SECOND INTERNATIONAL SYMPOSIUM

ON

HEAVY VEHICLE WEIGHTS AND DIMENSIONS

DESIGNING THE HIGHWAY SYSTEM TO ACCOMMODATE VERY LARGE VEHICLES

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INTRODUCTION

Last year the forest industry in Alberta produced products valued at 816 million dollars and employed 11,000 people. In the next decade, annual forest production is expected to be valued at 2.9 billion dollars (in terms of 1989 dollars) and employment is expected to reach 17,000 people. These figures represent a tripling of the value of production and an increasement in employment of approximately fifty percent.

While these are impressive figures, they only represent one of a number of natural resource industries poised for rapid expansion and growth. Substantial investments in oil sands recovery plants, coal mining and petro-chemical developments are also planned in various areas of the province. These are scheduled to occur at the same time that major efforts are being made to promote tourism. In fact, a goal of the Alberta government is to make tourism the province's second most important industry by the turn of the century.

All of these economic initiatives are bound to produce significant pressures on the highway transportation system. This paper is an attempt to discuss a few of the steps being taken by Alberta Transportation and Utilities to accommodate the growth of these resource industries and ensure that the highway system will continue to operate safely and efficiently.

TRAFFIC

Industrial development can be expected to generate four distinct types of traffic. These are:

1) Employee traffic during construction and during the production period. This traffic would include all persons having business at the facility.

2) Construction related traffic - primarily the movement of materials and machinery required to construct and operate the facility.

3) Transportation of raw materials used in the plant processes.

4) Transportation of final products from the plant to distribution centres and ultimately to the consumer.

Generally speaking the lion's share of the movement of goods and people to and from these sites is by highway. Railways frequently play an important role in the transportation and distribution of products produced but a relatively minor role in the movement of construction materials and delivery of raw materials. And, in Alberta at least, the railways and other modes of transport have almost no role in the transportation of people to the development sites.

Two of the four types of traffic are conventional and do not require special transportation facilities. In the case of employee traffic standard vehicles, both automobiles and buses, are involved. While the volume of traffic, coupled with other traffic that is normally on the road, may necessitate construction of new highways or upgrading of existing routes, conventional capacity and design factors are involved. Similarly, the transportation of products from the plant site involves conventional highway haul vehicles. In most cases design of access road and highway facilities will be based on weights and dimensions of vehicles which are permitted to operate on the entire highway network. These two types of traffic will not be discussed in this paper.

SOLUTIONS

Traffic involved in the movement of construction materials, plant machinery, and raw materials often requires special highway facilities for safety. The paper will now discuss four types of facilities which are being provided to facilitate the movement of very large vehicles. These facilities are:

1) High load corridors
2) Truck convoy turnouts
3) Rotatable traffic control signals
4) Long load intersection treatments

Following is a detailed discussion of each of these.

<u>High Load Corridors</u>

Traditionally the petroleum industry has had a need to move large, odd shaped loads. These include drilling rigs, field oil storage tanks, refining vessels, and many other components. Movement of these components and movement of other oversize objects, ranging from houses to farm machinery, often involved expensive raising and lowering of power and telephone lines and considerable delay and inconvenience to highway traffic, not to mention the inconvenience to residents and other users whose power was frequently interrupted. Recognizing the costs involved and frequency of movements, the department began a high load corridor development program in the early 1980's.

In establishing the corridor system, the department adopted the following policy: "All construction and maintenance projects shall consider the corridor to ensure the adequate clearance between the roadway and overhead obstructions to allow loads of up to nine metres in height to travel the corridor".

Industries can save significant amounts of time and money in constructing new plant facilities by preassembling components in locations where skilled labour and quality control are readily available and then transporting the parts in modular form to the plant site. Since Edmonton and Calgary are the largest population centres, the high load corridor links both cities to the major resource development areas. Figure 1 illustrates the completed corridor and some of the routes which are proposed to be added in the future.

