FINNCONTACT

Quarterly Newsletter of the Finnish Highway Transportation Technology Transfer Center, FinnT^2

Address: Finnish National Road Administration, FinnT^2, P.O. Box 33, 00521 Helsinki, FINLAND
Fax Int. 358 20444 2322. E-mail: finnt2@tieh.fi Editor: Arto Tevajärvi, Tel. Int 358 20444 2032
Editor-in-Chief: Jarmo Ikonen, Tel. Int. 358 20444 2118

VOL. 7 / No. 1 / April, 1999

FINNRA CELEBRATES ITS BICENTENNIAL

AT THE TURN OF THE CENTURY 200 YEARS AGO, FINLAND BELONGED TO THE KINGDOM OF SWEDEN. THE THEN KING LEFT A PERMANENT MARK ON THE FINNISH NATIONAL ROAD ADMINISTRATION'S (FINNRA) HISTORY, BECAUSE, ON DECEMBER 17, 1799, HE GAVE A PROCLAMATION CONCERNING THE FOUNDATION OF FINNRA'S EARLY PREDECESSOR, THE ROYAL FINNISH COMMITTEE FOR THE CLEARING OF WATER RAPIDS. IN 1840, THE NAME OF THE COMMITTEE WAS CHANGED TO THE ROAD AND WATERWAY TRANSPORT BOARD.

DURING THE PAST TWO CENTURIES FINNRA HAS BEEN INVOLVED IN MULTIPLE MISSIONS.

In the late 1850's, after a decade of hard work done by the Road and Waterway Transport Board, the construction of the Saimaa Channel was completed. Then, the Board was assigned to carry out the construction of the first railway in Finland: the connection between Helsinki and Hämeenlinna. Along with railways, channels, bridges and ferries, the Board was also responsible for telegraph communications since 1860.

Traditionally, the responsibility for roads belonged to peasants who owned and cultivated the land. The first road constructed by the state, or the Board, was completed in 1862-1883. Society eventually took the road management responsibility in 1921, a couple of years after Finland gained its independency. The state started to maintain some 24,600 kilometers of busy roads, and it was also in charge of building new ones.

In the late 1930's, a herald of future travel, air traffic, embarked on a new era. The organisation that built the Helsinki airport and was responsible for the construction and maintenance of airports in Finland until early the 1970's, was none other than the National Board of Public Roads and Waterways.

The current name of Finnra came into force in 1990, and nowadays the administration concentrates on roads only. In the course of time, the responsibility in the transport sector in Finland has been split: separate organisations have been established for each transport mode.

This anniversary has been and will be solemnized in many ways. A kick-off blast to open the anniversary took place on a construction site in the beginning of January and a set of jubilee stamps depicting roads and a first day cover was issued in mid-February. Finnra Festival with cultural events and an international seminar for guests will take place in Turku on June 10-13. A history of highway traffic and road construction in three volumes will be published in June and a television series in six parts entitled "The Story of Roads" will be broadcasted on Finnish TV1 in December. Regional events and open doors will be arranged along the anniversary.

JARMO IKONEN

The IRF Regional Conference on European Transport and Roads to be held in Lahti, Finland, on June 14-16, 1999 will be organized by the International Road Federation and the Finnish Road Association in cooperation with the Ministry of Transport and Communications of Finland, Finnish National Road Administration, Automobile and Touring Club of Finland and Finnish Trucking Association..

The overall theme of the Conference will be tackled in a high-level keynote session highlighting social, political and economic perspectives.

In the following technical sessions the overall theme will be discussed more concretely:
1. European Road Policy – Plans vs. Reality
2. Highlights of Technical Developments
3. Road Policy and Projects from a National Perspective

The last day for early (=lower rate) registration is by May 1, 1999.

For further information (registration, hotel reservations, post-congress tours, accompanying person's program, etc.) please contact:

Finnish Road Association
P.O.Box 131
FIN-00701 Helsinki
FINLAND
Fax int +358 9 351 1181
Tel. int +358 9 700 10 882

or

IRF'99 Secretariat, Ms Pia Vehnämäki
University of Helsinki
Kirkkokatu 16, FIN-15140 Lahti
FINLAND
Fax int. + 358 3 892 20219
Tel. int. + 358 3 892 20268

Also In This Issue:

CO_2 EMISSIONS OF TRANSPORT

IMPROVING FROST-SUSCEPTIBLE GRAVEL ROADS

CARBON DIOXIDE EMISSIONS OF TRANSPORT AND MEANS TO REDUCE THEM

INTRODUCTION

Several means have been recently sought to reduce emissions of carbon dioxide. Concerning the freight transport on roads, a certain measure has been totally forgotten. So far, this measure has been very successful both in Finland and Sweden.

