

you will find that these accumulated obstructions can occur as often as 100 per mile on each side of many of these highways.

On arterial streets, you will find that light standards, utility poles, trees, and fire hydrants make up a maze of roadside obstructions that can be lethal, but became an accepted practice and a normal part of the highway and street scene.

For many years, the State highway departments got little public support for even mowing highway rights-of-way or for moving utility poles toward the right-of-way line.

As early as 1950, the State highway departments, through AASHO, started developing design standards for the time that an Interstate program might be authorized. We started with the then present state of the art of freeway design as reflected in the few urban freeways and some of the early toll road practices. The Pentagon network was even studied in detail as one of the starting points for an evolutionary and refinement process that continued until the program was started, and the standards have been constantly reviewed and upgraded since that time.

Great emphasis was placed on such things as widths of pavements, widths of shoulders, controlling curves and grades, sight distances, and the required geometry of interchange layouts.

The purpose was to give the most efficient and safe roadway that could be devised. As stated previously, we were probably guilty at that time of not giving enough thought to the roadside itself and the obstructions that might be placed upon them.

Very few people realize or appreciate the scientific basis used in developing highway standards, for instance, deceleration rates are based on the coefficient of friction of a worn tire in contact with a wet pavement for the particular design speed involved.

These coefficients of friction, of course, change with design speeds and become lesser for faster speeds. By multiplying the coefficient of friction by the acceleration of gravity, the deceleration rate in feet per second is obtained, and this must be kept below that where small children might slide out of the seats of the vehicle. This factor, considered along with the perception and reaction time of the driver determines the stopping distance required.

We use the combined perception and reaction time of  $2\frac{1}{2}$  seconds, which includes the slowest reaction drivers on our highways. It is found that even an alert fast-reaction driver, under certain conditions, while driving on the highway may have considerably slower time than when tested in a laboratory and alerted to the test, so it is desirable to include a substantial safety factor in the time consideration.

In other words, a highway is designed with safety factors to provide an extra measure of safety for a driver who is giving reasonable attention to his driving.

In determining controlling vertical curvature, it must provide enough sight distance for a driver to have sufficient time to stop before hitting any obstruction on the roadway 6 inches or more in height. For this purpose, the driver's eye is assumed to be 3.75 feet above the pavement and, of course, must be based on the smaller cars in use today. The larger vehicle provides some added safety factor in this regard.