

IMPRESSIONS OF ROADING IN NEW ZEALAND

Dr. William B. Stuart,
Senior Research Fellow,
F.R.I.,
ROTORUA.

I am going to do something this afternoon that is very unscientific. I am going to talk about the impressions that I have gained of road building in New Zealand without specific evidence or research finding to back these up. Consequently, these impressions should not be treated as fact or universal truths, and please don't interpret them as if I, or someone else from my region, could have done better. Sometimes it is most useful to have a person with a different perspective look at a local problem. I hope I am performing that function.

My exposure to roads and roading in New Zealand has come by way of a request from John Kennedy that I take a look at some roads with him. John was kind enough to extend an invitation for me to travel with him around the South Island. In addition to those visits, I have also tried to pay attention to roading during my visits in the Pumice Plateau, Mangatu, Ngaumu, Maramarua and Northland. Unfortunately, it is very difficult for a visitor with only a short time exposure to develop a sound understanding of everything that he has seen.

One thing that has to impress an outsider, whether he is driving across New Zealand or flying over it in an aeroplane, is how difficult some of the topography that you fellows have to deal with is. Anyone who has a serious interest in identifying a road building challenge can find it in New Zealand. As a matter of fact he can choose any challenge he desires as New Zealand has one each of about every type of road building problem a person could want.

The second thing that I have discovered in talking to foresters in New Zealand, is that opinions on road building are about like wives. Most foresters have one and are going to stick with it. The fellow who has two is getting confused and really can't decide which one he is going to favour. Those that don't have any are looking hard for one and if you come across the fellow who doesn't have one and is not looking for one, keep your eye on him. There is something strange about him.

Let's begin at the beginning. New Zealand has a great deal of potential for commercial forestry with radiata pine, and the intensive silviculture you are currently using to grow your crops. I think it is important that you recognise that radiata is not a miracle species. Even the growth rates that New Zealand experiences are not good enough to carry all of the costs a forester can think about piling on the stand during its development. In other words, if you get careless about costs there are any number of countries that can take away expected export markets.

Wood is sold on an international market that is highly price-conscious. In addition, it is a relatively undifferentiated product. This is particularly true of the softwood species. Most customers can work out a rationale for substituting spruce for Douglas fir, radiata for spruce, or southern yellow pine for radiata with reasonable facility. We are experiencing that problem in the Southern U.S. right now because the Canadians, for a variety of reasons, are able to sell a 2 x 4 eight foot long stud in Atlanta cheaper than local manufacturers can put a comparable stud on the market. The customer is fickle and he will take the best financial deal. Consequently New Zealand, because of its remote location and high shipping cost to international markets, must be particularly careful of its cost structures.

In my opinion roading, transportation and harvesting are going to remain major components in determining the price of a log at the mill gate. I am somewhat amused and bemused that we have one group concentrating on the silviculture of radiata pine and have developed a silvicultural model which carries pampering a pine tree to ultimate and economic analyses that justify this degree of silvicultural intensity. Tree harvesting as a service function which can be bought and controlled without regard to the location of that tree, the difficulties in transport to market, and the infrastructure supporting the forest operations. At the same time, there is another group spending a great deal of effort looking at how we are going to make things out of clear wood resulting from this silviculture intensity, and the appropriate manufacturing and marketing options, but are not considering the costs and complexities of harvesting and transport. Hopefully, someone somewhere is working on Star Trek level technology so that Captain Kirk can call out "Beam her down here Scotty, we need more logs at the mill".

Another impression that I have formed is that roading costs are too often treated as stand-alone items. In many instances they aren't planned, they just happen as a result of continual upgrading and maintenance of management roads. Management roads are initially installed for

site preparation and planting. The argument is put forward that you must build a reasonable quality road so that you can get a crew in for a short period of time without upsetting them. Then this road gets a couple of loads of gravel this year, a curve is straightened out next year, a dip is adjusted a few years later, a water bar is replaced by a culvert, and after thirty years of adjusting this management road you have a logging road. It is important to note that these adjustments are often made with the justification that they will be important and useful at the time of harvesting. Quite often people involved really haven't considered, or are unaware of, the particular needs of a logging road, and the location chosen for management may not serve harvesting particularly well. Regardless, you have got a road there now with so much invested in that it is difficult to convince management that a second road is needed to support harvesting operations.

