

DESIGN and INSTALLATION PLANS and SPECIFICATIONS

for the

***SWAREFLEX WILDLIFE WARNING HIGHWAY REFLECTOR
SYSTEM***

F / N.

IMPORTEUR VOOR NEDERLAND VAN SWAREFLEX PRODUCTEN

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**DESIGN and INSTALLATION PROCEDURE
for the
SWAREFLEX WILDLIFE WARNING HIGHWAY REFLECTOR SYSTEM**

DIRECTED-ACROSS-THE-ROAD METHOD FOR THE ENTIRE HIGHWAY

Level Reflectors are used over the entire reflectorized area.

Up Slope Reflectors are located across the roadsides where "cut" or up slope bankments exist.

Down Slope Reflectors are located along the roadsides where "fill" or down slope bankments exist.

The Level Reflectors may be offset from the edges of 2-lane highways up to 40 feet, thereby keeping them out of the way of snow removal and mowing operations. However, if Down Slope Reflectors are mounted on the same posts as the Level Reflectors, they should be located at the shoulder break, preferably with the offset not exceeding 16 ft.

When used in conjunction on highways with more than two lanes and dual highways, the maximum distance between the Reflector Lines (RL) should not exceed 120 ft. Greater distances will result in lower Reflector effectiveness.

Refer to: Sheets 1 - 7 and Plans A - J

- Determine the location of the Reflector Line (RL) along the highway sides.*
- Determine the length of the highway for each type of cross section.*
- Determine the spacing for the Level Reflectors according to the S_{AR} formula with D_{AR} as the distance between the RL.*

Use the formula: $S_L = 1.06 \times D_{AR}$.

This is the basic layout of the Reflectors for the entire reflectorized area. The only areas where this spacing will vary is where the distances (D_{AR}) between the Reflector Lines (RL) change.

The Level Reflectors must always be staggered and never located directly across from each other. The Reflectors must be spaced according to the formula and not spaced too tightly. If any of these design conditions are not complied with, overlapping of glows observed from opposite directions will exist between the Reflector Lines (RL) and may cause confusion and warning of the deer on the highway. The probability of being struck from passing vehicles will be greatly increased.

9/21/90

**DESIGN and INSTALLATION PROCEDURE
for the
SWAREFLEX WILDLIFE WARNING HIGHWAY REFLECTOR SYSTEM**

CURVED SECTIONS OF HIGHWAYS

*On curved sections of the highway, the Reflector spacing and location are the same as for straight sections of the highway. The only exception is that the spacing for the Level Reflectors directed across the road applies to the Reflector Line (RL) on the *inside of the curve*. The spacing of the Reflectors on the outside of the curve should be evenly spaced and staggered from the Reflectors on the inside Reflector Line.*

The "fill" and "cut" areas installation procedures for curved sections are the same as for the straight highways.

9/21/90

SWAREFLEX WILDLIFE WARNING HIGHWAY REFLECTOR SYSTEM

TYPICAL HIGHWAY CROSS SECTIONS & PLAN VIEWS

Illustrating the Vertical and Horizontal Dispersion of Reflectors
and

Showing the Location, Spacing, and Direction of Reflectors
for Various Highway Configurations and Roadside Conditions

The Reflectors should be located and directed so that wherever deer may be located on or alongside the roadway, they will see the glow of at least one Reflector, but in one direction only.

To calculate Reflector spacing, determine the desired location of the Reflector Line (RL) and the Complete Coverage Line (CCL) and use the following equations:

$$S_L = 1.06 D \text{ for the Level Reflector model 7172}$$

$$S_S = 0.72 D \text{ for the Slope Reflector model 7182}$$

These equations are also listed under "REFLECTOR SPACING" contained on each drawing.

To calculate the location of the Complete Coverage Line (CCL), determine the desired spacing of the Reflectors and use the following equations:

$$D_L = 1.88 (S/2) \text{ for the Level Reflector model 7172}$$

$$D_S = 2.75 (S/2) \text{ for the Slope Reflector model 7182}$$

These equations are also listed under "COMPLETE COVERAGE LINE LOCATIONS" contained on each drawing.

When using up slope Reflectors to protect cut embankments or rising roadsides that are greater than $+5^\circ$, the up slope Reflectors should be directed across the highway. They should be double mounted on the same posts as the level Reflectors. Additional up slope Reflectors may be added in between the level Reflectors depending upon the location of the Complete Coverage Line (CCL).

When using down slope Reflectors to protect fill embankments or down sloping roadsides that are greater than -5° , the Reflector Line (RL) should be offset no more than 16 feet from the active highway edge. Reflectors may be further offset, however, the intensity of Reflector reflection decreases as the distance from the light source increases. Generally, the Reflector Line (RL) for down slope Reflectors should be located at the break of the shoulder.

The standard mounting height from the base of the Reflector is 24 inches above the roadway crown. However, if the roadway has heavy semi truck traffic, the Reflector height may be 30 inches above the roadway crown. When double or triple mounted, the base of the lowest Reflector should be 24 inches above the roadway crown.

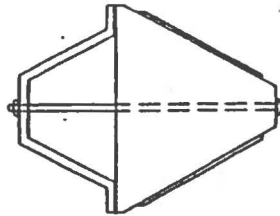
LEGEND

L	=	Level Reflector
S	=	Sloping Reflector
RL	=	Reflector Line
CCL	=	Complete Coverage Line
CCL _L	=	Complete Coverage Line for Level Reflectors
CCL _S	=	Complete Coverage Line for Sloping Reflectors
D _L	=	Distance between the RL and the CCL for Level Reflectors
D _S	=	Distance between the RL and the CCL for Sloping Reflectors
D _{AR}	=	Distance between the RL on one side of the Highway and the other side of the Highway for the Across-the-Road Method
S _L	=	Spacing between Level Reflectors
S _S	=	Spacing between Sloping Reflectors
S/2	=	Spacing between Level, or Sloping, or Level-Sloping Reflectors divided by 2 i.e.: $S_L/2$, or $S_S/2$, or $S_{LS}/2$

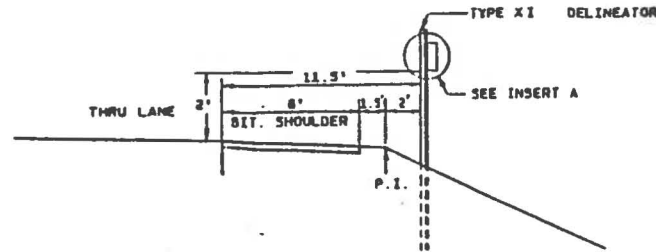
10/10/90

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CORPORATION
Feb 27 11 28 AM '86

TOP VIEW INSERT A



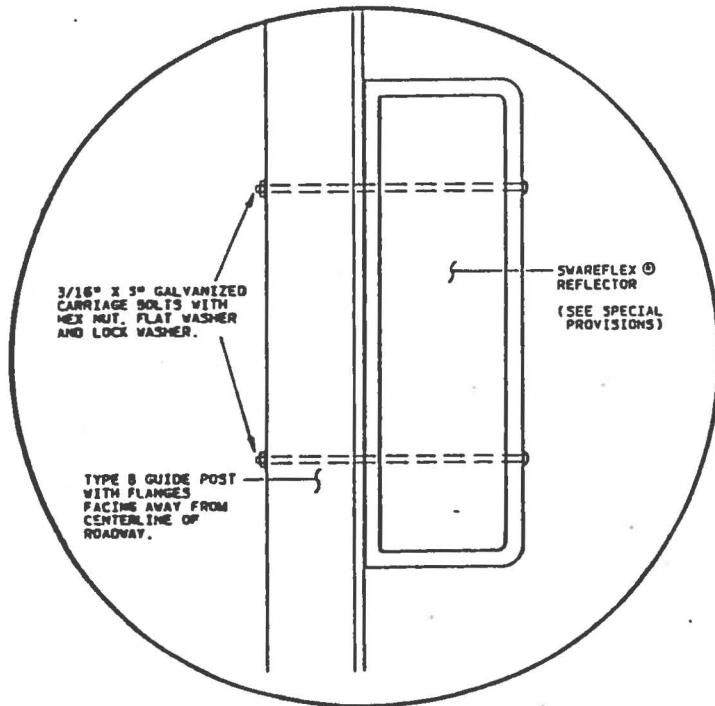
PROFILE VIEW



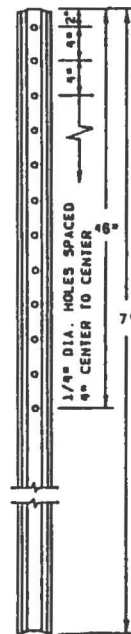
GENERAL NOTES

TYPE XI DELINEATORS ARE TO BE LOCATED AT THE FOLLOWING LOCATIONS RT. AND LT OF CENTERLINE.

INSERT A



TYPE B GUIDE POST



Typical Mounting & Placement Details

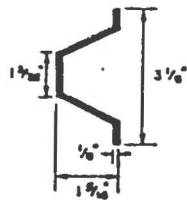
COURTESY OF THE
MINNESOTA DEPARTMENT OF TRANSPORTATION
Brainerd, Minnesota 56401

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SHEET 2

10/10/90



POST NO. 1

NOTES

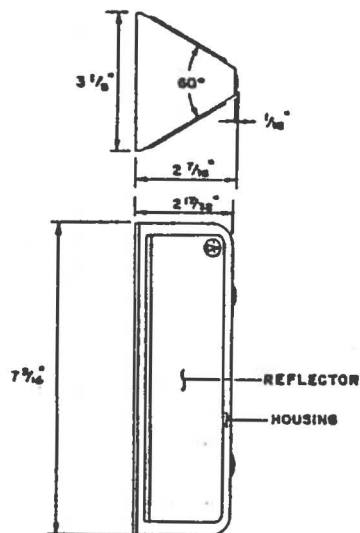
No. 1 Posts shall be galvanized steel manufactured from flanged U-channel sections weighing not less than 2 pounds per foot; or of aluminum with a minimum thickness of 0.125 inches.

Posts may be set and tamped in drilled holes or they may be driven using a suitable driving head. Posts deformed by driving will be rejected and replaced at the contractor's expense. Posts shall be placed vertically.

