LOGGING INDUSTRY RESEARCH ASSOCIATION
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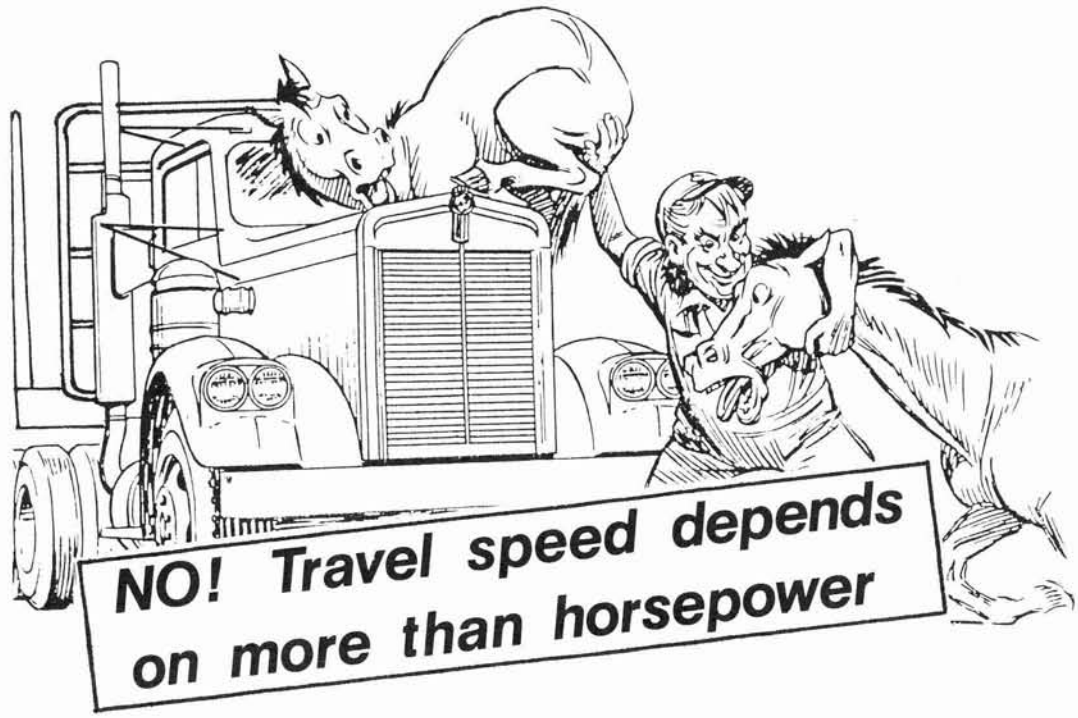
FACTORS AFFECTING LOG TRUCK TRAVEL SPEED



In a typical log truck operation 60% to 80% of a truck's in-shift time is spent travelling. Transporting loads is the primary function of a log truck and thus travel speed is one of the key factors affecting productivity.

This report summarises, from a range of reference material, the wide range of factors that influence log truck travel speed. It is presented as a follow-up to LIRA's earlier Report Vol.4 No.11 1979 on reducing log truck delays. Both of these reports are aimed at improving awareness of factors affecting log truck productivity.

ACKNOWLEDGEMENTS

Information and diagrams within this report have been taken from a number of references, as listed on Page 4. Data supplied by N.Z. Forest Products Limited and the N.Z. Forest Service has also been referred to.

As travel speed is closely linked with safety, any changes aimed at increasing travel speed must necessarily be within the constraint of safe operation. Achieving higher travel speeds is pointless unless effective use is made of the extra time made available for truck use.

Travel speed is determined by the vehicle, the road, and the driver. Each of these has a varying affect, many of which are often inter-related.

VEHICLE CHARACTERISTICS

The main vehicle characteristics with a bearing on travel speed are engine power, vehicle aerodynamics, drive train ratios and efficiency, and gross weight.

