Photo: PCI.

Vehicular Trends and the Future of Bridges

Designing for versatility will be key as technology improves life

William N. Nickas, *Editor-in-Chief*

As members of the bridge engineering profession, we want our structures to have a service life of 75–100 years or even longer. None of us wants to see a 20-year-old bridge removed for structural or operational reasons. But, if we are to build long-lasting bridges, we need to anticipate the vehicular trends of the future. My curiosity about those trends was sparked earlier this year when I attended the Transportation Research Board's annual meeting, where participants could observe and ride the Federal Highway Administration's autonomous vehicle. I then attended a chapter meeting of the International Bridge, Tunnel and Turnpike Association, where I was eager to learn what financial professionals and transportation planners envision for the future of bridges and highways.

One crucial variable in bridge design is the fleet of vehicles that will be on the roads in future decades. Trend watchers predict that electric vehicles will be one-third of the inventory by 2040 and one-half of the inventory by 2050. They also anticipate that autonomous vehicles will be on the roads soon, although the widespread impact of these vehicles on the transportation network is harder to predict.[1]

Emerging vehicular technology promises to change human habits in ways that will directly affect transportation solutions, including fundamental aspects of bridge design such as lane geometry and access points. For example, commuters may not care so much about personal time spent in traffic if they can relax while their autonomous cars drive them home. Their incentive to pay tolls for express lanes or to use managed lanes restricted to passenger vehicles may therefore decline. But parcel delivery businesses might be willing to pay a premium to access faster lanes and bridges and shorten the time that their vehicles spend in traffic.

I also wonder whether we will soon be designing bridges for mass-transit, fixed-guide systems with ride-share and autonomous-vehicle technologies. If so, we may need to revisit older transportation solutions. For example, the slab tracks originally designed for buses might be adapted for elevated, personal autonomous vehicle pods. If that happens, we will need to formulate operational protocols, such as how to manage a disabled autonomous vehicle on a confined corridor. Will connected trucks operate in the corridors and on structures? That innovation could have implications for the strength requirements of the structures or the weight limit of the individual trucks.

An area of uncertainty is throughput in our future traffic systems. I have heard it might increase, but it could decrease if computer-controlled autonomous vehicles require increased headways to reduce the risk for collisions. When autonomous technologies control vehicles, exceeding the speed limit will not be an option.

Researchers are currently engaged in studies to model how emerging vehicular technologies will affect the functioning of households, and they have already noted differences between urban and rural areas of the United States. In some cases, autonomous vehicles and phone-based applications will likely select routes that are not on the current mainline arterials, perhaps to avoid tolls or heavy traffic. At the same time, our vehicles and phones will collect data on our driving routines and preferences and use that information to make subsequent decisions about what routes to take and what tolls will be incurred.

Pilot projects in Colorado and Ohio will answer some questions about vehicle-to-vehicle and vehicle-to-road communications. As we gather insights, we'll need to decide what capital programs will be needed to make the transportation system of the future work. Now is a great time for bridge engineers to get engaged so we can understand how new technologies will influence our roadways, bridges, and interchanges. This is also the time to start reviewing the design assumptions underlying our bridge codes. Will our investment in variable toll rate commuter lanes with bridge assets become a feature whose use will need to be redefined to carry heavier trucks or platoons of trucks? With connected vehicles, like a platoon of trucks, what bridge code design assumptions will need to be revisited and how will these new load effects be reconciled with the inherent capacity of our existing inventory? I certainly hope our bridge colleagues in leadership roles are helping to identify consistent and prudent strategies.

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