Session 2648

Use of a Computer Tutor to Assist Students in Strength of Materials

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Abstract

The need to provide instruction that is more “student centered” in higher education while improving retention has created the requirement to give students more flexible help outside of the traditional classroom environment. A deeper challenge is how to accomplish this within the realities of today's departmental budgets.
The following paper describes how Eastern Washington University has chosen to meet this challenge in the instructional area of Strength of Materials. Eastern Washington University has decided to use a software package to allow the student to have more “on demand” help in solving strength/mechanics of materials problems. The software package allows the student to do problems then use the software to check his/her work, help understand where he may have erred, and provide an environment that encourages further exploration and discovery. The paper further relates the experience and lessons learned in using the software to augment the traditional class room experience. The software package is "MDSolids" developed by Timothy Philpot at the University of Missouri.

I. Introduction

Student retention has become one of the most important issues today in higher education. To address this issue we must look at the ways we are delivering instruction to the student and what his/her needs are. The traditional model of strict classroom lecture, homework assignments and tests does not meet the needs of many students who want and demand more in there learning experience. Today’s student is computer literate and is accustomed to using technology to explore in a free flowing "on demand" environment. This desire to explore and learn on demand has carried through to the student’s expectations of their college experience. One of these expectations is to have more flexible help outside of the traditional classroom environment. Providing help usually comes down to how to provide the resources to help the student. The deeper challenge is how to accomplish this within the realities of today’s departmental budgets. Eastern Washington University has decided to use a software package to allow the student to have more “on demand” help in solving strength/mechanics of materials problems. The following describes the software package that was chosen and how it is used to augment the course. I will relay my experience with using the software and how the students felt about the experience.

II. Software

The software package that Eastern Washington University decided to use is "MDsolids" developed by Timothy Philpot at the University of Missouri. The software is a window's based and runs on most standard PCs. The software has the following modules, Stress and Strain, Beam and Strut, Truss Analysis, Indeterminate Axial Structures, Torsion, Determinate Beams, Flexure, Section Properties, Column Buckling, Mohr's Circle and Pressure Vessels. (please refer to figure #1) There are two major aspects of the program that drew us to this particular software package. The first was that the software was written for use by a student in learning these areas and not as a design aide for the accomplished professional. It is a program for a student to help him/her learn and explore the subject of strength of materials written by a professor who was responding to a need of students with helps and guides to make the usage of the program fun and intuitive. The second was that the cost was within our budget limitations. The program is free to University Professors for use in the laboratory for students. There is a small fee for student to own their own copy of the program. The program can be downloaded of the web for a free 30 day trial. Unlike so many "free" software packages the software is extremely well done and stable.
To give you a small glimpse of the functions, student friendly help and explanations that are available to the student the following brief explanation is offered using the Determinate Beam Module. The student is first presented with a dialogue box and asked to select how the beam is supported. (please refer to figure #2) The student then chooses length of the beam. The student can choose to work in English or Metric units. As the student enters data the actual problem he is creating in shown in a separate window to the right. The student has the option of specifying as many loads as he/she wishes and the location that he/she wants them to act on the beam. The shear and moment diagrams are created as the loads are entered. The reactions can be viewed by the use of the arrow to the right of the reaction label. Loads can be view by a using the arrow by load label. The student can revise any of the loads, their placement and length of the beam. This encourages the student to play "what if" with the problem and explore the consequences of moving, increasing or introducing a new load on the beam. If the student is unsure of how the moment curve was calculated for a given area or the reason for the shape, the student can simply click on the area in question and a dialogue box appears giving a specific explanation of the calculation not just a generic nonspecific comment. (please refer to figure #3) The student can then move to the analysis option to explore the shear force and bending moment at any point along the beam. (please refer to figure #4) Under the design option (please refer to figure #5) the student can choose one of the many standard structural shapes or design one of his own. The program gives him an explanation of how the thickness of the beam was chosen and why. He is even able to have the program give him a view of the bending deformation for his problem. (please refer to figure #6) Well, I hope the above has given you an idea of the programs flexibility.