In the early 1970's the maximum gross train mass in Finland was 32 tons. In 1975, it was raised to 42 tons. This value was reached by 5 axles in the combination. However, the turning regulation of vehicle combinations quickly caused the 6th axle to be used in these combinations. This also gave more transport capacity without raising axle loads. So, in 1982, the maximum gross train mass was raised to 48 tons.

In 1990, the gross train mass was raised to 56 tons. However, during winters when the soil was frozen, the gross train mass of 60 tons was already applied. The gross train mass of 60 tons overall has been valid in Finland since 1993.

The effort against harmonization by the EU was very strict in Finland. The gross train mass was retained, and the maximum length was increased from 22 meters to 25.25 meters (module combination). The masses were not harmonized, and this fact can still be utilized in the traffic and transport policy in Finland.

In accepting the module concept, Finland again has vehicle combinations that have an extra axle needed for the gross train mass of 60 tons. The situation is similar to that in 1975-1982. Without raising the axle masses, which is very important for the road wear effect, the gross train mass of 68 tons could be adopted, if the towing vehicle has 3 axles. If it has 4 axles, the gross train mass of 74 tons could be allowed. If a 5-axled truck tows a 5-axled trailer, the gross train mass of 80 tons could be allowed.

The effect of the gross train mass on fuel consumption and carbon dioxide emissions as well as road wear is considered below.

SIMULATION AS CALCULATION METHOD

In principle, the effect of different technical factors of vehicles and roads on fuel consumption and hereby on carbon dioxide emissions could be studied by the measurements of fuel consumption with an analyzer. However, this would be an immense task – it is unrealistic taking account the resources in practice. Instead of this, a computer simulation is a very good tool for this purpose.

EXAMPLES IN THE STUDY

Instantaneous fuel consumption varies remarkably due to the variation of drive resistances (upgrades, downgrades). Thus, vertical geometry of the road affects also the average fuel consumption. Therefore different cases have been selected for the study. The road section between Helsinki and Turku is exceptionally hilly compared to the roads in general in Finland. The highest point is located approximately in the middle, and from there the road goes down in both directions. From Helsinki to Turku the rise is only 12.595 meters. The average rise is 7.32 m/km and the average fall is 7.24 m/km. The shares of rise, fall and level are 43.44 %, 42.75 % and 13.81 %, respectively. On the basis of these figures, an expectation could be that the difference of the fuel consumption and carbon dioxide emissions would not be great.

Another example is the road section between Helsinki and Lahti. The road rises from Helsinki to Lahti 103.690 meters. The average rise is 4.39 m/km and the average fall 3.23 m/km. The shares of rise, fall and level are 51.88 %, 38.62 % and 9.49 %, respectively. Because a drive from Helsinki to Lahti is a clear climb, the expected fuel consumption and carbon dioxide emissions are obviously higher towards Lahti than towards Helsinki. In order to determine the effect of the road 'hilly-ness', or rate of rise and fall, the simulations have been carried out in both directions on these road sections.

In addition, the fuel consumption and carbon dioxide emissions have been determined in a steady state, where the road gradient is 0 percent (level).

In the simulation, the following type vehicles have been surveyed (table at the bottom of this page):

The goal speed has been 80 km/h, and on downward slopes an increase of 10 km/h is allowed before the brakes are used. This increase is achieved by the gravitation (schwung) and not by the accelerator pedal. A gear shift down by two steps takes place, when the engine speed falls to 1100 rpm and up by one step only, when the engine speed of 1700 rpm is reached.

