International Journal of Engineering Inventions
e-ISSN: 2278-7461, p-ISSN: 2319-6491
Volume 11, Issue 12 [December. 2022] PP: 139-152

Criteria of Roadside Planting

RAMTHIANGHLIMITLAU
DEPARTMENTOF LANDSCAPEARCHITECTURE,
SCHOOL OF PLANNING AND ARCHITECTURE,NEW DELHI

Date of Submission: 09-12-2022 Date of Acceptance: 23-12-2022

1. DEFINITION/INTRODUCTION

The Roadside vegetation or bio engineering is a technique through which the life of road can be increased by controlling the moisture content of soil, by improving shear strength of soil, by improving infiltration capacity of soil & by controlling soil erosion. Through this technique we can also reduce the cost of construction, maintenance cost of roads. The road side vegetation technique orbio engineering technique requires assessment of existing road condition determination of type of roadside environment desired according to increased public demand and customer expectations. There are various factors on which vegetation techniques depend: Soil conditions; Traffic Composition; Location of road; Topography; Adjacent Land Use; The Priority of Road; Aesthetic appearance

2. OBJECTIVES OF ROADSIDE PLANTATION

The main objectives of planting along the Highways are as follows:-

- For aesthetic enhancement of the project corridors and places of importance by planting selective ornamental trees, landscaping and turfing with grasses and ornamental shrubs.
- To reduce the impacts of air pollution and dust as trees and shrubs are known to be natural sink for air pollutants. To provide muc h needed shade on glaring hot roads during summer.
- To reduce the impact of ever increasing noise pollution caused due to increase in number of vehicles. To arrest soil erosion at the embankments slopes.
- Prevention of glare from the headlight of incoming vehicles.
- Moderating the effect of wind and incoming radiation

Planting of trees along roads may be in the following manner and should be suitable for different locations:

1. Avenue Planting
2. Group Planting
3. Mixed Planting

1. Avenue Planting consists of planting areas in single or double rows along highways. In large cities and locations, where, land is available double avenues of trees may be provided. On divided carriageway having separate pedestrian footpath, the outer rows c onsisting of shady trees and inner row consisting of ornamental flowering trees may be adopted.

Avenue

2. Group Planting consistsof planting a clump of 3or 4 trees along the highway overcomes the monotony of avenue planting. To be more effective the spacing of the group should not be uniform. This system should be followed where availabilityofland isnotan issue.

3. Mixed Planting consistsof selecting different varietiesof trees, rather than one single variety. This system avoids monotony of single variety planting. During storm, when wind velocityishigh,the hardervarieties will survive and will protect the weaker varieties too.

Group

Mixed

The most common use of trees is on roads and avenues. The roadlandscape needs to be safe for all road users and should be designed to improve road safety, mitigate accidents and/or hazards, and where possible, encourage safer road user behavior. If the wrong kind of trees are planted at wrong locations or places, the safety of traffic isendangered. Therefore,itisnecessary to lay down certain criteria before adopting any plantationscheme forroads.

GENERALBENEFITSO F ROADSIDEPLANTING
ECONOMIC ASPECTS

- Improved Road side conditions enhance the visitorvisit.
- Reduce cost of construction activities due to lessrequirement ofimproved technology.
- Also improveslife of pavement.
- It also reduces maintenance cost and needs.
- Itimproves water infiltration capacity of soil & reduces runoff.
- The roots, stems & associated woods that we obtained from cutting areused to build the structures.

Figure C8-1: Providing attractive and useable facilities improves tourism potential, particularly in regional areas

SAFETY ASPECTS

- Vegetation proves an effective tool for slope protection inroadprojects.
- Itminimizes effect of rain, snow and ice formation.
- Italso minimizes hazardous conditions for maintenance staff.
- Itreduces the slippery on the roads and provides safety for vehicles.

