A REPORT ON THE VTRC VISIT TO THE CZECH REPUBLIC AND THE REPUBLIC OF SLOVAKIA

May 5-May 13

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VTRC Visit to the Czech Republic and the Republic of Slovakia

Findings and Recommendations for Future Collaboration

EXECUTIVE SUMMARY

As part of a technology exchange funded by the Federal Highway Administration, staff from the Virginia Transportation Research Council (USA) and the CDV (Czech Republic) met May 6-7 in Brno, where the CDV is located, to discuss research projects of mutual interest. Representatives from CDV, the Slovakia Road Administration, AKMI (Hungary), the Rhode Island Technology Transfer Center (USA), FHWA, and VTRC then participated in a Technology Transfer (T^2) Conference in Liptovský Ján in Slovakia on May 10-12.

This Executive Summary identifies potential collaborative efforts that CDV and VTRC may wish to pursue in the future: these efforts do not require the exchange of money but rather illustrate how data and ideas may be shared in areas of common interest. The summary also identifies key insights from both the technical exchange on May 6-7 and the T^2 meeting on May 10-12. Although most readers need only review the Executive Summary, the itinerary is detailed beginning on page 12.

The VTRC participants in the visit wish to express their deep appreciation for the generous hospitality shown by Jiří Kubita of Kubita Associates; Petr Polansky, Karel Pospíšil, and Pavel Tučka of CDV, and Ján Šedivý of the Slovak Road Federation. The technical communications are summarized in the report that follow and were productive; however, it should be noted that these individuals extended themselves to welcome the VTRC team in the Czech Republic and the Republic of Slovakia. The team was able to visit transportation sites in both countries, including a the CDV research center, the CDV Infrastructure Center, and a Slovak Road Administration tunnel near the border of Poland. The team also visited historic sites, such as Karlštejn Castle near Prague and a sheep farm near Liptovský Ján. Finally, team members were grateful for the logistical work of Tracy Busch of FHWA for organizing the trip, as well as the FHWA Office of International Programs which funded the exchange.

Potential Areas of Collaboration Between CDV and VTRC

Despite the large great spatial distance separating the two institutions, CDV and VTRC are similar in that both maintain a full complement of transportation research staff whose focus is on implementation of results in support of a transport ministry or department. Both institutions have been in existence, albeit under different names, for 50 years and both institutions, while coordinating research work with universities and contracting out some research as well, do not solely rely on contracts in order to complete research projects.

Accordingly, the identification of mutually beneficial topics was one reason for the visit. As is the case with any set of proposals, there are a large number of potentially viable ideas,

CDV is exposed to and is active in committees and research activities in Europe and VTRC in US. Mutual cooperation extends the knowledge base to a large pool of resources. Ten potential research projects in the areas of concrete technology, transportation planning, and highway safety have been identified. The next step should be for CDV and VTRC staff to identify which, if any, of these recommendations should be pursued further.

1. Roadside Safety Audits and Site Plan Reviews

Although the terminology differs between the two countries, Pavel Tučka and Petr Pokorný described a large category of *roadside safety audits* that must be performed by the Ministry of Transport which closely parallel the *site plan review* that must be performed by the Virginia Department of Transportation. These audits (or plan reviews) are done when private development, such as a hypermarket (supermarket), must be connected to the roadway network, and the purpose of the audit is to ensure that safety is fully considered. For example, Mr. Pokorný noted that a recent safety audit of a proposed roundabout design to accommodate a TESCO market showed that the investor's engineer (developer's consultant) had a number of errors that adversely affected safety, such as vehicular traffic moving too quickly, pedestrian crossing points being poorly located, and poor sight distance for vehicular turning movements.

Mr. Tučka and Mr. Pokorný would like to (1) train other staff to adequately perform roadside safety audits, and (2) identify legal methods such that these audits are routinely done. They clarified that they themselves have the skills to perform audits, however, they wanted assistance with *how to teach others* to do these audits. They also noted that the training should not be of a checklist nature but instead should teach the auditor how to look at safety comprehensively. Accordingly, there are several immediate steps that VTRC can undertake to share information with CDV in this area.

- VTRC can provide documentation on the topic of access management and site plan reviews that are used in Virginia and the USA This documentation includes (1) *NCHRP Report 420: Impact of Access Management Techniques* which shows how increased signal spacing affects the number of crashes along a corridor, (2) VDOT's Fredericksburg District *Site Access Guidelines* (which show how VDOT staff in one district perform site plan reviews for new developments), and (3) a VTRC report on access management by Bowman and Rushing that illustrates legislative options for institutionalizing such site plan reviews.

- VTRC can provide training materials that, although not specific to the topic of roadside safety audits, illustrate how to teach a skill that emphasizes the individual decision making of the operator. One possible set of training materials is that used to teach a course regarding the use of portable changeable message signs several years ago. The course aimed to teach operators better decision-making skills rather than giving them a checklist of procedures they had to follow.

- The Knowledge Management Center's T^2 division has a set of course notes on access management and these can be provided to CDV.

Recommendation: By June 30, 2004 John Miller of VTRC should take the initiative by gathering these materials and providing them to the CDV. The transfer of knowledge will likely not be one way, because CDV is gathering insights through roadside safety audits that may be of interest to VTRC.

2. *Comparison of European and USA Environmental Costs for Infrastructure Projects*.

Jiří Dufek described a European Union project in which CDV is participating, entitled *COST 350: Internal Assessment of Environmental Impacts of Road and Rail Infrastructure*, where the environmental costs are being computed at the European level. While CDV is not conducting this project alone but rather is providing input into the project, it was apparent from the presentation that Mr. Dufek has a strong knowledge of how these costs are being computed. Of a parallel nature, the Transportation Research Board's National Cooperative Highway Research Program (NCHRP) has published NCHRP Report 456: *Guidebook for Assessing the Social and Economic Effects of Transportation Projects*. This report is available at http://gulliver.trb.org/publications/nchrp/nchrp_rpt_456-a.pdf, and is supplemented by NCHRP *Report 466: Desk Reference for Estimating the Indirect Effects of Proposed Transportation Projects*, available at http://gulliver.trb.org/publications/nchrp/nchrp_rpt_466.pdf.

A future effort between CDV and VTRC would be to compare the European findings from COST 350 to the USA findings from NCHRP 456 and 466. For example, topics such as community cohesion, land use impacts, and environmental justice are difficult to quantify, and the research for doing this quantification in NCHRP 456 is often based on a few studies. There may be value to seeing whether the COST 350 report uses similar impact analyses to the NCHRP 456 report.

Recommendation: John Miller of VTRC and Jiří Dufek of CDV should each consult with their respective directors to ascertain whether agency management views comparison of USA and European impacts as a valuable project. If so, then a potential product within a year's time would be a journal publication comparing these costs.

3. *Detectors for Reducing Animal-Vehicle Collisions.*

Mr. Tučka also described a project using the SWAREFLEX detector which seeks to reduce nighttime collisions between vehicles and animals (Figure 1). Based on a recent CDV study, placement of the detectors 15 m apart along a 6 km corridor should a visible decrease in such vehicle/animal collisions. However, the small data set did not enable statistically-based significance testing of the results. VTRC, under a project led by Bridget Donaldson, is also initiating a project to prevent crashes between wildlife and vehicles; however, the VTRC focus is on identifying the extent to which existing structures, such as bridges and culverts, are used by wildlife. Although the projects currently have different foci, in the future, should work in this area continue, it may be possible to combine data from multiple studies to detect significance with a larger data set.

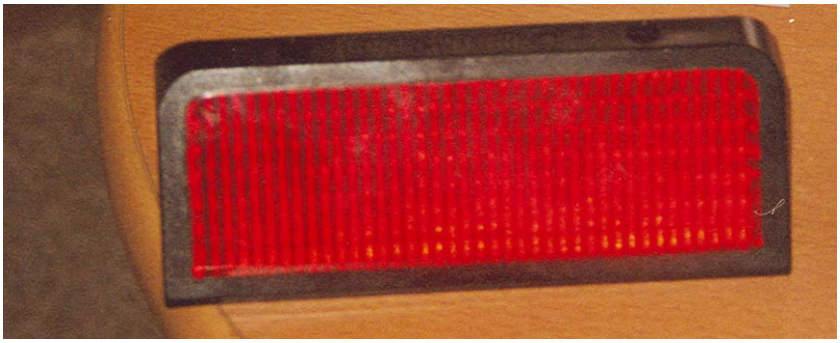

Figure 1. SWAREFLEX Detector Used by CDV to Prevent Vehicle-Animal Crashes

Recommendation: Assuming mutual interest, Bridget Donaldson of VTRC should provide to CDV her proposed work plan, and Pavel Tučka of CDV should provide to Bridget the results of the CDV study.

4. Roadside Safety Audits Generally

The category of audits described in section (1)—those conducted when an investor constructs new residential or commercial areas—are indeed a significant portion of roadside safety audits, but CDV noted that there are other types of audits as well. Interestingly, the Virginia Department of Transportation is also beginning to pursue roadside safety audits through efforts in the Mobility Management Division. No such audits have yet been performed, but there may be opportunities to share VDOT audits with CDV (and to obtain CDV audits that have been translated from Czech to English) within the next twelve months. Because Mr. Tučka noted that the Czech Republic's safety record has not improved (unlike comparable European countries) there may be opportunities for VTRC and CDV to collaborate further, especially in terms of pedestrian safety.