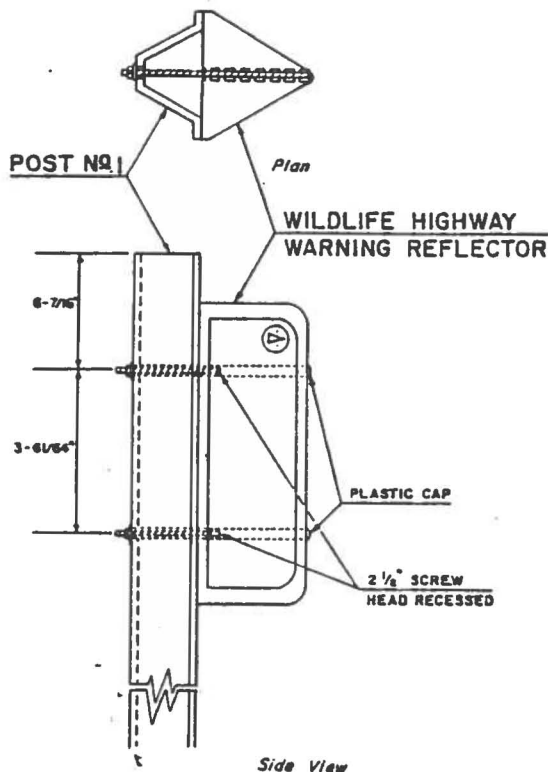
All Wildlife Highway Warning Reflectors will be for two way traffic and level roadways.

The reflector will be mounted to the post with two fasteners. The fasteners shall consist of 3/16"x2-1/2" round head machine screws with self locking nuts and #12 washers, all of stainless steel.

The base of the reflector housing shall be parallel with the highway centerline and the reflector lenses shall face toward the highway.

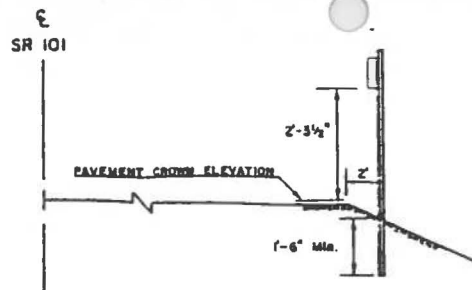


**WILDLIFE HIGHWAY
WARNING REFLECTOR**

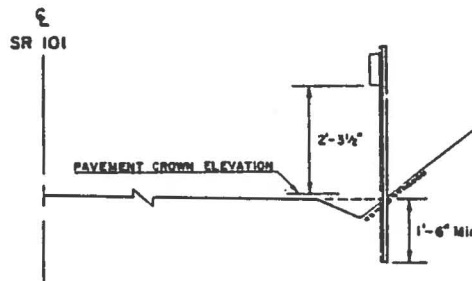


Side View

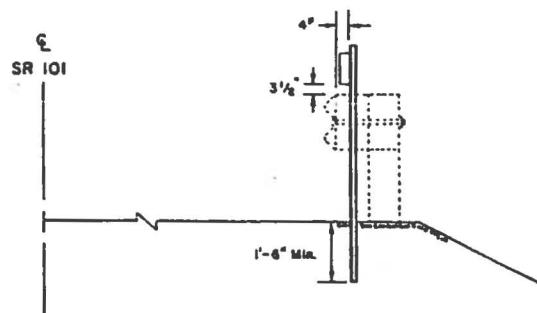
MOUNTING DETAIL



For Fill Conditions



For Cut Conditions



For Guardrail Locations

PLACEMENT DETAILS

Typical Mounting & Placement Details

Courtesy of the
Washington State
Department of Transportation

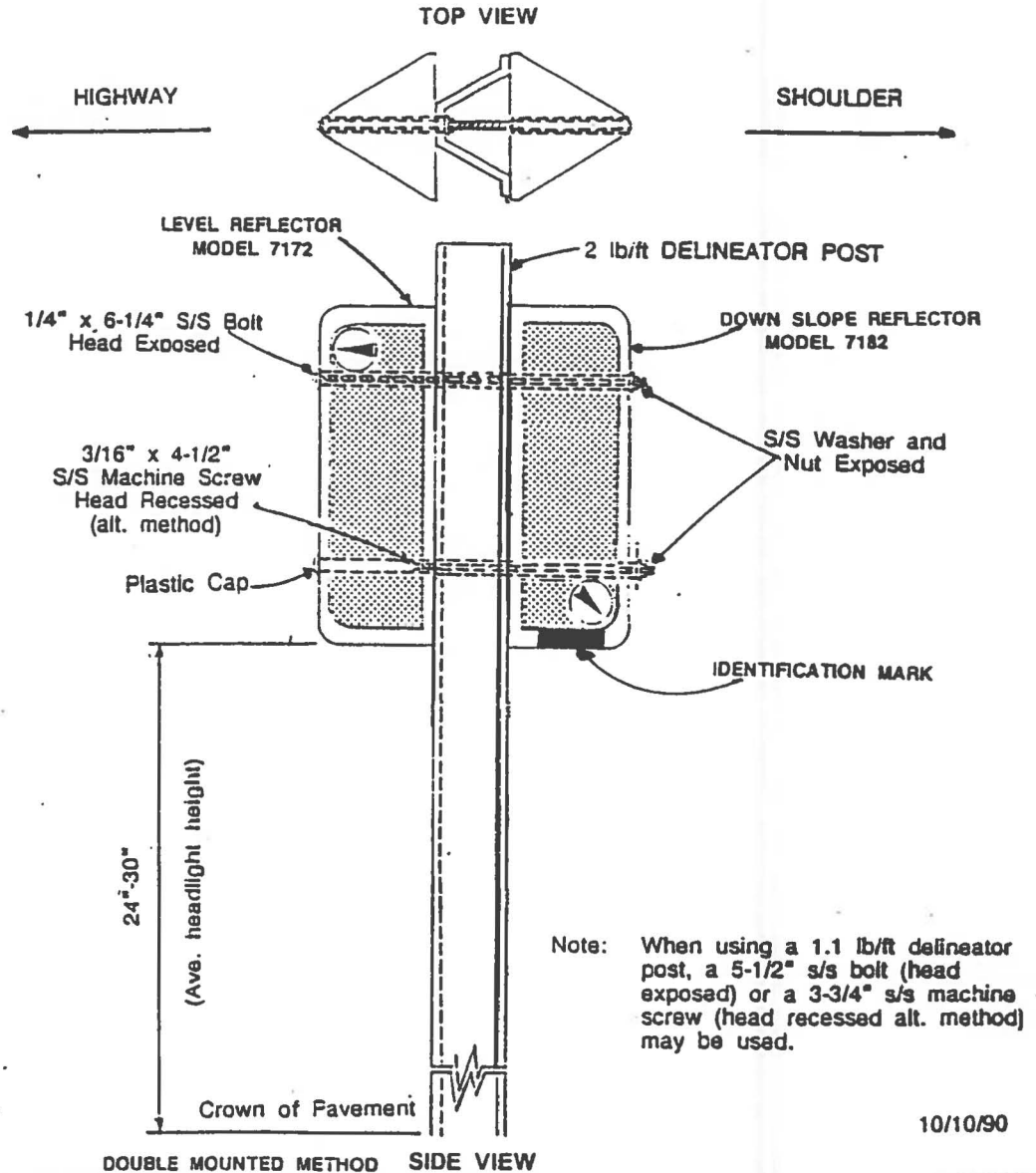
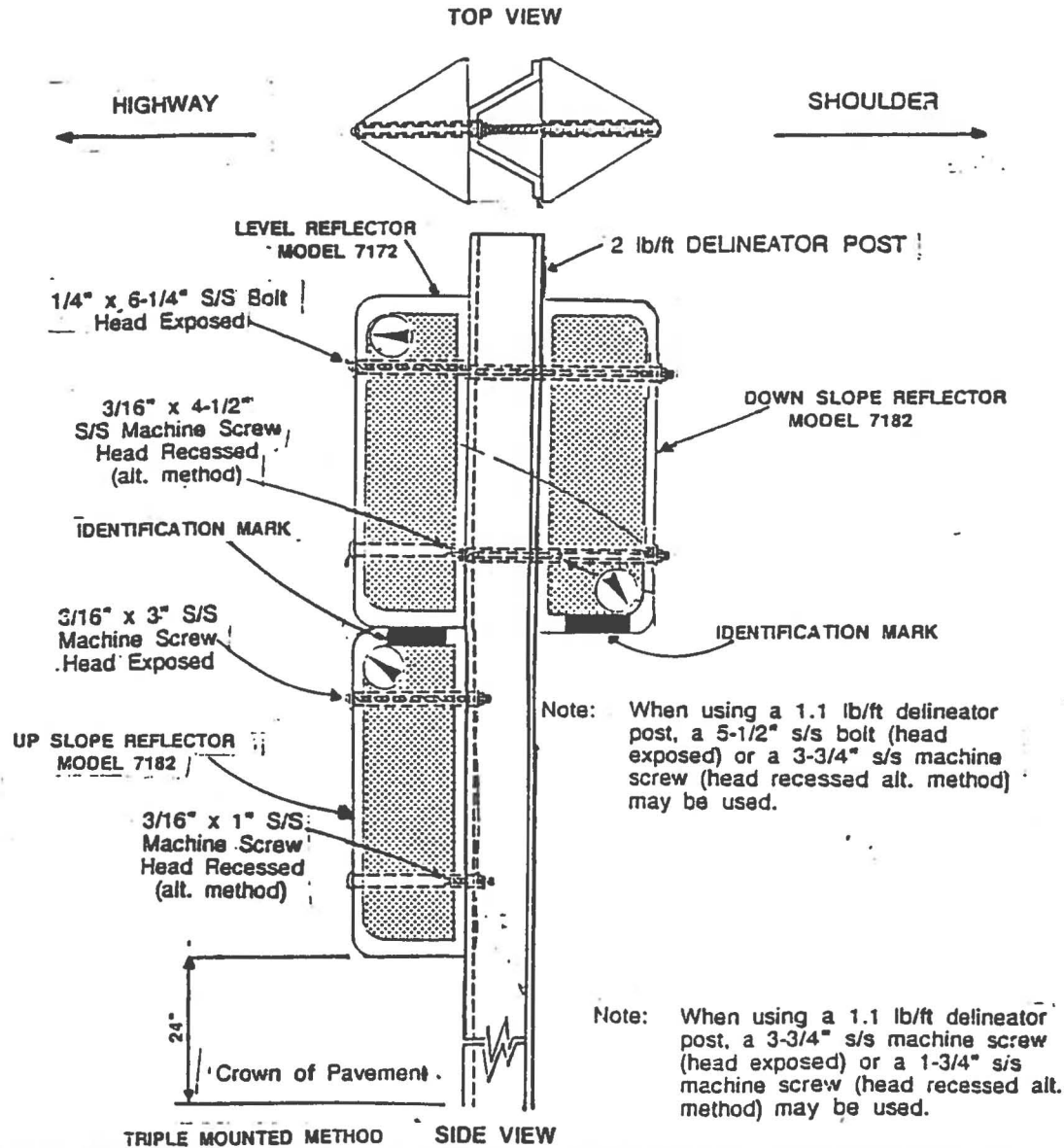
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SHEET 3

