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PREFLIGHT TRANSIENT DYNAMIC ANALYSES OF B-52 AIRCRAFT CARRYING SPACE SHUTTLE SOLID ROCKET BOOSTER DROP-TEST VEHICLE

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Abstract

This paper concerns the transient dynamic analysis of the B-52 aircraft carrying the Space Shuttle solid-rocket booster drop-test vehicle (SRB/DTV). The NASA structural analysis (NASTRAN) finite-element computer program was used in the analysis. The B-52 operating conditions considered for analysis were 1) landing and 2) braking on aborted takeoff runs. The transient loads for the B-52 pylon front and rear hooks were calculated. The results can be used to establish the safe maneuver envelopes for the B-52 carrying the SRB/DTV in landings and brakings.

Nomenclature

A = dynamic-load scale factor
DCL = left-rear-hook drag load, lb
E = Young's modulus of bar element, lb/in.²
F = dynamic load, lb
F₆ = front landing gear braking force at grid point 6, lb
F₁₅ = rear landing gear braking force at grid point 15, lb
G = shear modulus of bar element, lb/in.²
S = gravitational acceleration, 386.4 in./sec²
h₆ = front landing gear length, in.
h₁₅ = rear landing gear length, in.
Iₐₖ (i,j = 1,2,3) = moments of inertia of nodal weight based on [x₁, x₂, x₃] system, lb·in.²
Iₚ (or Iᵧ) = pitching (or yawing) moment of inertia of DTV, lb·in.²
Iᵣ = rolling moment of inertia of DTV, lb·in.²
Kₚ = spring constant for pylon pitching motion, in.·lb
Kₛ = spring constant for pylon side motion, lb/in.
Kᵧ = spring constant for pylon yaw motion, in.·lb
[M] = mass matrix
M₆ = braking moment at grid point 6, lb·in.
M₁₅ = braking moment at grid point 15, lb·in.
m = mass of DTV, lb·sec²/in.
P₆ = front landing gear reaction force, lb
P₁₅ = rear landing gear reaction force, lb
Sₐ = front-hook side load, lb
SCL = rear-hook side load, lb
t = time, sec
Vₐ = front-hook total vertical load, lb
VₐD = front-hook dynamic vertical load, lb
VₐS = front-hook static vertical load, lb
VCL = left-rear-hook dynamic vertical load, lb
Vₜ₁₅ = left-rear-hook static vertical load, lb
Vₛ = sink velocity of B-52, ft/sec
W = weight of mass element (nodal weight), lb
W₉ five = weight of B-52, lb
WDTV = DTV weight, lb
W₆ = weight on front landing gear, lb
W₁₅ = weight on rear landing gear, lb
X, Y, Z = global rectangular Cartesian coordinates used in NASTRAN model, in.
X₁, X₂, X₃ = local rectangular Cartesian coordinates for mass element used in NASTRAN model, in.

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The DTV was modeled using CBAR elements (uniform cross section bar element) for carrying the structural stiffnesses; the B-52 structural masses were lumped at most of the grid points, and were modeled by using C0NMI elements (concentrated mass elements of type 1) for carrying the structural inertiaw. Landing gears were not modeled. Grid points 9, 26, 24, 43, 62, 64, 71, and 73 are massless points; therefore, they were removed in the dynamic analyses with OMIT cards. Figure 3 shows the NASTRAN model of the B-52 carrying the DTV. The front and rear landing gears are located at grid points 6 and 15, respectively. The center of gravity of the B-52 varies between grid points 12 and 13. Because of very high stiffnesses, elements lying between grid-points 7 and 9, 9 and 10, 16 and 17, 23 and 26, and 24 and 43, were modeled as rigid elements, using CRIGDI constraints (rigid constraints of type 1).

The vertical tail has extremely high vertical bending stiffness (about the y-axis); therefore, CRIGD2 constraints (rigid constraints of type 2) were used to force the entire vertical tail to rotate as a whole about the y-axis. Namely, rotations about the y-axis of grid-points 27 through 35 were made identical to those of grid-point 26. Also, because of very high lateral bending stiffnesses (about z) of the wing roots, rotations about the z-axis of grid-points 67 and 68 were set equal to that of grid-point 9 through the use of CRIGD2 constraints. The reason for using the above rigid constraints CRIGD1 and CRIGD2 was to avoid the solution errors caused by using very large values of stiffnesses for the CBAR elements.