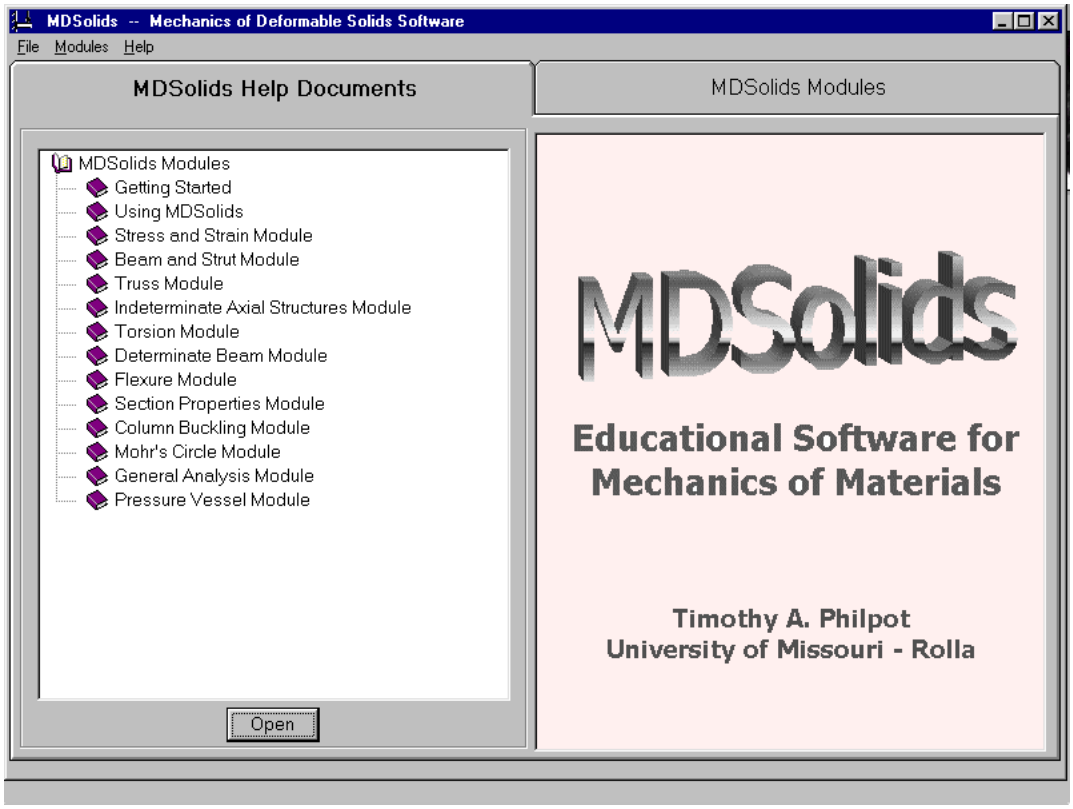
III. Course Augmentation Usage

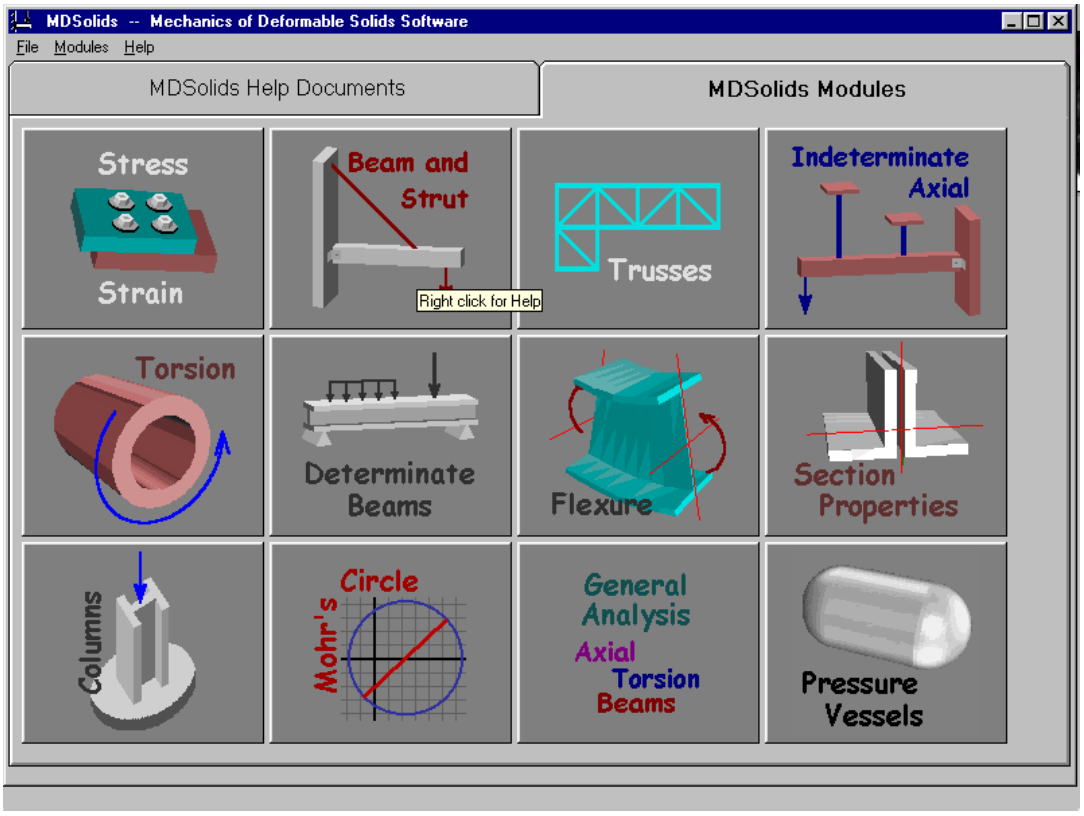
I used the program as an aide in the Strength of Materials course at Eastern Washington University. Homework problems were assigned and the students were encouraged to use the program to check their work and explore "what if" scenarios. Homework was still required to be turned-in using hand techniques including all calculations. The use of the program allowed students that were having trouble mastering concepts to receive help on demand using the

