Henderson

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6 - DAYMARKS

6-1 INTRODUCTION

Daymarks are targets which are affixed to or integral with aids to navigation in order to increase either or both the day or night visibility of the aid. They are used on all minor aids, lighted or unlighted. The function of the aids and consequently of their daymarks, may be divided into two categories:

1. To mark the edges of alignment of channels, such as on the western river system or the intracoastal waterway canal.

2. To mark isolated dangers.

In the past some Districts have conducted their own empirical investigations regarding daymark size, shape and color as a prelude to establishing rules for daymark design. These districts based their criteria on the samples in their experimental collection. Other districts have relied on intuition or artistic instincts when designing their daymarks. This has resulted in a multitude of daymark types being used throughout the Coast Guard. However, the results of systematic experiments in psychological optics in recent decades can be profitably applied to daymark design. Often these results agree with the products of the empirical studies mentioned above. They enable the Coast Guard as a whole to use an engineering approach to the problem of daymark design. Thus, operational requirements for daymarks may be established and calculations made of the area required for a mark of a chosen color and shape to be seen at the required range with a certain probability.

6-2 VISUAL PERCEPTION DURING THE DAY VERSUS AT NIGHT

Increasing amounts of information are conveyed by the daymark to the mariner as he approaches the detection range, the recognition range, and then the identification range. At the limit of the mark's visual range, the detection range, it will convey only the information of its existence; that is, it will just be detected as something at variance with its background. As the distance between the mariner and the aid decreases, the threshold for recognition is reached; that is, the detected object is recognized as an aid to navigation. At this time it may also be possible to identify it as a particular aid by means of its distinctive shape, color pattern and location. For minor daybeacons, however, a still closer approach is often needed in order to identify it as a particular aid, usually by means of numeral and/or letter markings.

The practical problem in designing a daymark is to determine the shape, color and size of daymark required to meet the operational needs of the mariner. The problem is analogous to selecting a lamp-

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The practical problem in designing a daymark is to determine the shape, color and size of daymark required to meet the operational needs of the mariner. The problem is analogous to selecting a lampoptic which projects the desired visual appearance to the operationally required luminous range at night. In both cases Allard's Law, equation (4), describes how the light from the source (lamp or daymark) is attenuated during transmission through the atmosphere as a function of the path length.

$$E = I\, T^{D}/D^{2} \qquad (4)$$

However, there are three (3) fundamental differences which complicate the daymark problem.

1. The source of light for a daymark is not controlled in intensity since it is the sun. The reflectivity of the daymark surface and the angle of the sun relative to the daymark and the observer determine the luminance or brightness of the source. This brightness, multiplied by the area of the target, is the quantity analogous to I, the light intensity, in equation (4).

2. The daymark is not a point source for which size or shape are negligible parameters. The effect of these parameters is summed up in the brightness contrast threshold of the daymark. The brightness contrast threshold between a target and its background is the fraction $\Delta B/B$, where ΔB is the brightness difference between the target and background required to render the target visible, and B is the brightness of the background. As the distance between an observer and a target increases, the apparent brightness contrast decreases exponentially. The effect of color is accounted for by means of an effective contrast enhancement factor which depends on the color of the background.

3. In night-time visual signalling the background brightness is more or less constant and dark. The effect of different background brightnesses is easily taken into account in Allard's Law by a multiplicative factor, which shows up as a triple scale on the abscissa of Figure 64. In daytime signalling changes in background brightness and color affect the contrast threshold of a daymark in a much more complicated way. Thus, different graphical solutions of the function relating visual range, atmospheric transmissivity, and target area are required for different background brightnesses and target shapes.

These complications result in an easily observed fault in daymarks which is difficult to remedy. This is that, unlike a light which presents essentially the same aspect throughout the night, the color and visual range of a daymark under actual search conditions will vary widely depending on the angles of the sun relative to the daymark and to the observer.

