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PARALLEL MOUNTED ON-PREMISE LETTER HEIGHT & SIGN SIZE

USSCF ON-PREMISE SIGNS / RESEARCH & STANDARDS

Parallel-mounted On-premise Letter Height & Sign Size

A Research Project Of The
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Background and Objectives

Research conducted by Zineddin and his colleagues (2005) scientifically proved what sign manufactures and owners had previously merely assumed, that on-premise signs mounted perpendicular to oncoming motorists (e.g., projecting signs) are more detectable and are readable further away and at a smaller size than parallel-mounted signs (e.g., wall signs). With that in mind, in 2006, an analytical study was conducted to determine just how much larger parallel-mounted sign letters must be for drivers to read them as comfortably and safely as they do perpendicular signs (Garvey, 2006). That study resulted in a simple mathematical model and a look-up table to determine minimum parallel-mounted on-premise commercial sign letter heights.

While that study has proven useful, because it did not include a field verification stage the recommendations and equations may have resulted in some anomalies when applied to signs in the real world. Also, while the study recommended specific minimum letter heights for parallel signs, it did not address overall minimum sign sizes (square feet of signage) that would comfortably accommodate those letter heights.

The objective of the current study was therefore two-fold:

A. **Field Validation**: Conduct a small-scale field validation of the 2006 research to determine if the minimum letter heights predicted by that research provide sufficient legibility, or if some modifications are required, and
B. **Sign Size**: Develop a look-up table or calculation that would provide minimum parallel sign square footage that the recommended parallel sign letter heights require.

Procedure

Field Validation

Sign and sign location descriptions

A set of eight parallel-mounted on-premise signs (i.e., wall signs) were identified in Nags Head, North Carolina (Appendix A). The signs varied in letter height and lateral offset from the roadway. The roadways varied in posted speed limit and cross-section (e.g., number and width of lanes). The two roadways were:

1. North Carolina Highway 12 (i.e., South Virginia Dare Trail), a two-way, two-lane primary highway with a posted speed limit of 35 mph, 10-foot wide travel lanes, separated by a solid double yellow no passing centerline. N.C. 12 has solid white edge lines and 3.5-foot wide shoulders
(Figure 1, northbound).

Figure 1. North Carolina Highway 12

2. United States Route 158 (i.e., South Croatan Highway), a two-way, five-lane undivided arterial highway with the fifth, center lane used for left turns, a posted speed limit of 45 mph, and 11-foot travel lane widths. U.S. 158 has solid white edge lines and 3.5-foot wide shoulders (Figure 2, northbound).

Figure 2. United States Route 158

All of the signs on N.C. 12 were viewed from the northbound lane with the signs on the driver's left, across one lane of traffic. Two of the signs on U.S. 158 were viewed from the southbound travel lane and two from the northbound travel lane, with all four of the signs on the driver's left, across four lanes of traffic, including the center turning lane.

Data Collection

After permission was obtained from the store managers, the sign letter heights and offsets from the roadway edge lines were measured. The experimenters then determined the Maximum Available Legibility Distances (MALD) and the distances at which the eight signs could be read from a moving vehicle (hereafter called Sign Legibility). The results are tabulated in Appendix B.

Maximum Available Legibility Distance (MALD)

As described by Garvey (2006), the MALD is the distance between the driver and the parallel mounted sign where the observation angle first allows the sign to become readable. This angle is critical in Garvey's calculations, as it, combined with sign lateral offset, determines letter height. Specifically, the way the 2006 research calculated minimum letter height for parallel signs is based first and foremost on achieving an angle at which the signs are capable of being

read. Based on an exhaustive literature review that was set conservatively at 30 degrees, as angles much smaller result in too much foreshortening. The distance on the road upstream of the parallel sign where this 30 deg angle is met depends on the number and width of the lanes and the sign's offset from the edge of the road. Theoretically, no matter how large you make the letters or the sign, a driver won't be able to read it beyond that distance.

The letter height calculation takes the distance between the sign and the observer as the maximum legibility distance possible, and determines letter height at that distance using a Legibility Index (LI) of 10 ft/in. For example, if the MALD is 300 feet, the letters would need to be 30 inches tall, at a minimum. This is three times the height of perpendicular letters at the same distance (assuming a standard LI of 30 ft/in). The 10 ft/in of LI was selected so that when the driver first has a chance to read the sign it is well above size threshold and much easier and faster to read in an attempt to counteract the shorter distances and larger viewing angle that parallel signs have.

