European Research Studies Journal
Volume XXIV, Special Issue 5, 2021

pp. 196-208

Ergonomic Criterion in the Design of Roadside Information: Letters Size Methodology Verification

Submitted 25/09/21, 1st revision 15/10/21, 2nd revision 04/11/21, accepted 10/12/21

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Abstract:

Purpose: *The aim of the analyses was to present the applicability of the developed methodology.*
Method: *Methodology was developed based on interdisciplinary analyses of research into human perceptual capabilities and recommendations for optimal human visual fields. The research was conducted on the example of informational road boards. A range of font dimensions on informative road boards was analysed. These dimensions are subject to international standardisation and legal regulations. The use of font size groups depends on the type of road and the permitted driving speed.*
Findings: *The analysed methodology made it possible, for example, the determination of reference distances from which the fonts on boards will be visible, the recommended font sizes for the expected distance from which the sign should be visible, the assessment of the distance and height of the positioning of information or advertising boards in relation to the road and the driver's field of vision, the recommended limiting number of letters/phrases on information boards (for slow or fast readers) depending on the driving speed, the time during which the observed words on the sign will be observed in the recommended field of vision.*
Practical implication: *The applied methodology may have a very wide practical application in the design of information systems in which text messages are used. During the analysis, the authors used a developed computer tool that facilitates both the process of evaluating existing information boards and designing new ones.*
Originality/value: *The authors verified a simulation model to support the selection of letters sizes on information and advertising boards.*

Keywords: *Design tools, eye movements, perceptual-motor performance, vision, driver behaviour.*

JEL classification: *M2, M29.*

Paper Type: *Research article.*

Declaration of interest statement: *The authors declare no conflict of interest.*

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1. Introduction

The driver receives a lot of textual information from information signs and advertising roadside billboards while driving. Road signs are subject to international and legal regulation (Chapter IX, 1968). The principles of sign design and placement have evolved through scientific analysis and practical experience. Billboards containing text have also evolved over the years and have been designed through experience, visual and image studies, marketing analyses, etc. The analysis of the relationship between man and his environment, which is of interest to ergonomists, also leads to the identification of criteria relevant to the design of text messages. Many different aspects of this issue can be identified:

- vision, visual perceptions and parameters of vision (Awh, Belopolsky, and Theeuwes, 2012; Sokolová, Beneš, and Holoubkowá, 2013);
- reading and understanding the content of the text (Buczkowska, 2016; Noorden and Campos, 2002; Wolfe, Sawyer, and Rosenholtz, 2020; Sadłowska-Wrzesińska and Mościcka-Teske, 2016; Sadłowska-Wrzesińska, Rejmer, and Drożyner, 2014);
- visibility of text, luminance, colour contrast (Carlson and Hawkins, 2002; Carlson and Holick, 2005);
- attracting the attention of the receivers of the information, positioning (important aspects for the design of billboards) (Wilson and Casper, 2016; Underwood, Chapman, and Brocklehurst, *et al.*, 2003).

By analysing the literature on the location of the read text in the field of vision and the conditions concerning the speed of reading the text, a simulation model has been developed to support the design of the placement of text information on road signs and information boards. It also makes it possible to:

- select the size of the letters on the text message board;
- analysis of the reference distance of the observer from the text on the billboard;
- determination of the time when the observed text is within the recommended and/or accepted field of view of the observer according to EN 894-2;
- calculation of a range for the number of letters that can be read while the observed text is within the recommended and/or accepted field of vision (the range includes values for slow and fast readers).

The primary objective of the analyses was:

- determination of the maximum reference distance d from the eye of the observer to the letters on the billboard, in which conditions of good vision are ensured in accordance with EN 894-2 (for legally defined sign locations (distance from the road (vertical and horizontal)) and size series of the letters);
- determination of the time periods in which the observed letters will be located in the recommended and acceptable zones of the field of vision (for the assumed speeds of movement of the observer in the vehicle and for the selected types of vehicles; it was assumed that during the observation the observer will be looking straight ahead in the direction of travel);

- calculation of the number of letters on the billboard to be read while they are within the recommended and accepted zones.

The following sections will present the application possibilities of the presented model.

