Input paper for the following Committee(s): check as appropriate Purpose of paper:

**□** ARM **🗹** ENG **□** PAP **🗹** Input

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Technical Domain / Task Number 2 …………………………………

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Estimation of Astragal and Glazing Losses on the Output of an Internally Fitted Integrated Lantern

# Summary

During a recent field light measurement, some lighthouses exhibited lower light intensities than expected. The potential cause was the effect of astragals on the light intensity in the direction of the measurement site. Whilst subsequent tests showed that some of the issues were related to the lanterns themselves, it became apparent that there was no effective model to determine the impact of astragals on the light output of a lighthouse. Another example of the problem is shown in , where during the measurement of a lighthouse in England, the lower lantern was partially obscured by an astragal.



Figure 1 – Example of obscuration of an internally fitted integrated lantern.

In the past, the astragals were not considered a problem because the active lit area of the optics was much larger than the area covered by the astragals. The effect on the intensity variation around the lighthouse was assumed to be negligible for this reason.

For integrated lanterns, the lit area of the optics are generally much smaller than the traditional optics they replace, including fixed optics with their narrow vertical strip of light. It was decided that it is necessary to calculate the effects of astragals on the intensity variation around the lighthouse since the area of the astragals were comparable with the lit area of the optics involved. This paper demonstrates the use of such a calculator and the impact of the intensity, and thus the performance, of the lighthouse.

# Methodology

The calculator takes a number of parameters that define both the astragals and the light source. An example is shown in Figure 2 and Figure 3.

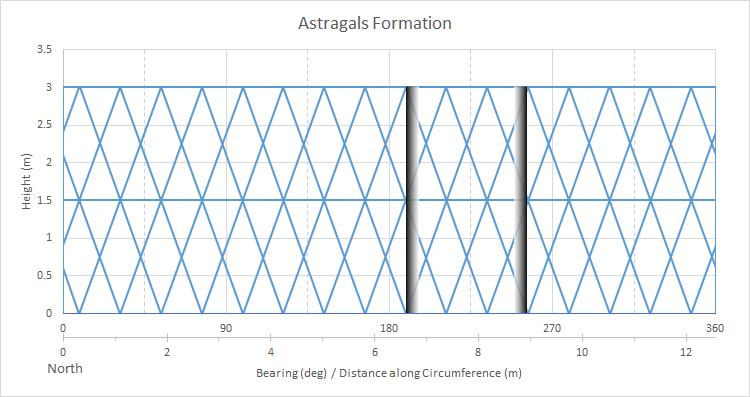
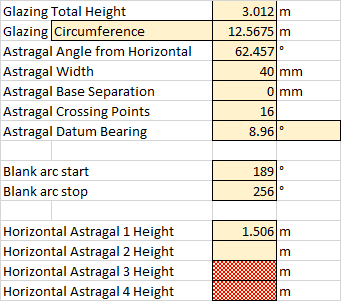


Figure 2 – An example model representation.

(with exaggerated aspect ratio and only blank sector limits shown)

