Review & Comment: on the FHWA Notice to the Federal Register and Technical Brief that rescinded Interim Approval (IA-5) for use of the Clearview type system.

This eliminates ongoing use of the Clearview typeface in positive contrast highway guide sign applications and supporting research.

The Clearview font was designed to improve legibility of roadway signs especially for older drivers. The original highway fonts were developed in the 1950s before modern reflective material was available. The letters in this original font were quite thick, made to accommodate old-fashioned bicycle-reflector type buttons or reflective paints to provide nighttime visibility. As departments of transportation moved to more durable and brighter retroreflective material on signs, they noticed that white letters on dark backgrounds could appear blurry at night. Clearview was designed to address this problem and to take advantage of modern sign fabrication methods.

The termination as posted in the Federal Register (1.25.2016) makes no mention of the accommodations for the older driver which are integral to the design and does not refer to the fact that the older driver is the greatest beneficiary of this research and design program. This effort to improve the road sign standard based on human factors research and an engineered design foundation to make the motorist, cyclist or pedestrian safer.

The government’s justification presented in the Technical Brief (1.28.2016) in support of the termination of the ongoing use of Clearview misrepresents the history, provides an incomplete summary of the research and invokes misapplication of the font that have nothing to do with its effectiveness when properly applied.

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1) Clearview reduces accidents and management costs on freeways and roads

The government stated in the Federal Register Notice to rescind Clearview: “The FHWA is committed to exploring solutions that can significantly contribute to enhanced road user safety and are readily and feasibly implemented. In this particular case (use of Clearview), there is no benefit to the alternative method that cannot be similarly achieved within established practice.”

Michigan DOT has attributed that upgrades of road signs using Clearview has improved overall safety of roads.

Michigan DOT began a major older driver initiative in 2004 on 93 percent of their freeways and 43 percent of their conventional roads. Statewide, this included upgraded guide signs with Clearview fonts (white on green) for guide sign legends and Fluorescent Yellow background (black on yellow) for all exit lane and single lane drop panels, combining these two safety improvements at exit points or other bifurcations. In a multi-year evaluation study that was issued in 2015, a team of researchers at Western Michigan University compared historic accident data for the years before guide signs were upgraded and annual accident data following the upgrade. This study included 156 road segments (79 freeway, and 43 non-freeway in rural areas and 34 non-freeway in urban areas) covering road configurations of all types. The findings were significant and showed that Clearview and Clearview with Fluorescent Yellow exit lane panels resulted in fewer fatalities, less severe crashes, and a reduced number of crashes overall. This reduction in the number of on-road incidents lowers road management costs, such as road repair and emergency services base on a valuation that is assessed by type of accident.

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>30%</td>
<td>Safer-Nighttime</td>
</tr>
<tr>
<td>25%</td>
<td>Safer Daytime</td>
</tr>
<tr>
<td>14%</td>
<td>Fatality Reduction</td>
</tr>
</tbody>
</table>

The night-time reductions for all severities averaged over 30 percent on all road types. Roads segments with Fluorescent Yellow upgrade alone did not show the level of reduction realized when the Clearview font was used on guide signs in combination with a yellow lane marker.

During day-time viewing, there was a 25 percent reduction of accidents for all severity levels and road types combined, but the greatest improvement was seen on non-freeway, urban roads.

The reduction of fatalities on conventional roads averaged 14 percent with the reduction greatest on urban roads.

This research helps to confirm the oft stated assumption that one or two seconds of added conspicuity and unambiguous readability makes a significant difference in saving lives and preventing debilitating accidents.

2) Clearview 5-W improves readability and legibility

A primary claim of the government is that “the compressed version (of Clearview 5-W-R) was found to provide no improvement over Series E (modified).” and that “The narrower letter forms of the provisional style (1-W, 2-W, 3-W and 4-W) were also not evaluated for legibility in these studies.”

These claims by FHWA in the recision are not true and the primary citations provided are not correct. The final design as adopted in 2004 with the Interim Approval shows significant improvement: a minimum of 10 percent greater legibility using Clearview 5-W, and 9.5 percent improvement with Clearview 5-W-R when compared to Series E (modified).