2. Methods

To analyse the size of the letters on the billboards and the maximum recommended and acceptable distance d from the observer's eye, used the methodology which was developed based on EN 894-2 (Dahlke, 2021). During the research, the size of the series of letters and the rules for placing signs such as E-1, E-2, E-13, E-14 and E-15 (pre-road signs board, sign board, road trail sign boards) were analysed according to the attachment to the Regulation of the Minister of Infrastructure on detailed technical conditions for road signs and signals and road safety devices and the conditions for their placement on the roads (Journal of Laws of 2019, item 2311). There are 9 groups of case of letters and numbers on the signs (Table 1) and there are four groups of size characters (Table 2).

Table 1. *Sizes of letters and numbers used on signs (mm) (Journal of Laws of 2019, item 2311)*

Size group of letters and numbers	**Height of uppercase letters and numbers**	**The main height of lowercase letters [mm]**
1	2	3
I	42	28
II	72	48
III	102	68
IV	132	88
V	162	108
VI	210	140
VII	282	188
VIII	348	232
IX	420	280

Source: *Own study.*

The Regulation also indicates the distance between the signs and the edge of the road (the distance of the sign from the road is determined horizontally to the nearest extreme point of the sign’s shield or board) (Journal of Laws of 2019, item 2311):

- on roads with dirt shoulders: minimum 0.5 m from the road crown (if this is impossible, at least 0.5 m from the edge of the road);
- on roads with hard shoulders: minimum 0.5 m from the road crest (if this is impossible - at least 0.5 m from the edge of the bituminous shoulder);
- in the case of a wide embankment, the distance from the edge of the mark (plate) should not be wider than 5 m from the edge of the road;
- in the streets, the distance from the edge of the road should be in the range of 0.5 to 2 m.

Table 2. *The heights of letters on the analysed road signs (Journal of Laws of 2019, item 2311)*

Number	Size group of sign	Type of sign: Pre-sign boards E-1, Signpost E-2, E-3, E-4, Road trail sign boards R-13, E-14	Arrow signposts E-5, E-6, E-21	Boards E-22
		Height series of the capital letters [mm]		
1	2	3	4	5
1	Great	420, 348, 282	282	282
2	Large	282, 210, 162, 132	210	210
3	Middle	210, 162, 132	132	162
4	Small	132, 102	132	-

Source: *Own study.*

During the analyses, the heights of the letters on sign boards were also assumed. Because the Regulation (Journal of Laws of 2019, item 2311) includes the types of design dimensions of board signposts, the heights of the bases of the upper lines of words were estimated based on the size of the detailed layout of graphic elements (Table 3).

Table 3. *Examples of the top row base height of words on sign boards (from the road surface) by size groups and design dimensions of signposts (Source: own elaboration based on (Journal of Laws of 2019, item 2311)*

Group of the size	h_z [m] for signs next to road	h_z [m] for signs on the streets	h_z [m] for signs next to different streets	h_z [m] for signs roads than above the road	Series of the construction heights of board signs [m]*
1	2	3	4	5	6
Great	3.405	3.905	2.405	6.405	2.170
Large	3.025	3.525	2.025	6.025	1.5
Middle	2.815	3.315	1.815	5.815	1.2
Small	2.49	2.99	1.49	5.49	0.76

Note: **Parameter taken into consideration during calculating A [m].*
Source: *Own study.*

Because of significant differences in the width of signboards, resulting from the amount of information contained on them, it is difficult to indicate a repeatable relationship that allows determining the location of individual letters on the board and the distance of the eye fixation point from the direction of travel width A (Figure 1)). The value of A can be identified individually during checking the ergonomics of placing information signs (including advertising) along roads. For the purposes of methodology verification, it was assumed that A was equal to the sum (formula 1):

- ¾ x "lane road width" (for a single-lane in a given direction) and n x "lane width" – 0,75, for roads with n lanes in a given direction;
- distances from the edge of the road or bituminous shoulder to the nearest extreme point of the disc sign or sign board (or billboard);
- half the width for the group of construction sizes of sign boards (four groups) (according to (Journal of Laws of 2019, item 2311)).

$$A = (S_{line} \times n - 0{,}75) + p + (0{,}5 \times S_{board}) \quad (1)$$

where:
S_{pline} – lane width [m] (recommended and minimum values are given in (Journal of Laws of 2019, item 2311)),
n – number of lanes,
p – distance from the edge of the road lane to the edge of the board with text information [m],
S_{board} – sign board width [m] (according to (Journal of Laws of 2019, item 2311)).

