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TECHNICAL NOTE 3245

CALCULATED SUBSONIC SPAN LOADS AND RESULTING STABILITY DERIVATIVES OF UNSWEPT AND 45° SWEPTBACK TAIL SURFACES IN SIDESLIP AND IN STEADY ROLL

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NACA

Washington
October 1954

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SUMMARY

Subsonic span loads and the resulting stability derivatives have been calculated for a systematic series of vertical- and horizontal-tail combinations in sideslip and in steady roll in order to provide information embracing a wide range of probable tail configurations. All calculations were made by application of the discrete-horseshoe-vortex method to the problem of estimating loads on intersecting surfaces. The investigation covered variations in vertical-tail aspect ratio, the ratio of horizontal-tail aspect ratio to vertical-tail aspect ratio, the effects of horizontal-tail dihedral angle (for the sideslip case), and the effects of vertical position of the horizontal tail for surfaces having their quarter-chord lines swept back 0° and 45°. The results of the investigation are presented in charts from which the span loads for the various conditions can be obtained. The resulting stability derivatives are presented as vertical- and horizontal-tail contributions as well as total-tail-assembly derivatives.

The results of this investigation, which was made for a wider range of geometric variables than previous studies, showed trends which were in general agreement with the results of previous investigations. Also presented in this paper and used in the computations is an extensive table of values of sidewash due to a rectangular vortex.

INTRODUCTION

Accurate information regarding tail loads and the spanwise distribution of these loads during various maneuvers is required by the aircraft designer as a basis for structural design and for providing estimates of the tail contribution to aerodynamic derivatives. Some information on tail loads is available in references 1 to 4, for example. Reference 1 is a rather complete theoretical study of span load distributions of unswept-tail configurations in sideslip in which the effects of horizontal-tail span, vertical position, and geometric dihedral are considered. The study, however, is based on the assumption of minimum induced drag which leads to an excessive end-plate effect of the horizontal tail for the range of tail size usually considered (see ref. 2). The theoretical analysis of reference 2 for tails in sideslip is based on lifting line theory and deals only with tail configurations having semielliptical vertical tails and elliptical horizontal tails with equal and coincident root chords. References 3 and 4 present some experimental data on total loads for unswept tails in sideslip. The variety of tail configurations currently in use, however, has accentuated the need for information embracing a greater range of probable configurations. The present investigation was made to help fulfill this need. Span loads were calculated by a method generally referred to as the discrete-horseshoe-vortex (or finite-step) method. This method has been used extensively in estimating wing loadings (see ref. 5, for example); however, some calculations made in conjunction with the investigation of reference 4 indicated its applicability to the calculation of loads on intersecting surfaces (tail surfaces) in sideslip. Since the basic method is explained in detail in reference 5, only the pertinent details are included herein (see appendix A). The discrete-horseshoe-vortex method was used in the present investigation to obtain subsonic spanwise load distributions and resulting aerodynamic derivatives for a systematic series of tail configurations in sideslip and in steady roll. Also, the additional span loadings due to the dihedral angle of the horizontal-tail surfaces were determined for the sideslip case. Calculations were made for surfaces having unswept and 45° sweptback quarter-chord lines and a taper ratio of 0.5. The geometric variables covered in this investigation included vertical-tail aspect ratio, ratio of horizontal-tail aspect ratio to vertical-tail aspect ratio, and vertical location of the horizontal tail.

The contribution of Mr. M. J. Queijo to the present paper was submitted to the University of Virginia in partial fulfillment of the requirements for a degree of master of science.

SYMBOLS

The results presented herein are referred to the stability system of axes with the origin at the quarter chord of the vertical-tail root chord (see fig. 1).

A aspect ratio, b^2/S

b span, ft

S area, sq ft

c local chord, ft

$\bar{c}$	average geometric chord, ft
d	semispan of rectangular horseshoe vortex, ft
K	circulation strength, sq ft/sec
p	rate of roll, radians/sec
v	sidewash velocity relative to stability axes, ft/sec
v'	sidewash velocity relative to horseshoe vortex, ft/sec
w	downwash velocity, ft/sec
V	free-stream velocity, ft/sec
$U_{3c/4}$	component of free-stream velocity normal to surface at control point, ft/sec
Λ	angle of sweep of quarter-chord line, deg
β	sideslip angle, radians
Γ	dihedral angle of horizontal tail, radians
x,y,z	coordinate distances relative to stability system of axes
x',y',z'	nondimensional coordinate distances relative to axes located at center of each bound vortex so that x' and y' are always in plane of horseshoe vortex (made nondimensional by dividing distances in feet by horseshoe-vortex semispan)
N	number of horseshoe vortices representing configuration
ρ	mass density of air, slugs/cu ft
f(x',y',z')	general form for either downwash or sidewash velocity at any point (x',y',z') caused by rectangular horseshoe vortex of unit semispan and circulation strength of 4π
F(x',y')	downwash velocity of f(x',y',z')
F(x',y',z')	sidewash velocity of f(x',y',z')
C_Y	lateral-force coefficient, $\frac{\text{Lateral force}}{\frac{1}{2}\rho V^2 S_V}$
C_l	rolling-moment coefficient, $\frac{\text{Rolling moment}}{\frac{1}{2}\rho V^2 S_V b_V}$

C_L lift coefficient, $\frac{\text{Lift on right horizontal-tail semispan}}{\frac{1}{2}\rho V^2 S_V}$

c_l section lift coefficient, $\frac{\text{Section lift}}{\frac{1}{2}\rho V^2 c}$

$$C_{Y_\beta} = \frac{\partial C_Y}{\partial \beta}$$

$$C_{l_\beta} = \frac{\partial C_l}{\partial \beta}$$

$$C_{L_\beta} = \frac{\partial C_L}{\partial \beta}$$

$$\frac{C_{Y_\beta}}{\Gamma} = \frac{\partial C_{Y_\beta}}{\partial \Gamma}$$

$$\frac{C_{Y_\beta}}{\Gamma^2} = \frac{\partial C_{Y_\beta}}{\partial \Gamma^2}$$

$$\frac{C_{l_\beta}}{\Gamma} = \frac{\partial C_{l_\beta}}{\partial \Gamma}$$

$$\frac{C_{L_\beta}}{\Gamma} = \frac{\partial C_{L_\beta}}{\partial \Gamma}$$

$$C_{Y_p} = \frac{\partial C_Y}{\partial \frac{pb_V}{V}}$$

$$C_{l_p} = \frac{\partial C_l}{\partial \frac{pb_V}{V}}$$

$$C_{L_p} = \frac{\partial C_L}{\partial \frac{pb_V}{V}}$$

Subscripts:

n general symbol which when replaced by number refers to particular horseshoe vortex

h horizontal tail

v vertical tail

Subscripts used in the span load coefficients, such as $\left(\frac{cc_l}{\bar{c}\beta}\right)_v$, signify that c_l and the chords c and $\bar{c}$ are based on vertical-tail geometry.

PRELIMINARY REMARKS

The finite-step method used herein is an adaptation of the method which has been applied to computation of wing loads (ref. 5, for example), and only the essentials of the method with emphasis on the application to intersecting surfaces are presented herein. (See appendix A.)

For all the tail configurations considered herein, the vertical tail is represented by six and the horizontal tail by 12 equispan horseshoe vortices (see fig. 2), a representation which results in values of lift-curve slope approximately 10 percent greater than the values predicted by the Weissinger theory (see ref. 6). Use of fewer vortices would result in values much greater than could be expected experimentally. Use of more vortices would improve the accuracy, but any significant improvement could be obtained only by greatly increased computational time, which was not felt to be justified. It should be noted that in performing the calculations adjacent horseshoe vortices are assumed to have no gap between them so that the trailing vortices between adjacent horseshoes are coincident.

Each tail combination (horizontal plus vertical tail) is represented by a total of 18 horseshoe vortices, which results in a set of 18 simultaneous equations with 18 unknown vortex strengths. Since rolling and sideslip loads on the horizontal-tail semispans are antisymmetric (equal but of opposite sign on each side), the number of equations to be solved was reduced to 12. All solutions of simultaneous equations required in the present investigation were obtained by use of relay-type computers.

All calculations performed herein were made for a two-dimensional lift-curve slope of 2π and do not take Mach number effects into account. Methods of accounting for Mach number effects and for variations of the section lift-curve slope from 2π are discussed in reference 5. The angles β, Γ, and pb_V/V are assumed to be sufficiently small so that the sine of the angle can be replaced by the angle in radians and the cosine of the angle can be replaced by 1.0. It is further assumed that vertical displacements of the vortices of the horizontal tail due to dihedral angle can be neglected.

SCOPE

Calculations were made for a systematic series of vertical- and horizontal-tail combinations in sideslip and in steady roll. For these two conditions, three basic span loadings were obtained, two resulting from the sideslip condition and one from the steady-roll condition. The three cases considered are:

(1) Loads resulting from sideslipping tail combinations having horizontal tails with zero dihedral

(2) Loads resulting from sideslipping horizontal tails having dihedral, but with the vertical tail at zero sideslip

(3) Loads resulting from rolling of the tail combinations about an axis coinciding with the root chord of the vertical tail.

The loads calculated for case (2) should be considered as additional loads due to the horizontal-tail dihedral angle. It is assumed that, for the small angles considered herein, the total load in sideslip on any tail combination having dihedral can be obtained by the proper addition of the loads obtained from case (1) and case (2). In all three cases the additional restriction that the horizontal surface remain at zero geometric angle of attack was imposed.

Span loads and the resulting force and moment derivatives are presented for unswept and 45° sweptback tail combinations consisting of horizontal and vertical surfaces of 0.5 taper ratio. Calculations were made for vertical tails having aspect ratios of 1, 2, and 3. Corresponding to each vertical-tail aspect ratio, horizontal tails having aspect ratios 1, 2, and 3 times the vertical-tail aspect ratio were considered at three vertical locations - at the base, at the mid position, and at the top of the vertical tail. For each configuration the vertical- and horizontal-tail root chords were assumed equal so that at the base or low position the root chords of the vertical and horizontal tails coincided. At the mid and high positions, the tail surfaces were always arranged so that the quarter chord of the horizontal-tail root chord intersected the vertical-tail quarter-chord line. Specifying equal root chords for a given vertical-tail aspect ratio essentially means that variations in horizontal-tail aspect ratio are the result of changes in horizontal-tail span. The range of vertical- and horizontal-tail aspect ratios covered in this investigation is shown in figure 3.

PRESENTATION OF RESULTS

The results of the investigation are presented in three main groups. The first group contains span loads, the second contains stability derivatives, and the third contains force derivatives associated with the horizontal-tail loads. In order to facilitate location of information for a particular condition, the following breakdown of figures is given:

	Figure
Span loads:	
Span loads resulting from sideslip for $\Gamma = 0$	4 and 5
Span loads resulting from sideslip for $\Gamma \neq 0$	6 to 9
Span loads resulting from roll for $\Gamma = 0$	10 to 13
Stability derivatives:	
Derivatives resulting from sideslip for $\Gamma = 0$	14 to 21
Derivatives resulting from sideslip for $\Gamma \neq 0$	22 to 31
Derivatives resulting from roll for $\Gamma = 0$	32 to 39
Horizontal-tail force derivatives:	
Derivatives resulting from sideslip for $\Gamma = 0$	40 and 41
Derivatives resulting from sideslip for $\Gamma \neq 0$	42 and 43
Derivatives resulting from roll for $\Gamma = 0$	44 and 45

In all span-load figures, negative values of the vertical-tail load coefficient indicate a negative lateral force. The horizontal-tail load coefficients are for the right (positive) tail semispan facing into the wind, and positive values signify lift loads. Loads on the left semispan of the horizontal tail are equal in magnitude but opposite in sign to the loads on the right semispan for the corresponding spanwise station.

In order to provide an indication of the relative magnitudes of the vertical- and horizontal-tail contributions to the total derivative for a given tail configuration, all the derivatives are based on the geometry (area and span) of the vertical tail.

RESULTS AND DISCUSSION

Span Loads

Sideslip ($\Gamma = 0$).- The span loads due to sideslip of unswept tail combinations having horizontal tails of zero geometric dihedral are presented in figure 4. A large influence on the load distribution of the vertical tail is apparent for each of the three vertical-tail aspect ratios considered when the horizontal tail is located at either extremity of the vertical tail. This influence is usually referred to as end-plate effect. For these two positions, changes in horizontal-tail aspect ratio (or span), as indicated by variations in the ratio A_h/A_v to values greater than 1.0, do not appear to alter the general shape of the load distribution but merely provide changes in the magnitude of the end-plate effect. For the tail combinations considered, it appears that a rather large percentage of the maximum possible end-plate effect can be obtained by a relatively small horizontal tail.

The horizontal tails located at the middle of the vertical tail had no appreciable effect on the vertical-tail span load.

The span loads induced on the horizontal tails are also presented in figure 4 and the results indicate that rather large magnitudes can be obtained by locating the horizontal tails at either extremity of the vertical tail. Of particular interest is the direction of the loads for these two horizontal-tail positions. For the high position the induced load results in a positive lift force whereas for the low or base position negative lift forces are obtained. The results presented in figure 4 are only for the right semispan of the horizontal tail and, as indicated previously, the loads on the left semispan are equal in magnitude but opposite in sign. Consequently, there results, for the complete tail configuration, a zero lift force. The loadings do, however, produce a shear load and a twisting or rolling moment about the root chord of the horizontal tail and about the stability roll axis located at the base of the vertical tail that could be of importance both structurally and from a stability viewpoint. For horizontal tails located at the mid position, the loads indicated for all three values of A_v can be traced directly to the effect of vertical-tail taper ratio.

Presented in figure 5 are corresponding tail configurations with all surfaces swept back 45°. In general, the results are similar to those for the unswept tail assemblies; however, a comparison of figures 4 and 5 shows that sweep does reduce the magnitude of the span load coefficients slightly and also reduces the effect of the ratio A_h/A_v on both the vertical- and horizontal-tail load distribution. For the sweptback tail configurations the load on the horizontal tail when at the mid position is almost nonexistant for all three values of A_v considered. In addition, for the larger vertical-tail aspect ratio considered $\left(A_v = 3.0\right)$, sweep appears to reverse the usual span effect on the vertical-tail load distribution in the region near the horizontal tail for the high and low horizontal-tail locations.

Sideslip of horizontal tail with dihedral.- As pointed out previously, these loads were calculated for the condition where a horizontal tail having dihedral was in sideslip while the vertical tail remained alined with the relative wind. Such a condition permits an evaluation of the additional load due to horizontal-tail dihedral angle. Results of calculation of the additional span load distribution on the vertical and horizontal surfaces of unswept tail configurations resulting from sideslip of the horizontal tail with dihedral are presented in figure 6. The induced loading on the vertical tail is such that the direction of the load is opposite for high and low horizontal-tail configurations. A similar condition exists for the horizontal tail in the mid position where the vertical-tail loads above and below the horizontal tail also have opposite signs. The magnitude of the induced loads on the vertical tail depends rather strongly on the horizontal-tail aspect ratio or span and indicates an increase in load for an increase in A_h.

The span load distributions on the horizontal tail and the effect of the ratio A_h/A_v on these loads are about as would be expected. For horizontal tails in the low and high positions, the load appears to drop off in the region near the vertical tail. This condition also appears, but to a much lesser extent, for some configurations having horizontal tails at the mid position. A consideration of the load distributions on isolated sideslipping horizontal tails having dihedral (see fig. 7) shows that the span load coefficients have a value of zero at the root chord. The induced effects on the horizontal tail due to the presence of the load on the vertical tail account for the value of the span load coefficient at the horizontal-tail root chord in figure 6. It is apparent therefore that mutual induced effects occur and that the decrease in load in the vicinity of the vertical tail which occurs for the high and low horizontal-tail positions and which is not so pronounced for the mid position is the result of difference in magnitude of the circulation change on the vertical tail at the respective positions.

In figure 8 the loading due to dihedral angle is shown for 45° sweptback tail combinations. The results indicated for the horizontal-tail load distribution are, in general, similar to those for unswept configurations. The effect of sweep on the horizontal-tail load is to reduce the load and cause it to shift outboard. Sweep appears to reduce considerably the induced load on the vertical tail when the horizontal tail is in the high position. In fact, increasing vertical-tail aspect ratio for this horizontal-tail position reduces the induced load and the effect of the A_h/A_v ratio until a negligible effect of the ratio A_h/A_v remains for the case where $A_v = 3.0$. A similar trend is indicated for the vertical-tail area below the horizontal tail when the mid position is employed. The load distribution on the vertical tail above the horizontal tail when in the mid and low positions is similar to the unswept configurations but of reduced magnitude.

Steady roll.- Calculated span load distributions on the vertical and horizontal surfaces of unswept tail configurations in steady roll about an axis alined with the vertical-tail root chord are presented in figure 10. The results indicate that vertical location and aspect ratio of the horizontal tail have a large influence on the span load distribution of the vertical tail, as does, of course, vertical-tail aspect ratio. Locating horizontal tails in the high position produces an induced effect that increases the loading across the entire vertical-tail span. At the mid horizontal-tail position, the load induced on the vertical tail appears somewhat similar to the load due to dihedral effect in that the induced portion of the span load coefficient has the opposite sign for stations above and below the horizontal tail. At the low horizontal-tail position, the larger horizontal tails produced a reduction in the total load carried on the vertical tail as compared with the results for vertical tail alone. Of particular interest at the low position for all three vertical-tail aspect ratios considered for an A_h/A_v value of 3 is the reversal of load in the region near the horizontal tail. It appears that a reversal of the side force from negative to positive and a possible reversal in the vertical-tail contribution to the damping in roll could result only for rather extreme tail configurations consisting of a horizontal tail of high aspect ratio in combination with a vertical tail of small aspect ratio.

As would be expected, the loads on the horizontal tail for a given vertical-tail aspect ratio appear to vary almost directly with horizontal-tail aspect ratio. A comparison of the results in figures 10(a), (b), and (c) for equivalent horizontal-tail aspect ratios indicates that the vertical-tail aspect ratio has some influence on the horizontal-tail load. In addition, it is apparent that vertical location of the horizontal tail also influences the span loads on the horizontal tail, particularly in the region near the vertical tail. This influence can be seen by noting the values of the span load coefficients at the root chord of the horizontal tail for a given vertical-tail aspect ratio and value of A_h/A_v. For the right semispan the span load coefficient has larger positive values at the high tail positions than at the low tail positions. In fact, for the low positions a reversal in the direction of the load is indicated for the region near the vertical tail for all three vertical-tail aspect ratios considered when the ratio A_h/A_v has a value of 1.0.

Figure 12 presents the calculated span loadings for 45° sweptback surfaces of tail combinations in steady roll. A comparison of figures 10 and 12 for corresponding configurations indicates that the most noticeable effects of sweep are a reduction in magnitude of the load on the horizontal tail and the shifting of the load outboard toward the tips for both the vertical and horizontal tails. In addition, figure 12 indicates that the effect of the ratio A_h/A_v on the vertical-tail load distribution decreases with an increase in vertical-tail aspect ratio for the three vertical positions of the horizontal tail.

Stability Derivatives

Sideslip ($\Gamma = 0$).- The lateral-force and rolling-moment stability derivatives C_{Y_β} and C_{l_β} are obtained from an integration of the span load distributions. Since the dihedral angle is zero for the horizontal tail, the derivative C_{Y_β} results only from the vertical-tail load. The C_{l_β} derivative, however, is composed of contributions from both the vertical- and horizontal-tail loads and represents, of course, the result for the complete tail configuration. The separate contributions of the vertical and horizontal tails $\left(C_{l_\beta}\right)_v$ and $\left(C_{l_\beta}\right)_h$, respectively, are also presented. Since the span loadings were obtained in the form of step loads, the integrations to obtain the resulting derivatives were performed on the step loadings and not on the faired loading curves shown in figures 4 and 5. (See appendix A.) Furthermore, to enable a direct comparison to be made of the magnitudes of the vertical- and horizontal-tail combinations, all derivatives are based on the vertical-tail area and span as indicated previously. Basing the derivatives on vertical-tail geometry not only applies for the side-slipping tail assembly results but also to the results of dihedral effect and steady roll.

The C_{Y_β} results for the unswept-tail combinations shown in figure 14 and for the swept configurations in figure 15 are plotted against the ratio A_h/A_v. The results for the unswept configurations show that an appreciable increase in C_{Y_β} can be obtained with horizontal tails located at either extremity of the vertical tail. The major increases in C_{Y_β} were obtained by increasing the value of A_h/A_v to about 1.0. The results show that this limiting value of A_h/A_v is a function of vertical-tail aspect ratio and that it increases as vertical-tail aspect ratio decreases. Further increases in this ratio above the limiting value produced negligible increases in end-plate effect. The maximum end-plate effect obtained by placing the horizontal tail at the extremities of the vertical tail appeared as an increase in C_{Y_β}, which amounted to a 20-percent increase for the high-aspect-ratio vertical tail and a 50-percent increase for the low-aspect-ratio vertical tail. Similar trends are indicated for the 45° sweptback surfaces presented in figure 15, particularly for the low horizontal-tail position. For the high horizontal-tail position, the effect of sweep appears to reduce the available end-plate effect for corresponding unswept tail configurations, particularly as vertical-tail aspect ratio is increased. For example, the curve for the swept configuration having a vertical tail of aspect ratio 3.0 indicates that the end-plate effects available by increasing the ratio A_h/A_v are almost negligible. The effect of sweep on the calculated C_{Y_β} for all three vertical locations of the horizontal tail is also apparent in the reduction of the magnitude of C_{Y_β} for equivalent tail aspect ratios and in the spread between the curves for different A_v values. In addition, increasing the ratio A_h/A_v had no effect on C_{Y_β} when the horizontal tail was placed at the center of the vertical tail.

A comparison of the unswept-tail results for the low and high horizontal-tail positions gives an indication of the magnitude of the effect of vertical-tail taper ratio on the available end-plate effect (for vertical tail of taper ratio 1.0 identical values for C_{Y_β} result for equivalent tail sizes). Comparing the results for high and low horizontal-tail locations for an A_v value of 1.0 for the unswept configurations indicates little difference; but as A_v is increased to 3.0, for example, the maximum available end-plate effect for high horizontal-tail locations is only about two-thirds of that indicated for the low position. Similar comparisons of the results for the swept configurations cannot effectively be made since the necessary differentiation between sweep angle and vertical-tail taper-ratio effects is almost impossible to perform for the limited range of tail configurations presented herein.

The estimated rolling-moment derivatives $\left(C_{l_\beta}\right)_v$, $\left(C_{l_\beta}\right)_h$, and C_{l_β} are presented in figures 16, 17, and 18, respectively, for the unswept tail configurations, and in figures 19, 20, and 21 for the 45° sweptback configurations. The results show that the horizontal tail at either extremity of the vertical tail contributes to the total rolling-moment coefficient in two ways. First, the horizontal tail acts as an end plate on the vertical tail, and thus increases the vertical-tail load and its resultant moment. Second, the horizontal tail has on it an induced load which results in a rolling moment of large magnitude when the aspect ratio (or span) is large. The direction as well as the magnitude of the loads on the horizontal tail depends on the vertical position of the horizontal tail. Thus, when the horizontal tail is in the high position the vertical- and horizontal-tail rolling moments are additive, while the moments subtract when the horizontal tail is in the low position. The induced load and rolling-moment contribution of the horizontal tail is small when the horizontal tail is at the center of the vertical tail.

The effects of sweep on the tail rolling moments appear to be rather small, particularly when the tails considered are of low aspect ratio. The moments of the surfaces having higher aspect ratios are slightly smaller for 45° sweptback tails than for unswept tails of the same aspect ratio.

Sideslip of horizontal tails with dihedral.- The additional loading on tail surfaces due to horizontal-tail dihedral causes both the horital tail and vertical tail to contribute to the lateral force coefficient. The vertical-tail force is a result of an induced load, whereas the horizontal-tail force is caused primarily by the lateral tilt of the lift vectors through an angle equal to the dihedral angle. The vertical-tail contribution is proportional to the dihedral angle, whereas the horizontal-tail contribution is proportional to the square of the dihedral angle. The results are shown in figures 22 and 23 for unswept tails and in figures 24 and 25 for 45° sweptback tails.

The contributions of the tail surfaces to the rolling moment are shown in figures 26 to 28 for unswept surfaces and in figures 29 to 31 for 45° sweptback surfaces. The results for both the unswept and swept tails indicate that the dominating effect is horizontal-tail size as indicated by the ratio A_h/A_v. For the unswept cases a small effect of vertical location is also evident, and from the separated contributions of the vertical and horizontal tails, it is apparent that most of the height effect is the result of differences in loading on the vertical tail. The calculations for $\left(\frac{C_{l_\beta}}{\Gamma}\right)_v$ for the unswept tails indicate that the effect of the vertical-tail aspect ratio is negligible. The usual effects of sweep, that is, a reduction in the magnitude of the derivatives for equivalent configurations and a reduction in the spread between the curves for comparable figures, are apparent. The calculated results for $\left(\frac{C_{l_\beta}}{\Gamma}\right)_v$ for the swept tails indicate that A_v has a slight effect for horizontal tails at the top of the vertical tail. The net result on $\frac{C_{l_\beta}}{\Gamma}$ for the complete configurations for variations in height is that an increase in height increases the magnitude of $\frac{C_{l_\beta}}{\Gamma}$ for vertical tails of aspect ratios 1 and 2; however, for $A_V = 3.0$ the opposite trend is observed for tails at the mid and high positions.

Steady roll.- The results obtained for lateral force due to roll are shown in figures 32 and 33 for unswept and 45° sweptback tails, respectively. The results show that C_{Y_p}, which is contributed only by the vertical tail, is largely affected by horizontal-tail aspect ratio if the horizontal tail is at either extremity of the vertical tail. Increasing the aspect ratio of the low horizontal tail causes C_{Y_p} to decrease in magnitude, whereas the opposite is true for the high horizontal tail. This effect is, of course, a consequence of the changes in vertical-tail span load caused by the horizontal-tail load. (See figs. 10 and 12.)

The calculated results for the damping in roll contributed by the unswept vertical tail, horizontal tail, and complete tail assemblies are shown in figures 34, 35, and 36, respectively. As expected, the results of figure 36 indicate that horizontal-tail aspect ratio or span, as indicated by the ratio A_h/A_V for a given value of A_V, has an appreciable influence on the resulting C_{l_p} of the tail assembly. What is of interest, however, is that for the low and mid horizontal-tail positions the ratio A_h/A_V has an influence only when the horizontal tail is larger than the vertical tail. For the range of values of A_h/A_V from 0 to 1.0 for the low and mid locations, the almost constant value of C_{l_p} appears to be essentially the result of two opposing effects. Consider, for example, the horizontal-tail contribution for the low horizontal-tail position as indicated in figure 35. An induced load exists on the horizontal tail similar to the sideslip load shown in figure 4, a result of the presence of the horizontal tail at the base of the vertical tail that is carrying a load. Superimposed on this load is a load due to steady rolling (fig. 11). These two loads oppose one another and tend to cancel. When the horizontal tail is of low aspect ratio, the resultant moment from the aforementioned loads is very small. For tail combinations with high-aspect-ratio horizontal tails, the rolling moment due to rolling predominates. A similar effect occurs on the vertical tail in that the end-plate effect tends to increase the rolling load on the vertical tail, and the rolling load on the horizontal tail induces a sidewash which tends to decrease it. The interaction of these loads is such that $\left(C_{l_p}\right)_V$ is only slightly influenced by the horizontal-tail aspect ratio, at least for the range of size presented here.

For the high horizontal-tail location similar effects on $\left(C_{l_p}\right)_v$ and $\left(C_{l_p}\right)_h$ occur; however, for this configuration the induced end-plate loads are in the same direction as the rolling loads.

The results for $\left(C_{l_p}\right)_v$, $\left(C_{l_p}\right)_h$, and $\left(C_{l_p}\right)$ for the 45° sweptback tail configurations are presented in figures 37, 38, and 39, respectively. A comparison of the results for the unswept and swept tails indicates the usual effects of sweep, such as, a reduction in the magnitude of the derivatives for corresponding configurations, a reduction in effects of aspect ratio of the tail surfaces involved, and a reduction in effects of vertical position of the horizontal tail.

CONCLUDING REMARKS

Subsonic span loads and the resulting contribution to the stability derivatives have been calculated for a systematic series of vertical- and horizontal-tail combinations in sideslip and in steady roll. All calculations were made by application of the discrete-horseshoe-vortex method to the problem of estimating loads on intersecting surfaces. The investigation covered variations in vertical-tail aspect ratio, the ratio of horizontal-tail aspect ratio to vertical-tail aspect ratio, the effects of horizontal-tail dihedral angle (for the sideslip case), and the effects of vertical position of the horizontal tail for surfaces having their quarter-chord lines swept back 0° and 45°. The results of the investigation are presented in charts from which the span loads for the various conditions can be obtained. The resulting stability derivatives are presented as vertical- and horizontal-tail contributions as well as total tail-assembly derivatives.

The results of this investigation, which was made for a wider range of geometric variables than previous studies, showed trends which were in general agreement with the results of previous investigations. Also presented in this paper is an extensive table of values of sidewash due to a rectangular vortex, which was used in the computations.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., June 29, 1954.

APPENDIX A

THEORETICAL CONSIDERATIONS

Applying the discrete-horseshoe-vortex method of determining span loads to a vertical- and horizontal-tail combination involves the representation of the surfaces by a finite number N of horseshoe vortices. (See fig. 2.) This procedure is equivalent to an approximation of the actual span load by means of a finite number of steps. After the circulation strength of each horseshoe vortex has been found, the local section force coefficient can be determined and integrated to yield the corresponding force and moment derivatives.

In this finite-step method the horseshoe vortices are so located that the center of each bound vortex lies on the surface quarter-chord line. The trailing legs of each vortex are contained in the plane of the surface and extend to infinity. The boundary condition to be applied is that the air flow is tangential to the surface at specified control points. These control points are located along the three-quarter-chord line at the midspan of each horseshoe vortex. For a tail configuration represented by N horseshoe vortices, there exist, of course, N control points; and the boundary condition is satisfied at each by equating the normal velocity arising from the complete vortex system to the component of the free-stream velocity normal to the surface at that point. This method yields a set of N simultaneous equations with one equation for each of the N control points. These equations are of the form

$$U_{3c/4} = \sum_{n=1}^{N} \frac{K_n}{4\pi d} f_n(x',y',z') \qquad (1)$$

The normal velocity component at any control point resulting from a system of horseshoe vortices representing two intersecting surfaces consists of the downwash contributed by all horseshoe vortices contained in the same plane as the control point plus the sidewash generated by all horseshoe vortices located in the intersecting plane. Reference 7 presents general expressions for the downwash and sidewash velocity components due to a single rectangular horseshoe vortex referred to a set of Cartesian coordinates with the origin located at the midpoint of the bound vortex. Nondimensionalizing the three coordinate distances appearing in the equations with respect to the vortex semispan and rearranging the terms yields the following expressions: For the downwash velocity w in the plane of a rectangular horseshoe vortex $(z' = 0)$,

$$w\frac{4\pi d}{K} = \frac{1}{x'}\left[\frac{y' + 1}{\sqrt{x'^2 + (y' + 1)^2}} - \frac{y' - 1}{\sqrt{x'^2 + (y' - 1)^2}}\right] -$$

$$\frac{1}{y' - 1}\left[1 + \frac{x'}{\sqrt{x'^2 + (y' - 1)^2}}\right] + \frac{1}{y' + 1}\left[1 + \frac{x'}{\sqrt{x'^2 + (y' + 1)^2}}\right] \tag{2}$$

and for the sidewash velocity v' at any point on an intersecting plane

$$v'\frac{4\pi d}{K} = \frac{z'}{z'^2 + (y' + 1)^2}\left[1 + \frac{x'}{\sqrt{x'^2 + z'^2 + (y' + 1)^2}}\right] -$$

$$\frac{z'}{z'^2 + (y' - 1)^2}\left[1 + \frac{x'}{\sqrt{x'^2 + z'^2 + (y' - 1)^2}}\right] \tag{3}$$

The right-hand side of equation (2) is defined herein as $F(x',y')$. Tabulated values of this function are available in various publications for a wide range of x' and y' values. (For example, see ref. 8.) Tables of the corresponding function $F(x',y',z')$ of equation (3) were not available and, consequently, the function was evaluated and tabulated for the x', y', and z' values applicable to the present investigation. (See appendix B.)

In the present investigation the vertical tail is represented by a system of six and the horizontal tail by 12 equispan rectangular horseshoe vortices. Each of the three basic types of loading investigated for each tail configuration leads to antisymmetrical load distributions on the horizontal tail. The loads carried on each semispan of the horizontal tail have the same magnitude and distribution but are opposite in sign. (For example, in fig. 2, $K_1 = -K_{12}$, $K_2 = -K_{11}$, etc.) Since this particular condition exists and since six horseshoe vortices were located on each semispan of the horizontal tail, the number of equations to be solved can be reduced from 18 to 12. If the circulation strengths K_n are assumed to be positive for the representation shown in figure 2, the form of the simultaneous equations becomes

$$U_{3c/4} = \sum_{n=1}^{n=6} \frac{K_n}{4\pi d_h} \left[f_n(x',y',z') - f_{13-n}(x',y',z') \right] \pm \sum_{n=13}^{n=18} \frac{K_n}{4\pi d_v} f_n(x',y',z') \qquad (4)$$

The summation from $n = 1$ to $n = 6$ represents the horizontal-tail contribution, and the summation from $n = 13$ to $n = 18$ represents the vertical-tail contribution. The sign preceding the second summation depends on where $U_{3c/4}$ is being computed. The plus sign is for horizontal-tail control points and the minus sign for vertical-tail control points. The term $U_{3c/4}$ represents the boundary conditions at a given control point and is usually replaced by a more appropriate form depending, of course, on the type of maneuver under consideration. The boundary conditions associated with tail combinations in sideslip and steady roll are as follows:

Case	Type of maneuver	Boundary conditions, $U_{3c/4}$	
		Horizontal tail	Vertical tail
(1)	Sideslip, $\Gamma = 0$	0	$V\beta$
(2)	Sideslip of horizontal tails, vertical tail at $\beta = 0$, $\Gamma \neq 0$	$V\beta\Gamma$	0
(3)	Roll	$\frac{pb_v}{V} \frac{y}{b_v}$	$\frac{pb_v}{V} \frac{z}{b_v}$

In case (3), the y and z coordinates appearing in the boundary conditions represent distances measured to each control point under consideration relative to the stability system of axes for the complete tail configuration and should not be confused with the primed values used previously. Substituting these boundary values into equation (4) for the appropriate control points and dividing through by $V\beta$, $V\Gamma\beta$, and $V\frac{\left(pb_v\right)}{V}$ for cases (1), (2), and (3), respectively, yield 12 simultaneous equations with 12 unknowns. As an illustrative example, case (1) in a more reduced form can be expressed in the following manner:

For control points located on the horizontal tail, that is, points 1 to 12 (see fig. 2),

$$0 = \sum_{n=1}^{n=6} \frac{K_n}{4\pi d_h V\beta} \left[F_n(x',y') - F_{13-n}(x',y') \right] +$$

$$\sum_{n=13}^{n=18} \frac{K_n}{4\pi d_v V\beta} F_n(x',y',z') \tag{5}$$

For control points on the vertical tail (13 to 18),

$$1 = \sum_{n=1}^{n=6} \frac{K_n}{4\pi d_h V\beta} \left[F_n(x',y',z') - F_{13-n}(x',y',z') \right] -$$

$$\sum_{n=13}^{n=18} \frac{K_n}{4\pi d_v V\beta} F_n(x',y') \tag{6}$$

The simultaneous equations of this type obtained for the various flow conditions can be solved for terms which yield the span loads. Now, if the term containing the unknown circulation strengths and boundary conditions is designated as load coefficient, then the load coefficient for the three cases considered herein can be obtained as follows:

For case (1),

$$\frac{K}{4\pi d_h V\beta} \text{ and } \frac{K}{4\pi d_v V\beta}$$

For case (2),

$$\frac{K}{4\pi d_h V\beta \Gamma} \text{ and } \frac{K}{4\pi d_v V\beta \Gamma}$$

For case (3),

$$\frac{K}{4\pi d_h \frac{pb_v}{V} V} \quad \text{and} \quad \frac{K}{4\pi d_v \frac{pb_v}{V} V}$$

The two load coefficients represented for each case differ only in the terms d_h and d_v appearing in the denominator. This difference is the result of using horseshoe vortices of different spans to represent the vertical and horizontal tails. A more convenient and useful form of the load coefficients can be derived by utilizing the well-known Kutta-Joukowski equation

$$l = \rho V K$$

where l is the load per unit span. By use of this equation, the following relationships can be obtained:

$$\left.\begin{aligned}
\left(\frac{cc_y}{\bar{c}\beta}\right)_v &= \frac{K_n}{4\pi d_v V\beta}\,\frac{4\pi A_v}{N_v} = 2.0944\ A_v\,\frac{K_n}{4\pi d_v V\beta} \\
\left(\frac{cc_l}{\bar{c}\beta}\right)_h &= 1.0472\ A_h\,\frac{K_n}{4\pi d_h V\beta} \\
\left(\frac{cc_y}{\bar{c}\beta\Gamma}\right)_v &= 2.0944\ A_v\,\frac{K_n}{4\pi d_v V\beta\Gamma} \\
\left(\frac{cc_l}{\bar{c}\beta\Gamma}\right)_h &= 1.0472\ A_h\,\frac{K_n}{4\pi d_h V\beta\Gamma} \\
\left(\frac{cc_y}{\bar{c}\,\frac{pb_v}{V}}\right)_v &= 2.0944\ A_v\,\frac{K_n}{4\pi d_v \frac{pb_v}{V} V} \\
\left(\frac{cc_l}{\bar{c}\,\frac{pb_v}{V}}\right)_h &= 1.0472\ A_h\,\frac{K_n}{4\pi d_h \frac{pb_v}{V} V}
\end{aligned}\right\} \tag{7}$$

Proper summation of these span load coefficients yields several of the more important aerodynamic derivatives. These derivatives and their corresponding summations are listed in table I.

APPENDIX B

SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX

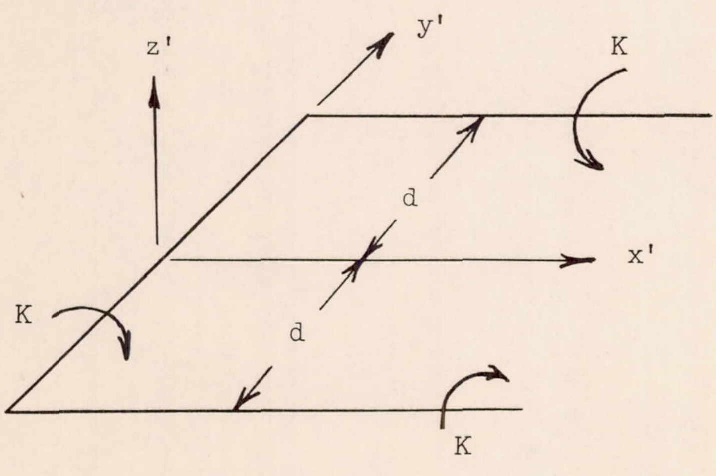
The sidewash due to a rectangular vortex of semispan d can be determined from the following equation:

$$F(x',y',z') = v' \frac{4\pi d}{K}$$

$$= \frac{z}{z'^2 + (y' + 1)^2}\left[1 + \frac{x'}{\sqrt{x'^2 + z'^2 + (y' + 1)^2}}\right] -$$

$$\frac{z'}{z'^2 + (y' - 1)^2}\left[1 + \frac{x'}{\sqrt{x'^2 + z'^2 + (y' - 1)^2}}\right] \qquad (8)$$

The x', y', and z' components are nondimensional distances (multiples of d) and are defined relative to the horseshoe vortex as indicated in the following sketch:



Equation (8) has been evaluated for the values of x', y', and z' required for the present investigation, and the results are presented in table II.

All y' and z' values of the table are positive. A change in sign of y' or z' changes the sign of $F(x',y',z')$. If both y' and z' are negative, then $F(x',y',z')$ retains the sign given in the table. Values of the function at points not given in the table can be obtained by careful interpolation, provided that $F(x',y',z')$ is not changing very rapidly with x', y', or z'. If $F(x',y',z')$ is changing rapidly, it is advisable to compute the actual value by use of equation (8).

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TABLE I

EQUATIONS FOR DETERMINING AERODYNAMIC

DERIVATIVES FROM SPAN LOADS

Derivatives	Vertical-tail contribution	Horizontal-tail contribution
C_{Y_β}	$\frac{1}{6}\sum_{n=13}^{n=18} 2.0944A_v \frac{K_n}{4\pi d_v V\beta}$	
C_{l_β}	$\frac{1}{6}\sum_{n=13}^{n=18} 2.0944A_v \frac{K_n}{4\pi d_v V\beta} \frac{z_n}{b_v}$	$-\frac{1}{6}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h V\beta} \frac{y_n}{b_v}$
C_{Y_β}/Γ	$\frac{1}{6}\sum_{n=13}^{n=18} 2.0944A_v \frac{K_n}{4\pi d_v V\beta\Gamma}$	
C_{Y_β}/Γ^2		$-\frac{1}{6}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h V\beta\Gamma}$
C_{l_β}/Γ	$\frac{1}{6}\sum_{n=13}^{n=18} 2.0944A_v \frac{K_n}{4\pi d_v V\beta\Gamma} \frac{z_n}{b_v}$	$-\frac{1}{6}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h V\beta\Gamma} \frac{y_n}{b_v}$
C_{Y_p}	$\frac{1}{6}\sum_{n=13}^{n=18} 2.0944A_v \frac{K_n}{4\pi d_v \frac{pb_v}{V}}$	
C_{l_p}	$\frac{1}{6}\sum_{n=13}^{n=18} 2.0944A_v \frac{K_n}{4\pi d_v \frac{pb_v}{V} V} \frac{z_n}{b_v}$	$-\frac{1}{6}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h \frac{pb_v}{V} V} \frac{y_n}{b_v}$
C_{L_β}		* $\frac{1}{12}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h V\beta}$
C_{L_β}/Γ		* $\frac{1}{12}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h V\beta\Gamma}$
C_{L_p}		* $\frac{1}{12}\sum_{n=1}^{n=6} 1.0472 \frac{{A_h}^2}{A_v} \frac{K_n}{4\pi d_h \frac{pb_v}{V} V}$

*Right semispan only.

