

Illumination Design for Transportation Applications

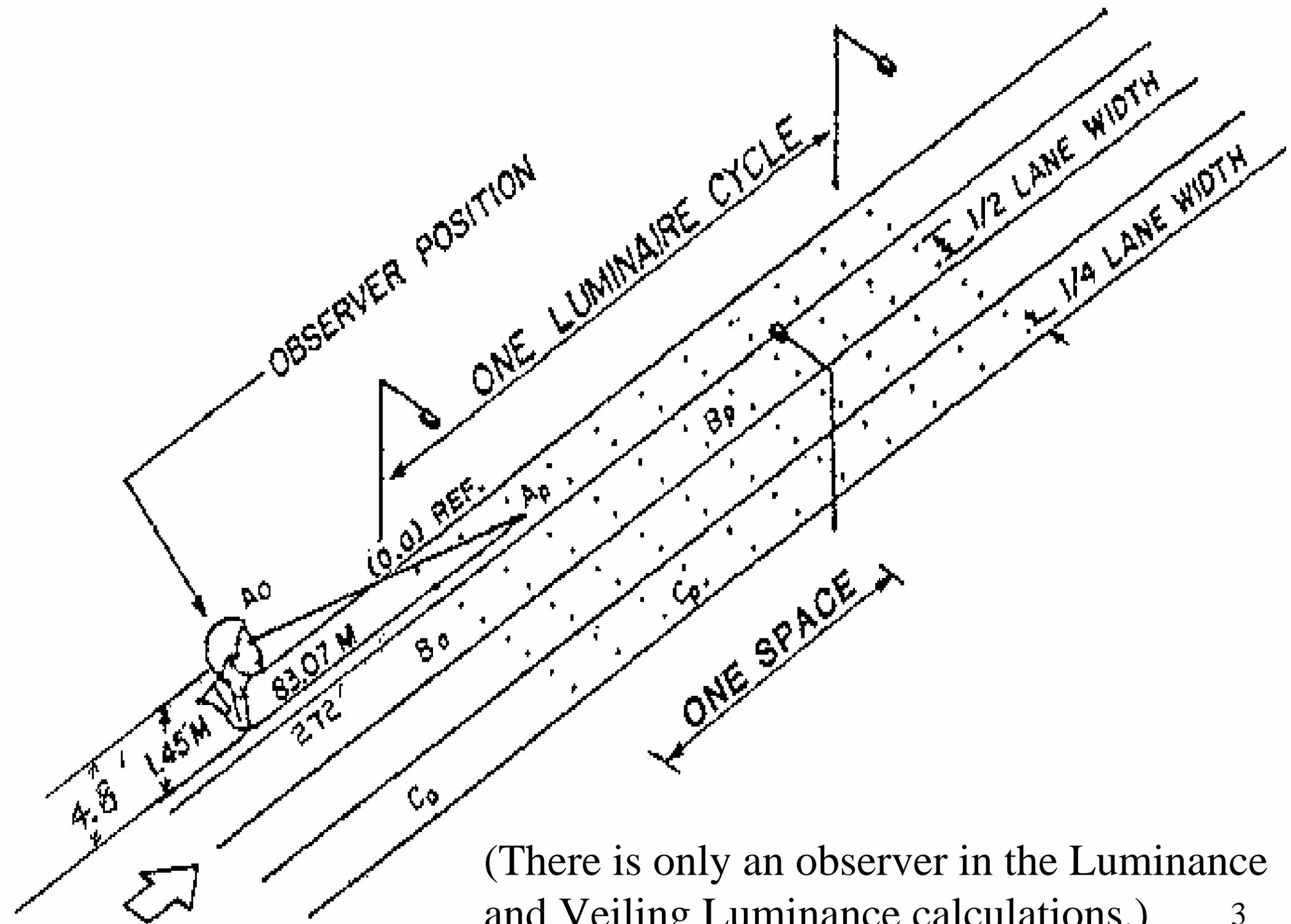
Presented by:

Terry Thayer – HQ Traffic Office

Keith Calais – HQ Traffic Office

Definitions

- Illumination (Illuminance) - the intensity of light per unit of area. (Roadway Lighting Design Guide - October 2005 - page 63) (RP-8-00 page 27)
- Luminance - luminous intensity, expressed in candles per unit projected area for the luminous surface. Roadway luminance is the light from a luminaire, projected onto a point on the roadway, then back to the observer, opposite the direction of travel. (Roadway Lighting Design Guide - October 2005 - page 64) (RP-8-00 page 57)
- Veiling Luminance - The stray light produced within the eye by the light source that alters the apparent brightness of an object within the visual field and the background against which it is viewed. (Roadway Lighting Design Guide - October 2005 - page 66) (RP-8-00 page 58)

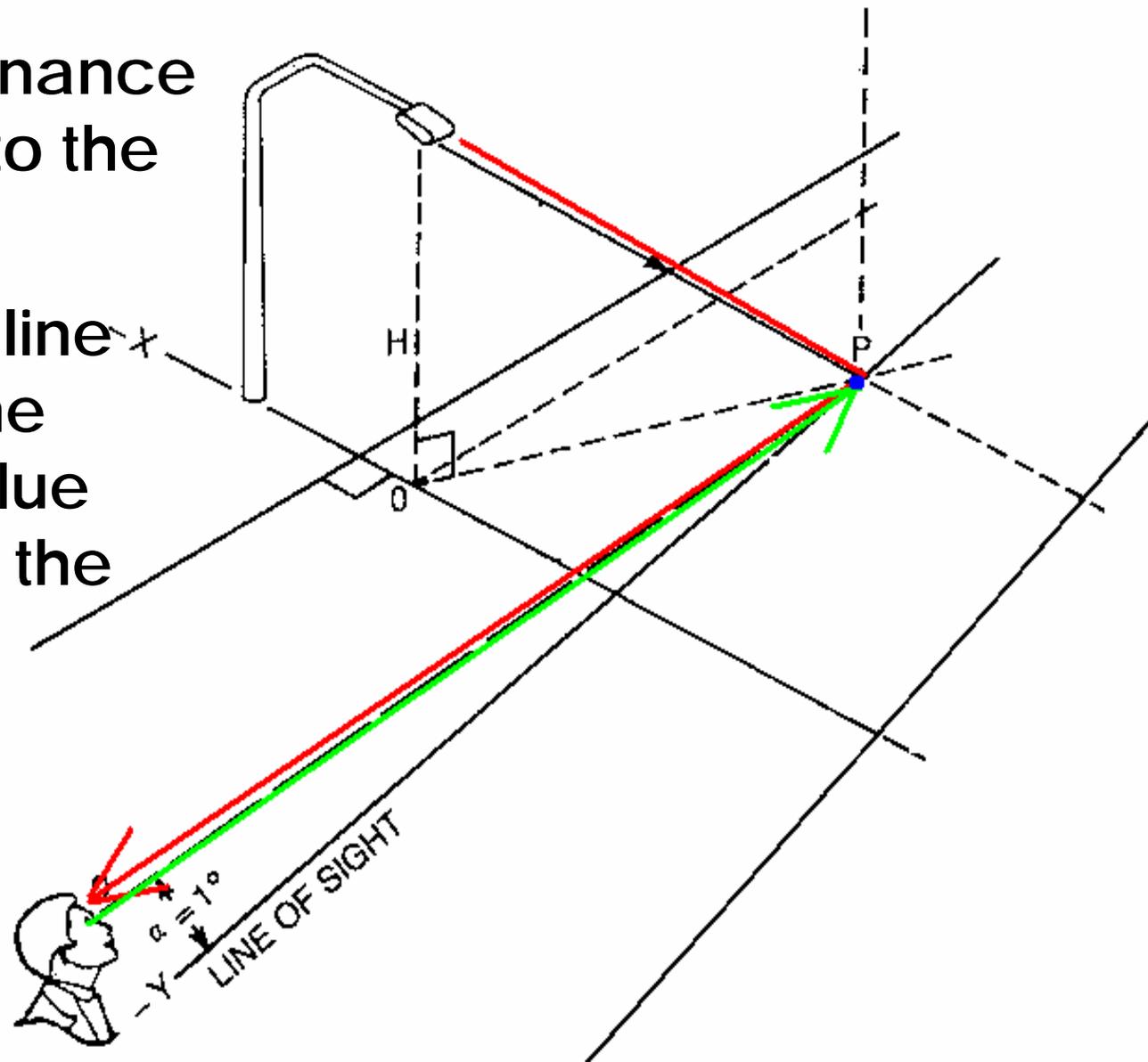


(There is only an observer in the Luminance and Veiling Luminance calculations.)

Luminance

Red → Path of Luminance from the luminaire to the observers eye.

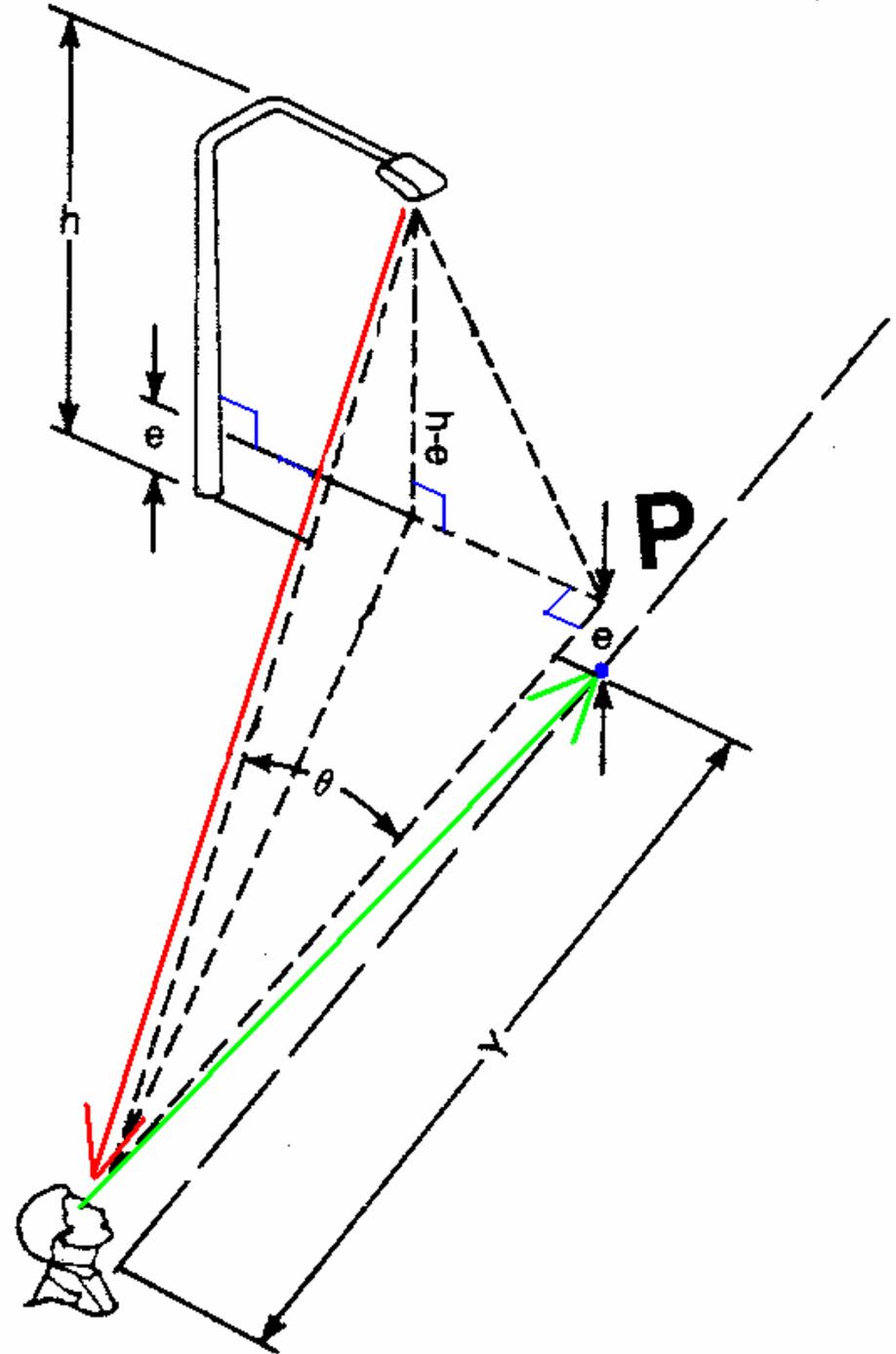
Green → Observers line of sight looking at the Luminance point value to be calculated on the pavement surface.



Veiling Luminance

Red → Path of Veiling Luminance (Disability Glare) from the luminaire to the observers eye.

Green → Observers line of sight looking at the Veiling Luminance point value (L_v) to be calculated on the pavement surface.



Definitions - continued

- Lamp lumens - The total output from a lamp, measured in lumens. (A lumen being a unit of luminous flux.)
- Luminous Flux - the time rate of flow of light radiation.
- Foot-candle - The illumination of a surface one square foot in area on which is uniformly distributed a flux of one lumen. A foot-candle equals one lumen per square foot.

Definitions - continued

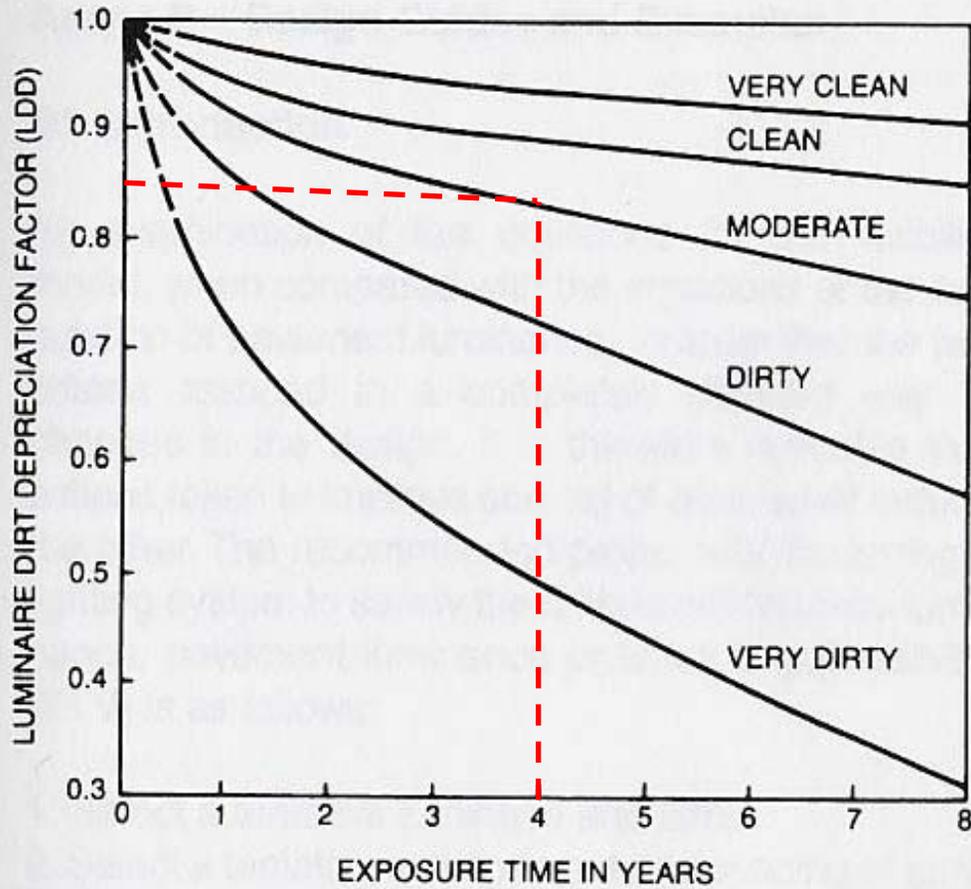
- Minimum light level - The minimum light intensity of illumination at any single point within the design area measured just prior to relamping the system. (DM-Nov 2006-page 840-2 @ page 840-41, figure 840-25, Note 1)
- Minimum average light level - The average of all light intensities within the design area measured just prior to relamping the system. (DM-Nov 2006-page 840-2 & page 840-41, figure 840-25, Note 6)
- Uniformity Ratio - The ratio of the minimum average light level on the design area to the minimum light level of the same area. (DM-Nov 2006-page 840-2 & page 840-41, figure 840-25, Note 1)

Definitions - continued

- Dirt Factor - the amount of environmental contamination deposited on the reflector, refractor or luminaire bulb. Expressed as percentage of light transmission loss at end of life / relamping time compared to new installation. $(DF) = 0.85$ (RP-8-00 page 27)
- Lamp Lumen Depreciation Factor - the factor used in illumination calculations to relate initial rated output to the anticipated output at replacement time. $(LLDF) = 0.73$ (GE Catalog Dec. 1995 - section 9050 page 2)
- Light Loss Factor (Maintenance factor) Percentage of light degeneration through the life of the lamp.
 $(DF) 0.85 \times (LLDF) 0.73 = \underline{0.62LLF}$

Dirt Factor

ANSI / IESNA RP-8-00



SELECT THE APPROPRIATE CURVE IN ACCORDANCE WITH THE TYPE OF AMBIENT AS DESCRIBED BY THE FOLLOWING EXAMPLES:

VERY CLEAN—No nearby smoke or dust generating activities and a low ambient contaminant level. Light traffic. Generally limited to residential or rural areas. The ambient particulate level is no more than 150 micrograms per cubic meter.

CLEAN—No nearby smoke or dust generating activities. Moderate to heavy traffic. The ambient particulate level is no more than 300 micrograms per cubic meter.

MODERATE—Moderate smoke or dust generating activities nearby. The ambient particulate level is no more than 600 micrograms per cubic meter.

DIRTY—Smoke or dust plumes generated by nearby activities may occasionally envelope the luminaires.

VERY DIRTY—As above but the luminaires are commonly enveloped by smoke or dust plumes.

Figure A5. Luminaire Dirt Depreciation (LDD) factors.

Lamp Lumen Depreciation Factor

HIGH PRESSURE SODIUM LAMP DATA

ORDERING ABBREVIATION	ANSI CODE	FINISH	LIGHT CENTER LENGTH INCHES	INITIAL LUMENS	LAMP LUMEN DEPRECIATION	
					MEAN	END OF LIFE
35-WATT-LIFE AT 10 HOURS/START = 16,000 HOURS						
LU35/Med	S76-HA-35	Clear	3-13/32	2,250	0.90	0.73
LU35/D/Med	S76-HB-35	Diffuse	3-13/32	2,150	0.90	0.73
50-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU50/Med	S68-XX-50	Clear	3-13/32	4,000	0.90	0.73
LU50/D/Med	S68-YY-50	Diffuse	3-13/32	3,800	0.90	0.73
LU50	S68-MS-50	Clear	5	4,000	0.90	0.73
LU50/D	S68-MT-50	Diffuse	5	3,800	0.90	0.73
70-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU70/Med	S62-LG-70	Clear	3-13/32	6,400	0.85	0.77
LU70/D/Med	S62-LH-70	Diffuse	3-13/32	5,950	0.85	0.77
70-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU70	S62-ME-70	Clear	5	6,400	0.85	0.77
LU70/D	S62-MF-70	Diffuse	5	5,950	0.85	0.77
100-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU100/Med	S54-SG-100	Clear	3-13/32	9,500	0.90	0.73
LU100/D/Med	S54-SH-100	Diffuse	3-13/32	8,800	0.90	0.73
LU100	S54-SB-100	Clear	5	9,500	0.90	0.73
LU100/D	S54-MC-100	Diffuse	5	8,800	0.90	0.73
150-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU150/Med	S55-RN-150	Clear	3-1/2	16,000	0.90	0.73
LU150/D/Med	S55-RP-150	Diffuse	3-1/2	15,000	0.90	0.73
LU150/55	S55-SC-150	Clear	5	16,000	0.90	0.73
LU150/55/D	S55-MD-150	Diffuse	5	15,000	0.90	0.73
LU150/100	S56-SD-150	Clear	5	15,000	0.90	0.73
LU150/100/D	S56-SE-150	Diffuse	5	14,000	0.90	0.73
200-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU200	S66-MN-200	Clear	5-3/4	22,000	0.90	0.73
250-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU250	S50-VA-250	Clear	5-3/4	28,000	0.90	0.73
LU250/D	S50-VC-250	Diffuse	5	26,000	0.90	0.73
LU250/S	S50-VA-250	Clear	5-3/4	30,000	0.90	0.73
310-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU310	S67-MR-310	Clear	5-3/4	37,000	0.90	0.73
350-WATT-LIFE AT 10 HOURS/START = 18,000⁺ HOURS						
LU350	S129-AG-350	Clear	5-3/4	50,000	0.90	0.73
400-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU400	S51-WA-400	Clear	5-3/4	50,000	0.90	0.73
LU400/D	S51-WB-400	Diffuse	7	47,500	0.90	0.73
750-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU750	S111-NH-750	Clear	6-7/8	110,000	0.90	0.73
1000-WATT-LIFE AT 10 HOURS/START = 24,000⁺ HOURS						
LU1000	S52-XB-1000	Clear	8-3/4	140,000	0.90	0.73

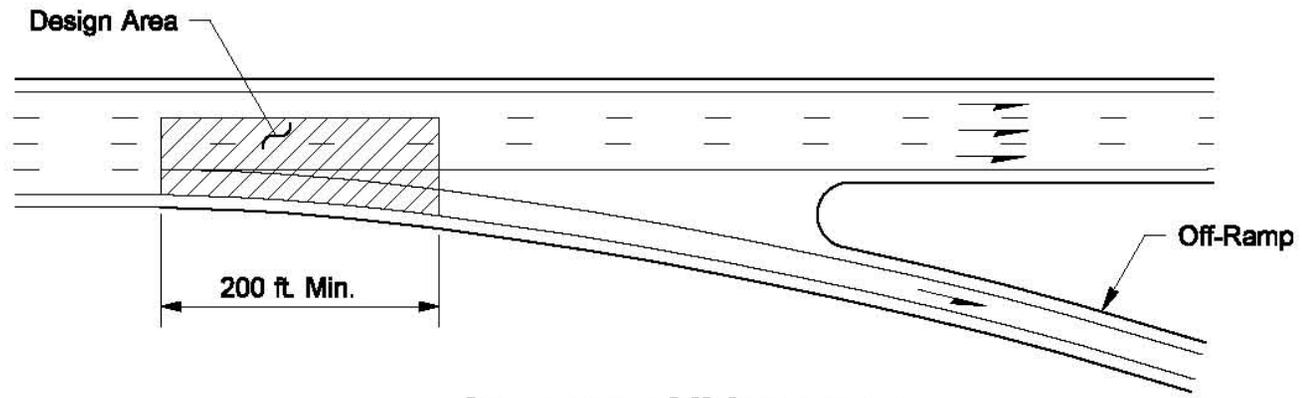
Definitions - continued

- Type III Medium Cutoff Fixture - Type I, II, III & IV are designations for asymmetrical (noncircular) distribution patterns. A “Type III” projects light further across the street (transverse) than a “Type II” and less far across the street than a “Type IV”.
- “Medium” is the distance up and down the highway (longitudinal) a luminaire directs light. This is in the range of $>2.0 \times \text{MH}$ (mounting height) & $< 4.0 \times \text{MH}$ (approx.).
- “Cutoff” - tells how much light a luminaire directs above 80 & 90 degrees vertical. A cutoff fixture directs almost no light (2% - 3%) above 90 degrees.

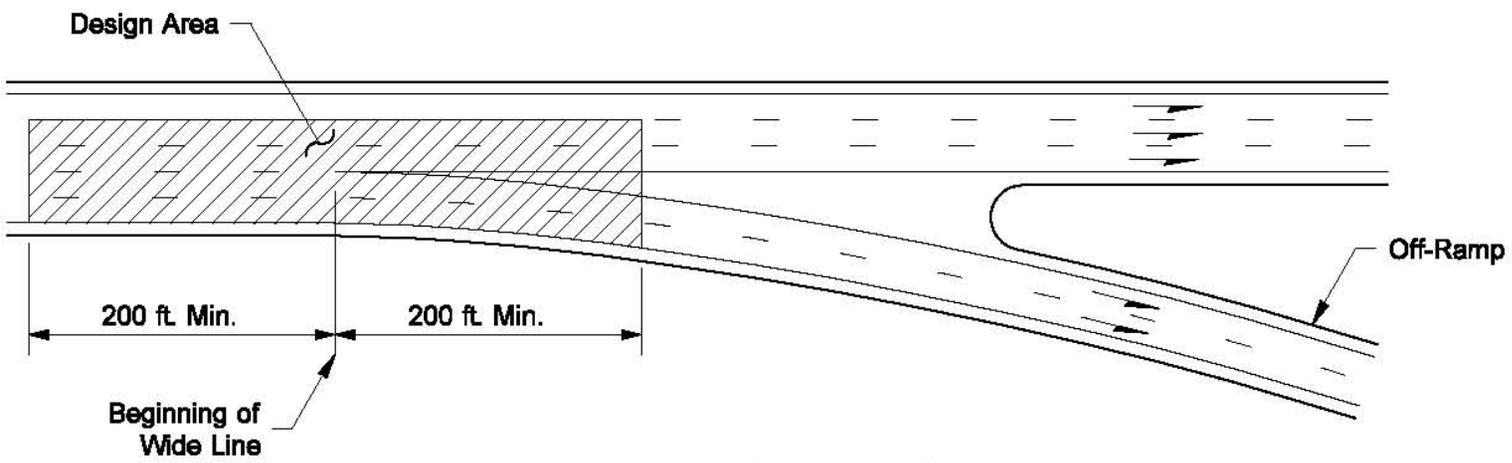
Required (Basic) Illumination

- The design matrices identify the design levels for illumination on all preservation and improvement jobs. (see Chapter 325 - Design Manual) (DM 840.05 – November 2006)
- The design matrices are shown in figures 325-3 through 325-7. Follow Design Manual guidance for all projects except as noted in the design matrices and elsewhere as applicable. (DM 325.03 – December 2003)
- A minimum of two light standards of standard pole height are required at all design areas, with the exception of ramp terminals and the entrance/exit points of minor parking lots. (addition to Nov. 2006 DM chapter 840).

Freeway Off Ramps and On Ramps (1)

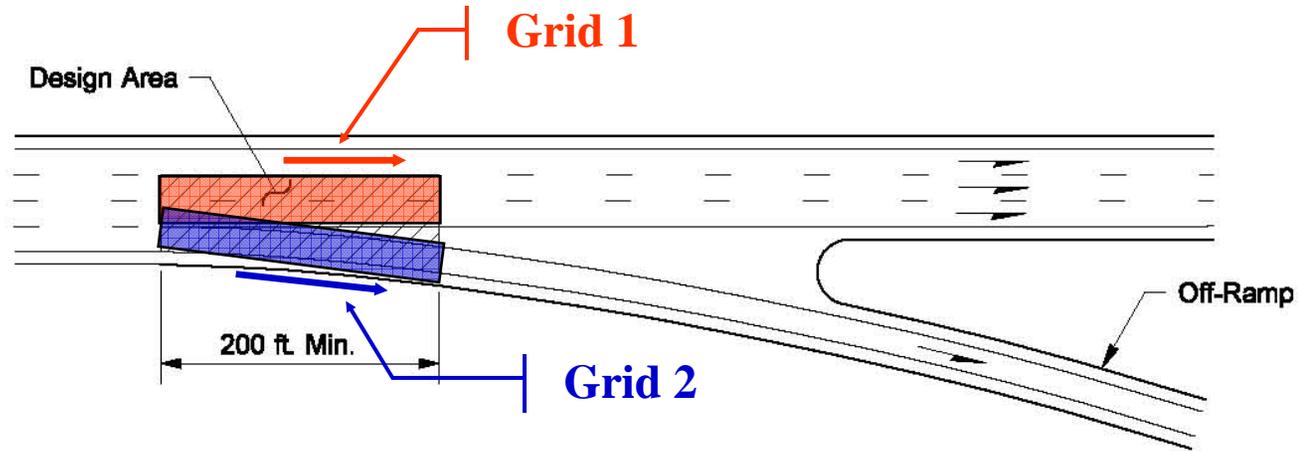


Single-Lane Off-Connection
(The Design Area May Be Shifted up to 100 Feet From the Beginning of the Wide Line)

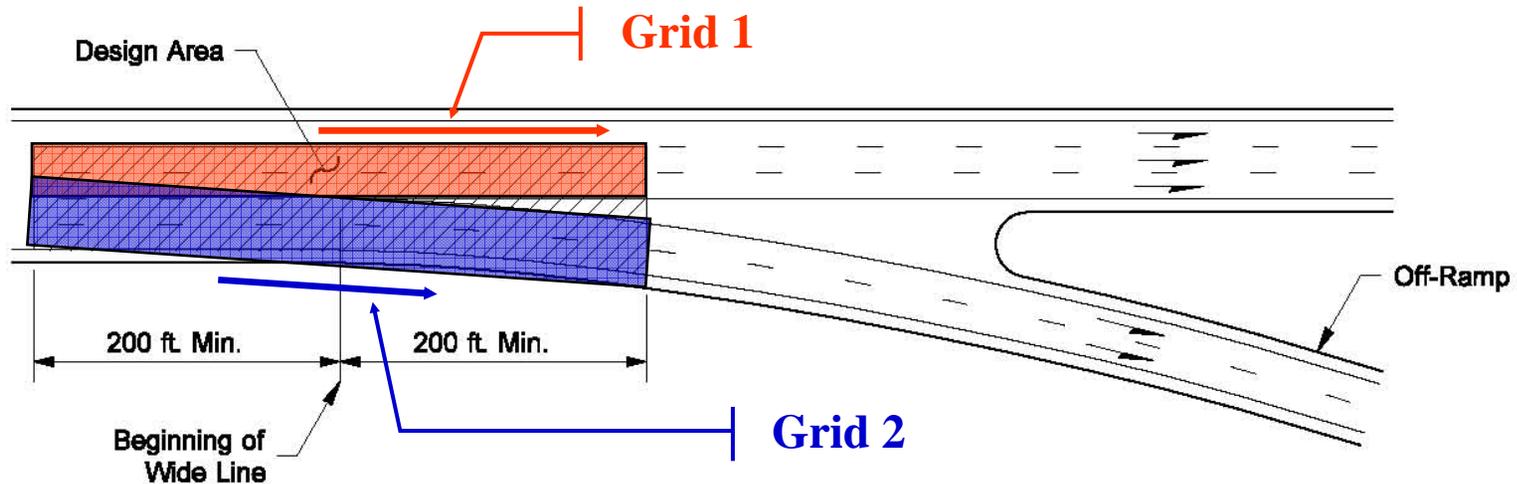


Two-Lane Off-Connection
(The Design Area Can Be Shifted up to 100 Feet From the Beginning of the Wide Line)

How to place Luminance & Veiling Luminance Grids

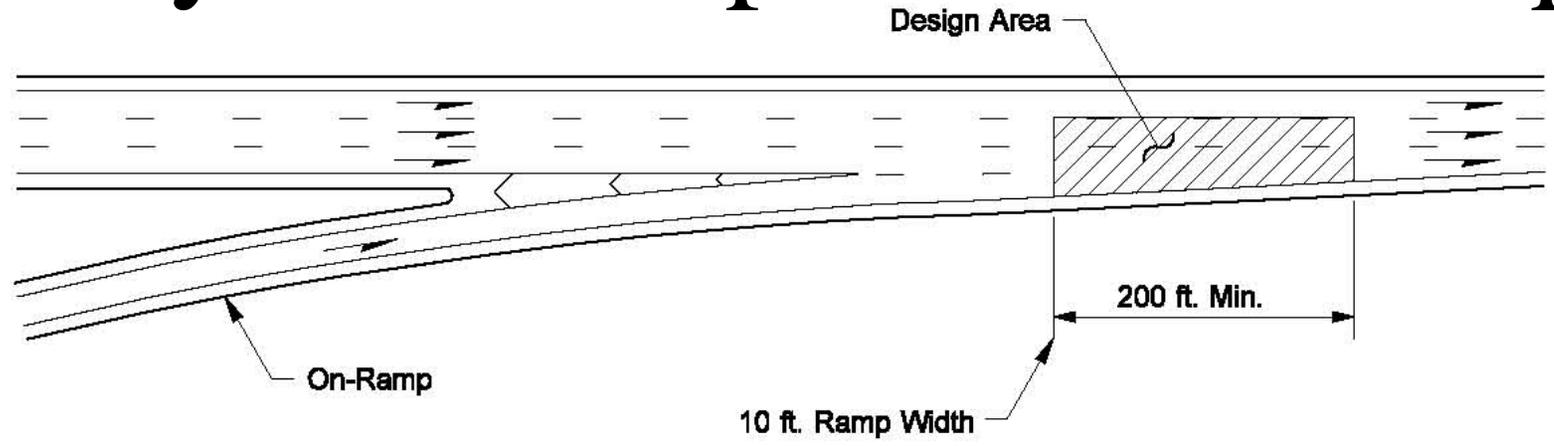


Single-Lane Off-Connection
(The Design Area May Be Shifted up to 100 Feet From the Beginning of the Wide Line)

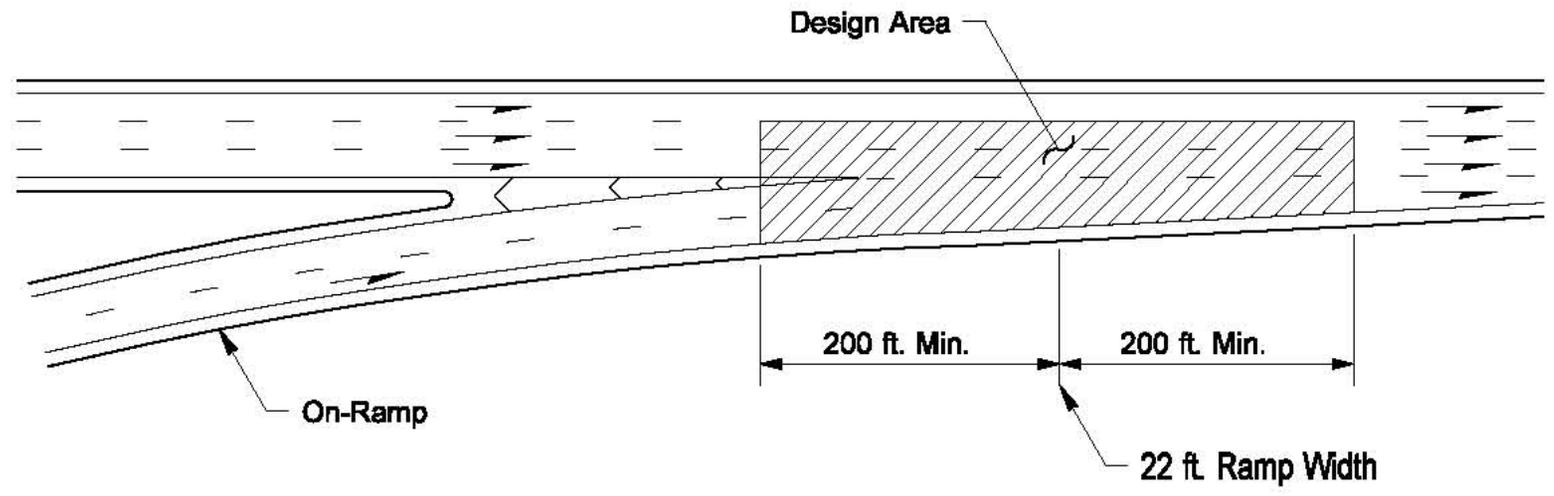


Two-Lane Off-Connection
(The Design Area Can Be Shifted up to 100 Feet From the Beginning of the Wide Line)

Freeway Off Ramps and On Ramps (1)

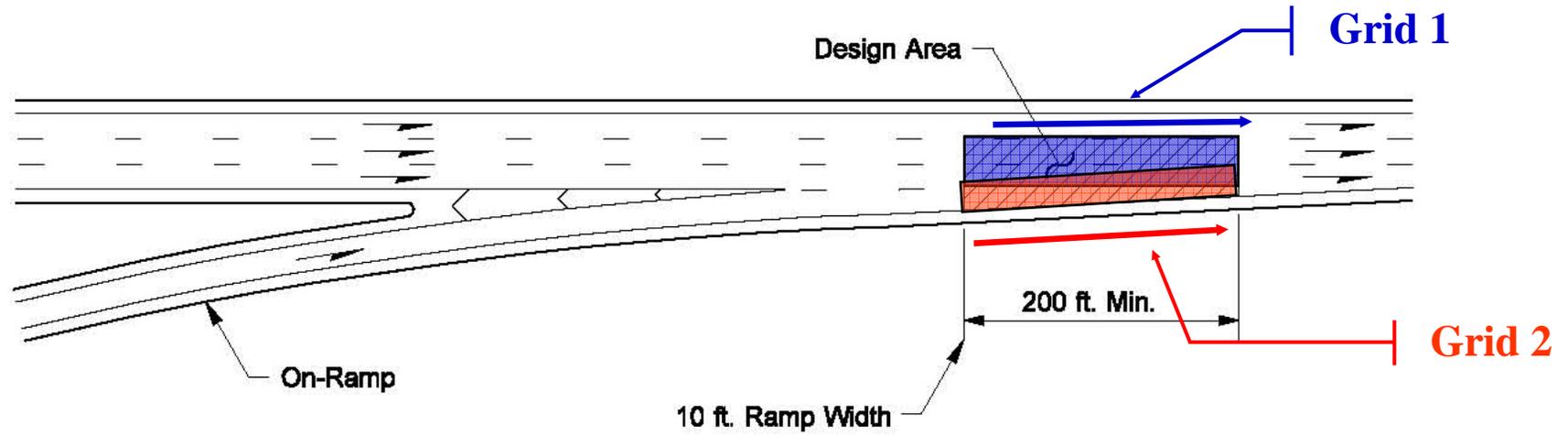


Single-Lane On-Connection
(The Design Area May Be Shifted up to 100 Feet From the 10-Foot-Wide Ramp Point)

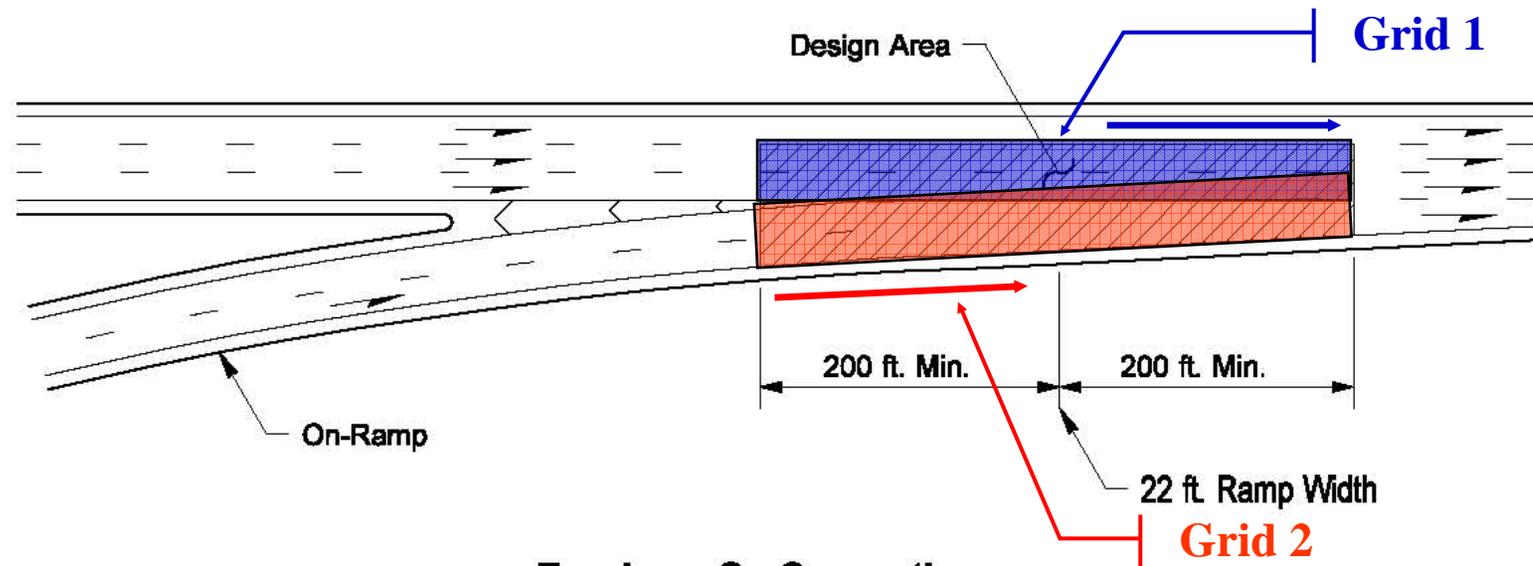


Two-Lane On-Connection
(The Design Area May Be Shifted up to 100 Feet From the 22-Foot-Wide Ramp Point)