In daytime viewing problems the term "visual range" is used in place of the term "luminous range," which is appropriate for night viewing problems. The visual range of an object is defined as the maximum distance at which the contrast of an object against its background is reduced by the atmosphere to the contrast threshold of the observer.

The clarity of the atmosphere is usually described in terms of "meteorological range" or "meteorological optical range" rather than transmissivity per unit distance when describing daytime visual signalling. The meteorological range is defined as that distance for which a standard black target displayed against a sky background is reduced to two percent of its inherent contrast (which is 1.0) due to the transmission properties of the atmosphere. It is related to the atmospheric transmissivity in the following way:

$$MR = \frac{\ln .02}{\ln T}$$

where MR is in sea-miles if T is transmissivity per sea mile. Similarly, the meteorological optical range is that range at which the contrast of a test target is reduced to five percent due to the properties of the atmosphere. Likewise,

$$MOR = \frac{\ln .05}{\ln T}$$

Figure 62 lists equivalent values of transmissivity, meteorological range, and Beaufort scale visibilities, while Figure 72 does the same for meteorological optical range. Figure 72.1 is a nomogram for converting transmissivity (per sea-mile) to meteorological range (sea-miles). Equivalent values of these two quantities lie on a horizontal line.

6-3 DETECTION RANGE FOR DAYMARKS

In daylight brightness contrast is the important factor for maximum distance sighting of objects; positive identification, at closer range, generally requires color or shape distinction. The solution to the problem of determining detection range in daytime for a non-point, achromatic target as a function of brightness contrast threshold, target area and shape, background brightness and meteorological range has been checked experimentally and presented graphically by Duntley. His graphs have been modified to give a detection probability of 95 percent and are shown in Figures 73: a, b, c and 74: a, b, c. Duntley's solution may be applied to daymarks by replacing the brightness contrast of the grey target with an effective contrast for various colored films and pigments. The effective contrast combines brightness and color contrast and takes into account the changes in contrast resulting from different backgrounds. Effective contrast values for several kinds of commonly used daymark colorings are listed in Figure 75.

Duntley's modified nomograms give detection range as a function of effective contrast and meteorological range for bright, overcast and twilight conditions. The choice of nomogram depends on the type of use planned for the daymark. If day use predominates the "twilight" nomogram should be used and the effective contrast value of the color chosen from Figure 75 should be the poorer value for either overcast or clear sky conditions. If day and night use are of equal importance the "full daylight" nomogram should be used with "clear sky" contrast values, unless at the particular location the sky is overcast nearly all the time. In that case the "overcast" sky nomogram should be used with "overcast sky" contrast values from Figure 75.

The modified Duntley nomograms are presented in two sets. The first set, Figure 73: a, b, c, is for target shapes which approximate circles, i.e. compact targets. The limiting proportions for compact target shapes are listed in the table in Figure 71.1. When these limits on the proportions of target shapes are exceeded, the second set of nomograms, Figure 74: a, b, c, labeled "elongated target" should be used.

The use of these nomograms to find the detection range of a particular, single colored daymark is quite simple. First find the effective contrast of the daymark coloring material from Figure 75. The lowest contrast for clear or overcast sky should be used if day use or overcast sky conditions predominate. (When day and night use are of equal importance and the sky is clear at least about 50% of the time, the clear sky contrast value should be used. Then in Section 12 look up the limiting transmissivity for the specific locale corresponding to a minimum frequency of visibility, and convert this to meteorological range using Figure 72.1. Then, on the proper nomogram for the target shape and usage concerned, connect the meteorological range in yards and the effective contrast with a straight line. By interpolation, find the point on this line at which it intersects the curve corresponding to the target area in square feet. A vertical line through this intersection point will cut the abscissa at the target detection range, in yards.

