Comments to the Draft Guidelines for Accessible Public Rights-of-Way

I am writing as the chair of a committee of American Public Works Association members charged with updating a section of the Kansas City Metropolitan Chapter construction specifications and guidelines. This section deals with incidental construction and includes sidewalks and sidewalk ramps. I have tried to reflect the views (which are varied) of the committee members. A draft of this document was distributed to the committee, but due to time constraints, this final document was not. I believe I have represented a consensus view, but will take full responsibility for these comments since the committee did not review this final draft.

Cross Slope: The 2% cross slope requirement in crosswalks (across streets) is problematic unless street designers use that requirement as the primary consideration in their design.

A method that would provide reliable slopes, and that would be conceptually simple and thus attainable would be to require all intersections to be a single plane. Entering streets would be warped by removing crown and by super-elevating the roadway to match the edge of the plane. The plane should be extended to the ends of the curb returns, or to the crossings. Drainage can be problematic in this type of design, especially in regions with freezing weather. In this area 1% is commonly used as the minimum allowable slope to provide drainage adding the requirement to limit slopes to 2% gives the roadway designer very little latitude in design.

Where the roadways were curbed, provisions would need to be made to intercept all drainage on the high sides prior to entering the plane. In areas with steep terrain (and I'm writing from Kansas, in a city where the average slope is 4-6%) this reduction in slope at an intersection might necessitate the inclusion of retaining walls to adjust grades within right-of-way on wider roadways.

On high speed roadways, the geometric requirements would dictate a lengthy transition from the 2% maximum plane slope to the normal slope of the street. This transition would be accomplished with a vertical curve that would begin tangent to the plane, thus extending this flatter than terrain slope some additional distance beyond the intersection.

Where the intersection is a thoroughfare or high volume roadway with a low volume local type street, designers are charged with preserving the high speed, high volume characteristics of the thoroughfare roadway. They would not normally alter the gradient, or the cross section of the thoroughfare. The side street intersection would be warped to match the through street. The ADA guidelines recognize the need to preserve the driveability of the roadway by allowing cross slopes of mid-block crossings to match the longitudinal slope of the street being crossed. This same concept should be extended so that the slope of crosswalks at minor street – thoroughfare intersections would be allowed at the slope of the thoroughfare – for the crossing of the thoroughfare.

Perhaps a more reasonable requirement would be to require 2% cross slopes on the narrower and lower speed local residential streets, and allow crossings of the higher volume roads to match the roadway slope with an admonition to make these crossings as flat as possible. Regardless of the law, high speed roadway designers will place the safety of the motoring public at the top of their list when designing these roads (we hope!).

We would like to see more research into mobility among the wheelchair community, and perhaps more importantly pedestrians using other mobility aids such as walkers or canes. We feel that more research is warranted regarding the 2% cross-slope. The roadway design methods that are in use have been derived from considerable research into the physics and physiology of driving motor vehicles. Where can we find that same level of research into the physiology of crossing a street with various mobility aids and when visually impaired? Is it possible that the majority of mobility aid users can tolerate steeper cross slopes?

Our fear is that when faced with a situation that cannot comply with ADA requirements (and there will be countless such cases – especially when retrofitting), the designer or contractor proceeds and fails to provide what could have been a workable solution. We need the gold, the silver and the bronze standard for compliance. Currently there is no guidance for the very common situation of greater than 2% cross slope.

Transition section: If a cross slope of 1:48 is unattainable at the street, the designer must transition from the 1:48 cross slope of the walk to the cross slope of the street. A design protocol that our committee found useful was to identify in plan view up to four elements at each ramp. 1) the walk, 2) the ramp, 3) a landing, and 4) a transition. The walk is self explanatory. The ramp as we defined it would be the steeper plane (1:12 or 15 ft) that would lower the sidewalk elevation from the top of curb elevation to the street elevation with a maximum 1:48 cross slope and would be coplanar throughout its rectangular dimension. The transition would connect the end of the ramp to the street, and would be as coplanar with the adjoining street section as was practicable. If the adjoining street (back of curb) slope exceeded 1:48, the transition would be used to warp from the 1:48 cross slope of the ramp to the street slope. Additionally, the transition would provide the geometric transition from the rectangular sidewalk and ramp sections to the curvature of the curb return at the intersection. This design process usually yields a "crease" normal to the direction of sidewalk travel at the top and bottom of a rectangular (and coplanar) ramp. We found that where ramps were constructed with a continuous transition from the sidewalk (at the top of the ramp) to the curb and where the sidewalk intersected the street within the curvature of a curb return, the cross slope along the ramp in some cases exceeded the cross slope of either end. This effect is most pronounced where the short side of the ramp intersected the curb return at a point lower than the point where the longer side intersected the curb return.