How to place Luminance & Veiling Luminance Grids

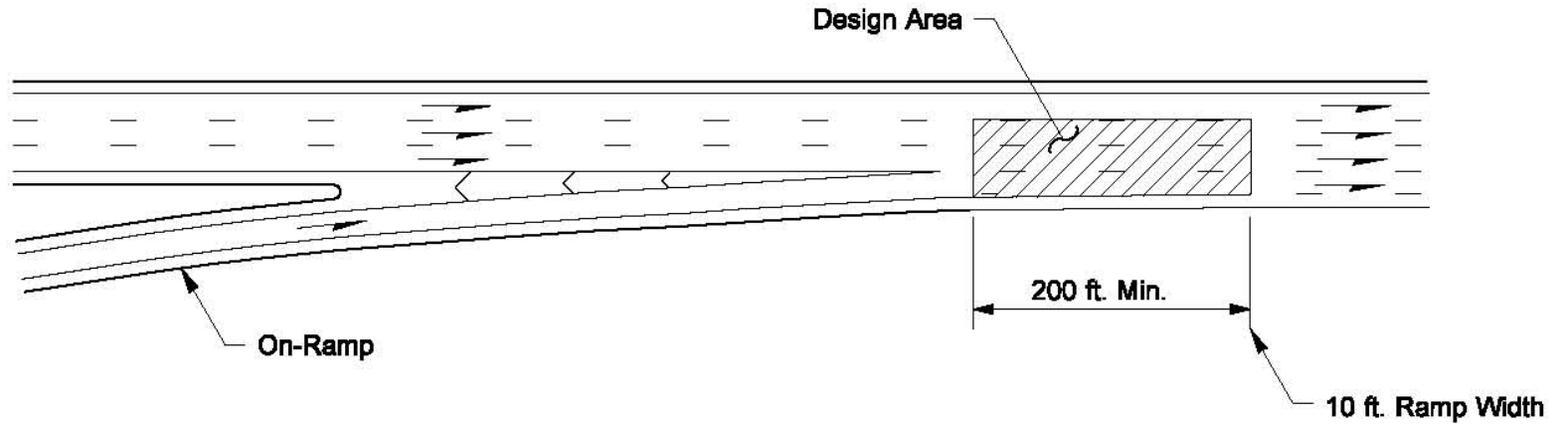


Single-Lane On-Connection
(The Design Area May Be Shifted up to 100 Feet From the 10-Foot-Wide Ramp Point)

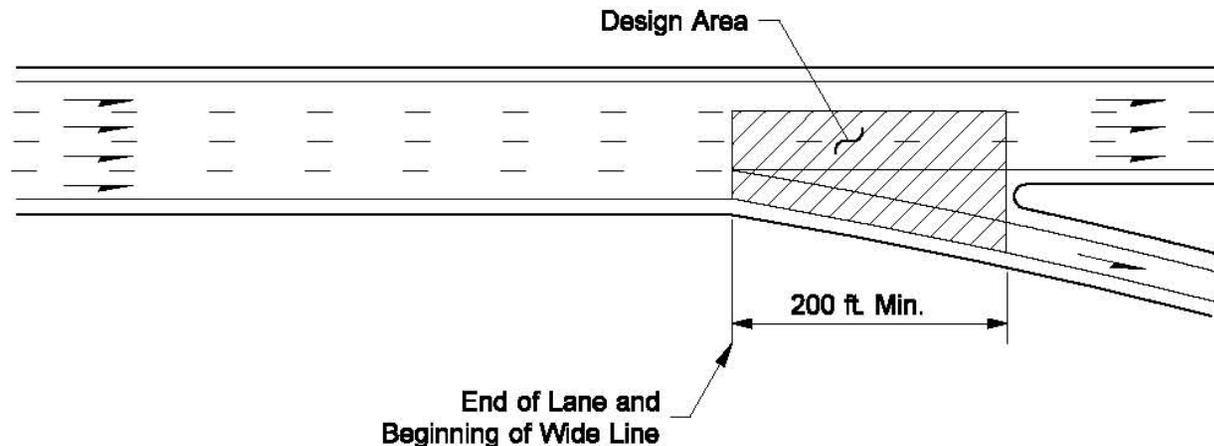


Two-Lane On-Connection
(The Design Area May Be Shifted up to 100 Feet From the 22-Foot-Wide Ramp Point)

Freeway Off Ramps and On Ramps (1)

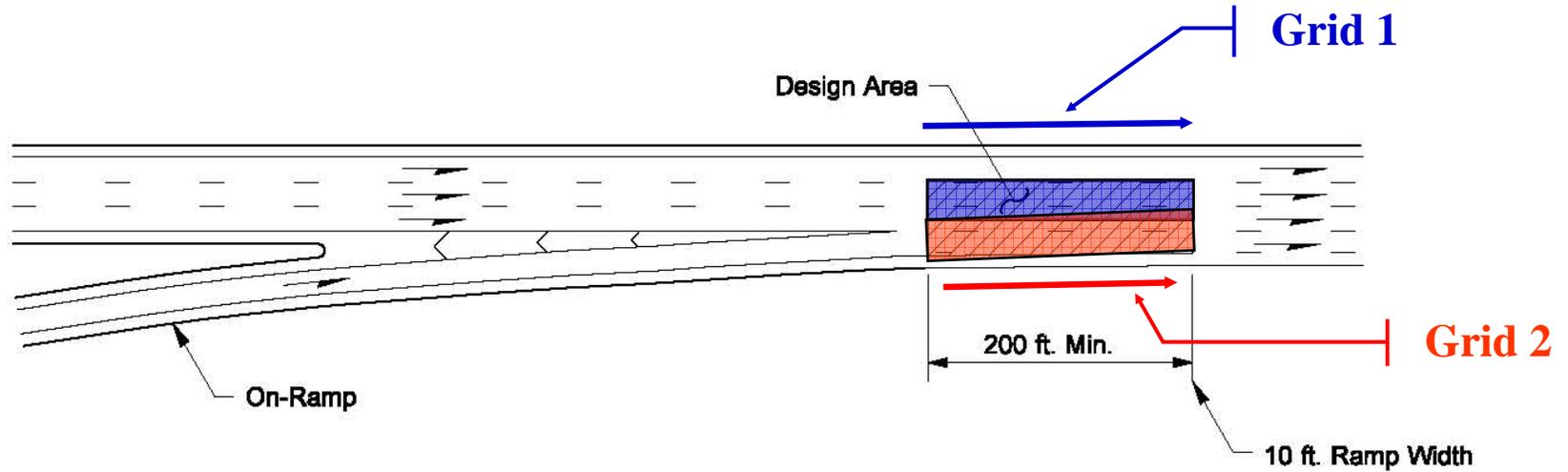


Auxiliary Lane at On-Connection
(The Design Area May Be Shifted up to 100 Feet From the 10-Foot-Wide Ramp Point)

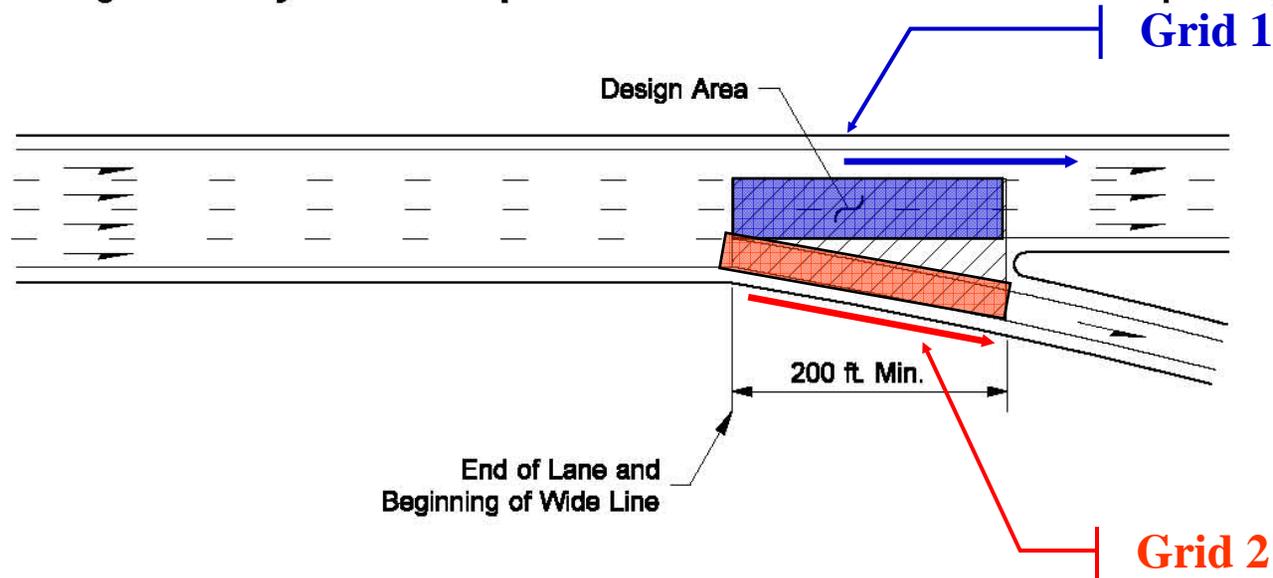


Exit-Only Lane
The Design Area May Be Shifted up to 100 Feet From the End of Lane and the Beginning of Wide Line

How to place Luminance & Veiling Luminance Grids

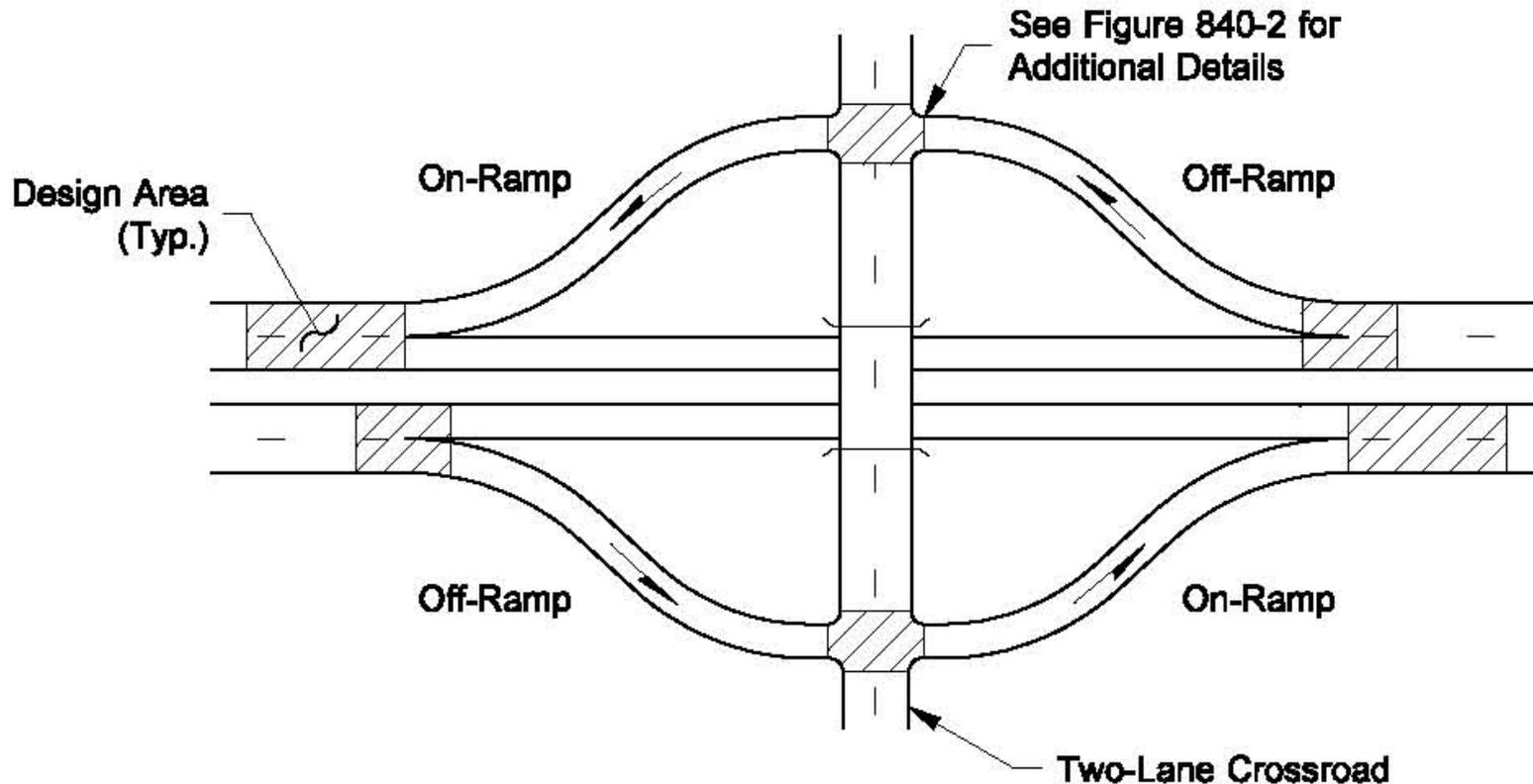


Auxiliary Lane at On-Connection
(The Design Area May Be Shifted up to 100 Feet From the 10-Foot-Wide Ramp Point)



Exit-Only Lane
The Design Area May Be Shifted up to 100 Feet From the End of Lane and the Beginning of Wide Line

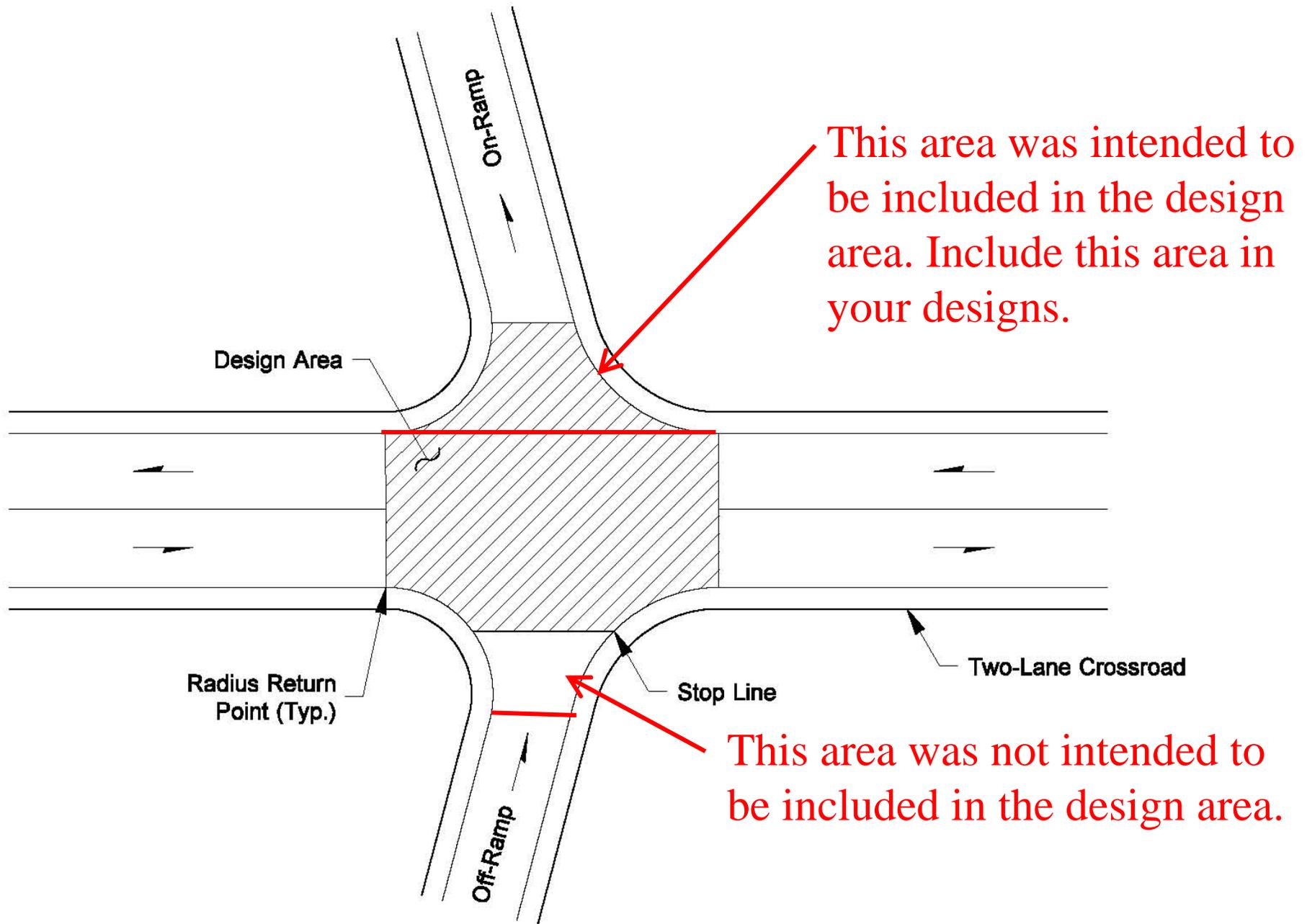
Freeway Ramp Terminals (2)



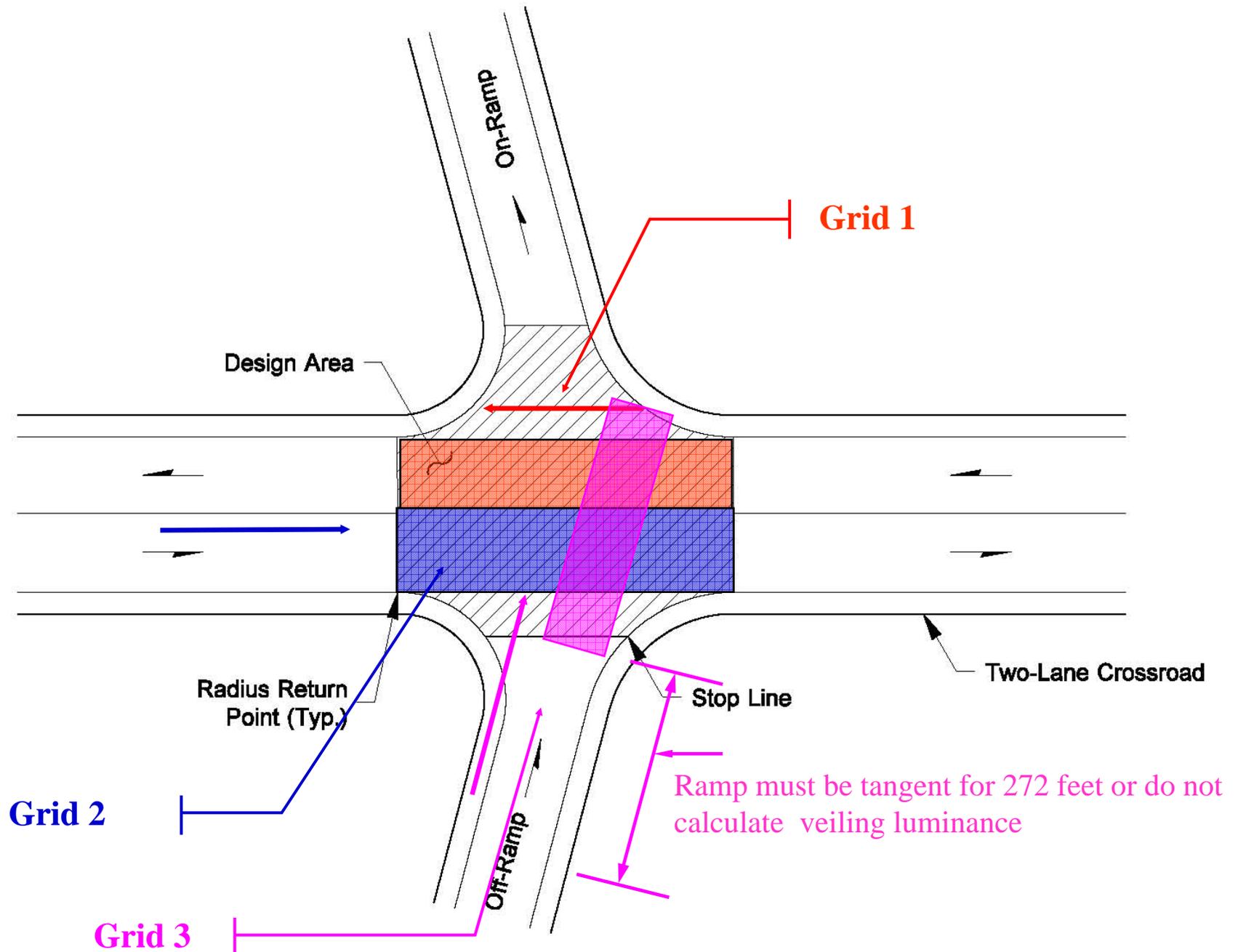
**Required Illumination for a Typical Diamond Interchange
(Shown for Single-Lane Ramp Connection and a Two-Lane Crossroad Without Channelization)**

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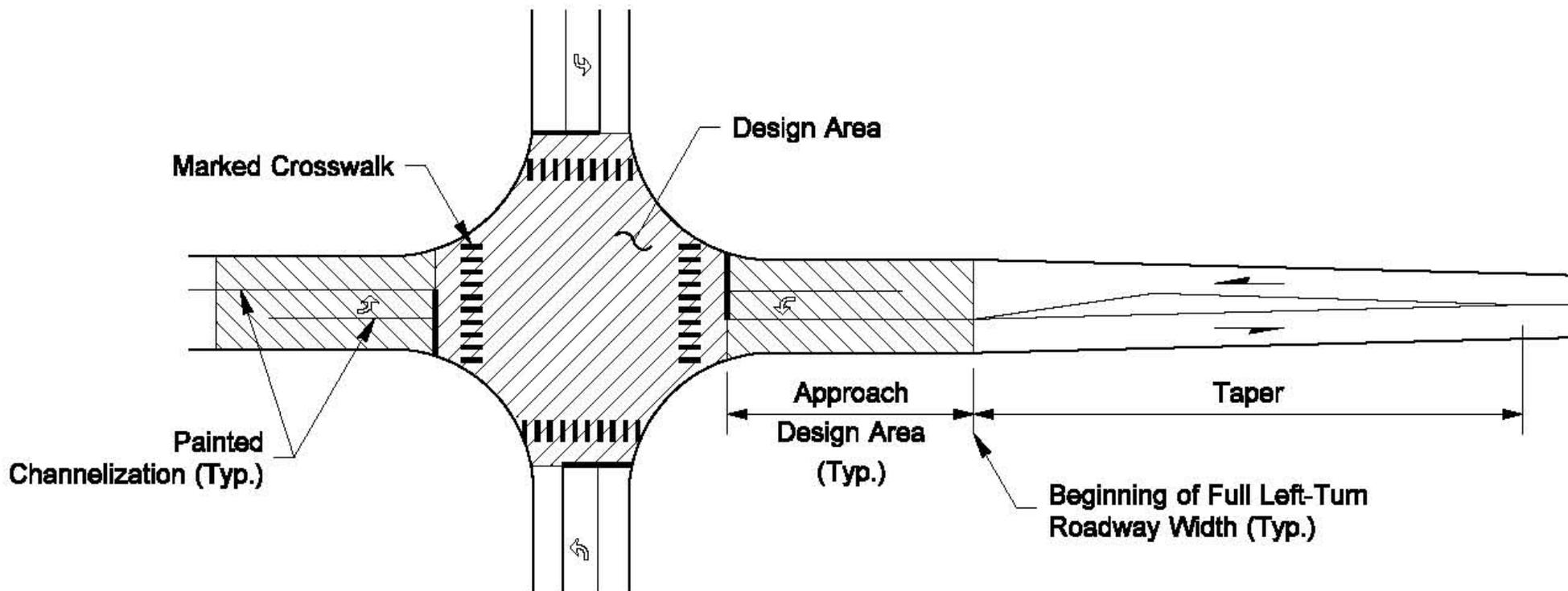
Freeway Ramp Terminals (2)



How to place Luminance & Veiling Luminance Grids

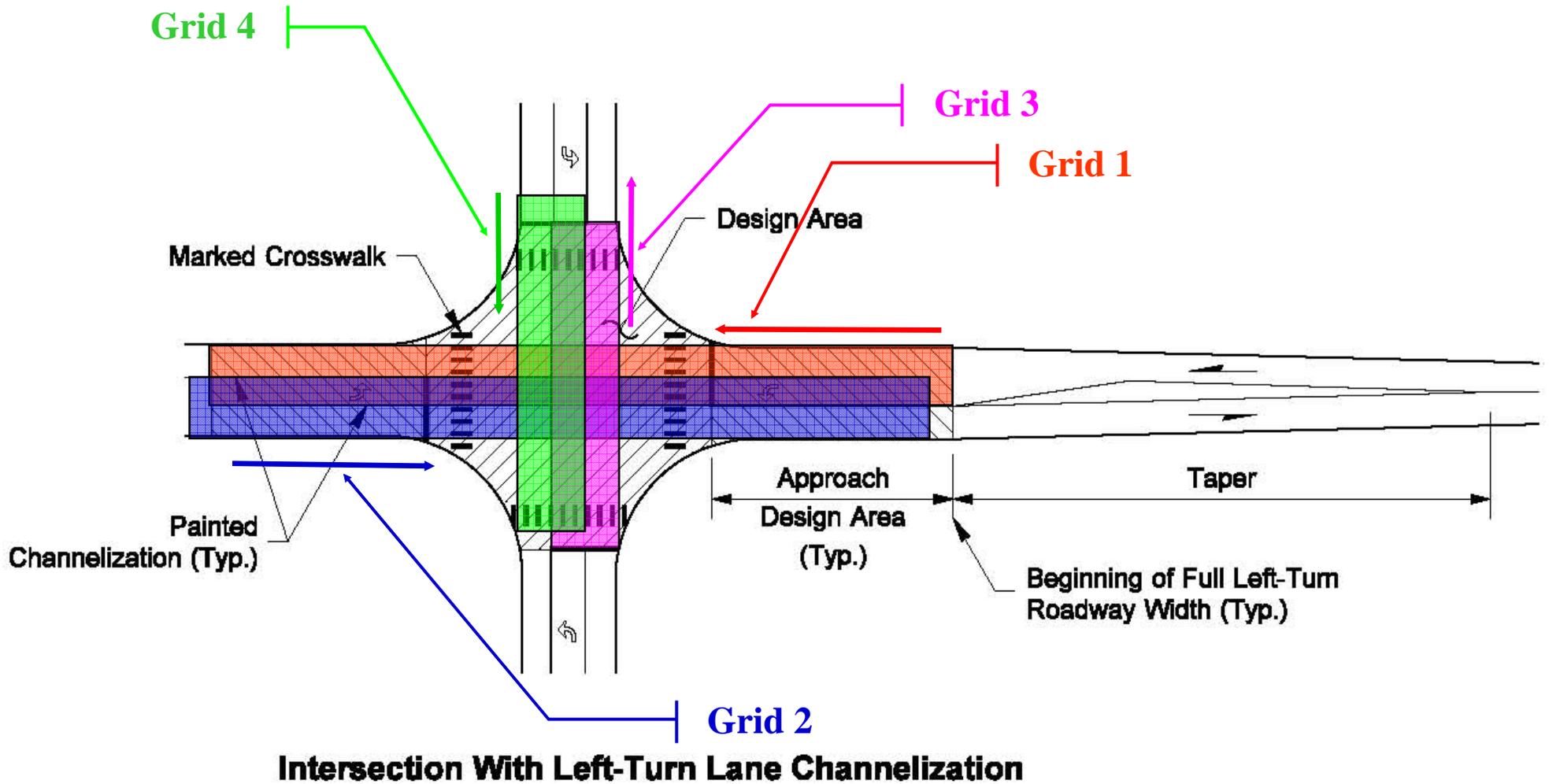


Intersections With Left Turn Channelization (3)

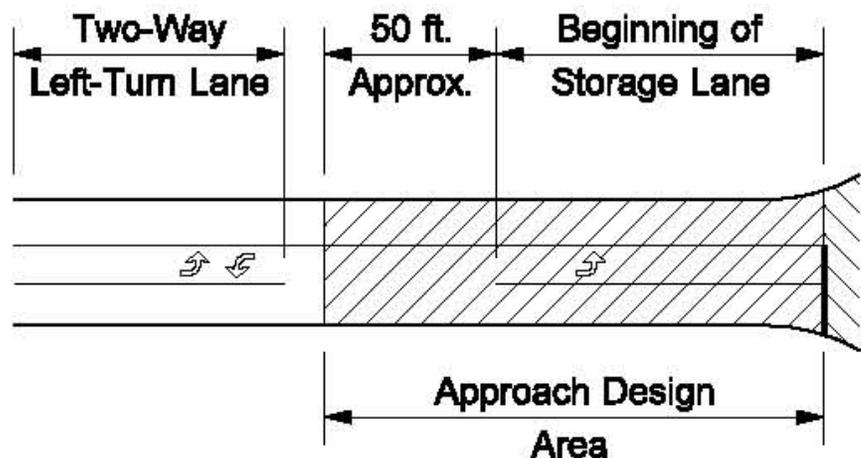


Intersection With Left-Turn Lane Channelization

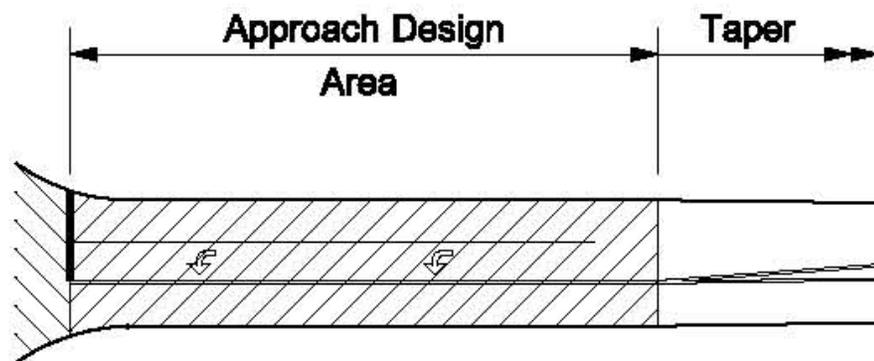
How to place Luminance & Veiling Luminance Grids



Intersections With Left Turn Channelization (3)

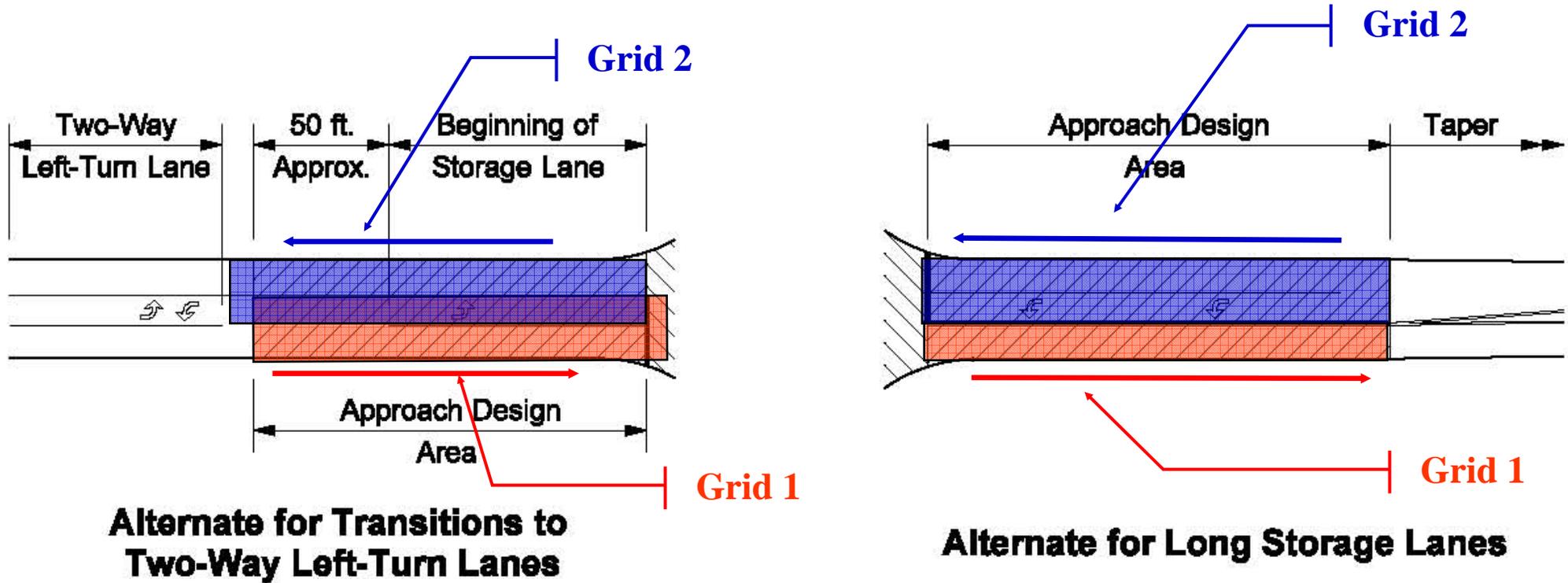


Alternate for Transitions to Two-Way Left-Turn Lanes

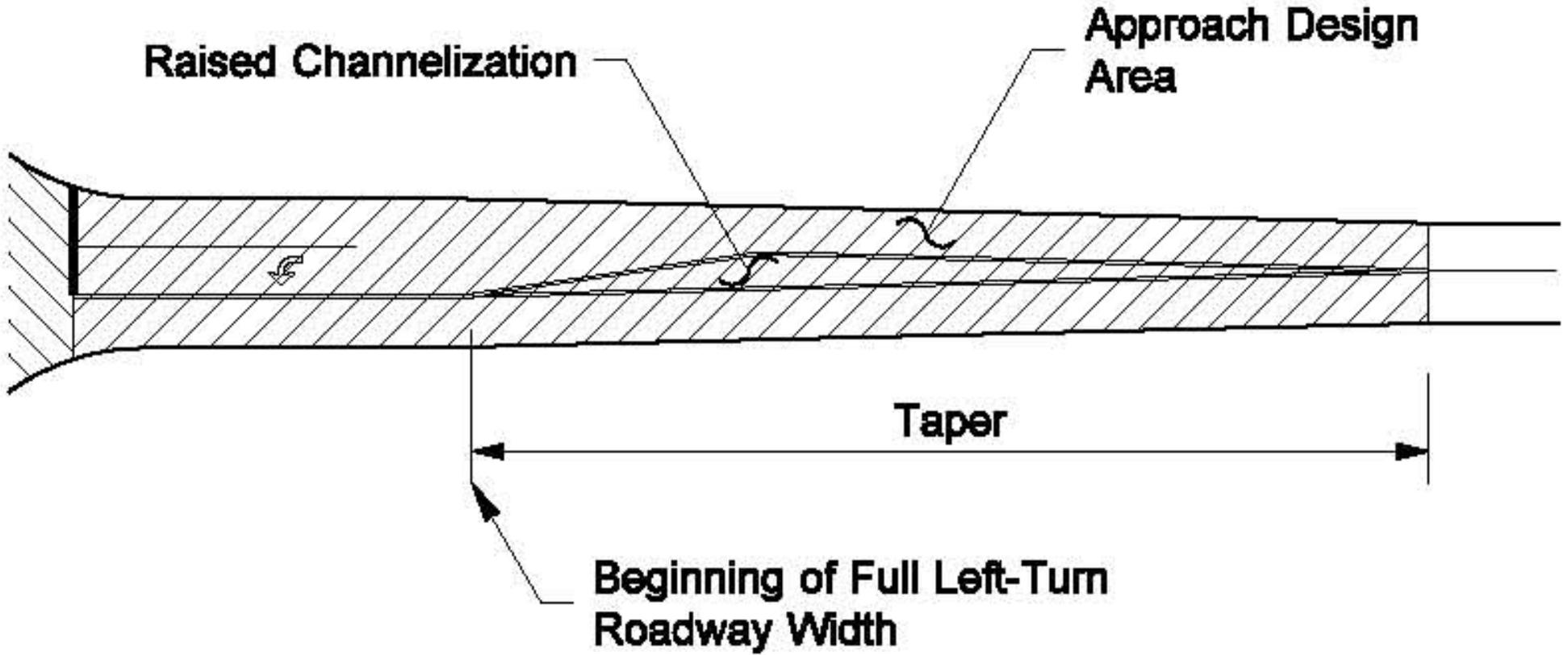


Alternate for Long Storage Lanes

How to place Luminance & Veiling Luminance Grids

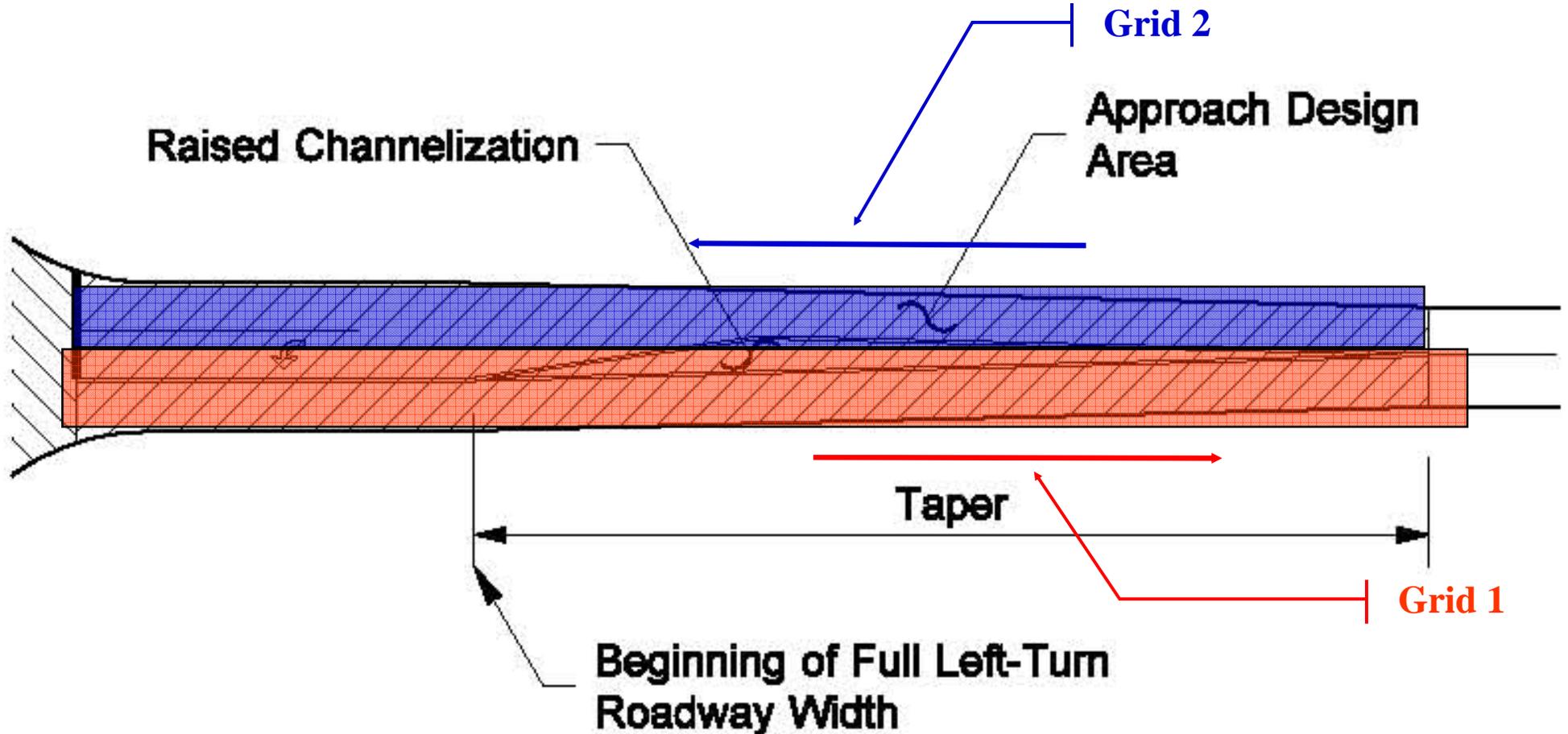


Intersections With Left Turn Channelization (3)