For example, in the Chesapeake Bay, a daymark with a 5 mile (10,000 yards) visual range is desired, and shape is not specified. The transmissivity for 90 percent frequency of visibility is 0.57 per sea-mile (Figure 10, section 12). From Figure 72.1, this corresponds to a meteorological range of 8.2 sea-miles or 16,400 yards. The background is sky. Consulting Figure 75, the best daymark material for sky background with an appreciable amount of clear weather is fluorescent yellow-orange Scotchcal. It has the highest effective contrast, 3.3, in clear weather and is nearly as effective as the black Scotchcal and the international orange enamel during overcast weather.

The contrast used in the solution below is for overcast conditions so that the daymark will function as well as a signal in all types of daylight. The target shape will be a "compact" diamond and its use predominately in the day, hence Figure 73.C is applicable. The data can be worked up as follows. The choice of the shape of

M.R. (yds)	Cy-o (F) (Overcast)	Range (yds)	Area (sq. ft.)	"L" & "W" Dimensions, ft. 1:1 Square	5:1 Diamond
16.400	1.0	10,000	400	20:20	64:12½

the target depends on whether a greater detection range is desired at the expense of the recognition range. or vice versa. Detection ranges are greatest for targets with shape ratios of about 1:1. Recognition ranges are greatest for large length to width ratios. Recognition of target shapes is further discussed in the following section. Range daymarks, for instance, are targets for which long recognition ranges are required.

6-4 RECOGNITION AND IDENTIFICATION OF DAYMARKS

After a target has been detected, the identification of it as an aid to navigation and the recognition of it as a particular aid depend on the aid's location with respect to its surroundings, on its shape and color pattern, and finally on information conveyed by numerals and/or letters. Color, target shape and identifying numerals are discussed in this section.

A. COLOR

Hue is the attribute of a color perception denoted by blue, green, yellow, red, etc. Achromatic means not possessing hue; an achromatic color perception is described as black, white or a shade of grey. The effect of atmospheric scattering due to haze on color is to grey it out, or wash it out. at long distances in proportion to the amount of haze present. Color contrast decreases as well as brightness contrast, however, as the colors of distant objects wash out they may still be perceived due to brightness contrast. Thus, although all targets are achromatic at long ranges, some will appear brighter, or have a higher brightness contrast with their surroundings and will therefore have a longer detection range. The results of actual outdoor experiments are summarized in the following paragraph.

As the distance from the object increases, or as the haze between the observer and the object increases, yellow takes on a greenish cast, decreasing chromatic contrast with a wooded grassy background. As the range increases further, yellows appear to be white. At about the same range, international orange, red, and green are seen as black. At still greater ranges, fluorescent red-orange is seen as a pale orange eventually becoming white. On losing color significance due to scattering, light colors (yellow, fluorescent yellow-orange, fluorescent green, etc.) appear as light grey alongside white objects or appear white alongside darker objects. Dark colors (international orange, bright red and green) appear as a dark grey alongside black objects and appear black alongside lighter objects. At long visual ranges or in heavy haze all colors appear as some shade of grey.

The effect of color contrast is taken into account in the calculation of detection ranges by means of an effective contrast. Effective contrast values, measured relative to an achromatic shade, are tabulated for the various colored pigments and films against several types of commonly encountered backgrounds (Figure 75). Thus, the problem of choosing a daymark color is simplified to merely selecting that color with the highest effective contrast for the backgrounds encountered.

Procedures for finding the effective contrast of a multi-colored target are given for the two cases (a) where the visual range is specified and the required area is to be determined, and (b) where the area of the mark is known and the visual range is to be determined. The procedures amount to calculating a weighted average of the contrast values of the different colored portions of the multi-colored target. The contrast value of each portion is weighted by its fraction of the total daymark area.

To calculate the <u>required area</u> of a <u>multi-colored</u> target for a given visual range and <u>meteorological</u> range (atmospheric transmissivity) proceed as in the following example with the method of successive approximation.

<u>EXAMPLE.</u> The target is a square dayboard whose basic color is black. It has a yellow border and white identifying numerals affixed to the center.

