Slope Analysis

1. October 2016 Assessment

Introduction

Ground and Water have carried out further ground investigation at the site comprising to further exploratory holes at the front and rear garden of the property. These showed the same sequence of Made Ground overlying London Clay. Made Ground was 0.6m thick at the front and 1.2m thick at the rear. Groundwater was monitored via a standpipe piezometer installed in the rear borehole. Groundwater monitoring subsequently showed the standpipe to be full, i.e. water at ground level. Some seepage at 1m was noted in the borehole. The high monitored level is not considered to be reflective of the real situation in the ground and probably results from water is seeping in from the surface, into the Made ground and then into the standpipe, which was partly sealed into the Made Ground. In our analysis groundwater has been taken at 1m below surface. The latest analysis has also modelled the house as a surcharge of $10kN/m^2$.

Results

The analysis results give an unacceptable factor of safety for the slope of 1.16. Whilst this value should not be regarded as absolute, the slope should be regarded as unsafe with the basement construction in place.
Brief analysis has shown that by lowering the ground water table immediately behind the property, by say the use of counterfort drains, has two benefits:

- Lowering of pore water pressures
- Improvement in soil strength by the introduction of granular material.

Analysis shows that this improves the factor of safety to 1.63, i.e. a 40% improvement.

See Figures 1 to 3 below.

