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Engineering Cases are an additional resource that can add new dimensions to learn about engineering. Lectures and problems in engineering science are essential for the students to learn the fundamentals of the craft. Students, however, should be made aware of the real-world relevance of the sciences they are studying, and how they can use them for decisions. The editor's note suggests only one *way that this Case can be used.*

Engineering Cases can be a source of anecdotes for the instructor or a source or real-world engineering problems that the student and instructor can work through together. Where and how Cases are used depends on the course objectives, the nature of the class and the instructor. Cases do not supplant lecture or other teaching methods. Case use is complementary and provides an additional, useful, powerful learning medium.

When using Engineering Cases, students and instructors may find better ways to deal with the technical problems than presented in the Case. This is because an Engineering Case focuses on how an engineer goes about performing tasks and obtaining results. It is not a technical paper! *It is a written account of an engineering activity as it actually occurred, rather than a demonstration of the validity of a particular or 'best' solution. It is intended to be a medium for classroom learning about engineering. Unsuccessful or incomplete efforts attempted before achieving successful results are often included.*

Contributions to the Engineering Case Library or Case Digest are invited. Manuscripts should be sent to Professor Dekker or to the Editor-in-Chief of the International Journal of Engineering Education. *Cases in the area of electronics and computer applications would be especially welcome.*

ECL-79: Stabilizer Link Failure in the Chaparral

This is a digest of an Engineering Case written for classroom use. It can be so used in its present form or modified, if desired. The original in the Engineering Case Library has six pages, including two full-page figures. The original has a photograph of the type of ball joint that failed. There is a one-page instructor's note with the Case.

Editor's note

This Case has been extensively used to introduce both students and professors to the Case method of instruction. It has been well received by both types of audience. H. O. Fuchs made the following suggestion when introducing this Case as the first Case for class discussion.

This being the first Case studied, the prime objective of the discussion should be to familiarize the class with what is expected of them with respect to Cases. Since the problem has to do with failure in a racing automobile it should be of inherent interest to a large number of students.

It should first be established exactly what the problem was. What component failed? What was the component's function? Why did it have that particular configuration? What was the mode of failure?

Then the class can pursue the question of what were the nature and magnitude of the loads on the element that failed. This is an opportunity to have the class make free body diagrams, to make estimates of loadings.

The kind of failure can be used to investigate the nature of fatigue, why failure took place at the thread (stress concentration), etc.

Discussion can pursue the question of whether

the ball joint was properly used. Why was it a 'ball' joint? The question of a fix can be considered. How can it be fixed?

Finally, if all the above aspects have been exhausted, the discussion can turn to Mr Hall as an engineer.

The original Case contains Mr Hall's actions to solve the problem. He straightened out the stabilizing link in order to eliminate the bending moment at the threaded rod; and he redesigned the joint so that it would be capable of withstanding three times the original design load. To accomplish this modification, however, Mr Hall had to flatten the left exhaust duct on his cars. After the initial discussion of the Case, students can be told of Mr Hall's actions and they can then evaluate them in the light of their previous discussion.

The complete Case ECL-79 suitable for classroom use and the Case catalogue of other Cases can be obtained from the Engineering Case Library by writing to: Professor Don L. Dekker, Engineering Case Library, Rose Hulman Institute of Technology, Terre Haute, IN 47803, USA.

G. Kardos

Carleton University, Ottawa, Canada

ECL-79: STABILIZER LINK FAILURE IN THE CHAPARRAL*

W. J. CLEMENS

From *Competition Press*, Vol. 16, No. 40, 8 October 1966:

NEW SPOILER SPOILS CHAPARRAL 2E DEBUT

Bridgehampton, N.Y. Sept. 18—The spoiler on the new Chaparral 2E more than lived up to its name in this second round of the Can Am series. In practice, a bolt fell off the device on Phil Hill's car, dropped down to the bodywork and onto a tire, causing it to blow, and the car slewed off the course at turn 11 and Hill trudged back to the pits.

