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Road Talk TTAP

A Layman's Report on Chinese Transportation Systems

by Spence Meyers

I have recently returned from a three week vacation in China. Our department, The Center for Transportation Research, has a very active visiting scholar exchange program arranged with several highly respected Chinese transportation institutions. We host visiting students and professors who come here for a year abroad in America. These scholars, while they are here, learn about our transportation systems and through collaboration on various projects we learn their transportation system. This is a great program for sharing knowledge and understanding. I have been working at TTAP for several years and have conducted many technical assistance projects. The scholars here are always interested in our data collecting methods. They also want to practice their English language skills.

My wife and I have appointed ourselves "Unofficial Ambassadors" to this program. We each have a background in Anthropology and are imminently curious about studying other cultures. Our friends here are as fascinated with American culture as we are about Chinese culture so this has worked out well for all of us. Our Chinese friends are very excited about coming to America and love their experiences here. We have invited them to our house for cookouts and firearm practice, which they enjoy very much. But, while they are excited about visiting our country they are just as proud and patriotic about China as we are about our country. We could not resist their invitation to visit them in China any longer.

Main Beijing Train Station (c. 1950's)

It is not that we did not want to go. It is simply that it is a very big endeavor. Traveling to any other country takes a lot of planning and this was no different. It took several months of planning and paperwork to ensure that everything would run smoothly. We also had to plan out our sightseeing agenda. China is a very big place with lots of things to see. With only three weeks, including the significant travel time, we had to be very judicious about our

Boarding the Bullet Train

continued on page 3

In this issue...

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From the Director

My calendar tells me that roughly six weeks remain before summer officially gives way to fall, but early August has already brought some fall-like weather to East Tennessee. I know better than to think we've seen the last of the hot, dry weather for 2017, but this has been a welcome preview of my favorite season. It won't be long before the Volunteers are dominating the headlines, but only time will tell if those headlines bring good news or bad. You never know around here. For now I'm going to keep my orange-colored glasses on and say that the Vols are going to surprise the naysayers.

Autonomous and connected vehicles (CAV) continue to be a hot topic, not only in the world of transportation engineering and research, but also in the news media. Most of the CAV discussion consists of serious and often technical analysis of technology, regulations, investment, and public reaction. This week introduced a little humor into the narrative as a Washington, DC, television reporter investigating reports of an autonomous van on the streets of Arlington, VA, instead found that the van was driven by a human wearing a disguise which allowed the driver to go undetected by casual observers. While this scenario initially sounds quite similar to several prank videos posted on YouTube, the non-autonomous vehicle is actually part of a legitimate research project being conducted by Virginia Polytechnic Institute and State University (Virginia Tech). The study is designed to measure the real-world human reaction to CAV technology. Specifically, researchers are trying to determine if additional exterior signals are necessary for pedestrians to safely and comfortably interact with these vehicles. These details paint a picture of serious and much-needed research rather than an elaborate prank, but I'm still quite amused by the thought of a researcher essentially dressed as a chair. Maybe some of my past office pranks weren't such a waste of time after all.

Finally, TTAP has at last taken the plunge into the world of social media. We hope to use our Facebook page (www.facebook.com/TNLocalRoads/) to share more news, facts, and training opportunities than RoadTalk and the TTAP website typically allow. Most importantly, we hope to have a little fun with this information (at least where it is appropriate to do so). While everyone at TTAP has contributed to this effort, most of our recent progress can be attributed to Sara McCurry, an undergraduate student in Psychology here at UT. Sara has been working at the Center for Transportation Research for about a year and we have enjoyed the fresh perspective that she brings to topics that can get a little dull at times. Please check us out if you spend time on Facebook and let us know if you have anything that you would like us to share with others.

That's all I have for now. Please do not hesitate to contact us if there is anything that TTAP can do to help you meet your community's transportation needs.

itinerary. The Chinese government is not resistive to foreign travelers; they just want to be sure that you have a place to stay and are planning to go home at the end of your visit. It is possible to stay in China and to live and work in China; they just want to know that it is your intention to do so before you arrive. In this respect it is much like our own immigration system. Luckily, we have many friends here at the University and many friends in China that could help us prepare and help us move about once we arrived there.

