

The Actively Stressed Soil Nail System complete with Corrosion Protection (Patented)

This new technology in anchor nailing was introduced to the Geotechnical Industry in an article published in Ground Engineering Volume 37 No.8 in August 2004.

Introduction

Early development of UK soil nailing technology utilised fully bonded, passive tensile members for retention of active zones of soil. Surface soil slippage was initially controlled by placement of geogrids or similar materials over the exposed slope surface, and the grid often restrained by driven pins (Figure 1).

As confidence in soil nail technology increased, cut faces became steeper and surface soil retention extended to semi-flexible and stiff facing systems; most commonly provided by shotcreting. The concept of constructing the facing and leaving both the face retention and the soil nail in a passive state, gave Engineers reason for concern. Face movement would initially be required to develop the nail retention forces, and subsequently active movement within the soil would take place in order to generate tension in the deeper component of the passive nails. The simplest and most practical solution appeared to be the consideration of the head of the nail as an anchor which justified the application of prestress (Figure 2). However, load cannot be applied to a bonded elastic tensile member without the occurrence of debonding progressively along the nail. This results in the applied face retention force being resisted by load transfer into the *active zone* of the soil mass.

The Actively Stressed Soil Nail System.

The new “Actively Stressed Soil Nail” is developed to ensure that the face retention force is transferred entirely *into the resistant zone* of the soil mass which is consistent with the original principles of wall retention. This is effected by the installation of two tensile members in each nail bore; one being actively stressed against the face and bonded in the resistant zone. The second member passively ties the active

zone soil to the resistant zone consistent with soil nail technology (Figure 3).

The two tensile members in the borehole are fully isolated from the environment, by their in-situ encapsulation within a plastic corrugated duct. This complies with the latest code recommendations and



Plate 1 Rig installing trial nails before excavation provides an 80° soil nailed face.

eliminates tendon corrosion this increasing life expectancy of the nail. Furthermore it has potential benefits in areas subjected to seismic disturbance.



Plate 2. Sacrificial testing of the dual-tendon, actively stressed soil nail prior to excavation. Note proximity of adjacent high level development which will be undercut by 14m face.

Nail Testing

The Active Soil Nail System was proposed for both stabilisation of the soil mass and for the prestressed retention of the 14m high 80 degree inclined Shotcrete face at Queenstown in New Zealand. (Plate 1).

Seven rows of actively stressed nails are to be used in conjunction with a single row of toe level SBMA anchors. The nails are founded in the silty sand and gravels; the multiple anchors in the weak underlying alluvial silts.

Trials supervised by Single Bore Multiple Anchor Ltd have been completed on the new nail system, achieving load capacities as high as 864kN without failure in the distal 6m length of a 12m long nail (Plate 2).

Summary

The Actively Stressed Soil Nail System provides the industry with a slope or face retention method that allows usage of a lightweight facing that itself may be retained by the soil in the resistant zone. It does not require heavy structural facing as required by prestressed ground anchors. Both the facing and the active soil mass are tied independently to the resistant zone of the soil mass.

At last the answer to those who have bandied around the term 'prestressed soil nail' has been made available to the Geotechnical Specialist.

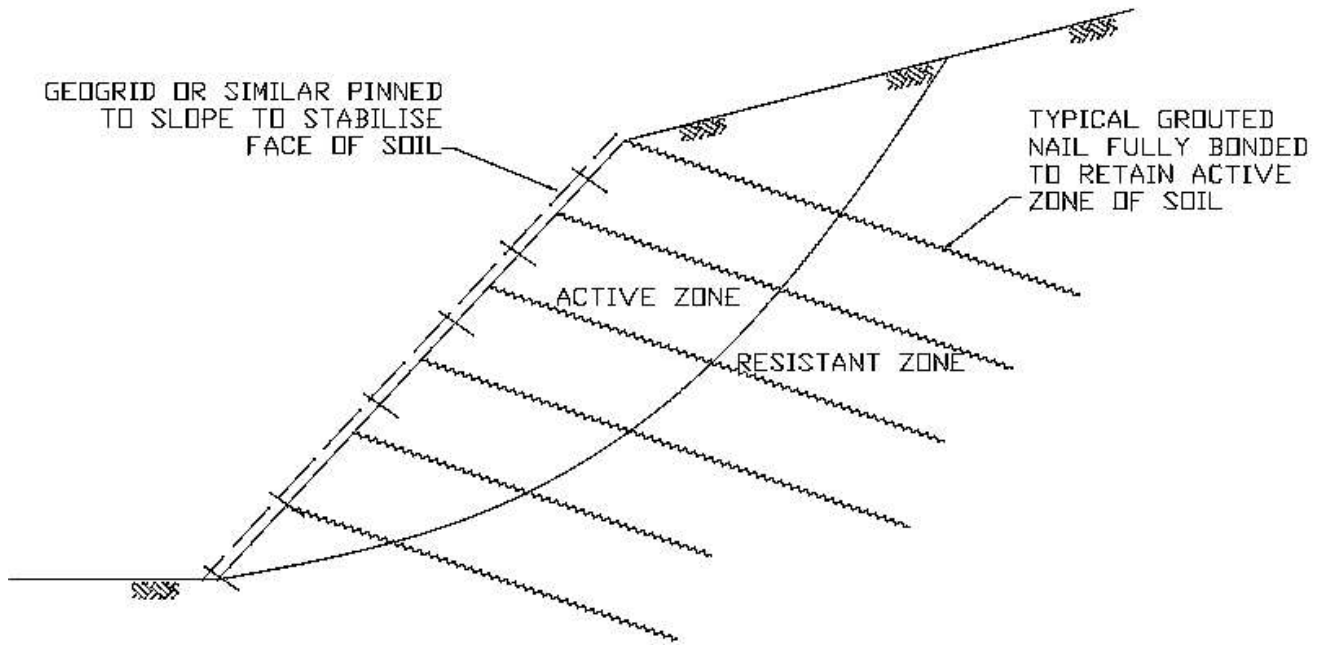


Fig 1. Shallow slope stabilisation with soil nails used to retain the active zone of soil.

