DOWNLOAD PDF ENGINEERING STATICS SOLVED PROBLEMS

Chapter 1 : Schaumâ€™s Outline of Engineering Mechanics: Statics

This free online statics course teaches how to assess and solve 2D and 3D statically determinate problems. The course consists of 72 tutorials which cover the material of a typical statics course (mechanics I) at the university level or AP physics.

A body under such a state is acted upon by balanced forces and balanced couples only. There is no unbalanced force or unbalanced couple acting on it. The concept must be really understood by every student. The size of a particle is very small compared to the size of the system being analysed. A body is formed by a group of particles. The size of a body affects the results of any mechanical analysis on it. Most bodies encountered in engineering work can be considered rigid from the mechanical analysis point of view becase the deformations that take place within these bodies under the action of loads can be neglected when compared to other effects produced by the loads. All bodies to be studied in this book are rigid, except for springs. Springs undergo deformations that cannot be neglected when acted upon by forces or moments. For the analyses ini this book, only the effects of the deformations of springs on a rigid body interacting with the springs are considered but the springs themselves will not be analysed as a body. Also, a force on on a body not only tends to cause the body to translate as in the case of the particle but also tends to cause the body to rotate about any axis which does not intersect with or is not parallel to the line of action of the force. To see what actually happens to any particular part of a structure, that part has to be isolated from the other parts of the body. The part which is isolated is called a free body. The system can be formed by a single body, part of a body, or a group of connected bodies. The bodies forming the system can either be rigid or non-rigid. A mechanical system can be solid, fluid, or even a combination of solild and fluid. The isolation enables us to see the interactions between the isolated part and the other parts. The part which has been cut imaginarily , forms a free body. A diagram which portrays the free body, complete with the system of external forces acting on it due to its interaction with the parts which have been removed, is called the free-body diagram FBD of the isolated part. The FBD of of a body system shows all loads acting on the external boundary of the isolated body. Assume that an analysis is to be carried-out on the whole structure of the arm when it is carrying a load as shown, where the weight of the component members of the arm can be nglected compared to the weight of the load. Assume also that all joints of the arm do not prevent rotation around the respective joints, i. Because the direction and the sense of every reactive force are not known, the direction nad sense shall be assumed. The arm can be isolated from the body of the lift truck at point A where it is pinned to the body of the lorry and at point C where it is acted upon by the active forceof the hydraulic piston rod. The isolated arm is shown in Figure 3. If what is to be analysed is the load container only, the FBD shown in Figure 3. Please note that, in the FBDs shown, the direction and sense of all the reactions are drawn arbitarily because they are assumed to be unknown. We will learn later how to determine the direction of some types of reactivce forces through observation. Show the body which has been isolated from its surroundings by drawing its outline. Show, on the drawing, all loads acting on the body. The loads consist of the active forces couples which cause the tendency to move and the reactive forces and couples caused by any constraint and tend to prevent motion. Use letters to indicate unknown magnitudes. Show all dimensions which are necessary to calculate moments. It must be stressed here that only a correctly drawn FBD will produce the correct solution. The joint at A is a pin joint. Draw the FBD of the scoop which is isolated from all other members of the scoop mechanism. Note that a pin joint can produce a reactive force only buat is not able to produce a reactive couple. For forces whose directions are unknown, they can be represented by two perpendicular components. Neglect the weight of the scoop and the weight of the links. The reactive force at B acts along the axis of the hydraulic cylinder. Its sense is unknown but can be assumed to act in any sense. The reaction at A is unknown both in terms of its direction and its sense. Hence it is represented by its two perpendicular components with the sense arbitarily set. Mathematically, equilibrium is determined by the conditions: The second expression says that the sum of the moment about any axis must be zero. The two conditions manifested by Equation 3. It is said to be necessary because fulfilling the first condition only will result in inequilibrium in terms of rotation. Similarly, if only the second condition is fulfilled, inequilibrium occurs in terms of trlanslation. The two conditions are said to be sufficient because equilibrium takes place when both the conditions are met without the need for any additional condition. For the purpose learning, the study on equilibrium in this book will be divided into two stages: The resultant moment vector acts perpendicularto that plane. Hence the resultant force vector can be represented by its two perpendicular components acting on the plane. On the other hand, the resultan moment vector can be represented by a ircular arrow which indiccates it sense of action. For example, if the surface ofthis book is taken as the plane of action of the given force system, say plane x-y, the following relationships are obtained: The second expression in this equation gives the magnitude of the resultant moment. The third expression states that the moment about any point O i. All three expressions of Equation 3. In addition, if a body is supported in such a way that all forces acting on the body can be determined by using Equation 3. In this early stage of their study, the students are required to handle only problems that can be solved using Equation 3. Note that only three independent equations exist to describe equilibrium in a plane. Hence, only three unknown values can be solved. In the early stageof their study, students often make the mistake of by adding the number of equation through taking moments about additional points. It is sstressed here that such an effort is fruitless since it will produce equations that are not independent and duplicate one of the three basic equations given in Equation 3. In general, the expressions in Equation 3. By doing this, the third unknown can be solved directly. Besides, the process of getting the solution can be simplified by specifying the orientation of the x-y axis system in such a way as to produce the simplest resultant force system in the diretion of the axes. These combinations can be used as alternatives to Equation 3. The first alternative equation is: For example, it cannot be used to solve the mechanism in Figure 3. The second alterntive equation involves tiga moment expressions i. It cannot, for example, be used to solve the mechanism in Figure 3. It can be proved that Equation 3. Hence, any one of the alternative equations can be used as a replacemanta for Equation 3.