Recommendation: John Miller of VTRC should provide examples of VDOT audits to CDV when such audits become available. Time permitting, Mr. Pokorný should provide an English translation of one CDV audit, such as that for the roundabout at the TESCO supermarket, to give VDOT staff a good example of a site plan review.

5. One-Time Information Transfers

CDV staff asked VTRC for several pieces of information that VTRC did not have readily available at the time of the visit. These are

- What is known about roundabouts in Utah, given that some articles have suggested that the Utah DOT has a large number of roundabouts? (Zdeněk Koňárek)
- Who in Virginia, whether at VTRC, UVA, or Virginia Tech, is performing at-grade rail crossing research? (Ivan Fencl)
- Please provide information on the truck parking information system, which is work being done by Nick Garber of VTRC. (Ivan Fencl)

- Please provide the summary paper on the decision making process for Maglev vs. conventional rail technology (Ivan Fencl)
- Please provide the contact information for work being done in ITS, including electronic tolling, in case that individual can attend the September toll conference (Ivan Fencl)
- Logistically, keeping 3800 email addresses updated (as the Virginia T2 Center indicates it does) must be a full time job, given that positions and people change. What does it take to keep a contact list of 3800 people current? (Jiří Kubita)

Recommendations: By June 30, John Miller of VTRC will collect this information and provide it to Ivan Fencl and Pavel Tučka of CDV. Information on roundabouts in Utah is available at http://www.roundaboutsusa.com/, Transportation Research Record 1858, and http://www.itsdocs.fhwa.dot.gov//JPODOCS/REPTS_TE/13612.html,

6. *Self-Consolidating Concrete*

Self-consolidating concrete (SCC) is a new technology that provides very high workability. SCC easily fills the congested spaces between the reinforcement and the formwork under the influence of its own weight without any additional consolidation energy. Easy flowing SCC would permit convenient and fast placement of concrete in beams. Eliminating the consolidation problem would enhance the strength and reduce the permeability of concretes, which is essential for longevity. SCC has been used in Japan and Europe advantageously since the early 1990's. Benefits include, but are not limited to, (1) less labor and increased construction speed, (2) improved mechanical properties and durability characteristics, (3) the ability to use this material in heavily reinforced and congested areas, (4) consolidation without vibration and without segregation, and (5) reduced noise levels at manufacturing plants and construction sites. However, there are some concerns with SCC, most notably segregation, the air-void system, shrinkage, and the bond between strands and concrete. There are no standard test procedures to determine the flow characteristics of SCC and the segregation potential.

Recommendation: Share information on USA and European experience with SCC. Work on similar or different topics to advance the technology and prepare a report that will be beneficial to both parties. Karel Pospíšil will be in the USA in August details of the study can be prepared during his visit.

7. *Two-Lift Paving Construction*

The Czech Republic has had good experiences with jointed concrete pavements. They see the benefits of the two-lift construction, where material unsuited for the wearing course can still provide the needed strength in the lower layer. With the automatic dowel bar inserter the dowels are inserted in the lower layer. The surface of the top layer is textured using jute. Concrete is cured with a curing compound. Paver, which can place concrete in two layers, is available in the USA.

Recommendation: Investigate the paving mixtures and the placement operations for two-lift construction from the Czech partners. Investigate the potential use of this technology in Virginia.

8. *Decks without the asphalt membrane and the overlay*

Chlorides in deicing salts penetrate into the deck and destroy the protective layer of the steel initiating corrosion. To prevent the infiltration of chlorides to the level of steel, in the USA high-performance concrete (HPC) with adequate cover over the reinforcement are widely used. In Europe, the common practice is to use asphalt membrane with asphalt overlay. The asphalt overlay may need replacement in about 10 years and adds an additional weight to the structure. Concrete left uncovered is functioning successfully in the USA.

Recommendation: Exchange information on the two different methods for protecting bridge decks. Assist the Czech counterparts with the designs and preparation of mixtures that will provide low permeability and are suitable for bridge decks. Mutual cooperation will indicate the benefits and drawbacks of each system used.

9. *Acoustic Emission Testing*

Corrosion of steel in reinforced concrete or prestressed concrete leads to expensive fixes. In early stages the damage can be fixed by costly repairs; however, at the later stages corrosion left unattended can lead to catastrophic consequences. The infrastructure center at CDV is experimenting with small and large size elements and actual structures to monitor distress due to corrosion of the reinforcement. (If the corrosion products cause cracking of the concrete the sound emitted is easily detected.) CDV attempts to detect corrosion before the cracking of the concrete occurs. Movement in strands during early stage of corrosion is expected to emit acoustic signals that will indicate the incipient corrosion.

Recommendation: VTRC could work with the CDV to learn from their experience and try acoustic emission technology on samples and actual bridge structures. Non destructive evaluation of the condition of structures is a high priority item. Distress caught at early stages can be remedied without the potential high cost and safety implications of an advanced stage of corrosion.

10. *Cast-in-Place Construction*

In the USA, precast, prestressed beams are widely used, since it is found to be cost-effective compared to cast-in-place construction. In the Czech Republic, cast-in-place construction of beams is the norm, as shown in Figure 2.

Recommendation: Evaluate the construction of bridge structures using precast and cast-in-place beams. Compare the benefits, drawbacks, and cost of using both methods of construction.

Figure 2. Use of Cast-in-Place Concrete Beams in Czech Republic

Insights from the CDV/VTRC Technical Exchange in the Czech Republic (May 8-9)

Although the body of the report contains the full itinerary and summary of presentations from the trip, it is appropriate to quickly identify observations regarding differences and similarities between the transportation research programs at CDV and VTRC.

Sustainable transport is a core focus of CDV. The technical session opened with Karel Pospíšil quoting the CDV director, Josef Mikulík, as saying that "Supporting sustainable transport is our main challenge…there is no greater risk than saving humanity from itself." In the areas of planning, for example, the Czech Republic is wrestling with issues of increased incomes leading to higher automobile usage, which in turn has implications for pedestrian safety.

CDV and VTRC noted an emphasis by their clients, the Czech Ministry of Transport and the Virginia Department of Transportation, respectively, on implementation. For example, CDV staff noted on Thursday's presentation that they were initially a bit surprised that the Ministry was highly interested in the use of instrumented black boxes in vehicles to improve highway safety, because the technology has been available for quite some time. However, the Ministry's emphasis—and CDV's emphasis—was on finding ways to better use the vast data gathered by these black boxes to improve highway safety, rather than developing the new technology per se. When VTRC noted that low-technology seat belt surveys to ascertain belt rates in Virginia were desired by Virginia government, CDV counterparts also nodded in agreement that their clients were interested in similar findings. In short, both institutes noted a need for practical results as opposed to always using the most advanced technology.

In some ways, the Czech Republic is poised to grow in a similar manner to the USA Fore example, in 1993, about half of all freight moved by truck instead of by rail; less than a decade later, in 2002, 72% of all freight moved by truck. However, two key differences remain between the Czech Republic and the USA. *First*, rising incomes are leading to increased auto usage and suburbanization, a trend that has occurred over the past 20 years. Karel Schmeidler notes, however, a key trend that differs from that of the USA: some persons who have moved into the suburbs have found that the expenses (incurred in part because of higher gas prices than

in the USA) and the time (due to extra commuting) cause them to return to the city locations. Thus this trend of moving back to the city differs from that observed in the USA on a wide scale. *Second*, there appears to be greater public awareness of environmental impacts in the Czech Republic than was observed in the USA following the second World War when suburbanization in the USA began in earnest. As an example, Dr. Schmeidler and Mr. Pokorný noted that government's initial desire to move a train station from central Brno, where it adequately serves the city's population, to the northern edge of Brno, where it will encourage greater development outward from the city. There is growing public awareness that such a move is not beneficial such that a petition to stop the move is being circulated.

The Czech republic has two institutional differences from the USA that affect highway safety. First, any blood alcohol content above zero for motorists is prohibited, whereas Virginia has a legal limit of 0.08 for BAC. Second, the Czech Republic recently passed a law in 2001 giving pedestrians, rather than motorists, the right of way at intersections. Although USA states have similar laws, the change in the Czech Republic is recent, and may have been responsible for high numbers of pedestrian crashes that have recently been observed.

CDV has several research projects underway, in addition to those described above, that VTRC may wish to pursue in the future. These include the e-box initiative described on page 14, which enables vehicle-to-vehicle communications in adverse weather conditions such as fog, a study of transit costs as shown on page 14 (interesting because unlike the small percentage of costs paid by USA passengers, almost half of public transport costs are paid by Czech passengers), and the study of habitat fragmentation on page 15, which VTRC could possibly use with local communities who are interested in the establishment of greenways. (Also, a surprise technical topic as discussed on page 29 was mentioned regarding the Hungarian experience of truck diversion from tolled motorways, and there may possibly be data that can help Virginia with its debate regarding the use of truck lanes on Interstate 81.)