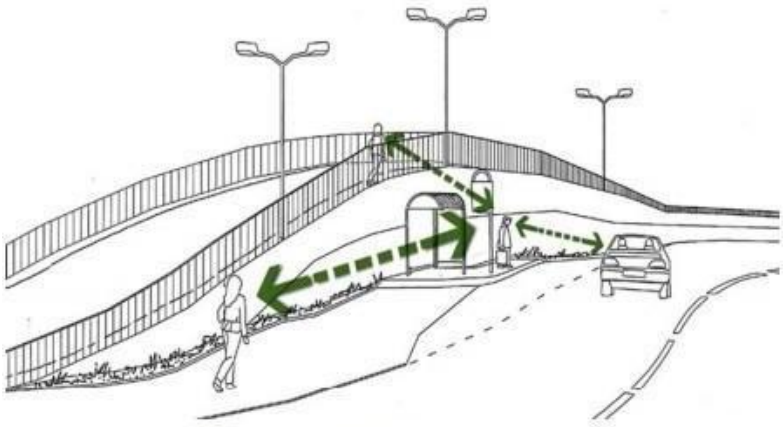


Figure C5-1: Maximise clear sightlines

3. GENERALBENEFITSO F ROADSIDEPLANTING

ENVIRONMENTALASPECTS

- Itimprovesairquality by absorbingcarbon monoxide, andcarbondioxide.
- Italso stabilizesthe ground surface to prevent soil erosionas withtime the strength of root system increases which increase the soilstabilityand the soilislessprone to soilerosion.
- Provideshabitatsforwildlife.
- Controlweedson roadside conditions.

Increased biodiversity(variationofspecies)

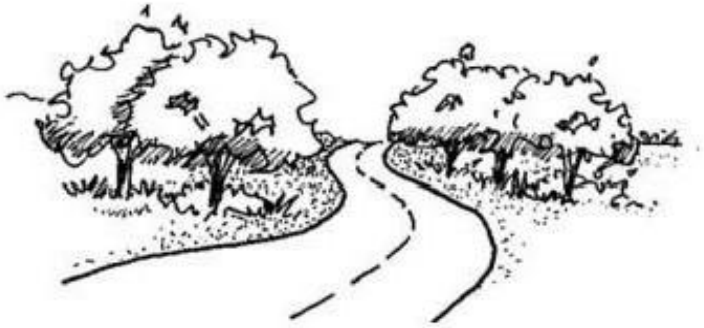


Figure C6-16: Roadway curvature responding to existing vegetation features

AESTHETIC ASPECT

- Roadside vegetation protects from unsightly views such as slums, Junk Yards, Storage depots etc.
- Trees provide shade, color if they are of flowering variety and also yields fruits

Figure C4-3: Natural values retained within the road landscape

4. PLANTATION SPECIFICATIONS ACCORDING TO DIFFERENT TYPES OF ROAD

TYPES OF ROAD :

1. National Highways:

The recommended minimum right of way (ROW) is 90 meters, wherever possible. However, within the city it shall not be less than 60 meters.

2. Arterial Roads: These include primary roads with access control and other primary roads.

i) Primary Roads: Vehicular routes carrying heavy volumes of traffic will generally have free / stable flow conditions with controlled access. The recommended ROW in existing urban area is 60-80m. and minimum 80m. in the proposed urban extension.

ii) Other Primary roads: The recommended ROW in existing urban area is 45-60 M. and minimum 60 m. in the proposed urban extension. Cycle tracks should also be constructed along all other primary roads wherever possible.

3. Sub Arterial (Collector) Streets: These include primary and secondary collector streets.

(i) Primary Collector: These roads will connect major arterial roads and inter residential district collectors. The recommended ROW in existing urban area is 30-40 M. and minimum 45 M. in the proposed urban extension. In addition to this, a separate cycle track should be provided wherever possible.

(ii) Secondary Collector: These roads are intended to collect traffic from local streets within one residential district. The recommended R/W in existing urban area is 18-24M. and minimum 30 M. in the proposed Urban extension.

4. Local Streets:

These are intended for neighborhood (or local) use on which through traffic is to be discouraged. The suggested ROW is 12 to 20 m. in the existing and proposed urban area. These roads should be made pedestrian and bic yc le friendly by using modern traffic calming designs to keep the speeds within limits as per design.

PLANTING RECOMMENDATIONS ACCORDING TO DIFFERENT TYPES OF ROAD

- **ALONG THE HIGHWAYS**

The technical specification for planting along the Highway are as follows

Ornamental plant except last row

Distance from embankment	1.0 mt. away from the toe of the embankment
spacing between plant to plant	3 mts.
Spacing between rows	3 mts.
Size of the pits [Normal soil]	60x60x60 cms
For Alkaline soil [Usar]	By Augar
Water logged areas	mounds with height varying depending on the water level
Species recommended	as per annexure
No. of plants per km	333
Activity and time schedule	As per table
Height of the plant	1.5m to 2 m

Shade plant (last row)

Distance from the preceding row	3 mts
Spacing between plant to plant	12 mts.
Size of the pits [Normal soil]	60x60x60 cms
Alkaline soil [usar]	By Augur
Water logged areas	Mounds
Species recommended	As per the table for shade plants
No. of plants per km	84
Height of the plants	more than 2 mts.

