LOGGING INDUSTRY RESEARCH ASSOCIATION
NEW ZEALAND

REVISED TECHNICAL RELEASE

ISSN 0111-4743

Vol. 6 No. 3 1984

WEIGHT/VOLUME CONVERSION FACTORS FOR LOGS

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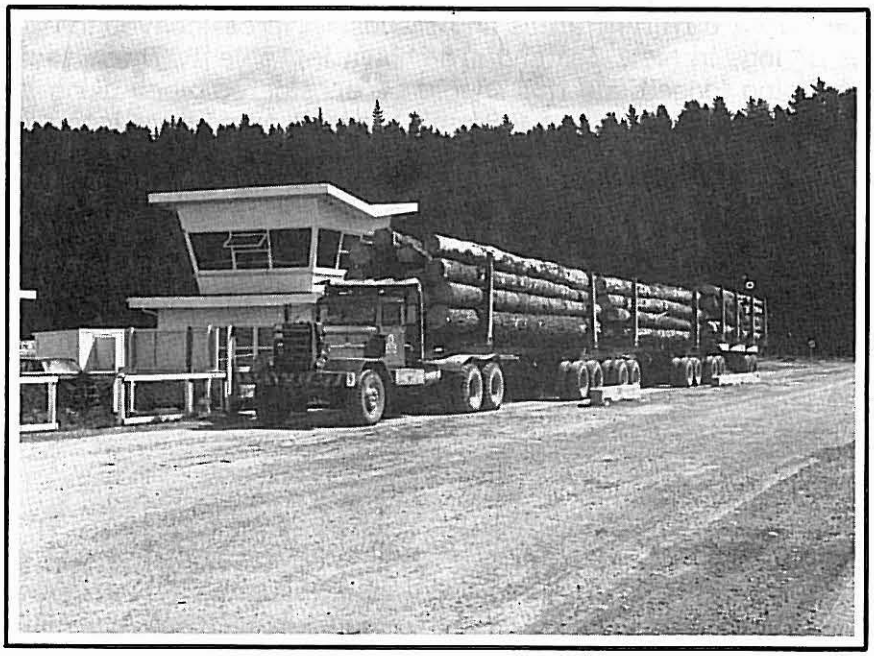

Fig. 1 - Sample load being weighed

INTRODUCTION

Weighing as a method of measuring log outturn from exotic forests has been used in New Zealand since 1967. This method is now widely accepted by the industry and is used for payment to logging and cartage contractors.

Where wood is sold by volume and measured by weight, conversion factors (m3/tonne) are used to estimate the volume of wood from the weight of wood and bark. The nett weight is found by weighing loaded trucks at weighbridges and deducting the tare weight of vehicles from the gross weight.

The main source of error with weight scaling is in the derivation of the conversion factor. This is generally based on sample loads of logs which have their volume and weight accurately measured at frequent intervals.

ACKNOWLEDGEMENT

The data base used for this report was collected and supplied by N.Z. Forest Service Conservancy staff. It has been assembled and analysed with the assistance of A. Gordon, J. Penman and L. Wybourne of the Forest Research Institute.

VARIATION IN CONVERSION FACTORS

Variation in factors is largely due to varying amounts of moisture contained in the wood. As a conversion factor is mainly used for payment of sales of logs and recording of yield from a stand, any variation will affect these estimates. The variation is demonstrated by the difficulty that logging truck operators have in obtaining the optimum payload. As a result, overloading and under-loading are frequent.

These differences may be caused by the following :

- tree species
- age of stand
- season
- basic density
- log size
- position of log in tree
- bark (removal)
- time since felling and trimming
- tree health and position in stand
- windthrow and salvage logging

In practice, the accuracy of conversion factors is increased by having separate factors for each species. For major species, factors may be determined for individual customers with factors based on samples from different areas and stands. Typical conversion factors for the main species of logs in New Zealand are shown in Table 1. These factors reflect the age of the stands being logged and this should be considered when using any factors. For radiata pine, a conversion factor of 0.96 m3/tonne is a realistic long term national average. The magnitude of the differences in conversion factors between regions for radiata pine and other species are also shown.

