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WHICH MAY BE INVOLVED.
A report is given on the feasibility of conducting static tests on a portion of the fuselage of the B-36B and C bomber to prove the structural integrity of the aircraft for large bombs and the VDT engine installation. The truss tubes, the side shear panels, and the lower longerons have been considered individually in order to determine the portion of the bomb bay region that would be most representative and thereby prove the structural integrity of the entire region. A general plan for the testing and test set up has been developed and is discussed. Data from the B-36A bomber static test program will be used wherever possible as substantiation of the B-36B and C structures.
BEST
AVAILABLE
COPY
PROPOSAL FOR STATIC TEST
OF
B-16B AND B-36C FUSELAGES

CONSOLIDATED VULTEE AIRCRAFT CORPORATION
FORT WORTH DIVISION • FORT WORTH 1, TEXAS
PROPOSAL FOR STATIC TEST

OF

B-36B AND B-36C FUSELAGES

SUBMITTED UNDER

Contract W33-038-ac-7
INTRODUCTION

The purpose of this report is to study the feasibility of conducting tests at this facility on a portion of the fuselage of the B-36A and C Airplane to prove the structural integrity of the aircraft for large bombs and the VDT engine installation.

A survey of the structural differences between the fuselages of the B-36A Airplanes and the B-36B or C Airplanes reveals that they are identical except for the bomb bay region (Sta. 4.0 to Sta. 10). It therefore follows that the fuselage forward of Sta. 4.0 and aft of Sta. 10 will have been tested adequately in the B-36A test program since the loadings in these regions are essentially the same for all three airplanes.

The greatest departure in the bomb bay region consists of the lower longeron which for the B-36B and C Airplanes is elastically supported at Stas. 6 and 8 when the swinging door track is open in flight prior to dropping bombs. The only satisfactory means of testing this longeron as a beam column with elastic supports is to test an entire section of fuselage. However, it is believed that this need only be done on the forward or aft portion of the bomb bay region. The feasibility of this idea is determined in Part I of this report and the results are shown on Pages 17 and 18. The general plan of testing and test setup are shown and discussed in Part II. Parts I and II will be worked out for the B-36B Airplane and the general effects of the B-36C loads as they affect the test are discussed on Page 19.
III.

DETERMINATION OF MOST REPRESENTATIVE PORTION
OF BOMB BAY FOR TEST

Assuming that it is highly desirable to test only one-half of the bomb bay region, (either forward or aft of wing) the following investigation is made to determine which half would be most representative and thereby prove the structural integrity of the entire region. To make this investigation, three items are to be considered. They are the truss tubes, the side shear panels, and the lower longerons themselves.

Truss Tubes

The truss tube sizes (based on 243T81) are shown for left and right hand sides, forward and aft in Fig. 1. Column (1) of Table 1 lists all of the different sizes of tubes shown in this figure and Columns 3 and 4 identifies all of the members either forward or aft where each size is used. The next two columns (5 & 6) list the most critical Grand Slam loading for each size both forward and aft. An inspection of this data makes it possible to list in Column 7 in which portion (forward or aft) the most critical loading occurs. This makes it possible to see immediately if one or the other portion is tested what tube sizes will not be covered. However, the results of this table are influenced by which tubes will have been substantiated in the B-36A test program. Therefore, Table 2 is shown to introduce this factor and is believed to be self explanatory. Column 5 of this table summarizes which tubes of the untested end will remain without substantiation depending upon which end is tested. It may be seen that a test of either portion alone leaves some tubes without static test coverage. However, further comments on these untested tubes are shown in Table 3. From these comments, and all of the data presented so far, it definitely appears that the most satisfactory test will be obtained on the truss tubes if the forward portion is tested.
### Table 2

<table>
<thead>
<tr>
<th>Test Conditions</th>
<th>Condition 1</th>
<th>Condition 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed</td>
<td>V1</td>
<td>Vmax</td>
</tr>
<tr>
<td>Altitude</td>
<td>5,000 ft</td>
<td>10,000 ft</td>
</tr>
<tr>
<td>Pressure</td>
<td>14.7 psi</td>
<td>14.1 psi</td>
</tr>
</tbody>
</table>

### Notes

- A: Closed cabin temperature
- B: Open cabin temperature
- C: Closed cabin pressure
- D: Open cabin pressure

**Conditions:**

1. Closed cabin temperature, open cabin pressure
2. Open cabin temperature, closed cabin pressure
3. Open cabin temperature, open cabin pressure

**Reactions:**

- X: Indicates applicable condition

---

*Signed by: [Signature]*

*Date: [Date]*
### Table 5. Remarks Belonging to Results of Investigation of Tests for Aft Fuselage Section of the B-36A Aircraft

