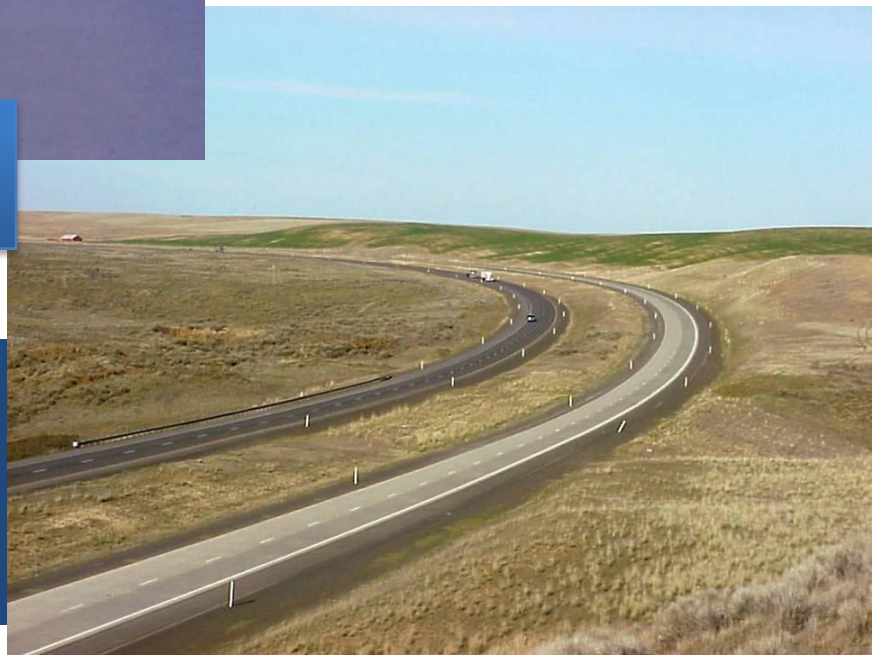
HIGHWAY ENGINEERING
CE431

CHAPTER 7

HIGHWAY ENGINEERING CE431

Geometric Design



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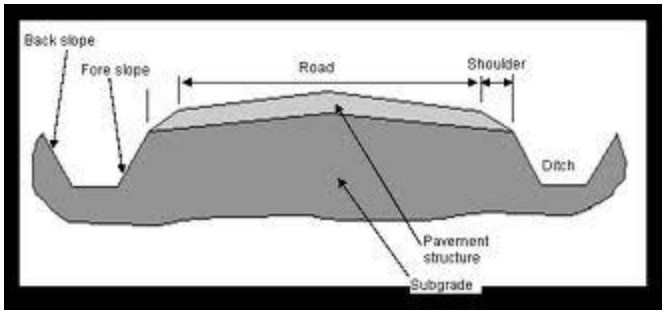