After many meetings, our committee determined that ramps should be fully designed as a part of the plans, and that elevations should be shown on street plans for each critical point on sidewalk to street intersections. Our detail sheet is attached. These spot elevations make it possible for a plan reviewer to check compliance with ADA guidelines, and shift the burden of the design from the contractor at the moment of construction, to the engineer designing the project. At least in our metropolitan area (and I suspect in most) engineers designing street improvement projects do not perform the field survey necessary to establish the spot elevations necessary to adequately design sidewalk to street intersections. They instead include a set of standard detail drawings and leave the process of design to the contractor building the project. Our measurement of ramp dimensions against plan drawings left little doubt that at least in our area this practice does not yield optimal (or even compliant) ramps. In situations where slopes cannot be met, the designer and the owner can determine the best alternative solution without the pressure associated with "designing while constructing." This practice also would build a database of situations with sufficient data for standards bodies to formulate workable solutions. Ramp interfaces are often complex geometric problems that should be solved by engineers.

Detectable Warning Location: The proposed rule, and several members of the access board have indicated that the detectable warning should be placed immediately behind the curb. The thinking is that the blind should have a clear tactile demarcation between the walk and the street. We would argue that there would be many benefits if this material were instead placed at the lower end of the ramp. Using the convention discussed above where the intersection is divided into the zones: sidewalk, landing, ramp, and transition; detectable warnings will always be in the transition where the sidewalk intersects the street at the curved portion of a street curb return. By its nature, this transition area will be the only part of the sidewalk to street intersection that is not planar, and in most cases non-rectangular. Our committee has examined various detectable warning materials. Here in the Midwest where freezing weather is common, we feel that the inlaid brick products would perform best, and would be least likely to be damaged by snow plows and by other large trucks that may wander into the area behind the curb return curb. Regardless of the material used, having a planar surface would make construction much easier, and would (we believe) reduce maintenance requirements.

Our detail shows this concept in ramp type 'A'. There is a small triangle (the transition) between the end of the ramp and the back of the curb without detectable warning material. If the blind walker were to believe that the street was actually at the end of the ramp, what harm would be done? At the point where he began to cross the street, he would need to take an extra half step at the beginning of his crossing, and an additional half step at the end, and in both cases would have a little additional protection from the vehicles traversing the curb return while waiting. If we adopted that same practice for ramp types B and C on the attached drawing the additional distance would be several steps.

The benefit to the design and construction community are several:

1) The detectable warning material would be built on a planar surface. In addition to the constructability improvement, this would also reduce the vibration to wheelchair users caused by trying to warp flat and rectangular bricks or flat sheets of hard plastic to fit a curved and non-planar surface.

2) The detectable warning material would be built to rectangular dimensions. All of the products we've seen have been rectangular. Bricks could be splayed around a curve, and sheeting could be cut, but both add considerable complexity to the construction process.

3) The detectable warning material would have a little more protection from errant vehicles unable to negotiate the standard curb return radius. Semi-trailers on occasion cross into the area behind a curb return. Most of our area cities have replaced storm drainage inlet tops broken by trailer tires that have strayed over the line. Snow plows have the additional problem of not being able to see the curb return (it being covered with snow). We don't have experience with the sheeting, but are concerned that a plow blade would catch the sheeting and pull it off.

