Session 2
Paper (f)

HAULAGE DEVELOPMENT AND ROAD STANDARDS IN SWEDEN

Lennart Radstrom
Forest Operations Institute
Sweden

This presentation is based on project work in the roading and transportation area and will follow generally the following areas :

* Introduction to forestry in Sweden
* Transportation (regulations, quantities, alternatives)
* Transportation cost, its importance to industry
* Substandard roads
* Tare weight and road standard
* Tare weight and transport economy
* A case study
* Road improvement
* Obstacles
* Conclusions

The summary from the published work follows. This report is being translated into English and will be available from LIRA when completed.

This is the final Report on the TFB*-funded project "Development of wood hauling techniques in areas with poor roads". On the basis of an initial problem survey the work was concentrated to the following three areas :

* Haulage technique and economy
* Haulage systems
* Road improvement

Within these areas several subprojects have been carried out and the results published. The results have also been presented to forestry companies, haulage contractors and manufacturers in the course "More-economical transportation". This Report is a summary of the main results from the project.

"Substandard roads" here refers to roads that do not meet the requirements of modern truck and trailer combinations (24 m overall length, max GVW, etc). In southern Sweden 50 percent of the forest is served by substandard roads. The corresponding figure in northern Sweden is 5 percent.

The adaptation of the vehicles to these roads leads to investments in extra equipment to meet the need for mobility as well as higher tare weights. The result of this is higher hauling costs.

The differences in tare weights between the vehicles used today and those that could be used in an "ideal situation" are estimated to 3.100, 2.500 and 2.400 kg for southern, central, and northern Sweden respectively.

Poor geometric design of the road layout makes secondary loading necessary, i.e. the truck goes in alone on the poor road, picks up the wood and returns to the main road where the wood is transferred to the trailer. This procedure increases the hauling cost by 25 percent in southern Sweden.

Alternatives to secondary loading could be shuttling to special wood terminals from which efficient hauling could take place or the use of tractive units with tandem semi-trailers. However, none of these alternatives appears cheaper than secondary loading. According to our studies the best alternative is road improvement coupled with modification of the vehicles.

Today it is possible to improve a substandard road to allow for 24 m truck and trailer combinations at a cost of approximately 40 SEK/meter. There is, however, scope to reduce this figure considerably through development of techniques and methods for improving the road layout and also the production of cheaper body materials.

According to our estimates it should be possible to save approximately SEK 20 million per year in southern Sweden if the need for secondary loading were eliminated through improved roads and the transport equipment were adapted to that situation. 75 percent of this saving could be referred to roads that already have a high standard. Once the improvement program has been completed and paid for, the annual net gain would be approx. four times greater.

Furthermore, the problem of secondary loading strongly limits the economic scope for recovering more of the forest biomass for energy purposes.

During the project a number of obstacles to the development of efficient haulage solutions in areas with substandard roads were identified.

Many small roads with a low return on investment on each individual road improvement project constitute the main obstacle. The advantage of improving individual roads is often considered marginal.

In order to remedy this situation we suggest that government grants for road improvements be increased. This should be done in such a way that the benefits beyond the individual improvement project are also reflected. Furthermore, enough funds should be allocated to a road improvement program to achieve rapid results.

Regional road improvement programs should be set up for a limited period. On completion of these programs the grants should be discontinued and the economic responsibility taken over by the parties on the wood market.

Table 1

National board of Forestry classification of private roads

General standard	Road classes for new construction, trafficable by 24-m vehicle trains				Certain older roads (no new construction in these classes)	
	Proper wearing course		Roadway without acceptable gravel surface (temporary road)		Trafficable by 18-m vehicle trains	Trafficable by trucks without trailers
	Nominal design speed, km/hour					
Trafficability	60	40	30	20		
Truck and passenger-car traffic all the year round.	1 A	2 A	3 A	4 A	5 A	
Truck traffic all the year round except during heavy thaw period. Passenger cars all the year round.	1 B	2 B	3 B	4 B	5 B	
Trucks all the year round except during thaw and prolonged wet weather. Passenger cars all the year round except during thaw.	1 C	2 C	3 C	4 C	5 C	6 C
Trucks largely during winter. Passenger cars during summer as well.	–	–	–	4 D		6 D