To date a total of $2.2 million has been spent by the province on the high load corridor. Approximately ninety-three percent of the total was paid to the two major electric power companies for raising or relocating distribution and transmission lines. The remainder was spent on upgrading railway crossing signals, traffic control signals, miscellaneous cables, and engineering.

In an effort to recoup some of the costs of developing the system, a structure for use was implemented in 1987. The fees are as follows:

Load Height	Rate
over 6.0 m to 7.0 m	$1.00/km
over 7.0 m to 8.0 m	$3.00/km
over 8.0 m	$6.00/km

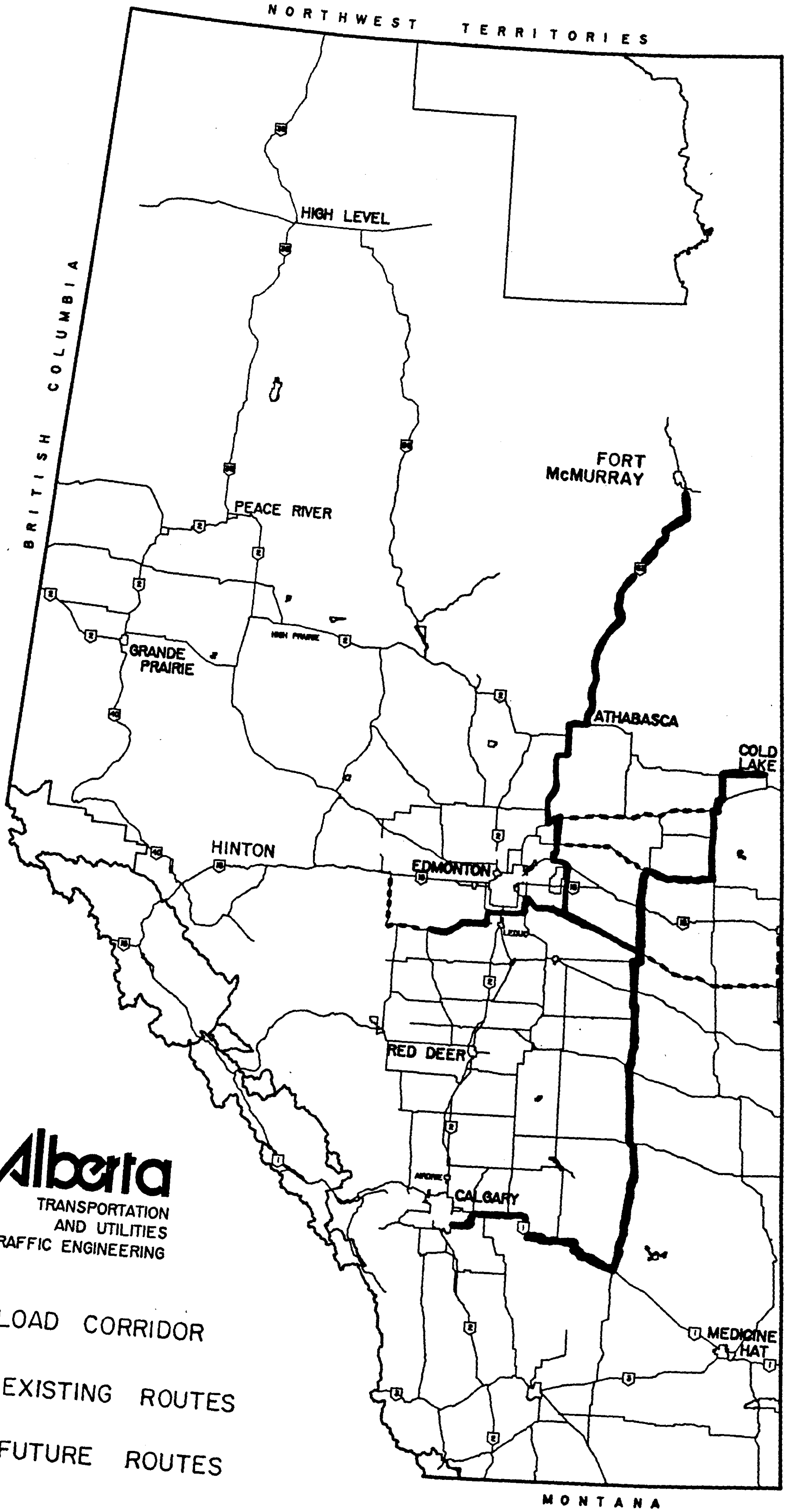
The fee is based on travel exceeding 10 kilometres and is assessed for each load regardless of whether or not the loads move in a convoy.

