
BOOK #2

TELEDYNE
NATIONAL TRACING PAPER

Procedures:

A. Determining Available Sight Distance.

The available sight distance (SD) is determined by making observations at each site under study. Assumptions and criteria used for this part of the study are as follows.

1. The driver's eye height is 3.50 feet.

2. The height of the target used at the driveway where passengers are picked up or discharged is 4.0 feet. This is approximately 1/2 the height of a school bus and would include the flashing lights and a substantial portion of the bus itself.

3. The observation point is positioned on the roadway at approximately the same lateral location as the driver's eye.

By using the above assumptions and criteria, the available sight distance is determined.

B. Determining The Stopping Sight Distance.

The method of computing stopping sight distance is taken from the 1984 edition of A Policy on Geometric Design of Highways and Streets published by AASHTO. Stopping sight distance is composed of two parts. First is the distance traveled during perception and reaction and second is the actual distance to brake to a stop. The following formula is used.

$$d = V(1.47)(t) + \frac{V^2}{30(f+g)}$$

The terms in this equation are defined as follows.

d = The total stopping sight distance in feet.

V = The initial speed in miles per hour.

t = The perception/reaction time in seconds.

f = The coefficient of friction between the tires and the roadway.

g = The grade expressed as a decimal.

Assumptions made in computing the stopping sight distance are as follows.

1. The initial speed is 60 MPH for a rural location which allows for a factor of safety over the posted 55 MPH speed limit. If the location is in a reduced speed zone, use the actual posted speed limit.

2. Perception time is 1.5 seconds.

3. Reaction time is 1.0 seconds.

4. Total perception - reaction time (t) equals 2.5 seconds.

5. The coefficient of friction (f) is 0.30 which is representative of wet pavement conditions.

6. The grade used is the actual percent divided by 100 or the average grade if the approach is on a vertical curve.

## FORMULAE FOR SOLVING RIGHT TRIANGLES

IM 9.101

The following is an example showing how the stopping sight distance should be computed. Data to be used is as follows.

V = 60 MPH

t = 2.5 seconds

f = 0.300 (wet pavement)

g = -4.50% or 4.50/100 = 0.045

$$d = V(1.47)(t) + \frac{V^2}{30(f \pm g)}$$

$$d = 60(1.47)(2.5) + \frac{(60)^2}{30(0.300 - 0.045)}$$

$$d = 220.5 + \frac{3600}{30(0.255)}$$

$$d = 220.5 + 470.6$$

$$D = 220.5 + \frac{120}{0.3 \pm g}$$

352
461

d = 691.1, rounded to 690 ft.

C. Determination of Signing Needs.

The available sight distance (SD) needs to be compared with the stopping sight distance (d) to determine if a School Bus Stop Ahead sign is needed.

When the situation involves approaching the front of a stopped school bus, 10 feet should be added for a passenger crosswalk and 25 feet for a clear zone. The analysis would be as follows.

(1a) If SD is greater than d + 10 + 25, a School Bus Stop Ahead sign is not justified.

(1b) If SD is equal to or less than d + 10 + 25, a School Bus Stop Ahead sign is justified.

When the situation involves approaching the rear of a stopped school bus, 35 feet should be added for the bus and 25 feet for a clear zone. The analysis is as follows.

(2a) If SD is greater than d + 35 + 25, a School Bus Stop Ahead sign is not justified.

(2b) If SD is equal to or less than d + 35 + 25, a School Bus Stop Ahead sign is justified.

D. Installation of a Sign.

If a School Bus Stop Ahead sign is justified under 1b or 2b in Section C above, a standard 30" x 30" warning sign should be used. It should be installed approximately 500 feet in advance of the point where 1/2 of the school bus is visible, i.e., SD + 500 feet.

c)





BOOK #2
INDEX

# School Bus Stop Ahead Requests for Sign Placement Sight Dist. & Calculations

School Bus Stop Ahead Sign Determination
1305 E Dunkerton Rd.
Requested by Princ.
Dunkerton Schools

Target Ht = 4.0'
Observer Ht = 3.5'

Sight Dist from West = 756'
Sight Dist. from East = 1185'

$$d = 60(1.47)2.5 + \frac{60^2}{30(0.30 - 0.04)}$$

$$d = 220.5 + \frac{3600}{7.8}$$

$$d = 682.0$$

d + 25 + 35 = Required Safe Dist. *

682.0 + 25 + 35 = RSD

RSD = 742'

Sign not recommended
in either direction

WL 2-7-96



Sight Distance West = 756'
Sight Distance East 1185'

School BUS "STOP Ahead" SIGN Determ.