Detectable Warning Contrast: The proposed rule provides no numeric guidance for contrast, and in addition to concern about the needs of the visually impaired, I have some concern about the need of the public agency that is asked by vendors and contractors to accept various detectable warning materials as having contrast with the concrete that is the most common sidewalk material. If you examine the photographs of the detectable warnings in the publication "Detectable Warnings: Synthesis of U.S. and International Practice", U.S. Access Board there are numerous examples where the grey scale contrast is very low. That same publication excerpts the appendix to ADAAG, and recommends that detectable warnings contrast visually with adjoining surfaces. It states:

The material used to provide contrast should contrast by at least 70%. Contrast is determined by:

$$Contrast = \left[\frac{(B_1 - B_2)}{B_1}\right] \times 100$$

Equation 1

Where B_1 = Light reflectance value (LRV) of the lighter area
And B_2 = Light reflectance value (LRV) of the darker area

Photographers use a Kodak gray card to establish exposure. These cards have a white side that is 90% reflective, and a grey side that is 18% reflective. This reflectance is essentially constant across the spectrum of visible light frequencies.

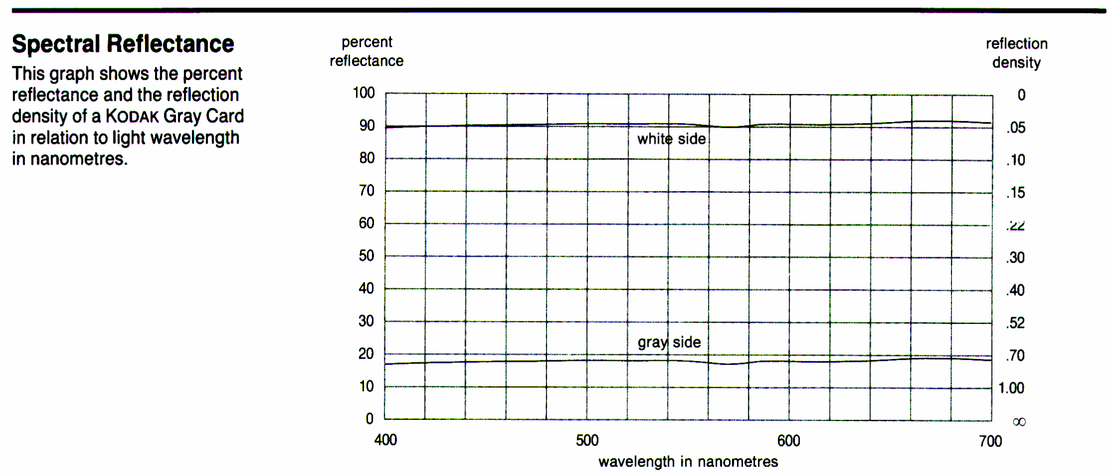
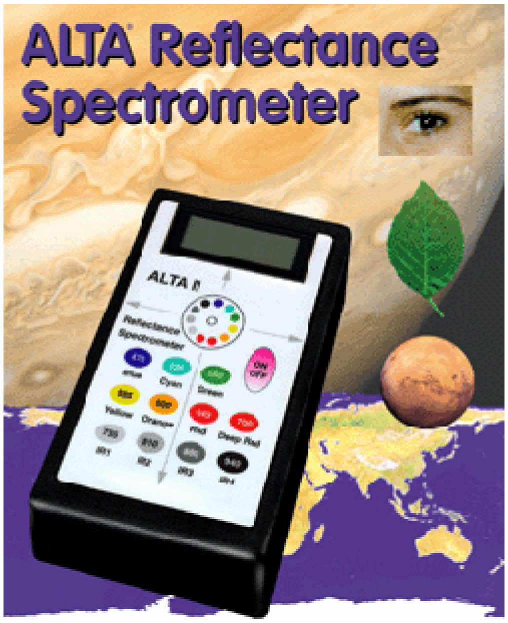


Figure 1 Light Frequency Response Curve from Kodak gray card package

Note that a 90% reflective white is a brighter white than most office copy/printing paper. In our office, the Georgia Pacific copy paper has a brightness of 84%. For the Kodak gray card, and using Equation 1 above, the contrast is 80%. Given the gray cards essentially flat frequency response, that contrast ratio is constant across the visible light spectrum.

Since concrete is the predominant material for sidewalks, we utilized a simple and inexpensive instrument to determine the reflectance value for concrete. The instrument was a Alta II Reflectance Spectrometer. This unit uses an array of light emitting diodes that emit light at various frequencies from 470 nanometers to 940 nanometers and a light sensor that records the reflectance of light at each frequency from the surface upon which the unit is placed.



