NEW LIMITATION CHANGE

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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

PREPARED BY: F. C. Host
G. F. Copeland
M. Ewing

GROUP: STRUCTURES

CHECKED BY: W. W. Johnson

APPROVED BY: J. W. Adams

NO. OF PAGES 306
NO. OF DIAGRAMS 26

REVISIONS

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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 I

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<th>PAGE</th>
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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 of 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 IIAA 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.

\[ B-36A, n_{(LAA)} = 1 + \frac{5K_{s}aV}{W/S} \]
\[ XB-36, n_{(LAA)} = 1 + \frac{3K_{s}aV}{W/S} \]
where $K = 2K_1$

at the 5,000' level

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

then

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

$$XB-36, n_{(\text{I AA})} = 1 + \frac{6K_1 aV \times .866}{W/S}$$

This gives an increase of factor for the XB-36 in the IAA 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

$$\frac{255,000}{268,000} = .95$$

of the B-36 loads.
<table>
<thead>
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<th>Blend Station</th>
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<th>V</th>
<th>Limit</th>
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<th>C4</th>
<th>C6</th>
<th>C2 x C4</th>
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*Table II: Data for Chordwise Air Load Distribution*
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### Table VI

**WING BULKHEAD # 22**

*Ref: Table II, P.5*

Calculated by: Goodwin
Checked by: Connell
### TABLE III

**CHORDWISE AIRLOAD PRESSURE DISTRIBUTION**

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<td><strong>9</strong></td>
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<td>2.24</td>
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*REF: TABLE II P-S*
WING BULKHEAD #0.0
(G6UW100)

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<td>13</td>
</tr>
<tr>
<td>VERTICAL STIFFENER DESIGN</td>
<td>16</td>
</tr>
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</table>
WING BULKHEAD #0.0

WOOD/100

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. F25-36-142).

The following condition impacts critical stiffener loading:

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

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

All section properties, allowables, and assumptions are the same as for the B-36A analysis. See Report No. F25-36-148, Page I-71.

**Crushing Loads**

\[
M_x^* = 151,000,000 \text{ ft-lb (Rept. F25-36-241, P. 63)}
\]

\[
I_x = 162,647\text{ in}^4
\]

\[
h = 81.2 \text{ in} = (I/Q)_x
\]

\[
L = 41.025\text{ in}
\]

\[
W = M^2/EIh \text{ ft-lb}
\]

**Net crush. load on BLKD =**

\[
W = \frac{(M_x^*)^2 L}{EI_x (\frac{h}{Q})_x}
\]

\[
P_c = \frac{(151 \times 10^6)^2 \times 41.025}{(10.3 \times 10^6) \times 162,647 \times 81.2} = 6875 \text{ ft-lb}
\]

**Average**

\[
P_c = \frac{6875}{12.4} = 55.5 \text{ ft-lb}
\]

**Av spar depth =** 74.75 in

\[
W_{F.S} = \frac{65.46}{74.75} (55.5) = 48.5 \text{ ft-lb}
\]

\[
W_{R.S} = \frac{84.03}{74.75} (55.5) = 62.4 \text{ ft-lb}
\]

48.5 ft-lb

62.4 ft-lb
### UPPER SURFACE

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**Note:** 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)

Crushing:
\[ P = \frac{49.28 \times 16.80}{2} = 415 \# (DOWN) \]
\[ P = 415 \# (UP) \]

Element:
\[ P = \frac{0 + 284}{2} = 142 \# (DOWN) \]
\[ P = \frac{7.40 \times 22,800}{9.40} = 17,960 \# (UP) \]

Total Stiff Loads:
\[ P_{TOTAL} (DOWN) = 415 + 142 = 557 \# \]
\[ P_{TOTAL} (UP) = 415 + 17,960 = 18,375 \# \]

The stiffener end loads as listed in Table Col. 8 and 9 were computed in a similar manner.
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. 1-125).

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. For (critical stringer load for two bay length) remains unchanged for the XB-36 since it is a function of stringer stiffness 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 ratio. 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. F25-36-192, PGS. 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. = 95,790,000 **
COND. II B.M. = 96,572,000 **

XB-36 BEND. MOM. (REF. F25-36-280, PGS. 234 + 235)

CONDITIONS:
I. A.G.W. 265,666 " (72-1080 GWP-D) H.A.A. @ 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. = 95,800,000 **
WING BULKHEAD STA. 10

BENDING MOMENT RATIOS

STA 10

COND. I, \( R_1 = \frac{95,400,000}{98,260,000} = 0.97 \)

COND. II, \( R_2 = \frac{99,500,000}{97,205,000} = 1.003 \)

STA 11

COND. I, \( R_1 = \frac{91,200,000}{95,790,000} = 0.952 \)

COND. II, \( R_2 = \frac{95,400,000}{96,547,000} = 0.989 \)

AVERAGE RATIO FOR COND. I = \( \frac{0.97 + 0.952}{2} = 0.961 \)

AVERAGE RATIO FOR COND. II = \( \frac{1.003 + 0.989}{2} = 0.996 \)

CRITICAL \( P \) (B-36A) = 151,200 \# COND. I \( \{ \text{REF F25-36-142} \}

= 113,000 \#, COND. II \text{ (PG. I-133)}

\( P(XB-36) \):

COND. I = 151,200 \# \times 0.961 = 146,200 \# 

COND. II = 113,000 \# \times 0.996 = 112,500 \#

\( P_{CR}(XB-36) \):

COND. I = 125,100 \# \text{ (REF F25-36-192)}

COND. II = 97,200 \# \text{ (PG. I-133)}

\( P_{VCR}(XB-36) \):

COND. I = 146,200 - 125,100 = 21,100 \# 

COND. II = 112,500 - 97,200 = 15,300 \#
THE AIRLOAD TO THE BULKHEAD ON 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 \( \frac{Z}{W} = +2.691 \) \( \text{REF F25-36-136} \) \( G_W = 278,640 \)

COND. II \( \frac{Z}{W} = +2.745 \) \( \text{PG. 30} \)

\[ \begin{align*} 
\text{COND. I} & \quad Z = 2.691 \times 278,640 = 747,060 \\
\text{COND. II} & \quad Z = 2.745 \times 278,640 = 763,060
\end{align*} \]

XB-36

COND. I \( \frac{Z}{W} = +2.697 \) \( \text{REF F25-36-142} \) \( G_W = 265,680 \)

COND. II \( \frac{Z}{W} = +2.997 \) \( \text{PG. 45} \)

\[ \begin{align*} 
\text{COND. I} & \quad Z = 2.697 \times 265,680 = 715,000 \\
\text{COND. II} & \quad Z = 2.997 \times 265,680 = 765,000
\end{align*} \]

AIRLOAD RATIOS

\[ \begin{align*} 
\text{COND I} & \quad K = \frac{715,000}{747,060} = 0.957 \\
\text{COND II} & \quad K = \frac{765,000}{763,060} = 1.002
\end{align*} \]

AIRLOAD (B-36A), \( \text{COND I} = -56.1 \) \( \%_W \), \( \text{REF F25-36-142} \)

\[ \begin{align*} 
\text{COND II} & \quad = -72.2 \%_W \text{ PG. 1-136}
\end{align*} \]

AIRLOAD (XB-36), \( \text{COND I} = -56.1 \times 0.957 = -53.6 \%_W \\
\text{COND II} = -72.2 \times 1.002 = -72.4 \%_W \]
WING BULKHEAD STA 10

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

\[
\text{RATIO (COND. I)} = (\frac{1}{1.06})^2 = 0.924
\]
\[
\text{RATIO (COND. II)} = (\frac{1}{1.09})^2 = 0.992
\]

CRUSHING LOADS (8-36A):

\[
\begin{align*}
\text{COND. I} & = 50.3 \times 0.924 \text{ kips} \\
\text{COND. II} & = 49.2 \times 0.992 \text{ kips}
\end{align*}
\]

CRUSHING LOADS (18-36):

\[
\begin{align*}
\text{COND. I} & = 0.924 \times 50.3 = 46.5 \text{ kips} \\
\text{COND. II} & = 0.992 \times 49.2 = 48.8 \text{ kips}
\end{align*}
\]

SUMMARY

\text{COND. I:}

\[
\begin{align*}
\text{CRITICAL } P_{\text{cr}} & = 21,100 \text{ kips} \\
W_0 & = 53.6 - 46.5 = 7.1 \%
\end{align*}
\]

\text{COND. II:}

\[
\begin{align*}
\text{CRITICAL } P_{\text{cr}} & = 15,300 \text{ kips} \\
W_0 & = 72.4 - 48.8 = 23.6 \%
\end{align*}
\]
ANALYSIS: WING
PREPARED BY: CONWAY
CHECKED BY: JOHNSON
REVISED BY:

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

REVISION DATE: 18-36

WING BULKHEAD STA 10

CONCLUSION:

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

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<td>W0</td>
<td>23.0 %</td>
<td>23.6 %</td>
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*W0 = NET LOAD #/IN.


THE SLIGHT INCREASE IN LOADING FOR THE XB-36 SYSTEM - W0 = 23.6 %/IN VERSUS 23 %/IN (B-36 A) WILL BE MORE THAN OFFSET BY THE EXCESS STIFFNESS SUPPLIED BY VIRTUE OF THE DECREASE IN (P-Pk).
WING BULKHEAD #3

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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) IAA A 5000'

Sketch of Bulkhead #3
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<th>Z</th>
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For definition of terms see front.
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**Note:** For definition of terms, see page 325.
CONDITION I - DGW (265/192) 11.49 @ 5000'

\[ N_1 = 54,500'' \]  
\[ M_1 = 13,4000'' \]  
\[ N_5 = 14,780'' \]  
\[ M_5 = 19,5000'' \]  
\[ N_3 = 8,580'' \]  
\[ M_3 = 45,3000'' \]

(REF: TABLE XI)

**Reactions on Bulkhead**

Transferring all external forces to FA

\[ V = N_1 + N_5 = 10,230'' \]

\[ T_{EA} = M_1 + M_5 + 65.69 \times V = 411,000'' \]

Reactions on FS & RS due to V

\[ V_2 = \frac{65.69 \times 10,230}{11,37} = 5770'' \]

\[ V = 10,230 - 5770 = 4460'' \]

Shear flow due to \( T_{EA} \)

\[ q_0 = \frac{411,000}{17,830} = 23.2 \text{ MN} \]

\[ * 24 = 178.300'' \]

(REF: FZS-36-141 R206)
**CRUSHING LOADS**

\[ P = \frac{(M) L}{I_{c}/E I} \]

- \( L = 33.25 \)
- \( M_c = -16.70 \times 10^6 \) (Ref 125-340)
- \( I_{c} = 75.75'' \)
- \( I = 134500''^2 \)
- \( E = 10.3 \times 10^6 \)

*Replacing \( P \) with equivalent trapezoid such that*

\[ \frac{h_f}{h_c} = \frac{w_f}{w_c} \]
*Where \( h_f \) & \( h_c \) are contour depths of front & rear spar respectively.*

- \( w_f = 10.54 \)
- \( w_c = 13.61 \)

**AIR LOADS**

*Replacing the air loads with equivalent trapezoids.*

**Composite Interspar Load (N**

- \( w_{c0} = 77.8 \)
- \( w_{c1} = 4.3 \)

**Lower Surface Load (N**

- \( w_{2} = 91.6 \)
- \( w_{2c} = 55.9 \)

**Upper Surface Load**

- \( w_{fu} = w_{c0} - w_{2c} = 13.8 \)
- \( w_{ru} = w_{c1} - w_{2c} = 51.6 \)
DGLU 265,196" 14.44 @ 5000' (cont)

**COMBINED AIR & CRUSHING LOADS**

**BULKHEAD #2**

**COMBINED LOADS**

**BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS**

\[
\begin{align*}
P_A &= 153 \text{**} \\
P_B &= 564 \text{**} \\
P_C &= 1028 \text{**} \\
P_D &= 670 \text{**} \\
P_E &= 910 \text{**} \\
P_F &= 2165 \text{**} \\
P_G &= 2630 \text{**} \\
P_H &= 1465 \text{**}
\end{align*}
\]
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.

\[ T_0 = 2A_0 \rho_o = 90,450 \text{ lbf} \]

\[ R_0 = \frac{90,450}{116.37} = 775.5 \text{ lbf/ft} \]

\[ T_1 = 2A_1 \rho_1 = 9050 \text{ lbf} \]

\[ R_1 = \frac{9050}{116.37} = 77.7 \text{ lbf/ft} \]

CORRECTED PANEL POINT LOADS

\[ P_4 = 308 \text{ lbf} \]
\[ P_6 = 494 \text{ lbf} \]
\[ P_7 = 998 \text{ lbf} \]
\[ P_8 = 1387 \text{ lbf} \]
CONDITION II - AGW (2-1000 lb bombs) HAA @ 5000'

\[ N_1 = 5420 \text{ in.} \]  (Ref: Table III)
\[ M_2 = 128700 \text{ in.} \]
\[ N_5 = 8287 \text{ lb} \]
\[ M_3 = 424000 \text{ lb-in} \]
\[ N_0 = 7456 \text{ lb} \]
\[ M_0 = 394000 \text{ lb-in} \]

**REATIONS ON BULKHEAD**

Transferring all external forces to EA.

\[ V = N_1 + N_3 = 13707 \text{ in.} \]

\[ T_{EA} = M_2 + M_3 + 65.69 \times V = 604700 \text{ lb} \]

**REATIONS ON FS & RS. DUE TO V**

\[ V_F = \frac{65.69 \times 13707}{116.37} = 7790 \text{ in.} \]

\[ V_F = 13707 - 7790 = 5917 \text{ in.} \]

**SHEAR FLOW DUE TO T_{EA}**

\[ \theta_0 = \frac{T_{EA}}{3A} = \frac{604700}{17230} = 3.5 \text{ lb/in} \]
**A.G.W. (12-1000*bomb) H/A @ 5000' (contd)**

**Bulkhead #3**

**Crushing Load**

\[ P = \frac{(M_i)^2 L}{2 \rho_a EI} \]

\[ M_i = 126.5 \times 10^6 \text{ (Ref: Table 27, Pg.42)} \]

\[ L = 53.25'' \]

\[ I_d = 75.75 \]

\[ E = 10.3 \times 10^6 \]

\[ I = 134.500 \text{ in}^4 \]

Replace \( P \) with equivalent trapezoid such that

\[ h_c = \frac{w_c}{w_r} \]

where \( h_c \) & \( h_r \) are contour depths of front & rear spar respectively.

\[ w_c = 37.8 \]

\[ w_r = 48.9 \]

**Air Loads**

Replacing air loads with equivalent trapezoid

**Composite Interspar Load (Nz)**

\[ w_{Fc} = 97.3 \]

\[ w_{Fc} = 45.2 \]

**Upper Surface Load**

\[ w_{Fu} = 81.7 \]

\[ w_{Eu} = 46.6 \]

**Lower Surface Loads**

\[ w_l = 156 \]

\[ w_{Re} = -1.4 \]
A.G.W. (92-1000 lb. BOMBS) H/H @ 5000' (CONT)

COMBINED AIR & CRUSHING LOADS

COMBINED LOADS

BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS

\[ P_a = 775 \text{ lb} \]
\[ P_b = 104 \text{ lb} \]
\[ P_c = 542 \text{ lb} \]
\[ P_1 = 89 \text{ lb} \]
\[ P_2 = 942 \text{ lb} \]
\[ P_3 = 1933 \text{ lb} \]
\[ P_4 = 1976 \text{ lb} \]
\[ P_5 = 1002 \text{ lb} \]
BULKHEAD #3

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.

\[ T_u = 2A_u g_0 = 20,000 \text{ "}" \]
\[ R_u = \frac{20,000}{116.37} = 173.5 \text{ "}" \]

\[ T_L = 2A_L g_0 = 5,850 \text{ "}" \]
\[ R_L = \frac{5,850}{116.37} = 50.9 \text{ "}" \]

CORRECTED PANEL POINT LOADS

\[ P_0 = 601 \text{ "}" \]
\[ P_1 = 233 \text{ "}" \]
\[ P_2 = 1017 \text{ "}" \]
\[ P_4 = 925 \text{ "}" \]
CONDITION III. AG61 (72-1000# Bombs) L199 @ 5000'

\[ N = 4060 \text{#} \quad (\text{Ref Table III}) \]
\[ M_1 = 21,250 \text{#} \text{ft} \]
\[ N_2 = 8,500 \text{#} \]
\[ M_2 = 44,500 \text{#} \text{ft} \]
\[ N_4 = 11,100 \text{#} \]

REACTION ON BULKHEAD

TRANSFERRING ALL EXTERNAL FORCES TO E.A.

\[ V = N \cdot I \cdot N = 12,540 \text{#} \]

\[ T_e = M_1 + M_2 + 12540 \cdot V = 44,500 + 750 \text{#} \text{ft} \]

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

\[ V_x = \frac{12540}{17,830} \cdot 12560 = 9080 \text{#} \]

\[ V_y = 12560 - 9080 = 3480 \text{#} \]

SHEAR FLOW DUE TO T_e

\[ \tau = \frac{T_e}{2A} = \frac{44,500}{17,830} = 2.5 \text{#} / \text{in} \]
ANALYSIS

Ilonsolidated

Vulte Aircraft Corporation

Consolidated Vultee Aircraft Corporation

FORT WORTH DIVISION

FORT WORTH, TEXAS

REPORT NO.

F25-36-242

MODEL

XB-36

DATE

11-47

BULKHEAD #3

AGM (32-1000" Bombs) LAA @ 5000' (Cont'd)

CRUSHING LOAD

\[ P = \frac{M'}{I_Q EI} \]

\( M' = 132,410,000 \) (F25-36-242)

\( L = 33.25 \)

\( P = 5,530 \) #

REPLACE \( P \) WITH EQUIVALENT TRAPEZOID SUCH

THAT \( \frac{h_f}{h_R} = \frac{W_f}{W_R} \) WHERE \( h_f \) & \( h_R \) ARE THE CONTOUR

DEPTHs OF FRONT & REAR SPARS RESPECTIVELY.

\( W_f = 41.4 \)

\( W_R = 53.6 \)

AIR LOAD

REPLACING THE AIR LOADS WITH EQUIVALENT

TRAPEZOIDS.

COMPOSITE INTERSPAR LOAD

\( W_{fC} = 87.3 \) #

\( W_{RC} = 58.9 \) #

UPPER SURFACE LOAD

\( W_{fU} = 102.0 \) #in

\( W_{RU} = 88.1 \) #in

LOWER SURFACE

\( W_{fL} = 16.2 \) #in

\( W_{RL} = 29.2 \) #in

FW 444
AGW (72-1000* Bombs) LAA @ 5000' (Cont'd)

**Combined Air & Crushing Loads**

![Diagram showing air load and crushing load combinations for bulkhead #3.](image)

**Breakdown of Net Air and Crushing Loads into Panel Point Loads**

\[ P_a = 1110 \text{ lb} \]
\[ P_b = 2015 \text{ lb} \]
\[ P_c = 1706 \text{ lb} \]
\[ P_d = 789 \text{ lb} \]

\[ P_e = 485 \text{ lb} \]
\[ P_f = 978 \text{ lb} \]
\[ P_g = 984 \text{ lb} \]
\[ P_h = 493 \text{ lb} \]
AGW (2-1000# Bombs) /A9 @ 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.

\[ T_u = 2A_2 g_0 = 15400 \text{''} \]

\[ P_u = \frac{116.57}{116.57} = 180.5 \text{''} \]

\[ T = 2A_2 g_0 = 6740 \text{''} \]

\[ P_2 = \frac{116.57}{116.57} = 578 \text{''} \]

Corrected Panel Point Loads:

\[ P_4 = 979 \text{''} \]

\[ P_0 = 870 \text{''} \]

\[ P_2 = 543 \text{''} \]

\[ P_4 = 435 \text{''} \]
<table>
<thead>
<tr>
<th>Member</th>
<th>Condition</th>
<th>Critical Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>AK</td>
<td>2440 -2300 -6240</td>
<td>2440 2300</td>
</tr>
<tr>
<td>AK</td>
<td>+1105 -670 -6255</td>
<td>1105 970</td>
</tr>
<tr>
<td>BN</td>
<td>+1365 -685 -1000</td>
<td>1365 685</td>
</tr>
<tr>
<td>BN</td>
<td>+25 +640 +900</td>
<td>25 900</td>
</tr>
<tr>
<td>CP</td>
<td>+1350 -1390 -1205</td>
<td>1350 1390</td>
</tr>
<tr>
<td>CP</td>
<td>0 0 0</td>
<td>0 0</td>
</tr>
<tr>
<td>DP</td>
<td>+259 +233 +870</td>
<td>870</td>
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<td>+3479 -4235 +4320</td>
<td>3479 4320</td>
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<td>1325 1910</td>
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<tr>
<td>EO</td>
<td>- 25 - 640 - 910</td>
<td>- 250</td>
</tr>
<tr>
<td>FM</td>
<td>+510 - 50 - 575</td>
<td>790 1510</td>
</tr>
<tr>
<td>FM</td>
<td>- 615 - 55 - 520</td>
<td>- 615</td>
</tr>
<tr>
<td>GL</td>
<td>-1375 +1255 +440</td>
<td>1255 1920</td>
</tr>
<tr>
<td>GL</td>
<td>+1615 -2415 -290</td>
<td>1615 2415</td>
</tr>
<tr>
<td>J</td>
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<td>600</td>
</tr>
<tr>
<td>K</td>
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<td>2230 340</td>
</tr>
<tr>
<td>LM</td>
<td>+1210 +1970 -315</td>
<td>2710 1970</td>
</tr>
<tr>
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<td>+1640 +1555 +220</td>
<td>1525 1640</td>
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<tr>
<td>NO</td>
<td>+3590 -3250 +179</td>
<td>3590 3250</td>
</tr>
<tr>
<td>OP</td>
<td>-2920 +4270 +4215</td>
<td>4270 2920</td>
</tr>
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</table>
WING BULKHEAD #3
DETAIL ANALYSIS

The detail analysis of the XB-36 bulkhead #3 will be accomplished in the same manner as the XB-36 B-36A analysis, rep: F25-36-144. 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 (rep: P-1181 F25-36-144), and will be checked in this analysis.
<table>
<thead>
<tr>
<th>MEMBER</th>
<th>TWO</th>
<th>E1</th>
<th>E2</th>
<th>E3</th>
<th>E4</th>
<th>E5</th>
<th>E6</th>
<th>E7</th>
<th>E8</th>
<th>E9</th>
<th>E10</th>
<th>E11</th>
<th>M.S.</th>
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<tr>
<td>KL</td>
<td>650</td>
<td>1541</td>
<td>-340</td>
<td>366</td>
<td>-2570</td>
<td>72000</td>
<td>1.58%</td>
<td>0.658</td>
<td>107.5</td>
<td>1200</td>
<td>1.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LM</td>
<td>650</td>
<td>1541</td>
<td>-1270</td>
<td>404</td>
<td>-4880</td>
<td>68000</td>
<td>2.627</td>
<td>0.806</td>
<td>82.7</td>
<td>12700</td>
<td>1.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MN</td>
<td>650</td>
<td>1541</td>
<td>-1640</td>
<td>2935</td>
<td>-5670</td>
<td>7275</td>
<td>1519</td>
<td>0.925</td>
<td>107.2</td>
<td>7600</td>
<td>1.32</td>
<td></td>
<td></td>
</tr>
<tr>
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<td>1541</td>
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<td>587</td>
<td>-8300</td>
<td>14000</td>
<td>3.436</td>
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<td>78.5</td>
<td>14000</td>
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<td>1541</td>
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<td>80.06</td>
<td>2.56%</td>
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<td>85.1</td>
<td>12000</td>
<td>1.59</td>
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<td></td>
</tr>
</tbody>
</table>

*Truss tube column allowable from Fig. 5-10 P-3-62. Fig. 5-14-42.*

By [Signature]

Checked by [Signature]
**Detail Analysis**

**Analysis of Member "NO" End Attachment**

<table>
<thead>
<tr>
<th>Item</th>
<th>Area</th>
<th>( Y )</th>
<th>( AY )</th>
<th>( AY^2 )</th>
<th>( I_0 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.015</td>
<td>0.0096</td>
<td>0.015</td>
<td>0.0096</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0.0234</td>
<td>0.0111</td>
<td>0.0234</td>
<td>0.0111</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0.0059</td>
<td>0.0002</td>
<td>0.0059</td>
<td>0.0002</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0.0254</td>
<td>0.0111</td>
<td>0.0254</td>
<td>0.0111</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0.0115</td>
<td>0.0096</td>
<td>0.0115</td>
<td>0.0096</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>0.1540</td>
<td>0.0400</td>
<td>0.1540</td>
<td>0.0400</td>
<td>0.1040</td>
</tr>
</tbody>
</table>

**Section at Attachment to Chord Member**

\[ Y = \frac{\Sigma AY}{2A} = \frac{0.2357}{0.4778} = 0.489 \text{ in.} \]

\[ Y_c = 0.489 \text{ in.}, \quad Y_c = 0.637 \text{ in.} \]

\[ I = \Sigma AY^2 + I_0 - \Sigma AY^2 = 0.1884 + 0.0088 - (0.4778)(0.489)^2 = 0.0834 \text{ in.}^4 \]

**The Maximum Load \( P \) is 3500 lb \((\text{Ref. P.45})\)**

\[ F_c = \frac{P}{A} + \left( \frac{F_c}{I} \right) Y_c = \frac{3550}{0.4778} + \left( \frac{3550 \times 0.489}{0.0834} \right) \]

\[ = 17810 \text{ lb/in}^2 \]

\[ F_c = 0.70 (70000) = 49000 \text{ lb/in}^2 \]

\[ M_S = \frac{49000}{17810} = 1 \]

\[ + 1.75 \]
END ATTACHMENT OF "NO"

The attachment of the channel insert (-3 channel) to the chord member is critical, and the (8) \( \frac{3}{8} \) " rivets are critical in shear.

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

**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 B-36A airplane, this analysis will be done by a ratio of the two loads.

\[
F_{oa} = 4560*
\]
\[
P_{oa} = 4270 \quad \text{(Ref. p 145)}
\]
\[
f_{e} = \frac{4270}{4560} \times 24700 = 23,200 \text{ psi} 
\]
\[
x_{e} = .7 \times 70,000 = 49,000 \text{ psi} 
\]
\[
M.S. = \frac{49000}{23200} - 1 = +1.11
\]

*Ref. F-85-36-142 P. I-184 & I-185
ANALYSIS OF LOWER CHORD MEMBER

DGW ILAAH S0001 CONDITION

L.S. LOADING (G-56A)

15"
W = 63.80 #/in

W1 = 71.29 #/in
W2 = 28.73 #/in

L.S. LOADING (KB-56)

15"
W3 = 76.1 #/in

W4 = 81.10 #/in
W5 = 42.29 #/in

CRITICAL SECTION OCCURS AT 15" AFT OF
F-5 (Ref. F25-36-142, P I-197)

Axial Load = 1460 # (Ref. P-50)

M8-56A = 7600 in# (Ref. F25-36-142, P I-196)

M = \[ \frac{W}{W} \cdot M8-56A = \frac{76.1}{63.8} \cdot 7600 = 8800 \, \text{in}^2 \]

A = 2.586 in²; Yc = 5.83 in; I = 7.36 in⁴
(Ref. F25-36-142, P I-192)

\[ f_c = \frac{P}{A} + \frac{MY_c}{I} = \frac{1460}{2.586} + \frac{8800 \cdot 5.83}{7.36} \]

= 7525 #/in²

\[ f_c = 25,000 \, \text{#/in²} \] (Ref. F25-36-142, P I-197)

M.S. = \[ \frac{25,000}{7525} - 1 = +2.32 \]

ANALYSIS OF UPPER INTERCOSTAL

From F25-36-142 (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.

