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Paper (a)

GEOTEXTILES: PRACTICAL TECHNIQUES

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1.0 Abstract

Organisational and field proceedures are equally as important as the preceeding selection and design work in ensuring satisfactory performance of geotextiles. This paper covers some practical points on equipment, people and the organisation necessary for the successful use of geotextiles in logging road construction.

2.0 Introduction

To date, much has been written about the physical properties of geotextiles in the roading and construction industry, especially regarding attributes such as burst strength, water permeability, apparent pore opening size and elongation.

These factors are important in ensuring that the correct geotextile is chosen for the job, but equally important I believe are the techniques used by a company to introduce this product to the workforce and include the use of geotextiles in regular logging road construction, i.e. how they get the fabric into the road.

3.0 Geotextiles

The word Geotextile was coined at the First International Conference on the use of Fabrics in Geotechniques held in Paris in 1983 (ref 2). It was defined in the draft Australian code as "any textile permeable to water, used within a foundation, soil, rock, earth or any other geotechnical engineering- related material as an integral part of a man-made project, structure or system". (ref 1).

Table 3.1 Functions of Geotextiles (ref 1)

FUNCTION	DEFINITION	EXAMPLE
Drainage	Collects liquid and conveys it.	Prefabricated vertical drains.
Filtration	Allows liquid to pass but prevents the passage of soil.	Filter in sub-surface drainage.
Separation	Prevents two different types of materials from intermixing.	Fabric placed between subgrade and basecourse
Reinforcement	Improves the stability/ mechanical behaviour of an earth structure.	Embankment construction on soft foundation.

The principle use of geotextiles in logging road construction has been as a separation layer (the third function in table 3.1) between a soft subgrade and basecourse material. To this end, the geotextile prevents the intermixing of fines with the granular material. If one remembers that 100mm of bad material mixed with 900mm of good material results in 1000mm of bad material, the need for this separation layer in roading is obvious.

Some reinforcement may also be provided by the geotextile but this is only in the heavier more expensive fabrics, the behaviour of lighter fabrics, with which I am familiar, indicate that they provide little reinforcement.

4.0 NZFP Forests Limited & Geotextiles

NZFP Forests Limited has been using geotextiles since 1984. The first use was not a commercial product, but a trial run with used papermill felt. This performed satisfactorily and the principles of use were accepted by the construction supervisors so a commercial product was purchased.

The fabric is now used regularly on trouble spots, and a roll is kept in store. To date we have laid some 5000 m2 of a woven slit film product "Polyweave R".

We have not used geotextiles in road sub-drainage as yet, but it has formed an integral part of an earth dam filter structure as a filter surrounding an agregate drainage blanket.

5.0 Practical Techniques

5.1 Where To Use It

In the forest roading situation the most benifit can be obtained by using geotextiles where the subgrade is soft and plastic i.e. on sensitive soils. Economics govern it's use. If the cost of basecourse that would be lost to the subgrade is more than the cost of the geotextile then it should be used.

5.2 Organisation Requirements

If the organisation is keen to try geotextiles and has any of the above situations it is essential that the fabric be held in store, or can be purchased locally. Having construction equipment waiting for the fabric to arrive is not good economics, it may be cheaper overall in these situations to put on extra metal and get on with the job.

Plan the operation, ensure there is sufficient manpower and equipment avaliable to handle the fabric and metal.

Ensure that UV sensitive geotextiles are stored in the dark. Deterioration in sunlight is very rapid, a matter of weeks.

5.3 People

In this day and age of the bottom line it is easy to forget that people actually make up organisations, not machines or products. Any new idea introduced, which has the potential, to save money can fail if the people involved in its use are not interested, not informed.

To give a new product, such as Geotextiles every opportunity to be sucessfull it is necessary to

- Explain the economics behind the use of geotextiles, and the equivelent basecourse depth basis for it's use.
- Explain to field personnel what geotextiles in general can do, and what this one is supposed to do.
- Explain what the limitations are and how to avoid failure of the fabric.
- Encourage them to experiment for themselves (within reason) with its use.
- Listen to suggestions of other situations in which they feel it may be of use.

