



THE FORENSIC ENGINEERING REPORT

I-ENG-A® [IN-JUH]

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BRIDGE TRIVIA:

- What is the total no. of structurally deficient bridges in the USA ?
- Which State has the highest # of bridges classified as structurally deficient?
- What do you call the fear of crossing bridges?

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THE AUTOMOTIVE EVENT DATA RECORDER (EDR)

Most people are familiar with "black box" technology in modern aircraft as a means to record information in the few minutes before a crash. However, most individuals are not aware that this very same technology might be present in their personal vehicle. It is referred to as an automotive Event Data Recorder (EDR), and it has tremendous implications for any accident reconstructionist.

The EDR in most vehicles is located in the airbag control module, and the purpose for that module is to monitor crash scenarios and deploy the airbags, as needed. To complete this task, the module contains several accelerometers that record vehicle accelerations. When a large acceleration (or deceleration) is detected, the module recognizes an "event." The EDR records only after the airbag module has completed its evaluation of an event.

The EDR will record approximately five seconds of pre-crash data, depending on the type of vehicle. This data includes:

1. Vehicle speed
2. Brake application
3. Accelerator application
4. Engine speed

The EDR will also record the crash phase, evaluating the various parameters every five milliseconds before the impact. This data can thus be analyzed to calculate delta-V and the duration of the impact. From this information and the pre-crash data, an impact velocity can be calculated.

In order to evaluate the contents of the EDR, it is necessary to have an interface that is capable of downloading the EDR data into a workable for-

mat. The Crash Data Retrieval system, or "CDR," was developed by Vetronix Corporation for this very purpose. Their relationship with General Motors began in 1984 when GM first started research and development on EDR technology.

Subsequently, Vetronix developed the first data retrieval system for GM in 1990. This system became available to the public in 2000. Several other automakers have since expressed an interest in the technology. In 2003, Ford contracted with Vetronix and the system has been updated to download data from a variety of Ford vehicles.

The Vetronix CDR downloads pre-crash and crash data from the vehicle's EDR module to any computer, and the Windows-based software presents

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HOW SAFE ARE OUR NATION'S BRIDGES?

On August 1, 2007, the I-35 W Bridge in Minneapolis, Minnesota collapsed. In light of what has been described as 'uncertainty' surrounding the cause by the United States Department of Transportation Federal Highway Administration, a Technical Advisory has been sent to the Division Administrations Directors of Field Services Federal Land Highway Division Engineers. The directive "strongly advises that all State Transportation Agencies and other bridge owners imme-

diately re-inspect all steel deck truss bridges with fracture critical members. At a minimum, State Transportation Agencies and other bridge owners should review inspection reports, including those for routine, in-depth, fracture critical, and underwater, to determine whether more detailed inspections are warranted."

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THE AUTOMOTIVE EVENT DATA RECORDER (EDR)

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this data in easy-to-read graphs and tables. The EDR data can be downloaded either from the vehicle diagnostic link (usually beneath the dash), or directly from the airbag module.

The CDR system will download over 90 percent of all GM vehicles newer than 1994, and most Ford products newer than 2001. This means that over 40 million vehicles on the road are covered by the Vetronix CDR system. More auto manufacturers are looking to come on-line with the system in the near future. Both Toyota and Daimler-Chrysler have EDR technology in at least a limited number of vehicles.

There are many useful applications for the use of this technology. While the data is considered by many to be unsupported on its own, it can be used to support other forms of collision analysis such as crush energy calculations, delta-V, force, and momentum. The system has been used successfully by law enforcement in criminal trials and the data has been admitted into court. Insurance adjustors can use the data to support or disprove their cli-

ents' automotive claims. It is also a valuable tool for fleet managers to monitor their drivers' actions. The National Highway Traffic Safety Administration (NHTSA) and vehicle manufacturers alike have utilized this data in vehicle crash tests and safety studies.