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 0.5000						
-7.9444	------	------	------	------	------	0.0003
-6.6667	------	------	------	------	------	.0004
-5.9444	------	------	------	------	0.0007	------
-4.6667	------	------	------	------	.0010	------
-3.9444	------	------	------	0.0019	------	------
-2.8333	------	------	------	------	------	.0010
-2.6667	------	------	------	.0029	------	------
-1.9444	------	------	0.0079	------	------	------
-.8333	------	------	------	------	.0024	------
-.6667	------	------	.0135	------	------	------
.0556	------	0.0896	------	------	------	------
1.1667	------	------	------	.0075	------	------
1.3333	------	.1411	------	------	------	------
1.4444	3.7048	.1440	.0241	.0079	.0035	.0018
1.6667	3.7240	.1490	.0250	.0081	.0036	.0019
1.8889	3.7362	.1533	.0259	.0084	.0037	.0019
2.0556	3.7426	------	------	------	------	------
2.1111	3.7443	.1568	.0267	.0086	.0038	.0020
2.1667	3.7459	.1575	.0269	.0087	.0038	.0020
2.3333	3.7498	.1596	.0274	.0088	.0038	.0020
2.5000	3.7528	.1614	.0279	.0090	.0039	.0020
2.5556	3.7536	.1620	.0281	.0090	.0039	.0020
2.8333	3.7568	.1643	.0288	.0093	.0040	.0021
3.1667	3.7593	.1665	.0296	.0096	.0042	.0021
3.3333	3.7602	------	------	------	------	------
3.5000	3.7609	.1681	.0302	.0098	.0043	.0022
3.8333	3.7619	.1693	.0308	.0101	.0045	.0023
4.0556	3.7625	------	------	------	------	------
4.3333	3.7630	.1706	.0315	.0104	.0045	.0023
5.0000	3.7637	.1717	.0321	.0107	.0047	.0024
5.1667	------	.1719	------	------	------	------
5.3333	3.7639	------	------	------	------	------
5.6667	3.7641	.1724	.0326	.0110	.0048	.0025
6.0556	------	.1726	------	------	------	------
6.3333	3.7643	.1728	.0329	.0112	.0050	.0026
7.0000	3.7644	.1731	.0332	.0114	.0051	.0026
7.1667	3.7644	------	------	------	------	------
7.3333	------	.1732	------	------	------	------
7.6667	3.7645	.1733	.0334	.0115	.0051	.0027
8.0556	------	------	.0334	------	------	------
9.1667	3.7646	------	------	------	------	------
9.3333	------	------	.0336	------	------	------
10.0556	------	------	------	.0118	------	------
11.1667	------	.1736	------	------	------	------
11.3333	------	------	------	.0118	------	------
12.0556	------	------	------	------	.0054	------
12.1250	------	------	------	------	.0054	------
13.1667	------	------	.0339	------	------	------
13.3333	------	------	------	------	.0054	------
14.0556	------	------	------	------	------	.0030
15.1667	------	------	------	.0120	------	------
15.3333	------	------	------	------	------	.0030
17.1667	------	------	------	------	.0055	------
19.1667	------	------	------	------	------	.0030

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 0.6667						
-10.7037	------	------	------	------	------	0.0003
-10.2593	------	------	------	------	------	.0003
-10.2222	------	------	------	------	------	.0003
-9.5556	------	------	------	------	------	.0003
-9.0741	------	------	------	------	------	.0004
-8.7778	------	------	------	------	------	.0004
-8.7037	------	------	------	------	0.0005	------
-8.6296	------	------	------	------	------	.0004
-8.4444	------	------	------	------	------	.0004
-8.2593	------	------	------	------	.0005	------
-8.2222	------	------	------	------	.0005	------
-7.7778	------	------	------	------	.0006	------
-7.7037	------	------	------	------	------	.0005
-7.5556	------	------	------	------	.0006	------
-7.4444	------	------	------	------	------	.0005
-7.0741	------	------	------	------	.0007	------
-6.7778	------	------	------	------	.0008	------
-6.7037	------	------	------	0.0010	------	------
-6.6296	------	------	------	------	.0008	------
-6.5556	------	------	------	------	------	.0006
-6.4444	------	------	------	------	.0008	------
-6.2593	------	------	------	.0011	------	------
-6.2222	------	------	------	.0012	------	------
-5.7778	------	------	------	------	.0010	------
-5.5556	------	------	------	.0015	------	------
-5.4444	------	------	------	------	.0011	------
-5.2222	------	------	------	------	------	.0008
-5.0741	------	------	------	.0017	------	------
-4.7778	------	------	------	.0019	------	------
-4.7037	------	------	0.0028	------	------	------
-4.6296	------	------	------	.0020	------	------
-4.5556	------	------	------	------	.0014	------
-4.4444	------	------	------	.0021	------	------
-4.2593	------	------	.0034	------	------	------
-4.2222	------	------	.0035	------	------	------
-3.7778	------	------	------	.0027	------	------
-3.5556	------	------	.0048	------	------	------
-3.4444	------	------	------	.0030	------	------
-3.2222	------	------	------	------	.0019	------
-3.0741	------	------	.0061	------	------	------
-2.7778	------	------	.0070	------	------	------
-2.7037	------	0.0137	------	------	------	------
-2.6293	------	------	.0075	------	------	------
-2.5556	------	------	------	.0040	------	------
-2.4444	------	------	.0082	------	------	------
-2.2593	------	.0195	------	------	------	------
-2.2222	------	.0201	------	------	------	------
-1.7778	------	------	.0111	------	------	------
-1.5556	------	.0349	------	------	------	------
-1.4444	------	------	.0129	------	------	------
-1.2222	------	------	------	.0059	------	------
-1.0741	------	.0518	------	------	------	------
-.7778	------	.0652	------	------	------	------
-.7037	0.3086	------	------	------	------	------
-.6296	------	.0728	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 0.6667						
-0.5556	------	------	0.0184	------	------	------
-.4444	------	0.0829	------	------	------	------
-.2593	0.8246	------	------	------	------	------
-.2222	.8914	------	------	------	------	------
.2222	------	.1230	------	------	------	------
.4444	2.1511	------	------	------	------	------
.5556	------	.1422	------	------	------	------
.7778	------	------	.0276	------	------	------
.9259	2.5070	------	------	------	------	------
.9630	2.5210	.1624	.0287	0.0096	0.0043	0.0023
1.1111	2.5663	.1687	.0297	.0098	.0044	.0023
1.2222	2.5916	------	------	------	------	------
1.2593	2.5988	.1744	.0305	.0101	.0045	.0024
1.3704	2.6171	------	------	------	------	------
1.4074	2.6223	.1795	.0314	.0103	.0046	.0024
1.4444	2.6272	.1806	.0316	.0104	.0046	.0024
1.5556	2.6397	.1840	.0322	.0105	.0047	.0025
1.6667	2.6497	.1871	.0328	.0107	.0047	.0025
1.7037	2.6526	.1880	.0330	.0108	.0047	.0025
1.8889	2.6644	.1924	.0339	.0110	.0049	.0025
2.1111	2.6742	.1969	.0349	.0114	.0050	.0026
2.2222	2.6779	------	------	------	------	------
2.3333	2.6810	.2005	.0359	.0117	.0051	.0027
2.5556	2.6857	.2036	.0367	.0119	.0052	.0027
2.7778	------	.2060	------	------	------	------
2.8889	2.6904	.2071	.0379	.0123	.0054	.0028
3.3333	2.6941	.2105	.0392	.0128	.0056	.0029
3.4444	2.6947	------	------	------	------	------
3.7778	2.6962	.2128	.0402	.0133	.0058	.0030
4.2222	2.6974	.2144	.0410	.0136	.0060	.0031
4.6667	2.6982	.2156	.0417	.0139	.0061	.0032
4.7778	2.6984	------	------	------	------	------
5.1111	2.6987	.2164	.0422	.0142	.0063	.0032
z' = 1.0000						
-10.5556	------	------	------	------	------	0.0004
-9.8889	------	------	------	------	------	.0004
-9.8333	------	------	------	------	------	.0004
-8.8333	------	------	------	------	------	.0006
-8.5556	------	------	------	------	0.0007	------
-8.1111	------	------	------	------	------	.0006
-7.8889	------	------	------	------	.0008	------
-7.8333	------	------	------	------	.0009	------
-7.6667	------	------	------	------	------	.0007
-7.4444	------	------	------	------	------	.0007
-7.1667	------	------	------	------	------	.0008
-6.8333	------	------	------	------	.0011	------
-6.5556	------	------	------	0.0015	------	------
-6.1667	------	------	------	------	------	.0010
-6.1111	------	------	------	------	.0013	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 1.0000						
-5.8889	------	------	------	0.0019	------	------
-5.8333	------	------	------	.0020	------	------
-5.6667	------	------	------	------	0.0015	0.0011
-5.4444	------	------	------	------	.0016	------
-5.1667	------	------	------	------	.0017	------
-4.8333	------	------	------	.0027	------	------
-4.5556	------	------	0.0044	------	------	------
-4.3333	------	------	------	------	------	.0014
-4.1667	------	------	------	------	.0022	------
-4.1111	------	------	------	.0035	------	------
-3.8889	------	------	.0060	------	------	------
-3.8333	------	------	.0062	------	------	------
-3.6666	------	------	------	.0041	.0025	------
-3.4444	------	------	------	.0044	------	------
-3.1667	------	------	------	.0048	------	------
-2.8333	------	------	.0099	------	------	------
-2.5556	------	0.0217	------	------	------	------
-2.3333	------	------	------	------	.0035	.0021
-2.1667	------	------	------	.0066	------	------
-2.1111	------	------	.0139	------	------	------
-1.8889	------	.0366	------	------	------	------
-1.8333	------	.0383	------	------	------	------
-1.6667	------	------	.0169	.0076	------	------
-1.4444	------	------	.0186	------	------	------
-1.1667	------	------	.0209	------	------	------
-.8333	------	.0830	------	------	------	------
-.5556	0.3626	------	------	------	------	------
-.3333	------	------	------	.0108	.0052	------
-.1667	------	------	.0302	------	------	------
-.1111	------	.1328	------	------	------	------
.1111	.9005	------	------	------	------	------
.1667	.9496	------	------	------	------	------
.3333	------	.1659	.0351	------	------	------
.5556	------	.1816	------	------	------	------
.8333	------	.1994	------	------	------	------
1.1667	1.4667	------	------	------	------	------
1.4444	1.5137	.2303	.0450	.0152	.0068	.0036
1.6667	1.5380	.2387	.0467	.0157	.0070	.0037
1.8333	------	.2441	------	------	------	------
1.8889	1.5547	.2457	.0483	.0162	.0072	.0038
2.1111	1.5664	.2517	.0498	.0166	.0074	.0039
2.1667	1.5688	.2530	.0501	.0167	.0074	.0039
2.3333	1.5748	.2566	.0511	.0171	.0075	.0039
2.5000	1.5794	.2598	.0520	.0174	.0077	.0040
2.5556	1.5807	.2607	.0523	.0175	.0077	.0040
2.8333	1.5860	.2649	.0537	.0180	.0079	.0041
3.1667	1.5902	.2687	.0552	.0185	.0081	.0042
3.5000	1.5930	.2717	.0564	.0190	.0084	.0043
3.6667	------	.2728	.0569	------	------	------
3.8333	1.5949	.2739	.0574	.0195	.0086	.0044

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 1.0000						
4.1667	------	------	------	------	0.0088	------
4.3333	1.5967	0.2763	0.0588	0.0200	.0089	0.0046
4.5556	1.5972	------	------	------	------	------
5.0000	1.5980	.2784	.0600	.0207	.0092	.0048
5.1667	------	------	------	------	.0093	------
5.6667	1.5987	.2797	.0609	.0212	.0095	.0049
5.8333	1.5988	------	------	------	------	------
6.3333	1.5992	.2805	.0616	.0216	.0097	.0051
6.5556	------	.2807	------	------	------	------
7.0000	1.5994	.2810	.0621	.0220	.0099	.0052
7.6667	1.5996	.2814	.0624	.0222	.0101	.0053
7.8333	------	.2814	------	------	------	------
8.5556	------	------	.0628	------	------	------
9.6667	1.5998	------	------	------	------	------
9.8333	------	------	.0631	------	------	------
10.5556	------	------	------	.0228	------	------
11.6667	------	.2821	------	------	------	------
11.8333	------	------	------	.0230	------	------
12.5556	------	------	------	------	.0107	------
13.6667	------	------	.0634	------	------	------
13.8333	------	------	------	------	.0108	------
14.5556	------	------	------	------	------	.0058
15.6667	------	------	------	.0232	------	------
15.8333	------	------	------	------	------	.0059
17.6667	------	------	------	------	.0109	------
19.6667	------	------	------	------	------	.0059
z' = 1.5000						
-7.1667	------	------	------	------	------	0.0012
-6.9444	------	------	------	------	------	.0012
-6.0000	------	------	------	------	------	.0015
-5.6667	------	------	------	------	------	.0016
-5.1667	------	------	------	------	0.0026	------
-4.9444	------	------	------	------	.0027	------
-4.0000	------	------	------	------	.0034	------
-3.6667	------	------	------	------	.0037	------
-3.1667	------	------	------	0.0069	------	------
-2.9444	------	------	------	.0074	------	------
-2.5000	------	------	------	------	------	.0030
-2.0000	------	------	------	.0099	------	------
-1.8333	------	------	------	------	------	.0033
-1.6667	------	------	------	.0109	------	------
-1.1667	------	------	0.0286	------	------	------
-.9444	------	------	.0312	------	------	------
-.5000	------	------	------	------	.0073	------
.0000	------	------	.0430	------	------	------
.1667	------	------	------	------	.0082	------
.3333	------	------	.0473	------	------	------
.8333	------	0.2180	------	------	------	------
1.0556	------	.2315	------	------	------	------
1.4444	0.7690	.2516	.0604	.0215	.0099	.0053
1.5000	------	------	------	.0217	------	------
1.6667	.7891	.2611	.0627	.0222	.0101	.0054

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
	z' = 1.5000					
1.8889	0.8041	0.2693	0.0648	0.0229	0.0104	0.0055
2.0000	------	.2729	------	------	------	------
2.1111	.8153	.2763	.0667	.0236	.0107	.0057
2.1667	.8176	.2778	.0672	.0237	.0107	.0057
2.3333	.8237	.2822	.0685	.0242	.0109	.0058
2.5000	.8286	.2860	.0698	.0246	.0111	.0059
2.5556	.8301	.2872	.0702	.0248	.0112	.0059
2.8333	.8359	.2923	.0721	.0255	.0115	.0060
3.0556	.8394	------	------	------	------	------
3.1667	.8408	.2972	.0741	.0262	.0118	.0062
3.5000	.8441	.3010	.0758	.0269	.0121	.0064
3.8333	.8465	.3039	.0772	.0276	.0124	.0065
4.0000	.8474	------	------	------	------	------
4.1667	------	------	.0785	------	------	------
4.3333	.8488	.3072	.0790	.0284	.0128	.0067
4.8333	.8502	------	------	------	------	------
5.0000	.8506	.3100	.0808	.0294	.0133	.0070
5.0556	.8507	------	------	------	------	------
5.5000	------	.3114	------	------	------	------
5.6667	.8516	.3118	.0821	.0301	.0137	.0072
6.0000	.8519	------	------	------	------	------
6.1667	------	.3127	------	------	------	------
6.3333	.8522	.3129	.0831	.0307	.0141	.0074
6.8333	------	.3135	------	------	------	------
7.0000	.8525	.3137	.0838	.0312	.0144	.0076
7.0556	------	.3137	------	------	------	------
7.5000	.8527	------	------	------	------	------
7.6667	.8528	.3142	.0843	.0316	.0146	.0078
8.0000	------	.3144	------	------	------	------
8.1667	.8529	------	------	------	------	------
8.3333	------	.3146	------	------	------	------
8.8333	------	------	.0848	------	------	------
9.0556	------	------	.0849	------	------	------
9.5000	.8531	------	------	------	------	------
10.0000	------	------	.0852	------	------	------
10.1667	.8531	------	------	------	------	------
10.3333	------	------	.0853	------	------	------
10.8333	------	------	------	.0325	------	------
11.0556	------	------	------	.0326	------	------
11.5000	------	.3153	------	------	------	------
12.0000	------	------	------	.0327	------	------
12.1667	------	.3154	------	------	------	------
12.3333	------	------	------	.0327	------	------
12.8333	------	------	------	------	.0156	------
13.0556	------	------	------	------	.0156	------
13.5000	------	------	.0857	------	------	------
14.0000	------	------	------	------	.0157	------
14.1667	------	------	.0857	------	------	------
14.3333	------	------	------	------	.0157	------
14.8333	------	------	------	------	------	.0086

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 1.5000			
15.0556	------	------	------	------	------	0.0086
15.5000	------	------	------	0.0330	------	------
16.0000	------	------	------	------	------	.0086
16.1667	------	------	------	.0330	------	------
16.3333	------	------	------	------	------	.0086
17.5000	------	------	------	------	0.0158	------
18.1667	------	------	------	------	.0158	------
19.5000	------	------	------	------	------	.0087
20.1667	------	------	------	------	------	.0087
			z' = 2.0000			
-11.8889	------	------	------	------	------	0.0006
-11.4444	------	------	------	------	------	.0006
-11.3333	------	------	------	------	------	.0006
-10.6667	------	------	------	------	------	.0007
-10.1111	------	------	------	------	------	.0008
-9.8889	------	------	------	------	0.0010	------
-9.6667	------	------	------	------	------	.0009
-9.4444	------	------	------	------	.0011	------
-9.3333	------	------	------	------	.0011	------
-8.7778	------	------	------	------	------	.0011
-8.6667	------	------	------	------	.0013	.0011
-8.3333	------	------	------	------	------	.0012
-8.1111	------	------	------	------	.0015	------
-7.8889	------	------	------	0.0019	------	.0013
-7.6667	------	------	------	------	.0017	------
-7.4444	------	------	------	.0022	------	.0014
-7.3333	------	------	------	.0023	------	.0015
-6.7778	------	------	------	------	.0022	------
-6.6667	------	------	------	.0028	.0022	.0017
-6.3333	------	------	------	------	.0024	------
-6.1111	------	------	------	.0034	------	------
-5.8889	------	------	0.0044	------	.0027	------
-5.6667	------	------	------	.0039	------	.0021
-5.4444	------	------	.0054	------	.0030	------
-5.3333	------	------	.0056	------	.0031	------
-5.2222	------	------	------	------	------	.0023
-4.7778	------	------	------	.0052	------	------
-4.6667	------	------	.0075	.0054	.0037	------
-4.3333	------	------	------	.0060	------	.0027
-4.1111	------	------	.0096	------	------	------
-3.8889	------	0.0134	------	.0069	------	.0030
-3.6667	------	------	.0117	------	.0047	------
-3.4444	------	.0178	------	.0080	------	------
-3.3333	------	.0191	------	.0083	------	.0033
-3.2222	------	------	------	------	.0053	------
-2.7778	------	------	.0173	------	------	------
-2.6667	------	.0297	.0182	.0102	------	------
-2.3333	------	------	.0211	------	.0065	------
-2.1111	------	.0432	------	------	------	------
-1.8889	0.0455	------	.0254	------	.0071	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 2.0000						
-1.6667	------	0.0580	------	0.0137	------	------
-1.4444	0.0710	------	0.0304	------	------	------
-1.3333	.0793	------	.0317	------	0.0080	0.0047
-1.2222	------	------	------	.0154	------	------
-.7778	------	.1009	------	------	------	------
-.6667	.1492	.1074	.0405	------	------	------
-.3333	------	.1282	------	.0191	------	.0055
-.1111	.2321	------	------	------	------	------
.3333	.3029	------	.0548	------	------	------
.5556	------	.1859	------	------	------	------
.6667	------	.1926	------	.0235	.0113	------
.7778	------	------	.0610	------	------	------
.9630	.3864	.2095	.0635	.0247	.0118	.0065
1.1111	.4014	.2173	.0655	.0253	.0120	.0066
1.2222	.4116	------	------	------	------	------
1.2593	.4147	.2246	.0673	.0259	.0123	.0067
1.3333	.4208	.2280	------	------	------	------
1.4074	.4264	.2314	.0692	.0265	.0125	.0068
1.4444	.4290	.2330	.0696	.0267	.0126	.0068
1.5556	.4365	.2376	.0709	.0271	.0127	.0069
1.6667	.4432	.2420	.0722	.0275	.0129	.0070
1.7037	.4452	.2434	.0726	.0276	.0130	.0070
1.8889	.4545	.2499	.0746	.0283	.0133	.0072
2.1111	.4634	.2569	.0769	.0291	.0136	.0073
2.3333	.4705	.2628	.0790	.0299	.0139	.0075
2.5556	.4762	.2680	.0809	.0306	.0142	.0076
2.6667	.4785	------	.0818	.0310	------	------
2.7778	------	.2724	------	------	------	------
2.8889	.4825	.2744	.0835	.0316	.0147	.0078
3.3333	.4881	.2809	.0865	.0329	.0152	.0081
3.6667	------	.2846	------	.0337	------	------
3.7778	.4918	.2856	.0889	.0340	.0158	.0084
4.1111	------	.2883	------	------	------	------
4.2222	.4942	.2891	.0909	.0350	.0162	.0086
4.3333	.4946	.2898	.0913	.0352	.0163	.0087
4.6667	.4958	.2916	.0925	.0358	.0167	.0089
4.7778	.4961	------	------	------	------	------
5.0000	.4966	.2931	.0935	.0364	.0170	.0091
5.1111	.4969	.2935	.0938	.0365	.0171	.0091
5.6667	.4978	.2952	.0951	.0373	.0175	.0094
6.1111	.4983	------	------	------	------	------
6.3333	.4985	.2966	.0963	.0381	.0180	.0096
6.6667	.4988	.2971	------	------	------	------
7.0000	.4990	.2975	.0972	.0387	.0183	.0099
7.6667	.4993	.2982	.0978	.0391	.0187	.0101
8.3333	------	------	.0983	------	.0189	------
8.6667	.4995	.2988	.0985	.0397	.0190	.0103
9.6667	.4997	------	------	------	------	------
10.0000	.4997	.2993	.0990	.0402	.0194	.0106
10.3333	------	.2994	------	.0403	------	------
11.3333	.4998	.2995	.0994	.0405	.0197	.0108
12.3333	.4999	------	.0995	------	------	------
12.6667	.4999	.2997	.0996	.0407	.0199	.0110
14.0000	.4999	.2998	.0997	.0408	.0200	.0111
14.3333	------	.2998	------	------	------	------
15.3333	.5000	.2999	.0998	.0409	.0201	.0111
16.3333	.5000	------	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 2.5000						
-6.3889	------	------	------	------	------	0.0022
-5.3333	------	------	------	------	------	.0027
-4.3889	------	------	------	------	0.0048	------
-3.3333	------	------	------	------	.0062	------
-2.3889	------	------	------	0.0129	------	------
-2.1667	------	------	------	------	------	.0050
-1.3333	------	------	------	.0173	------	------
-.3889	------	------	0.0475	------	------	------
-.1667	------	------	------	------	.0117	------
.6667	------	------	.0629	------	------	------
1.4444	0.2560	0.1990	.0733	.0304	.0148	.0082
1.6111	------	.2049	------	------	------	------
1.6667	.2654	.2067	.0759	.0313	.0152	.0084
1.8333	------	------	------	.0320	------	------
1.8889	.2733	.2137	.0785	.0323	.0156	.0086
2.1111	.2799	.2199	.0808	.0332	.0160	.0088
2.1667	.2814	.2213	.0814	.0334	.0161	.0088
2.3333	.2854	.2254	.0830	.0340	.0164	.0090
2.5000	.2888	.2290	.0846	.0347	.0167	.0091
2.5556	.2899	.2302	.0851	.0349	.0168	.0092
2.6667	------	.2323	------	------	------	------
2.8333	.2944	.2353	.0874	.0358	.0172	.0094
3.1667	.2985	.2404	.0899	.0369	.0177	.0096
3.5000	.3016	.2446	.0921	.0379	.0182	.0099
3.6111	.3025	------	------	------	------	------
3.8333	.3039	.2479	.0940	.0388	.0187	.0101
4.3333	.3064	.2517	.0964	.0401	.0193	.0105
4.6667	.3076	------	------	------	------	------
5.0000	.3085	.2552	.0988	.0414	.0200	.0109
5.6111	.3096	------	------	------	------	------
5.6667	.3097	.2575	.1007	.0425	.0207	.0112
5.8333	------	.2580	------	------	------	------
6.3333	.3105	.2591	.1020	.0434	.0212	.0116
6.6667	.3108	------	------	------	------	------
7.0000	.3110	.2602	.1030	.0441	.0217	.0119
7.6111	------	.2609	------	------	------	------
7.6667	.3113	.2609	.1038	.0447	.0220	.0121
7.8333	.3114	------	------	------	------	------
8.6667	------	.2616	------	------	------	------
9.6111	------	------	.1050	------	------	------
9.8333	.3119	------	------	------	------	------
10.6667	------	------	.1054	------	------	------
11.6111	------	------	------	.0464	------	------
11.8333	------	.2626	------	------	------	------
12.6667	------	------	------	.0466	------	------
13.6111	------	------	------	------	.0236	------
13.8333	------	------	.1060	------	------	------
14.6667	------	------	------	------	.0237	------
15.6111	------	------	------	------	------	.0134
15.8333	------	------	------	.0469	------	------
16.6667	------	------	------	------	------	.0135
17.8333	------	------	------	------	.0239	------
19.8333	------	------	------	------	------	.0136

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
	z' = 3.0000					
-12.3333	------	------	------	------	------	0.0008
-11.6667	------	------	------	------	------	.0009
-11.5000	------	------	------	------	------	.0009
-11.3333	------	------	------	------	------	.0009
-10.5000	------	------	------	------	------	.0011
-10.3333	------	------	------	------	0.0013	------
-9.6667	------	------	------	------	.0015	------
-9.5000	------	------	------	------	.0015	------
-9.3333	------	------	------	------	.0016	------
-9.0000	------	------	------	------	------	.0015
-8.5000	------	------	------	------	.0020	------
-8.3333	------	------	------	0.0023	------	------
-7.6667	------	------	------	.0028	------	------
-7.5000	------	------	------	.0030	------	------
-7.0000	------	------	------	------	.0029	.0023
-6.5000	------	------	------	.0041	------	------
-6.3333	------	------	0.0049	------	------	.0026
-5.6667	------	------	.0064	------	------	.0030
-5.5000	------	------	.0068	------	------	.0031
-5.0000	------	------	------	.0065	.0047	------
-4.5000	------	------	.0102	------	------	.0037
-4.3333	------	0.0120	------	------	.0055	------
-3.6667	------	.0172	------	------	.0065	------
-3.5000	------	.0189	------	------	.0067	------
-3.0000	------	------	.0188	.0120	------	.0049
-2.5000	------	.0329	------	------	.0084	------
-2.3333	0.0233	------	------	.0145	------	------
-1.6667	.0375	------	------	.0174	------	------
-1.5000	.0421	------	------	.0181	------	------
-1.0000	------	.0726	.0396	------	.0114	.0069
-.5000	.0795	------	------	.0230	------	------
-.3333	------	------	.0487	------	------	------
.3333	------	------	.0580	------	------	------
.5000	------	------	.0603	------	------	------
1.0000	.1463	.1489	------	.0306	.0157	------
1.4444	.1614	.1633	.0726	.0328	.0167	.0094
1.5000	------	------	.0733	------	------	------
1.6667	.1676	.1697	.0752	.0338	.0171	.0096
1.8889	.1731	.1755	.0777	.0348	.0175	.0099
2.1111	.1778	.1807	.0800	.0357	.0180	.0101
2.1667	.1789	.1819	.0806	.0360	.0181	.0101
2.3333	.1818	.1854	.0822	.0367	.0184	.0103
2.5000	.1845	.1886	.0837	.0373	.0187	.0104
2.5556	.1853	.1896	.0842	.0375	.0188	.0105
2.8333	.1889	.1942	.0866	.0386	.0193	.0108
3.0000	.1907	------	.0879	.0392	------	------
3.1667	.1923	.1989	.0891	.0398	.0199	.0110
3.5000	.1949	.2027	.0913	.0408	.0204	.0113
3.6667	.1960	------	------	------	------	------
3.8333	.1970	.2059	.0933	.0418	.0209	.0116

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 3.0000						
4.3333	0.1992	0.2096	0.0958	0.0432	0.0216	0.0120
4.5000	.1998	------	------	------	------	------
5.0000	.2012	.2131	.0984	.0447	.0224	.0125
5.5000	.2022	------	------	------	------	------
5.6667	.2025	.2155	.1003	.0459	.0232	.0129
6.3333	.2033	.2171	.1018	.0469	.0238	.0133
7.0000	.2038	.2183	.1029	.0477	.0243	.0136
7.5000	.2041	------	------	------	------	------
7.6667	.2042	.2191	.1037	.0483	.0247	.0139
8.3333	------	.2197	------	------	------	------
9.0000	.2046	------	------	------	------	------
9.5000	------	.2203	------	------	------	------
10.3333	------	------	.1054	------	------	------
11.0000	.2049	------	------	------	------	------
11.5000	------	------	.1058	------	------	------
12.3333	------	------	------	.0504	------	------
13.0000	------	.2211	------	------	------	------
13.5000	------	------	------	.0506	------	------
14.3333	------	------	------	------	.0266	------
15.0000	------	------	.1063	------	------	------
15.5000	------	------	------	------	.0267	------
16.3333	------	------	------	------	------	.0155
17.0000	------	------	------	.0509	------	------
17.5000	------	------	------	------	------	.0155
19.0000	------	------	------	------	.0269	------
21.0000	------	------	------	------	------	.0157
z' = 3.3333						
-13.0741	------	------	------	------	------	0.0007
-12.6297	------	------	------	------	------	.0008
-12.4444	------	------	------	------	------	.0008
-11.7778	------	------	------	------	------	.0009
-11.0741	------	------	------	------	0.0012	------
-10.6296	------	------	------	------	.0013	------
-10.5556	------	------	------	------	------	.0012
-10.4444	------	------	------	------	.0013	------
-9.7778	------	------	------	------	.0016	------
-9.2222	------	------	------	------	------	.0015
-9.0741	------	------	------	0.0020	------	------
-8.6297	------	------	------	.0023	------	------
-8.5556	------	------	------	------	.0021	------
-8.4444	------	------	------	.0024	------	------
-7.7778	------	------	------	.0030	------	------
-7.2222	------	------	------	------	.0029	------
-7.0741	------	------	0.0040	------	------	------
-6.7037	------	------	------	------	------	.0026
-6.6296	------	------	.0047	------	------	------
-6.5556	------	------	------	.0043	------	------
-6.4444	------	------	.0050	------	------	------
-6.2593	------	------	------	------	------	.0028
-6.2222	------	------	------	------	------	.0029
-5.7778	------	------	.0064	------	------	------
-5.5556	------	------	------	------	------	.0033

