JP RESEARCH INDIA PVT LTD

SAFETY SPEAK!

Road and Traffic Safety Newsletter Volume 6, No. 1 February 2011

From the Editor's Desk...

In this Issue!

189

No. of Accident Vehicles investigated to date by JPR India researchers as part of our India Traffic Studies

Once again, let me welcome in a new year by wishing you all health and happiness. For me, this year started out wonderfully with 3 weeks in India. The trip included a week in Pune for the SIAT 2011 conference, held by ARAI, where I had the pleasure of spending time with several automotive colleagues. The SIAT Conference and Expo booths have become a familiar scene for JPR India over the past few years, and we are proud to have been part of so many of these informative events.

The trip also coincided with a significant milestone achieved by JPR India: the opening of a new office in Coimbatore, Tamil Nadu, which will be our accident data collection and investigation center for the South. Our Chennai office will still serve as headquarters to oversee our operations until a smooth transition is completed. JPR India staff and I cordially invite you all to come and visit us in Coimbatore. (You might even get to watch a crash investigation on site!) The building is being made ready, and we hope to start full operations by the beginning of April.

Back home in the USA, I have been invited by the US National Highway Traffic Safety Administration (NHTSA) to participate in a workshop of experts on the question of how vehicle mass and size affects vehicle safety. The workshop would build on the work plan included in the final rule for the 2012-2016 CAFÉ (Corporate Average Fuel Economy) model year standards for light-duty vehicles, as well as address the Notice of Intent (NOI) for a 2017+ model year CAFÉ-plus-Greenhouse Gas Emission Standard. In that NOI, NHTSA and the US Environmental Protection Agency detail how this issue will be examined for future rulemakings. JPR USA will be presenting our findings from several accident data research projects on the influence of vehicle mass, size and other parameters on fleet safety. All in all, it is shaping up to be an interesting year!

-Jeya

Rules You Should Know...

Rules of the Road Regulations, 1989

Rule 8: Caution at Road Junction

The driver of a motor vehicle shall slow down when approaching a road intersection, a road junction, pedestrian crossing or a road corner, and shall not enter any such intersection, junction or crossing until he has become aware that he may do so without endangering the safety of persons thereon.

Rule 11: Right of Way

The pedestrians have the right of way at uncontrolled pedestrian crossings. When any road is provided with a footpath or cycle tracks specially for other traffic, except with permission of a police officer in uniform, a driver shall not drive on such footpath or track.

Infrastructure Analysis: Roadside Infrastructure

Doesn't the road in this photo look inviting, with its wide roadway, large shoulders, neatly asphalted surface, distinct white painted lane markers, and attractive striped poles on either side? If you are thinking this is a perfect road to take for a thrill ride, you are (possibly literally) dead wrong.


The NH47 Bypass

This is a newly built section of national highway in the Coimbatore district: the NH47 Bypass. It is one of four stretches of highway on which JPR India, in conjunction with Coimbatore Rural Police, conducted in-depth road traffic accident studies. While the JPR India team again noted numerous problems involving faulty intersection designs (see *SafetySpeak!* Vol. 5, No. 1), we also found that roadside infrastructure—specifically, those nice looking striped poles—can seriously affect crash severity.

ROADSIDE CONCRETE POLES

The striped poles on the roadside, seen in the above photo, are called delineators, guide-posts or roadway indicators. They are roughly 1.5 meters high before installation, have an octagonal cross-section, and are made of concrete. They have a slope profile, with the top diameter being about 18cm and the average diameter being 22cm (see diagram), and they are posted along roads at a constant gap of about 3 meters.

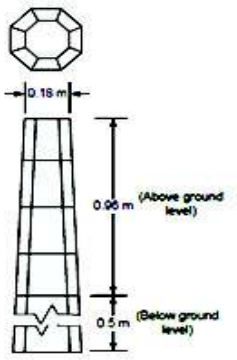


Diagram of a concrete pole, with dimensions.

The main purposes of these roadside delineators are to:

1. Indicate the alignment of the roadway to the road users, particularly at locations where the alignment might be confusing or unexpected.
2. Assist drivers to judge their position on the road while driving (i.e., help keep them on the roadway.
3. Guide drivers on road sections where visibility is often poor due to mist, fog and snowy conditions.