Figure 3. Public Transportation in the Czech Republic (Brno)

Finally, the technical exchange taught the attendees about how to collaborate. Ten years ago, a PowerPoint presentation might have been relatively rare, but today such presentations are commonplace. An observation of Mr. Tučka, with Mr. Miller in agreement, was that the formal presentations—while adding value—were not the most important part of the conversation. Instead, the actual dialog between participants was of value. For example, on Friday, when time ran short, CDV and VTRC cut short the presentations and spent about an hour just discussing the mechanics of the roadside safety audits, following the details described by Mr. Pokorný on page 22. That conversation—although focused on a very specific topic—conveyed in a short amount of time much more information about CDV and VTRC than could have been conveyed with a formal lecture.

Insights from the Technology Transfer Conference in Slovakia (May 10-12)

Generally, the Technology Transfer Conference held in Slovakia gave individual centers an opportunity to describe techniques with which they have had success. The Conference also did not always give definitive answers but rather helped to crystallize questions regarding the future role of T^2 Centers.

Generally, T^2 centers have an administrative rather than a technical role. One vision of a T^2 center is that of a clearinghouse for providing short courses, where the T^2 center identifies instructors, courses, and potential attendees. Another vision offered by Mr. Kubita is that of a center whose role is more technical rather than administrative—that is, a center whose purpose is to capture and preserve knowledge.

Generally, the T^2 centers focus on technician training. A salient comment made by the Rhode Island T^2 center was that 85% of their courses were for technicians with only 15% for managers—a proportion that matches the distribution of employment types within state government.

The purpose of the international exchange and technology transfer conference may be various. From the perspective of VTRC, there were up to three different reasons for the exchange. One reason was to document the state of transportation research in each country, given that this had been the approach followed in the report of the previous CDV/VTRC exchange. (In fact, this documentation is provided on pages 12 through 25.) A second purpose was to identify areas of collaboration between the two research institutes. (Suggestions in this area are on pages 2 through 8 of this document.) During the T^2 conference in Slovakia, a third reason was informally mentioned by FHWA—the introduction of American companies to markets abroad and to access technology and innovation from other countries. For this last purpose, trade associations and industry representatives can be included in the future meetings. Even though each purpose appears to have a different emphasis, they are consistent with the concept of "technology and information sharing."

The reason for different views regarding the purpose of the T^2 conference and the international exchange may have been that attendees have different roles even within their own organization. For example, the Rhode Island FHWA representative was present, but the Virginia

FHWA representative was not. Mr. Kubita from the Czech Republic was closely involved with the IT activities, whereas the team members from VTRC currently work in the materials and traffic engineering areas. To some extent, therefore, it is logical that the conferees would have different areas of emphasis, and each approach has a valid role in the activities of the T^2 center and international exchange program.

Worker retention and training was a common area of interest. Participants agreed that a high volume of retirements meant that expertise was leaving transport ministries and departments. Participants also had different ways of attempting to retain this knowledge—and to maintain a high level of professionalism with the ranks of transport ministries. More young talent was needed in the transportation field. Diverse ideas included the following:

- *Vocational training:* Training employees in different areas is a top priority. For example, in Hungary technical supervisors are by law required to take certain courses.

- *Periodic recertification for employees*. Representatives on both sides of the Atlantic could point to technician certification, but Hungary and Rhode Island were able to give examples of re-certifying maintenance employees, such as the Rhode Island Snowfighter course, every five years.

- *Hands-on technical training.* Jeff Cathcart described an innovative T2 course, where a village that needed concrete sidewalks received them free of charge and was able to train their staff in concrete sidewalk construction: a contractor donated the materials, and the instruction for the course was accomplished by having the participants build the village's sidewalks as their course of study. He also discussed a workshop for the "safe chain saw" use by an expert for clearing trees.

- *Translation of documents into English*. It had been noted that language barriers can be a problem between European countries—for example, some very useful documents are only written in Hungarian. Mr. Havasy had also mentioned that while it was relatively easy to find a person to translate from Hungarian to English, the problem was that a second translation was needed from the "lay English" to the "technical English." Thus one possibility suggested at the conference by John Miller was that perhaps representatives from the USA states could assist with this second level of translation in some subject areas.

Although the Conference was enlightening for all attendees in that it facilitated an exchange of information, a retrospective consideration of the material is that the five groups present had overlapping but often different definitions of technology transfer. That underlying unresolved question was probably aptly captured by Mr. Kubita in a discussion with the Virginia team after the conference had ended: consider a technology transfer center that already has reached the point where short courses are already successfully administered (e.g., topics are identified, outside speakers are brought in, attendees are invited, and coffee/refreshments are taken care of). *What, beyond this administrative function, would an ideal technology transfer professional do?*

Mr. Kubita noted that several years ago when he first entered the transportation business, he thought that a rule-based expert system would be the answer. With the benefit of experience, he suggested that an individual qualified to do this perfect technology transfer—beyond the administrative function—would necessarily be a person with high qualifications. The T^2 center itself would extend beyond the basic administrative duties to a media where the state-of-the art technology and best practices would be exchanged. In fact, the importance of the technology transfer was included in the three main areas emerged at the end of the Central European (CE) and US meetings in Slovakia: work force development, traffic safety, quality control and quality assurance which encompasses existing and new or developing test procedures.

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Although the identification of collaborative projects was a prime purpose of the trip, the exchange also provided VTRC with an opportunity to learn about CDV projects in the various transportation research areas of materials, structures, safety, planning, and engineering. Participation in the technology transfer conference in Slovakia enabled VTRC to identify how others approach the function of T^2. The remainder of this report documents the findings from those presentations and discussions.

Wednesday May 5: Arrival in Prague and Travel to Brno

Celik Ozyildirim and John Miller arrived in Prague on Wednesday morning at 9 am, where they met Jiří Kubita of CDV; the group traveled to Brno the same day. The drive on the motorway showed features of interest, such as signs that flash the speed limit as a vehicle approaches and clear noise walls. To reduce animal collisions, the latter have a picture of a bird in the middle. However, the clear noise walls have not been very effective in noise reduction and caused bird fatalities. It was also noticed that the jointed concrete pavements without dowels were performing well except near Brno where faulting had occurred. These are about 30 years old and the faulting was related to the subbase. The recent construction uses dowels.

Figure 4. (a) Clear Sound Barriers

(b) Electronic Speed Limit Signs

Thursday May 6: Meeting at CDV Headquarters

Staff from CDV (Stephanaka Dolezelova, Jiří Dufek, Ivan Fencl, Zdeněk Koňárek, Marek Hradil, Eva Hauke, Jaroslav Heinrich, Josef Kraus, Jaroslav Martinek, Karel Pospíšil, Pavel Tučka) met with Jiří Kubita (of Kubita Associates, which coordinates technology transfer for CDV) and VTRC staff (Celik Ozyildirim and John Miller). After an introduction in Czech by Jiří Kubita, presentations and discussion occupied the remainder of the day.

Figure 5. City of Brno

Morning Presentations and Discussion

Karel Pospíšil presented an *Overview of CDV Research Activities*, noting that although CDV was formally started in 1993, it succeeds the former Federal Transport Research Institute. To support Director Mikulík's mission of becoming Europe's leading research organization, CDV pursues four main areas of interest: research and development, expert services for the Czech Ministry of Transport, technology transfer, and implementation of research findings. Areas of research include transport policy, modeling, safety, economics, intermodalism, geographic information systems (GIS), and an emphasis on sustainable transport, including the modes of air, rail, highway, and bicycling, geotechnical, structural materials and construction, and non-destructive testing. CDV has grown in it short time, from 73 staff in 1993 to 118 staff in 2002; at present, CDV has 22 high school graduates, 70 university graduates, and nine persons with doctoral degrees. Mr. Pospíšil noted that CDV plays an active role in collaboration with other institutions (BASt in Germany, LCPC in France, DTF in Denmark, CRR in Belgium, TRL

in the United Kingdom), organizations (ECTRI, FERSI, and FERRL which address transport, safety, and infrastructure needs respectively), and framework programs (SARTRE, COST, HUMANIST, SAFESTART, RECORDIT, and TRANSFORUM).

John Miller and Celik Ozyildirim then gave an *Overview of VTRC Research Activities*, explaining that VTRC is split into five technical teams (Mobility Management, Safety/Legal/Planning, Financial and Organizational Studies, Structure and Bridge, and Materials) and that similarly VTRC's mission is to support VDOT. Key trends that have been observed at VTRC over the past five years were also noted, such as movement away from basic and toward applied research, VDOT playing a greater role in selection of research projects, and more decision making being given to advisory committees, including the latter's increased interest in discussions rather than formal presentations, completing projects on time and on budget, and to ensure that research findings are implemented and tangible benefits documented by dollar savings are acquired. Specific projects from various teams, such as safety belt surveys, validation of simulation models, rail studies, red light running, concrete research, and bridge research were briefly mentioned.

Ivan Fencl, head of the CDV ITS Systems Department, presented an *Overview of ITS Activities at CDV*. Initiatives being led by CDV included a pilot project for electronic fee collection (EFC, which is the same as electronic toll collection in the USA), data acquisition from black boxes placed in cars (e.g., ways to use that data to improve safety), and an "e-box" study, which is a simple communications protocol between vehicles. The e-box project, although just beginning, may have potential to reduce fog-related crashes and would be of interest to VTRC and VDOT which have wrestled with fog-related crashes on Afton Mountain for Interstate 64 in Virginia. Dr. Fencl also noted a variety of collaborative efforts between CDV and other institutions, such as participation in the European-based ITS architecture standards group (WG 13), the tunnel safety project (UPTUN), and Partners for Roads.

