Mike Dreznes and Rod Troutbeck called the meeting to order at 9:02 AM on Tuesday July 17, 2012 in the Passive Safety Lab of Politecnico di Milano in Milan, Italy. One hundred and eighteen people attended the meeting.

Dreznes explained the history of the AFB20 (2) International Research Subcommittee as well as its purpose and current status. The AFB20(2) International Research Subcommittee currently has one hundred and two Members, twenty four Corresponding Members and two hundred and fifty one Friends from thirty three Countries.

To become a Member, a person must attend three meetings. To remain a Member, Members from outside the USA and Canada are expected to attend a winter or summer meeting once every two years. USA and Canadian Members are expected to attend a winter or summer meeting twice every two years in order to remain a Member.

Corresponding Membership is a new classification. Corresponding Membership is only by invitation from the co-chairs. Attendance at the meetings by Corresponding Members is strongly encouraged, but not required. This type of membership was created to enable industry experts to have a greater involvement even though their ability to travel is limited. It expands the Subcommittee’s ability to meet its stated mission by having a greater involvement of representatives from North America and Europe.

The Membership list is on the Committee’s website.

Mike Dreznes presented an update on the “END Turned Down ENDS” initiative. This initiative is intended to help eliminate the use of turned down ends, “fishtails” and “spoons” on the approach end of longitudinal barriers. It is being well accepted when presented to road authorities around the world. Jamaica, Brazil and Abu Dhabi are revising their standards to ensure the use of crashworthy terminals on the approach ends of their longitudinal barriers. The European Members of the Subcommittee recognize the importance of crashworthy terminals. It was noted that one country has approved the use of a particular design of a turned down end terminal when used at a site with a design speed under 80 km/h. It also was noted that some approach end turned down end terminals may be acceptable if the terminal is located outside the clear zone. Members and Friends are encouraged to promote the use of this “END Turned Down ENDS” initiative whenever possible.

The following Presentations were made. A TRB Circular with a summary of each presentation will be available in the near future.

**Presentations**

**SESSION I CHAIRMAN: Rod Troutbeck, Troutbeck Associates, Australia**

1. *NCHRP 350 Compared to MASH*
2. **Can EN 1317 and NCHRP 350/MASH be Used Interchangeably?**
   Jason Hubbell, Atlanticum Bridge Corp, Italy (15 min)

3. **Current Status of EN 1317. US/Europe Test Result Mutual Recognition**
   Marco Anghileri, Politecnico di Milano, Italy, (20 min)

4. **EN1317 & CE Marking versus National Regulations**
   Franz Muller, Road Safety Consultant, Italy (15 min)

5. **The Latest Update to the British Vehicle Restraint Assessment Process**
   Martin Heath, MHA Planning & Transport, UK (15 min)

10:30 am  **BREAK**

**SESSION II CHAIRMAN: Marco Anghileri, Politecnico di Milano, Italy**

6. **An Introduction (or Re-Introduction) to the Safe System Approach**
   Raph Grzebieta, Transport & Road Safety (TARS) Research, UNSW, Australia (20 min)

7. **Real World Implications of the Safe System Approach**
   J. Marten Hiekmann, PASS CO, Germany (20 min)

8. **Introducing the IRDES Project (Improving Roadside Design to Forgive Human Errors)**
   Prof. Eng. Francesca La Torre, University of Florence, Italy (20 min)

9. **END Turned Down ENDS**
   Mike Dreznes, International Road Federation, USA (15 min)

10. **END Turned Down ENDS – How the United Kingdom Accomplished It**
    Steve Powell, Highway Care Ltd., UK (20 min)

11. **End Treatments of Safety Barriers - Best Practice and Challenge in Germany – German Experience**
    Uwe Ellmers, BASt, Germany (15 min)

12:30 pm  **LUNCH**

**SESSION III CHAIRMAN: Ali Osman Atahan, Mustafa Kemal University, Turkey**

    Angel Martinez, HIASA, Spain (15 min)

    Gavin Williams, TRL, United Kingdom (15 min)

14. **Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Guardrail Posts by Motorcyclists as well as Trees and Posts – Australian Experience**
    Raph Grzebieta, NSW Injury Risk Management Research Centre. Australia (15 min)

15. **Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Obstacles and Road Equipment – Swedish Experience**
    Åke Löfqvist, Swedish Transport Administration, Sweden (15 min)

Frank Brandt, Volkmann & Rossbach, Germany (15 min)

17. **Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Posts and Luminaire Supports – United States and Other International Experiences**
   Art Dinitz, Transpo Industries, USA (20 min)

18. **Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Posts and Luminaire Supports based on EN12767–Europe**
   Carolien Willems, Safety-Product, Belgium (15 min)

3:30 pm  
BREAK

SESSION IV CHAIRMAN: Gavin Williams, TRL, United Kingdom

19. **Development of a Redirective Crash Cushion to EN 1317-3**
   Luigi Grassia, Second University of Naples, Italy (15 min)

