AIDS to NAVIGATION
Application Notes

Advantages
of wide vertical divergence of a buoy light

A floating buoy serving as a platform for aids to navigation is very often – if not most of the time - out of the plumb, or inclined. This effect is caused by the winds, currents, tides, ice, or rolling and pitching induced by the waves. Such inclination of the buoy affects the actual range of visibility of the navigation light attached to the buoy since the focal plane (centerline of the vertical distribution pattern) of the radiated light changes from the horizontal. The resulting decrease of the actual visibility range is even more significant when using contemporary LED lanterns with a quite narrow vertical divergence which is often as narrow as 4 degrees. The purpose of this application note is to draw attention to this effect, warning against potential safety issues arising from application of LED lanterns with narrow vertical divergence on other than fixed platforms.

Fig.1 shows the vertical distribution of the light beam from a buoy light. The vertical divergence of the light shown is 25 degrees. Both observers A and B can spot the light from the nominal range of the light.

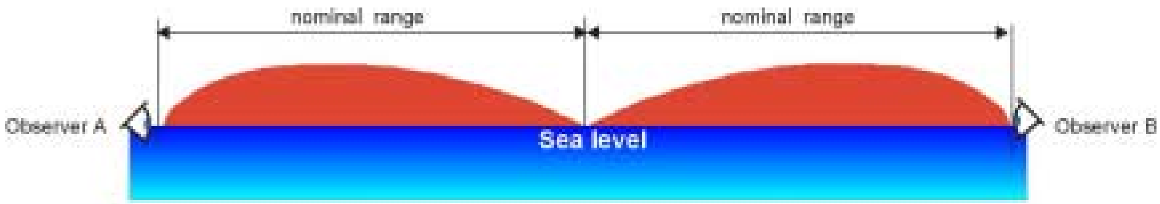

Fig.1.

Fig.2 shows the vertical distribution of the light beam when the same buoy is inclined eight degrees. In this case, neither observer A nor B can see the light from the same distance. The light can be seen by observers C and D from the closer distance which is now the actual range of the inclined buoy light. However, due to the relatively wide vertical divergence of this light (25°), the relative decreasing of the range is not critical.

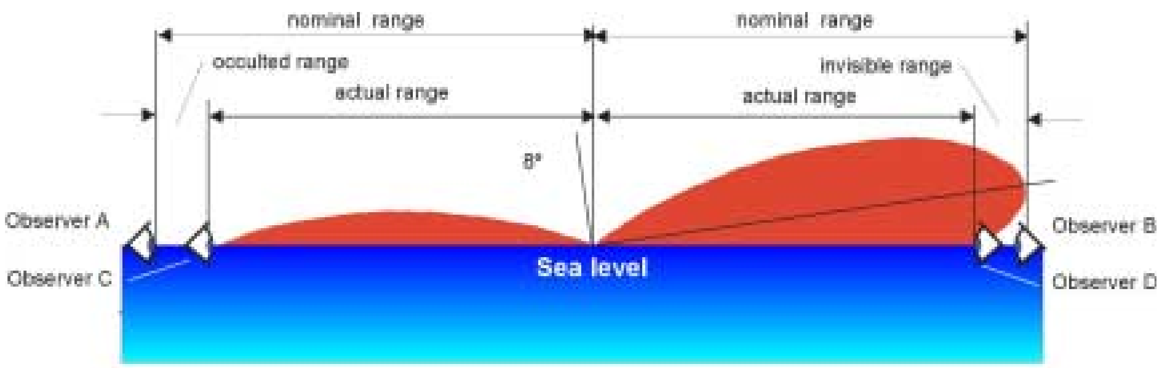

Fig.2

In the case of applying light sources with a more narrow vertical divergence, diminishing of the actual range of visibility caused by the inclination of the buoy can be quite significant, dangerously reducing the extended visibility range achieved by sharper focusing of the light beam. To illustrate this, *Fig.3* presents an example of an inclined buoy carrying a light source with the vertical divergence of eight degrees (8°).

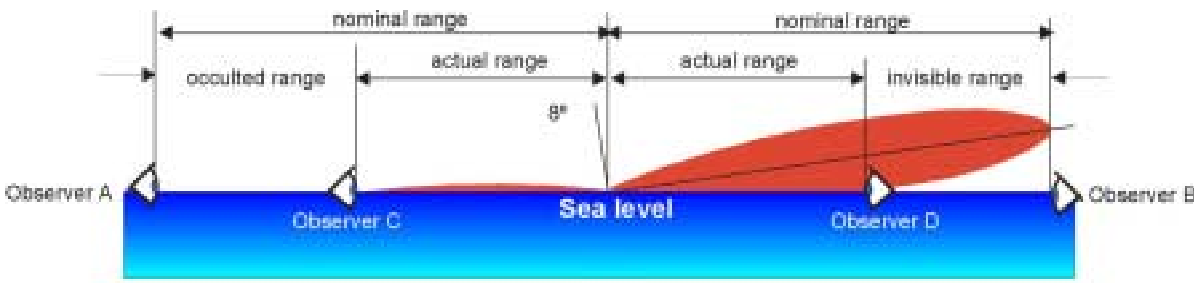

Fig.3

In order to establish the measure of adverse effects of buoy inclination upon the actual visibility range, we have created a computer simulation model of the light beam, and have experimented with technical data of some commercially available LED lanterns, calculating both the actual and relative visibility ranges for selected lanterns. In these calculations made within the MS Excel environment, the height of the buoy light's focal plane has been selected to be the typical 2m above sea surface, while the eye level of the observer has been set to 5m above sea surface. It is worth mentioning that the negative effect of buoy inclination is affecting the navigators using smaller vessels even more seriously.