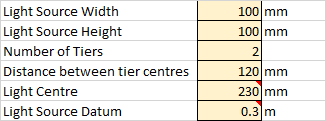
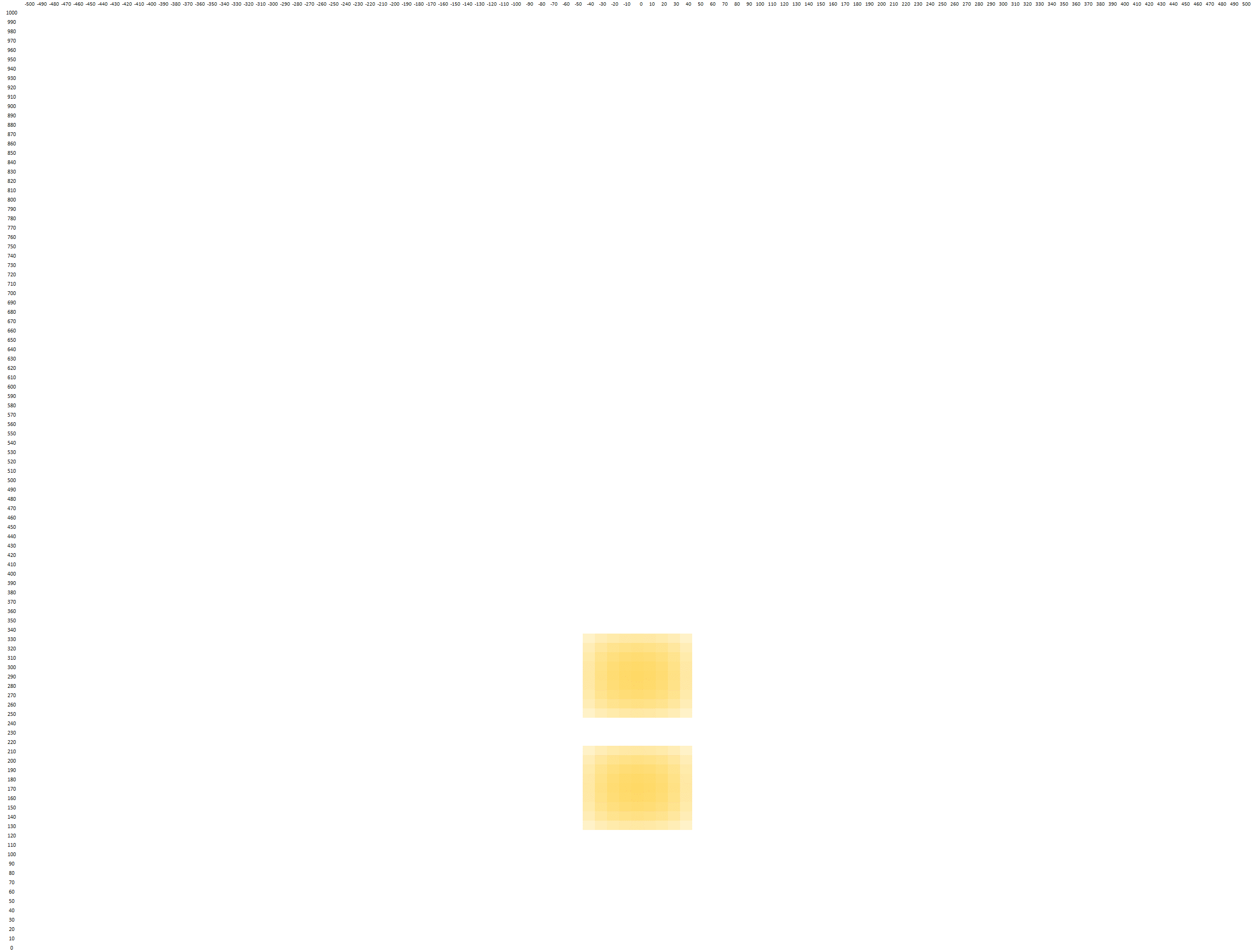
 

Figure 3 – Example light source settings and assumed luminance distribution.

Once all the parameters have been set, the model then calculates the total amount of light generated by the light source. This will be the reference value and is that of the bare lantern as would be measured on the light range.

The model then assumes a bearing, and scans across the face of the light source. At each point, it determines if an astragal covers that particular point, and marks it as such if it does. When all the points across the face of the lantern have been checked, the model then sums all the light that is seen following the application of the obscuration. This sum becomes the total light available for that bearing.

The model then continues to the next bearing, and repeats the process. It continues until the model has checked all around the lantern.

At each bearing, the result of the above process is compared with the reference value (i.e. of the bare lantern), and the percentage drop is calculated.

Finally, the amount of obscuration at every angular step is applied to the intensity distribution, allowing for the alignment of the lantern relative to True North.

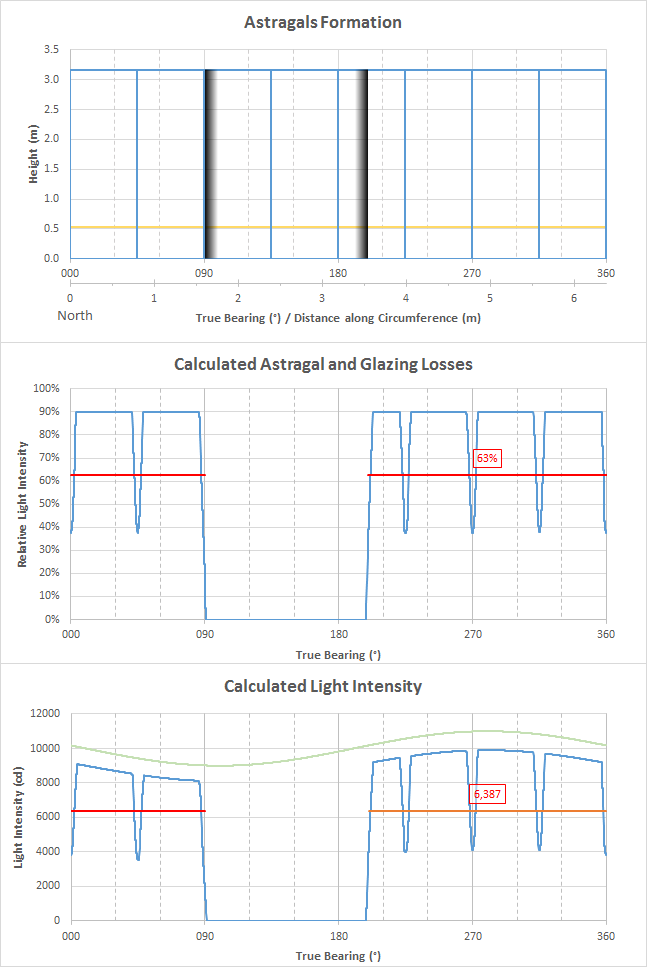


Figure 4 – Example graphical analysis of the results.