The purpose of my trip was, of course, tourism. However, I was keen to observe as many roadway similarities and differences as I could. Any visit to China will require a lot of transportation. It is a very large country and some of the most significant sites are well outside the cities. One of the first things you may notice about transportation in China is the prolific public transportation system. In the bigger cities you will have multiple bus routes on the main roads with multiple buses on each route. You will also often find these buses full of people. They even have many double-decker buses which my son was determined to ride. They have many routes and they are well used by citizens and tourists alike. The public transportation system does not stop at the street level. Underground you will find clean, fast, numerous, on time and crowded subway lines serving all of the major parts of the cities. When it comes to the end of the line and you go up top you will easily find a bus or taxi to take you to your final destination.

On a larger scale you will find the intercity transportation systems to be prolific and well used. We took the high speed rail line (Bullet Train) from Beijing to Dalian, an ocean side city in the North. Most international connecting flights come through Beijing City International Airport (PEK) so this is how we arrived in the country. Beijing alone has four major rail stations. Our tickets were for the main station downtown. The rail station was a 1950s era structure. Although old, it was a fully modern terminal. Ticketing and boarding privilege was completely computerized. One consideration, at least to us on this day, English was not spoken anywhere at the train station. Airports are fully bilingual but not the train stations. Our friends in Beijing were able to get us set up at the correct waiting area and from there it was a simple matter to get on the train.

Transportation Laboratory at Beijing Transportation University (Former CTR Scholar Liu Hua)

The train was on time and was as clean as a whistle. We "giant" Americans found the seats a little small but not terribly uncomfortable. Maybe a little less accommodating than a small airplane might be but not impossible. The Bullet Train is powered electrically so it leaves the station and picks up speed completely soundless. The tracks must be very smooth for the train to reach high speeds so even at over 200 mph the train is very quiet until another train meets us in the opposite direction. You really can notice the 400 mph "tornado" between the two trains. This was one of the experiences I was most eager to try out. I would be taking a real train ride. I was not disappointed. It gave us an opportunity to see the countryside and all of the small villages and some big towns along the way. There were huge mountains and beautiful rivers lining the tracks. It definitely takes longer to travel by train than by airplane, but some of the routes are equivalent overall after you calculate going through airport security and making your way to the proper gate in these huge airports. The train station is often much closer to the parts of the city you want to visit. Overall at least one trip on the bullet train should be everyone's goal in China.

Intercity air travel is very much comparable to what you may find in America. Ticket kiosks are prominently placed in the airports, at least at the three we used. Expect long lines to get your boarding pass and a long walk to the gate and a long line to board the plane. Long lines are actually

continued on page 4

prominent all over China, not only at airports. It is not difficult to find English speakers at airports. Their English may not be perfect so it may take a conversation for even the simplest questions but you will not have any trouble getting around. Security at Chinese airports is very stringent but not quite as demanding as in American airports. It is also much quicker.

There are lots of cars in China and lots of traffic. I was only in a few really bad traffic jams but there was almost always lots of traffic. The roads were all very good. They had very well maintained asphalt surfaces. Traffic control devices were generally well placed and prevalent enough to direct traffic. I did not understand all of them, but I eventually figured out most of them. For instance, the curvy road ahead sign in China looks like a lightning bolt instead of a smooth "ess" shape. Most traffic lights had countdown timers so you could tell how much time remained on green or red.

Traffic behaves differently in China. A typical trip has the driver changing lanes almost constantly. This is possible because of much lower speeds and slower acceleration than those with which we are familiar. There is a lot more stopping and turning on streets here which causes backups for drivers to negotiate. It is very common and appropriate for a driver, while using the turn signal, to pull in front of moving traffic to avoid these stoppers. The turn signal is almost always used in these settings. Another widely used tool in China is the horn. The horn is used here more like an announcement that "I am here". If a driver is beginning a lane change, another driver may indicate that there will not be room for the maneuver by blowing the horn. The very frequent use of the horn is perhaps the most noticeable difference from our traffic.