The forester or ranger on one of the smaller forests may have developed a considerable body of knowledge on harvesting while logging the indigenous. This has been put on the shelf while he has been involved in planting pine trees, running pruning crews and conducting other silvicultural operations. His exposure in harvesting the exotics has been limited and his exposure to the harvesting equipment and techniques available at the time his patch will be harvested is even more constrained. Consequently, his thinking about harvesting reverts back to his indigenous experience. We need to get a road up through here so we can get a hauler out on that point, and the rest of the system evolves from there. No-one can really challenge his opinion that this is hauler country until it is too late.

Engineering expense quite often seem to be considered an expendable item which could be skipped to minimise the operating cost of a forest. I don't need to get those engineers out here. All I need to do is silver solder an Abney level to the hood of my T9 and turn my operator loose. "I have got me a good operator and he can put a road up that hill with no problem. All the engineers will do is get in his way".

I ran into one of these roads that was particularly interesting. The fellow I was travelling with was telling me that he didn't need to call the engineering group to get a road engineered up this slope. He had a tractor operator that could build any kind of road that he wanted, and it would be a good road.

We got half way up the hill and came around a very tight 180 degree turn. He points to a spot down in the bottom of a gully and said "that's where my hauler went rolling". I asked what happened. He

said "well, when a truck driver came around the curve with the hauler on board the wheel base was too long. The rear wheels dropped off the inside edge of the curve and the transporter tipped. The hauler rolled off and went down there. It took us several days to pull the hauler out and get it back on the truck". Trying to be sympathetic, I said "well, the road must have been slippery". He said, "no, the road was dry. The curve was just too tight." I didn't say much but came away feeling that the dozer operator he had was probably good for laying out vertical curves, but wasn't much on horizontal curves.

I came across another instance where the forester had an excellent experience with water tables. They were hanging up about two and a half feet in the air on both sides of the road, and water was running down through the gully between the water tables. I raised a question, "don't you think it would be to your advantage to form this road up and put in proper water tables to get good drainage?" He said, "no, we don't like deep water tables around here. That makes the truck drivers drive down the middle of the road. They're scared of them." I was left with the impression that if barging ever comes back into fashion, he has got a good canal there. I wouldn't call it a rut, but it looked like a grave with both ends knocked out. There was one good thing about it. The truckers weren't going to fall off into the water tables.

I also found that sometimes the relationship between construction and maintenance cost was difficult to derive. I saw a good many roads with fairly high cut banks and steep batter slopes. there had been a water table installed at the base of the batter slope, but the bank had slumped down blocking it. When a heavy rain hit, the water came rushing down the water table, hit the slumped batter slope took off at an angle across the road and went into the far ditch cutting a fairly deep channel across the road bed and carrying a fair amount of the road and metal into the valley below.

I raised the question, "Why didn't you lay that bank back at the angle of repose to avoid slumping?" The response was "Angle of what?" I figured I had lost on that question so I asked "Why didn't you put some grass on the bank to try and keep the run-off down and gain some bank stabilisation?" The answer was "Well I really don't like that grass because it gets in the water tables and clogs those water tables off." I went away thinking that if the grass could find the water table it was welcome to plug it.

I travelled to a forest where there has been a great deal of money available to prune and tend the tree crop but nearly every culvert encountered was lacking a culvert box and was plugged with rocks and earth

that had washed down from the water table. In most instances, it was obvious that the culverts had been placed in the appropriate location, because the water was washing a channel across the road fairly close to the culvert to get away. In asking why boxes hadn't been installed and the culverts hadn't been washed or dug-out, I got the answer that labour was scarce and expensive, and we would worry about those things another day.

To be perfectly honest, I have got to admit that I am having a little bit of fun here. I am exaggerating some just to make a point, and again I would like to emphasise that these problems are universal in forestry and not particularly unique to New Zealand.

Another area that intrigued me was that of protecting plant. I know all foresters really need a bulldozer. I was trained as a forester, many of my best friends are foresters and there is nothing that a forester loves better than a bulldozer. It comes with the territory. In many instances, particularly in the New Zealand Forest Service, capital allocation monies are such that if you ever act like you don't really need a bulldozer, or that you are not using a bulldozer, then it will be taken away. Taking the bulldozer away results in a serious drop in prestige. So you find jobs for the bulldozer, some that really need to be done and some that are really only questionable.