With mixed case mid-weights (page 4) of Clearview in both negative contrast (2-B, 3-B and 4-B) and positive contrast (2-W, 3-W and 4-W) formats showed improvements of 18 to 35 percent depending on weight in day/night, older driver legibility study.

In most all cases, the older driver has been a primary beneficiary in those states where Clearview is used.

The Technical Brief did not cite critical studies that were instrumental to Clearview development including first generation studies by Larson Transportation Institute and research by Texas Transportation Institute that shaped the program for both conventional roads and freeways. Although many FHWA referenced studies showed improvement, most were long out-of-date as the typeface design was upgraded over the multi-year development (5 versions) as the design of the font was refined during ongoing research and field study. Although the data referenced was informative at the time, any research prior to 2002 was now out of date, or the interpretation of the data was inaccurate. A referenced 2014 study (Miles et al.) was incomplete, claims unsupported and data not corroborated.

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Other studies corroborate this level of improvement (or greater than 10 percent) but this example demonstrates the improved legibility of Clearview 5-W-R questioned in the Technical Brief.
This study shows the legibility of mixed case Clearview in comparison to similar weights of FHWA Standard Alphabets. This was a day/night, young/middle age/older driver study conducted at the Larson Transportation Institute test track.

The companion recognition/readability study that would have included multi word phrases similar to regulatory signs was planned as a second part (now tabled based on termination of IA-5).
3) **Design evolves to accommodate current requirements**

In 1991, only E-modified had a lower case as used for destination names on freeways guide signs with all conventional road and guide signs being displayed in all upper case letters.

The government argues that a new type system was developed instead of fixing the existing alphabets.

In fact, the design team made a significant and well-documented effort to create a new design from the existing standard. This process and the development of the design was shared with – and field demonstrated for – the FHWA staff at various points in the development process.

The standard alphabets could not be upgraded based on the basic character of original source material. Given six weights, the challenge was to build a consistent typographic structure in all weights. With mixed case—the letterforms need to be designed for viewing from long distances and support clear word pattern definition.

Clearview had very particular requirements. Designing for the older driver whose reduced visual acuity and reduced sensitivity to contrast (the bright appears brighter and darks appears darker) required a departure from the standard alphabets. The federal standard developed in the late 1950s (as recorded in various histories) pre-dates efforts to address the needs of the older driver. Furthermore, roads are now wider and there are more lanes; traffic is more congested; country roads are now major suburban routes with overwhelming commercial signing that competes for the motorists’ attention. Within urban and suburban areas, cycling and pedestrian use has increased and is encouraged. Any design must support a more systematic and consistent approach to design.

Metamorphosis of Design:
FHWA Standard Highway Alphabet E-modified to Clearview

Early drawings of the 1:5 weight font attempted to build on the Standard Alphabets. Based on the lower case “a, e, and s” the fixing or updating of the Standard Alphabets became impossible as the character of the stroke would not allow the typeface to open from the inside out.
Historic reference and modern experience influence design (cont’d)

The standards in the MUTCD had their roots in the lettering approaches and technologies that are now sixty to ninety years old.

The all upper case Standards Alphabet Series D (and series A–F) were originally created as hand painted brush lettering (lower left) of the 1920s with each of the various weights coming from various width brushes. As silk screen, die-cut adhesive and metal demountable, and finally digital became the technology, the original letterforms were adapted to the new methods but the design of the letter forms remained basically unchanged.

E-modified, developed for destination names on the new divided highways in California was created in 1948 by highway engineer Ted Forbes on a Leroy lettering machine used to label engineering drawings—an effective innovation at that time (upper left and middle right). We assume that letters were made at text scale and photo enlarged to highway proportions. It is a 1:5 stroke width to height ratio typeface with no variation in stroke. Why the ascending and descending letters were chamfered is a mystery.

In the early 1960s the road sign standard in the U.K. had outlived its effectiveness. In 1964, two designers, Jock Kenneir and Margaret Calvert were commissioned to create a functional order to road signs. The resulting system, including the design of a new mixed case typeface (British Transport) has more than stood the test of time. Although a TTI study showed an early version of Clearview performed more effectively than Transport, one cannot disregard the quality of thought that went in to this effort.
The government argues that although many studies were performed, the findings were “inconsistent and counter intuitive conclusions have been drawn from the results to support or promote use...”.

