Students on Design Fast Track...

Dr. Larry Stikeleather's BAE 202 class is an introduction to the design process, CAD, and hands-on basic manufacturing shop skills. April's class participated in a unique multiphase project. Students assigned two to a team were given a set of specifications for a pinewood derby car. The car was designed in Pro/ENGINEER with freedom of design as long as a 3-axis CNC mill could cut the basic shape and meet the limits of length, width, and axle locations. Car designs also had to make provision for the mounting of standardized auxiliary masses. Maximum total car mass was specified and Pro/E was used to compute the mass

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Students designed pinewood derby cars in Pro/ENGINEER using 3D solid modeling CAD methods.

Seeing their own designs materialize and undergo hands-on testing brings out the smiles.

Student designs had to meet specific mass and mass properties specifications so they could run a designed 2 factor, 2 level experiment (2x2) to evaluate the effects of mass and mass location and the interaction of these factors on performance.

And at the end of the track the cars break light beams which switch phototransistors ...

Students follow their test matrix for randomized runs and set up the cars to one of 5 configurations for each test run. One team member sets up the car and the other collects the test data.

The computer reads the phototransistors via a data acquisition board and a virtual instrument (VI) timer programmed in LabVIEW. LabVIEW then computes and displays the times for tracks in large numbers to the nearest thousandth of a second so the students can enter their data on data sheets.

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properties including the mass moments of inertia for each car configuration based on the densities of the various materials in the assemblies. Once the designs met the requirements, the students generated the G code in Pro/E and transferred this code to a small CNC mill machining the cars from rigid sign foam stock. The light weight rigid sign foam allowed more of the total mass to be made up of steel ballast, so the effect of mass and mass location could be varied substantially.

The primary objective was to conduct a 2x2 designed experiment to determine how mass and mass location affected performance. Many of the students had already experienced a Scout pinewood derby as youngsters, adding interest to the project from an engineer's view. Teams ran tests, collected and analyzed the data, wrote a report like a technical paper and then made an oral presentation. Presentations were given to the class and evaluated by faculty and staff. Most (95%)of the teams concluded that the maximum (+1) level of rear car ballast gave the best performance. In some cases, teams found that mass made a significant difference but location did not. Most teams found a strong interaction between the mass and mass location factors. A few teams ran into stability, wheel/axle alignment, and excess friction problems with some configurations of their prototype cars and obtained some surprising results (which were explained in engineering terms). The project experience should make them better engineers and the conclusions they reached will no doubt influence the input they give their own little Scouts some day. ■