- Growth of mixed trees, the avenues present a patchy appearance. It is therefore best and most convenient to use the same species on either side of a road for at least 5 km or so and secure regularly grown avenues of the same form and type. Such avenues will mature at about the same time and can be replaced with minimum sacrifice.
- An average spacing of 12 mts. requiring 84 plants per km. and will provide ample growing space for most species. Too many trees apart from involving higher planting costs, very often unnecessarily reduce visibility for fast traffic. Excessive dense avenues serve no useful purpose and apart from affecting the tree growth adversely. It also reduces visibility and proves to be dangerous to fast moving traffic. Close spacing on curves and crossing can be dangerous so best plan is to miss a tree or two at such locations.

Planting on Median

- Low height plants or shrubs should be planted at a spacing of 3m.
- Only two rows of shrubs will be planted on median of width of 5m. The plants will be at a spacing of 1.5m from the inner edge of the median.
- The height of the plants will not be less than 1 ft. and need to be in polythene bags until the planting.
- All plants supplied must be planted within three days of removal from the nursery.
- Size of the pits for planting shrubs:-45x45x45cm.
- No. of plants per km -666

- Use of compost and manure -2kg. per pit.

ARTERIAL ROAD

- Groundcovers and shrubs should be avoided or only used in carefully selected areas. Space for pedestrians and vehicles should be maximized
- Trees should be used to ameliorate the impacts of traffic and the expanse of the road and provide an attractive structure to the town or village
- It is preferable that trees are located to the edge of the road behind the kerb and outside the clear zone. Trees may be provided in the median but if this is their only location they would not offer any shade benefit for pedestrians
- Subject to context and local community requirements it is desirable that deciduous trees are utilized to allow sunlight to penetrate to street level in winter
- Tree species should be medium to large in size at maturity, have a good history of survival in urban areas and be able to be maintained with a high crown. They should be planted at a large size, a minimum of 45 liter where early effect is required.

LOCAL STREETS

- Trees should not obstruct the pedestrian flow or vehicular flow. Clear walkable footpath should be available depending on the road width.
- Thorny plants should not be planted.
- Street trees should typically be upright and branched above 2.4m to provide adequate walking clearance under branches.
- In case of narrow streets and in absence of Multi-utility zone, trees should be planted in parking zone / shoulder as it is advisable that trees utilize parking space instead of compromising walking space.
- It is mandatory to have tree pits which provide space for tree growth. Tree pits can be individual, elongated or connected. They may be surfaced with porous pavers, or grates that allow water to readily flow to the root zone.

ROUNDABOUTS

- In general, ground c overs and grasses should be used in roundabouts. A wide concrete kerb should be provided to protect planting
- If used, trees must not be planted in a configuration that will impede road user sight lines or be in a location that might obstruct errant vehicles unable to stop at the roundabout. If used, trees should be frangible with a high crown. These should be planted at least an advanced size
- Mass planting of shrubs should be dense low groundcovers and native grasses, planted into weed mat overlaid with mulch. Species c hoice should c onsider whether the profile of the roundabout is domed, flat, or depressed
- Adequate drainage must be provided in such self-contained, small areas.

INTERSECTION

New trees should be planted no closer than 50m from major intersections.

CONCEPT OF PLANTATION FOR DIFFERENT AREAS

Rural areas Common plants generally rec ommended for national and state highways passing through rural areas, are Amaltas (C assia fistula) alternating with shade trees like, Azadirac hta indic a, Tarmarindus indica. Tall trees like Euc alyptus are not suitable as they interfere with electric and telephone lines and moreover are safety hazards on the road. Medium trees like, Acacia auriculiformis, Gravillea robusta, are ideal for screening. In a tropical country like India, where the temperature during summer months may rise up to a maximum of 46°C or more, the 'shade' is of greatest value to the travelers. Thorny trees like Acacia Arabica and Ber (Zizyphus jujuba) are avoided, as these create a nuisance for the pneumatic tyre of motor vehicles.

Urban Areas Near market places and congested areas, the trees known for behaving as 'pollution sink' are proposed. Though, trees in general absorb the pollutants, filter the air from pollutants, and act as noise barrier, but some trees like Neem (Azadirachta Indica), Mango (Mangifera Indica), Paker (Ficus Infectoria), Shisham (Dalbergia Sisso), Imli (Tamarindus Indica) can do it in a better way. Near sensitive areas like schools and hospitals, tall trees with thick canopies can create a wind screen through which the air can be filtered and the noise levels be considerably reduced. Some such trees are Acacia auriculiformis and Gravillea robusta. Tall shrubs like Casia biflora, hamelia patens etc are provided at the sensitive noise rec eptors for maximum possible screening.