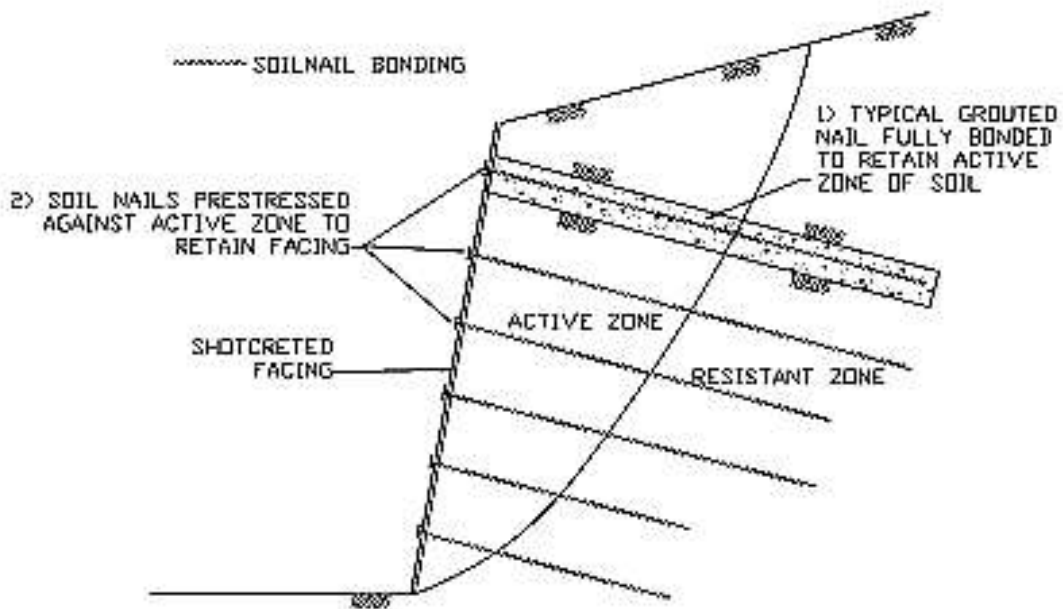


Fig 2. Steep slope stabilisation with soil nails used for dual purpose.

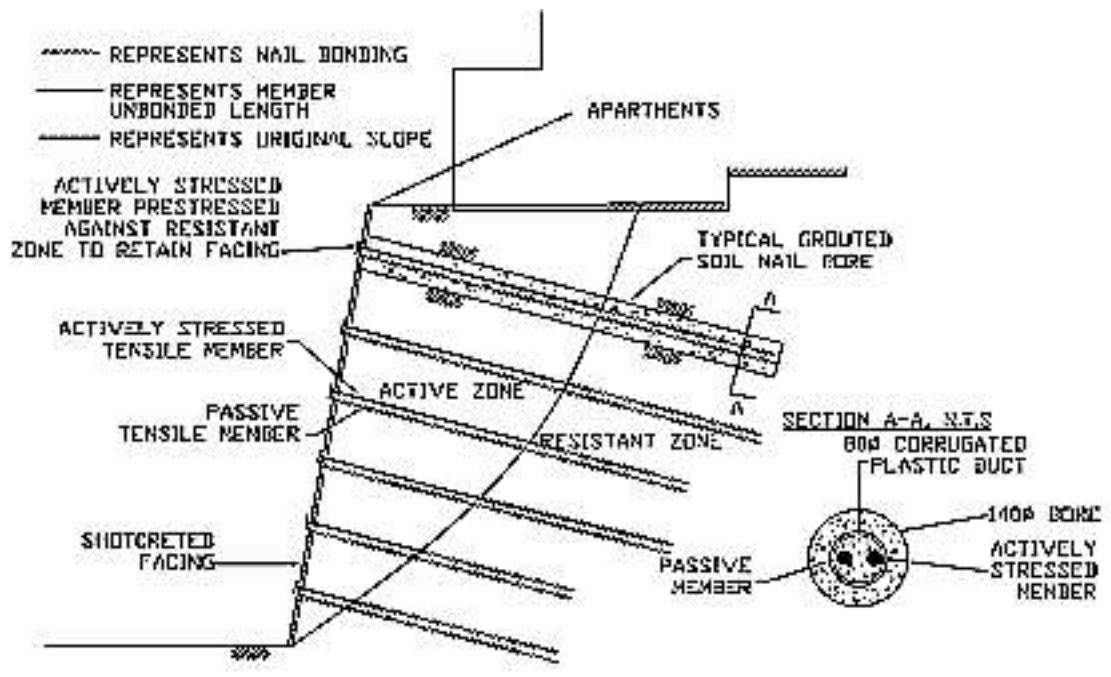


Fig 3. Steep slope stabilisation with actively stressed soil nails, designed for dual purpose usage