<u>SOLUTION.</u>

1. Enter the appropriate nomogram (one of 73: a, b, c) with the effective contrast C_1 of the basic color (black) obtained from Figure 75, to determine the area of A_1 for the given range in the first approximation. Connect the meteorological range with the effective contrast, C_1, by a straight line. Draw a vertical line up from the desired visual range. The intersection of these two lines is a point which falls somewhere in the curved grid representing the area scale. Interpolate on the area grid to find the required area as represented by the intersection point.

2. Returning to Figure 75 determine the absolute value of the difference in effective contrast between the basic color (black)

and the next most predominant color in this case (yellow):

$$\Delta C_1 = |C_1 - C_y|$$

3. Letting A_1 be the area of the entire dayboard, calculate the area of yellow border desired, A_y, and the ratio A_y/A_1.

4. Multiply ΔC_1 by this ratio, A_y/A_1.

5. If C_y is greater than C_1, then add the number calculated in step 4: $(\Delta C_1)\cdot(A_y/A_1)$, to C_1 to get C_2, the effective contrast of the black target with the yellow border. If C_y is less than C_1 then subtract $(\Delta C_1)\cdot(A_y/A_1)$ from C_1 to get the effective contrast of the combination, C_2.

6. Re-enter the same nomogram with C_2 using the same meteorological range and required visual range, to determine the total area required, A_2, to the second approximation.

7. Repeat steps 2 through 6, using target area A_2 and effective contrast C_2 to find the total area of the dayboard in the third approximation when the white numerals are included. The white numerals will have an area of A_W and an effective contrast C_W. The effective contrast C_2 will be increased or decreased by the amount $(A_W/A_2) \cdot \Delta C_2 = |C_2 - C_W| \cdot (A_W/A_2)$ if C_W is greater than or less than C_2, respectively, resulting in the effective contrast of the three-colored dayboard, C_3. The third and final approximation to the total area required is obtained by entering the same nomogram with the same meteorological and visual ranges and an effective contrast of C_3 to get A_3. At this point recalculate the border width so that the ratio of border area to total area, A_y/A_3, is the same as that calculated in Step 3.

To calculate the <u>visual range</u> of a <u>multi-colored target</u> given the areas and effective contrasts of the variously colored portions of the target, calculate an effective contrast value for the target as a whole, as follows:

Let A_1, A_2, A_3, etc. be the areas of the variously colored sections with A_1 bigger than or equal to A_2, A_2 bigger than or equal to A_3, etc. Let C_1, C_2, C_3, etc. be the corresponding effective contrasts of the colors of these areas, and A_T be the total area of the target. Again proceed in pairs by combining C_1 and C_2 as in steps 2 through 5 of the preceding example, to get C_{T1}, the first approximation to the effective contrast of the total target.

$$C_{T1} = C_1 \pm |C_1 - C_2| \cdot (A_2/A_T).$$

The plus sign is used if C_2 is greater than C_1 and vice versa. The second approximation C_{T2} to the effective contrast of the total target is

$$C_{T2} = C_{T1} \pm |C_{T1} - C_3| \cdot (A_3/A_T) \qquad (14)$$

Continue down the line accordingly until all the colors have been taken into account, and a final effective contrast, C_T, of the target has been calculated. Enter the appropriate Duntley nomogram with contrast C_T, area A_T. and the appropriate meteorological range to find the visual range of the multi-colored target. A straight line is drawn connecting the M.R. and C_T. Read down from the intersection of this line with the (interpolated) curve representing the total target area A_T to find the visual range on the abscissa.