20. **Development of N2/H1 Performance Level Guardrail: Crash Testing and Simulations**
   Ali Osman Atahan, Mustafa Kemal University (MKU), Turkey (15 min)

21. **Risks of Unprotected Median Drainage Ditches on Vehicle Stability**
   Ali Osman Atahan, Mustafa Kemal University (MKU), Turkey (15 min)

22. **How High Friction Surfacing can Help to Reduce Roadside Hardware Crashes**
   John LeFante, DBI Services, USA (15 min)

23. **Development of a Recycled Substrate Material for Road Signs**
   Jason Hubbell, Atlanticum Bridge Corp, Italy & Liz Walker, Image Microsystems, USA (15 min)

24. **A Very High Precision “Weigh In Motion” Concept Based on Optical Fibers Technology**
   Andrea Demozzi, IRIS, Italy (15 min)

25. **The ABC’s of TMAs**
   Mike Dreznes, International Road Federation, USA (15 min)

26. **The Importance of an Appropriate Transition in a Longitudinal Barrier Design**
   Mike Dreznes, International Road Federation, USA (15 min)

27. **Consideration of Wood Mechanical Properties Variation in Roadside Safety Barriers Performances Evaluation**
   Clément Goubel, INRETS Road Equipment Test Laboratory, France (15 min)

1. **NCHRP 350 Compared to MASH**
   Mike Dreznes discussed the differences between NCHRP 350 and MASH. He summarized the differences in vehicles, angles, and implementation procedures. Dreznes emphasized that NCHRP 350 products will continue to be used in the United States for many years since each state can decide when they want to stop using NCHRP 350 products. He suggested that countries outside of the United States and Europe allow products that meet either NCHRP350/MASH or EN-1317 depending on their vehicle fleet.

2. **Can EN 1317 and NCHRP 350/MASH be Used Interchangeably?**
   Jason Hubbell explained how NCHRP 350 and MASH could compare to EN1317 when reviewing kinetic impact energy. His conclusion was that a much more thorough analysis would need to be done to show exactly how these standards might align to one another.
Hubbell also explained that such an analysis would be important in countries that are currently applying both EN1317 and NCHRP 350 or MASH. Such a comparison could potentially give guidance to road design engineers as to which EN1317 products could be safely installed with NCHRP 350 or MASH products (or vice versa). Countries such as Australia and the UAE are examples of markets using products on their roadways that have been tested to either EN1317 or NCHRP 350/MASH. Having such guidance could potentially prevent dangerous roadside hardware combinations.

3 Current Status of EN 1317. US/Europe Test Result Mutual Recognition
Marco Anghileri pointed out the differences between EN 1317 and MASH. He emphasized that EN1317 and MASH are too different to be used as a single standard, but many of the technologies used to perform the tests, acquire data and evaluate performances are the same. He explained that the European TMA standard probably will accept NCHRP 350 or Mash tests, although it may require a test with a 1500 kg vehicle.

Anghileri pointed out that tests run at accredited test houses, regardless of the location of the test house, should be acceptable in Europe or the United States. This continues to be a matter of discontent in Europe and needs to be resolved. Dreznes emphasized that tests must be run using the specific criteria in either EN-1317, MASH or NCHRP 350 and test houses should not modify the criteria and then say the product was tested “in the spirit” of the test criteria. This reduces the credibility of the test criteria.

4 EN1317 & CE Marking versus National Regulations
Franz Muller explained that many people try to understand EN-1317 and they consider the standard as the only European rule since CE marking is necessary to sell in the market. However, these are only the rules for products and producers, not for the installation, where each country is free to decide what to install where. Part 5 is already mandatory in several countries and will become mandatory for all EC Countries on July 1, 2013 when the new CPR will become effective.

Muller pointed out some of the discrepancies between European countries regarding which roadside safety products should be installed where. The result is that there are different safety levels on roads in the different European countries. Muller showed examples from Italy, France, Germany, Spain, Poland and the United Kingdom.

Muller suggested that a European Directive for uniformity be created. This work could be started by the experts at CEN by creating an installation standard and developing guidelines that can be a reference for all European Countries.

5 The Latest Update to the British Vehicle Restraint Assessment Process
A terrible accident in in 2001 England where a car went behind a longitudinal barrier and landed on a train track that caused two trains to impact each other forced the Highway Agency to review their standards for road safety restraint systems.

Martin Heath explained how a Risk-Based Methodology was developed. A spreadsheet was created and by inputting site data information a Total Risk Factor that could be determined. This Total Risk Factor can be used to establish priorities.

6 An Introduction (or Re-Introduction) to the Safe System Approach
Raph Grzebieta presented the history of the Safe System Approach. Safe System thinking evolved from visions emerging in Sweden and the Netherlands in the mid-1990s and then later from Australia at the turn of the century in 1999 to 2002.