Research validated and instructed the design process. This however is a design program that used research to aid the process. Some of the work was pure R&D to test and update the design. Comparative studies utilized prior research evaluations of specific applications. In most cases the design process was informed by more than one study. For example, a negative contrast study from TTI found no difference between all uppercase and mixed case legibility for a specific warning sign. Using findings from another LTI negative contrast legibility study, it was learned that selecting the appropriate weight of Clearview would create a sign that outperformed both of the earlier signs. The prime research influence on word pattern recognition evolved from two early Clearview lab studies, and an older driver field study by LTI and a later typeface research program for the National Park Service to study word recognition.

The Illinois DOT relied on existing research from Texas A&M, and Penn State when adopting Clearview. In an existing conditions review after six years they observed; “legibility distance improvement alone is an incomplete measure of the potential benefits of Clearview—reducing the strain of reading means drivers can return to driving tasks and spend less time reading,” and “any real gains from implementation of Clearview may be the result of the reduced cognitive strain on perceptual and central processing, allowing drivers to quickly return to other driving tasks.” The comments are instructive and confirm observations by others when looking at the complete panel design. Illinois is one of the states that is being required to terminate use of Clearview.
Above: The basic font structure was developed around the designs for Clearview 5-W and Clearview 3-W. The goal for 5-W was to meet a 1:5 stroke width to height ratio without the weight that it carried being apparent. This structure is applied to all weights.

Below: Each letterform was imported into Ikarus and Font Lab software for harmonization and to program specific letter space and metrics for the specified (TrueType) applications.
5) Brightness vs Legibility

The government refers to legibility primarily as a factor of brightness and implies that the design of letterforms is not the issue.

If brightness were the only issue, the 3M Company would not have contributed to the original Clearview development. Based on their experience, 3M was well aware that the solution would begin with letterforms. The issue of brightness does not address long standing complaints with the E-modified design for older drivers and concerns about letterform design and halation. Brightness has no place in any attempt to justify termination of the use of Clearview.

Effectiveness of the sign is contingent on factors including figure/field layout, appropriate contrast balance, the shape of letterforms, letter space and the footprint of words. Brightness in conjunction with the selection of the appropriate sheeting type and contrast ratio is important but brightness is not a single determinant of effectiveness. Signs viewed in retroreflective conditions from threshold and on approach must have legends harmonized for optimal reading. To this end, the size and balance of secondary elements are also critical. A key component of the Clearview development has been the design of letter shapes that eliminate “hot spots” caused by bright sheeting when viewed by older drivers who generally have a decreased sensitivity to contrast. Creating clear unambiguous word patterns enhances sign readability.
Although the IA-5 limits use to positive contrast applications, comments in the Technical Brief about negative contrast, assumptions about line space, word length and incompatibility of structures are either wrong or not relevant.

While jurisdictions may be using negative contrast and mixed case Clearview in ways that do not comply with standards, this issue should have no bearing on the IA-5 for guide signs. These concerns lack documentation and indicate the need for more research given the success of current efforts. FHWA disregards the fact that Clearview saves lives, reduces the severity of crashes and reduces accidents.

The transition from all uppercase block letters to mixed case that includes descending letters must be accommodated in layout guidelines just as the mixed case FHWA Standard Alphabets would. The taller lower case may be different from current convention but if all guidance is tied to the initial capital letter height, and descending letters are accommodated, the rules for Clearview are the same as for Standard Alphabets. As shown below, Clearview does not require more line space.

A prominent complaint by the FHWA is that Clearview 5-W is not a perfect match to E-modified: a 1948 design that was not addressing the myriad requirements of current applications and motoring environments. With reduced letterspace, Clearview compared to E-modified at the same capital letter height and footprint size is 9.5 percent improved in legibility and readability. Clearview 5-W with slightly more letter space provided a 10 percent improvement.

Improving the readability of destination names on conventional road guide signs was also critical. Clearview 3-W compared to mixed case Series D was more legible day and night by 29 and 22 percent respectively and similar studies of other weights in both positive and negative contrast show improvements that are as significant.

The government mistakenly states that with the lower-case loop and rising stem heights in Clearview that the resulting space between lines of legend is reduced and that "...signs whose legends appear crowded are likely attributable to this effect."