There is a growing future for the use of this system. Next generations systems will not only record delta-V's in the forward direction, but will also record lateral events. A new rule issued on August 21, 2006 by NHTSA requires that new car buyers be notified if an EDR has been installed. The new rule will take effect starting with model year 2011 passenger cars and light trucks. The rule also requires automakers to each collect the same data.

The Investigative Engineers Association Member Firm in Colorado, Professional Investigative Engineers (PIE), is equipped to conduct airbag module examinations and EDR downloads using Vetronix CDR. In September 2006, PIE conducted a staged crash test in order to further evaluate the capability of the system. PIE will

analyze the crash using momentum, crush energy, and force analysis, and will compare these results to the EDR data. I-ENG-A will publish the results of this test in a future article.

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HOW SAFE ARE OUR NATIONS BRIDGES CONTINUED...

According to a final report by the US Department of Transportation, at the national level, over 28% of all bridges are classified as structurally deficient or functionally obsolete ("The Status" 1999). Further, bridges requiring replacement are located on busy highways. The costs associated with traffic detours and loss of use and disruption to the local economy can exceed the cost of the bridge structure.

A need for standardized modular bridge systems is stressed as the solution. Studies are being performed to assess new technology and identify the most suitable systems.

The following statistics are reported by Steven B. Chase with the Federal Hwy Administration:

- The most frequent deficiency is a narrow roadway, close to 90,000 bridges.
- The second most frequent, and most important from a bridge safety perspective is the structural appraisal rating. Almost 60,000 bridges have load ratings which are well below current standards.
- Waterway appraisal is not a major contributor, yet failure during a flood is the #1 cause of bridge failure.
- Vulnerability in general is not considered!

In an analysis concerning the visual inspection and NBI rating system, the results brought questions as to the reliability of the current system.

For forty (40%) of the bridges that were considered having load ratings below current standards, the method used to calculate the loads could not be reported. Further, the evaluation rating systems are subjective and non-quantitative. The evaluation rating system, the data recorded and the guidance for assignment of condition and appraisal ratings are in the Recording and Coding Guide for the Structure Inventory and Appraisal of the Nation's Bridges and is published by the Federal Highway Administration; aka the National Bridge Inspection program (NBI).

There are bi-annual inspections of 583,000 bridges and 116 fields of data collected, yet the condition ratings are assigned based upon a 0 to 9 scale. If the condition rating is 4 (poor) or worse, the bridge is considered deficient.

According to this same report, the NBI data has proven to be adequate for the equitable allocation of funds to the States, yet "most states augment the NBI data for their own purposes."

Because it is not possible to determine from looking at a bridge if it has been overloaded and settled unless it's severity has caused the lines of the bridge to change, 'smart sensors' which can record data from the structure are being recommended. Technology such as laser sensing and acoustical monitoring are technologies available commercially mentioned in the report.

The National Academies of Science and Engineering have been working to define a comprehensive research agenda. The result is a National Infrastructure Renewal Research Agenda. The entire agenda, some 40 pages, is assessable for review and comment at the homepage of the Transportation Research Board located here: <http://nationalacademies.org/trb/>

The ASCE has also assessed the state of our nation's infrastructure through the [Report Card for America's Infrastructure](#) and is calling for public policy action to make our country safer and sustainable for future generations. For more information about the infrastructure in your state, visit: <http://www.asce.org/reportcard/2005/index.cfm>.

To view the number of structurally deficient or obsolete bridges in your state visit: <http://www.fhwa.dot.gov/bridge/structyr.htm>

Bridge inspection programs will be a topic at the upcoming 2007 I-ENG-A Convention.

Information Source: Turner Fairbank Highway Research Center
Report located: <http://www.tfirc.gov/hnr20/nde/ppt/sld001.htm>



Prefabricated Bridge Elements and Systems: Bridges of Today—Photo credit: Texas Department of Transportation

Bridge Trivia Answers:

- 1: Total structurally deficient bridges in the US = 73, 694
- 2: The State with the highest # of structurally deficient bridges is Oklahoma with 6,299.
- 3: Gephyrophobia is the fear of crossing bridges.

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