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*Applied plate theory for the engineer [Conrad P. Heins] on theinnatdunvilla.com *FREE* shipping on qualifying offers.*

Plate Theory Beam Theory vs. Plate Theory OP 17 Dec 02 All through college, all I was ever exposed to was beam theory. I went on, got my BSME, and joined the workforce. Since that time, about once every few months, I have received requests for calculations to determine the required steel or aluminum plate thickness required to support a specific load over a given span. We since picked up another engineer who is also more experienced than I, but he sticks with the beam approach, examining the condition on a per foot basis. Is there a way, such as thickness to width ratio that I could use to determine which approach is more applicable? However, the best books that give good, working examples of plate theory and shell theory, too vs. Plate Theory borac Mechanical 17 Dec 02 Always think in terms of how this member will behave under the service load and remember - there is no hard rule. There are some in AISC steel manual plates vs. Plate Theory 17 Dec 02 As you noted it needs to be on a case by case basis. However, this is very short-sighted when considering all areas that engineers practice. Having said that please note If you have a small element whose stress or deflection is critical - use plates. As Daveviking noted if your boundary conditions are such to mandate a look at plate theory then use it. Especially if you have a small element with relatively large boundary effects. If you are looking at something in the public sector work and by code are required to factor the loads or reduce the stress then plate theory is a little akin to smashing a fly with a mallet while a perfectly good flyswatter is nearby. If the element is really large or thick, chances are you have a geometric or materail non-linearity and should be using a more appropriate analysis. The work probably best described as by code. Problem is that if I go by the plate theory via Roark, there are instances where the maximum yield stress of the metal would be exceeded. But the same cover calculated by beam theory says that the stresses are within acceptable limits. Which should I believe? Plate Theory poldolo Automotive 18 Dec 02 You should use the shell elements QUAD4 or 8 using Nastran if you have to model a thin plate with nearly equal length-width. A roof of a tank collapsed. This was because the breather on top did not function well which resulted in a vacuum pressure. The roof is cone shaped with a 15 degr. We decided to just pull it back into shape, but I need to calculate the force needed to insure the welds would hold. The FEM is the only way to go I think and a model software would be best. But you need to be exact when modeling! On the perimeter of those holes were pumps that weighed 24, lbs each. I did not feel comfortable doing a simple plate analysis, so I chose to run an FEM. Plate Theory 24 Jan 03 At that price you are still only paying for the paper, ink and binding. These are excellent books furnished out of the generosity of the Lincoln Arc Welding Foundation. They skip all the theoretical gobbledygook and just tell you how to do it. There is a great section on torsional stiffness complete with photographs of actual torsion tests and tabulated results proving that polar moment of inertia is a dangerous way to calculale torsional deflections. Everyone who deals with steel should have these books. If it is the latter subject, I think a plate model for analysis is the precise solution. However in some special condition we can deduce to a simpler problem - beam. For example, a square slab is supported in two opposite side or a infinitely long slab supported on 4 side with a uniform load or line load. Something like a plane-strain problem. Of course in other cases e. Steel likes to act as a beam. Waxing philosophical, for your further consideration: Steel, beams, and engineers have several things in common: They can be quite simple, easy to analyze. They are often quite predictable in their behavior under load. Their individual contributions to the strength of a design can most often be superimposed to get the composite strength of the final configuration. What would the world be like without Roarke. I hope he knew what he was doing because it seems everything built today uses Roarke as a basis. A good rule is: That is, I believe an engineer must be able to model his problem, in his head, on the back of an envelop, on a spread sheet, markerboard before ever considering going to FEA or other software to resove the details. I politely disagree with those who suggest you go straight to software for analysis or solution. Plate Theory diblazing Mechanical 27 Jan 04 I am now faced with a critical design issue that may need plate theory to be correctly modeled. I need to determine the appropriate thickness and the necessary number of bolts needed for a? This flat will have a possible point force at the end of the cantilever of lbs. Is it possible to use beam theory on a per unit basis or do I need plate theory in order to determine the bending in both directions. I have not seen any plate theory that deals with a cantilever situation either. I would also like to know about any rules of thumb if applicable. Any help or direction would be appreciated.