B. SHAPE

✓ If the maximum values of length to width ratios specified in the table on page 55 are used to form targets of equal area with shape ratios of diamond 5:1, rectangle 6:1, triangle 3:1, then the shapes are arranged in the table in order of recognition range (the range at which the shape can just be recognized). The most easily recognized shape (i.e. possessing the longest recognition range) is the elongated diamond. When ratios other than the above are used, the nomogram in Figure 76 may be used to determine which shape will be recognized first. On this nomogram relative recognition range is plotted increasing downwards. There is a target width to length ratio scale for each basic target shape. The ratios are indicated at a distance down from the base line corresponding to relative recognition range. A horizontal line cutting the scales indicates equivalent width to length ratios for the basic target shapes for equal recognition ranges. For example, a rectangle of width to length ratio 1:3 will be recognized at a greater distance than a diamond of ratio 1:2, and at about the same distance as a triangle of ratio 1:2.

For example, suppose that a channel is to be marked with yellow-bordered, white daymarks, and that square boards are reserved for the port side and triangular ones for the starboard. It is desired that the two sets of boards have the same area and the same recognition range. Then Figure 76 indicates that the triangular boards should have a shape ratio of 1:½, width to length.

If the maximum length to width ratios listed in the nomogram are exceeded, the recognition range is increased, but at the expense of the detection range. The detection range is decreased because of a reduction in contrast due to letting the width become smaller than a minimum perceptible angle for compact targets. Daymark targets of extended height, such as a light house or tower, fall in this category. To calculate their detection range the second set of visual range nomograms, Figures 74: a, b, c, labeled elongated targets is used.

C. IDENTIFYING NUMERALS; VISUAL ACUITY

To identify a recognizable aid as a particular aid, some type of code marking is required. This is accomplished with numerals, letters, characteristic stripes, bands, etc. The most widely used identification code for aids to navigation is the numerical one in which port side aids are marked with odd numerals and starboard side aids with even ones. One of the factors which governs the legibility of numerals is visual acuity (acuteness or sharpness). When the brightness difference between a target and its field vanishes because of the smallness of the target, the reciprocal of its angular size is the index of visual acuity.

$$\text{Visual acuity} = \frac{1}{\text{minimum perceptible angle, in minutes of arc}}$$

There is considerable variation in estimates of the minimum perceptible angle. Much of this variation appears to be due to differences in the target used. The measure of visual acuity also depends on pupil size, the size and brightness of the surroundings, the wave length of transmitted light, the area and the distance. Visual acuity for a near object is greater than for a similar distant object, even though the latter is large enough to subtend the same visual angle.* The term visual acuity has been used whenever any sort of minimum visible angle has been under discussion: the limbs of a broken circle, the effect of a broken line or contour, the separation of bars in a grid pattern, the separation of two bright points, etc. These ideas are illustrated in Figure 76.1. The best resolution is obtained for a single line, followed by that for vernier acuity, then for bars in a grid, and finally for the separation of two bright points. Vernier acuity is defined as the minimum lateral displacement necessary for two portions of a line to be perceived as discontinuous.

The range at which a numeral of a certain height can be identified is determined by application of the concept of visual acuity. For at the identification range, the numeral height must subtend a visual angle of at least 4 minutes of arc. Thus,

$$\text{Identification Range} = \frac{\text{Numeral Height}}{\tan 4'} = \text{Numeral Height} \times 860 \qquad (16)$$

where the identification range and numeral height are both expressed in feet. The identification range will usually be much shorter than the detection range for reasons of practicality and economy.

The other important factor governing the legibility of numerals is that they have good contrast with their background. Good color contrast with retro-reflective numerals can be obtained by using white (signal Silver) retro-reflective numerals on backgrounds of all colors except white. On white backgrounds the numerals should be of red or green retro-reflective material, as appropriate to conform with the lateral color system. For Coast Guard use, all identifying numerals and letters are to be of retro-reflective material. Retro-reflective materials are discussed in detail in Section 7.

Good brightness contrast is achieved by placing numerals in the center of the background field. As a general rule, to insure good brightness contrast and legibility, the retro-reflective numerals should be far enough away from other retro-reflective materials to avoid a blurred appearance. For this reason the non-retro-reflective background space between two retro-reflective areas should subtend an angle no smaller than 1.5 minutes at the identification range.

