

A new laser ranging calibration target suited for accurate surveying at the SGF, Herstmonceux

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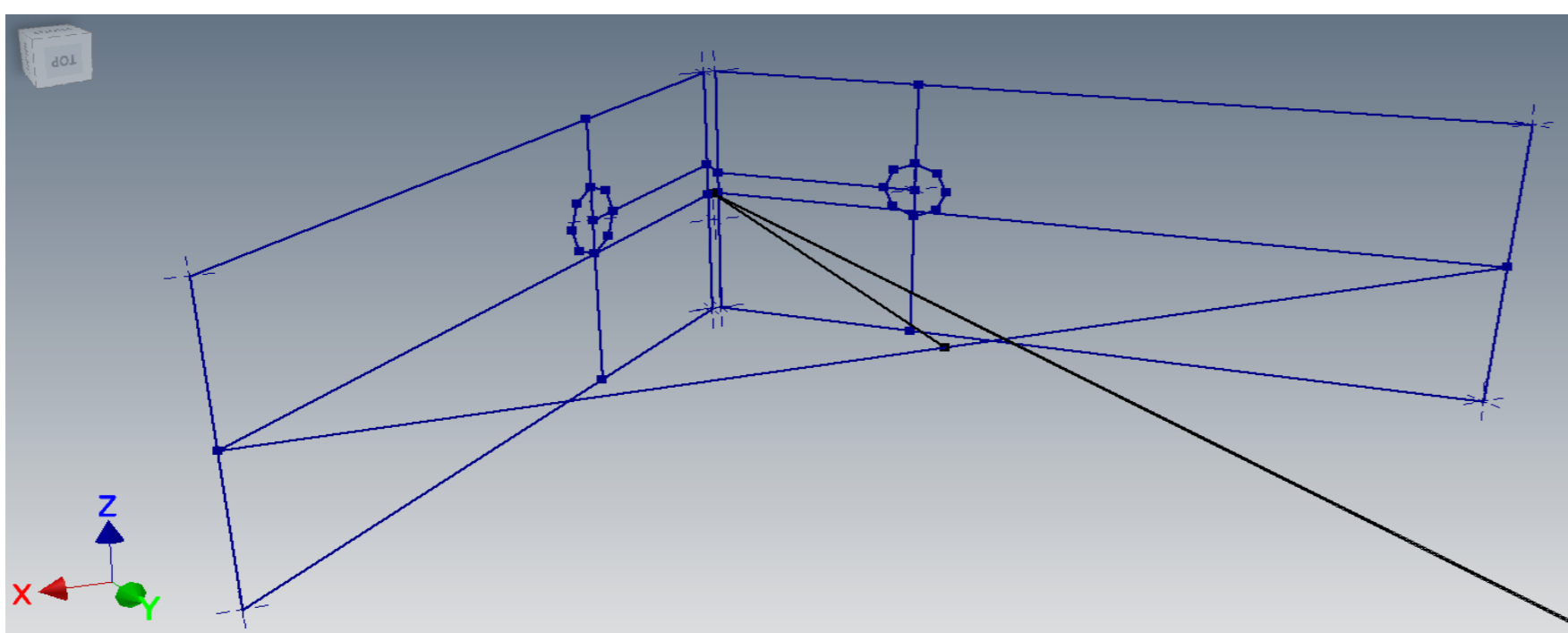
Introduction

The legacy ground based SLR calibration target at the SGF is positioned on the side of a brick building approximately 20m high and 120m away from the SLR telescope. This target has been used as a calibration point for around 20 years. However, it was considered that its construction characteristics could not guarantee the survey accuracy requirements of 1 mm. This led to the design and construction of a new target with a well defined and easily determined survey reference point.