However, its application relied on road authorities and others interpreting the principles and planning actions consistent with this thinking. The Safe System Approach called for a “paradigm shift” in road safety thinking. It required the development and management of a road traffic transport system that is inherently safe for human users. It emphasized that the road designer must be actively or passively aware of human error and compensate for it.

The Safe System Approach requires designers to propose countermeasures that reduce crash severity to survivable limits and/or eliminate or compensate for the human error. It also shifts responsibility from an emphasis on road users being responsible for their behavior on the road to a greater responsibility for road system designers and managers to build safe guards into the system to prevent injury-causing crashes.

The Safe System Approach underpins the Decade of Action and WHO’s approach to road safety. Its success will be determined by the level of political and managerial commitment and leadership. It is an ethical approach to road safety focusing on human injury tolerance and accepting that humans make errors requiring road designs to be error tolerant.

Designers of the system are ultimately responsible for the design, operation and use of the road transport system and responsible for the level of safety within the entire system. Infrastructure engineers must fundamentally change their focus from building roads that accept a certain level of death and injury will always occur, to building roads that recognize human error, encourage self-correction, and if human error occurs, reduce crash forces to not only survivable levels, but to levels where a road user can fully recover from the event;

Motor vehicle manufacturers must design cars with both active and passive safety. Vehicles must perceive when a driver is about to lose control of the vehicle and actively correct the vehicle either back on track or away from the crash trajectory. If a crash is imminent, technology must slow the vehicle down faster than the driver can while activating all restraint systems into crash mode. The passive crashworthy systems must then activate during the crash event. Raphael also indicated that wherever passive forgiving wire-rope barrier systems coupled with tactile line marking for alerting fatigued drivers have been installed there have been dramatic falls in fatal and serious injury crashes.

The Safe System Approach will require motor vehicle drivers to drive more slowly than they might like until inherent safety of the road traffic system can be assured. The aims of no harm to humans may seem unrealistic to the community and many of its leaders, but it should be pursued. Additional resourcing may be required to meet the needs of infrastructure re-engineering, especially in countries with vast road networks and small populations.

7 Real World Implications of the Safe System Approach

J. Marten Hiekmann explained that due to the creation of the EU, traveling within the EU has become easier and more frequent. The European Commission set up a program to ensure that road users (drivers, vulnerable road users) of Member States had equal quality of passive road safety on roads, highways, etc. regardless of the country where they were driving.
To accomplish this goal, the European Commission established the following objectives: Create a minimum standard for passive road safety, a standard for Road Restraint Systems; and Open the EU market to Vehicle Restraint System manufacturers without technical trade barriers and national requirements (free trade, “New Approach”).

The EC published the Construction Product Directive (CPD 89/106/EEC) in 1988 to standardize testing, performance and conformity procedures. In 1992, under Mandate M/111, the EC commissioned the European Committee of Standardization (abbreviated to CEN hereafter) to provide the technical specifications for Road Restraint Systems (CEN/TC226/WG1). These specifications were published as the EN 1317, which declared that a CE mark was obligatory for Vehicle Restraint Systems from 01. January 2011.

Hiekmann commented that three parties are critical to the passive road safety planning chain:
1. Road authorities/road safety planners;
2. Vehicle Restraint System manufacturers; and

He also noted that the passive road safety planning chain consists of three steps:
1. Planning – what product to put where, why and when?
2. Proceeding – correct installation and repair work? Traceability?
3. Maintaining – approve and tolerate construction defects?

To avoid defects and errors, the above-mentioned steps need special attention when it comes to Vehicle Restraint Systems. Vehicle Restraint Systems need to be assembled without any interruption, with tested connections, terminals and transitions.

Vehicle Restraint System manufacturers can offer high technology solutions and take responsibility for the performance and quality of their systems, according to the norms. Road planners, authorities, and administrations need to be sensitized to ensure that road users do receive the minimum required passive road safety. To accomplish this, more attention must be drawn to the installation and assembly of Vehicle Restraint Systems. Special training, approval systems and employment of confirmed Vehicle Restraint System assemblers need to receive more recognition in future.

8 Introducing the IRDES Project (Improving Roadside Design to Forgive Human Errors)

Prof. Eng. Francesca La Torre explained that the purpose of the IRDES Project was to provide a practical guideline for designing forgiving roadsides. Two outputs with specific reference to a well identified set of roadside features were developed: A practical and uniform guideline that will allow the road designer to improve the forgivingness of the roadside and a practical tool for assessing (in a quantitative manner) the effectiveness of applying a given roadside treatment.

The roadside features that were considered included barrier terminals, forgiving support structures for road equipment, shoulder rumble strips and shoulder widths. Webinars were an extremely useful tool for discussion during the development of the project to ensure the final outcome met the user’s expectations. Preliminary feedback on the Guideline has been extremely positive.

9 END Turned Down ENDS
Mike Dreznes explained that road authorities worldwide recognize that the most dangerous part of a longitudinal barrier is the end. Understanding the importance of a safe barrier end, researchers have developed a variety of end treatments or terminals since their introduction in the 1960’s to reduce the dangers of blunt ends.