1. Assuming Forward Fuselage is Tested for Two Conditions: 
   a. Single Landing Gear, and b. L/L @ 5000.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Design Loads (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 5 x 134</td>
<td></td>
<td>TUBES USED AS FITTING ONLY, NONE IN B-36A</td>
</tr>
</tbody>
</table>
| Round 4 x 018|                  | LOAD IN AFT TUBES 450100 POUNDS. LOAD IN TWO TUBES 15 +45300 PSI (25% OF 5364 LOADS)诡邪。
| None 10 x 102 |                  | TUBES USED AS FITTING ONLY, NONE IN B-36A    |

2. Assuming Aft Fuselage is Tested for Two Conditions: 
   a. Single Landing Gear, and b. L/L @ 5000.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Design Loads (%)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Round 5 x 134</td>
<td></td>
<td>NONE AFT ON B-36A, B-36A LOADS HERE: 42500. 45,000.</td>
</tr>
<tr>
<td>Round 5 x 102</td>
<td></td>
<td>NONE AFT ON B-36A AND NOT RECOMMENDED AT ALL ON B-36A.</td>
</tr>
<tr>
<td>Round 5 x 102</td>
<td></td>
<td>NONE AFT ON B-36A AND NOT RECOMMENDED AT ALL ON B-36A.</td>
</tr>
<tr>
<td>Round 5 x 102</td>
<td></td>
<td>NONE AFT ON B-36A AND NOT RECOMMENDED AT ALL ON B-36A.</td>
</tr>
<tr>
<td>Round 5 x 102</td>
<td></td>
<td>NONE AFT ON B-36A AND NOT RECOMMENDED AT ALL ON B-36A.</td>
</tr>
</tbody>
</table>
Side shear panels

The side shear panel rages and maximum shears for each panel both forward and aft are shown in Table 4. It should be noted that the LAA condition should be run with the arch open and also with the arch closed, since this effects the side shear panel shear distribution. The B-36A shear flows are also shown on this table, since they will have been substantiated by the B-36A static test program.

Investigation of the data shows that if the forward portion is tested to LAA and VALR, the maximum shear flow for the .051 sheet of the aft portion will not be attained. However, if the aft portion is tested, the maximum shear flow for the .040 sheet of the forward portion will not be attained. In addition to this, if the aft portion is tested, no test will be made of the forward vertical shear panel in the turret bay. On this basis it appears desirable to test the forward portion and to introduce local shears in the region of the .051 sheet which will substantiate the shear flow which exists in the aft .051 skin. Such a local shear could not be introduced in the aft end turret bay panel to substantiate the forward turret bay, because the sheet gage of the forward turret bay panel is .016 whereas the aft turret bay panel is .020. All of the foregoing data indicates that a test of the forward portion would substantiate the aft portion provided a supplementary shear is introduced into the .051 sheet.
### Table 4(a) - Side Shear, Wind - Ground Loading, 1/2 Ailerons

<table>
<thead>
<tr>
<th>BAY</th>
<th>5TH SHT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>111.5</td>
</tr>
<tr>
<td></td>
<td>108.5, 108.5, 108.5, 108.5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>FOR</th>
<th>40-11</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>046</td>
</tr>
<tr>
<td></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>301</td>
</tr>
<tr>
<td></td>
<td>341</td>
</tr>
</tbody>
</table>

| 4.1-5.0 | 046 | - | 301 | 342 |

| 5.0-5.1 | 046 | - | 376 | 402 |

| 5.1-6.0 | 040 | - | 376 | 372 |

| 5.2-6.0 | 040 | - | 376 | 375 |

| 6.0-6.1 | 051 | 484 | 532 | 507 |

| 6.1-6.2 | 040 | 465 | 513 | 312 |

| 7.1-7.2 | 051 | - | 609 | 540 |

| 7.2-8.0 | 051 | - | 609 | 560 |

| 8.0-8.1 | 051 | 330 | - | 330 |

| 8.1-8.2 | 040 | 452 | - | 329 |

| 8.2-9.0 | 040 | 326 | - | 319 |

| 9.0-9.1 | 040 | 266 | - | 310 |

| 9.1-10.0 | 040 | 240 | - | 310 |

**Notes:**

1. From STA. 4.0 to STA. 6.0 ground turning condition yields max. shear for ground slam conditions.
2. From station 7.1-8.0 max. shears occur in 2-wheel landing - inclined runway condition - high is closed.
3. From STA. 8.0 to STA. 10.0, shears are greatest with high closed.

