

# Brickfield Cottages Ground Stabilisation Scheme

## Project Profile

**Client:** Hexagon Housing

**Designer:** Peter Brett Associates

**Period:** June 2016 to Feb 2018

**Value:** £1.8m



This was an Emergency Investigation and Treatment Works Contract which was undertaken following the formation of a ground collapse directly outside a property on this newly constructed housing development in Plumstead, South East London. The residents adjacent to the collapse were immediately evacuated and the initial collapse filled with concrete. Peter Brett Associates were appointed by the client to design and supervise a site investigation followed by a ground treatment scheme.

Preliminary site investigation involved drilling probe holes at the collapse location then extending the drilling grid to determine the extent of the anomaly. The initial investigation phase around the area of collapse revealed that the anomaly was likely to be a historic mine working in the chalk strata. The expanded investigation (Phase 2) proved that the mine working feature extended beneath the adjacent block of 10 houses and would require treatment to ensure protection against potential settlement or collapse. The residents of these properties were re-housed until the area was assessed as safe by the Engineer.

Investigation work consisted of rotary probing and we used inclined drilling techniques for drilling under the properties so we could carry out the work from roads, gardens and courtyards around the buildings, rather than carry out any of the work from inside properties which would have been immensely disruptive. Rig types used included Casagrande C6S dual head drilling rigs and a Krupp 30G Mini rig for areas of restricted access.

A Compaction Grouting methodology was used to complete the stabilisation works the aim of which is to improve the strength of weak or collapsed strata by injecting controlled volumes of mortar grout in ascending stages using drilling and grouting methods. Injection of grout at low pressure on a prescribed grid through the vertical extent of weak material provides key ground improvement benefits;

- Densifying the weak host material by compaction through the introduction of a connected series of 'bulbs' of grout which also provide a grid of grouted 'inclusions' in the host material which act as stronger columns.
- Strength gain expected in the host material is validated using Dynamic Probing techniques.
- The expected grout volume injected to achieve this strength increase is in the range of 8 – 15% of the treatment volume depending on the characteristics of the host soils.
- The system can be used iteratively i.e. following DCP soil strength testing of the first set of compaction grout boreholes, secondary holes can be targeted in areas that need further improvement.
- Specific areas of weaker material can be targeted within the strata.

Here a 6:2:1:0.1 mix of sand, PFA, cement and bentonite was injected using an 'end of casing' injection method, 150mm diameter rotary steel casing was drilled to the full hole depth and then used as the grout injection tube, the casing was withdrawn in stages thus allowing complete control and monitoring of grout volumes and pressures.

51 holes were drilled and 78 tonnes of grout injected into the first phase of the works around the original collapse



# Brickfield Cottages Ground Stabilisation Scheme (Cont'd)

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Further desk study, historical searches and risk assessment were carried out by Peter Brett Associates who concluded that there was a high probability of further historical chalk mine workings being present on part of the site. This resulted in 3 further properties being deemed to be at risk and requiring further investigation (Phase 2). It was also proposed that the remaining properties should be investigated to prove that no further anomalies existed on the site (Phase 3). These further phases required the residents to be re-housed while investigation and treatment works were in progress.

The Phase 2 investigations proved that historical mine workings anomalies were indeed present and that further treatment was required. 162 holes were drilled (both investigation and treatment) and 1315 tonnes of 6:2:1:0.1 mix of sand, PFA, cement and bentonite grout were injected using the same compaction grouting techniques to consolidate the macro voided, loosely infilled or collapsed areas of chalk.

The Phase 3 investigation was completed in stages and resulted in 445 rotary investigation bore holes being drilled to 30m in depth. 10 Cable Percussive boreholes were also drilled to provide samples of undisturbed strata for analysis.

During rotary investigation drilling various parameters were recorded including rotation speeds, air pressures, penetration rates and flush returns which gave Peter Brett engineers a clear indication of ground conditions and the presence of mining or other anomalies.

Casagrande C6S dual head geotechnical drill rigs with simultaneous casing capability were also used during the Phase 2 and Phase 3 Investigation and treatment phases which allowed fully controlled end-of-casing stage grouting. In addition the Krupp 30G Mini rig was used in difficult to access areas.

During the investigation and stabilisation work continuous monitoring of properties was carried out using laser levelling, EDM surveys, crack monitoring 'tell tales' and physical condition surveys.

Close liaison was maintained at all times with the Client, Designer and Residents to ensure successful completion in as short a time frame as possible and to ensure minimal disruption was caused to remaining residents. However, in order to complete the works a full evacuation of the development was eventually required which was achieved in Mid-December 2017. This enabled completion of the final investigation works at the end of February 2018.

On completion of drilling and stabilisation work the site was completely reinstated in line with the clients requirements.