THE PROBLEM WITH CONCRETE POLES AS DELINEATORS

WHAT DID WE SEE?

Total crashes examined by JPR India on this highway	**17**
Total object impacts	**7** (all involved delineators)
Crashes during the day	**1**
Crashes during the night	**5**
Crashes during the dawn/dusk	**1**

Impact with these rigid delineators can cause small vehicles, such as cars, to stop abruptly, thus increasing the delta-V (or change in velocity as a result of impact) of the vehicle, which in turn has a direct effect on injury severity for occupants. While larger vehicles are rarely stopped dead by impact with these structures (the poles are not sturdy enough to obstruct a full-sized truck at speed), the vehicle usually sustains substantial damage. And in both cases, the delineators themselves are usually demolished or uprooted completely.

WHY DID THE VEHICLE GO OFF THE ROAD?

No, this is not the beginning of a riddle, but it *is* an interesting question: What causes vehicles to veer off the road and into the delineators? This highway is undivided, and lot of vehicles overtake each other using the oncoming lane (you can see this happening in the top photo, in fact). Of the 7 object-impact crashes JPR India investigated during its short period of study on this road, 3 were caused due to unsafe overtaking, and 2 more occurred due to drowsiness or inattention (reasons for the final 2 crashes are unknown); however, *all* involved delineators. To avoid collision with an oncoming vehicle due to overtaking or a sleepy or distracted driver, drivers often have little choice but to go off the road. Unfortunately, in this case, the roadside is not always a safer option.


Damage to a car after collision with a concrete pole.


A truck gone off the road. Note the uprooted concrete poles thrown into the distance.


Concrete pole crushed after it was hit by a vehicle.

Infrastructure Analysis: Roadside Infrastructure *(cont'd)*

RECOMMENDATIONS—SO WHAT CAN BE DONE?

Flexible delineators could be used in places where the roadside geography is fairly level (no steep drop-offs) or as dividers on two-lane highways. Made of brightly colored plastic or PVC, with reflective strips (see photos), this "impact friendly" type of delineator guides drivers safely along roadways, even in the dark. Flexible delineators are designed to give way to vehicles going off the road, without causing serious harm to vehicles or occupants. When placed along center medians (for example, in high-traffic areas or where visibility for overtaking is impaired), they would also prevent most vehicles from crossing into oncoming lanes.

Flexible Delineators

Jersey Wall

When there is a steep profile on either side of the road, or two-way traffic is particularly dangerous, concrete delineators could be replaced with **crash barriers** (jersey wall or guard-rail). In such cases, the threat to life for vehicle occupants due to a fall (or increased chance of a head-on collision) is greater than the risks presented by the crash barrier itself. These crash barriers not only prevent vehicles from going off road/crossing dividers, but they are designed to deflect them back to the roadway/proper lane without serious damage or injury. Since there is no sudden deceleration, the delta-V (and corresponding injury severity) is considerably less than seen with the concrete poles. These options make it clear that the choice of roadside infrastructure plays a major role in decreasing crash severity.

THE SCIENCE BEHIND THE DESIGN

Sizing Up Crash Test Dummies

Accurate and detailed road accident data is critical for vehicle and road safety design applications. But data needs don't end with the details analysts can glean from crash forensics. It is one thing to know that crash victims in certain crashes typically sustain certain injuries, but it is quite another thing to know how to design a vehicle to protect an occupant from that and other types of injuries. That is where anthropometric data concerning the target users of such vehicles come into play.

As reported by Kulkarni , et al., at the 2011 SIAT conference in January, the Automotive Research Association of India (ARAI) recently initiated a comprehensive project—SIZE INDIA—to collect anthropometric data for India's population using a three-dimensional (3D) whole body scanner. The project used a stratified random sampling method that looked at five geographical zones of India (North, East, South, West and Central). In each region, ten sites representing the region were selected for the survey. A total of about 5,000 drivers between 18 and 65 years of age were surveyed, and a set of 100 dimensions relating to ergonomic and safety design were measured for each.

The SIZE INDIA study found that the mean standing height of an Indian male was 167 cm (5 feet, 6 inches), which is 10 cm (4 inches) shorter than the mean standing height of a North American male and 2 cm (1 inch) shorter than the mean Japanese male. The corresponding data for an Indian female was 156.2 cm (5 feet and one inch), which is 6 cm (3 inches) shorter than the mean standing height of a North American female and 2 cm (1 inch) shorter than the mean Japanese female. The study also noted that the average height was greater for ages 18-29 compared with ages 30-59.