If the angle is actually smaller than 30 degrees (i.e., the sign can be read further upstream), then the MALD would be longer and the minimum letter height would be greater, if the angle is larger (i.e., the observer must be further downstream to read it), minimum letter height would be smaller.

To precisely determine the MALD for the test signs, and to field test the 30 degree observation angle, the two experimenters walked along the edge of the two roadways in fair weather, daylight, and dry conditions. As soon as the signs' angles allowed both experimenters to just barely make out the sign copy, that location was marked using an iPhone 6S. The experimenters continued to walk until they became parallel with the sign where they again marked the location, and the distance between the two locations was calculated via an application called Distance Tool. This gave the experimenters sides a and b of a right triangle from which they were able to determine the hypotenuse (MALD) and the observation angle (angle A or alpha). This procedure was repeated for each of the eight target signs.

Legibility Distance

The two experimenters, one driver and one passenger, drove a 1997 BMW 328i along the two roadways at the posted speed limit, in fair weather, daylight, and dry conditions. The passenger was tasked with reading the target signs as soon as they were able to do so with certainty. As with the MALD study, that location was marked using an iPhone 6S. When the vehicle was aligned with the sign, the passenger again marked the location, and the distance between the two locations was calculated via the Distance Tool application. Again, this gave the experimenters side a and side b of a right triangle from which they were able to determine the hypotenuse (MALD) and the observation angle. This procedure was repeated for each of the eight target signs.

Data Analysis and Results

The findings of the two empirical tasks just described were compared to the predictions from the 2006 study to determine if any modifications need to be made to the 2006 calculations in order to establish appropriate minimum letter heights for parallel mounted signs (Appendix B).

Overall, the results show that the average observation angle found in the driving legibility study was 27.75 degrees, very close to Garvey's 30 degrees. However, the average observation angle found in the more precise walking MALD study was only 16.14 degrees.

According to Garvey's 2006 calculations, the minimum letter height for a parallel mounted sign in inches comes out to ten percent of the MALD for that sign in feet. This is because he used 10 ft per inch of letter height as the Legibility Index. This results in the minimum letter heights for the eight signs in this study shown in Appendix B, column E. If the calculation is applied to the two empirical studies reported here, the minimum letter heights are found in Appendix B, columns L and V.

Sign Size

The letter heights and the number of letters on the eight signs were applied to an equation to determine the appropriate associated sign area in square feet (Appendix C). Figure 3 shows an example of this with 18 inch letter heights and a sign that has 30 letters. Letter height is assumed to be equal to letter width, which is conservative and takes into consideration inter-character spacing, as for most fonts the W:H ratio is less than one (i.e., thinner letter width). The results are shown in Appendix B, columns F, M, and W for the eight signs, using Garvey (2006) letter heights, the walking task, and the driving tasks from the current study, respectively.

Sign Size Calculation:			
Height of characters (in inches)	18.00		
Area for each character (in ft^2), assuming letter width = height	2.25	324.00	(in^2)
Number of characters = 30 (assuming 6 words with 5 characters each)	30.00		
Total area of all characters (in ft^2)	67.50		
Area of negative space (in ft^2), assuming industry standard of 60% of sign	101.25		
Total sign size (in ft^2): text + neg. space	168.75		

Figure 3. Example of sign size calculator

Conclusions

The 30 degree observation angle used in the parallel sign minimum letter height calculations found in Garvey, 2006 is consistent with the mean of 28 degree found in the driving legibility task conducted in this research. However, the observation angle of 16 degrees found with the more precise walking MALD study was roughly half that used in Garvey's 2006 calculations. If this angle is substituted in Garvey's calculations, the minimum recommended letter heights are roughly doubled and the sign sizes quadrupled.

To determine whether or not the data warrant using these larger letter

heights, a closer evaluation of the results was conducted. Two of the eight signs tested used letter heights that exceeded Garvey's 2006 recommendations (Life is Good and Midgetts Seafood). Of those two, Midgets Seafood had appreciably increased legibility distances, increased MALD, and reduced observation angles. The Life is Good sign may have had similar results, however the letters were faded by the sun, thereby reducing both contrast and legibility.

This follow-up study found that smaller observation angles, and therefore larger letter heights and sign sizes, can improve the legibility distance of parallel mounted signs and bring their performance closer to that of perpendicular signs. Due to the nature of the experimental design (i.e., using real signs in the built environment vs geometric calculations used in the earlier research) however, there were some uncontrollable variables (e.g., letter height, font, contrast, and offset); future research is recommended to further validate these results using a larger subject sample size and greater experimental control over sign characteristics. This could be achieved with a closed track experimental design and specially designed test signs.