In the cases of freeway signs and conventional road signs, this follows the same interline layout proportions built for FHWA Standard Alphabets using mixed case legends. This claim is just wrong.

Within the applications design process, the design team made efforts to make sure Clearview could be consistently adapted to current standards.

FHWA has four different fraction proportions specified. In Clearview the designers have created a standard proportional relationship for fractions in relation to whole numbers and to the base-line. This design allows greater uniformity regardless of size. The fraction is a ligature that uniformly stands alone or with a whole number.
The government noted: "The presence and availability of two separate letter styles with differing criteria have resulted in significant confusion and inconsistency in the highway sign design and fabrication process."

The complaint is not clear. One interpretation is that the coexistence of FHWA Standard Alphabets and Clearview as two separate letter styles causes confusion. The other is that two Clearview versions in each weight causes confusion.

The first interpretation implies that the coexistence of Standard Alphabets and Clearview may cause confusion, especially as one is transitions from all capital letters to mixed case. Clear guidance should mitigate referenced confusion. However, the benefits of a second style, specifically safety benefits are not addressed.

The second interpretation leads to further explanation. Clearview Type System is a six weight series. Within each series there are two versions: one for positive contrast signs and one for negative contrast signs (or part of sign that has both). The functional goal is to tailor the stroke width for improved readability when using high-brightness sheeting. This change aids the older driver, especially at night.

The positive contrast version is used for guide signs and applications in which the background is darker than the letters. This is identified as the “W” series (‘white” letters). The lighter letters can bloom or cause halation when illuminated by headlights and viewed by older eyes. These letter shapes are drawn to reduce or eliminate the negative effects of overglow when the figure is brighter than the field.

The negative contrast version has slightly wider letters. These are generally black and non-reflective letters placed on a bright retroreflective background. Their identity is the “B” series (for black). The dark letter is surrounded by the brighter retroreflective background that makes the letter appear thinner. The width of the negative contrast is drawn so that the they appear to be the same width as the white positive contrast legends.

The sign designer or sign maker understands and appreciates the functional difference.

Although it is difficult to see the difference in print and at this scale, the adjustment in stroke width is quite pronounced when viewed at night under the illumination of headlights and with brighter grades of sheeting.

E-modified, shown on the right side is the same for both positive and negative contrast applications.
Historically the typefaces used on highway signs were hand cut or photo imaged from master drawings in the Standard Highway Signs Book. It was not until the mid 1980s that users began to scan and digitize letterforms for use in computer based software. There seems to be no quality control by the FHWA as to the accuracy of the letter designs or adherence to letterspacing tables.

In practice, local DOTs and sign shops purchase software for every font regardless of it being a Standard Alphabet font series or Clearview. Standard Alphabets are commercial products, and free versions are also available. In the same way, there are free copies of Clearview as well as a master ClearviewHwy® font of the six weights in positive and negative contrast and includes precision spacing.

When the Interim Approval (IA-5) was granted, FHWA asked that the design team provide the Clearview designs free to the users of the MUTCD as a supplement to the SHS book. The designs, including glyphs for each of 13 fonts and spacing tables, were provided in high resolution panels. This finished set of designs represented thousands of hours of original work over many years from early prototype designs to final design. The effort to develop Clearview and create proportion based applications has also been released to the government and the public at no charge.

The ClearviewHwy® font software was developed at the request of state DOTs. This TrueType font software includes standard spacing for use on industry standard programs including: MicroStation, full feature CAD programs such as GuidSign and all related cutting and plotting equipment. The software provides accuracy and saves time in layout and production and insures files transferred from design to production are compatible. This font software is purchased as a one time cost.

There are 6 different levels of compression in the Clearview Font System. Each has two versions. One for positive contrast applications (light on dark), and the other for negative contrast applications (dark on light). The negative contrast version is slightly heavier to compensate for the reverse overglow of the lighter retroreflective background. In the positive contrast version the overglow is from the inside out. For both applications the letters were designed to compensate so the brighter letters will not overglow when viewed at night by a motorist with reduced contrast sensitivity.
The government, in multiple entries, associates Interim Approval IA-5 with the downfall of sign design. The FHWA claims: “Poor sign design practices are becoming unduly institutionalized. This phenomenon appears to have coincided with the provisional allowance of an alternative lettering style due to a lack of consistent implementation and inaccurate presumptions that lesser sign design criteria, such as reduced interline and edge spacing, are broadly acceptable.”