FW 444.6-46 UTILITY REPORT SHEET
**Analysis:**

**Wing**

Prepared by: [Signature]

Checked by: [Signature]

Revised by: [Signature]

Consolidated Vultee Aircraft Corporation

Fort Worth Division, Texas

Report No. DEC-36-24

Model 16-36

Date: 1/24

**Gahn (78,000)***

\[ W = \text{U.S. Loading (8.36)} \]
\[ W_1 = 66.5 \text{#/in} \]
\[ W_2 = 31.14 \text{#/in} \]
\[ W = 56.30 \text{#/in} \]

**Average Transverse Shear:**

\[ \frac{W}{W} \times \text{Shear (8.36)} \]
\[ = 53.9 \times 1108 \]  
\[ = 1060 \text{#} \]

**The Intercostal Load due to Transverse Shear:**

\[ \frac{V_0}{I} = \frac{1060 \times 11.04 \times 8.5}{595} = 1680 \text{#} \]

**The Intercostal Load due to the Chord Member Axial Load is the Difference Between P1 and P2 as Shown on the Accompanying Sketch, Where:***

\[ P_1 = \frac{P_1}{A_{total}} = 880 \times \frac{374}{674} = 376 \text{#} \]

\[ P_2 = \frac{P_2}{A_{total}} = 625 \times \frac{374}{674} = 268 \text{#} \]

\[ P_1 - P_2 = 376 - 268 = 108 \text{#} \]

**Total Intercostal Load:**

\[ 1680 + 108 = 1788 \text{#} \]

**Shear**

\[ \frac{1788}{6} = \frac{1788}{4.3 - 3(3/4)} \times 0.51 = 12800 \text{#/in}^2 \]

*([Eq. 125-36-142, p 1-199])
\[ F_{cR} = 28 \, 000 \, \text{lb/in}^2 \quad \text{(Ref. F25-36-142, PE-201)} \]

\[ M_S = \frac{28 \, 000}{12 \, 800} - 1 = -1.18 \]
BULKHEAD NO. 18 (36W.13)

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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. IAA @ 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 16
2. Chord member analysis, which is accomplished by comparison with B-36A data.
3. Intercostal analysis; by use of B-36A data.
NOTE: POSITIVE LOADS ACT UPON LOWER SURFACE AND DOWN ON UPPER SURFACE.
POSITIVE NET LOADS ACT DOWN.
### Table 37

**COMPUTATION OF *NL, Nt, ML & MT FOR AIR LOADS**

<table>
<thead>
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<th>Z</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
<th>X</th>
<th>Y</th>
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<td>3.9</td>
<td>-3.1</td>
<td>4.7</td>
<td>-5.6</td>
</tr>
</tbody>
</table>

---

**Definitions of Terms**

- **NL**: Leading Edge Airload Shear
- **Nt**: Leading Edge Airload Moment About E.E.
- **ML**: Trailing Edge Airload Moment About E.E.
- **MT**: Trailing Edge Airload Moment About R.S.

---

**Notes**

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.
<table>
<thead>
<tr>
<th>DISTANCE FROM L.E. (LIMIT)</th>
<th>P/A</th>
<th>AREA</th>
<th>DIST. TO 2 G. FRM. (UNIT)</th>
<th>MOMENT ABOUT 2 G.FRM. (UNIT)</th>
<th>DISTANCE FROM L.E. (LIMIT)</th>
<th>P/A</th>
<th>AREA</th>
<th>DIST. TO 2 G. FRM. (UNIT)</th>
<th>MOMENT ABOUT 2 G. FRM. (UNIT)</th>
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**Leading Edge Airloads**

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<tr>
<th>P/A</th>
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<th>ADJ. MULTIPLE</th>
<th>(ADJ. MULTIPLE)</th>
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**Trailing Edge Airloads**

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<th>(ADJ. MULTIPLE)</th>
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</table>

**Notes:**
- Signs (force) 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.
- For definition of terms, see page 57.

**Calc. by:** [Signature]
**Checked by:** [Signature]
### Table XIII

#### Composite Interspar Air Loads

<table>
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<th>Station</th>
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<td>S.M. (%)</td>
<td>Moment</td>
<td>S.M. (%)</td>
<td>Moment</td>
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<td>Moment</td>
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<td>Moment</td>
<td>S.M. (%)</td>
<td>Moment</td>
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<td>1.450</td>
<td>3</td>
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<td>2.240</td>
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<td>1.750</td>
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<td>2.824</td>
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<td>35</td>
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<td>1.192</td>
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<td>2.240</td>
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<td>1.760</td>
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<td>1.750</td>
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<td>2.060</td>
<td>1.375</td>
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<td>1.450</td>
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<td>1.750</td>
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<td>2.824</td>
<td>1.410</td>
<td>1.760</td>
<td>1.750</td>
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</tr>
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### Computations of $N_s$, $N_m$, $M_s$, $M_m$ for AIR LOADS

**Station:** B.G.W. - 228.5 in. L.S.A. 8.000

<table>
<thead>
<tr>
<th>Term</th>
<th>Computation</th>
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<tbody>
<tr>
<td>$N_s$</td>
<td>$1.56 \cdot 0.03875 \cdot 12000 = 4604 \text{ lb}$</td>
</tr>
<tr>
<td>$N_m$</td>
<td>$1.56 \cdot 0.03875 \cdot 34576 = 5777 \text{ in} \cdot \text{lb}$</td>
</tr>
<tr>
<td>$M_s$</td>
<td>$1.56 \cdot 0.03875 \cdot 34576 = 5777 \text{ in} \cdot \text{lb}$</td>
</tr>
<tr>
<td>$M_m$</td>
<td>$1.56 \cdot 0.03875 \cdot 34576 = 5777 \text{ in} \cdot \text{lb}$</td>
</tr>
</tbody>
</table>

**X** = $15.812 = 34.476$" AFT P.S.

**Y** = $15.812 = 34.476$" AFT P.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.
### TABLE IX

**LEADING EDGE AIR LOADS**

<table>
<thead>
<tr>
<th>DISTANCE FROM LEADING EDGE (LIMIT)</th>
<th>P</th>
<th>AREA</th>
<th>DIST. TO LINES (LIMIT)</th>
<th>T.P.</th>
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<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>150</td>
<td>0.75</td>
<td>1.00</td>
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<td>1</td>
<td>249</td>
<td>0.69</td>
<td>0.75</td>
<td>1.25</td>
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<tr>
<td>2</td>
<td>270</td>
<td>0.70</td>
<td>0.75</td>
<td>1.50</td>
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<td>268</td>
<td>0.70</td>
<td>0.75</td>
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**TRAILING EDGE AIR LOADS**

<table>
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<tr>
<th>DISTANCE FROM TRAILING EDGE (LIMIT)</th>
<th>P</th>
<th>AREA</th>
<th>DIST. TO LINES (LIMIT)</th>
<th>T.P.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>150</td>
<td>0.75</td>
<td>1.00</td>
</tr>
<tr>
<td>1</td>
<td>249</td>
<td>0.69</td>
<td>0.75</td>
<td>1.25</td>
</tr>
<tr>
<td>2</td>
<td>270</td>
<td>0.70</td>
<td>0.75</td>
<td>1.50</td>
</tr>
<tr>
<td>3</td>
<td>269</td>
<td>0.70</td>
<td>0.75</td>
<td>1.75</td>
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<tr>
<td>4</td>
<td>268</td>
<td>0.70</td>
<td>0.75</td>
<td>2.00</td>
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**COMPUTATION OF N, Nt, M, and M for Air Loads**

**STATION 15, R.G.W. (72-1000* BOMBS) L.A.A. 5000**

**T.P.**

<table>
<thead>
<tr>
<th>T.P.</th>
<th>S.M</th>
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<th>8 x 10</th>
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<td>24.00</td>
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<td>32.00</td>
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**M**

<table>
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<th>MOMENT MULTIPLIER</th>
<th>8 x 10</th>
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<td>0.00</td>
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<td>0.00</td>
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<tr>
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<tr>
<td>4</td>
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**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:**

**CURR. BY:**
### Table XX

#### Composite Interspar Air Loads

<table>
<thead>
<tr>
<th>Station</th>
<th>Distance (in.)</th>
<th>B.M.S.</th>
<th>Moment (10^-4 lb. ft.)</th>
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<tbody>
<tr>
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<td>45.00</td>
<td>-5.8</td>
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</tr>
<tr>
<td>2</td>
<td>36.95</td>
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<td>3</td>
<td>55.00</td>
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<td>4</td>
<td>31.375</td>
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<td>6</td>
<td>23.25</td>
<td>-3.0</td>
<td>-1.7</td>
</tr>
<tr>
<td>7</td>
<td>18.750</td>
<td>-4.7</td>
<td>-3.0</td>
</tr>
<tr>
<td>8</td>
<td>15.625</td>
<td>-0.9</td>
<td>-0.8</td>
</tr>
<tr>
<td>9</td>
<td>12.000</td>
<td>-0.3</td>
<td>0.0</td>
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</table>

#### Longe Surface Interspar Air Loads

<table>
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<tr>
<th>Station</th>
<th>Distance (in.)</th>
<th>B.M.S.</th>
<th>Moment (10^-4 lb. ft.)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>45.00</td>
<td>-5.8</td>
<td>-4.0</td>
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<td>2</td>
<td>36.95</td>
<td>-2.6</td>
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<td>4</td>
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<td>-2.5</td>
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<td>9</td>
<td>12.000</td>
<td>-0.3</td>
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</table>

#### Calculations

- \( N_a = 1.5bc \cdot \frac{0.9875 \cdot (122)}{144} = 778.1 \text{ lb.} \)
- \( M_{a} = 1.5bc \cdot \frac{0.9875 \cdot (122)}{144} = 349.9 \text{ lb. ft.} \)
- \( x = \frac{-56.04}{44.075} = 1.27 \text{ " aft F.S.} \)
- \( x = 118.72 \text{ " aft F.S.} \)

#### Notes:

- 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]
- Filled 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 TRAPEZIODS,

COMPOSITE INTERSPAR LOAD = N_L = 8293#  
C.G. AFT OF F.S. = 44.848" (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 x 10^6 in #  REF. FZS-36-240, P.81

E = 10.3 x 10^6

L = 36.375 in. (BULKHEAD SPACING)

I_X = 69.535 in^4  REF. FZS-36-141, P.89

I_X / Q_X = 61.3 in  REF. FZS-36-141, P.207

CRUSHING LOAD = \frac{(M_X)^2 L}{(I / Q)^2 EI} = \frac{(83.45 \times 10^6)^2}{(69.535 \times 36.375)} \times 61.3 \times 10.3 \times 10^6 = 5770#
REPLACING THE CRUNCHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $HR = \frac{WF}{HF}$ WHERE $HF = \text{CONTOUR DEPTH OF FRONT SPAR}$.

$HR = 63.789\text{"}$, $HF = 49.353\text{"}$

$WF = 52.29\text{#/in}$ (REF. P. 11)

$WR = 67.61\text{#/in}$

**FUEL LOAD**

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

$P_{\text{FUEL}} = 6418.7 \times 33069 = -21507\text{#}$

$P_{\text{FUEL}}(x836) = \frac{21507}{21703} = .991$ (INERTIA LOAD FACTOR - F25-36-126, P. 84)

$WF_{\text{FUEL}}(x836) = 193.325(.99) = 192.32\text{#}$

$WR_{\text{FUEL}}(x836) = 251.610(.99) = 249.35\text{#}$

$X = 48.98\text{"}^*$ (REF. P. 65)

$*$ FUEL LOAD FOR 836A TAKEN FROM P. I-215

F25-36-142.
BULKHEAD #13
D.G.W. (265 lb) L.A.A. @ 5000 ft

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

UPPER SURFACE

F.S. ORDIATE =
WFU + Wf = -68.44 #/in
R.S. ORDIATE =
WRU + WR = -28.94 #/in

LOWER SURFACE

F.S. ORDIATE =
WFH + Wf + WFE = 162.50 #/in
R.S. ORDIATE =
WRL + WR + WRF = 203.46 #/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**
- $P_A = 1026#$
- $P_B = 1776#$
- $P_C = 1330#$
- $P_D = 535#$

**LOWER SURFACE**
- $P_E = 282#$
- $P_F = 6210#$
- $P_G = 5714#$
- $P_H = 2086#$

**COMBINED LOADS**

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

$$\frac{ML}{46.30} = \frac{72400}{46.30} = 1568#$$

(REF. TABLE XIII P. 57)

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

$$\frac{MT}{60.83} = \frac{21804}{60.83} = 3600#$$

(REF. TABLE XIV P. 57)

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

TRANSFERRING ALL FORCES TO THE E.A.
\[ V = N_L + N_S + N_T + P_{FUEL} \]
\[ = 3539 + 8233 + 4948 + 21507 = -4327 \text{#} \]
\[ T_{BA} = M_L + M_{FS} + N_T (\bar{X}_{TE} + 1.5 \text{ CHORD}) \]
\[ + P_{FUEL}(\bar{X}_{TE} + 54.33 \text{ V}) \]
\[ = 72,600 - 371,883 - 4948(44.263 + 96.245) \]
\[ + 21507(49.83) + 54.33(-4327) \]
\[ = 154,740 \text{#} \]

REATIONS ON F.S. & R.S. DUE TO V
\[ V_{FS} = \frac{41,915}{36.243} \times 43.27 = 1884 \text{#} \]
\[ V_{RS} = V - V_{FS} = 4327 - 1884 = 2443 \text{#} \]
\[ Q_{V_{FS}} = \frac{1884}{46.30} = 40.691 \text{#/IN} \]
\[ Q_{V_{RS}} = \frac{2443}{60.83} = 40.101 \text{#/IN} \]

REATIONS DUE TO T_{BA}
\[ Q_0 = \frac{T_{BA}}{2A} = \frac{154,740}{11840} = 13.069 \text{#/IN} \]
\[ (2A = 11840 \text{#/IN REF. FES-36-141. P.206}) \]

NET REATIONS OF F.S. AND R.S.
\[ Q_{FS} = 40.691 + 13.069 = 53.760 \text{#/IN} \]
\[ Q_{RS} = 40.101 + 13.069 = 53.170 \text{#/IN} \]

\*DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE PG. 19
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

\[ T = 2A_{\phi} \times 240.53 \times 13.069 = 6290 \text{**} \]

\[ R_{UFR} = \frac{6290}{96.245} = 65.35 \text{**} \]

LOWER SURFACE

\[ T = 2A_{\phi} \times 107.82 \times 13.069 = 2815 \text{**} \]

\[ R_{LFR} = \frac{2815}{96.245} = 29.25 \text{**} \]

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

\[ P_A = 1026 + R_{U} = 1081.35 \text{**} \]

\[ P_D = 535 - R_{U} = 469.65 \text{**} \]

\[ P_L = 3282 + R_{L} = 3311.25 \text{**} \]

\[ P_H = 2686 - R_{L} = 2656.75 \text{**} \]

*SEE PAGE 17 FOR \( q_0 \)*
CONDITION II - D.G.W. (265.192#) ILAA @ 5000'

BULKHEAD #13

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

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZIODS,

COMPOSITE INTERSPAR AIR LOAD = N_{c,6} = 4604#

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

\[ W_{FC} = 88.50#/in \]

\[ W_{c,F} = 7.25#/in \]

LOWER SURFACE INTERSPAR AIR LOAD = N_{L,5} = -7866#

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

\[ W_{FL} = 102.40# /in \]

\[ W_{c,L} = 61.00# /in \]

UPPER SURFACE INTERSPAR AIR LOAD

\[ W_{FU} = W_{FC} - W_{FL} = 88.50 - 102.40 = -13.90# /in \]

\[ W_{RU} = W_{c,F} - W_{c,L} = 7.25 - 61.00 = -53.75# /in \]

CRUSHING LOADS

CALCULATING THE CRUSHING LOAD,

\[ M_x = -54.12 \times 10^6 \]  \hspace{1cm} \text{REF. FZS-36-240, P. 97}

\[ E = 10.13 \times 10^6 \]

\[ L = 36.375\text{ in} \quad \text{(BULKHEAD SPACING)} \]

\[ I_x = 69,535 \text{ in}^4 \]  \hspace{1cm} \text{REF. FZS-36-141, P. 59}

\[ I_{x/Q_x} = 61.3 \text{ in} \]  \hspace{1cm} \text{REF. FZS-36-141, P. 207}

CRUSHING LOAD = \( \frac{(M_x)^2 L}{(I_x/Q_x)EI} \)

\[ = \frac{(-54.12 \times 10^6)^2 \times 36.375}{61.3 \times 10^3 \times 10^6 \times 69,535} \]

\[ = 24.27# \]
**BULKHEAD # 13**

*D.G.W. (263,192*) I LAA @ 5000*

**CRUSHING LOADS (CONT'D)**

Replacing the crushing load with the equivalent trapezoid such that

\[
\frac{H_F}{H_F} = \frac{W_F}{W_F}
\]

Where \( H_F \) = contour depth of front spar,

\[
H_F = 63.789", \quad H_F = 49.353"
\]

\( W_F = 22.00\#/in. \)

\( W_R = 28.43\#/in. \)

(REF. P. 72)

**FUEL LOAD**

Since the air loads operate downward, the fuel load acts on the upper surface.

\[
P_{FUEL} = 5418.7 \times 1.675 \times 1.5 = 13617\#
\]

REF: LOAD-F25-36-240, P.52

Inertial load factor -

F25-36-126, P. 84

Using ratio of fuel loads, B-36A & XB-36.

\[
P_{FUEL}(XB-36) = \frac{13617}{13574.6} = 1.003
\]

\[
W_{FUEL}(XB-36) = 124.713(1.003) = 125.09\#/in (REF. P. 72)
\]

\[
W_{FUEL}(XB-36) = 157.373(1.003) = 157.85\#/in
\]

Fuel load for B-36A taken from P. 1-222.

F25-36-142.
BULKHEAD #13
D.O.N. (265,192#) ILAA@5000

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

UPPER SURFACE
F.S. ORDINATE =
\[ W_f + W_e + W_{fuel} = 116.39 \text{ lb/in} \]
R.S. ORDINATE =
\[ W_r + W_e + W_{fuel} = 183.17 \text{ lb/in} \]

LOWER SURFACE
F.S. ORDINATE =
\[ W_f + W_e = 80.40 \text{ lb/in} \]
R.S. ORDINATE =
\[ W_r + W_e = 32.57 \text{ lb/in} \]

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

UPPER SURFACE
\[ P_a = 1994 \text{ lb} \]
\[ P_b = 4459 \text{ lb} \]
\[ P_c = 5168 \text{ lb} \]
\[ P_d = 2824 \text{ lb} \]
BULKHEAD #13
D.G.W.(265,192#) ILDA@5000

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

LOWER SURFACE

\[ P_a = 606\text{#} \]
\[ P_f = 1559\text{#} \]
\[ P_g = 2068\text{#} \]
\[ P_h = 1205\text{#} \]

COMBINED LOADS

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

\[ M_L = \frac{101,927}{46.30} = 2185\text{#} \quad \text{(Ref: Table VIII P.59)} \]

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

\[ M_T = \frac{22111}{60.83} = 364\text{#} \quad \text{(Ref: Table VIII P.59)} \]

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE P. 77
ANALYSIS 生产者: Consolidated Vultee Aircraft Corporation
PREPARED BY: 置换: FORT WORTH DIVISION
CHECKED BY: FORT WORTH, TEXAS
REVISED BY: DATE 11/47

BULKHEAD #13
D.G.W. (265.182#) ILAA@5000

WING STATION #13 FUEL AND AIR LOADING

FUEL 13617#
AIR 5058#
AIR 4604#

REATIONS ON BULKHEAD

TRANSFERRING ALL FORCES TO E.A.

\[ V = N_L + N_S + N_T + P_{FUEL} \]

\[ = 5058 + 4604 - 140 - 13617 \]

\[ = 4095\# \]

REF: TABLE VIII P. 57
TABLE IX P. 60

\[ T_{E.A.} = M_L + M_{PS} + N_T (X_{TE} + 15.5\text{ CHORD}) + P_{FUEL} (X_{FUEL}) + 54.33V \]

\[ = -101,192 + 15871.9 - 140 (157.94 + 96.245) \]

\[ - 13617 (49.98) + 54.33 (4095) \]

\[ = -436,156\# \]

FW 444 8-46 UTILITY REPORT SHEET
BULKHEAD #13
D.G.W. (265,192#) ILAA @ 5000#

REATIONS ON BULKHEAD (CONT'D)

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

\[ V_{F} = \frac{41.915 \times 40.95}{96.245} = 1784# \]

\[ V_{R} = 40.95 - 1784 = 2311# \]

\[ q_{V_{F}} = \frac{1784}{46.30} = 38.53\#/.in \]

\[ q_{V_{R}} = \frac{2311}{60.83} = 37.83\#/.in \]

REACTIONS DUE TO TBA.

\[ q_{0} = \frac{118.40}{2A} = 36.84\#/.in \]

(2A = 118.40") REF: F25-36.141, P. 206)

Net REACTIONS OF F.S. AND R.S.

\[ q_{F.S.} = -38.53 + 36.84 = -1.69\#/.in \]

\[ q_{R.S.} = -37.83 - 36.84 = -74.87\#/.in \]

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

\[ T = 2Aq_{0} = 2 \times 240.53 \times 36.84 = 17,722"# \]

\[ R_{UF,4R} = \frac{17,722}{96.245} = 184.1"# \]

* DEPTH OF SPAR BETWEEN TRUSS POINTS, SEE P. 69
BULKHEAD #13
D.G.W. (265,192#) ILAA @ 5000'

CORRECTION LOADS (CONT'D)

LOWER SURFACE

\[ T = 2A_Lq_0 = 2 \times 107.82 \times 36.84 = 7944\text{#} \]

\[ R_{LP/4R} = \frac{7944}{36.245} = 220.5\text{#} \]

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

\[ P_A = 1994 + 184 = 2178\text{#} \]

\[ P_D = 2824 - 184 = 2640\text{#} \]

\[ P_E = 600 + 82.5 = 683.5\text{#} \]

\[ P_H = 1205 - 82.5 = 1122.5\text{#} \]
CONDITION III - R.G.W. (72,000# BOMBS) LAA @ 5000'  

BULKHEAD #13  

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

REPLACING THE AIR LOADS WITH EQUIVALENT TRAPEZOIDS,  

COMPOSITE INTERSPAR AIR LOAD = N_c = 7781#  
C.G. AFT OF F.S. = 44.975"  

\[ W_{Fc} = 96.59#/in \]  
\[ W_{Rc} = 65.10#/in \]  

LOWER SURFACE INTERSPAR AIR LOAD = N_L = 2208#  
C.G. AFT OF F.S. = 53.777"  

\[ W_{Fl} = 14.97#/in \]  
\[ W_{Rl} = 30.92#/in \]  

UPPER SURFACE INTERSPAR AIR LOAD  
\[ W_{Fu} = W_{Fc} - W_{Fl} = 96.59 + 14.97 = 111.56#/in \]  
\[ W_{Ru} = W_{Rc} - W_{Rl} = 65.10 + 30.92 = 96.02#/in \]  

CRUSHING LOADS  

CALCULATING THE CRUSHING LOAD  
\[ M_x^2 = 78.6 \times 10^6 \]  
REF: F25-36-240, P. 153  
\[ E = 10.3 \times 10^6 \]  
\[ L = 36.375\text{ in} \text{ (BULKHEAD SPACING)} \]  
\[ I_x = 69.535\text{ in}^4 \]  
REF: F25-36-141, P. 50  
\[ I_x/Q_x = 0.13 \text{ in} \]  
REF: F25-36-141, P. 207  
\[ \text{CRUSHING LOAD} = \frac{(M_x^2)L}{(I_x/Q_x)EI} = \frac{(78.6 \times 10^6)^2 \times 36.375}{0.13 \times 10.3 \times 10^6 \times 69.535} = 5250\# \]
BULKHEAD #13
R.G.W. (72-1000# BOMBS) LAA@ 5000'

CRUSHING LOADS (CONT'D)

REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT H_R = W_F WHERE H_F = H_F

CONTOUR DEPTH OF F.S.

H_R = 63.789", H_F = 49.353"

W_F = 47.58# /in. (CER. FIG. BELOW)

W_R = 61.51# /in.

COMBINED AIR (INTERSPAR) AND CRUSHING LOADS ON BULKHEAD.

UPPER SURFACE
F.S. ORDIATE =
W_F + W_R = 63.98 # /in
R.S. ORDIATE =
W_R + W_R = 34.51 # /in

LOWER SURFACE
F.S. ORDIATE =
W_L + W_F = 32.61 # /in
R.S. ORDIATE =
W_R + W_R = 30.59 # /in
BULKHEAD #13
B.G.W. (72-1000# BOMBS) LAA@5000'

BREAKDOWN OF NET AIR AND CRUSHING LOADS INTO PANEL POINT LOADS

UPPER SURFACE

\[ \begin{align*}
   P_A &= 974 \# \\
   P_B &= 1737 \# \\
   P_C &= 1422 \# \\
   P_D &= 606 \# \\
\end{align*} \]

LOWER SURFACE

\[ \begin{align*}
   P_E &= 494 \# \\
   P_F &= 1004 \# \\
   P_G &= 1023 \# \\
   P_H &= 521 \# \\
\end{align*} \]

**COPPELE AT FRONT SPAR RESULTING FROM L.E. AIR LOAD**

\[ \frac{M_L}{46.30} = \frac{66396}{46.30} = 1434 \# \] (REF: TAB. XX P. 61)

**COPPELE AT REAR SPAR RESULTING FROM T.B. AIR LOAD**

\[ \frac{M_T}{60.83} = \frac{210824}{60.83} = 3460 \# \] (REF: TAB. XX P. 61)

*DEPT OF SPAR BETWEEN TRUSS POINTS, SEE P. 84*
WING STATION #13 AIR LOADING

REACTIIONS ON BULKHEAD

TRANSFERRING ALL FORCES TO E.A.

\[ V = N_L + N_s + N_T \]

\[ = 3622 + 7781 + 4741 \]

\[ = 16,144 \]  

\[ E.A. LOCATION = \]

\[ = 0.175 \times 310.471 = 54.33'' \]

\[ T_ea = M_L + M_s + N_T (X_{TE} + 1.5 \times \text{CHORD}) + 54.33 \times V \]

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

\[ = -73,584'' \]
REATIONS ON BULKHEAD (CONT'D.)

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

\[ V_F = \frac{41.915}{56.245} \times 16144 = 7031 \text{#} \]

\[ V_R = 16144 - 7031 = 9113 \text{#} \]

\[ q_v = \frac{7031}{46.30} = 151.87 \text{#/in} \]

\[ q_v = \frac{9113}{60.23} = 149.01 \text{#/in} \]

REATIONS DUE TO Tea

\[ q_0 = \frac{T_{ea}}{2A} = \frac{73584}{11840} = 6.21 \text{#/in} \]

\[ (2A = 11840^2) \text{REF: F35-36-141, P.206} \]

NET REATIONS OF F.S. & R.S.

\[ q_{F.S.} = 151.87 - 6.21 = 145.66 \text{#/in} \]

\[ q_{R.S.} = 149.01 + 6.21 = 156.02 \text{#/in} \]

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

\[ T = 2A_0 q_0 = 2 \times 240.53 \times 6.21 = 2987 \text{#} \]

\[ R_{u+f} = \frac{2987}{56.245} = 52 \text{#} \]

SEE P. 82 FOR \[ q_0 \]

* DEPTH OF SPARK BETWEEN TRUSS POINTS, SEE P. 84
**BULKHEAD #12**

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

**CORRECTED LOADS (CONT'D)**

**LOWER SURFACE**

\[ T = 2A_{L}g_{0} = 2 \times 107.82 \times 6.21 = 1339\text{#} \]

\[ R_{FL\#r} = \frac{1339}{96.245} = 14\text{#} \]

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

\[ P_{A} = 374 + 31 = 405\text{#} \]

\[ P_{D} = 600 - 31 = 569\text{#} \]

\[ P_{B} = 484 - 14 = 470\text{#} \]

\[ P_{H} = 521 + 14 = 535\text{#} \]
# Summary of Axial Loads

## Table XXII

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>CONDITION</th>
<th>MAXIMUM LOAD</th>
<th>MAXIMUM LOAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN</td>
<td>1 - 1.4% N 38100 84400 24100</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
</tr>
<tr>
<td>AN</td>
<td>1 - 1.4% N 56400 91600 28500</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
</tr>
<tr>
<td>BP</td>
<td>1 - 1.4% N 38100 84400 24100</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
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<tr>
<td>BP</td>
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<td>36200 41500 13200</td>
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<tr>
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<td>36200 41500 13200</td>
<td>13200 21700</td>
</tr>
<tr>
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</tr>
<tr>
<td>EE</td>
<td>1 - 1.4% N 56400 91600 28500</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
</tr>
<tr>
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<td>13200 21700</td>
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<td>36200 41500 13200</td>
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<td>36200 41500 13200</td>
<td>13200 21700</td>
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<td>36200 41500 13200</td>
<td>13200 21700</td>
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<tr>
<td>HO</td>
<td>1 - 1.4% N 56400 91600 28500</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
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<tr>
<td>IM</td>
<td>1 - 1.4% N 38100 84400 24100</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
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<tr>
<td>IM</td>
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<td>36200 41500 13200</td>
<td>13200 21700</td>
</tr>
<tr>
<td>KM</td>
<td>1 - 1.4% N 38100 84400 24100</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
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<td>13200 21700</td>
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<td>36200 41500 13200</td>
<td>13200 21700</td>
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<tr>
<td>OR</td>
<td>1 - 1.4% N 38100 84400 24100</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
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<tr>
<td>OR</td>
<td>1 - 1.4% N 56400 91600 28500</td>
<td>36200 41500 13200</td>
<td>13200 21700</td>
</tr>
</tbody>
</table>

---

**Diagram:**

The diagram illustrates the structure and load distribution across various members of the bulkhead. The notation used in the diagram correlates with the table, indicating specific load conditions and member designations such as A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z.

