ENGINEERING ASPECTS THAT LIMIT THE ECONOMICS OF THINNING

A Panel and Discussion

Chairman: C. H. BROWN, with O. A. BOYD, M. C. GOUDIE, J. J. K. SPIERS and R. WREN

The following is an abridged discussion of questions put to the panel on 19 May 1967, and transcribed subsequently by F. J. N. Williams.

Brown: The main problems for thinning as compared with clear-felling are (1) Small piece size, (2) Restricted movement, and (3) The care which must be taken of the trees that are to remain.

Traditionally, thinning has been carried out with animals, either oxen or horses. In the last ten years or so the art of the horseman has vanished as we have turned to machines. In addition, wages have risen and the need to obtain a greater output per man has become urgent. It can generally be taken that the cost of thinning is almost double that of clearfelling. Either we must accept a lower stumpage and hope to recover it in the improvement of the final crop or we must convert thinnings to a high-grade item—as where one is fortunate enough to have a post and pole market.

The first prepared question, which I will toss to Owen Boyd, is: “What aspects of a stand do you think most important in planning a thinning operation?”

Boyd: I think the first thing you must consider in any stand you are going to log is the topography. It has the greatest effect on logging. Secondly, you must see what roaing access you already have to the area, as it may affect the method of extraction. The two other important things to consider are the piece size and the volume per acre.

Wren: I would agree with Owen generally, except that I would change his ranking—putting piece size first, as the most important part of a thinning operation, topography second and distance of haul third. Any changes in these three have the greatest effect on costs.

Spiers: I think that you have got to consider the silvicultural prescription you are working to, particularly the number of stems per acre that are going to be left. In the area of radiata we saw at Whaka Forest yesterday, the steep conditions would give you no show of leaving 150 stems per acre if tractors were to be used, whereas you would be able to leave 70 stems per acre.

Goudie: In our situation I would say that stem size is the most important aspect. It affects the method, whether billet or clearing. The next most important is prescription, particularly the method that has been allowed for extraction. Topography, volume per acre and residual crop are also important.

Allison: Without doubt the most important consideration in the planning of thinning is to have a look at the market.
Wren: I don’t think you would be thinning, Brian, unless you had a market!

Spiers: We were considering the aspects of the stand and I think the three things we have to consider are the tactical plan, the economic situation, which includes the market, and the silvicultural requirements.

Chavasse: Does the panel think that the silviculturist and the engineer should get together very early in the piece to map out the silvicultural regime of the stand.

Goudie: Yes, I agree wholeheartedly with this concept. I think that the planning of the thinning operation can benefit both the silviculturist and the logger if they get together. There is quite a lot of give and take. If either viewpoint dominates, it will usually react adversely on the whole operation.

Spiers: I disagree with this. I think that you cannot go running to particular specialists to do every part of the job. It is the job of the forest manager to be able to plan all parts of his job. Obviously the background of some of our foresters is not good enough.

Grayburn: I am rather amused at Jim. He began by saying that silvicultural prescription is most important and he immediately changed foot and said that you could not leave 150 stems per acre, you could only leave 80 or 90 stems per acre!

Swale: Surely the job of the manager is to call upon these specialists? Is not this management?

Brown: I think we will leave this question here—we seem to be getting away from engineering.

The next question, which Ron is going to introduce for us, is: “What is the smallest piece size that can be handled in a thinning and, more important, how would you handle it?”

Wren: I think the smallest piece size you can handle in the forest depends very much on the conversion factor of the equipment in the mill. For example, we have a mill which takes logs up to 22 in. in diameter. Through the barking drum also go the first thinnings from our second-rotation crop; but, because of the large capacity of the barking drum, the minimum piece size is limited to 4 in. I think that if we were chipping in the forest we could probably go down to three, maybe even to two inches. This is merely because of the conversion equipment in the mill—it has nothing whatever to do with the harvesting system in the bush.

Goudie: I think that piece size is determined to some extent by silvicultural considerations. In our situation we must handle an average piece size of three cubic feet. The other important consideration is the distribution of diameter classes. This can affect the cutting costs considerably. In our situation, we find that for the very small sizes cutting and piling at the stump is the most economical method.
**Boyd:** I consider that what you are getting for your product will affect what size you bring out. For instance, if you are faced with thinning stands on very difficult country, you might do it very profitably if posts were extracted, but what you would get for that same material as pulp could well make the operation run at a loss.

**Brown:** We have not yet discussed the means of handling small piece sizes.

**Spiers:** I was just about to add my bit to the other one. I think that the minimum practical size for most operations in New Zealand would be about one cubic foot. The most important thing in handling small pieces is to try to aggregate them as quickly as possible, so that you can handle with bigger machines. The bigger the load you can take, the more economic handling becomes—so small piece sizes (i.e., posts or pulpwood) must be bundled as quickly as possible. I think the earthmoving industry proved to us without doubt that big machines moving big loads do it more cheaply than any other method.