EDGESALONG CLEARZONE

The clear zone along the Grand Trunk Road is of varied nature depending upon the different embankment heights. Some areas have steep gradients that need intensive stone pitching treatment. Inorder to increase the structural stability of this type of treatments, plant materials such as shrubs and ground covers, can be introduced in the interstices. They can be used with emphasis on their rooting characteristics, so that they help in binding the stonepitching treatments. Inareas of high water table or water logging,special emphasis has been given on the selection of plant materialsthat can survive in moistconditions.

WATERLOGGED AREAS

Waterlogged areas along the road are generally a result of Inadequate drainage conditions, the road acting as a bund andcontributing to water logging, high water table of the region or theLow lying nature of the terrain itself. Water logged areas are generally associated with larger water bodies, serving as waterfowl habitat and often, scenic spots with religious and recreational setting. One of the common situations met for roadside plantation is the water logging since roadsides have been dug for excavating the earth for putting on road edge. This type of situation is common throughout the plains in the country.
Planting of such sites after proper drainage is now a commonpractice. *Eucalyptus, Terminalia arjuna, Scyzinium cuminii* arerecommended species for waterlogged areas.

HILLROADS

As hill ranges are very young due to which a minor disturbances can cause slips, subsidence and Land-slides. Landslides are basic problem on all hill roads. There are many factors which contribute the land slide whereas deforestation, grazing of animals is also a major contributing factor. As trees or vegetation on roadside not only increase shear strength along the failure plane but also improves the load carrying capacity of soil along the failure plane, provides lateral support by preventing soil erosion. As a preventive measure to avoid landslides afforestation & fencing should be done so that grazing of animalsshould be stopped.

WOODED AREAS

As far as possible roads should be aligned along the outskirt of the forest and it should form a part of the road landscape; cutting of treesshould be avoided. Even if it isnecessary to cut certain trees, itshould neither disturb appearance of the forest nor the animal life. The fellingof trees should be done in stages i.e., first the thinning be done at the proposed road/ land boundary then the gaps from where thinning wasdone be planted with low and medium plantation and lastly when the new plantationcomesup the centralarea be cleared fromthe road.

INDUSTRIALAREAS

Where the roads are passing through the industrial area, screen planting should be done on both sides of the road so that views are addressed and they act as a buffer for noise and air pollution. In conditions where chemical industries are existingor are proposed itisadvisable to have a thick green buffer which isresistantto obnoxiousfumes.

PROTECTEDFOREST/RESERVEDFORESTAREAS

The design has been worked out to minimise the impacts on the forest stretches along the proposed alignment. For stretches of the corridor through the reserved / protected areas, the contractor shallensure that the construction activities shall be limited to the proposed RoW, so as to avoid any impacts on the vegetation vithin the forest areas. Along the sec tionspassing throughprotected Ireserved forests,dense plantation hasbeen proposed within the RoW

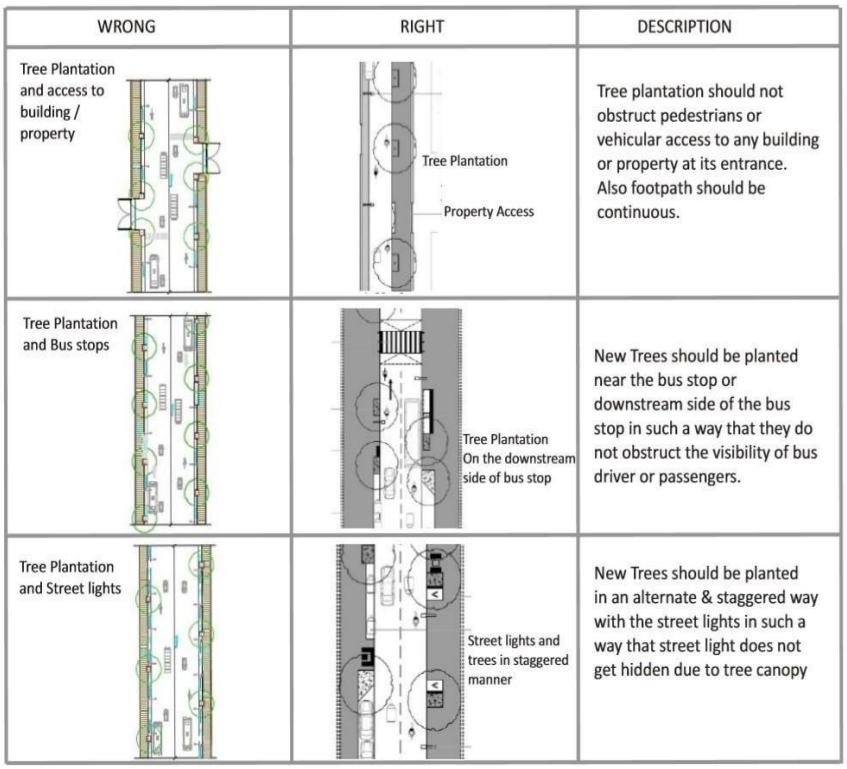
WOODED AREAS

As far as possible roads should be aligned along the outskirt of the forest and it should form a part of the road landscape; cutting of treesshould be avoided. Even if it isnecessary to cut certain trees, itshould neither disturb appearance of the forest nor the animal life. The fellingof trees should be done in stages i.e., first the thinning be done at the proposed road/ land boundary then the gaps from where thinning wasdone be planted with low and medium plantation and lastly when the new plantationcomesup the centralarea be cleared fromthe road.