**Calc. by:** [Signature]

**Checked by:** [Signature]
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 ACCOMP-
PANYING SKETCH.

A COMPARISON WAS MADE OF
THE TRUSS MEMBERS AND THEIR
AXIAL LOADS FOR THE YB3G &
THE XB3G. FROM THIS COMPAR-
ISON & A STUDY OF THE YB3G
ANALYSIS (FZS-36-142 P-I-237),
IT WAS FOUND THAT THE UPPER
ENDS OF TUBES NO. 4 & PQ WERE
CRITICAL IN COMBINED BENDING
& TENSION IN THE END SECTION,
& FOR THE NIVET ATTACHMENT
TO THE CHORD MEMBER.
THE ANALYSES OF THESE JOINTS
ARE, THEREFORE, MADE.
<table>
<thead>
<tr>
<th>Member</th>
<th>Max. Compressed Load</th>
<th>Tube Number</th>
<th>Size of Tube</th>
<th>Area of Tube</th>
<th>&quot;P&quot;</th>
<th>L</th>
<th>I</th>
<th>F &quot;E&quot;</th>
<th>F &quot;C&quot;</th>
<th>M S C</th>
<th>Max. Tensile</th>
<th>60 T</th>
<th>M S T</th>
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<tbody>
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<td>MN</td>
<td>3251</td>
<td>36W13-3S-53</td>
<td>1.5x1.75 x 0.040</td>
<td>2988</td>
<td>11.40</td>
<td>53</td>
<td>.89</td>
<td>.7244</td>
<td>71.2</td>
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<td>4800</td>
<td>18.750</td>
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<tr>
<td>OR</td>
<td>36W13-3S-5S</td>
<td>2.0 x 2.0 x 0.051</td>
<td>2783</td>
<td>73.2</td>
<td>16.100</td>
<td>+.73</td>
<td>3700</td>
<td>9.010</td>
<td>42500</td>
<td>+5.11</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

Note: *Distance between C.G.'s of attaching rivets  
† For allowable stresses, refer to Page 1-67, FAS-56-142.
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 XII)

\[ \text{M.S.}_t (\text{YB36}) = +.32 \] (P. I-240, FZS-36-142)

\[ \text{M.S.}_t (\text{XB36}) = (.32 + 1) \left( \frac{4300}{4860} \right) - 1 = +.17 \]

RIVETED ATTACHMENT

\[ \text{M.S. rivets (YB36)} = +.20 \] (P. I-240, FZS-36-142)

\[ \text{M.S. rivets (XB36)} = (.20 + 1) \left( \frac{4300}{4860} \right) - 1 = +.06 \]
**BULKHEAD #13**

**ANALYSIS OF TUBE "PQ" AND RIVET ATTACHMENT IN TENSION**

![Diagram](image)

**CRITICAL SECTION**

- \( \bar{y} = 0.4512 \) in
- \( y_t = 0.4512 \) in
- \( y_r = 0.5263 \) in
- \( I = 0.04691 \) in\(^4\)

The maximum load is 4900 lb in tension (\( P \)).

\[
\sigma_t = \frac{P}{A} + \frac{P \cdot y_t}{I} = \frac{4900}{0.3616} + \frac{4900 \times 0.4512 \times 0.4512}{0.04691}
\]

\[
= 13,550 + 2,178.7 = 34,820 \text{ lb/in}^2
\]

\[
\sigma_c = \frac{P}{A} - \frac{P \cdot y_c}{I} = 13,550 - \frac{4900 \times 0.4512 \times 0.5263}{0.04691}
\]

\[
= 13,550 - 24,800 = -11,250 \text{ lb/in}^2
\]

Conservatively assuming a combined concentration

- rivet factor \( R \times Cr = 0.70 \)
- \( F_{tu} = 70,000 \text{ lb} \) (Structures Bulletin B-1)

\[
M.S.t = \frac{0.70 \times 70,000}{34,820} - 1 = +.41
\]
BULKHEAD #13

ANALYSIS OF TUBE "PQ" (CONT'D)

RIVETED ATTACHMENT

THE ATTACHMENT OF THE CHANNEL INSERT 3GW113-39 TO THE UPPER CHORD MEMBER IS CRITICAL. THE (6) RIVETS (Q4305-D8) ARE CRITICAL IN SHEAR.

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

\[
M.S. \text{ RIVETS} = \frac{6 \times 1764}{4900} - 1 = +1.16
\]

CHORD MEMBERS

ANALYSIS PAGE
PREPARED BY
CHECKED BY
REVISED BY

Consolidated Vultee Aircraft Corporation
FORT WORTH DIVISION
FORT WORTH, TEXAS

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 COMRESSIVE 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 BEAR SPAR.

CONDITION I
(DGW-LAA @ 5000')

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

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

BORDINATE (YB36) = 38.106# IN.*

BORDINATE (XB36) = 55.25# IN. (P. 66)

M(YB36) = 4471"# *

M(XB36) = \frac{4471 \times (55.25)}{38.106} = 6490"#

* (REF: FZS-36-142, P. 1-210)

I-252)
BULKHEAD #13

CHORD MEMBERS (CONT'D)

UPPER CHORD MEMBER (ABCD)

CONDITION I

\[ f_c = \frac{P}{A} + \frac{M}{I/c} = \frac{4489}{9058} + \frac{6490}{2.472} = 7585 \text{#/in} \]

A & I/C TAKEN FROM YB3G REPORT FZS-36-142 - CHORD MEMBERS SAME.

\[ f_c = 27,900 \text{#/in} \text{ (FZS-36-142)} \]

\[ M.S. \text{ comp.} = \frac{21900}{7585} - 1 = +2.68 \]

CONDITION II

(DGW = ILAA @ 5000')

AXIAL LOAD, \( P \), = 1340# (P. 86) TENSION

(CRITICAL POINT, \( X \), IS 13" FWD R.S.)

\[ X \text{ORIGINATE (YB3G)} = 160.394 - 0.0237 \times 13 \]
\[ = 152.286 \text{#/in.} \]

\[ X \text{ORIGINATE (XB3G)} = 183.17 - 0.0876 \times 13 \text{ (P. 73)} \]
\[ = 174.231 \text{#/in.} \]

\( M(yb3G) = 12612 \text{#} \times \)

\( M(xb3G) = 12612 \left( \frac{174.231}{152.286} \right) = 14530 \text{"} \)

\( \ast \text{ (REF: FZS-36-142, P. I-223)} \)

\( \text{P. I-251) \)
BULKHEAD #13

CHORD MEMBERS (cont'd)

UPPER CHORD MEMBER (ABCD)

CONDITION II

\[
\frac{O_{f/c}}{P} = \frac{M}{I/c} = \frac{1340}{9058} = \frac{14530}{1.294} = - 9731 \text{ ft/lb}
\]

\[
F_c = 25000 \, \text{ft/lb} \quad (FZS-36-142 \, P-I-201)
\]

\[
M.S. \, \text{comp.} = \frac{25000}{9731} - 1 = +1.57
\]

LOWER CHORD MEMBER (EFGH) (36W113-0)

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, \( P = 3440 \, \text{lb} \) (P. 85) TENSION

\[
X_{\text{ordinate (YB36)}} = 193.360 - \frac{57.438 \times 13}{96.245} \quad (*)
\]

\[
= 185.534 \, \text{ft/lb}
\]

\[
X_{\text{ordinate (XB26)}} = 203.460 - \frac{4879 \times 13}{128.117} \quad (P. 66)
\]

\[
= 202.117 \, \text{ft/lb}
\]

* (REF: FZS-36-142, P. I-216)
BULKHEAD #13

CHORD MEMBERS (CONT'D)

LOWER CHORD MEMBER (EFGH)

\[ M_{YB36} = 15360"# \quad (FZS-36-142, P.1-256) \]

\[ M_{XB36} = 15360 \left( \frac{203.117}{185.594} \right) = 16800"# \]

\[ F_c = \frac{P}{A} + \frac{M}{I/c} = \frac{3440}{2.612} - \frac{16800}{1.332} = -112.82"/d" \]

\[ F_c = 25,000"/d" \]

\[ M.S. = \frac{25000}{11282} - 1 = +1.22 \]

\[ *(R.E.F.: \text{FZS-36-142, P.1-256}) \]
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 = 1LAA @ 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.

**BULKHEAD #13**

**INTERCOSTAL ANALYSIS**

**ANALYSIS OF UPPER INTERCOSTALS (CONT'D)**

<table>
<thead>
<tr>
<th>7TH PANEL POINT</th>
<th>R.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>XB36</td>
<td></td>
</tr>
<tr>
<td>YB36</td>
<td></td>
</tr>
</tbody>
</table>

- 183.17 #/IN
- 160.394 #/IN
- SLOPE = .6876 #/IN²
- SLOPE = .6231 #/IN²

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

**NET LOADING ON UPPER SURFACE**

**REF:** FZS-36-142 P.1-223
P.72 THIS REPORT

**LOADING FOR YB36 = 160.394 - .6237 (27.94) = 142.968 #**

(27.94" FWDR. R.S.)

**LOADING FOR XB36 = 183.17 - .6876 (27.94) = 163.958 #**

(27.94" FWDR. R.S.)

**AVERAGE TRANSVERSE SHEAR (YB36) = 2240 #**

(F.1-137 FZS-36-142)

**AVERAGE TRANSVERSE SHEAR (XB36) = 2240 \(\frac{163.958}{142.968}\) = 2569 #**

**THE INTERCOSTAL LOAD DUE TO TRANSVERSE SHEAR**

\[ \frac{VQ}{I} \]

\[ = \frac{2569 \times 1.025 \times 8.3}{5.223} = 4180 \]
INTERCOSTAL ANALYSIS

ANALYSIS OF UPPER INTERCOSTALS (CONT'D)

The intercostal load due to the chord member axial load is the difference of \( P_{1L} \) and \( P_{2L} \) as shown on the accompanying sketch, where

\[
P_{1L} = P_1 \frac{A_L}{A_{TOTAL}} = \frac{2050 \cdot 4058}{8058} = 920 \#
\]

\[
P_{2L} = P_2 \frac{A_L}{A_{TOTAL}} = \frac{1740 \cdot 4058}{8058} = 780 \#
\]

\[
P_{1L} - P_{2L} = 920 - 780 = 140 \#
\]

(REF: FZS-36-142, P. I-250)

Total intercostal load \( = 4180 + 140 = 4320 \#\)

\[
f_s = \frac{4320}{bt} = \frac{4320}{[4.1-3(1/4)] \cdot 0.064} = 20,150 \# / \text{in}
\]

The allowable shear strength of the intercostal will be taken as the critical buckling stress of the intercostal element: \( F_{sc} = 30,000 \# / \text{in} \)

(REF: FZS-36-142, P. I-263)

\[
M.S._{cr} = \frac{30000}{20 \cdot 150} = .94
\]
INTERCOSTAL ANALYSIS

ANALYSIS OF UPPER INTERCOSTALS (CONT'D)

T-SECTION

CHECK OF CRITICAL SECTION OF TEE:

\[ \sigma = \frac{4320}{(3-3\frac{3}{8})} = 24000 \text{ lb/in}^2 \text{ Ref: R2-258 P25-36-142} \]

\[ F_{u (Bolstrm)} = 37000 \text{ lb/in}^2 \]

\[ M.S. = \frac{37000}{24000} = \]

CHECK OF RIVET PATTERN TYPING T-SECTION TO SKIN.

RIVET PATTERN

(1/4 in. 197 rivets)

CRITICAL RIVETS \#1 & \#3

CONSIDER \#1

\[ H_0 = \frac{4320}{6} = 720 \text{ lb} \rightarrow \quad H = 1173 \text{ lb} \]

\[ H_m = \frac{5615 \times 4}{4.96} = 453 \text{ lb} \]

\[ V_m = \frac{5615 \times 1}{4.96} = 1132 \text{ lb} \]

\[ P = \sqrt{(1173)^2 + (1132)^2} = 1632 \text{ lb} \]

RIVET ALLOWABLE IN SHEAR = 1764 lb

\[ M.S. \text{ RIVET} = \frac{1764}{1632} = -1 \]

\[ +0.08 \]
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 DOW-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.

YB36 (R.S. ORD. = 193.360#IN)
XB36 (R.S. ORD. = 209.46#IN.)

AVERAGE LOAD IS 5" FWD 2ND PANEL POINT

SLOPE = .5974#IN
SLOPE = .4879#IN

LOADING FOR YB36 = 193.360 - 37.09(.5974) = 171.708#IN
LOADING FOR XB36 = 209.46 - 37.09(.4879) = 191.364#IN

AVERAGE TRANSVERSE SHEAR (YB36) = 2100#
(XB36-36-142, P. I. 216)

REF: F25-36-142, P. I. 216
P. 15, THIS REPORT

FW 444 6-46 UTILITY REPORT SHEET
INTERCOSTAL ANALYSIS

ANALYSIS OF LOWER INTERCOSTALS (CONT'D)

AVERAGE TRANSVERSE SHEAR (XB3G) = $2100 \left( \frac{191.364}{171.208} \right) = 2347$ *

THE INTERCOSTAL LOAD DUE TO TRANSVERSE SHEAR

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

$$= 2347 \times 1.47325 \times 10 = 4645\text{ atm}$$

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

$$P = \frac{4645}{.67} = \frac{4645}{3.4 \times .051} = 10,330\text{ atm}$$

THE ALLOWABLE SHEAR STRENGTH OF THE INTERCOSTAL WILL BE TAKEN AS THE CRITICAL BUCKLING STRESS OF THE INTERCOSTAL ELEMENT - $F_{cr} = 12,100\text{ atm}$

($FZS-36-142$, P. 1-263)

$$M.S. = \frac{12100}{10830} - 1 = -1.12$$
# Wing Bulkhead #19
(3GW 119)

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<td>Air Load Distribution Curve</td>
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<td>Computation of Bulkhead Air Loads</td>
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</table>
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 & 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) - IIAH @ 5000 ft. and RGW-12(4000# Bombs) - IIAR @ 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

LEGEND

A. D.G.W. = F.D.L.G.E. at sea level

C. R.G.W. = F.D.L.G.E. (7E-1000) at sea level

NOTES: Positive loads act up on lower surfaces and down on upper surfaces.

(See Table VII.)
### Table XXX

**Station 19**

<table>
<thead>
<tr>
<th>Leading Edge</th>
<th>Trailing Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Station</strong></td>
<td><strong>Moment</strong></td>
</tr>
<tr>
<td>PL</td>
<td>M.E.</td>
</tr>
<tr>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
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<td>1</td>
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<td>2</td>
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<td>10</td>
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<tr>
<td>12</td>
<td>-203</td>
</tr>
</tbody>
</table>

**Definition of Terms:**

- **N** = Leading Edge Airload Shear
- **M** = Leading Edge Airload Moment About E.S.
- **N** = Trailing Edge Airload Shear
- **M** = Trailing Edge Airload Moment About E.S.

**Ult. N** = \( \frac{1.5(6.256)}{1.44} \) \( \frac{2.57}{2} \) = -2496 \* 4

**Ult. M** = \( \frac{1.5(6.256)}{1.44} \) \( \frac{2.57}{2} \) = -246,767 \* 3
## Table: Computation of \( N_s \), \( N_g \), \( M_{1s} \) \& \( M_{1g} \) for Airloads

<table>
<thead>
<tr>
<th>Station</th>
<th>( S.M. )</th>
<th>( 4 \times 4 )</th>
<th>( 8 \times 8 )</th>
<th>Upper Surface Intersecting Airload Shear</th>
<th>Upper Surface Intersecting Airload Moment</th>
<th>Upper Surface Airload Moment</th>
<th>Lower Surface Airload Shear</th>
<th>Lower Surface Airload Moment</th>
<th>Lower Surface Airload Moment</th>
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</thead>
<tbody>
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<td>0</td>
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</tr>
</tbody>
</table>

\* Definition of Terms:
- \( N_s \): Total(upper \& lower) intersecting airload shears
- \( N_g \): Total(upper \& lower) intersecting airload shear
- \( M_{1s} \): Intersecting airload moment (upper surface)
- \( M_{1g} \): Intersecting airload moment (lower surface)
CONDITION I - D.G.W. - F.O. L.G.E. @ SEA LEVEL

**AIR LOADS (INTERSPAR)**

Replacing the air loads with equivalent trapezoids:

**Composite Interspar Load =** $N_s = 57.63\#$

C.G. Aft of F.S. = 40.02" (Ref: 9.105)

$W_{n0} = 76.0\#/in$

$W_{n1} = 63.9\#/in$

**Upper Surface Interspar Load =** $N_u = 5.33\#$

C.G. Aft of F.S. = 40.70" (Ref: 9.105)

$W_{u0} = 46.8\#/in$

$W_{u1} = 62.4\#/in$

**Lower Surface Interspar Loads**

$W_{l0} = W_{n0} - W_{u0} = 76.0 - 46.8 = 9.2\#/in$

$W_{l1} = W_{n1} - W_{u1} = 63.9 - 62.4 = 1.5\#/in$

**AIR LOADS (FLAP - 40° DEFLECTION)**

For 50K F.R.S. Gust

(Ref: F25-36-148, 00.50 48)

$E_{190} = 9700 \#^1$ (Acting at C.P. of Flaps)

$E_{190} = 609\#^1$

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.T. has been used to determine the YB-36 flap loads, these loads (Ref: F25-36-142, Ref. 279) are conservatively used for the XB-36 bulkhead analysis.

$V_{50} = 7861\#$

$P_{o} = 882\#$ (At upper truss Pt.)

$P_{l} = 4841\#$ (At lower truss Pt.)
Surface loads in the planes of the shear centers of the upper and lower surfaces of the integrable box:

\[ \alpha = \tan^{-1} 1.0811 \]
\[ \beta = \tan^{-1} 0.03924 \]

From flap loads: (Ref: F25-36-142, M.1.281)

- Upper surface contour load = 2,466 *
  - Horizontal component = 2,451 *
- Lower surface contour load = 3274 *
  - Horizontal component = 3271 *

Crushing loads

From preliminary calculations, \( M_x = 28.85 \times 10^6 \) in*

And since \( M_y \leq M_x \), this value will be used for computing the crushing loads:

\[ E = 10.3 \times 10^6 \]
\[ L = 38.875 \]
\[ I_x = 41,174 \text{ in}^4 \]
\[ I_y / Q_x = 51.5 \text{ in} \]

Crushing load = \( \frac{(M_x^2)}{(I_y / Q_x)EI} = \frac{(28.85 \times 10^6)^2(38.875)}{(51.5)(10.3 \times 10^6)(41.174)} \)

= 1481 *
REPLACING THE CRUSHING LOAD WITH THE EQUIVALENT TRAPEZOID SUCH THAT $H_C = \frac{W_F}{H_F}$ WHERE $H_C =$ CONTOUR DEPTH OF FRONT SPAR AND $H_F =$ CONTOUR DEPTH OF REAR SPAR.
$H_C = 55.807''$; $H_F = 41.644''$
$W_F = 15.7 \# / \text{in.}$
$W_C = 20.6 \# / \text{in.}$

FUEL LOAD

Since this is a normal flight condition, the fuel load acts on the lower surface.

$P_{\text{fuel}} = 4186.5 \times 1.3 \times 2.090 = 13,125 \# (P_{\text{fuel}} = 36.340)$

$Y_{\text{fuel}} = 77.4 - 31.95 = 45.45''$ (AFT F.S.)
$W_{\text{fuel}} = 112 \# / \text{in.}$
$W_{C\text{fuel}} = 20.6 \# / \text{in.}$

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

UPPER SURFACE
F.S. ORDI NATE $=$ $W_{\text{air}} + W_{\text{crush}}$
$= 66.8 - 15.7 = 51.1 \# / \text{in.}$

R.S. ORDI NATE $=$ $W_{\text{air}} + W_{\text{crush}}$
$= 62.4 - 20.6 = 41.8 \# / \text{in.}$

LOWER SURFACE
F.S. ORDI NATE $=$ $W_{\text{air}} + W_{\text{crush}} + W_{\text{fuel}}$
$= 15.7 + 9.2 - 112 = -87.1 \# / \text{in.}$

R.S. ORDI NATE $=$ $W_{\text{air}} + W_{\text{crush}} + W_{\text{fuel}}$
$= 20.6 + 1.5 - 206 = -183.9 \# / \text{in.}$
ANALYSIS

PREPARED BY: C. Field
CHECKED BY: W. Allen
REVISED BY: 

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION
FORT WORTH, TEXAS

PAGE III
REPORT NO. FWE-36-242
MODEL XB-36
DATE 10/47

BLHND. #19
COND. I

INTERSPAR LOADING DIAGRAM
BLHND. #19 (O.G.W. - F.O.L.G.E. @ Sealevel)
WING STATION LOADING

APPLIED LOADS ON BULKHEAD

TRANSFERRING ALL FORCES TO THE E.A.

\[ V = N_{LE} + N_{TS} + N_{TE} + V_{FLAP} + V_{FUEL} \]
\[ = 2496 + 5763 + 5400 + 7861 - 13125 \]
\[ = 8395 \text{#} \]

\[ D = D_{FLAP} = 5723 \text{#} \]

\[ T_{EA} = (2496)(15.84 + 46.60) + (5763)(46.60 - 40.02) \]
\[ -(5400)(35.95 + 45.70) - (7861)(35.95 + 125.62) \]
\[ -(13125)(46.60 - 45.45) - (5723)(13.15 + 14) \]
\[ = -1,592,672 \text{"#} \]

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

\[ V_{FS} = \frac{35.95}{53.81}(8395) = 3656 \text{#} \]

\[ V_{ES} = V - V_{FS} = 8395 - 3656 = 4739 \text{#} \]

\[ 8V_{ES} = \frac{3656}{41.64} = 87.8 \text{#/in.} \]

\[ 9V_{ES} = \frac{4739}{53.81} = 88.1 \text{#/in.} \]
**Shear Flow Due to TEA:**

\[
\theta_0 = \frac{\text{TEA}}{2A} = \frac{1,552,672}{8707} = 182.9 \text{ #/in}^2
\]

**Shear Flow Due to Drag Load**

\[
\theta_u = \frac{2451}{82.55} = 29.7 \text{ #/in} \quad (\text{Ref.: Pg. 109})
\]

\[
\theta_L = \frac{3271}{82.55} = 39.6 \text{ #/in} \quad (\text{Ref.: Pg. 109})
\]

**Blend No. 19: Applied Shear Flows**

(D.G.W. - F.O.L.E.E. @ Sea Level)

**Net Shear Flow**

\[
\theta_F S = 182.9 - 87.8 = 95.1 \text{ #/in}
\]

\[
\theta_F S = 182.9 + 88.1 = 271.0 \text{ #/in}
\]

\[
\theta_u = 182.9 - 29.7 = 153.2 \text{ #/in}
\]

\[
\theta_L = 182.9 + 39.6 = 222.5 \text{ #/in}
\]
REATIONS AT F.S. AND R.S. DUE TO VERTICAL
COMPONENTS OF SURFACE LOADS.

\[ V_{B_s} = (29.7)(8.02) = 266 \text{ #} \]

\[ V_{B_s} = (39.6)(3.24) = 129 \text{ #} \]

\[ V_{B_k} = 266 - 129 = 137 \text{ #} \] (Acting at E.A.)

\[ V_{F5} = \frac{46.60}{62.55} \times 137 = 77 \text{ #} \]

\[ V_{F5} = 137 - 77 = 60 \text{ #} \]

NET APPLIED SHEAR ON FRONT SKEAR SPAR

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

= 4,020 \text{ #} \]

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

= 14,506 \text{ #} \]
BREAKDOWN OF NET AIR, CRUSHING, AND FUEL LOADS INTO PANEL POINT LOADS.

**UPPER SURFACE**
- $P_a = 770\#$
- $P_b = 1342\#$
- $P_c = 1168\#$
- $P_d = 562\#$

**LOWER SURFACE**
- $P_e = 2327\#$
- $P_f = 4000\#$
- $P_g = 3409\#$
- $P_h = 1456\#$

**CORRECTION LOADS**

Correction loads are applied to the front and rear spars to account for the transverse flow from the contours to the centroids of the straight line chord members.

**UPPER SURFACE**
- $T = 2A_u g_u - g_u y_c = \left[2(202) - (2.13)(82.55)\right] 153.1$
- $R_{LFR} = \frac{34.884}{82.55} = 423\#$

**LOWER SURFACE**
- $T = 2A_L g_L - g_L y_c = \left[2(89) - (7.9)(82.55)\right] 222.5$
- $R_{LFR} = \frac{25.143}{82.55} = 305\#$

**Corrected Panel Point Loads at F.S. & R.S.**
- **UPPER SURFACE**
  - $P_a = 770\# + 423 = 1193\#$
  - $P_b = 562 - 423 = 139\#$
LOWER SURFACE

\[ P_L = 1456 - 305 = 1151 \, \# \]

\[ P_E = 2527 + 305 = 2632 \, \# \]

COUPLE AT FRONT SPAR RESULTING FROM LEADING EDGE AIR LOAD:

\[ \frac{M_L}{38.72} = \frac{39520}{38.72} = 1020 \, \# \]

COUPLE AT REAR SPAR RESULTING FROM TRAILING EDGE AIR LOAD:

\[ \frac{M_T}{50.88} = \frac{246727}{50.88} = 4880 \, \# \]

COUPLE AT REAR SPAR RESULTING FROM VERTICAL COMPONENT OF FLAP LOAD (40° DEPAR

\[ \frac{M_{VFLS}}{50.88} = \frac{7861 \times 123.62}{50.88} = 19100 \, \# \]

NET HORIZONTAL LOADS AT TRUSS PTS. OF REAR SPAR

\[ P_{in} = 4850 + 19100 - 882 = 23068 \, \# \]

\[ P_{en} = 4850 + 19100 + 4841 = 28791 \, \# \]

VERTICAL LOAD AT R.S. LOWER PANEL POINT

\[ P_E = 5400 + 7861 - 2632 \]

\[ = 10629 \, \# \]
CONDITION II - F.G.W. (72-1000# Bombs) F.O.L.G.E. @ 500 L.F.

AIR LOADS (INTERSPAR)
REPLACING THE AIR LOADS WITH EQUIVALENT TEMPERATURES:

COMPOSITE INTERSPAR LOAD = \( N_i = 5,255\) #
C.G. AFT. OF F.S. = 40.50 in.
\( W_{C2} = 67.4 \) #/in. ↑ (Ref.: pg. 107)
\( W_{C1} = 60.0 \) #/in. ↑

UPPER SURFACE INTERSPAR LOAD = \( N_U = 4,987\) #
C.G. AFT. OF F.S. = 41.08 in.
\( W_{U} = 61.0 \) #/in. ↑ (Ref.: pg. 107)
\( W_{U} = 59.8 \) #/in.

LOWER SURFACE INTERSPAR LOAD:
\( W_{L2} = W_{U} - W_{C2} = 6.4 \) #/in. ↑
\( W_{L1} = W_{U} - W_{C1} = 1.2 \) #/in. ↑

AIR LOADS (FLAP)

NET VERTICAL LOAD = 7,861 #
C.G. 18.125 in.
NET HORIZONTAL LOAD = 5,932 #
of F.S.
\( P_1 = 582 \) # → (Ref.: pg. 108)
\( P_2 = 484 \) # →

AIR LOADS (COMBINED TR. EDGE & FLAP AT TRUSS P.F.T.