### Table 4(b) - Vertical Shear, Panel Loads & Tackles, etc.

<table>
<thead>
<tr>
<th>BAY</th>
<th>WHEL</th>
<th>MAX. SHEARS - ADX</th>
<th>MAX. SHEARS, BAY 6-8, CHECKED BY FILM TEST FOUND TO BE 1.03X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.11</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>2</td>
<td>1.09</td>
<td>165</td>
<td>165</td>
</tr>
<tr>
<td>3</td>
<td>1.01</td>
<td>125</td>
<td>125</td>
</tr>
<tr>
<td>4</td>
<td>1.06</td>
<td>150</td>
<td>150</td>
</tr>
</tbody>
</table>
Longerons

A. Lower

A comparison of the B-36B forward and aft longeron compressive stresses, deflections and margins of safety are shown in Fig. 2 for the Grand Slam loading conditions. It will be noted that for the aft longeron the stresses for the 2 Wheel Landing With Inclined Reactions Condition are shown rather than the stresses for LAA condition, which is shown to be more critical in C.V.A.C. Report PZ-36-144B. New rational tail loads using overall airplane pitching moment coefficients are such that the lower longeron compressive stresses in the LAA condition are approximately 50% as great as those shown in the above mentioned report. Therefore, the LAA condition was not considered in this comparison. Also shown on Fig. 2 are the maximum aft longeron compressive stresses for the B-36A Airplane, which will be substantiated in the B-36A static test program.

In view of the data presented it was determined that a static test of the forward lower longeron in compression will be the more representative test for the following reasons: (1) The maximum stresses on the aft longeron occur when the arch at Sta. 8.0 is closed (landing); (2) the B-36A static test program will substantiate the aft longeron with the arch closed; (3) margins of safety on the forward lower longeron for Grand Slam loadings are smaller in the regions where the stresses are most critical.

B. Upper

For the Grand Slam loadings, the upper longerons do not receive the local bending loads to which they are subjected on the B-36A Airplane. A comparison of margins of safety between the B-36A and B-36B airplanes show that with very few exceptions, the margins on the B-36B are greater than those for the B-36A. Since there is no difference in their construction, support or general design procedures, it is felt that the B-36B upper longeron design will have been substantiated by the B-36A test. Therefore, it is not necessary to conduct a static test to test the upper longerons to static load. This will remove one critical test loading to be run on the forward lower longeron. 
**B-36B - LOWER LONGERON COMPRESSION STRESSES TO BE SUSTAINED BY B-36A STATIC TEST PROGRAM (Ref: F-660, FEB-36-44)**

<table>
<thead>
<tr>
<th>STA.</th>
<th>1.0</th>
<th>2.0</th>
<th>3.0</th>
<th>4.0</th>
<th>5.0</th>
<th>6.0</th>
<th>7.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATERAL DEFL. IN.</td>
<td>0.019</td>
<td>0.017</td>
<td>0.014</td>
<td>0.012</td>
<td>0.01</td>
<td>0.007</td>
<td>0.004</td>
</tr>
<tr>
<td>% y STRESS 47,000</td>
<td>45,000</td>
<td>47,000</td>
<td>44,700</td>
<td>44,700</td>
<td>43,000</td>
<td>42,000</td>
<td>47,000</td>
</tr>
<tr>
<td>% H. STRESS 45,000</td>
<td>47,000</td>
<td>44,700</td>
<td>45,000</td>
<td>45,000</td>
<td>42,000</td>
<td>41,000</td>
<td>47,000</td>
</tr>
<tr>
<td>M.S. Comp. 4.75</td>
<td>4.26</td>
<td>4.02</td>
<td>3.80</td>
<td>3.80</td>
<td>3.56</td>
<td>3.56</td>
<td>4.13</td>
</tr>
</tbody>
</table>

