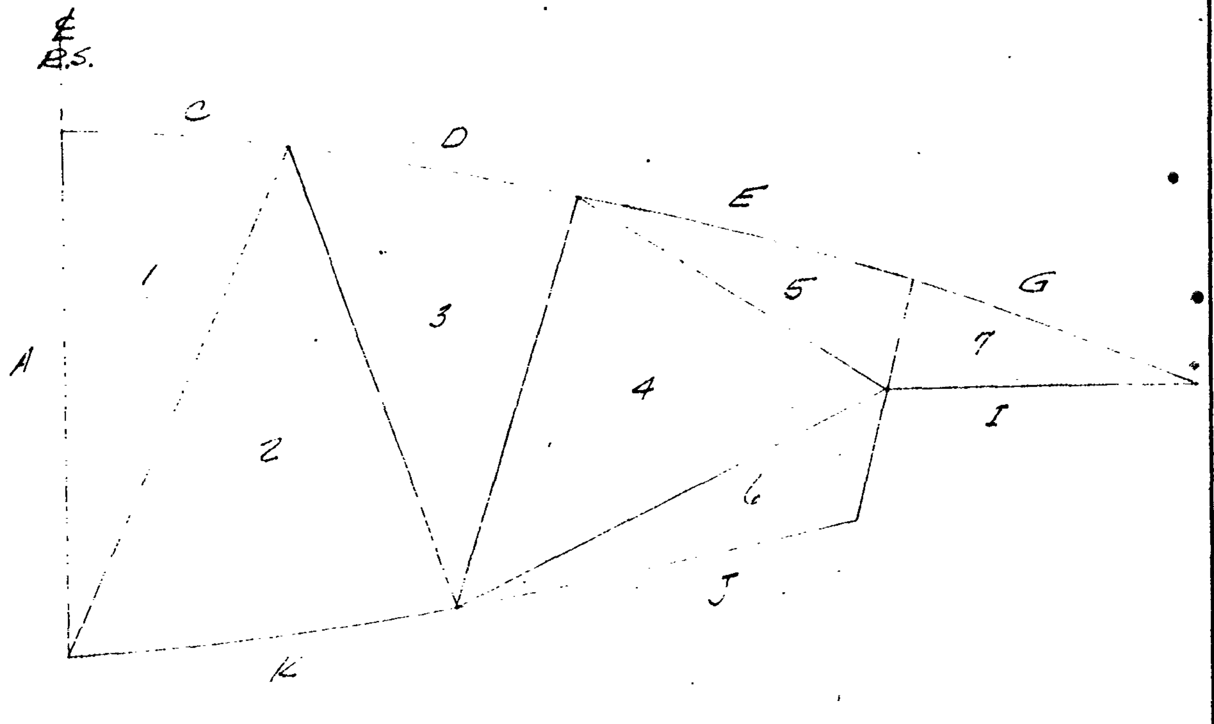
MEMBER 7-I HAS A MARGIN OF SAFETY OF +.06 FOR THE B-36A. THERE IS CONSIDERED TO BE NO CHANGE FOR THE XB-36 SINCE THE

T.E. BLKHD. #12

LOADS IN MEMBER 7-I ARE A DIRECT FUNCTION OF FLAP LOADS WHICH REMAIN UNCHANGED., REF. FZS-36-248

MEMBER J-6

MEMBER J-6 HAS A MARGIN OF SAFETY OF +.01 FOR THE B-36A. THIS IS A CONSERVATIVE ANALYSIS SINCE IT DOES NOT CONSIDER THE ABILITY OF THE LOWER SURFACE WAFFLED SKIN TO CARRY A PORTION OF THE LOWER SURFACE AIR LOAD APPLIED TO THIS MEMBER. FOR THIS REASON THE B-36A MARGIN OF SAFETY IS APPLICABLE TO THE XB-36.



TE [illegible]

[illegible] IS [illegible] TO THE SAME [illegible] IN THE [illegible] STRUCTURAL [illegible] REPORT [illegible] FZS-[illegible]-[illegible], PAGE III-44.

THREE CONDITIONS OF FLIGHT ARE CONSIDERED IN THE ANALYSIS OF THIS STRUCTURE.

I. [illegible]

WHICH IS CRITICAL FOR [illegible] MEMBERS [illegible], [illegible] & [illegible] (REF. FZS-36-142, PG III-422)

II. D.G.W. L.H.H. @ 5000'

WHICH IS CRITICAL FOR THE UPPER CHORD MEMBER AND MEMBER 3-4.

III. [illegible] @ 5000'

WHICH IS CRITICAL [illegible] CHORD MEMBER.