TRIPLE AND DOUBLE MOUNTING METHODS:



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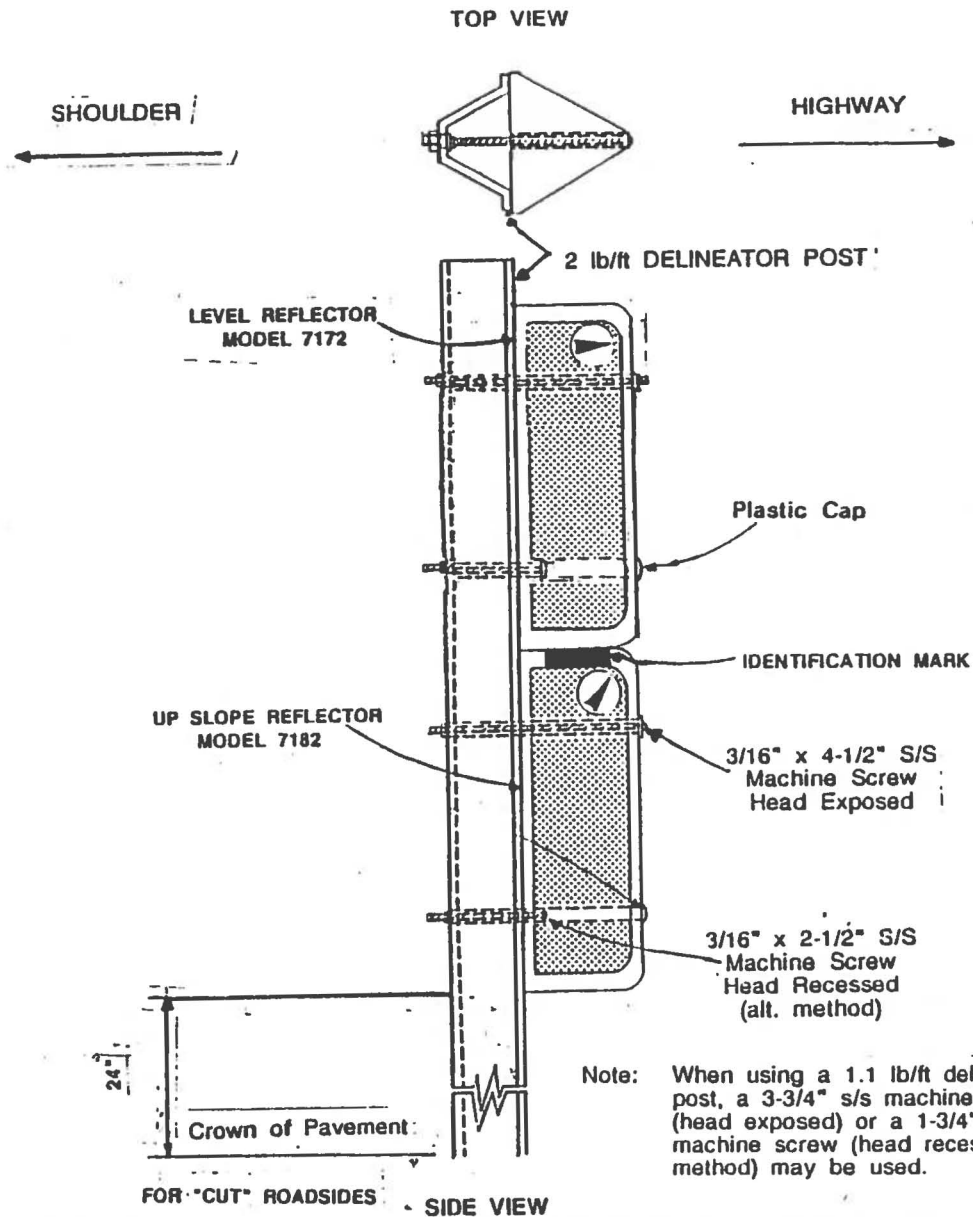
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SHEET 4

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CUT AND UNDER MOUNTING METHOD



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SHEET 5

Important Installation Information on the DIRECTED-ACROSS-THE-ROAD METHOD

This method specifies that the Reflectors are placed on both sides of the roadway and that the glows are directed across the road.

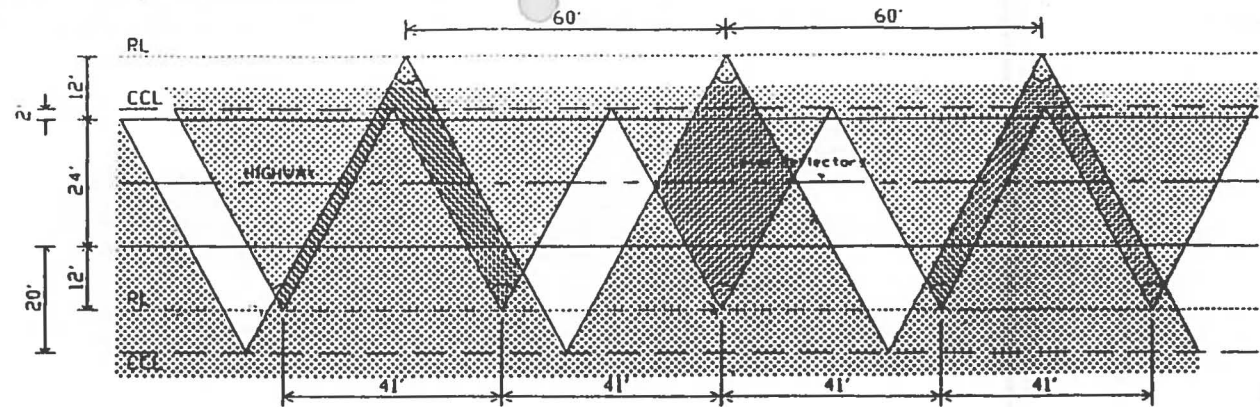
A problem may occur if the Reflectors are spaced too closely together or directly across from each other, there are overlaps in the coverage area. If by chance a deer would be standing on the roadway in the overlap area when the Reflectors are activated, the deer could see the glow of Reflectors from both sides of the road. This may cause the deer to become confused and spin in circles, a reaction witnessed by motorists.

Consequently, we have derived four installation rules for the Directed-Across-the-Road method:

- Rule #1: When determining the spacing of Reflectors, the distance (D_{AR}) is the distance from the Reflector Line (RL) on one side of the road to the Reflector Line (RL) on the other side. This places the CCL at the RL.
- Rule #2: The Reflectors must be staggered and not placed directly opposite from each other.
- Rule #3: Spacing on both sides of the roadway must be the same.
- Rule #4: The Reflector Lines on each side of the highway need not be the same distance from the edge of the roadway.

Refer to the drawings which illustrate both proper and improper installations of the Directed-Across-the-Road method.

Using this method, the Reflectors may be offset up to 40 ft. from the highway edge. However, if down slope Reflectors are mounted on the same post as the level Reflectors, they should be located at the shoulder break, preferably with the offset not exceeding 16 ft. Refer to our Typical Highway Plans: C and D.

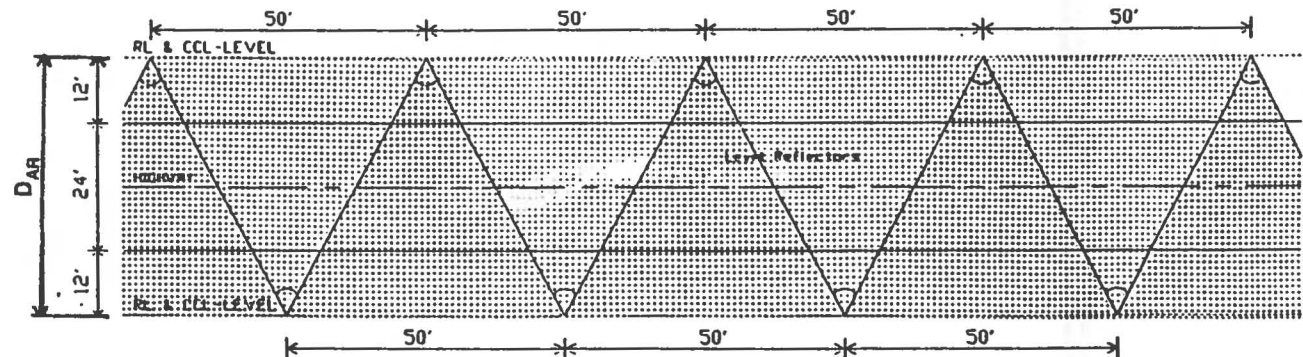


$$S_L = 41' \quad D_L = 1.88(S/2) = 38'$$

$$S_L = 60' \quad D_L = 1.88(S/2) = 56'$$

IMPROPER INSTALLATION
of the
Directed-Across-the-Road Method
(Reflectors are placed on both sides of the roadway with reflection directed across the road)

Illustration showing overlaps in Reflector coverage area which may cause deer to spin when different spacings are used and the Reflectors are directly across from each other.



$$D_{AR} = 12' + 24' + 12' = 48'$$

$$S_L = 1.06 \times D_{AR} = 50'$$

PROPER INSTALLATION
of the
Directed-Across-the-Road Method

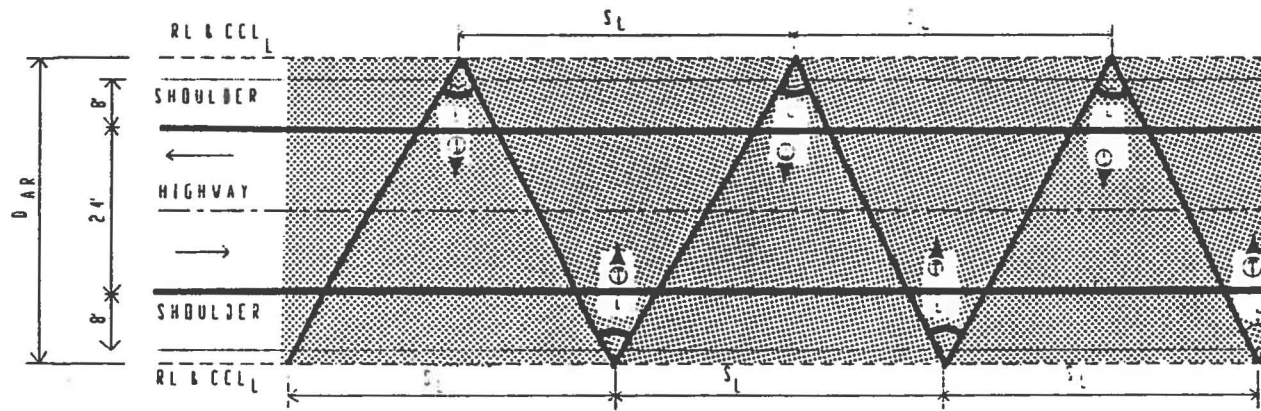
(Reflectors are placed on both sides of the roadway with reflection directed across the road)

Illustration of Across-the-Road Method when D_{AR} equals the distance from RL to RL.

