Soil moisture expansion coefficients and Pukekura

I understand that the top 30 odd metres of soil in the greater New Plymouth area has its origin in a massive eruption of the mountain in which the cloud of ash had an extremely low content of clay particles.

Clay is a component of most soils. Its particles have the capacity to absorb and retain a high proportion of moisture with consequent expansion in volume creating pugginess. When the water is lost in dehydration the particles shrink resulting in cracks forming and the soil becoming very hard and unworkable.

New Plymouth soil is at the very lowest end of the scale. We can work our soils very soon after even heavy rainfall which has been an enormous bonus to agriculture and horticulture. But it is also of great consequence to civil engineers, particularly those involved in roading design and construction.

In June 1926 a group of gardeners either totally ignorant of moisture expansion coefficients or alternatively perhaps, well versed in their influence on local soil cleared away vegetation from sloping ground and dug away topsoil to form two level benches at different levels of the slope. The spoil was taken down to a lower area, probably by wheelbarrows and used to reclaim a swamp. They then proceeded to excavate three large pits, two in the upper level. Either daringly or with great wisdom they sculptured almost vertical walls to the pits, each of which was separated from its neighbour by several metres.

They then ventured into positive recklessness by connecting the pits with tunnels for which they had neither the skill nor the money to line with concrete.

The next step was suicidal madness, possibly spurred by the fact that no lives or even limbs had been lost in the escapade to date. They covered the three pits with conventional glasshouse roofing pitched from ground level but perhaps to save even more money or more likely to add authenticity, they used the felled trunks of large tree ferns for the uprights!

The outcome of this highly unorthodox venture is the famous Fernery at Pukekura Park which was officially opened to the public in January 1928. Its design and construction with ferns etc. thriving on almost vertical, but stable banks and its raw earth tunnels has confounded visiting engineers ever since. However in recent times they have at least not been obliged to grapple with the added logistics associated with walking under tons of glass propped up on tree fern trunks because these were replaced with ‘proper’ wooden uprights many years ago.
About fifty years later, another group of gardeners, bolstered with a landscaper undertook the realignment of a carriageway which began/ended very

inappropriately immediately opposite and close to the back door of a building of major importance.

A cutting was required through a knoll, the presence of which had been the reason for the deflection of the carriageway originally.

Growing on the knoll was a group of rimu (Dacrydium cuppessinum) with diameters in the 30cm range and heights of about 10 – 15m.

In order to attain minimum loss of trees in a very public and sensitive area it was calculated that a cutting with a cross-section profile of 2.6m wide at the base, 4m high and 3.5m wide across the top was the only option. It is 24m long. These figures mean that the south-facing edge is vertical and the north only a few degrees off vertical.

Some of the trees are within a metre of the edges of the cutting which has changed the knoll into an 'island' cut off from the high ridge by the sealed carriageway. However, despite the steepness of the banks the amount of material crumbling from them in the course of a year would probably be less than a barrowful.

This cutting is familiar as the lowermost section of the Racecourse Walk beside the Tea House. Together with the Fernery tunnels and banks it beggars description from civil engineers. These exploitations of unusual soil characteristics are unique to New Plymouth.

In reflecting on how the nature of local soil is so very extraordinary to the point that accepted engineering standards don't always apply, I recall having read that in applying the theoretical principles of aerodynamics to a bumblebee it is not possible for it to fly and when laden, certainly could not hover like a helicopter.

There is considerable evidence of steep bank stability in many places in New Plymouth, another being the terraces of the Sportsground and for this reason I am very surprised that the batters of the cuttings in the proposals for realigning the upper half of the access road between the Racecourse and the Bowl of Brooklands are so extravagant and therefore excessively destructive both of existing mature vegetation and critical water catchment areas for trees that would not be removed.

Surely there is enough practical evidence to conclude that design specifications that apply to cut and fill motorways being laid in areas where the soil has a high clay content are not relevant in this situation. High vertical banks immediately adjoin the existing road as a glaring example.

Compiled for FoPP by George Fuller May 2009