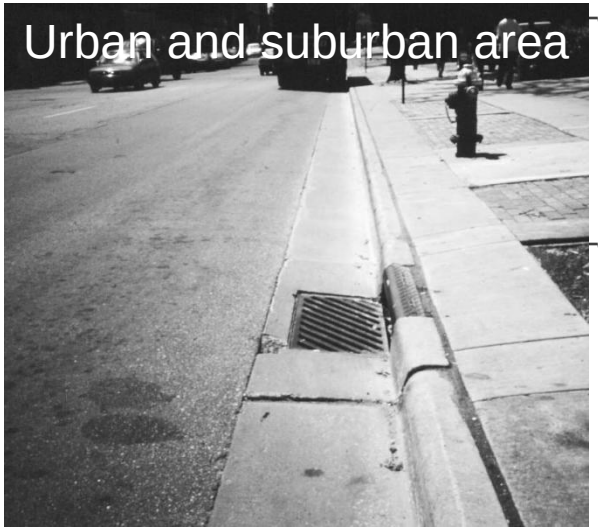
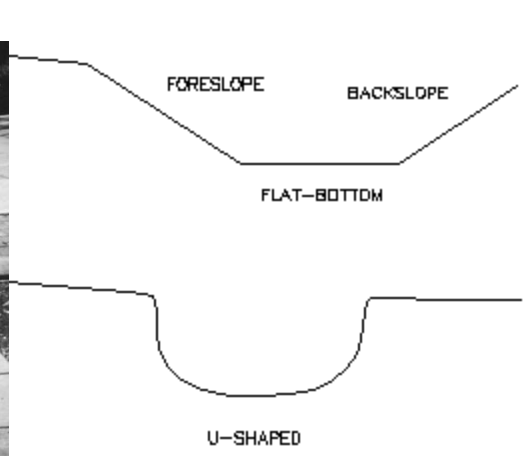
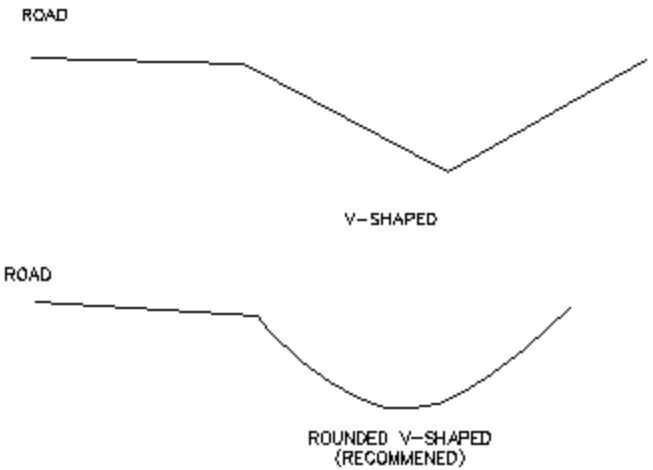
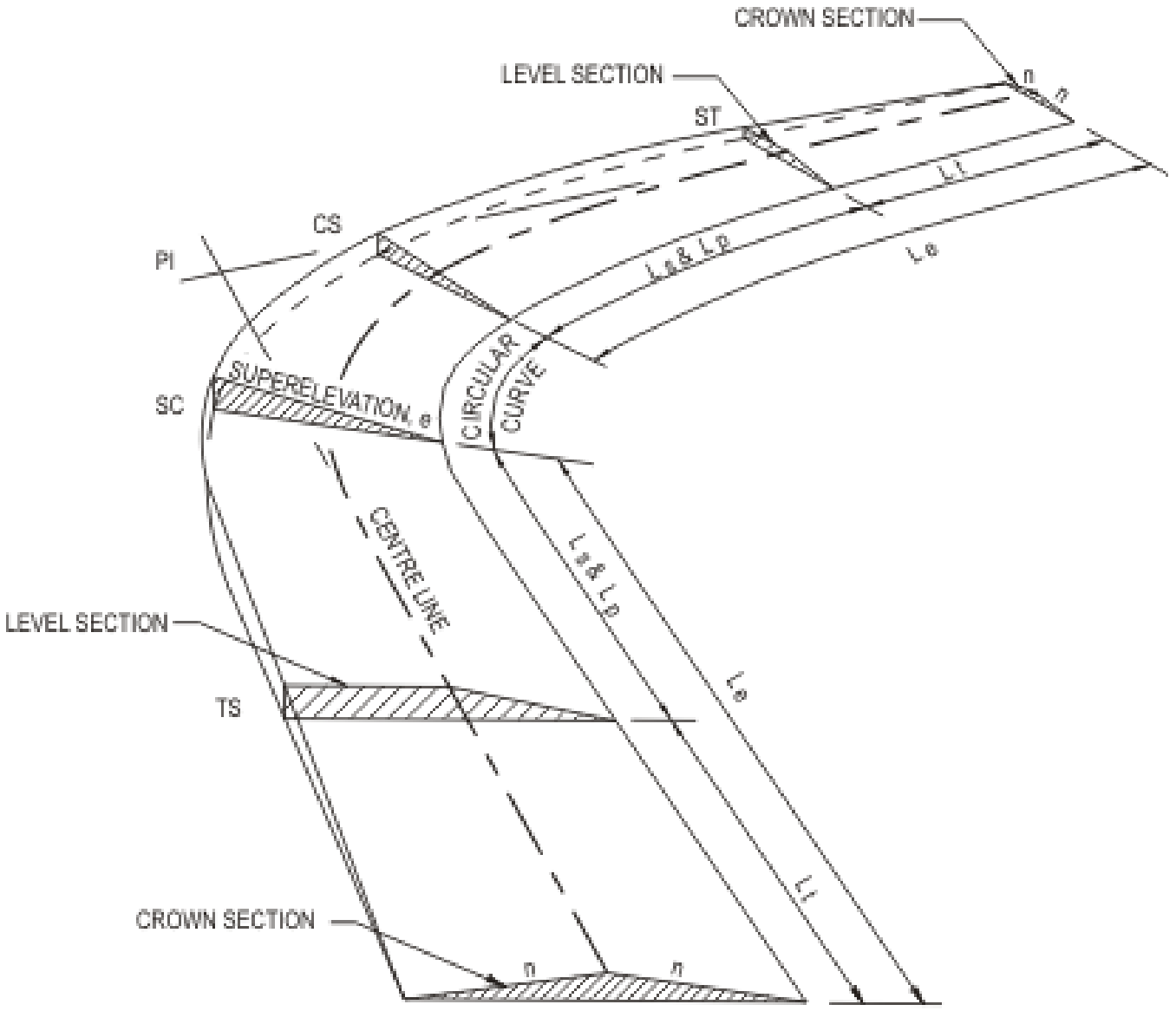