TABLE 1 - AVERAGE WEIGHT-TO-VOLUME CONVERSION FACTORS FOR NEW ZEALAND - 1978-1982

(in m3/tonne)

Species	Auckland	Rotorua	Nelson	Canterbury	Westland	Southland	Combined
Radiata pine	0.959	1.013	0.933	1.030	0.858	0.932	0.959
Douglas fir		1.111	1.203	1.210		1.177	1.127
Corsican pine	0.857	0.885	0.924	0.913	0.769	0.872	0.884
Austrian pine				0.911			0.911
Ponderosa pine		0.887		0.937	0.937		0.901
Larch		1.022		1.131		1.079	1.046

Note - The factors above are weighted averages

Age of Stand

The amount of heartwood (or drywood) in a tree increases with age. Consequently, a given section of tree stem becomes less dense and conversion factor increases. Conversion factors in radiata pine change about 1% for every $2\frac{1}{2}$ year's change in stand age.

Season

In winter, logs are heavier than for the same volume in summer, so conversion factors are lower. This is due to more water contained in the bark, reduced drying rates, and mud on the bark. The difference between summer and winter factors in radiata pine is approximately 4%. In Fig. 2 below, it can be seen that the lowest factors are in June/July/August and the highest factors are in November/January/February. The high factors in October/November are caused by the spring flush when the bark peels away from the logs during extraction.

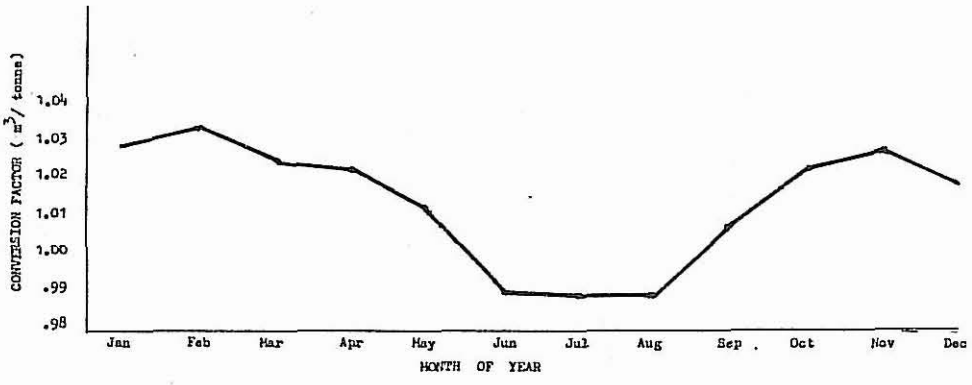

Fig. 2 - Seasonal change in radiata pine conversion factors in Rotorua Conservancy

F.R.I. results indicate that the seasonal variation in conversion factors for radiata pine is about half that of Douglas fir. This is because the thick bark on the lower stem of Douglas fir gains and holds more moisture than radiata pine.

Basic density

There can be up to a 20% difference in density between neighbouring trees in the same stand. At least six sample loads of radiata pine are necessary to estimate a mean conversion factor for a single stand within 5% confidence limits. To estimate a factor within 3% confidence limits, about ten sample loads would be required.

Log size

The size of logs from an individual stand can also affect the conversion factor. A truck load of small logs will have a lower conversion factor than a load of large logs. This is due of the difference in age between butt logs and logs from the top of the same tree. There can be a 10% increase in conversion factor between logs where the average piece size is doubled.

Time since felling and trimming

Logs do lose some moisture from their ends, but little other moisture is lost until bark is removed. The combination of losing bark and wood drying is in the order of 10% loss in weight over a six week period in summer. Thus, conversion factors can be higher for stockpiled logs than for fresh logs.

Tree location in stand

Trees with green crowns which extend to the ground, such as edge trees, have lower conversion factors than spindly suppressed trees with small tops.

Windthrow and salvage logging

Salvage logging after windthrow produces logs in many different conditions. Some logs have bark stripped by falling trees during the gale and bark is frequently lost during extraction. F.R.I. figures show that variation in conversion factors increases threefold during salvage logging. Added to this variation is the gradual change in material removed from windthrown stands. As logging progresses, wet dead material may be left behind because of the incidence of sapstain and other fungi. Towards the end of the salvage, only green wood and sound deadwood are removed, giving an apparent increase in conversion factor. Another contributing factor is time elapsed and resulting drying.

Fig. 3 - Measurement of sample load to obtain volume

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