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STANDARDS FOR LOGGING ROADS

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INTRODUCTION

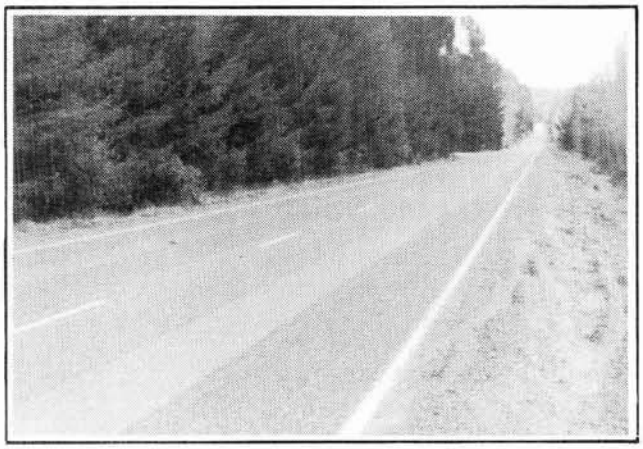


Figure 1 - High quality major logging road

When considering the question of suitable standards for logging roads, it is imperative to bear in mind that any transportation system is a balance between the objectives of minimising road construction and maintenance costs, whilst at the same time providing for the efficient and safe operation of heavy transport vehicles.

The combined cost of roading and transportation is a major proportion of current harvesting costs. As harvesting increases in forests established on difficult terrain, these costs will become more significant. Indeed the economic viability of many future harvesting operations could well hinge on these cost inputs (Ref. 1). It becomes vital to avoid any under, or over, design of logging roads.

Through implementation of sound planning/ design principles, adoption of proven construction techniques and with emphasis given to sound construction supervision practices, expenditure on road construction can be optimised to give minimum combined transportation and roading costs.

DEFINITIONS

Misunderstanding about what roading standards are can be clarified by defining these four terms :

CLASSIFICATION	-	defines road function
CATEGORY	-	notation given to a classification
STANDARD	-	defines road geometry
SPECIFICATION	-	defines design/ construction details

Logging Road Classification/Categories

It is traditional in the forest industry to classify roads by service function, or some form of category identifier.

As stated by Paterson and others in their FERIC (Forest Engineering Research Institute of Canada) Technical Report "Standard Classification for Forest Roads" (Ref. 2) :

"In any classification system the division between classes must be arbitrary and consequently there are bound to be differences of opinion as to the best definition for each class. Small differences of opinion are not of great significance, but it is important that once established the system be adhered to by all concerned .... The description provided for any given class should be clear enough to convey the same picture to all who may use the system."

	MAJOR LOGGING ROADS (Maximum traffic/ loading)	LOGGING ROADS (Medium traffic/ loading)	SPUR/SHUNT LOGGING ROADS (Low traffic/ loading)	ESTABLISHMENT/ MANAGEMENT ROADS
N.Z. Forest Service	D	E G	G 1	G1
N.Z.Forest Products Limited	Arterial (2 lanes sealed)	Secondary (2 lanes)	Spur	Planting
Baigent Forest Ind.Ltd.	Arterial	Secondary	Spur	Planting
Carter-Holt Central Ltd.	Class I	Class 1 Class 2	Class 3	Class 4
P.F. Olsen Ltd.		Class 1	Class II	Class III Class IV
Tasman Forestry Ltd. :				
Murupara	Arterial	Arterial	Spur	
Kawerau	Arterial	Secondary	Spur	

It is important to recognise that road classification descriptions and/or category idendifiers are neither mandatory prescriptions nor roading construction standards

Figure 2 - Road Classification/Categories used by some New Zealand forestry organisations

FERIC further state :

"that a good classification system should :

(a) permit dialogue without confusion over terminology
(b) provide a basis for the design of any new roads
(c) provide a basis for the evaluation of existing roads."

Figure 2 shows the various terms currently in use in New Zealand.

