Effect of Planting in Median Strip on Night-Visibility Distances

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● THERE is a general belief that the planting of shrubs in the median strip of divided highways is an effective means of reducing headlight glare; however, there is little reported experience as to desirable types of shrubs, pattern of planting, or relationship to line and grade. Some disadvantages are recognized, particularly as to the creation of a snow fence, the accumulation of papers and trash, and the difficulties of mowing the remaining grass areas in an economical manner. The tests reported were conducted by the New Jersey Turnpike Authority in cooperation with the General Electric Company to evaluate the glare reduction which might be provided by a simple planting along the center of the dividing median.

The width of the median on the New Jersey Turnpike is sufficient to minimize the effects of headlight glare, being 26 feet throughout most of its length. Accident records do not show that glare is a serious contributory cause in night accidents. On the other hand, it is known that many drivers use their low beams from habit when meeting other traffic, and that the low beams are not effective for high-speed driving. While the authority has received some drivers' complaints against the use of high beams, advice from several traffic experts has been that drivers should be encouraged to use high beams because of the increased seeing distance thereby obtained.

Previous tests, as reported before the Illuminating Engineering Society[1] indicate that there is a definite seeing advantage with high beams opposing high beams as against low beams opposing low beams when the traffic lanes are separated by a distance of 21 feet or more. Present studies were initiated to determine the degree to which median plantings might be indicated as a prerequisite to encouraging all drivers to use their high beams.

Several planting patterns were developed by the turnpike engineering staff. Design aims included the use of a minimum number of trees, reasonable ease in mowing grass areas and avoidance of a hedge effect. The design trees were considered to be arbor vitae, 3 feet high when planted, and 4½ feet high and 15 inches in diameter at a point 2 feet 9 inches above the ground after 2 years of growth. The most satisfactory pattern appeared to be that whereby a pair of trees were set 5 feet apart, measured along the centerline of the median, and at an angle such that each tree was offset a foot from the centerline of the median; the trees were thus about 5 feet apart. The pairs of trees were located 24 feet 4 inches on centers, which makes the angular displacement equal between succeeding trees. At approach angles less than 15 deg. this pattern should cut out glare from opposing headlights on a level grade; further growth would improve the effectiveness.

The first test was made on the turnpike itself with cut trees inserted in small holes made with a crowbar. The trees used were scrub cedars and the total length of planted area was 3800 feet. The tests were conducted by comparing the average seeing distance to international standard dummies in the planted area and in an area where no shrubs were planted. Four dummies were placed in each area at successive intervals of 600 feet, 400 feet and 500 feet.

TABLE 1

Observer	Number of Readings with trees	Seeing Distance with trees	Number of Readings without trees	Seeing Distance without trees
		ft		ft.
I	24	418	24	423
II	25	470	24	497
III	28	367	28	357
IV	26	253	28	245
V	27	283	17	216
VI	28	365	28	412
Average, All Observers		359		358

They were five feet off the right lane on the shoulders. Fixed glare cars were parked on the outside shoulder of the opposing roadway so aimed that the high-beam headlamps would strike the test driver's eyes at or near the first dummy. Six observer drivers were tested, each making a minimum of five runs through the test

[1] "Seeing Against Headlamp Glare", Val Roper and G. E. Meese, Illuminating Engineering, March, 1952.

course. The seeing distance to the dummy was measured by having the driver press the horn rim on the vehicle when he first saw the dummy, this action being indicated electrically on a remote recorder geared to the transmission of the test vehicle so as to measure the elapsed distance between this action and the closing of the circuit by an observer riding in the car, who operated a pushbutton when the vehicle passed the dummy. Individual seeing distances ranged from 100 feet to 625 feet. The average seeing distance for the various observers is shown in Table 1.

seeing. This was further brought out by glare measurements which showed 0.0045 to 0.045 footcandles of glare in the planted area as compared to 0.02 to 0.11 footcandles in the unplanted area.