Coincident events do not prove causality. Clearview installations observed nationwide have been refined and consistent. The work product addressed inconsistency.

The Clearview project began by asking why conventional road intersection signs were cluttered and inconsistent, why use all upper case lettering for destination names and why are the assemblies so disordered (photos below)?

With the Interim Approval IA-5, the design team developed a grid system for efficient layout of positive contrast signs using formats based on a consistent set of mathematical proportions. This conceptual design afforded one system in lieu of many currently used for conventional road guide signs, route shield display, recreational and cultural interest area signing, recreation symbol sign display and motorist services signing. The grids (page 13) accommodate mixed case legends with descending letters and other wayfinding devices (shields, arrow, numbers and fractions).

In developing the proportion based grid system for freeways the team was very aware of inconsistency in the underlying proportions and size relationships of existing freeway signs. The design team identified proportional relationships that would uniformly apply while uniformly sizing and increasing action word legends to aid older drivers and eliminates graphic elements and inconsistent relationships to aid glance reading (page 14). In this layout, the thirty most common guide sign applications for freeways use the same nine proportion relationships based on the primary legend size (all simple fractions). This eliminated traditional layouts that would require 25-35 unique measurements that are not consistent from one sign to the next. This change of proportion as developed results in signs with uniform figure/field and inter-line proportions. This effort did not include diagrammatic signs. (Design guides were presented at TRB and published by TRB and ASCE.)

Other white papers were prepared on street name signs, parking control, wrong way one way and a uniform approach to signing for cycling. The purpose was to show how all the disparate parts in the MUTCD could be an ordered system of signs.
Proportion based grid system for: conventional road guide signs, route shield display, recreational and cultural interest area signing, recreation symbol sign display, and motorist services signing.

Original concept based on FHWA studies of “positive guidance.” Route shield panels use modules applied to a base panel to eliminate clutter of individual panel assemblies.


Proportion based grid system for freeways and expressway guide signs.

Action words, cardinal direction and exit legends all sized to appear the same in relation to primary legend (X). Route shield size may change but is also a proportion of “X” and area for action word is always uniformly sized to “X” to address backlighting. Cardinal direction eliminates larger initial letter as it tests poorly based on 2004 LTI research requested by FHWA.

The Clearview project has made significant contributions to road safety and demonstrates that design of typefaces and layouts can impact the readability of road signs and the quality of the roadscape. This effort has provided:

- An understanding that effectively designed mixed case typefaces enhance word pattern recognition with a same size legend and improves readability for older drivers, especially at night.

- An alternative to E-modified that increases readability by a minimum of 10 percent in older driver studies.

- A full complement of six weights in both negative contrast format and in positive contrast format with upper case, lower case and figures that are twenty to thirty percent more legible than comparable Standard Alphabets (also older driver studies).

- A uniform proportion based grid system using proportional relationships for layout of freeway and expressway signs that are applicable to over 30 primary signs used for limited access highways.

- A proportional system of grids for conventional road guide signs, route markers, recreational and cultural area guide and motorist services to afford consistent guidance without clutter or ambiguity. Essentially one format system instead of many.

- A system to uniformly designed signs for cycling within cities that includes identification (lanes and route systems), guidance, regulatory, warning and lane management. This system, using Clearview was developed in conjunction with NACTO (Cities for Cycling) and the League of American Bicyclists and Virginia Tech

- Created white papers and guidelines to assist cities in the application of mixed case lettering on street name signs.

This list of benefits sets the stage for upgraded signing in states, cities and counties throughout the United States. A multi-year research program from planned corridors with signs installed found that accidents were fewer, the severity of crashes was reduced, accidents were avoided and lives were saved. There are cost savings when the Clearview typeface is made part of a department of transportation sign and motorist safety and older driver signing strategy.

The Federal Register Notice to terminate the use of Clearview deprives the public of a typeface that has made the roadscape safer for all drivers with particular attention to older drivers.