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

Introduction

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

Early development of the 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, with the grid often restrained by driven pins (Figure 1 & 2.)

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 mass would take place in order to generate tension in 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 (Figures 3). However, load cannot be applied to a bonded elastic tensile member without the occurrence of debonding progressing along the nail. This results in the applied face retention force being resisted by load transfer and progressive debonding into the active zone of the soil mass.

The Actively Stressed Soil Nail System (ASSN)

The new “Actively Stressed Soil Nail” has been 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, prestressing the retained soil behind the facing, yet fixed in the resistant zone. The second member passively ties the active zone soil to the resistant zone consistent with soil nail technology (Figure 4 & 5).

Where conventional soil nails are particularly long they require considerable face and active zone movement to utilise the restraint available in the resistant zone. Design approach and programmes generally base slope stability on the transfer of active load into the resistant zone via the elastic soil nail tendons irrespective of length. The actively
stressed soil nail can offset some of this movement owing to the direct application of some
prestress to the face and preloading of part of the nail tendon component.
The two tensile members in the borehole are fully isolated from the environment, by their
in-situ encapsulation within a plastic corrugated duct. This protection complies with the
latest Soil Nail Code Recommendations for high risk slopes. It eliminates tendon corrosion
thus increasing life expectancy of the nail.
The presence of two tensile members, which transfer load independently to the facing and
to the active soil zone, ensures an increased factor of safety, and may provide benefits in
areas subjected to seismic disturbance.

Nail Testing and Usage

The Active Soil Nail System has been 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
fixed length of a 12m long nail (Plate 2).

Summary

The Actively Stressed Soil Nail System provides the industry with a slope and face
retention method that allows usage of a light weight facing or lightweight face blocks. The
face itself can be retained by prestressed tendon fixed in the resistant zone beyond the
active zone of soil. The system 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 soil mass and this is particularly beneficial when very long nails are
installed and when slopes are very steep.

At last the perfect answer to those who have banded around the term “prestressed soil
nail” for face retention has become available to the Geotechnical Industry.

For further information see www.SBMASystems.com and
www.Theanchorman.com
Or contact Tony Barley at Tony.barley@SBMASystems.com

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

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