SOME FLIGHT AND WIND-TUNNEL LONGITUDINAL STABILITY MEASUREMENTS ON THE BAC SLENDER-WING AIRCRAFT pdf

1: AeroWindTunnel, Airplane Flight Dynamics and Stability Analysis for Gliding and Powered Flight

The BAC ogee-wing research aircraft, Flgs.1 and 2, was built for the investigation of the aerodynamic and handling characteristics of a slender aircraft over a wide speed range from subsonic to supersonIc speeds.

Deep stall condition â€” T-tail in "shadow" of wing The deep stall affects aircraft with a T-tail configuration. A deep stall or super-stall is a dangerous type of stall that affects certain aircraft designs, [31] notably jet aircraft with a T-tail configuration and rear-mounted engines. In these designs, the turbulent wake of a stalled main wing, nacelle-pylon wakes and the wake from the fuselage [32] "blanket" the horizontal stabilizer, rendering the elevators ineffective and preventing the aircraft from recovering from the stall. Taylor [33] states T-tail propeller aircraft, unlike jet aircraft, do not usually require a stall recovery system during stall flight testing due to increased airflow over the wing root from the prop wash. Nor do they have rear mounted nacelles which can contribute substantially to the problem. He also gives a definition that relates deep stall to a locked-in condition where recovery is impossible. Typical values both for the range of deep stall, as defined above, and the locked-in trim point are given for the Douglas DC-9 Series 10 by Schaufele. The final design had no locked in trim point so recovery from the deep stall region was possible, as required to meet certification rules. Taylor and Ray [39] show how the aircraft attitude in the deep stall is relatively flat, even less than during the normal stall, with very high negative flight path angles. Effects similar to deep stall had been known to occur on some aircraft designs before the term was coined. A prototype Gloster Javelin serial WD was lost in a crash on 11 June , to a "locked in" stall [40] However, Waterton [41] states that the trimming tailplane was found to be the wrong way for recovery. Low speed handling tests were being done to assess a new wing. The brake parachute had not been streamed as it may have hindered rear crew escape. Stick shakers are now a standard part of commercial airliners. Nevertheless, the problem continues to cause accidents; on 3 June , a Hawker Siddeley Trident G-ARPY , was lost to deep stall ; [45] deep stall is suspected to be cause of another Trident the British European Airways Flight G-ARPI crash â€” known as the "Staines Disaster" â€” on 18 June when the crew failed to notice the conditions and had disabled the stall recovery system. It recovered from the deep stall after deploying the anti-spin parachute but crashed after being unable to jettison the chute or relight the engines. One of the test pilots was unable to escape from the aircraft in time and was killed. Two Velocity aircraft crashed due to locked-in deep stalls. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. November Learn how and when to remove this template message Aircraft with a swept wing suffer from a particular form of stalling behaviour at low speed. At high speed the airflow over the wing tends to progress directly along the chord, but as the speed is reduced a sideways component due to the angle of the leading edge has time to build up. Airflow at the root is affected only by the angle of the wing, but at a point further along the span, the airflow is affected both by the angle as well as any sideways component of the airflow from the air closer to the root. This results in a pattern of airflow that is progressively "sideways" as one moves toward the wingtip. As it is only the airflow along the chord that contributes to lift, this means that the wing begins to develop less lift at the tip than the root. In extreme cases, this can lead to the wingtip entering stall long before the wing as a whole. In this case the average lift of the wing as a whole moves forward; the inboard sections are continuing to generate lift and are generally in front of the center of gravity C of G , while the tips are no longer contributing and are behind the C of G. This produces a strong nose-up pitch in the aircraft, which can lead to more of the wing stalling, the lift moving further forward, and so forth. This chain reaction is considered very dangerous and was known as the pitch-up. Tip stall can be prevented in a number of ways, at least one of which is found on almost all modern aircraft. An early solution was the addition of wing fences to re-direct sideways moving air back towards the rear of the wing. A similar solution is the dog-tooth notch seen on some aircraft, like the Avro Arrow. A more common modern solution is to use some degree of washout. Warning and safety devices[edit] Fixed-wing aircraft can be equipped with devices to prevent or postpone a stall or to make it less or in some cases more severe, or to make recovery easier. An aerodynamic twist can be introduced to the wing with the leading edge near the wing tip twisted downward. This is called washout and causes the wing root to stall before the wing tip. This makes the stall gentle and progressive. Since the stall is delayed at the wing tips, where the ailerons are, roll control is maintained when the stall begins. A stall strip is a small sharp-edged device that, when attached to the leading edge of a wing, encourages the stall to start there in preference to any other location on the wing. If attached close to the wing root, it makes the stall gentle and progressive; if attached near the wing tip, it encourages the aircraft to drop a wing when stalling. A stall fence is a flat plate in the direction of the chord to stop separated flow progressing out along the wing [59] Vortex generators , tiny strips of metal or plastic placed on top of the wing near the leading edge that protrude past the boundary layer into the free stream. As the name implies, they energize the boundary layer by mixing free stream airflow with boundary layer flow thereby creating vortices, this increases the momentum in the boundary layer. By increasing the momentum of the boundary layer, airflow separation and the resulting stall may be delayed. An anti-stall strake is a leading edge extension that generates a vortex on the wing upper surface to postpone the stall. A stick pusher is a mechanical device that prevents the pilot from stalling an aircraft. It pushes the elevator control forward as the stall is approached, causing a reduction in the angle of attack. In generic terms, a stick pusher is known as a stall identification device or stall identification system. A stall warning is an electronic or mechanical device that sounds an audible warning as the stall speed is approached. The majority of aircraft contain some form of this device that warns the pilot of an impending stall. The simplest such device is a stall warning horn, which consists of either a pressure sensor or a movable metal tab that actuates a switch , and produces an audible warning in response. An AOA indicator provides a visual display of the amount of available lift throughout its slow speed envelope regardless of the many variables that act upon an aircraft. This indicator is immediately responsive to changes in speed, angle of attack, and wind conditions, and automatically compensates for aircraft weight, altitude, and temperature. An angle of attack limiter or an "alpha" limiter is a flight computer that automatically prevents pilot input from causing the plane to rise over the stall angle. Some alpha limiters can be disabled by the pilot. Stall warning systems often involve inputs from a broad range of sensors and systems to include a dedicated angle of attack sensor. Blockage, damage, or inoperation of stall and angle of attack AOA probes can lead to unreliability of the stall warning, and cause the stick pusher, overspeed warning, autopilot, and yaw damper to malfunction. Therefore, when the aircraft pitch increases abnormally, the canard will usually stall first, causing the nose to drop and so preventing the wing from reaching its critical AOA. Thus, the risk of main wing stalling is greatly reduced. However, if the main wing stalls, recovery becomes difficult, as the canard is more deeply stalled and angle of attack increases rapidly. In this case, the wing can be flown at higher lift coefficient closer to stall to produce more overall lift. Flight beyond the stall[edit] As a wing stalls, aileron effectiveness is reduced, making the plane hard to control and increasing the risk of a spin starting. Post stall , steady flight beyond the stalling angle where the coefficient of lift is largest requires engine thrust to replace lift as well as alternative controls to replace the loss of effectiveness of the ailerons. For high-powered aircraft, the loss of lift and increase in drag beyond the stall angle is less of a problem than maintaining control. Some aircraft may be subject to post-stall gyration e. Control beyond-stall can be provided by reaction control systems e. NFA , vectored thrust, as well as a rolling stabilator or taileron. The enhanced manoeuvering capability by flights at very high angles of attack can provide a tactical advantage for military fighters such as the F Raptor. Spoiler aeronautics Except for flight training, airplane testing, and aerobatics , a stall is usually an undesirable event. Unlike powered airplanes, which can control descent by increasing or decreasing thrust, gliders have to increase drag to increase the rate of descent. In high-performance gliders, spoiler deployment is extensively used to control the approach to landing. Spoilers can also be thought of as "lift reducers" because they reduce the lift of the wing in which the spoiler resides. For example, an uncommanded roll to the left could be reversed by raising the right wing spoiler or only a few of the spoilers present in large airliner wings. This has the advantage of avoiding the need to increase lift in the wing that is dropping which may bring that wing closer to stalling. History[edit] Otto Lilienthal died while flying in as the result of a stall. Wilbur Wright encountered stalls for the first time in , while flying his second glider. This made recoveries from stalls easier and more gentle. In developing the resulting " autogyro " aircraft, he solved many engineering problems which made the helicopter possible.