A crashworthy end treatment must be able to act as an anchor to redirect an errant motorist during an impact near the upstream or nose of the barrier. Therefore, it must be very strong. However, crashworthy end treatments also must act like a cushion to reduce the deceleration of an errant motorist who inadvertently impacts the end of the barrier head-on without ramping, rolling or pitching. Therefore, the end treatment must also be soft with the ability to cushion an errant motorist.

Too many countries still have non-crashworthy terminals, such as turned down ends, fishtails, or spoon terminals in their standards. A “NON-CRASHWORTHY TERMINAL” by definition is a terminal that either has not been tested to EN 1317-4 (now 7), or NCHRP 350/MASH or it is used at a site that has a design speed that is higher than the speed the terminal was tested to in EN 1317-4 (now 7) or NCHRP 350/MASH.

On January 24, 2011, the Transportation Research Board AFB20 (2) Roadside Safety Design Subcommittee on International Research introduced the “END Turned Down ENDS” resolution that was designed to eliminate the use of outdated and ineffective non-crashworthy, longitudinal barrier terminals like “Fishtails” or “Spoons” or “Turned Down Ends.” This resolution was endorsed by the International Road Federation (IRF) Washington on March 23, 2011. This resolution needs to be enforced around the world.

Dreznes discussed the current status of EN1317-4, which is the testing criteria for terminals in Europe. European road authorities were encouraged to mandate the use of these criteria and not to make it voluntary. Dreznes questioned the reason for separate testing criteria for 80 km/h “non-energy absorbing terminals.” This appears to be an attempt to create a performance specification to meet a particular existing design. Dreznes suggested that this format is not in the best interest of safety on the roads and all terminals should be tested to the same performance criteria regardless of their design.

10 END Turned Down ENDS – How the United Kingdom Accomplished It

Steve Powell explained the process that the UK experienced to ultimately ban the use of non-crashworthy terminals. The Highway Agency needed to accept the fact that the terminals they were using were not tested and were unlikely to meet the requirements of EN 1317-4 at 110 km/h (P4). A number of highly visible fatal accidents with ramped ends occurred and the Fifth Gear television program ran a demonstration showing the performance of the ramped end.

Powell explained all the reasons the Highway Agency did not immediately respond to efforts to outlaw the non-crashworthy terminals. These included the belief that there was no real evidence of ramped ends being hit; concern that over with over 30,000 ramped ends if only some were replaced with P4 terminals that it would leave itself open to liability issues; and the cost of P4 terminals. These points were debated and ultimately the Highway Agency did outlaw the use of non-crashworthy terminals, including turned down ends in 2004. Terminals that are tested to 110 km/h must be used on the approach end of longitudinal barriers at sites with design speeds over 80 km/h.
Today over 6,000 crashworthy terminals have been installed in the United Kingdom.

11 End Treatments of Safety Barriers - Best Practice and Challenge in Germany– German Experience

Uwe Ellmers presented the German position regarding terminals. Terminals are needed at the beginning and end of road restraint systems. In the national guidelines, no products are described, only performance requirements. Terminals are necessary as anchorage for steel guard rails. Most of the terminals in use in Germany are turned down end terminals.

Terminals have to be (successfully) crash-tested acc. to ENV1317-4 or 1317-7. P-2 (80 km/h) Terminals are required and a minimum length of safety barrier including terminal must be present in front of an obstacle. If there is not enough length in front of an obstacle, crash cushions were used.

The German Provinces (Bundesländer) were surveyed and they said they do not have a safety problem with turn-down ends in Germany. They have some accidents on these devices. It could happen that there is a second incident. Often the position of the terminal is wrong or the installation is wrong.

The German Road Authorities will wait for the Harmonization of 1317-7 and they plan to qualify their standard turn-down ends to this European Standard. They will increase the performance class up to T 80/T100 with a modified turn-down end terminal. The German Road Authorities will monitor the (accident) situation and the market and find solutions for locations where turn-down ends are not suitable and crash cushions are disproportionate.

The German Road Authorities do not regard the topic of “Terminals“as a safety problem or one of the major topics to deal with. There are other more important topics to solve.

13 Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Guardrail Posts by Motorcyclists – United Kingdom Experience

Gavin Williams explained the process leading up to the first installation of a motorcyclist protection device (MPS) in the UK in March 2004 at the A2070 Cloverleaf Junction, Kent.

This site had been identified as having an existing problem at the Cloverleaf Junction with numerous fatalities and serious accidents mostly involving motorists losing control and colliding with the support posts for the safety barrier. At a Coroner’s Inquest into a fatal accident in August 2002, the Coroner instructed the Local Highway Authority to undertake such measures as to prevent the likelihood of further accidents of this nature and severity from re-occurring.

In the five years prior to the installation, fourteen motorcyclist casualties had occurred at the location (3 fatalities, 8 serious and 3 slight injuries.) All of the incidents occurred in dry conditions during the months between February and September.

