Modeling –the Key to Analysis

Simple supports, fixed ends, springs, beams, uniaxial bars, etc. are easily identifiable in your textbooks where the authors prefer to show schematics rather than detailed drawings. However, when you design, you are often faced with geometries and supports that are less than ideal. Modeling, the act of reducing a complex system to a simpler set of components and connections, is vital to the design process.

You can determine the type of support by determining the type of motion that is restricted. For example, a hinge restricts translation in three orthogonal directions, and rotation about two orthogonal axes, whereas rotation is possible about one axis, as in the case of a door. A roller relaxes the constraints against translation in one or more directions. A TV cart with caster wheels is a likely choice for a roller supported system. Finally, when rotation and translation are prevented in all directions, we use the term fixed support and illustrate it by the wall symbol ( ). The support of a bathroom towel rack which is mounted to the wall may be considered fixed.

Exercise 2. Take a look around your dorm or apartment and identify systems that contain each type of support: pin (hinge), roller and fixed. Draw a schematic to show each system and write a statement as to why you are assuming that particular support. Be prepared to share these in class.

Like supports, actual objects rarely appear as their simplified forms of bars and beams; however, we often replace a more complicated shape with a more familiar structure. Once we identify the familiar structure and the type of load to which it is subjected, the theory which will be employed to solve the problem is identified. As shown in Figure 1, objects which are subjected to axial loads, torsion loads, transverse loads, etc. dictate the theory that will be used in the analysis. A structure which looks like a frame may be subjected to many different loads which require individual analysis.

Exercise 3. Look at each component (arm, leg, seat, back, etc.) of a chair in a classroom and decide what type of familiar structure it is and what type of loads act on it during normal use. List each component, state where and how the load acts and select the theory which you would have to consider when analyzing the stresses in the chair. Prepare your response in tabulated form and be prepared to submit it for homework credit.