References

Garvey, P.M. (2006). Determination of parallel sign legibility and letter heights. United States Sign Council (USSC) Research Project, Final Report. https://usscfoundation.org/wp-content/uploads/2018/03/USSC-Parallel-Sign-Legibility-2018.pdf

USSCF. (2006). Computation equations: sign area; viewer reaction; projection control; letter height. United States Sign Council Foundation Report. https://usscfoundation.org/wp-content/uploads/2018/03/USSCF-Computation-Equations-2018.pdf

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APPENDIX A - SIGN PHOTOS

RED DRUM SEAFOOD

FARM DOG SURF SCHOOL

APPENDIX A - CONTINUED

LIFE IS GOOD

MIDGETTS SEAFOOD

APPENDIX A - CONTINUED

SECRET SPOT SURF SHOP

OUTER BANKS BOARDING COMPANY

APPENDIX A - CONTINUED

GRITS ‘N GRILLS

DEPARTMENT OF MOTOR VEHICLES

APPENDIX B - DATA

	Number of Letters	Sign Offset	Letter Height		Sign Size	Maximum Available Legibility Distance (MALD)					Letter Height	Sign Size	Sign Legibility (Measured while driving at posted speed limit)									
	Measured	Measured	Measured	Garvey, (2006) Calculated Minimum	Garvey, (2006) Calculated Minimum	Garvey (2006) Calculated based on measured offset and assumed 30 degree observation angle		Measured in walking study					Observer 1		Observer 2		Mean of 2 observers, 2 observations each					
N.C. 12		Feet	Inches	Inches	ft^2	Feet	Seconds	Feet	Seconds	Observation Angle (deg)	Minimum (inches)	Minimum (ft^2)	Feet		Feet		Feet	Seconds	MALD	Observation Angle (deg)	Minimum Letter Height (inches)	Minimum Sign Size (ft^2)
Red Drum Seafood	17	39.34	12	11.87	41.57	118.68	2.31	234	4.40	14.63	23.40	161.61	67	71	141	147	106.50	2.07	121.75	28.98	12.18	43.75
Farm Dog Surf School	21	39.42	9	11.88	51.49	118.84	2.32	245	4.66	13.86	24.50	218.84	82	82	170	139	118.25	2.30	132.15	26.52	13.22	63.67
Life is Good	10	44.50	14	12.90	28.89	129.00	2.51	242	4.54	15.36	24.20	101.67	115	136	142	116	127.25	2.48	142.66	26.88	14.27	35.33
Midgetts Seafood	15	31.50	23	10.30	27.63	103.00	2.01	266	5.08	11.16	26.60	184.26	155	147	160	171	158.25	3.08	166.42	18.03	16.64	72.12
U.S 158																						
Secret Spot Surf Shop	8	74.00	20	24.80	85.42	248.00	4.83	288	5.07	25.50	28.80	115.20	153	142	125	169	147.25	2.87	192.51	40.10	19.25	51.47
Outer Banks Boarding Company	20	93.50	28	28.70	286.00	287.00	5.59	505	9.43	16.51	50.50	885.50	339	374	341	352	351.50	6.85	379.66	22.21	37.97	500.49
Grits 'n Grill	10	108.00	24	31.60	173.36	316.00	6.16	549	10.25	11.60	54.90	523.27	262	220	319	298	274.75	5.35	316.94	29.90	31.69	174.39
Department of Motor Vehicles	3	148.50	30	39.70	82.09	397.00	7.73	528	9.53	20.50	52.80	145.20	325	312	376	397	352.50	6.87	404.55	29.39	40.46	85.24
Mean										**16.14**										**27.75125**		

APPENDIX C - SIGN SIZE CALCULATOR

Sign Size Calculation:			
Height of characters (in inches)*	12.00		
Area for each character (in ft^2), assuming letter width = height	1.00	144.00	(in^2)
Number of characters = 30 (assuming 6 words with 5 characters each)	30.00		
Total area of all characters (in ft^2)	30.00		
Area of negative space (in ft^2), assuming industry standard of 60% of sign	45.00		
Total sign size (in ft^2): text + neg. space	75.00		

*** For Parallel Signs, obtain Height of characters from the 2006 USSCF Parallel Sign report Available at www.usscfoundation.org**

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