For each C0NMI element, a local rectangular Cartesian coordinate system (x1, x2, x3) with origin located at the associated mass grid point was defined by using CONDZR cards. At each mass grid point, the mass matrix [M] was set up in the (x1, x2, x3) system for input to the C0NMI card. Because the centers of mass of most of the C0NMI elements were offset from the associated grid points, some of the off-diagonal terms in [M] shown below were nonzero:

\[
[M] = \frac{1}{8} \begin{bmatrix}
 W & 0 & 0 & x_2 W & -x_3 W \\
 0 & W & -x_3 W & 0 & x_1 W \\
 x_3 W & 0 & W & -x_1 W & 0 \\
 x_2 W & -x_3 W & 0 & I_{11} & -I_{12} & -I_{13} \\
 0 & x_1 W & -x_2 W & I_{12} & -I_{22} & -I_{23} \\
 0 & 0 & 0 & I_{13} & I_{23} & I_{33}
\end{bmatrix}
\]  

(1)

where W is the weight of the C0NMI element (or C0NMI2 element described below), and I_{ij} (i,j = 1, 2, 3) are the weight moments of inertia of the C0NMI element (or C0NMI2 element) referred to the (x1, x2, x3) system. The DTV was modeled by using one C0NMI2 element (concentrated mass element of type 2) with the DTV center of mass.
In modeling the pylon, two cases were considered: a rigid pylon and an elastic pylon. For the case of the rigid pylon, grid-point 85 was rigidly attached to grid-point 70 through a CRIGD1 rigid constraint. For the elastic pylon, a CRIGD2 card was used to rigidly couple the motions in the x- and z-directions of grid-point 85 to those of grid-point 70 (i.e., perfectly rigid in z-extension, infinite shear stiffness in the x-z plane). The rest of the degrees of freedom were set free (see Fig. 4). For the yaw motion, a torsional spring CELAS2 element was attached between grid-points 70 and 85 (Fig. 4a) to allow spring resistance only in yaw motion (sixth degree of freedom). For the roll motion (or side motion), a CRIGD1 rigid element was attached between grid-points 70 and 85 (grid-point 87 is coincident with grid-point 85). A spring CELAS2 element was then attached between grid-points 85 and 87, permitting the motion of grid-point 85 only in y-direction (second degree of freedom) (Fig. 4b). Lastly, the pitching elastic resistance was modeled by connecting a bending spring element CELAS2 between grid-points 70 and 85, permitting only the pitching motion (fifth degree of freedom) of the pylon (Fig. 4c). The spring constants for the above three CELAS2 elements were calculated from the measured vibration frequencies (derived from X-15 reports) using the following equations:

\[ K_Y = \frac{I_Y \omega_Y^2}{S} \]  
\[ K_S = \frac{m \omega_Y^2}{S} \]  
\[ K_P = \frac{I_P \omega_P^2}{S} \]  

where \( K_Y, K_S, \) and \( K_P \) are, respectively, spring constants for yaw, side, and pitching motions; \( m \) is the mass of the DTV; \( I_P \) and \( I_Y \) are, respectively, the pitching and the yawing moments of inertia of DTV; and \( \omega_Y, \omega_S, \) and \( \omega_P \) are, respectively, angular vibration frequencies in yaw, side, and pitching motions.

The entire B-52/DTV NASTRAN model has 88 grid points, 78 CBAR elements, 7 CRIGD1 elements, 76 CWM1 elements, and 1 CWNM2 element. The NASTRAN model free system is reported at grid-points 12 (with components 1, 2, 3, and 4 constrained) and 13 (with components 2 and 3 constrained) through the use of a SUPORT card which is to remove the stress-free, rigid-body motion component from the free system.