These tests also indicated further practical difficulties in experimentation with median barrier plantings on the turnpike itself. The movement of other vehicles even at low traffic periods provided additional glare which could not be controlled in the tests and it was difficult to find intervals for operating the test vehicle when no other vehicles were going in the same direction

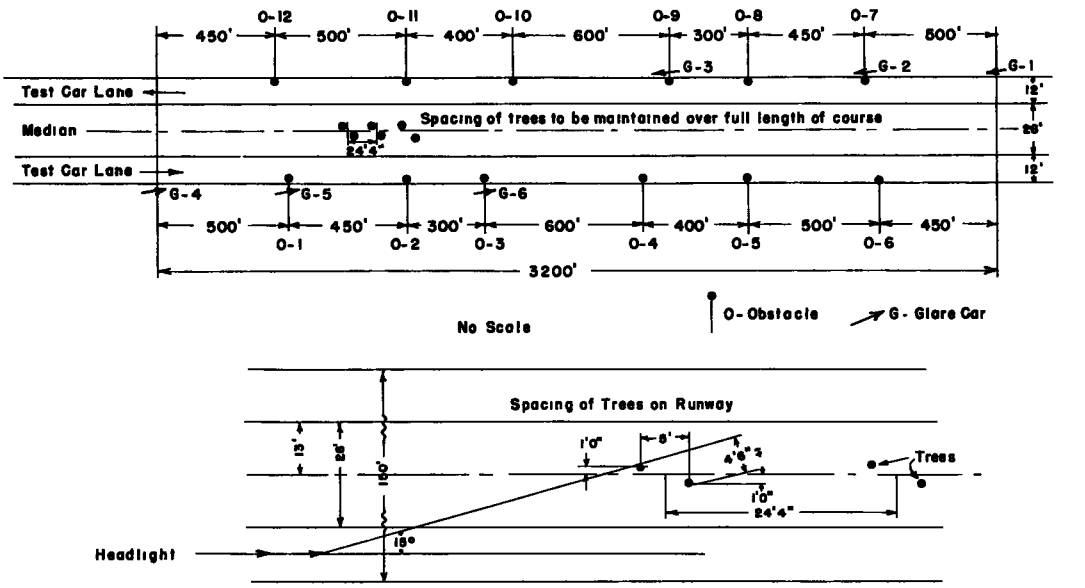

Figure 1.

The indicated results were considered unsatisfactory. Further analysis indicated that the slight curvature of the roadway which included a 12,000-foot-radius curve to the right in the planted area and a 20,000-foot-radius curve to the left in the unplanted area did not make the results comparable. Calculations taking into account the effect of headlight illumination because of the curvature showed that 20,000 candlepower (beam) was directed on the test objects in the planted area compared to 50,000 candlepower in the unplanted area. Although the overall average seeing distance for all six observers was not materially different for the planted and unplanted areas, there was a definite indication that there must have been better glare protection in the planted area, since less light was available for and, hence, adding their headlight illumination on the test objects. It was concluded that further tests should be run under more carefully controlled conditions before any conclusions could be drawn.

The second series of tests were conducted on an unused runway at Newark Airport, used through the courtesy of the Port of New York Authority. Scrub cedar trees were again used to simulate planting, each tree being wedged into a concrete building block and trimmed to a uniform height of 5 feet 6 inches. This Christmas-tree arrangement allowed the pattern to be changed readily and avoided the need for making holes in the runway. The test course was carefully laid out to simulate turnpike conditions of median width.