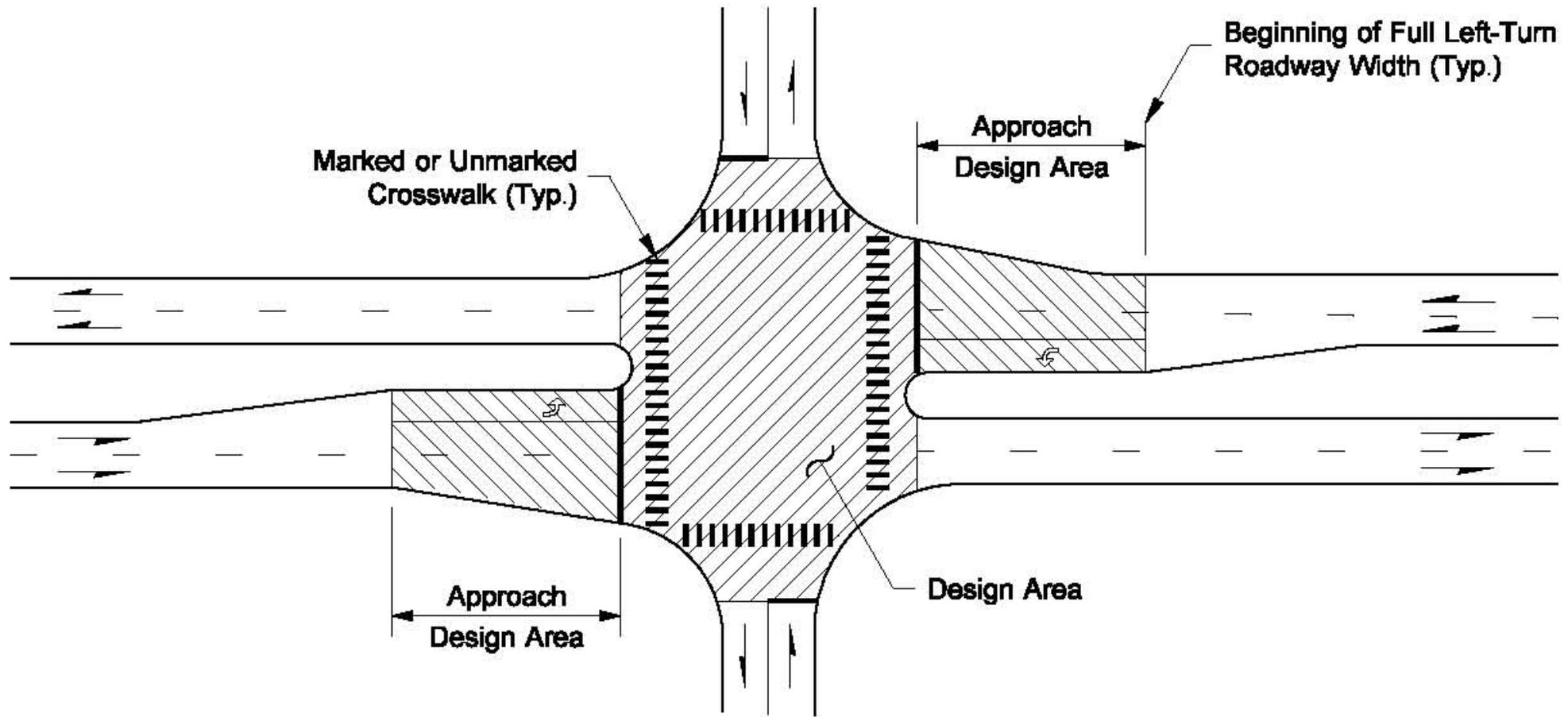
Alternate for Raised Channelization

How to place Luminance & Veiling Luminance Grids

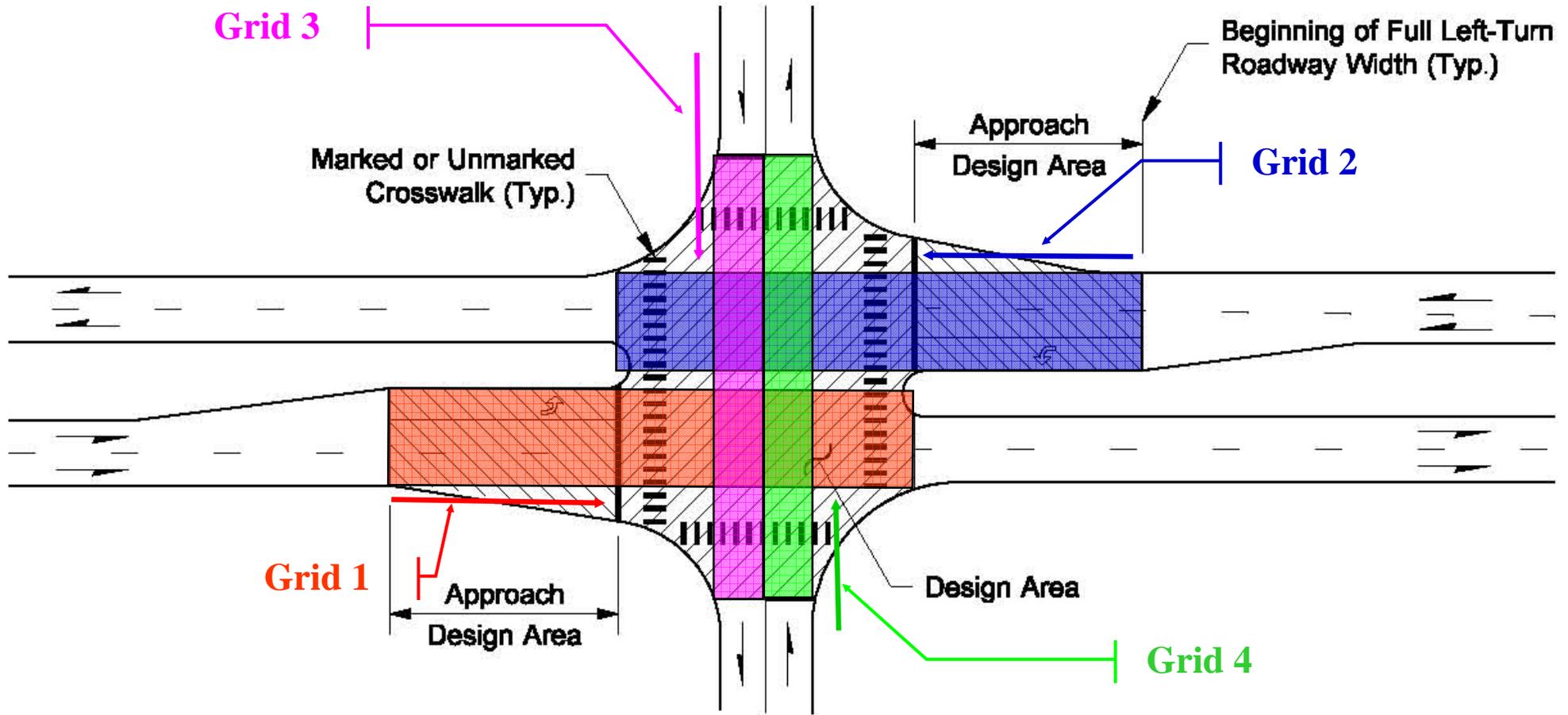


Alternate for Raised Channelization

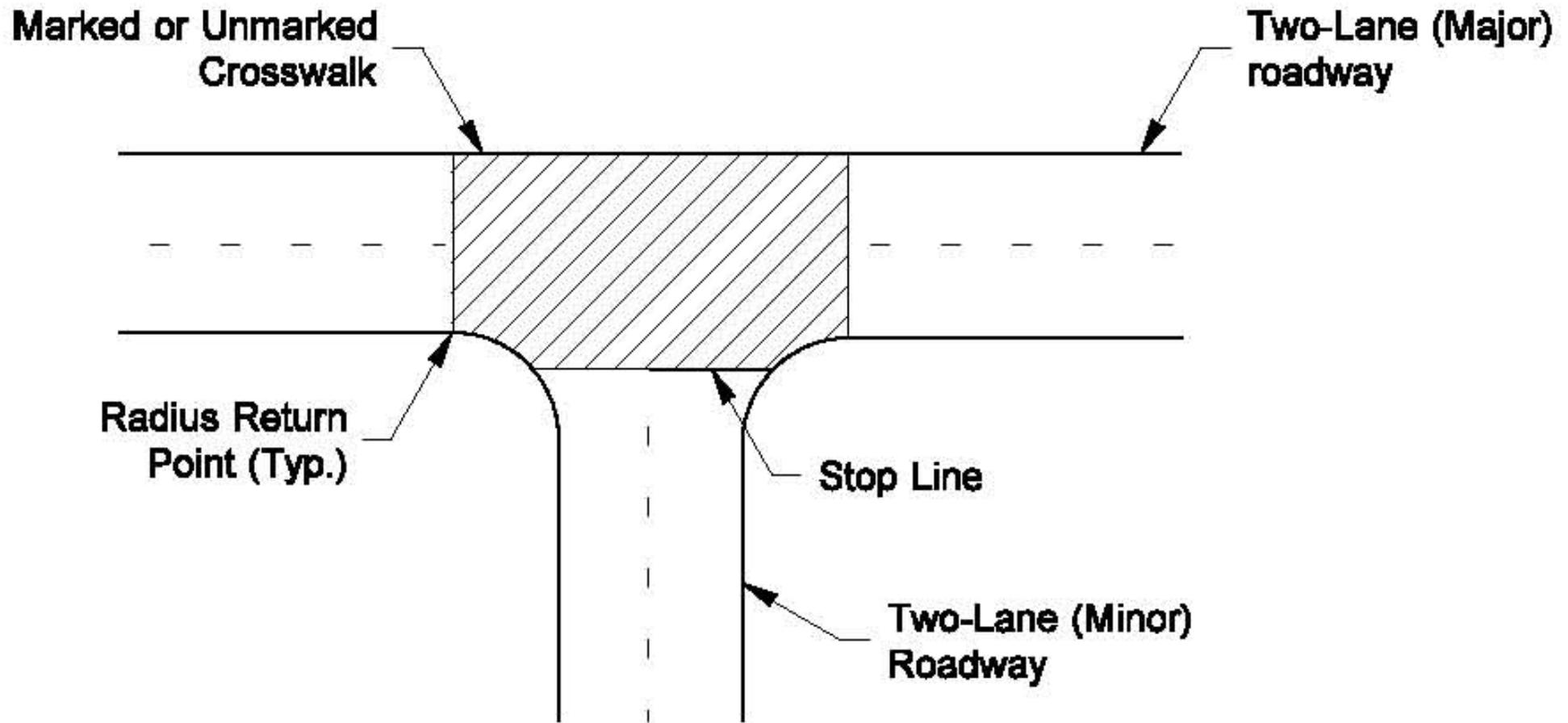
Intersections With Left Turn Channelization (3)



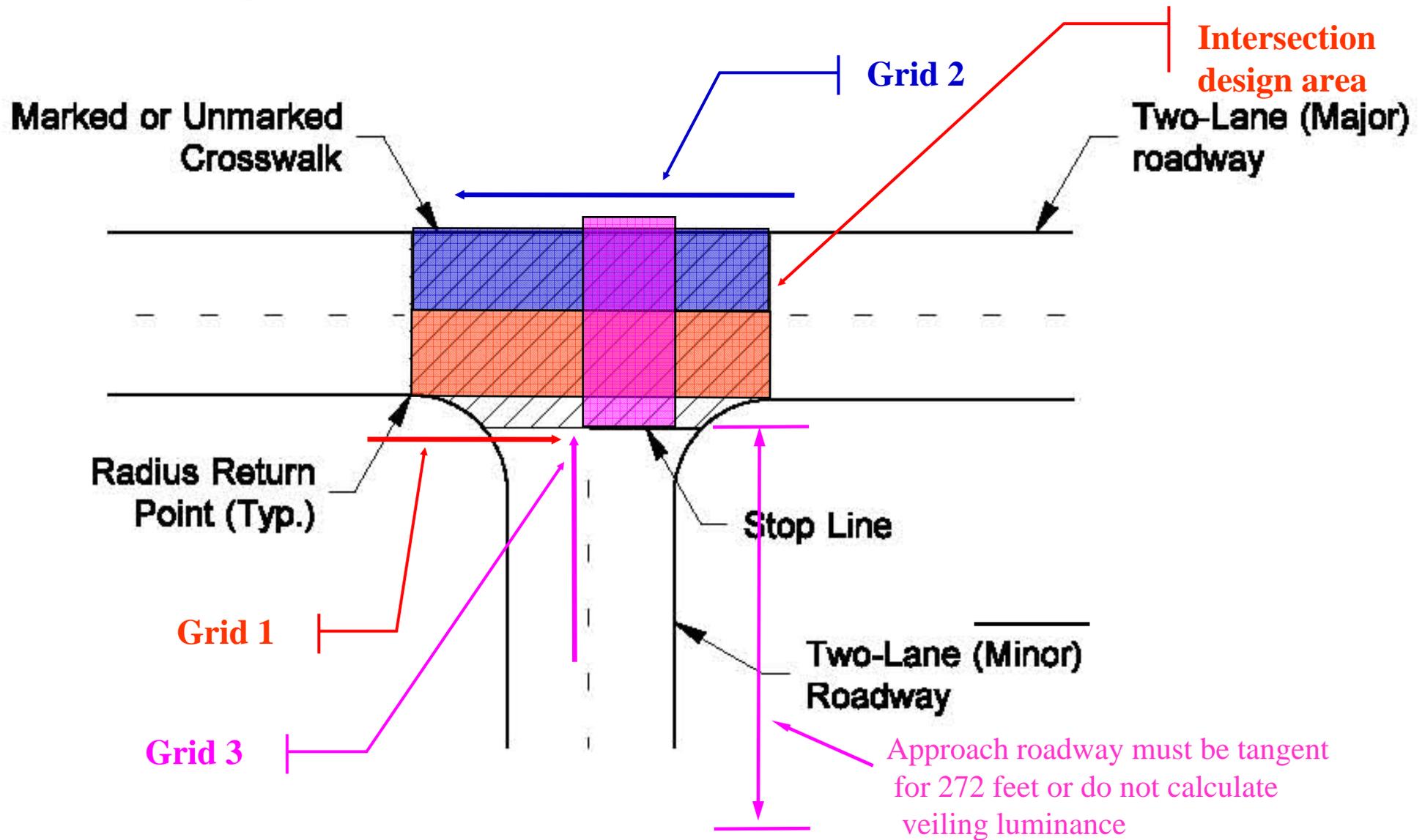
How to place Luminance & Veiling Luminance Grids



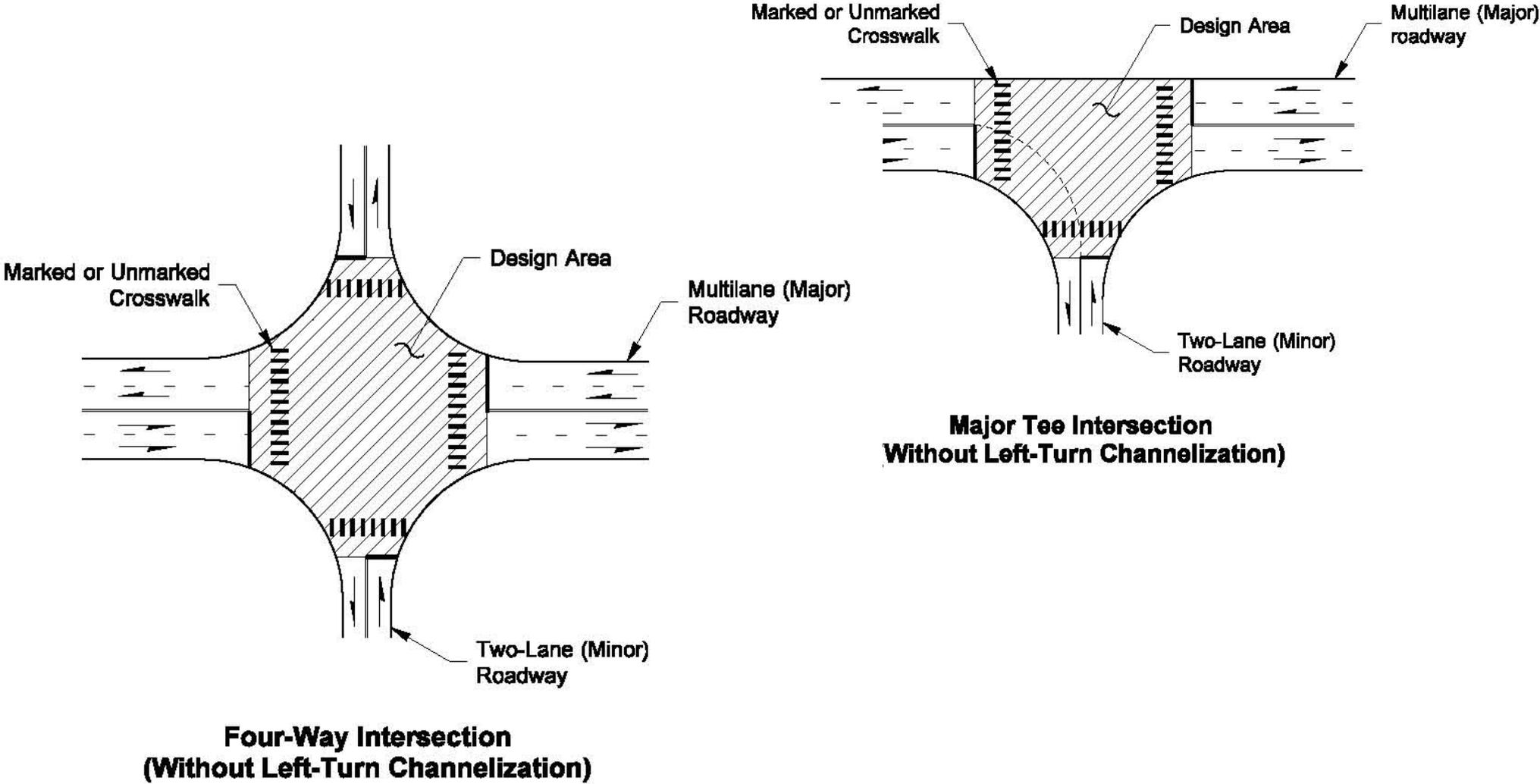
Intersections without channelization AI(5)



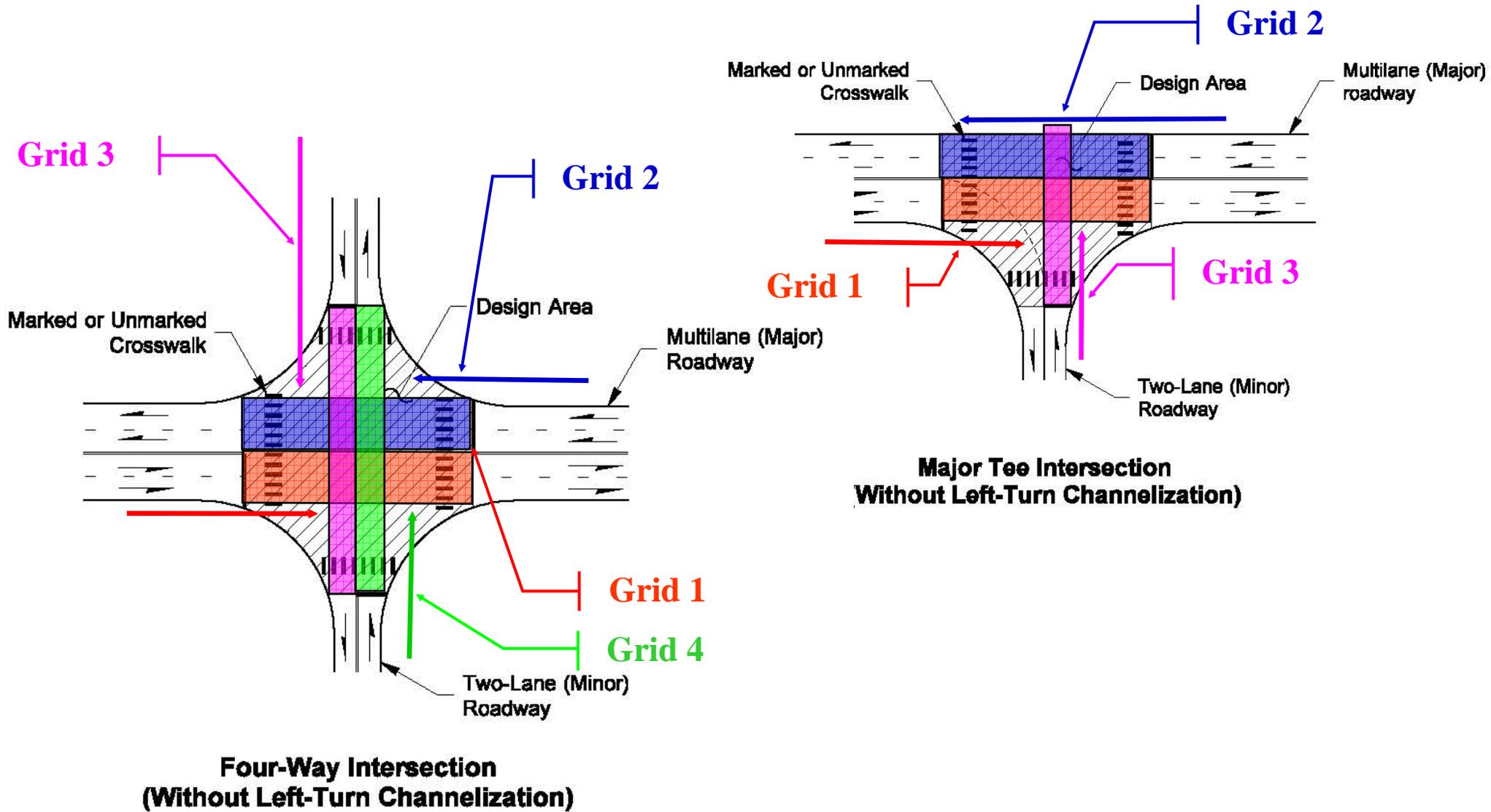
How to place Luminance & Veiling Luminance Grids



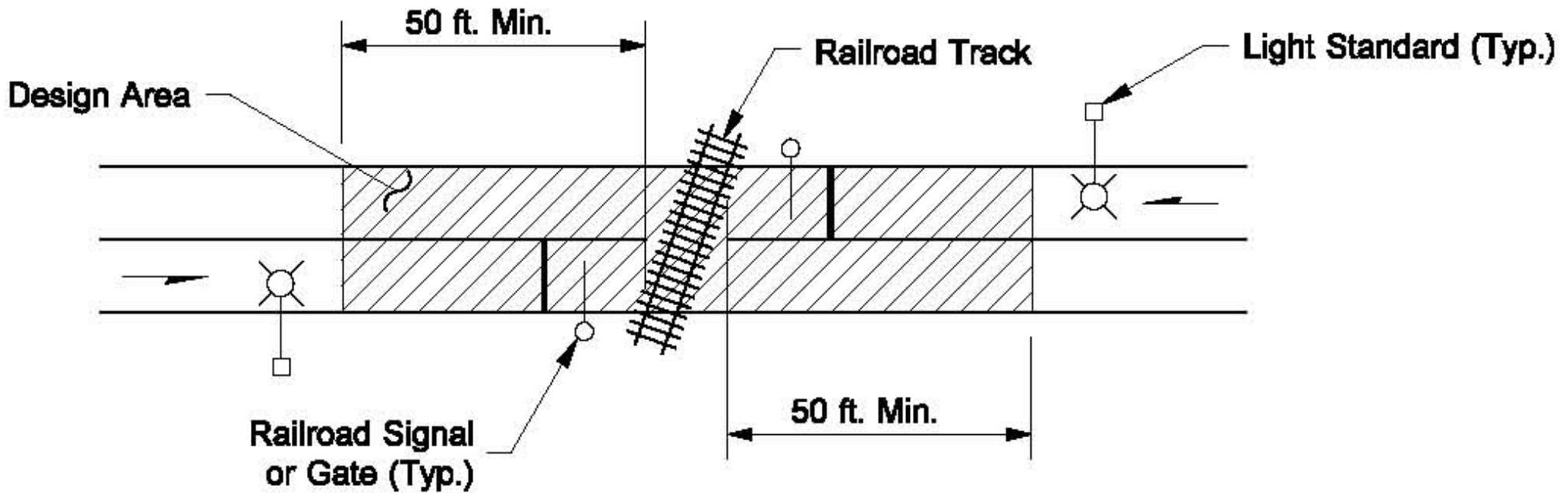
Intersections With Traffic Signals (4)



How to place Luminance & Veiling Luminance Grids

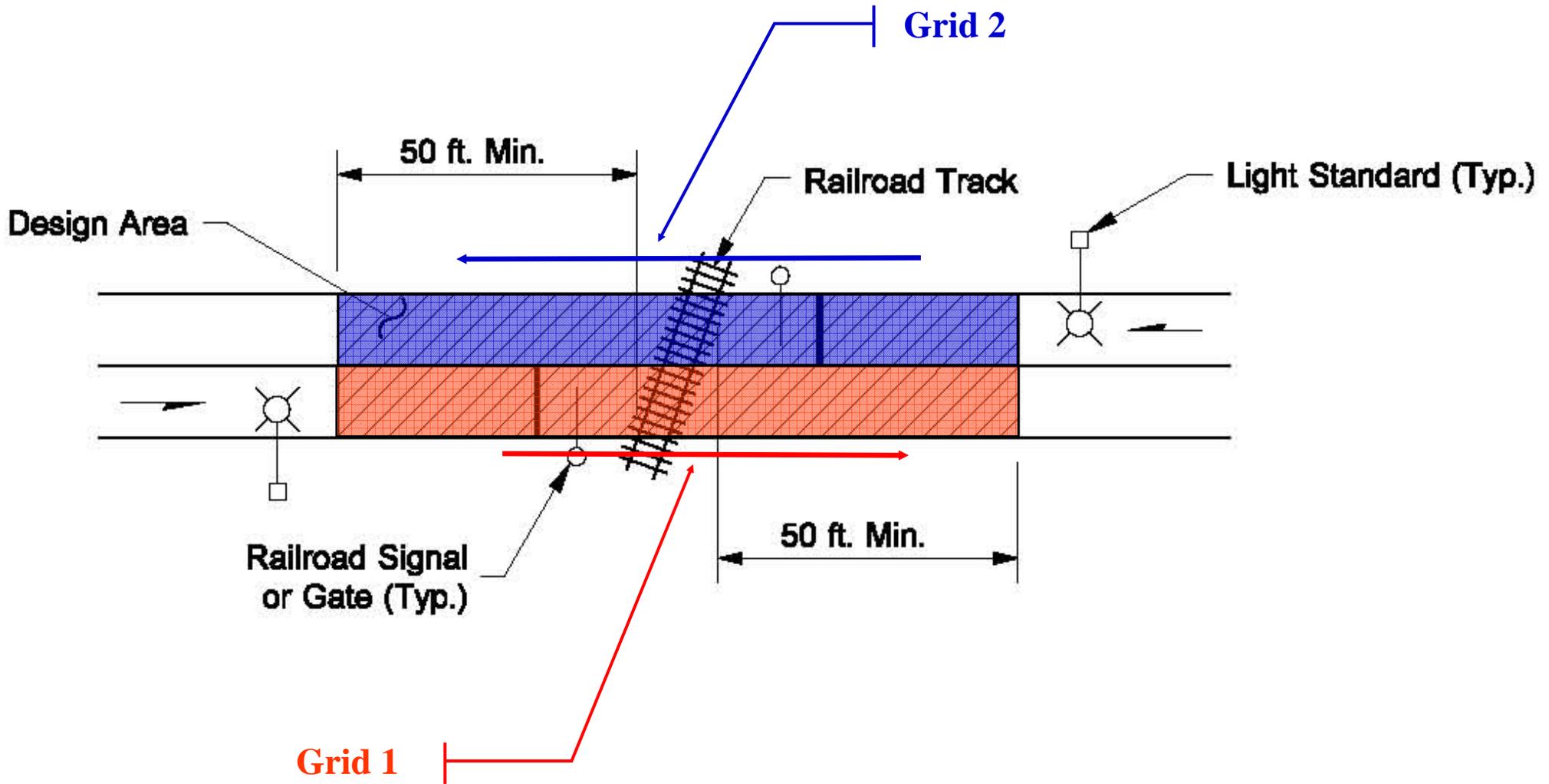


Railroad Crossings With Gates or Signals (5)

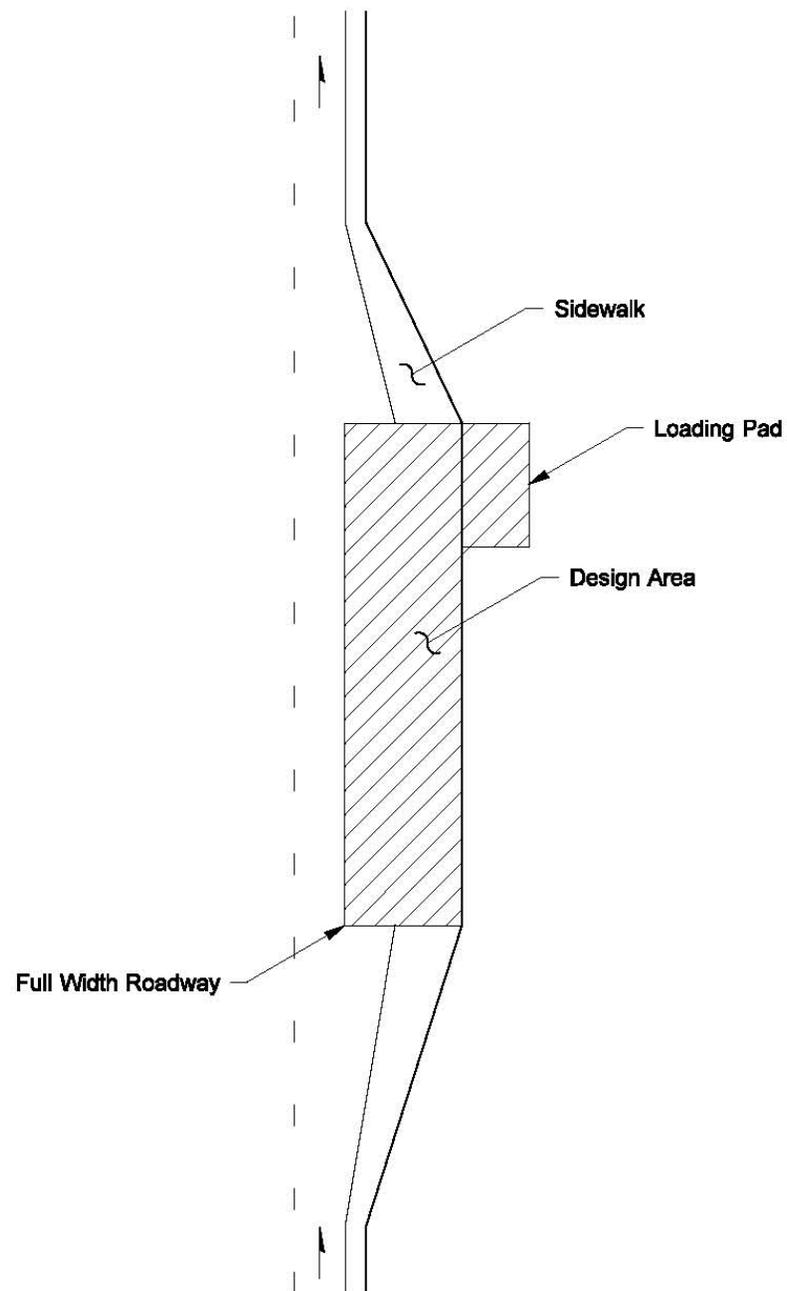


Note: Luminaires are shown in specific locations, and should be installed on the side of road as detailed here.

How to place Luminance & Veiling Luminance Grids

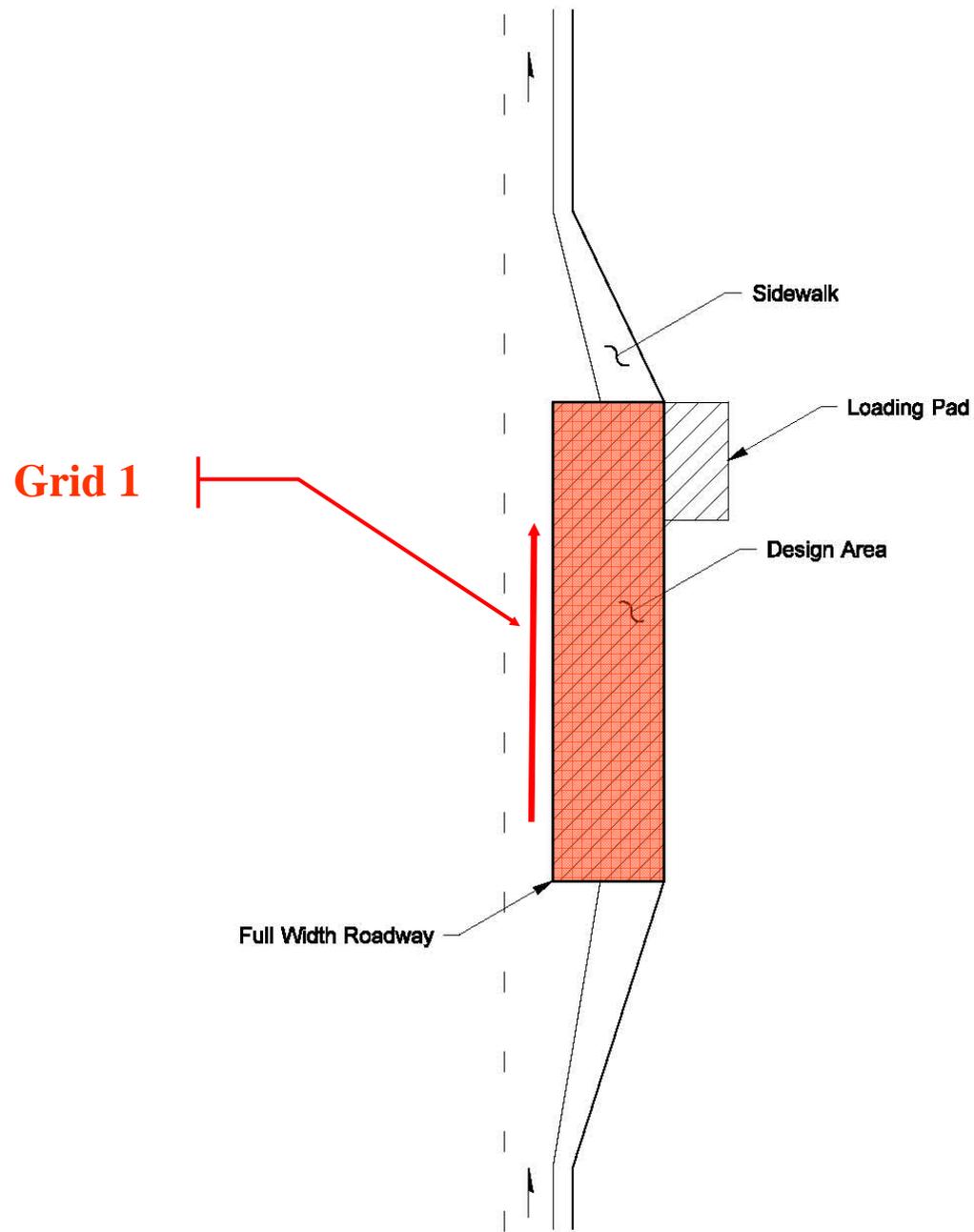


Transit Flyer Stop (6)

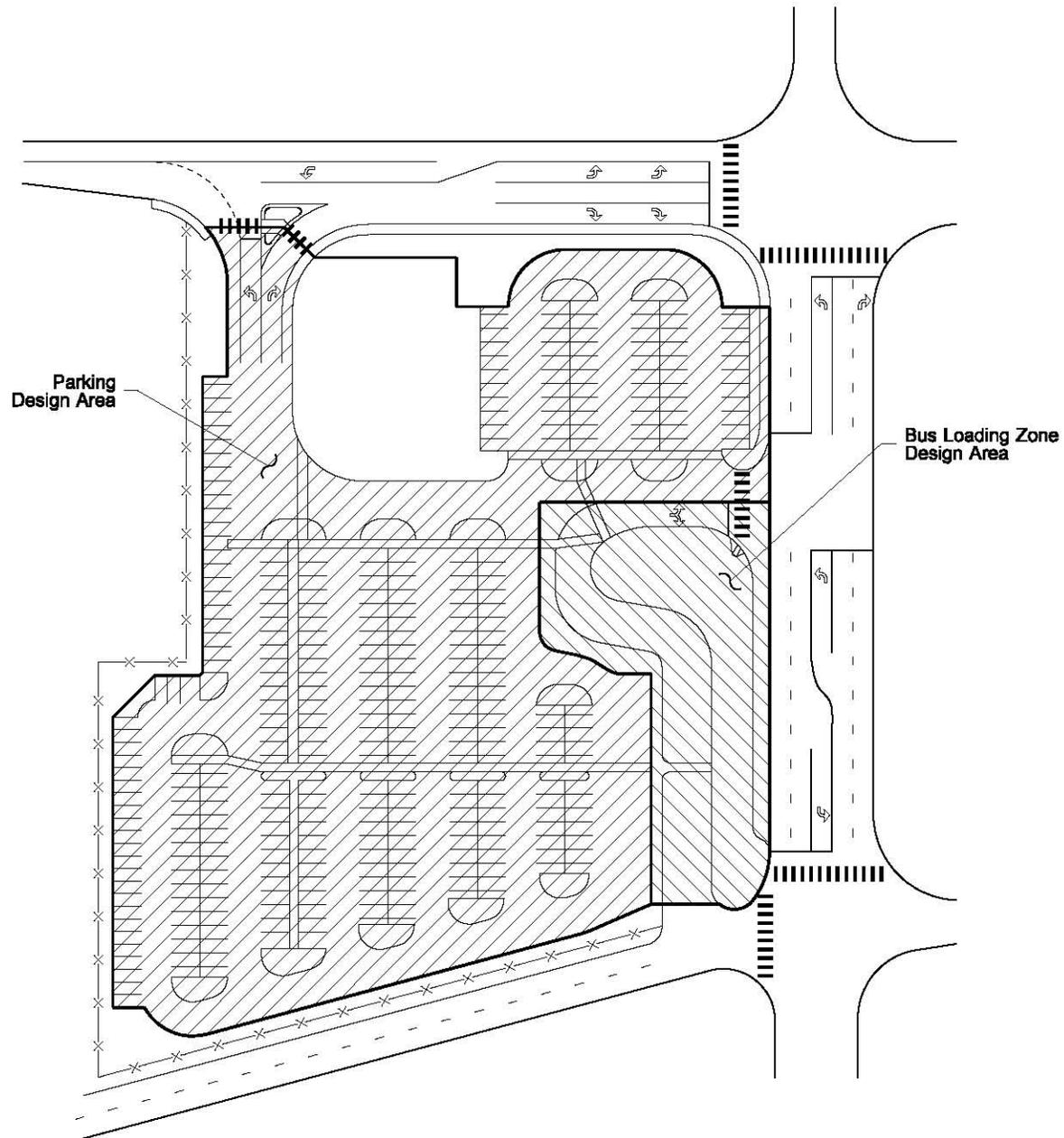


RI(6) DM 840-3 & figure DM 840-6

How to place Luminance & Veiling Luminance Grids

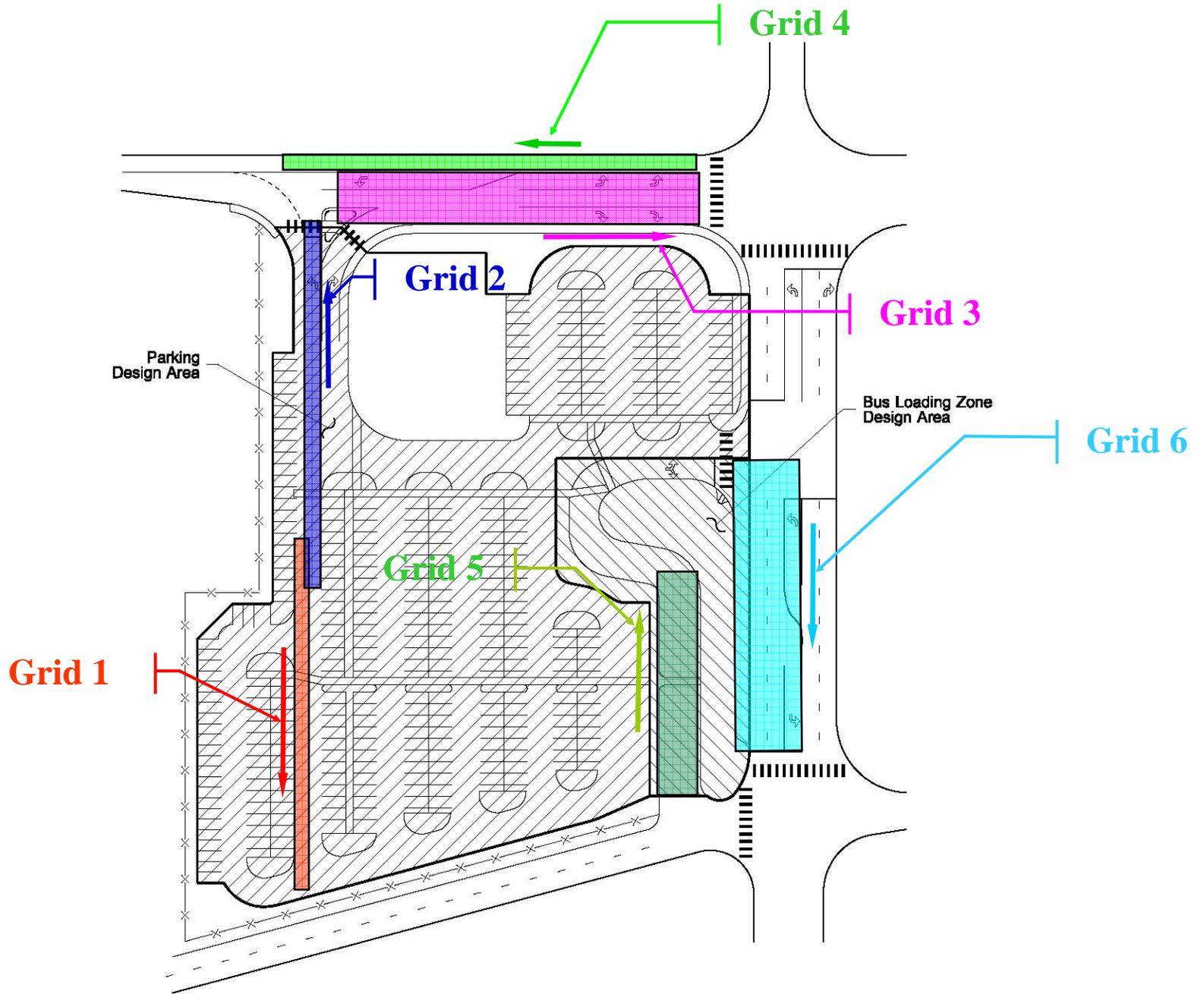


Major Parking Lot (7)