Stephanaka Dolezelova presented the activities of the *Road Integrated and Combined Transport Section*, which entailed work done across eight areas as they relate to public transportation. The first four addressed passenger transportation and were (1) how to finance public transportation services, (2) gathering input from public transport providers and passengers, (3) devising methods for efficient public transport in terms of timetables and concessions, and (4) collection of public transport operational information, such as amount of state support and passenger-kilometers served. Two additional topics address linking Czech Republic practices to that of the European Union, of which the Czech Republic had become a member on May 1: these were (5) harmonization of Czech Republic laws with EU laws and (6) project INTERFACE which seeks to improve data exchange. The latter two projects—RECORDIT and BESTUFS—addressed techniques for reducing public transport costs and improvements to freight transport, respectively. An interesting statistic presented by Ms. Dolezelova was that in the Czech Republic, approximately 40% of the public transport cost is paid by the passenger; in the USA, that figure is closer to 5%.

Eva Hauke presented an *Overview of the Department of Legislation and EU Integration* whose mission is to match Czech laws to EU laws. Ms. Hauke expects improved safety to arise from initiatives at two levels: harmonization of checks and penalties (the driver level) and new

technologies to improve safety (vehicle and roadway level). A resultant road action plan seeks to reduce the number of victims by half by year 2010 through (1) better education, (2) technical improvements (better vehicles, better seat belts, and ITS initiatives), (3) road safety audits, (4) better EMS, and (5) better crash data. Although many of these initiatives are not yet required, they will be starting soon. The recent passage of the Czech Republic's Road Traffic Act institutes a point system (as is found in the USA) for driver offenses.

Josef Kraus described the work of the *Civil Aviation Section*, noting that his section consisted right now of two people, with the other individual expecting to retire in the very near future. Nonetheless, Mr. Kraus noted two aviation topics that have direct safety implications for Europe and the USA First, Mr. Kraus noted that the THEATRE project seeks to improve efficiency of air traffic control in Europe. (In the USA, there are 22 traffic control centers that accommodate 20 million movements annually, whereas in Europe, there are 41 traffic control centers that handle 10 million movements annually). Thus the EU would like to enable these 41 traffic control centers to operate under a "single sky" system which will be more efficient. Mr. Kraus's second topic had a human factors lesson: the aviation crash between a Russian and a Swiss craft resulted because although both aircraft received warnings about the other craft approaching, pilots did not heed the warnings because they thought the technology, which was recently acquired, was in error. Mr. Kraus drew a lesson that when procuring new technology for safety purposes, the question becomes "how rich is the nation that is buying" this technology?

Marek Hradil summarized *CDV's Information Technology Department Initiatives* across four areas. The first is comparable to that at VTRC: the service network department provides computer purchasing, software installation, security, and hardware/software management services. These second is a bit different, however: CDV's IT department develops applications for the Ministry of Transport, including web-based applications. The IT Department also performs two T2 functions. One of these is the Center of Publicity, which publishes CDV's *Mobility Magazine* and the other is the library, which provides a variety of search services as well as access to proprietary databases (ECMT, PROQUEST, and OLISNET).

Jiří Dufek summarized work being done by the *Department of Environmental Studies*. Research projects are being done by CDV staff in four key areas: acoustics and vehicle power trains (noise analysis, anti-noise measures, alternative fuels, and energy assessments), environmental economics (benefit/cost analysis, external costs, and air pollution), experimental analysis with pollutants and toxicity, and environmental laboratory work with sediments. Mr. Dufek also outlined CDV's participation in the EU's COST program, noting several specific projects that may dovetail with USA interests: COST 341 (Habitat Fragmentation due to Transport Infrastructure), the previously mentioned COST 350 report, COST 633 (Particulate Matter Properties affecting Health), and an OECD effort regarding low emission vehicles. Mr. Dufek also suggested that fields of cooperation between VTRC and CDV could include (1) environmental impact assessments, (2) assessment of legal remedies for environmental considerations, and (3) economic impacts of different transportation decisions.

Jaroslav Martinek presented the *National Cycling Strategy*, which is a four pronged approach consisting of (1) developing bicycling as an equally feasible mode of transport, (2)

encouraging cycling for tourism purposes, (3) marketing cycling as a measure to protect both the environment and personal health, and (4) coordinating cycling with other institutions. Because 60% of nationally designated bicycle routes share the roadway with automobile traffic, the Czech Republic is looking at greenways as feasible locations for bicycle routes. CDV also sponsors a "Clever Cyclist" leaflet and lecture series to support safe riding, and Mr. Martinek concluded that the only feasible way to improve cycling conditions is to have strong partnerships among the affected agencies (state government, regional government, and municipalities).

Afternoon Presentations and Discussion

Pavel Tučka presented an *Overview of the Department of Road Safety*, highlighting key activities of that section (road signing, traffic signing, examination of the penalty point system previously described by Ms. Hauke, and participation in EU activities that focus on work zone safety, such as ARROWS and SAFESTAR). Mr. Tučka also described the topic of road safety audits (RSAs) as mentioned previously in the Executive Summary on page 3 of this document. However, Mr. Tučka clarified that these audits occur not only when new commercial or residential construction occurs, but also as a tool for addressing "black spots" which are locations that are potentially dangerous. A critical feature of the audit is that it ideally can identify dangerous locations before crashes occur. The presentation concluded with the description of a roadway measuring vehicle, which is a jeep instrumented with a camcorder, sensors, and software that can obtain roadway geometry and traffic information. (Different examples of traffic engineering are shown in Figure.)

Zdeněk Koňárek presented an *Overview of the Traffic Engineering Section*, describing its focus as being on elimination of road accidents as well as improving traffic flow. The most important project as described by Mr. Koňárek was a roadway prioritization system, where each segment is given a rating from 1 (excellent condition) to 5 (reconstruction is absolutely necessary); the rating is based on capacity, safety, and environmental factors. The biggest problem facing the traffic engineering section is pedestrian accidents, partly caused by change in Czech law that in 2001 gave pedestrians, rather than drivers, right of way at intersections (previously mentioned on page 9 in the Executive Summary). Mr. Koňárek is currently pursuing roundabout safety research and would like information on Utah's experience with roundabouts.

Figure 6. (a) Vienna subway providing real time information (b) Signing for Leaving Town of Malinky

Jaroslav Heinrich described the *Activities of the Transport Planning Section*. The presentation began with a description of the National Route Safety Plan, which addresses issues such as speed management, parking management, and new technologies for road safety. The

resultant discussion, however, then focused on three topics. First, Mr. Heinrich noted that fatalities have increased in the Czech Republic with every social change; for example, in the three years before 1968 and again in the three years before 1989, both times of social upheaval, the fatalities increased. Second, Mr. Heinrich described the challenges with using real world data to investigate safety impacts; for example, a study had sought to determine the relationship between lane width and travel speed, but the study did not find a relationship because of other factors. Finally, Mr. Heinrich noted a project where he is trying to develop a knowledge-based expert system to capture and store findings learned from expert witnesses who periodically testify regarding roadway conditions.

Mr. Karel Pospíšil's presentation on transport infrastructure indicated that they were involved in the process of planning and building highways and airports with research tasks focused on designing, building, maintaining, and repairing roads, railway constructions, and bridges. The current research covered geotechnical area including measurements and soil mechanics testing, gabion construction, geosynthetic materials; structural materials and construction including special concrete and mortars, durability of structural materials and construction, and recycled materials; non-destructive testing including diagnostics of steel corrosion and defects and damage of concrete construction. Their infrastructure research facility including the laboratories for testing geotechnical, soil mechanics, mortar, concrete, and non-destructive evaluation are located in Tišnov.

The May 6 discussions concluded with comments that additional CDV projects are available from the guidemaps website (see www.guidemaps.info) and from the MOST MOBILITY website (see http://mo.st). Additional detailed CDV information for each section was distributed in hardcopy form and is available at http://www.cdv.cz/english/.

Figure 7. Karel Pospíšil, Jiří Kubita, Josef Mikulík, Petr Polansky, and Ján Šedivý

Friday May 7: Technical Meetings with the Concrete and Safety Sections

On Friday May 7 Celik Ozyildirim visited Karel Pospíšil (and his staff) and John Miller visited Pavel Tučka (and his staff), respectively, to discuss in greater detail work done in the materials/structures and safety/planning areas.