Truck Convoy Turnouts

Convoying of large loads, such as plant modules, is regulated in terms of routes to be followed, days and hours on which hauling is permitted, escort requirements and traffic control procedures. Not only is safety of utmost importance but minimizing delay and inconvenience to other highway users is a prime consideration. With these factors in mind, it is usually necessary for haulers of very wide loads to stop frequently to permit following vehicles to overtake. Additionally, in many cases it is necessary to stop vehicles approaching from the opposite direction and hold them while the wide load moves from one stopping point to the next.

To minimize public inconvenience and facilitate movement of these loads, the province has embarked on a program of

FIGURE I



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TRAFFIC ENGINEERING

HIGH LOAD CORRIDOR

—— EXISTING ROUTES

---- FUTURE ROUTES

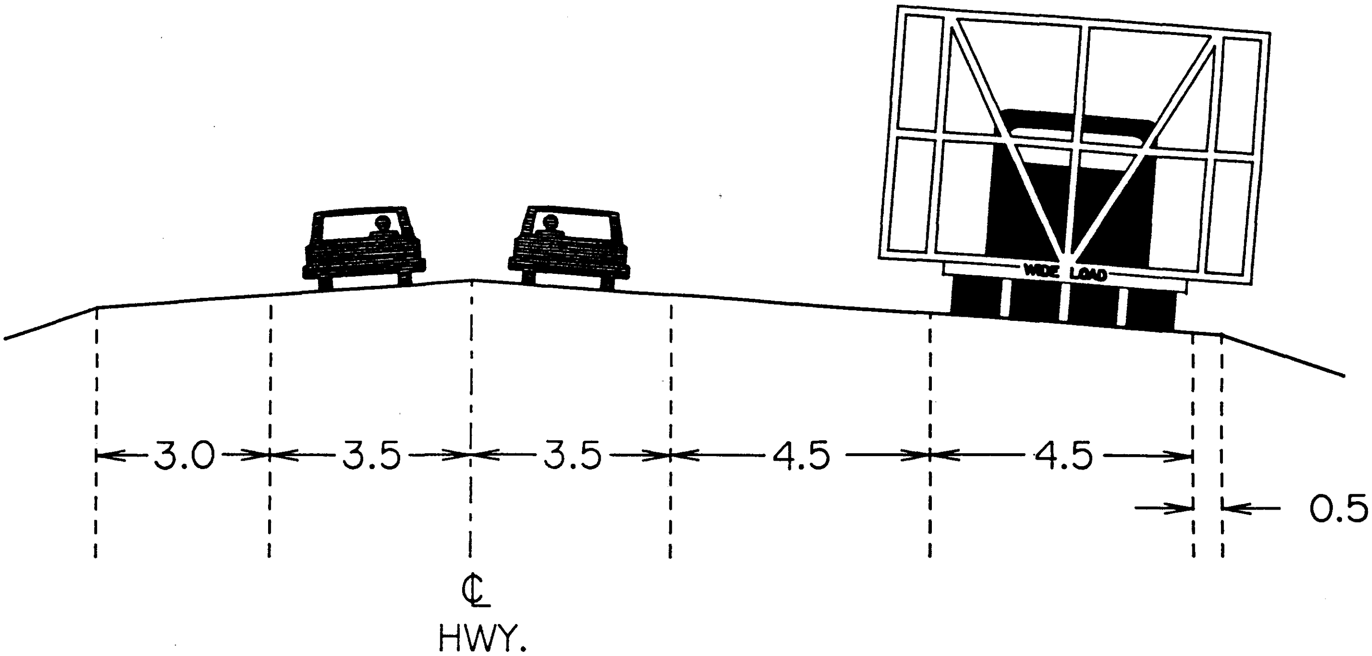
constructing specially designed turnouts or laybys strategically placed along the most commonly used routes. The turnouts, as illustrated in Figure 2, are a modification of the standard turnouts constructed along most highways. Typically turnouts provide a place for truck drivers to stop to check their vehicles and loads. Many are equipped with telephones and litter barrels and are therefore used by other drivers for short stops and breaks. Provincial law prohibits drivers from stopping on the shoulder of primary highways and therefore the turnouts provide a safe stopping location. The turnouts are not considered to be "rest areas" although there is no restriction on how long a driver may stop in one.