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 3.3333						
-5.2222	------	------	------	0.0064	------	------
-5.0741	------	0.0083	------	------	------	------
-4.7778	------	------	------	------	------	0.0038
-4.7037	------	------	------	------	0.0054	------
-4.6296	------	.0104	------	------	------	------
-4.5556	------	------	0.0104	------	------	------
-4.4444	------	.0114	------	------	------	------
-4.2593	------	------	------	------	.0060	------
-4.2222	------	------	------	------	.0061	------
-3.7778	------	.0161	------	------	------	------
-3.5556	------	------	------	------	.0071	------
-3.4444	------	------	------	------	------	.0049
-3.2222	------	------	.0176	------	------	------
-3.0741	0.0129	------	------	------	------	------
-2.7778	------	------	------	------	.0085	------
-2.7037	------	------	------	.0137	------	------
-2.6297	.0172	------	------	------	------	------
-2.5556	------	.0306	------	------	------	------
-2.4444	.0194	------	------	------	------	------
-2.2593	------	------	------	.0155	------	------
-2.2222	------	------	------	.0156	------	------
-1.7778	.0300	------	------	------	------	------
-1.5556	------	------	------	.0186	------	------
-1.4444	------	------	------	------	.0112	------
-1.2222	------	.0596	------	------	------	------
-.7778	------	------	------	.0224	------	------
-.7037	------	------	.0430	------	------	------
-.5556	.0613	------	------	------	------	------
-.2593	------	------	.0488	------	------	------
-.2222	------	------	.0492	------	------	------
.4444	------	------	.0581	------	------	------
.5556	------	------	------	.0293	------	------
.7778	.1043	------	------	------	------	------
.9630	.1096	.1283	.0647	.0313	.0166	.0096
1.1111	.1137	.1326	.0666	.0320	.0169	.0098
1.2222	------	------	.0679	------	------	------
1.2593	.1175	.1367	.0683	.0328	.0172	.0099
1.2963	------	.1377	------	------	------	------
1.4074	.1210	.1407	.0701	.0335	.0175	.0101
1.4444	.1219	.1416	.0705	.0337	.0176	.0101
1.5556	.1243	.1444	.0718	.0342	.0178	.0102
1.6667	.1267	.1471	.0730	.0347	.0181	.0103
1.7037	.1274	.1480	.0734	.0349	.0182	.0104
1.7407	------	.1488	------	------	------	------
1.7778	------	.1497	------	------	------	------
1.8889	.1309	.1521	.0754	.0357	.0185	.0106
2.1111	.1347	.1567	.0776	.0367	.0190	.0108
2.3333	.1379	.1609	.0797	.0376	.0194	.0110
2.4444	------	.1628	------	------	------	------
2.5556	.1408	.1646	.0817	.0385	.0199	.0113
2.8889	.1443	.1696	.0844	.0398	.0205	.0116
3.2222	------	.1737	------	------	------	------
3.2963	.1477	------	------	------	------	------
3.3333	.1480	.1749	.0876	.0414	.0213	.0120
3.7407	.1504	------	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 3.3333						
3.7778	0.1506	0.1792	0.0903	0.0428	0.0220	0.0124
4.2222	.1526	.1825	.0926	.0440	.0227	.0128
4.4444	.1534	------	------	------	------	------
4.5556	------	.1845	------	------	------	------
4.6667	.1540	.1851	.0945	.0451	.0233	.0131
5.1111	.1551	.1871	.0961	.0461	.0238	.0134
5.2222	.1553	------	------	------	------	------
6.5556	.1571	------	------	------	------	------
z' = 3.5000						
-5.6111	------	------	------	------	------	0.0034
-4.6667	------	------	------	------	------	.0041
-3.6111	------	------	------	------	0.0072	------
-2.6667	------	------	------	------	.0089	------
-1.8333	------	------	------	------	------	.0067
-1.6111	------	------	------	0.0186	------	------
-.6667	------	------	------	.0232	------	------
.1667	------	------	------	------	.0151	------
.3889	------	------	0.0563	------	------	------
1.3333	------	------	.0678	------	------	------
1.4444	0.1067	0.1317	.0691	.0339	.0180	.0104
1.6667	.1109	.1367	.0715	.0350	.0185	.0107
1.8889	.1146	.1414	.0738	.0360	.0190	.0109
2.1111	.1180	.1457	.0760	.0370	.0194	.0111
2.1667	.1188	.1467	.0765	.0372	.0195	.0112
2.3333	.1209	.1496	.0781	.0379	.0199	.0114
2.3889	------	.1505	------	------	------	------
2.5000	.1229	.1523	.0795	.0386	.0202	.0116
2.5556	.1235	.1531	.0800	.0388	.0203	.0116
2.8333	.1263	.1571	.0822	.0399	.0208	.0119
3.1667	.1290	.1611	.0847	.0411	.0214	.0122
3.3333	------	.1629	------	------	------	------
3.5000	.1312	.1646	.0869	.0422	.0220	.0125
3.8333	.1329	.1674	.0888	.0432	.0226	.0128
4.1667	------	------	.0905	------	------	------
4.3333	.1349	.1709	.0913	.0446	.0233	.0133
4.3889	.1351	------	------	------	------	------
5.0000	.1367	.1743	.0939	.0462	.0242	.0138
5.3333	.1374	------	------	------	------	------
5.6667	.1379	.1766	.0959	.0475	.0250	.0142
6.1667	------	.1779	------	------	------	------
6.3333	.1387	.1783	.0974	.0486	.0257	.0147
6.3889	.1388	------	------	------	------	------
7.0000	.1392	.1795	.0985	.0494	.0262	.0150
7.3333	.1394	------	------	------	------	------
7.6667	.1396	.1803	.0994	.0501	.0267	.0154
8.1667	.1398	------	------	------	------	------
8.3889	------	.1810	------	------	------	------
9.3333	------	.1816	------	------	------	------
10.1667	.1403	------	------	------	------	------
10.3889	------	------	.1013	------	------	------
10.8750	------	------	.1015	------	------	------
11.3333	------	------	.1017	------	------	------
12.1667	------	.1824	------	------	------	------
12.3889	------	------	------	.0524	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 3.5000						
12.8750	------	------	------	0.0525	------	------
13.3333	------	------	------	.0526	------	------
14.1667	------	------	0.1022	------	------	------
14.3889	------	------	------	------	0.0289	------
15.3333	------	------	------	------	.0290	------
16.1667	------	------	------	.0529	------	------
16.3889	------	------	------	------	------	0.0172
17.3333	------	------	------	------	------	.0172
18.1667	------	------	------	------	.0292	------
20.1667	------	------	------	------	------	.0173
z' = 4.5000						
-4.8333	------	------	------	------	------	0.0046
-4.1667	------	------	------	------	------	.0052
-4.0000	------	------	------	------	------	.0054
-3.0000	------	------	------	------	------	.0064
-2.8333	------	------	------	------	0.0096	------
-2.1667	------	------	------	------	.0110	------
-2.0000	------	------	------	------	.0113	------
-1.5000	------	------	------	------	------	.0081
-1.0000	------	------	------	------	.0136	------
-.8333	------	------	------	0.0226	------	------
-.1667	------	------	------	.0258	------	------
.0000	------	------	------	.0266	------	------
.5000	------	------	------	------	.0172	.0107
1.0000	------	------	------	.0314	------	------
1.1667	------	------	0.0555	------	------	------
1.4444	0.0523	0.0847	.0580	.0334	.0194	.0118
1.6667	.0544	.0878	.0599	.0344	.0199	.0121
1.8333	------	------	.0613	------	------	------
1.8889	.0562	.0907	.0618	.0354	.0204	.0124
2.0000	------	------	.0627	------	------	------
2.1111	.0579	.0935	.0635	.0363	.0209	.0127
2.1667	.0583	.0941	.0640	.0365	.0210	.0127
2.3333	.0595	.0960	.0652	.0372	.0214	.0129
2.5000	.0606	.0978	.0664	.0379	.0217	.0131
2.5556	.0609	.0984	.0668	.0381	.0218	.0132
2.8333	.0625	.1011	.0687	.0391	.0224	.0135
3.0000	------	------	.0698	------	------	------
3.1667	.0642	.1040	.0708	.0403	.0230	.0138
3.5000	.0656	.1065	.0727	.0414	.0236	.0142
3.8333	.0668	.1088	.0744	.0424	.0242	.0145
4.0000	------	.1097	------	------	------	------
4.3333	.0682	.1115	.0766	.0438	.0250	.0150
4.5000	------	------	.0773	.0442	------	------
5.0000	.0696	.1143	.0791	.0454	.0260	.0156
5.1667	.0699	------	------	------	------	------
5.6667	.0706	.1164	.0810	.0468	.0269	.0161
5.8333	.0708	------	------	------	------	------
6.0000	.0710	------	------	------	------	------
6.3333	.0713	.1180	.0825	.0479	.0276	.0166
6.5000	------	------	.0828	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 4.5000			
7.0000	0.0718	0.1191	0.0837	0.0488	0.0282	0.0170
7.1667	.0719	------	------	------	------	------
7.6667	.0722	.1199	.0846	.0495	.0288	.0174
7.8333	.0722	------	------	------	------	------
8.0000	.0723	------	------	------	------	------
8.5000	.0725	.1207	------	------	------	------
9.0000	.0726	------	------	------	------	------
9.1667	------	.1211	------	------	------	------
9.8333	------	.1215	------	------	------	------
10.0000	------	.1216	------	------	------	------
10.5000	.0729	------	------	------	------	------
11.0000	------	.1219	------	------	------	------
11.1667	------	------	.0870	------	------	------
11.8333	------	------	.0872	------	------	------
12.0000	------	------	.0873	------	------	------
12.5000	.0731	.1222	------	------	------	------
13.0000	------	------	.0875	------	------	------
13.1667	------	------	------	.0523	------	------
13.8333	------	------	------	.0524	------	------
14.0000	------	------	------	.0524	------	------
14.5000	------	.1225	.0877	------	------	------
15.0000	------	------	------	.0526	------	------
15.1667	------	------	------	------	.0314	------
15.8333	------	------	------	------	.0314	------
16.0000	------	------	------	------	.0315	------
16.5000	------	------	.0879	.0527	------	------
17.0000	------	------	------	------	.0315	------
17.1667	------	------	------	------	------	.0196
17.8333	------	------	------	------	------	.0197
18.0000	------	------	------	------	------	.0197
18.5000	------	------	------	.0529	.0317	------
19.0000	------	------	------	------	------	.0197
20.5000	------	------	------	------	------	.0198
22.5000	------	------	------	------	------	.0198
			z' = 4.6667			
-14.2593	------	------	------	------	------	0.0008
-13.5556	------	------	------	------	------	.0009
-12.2593	------	------	------	------	0.0012	------
-11.5556	------	------	------	------	.0014	------
-11.4444	------	------	------	------	------	.0013
-10.2593	------	------	------	0.0019	------	------
-9.5556	------	------	------	.0022	------	------
-9.4444	------	------	------	------	.0022	------
-8.2593	------	------	0.0031	------	------	------
-7.5556	------	------	.0039	------	------	------
-7.4444	------	------	------	.0039	------	------
-6.2593	------	0.0051	------	------	------	------
-5.5556	------	.0067	------	------	------	------
-5.4444	------	------	.0079	------	------	------
-5.0741	------	------	------	------	------	.0045
-4.4444	------	------	------	------	------	.0050
-4.2593	0.0052	------	------	------	------	------
-3.5556	.0072	------	------	------	------	------
-3.4444	------	.0163	------	------	------	------
-3.0741	------	------	------	------	.0092	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 4.6667			
-2.5556	------	------	------	------	------	0.0070
-2.4444	------	------	------	------	0.0105	------
-1.4444	0.0194	------	------	------	------	------
-1.0741	------	------	------	0.0213	------	------
-.5556	------	------	------	------	.0148	------
-.4444	------	------	------	.0243	------	------
.9259	------	------	0.0514	------	------	------
.9630	.0428	0.0721	.0517	.0309	.0184	.0114
1.1111	.0442	.0742	.0531	.0316	.0187	.0116
1.2593	.0455	.0763	.0544	.0322	.0191	.0118
1.4074	.0468	.0783	.0556	.0329	.0194	.0120
1.4444	.0471	.0788	.0559	.0331	.0195	.0120
1.5556	.0480	.0802	.0569	.0336	.0198	.0121
1.6667	.0489	.0816	.0578	.0340	.0200	.0123
1.7037	.0492	.0821	.0581	.0342	.0201	.0123
1.8889	.0505	.0843	.0596	.0350	.0205	.0126
2.1111	.0521	.0869	.0613	.0359	.0210	.0128
2.3333	.0535	.0893	.0629	.0368	.0215	.0131
2.5556	.0548	.0915	.0645	.0376	.0219	.0133
2.8889	.0565	.0945	.0666	.0389	.0226	.0137
2.9259	------	.0948	------	------	------	------
3.3333	.0585	.0980	.0692	.0404	.0234	.0142
3.4444	------	------	.0698	------	------	------
3.5556	------	.0995	------	------	------	------
3.7778	.0600	.1009	.0715	.0418	.0242	.0147
4.2222	.0613	.1033	.0735	.0430	.0250	.0151
4.6667	.0623	.1053	.0752	.0441	.0256	.0155
4.9259	.0628	------	------	------	------	------
5.1111	.0631	.1070	.0767	.0452	.0263	.0159
5.4444	------	.1080	------	------	------	------
5.5556	.0637	------	------	------	------	------
7.4444	.0653	------	------	------	------	------
			z' = 5.0000			
-14.1111	------	------	------	------	------	0.0008
-13.4444	------	------	------	------	------	.0009
-13.1667	------	------	------	------	------	.0010
-12.1667	------	------	------	------	------	.0012
-12.1111	------	------	------	------	0.0013	------
-11.4444	------	------	------	------	.0014	------
-11.1667	------	------	------	------	.0015	------
-10.3333	------	------	------	------	------	.0017
-10.1667	------	------	------	------	.0019	------
-10.1111	------	------	------	0.0020	------	------
-9.4444	------	------	------	.0024	------	------
-9.1667	------	------	------	.0026	------	------
-8.3333	------	------	------	------	.0029	.0025
-8.1667	------	------	------	.0033	------	------
-8.1111	------	------	0.0033	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 5.0000			
-7.4444	------	------	0.0041	------	------	------
-7.1667	------	------	.0045	------	------	------
-6.3333	------	------	------	0.0055	0.0046	------
-6.1667	------	------	.0062	------	------	------
-6.1111	------	0.0053	------	------	------	------
-5.4444	------	.0069	------	------	------	------
-5.1667	------	.0077	------	------	------	------
-4.5556	------	------	------	------	------	0.0051
-4.3333	------	------	.0114	.0095	------	------
-4.1667	------	.0115	------	------	------	------
-4.1111	0.0052	------	------	------	------	------
-3.8889	------	------	------	------	------	.0058
-3.8333	------	------	------	------	------	.0058
-3.4444	.0070	------	------	------	------	------
-3.1667	.0080	------	------	------	------	------
-2.8333	------	------	------	------	------	.0069
-2.5556	------	------	------	------	.0104	------
-2.3333	------	.0237	.0217	------	------	------
-2.1667	.0124	------	------	------	------	------
-1.8889	------	------	------	------	.0118	------
-1.8333	------	------	------	------	.0119	------
-1.6667	------	------	------	------	------	.0083
-.8333	------	------	------	------	.0142	------
-.5555	------	------	------	.0233	------	------
-.3333	.0249	.0462	------	------	------	------
.1111	------	------	------	.0263	------	------
.1667	------	------	------	.0265	------	------
.3333	------	------	------	------	.0170	.0109
1.1667	------	------	------	.0310	------	------
1.4444	.0384	.0683	.0519	.0322	.0196	.0123
1.6667	.0399	.0707	.0536	.0331	.0201	.0126
1.8889	.0412	.0730	.0552	.0340	.0206	.0128
2.1111	.0425	.0752	.0568	.0349	.0210	.0131
2.1667	.0428	.0757	.0572	.0351	.0211	.0132
2.3333	.0436	.0773	.0583	.0358	.0215	.0134
2.5000	.0444	.0787	.0594	.0364	.0218	.0136
2.5556	.0447	.0792	.0597	.0366	.0220	.0136
2.8333	.0459	.0814	.0614	.0376	.0225	.0139
3.1667	.0472	.0838	.0633	.0387	.0232	.0143
3.4444	------	.0856	------	------	------	------
3.5000	.0483	.0859	.0650	.0398	.0238	.0147
3.8333	.0493	.0878	.0665	.0408	.0244	.0150
4.1111	------	.0892	------	------	------	------
4.1667	------	.0895	------	------	------	------
4.3333	.0505	.0902	.0686	.0421	.0252	.0155
5.0000	.0517	.0927	.0709	.0437	.0262	.0161
5.1667	------	.0933	------	------	------	------
5.4444	.0523	------	------	------	------	------
5.6667	.0526	.0946	.0727	.0450	.0270	.0167
6.1111	.0530	------	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 5.0000						
6.1667	0.0531	------	------	------	------	------
6.3333	.0532	0.0961	0.0741	0.0461	0.0278	0.0172
7.0000	.0537	.0971	.0753	.0470	.0284	.0176
7.1667	.0538	------	------	------	------	------
7.6667	.0540	.0980	.0762	.0478	.0290	.0180
8.1111	.0542	------	------	------	------	------
8.3333	.0543	.0986	------	------	------	------
9.1667	.0545	------	------	------	------	------
10.1111	------	.0996	------	------	------	------
10.3333	.0547	------	------	------	------	------
11.1667	------	.1000	------	------	------	------
12.1111	------	------	.0789	------	------	------
12.3333	.0549	------	------	------	------	------
13.1667	------	-------	.0792	------	------	------
14.1111	------	------	------	.0508	------	------
14.3333	------	.1005	------	------	------	------
15.1667	------	------	------	.0510	------	------
16.1111	------	------	------	------	.0318	------
16.3333	------	------	.0796	------	------	------
17.1667	------	------	------	------	.0319	------
18.1111	------	------	------	------	------	.0204
18.3333	------	------	------	.0512	------	------
19.1667	------	------	------	------	------	.0205
20.3333	------	------	------	------	.0321	------
22.3333	------	------	------	------	------	.0206
z' = 5.5000						
-4.0556	------	------	------	------	------	0.0058
-3.3333	------	------	------	------	------	.0066
-2.0556	------	------	------	------	0.0115	------
-1.3333	------	------	------	------	.0131	------
-1.1667	------	------	------	------	------	.0092
-.0556	------	------	------	0.0244	------	------
.6667	------	------	------	.0274	------	------
.8333	------	------	------	------	.0180	------
1.4444	0.0289	0.0554	0.0461	.0306	.0194	.0125
1.6667	.0300	.0573	.0476	.0314	.0199	.0128
1.8889	.0310	.0592	.0490	.0323	.0204	.0131
1.9444	------	------	.0493	------	------	------
2.1111	.0319	.0610	.0503	.0331	.0209	.0134
2.1667	.0321	.0613	.0506	.0333	.0210	.0134
2.3333	.0328	.0625	.0516	.0339	.0213	.0136
2.5000	.0334	.0637	.0526	.0345	.0217	.0138
2.5556	.0336	.0641	.0529	.0347	.0218	.0139
2.6667	------	------	.0535	------	------	------
2.8333	.0345	.0659	.0543	.0356	.0223	.0142
3.1667	.0355	.0679	.0560	.0367	.0229	.0146
3.5000	.0364	.0697	.0575	.0377	.0235	.0150
3.8333	.0372	.0713	.0589	.0386	.0241	.0153
3.9444	------	.0718	------	------	------	------
4.3333	.0382	.0733	.0608	.0399	.0249	.0158
4.6667	------	.0745	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 5.5000						
4.8333	------	------	0.0624	------	------	------
5.0000	0.0392	0.0755	.0629	0.0414	0.0259	0.0164
5.6667	.0400	.0772	.0646	.0427	.0268	.0170
5.9444	.0403	------	------	------	------	------
6.3333	.0406	.0786	.0660	.0438	.0275	.0175
6.6667	.0408	------	------	------	------	------
6.8333	------	.0793	------	------	------	------
7.0000	.0410	.0796	.0671	.0447	.0282	.0180
7.6667	.0413	.0804	.0680	.0454	.0288	.0183
7.9444	.0414	------	------	------	------	------
8.6667	.0417	------	------	------	------	------
8.8333	.0417	------	------	------	------	------
9.9444	------	.0819	------	------	------	------
10.6667	------	.0822	------	------	------	------
10.8333	.0421	------	------	------	------	------
11.9444	------	------	.0706	------	------	------
12.6667	------	------	.0708	------	------	------
12.8333	------	.0827	------	------	------	------
13.9444	------	------	------	.0485	------	------
14.6667	------	------	------	.0486	------	------
14.8333	------	------	.0712	------	------	------
15.9444	------	------	------	------	.0316	------
16.6667	------	------	------	------	.0317	------
16.8333	------	------	------	.0489	------	------
17.9444	------	------	------	------	------	.0209
18.6667	------	------	------	------	------	.0209
18.8333	------	------	------	------	.0319	------
20.8333	------	------	------	------	------	.0210
z' = 6.0000						
-15.4444	------	------	------	------	------	0.0007
-14.6667	------	------	------	------	------	.0009
-13.6667	------	------	------	------	------	.0010
-13.4444	------	------	------	------	0.0011	------
-12.6667	------	------	------	------	.0013	------
-12.3333	------	------	------	------	------	.0013
-12.0000	------	------	------	------	------	.0014
-11.6667	------	------	------	------	.0015	------
-11.4444	------	------	------	0.0016	------	------
-10.6667	------	------	------	.0019	------	------
-10.3333	------	------	------	------	.0020	------
-10.0000	------	------	------	------	.0022	.0020
-9.6667	------	------	------	.0024	------	------
-9.4444	------	------	0.0023	------	------	------
-8.6667	------	------	.0029	------	------	------
-8.3333	------	------	------	.0034	------	------
-8.0000	------	------	------	.0037	.0034	------
-7.6667	------	------	.0039	------	------	------
-7.4444	------	0.0032	------	------	------	------
-7.0000	------	------	------	------	------	.0035
-6.6667	------	.0041	------	------	------	------
-6.3333	------	------	.0058	------	------	------
-6.0000	------	------	.0064	.0061	------	------
-5.6667	------	.0058	------	------	------	------
-5.4444	0.0025	------	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 6.0000						
-5.0000	------	------	------	------	0.0064	------
-4.6667	0.0034	------	------	------	------	------
-4.3333	------	0.0093	------	------	------	------
-4.0000	------	.0104	.0116	------	------	------
-3.8889	------	------	------	------	------	0.0061
-3.6667	.0050	------	------	------	------	------
-3.3333	------	------	------	------	------	.0067
-3.0000	------	------	------	0.0128	------	.0071
-2.3333	.0082	------	------	------	------	------
-2.0000	.0092	.0202	------	------	------	------
-1.8889	------	------	------	------	.0118	------
-1.6667	------	------	------	------	------	.0087
-1.3333	------	------	------	------	.0130	------
-1.0000	------	------	.0260	------	.0137	------
-.3333	------	------	------	------	------	.0104
.0000	.0167	------	------	------	------	.0108
.1111	------	------	------	.0238	------	------
.3333	------	------	------	------	.0166	------
.6667	------	------	------	.0259	------	------
.9630	.0205	.0419	.0379	.0270	.0180	.0120
1.0000	------	.0422	------	.0271	------	------
1.1111	.0211	.0430	.0388	.0275	.0183	.0122
1.2593	.0216	.0441	.0397	.0281	.0186	.0124
1.4074	.0222	.0451	.0405	.0286	.0190	.0126
1.4444	.0223	.0454	.0407	.0287	.0190	.0126
1.5556	.0227	.0461	.0414	.0291	.0193	.0128
1.6667	.0231	.0469	.0420	.0295	.0195	.0129
1.7037	.0232	.0471	.0422	.0297	.0196	.0130
1.8889	.0238	.0483	.0432	.0303	.0200	.0132
2.0000	------	------	------	------	.0202	.0133
2.1111	.0245	.0497	.0444	.0311	.0204	.0135
2.3333	.0252	.0510	.0455	.0318	.0209	.0137
2.5556	.0258	.0523	.0466	.0325	.0213	.0140
2.6667	------	------	.0471	------	------	------
2.8889	.0267	.0540	.0481	.0335	.0219	.0144
3.0000	.0269	------	.0486	------	------	------
3.3333	.0277	.0561	.0500	.0348	.0227	.0149
3.6667	------	------	------	.0357	------	------
3.7778	.0286	.0580	.0517	.0360	.0235	.0154
4.0000	------	------	------	.0366	.0239	------
4.1111	------	.0592	------	------	------	------
4.2222	.0293	.0596	.0532	.0371	.0242	.0158
4.3333	.0295	.0600	.0536	.0374	.0244	.0159
4.6667	.0300	.0610	.0546	.0381	.0249	.0162
5.0000	.0303	.0619	.0555	.0388	.0253	.0165
5.1111	.0305	.0622	.0558	.0390	.0255	.0166
5.6667	.0310	.0634	.0571	.0400	.0262	.0171
6.0000	------	------	.0577	.0406	------	------
6.1111	.0314	------	------	------	------	------
6.3333	.0315	.0646	.0584	.0411	.0269	.0176
6.6667	.0317	------	------	------	------	------
7.0000	.0319	.0656	.0594	.0420	.0276	.0181
7.6667	.0322	.0663	.0602	.0427	.0282	.0185
8.0000	------	.0666	.0606	------	------	------
8.3333	.0324	------	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 6.0000						
8.6667	0.0325	0.0671	0.0612	0.0436	0.0289	0.0190
9.0000	------	------	------	.0438	------	.0192
9.6667	.0328	------	------	------	------	------
10.0000	.0328	.0678	.0621	.0445	.0296	.0196
11.0000	------	------	.0626	------	.0300	------
11.3333	.0330	.0683	.0627	.0451	.0301	.0200
12.0000	.0330	------	------	------	------	------
12.6667	.0331	.0685	.0631	.0455	.0305	.0204
13.0000	------	.0686	------	.0456	------	------
14.0000	.0332	.0687	.0634	.0458	.0308	.0206
15.0000	.0332	------	.0635	------	------	------
15.3333	.0332	.0689	.0636	.0460	.0310	.0208
17.0000	------	.0690	------	------	------	------
19.0000	.0333	------	------	------	------	------
z' = 7.0000						
-15.8889	------	------	------	------	------	0.0008
-14.8333	------	------	------	------	------	.0009
-13.8889	------	------	------	------	0.0011	------
-12.8333	------	------	------	------	.0013	------
-11.8889	------	------	------	0.0015	------	------
-11.6667	------	------	------	------	------	.0016
-10.8333	------	------	------	.0019	------	------
-9.8889	------	------	0.0021	------	------	------
-9.6667	------	------	------	------	.0025	------
-8.8333	------	------	.0028	------	------	------
-7.8889	------	0.0026	------	------	------	------
-7.6667	------	------	------	.0040	------	------
-6.8333	------	.0036	------	------	------	------
-5.8889	0.0019	------	------	------	------	------
-5.6667	------	------	.0065	------	------	------
-4.8333	.0027	------	------	------	------	------
-3.6667	------	.0096	------	------	------	------
-2.1111	------	------	------	------	------	.0082
-1.6667	.0072	------	------	------	------	------
-1.1667	------	------	------	------	------	.0093
-.1111	------	------	------	------	.0148	------
.8333	------	------	------	------	.0166	------
1.4444	.0140	.0311	.0316	.0248	.0178	.0125
1.6667	.0144	.0321	.0325	.0255	.0182	.0128
1.8889	.0148	.0330	.0334	.0261	.0186	.0130
2.1111	.0153	.0339	.0342	.0267	.0190	.0133
2.1667	.0154	.0341	.0345	.0269	.0191	.0133
2.3333	.0157	.0348	.0351	.0273	.0194	.0135
2.5000	.0159	.0354	.0357	.0278	.0197	.0137
2.5556	.0160	.0356	.0359	.0279	.0198	.0138
2.8333	.0165	.0366	.0369	.0286	.0203	.0141
3.1667	.0170	.0377	.0380	.0295	.0209	.0145
3.5000	.0174	.0387	.0390	.0303	.0214	.0148
3.6667	------	------	------	------	.0217	------
3.8333	.0179	.0397	.0400	.0310	.0219	.0151
3.8889	------	------	.0401	------	------	------
4.3333	.0184	.0410	.0413	.0321	.0226	.0156
4.8333	------	------	.0425	------	------	------
5.0000	.0190	.0424	.0428	.0333	.0235	.0162
5.6667	.0195	.0436	.0441	.0344	.0243	.0168

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 7.0000			
5.8889	------	0.0439	------	------	------	------
6.3333	0.0199	.0445	0.0452	0.0353	0.0250	0.0173
6.8333	------	.0451	------	------	------	------
7.0000	.0203	.0453	.0461	.0361	.0257	.0178
7.6667	.0205	.0460	.0469	.0368	.0262	.0182
7.8889	.0206	------	------	------	------	------
8.8333	.0208	------	------	------	------	------
9.6667	------	.0472	------	------	------	------
9.8889	.0210	------	------	------	------	------
10.8333	.0212	------	------	------	------	------
11.6667	.0212	------	------	------	------	------
11.8889	------	.0479	------	------	------	------
12.8333	------	.0481	------	------	------	------
13.6667	.0214	------	------	------	------	------
13.8889	------	------	.0499	------	------	------
14.8333	------	------	.0500	------	------	------
15.6667	------	.0484	------	------	------	------
15.8889	------	------	------	.0402	------	------
16.8333	------	------	------	.0403	------	------
17.6667	------	------	.0503	------	------	------
17.8889	------	------	------	------	.0294	------
18.8333	------	------	------	------	.0295	------
19.6667	------	------	------	.0405	------	------
19.8889	------	------	------	------	------	.0210
20.8333	------	------	------	------	------	.0211
21.6667	------	------	------	------	.0297	------
23.6667	------	------	------	------	------	.0212
			z' = 7.3333			
-16.6296	------	------	------	------	------	0.0007
-15.7778	------	------	------	------	------	.0008
-14.6296	------	------	------	------	0.0010	------
-13.7778	------	------	------	------	.0011	------
-13.2222	------	------	------	------	------	.0012
-12.6296	------	------	------	0.0013	------	------
-11.7778	------	------	------	.0016	------	------
-11.2222	------	------	------	------	.0018	------
-10.6296	------	------	0.0018	------	------	------
-9.7778	------	------	.0022	------	------	------
-9.2222	------	------	------	.0028	------	------
-8.6296	------	0.0021	------	------	------	------
-7.7778	------	.0027	------	------	------	------
-7.2222	------	------	.0042	------	------	------
-6.6296	0.0014	------	------	------	------	------
-5.7778	.0019	------	------	------	------	------
-5.2222	------	.0057	------	------	------	------
-3.2222	.0041	------	------	------	------	------
-2.7037	------	------	------	------	------	.0075
-2.2222	------	------	------	------	------	.0080
-.7778	------	------	------	------	------	.0097
-.7037	------	------	------	------	.0133	------
-.2222	------	------	------	------	.0142	------
.9630	.0113	.0257	.0272	.0222	.0164	.0118
1.1111	.0115	.0263	.0278	.0226	.0167	.0119

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 7.3333			
1.2593	0.0118	0.0269	0.0283	0.0230	.0169	0.0121
1.2963	------	------	------	.0231	------	------
1.4074	.0120	.0275	.0289	.0234	.0172	.0123
1.4444	.0121	.0276	.0290	.0235	.0173	.0123
1.5556	.0123	.0280	.0294	.0238	.0175	.0125
1.6667	.0125	.0285	.0298	.0241	.0177	.0126
1.7037	.0125	.0286	.0300	.0242	.0177	.0126
1.7778	------	------	------	.0244	------	------
1.8889	.0128	.0293	.0306	.0247	.0181	.0129
2.1111	.0132	.0300	.0314	.0253	.0185	.0131
2.3333	.0135	.0308	.0322	.0259	.0189	.0134
2.5556	.0139	.0315	.0329	.0264	.0192	.0136
2.8889	.0143	.0326	.0339	.0272	.0198	.0140
3.2222	------	------	------	.0280	------	------
3.2963	------	------	.0352	------	------	------
3.3333	.0149	.0339	.0353	.0283	.0205	.0144
3.7778	.0154	.0350	.0365	.0292	.0212	.0149
4.2222	.0159	.0361	.0376	.0301	.0218	.0153
4.6667	.0162	.0370	.0386	.0309	.0224	.0157
5.1111	.0166	.0378	.0395	.0317	.0229	.0161
5.2222	------	------	.0397	------	------	------
5.2963	------	.0381	------	------	------	------
5.7778	------	.0389	------	------	------	------
7.2222	------	.0405	------	------	------	------
7.2963	.0177	------	------	------	------	------
7.7778	.0179	------	------	------	------	------
9.2222	.0182	------	------	------	------	------
			z' = 7.5000			
-1.8750	------	------	------	------	------	0.0084
-1.3889	------	------	------	------	------	.0089
-.3333	------	------	------	------	------	.0102
.6111	------	------	------	------	0.0155	------
1.4444	0.0113	0.0261	0.0278	0.0229	.0170	.0123
1.6667	.0116	.0268	.0286	.0235	.0174	.0125
1.8889	.0120	.0276	.0293	.0240	.0178	.0128
2.1111	.0123	.0283	.0301	.0246	.0182	.0130
2.1667	.0124	.0285	.0303	.0247	.0183	.0131
2.3333	.0126	.0290	.0308	.0251	.0185	.0133
2.5000	.0129	.0296	.0313	.0256	.0188	.0134
2.5556	.0129	.0297	.0315	.0257	.0189	.0135
2.6111	------	------	------	.0259	------	------
2.8333	.0133	.0305	.0323	.0263	.0194	.0138
3.1667	.0137	.0315	.0333	.0271	.0199	.0142
3.5000	.0141	.0323	.0342	.0278	.0204	.0145
3.6667	------	------	------	.0282	------	------
3.8333	.0144	.0331	.0350	.0285	.0209	.0148
4.3333	.0149	.0342	.0362	.0294	.0216	.0153
4.6111	------	------	.0368	------	------	------
4.8333	------	------	------	------	.0222	------
5.0000	.0154	.0355	.0376	.0306	.0224	.0159
5.6667	.0158	.0365	.0388	.0316	.0232	.0164
6.3333	.0162	.0374	.0398	.0325	.0239	.0169
6.6111	------	.0377	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 7.5000			
6.8333	------	------	------	0.0331	------	------
7.0000	0.0165	0.0381	0.0406	.0333	0.0245	0.0174
7.6667	.0167	.0386	.0413	.0339	.0250	.0178
8.6111	.0169	------	------	------	------	------
8.8333	------	------	.0423	------	------	------
9.6667	.0171	------	------	------	------	------
10.6111	.0173	------	------	------	------	------
10.8333	------	.0402	------	------	------	------
11.6667	.0174	------	------	------	------	------
12.6111	------	.0406	------	------	------	------
12.8333	.0175	------	------	------	------	------
13.6667	------	.0408	------	------	------	------
14.6111	------	------	.0443	------	------	------
14.8333	.0176	------	------	------	------	------
15.6667	------	------	.0444	------	------	------
16.6111	------	------	------	.0373	------	------
16.8333	------	.0411	------	------	------	------
17.6667	------	------	------	.0374	------	------
18.6111	------	------	------	------	.0283	------
18.8333	------	------	.0447	------	------	------
19.6667	------	------	------	------	.0283	------
20.6111	------	------	------	------	------	.0207
20.8333	------	------	------	.0376	------	------
21.6667	------	------	------	------	------	.0208
22.8333	------	------	------	------	.0285	------
24.8333	------	------	------	------	------	.0209
			z' = 9.0000			
-17.6667	------	------	------	------	------	0.0007
-16.5000	------	------	------	------	------	.0008
-15.6667	------	------	------	------	0.0009	------
-14.5000	------	------	------	------	.0011	------
-13.6667	------	------	------	0.0011	------	------
-13.0000	------	------	------	------	------	.0014
-12.5000	------	------	------	.0014	------	------
-11.6667	------	------	0.0014	------	------	------
-11.0000	------	------	------	------	.0020	------
-10.5000	------	------	.0018	------	------	------
-9.6667	------	0.0015	------	------	------	------
-9.0000	------	------	------	.0028	------	------
-8.5000	------	.0020	------	------	------	------
-7.6667	0.0009	------	------	------	------	------
-7.0000	------	------	.0039	------	------	------
-6.5000	.0012	------	------	------	------	------
-5.0000	------	.0046	------	------	------	------
-3.0000	.0029	------	------	------	------	------
-.3333	------	------	------	------	------	.0094
.5000	------	------	------	------	------	.0102
1.4444	.0065	.0160	.0191	.0176	.0144	.0112
1.6667	.0066	.0165	.0196	.0181	.0147	.0114
1.8889	.0068	.0169	.0201	.0185	.0151	.0116
2.1111	.0070	.0173	.0206	.0189	.0154	.0119
2.1667	.0070	.0174	.0207	.0190	.0154	.0119

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
	z' = 9.0000					
2.3333	0.0071	0.0177	0.0210	0.0193	0.0157	0.0121
2.5000	.0073	.0180	.0214	.0196	.0159	.0122
2.5556	.0073	.0181	.0215	.0197	.0160	.0123
2.8333	.0075	.0186	.0220	.0201	.0163	.0126
3.0000	------	------	------	------	------	.0127
3.1667	.0077	.0191	.0227	.0207	.0167	.0129
3.5000	.0079	.0196	.0233	.0212	.0172	.0132
3.6667	------	------	------	.0215	------	------
3.8333	.0081	.0201	.0238	.0217	.0176	.0135
4.3333	.0084	.0208	.0246	.0224	.0181	.0139
4.5000	------	------	------	.0227	------	------
5.0000	.0087	.0216	.0256	.0233	.0188	.0144
5.6667	.0090	.0223	.0264	.0241	.0195	.0149
6.3333	.0092	.0229	.0272	.0248	.0201	.0153
6.5000	------	------	.0274	------	------	------
7.0000	.0094	.0234	.0278	.0255	.0206	.0158
7.6667	.0096	.0238	.0284	.0260	.0211	.0161
8.5000	------	.0243	------	------	------	------
9.0000	------	------	.0293	------	------	------
9.6667	.0099	------	------	------	------	------
10.5000	.0100	------	------	------	------	------
11.0000	------	.0251	------	------	------	------
11.6667	.0101	------	------	------	------	------
12.5000	.0102	------	------	------	------	------
13.0000	.0102	------	------	------	------	------
13.6667	------	.0256	------	------	------	------
14.5000	------	.0257	------	------	------	------
15.0000	.0103	------	------	------	------	------
15.6667	------	------	.0311	------	------	------
16.5000	------	------	.0312	------	------	------
17.0000	------	.0259	------	------	------	------
17.6667	------	------	------	.0292	------	------
18.5000	------	------	------	.0292	------	------
19.0000	------	------	.0314	------	------	------
19.6667	------	------	------	------	.0242	------
20.5000	------	------	------	------	.0243	------
21.0000	------	------	------	.0294	------	------
21.6667	------	------	------	------	------	.0191
22.5000	------	------	------	------	------	.0191
23.0000	------	------	------	------	.0244	------
25.0000	------	------	------	------	------	.0192
	z' = 10.0000					
-17.2222	------	------	------	------	------	0.0007
-15.8889	------	------	------	------	------	.0009
-15.3333	------	------	------	------	------	.0010
-15.2222	------	------	------	------	0.0010	------
-13.8889	------	------	------	------	.0012	------
-13.3333	------	------	------	------	.0013	.0013
-13.2222	------	------	------	0.0012	------	------
-11.8889	------	------	------	.0016	------	------
-11.3333	------	------	------	.0017	.0018	------
-11.2222	------	------	0.0015	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 10.0000						
-9.8889	------	------	0.0019	------	------	------
-9.6667	------	------	------	------	------	0.0024
-9.3333	------	------	.0022	0.0025	------	------
-9.2222	------	0.0015	------	------	------	------
-7.8889	------	.0021	------	------	------	------
-7.6667	------	------	------	------	0.0035	------
-7.3333	------	.0023	.0033	------	------	------
-7.2222	0.0009	------	------	------	------	------
-5.8889	.0012	------	------	------	------	------
-5.6667	------	------	------	.0051	------	.0044
-5.3333	.0014	.0036	------	------	------	------
-3.6667	------	------	.0070	------	.0067	------
-3.3333	.0021	------	------	------	------	------
-1.6667	------	.0076	------	.0100	------	------
.3333	.0040	------	.0132	------	------	------
1.8889	------	------	------	------	------	.0107
2.3333	------	.0131	------	------	------	------
2.8889	.0054	.0138	.0173	.0168	.0144	.0116
3.2222	------	------	------	------	------	.0118
3.3333	.0056	.0143	.0180	.0174	.0149	.0119
3.7778	.0058	.0148	.0186	.0180	.0153	.0123
3.8889	------	------	------	------	.0154	------
4.2222	.0060	.0153	.0191	.0185	.0158	.0126
4.3333	.0060	.0154	.0192	.0186	.0159	.0127
4.6667	.0061	.0157	.0196	.0190	.0162	.0130
5.0000	.0062	.0160	.0200	.0194	.0165	.0132
5.1111	.0063	.0161	.0201	.0195	.0166	.0133
5.2222	------	------	------	------	.0167	------
5.3333	------	------	------	------	.0168	.0134
5.6667	.0064	.0165	.0207	.0200	.0171	.0136
5.8889	------	------	------	.0202	------	------
6.3333	.0066	.0170	.0213	.0206	.0176	.0141
7.0000	.0068	.0174	.0218	.0212	.0180	.0144
7.2222	------	------	------	.0213	------	------
7.3333	------	------	------	.0214	.0183	------
7.6667	.0069	.0177	.0223	.0216	.0185	.0148
7.8889	------	------	.0224	------	------	------
8.6667	.0071	.0182	.0229	.0222	.0190	.0153
9.2222	------	------	.0231	------	------	------
9.3333	------	------	.0232	.0226	------	------
9.6667	------	------	------	------	.0195	------
9.8889	------	.0186	------	------	------	------
10.0000	.0072	.0186	.0235	.0229	.0196	.0158
11.2222	------	.0189	------	------	------	------
11.3333	.0074	.0189	.0239	.0234	.0201	.0162
11.6667	------	------	------	.0235	------	.0163
11.8889	.0074	------	------	------	------	------
12.6667	.0074	.0192	.0243	.0238	.0205	.0166
13.2222	.0075	------	------	------	------	------
13.3333	.0075	.0193	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 10.0000						
13.6667	------	------	0.0245	------	0.0207	------
14.0000	0.0075	0.0193	.0245	0.0241	.0208	0.0168
15.3333	.0075	.0195	.0247	.0243	.0210	.0171
15.6667	------	.0195	------	.0243	------	------
17.6667	.0076	------	.0249	------	------	------
19.6667	------	.0197	------	------	------	------
21.6667	.0076	------	------	------	------	------
z' = 10.5000						
1.3889	------	------	------	------	------	0.0098
1.4444	0.0040	0.0104	0.0135	0.0135	0.0119	.0099
1.6667	.0041	.0107	.0138	.0138	.0122	.0101
1.8889	.0042	.0109	.0141	.0141	.0124	.0102
2.1111	.0043	.0112	.0144	.0144	.0126	.0104
2.1667	.0043	.0113	.0145	.0144	.0127	.0105
2.3333	.0044	.0114	.0147	.0147	.0129	.0106
2.5000	.0045	.0116	.0149	.0149	.0131	.0107
2.5556	.0045	.0117	.0150	.0149	.0131	.0108
2.8333	.0046	.0120	.0153	.0153	.0134	.0110
3.1667	.0047	.0123	.0158	.0157	.0137	.0113
3.3889	------	------	------	------	.0139	------
3.5000	.0049	.0126	.0162	.0162	.0140	.0115
3.8333	.0050	.0129	.0165	.0164	.0144	.0118
4.3333	.0051	.0133	.0171	.0170	.0148	.0121
5.0000	.0054	.0139	.0178	.0176	.0154	.0126
5.1667	------	------	------	------	------	.0127
5.3889	------	------	------	.0180	------	------
5.6667	.0055	.0143	.0184	.0182	.0159	.0130
6.3333	.0057	.0148	.0189	.0188	.0164	.0134
7.0000	.0058	.0151	.0194	.0193	.0168	.0138
7.1667	------	------	------	------	.0169	------
7.3889	------	------	.0196	------	------	------
7.6667	.0059	.0154	.0198	.0197	.0172	.0141
8.3333	------	------	.0202	------	------	------
9.1667	------	------	------	.0205	------	------
9.3889	------	.0161	------	------	------	------
10.3333	------	.0163	------	------	------	------
11.1667	------	------	.0213	------	------	------
11.3889	.0063	------	------	------	------	------
12.3333	.0064	------	------	------	------	------
13.1667	------	.0168	------	------	------	------
13.3889	.0065	------	------	------	------	------
14.3333	.0065	------	------	------	------	------
15.1667	.0065	------	------	------	------	------
15.3889	------	.0171	------	------	------	------
16.3333	------	.0171	------	------	------	------
17.1667	.0066	------	------	------	------	------
17.3889	------	------	.0223	------	------	------
18.3333	------	------	.0224	------	------	------
19.1667	------	.0173	------	------	------	------
19.3889	------	------	------	.0226	------	------
20.3333	------	------	------	.0227	------	------
21.1667	------	------	.0225	------	------	------
21.3889	------	------	------	------	.0203	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 10.5000			
22.3333	------	------	------	------	0.0203	------
23.1667	------	------	------	0.0228	------	------
23.3889	------	------	------	------	------	0.0170
24.3333	------	------	------	------	------	.0170
25.1667	------	------	------	------	.0204	------
27.1667	------	------	------	------	------	.0171
			z' = 11.0000			
-19.4444	------	------	------	------	------	0.0006
-18.1667	------	------	------	------	------	.0007
-17.4444	------	------	------	------	0.0007	------
-16.1667	------	------	------	------	.0008	------
-15.4444	------	------	------	0.0008	------	------
-14.3333	------	------	------	------	------	.0012
-14.1667	------	------	------	.0010	------	------
-13.4444	------	------	0.0009	------	------	------
-12.3333	------	------	------	------	.0015	------
-12.1667	------	------	.0012	------	------	------
-11.4444	------	0.0009	------	------	------	------
-10.3333	------	------	------	.0020	------	------
-10.1667	------	.0012	------	------	------	------
-9.4444	0.0005	------	------	------	------	------
-8.3333	------	------	.0025	------	------	------
-8.1667	.0006	------	------	------	------	------
-6.3333	------	.0025	------	------	------	------
-4.3333	.0014	------	------	------	------	------
1.4444	.0035	.0092	.0120	.0124	.0112	.0094
1.6667	.0036	.0094	.0123	.0126	.0114	.0096
1.8889	.0036	.0096	.0126	.0129	.0116	.0098
2.1111	.0037	.0098	.0128	.0131	.0118	.0099
2.1667	.0037	.0098	.0129	.0132	.0119	.0100
2.3333	.0038	.0100	.0131	.0134	.0120	.0101
2.5000	.0039	.0101	.0133	.0136	.0122	.0102
2.5556	.0039	.0102	.0134	.0136	.0122	.0103
2.8333	.0040	.0104	.0137	.0139	.0125	.0105
3.1667	.0041	.0107	.0140	.0143	.0128	.0107
3.4444	------	------	------	------	.0131	------
3.5000	.0042	.0110	.0144	.0146	.0131	.0110
3.8333	.0043	.0113	.0147	.0150	.0134	.0112
4.1667	------	------	------	------	.0137	------
4.3333	.0044	.0116	.0152	.0155	.0138	.0115
5.0000	.0046	.0121	.0158	.0161	.0143	.0119
5.4444	------	------	------	.0164	------	------
5.6667	.0048	.0125	.0163	.0166	.0148	.0124
6.1667	------	------	------	.0170	------	------
6.3333	.0049	.0129	.0168	.0171	.0153	.0127
7.0000	.0050	.0132	.0173	.0176	.0157	.0131
7.4444	------	------	.0175	------	------	------
7.6667	.0051	.0135	.0177	.0180	.0161	.0134
8.1667	------	------	.0179	------	------	------
8.3333	------	------	------	.0183	------	------
9.4444	------	.0141	------	------	------	------
10.1667	------	.0143	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
z' = 11.0000						
10.3333	------	------	0.0188	------	------	------
11.4444	0.0055	------	------	------	------	------
12.1667	.0056	------	------	------	------	------
12.3333	------	0.0147	------	------	------	------
13.4444	.0056	------	------	------	------	------
14.1667	.0056	------	------	------	------	------
14.3333	.0056	------	------	------	------	------
15.4444	------	.0150	------	------	------	------
16.1667	------	.0151	------	------	------	------
16.3333	.0057	------	------	------	------	------
17.4444	------	------	.0200	------	------	------
18.1667	------	------	.0201	------	------	------
18.3333	------	.0152	------	------	------	------
19.4444	------	------	------	0.0208	------	------
20.1667	------	------	------	.0208	------	------
20.3333	------	------	.0202	------	------	------
21.4444	------	------	------	------	0.0190	------
22.1667	------	------	------	------	.0190	------
22.3333	------	------	------	.0209	------	------
23.4444	------	------	------	------	------	0.0162
24.1667	------	------	------	------	------	.0162
24.3333	------	------	------	------	.0191	------
26.3333	------	------	------	------	------	.0163
z' = 13.5000						
1.4444	0.0018	0.0051	0.0072	0.0080	0.0079	0.0073
1.6667	.0019	.0052	.0073	.0082	.0081	.0074
1.8889	.0019	.0053	.0075	.0083	.0082	.0075
2.1111	.0020	.0054	.0076	.0085	.0083	.0076
2.1667	.0020	.0054	.0076	.0085	.0084	.0076
2.3333	.0020	.0055	.0077	.0086	.0085	.0077
2.5000	.0020	.0055	.0078	.0087	.0086	.0078
2.5556	.0020	.0056	.0079	.0088	.0086	.0079
2.8333	.0021	.0057	.0080	.0089	.0088	.0080
3.1667	.0021	.0058	.0082	.0092	.0090	.0082
3.5000	.0022	.0060	.0084	.0094	.0092	.0083
3.8333	.0022	.0061	.0086	.0096	.0094	.0085
4.1667	------	------	------	------	------	.0087
4.3333	.0023	.0063	.0089	.0099	.0096	.0087
5.0000	.0024	.0065	.0092	.0102	.0100	.0091
5.6667	.0025	.0068	.0095	.0106	.0103	.0094
6.1667	------	------	------	------	.0106	------
6.3333	.0025	.0070	.0098	.0109	.0106	.0096
7.0000	.0026	.0072	.0101	.0112	.0109	.0099
7.5000	------	------	------	------	------	.0101
7.6667	.0027	.0073	.0103	.0115	.0112	.0101
8.1667	------	------	------	.0117	------	------
9.0000	------	------	------	.0119	------	------
9.5000	------	------	------	------	.0118	------
10.1667	------	------	.0110	------	------	------
11.0000	------	------	.0112	------	------	------
11.5000	------	------	------	.0126	------	------
12.1667	------	.0081	------	------	------	------
13.0000	------	.0082	------	------	------	------
13.5000	------	------	.0116	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - *Continued*