A review of motorcyclist protection systems available at the time was then undertaken – the effect on the performance of the safety barrier was included in the review. A submission for the
addition of a secondary rail was submitted to the Highways Agency in January 2004, with approval being granted in March 2004. The system was then installed in late March 2004 and the speed limit was reduced from 70mph to 50mph.

Since the installation of the system (and the reduction in speed limit) no personal injury accidents have been reported - there may have been one motorcyclist impact with the system during that time.

Some of the research that was conducted revealed that 92% of injured motorcyclists are male, even though they only travel 75% of the motorcycled miles. Seventeen percent of the fatal motorcycle to VRS impacts involved a prior impact with a curb. The research showed that 77.6% involved no pre-collision, 72.7% of the fatal incidents occurred during daylight, whilst 84.6% were in lit surroundings (i.e. daylight or a lit road.)

TD19/06 requires that motorcyclist protection be considered for areas with a potentially high risk of a motorcyclist impact, although no methodology is currently provided. TRL are currently undertaking work on behalf of the Highways Agency and Transport Scotland to update the data within the original analysis. This will lead to a further understanding of the issues regarding motorcyclists and VRS. In turn, this may lead to the development of risk assessment methodologies for the installation of motorcyclist protection devices. The protection of other road users will also be considered within any decision making processes.

14 Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Guardrail Posts by Motorcyclists as well as Trees and Posts – Australian Experience

Raph Grzebieta presented conclusions from a retrospective study of motorcyclists that were fatally injured following a collision with a roadside barrier during the period 2001 to 2006 in Australia and New Zealand. Data revealed that such crashes are very infrequent events constituting around 6.6% of all motorcycle crashes and only around 1.3% of all road fatalities in Australia. Other countries also display similar low figures. For example, Clay Gabler from the US Virginia Tech is having difficulty finding sufficient cases for the NCHRP PROJECT 22-26 ‘Factors Related to Serious Injury and Fatal Motorcycle Crashes with Traffic Barriers.’ Since March of 2009 only 10 cases have been collected to date.

It was found that rider behavior plays a significant role in motorcyclist fatalities into roadside barriers in Australia and New Zealand. Alcohol, drugs or speed played a role in two out of every three fatal barrier crashes. Further, crashes appeared to occur predominantly on recreational rides. It was also noted that a high proportion of the motorcyclists were on recreational rides in areas that provide challenging riding conditions when they collided with a barrier. An association between riding a sports motorcycle and receiving thorax injuries was established.

A similar situation exists in the United States in that rider behavior in terms of excessive speed and not wearing helmets also appears to play a significant role in motorcyclist fatalities. The study also found that a motorcyclist was 3.6 times more likely to be killed hitting a tree than when hitting a roadside barrier. Enforcing helmets and travel speeds within speed limits, coupled with the installation of a roadside barrier where tree and pole impacts are a risk, eliminate fatalities.
The majority of motorcycle into barrier crashes resulted from collisions with steel W-beam barriers in Australian and New Zealand. Both sliding and upright crash postures were approximately equally represented and mean pre-crash speeds and impact angles were found to be 100.8 km/h and 15.4° respectively. The thorax region was found to have the highest incidence of injury and the highest incidence of maximum injury in fatal motorcycle barrier crashes, followed by the head region. As existing motorcycle-barrier crash testing protocols do not specify a thorax injury criterion, there appears to be a need to determine such criteria. Similarly around a quarter of the crashes involved an upright crash posture with the rider subsequently sliding and tumbling along the top of the barrier. An additional test should be developed, possibly similar to the DEKRA test, which requires the rider to impact the barrier upright and then slide along the top of the barrier.

Grzbieta proposed that a rub rail along the bottom of the barrier and a smooth surface along its top would reduce motorcycle into barrier injuries. He also suggested that any retrofitting of roadside barriers for better motorcycle protection be focused on blackspot areas where motorcyclists are prevalent and that installing motorcycle friendly barriers and retrofitting barriers will not have any significant effect on motorcycle casualties.

15 Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Obstacles and Road Equipment – Swedish Experience
Åke Löfqvist explained that road fatalities continue to be reduced on the roads in Sweden. Most common fatal accident type has changed from head-on to single run-off accident due to the installation of 3,000 km of median barrier on former two-lane roads that was started in 1998.

Löfqvist mentioned the efforts to make Swedish roadsides safer by using rumble strips, clear zones, guardrails and smoother slopes. Speed limits also are being reduced on certain roads.

The Swedish Road Authorities will issue new design standards in the fall of 2012. For terminals on roads with design speeds above 80 km/h: Flared guardrail, with a flare rate up to 1:20 (110-120 km/h) will be the preferred option followed by terminals anchored in the back slope beyond the ditch or energy absorbing terminals, which will be used due to lack of space, aesthetical reasons or urban areas.