Another noticeable feature is the types of vehicles. I have already mentioned the prolific bus service. In addition to these is the widespread use of "electric bicycles". These look like little motorcycles but are powered by a battery. I think they are more reminiscent of a moped. They are small, have a limited speed and have a small load capacity (generally one operator and one rider). A variation of this design has a large box (about 3 feet wide, 3 feet high and about 5 feet long) or a flatbed (about 3 feet by 5 feet) immediately behind the driver. This is what almost all deliveries are made with inside the city. There are no delivery trucks (like Fed Ex or UPS) and no semis on these urban roads. The box "scooters" are typically for mail order fulfillment. The flatbeds carry everything else. I saw a flatbed scooter with furniture, appliances, garbage or recyclables stacked six feet high, even dozens of cases of water bottles. This seemed the most improbable. There must have been 500 pounds of water on this scooter. And, of course, there were regular bicycles. They have millions of bicycles in the urban areas. All of these were significant obstacles to automobile traffic. I think overall the lack of semis on these crowded roads may have been a net plus.

Both highways and roads in China are in very good repair. This is partly due to a heavier reliance on rail for intercity freight and passenger service. Also many highways are toll roads. Our Chinese friends shrugged this off as a "you get what you pay for" kind of thing. The tolls were not large but they were common. The roads are very busy close to and within cities but on the open stretches of highways and toll roads they are quite clear. Speeds also increase in these settings. With a quick metric conversion in my head while traveling around the country it seemed that some of the fastest speeds were equivalent to our top interstate speeds but lower speeds were the norm. The Chinese rely heavily on traffic cameras for enforcement. I saw no police presence on any of the highways. In fact there were very few police cars on any of the streets that I traveled.

We have a lot to learn from our Chinese friends about mass transit. I think in general Chinese people are willing to sacrifice more conveniences to use mass transit than most Americans are, myself included. I want to be able to have my automobile close by. I want the freedom that driving myself to work allows. I think maybe with the huge population of people in China it is a luxury that is impossible to attain. The Chinese people really make good use of their public transportation systems. I feel that this is a lesson we need to learn here in America. More public transit would save on our fossil fuel usage and parking requirements. It would reduce snarling traffic jams. There are many potential benefits from more of us taking advantage of mass transit. But, we love cars in America. Well, the Chinese people love cars too.

Bicycles vs Railroad Crossings – A Case Study of Crashes

Source: Factors influencing single-bicycle crashes at skewed railroad grade crossings – Ziwen Ling, Christopher Cherry, Nirbesh Dhakal.

More travelers are choosing bicycles as a healthy, economical, and environmentally-friendly mode of transportation. As bicycle travel increases, we must not fail to consider this mode of travel in ongoing transportation planning, operations, and safety activities. In some instances, bicycle-specific issues may not be immediately apparent. University of Tennessee Civil and Environmental Engineering Professor Chris Cherry, along with graduate students Ziwen Ling and Nirbesh Dhakal, studied one such bicycle safety issue that had previously gone undetected within view of the department's building on the UT campus.

Video recordings of bicycles traversing a skewed highway-railroad grade crossing on Neyland Drive in Knoxville provided empirical data for this unique study of single-bicycle crashes. Observed crash rates were much higher than expected and almost all of them were unreported. The video was captured from the fourth floor of a building located approximately 450 feet from the crossing. The camera captured continuously at 720p resolution at 30 frames per second from August 2, 2014, to October 3, 2014. There are two cyclist grade crossings in this area; a parallel 10-ft. wide shared-use pathway (greenway) on the north side of the roadway (approximately 20° rail skew tangent to tangent), and a wide (approximately 11.5 ft.) shoulder on the south side of the roadway (approximately 10° rail skew). In both cases, cyclists can cross the rails at approximately 45° at low speeds within the shoulder or greenway. On the shoulder, many cyclists cross into the adjacent travel lanes to cross the tracks at larger angles. The speed limit on Neyland Drive is 45 mph.