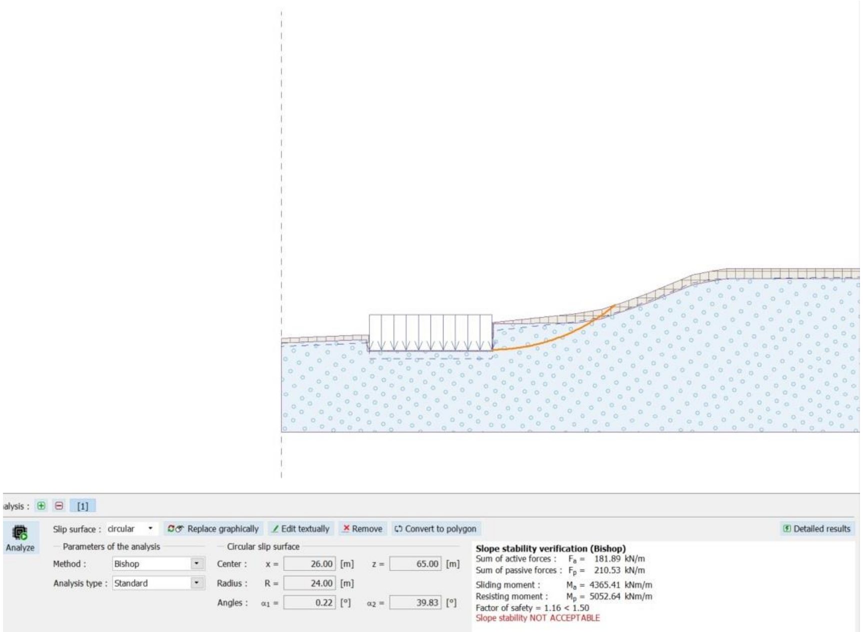

Figure 1: No groundwater lowering

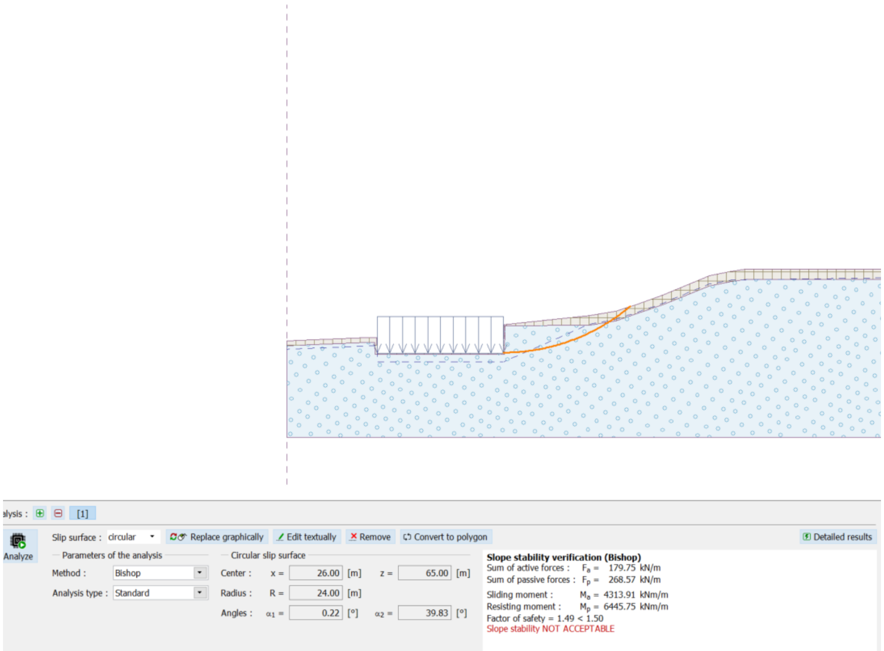

Figure 2: Groundwater lowering

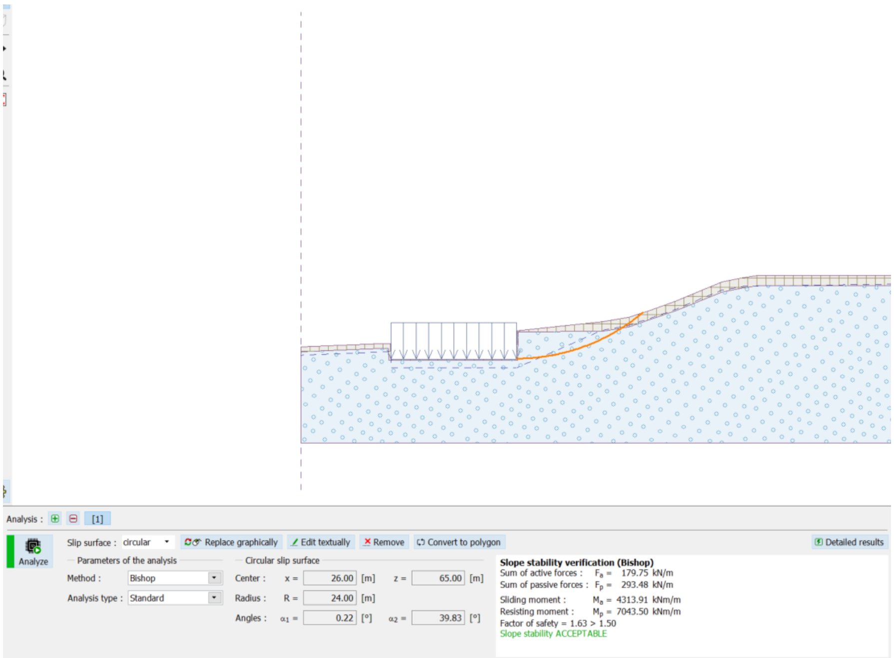

Figure 2: Groundwater lowering and enhanced soil strength

Conclusions and Recommendations

The construction of a basement at the property show that there is a potential risk of instability due the removal of soil load form the toe of the slope. The use of drains to lower the groundwater in the rear garden area and the introduction of granular drainage material itself is likely have a beneficial effect on slope stability.

It is recommended that a walkover survey of the slope is undertaken, particularly as vegetation dies back in the late autumn/ winter. The disturbed samples taken during the last phase of investigation should be tested for water content and atterberg limits. Ideally undisturbed samples should be taken and tested for undrained shear strength and effective stress parameters. In addition the installation of a piezometer in the slope would be useful to gain more confidence in groundwater levels.

The above will enable mitigation measures to be appropriately analysed and designed.