**Goudie:** In our situation we billet and pile; but it is also important that the manual effort in building the pile should be kept to a minimum. The average piecework cutter can walk many miles per day unnecessarily in building oversized units. I agree with the use of large equipment.

**Essex:** Heavy equipment is fine for clearfelling, but in a thinning operation it causes unacceptable root damage to the final crop.

**O'Neill:** What is the panel's suggestion for handling small forest produce from a small forest? This is the kind of problem most of us have to face.

**Barr:** I think New Zealand forestry suffers from delusions of grandeur. As one overseas forester pointed out to me, we go over to the west coast of America where they have good stumpages and can afford these machines. We come back with all the expensive equipment to handle "knotty cored punk". (Maybe it is not punk but the stumpages would give you that impression.) I was very impressed with the Australian approach—the smaller the track they can put a machine on, the better they are pleased. Kerruish in Canberra could well come over here and give us a course on how to get small logs out of small forests cheaply and make a profit. I do not know if any of you in this room use your own money to do this? My banker would be on my back very smartly if I was not making a profit out of anything I did with trees. We must get down off our high horses and down to plain economics.

**Brown:** I have not finished with you yet. You have been destructive, so I now want some constructive ideas on how you would yourself go about thinning.

**Barr:** The rubber-tyred tractor is the answer... although I wish I had a horse. There are plenty of cheap, serviceable tractors on farms, so why not use them. Small rubber-tyred tractors with a four-wheel drive are relatively cheap today. Also the more we can contour road to get the small produce out the better; but this is dependent upon better prices for our products.

**Bowers:** What would you define as a large machine? Surely it depends upon the age at which you are thinning and the size of
the material you are taking out. A large machine for one operation could be a small machine for another operation.

 Spiers: I will not answer that question immediately, as I would like to answer Neill Barr first. I do not think he has really absorbed what we are saying, even though he has practised it himself. The point is that you must assess the situation in terms of market, material at hand, and the amount of produce. Obviously, it would be idiotic to take a large machine into a woodlot of two acres to get a farmer several posts. If the production is small, obviously you have got to limit yourself to the smallest machine. Possibly the most efficient way of handling small material over a short distance is by hand.

 Grayburn: I believe there is absolutely no difference in the type of equipment you use in the very large forest or in the very small forest. The only difference is in the amount of this equipment you should use.

 Boyd: If I were in a small forest doing an operation involving 200 or 300 posts per day . . . , I would put horses on to it. Otherwise, like Mr Barr, I would use a farm tractor.

 Brown: We really must leave this one here and get on to the rest of the questions. The third question is: “What is the best equipment now available for thinning?” I will ask Murray to introduce it.

 Goudie: Here again we must consider the size of operation and stem size. My comments will relate to a reasonably large scale operation and fairly small stem sizes. At present our feeling is that the small rubber-tyred tractor is well suited to a small-scale operation on moderate terrain. The rubber-tyred, four-wheel-drive skidder has a phenomenal potential. We have several of these on our thinning operations and they are fast, reliable, and do not damage the soil—provided they do not carry too heavy a load. They have allowed us to open up our road spacing to about twice what it was with crawlers. In moderate terrain I would favour the agricultural tractor for the smaller operation and the rubber-tyred skidder for the larger scale operation, preferably carrying bundles and equipped with a loading boom—so that you could pick up the material at the stump, transport it to the roadside and load it into pallets or on to trucks in one operation. We have tried this method successfully and it is the most efficient one in a larger scale operation.

 Brown: Something which we have not discussed is the steeper country—on which the rubber-tyred vehicles do not work well. Could you comment on that, Jim?

 Spiers: Much of the steeper land planted in this country cannot be tackled with tractors, and I feel we will have to use light mobile haulers.

 Brown: Perhaps we could have the next question now, and then throw them both open to the audience. Jim, “Along what lines do you think equipment could be developed?”
Spiers: As I mentioned, light mobile haulers will be important in handling steep country. The method of operating these will, of course, be quite different from the traditional type of hauler used for clear-felling. The other important thing we should give some attention to is mechanization of limbing. At present on Kaingaroa up to 30% of our manpower is used for this.

Wren: As a very brief answer, I would like to see someone develop a crawler tractor to fit our bush operations, and not keep trying to sell us adapted road machines. There is much improvement possible for crawlers, along the lines of current development with rubber-tyred equipment. I envisage a four-tracked crawler unit, articulated in the middle, with a very low centre of gravity, that could efficiently work at least the lower hauler slopes. I think that, if we had this, we could work these areas much more easily and efficiently than with haulers.