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2: Stall (fluid mechanics) - Wikipedia

Abstract. Preliminary flight measurements of the longitudinal trim and dynamic stability of the BAC aircraft have been made. The flight measurements are of reasonable quality in spite of difficulties associated with the aileron control system, an early instrumentation standard, and the handling characteristics of the aircraft at high incidence.

Methods of data input and model definition a Aerodynamic components include fuselage, wings standard and double-delta , horizontal tail, elevator and a user defined quantity of vertical fins. Instead, AeroWindTunnel is a computer-based, conceptual-design wind tunnel program that uses slider-bar entry and imported fuselage shapes to quickly estimate stability of airplanes and gliders. None perfectly smooth , Camouflage paint on aluminum, smooth paint, production sheet metal, polished sheet metal, and finally smooth molded composites. File and data manipulation a Plot total airplane moment coefficient Cmcg around center of gravity verses angle of attack a. DAT files to disk. Real-time airplane design values displayed on plan view and side view a Airplane center of gravity cg. Results Plots a Plot nine coefficients verses angle of attack to 25 degrees. In order to verify the validity of each request for a FREE version of AeroWindTunnel please provide name, the exact email used during original purchase and date of original purchase. Now, the actual value is the displayed value multiplied by as described in the heading for TR and VR. Mach number command is selected the listing did not display coefficients as a function of Mach number but incorrectly showed the variation as a function of angle of attack in degrees. In previous versions only thrust required for level flight was computed. Validated these modifications using the existing collection of airplane analyses in addition to a new analysis for the Me rocket plane developed during World War II by Germany. Please request the new Me analysis if you already own AeroWindTunnel. This units error effected supersonic flight coefficients and thrust requirements. After the double delta wing is specified the user has the option of inserting a double-delta wing into the plots or inserting an equivalent double-delta wing into the analysis and plots. The double-delta wing and its variants are used to reduce the affect of the rearward aerodynamic-center shift that occurs in the transition between subsonic and supersonic flight. Now, fin-to-fin spacing and fin Y-location inputs can locate one vertical fin at each wing-tip location. This version adds a vertical fin Y-location input to accurately locate up to two fins in the vertical direction. This was a geometry problem that did not alter AeroWindTunnel results. For versions prior to 6. Input data for all AeroRocket programs must use a period. If periods are not used in all inputs and outputs the results will not be correct. Pentium 3 or 4 4 Memory:

3: Avro Vulcan - Wikipedia

Dynamic longitudinal stability measurements were obtained in free flight from an M-wing model which had the same gross wing area as the swept-wing models end a similar body and tail.

V bombers Silhouettes of an early Avro concept and the cancelled Avro The origin of the Vulcan and the other V bombers is linked with early British atomic weapon programme and nuclear deterrent policies. This anticipated a government decision in January to authorise research and development work on atomic weapons, the U. Atomic Energy Act of McMahon Act having prohibited exporting atomic knowledge, even to countries that had collaborated on the Manhattan Project. In addition to a "special" i. It was obvious to the design team that conventional aircraft could not satisfy the specification; knowing little about high-speed flight and unable to glean much from the Royal Aircraft Establishment or the US, they investigated German Second World War swept wing research. Realising that swept wings increase longitudinal stability, the team deleted the tail empennage and the supporting fuselage , it thus became a swept-back flying wing with only a rudimentary forward fuselage and a fin vertical stabilizer at each wingtip. Outboard of the engines were two bomb-bays. In April , Vickers also received authority to proceed with their Type which, although falling short of the B. Avro As Avro had no flight experience of the delta wing, the company planned two smaller experimental aircraft based on the , the one-third scale model for low-speed handling and the one-half scale model for high-speed handling. Two of each were ordered. However, the was cancelled when it was considered too time-consuming to develop; a high-speed variant of the was designed in its place, the A. The high speed A, WD, followed in July The chief of the air staff preferred a V-class of bombers, and the Air Council announced the following month that the would be called Vulcan after the Roman god of fire and destruction. Both prototypes had almost pure delta wings with straight leading edges. During trials in July , VX was substantially damaged in a heavy landing at Farnborough. The solution included the "phase 2" wing, featuring a kinked and drooped leading edge and vortex generators on the upper surface, first tested on A WD An auto-mach trimmer was introduced to give a nose-up pitching moment, but more than was necessary just to counteract the diving tendency, so that the control column had to be pushed rather than pulled to maintain level flight. This artificial pitch-up made the Vulcan appear more like other aircraft as the speed increased. After two days flying, he was called in front of service and civil aviation authorities and ordered to refrain from carrying out this "dangerous" manoeuvre. Many of these early examples in a metallic finish remained the property of the Ministry of Supply being retained for trials and development purposes. It was anticipated that the first B. Nevertheless, to extend the B. The first 10 B. Anticipating even more powerful engines, the air intakes were deepened on the 11th XH and subsequent aircraft. Many of the early aircraft were retained for trials and it was the 12th B. Though Skybolt was cancelled in November , many aircraft were delivered or retrofitted with "Skybolt" blisters. Whilst in service the B. It would have been powered by four Bristol Olympus BOl. Avro Atlantic The Avro Type Atlantic was a proposal announced in June for a passenger delta-winged airliner based on the Type Unlike the proposed Avro low-level bomber of or the Avro supersonic stainless steel canard bomber dating from cancelled in before completion of the prototype , the Type showed its Vulcan heritage. With some reluctance, ministers approved the export of a single aircraft but emphasised that clearance had not been given for the sale of a larger number. A letter from the British Foreign and Commonwealth Office to the Ministry of Defence in January stated that little prospect was seen of this happening without ascertaining the Argentine interest and whether such interest was genuine: Avro Vulcan XH at Duxford Airshow Bomb bay Overview[edit] Despite its radical and unusual shape, the airframe was built along traditional lines. Except for the most highly stressed parts, the whole structure was manufactured from standard grades of light alloy. The airframe was broken down into a number of major assemblies: These seats were no more than cushions, a full harness and an oxygen and intercom facility. The tanks were split into four groups of almost equal capacity, each normally feeding its respective engine though cross-feeding was possible. The centre of gravity was automatically maintained by electric timers which sequenced the booster pumps on the tanks. The last 13 Vulcan B. Beginning in , 10 Vulcans received a wrap-around camouflage of dark sea grey and dark green [81] [82] because, during Red Flag exercises in the US, defending SAM forces had found that the grey-painted undersides of the Vulcan became much more visible against the ground at high angles of bank. Decca Doppler 72 replaced Green Satin in the B. Note the lower outer starboard airbrake, which was later deleted. The aircraft was controlled by a fighter-type control stick and rudder bar which operated the powered flying controls PFCs. Artificial feel and autostabilisation in the form of pitch and yaw dampers were provided, as well as an auto mach trimmer. Backup power was provided by four 24 V 40 Ah batteries connected in series providing 96 V. The 28 V DC system was backed up by a single 24 V battery. Engine starting was then by air-starters supplied from a Palouste compressor on the ground. The standby batteries on the B. Hydraulic pressure was provided by three hydraulic pumps fitted to Nos. An electrically operated hydraulic power pack EHPP could be used to operate the bomb doors and recharge the brake accumulators. A compressed air later nitrogen system was provided for emergency undercarriage lowering. Each Vulcan had four engines buried in the wings, positioned in pairs close to the fuselage. Later aircraft were delivered with Olympus s. The Olympus was designated on being fitted with a rapid air starter. The tour was to be an important demonstration of the range and capabilities of the aircraft, but it also had other benefits in the form of conducting goodwill visits in various countries; in later life Vulcans routinely visited various nations and distant parts of the former British Empire as a show of support and military protection. The results of the tests were classified until These were supplemented by U. The Valiant retained U. Red Beard was pre-positioned in Singapore for use by Vulcan and Victor bombers.