The ALTA® hand-held Reflectance Spectrometer measures 3.75" × 6.75" and weighs only 9 ounces.

We tested four sidewalk panels. All were concrete, and the age varied among the four from new to nearly 20 years old. The newer concrete is labeled "Concrete 3" in Figure 2 below. The higher reflectance is at least partly attributable to the white curing compound that was still visible on the surface of the concrete. If we select a "dark" LRV of 25%, in order to meet 70% contrast, the "light" value would need to be at least

$$70 = \frac{(B_1 - .25)}{B_1} \times 100$$

or

$$B_1 = \frac{25}{30} = .8333$$

This would require a "light" only slightly less white than economy white office paper. With the newer concrete and assuming a LRV value of 30% (which is a darker value than the reflectance across most of the spectrum) the "light" color would need to have a LRV of 100% which is obviously not attainable new or after the materials had aged.

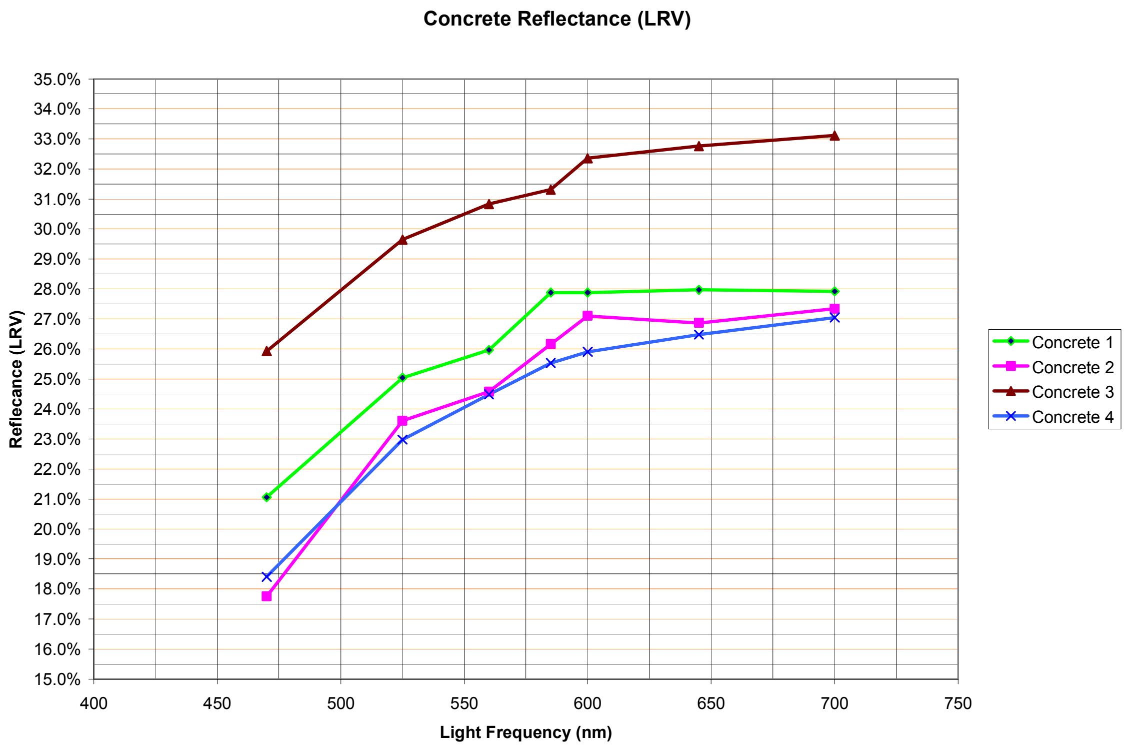


Figure 2 - Selected Concrete Reflectance

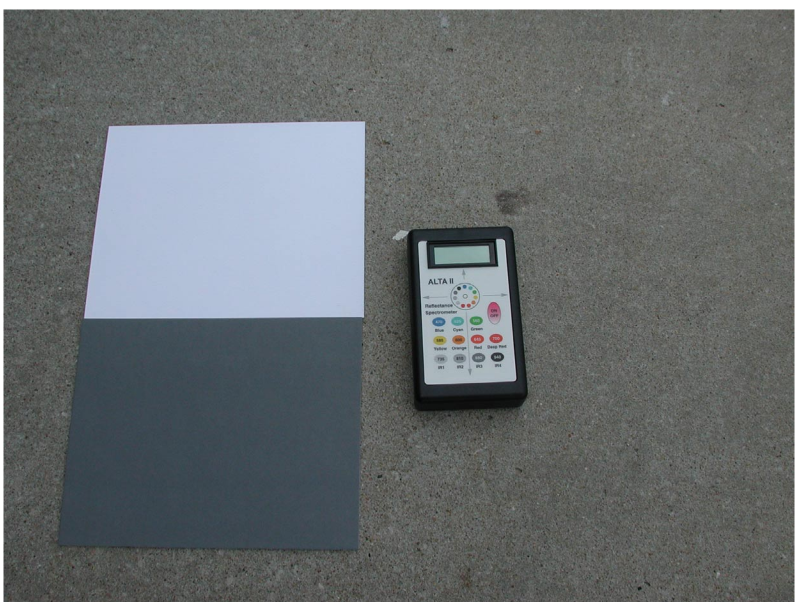


Figure 3 – Alta II, Kodak gray cards on Concrete 1

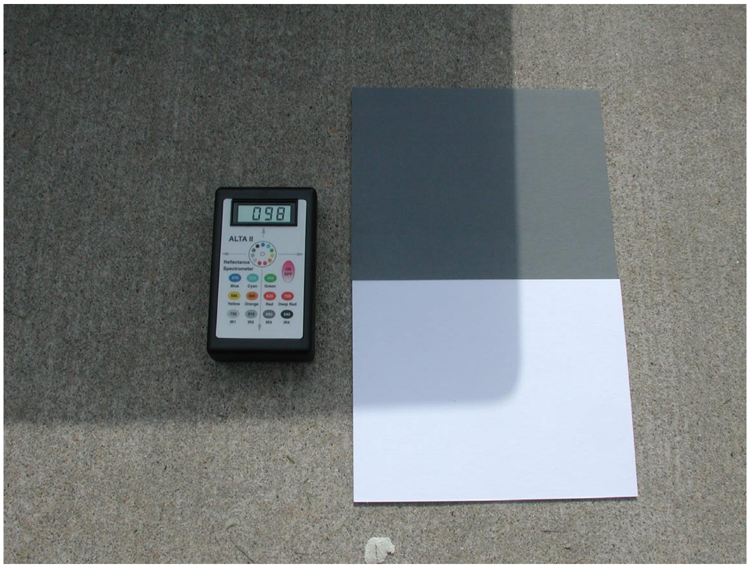


Figure 4 - Alta II, Kodak gray cards on Concrete 2

Figure 5 - Alta II, Kodak grey cards on concrete 3

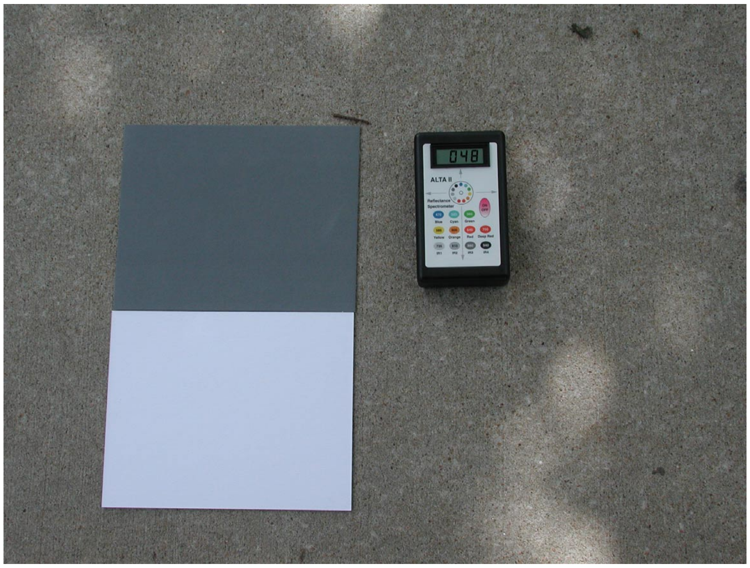


Figure 6 - Alta II, Kodak gray cards on concrete 4

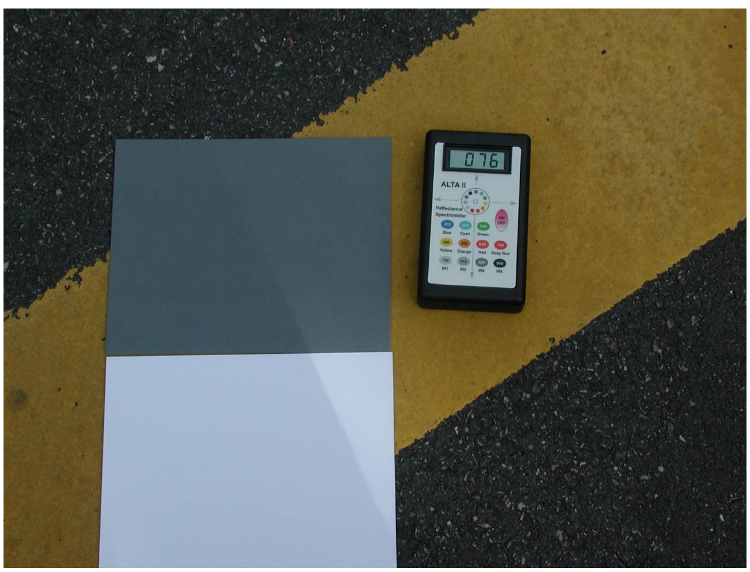


Figure 7 AltaII, Kodak gray cards on yellow thermoplastic over asphalt

If a visual cue is important, I'd recommend that the end of the ramp be marked with white thermoplastic or other similar pavement marking materials. This material is retro-reflective (has embedded glass beads that reflect light) and would provide a high degree of contrast against the darker concrete (at least while new).