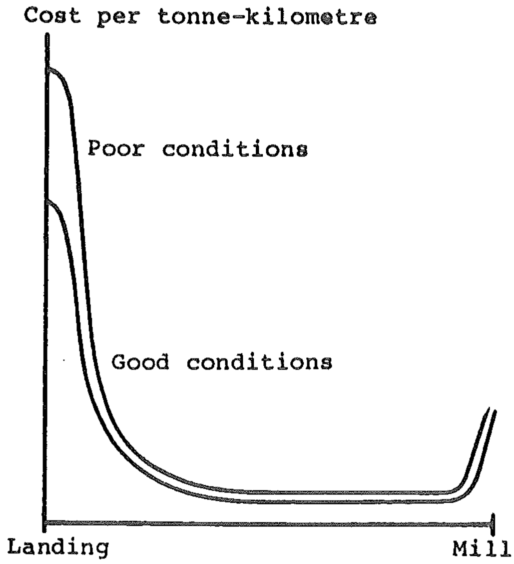
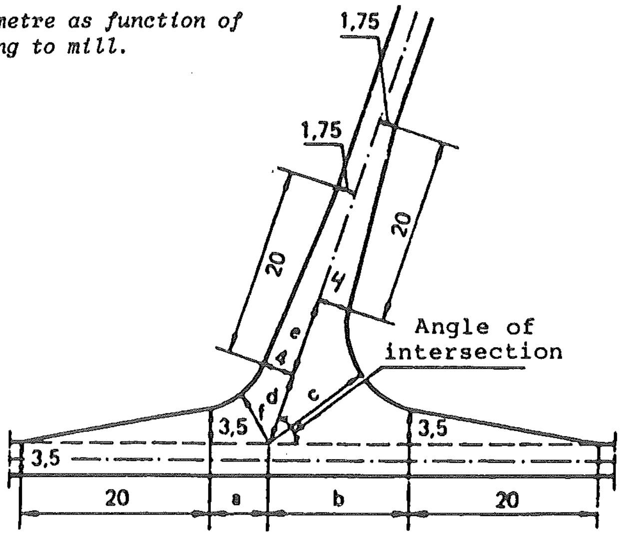


Figure 1
Haulage cost per tonne-kilometre as function of haulage distance from landing to mill.

Table 2

Specification of vehicles for which class 1-4 roads are passable

Overall length, m	24
Width, m	2.6
Height, m	4.5
GVW, tonne	60
Axle load on road, tonne	10
Axle load over bridges, tonne	14
Bogie load on road, tonne	18
Bogie load over bridges, tonne	18-22



ALL DIMENSIONS IN METRES

	Angle of intersection			
	70	80	90	100
a	5,5	7	8	9,5
b	16,5	14	11,5	9,5
c	13	11	10	8
d	6	7	8,5	10
e	11	7,5	3,5	0
f	5,5	6	7	8

Figure 2
Design of road junction, class 1-4 roads.