The last necessary step to carry out the analysis according to the above methodology is defending the height of the driver's eyes in relation to the base plane, which is also the basis for measuring the location of letters on a road sign (it was assumed that this is the road on which the vehicle is traveling – for theoretical considerations assumed that it is horizontal). Measurements of this parameter for sample vehicles can be found in the sources (Kotecka and Kowalska, 2019) (Table 4). It has been measured from the road surface to the entokanthion anthropometric point (PN-N-08012:1986).

Table 4. *The eye heights of drivers with the limit dimensions of C_{5K} and C_{95M}, measured from the road surface to the entokanthion anthropometric point for sample vehicles (Kotecka and Kowalska, 2019)*

Make or type of the vehicle	**Car seat height measured from the road surface + seat eye height** C_{5K}	C_{95M}	**SD**
1	2	3	4
Semi-trailer truck	2595.3	2749.3	1.55
Truck - permissible gross weight – 8T	2345.5	2499.5	1.50
Truck - permissible gross weight - 3T	1795.7	1949.7	1.79
City bus - MAN Nl 263 Lion's City	1665.5	1819.5	1.75
City bus - Solaris Urbino 12	1645.6	1799.6	1.43
City bus - Solaris Urbino 18	1643.6	1797.6	1.28
Passenger car Audi Q7	1386	1540	1.55
Passenger car Dacia Duster II	1296.1	1450.1	1.58
Passenger car Citroen C3	1246.3	1400.3	1.42
Passenger car Skoda Octavia II kombi	1215.6	1369.6	1.43
Passenger car Renault Clio	1195.9	1349.9	1.58

Source: *Own study.*

To estimate the time needed to read text on the sign board approximate information on the time of saccades, fixations, and regression movements while reading might be used (see Chapter 1). In many research works both the time of recognition of words in reading and the structure of individual phases of eye movement have been measured (Buczkowska, 2016; Carpenter, 2004; Sereno and Rayner, 2003; Hauk, Coutout, Holden, *et al.*, 2012; Ducrot, Pynte, Ghio, *et al.*, 2013). During the reading and recognition of a word, for example, stages lasting from 200 to 600 ms are distinguished (Sereno and Rayner, 2003):

- stimulus to visual cortex – at the beginning of a fixation, it takes 60 ms for information about the fixated word to travel to higher cortical areas where lexical processing begins;
- initiate eye movement motor program; shift attention;
- signal to eye muscles;
- saccade.

Table 5. *Time of visual components during text reading (Buczkowska, 2016)*

No.	**Visual components during text reading**	**Minimum reading time from 8 to 18 characters (for a single saccade) [s]**	**Maximum reading time from 8 to 18 characters (for a single saccade) [s]**
1	2	3	4
1	Saccades	0.025	0.04
2	Fixation	0.1	0.5
3	Regression movement	1 x 0.025	2 x 0.04
	TOTAL:	0.15	0.62

Source: *Own study.*

Reading time depends on many factors, for example the size of the effective visual field and efficiency of comprehension at a single gaze (Rayner, Slattery, and Bélanger, 2010; Yokoi, Tomita, and Saida, 2012). Due to the large individual variations, reading time ranges from 8 to 18 characters were adopted (Table 5).

The above data enable estimating the number of saccades, fixations, and regression movements while the field of view is in zones A and B (horizontal and vertical), and the number of characters has been read during the saccades (assuming that for a single saccade, the number of characters in space may range from 8 to 18 (Buczkowska, 2016)).