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* Visual angle - The angle subtended by an object at the eye. The magnitude of this angle determines the size of the corresponding retinal image independent of the size of the object.

Again, to insure good brightness contrast, the maximum umeral height for a particular dayboard design is determined as fol- ows: Find the available height for numerals - the height of plain ield - between dayboard edges, between the inside edges of daymark orders, or between characteristic markings on the daymark, as the ase may be. The maximum numeral height is then 4/7 of the available eight.

Regarding the numerals themselves, they should be the stan- ard Series C type (illustrated in Figures 77: a and b), of retro- eflective material and of maximum height as described above. In ddition, specific rules for numeral spacing have been formulated to nsure good legibility at the identification range. The rules are tated in terms of numeral groups and letter-strokes. The numeral roups are as follows:

Type A: 3,5,6,8,0

Type B: 1,2,4,7,9

letter-stroke is a vertical space of width equal to the dimension A ı the number charts (Figures 77: a and b). The spacing rules are:

1. Between A and B type numerals allow a space of vo letter-strokes.

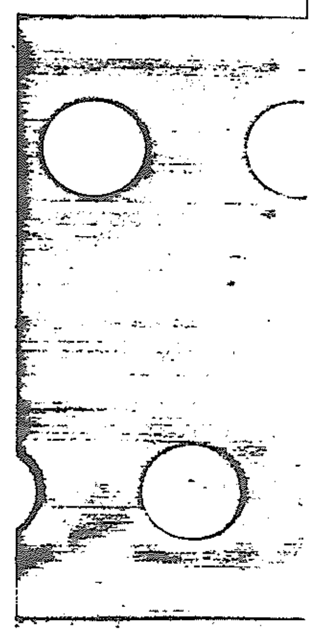
2. Between two type B numerals allow a space of two ıd one-half letter-strokes.

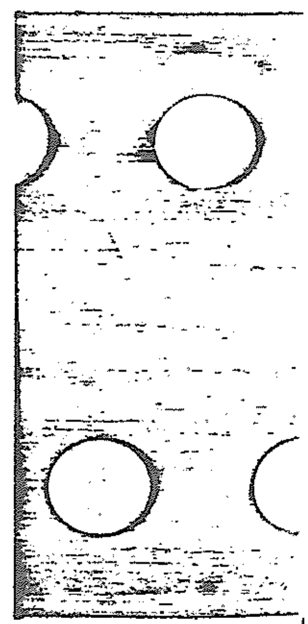
3. Between two type A numerals allow a space of three ɛtter-strokes.

·5 DAYBOARDS ON RANGE STRUCTURES

Dayboards on range structures serve the same function during the ıy that the lights do at night. By their degree of alignment they ıdicate to the mariner his position in the channel relative to the ɛnter-line. Hence a range dayboard should give both maximum detec- .on and recognition ranges. This is essentially a problem in visual uity: what size and separation of marks is required so that they ɔok distinct (opening effect) at the proper distance off the channel ɛnter-line. Since vernier acuity gives the best resolution of angular paration, range dayboards should approach line targets, but they ould maintain a length to width ratio such that contrast is not riously reduced. From this type of reasoning one concludes that e best range targets are either rectangles of length to width ratio 1 or diamond targets of length to width ratio 5:1. (See Figure 78.)

Experiments in the German lighthouse service with range daymarks sulted in their use of "U/1" marks. The name describes the shape of e marks (see Figure 78). Their shape criteria are that





1. The shanks of the U and I subtend visual angles of 1/2 minute in breadth and of 4 to 5 minutes of arc in length at the outer usable limit of the channel.

2. The distance between the shanks of the U should subtend a minimum visual angle of 4 minutes at the outer usable limit of the channel so that the I will be seen outside of the U when the observer is far enough off the center-line to warrant correcting his course, with due regard to the width of channel in which he can maneuver safely.