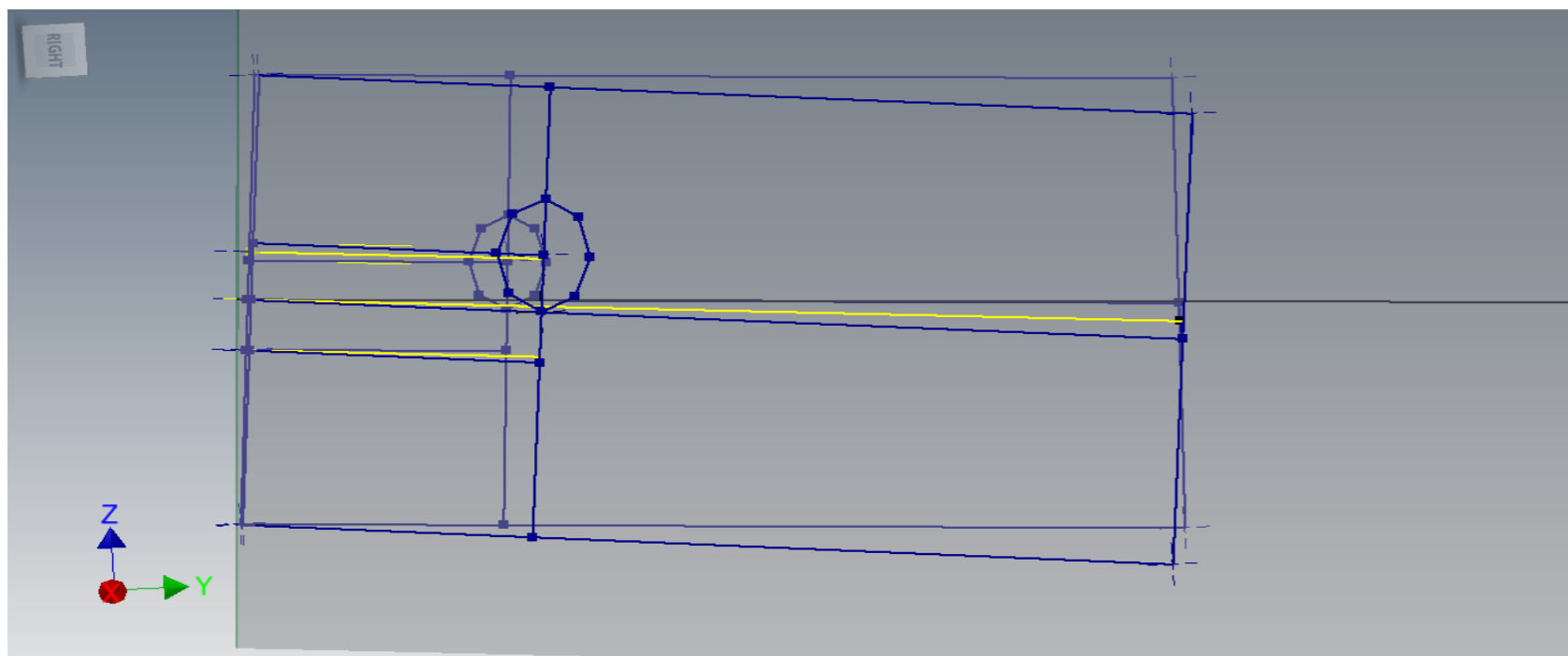
Analysis of the legacy target and currently applied site survey

The legacy target is not a perfect retroreflector, as the two metal plates are not perfectly flat or perpendicular to each other. The target was simply positioned and adjusted to give the best return signal during calibrations. Despite the imperfect shape of the target the two laser reflection points must be near perpendicular otherwise the returning beam would not enter the telescope. However, these imperfections limit our ability to survey and establish an accurate Target Reference Point (TRP). The TRP of two perfectly perpendicular plates lies in the line at which the two surfaces intersect, which is simple to determine. However, in the case of our legacy target, the two plates are at slightly different angles and not perfectly flat so where the surfaces intersect is not so easy to define. Defining the TRP is therefore open to interpretation.

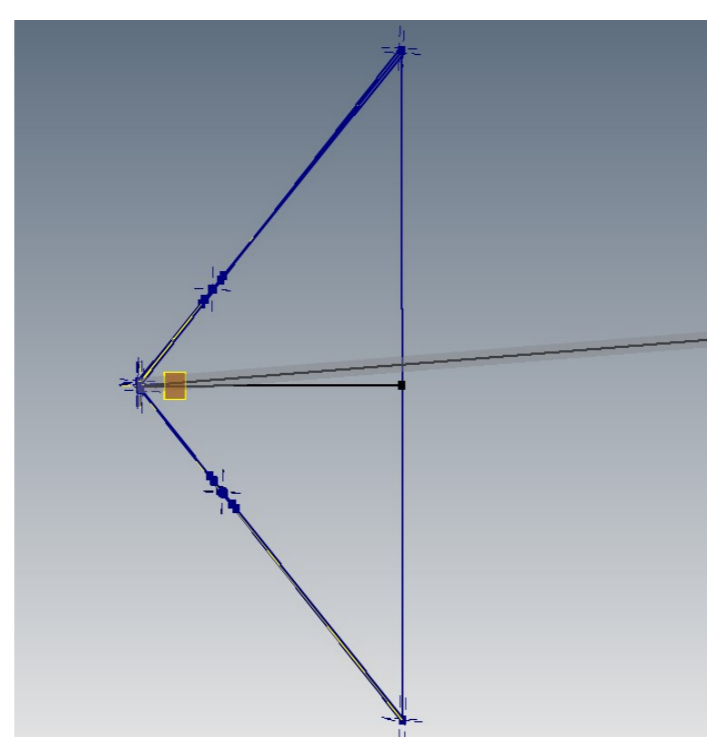
As part of the site survey carried out by IGN in 2008 a number of points on the target structure were measured, relative to the Telescope Invariant Point (TIP). These points were drawn using CAD software to better understand the shape of the target and how its TRP was determined. The two discs in the figure below represent the reflection points of the laser beam, surveyed by SGF staff.



