



FSGP 2011 Structural Report

Due: 2011.02.01, Submit to FSGP Team Registration
ascteams@americansolarchallenge.org

It is the intent of the Innovators Educational Foundation to maintain the safest entries possible while encouraging a wide variety of designs and materials for solar-powered vehicles. The purpose of the structural report is to require each team to document, by calculation or testing, the structural integrity of their vehicle and the protection provided to their drivers. Note that each team is responsible for the safety of its members, and any minimum criteria specified by FSGP should not be construed as design specifications for the construction of a "safe" solar vehicle.

The structural report shall be presented in the format described in this document. Reports that do not meet this format will not be read and could jeopardize a team's chances for competing in the event. The report should be written to be as concise as possible and should only present information relevant to the requirements of the report. The report is limited to a total of 50 pages, including appendices.

Reports can be submitted in PDF format to ascteams@americansolarchallenge.org by Feb 1, 2011. A confirmation email will be sent acknowledging receipt of the report.

Section 1: Introduction

A brief summary of your overall mechanical design of your vehicle. This should include overall dimensions, component location and layout, and driver position. Teams should describe the vehicle both in its normal racing configuration, and in its stationary charging configuration.

Section 2: Mechanical Systems Analysis

The mechanical systems analysis section must include the following six sub-sections:

- Front suspension
- Rear suspension
- Brakes
- Steering
- Wheels & Tires
- Battery Enclosure

Each sub-section must contain all of the following information:

- **Material Specifications:** Describe the materials utilized, their important dimensions (e.g., tubing diameter and thickness), and material properties (in the "as welded" or "as fabricated" condition).
- **Loading Conditions:** Describe the specific loading conditions used in the analysis of the component. Teams should consider road and traffic conditions when determining loading criteria and potential failure modes. For suspension and steering systems, analysis needs to include at least a 1G turn, a 2G bump, and 1G braking case. Loads should be provided in dimensional units. Include any relevant assumptions used in the analysis.

- **Drawings:** Include component drawings or photographs and mechanical system assembly drawings or photographs. All drawings must be identified by number and must include a description. In the case of purchased or procured components, include the manufacturer and part numbers.
- **System Analysis:** Mechanical components and systems must be analyzed to show that they will not fail due to fatigue and possess a reasonable factor of safety for strength and stress. Provide a summary of both the analytical methods used and the analytical results for each mechanical component or system. Analyses may be in the form of either calculations, computer modeling (such as finite-element analysis), or empirical testing of the actual vehicle or its components. If testing is not completed at the time the report is submitted, detailed plans of the scheduled testing must be included in the report. The results from the described tests must be submitted once they have been completed. All teams must include the expected static weight on each tire.

Teams must show how they intend to build and secure battery enclosures to meet the requirements of Regulation 5.6. Include a description of how the enclosure will be ventilated and how the cells will be secured within the battery enclosure. Provide a discussion of your findings and how the results impacted your design.

Section 3: Vehicle Impact Analysis

The vehicle impact analysis section must include the following topics.