Mills: Surely the practical solution is to keep to the crawler tractor with a double drum winch and work on contour roads. I appreciate that some trees will still be destroyed, but I think this is the ultimate answer: Many of the roads will be used in the final harvesting. In very bad country, siting the haulers is still going to be a real problem.

Skudder: If you strike rock, of course, you cannot contour-track—and rock is often associated with the steeper slopes. Slopes above 25° are fairly difficult to contour.

Bunn: I would like to ask Mr Goudie whether he can envisage the contour tracking done for site preparation being used for thinning; and, is the interval between contour tracks ideal for this purpose?

Goudie: We have considered this. The portable skyline has potential but is suitable only for short hauls. We hope to try to use the existing contour lines, which are planted initially, by removing the stems at the first thinning and possibly using a light skyline for extraction on every second contour. This is not applicable to more than half our areas because rocky areas preclude the use of contouring.

Mitchell stated that the Tarawera alley was, because of its soil and topography, an example of country unsuitable for contour tracking.

Brown: I should like Owen Boyd to comment on the next question: "Is loading equipment designed to handle clearfelling equally as satisfactory for thinnings?"

Boyd: Basically, no!—but it depends again upon the scale of the thinning operation. In clearfelling the loader is often the factor limiting production, but one thinning gang will not keep a large loader going. If you are handling small piece sizes in small volumes, I think you have got to have some type of loading attachment on whatever extraction unit is being used. In a large-scale operation with long lengths and large volumes (around two million cubic feet per year) the similar type of loader is mounted on a truck.
Olsen: The hydraulic extensible boom seems to have opened up a possibility of much smaller capital investment in loading equipment, and greater flexibility in piece size. There is a wide range of these and it seems to me that there is now a better future for smaller operations.

Wren: It depends upon the size of the operation and wood volume flow. This type of equipment is limited in its capacity. We have found that grapple units on front-end loaders have far greater capacity. Extensible boom units do have their uses however—this might be the type of equipment Mick O'Neill is looking for, to use with horse extraction.

Boyd: There is just one point to remember. If the loader is mounted on a truck, its weight is just so much less wood that can be carried on public highways.

Olsen: It does not necessarily have to be attached to the truck. A further advantage at present is that in contract operations the logger is also the loader. They can also handle considerable variation of piece size—which is one of the difficult problems in designing inexpensive equipment.

Spiers: This lighter hydraulic equipment is probably the best type for smaller operations such as contracting and farm forestry. The Swedish logging industry is primarily based on such loading equipment, mounted on trucks.

Brown: Would it be true to say, Jim, that the weight of the equipment does not matter as long as you have a short haul?

Spiers: Yes.

Swale: This might again depend upon the size of the operation. One suggestion we have had is that it be mounted on a second-hand Landrover, and perhaps used to serve several thinning gangs.

Spiers: This has been done, but not particularly successfully, in Nelson. It is very hard to achieve stability for any load over 10 to 12 cubic feet.

Weatherhead: These problems are fairly hard to overcome and in overcoming them the machine becomes rather more expensive.

McKee: In Sweden this type of equipment can be seen everywhere. It is mounted on a trolley on to which the truck backs, and then attaches its power take-off. They are used to load several trailers and the truck and then detached.

Fitzgerald: We have spoken a good deal about piece size being a factor but another is the range of piece size. Perhaps it is the largest piece size that dictates what will be needed to handle the job?

Olsen: The Hyab is capable of handling a large piece size and a large volume per day. For example, the largest radiata log felled in Whaka Forest of recent years was 44 ft long and 22 in. small end diameter. It was loaded out by this machine in 16 ft lengths.
Bunn: Surely choice of loader is to some extent determined by whether you are logging in long or short lengths. Under what conditions is short-length extraction preferable to long-length extraction?

Wren: This is determined by the volume available. For example, in the first thinning of the second rotation we have available some 1,700 cu. ft per acre. A good part of this is in small diameter classes, between 4 and 6 inches. If you cut them into short lengths they can be more easily extracted. Moreover, a large proportion of small diameter wood fed into the mill in long lengths will effectively decrease the volume flow to the barking drum. With short lengths this can be bypassed by feeding direct to the barking drum. We would not consider handling as short lengths piece sizes over 8½ cu. ft, such as we get in second thinnings. It then becomes more economic to handle in long lengths and all our equipment is geared for this.

Brown: We had better pass on now to the subject of roading for thinning: "The intensity of roading theoretically equates logging costs with roading costs so that both are at a minimum. What effect has machinery developed in the last ten years had on the intensity of roading for thinning?" I am going to ask Jim Spiers to introduce this.

Spiers: Probably the most significant machine developed in the last ten years has been the rubber-tyred, integral-arch tractor, designed for logging. Because this equipment is theoretically faster we should be able to space roads wider apart. This is possible where the machine can be used under the right conditions; but often it has been impossible to make tracks sufficiently good for it to operate at optimum speed.