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4: Short Biographies of Some Stability and Control Figures | Helicopters & Aircrafts

This paper has looked at some historical connections of aeronautical theory/CFD, wind-tunnel experiments and flight tests, with an emphasis on the changes that have taken place over time with respect to slender wing aircraft in which vortical flows play a leading role.

Airbus A â€" The Airbus A is a double-deck, wide-body, four-engine jet airliner manufactured by European manufacturer Airbus. It is the worlds largest passenger airliner, and the airports at which it operates have upgraded facilities to accommodate it and it was initially named Airbus A3XX and designed to challenge Boeings monopoly in the large-aircraft market. The A made its first flight on 27 April and entered service on 25 October with Singapore Airlines. The As upper deck extends along the length of the fuselage. The A has a range of 8, nautical miles, serving the second- and third-longest non-stop scheduled flights in the world. As of February , Airbus had received firm orders and delivered aircraft, mcDonnell Douglas unsuccessfully offered its smaller, double-deck MD concept for sale. Airbus organised four teams of designers, one each of its partners to propose new technologies for its future aircraft designs. Despite the fact only two airlines had expressed public interest in purchasing such a plane, Airbus was already pursuing its own large-plane project. In June , Airbus announced its plan to develop its own very large airliner, Airbus considered several designs, including an unusual side-by-side combination of two fuselages from its A, the largest Airbus jet at the time. From to , as the East Asian financial crisis darkened the market outlook, Airbus refined its design, the A designation was a break from previous Airbus families, which had progressed sequentially from A to A It was chosen because the number 8 resembles the double-deck cross section, the aircraft configuration was finalised in early , and manufacturing of the first A wing-box component started on 23 January V-tail â€" The aft edge of each twin surface is a hinged control surface which combines the functions of both elevators and rudder. The V-tail, invented and patented in by Polish engineer Jerzy Rudlicki, has not been a choice for aircraft manufacturers. The X-shaped tail surfaces of the experimental Lockheed XFV were essentially a V tail that extended both above and below the fuselage, the most popular conventionally V-tailed aircraft that was mass-produced is the Beechcraft Bonanza Model 35, often known as the V-tail Bonanza or simply V-Tail. Unmanned aerial vehicles such as the Amber, GNAT and the MQ-1 Predator would later feature this type of tail, the Ultraflight Lazair ultralights, of which over were produced, also featured an inverted V-tail. Ideally, with fewer surfaces than a conventional three-aerofoil tail or a T-tail, in the mids, the Federal Aviation Administration grounded the Beechcraft Bonanza due to safety concerns. While the Bonanza met the initial certification requirements, it had a history of fatal mid-air breakups during extreme stress, the type was deemed airworthy and restrictions removed after Beechcraft issued a structural modification as an Airworthiness Directive. Ruddervators are the surfaces on an airplane with a V-tail configuration. They are located at the edge of each of the two airfoils making up the tail of the plane. Later Polish engineer Jerzy Rudlicki designed the first practical ruddervators in , the name is a portmanteau of the words rudder and elevator. In a conventional aircraft tail configuration, the rudder provides yaw control, ruddervators provide the same control effect as conventional control surfaces, but through a more complex control system that actuates the control surfaces in unison. Yaw moving the nose to the left is produced on an upright V tail by moving the left which deflects the left-hand ruddervator down and left. The opposite produces yaw to the right, pitch nose up is produced by moving the control column or stick back which deflects the left-hand ruddervator up and right and the right-hand ruddervator up and left. Canard aeronautics â€" A canard is an aeronautical arrangement wherein a small forewing or foreplane is placed forward of the main wing of a fixed-wing aircraft. The term canard may be used to describe the aircraft itself, despite the use of a canard surface on the first powered aeroplane, the Wright Flyer of , canard designs were not built in quantity until the appearance of the Saab Viggen jet fighter in The aerodynamics of the configuration are complex and require careful analysis. The Wright Brothers began experimenting with the foreplane configuration around and their first kite included a front surface for pitch control and they adopted this configuration for their first Flyer. They were suspicious of the aft tail because Otto Lilienthal had been killed in a glider with one, the Wrights realised that a foreplane would tend to destabilise an aeroplane but expected it to be a better control surface, in addition to being visible to the pilot in flight. They believed it impossible to provide control and stability in a single design, and opted for control. Many pioneers initially followed the Wrights lead, the Fabre Hydravion of was the first floatplane to fly and had a foreplane. After , few canard types would be produced for many decades, in W. Evans commented that the Canard type model has practically received its death-blow so far as scientific models are concerned. First flown in , the experimental Focke-Wulf F19 Ente was more successful, two examples were built and one of them continued flying until These were attempts at using the configuration to give advantages in areas such as performance, armament disposition or pilot view. The Shinden was ordered into production off the board but hostilities ceased before any other than prototypes had flown. But the stability and control problems encountered prevented widespread adoption, in the Swedish company Saab patented a delta-winged design which overcame the earlier problems, in what has become known as the close-coupled canard. It was built as the Saab 37 Viggen and in became the first modern aircraft to enter production. The success of this aircraft spurred many designers, and canard surfaces sprouted on a number of derived from the popular Dassault Mirage delta-winged jet fighter 4. Tandem wing â€" A tandem wing aircraft has two main wings, with one located forward and the other to the rear. In a tandem wing design the vectors on the two wings are spread far apart longitudinally, allowing them to act together to achieve stability. Fly-by-wire â€" Fly-by-wire is a system that replaces the conventional manual flight controls of an aircraft with an electronic interface. Both systems often require redundant backup to deal with failures, which increases weight, both have limited ability to compensate for changing aerodynamic conditions. The term fly-by-wire implies a purely electrically signaled control system and it is used in the general sense of computer-configured controls, where a computer system is interposed between the operator and the final control actuators or surfaces. This modifies the manual inputs of the pilot in accordance with control parameters, side-sticks, centre sticks, or conventional flight control yokes can be used to fly FBW aircraft. Fly-by wire systems are complex, but their operation can be explained in simple terms. When a pilot moves the control column, a signal is sent to a computer the signal is sent through wires to ensure that the signal reaches the computer. A Triplex is when there are three channels being used, in an Analog system, the computer receives the signals, performs a calculation and adds another channel. These four Quadruplex signals are sent to the control surface actuator. Potentiometers in the actuator send a signal back to the computer reporting the position of the actuator, when the actuator reaches the desired position, the two signals cancel each other out and the actuator stops moving. The computer then commands the flight control surfaces to adopt a configuration that will achieve the flight path. Fly-by-wire control systems allow aircraft computers to perform tasks without pilot input, automatic stability systems operate in this way. Gyroscopes fitted with sensors are mounted in an aircraft to sense movement changes in the pitch, roll, any movement results in signals to the computer, which automatically moves control actuators to stabilize the aircraft. Aircraft systems may be quadruplexed to prevent loss of signals in the case of failure of one or even two channels, pre-flight safety checks of a fly-by-wire system are often performed using built-in test equipment. On programming the system, either by the pilot or groundcrew, any failure will be indicated to the crews. A FBW aircraft can be lighter than a design with conventional controls. These include the vertical and horizontal stabilizers that are at the rear of the fuselage, if these structures can be reduced in size, airframe weight is reduced. The advantages of FBW controls were first exploited by the military, the Airbus series of airliners used full-authority FBW controls beginning with their A series, see A flight control. Boeing followed with their and later designs, electronic systems require less maintenance, whereas mechanical and hydraulic systems require lubrication, tension adjustments, leak checks, fluid changes, etc 6. Wind tunnel â€" A wind tunnel is a tool used in aerodynamic research to study the effects of air moving past solid objects. A wind tunnel consists of a passage with the object under test mounted in the middle. Air is made to move past the object by a fan system or other means. The test object, often called a wind tunnel model, is instrumented with sensors to measure aerodynamic forces, pressure distribution. The earliest wind tunnels were invented towards the end of the 19th century, in the days of aeronautic research. In that way an observer could study the flying object in action. The development of wind tunnels accompanied the development of the airplane, large wind tunnels were built during World War II. Wind tunnel testing was considered of importance during the Cold War development of supersonic aircraft. Determining such forces was required before building codes could specify the required strength of such buildings, in these studies, the interaction between the road and the vehicle plays a significant role, and this interaction must be taken into consideration when interpreting the test results. The advances in fluid dynamics modelling on high speed digital computers has reduced the demand for wind tunnel testing. Air velocity and pressures are measured in several ways in wind tunnels, air velocity through the test section is determined by Bernoullis principle. Measurement of the pressure, the static pressure, and the temperature rise in the airflow. The direction of airflow around a model can be determined by tufts of yarn attached to the aerodynamic surfaces, the direction of airflow approaching a surface can be visualized by mounting threads in the airflow ahead of and aft of the test model. Smoke or bubbles of liquid can be introduced into the upstream of the test model. Aerodynamic forces on the test model are usually measured with beam balances, connected to the test model with beams, strings, or cables. Pressure distributions can more conveniently be measured by the use of pressure-sensitive paint, the strip is attached to the aerodynamic surface with tape, and it sends signals depicting the pressure distribution along its surface. The aerodynamic properties of an object can not all remain the same for a scaled model, however, by observing certain similarity rules, a very satisfactory correspondence between the aerodynamic properties of a scaled model and a full-size object can be achieved 7. Embraer E-Jet family â€" The Embraer E-Jet family is a series of narrow-body medium-range twin-engine jet airliners produced by Brazilian aerospace conglomerate Embraer. Launched at the Paris Air Show in , and entering production in , the aircraft is used by mainline and regional airlines around the world. As of 30 September , there is a backlog of firm orders for the E-Jets, options and units delivered, the Embraer E-Jets line is composed of two main commercial families and a business jet variant. The smaller E and E make up the model aircraft. All E-Jets use four-abreast seating and have a design, which Embraer developed for its commercial passenger jets. The E-Jets have turbofan engines designed to reduce noise, which allows them to operate in airports that have strict noise restrictions, such as London City Airport. Embraer first disclosed that it was studying a new seat aircraft, the EMB was to feature a new wing and larger-diameter fuselage mated to the nose and cockpit of the ERJ In February , Embraer announced it had abandoned the approach in favour of an all-new design. Its first flight occurred on February 19,, marking the beginning of a flight test campaign. In November , Embraer announced that it would develop revamped versions of the E-Jets family with improved engines, rather than an all-new aircraft. The new variants are to be powered by new more efficient engines with larger diameter fans, and include slightly taller landing gear, the new E-Jet variants are to be better-positioned to compete with the Bombardier CSeries. The new variants are to service in 8. Airliner â€" An airliner is a type of aircraft for transporting passengers and air cargo. Such aircraft are most often operated by airlines, although the definition of an airliner can vary from country to country, an airliner is typically defined as an aircraft intended for carrying multiple passengers or cargo in commercial service. The largest airliners are wide-body jets and these aircraft are frequently called twin-aisle aircraft because they generally have two separate aisles running from the front to the back of the passenger cabin. These aircraft are used for long-haul flights between airline hubs and major cities with many passengers. A smaller, more class of airliners is the narrow-body or single aisle aircraft. These smaller airliners are used for short to medium-distance flights with fewer passengers than their wide-body counterparts. Regional airliners typically seat fewer than passengers and may be powered by turbofans or turboprops and these airliners are the non-mainline counterparts to the larger aircraft operated by the major carriers, legacy carriers, and flag carriers and are used to feed traffic into the large airline hubs. These regional routes then form the spokes of an air transport model. These airliners would have a significant impact on society, economics. If an airliner is defined as an aircraft intended for carrying passengers in commercial service. The Ilya Muromets was an aircraft with a separate passenger saloon, wicker chairs, bedroom, lounge. The aircraft also had heating and electrical lighting, the Ilya Muromets first flew on December 10,