\( H_{E.S.} = \frac{(7861)(128.42)}{50.88} + \frac{2411.983}{50.88} - 88.2 \)
= 22,974 #
ANALYSIS OFING
CONSOLIDATED VALISE AIRCRAFT CORPORATION
PREPARED BY JOHN MILTON
CHECKED BY ALVA
REVISED BY

\[ \frac{H_C}{lov} = \frac{12100 + 4756 + 4841}{3} = 28,697 \] #

\[ V_C = 5237 + 7861 = 13,098 \] #

\[ \text{CRUSHING LOADS} \]

\[ \text{FROM PRELIMINARY CALCULATIONS: } M_X = 24.55 \times 10^6 \text{ in}^2 \] #

\[ \text{AND SINCE } M_X \geq M_Y \text{ THIS VALUE WILL BE} \]

\[ \text{USED FOR COMPUTING THE CRUSHING LOADS.} \]

\[ E = 10.3 \times 10^6 \] 

\[ L = 56.875 \] 

\[ I_X = 41.179 \text{ in}^4 \] 

\[ I_X/Q_X = 51.5 \text{ in} \]

\[ \text{CRUSHING LOAD} = \frac{(M_X)^2 L}{(I_X/Q_X)EI} = \frac{(24.55 \times 10^6)^2 (35.675)}{(51.5)(10^3)(1417)} = 1070 \] #

\[ \text{REPLACING THE CRUSHING LOAD WITH THE} \]

\[ \text{EQUIVALENT TRAPEZOID SUCH THAT } H_F = \frac{W_F}{W_E} \]

\[ \text{WHERE } H_F = \text{CONTOUR DEPTH OF FRONT SPAR} \]

\[ H_R = \text{CONTOUR DEPTH OF REAR SPAR} \]

\[ H_R = 53.807 \text{ in} ; H_F = 41.644 \text{ in} \]

\[ W_F = 11.32 \text{ #/in} \]

\[ W_E = 14.61 \text{ #/in} \]

\[ \text{FUEL LOAD} \]

\[ \text{SINCE THIS IS A NORMAL FLIGHT CONDITION} \]

\[ \text{THE FUEL LOAD ACTS ON THE LOWER SURFACE.} \]

\[ P_{fuel} = 1.5 \times 2.259 \times 2761 = 9356 \] #

\[ \bar{P}_{fuel} = 77.2 - 31.95 = 45.25 \text{ in. (AFT. F.S.)} \]

\[ W_{fuel} = 51 \text{ #/in.} \]

\[ W_{fuel} = 14.6 \text{ #/in.} \]
INTERSPAR LOADING DIAGRAM

Blend #19

E.G.W. (72-1000 # bombs), F.D.L. G.E. @ sea level
Combined Air (Interspar) Crushing and Fuel Loads Acting on Bulkhead

Upper Surface:
F.S. Ordinate = \( W_{\text{Air}} + W_{\text{Crush}} \) = \( 610 - 11.32 = 49.68 \) #/in

P.S. Ordinate = \( W_{\text{Air}} + W_{\text{Crush}} \) = \( 59.8 - 14.61 = 45.19 \) #/in

Lower Surface:
F.S. Ordinate = \( W_{\text{Air}} + W_{\text{Crush}} + W_{\text{Fuel}} \) = \( 6.4 + 11.32 - 810 = -63.28 \) #/in

P.S. Ordinate = \( W_{\text{Air}} + W_{\text{Crush}} + W_{\text{Fuel}} \) = \( .2 + 14.61 - 146 = -151.19 \) #/in

Wing Station Loading

Applied Loads on Bulkhead
Transferring all forces to the E.A.

\[ V = 2128 + 5255 + 5237 + 7860 - 9356 = 11124 \] #

\[ D = D_{\text{Flap}} = 5723 \] #

\[ T_{\text{EA}} = (2128)(15.82 + 46.60) + 5255(46.60 - 40.50) - (5237)(35.95 + 46.21) - (7860)(35.95 + 123.62) - (5723)(142 + 19.18) - (9356)(46.60 - 45.25) = -11608.296 \] #
ANALYSIS

PAO'V

PREPARED BY: [Redacted]

CONSOLIDATED VULTEE AIRCRAFT CORPORATION

FORT WORTH DIVISION

FORT WORTH, TEXAS

REPORT NO. F25-36-242

MODEL: X8-36

REVISED BY: [Redacted]

DATE: 11/47

BLEND #19

CONQ II

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

\[ V_{F5} = \frac{55.55}{82.55} (11,124) = 4.845 \text{ ft} \]

\[ V_{F5} = V - V_{F5} = 6.279 \text{ ft} \]

\[ 8_{F5} = \frac{4.845}{41.64} = 0.1164 \text{ in} \]

\[ 8_{F5} = \frac{6.279}{53.81} = 0.1167 \text{ in} \]

*(F.S. & F.S. DEPTHS)

SHEAR FLOW DUE TO TEA:

\[ 8_0 = \frac{1608.296}{2 	imes 8707} = 0.1847 \text{ in} \]

SHEAR FLOW DUE TO DRAG LOAD

\[ 8_0 = 29.7 \text{ in} \]

\[ 8_0 = 39.6 \text{ in} \]

\[ 8_0 = 23.7 \text{ in} \]

\[ 8_0 = 184.7 \text{ in} \]

\[ 8_0 = 35.6 \text{ in} \]

BLEND 19 - APPLIED SHEAR FLOWS

R.G.W. (78-1000 *BOMBS), F.D.L.G.E. @ SEA LEVEL
Net Shear Flows

\[ B_{FS} = 184.7 - 116.4 = 68.3 \text{#/in} \uparrow \]
\[ B_{RS} = 184.7 + 116.7 = 301.4 \text{#/in} \uparrow \]
\[ B_u = 184.7 - 20.7 = 155.0 \text{#/in} \rightarrow \]
\[ B_l = 184.7 + 30.6 = 224.3 \text{#/in} \rightarrow \]

Reactions at F.S. and R.S. due to vertical components of Surface Loads:

\[ V_{FS} = 77 \text{#} \uparrow \quad (\text{Ref.: Pg. 114}) \]
\[ V_{RS} = 60 \text{#} \uparrow \]

Net Applied Shear on Front and Rear Spars

F.S.
\[ V = (68.3)(41.67) + 60 = 2,904 \text{#} \uparrow \]

R.S.
\[ V = (301.4)(63.81) - 77 = 16,141 \text{#} \uparrow \]

Breakdown of net air, crushing, and fuel loads into panel point loads:

Upper Surface
\[ P_1 = 748 \text{#} \uparrow \]
\[ P_2 = 1350 \text{#} \uparrow \]
\[ P_3 = 1216 \text{#} \uparrow \]
\[ P_4 = 601 \text{#} \uparrow \quad (\text{Ref.: Pg. 111 for location of panel points}) \]

Lower Surface
\[ P_5 = 1660 \text{#} \uparrow \]
\[ P_6 = 2853 \text{#} \uparrow \]
\[ P_7 = 2452 \text{#} \uparrow \]
\[ P_8 = 1055 \text{#} \uparrow \]
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**

\[ T = 2Au \quad g_u = 8u \quad y_{uc} = \left[2(202) - 213(82.55)\right]1.55 \]

\[ = 35,340 \] #

\[ R_{U,E} = \frac{35,340}{82.55} = 428 \] #

**Lower Surface**

\[ T = 2Au \quad g_u = 8u \quad y_{uc} = \left[2(89) - (79)(82.55)\right]224.5 \]

\[ = 25,346 \] #

\[ R_{L,E} = \frac{25,346}{82.55} = 307 \] #

**Corrected Panel Point Loads at F.S. & R.S.**

**Upper Surface**

\[ F_u = 745 + 428 = 1173 \] #

\[ F_o = 601 - 428 = 173 \] #

**Lower Surface**

\[ F_u = 1055 - 307 = 748 \] #

\[ F_o = 1660 + 307 = 1967 \] #

**Couple at F.S. Resulting from Leading Edge Air Load**

\[ M_{L} = \frac{35,340}{38.72} = 863 \] #

**Couple at R.S. Resulting from Trailing Edge Air Load**

\[ M_{T} = \frac{241,285}{50.88} = 4756 \] #
COPPLIING AT E.S. RESULTING FROM VERTICAL COMPONENT OF FLAP LOAD (40° DEFLECTION)

\[ \frac{MN_{E,3}}{50.88} = \frac{7861 \times 123.62}{50.88} = 19,100 \# \]

NET HORIZONTAL LOADS AT TEUSS PTS. OF REAR SPAR
\[ P_{n1} = 4756 + 19100 - 882 = 22,974 \# \]
\[ P_{n2} = 4756 + 19100 + 4841 = 28,657 \# \]

VERTICAL LOAD AT E.S. LOWER PANEL POINT
\[ P_{v} = 7861 - 1967 + 5257 \]
\[ = 11,131 \# \]
## Table

<table>
<thead>
<tr>
<th>Member</th>
<th>0G.L.</th>
<th>E.G.L.</th>
<th>0.G.L.</th>
<th>R.G.L.</th>
<th>Max. Loads</th>
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<td>-1,200-1,070</td>
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*Used B-36A Values from F35-36-242.

**Report No:** F35-36-242

**Model:** XB-36

**By:** Cuy Jull

**Check By:** All.

**Date:** 11-47
### Table: TUBULAR MEMBERS IN COMPRESSION & TENSION

<table>
<thead>
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<th>Member</th>
<th>Member End</th>
<th>Tube No</th>
<th>Size of Tube</th>
<th>AFC (in)</th>
<th>Fl (in)</th>
<th>L (in)</th>
<th>I (in^4)</th>
<th>Kf</th>
<th>M (in)</th>
<th>Load (#10)</th>
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<td>1.5 x 15 x 0.62</td>
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<td>8050</td>
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</tr>
</tbody>
</table>

*Distance between C.G. of attaching rivets*

---

By: [Signature]

Checked: [Signature]
TUBE END OP IN TENSION

The critical bending stresses in an end connection occur in member OP:

\[ \sigma = \frac{P}{A} + \frac{P_e \cdot h_e}{I} \]

\[ I = 0.0216 \text{ in}^4 \]
\[ h_e = 0.341 \text{ in} \]
\[ t = 0.394 \text{ in} \]

\[ \sigma = \frac{5800 + (5800)(0.341)^2}{0.2850 + 0.0216} \]
\[ \sigma = 51550 \text{ psi} \]

Assume \( C_e = 0.6 \) and a rivet concentration factor of \( R_e = 0.9 \)

\[ R_e = 0.6 \times 0.9 \times 74000 = 53880 \text{ psi} \]

M.S. = \[ \frac{53880}{51550} - 1 = +0.03 \]

Rivet attachment of Tube End OP

\[ P_{max} = 8050 \text{ psi} \] (Ref. P. 127) for RGK(12-1000 @ 1000) FDLAE, 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 = \[ 18 \times 536 = 10,730 \text{ psi} \]

M.S. = \[ \frac{10730}{8050} - 1 = +0.33 \]
**Upper Chord**

From a study of the B-36A analysis (Ref: F25-36-142, PAI-321) it is found that the critical stresses in the upper chord occur at the rear spar. The critical condition is D/W F/D GE 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

\[ P = -25,050 \text{ N} \quad \text{(Ref: PAI-127)} \]

\[ A = 1.065 \text{ m}^2 \quad \text{(Ref: F25-36-142, PAI-319)} \]

\[ f_c = \frac{P + M_c}{A} = \frac{25,050}{1.065} = 21,650 \text{ N/m}^2 \]

\[ f_c = 25,000 \text{ N/m}^2 \quad \text{(Ref: F25-36-142, PAI-322)} \]

\[ M.S. = \frac{25,000}{21,650} - 1 = 0.15 \]

**Lower Chord**

From a study of the B-36A analysis (Ref: F25-36-142, PAI-325) it is found that the R.G.W., LARH for @5000' (12-4000# bombs), produced the critical stresses in this member with a M.S. = 1.20. 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: F25-36-142, PAI-333) therefore an
ICOSTAL 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.D.L.G.C., 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 COM-
PRESSIVE 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
THE MAXIMUM BENDING MOMENT
OCCURS FOR THE TRIANGULAR LOADING
RESULTING FROM FUEL PRESSURE IN THE
D.G.W., F.D.L.G.C. @ SEA LEVEL CONDITION.

CHECK JUST ABOVE LOWER CHORD MEMBER

\[ A = 0.8137 \text{ in}^2 \]
\[ I_{NA} = 0.7814 \text{ in}^4 \]
\[ I_{C6} = \frac{0.7814}{1.886} = 0.415 \text{ in}^3 \]
For this check the ends of the member are conservatively considered fixed.

\[ \frac{-N_2}{W} = -2.090 \quad \text{(Ref: F-35-36-126)} \]

\[ P_{\text{max}} = \frac{6}{231} \times 50.878 \times 2.09 \times 1.5 \]

\[ = 4.14 \text{#/in}^2 \]

\[ W = \frac{4.14 \times (10.25) \times (48)}{2} = 1020 \text{#} \]

\[ M_6 = \frac{Wl}{10} = \frac{1020 \times 48}{10} \]

\[ = 4900 \text{in}.# \]

\[ f_2 = \frac{P + MC}{I} = \frac{15200}{0.8157} + \frac{4200}{0.8157} \]

\[ = 30,490 \text{#/in}^2 \]

*The allowable is that of the lipped element of the ZCC*

\[ \alpha = 25 \quad \beta = 635 \quad \gamma = 0.064 \]

\[ \beta/\gamma = 6.3 \]

For 245T8A

\[ f_{ey} = 64,000 \text{psi} \]

\[ f_{te} = 70,000 \text{psi} \quad \text{(Ref: C.W.A.C. Struct. Handbook, pg. 2.732)} \]

\[ M.S. = \frac{70000}{30490} - 1 = +1.29 \]
Section at 57.74% of stiffener from top

\[ A = 0.6857 \text{ in}^2 \]
\[ I_{NA} = 7101 \text{ in}^4 \]

\[ f_c = \frac{7101}{1.756} = 4041 \text{ in}^3 \]

\[ b_c = 57,300 \text{ #/in} \]

(FOR DIMENSIONS SEE P2.

For this check the ends of the member are conservatively assumed simply supported.

\[ S = \frac{15200 - 690}{48} = 303 \text{ #/in} \]

Axial load at 57.74% L

\[ = 690 + (0.5774)(48)(303) = 9090 \text{ #} \]

\[ M_{max} = 0.128 WL = 0.128(1020)(48) = 6260 \text{ in}^2 \]

\[ f_c = \frac{S}{A} + \frac{MC}{I} \]
\[ = \frac{9090}{0.6857} + \frac{6260}{0.404} \]
\[ = 13,250 + 15,500 \]
\[ = 28,750 \text{ #/in}^2 \]

M.S. = \[ \frac{57,500}{28,750} - 1 \]

+ 100
**WING BULKHEAD #11**
(36 W 111)

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WING BULKHEAD II

DISCUSSION:

BULKHEAD II 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. (555,272 tons) LESS BOMBS, FULL FUEL AND OIL.
(II) MIN. FLYING W.T. (136,015 lbs) ILAA, H.S @ 5000 FT.
(III) SIDE DRIFT LANDING, A.G.W. (112,500 lbs, 05)

These conditions are similar to those found to be critical for the B-36A airplane (225-36-142, fig. 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.
DISCUSSION (CONT'D)


THE X-2-36 BULKHEAD LOADS DUE TO AIRLOADS, CRUSHING LOADS, AND FUEL LOADS FOR CONDITION (II) ARE OBTAINED FROM THE B-36A LOADS AS SHOWN ON PAGES 153.
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 F2S-36-153, P. 137 TO 139.

CALCULATION FOR CONDITION I - DGW (255,272 lb) - TWO WHEEL LANDING - I.R.-N.D.

\[ n_y = -4.00 \text{ ULTIMATE (DOWN)} \]

\[ n_d = 1.32 \text{ ULTIMATE (FWD)} \] (Ref. AWC-2)

BECAUSE OF THE PITCHING ACCELERATION DURING LANDING THE VERTICAL LOAD FACTOR IS INCREASED.

\[ \frac{\alpha}{127} = -0.006516 \] (Ref. F2S-36-240 P. 174)

DISTANCE OF C.G. OF INBD. ENGINE AFT. OF C.G. OF AIRPLANE = 154.3 in.

\[ n'_y = -4.00 + (-0.006516)(154.3) = -5.00 \]

RESOLVING THE LOAD FACTORS INTO PLANES PERPENDICULAR & PARALLEL TO THE THRUST LINE:

\[ \theta \text{ CHORD PLANE} \]

\[ \text{HORIZ REF LINE} \]

\[ \text{INBD} \]

\[ \text{DOWN} \]
COND. I LOAD FACTORS CONT'D.

\[ n_{v1} = 5.00 \cos 2^\circ = 5.00 (0.99939) = 5.00 \text{ (Down)} \]

\[ n_{d1} = 5.00 \sin 2^\circ = 5.00 (0.0349) = 0.17 \text{ (INBD)} \]

\[ n''_{v} = 5.00 \cos 3^\circ + 1.32 \sin 3^\circ = 5.00 (0.99863) + 1.32 (0.05234) \]
\[ = 5.06 \text{ (Down)} \]

\[ n''_{d} = 1.32 \cos 3^\circ - 5.00 \sin 3^\circ = 1.32 (0.99863) - 5.00 (0.05234) \]
\[ = 1.06 \text{ (FWD)} \]

\[ n''_{d} = 1.06 \cos 3^\circ = 1.06 (0.99863) = 1.06 \text{ (FWD)} \]

\[ n''_{s} = n_{s1} + n_{s2} = 0.17 + 1.06 \sin 3^\circ = 0.23 \text{ (INBD)} \]

SUMMARY OF LOAD FACTORS FOR USE IN OBTAINING FITTING LOADS IN THE DGW-ZWL-IR-ND CONDITION.

\[ n''_{v} = 5.06 \text{ (Down)} \]
\[ n''_{d} = 1.06 \text{ (FWD)} \]
\[ n''_{s} = 0.23 \text{ (INBD)} \]
CALCULATION & RESOLUTION OF LOAD FACTORS FOR CONDITION II  
MIN. FLYING WT. = 136,018 lb - I LAA @ 5000'  

\[-\frac{N_A}{W} = 2.236 \text{ (LIMIT)}\]

\[\frac{X_M}{W} = -0.012 \text{ (LIMIT) (REF. F25-3.6.126. P. 84)}\]

RESOLVING THE LOAD FACTORS INTO PLANES PARALLEL & PERPENDICULAR TO THE THRUST LINE:

\[N_V = \frac{N_A}{W} \cos 2^\circ (1.5) = 2.236 \times 99.939 \times 1.5 = 3.35 \text{ (UP)}\]

\[N_D = \frac{X_M}{W} \cos 3^\circ (1.5) = -0.012 \times 99.863 \times 1.5 = -0.018 \text{ (FWD)}\]

\[N_O = \left(\frac{N_A}{W} \sin 2^\circ + \frac{X_M}{W} \sin 3^\circ\right) 1.5 = \left(2.236 \times 0.0394 - 0.012 \times 0.0523\right) \times 1.5\]

\[= 1.312 \text{ (OUTBD)}\]
<table>
<thead>
<tr>
<th>MEMBER</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<tbody>
<tr>
<td>AW</td>
<td>0</td>
<td>0</td>
<td>1010T</td>
<td>0</td>
</tr>
<tr>
<td>CW</td>
<td>14.2T</td>
<td>14.2T</td>
<td>9.6T</td>
<td>9.3T</td>
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<td>10.0T</td>
<td>2.0T</td>
<td>1.4T</td>
<td>1.0T</td>
</tr>
</tbody>
</table>

*REF. F25-36.59 TABLE XXXIII*

**ULTIMATE MEMBER LOADS - DOW-ZWL-IR-WD**

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<tr>
<th>MEMBER</th>
<th>1</th>
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<td>13.06T</td>
<td>12.15T</td>
<td>5.940C</td>
<td>2.790C</td>
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**ULTIMATE MEMBER LOADS - MIN. FLYING WT. ILAA @ 5000'**

<table>
<thead>
<tr>
<th>MEMBER</th>
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<th>2</th>
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<tbody>
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<td>AW</td>
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<td>21100</td>
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<tr>
<td>CW</td>
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<td>8.170C</td>
<td>4.100T</td>
<td>1720T</td>
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<td>CR</td>
<td>6.4</td>
<td>3.6</td>
<td>2.02</td>
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CALC. BY: JGK
CR. BY: Johnson
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<th>POINT</th>
<th>FROM VERT. LOAD OF 1000#</th>
<th>DRAG LOAD OF 1000#</th>
<th>FROM VERT. LOAD OF 1000#</th>
<th>DRAG LOAD OF 1000#</th>
<th>FROM VERT. LOAD OF 1000#</th>
<th>DRAG LOAD OF 1000#</th>
<th>FROM VERT. LOAD OF 1000#</th>
<th>DRAG LOAD OF 1000#</th>
<th>FROM VERT. LOAD OF 1000#</th>
<th>DRAG LOAD OF 1000#</th>
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<tr>
<td>B</td>
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<td>+4</td>
<td></td>
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<td>-34.3</td>
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<td>C'</td>
<td>-47.9</td>
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<td>-47.9</td>
<td>+120</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

+ COMPONENT INBD.

(REF. F25-36-153, TABLE XXXIV.)

CALC. BY: JOHNSON

CK: BY: JOHNSON
DETERMINATION OF FLANGE LOADS IN UPPER & LOWER SHEAR BEAMS OF INBOARD EXTENSION MOUNT.

\[ P_f = \text{FLANGE LOAD} = \text{NET SHEAR} \times 74.5/48.5 \text{ FOR UPPER SURF} \]
\[ P_f = \text{TENSION FIELD FACTOR} = \text{NET SHEAR} \times \frac{\cot \alpha}{2} \]

\[ \cot \alpha = 1.185 \text{ FOR UPPER SURF} \]
\[ \cot \alpha = 1.205 \text{ FOR LOWER SURF} \]

MIN. FLYING WT.-ILAM @ 5000' (L.H. MOUNT)

5519' A (2946') A' 2573'

PLAN VIEW UP UPPER SURF

\[ P_f = 4530' \]
\[ P_f = 1744' \]
\[ R = 2946 \times \frac{74.5}{48.5} = 4550' \]

PLAN VIEW LOWER SURF

\[ P_f = 4140' \]
\[ P_f = 1680' \]
\[ R = 2310 \times \frac{74.5}{48.5} = 3246' \]

FIG. 15
<table>
<thead>
<tr>
<th>CONDITION</th>
<th>MEMBER</th>
<th>INERTIA LOADS</th>
<th>THRUST LOADS</th>
<th>Torsion LOADS</th>
<th>FLANGE LOADS</th>
<th>V.COTX</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>TABLE XXXX</td>
<td>(REF. Fig. 16)</td>
<td>FIG. 13</td>
<td>FIG. 13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1)</td>
<td>(2)</td>
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<td>(6)</td>
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<td>DGW-2WL-1R-HD</td>
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</tbody>
</table>

*LOADS DUE TO V.COTX ARE USED ONLY IF THEY INCREASE MEMBER LOAD.
**CONDITION:**

- **D.G.W.:** 255,272 lb. (Less Bombs)
- **Full Fuel & OIl:** 2 W.L.-IR-ND

### Engine Mount Fitting Loads (Ref. PE 146)

**Upper Fitting (Point W):**

<table>
<thead>
<tr>
<th>Member</th>
<th>Load</th>
<th>Direction Cosine</th>
<th>Upper Fitting (Point W)</th>
</tr>
</thead>
<tbody>
<tr>
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<td>38,125 lb</td>
<td>0.292</td>
<td>5,210</td>
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<tr>
<td>CN</td>
<td>25,512 lb</td>
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<tr>
<td>CR</td>
<td>67,405 lb</td>
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</table>

**Lower Fitting (Point R):**

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<tr>
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<th>Direction</th>
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</thead>
<tbody>
<tr>
<td>AN</td>
<td>0</td>
<td>0</td>
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<tr>
<td>CN</td>
<td>4,300 lb</td>
<td>0.292</td>
</tr>
<tr>
<td>CR</td>
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<td>0</td>
</tr>
</tbody>
</table>

### Analysis

- **V_{W} = 21,950 lb (Down)**
- **ZD_{W} = 57,100 lb (Aft)**
- **ZS_{W} = 2,100**

**Notes:**

- **FW 444 8-46 Utility Report Sheet**
COND: DGW-2WL-IR-ND

The drag & side loads are resolved into the plane of the bulkinous & the plane of the rear spar.

**UPPER FITTING**
\[ D = D \cos \delta - S \sin \delta = 57,100 \times 9.99 - 2100 \times 0.052 = 56,900 \text{ ft} \]
\[ S = D \sin \delta + S \cos \delta = 57,100 \times 0.052 + 2100 \times 9.99 = 5,070 \text{ in} \]
\[ D'' = S \tan 10^\circ = 5,070 \times 1.76 = 890 \text{ ft} \]
\[ D_{TOTAL} = D' + D'' = 56,900 - 890 = 56,010 \text{ ft} \]

**LOWER FITTING**
\[ D' = D \cos \delta - S \sin \delta = 47,000 \times 9.99 - 2290 \times 0.052 = 66,880 \text{ ft} \]
\[ S' = D' \sin \delta + S' \cos \delta = 47,000 \times 0.052 + 2290 \times 9.99 = 57,710 \text{ in} \]
\[ D' = S' \tan 10^\circ = 57,710 \times 1.76 = 1,020 \text{ ft} \]
\[ D_{TOTAL} = 66,880 - 1,020 = 65,860 \text{ ft} \]

Additional vertical & drag loads must be included at points W & R due to inertia items of the extension mount beam to these points.

**POINT W**
\[ V = 85^\circ \text{ (down)} \]
\[ D = 17^\circ \text{ (Fore)} \]

**POINT R**
\[ V = 111^\circ \text{ (down)} \]
\[ D = 24^\circ \text{ (Fore)} \]

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.
CONDIDGW-2WL-IR-ND

SUMMARY OF FITTING LOADS

UPPER FITTING
\[ V = 21450 + 85 = 22035 \text{# (Down)} \]
\[ D = 56,010 - 17 = 55,993 \text{# (Aft)} \]

LOWER FITTING
\[ V = 4300 + 111 = 4411 \text{# (Down)} \]
\[ D = 65,840 + 74 = 65,884 \text{# (Fwd)} \]

FUEL LOADS

THE CENTER FUEL TANK IS FULL OF FUEL FOR THIS CONDITION.