Chapter 2 : Beam Theory vs. Plate Theory - Structural engineering other technical topics - Eng-Tips

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The jam nut should go on first! Otherwise the effectiveness of the nut pair is greatly reduced. Before I move on to the next one I need to clarify the difference between static loads and fatigue loads. Static loads do not change over time. If a bolt is rated to yield at 3, lbs of tension, any static load less than that will not have a permanent effect. However, if you were to vary that applied load over time you can fatigue the bolt until it breaks using less than 3, lbs! In the same way that a small stream can carve out the Grand Canyon, fatigue loads gradually chip away at the structural integrity of fasteners over time. The relationship between fatigue load and the number of cycles until bolt failure occurs can be predicted using experimentation. It turns out that you can make reasonably accurate predictions of the cycle count at failure by performing as few as three experiments though I would recommend doing at least 6 to attain some real accuracy. All it takes are a few data points and a regression line to create a high cycle fatigue life curve aka an S-N curve. Why is this useful? Now that you know bolts can break from small fatigue loads, imagine trying to build a bridge using riveted or bolted connections. How could you trust that you ever had a big enough fastener? It turns out that fatigue loads below a certain threshold will never cause the fastener to break. This is not so! In fact ANY additional load, no matter how small, will add to the tension in the bolt. But not at a 1: Think of pulling on a fastened connection as if it were 2 stacked springs. Both springs stretch measurably, but the weaker one stretches more. Part of the external load is absorbed by the joint and part by the fastener. To be crystal clear, as you tighten the nut the bolt will compress the two parts together. The bolt itself has an internal reaction force equal to the amplitude of the compression force, but the bolt itself is in tension. If you were to graph the tension on the bolt while you tighten the nut, the plot would look like the graph below. Any more force and the bolt will enter the plastic region and permanently deform. Since any additional force will begin to yield the bolt, you want to give yourself some margin for error. Engineers select a bolt tension that is somewhere between the calculable minimum functional clamping force and the yielding forceâ€¦. It is actually quite difficult to determine the exact load the fastener sees during clamping. We now know how important it is to avoid over tightening a bolt, but how do we know when it is yielding? For everyday purposes the clamping force can be approximated by measuring the tightening torque. Those methods work OK for most things, but some critical applications require you to be certain of the clamping force think spacecraft or large weights above your head. The torque method has difficultly accounting for friction and lubrication, but at least the torque is mathematically correlated to the clamping force. There are better options though. Load indicating washers can accurately verify bolting loads by squishing open a paint sack after reaching a specific load. The drawback with these is that they only work once. This is by far the most accurate method of measuring bolt clamping load. Neat, I just wish I could afford one. Bolts actually stretch very slightly when force is applied, which causes the loading on each thread to be different. Because of this stretch, when you apply a tensile load on a threaded fastener the first thread at the point of connection sees the highest percentage of the load. The load on each successive thread decreases from there, as seen in the table below. Additional threads beyond the sixth will not further distribute the load and will not make the connection any stronger. So will a bolt break before the nut strips? Have you ever seen a fastener labeled with a 2A or 3B rating and wondered what that meant? That number-letter combo is used to indicate the thread class of the fastener. Thread classes include loose to tight , A external , and B internal. These ratings are clearance fits which indicates the level of interference during assembly. Class 1 is a good choice when quick assembly and disassembly is a priority. Class 2 is the most common thread class because it offers a good balance between price and quality. Class 3 is best used in applications requiring close tolerances and a strong connection. Class 4 is precision tight, typically used for lead screws and such. Finely threaded bolts have slightly larger cross-sectional areas than coarse bolts of the same diameter, so if you are limited on the bolt size due to dimensional constraints, choose a fine thread for greater strength. Fine threads are also a better choice when threading a thin walled member. Fine threads also permit greater adjustment accuracy by requiring more rotations to move linearly. On the other hand, coarsely threaded bolts are less likely to be cross threaded during assembly. They also allow for quicker assembly and disassembly, so choose these when you will be reassembling a part often. Coarse ly threaded fasteners are much more commonly available in the united states. Would you expect a bolt to be stronger or weaker at very high temperatures? How about at cryogenic temperatures? Why would steel be strongest at whatever typical room temperature happens to be? Room temperature is just another non-extreme point on the curve. You can make bolted connections more resistant to shear loads by using clever design instead of larger bolts. For maximum strength, try to use the correct thread length for the connection. In the image below you can see two connections which are identical except that the one on the right has a properly sized thread length. It exposes the bolt shank rather than the threads to the applied load at the connection seam. All else remaining the same, the connection on the right will be stronger because the shank has a larger cross-sectional area and no stress concentrations. In the images below there are two connections. The one on the right is twice as strong as the one on the left because it would have to shear the bolt off in two places to become free. Also, the single shear configuration can also lead to bending loads on the fastener and loosening of the connection see 1. Have you ever cursed the day you were born because you just stripped out a Phillips head screw? As frustrating as that is, it turns out that Phillips head screws are designed to strip out via the tapered point and rounded edges. The technical term is called a cam-out and every time it happens the relative surface motion wears out your screw. Alternate screw heads like torx and pozidriv are specifically designed not to cam-out. Actually every book by Carroll Smith is pure gold.