Early "Sierra Sam" dummies, modeled on North American men
http://www.ncl.ac.uk/nsa/sam.htm

A SHORT HISTORY OF TALL DUMMIES

Accurate anthropometric data for a nation is extremely important for safety systems designs, but in the less scientific early days of crash testing, cadavers and some plucky researchers were used to test designs. However, in the early 1950s, crash/injury science took a giant step forward when Alderson Research Labs (US) and Grumman created a standardized, mass-producible dummy for conducting crash tests in both motor vehicles and aircraft. Alderson went on to produce its VIP-50 series, built specifically for General Motors and Ford, but also adopted by the National Bureau of Standards. Then GM engineers decided to combine the best features of the VIP series and "Sierra Stan" (another dummy design that existed at the time, derived from the earlier "Sierra Sam"—see photo box), and the 1971 Hybrid I was born.

Sizing Up Crash Test Dummies *(cont'd)*

ALL IN THE FAMILY

Hybrid I was a "50th percentile male" dummy (modeled on an average North American male in height, mass, and proportion). The original 1949 dummy that Sierra Stan was modeled on had been a 95th percentile male dummy (heavier and taller than 95% of human males). In time, GM and the Society of Automotive Engineers (SAE) shared both this design and a 5th percentile female dummy with the greater safety design industry.

Over the years, dummies have grown increasingly sophisticated. Hybrid II, the first dummy to comply with the American Federal Motor Vehicle Safety Standard (FMVSS) for testing of automotive lap and shoulder belts, offered improved shoulder, spine, and knee responses, and more rigorous documentation. In 1973, a 50th percentile male Hybrid II dummy was released, and then NHTSA and GM began work on Hybrid III.

Hybrid III Family

The 50th percentile Hybrid III male dummy which made its first appearance in 1976, is the familiar crash test dummy, and he is now a family man. If he could stand upright, he would be 175 cm (5 ft. 9 inches) tall and would have a mass of 77 kg (170 lb). He occupies the driver's seat in all the Insurance Institute for Highway Safety (IIHS) 65 km/h (40 mph) offset frontal crash tests. He is joined by the bigger 95th percentile Hybrid III, at 188 cm (6 ft 2 in) and 100 kg (223 lb). Ms. Hybrid III is a 5th percentile female dummy, at a diminutive 152 cm (5 ft) tall and 50 kg (110 lb). The three Hybrid III child dummies represent a ten-year-old, six-year-old, and three-year-old, ranging in weight from 15-21 kg (33-47 lb). The child models are very recent additions to the crash test dummy family. Because so little hard data are available on the effects of accidents on children, and such data are very difficult to obtain, these models are based in large part on estimates and approximations. The primary benefit provided by the Hybrid III is improved neck response in forward flexion and head rotation that better simulates human movement.

MOVING BEYOND HYBRID III

Hybrid IIIs are designed for research into the effects of *frontal* impacts; they are less valuable in assessing the effects of other sorts of impacts, such as side impacts, rear impacts, or rollovers. Also, as mentioned, they are quite large and thus not particularly useful outside North America. Some other standard dummies now available for wider application include:

The SID (Side Impact Dummy) family of test dummies has been designed to measure rib, spine, and internal organ effects in side collisions. SIDs also assesses spine and rib deceleration and compression of the chest cavity. SID is the US government testing standard, EuroSID is used in Europe to ensure compliance with safety standards, and SID II represents a 5th percentile female. BioSID is a more sophisticated version of SID and EuroSID, but is not used in a regulatory capacity. The WorldSID is a project to develop a new generation of dummy under the International Organization for Standardization.

Thor

BioRID is a dummy designed to assess the effects of a rear impact. Its primary purpose is to research whiplash and to aid designers in developing effective head and neck restraints. BioRID is more sophisticated in its spinal construction than Hybrid III. 24 vertebra simulators allow BioRID to assume a much more natural seating posture and to demonstrate the neck movement and configuration seen in rear-end collisions.