Structural materials and Testing (Infrastructure Section)

Celik Ozyildirim summarized VTRC work on materials and structural applications. He discussed the importance of longevity leading to high performance concretes (HPC). The two most important hardened properties of HPC are durability and strength. He described work on concretes with low permeability. Use of pozzolans and slag with low water-cementitous materials ratio (w/cm) enables durable concretes with low permeability. Low w/cm also lead to high strengths. He explained early applications of HPC in Virginia with collaboration with the FHWA. Concrete strengths in beams were as high 10,000 psi and concretes with low permeability were implemented. He discussed the recent improvements in the placement operations through the use of self-consolidating concretes. Virginia has used SCC in an arch bridge in 2001, and in 2003 two bulb-T beams with SCC were built for testing at the FHWA structures laboratory. He summarized the pavement studies in Virginia with jointed and continuously reinforced concrete pavements. HPC mixtures with high flexural strength (minimum 650 psi) and low shrinkage (400 microstrain at 28 days) are developed and used. In some of these projects, large aggregates with a nominal maximum size of 2 in are used to reduce the water and paste demand. Large aggregate also provides aggregate interlock when cracks occur. He indicated that in an upcoming project ultra high performance fiber reinforced concrete is planned. In this project, due to height restrictions, steel plate girders were planned in four of the spans of a mile long bridge. However, Ultra High Performance Fiber Reinforced Concrete (UHPFRC) will be used since UHPFRC has very high strength (about 30,000 psi) enabling spanning of long spans with shallow beams and is highly durable. There were many questions and discussions of concreting in USA and CZ.

At lunch contractors were very much interested in two lift paving construction and the automatic dowel bar insertion using GOMACO equipment. GOMACO Corporation, a leading manufacturer of equipment for the construction industry, is headquartered in Ida Grove, Iowa, USA. The contractors had a brochure from Gomaco and were ready to purchase a two-lift paver with automatic dowel insertion. They claimed that two-lift construction was better and cheaper since they could put any concrete in the lower level topped with a high quality overlay. They were also discussing the use of recycled aggregates for the bottom layer. In USA, two-lift construction is thought to be expensive, and in Virginia single lift construction is the norm. Given the lunchtime discussions, Virginia should investigate the possibility of using two-lift construction. We require non-polishing aggregates on the surface course, which are at a premium at some locations in the state. Use of two-lift construction would permit the use of any aggregate at the bottom layers and may lead to more economical pavements.

In the afternoon, the team visited the Infrastructure Center in Tišnov. Staff from the center gave a tour of the laboratories explaining the current projects: soil reinforcement with

geosynthetic materials in order to increase the bearing capacity of soft subgrade; new construction and materials of railway substructure and superstructure aimed at calculating the bearing capacity of geosynthetic material used in railway construction; compressibility of the subgrade soil aimed at finding relationships between the California Bearing Ratio used in design and the deformation modulus determined on site; evaluation of gabion constituents and performance in the support wall; and using concrete as the wearing course on bridges (it is common practice to use asphalt membrane and asphalt overlay on bridge structures in Europe). The Czech counterparts are very interested in using HPC and leaving the concrete surfaces uncovered with asphalt); using non-destructive acoustic emission technique to monitor distress in reinforced concrete with regular and prestressed reinforcement (Figure); using self-consolidating concrete for use in pavement construction. VTRC is currently experimenting with SCC in bridge structures. In 2001, an arch bridge was fabricated with SCC and in 2003 two bulb-T beams were cast for testing.) The Infrastructure Center is also working on national/international projects within the European Union. One of these projects--COST 347--dealt with the evaluation of European experience with accelerated test tracks. The other one--COST 344--dealt with improvements to snow and ice control on European Roads.

SCC is a topic of mutual interest. CDV has ongoing research project where they are making and testing SCC concretes. Japan and Europe have been using SCC extensively; however, use in pavements is questionable since concrete highways built in USA use slip-form paving with stiff concrete mixtures. Yet, SCC technology developed in CDV is very helpful in bridge structures. SCC has high flow rates and standard tests are not available in USA to determine the high flow rate and the segregation potential. Collaboration in this area would be highly beneficial to both sides and expose VTRC to the European experience. CDV made a batch of concrete that had a high flow rate and high stability without any segregation (Figure 8).

Figure 8. (a) Acoustic emission testing (b) Flow test for SCC (c) L-box for testing SCC

During discussions at the infrastructure center several topics emerged that would benefit one or more of the partners:

- SCC is a HPC material with high flow rates that results in fast construction and convenient placement in congested areas. Both parties are interested in this area and lack of standard methods and concerns with segregation require more work. In August Mr. Karel Pospíšil will be visiting USA. At that time more detailed discussion would lead to a work program beneficial to both parties.

- Two-lift concrete pavement construction is a desirable placement method. In the USA it is not practiced due to perceived high cost of this system compared to a single lift construction. However, there are new machines available from the USA that enables the same paver to place both layers. This eliminates the need for two pavers, which are expensive, and the possibility of a cold joint if there is a delay between the pavers. The two stage construction enable the use of local aggregates, which may not be suitable for a wearing course to be used at the bottom layer. VTRC should look into this system and learn from the experience of Czech partners.

- Concrete bridge decks are covered with an asphalt membrane and asphalt overlay in Europe. In Virginia and most of USA, concrete decks are left as is and low permeability concrete in decks is commonly used to prevent the intrusion of water and chlorides. Reinforcement in deck concrete in USA is epoxy-coated; however, other reinforcement that are non-corrosive are evaluated. USA technology for HPC decks can be disseminated to the Czech partners and more information on asphalt membrane and overlay can be obtained from Czech partners for comparison.

- Acoustic emission studies can be used to monitor distress due to corrosion with or without cracking. The concrete does not have to crack to generate sound for detection. The movement of corroding strands could be detected by the acoustic emission technique and indicate the level of corrosion.

- Cast-in-place construction methods, which have been found to be cost-effective in the Czech Republic, may be compared to Virginia's experiences with precast construction methods.

Safety and Planning Exchange (CDV Safety Section)

Karel Schmeidler described several research projects in the areas of driver safety, comprehensive urban planning, and traffic calming that are undertaken by staff who have expertise in sociology, planning, and psychology. In town planning, CDV is working to encourage cities to change their master plans: in the past, it was appropriate for planning to clearly separate residential from high-polluting industrial areas, but with cleaner industries now mean that land uses can be mixed without adversely affecting residents. Dr. Schmeidler also noted that, as has been the case in the USA, planning trends may move in and out of fashion: he gave an analogy where twenty years ago, tree-lined streets were common. Then, a realization that the trees presented a driving hazard caused them to be removed. Now, a realization that some communities benefit from traffic calming means that trees may be brought back to naturally slow the traffic! On a positive note, Dr. Schmeidler explained that retailers from inner cities had initially been wary of traffic claming but had now endorsed the effort. Finally, Dr. Schmeidler described the creation of a *unified database for connec*tivity, where a database of medical conditions that affect driving, and how such conditions can be successfully resolved, is being created. (For example, in some countries, persons with one leg are not allowed to drive, but in other countries vehicles can be equipped so such persons can drive; the purpose of the database is to ensure that these lessons are learned to preserve maximum mobility.)

Josef Kraus gave a chilling description of how statistics might or might not be used. The conversation began with discussion of the table shown below, which gives costs, in euros, for accidents, noise pollution, and air pollution for every 1,000 passenger-km of travel (or every thousand ton-km of movement for freight modes.

Table 1. Costs, in Euros, for Every Thousand Passenger-km of Travel (or every Thousand Ton-km of Freight Movement) by Mode, Courtesy of Josef Kraus

	Cars	Buses	Truck	Passenger Rail	Cargo Rail	Passenger Air	Cargo Air	Water
Accidents	32.3	9.4	22.2	1.9	0.9	--	--	--
Noise	4.5	4.2	12.7	3.1	4.7	3.0	16.5	--
Air	13.2	6.8	23.6	5.0	1.8	14.8	76.8	6.1

During the conversation, the question arose as to whether these statistics were used in decision making. Mr. Kraus pointed out that the answer was no—for two reasons. The first was that in budgetary processes (as is the case in the USA) there are often interest groups, such that more efficient modes would not necessarily lose funding relative to less efficient modes. For example, new terminals are being built for which the need is not yet apparent because the terminals do encourage local economic development in the region where they are situated.

The second reason was that Mr. Kraus emphasized there is no enforcement mechanism to ensure that numbers are heeded. He traced this back to the influence of the communist era, giving an example where two months prior to this exchange, between twenty and forty tons of CL^2 were released from chemical factories in northern Bohemia. Despite that the spill was evident, the fact was denied.