As a consequence, equipment tends to get used, whether or not it is the most appropriate equipment for the job, or whether the end product is as good as it really could be. It is apparent that there are many instances where roads have been constructed by side casting with a bulldozer when a more appropriate technology might have involved the use of hydraulic excavators, scrapers or even construction graders. As a consequence, the industry has ended up with a lot of roads that wind round and round the hill.

I used to drive a truck and I spent quite a while driving log trucks, dump trucks and long haul trucks, so I tend to look at roads a little bit different than your average forester. I think about how many times my foot is going to have to go up and down to shift gears and brake going up and down these grades. In the right topography, it is possible to build side-cast roads in and out of gullies at the appropriate spacing where you get the truck driver to think he is riding a bicycle because his feet and legs are in constant motion.

I am also impressed with the amount of loose metal on the surface of many of these roads. May be this has been reinforced because when I got here I bought a Commer van. For those of you who don't know these vehicles, the front end is narrower than the rear end.

Consequently, it is extremely difficult to get any two tyres on the same travel surface at the same time. If you want a real experience you want to try driving this vehicle on a gravel road after the gravel has migrated out of the travel path in the centre and on to the road edge. The driver always has the option of either getting one front wheel or both rear wheels on the travel path. He is constantly making decisions about which combination will give him the best control. On a recently graded county road with two inches of loose gravel, the van is essentially hydroplaning on ballbearings at a speed greater than 30 kilometres an hour. You aren't really driving the machine. You are herding it.

I had one experience riding with a local in a ute. I think it was a Toyota. I really couldn't tell because the name plate was on the dash and my hands were locked over it. We were coming down from a hauler site on one of these tight blind curves with the road outsloped for drainage to avoid the necessity of a water table, and the normal two inches of loose stones on the road. The driver was talking to me and was a little bit late in braking for the curve. As a consequence, we went sliding through it sideways with the front end pointed towards the cut bank and the tail end heading for Australia. Fortunately, he got control before the rear wheels went completely over the outslope. To hide my nervousness I hit him with a series of questions. "Why didn't you do a little compaction work here? Why is all this gravel necessary? Have you ever thought about super-elevating this curve? What about sight distance?"

He cast an evil eye on me and said "Son, we are not in the business of building motorways. What we are looking for is an economical way to get logs down off this here hill." All I could say was, "Well yes" and accept the argument, but in my heart I would loved to have had him in the seat of a Kenworth coming down over that grade with 30 tonne of logs on the back end, and having to lock up the brakes on that curve because the driver met a Peterbilt coming up the hill in the middle of the road. There would have been no argument. It would have been an efficient way to get logs off the hill. It would have been a fast trip down but they would have spent quite a bit of time picking up the pieces at the bottom.

What I am trying to point out is that there are considerations that should enter into strategies for minimising road building costs. It is possible to build an efficient road without building a motorway. A truck driver coming down over that grade, his gearbox locked up in grandpa and his brakes on hair-trigger while easing through that curve is not really being economical. The amount of money that it would have required to increase the radius of that curve and put a little super-elevation on it would probably

have been recovered many times over as the stand was harvested. If it is necessary to metal the road, fine. Then put a roller over it and compact that gravel down into the surface where it does something besides lubricate. The transport trucks will come down over there a little quicker and might even be able to squeeze in another load per day.

Now I realise in many New Zealand situations you are essentially renting trucks at the rate of hours per load, so you don't have to be really concerned about capital efficiency. However, I think if the economics of transport were more fully considered, some of these alternate strategies might look more promising.

One thing that occupies a scientist, or a supposed scientist, although I am not really certain that I am one, is trying to work out theories of how costs can be traded off. On another visit, I went out with a group that were very proud of their silviculture. They had planted, pruned, thinned to waste, re-pruned and so forth. They were pointing out to me that they were going to be growing 6 tonne trees. So we went out to look at this site and we turned off on to two miles of narrow gravel road lying on a constant 1 in 6 slope. This road seemed to climb on forever. I wondered if the good Lord knew we were coming and if he would recognise us when we got there.