ENGINE POWER

Travel speed can be increased with higher engine power. The speed increase, however, is not proportionate with the power increase due to power being absorbed at higher speeds to overcome other factors. Local experience indicates that a 20% power increase (200 kW to 240 kW) produces a 10% speed increase within the 60-80 kilometer per hour range (11% loaded, 8% empty).

Engine power available is influenced by altitude and air temperature and this can affect speed. Engines have an optimum rpm range and fluctuations from this influence power availability. Engine rpm itself has a direct bearing on travel speed.

VEHICLE AERODYNAMICS

On a loaded log truck air resistance absorbs considerable power at higher travel speeds (over 50 km/h) as indicated in *Figure 1*. It is, however, of little consequence at travel speeds less than 50 km/h. As the aerodynamic design of typical log trucks is practically nil, the projected frontal area of the vehicle and load essentially determine air resistance and the resulting affect on speed.

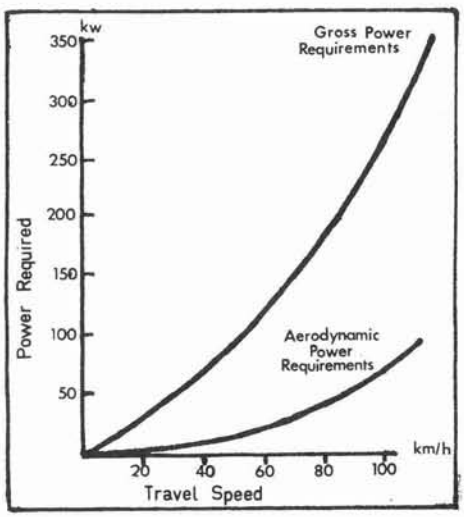


Figure 1. Power Requirements of a Loaded Truck on a level road.

DRIVE TRAIN FACTORS

The total geared reduction ratios between engine and drive axles directly affect travel speed. The lower the reduction ratio the higher the attainable speed. The tyre rolling radius of the drive wheels also has a direct influence, with larger diameter tyres increasing speed. Power losses normally occur in the drive train between engine and driving wheels, and for practical purposes, the log truck drive train can be taken as 85% efficient.

GROSS WEIGHT

Travel speed is reduced with increasing gross weight due to the effect gross weight has on grade and rolling resistance. Local experience indicates that a 10% increase in gross weight from 37.5 tonnes results in a 3% speed decrease.

ROAD CHARACTERISTICS

The main road characteristics with influence on travel speed are surface type, road grade, alignment factors, lane and shoulder widths, traffic density, and special speed restrictions.

SURFACE TYPE

The road surface affects rolling resistance on the vehicle and thus its speed. A change from a gravel surface to a sealed surface will increase travel speed, and local experience indicates that a 7-8% increase in truck speed can result. Additional gains with sealing also come from the absence of dust, less surface deterioration in wet weather, more driver comfort, and reduced truck maintenance.

ROAD GRADE

A zero grade has no influence on potential truck travel speed. Steep grades, both adverse and favourable, however, quickly reduce truck speed as indicated in