On roads with design speeds less than 80 km/h, ramped down terminals that are flared less than 0, 5 m, normally 12 m length will be used. Alternatively energy absorbing terminal may be used due to high traffic flow, exposed installation e.g. outside curve or urban areas.

16 Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Trees and Posts – German Experience
Frank Brandt presented a variety of situations where appropriate longitudinal barriers should be used. Nearly 20% of all fatal accidents on German roads result from a crash with a tree. The chance of road users dying after a collision with a tree is around 2.3 times greater than the chance of dying in an average traffic accident on a road outside of a built-up area (excluding freeways). Trees beside the road are black spots, causing a high danger for road users. If it is necessary to remove them, they must be replaced in places far away from the traffic. Trees which
cannot be removed due to protection by law (objects of cultural value) must be protected with guard rails.

Brant discussed a number of new products that have been designed to meet a range of different needs. For instance, there is a steel system that is stiffened near a tree so that the deflections are manageable. This system is used to protect single obstacles like trees or poles. In combination with other standard guardrails it is also suitable for tree-lined roads.

Brandt also presented a post and rail system where the posts are at various spacings allowing for different containment levels. He also presented a guard rail system with rails at multiple heights that fulfills requirement classes H2 and H4b of DIN EN 1317-2 and combines high restraint capacity with very low system deflection.

17  Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Posts and Luminaire Supports – United States and Other International Experiences

Art Dinitz explained that the use of Breakaway Supports that are designed to break away quickly and cleanly upon impact with consistent, predictable behavior, regardless of the vehicle's angle of impact (Omni-directional) will reduce property damage and save lives.

Run off the road impacts frequently encounter fixed objects (Sign posts & Luminaires). Road authorities can increase safety by moving fixed objects out of clear zone. Objects that cannot be moved should be made “Breakaway”. Breakaways perform best if they have Omni-Directional capability.

In the United States, Omni-directional breakaway couplings as the pole/post support has become the standard for many states.

New Zealand, Australia, Canada and others have begun to use Omni-directional breakaways and there is increasing global interest in this technology. Eastern Europe and the Netherlands are currently examining the use of breakaways for their roadways.

In Israel, Highway safety support structures have been used for over 20 years. Dozens if not hundreds of accidents have been witnessed with no fatalities or serious bodily harm injuries reported on light poles using Omni-directional breakaways.

Up until now, in Europe, the use of energy absorbing posts has been the only form of yield supports used. However, as seen in many of the crash tests in the US, these energy absorbing posts, at high speeds, can entrap the vehicle and cause serious ‘yaw’ causing overturns and serious bodily harm.

18  Best Practices & Strategies to Reduce Fatal/Serious Injury Crashes into Posts and Luminaire Supports based on EN12767– Europe

Carolien Willems explained that road authorities in some European countries are recognizing that rigid objects located close to the road should be eliminated, moved further from the road or modified to make them less rigid. Poles for public lighting must basically correspond to the European standard EN 40. Poles for signalization apply to EN12899, regarding resistance. These standards define the technical properties of poles regarding dimensions, installation and other
characteristics yet do not deal with a pole as a passive element of traffic in respect to the safety. Road authorities in some European countries are recognizing that rigid objects located close to the road should be eliminated, moved further from the road or modified to make them less rigid.

In EN12767 the impact for passengers and the exit speed is determined. The energy of the crash absorbed by the infrastructure will reduce the speed and will minimalize the severity of the first crash.

Willems introduced a new energy absorbing pole that is constructed of steel plates making a cross section with nine angles. The plates are not welded together to form the final shape but are joined with rivets. Such construction ensures that the column is strong enough for the functional use. It can support the lamp or other equipment but in the same time, in case of car’s impact, it starts flattening step by step, so that it turns the form from almost round shaped into a ribbon, which means that the deformation of the column reduces the impact force of the vehicle.

19 Development of a Redirective Crash Cushion to EN 1317-3
Luigi Grassia introduced a new Redirective crash cushion that has been developed in Italy. The product has been successfully tested 50 km/h, 80 km/h, and 100 km/h and will soon be tested at 110 km/h.

The energy absorber consists of a steel honeycomb. The honeycomb is obtained by stamping and then welding metal sheets. The design of the crash cushion and the high efficiency of the honeycomb energy absorber will allow this crash cushion to be one of the shortest crash cushions in the market.

20 Development of N2/H1 Performance Level Guardrail: Crash Testing and Simulations
Ali Atahan described the development of a new lightweight N2/H1 performance level guardrail, called AG04. A series of computer simulations and crash tests were performed for the crashworthiness evaluation of AG04 system. A non-linear multipurpose 3D finite element code, LS-DYNA, was used for the crash test simulations. After two failed crash tests, necessary modifications were made and AG04 guardrail successfully met the criteria outlined in EN1317-1 and 2.

AG04 achieved N2-W3-A and H1-W4-A performance levels when breakaway bolts were used between post and rail. Crash test results showed that AG04 system with both A and B type W-beam rails performed similarly which indicated either rail type can be used for an acceptable performance. It was concluded that properties of post-to-rail bolt and details of 10,000 kg truck are the most critical parameters for a satisfactory crash test performance for the AG04-2.0 barrier.