Hall offered the ex-world champ his own car 'to get some practice in' and out went Hill again. After five tours of the track a bolt fell off the spoiler on Hall's car (Hill driving), dropped down into the bodywork and onto a tire, causing to blow. The car slewed off the course at turn 11 and parked right next to the first car.

Then, with Hill's the only car capable of proper repair, Hall withdrew his pole-sitting 2E and Hill began a classic chase of eventual winner Dan Gurney. For 50 laps they were within fractions of a second of each other until the spoiler on the Chaparral stuck in the 'brake' position and Hill dropped back to finish fourth.

At a luncheon meeting, some time after the above incident, at which he was a guest speaker, Mr Jim Hall was asked to comment on some bolt failures on his new Chaparral 2E automobiles which had been reported in the press. A number of responsible publications had reported that during some practice runs prior to the Bridgehampton Grand Prix, identical bolt failures had occurred on two of Mr Hall's cars.

The Chaparral is a custom racing machine designed particularly for Grand Prix style sports car races. It is revolutionary in that it is the first and only consistently successful competition automobile to make use of an automatic transmission. Perhaps its most noticeable feature is the distinguishing wing (spoiler) mounted on the rear deck of the car. Early models had the 'spoiler' mounted on the automobile chassis close to the rear deck. The newer Chaparral 2E, however, has a wing mounted on struts approximately 2 ft above the highest point on the car. The angle of attack of the wing is controlled by a foot pedal in the driver's compartment and by changing this angle, the driver can put more force on the rear wheels of the car, increasing the car's cornering ability over that of its competitors. The wing is also used to increase aerodynamic drag of the vehicle for braking.

For the lateral support of the wing assembly, Mr Hall had provided a stabilizing side-link attaching the left wing strut to a rear chassis bulkhead. To avoid disturbing the exhaust duct on that side of the car, Mr Hall put a bend, as shown in Exhibit 1, in the stabilizing link so that it would miss the duct.

Mr Hall pointed out to those at the meeting that the failure the press referred to on each of his cars was not a bolt failure, but was a fracture of the rod end where the stabilizing link shown in Exhibit 2 is joined to one end of a ball joint, which, in turn, is joined to the wing strut. What actually happened was that these rod ends broke and the strut fell against the rear wheel, causing the reported blowouts. The stabilizing link was connected to the wing strut by a ball and socket joint, one end of the joint being rigidly attached to the link. The joint was screwed into the link and held in place by means of a locknut. The fracture, which appeared to be a fatigue failure, was located on the threaded shaft of the joint where the locknut had joined the stabilizing link. Mr Hall assumed in the initial design of the strut assembly that the main force acting on the link would not exceed that caused by a lateral acceleration of 1 *g*. The links that broke should have withstood this force.

 Prepared in the Design Division of the Department of Mechanical Engineering by William J. Clemens under the direction of Professor Henry O. Fuchs with financial support from the National Science Foundation.

