Comparative Study of Free Vibrational Analysis and Modes Shapes of FSAE Car Frame Using Different FEM Modules

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Abstract : Formula SAE cars are the student designed and fabricated formula prototype cars, designed according to SAE INTERNATIONAL design rules which compete in the various national and international events. This paper shows a FEM based comparative study of free vibration analysis of different mode shapes of a formula prototype car chassis frame. Tubing sections of different diameters as per the design rules are designed in such a manner that the desired strength can be achieved. Natural frequency of first five mode was determined using finite element analysis method. SOLIDWORKS is used for designing the frame structure and SOLIDWORKS SIMULATION and ANSYS WORKBENCH 16.2 are used for the modal analysis. Mode shape results of ANSYS and SOLIDWORKS were compared. Fixed –fixed boundary conditions are used for fixing the A-arm wishbones. The simulation results were compared for the validation of the study. First five modes were compared and results were found within the permissible limits. The AISI4130 (CROMOLY- chromium molybdenum steel) material is used and the chassis frame is discretized with fine quality QUAD mesh followed by Fixed-fixed boundary conditions. The natural frequency of the chassis frame is 53.92-125.5 Hz as per the results of ANSYS which is found within the permissible limits. The study is concluded with the light weight and compact chassis frame without compensation with strength. This design allows to fabricate an extremely safe driver ergonomics, compact, dynamically stable, simple and light weight tubular chassis frame with higher strength.

Keywords : FEM, modal analysis, formula SAE cars, chassis frame, Ansys
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