Two planting patterns were used, one as

TABLE 2

	Observer	Obstacles 1	2	3	4	5	6	7	8	9	10	11	12	Ave
Trees Staggered		583	541	547	513	525	556	499	502	514	551	523	577	536
Trees in Line	A	586	587	603	535	533	573	536	472	562	549	615	606	563
No Trees		493	441	505	434	472	468	366	382	427	388	401	504	440
Trees Staggered		403 0	361 0	321 002	317 078	359 001	387 007	393 0	316 001	357 001	344 007	320 043	381 025	355 014
Trees in Line	B	414 0	401 0	374 002	348 017	341 002	385 010	386 0	400 001	399 002	366 008	380 025	428 026	386 008
No Trees		430 006	432 011	361 019	361 420	308 034	390 086	361 025	297 042	345 060	303 355	292 610	409 315	357 165
Trees Staggered		415	409	432	380	393	450	393	366	419	441	460	444	417
No Trees	C	358	379	408	339	371	370	287	315	342	301	368	371	351
Trees Staggered		392 0	375 0	371 002	326 068	345 001	359 016	341 0	331 001	366 002	360 005	351 048	407 025	360 009
No Trees	D	387 007	332 012	345 021	296 372	300 033	309 119	311 024	255 042	323 059	281 185	327 253	347 190	318 110
Trees Staggered		498	554	538	565	474	510	520	487 *	530	542	513	556	524
No Trees	E	521	495	499	471	394	432	425	410	434	402	400	512	450
Trees Staggered		499 0	488 001	499 002	469 034	389 002	443 010	428 0	419 001	483 002	431 005	466 033	469 035	457 010
No Trees	F	453 005	441 010	394 018	401 162	368 028	401 101	383 022	317 039	383 055	360 189	359 530	479 342	378 125
Trees Staggered	Ave	465 0	455 0	461 002	428 060	414 001	451 011	429 0	404 001	445 002	445 006	439 041	472 031	
No Trees	"	440 006	420 011	419 019	384 318	369 032	395 102	389 024	329 041	376 058	339 243	358 464	437 282	
Trees Staggered	Ave	477 0	473 0	477 002	451 060	425 001	464 011	436 0	421 001	462 002	465 066	463 041	491 031	
No Trees	without Observer B	442 006	418 011	430 019	388 318	381 032	396 102	354 024	336 041	382 058	346 243	371 464	443 282	

in the previous test and the other with the trees on the centerline, spaced 12 feet 2 inches apart. The layout of the test course is shown in Figure 1. The test procedure was similar to that previously used, with six observers making a minimum of six runs each on the staggered planting pattern and without any shrubs. The in-line pattern was tested by only two observers, and discarded because of the flicker effect of spilled light between the trees. The results are shown in Table 2.

From those data, it may be seen that there was a great variation between observers. Observer B, who says that he is not troubled by glare, was found to show little improvement with the plantings; it may be that he does not see well at night under any conditions. Observer A, who is greatly troubled by glare, showed the greatest benefit from the plantings: a 28 percent improvement.

The average increase in seeing distance for all obstacles and all observers was 14 percent with the planting of trees. Eliminating Observer B the average increase in seeing distance was 18 percent. On the basis of obstacle location, the average increase in seeing distance with the trees ranged from a low of 6 percent to a high of 31 percent, considering all observers. Leaving out Observer B, the increased seeing distance for the condition of tree planting ranged from a low of 10 percent to a high of 34 percent over the range of obstacle locations. Analyzed on the basis of individual seeing distance and at each obstacle location, the seeing distance with trees as compared to no trees ranged from 93 percent (Observer B at Obstacle 2) to 153 percent (Observer A at Obstacle 11). It therefore appears that as much as 50 percent increased seeing distance can be expected with trees planted as in this trial. Further increased seeing distance can be expected as the trees obtain more foliage, because there was still some glare through the trees.

There is another factor which may be illustrated by traces from the glare recordings: The discomfort or annoyance when driving the expressway without planting as compared to that with planting. The highest recorded value in footcandles at the eye for the condition of the planting was 0.06 footcandles with an average at the 12 obstacle locations of 0.013 footcandles. For the condition of no trees, the highest recording in footcandles at the eye was 0.464, almost eight times the highest value recorded with the trees. The average over the twelve obstacle locations was 0.133 footcandles, or ten times the average with the trees.

What this major reduction in glare would mean in terms of lessened fatigue and annoyance is anybody's guess. The increase in seeing distance for the condition of the trees was substantial: up to 214 feet.

The tests conducted to date have not taken into account problems of line and grade. Further studies are being considered by the turnpike authority in combination with other median problems, and will be reported upon from time to time.

Discussion

NELSON M. WELLS, Director, Landscape Bureau, State of New York, Department of Public Works — My reasons for objecting to plantings in the mall to reduce headlight glare are as follows:

1. Plantings in the 20-foot-wide depressed mall will probably interfere with drainage. Leaving a 5 foot shoulder clearance on each side, two 2½ foot-wide strips of planting would soon interfere with a desirable 5 foot-wide center ditch clearance.