computer. The instructor still encouraged students to come to his office and ask questions but found that the student was more prepared with better questions because he/she had used the program first. A computer program is not a substitute for live instruction but allows the student to have an additional means of exploring and tutoring in the many areas of strength of materials. As each new area is introduced, the student can explore the subject area with the "computer tutor". He can make mistakes and correct them without any pier pressure for the mistake. The student is able to do additional problems in the text by hand and then check them with the computer.

IV. Conclusion and Lessons Learned

The program is a great tool for the student when used properly. However, the tool can be used incorrectly and/or improperly. The ability of the student to get immediate feed back on his/her homework attempts is of great value. Mistakes in method are learned quickly before they become a habit that must be broken. Problem areas can be identified earlier by the student and additional help received form the computer program or from the instructor. The program encourages the student to explore on his own and help arrive at the right conclusions due to the immediate feedback and help screens. As with all tools the program can be used improperly and the desired result not obtained. The student could use the program as simply a short cut method to do the homework fast without any understanding of the problem. This of course would have dire consequences on the exam the student takes. To help student not fall into this trap, I still require that the homework problems be turned-in done by hand showing all equations and work. You cannot completely keep a student from not doing the homework himself just as you can control the fact that he/she could copy the homework from a fellow student. There is the danger that the student will just plug things into the program blindly until he happens into the right answer without fore thought. I believe that the advantage of immediate "on demand" feed back and help far exceeds this problem. The students who have used the program relate that they are happy with the software and are happy to have it available. I believe it has help students explore and allowed students not to "spin their wheels" on a problem. The program often is a substitute study partner. I still believe that live study groups are important but many of today's nontraditional students simply cannot meet with other students due to their schedule. Some students are to concerned of appearing not smart enough in a study group and have questions left unanswered. The program may help these situations. I believe this program or similar programs should be made available to aide students in the study of strength of materials. I intend to continue to use "MDSolids" in my course and encourage you to try this program or a similar one in your courses. In the bibliography I have included the URL for the program web site.


MDSolids -- Mechanics of Deformable Solids Software
File Modules Help
MDSolids Help Documents
MDSolids Modules
MDSolids Modules
Getting Started
Using MDSolids
Stress and Strain Module
Beam and Strut Module
Truss Module
Indeterminate Axial Structures Module
Torsion Module
Determinate Beam Module
Flexure Module
Section Properties Module
Column Buckling Module
Mohr's Circle Module
General Analysis Module
Pressure Vessel Module
Open
MDSolids
Educational Software for Mechanics of Materials
Timothy A. Philpot
University of Missouri - Rolla


MDSolids -- Mechanics of Deformable Solids Software
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Axial
Torsion
Beams
Pressure
Vessels