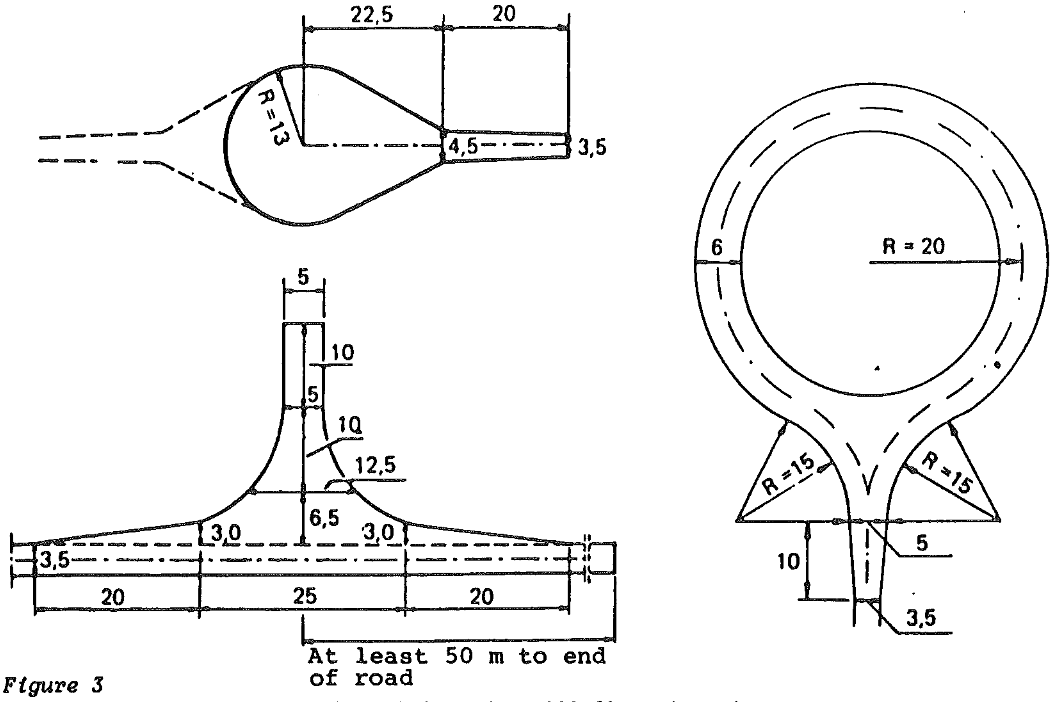
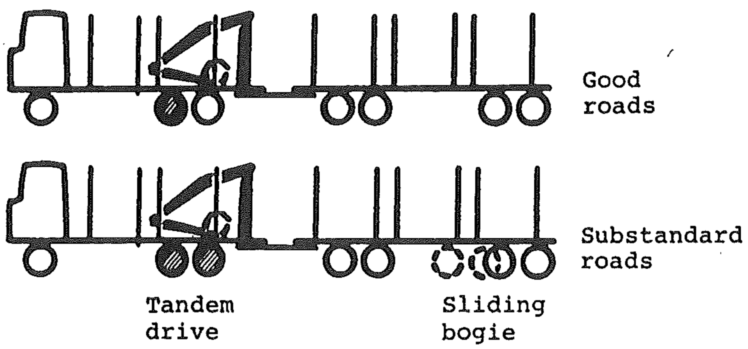


Figure 3
Design of turning zones, class 1-4 roads. All dimensions in metres.



	Tare weight, kg	Maximum permissible payload, kg
Good roads	16,000	35,400
Substandard roads	16,900	34,500
	= +900	= -900

Figure 5
Differences in tare weight and maximum permissible payload resulting from adjustments necessary to accommodate poor trafficability.