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5: Wing configuration | Revolvy

Flight Tests Longitudinal stability and control tests a comparison of flight and wind-tunnel data, but some aircraft has a delta wing plan form with a

Tailless Dihedral and anhedral Angling the wings up or down spanwise from root to tip can help to resolve various design issues, such as stability and control in flight. Used to reduce stability where some other feature results in too much stability. The Sopwith Camel had a flat upper wing and dihedral on the lower wing, while the Hanriot HD-1 had dihedral on the upper wing but none on the lower. Dihedral Biplane with dihedralon both wings Biplane with dihedralon lower wing In a cranked or polyhedral wing the dihedral angle varies along the span. Note that the description "cranked" varies in usage. Sometimes used to improve visibility forwards and upwards and may be used as the upper wing on a biplane as on the Polikarpov I The opposite of a gull wing. May be used to reduce the length of wing-mounted undercarriage legs while allowing a raised fuselage, as on the German Junkers Ju 87 Stuka dive bomber. Gull wing Dihedral tips Anhedral tips The channel wing includes a section of the wing forming a partial duct around or immediately behind a propeller. Flown since in prototype form only, most notably on the Custer Channel Wing aircraft. Channel wing Wings vs. This may be because one or other of these is missing, or because they merge into each other: Blended body or blended wing-body: Reduces wetted area and can also reduce interference between airflow over the wing root and any adjacent body, in both cases reducing drag. The Lockheed SR spyplane exemplifies this approach. Flying wing Blended body Lifting body Some designs may fall into multiple categories depending on interpretation, for example the same design could be seen either as a lifting body with a broad fuselage, or as a low-aspect-ratio flying wing with a deep center chord. Variable geometry A variable geometry aircraft is able to change its physical configuration during flight. Some types of variable geometry craft transition between fixed wing and rotary wing configurations. For more about these hybrids, see powered lift. Variable planform Variable-sweep wing or Swing-wing. The left and right hand wings vary their sweep together, usually backwards. The first successful wing sweep in flight was carried out by the Bell X-5 in the early s. In the Beech Starship , only the canard foreplanes have variable sweep. The WSA study proposed a long wing for efficient subsonic cruise, which then ejects the outer panels to leave a short-span wing for a short supersonic "dash" to its targets. Extending wing or expanding wing: The outer sections of the XB Valkyrie wing folded down during supersonic cruise. Many aircraft have wings that may be folded for storage on the ground or on board ship. These are not folding wings in the sense used here. Folding wing Variable chord Variable incidence: The wing on the Vought F-8 Crusader was rotated, lifting the leading edge on takeoff to improve performance. If powered prop-rotors are fitted to the wing to allow vertical takeoff or STOVL performance, merges into the powered lift category. An early example was flown on the Westland N. Charles Rocheville and others flew some experimental aircraft. The Nikitin-Shevchenko IS "folding fighter" prototypes were able to morph between biplane and monoplane configurations after takeoff by folding the lower wing into a cavity in the upper wing. The slip wing is a variation on the polymorphic idea, whereby a low-wing monoplane was fitted with a second detachable "slip" wing above it to assist takeoff, which was then jettisoned once aloft. The idea was first flown on the experimental Hillson Bi-mono. Polymorphic wing Minor independent surfaces Various minor surfaces Aircraft may have additional minor aerodynamic surfaces. Some of these are treated as part of the overall wing configuration: Reduces the size of vortices shed by the wingtip, and hence also tip drag. Strakes may be located at various positions in order to improve aerodynamic behaviour. Leading edge root extensions LERX are also sometimes referred to as wing strakes. When used aerodynamically it is extended outwards to form a lifting surface, typically blending into the main wing. As well as improving low speed high angle of attack handling, provides extra lift at high supersonic speeds for minimal increase in drag. Seen on the Lockheed SR Blackbird. Typically is retractable for high speed flight. Deflects air downward onto the wing root, to delay the stall. Seen on the Dassault Milan. Additional minor features Additional minor features may be applied to an existing aerodynamic surface such as the main wing: High lift High-lift devices High-lift devices maintain lift at low speeds and delay the stall to allow slower takeoff and landing speeds: The spanwise gap behind it forms a leading-edge slot. Air flowing up through the slot is deflected backwards by the slat to flow over the wing, allowing the aircraft to fly at lower air speeds without flow separation or stalling. A slat may be fixed or retractable. Types include plain, slotted, and split. Some, such as Fowler Flaps , also extend rearwards to increase wing area. The Krueger flap is a leading-edge device. Spanwise flow control Spanwise flow control device On a swept wing, air tends to flow sideways as well as backwards and reducing this can improve the efficiency of the wing: Used to control spanwise airflow over the wing. Vortex generators create additional drag at all speeds.