Chapter 2 : Engineering Statics - OLI

Features hundreds of solved problems and support for all the major textbooks for static courses. Topics include: Vectors, Forces, Coplanar Force Systems, Noncoplanar Force Systems, Equilibrium of Coplanar Force Systems, Equilibrium of Noncoplanar Force Systems, Trusses and Cables, Forces in Beams, Friction, First Moments, Centroids.

Concentrated Forces and Their Effects Module 1: Representing Interactions Between Bodies Draw force vectors on bodies to reflect their attributes. Identify attributes of forces acting between a body and an attached cable. Identify attributes of forces acting between a body and an attached spring. Identify attributes of forces acting between frictionless contacting bodies. Recognize when two bodies interact. Explain the purpose of drawing FBDs. Effects of Force Define the tendency of the force to create rotation as the moment, and quantify the effect of the force magnitude, direction, sense and position on the moment. Determine the moment of a force by identifying the moment arm perpendicular distance from the moment center. Distinguish between various motions produced by forces on bodies: Recognize the roles of force magnitude, direction, sense, and line of action on the tendencies to cause translation and rotation motions. Effects of Multiple Forces Add moments due to known forces when their moment arms are given. Determine the components of force vectors. Determine the moment of a force as a sum of the moments of its components parallel and perpendicular to the line between the moment center and the point of application of the force. Determine the moment of a force as a sum of the moments of its vertical and horizontal components. Determine the sum of concurrent forces by summing their components. Find the force magnitude and sense that balances the moment created by other forces. Judiciously choose method of calculating the moment of a force. Recognize that rotational effects of forces combine through the addition of moments. Recognize that translational effects of forces combine as in vector addition. Equilibrium Under 2D Concentrated Forces Impose the conditions of equilibrium for general coplanar forces for which both force and moment equilibrium need to be explicitly satisfied. Impose the conditions of equilibrium for systems where all the forces act in one direction for which both force and moment equilibrium need to be explicitly satisfied. Impose the conditions of equilibrium for systems with collinear forces for which the net moment about any point on the line is zero. Impose the conditions of equilibrium for systems with concurrent forces for which the net moment about a point of intersection is zero. Recognize the equilibrium conditions under which bodies have no tendency to translate or rotate. Complex Interactions Between Bodies Module 6: Couples Determine the moment of the couple from the forces producing it or balancing it, and recognize that a set of forces that can be represented as couples produces the same net moment about all points regardless of where they are applied. Recognize circumstances in which a multi-force interaction between two bodies can be represented as a couple, and determine the moment of the couple from what the couple interaction is balancing. Recognize that at least two forces are necessary to cause only a rotation of a body, and utilize the concept of a couple and its symbol to represent combinations of forces that produce zero net force only a tendency to rotate. Statically Equivalent Loads Distinguish between fully equivalent loadings and statically equivalent loadings. Replace a general set of forces and couples with a force and couple at a given point. Replace a general set of forces and couples with a single force at a location that needs to be determined. Replace a single force acting at a point with a statically equivalent force at a different point and an appropriate couple for the following situations: Replace two parallel forces acting in the same direction and opposite senses with a statically equivalent load force and couple. Replace two parallel forces acting in the same direction and sense with a single force. Applications of Static Equivalency to Distributed Forces Determine the location of the center of gravity for bodies that can be decomposed into rectangular prisms. Recognize the role of symmetry planes in determining the location of the center of gravity. Replace a simple known distributed load by a single force with an appropriate line of action. Represent unknown distributed forces due to contact between symmetrical flat bodies by a statically equivalent force acting at an unknown location somewhere in the contact area. Use symmetry to reduce three-dimensional situations to two-dimensional representations. Use tabulated results to determine the location of the center of gravity for bodies that can be decomposed into simple shapes and recognize that the location of the center of gravity for prismatic bodies can be determined by integration. Representing Engineering Connections Recognize pin connections that can be modeled in 2-D even though forces act in different planes in 3-D: Recognize two most common connections: Represent interaction between bodies connected by a rigid sliding joint. Represent interactions between a cylindrical rod and contacting surfaces common in connections. Represent interactions between bodies connected by a cable and a mass less pulley. Represent interactions between bodies connected by a link with two pins. Represent interactions between bodies connected by rollers, rockers, and pins in slot. Represent interactions between bodies joined by fixed connections. Drawing FBDs of a Single Subsystem For an identified subsystem, which is part of a larger system with engineering connections, represent all interactions with external parts on a FBD labeling all their known and unknown attributes. Equilibrium of a Single Subsystem Account properly for forces and couples in equilibrium equations, and deduce their actual senses given their signs found from equilibrium and their assumed senses. Account properly for pre-modeled known distributed force described as q x. Account properly for unknown distributed contact forces, and interpret the results of solution by recognizing physically impossible outcomes. Find the range of a parameter that ensures equilibrium, or the configuration that minimizes or maximizes a force. Use equilibrium conditions in a qualitative way, without actually solving them, to: Choosing a Solvable Subsystem Choose solvable subsystems by recognizing two-force members when present. Choose solvable subsystems for simple systems without engineering connections. Choose solvable subsystems for systems with engineering connections. Choose solvable subsystems for systems with pulleys. Frames and Machines Module Identify a sequence of fully solvable subsystems step 3 and solve for all unknowns in each subsystem by imposing successive equilibrium equations, each containing one unknown step 4. Annotated Practice Problems â€" Machines Solve complete multi-body statics problems by applying the four Steps of Statics studied in previous modules. Method of Joints Determine forces in bars connected to a single solvable joint. Select a sequentially solvable series of joints that allows all forces in truss members to be determined. Method of Sections Determine internal forces in bars for a given section. Select subsystems that allow for an efficient solution for the desired forces. Given the load, geometry and friction coefficient, determine if the body is stationary or slips. Recognize that the force between contacting bodies may have a normal and a tangential component. Define friction force, its limits and friction coefficients. Recognize that two contacting bodies may remain in contact, slip with respect to one another, or tip. Determine conditions for motion to initiate, and the type of impending motion. Moments of Inertia Module Second Moment of Area Define polar moment of area and recognize circumstances when it matters. Recognize second moment of area as a property relevant when the distribution of area is important rather than merely the area itself, and define second moment of an area. Use parallel axis theorem to find second moments of area about an arbitrary axis. Use tabulated results to determine second moment of area for simple shapes, including composite bodies with common centroidal axis. Mass Moment of Inertia Recognize that distribution of mass, rather than mass alone, affects resistance to rotational motion, and define mass moment of inertia as measure of resistance to changes in its angular motion. Understand mass radius of gyration as an alternative measure of the resistance to rotation, which replaces an object of complicated shape with an equivalent ring with same mass moment of inertia. Use parallel axis theorem to find mass moments of inertia about an arbitrary axis. Use tabulated results to determine mass moment of inertia for simple shapes, including composite bodies with common centroidal axis. Course assessments, activities, and outline How to use this course What is Statics? Representing Interactions Between Bodies Quiz: Representing Interactions Between Bodies Module 2: Introduction to Free Body Diagrams Quiz: Introduction to Free Body Diagrams Module 3: Effects of Force Quiz: Effects of Force Module 4: Effects of Multiple Forces Quiz: Effects of Multiple Forces Module 5: Applying Force Equilibrium Quiz: Statically Equivalent Loads Quiz: Statically Equivalent Loads Module 8: Simplifying 3D Loadings Quiz: Center of Gravity and Centroid Module 9: Representing Engineering Connections Quiz: Equilibrium of a Single Subsystem Quiz: Equilibrium of a Single Subsystem Module Choosing a Solvable Subsystem Quiz: Solving Multiple Subsystems Quiz:

Chapter 3 : Engineering Mechanics - Wikibooks, open books for an open world

DOWNLOAD PDF ENGINEERING STATICS SOLVED PROBLEMS

Lecture Series on Mechanics of Solids by calendrierdelascience.com Kumar, Department of Applied Mechanics,calendrierdelascience.com Other lectures can be found by searching 'mechanics of solids - IITM' in the youtube.

Chapter 4 : Hibbeler, Engineering Mechanics: Statics | Pearson

1 | S t a t i c s Statics What You Will Learn What forces and moments are, how they are different, and how they are related. How to draw a Free Body Diagram (FBD), and why you should for every problem.

Chapter 5 : Chapter 3: Equilibrium â€“ Engineering Mechanics â€“ Statics

Sample Problems from Solving Statics Problems in MATLAB by Brian D. Harper Ohio State University Solving Statics Problems in MATLAB is a supplement to the textbook Engineering Mechanics: Statics (5th Edition) by J.L. Meriam and.

Chapter 6 : Engineering Mechanics Questions and Answers

4 Solving Statics problems Procedure good at solving Engineering Mechanics problems by practising problem solving, and not just by reading the course Units.

Chapter 7 : Statics eBook: Problem Solving & Significant Digits

Engineering Mechanics: Statics is an online learning system designed to address the key learning and teaching issues in today's engineering mechanics courses. Built for a digital environment, this program includes powerful and customizable resources to facilitate mastery of introductory statics concepts for students with a wide range of abilities and backgrounds.