Don't just send a roll out to the job and expect the staff to know what to do with it, after all if those actually installing the geotextile decide they don't like it, for whatever reason, they will ensure it won't work. To your organisation it will appear a failure, never to be used again. You will be losing a tool which does have a place in road construction hence you will be that much less competitive in the $/tonne rate in getting the wood to the processing plant.

Generally it requires two people to handle the fabric and one person to supervise the laying and metal application. Supply a 'Stanley' knife or similar to cut the fabric with. It can prevent fabric waste.

5.4 Placing Fabric

Lay the fabric as the metal is spread, rather than rolling out long lengths. One supervisor commented that KZ 7's sails were nothing compared to a 50m length of geotextile billowing in the breeze.

On corners you will get creases. If the fabric is only for separation then this does not matter, if it is for reinforcement, (tensioned membrane function) then these areas will deform more before the fabric begins to contribute to the strength of the structure. Allow an overlap of 600mm if more than one width of fabric is being used, any less and the layers will part, forcing subgrade in to the basecourse.

5.5 Placing Basecourse

To avoid having equipment on standby it is recommended that the basecourse be stockpiled close by, or that the equipment can be worked on a nearby job while metal is being transported to the fabric.

Delivery to the fabric best by tipping truck rather than underbody type, the later is not suited to stockpiling in confined situations and invariably has to be towed out when the metal jams the chutes.

To apply the basecourse to the fabric we have used both tractors and excavators with wide buckets. The tractor is sometimes the only machine available but it has the following disadvantages;

* Cannot pull metal back.

* Pushes metal into water table from edge of blade.

Overall there is less control of the basecourse therefore more metal may be required.

The excavator is the preferred machine as it can place the metal where it is needed, confine it to the fabric, recover metal from water tables and does not have to walk on the fabric to apply the metal.

On a soft plastic subgrade, where 350mm to 400mm would normally be applied, 300mm is a good minimum cover on the geotextile to start with. The fabric cost equivelent metal depth for Polyweave R in the Kinleith region is around 50mm. Hence that is the minimum metal saving one would require before it's use is economic.

On sections where one would normally apply only 150 to 200mm of basecourse there is little point using a geotextile as it will probably fail. If it doesn't then it is likley that you did not need it in the first place.

Having exhumed fabric on one section of road, I would now recommend using some form of level control to ensure the design depth of metal is applied. Level pegs and stringline or simply counting truck loads would suffice.

5.6 Failures

Since using geotextiles at NZFP Forests Limited, we have noted three main types of failure.

1. Burst failure - Where a wheeled vehicle has produced a high enough ground pressure to cause the fabric to fail, and either force the basecourse into the subgrade or the subgrade up into the basecourse.

2. Overlap failure - Where wheel loads either side of an overlap have caused sufficient subgrade deformation to pull the overlap apart (same result as in (1).

3. Grader failure - Where a grader has cut too heavily and catches the fabric, this has been noted especially in the area between wheel tracks.

6.0 Benefits of Geotextiles

If used correctly, geotextiles can be expected to provide savings in the following areas;

- in the quantity of metal applied as less is "lost" to the subgrade.
- reduced need for subbase surfacing and consequential stripping and borrow pit expenses.
- reduced time to complete road construction job.

Overseas experience indicates that maintenance costs maybe reduced on those sections of road which have utilised geotextiles. Areas where we have used geotextiles have stood up well to continued use.

7.0 Summary

- In our experience at NZFP Forests Limited geotextiles in logging roads generally provide separation only.
- They should be used in areas where the subgrade is sensitive.
- To obtain maximum benefit field personnel must understand the basic principles behind the use of fabrics.
- The organisation must support their use with timing and correct equipment.

8.0 Conclusions

Geotextiles do have a place in the forest industry in road construction.

This paper has briefly covered some practical points in the use of geotextiles as a separation layer, when to use them, and organisional requirements necessary to support their use.

If the organisation ensures that the field staff who use the fabric are as informed as those who propose it, geotextiles will be another costsaving technique valuable to the logging industry.

9.0 References

1. Lawson C.R. & Curiskis J.I. "Geotextiles" Sydney Australia 1985
2. Civil Engineering Nov/Dec 1986: Supplement: "Geotextiles and Geomembranes"
3. East GRW M.W.D. Laboratory "Geotextile Fabric Seminar Notes" September 1983.