3. Results of Simulation Tests

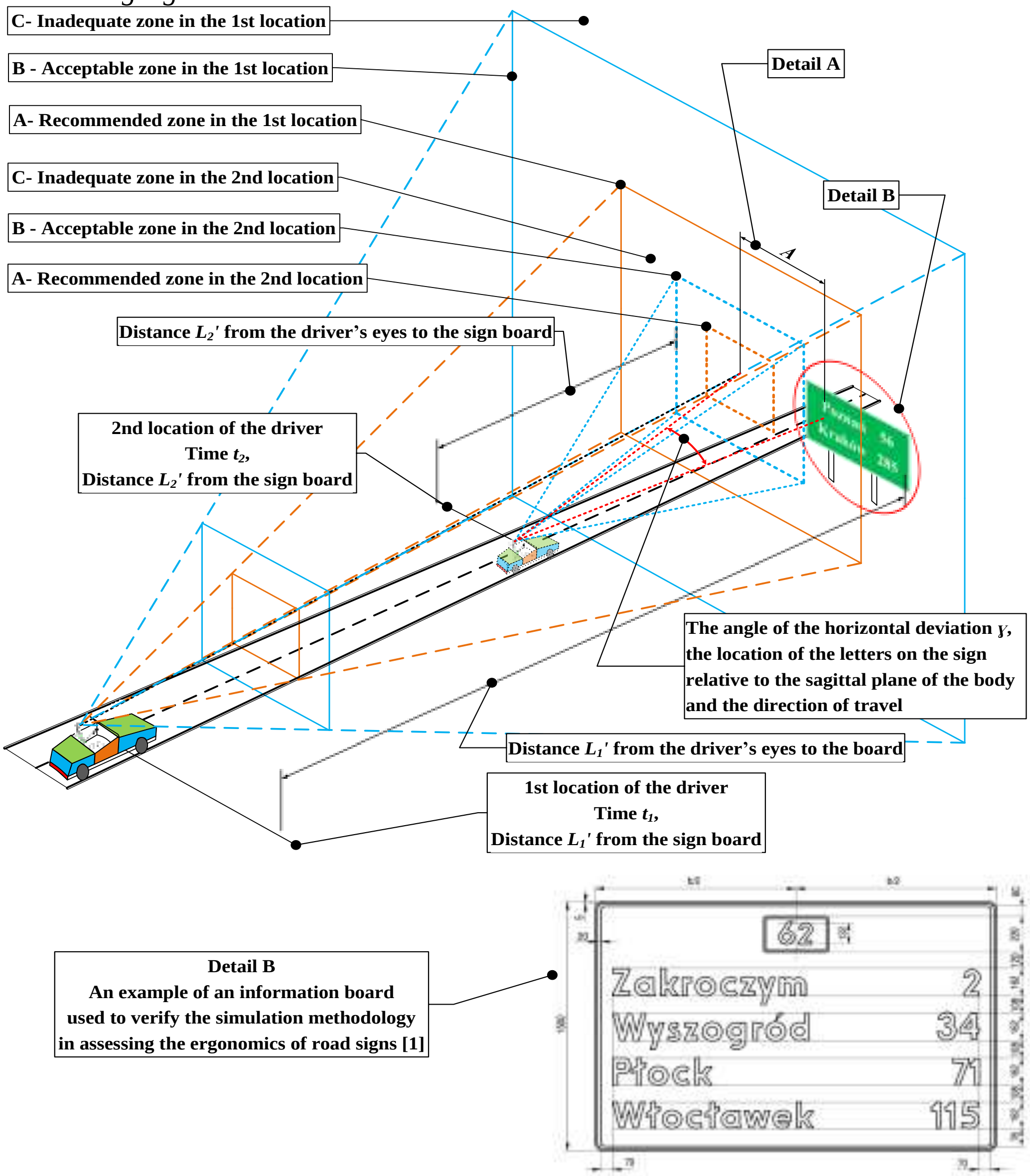
The verification of the methodology presented in Chapter 2 was made on the example of the E-14 road route table (Detail B on Figure 1). According to the Journal of Laws of 2019, item 2311, both the table and the size of the letters are categorized as large. For the analysis, several preliminary assumptions have been made:

- the study was carried out for the extreme position of the top row ("Zakroczym");
- as the location of the eye fixation area to calculate the distance A, the location of the letter "Z" was adopted;
- calculations and simulations were performed for a number of capital letters;
- two cases of the placement of the sign board were considered: a sign placed on the street (height of the lower part of the sign placed 2.5 m above the pavement); the board located above the road (height of the lower part of the board is 5 m above the road);
- the eye height of the observer was selected for C_{95M}, and the total height of the position of the eyes above the road was determined for a truck with a permissible gross weight of 3 t (h_{cz} = 1949.7 mm (Table 4);
- the analyses were performed for one or two lanes (n = 1 or 2) with a width of 3 m, recommended for a speed limit below 60 km/h;

- in the case of a sign above the road, it was assumed that the angle $\gamma = 0°$.