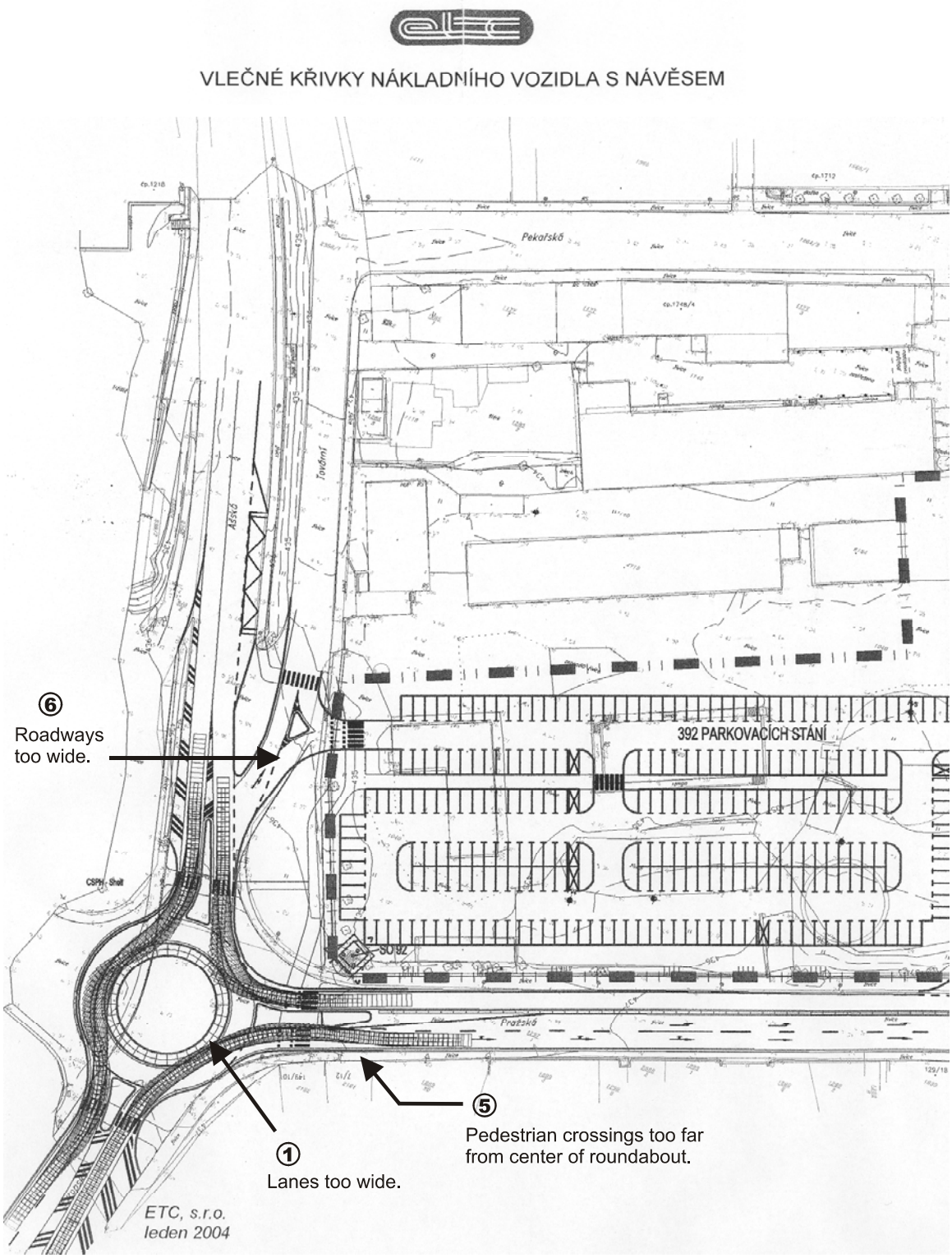
Ivan Fencl described a variety of CDV Telematics/ITS projects, including the operations for the main traffic center in Prague, a parking information system that used to be needed for the border between the Czech Republic and Germany (prior to the Republic's joining the EU), and an in-care navigation project. Dr. Fencl noted that in the public transport area, CDV is working to put real-time information on mobile phones. Websites describing some of this work were also given (http://www.itsportal.cz, http://www.rds-tmc.cz) the latter of which describes an in-car navigation project. Both sites are in Czech. One of the most interesting aspects of the meeting replicated a phenomenon that occurs in the USA, however: the discussion over whether the application of a piece of ITS technology—which in this case was a fixed-mounted changeable message sign—was deployed in accordance with standard traffic engineering practices. The sign was deployed in a manner similar to that shown in the figure below.

Mr. Tučka noted several errors with the sign as deployed: the number of arrows did not match the number of lanes (but should have), the text should have been left justified, the arrows should have been centered above the roadway, and the sign should not have been deployed immediately adjacent to another road priority sign (which it was).

As described on page 3, *Pavel Tučka and Petr Pokorný described in detail the need for roadside safety audits*, and Mr. Tučka emphasized that he would like to see collaboration in this area, especially in terms of teaching other to do these audits. Mr. Pokorný explained that since 2000, approximately 17 safety audits had been performed: 8 at the request of a city, 4 requested by the private sector, two requested by a highway director, two requested by a regional transport agency, and one requested by the police department. CDV staff themselves have the skills to perform the audits, however, CDV would like to be able to train others to perform these audits, where such training would not be by rote but rather would entail how to comprehensively consider safety.

An example of the aforementioned TESCO audit was enlightening, because it explained some of the characteristics that an auditor must examine. The TESCO audit showed that a proposed site plan had the following deficiencies (see Figures 9 and 10). In terms of teaching this material, the explanation by Mr. Pokorný showed that indeed a simple checklist of items would not suffice—rather, auditors needed to be taught how to comprehensively consider safety, as had been done with the TESCO audit.

1. The roundabout design vehicle was too big and too fast, resulting in lanes that were too wide. (The solution was to use a smaller and slower design vehicle)
2. Sight distance was a problem for turning vehicles (when approaching vehicles come from the left)
3. There were some areas of pavement where striping was put to eliminate vehicle flow, but realistically the pavement must be removed and those areas be kept grassy to truly deter vehicles.
4. Because the TESCO would have 24 hour operation, lighting is also needed
5. The pedestrian crossings occurred to far away from the center of the roundabout. Since vehicles would be traveling slower in the roundabout, the crossings should be moved close to the roundabout where pedestrians would face slower moving vehicles.
6. Some roadways were too wide and shown as one-way, when in fact they should have traffic moving in two directions with narrower lanes
7. Bicycle and traffic movements needed greater lateral separation.
8. Some information was lacking entirely from the proposed layout. For example, since the pedestrian movements were not given, it was not possible to determine exactly where bus turnouts were needed.



Figures 9. Site Plan Review for the TESCO Road Safety Audit (Left Half)

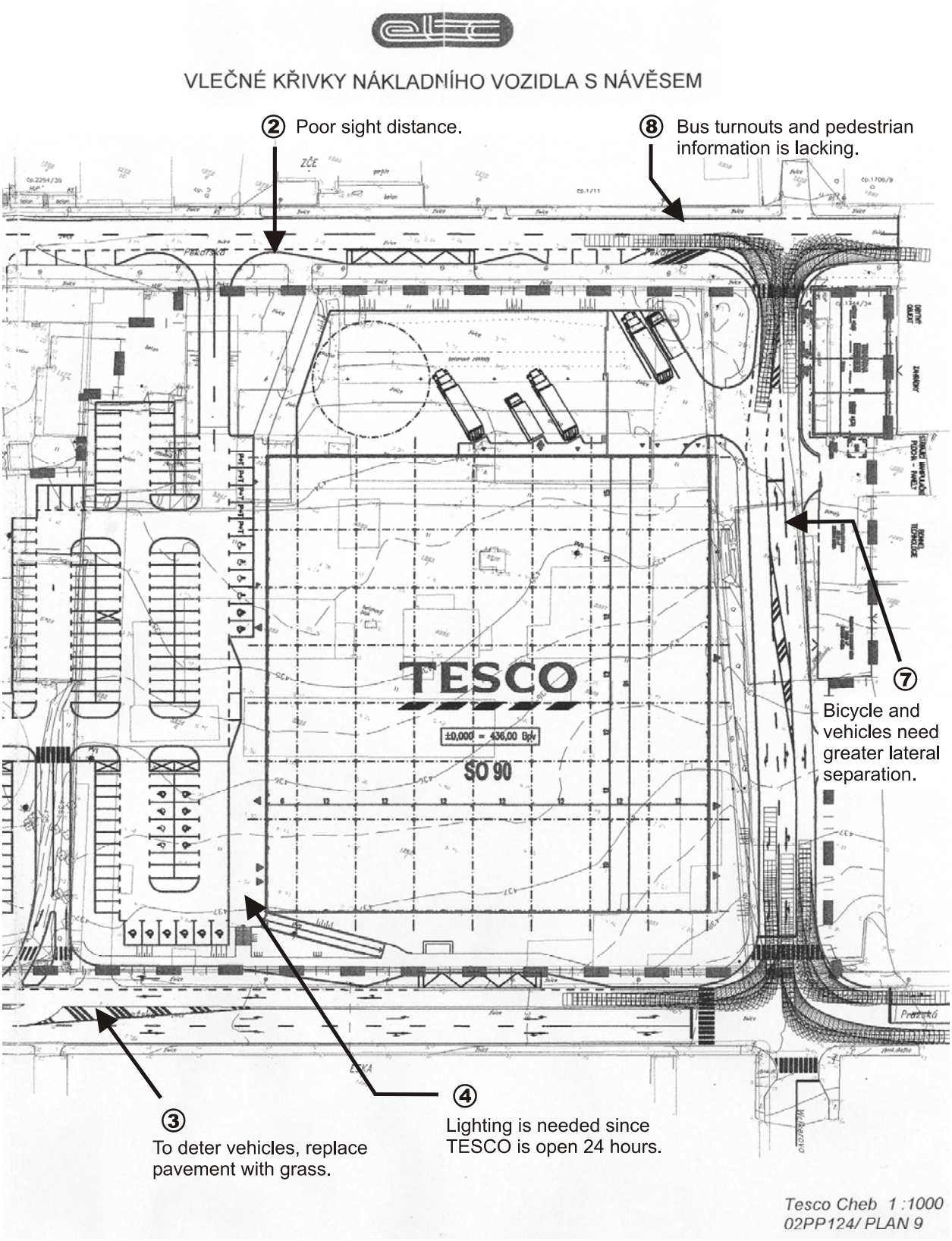


Figure 10. Site Plan Review for the TESCO Road Safety Audit (Right Half)

Jan Weinberger described a method of peer education for young drivers. Noting that many students have the perception that "accidents will not happen to me", Mr. Weinberger described a project involving students who have a definite and visible physical impairment resulting from an accident. Those students will be asked to participate in education efforts for their peers, and the project will be begin this fall in Austria, Sweden, and Germany. Mr. Weinberger described other efforts toward improving safety: requiring vision tests every five years, using a point system for driving, and collection of best practices within the 25 EU countries for educating young children (e.g., how to use the crosswalks).