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REFLECTOR SPACINGS

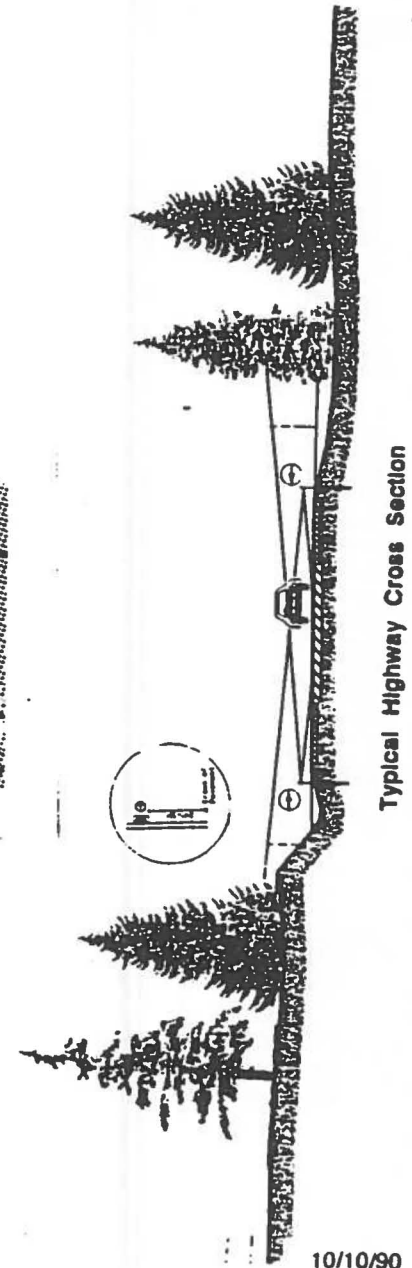
$S_L = 1.06 D$ for Level Reflectors model 7172
 $S_S = 0.72 D$ for Slope Reflectors model 7182
COMPLETE COVERAGE LINE LOCATIONS
 $D_L = 1.88 (S/2)$ Level Reflectors model 7171
 $D_S = 2.75 (S/2)$ Slope Reflectors model 7182



Typical Plan View

Reflection of Reflectors are directed across roadway. Care must be taken to assure the location of the Complete Coverage Line (CCL) to coincide with the Reflector Line (RL).

D_{AR} = Distance between the Reflector Lines (RL) on each side of the highway.



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PLAN A

REFLECTOR SPACINGS

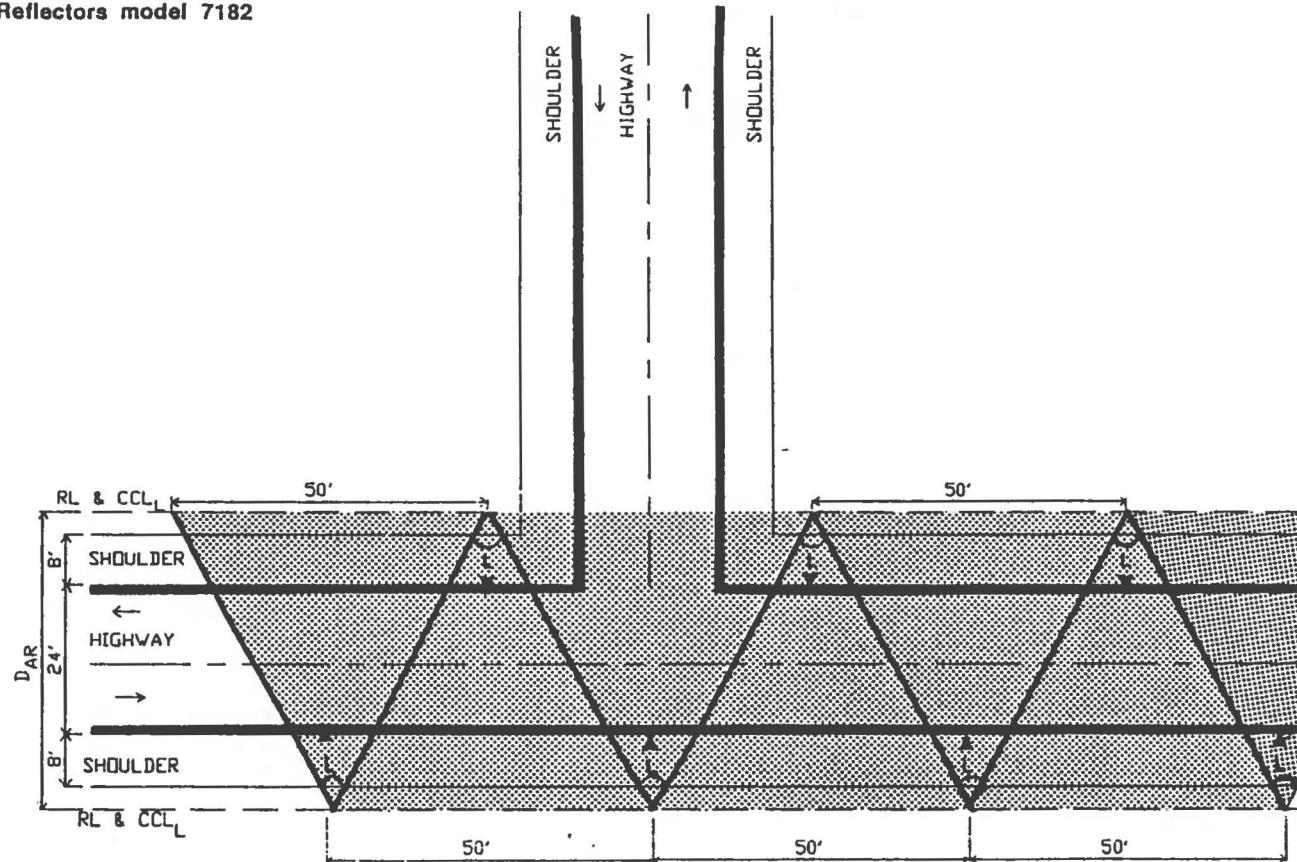
$S_L = 1.06 L$ for Level Reflectors model 7172

$S_S = 0.72 D$ for Slope Reflectors model 7182

COMPLETE COVERAGE LINE LOCATIONS

$D_L = 1.88 (S/2)$ Level Reflectors model 7171

$D_S = 2.75 (S/2)$ Slope Reflectors model 7182

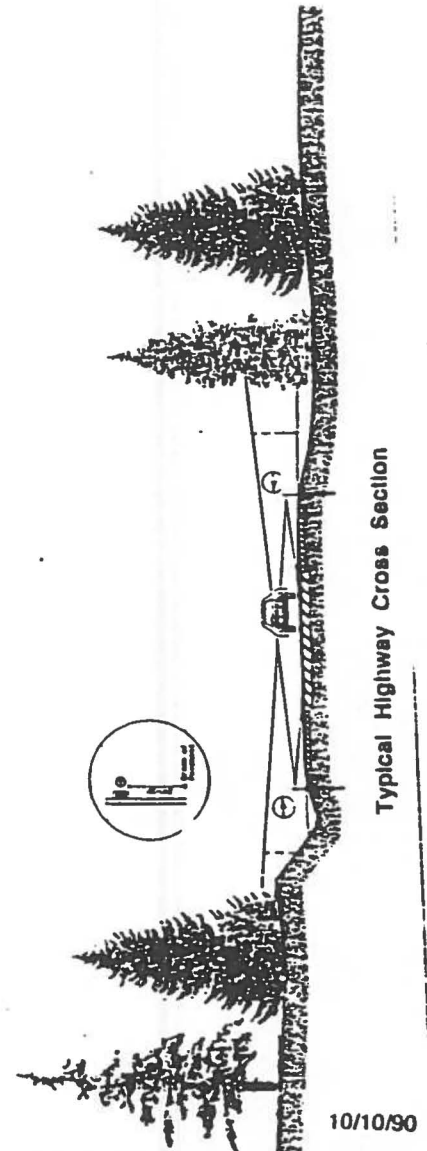


Typical Plan View

Location and direction of level Reflectors at a "T" intersection. Spacing of the Reflectors should begin with a Reflector opposite the centerline of the intersecting highway.

Reflection of Reflectors are directed across the roadway. Care must be taken to assure the location of the Complete Coverage Line (CCL) to coincide with the Reflector Line (RL).

$D_{AR} =$ Distance between the Reflector Lines (RL) on each side of the highway.



