Constructing platforms using trigonometry and geometry

My placement is with a joint venture between Balfour Beatty and Mott MacDonald (BBMM). They provide maintenance and consultancy for The Highway Agency's Area 4, covering the strategic road network in Kent and Sussex.

Introduction to the problem:

M23 Coopers Hill Viaduct is a multi-spanning bridge that carries the M23 motorway. It connects a substantially important and busy route, Gatwick to London. Inspecting and maintaining the underside of the bridge deck had always been a very cumbersome job due to the steep slope of the revetment (Photo 1). Any slips and trips down the slope could lead to drastic consequences. Therefore a solution was required that was quick and practical.

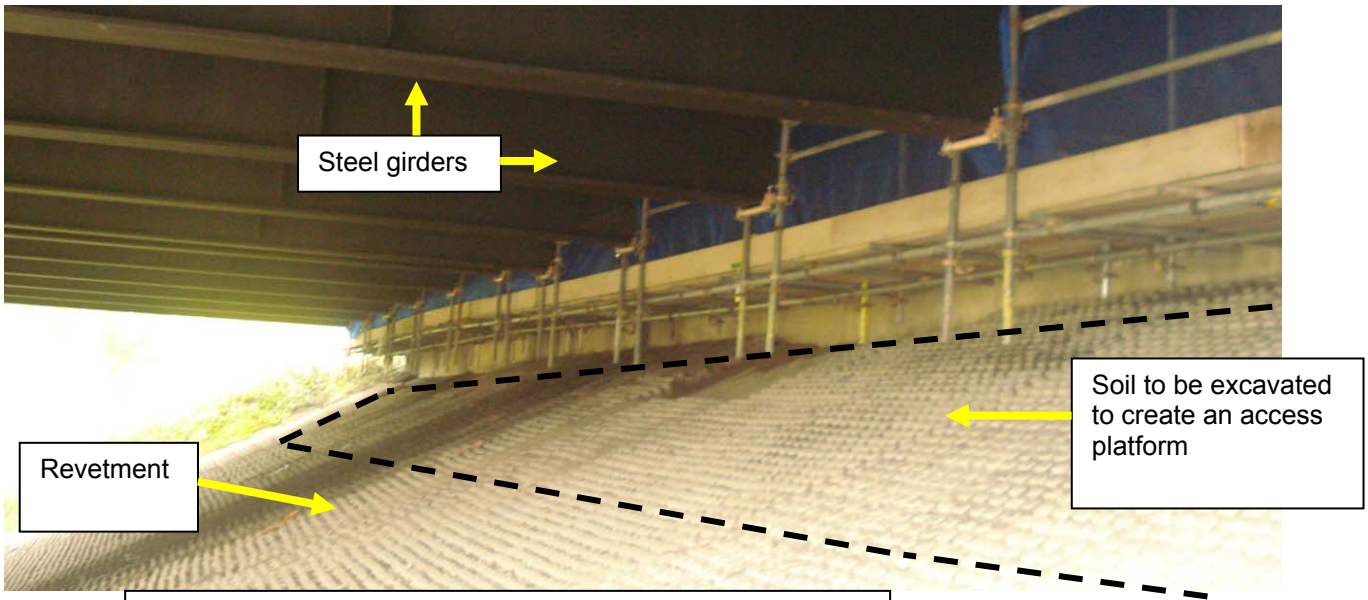

Photo 1: View from underneath the bridge. Courtesy of BBMM

Proposed solution:

It was proposed to design and construct a 2m wide access platform. This would run underneath the entire length of the bridge deck, benefiting the inspectors by adding an extra 1.5 m of headroom (Fig 1), in addition to a flat surface to stand on. Consequently a certain volume of soil had to be excavated from the revetment (as shown in Photo1).

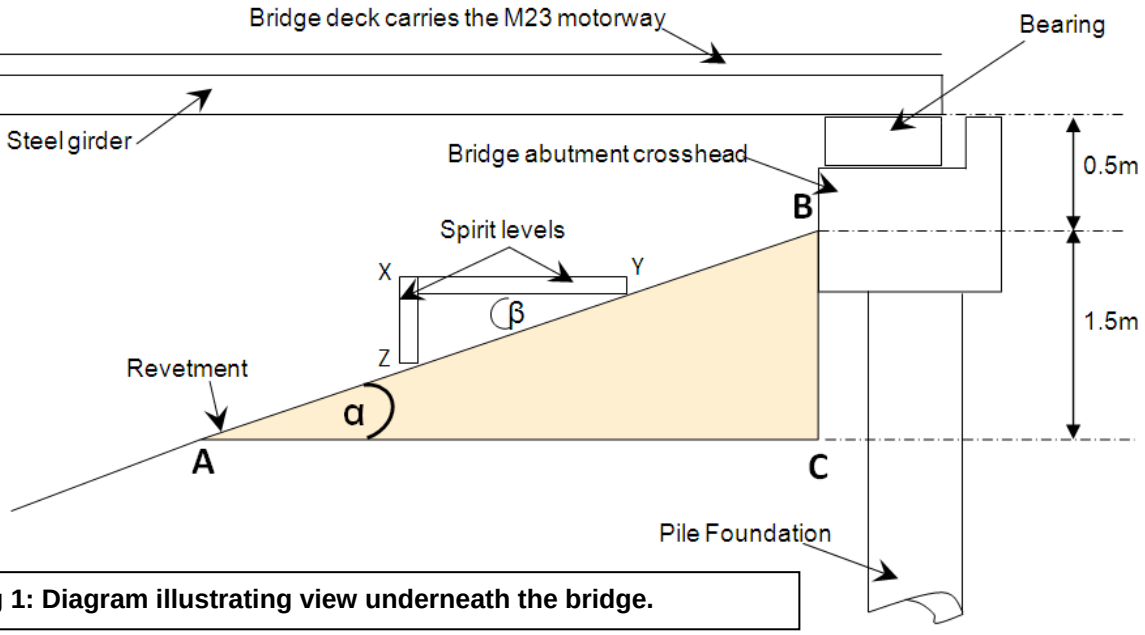

Fig 1: Diagram illustrating view underneath the bridge.

Approach:
To work out the volume of soil to be excavated, firstly angle β had to be measured. This was done be by calibrating spirit levels of known lengths, vertically and horizontally (as shown in Fig 1). Hence, $\beta = \tan^{-1}(\frac{XZ}{XY})$. This was worked out to be 35°. Since triangles ABC and XYZ are similar, β =α =35°.

This angle and the height BC were given to me to work out the volume of soil to be excavated. Firstly, I had to work out the cross sectional area of the part of the revetment, ABC (shaded area on Fig 1). The length AC was worked out using the formula, AC = $\frac{\mathbf{1.5m}}{\mathbf{\tan(35^\circ)}}$. Once AC is known and the depth of the prism is 40m (the entire length of the bridge deck), the volume can be worked out as follows:
V = Cross sectional area X Depth
= Area of triangle ABC X Length of bridge deck
= [0.5 X AC X BC] X 40
= 0.5 X 2.142m X1.5mX 40m
= **64.3m^3** (3 sf)

Outcome:
It took the construction team five weeks in order to construct this access platform and this is what it looks like now:

Photo 2: View from underneath the bridge after construction. Courtesy of BBMM

Looking at the above photograph gave me a great sense of achievement as the whole scheme revolved around simple, yet beautiful use of trigonometry and geometry. This small input of mine had a huge effect on the precise construction of this access platform which would benefit inspectors for years to come.