21 Risks of Unprotected Median Drainage Ditches on Vehicle Stability
Ali Atahan showed the results of testing different median ditch configurations as well as recommended remedies. His research utilized computer simulations with different weight vehicles and with different positioning of longitudinal barriers.
Based on the simulation results it was determined that H1 level guardrails evaluated in this study could provide the desired level of protection at median drainage ditches when placed at a minimum 50 cm away from ditch slope break point. Many of the other simulations where the guardrail was positioned in a different location relevant to the break point resulted in vehicle stability problems and eventually truck rollover.

Based on his findings, Atahan recommended the utilization of a new generation guardrail system AG04-2.0 due to its advantages, such as weight, ease of production, speed of construction over EDSP-1.33 system.

22 How High Friction Surfacing can Help to Reduce Roadside Hardware Crashes

John LeFante introduced a concept to reduce the number of run off the road crashes High Friction Surface Treatments (HFST) to increase the coefficient of friction of the road.

LeFante showed a series of examples where HFST has been used to reduce the number of run off the road crashes in different countries. HFST has been and is currently utilized in over 20 countries worldwide as a method to reduce roadway crashes and roadside departures. With thirty years track record of saving lives, HFST has proven effective in improving the friction of various surfaces. The United States Department of Transportation has stated that “….70% of wet pavement crashes can be affected by friction improvements.”

HFST is commonly utilized in areas in which a reduction of stopping distance is warranted (intersections, roundabouts) or road departure incidents are common (horizontal curves). Most importantly HFST save lives.

23 Development of a Recycled Substrate Material for Road Signs

Jason Hubbell explained the problems many countries are experiencing with excess waste from ABS plastic, some of which comes from scrapped computer, mobile phones and games. This plastic is known as e-waste. He also explained that some developing countries are experiencing serious problems because vandals are stealing aluminum street signs to sell them as scrap. One solution suggested by Hubbell was the use of signs made with e-waste instead of aluminum since e-waste has little, if any no scrap value.

Hubbell also noted that this recycled ABS plastic sheeting is also approximately 35% less expensive than aluminum. Recent advances in recycling technology allow for the recycling of e-Waste ABS plastic into sheeting. A significant amount of testing has been conducted on ABS recycled plastic sheeting to support the possibility for use as a traffic sign substrate. ABS sheeting products that have similar resistance and adhesion characteristics as aluminum for reflective sheeting are available. Many of the markets manufacturers of retro reflective sheeting, including Nippon Carbide, Avery Dennison and 3M, have issued letters extending their warranties to specific ABS plastic sheeting.

Hubbell suggested that an independent study of recycled ABS plastic sheeting be commissioned. This could be the basis for the development of a standard, specification or recommendation. Standardizing recycled ABS plastic sheeting will allow road authorities to utilize recycled ABS plastic sheeting for their signing needs with the knowledge that their sign products are of a specific quality and they will have specific expectations from that quality.
24 A Very High Precision “Weigh In Motion” Concept Based on Optical Fibers Technology

Andreas Demozzi explained the problems caused by overweight trucks on European roads. These include additional road maintenance costs due to the excessive wear and damage to roads, bridges and pavements; unfair competition; negative impacts on road safety since overloading; makes the vehicle less stable, difficult to steer and takes longer to stop; massive strains on vehicle tires that can cause the tires to overheat and wear rapidly, which increases the chance of premature, dangerous and expensive failure; • increased fuel consumption, which will increase costs and pollutions; and the fact that much of the installed roadside safety equipment will not function with these higher weight trucks.

Police often use Weigh in Motion (WIM) devices to identify these overweight vehicle and to get them off the roads. Demozzi introduced a new weigh in motion device that utilizes Fiber Bragg Grating (FBG) sensors optical fibers instead of piezo-electric systems (“load cells”) or bending-plates (“strain sensors.”)

FBG sensors are an excellent tool for WIM systems. It provides a fiber optical sensor that requires no electricity. The results are very precise (pico-metric level) with no influences from magnetic fields or corrosion by anti-freezing salts, acid rains, or air pollutions.

Demezzi explained the testing process used to develop this new concept in WIM. Computer simulations and indoor actual tests were conducted. Outdoor real-scale tests, with real world speeds and weights are scheduled to be run in September 2012. An actual on-site installation (Brenner Motorway) that will be constantly monitored and checked is scheduled for April 2013.

25 The ABC’s of TMAs

Mike Dreznes explained the importance of the use of Truck Mounted Attenuators (TMA) on the backs of stopped or slow moving vehicles in a work zone. He explained that TMAs help to protect the motorists, the truck driver and the truck. Most contractors are more concerned about their truck or their truck drivers than they are about the motorists. Therefore it is the responsibility of the road agency to mandate the use of TMAs if they are to be universally applied.