<table>
<thead>
<tr>
<th>Forcing Functions</th>
<th>Sink speed ( V_s ), ft/sec</th>
<th>Nose-up angle, deg</th>
<th>Front landing gear touchdown delay time ( \tau ), sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 1</td>
<td>3</td>
<td>3</td>
<td>0.82</td>
</tr>
<tr>
<td>Case 2</td>
<td>3</td>
<td>6</td>
<td>1.30</td>
</tr>
<tr>
<td>Case 3</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Case 4</td>
<td>6</td>
<td>3</td>
<td>0.47</td>
</tr>
</tbody>
</table>

In the landing analyses, four cases of landing conditions were considered, and are shown above:

Also, in the Case Control Deck, the dynamic load set must be defined through \( DL\text{LOAD} = n \), where \( n \) is the set identification number. The initial velocity (sink velocity, in the negative z-direction) of the NASTRAN model was defined by using TIC cards in the Bulk Data Deck for all the grid points excluding the massless grid points and the rigid element grid points. In the Case Control Deck, the transient initial condition set must be selected through the use of IC = n' where n' is the set identification number. The integration time-steps and the solution output time-intervals were specified by using a TSTEP card in the Bulk Data Deck. The time-delay effect (\( \tau \)) of the front-landing-gear forcing function can be handled in two ways:

1) Without using the DELAY card, construct the front-landing-gear forcing function table TABLED1 in such a way that the delay time is absorbed into the table

2) Using the DELAY card, construct the front-landing-gear forcing function table TABLED1 by shifting the time origin to the force rising time [i.e., by using (\( \tau - \tau \)) as the time scale]
The surface was taken to be 0.55. Brakes were applied when the B-52 was taxiing at 135 knots (2734.25 in./sec). The lengths of braking force ramp-rise-time to Fig. 7 (considered in the braking analyses are

\begin{align*}
\text{Case} & \quad \tau_0, \sec \\
1 & \quad 0.2 \\
2 & \quad 0.5 \\
3 & \quad 1.0
\end{align*}

The braking forces and the associated braking moments at the landing-gear attach points 6 and 15 are given by

\begin{align*}
F_6 &= \mu W_6 \\
F_{15} &= \mu W_{15} \\
M_6 &= h_s F_6 \\
M_{15} &= h_s F_{15}
\end{align*}

where \( W_6 \) (i = 6, 15) is the weight on the landing gear at grid-point i, where \( F_6 \) (i = 6, 15) and \( M_6 \) (i = 6, 15) are, respectively, the braking force and the braking moment at grid-point i, and where \( h_s \) (i = 6, 15) is the length of the landing gear. The braking force guidelines and the initial conditions were input into the NASTRAN model in a way similar to that used in the landing analyses. DELAY cards may be omitted since there is no time delay of the front-landing-gear forcing function.

**Input Data for Structural Model**

The grid-point coordinates, nodal weight, and stiffness data for input to the B-52 NASTRAN model and the inertia data for input to Eq. (1) were taken from Ref. 2. Other input data are

\begin{align*}
E &= 10 \times 10^6 \text{ lb/in.}^2 \\
G &= 4 \times 10^6 \text{ lb/in.}^2 \\
B-52 \text{ structural damping coefficient} &= 0.015 \text{ lb·sec/fn.} \\
\text{DTV weight} W_{DTV} &= mg = 49,000 \text{ lb} \\
\text{DTV pitching (or yawing) moment of inertia} I_p &= 1.4591 \times 10^6 \text{ lb·in.}^2 \\
\text{DTV rolling moment of inertia} I_R &= 4.5537 \times 10^7 \text{ lb·in.}^2 \\
\text{Pylon weight} &= 1170 \text{ lb}
\end{align*}

Pylon mass matrix:

\[
[M]_{\text{pylon}} = \frac{1}{g} \begin{bmatrix}
1170. & 0. & 0. & -22670. & 0. \\
1170. & 0. & 22670. & 0. & -32683. \\
1170. & 0. & 0. & 32683. & 0. \\
3.6949 \times 10^6 & 0. & 0. & 0. & 0. \\
3.0268 \times 10^6 & 0. & 0. & 0. & 1.1623 \times 10^6
\end{bmatrix}
\]
The peak value of $V_{CL}$ reached only 38% of the limit value of 57,600 lb. The time-histories of the hook loads for the rest of the landing conditions - $V_S = 3$ ft/sec, $\theta = 6^\circ$; $V_S = 3$ ft/sec, $\theta = 0^\circ$ (simultaneous touchdown of the front and rear landing gears); and $V_S = 6$ ft/sec, $\theta = 3^\circ$ are quite similar to the case in which $V_S = 3$ ft/sec, $\theta = 3^\circ$; therefore, they are not shown here. The calculated peak values of $V_A$, $V_{CL}$, $S_A$, $S_{CL}$, and $D_{CL}$ for the elastic pylon for the four landing conditions are listed in Table 1; the peak values of $V_A$ and $V_{CL}$ are plotted in Figs. 17 ($V_A$) and 18 ($V_{CL}$). The landing condition ($V_S = 6$ ft/sec, $\theta = 3^\circ$) induced the highest peak values of $V_A$ (86% of limit load) and $V_{CL}$ (48% of limit load). Figures 26-28, respectively, show $\bar{z}$ and $\bar{\theta}$ at grid-point 85 (DTV) for the braking condition at $\tau = 0.2$ sec, $\mu = 0.55$, for both elastic and rigid pylons. The $\bar{z}$ for the braking is insignificant when compared with $\bar{\theta}$ which has about 3 cycles/sec of oscillation for both elastic and rigid cases.

All the calculated time-histories for the hook loads (see Appendix) are shown in Figs. 21-25 for the braking condition at $\tau = 0.2$ sec, $\mu = 0.55$, for both elastic and rigid pylons. Notice that the rear-hook drag load $D_{CL}$ (Fig. 25) reflects the shape of braking forcing function. The time histories of the hook loads for the other two braking conditions - $\tau = 0.5$ sec, $\mu = 0.55$ and $\tau = 1.0$ sec, $\mu = 0.55$ - are similar to the case $\tau = 0.2$ sec; therefore, they are not shown. The braking tends to decrease the mean value of $V_A$ from its static value and increase the mean value of $V_{CL}$ from its static value. However, the peak values of $V_{CL}$ stay well below the limit value. The peak values of $V_A$, $V_{CL}$, $S_A$, $S_{CL}$, and $D_{CL}$ for the elastic pylon for the three braking conditions are tabulated in Table 1, and the peak values of $V_A$, $V_{CL}$, and $D_{CL}$ are plotted in Figs. 26-28. The braking condition $\tau = 0.2$ sec, $\mu = 0.55$ gives the highest peak values of $V_A$ (96% of the limit load), $V_{CL}$ (46% of the limit load), $S_A$ (89% of the limit load), $S_{CL}$ (41% of the limit load), and $D_{CL}$ (35% of the limit load). The peak values of $V_A$ for all three cases stay close to its static value.

Summary

The NASTRAN finite-element computer program was used in transient dynamic analyses of a B-52 aircraft carrying the Space Shuttle solid-rocket booster drop-test vehicle when either landing or braking. All the hook loads of the B-52 pylon were calculated for different landing and braking conditions. Both elastic and rigid pylons were considered. For landing, it was found that the vertical hook loads were more sensitive to the landing conditions than side and drag loads. The landing condition (6-ft/sec sink rate, 3° nose-up) was found to be the worst case; it caused the peak value of $V_A$ to reach 86% of its limit load, and the peak value of $V_{CL}$ to reach 48% of its limit load. For braking, the peak values of $V_A$ and $V_{CL}$ are relatively insensitive to the braking conditions, but the side loads of both front and rear hooks oscillate considerably about their static values (i.e., zero). The rear-hook drag load was quite sensitive to the braking conditions. Braking tends to decrease the front-hook mean vertical load from their respective static values.

The information on the hook loads can now be used to establish safe maneuver envelopes for the B-52 carrying the SRB/DTV when landing or braking.

Appendix: Equations for Hook Loads

The following equations for hook loads were developed in accordance with the dimensions shown in Figs. 29 through 31.