Back slope
Fore slope
Road
Shoulder
Ditch
Pavement structure
Subgrade

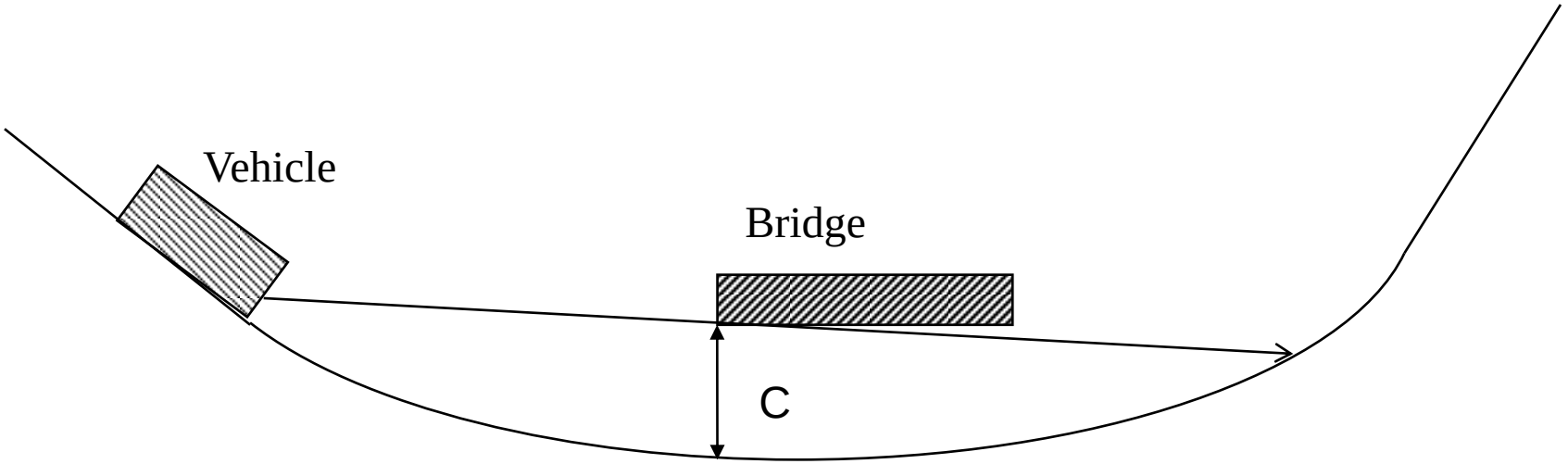

Urban and suburban area


ROAD
FORESLOPE
BACKSLOPE
FLAT-BOTTOM
U-SHAPED


ROAD
V-SHAPED
ROAD
ROUNDED V-SHAPED
(RECOMMENED)