After dodging in and out around rock outcroppings we finally got out at the top and got out of the truck to look around and I asked, "Well, how much do you think it is going to cost to get your road in here?" The answer was, "Oh, about \$100,000 per kilometre".

I asked, "For log trucks?" The fellow I was travelling with said, "No, no. We don't need to build that kind of a road up here for log trucks. We have to get the hauler up here. That is what it is going to take to build a road that we can get the hauler up on."

I asked, "Well, why do you need the hauler?"

He said, "Well, we are going to have these 6 tonne trees and it is going to take a big hauler to get a 6 tonne piece up the hill."

I asked, "Did you ever think of growing a 3 tonne tree that would only require a \$50,000 road and a smaller hauler?"

Well, as it turned out the silvicultural regime had been selected with only minimal consideration of the logging and roading cost associated with what was being produced in that particular location. The analyses were based on industry-wide and system-wide averages and no-one really asked the Logging Officer's opinion before

they proceeded with the silvicultural rotation. From a forest management standpoint the best solution was to grow as big a tree as possible.

In all too many instances, the jobs are so well segmented and communications are crossed, individual responsibilities are so poor that the full economic implications of any one decision are really not considered as fully as they should be. Perhaps the situation in New Zealand is unique enough that it will be possible to rewrite the book on timber production economics. That harvesting and transportation will only be a small share of the total cost of wood production. I expect however that it won't be all that different and that harvesting and transport costs, including roading, will comprise a major share of the cost of wood production. Economic analysis and future markets scenarios which ignore this very significant component can result in inappropriate solutions.

I poke a little fun at things and exaggerate a little bit, and try to make the story sound a little better on re-telling. Everybody I met in the field were good, hard-working, conscientious, concerned folk. They were trying to do their job as best they could. Sometimes because of their training, because of their experience and because of their past exposure, there were voids in their understanding of what the tasks at hand were, and what the long term implications of their application would be.

There is a story in the States about a newspaper man that went out to write a personal interest story on construction work. He got with the local job foreman on a construction job and asked the foreman if it was all right for him to walk around the site. He and the foreman set out together and the first man they met was welding girders together on the ground. The newspaper man says, "What are you doing?" The welder replied, "I'm welding girders". Walked on a little ways and met another one that was shovelling sand into a cement mixer. He said, "What are you doing?" The man replied, "I'm making cement, I'm mixing mortar". Finally, they climbed up on a scaffold and found a bricklayer happily working away, a smile on his face, and whistling a happy tune. The newspaper man said, "What are you doing?" The bricklayer replied, "I'm building a cathedral. Some day people will come in here and find peace. Their souls will sing. It will be a house of joy". The foreman looks at the bricklayer and says, "You're fired". The newspaper man says, "I don't understand. Why did you fire that guy?" He's happy, he's hardworking, he's really involved in his work, and he sees a purpose in it." The foreman replied "We're building a grocery store. If that fool had been able to read the blueprints like he said he could, he would have known what we were up to."

The point is that dedication to a job is often not enough. The individual involved needs to understand the full implications of his activities and be entrusted with sufficient power to allow him to change plans to suit those needs better.

In another one of my visits, I was riding in a truck along the top of a mountain, down a razorback ridge. There was nothing on either side but down, and lots of that. So there we were driving along this ridge top with 200 m of continuous slope lying on a 20° angle on both sides, and there was water laying in the road.

Again, demonstrating my ability to ask inane questions, I wanted to know why this road was right down the top of the ridge. Why wasn't it hung off to the north side a little bit so that you could get some proper drainage and sunlight in to dry it out. The response was that the individual who laid the road out had been told at the FTC to build roads along the top of the ridge, and he hit it dead centre. If the ridge went left, he went left, and if the ridge went right, he went right. There was probably no more than a three inch deviation from the centre line of that ridge all away along the road. The majority of information at hand was correct. From the silviculture, fire control and other aspects it was probably better to put the road on the top of the ridge, rather than hang it somewhere down on a side slope. This minimised construction cost and increased its utility. However, moving the road from dead centre and top of the ridge would have minimised the maintenance cost, improved the drainage and perhaps increased its utility for harvesting. In other words, instructions aren't all that they appear to be.