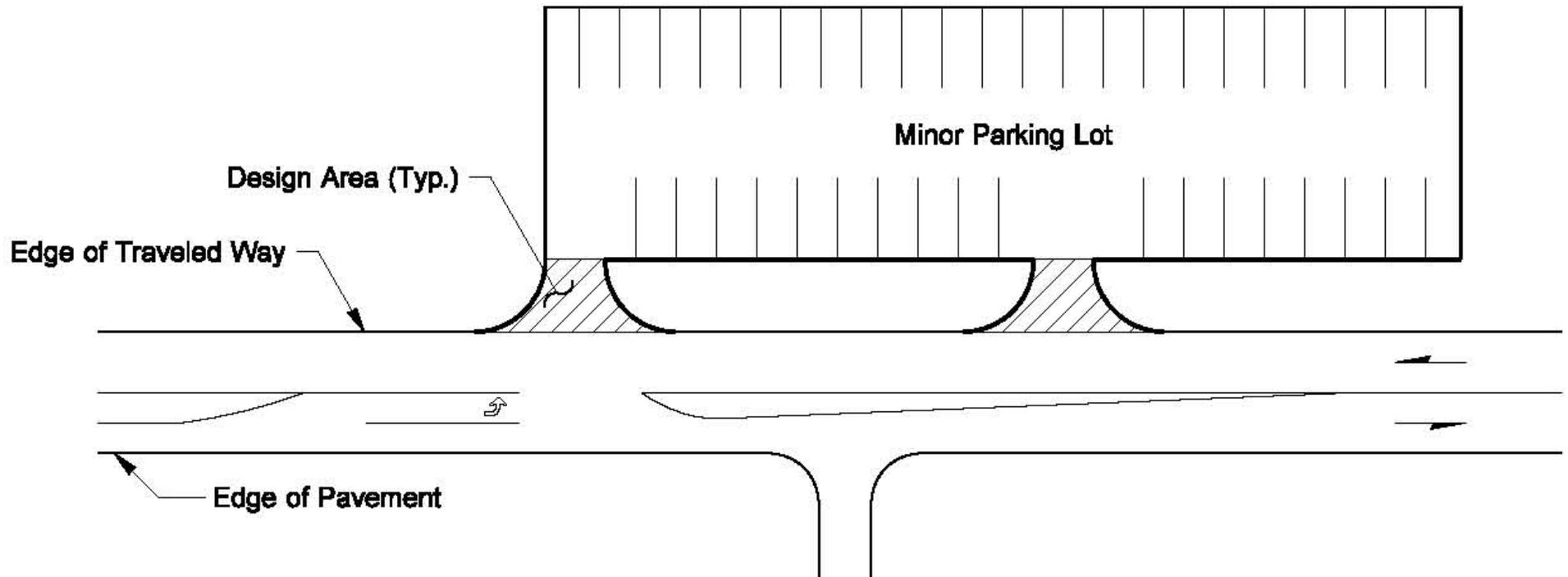


RI(7) DM 840-3, Figure 840-7

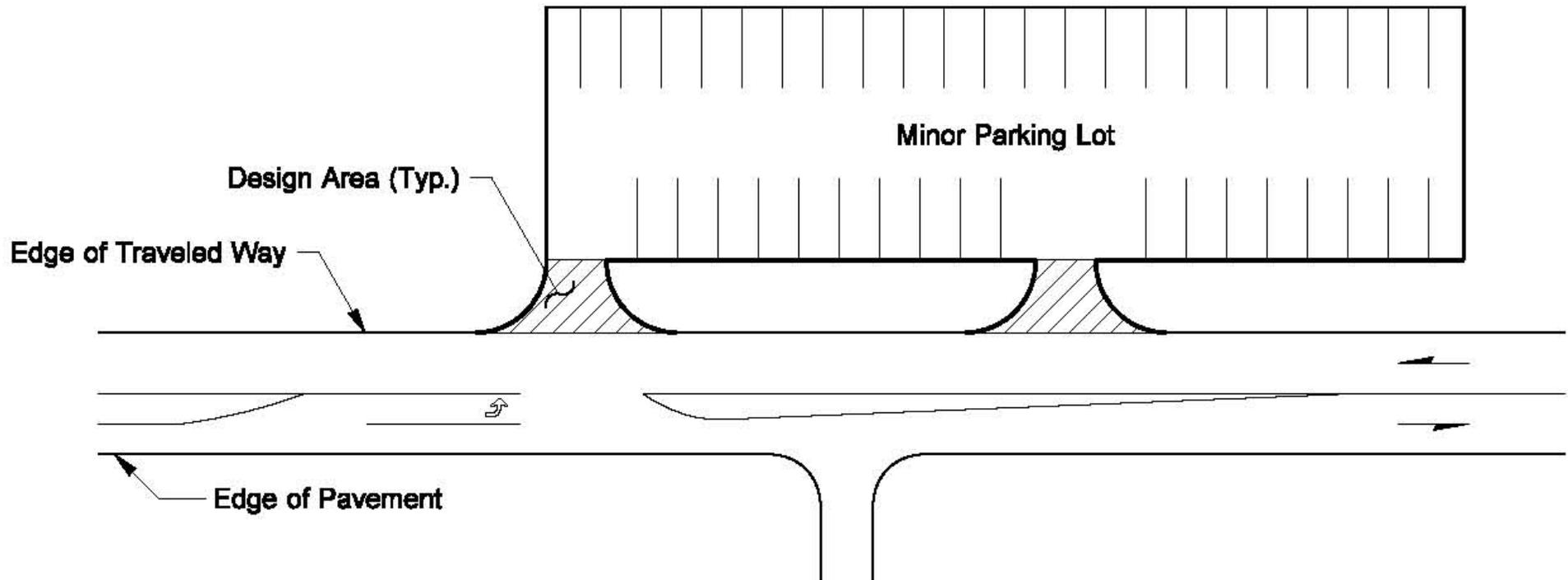
How to place Luminance & Veiling Luminance Grids



Minor Parking Lot (8)

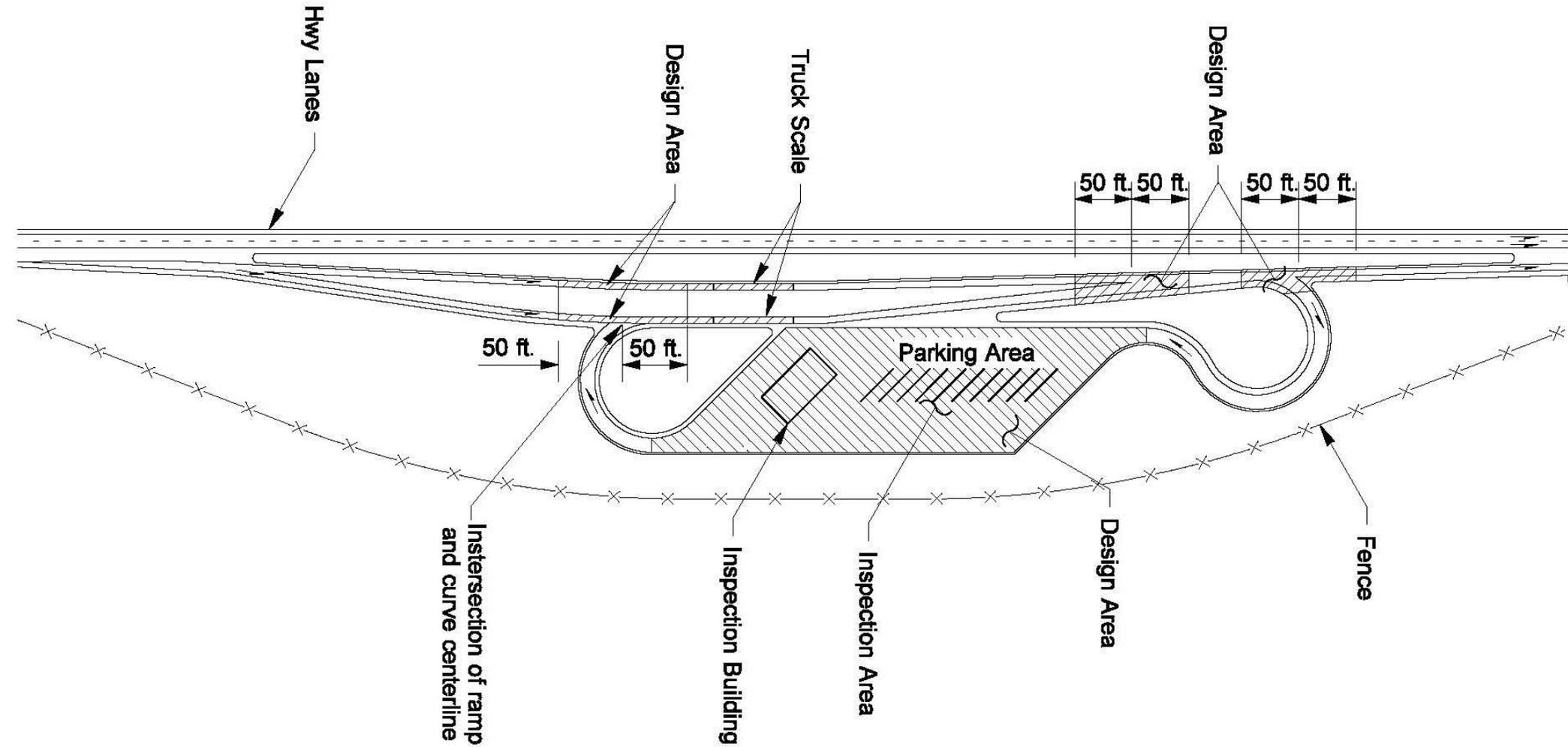


How to place Luminance & Veiling Luminance Grids



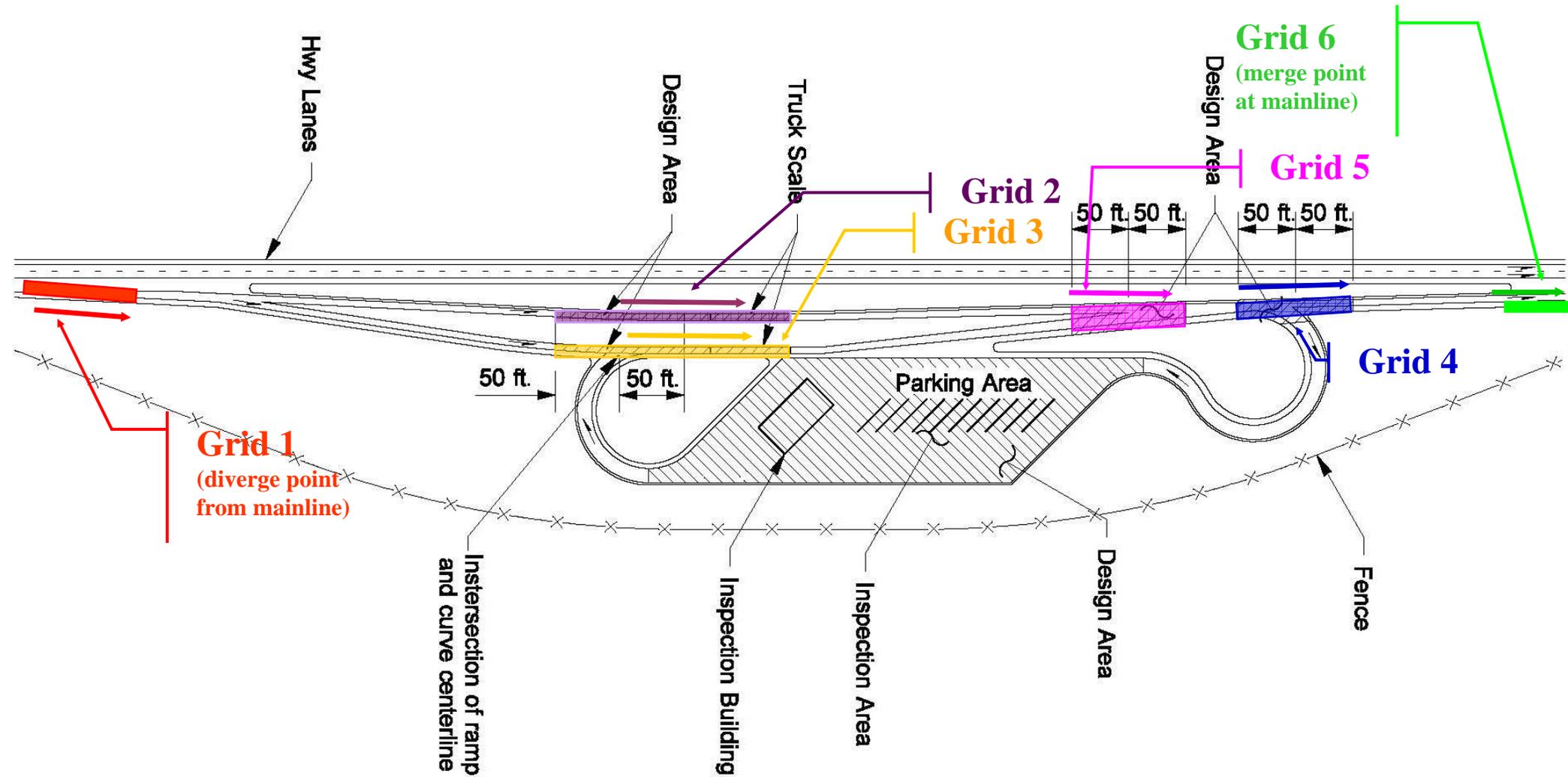
None required

Truck Weigh Sites (9)

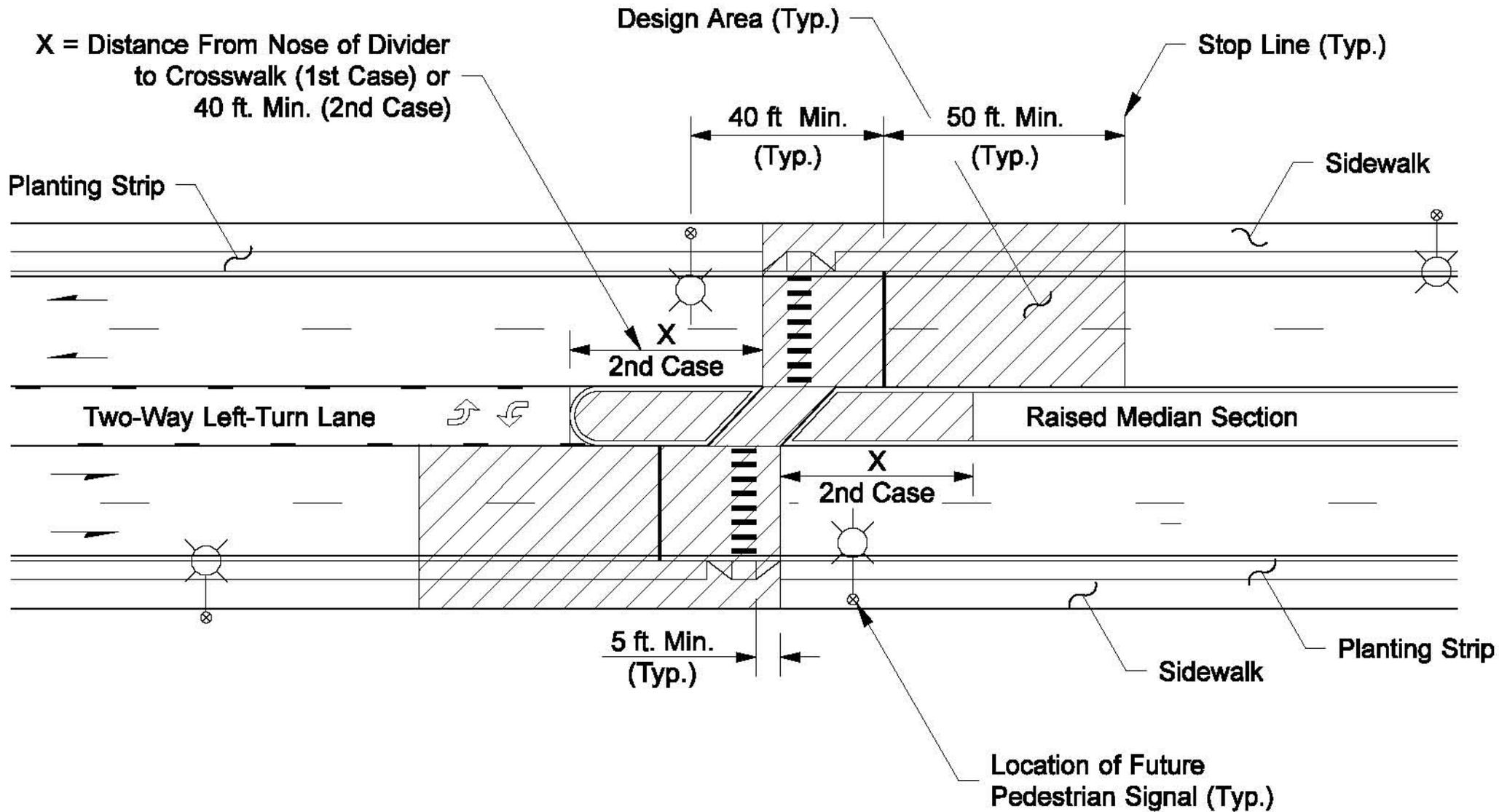


RI(9) DM 840-5, Figure 840-9

How to place Luminance & Veiling Luminance Grids

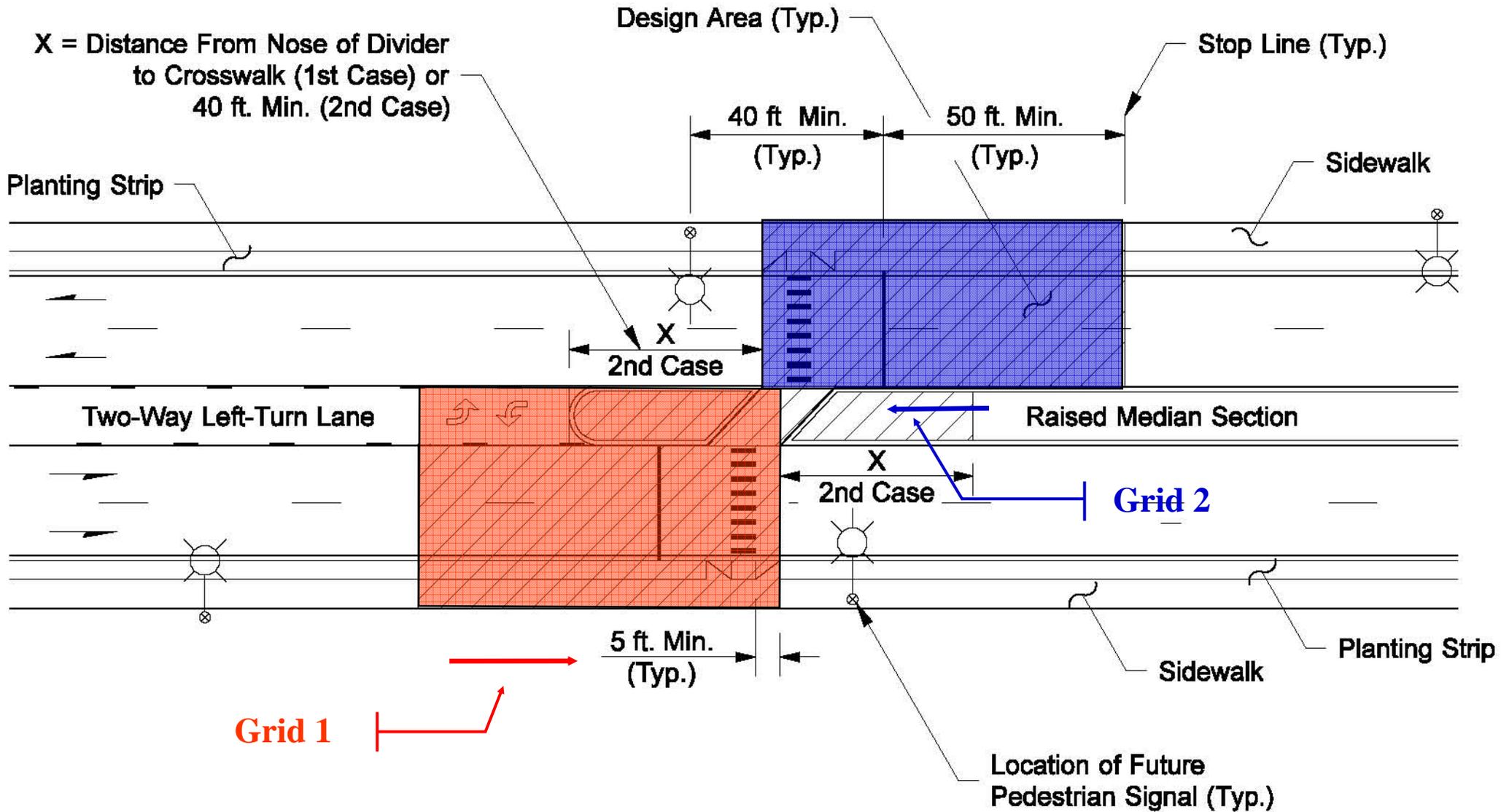


Midblock Pedestrian Crossing (10)

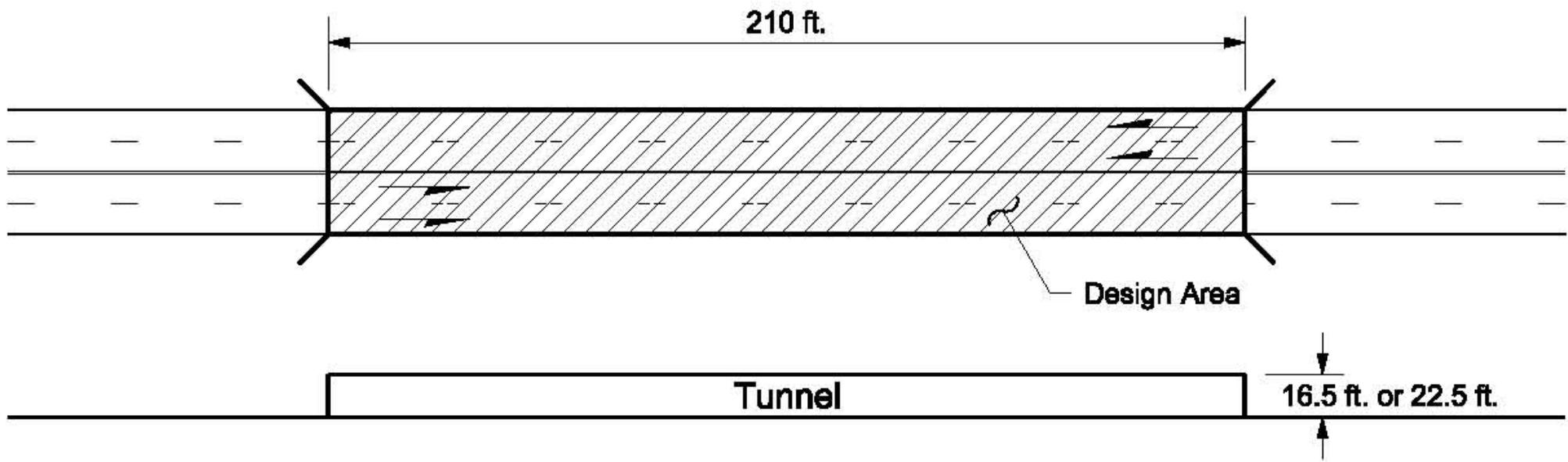


Design area encompasses midblock crossing with raised median pedestrian refuge, and the crossing is not within the limits of a continuously illuminated roadway.

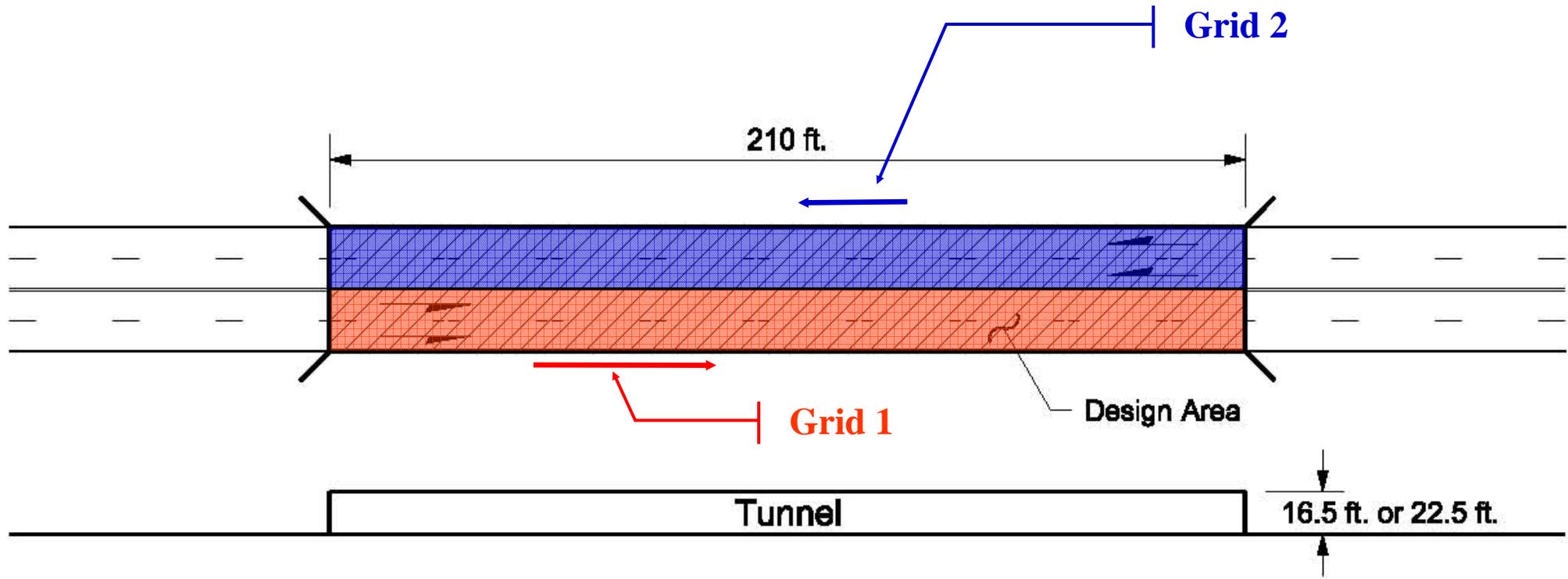
How to place Luminance & Veiling Luminance Grids



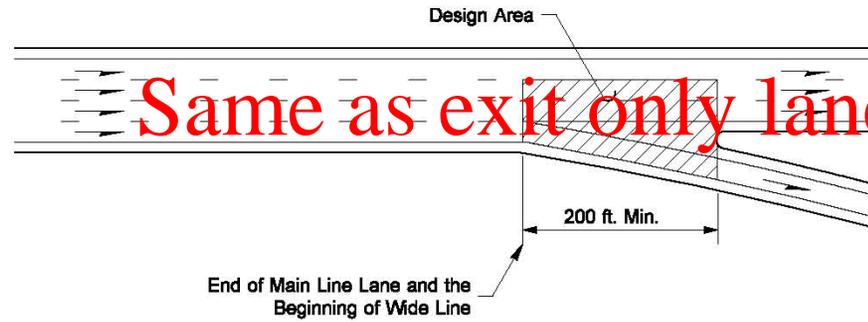
Long Tunnel (11)



How to place Luminance & Veiling Luminance Grids

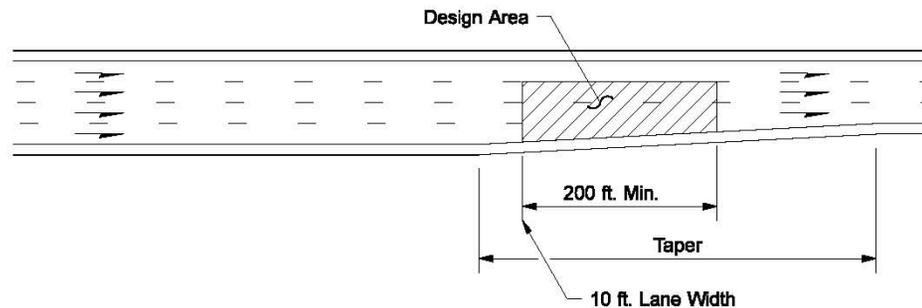


Lane Reduction (12)



Same as exit only lane – slide 17

Main Line Lane Reduction
(The Design Area Can Be Shifted up to 100 Feet From the End of Lane and the Beginning of Wide Line)

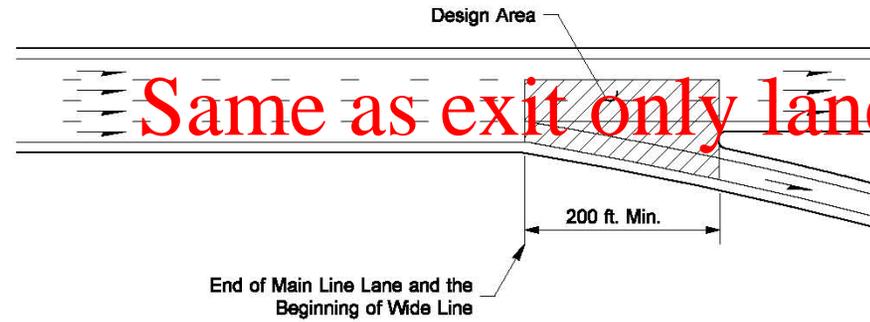


Lane Reduction

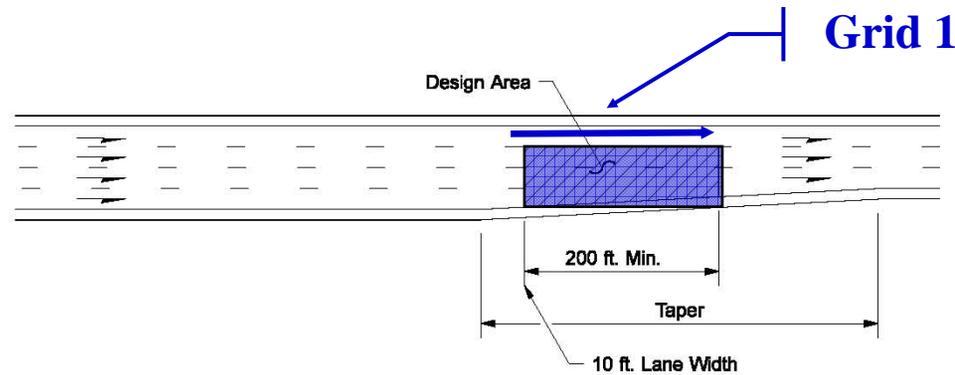
Lane Reductions

Figure 840-12

How to place Luminance & Veiling Luminance Grids



Main Line Lane Reduction
(The Design Area Can Be Shifted up to 100 Feet From the End of Lane and the Beginning of Wide Line)

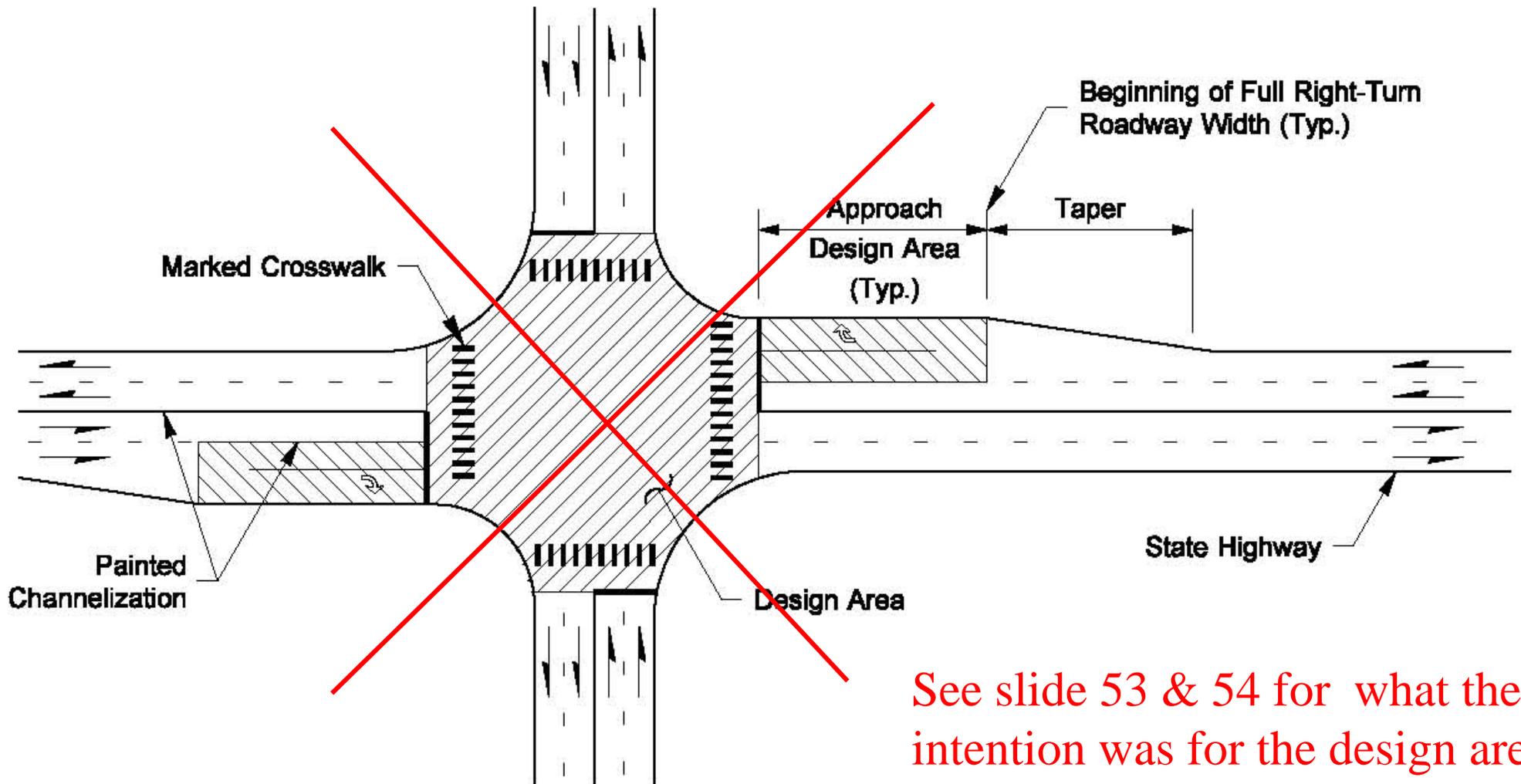


Lane Reduction

Lane Reductions

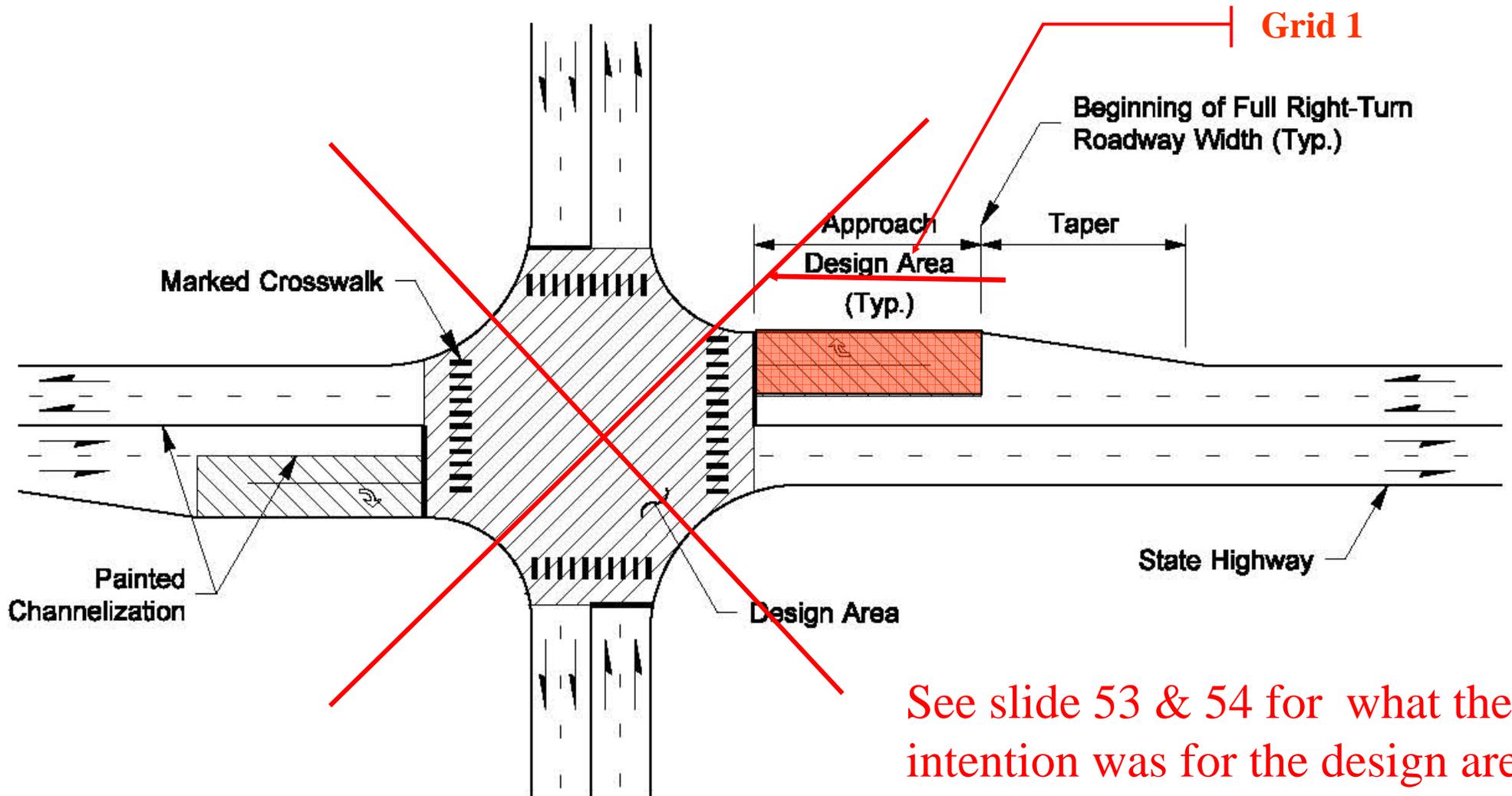
Figure 840-12

Intersection with Right Turn channelization (13)



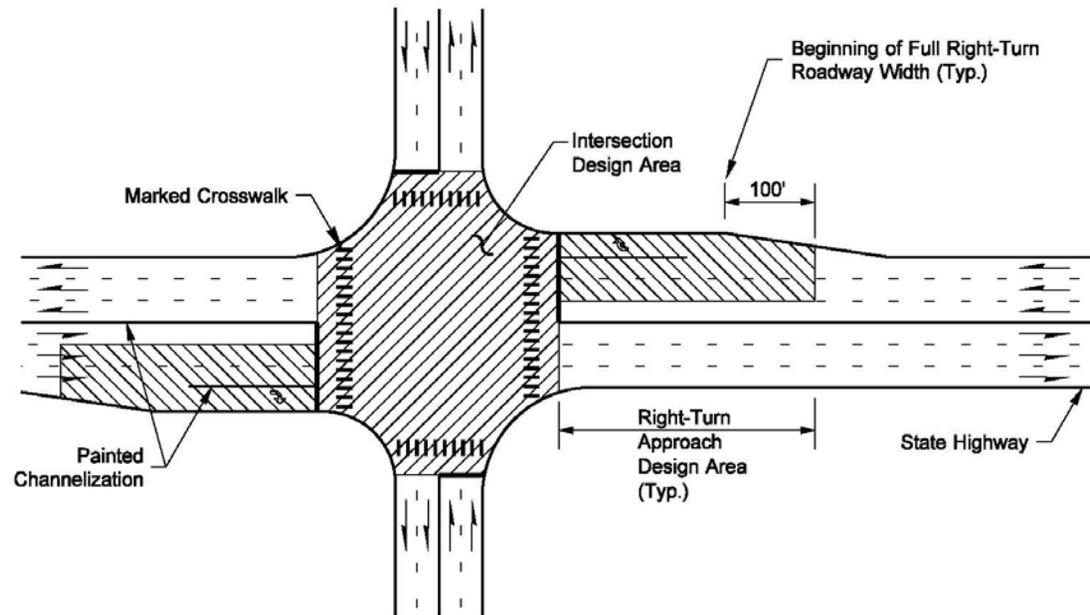
See slide 53 & 54 for what the intention was for the design area of a right turn lane.

