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EARTHWORKS RESTORATION USING INSTANT TURF BASED ON EXPERIENCE AT THE ALEXANDRA REDOUBT, A FORMER ARMED CONSTABULARY FORTIFICATION AT PIRONGIA

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ABSTRACT

Deep ruts created by children sliding down the steep earthworks of the Alexandra redoubt at Pirongia were repaired recently using instant turf in two forms. As this product has not been widely used in earthworks restoration in New Zealand, an outline is presented here as it is likely to be suitable for turf restoration or repairs on other grassed earthwork sites in some localities.

INTRODUCTION AND BRIEF HISTORY

Following the conclusion of the Waikato War in 1864 and the subsequent confiscation of more than one million acres there was considerable unease among the European population of the Alexandra (Pirongia) district and fear of Maori raids because of the frontier settlement's proximity to the aukati (confiscation) line (Ritchie 1992).

With the disbanding of the Waikato Militia regiments, the Armed Constabulary was given the task of defending the frontier. They erected the present Alexandra redoubt (S15/28) in 1872, but it is actually the second on the site. The earlier redoubt, completed in December 1868, "for a garrison of 100 men," was constructed on the same low hill (*Daily Southern Cross* 21 & 24 November 1868; Colonial Defence Office files Dec.1868). It enclosed an Anglican Church, St Saviour's, erected the previous year by European settlers. During the late 1860s, fuelled by isolated incidents and rumours, the settlers pleaded to the Government for a "blockhouse or fortification to be erected in the event of an outbreak" and for "a flagstaff on Church Hill from which a danger signal may be displayed day and night" (Gilchrist 1988:8). The request was granted in 1871. The next year, after the church had been removed, the old redoubt was levelled, and a new one constructed. It was completed in October 1872. Within the redoubt's high walls and deep surrounding trench, a blockhouse and flagstaff were also erected. Although there was little need for the new redoubt by the time it was completed, it was garrisoned until 1883 when the Armed Constabulary was withdrawn from Alexandra (Cowan 1922).

In 1900, another church was built within the redoubt walls. Following the

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building of a new church in Pirongia in 1959, the church in the redoubt was moved to its present site in the Waikeria prison settlement.

About this time the Alexandra redoubt was acquired by the New Zealand Historic Places Trust. A survey plan was produced (Maihi 1984) and the Trust erected a noticeboard in 1986. Day to day management is undertaken by the Dept of Conservation's Waikato Conservancy. The redoubt is generally regarded as the "best presented" of the five redoubts in the Waikato which are maintained by the Department. The configuration of the redoubt is well illustrated in Figure 1. The trench surrounding the earthworks is c.2.5 metres deep, while the earthworks add another 2 metres in vertical height. Annual visitation, determined by track counter, is over 12,000 persons, many of whom are part of school groups.