CROWN SECTION
LEVEL SECTION
ST
CS
PI
SC
SUPERELEVATION, e
CIRCULAR CURVE
CENTRE LINE
LEVEL SECTION
TS
CROWN SECTION
n
n
n
n
L
Ls & Lp
Le

Minimum length of sag vertical curve as controlled by sight distance underneath a structure (bridge)

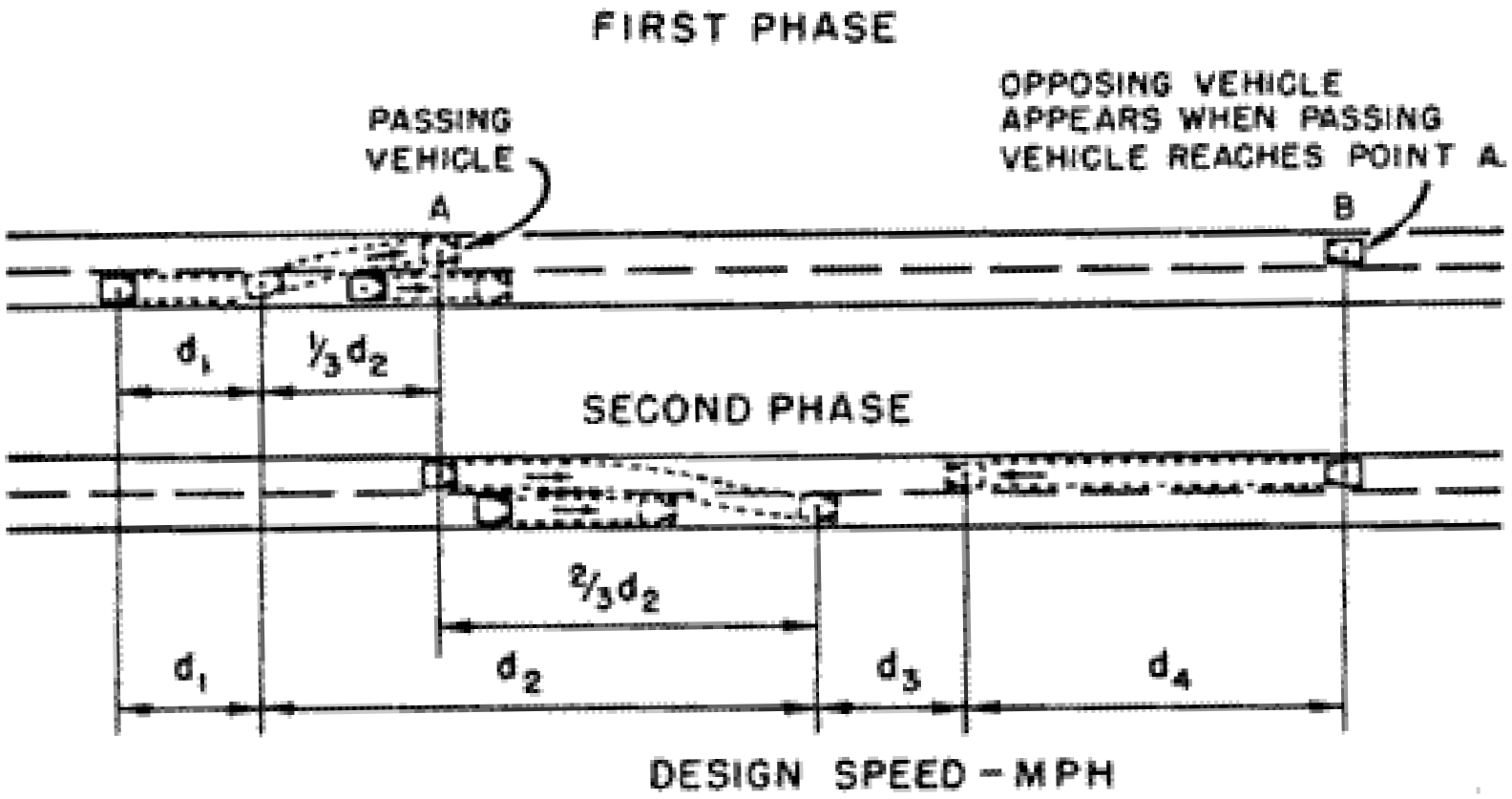


$S < L$ $\qquad L = \dfrac{AS^2}{8\left[C - \dfrac{h_1 + h_2}{2}\right]}$

$S > L$ $\qquad L = 2S - \dfrac{8\left[C - \dfrac{h_1 + h_2}{2}\right]}{A}$

C = Vertical clearance to the critical edge of the structure