A few years ago, I read a quote by one of the fathers of American forestry. I believe it was Dr. Schenk, who in his retirement wrote a letter to friends that contained the statement "Roads, roads, roads, What is forestry but roads. If I had the tongue of angels I would sing nothing but roads, roads, roads." I believe the New Zealand experience indicates that Dr. Schenk was correct. Every forester has a need for a road. Since the establishment people get there first, their road becomes the basis of all others. This is then followed by silviculture's need for a road, fire-protection's need for a road and harvesting's need for a road. Certain trade-offs sound promising, such as incorporating roads and fire-breaks into one combined loss of growing space. But I think the forest manager needs to be given stronger criteria for evaluating whether incorporating these two together provides the best solution, especially when there appears to be a consideration for attempting to minimise certain non-economic measures such as the metres of road per hectare. If the manager is not careful, all his road-building budget can be consumed in fire-breaks. By looking at the criteria of metres

per road per hectare, he is not going to have any roading allotment left for logging.

It may not be bad to incorporate the two. But from an economic and operational standpoint, it may well be worthwhile to differentiate between a fire break and a road. Until the land manager has some method of an integrated analysis to determine which is the best economic alternative for him, the situation will be sub-optimised. One of the most crucial aspects in this is a lack of comparative data on alternative approaches or methods. There have not been enough studies documenting the advantages and disadvantages of alternate approaches. A great deal of information is passed by word of mouth, and like any good story the interpretation improves with the telling. Probably one of the most common expressions encountered in hearing somebody talk about another person's experience was "bloody disaster". I finally reached the conclusion that a bloody disaster is a road that is built in any manner other than the way the person describing the situation would have done it. There have been some bloody disasters. But there is also a good many roads which may appear a bloody disaster from one selected criteria, but which performs wonderfully well on the production side. Much of the forest management in New Zealand today is timber oriented, rather than operations oriented. The timber manager will only reluctantly surrender a square metre of potential growing space because that may reduce future crop production and revenues. Consequently, there is a great desire to see one road serve all needs. Again there is no method for evaluating the economic viability of multiple low standard roads throughout the forest.

Quite often people are given non-economic goals as a mean of simplifying their decision making task. Metres of road per hectare is what I consider a non-economic goal. It measures something, but nobody is certain what it actually measures. It does not necessarily measure average skidding distance, average seedling transport distance for planting, average ladder carrying distance for pruning, or any true operational measure. It is just a criteria that can be used to make certain that one forest doesn't get more roads than the other.

The concept of least cost trying, to find the point where the average cost per cubic metre for roading and inwoods transport is minimised, and using that as a criteria for establishing road spacing is also difficult to deal with. Most of the formulas for identifying this low cost point are useful only on large areas of flat ground that can be roaded in any direction with equal facility. But the use of the least cost criteria generally results in sub-optimisation of operations and a reduction in potential net profits. In other words, the idea of trying to minimise the cost per unit for each element as you go along, felling limbing, loading, road building and what have you, is not necessarily going to guarantee that the

operation will result in the maximum profit in the long run. In most instances, it won't and what happens is that each element in the chain is attempting to minimise their cost by passing the cost on to others.

Financial accountability needs to be guarded closely as well because the books do not necessarily tell the whole story. I had a friend who worked for one of the pulp and paper companies in the South East as road Construction Supervisor. Henry was somewhat lacking in formal education, but had developed a great deal of practical knowledge on how men, machines and large corporations run. Henry tended to direct his energies to make certain that the job at hand was completed. He came across the situation where he needed 5,000 tonne of gravel, or metal as you would call it. He went to the boss and he said I need 5,000 tonne of metal to get this job done. The boss said that that was too bad. The construction money had been spent and Henry would just have to delay the operation until next year. Well, Henry realised that the road was needed regardless of what the Board of Directors and the bright young accountant in the Head Office felt. So he stood outside for a while and went back in and asked the boss if it was okay if he took a trip to visit some of his compatriots further south. The boss said yes, that is fine. There is plenty of travel money this year and you might as well take advantage of it. Henry said that was fine, walked out of the office, picked up the telephone, called the gravel supplier and ordered his 5,000 tonne. The next expense account from Henry that came in had three meals, a new tyre for his pick up truck and 5,000 tonne of gravel on it. As it turned out Henry had accomplished two good things. He got his gravel and got it in place, making certain that it was spread before he turned his expense account in. The second thing was that after all the manoeuvring that had gone on to justify that travel expense report, the travel allowance for the whole Woodlands Section went up the next year, because they had done such a good job of using their current year's budget. The boss had little difficulty explaining how a section of the company as small as his could have spent that much money on travelling, and assuring corporate administration that there were no inappropriate actions taking place. Everyone who was involved recognised what had happened that year, but without a doubtsomeone checking historical cost who lacked full knowledge of the folk lore associated with those costs, won't be able to reconstruct the same saga.

