

INTERACTIVE COMPUTER-BASED EXERCISES FOR ENGINEERING STATICS AND MECHANICS OF MATERIALS

*Paul S. Steif
Department of Mechanical Engineering
Carnegie Mellon University
Pittsburgh, PA 15213*

Abstract - *The ability to solve new problems is one of the most important skills to be learned in engineering courses. Successfully solving a wide range of engineering problems requires systematic thought processes and a physically-based, intuitive appreciation for principles which allows for them to be flexibly applied. While lectures are an opportunity for the instructor to explain the subject and to discuss and demonstrate problem solving, students become proficient at problem solving only through practice. Unfortunately, nearly all student attempts at solving problems occur away from the eye of instructors. In addition, in the normal course of events, students receive feedback in the form of graded homework several days after handing in their assignment, often too late to have much impact. Students can easily develop bad problem solving habits which may never be broken. An additional weakness observed even in students who do well by standard measures is an over-reliance on manipulating equations rather than on physical and geometric reasoning.*

The above observations have motivated the development of highly interactive computer-based exercises. The key pedagogic features of these materials are: (i) they have students actively focus on topics which tend to be the most challenging; (ii) they exercise physical and geometric reasoning, rather than algebraic methods; (iii) they provide immediate feedback; and (iv) they often advocate systematic problem solving and reasoning strategies. These educational materials are not intended to replace textbooks and lectures, but to supplement or partially replace traditional homework assignments.

A suite of programs is being prepared which focuses on a range of topics in statics and mechanics of materials. In some instances, the exercises are quite distinct from those in textbooks or are impossible without the aid of the computer. In other instances, the exercises offer "incremental feedback": successive incorrect responses to a problem evoke successively more pointed feedback, akin to that which might be offered by an instructor in real time. In this talk, programs focusing on free body diagrams and on shear force and bending moment diagrams will be described.