How to place Luminance & Veiling Luminance Grids



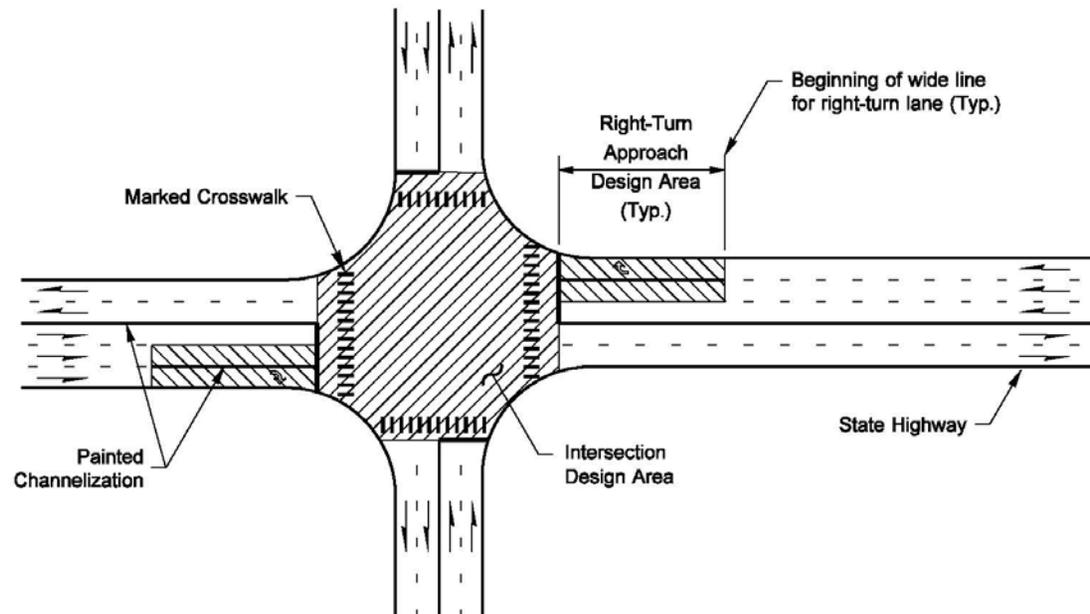
See slide 53 & 54 for what the intention was for the design area of a right turn lane.

Intersection with Right Turn channelization (13)



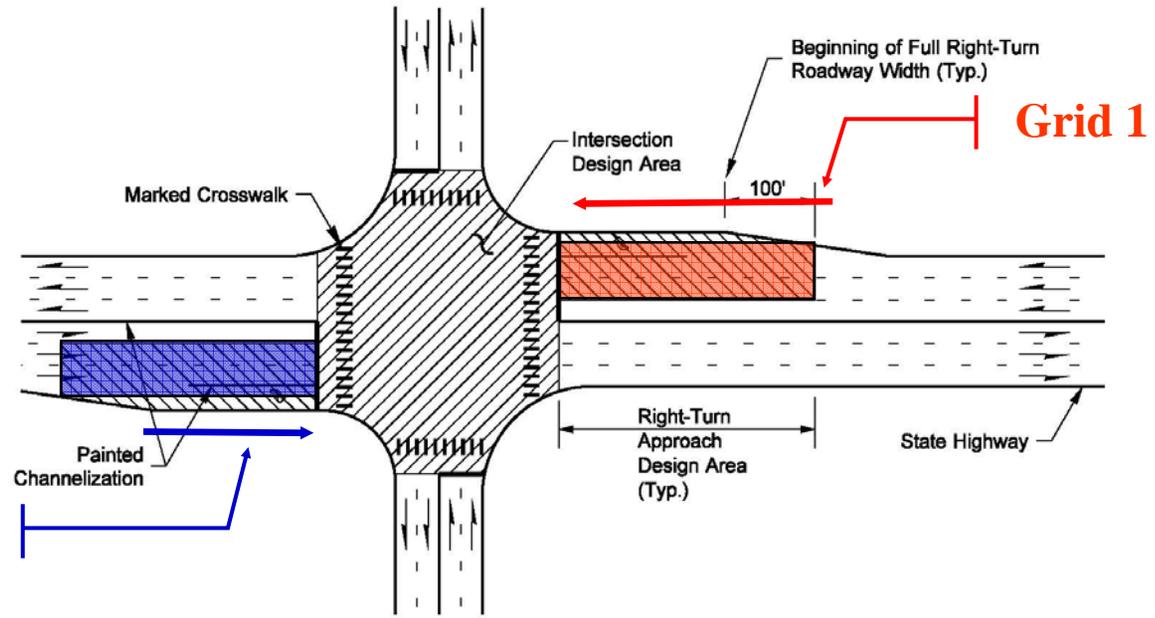
Intersection With Right-Turn Lane Channelization

Figure 840-13



How to place Luminance & Veiling Luminance Grids

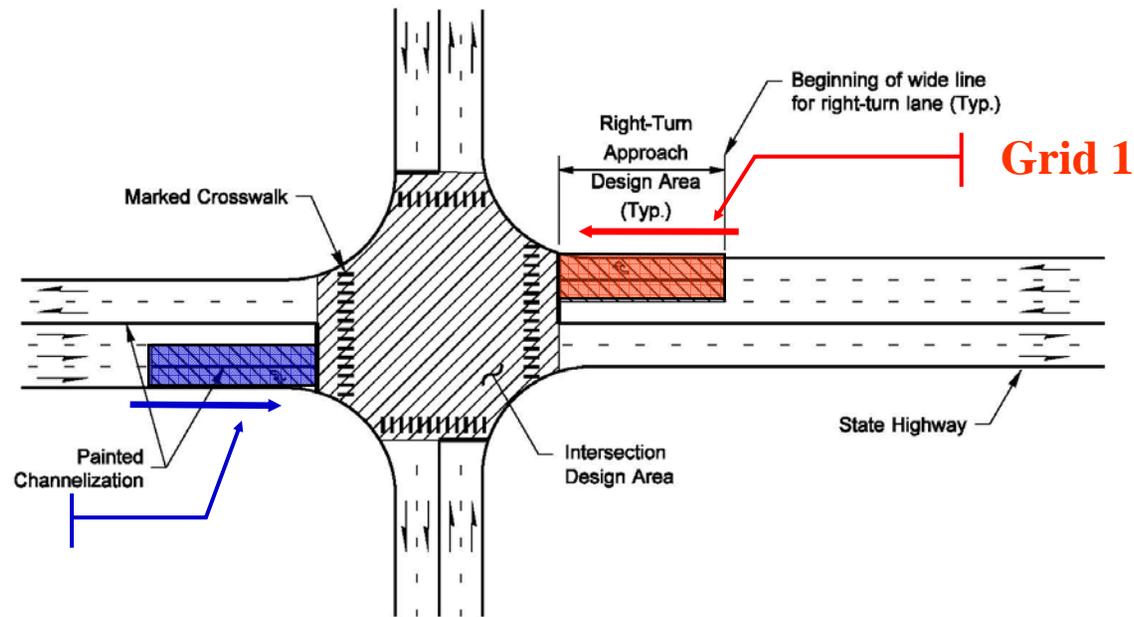
Grid 2



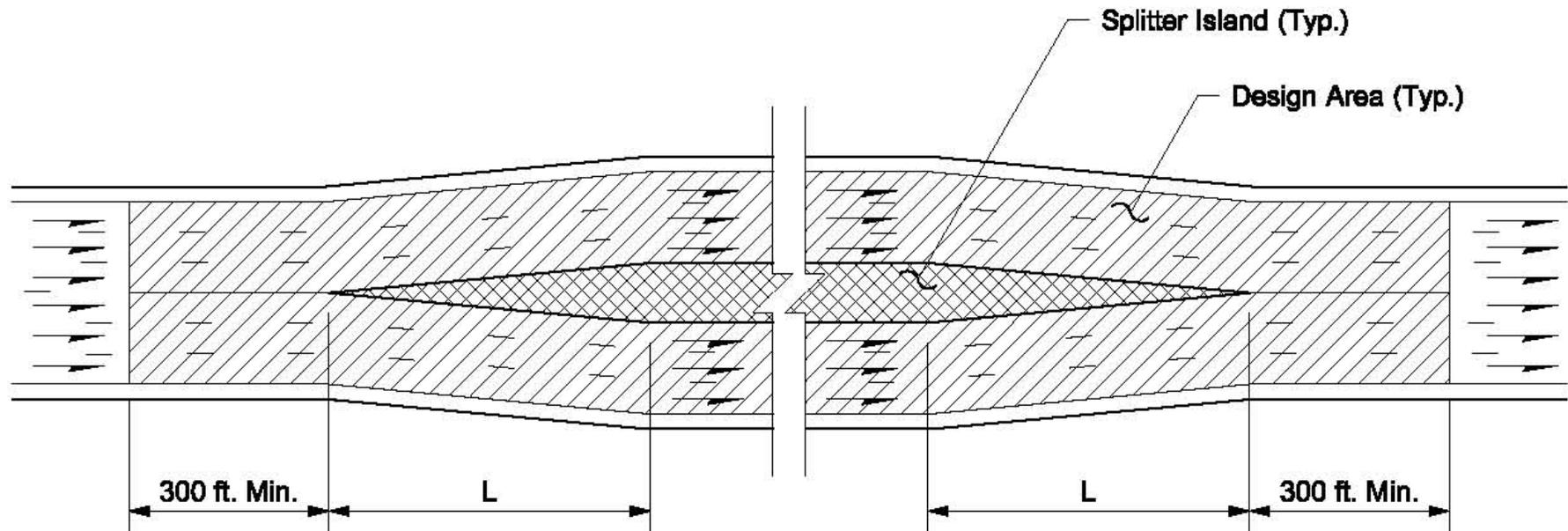
Intersection With Right-Turn Lane Channelization

Figure 840-13

Grid 2



Same direction traffic split around an obstruction (14)



For speeds 45 mph or more: $L = WS$

For speeds less than 45 mph: $L = WS/60$

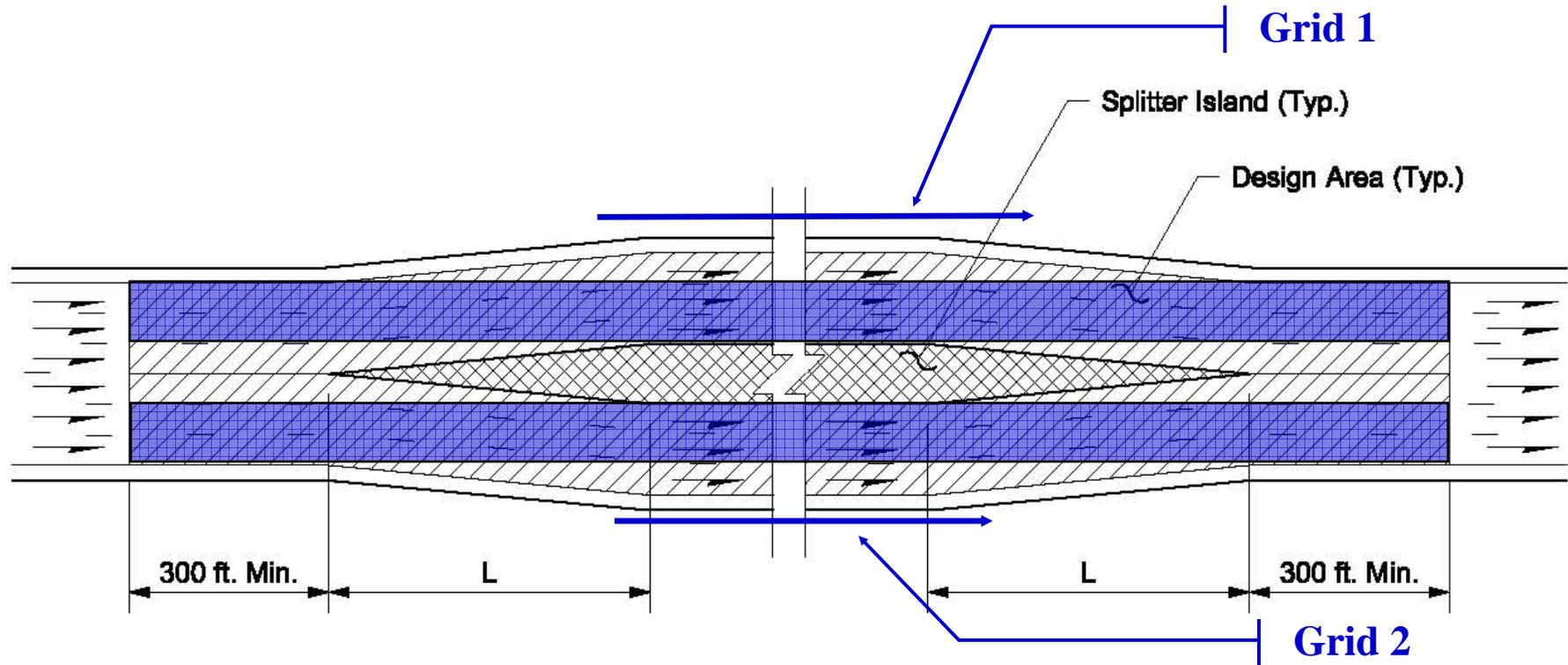
L = Taper length in feet

W = Width of offset in feet

S = Posted speed

For temporary Work Zone Plan applications a site-specific Traffic Control Plan is required. Refer to Chapters 710 and 720 for traffic barrier and attenuator information, Chapter 810 for Work Zone information, and Chapter 820 for signing information.

How to place Luminance & Veiling Luminance Grids



For speeds 45 mph or more: $L = WS$

For speeds less than 45 mph: $L = WS/60$

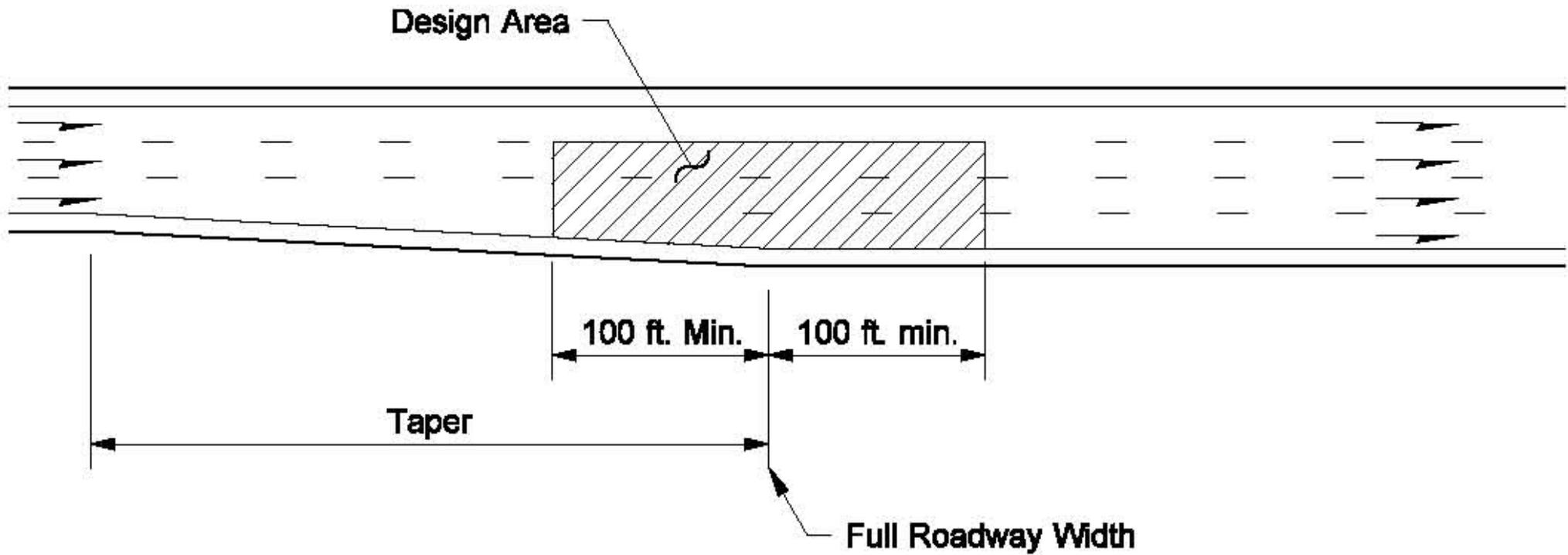
L = Taper length in feet

W = Width of offset in feet

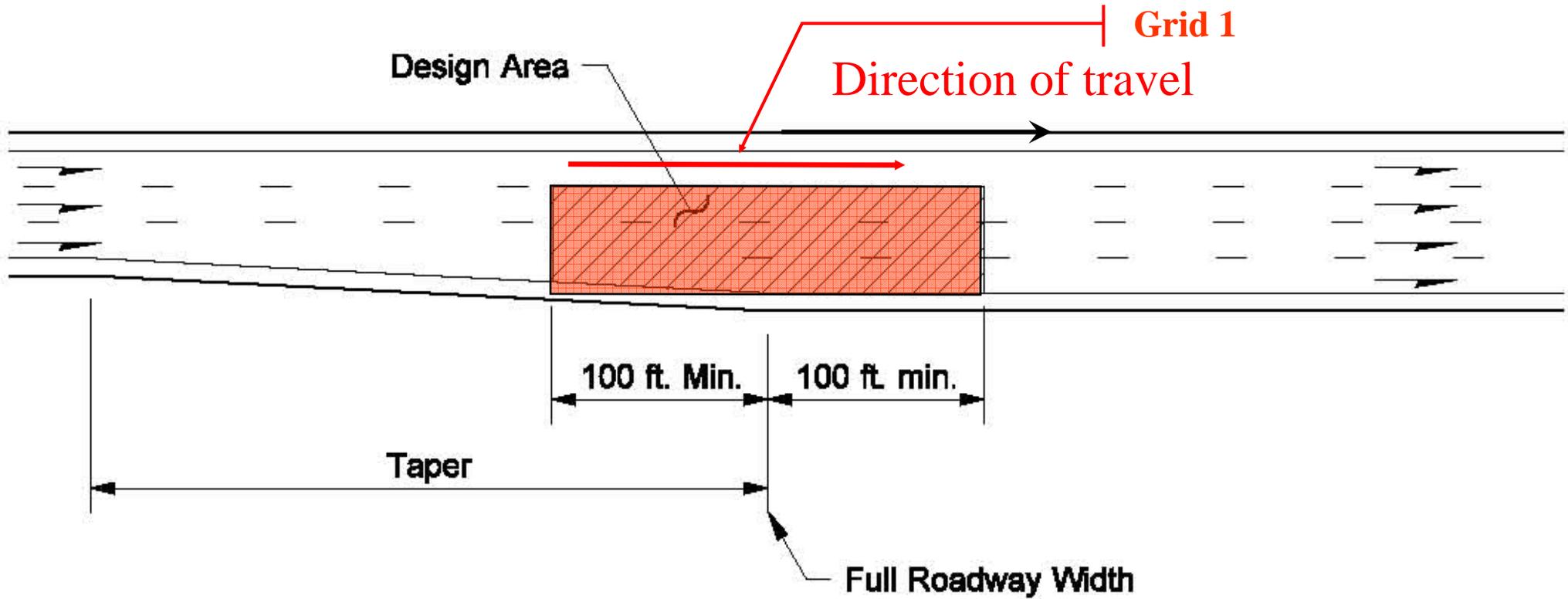
S = Posted speed

For temporary Work Zone Plan applications a site-specific Traffic Control Plan is required. Refer to Chapters 710 and 720 for traffic barrier and attenuator information, Chapter 810 for Work Zone information, and Chapter 820 for signing information.

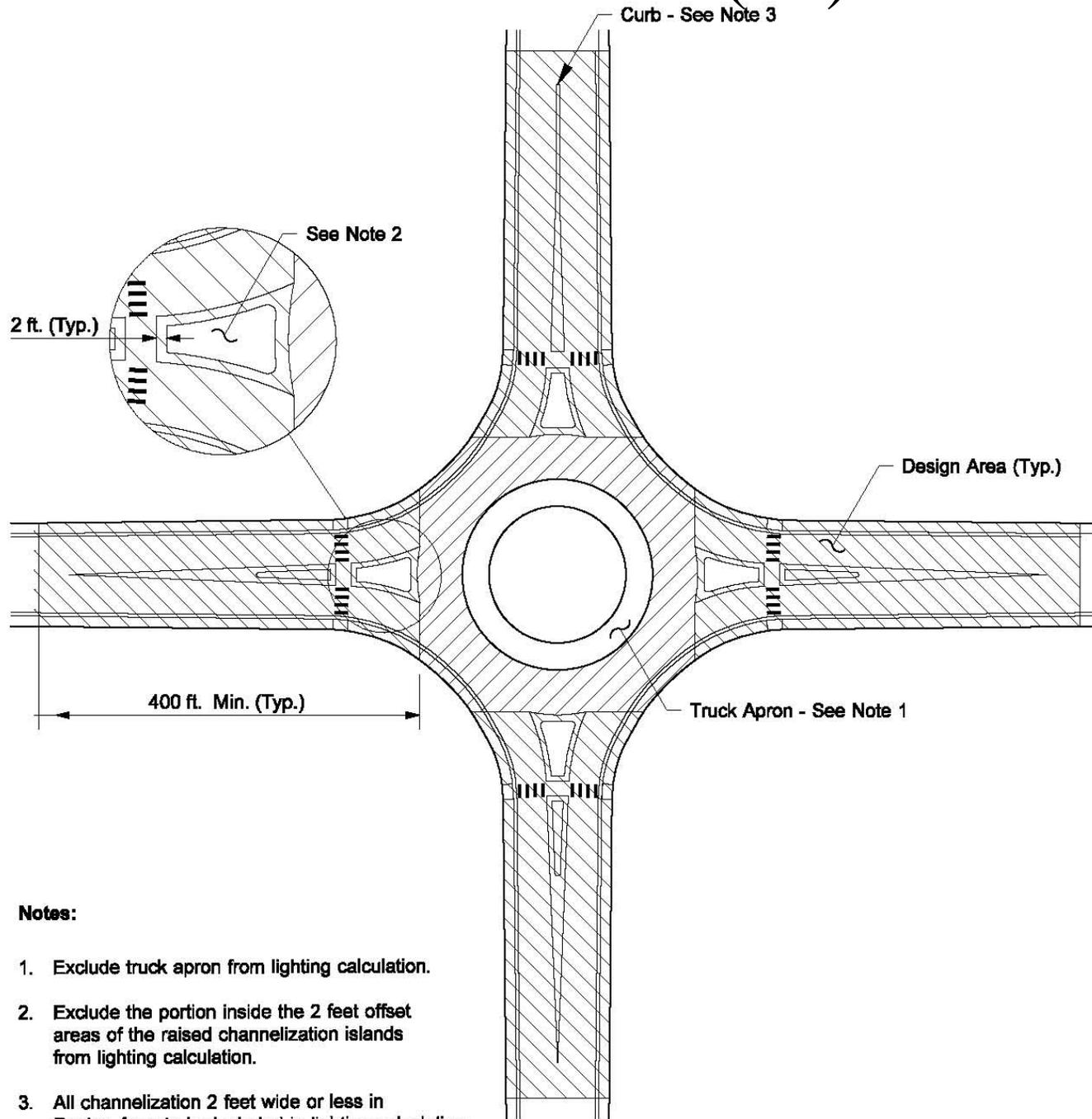
Add Lane channelization (15)



How to place Luminance & Veiling Luminance Grids



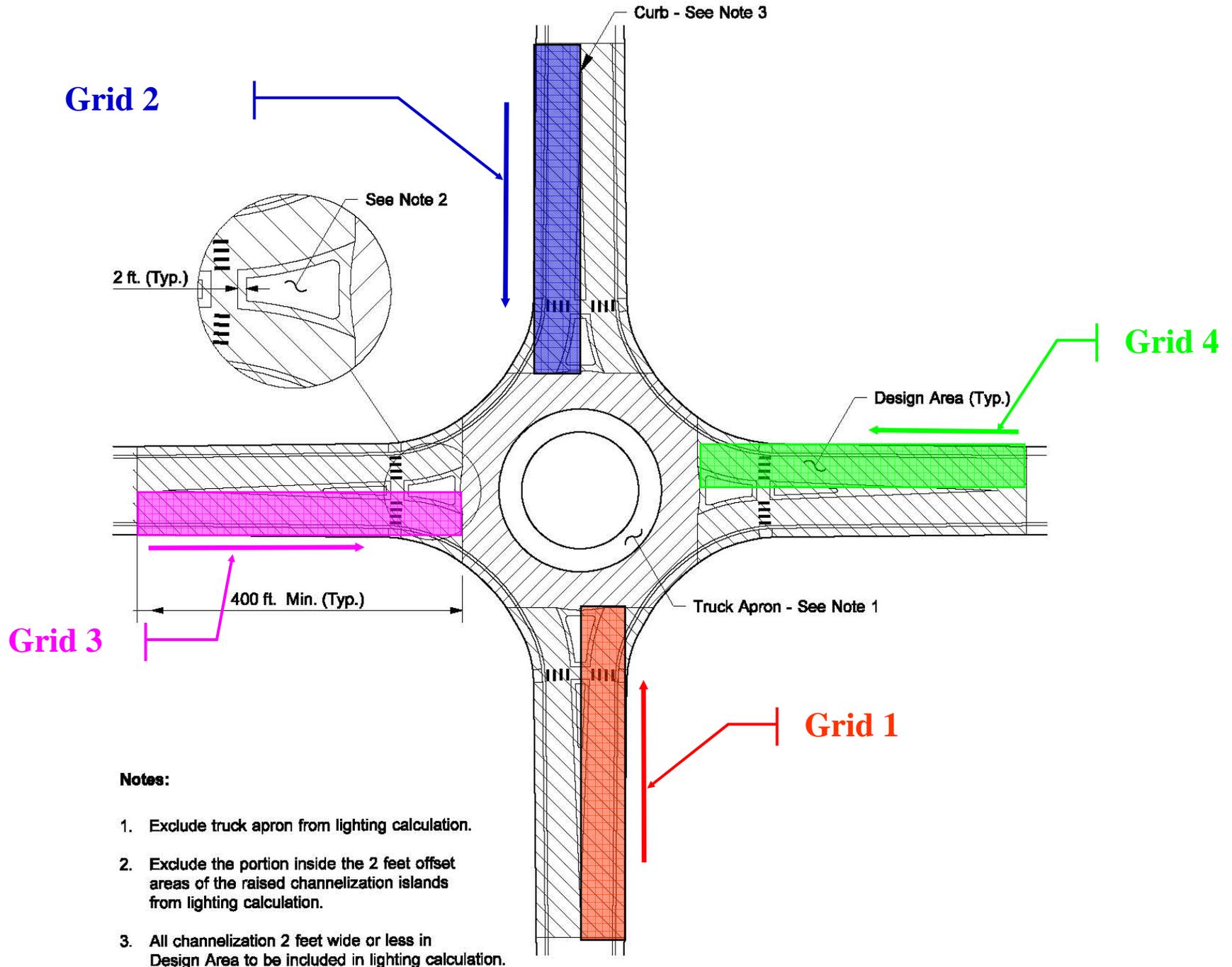
Roundabouts (16)



Notes:

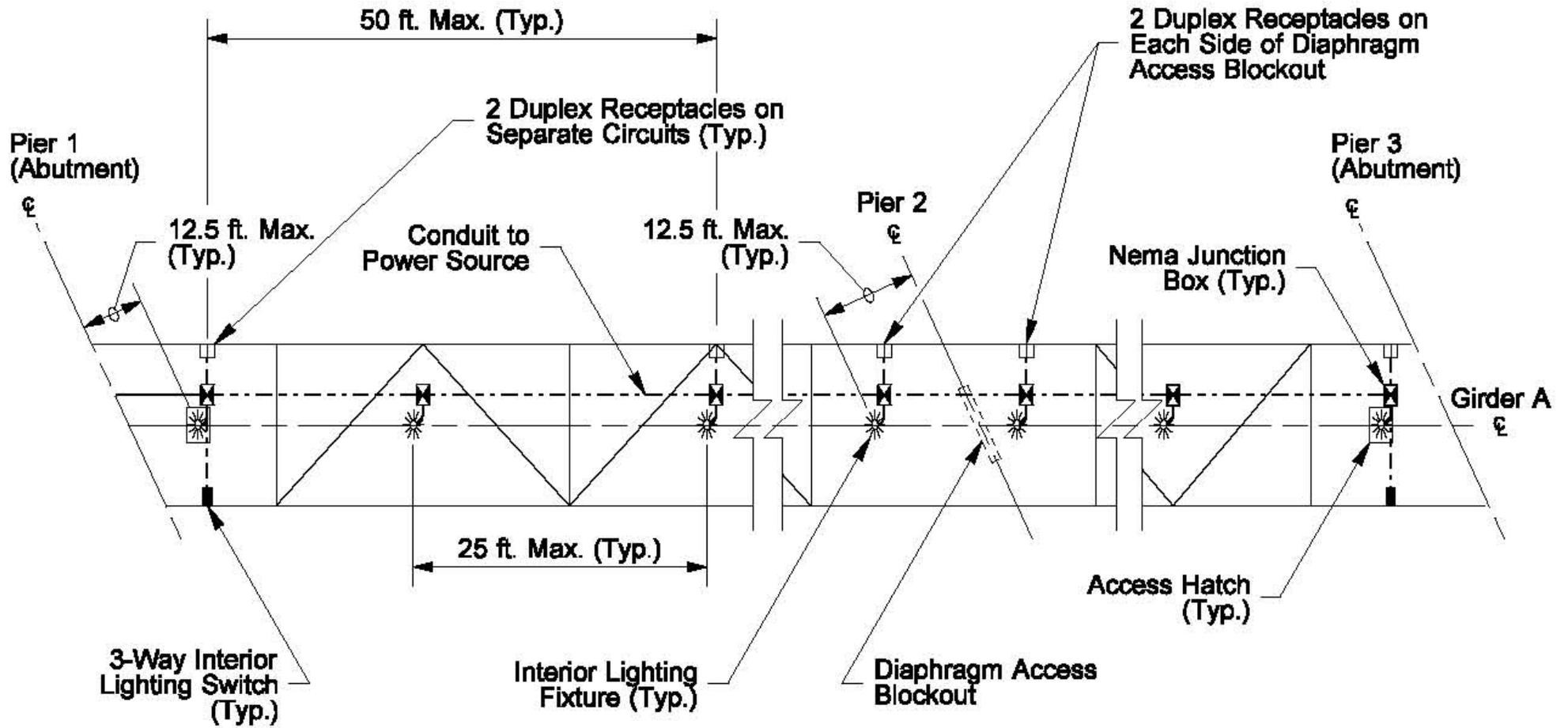
1. Exclude truck apron from lighting calculation.
2. Exclude the portion inside the 2 feet offset areas of the raised channelization islands from lighting calculation.
3. All channelization 2 feet wide or less in Design Area to be included in lighting calculation.

How to place Luminance & Veiling Luminance Grids



RI(16) 840-6 figure 840-16

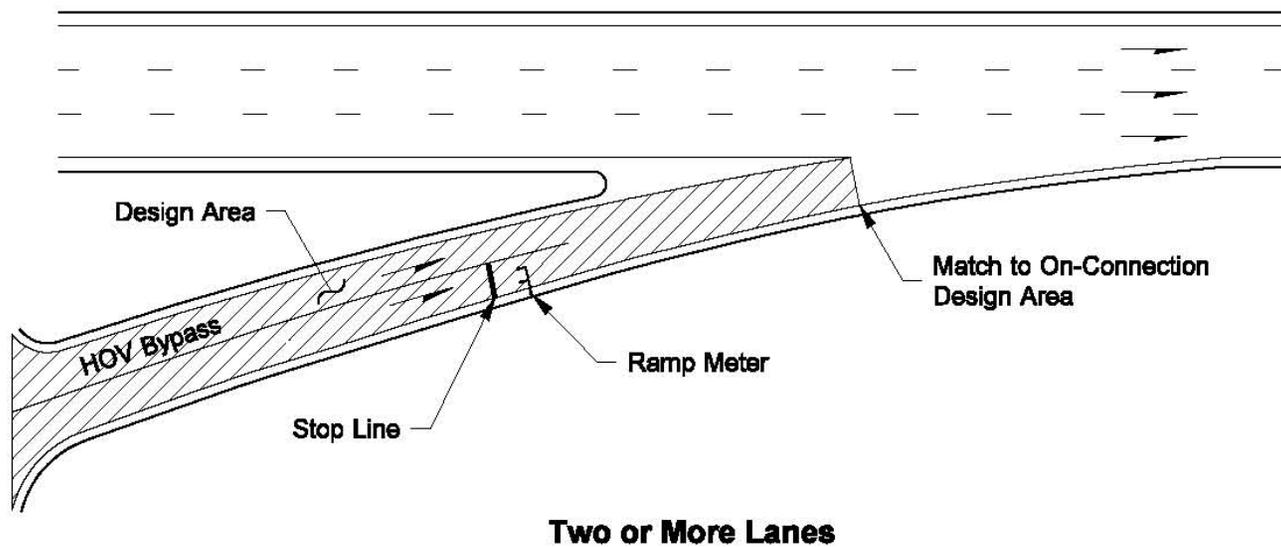
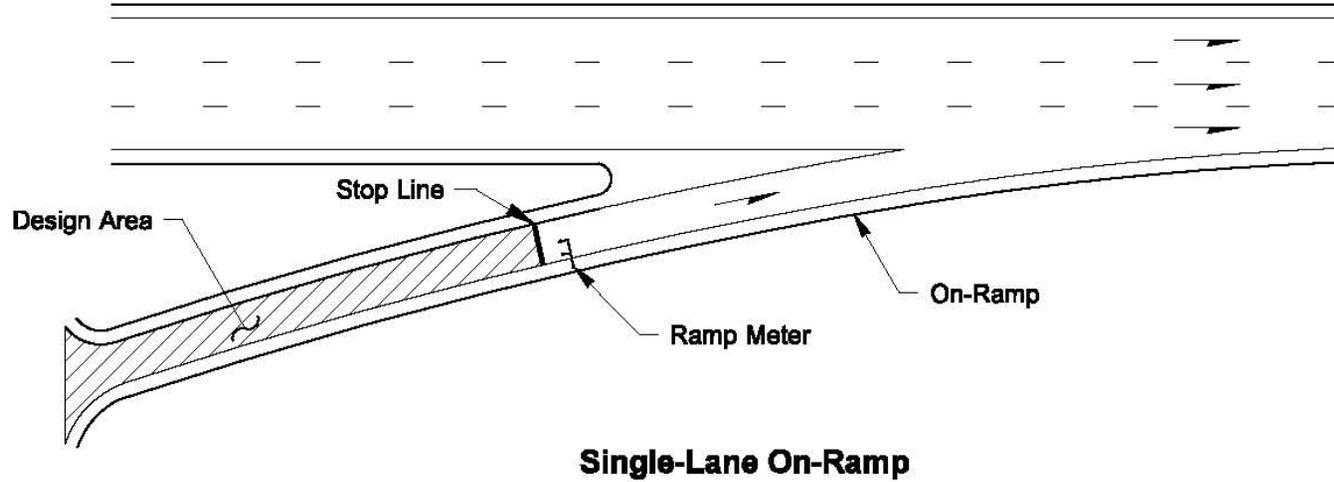
Bridge Inspection Lighting (17)



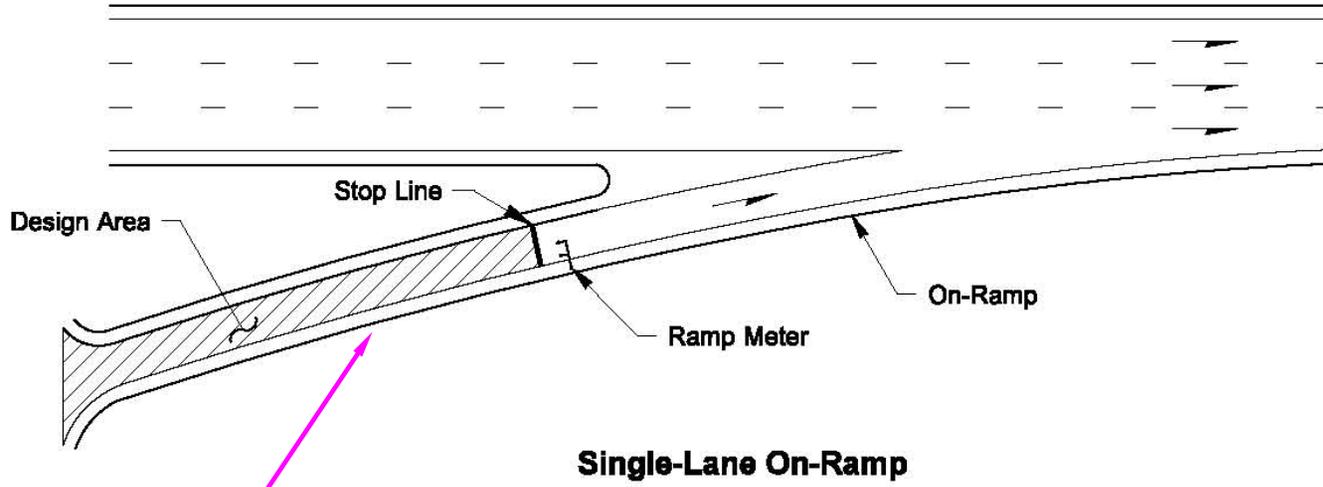
RI(17) 840-6 figure 840-17

Blank Page

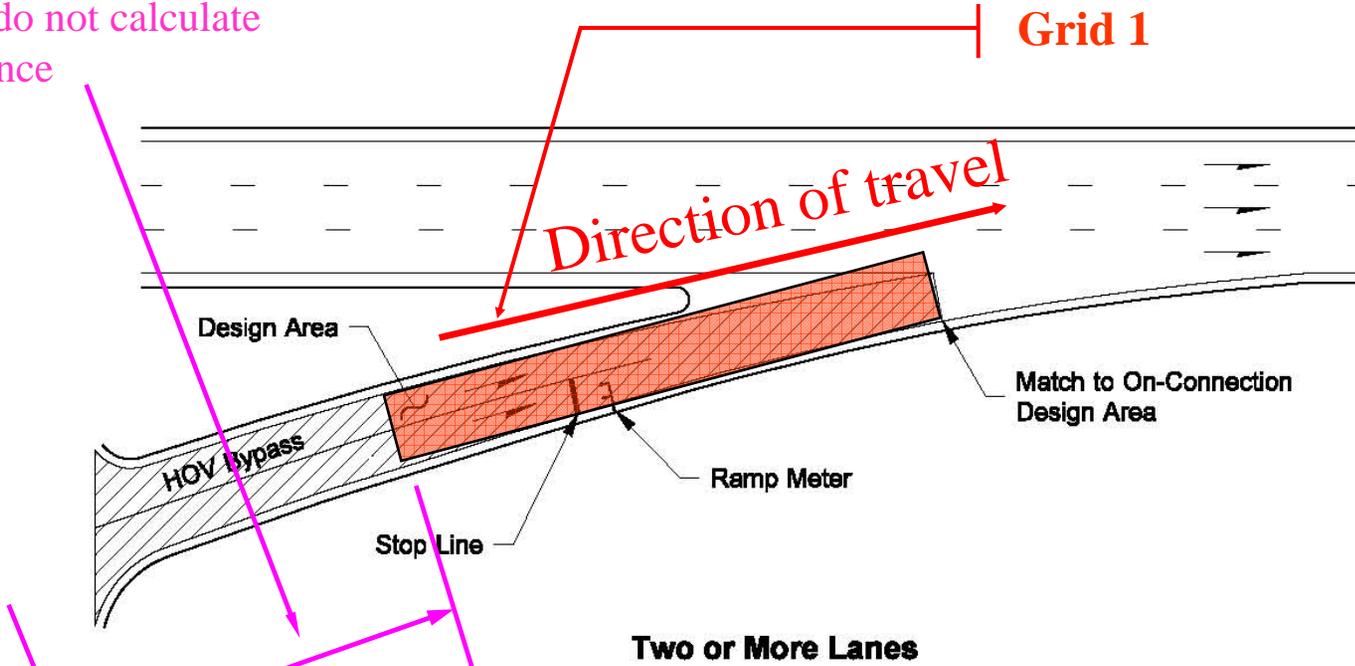
Freeway On-Ramps with ramp Meter Signals (18)