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PLAN B

REFLECTOR SPACINGS

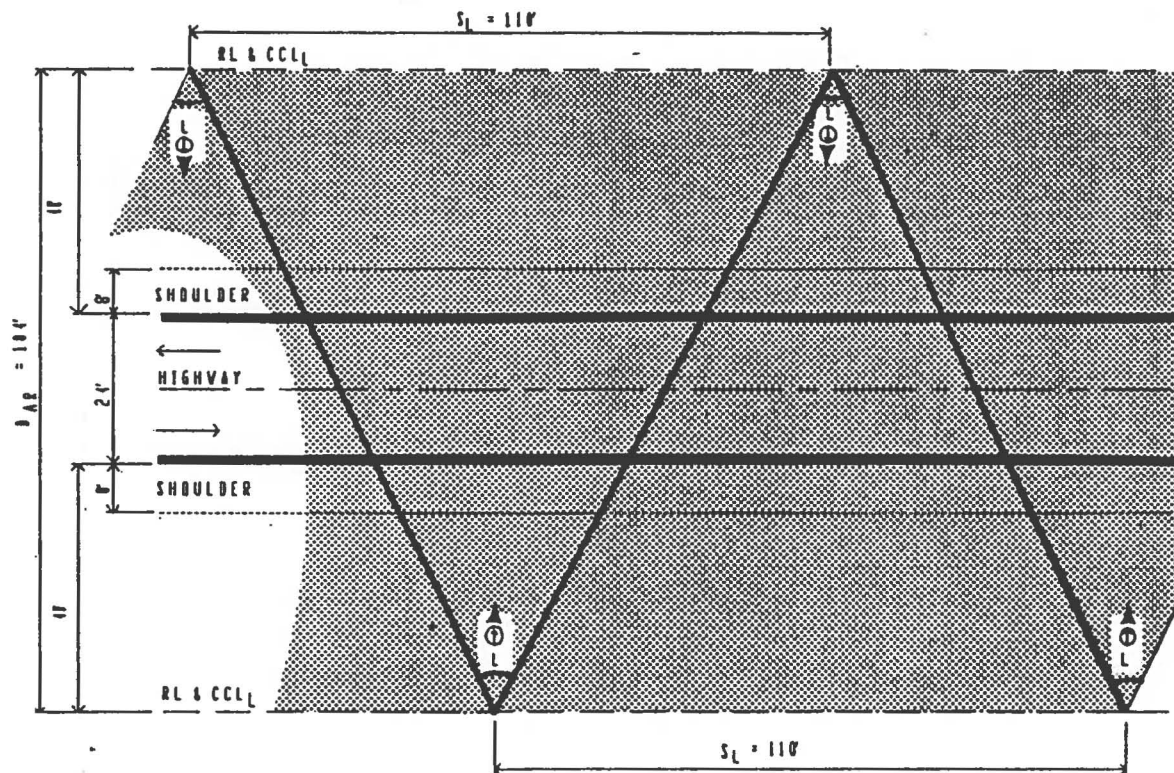
$S_L = 1.06 D$ for Level Reflectors model 7172

$S_S = 0.72 D$ for Slope Reflectors model 7182

COMPLETE COVERAGE LINE LOCATIONS

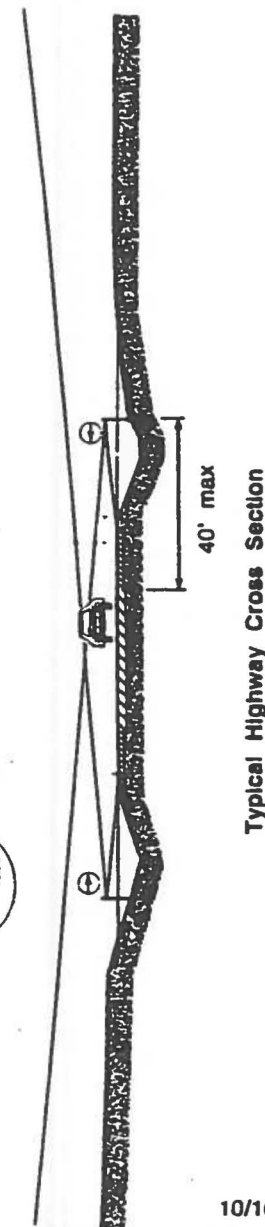
$D_L = 1.88 (S/2)$ Level Reflectors model 7171

$D_S = 2.75 (S/2)$ Slope Reflectors model 7182



Typical Highway Cross Section

Location and direction of level Reflectors where the Reflector Lines (RLs) are offset up to 40 feet for snow removal and/or vegetation maintenance.



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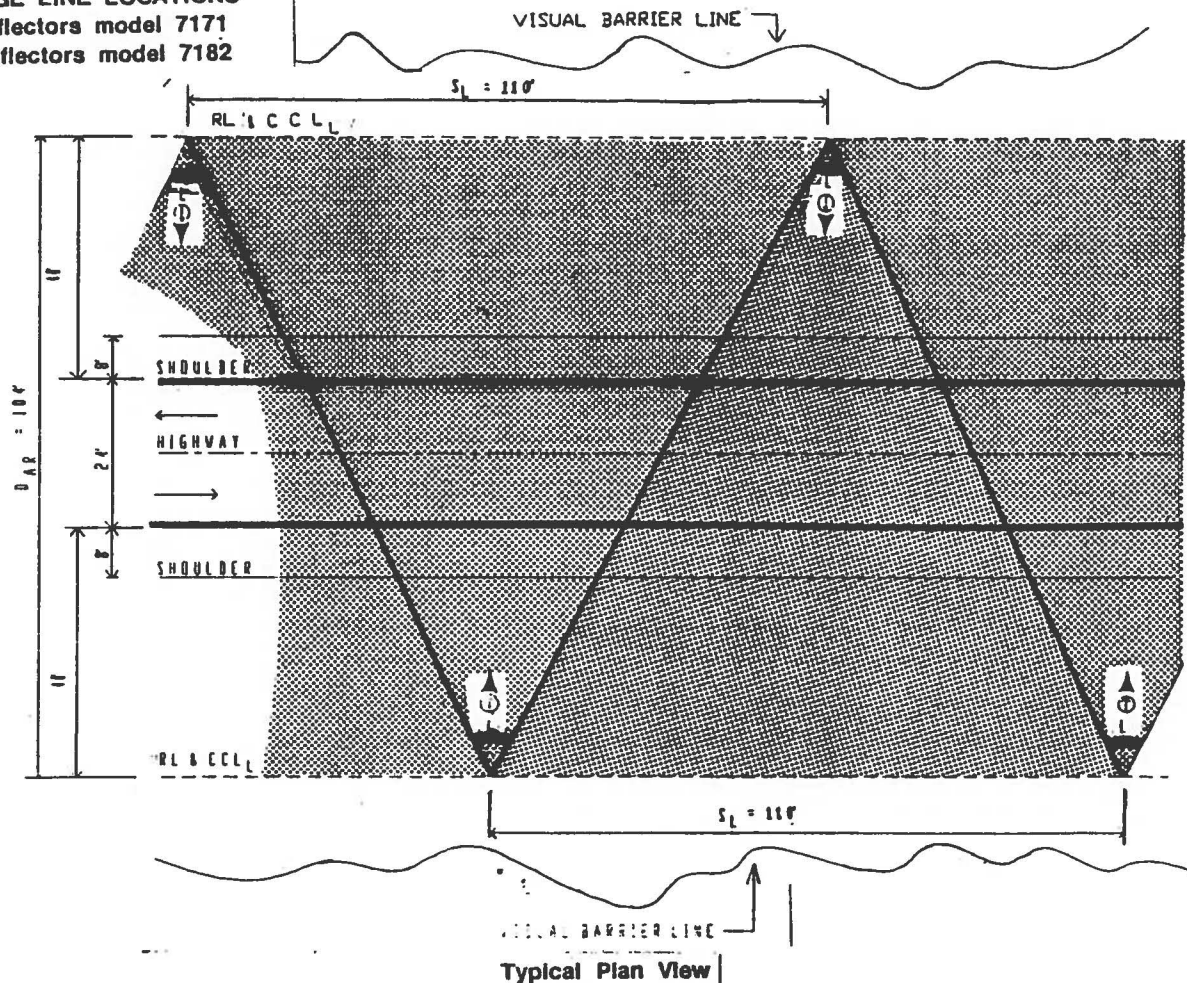
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PLAN C

REFLECTOR SPACINGS

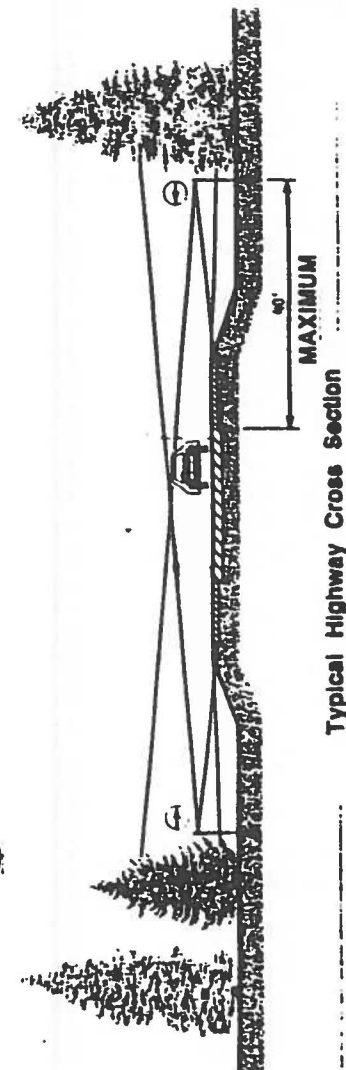
- $S_L = 1.08 D$ for Level Reflectors model 7172
 - $S_S = 0.72 D$ for Slope Reflectors model 7182
- ## COMPLETE COVERAGE LINE LOCATIONS
- $D_L = 1.88 (S/2)$ Level Reflectors model 7171
 - $D_S = 2.75 (S/2)$ Slope Reflectors model 7182



Location and direction of Level Reflectors where roadside visual barriers exist along both sides of the roadway and where it is desired to locate the Reflector posts a considerable distance from the highway edges.

Where tree or bush lines are in close proximity to the highway, Reflectors and posts may be installed along the borders of the visual barriers to provide greater clearance for vehicles driving off the shoulders, for snow plowing, and mowing operations. The expense of longer posts may be offset in maintenance savings.

Note: Reflection of Reflectors are directed across the roadway.



