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DEVELOPMENTS IN HELICOPTER TAIL BOOM STRAKE APPLICATIONS IN THE UNITED STATES

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SUMMARY

The use of a strake or spoiler on a helicopter tail boom to beneficially change helicopter tail boom air loads was suggested in the United States in 1975. The anticipated benefits were a change of tail boom loads to reduce required tail rotor thrust and power and improve directional control. High tail boom air loads experienced by the YAH-64 and described in 1978 led to a wind tunnel investigation of the usefulness of strakes in altering such loads on the AH-64, UH-60, and UH-1H helicopters. The wind tunnel tests of two-dimensional cross sections of the tail boom of each demonstrated that a strake or strakes would be effective. Several limited flight test programs with the U.S. Army's OH-58A, AH-64, and UH-60A were conducted which showed the effects of strakes were modest for those helicopters. The most recent flight test program, with a Bell 204B, disclosed that for the 204B the tail boom strake or strakes would provide more than a modest improvement in directional control and reduction in tail rotor power.

INTRODUCTION

Helicopters experience significant aerodynamic loading on the tail assembly and fuselage during hovering and low-speed flight because of combinations of wind speed, maneuver velocity, and downwash from the main rotor. Aerodynamic loading on the tail boom is of particular interest because it is subjected to the highest rotor wake velocities and varying flow angles. The down load must be offset by thrust from the main rotor with a corresponding reduction in payload. Sideward loading of the tail boom can increase the thrust required of the tail rotor. Since the forces and moments from the tail boom loads must be balanced by tilting of the tip path plane of the main rotor and/or by additional tail rotor thrust, the result is a reduction in payload and available directional control.

Of course, there are other handling qualities problems for helicopters in low-speed flight. For example, the tail rotor can experience operation in a "vortex ring state". This is most likely to occur when a helicopter is flown to the left rear (or if in hovering, winds coming from the azimuth range of 210° to 330°). In that state the tail rotor experiences significant thrust variations which lead to uncommanded pitch, roll, and yaw excursions of the helicopter. For relative winds in the azimuth region of approximately 280° to 330°, the main rotor vortices may be directed into the tail rotor also resulting in severe thrust variations. Another disturbing characteristic of helicopters is that of weathercock instability of the fuselage in rearward flight (or winds from the azimuth range of approximately 120° to 240°). These characteristics impose heavy workloads on the pilot to maintain control. Effecting a beneficial change in any such undesirable characteristics of low-speed flight operation offers relief to the pilot, more precise control, and lessening of the risk of accident.

Tail boom air loads have contributed to the reduction of available directional control in near hovering flight at high gross weight or high altitude. This has been experienced by several types of helicopters which when first flown, may demonstrate adequate directional control. Inevitably the helicopter operating gross weight increases above the original design level and the increased main rotor torque required adds to the thrust required of the tail rotor. The British Sea King helicopter experienced such a problem (Ref. 1) in the Falklands crisis. For helicopters designed in the United States and United Kingdom (the main rotor rotates such that the advancing blade is on the right-hand side of the helicopter) the directional control margin is minimum in right sideward flight at low flight speeds, or hovering in winds from the right at speeds as low as 10 knots. The UH-1H, AH-64, and OH-58A have such limitations (Ref. 2,3, and 4).

That such could occur was suspected as early as 1972 as mentioned in reference 5. Wind tunnel tests in 1972 of small scale helicopter fuselages placed in the wake of a rotor demonstrated that substantial yawing moment could be induced on the fuselage (Ref 6). Also, in reference 5 there is mention of a possible solution for the problem of high yawing moment and that is the mounting of strakes on the tail boom to alter the air loads.

The installation of a strake on the tail boom of the Sea King helicopter was shown by Brocklehurst (Ref. 1) in 1982 to produce a significant improvement in that helicopter's low flight speed yaw control. That means of altering the flow patterns around the tail boom by promoting flow separation enabled the Sea King to be flown in winds from the right of up to 30 knots at high gross weight whereas it had been limited to 10 knot winds prior to the strake installation

In 1978, reference 7 cited a problem of large sideforces on the tail boom of the U.S. Army's AH-64 in right sideward flight. It was mentioned in that reference that a solution to reduce the loads was not evident. The need was then apparent to conduct an investigation of the basic aerodynamics of the problem and a possible solution to the problem was cited. An investigation was begun to include analyses, wind tunnel testing, and flight testing of solutions developed. A possible solution was that offered in reference 5 in 1975 i.e. a strake or strakes mounted on the tail boom.

Apparatus for testing typical two-dimensional cross sections of helicopter tail booms was designed and fabricated for wind tunnel tests. Testing was conducted in the NASA Langley 14 by 22 Foot Subsonic Tunnel. Thereafter, brief flight tests of strakes mounted on tail booms were accomplished for the U.S. Army's OH-58A, AH-64, and UH-60A. The latest flight test and more extensive effort was that with a Bell 204B, which is the civil version of the U.S Army's UH-1B. That effort was recently concluded.

DISCUSSION

Wind Tunnel Tests

Experimental investigations had been conducted on many cross-sectional shapes typical of fixed-wing aircraft fuselages. None of these tests dealt with the typical helicopter tail boom cross section that has a unique protuberance introduced by the tail rotor drive-shaft cover. Since there were insufficient data available for the understanding of air loads on helicopter tail booms, an experimental study (Ref. 8 and 9) was undertaken of two-dimensional cross-sectional shapes of three current U.S. Army helicopter tail booms (those of the AH-64, UH-60, and UH-1H, which together constitute the bulk of the U.S. Army helicopter fleet). Each shape represented, at reduced size (approximately 50 percent for the UH-60 and AH-64 and 82 percent for the UH-1H), the cross section at a station approximately 80 percent of the rotor radius behind the main rotor shaft (the location where maximum rotor wake velocities are generally experienced in hover, (Ref. 8)). The AH-64 configuration was circular when the tail rotor drive-shaft cover was removed. The other two configurations were roughly oval with large corner radii and, though symmetric about the vertical axis, were nonsymmetric about the horizontal axis even when the tail rotor drive-shaft covers were removed (Fig. 1).