THE SURFACE PRESSURES ON THE [illegible]

D.G.W. L.H.H. @ 5000'

ARE GIVEN ON PAGE III-24 OF [illegible] REFERENCE [illegible] THE [illegible] SURFACE PRESS [illegible] TO BE 2.50 #/[illegible] AT 40% OF THE CHORD FROM THE LEADING EDGE AND [illegible] #/[illegible] AT 60% OF THE CHORD FROM THE LEADING EDGE. [illegible]

[illegible] ALL IN THE [illegible] THE [illegible] L.H.H. @ 5000' [illegible] AND

ANALYSIS WING | PAGE 304
PREPARED BY [illegible] | REPORT NO. FZS-36-242
CHECKED BY [illegible] | MODEL XB-36
REVISED BY | DATE 5-48

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

T.E. RIB #13

[illegible] 2.0 [illegible]
[illegible]
[illegible] 4.7 [illegible]
[illegible] THIS RESULTS
IN A [illegible]
[illegible] LOADS [illegible]
[illegible] FOR THE
[illegible] 2 5000 [illegible]

FOR FLIGHT CONDITION I
[illegible] [illegible] LOADS [illegible]
[illegible] LOADS
ON THE [illegible] NO. 1 AND NO. 5
PAGE 247 [illegible]
OF LOADS [illegible], THIS
[illegible] INCREASE [illegible] CON-
SIDERED TYPICAL FOR ALL THE XB 36
TRAILING EDGE STRUCTURE.

FOR FLIGHT CONDITION III, DGW ILAH @ 5000'

IN THE SAME MANNER AS FOR
CONDITION I, BY COMPARISON OF
XB-36 AND B-[illegible] LOADS ON THE
INBOARD TRAILING EDGE IT IS
FOUND THAT INCREASES OF LOADS
FOR THIS CONDITION ARE SO
SMALL THAT MARGINS OF SAFETY
FOR [illegible] ARE APPLICABLE
TO THE XB-36.

[illegible] IN THIS
[illegible] CONDITION I
[illegible]

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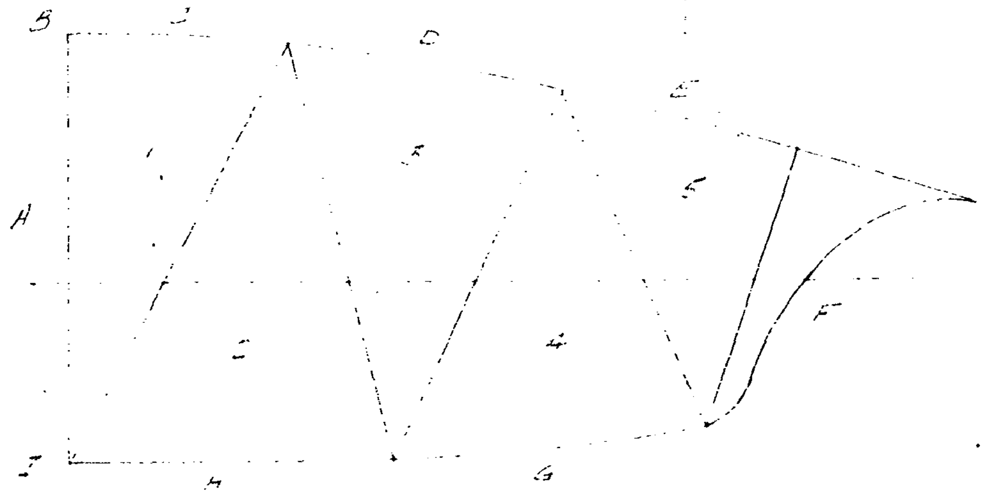
T.E. RIB #13

WILL BE INVESTIGATED SINCE THE [illegible] BETWEEN XB-36 AND B-36 LOADS FOR CONDITION I AND III IS VERY SLIGHT.



[illegible]

MEMBER	MAXIMUM [illegible] OF SAFE[illegible]	
	B-36	XB-36*
C-1	-.24	0
D-3	+.15	-.1
E-5	+.25	+.81
F-4	+2.0	+1.13

* XB-36 M.S. = [illegible]

[illegible]

ANALYSIS OF THE WING LEADING EDGE

The leading edge loads are directly proportional to the gross weight of the airplane and since the B-36A and the XB-36 leading edge structures are similar it will not be necessary to make a detail analysis of the XB-36 leading edge. The loads on the XB-36 leading edge will decrease from the loads on the B-36A (Ref. FZS-36-142, page III-428) by the ratio of their gross weights, 2[illegible],192/27[illegible],000 = .955, and the margin of safety of B-36 (Ref. page III-484, FZS-36-142) will increase by 4.5% for the XB-36 leading edge margins of safety

The minimum margin of safety for the B-36 leading edge structure exists in the diagonal tube of a typical leading rib, wing station 127.16

$$M.S._{(B-36A)} = 0 \quad \text{(Ref: FZS-36-142, P. III-486)}$$

$$M.S._{(XB-36)} = 1.045 \times 1 - 1 = \underline{+.045}$$

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CONSOLIDATED VULTEE AIRCRAFT CORP., FORT WORTH DIV.,
TEX. (REPORT NO. FZS-36-242)

STRESS ANALYSIS OF WING CENTER SECTION - PART III - INTERSPAR
BULKHEADS - LEADING AND TRAILING EDGE STRUCTURE - MODEL XB-36

N.S. MEFFORD; B.C. VOSS; A.B. CANFIELD AND OTHERS
MAY '48 306PP. TABLES, GRAPHS

USAF CONTR. NO. W535-AC-22352

STRUCTURES (7) WINGS - STRESS ANALYSIS
DESIGN AND DETAILS (3) B-36 - STRESS ANALYSIS
B-36

3

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