2. Plantings which are high, dense and continuous enough to screen headlights will cause snow to drift on the pavement in narrow mall sections.

3. Plantings would occupy space which may be needed for snow storage.

4. Plantings have been severely broken down by snow piled in malls.

5. Plantings in a mall would interfere with the flow pattern of high speed mowing equipment and usually require considerable hand mowing.

6. Evergreen shrubs or trees would be required for year-around effectiveness. Trees such as pines, spruce and hemlock would soon grow to a size where their heavy trunks would be disastrous to a car out of control. Red Cedars and Arborvitae are not so large growing and would succeed in most soils along the Thruway. A single line hedge of either of these at a height to be immediately effective would cost about $20,000 per mile. Their effectiveness would last 10 or 15 years or until their lower branches were shaded out.

7. Deciduous plants are not as effective and would need frequent pruning to create a dense twig growth for some screening in winter. Two rows of such plants as Hawthorns would cost about $70,000 per mile. Two rows of shrubs would cost about $5,300 per mile but would not be effective for at least 3-4 years. Mixed evergreen and deciduous shrubs and trees on both sides of the ditch would cost about $40,000 to $50,000 per mile. A woven wire fence with Honeysuckle vines would cost about $16,000 per mile and might be effective if used south of Poughkeepsie.

8. Plantings require considerable care for at least two years after planting. Maintenance crews would be needed to start immediately to care for such prominent plantings. The principal maintenance would be hand weeding and watering. Hand weeding several times a year may be required for four years.

9. Maintenance costs would undoubtedly be increased as a result of removing papers, leaves and other debris from such a barrier.

10. The artificiality of a detached hedge in the midst of generally open countryside would impair the natural landscape qualities of the Thruway route.

GENERAL DATA

In the spring of 1947 inquiries on headlight-glare control were addressed to nine leading agencies. Each recommended wide malls as based on their opinions. The Nela Park Engineering Department of General Electric Co., Cleveland, gave the only answer based on tests and they said that unless a screen were continuous the mall should be 200 feet wide on tangents and 2,000 feet wide on curves. The Bureau of Highway Traffic, Yale, assumed a 30-foot mall adequate on tangents and shrubs needed on curves. They called attention to the bad features of tree trunks, drainage, snow drifting and catching debris.

In the fall of 1950 after surveys in nurseries and parks, consultants with the New York State College of Agriculture and the State Botanist, a selection of deciduous shrubs were specially purchased and planted on an 800-foot stretch of a curve on the New York Thruway. The best of these are still ineffective above a height of 3 feet.

Clipped hedges of hawthorns planted in a 6-foot mall on the Henry Hudson Parkway in about 1936 have been successful. They are now effective only for the top 12 inches of their 4-foot height.

Heavy plantings of mixed trees and shrubs were planted in malls on the Merritt Parkway in about 1936. Within 10 years after planting, the evergreen trees had lost their lower branches and other trees and shrubs had to be drastically cut back from encroachment on the pavement.

About three years ago Japanese Holly hedges were planted in the mall on US 1 near the Newark Airport and much publicized at the Highway Research Board. Inspection reveals that this expensive installation has proven ineffective.

In the spring of 1952 a heavy planting of deciduous shrubs mostly 3 to 4 feet high was made at the curves in a 30-foot-wide mall on Route 1841 north of Babylon. Removing weeds has been a costly problem and after two growing seasons the mass is not yet effective against headlight glare.

Oliver Deakin, New Jersey Parkway Engineer, reported in 1952 to the American Society of Landscape Architects as chairman of a committee on Public Roads, Controlled - Access Highways, Parkways: "Committee . . . admits . . . inability as landscape designers to correct headlight—glare conditions on divided highways by planting methods when medians are less than 20 feet wide."

Naturalistic plantings in wide malls are considered successful along various New York State Parkways and I believe it is possible to create a screen with plants in any mall but with numerous complications.