Figure #1

Figure #2

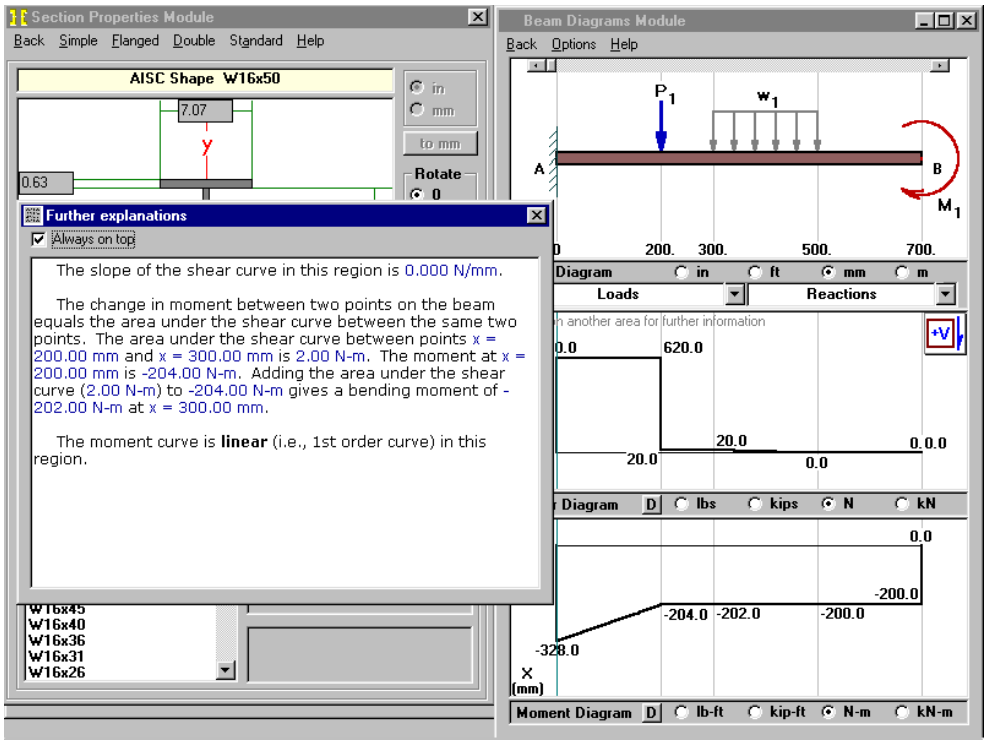

Figure # 3

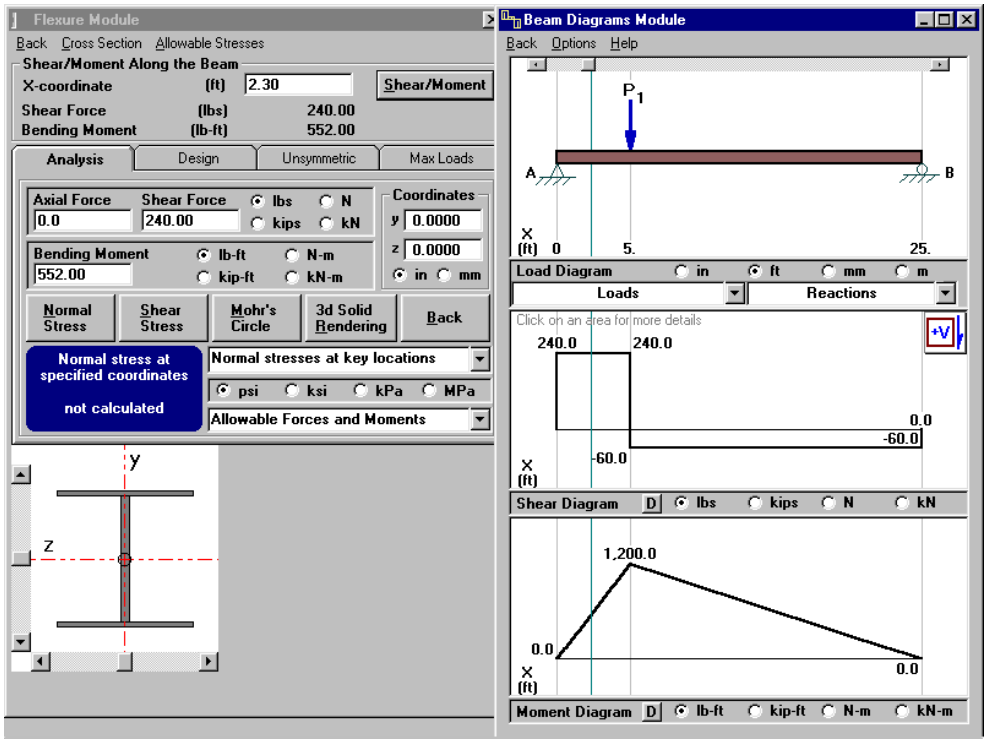

Figure # 4

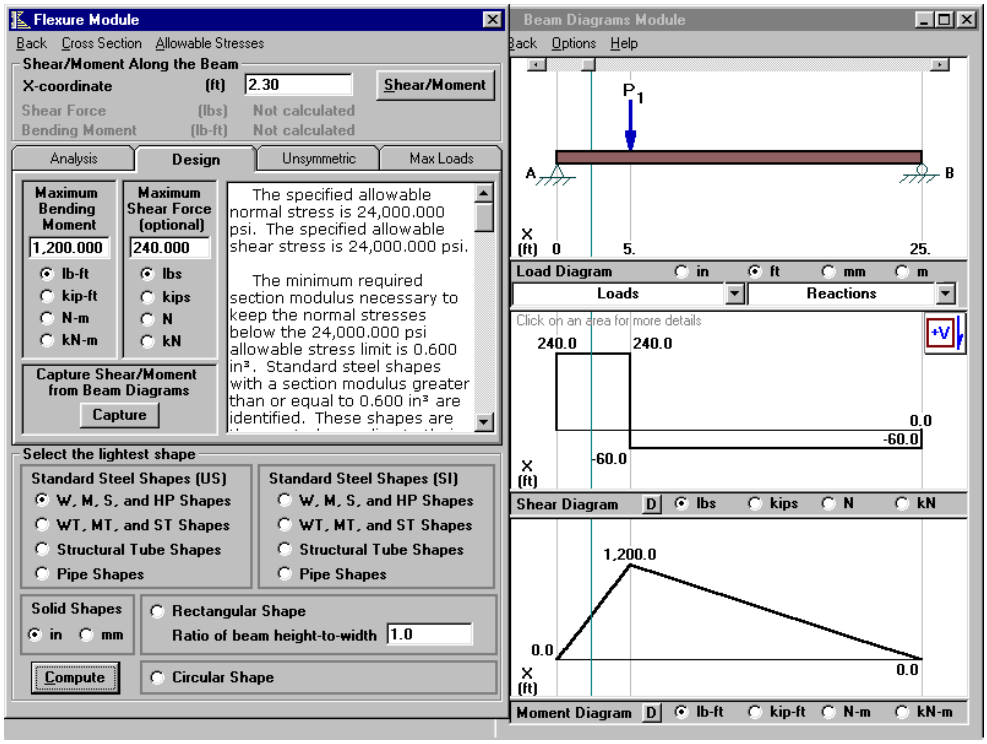

Figure # 5

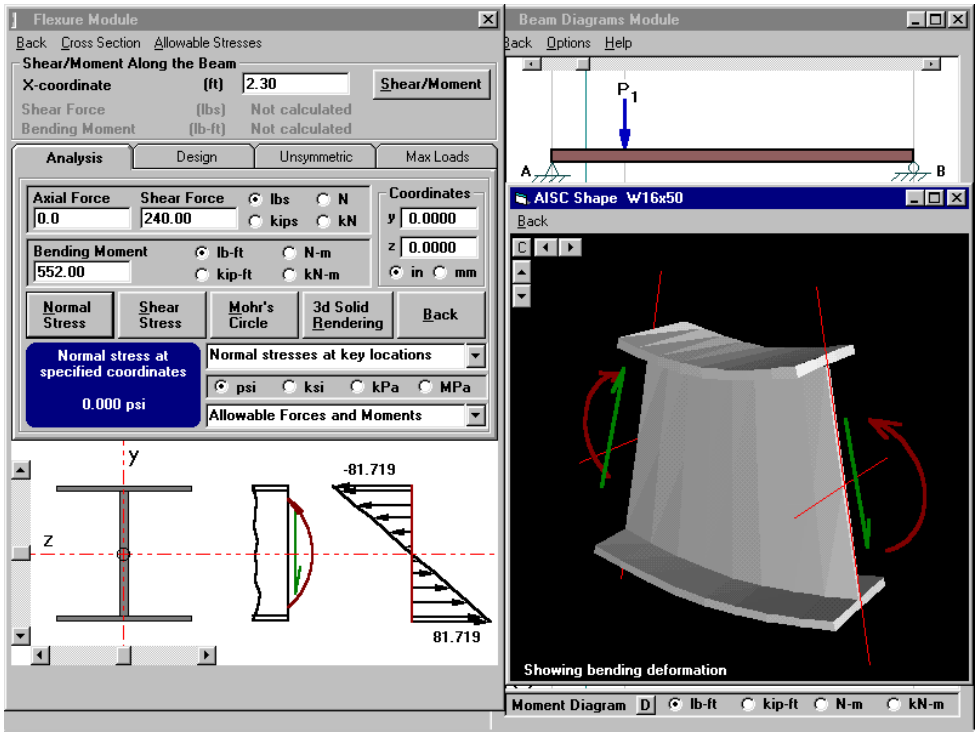

Figure # 6

Bibliography

1. MDSolids, Timothy Philpot URL: http://msumusik.mursuky.edu
2. "Bridging the Gap between Mechanics of Material Lectures and Homework with MDSolids", Timothy Philpot, Technology Interface, Spring 1998
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4. "Mechanics of Materials", Craig, 2nd Edition, Wiley

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