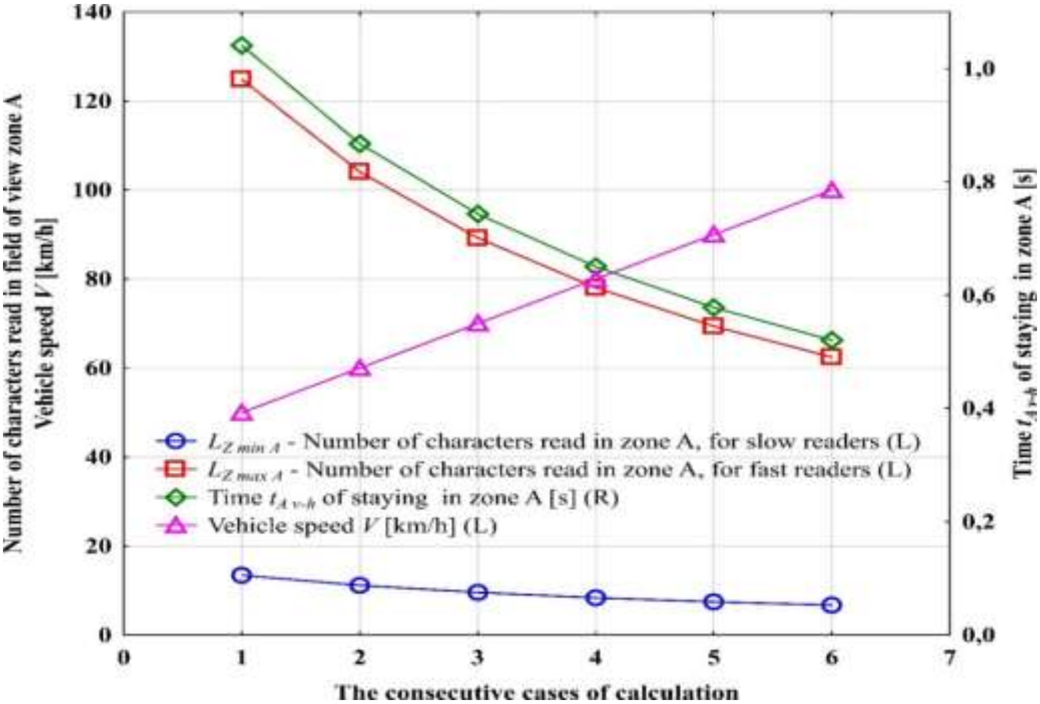
Replacing the above assumptions will have an impact on the calculation values, interpretation, and development of recommendations for the use of the sign board.

Figure 1. *Change in the position of the zones of the driver's field of vision along with the change of the distance from the sign with Detail B: An example of an information board used to verify the simulation methodology in assessing the ergonomics of road or advertising signs.*



Source: *Own work based on Dahlke, 2021, Journal of Laws of 2019, item 2311.*

Figure 2. *Dependence of the number of characters read from the information boards (for slow and fast readers) on the speed of the vehicle (example 1 from table 6: Large sign – on the street: h = 162 mm; h_Z = 3433 mm (without taking into account the height of the curb; distance from the sidewalk to the bottom of the mark is 2.5 m); Lane width of 3 m; Number of road lanes, n = 1;* $\alpha_{z\ optimal\ recommended} = 22'$; $h_{cz} = 1949.7$ mm; A= 2.845 m.



Source: *Own study.*

During the analyses, the cases of exceeding the permissible speed were taken into consideration, presenting the reduction of the time the letters remained in the recommended and acceptable zones (horizontal or vertical) (Table 6, columns 5 and 6). The visible height of the sign h' changes depending on the angle β of the line of sight (Table 6, column 2) and the recommended maximum distance view d (column 3). Driving speed affects the time which driver must read the sign in zone A or B (Table 6, columns 5 and 6). The time $t_{B\ v\text{-}h}$ is in many cases the same for the viewing angle $\alpha_z \in \langle 22'; 18' \rangle$, because the value was influenced by the position of the eye in relation to the letter in the vertical (at the angle of the line-of-sight β) or horizontal (at the angle of the line-of-sight ɣ) zones.