A photograph of the installation in the NASA Langley 14 by 22 Foot Subsonic Tunnel is shown in figure 2. The arrangement of cylindrical components and balance is described in figure 3. The upper and lower cylindrical segments were attached rigidly to a center strut. The middle segment was the metric component, and it was attached to a strain-gage balance (measuring the forces and moments). Pressure distributions on the middle segment were obtained as well. The center strut was attached to a model mounting support below the tunnel floor that could be rotated to vary flow incidence. Large-diameter end plates were attached to the top and bottom segments to help ensure that two-dimensional flow would be achieved on the metric section.

The cylinders were tested at constant flow incidence angles over a range of dynamic pressure; hence, data were obtained over a range of Reynolds number. Also, tests were made at constant dynamic pressure for a range of flow incidence angles. Flow incidence was varied by rotating the cylinders about their longitudinal axes (i.e. vertical in the tunnel) through a range from -45° to 90° (Fig. 4). The dynamic pressure range from 1.5 to 50 psf was selected to encompass the range of flow conditions characterized by Reynolds number that may be experienced by full-scale helicopter tail booms. The large range of flow incidence covered the extreme flow angles that may be experienced by the tail boom. For example, the flow incidence range included 90° that could occur in right sideward flight, if the sideward flight speed is high enough and the rotor wake is clear of the tail boom.

The variations of c_y and c_z (coefficients and symbols are described in Table 1) with flow incidence for the three shapes are similar for the UH-60 and UH-1 but significantly different for the AH-64 (Fig 5). Of course, the tail rotor drive-shaft cover increases the asymmetry about the y-axis for the UH-1H and UH-60 shapes (and adds asymmetry about the y-axis to the AH-64 shape), resulting in significant effects on the patterns of c_y and c_z plotted against flow incidence.

After the understanding of the basic aerodynamic characteristics (variation of c_y and c_z with flow incidence) of these shapes was established in the wind tunnel tests, the primary objective of beneficially affecting these characteristics with spoilers (i.e. strakes when mounted on the tail boom) was sought. The beneficial effect desired was a positive increase in c_y, which implies a side air load to the right (if viewing the helicopter from the rear) that would result in a decrease of the thrust required of the tail rotor. Two strake configurations were tested. All three cross section shapes were tested with one strake mounted on the "upper" left shoulder. The UH-60 and UH-1H shapes were also tested with a second strake on the lower left side. Only two strake heights, one inch and two inches, were used, which at full scale would be approximately doubled in height. The strakes were attached at locations found from preliminary tests to alter the side-force (c_y) characteristics beneficially (Ref 8).

For the AH-64 boom, either of the strake heights produces a positive c_y increment for the range of flow incidence from -20° to 48° (Fig. 6). Such a range may well encompass the flow incidence felt by the AH-64 tail boom from hover (where wake swirl produces a small negative incidence) through a portion of right sideward flight (where $\phi > 0^\circ$). The favorable shift in the side force is accompanied with a penalty in the positive increment in c_z, i.e. a down load.

For the UH-60 boom, several strake configurations were investigated. There were combinations of 1 inch and 2 inch strakes on the "upper" left shoulder with the same sizes on the "bottom" left side of the cylinder. It was judged that the combination of a 2 inch strake on the upper left side and a 1 inch strake on the bottom left was the most promising configuration. Not only does it provide a positive c_y increment for the range of flow incidence from -10° to 30° (Fig. 7) equivalent to the single strake configuration, it provides a significant c_y increment for $\phi < -20^\circ$. That increment could be beneficial for a helicopter spinning to the right after yaw control is lost (loss of tail rotor effectiveness) because the c_y increment would tend to slow the spin.

For the UH-1H boom, only one strake configuration was evaluated. That was a 1 inch strake on the upper left side and a 2 inch strake on the lower left side of the cylinder. A positive increment in c_y was obtained over a flow incidence range of -10° to 50° (Fig. 8). Though there wasn't an opportunity to evaluate a configuration similar to that which was best for the UH-60, it was expected that such would be best for the UH-1H also because of the similarity of cross section shapes.

These wind tunnel tests, concluded in 1982, provide for understanding of the air loads that can result on a tail boom of a helicopter in low speed flight (Ref. 8 and 9). The use of strakes to beneficially alter those loads was sufficiently promising to encourage flight test evaluation.

<u>OH-58A Flight Test</u>

A limited flight investigation utilizing an OH-58A helicopter (Fig. 9) was conducted to evaluate several tail boom strake configurations (Ref. 4). This program was conducted in 1983 by the U.S. Army's Applied Technology Laboratory (ARTA, AVSCOM) at Fort Eustis, Virginia. The purpose was to measure and explore the effect of various strake configurations on the directional control margin in right sideward flight and, possibly, reduce aircraft unsteadiness as a result of the tail rotor operating in the vortex ring state during left sideward flight. A variety of strake configurations were tested. Generally, the configurations tested varied in the longitudinal positions of strakes on the the tail boom, that is, segments mounted on both left and right sides of the boom (Fig. 10). The angular position was based on the results of the previous wind tunnel tests (Ref. 8). However, the strake height was greater in proportion to the tail boom cross section size than tested in the wind tunnel. The height of the strakes was 2 inches which was approximately 20 percent of the tail boom diameter whereas in the wind tunnel tests the height was approximately 13 percent. (Like the AH-64, the tail boom shape of the OH-58A is circular but usually the tail rotor shaft cover is not installed.)