2. Previous Assessment (August 2016)

Given the limited data on the slope particularly in terms of the nature and configuration of the soils and groundwater, the analysis of the slope is best interpreted in terms as a comparison, looking at the change in potential stability in the two scenarios, i.e. before and after basement construction.

Two sets of analyses have been carried out, modelling before and after scenarios for the basement.

The first analysis without the basement in place, used a common point at the location of the basement floor on the upslope side of the house. This served as a straight comparator to an equivalent analysis with the basement in place and avoided modelling failures through the wall. A further analyses used a grid with a range of possible radii for slip circles. In addition a lower common point was used to assess the effects of a deeper basement wall to 35m AOD at the back of the property.

The analyses with the basement in place used the same approach.

The summary of the analyses is tabulated below:

	No Basement	**Basement**
Common Point	1.032	0.704
Variable Radii	1.015	0.576
Lower Common Point	1.054	0.623

Table 1: Minimum Factor of Safety

*approximate value depending on exact circle taken

See figures below:

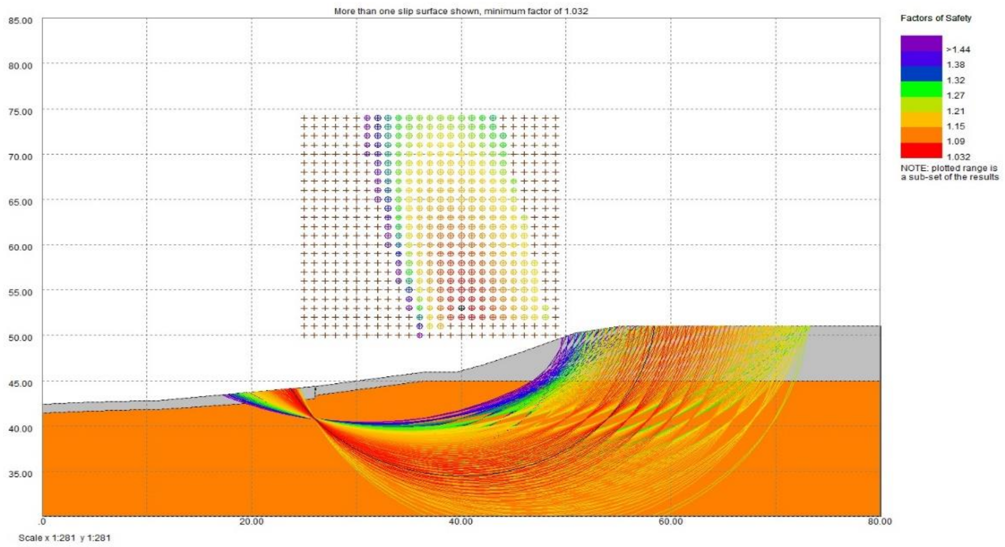

Figure A: No basement, Common Point at rear basement floor

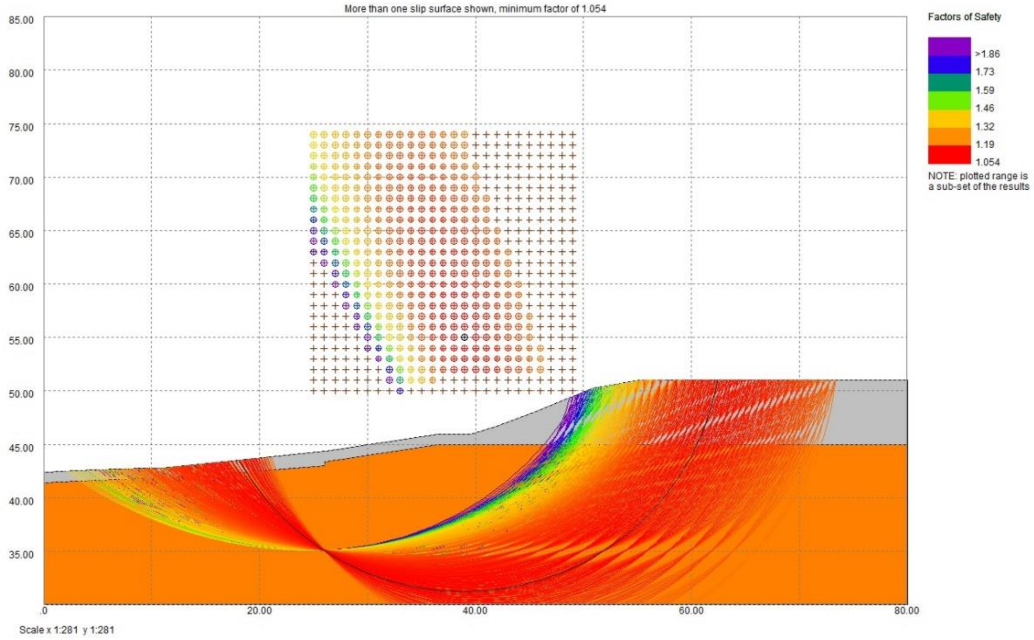

Figure B: No basement, Common Point at 35m AOD, below rear basement floor

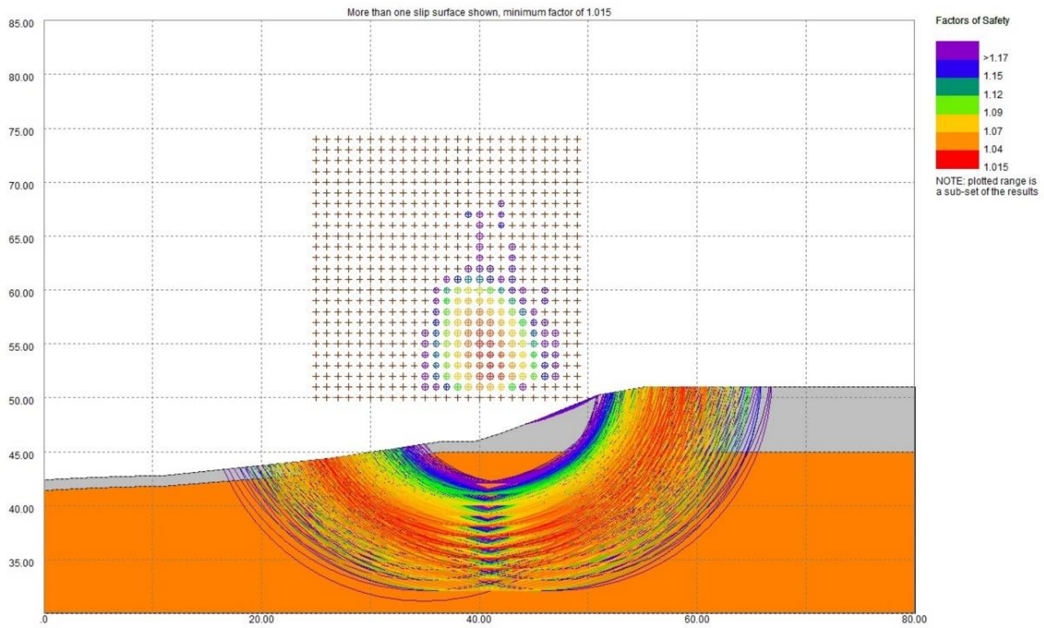

Figure C: No basement, Variable slip circle radii

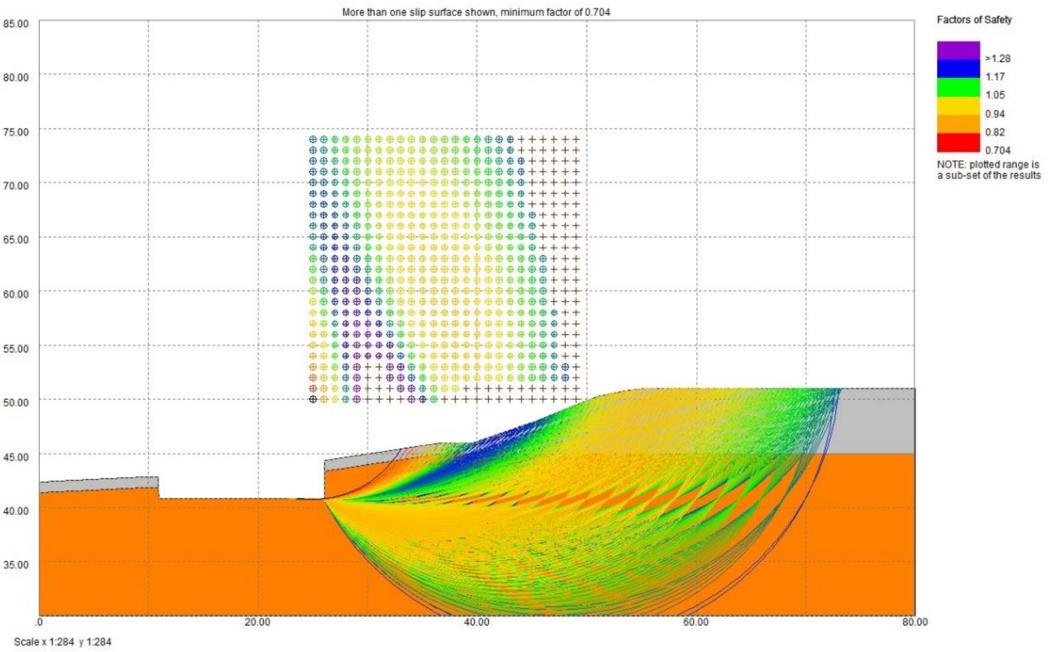

Figure D: With basement, Common Point at rear basement floor

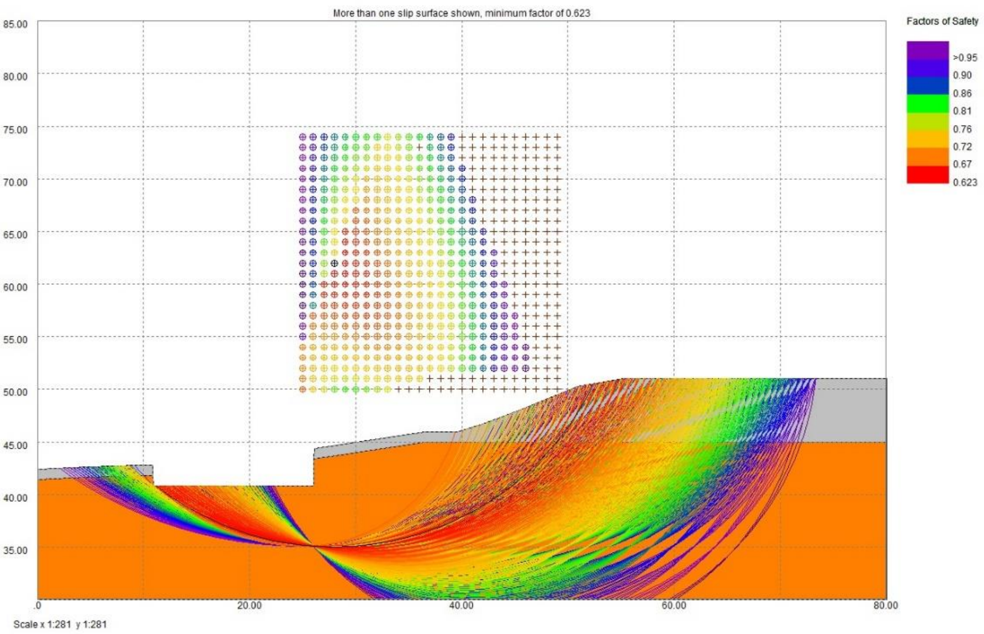

Figure E: With basement, Common Point at 35m AOD, below rear basement floor

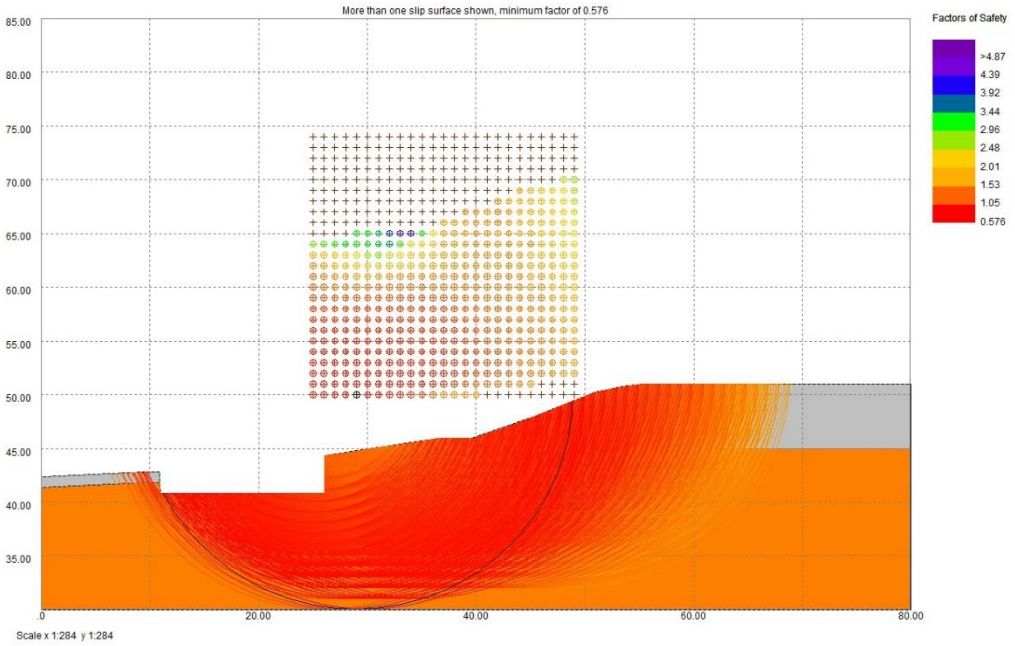

Figure F: With basement, Variable slip circle radii

Conclusions