The turnouts designed for the large loads have been lengthened and widened. The design permits up to three modules and their assorted escort and support vehicles to be parked at one time. This design was chosen because of two important factors. Firstly, a large processing facility, such as an oil sands refinery, could involve several hundred modules. For efficiency in plant assembly, minimizing traffic disruption, and to keep hauling costs down, the modules could be moved in convoys of up to three units. Therefore each turnout must be large enough to accommodate an entire convoy. Secondly, the turnouts have been widened to provide a safe working environment for the drivers and other employees who may have to inspect, adjust, or repair the vehicles or loads while enroute to the destination. With loads of up to eight metres wide, the turnouts must be wide enough to keep people and vehicles well clear of the normal traffic passing on the highway. A parking area 160 metres long by 9.5 metres wide was selected.

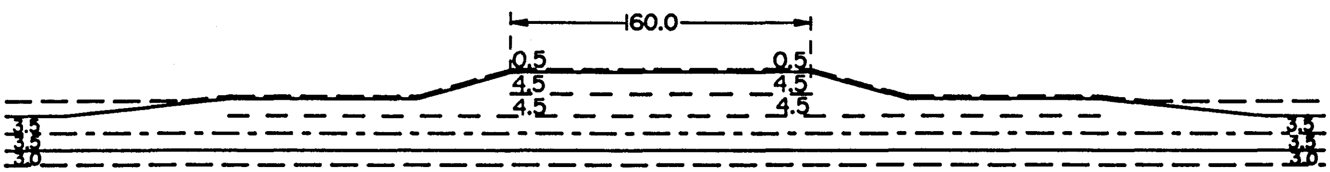
Construction of turnouts of this type can not be considered inexpensive. Where a turnout is added to an existing highway the cost is approximately $100,000 per site. If the construction can be carried out in conjunction with other highway work, such as highway widening or pavement rehabilitation, the construction cost is reduced by roughly fifty percent. These costs are based on grading and paving suitable for the expected loads.

Obviously significant economic benefit must be realized to justify construction costs of this magnitude. Figures are not available for previously constructed mines and plants but estimates have been prepared for a new oil sands plant. Negotiations are now underway for a new oil sands recovery development north of the City of Fort McMurray. The plant, commonly referred to as the OSLO project, will initially produce 75,000 barrels of oil per day. The overall plant cost is estimated $4.1 billion. The lease operators estimate that construction costs will be reduced by at least ten percent by prefabrication in major assembly yards in the Edmonton area. This translates into more than $400 million construction cost

FIGURE 2



X-SECTION OF TURNOUT



PLAN VIEW OF OVERSIZE TRUCK TURNOUT

saving. Additionally some 2,000 fewer workers will be required at the plant site during the peak construction period. This produces a significant reduction in infrastructure costs in and around the city of Fort McMurray. Prefabrication will, however, create approximately 1,500 modules that will have to be moved to the site by highway transport. The majority of the modules will be 7.5 metres X 7.5 metres X 25.0 metres although a number will be significantly larger.