CRABI is a child dummy used to evaluate the effectiveness of child restraint devices, including seat belts and airbags. There are three models of the CRABI, representing 18-month, 12-month, and 6-month-old children.

THOR is an advanced 50th percentile male dummy. The direct successor to Hybrid III, THOR has a more humanlike spine and pelvis, and its face contains a number of sensors which allow analysis of facial impacts to an accuracy currently unobtainable with other dummies. THOR's range of sensors is also greater in quantity and sensitivity than those of Hybrid III.

APPLICATIONS FOR INDIA

Even though many comprehensive dummies are available representing developed countries populations, anthropometry for the Indian population was largely unknown until recently. The implications for Original Equipment Manufacturers (OEMs) are significant. Models (dummies) currently used in vehicle and safety design might not take into account the shorter stature of the Indian people or their apparent growth in recent generations. Any vehicle safety systems designed for the Indian population must take these factors into account, particularly in conjunction with data on the age and gender of driver/occupants involved in most crashes. If most of the drivers will be under 30, or perhaps even under 40 (to allow for a 10-year useful road life of the vehicle), it would make sense to use the larger height data for the up and coming generation. Clearly there is still information to be gathered and analyses to be performed, but the result should be safer vehicles for India.

JPR India at SIAT 2011

This January, JPR India took part in the 2011 **Symposium on International Automotive Technology (SIAT)** conference and expo in ARAI, Pune. JP Research group President and Founder, Ms. Jeya Padmanaban was an invited keynote speaker at the conference. Her presentation, "**Safety, Is It Green?**", emphasized that "green" vehicles must be good not only for the environment but for their occupants and others who may be involved in road crashes with them. For example, a crudely retrofitted vehicle with an LPG tank in the back seat was shown to have been very bad for those in its immediate "environment". Fortunately, many new green vehicle designs incorporate new safety features as well, such as busses in India that address the serious injury and fatality problems associated with riders on foot-boards and with busses running over sideswiped two-wheelers. By adding doors to eliminate open foot-boards and lowering floors to prevent underrun, the new vehicles address two major safety issues posed by older bus designs. Of course, in order to develop safety solutions specific to India's roads and users, designers first need to identify what these problems are and how they differ from the problems seen in other countries (for example, there are more pedestrians on the roads in India than in the US). For that, India needs to collect good crash and injury data. Then our vehicles, green or not, can help to ensure we all live a little better, and isn't that the point of going green?

Ms. Jeya Padmanaban, making her keynote presentation during SIAT '2011.

JPR India stall at SIAT Expo

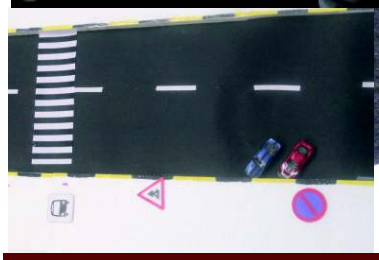
And at the Expo...

JPR India also took part in SIAT Expo 2011, with an exhibition stall at the venue. The stall sported posters showing methodology and statistics from our on-site crash investigation studies, but the greatest attraction was a remote-control car game where the goal was to drive to a crash spot from our JPR India base and back without breaking any traffic rules. The course was extremely challenging, but that didn't stop an enthusiastic driver from making the run in a record 1 minute and 39 seconds!

We also encouraged all our visitors to take a simple survey about traffic rules and road safety. Our questionnaire consisted of 20 questions that focused on their understanding of traffic rules as well as people's usual road behavior and asked their opinion of changes that could improve road safety in India. To link these two activities, we introduced some obvious mistakes into the course of the remote-control game (some of them shown in the photos, below). We then had a field in the questionnaire asking: "List all the mistakes you see in the course". To our surprise, most of the answers focused on the road surface or sharp turns, and the fewest noted improper lane markings, incorrect road signs, and problems with the pedestrian infrastructure. Are we learning the art of "getting used to" what is not correct? The analysis of these answers should be interesting and will be presented in our next issue of ***SafetySpeak!***

Overwhelming response for the stall by visitors of all age groups. (Left)

Remote control car course (Right). Note the improper lane markings, absence of deceleration lanes for U-turns, and absence of pedestrian crossing at a 4-way junction.



