Abridgment

Simulation of Operation of Disabled Vehicle Location and Aid Systems on Limited-Access Highways

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The operation of alternative disabled vehicle aid and location systems for use on limited-access highways has been examined by digital computer simulation. Characteristics of disabled vehicles input to the simulation programs were obtained from studies carried out on British motorways and reported to the 1975 Annual Meeting of the Transportation Research Board.

Three location systems have been studied: the emergency telephone system currently in use on British motorways, the service patrol, and the "flash" system.

The simulation models reproduced real-life breakdowns for any highway and the operation of a disabled vehicle location and aid system whose characteristics were input into the simulation model. These characteristics include

1. Length of highway being simulated,
2. Period of real time for which simulation is required,
3. Hourly traffic volumes and proportions of goods vehicles,
4. Distribution of types of faults and disablement probabilities,
5. Speed-flow relationships for highway, and
6. Operating details of disabled vehicle location and aid systems.

Output from the models included

1. Time and position of each breakdown,
2. Type of vehicle involved and disabling fault,
3. Time required to detect an incident, and
4. Time required to bring aid to the disabled vehicle.

Validation of the breakdown procedure of the simulation models was achieved by the ability of the program to reproduce the observed pattern of vehicle disablements on a section of the M1 motorway in Yorkshire, England. Given the necessary input data, the models were able to reproduce realistically the pattern of vehicle disablements that occur on a real highway. If the characteristics of any disabled vehicle location and aid system are known, one can evaluate its effectiveness without actual implementation of the system.

In the simulated emergency telephone system, detection is performed by the disabled motorist and detection time is assumed to be a function of the distance to an adjacent emergency telephone. Aid to disabled motorists was provided by private garages contacted by the emergency telephone control center. Input to this model was a list of garages able to provide assistance, their location in relation to the highway, and details of the hours during which they operate. On receipt of a call for aid, the model selects the garage nearest to the disabled vehicle that is able to respond to the call for aid. Monte Carlo processes are used to model the time required by a garage to turn out on receipt of a call.

The service patrol system as simulated both detects disabled vehicles and offers limited aid to the motorist in the form of gasoline, water, oil, first aid equipment, and emergency warning signs. Each patrol is allotted a beat of 16 km (10 miles) and travels at the prevailing roadway speed. If the patrol cannot give aid, then the disabled vehicle is further delayed until aid requested from a private garage by the control center near the service patrol arrives.

The flash system investigated was that designed and developed by the Airborne Instruments Laboratory. Evaluated on the cooperative motorist concept, it allows drivers who sight a disabled vehicle to summon aid by flashing their lights at one of a series of electronic detectors situated at the roadside.

The simulation model assumed that the time required to detect a disabled vehicle was composed of two elements: (a) the time required for a passing vehicle to detect the disabled vehicle and (b) the travel time of the detecting vehicle before it reached the detector.

Operation of the systems was simulated for the traffic flow conditions that occurred on the M1 motorway for a total of 7 Fridays between 6:00 a.m. and 10:00 p.m. The average waiting time required to locate and provide aid to disabled vehicles under these traffic conditions was

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determined from the simulation models. For the system characteristics input into the simulation models, the flash system produced the shortest average waiting time, the emergency telephone system produced greater delay, and the service patrol produced the greatest delay.

This study has developed computer simulation models that can reproduce the pattern of breakdowns on a typical section of the British motorway system. The operation of three location and aid systems also can be simulated by using assumed system characteristics.