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PLAN D

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RE: CTOR SPACINGS

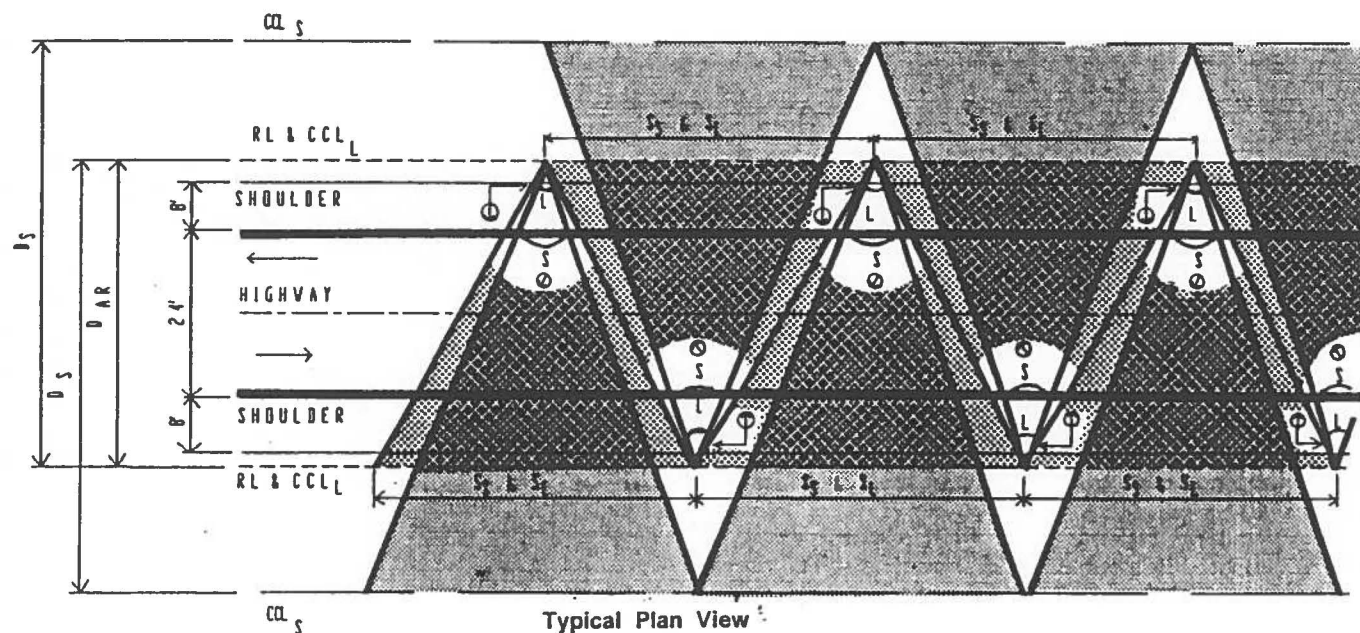
$S_L = 1.06 D$ for Level Reflectors model 7172

$S_S = 0.72 D$ for Slope Reflectors model 7182

COMPLETE COVERAGE LINE LOCATIONS

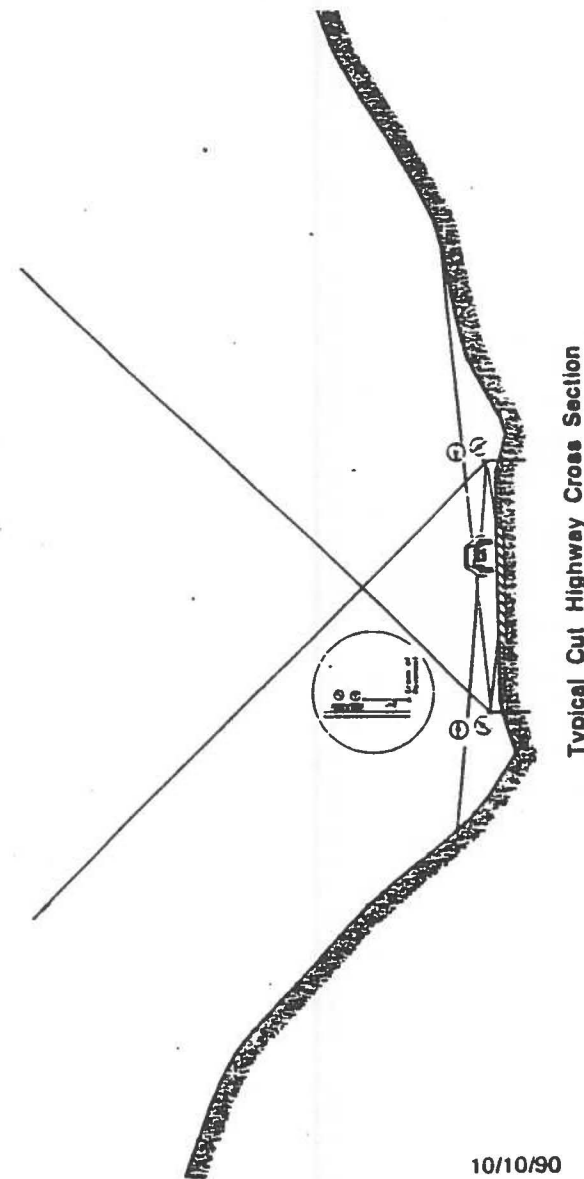
$D_L = 1.88 (S/2)$ Level Reflectors model 7171

$D_S = 2.75 (S/2)$ Slope Reflectors model 7182



Location and direction of Level and Sloping Reflectors where up sloping roadsides exist on both sides.

First determine the spacing of the Level Reflectors directed across the road using D_{AR} equal to the distance between the Reflector Lines (RL). Up Slope Reflectors are to be installed on the same posts and under the Level Reflectors and directed across the roadway. Determine the CCL_S for the "cut" areas and calculate the proper spacing of the Up Slope Reflectors. If the Complete Coverage Line (CCL_S) of the Slope Reflectors needs to be closer, intermediate Up Slope Reflectors may be located in between the Level Reflectors to provide tighter spacing.



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PLAN E

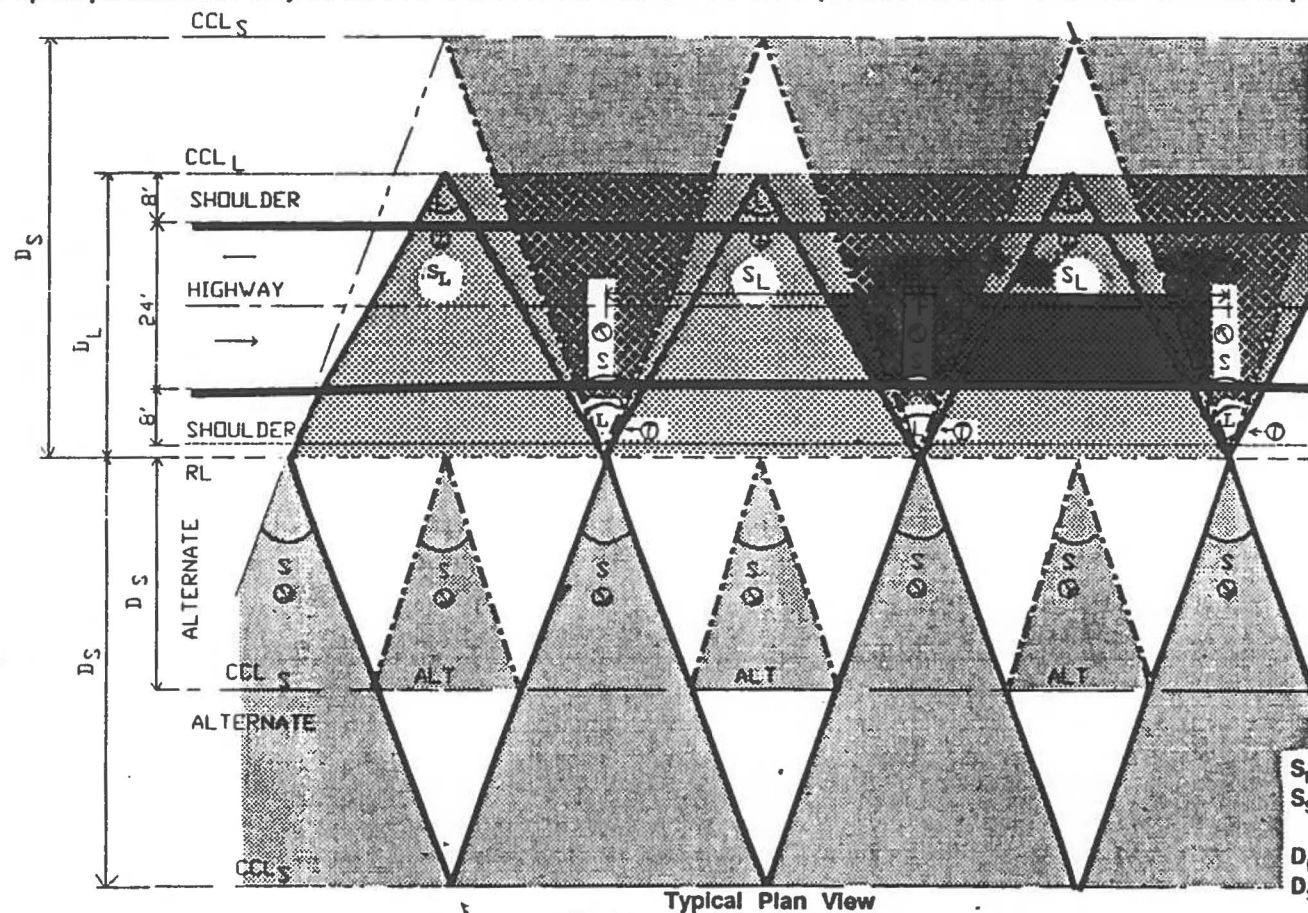
Location and Position of Triple Mounted Slope and Level Reflectors are on the other side.

Up sloping roadsides are on one roadside

down sloping roadsides

First determine the spacing of the Level Reflectors directed across the road using D_{AR} equal to the distance between the Reflector Lines (RL). Triple mount the Slope Reflectors on the same posts as the Level Reflectors on the side opposite the cut embankment.

Up Slope Reflectors are to be installed (triple mounted) on the same posts and under the Level Reflectors and directed across the roadway. Determine the CCL_S for the "cut" areas and calculate the proper spacing of the Up Slope Reflectors. If the Complete Coverage Line (CCL_S) of the Slope Reflectors needs to be closer, intermediate Up Slope Reflectors may be located in between the Level Reflectors (mounted back-to-back with the Down Slope Reflectors) to provide tighter spacing.



REFLECTOR SPACINGS

$S_L = 1.06 D$ for Level Reflectors model 7172

$S_S = 0.72 D$ for Slope Reflectors model 7182

COMPLETE COVERAGE LINE LOCATIONS

$D_L = 1.88 (S/2)$ Level Reflectors model 7171

$D_S = 2.75 (S/2)$ Slope Reflectors model 7182

Down Slope Reflectors are to be installed (triple mounted) on the same posts back-to-back with the Level Reflectors and directed away from the roadway and towards the down slope roadsides. Intermediate Down Slope Reflectors should be located in between the Level Reflectors to provide approximately 30'-35' spacing.

NOTE: Maximum Down Slope Reflector Line (RL_D) offset is 16 ft.