ENERGY CONSUMPTION AND CARBON DIOXIDE EMISSIONS

Because the complete engine maps of emissions are not available from all the engines mentioned above, only carbon dioxide emissions have been studied in this context. Because there is a compar-

Vehicle type	Engine power kW	Number of axles	Gross mass t	Net mass t	Load size t
Truck+semitrailer	280	5	40	16	24
Truck+trailer	376	6	53	17	36
Truck+trailer	386	7	60	18	42
Truck+trailer	386	8	68	19	49
Truck+trailer	386	9	74	20	54
Truck+trailer	386	10	80	21	59

ison between the different alternatives, a sufficient accuracy is achieved, if the carbon dioxide emissions are determined as a linear dependence of fuel consumption. The relationship is 3.13 kg carbon dioxide per 1 kg diesel fuel.

When vehicle mass is increased, fuel consumption per the driven distance unit (traffic product) [veh*km] naturally increases, too. However, the load size (payload) is also increased simultaneously, and in addition more efficiently than the fuel consumption. Therefore the survey must be concentrated to the transport product or the transport work [tkm], because a certain transport task or potential means a reduced traffic product [veh*km], if the load size is increased.

For the different type vehicles and road sections the following fuel consumption values were obtained:

Gross	FUEL CONSUMPTION [l/100 km]									
mass	HEL-TUR		TUR-HEL		HEL-LAH		LAH-HEL		STEADY STATE	
t		Index		Index		Index		Index		Index
40	39.897	76.2	39.009	76.2	40.079	77.9	34.855	79.3	37.381	78.7
53	48.192	92.1	47.054	91.9	47.653	92.6	41.005	93.3	44.611	93.9
60	52.346	100.0	51.215	100.0	51.466	100.0	43.949	100.0	47.499	100.0
68	56.714	108.3	55.443	108.3	55.546	107.9	47.187	107.4	51.315	108.0
74	60.004	114.6	58.705	114.6	58.645	113.9	49.716	113.1	54.372	114.5
80	63.299	120.9	61.868	120.8	61.724	119.9	52.321	119.0	57.449	120.9

,or determined per transport product unit:

Gross	FUEL CONSUMPTION [l/100 km]									
mass	HEL-TUR		TUR-HEL		HEL-LAH		LAH-HEL		STEADY STATE	
t		Index		Index		Index		Index		Index
40	1.662	133.4	1.625	133.3	1.670	136.3	1.452	138.8	1.558	137.7
53	1.339	107.4	1.307	107.2	1.324	108.0	1.139	108.9	1.239	109.6
60	1.246	100.0	1.219	100.0	1.225	100.0	1.046	100.0	1.131	100.0
68	1.157	92.9	1.131	92.8	1.134	92.5	0.963	92.0	1.047	92.6
74	1.111	89.2	1.087	89.2	1.086	88.6	0.921	88.0	1.007	89.0
80	1.073	86.1	1.049	86.0	1.046	85.4	0.887	84.7	0.974	86.1

(HEL = Helsinki TUR = Turku LAH = Lahti)

Carbon dioxide emissions per traffic product unit are:

Gross	CARBON DIOXIDE EMISSIONS [g/km]									
mass	HEL-TUR		TUR-HEL		HEL-LAH		LAH-HEL		STEADY STATE	
t		Index		Index		Index		Index		Index
40	1061.8	76.2	1038.2	76.2	1066.7	77.9	927.6	79.3	994.9	78.7
53	1282.6	92.1	1252.3	91.9	1268.3	92.6	1091.3	93.3	1187.3	93.9
60	1393.2	100.0	1363.1	100.0	1369.7	100.0	1169.7	100.0	1264.2	100.0
68	1509.4	108.3	1475.6	108.3	1478.3	107.9	1255.9	107.4	1365.7	108.0
74	1597.0	114.6	1562.4	114.6	1560.8	113.9	1323.2	113.1	1447.1	114.5
80	1684.7	120.9	1646.6	120.8	1642.7	119.9	1392.5	119.0	1529.0	120.9

,and carbon dioxide emissions per transport product unit are:

Gross	CARBON DIOXIDE EMISSIONS [g/tkm]									
mass	HEL-TUR		TUR-HEL		HEL-LAH		LAH-HEL		STEADY STATE	
t		Index		Index		Index		Index		Index
40	44.243	133.4	43.258	133.3	44.445	136.3	38.652	138.8	41.453	137.7
53	35.628	107.4	34.786	107.2	35.229	108.0	30.315	108.9	32.980	109.6
60	33.170	100.0	32.454	100.0	32.613	100.0	27.849	100.0	30.099	100.0
68	30.804	92.9	30.114	92.8	30.170	92.5	25.630	92.0	27.872	92.6
74	29.574	89.2	28.933	89.2	28.904	88.6	24.503	88.0	26.798	89.0
80	28.554	86.1	27.908	86.0	27.843	85.4	23.602	84.7	25.915	86.1