Myron Meinhart 12335 HOLMES RD.

Req by DAVID Pappone, Hudson Schools Supt.

Letter dtd 9-3-97 Rec'vd 9-4-97

TARGET HT. = 4.0' (℄ RES. ENTR. on W. Edge Rd)

Observer = 3.5' @ 362' N. of TARGET Loc.

$$d = \frac{(60)(1.47)(2.5)}{\text{MPH}} + \frac{60^2}{30(.30+G)}$$

$$d = 221 + \frac{60^2}{30(.30-.04)}$$

$d = 221 + 461$

$d = 682.5$ (Req.) vs. 362' (OBS.)

$717.5 = d + 10 + 25$ (Approach front - REQ.)

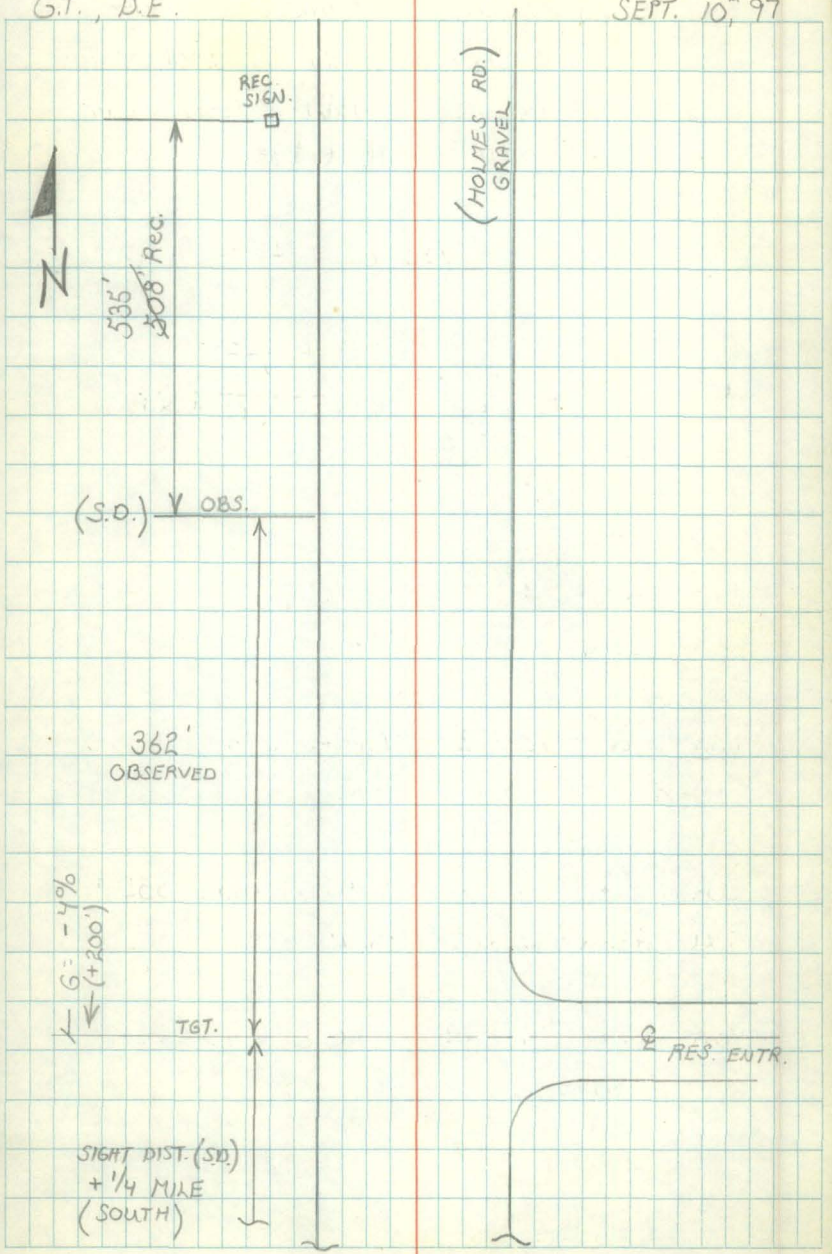
$742.5 = d + 35 + 25$ (Approach Rear - REQ.)

Observed @ 362' (LESS than Required 682.5')

"SIGN Recommended." - D.E. -

WARNING SIGN TO BE PLACED 897' NORTH of ℄ drive. Field staked recommended location @ West edge gravel road, 9/10/97

G.T., D.E. SEPT. 10th, 97



School Bus STOP Ahead SIGN Det.

Wayne McGarvey 2814 W. EAGLE RD.