Table 6
Haulage cost for 3-m pulpwood

Haulage distance, km	SEK/tonne
20	16.60
80	35.90
150	58.00

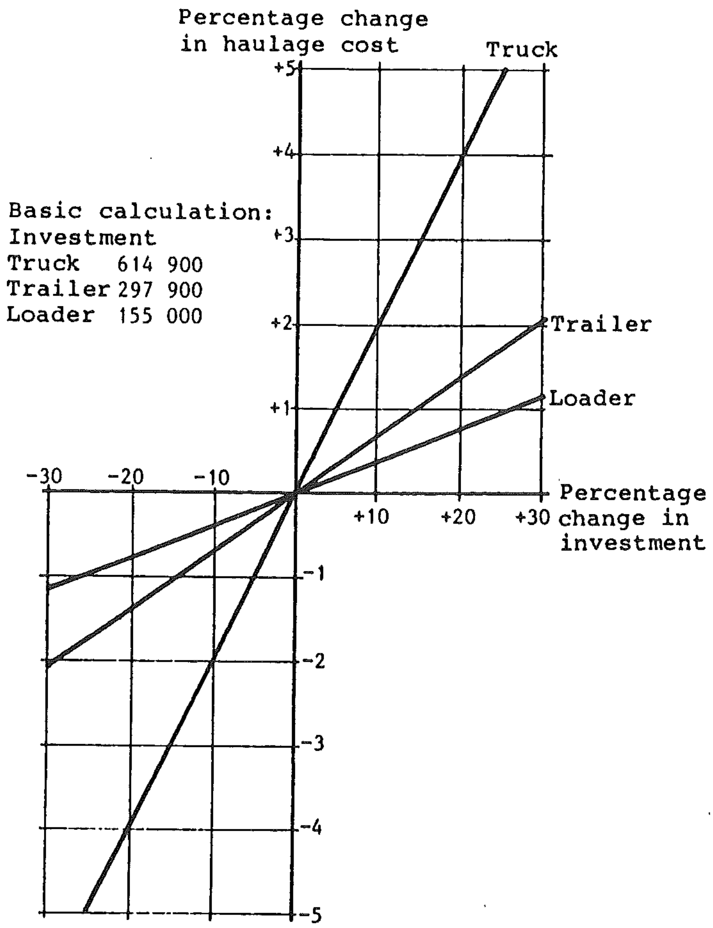


Figure 7
Change in haulage cost as function of ***differing investment.***

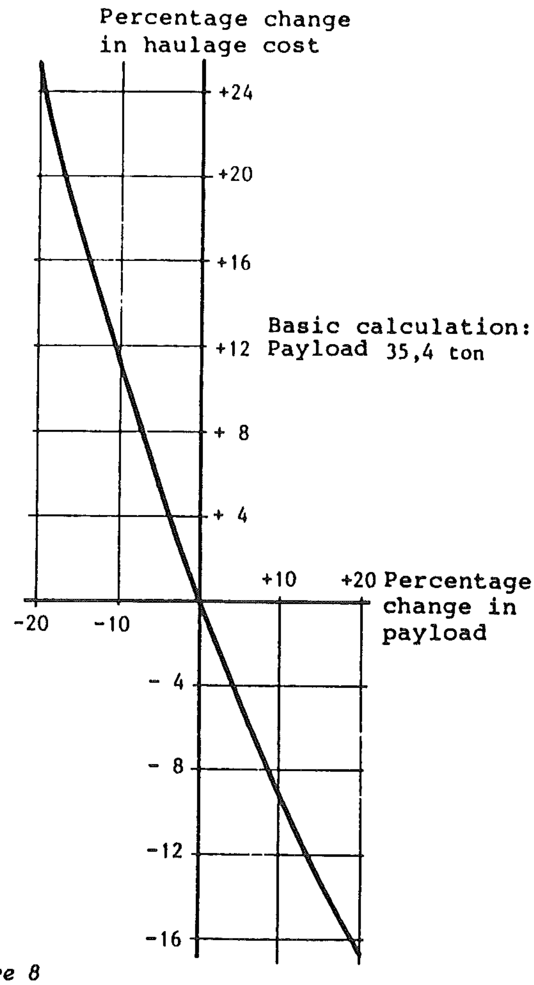


Figure 8
Change in haulage cost as function of ***differing payload.***

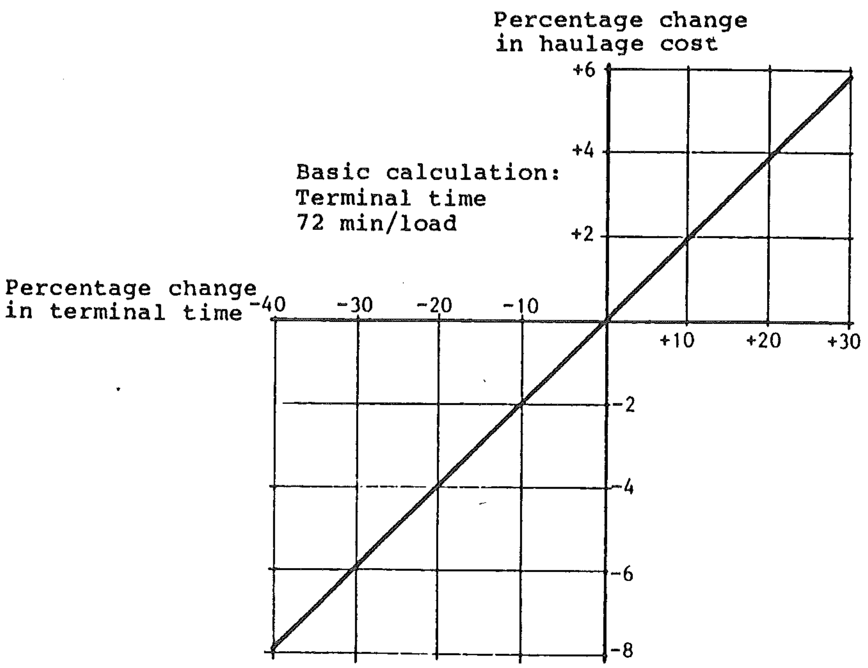


Figure 9
Percentage change in haulage cost as function of ***differing terminal time.***