Logging Road Standards

Be definition LOGGING ROAD STANDARDS are the :

"Optimum standards for the minimum combined cost of road construction/ maintenance and truck hauling" (Ref. 3).

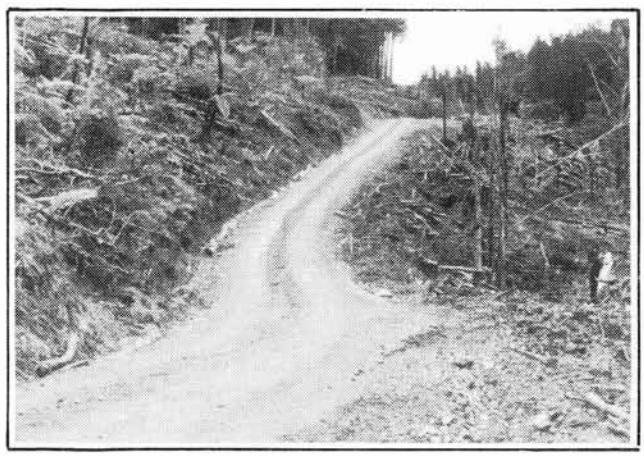


Figure 3 - Typical spur/shunt logging road

The costs for these operations cannot be treated in isolation. They are directly related to, and affected by, the wood volume available within the service life of the road.

They are an integral part of the total harvesting operation and therefore affect the overall economic viability of the operations.

Construction standards specify the level of service required from the various components of a roading system. They are most readily expressed in terms of road geometrics (i.e. speed, width, gradient, alignment, etc) and pavement loading/surfacing criteria.

Figure 4 - Major logging road carrying high volumes of heavy vehicle traffic

Logging Road Specifications

Construction specifications concern the "nuts and bolts" of roading construction and are the technical details that enable design to be carried through to construction. They can consist of :

e.g.
- pavement design detail
- data to determine optimum pavement thickness relative to soil conditions/types
- typical road cross-sectional details
- super-elevation and extra widening detail
- road metal specifications
- sight distance criteria
- drainage and culverting criteria
- road maintenance considerations
- earthworks considerations
- sub-grade and pavement compaction criteria
- soil / pavement / material testing procedures

To summarise, ROADING/CLASSIFICATION CATEGORY DESCRIPTIONS ARE A BASIS ON WHICH TO FORMULATE A PLANNING AND DESIGN PROCESS, in which the vital elements are :

(a) **Construction standards** that reflect technical and economic considerations (in terms of both roading and transportation criteria)

and

(b) **Construction specifications** appropriate to road usage/function considerations.

There can be no such thing as common roading standards or construction specifications that are, or could be, appropriate to all harvesting operations.

Figure 5 - Grid roller used for base course compaction

The optimum standard for a particular logging road will be dictated by economic considerations, arising from the :

- total volume of wood available
- market value of the wood
- time base over which the wood is to be extracted
- total haulage distance from landing to point of utilisation
- seasonal variations and constraints
- environmental constraints

These factors should be quantified during the logging planning phase of harvesting operations, and at that stage be translated into appropriate roading standards in terms of economics, design life and serviceability.