For example, if the gross train mass is raised from the present 60 tons to 68 tons, the fuel consumption and carbon dioxide emissions per transport product unit [tkm] are reduced by 7 to 8 percent, but if the gross train mass were 74 tons, the reduction would be 11 to 12 percent. The reduction would be 14 to 15 percent compared to the present situation, if the gross train mass were 80 tons (this is possible with 10 axles in the vehicle combination).

The transport policy within the European Union causes 33 to 29 percent more carbon dioxide emissions per transport product unit than the Nordic transport policy. If the EU policy were compared to 80 tons, the EU value would be 55 to 64 percent higher than that of Finland.

The figures beside show that though the absolute values differ from each other on different road sections due to the variation of the rate of rise and fall, the relative changes are quite close to each other. Though a conclusion could be made that the best benefit of the increase of the gross train mass would be achieved when a vehicle moves downward as much as possible (Lahti-Helsinki), the order of the relative effect remains the same. In other words, it does not make any difference which kind of road is used.

EFFECT OF GROSS MASS ON ROAD WEAR

It is thought very commonly that road wear is increased if the gross masses of vehicles or vehicle combinations are raised. However, this is not true if the rise takes place only by adding the number of axles, but not raising the axle or axle group masses.

Road pavement wear can be described best by the total sum of equivalent axles during the road design period which is 20 years in general. This is a product composed of the number of vehicles and the number of equivalent axles in an individual vehicle or a combination. Determining the road wear effect as a monetary value is not very simple, and therefore this presentation does not try to do this, but the best method is to describe it with the aid of this axle equivalent product. Thus the relative difference and effect between different vehicle types can best be revealed.

Road pavements are dimensioned by the number of equivalent single axle loads (ESAL). Pavement must generally stand a certain amount of ESALs during the period of 20 years, which means the number of equivalent axles converted to 10-ton axles with twin wheels during that period.

As mentioned above, road pavement wear cannot be explained only by the number of axles in an individual vehicle (combination), but also by their types and number of vehicles. Thus, the comparison between the different vehicle types cannot be made this way. The higher the load size, the fewer vehicles are needed for the transportation. From this viewpoint the best way to compare different vehicle types is to calculate the ratio of the net load size and the number of equivalent axles in the vehicle or in the combination (tons/equivalent axle). This value should be maximized or its inverse value (equivalent axles/ton) should be minimized.

When type vehicles are surveyed so that they are fully loaded and the mass distribution on the axles is optimal (legal), the following results are obtained:

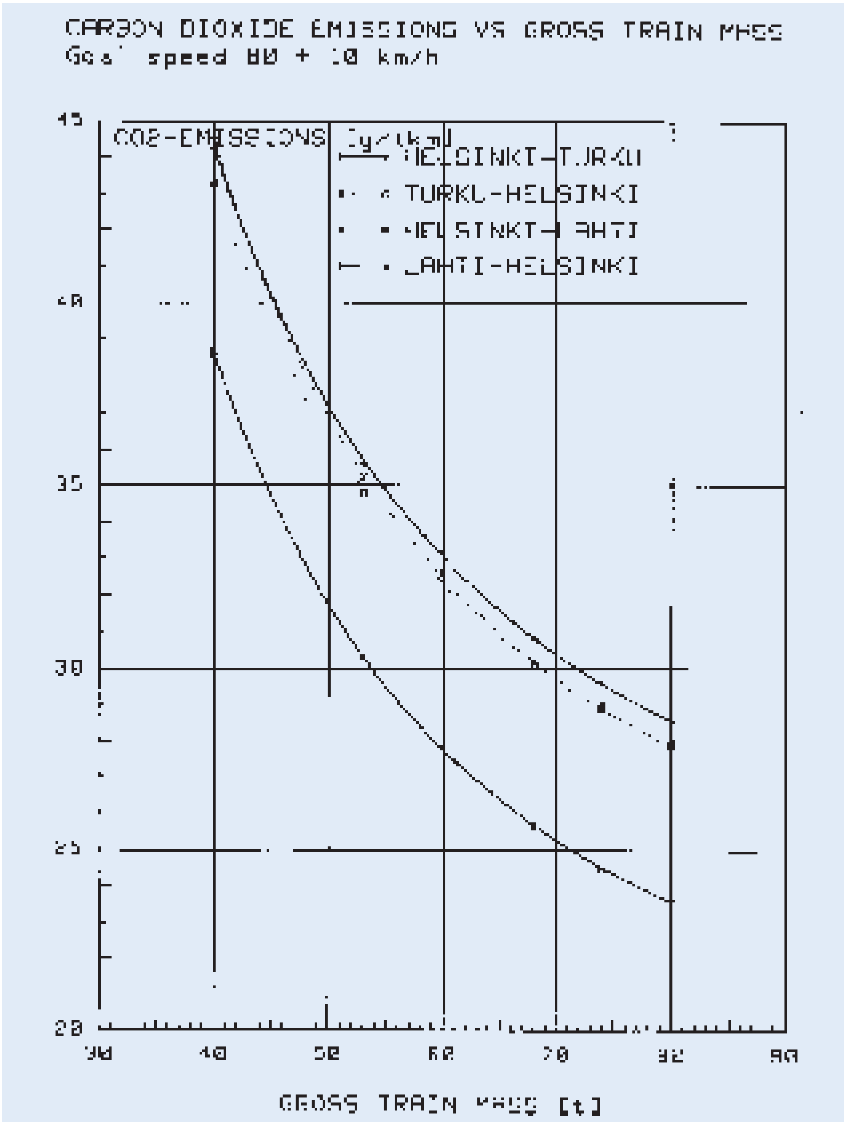
Gross mass	Load size	Number of axles	Equivalent axles	Road wear effect
t	t			eq.axles/100 t
40	24	5	3.4168	14.2367
53	36	6	3.3379	9.2720
60	42	7	3.5702	8.5005
68	49	8	3.6674	7.4845
74	54	9	4.0387	7.4791
80	59	10	4.2111	7.1375

The figures above show that the present combination of 60 tons wears a road by 8.50 equivalent axles per 100 tons of goods. If the gross mass were raised, road wear would decrease, and at 80 tons it would be only 7.14 equivalent axles per 100 tons of goods.

Hence in freight transport the rise of the gross train mass would be one of the means to reduce the fuel consumption and carbon dioxide emissions. However, for the time being, decisions like this are not planned in Finland.

Mr. OLAVI KOSKINEN, Ministry of Transport and Communications of Finland

A typical Finnish vehicle combination (Sisu E12); mass 60 tons and length 25.25 metres.



Relationships between carbon dioxide emission and gross train mass.

NEW METHODS IMPROVING FROST-SUSCEPTIBLE GRAVEL ROADS

GENERAL

Gravel roads cover about 28,000 km (or 36 %) of Finland's public road network. Most of these roads are "unbuilt" (i.e. they were spontaneously created) gravel roads with little traffic. However, because they provide basic connections, their significance in the road network is considerable, and they should be accessible all year round. In recent years an average of FIM 190 million per year have been spent on the maintenance of this part of the road network. A significant part of the annual maintenance costs stems from repair of damages caused by an inadequate load-bearing capacity and repair of frost damages to the road structure.

On the basis of the inventories performed during the three-year period from 1996 to 1998, the number of frost-susceptible gravel roads is growing. As shown in Figure 1, the share of damaged roads was 5.7 % of the total gravel road length in 1998.

A look at the type of damages occurring during the same period reveals that the amount of serious damages has increased nearly 6.8 times. The total length of damaged gravel roadway was 1,545 km at the end of the period (see Figure 2).

Road management resources in Finland have sharply decreased during recent years, and the measures have been concentrated on busy main roads. Even scantier resources have been available for the maintenance of very low-volume roads. In order to preserve basic service level on these very low-volume roads, the situation has made it necessary to search for structural solutions that are less expensive than traditional repair methods.