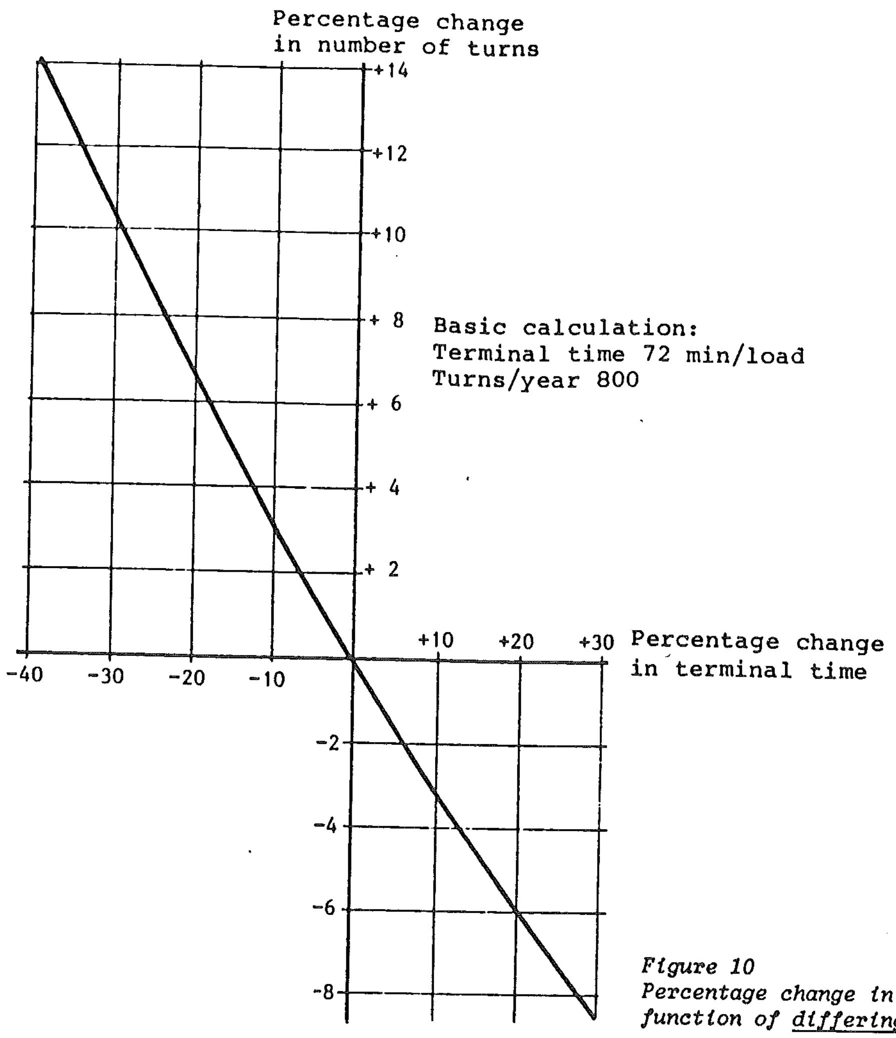
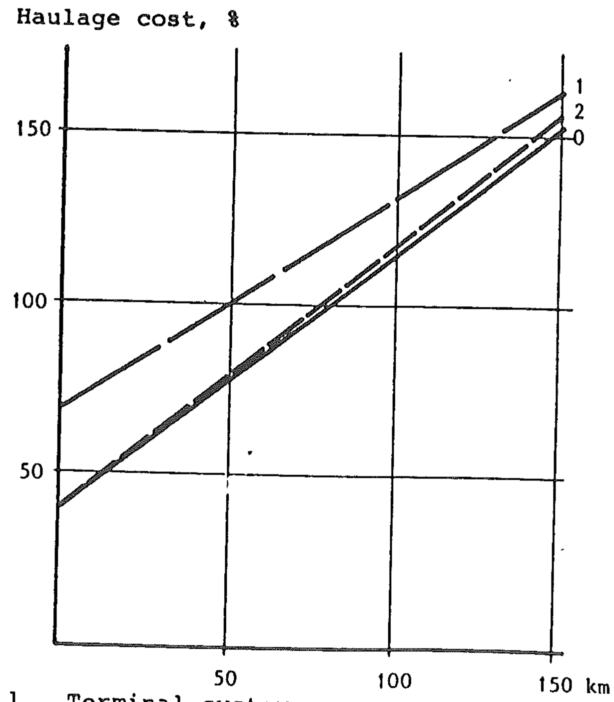


Figure 10
Percentage change in number of turns per year as function of differing terminal time.



1 Terminal system
2 Truck with tandem semi-trailers
0 Secondary loading

Figure 16
Comparison of costs in the different haulage alternatives.