Onboard instrumentation provided pedal position and angular yawing velocity time histories which were recorded on a tape recorder located in the passenger area behind the pilot's seat. A ground pace vehicle equipped with a calibrated fifth wheel provided recording of ground speed. During each data acquisition run, ambient wind speed and direction were recorded. Air temperature and barometric pressure were recorded as well. For flow visualization, wool tufts were attached to the boom and photographs were obtained for some flight conditions.

Repeatable data were obtained on the directional control margin characteristics of the test aircraft with and without strakes. The aircraft speed was varied in 5-knot increments from 0 to 35 knots at wind azimuth angles of 0°, 90°, 135°, 180°, 225°, and 270°, where the pace vehicle provided the reference for these conditions. The primary flight directions of interest were 90° (right sideward flight) and 270° (left sideward flight).

Based on the analysis of the data obtained in conjunction with pilot comments, it was determined that installation of a strake on the test helicopter did alter the aerodynamic loading on the tail boom, resulting in a modest improvement in pedal control margin (Fig. 11) and thus a decrease in tail rotor thrust required. In left sideward flight, where most helicopters have difficulty with the tail rotor in the vortex-ring state, a strake increased slightly the aircraft unsteadiness and pilot workload. It is suspected now that the "double strake" may reduce that unsteadiness and offer to the pilot a means to cope with the right spin that can result from loss of tail rotor effectiveness. The concept of a double strake has been patented in the United States (Ref. 10).

UH-60A Flight Test

Arrangements were made in 1985 with the US Army Aviation Engineering Flight Activity (USAAEFA) at Edwards Air Force Base in California to evaluate the effects of a single strake mounted on the UH-60A tail boom (Fig. 12). The effect of a strake on the UH-60A was expected to be much more significant than that shown for the OH-58A because the tail boom cross sectional area is larger and the main rotor disk loading is much higher. In addition to the comprehensive instrumentation normally used by USAAEFA on the test helicopter, two video cameras were mounted on the stabilator to record tufting patterns on the tail boom. Also, a ground pace vehicle was to determine accurate ground speed which was used in conjunction with wind speed to provide a precise true airspeed reference for the test aircraft.

Tests were conducted to evaluate performance and handling qualities of the UH-60A both with and without the strake installed. Testing was performed at speeds up to approximately 45 knots true airspeed in left and right sideward flight (i.e wind azimuths of 90° and 270°). The helicopter was flown in ground effect at a wheel height of 15 feet. Testing was terminated after three flights when it was judged by USAAEFA test personnel that there were no significant improvements in performance or handling qualities.

Though the overall performance and handling qualities appeared to be essentially unchanged by the installation of the strake, there were minor improvements noted in the test report (Ref. 11). There was a 5% (i.e. 0.25 inch) directional control margin increase for right sideward flight at 35 to 45 knots. Also, right sideward flight required 0.3 to 0.4 in. less right cyclic control with the strake installed. Some modest reductions in pilot workload were noted. The video records of flow patterns on the tail boom do confirm that the strake effects were as predicted by the wind tunnel tests, causing flow separation on the tail boom in the airspeed range of hover to 20 knots in right sideward flight. A notable recommendation of the test report was that, since the UH-1H has a documented problem with tail rotor control margins during hover and sideward flight, an evaluation of tail boom strake on the UH-1H should be considered.

__AH-64 Flight Test__

The problem of the AH-64 with high tail boom air loads cited in 1978 (Ref. 7) which stimulated the wind tunnel testing of two-dimensional tail boom cross sections was addressed in flight tests contracted with McDonnell Douglas Helicopter (MDHC) by the Aviation Applied Technology Directorate (USAARTA, AVSCOM) at Ft. Eustis, Virginia. A rather limited flight investigation of a strake mounted on an AH-64 helicopter tail boom (Fig. 13) was conducted by MDHC in 1986 in Mesa, Arizona.

For the tests, a strake with a height of 3 inches was attached to the upper left side of the tail boom and positioned as tested in the wind tunnel (Ref. 8). The aircraft was thoroughly instrumented for the testing, including measurements of control positions and tail rotor torque. A pace vehicle was used to establish airspeed. Data were obtained for the airspeed range of 45 knots left sideward flight to 45 knots right sideward flight in 5 knot increments. The right sideward flight was essentially at a wind azimuth of 90° and the left sideward flight was at a wind azimuth of 240°, which was considered the critical azimuth by MDHC because of high pilot workload at that azimuth. The helicopter was tested without the strake in January, 1986 and then tested with the strake in June, 1986.

Though the results of the program have not been formally reported, some information has been made available. Analysis of the data indicated that the strake had a small beneficial effect on the AH-64. Though a maximum reduction of tail rotor power at 15 knots in right sideward flight of 60 hp was shown by the data (with a corresponding reduction of directional control position of 8 percent), outside the range of 10 to 20 knots in right sideward flight the tail rotor power reduction averaged only a modest 15 hp. The operational suitability of the tail boom strake on the AH-64 was not demonstrated by this test program. Perhaps, with a better understanding of the flow environment on the AH-64 tail boom and a more optimal strake configuration (for example, two strakes, one "upper" and one "lower" as tested for the UH-60A and UH-1H in wind tunnel tests (Ref. 8)) suitability could be demonstrated with testing throughout the flight envelope.