Typical Fill and Cut Highway Cross Section

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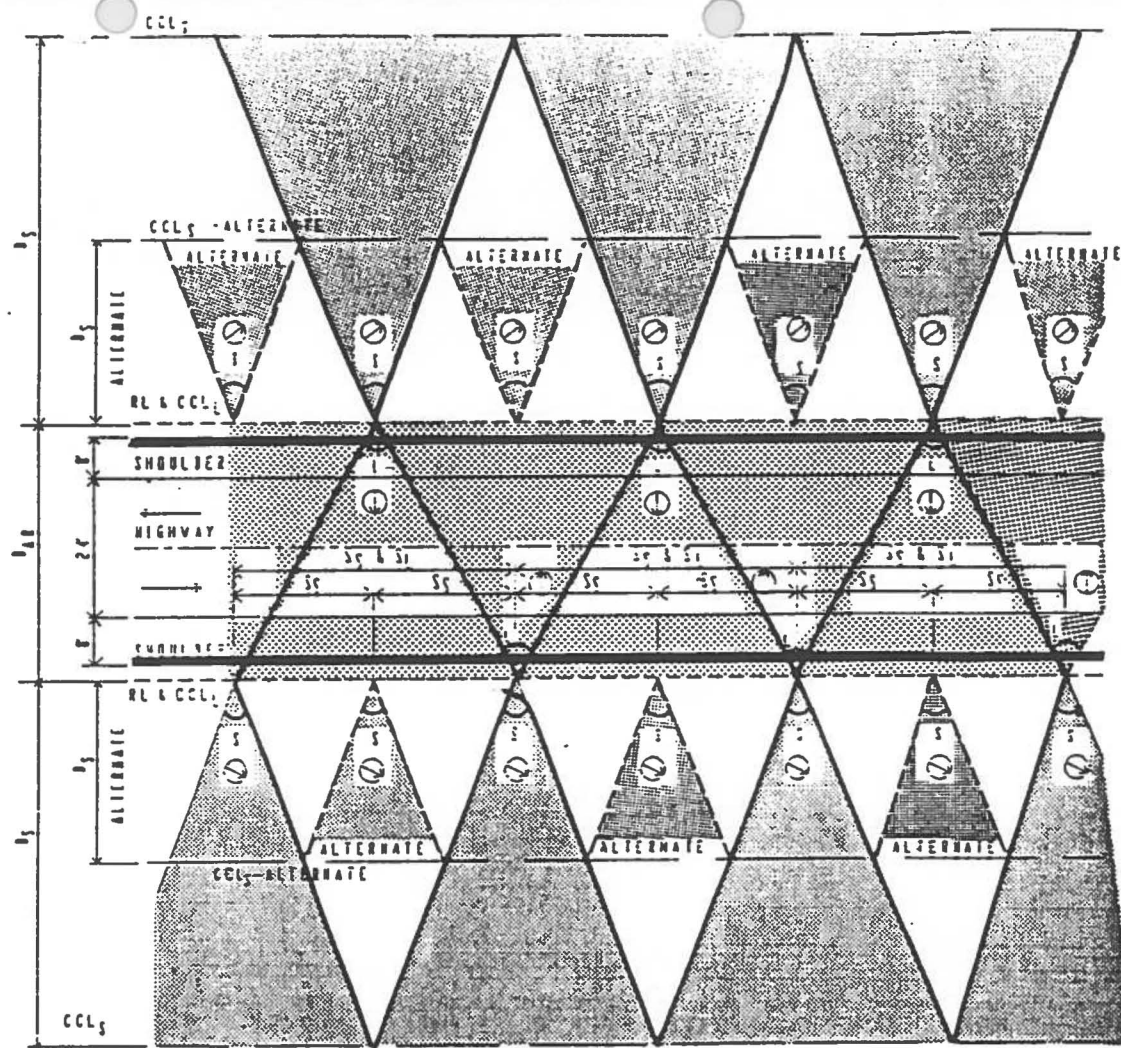
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PLAN F

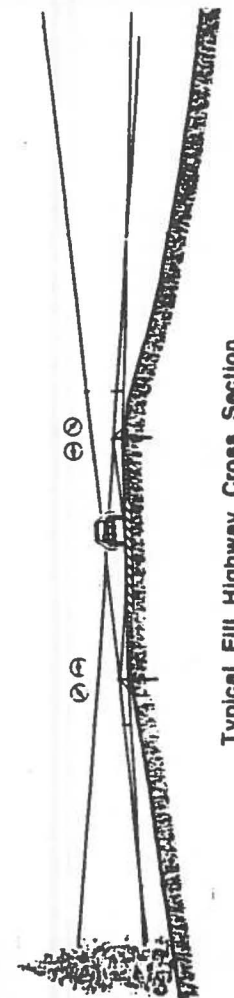
10/10/90

S_L = 1.06 for Level Reflectors model 7172
S_S = 0.72 D for Slope Reflectors model 7182
COMPLETE COVERAGE LINE LOCATIONS
D_L = 1.88 (S/2) Level Reflectors model 7171
D_S = 2.75 (S/2) Slope Reflectors model 7182

**NOTE: Maximum Down Slope Reflector
Line (RL_s) offset is 16 ft.**



Where "fill" or down sloping roadsides exist, Down Slope Reflectors are to be installed on the same posts back-to-back with the Level Reflectors and directed away from the roadway and towards the down slope roadsides. Intermediate Down Slope Reflectors should be located in between the Level Reflectors to provide approximately 30'-35' spacing.



Typical Fill Highway Cross Section

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PLAN G

REFLECTOR SPACINGS

$S_L = 1.06 D$ for Level Reflectors model 7172

$S_S = 0.72 D$ for Slope Reflectors model 7182

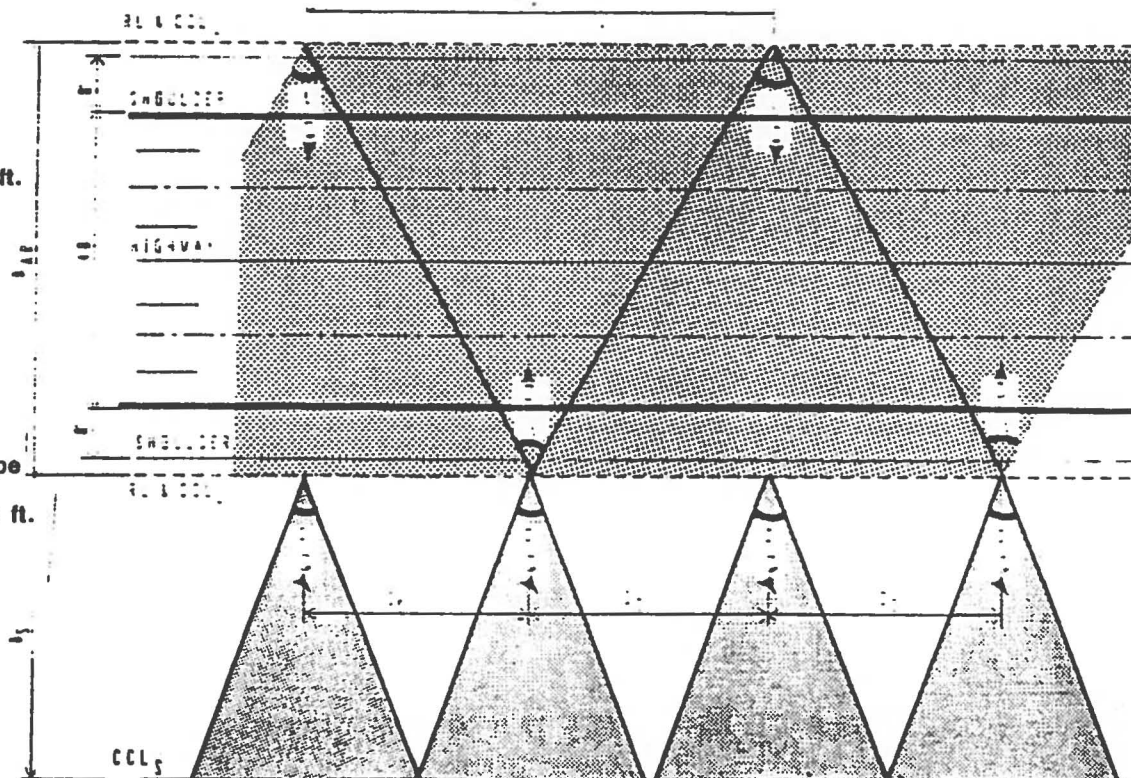
COMPLETE COVERAGE LINE LOCATIONS

$D_L = 1.88 (S/2)$ Level Reflectors model 7171

$D_S = 2.75 (S/2)$ Slope Reflectors model 7182

NOTE: Maximum D_{AR} is 120 ft.

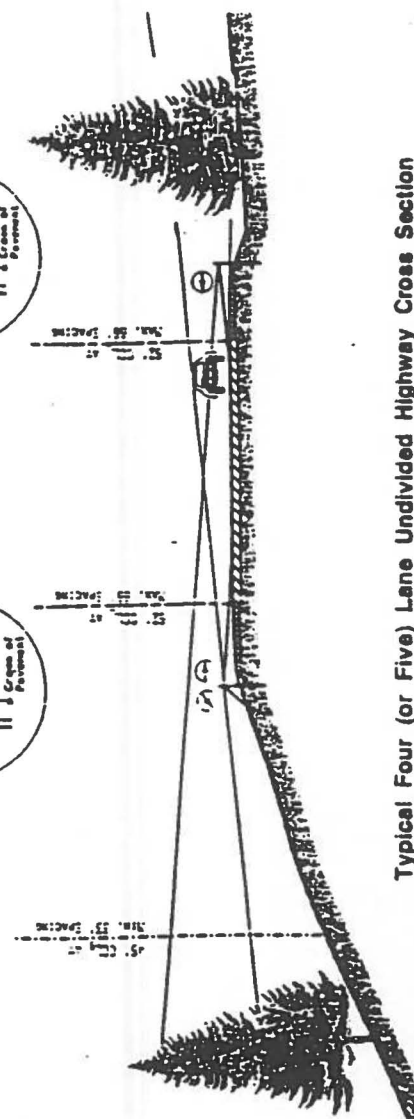
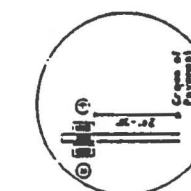
NOTE: Maximum Down Slope
Reflector Line (RL_S) offset is 16 ft.



Typical Plan View

Location and direction of Reflectors of a four (or five) lane undivided highway.

Where "fill" or down sloping roadsides exist, Down Slope Reflectors are to be installed on the same posts back-to-back with the Level Reflectors and directed away from the roadway and towards the down slope roadsides. Intermediate Down Slope Reflectors should be located in between the Level Reflectors to provide approximately 30'-35' spacing.