19 FUEL LOAD AT FLX.KT. #11 = 3008.2 #
C.G. FUEL IS 54.81” AFT. OF F.S. (Ref. FES-36-240 P.13)

THE VERTICAL LOAD FACTOR AT THE FUEL C.G. IS:

\[ \gamma_{v} = -4.00 - 0.00651.0 x(-44.86) = -2.708 \]
(Ref. AN02 & FES-36-240 P.174)

WHERE -44.86” IS THE DISTANCE OF THE FUEL C.G.
FWD. OF THE AIRPLANE C.G. (Ref. FES-36-237 P.14&81)

THE ULTIMATE FUEL LOAD IS:

\[ P_u = 3,008.2 \times 2.708 = 11,140 \text{#} \]

THE FUEL IS ASSUMED DISTRIBUTED AS A TRAPEZOID
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 base proportional to the clearance.

\[ F = \frac{U \times S}{L} \]

\[ U = \frac{134.8}{10} \text{ (Referee P.240)} \]

\[ L = \frac{32.5}{2} = 16.25 \text{ in} \]

\[ F = \frac{85.25 \times 16.25}{10} = 1.348 \text{ kips} \]
APPLIED LOADS ON THE BULKHEAD

- 247% CRUSHING
- 55,993#
- 19.667"
- 57.09" - 44.04" - 36.84"
- 22.035#
- 22.433"
- 26.45#
- 65.884#
- 4411#

- 247% CRUSHING
- 31.8#

- 83% FUEL
- 138#
- 2.29"
COND: I DGW - ZWL - IR - ND

TRANSFERRING LOADS TO THE ELASTIC AXIS OF THE BULKHEAD:

\[ D = + 55.99^2 - 65.88.4 = - 9.89^1 \text{ (FWD)} \]

\[ V = 22.03 + 4.411 + 11.140 = 27,586^\# \text{ (DOWN)} \]

\[ T_{EA} = 22.03 x 44.04 + 4.411 x 44.04 + 55.993 x 36.84 \]
\[ + 65.88.4 x 26.45 - 11.140 x 2.29 = 4,944,590^{11 \#} \]

REACTING THE DRAG LOAD AT THE UPPER & LOWER SURFACES: \text{REF: F25-36-142, P. II - 3}

\[ R_u = 9.891 \times \frac{42.44}{15.92} = 4,550^* \text{ (AFT)} \]

\[ R_l = 9.891 \times \frac{41.48}{12.92} = 5,550^\# \text{ (AFT)} \]

REACTING \( R_u \) & \( R_l \) AS SHEAR FLOWS IN THE UPPER & LOWER SURFACES: \text{REF: F25-36-142, P. II - 3}

\[ g_u = \frac{4350}{101.13} = 42.8^1/1 \]

\[ g_l = \frac{5550}{101.13} = 55.3^1/1 \]

THE NET VERTICAL COMPONENT DUE TO SHEAR FLOW IS \( 43 x 10.714 - 55 x 4.534 = 212^* \text{ (UP)} \)

& IS REACTED AT THE FRONT & REAR SPARS.

\[ P_{Rs} = 212 \times \frac{44.04}{101.13} = 9.2^1 \text{ (DOWN)} \]

\[ P_{Rs} = 212 \times \frac{57.09}{101.13} = 120^1 \text{ (DOWN)} \]

THE VERTICAL SHEAR LOAD ON THE BULKHEAD IS REACTED AT THE FRONT & REAR SPARS.

\[ P_{Rs} = 27,586 \times \frac{44.04}{101.13} = 16,250^1 \text{ (UP)} \]

\[ P_{Rs} = 27,586 \times \frac{57.09}{101.13} = 21,200^1 \text{ (UP)} \]
TRANSFER OF LOADS TO E.A. "CONTIC"

THE TORSION ABOUT THE ELASTIC AXIS (C=E) IS

\[ \frac{T_{EA}}{2A} = \frac{40,445}{2 \times 6.99} \]

\[ 8.13 \text{ ft} \]

\[ 21,200 \text{ lb} \]

\[ 120 \text{ lb} \]

\[ 16,350 \text{ lb} \]

\[ 1 \text{ in} \]

\[ 4.89 \text{ lb} \]

\[ 2.97 \text{ in} \]

\[ 9.15 \text{ in} \]

\[ 5.86 \text{ in} \]
CONDITION: II. MINIMUM FLYING WEIGHT = 134,018^w - ILAA (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:

\[ W_{\text{XB-36}} = 2.043 \] (Ref. F-536-12b, p. 40)

\[ W_{\text{B-36A}} = a \]

\[ -2.043 \times 29.9 = 40.9 \text{ \%} \] (since \( W \) for the XB-36 and B-36A is almost the same, this ratio will be used)

\[ \frac{29.9}{\text{FW}^*} \]

AIR LOAD DESIGNATIONS

- \( P_m^f \): Flange Couple Load from Leading Edge Moment.
- \( P_m^i \): Fitting Couple Load from Nacelle Moment.
- \( P_m^t \): Fitting Couple Load from Trailing Edge Moment.
- \( S_l \): Swear at Front Spar from Leading Edge.
- \( S_t \): Swear at Rear Spar from Trailing Edge.

FW 444 6-46 UTILITY REPORT SHEET
CONDITION: II  MINIMUM FLYING WEIGHT = 136,018 lb, ILA (HS) @ 5000 ft

ENGINE MOUNT FITTING LOADS

UPPER FITTING

\[ W = -32,009 \text{ lb} \]
\[ A = -19,764 \text{ lb} \]

INBD. EXTENSION MOUNT TRUSS

LOWER FITTING

\[ R = +40,862 \text{ lb} \]

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>LOAD #</th>
<th>DIRECTION COSINE</th>
<th>UPPER FITTING (POINT W)</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>( V ) ( \alpha )</td>
<td>( D ) ( \alpha )</td>
</tr>
<tr>
<td>AW</td>
<td>32,009</td>
<td>13.67</td>
<td>0.990</td>
</tr>
<tr>
<td>CW</td>
<td>19,764</td>
<td>0.560</td>
<td>7.756</td>
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<tr>
<td>CR</td>
<td>40,862</td>
<td>0.060</td>
<td>9.970</td>
</tr>
</tbody>
</table>

\( V_{w} = 17,340^\circ \)
\( D_{w} = 45^\circ \)
\( S_{w} = 172^\circ \)

TOTAL OF VERTICAL LOAD

UPPER FITTING (POINT W)
\[ V = 17,340 \times 42 = 17,382 \text{ lb (UP)} \]

LOWER FITTING (POINT R)
\[ V = 26,200 + 59 = 26,259 \text{ lb (UP)} \]

\( \text{FOR} \ A V_w = 42^\circ \ A V_R = 59^\circ \)

\( \text{SEE P/67} \)
CONIC: MFW-LLA (H.S.) @ 5,000

THE DRAG & SIDE LOADS ARE RESOLVED INTO THE PLANE OF THE BULKHEAD & THE PLANE OF THE REAR SPAR.

\[ \begin{align*}
D &= D \cos \beta' - S \sin \beta' = 46,650 \times 0.999 - 1720 \times 0.052 = 46,510^\circ \text{ (FWD)} \\
S &= D \sin \beta' + S \cos \beta' = 46,650 \times 1.052 + 1720 \times 0.999 = 4,150^\circ \text{ (OUTBD)} \\
D' &= S \tan 10^\circ = 4,150 \times 0.176 = 730^\circ \text{ (AFT.)} \\
D_{\text{TOTAL}} &= D + D' = 46,510 - 730 = 45,780^\circ \text{ (FWD)}
\end{align*} \]

UPPER FITTING

LOWER FITTING

ADDITIONAL VERTICAL & DRAG LOADS MUST BE INCLUDED AT POINTS W & R DUE TO INERTIA ITEMS OF THE EXTENSION MOUNT BEING PLACED TO THESE POINTS.

POINT W

\[ V = 42^\circ \text{ (UP)} \]  

(RREF FES-36-142 P-1-25)

POINT R

\[ V = 59^\circ \text{ (UP)} \]

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 = 134.0LB * ILAA (H.S.)@5000

CRUSHING LOADS

Mx for this condition is not contained in any report; Mx has been calculated independently & is considered sufficiently close to Mx for use.

\[ M_x = M_x \text{ (REF. F25-36-141 P.54)} \]
\[ I_x = 86.385 \text{ in}^4 \]
\[ Q_x = 133.8 \text{ in}^3 \]
\[ L = 32.0'' \]

\[ P_{\text{crushing}} = \frac{(21.5 \times 10^3) \times 32.0}{86.385 \times 10^3 \times 0.5 \times 10^3 \times 86.385} = 414 \text{#} \]

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

\[ \begin{array}{c|c|c}
\text{3.58} & \downarrow & \downarrow \\
\hline
\text{CRUSHING LOAD} & \text{4.62} & \text{#} \\
\end{array} \]

\[ \begin{array}{c|c|c}
\text{5690} & \downarrow & \downarrow \\
\hline
\text{2330} & \downarrow & \downarrow \\
\end{array} \]

\[ \begin{array}{c|c|c}
\text{1265} & \downarrow & \downarrow \\
\hline
\text{CRUSHING LOAD} & \text{3.58} & \text{#} \\
\end{array} \]
Cond. II MFW ILAM (A.T.) @ 5000’

Transferring loads to the Elastic Axis of the Bulkhead:

\[ D = -45,780 + 40,000 = -5,780 \text{ lb} \] (FWD)

\[ V = 5690 + 10,670 + 17,332 - 888 - 2679 - 6430 = 11,019 \text{ lb} \] (UP)

\[ \text{Tea.} = (6430 \times 0.49) - (2330 \times 0.21) - (5690 \times 0.09) - (17,332 \times 0.888) + (2679) \times 44.04 - (924 \times 0.87) \times 63.285 - (45,780 \times 3.384) - (10,670 \times 9.59) = -4,318,000 \text{"lb} \]

(COUNTERCLOCKWISE)

Reacting the Drag Load at the Upper & Lower Surface Shear Centers: Ref. F35-66-142, P. II-3 For Dimensions:

\[ Ru = \frac{5780 \times 32.44}{73.92} = 2540 \text{ lb} \]

\[ RL = \frac{5780 \times 41.48}{73.92} = 3240 \text{ lb} \]

Reacting \( Ru \) & \( RL \) as Shear Flows in the Upper & Lower Surfaces:

\[ \beta U = \frac{2540}{10.13} = 25.1 \% \]

\[ \beta L = \frac{3240}{10.13} = 32.1 \% \]

The vertical component of upper & lower surface shear is:

\[ Rv U = 2540 \times 10.714 = 2694 \text{ lb} \] (UP)

\[ Rv L = 3240 \times 4.334 = 1455 \text{ lb} \] (DOWN)

The net vertical component is 124 lb (UP) & is reacted at the front & rear spars:

\[ P_F S = 54 \text{"lb} \] (DOWN)

\[ P_R S = 70 \text{"lb} \] (DOWN)
COND: II MFW-ILAA (4.5) @ 5000'

The vertical shear load on the bulkhead is reacted at the front & rear spars:

\[ R_{es} = 11,019 \times \frac{4.04}{10.113} = 4,780^\# \text{ (Down)} \]

\[ R_{es} = 11,019 \times \frac{57.09}{10.113} = 6200^\# \text{ (Down)} \]

The torsion about the elastic axis (T_ea) is reacted by a shear flow around the entire bulkhead:

\[ \theta_0 = \frac{T}{2A} = \frac{4,318,000}{2 \times 6699} = 323^\% \]
### Table XXXI

<table>
<thead>
<tr>
<th>STATION INCHES FROM F.S.</th>
<th>Au</th>
<th>Al</th>
<th>Δh</th>
<th>Δh*</th>
<th>ΔV</th>
<th>ΔV*</th>
<th>η</th>
<th>η*</th>
<th>M1</th>
<th>M1*</th>
<th>M2</th>
<th>M2*</th>
<th>M3</th>
<th>M3*</th>
<th>M4</th>
<th>M4*</th>
</tr>
</thead>
<tbody>
<tr>
<td>FS</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
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<td>-</td>
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<td>-163.000</td>
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<td>40.452</td>
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<td>570</td>
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<td>-2756</td>
<td>21.2</td>
<td>-</td>
<td>3.180</td>
<td>17.75</td>
<td>9.035</td>
<td>60.800</td>
<td>341.000</td>
<td>-584.000</td>
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<td>60.618</td>
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<td>-</td>
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<td>-239.000</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Moment at Front Spa (M₃₃) = 239.01 x 21 = 4,11500**

**Vertical Load at Front Spa (V₃₃) = -549.0 - 9710 - 3.4 + (124 x 52.7) / 2 + 6.306**
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.

\[ T = \frac{S}{h t} \]

\[ S = 19,392 \text{"} \]
\[ h = 14.47" \text{ } \text{ (Ref. F25-36-142 P.II-31)} \]
\[ t = .037" \]

\[ T = \frac{19,392}{66.41 \times .037} = 9120 \frac{"}{0"} \]

\[ T_{SW} = 21,000 \frac{"}{0"} \text{ } \text{ (Ref. F25-36-142 P.II-32)} \]

\[ M.S. = \frac{21,000}{9120} = 1.130 \]

FLANGE ANALYSIS

Compressive stress in the lower flange:

\[ M = 3790,000" \text{"} \text{ } \text{ (Conf: 2W1-L-2W1-1L)} \]
\[ h = 66.74" \text{ } \text{ * (Ref. F25-36-142 P.II-34)} \]
\[ Sa = 19,392 \text{"} \]
\[ h = 56" \]
\[ I = 6721 \text{ in}^4 \text{ } \text{ *} \]
\[ Q = 100.8 \text{ in}^4 \text{ } \text{ *} \]
\[ Scr = 3,140" \]

\[ P_c = \frac{M}{H} + \frac{Stu \cdot \cot \alpha \cdot 2}{2} \text{ } \text{ (Ref. AAF TR #413, P.257 Eq.11-38)} \]

\[ Stu = \frac{Sa}{K_g} - Scr \text{ } \text{ } \text{ } K_g = \frac{I}{h} = \frac{6721}{100.8 \times 56} = 1.191 \]

\[ Stu = 19,392 - 3140 = 16,252" \text{"} \]

\[ P_c = \frac{3790,000}{66.74} + \frac{13,160}{2} - (1086) \]

\[ P_c = 63,940" \]
The axial load on the bulkhead is beamed to the flange centroids:

\[ P_c' = 9,890 \times \frac{39.85}{66.735} = 5,880 \text{ lb} \]

**Total compressive stress in the lower flange:**

\[ P_c \text{ total} = 63,940 + 5,880 = 69,820 \text{ lb} \]

\[ f_c = \frac{69,820}{3.8 \times 2.4} = 20,500 \text{ psi} \]

*(Ref. FZ5-36-142 PII-31)*

**Allowable compressive stress:**

\[ F_c = 36,500 \text{ psi} \]  
\[ \text{M.S.} = \frac{36,500}{20,500} - 1 = 1.78 \]

**Tensile stress in the upper flange (Cono: DGR-W2WL-IRN)**

\[ P_t = \frac{M}{h} \times \cot \alpha \]

= 56,800 \times 1.140 = 49,600 \text{ lb} \]

\[ F_t = 49,600 \times \frac{27081}{66.735} = 4010 \text{ lb} \]

\[ P_t \text{ total} = 49,600 - 4010 = 45,650 \text{ lb} \]

\[ f_t = \frac{45,650}{2.718} = 14,800 \text{ psi} \]

*(Ref. FZ5-36-142 PII-31)*

\[ F_t = 45,600 \text{ psi} \]  
\[ \text{M.S.} = \frac{45,600}{14,800} - 1 = 1.72 \]
The minimum flying weight - I.L.A.A @ 5000 condition gives the maximum compressive stress in the upper flange:

\[ M = 2,875,500 \text{ lb} \]
\[ S_a = 7016 \text{ lb/in} \]
\[ S_{cr} = 3140 \text{ lb/in} \]
\[ S_{tu} = \frac{7016}{3140} = 2.24 \]
\[ P_c = \frac{2,875,500}{60.72} + \frac{2760}{2} (1.086) \]
\[ P_c = 44,590 \text{ lb} \]

Axial load:

\[ P_c' = 5760 \times \frac{27087}{60.728} = 2340 \text{ lb} \]

Total flange load:

\[ P_c_{total} = 44,590 + 2340 = 46,930 \text{ lb} \]
\[ f_c = \frac{46,930}{2.718} = 17300 \text{ lb/in} \]
\[ M_{cr} = \frac{36,500}{17300} = 2.11 \]

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, all loading is side drift landing for the B-36A (Ref. FZS-36-141, P.284). To 1.408, all loading side drift landing for the XB-36 (Ref. FZS-36-243, P148). The values of the table II-II P.1-39 (Ref. FZS-36-142) will be 1.437 or 2% conservative for the XB-36.
**CONDITION:** III AGW (112.500 ft-mph); Side Drift Landing

**STIFFENER ANALYSIS**

<table>
<thead>
<tr>
<th>STIFFENER</th>
<th>B-36A</th>
<th>XB-36</th>
<th>M.S. (TEN.)</th>
<th>M.S. (COMP.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>REF. 30W11</td>
<td>12</td>
<td>18</td>
<td>1.400 x 2/1.454</td>
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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\#), ILGA, UNSYM.
   GUST, H.S. @ 5000 FT. - REF. P. 179
3. TACKING COND. - DG1W (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-36 AIRPLANE (REF F25-36-192, PG II-99). 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 F25-36-253 and are tabulated on PG 167.

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) and (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 F25-36-242, PG 11 to II-14).
WING BULKHEAD 18

AIRLOADS

CONDITION: MIN FLYING WT, LAA, M.S. @ 5000 FT.


B-36 A:

\[
\frac{Z}{W} = +3.597
\]

\[
W = 136,713^* \quad \text{PG. 71}
\]

\[
Z = 492,000^*
\]

XB-36:

\[
\frac{Z}{W} = +4.256
\]

\[
W = 136,018^* \quad \text{PG. 84}
\]

\[
Z = 579,000^*
\]

RATIO = \frac{579,000}{492,000} = 1.178

XB-36 AIRLOADS = B-36A AIRLOADS x 1.178
WING BULKHEAD #18

AIRLOADS (CONT'D)

XB-36 AIRLOADS
10300#

121.2

121.2

3510#

1018#

488#

45.9

3270#

30.9

2800#

F.A.

11#

3510#

1018#

2930#

FOR B-36A AIRLOADS SEE F2S-36-142, PG II-III

CRUSHING LOADS

COND: MIN. FLYING WT., L.A.A., H.S. AT 5000 FT

THE B-36A CRUSHING LOADS (REF. F2S-36-142, PG II-III), WILL BE MULTIPLIED IN PROPORTION TO THE SQUARE OF THE BENDING MOMENTS TO OBTAIN THE XB-36 CRUSHING LOADS.
WING BULKHEAD 

CRUSHING LOADS (CONT'D)

B-36A: B.M. = 32,266,000 lb" (Ref. F25-36-142, P6 II-110)

XB-36: B.M. = 37,550,000 lb" (PRELIMINARY CALCULATIONS)

\[
\text{RATIO} = \frac{(37,550,000)^2}{(32,266,000)^2} = 1.352
\]

XB-36 CRUSHING LOADS = B-36A CRUSHING LOADS x 1.352

2655 lb

273 \%u

352 \%u

2655 lb

FOR B-36A CRUSHING LOADS SEE F25-36-142, P6 II-111

FUEL LOADS

COND: MIN. FLYING WT., L.A.A., UNSYM. GUST @ 5000

THE FUEL LOADS WILL BE RATIOED FROM THE B-36A FUEL LOADS, IN PROPORTION TO THE VERTICAL LOAD FACTORS, SEE REF. F25-36-142, P6 II-111 FOR B-36A FUEL LOADS.
WING BULKHEAD 18

FUEL LOADS (CONT'D)

B-36A:

\[ \gamma = -5.64 \]  
(REF F2S-36-153, PG 10)

XB-36:

\[ \gamma = -6.572 \]  
(REF F2S-36-253, PG 8)

\[
\text{RATIO} = \frac{6.572}{5.64} = 1.168
\]

XB-36 FUEL LOADS = B-36A FUEL LOADS \times 1.168

\[
38.9 \%W
\]

\[
38.9 \%W
\]

FOR B-36A FUEL LOADS SEE F2S-36-192, PG II-111
WING BULKHEAD #18

CONDITION - M.F.W., L.A.A., U. GUST @ 5000 FT.

SUMMARY OF LOADS (REF. PGS. 171, 172 & 173)

10,300 lbs

121.2% N. AIRLOAD

27.3% N. CRUSHING LOAD

35.2% N.

EXT. NET LOADS NET AIRLOADS NET

71400 - 3570 = 67,830 lbs

-4570 + 480 = -4082 lbs

-2770 + 0 = 2770 lbs

-2730 + 2430 = -2730 lbs

-75200 + 3570 = -69,630 lbs

1018°

43.1°

273°

20.46°

31.8°

31.2°

17.3°

35.2°

38.9°

45.9°

FW 444-6-46 UTILITY REPORT SHEET
WING BULKHEAD #18

\[ \Sigma V = 10,300 - 4082 - 24,300 + 86 - 3270 - 3320 + 2790 \]
\[ = -21,796'' \]
\[ \Sigma D = 67,890 + 2770 - 69,690 = 970'' \]

\[ T_{EA} = (1018 \times 43.12) + (2790 \times 9808) + (10,300 \times 5.77) - (3320 \times 5.59) - (3270 \times 2.62) + (28,296 \times 3709) + (67,890 \times 31.2) + (2770 \times 5.37) + (69,690 \times 20.96) \]
\[ = 4820.325'' \]

\[ \theta_T = \frac{T}{2A} = \frac{4820.325''}{2 \times 4665} = 517''/in. \]
WING BULKHEAD *18

E LOADS ABOUT E.A. (CONT'D)

\[ g_{xs} = 21,796 \left( \frac{37.09}{85.17} \right) \frac{1}{43.12} = 2.21 \% \]

\[ g_{rs} = 21,796 \left( \frac{60.08}{65.17} \right) \frac{1}{55.72} = 2.21 \% \]

\[ g_{y} = 2170 \left( \frac{25.22}{60.84} \right) \frac{1}{65.17} = 4.8 \% \]

\[ g_{z} = 2170 \left( \frac{55.05}{60.84} \right) \frac{1}{85.17} = 6.6 \% \]

NET BALANCING SHEAR FLOWS

\[ 296.8 \text{ In.} \]

\[ 738 \text{ In.} \]

\[ 570.4 \text{ In.} \]

SUMMATION OF "V", "P" + "M" FOR SECTIONS

\[ V_{sz} = -12780 + 2790 = -9990 \text{ In.-Lb} \]

\[ M_{sz} = M'_{z} = 43,900 \text{ In.-Lb} \]

\[ P = 0 \]
WING BULKHEAD "A8"

AIRLOADS

CONDITION: MIN. FLYING WT, ILAA, H.S. @ 5000 FT


B-36A:

\[
\frac{Z}{W} = 1.494 \\
W = 130,712^* \\
Z = 209,500^*
\]

XB-36:

\[
\frac{Z}{W} = 2.043 \\
W = 136,018^* \\
Z = 278,000^*
\]

\[
\text{RATIO} = \frac{278,000}{209,500} = 1.36
\]

XB-36 AIRLOADS = B-36A AIRLOADS x 1.36
WING BULKHEAD #16

AIRLOADS (CONT'D)

XB-36 AIRLOADS

FOR B-36A AIRLOADS SEE F25-36-142, PG II-124
CRUSHING LOADS

COND.: MIN. FLYING WT., I.L.A.A., N.S. @ 5000FT.

THE B-36A CRUSHING LOADS (REF. F25-36-142, PG II-124), 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. = 18,911,000"# (F25-36-142, PG. II-123)
B-36: B.M. = 37,559,000"# (PRELIMINARY CALCULATIONS)

\[
\text{RATIO} = \frac{(24,990,000)^2}{(18,911,000)^2} = 1.74
\]

XB-36 CRUSHING LOADS = B-36A CRUSHING LOADS X 1.74

1170#

12.0%  
15.5%W.

FUEL LOADS

COND: MIN. FLYING WT., ILAG, UNSYM. GUST@5000'

THE FUEL LOADS WILL BE RATIOED FROM THE B-36A FUEL LOADS, IN PROPORTION TO THE VERTICAL LOAD FACTORS. SEE F25-36-142, PG. II-124, FOR B-36A FUEL LOADS.
WING BULKHEAD 18

FUEL LOADS (CONT'D)

B-36A:

\[ \eta_y = 2.60 \quad (\text{REF. FZS-36-153, PG. 11}) \]

XB-36:

\[ \eta_y = 3.40 \quad (\text{REF. FZS-36-253, PG. 11}) \]

\[ \text{RATIO} = \frac{3.40}{2.60} = 1.31 \]

\[ \text{XB-36 FUEL LOADS} = \text{B-36A FUEL LOADS \times 1.31} \]

For B-36A FUEL LOADS see FZS-36-142, PG. 124.
WING BULKHEAD #18

CONDITION - M.F.W., I.L.A.A., UNSYM. GUST @ 5000'

SUMMARY OF LOADS (REF PG 180, 181 & 182)

- AIRLOAD
- 38.2 %
- 89.1 %

- FUEL LOAD
- 20.05 %
- 20.05 %

- CRUSHING LOAD
- 12.0 %

- EXT. MT. T.E. NET LOAD AIRLOAD
- 47,000 - 1312 = - 45,688

- 3020 + 135 = 3155

- 17,000 + 805 = 17,805

- 44,800 + 1312 = 46,112

- 4.2 UTILITY REPORT SHEET
WING BULKHEAD * 18

\[ \Sigma \text{LOADS ABOUT E.A.} \]

\[ \Sigma V = -4860 + 5430 + 3155 + 18505 - 63 + 1710 - 9220 = 14659 \* \]

\[ \Sigma D = -48312 - 1880 + 46112 = -4080 \* \]

\[ T \text{E.A.} = -(1960 \times 33.13) - (4860 \times 48.08) - (5430 \times 2) \]
\[ - (21379 \times 37.09) - (1710 \times 5.5) - (9220 \times 8.3) \]
\[ - (48312 \times 31.2) - (1880 \times 53.7) - (46112 \times 20.96) \]

\[ = 3639.115 \* \]

APPLIED LOADS ARE REACTED BY SHEAR FLOWS:

\[ q = \frac{T}{2A} = \frac{3639.115}{2 \times 4665} = 390 \* \]
WING BULKHEAD #18

\[ Q'_{FS} = 14,657 \left( \frac{37.0}{85.17} \right) \frac{1}{43.12} = 148 \text{ kN} \]

\[ Q'_{BS} = 14,657 \left( \frac{48.08}{85.17} \right) \frac{1}{55.72} = 150 \text{ kN} \]

\[ Q'_{U} = 4080 \left( \frac{25.79}{60.84} \right) \frac{1}{85.17} = 20 \text{ kN} \]

\[ Q'_{L} = 4080 \left( \frac{35.05}{60.84} \right) \frac{1}{85.17} = 28 \text{ kN} \]

Net balancing shear flows:

\[ Q_{FS} = 242 \text{ kN} \]

\[ Q_{BS} = 540 \text{ kN} \]

\[ Q_{U} = 410 \text{ kN} \]

\[ Q_{L} = 362 \text{ kN} \]

Summation of \( V \), \( P \), and \( M \) for sections:

\[ V_{FS} = 10,520 - 4860 = 5660 \text{ kN} \]

\[ M_{FS} = M_{U} = -24,500 \text{ kN.m} \]

\[ P = 0 \]
### Table: Wing Bulkhead #18

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<td>30</td>
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#### Notes:
- * Subscript "X" denotes fuel loads.
- * Subscript "Y" denotes fuel loads.
WING BULKHEAD 18

JACKING CONDITION - D.G.W. (266,000*)

No analysis will be shown for members critical for this condition, because the design gross wt. has been reduced from 279,000* on the B-36A to 265,000* on the XB-36. The B-36A analysis will be used and considered conservative. (Ref. F-25-36-142, p. 11-212). This condition is critical for the web and hor. stiffeners.

SIDE DRIFT LANDING COND [A.G.W. (112-500* bomb)]

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.

\[ P = \frac{6 \times 1.1}{231} \]

Where:
- \( \gamma_b = 1.408 \) = ult. airplane side load factor (Ref. F-25-36-143, p. 183)
- \( b = \) spanwise length of fuel cell
  \( (5th \#18 \text{ to } 5th \#22 = 155.5) \)

\[ P = \frac{6 \times 1.408 \times 155.5}{231} = 5.68 \text{ \% of } \]

\[ P(36\%) = 5.81 \text{ \% of } \text{ (Ref. F-25-36-142, p. 11-133)} \]

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 member's critical for this condition.
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)                   MFW(136,018') ILAA, AND LAA
                      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 MIX SECTION, WHICH IS 37.2% 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:

\[ h_0 = 33.7'' \]
\[ h' = 29.2'' \]
\[ h = h_0 + h' = 52.9'' \]
\[ A_{uc} = 1.247 sq.in. \]

\[ V = 9480'' \]
\[ M' = 1,580,000'''' \]
\[ P = 2750'' \]

FLANGE LOAD, \[ P = \frac{M'}{h} + P\left(\frac{h'}{h}\right) + \frac{V\cot\theta}{2} \]

\[ \cot\theta = 1.15 \text{ (REF F25-86-142, PG. II-191) } \]
\[ \cot\theta = 1.15 \text{ (ASSUMED) } \]
\[ P = \frac{1580,000}{52.9} + 2750\left(\frac{29.2}{52.9}\right) + \frac{9480\times1.15}{2} \]

\[ = 33910'' \]
WING BULKHEAD # 18

UPPER CHORD (CONT'D)

\[ f_{cu} = \frac{33,910}{1.247} = 27,200 \text{ psi} \]

\[ F = 30,000 \text{ psi} \quad \text{(REF. F25-36-142, PG. II-149)} \]

\[ M_S = \frac{30,000}{27,200} = 1.10 \]

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.

\[ V = -15,300 \]
\[ M = -2,370,000 \quad \text{**} \]
\[ P = -655 \quad \text{*} \]

\[ P_{to} = \frac{M}{h} + P \left( \frac{h}{4} \right) = -\frac{2,370,000}{57.9} + (-655) \left( \frac{24.2}{57.9} \right) \]
\[ = -41,174 \]

\[ f_{cu} = \frac{41,174}{1.247} = 33,000 \text{ psi} \]

\[ F_{cu} = 45,600 \text{ psi} \quad \text{(REF. F25-36-142, PG. II-149)} \]

\[ M_S = \frac{45,600}{33,000} = 1.38 \]
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.

\[ h'_{u} = 33.9" \]
\[ h'_{1} = 23.0" \]
\[ h' = h'_{u} + h'_{1} = 56.4" \]
\[ q_0 = 2.965 \text{ psf.in.} \]
\[ V = -14,100\text{"} \]
\[ M = -3,100,000\"^2 \]
\[ P = 1690\# \]

\[ \cot \alpha = 1.15 \text{(Ref. F25-36-142, Pg. II-14)} \]
\[ \text{Assumed same } \cot \alpha \]

Flange load, \( P = \frac{h'_{1}}{h'} \left( \frac{h'_{u}}{h'} \right) + \frac{V \cot \alpha}{2} \)
\[ P_u = \frac{3,100,000}{56.4} + (-1690) \frac{23}{56.4} + \frac{14,100(1.15)}{2} = 64,600\# \]
\[ f_u = \frac{64,600}{2.965} = 21,800\# \text{psf} \]

\[ f = 44,500\# \text{psf} \text{ (Ref. F25-36-142, Pg. II-15)} \]

\[ M_S = \frac{44,500}{2180} - 1 = 440\# \text{psf} \]
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SIDE DRIFT LANDING CONDITION — — — — — — 198
DETAIL ANALYSIS — — — — — — — — — — — — 198
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 *), LONG, UNSYM. GUST @ 5000'
2) MIN. FLYING WT (136.018 *), ILAA, UNSYM. GUST @ 6000'
3) TAKING CONDITION-O.G.W. (265.192 *)
4) SIDE DRIFT LONGITUDE, ALT.5,461 (112-300 ROWN)

IN ADDITION THE STIFFENERS IN THE OIL TANK REGION ARE CHECKED FOR A TEST PRESSURE OF 75% S.G. M.