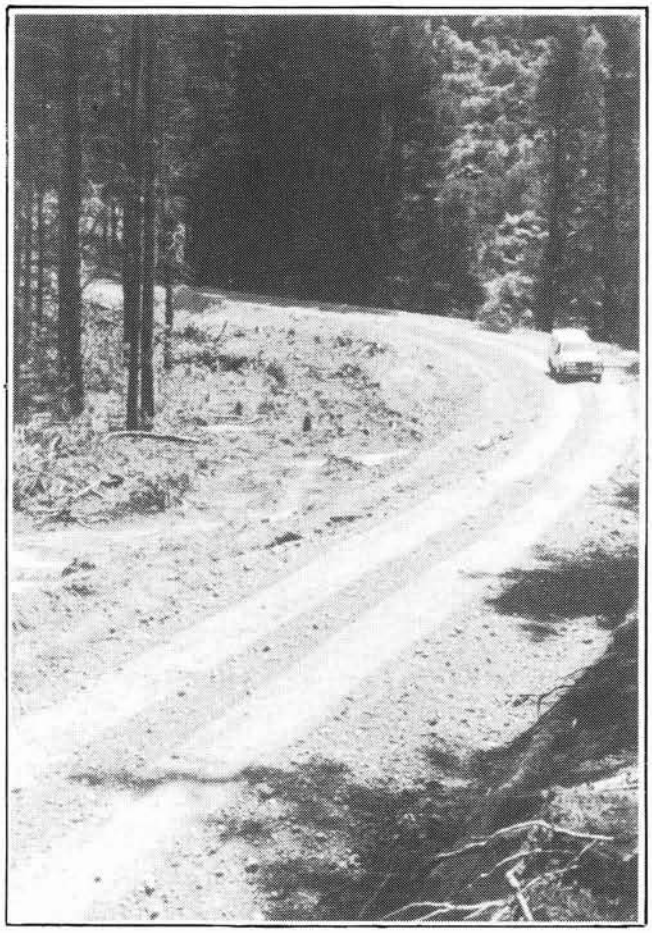


Figure 6 - An upgraded logging road - note grade and alignment

FACTORS THAT INFLUENCE LOGGING ROAD STANDARDS

Whilst the methodology for the selection of the best road route in terms of engineering considerations over any given terrain is well known, little information is available, in a practical form, which can be used to determine optimum logging road construction, maintenance and haulage expenditure.

In theory, of course, the task is simply one of finding the least cost solution, i.e. the location, width and alignment that give the lowest combined cost of road construction, maintenance and haulage.

The practical solution, however, is not that straight forward; it is complicated by the uncertainties injected into the system by a large number of other crucial considerations. For instance, optimum logging road standards must interact with :

- logging system options
- internal forest transportation options
- environmental constraints
- public roading standards
- volumes of production
- product type and market value
- seasonal scheduling of operations
- vehicle operating and maintenance costs
- effect of surface conditions on vehicle performance.

It is these elements that dictate, or determine, the most appropriate road classification or category to be adopted (i.e. whether the proposed road should be an Arterial, Secondary, Spur/Shunt, Haul, etc type road).

Consideration, and evaluation, of the above factors will, or should, influence, or control, the location, timing and construction standard of the logging road.

The determination of appropriate construction standards, in terms of geometrics (i.e. alignment, width, gradient, speed etc) and the subsequent development of construction specifications requires technical evaluation of anticipated road usage/function criteria, in terms of :

- vehicle type
- speed
- safety
- axle loads
- traffic density/frequency
- road life/maintenance
- seasonal requirements
- directional flow of traffic

combined with assessment of :

- terrain (topography, geology)
- existing road networks
- technical staffing resources
- construction plant availability
- construction options
- road building materials resources
- economic evaluations

Figure 7 - Constructing a spur road in indigenous forest

The design of optimum logging road standards is a specialised area, requiring an understanding of civil engineering roading sciences. Expertise in this area may be achieved either by professional qualifications (i.e. a degree in civil or forest engineering), attainment of an appropriate technical qualification (N.Z. Certificate in Engineering - Civil), or specialised training programmes. As yet, New Zealand has no recognised qualification that embraces specifically all the skills required by forest engineers.

The list of references highlights the skills and knowledge required. It is also a recommended reading list for those working in the harvest planning areas who do not as yet possess the particular skills referred to above.

If roading costs are to be optimised and transportation costs minimised, the benefits that can accrue from engineering input at the harvest planning stage has to be acknowledged.

FERIC APPROACH TO LOGGING ROAD STANDARDS

The FERIC approach to achieve a STANDARD CLASSIFICATION FOR FOREST ROADS identifies five important parameters to fully describe a logging road. They are :

(i) Axle Load

The axle load used is the maximum single load expected to occur regularly over the life of the road. The maximum anticipated axle load determines the design bearing capacity of the road.