TMAs are mandated in most states in the United States as well as the United Kingdom, Belgium, Netherlands, Norway, Sweden, Denmark, Australia and New Zealand for selected work zone applications. TMAs are extremely effective when used to shield Shadow Vehicles, since few other options for protection are available. The Manual on Uniform Traffic Control Devices (MUTCD) in the United States recommends, but does not require the use of TMAs.

Dreznes showed examples of TMAs in use and he discussed the different testing criteria including NCHRP 350, MASH, the UK Testing Criteria and the currently under development EN1317 Test Criteria. Dreznes also emphasized that tests must be run using the specific criteria in either EN-1317, MASH or NCHRP 350 and test houses should not modify the criteria and then say the product was tested “in the spirit” of the test criteria even if the tested vehicle is more represented in the local vehicle fleet. This compromises the credibility of the test criteria.
Dreznes discussed the importance of rollahead, which is not significantly affected by the TMA. Thinking that only vehicles with TMAs attached have rollahead is a source of confusion in the industry and it needs to be clarified immediately.

Since the consequences of lightweight vehicle impacts into the back end of a truck will be more severe for the occupants than heavier vehicle impact, the lightweight car crash test under NCHRP 350 is conducted with the host vehicle up against a concrete wall to eliminate rollahead. Successfully passing this worst case scenario test ensures the maximum weight of the work vehicle has already been considered when a TMA is used. Most manufacturers would recommend that the lightest weight work vehicle using a TMA would be 4,500 kg due to roll ahead and maneuverability issues.

26 The Importance of an Appropriate Transition in a Longitudinal Barrier Design

Mike Dreznes presented the importance of a transition between longitudinal barriers with different deflection characteristics. A transition is defined as a section of barrier used to produce the gradual stiffening of a Flexible or Semi-Rigid barrier as it connects to a more Rigid barrier or fixed object.

Crash tests have shown that if a transition is not used, an errant motorist that impact the Semi-Rigid or Flexible barrier on an angle could be snagged and/or be redirected into the blunt end of the Rigid barrier. This is commonly referred to as “pocketing.” A properly configured and installed transition is designed to shield these unprotected ends of Rigid barriers because they are hazards. These transitions should provide an effective transition between longitudinal barriers with different lateral stiffness and redirect impacting vehicles without any contact with the Rigid barrier.

Dreznes provided some examples of good and bad transitions. He commended Germany and England on their use of transitions. He discussed the current status of MASH and NCHRP350 testing as well as EN1317-4. He emphasized that the use of transitions is an example of “common sense engineering” and questioned why they are not mandated in Europe.

27 Consideration of Wood Mechanical Properties Variation in Roadside Safety Barriers Performances Evaluation

Clement Goubel presented his work that was designed to develop a validated tool to study, understand and optimize the use of wood in roadside safety devices.

He discussed his efforts to model Steel-wood structures, such as longitudinal barriers. He presented an assessment of wood variability, validated his vehicle/VRS crashes numerical model and made an assessment of the effects of wood variability through the use of 288 simulations.

He concluded that the poor effect of wood mechanical properties created variation towards device severity performances. There may be a more brittle behavior at low temperatures, but overall wood is safe since all tested configurations meet the EN1317 requirements.

Concluding Remarks and Meeting Close
The presenters were thanked for their excellent contributions. Copies of all presentations will be available on the Midwest Research website in the near future. The website address is ftp://mwrsf.unl.edu/afb20. The user name is afb20 and the password is afb20.

All attendees agreed that this was a great meeting and the attendees definitely want to do it again next year. The plan would be to have the meeting next April or May and encourage the European Road Federation (ERF) to work with the International Road Federation Washington and TRB AFB20 (2) to make it happen.

The two options that were proposed for the next meeting were Istanbul on May 28, 2013 prior to Intertraffic Istanbul http://www.intertraffic.com/intertraffic-tr/Pages/default.aspx or at the CEN meeting center in Brussels at a yet to be decided date, but preferably in April or May. Ali Atahan offered to help to coordinate the Istanbul meeting. ERF would be the logical coordinator if the meeting was held in Brussels and Gavin Williams offered to help with coordination in Brussels. Attendees and AFB20 (2) Members will be polled to get their preference.

The attendees also agreed that it would make good sense to tie the meeting to Intertraffic Amsterdam on the even years, and to conduct the meeting either the day before the exhibition opens officially or do it on the last day of Intertraffic Amsterdam. This would encourage more international attendance from outside Europe.

A task force will be created to move the AFB20 (2) Subcommittee International Meeting concept forward.

Marco Anghileri and his staff and students at the Passive Safety Lab at Politecnico di Milano were thanked for their support and efforts. This would not have happened without them. Margaritelli was thanked for their support of the lunch and breaks and again the presenters were thanked for their hard work.

All attendees were encouraged to attend the next AFB20 (2) Subcommittee Meeting on July 29, 2012 in Irvine California.

The meeting was adjourned at 6:49 PM.