INDUSTRIALAREAS

Where the roads are passing through the industrial area, screen planting should be done on both sides of the road so that views are addressed and they act as a buffer for noise and air pollution. In conditions where chemical industries are existingorare proposeditisadvisable to have a thickgreen buffer whichisresistantto obnoxiousfumes.

WITHRESPECTTO PROPERTYACCESS, STREETLIGHTSAND BUSSTOPS



GENERALGUIDELINES

SIGHTDISTANCEAND VISIBILITY

Landscape treatments such as vegetation, fencing or bollards shall not obstruct the motorist's sight lines and distance requirements to users of pedestrian and cyclist facilities, this includes:

- pedestrian refuges, medians and crossings, and junctions offootpaths, cycle paths, underpasses, and overpasses with theroad.

Landscape treatments must not obstruct the pedestrian/ cyclist's line of sight and visibility providing and encouraging safety whenusing these facilities.

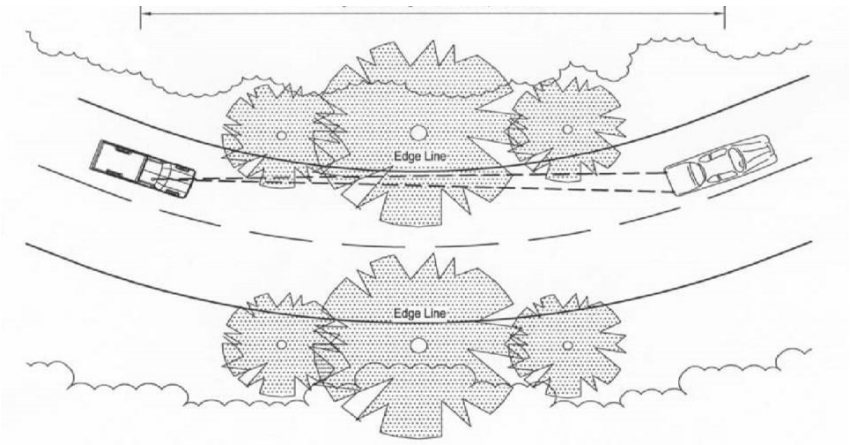
- Landscape works shall not block users/cyclists ability to seeother users on the facility, allowing enough time for the usertostoparound an obstruction to preventa collision.
- Vegetation adjacent to facilitiesshouldbe kept at a lowheightto allowvisibilityto and on facilitiesinorderto:
- providea clearlineof sightto signagewhich mightwarn usersofchangesahead,
- ensure lighting is not obstructed or creating shadows with thepotential for hidden areas for undesirable activities, and
- providea perceived sense of safetyand deter undesirableactivitiesthrough encouraged viewerexposure.

SIGHTLINESAND ROADALIGNMENT

- The road alignment can restrict sight visibility. "Restrictions" tovisibility may occur on vertical curves and on horizontalcurves"to roadways. There are two types of restrictions on the road alignment that landscape works could potentially obstruct; sagverticalcurvesand horizontalcurves

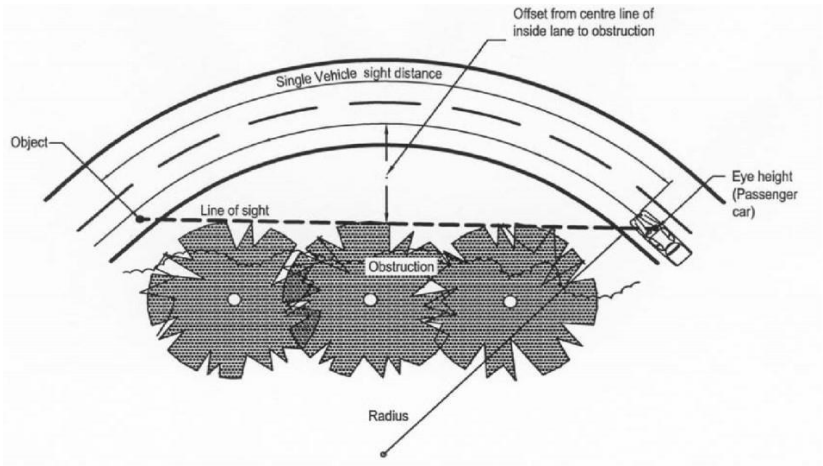
Sag Vertical Curve Restrictions

Visibility may be restricted on sag vertical curves due to an overheadobstruction. "Care should be taken in the design of landscaping in these circumstances to avoid the creation of a vegetation canopy that restricts sight distance in a similar way to overhead bridges". This situation is most likely to occur on narrower roadways (single or double carriageways) or where there is design intent to create an effect of tree canopies overhanging the road.