SOME FLIGHT AND WIND-TUNNEL LONGITUDINAL STABILITY MEASUREMENTS ON THE BAC SLENDER-WING AIRCRAFT pdf

6: CiteSeerX â€” ON THE BAC SLENDER-WING AIRCRAFT

An experimental investigation of the effect of planform shape on the subsonic longitudinal stability characteristics of slender wings. flight and wind tunnel.

On 19 October, the Montgolfiers launched the first manned flight, a tethered balloon with humans on board, at the Folie Titon in Paris. On 21 November, the Montgolfiers launched the first free flight with human passengers. On 1 December, Jacques Charles and the Nicolas-Louis Robert launched their manned hydrogen balloon from the Jardin des Tuileries in Paris, as a crowd of , witnessed. After Robert alighted Charles decided to ascend alone. Ballooning became a major "rage" in Europe in the late 18th century, providing the first detailed understanding of the relationship between altitude and the atmosphere. The young Ferdinand von Zeppelin first flew as a balloon passenger with the Union Army of the Potomac in In the early s ballooning was a popular sport in Britain. These privately owned balloons usually used coal gas as the lifting gas. This has half the lifting power of hydrogen so the balloons had to be larger, however coal gas was far more readily available and the local gas works sometimes provided a special lightweight formula for ballooning events. Airships were originally called "dirigible balloons" and are still sometimes called dirigibles today. Work on developing a steerable or dirigible balloon continued sporadically throughout the 19th century. Another advance was made in , when the first fully controllable free-flight was made in a French Army electric-powered airship, La France , by Charles Renard and Arthur Krebs. However, these aircraft were generally short-lived and extremely frail. Routine, controlled flights would not occur until the advent of the internal combustion engine see below. The first aircraft to make routine controlled flights were non-rigid airships sometimes called "blimps". The most successful early pioneering pilot of this type of aircraft was the Brazilian Alberto Santos-Dumont who effectively combined a balloon with an internal combustion engine. Santos-Dumont went on to design and build several aircraft. At the same time that non-rigid airships were starting to have some success, the first successful rigid airships were also being developed. These would be far more capable than fixed-wing aircraft in terms of pure cargo carrying capacity for decades. Rigid airship design and advancement was pioneered by the German count Ferdinand von Zeppelin. Construction of the first Zeppelin airship began in in a floating assembly hall on Lake Constance in the Bay of Manzell, Friedrichshafen. This was intended to ease the starting procedure, as the hall could easily be aligned with the wind. Its first flight, on July 2, , lasted for only 18 minutes, as LZ 1 was forced to land on the lake after the winding mechanism for the balancing weight had broken. It would be several years before the Count was able to raise enough funds for another try. Although airships were used in both World War I and II, and continue on a limited basis to this day, their development has been largely overshadowed by heavier-than-air craft. Heavier than air[edit] Main article: This flying machine consisted of a light frame covered with strong canvas and provided with two large oars or wings moving on a horizontal axis, arranged so that the upstroke met with no resistance while the downstroke provided lifting power. Swedenborg knew that the machine would not fly, but suggested it as a start and was confident that the problem would be solved. The science of mechanics might perhaps suggest a means, namely, a strong spiral spring. If these advantages and requisites are observed, perhaps in time to come some one might know how better to utilize our sketch and cause some addition to be made so as to accomplish that which we can only suggest. Yet there are sufficient proofs and examples from nature that such flights can take place without danger, although when the first trials are made you may have to pay for the experience, and not mind an arm or leg. The 19th century[edit] Throughout the 19th century, tower jumping was replaced by the equally fatal but equally popular balloon jumping as a way to demonstrate the continued uselessness of man-power and flapping wings. Meanwhile, the scientific study of heavier-than-air flight began in earnest. Sir George Cayley and the first modern aircraft[edit] Sir George Cayley was first called the "father of the aeroplane" in Among his many achievements, his most important contributions to aeronautics include: Clarifying our ideas and laying down the principles of heavier-than-air flight. Reaching a scientific understanding of the principles of bird flight. Conducting scientific aerodynamic experiments demonstrating drag and streamlining, movement of the centre of pressure, and the increase in lift from curving the wing surface. Defining the modern aeroplane configuration comprising a fixed wing, fuselage and tail assembly. Demonstrations of manned, gliding flight. Setting out the principles of power-to-weight ratio in sustaining flight. In he set down the concept of the modern aeroplane as a fixed-wing flying machine with separate systems for lift, propulsion, and control. He also identified and described the importance of the cambered aerofoil , dihedral , diagonal bracing and drag reduction, and contributed to the understanding and design of ornithopters and parachutes. In he had progressed far enough to construct a glider in the form of a triplane large and safe enough to carry a child. A local boy was chosen but his name is not known. Minor inventions included the rubber-powered motor ,[citation needed] which provided a reliable power source for research models. By he had even re-invented the wheel, devising the tension-spoked wheel in which all compression loads are carried by the rim, allowing a lightweight undercarriage. Although only a design, it was the first in history for a propeller-driven fixed-wing aircraft. Employing two contra-rotating propellers on the first attempt, made indoors, the machine flew ten feet before becoming destabilised, damaging the craft. The second attempt was more successful, the machine leaving a guide wire to fly freely, achieving some thirty yards of straight and level powered flight. To test his ideas, from he had constructed several gliders, both manned and unmanned, and with up to five stacked wings. He realised that long, thin wings are better than bat-like ones because they have more leading edge for their area. Today this relationship is known as the aspect ratio of a wing. The latter part of the 19th century became a period of intense study, characterized by the " gentleman scientists " who represented most research efforts until the 20th century. Among them was the British scientist-philosopher and inventor Matthew Piers Watt Boulton , who studied lateral flight control and was the first to patent an aileron control system in Meanwhile, the British advances had galvanised French researchers. Developing his ideas with a model powered first by clockwork and later by steam, he eventually achieved a short hop with a full-size manned craft in It achieved lift-off under its own power after launching from a ramp, glided for a short time and returned safely to the ground, making it the first successful powered glide in history. He reportedly achieved a height of meters, over a distance of meters. The planophore also had longitudinal stability, being trimmed such that the tailplane was set at a smaller angle of incidence than the wings, an original and important contribution to the theory of aeronautics. A tailless monoplane with a single vertical fin and twin tractor propellers, it also featured hinged rear elevator and rudder surfaces, retractable undercarriage and a fully enclosed, instrumented cockpit. The Aeroplane of Victor Tatin, It was powered by compressed air. Flown tethered to a pole, this was the first model to take off under its own power. It was intended as a test rig to investigate aerodynamic lift: Completed in , on its third run it broke from the rail, became airborne for about yards at two to three feet of altitude [50] and was badly damaged upon falling back to the ground. It was subsequently repaired, but Maxim abandoned his experiments shortly afterwards. In the last decade or so of the 19th century, a number of key figures were refining and defining the modern aeroplane. Lacking a suitable engine, aircraft work focused on stability and control in gliding flight. In Biot constructed a bird-like glider with the help of Massia and flew in it briefly. The Englishman Horatio Phillips made key contributions to aerodynamics. He conducted extensive wind tunnel research on aerofoil sections, proving the principles of aerodynamic lift foreseen by Cayley and Wenham. His findings underpin all modern aerofoil design. Otto Lilienthal , May 29, He also produced a series of hang gliders , including bat-wing, monoplane and biplane forms, such as the Derwitzer Glider and Normal soaring apparatus. Starting in he became the first person to make controlled untethered glides routinely, and the first to be photographed flying a heavier-than-air machine, stimulating interest around the world. He rigorously documented his work, including photographs, and for this reason is one of the best known of the early pioneers. Lilienthal made over 2, glides until his death in from injuries sustained in a glider crash. Picking up where Lilienthal left off, Octave Chanute took up aircraft design after an early retirement, and funded the development of several gliders. In the summer of his team flew several of their designs eventually deciding that the best was a biplane design. Like Lilienthal, he documented and photographed his work. In Britain Percy Pilcher , who had worked for Maxim, built and successfully flew several gliders during the mid to late s. The invention of the box kite during this period by the Australian Lawrence Hargrave would lead to the development of the practical biplane. In Hargrave linked four of his kites together, added a sling seat, and flew 16 feet 4. In he published Experiments in Aerodynamics detailing his research, and then turned to building his designs. He hoped to achieve automatic aerodynamic stability, so he gave little consideration to in-flight control. It was launched from a spring-actuated catapult mounted on top of a houseboat on the Potomac River near Quantico, Virginia. On both occasions the Aerodrome No. On November 28, , another successful flight was made with the Aerodrome No. So little remained of the original aircraft that it was given a new designation. With the successes of the Aerodrome No. Spurred by the Spanishâ€”American War , the U. With the basic design apparently successfully tested, he then turned to the problem of a suitable engine. Now with both power and a design, Langley put the two together with great hopes. To his dismay, the resulting aircraft proved to be too fragile. Simply scaling up the original small models resulted in a design that was too weak to hold itself together. Two launches in late both ended with the Aerodrome immediately crashing into the water. The pilot, Manly, was rescued each time. Nine days after his second abortive launch on December 8, the Wright brothers successfully flew their Flyer.