Distance calculation from the sign is independent of the d value of the recommended maximum distance from the observed letter on the sign board for $L_{2\ \gamma=15°}' > L_{2\ \beta=15°}'$. The same times $t_{B\ v\text{-}h}$ were thus obtained for $\alpha_z \in \langle 22'; 18' \rangle$, when the location of the letters in the acceptable horizontal zone (horizontal zone B) was considered. Increasing the speed of the vehicle reduces the perceptive capabilities of the reader of the content on the sign board. Due to the individual differentiation, the ranges (minimum and maximum) of the number of read characters were calculated.

During the analysis of the values from columns 11, 12, 13 and 14, attention should be paid to the possibility of various stimuli appearing in the field of view, which will affect the dispersion of the saccade movement and the reduction of reading times (Ho, Scialfa, and Caird, *et al.*, 2001; He and Donmez, 2020; Munigety, 2018; Robbins and Chapman, 2018; Steinbakk, Ulleberg, and Sagberg, *et al.*, 2019); Uc, Rizzo, and Anderson, *et al.*, 2005; Seya, Nakayasu, and Yagi, 2013). The relationships presented in Table 6, for example 1, are illustrated in Figure 1.

If a total of 40 characters appears on the board (without the road number), then the required time to read all the content in zones A and B will highly exceed the available ($t_{A\ v-h}$ + $t_{B\ v-h}$) for a part of the population. As the speed increases, this will also apply to fast readers (needs to read in zone C during changing the position of the head). Reading proper names of the towns which the reader knows is a process that may be implemented on different principles than presented in the methodology in Section 2. A similar situation may apply to known text messages. However, if previously unknown information content with many characters appears on the boards, the location of the boards and the speed of the vehicle will be an important factor in limiting the effectiveness of the content.

Table 6. *The results of simulation calculations for the example from Figure 1 (Detail B)*

Recommended viewing angle α_z according to EN 894-2	h' [mm]	d [m], for h', β, α_z & h	V [km/h]	$t_{A\ v-h}$ [s]	$t_{B\ v-h}$ [s]	$L_{S\ min}$ for $t_{A\ v-h}$	$L_{S\ min}$ for $t_{B\ v-h}$	$L_{S\ max}$ for $t_{A\ v-h}$	$L_{S\ max}$ for $t_{B\ v-h}$	$L_{Z\ min\ A}$	$L_{Z\ min\ AB}$	$L_{Z\ max\ A}$	$L_{Z\ max\ AB}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Large sign – on the street: h = 162 mm													
h_z = 3433 mm (without taking into account the height of the curb; distance from the sidewalk to the bottom of the mark is 2.5 m); Lane width of 3 m; Number of road lanes, n = 1													
$\alpha_{z\ optimal\ recommended}$ = 22'; $\alpha_{z\ acceptable\ recommended}$ = 18'; h_{cz} = 1949.7 mm; A = 2.845 m													
22'	161.7	25.27	50	1.04	0.41	6.94	2.73	1.68	0.66	13.4	18.7	124.9	174.1
18'	161.8	30.90		1.45		9.66		2.34		18.7	24.0	173.9	223.1
22'	161.7	25.27	60	0.87	0.34	5.78	2.28	1.40	0.55	11.2	15.6	104.1	145.1
18'	161.8	30.90		1.21		8.05		1.95		15.6	20.0	144.9	185.9
22'	161.7	25.27	70	0.74	0.29	4.96	1.95	1.20	0.47	9.6	13.4	89.2	124.3
18'	161.8	30.90		1.04		6.90		1.67		13.4	17.1	124.2	159.3
22'	161.7	25.27	80	0.65	0.26	4.34	1.71	1.05	0.41	8.4	11.7	78.1	108.8
18'	161.8	30.90		0.91		6.04		1.46		11.7	15.0	108.7	139.4
22'	161.7	25.27	90	0.58	0.23	3.86	1.52	0.93	0.37	7.5	10.4	69.4	96.7
18'	161.8	30.90		0.81		5.37		1.30		10.4	13.3	96.6	123.9
22'	161.7	25.27	100	0.52	0.21	3.47	1.37	0.84	0.33	6.7	9.4	62.5	87.0
18'	161.8	30.90		0.73		4.83		1.17		9.4	12.0	87.0	111.5
Large sign – on the street: h = 162 mm													
h_z = 3433 mm (without taking into account the height of the curb; distance from the sidewalk to the bottom of the mark is 2.5 m); Lane width of 3 m; Number of road lanes, n = 2													
$\alpha_{z\ optimal\ recommended}$ = 22'; $\alpha_{z\ acceptable\ recommended}$ = 18'; h_{cz} = 1949.7 mm; A = 5.845 m													
22'	161.7	25.27	50	0.20	0.84	1.31	5.61	0.32	1.36	2.5	13.4	23.6	124.6
18'	161.8	30.90		0.61		4.08		0.99		7.9	18.8	73.5	174.5
22'	161.7	25.27	60	0.16	0.70	1.10	4.68	0.27	1.13	2.1	11.2	19.7	103.9
18'	161.8	30.90		0.51		3.40		0.82		6.6	15.6	61.2	145.4