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 13.5000			
14.1667	0.0030	------	------	------	------	------
15.0000	.0030	------	------	------	------	------
15.5000	------	0.0084	------	------	------	------
16.1667	.0031	------	------	------	------	------
17.0000	.0031	------	------	------	------	------
17.5000	.0031	------	------	------	------	------
18.1667	------	.0085	------	------	------	------
19.0000	------	.0086	------	------	------	------
19.5000	.0031	------	------	------	------	------
20.1667	------	------	0.0122	------	------	------
21.0000	------	------	.0122	------	------	------
21.5000	------	.0086	------	------	------	------
22.1667	------	------	------	0.0138	------	------
23.0000	------	------	------	.0138	------	------
23.5000	------	------	.0123	------	------	------
24.1667	------	------	------	------	0.0137	------
25.0000	------	------	------	------	.0137	------
25.5000	------	------	------	.0139	------	------
26.1667	------	------	------	------	------	0.0126
27.0000	------	------	------	------	------	.0127
27.5000	------	------	------	------	.0138	------
29.5000	------	------	------	------	------	.0127
			z' = 14.0000			
-20.7778	------	------	------	------	------	0.0005
-18.7778	------	------	------	------	0.0006	------
-18.6667	------	------	------	------	------	.0006
-16.7778	------	------	------	0.0006	------	------
-16.6667	------	------	------	------	.0008	------
-14.7778	------	------	0.0007	------	------	------
-14.6667	------	------	------	.0009	------	------
-12.7778	------	0.0006	------	------	------	------
-12.6667	------	------	.0009	------	------	------
-12.3333	------	------	------	------	------	.0015
-10.7778	0.0003	------	------	------	------	------
-10.6667	------	.0008	------	------	------	------
-10.3333	------	------	------	------	.0019	------
-8.6667	.0004	------	------	------	------	------
-8.3333	------	------	------	.0023	------	------
-6.3333	------	------	.0025	------	------	------
-4.3333	------	.0023	------	------	------	------
-2.3333	.0011	------	------	------	------	------
2.8889	.0019	.0051	.0073	.0083	.0082	.0076
3.3333	.0019	.0053	.0075	.0085	.0085	.0078
3.7778	.0020	.0054	.0078	.0087	.0087	.0080
4.2222	.0020	.0056	.0080	.0090	.0089	.0082
4.3333	.0020	.0056	.0080	.0090	.0090	.0083
4.6667	.0021	.0057	.0082	.0092	.0091	.0084
5.0000	.0021	.0059	.0083	.0094	.0093	.0085
5.1111	.0021	.0059	.0084	.0094	.0094	.0086
5.6667	.0022	.0061	.0086	.0097	.0096	.0088
6.3333	.0023	.0062	.0089	.0100	.0099	.0091
6.7778	------	------	------	------	------	.0093
7.0000	.0023	.0064	.0091	.0103	.0102	.0093

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 14.0000			
7.6667	0.0024	0.0066	0.0093	0.0105	0.0104	0.0096
8.6667	.0025	.0068	.0096	.0109	.0108	.0099
8.7778	------	------	------	------	.0108	------
10.0000	.0025	.0070	.0100	.0112	.0112	.0103
10.6667	------	------	------	------	.0113	------
10.7778	------	------	------	.0114	------	------
11.3333	.0026	.0072	.0102	.0116	.0115	.0106
12.6667	.0027	.0073	.0105	.0118	.0118	.0109
12.7778	------	------	.0105	------	------	------
14.0000	.0027	.0074	.0106	.0120	.0120	.0111
14.3333	------	------	------	------	------	.0111
14.6667	------	------	.0107	------	------	------
14.7778	------	.0075	------	------	------	------
15.3333	.0027	.0075	.0108	.0122	.0122	.0113
16.3333	------	------	------	------	.0123	------
16.6667	------	.0076	------	------	------	------
16.7778	.0028	------	------	------	------	------
18.3333	------	------	------	.0125	------	------
18.6667	.0028	------	------	------	------	------
20.3333	------	------	.0111	------	------	------
22.3333	------	.0078	------	------	------	------
24.3333	.0028	------	------	------	------	------
			z' = 16.5000			
1.4444	0.0010	0.0028	0.0042	0.0050	0.0053	0.0052
1.6667	.0010	.0029	.0043	.0051	.0054	.0053
1.8889	.0010	.0029	.0043	.0052	.0055	.0054
2.1111	.0010	.0030	.0044	.0052	.0055	.0054
2.1667	.0011	.0030	.0044	.0053	.0056	.0055
2.3333	.0011	.0030	.0045	.0053	.0056	.0055
2.5000	.0011	.0030	.0045	.0054	.0057	.0056
2.5556	.0011	.0030	.0045	.0054	.0057	.0056
2.8333	.0011	.0031	.0046	.0055	.0058	.0057
3.1667	.0011	.0032	.0047	.0056	.0059	.0058
3.5000	.0012	.0032	.0048	.0057	.0060	.0059
3.8333	.0012	.0033	.0049	.0058	.0062	.0060
4.3333	.0012	.0034	.0050	.0060	.0063	.0062
5.0000	.0013	.0035	.0052	.0062	.0065	.0064
5.6667	.0013	.0036	.0054	.0064	.0067	.0066
6.3333	.0013	.0038	.0056	.0066	.0069	.0068
6.9444	------	------	------	------	------	.0069
7.0000	.0014	.0039	.0057	.0068	.0071	.0069
7.6667	.0014	.0040	.0059	.0070	.0073	.0071
8.9444	------	------	------	------	.0076	------
9.6667	------	------	------	------	.0078	------
9.8333	------	------	------	------	------	.0076
10.9444	------	------	------	.0076	------	------
11.6667	------	------	------	.0077	------	------
11.8333	------	------	------	------	.0082	------
12.9444	------	------	.0067	------	------	------
13.6667	------	------	.0067	------	------	------
13.8333	------	------	------	.0080	------	------
14.9444	------	.0046	------	------	------	------
15.6667	------	.0046	------	------	------	------

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 16.5000			
15.8333	------	------	0.0069	------	------	------
16.9444	0.0017	------	------	------	------	------
17.6667	.0017	------	------	------	------	------
17.8333	------	0.0047	------	------	------	------
18.9444	.0017	------	------	------	------	------
19.6667	.0017	------	------	------	------	------
19.8333	.0017	------	------	------	------	------
20.9444	------	.0048	------	------	------	------
21.6667	------	.0048	------	------	------	------
21.8333	.0017	------	------	------	------	------
22.9444	------	------	.0072	------	------	------
23.6667	------	------	.0072	------	------	------
23.8333	------	.0049	------	------	------	------
24.9333	------	------	------	0.0087	------	------
25.6667	------	------	------	.0087	------	------
25.8333	------	------	.0073	------	------	------
26.9444	------	------	------	------	0.0093	------
27.6667	------	------	------	------	.0093	------
27.8333	------	------	------	.0088	------	------
28.9444	------	------	------	------	------	0.0092
29.6667	------	------	------	------	------	.0092
29.8333	------	------	------	------	.0093	------
31.8333	------	------	------	------	------	.0092
			z' = 18.0000			
-24.3333	------	------	------	------	------	0.0003
-22.3333	------	------	------	------	0.0004	------
-22.0000	------	------	------	------	------	.0004
-20.3333	------	------	------	0.0004	------	------
-20.0000	------	------	------	------	.0005	------
-18.3333	------	------	0.0004	------	------	------
-18.0000	------	------	------	.0005	------	------
-16.3333	------	0.0003	------	------	------	------
-16.0000	------	------	.0005	------	------	------
-15.0000	------	------	------	------	------	.0009
-14.3333	0.0001	------	------	------	------	------
-14.0000	------	.0004	------	------	------	------
-13.0000	------	------	------	------	.0011	------
-12.0000	.0002	------	------	------	------	------
-11.0000	------	------	------	.0012	------	------
-9.0000	------	------	.0012	------	------	------
-7.0000	------	.0009	------	------	------	------
-5.0000	.0004	------	------	------	------	------
2.8889	.0008	.0024	.0036	.0044	.0048	.0048
3.3333	.0009	.0025	.0037	.0045	.0049	.0049
3.7778	.0009	.0025	.0038	.0046	.0050	.0050
4.2222	.0009	.0026	.0039	.0048	.0051	.0052
4.3333	.0009	.0026	.0039	.0048	.0052	.0052
4.6667	.0009	.0026	.0040	.0049	.0053	.0053
5.0000	.0009	.0027	.0041	.0049	.0053	.0054
5.1111	.0010	.0027	.0041	.0050	.0054	.0054
5.6667	.0010	.0028	.0042	.0051	.0055	.0055
6.3333	.0010	.0029	.0043	.0052	.0057	.0057
7.0000	.0010	.0029	.0044	.0054	.0058	.0058
7.6667	.0011	.0030	.0045	.0055	.0060	.0060

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Continued

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 18.0000			
8.6667	0.0011	0.0031	0.0047	0.0057	0.0062	0.0062
10.0000	.0011	.0032	.0049	.0059	.0064	.0064
10.3333	------	------	------	------	------	.0065
11.3333	.0012	.0033	.0050	.0061	.0066	.0066
12.0000	------	------	------	------	------	.0067
12.3333	------	------	------	------	.0067	------
12.6667	.0012	.0034	.0052	.0063	.0068	.0068
14.0000	.0012	.0035	.0053	.0064	.0070	.0070
14.3333	------	------	------	.0065	------	------
15.3333	.0012	.0036	.0054	.0065	.0071	.0071
16.0000	------	------	------	.0066	------	------
16.3333	------	------	.0054	------	------	------
17.0000	------	------	------	------	------	.0073
18.0000	------	------	.0055	------	------	------
18.3333	------	.0037	------	------	------	------
19.0000	------	------	------	------	.0074	------
20.0000	------	.0037	------	------	------	------
20.3333	.0013	------	------	------	------	------
21.0000	------	------	------	.0069	------	------
22.0000	.0013	------	------	------	------	------
23.0000	------	------	.0057	------	------	------
25.0000	------	.0038	------	------	------	------
27.0000	.0013	------	------	------	------	------
			z' = 22.0000			
-27.8889	------	------	------	------	------	0.0002
-25.8889	------	------	------	------	0.0002	------
-25.3333	------	------	------	------	------	.0003
-23.8889	------	------	------	0.0002	------	------
-23.3333	------	------	------	------	.0003	------
-21.8889	------	------	0.0002	------	------	------
-21.3333	------	------	------	.0003	------	------
-19.8889	------	0.0002	------	------	------	------
-19.3333	------	------	.0003	------	------	------
-17.8889	0.0001	------	------	------	------	------
-17.6667	------	------	------	------	------	.0006
-17.3333	------	.0002	------	------	------	------
-15.6667	------	------	------	------	.0006	------
-15.3333	.0001	------	------	------	------	------
-13.6667	------	------	------	.0007	------	------
-11.6667	------	------	.0006	------	------	------
-9.6667	------	.0005	------	------	------	------
-7.6667	.0002	------	------	------	------	------
2.8889	.0004	.0013	.0020	.0026	.0029	.0031
3.3333	.0005	.0013	.0021	.0026	.0030	.0032
3.7778	.0005	.0014	.0021	.0027	.0031	.0032
4.2222	.0005	.0014	.0022	.0028	.0031	.0033
4.3333	.0005	.0014	.0022	.0028	.0031	.0033
4.6667	.0005	.0014	.0022	.0028	.0032	.0034
5.0000	.0005	.0014	.0022	.0028	.0032	.0034
5.1111	.0005	.0014	.0022	.0029	.0032	.0034
5.6667	.0005	.0015	.0023	.0029	.0033	.0035
6.3333	.0005	.0015	.0024	.0030	.0034	.0036
7.0000	.0005	.0016	.0024	.0031	.0035	.0037
7.6667	.0006	.0016	.0025	.0032	.0036	.0038

TABLE II.- SIDEWASH DUE TO A RECTANGULAR HORSESHOE VORTEX - Concluded

x'	-F(x',y',z')					
	y' = 1	y' = 3	y' = 5	y' = 7	y' = 9	y' = 11
			z' = 22.0000			
8.6667	0.0006	0.0017	0.0026	0.0033	0.0037	0.0039
10.0000	.0006	.0017	.0027	.0034	.0038	.0041
11.3333	.0006	.0018	.0028	.0035	.0040	.0042
12.6667	.0006	.0018	.0028	.0036	.0041	.0043
13.8889	------	------	------	------	------	.0044
14.0000	.0006	.0019	.0029	.0037	.0042	.0044
15.3333	.0007	.0019	.0030	.0038	.0043	.0045
15.8889	------	------	------	------	.0043	------
17.3333	------	------	------	------	.0044	------
17.8889	------	------	------	.0039	------	------
19.3333	------	------	------	.0040	------	------
19.6667	------	------	------	------	------	.0048
19.8889	------	------	.0031	------	------	------
21.3333	------	------	.0032	------	------	------
21.6667	------	------	------	------	.0046	------
21.8889	------	.0020	------	------	------	------
23.3333	------	.0021	------	------	------	------
23.6667	------	------	------	.0041	------	------
23.8889	.0007	------	------	------	------	------
25.3333	.0007	------	------	------	------	------
25.6667	------	------	.0032	------	------	------
27.6667	------	.0021	------	------	------	------
29.6667	.0007	------	------	------	------	------

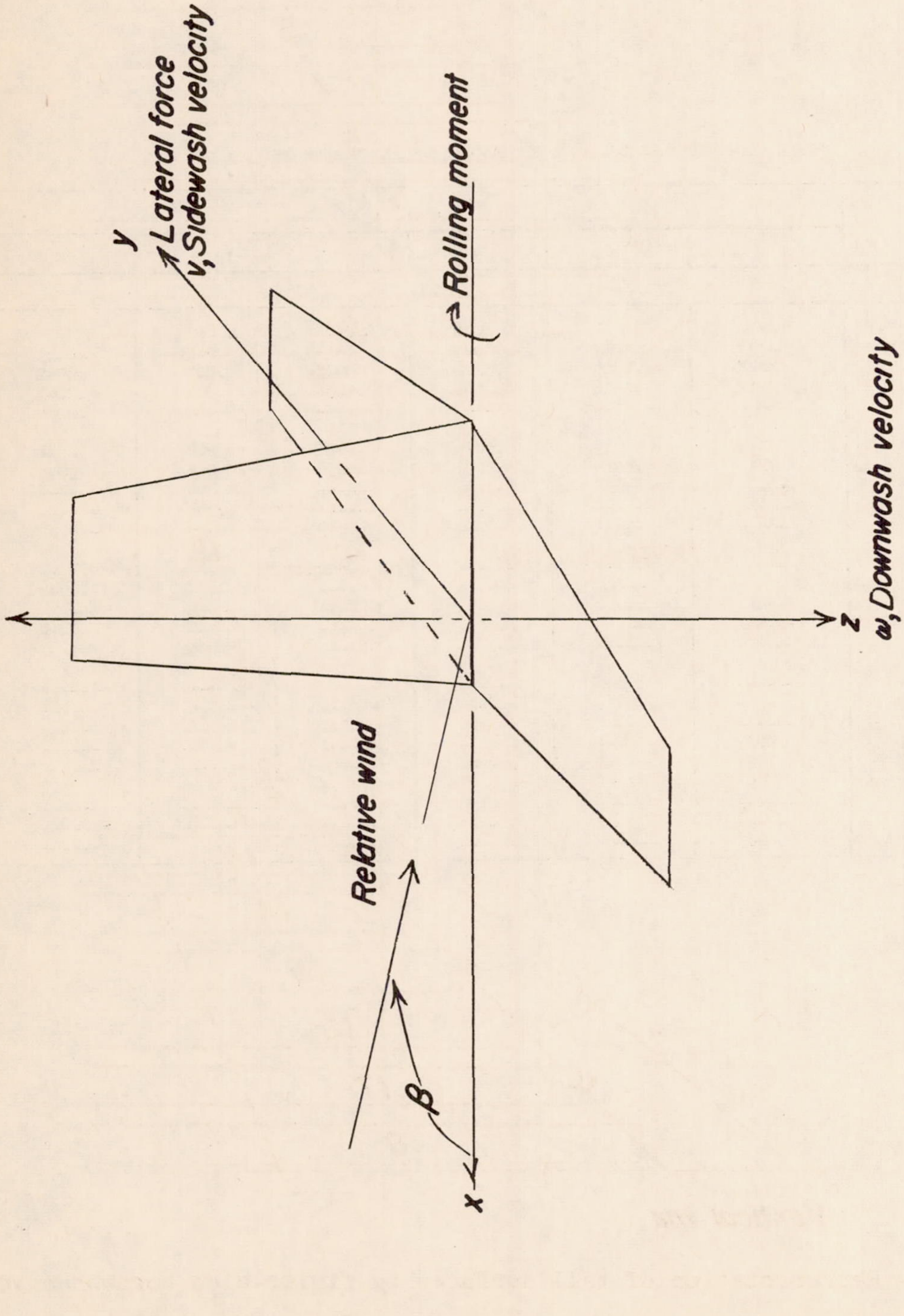


Figure 1.- System of axes used.

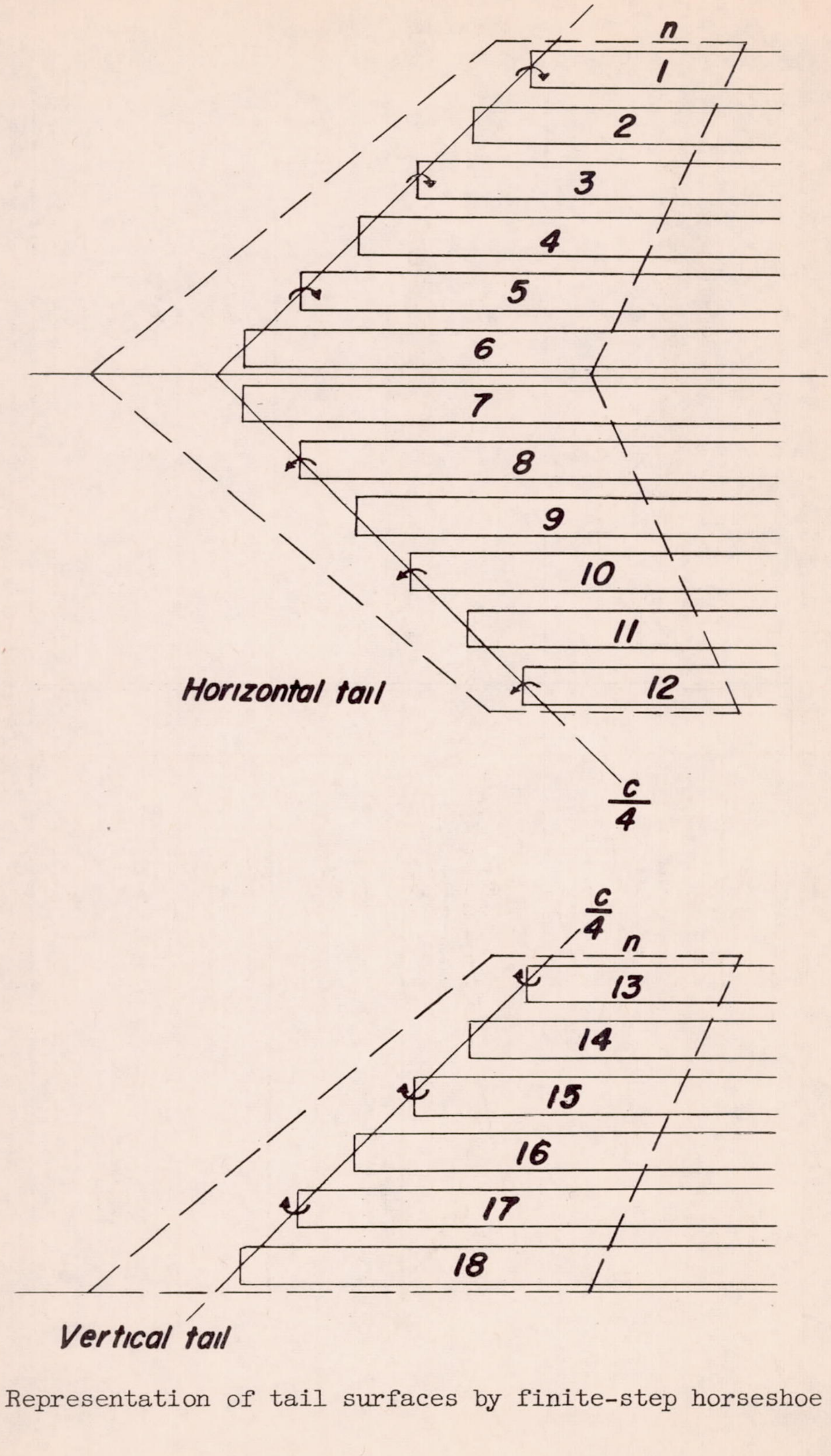
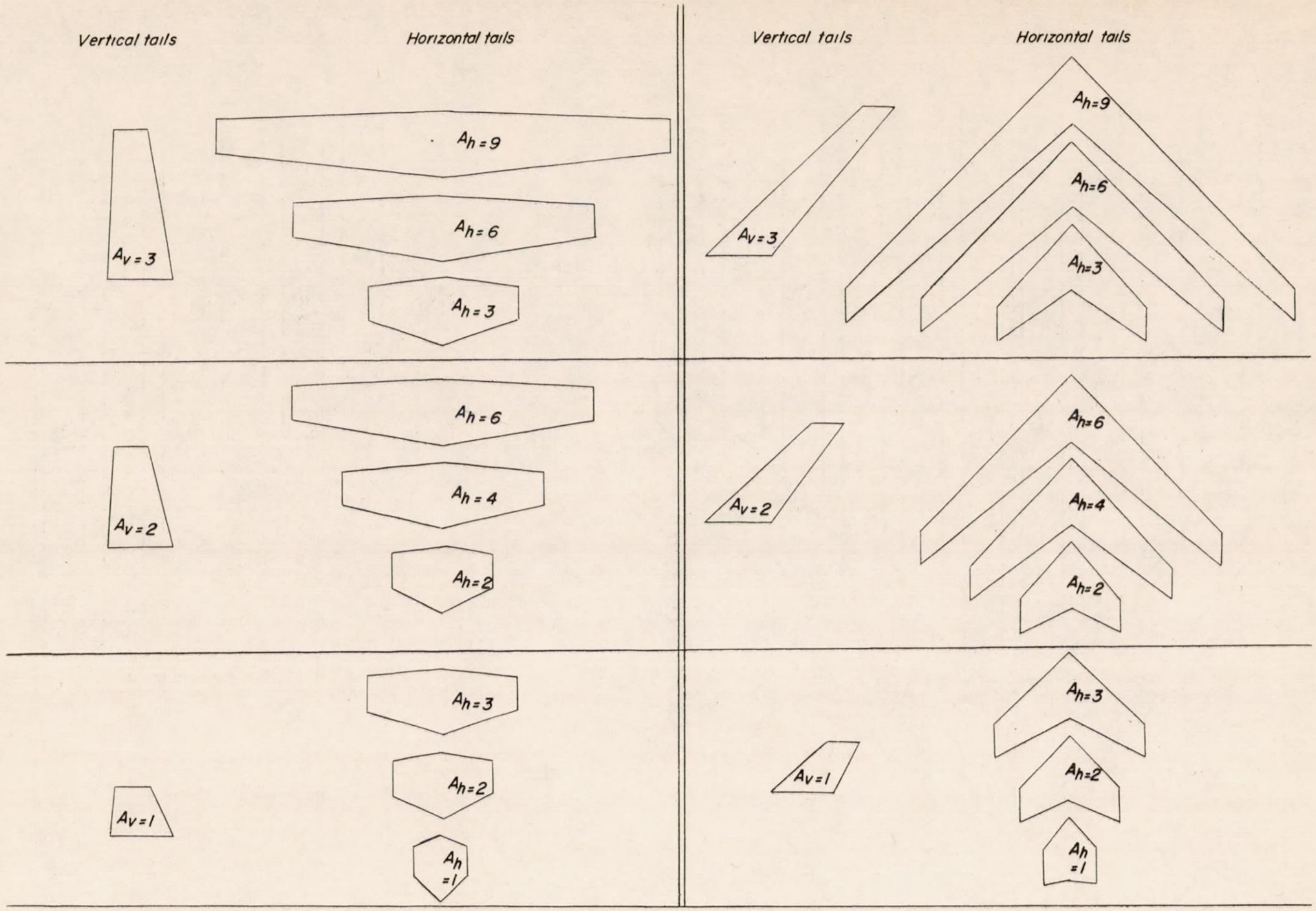
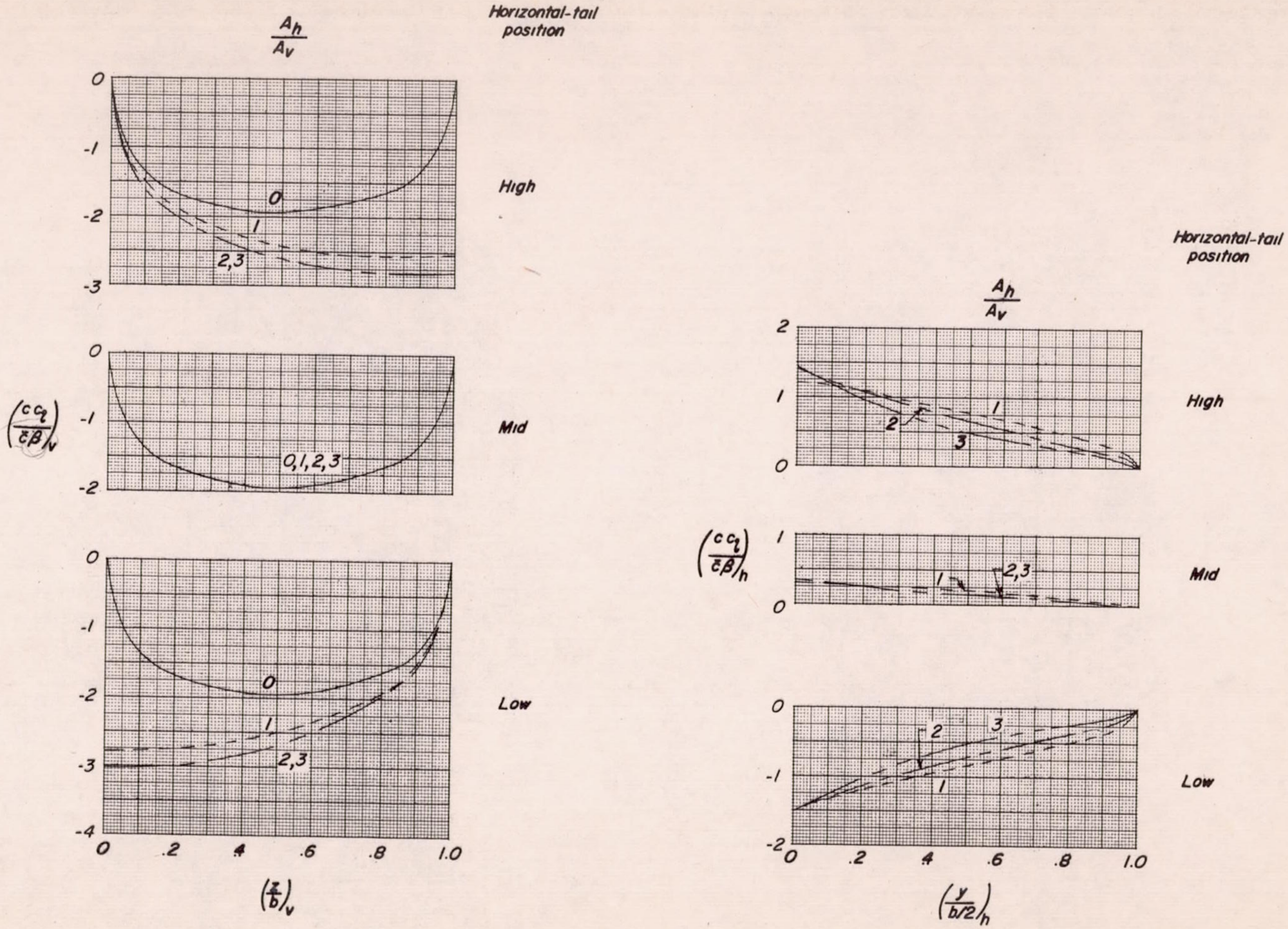


Figure 2.- Representation of tail surfaces by finite-step horseshoe vortices.



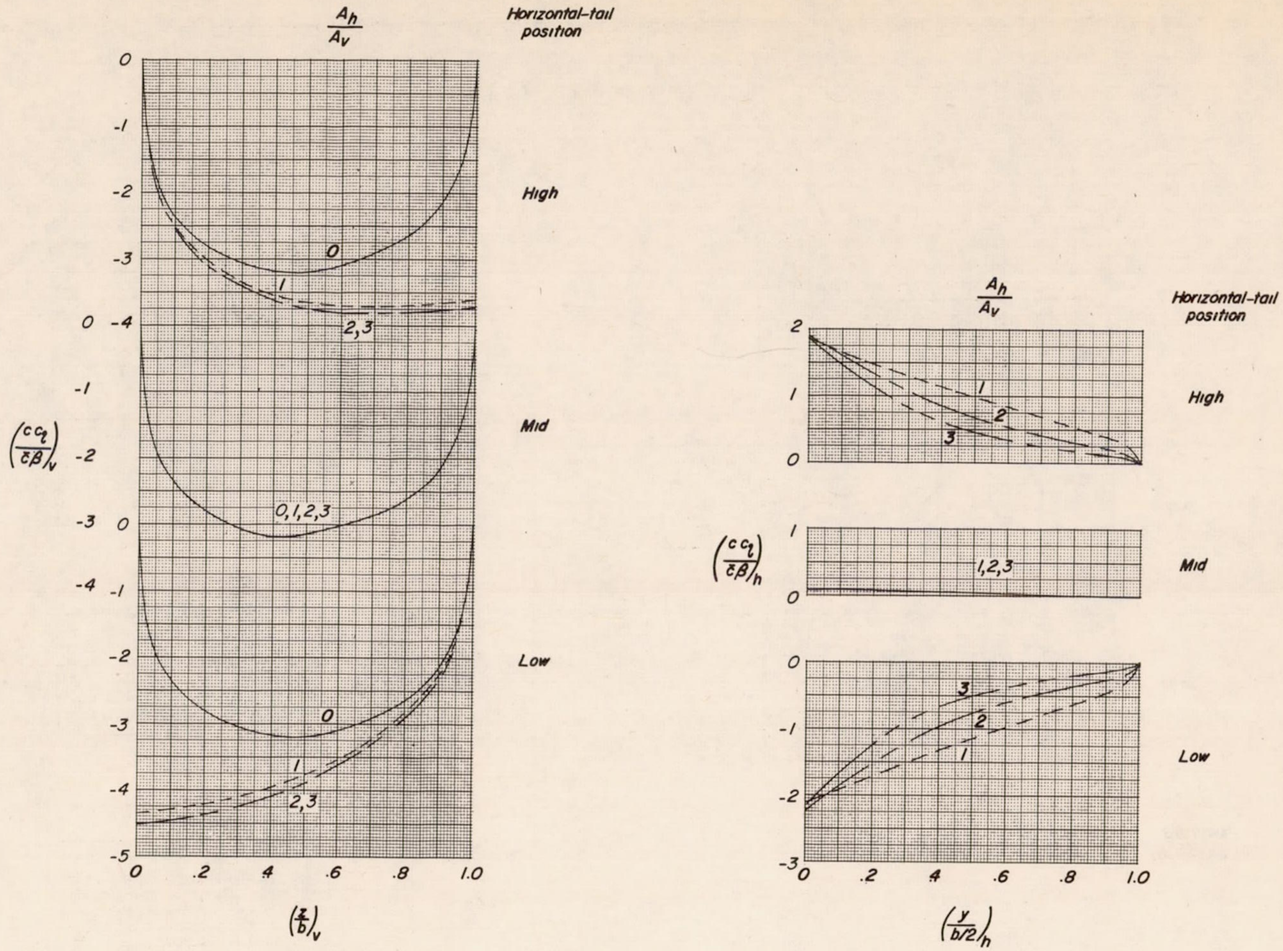
(a) $\Lambda = 0^\circ$. (b) $\Lambda = 45^\circ$.

Figure 3.- Tail surfaces for which span loads and derivatives were calculated.



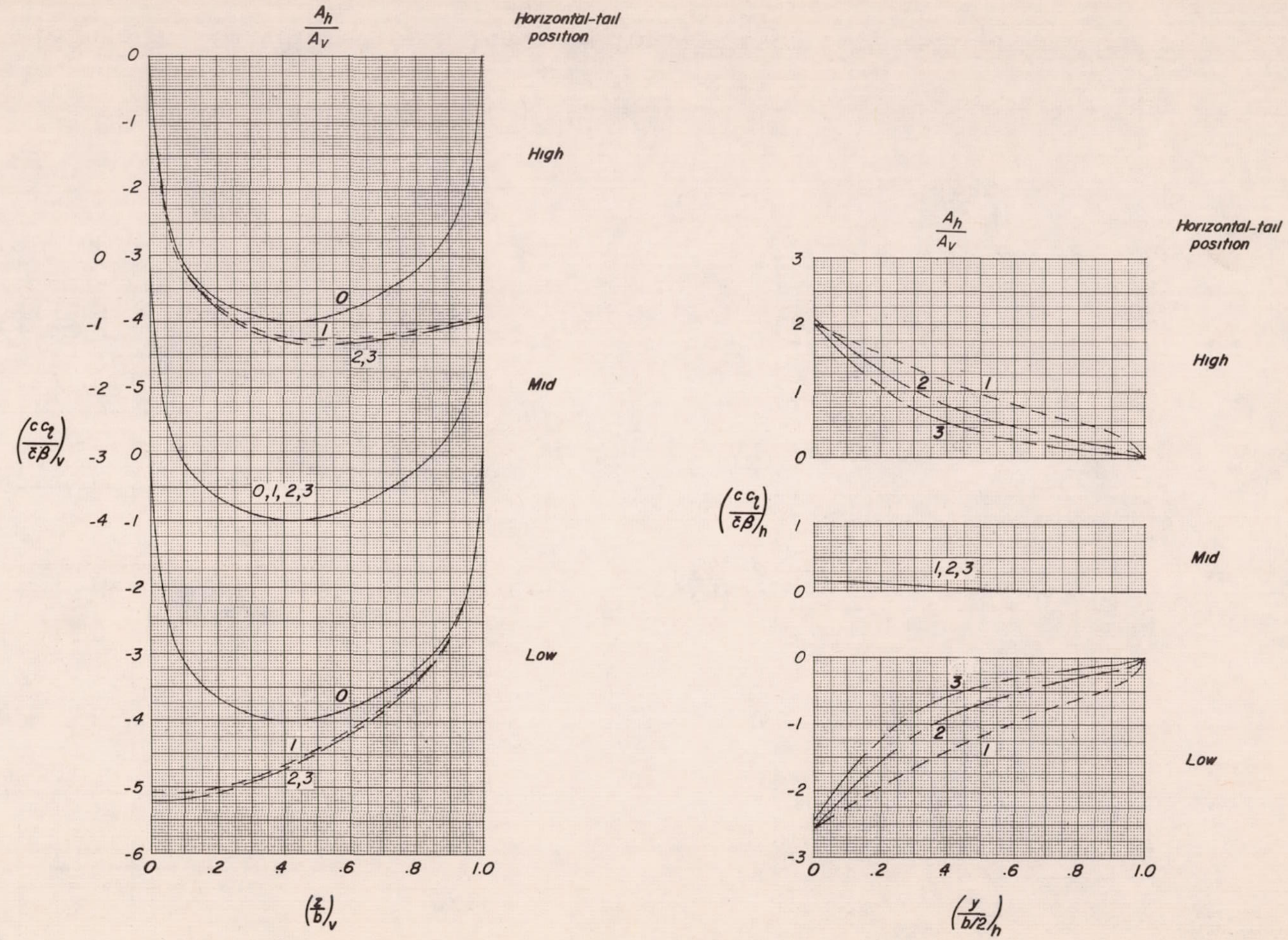
(a) $A_V = 1.0$.

Figure 4.- Calculated span loadings for unswept tail assemblies in sideslip. $\Gamma = 0$.



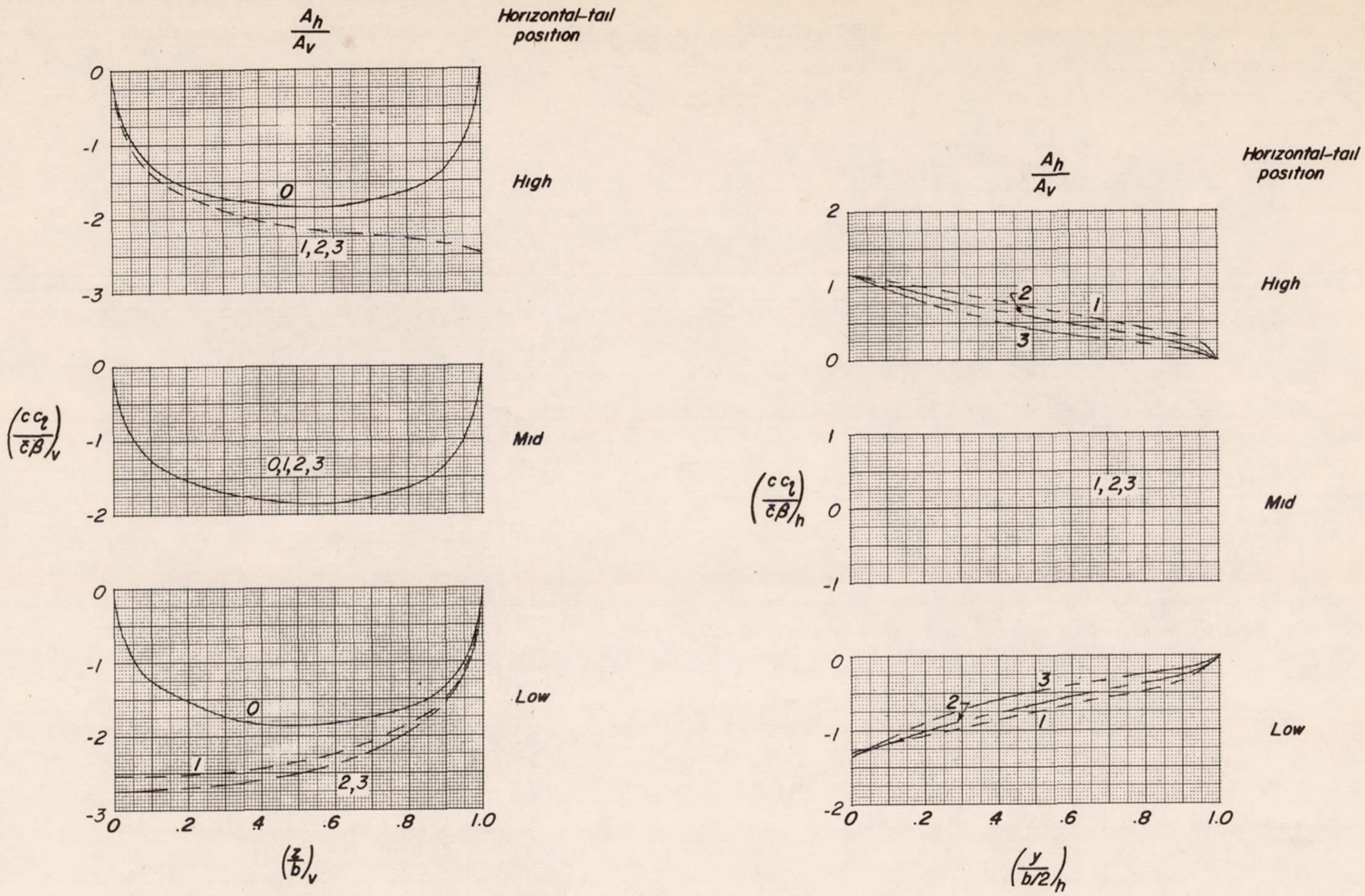
(b) $A_V = 2.0$.

Figure 4.- Continued.



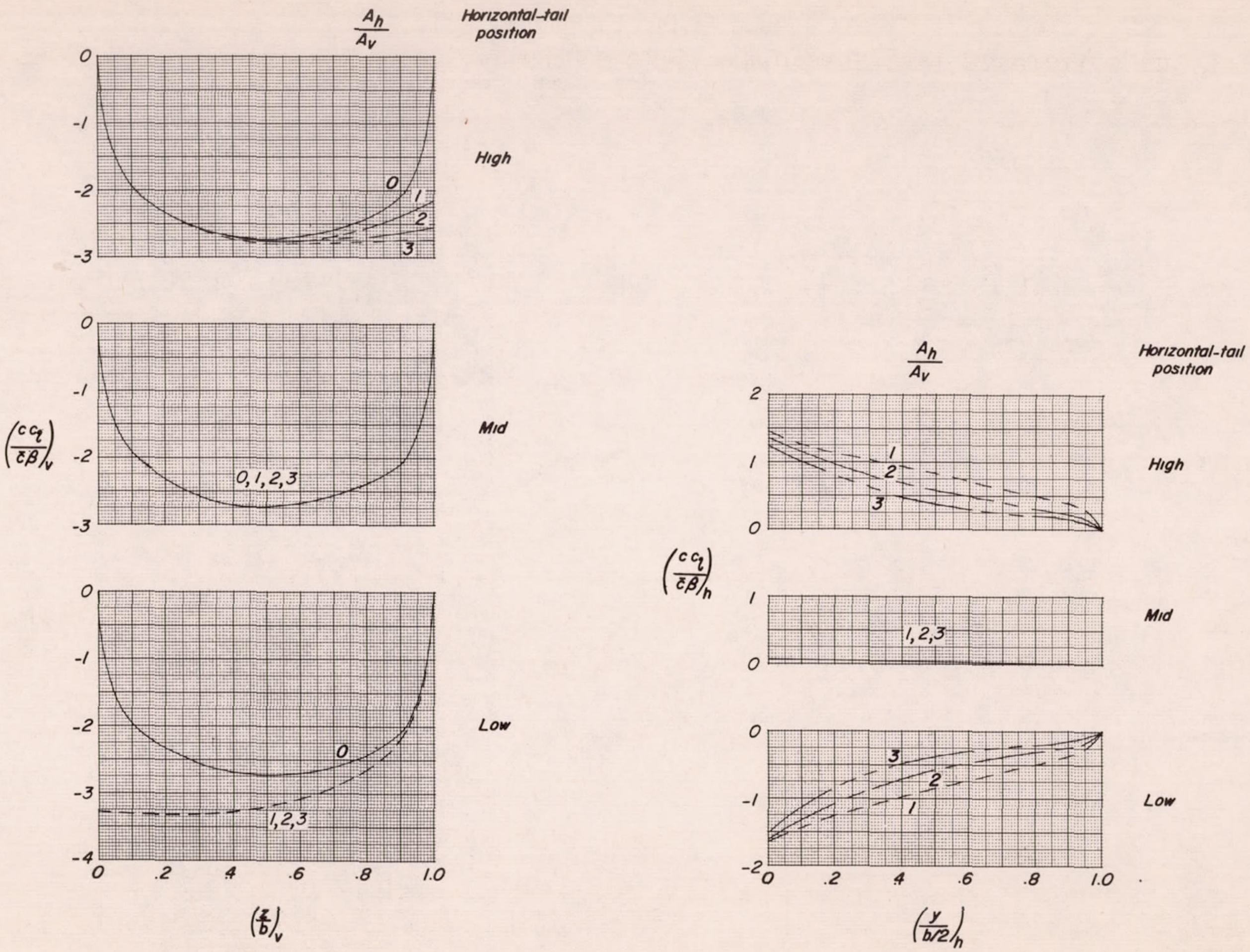
(c) $A_V = 3.0$.