How to place Luminance & Veiling Luminance Grids



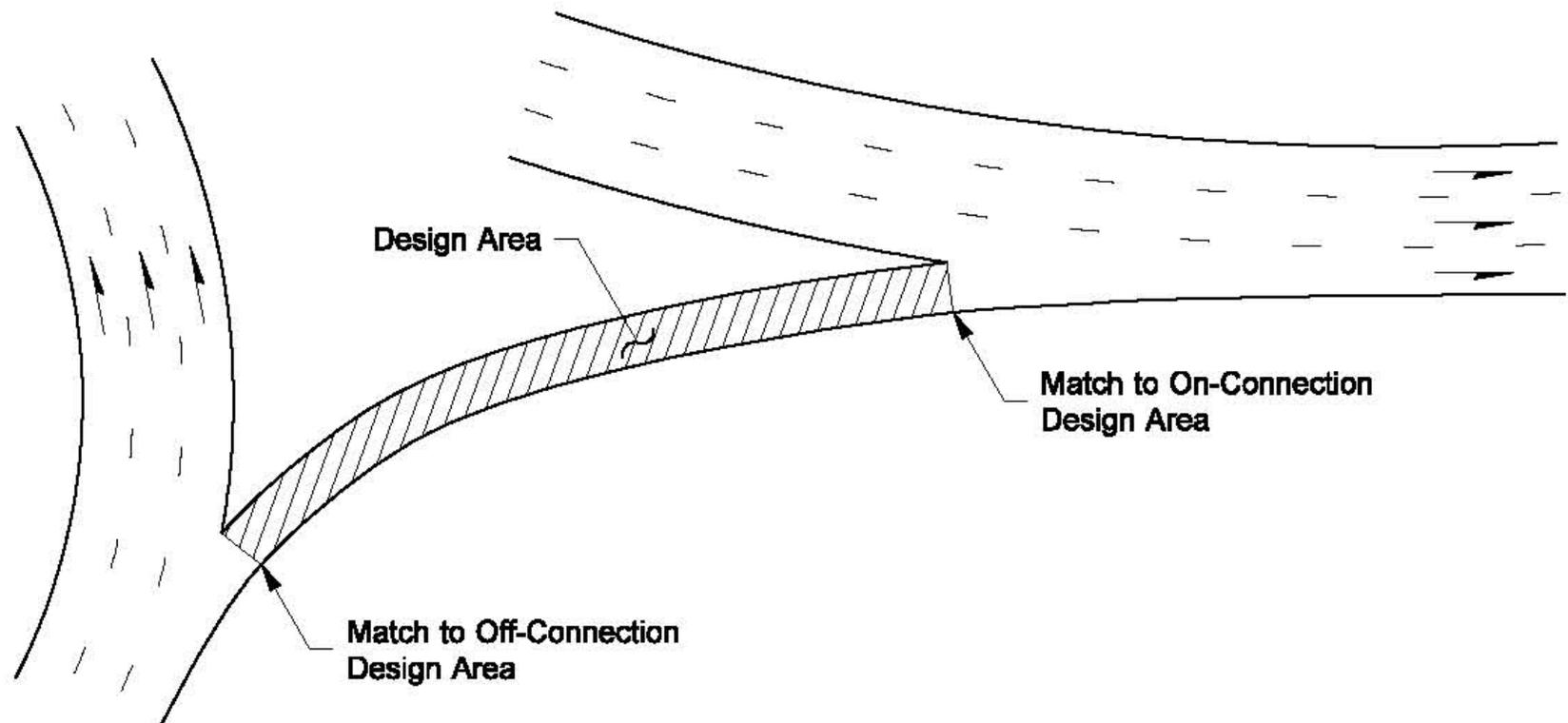
Approach roadway must be tangent for 272 feet or do not calculate veiling luminance



RI(18) 840-6 figure 840-18

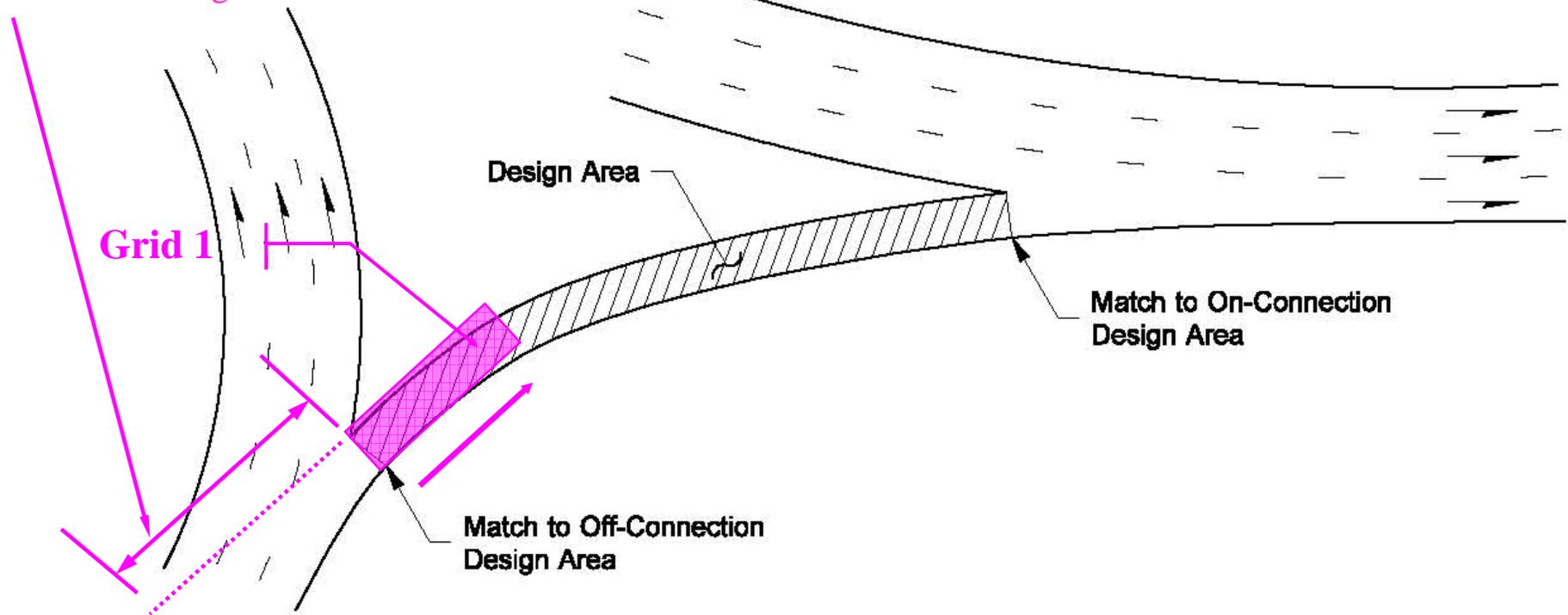
Freeway to Freeway Ramp connections - (19)

- Provide the necessary light standards to illuminate freeway-to-freeway ramps.

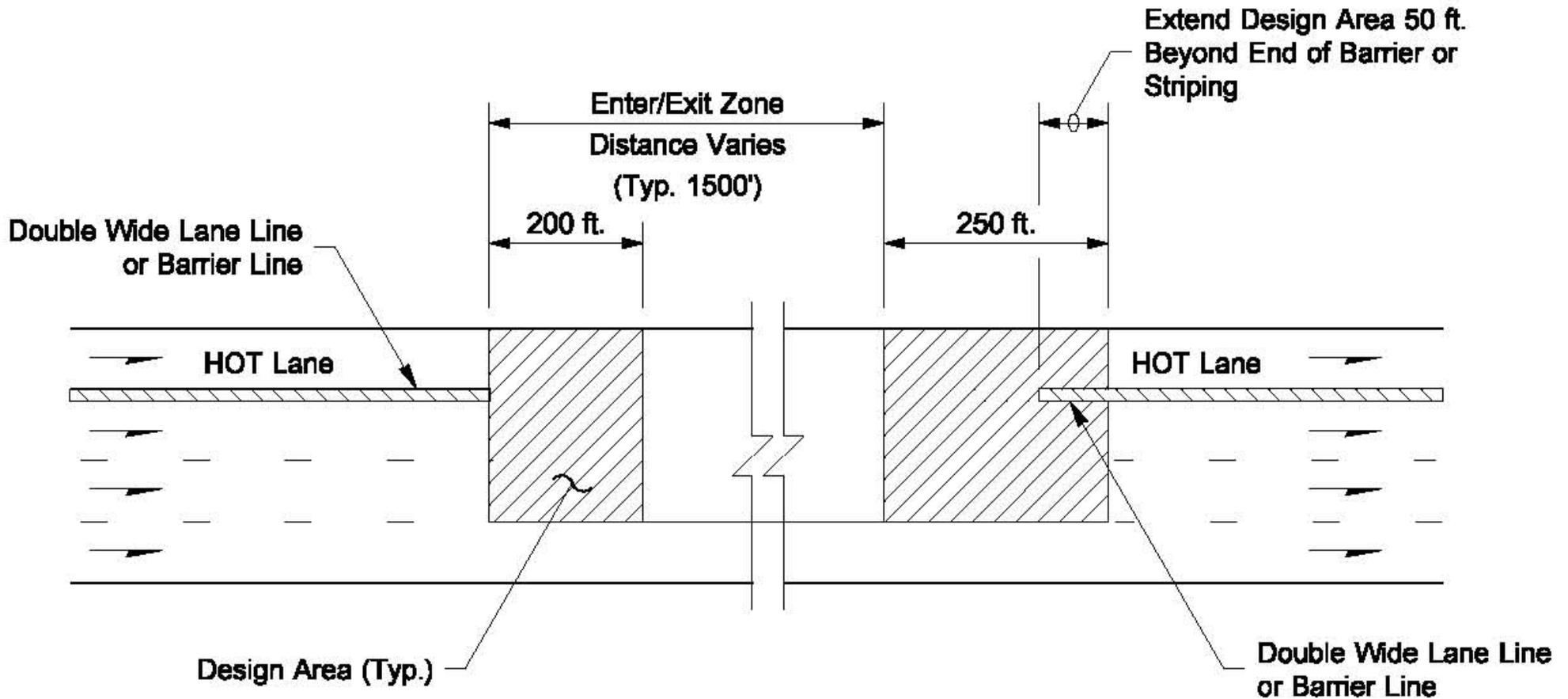


How to place Luminance & Veiling Luminance Grids

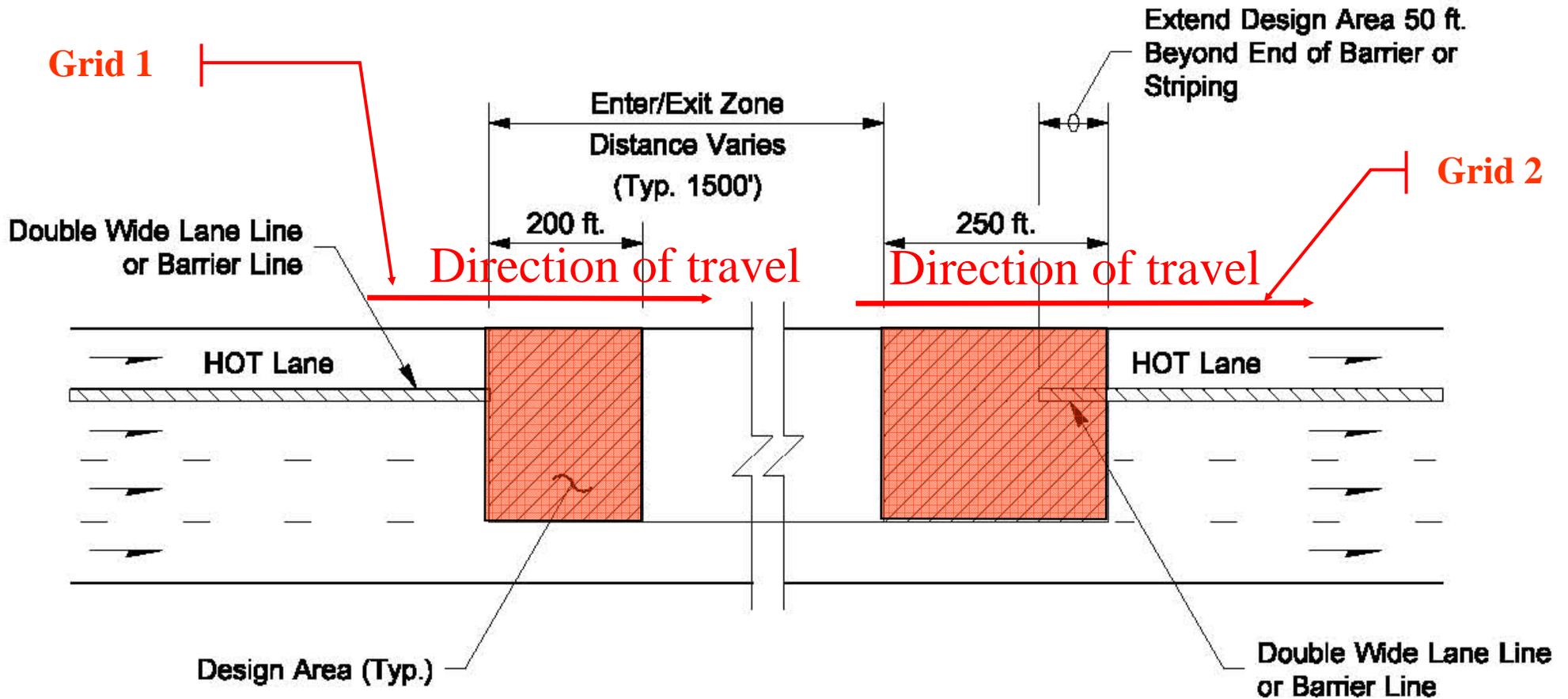
Ramp must be tangent for 272 feet or do not calculate veiling luminance.



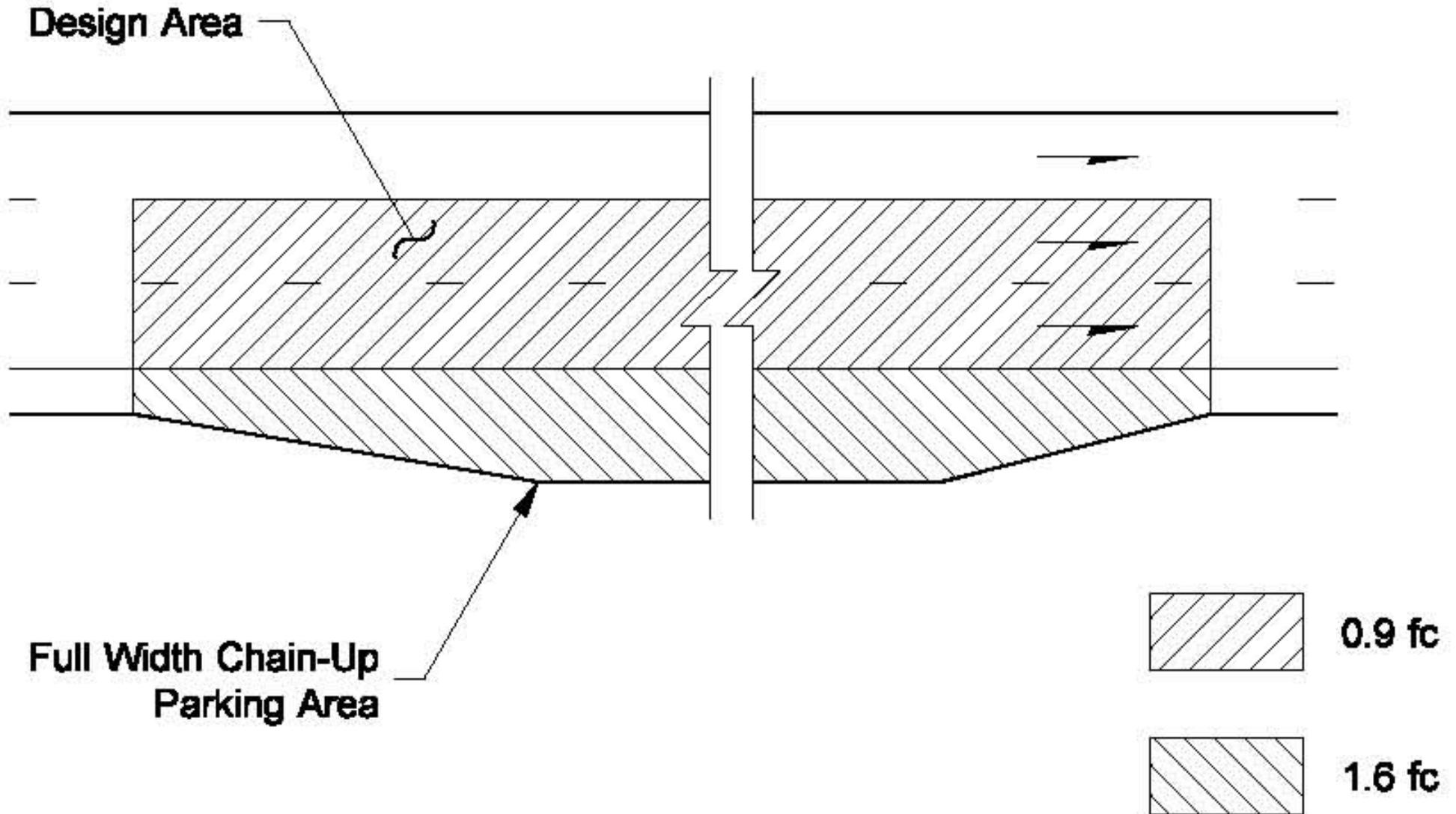
HOT (High Occupancy Toll) Lane enter/exit zones - (20)



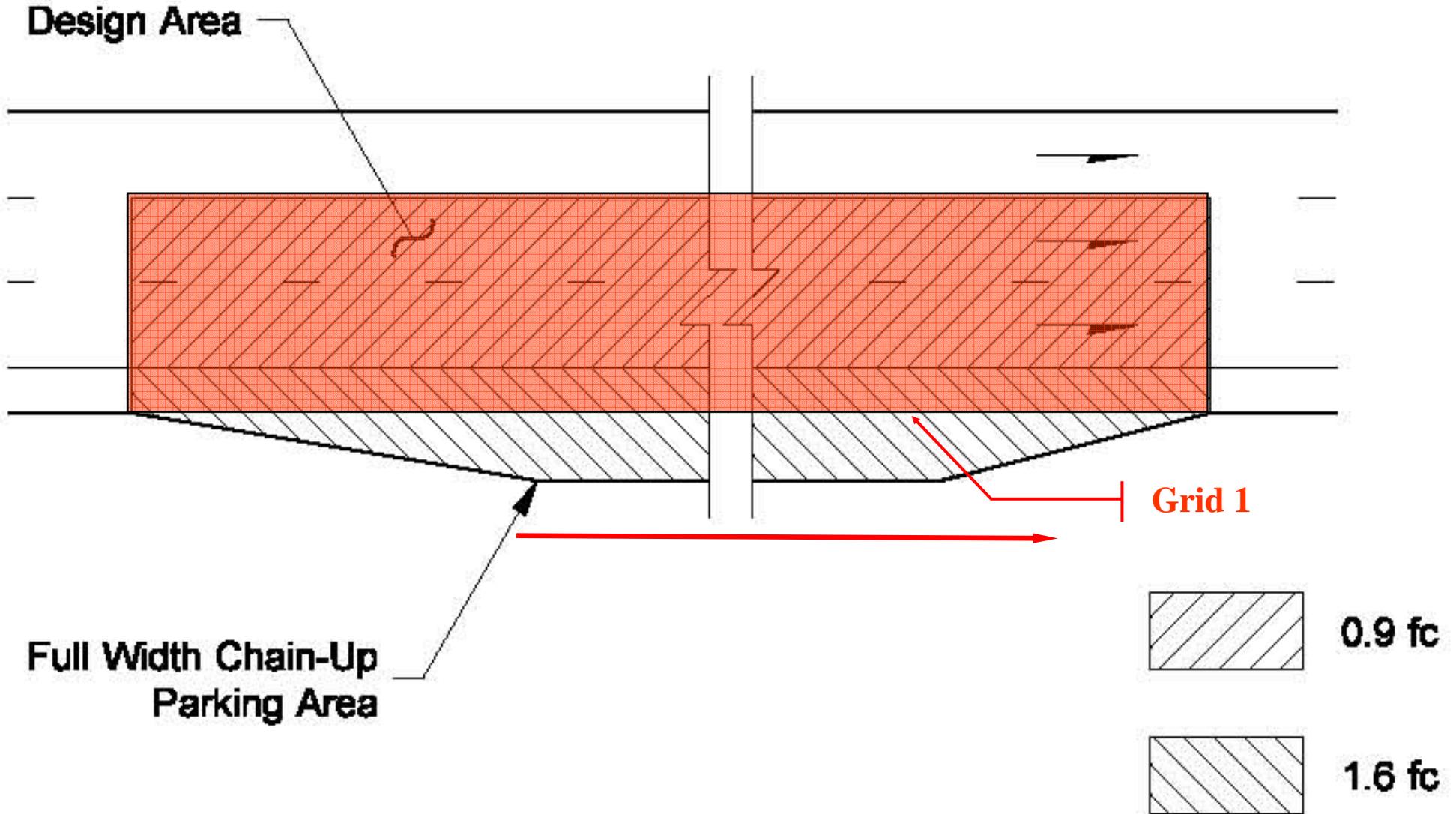
How to place Luminance & Veiling Luminance Grids



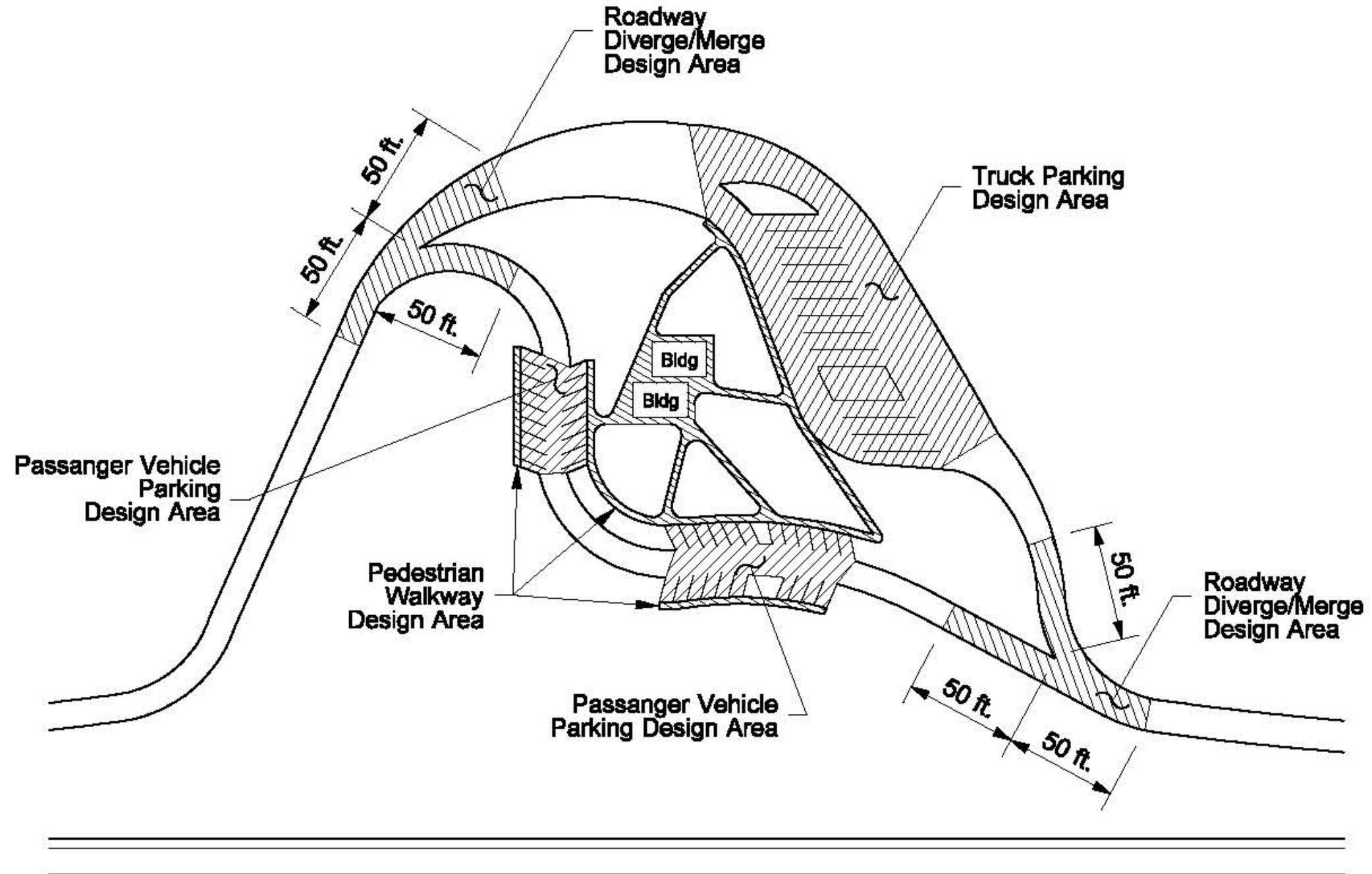
Chain up / Chain off Parking Areas - (21)



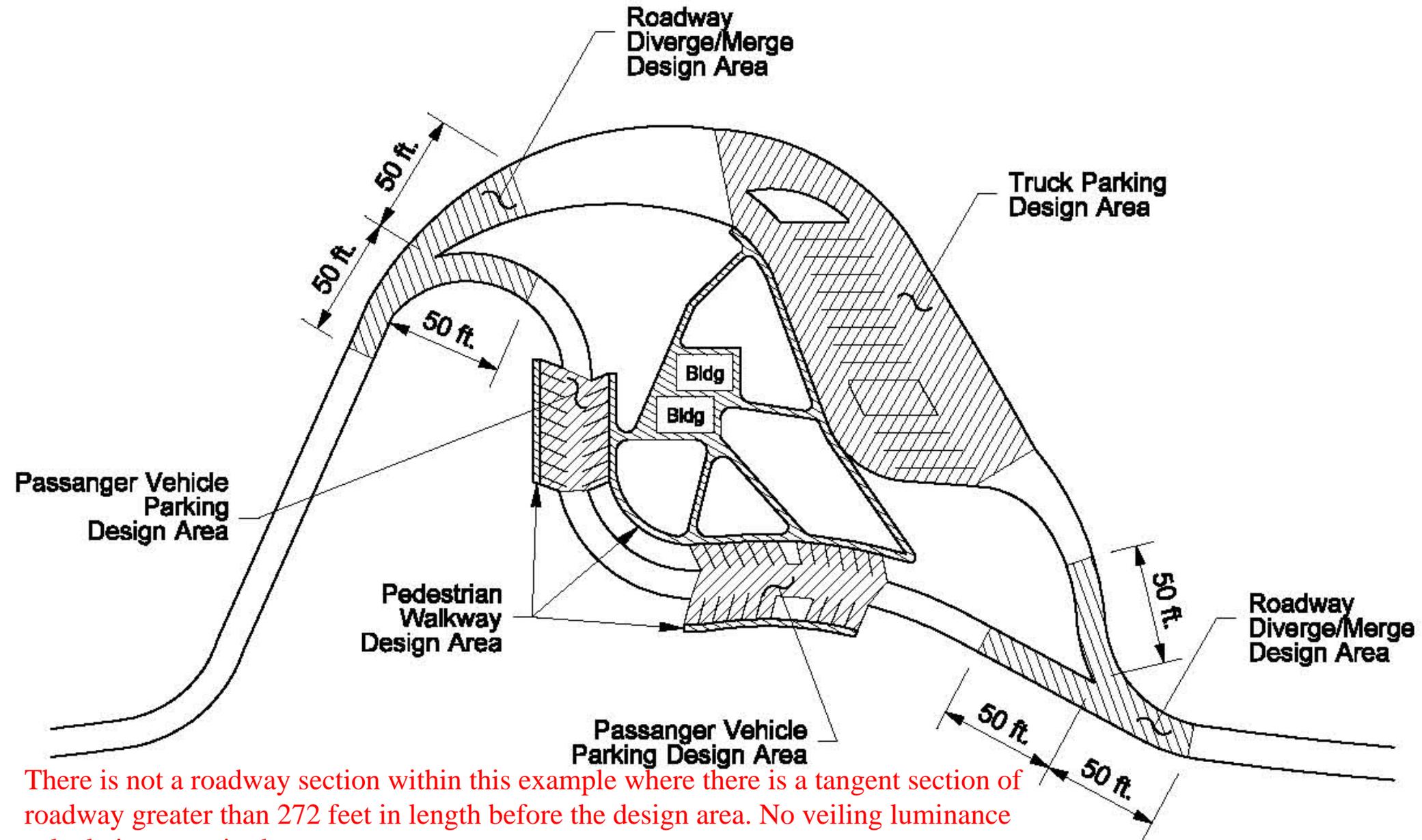
How to place Luminance & Veiling Luminance Grids



Rest Areas - (22)



How to place Luminance & Veiling Luminance Grids



There is not a roadway section within this example where there is a tangent section of roadway greater than 272 feet in length before the design area. No veiling luminance calculations required.

Overhead Sign Illumination - (23)

- Provide sign lighting on overhead signs as discussed in Design Manual Chapter 820.
- When DM Chapter 820 is updated the overhead sign lighting section will move to DM Chapter 840.

Additional Illumination

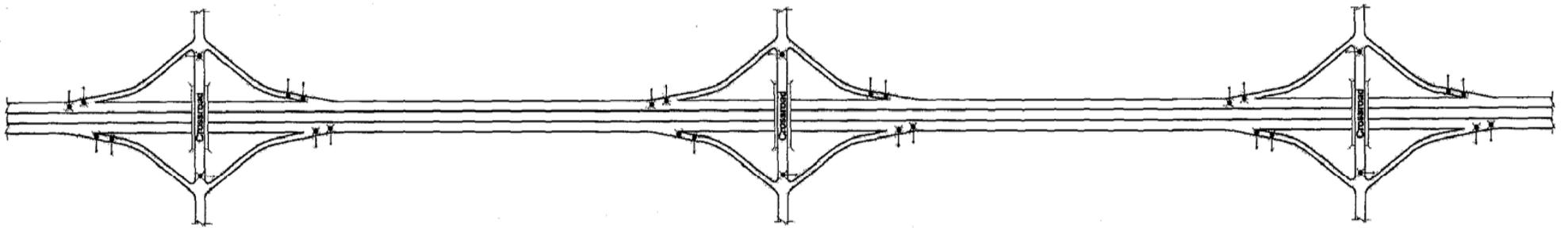
- Diminished Level of Service
 - Mobility condition where the peak level of service is “D” or lower
- Nighttime Collision Frequency
 - Condition when the number of nighttime accidents equal or exceed the number of daytime accidents
 - An Engineering study is needed to show that installing illumination will result in a reduction of nighttime accidents
- High nighttime pedestrian accident locations
 - AI 840-7

Highways AI (1) (a)

- On the mainline of full limited access highways, consider full illumination if a diminished level of service exists and any two of the following conditions exist:
 - There are three or more successive interchanges with an average spacing of 1 ½ miles or less.
 - The roadway segment is in an urban area.
 - The nighttime accident frequency condition exists.
 - A cost benefit analysis between the required and full (continuous) illumination.

- AI 840-8

Highways With Full Access Control (1)(a)



Highways AI (1) (b) - continued

- Mainline of highways without Full Access Control (b)
- Consider full (continuous) illumination if the segment of highway is in a commercial area, and either
 - A diminished level of service exists.
 - Or, the nighttime accident frequency exists
- And an engineering study indicates that nighttime driving conditions will be improved.

Ramps - AI (2)

- At ramps, consider additional illumination if a diminished level of service exists for the ramps and any of the following conditions are present:
 - **Complex ramp alignment & grade.** (“complex ramp alignment & grade” is: The exit advisory speed is 35 mph or lower than the posted mainline speed, or there is a 6% or greater change in grade from exiting mainline grade to the ramp grade)
 - Routine queues of five or more vehicles per lane at ramp terminal.
 - The nighttime accident frequency condition exists.
 - The criteria for continuous mainline illumination has been satisfied.

AI(2)
DM 840-8



The gore point of the exit ramp is past this sign



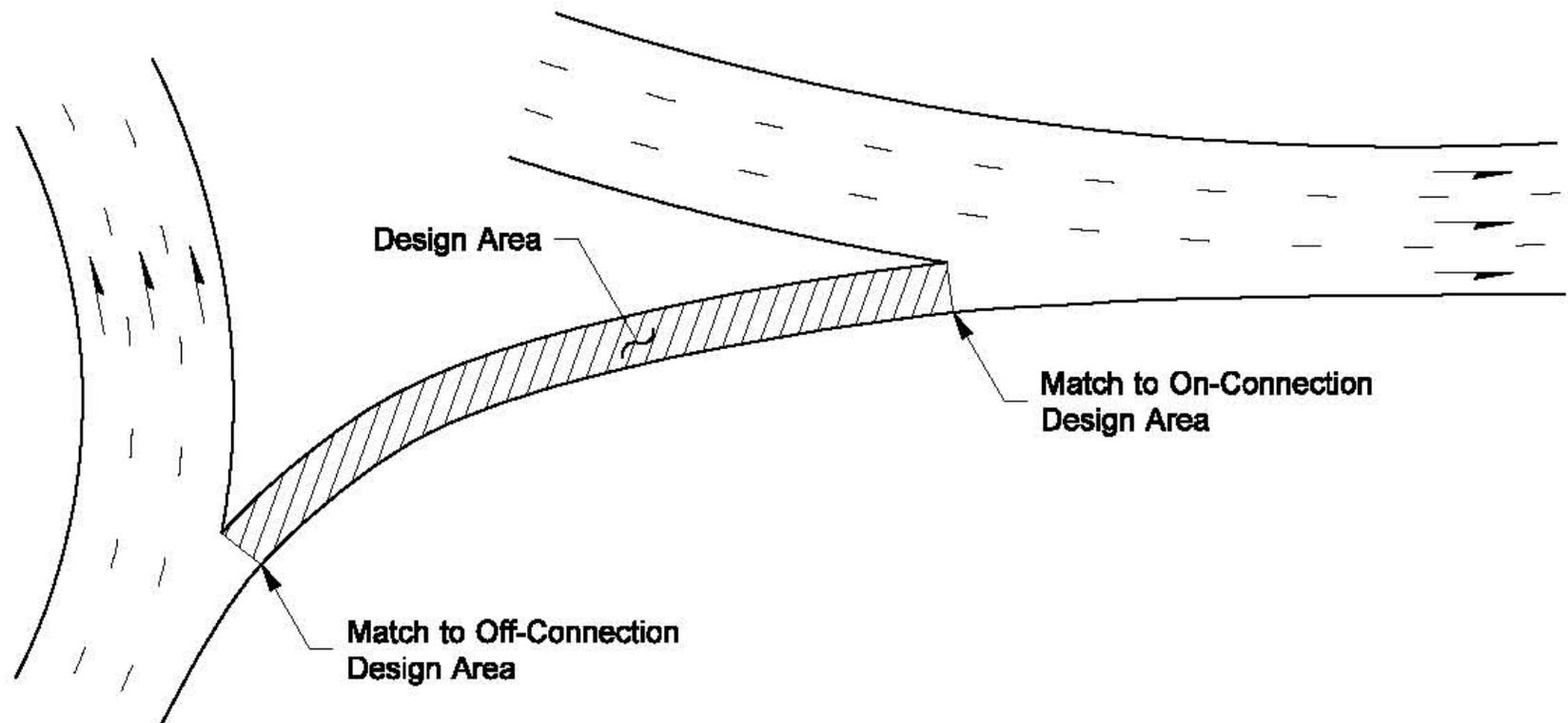
The gore point of the exit ramp is past this sign

The ramp traffic begins here



Highway to Highway Ramp connections - AI (3)

- Provide the necessary light standards to illuminate highway-to-highway ramps.



Crossroads - AI (4)

- At crossroads, consider additional illumination when:
 - A diminished level of service exists, and
 - the nighttime accident frequency condition exists.
 - Also, consider additional illumination if the crossroad is in a tunnel, under crossing or lid.

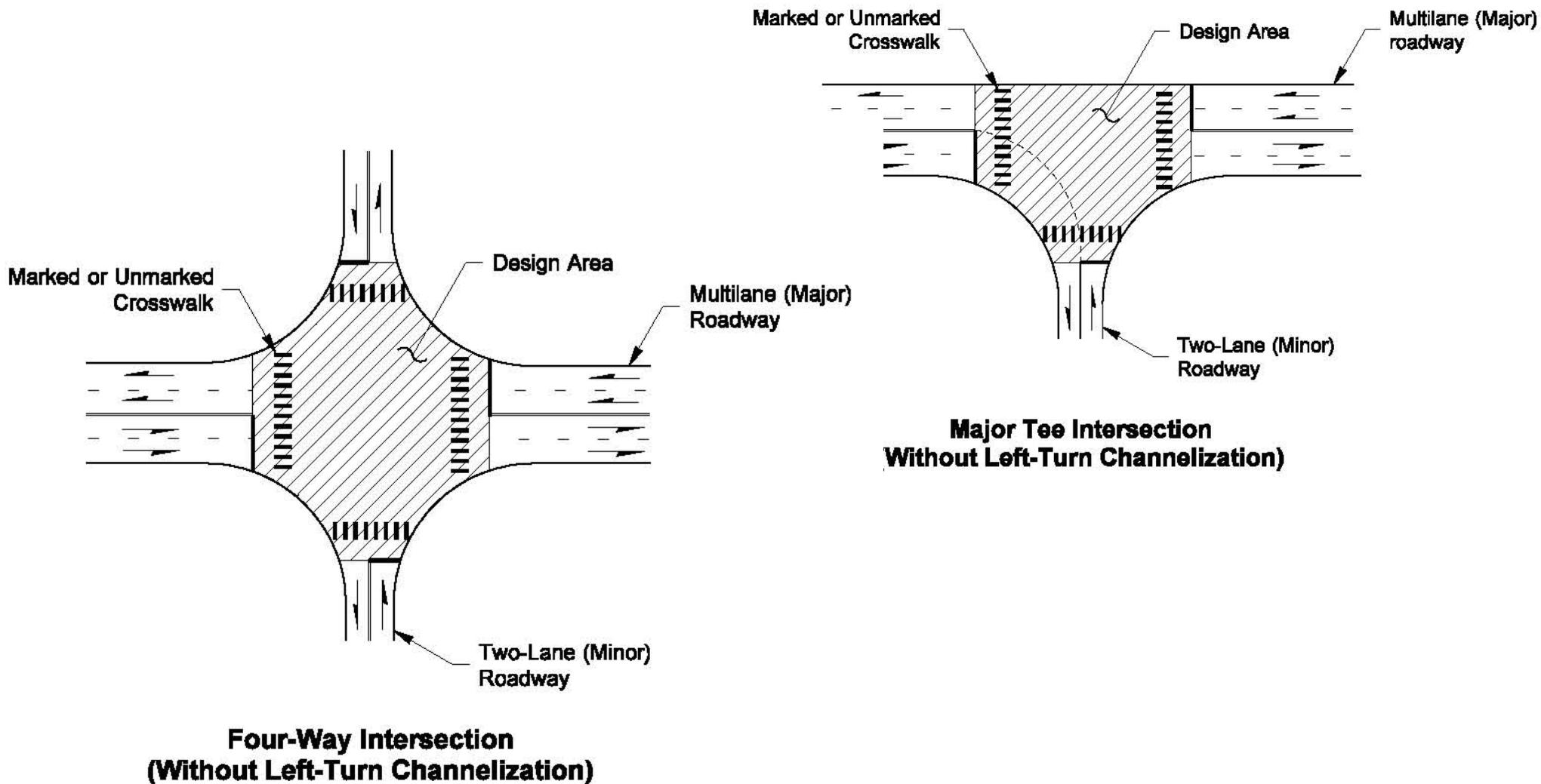
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Intersections w/o Channelization AI (5)

- Consider illumination of an intersection without channelization if:
 - The intersection is located in an urban area.
 - The nighttime intersection accident frequency condition exists.
 - Traffic volumes and movements would be improved with the installation of left turn channelization.