There has probably not been an accounting system constructed that motivated intelligent people cannot find some way to subvert, either knowingly or unknowingly. To get good cost and production control the man in the field must view the record keeping system as having an important functional role for him as well as for the bean counter in the Head Office.

A little while ago Peter Farley raised the question of how much research that has been done overseas could be transferred into New Zealand. I think this question has to be addressed very carefully. The amount that could be picked up today, put in practice tomorrow with a guarantee of success is probably very small. There may be some elements that are based on similar topography which could have direct application. But I think from most of the research should be brought to New Zealand and tested and verified for local applications. You can't for example, say what the exact advantages gained from road building with an excavator and end hauling with dump trucks will be in New Zealand based upon what they were in British Columbia. The problem will probably have to be addressed in two steps. The first is identifying the probability of the advantages gained in British Columbia being achievable in New Zealand, and the second, what problems unique or indigenous to New Zealand might increase or decrease the impact of those advantages. After that analysis is completed, trials should be conducted to test if the initial hypothesis was correct. In other words, these off-shore research findings can serve as guidelines to selecting those approaches which have the greatest promise for New Zealand, and as a guide for undertaking local projects to determine if that promise can be realised.

Given the increase in demand for timber production scheduled to occur over the next 10 to 15 years, there is a whole range of research activities that need to be undertaken in the New Zealand environment. These range cross a continuum with economic studies at one end and detailed engineering studies on the other. From the economic model standpoint, there is a great deal that can be done towards defining what the economic expectation of our undertakings are, and how the benefits of a particular treatment, whether design, construction, maintenance, production or road retirement will be realised. There is a need for analysis techniques that will result in assessments of maximum profitability from forest production focusing on silviculture, harvesting, transport and marketing can mesh together most effectively.

In the mid-range there is a need for reasearch in the operational aspects. What is the best means of road formation, compaction, pavement selection, pavement depth for each of the individual soil types and soil problems that could be encountered in New Zealand. At the far end are design questions, including but not limited to adjusting harvesting operations to minimise E.D.A. requirements, advantages of one-way versus return travel roads, cut bank design and stabilisation for individual soil types, alternative pavement materials, the differences in design for off-road versus over the highway vehicles, and a range of other problem areas.

There is a whole range of research activities here that could keep several organisations within New Zealand very busy for a long time. This group needs to identify which of these are major areas to concentrate on, and how does research get started across each of the areas in the continuum. What benefits can be derived for the forest and adjacent land owners, and what are the best construction and maintenance techniques given the equipment and manpower spread available on an individual forest? the problem appears to be so large that there is really no lack of opportunity or need. I think all of us are in a position of being unable to select a proper beginning point. When you are caught in a whirlpool you really don't worry about where the water came from.

Listening to discussions leading up to this meeting, I am reminded of a couple of old saws (men) that used to circulate around the logging community in the States. One states "Building a good road is a one time thing - but you build a bad road every spring". This is a fairly common plea in the northern areas where roads go through a serious breakup problem as the frost is drawn out each year.

The second one says, "You pay only once to build a proper road, but you buy a bad one with every load". The idea behind both of these very simple statements is that proper roading at the start can save a great deal of money in both maintenance and operating costs.

Gentlemen, I have appreciated this opportunity to talk with you today. I would like to say that I really enjoyed my experiences in New Zealand and have appreciated the opportunity to see just how common our problems are. I hope I didn't hurt anyone's feelings. That wasn't my intention, and I say that I respect you because you have got a whale of a challenge ahead of you, and having seen Kiwi ingenuity in action I know that you will rise to the occasion. Thank you.