Figure 4.- Concluded.



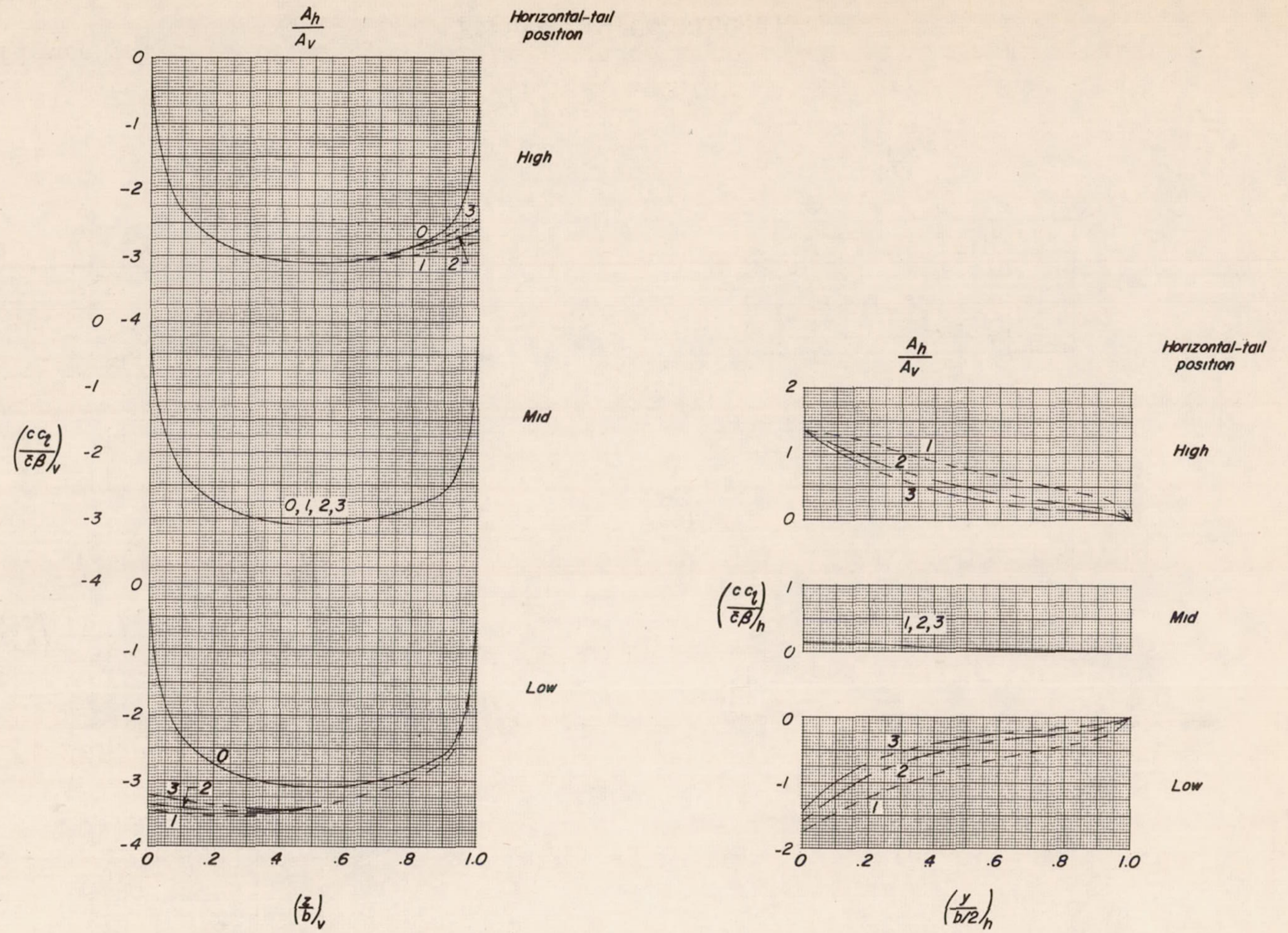
(a) $A_V = 1.0$.

Figure 5.- Calculated span loadings for 45° sweptback tail assemblies in sideslip. $\Gamma = 0$.



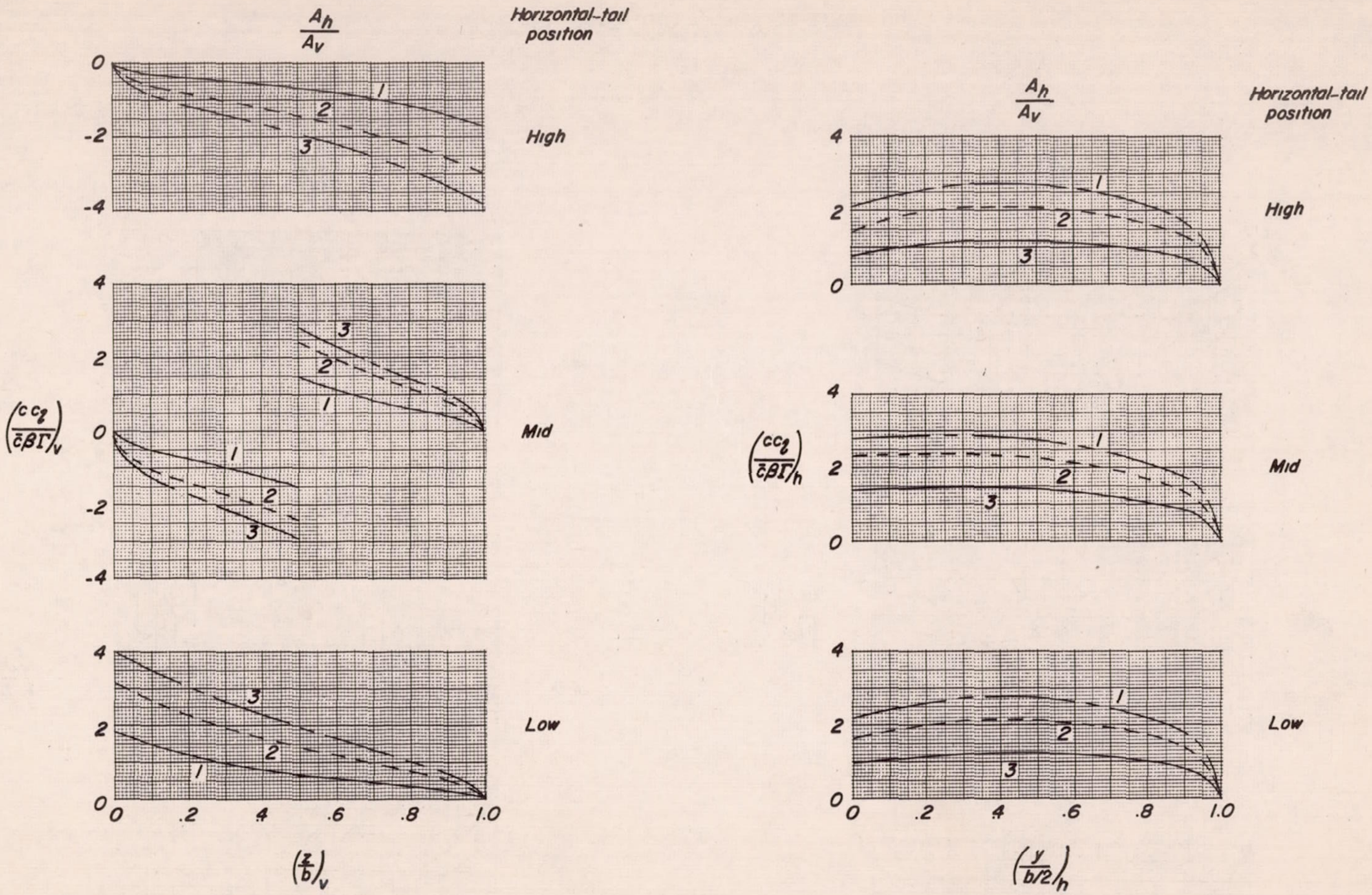
(b) $A_V = 2.0$.

Figure 5.- Continued.



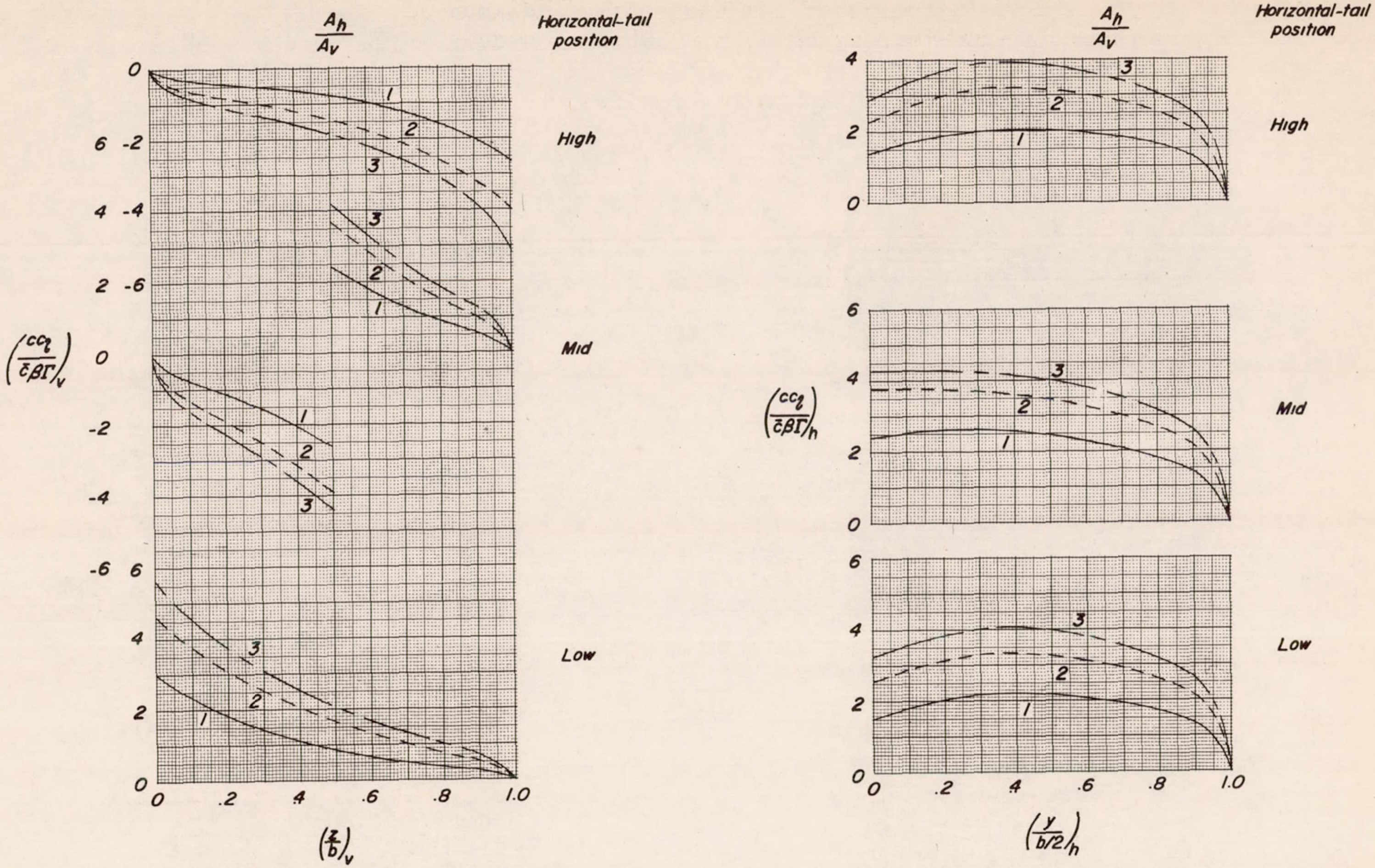
(c) $A_V = 3.0$.

Figure 5.- Concluded.



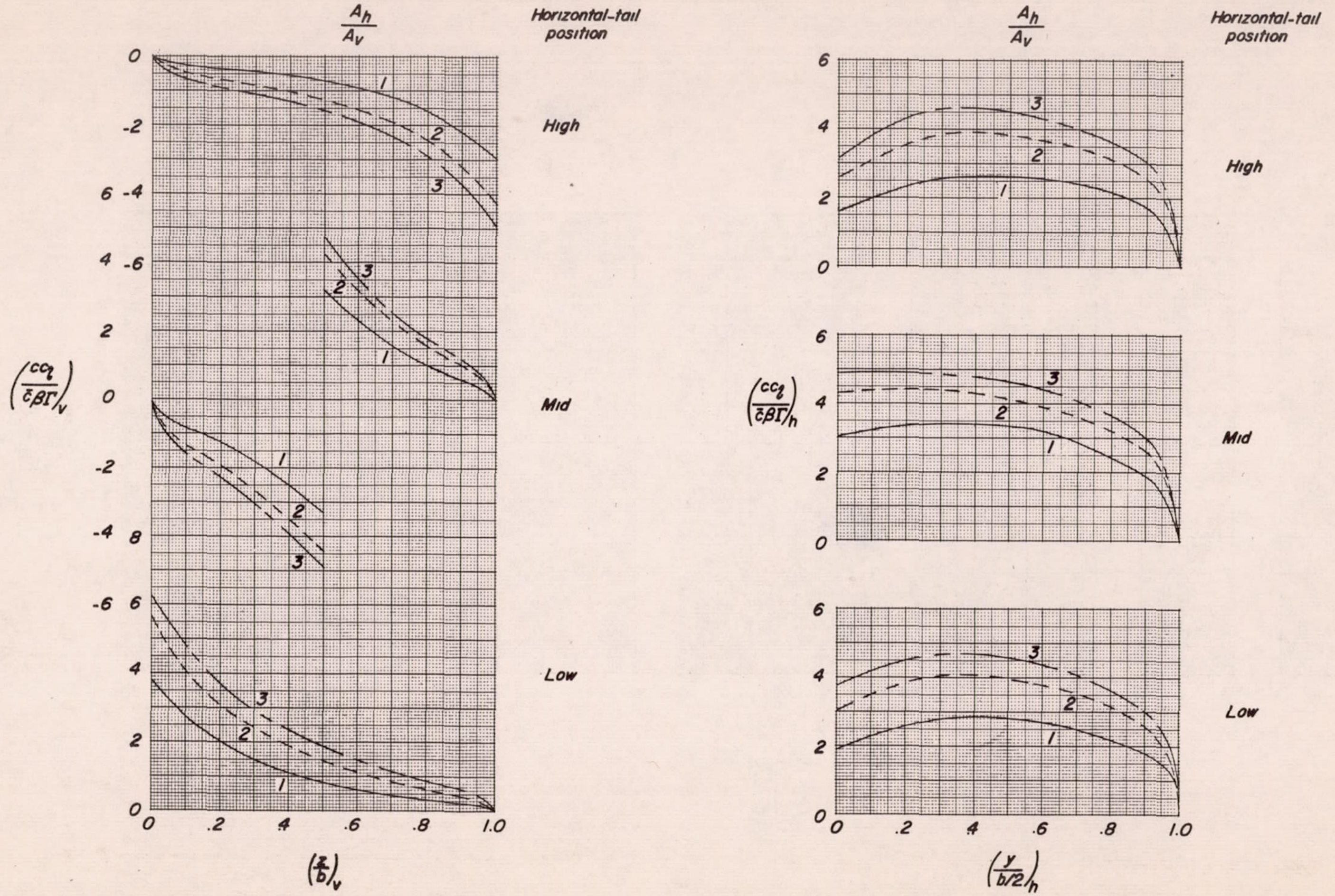
(a) $A_V = 1.0$.

Figure 6.- Calculated span loadings due to horizontal-tail dihedral angle for unswept tail assemblies in sideslip.



(b) $A_V = 2.0$.

Figure 6.- Continued.



(c) $A_V = 3.0$.

Figure 6.- Concluded.

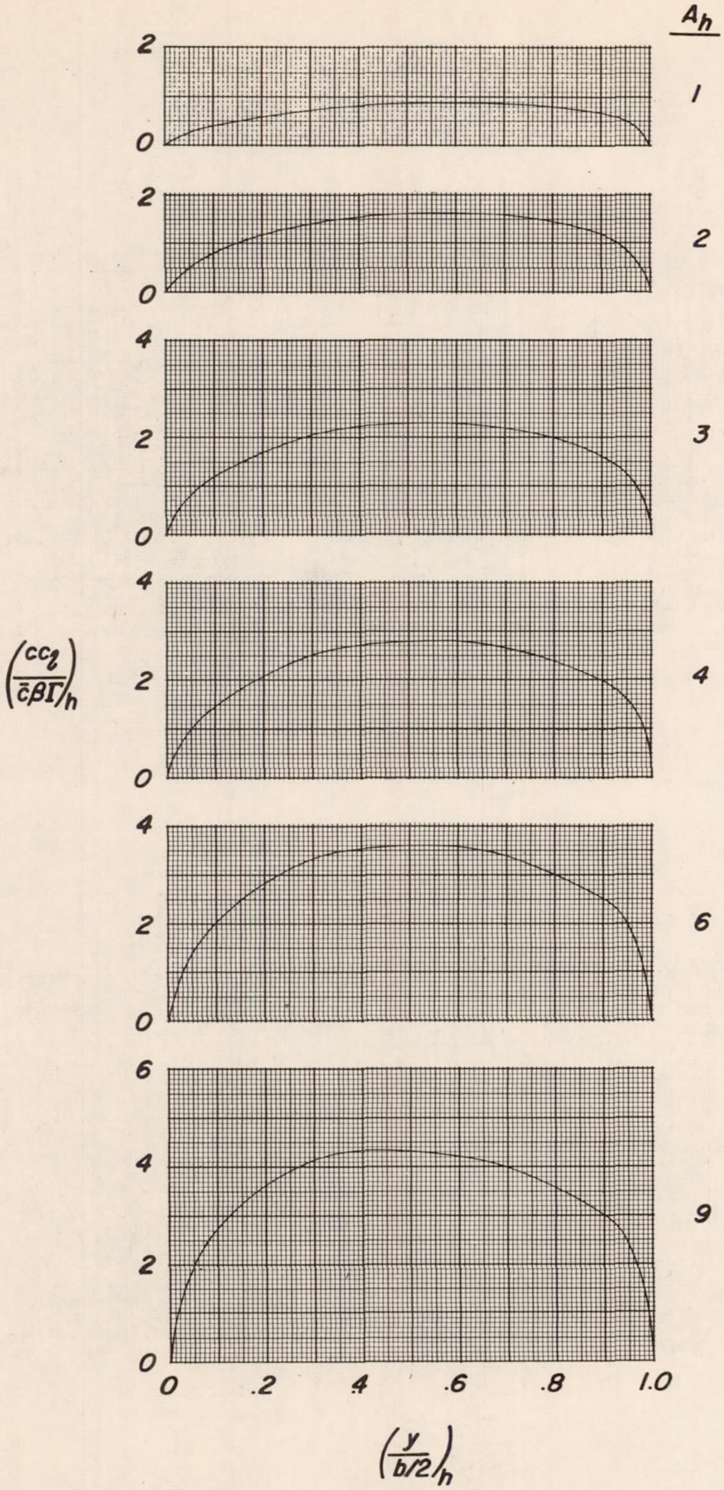
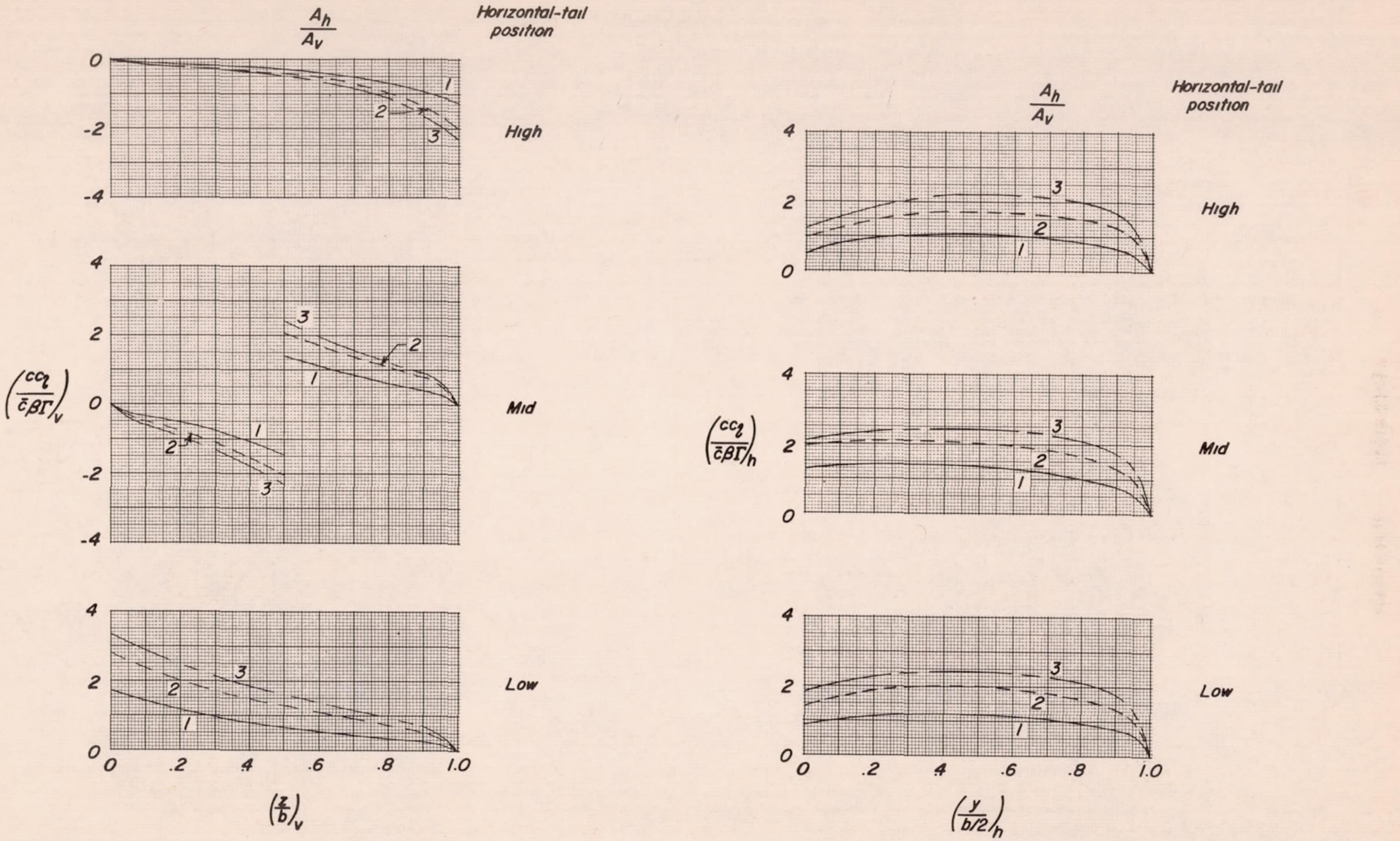
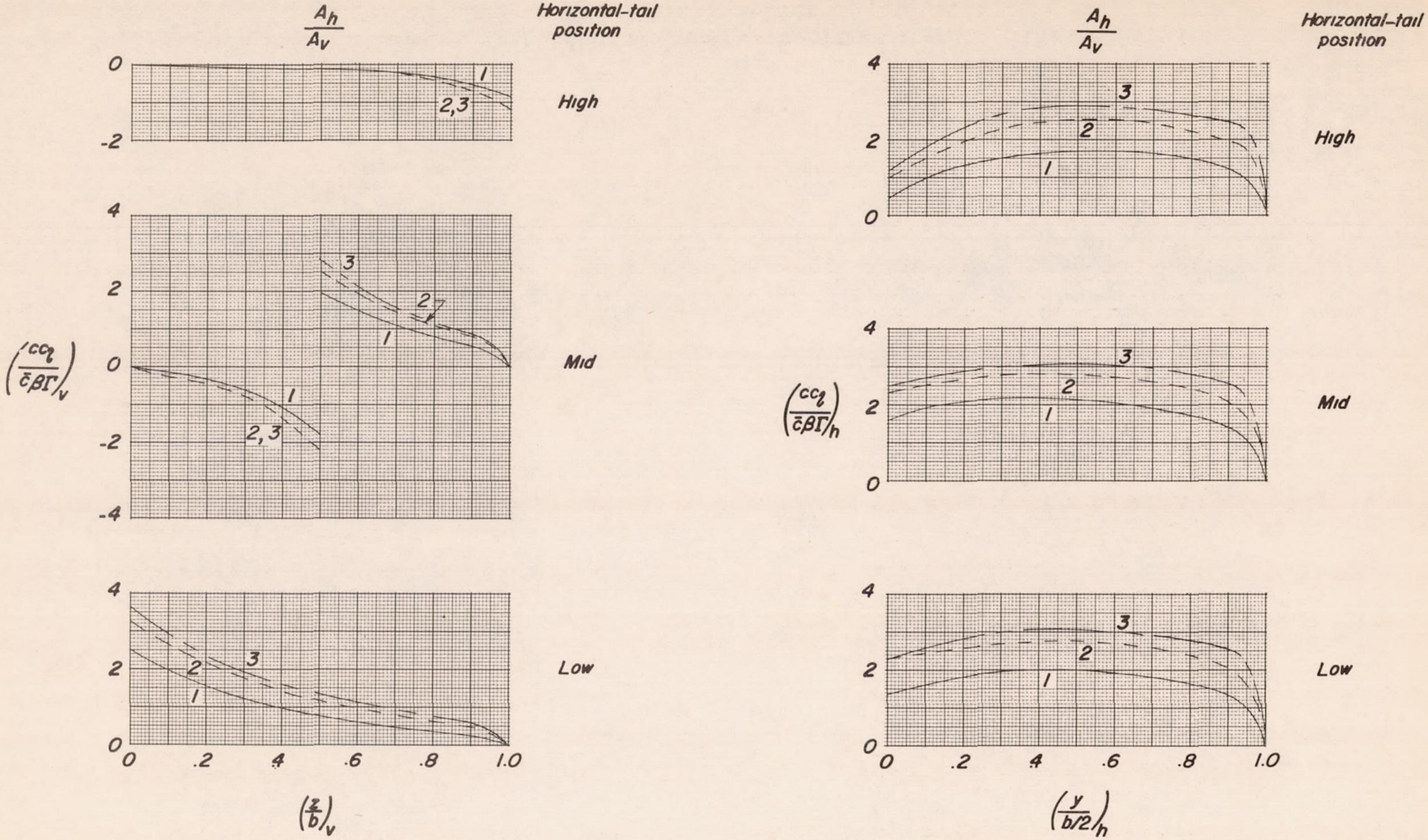


Figure 7.- Calculated span loadings due to sideslip for unswept isolated horizontal tails with dihedral.



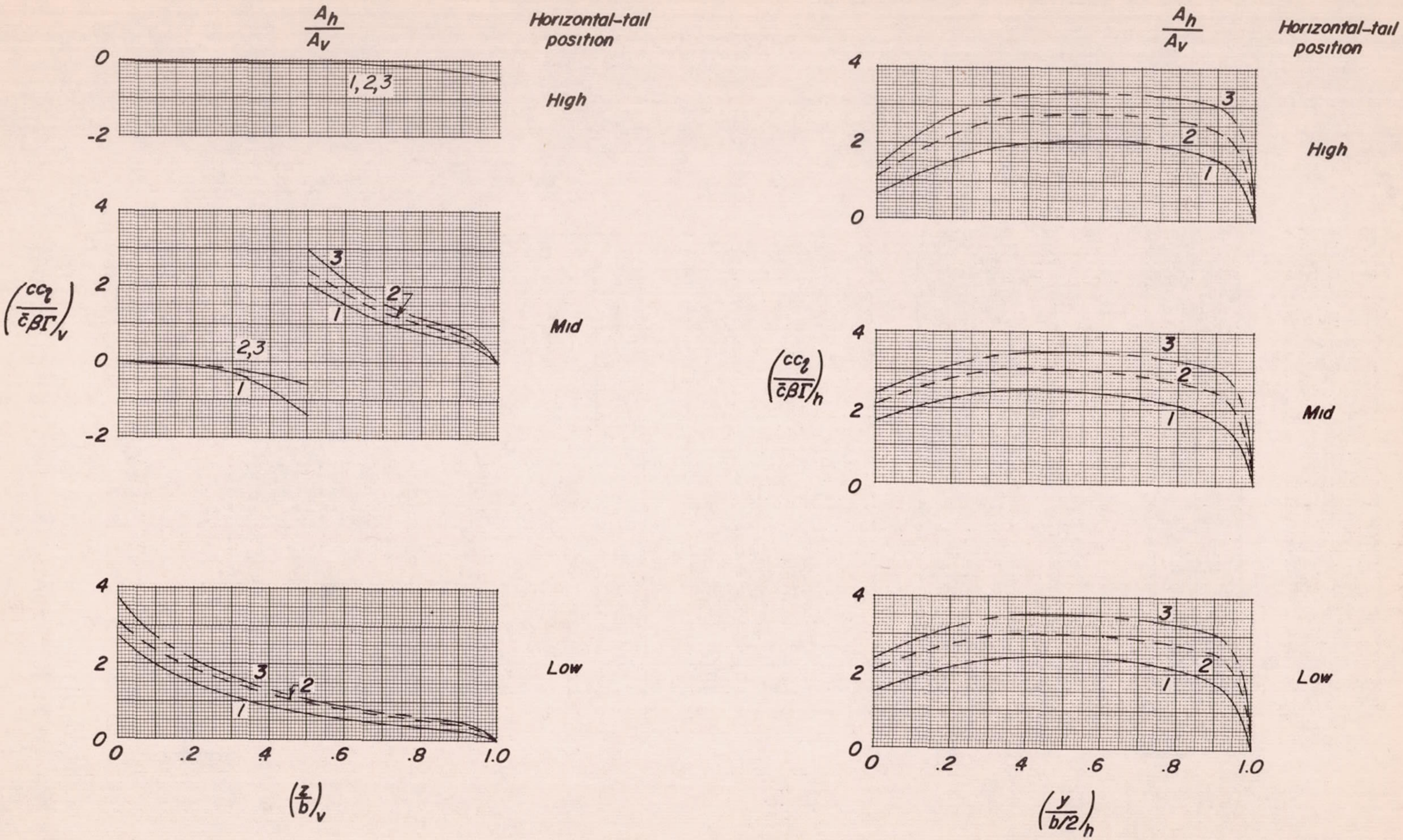
(a) $A_V = 1.0$.

Figure 8.- Calculated span loadings due to horizontal-tail dihedral angle for 45° sweptback tail assemblies in sideslip.



(b) $A_V = 2.0$.

Figure 8.- Continued.



(c) $A_V = 3.0$.

Figure 8.- Concluded.

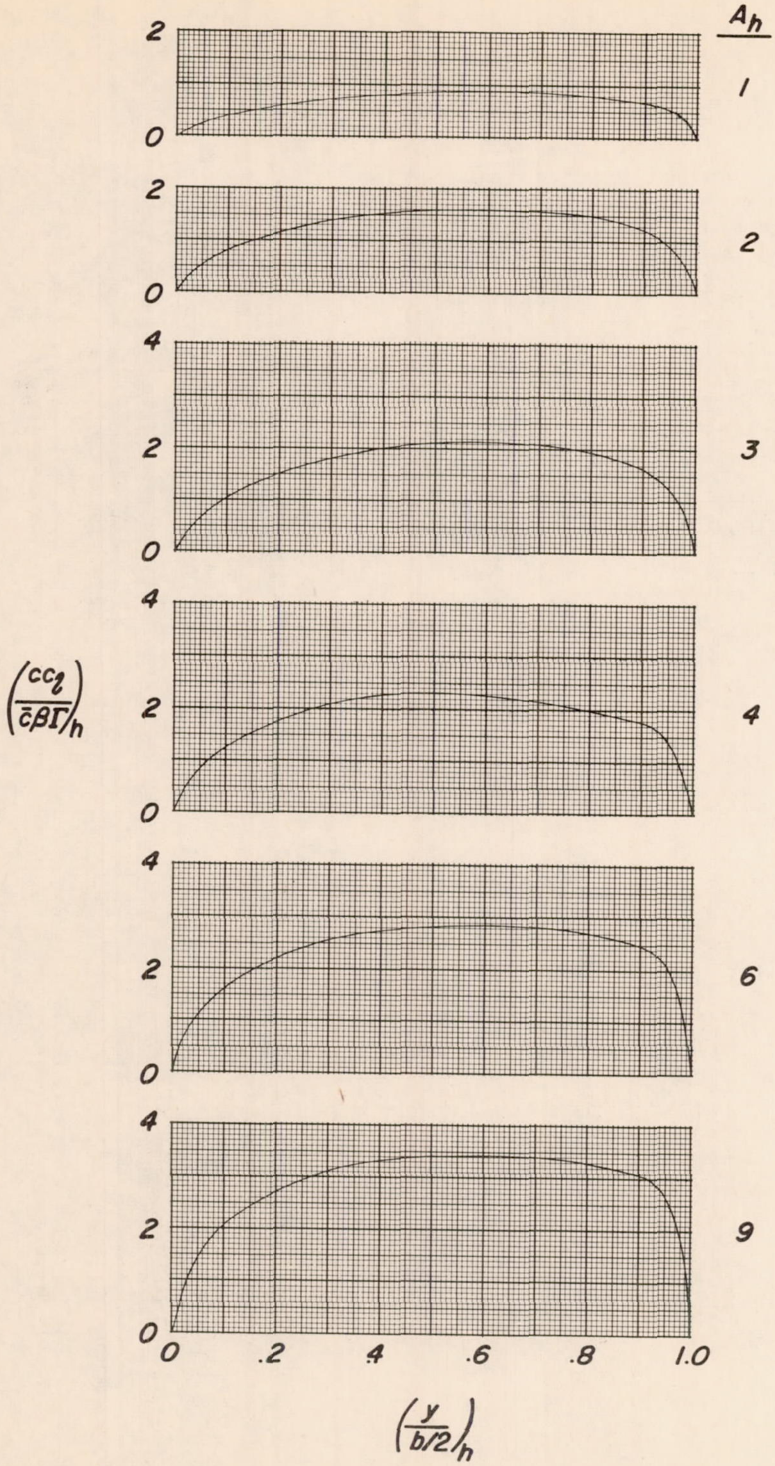
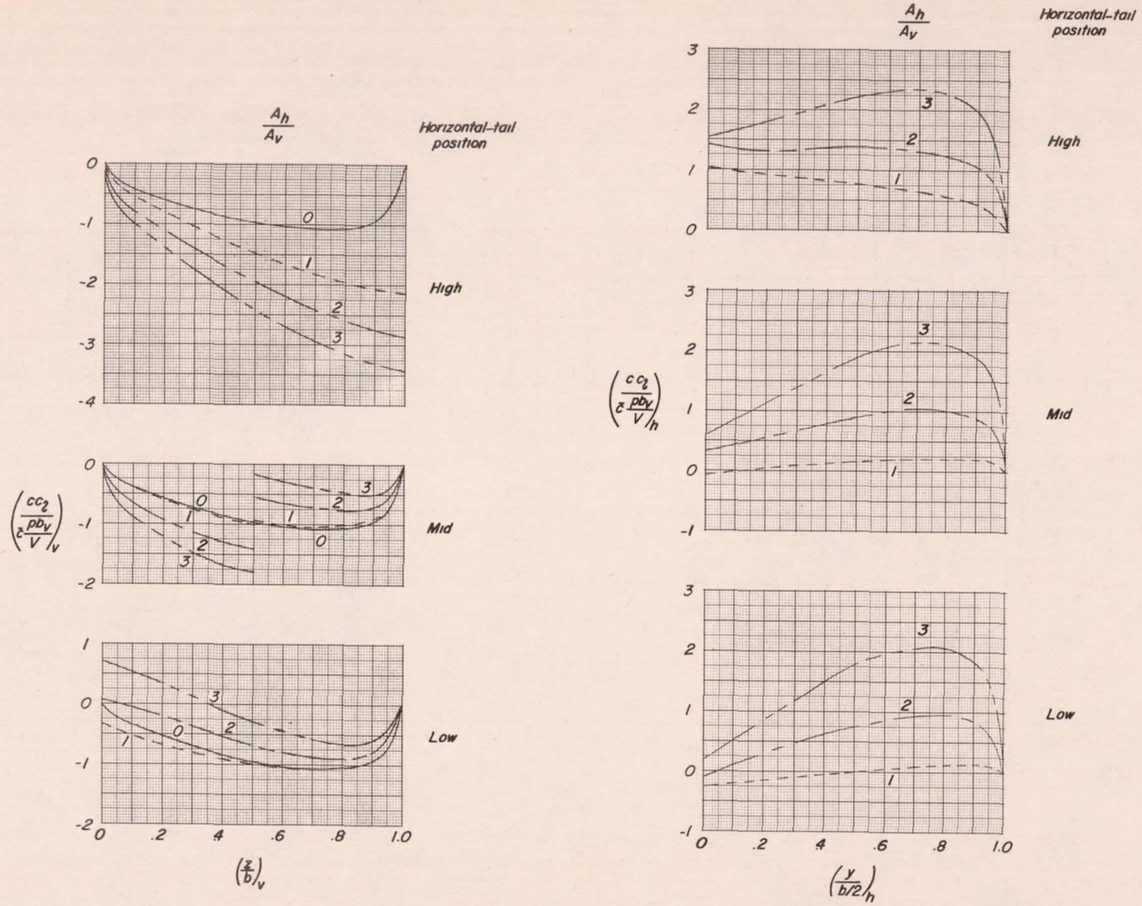
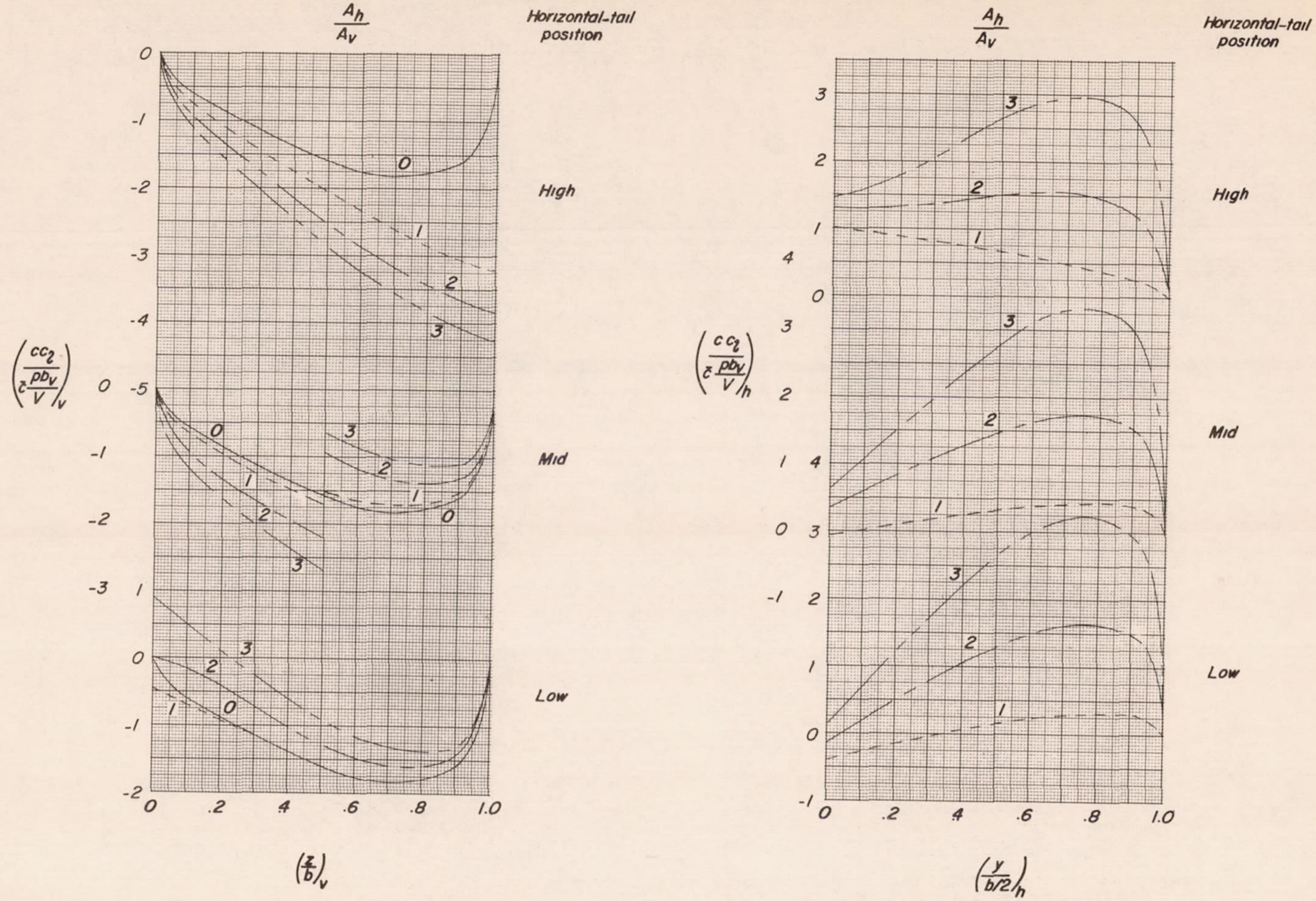


Figure 9.- Calculated span loadings due to sideslip for 45° sweptback isolated horizontal tails with dihedral.