Intersections Without Channelization (5)

(and without a traffic signal)

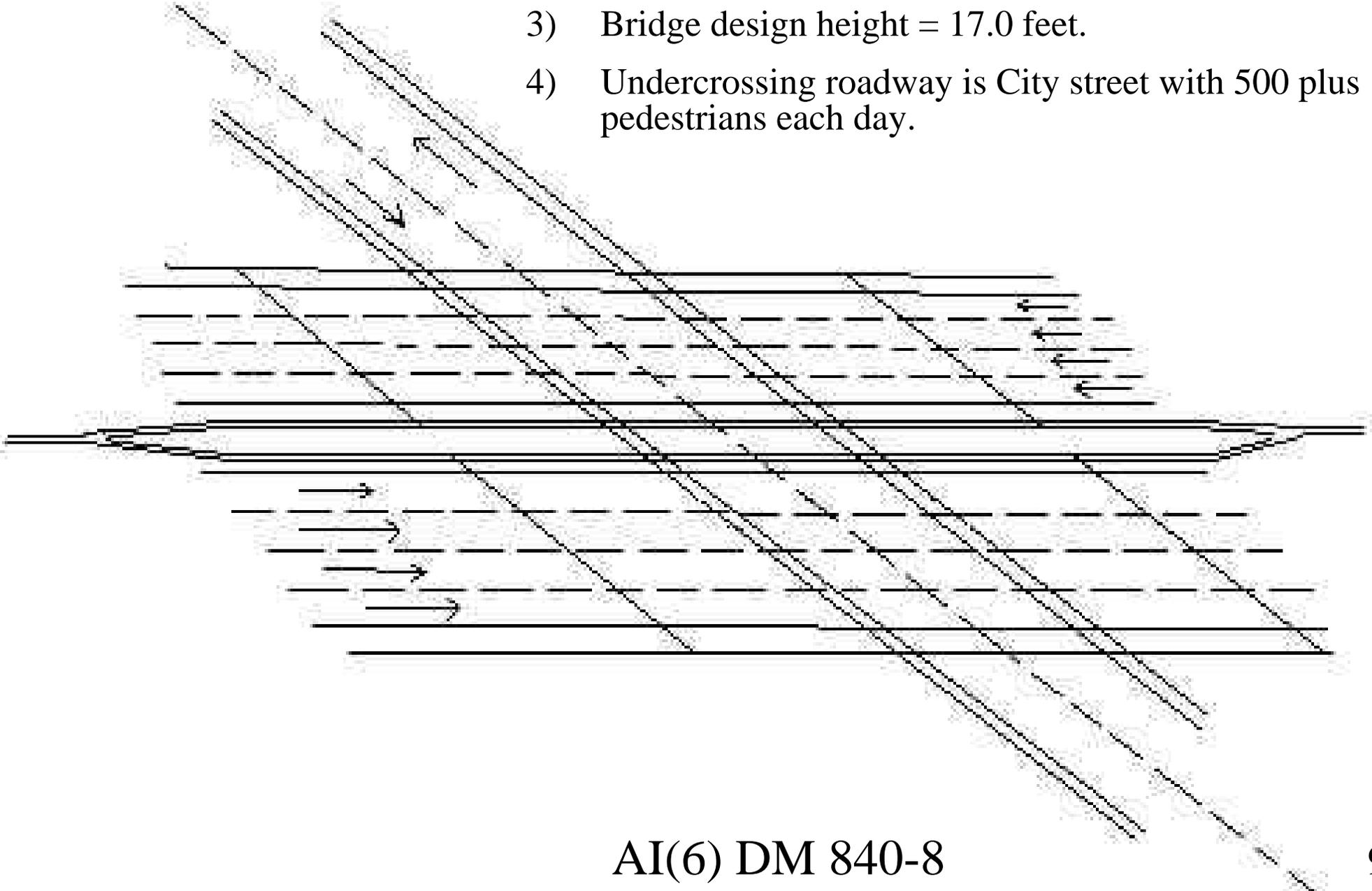


Short Tunnels, Underpasses, or Lids AI (6)

- Consider illumination if:
 - portal conditions result in a brightness in the tunnel, underpass or lid that is less than the measured daytime brightness of the approach roadway divided by 15 and,
 - The length to vertical clearance ratio is 10:1 or greater.
 - Note: IESNA RP-22-05 (Recommended Practice for Tunnel Lighting) recommends daytime illumination of underpasses greater than 80 feet in length. This significant change was not implemented in the 2006 rewrite of DM chapter 840. The entire concept of illuminating short tunnels, underpasses, or lids is under review.

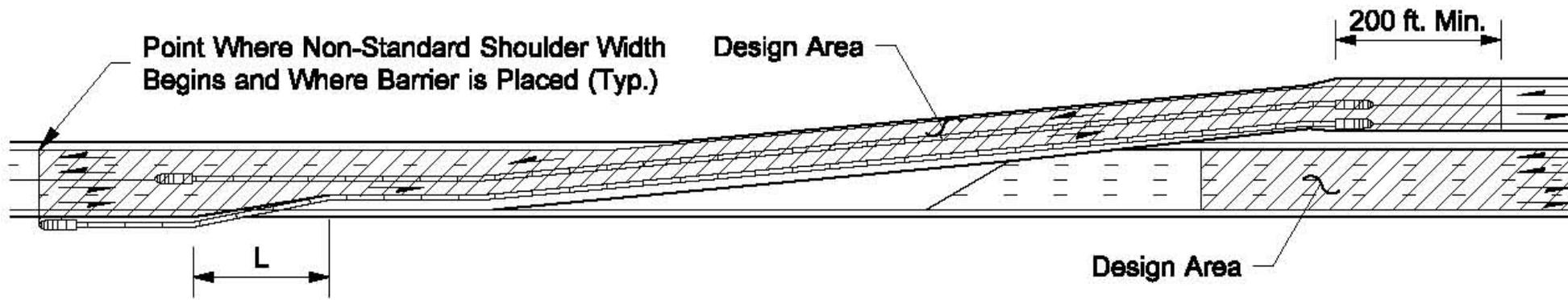
Given:

- 1) Widen three lane roadway to four lane roadway.
- 2) Gap between new traffic barrier on structures is 4 feet.
- 3) Bridge design height = 17.0 feet.
- 4) Undercrossing roadway is City street with 500 plus pedestrians each day.

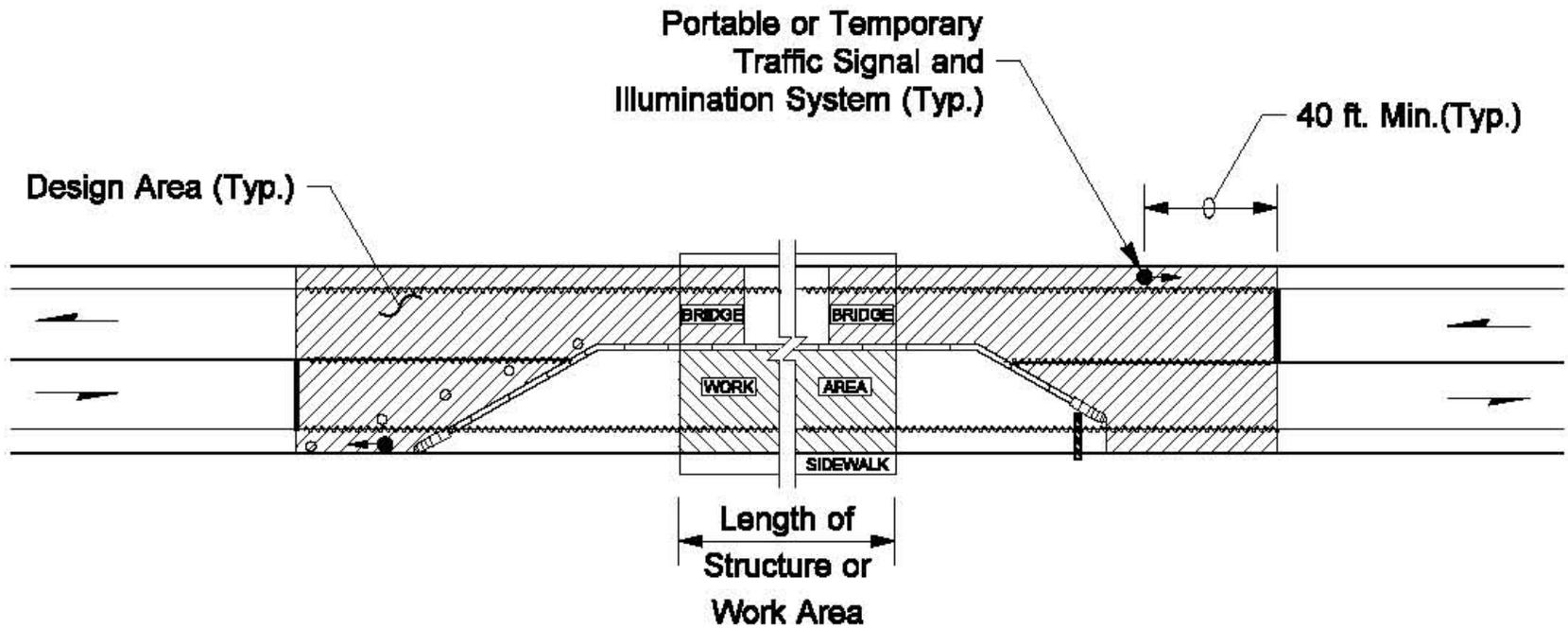


Work Zones and Detours AI (7)

- Consider temporary illumination of the highway through work zones and detours when changes to the highway alignment or grade remain in place during nighttime hours, and when the following conditions may be present:
 - Nonstandard features such as narrow lanes, shoulders, or shy distance to barriers or structures are present.
 - When the temporary alignment includes abrupt changes in highway direction or lane shift with substandard lane shift tapers.
 - When other unusual highway features such as abrupt lane edge drop-offs, sudden changes in pavement conditions, or temporary excavation or trenching covers are present.
 - When there is an anticipation of heavy construction truck traffic, possibly requiring flaggers, entering and exiting the highway during nighttime hours.



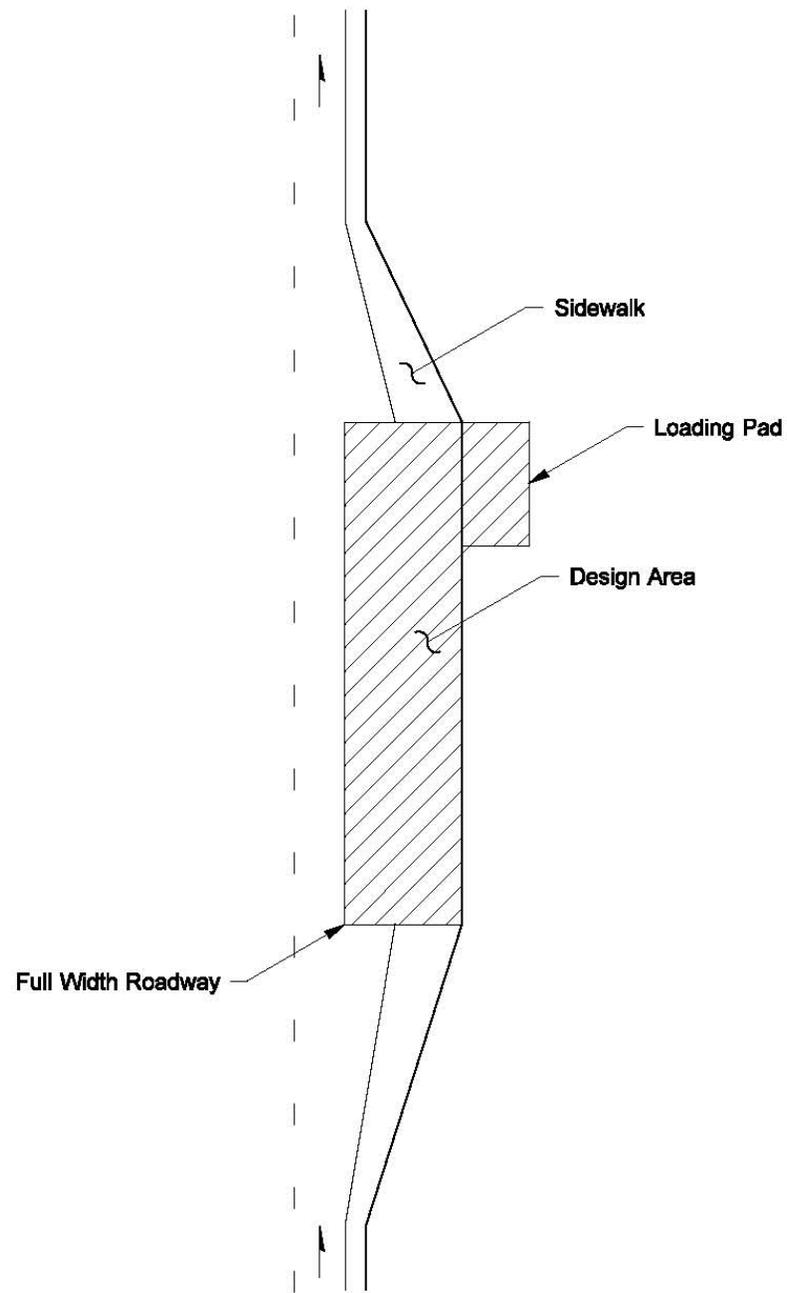
Detour Traffic



Transit Stops AI (8)

- The responsibility for lighting at transit stops is shared with the transit agency. Negotiating a memorandum of understanding with the transit agency is preferred over spot negotiations. If the agency is unable or unwilling to participate in the funding or maintenance of the illumination, a single light standard positioned to illuminate both the transit pullout area and the loading area can be considered.
- Transit stops with shelters are indicative of higher passenger usage. Consider illumination of transit stops with shelters. This lighting consists of one luminaire positioned to illuminate both the transit pull out area and the loading area.
- Additional illumination to further illuminate the loading area at transit stops with significant, nighttime activity may be considered, if the transit agency will provide the funding for construction and maintenance.

Transit Stop AI(8)



Bridges AI (9)

Railroad Xing Without Gates or Signals AI (10)

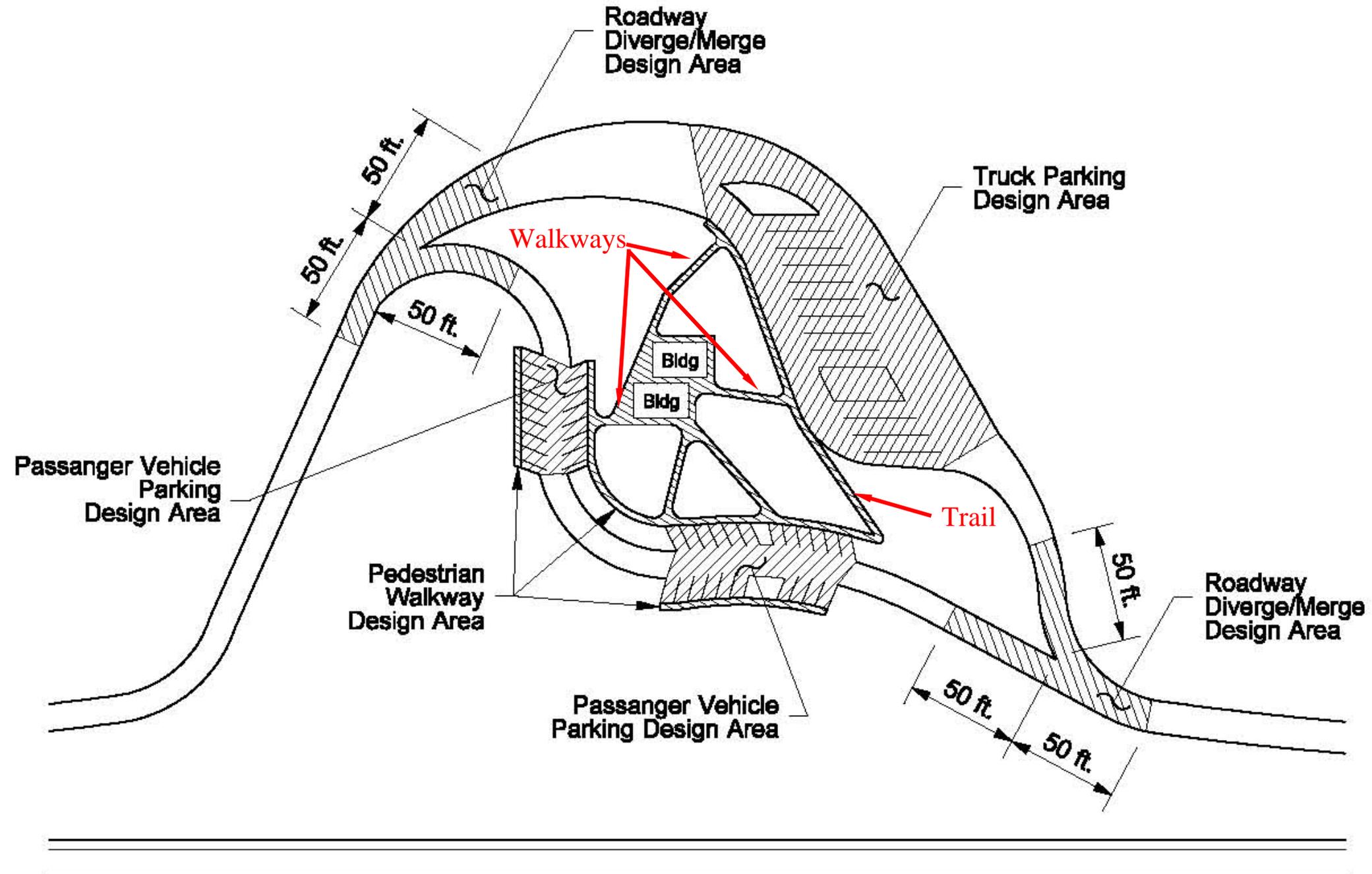
- Bridges:
 - Justification for illuminating bridges is the same as that for highways, with or without full limited access control, as applicable.
- Railroad Crossings Without Gates or Signals:
 - Consider illuminating these facilities when:
 - Collision history indicates motorists experience difficulty seeing trains.
 - There is a substantial amount of nighttime activity.
 - The crossing is blocked for long periods of time due to low train speeds.
 - The crossing is blocked for long periods at night.

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Walkways and Bicycle Trails AI (11)

- Walkways and Bicycle Trails
 - Consider Illuminating the walkway if it is a connection between two highway facilities.
 - Consider illuminating existing walkways or bicycle trails if security problems have been reported.
 - Consider illuminating of new construction walkways or bicycle trails if security problems are anticipated.

Walkways and Bicycle Trails - AI(11)



What's new in illumination design (or not so new)

- Getting the base map from the Design Office.
- You should have only one base map file you get from the location office. The contents of this file is spelled out in the “Traffic PS&E Preparation CADD Base plan requirements” Current Practices. Everything listed on this sheet is critical and should be shown in the base map.
- Supervisors – send a copy of this CADD requirements sheet to the location office when you are scoping the job.
- Designer - Send a copy of this CADD requirements sheet to the location office when you are first assigned the job.
- Having only one base map insures this process works easily throughout the design stages.

YOUR REGION
Traffic PS&E Preparation
CADD BASE PLAN REQUIREMENTS

The base plan needs to contain the following if they apply specifically to this project.

- North Arrow, Township and Range
- Existing and Proposed Alignment
- Existing and Proposed Right of Way, Limited Access and Easements
- Existing and Proposed Channelization
- Existing and Proposed Striping (crosswalks, stop bars)
- Existing and Proposed Utilities (overhead/underground)
- Existing and Proposed Drainage, including wetlands, ecology embankments, etc.
- Existing Illumination System¹
- Existing Traffic Signal System²
- Existing ITS System
- Existing Signing
- Existing and Proposed bridge structures, walls, drainage vaults, etc. (all structures)

All of the items listed above must be contained in one CADD file.

NOTE: THE BASE PLAN CADD FILE SHALL BE PER THE PLANS PREPARATION MANUAL.

In order for us to have a complete understanding of the project, we also need copies of the following:

- Approved Channelization Plan
- Traffic Analysis
- Project Summary (Prospectus)
- Project File (Design Report)
- Signal Permit
- Roadway Sections

Engineering back up data to support all illumination design shall be submitted along with the PS&E for each project.

¹ Light standards, conduit runs, junction boxes, electrical service cabinet with service agreement number. Depending on the nature of the work it may be necessary to survey any or all of these items. Signal Maintenance will assist in locating these elements in the field on request. Once surveyed it is imperative that the information is accurately included in the base plan. (Electrical Maintenance Supervisor -- Name Here -- Ph.#) (ITS Maintenance Supervisor -- Name Here -- Ph.#).

² Same as Footnote 1 with the addition of signal poles and signal controller cabinet. Signal poles, controllers, electrical service, junction boxes and all other above ground improvements at traffic signal intersections must be shown accurately, this will require a survey.

Note: Base plans have been prepared incorrectly by using As-Builts as the only source of information on existing features, this approach has cost many preliminary engineering dollars and has also had a negative impact on project scheduling. We assume the data you provide to be correct and verify it only if something appears to be grossly wrong.

Please direct questions to:

Name Here, Your Traffic Signal Design Team Supervisor
Ph. #

Name Here, Your ITS Supervisor
Ph. #

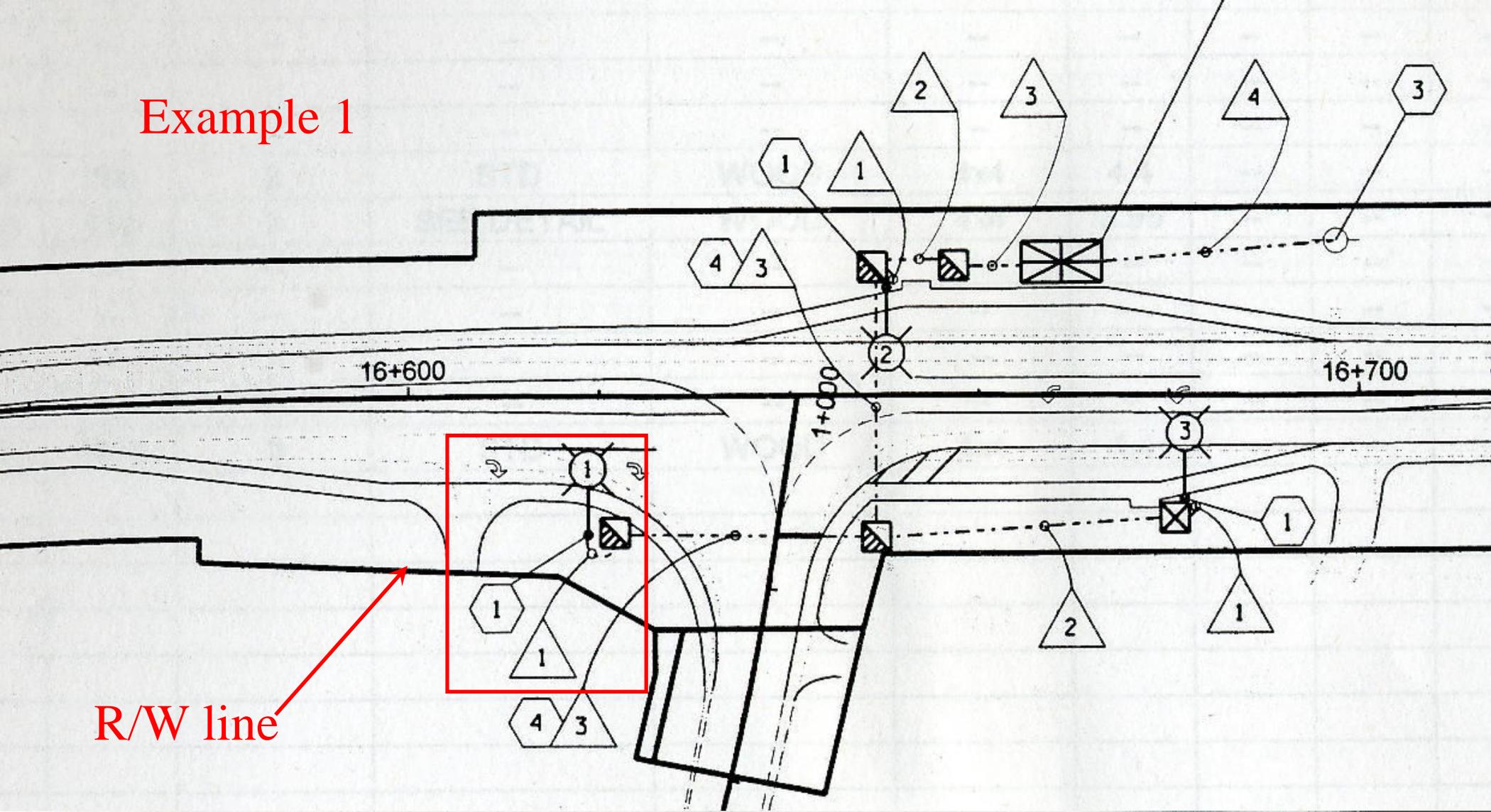
Name Here, A second Signal Design Team Supervisor here
Ph. #

Name Here, Signing Team Supervisor here
Ph. #

What's new in illumination design (or not so new) - continued

- Placement of Light Standards.
 - Luminaires should be placed as far back from the traveled way as is practical, generally 16' from the fog stripe. Luminaires should not be placed; in ditches, in ecology embankments, on steep cut slopes, above buried utilities, below overhead utilities, or within 10' (measured circumferentially) of power wires - including the neutral (depending on the voltage of the line the distance may be greater than 10 feet).
 - Watch your wetlands!

Example 1

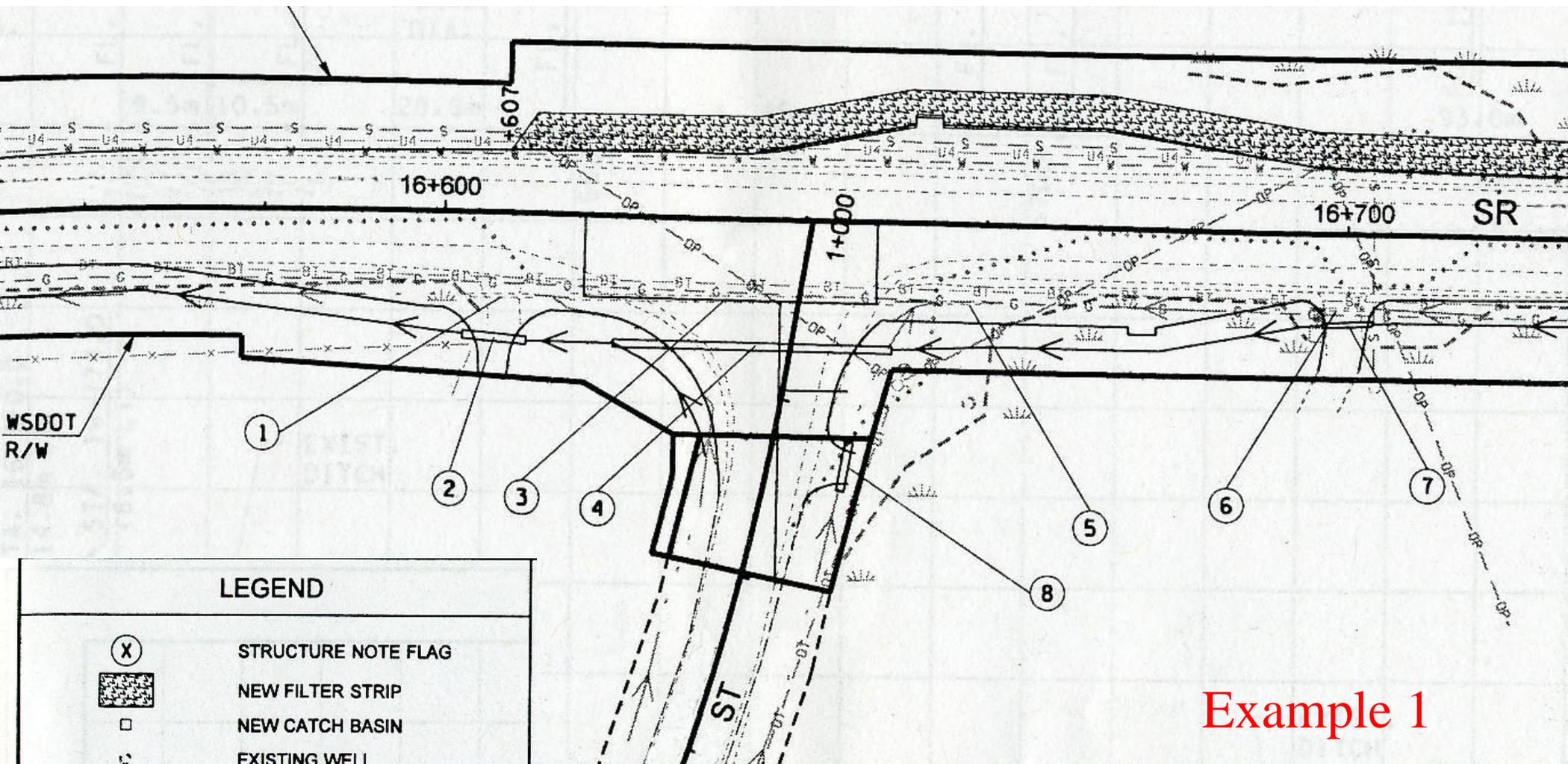


R/W line

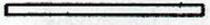
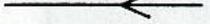
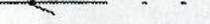
LUMINAIRE SCHEDULE

SERVICE NO.

LUMINAIRE NUMBER	CIRCUIT	LOCATION		TYPE-DISTRIBUTION-WATTAGE	MAST ARM	Hi	BASE TYPE	COMMENTS
		STATION	OFFSET					
1	A	SR	STA 16+618.74	14.06m RT	III-MED CUTOFF-400 HPS	4.88m	15.2m	SLIP
2	A	SR	STA 16+650.22	11.01m LT	III-MED CUTOFF-400 HPS	4.88m	15.2m	SLIP
3	A	SR	STA 16+681.56	10.54m RT	III-MED CUTOFF-400 HPS	4.88m	15.2m	SLIP



LEGEND

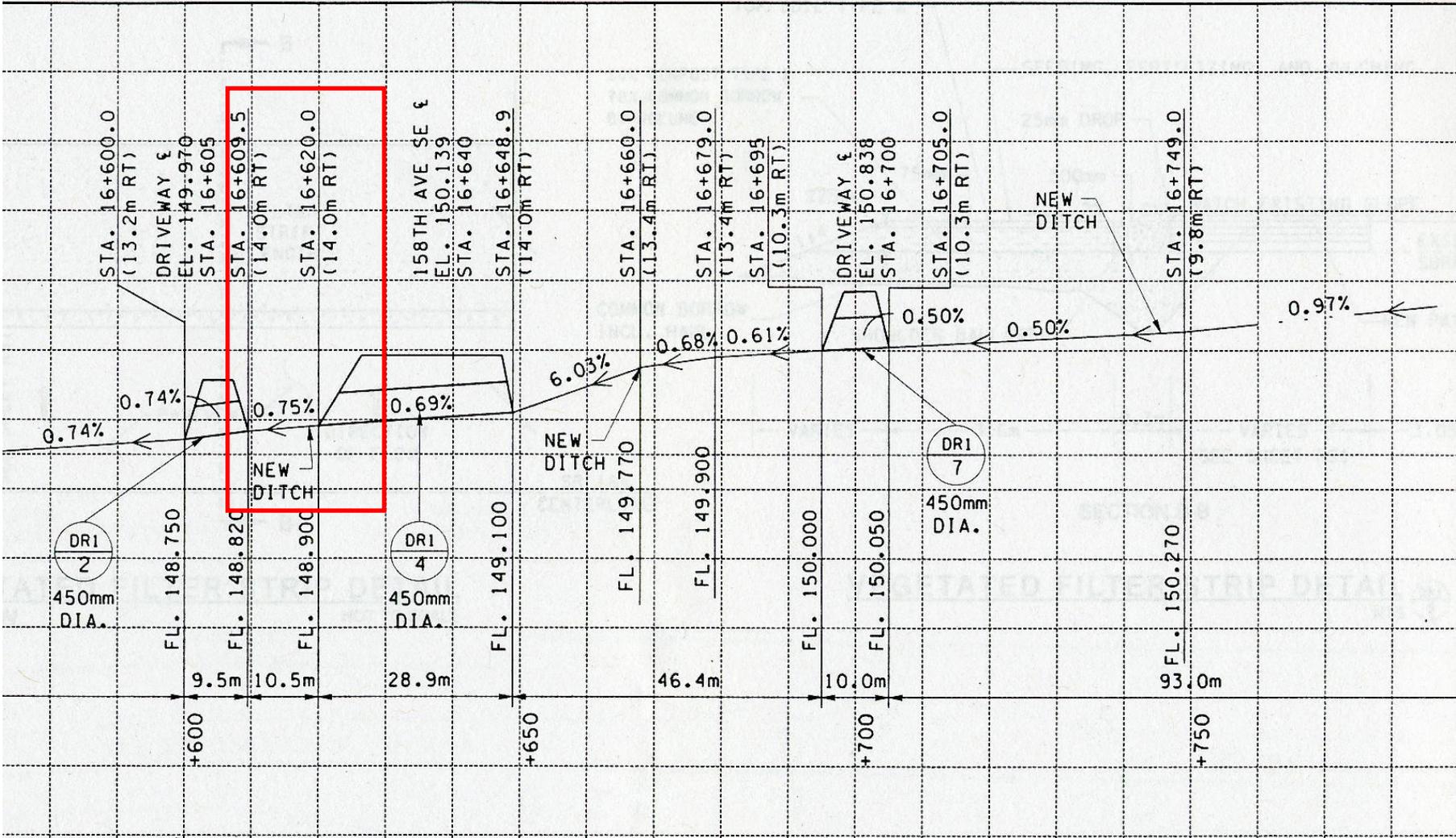
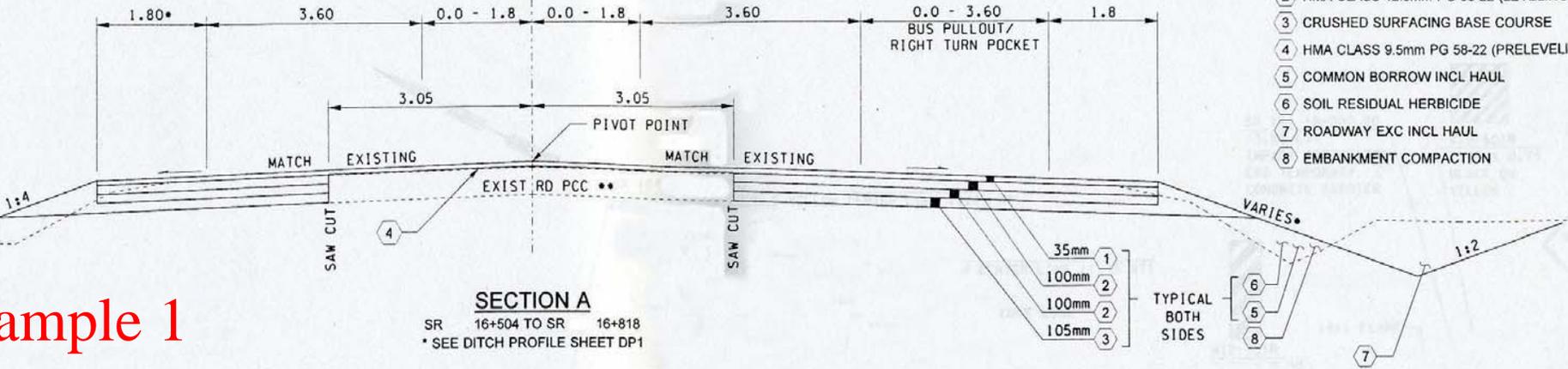
-  STRUCTURE NOTE FLAG
-  NEW FILTER STRIP
-  NEW CATCH BASIN
-  EXISTING WELL
-  EXISTING CATCH BASIN
-  NEW PIPE
-  EXISTING CULVERT
-  NEW DRAINAGE DITCH
-  EXISTING DRAINAGE DITCH
-  EXISTING WETLAND BOUNDARY
-  EXISTING WETLAND BUFFER
-  WETLAND SYMBOL

Example 1

Example 1

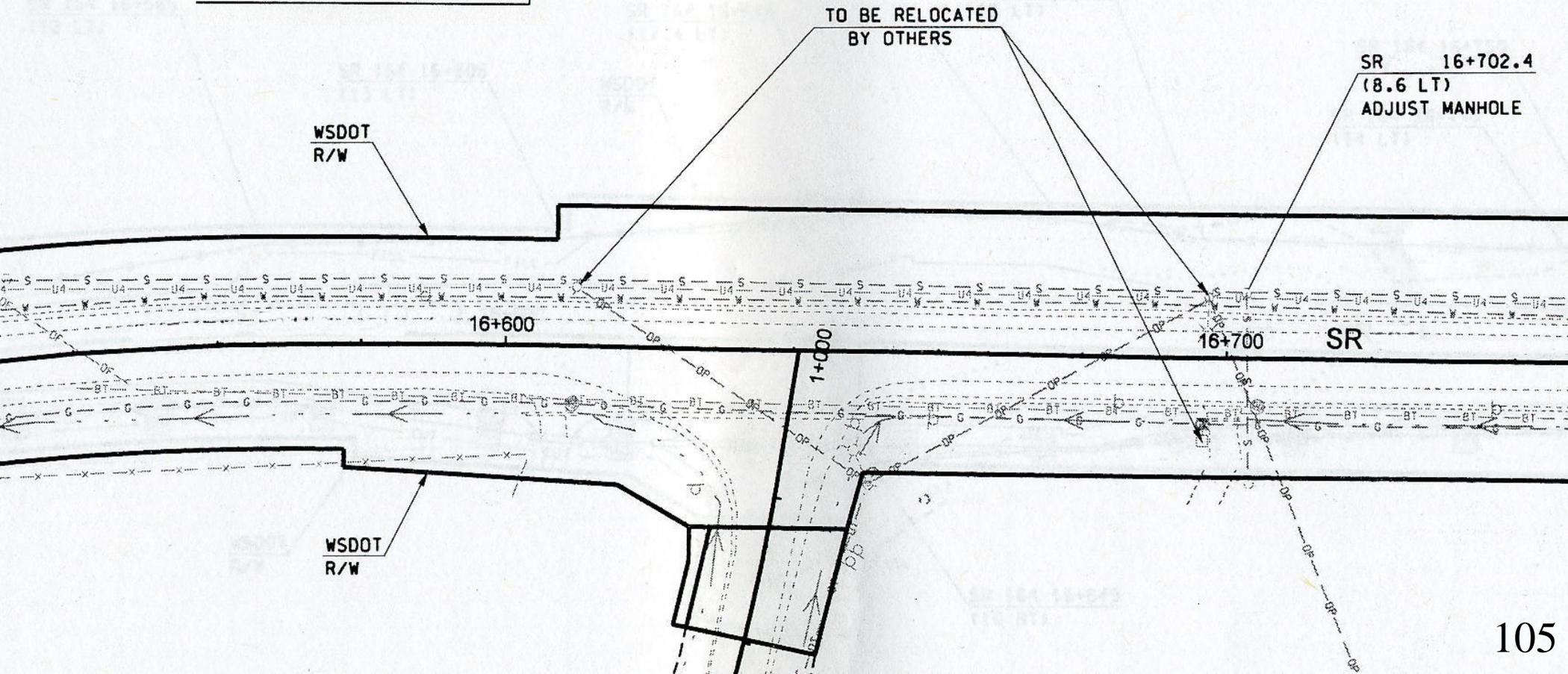
LEGEND

- ① HMA CLASS 12.5mm PG 58-22 (WEARING COURSE)
- ② HMA CLASS 12.5mm PG 58-22 (LEVELING COURSE)
- ③ CRUSHED SURFACING BASE COURSE
- ④ HMA CLASS 9.5mm PG 58-22 (PRELEVELING COURSE)
- ⑤ COMMON BORROW INCL HAUL
- ⑥ SOIL RESIDUAL HERBICIDE
- ⑦ ROADWAY EXC INCL HAUL
- ⑧ EMBANKMENT COMPACTION



EXISTING LEGENDS	
	POWER POLE
	WELL
	WATER OR GAS VALVE
	JUNCTION BOX
	LUMINAIRE
	TELEPHONE BOX
	GAS LINE
	SEWER LINE
	WATER LINE
	BURIED TELEPHONE
	OVERHEAD FIBER OPTIC
	OVERHEAD POWER
	OVERHEAD FIBER OPTIC, POWER, TELEPHONE, & TELEVISION
	WETLAND BOUNDARY
	WETLAND BUFFER
	WETLAND SYMBOL

