

THE KILLER TREE PROBLEM

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Responding to the following prompt

What steps need to be taken to place road safety at the same priority level that the environmentalists have on a road project? No road projects can be started without an environmental study. Why not require the same for a road safety audit? Why is it that a killer tree that is located close to the road and has killed errant motorists cannot be removed because of environmental concerns? Who is responsible the next time this killer tree kills another motorist causing a needless death?

BACKGROUND

For over 40 years, impacts with roadside trees have been one of the most common, and deadly, crash types. Vehicle-tree crashes are responsible for more fixed-object crashes annually than any other fixed object on the roadside, and result in over 3,000 fatalities annually in the United States, accounting for 28% of crashes with fixed objects [1]. Moreover, many state DOTs and municipalities have limited reaction to these tree deaths because of social and political pressure to retain the trees. However, removing killer trees from the roadside would result in significant safety and economic benefits. Yet, environmentalists continue to get priority when it comes to tree placement, despite several glaring safety problems with roadside trees located near streets and highways.

The frequency and severity of tree crashes are strongly related to the tree's location and proximity to the road. A study [2] in 2005 on Massachusetts roadways found that fatal tree crashes are most prevalent on local rural roads, followed by major rural collectors, and other roads, with 90% of all fatal tree crashes occurring on two-lane roads. A summary of the distribution of fatal tree crashes per functional class is shown in Figure 1. More accidents occur between 0 to 12 feet from the travel lane, with significantly less between 12 to 30 feet. Additionally, more than 60% of the tree collisions involved drivers that had been drinking and over 60% of the fatalities were under the age of 35 [3]. Trees are addressed in the *Strategic Highway Safety Plan* [2], but recommendations were limited to clear zone treatments. Tree crash prevention is not currently well defined in design policies; therefore, mandatory safety measures are not in place to reduce the frequency and number of fatalities.

Figure 1 Distribution of Fatal Tree Collisions by Functional Class [2]

Road Safety Audits

Environmental studies are completed before any road project can be started. Unfortunately, road safety audits are not often required. The road safety audit is a systematic procedure that brings traffic safety knowledge into the road planning and design process to prevent traffic crashes [4]. The purpose is to assess the current conditions of the roadway and make suggestions to minimize death and serious injury. These audits can be completed for new construction, as well as for rehabilitation projects on existing roadways. The audit will work toward lowering the number of needless fatalities associated with vehicle-tree crashes. Road safety audits will also allow changes to be made to the road design before installation and could reduce possible litigation costs. Audits are very common around the world, but they have not yet become standard practice in the United States.

A road safety audit can greatly help place road safety at a similar priority level to that associated with environmental concerns, such as clean water and clean air. The results of each of these studies must be

considered in conjunction so there are no conflicts. In one such instance [5], \$12,000 was spent to conduct a road safety audit in which the following suggestions were made: install curve warning and chevron signs; paint thicker edgelines; and remove trees along the roadway. These safety improvements totaled \$23,000, reduced the crash rate by 3.5% and resulted in a benefit-to-cost ratio of 20:1. This is a dramatic example of the safety and economic benefits that road safety audits can provide. These need to be as commonplace as environmental audits, because the safety of the road users is believed to be as important as most environmental concerns.

Causes of Needless Deaths

Some factors that may contribute to vehicle-tree crashes include presence of horizontal and/or vertical curves, excessive speed, inadequate clear zone, and high tree density. Of these, it was found in the Massachusetts study [6] that speed limit, clear zone, and tree density have the greatest impact on the number of fatal tree collisions. Crashes with trees are far more dangerous than crashes with other vehicles, because the consequences are often greater when the object involved in the collision is rigid, narrow, and lacks energy absorption. Although crashes with vehicles are far more common, head-on crashes with fixed objects are far more injurious than vehicle-to-vehicle crashes. Based on the increased risks for vehicle-tree crashes, a road safety audit should be performed along with an environmental audit to identify critical road safety concerns.

Despite the need to remove trees from within the clear zone, there is major public resistance to eliminating, reducing, or relocating roadside trees due to their aesthetic appeal and perceived environmental road benefits. Trees collect stormwater runoff that would otherwise drain into local streams. However, falling leaves and branches can clog sewer drains and make the stormwater runoff problem significantly worse. Trees may help to reduce erosion and can even reduce the surface temperature of the pavement by providing shade. However, shade can also prevent chemical treatments from reaching an activation temperature to properly melt snow and ice on the roadway. Further, trees may not like to be close to nearby road salts and other de-icing chemicals as well as petroleum-based products that splash onto nearby soils. Trees can also be used to screen out commercial areas that may be displeasing to drivers. Sound walls can also provide the same benefits and have the added benefit of being crashworthy. In all, it is important to realize that the efficiency and safety of streets are more important than placing trees near the road and other environmentalists' concerns.