Summary: These comments address several specific issues, that our committee addressed while preparing our specifications, and are not a comprehensive review of the entire draft guideline. Those issues are summarized as follows:

1. The 2% crosswalk cross slope is unrealistic even in new construction, and may impede good designs in difficult situations because this standard is often unattainable and alternatives are not contemplated.

2. As a general comment, wheelchair ramps should be individually designed. Agencies should require that ramps show elevations at critical points so that ADA compliance can be determined prior to construction.

3. Moving the detectable warnings to the nearest planar, rectangular surface would make them much easier to design, construct and maintain

4. A method of measuring contrast should be established, and a realistic contrast value should be established. Paving marking materials might provide a better visual indication, and could be more precisely located than the truncated dome materials.

Our committee and our metropolitan community are committed to providing access. We are fortunate in having Michele Ohmes on our committee, and have spent some time on field trips where Michele demonstrated problems that wheelchair users have with ramps and walks. I'm sorry to report that some of those problem ramps were new. Engineers need guidance for the situation that does not and will not meet the 2% cross slope criteria, and we all would benefit from further research into the physiology of the use of mobility aids.

Terms: To be clear, the following geometric terms are used in the discussion, and have the following meaning.

Crown: Raising the center of a roadway to provide slope to either side. Crown provides drainage, and on curbed streets where storm water is trapped by curbing, keeps flowing water at the outer edges of a roadway.

Curb return: The curve that connects two intersecting streets at their outer edge. This dimensions of this curve are designed around standard vehicle turning geometry, and generally increase with the volume (and design speed) of the roadway(s).

Plane: A surface containing all the straight lines that connect any two points on it. We could use the term "flat" except that in many definitions flat combines the concept of a plane with the requirement that all points have the same elevation. As used here, plane or planar refer to the surface that is straight in two dimensions, without curvature or warp. Coplanar means that two adjoining surfaces share the same plane.

Superelevation: the cross slope of a roadway section. Superelevations are generally associated with highway curves, where the curve is constructed with cross slope or superelevation to counteract the centrifugal forces caused by driving along a curved path. The straight (tangent) sections entering and exiting the curve transition from no superelevation to the superelevation (or bank) of the curve. Rates of superelevation can be expressed as a difference in longitudinal slope between the edges of the roadway and vary with design speed. The process of calculating superelevation and transitions into and out of superelevated sections and are a fundamental design concept in highway design.

Warp: To distort a planar surface so that parallel lines within that surface have different (usually constantly varying) slopes along an axis.

Respectfully submitted,

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