1) Front-hook dynamic vertical load $V_{AD}$ (considering moment about point A) (Fig. 30a):

$$ V_{AD} = \frac{1}{211.0} (m_{\bar{z}}(60.8) - m_{\bar{\theta}}(27.35 - 17.5) + (I_p + m(60.8)^2 + (27.35 - 17.5)^2)\bar{\theta})_{\bar{\theta}} \quad (A1) $$

2) Front-hook static vertical load $V_{AS}$:

$$ V_{AS} = 60.8 \times \frac{W_{DTV}}{211.0} $$

3) Front-hook total vertical load $V_A$:

$$ V_A = V_{AD} + V_{AS} \quad (A3) $$

4) Front-hook side load $S_A$ (considering equivalent moment about point 0) (Fig. 30b):

$$ S_A = \frac{1}{220.29} (m_{\bar{z}}(60.8) - (I_p + m(60.8)^2)\bar{\theta}) \quad (A4) $$

where 220.29 is the equivalent moment arm (from Ref. 3).

5) Rear-hook dynamic vertical load $V_{CLD}$ (considering moment about point CR) (Fig. 31):

$$ V_{CLD} = \frac{1}{62.624} (m_{\bar{z}} - V_{AD})(31.312) - m_{\bar{\theta}}(9.85) - S_A(16.3125) - (I_R + m(9.85)^2 + (31.312)^2)\bar{\theta}_{\bar{\theta}} \quad (A5) $$

6) Rear-hook static vertical load $V_{CLS}$:

$$ V_{CLS} = \frac{1}{2} 150.2 \times \frac{W_{DTV}}{211.0} \quad (A6) $$

7) Rear-hook total vertical load $V_{CL}$:

$$ V_{CL} = V_{CLD} + V_{CLS} \quad (A7) $$

8) Rear-hook side load $S_{CL}$:

$$ S_{CL} = m_{\bar{z}} - V_{A} \quad (A8) $$

9) Rear-hook drag load $D_{CL}$ (considering equivalent moment about point 0) (Fig. 30b):
\[ D_{CL} = \frac{1}{1484.475} \left( \left[ I_p + \frac{m(60.8)^2}{2} \right] \bar{y} - w y(60.8) \right) \]

where 1484.475 is the equivalent moment arm (from Ref. 3).

References

1"NASTRAN Theoretical Manual, NASTRAN Users' Manual," Computer Software Management and Information Center (COSMIC), Ballows Halls, University of Georgia, Atlanta, Ga., 1978.


Table 1 Peak hook loads associated with different landing and braking conditions

<table>
<thead>
<tr>
<th>Condition</th>
<th>( V_A ), lb</th>
<th>( V_{CL} ), lb</th>
<th>( S_A ), lb</th>
<th>( S_{CL} ), lb</th>
<th>( D_{CL} ), lb</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(% load limit)</td>
<td>(% load limit)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Landing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( V_S ), ft/sec ( \theta ), deg</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>21,870(58%)</td>
<td>20,220(35%)</td>
<td>1,708(20%)</td>
<td>4,457(18%)</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>27,703(73%)</td>
<td>21,751(38%)</td>
<td>3,206(1^a)</td>
<td>5,196(21%)</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>32,083(85%)</td>
<td>23,371(41%)</td>
<td>3,004(1^a)</td>
<td>8,335(1^a)</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>32,600(85%)</td>
<td>27,682(48%)</td>
<td>3,042(1^a)</td>
<td>5,637(1^a)</td>
</tr>
<tr>
<td>Braking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \tau_0 ), sec</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>14,138(38%)</td>
<td>22,138(38%)</td>
<td>1,513(17%)</td>
<td>1,134(5%)</td>
<td>14,278(46%)</td>
</tr>
<tr>
<td>0.5</td>
<td>14,157(38%)</td>
<td>22,895(40%)</td>
<td>2,359(27%)</td>
<td>2,646(11%)</td>
<td>14,643(47%)</td>
</tr>
<tr>
<td>0.2</td>
<td>14,888(39%)</td>
<td>26,038(46%)</td>
<td>7,717(89%)</td>
<td>9,984(41%)</td>
<td>16,717(53%)</td>
</tr>
</tbody>
</table>

Limit load, lb

37,700 57,600 8,667 24,501 31,290

\( ^a \)Peak values within \( t = 3 \) sec limit of computation; actual peak values could be higher.
Fig. 1 Geometry of Space Shuttle solid-rocket booster drop-test vehicle (DTV) attached to B-52 pylon; view looking inboard at right side of B-52 and SRB/DTV.

