Easy Rider

the Case for Concrete Roads

The advantages of concrete pavements will continue to elude local communities while road funding criteria in New Zealand operate on a limited life basis. In this issue ***concrete*** updates the case for rigid pavements, and looks at examples of concrete and cement use in our roads.

Modern concrete technology is making rigid pavement the first choice in countries all around the world, and information continues to stack up in its favour. In New Zealand, though, concrete is generally restricted to high-strength roading components, such as roundabouts and intersections.

The facts. Research confirms concrete roads are:

- durable
- cost-competitive
- environmentally friendly.

Overseas data has demonstrated that concrete roads have a longer life span and lower maintenance costs than flexible pavement alternatives. Earlier this year, escalating petrol prices hit a record high and minor adjustments aside, things are predicted to stay that way for some time. Could the fact that vehicles driven on concrete roads use significantly less fuel encourage New Zealand's decision makers to look more closely at concrete roads?

Both local and international research has shown that the smooth, hard surface of concrete pavement reduces vehicle fuel consumption, perhaps by as much as 13% for heavy vehicles. Locally, Opus International Consultants and the Department of Mechanical Engineering at Canterbury University have established that the coarser the road surface, the more fuel used by cars. The conclusion: the coarse pavements of New Zealand's mainly chipseal roads carry a significant environmental, and increasingly financial, cost.

Safety First: the Case for Concrete

While there is plenty of technical data to back up these claims, some of the benefits of rigid pavement are quite simple. Concrete roads are safer. They're not subject to the wear-and-tear defects – rutting, cracking, stripping, loss of texture, and pot holes – that can occur with flexible pavement surfaces. Less maintenance also means fewer delays, a big advantage on some of our already congested highways. Improved visibility is another factor in reducing accidents – concrete pavements reflect up to six times as much light after dark as conventional bitumen-based surfaces.

If there are few examples in New Zealand of concrete's durability, overseas it is another story, one that's only getting better with age. There are now 200 kilometres of concrete highway in Washington State over 40 years old, which have carried traffic loads five times higher than originally anticipated. In California, where concrete has been used for roads and pavements for 90 years, a 50-year design life is the expected standard. Not only does this mean the cost of the road can be spread across a longer life (a conservative 40-years-plus vs asphalt's 10-14 years), but in that time costs and disruptions associated with maintenance are minimal. In Australia, for example, concrete roads built as long ago as 100 years are still in use and require little upkeep.

A strip of highway north of Sydney, which incorporates a number of different pavement types – continuously reinforced concrete with asphalt wearing course, plain concrete, macadam, and flexible – provides an interesting comparison of costs over its 30-year life. Highlights include the facts that asphalt pavements cost at least three times as much in regular maintenance as concrete pavements; asphalt pavements cost an additional A$36,000 per 10 kilometres every year in unprogrammed heavy patching; and, while initially 15% cheaper to build, asphalt will cost 230% more than concrete based on whole-of-life costing.

The Ideal Concrete Subject?

A case was made recently for the use of concrete pavement on the Albany to Puhoi motorway realignment in Auckland. A $145 million project, this seemed an ideal subject for concrete pavement: high traffic density, high forecast traffic growth and relatively weak subgrades. The analysis demonstrated the viability – depending on the formula used, maintenance costs of more than 55% less for plain concrete pavement and more than 80% less for continuously reinforced concrete pavement, for example. The benefits to individuals and society were outlined: reductions in fuel consumption, savings in vehicle operating costs, reductions in delays resulting from maintenance programmes, and reductions in CO_2 emissions. Yet despite these advantages, a flexible pavement was the final choice.

The detailed data generated by this exercise points to the issues that need to be addressed: roading assets need to be valued on the internationally favoured long-life pavement philosophy, and realistic discount rates adopted to allow different pavement types to be assessed equally.

In the interim, examples of concrete use in pavement in New Zealand remain scarce.

Cement Advantage

In-situ stabilisation, in which cement is used to add strength to pavement base courses, is, however, a widely used technique. This process, also known as pavement recycling, adds strength, improves durability and minimises the need for maintenance of all pavement surfaces. Growing heavy traffic volumes, tight budget constraints and environmental concerns mean use of this technique is likely to increase. The current situation in New Zealand and Australia (where finances generated by a bigger industry have brought investment in new machinery) is examined on page 16-17.

There is potential too to use concrete in the rehabilitation of asphalt roads. Deteriorated asphalt can be excavated and replaced with concrete inlays – this process has been successfully used in South Africa, where inlays 16 kilometres in length and four kilometres wide were poured. “Ultra-thin white topping” is another maintenance option, in which a thin layer of concrete is placed over a prepared surface of distressed asphalt. Generally suitable for residential or low traffic loads, the concrete topping layer – which has proven to be two or three times more durable than asphalt overlays – is generally placed over a substantial thickness of asphalt. Fast-tracking this process can achieve an opening time of under 24 hours.

A rare new strip of concrete road was, however, the choice for BHP’s Glenbrook steel mill. On page 16 Opus and Fulton Hogan outline their answer to a brief that specified a cost-competitive, no- or low-maintenance surface able to withstand the heavy demands of trucks laden with molten slag. The results speak for themselves.

The Fairfield bypass motorway, at present under construction near Dunedin, has a 225-metre-long section of concrete highway. The designer, Duffill Watts and King Ltd, was faced with the challenge of constructing a major highway over an area containing near-surface coal mine tunnels. The solution is a 200-millimetre thick concrete pavement supported on four longitudinal concrete beams. The road is akin to a bridge supported on the ground. Where the mine tunnels are very close to the surface, concrete piles are also utilised. Fulton Hogan has completed the construction using free screeding techniques. The surface has a broom finish transverse to the direction of traffic.

Long-held perceptions about concrete pavement – such as the “thump thump” noise factor as a vehicle crosses uneven slabs in an older concrete road, now eliminated thanks to advances in construction technology and material design (check out “whisper concrete”) – need to be challenged. The advantages aren’t just there for high-density, high-capital-investment projects in Europe; concrete is working all around the world, from South Africa to China to the United States. The Albany to Puhoi study demonstrated the high benefit/cost ratio possible, and shows it could be working for New Zealand too.

1. *Concrete Trends* September 2000

2. RTA [Road Transport Authority]of New South Wales study of the F3 Sydney to Newcastle Freeway

3. Case Study A, Albany to Puhoi Motorway Realignment, www.goldenbay.co.nz

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