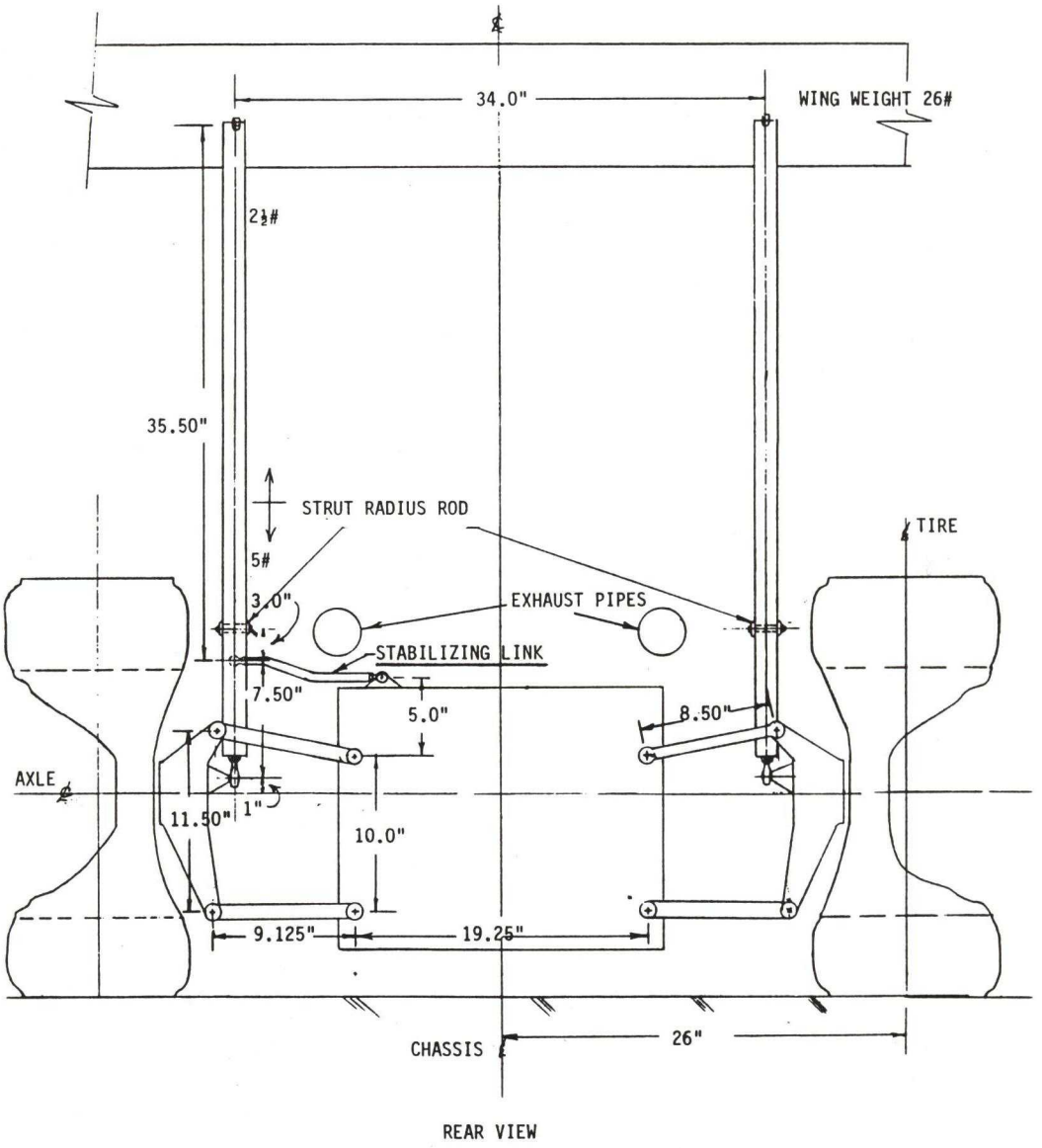

Exhibit 1. Chaparral wing support diagram.

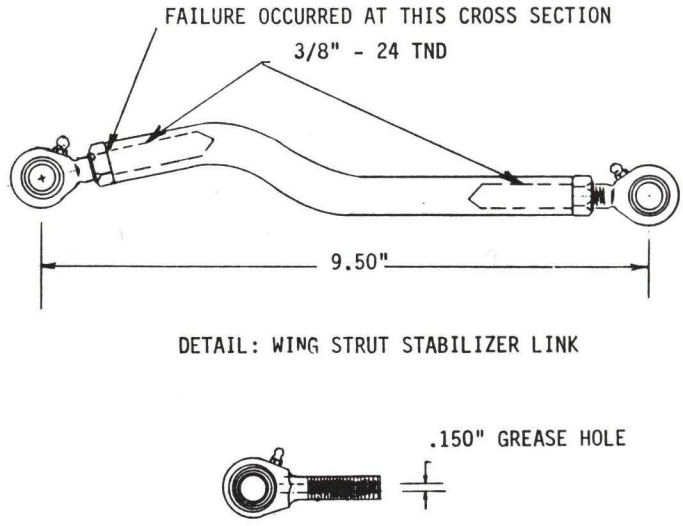

Exhibit 2.