NEW, INEXPENSIVE, LONG-LASTING STRUCTURAL SOLUTIONS UNDER DEVELOPMENT

Slag – produced as a by-product of the steel industry - has been used in replacing traditional stone materials in road structures already in the 1980's. However, the use of fibrous waste from the wood refining industry, coal, peat and mixed ashed ashes produced in

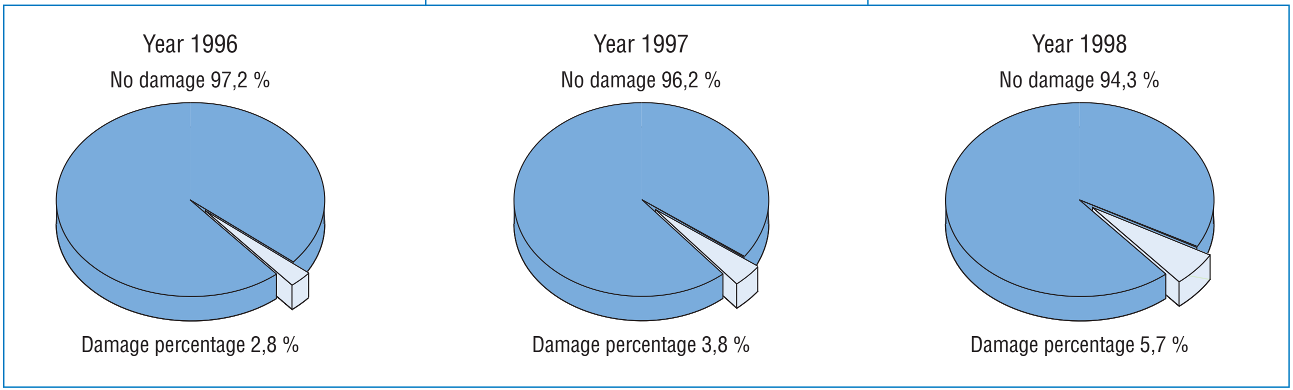


Figure 1. Frost-damaged road structures of gravel roads in Finland in 1996, 1997 and 1998.

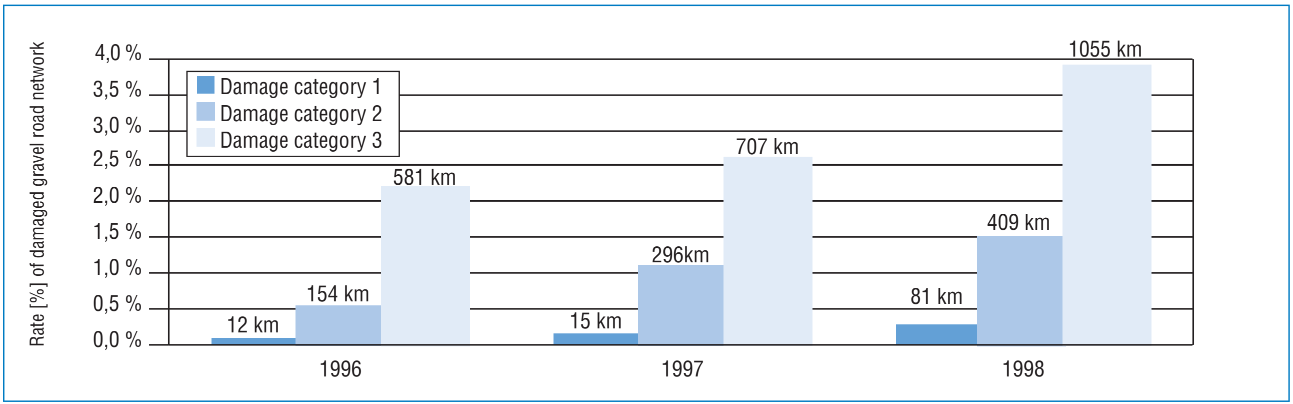


Figure 2. Length and percentage of gravel roads with structural frost damages by category in Finland in 1996, 1997 and 1998.

power plants has not emerged as a material replacement until the 1990's. Certain waste gypsum materials have also been studied and successfully used to stabilize old road structures in the 1990's. Ash and fibrous ash provide good frost insulation and significantly improve structural load-bearing capacity. Based on these experiences, the Finnish National Road Administration (Finnra) has collaborated with the industry and with company Viatek/SGT Ltd in initiating an extensive development project dealing with the possibilities of using industrial by-products to improve frost-susceptible gravel roads. On the basis of pilot structures realized in the beginning of the 1990's, the analyses made in 1997-1998, and the experience with more extensive pilot construction, the 5 structural solutions presented in adjoining photographs have proved to be functional, long-lasting and inexpensive.