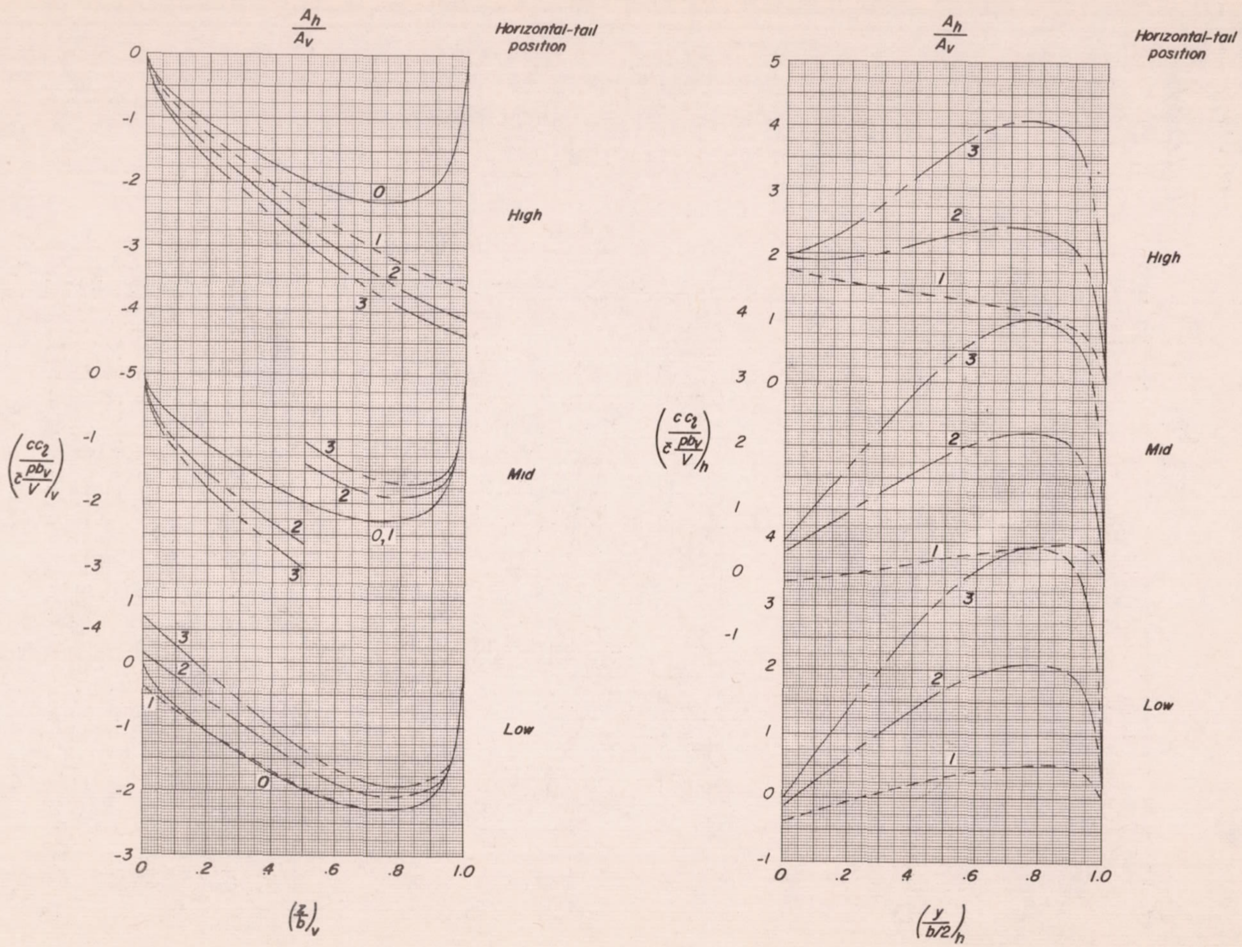
(a) $A_V = 1.0$.

Figure 10.- Calculated span loadings for unswept tail assemblies in steady roll. $\Gamma = 0$.



(b) $A_V = 2.0$.

Figure 10.- Continued.



(c) $A_V = 3.0$.

Figure 10.- Concluded.

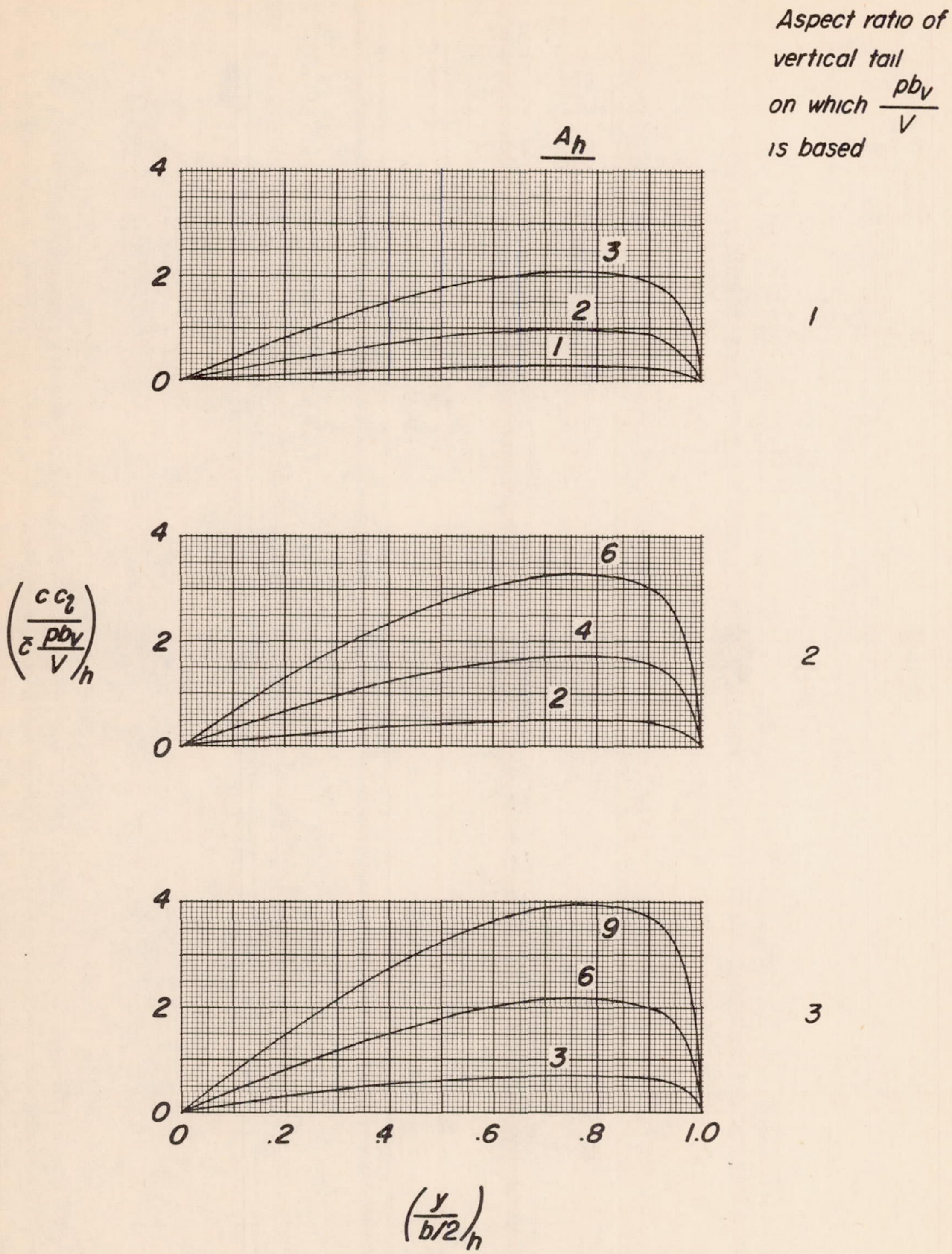
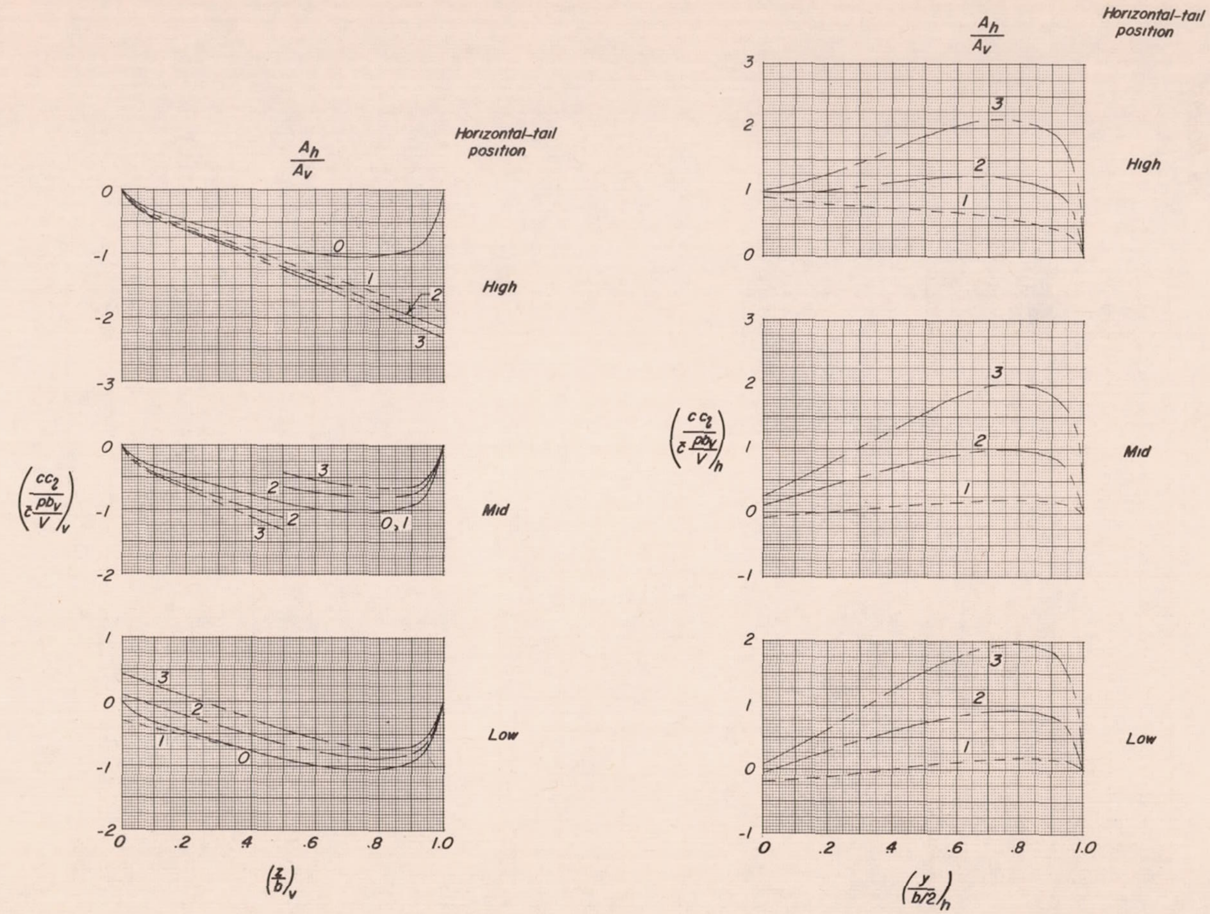
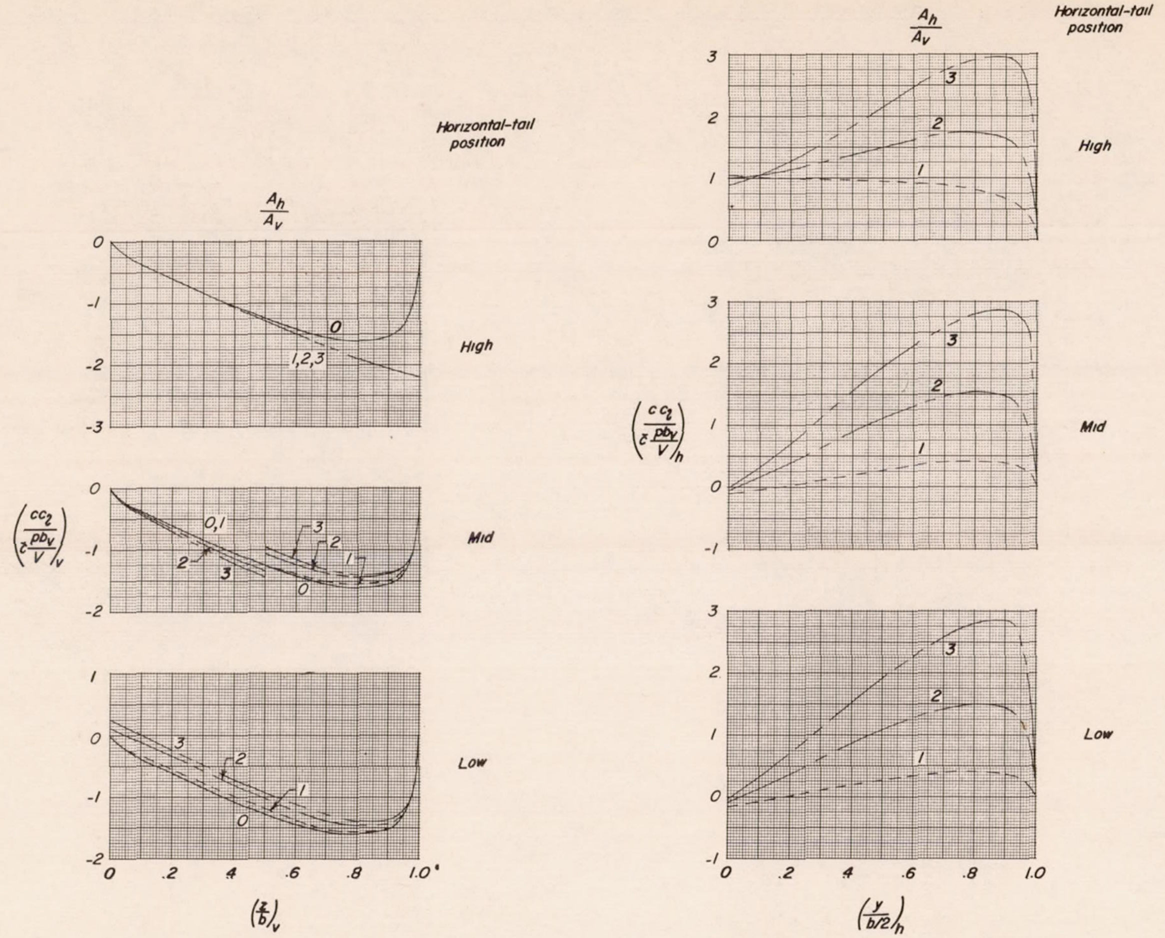


Figure 11.- Calculated span loadings due to steady roll for unswept isolated horizontal tails. $\Gamma = 0$.



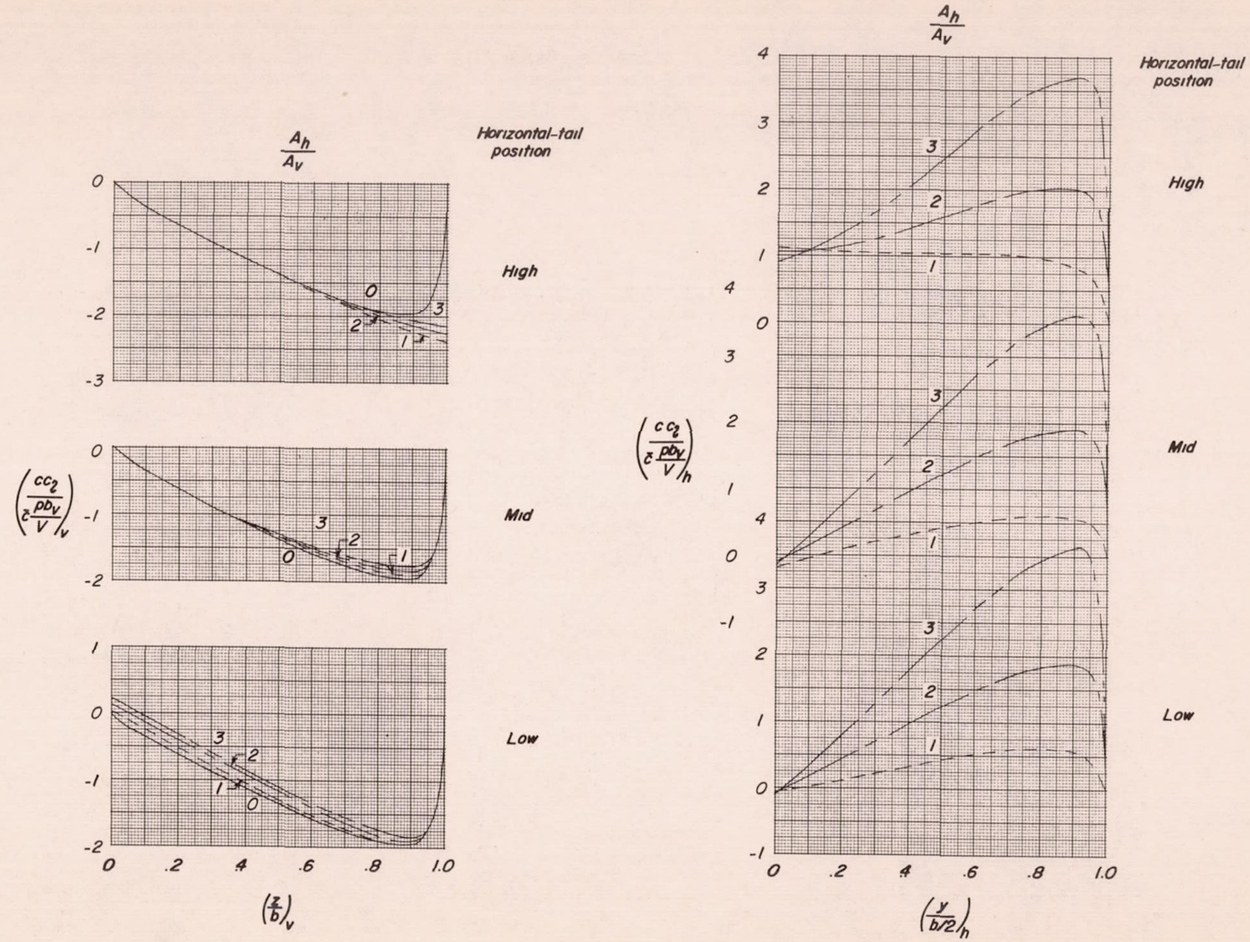
(a) $A_V = 1.0$.

Figure 12.- Calculated span loadings for 45° sweptback tail assemblies in steady roll. $\Gamma = 0$.



(b) $A_V = 2.0$.

Figure 12.- Continued.



(c) $A_v = 3.0$.

Figure 12.- Concluded.

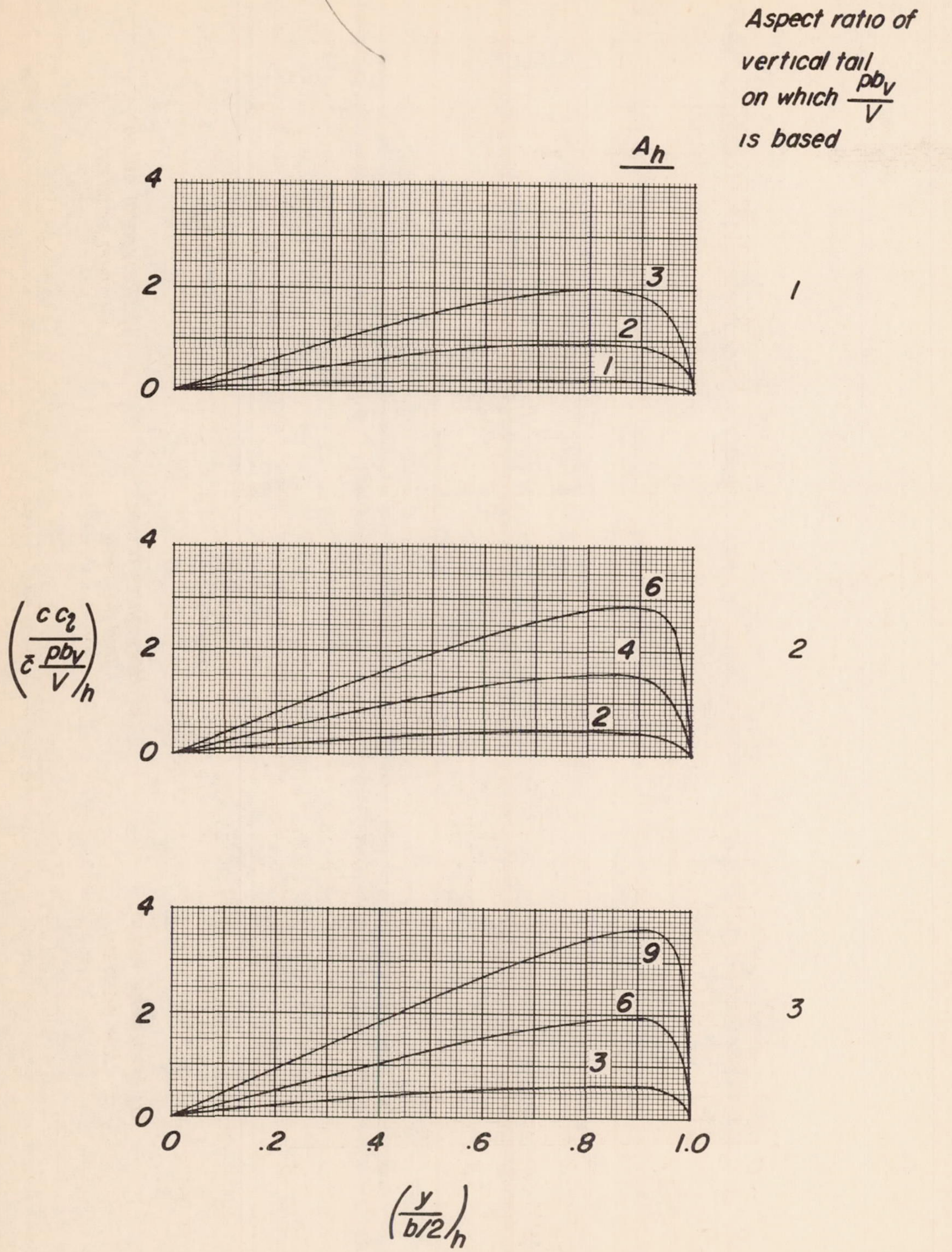


Figure 13.- Calculated span loadings due to steady roll for 45° swept-back isolated horizontal tails. $\Gamma = 0$.

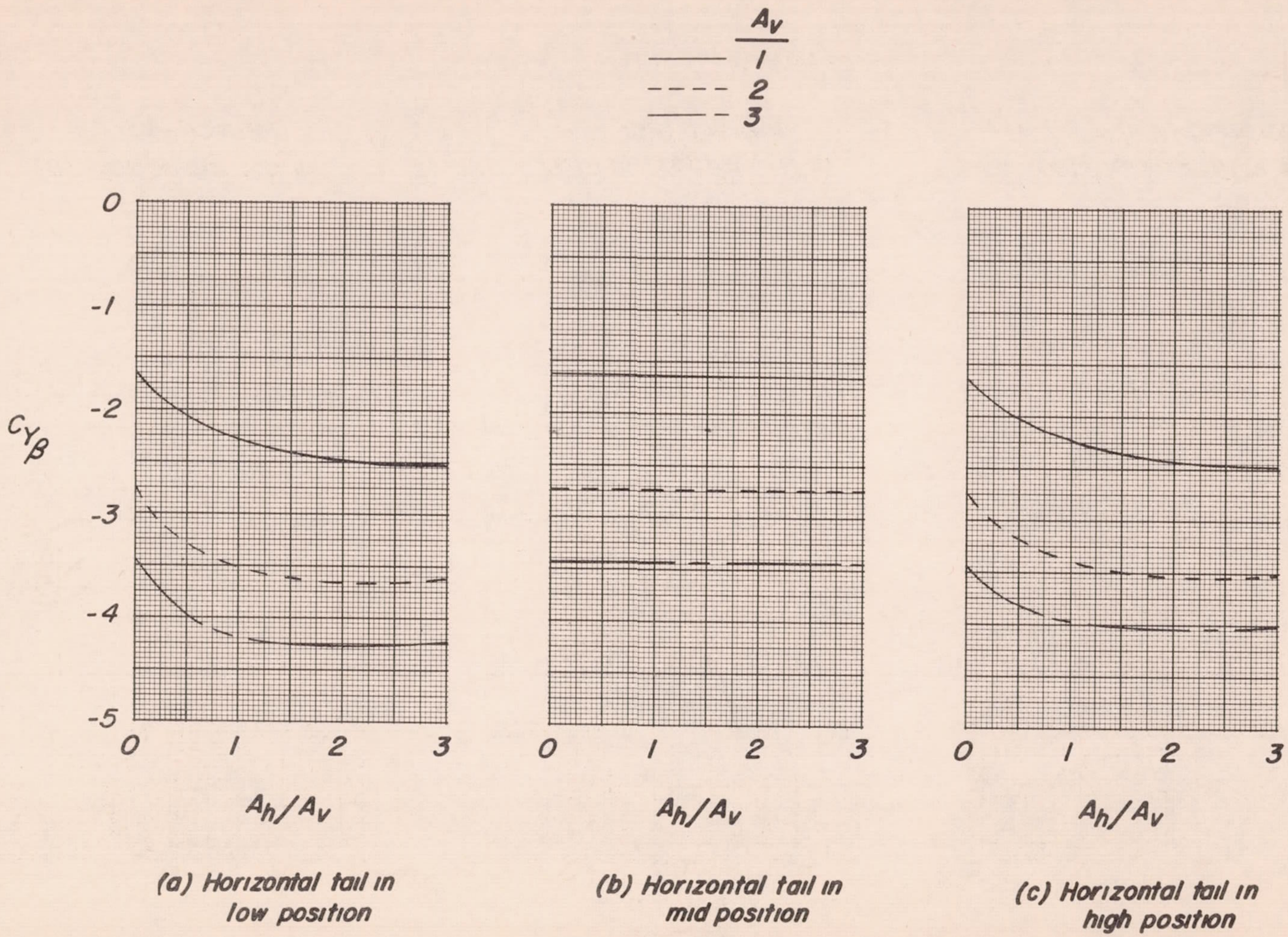


Figure 14.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{Y_β} for various unswept tail assemblies. $\Gamma = 0$.

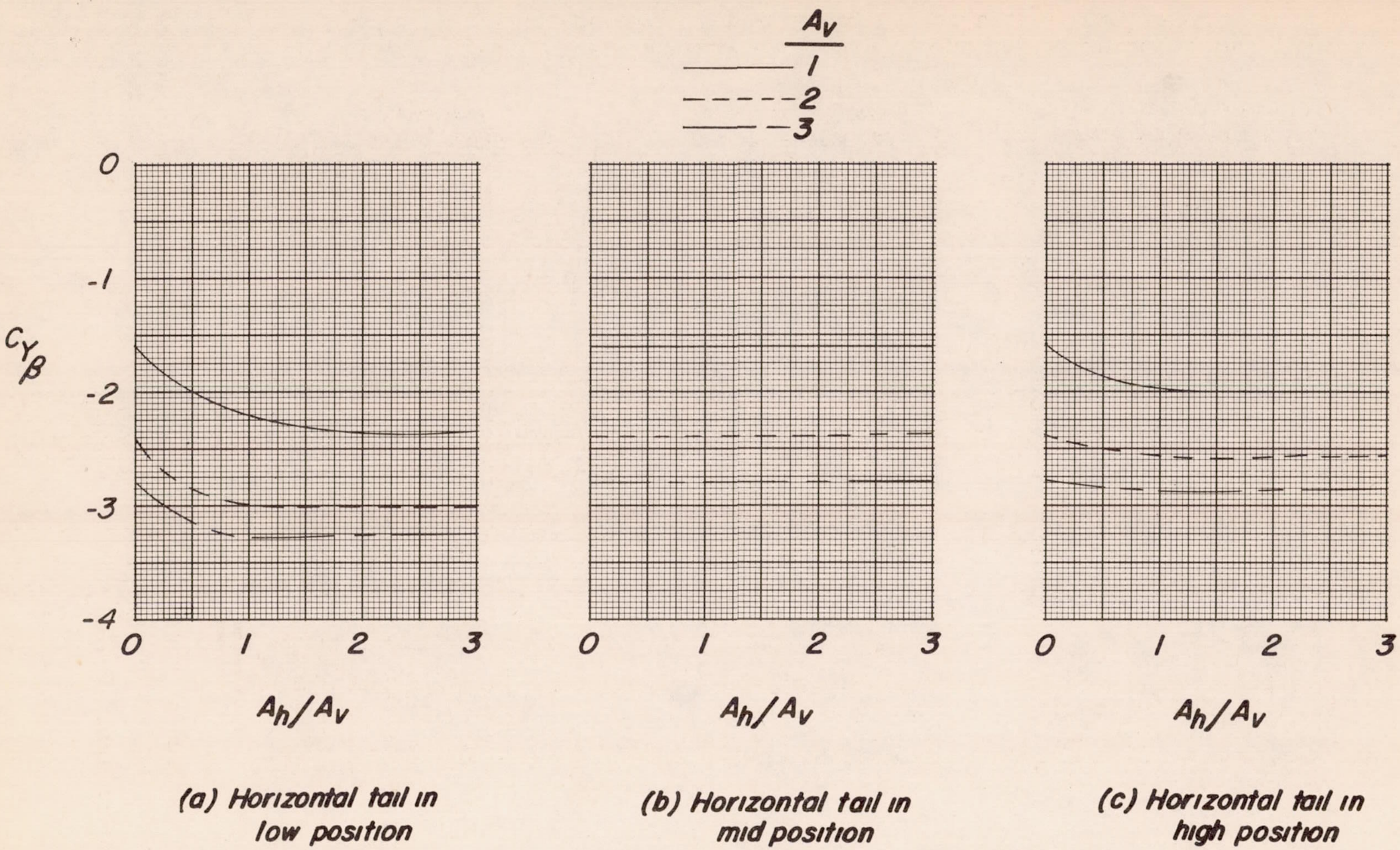


Figure 15.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{Y_β} for various 45° sweptback tail assemblies. $\Gamma = 0$.

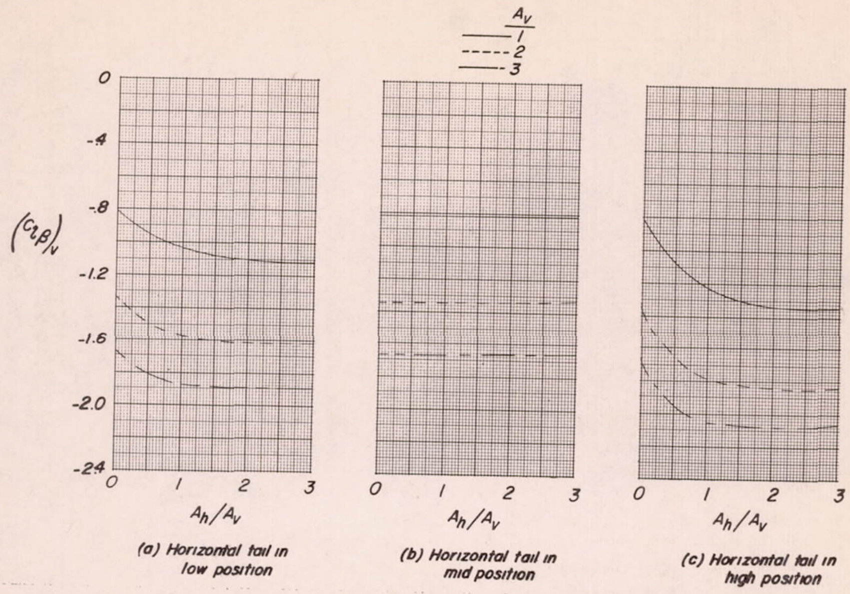


Figure 16.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{l_β} of various unswept tail assemblies. $\Gamma = 0$.

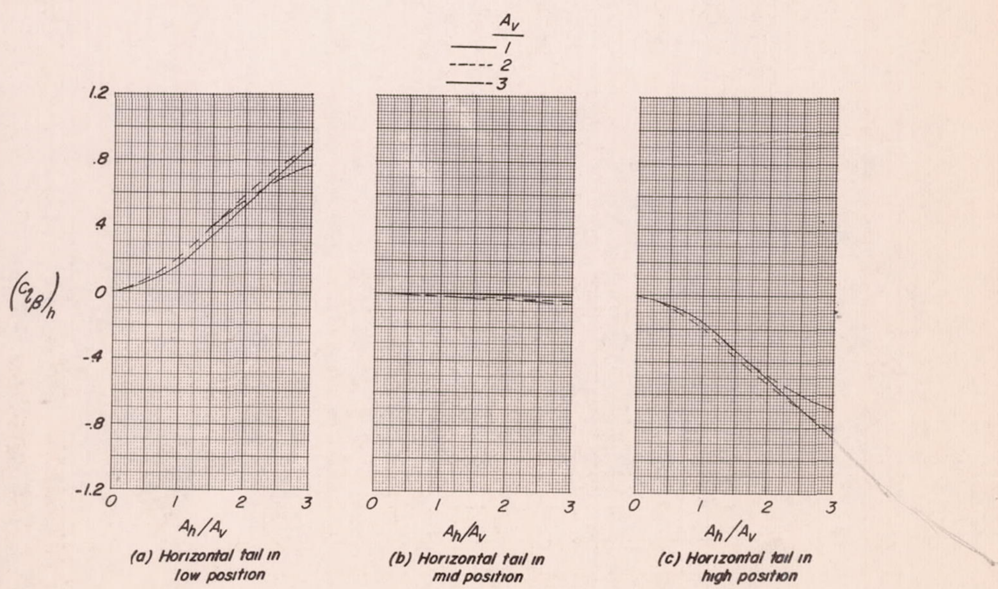


Figure 17.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{l_β} of various unswept tail assemblies. $\Gamma = 0$.

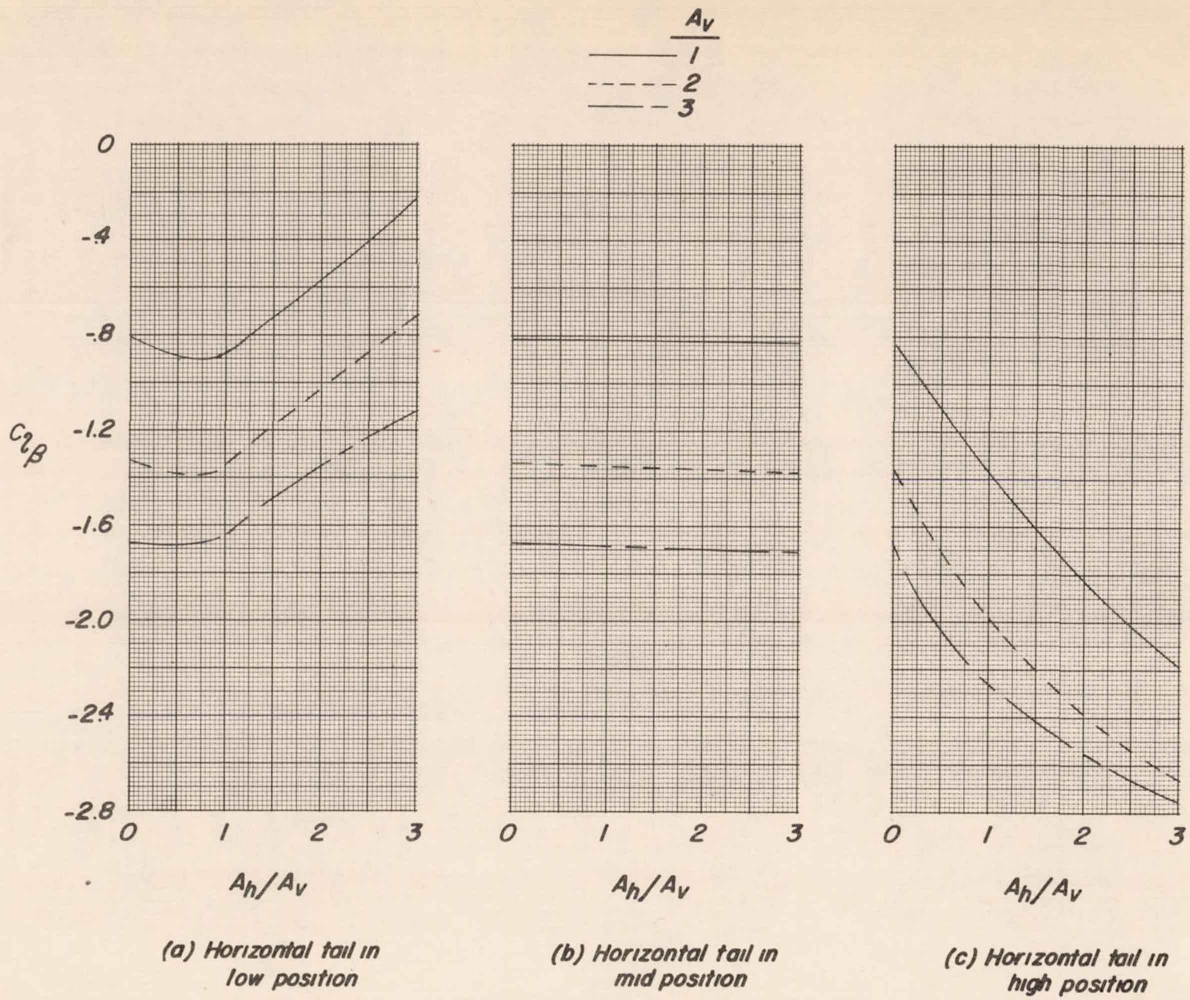


Figure 18.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{l_β} for various unswept tail assemblies. $\Gamma = 0$.

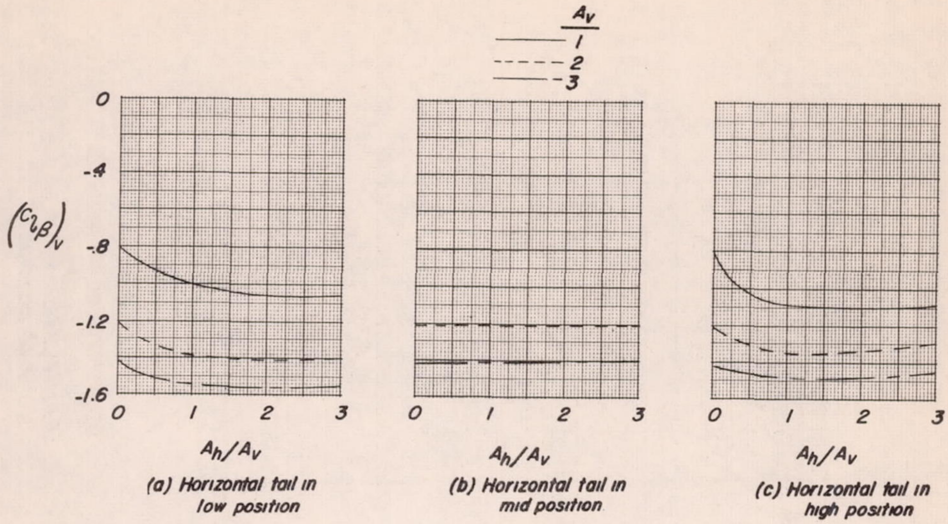


Figure 19.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{l_β} of various 45° sweptback tail assemblies. $\Gamma = 0$.