Toward the end of the day, *Mr. Tučka and Mr. Pokorný* gave some information regarding bicycle collaboration between the Ministry of Transport and the Ministry of Health, which was a pilot project in the City of Olomouc. (In sum, in that effort, the Ministry of Health provided information to persons to encourage it among this city of 100,000 people). It was also noted that, as described, the Czech Republic is poised to see rapid automobile growth: the number of passenger vehicles increased by almost 50% (from 2.3 million to 3.0 million) over a five year period (from 1990 to 1995).

Figure 11. (a) Pavel Tučka and colleagues who worked on the Smart Car, and (b) Petr Pokorný

Technology Transfer Conference in Liptovský Ján

The team traveled from Brno (Czech Republic) to Liptovský Ján (Slovakia) to participate in the Central European T^2 Conference. Participants at that meeting included Jiří Kubita of Kubita Associates; Petr Polansky of CDV, Ján Šedivý of the Slovak Road Federation, John Nicholson, Dan Berman of FHWA (Rhode Island Division), Richard Horn of the Rhode Island T^2 Center, and István Havasy and Bálazs Szirányi of AKMI, which is the Hungarian T^2 Center. The focus of the Conference was primarily on methods for performing technology transfer, although by the third day of the Conference, discussions had moved to the topic of what collaboration among the member states (Czech Republic, Slovak Republic, Hungary, Ohio Rhode Island, and Virginia) should accomplish. All states were represented at the conference except Ohio, whose representatives could not obtain permission to make this trips.

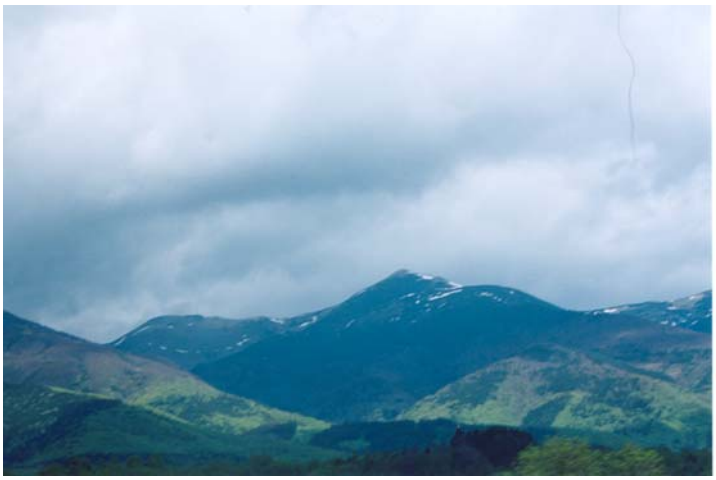


Figure 12. Mountainous Terrain of Slovak Republic

Monday May 10

Dan Berman presented, on behalf of Tracy Busch, an *Overview of FHWA's Office of International Programs*. Mr. Berman noted that authorization for FHWA participation in this venture (working with other countries in the area of T^2) came from Section 506 of Title 23. Mr. Berman noted that FHWA topics of interest include safety improvements, environmentally sensitive practices, warranties, ITS for incident management, weather prediction (especially for the purposes of mitigating black ice), and road traffic information systems. Mr. Berman also noted that OIP has other outreach activities besides this conference. Examples include *scanning tours* (covering diverse topics such as winter maintenance and the environment), an *international visitor program* (e.g., where FHWA works with other countries' visitors to convey some type of technology, such as toll bridges), a *technical assistance program* (covering topics such as heavy vehicle simulators) and other *international activities* with Africa, Japan, Korea, and Russia. Mr. Berman concluded by urging the participants to consider specific topics for joint projects.

Dan Berman then presented the *Results of an FHWA Public Opinion Survey*. Areas the public identified as needing improvement include *work zones* and *maintaining traffic flow*. FHWA also noted emerging issues including workforce development (many people are close to retirement, so how do you transfer that knowledge), work zone duration (work zones will be cause certain lanes to be closed an average of 11.8 hours per day during the summer), arterial road safety (in the USA, there were 17,718 fatalities on arterial roadways), and common contributors to fatalities (for example, more than a third of fatal crashes are single vehicle run off the road). It was not surprising, therefore, that one FHWA-recommended area of collaboration involved wire-rope guardrails. Other potential collaborative areas suggested by FHWA include cell phone usage, storm water management planes, innovative materials (high performance steel, concrete, and polymers, and training for young drivers. Regarding the latter, Jan Weinberger's work with peer education (see page 23) was passed on to Mr. Berman. Discussion also returned to the topic of worker retention, where it was noted not enough engineers are entering the areas of construction and maintenance. Richard Horn noted that transport should also be defined more broadly than just roads, citing the fact that while transport may occupy 10% of the gross domestic product, much of that figure comes not from road construction and maintenance but rather other areas such as logistics.

Jiří Kubita described the *C3 Technological Standards Working Group*, which was an EU committee that sought to identify successful T^2 methods in developing countries. That committee was divided into three working groups: WG1—training directed towards social developments (e.g., mapping T^2 centers), WG2—technology of T^2 (e.g., identification of tools available), and WG3 (evaluation of products such as CD-ROMS, T^2 newsletters, and seminars). Mr. Kubita's reason for discussing C3 was to illustrate the pitfalls of having meetings without a clearly defined purpose—as Mr. Berman had briefly mentioned earlier, Mr. Kubita noted that for this T^2 conference to have value, participants should agree on some key goals to accomplish.

István Havasy introduced a *Survey of AMKI Hungary T^2 Clients* which had two goals: to develop a prototype survey that could be distributed outside the borders of Hungary and to identify strategies for effective technology transfer. After showing the survey instrument, Mr. Havasy explained that later in the conference he would present the results.

Jiří Kubita concluded Monday's meeting with the *T^2 Centers Budget Agreement*, noting that CDV will serve as the central organization for the various country centers and shall cooperate with other states as necessary. Mr. Kubita noted that as of the end of 2003, a balance of $34,595 remained for technology transfer initiatives among the Central European countries.

Tuesday May 11

Alicia Szebenyiova gave an *Overview of the Slovak Road Databank*. Ms. Szebenyiova described the processes of data collection and data elaboration. The databank is in a GIS environment and includes road inventory data, pavement data, structural data on bridges and culverts, and investment data related to construction. The database is calibrated by establishing GPS coordinates of a "screw" that is physically embedded in the roadway. A profilograph mounted to an instrumented vehicle is used to determine rutting. Data elaboration is performed with the .dbf format (tabular data) and the .dgn format (graphical data). Applications with these data include pavement management system, establishment of routes for oversized roads, and transport engineering. The data appear to be reasonable; for example, in verifying the condition of the pavement, there is little rutting on motorways compared with secondary class roads, as one would expect. Future efforts will emphasize data collection training. After the presentation the group went to the parking lot to observe the equipment: the FWD (falling weight deflectometer that measures the total pavement stiffness, the skid tester, and the video van (Figure 13).

Figure 13. (a) FWD equipment (b) Ján Šedivý demonstrates the skid tester (c) Video Van

Bálazs Szirányi and István Havasy gave an overview of the *Hungarian Road Administration*, summarizing the assets and organizational structure. Of interest is the number of bridges: Hungary has only 37 km of expressways, 535 km of motorways, 2173 km of primary roads, 4330 km of secondary main roads, yet 6000 bridges. AKMI was founded with the aim of generalized coordinating activities and has six main duties: quality management (e.g., verifying performance-based invoices), research development, operating the national road databank, road information services (e.g., measuring weights and dimensions of vehicles), training, and road licensing/border crossings. AKMI emphasizes training: persons who physically do the work (truck driving, patching, etc.) are all certified with a state licensing program. AKMI has provided around 50-60 courses per year, with the now required "technical supervisor" course being the most popular. For more details, the website in English is available at http://web.kozut.hu/cms/netalon.xml?data_id=1191. AKMI also performs other steps such as job analysis, development of curricula, and the establishment of a process for creating training courses designed for a specific target group.

Jiří Kubita and Petr Polansky gave the *History of the T^2 Center at CDV*. Mr. Kubita described the beginnings of the center and the difficulty of defining what is technology transfer. Initially, the Center had an IT focus, with four basic activities being (1) technical infrastructure, (2) library information services, (3) a CDV information system, and (4) the classic T^2 functions (short courses, newsletter, etc.) Mr. Polansky explained that many of the functions are still rooted within IT, including activities such as the preparation of MOBILITY magazine, preparation of web pages, and providing access to EU publications.