PRODUCT GENERATION UNDERWAY

Based on experiences with the pilot construction project, the work has addressed the development of general directives that will include design directives, work instructions, construction quality monitoring requirements, and other rules. Product or structure generation will be extended to the most significant by-product groups that also have potential use outside the production area.

ENVIRONMENTALLY FRIENDLY PRODUCTS WITH MATERIAL SAVINGS

The use of by-products promotes the re-use of old structures and reduces the need to use new materials from the ground. Even though industrial waste products are not locally available everywhere, their low initial price still makes them competitive compared to traditional stone materials which may also be sparsely available. If a by-product is a good and effective binder, it may have, depending on its characteristics, potential economic use regardless of long transporting distances. Structures based on the use of by-products can truly be called road structures that comply with the principle of sustainable development.

For more information, please, contact the authors of this article: Mr. Pentti Lahtinen at Viatek/SGT Ltd, fax int +358-3-536 1584, e-mail:pentti.lahtinen@sgt.pp.fi or Mr. Heikki Suni at Finnra, fax int +358-20444 6916, e-mail:heikki.suni@tieh.fi.

Mr. PENTTI LAHTINEN, Viatek/SGT Ltd and Mr. HEIKKI SUNI, Finnra

Structure 1. Fibrous ash structure (a 200 mm layer of fibrous ashes covered with a 100 mm layer of crushed gravel).

Structure 2. Ash structure (a 200 mm layer of ashes covered with a 100 mm layer of crushed gravel).

Structure 3. Blast-furnace sand stabilization (the old structure is stabilized to a depth of 200 mm using blast-furnace sand; this is covered with a 100 mm layer of crushed gravel).

Structure 4. Gypsum-lime stabilization (the old structure is stabilized to a depth of 200 mm using a mixture of gypsum and lime; this is covered with a 100 mm layer of crushed gravel).

Structure 5. Slag-ash stabilization (the old structure is stabilized to a depth of 200 mm using a mixture of powdered slag and light ashes; this is covered with a 100 mm layer of crushed gravel).

ELK ACCIDENTS CAN BE REDUCED BY USING TRANSPORT TELEMATICS

PROBLEM

The number and costs of elk accidents are increasing both in Finland overall and in the region of Uusimaa Province shown by an upward trend since the early 1990´s. Elk accidents constitute about 20 % of all accidents. In 1995, there were 435 reported accidents which involved elks on the public roads of the Uusimaa Region of the Finnish National Road Administration (Finnra). Fortunately, the accidents are less severe than average and only 7 % of these accidents resulted in personal injuries.

In a recent survey conducted by Finnra, various concentration points of elk accidents on the road network of the Uusimaa Region were identified. These accidents typically occur in forest areas of low terrain, and close to river beds or the edge of a field. Accident statistics over five years were analysed and findings show elk accidents were found to be numerous on the same stretches of road.

The easy years in road safety work are over. The most efficient measures to decrease the number of road accidents have already been implemented. A comprehensive approach is needed to achieve further reductions. This applies to elk accidents as well.

When designing new roads it is necessary to arrange natural safe crossings for elks. For this, an analysis of the natural paths for the animals is required.

Traffic signs are presently used in accident-prone road sections. The sites for the signs have to be checked annually to account for the changed patterns of elk “traffic”. The effect of warning signs on driving speed is very small. Drivers detect the signs, but many fail to remain on the alert for elks for the entire section of road.

Elk fences are an effective and acceptable solution on motorways. They can reduce these accidents up to 80 %. It has been noted that elks change their travel behaviour because of fences. Proper crossing arrangements need to be made to guide elks to the most safe crossing points. Bridges and tunnels can often be built for elks. However, because this is not always possible, elk crossing concentration points are potential accident prone sections.

SOLUTION

Elk crossing points should be designed so that the risk for accidents can be kept as low as possible. The sites for the “doors” in an elk fence must have especially good visibility from both directions of the road. Special road safety measures can be arranged by using transport telematics. This has been demonstrated in Finland.

The objective of a pilot system built on Highway 7 in Box in the Uusimaa Region was to evaluate the use of variable message signs to reduce elk accidents.

In 1996, a new elk fence 1650 metres long was built on Highway 7. An old “door” was shut and a new “door” was opened at Box.