The analysis shows that there is a significant reduction in the factor of safety of the slope arising from the introduction of the basement.

The nature of the assessment is such that very preliminary data has been used and a number of often conservative assumptions made. Notwithstanding this the analysis of the slope without a basement gives factors of safety which are marginally above 1.0. Once the basement is introduced the factor of safety reduces by around 30 to 40%.

Whilst this assessment is probably conservative the figures indicate a reduction in the stability of the slope on the introduction of the basement.

Recommendations

This assessment has had to rely on a number of assumptions, due to limited data on the soils, groundwater and make-up of the slope to the rear of 43 Burghley Road. A number of data gaps have been identified:

- The engineering properties of the London Clay at this location
- The nature and engineering properties of the soils which make-up the slope, in particular the nature of the made ground and the level of its interface with natural soils
- The presence (or absence) of Head Deposits at the site
- The level and variability of groundwater

- The nature of the college building foundations plus data from its design and construction.
- History of instability of the slope should be investigated.

It is therefore recommended that some intrusive works are carried out at the top of the slope and within the rear garden of no. 43. The college should be approached to see if there is useful borehole and other related data available.

The borehole is the garden could be drilled using a terrier rig and should take undisturbed and disturbed samples of the soils for appropriate laboratory testing. The borehole at the top of the slope would best be drilled using a cable tool percussive rig. Groundwater monitoring standpipe piezometers should be installed. This will then enable more rigorous analysis to be carried out.