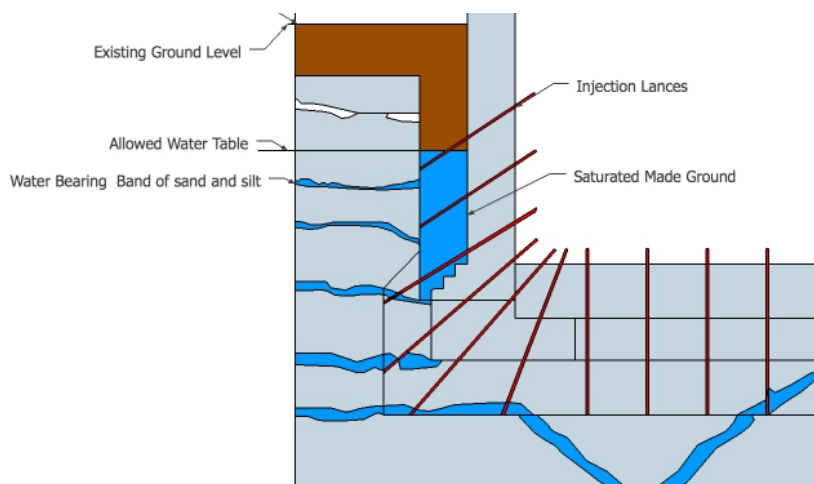


2.2 Method of works

There are several different options in regards to materials, injection grids and equipment. Materials and methodology below have been suggested taking into cost, time, risk and value for money.

2.2.1 Source of Water Ingress

Ground in which the basement extension is to be undertaken is all within the Claygate member, as per ground investigation report dated July 2012. Although the bulk of this ground is impermeable clay, there are bands of sand and silt that allow water flow. Exact grain size affects the hydraulic conductivity / flow rates within these bands. This also affects the viscosity of grout that can be used.



D1: Section of wall, showing injection lances

The below table is an extract from a British Geological Society Paper on Permeability

Table 1.1 Typical ranges in hydraulic conductivity of common rock types (after Lewis, 1989)

Lithology	Hydraulic conductivity (m/day)
Clay*	5×10^{-7} to 10^{-3}
Loess	10^{-2} to 1
Silt	10^{-3} to 10^{-1}
Sand	10^{-1} to 5×10^2
Gravel	5×10^1 to 5×10^4
Sand and gravel	5 to 10^2

2.2.2. Injection Grout

From experience gained during site trial and comparing the above table with the below. We believe the Geotek LV is best suited for the project, this will fill all or the majority with the least impact equipment and time. As it is a slightly expansive grout (approx 4 times), it also reduces packaging and movement logistics.

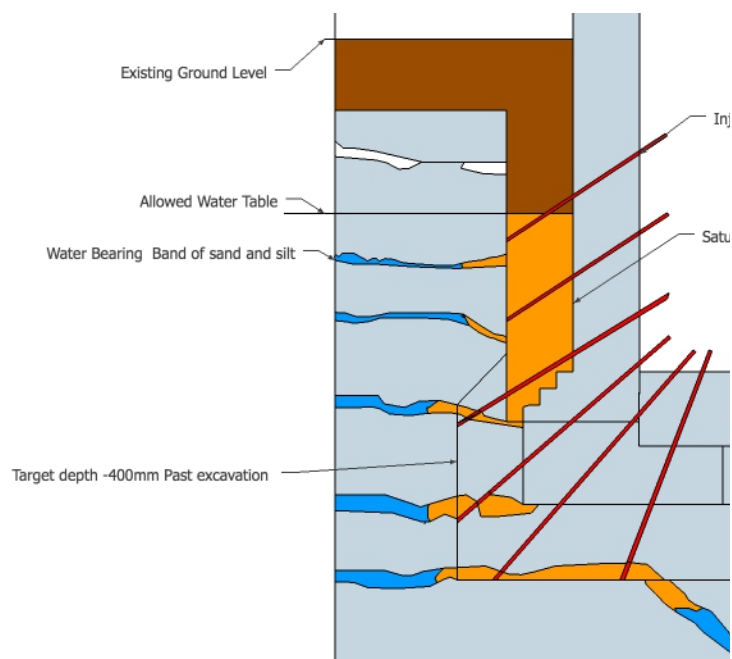
Tam GeoTek LV is a low viscosity, single shot polyurethane based grout, with an added catalyst to adjust expansion and setting times. The system only reacts when it comes into contact with water, forming rigid polyurethane foam. As the reacted material is rigid, it is less prone to splitting into thin sections.

$k = 10^{-6}$ or less: ungroutable
 $k = 10^{-5}$ to 10^{-6} : groutable with difficulty by grouts under 5cP viscosity* and Ungroutable for higher viscosities
 $k = 10^{-3}$ to 10^{-5} : grout-able by low-viscosity grouts but with difficulty when k is more than 10 cP
 $k = 10^{-1}$ to 10^{-3} : groutable with all commonly used chemical grouts
 $k = 10^{-1}$ or more: use suspended solids grout or chemical grout with a solids filler

2.2.1 Target area

Methodology are based on the injection of Geotek LV around the perimeter from the allowed water table level (1m below existing external ground level - as per neighbours engineers comments, dated 28th October 2013) down to below the underpinning height. With a target saturation/ affected area of 400mm deeper than that of the expected excavation.

The drawing D2 is showing the lances on a angle to pick up as much of the silt bands as possible.



D2: Section of wall

2.2.3 Injection Grid and Angle

A 500mm centre grid will be initially implemented, this will be adjusted as distance of spread is realised during injection. The angle of the driven in lances will be dependent on location, partly driven by ceiling height. As the bands of water bearing material generally run with the slope of the land, injection points within the wall will be on a downward angle. Lower areas and into the floor will be less on an angle or straight down.

2.2.4 Injection

The injection of the Geotek Lv into target area would hope to seal the water flow, in some areas bands will be missed by the injection grid. These missed areas will only be obvious when the underpinning has commenced. The leaking area would have Geotek Lv present therefore the secondary injection to tighten up, would be with the Acrylic TamGeo Tek AC that Tempo trial with. The Acrylic is able penetrate smaller areas than the Geotek and will help seal any remaining issues.

2.2.4 Clean up

Clean up is minimal, any leakage during injection will be cleaned down with water at the time. As is all pumps and equipment, no specialist cleaners required.

All rubbish will be removed from site at end of the project, consisting mainly of wooden pallets and bags material supplied in.