In contrast to these construction savings costs, an estimate of the cost of providing turnouts on the haul route has been completed. Some options are still available but on the basis of constructing the turnouts at approximately 30 and 40 kilometre intervals between Edmonton and the plant site, costs are placed at $1.4 million and $1.2 million respectively. This cost is based on much of the construction being done in conjunction with other work planned for this highway. There are other costs which should be taken into account, for example the cost of time delays for motorists who must stop for the wide loads, but these costs are relatively small since most loads will move during late night hours when traffic is minimal. Therefore, it is clear that the use of modular construction techniques produces a very significant economic benefit.

This is but one example and may not be indicative of the benefits to be attained with other large developments. Earlier mention was made of the proposed pulp and paper developments which have been announced or are anticipated. Each of these will be evaluated to determine if expansion to the highway facilities are necessary to promote the construction.

Rotatable Traffic Control Signals

Traffic control signal structures are generally a major impediment to the movement of very large loads. Not only do the overhead davits create a restriction for high loads, but because signals are usually installed in response to traffic increases it is difficult to maintain routes which are free of signal structures.

Normally when high loads are being moved and a restriction free route is not available, significant costs, delays, and inconvenience occur at traffic control signal locations. Frequently a signal arm must be removed, often using fairly heavy equipment, to allow passage. More often traffic must be delayed while the overdimensional vehicle maneuvers around the signal structure, usually by travelling on the wrong side of the road. To minimize the transportation costs, Alberta Transportation and Utilities, with co-operation from some members of the heavy load industry, began a program of installing special bases on certain critical signal structures. These are used on signal structures on routes which are most frequently used to transport large objects.

The traffic control signal base is designed to permit rotation of the entire signal structure through 90 degrees so that the overhead signals move to a position parallel to the traffic lanes. During the rotation, the signals continue to function normally and no adjustments to either the signal head or power supply are necessary. At each intersection only those signal poles which are impacted by heavy hauls are equipped with the bases. In most cases only one pole needs to be equipped.

Figure 3 illustrates the design and installation of a rotatable base. The design has evolved to the point where now one or two men can turn a signal to allow a load to pass and then return the signal to its normal position in a matter of a couple of minutes. In each case, at least one of the bolts which secure the signal structure to the base is fitted with lock and key. The lock is to prevent unauthorized and inappropriate movement of the signals. The key is kept at the nearest department highway maintenance office. Applicants for overdimensional hauling permits are advised whom to contact for access to the signal.

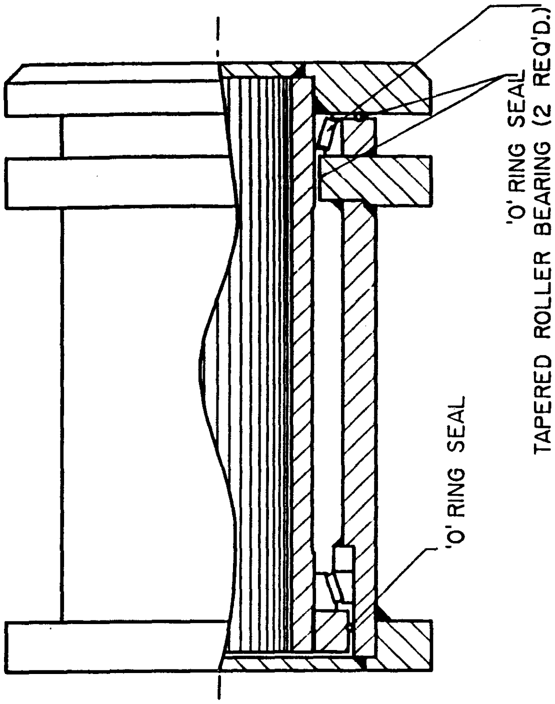
Overall, the rotatable base program has been very popular with the trucking industry. The cost of each rotatable base is approximately $5,500. More than half of all installations have been requested and paid for by heavy haul companies. On routes where the devices have already been installed, the department automatically adds them to new signal installations if it is believed that more hauling of large loads is likely.