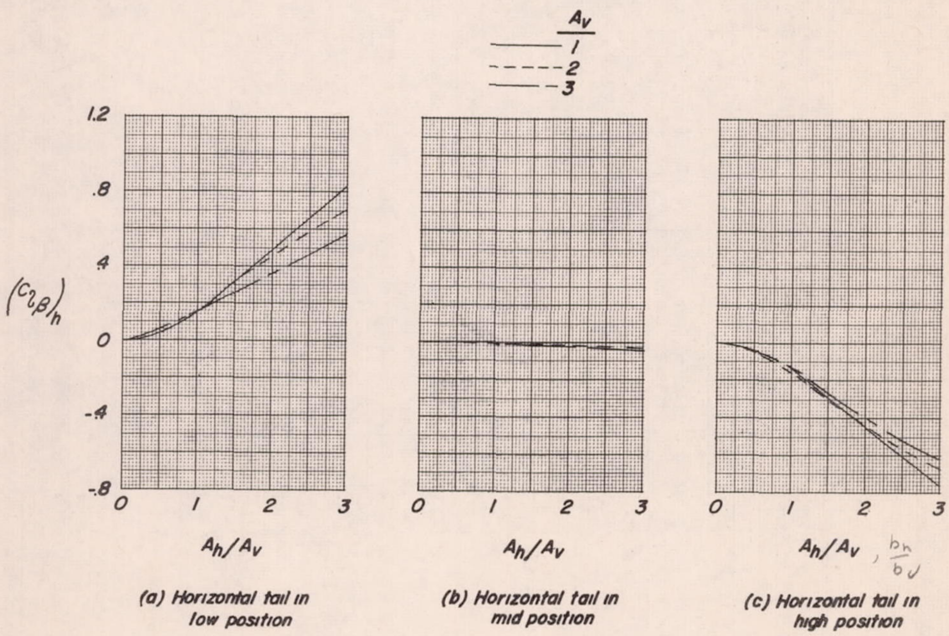
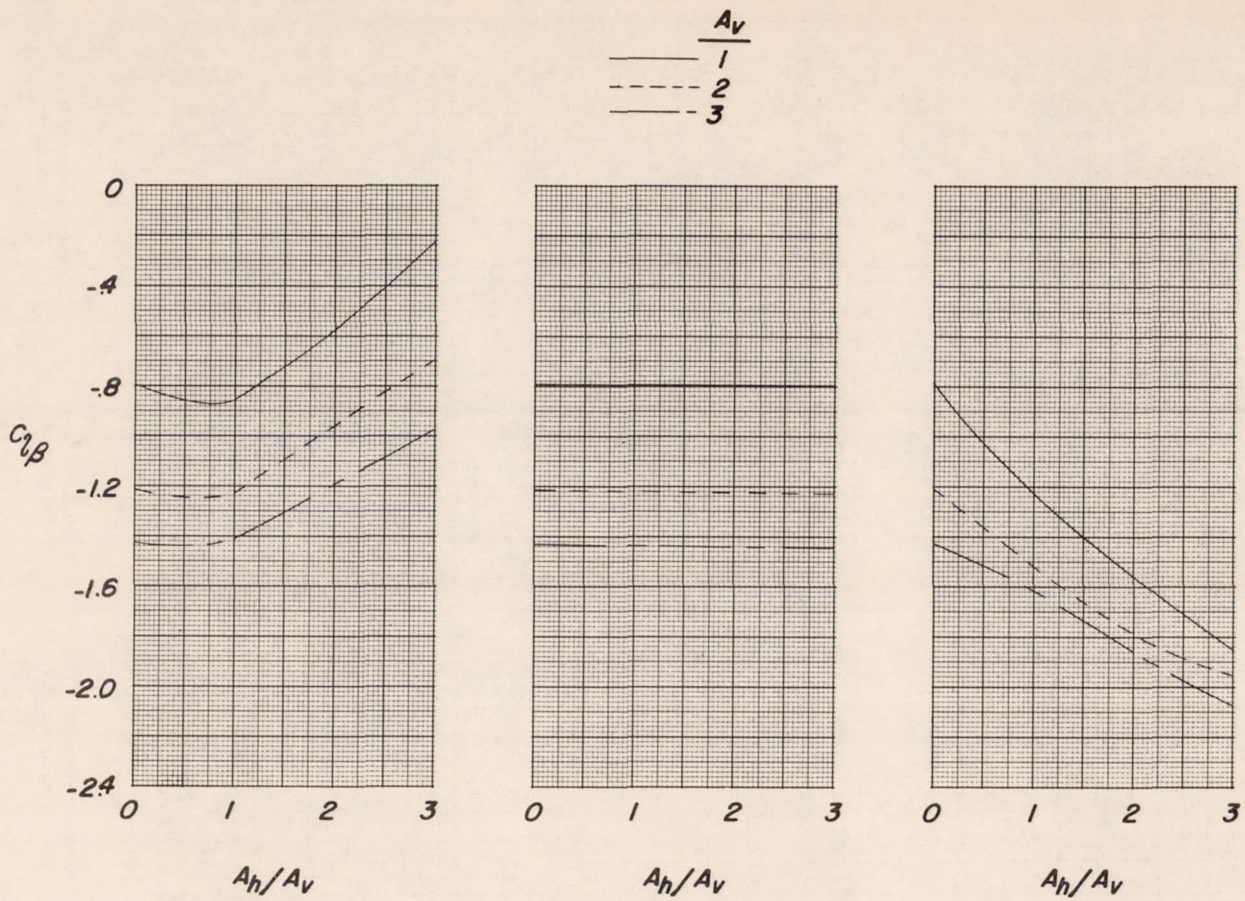


Figure 20.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{l_β} of various 45° sweptback tail assemblies. $\Gamma = 0$.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 21.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{l_β} for various 45° sweptback tail assemblies. $\Gamma = 0$.

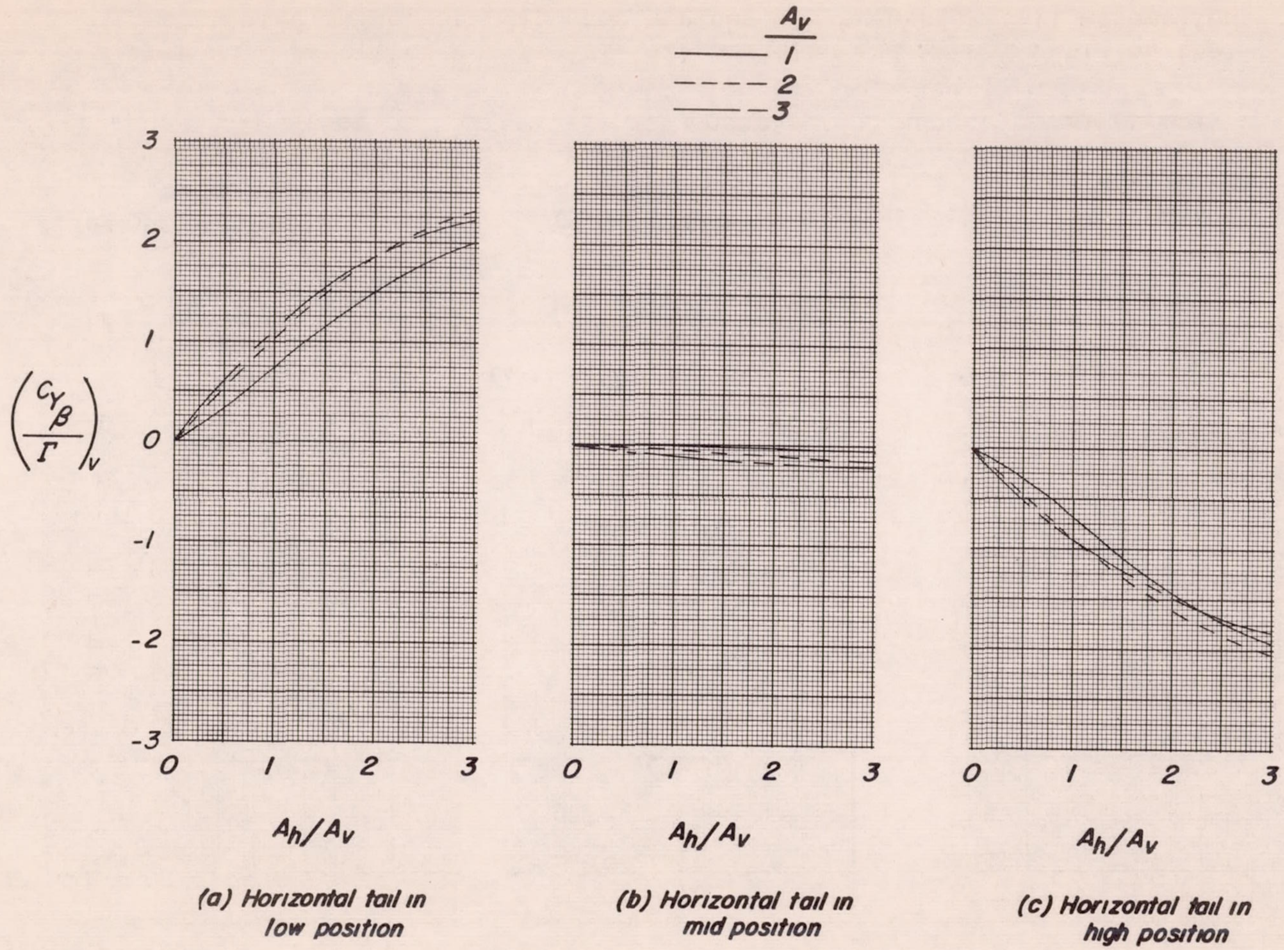
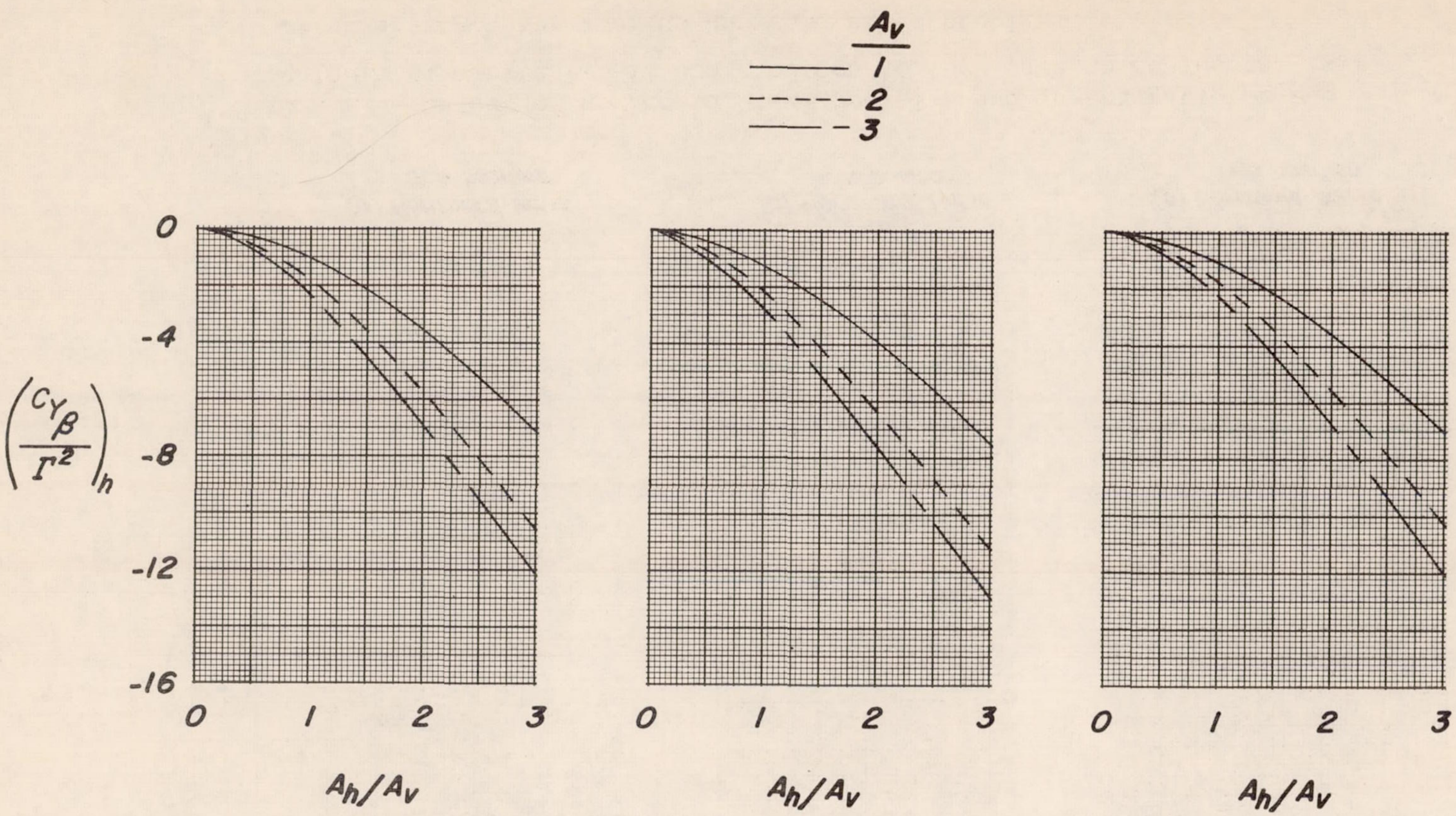


Figure 22.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{Y_β} due to horizontal-tail dihedral angle for various unswept tail assemblies.

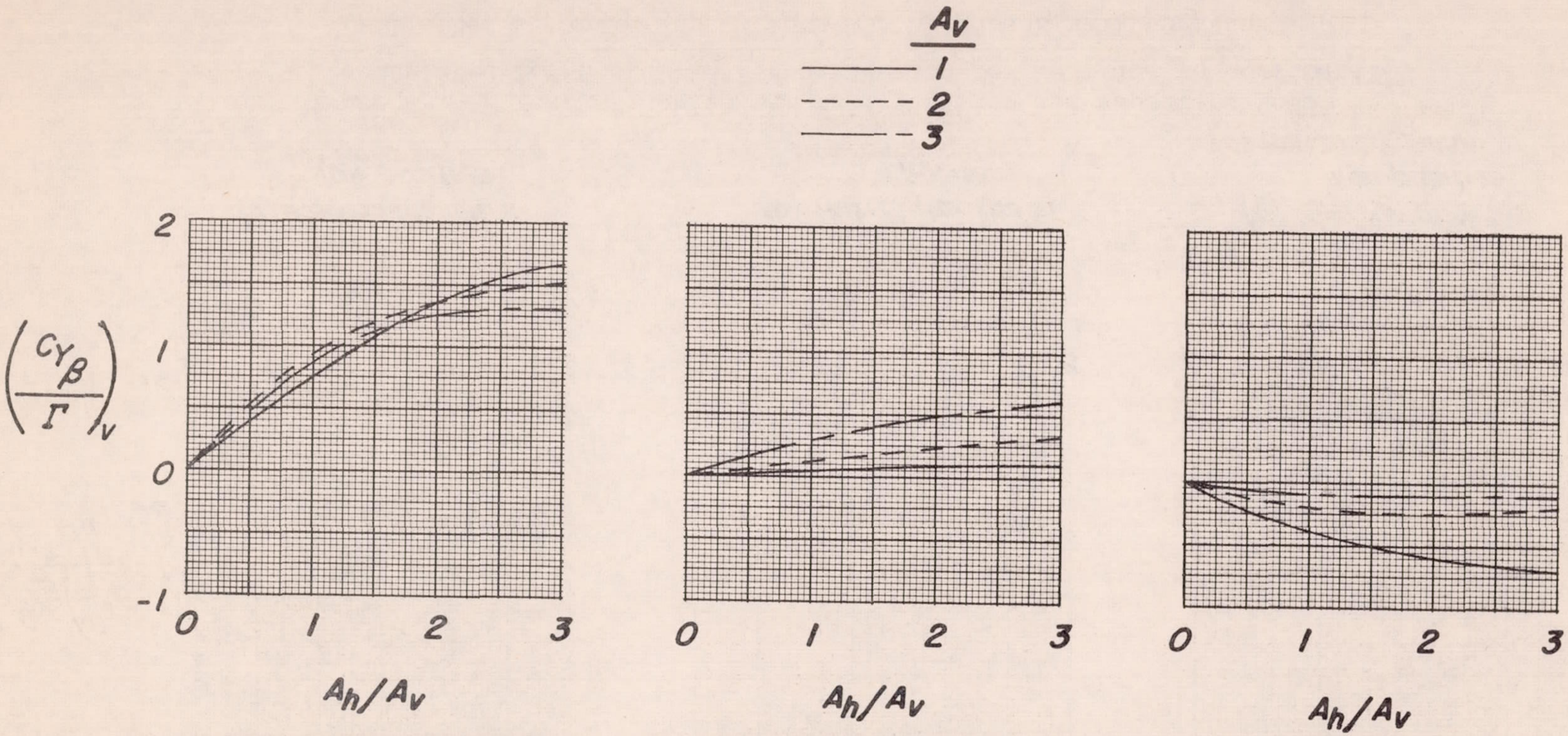


(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 23.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{Y_β} due to horizontal-tail dihedral angle for various unswept tail assemblies.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 24.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{Y_β} due to horizontal-tail dihedral angle for various 45° sweptback tail assemblies.

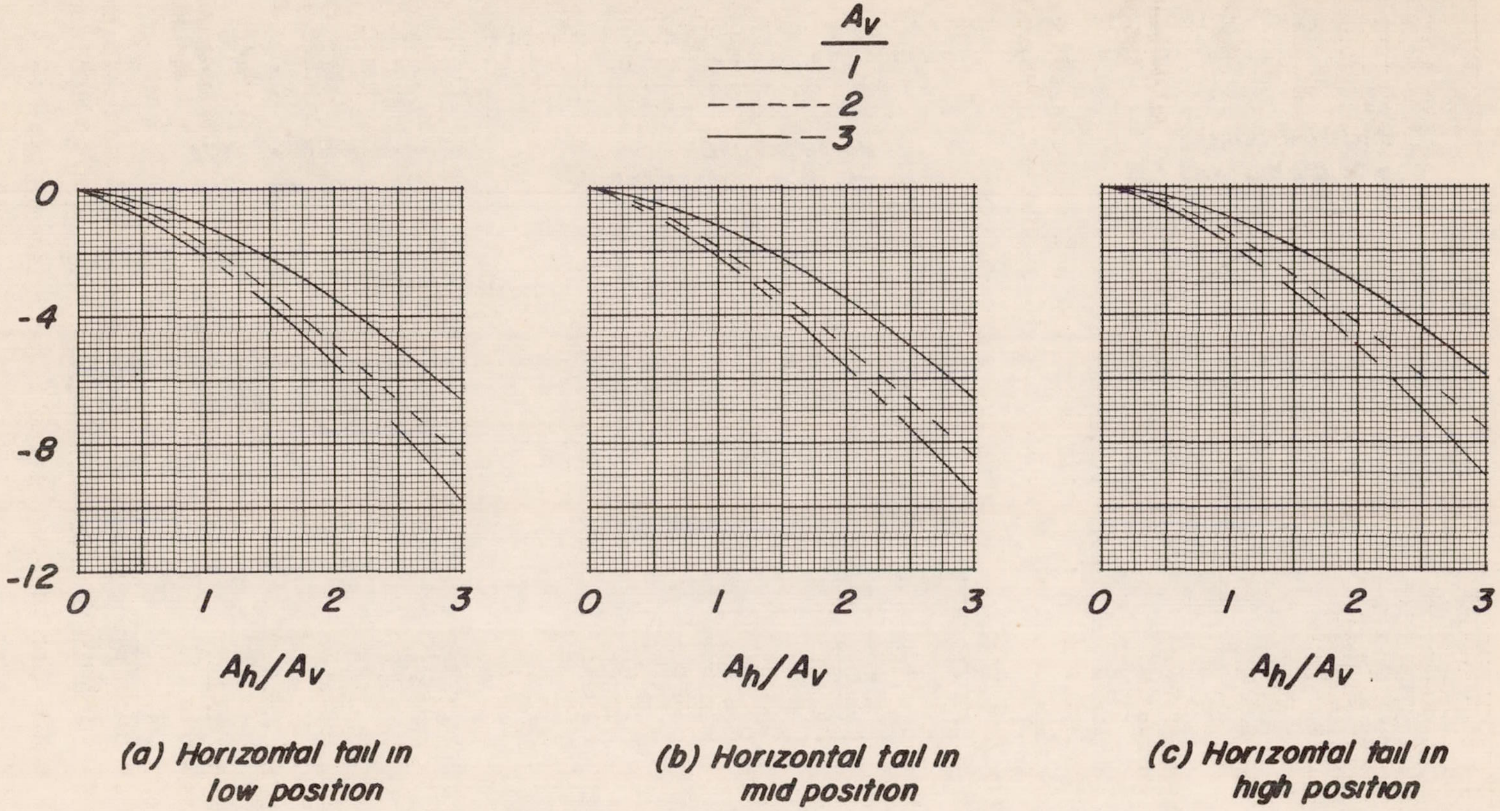


Figure 25.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{Y_β} due to horizontal-tail dihedral angle for various 45° sweptback tail surfaces.

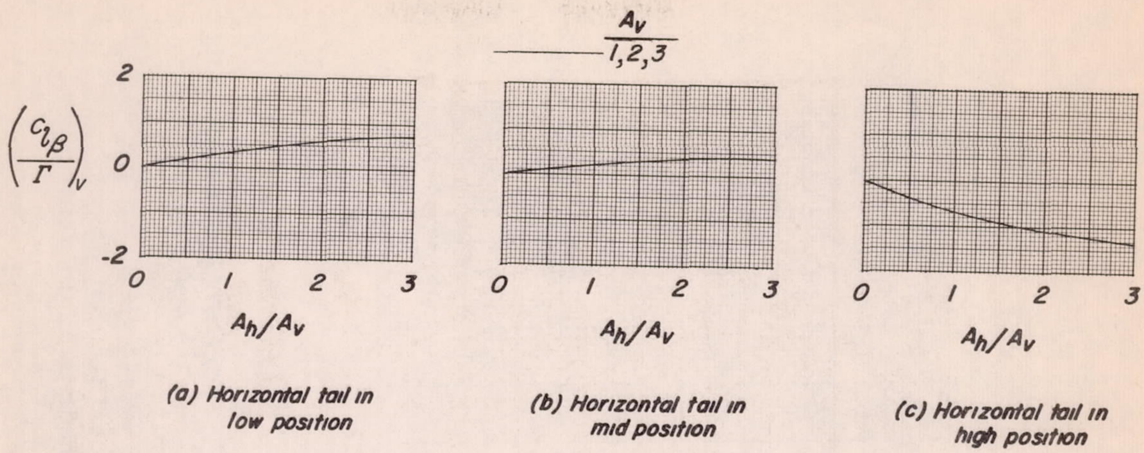


Figure 26.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{l_β} due to horizontal-tail dihedral angle for various unswept tail assemblies.

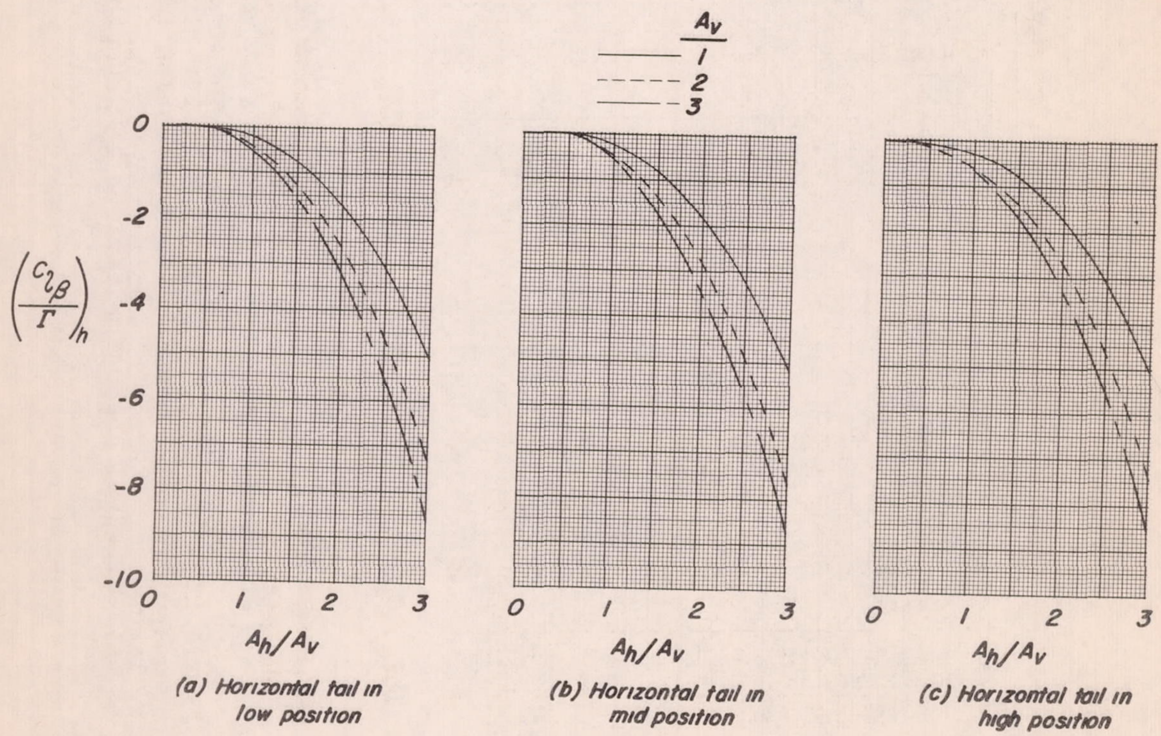


Figure 27.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{l_β} due to horizontal-tail dihedral angle for various unswept tail assemblies.

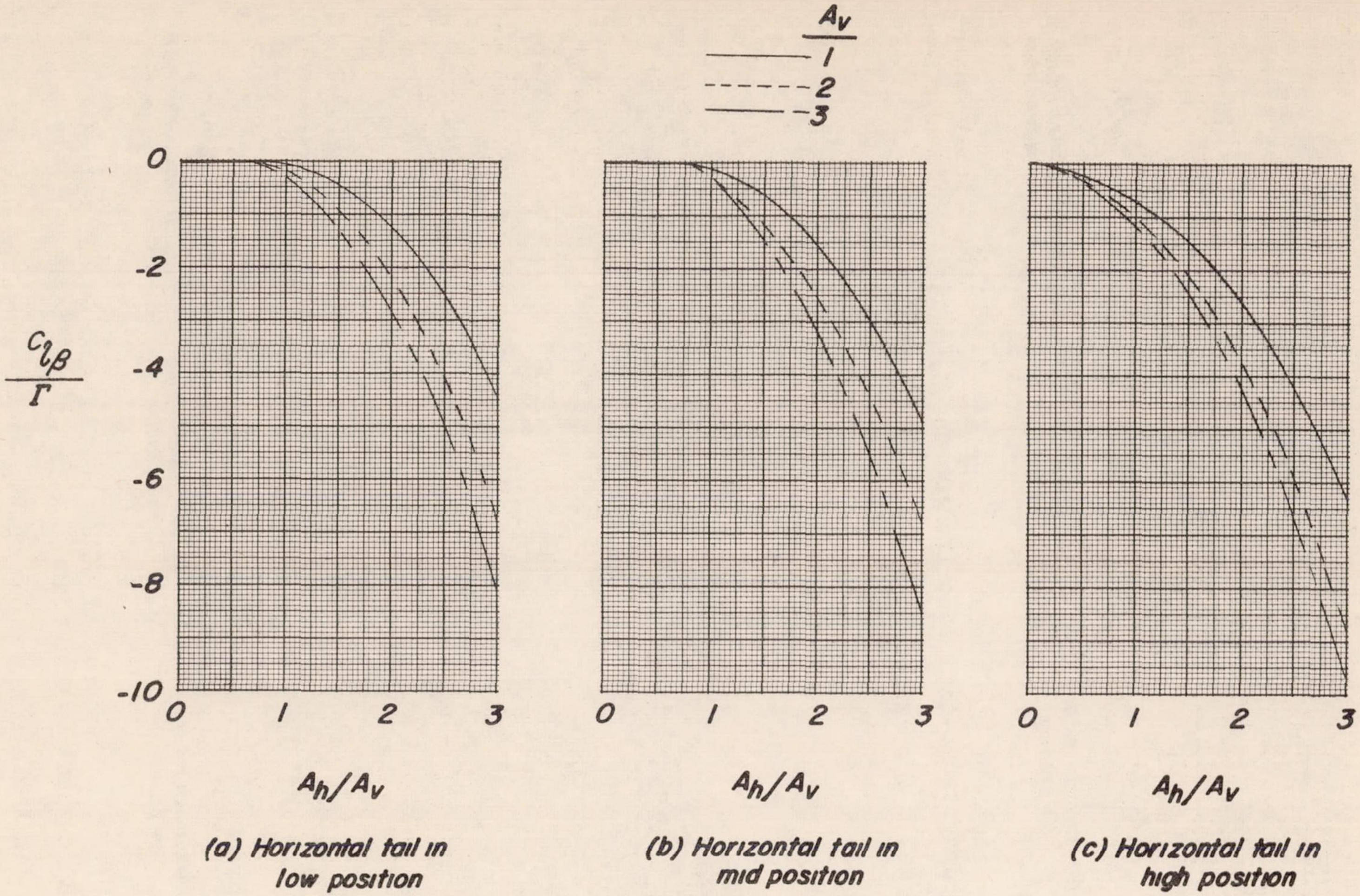


Figure 28.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{l_β} due to horizontal-tail dihedral angle for various unswept tail assemblies.

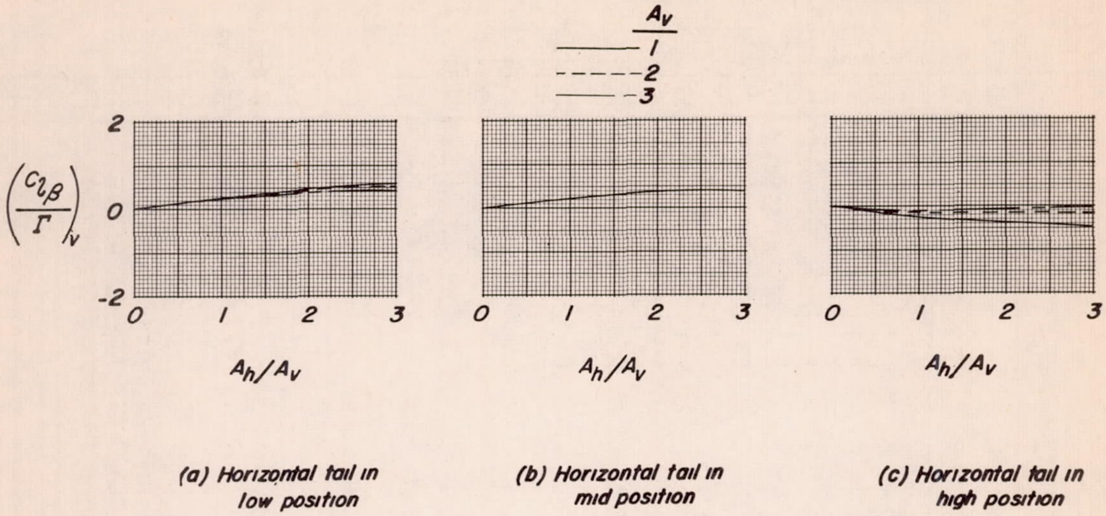


Figure 29.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{l_β} due to horizontal-tail dihedral angle for various 45° sweptback tail assemblies.

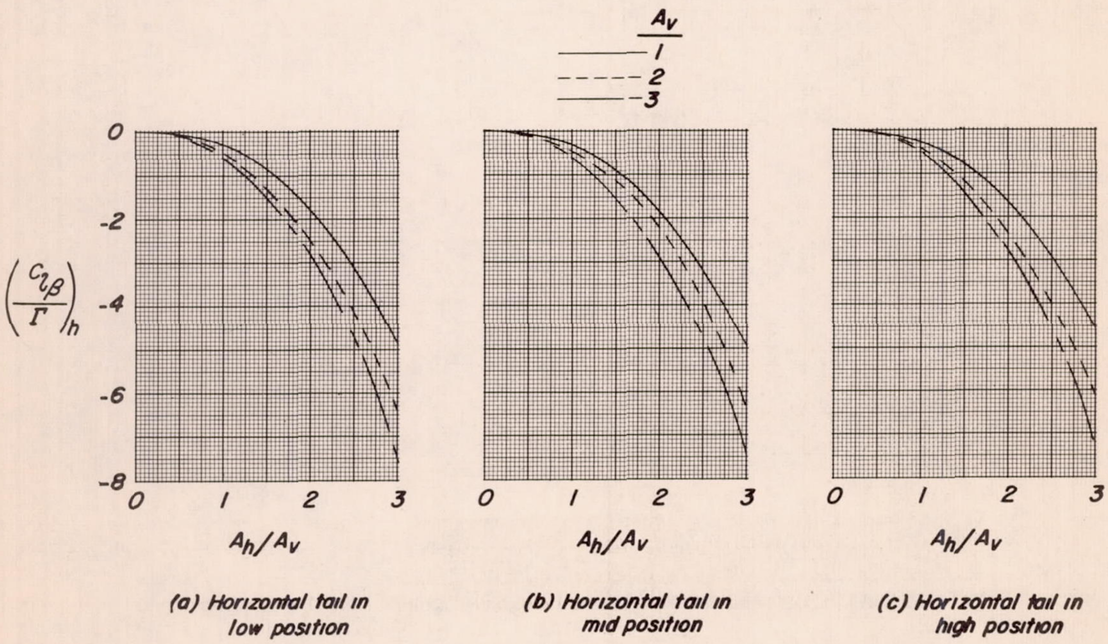
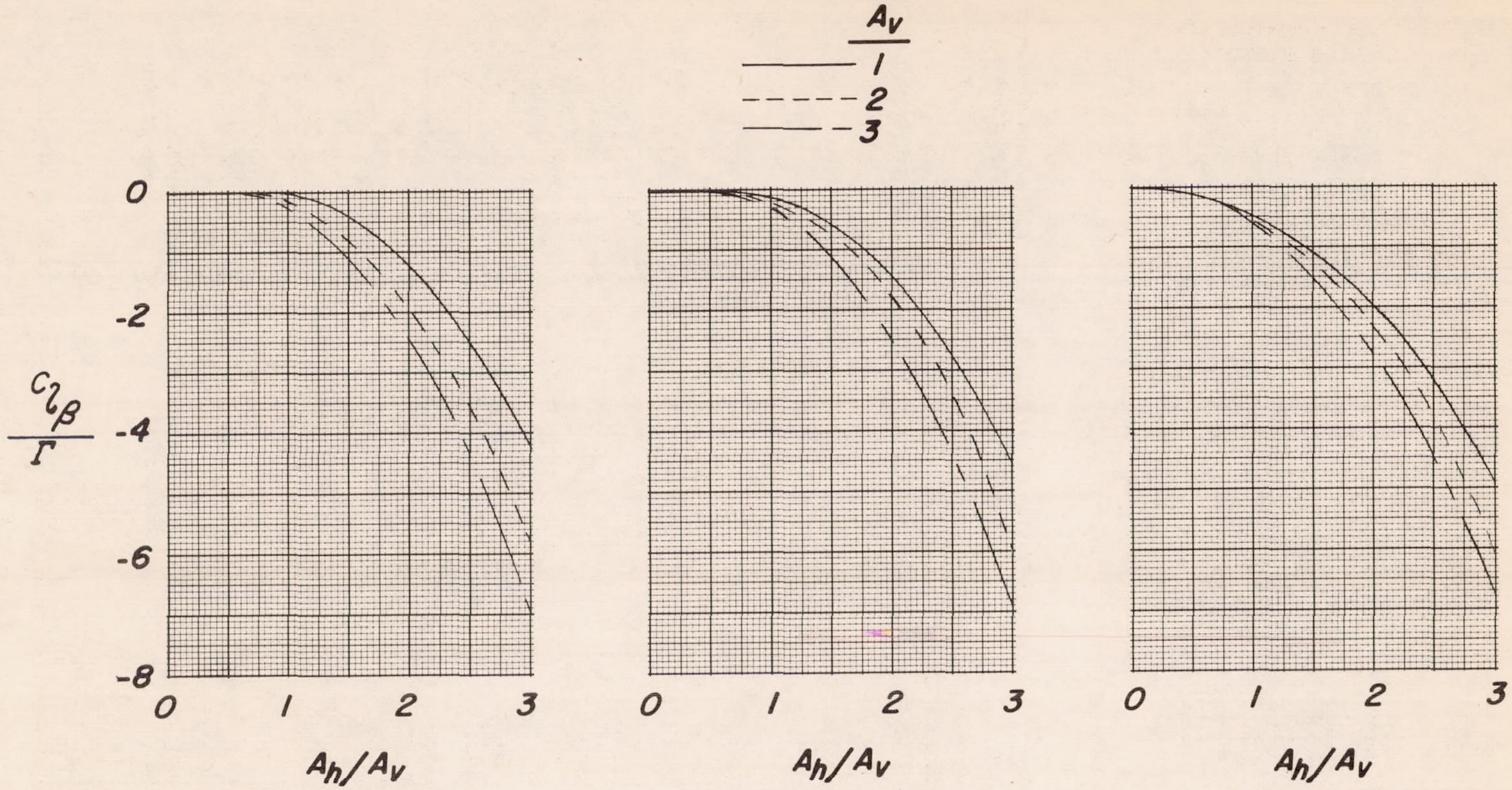


Figure 30.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{l_β} due to horizontal-tail dihedral angle for various 45° sweptback tail assemblies.

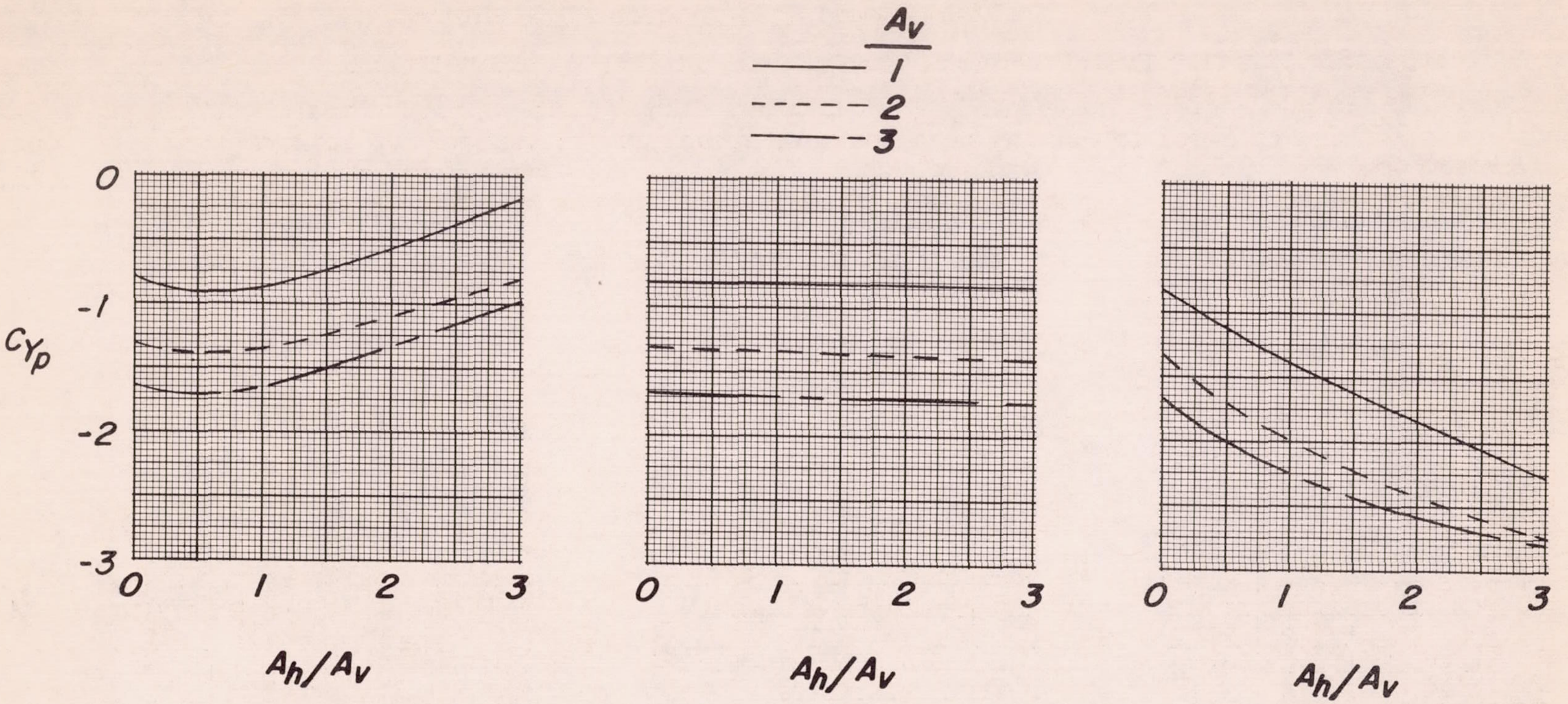


(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 31.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{l_β} due to horizontal-tail dihedral angle for various 45° sweptback tail assemblies.