Example 1





Example 1

JUL 6 2005

Example 1



JUL 6 2005

Example 1



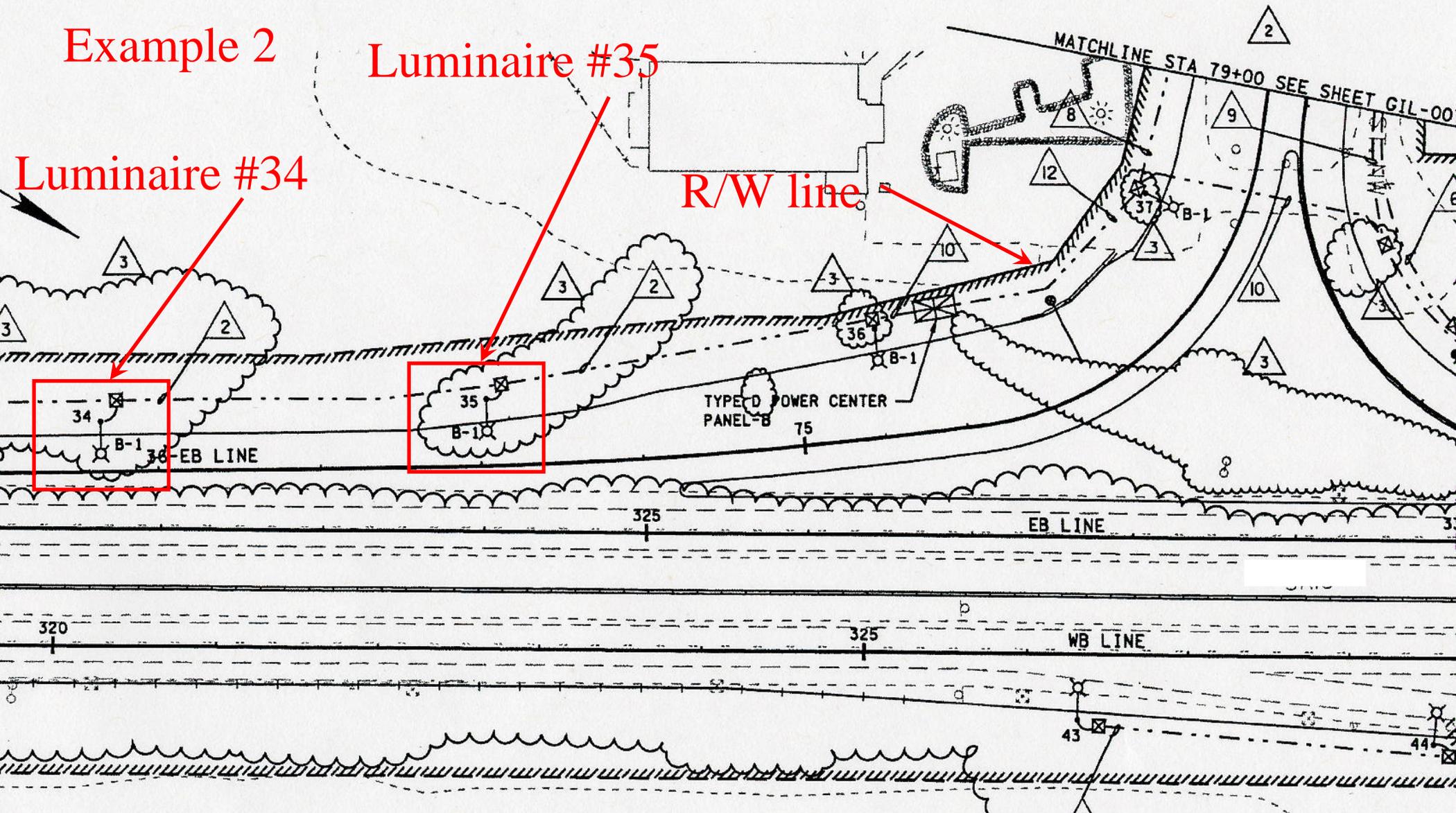
JUL 6 2005

Example 2

Luminaire #35

Luminaire #34

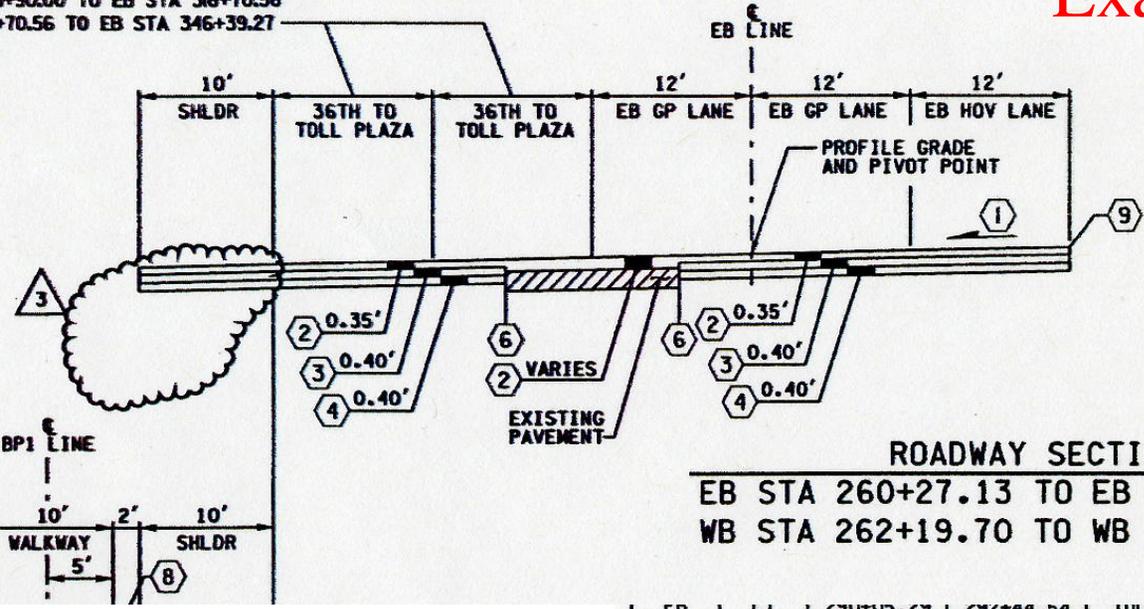
R/W line



POLE AND LUMINAIRE SCHEDULE									
POLE NO.	DIST. TYPE	LOCATION		LUMINAIRE TYPE	MAST ARM	HT	POLE BASE TYPE	DESCRIPTION	
		STATION	OFFSET						
34	III	36-EB STA 70+65.00	30.00' LT	400 HPS	14'	40'	BREAKAWAY	PROVIDE MULTIVOLTAGE BALLAST	
35	III	36-EB STA 73+04.00	40.00' LT	400 HPS	14'	40'	BREAKAWAY	PROVIDE MULTIVOLTAGE BALLAST	
36	III	36-EB STA 75+50.00	65.00' LT	400 HPS	14'	40'	BREAKAWAY	MULTIVOLTAGE BALLAST	
37	III	36-EB STA 78+10.00	60.00' LT	400 HPS	14'	40'	BREAKAWAY	MULTIVOLTAGE BALLAST	
43	III	WB STA 326+32.00	43.00' RT	400 HPS	16'	40'	BREAKAWAY	PROVIDE MULTIVOLT BALLAST & INDIVIDUAL PHOTOCCELL	
44	III	WB STA 328+52.00	60.00' RT	400 HPS	16'	40'	BREAKAWAY	PROVIDE MULTIVOLT BALLAST & INDIVIDUAL PHOTOCCELL	

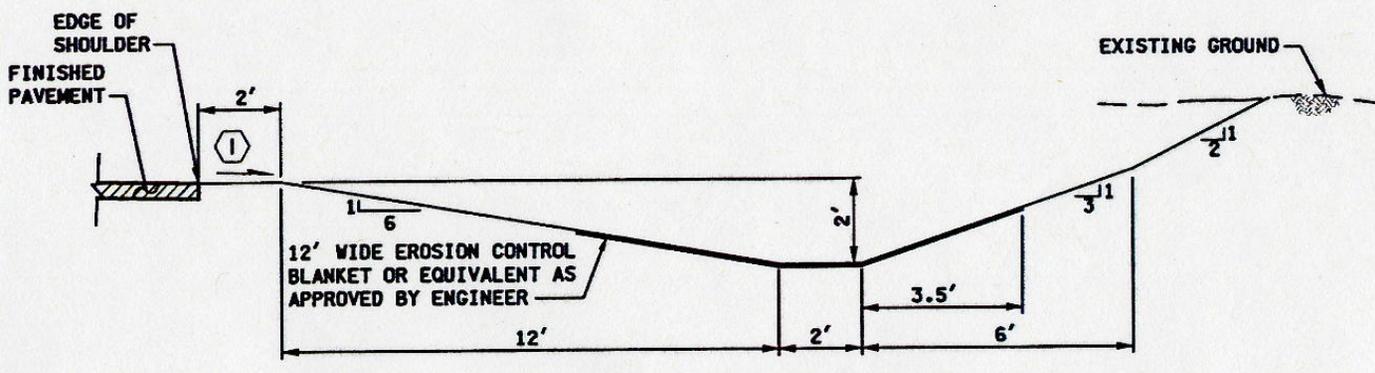
Example 2

0' EB STA 260+27.13 TO EB STA 305+90.00
 12' EB STA 305+90.00 TO EB STA 316+70.56
 0' EB STA 316+70.56 TO EB STA 346+39.27

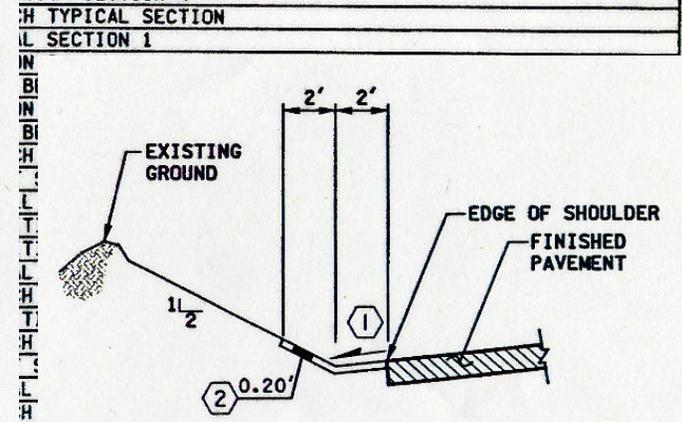


ROADWAY SECTION F
 EB STA 260+27.13 TO EB STA 346+39.27
 WB STA 262+19.70 TO WB STA 345+05.00

CD	LT	290+05.29	292+44.54	TOLL PLAZA MEDIAN SECTION 4
EB	LT	292+44.54	294+30.00	TOLL PLAZA MEDIAN SECTION 5
EB	LT	294+30.00	297+80.00	TOLL PLAZA MEDIAN SECTION 3
EB	LT	297+80.00	298+30.64	TOLL PLAZA MEDIAN SECTION 6
EB	LT	298+30.64	306+00.00	SPECIAL CUT SECTION 4
EB	LT	306+00.00	307+99.00	SPECIAL CUT SECTION 5
EB	LT	307+99.00	308+22.00	TRANSITION SPECIAL CUT SECTION 5 TO TYPE 1 DITCH TYPICAL SECTION
EB	LT	308+22.00	312+73.00	TYPE 1 DITCH TYPICAL SECTION
EB	LT	312+73.00	313+58.00	TRANSITION TYPE 1 DITCH TYPICAL SECTION TO SPECIAL CUT SECTION 4
EB	LT	313+58.00	317+54.00	SPECIAL CUT SECTION 4
FR	LT	317+54.00	317+84.00	TRANSITION SPECIAL CUT SECTION 4 TO TYPE 1 DITCH TYPICAL SECTION
EB	LT	317+84.00	320+55.00	TYPE 1 DITCH TYPICAL SECTION
EB	LT	320+55.00	320+87.00	TRANSITION TYPE 1 DITCH TYPICAL SECTION TO SPECIAL CUT SECTION 4
EB	LT	320+87.00	323+59.61	SPECIAL CUT SECTION 4
EB	LT	323+59.61	325+24.53	TURF REINFORCEMENT MAT SLOPE
FR	LT	325+24.53	327+80.00	DAMP TRANSITION SECTION 4



TYPE 1 DITCH TYPICAL SECTION
 NTS



SPECIAL CUT SECTION 4
 NTS



Example 2



Example 2

Is the signpost plumb or is
the luminaire plumb?



Example 3



Example 3



Example 3



Example 4



Example 4

I met with [redacted] and we probed and took measurements of several foundation where the ecology embankment has been installed behind the foundation.

These are on the off ramp from SR [redacted] to 244 Ave. SE. The measurements are taken from top of foundation to the depth that we could push the bar down into the material. We probed the sides also and they stayed fairly consistent at 8 inches of unstable material on the surface.

Pole base number Depth of unstable material at **2-ft. 4-inches** back of foundation and **1-foot back** of foundation

# 12	4'5"	2'
# 11	2'	1'
# 10	3'1"	3'8"
# 9	3'6"	3'
# 8	3'	3'

The last pole we checked was on SE 200 Street at SE 257 St. This is [redacted] pole base number K 31.

K 31 20-inches back: 3'4" of unstable material and at 36-inches back: 3' of unstable material.

I have attached 2 pictures of the foundation number 12 with the bar pushed into the ground at 2 foot 4 inches back of the foundation and a straight edge laying across the top of the foundation. The red mark on the bar is at 4-foot. This is how we took the measurements listed above.

Example 5



Example 5

AUG 8 2005

Example 6

This person is standing on the grated inlet that was constructed (by change order) to drain the water away from the hole this traffic signal pole was built into.



The guardrail was also constructed (by change order) to keep vehicles away from the hole this traffic signal pole was built into.



Example 6

Grade line

Example 7

JUL 1 2004



Roughly 5' 3"
Existing grade

JUL 1 2004





Example 7

Back fill est. line

JUL 1 2004

WARNING
ELECTRICAL HAZARD
DO NOT TOUCH
UNLESS QUALIFIED

Example 8



Example 8



Example 8



Example 9

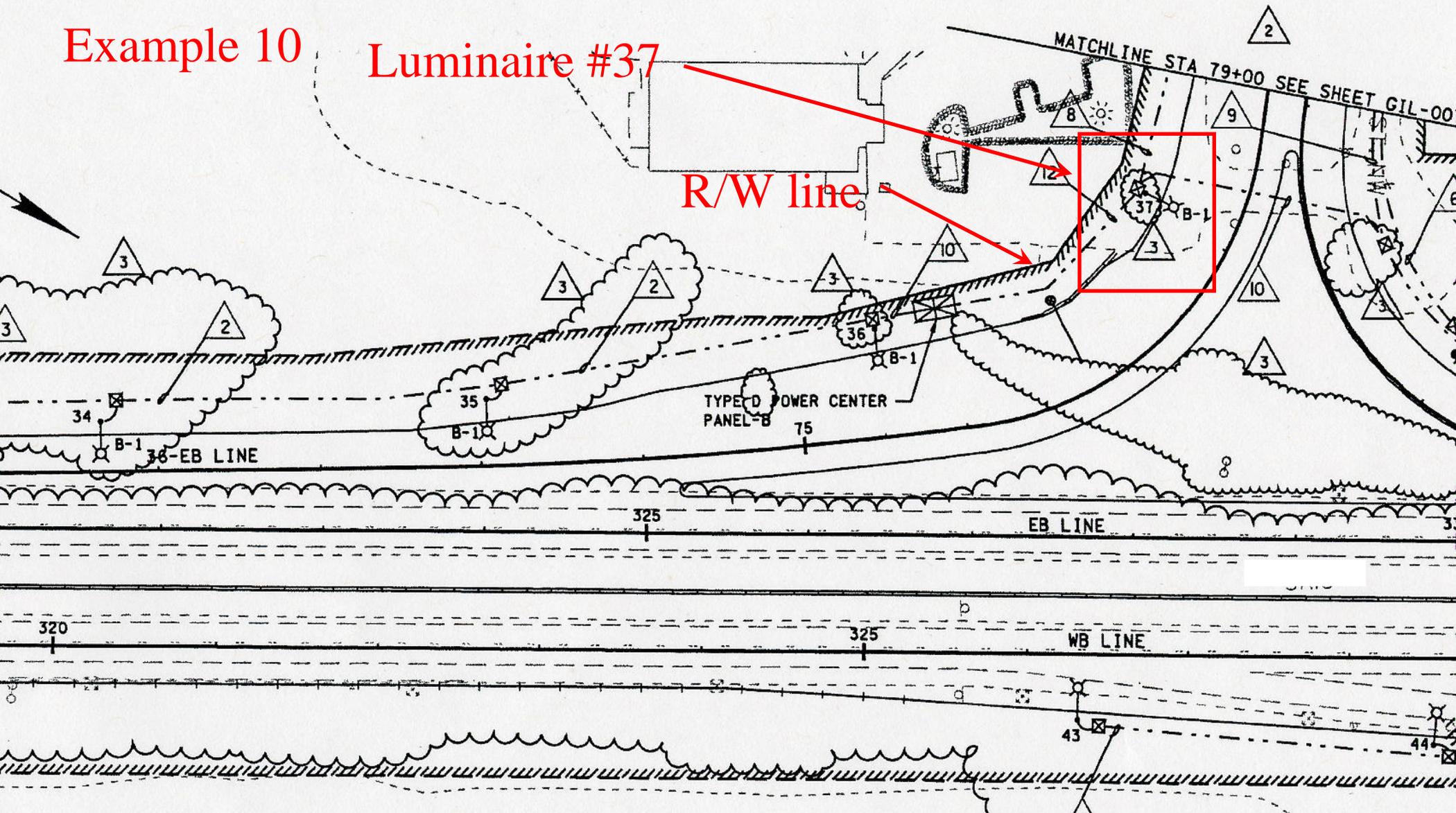




Example 9

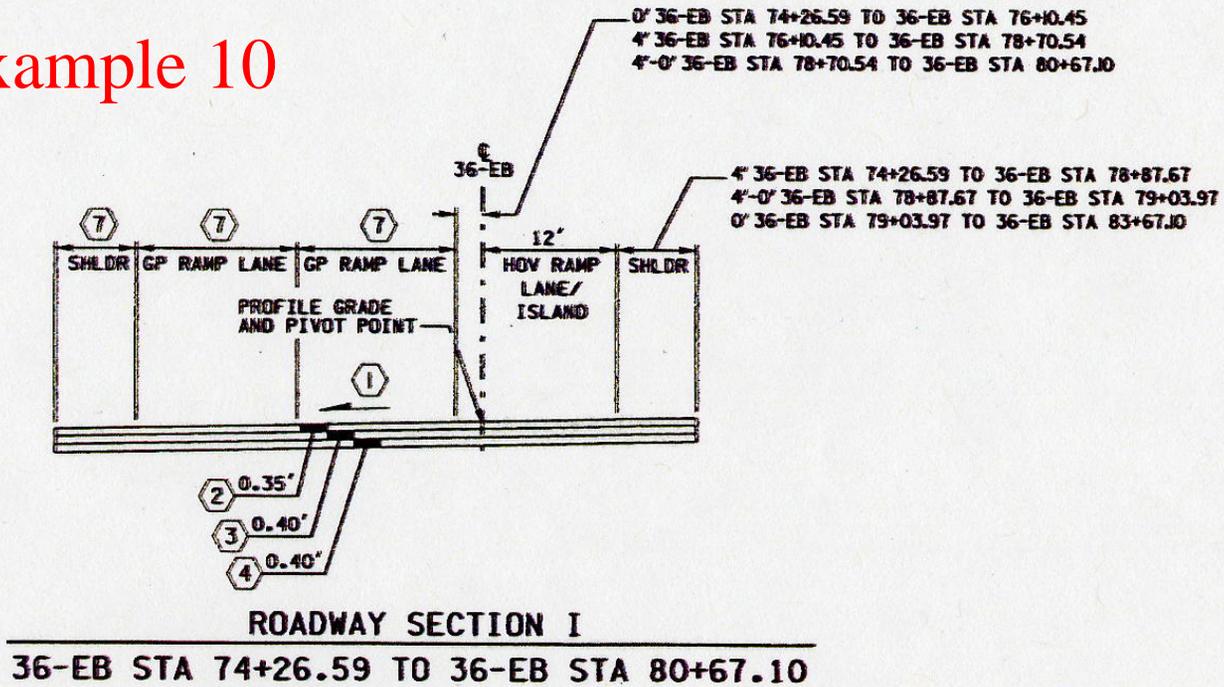
Example 10

Luminaire #37

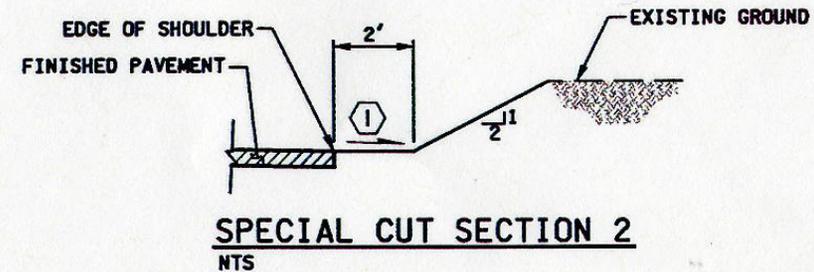


POLE AND LUMINAIRE SCHEDULE									
POLE NO.	DIST. TYPE	LOCATION		LUMINAIRE TYPE	MAST ARM	HT	POLE BASE TYPE	DESCRIPTION	
		STATION	OFFSET						
34	III	36-EB STA 70+65.00	30.00' LT	400 HPS	14'	40'	BREAKAWAY	PROVIDE MULTIVOLTAGE BALLAST	
35	III	36-EB STA 73+04.00	40.00' LT	400 HPS	14'	40'	BREAKAWAY	PROVIDE MULTIVOLTAGE BALLAST	
36	III	36-EB STA 75+50.00	85.00' LT	400 HPS	14'	40'	BREAKAWAY	MULTIVOLTAGE BALLAST	
37	III	36-EB STA 78+10.00	60.00' LT	400 HPS	14'	40'	BREAKAWAY	MULTIVOLTAGE BALLAST	
43	III	WB STA 326+32.00	45.00' RT	400 HPS	16'	40'	BREAKAWAY	PROVIDE MULTIVOLT BALLAST & INDIVIDUAL PHOTOCCELL	
44	III	WB STA 328+52.00	60.00' RT	400 HPS	16'	40'	BREAKAWAY	PROVIDE MULTIVOLT BALLAST & INDIVIDUAL PHOTOCCELL	

Example 10



SHOULDER SLOPE TABLE				
LINE	SIDE	LIMITS		SHOULDER SECTION
		STA	STA	
36-EB	RT	74+26.59	76+87.84	RAMP TRANSITION SECTION 4
36-EB	RT	76+87.84	77+15.00	TYPE 1 DITCH TYPICAL SECTION
36-EB	RT	77+15.00	78+60.00	FILL TYPICAL SECTION 1
36-EB	RT	78+60.00	81+00.00	FILL TYPICAL SECTION 1 AND TYPE 2 DITCH TYPICAL SECTION
36-EB	RT	81+00.00	81+90.85	FILL TYPICAL SECTION 1
36-EB	RT	81+90.85	82+64.00	BARRIER CURB SECTION 2
36-EB	RT	82+64.00	84+04.00	BARRIER CURB SECTION 1
36-EB	RT	84+04.00	85+91.00	BARRIER CURB SECTION 2
36-EB	RT	85+91.00	86+60.00	BARRIER CURB SECTION 1
36-EB	RT	86+60.00	87+03.00	BARRIER CURB SECTION 3
36-EB	RT	87+03.00	87+16.97	BARRIER CURB SECTION 1
36-EB	LT	74+26.59	76+33.52	TURF REINFORCEMENT MAT SLOPE
36-EB	LT	76+33.52	77+55.00	SPECIAL CUT SECTION 1
36-EB	LT	77+55.00	79+50.00	SPECIAL CUT SECTION 2
36-EB	LT	79+50.00	80+15.00	FILL TYPICAL SECTION 1 AND TYPE 2 DITCH TYPICAL SECTION
36-EB	LT	80+15.00	80+95.00	GALVANEZED DITCH
36-EB	LT	80+85.00	81+90.85	BARRIER CURB SECTION 1
36-EB	LT	81+90.85	82+45.00	BARRIER CURB SECTION 1
36-EB	LT	82+45.00	84+15.00	FILL TYPICAL SECTION 1
36-EB	LT	84+15.00	85+60.00	SPECIAL CUT SECTION 2
36-EB	LT	85+60.00	87+16.97	BARRIER CURB SECTION 1
EB-36	RT	52+30.00	56+73.39	FILL TYPICAL SECTION 1
EB-36	LT	50+27.04	51+77.00	FILL TYPICAL SECTION 1 AND TYPE 2 DITCH TYPICAL SECTION
EB-36	LT	51+77.00	52+00.00	TRANSITION TO BERM SECTION 1
EB-36	LT	52+00.00	53+83.00	BERM SECTION 1
EB-36	LT	53+83.00	54+06.00	TRANSITION BERM SECTION 1 TO BERM SECTION 2
EB-36	LT	54+06.00	54+35.00	BERM SECTION 2
EB-36	LT	54+35.00	54+94.00	TRANSITION BERM SECTION 2 TO BERM SECTION 1
EB-36	LT	54+94.00	56+73.39	BERM SECTION 1





Example 10



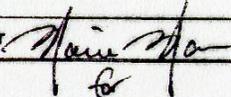
Example 10

Request for Information

RFI-869

Page 1 of 1

(Number is assigned by TNC Construction)

Part 1: Request (from TNC construction, subcontractors or quality control)			
1. Originator: JJ Jacoby		Company: TNC	
		Ph #: 853-9715	
2. Project Area:	<input checked="" type="checkbox"/> Gig Harbor	<input type="checkbox"/> NB Substructure	<input type="checkbox"/> NB Superstructure
		<input type="checkbox"/> Existing Bridge	<input type="checkbox"/> Tacoma
3. Reference Drawing(s) or Specification(s):		Rev No:	Title of Document
GIL-005		3	Gig Harbor Mainline Illumination Plan EB Sta 320+00 to EB Sta 335+00
4. Reason for the request and potential solution: (include potential cost or schedule impact)			
The luminaire pole # 37 is located at the top of a cut slope at 18' behind the fog line. The slope of the cut is approximately 1-1/2 to 1. The luminaire pole base is 3-0' diameter by 4-1/2', deep per the standard plans. This would leave the leading edge of the pole with only 2-1/2' below grade. This does not appear to be an optimal depth for the pole base.			
We suggest that the pole depth be increased to 6-1/2', to compensate for the placement in the slope.			
We also suggest that the pole center be relocated 2' closer to the fog line so that the luminaire avoids interferences with existing utilities at the top of the slope.			
5. Requested Response Date:		9/March/2005	Date Sent: 7/Mar/2005
6. Send to TNC:		E-Mail: pcwheato@bechtel.com	Fax: 253-858-1816
Part 2: TNC Review / Response (by TNC Construction)			
7. TNC Response:			
8. TNC Reviewer:		Date of Review:	
Part 3: Design Response			
9. Design Responder: Guillermo Sanchez		Company: PTG/HNTB	Ph#: 425.450.2543
10. Design Response or Comments:			
As coordinated with Joe Jacoby on 3/09/05.			
Per the design the cut slope should have been a 2:1 slope at the location where the pole is to be installed. It is acceptable to install the luminaire pole 2 ft closer to the edge stripe. It is acceptable to increase the luminaire pole foundation depth to 6½'.			
DCN GIL-005-03-01 will be issued concurrently with this response to revise the pole location and depth of foundation.			
11. Design Reviewer Approval:		Ray Wright	Date: 3/09/05
12. Design Supervisor Approval:		Ben Whisler 	Date: 3/14/05

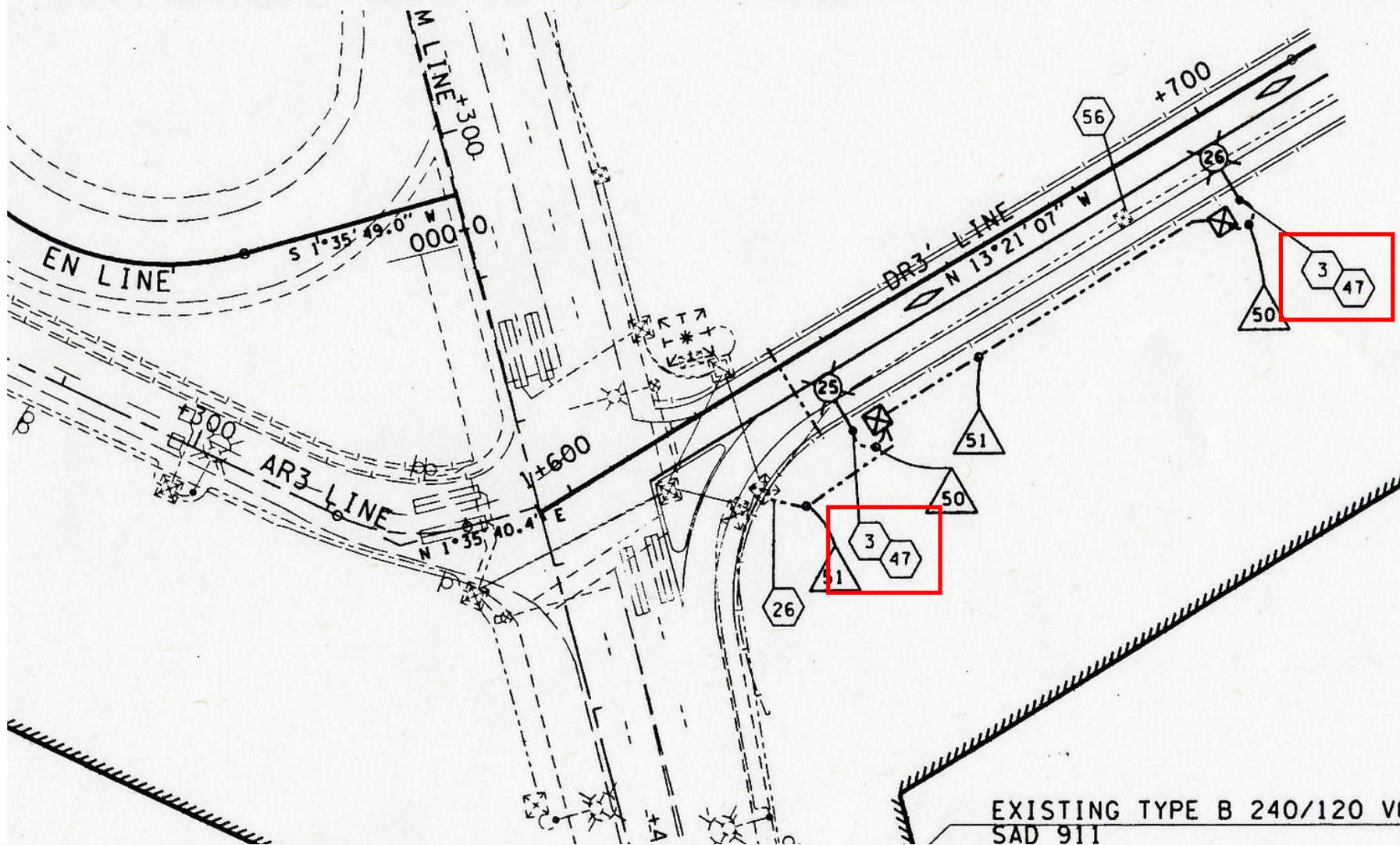
Example 10

"RFIs are not authorized change documents and cannot be used to direct a change in (sub) contract requirements. If the response has a cost or schedule impact, it is the (sub)contractor's responsibility to immediately advise TNC's Authorized Representative and follow up the notice in a "pre determined" number of days with a (sub)contractor change proposal. Work undertaken without this approval is at the (sub) contractor's risk and expense."

CONSTRUCTION NOTES:

Example 11

- 3 CONSTRUCT FOUNDATION AND INSTALL LUMINAIRE STANDARD PER LUMINAIRE SCHEDULE.
- 26 INSTALL CONDUIT INTO EXISTING JUNCTION BOX. SPLICE NEW CIRCUIT WIRES TO EXISTING CIRCUIT "A" ILLUMINATION CONDUCTORS.
- 47 EXTEND FOUNDATION DEPTH 4FT. VERIFY ADDITIONAL DEPTH WITH THE ENGINEER.



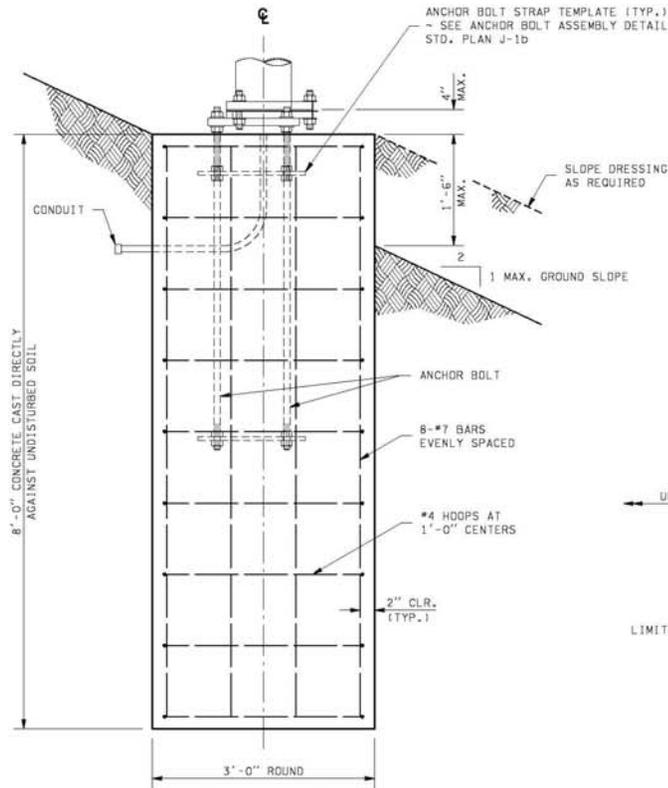
LUMINAIRE SCHEDULE SERVICE NO. SAD 911

LUMINAIRE NUMBER	CIRCUIT	LOCATION			LUMINAIRE ELEVATION	TYPE-DISTRIBUTION-WATTAGE	MAST ARM	HI	BASE TYPE	COMMENTS
		STATION	OFFSET	RT						
25	A	DR3' 1+637.60	12.17	RT	N/A	TYPE III-MEDIUM CUTOFF-400W HPS	4.9M	15.24M	FIXED	IN GRADE
26	A	DR3' 1+699.07	12.66	RT	N/A	TYPE III-MEDIUM CUTOFF-400W HPS	4.9M	15.24M	FIXED	IN GRADE

- ① TEMPORARY SLOPE OR SHORE AS REQUIRED
- ② ANY EXPOSED TOP PORTION (1'-6" MAX.) OF THE FOUNDATION SHALL BE FORMED TO CREATE A SMOOTH CONCRETE SURFACE. ALL FORMING SHALL BE REMOVED UPON COMPLETION OF FOUNDATION CONSTRUCTION.

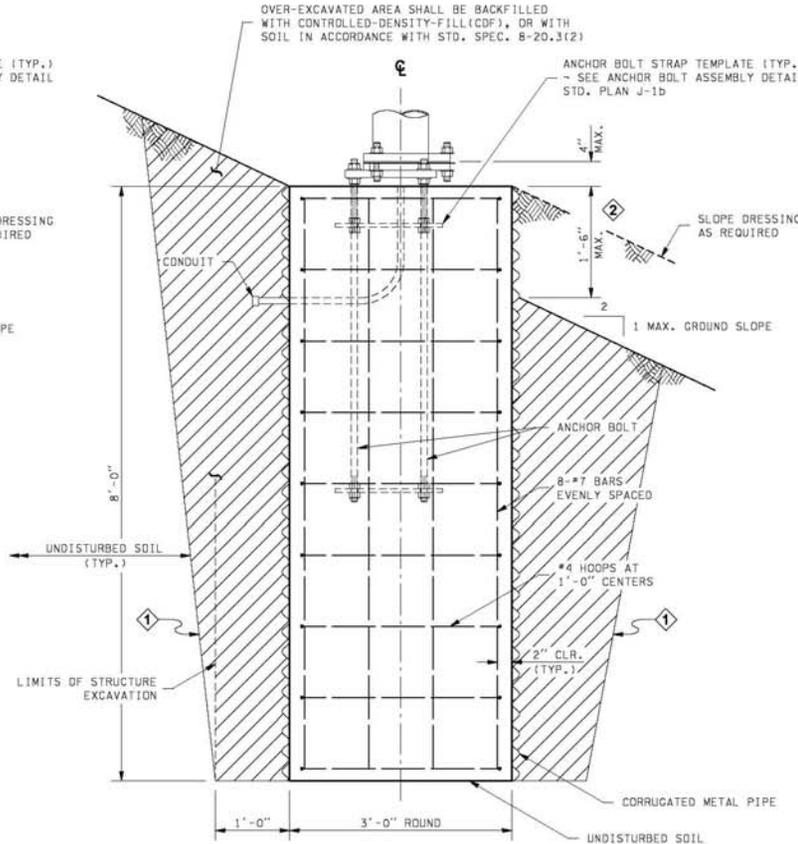
NOTES

1. See Standard Plan J-1b for anchor bolt, slip base, fixed base, and anchor bolt orientation details not shown.
2. Strap templates shall be held in place by nuts and a 4"x 3/4" square washer, 6" from the top of the foundation and 3" from the bottom of the anchor bolts. The square washer shall be placed between the bottom nut and the strap template. 12 nuts and 6 washers required per fdn.
3. These foundations are designed for a minimum of 1,500 PSF allowable lateral bearing pressure for the soil. A special foundation shall be required for soil with lower allowable lateral bearing pressure than 1,500 PSF.
4. These foundations are designed for installation on level ground, or on sloping ground not to exceed 2:1. Slopes steeper than 2:1 require a special design.
5. Slip bases are not required on poles outside of the Design Clear Zone, nor on poles installed behind traffic barrier at an offset which exceeds the deflection distance of the barrier system.
6. Light standard pole height shall not exceed 50'.
7. Installation of 50' pole with double mast arms on a slip base is not allowed.
8. For installation of a 50' pole with 12'-0" max. double mast arms on a fixed base, the foundation shall be 8'-0" deep; for anchor bolts see Standard Plan J-1b.
9. For foundations within the Design Clear Zone, the slip base shall be within 4" above the ground surface.
10. See Std. Plan C-8b for base plate and foundation requirements when light standards are mounted on conc. barrier.
11. Foundation constructed within Ecology Embankments shall be increased in depth by the depth of the Ecology Embankment.



FOUNDATION REINFORCEMENT DETAIL
CONCRETE CAST DIRECTLY AGAINST UNDISTURBED SOIL

ALTERNATE # 1
N.T.S.



FOUNDATION REINFORCEMENT AND BACKFILL DETAIL
CONCRETE CAST INSIDE CORRUGATED METAL PIPE STAY-IN-PLACE FORM. PAPER OR CARDBOARD FORM SHALL NOT BE USED BENEATH THE GROUND SURFACE. ②

ALTERNATE # 2
N.T.S.

FILE NAME	LightStandardFoundationPlan	REGION NO.	STATE	FED. AID PROJ. NO.		PL01
TIME	10:30:34 AM	10	WASH			SHEET
DATE	2/8/2006	JOB NUMBER			OF	
PLOTTED BY	su jkam	CONTRACT NO.		LOCATION NO.		SHEETS
DESIGNED BY						
ENTERED BY						
CHECKED BY						
PROJ. ENGR.						
REGIONAL ADM.		REVISION	DATE	BY		

What's new in illumination design (or not so new) - continued

- Cross-sections
- At every location you are installing a luminaire you need to check the roadway sections for the slope in that area. You need this information to input the mounting height of the luminaire in AGI and to know how big to make the foundation.

What's new in illumination design (or not so new) - continued

- Reviewing luminaire locations
 - After initial luminaire locations are identified the designer needs to check to make the location will work with other design features. The designer should review the approved channelization plan, existing and proposed utility plans, existing and proposed drainage plans, existing and proposed ITS plans, existing and proposed signing plans, last minute changes / addendums and all those other items that caught you in the past. (let us know what they are and we will add them here)

Reference Materials

- Roadway Lighting Design Guide – AASHTO Oct. 2005
(update to-An Informational Guide for Roadway Lighting – AASHTO. 1984)
- Roadway Lighting - RP-8-00 IESNA (Illuminating Engineering Society of North America) 2000 (update to RP-8, 1983)
- Recommended Practice for Tunnel Lighting IESNA RP-22-05
(updates Recommended Practice for Tunnel Lighting – IESNA. 1996)
- Tunnel Lighting Design Procedures – FHWA. 1985
- International Commission on Illumination (CIE). 1992
- WSDOT Design Manual. Chapter 840 Nov. 2005
- WSDOT Design Manual . Chapter 820 Nov. 1999
- WSDOT Traffic Manual. 1993

Contacts

- Terry Thayer – Traffic Standards Engineer - HQ
Traffic Office 360-705-7290
- Keith Calais – Signal & Illumination Engineer -
HQ Traffic Office 360-705-6986
- Ted Bailey – Signals, Illumination & ITS Engineer
- HQ Traffic Office 360-705-7286

Any questions?