Minimum Passing Sight Distance

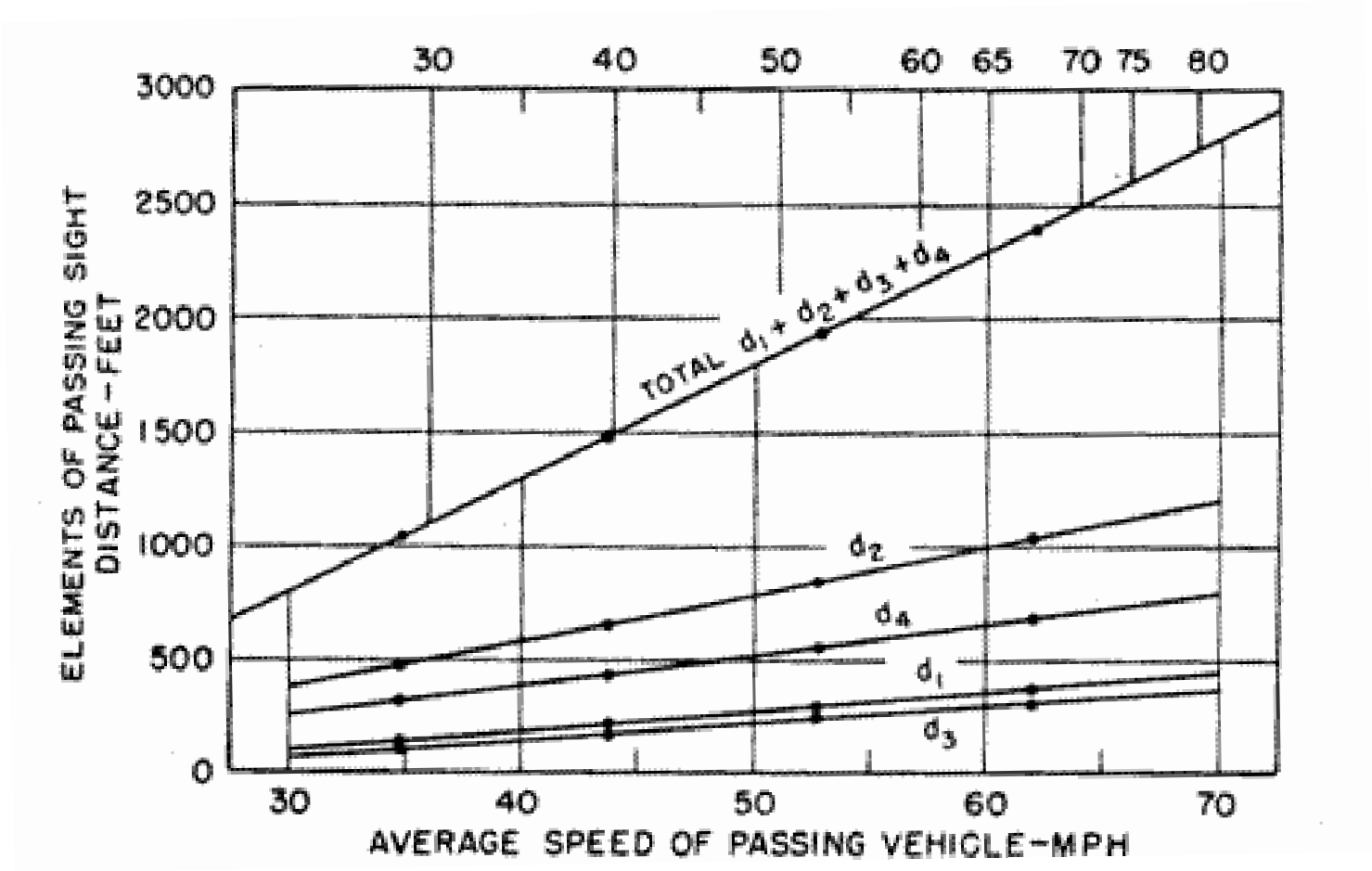


Minimum Passing Sight Distance (continued)

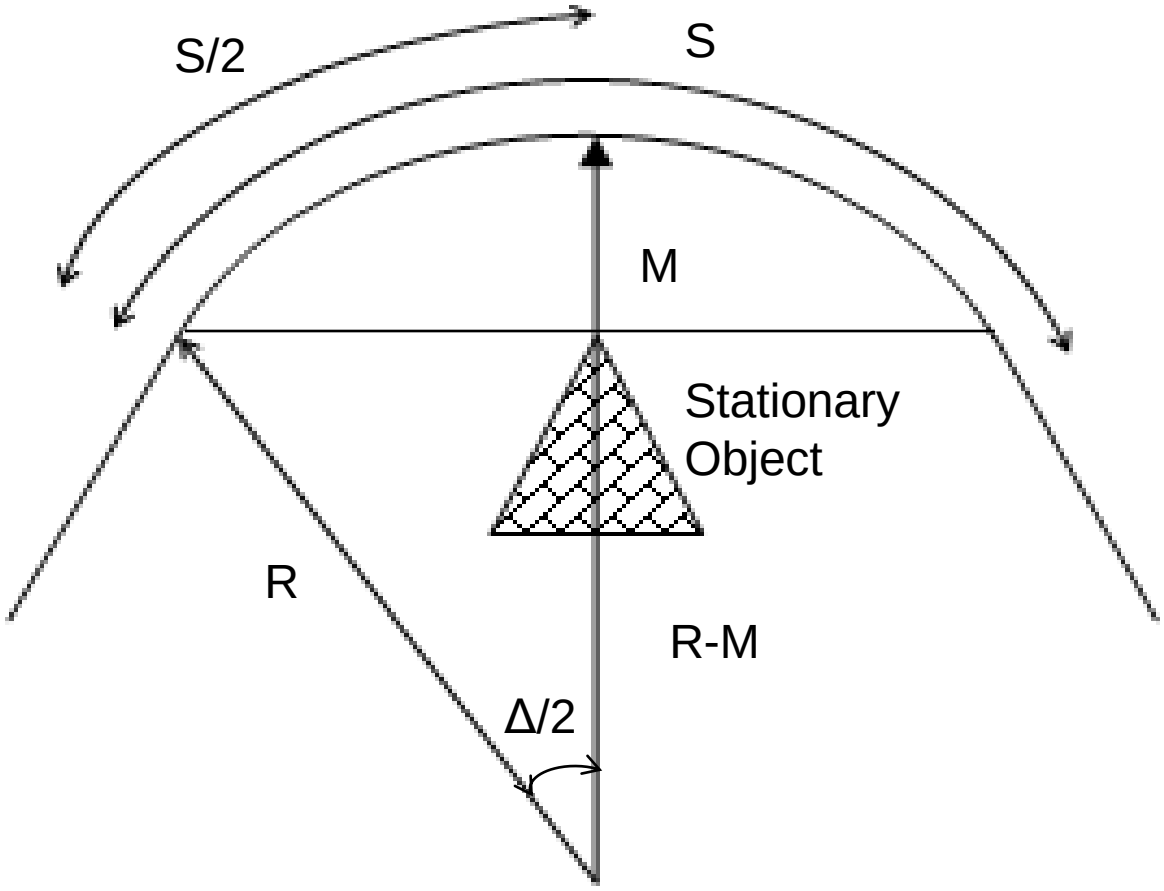
Elements Of Safe Passing Sight Distance For Two-lane Highways