During the study period, 13,247 cyclists traversed the crossings, including 9,521 on the Neyland Greenway (Eastbound and Westbound) and 2,091 on Neyland Drive shoulder (Eastbound), with the remaining 1,635 traversing at different parts of the roadway. During the study period, 53 crashes occurred at the crossing, including 21 (crash rate: 2.2 per 1000 traversings) on the Neyland Greenway (both directions) and 32 (crash rate: 15.3 per 1000 traversings) on Neyland Drive shoulder (eastbound).

Due to the restricted view and geometric characteristics, the study only focused on traversings and crashes that occur on the eastbound shoulder of Neyland Drive. That crossing is constructed from pre-cast concrete panels that includes a uniform 2.5-in. wide and 3–4-in. deep flangeway gap between the rail and the panel. An example of a bicycle crash mechanism at the railway crossing is shown in Figure 1.

Although approach angle is the most obvious and important factor to consider when designing rail crossings, other environmental or rider attributes influence crash outcomes. According to the study, group riders, women, and wet roadway conditions all contribute to higher crash rates. Facilities that share these characteristics should be designed with increased scrutiny.

The study suggests countermeasures, like jughandle designs, that improve the traversing angle for cyclists. Improving traversing angle up to 90° is ideal but often infeasible due to space constraints. Any

Figure 1 - An example of a bicycle crash at the study location.

continued on page 6

traversing angle more than 30° would be highly effective at reducing crashes and providing traversing angles greater than 60° would effectively eliminate them. The crossing studied here was infeasible to construct at a crossing angle that approached 90°. Responding to the problem, the City of Knoxville did construct a jughandle design (Figure 2) with a tangent angles of 57°, with a possible minimum angle of 37° (inside-to-outside of bike lane). This design encourages cyclists to approach this crossing with larger than 37° angle. It has effectively eliminated crashes except in cases where cyclists traverse the hash marks and cross at low angles.

A complete copy of the study is available at https://doi.org/10.1016/j.jth.2017.01.004.

Please take a moment to watch a YouTube video documenting the crashes used in the paper. It is available at https://youtu.be/YfeQvbIFBks

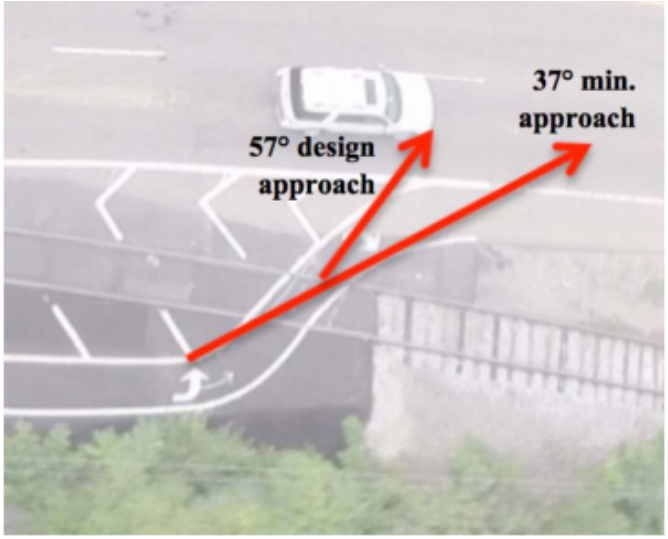

Figure 2 – Jughandle design in the city of Knoxville

Bank Erosion and Bridge Scour – NCHRP Practice Ready Solutions

by Airton Kohls - Source: NCHRP Research Topic Highlights July 2017 and FHWA EDC-4 Innovations

The National Cooperative Highway Research Program just released an 8 page document where it highlights some of the research on prediction and prevention of bank erosion and bridge scour. The document can be found at the following address http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_researchtopichighlights_02.pdf

The most common cause of bridge failure is scour, which occurs when moving water erodes the soil and rock from around bridge piers and abutments, or from the banks or bed of the river channel spanned by the bridge. The sediment surrounding piers and abutments supports their foundations and is vital to the stability of bridges. Consequently, one of the most important elements of bridge design is the ability to predict the effects of scour so that foundations can be designed to withstand these effects over the life of the bridge. Such predictions require the use of complex hydraulic equations, which are set out in several FHWA's Hydraulic Engineering Circulars (eg.: HEC-18, HEC-20 and HEC-23).