Chapter 3 : On Classical Plate Theory and Wave Propagation | Journal of Applied Mechanics | ASME DC

The aim of plate theory is to calculate the deformation and stresses in a plate subjected to loads. Of the numerous plate theories that have been developed since the late 19th century, two are widely accepted and used in engineering.

Strength[edit] Strength depends upon material properties. The strength of a material depends on its capacity to withstand axial stress , shear stress , bending, and torsion. A structure fails the strength criterion when the stress force divided by area of material induced by the loading is greater than the capacity of the structural material to resist the load without breaking, or when the strain percentage extension is so great that the element no longer fulfills its function yield. Stiffness[edit] Stiffness depends upon material properties and geometry. The deflection of a structure under loading is dependent on its stiffness. The dynamic response of a structure to dynamic loads the natural frequency of a structure is also dependent on its stiffness. In a structure made up of multiple structural elements where the surface distributing the forces to the elements is rigid, the elements will carry loads in proportion to their relative stiffness - the stiffer an element, the more load it will attract. In a structure where the surface distributing the forces to the elements is flexible like a wood framed structure , the elements will carry loads in proportion to their relative tributary areas. A structure is considered to fail the chosen serviceability criteria if it is insufficiently stiff to have acceptably small deflection or dynamic response under loading. The inverse of stiffness is flexibility. Safety factors[edit] The safe design of structures requires a design approach which takes account of the statistical likelihood of the failure of the structure. Structural design codes are based upon the assumption that both the loads and the material strengths vary with a normal distribution. The job of the structural engineer is to ensure that the chance of overlap between the distribution of loads on a structure and the distribution of material strength of a structure is acceptably small it is impossible to reduce that chance to zero. It is normal to apply a partial safety factor to the loads and to the material strengths, to design using 95th percentiles two standard deviations from the mean. The safety factors for material strength vary depending on the material and the use it is being put to and on the design codes applicable in the country or region. Load cases[edit] The examples and perspective in this article may not represent a worldwide view of the subject. You may improve this article , discuss the issue on the talk page , or create a new article , as appropriate. December A load case is a combination of different types of loads with safety factors applied to them. A structure is checked for strength and serviceability against all the load cases it is likely to experience during its lifetime. Typical load cases for design for strength ultimate load cases; ULS are: For example, in the case of design for fire a load case of 1. In multi-story buildings it is normal to reduce the total live load depending on the number of stories being supported, as the probability of maximum load being applied to all floors simultaneously is negligibly small. It is not uncommon for large buildings to require hundreds of different load cases to be considered in the design. With these laws it is possible to understand the forces on a structure and how that structure will resist them. The Third Law requires that for a structure to be stable all the internal and external forces must be in equilibrium. This means that the sum of all internal and external forces on a free-body diagram must be zero:

Chapter 4 : Loaded Flat Plates

Engineering Strain Engineering strain Îµ is deï¬•ned as the relative displacement: Îµ = In the classical bending theory of plate, the in-plane.

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Chapter 6 : Structural engineering theory - Wikipedia

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For example, you may be able to approximate plate theory results by performing beam theory analysis. In some cases you may find that the difference in results provided by either theory is negligible (i.e. using a plate thickness of " vs. a plate thickness of ").