The set of nomograms for detection range of elongated targets may also be used to calculate area requirements for the U/I type marks. The size of each shank of the U, and of the I should be calculated separately. Good color contrast should be maintained between the U and the I as well as between each mark separately and its background.

There are two rules to follow in deciding on the placement of the daymarks on the range structures to assure good detectability and visibility.

1. At the inner edge of the range the front mark should not obscure the rear mark or the rear light.

2. The bottoms of the marks should be high enough so that they have sufficient geographic range for the entire mark to be seen at the far point of the range.

6-6 APPLYING COLOR TO THE DAYMARK

Until recent years, daymark color has been obtained by using either the natural color of the structure materials, or paint. For example, the Light List has lighthouses described as daymarks as "grey granite structure" (natural coloring), or "white masonry tower" (painted). The practice of leaving the structure unpainted is disappearing since natural colors generally provide poor contrast. Common paints permit the selection of any desired color and can generally be applied to any surface whether rough or smooth. Newer structures of concrete have the pigment added to the concrete during pouring while recent steel frame lighthouses have used aluminum panels with a surface covering of baked enamel (porcelainized) to provide long pigment life with low maintenance. These panels are also suitable for certain small daymarks, the enamel being of the proper daymark color.

For reasons of true economy, convenience and permanence, metal surfaces provide the most satisfactory target base materials, aluminum and galvanized sheet metal being the most practical. These surfaces are very compatible with the recently developed pigmented films. These are long-lived, low-maintenance pigments on thin films with pressure (or heat) sensitive adhesive backings. They are easily applied, do not chalk, and are relatively free from pigment fading. Film pigments are best applied to smooth surfaces. They should not be confused with retro-reflectives and fluorescents on film.

Fluorescent pigments are finding increasing use in daymark application because of the high average contrast they provide (see Figure 75). These pigments absorb short wavelength light (in the ultra-violet end of the spectrum) and emit the light at a longer wavelength. Thus, they convert the sun's invisible radiations to visible light. They are no better than common pigments at night when illuminated by a searchlight, but in the daytime they provide a higher average contrast for almost all viewing conditions. Fluorescent pigments are especially effective during twilight when much of the shorter wavelengths of the sun's radiation are present due to scattering. Another especially effective application of fluorescent materials is on targets set against confused backgrounds, such as city wharves.

Another new development is encapsulated or high density overlaid plywood. These weather-resistant plywoods provide a superior surface for paint, compared to ordinary plywoods. They are also produced with a color-impregnated resin bonded to the wood. At present the finishes available are red, green, white, black and clear.

At this point it is well to emphasize that the purpose for building a structure which carries a daymark and light is to exhibit a warning signal to the mariner. The signal's effectiveness should not be compromised for the sake of false economies or small expediencies in construction, since almost any practical daymark considered, no matter how extravagant it may seem (fluorescent films, aluminum backing, retro-reflective materials, etc.), will invariably cost less than one-half of one percent of the cost of the entire structure - a lighted minor aid.

6-7 SLOTTED DAYMARKS

Heretofore, discussion has been limited to solid daymarks, although in the past dayboards on minor structures have often consisted simply of boards nailed to a frame. The boards were spaced to make a slotted mark in an effort to lower wind resistance and reduce silhouetting when the sun is behind the mark. Neither of the hoped for results were achieved. The net effect of slotting is to reduce the effective contrast in proportion to the ratio of the area of the slots to the whole. As stated above, the best method of constructing dayboards from the standpoints of visibility, costs and maintenance is to build a solid mark of adequate size constructed of either aluminum or high density encapsulated plywood.

* * *

Problems on daymark design applying the principles of Section 6 are worked out in the Appendix to Civil Engineering Report No. 37 - Daymarks. Also shown there are some standard daymark designs.