Parking in 'No Parking' zones; no separate bus stop lane

'Compulsory Horn' sign placed near a hospital

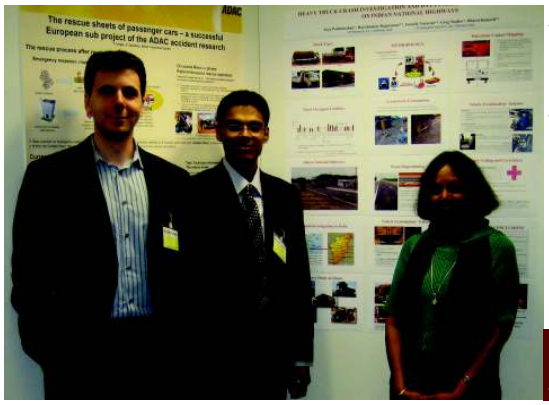
Conferences …. Past and Future

After a successful finish of our 60-day, on-scene crash investigation study in Coimbatore, conducted with the help of Tamil Nadu Police, JPR India began the effort to share our findings. Project principals attended various conferences world wide to present and publish results of the in-depth traffic crash studies we carried out in India. Below is a glimpse.

SIAM Convention 2010, Chandigarh, India

JPR India was invited to give a presentation at the Society of Indian Automobile Manufacturers (SIAM) Convention 2010, which was held in Chandigarh on 5 May 2010. Mr. Ravishankar Rajaraman gave a presentation on **"Crash Investigation & In-Depth Accident Data Collection"**. The presentation explained the methodologies used by JP Research to perform in-depth accident study in India and also the need for in-depth crash data collection in the country.

IRCOBI and ESAR 2010, Hannover, Germany



Dr. Vitaly Eyges, Mr. Swastik Narayan, and Ms. Jeya Padmanaban, in front of the JPR India poster at ESAR 2010

JPR India participated in the International Research Council on Biomechanics of Injury (IRCOBI) and Expert Symposium in Accident Research (ESAR) conference held in Hannover, Germany on the 13-19th of September. Ms. Jeya Padmanaban presented a paper on **"Analysis of In-Depth Crash Data on Indian National Highways and Impact of Road Design on Crashes and Injury Severity"**, explaining the effect of road structure on crashes. The findings presented result from detailed crash investigation and research JPR India has done on the national highways of Tamil Nadu**.** JPR India also presented a poster on **"Heavy Truck Crash Investigation and Data Collection Methodology on Indian National Highways"**, which explained the truck investigation methodology we use to examine truck crashes in India.

ICRASH 2010, Washington DC, USA

JPR India also attended the ICRASH Conference 2010 held in Washington D.C. on 21-23 October 2010. Mr. Ravishankar Rajaraman presented a paper on **"Analysis of Fatal Crashes of Chennai City's Metropolitan Transport Corporation (MTC) Buses",** which resulted from a pioneering study made by JPR India to understand the MTC bus crashes in Chennai city. As always, we would be happy to share any of these presentations with you, in reply to your email request.

Coming Up for 2011, Some Conferences You Don't Want to Miss:

SAE 2011 World Congress
12-14 April 2011
Cobo Center
Detroit, Michigan USA

AAAM, 55th Annual Conference
2-5 October 2011
Paris, France

2011 IRCOBI Conference
14-16 September 2011
Krakow, Poland

In the News

NHTSA concludes "No electronic cause of Unintended Acceleration (UA) incidents for Toyota vehicles"

NHTSA conducted a 10-month investigation and concluded that there is no electronic-based cause for unintended high speed acceleration in Toyotas. In addition to enlisting NASA to identify any vulnerabilities in the Toyota electronic control system (ECS), NHTSA obtained the services of the National Academy of Sciences to examine the safety implications of ECSs, which are increasingly common in motor vehicles. NHTSA has decided to take several actions aimed at diminishing the risk of UA and strengthening the agency's ability to address current and future issues related to safety of ECSs. Some of these actions include initial rulemakings on brake override systems, keyless ignition systems and event data recorders. In addition, NHTSA will begin research on the placement of accelerator and brake pedals and driver usage of pedals.

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JPR India Mission Statement

To mitigate accidents and injuries to road users in India by helping local automotive safety organizations, government agencies, and manufacturers through accident and safety research and training, and creating public awareness of automotive safety issues.

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