

# DEVELOPMENT OF ROAD WINTER MAINTENANCE

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## 1. Abstract

The Latvian public road network is approximately 64000 kilometres long. The Latvian Road Administration is responsible for the state roads with the total length of 20318 km. The Ministry of Transport (MOT) has the overall responsibility for the road system in Latvia. The Latvian Road Administration is a non profit state-owned joint stock company and has a contract for managing the state roads, supervising municipal roads and administrating the State Road Fund with the Ministry of Transport. The role of the Road Administration is to set the policy and standards, to plan financial resources and to manage the implementation of road maintenance programs. All periodic and routine maintenance operations are contracted out. More than twenty specialised private contractors participate in pavement and bridge reconstruction and periodic maintenance tenders. Four state owned maintenance joint stock companies are the main routine works contractors.

On the way to efficient road winter maintenance system the Latvian Road Administration has met a number of serious problems such as insufficient financing, lack of modern technologies, equipment and education.

## 2. Climatic condition and state road network

The Republic of Latvia is located in the northern part of the Eastern Europe, roughly at 57 ° N latitude, its area is 64 000 square kilometres and total population – 2 480 000 people. Riga is the capital and the largest city with the population of 815 900. More than one million inhabitants are living in the Riga area. As a centre of the culture, finances and business it is situated near the Gulf of Riga in the middle of the country. Almost all major roads lead to Riga, except A 13 St Petersburg – Warsaw.

Climatic conditions vary from west to east - maritime in Courland (the western part of the country) and continental in Latgale (the eastern part). Temperature ranges from -30° to +30°C (extremes of -43° to +36°C). In winter season temperatures range from +14° to -30°C (average in January is -5°C). Snow layer is 20 – 126 cm, amount of precipitation in water millimetres - 400 – 1000 mm. Number of thaws during winter rounds up to 25 times. Days without frost are 130 – 170.

For better use of financial resources and easier planning the method of seasons was introduced in 1998. Now the road routine maintenance year starts on the 1<sup>st</sup> of October in the current year and lasts up to the 30<sup>th</sup> of September of the next year. The winter season lasts from October to the 1<sup>st</sup> of April, but summer season from April to the 30<sup>th</sup> of September. However, some season works are done if there is a need for them. The strongest snowstorm in the year 2001 was during the Easter weekend, April 14-15.

The Latvian state road network is 20318 kilometres long (Table 1): main roads are 8%, 1<sup>st</sup> class roads - 27%, and 2<sup>nd</sup> class roads - 65%. Out of them paved roads are 39% and gravel roads are 61%.

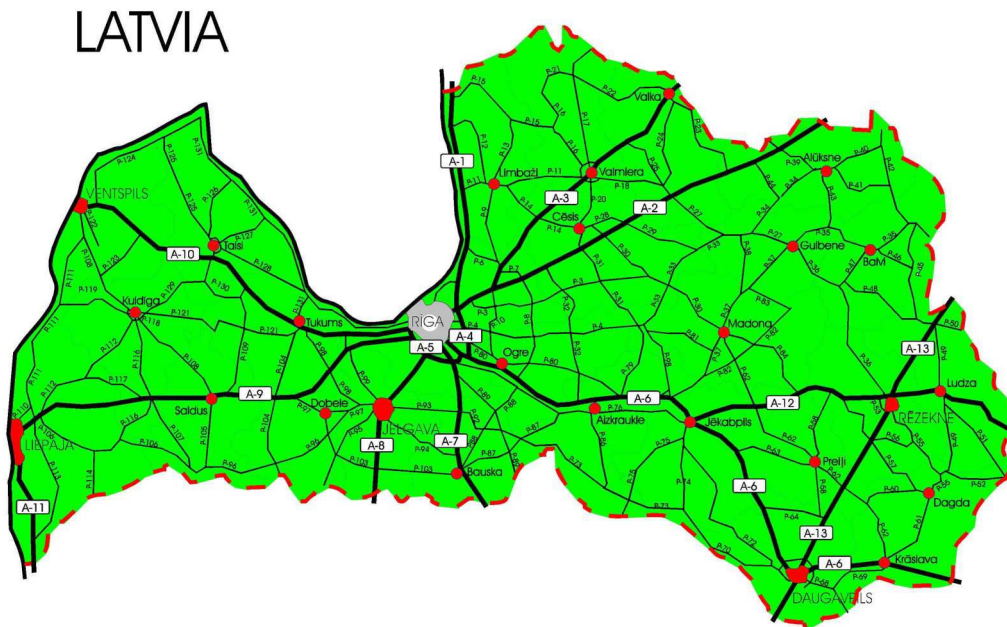
**Table 1 Road classification according to importance and pavement types**