(ii) Speed

The minimum sustained speed below which the design vehicle should not be required to go. By adoption of a minimum design speed, accurate information regarding maximum allowable design grades and grade lengths is conveyed.

(iii) Availability

The period of the year that the design vehicle may travel on the road at speeds equal to, or greater than, the minimum desirable sustained speed.

(iv) Traffic Density

Traffic density is given as the number of equivalent 80 kN (18,000 pounds) single axles per day.

Because there are numerous axle weights and configurations, it is recognised that there is a need for some standard form of reporting axle loads. By summing up all the equivalent axle loads, the equivalent incremental damage a given axle load and configuration will inflict on the pavement with each pass can be indicated.

(v) Life

The number of years the road is to be used before replacement or abandonment.

FERIC Technical Report "Standard Classification for Forest Roads" reinforces the contention that optimum logging road standards evolve, initially, by evaluating at the harvest planning stage the services a logging road has to provide (and at what cost). This is followed by a design process to develop construction specifications to provide those services both efficiently and economically.

ROLE OF TECHNICAL STAFF

The functions of specialist civil engineering personnel - whether they be engineers, graduates, technicians or construction supervisors - and their roles relative to foresters and forest management personnel is ill-defined within the New Zealand forest industry (with the exception of N.Z. Forest Products Limited, Kinleith (Ref. 4)).

It also needs to be recognised that engineers, graduates, technicians and construction supervisors do not have any clearly defined roles within civil engineering. Their functions and capabilities overlap to a considerable degree. However, they each have a particular expertise to offer at the planning, design and construction phases of roading operations (see Figure 2).

Logging road planning, design and construction requires a fusion of a variety of disciplines and skills.

It is the function of logging planners to; give clear definitions of the use expected of a logging road (in terms of: vehicle type, speed, axle loads, traffic density, road life, seasonal requirements, timber volumes and directions, logging systems, etc), the operational impacts of changes in road location or standards, the tolerable level of maintenance costs and to define their needs in terms which will permit engineering staff to develop appropriate road construction standards.

The specialist engineering function is to ensure that roads are designed to meet the logging planners' criteria, not only efficiently and economically but also to minimise environmental impacts and land loss. The outcome of engineering input must be a clear definition of road location, road design criteria, estimated costs and appropriate road construction standards and specifications that can be interpreted by construction supervisors.

The function of construction supervisors is to closely supervise and manage construction works, apply proven and appropriate construction techniques and monitor plant/labour performance to ensure roads are not only constructed to design specifications but also on time and within estimated/ budgeted costs.

Often the functions of logging planners, roading engineers and construction supervisors will overlap, in planning and design of harvesting operations they each have a particular expertise to offer and certainly close liaison and joint planning is necessary to ensure objectives, designs and methods are compatible.

To provide a structure with the skills required provided by the specialised technical personnel will often only be possible within major companies. Nonetheless, the fact remains that even the smallest company must have access to such skills, or encumbent staff given additional training in order to carry out these specialist functions.