__204B Flight Test__

In 1986 it was recognized that a more thorough flight test evaluation of the effects of tail boom strake (or strakes) installation was needed. The three earlier tests with the OH-58A, UH-60A, and AH-64 concentrated on nearly pure left and right sideward flight. Also for all three the results showed only modest benefits whereas significant benefits for the Westland Sea King helicopter had been demonstrated by Brocklehurst (Ref. 1). Those benefits were the result of a well done program which addressed a significant need of the Sea King for improved directional control in right sideward flight. Also, the Sea King tail boom with its deep, elliptical cross section was most promising for alteration of air loads with a strake. Arrangements were made at NASA Langley to use the civil version of the UH-1B, a Bell 204B (Fig. 14) owned by NASA Langley, in a thorough evaluation of strake installations. A further advantage to using the 204B was that if a strake configuration proved beneficial then a directional control limitation experienced by both the UH-1 series of helicopters and the AH-1S (Ref. 2 and 3) in right sideward flight might be reduced since all have essentially the same tail boom geometry.

The test program was planned to evaluate tail boom strake configuration benefits and limitations with closely controlled conditions. Onboard instrumentation provided measurements of all control positions, angular velocities for pitch, roll, and yaw , main rotor power, angle of attack and sideslip, and tail rotor blade pitch angle. In addition, a special compact telemetry system was mounted on the tail rotor drive shaft to obtain high accuracy tail rotor torque at the tail rotor hub. The system was used instead of a slipring assembly to transmit the signals for shaft torque and blade pitch angle. Miniature color video cameras were mounted on both sides of the fuselage near the passenger compartment to record wool tuft patterns on the tail boom as affected by airflow over the tail boom. The low flight speed testing was conducted at the NASA Wallops Flight Facility located on the eastern shore of Virginia. The Wallops Flight Facility furnished a ground pace vehicle, tracking radar. and continuous monitoring of winds and atmospheric parameters.

Comparisons of the effects on tail rotor power of strake configurations are shown in figure 15. The critical azimuth range for the 204B was between 45° and 90°. In this range the directional control (i.e. pedal position)can approach a limit of 3.4 inches deflection and the tail rotor power required can exceed the design limit of 105 hp. For this helicopter, without strakes, at a gross weight of approximately 8200 lbs at near sea level conditions the average pedal position reached a maximum of 2.9 inches left pedal at 20 knots at a wind azimuth of 60°. The tail rotor power exceeded the design limit by requiring 120 hp. With a single strake the pedal position required was reduced by 15 percent while the double strake resulted in a reduction of 10 percent. Both strake configurations brought the tail rotor power down to within the design limit. At a wind azimuth of 75° the double strake is more effective than the single in reducing both pedal deflection and tail rotor power. A comparison of strake effects at 45° azimuth was not possible because of loss of the data acquired for the double strake.

These test results do not demonstrate the dramatic improvement offered by a tail boom strake that has been shown for the Westland Sea King. It is noted in Ref. 1 that without a strake the Sea King tail rotor would normally be operated deeply into stall at high gross weight and the strake helped to make a large reduction of tail rotor profile power. For the 204B tests varying the gross weight or varying the effective gross weight (i.e. with altitude variation) was not practical to force the tail rotor into a stalled condition. However, the maximum deflection of 2.9 inches at 20 knots at 60° azimuth leaves only a 10 percent control margin. Ref. 2 concluded that when the average control position in sideward flight was within the 10 percent control margin, control was lost while hovering or making approaches in actual winds. The 204B, therefore, was at a normal operational limit. According to some information in reference 2 that 10-percent margin could be eroded by increasing the effective gross weight. Strakes offer the means to increase that margin at the worst condition of 20 knots at 60° azimuth.

The 204B test program provided more than a "limited" evaluation of the value of installing strakes on the UH-1 helicopter type. Since the critical azimuth for the 204B was other than 90° (i.e. 60°), the results suggest that the previous test programs for the OH-58A, UH-60A, and AH-64 should have explored the range of 45° to 90°. But, it was not exhaustive by any means. The strakes were not optimal. They had a fixed height of 4 inches along the boom which varied in size. Near the tail rotor the ratio of strake height to boom size was much greater than that tested in the wind tunnel. Tapering of the height from 4 inches at the forward end to, perhaps, 2 inches at the aft end of the tail boom as well as extending the strake length to the tail rotor pylon juncture with the tail boom may well result in increased effectiveness.

CONCLUDING REMARKS

Adding strakes to helicopter tail booms as a way of promoting flow separation is a rather inexpensive and easy way of beneficially altering tail boom air loads at low flight speeds. In the United States it has slowly developed from a concept in the early 70's to the most recent appraisal in flight test with a Bell 204B. The most promising application is for helicopters such as the Westland Sea King which has a large, deep tail boom and a directional control limitation at high effective gross weight. In the U.S. the AH-64 and UH-60A do not have directional control limitations at this time which could be alleviated with a strake or strakes. In tests with both helicopters the effects of a strake were modest for 90° wind azimuth. However, with the 204B, a smaller and lighter helicopter, either a single or a double strake installation offers more than a modest benefit in reduced tail rotor power required and improved directional control.