Results of our calculations represent the behaviour of LED lanterns with the following parameters:

L1 - with vertical divergence of 4º and light intensity of 65cd;
L2 - with vertical divergence of 8º and light intensity of 25cd;
L3 - with vertical divergence of 15º and light intensity of 10cd;
L4 - with vertical divergence of 25º and light intensity of 15cd (ekta™ lantern E807).

Fig.4 shows dependence of the absolute value of actual visibility range upon the angle of inclination of the buoy carrying the light source (lantern). Relative values of the actual range (percentages of maximum range) are presented on *Fig.5*.

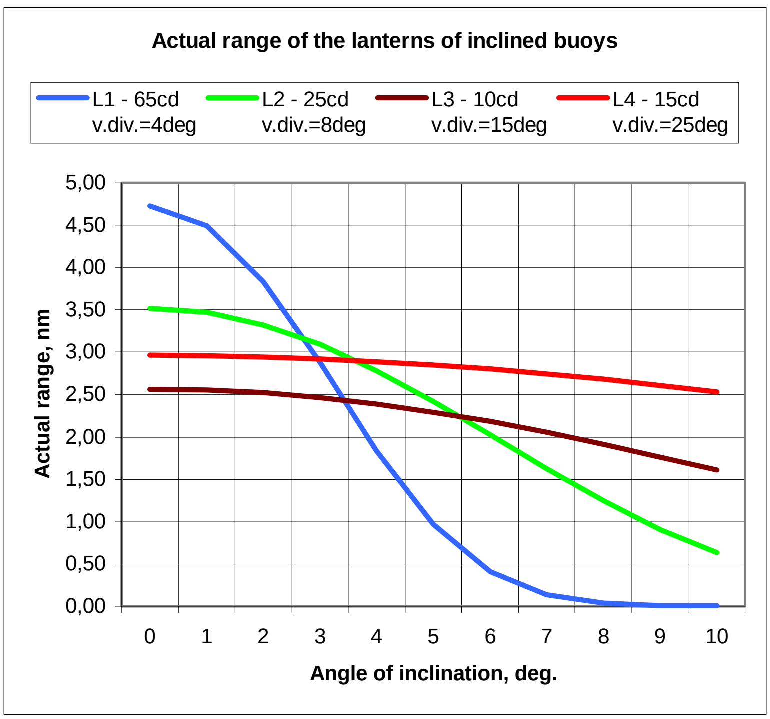

Fig. 4

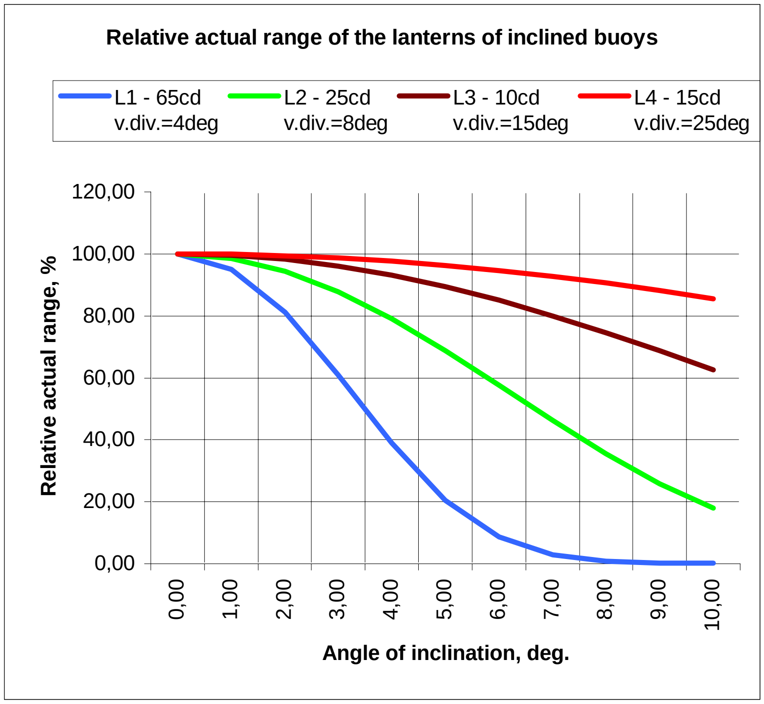

Fig. 5

Based on the results of these calculations, we can make the following conclusions:

1. Lanterns with vertical divergence of 4º are extremely sensitive to the inclination. Even quite insignificant inclination angles (2...3 degrees) cause decreasing of the actual visibility range by 20...30%. Therefore, such lanterns can be recommended only for application on fixed platforms.
2. Lanterns with vertical divergence of 8º are less sensitive to the inclination, and as such can be safely used on buoys situated in relatively calm waters.
3. Lanterns with vertical divergence of 15º and more can be used in more universal applications, with no risk of reduced visibility range due to moderate inclination of the platform (buoy).

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