There has been a considerable increase in the amount of construction work on the U.S. national highways. Due to the capacity drop, which is the result of lane closure in work zone area, congestion occurs with a high traffic demand. The congestion increases number and severity of traffic conflicts which raise the potential for accidents; furthermore traffic operational properties of roadway in work zone area become worse. Intelligent Transportation System technologies have been developed and are being deployed to improve the safety and mobility of traffic in and around work zones. The use of Dynamic Merge Controls (dynamic early merge and dynamic late merge) have been initiated to enhance traffic safety and to smooth traffic operations in work zone areas. The use of variable speed limit (VSL) systems at work zones is also one of those measures. VSL systems improve safety by helping the driver in determining the maximum speed that drivers should travel. Besides adding improvement to safety, they are also expected to improve mobility at the work zones. The main goal of this study was to evaluate the safety and operational effectiveness of the dynamic merge systems in the presence of VSL controls. VISSIM model is utilized to simulate a two-to-one lane configuration when one out of the two lanes in the work zone is closed for traffic. Two scenarios each for early and late simplified dynamic lane merge system (SDLMS) with and without VSLs, whereas one scenario each for the current Motorist Awareness System (MAS) and VSL alone were adopted to assess the effectiveness of these scenarios under different traffic demand volumes and different drivers' compliance rates to the messages displayed by the systems. Mean throughputs and travel time were operational measures of effectiveness whereas speed variance and deceleration means were taken as safety surrogate measures. Three different logics were coded each for VSL alone, early SDMS+VSL and late SDLMS+VSL in calibrated and validated VISSIM model for SDLMS through Vehicle Actuated Programming (VAP) code. It is found that for low and medium volume levels (V0500, V1000 and V1500), there is no significant difference between the Maintenance of Traffic (MOT) plans for mean throughputs. For higher volume levels (V2000 and V2500), late SDLMS with and without VSL produced significantly higher mean throughputs for all compliance rates and truck percentages. This study revealed that VSL increases travel time through the work zone. It is also found out that VSL makes the system safer at higher volumes (2,000 vph and 2,500 vph). Another outcome of this study is that the addition of VSL to the dynamic merge systems helps in improving the overall safety of the system by lowering speed variances and deceleration means of the vehicles travelling through the work zone. The passage of traffic through the work zone is made safer when a speed control is integrated to a dynamic merge system.

Major: Civil Engineering

Educational Career:
Bachelor's of Civil Engineering, BS, 2004, University of Engineering and Technology, Lahore, Pakistan

Committee in Charge:
Dr. Essam A. Radwan, Chair, CECE
Dr. Mohamed Abdul Aty, CECE
Dr. Rami C. Harb, CECE

Approved for distribution by Dr. Essam A. Radwan, Committee Chair, on April 8, 2010.

The public is welcome to attend.