From a safety perspective, the signal structures remain as secure and stable as structures that have conventional bases. The height of the overhead signals is somewhat greater but still well within the normal cone of vision. The department normally places guardrail or inertial barriers around signal structures as a safety measure and therefore none of the signals equipped with the bases has been struck by a vehicle. In any case, it is not expected that the structure would fall on the road if struck in a typical collision.

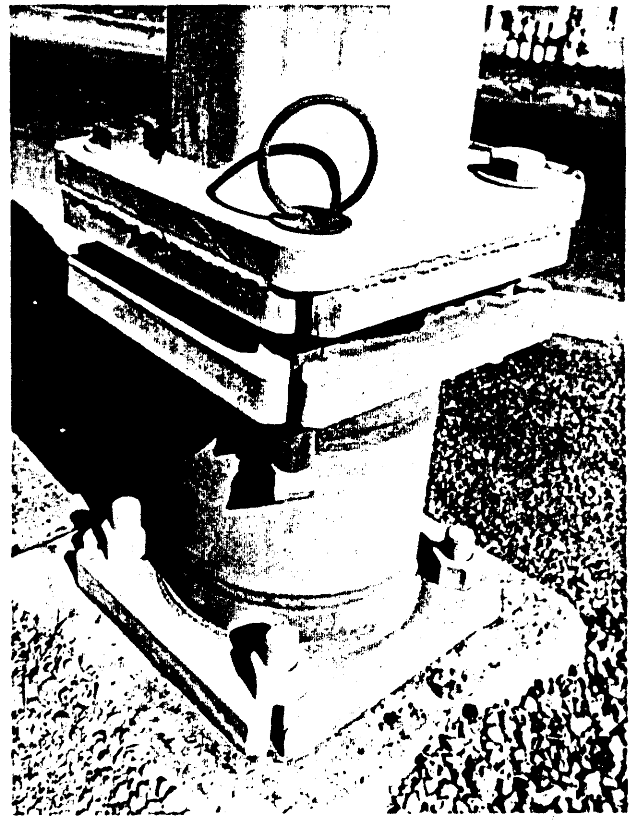
Long Load Intersection Treatments

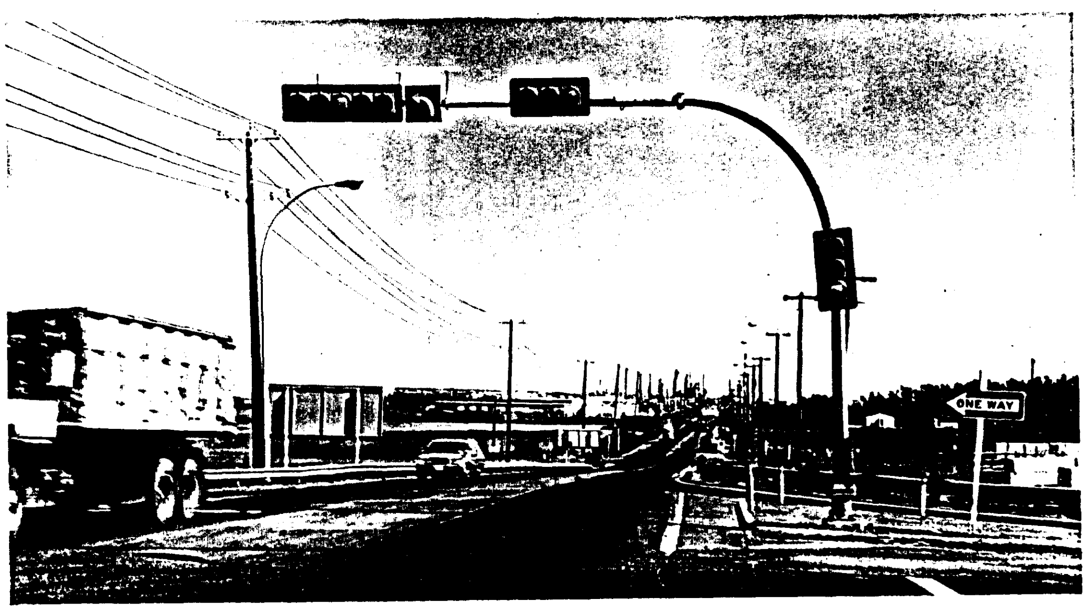
The fourth and final special design to be discussed in this paper relates to intersections designed to accommodate very long loads. In the introduction, mention was made of the announced and anticipated growth in the forest industry in Alberta. Because a large percentage of the tree harvest moves from the forests to the mills as tree length (up to 30 metre) logs, major intersections must be modified to prevent the long loads from interferring with other traffic at the intersection.