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TABLE 1

List of Symbols

b	maximum width of cylinder normal to flow at zero flow angle, ft
c_y	section side-force coefficient (Fig. 4), $\frac{\text{Side force per unit length}}{bq}$
c_z	section drag-force coefficient (Fig. 4), $\frac{\text{Drag force per unit length}}{bq}$
q	dynamic pressure, $\rho V^2/2$, psf
ρ	free-stream air density, slugs/ft^3
V	free-stream velocity, ft/sec
ϕ	angle of flow incidence in plane normal to axis of two-dimensional cylinder (Fig. 4), deg

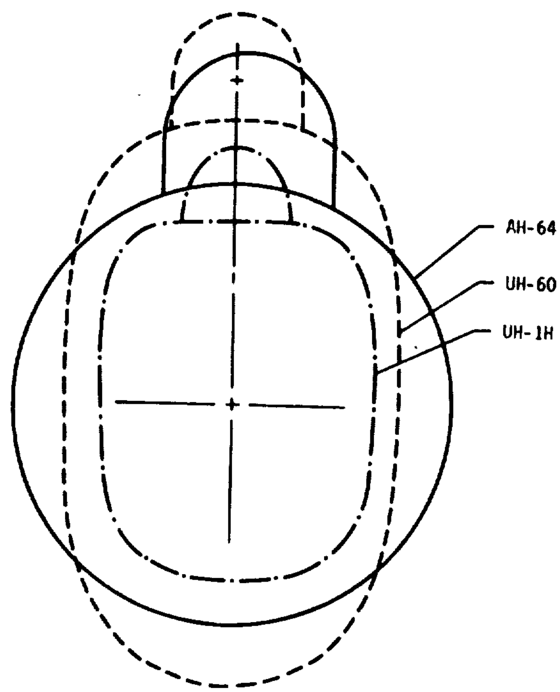

Figure 1. Tail boom cross section shapes of the AH-64, UH-60, and UH-1H tested in wind tunnel (Ref. 8)

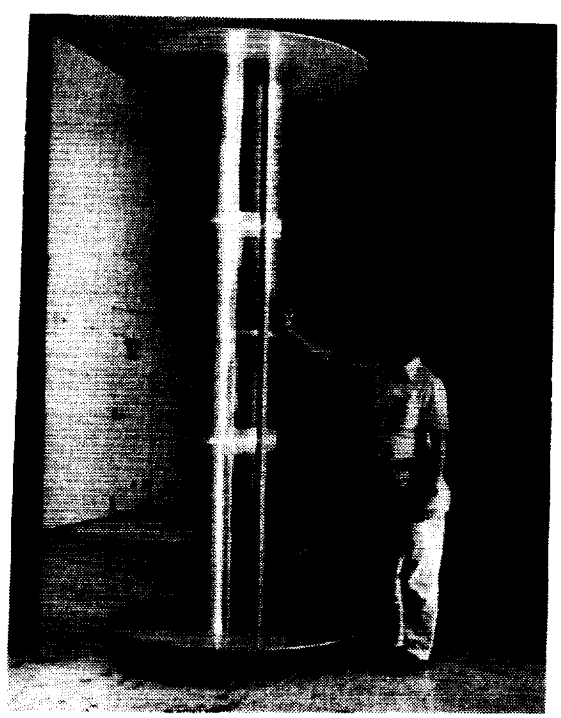

Figure 2. Two-dimensional test apparatus in the Langley 14 by 22 Foot Subsonic Tunnel. AH-64 cross section shown.

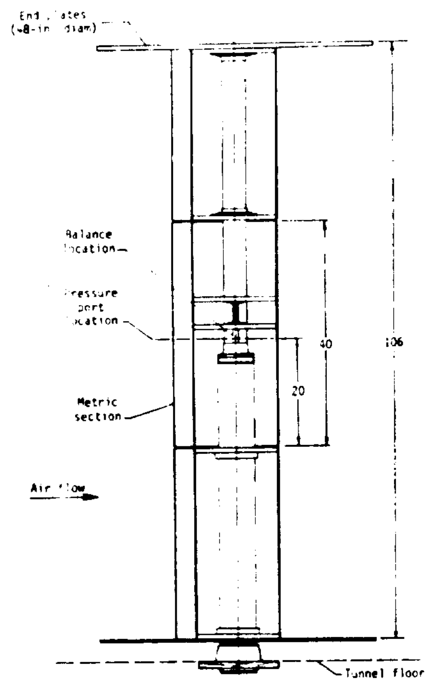

Figure 3. Schematic drawing of helicopter cross-sectional test apparatus Dimensions are given in inches.

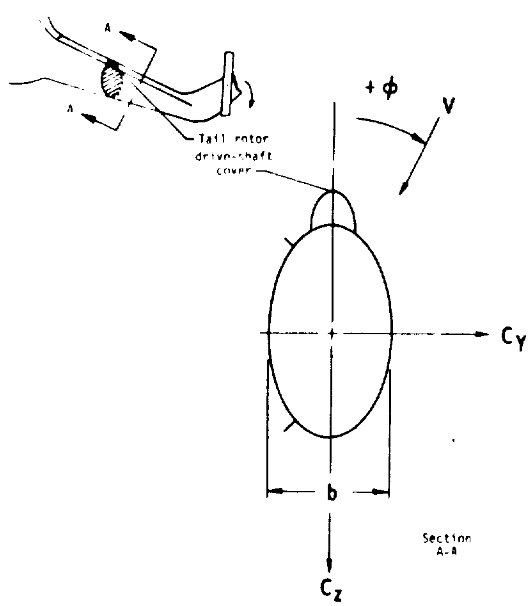

Figure 4. Convention for positive sense of flow inclination, cylinder reference dimensions, and aerodynamic coefficients.