Typical Four (or Five) Lane Undivided Highway Cross Section

10/10/90

SWAREFLEX WILDLIFE WARNING HIGHWAY REFLECTOR SYSTEM

STRIETER CORPORATION - EXCLUSIVE IMPORTER - UNITED STATES AND CANADA

STRIETER CORPORATION

2100 Eighteenth Avenue • Rock Island, Illinois 61201
Phone F: 309/794-9800 FAX F: 309/788-5646

PLAN H

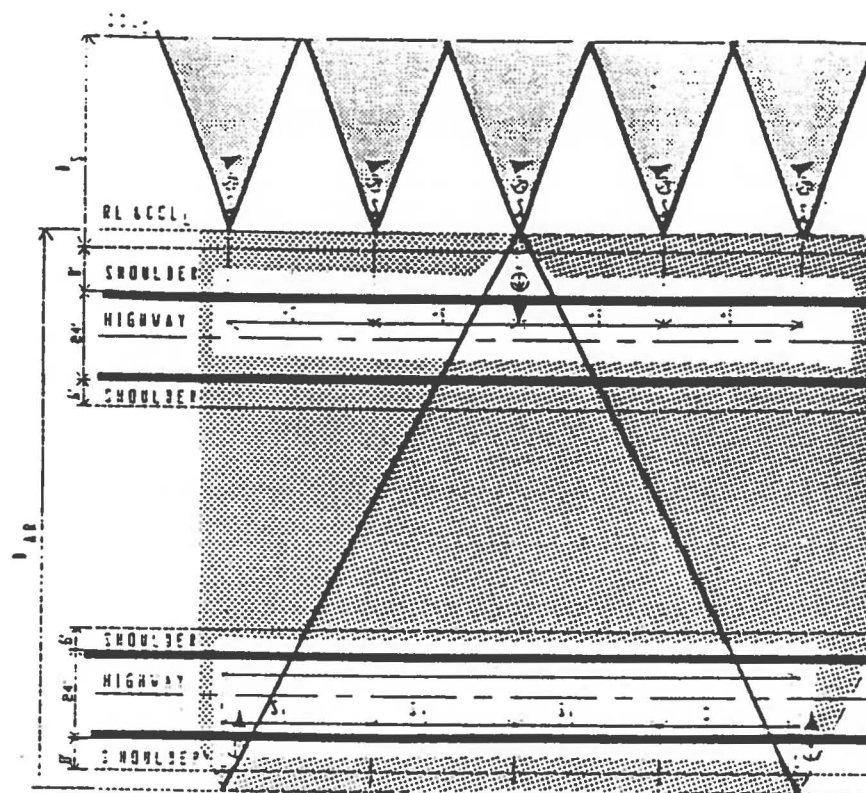
REFLECTOR SPACINGS

- $S_L = 1.05 D$ for Level Reflectors model 7172
 $S_S = 0.72 D$ for Slope Reflectors model 7182
COMPLETE COVERAGE LINE LOCATIONS
 $D_L = 1.88 (S/2)$ Level Reflectors model 7171
 $D_S = 2.75 (S/2)$ Slope Reflectors model 7182

NOTE: Maximum Down Slope Reflector Line:

(RL_s) offset is 16 ft.

NOTE: Maximum D_{AR} is 120 ft.

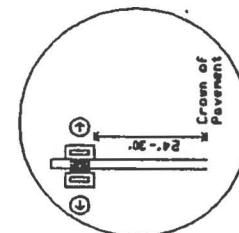
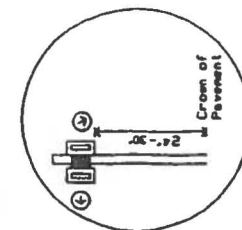


Typical Plan View

Location and direction of Level Reflectors on a dual highway where D_{AR} does not exceed 120 ft.

Where "fill" or down sloping roadsides exist, Down Slope Reflectors are to be installed on the same posts back-to-back with the Level Reflectors and directed away from the roadway and towards the down slope roadsides. Intermediate Down Slope Reflectors should be located in between the Level Reflectors to provide approximately 30'-35' spacing.

NOTE: In dual highway configurations where the width of the median and/or the number of traffic lanes in each direction would require the D_{AR} to exceed 120 ft, design the installation of the Reflectors as two separate highways. Each direction of the dual highway will have Level Reflectors directed across the highway with Reflector Lines on each side of the highway as in Plan A. This requires four Reflector Lines for the dual highway. In areas of "cut" or "fill" Plans E and H will apply.



Typical Dual Highway Cross Section

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PLAN I

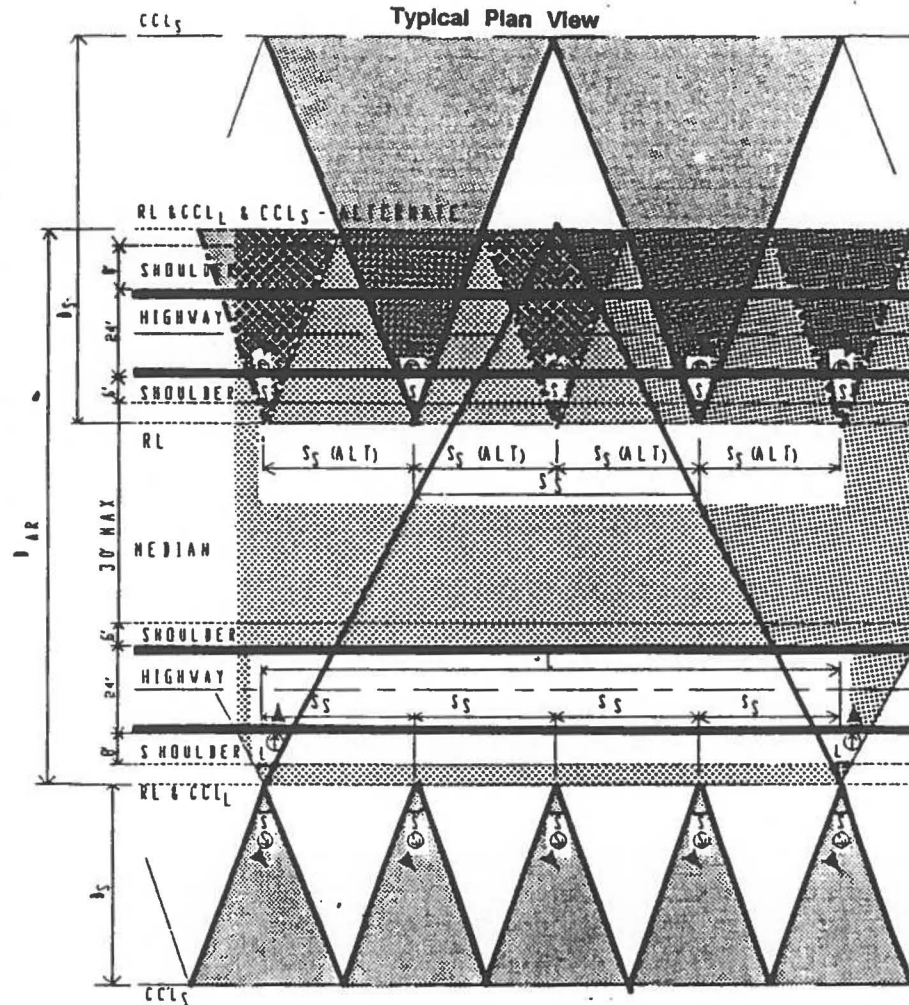
Location and direction of Reflectors where up sloping roadsides are on one side of the dual highway and sloping roadsides are on the other side. NOTE The D_{AR} should not exceed 120 ft.

REFLECTOR SPACINGS

- $S_L = 1.06 D$ for Level Reflectors model 7172
 $S_S = 0.72 D$ for Slope Reflectors model 7182
COMPLETE COVERAGE LINE LOCATIONS
 $D_L = 1.88 (S/2)$ Level Reflectors model 7171
 $D_S = 2.75 (S/2)$ Slope Reflectors model 7182

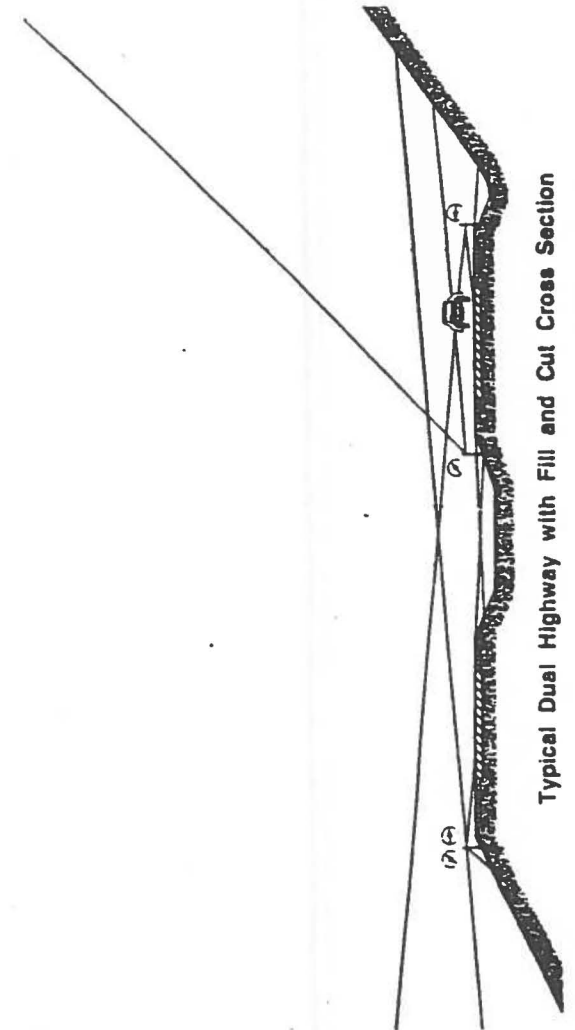
NOTE: Maximum D_{AR} is 120 ft.

NOTE: Maximum Down Slope Reflector Line (RL_S) offset is 16 ft.



Where "cut" or up sloping roadsides exist, Up Slope Reflectors are to be installed on the same posts and under the Level Reflectors and directed across the roadway. Determine the CCL_S for the "cut" areas and calculate the proper spacing of the Up Slope Reflectors. If the Complete Coverage Line (CCL_S) of the Slope Reflectors needs to be closer, intermediate Up Slope Reflectors may be located in between the Level Reflectors to provide tighter spacing.

Where "fill" or down sloping roadsides exist, Down Slope Reflectors are to be installed on the same posts back-to-back with the Level Reflectors and directed away from the roadway and towards the down slope roadsides. Intermediate Down Slope Reflectors should be located in between the Level Reflectors to provide approximately 30'-35' spacing.



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PLAN J

10/10/90