Horizontal Curve Restrictions

Visibility may be restricted on horizontal curves due to an obstructionon the innerside of the curve.
Horizontal curve sightlines are most likely to affect the landscape treatment, as the clear line of sight required is directly across the embankment of the roadway; the area where landscape treatment is typically applied. In some instances, the cut batter in this location can be the obstruction and alternatives such as benching, or a larger curve radius, may have to be applied by the civil designer.
The difference between sight distance requirements for interchanges will be created by the overpass/underpass grade separation of two or more roads. All vertical landscape elements must be considered for roads that make up the interchange. For example, tree canopies that may not have affected the sight visibility at road level may affect an overpassthatisabove thisroad.



FUNCTIONALUSEOF PLANTING FORSAFETY FACTORS
Landscape planting can be used to actively enhance safety objectives. Plant species selection must be based upon that speciesabilityto achieve a specificdesignfunction.

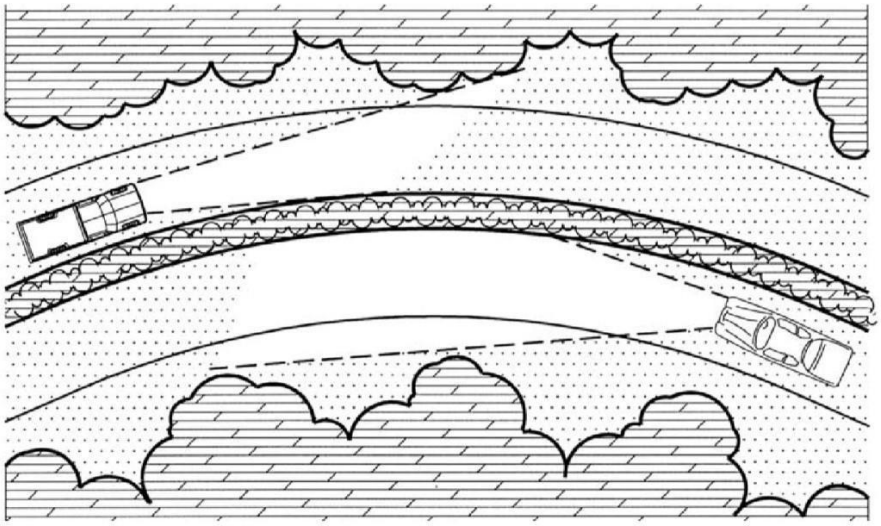
Headlight Screen Planting
Planting can be an effective method to screen headlight glare fromoncoming traffic, benefiting drivers and adjacent properties. The most c ommon and effec tive application isto the medium strips ofdual carriageways, rural roads, roads adjoining railways lines, serviceroads and on horizontal curves. Dense shrubs and groundcovers withfoliage to ground level are effective inpreventing headlightglare.

Buffer Planting

Planting can be used as a safety buffer zone for "errant vehicles by cushioning the impact of the vehicle before it collides with more hazardous objects or other vehicles" (Grieves and Lloyd, 1984:98). Dense shrubs with trunks less than 70-100mm thick branches would best achieve this function.

Visual Screening

Planting can be used to screen undesirable views both to and from the road, depending on the function required. It can prevent drivers from being distracted or be used to reduce driver monotony along stretches of road that do not call for changes of eye focus.



Visual Guidance Planting

The road landscape can assist with the visual guidance of the driver, "when they are unfamiliar with the route or the visibility is affected (for example, through rain or heavy shadows)". Planting can be used to exaggerate or provide these visual cues by:

- "providing a visual backdrop against which the roadway can more easily be seen.
- highlighting an obstruction ahead such as a traffic island, or diverging roadway.
- screening disruptive features and views".
- consistent use of contrasting planting at critical features in the road, such as intersections or roundabouts, to alert the driver of a change of movement.
- contrasting vegetation types, forms, textures and/or colors to help increase driver recognition of road delineation, such as the central island of a roundabout having vegetation that contrasts with the surrounding features.
- using plants, particularly shrubs, on the outside of curves to indicate and provide guidance to the change in alignment of the roadway.
- "spacing of individual trees so that the successive interval between these vertical elements is indicative of the curved radius of the roadway"

No indication of direction or alignment beyond crest of road

Tree planting used to provide indication of alignment beyond crest

Glare Screen Planting

Many roads experienc e strong glare due to the setting of the sun. This glare from low-angle sunlight can be reduced through carefully aligned planting. For north-south orientation of roads, the solution isto provide ridgeline screening on the western side of the road.
"When using planting to screen glare care should be taken not to create a strobing effect through transparent foliage, asthiscould bea biggerproblemthan the glare".