Fig. 2 B-52 structure represented by bar elements and concentrated mass elements.
Fig. 3 B-52 NASTRAN model.

Fig. 4 Modeling of elastic pylon. a) Yaw, b) roll, c) pitch.
**Fig. 5** Combined front landing gear force: $V_S = 3 \text{ ft/sec}, \theta = 3^\circ$.

**Fig. 6** Combined rear landing gear force: $V_S = 3 \text{ ft/sec}, \theta = 3^\circ$.

**Fig. 7** Landing-gear braking force (or moment) curve.

**Fig. 8** Transient dynamic response of B-52 to upward triangular pulse (1.5 g) at front and rear landing gears: $t = 1 \text{ sec}$, single-point constraint at grid points 12 and 13.
Fig. 9 Transient dynamic response of B-52 to upward triangular pulse (1.5 g) at front and rear landing gears: \( t = 2.1 \) sec, single-point constraint at grid points 12 and 13.

Fig. 10 \( z \)-acceleration at grid point 85 (DTV): landing, \( V_s = 3 \) ft/sec, \( \theta = 3^\circ \).

Fig. 11 Angular acceleration about \( y \)-axis at grid point 85 (DTV): landing, \( V_s = 3 \) ft/sec, \( \theta = 3^\circ \).

Fig. 12 Front-hook vertical load versus time: landing, \( V_s = 3 \) ft/sec, \( \theta = 3^\circ \).

Fig. 13 Front-hook side load versus time: landing, \( V_s = 3 \) ft/sec, \( \theta = 3^\circ \).

Fig. 14 Rear-hook vertical load versus time: landing, \( V_s = 3 \) ft/sec, \( \theta = 3^\circ \).
Fig. 15 Rear-hook side load versus time: landing, $V_s = 3$ ft/sec, $\theta = 3^\circ$.

Fig. 16 Rear-hook drag load versus time: landing, $V_s = 3$ ft/sec, $\theta = 3^\circ$.

Fig. 17 Variation of front-hook peak vertical load with landing conditions.

Fig. 18 Variation of rear hook peak vertical load with landing conditions.

Fig. 19 $z$-acceleration at grid point 85 (DTV): braking, $\tau_0 = 0.2$ sec, $\mu = 0.55$.

Fig. 20 Angular acceleration about y-axis at grid point 85 (DTV): braking, $\tau_0 = 0.2$ sec, $\mu = 0.55$. 
Fig. 21 Front-hook vertical load versus time: braking, $T = 0.2$ sec, $\mu = 0.55$.

Fig. 22 Front-hook side load versus time: braking, $T_0 = 0.2$ sec, $\mu = 0.55$.

Fig. 23 Rear-hook vertical load versus time: braking, $T_0 = 0.2$ sec, $\mu = 0.55$.

Fig. 24 Rear-hook side load versus time: braking, $T_0 = 0.2$ sec, $\mu = 0.55$.

Fig. 25 Rear-hook drag load versus time: braking, $T_0 = 0.2$ sec, $\mu = 0.55$.

Fig. 26 Variation of front-hook peak vertical load with braking condition.
Fig. 27 Variation of rear-hook peak vertical load with braking condition.

Fig. 28 Variation of rear-hook peak drag load with braking condition.

Fig. 29 Locations of DTV and front and rear hooks: Eq. (Al).
Fig. 30 Locations of DTV and front and rear hooks: Eqs. (A4) and (A9). a) Side view; b) Top view.

Fig. 31 Locations of DTV and front and rear hooks: Eq. (A5).
This paper concerns the transient dynamic analysis of the B-52 aircraft carrying the Space Shuttle solid-rocket booster drop-test vehicle (SRB/DTV). The NASA structural analysis (NASTRAN) finite-element computer program was used in the analysis. The B-52 operating conditions considered for analysis were 1) landing and 2) braking on aborted take-off runs. The transient loads for the B-52 pylon front and rear hooks were calculated. The results can be used to establish the safe maneuver envelopes for the B-52 carrying the SRB/DTV in landings and brakings.