The irregular shape of the target is visible in the drawing when viewed from the side. With perspective removed from the drawing view the outlines of the two plates should overlap yet they clearly do not.

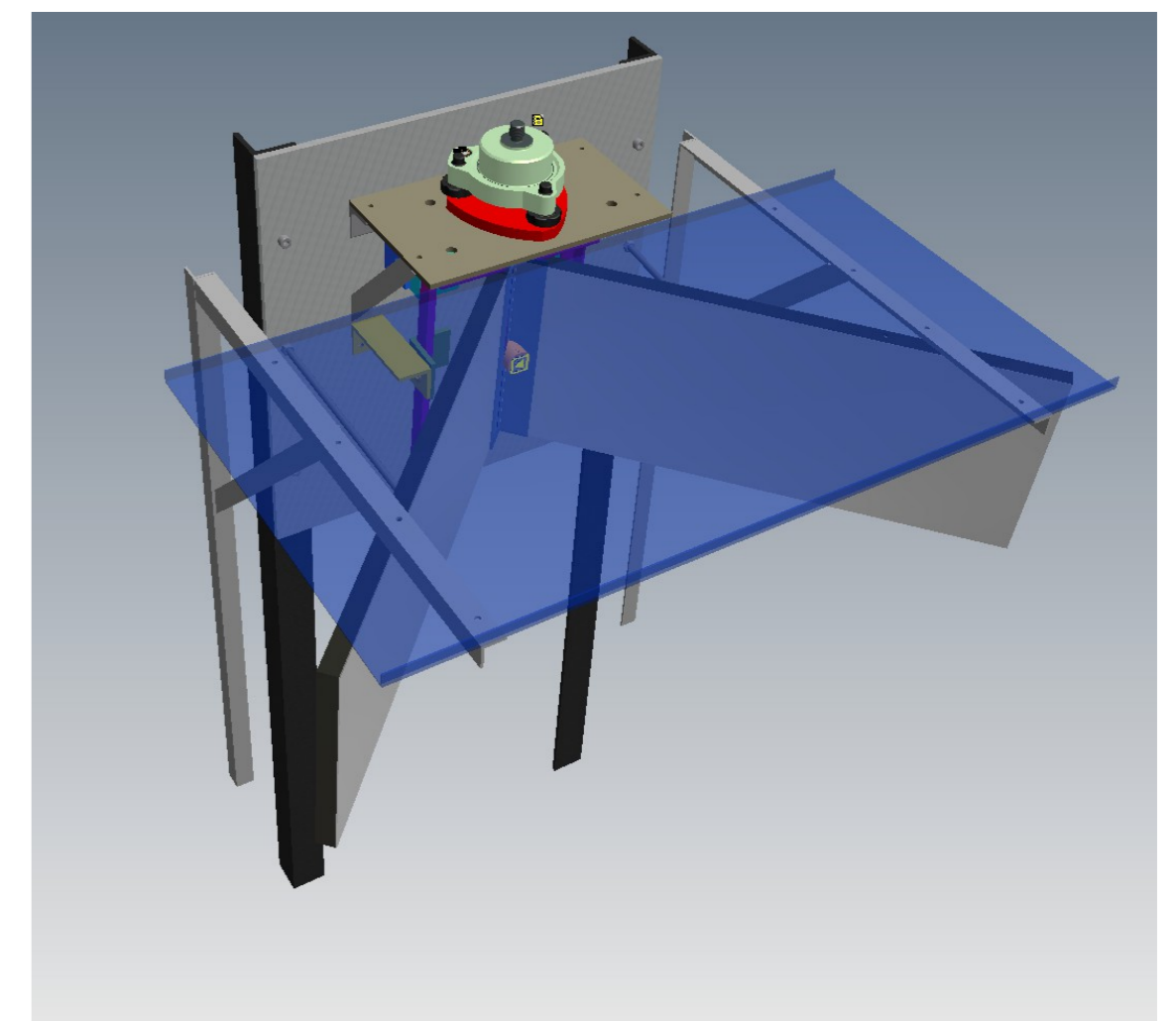
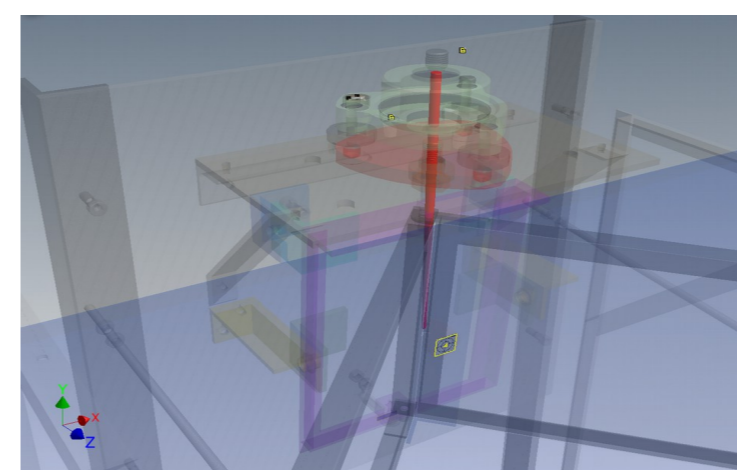