THIS BULKHEAD IS CRITICAL FOR THE SAME CONDITIONS AS BULKHEAD #18. BY COMPARISON OF BULKHEAD #18 LOADS FOR COND. (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 PERCENT 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 B-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 lbs), L.O.A., UNSYM. GUST, N.S. @ 5000 FT.

(2) MIN. FLYING WT. (136,018 lbs), I.L.A.A., UNSYM. GUST, N.S. @ 5000 FT.

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 F25-36-142, 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

\[ P = \frac{6}{231} \times h \times \frac{h}{1} \times \frac{1}{1} \times \frac{1}{1} \]

WHERE:

- \( h \) = 1.402 - VULF AIRPLANE SIDE LOAD FACTOR
  (Ref F25-36-243, pg. 193)
- \( l = \) SPANWISE LENGTH OF FUEL CELL
  (STA. 88.11 TO STA. 12.22 = 182"

\[ P = \frac{6}{231} \times 1.402 \times 182 = 6.65 \% \]

\[ P(B-36A) = 6.79 \% \] (Ref F25-36-142, pg. II-70)
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. F25-36-142, PG 8-81)

OIL TANK TEST PRESSURE

THE PORTION OF THE BULKHEAD IN THE OIL TANK REGION IS SUBJECTED TO A TEST PRESSURE OF 7.5 PSIG. 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. F25-36-142, PG 8-87)

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)

<table>
<thead>
<tr>
<th>PART</th>
<th>CRITICAL CONDITION</th>
</tr>
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<tbody>
<tr>
<td>(1)</td>
<td>D.G.W. JACKETING COND. (FOR DISCUSSION SEE PG 195)</td>
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<tr>
<td>(2)</td>
<td>A.G.W. SIDE DRIFT LOADING COND. (112-500# BOMBS) (FOR DISCUSSION SEE PG 195)</td>
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<tr>
<td>(3)</td>
<td>M.F.W. (136,018#) L.A.A., AND L.A.A., UNSYM. GUST @ 5000 FT. (SEE FOLLOWING CALCULATIONS)</td>
</tr>
</tbody>
</table>

CHORD MEMBER ANALYSIS

UPPER CHORD


(A) M.F.W. (136,018#) L.A.A. UNSYM. GUST @ 5000FT IS CRITICAL FOR TENSION.

\[
M.S.(18-36) = \frac{1.47 + 1}{1.35} = 1.09
\]

(B) M.F.W. (136,018#) L.A.A. UNSYM. GUST @ 5000FT IS CRITICAL FOR COMPRESSION.

\[
M.S.(18-36) = \frac{1.83 + 1}{1.35} = 1.49
\]
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.O.A. unsym gust @ 5000 ft is critical for compression.

\[
M.S. (B-36A) = +1.154 \text{(FZS-36-142, PG. 2-95)}
\]

\[
M.S. (XB-36) = \frac{1.54 + 1}{1.35} = +1.58
\]

(B) M.F.W. (136.018) L.O.A. unsym gust @ 5000 ft is critical for tension.

\[
M.S. (B-36A) = +4.41 \text{(FZS-36-142, PG. 2-95)}
\]

\[
M.S. (XB-36) = \frac{4.41 + 1}{1.35} = +3.01
\]
BULKHEAD #22 (36W122)

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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

U.S. SHEAR CENTER

CHORD LINE

FIGURE 18
CONDITION: IDGW-FD-LGE

LEADING & TRAILING EDGE MOMENTS & SHEARS, & FLAP FITTING LOADS ARE CALCULATED IN THE SAME MANNER AS FOR THE B-36A.

(REF. F25-36-142, P.11-157)

LOAD FACTORS ARE TAKEN FROM F25-36-126 P. 85.

LOAD FACTORS

\[
\frac{N_A}{W} = -2.090 \quad (\perp \text{TO ROOT CHORD})
\]

\[
\frac{X_M}{W} = -0.031 \quad (\parallel \text{TO ROOT CHORD})
\]

RESOLVING VERTICAL LOAD FACTOR INTO THE PLANE OF THE BULKHEAD:

\[
\eta_V = -2.09 \cos 2^\circ = -2.0775
\]

\[
\eta_S = -2.09 \sin 2^\circ = -0.0718
\]

\[
\eta_D = -0.031
\]
CHORDWISE AERLOAD DISTRIBUTION STA 422
FLAPS DOWN - LANDING GEAR EXTENDED, D.O.W.
<table>
<thead>
<tr>
<th>LEADING EDGE</th>
<th>STATION P%</th>
<th>S.M.</th>
<th>(b)</th>
<th>MULTIPLES</th>
<th>Δ11</th>
</tr>
</thead>
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<td></td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
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<td>1</td>
<td>-200</td>
<td>1</td>
<td>-200</td>
<td>6</td>
<td>1200</td>
</tr>
<tr>
<td>2</td>
<td>-204</td>
<td>4</td>
<td>-836</td>
<td>5</td>
<td>4110</td>
</tr>
<tr>
<td>4</td>
<td>-205</td>
<td>2</td>
<td>-410</td>
<td>4</td>
<td>1640</td>
</tr>
<tr>
<td>6</td>
<td>-201</td>
<td>4</td>
<td>-804</td>
<td>3</td>
<td>2412</td>
</tr>
<tr>
<td>8</td>
<td>-196</td>
<td>2</td>
<td>-392</td>
<td>2</td>
<td>784</td>
</tr>
<tr>
<td>10</td>
<td>-190</td>
<td>4</td>
<td>-780</td>
<td>1</td>
<td>760</td>
</tr>
<tr>
<td>12</td>
<td>-185</td>
<td>1</td>
<td>-156</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
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<th>STATION P%</th>
<th>S.M.</th>
<th>(b)</th>
<th>MULTIPLES</th>
<th>Δ11</th>
</tr>
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<tr>
<td>1</td>
<td>-190</td>
<td>4</td>
<td>-760</td>
<td>1</td>
<td>-760</td>
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<tr>
<td>3</td>
<td>-190</td>
<td>1</td>
<td>-156</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

\[
ULN = \frac{15.65 + (-803 \times 0.02)}{144} = -3184.95 \text{ in.} \\
ULN = \frac{15.65 + (-803 \times 0.02)}{144} = -3184.95 \text{ in.}
\]

\[
\text{ULT } M_{L} = 15560 \left( -0.94 \times 0.02 \right) = -4970 \text{ in.} \\
\text{ULT } M_{T} = 15560 \left( -0.94 \times 0.02 \right) = -4970 \text{ in.}
\]

**DEFINITION OF TERMS:**
- \( M_{L} \): Leading Edge Airload Moment About F.S.
- \( M_{T} \): Trailing Edge Airload Moment About F.S.
- \( M_{L} \): Leading Edge Airload Moment About T.S.
- \( M_{T} \): Trailing Edge Airload Moment About T.S.
- **FLAP DOWN 90°**

*CALCULATED BY: ENBICK
CHECKED BY: C. C. FIELD*
### Table 2.7: Interspar Airload Shears & Moments

<table>
<thead>
<tr>
<th>Station</th>
<th>Upper Surface</th>
<th>Lower Surface</th>
<th>D.G.W.</th>
<th>F.D.</th>
<th>L.G.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>155</td>
<td>35</td>
<td>12</td>
<td>210</td>
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</tr>
<tr>
<td>17.17</td>
<td>656</td>
<td>32</td>
<td>17.17</td>
<td></td>
<td>580</td>
</tr>
<tr>
<td>22.33</td>
<td>354</td>
<td>18.36</td>
<td>10.1</td>
<td>480</td>
<td></td>
</tr>
<tr>
<td>27.60</td>
<td>320</td>
<td>19.80</td>
<td>4.5</td>
<td>80</td>
<td></td>
</tr>
<tr>
<td>32.66</td>
<td>400</td>
<td>16.60</td>
<td>20.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>37.83</td>
<td>402</td>
<td>16.91</td>
<td>24.1</td>
<td></td>
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<tr>
<td>43</td>
<td>142</td>
<td>17</td>
<td>43</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Equivalents:**

- **Area of Trapezoids: 45.30**
- **Upper Surface: 64.1%**
- **Lower Surface: 28.9%**

**Moments:**

- **M = 16,680** (Ultimate)
- **N = 372** (Ultimate)

**Calculation:**

\[ M = \frac{1.500 \times 3.230 \times 3.230}{144} = 16,680 \text{ (Ultimate)} \]

\[ N = \frac{1.500 \times 3.300 \times 3.300}{144} = 372 \text{ (Ultimate)} \]
CONDITION: I DGW-FD-LGE

AIR LOADS
LEADING EDGE

\[ N_L = 21.84^* \]
\[ M_L = 32200''^* \]

"\( M_L \) AS A COUPLE AT UPPER & LOWER SURFACES = \[ \frac{32200}{31.174} \] = 865^* \]

TRAILING EDGE

\[ N_T = 4470^* \]
\[ M_T = 175000''^* \]

"\( M_T \) AS A COUPLE AT UPPER & LOWER FITTINGS = \[ \frac{175000}{42.975} \] = 3980^* \]

INTEGERS, AIR LOAD

UPPER SURFACE = 4520^*
LOWER SURFACE = 378^*

FUEL & OIL LOADS

1G LOAD = 1132.8 AT 25.75% CHORD
(REF. TABLE 16, P52, FES-36-240)
ULTIMATE LOAD = 1132.8 \times 2.0775 \times 1.5 = 3525^*

A TRAPEZOIDAL DISTRIBUTION OF COMBINED FUEL & OIL LOADS IS ASSUMED.
COND: MDW-FD-LGE

FLAP LOADS ARE THE SAME AS FOR THE B-36A

(FLAP LOADS TAKEN FROM FZ'S 36-148, P 36)

RESOLVING LOADS OF FIG. ABOVE INTO VERTICAL & HORIZONTAL COMPONENTS

\[ V = 9.040 \text{ sin } 40^\circ \cdot 107.4 = 7312 \text{ ft} \]

\[ D = 9.040 \text{ sin } 40^\circ \cdot 625 \cdot \cos 40^\circ = 5333 \text{ lbs} \]

\[ M_{rs} = 7312 \times 107.4 = 787,000 \text{ lbs-ft} \]

"M" AS A COUPLE AT UPPER & LOWER FITTINGS:

\[ 787,000 = 17.900 \text{ lbs} \]

DRAG LOAD BEAMED TO UPPER & LOWER FITTINGS:

\[ D_u = \frac{3.811 \times 5333}{4397.5} = 468 \text{ lbs} \]

\[ D_l = \frac{40.054 \times 5333}{4397.5} = 4865 \text{ lbs} \]
ANALYSIS

Consolidated Vultee Aircraft Corporation

PREPARED BY: VOA.

CHECKED BY: C. A. Field.

REVISED BY: C. A. Field.

WING III


MODEL: V-8 316.

DATE: 4-48

COND: I DGW-FD-LGE.

SUMMARY OF APPLIED LOADS ON BULKHEAD

- 64.7% AIR LOAD
- 57.1% AIR LOAD
- 7.8% AIR LOAD
- 31.9% FUEL & OIL LOAD
- 2184* 7.8" 3960* 7.325" 4470* 3.930 17,900* 4845* 3156* 6.46 4.065* 300 4.250* 3.525* 4470* 15.252*

TRANSMITTED LOADS TO THE END OF THE BLKHD:

D = 4865 + 468 (NFT)
V = 2184 + 378 + 4250 + 7325 - 3525 - 4470 = 15.252 (N)

TEN. = 32200 + 2184(42.163) - 175000 - 4470 (32.527)
- 5333 (12.97) - 7325 (139.923) - 3525 (8.923)
+ 4520 (5.473) + 378 (11.573)
= -1.292 205 (°)

REACTION TO THE TORSION ABOUT THE ELASTIC AXIS AS A SHEAR FLOW AROUND THE BLKHD:

\[ q = \frac{T}{2A} = \frac{1292.205}{2(3526.2)} = 183.2 \text{ #/ft} \]
COND: I DGW- FD- LGE

REACTING DRAG FORCE AT UPPER & LOWER SHEAR CENTERS:

\[ R_u = 53.52 + \frac{218.14}{52.432} = 221.0^* \]

\[ R_L = 53.52 + \frac{30.410}{52.432} = 311.3^* \]

\[ q_u = \frac{222.0}{74.16} = 29.7^* \text{ (FWD)} \]

\[ q_L = \frac{311.3}{74.16} = 41.6^* \text{ (FWD)} \]

THE VERTICAL COMPONENT OF UPPER & LOWER SURFACE SHEAR IS:

\[ V_u = 2220 \times \tan 6.25^\circ = 2220 \times 0.1093 = 242^* \text{ (UP)} \]

\[ V_L = 311.3 \times \tan 2.067^\circ = 311.3 \times 0.0361 = 11.5^* \text{ (DOWN)} \]

REACTING VERTICAL SHEAR AT FRONT & REAR SPARS:

\[ R_{F.c} = (-15.352 + 242 - 112.5) \times \frac{32527}{74.16} = 6630^* \text{ (DOWN)} \]

\[ R_{R.c} = (-15.352 + 242 - 112.5) \times \frac{42.403}{74.16} = 8593^* \text{ (DOWN)} \]

SUMMARY OF BULKHEAD REACTIONS:

\[ 29.7^* \]

\[ 183.2^* \]

\[ 6630^* \]

\[ 8593^* \]

\[ 41.6^* \]
<table>
<thead>
<tr>
<th>Diameter</th>
<th>H (ft)</th>
<th>( \Delta H ) (in)</th>
<th>( \Delta H ) (in)</th>
<th>( \Delta H ) (in)</th>
<th>( \Delta H ) (in)</th>
<th>( \Delta H ) (in)</th>
<th>( \Delta H ) (in)</th>
<th>( \Delta H ) (in)</th>
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<tr>
<td>6/16</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>0</td>
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<tr>
<td>10/17</td>
<td>14,788</td>
<td>12,324</td>
<td>12,577</td>
<td>12,817</td>
<td>10,817</td>
<td>8,817</td>
<td>6,817</td>
<td>4,817</td>
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<tr>
<td>12/18</td>
<td>28,956</td>
<td>26,448</td>
<td>26,702</td>
<td>26,956</td>
<td>25,176</td>
<td>23,736</td>
<td>21,736</td>
<td>19,736</td>
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<tr>
<td>24/24</td>
<td>45,696</td>
<td>43,288</td>
<td>43,544</td>
<td>43,796</td>
<td>42,016</td>
<td>39,576</td>
<td>37,136</td>
<td>34,696</td>
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<tr>
<td>58/58</td>
<td>91,392</td>
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<td>89,492</td>
<td>87,712</td>
<td>85,272</td>
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<td>21,648</td>
<td>21,904</td>
<td>22,160</td>
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<td>18,540</td>
<td>16,700</td>
<td>14,860</td>
</tr>
</tbody>
</table>

Circling

*Signature*: [Handwritten Signature]
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. 11-177 to 11-180). 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. 11-182 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:

\[ P_c = \frac{M}{h'} + Stu \cot \alpha + P_A \]  

(Ref. AAF TR 4313; P. 257 EQ. 11-38)

\[ Stu = S - ScR \]

Comparing loads for B-36A and XB-36 Airplanes:

<table>
<thead>
<tr>
<th>B-36A</th>
<th>XB-36</th>
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<tbody>
<tr>
<td>Ref. FZS-36-142</td>
<td>Ref. FZS-36-142</td>
</tr>
<tr>
<td>P. 11-167</td>
<td>P. 11-167</td>
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<tr>
<td>S = 5431#</td>
<td>S = 5647#</td>
</tr>
<tr>
<td>W = 1,044,250&quot;#</td>
<td>W = 1,072,300&quot;#</td>
</tr>
<tr>
<td>P_A = -5333#</td>
<td>P_A = -5330#</td>
</tr>
</tbody>
</table>

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.
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<td>LAA Unsym GUST @ 5000'</td>
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<td>Nacelle Air Loads</td>
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<td>LAA Unsym GUST @ 5000'</td>
<td>241</td>
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<tr>
<td>Nacelle Air Loads</td>
<td>246</td>
</tr>
<tr>
<td>L.E. &amp; T.E. Air Loads</td>
<td>247</td>
</tr>
<tr>
<td>Applied Loads</td>
<td>249</td>
</tr>
<tr>
<td>Panel Point Loads</td>
<td>253</td>
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<tr>
<td>Truss Member Loads</td>
<td>257</td>
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<td>Summary of Truss Member Loads</td>
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<td>Detailed Analysis</td>
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<td>Analysis of Web Section</td>
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<td>Analysis of Rear Spar. Vertical</td>
<td>269</td>
</tr>
</tbody>
</table>
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#) IIAA, 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 air load in the wing to satisfy 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
<table>
<thead>
<tr>
<th>BASIC MT PRINT</th>
<th>I-G VERTICAL LOAD ON BASIC MOUNT (Acting DOWN)</th>
<th>I-G SIDE LOAD ON BASIC MOUNT (Acting INBOARD)</th>
<th>I-G DRAG LOAD ON BASIC MOUNT (Acting AFT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>11807 +622.7 +7858</td>
<td>7.925 +4.08 +794</td>
<td>-135 +294 +193</td>
</tr>
<tr>
<td>A'</td>
<td>11807 +622.7 +7858</td>
<td>7.925 +4.08 +794</td>
<td>-135 +294 +193</td>
</tr>
<tr>
<td>C</td>
<td>1666 -623.3 +7860</td>
<td>7.224 +1502 +2756</td>
<td>+142 +2252 +7295</td>
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<td>1666 -623.3 +7860</td>
<td>7.224 +1502 +2756</td>
<td>+142 +2252 +7295</td>
</tr>
</tbody>
</table>

* REF FZS-36-35 ADD.

TABLE XVIII PG 69

SIGN CONVENTION & DIRECTION OF LOADS

- **Vertical Loads** are normal to the chord.
  - (+) when directed down.
  - (-) when directed up.
- **Thrust Loads** are parallel to the plane of the wing.
  - (+) when directed aft.
  - (-) when directed forward.
- **Side Loads** are parallel to the chord.
  - (+) normal to the 6:00 thrust & 12:00 (+)
  - (-) normal to the 12:00 thrust & 6:00 (-)
  - 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 occurring on the R.H. side. Single signs are for loads that occur on both sides.

PREPARED BY: VOSK 10/6/47
CHECKED BY: JOHNSON 11/6/47
**CONRADUDEO**

**VULTEE AIRCRAFT CORPORATION**

**WINGS BULKHEAD #23**

**ULT LOADS AT MOST TWO PINTS OF OUTSIDE BASIC L.E. AT 69 R.P.M.**

<table>
<thead>
<tr>
<th>V</th>
<th>D</th>
<th>S</th>
<th>V</th>
<th>D</th>
<th>S</th>
<th>V</th>
<th>D</th>
<th>S</th>
<th>TOTAL LOADS</th>
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<tbody>
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<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
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</table>

<table>
<thead>
<tr>
<th>LOADS AT</th>
<th>BASIC L.E.</th>
<th>AT 80% L.E.</th>
<th>AT 90% L.E.</th>
<th>AT 100% L.E.</th>
<th>AT 125% L.E.</th>
<th>AT 125% L.E.</th>
<th>AT 125% L.E.</th>
<th>AT 125% L.E.</th>
<th>AT 125% L.E.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12,810</td>
<td>12,700</td>
<td>5,190</td>
<td>-324</td>
<td>-129</td>
<td>-77</td>
<td>-2</td>
<td>14</td>
<td>-2</td>
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<tr>
<td>B</td>
<td>12,810</td>
<td>12,700</td>
<td>5,190</td>
<td>-324</td>
<td>-129</td>
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<tr>
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<td>12,700</td>
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<td>-129</td>
<td>-77</td>
<td>-2</td>
<td>14</td>
<td>-2</td>
</tr>
</tbody>
</table>

**CONDITION:** MIN. FLYING ROGHT = 136.0° UNSYM. GUST - 1,140 + 100 F.P.T.

---

**SIGN CONVENTION**

(1) CRITICAL LOADS, DOWN - L DESIGNATES L.H. MOUNT
(2) DEAD LOADS, UP - R DESIGNATES R.H. MOUNT
(3) SHEAR LOADS, ABD.

*These loads due to torque reqs for a .25 gear ratio from F25-36-36.
ENGINE MOUNT FITTING LOADS

These are applied loads to the engine mount fittings. (Ref. Pg. 222)

MIN. FLYING WT (136,018 lb) L.A.A. UNSYM GUST 5000 ft

<table>
<thead>
<tr>
<th>V</th>
<th>D</th>
<th>S</th>
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<tr>
<td>Upper Fitting</td>
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<td>Lower Fitting</td>
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MIN. FLYING WT (136,018 lb) L.A.A. UNSYM GUST 5000 ft

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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 lbs.) L.A.A. UNSYM.
GUST @ 5000 ft
WING BULKHEAD 23

CRUSHING LOADS (M.F.W. L.A.A. UNSYMMETRIC @ 5000)

\[ M_x \text{ assumed equal to } M_k \]
\[ M_k = 23,760,000 \text{ lb in.} \]
\[ I_x = 22,660 \text{ in.}^4 \]
\[ P_e = \frac{(M_k)^2}{(E I)} \]
\[ P_e = \frac{22,660}{515.24} \times 10 \times 10 \times 10 \]

\[ P_e = 2030 \text{ lb} \]

CRUSHING LOAD WILL BE DISTRIBUTED IN PROPORTION TO SPARK DEPTHS.

F.S. = 35.935
R.S. = 46.913

\[ \frac{35.935}{46.913} \times 10 \times 10 = 91.174 \text{ AVERAGE SPARK DEPTH.} \]

\[ \frac{2030}{72.4} = 28.05 \% \text{ A.U. LOADING OVER CHORD} \]

AT F.S., \[ w = \frac{25,925}{91.174} \times 28.05 = 24.5 \% \text{ U} \]

AT R.S., \[ w = \frac{46,913}{91.174} \times 28.05 = 31.6 \% \text{ U} \]

\[ 24.5 \% \text{ F.S.} 72.4 \text{ in.} 31.6 \% \text{ R.S.} \]
<table>
<thead>
<tr>
<th>% INCAP (%)</th>
<th>DIST FROM W.S.</th>
<th>DIST BETWEEN Stra</th>
<th>P(%)</th>
<th>P(M)</th>
<th>C (LIMIT)</th>
<th>DIST FROM 0 IN. TO WING</th>
<th>ALPHA</th>
<th>N.A.</th>
<th>N.A. (LIMIT)</th>
<th>S (ULT)</th>
<th>M (ULT)</th>
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<tr>
<td>(1)</td>
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<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
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C = 233.546 in.
D = 3200 in.
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<th>DIST. FROM STA</th>
<th>P PER</th>
<th>P AV</th>
<th>0 S</th>
<th>S LIMIT</th>
<th>DIST. FROM STA TO C.G.</th>
<th>OM</th>
<th>OM X</th>
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<td>576457</td>
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</tr>
</tbody>
</table>

**WING BULKHEAD AIRLOAD**
**COND.: M.W. LAA UNSYM GUST 5000**

**EQUIV. TRAPEZOIDAL LOADING**

**PREPARED BY: RUSSELL**
**CHECKED BY: C. J. H.
WING BULKHEAD #23

NACELLE AIR LOAD

SEE DISCUSSION ON PG II-97, F25-36-142.

\[ P(u2) = 1.5 \left( \frac{28}{2} \times \frac{29.85 \times 37}{12} \right) = 1270 \text{ lb} \]

THIS LOAD IS INTRODUCED AS A COUPLE AT THE ENGINE MT FITTINGS AND AN EQUAL SHEAR ON EACH FITTING.

COUPLE = \( \frac{1270 \times 29.825}{49.5} = 1990 \text{ lb-ft} \)

SHEAR = \( \frac{1270}{2} = 635 \text{ lb} \) (up)
WING BULKHEAD #23

L.E. & T.E. AIRLOADS

L.E. SHEAR = 1821 # (UP)
L.E. MOM. x = 23600 # (CLOCKWISE)
T.E. SHEAR = 2640 # (UP)
T.E. MOM. x = -70,800 # (CLOCKWISE)

The L.E. shear is applied to the F.S. The L.E. moment is applied as a couple to the F.S. flanges.

COURPE = \frac{23,600}{35735} = 662 #

The T.E. shear is applied equally to the engine MT. fittings.

\frac{2640}{2} = 1320 # (UP)

The T.E. moment is applied as a couple to the engine MT. fittings.

COURPE = \frac{70,800 - 2641(5735)}{49.5} = 1120 #
WING BULKHEAD #23

ENGINE MT. FITTING LOADS:
M.F.W. = L.A.A. UNSYM. GUST @ 6'000', REF. P. 222

UPPER FITTING
\[ D = 53.911^\circ \, (AFT) \]
\[ V = 17.468^\circ \, (DOWN) \]
\[ S = 7.233^\circ \, (NB'D) \]

LOWER FITTING
\[ D = 60.344^\circ \, (FW'D) \]
\[ V = 15.449^\circ \, (DOWN) \]
\[ S = 6.762^\circ \, (OBF'D) \]

ENGINE MT. LOADS ARE RESOLVED INTO PLANE OF BLK'D AND R.S.

