The Impact of Using Computer Models on Academic Performance of Engineering Students

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Encouraging students to take on a Science, Technology, Engineering, and Math (STEM) major has recently been a top priority in the nation's policy-making debates[1,2]. STEM-related majors often time are deemed very difficult and demanding. Specifically, students tend to face difficulties to conceptualize engineering problems which can eventually impede otherwise successful individuals from pursuing a career in engineering. Conceptualizing a problem help students see the 'big picture' of a system and its components[3]. Finite Element-based computer programs such as COMSOL Multiphysics, are able to demonstrate accurate spatial models and present various post-processing plots, so that users can visualize engineering phenomena.

Computational Methods: By using COMSOL, a 3D multi-section cantilever beam model was developed to display deformation due to various forces acting on the beam and provide the corresponding moment and shear plots. Accordingly, the moments, forces and displacements of a specific cut section of the beam were obtained by integrating stresses and displacements over the cut-section area. In addition, many useful plots such as normal stress, shear flow and deformed shape of the cut section were presented in the model.

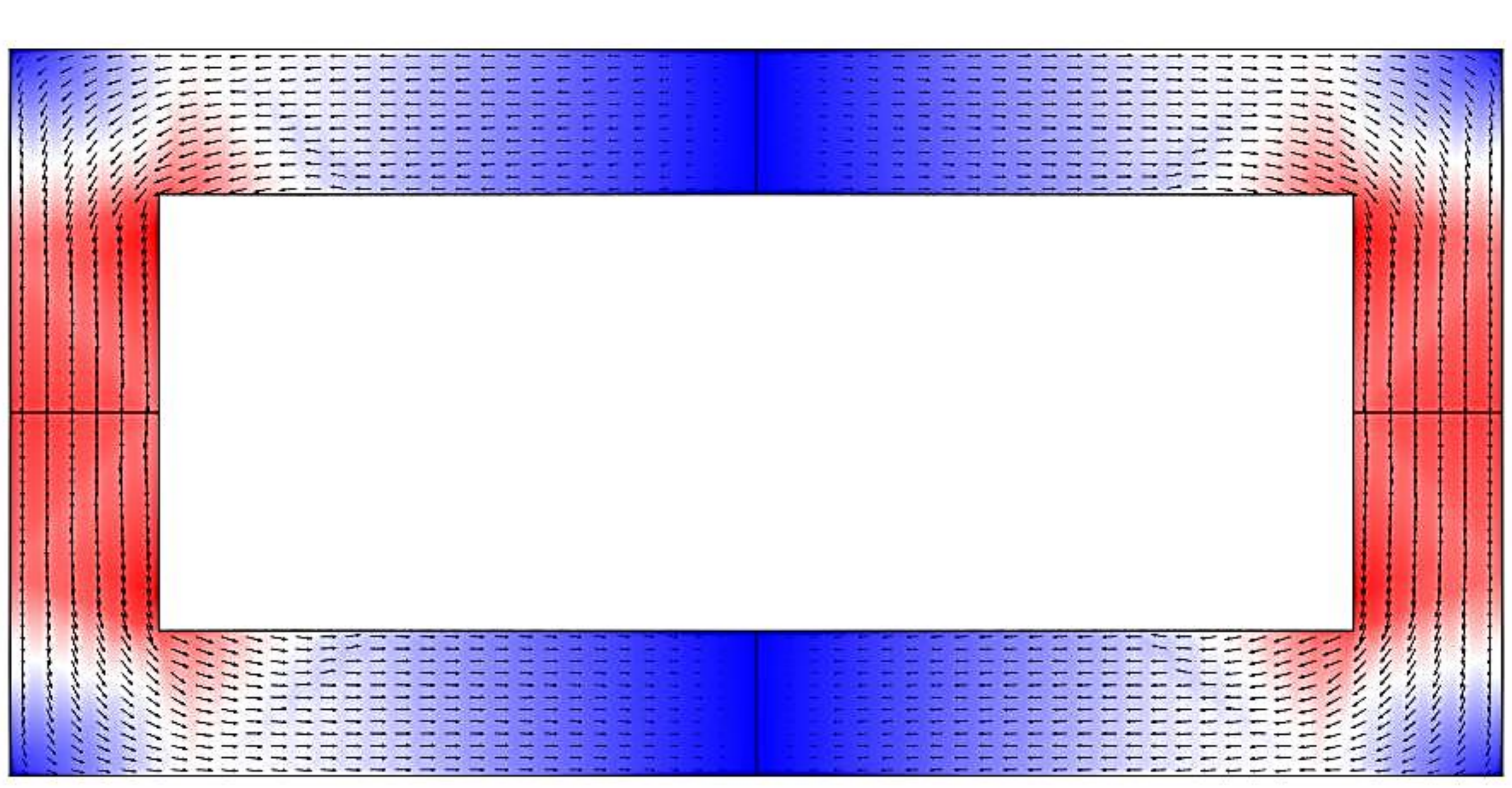

Figure 1. shear flow of the cut section

Results: Participants, engineering college students, were asked to take a test comprising ten conceptual problems pertaining to solid mechanics once before they are acquainted with the model, and once again after the model with ample instruction was presented to them.

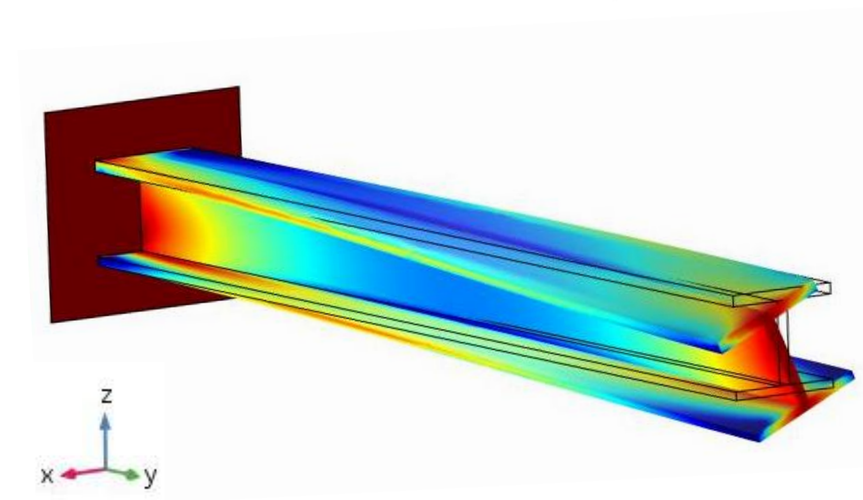

Figure 2. I-beam deformation

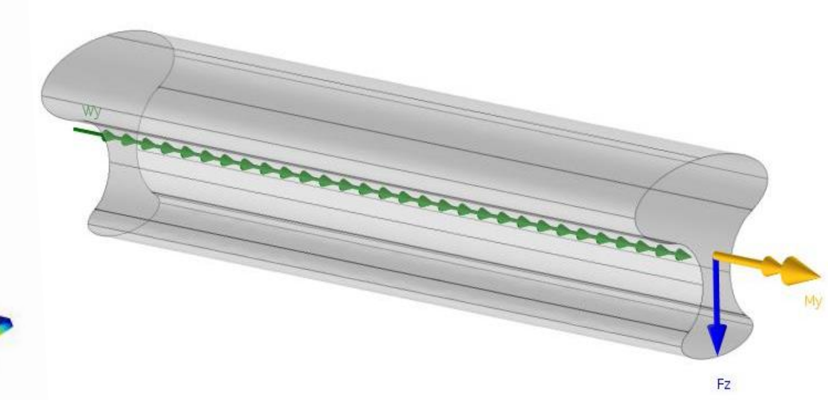

Figure 3. applied forces

Variable	Resultant value	Units
X-comp. moment	-3242	lb.ft
Y-comp. moment	997	lb.ft
Z-comp. moment	-8.47	lb.ft
X-comp. force	14.05	lb
Y-comp. force	-10020	lb
Z-comp. force	1002	lb
Max. Disp. X direction	5.351	mil
Max. Disp. Y direction	0.427	mil

Table 1. Moments, forces and deformation values obtained by using integration technique over the cut section.

Conclusions: Findings of this study can potentially show an improvement in conceptualizing and visualizing engineering problems and their equivalent real-world replicates.

References:

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