

THE EUREKA GEODETECT[®] PROJECT

Prepared by:

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Feeling the Earth Move

Ground subsidence can cause dangerous and costly damage to buildings, railways and roads. A novel product can now be built in to detect early signs of subsidence before serious damage is caused.



EUREKA project E! 2579 GEODETECT has developed an effective and totally novel product for detecting soil subsidence – vital for avoiding costly damage to buildings and infrastructures. Optical fibres are embedded in a composite ‘geotextile’ to make a layer which can be built into structures where earth subsidence is critical, e.g. railway tracks, in regions where the geology predicts that subsidence is likely. The sensory fibres offer continuous monitoring and early warning of earth movement. Since its development the product has been installed in parts of the French railway system and also around the world in key supporting structures for roads, like bridges and embankments.

Some types of underlying geology make soil liable to subside, especially (but not exclusively) where there are underground mines. Cavities between the rocks can eventually extend to the surface, causing structural damage to buildings, roads and railways. Sometimes subsidence can happen suddenly and without warning, giving great risk of accidents. The monitoring systems available until now for detecting subsidence are not efficient and depend on visual inspection; but by the time visual assessment can be made, the damage is well advanced and repair is costly. Also geological surveys by radar in areas where building is needed can only describe the ground structure at that time, but it can change. What is needed is continuous or random monitoring.

Subsidence is a particular problem for railways, where even a few millimetres’ change in track level could have disastrous results. This is particularly vital because of the current upgrading of railway systems throughout the EU to establish the European high-speed rail network. Very high costs result from repairing damage to railways, roads and buildings, or using other structural solutions like reinforced bridges at critical locations liable to subside.

High-Strength Matting

The EUREKA GEODETECT® project set out to add a sensory system to an existing material called geotextile. This is a non-woven, fibrous matting made of continuous polypropylene fibres, reinforced with high-strength polyester yarns. It was already manufactured by GEODETECT’s® main project partner Bidim Geosynthetics, now TenCate Geosynthetics France. With its high mechanical strength, resistance to mechanical and chemical damage and long life, the geotextile matting was already used without sensors in the foundation beneath roads and railways, where it reinforces the soil beneath the gravel layers and gives it added strength.

Now we know the potential exists, we continue to see a great opportunity to develop.

Dr Alain Nancey - *Tencate Geosynthetics Europe, France*

GEODETECT's® innovation was to develop a grid of fibre-optic sensors and incorporate it into the geotextile material. The sensor was developed by the other project partner, IDFOS (now FOS&S) from Belgium, which had already been involved in monitoring the structural soundness of buildings and bridges. The project's second main challenge was to incorporate the optical fibres into the geotextile material. Developing optical fibres suitable for this purpose was a particular challenge. To give warning of subsidence when laid in the ground, they had to be able

to withstand lengthening of up to 6% - previous technology only allowed elongation of 1.5% before the fibres would break.

Picking up the early warning

Dr Alain Nancey of TenCate Geosynthetics Europe explains how the system works. "Adding sensors linked by optical fibres into the geotextile enables hundreds of them to be installed quickly into the ground, in a critical area where there is risk of collapse. If a cavity appears in the soil under the geotextile, the resulting lengthening of the fibres in the matting will be detected by the sensors and be relayed to the monitoring system. The data is relayed to the system operators where it will raise the alarm. In the case of a railway, for example, the affected track section can then be isolated and repaired quickly, possibly by injecting concrete, before real damage is done." This system continuously monitors any ground movement, and sends out an instant alert if significant changes occur. The system operator defines the critical level at which the alert is given.

Detecting subsidence in roads is not quite so critical as for railways, which cannot tolerate a change of more than 2mm. But detecting subsidence is important for supporting structures used in roadbuilding, like bridges, retaining walls and reinforced embankments. Here the geotextile incorporating optical fibres has been used in the form of small strips rather than in the big 5 metre-wide rolls used for ground coverage.

We needed a support to develop the detection system, so we found a partner who already had experience in this field and was very motivated and efficient.

Dr Alain Nancey - Tencate Geosynthetics Europe, France



A Growing Market

The GEODETECT® product has been of great interest to the French national railway company SNCF, and has already been put into use in a section of railway line in mid-France. Further opportunities are opening for the large-scale matting, particularly with the building or conversion of railways to take high-speed trains. This is a vital EU development as part of the plan to introduce a trans-European rail network, linking the major cities of Europe. In another applications not linked to a risk of underground cavities, the geotextile strips using sensors have been successfully installed in French road structures since 2004, and are now in use in 15 regions of Europe, the US and Asia.

Being part of a EUREKA project has helped both partners because they feel this has recognised the value of their new technology development. Having a EUREKA involvement has also opened doors toward discussions with a number of regulatory authorities.