Speed Group (mph)"	*30-40*	*40-50*	*50-60*	*60-70*
Average Passing Speed (mph)	34.9	43.8	52.6	*62.0*
Initial maneuver:				
a = average acceleration (mphps)"	1.40	1.43	1.47	1.50
t_1 = time (sec)"	3.6	4.0	4.3	4.5
d_1 = distance traveled (ft)'	145	215	290	370
Occupation of left lane:				
t_2 = time (sec)"	9.3	10.0	10.7	11.3
d_2 = distance traveled (ft)	475	640	825	1030
Clearance length:				
d_3 = distance traveled (ft)	100	180	250	300
Opposing vehicle:				
d_4 = distance traveled (ft)	315	425	550	680
Total distance, $d_1 + d_2 + d_3 + d_4$ (ft)	1035	1460	1915	2380

Minimum Passing Sight Distance (continued)



Sight Distance on Horizontal Curves



Sight Distance on Horizontal Curves (continued)

- For $S < L$
- $(S/2)/\theta = 100/D$, $\theta = SD/200$
- $M = R - R \cos \theta = R [1-\cos (SD/200)]$
- $S = (200/D) \cos^{-1} [(R-M)/R]$

- Other approximate equations:
- $M = L (2S-L)/ 8R$ for $S \geq L$
- $M = S^2 / 8R$ for $S \leq L$

CHAPTER 13

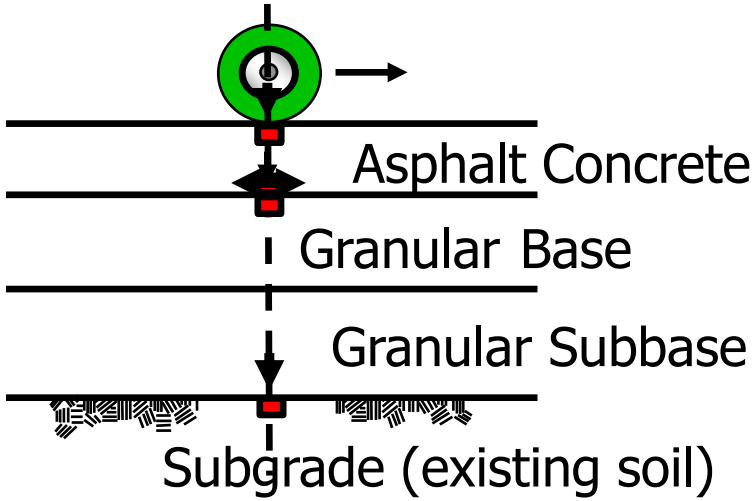
SURVEYS, PLANS, AND ESTIMATES

Aerial Photograph (stereographic)

Aerial Photograph (Oblique)

CHAPTER 15

HIGHWAY MATERIALS



Moisture–Density Relationship

→ 95% MOD means?

$\gamma_{field} = \gamma_{laboratory} * 0.95$

$\gamma_{lab} \Longrightarrow$ Modified AASHTO Compaction.

→ How we get γ_{field}?

Use sand replacement test

OR Troxilars (nuclear devices)

Why need to determine optimum moisture content?

Because it is the content that provides maximum density.

Why $\gamma_{field} < \gamma_{lab}$?