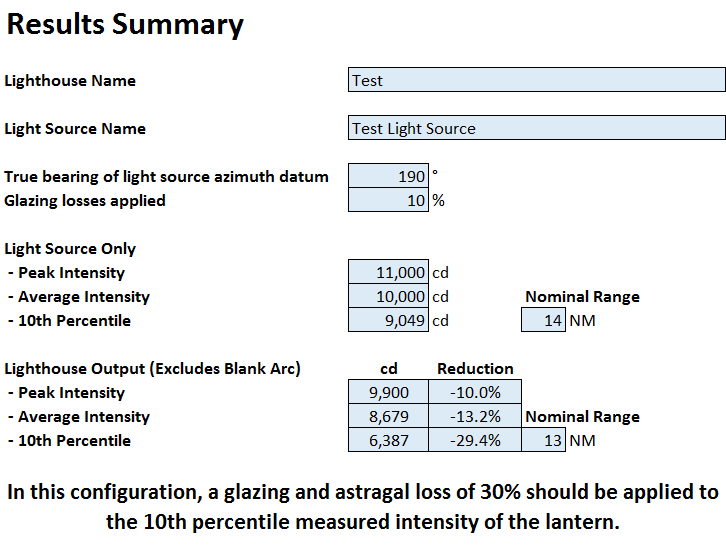


Figure 5 – Example numerical analysis of the results.

The variation of obscuration is then plotted as a function of bearing and the 10th percentile relative intensity is determined to indicate the overall effect of mounting the lantern inside the lantern room with the given conditions. Figure 4 and Figure 5 shows an example output from the calculation. Note that the 10th percentile is more accurate with a higher number of calculation points, so an interval of least a 1-degree is chosen. Also, note that the 10th percentile will ignore the obstruction caused by the blank arc.

# Comparison with Measurement

We can compare the results of the model with the physical simulation for the different astragal widths to determine the performance of the model. An LED lantern was placed in the light range, and vertical astragals of varying widths were simulated using black card. The vertical astragal was placed at a fixed radius from the lantern. The azimuth of the light was measured with the astragal rotating with the light.

The results of the comparison are shown in Table 1. In almost all cases, the model has a tendency to overestimate the intensity reduction due to astragals obscuration. However, the results are sufficiently acceptable for design guidance purposes.

|  |  |  |
| --- | --- | --- |
| **Vertical Astragal Width** | **Model Prediction** | **Physical Simulation** |
| 46 mm | 26% | 27% |
| 40 mm | 21% | 19% |
| 30 mm | 15% | 11% |
| 20 mm | 8% | 5% |

Table 1 – Difference in 10th percentile intensity reduction between the model and a physical simulation.

# Conclusions

This paper details an Astragal Obscuration Calculator written in Excel. It uses measurable parameters and several assumptions in order to determine the level of obscuration astragals present to a lantern fitted inside a lighthouse lantern room. With this being the apparent trend of design, it is important to consider the impact of the astragals on the lantern output, particularly since the projected light source area is usually much smaller than the light source it replaces. This may mean that the 15% glazing and astragal losses normally applied to internal light sources would be insufficient to account for their impact on integrated lanterns. In some cases, 15% would not be sufficient to cover the losses before adding glazing effects.

The model compares favourably with a physical astragal simulation experiment carried out by R&RNAV, and sets to confirm the suitability of the model to provide guidance in the early stages of design.

As with any model, it is only as good as the data entered into it. For example, the model would not capture variations in the size of astragals at the lighthouse. However, perhaps the largest source of error is the assumed luminance distribution of the light source. R&RNAV currently have no reliable means of measuring this, and therefore the model must rely on the assumed distribution. In addition, it is likely that this distribution varies with azimuth, which adds another layer of complication to the model.

Nevertheless, the model provides a useful tool in the design stage to understand the impact of installing lanterns inside a lighthouse lantern room. It will also help the designer to determine the best orientation to minimise the obscuration to the most luminous parts of the lantern.

# Action

IALA is kindly asked to consider providing guidance on the use of integrated lanterns inside existing lighthouse housing, taking into account the increased levels of obscuration. The existing recommended glazing and astragal loss of 15% may not be sufficient to cover the losses experienced in this method of design, and it may be appropriate to increase the level of losses.

1. Leave open if uncertain [↑](#footnote-ref-1)