SOME FLIGHT AND WIND-TUNNEL LONGITUDINAL STABILITY MEASUREMENTS ON THE BAC SLENDER-WING AIRCRAFT pdf

7: ARC-RM : Abbott Aerospace SEZC Ltd.

Static computational-fluid-dynamics results of forces and moments as well as the flow structure of the longitudinal and lateral flow conditions are compared to wind-tunnel measurements.

The model, consisting of a sharp-edged delta plate, could be deformed in a particular mode of chordwise bending over its forward portion only; the deformation could be applied either as a static condition or as a continuous variation in the form of a sinusoidal oscillation. Surface pressures across the span were measured at two chordwise stations on the stationary part of the wing, the model being set throughout at a mean incidence of 5 degrees to ensure the presence of moderately strong vortices. The range of parameter variation was sufficient for the measurements to show the separate effects of frequency parameter and amplitude of deformation. Spanwise distributions of Fourier harmonic components derived from the measured oscillatory pressure changes were examined in relation to the behaviour of the vortices; non-linearities are present in the relationship between pressure change and deformation, and analysis of the results indicates the magnitude of the harmonics above the fundamental that are present in the pressure variations at spanwise positions close beneath a vortex. The fundamental components of the pressure variations are compared with the results of calculations based on lifting-surface theory. Within the limitations of the experiments pressure measured only downstream of deformation an empirical relationship involving a convective time-delay has been established between the unsteady pressures for an oscillatory deformation and the steady pressures for static deformations; the experimental conclusions are examined in relation to slender-wing theory, and more general implications of the results of the experiment are discussed. Some comments on air condensation effects in a hypersonic helium tunnel L. The main difference between this and the more common problem of condensation of water vapour in air or of a condensing diatomic gas alone, is that the mass fraction of the contaminant cannot be ignored. In this Report a brief analysis of the problem is outlined and the more important points discussed. The theoretical and experimental results are compared with those of Henderson and Swalley. Low-speed wind-tunnel measurements of the oscillatory lateral aerodynamic derivatives of a BAC model and comparison of results with similar Concorde and HP data C. An approximate analysis of the non-linear lateral motion of a slender aircraft HP at low speeds A. Jean Ross and L. The method has been applied to the lateral motion limit cycle encountered at low speeds on the HP aircraft, and comparisons with the results of wind tunnel dynamic simulations show that the onset and nature of the sustained oscillation is predicted very satisfactorily. The measurement of ground effect using a fixed ground board in a wind tunnel L. The influence which the boundary layer on the fixed ground board has on the flow about the model has been determined from overall force measurements on three models of aspect ratios 1. These measurements and calculations show that the boundary layer influence is most significant at the lower aspect ratios and for these configurations an experimental procedure is proposed which enables this influence upon the data to be eliminated. The form of the threedimensional boundary layer which grows on a fixed ground board beneath a low aspect ratio model is discussed and the reason for its influence upon the model explained. A brief discussion of the form of the threedimensiona! A technique for the automatic, digital analysis of flight dynamic response data A. The analysis method is based on model matching by least squares using an automatic iterative method and has been found capable of handling coupled three-dimensional motions of much greater complexity than it has been possible to analyse previously. The particular problem of solution divergence which limits the usefulness of iterative methods has been overcome, giving a virtually fully-automatic system for response analysis that can be applied to a wide range of aircraft-like problems. A full description is given of the use of the techniques for the analysis of dynamic response data from free flight models. However, few modifications would be necessary to the computer programs for application to full-scale aircraft tests and even dynamic stability tests in windtunnels. Effects of suction on the interaction between shock wave and boundary layer at a compression corner L. The wedges could be raised from the tunnel floor through distances comparable with the boundary layer thickness, and suction was applied at the resulting slot. The pressure distributions and boundary layer traverses show how the suction reduces and eventually eliminates the separation region, causing the flow to approach that of ideal fluid theory. Estimates of optimum suction quantity and bleed height are obtained. Low-speed wind-tunnel tests on an unswept wing-fuselage model of aspect ratio 9.

SOME FLIGHT AND WIND-TUNNEL LONGITUDINAL STABILITY MEASUREMENTS ON THE BAC SLENDER-WING AIRCRAFT pdf

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An industrial view on experimental and numerical investigations related to advanced combat aircraft needs is given. A critical comparison between experimental and numerical results under wind-tunnel conditions and real flight numerical simulations is presented.