UPPER
\[ D' = D \cos 3^\circ - S \sin 3^\circ = 53.911 \times 0.995 - 7233 \times 0.0523 = 53.458^* \]
\[ S' = D \sin 3^\circ + S \cos 3^\circ = 53.911 \times 0.0523 + 7233 \times 0.995 = 10.043^* \]
\[ D'' = S' \tan 10^\circ = 10.043 \times 1.763 = 17.71^* \]
\[ D_{\text{total}} = 53.458 + 17.71 = 55.229^* \]

LOWER
\[ D' = -60.344 \times 0.995 + 6762 \times 0.0523 = -59.906^* \]
\[ S' = -60.344 \times 0.0523 - 6762 \times 0.995 = -9.909^* \]
\[ D'' = -9.909 \times 1.763 = -17.27^* \]
\[ D_{\text{total}} = -59.906 - 17.27 = -67.173^* \]
WING BULKHEAD #23

LOADS ABOUT STATIC AXIS

DRAG

\[ D = 55.227 - 61.653 = -6.424^\circ \] (FD)

VERT.

\[ V = 6926 - 2297 - 17968 - 15449 + 2(635) + 2(1320) + 1824 \]
\[ = -22,507^\circ \] (down)

\[ \alpha = 90^\circ \] (clockwise)

MOM. = +662 (35,935) + 1821 (40,871) + 6926 (4,471)
-2477 (2,871) - 1990 (49.50) - 1120 (49.50) + 55227 (27.65)
+ 61.653 (21.85) - 1320 (2) x 37.253 - 2(635) x 37.253
+ 4.439 (27.253) + 1.5449 x 37.253
\[ = +3,927,821^\circ \]

\[ 6.36^\circ \]

\[ l = \]

\[ +3,927,821^\circ \]

\[ -6.424^\circ \]

\[ -22,507^\circ \]
WING BULKHEAD 23

2 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 FORCES.

\[ q_u = \frac{2958}{72.4} = 40.8^\circ \\ q_l = 72.4 \]

TOTAL = \[ 200^* \] (UP)

REACT AT FRONT AND REAR SPAR.

\[ F.S. = 200 \left( \frac{34.5^\circ - 90^\circ}{72.399} \right) = -87^* \] (DOWN)

\[ R.S. = 200 - 87 = 113^* \] (DOWN)
ANALYSIS

WING BULKHEAD 23

LOADS ABOUT E.A (CONT'D)

REACT. VERT. UNBALANCE AT F.S. + KS.

\[ R_{E.S} = 22,507 \left( \frac{31.578}{72.399} \right) = 9,800^\# (\text{up}) \]

\[ R_{E.S} = 22,507 \left( \frac{40.871}{72.399} \right) = 12,701^\# \]

REACT. TORQUE AS SHEAR AROUND BLDG

\[ \frac{T}{2A} = \frac{3,927 \times 821}{6616} = -594^\% \]

REATIONS TO BULKHEAD

![Diagram showing wing bulkhead with reactions and loads.](image-url)
WING BULKHEAD #23

PANEL POINT LOADS (UPPER SURF)

Calculation of panel point loads due to crushing & airloads. (Ref. for applied loads pg. 232)

\[
\frac{73.6 - 61.9}{72.4} = \frac{w_1}{72.4} \quad \Rightarrow \quad w_1 = \frac{11.7(11.4)}{72.4} = 1.84
\]

\[
\frac{11.9(31.65)}{72.4} = 5.11
\]

\[
\frac{11.9(51.30)}{72.4} = 6.32
\]

Ordinates

1 = 61.9 + 1.84 = 63.7

2 = 61.9 + 5.11 = 67.0

3 = 61.9 + 6.38 = 70.3

Panel point loads
WING BULKHEAD 23

PANEL POINT LOADS (LOWER SLAB)

CALCULATION OF PANEL POINT LOADS DUE TO CRUSHING + AEROLOADS. (REF. FOR APPLIED LOADS PG 232)

\[
\frac{2x \cdot 0.35}{72.4} = \frac{w}{72.4}
\]

\[
W_1 = \frac{62.9 \cdot 4.35}{72.4} = 5.78 \%\
W_2 = \frac{40.75 \cdot 4.35}{72.4} = 1.77 \%\
W_3 = \frac{20.5 \cdot 4.35}{72.4} = 1.23 \%
\]

ORDINATES

At:
1. \( 0.85 + 3.78 = 4.63 \% \)
2. \( 0.85 + 2.44 = 3.29 \% \)
3. \( 0.85 + 1.23 = 2.08 \% \)

PANEL POINT LOADS
WING BULKHEAD #23

WEB REACTIONS TO TRUSS

\[ \Sigma M_A = 0 \]

\[ 47.95 \, R_B = -\left(356 + 96.913(597) + 12,598 - 24\right)11.4 \]
\[ + \left(15,513 + 13,876\right)17.125 + 58,593(1863) \]
\[ + 52,119(87) \times 69(1.9) - 642.3 \times 2(231) \]
\[ = +2,622,670'' \text{ (clockwise)} \]

\[ R_B = \frac{-2,622,670}{47.95} = +55,000'' \text{ (off)} \]
WEB REACTIONS TO TRUSS (CONT'D)

\[ \Sigma_H = 52119 - 553.2 (11.4) - 58543 + 642.3 (9.5) \]
\[ = -6634^* (FWD) \]

\[ R_{AH} = R_{BH} - 6634^* \]
\[ = 55000 - 6634 = 48366 (FWD) \]

\[ R_{AV} = 55000 \times \tan 3.07^\circ = 2950^* (UP) \]

\[ \Sigma_V = 256 - 15513 + 574 (46.413) + 12594 - 24 \times 1014 \]
\[ -13,391 - 69 \times 553.2 (674) + 642.3 (163) \]
\[ = +13390^* \]

\[ R_{OV} + R_{OV} = -13390 \]

\[ R_{AV} = -13390 - 2950 \]
\[ = -16340^* \]
WING BULKHEAD 23

CONDITION

MIN. FLYING WT. (156,018#) TLAP, UNSM. GEAR @ 6000'

WING BULKHEAD #23

CRUSHING LOADS (M.F.W. - I.C.A.A. UNSYMMETRIC @ 5000)

$M_X$ is assumed equal to $M_W$

$M_X = 16,200,000$ (obtained from preliminary calculations)

$$P_{ce} = \frac{M_X}{(E)(I)}$$

$$P_{ce} = \left(\frac{16,200,000}{22,660}\right) \left(\frac{37}{575.2}\right) = 993$$

$$I = 22,660 \text{ in.}^4$$

$$E = 10,300,000$$

Crushing load will be distributed trapezoidally in proportion to spar depths.

F.S. = 35.935

R.S. = 96.413

$$\frac{182.348}{41.174} \text{ average spar depth}$$

993 $\times$ 13.03\% average loading over chord

AT. F.S., $w = \frac{35.935}{41.174} \times 13.03 = 11.38\%$

AT. R.S., $w = \frac{96.413}{41.174} \times 13.03 = 19.70\%$
<table>
<thead>
<tr>
<th>% CHORD (1%)</th>
<th>DIST FROM F.S.</th>
<th>DIST PRIV. STR.</th>
<th>P (kN)</th>
<th>P (kN)</th>
<th>OS ( b = 37 )</th>
<th>S (LIMIT)</th>
<th>DIST TO CENTROID (CM)</th>
<th>( \Delta M ) (kN·cm)</th>
<th>( M ) (kN·cm)</th>
<th>( S ) (ULT)</th>
<th>( M ) (ULT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28.71</td>
<td>467</td>
<td>351</td>
<td>421</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>.02</td>
<td>23.46</td>
<td>467</td>
<td>377</td>
<td>421</td>
<td>0</td>
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<td>0.24</td>
<td>1002</td>
<td>0</td>
<td>710</td>
<td>977</td>
</tr>
<tr>
<td>.04</td>
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<td>355</td>
<td>439</td>
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<td>0</td>
<td>0.33</td>
<td>1004</td>
<td>0</td>
<td>977</td>
<td>977</td>
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<tr>
<td>.06</td>
<td>14.11</td>
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<td>370</td>
<td>392</td>
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<tr>
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<td>240</td>
<td>306</td>
<td>191</td>
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<td>0</td>
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<tr>
<td>.12</td>
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<td>215</td>
<td>273</td>
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<td>0.46</td>
<td>1008</td>
<td>0</td>
<td>977</td>
<td>977</td>
</tr>
</tbody>
</table>

PREPARED BY: RUSSELL 11/17/67
CHECKED BY: W.S. R. 12/1/67
### TABLE 2: SHEAR AND BENDING MOMENT OF AIRLOAD ABOUT 10 (TE AIRLOAD)

| % chord (N%) | Dist. from 10, 149 | Dist. between strts. | P(o) | P(one) | OS (in) | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|--------------|---------------------|---------------------|------|--------|---------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 100          | 12.79               | 52.16               | 6.27 | -25    | -25    | -44 | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  | 0  |
| 110          | 6.65                | 21.39               | 5.84 | -25    | -25    | -38 | 2.92 | -11 | -51 | -51 |
| 120          | 6.25                | 21.75               | 5.84 | -25    | -25    | -38 | 2.92 | -11 | -51 | -51 |
| 130          | 6.00                | 29.71               | 5.84 | -25    | -23.5  | -35 | 2.86 | -11 | -97 | -101|
| 140          | 5.75                | 33.87               | 5.84 | -22    | -20    | -30 | 2.83 | -100| -92 | -190 |
| 150          | 5.50                | 28.03               | 5.84 | -18    | -15.5  | -23 | 2.76 | -85 | -90 | -290 |
| 160          | 5.25                | 28.19               | 5.84 | -13    | -10    | -15 | 2.76 | -108| -104 | -404 |
| 170          | 6.00                | 16.35               | 5.84 | -7     | -3.5   | -5  | 2.63 | -10 | -15 | -55 |
| 180          | 4.25                | 10.51               | 5.84 | 0      | +4     | +5  | -223 | 1.93 | -130 | -67 |
| 190          | 4.50                | 4.67                | 5.84 | +8     | +12    | +18 | -222 | +23 | -132 | -79 |
| 200          | 4.90                | 0.67                | 5.84 | +16    | +16    | +18 | -209 | +17 | -103 | -713 | -306 | -1380 |

**TRANSFER SHEAR TO AFT FITTINGS**

**REDUCED MOM. = 13,380 - 306(57.25) = 11,630**

PREPARED BY: RUSSELL 11/12/49
CHECKED BY: M. W. 11/13/49
<table>
<thead>
<tr>
<th>Flight</th>
<th>% Chord</th>
<th>Dist. Before Str.</th>
<th>P(q) Off</th>
<th>0/6-37</th>
<th>S (Limit)</th>
<th>Dist. to Centroid</th>
<th>OM</th>
<th>OM (Limit)</th>
<th>S (Int.)</th>
<th>M (Int.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12</td>
<td>700</td>
<td>37.5</td>
<td>67</td>
<td>4.0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>15</td>
<td>1168</td>
<td>87</td>
<td>98.5</td>
<td>296</td>
<td>5.6</td>
<td>120</td>
<td>780</td>
<td>2110</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>1168</td>
<td>110</td>
<td>117.5</td>
<td>353</td>
<td>5.71</td>
<td>1660</td>
<td>3440</td>
<td>9010</td>
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</tr>
<tr>
<td>30</td>
<td>1168</td>
<td>125</td>
<td>125.5</td>
<td>382</td>
<td>5.79</td>
<td>2210</td>
<td>1950</td>
<td>2610</td>
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<td></td>
</tr>
<tr>
<td>35</td>
<td>1268</td>
<td>126.5</td>
<td>1915</td>
<td>5600</td>
<td>28.450</td>
<td>4.825</td>
<td>88.30</td>
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<td>42</td>
<td>123</td>
<td>127</td>
<td>235</td>
<td>423</td>
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<td></td>
</tr>
<tr>
<td>15</td>
<td>253</td>
<td>224</td>
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<td>615</td>
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<td>4960</td>
<td>10480</td>
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<tr>
<td>20</td>
<td>213</td>
<td>218.5</td>
<td>655</td>
<td>1763</td>
<td>5.90</td>
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<td>7240</td>
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<tr>
<td>30</td>
<td>198</td>
<td>567</td>
<td>379</td>
<td>3660</td>
<td>5.94</td>
<td>3370</td>
<td>29000</td>
<td>5670</td>
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</tr>
<tr>
<td>35</td>
<td>180</td>
<td>294.6</td>
<td>146</td>
<td>3728</td>
<td>5550</td>
<td>95260</td>
<td>5740</td>
<td>87080</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Prepared by: Russell 1/24/07
Checked by: 1/24/07
WING BULKHEAD 23

NACELLE AIR LOAD

SEE DISCUSSION ON PG II-97, F25-36-142

\[ P_{(LT)} = 1.5 \left( \frac{25}{2} \times \frac{74.85 \times 37}{12} \right) = 361 \text{ kips} \]

THIS LOAD IS INTRODUCED AS A COUPLE AT THE ENGINE MT FITTINGS AND AN EQUAL SHEAR ON EACH FITTING.

\[ \text{COUPLE} = \frac{361 \times 77.95}{49.5} = 565 \text{ kips} \]

\[ \text{SHEAR} = \frac{361}{2} = 180.5 \text{ kips/fitting (up)} \]
WING BULKHEAD #23

L.E. + T.E. AIRLOADS

L.E. SHEAR = 3280" (DOWN)

L.E. MOMENTS = 50,200" (CLOCKWISE)

T.E. SHEAR = 306" (UP)

T.E. MOMENTS = 11,630" (CLOCKWISE)


COUPLE = \frac{50,200}{35.735} = 13.96°

THE T.E. SHEAR IS APPLIED EQUALLY TO THE ENGINE MT. FITTINGS.

\frac{306}{2} = 153"/FITTING (UP)

THE T.E. MOMENT IS APPLIED AS A COUPLE TO THE ENGINE MT. FITTINGS.

COUPLE = \frac{11,630}{49.5} = 235°
WING BULKHEAD #23

ENGINE MT FITTING LOADS
M.F.W.-LOAD - UNSYM GUST 600 MPH REF P 222

UPPER FITTING

\[ V = \pm 11.279^\circ \]
\[ D = -35.861^\circ \]
\[ S = -4.617^\circ \]

LOWER FITTING

\[ V = \pm 10.097^\circ \]
\[ D = +34.528^\circ \]
\[ S = +3.940^\circ \]

\[ D = D_{\cos} S + S_{\sin} 3^\circ = 39.528(0.9986) + 3990(0.0523) = 39,270^* \]
\[ S = D_{\sin} S + S_{\cos} 3^\circ = 39,528(0.9986) + 3990(0.0523) = 39,270^* \]
\[ D_{\tan 10^\circ} = 35,570 \times (-1) = -36,710^* \]

ENGINE MT LOADS ARE RESOLVED INTO PLANE OF BLK'D AND R.S.

\[ D_{\cos} = 35,570 \times (0.9986) = 35,570^* \]
\[ S_{\sin} = 35,570 \times (0.0523) = 1830^* \]
\[ D_{\tan 10^\circ} = 5790(0.1763) = +1010^* \]
\[ D_{\tan 20^\circ} = 34,270 + 1010 = +35,280^* \]

PW 444 6-46 UTILITY REPORT SHEET
APPLIED LOADS

M.F.W - I.L.A.A - UNSYM GUST @ 6000'

[Diagram with various measurements and loads indicated]
WING BULKHEAD 23

LOADS ABOUT ELASTIC AXIS

DRAG

\[ D = -36.710 + 35.280 = -1.430 \text{ (FWD)} \]

VERT.

\[ V = +2875 + 11279 + 333.5 + 10,097 + 333.5 \]
\[ -5590 - 328.0 \]
\[ = +16,048^\circ \text{ (UP)} \]

\[ \sum M_{g_{x}y} (+ \text{clockwise}) \]

\[ \text{mom.} = -1376(35.935) - 3280(40.871) - 2875(829) \]
\[ -11,618(37.293) - 37,510(27.65) - 36,080(24.85) \]
\[ -10,431(37.253) - 5590 (1.472) \]
\[ = -2,876 - 90^\circ \]

\[ 64^\circ \]

\[ 16,048^\circ \]

\[ 2,876,580^\circ \]

\[ 1430^\circ \]
WING BULKHEAD 23

2 LOADS ABOUT E.A. (CONT'D)

THE DRAG IS REACTED AT THE UPPER AND LOWER SURFACE SHEAR CENTERS.

\[ R_u = 1430 \left(\frac{2.25}{50.70}\right) = 653^* \]

\[ R_l = 1430 \left(\frac{27.65}{50.70}\right) = 777^* \]

RESOLVE \( R_u \) AND \( R_l \) PARALLEL TO SHEAR CENTERS.

\[ R'_u = \frac{653}{\cos 6.26^*} = 658^* \]

\[ R'_l = \frac{777}{\cos 2^*} = 778^* \]

REACT \( R'_u \) AND \( R'_l \) AS SHEAR FLOWS.

\[ \delta_u = \frac{653 \times 6.26^*}{724} = 4.9 \text{ in} \quad \delta_l = \frac{777}{724} = 10.75 \text{ in} \]

RESOLVE \( R_u \) AND \( R_l \) \perp TO CHORD LINE.

\[ R_{u,l} = 653 \tan 6.26^* = 70.5^* \text{ (up)} \]

\[ R_{v,l} = 777 \tan 2^* = 27.1^* \text{ (down)} \]

TOTAL = 93.9 (up)

REACT AT FRONT AND REAR SPAR.

\[ F.S. = \frac{93.9 \times 31.528}{72.399} = 18.9^* \text{ (down)} \]

\[ K.S. = 43.9 - 18.9 = 24.5^* \text{ (down)} \]
WING BULKHEAD #23

LOADS ABOUT EA. (CONT'D)

REACT VERT. UNBALANCE AT F.S. & R.S.

\[ R_{F.S.} = 16048 \left( \frac{31.528}{72.4} \right) = 6720^\circ \text{ (down)} \]

\[ R_{R.S.} = 16048 \left( \frac{90.871}{72.4} \right) = 9058^\circ \text{ (down)} \]

REACT TORQUE AS SHEAR AROUND BLK'D.

\[ g_r = \frac{T}{2A} = \frac{2876580}{6616} = 434^\circ \text{ in.} \]

REACTIONS TO BULKHEAD

\[ 9.1^\circ \text{ in.} \]

\[ 934^\circ \text{ in.} \]

\[ 9058^\circ \]

\[ 24.5^\circ \]

\[ 734^\circ \text{ in.} \]

\[ 10.75^\circ \text{ in.} \]
WING BULKHEAD #23

PANEL POINT LOADS (UPPER SURF)

CALCULATION OF PANEL POINT LOADS DUE TO CRUSHING + AIR LOADS. (REF PG. 249 FOR APPLIED LOADS).

<table>
<thead>
<tr>
<th>Location</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>19.60%</td>
</tr>
<tr>
<td>2</td>
<td>29.82%</td>
</tr>
<tr>
<td>3</td>
<td>38.02%</td>
</tr>
<tr>
<td>4</td>
<td>43.20%</td>
</tr>
</tbody>
</table>

ORDINATES AT PANEL POINTS

\[
\frac{32.93}{72.4} = \frac{x}{L}, \quad 32.93 \frac{L}{72.4} = x, \quad x = 0.455 \frac{L}{72.4}
\]

AT 1: \( W = 10.27 + 0.75 \times (0.455) = 29.02 \% 

AT 2: \( W = 10.27 + 20.25 \times (0.455) = 28.82 \% 

AT 3: \( W = 10.27 + 20.5 \times (0.455) = 19.60 \% 

PANEL POINT LOADS
WING BULKHEAD #23

PANEL POINT LOADS (LOWER SURF)

CALCULATION OF PANEL POINT LOADS
DUE TO CRUSHING AND AIR LOADS
(REF. P6 249 FOR APPLIED LOADS)

ORDINATES AT PANEL POINTS

\[ \frac{32.12}{92.4} = \frac{x}{L} \quad \frac{39.12}{72.4} = x \quad x = 0.54(L) \]

\[ \begin{align*}
\text{AT } 1 & : \ W = 44.8 + 9.5(0.54) = 49.925 \text{ lb} \\
\text{AT } 2 & : \ W = 44.8 + 31.65(0.54) = 61.90 \text{ lb} \\
\text{AT } 3 & : \ W = 44.8 + 51.90(0.54) = 72.8 \text{ lb}
\end{align*} \]

PANEL POINT LOADS

FW 444 6-46 UTILITY REPORT SHEET
WING BULKHEAD # 3

WEB REACTIONS TO TRUSS

\[ \sum M_A = 0 \]

\[ 47.95 \, k = -11.9 \, (231) + 11.4 \, (93.5 \times 96.9 / 3) + 11.9 \, (9032.5) + 11.4 \, (221) - 17.125 \, (11.563) - 17.125 \, (10.381) - 87 \, (37500) - 98.63 \, (36080) + 2 \, (231) \times 423.25 + 1.9 \, (821) \]

\[ = -1637000 \, \text{"} \]

\[ k_{34} = \frac{1637000}{47.95} = -34100 \, \text{"} \, \text{FWD} \]
WING BULKHEAD 23

WEB REACTIONS TO TRUSS (CONT'D)

\[ \Sigma_y = 0 \]

\[ = 1443.1(11.4) - 37.510 + 36,080 - 923.25(4.5) \]
\[ - 39.100 + R_{AH} = 0 \]

\[ R_{AH} = 34.510^4 \text{ (AFT)} \]

\[ R_{BY} = R_{B, 30^\circ} \tan 3.07^\circ = -34,680(0.0396) = -1350^2 \text{ (Down)} \]

\[ \Sigma_v = 0 \]

\[ = -443.1(679) + 237 + 11,563 - 434(46.1) - 9032.5 \]
\[ + 10,381 - 221 - 821 + 580 - 923.25(0.63) - 1850 + R_{VA} = 0 \]

\[ R_{VA} = 9974^2 \]
## MEMBER LOADS

### SUMMARY

#### TABLE III

<table>
<thead>
<tr>
<th>MEMBER</th>
<th>CONDITION (M.E. W. LAMINATED GLASS)</th>
<th>CONDITION (M.E. W. LAMINATED GLASS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AM</td>
<td>-280*</td>
<td>1360*</td>
</tr>
<tr>
<td>AM</td>
<td>11,000*</td>
<td>-8,090*</td>
</tr>
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<td>BO</td>
<td>14,900*</td>
<td>-10,280*</td>
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<td>BO</td>
<td>26,100*</td>
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<td>41,300*</td>
<td>-30,550*</td>
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<tr>
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<td>Q0</td>
<td>18,100*</td>
<td>-10,320*</td>
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WING BULKHEAD #23

VERTICAL + DIAGONAL MEMBERS

MEMBER MN

MEMBER NO

FW 444 6-46 UTILITY REPORT SHEET
WING BULKHEAD #23

VERTICAL AND DIAGONAL MEMBERS

MEMBER OP

MEMBER PQ

MEMBER OR

FW 444-6-44 UTILITY REPORT SHEET
<table>
<thead>
<tr>
<th>MEMBER</th>
<th>AREA</th>
<th>P (N)</th>
<th>P (A)</th>
<th>P (A)</th>
<th>P (M)</th>
<th>C</th>
<th>C</th>
<th>E</th>
<th>( F_2 )</th>
<th>M.S.</th>
<th>( F_2 ) (M.S.)</th>
<th>M.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN</td>
<td>3969</td>
<td>19100</td>
<td>19100</td>
<td>45600</td>
<td>44000</td>
<td>-0.23</td>
<td>53.2</td>
<td>43.3</td>
<td>71.8</td>
<td>22.10</td>
<td>93.300</td>
<td>2.50</td>
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<tr>
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<td>1820</td>
<td>6400</td>
<td>6400</td>
<td>22000</td>
<td>20000</td>
<td>+1.34</td>
<td>12.75</td>
<td>8.76</td>
<td>55.8</td>
<td>28.20</td>
<td>93.300</td>
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<tr>
<td>OP</td>
<td>3300</td>
<td>17200</td>
<td>15200</td>
<td>36000</td>
<td>34000</td>
<td>+0.34</td>
<td>10.60</td>
<td>9.89</td>
<td>52.8</td>
<td>25.60</td>
<td>13.900</td>
<td>1.24</td>
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<tr>
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<td>3400</td>
<td>17300</td>
<td>15300</td>
<td>36000</td>
<td>34000</td>
<td>+2.04</td>
<td>9.25</td>
<td>9.91</td>
<td>42.8</td>
<td>29.70</td>
<td>13.900</td>
<td>1.24</td>
</tr>
<tr>
<td>OR</td>
<td>3969</td>
<td>19100</td>
<td>19100</td>
<td>45600</td>
<td>44000</td>
<td>+0.23</td>
<td>53.2</td>
<td>43.3</td>
<td>71.8</td>
<td>22.10</td>
<td>93.300</td>
<td>2.50</td>
</tr>
</tbody>
</table>

* E: FOC, STEEL AND ALUMINUM

PREPARED BY: RUSSELL
CHECKED BY: CHAPIN
WING BULKHEAD #23

UPPER CHORD (AFT PORTION)

THE UPPER CHORD ANALYSIS WILL BE MADE SIMILAR TO THE B-36A ANALYSIS (REF. F25-36-142, PG. II-213).

THE UNSUPPORTED SKIN BETWEEN HAT STRINGERS IS CRITICAL.

CHORD LOADING (I.L.A.A.)

B-36A (F25-36-142, PG. II-213)

\[ \text{TOTAL} = 1950 \text{"} \]

\[ \text{72.4"} \]

13.5\% 40.31\%

XB-36 (REF. PG. 253)

\[ \text{TOTAL} = 1950 \text{"} \]

\[ \text{72.4"} \]

10.27\% 43.2\%

WING BULKHEAD #23

UPPER CHORD (cont'd)

AXIAL LOAD

\[
\begin{align*}
C'Q &= -30550^* & \text{Ref. P.258} \\
CQ &= -21700^* \\
P &= -30550 + (30550-21700) \frac{6}{10.15} \\
&= -27,900^*
\end{align*}
\]

BEND MOM. = 12.08"^2 (Ref. F2S-36-142, Pg. 22-234)

USE 6" WIDTH OF .102 SKIN

\[
\begin{align*}
\text{AREA} &= 1.424 + 2(102) = 1.632 \text{ in}^2 \\
I &= 12,256 \text{ in.}^4 \\
C &= 4.11"^4
\end{align*}
\]

\[
\begin{align*}
F_c &= \frac{27900 + 1280 \times 9.11}{1.632}  \\
&= 17,500 \frac{lbs}{in}
\end{align*}
\]

\[
F_c = 19,800 \frac{lbs}{in} \quad (\text{Ref. F2S-36-142, Pg. 22-234})
\]

\[
\begin{align*}
M. S &= \frac{19,800}{17500} - 1 = 4.08
\end{align*}
\]
WEB SECTION

M.F.W. - L.G.A. @ 5000 FT IS CRITICAL

REWORK AFT SECTION WITH REACTIONS
AT CENTROIDS OF CHORDS. REF PG 258

FOR LOADS 15.513°

\[ E_{MA} = +29007(15.985) \times 58543(45.06) \]
\[ -52.119(1.94) - 40,527(11.26) \]
\[ -642.3(421) \]
\[ = 2,595 \times 10^6 \]

\[ R_B = \frac{-2,595,000}{42.1} = 62,250 \text{ kN} \]

\[ \kappa_{E_B} = 62,250 \cos 3.07^\circ = 60,000 \text{ kN} \text{ (AFT)} \]

\[ \kappa_{B_Y} = 62,250 \sin 3.07^\circ = 32,300 \text{ kN} \text{ (UP)} \]

\[ \Sigma_Y = 13,390 \text{ kN (UP)} \]

\[ \kappa_{A_U} = 13,390 + 32,300 = 16,620 \text{ kN (DOWN)} \]

\[ \Sigma_H = -6639 \text{ kN (FWD)} \]

\[ \kappa_{A_H} = 60,000 - 6634 = 53,366 \text{ kN (FWD)} \]
WING BULKHEAD 23

SUMMARY OF LOADS

FOR BENDING MOMENTS, SHEARS, AND
AXIAL LOADS ON WEB SECTION, SEE
FOLLOWING PAGE.
WING BULKHEAD #23

WEB SECTION (CONT'D)

MEMBER ER

ADJACENT TO LOWER CHORD

\[ B.M. = +213,000 \quad \text{(COMP IN ER)} \]
\[ P = -5527 \quad \text{(TENS IN ER)} \]
\[ S = +7557 \quad \text{(COMP IN ER)} \]

\[
\begin{align*}
5.25 \sin 2.27' &= 0.208 \\
9.500 + 0.208 &= 9.708 \\
\bar{S} &= 9.708 - 1.562 - 0.381 \times 8.765
\end{align*}
\]

\[
P_c = \frac{213,000 + 7557 \times 1.35}{8.765} - 5527 \left( \frac{0.208}{9.708} \right)
\]

\[
= 27,440 \quad \text{\scriptsize (COMP)}
\]

ADJACENT TO UPPER CHORD

\[ B.M. = -151,500 \quad \text{(TENS IN ER)} \]
\[ P = +23,800 \quad \text{(COMP IN ER)} \]
\[ S = +7557 \quad \text{(COMP IN ER)} \]

\[
\bar{S} = 9.62
\]

\[
P_c = \frac{151,500 + 5,100 + 23,800 \times 3.46}{9.62}
\]

\[
= 2,990 \quad \text{\scriptsize (TENS)}
\]
WING BULKHEAD #23

WEb SECTION (CONTD.)