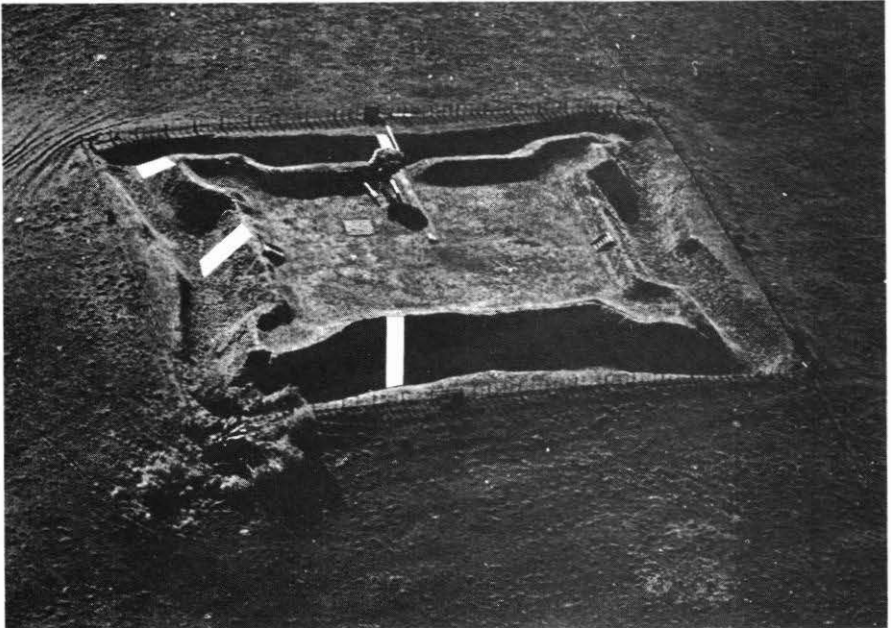


Figure 1. An aerial view of the Alexandra redoubt, Pirongia taken in 1980 (Photo: Waikato Museum). The three white oblongs show the location of the main repair work outlined in the text.

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THE SITE AND THE RESTORATION REQUIREMENT

The Alexandra redoubt and surrounding paddocks are grassed. According to the Department of Conservation, Hamilton Field Centre staff who maintain it, it is a relatively low maintenance site, being maintained by monthly grass-mowing in summer and bimonthly mowing (wetness permitting) in winter. Bracken growing naturally on the inner sides of the defensive ditch is maintained to aid slope stability and occasionally lightly trimmed to maintain appearances. Gorse and other problem weeds, depending on their location, are spot sprayed if necessary, otherwise just trimmed along with the bracken.

While the redoubt is a generally low maintenance and well maintained site, periodically the earthworks have been damaged by children (mainly locals) who slide down the steep slopes of the defensive ditch creating sizeable channels in the clayey matrix of the walls, which erode rapidly if not stabilised. In the past, Field Centre staff have relayed their concerns about this and BMX bike damage to the community through the local newspaper and the school. The results of these communications and quick regrassing of damaged areas by fieldstaff has generally curbed this sort of damage before it became substantial.

However, during the first half of 1994 two very large ruts, up to 80cm deep, and several more shallow ones were rapidly created in the ditch embankments by another outbreak of "sliding". The Field Centre responded by hand delivering 250 notices to Pirongia households. The notices outlined the historical significance of the site, encouraged the locals to take pride in it, and sought parental co-operation to protect it. The leaflet also indicated that the recent damage was significant and would require repairs by Conservation staff and use funds which the Department could ill afford to waste.

The repair work was planned by the Regional Archaeologist (NZHPT authority 1994/58) and implemented with the assistance of other staff. While, outwardly it was a simple operation requiring infilling of the channels and the re-establishment of vegetation cover (grass in the first instance), the steep slopes and dryness of the site over summer called for rapid action if a good grass strike (from seed) was to be achieved. Faced with these factors, and following consultation with an instant turf manufacturer, I decided to use instant turf, in two forms, "rotten turf" and "instant turf" to restore the damaged areas. Both these products were available from the same supplier, Finelawn Instant Turf of Hamilton.

To my knowledge instant turf has not been used elsewhere for repairs on earthwork sites. The reconstruction work on the Monmouth redoubt at Tauranga is a notable exception, but here machine-cut turfs were stacked in layers to build up the walls, with not inconsiderable stability problems initially, rather than merely to re-establish grass cover. A large part of the problems at Monmouth

are attributable to the fact that the turf used for reconstructing the redoubt was obtained from sheep paddocks and redundant sports ground surfaces (Koopman pers.comm.). Although the latter is usually a very resilient grass, in this instance it had a very sandy crumbly matrix and tended to fall apart when it was handled and stacked during the reconstruction work. Furthermore, the job was done during the summer months, and despite the extensive use of soaker hoses, the application of plenty of liquid fertilizer, netting and tie-backs, some sections of the restored earthworks collapsed and had to be rebuilt, in some instances more than once. In summary, the only similarity with the Pirongia restoration work is that the turf used at both locations was cut using a turf cutting machine but the material used on the Monmouth redoubt was not purpose-grown instant turf with its associated properties, which are discussed further below.