The black line shows a direct line from the TRP to TIP. This shows the target is not ideally orientated. In particular the target is tilted forward, meaning that a ranging measurement at the upper edge of the target would give a slightly shorter distance than at the lower edge. After studying the target and survey details it is thought that there could be an inaccuracy in the measurement applied to calibrations of +/- 1.0mm.



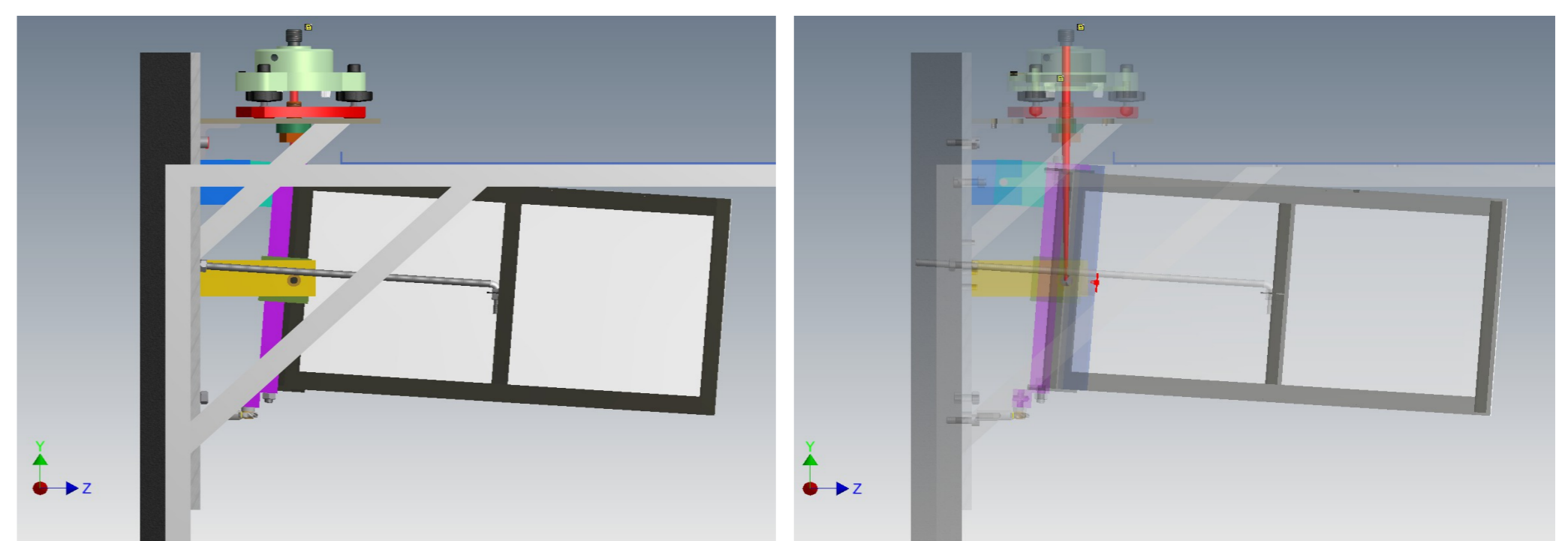
New target design

A new target is required. It should be as close as possible to a perfect retroreflector and facilitate site surveying. In addition it will allow long term measurement of its stability.



Design Features:

- Rigid reflector plates, held perpendicular to one another
- Detachable/interchangeable Leica mount with centre positioned at known distance, vertically above TRP. This Leica mount can be used for attaching a retroreflector or GNSS antenna for surveying and long term monitoring of target position
- Alignment adjustment designed to retain TRP in fixed position with respect to Leica mount
- Additional central reference face at known distance to TRP. Ideal for surveying adhesive retro reflector. This also features a threaded hole that could be used to attach other surveying equipment.



Above images show centre of Leica mount positioned directly above TRP and axis of tilt adjustment passing through TRP, ensuring the TRP will remain directly below Leica mount centre when adjusted for best position.

Target constructed and installed



The new target has been fitted and aligned, giving a stronger return signal compared to the legacy target. We regularly perform calibrations to it to assess its stability via inter-target comparisons. A new site survey is now required before it can be used as our primary calibration target.