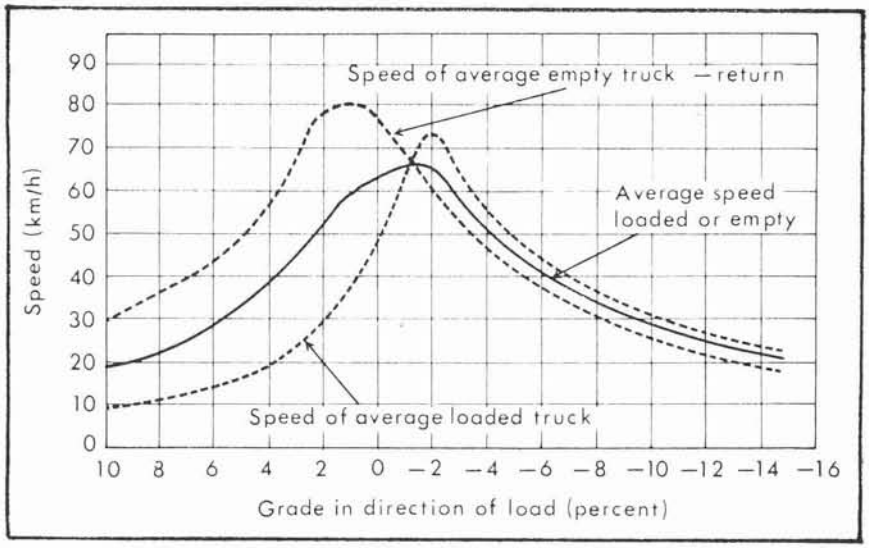


Figure 2. Logging Truck Speed Versus Road Grade For Metal Roads

Figure 2. A loaded truck quickly increases speed if the adverse grade becomes less than 6%. It reaches maximum speed at a 2% favourable grade and then speed drops very quickly as the favourable grade increases Wheel slippage also becomes an important consideration on steep grades.

ALIGNMENT FACTORS

Road alignment factors greatly affect travel speed through a combination of curve radius, curve frequency, curve super-elevation, and sight distance. Curve radius has a greater influence than curve frequency, although once curve radius is small (less than 60 metres) then the curve frequency also has a noticable affect on travel speed.

A vehicle travelling around a flat curve tends to move sideways and this reduces speed. To counteract this and enable faster cornering speeds, the road can be tilted or super-elevated. Generally the higher the super-elevation the higher the road speed. Local experience suggests that super-elevation on forest roads should be limited to 10 cm per metre.

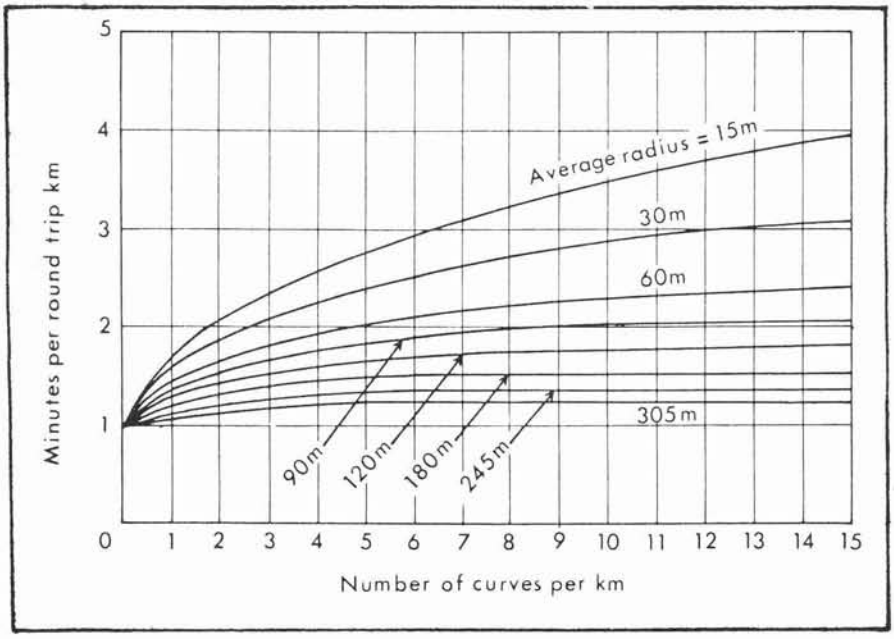


Figure 3. The Affect of Curves & Curve Radius on Loaded Truck Travel

LANE & SHOULDER WIDTHS

The optimum lane width for two lane roads is the overall vehicle width plus 1.22 metres. A reduction in lane width can cause reduction in speed (up to 1 km/h per 30 cm reduction) and in speeds when passing or meeting other vehicles (up to 1 km/h per 5 cm reduction). Shoulder widths should not be less than 1.22 metres as speeds can drop by 1 km/h for each 6 cm reduction.