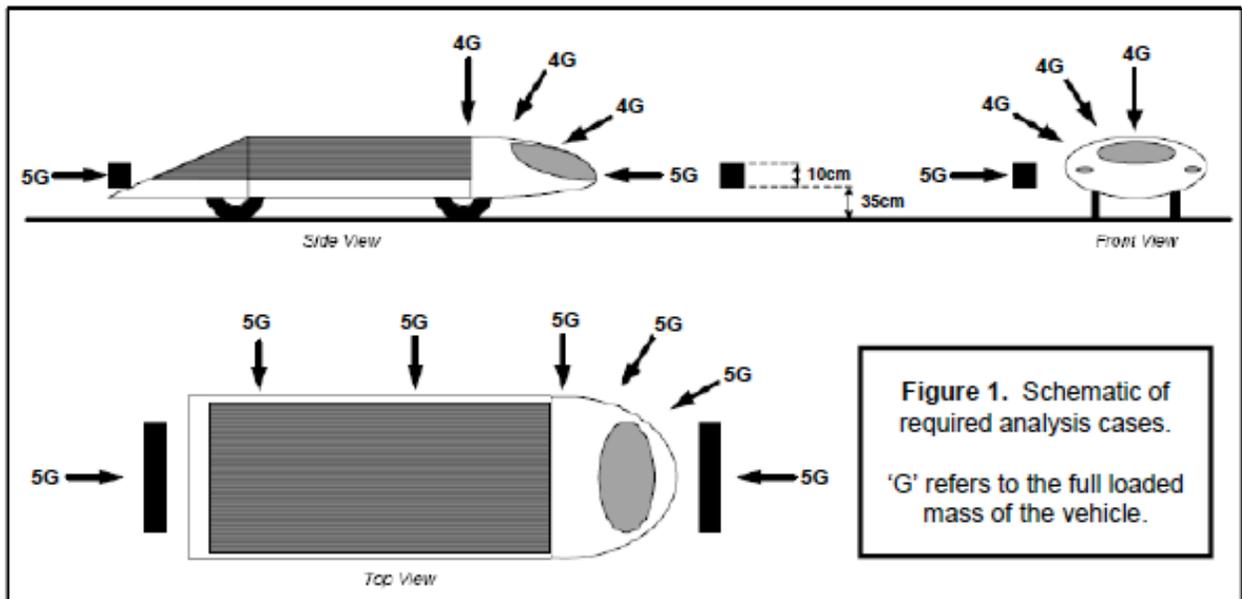
- **Specifications:** The report must describe the vehicle frame and construction techniques (aluminum space frame, composite monocoque, etc.), including the materials utilized, their important dimensions (e.g., tubing diameters and thicknesses, number and types of plies in composite constructions), and their properties (in the "as welded" or "as fabricated" condition). The report must also list the specific impact criteria that are assumed for each case, as well as sample calculations and computer output as applicable. Other relevant assumptions used in the analysis should be listed.
- **Drawings:** The report must include structural drawings of the vehicle from five viewpoints: top, front, side, rear, and isometric. These drawings must illustrate the following:
 - Driver location and orientation
 - All members considered "structural"
 - Locations of ballast and batteries
 - Locations of chassis hard points (points of attachment).
 - Calculated center of mass

The report must contain structural drawings of the driver's compartment from three viewpoints: top, front, and side. These drawings must illustrate the following:

- Driver location
- "Crush" space between the driver and the outer perimeter of the vehicle
- Roll cage design and location
- Location of structural members
- Driver's harness attachment points

The report must contain an isometric drawing of the body and solar array. All drawings must be identified by number and must include a description.

- **Analysis:** Analyzes may be in the form of computer modeling (such as a finite-element analysis) or empirical testing of the actual vehicle or its components. The report must document the performance of the vehicle regarding front, rear, side, and rollover impact, using appropriate forms of analysis. Front, rear, and side impact with another vehicle assumes a bumper height of 10cm and elevation off the ground of 35cm as shown in Figure 1. Rollover analysis must address loads at a minimum vertical and two increments between horizontal and vertical. The minimum criteria for these impacts are loads 4 or 5 G, where the G is the total gross mass of the vehicle (including driver and ballast) as illustrated in Figure 1. Emphasis should be placed on how protection is provided for the driver under these conditions. All impact scenarios must take into account movement of body panels and the vehicle's solar array to ensure that these members do not penetrate the space occupied by the driver during the impact.



- **Conclusions:** The report should contain a summary of the findings for each impact case and a brief discussion of the results. Raw data should be attached as an appendix to the report.

Section 4: Appendix

The appendix should only include relevant information that is referenced from the main body of the report. Appendix items should be organized into two appendices. Examples of what could possibly be included in the appendices are: detailed calculations and results, empirical testing data, details on construction techniques, and component specifications that are particularly relevant to the analysis.

- **Appendix A** -Mechanical Systems Analysis Supporting Documentation
- **Appendix B** -Vehicle Impact Analysis Supporting Documentation