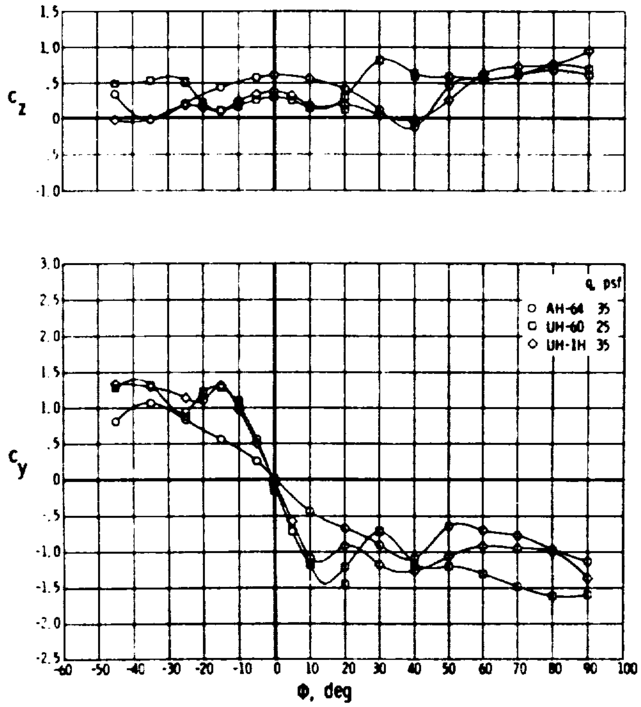

Figure 5. Comparison of effects of flow incidence on drag and side force of AH-64, UH-60, and UH-1H shapes with the tail rotor shaft cover.

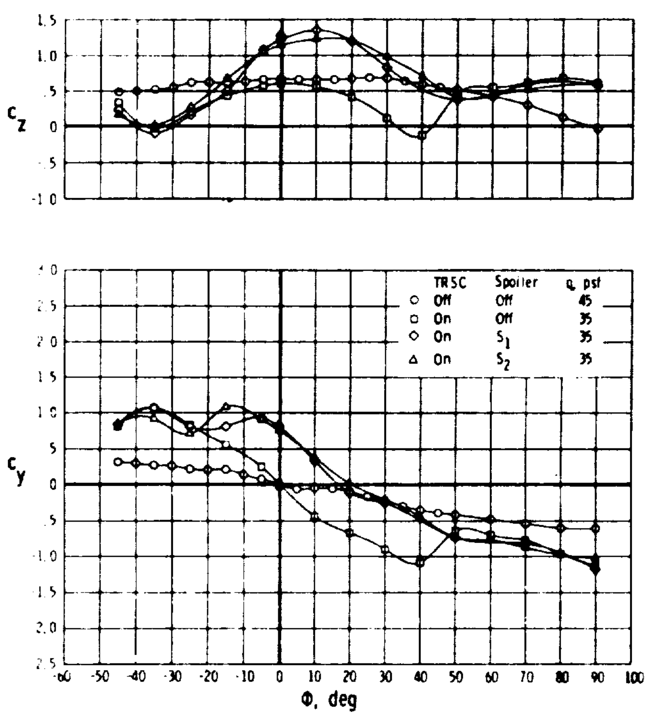

Figure 6. Comparison of effects of flow incidence on drag and side force of AH-64 shape with and without the tail rotor shaft cover (TRSC) with 1 inch (S_1) and 2 inch (S_2) strakes.

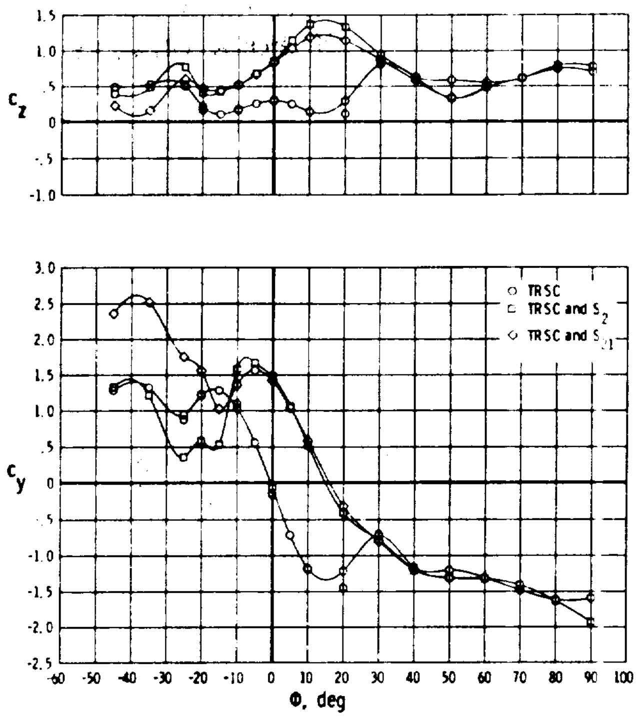

Figure 7. Comparison of drag and side-force variation with flow incidence of UH-60 shape with tail rotor shaft cover (TRSC) and 2 inch single strake (S_2) and double strake (S_{21}).

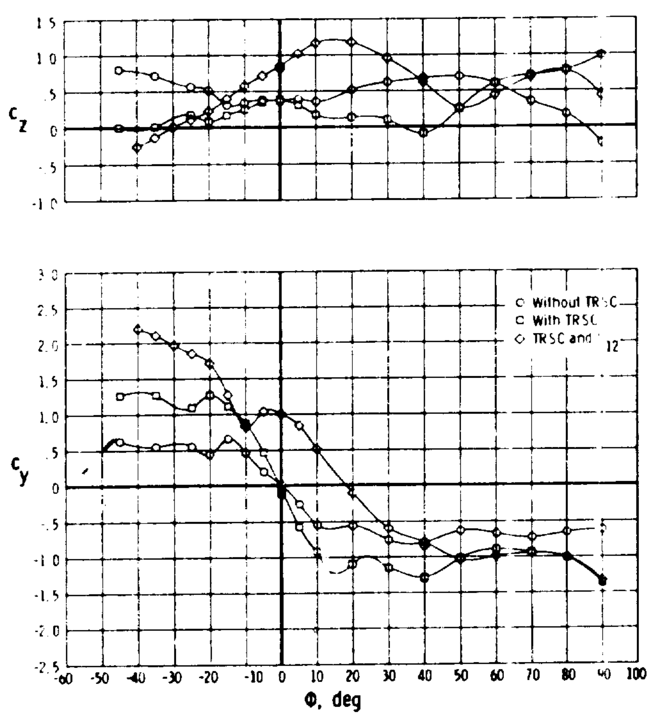

Figure 8. Comparison of drag and side-force variation with flow incidence for UH-1 shape with and without tail rotor shaft cover (TRSC) and with double strake (S_{12}).