NO PLANTATION ZONE

Theplantationmaynotbe carried outinthe followingareas:

- Within1.5mfromthe toe ofthe carriageway.
- At median cut and grade separator, at least5mblank space shallbe leftforclearview ofthe traffic.

"At curve, dense and tall height tree reduce visibility in plain terrain,a stopping sight distance of 170 m corresponding to the design speed of 100kmper hourshouldbe ensured on allcurved sections,onthe innermostlane ofthe curve.

- At median, medium and large size trees are more prone to cyclone damage resulting in accidents, disruptionof trafficand clearview of the c arriageway. Long rooted plantsmay also damage thecarriageway.
- Screenplantationasa visualbarrierinschools,hospitals,residentialcolonies,etc.

DESIGN WITHRESPECTTO ROADSIDEPLANTING

DESIGNCRITERIA
Select and locate plants with the following criteria in mind to avoidfuture problems and to avoid increased or difficult maintenance.

- **Sight Distanc e** Design forand maintain sight distanc e for motorist, bicycle, and pedestrian traffic. Sight distance isalsoa securityissue forsafetyrestareas,parkand ride lots,pedestrianfacilities,and bicycle facilities(seethe Design Manual).

- **Design Clear Zone** The Design Clear Zone isa function of posted speed, side slope, and traffic volume. Do not locate trees that cangrow overfourinc hesin trunk diameter in the Design Clear Zone(see the Design Manual). Shrubs are appropriate forthiszone.

- **Traffic Barriers** Set shrubsand ground coverplantsa minimum of2 ft and trees a minimum of 6 ft from traffic barriers to reduce maintenance.

- **Vertical Clearance** Provide appropriate setbacks for trees that might overhang the roadway. When trees do overhang the roadway, provide a minimum vertical clearance of 16 ft. Minimumvertical clearance over trails and pedestrianfacilitiesis10ft.

- **Medians and Gore Areas** Design mediansand gore areas to be a minimum of 10 ft wide. Narrower areas tend to be a problem for maintenance personnel, are expensive to irrigate, and generally are unsatisfac tory for

revegetation. Consider paving, stone, or otherbare surface materialingore areaslessthan 10ftwide.

- **Right of Way Line** Placetreesand shrubsa minimumof 6ftinsidethe rightofwayline.
- **Curb Lines of City Streets** Comply with local agency standards and WSDOT sight distance criteria for revegetation

.**Structures** Locate trees as far back from structures as necessary to avoid operational conflicts and the need for excessive pruning.

- **Trails** Set back evergreen trees with branches less than 2 m (6 ft)from the ground a minimum of 6 m (20 ft) from trails. Select species native to the area wherever possible. Set back shrubs higher than 1.5m (5ft) a minimum of 2.4m (8ft) fromtrails,for securitypurposes.

PLANTATIONPATTERN

The concept of road landscape shall be evolved so as to maintain visual characteristics and uniformity in terms of landscape along thestretc h. In the absenc e of uniform land availability forthe plantations, different schemes may be worked out in tune with localvariations in the design. To achieve this, the entire stretch of the project corridor shall be divided into homogeneous landscape sections based on similarity in terms of available width, soil conditions, climate (temperature and rainfall) and topography. A study on the local flora and vegetation cover native to these sections shallbe carried out as part of the field surveysto enable a choice of the suitable species for particular section. Depending on the available ROW, plantation pattern shall be worked out as follows:

- the firstrowalong the highwaywillbe of smallto mediumsizedornamentaltrees
- subsequent rows depending on the availability of width will comprise of ornamental and/or shade bearing species,of moreheightthanthose inthe firstrow.
- Inruralsectionsthelastrowwillalwaysbe of shade wearingtalltrees
- planting ofshrubsinthe median
- planting of herbaceous speciesas ground cover inthe median,speciallandscapesand embankmentslopes
- turfing withgrassinthe median,speciallandscape andembankmentsslopes

Table1,2& 3lista few species,whichcan generallybe plantedthroughoutIndia

The shrubs to be planted in the median shall be of low or mediumheight for prevention of the headlight glare. One to two rows of flowering shrubs may be provided according to the varying width ofthe median in different sections. In sectionswherethe median widthislessthan 1.5m,onlygrassesturfisadvisable.