Log haul in Alberta is regulated with dimensional and equipment requirements based on the type of road being used. The



CUTAWAY FULL ASSEMBLY





TRAFFIC CONTROL SIGNAL WITH ROTATABLE BASE

strictest regulations, quite naturally, apply to the primary highway system where the log haul vehicles must mix with substantial volumes of public traffic. At the opposite end of the spectrum the least restrictive conditions apply on haul roads built specifically as access to the cutting areas. However, as Alberta does not have private roads even on the logging road, some public travel occurs and therefore safety standards must be maintained.

The greatest risk to other road users occurs when trucks make right or left turns. As the logs may overhang the rear axles by as much as nine metres, there is a constant danger that the end of the load will swing into the adjacent lane while the truck is turning and strike any vehicle which may be passing. The most common situation occurs when a driver attempts to overtake a logging truck which is signaling for a right or left turn. Several serious collisions have occurred where the overtaking driver has run into the logs as they suddenly sweep across his lane.

The solution to this problem is to construct intersections with turning lanes designed to provide additional separation between the through and turning vehicles to prevent collisons. Such solutions are only practical at locations where substantial numbers of trucks are turning. Therefore, while collisions of the type described may occur with other long loads, for example pipe, to date problem intersections not related to the logging industry have not been identified.

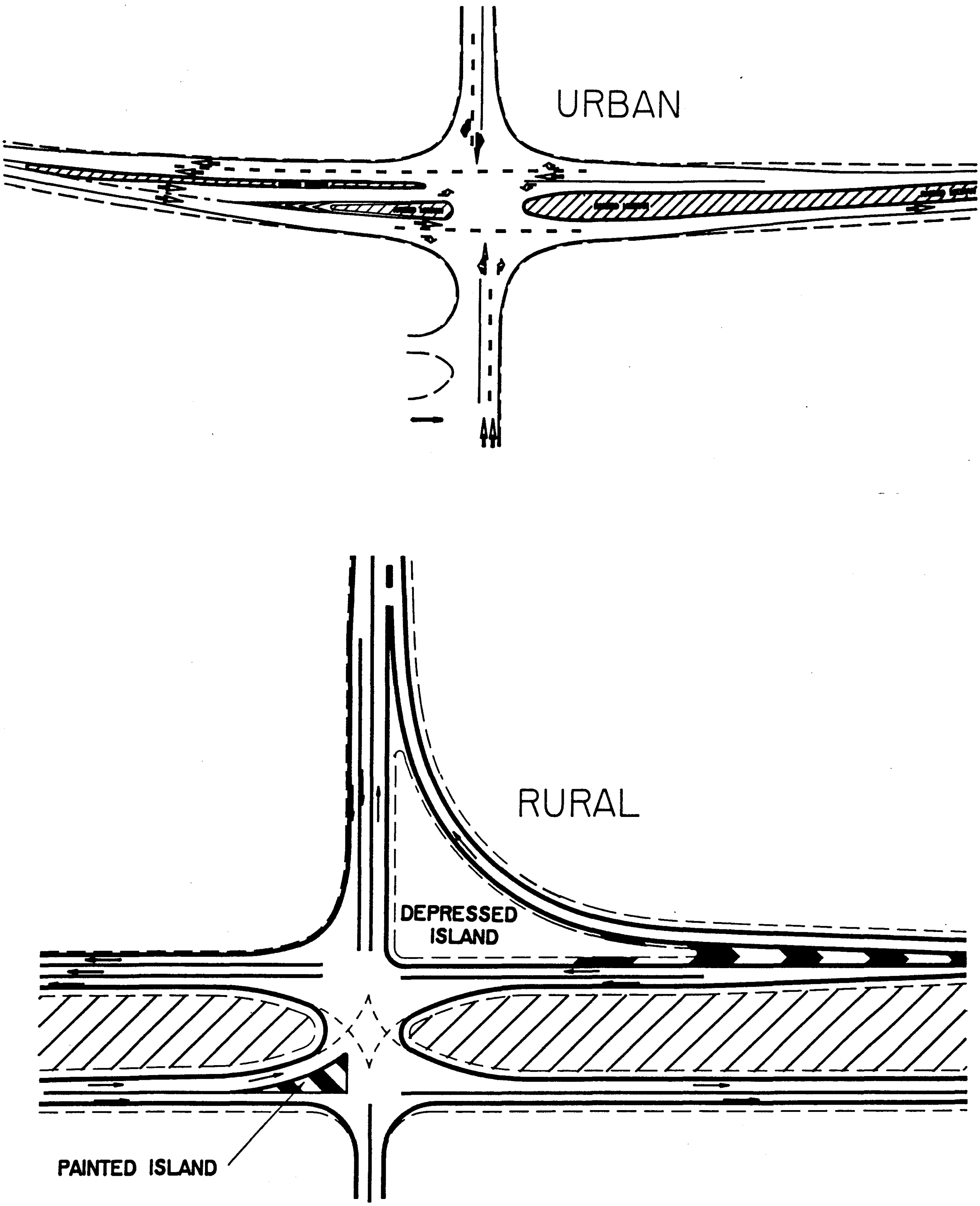
Figure 4 illustrates two intersection designs for this purpose. In urban areas the design relies on using raised concrete islands and medians to separate the traffic while the rural design calls for depressed island and medians in a considerably wider right-of-way. The cost of each is about the same and is currently estimated at one-half million dollars.