THE METHOD, PROPERTIES AND SUITABILITY OF INSTANT TURF

From the outset of the Pirongia job, it was appreciated that the displaced material at the bottom of the three main ruts (marked on Fig.1) did not appear to contain enough deposit to backfill them. In other words, some fill would have to be brought from another location. With this in mind the following strategy was devised (depicted in Figs. 2-5):

1. Place short pieces of untreated planks across the two deep ruts and hold these in position with untreated wooden pegs (so that the timberwork will rot away reasonably rapidly).
2. Backfill each rut by shovelling the eroded material above the retaining planks and compacting it.
3. Top the ruts up with "rotten turf" and compact and smooth it, ready for overlaying rolls of instant turf.
4. Lay, cut and fit rolls of instant turf over the infilled ruts and secure the instant turf using popsicle sticks (which rapidly rot away).
5. Erect temporary fences around the repaired areas to enable the grass to get well established.

To understand the pros and cons of using instant turf for grassed earthworks restoration, it is necessary to have some knowledge of the product. If grown and laid properly, instant turf enables the establishment very rapidly of a high quality durable grass cover. The turf itself is usually grown on specialised turf farms and cut using turf cutting machines. Typically these produce lengths of turf measuring 7ft x 18ins (2.2m x 46cm); most of the turf

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Figure 2. View showing initial backfilling of the rut on the west wall of the Alexandra redoubt using displaced material. All the ruts were created by children sliding down the slopes.

cutting machines in New Zealand are of U.S. origin hence the imperial measurements) and handrolled into rolls weighing about 14kg each. Each roll is the equivalent of one square metre. The thickness of instant turf can be varied but typically the soil portion is 10-15mm thick.

A wide range and combination of grass species are used for the production of instant turf, depending on the location, its primary usages and the grower's preferences. In this case the product consists of a combination of Chewings, Red Fescue and Dwarf Rye grasses. The grass itself is planted very densely and is typically grown with high herbicide and fertilizer loadings. These



Figure 3. View showing the retaining boards in position and backfilling well underway using rotten turf (west side)

virtually negate weed growth, as well as promoting very efficient grass growth and a turf with a very dense root structure. Weed and pest control (especially grass grub) is also achieved by sterilizing the ground by injecting methyl bromide and similar chemicals prior to planting. Despite these interventions, the instant turf we acquired was teeming with earthworms suggesting it contained minimal residues of a harmful nature.

"Rotten turf" is not a recognised product. It simply comprises reject instant turf (ends of cutting runs, damp patches etc) which is scrapped into piles and allowed to decompose. Normally it is allowed to weather and compost for six-twelve months, then spread and tilled back into the paddocks prior to reseedling

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Figure 4. The upper part of the same rut after the rotten turf has been hand-tamped and a smooth surface created for overlying the instant turf.

for instant turf production. Based on the Finelawn manager's suggestion that rotten turf might be useful for filling the ruts, I inspected a few piles of the product. It was immediately apparent, but dependent on the degree of weathering, that rotten turf holds together well because of the dense root content, and appeared to have enough plasticity, tackiness and water retention capability so that it could be tamped into place and stay put. Another attraction was that the product (i.e. the rotten turf) was offered to us gratis and it could be loaded directly onto a trailer with a front end loader.

The three main ruts were backfilled with a combination of the original fill and the rotten turf, both products being hand kneaded, tramped, or tamped into



Figure 5. Rolls of instant turf being laid and cut to fit and secured in place using popsicle sticks (south side rut).

place with the back of a spade. The rotten turf compacted by at least one third of its volume when tamped into place. It proved easiest to handle and had the maximum adhesion when it was damp (i.e. when it was placed after or during rain showers). The untreated short-term retaining boards effectively held the fill on the steep slope but from hindsight longer pegs (up to 1m long) and wider boards would have sped up the process and generally made it easier. The untreated pegs and retaining planks were made from demolished pallets. Our experience would suggest it is probably easier to cut pieces of wood to the exact length required at the work site if possible.