Recommended viewing angle α_z according to EN 894-2	h' [mm]	d [m], for h', β, α_z & h	V [km/h]	$t_{A\ v\text{-}h}$ [s]	$t_{B\ v\text{-}h}$ [s]	$L_{S\ min}$ for $t_{A\ v\text{-}h}$	$L_{S\ min}$ for $t_{B\ v\text{-}h}$	$L_{S\ max}$ for $t_{A\ v\text{-}h}$	$L_{S\ max}$ for $t_{B\ v\text{-}h}$	$L_{Z\ min\ A}$	$L_{Z\ min\ AB}$	$L_{Z\ max\ A}$	$L_{Z\ max\ AB}$
1	2	3	4	5	6	7	8	9	10	11	12	13	14
22'	161.7	25.27	70	0.14	0.60	0.94	4.01	0.23	0.97	1.8	9.6	16.9	89.0
18'	161.8	30.90		0.44		2.92		0.71		5.6	13.4	52.5	124.6
22'	161.7	25.27	80	0.12	0.53	0.82	3.51	0.20	0.85	1.6	8.4	14.8	77.9
18'	161.8	30.90		0.38		2.55		0.62		4.9	11.7	45.9	109.1
22'	161.7	25.27	90	0.11	0.47	0.73	3.12	0.18	0.75	1.4	7.5	13.1	69.3
18'	161.8	30.90		0.34		2.27		0.55		4.4	10.4	40.8	96.9
22'	161.7	25.27	100	0.10	0.42	0.66	2.81	0.16	0.68	1.3	6.7	11.8	62.3
18'	161.8	30.90		0.31		2.04		0.49		4.0	9.4	36.7	87.2
Large sign – above the road: h = 162 mm													
h_z = 5933 mm (distance from the road surface to the bottom of the sign is 5 m); Lane width of 3 m; Number of road lanes, n = 1													
$\alpha_{z\ optimal\ recommended}$ = 22'; $\alpha_{z\ acceptable\ recommended}$ = 18'; h_{cz} = 1949.7 mm; A = 0 m													
22'	160.0	24.99	50	0.69	0.58	4.63	3.89	1.12	0.94	9.0	16.5	83.4	153.5
18'	160.7	30.68		1.11		7.40		1.79		14.3	21.8	133.3	203.1
22'	160.0	24.99	60	0.58	0.49	3.86	3.24	0.93	0.79	7.5	13.8	69.5	127.9
18'	160.7	30.68		0.92		6.17		1.49		11.9	18.2	111.1	169.2
22'	160.0	24.99	70	0.50	0.42	3.31	2.78	0.80	0.67	6.4	11.8	59.6	109.6
18'	160.7	30.68		0.79		5.29		1.28		10.2	15.6	95.2	145.1
22'	160.0	24.99	80	0.43	0.37	2.90	2.43	0.70	0.59	5.6	10.3	52.1	95.9
18'	160.7	30.68		0.69		4.63		1.12		9.0	13.7	83.3	126.9
22'	160.0	24.99	90	0.39	0.32	2.57	2.16	0.62	0.52	5.0	9.2	46.3	85.3
18'	160.7	30.68		0.62		4.11		0.99		8.0	12.1	74.0	112.8
22'	160.0	24.99	100	0.35	0.29	2.32	1.95	0.56	0.47	4.5	8.3	41.7	76.7
18'	160.7	30.68		0.56		3.70		0.90		7.2	10.9	66.6	101.6