Microwave detectors were installed for the detection of elks on both sides of the road. There are five poles on each side with two radars on each pole. Poles are situated 25 metres from the edge of the fence, 50 metres apart and 5-20 metres away from the side of the road. The radars face away from the road. The detection zone of the radars reaches up to 50 metres from the detector and each detector can see horizontally a sector of 60 degrees. There is also a video camera and a recorder in the system. In the middle of the “door” there are inductive loop detectors to monitor traffic volume and speeds. Static warning signs and variable message signs are placed 500 metres and 200 metres respectively before the “door” on both sides of the carriageway.

The system is connected to the Traffic Management Centre of the Uusimaa Region via a dial up connection. The user interface is a PC program with a Windows operating system. Operations that are possible to perform are:

- Collecting the log data files
- Configurating the field system (e.g. detection timings and algorithms, camera controls, etc.)
- Monitoring of the current status of the field system
- Service operations, e.g. updating the programs.

Later, 16 passive infrared detectors and a rain detector were added to the system.

When the detectors detect a movement, the variable message signs display a warning sign, the video recorder starts to record, and the video camera turns to the direction of the detection. The camera turns back to the normal position after one minute. The variable message signs are turned off three minutes after the last detection. Three more minutes are recorded on tape. These time parameters can be changed with the user interface program of the system at the Traffic Management Center.

A variable elk warning sign.

The implementation phase was finalised in September, 1996. However, there were various technical difficulties, and more than three months were needed to test-run the system, partly with the signs turned off. The system has been in full operation since mid-December, 1996.

The implementation costs of the warning system were about USD 90,000. The system supplier is Sabik Ltd, Finland.

EVALUATION OF THE EFFECTS

A survey was conducted by the Uusimaa Region of Finnra to find out the effects of the warning system on driver behaviour. Another objective of the survey was to evaluate the technical performance of the system for further development. The survey period was January-February, 1997 and June-July, 1997.

In the daylight, the mean speed of all vehicles was 106,4 km/h and the mean speed of free (not in queue) vehicles was 109,0 km/h. When the warning sign was on, the speed of all vehicles was 0,5 km/h higher and the speed of free vehicles was 0,4 km/h higher than in the control period. The variation between different time periods was very high.

In the dark, the mean speed of all vehicles was 101,2 km/h and the mean speed of free (not in queue) vehicles was 103,9 km/h. When the warning sign was on, the speed of all vehicles was 2,6 km/h lower and the speed of free vehicles was 1,6 km/h lower than in the control period.

In the rain, the mean speed of all vehicles was 99,8 km/h and the mean speed of free (not in queue) vehicles was 103,4 km/h. When the warning sign was on, the speed of all vehicles was 14,0 km/h lower and the speed of free vehicles was 15,6 km/h lower than in the control period.

The reasons for the alarms were studied from the video recordings. This was practical only in good conditions. Only one detection out of 107 was positively identified as caused by an elk. This survey together with other observations gave many reasons for technical improvements of the system. These improvements have been implemented. There are still various “false alarms” but this is intentional since the objective is to keep the detection rate as close to 100 % as possible.

CONCLUSIONS

The drivers decreased their speed in all cases in the rain and in many cases in the dark. However, it seemed that the system had little effect on driving speeds in good visibility conditions. There can be several reasons for this undesired behaviour. When visibility on the site is good, the drivers can see a wide area very well, and therefore judge that there is no reason for slowing down. Another reason may be that in the early stages of the system there were many false alarms and drivers may have lost their faith in the system. The system is the first of its kind in Finland and further publicity is needed to improve drivers’ awareness of the system.

The survey gave valuable information about the functioning and defects of the system and driver behaviour. The pilot system has shown that with minor modifications the system can be potentially useful and further use of this type of system on elk-accident prone sites on roads in Finland should be considered. Special attention has to be paid to the selection and design of the site and the detection arrangements. It would be ideal if the area of detection were owned by the Road Administration in order to control the land use of the area.

For more in formation, please contact Ilpo Muurinen, fax int. +358-204 44 322,
e-mail: ilpo.muurinen@tieh.fi or Tomi ristola, fax int. +358-9-803 1344,
email: tomi.ristola@traficon.fi.

Mr. ILPO MUURINEN, Finnra and Mr. TOMI RISTOLA, Traficon Ltd