Some herbaceous species may be planted as a ground cover notonly on the median but on special landscapes an embankmentslope also. The species proposed for the purpose of turfing/groundc overare: *Cynodon dactylon, Cythoc line perpurea, Solanum nigrum, Alternanthera, Chlorophytum, Eupatorium, Wedelia, Duranta, Portulacca, Ipomea, Pelia cardii, Beleprone oblongata,Tradescantia, Asparagus, etc.* The shrub species proposed in themedian are mainly *Bougainvillea and Thevetia nerifolia*. However, other suitable species may be planted in consultation with the local horticulture specialists.

Table 1- Species Recommended for 1st Row of Avenue Plantations

S.NO.	SOIL	BOTANICAL NAME	LOCAL NAME
1.	Loamy	Delonix regia	Gulmohar
2.		Cassia fistula	Amaltas
3.		Bauhinia sps.	Kachnar
4.		Cassia nodusa	Cassia
5.		Jacaranda mimosaefolia	Jacranda
6.		Peltophorum ferrugineum	Peltophorum
7.	Water logged condition	Terminalia arjuna	Arjun
8.		Syzygiumcuminii	Jamun
9.		Cordia dicotma	Lasoda
10.	Alkalinesoils[Usar]	Terminalia arjuna	Arjun
11.		Pongamia pinnata	Kanji
12.		Albizzia lebbek	Kala Siris

Table 2- Species Recommended for 2nd Row, except last Row of Avenue Plantations

1.	**Loamy**	Melia azadiracta	Bakain	
2.		Pongamia pinnata	Kanji	
3.		Gravillea robusta	Slver Oak	
4.		Albizzia lebbek	Kala siris	
5.		Dalbergia sissoo	Shisham	
6.		Terminalia arjuna	Arjuna	

Table 3- Shade trees recommended for last (or the only) Row in roadside avenue

SOIL	SPECIES	
LOAMY	Local name	BOTANICAL NAME
	Peepal	Ficus religiosa
	Paker	Ficus infectoria
	Mahua	Madhuca indica
	Mango	Mangifera indica
	Neem	Azadirachta indica
	Imli	Tamarindus indica
	Jamun	Syzynium cuminii
	Shisam	Dalberjia sissoo
SANDY	Shisam	Dalbergia sissoo
ALKALINE [USAR]	Neem	Azadirachta indica [at ph up to 8.5]
	Kanji	Pongamia pinnata [upto 9.0 p h]
	Arjun	Terminelia arjuna
WATER LOGGED AREA	Jamun	Syzyniumcuminii
	Arjun	Terminalia arjuna

5. CONCLUSION

Although roadside vegetation has certain limitations like limited plantation season of trees but keeping in view all the above of roadside vegetation, considering its economic, environmental, safety aspect etc. it should be given due importance. Since, roadside vegetation has varied benefits on hilly roads, embankments, to improve soil strength, improving infiltration capacity of soil, reduction in soil erosion.

CONCLUSION

The roadside trees are a cheaper and positive way to preserve and improve environment. With ever increasing use of roads for transportation in modern life, the roadside vegetation has become one of the major elements of the roadside environment which people experience on a frequent basis. A properly designed and established roadside planting makes the road safe, pleasant for the driver and passengers, protective for vehic les and most of all inexpensive for its maintenance.

Landscaping enhances both the visibility and the visual quality of the road dividers. Roadside vegetation should be designed or maintained to accomplish specific goals of sight-distance, clear view of obstructions, erosion control, and aesthetics, plants must not be planted where they may obstruct any signs, sightlines, or driver visibility, plant use in intersection areas must be limited to low-growing varieties, plants must not be placed near merging lanes, landscape improvements must avoid the creation of unsafe c onditions for motorists and proper c riteria and guidelines should be followed for roadside planting.

REFERENCES/SOURCES

[1]. Wikipedia
[2]. Urban Green Guidelines, by Ministry of Urban Development
[3]. Handbook of Landscape by CPWD
[4]. Tree Plantation Strategy- Grand Trunk Road Improvement Project by National Highways Authority of India
[5]. Green Highways by Ministry of Road Transport and Highway

[6]. Importance of Roadside Vegetation by India Technical Research Organisation
[7]. MPD by DDA
[8]. Street Design Guidelines by DDA
[9]. Road Landscape Manual by Department of Transport and Main Roads
[10]. Management of roadside vegetation, road-island planting and slope cover by V. Kollarou* and G. Kollaros
[11]. Landscape design guideline
[12]. Code of Practice (Part-1) by Ministry of Urban Development