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Figure 9. OH-58A test aircraft.

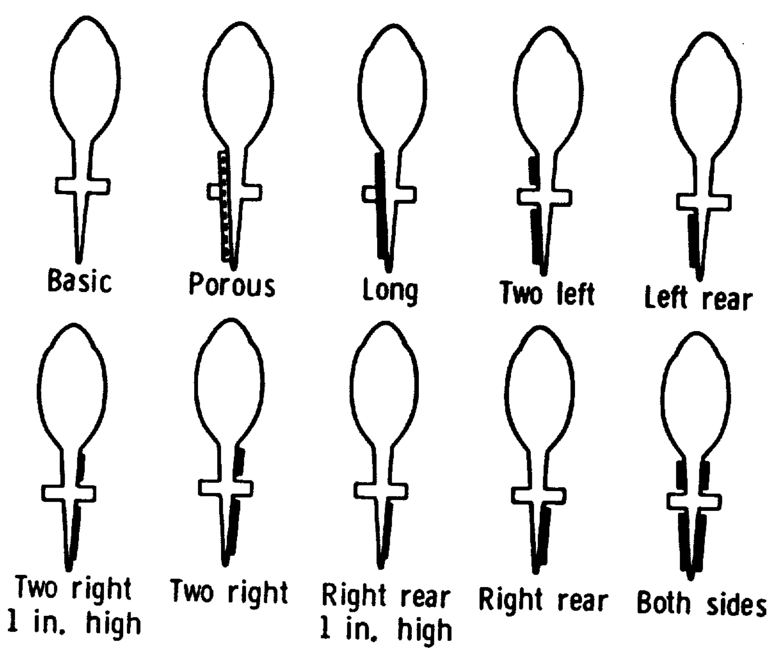

Figure 10. Sketches of strake configurations tested on the OH-58A.

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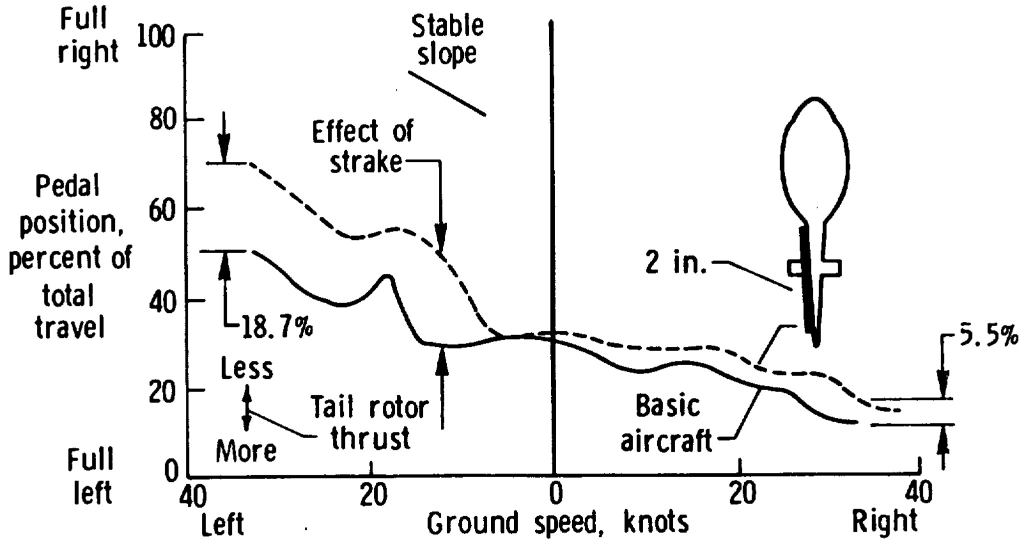

Figure 11. Effect of long strake on pedal control position in sideward flight compared to that of basic OH-58A.

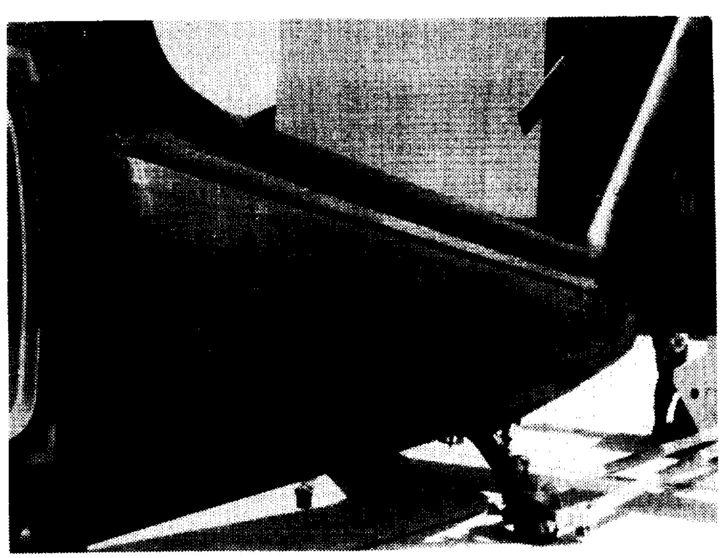

Figure 12. UH-60A test aircraft with strake installed.