After government laboratory work, he joined Douglas Aircraft, where he was stability and control lead engineer for the A2D-1 and A4D He used ground-based fight simulation as a tool in solving flight dynamics problems associated with hazardous flight. Los Altos Hills, CA. His stability and control career started in industry, first at North American Aviation, then with the Northrop P spoiler ailerons and design requirements forthe XB power controls and artificial-feel systems. He is best known for applying man â€" in-the-loop theory for flying qualities prediction and as a co-author of Aircraft Dynamics and Automatic Control. Bairstow, Leonard , b. Royal College of Science, London. The second edition of his Applied Aerodynamics was a useful stability and control reference for years. His career in the United Kingdom industry from to included research and development for flight controls, flying qualities, and flight simulation. Barnes proposed the original numerical rating scale for pilot opinion on flying qualities. Bihrle contributed to the stability and control designs of the Republic F and XF airplanes. He invented the widely used control anticipation parameter for pullups and plays a leading part in developing advanced spin tunnel rotary balance techniques and methods for improving high angle of attack stability and control. As a leading NASA expert on spinning, Bowman consulted with military and commercial designers on spin problems for many years. He is the author or co-author of more than 40 reports on spinning, including NASA TP on pressure distribution at spinning attitudes. Bratt was a stability and control engineer at the El Segundo Division of Douglas. He pioneered in the application of digital computers to maneuvering flight. He solved drop vehicle instability problems involving aeroelasticity and inertial coupling. He later became Chief of Preliminary Design at Northrop. Bryan, George Hartley , b. He later made contributions to compressible flow theory. He shared stability and control responsibility for the SR, the Have Blue prototype, and the FA, whose air data measurement system he designed. At Elliott Flight Automation, Ltd. Cook was a designer of the Boeing High-Speed Wind Tunnel and was involved with the stability and control development of many Boeing designs, including the B, XB, and He was co-inventor of the B electronic yaw damper, one of the first of its kind. Czinczenheim, Joseph , b. Professor Doetsch is an aeronautical scientist as well as a 3, hour test pilot. His contributions are fly-by-wire control Avro C, Do 27, Pembroke , flight simulation, flight recording, and advanced aircraft flight controls. Duncan, William Jolly , b. Duncan was co-author of the important textbook Elementary Matrices and author of the book Control and Stability of Aircraft. His other contributions were in the theories of aileron reversal, tail buffeting, aerodynamic derivatives, and flap hinge moments. He produced a useful synthesis of methods for control force reduction by various tab systems. As Director of Aerodynamics he saw the DC through certification. As an expert in flight dynamics and control and in pilot-in-the-loop problems, Dr. He is a member of the SAE control and guidance systems committee. Etkin, Bernard , b. Hon , Carleton U. Etkin had a long career at the University of Toronto, becoming University Professor in He wrote three standard stability and control texts, which have German, Russian, and Chinese editions. Gates was a brilliant theorist who did remarkable work on analyzing spins and predicting spin recovery with minimal facilities. Gates is responsible for the important flying qualities parameters of static and maneuver margins and stick force per g. V Stephens, he established the effect of air density on spins. The scope of his stability and control work is truly wide. Gates was the British counterpart of R. Gilruth in flying qualities research. Gee, Brian , b. Gera, Joseph , b. He is responsible for the phase-gain, dropback, and other criteria used to prevent pilot-induced oscillations by design. He joined NACA in His major stability and control contributions were design methods for static longitudinal stability and roll performance and an early complete set of flying qualities requirements. He retired in and was a consultant to NASA from to Glauert, Hermann , b. He made the first nondimensionalization of the equations of airplane motion. In charge of large NASA Ames wind tunnels, he directed high-lift and stability research on swept wings. Goto, Norohiro , b. Goto developed methods to identify pilot-control behavior in practical multi-input and multi-output aircraft control systems. As an aerodynamicist at Boeing in and , Graham made an early analysis of inertial coupling on a pilotless aircraft. He is recognized internationally for the development and use of in-flight simulators. He is a leader in European vehicle system identification and in handling qualities research. Harper was a Calspan engineer and test pilot who is noted for his part in developing the Cooper-Harper flying qualities rating. He was project engineer on the F and NTA variable-stability airplanes during simulation of reentry vehicles and the X, as well as during basic flying qualities research. Harris, Thomas Aubrey , b. Harris designed the NASA Langley Atmospheric and 7 by foot wind tunnels during a long career at Langley He was an expert on flaps and tabs, and he contributed to numerous wind-tunnel studies of control surfaces. Haus, Frederic Charles , b. In a long, productive career, Professor Haus headed the famous aeronautical laboratory of Rhode-St. Heald headed stability and control at the El Segundo division of Douglas Aircraft during the years when that division produced new airplanes on the average of one every two years. He took part in the stability and control work on the U. Later, Heald was Chief Engineer for the U. At Lockheed Aircraft, Heppe made significant contributions to understanding the inertial coupling problems of the F and other USAF fighters, and helped find corrections for those problems. He contributed in the unlimited angle-of-attack maneuvering areas of the YFA prototypes. He became president of the Lockheed-California Company. Hodgkinson, John , b. He is the author of Aircraft Handling Qualities. Jex developed analytical models of operator-vehicle control and applied them to handling qualities, landing displays, and workload studies. Jex designed the control system for the first autostabilized-while-flapping ornithopter, the Q-N pterodactyl replica. Jones, Bennett Melvill , b. He joined the National Physical Laboratory in His research at Cambridge was on stalling. Jones was a pilot and a decorated gunner in World War I. His long career there produced notable stability and control contributions in lateral control, in the theory of two-control flight, in all-movable controls, and in a very early application of operator theory to the solution of the equations of aircraft motion. Kalviste, Juri , b. Kalviste made innovative formulations of the large-amplitude equations of airplane motion to develop departure parameters and methods of combining rotary balance and oscillatory aerodynamic data. Katayanagi, Ryoji , b. At Mitsubishi Heavy Industries, Katayanagi analyzed flying qualities and flight controls of the T-2 trainer. His research interests are multiloop flight controls and PIOs. He leads the engineering team for the NAL scaled supersonic research airplane. He joined MIT in and taught airplane stability and control and airplane design courses there until his retirement in Koppen did early work on the effects of closing loops on stability. Koppen test-flew the Helioplane prototype in and continued to fly at a ripe age, getting an FAA instrument rating at age He developed stability derivative extraction methods using time vector analysis. He is a recognized expert on propeller design. Lecomte, Pierre , b. He initiated a new handling qualities approach based on normal and peripheral flight envelopes and a theoretical explanation of wing drop. At Systems Technology, Inc. His enormous personal contributions to the field include mathematical models for human control and information processing in closed-loop systems and a well-tested theory of vehicle handling qualities. McWha, James , b. McWha was chief engineer of flight systems at Boeing Commercial Group throughout the development of the fly-by-wire transport. Prior to a year employment at Boeing, he worked at Shorts Brothers, N. At Cornell Aeronautical Laboratory, later Calspan, he was a leader in the application of servomechanism techniques to airplane stability and control, including the determination of airplane stability derivatives and transfer functions from flight-test frequency-response measurements. Mueller produced one of the first electronic analog computers while doing his Sc.

SOME FLIGHT AND WIND-TUNNEL LONGITUDINAL STABILITY MEASUREMENTS ON THE BAC SLENDER-WING AIRCRAFT pdf

9: Stabilizer (aeronautics) - WikiVisually

AeroWindTunnel is a true wind tunnel simulation program in that it determines whether an airplane is stable based on the position of the wing-body neutral point relative to the center of gravity and whether the relative contribution of the wings, fuselage and vertical fins to the forces and moments around the airplane center of gravity are.