Predicting river channel migration and deploying bank erosion countermeasures, such as placing rocks and vegetation along banks to protect the soil from the flow of water, are critical to preventing bridge scour. Predicting channel migration has historically been difficult to do, even with the best computer models. In NCHRP Report 533, researchers provide engineers with a practical and empirical GIS-based methodology for predicting channel migration. Use of vegetation can be an environmentally sensitive and aesthetic way to prevent stream bank erosion. NCHRP administered research to evaluate existing guidelines for the design, installation, monitoring, and maintenance of environmentally sensitive stream bank stabilization and protection measures. The resulting NCHRP Report 822 provides updated design guidelines for three widely

continued on page 7

used treatments: live siltation and live staking with a rock toe, vegetated mechanically stabilized earth, and vegetated riprap.

Abutments and embankments are the most commonly damaged bridge components during floods. Image courtesy of Lake County, MN.

Scour countermeasures are at once necessary and costly, making their selection, design, and construction important considerations for transportation agencies. NCHRP research has been critical in establishing practical guidance for using scour countermeasures. NCHRP Report 593 includes practical selection criteria for bridge pier scour countermeasures; specifications for their design and construction; and guidelines for their inspection, maintenance, and performance evaluation. The report is accompanied by a spreadsheet containing an interactive version of the countermeasure selection methodology. Bridge abutments and their approach embankments are the most commonly damaged bridge components during floods. NCHRP Report 587 provides validated selection criteria and guidelines for the design and construction of countermeasures to protect bridge abutments and approach embankments from scour damage. Solutions include flow-altering devices, such as guide banks and weirs, and nontraditional abutment scour countermeasures, including articulated or tied mats and blocks. Before NCHRP research, most states had differing specifications for classifying riprap size and gradation, and construction practices were sometimes ineffective. NCHRP Report 568 provides engineers with design guidelines; material specifications and test methods; construction specifications; and construction, inspection, and quality control guidelines for riprap at streams, riverbanks, bridge piers, and abutments.

Bridge scour analysis and scour countermeasure analysis are also some of the applications of CHANGE (Collaborative Hydraulics: Advancing to the Next Generation of Engineering), one of FHWA's Every Day Counts (EDC) 4 – Innovations – initiative. (https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/change.cfm) With CHANGE, the Federal Highway Administration (FHWA) continues to recognize the benefits of 2D modeling for the safety of the traveling public and in the resilience of transportation infrastructure. This next generation of hydraulic engineering tools, particularly two-dimensional (2D) modeling and graphical visualization features, allows users to create better representations of the often complex interaction between transportation assets and the riverine or coastal environments. These representations provide the planning and design team with better data with which project quality can be improved.

In Tennessee, the TDOT structures division has scour studies as one of their key responsibilities. In addition, the division is responsible for designing and developing plans and specifications relating to all highway structures and for the inspection of all bridges in Tennessee. These include the design of foundation conditions, tolerances and complex geometry; the design of major or unusual structures; resolution of hydrology and hydraulic problems; coordination of Geological Survey services; processing of federal disaster assistance, hydraulic studies involving legal action; inspection of prefabrication plants, welding procedure review; on-site erection supervision; design and development of contract plans specifications; development of automated structural detailing systems; and bridge inspection. The Structures Division has over 100 employees to accomplish its objectives. Annually, it prepares hydraulic and structural designs for approximately 120 bridges for on-system and off-system routes. Additional information may be found at http://www.tn.gov/tdot/section/structures-home.

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TALK TO TTAP

We are always looking for your comments, ideas and suggestions to help make the TTAP Program more useful to you. Please fill out and fax the form below to TTAP at (865) 974-3889 or mail to TTAP; Suite 309 Conference Center Building, Knoxville, TN 37996-4133 or email TTAP@utk.edu if you have any questions.

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