I. German Testing Procedures

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The German standard for permanent safety barriers was published in 1972, on the basis of extensive tests conducted between 1962 and 1968. These tests already took into consideration the deceleration value as an important factor for road safety. The German standard is a standard for a definitive system. Test results have shown that the steel guardrail system is the most suitable system. Everything on this system is completely defined, and any change in the smallest detail is out of specification and unacceptable.

But do not be afraid either of German inflexibility or of our lack of dynamic development. As you may infer from the statement above, the German standard has been revised and amended several times since 1972. Here are some outstanding and decisive changes:

1. In 1980, it was decided by the federal ministry that it should be mandatory to install guardrails in central reserves of highways regardless of their width. This decision was made as a result of critical accidents that took place in central reserve sections that were wider than 10 m and had no guardrail. Since this amendment, the accident rate and severity of the accidents in central reserve areas have been dramatically reduced.
2. Another amendment was the introduction of a post with rounded edges called the "sigma" post. This change of the standard has also resulted in a tremendous success, considering the reduction of the severity of the accidents involving two-wheeled vehicles.

In August 1989, the German standard was extensively revised. The traditional steel guardrail system, however, was not at all changed as a permanent passive safety device. The revision, which has been published under the initials "RPS," mainly affects the guidelines for installation, taking into account the recent variations of vehicle weight and other components of public interest.

Other important amendments are the inclusion of crash cushions, which have been known for many years in the United States, and concrete barriers with very special applications on German roads. In the CEN committee, which consists of 18 European countries, we have taken over a huge responsibility. Our aim is to harmonize and standardize the traffic safety systems. In Germany we have found out that standardization of safety systems or devices does not make sense at all. In consequence, we are working on standardization of performance parameters, test procedures, test equipment, and test vehicles. We emphasize that the deceleration criteria is decisive for the effectiveness of a safety system. We also take into consideration other criteria, such as the displacement of the system upon impact, etc., which are of minor value, but useful for the overall evaluation. My personal opinion regarding deceleration values is that we can live with the ASI method for steel barrier safety systems because they are mainly installed for redirection purposes.

But for crash cushions, which are usually designed for frontal impacts, aiming to bring the vehicle to a controlled stop, we have to find another method for the evaluation. In this regard, I propose to intensify the cooperation between the United States and Europe because my understanding is that U.S. research and experience in this field is already both very advanced and efficient. See, for example, NCHRP Report 230 or other publications. Among the concerned European authorities and related industry, there are intensive discussions on rigid and nonrigid (flexible) systems as permanent passive safety devices. Regarding this problem, my personal opinion is as follows: it is impossible to please everybody. This is what common sense tells us.

The basis for my conception of promoting highway traffic safety is the prevention or the reduction of the number and severity of accidents, respectively, by the appropriate installation of passive safety devices, with the goal of providing adequate protection to those who are statistically the largest part of the highway accident rate and the aftereffects connected with them. Above all, this involves, of course, the prevention of fatal accidents and the decrease of accident severity from severe to medium or minor accidents, as well as a reduction of personal injury and material damages.

Getting back to my familiar quotation cited at the beginning, one cannot expect from the development and installation of passive safety devices for the highway, that all accidents and damage can be prevented or reduced, but rather numerically and qualitatively the largest part of a country's accident rate. Only this has a really good chance for economic success. It is not a matter of preventing one severe accident per year at a particular place and with a vehicle of a particular weight.

It is a matter of getting the greatest possible number of all potential accidents safely under control through the use of those safety devices that above all offer the person the greatest possible chance of surviving with, if possible, a simultaneous decrease in material damage.

If one agrees to this concept of safety and the understanding of safety connected with it, in my opinion, there cannot be any confusion about which basic system of passive safety devices has so far optimally met these requirements all over the world. It is the flexible and elastic steel guardrail system.

The inflexible (rigid) concrete barrier system (BGW) can never meet the requirements of modern safety systems, which are based on reasonable, that is, tolerable deceleration rates.

Again, if I set out to reduce the number and severity of accidents, for economic reasons I will have to follow the rules of the majority; and that means in this case that I have to consider the frequency curve of the highway accident rate. Therefore, to make sense economically, I must start with those accident groups that occur most often. The following are some round figures from Germany taken from official accident statistics for 1988:

Existing Vehicles

Automobiles	95 percent
Trucks	5 percent

Kilometers Traveled

Automobiles	90 percent
Trucks	10 percent

Accidental Deaths from

Automobiles	95 percent
Trucks	5 percent

On the basis of these bare numbers alone, it is obvious that approval of a trend towards inflexible systems is out of the question, simply because they are better in preventing a truck from breaking through a safety system. Actually, we rarely hear publicly of the tolerance of deceleration rates and their decisive effect on vehicle passengers, which are underestimated or hardly considered.

From the preceding, it is obvious to me that the development of the rigid BGW system as the commonly applied passive safety device for highways is clearly erroneous, which in reality overlooks modern knowledge of accident analysis. The BGW systems are justifiable in those cases that are cited in the German Standard RPS of 1989. At this point, for the good of highway traffic safety, the matter should rest.

Safety Barriers in Highway Work Zones

The subject of safety barriers in work zones has been characterized by requirements for separation of driving lanes, reduction in width of lanes, control of traffic flow, and transition from normal permanent to temporary situations. These situations have been dominated by products like road markings, including pre- fabricated foils; road studs or cat's eyes; plastic barriers; and portable concrete barrier sections.

But, because the frequency of results of recent accident analysis clearly shows that the numbers and severity of accidents in work zones are increasing dramatically, we have--as a steel guardrail manufacturer—decided to concentrate our efforts in research and development of new steel products and safety systems for work zones.

As steel people and hardliners for the flexible barrier systems, we are looking to find solutions on the basis of the safety parameters valid for flexible systems.

It is our aim to find the most adequate barrier combinations for

- Flexible and safe reaction after impact;
- Tolerable displacement of the system on impact;
- Smooth redirection of the vehicle after impact;
- Reduced danger of vaulting the system and crashing into oncoming traffic;
- Easy storage, loading, transportation, installation, repair, and maintenance of the system;
- Either no anchorage on the road or only anchorage at the beginning and end of the system;
- Easy disassembly in case of emergency;
- Easy reapplication after termination of the work zone;
- Easy transfer of the total system by special device in the work zone (e.g., changing from two to three lanes, or vice versa); and
- Reasonable costs.

Results of our first efforts in research and development are the systems Vario-Guard and Mini-Guard. These have been carefully tested by the University of Zurich, Switzerland (Vario-Guard) and the BAST, Federal Research Institute in Germany (Mini-Guard). Experience with our installation in Germany since last year is confirming our enthusiasm for these two systems, which may lead to a new successful era of steel guardrail systems as outstanding safety devices for the protection of people and vehicles in work zones.