Goudie: Our operations produce about 800 cu. ft per acre at first thinning and as little as 300 cu. ft per acre at second thinning. We have found that articulated rubber-tyred vehicles enable us to road at half the original intensity without increasing extraction costs.

Brown: What was your previous method of thinning?

Goudie: Crane trucks, carrying bundles on a boom behind them. They were limited to a 10 chain extraction distance, whereas we can now go up to 30 chains.

Olsen: I think we have been dodging the question of access within the stand. The rubber-tyred vehicle is limited by stumps. In the pumice country we have been able to road relatively intensively because we have not had the cost of carting in metal. If we can get the stumps out, we enable a cheap tractor to run fast. Does this not change the whole concept of extraction?

Boyd: Murray was speaking of operations involving very small volumes per acre. We have the other extreme at Kaingaroa where the thinnings are often delayed and volumes are 6,000 cu. ft per acre or more. We have found that there is not a great deal of difference between a Timberjack and an HD6 tractor, though the
latter will pull more and the former is faster on the return leg. This is only the situation in Kaingaroa and would not apply in any young forest. Travel is but a small item in the total time for turn around.

Olsen: How about planting at a spacing that provides good access for rubber-tyred vehicles? This is bound to affect the cost and intensity of roading required.

McKee: Yes. I think this is coming throughout North America. I appreciate the difficulties in these very dense stands, but I do not think they will be general. What effect does a 30 chain haul have on your overall logging costs?

Goudie: As Owen mentioned, under good conditions the actual running time of the machines is a very small part of the extraction cycle and I do not think it would reduce our costs significantly. The average distance of haul is actually 15 chains.

McKee: In a pre-logging operation in rough country using 5 Tree Farmers or Timberjacks, it was found that 20 chains was about the economic limit.

Spiers: In America they classify two types of operation. In a “hot logging” operation each tree is prepared and almost immediately skidded. This demands synchronization between bushmen and the man on the tractor. Quite often the bushmen are the limiting factor in the cycle. The other and more widely used type is the “cold decking” operation, in which loads are prepared beforehand. This means that the tractor is independent of the men in the bush and can be used more efficiently and over longer distances.

Brown: The next question is: “Does the quality of a road for thinning have to be as good as one for clearfelling?” Would you comment, Owen?

Boyd: Again, it depends on how much you are going to haul over the road. If it is a small-scale or “oncer” operation, you should not invest too much capital; but if it is a large-scale operation, such as is common here, the quality must be as high as for clearfelling. You are using the same type of truck, carrying the same loads, and you will expect to use the same road for a later thinning or for clearfelling.

McKee: Our truck today seem to be getting bigger. Thus, roads must be of better quality than when we were using 5 or 6 ton trucks.

Allison: It is very easy to lose, as roads, land that would grow more wood. I think we ought to be developing our rubber-tyred tractors so that we can use the same machine to extract a load, change into high gear and go for a mile or two to a good road where you have a big truck.

McKee: For first and second thinnings we could develop the Tree Farmer or Timberjack type of rubber-tyred equipment pulling to a skid track or to a larger rubber-tyred tractor. This could receive loads from four or five such machines and then itself run another half-mile or so to a proper road.
Brown: I will ask Owen again: “How does roading layout for thinning differ from that for clearfelling?”

Boyd: It depends on the country. On flat, easy country there is not a great deal of difference, but on steep country it can be entirely different. Normally in clearfelling you are using the ridge tops, but if a gravity method of extraction is used for thinning the roads must be at the bottom of the slope. This is the major difference.

Wendelken: What is the “gravity method” for getting the logs to the bottom of the slope?

Boyd: Anything you like—manpower, horses or tractors.

Allison: Are we to road specially for thinning?

Boyd: On hauler country how do you propose to bring the thinning up the slope?

Allison: How do you justify thinning if a special road system is needed for it?

Boyd: Again this would depend on the volume per acre to be extracted?

Brown: This is probably quite a hot question—Have you found that contractors make more successful thinnings than company crews, Murray?

Goudie: Our operations are based on a system of contracting that has many advantages to us because of the scattered nature of our operations. Fundamentally, the contract system provides the incentive for the bush logger to get the high outputs necessary in this sort of operation. The difference is quite remarkable. However, I will qualify this. The average contractor is intent on making a few bob and often goes about it in a way that anyone with the time and money to experiment would disagree with. A small company operation by an expert crew should be available to develop methods, to demonstrate equipment, and to accumulate the detailed time study information for rate setting.

Mills: I think we have a double problem. The contractor is naturally looking for a profit margin; but surely any study of methods also builds up costs.

Goudie: Most contractors show an amazing ability to get the job done at a minimum cost. In our experience, company crews just cannot compete. Where you have a complex operation, such as thinning or logging, there is need to provide an advisory service and also to have a basis on which fair and reasonable rates are set.