Construction of a number of these intersections has been completed. Observations indicate that all are operating very well with no reported safety or delay problems. In fact the design is considered much superior to the jug-handle design that is often proposed. Construction is scheduled at several other locations where new forestry developments are committed and in most cases the costs are included in the overall development cost.

SUMMARY

The four design features which have been discussed have all been based on the concept of facilitating industrial development without compromising the safety and integrity of the highway system. The immediate beneficiaries are not only the companies directly affected, but the residents of the

FIGURE 4



OVERSIZE LOAD INTERSECTIONAL TRATMENT

province as a whole, as our collective wealth is based on development and employment. In an overall benefit-cost analysis, it is reasonable to include the costs of providing these facilities as road costs and the accrued benefits as a legitimate part of the benefit calculation.

Substantial capital costs are required to provide these special facilities but, as has been suggested some, if not all, of these costs will be recouped. The cost of providing the high load corridor is being recovered through over dimensional haul permit fees. Most of the rotatable traffic control signal bases have been paid for by trucking companies and some of the special intersections for long loads are being charged directly to the forestry companies. In Alberta, the cost of developing and producing natural resource based products is about the same as elsewhere in the world. Transporation costs are generally the determining factor as to whether or not projects are economically feasible. Designs such as have been discussed help to promote our growth and expansion.

Undoubtedly there will be continuing pressure to ensure that the transportation system is designed to cope with more growth in the future. Trucks may not get larger, but as both trucking and public travel increase, the transportation department will have to remain innovative. Some items which are being considered or tried are high load warning detectors, bridge strengthening agreements, passing lanes, traffic control signal phases that automatically adjust for vehicle size, and improved railway crossing designs. These are all subjects for future evaluation.