Benefits of Removing Trees

The first major benefit of removing or relocating trees that are close to the roadway would be increased motorist safety with the elimination of rigid, discrete hazards. The best way to obtain this benefit is to adopt the clear zone concept. A clear zone is defined as the distance adjacent to the road edge that is free and clear of fixed objects, which could damage a vehicle and harm occupants upon impact [7]. By clearing the area of rigid hazards, a driver can safely return to the road or bring the vehicle to a safe stop before encountering additional harmful consequences. A 30-ft clear zone is often recommended for high-speed, rural roads, while a 10-ft clear zone is often noted for low-speed roads [2]. Figure 2 depicts trees within the clear zone, which can cause crash and sight distance concerns. As noted above, a reduction in the number of vehicle-tree crashes can be achieved with the use of a clear zone.

Figure 2 Median Trees Near Traveled Way (Lincoln, Nebraska)

Trees cause significant issues aside from being struck by vehicles and causing fatalities. A tangible example of trees having a negative impact aside from fatalities is the economic strain they place on municipalities. Most noticeably, sidewalk maintenance due to tree root growth has become a recent issue in numerous cities across the country. In the city of Lincoln, Nebraska, over \$6.5 million has been allotted in the past two years for the repair of over 1,550 sidewalks [8]. Although trees are not the only cause for requiring sidewalk replacement, they have caused excessive damage and cost cities like Lincoln a

significant amount of money. Sidewalk repairs can cause municipalities to greatly increase budgets for general tree maintenance. Further, trees have caused damage to other city infrastructure, such as roads, curbs, and sewers. This finding fortifies the fact that urban roadside trees may be causing more harm than good when placed close to the traveled way.

Potential Solutions

In order to bring road safety and environmentalists' concerns to the same level, a few concepts can be used. Initially, not all trees may need to be removed or relocated, as high-risk locations should be treated first, such as near curves along roads with speeds of 30 mph or greater. Streets can still remain aesthetic and livable with trees located outside the clear zone. Planting guidelines must be put into place and require minimum lateral distances to edge of traveled way for tree placement based on the posted speed limit of the roadway. Initial placement criteria may be based on the 10 ft and 30 ft suggested clear zones for low and high speed roads, respectively.

The concept of layering trees can also prove beneficial and allow trees in regions to enhance aesthetics. Layering involves placing small shrubs and bushes closer to the road, with small diameter, less injurious, mature trees placed farther behind the shrubs. Larger trees can be used when located farther outside the clear zone. By placing differing levels of foliage before the large trees, some limited energy can be dissipated before the vehicle reaches the most harmful object with additional lateral space for errant vehicles to recover. Layering may be the most important in urban roadway medians, such as in Figure 3, where small diameter trees are placed within the clear zone. When considering layering and tree sizes, it is important to remember that trees expand in size over time. It has been suggested to limit roadside and median trees to 4 in. diameter or less to reduce crash severity. However, it is important to note that a 4-in. diameter tree may grow into a 10-in. diameter tree in 10 to 15 years. Layering with small diameter trees would still allow the foliage to be in place along the roadside, but it would reduce the risk of killer trees due to an increased lateral offset to the traveled way combined with a small diameter, mature trunk.

Figure 3 Layering Concept in a Median (Lincoln, Nebraska)

Design Responsibility and Tort Risk

In order to ensure that tree safety measures, such as the clear zone and layering, are considered during roadway design or as part of safety improvements, greater personal responsibility should be assigned to those charged with completing the overall roadway design or street plan. The lead project or design engineer and their employer should hold a major responsibility for the roadside design, including tree placement, due to their professional stamping of the project plans. Due to this fact, the project or design engineer would be more likely to consider tree risks for fear of litigation if a needless death were to occur. Likewise, more responsibility should be given to the road authority that developed and/or implemented the tree placement plan. By placing direct liability on these two groups, more collaboration would take place and the safest option for the motoring public would likely be chosen.

CONCLUSION

Street trees, as they are currently being used, are dangerous and expensive to maintain. A decision to move trees farther away from the traveled way can save lives in the long term. By removing trees from within the clear zone and/or relocating trees beyond the clear zone, both roadway designers and environmentalists could be satisfied. Layering, when the median is wide enough, can also provide a safe approach and keep large trees outside of the clear zone. Efficiency and safety of roadways needs to become the focal point of roadside design. The epidemic level of roadside tree fatalities is a growing concern, yet with collaboration between competing arguments, less people will die as a result of vehicle-tree collisions. Collaboration will follow when greater responsibility and liability is doled out to the

roadway engineer, environmentalist, and road authority. In this case, the safest design option will be chosen and less needless deaths will occur.

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