Once the ruts were filled the surface was smoothed and rolls of instant turf

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laid and cut to fit if necessary. Although instant turf rolls like a carpet and tends to follow the contours it is critically important to avoid gaps between the bottom of the turf and the underlying ground surface if a good grass strike (without dead patches) is to be achieved. This is because grass roots tend to die back if exposed to air. The other major concern was the possibility that sections of instant turf might slip down the steep sides of the redoubt following their initial placement. This potential problem is resolved by a simple trick of the trade- viz. popsicle sticks which are poked (about 6-12 per roll of turf) through the grass and into the underlying surface. The popsicle sticks hold the turf in place on the steep slope until the roots are well established, and rapidly rot away thereafter. They also present no impediment to mowing.

The restoration crew had some difficulty at times in maintaining their footing on the steep slopes. On the second day of the job a step ladder was used. Laid directly on the work surface it proved a simple solution to this problem.

COMMENTS AND CONCLUSIONS

At this stage, about one month after the repairs (3 big ruts and a few small patches) were completed, the combination of rotten and instant turf appears to be working very well. The repairs are not starkly visually intrusive (Fig.) and within a few months are likely to be barely apparent on the surface. The method proved rapid (1.5 days work x 5 persons including hauling the materials to the site), efficient, and cost effective. The repairs cost less than \$200 in terms of materials (60 sq. m. of instant turf at c.\$3.00 sq.m. plus GST, a few packets of popsicle sticks, plus the labour, vehicle running costs, and some temporary fencing materials which can be used elsewhere later). Premium grade instant turf usually costs \$3.00-3.50 sq. metre plus GST; we opted for second grade material because we did not require perfect turf and it was also cheaper.

The job was done over 26-27 September 1994. A good grass strike using instant turf can be guaranteed in the Waikato so long as it is planted between autumn and early spring (Cap pers.comm.). Most years (but not 1994) rainfall drops off dramatically from late spring and over the summer months.

Potential users of instant turf should be aware that the product varies widely in quality depending on the supplier, the length of time it has been growing before it is sold, and how it is grown. Some instant turfs are notably inferior to others, often because they have been harvested too soon. So it pays to shop around if several suppliers are available. Furthermore users should be aware of two characteristics of the product related to its high fertilizer and to a lesser extent herbicide loading. These result in a grass which remains very green when it dries out, and strong weed resistance. These factors need to be

considered. In our case, the locations where the instant turf were used are at the back of the redoubt and out of sight to a large extent. The redoubt banks are fairly green and it is anticipated that bracken and gorse will gradually penetrate the instant turfed areas and gradually become indistinguishable from its surroundings. It is probably unsuitable for earthwork repairs in dry climate areas and in locations where grass grows poorly for other reasons. To ensure good even growth it is essential to infill potential voids under the turf mats and to lay the turf at the optimum time of year- during early spring.

Archaeologically the repaired areas should be readily distinguishable by their high soil content compared with the more clayey composition of the original walls.

One other matter is worth mentioning. One of the staff who was most involved in hand-tamping the rotten turf into the ruts during the repair work developed swollen knees and forearms following the work which lasted for a couple of days before settling down without medication. According to the manager of the company that supplied the instant turf there are no recognised health risks in directly handling instant turf (Cap pers.comm.). The National Poisons Centre in Dunedin was contacted and after consultation with the grower about the herbicides they used decided that it was very unlikely that the medical problem was due to chemical residues, but could not rule out natural soil bacteria as a causal factor. They suggested as an precautionary measure that anyone who is "hand-working" a large quantity of rotten turf, should avoid direct skin contact with it, i.e. wear gloves and other protective clothing.

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