Note: *h - height of the letters on the sign board [mm]; hz - height of the base of the character line [mm]; hcz - height of the eye position [mm]; A - distance (formula 14 – Fig. 1) [m]; Column 2: Actual visible heights h' [mm] for the angle β, αz and h; Column 3: Maximum distance d [m], for actual h', for angle β, α_z and h (on sign board); Column 4: Vehicle speed V [km/h]; Column 5: Time $t_{A\ v-h}$ of staying in zone A [s]; Column 6: Time $t_{B\ v-h}$ of staying in zone B [s]; Column 7: $L_{S\ min}$ for $t_{A\ v-h}$ - Number of saccades for the time $t_{A\ v-h}$ [s] of staying in zone A [s] (for minimum reading times); Column 8: $L_{S\ min}$ for $t_{B\ v-h}$ - Number of saccades for the time $t_{B\ v-h}$ [s] of staying in zone B [s] (for minimum reading times); Column 9: $L_{S\ max}$ for $t_{A\ v-h}$ - Number of saccades for the time $t_{A\ v-h}$ [s] of staying in zone A [s] (for maximum reading times); Column 10: $L_{S\ max}$ for $t_{B\ v-h}$ - Number of saccades for the time $t_{B\ v-h}$ [s] of staying in zone B [s] (for maximum reading times); Column 11: $L_{Z\ min\ A}$ - Number of characters read in zone A, for slow readers; Column 12: $L_{Z\ min\ AB}$ - Number of characters read in zones A and B, for slow readers; Column 13: $L_{Z\ max\ A}$ - Number of characters read in zone A, for fast readers; Column 14: $L_{Z\ max\ AB}$ - Number of characters read in zones A and B, for fast readers;*

Source: *Own study.*

By increasing the horizontal distance of the sign board from the road, the time the fixed area remains in the horizontal field of view of zones A and B is reduced. In Polish law (Journal of Laws of 2019, item 2311), this distance must not exceed 2 m on the streets.

For this value, the initial letters of the analysed table will be outside the horizontal zone A for d = 25.27 m and the viewing angle αz optimal recommended = 22'.

4. Discussion and Conclusions

Findings of the Vienna Convention on road signs and signals, adopted in 95 countries (often not in full) (Chapter XI, 1968). On its basis, legal requirements for the design of in-formation signs have been defined in individual countries. These are not identical, and for example include the variety of typefaces (Carlson and Hawkins, 2002; Carlso and, Holick, 2005; Dobres, Chrysler, Wolfe, Chahine, and Reimer, 2017; Garvey, Klena, Eie, Meeker, and Pietrucha, 2016; Garvey, Pietrucha, and Meeker, 1997). The variety of typefaces can affect the speed at which the information is read (Minakata and Beier, 2021) and increase the distance from which the text will be seen, giving more time to read the information (depending on driving speed) (Carlson and Brinkmeyer, 2002).

However, no simple tools have appeared in the literature that combine the above principles, to support the selection of letter height and amount of text with the simultaneous positioning of information boards, matching them to the speed of travel. Using the designed methodology (Dahlke, 2021), it is possible to evaluate the placement of existing information signs and billboards, as well as to support the design and placement of new solutions. In the presented analysis, several assumptions were introduced that may increase the uncertainty of the results, such as (Buczkowska, 2016):

- the assumption of the distance of the position of the text in relation to the road and the horizontal line of sight,
- the choice of the vehicle conditioning the height of the position of the eyes in relation to the text,
- the ranges of the speed of reading letters defined in research works.

The structure of the simulation model and algorithms in the computer tool allows for the conversion of data into real data (when auditing existing solutions) or planned data (when designing new signs). The detailed structure of the computer tool will be the subject of separate publications by the authors.

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