Early history[edit] Early aircraft adhered to the basic design of square wings at right angles to the body of the machine, but there were experimentalists who explored other geometries to achieve better aerodynamic results. The swept wing geometry appeared before World War I , and was conceived as a means of permitting the design of safe, stable, and tailless flying wings. It imposed "self-damping" inherent stability upon the flying wing, and, as a result, many flying wing gliders and some powered aircraft appeared in the interwar years. He followed this up with a version powered by an Anzani engine driving two propellers. A Burgess-Dunne tailless biplane: At the same time the Anglo-Irish engineer J. Dunne was experimenting along similar lines, obsessed with achieving innate stability in flight. He was able to successfully employ severely swept wings in his tailless aircraft as a means of creating positive longitudinal static stability. The idea of using swept wings to reduce high-speed drag was developed in Germany in the s. At a Volta Conference meeting in in Italy, Dr. Adolf Busemann suggested the use of swept wings for supersonic flight. He noted that the airspeed over the wing was dominated by the normal component of the airflow, not the freestream velocity, so by setting the wing at an angle the forward velocity at which the shock waves would form would be higher the same had been noted by Max Munk in , although not in the context of high-speed flight. The presentation was largely of academic interest, and soon forgotten. The results of these tests confirmed the drag reduction offered by swept wings at transonic speeds. The tests were expanded in to include wings with 15, 30 and degrees of sweep and Mach numbers as high as 1. The German jet-powered Messerschmitt Me and rocket-powered Messerschmitt Me suffered from compressibility effects that made them very difficult to control at high speeds. In addition, the speeds put them into the wave drag regime, and anything that could reduce this drag would increase the performance of their aircraft, notably the notoriously short flight times measured in minutes. This resulted in a crash program to introduce new swept wing designs, both for fighters as well as bombers. A prototype test aircraft, the Messerschmitt Me P. Technology transfer to the Allies[edit] Germans believed based on wartime experience that swept wings were necessary for supersonic flight, and after the war convinced American experts. When the swept wing design came to light the project was cancelled, as it was thought it would have too much drag to break the sound barrier, but soon after the US nevertheless did just that with the Bell X The de Havilland DH , a prototype swept-wing aircraft, produced in The project engineer on the de Havilland DH was John Carver Meadows Frost , and his aircraft was used as a testing bed for the technology. With only a team of 8â€”10 draughtsmen and engineers, in Frost created a remarkable aircraft by marrying the front fuselage of the de Havilland Vampire to a swept wing and short stubby vertical tail to make the first British swept wing jet, soon to be unofficially known as the "Swallow". Company test pilot and son of the builder, Geoffrey de Havilland Jr. On 12 April , a D. The Air Ministry introduced a program of experimental aircraft to examine the effects of swept wings as well as delta wings and introduced their first combat designs as the Hawker Hunter and Supermarine Swift. The Soviet Union was also intrigued about the idea of swept wings on aircraft at the end of World War II in Europe, when their "captured aviation technology" counterparts to the western Allies spread out across the defeated Third Reich. The American Operation Paperclip reached Braunschweig on May 7 and discovered a number of swept wing models and a mass of technical data from the wind tunnels. One member of the US team was George S. Schairer , who was at that time working at the Boeing company. He immediately forwarded a letter to Ben Cohn at Boeing stating that they needed to investigate the concept. He also told Cohn to distribute the letter to other companies as well, although only Boeing and North American made immediate use of it. Jones started looking at highly swept delta wings and V shapes, and discovered the same effects as Busemann. He finished a detailed report on the concept in April, but found his work was heavily criticised by other members of NACA Langley , notably Theodore Theodorsen, who referred to it as "hocus-pocus" and demanded some "real mathematics". All of this was compiled into a report published on June 21, , which was sent out to the industry three weeks later. The first American swept-wing aircraft, the Boeing B Stratojet Boeing was in the midst of designing the Boeing B Stratojet , and the initial Model was a straight-wing design similar to the B , B and B it competed with. A recent design overhaul completed in June produced the Model , another four-engine design with the engines buried in the fuselage to reduce drag, and long-span wings that gave it an almost glider-like appearance. By September the Braunschweig data had been worked into the design, which re-emerged as the Model , a larger six-engine design with more robust wings swept at about 35 degrees. With the engines mounted away from the wings on struts equipped with fuse pins, an out-of-balance engine would simply shatter the pins and fall harmlessly away, sparing the aircraft from destructive vibrations. The resulting B design had performance rivaling the fastest fighters and trounced the straight-winged competition. In fighters, North American Aviation was in the midst of working on a straight-wing jet-powered naval fighter then known as the FJ It was submitted it to the Air Force as the XP Larry Green, who could read German, studied the Busemann reports and convinced management to allow a redesign starting in August With the appearance of the MiG, the F was rushed into combat and straight-wing jets like the Lockheed P Shooting Star and Republic F Thunderjet were soon relegated to ground attack. Some such as the F and Grumman F-9 Cougar were later redesigned with swept wings from straight-winged aircraft. Later planes such as the North American F Super Sabre would be designed with swept wings from the start, though additional innovations such as the afterburner, area-rule and new control surfaces would be necessary to master supersonic flight. Although not well known outside Sweden, the Tunnan was a very competitive design, remaining in service until in some roles. The Avro Vulcan , flying at Farnborough , The introduction of the German swept wing research to aeronautics caused a minor revolution, especially after the dramatic successes of the Hawker Hunter, the B and F Eventually almost all design efforts immediately underwent modifications in order to incorporate a swept wing. The classic Boeing B, designed in the s, continues in service as a high-subsonic long-range heavy bomber despite the development of the triple-sonic North American B Valkyrie , supersonic swing-wing Rockwell B-1 Lancer , and flying wing designs. While the Soviets never matched the performance of the Boeing B Stratofortress with a jet design, the intercontinental range Tupolev Tu turboprop bomber also remains in service today. By the s, most civilian jets also adopted swept wings. By the early s nearly every new fighter was either rebuilt or designed from scratch with a swept wing. Most early transonic and supersonic designs such as the MiG and F used long, highly swept wings. Swept wings would reach Mach 2 in the arrow-winged BAC Lightning, and stubby winged Republic F Thunderchief , which was found to be wanting in turning ability in Vietnam combat. By the late s, the F-4 Phantom and Mikoyan-Gurevich MiG that both used variants on tailed delta wings came to dominate front line air forces. After the s, most newer generation fighters optimized for maneuvering air combat since the USAF F and Soviet Mikoyan MiG have employed relatively short-span fixed wings with relatively large wing area. The unswept wing of a Maule MB Super Rocket light aircraft Subsonic and transonic behavior[edit] Yakovlev Yak swept wing In the transonic phase, the swept wing also sweeps the shock which is at the top rear of the wing. Only the velocity component perpendicular to the shock is affected. As an aircraft enters the transonic speeds just below the speed of sound, the pressure waves associated with subsonic flight converge and begin to impinge on the aircraft. As the pressure waves converge the air in front of the aircraft begins to compress. This creates a force known as wave drag. This wave drag increases steeply until the whole aircraft is supersonic and then reduces. A rapid drop in air density caused by aircraft contours will reduce the local air temperature and will correspondingly cause a drop in the local speed of sound that can cause shock waves to form. This is why shock waves are often associated with the part of a fighter aircraft cockpit canopy with the highest local curvature, appearing immediately behind this point. At the point where the density drops, the local speed of sound correspondingly drops and a shock wave can form. The angular change to the air that is normally part of lift generation is decreased and this lift reduction is compensated for by deeper curved lower surfaces accompanied by a reflex curve at the trailing edge. This results in a much weaker standing shock wave towards the rear of the upper wing surface and a corresponding increase in critical mach number. Shock waves require energy to form. This energy is taken out of the aircraft, which has to supply extra thrust to make up for this energy loss. Thus the shocks are seen as a form of drag. Since the shocks form when the local air velocity reaches supersonic speeds, there is a certain " critical mach " speed or drag divergence mach number where this effect becomes noticeable. This is normally when the shocks start generating over the wing, which on most aircraft is the largest continually curved surface, and therefore the largest contributor to this effect. Sweeping the wing has the effect of reducing the curvature of the body as seen from the airflow, by the cosine of the angle of sweep. When applied to large areas of the aircraft, like the wings and empennage , this allows the aircraft to reach speeds closer to Mach 1. One of the simplest and best explanations of how the swept wing works was offered by Robert T. Now, even if the local speed of the air on the upper surface of the wing becomes supersonic, a shock wave cannot form there because it would have to be a sweptback shock â€” swept at the same angle as the wing â€” i. Such an oblique shock cannot form until the velocity component normal to it becomes supersonic. If a swept wing is continuous â€” an oblique swept wing , the pressure iso-bars will be swept at a continuous angle from tip to tip. However, if the left and right halves are swept back equally, as is common practice, the pressure iso-bars on the left wing in theory will meet the pressure iso-bars of the right wing on the centerline at a large angle. As the iso-bars cannot meet in such a fashion, they will tend to curve on each side as they near the centerline, so that the iso-bars cross the centerline at right angles to the centerline. This causes an "unsweeping" of the iso-bars in the wing root region. This proved to not be very effective.

SOME FLIGHT AND WIND-TUNNEL LONGITUDINAL STABILITY MEASUREMENTS ON THE BAC SLENDER-WING AIRCRAFT pdf

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