Req. by David Pappone, Hudson Schools Supt.

Letter dtd 9-3-97 Rec'vd 9-4-97

TARGET = 4.0' (℄ Res. Entr. on S. Edge Rd.)

Obserserver = 3.5' @ 603' W. of Target Loc.

$$d = (60)(1.47)(2.5) + \frac{60^2}{30(.30 + g)}$$

$$d = 221 + \left(120 \div (.30 - .02)\right)$$

$d = 221 + 429$

$d = 650'$ (Req.) vs. S.D. = 603' (OBSERVED)

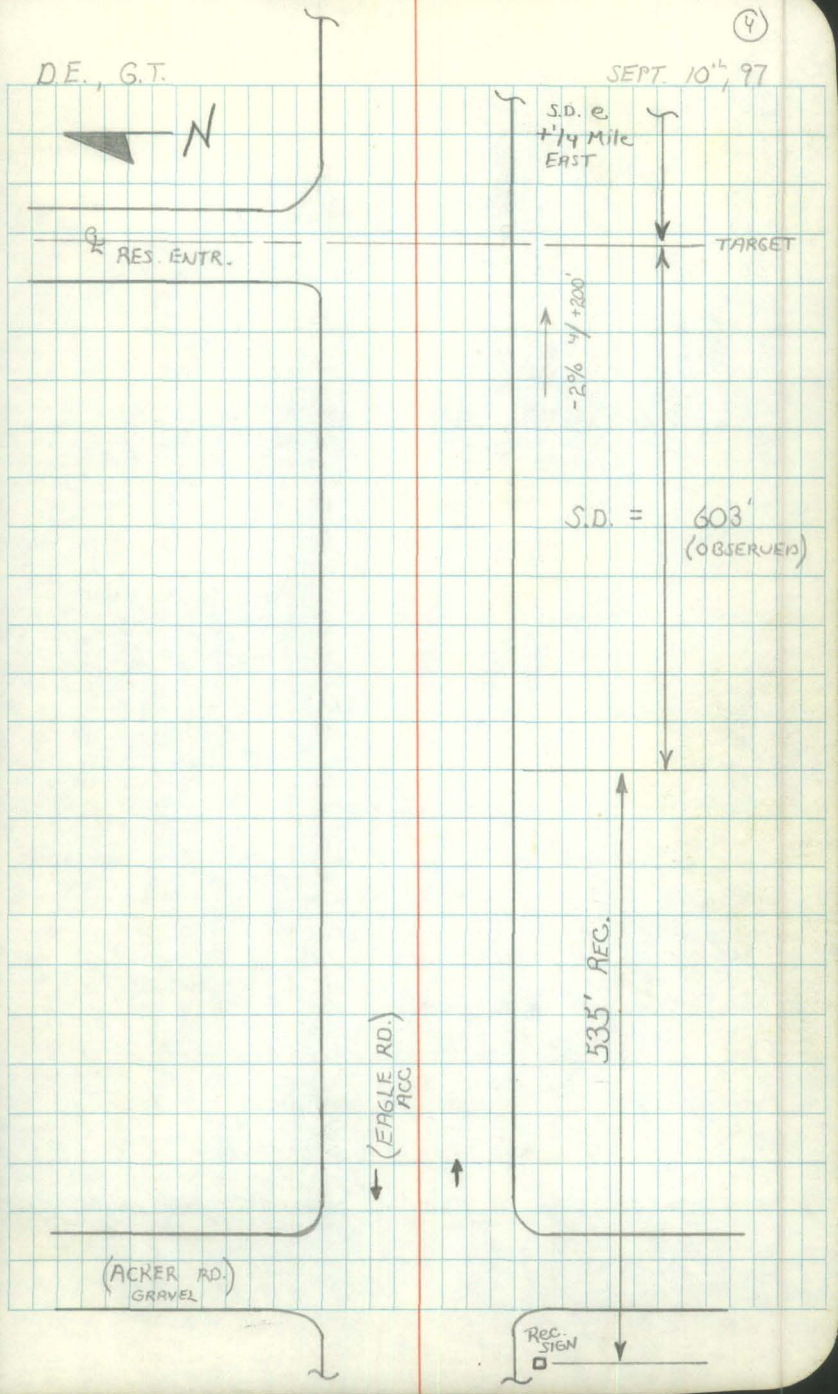
"SIGN Recommended" OBS. < Req.