**B-36A - AFT LOWER LONGERON COMPRESSION STRESSES TO BE SUSTAINED BY B-36A STATIC TEST PROGRAM (Ref: F-660, FEB-36-44)**

<table>
<thead>
<tr>
<th>STA.</th>
<th>9.0</th>
<th>8.8</th>
<th>8.1</th>
<th>8.0</th>
<th>7.8</th>
<th>7.2</th>
<th>7.1</th>
<th>7.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>LATERAL DEFL. IN.</td>
<td>0.019</td>
<td>0.017</td>
<td>0.014</td>
<td>0.012</td>
<td>0.01</td>
<td>0.007</td>
<td>0.004</td>
<td>0.00</td>
</tr>
<tr>
<td>% y STRESS 47,000</td>
<td>45,000</td>
<td>47,000</td>
<td>44,700</td>
<td>44,700</td>
<td>43,000</td>
<td>42,000</td>
<td>47,000</td>
<td>47,000</td>
</tr>
<tr>
<td>% H. STRESS 45,000</td>
<td>47,000</td>
<td>44,700</td>
<td>45,000</td>
<td>45,000</td>
<td>42,000</td>
<td>41,000</td>
<td>47,000</td>
<td>47,000</td>
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<td>M.S. Comp. 4.75</td>
<td>4.26</td>
<td>4.02</td>
<td>3.80</td>
<td>3.80</td>
<td>3.56</td>
<td>3.56</td>
<td>4.13</td>
<td>4.13</td>
</tr>
</tbody>
</table>
SUMMARY OF RESULTS

A survey of the foregoing data indicates that a satisfactory proof of the structural integrity will be obtained if the following tests and procedures are followed:

(1) The forward bomb bay region (Sta. 4.0 to Sta. 7.0) should be subjected to the full design shears for:

   (a) Reduced Gross Weight, High Speed, 'A' Condition (1-42,000# bombs)

   (b) Alternate Gross Weight 37LR Condition (2-42,000# bombs)

(2) The lower longeron should be subjected to its full axial compression load simultaneously with the shears for the conditions mentioned in (1) above.

(3) The upper longerons in the conditions of (1) above will receive an axial load which amounts to the delta moment between Sta. 4.0 and Sta. 6.1 in these conditions.

(4) The forward bomb rack installation will be used to introduce the loads into the structure and will therefore be tested automatically for the conditions of (1) above.

(5) The aft bomb racks will be set up and tested for design loads on a separate jig.

(6) Supplementary shear tests will be run on the shear panel skins to substantiate any aft panel shears which are greater.

(7) The three tubes of the aft portion which are not covered by the forward test (Ref. Table 3) will be handled as follows:

   (a) Strain gages will be placed on forward bay tubes that have a corresponding location.

   (b) Loads in these tubes will be obtained from the strain gage data and will be used to verify the stress analysis distribution and polarity.

   (c) If loads are substantial, the members can be shown to be satisfactory by comparing test loads on existing sections with new data, etc.
(F) Data from the S-36A Static Test Program will be used wherever possible as substantiation of S-36B structure.
DISCUSSION OF B-36C LOADS

No final stress analysis is yet available on the B-36C Airplane. However, the Contractor has investigated the critical conditions for this airplane and found that the only effect is to get slightly higher shears in two of the shear panels. It is felt that this increase in shear could be substantiated by making supplementary tests on the portion proposed for test.
PART II

TEST SETUP AND PROCEDURE

Forward Bomb Bay

The general test set up is as shown in Fig. 3. It is proposed to apply to a dummy bulkhead at Sta. 4.0, a shear load equal to that of all items forward of Sta. 4.0. The shears for all items from Sta. 4.0 to Sta. 6.2 will be applied as indicated in the Fig. 3. A compression load, equal to the calculated longeron load will be applied to the lower longeron at Sta. 4.0. The applied loads will be reacted by a steel fixture simulating the fuselage and wing box structure between fuselage station 6.2 and a point approximately ten inches aft of station 7. As shown by the figure, all shears will be reacted at station 6.2. Furthermore, the lower longers at Sta. 6.2 will be adjusted laterally the amount indicated in the final stress analysis for the condition concerned to simulate the effect of wing deflection.

Every effort will be made to design the test fixtures so that a minimum amount of changing will be necessary to complete both test conditions.

Aft Bomb Racks

The aft bomb bay racks and beams for the 43,000# and 22,000# bombs will be tested on separate test fixtures simulating airplane attaching structure.

Supplementary Tests

Supplementary tests of the side shear panels will be made by simply introducing greater shears over the prescribed panel and then reacting this increase by other test equipment.
TITLE: Proposal for Static Test of B-36B and B-36C Fuselages

AUTHOR(S): Alexander, M. M.; Cosby, J. T.

ORIGINATING AGENCY: Consolidated Vultee Aircraft Corp., Fort Worth, Texas

PUBLISHED BY: USAF Contract W33-038-AC-1

ABSTRACT:
A report is given on the feasibility of conducting static tests on a portion of the fuselage of the B-36B and C bomber to prove the structural integrity of the aircraft for large bombs and the VDT engine installation. The truss tubes, the side shear panels, and the lower longerons have been considered individually in order to determine the portion of the bomb bay region that would be most representative and thereby prove the structural integrity of the entire region. A general plan for the testing and test set up has been developed and is discussed. Data from the B-36A bomber static test program will be used wherever possible as substantiation of the B-36B and C structures.

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