MEMBER ER (CONTD.)

\[ \text{AVERAGE LOAD IN ER} = \frac{F_2 - F_1}{2} \approx 12,225 \ (\text{lbs}) \]

\[ F_1 = \frac{12,225}{.592} = 20,600 \ (\text{lbs}) \]

\[ F_2 = 33,000 \ (\text{lbs}) \]  
\[ (\text{REF: F2S-36-192, PG. II-241}) \]

\[ M.S. = \frac{33,000}{20,600} - 1 = +.60 \]

WEb

\[ S = 7557 \ (\text{lbs}) \]  
\[ (\text{REF: P-260}) \]

\[ t = 10.3 \]

\[ t = \frac{7557}{10.3 \times 0.090} = 18.350 \ (\text{in}) \]

\[ \sigma_y = 2930 \ (\text{lbs/in}) \]

\[ \sigma_u = 29,700 \ (\text{lbs/in}) \]  
\[ (\text{F2S-36-192}) \]

\[ \sigma_w = 29,300 \ (\text{lbs/in}) \]

\[ M.S. = \frac{29,300}{18.350} - 1 = +.325 \]

THE WEB STIFFENERS WILL BE CONSIDERED SATISFACTORY, BECAUSE THE MARGIN OF SAFETY ON THE B-36A IS LARGE.
ANALYSIS OF REAR SPAR VERTICAL


THE CRITICAL CONDITION FOR THE XB-36 IS; ALT. GROSS WT. (72,000# BOMB) L.A.A. @ 35,000 FT. AND THE CRITICAL CONDITION FOR THE B-36A IS; DESIGN GROSS WT. L.A.A. @ 30,000 FT.

FLIGHT INERTIA FACTORS

COND = O.G.W. - C.A.A. (72-1000# BOMBS) @ 35,000 FT

\[
\begin{align*}
N_a &= -2.668 \\
W &= \frac{N_a}{W} \\
X_m &= \frac{X_m}{W} = 0.101 \\
& \text{REF. F25-36-126, PG. 69.}
\end{align*}
\]

RESOLVE FACTORS INTO PLANE 1 AND PARALLEL TO THRUST LINE.

\[
\begin{align*}
\eta_v &= -\frac{N_a}{W} \cos 2^\circ(1.5) \\
&= -2.668 \times 0.99 \times 1.5 \\
&= -4.0 \text{ DOWN (ULT)}
\end{align*}
\]

\[
\begin{align*}
\eta_d &= \frac{X_m}{W} \cos 3^\circ (1.5) \\
&= 0.101 \times 0.998 \times 1.5 \\
&= 1.1512 \text{ AFT (ULT)}
\end{align*}
\]

\[
\begin{align*}
\eta_2 &= \left(-\frac{N_a}{W} \sin 2^\circ + \frac{X_m}{W} \sin 3^\circ \right)(1.5) \\
&= \left(-2.668 \times 0.0399 + 0.101 \times 0.0523 \right)(1.5) \\
&= +0.1318 \text{ INBD (ULT)}
\end{align*}
\]
| POINTS | N | V | D | S | V | D | S | V | D | S | V | D | S | V | D | S | V | D | S | V | D | S | V | D | S |

**SIGN CONVENTION**

1. **V** = VERTICAL LOADS, DOWN
2. **D** = DIRECT LOADS
3. **S** = SIDE LOADS, IN AND OUT
4. **LH** = DESIGNATES L.H. MOUNT
5. **RH** = DESIGNATES R.H. MOUNT

**APPENDIX**

**CHECKED BY**: J. G. 4/26/61

**CHECKED BY**: E. F. 5/10/45
WING BULKHEAD 23

B-36 LOADING

D.G.W. C.O.A. @ 30,000 FT.

CRUSHING LOAD

68.5 %M

82.0 %M

AIRLOAD

108.2 %M

62 %M

32.868 %M

162 %M

162 %M

4000

3226

135'600''

10,774 %M

36,732 %M

AIRLOAD

18.2 %M

-3.4 %M

CRUSHING LOAD

63.5 %M

82.0 %M

AIRLOAD

THE XB-36 AIR LOADS WILL BE OBTAINED BY MULTIPLYING THE B-36A AIRLOADS ON WING BULKHEAD *23 BY THE RATIO OF Z (B-36A) / Z (B-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)

\[
\begin{align*}
B-36 & : \quad \frac{z}{w} = +2.758 \quad \text{REF. F25-36-13G} \\
& \quad w = 268,213 \end{align*}
\]

\[
\begin{align*}
XB-36 & : \quad \frac{z}{w} = +2.779 \quad \text{REF. F25-36-12G} \\
& \quad w = 254,793 \end{align*}
\]

\[
B-36A; \quad z = 738,000^* 
\]

\[
XB-36; \quad z = 708,000^* 
\]

\[
L = \frac{708,000}{738,000} = 0.960
\]

\[
\begin{align*}
\text{(LE)} & \quad 4040 \times 0.960 = 3908^* \\
& \quad 1622 \times 0.960 = 1560^* \\
\text{(TE)} & \quad 3226 \times 0.960 = 3100^* \\
& \quad 135,600 \times 0.960 = 130,200^* \\
\text{(U.SURF)} & \quad 103.2 \times 0.960 = 99 \% \text{U.} \\
& \quad 62 \times 0.960 = 59.2 \% \text{U.} \\
\text{(L.SURF)} & \quad 18.2 \times 0.960 = 17.5 \% \text{U.} \\
& \quad -3.4 \times 0.960 = -3.2 \% \text{U.}
\end{align*}
\]

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 \( \frac{\text{BEND MOM.}}{\text{BEND MOM.}} \) B-36.
WING BULKHEAD #23

CRUSHING LOADS (CONT'D)

B-36 A: BEND MOM = 38,500,000" (REF. F25-36-140)  (PG. 115)

XB-36; BEND. MOM = 35,750,000" (REF. F25-36-240) (PG. 121)

\[ \frac{(35,750,000)^2}{(38,500,000)^2} = 0.882 \]

\[ 63.5 \times 0.882 = 56 \text{%} \]
\[ 82.0 \times 0.882 = 72.3 \text{%} \]

ENGINE MOUNT FITTING LOADS

UPPER FITTING (A): \[ V = 11,014 \text{#} \]
\[ D = 34,421 \text{#} \] \[ S = 4535 \text{#} \] (REF. PG. 222)

LOWER FITTING (C): \[ V = 9794 \text{#} \]
\[ D = -37,966 \text{#} \] \[ S = -4245 \text{#} \] (REF. PG. 222)

THE DRAG AND SIDE LOADS ARE RESOLVED INTO THE PLANE OF THE BULKHEAD AND THE PLANE OF THE REAR SPAR.
ENGINE MOUNT FITTING LOADS (CONT'D)

UPPER FITTING (A):

\[
D' = 34,921 \cos 3° - 9535 \sin 3° = 34,163^*
\]

\[
S' = 34,921 \sin 3° + 9535 \cos 3° = 6325^*
\]

\[
D'' = 6325 \tan 10° = 1117^*
\]

\[
D_{total} = 34,163 + 1117 = 35,280^*
\]

LOWER FITTING (C):

\[
D' = -37,966 \cos 3° + 4245 \sin 3° = -37,678^*
\]

\[
S' = -37,966 \sin 3° - 4245 \cos 3° = -6215^*
\]

\[
D'' = -6215 \tan 10° = -1095^*
\]

\[
D_{total} = -37,678 - 1095 = -38,773^*
\]
WING BULKHEAD 23

XG-36 LOADING (ALT. G.W. 2.4 A @ 35,000 FT)

56% 2 72.3% 7

SUMMATION OF LOADS ABOUT E.A

\[ V = 7583 \text{ (down)} \]
\[ D = 4610 \text{ (FWD)} \]
\[ T_{EA} = 2,594,850 \text{ (clockwise)} \]
WING BULKHEAD #23

REACTIONS TO VERT. LOAD

\[ q_1 = \frac{7583 \times 31.53}{72.4 \times 35.94} = 92.0 \% \text{in. (up)} \]

\[ q_2 = \frac{7583 \times 40.87}{72.4 \times 46.41} = 92.2 \% \text{in. (up)} \]

REACTIONS TO DRAG LOAD

\[ q_v = \frac{4610 \times 23.35}{50.90 \times 72.90} = 29.2 \% \text{in. (AFT)} \]

\[ q_l = \frac{4610 \times 27.65}{50.90 \times 72.40} = 34.6 \% \text{in. (AFT)} \]

REACTION TO \( T_{10} \)

\[ q_0 = \frac{359.450}{6785.2} = 50.1 \% \text{in.} \]
WING BULKHEAD 23

TRANSFER OF UPPER FITTING LOADS TO BULKHEAD

\[ EM_0 = 0 \]

\[ 7.45 \quad R_1 = 34200 \times 1.87 \times \frac{(11014 - 2025) \times 5.34}{15000} \quad \text{(AFT)} \]

\[ EM_1 = 0 \]

\[ 7.43 \quad R_3 = 34200 \times (7.43 \times 1.87) + (11014 - 2025) \times 5.34 \]

\[ R_3 = 99250 \quad \text{(FWD)} \]

\[ EM_2 = 0 \]

\[ 5.34 \quad R_2 = -34200 \times 1.87 + 15000 (7.45 - 29) \]

\[ R_2 = 8160 \quad \text{(UP)} \]

TRANSFER OF LOWER FITTING LOADS TO BULKHEAD

\[ \begin{align*}
EM_0 &= 0 \\
7.45 \quad R_1 &= 34200 \times 1.87 \times \frac{(11014 - 2025) \times 5.34}{15000} \\
&\quad \text{(AFT)} \\
7.43 \quad R_3 &= 34200 \times (7.43 \times 1.87) + (11014 - 2025) \times 5.34 \\
&\quad R_3 = 99250 \quad \text{(FWD)} \\
5.34 \quad R_2 &= -34200 \times 1.87 + 15000 (7.45 - 29) \\
&\quad R_2 = 8160 \quad \text{(UP)} \\
\end{align*} \]
WING BULKHEAD #23

TRANSFER OF LOWER FITTING LOADS TO BLK #2 (CONT)

\[ \varepsilon M_6 = 0 \]

\[ 12.12 R_1 = 38,773 (155 + 0.40) + 9799 \times 15.495 \]

\[ R_1 = 14,590^{\circ} (UP) \]

\[ \varepsilon M_c = 0 \]

\[ 12.17 R_2 = 38,773 (155 + 20.0) + 9799 \times 3.37 \]

\[ R_2 = 8280^{\circ} (DOWN) \]

\[ \varepsilon M_d = 0 \]

\[ 1.74 R_3 = -9799 \times 3.37 + 8280 (10.60 + 20) \]

\[ R_2 = 38,200^{\circ} (AFT) \]

LOADS IN K.S. VERTICOL FROM SPAR ANALYSIS

FROM FIZZ-36-241 PG. 105, THE STRESSES AT STA. #23 WERE CALCULATED AS 99.6% IN R. AND 14.9% IN CUTF. THE NEAR SPAR DEPTH IS 46.413" THEREFORE THE COMPRRESSIVE END LOADS ON THE MEMBER ARE:

\[ P_0 = 99.6 \times 46.413 = 46,200^{\circ} \]

\[ \theta = 14.9 \times 46.413 = 67.1^{\circ} \]
WING BULKHEAD #23

LOAD IN A.S. VERTICAL SHEAR 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 2,200* 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 R2 will be corrected to 62,450* to balance the shear flow from the bulkhead analysis.
WING BULKHEAD #23

WEB PORTION REACTIONS

\[ \Sigma \text{Mom.} = 1,733,349"^* \]

\[ R_8 \times 43.1 = 1,733,349 \]

\[ R_8 = 40,200"^* \]

\[ R_{8x} = 40,200 \cos 3.1^\circ = 40,000"^* \text{(AFT)} \]

\[ R_{8y} = 40,200 \sin 3.1^\circ = 2160"^* \text{(UP)} \]

\[ \Sigma V = 7889"^* \text{(UP)} \]

\[ R_{8y} = -2160 - 7889 = -9049"^* \text{(DOWN)} \]

\[ \Sigma H = -4000"^* \text{(FWD)} \]

\[ R_{8y} = -40,000 + 4000 = -36,000"^* \text{(FWD)} \]

SHEAR, MOMENT, & AXIAL LOAD AT SECT. I

\[ \Sigma \text{Mom.} = 4100"^* \text{ (CLOCKWISE)} \]

\[ \Sigma V = 65,828"^* \text{(UP)} \]

\[ \Sigma H = 6000"^* \text{(AFT)} \]
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. F25-36-142, 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

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TITLE

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Determination of Loads

Analysis of Bulkhead #5

Analysis of Bulkhead #7

Analysis of Bulkhead #8

Analysis of Bulkhead #9

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287
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# 2TL-1H-ND
- AGW 255,030# (62-1000# Bombs) 2TL-1H-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.

<table>
<thead>
<tr>
<th>CONDITION</th>
<th>WEIGHT AT LANDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>B-36A</td>
<td>XB-36</td>
</tr>
<tr>
<td>DGW (No Bombs)</td>
<td>268,000#</td>
</tr>
<tr>
<td>AGW (62-1000# Bombs)</td>
<td>255,030#</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Part Description</th>
<th>M.S. B-36A</th>
<th>M.S. XB-36 4-WHEG</th>
</tr>
</thead>
<tbody>
<tr>
<td>UPPER FLANGE</td>
<td>+ .06</td>
<td>+ .11</td>
</tr>
<tr>
<td>LOWER SURFACE INTERCOSTAL</td>
<td>+ .34</td>
<td>+ .39</td>
</tr>
<tr>
<td>LOWER FLANGE</td>
<td>+ .04</td>
<td>+ .09</td>
</tr>
<tr>
<td>WEBSE (-8) (WEB)</td>
<td>+ .03</td>
<td>+ .08</td>
</tr>
<tr>
<td>WEB SPACES</td>
<td>+ .21</td>
<td>+ .26</td>
</tr>
<tr>
<td>STIFFENERS, #9</td>
<td>- .01</td>
<td>+ .01</td>
</tr>
</tbody>
</table>
BULKHEAD #8

A. G. W. 2/1-IR-XD 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>
<thead>
<tr>
<th>PART DESCRIPTION</th>
<th>B-36A M.S.</th>
<th>XB-36 M.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>- 6 Web</td>
<td>-.004 +.046</td>
<td></td>
</tr>
<tr>
<td>- 7 Web</td>
<td>-.018 +.032</td>
<td></td>
</tr>
<tr>
<td>- 8 Web</td>
<td>+.003 +.053</td>
<td></td>
</tr>
<tr>
<td>- 9 Web</td>
<td>-.008 +.042</td>
<td></td>
</tr>
<tr>
<td>Inter Flange Web of Lower Chord</td>
<td>+.005 +.055</td>
<td></td>
</tr>
<tr>
<td>Riveted Connections</td>
<td>+.22 +.27</td>
<td></td>
</tr>
<tr>
<td>Chord Members</td>
<td>+.16 +.21</td>
<td></td>
</tr>
<tr>
<td>Stiffeners</td>
<td>-.006 +.044</td>
<td></td>
</tr>
</tbody>
</table>

* FZS-36-142B, Page 31
INDEX

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DETERMINATION OF UPPER & LOWER SURFACE PRESSURE — — — 291

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ANALYSIS OF AUXILIARY SPAR — — — — — 296

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ANALYSIS OF T.E. BULKHEAD #12 — — — — — 301

ANALYSIS OF T.E. BULKHEAD #3 — — — — — — 303
TRAILING EDGE INBOARD MUZZLE TO WING FAIRING INTERFACE

THE WING TRAILING EDGE STRUCTURE BETWEEN THE MUZZLE MUZZLE AND THE FAIRING FACE TO FACE IS IDENTICAL TO THE SAME STRUCTURE IN THE B-36 AIRPLANE. THIS IS THE CASE SINCE THE XB-36 AIRPLANE IS NOW EQUIPPED WITH THE FOUR WHEEL MAIN LANDING GEAR, REF A-H 267A.

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.


NO CONSIDERATION IS MADE IN THIS ANALYSIS OF THE CHANGE IN PRESSURE DISTRIBUTION FOR THE AREAS WHICH CONTAIN PROTRUSIONS 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-81m PRESSURE DISTRIBUTIONS AND
THE RATIO OF THE COMPRESSIVE
PRESSURES FOR THE TWO AIRPLANES
WILL REMAIN UNCHANGED IN THE
AREAS CONTAINING PRESSURIZED
COMPARTMENTS. REF-36-1426, PAGES 38, 40, 41.
Determined lower surface pressures:

\[ \text{N} = 416 \text{ use } N = 40 \]

**Station 2**

\[ C_{d1} = 0.928 \quad C_{d0} = 0.026 \]
\[ C_{n0} = 0.98 (0.928 + 0.026) = 0.775 \]

**Station 8**

\[ C_{d1} = 0.964 \quad C_{d0} = 0.025 \]
\[ C_{n0} = 0.964 (0.928 + 0.025) = 0.749 \]

\[ \text{Nuss } C_{n0} = +0.75 \]
\[ \Delta P = \frac{1.5 \times 213.1}{3} \frac{\Delta P}{\text{in}} = 2.22 \frac{\Delta P}{3} \text{ in} \]

**Table XVII**

<table>
<thead>
<tr>
<th>( % )</th>
<th>( \Delta P \text{ (inch)} )</th>
<th>( \Delta P \text{ (FSL)} )</th>
<th>( \frac{\Delta P}{3} \text{ (lower)} )</th>
<th>( \frac{\Delta P}{3} \text{ (lower)} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>-1.15</td>
<td>2.855</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>50</td>
<td>-0.893</td>
<td>1.985</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>60</td>
<td>-0.45</td>
<td>1.40</td>
<td>-0.04</td>
<td>-0.04</td>
</tr>
<tr>
<td>70</td>
<td>-0.85</td>
<td>8.755</td>
<td>+1.94</td>
<td>+1.94</td>
</tr>
<tr>
<td>80</td>
<td>+0.14</td>
<td>+1.94</td>
<td>+0.24</td>
<td>+0.24</td>
</tr>
<tr>
<td>90</td>
<td>+0.34</td>
<td>+1.94</td>
<td>+0.24</td>
<td>+0.24</td>
</tr>
<tr>
<td>100</td>
<td>+0.54</td>
<td>+2.25</td>
<td>+0.24</td>
<td>+0.24</td>
</tr>
</tbody>
</table>

**Chordwise Pressure Distribution is Illustrated For All Sections** (Nuss).
THE 52.5% BEAM (SWN-223)

The 52.5% beam in the XB-36 is identical to the 50% beam in the B-36A (SWN-213). For a discussion of its function and structural design, refer F-26-50-1428, page 117-118.

The critical loading condition for the beam is DOW-650, 3500 lb. A study of Fig. 20, page 112, shows that this condition yields loads for the B-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.

\[ \text{M.S.} \times 10^{-3} = \frac{(1.065)}{1} \]

\[ \text{M.S.} \times 10^{-3} = \frac{(1.065)}{-1} \]

XB-36 margins of safety for the same portions of this beam may be estimated by reducing the B-36A margins by 3%, in the manner shown in F-26-50-1428, page 73 to 79.
THE 65% BEAM (56%+17%)

THE 65% BEAM IN THE XB-36 IS THE SAME MEMBER (56%+17%) AS USED IN THE B-30 AIRPLANE.

INFORMATION ON ITS STRUCTURAL PROPERTIES AND STRESSES AND LOADS CAN BE FOUND IN SECTIONS 14-16, PAGES 81, 83.

LOADINGS FROM LAX @ 5000' CONDITION ARE CRITICAL FOR THE DESIGN OF THE BEAM AND A STUDY OF THIS CONDITION, REF: FIG 26, PAGE 202, SHOWS THE XB-36 LOADING TO BE APPROXIMATELY 3% GREATER THAN FOR THE B-30.

ALL MAINTAINING SAFETY OF THE BEAM ON THE B-30 ARE SUFFICIENTLY GREAT SO THAT INCREASING THE LOAD 3% WILL NOT CRITICALLY LOWER THE MARGINS. THE MINIMUM MARGIN OF SAFETY FOR THE B-36 65% BEAM IS 1.04 IN THE LOWER FLANGE.

(REF: F25-56, 1428, PAGE 94) THE MARGIN OF SAFETY FOR THE SAME MEMBER IN THE XB-36 IS SHOWN BELOW.

\[
M.S._{XB-36} = \frac{1.04}{1.03} - 1 = 0.08
\]

REF: F25-56, 1428, PAGES 91 TO 96 TO OBTAIN DATA.
THE DIAGONAL BEAM, 36W282

THE DIAGONAL BEAM (36W282) IN THE XB-36 WING TAILING EDGE IS IDENTICAL TO THE SAME MEMBER IN THE B-36 AIRPLANE. THE DESIGN AND METHOD OF ANALYSIS OF THIS MEMBER IS GIVEN IN LEHOLT'S "B-52-3"-142, PAGE 115.

THE CRITICAL CONDITION FOR THIS BEAM IS

O.G.W. FLAPS DOWN @ SEA LEVEL.

THIS CONDITION YIELDS LOADS WHICH AVERAGE LESS THAN 1% GREATER THAN FOR THE B-36A AIRPLANE. LET THE COMPARATIVE PRESSURE CURVES GIVEN ON PAGE 292.

SINCE THE INCREASED 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 (SANS 5) used in the XC-52 Aircrane is identical to that in the B-36A Airplane.

A discussion and method of analysis for this beam is given in reports F25-36-141, F25-154, and F25-36-141B pp 118.

The critical condition for the design of the auxiliary spar is:

D.S.W. -5% down & sq. level.

A study of loads from fig. 96 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 XC-52 Airplane.
TE. BULKHEAD NO. 8

TRAILING EDGE BULKHEAD NO. 8 (501212) IS IDENTICAL TO TRAILING EDGE BULKHEAD NO. 9 ON THE B-36 AIRPLANE. A DISCUSSION OF ITS FUNCTION AND STRUCTURAL DESIGN IS FOUND IN REPORT F28-36-148 PAGE III-252.

The applied loads to the trailing edge bulkhead #8 for the B-36 airframe is shown D.G.W. FLAPS DOWN 30% SEA LEVEL 11,901 #

The moment of the applied loads about the rear spar is shown

"EV = 11,901 #"

AND THE MOMENT OF THE APPLIED LOADS ABOUT THE REAR SPAR

"EV = -2143380" #

IN A SIMILAR MANNER THE APPLIED LOADS TO THE XB-32 AIRPLANE ARE FOUND TO GIVE

"EV = 59135 #"

"EV = -29303.10" #
AND THE FOLLOWING LOAD COMPARISON MAY BE MADE.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>E-63A</td>
<td>E-36A</td>
</tr>
<tr>
<td>2V</td>
<td>2.502</td>
</tr>
<tr>
<td>Lbs.</td>
<td>2,637,290</td>
</tr>
</tbody>
</table>

THE CALCULATIONS OF REACTIONS FOR THE INBOARD TRAILING EDGE SECTION IS ACCOMPLISHED AS SHOWN IN PAGE 57 OF FS5-36-148, 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

NOW ZONE 811-911, ECON.

SINCE THE INCREASE IN APPLIED LOADS IS NO GREATER THAN INDICATED, THE B-63A ANALYSIS AND MARGINS OF SAFETY WILL BE APPLICABLE FOR THE E-36 AIRPLANE TRAILING EDGE BULKHEIND NO. 8.
TANKING EDGE BULLETIN NO. 2 IS THE CIVIL AIRPLANE DEPARTMENT REPAIRMENT BULLETIN 140-143, P-2-183 AND P-2-143, A 197 shows the GREATEST PHASE OF THIS ENVELOPE IS OPTIMIZED FOR THE D.W.I. FLAPS DOWN UNDER.

HONEVER, THE TRIM POSITION AT THE END OF THIS ENVELOPE IS OPTIMIZED FOR THE D.W.I. FLAPS UP.

YOU WILL NOT IDENTIFY ORphan ET THE TEE TO THE 62° C BUM.

OPTIMIZED FOR THE D.W.I. FLAPS DOWN.

A STUDY OF THE NOISE TO BULLET No. 1 TO DETERMINE THE EFFECT OF INCREASED JET NOISE.

PAGES 260 AND 261 TO 26.

SHOWED THAT:

1. D.W.I. FLAPS DOWN BUSH LEVEL COND.

AN ATTENUATION OF 50 TO 100, SEE PAGE 298.

2. D.W.I. FLAPS DOWN COND.

CHILTON WALLER LOADING RATE SMALLER, SEE PAGE 2.

3. D.W.I. FLAPS DOWN COND.

AN ATTENUATION OF 50 TO 100, INDICATED BY ATTACHMENT 31 TO 15.

Indicated by Chart 3 No. 1. THE LAST OF FIFTH, charts No. 1.
THE B.E.A. ANALYSIS:

The E.E.F. Rule: H.2 Pp. 108-110 shows the need to have a margin of safety of 1.5. Since the full-length bending moment and axial force act at the point for the X.B. wing, an increase in production to the increase in bending stress which has occurred by use of the pressure distribution curve, P.H. 3.

Margins of safety for the X.B. wing members may be obtained by treating the B-3A margins of safety by the use of B-3A weight loads in X.B. wing loads.

The X.B. wing margin of safety for the lower flange at a section 15" aft of the 52.5% beam is

\[ M.S. = \frac{(L.H. + 1)}{4} \]

The margin of safety for the same member in the X.B. wing is

\[ M.S. = \frac{(L.H. + 1)}{4} \]

Since the increase in load for the steel in the X.B. wing was 25% over that of the B-3A, the 1.5 safety margin is adequate.
TRAILING EDGE, INSIDE TO CENTER NACELLE

T.E. BULKHEAD NO. 12

TRAILING EDGE BULKHEAD NO. 12 IS IDENTICAL TO THE SAME STRUCTURE IN THE B-30A. FOR A DISCUSSION OF ITS FUNCTION AND STRUCTURAL PROPERTIES, REFER TO REPORT F2S-55-142.

THE CRITICAL DESIGN CONDITION FOR THE MAJOR PORTION OF THE BULKHEAD IS:

DRAWN FULLY DEFLECTED @5 L.

REFERENCE TO THE ANALYSIS OF LOADS ON T.E. BULKHEADS NO. 2 AND NO. 3 ON PAGE 297 SHOWS AN INCREASE OF LOADS OF LESS THAN 1%. THIS AMOUNT OF INCREASE MAY BE CONSIDERED TYPICAL FOR T.E. BULKHEAD NO. 12.

MEMBERS WITH THE LOWEST MARGINS OF SAFETY IN THE B-30A ANALYSIS WILL BE GIVEN FURTHER CONSIDERATION IN THIS ANALYSIS.

MEMBER 7-I

(REF: SKETCH, PAGE 302)

MEMBER 7-I HAD A MARGIN OF SAFETY OF 1.06 FOR THE B-30A. THERE IS CONSIDERED TO BE NO CHANGE FOR THE B-30. SINCE THE
LOADS IN MEMBER 7-1 ARE A DIRECT FUNCTION OF FLAP LOADS WHICH REMAIN UNCHANGED. REF. F25-36-248.

MEMBER 7-6 HAS A MARGIN OF SAFETY OF 1.01 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.
For Flight Condition I, use the data on the back of this report as the basis for the design of the XB-36. For Flight Condition II, use the data on the back of this report as the basis for the design of the XB-36. For Flight Condition III, use the data on the back of this report as the basis for the design of the XB-36.
ANALYSIS

WILFE INVESTIGATED SCALE THE
EFFICACY BETWEEN XB-3, AND
E-3 FOR CONDITIONS I AND III
IS VERY SEEN.

<table>
<thead>
<tr>
<th>SHEET</th>
<th>MAX. A.</th>
<th>SCALE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1</td>
<td>10.0</td>
<td>1.0</td>
</tr>
<tr>
<td>D-3</td>
<td>10.5</td>
<td>1.5</td>
</tr>
<tr>
<td>2-5</td>
<td>12.0</td>
<td>2.0</td>
</tr>
<tr>
<td>2-4</td>
<td>11.0</td>
<td>1.5</td>
</tr>
</tbody>
</table>

XB-3 MAX. = (15.0 x 1.0) / 3
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 XP-76 leading edge structures are similar it will not be necessary to make a detailed analysis of the XP-76 leading edge. The loads on the XP-76 leading edge will decrease from the loads on the B-36A (Ref. FES-76-142, page III-482) by the ratio of their gross weights, \( \frac{27,000}{192/27,000} = 1.35 \), and the margin of safety of B-36 (Ref. page III-482, FES-36-142) will increase by 4.5% for the XP-76 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 edge, wing station 127.16

\[
L.S. (F-36A) = 0 \quad \text{(Ref: FES-36-142, P. III-482)}
\]

\[
L.S. (XP-76) = 1.045 \times 1 - 1 = 0.045
\]
"NOTICE: When Government or other drawings, specifications or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the U.S. Government thereby incurs no responsibility, nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications or other data is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use or sell any patented invention that may in any way be related thereto."
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

M. S. MEFFORD; B. C. VOSS; A. B. CANFIELD AND OTHERS
MAY 34 306PP. TABLES, GRAPHS

USAF CONTR. NO. W535-AC-22352

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