SIGN Recommended being placed @ 1138'
West of ℄ Residential drive. (603' + 535')
Field staked S. Edge Shoulder w/ LATH 9/10/97

NOTE: SIGN MAY need moved West increasing distance due to sight visibility @ intersection w/ Acker Rd.
NOTE location will not be visible to traffic turning EAST Bound from ACKER RD.!



D.E., G.T. SEPT. 10th, 97



School Bus "STOP Ahead" Sign. Req.

DEAN FRENCH 9737 E. MARQUIS RD.

(9/18/98 Per ph.) - Req. by _____, DUNKERTON SCHOOLS SUPT.
Letter dated _____ Rec'vd

TARGET = 4.0' (℄ RES. ENTR. ON WEST SIDE RD.

OBSERVER = 3.5' @ 581' N. of Target loc (IN CURVE)

$$d = (60)(1.47)(2.50) + \frac{60^2}{30(.30 + G)}$$

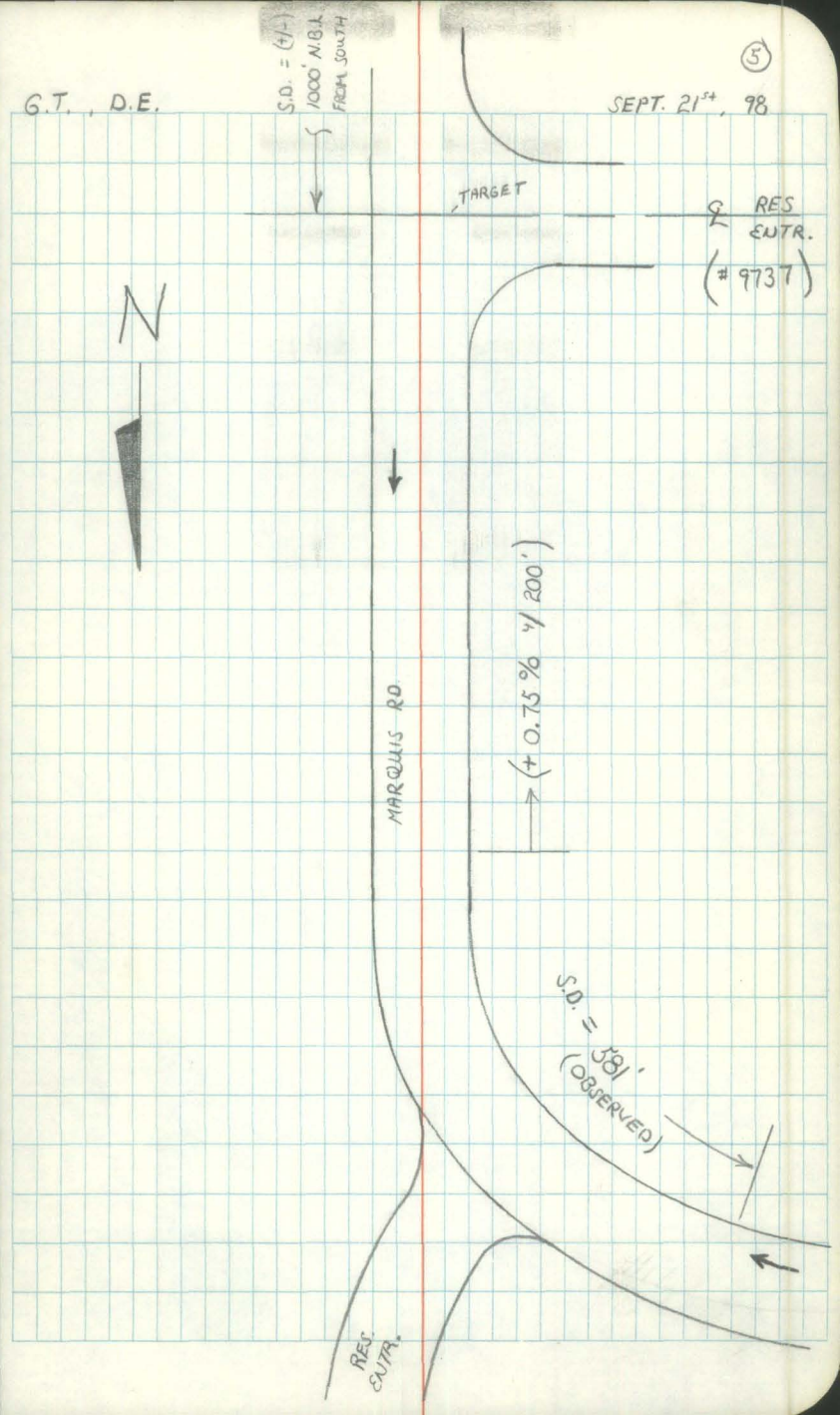
$$d = 220.5 + \left(120 \div (.30 + .0075)\right)$$

