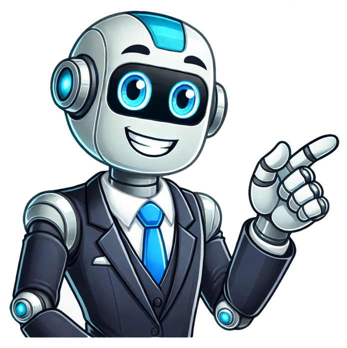

Aircraft structures peery

Equilibrium of Forces in Aeronautical Engineering: An Introduction Dover Publications, Inc., Copyright 2014 All rights reserved ISBN: 978-0-486-48580-5 Preface, Chapter 1: Equilibrium of Forces The design of an airplane or any other machine requires the determination of loads acting on each member. These loads can arise from various sources such as ground reactions, aerodynamic forces, and propeller forces. The loads are resisted by the weight or inertia of the parts. In designing a member, it is essential to consider all the forces acting on it, including inertia forces. The equations of equilibrium are crucial in determining the loads on an airplane during different conditions. The terms Fx, Fy, and M represent the summations of forces along x and y axes and moments about any point, respectively. These equations can be set up in various ways, but only three independent equations exist for any free body. A set of four equations derived from force and moment calculations about two points cannot be solved independently due to their interdependence. This occurs because one equation can be obtained by combining the other three, rendering them non-independent conditions. When analyzing structures with multiple members, it is crucial to create separate free-body diagrams for each member, as forces acting on a composite structure are often balanced at joints. To simplify calculations, choose axes and moment centers that result in only one unknown per equation. In structural analysis, single bolt or pin joints are typically assumed to have no resistance to rotation, with the force passing through the center of the joint. The components Fx and Fy can be determined from these forces using equations (1.2) and (1.3). Solving for Fx and Fy results in determining the force magnitude F and direction θ. The concept of two-force members is significant, as they are used extensively in aircraft structures due to their minimal weight requirements. These members typically consist of straight sections and can be found throughout fuselage, engine mounts, and other structural components. To solve structural problems, we need to apply these equations to various types of structures and analyze a typical structure as an example problem. 1. First, we need to find the forces on all members of a biplane structure by considering it as a free body. 2. Next, we have to calculate the forces at specific points like A and B in the landing gear. 3. Similarly, we are required to determine the forces V and M at a particular cross section of a beam. 4. Truss structures consist entirely of two-force members, which can be classified into statically determinate or indeterminate types based on their number of unknown forces compared to independent equations of statics. 5. Statically determinate trusses have enough known forces to determine the entire set of forces within the truss using equilibrium equations. In contrast, statically indeterminate trusses cannot be solved solely by these equations due to insufficient information. 6. The structure is considered externally statically indeterminate if it supports more than three reaction components. Internally, a truss with more members than required but only three reaction force components exhibits internal static indeterminacy. 7. Trusses typically form triangular frames; the relationship between the number of members (m) and joints (j) in such frames is provided by equation m = 2j - 3. 8. If a truss has one less member than specified, it becomes unstable with one degree of freedom, while having more members results in internal static indeterminacy. 9. Considering each pin joint as a free body allows us to apply the two statics equations, [summation]Fx = 0 and [summation]Fy = 0, with 2j independent equations for a truss containing j joints. 10. The equilibrium of the entire structure is interdependent on the equilibrium of its individual joints, as can be seen by deriving equations for the entire structure from those for each joint. The entire truss can be derived from the equations for its joints. By equating the number of unknown forces with the number of independent equations, we get m + r = 2j, where m is the number of members and r is the number of reactions. However, this equation must be applied with care, as it only applies to normal trusses with three external reactions. Other trusses require inspection to ensure stability. The truss shown in Fig. 1.5(a) satisfies the equation but has an unstable left panel. The truss shown in Fig. 1.5(c) is stable and statically determinate, despite not being constructed entirely of triangular frames. The number of reactions r can be substituted for three in Eq. 1.4a, giving m = 2j - r. This means that the number of independent equations is sufficient to obtain the m + r unknown forces. An example of a stable and statically determinate truss with four reactions can be obtained by adding a horizontal reaction to Fig. 1.5(a) and removing one diagonal member. In truss analysis by the method of joints, two equations of static equilibrium are applied for each joint as a free body. Two unknown forces can be obtained for each joint. Since each member is a two-force member, it exerts equal and opposite forces on its ends. The joints must be analyzed in sequence, starting at a joint with only two members with unknown forces. After finding the forces in these members, an adjacent joint will have only two unknown forces, and so on. In most structures, three external reactions are needed to find only two unknown forces at each joint. These equations are used in addition to the 2j equations at the joints. The analysis of a truss by the method of joints will be illustrated with a numerical example. Example: Find the loads in all members of the truss shown in Fig. 1.6. Solution: Draw free-body diagrams for the entire structure and each joint, as shown in Fig. 1.7. Care must be taken to show forces correctly on the sketch, as there is always a force acting on each member that is equal and opposite to the force acting on its ends. Aircraft Structures by David J. Peery remains a seminal reference on aircraft stress analysis, offering a comprehensive understanding of basic structural theory and its application to analyze aircraft structures. First published in 1950, this classic book has stood the test of time, with its fundamental principles unchanged despite advancements in materials and construction methods. For undergraduate students, this volume provides an in-depth coverage of equilibrium of forces, space structures, inertia forces, load factors, shear stresses, bending stresses, beams with unsymmetrical cross-sections, and additional topics such as spanwise air-load distribution, external loads on the airplane, joints, deflections of structures, and special methods of analysis. The book also delves into aerodynamics topics in its final chapters, allowing students to study prerequisite aerodynamics topics concurrently. The first edition of Aircraft Structures is considered a masterpiece, with an abundance of content that makes it "fun for the whole family." It covers various topics, including shear flow in unsymmetrical beams, load distribution on fuselage bulkheads, and analysis of wing ribs. The comparison between Fourier's Series Method and Schrenk's Method for Spanwise Air-Load Distribution is considered worth the investment. Note: Due to errata, readers are advised to verify specific values mentioned in certain sections of the book. The area is supposed to measure 0.556 inches, but it's better off buying the first edition because subsequent ones might not be as good. Mange Takk! You can find this hardcover book titled "Aircraft Structures" by David J. Peery published in 1950 with 566 pages. The condition of this particular copy is good, although the dust jacket is missing. It has bumped and scuffed boards, a tight binding, and clean text without any marks. Another edition of the same book, which is in very good condition, was published in 1982 by McGraw-Hill Book Company. This second edition has 454 pages, an octavo format, a tight binding, and clean pages throughout. There's some light soiling on the gray boards with a bump to the lower left corner, but it still looks attractive.