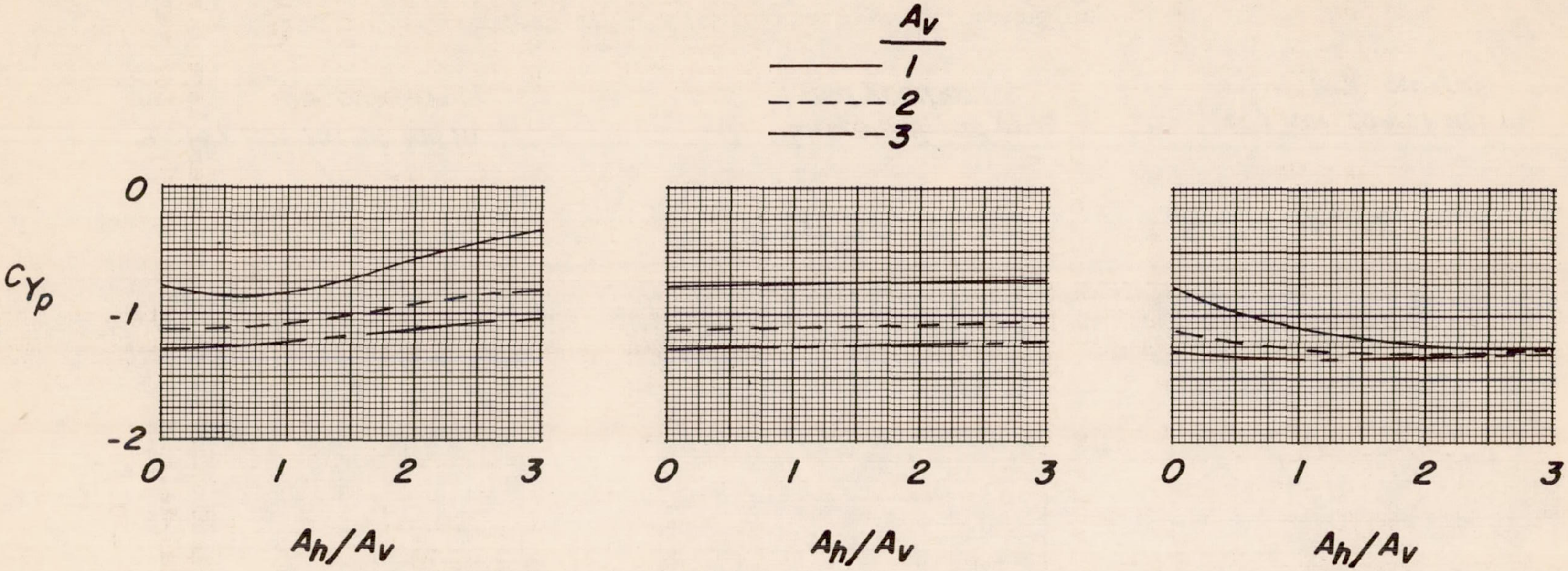


(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 32.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{Y_p} for various unswept tail assemblies. $\Gamma = 0$.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 33.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{Y_p} for various 45° sweptback tail assemblies. $\Gamma = 0$.

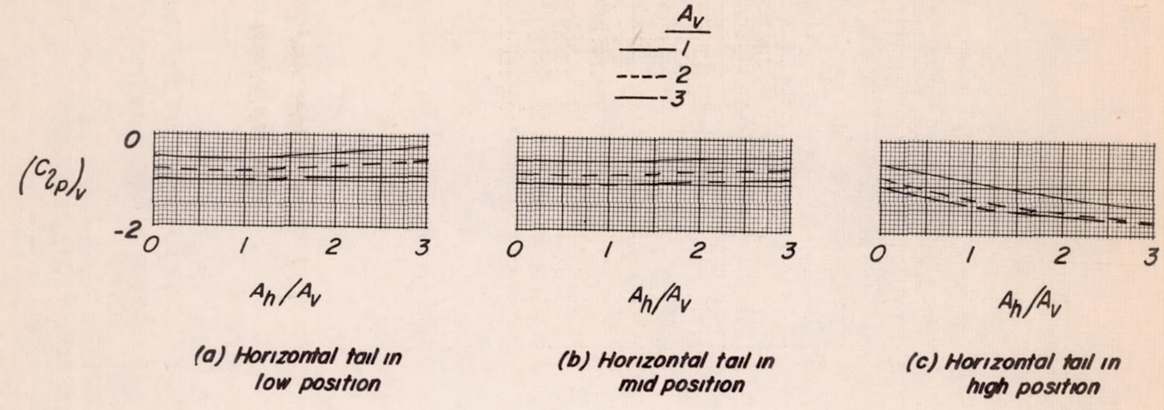


Figure 34.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{l_p} for various unswept tail assemblies. $\Gamma = 0$.

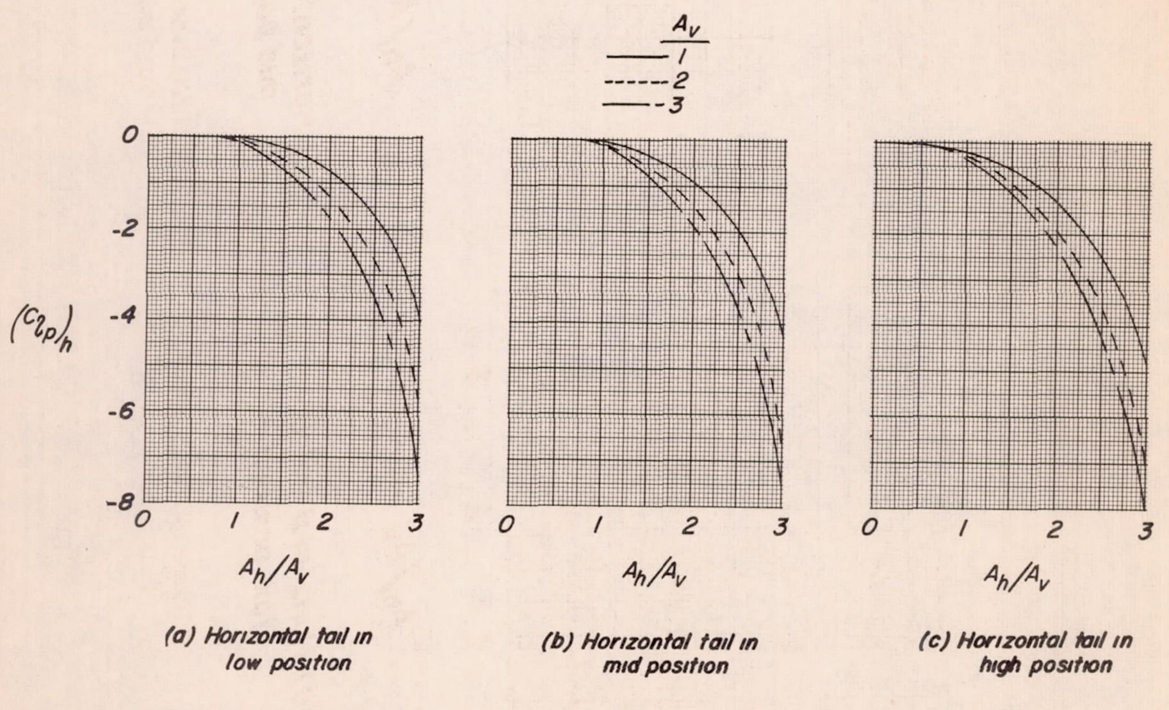
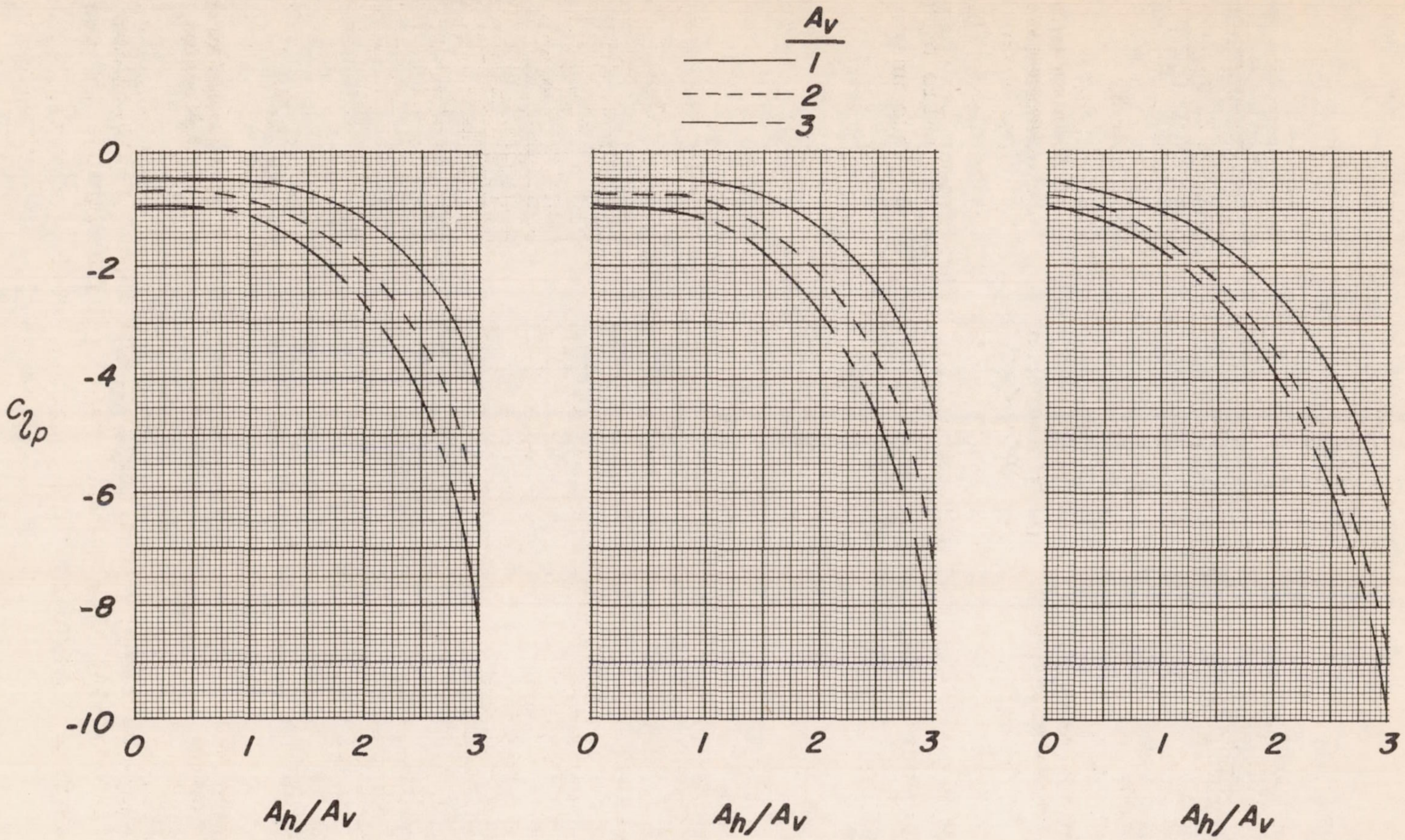


Figure 35.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{l_p} for various unswept tail assemblies. $\Gamma = 0$.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 36.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{l_p} for various unswept tail assemblies. $\Gamma = 0$.

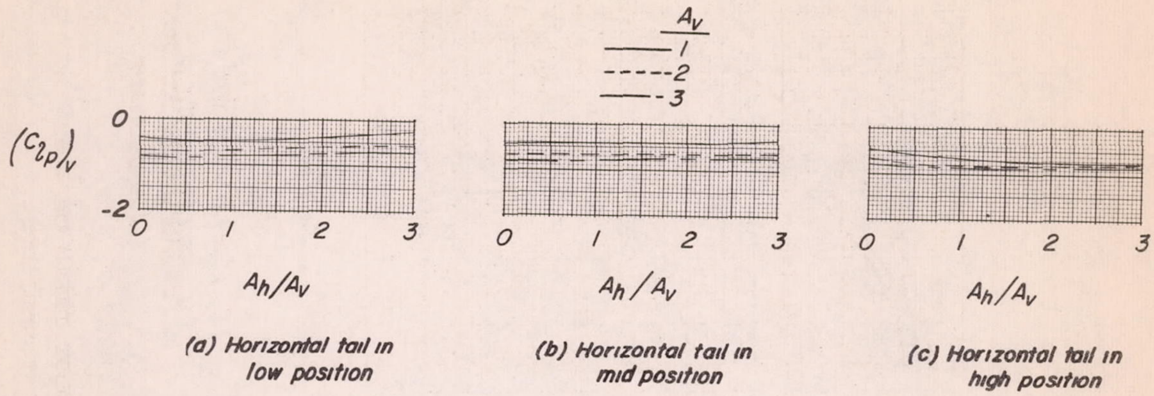


Figure 37.- Effect of horizontal-tail position and aspect ratio on the calculated vertical-tail contribution to C_{l_p} for various 45° sweptback tail assemblies. $\Gamma = 0$.

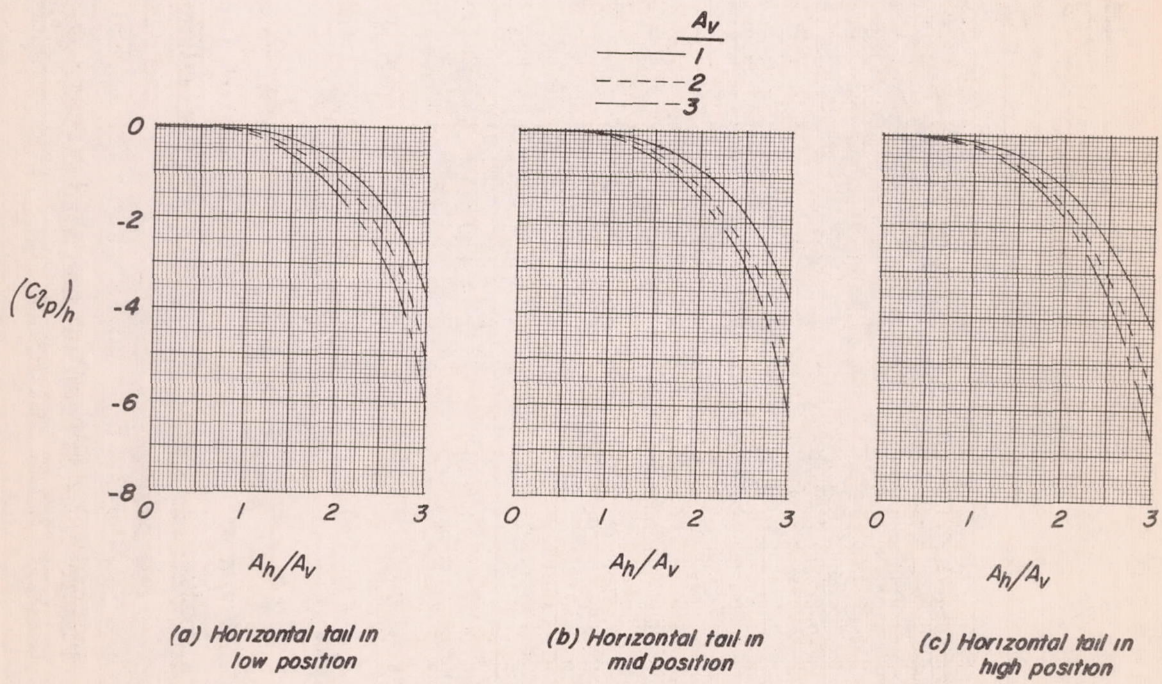
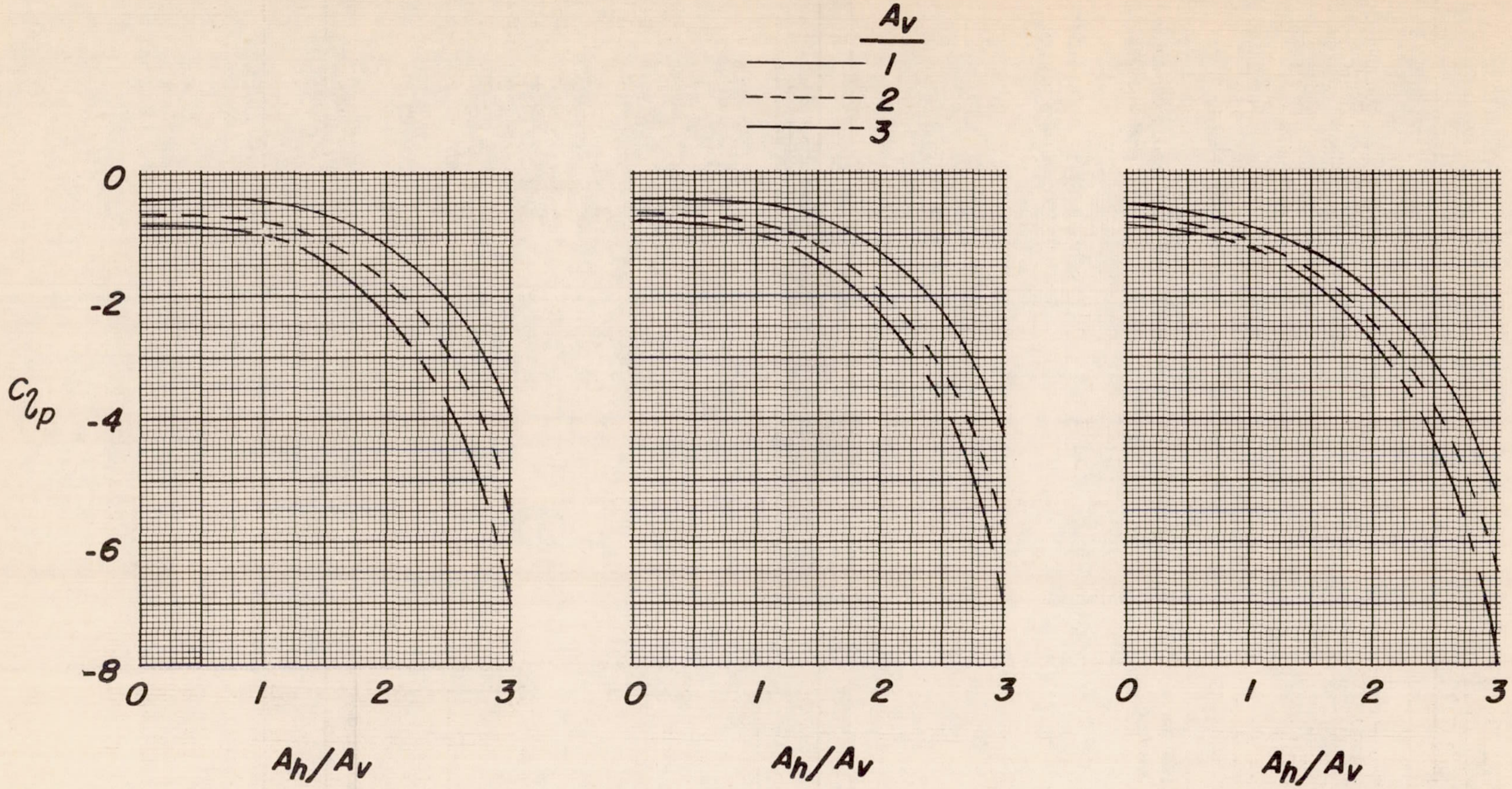


Figure 38.- Effect of horizontal-tail position and aspect ratio on the calculated horizontal-tail contribution to C_{l_p} for various 45° sweptback tail assemblies. $\Gamma = 0$.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 39.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{l_p} for various 45° sweptback tail assemblies. $\Gamma = 0$.

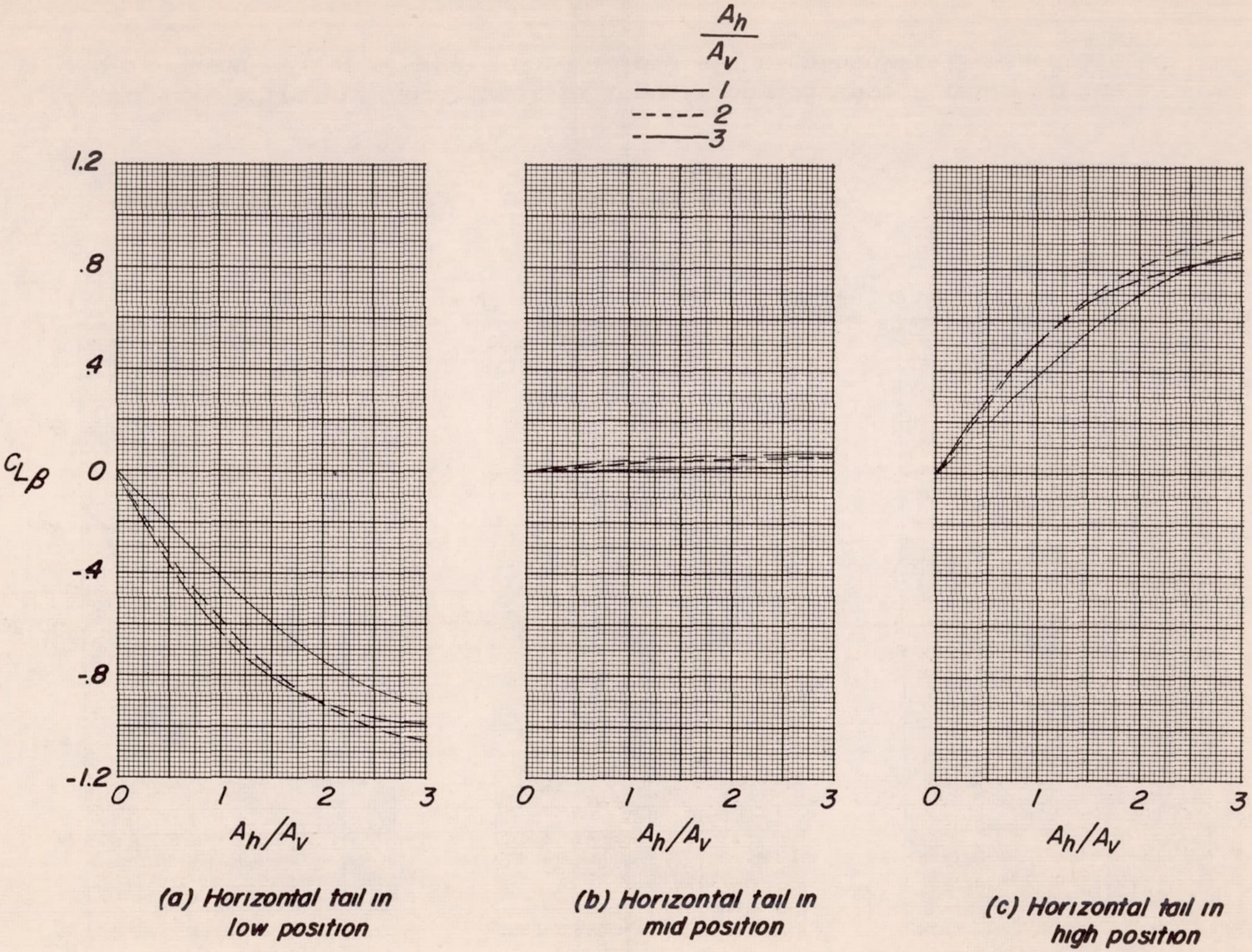
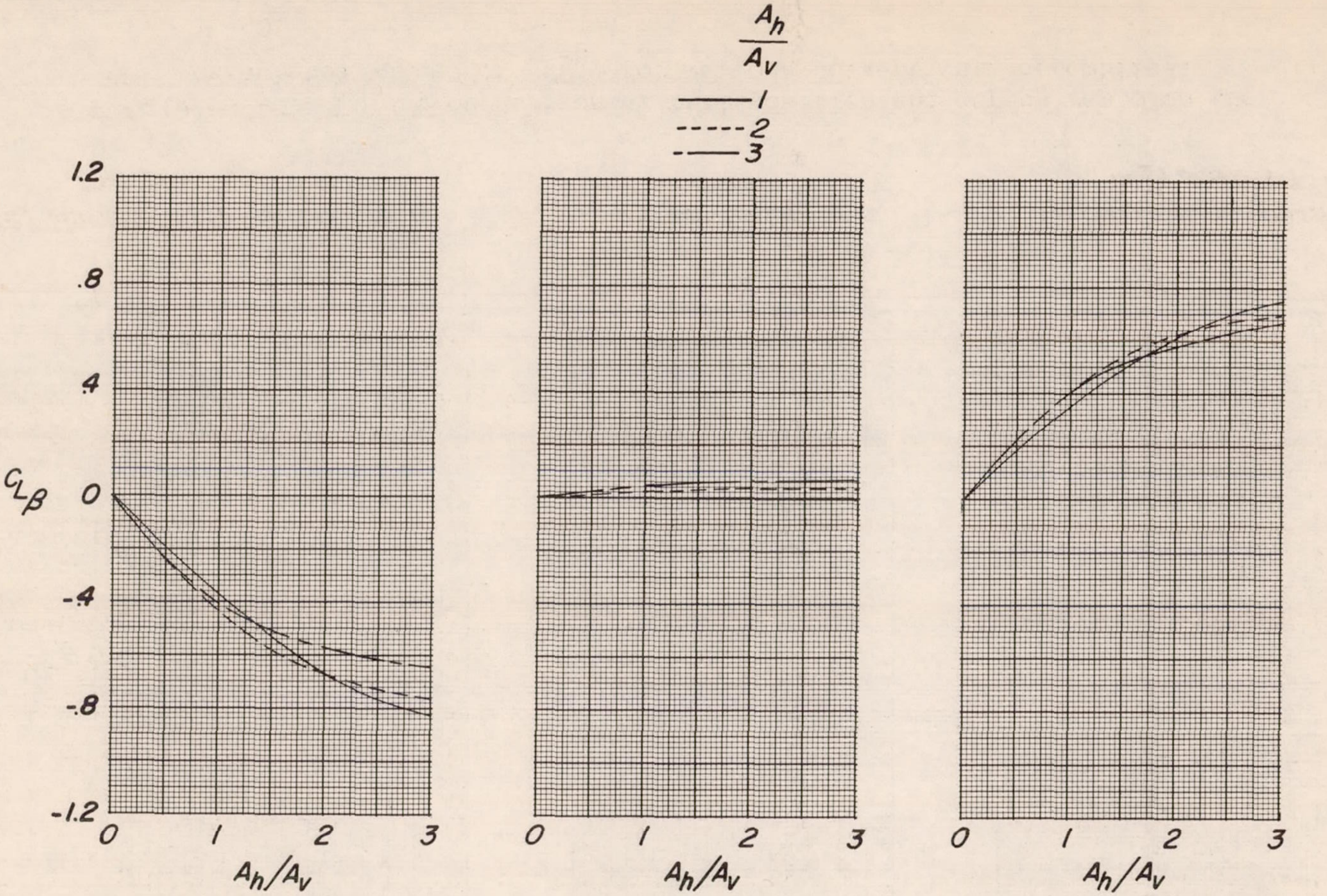


Figure 40.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{L_β} for various unswept tail assemblies. $\Gamma = 0$.

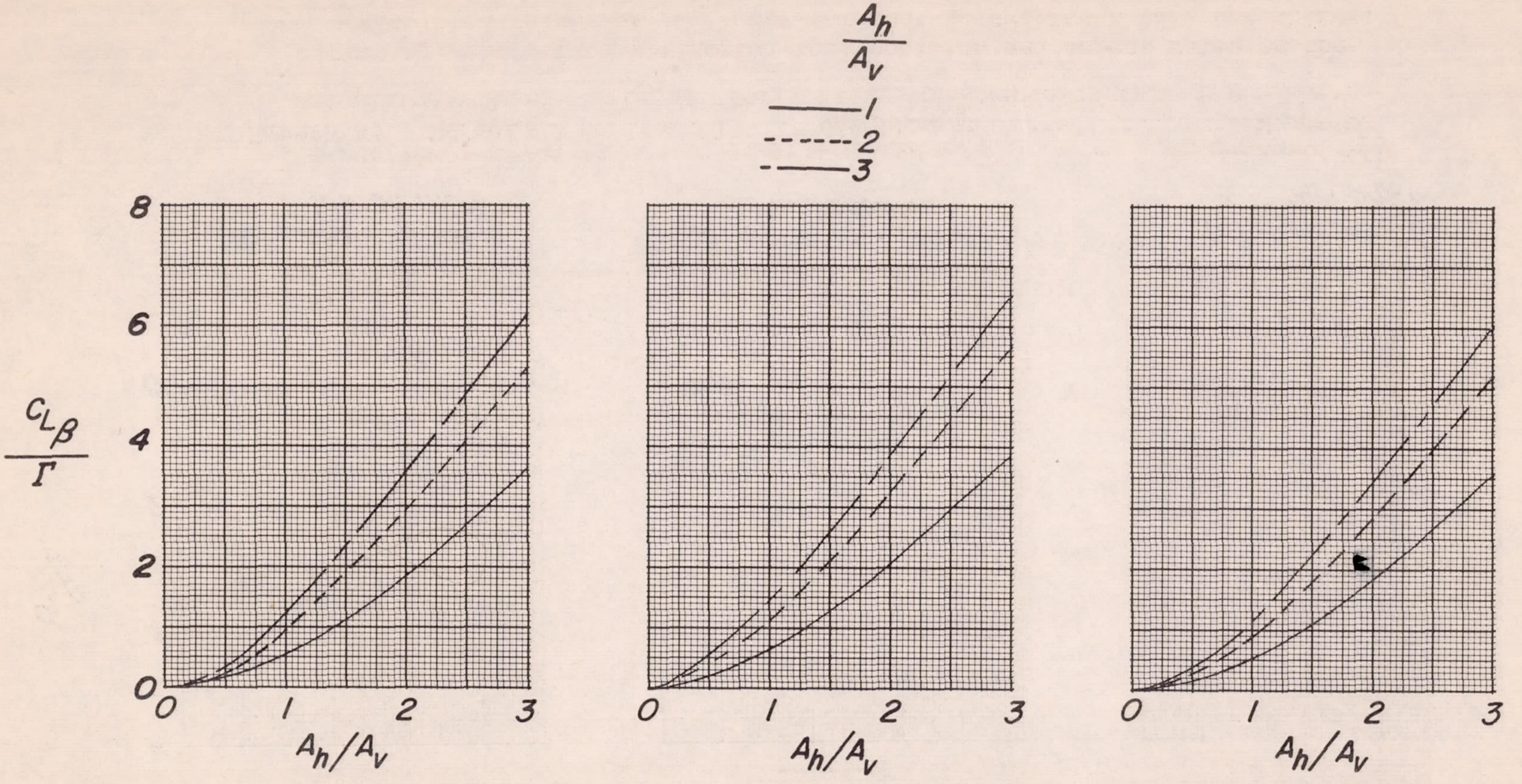


(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 41.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{L_β} for various 45° sweptback tail assemblies. $\Gamma = 0$.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 42.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{L_β}/Γ for various unswept tail assemblies.

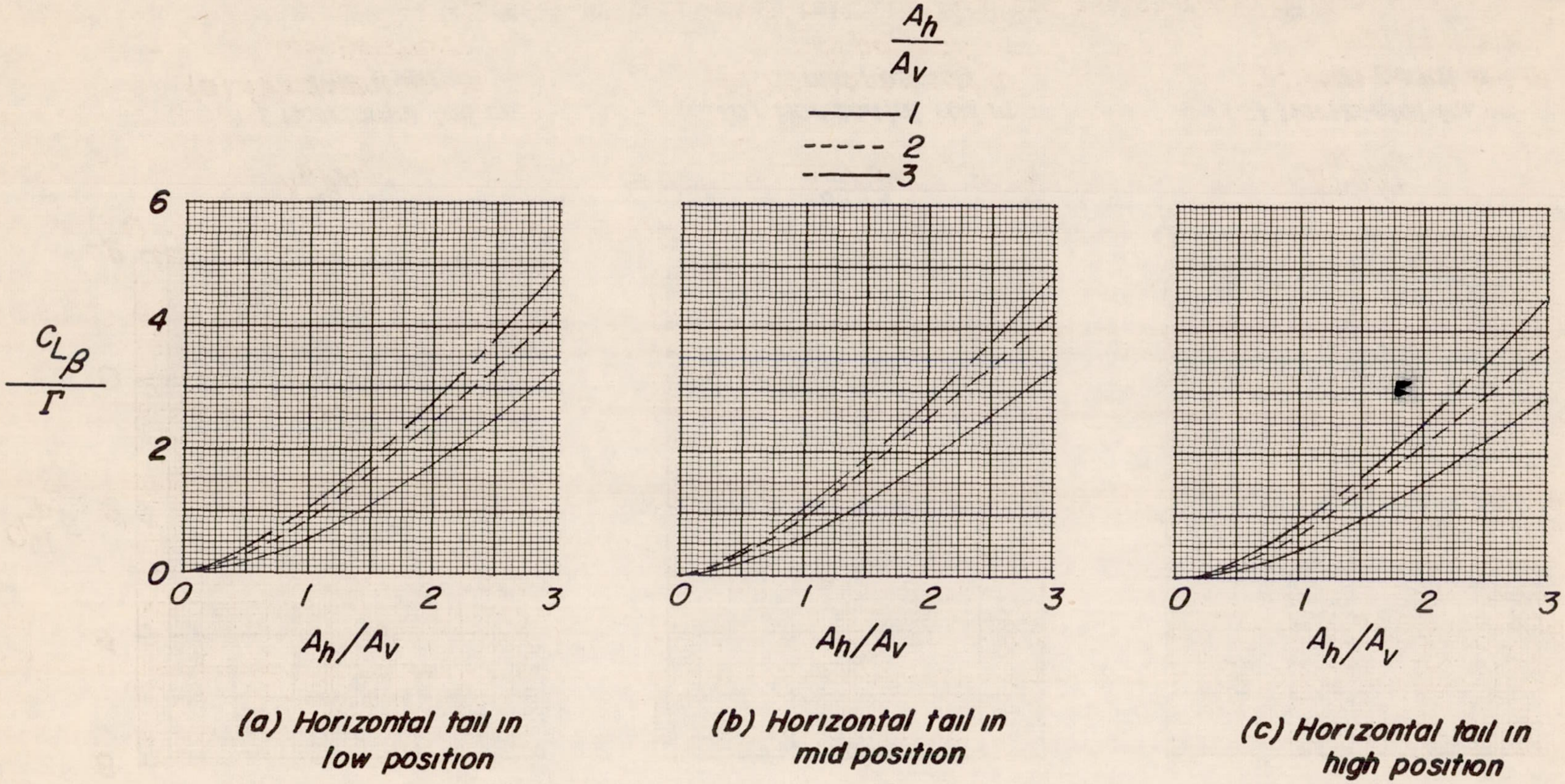


Figure 43.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{L_β}/Γ for various 45° sweptback tail assemblies.

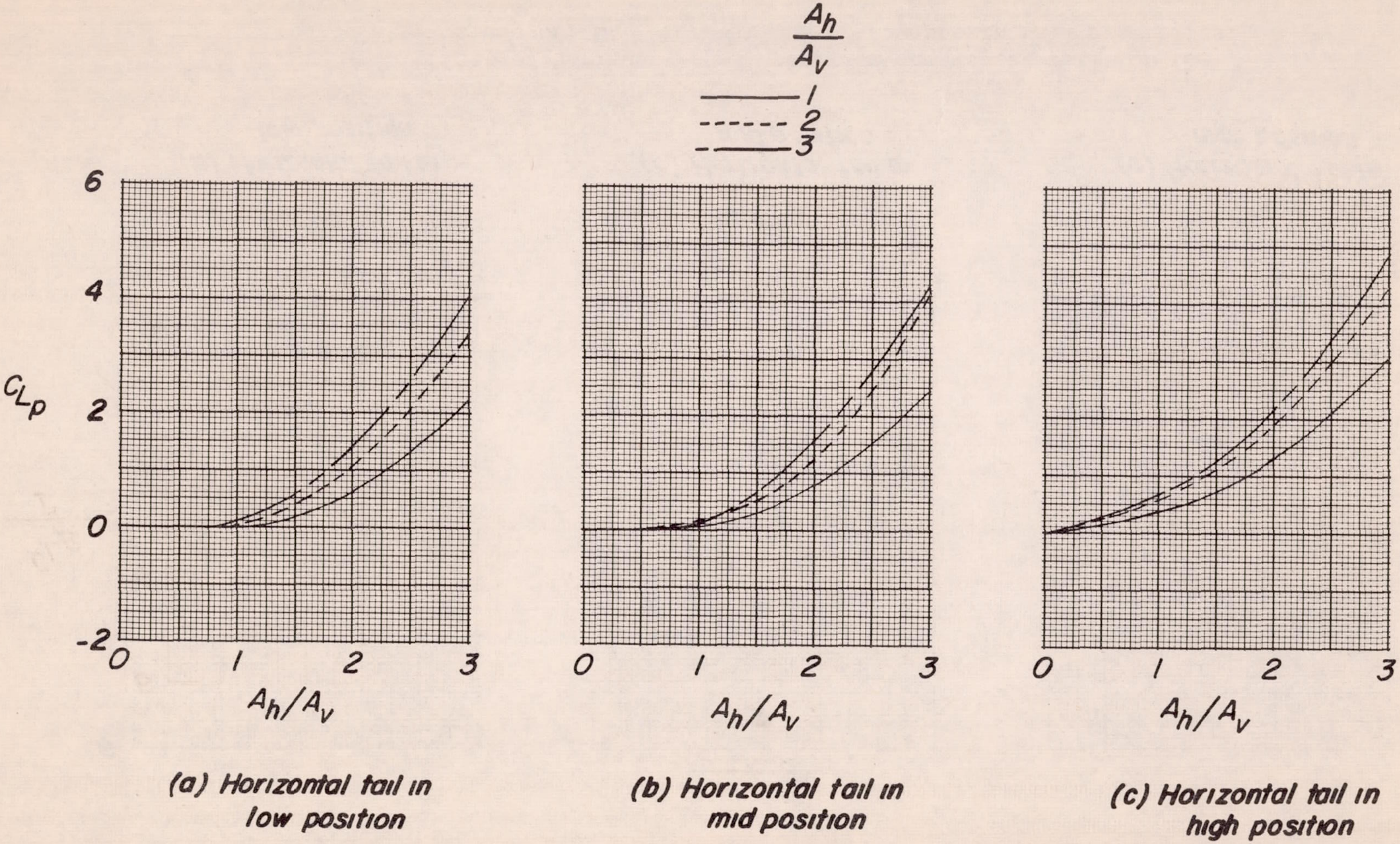
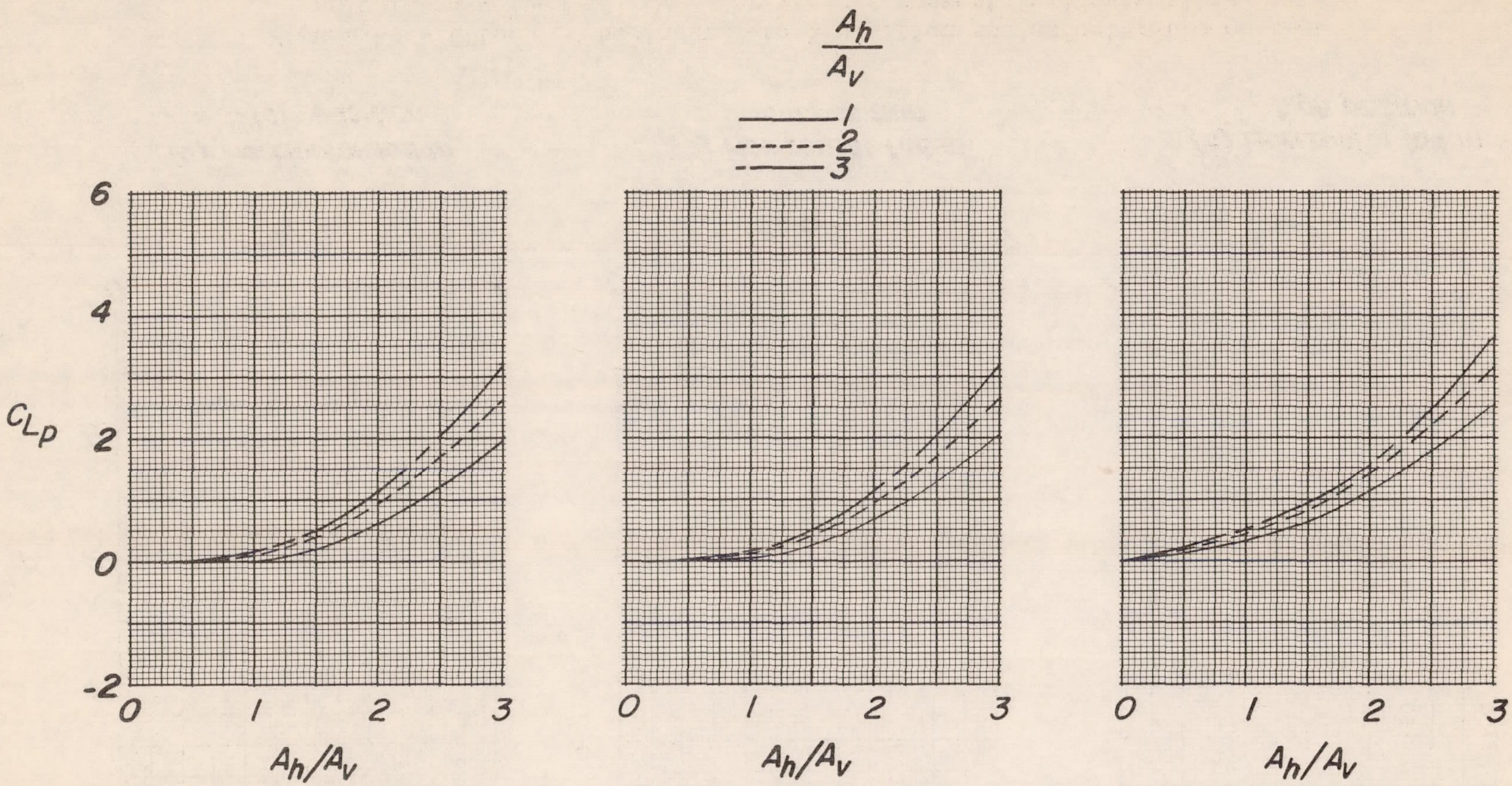


Figure 44.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{L_p} for various unswept tail assemblies. $\Gamma = 0$.



(a) Horizontal tail in low position

(b) Horizontal tail in mid position

(c) Horizontal tail in high position

Figure 45.- Effect of horizontal-tail position and aspect ratio on the calculated values of C_{L_p} for various 45° sweptback tail assemblies. $\Gamma = 0$.

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