$$d = 220.5 + 390.24$$

d = 610.7 (REQ) vs. 581 = (S.D.) -observed-

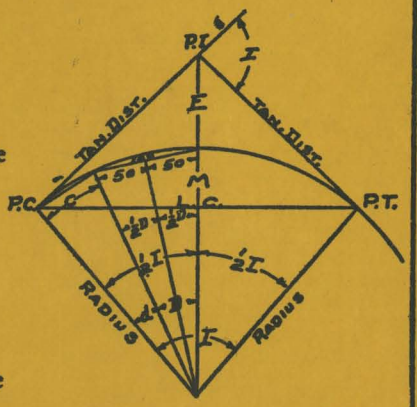
"SIGN RECOMMENDED" OBS < REQ. M.T.

Recommend being placed @ 1116' (581' + 535')
N.W. of TARGET, POS. being a P.O.C. for CURVE
from West to South (effected travel lane).
FIELD staked S. Edge shoulder w/ LATH 9/21/98



## CURVE FORMULAE

D=Degree of Curve
1°=1-Degree of Curve
2°=2-Degree of Curve
P.C.=Point of Curve
P.T.=Point of Tangent
P.I.=Point of Intersection
I=Intersection of Angle, Angle Between Two Tangents
L=Length of Curve, from P.C. to P.T.
T=Tangent Distance
E=External Distance
R=Radius
L.C.=Length of Chord
M=Length of Middle Ordinate
c=Length of Sub-Chord
d=Angle of Sub-Chord




$$R = \frac{L.C.}{2 \sin \frac{1}{2} I} \quad T = R \tan \tfrac{1}{2} I = \frac{L.C.}{2 \cos \frac{1}{2} I}$$

$$\frac{L.C.}{2} = R \sin \frac{I}{2}, \; D\,1° = R = 5730, \; D\,2° = \frac{5730}{2}, \; D = \frac{5730}{R}$$

$$M = R\,(1 - \cos \tfrac{1}{2} I), = R - R \cos \frac{I}{2}$$

$$\frac{E+R}{R} = \sec \frac{I}{2}, \; \frac{R-M}{R} = \cos \frac{I}{2}$$

$$c = 2R \sin \tfrac{1}{2} d, \; d = \frac{c}{2R}$$

$$L.C. = 2R \sin \tfrac{1}{2} I, \; E = R\,(\sec \tfrac{1}{2} I - 1), = R \sec \frac{I}{2} - R$$

## Minutes in Decimals of a Degree.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1′ | .0167 | 11′ | .1833 | 21′ | .3500 | 31′ | .5167 | 41′ | .6833 | 51′ | .8500 |
| 2 | .0333 | 12 | .2000 | 22 | .3667 | 32 | .5333 | 42 | .7000 | 52 | .8657 |
| 3 | .0500 | 13 | .2167 | 23 | .3833 | 33 | .5500 | 43 | .7167 | 53 | .8833 |
| 4 | .0667 | 14 | .2333 | 24 | .4000 | 34 | .5667 | 44 | .7333 | 54 | .9000 |
| 5 | .0833 | 15 | .2500 | 25 | .4167 | 35 | .5833 | 45 | .7500 | 55 | .9167 |
| 6 | .1000 | 16 | .2667 | 26 | .4333 | 36 | .6000 | 46 | .7667 | 56 | .9333 |
| 7 | .1167 | 17 | .2833 | 27 | .4500 | 37 | .6167 | 47 | .7833 | 57 | .9500 |
| 8 | .1333 | 18 | .3000 | 28 | .4667 | 38 | .6333 | 48 | .8000 | 58 | .9667 |
| 9 | .1500 | 19 | .3167 | 29 | .4833 | 39 | .6500 | 49 | .8167 | 59 | .9833 |
| 10 | .1667 | 20 | .3333 | 30 | .5000 | 40 | .6667 | 50 | .8333 | 60 | 1.0000 |

## Inches in Decimals of a Foot.

| 1/16 | 3/32 | 1/8 | 5/32 | 1/4 | 5/16 | 3/8 | 1/2 | 5/8 | 3/4 | 7/8 |
|---|---|---|---|---|---|---|---|---|---|---|
| .0052 | .0078 | .0104 | .0156 | .0208 | .0260 | .0313 | .0417 | .0521 | .0625 | .0729 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
| .0823 | .1667 | .2500 | .3333 | .4167 | .5000 | .5833 | .6667 | .7500 | .8333 | .9167 |