Celik Ozyildirim presented an *Overview of Knowledge Management and Technology Transfer in Virginia*. The emphasis of the presentation was on knowledge management, because VDOT will lose a significant portion of its 10,000 employees within the next five years due to retirement. Knowledge management tries to capture what is primarily classified as "tacit" knowledge—informally shared between two people—as opposed to explicit knowledge which is found within libraries and publications. Virginia's efforts are just getting started: Virginia has surveyed practitioners, prioritized areas, and initiated interviews in key knowledge areas, but the results of this work, which will culminate in the form of "communities of practice" are not yet available. Maureen Hammer, director of VDOT's Knowledge Management Office, will be leading these CoPs in an attempt to avoid information overload for participants. Dr. Ozyildirim also summarized the activities of Virginia's T2 Center, including the presentation of courses and the dissemination of a newsletter. There was some discussion of the expense of these courses (around $40 per person for non-NHI courses compared with $100 per person for NHI courses), and discussion of Rhode Island's policy of giving the courses free of charge.

John Miller summarized the *Botetourt County-Virginia DOT Transportation/Land Use Coordination* project, as an example of how to move forward in an area where collaboration is desired but it is not clear at the outset what should be done. The specific project was one where a rural Virginia county—Botetourt—wanted to know how certain types of development (commercial, industrial, etc.) would affect traffic congestion on nearby streets. Thus, the specific methods discussed pertained to trip generation and highway capacity analysis to estimate vehicle delay at key intersections. Although the topic of transportation/land use coordination was closer to the "soft side" of planning and safety as opposed to the "hard side" of structures and materials,

several lessons that applied to the issue of translating goals into a result were identified. These included picking something tangible to do, even if it is simple, keeping everyone updated, dedicating staff to performing the actual work, creating a problem statement even if it is defined imperfectly, and making mistakes early on—that is, doing some of the technical analysis as early as possible when participants have a lot of energy and enthusiasm.

In the afternoon a tunnel opened late last year was visited (Figure 14a). The Branisko tunnel is 5019 m long with two concrete lanes. They indicated that due to fire hazard asphalt is not used in tunnel roads. There is a smaller escape tunnel running parallel to the main tunnel with connections at intervals. The modern tunnel has state-of-the art command center (Figure 14b). Its venting system is also state-of-the art with sound reducing columns in the intake section (Figure 14c). Directional signing is within the tunnel to guide pedestrians in the event of a fire (Figure 15).

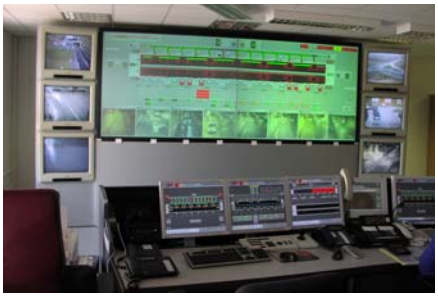


Figure. 14(a) The Branisko tunnel (b) Tunnel command center (c) Tunnel vent system.

Figure 15. Directional Signing in the Branisko Tunnel

Wednesday May 12

(A toll road was briefly described by AKMI staff which may have potential transport planning applications for VDOT: on a short stretch of motorway, heavy tolling caused diversion to alternative local routes. Subsequently, the tolls on the motorway were reduced and trucks weighing over 7,500 kg were required to use the main motorway. If data are available, it may be possible to learn lessons from this experience that can be applied to Virginia's considerations of truck diversion strategies on Interstate 81.)

John Nichols of *Rhode Island DOT* presented an overview of the most critical sections of the DOT (the maintenance section), as well as the less important divisions (ITS, program development, design, and construction). Maintenance is where the public sees something tangible produced by the DOT—cutting grass, sweeping roads, etc. Mr. Nichols also described three key RIDOT projects: construction of an intermodal station, the Freight Rail Improvement Project, and a reconstruction of Interstate 195, which is of interest in that it will *create* about 40 acres of land in downtown Providence. (The project is also expensive because of the vast amount of infrastructure that must be relocated: part of the $500 million cost arises because of the relocation of 54 inch sewer pipes and 30 inch gas pipes.) Mr. Nichols concluded with remarks that echoed a Virginia situation from several years ago: the extensive use of consultants in the design section has led to decreased efficiency. (He also explained this was his opinion rather than being the official position of RIDOT).

Richard Horn summarized the *University of Rhode Island Transportation Center*, which offers approximately 200 degree programs related to transportation. Mr. Horn noted that each of the 27 federally funded USDOT transportation centers has a focus, and that of URITC is transferability of research results. URITC leverages state and federal funding sources by requiring proposed projects to have a 50% match from other sources, furthermore, each project requires significant student involvement. URTIC has involved 72 faculty and 21 departments from six different colleges in these projects, and supports a total of 80 students annually (half graduate, half undergraduate). URITC is also developing projects for primary and secondary school students (kindergarten through the last year of high school) in order to encourage math and science interest in the pre-university years.

Jeff Cathcart summarized *Technology Transfer at URITC*, emphasizing the courses and newsletter provided by the Center. For about ten years, the program was at the State Department of Administration, but it recently was moved to URITC. Mr. Cathcart gave his philosophy as being "outside of the box" adding that it was important to be "out of the office and in the field almost all of the time." He described the ratio of T^2 workshops and seminars to hands-on training for manual workers as being 15%/85%--similar to the ratio found in state government. Although it is important for the T^2 to provide a product of tangible value, such as the hands-on course in concrete sidewalks that, at the request of a village, provided sidewalks to the village and training to their public works department in how to build these sidewalks, it is also important than people get fed! They do not charge registration fee for the workshops and provide free lunches. The workshops are popular and well attended. Other hands on activities include equipment shows snow plow rodeos, hands on training in welding and computers, chain saw training, and the production of the *Rhode Report* newsletter, available at www.uritc.uri.edu/t2center. Mr. Cathcart's emphasis was on the diversity of subjects covered by the Center as well as an emphasis on doing projects for local communities; for example, a T^2 intern had refurbished 30 surplus state computers and given these to localities free of charge. Finally, the Center reaches out to students with construction career days, where students get to place concrete, tie steel, and run backhoes.

Ján Šedivý presented the *Road Network in the Slovak Republic and T^2 Activities*. The Slovak Republic has 49,034 km^2 of land, 5.4 million people, 313 km of motorways, and 17,459 km of first second and third class roads, not including the portions within cities. Almost all

roads are paved.. In the past, the Slovak Road Authority (SRA) was responsible of investment, transport planning, maintenance, and operations for all 42,997 km of roads, but the administrative structure for maintaining these roads is changing. As of January 2004 SRA controls just 3,653 km, with eight local governments responsible for 14,124 km and cities responsible for 25,220 km of urban roads. This administrative change has means that the highest priority for the new T^2 Center (Útvar Výmeny Informáccií), as described by Dr. Šedivý, is to find the appropriate role for that center within the new road sector structure. Organizationally, this means determining how the Center should cooperate with the Slovak Road Society and how the T^2 Center can build on collaboration with outside organizations (such as participation from the XXIL World Road Conference in Bratsilava in April 2004. Dr. Šedivý also noted that the T^2 Center needed an advisory board as well as better software for the library that would support the Center.

Jiří Kubita and *István Havasy* summarized findings from *A Survey of International Events* regarding how technology transfer funds have been spent. Speaking for the Czech Republic's use of the funds, Mr. Kubita noted that out of 176 questionnaires, 32 were returned, 28 of which were usable. Almost half of the travel was to Slovakia, with 43% of the events being conferences and symposiums; big topics were network development, and road and bridge maintenance. Mr. Havasy had similar findings from Hungary's perspective, and developed a metric called volume to denote how much training is accomplished; volume is the number of visitors multiplied by the number of training days. (For example, since the technology transfer conference had 11 visitors and lasted for 3 days, its volume was 33 training-days.) Between 1998 and 2003, Hungary's annual volume ranged from a low of 2016 to a high of 4270, with most training lasting in the range of 3-6 days. Although Mr. Havasy noted that a limitation of the survey is that some employers to do not wish to answer the survey completely, he also noted that a change in tax law will soon give better results (because non-professional travel will be taxed.)

The conference ended with a *Summary of Basic Guidelines and Future Directions*: this was a discussion led by Jiří Kubita that involved all of the participants. Three main areas that were agreed upon as being of interest are work force development, traffic safety, and quality control/quality assurance. Participants also discussed practical next steps for collaborating together, such as

- Identifying specific projects at the next technology transfer meeting
- Defining what this group (Czech Republic, Hungary, Republic of Slovakia, Ohio, Rhode Island, and Virginia) should accomplish.
- Sharing resources through meetings and visit
- Linking this group to other groups

Overall, there was much interest in working together. At this point, the next step is to translate this cooperation into specific steps. It emerged from the discussion that some cooperation can be initiated by one state working with another (e.g., CDV and VTRC can work together on specific projects as described at the beginning of this report.)

The conference ended on May 12, at which point the team traveled to Prague, returning to the USA on May 13.

Figure 16. Jiří Kubita: T^2 Leader for Kubita Associates and Honorary Member of the Virginia Team