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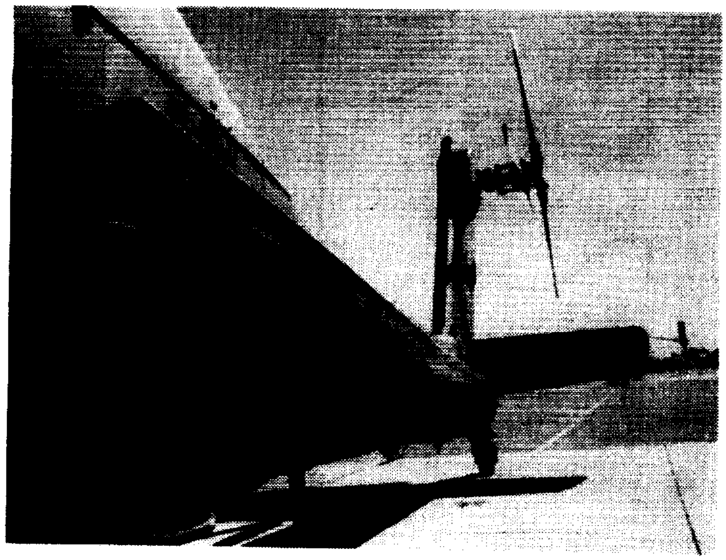
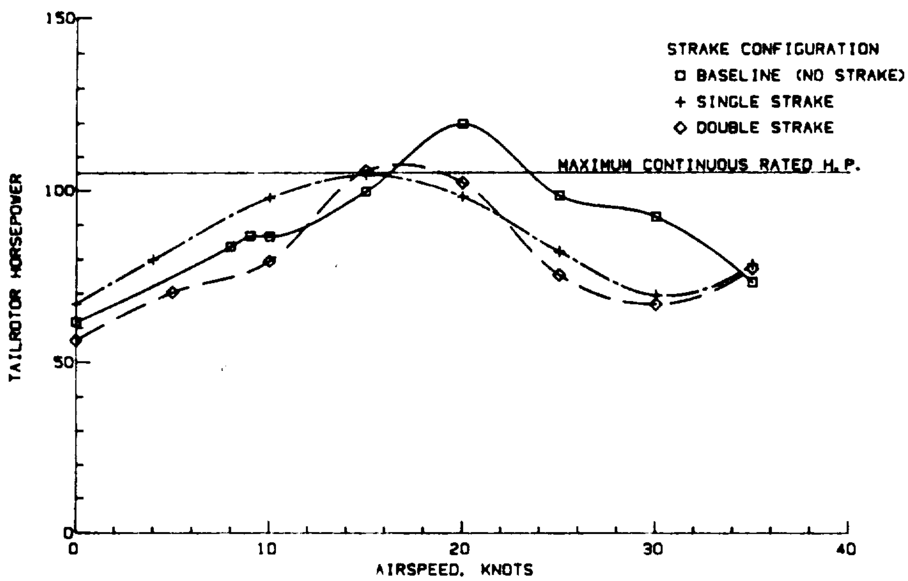
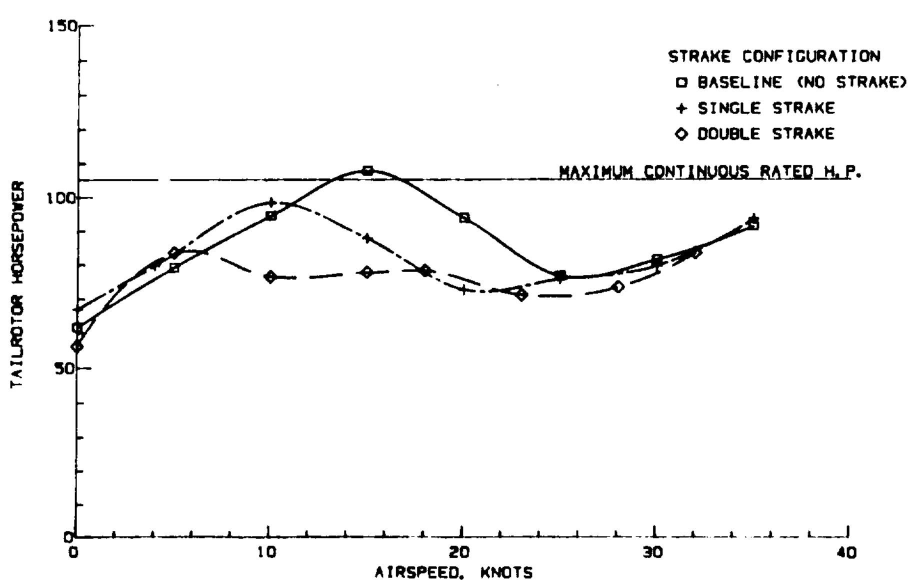


Figure 13. AH-64 test aircraft with strake installed.

Figure 14. Bell 204B test aircraft with double strake installed.



(a) Azimuth 60 degrees.



(b) Azimuth 75 degrees.

Figure 15. Effect of strakes on 204B tail rotor power required as a function of airspeed.

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16. Abstract

The use of a strake or spoiler on a helicopter tail boom to beneficially change helicopter tail boom air loads was suggested in the United States in 1975. The anticipated benefits were a change of tail boom loads to reduce required tail rotor thrust and power and improve directional control. High tail boom air loads experienced by the YAH-64 and described in 1978 led to a wind tunnel investigation of the usefulness of strakes in altering such loads on the AH-64, UH-60, and UH-1 helicopters. The wind tunnel tests of two-dimensional cross sections of the tail boom of each demonstrated that a strake or strakes would be effective. Several limited tests programs with the U. S. Army's OH-58A, AH-64, and UH-60A were conducted which showed the effects of strakes were modest for those helicopters. The most recent flight test program, with a Bell 204B, disclosed that for the 204B the tail boom strake or strakes would provide more than a modest improvement in directional control and reduction in tail rotor power.

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