CONCLUSIONS

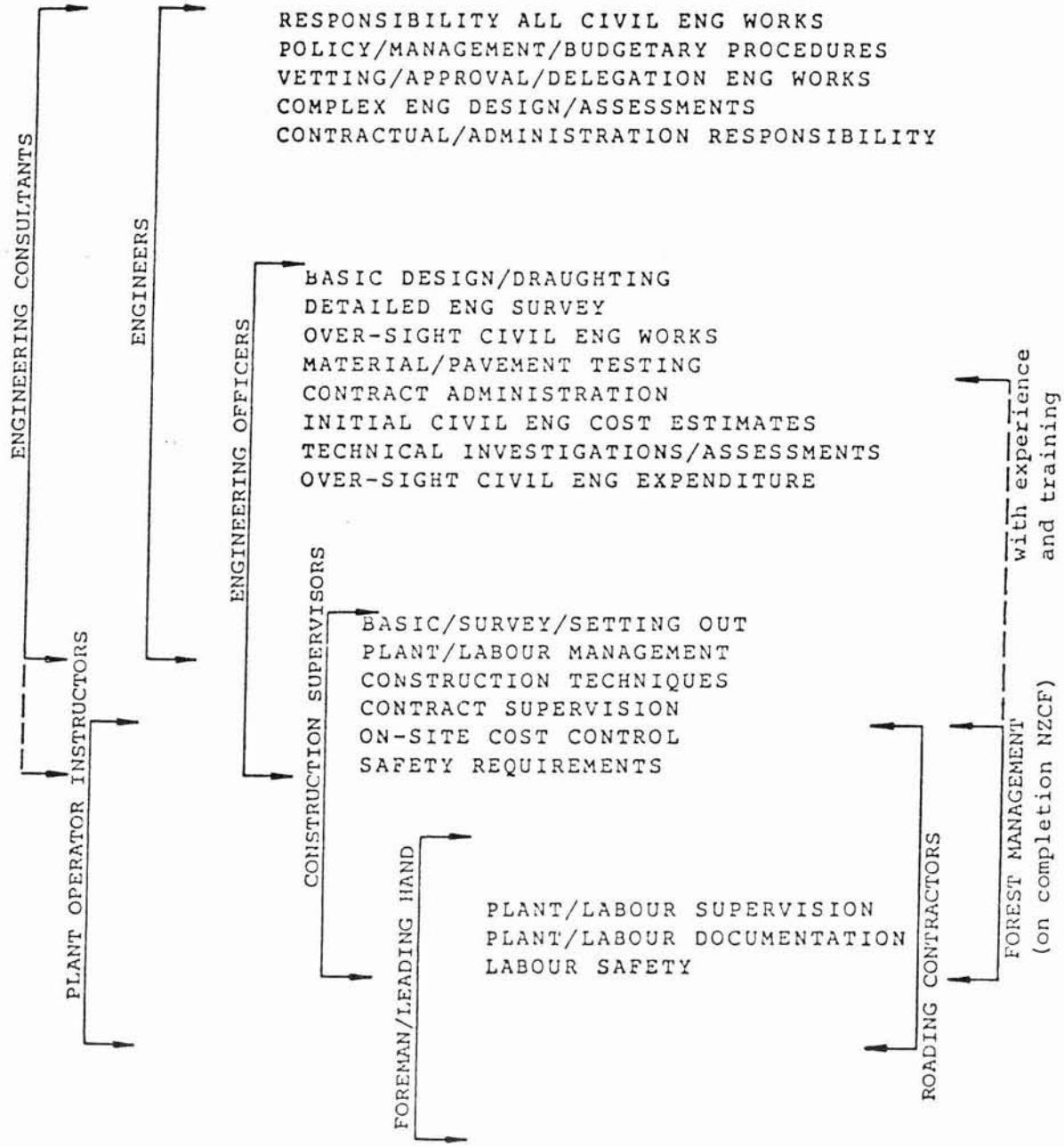
(i) Before entering into expensive road construction programmes, all available alternatives should be considered and properly evaluated.

(ii) The harvesting and transport systems must be designed together to ensure the minimum total production costs.

(iii) The primary function of specialist engineering personnel is to minimise costs in the long term.

(iv) In every case roading standards should be determined to maximise the profitability of the forest.

(v) There is no one simple answer, or manual, that will give you all the answers to the myriad of questions that arise when endeavouring to determine SUITABLE STANDARDS FOR LOGGING ROADS.



ENGINEER - B.E. DEGREE

ENGINEERING OFFICER - NZ CERTIFICATE IN ENGINEERING

CONSTRUCTION SUPERVISOR - NZ CIVIL ENG WORKS SUPERVISOR CERTIFICATE

Figure 8 - Job categories - functional relationship

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