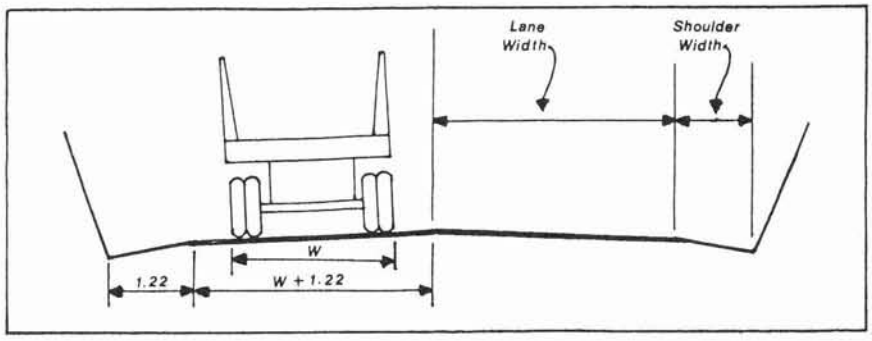


Figure 4. Optimum Road Width

TRAFFIC DENSITY

Other traffic travelling in the same direction as a log truck will reduce travel speed if it is slower than the logging truck. Other traffic flowing in the opposite direction as a log truck will only reduce speed on a narrow road.

SPECIAL SPEED RESTRICTIONS

Studies indicate that log trucks follow speed restrictions in built-up areas, however, on the open road log trucks tend to go as fast as the road conditions and truck characteristics will allow. Typically, trucks average 40-45 km/h in a 50 km/h restricted area, whether loaded or empty. On an open road with 70 km/h restriction and favourable conditions, trucks average 75-80 km/h when empty and 65-70 km/h when loaded. Adverse conditions on the open road slow truck speeds markedly though.

DRIVER CHARACTERISTICS

References suggest that the major driver characteristics that affect log truck travel speed are experience and ability, and motivation and attitude.

EXPERIENCE AND ABILITY

Log truck speed is influenced by experience for as long as it takes the driver to gain full confidence in the control of his vehicle. Ability in such things as judgement and perception is inherent. Inexperienced drivers initially may reduce travel speed by up to 40%, but towards the end of the learning period (estimated 4-12 weeks) the reduction in speed through inexperience is less than 5%.

MOTIVATION AND ATTITUDE

Psychological and environmental factors such as relationship with employer, personal influences, financial incentives, prospects, a desire to work, working conditions, team spirit, etc., are considered to cause up to a 30% variation in truck travel speed.

SUMMARY

Many factors influence log truck travel speed, and at the extremes each and every one can be very significant. In general, the more prominent factors are the vehicle characteristics of power and gross weight, the road characteristics of alignment, grade, and surface condition, and driver characteristics of motivation and attitude.

Log transport operations can benefit significantly by using trucks with power and gross weight matched to the job, by minimising the affects of road alignment, grade, and surface condition, and by effectively motivating truck drivers.

Some excellent references available in LIRA's library, which detail some of these topics are:

"Trucks and Trailers and Their Application to Logging Operations"
By J.A. McNally. A 1975 University of New Brunswick reference manual.

"Logging Road Handbook, The Affect of Road Design on Hauling Costs"
By J.J. Byrne, R.J. Nelson, & P.H. Googins. A 1960 U.S. Department of Agriculture Forest Service Handbook.

"Log Transport & Loading Seminar Proceedings"
LIRA Project Report No. 8, 1979. Papers 6(a) & 6(b).

"Wind Tunnel Tests of Devices for Reducing the Aerodynamic Drag of Logging Trucks"
By G.J. Garner FERIC Technical Report TR-27, 1978.

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