Roads	Asphalt pavement (km)	Gravel (km)	Total (km)
Main roads	1618	–	1618
1 <sup>st</sup> class roads	3797	1588	5385
2 <sup>nd</sup> class roads	2431	10884	13315
Total	7846	12472	20318

Due to postponed road preservation and reconstruction works of 325 million Lats (523 million USD), the quality of roads is critical. In good condition there are 32%, fair - 38%, poor - 19% and very poor - 11% or 894 km of asphalt pavements. Poor condition of pavements, bridges and other road elements seriously influences the amount and quality of routine works.

The Latvian Road Administration is responsible for 929 bridges with a total length of 31 137 m.

**Figure 1 Main and 1<sup>st</sup> class state road network**



### 3. Financing of winter maintenance

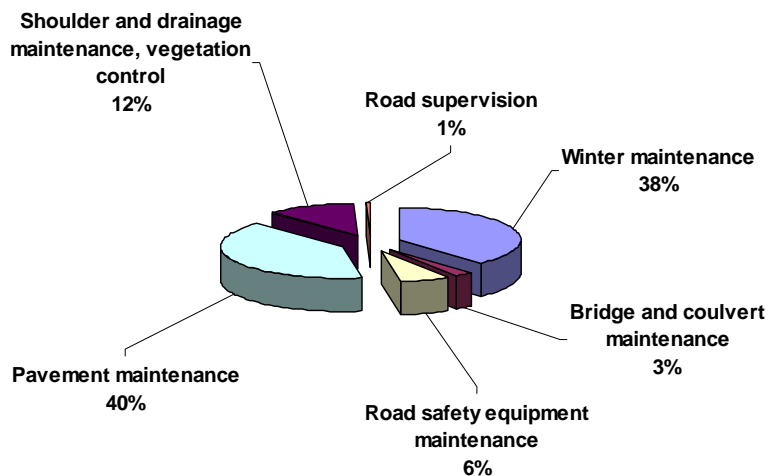
The winter maintenance of the state roads is 100% financed from the State Road Fund. The State Road Fund was established in 1994 as a special unit in order to create a new separate, and predictable source of income to increase the overall budget for roads. The following sources of revenue are used for road financing :

- annual vehicle tax
- fuel tax
- state public investment resources
- loans

However, still the budget allocated for the road maintenance remains insufficient to ensure the whole state road network optimally maintained.

According to data from the Central Statistics Bureau, the gross domestic product (GDP) in 2000 increased by 6.6%, comparing to 1999. Although these optimistic figures indicate the stabilisation of national economy, they are not corresponding to the incomes of the State Road Fund. In 2000, the freight turnover in the transport by road increased by 15%, but the State Road Fund received only 45 million Lats (69 million USD) instead of the planned 53 million Lats (85 million USD). The yearly routine maintenance program has the total budget of 16 million Lats (26 million USD): 7.5 million Lats (12 million USD) for winter maintenance and 8.5 million Lats (14 million USD) for other routine works. Usually more than 50% from routine maintenance annual budget are spent in winter season. The winter maintenance has the highest priority status in the structure of routine maintenance works.

**Figure 2 Structure of routine works in 2000**



#### 4. Winter service levels

The winter service levels are defined in accordance with traffic, road class, possible finances and social needs. The contractors' capacity and resources are insufficient to provide immediate care of every road in our usually unpredictable winter weather, therefore five winter standard classes are served. The regulations of the Ministry of Transport since 1998 has set the winter standards for the state roads.

Table 2 Winter service classes

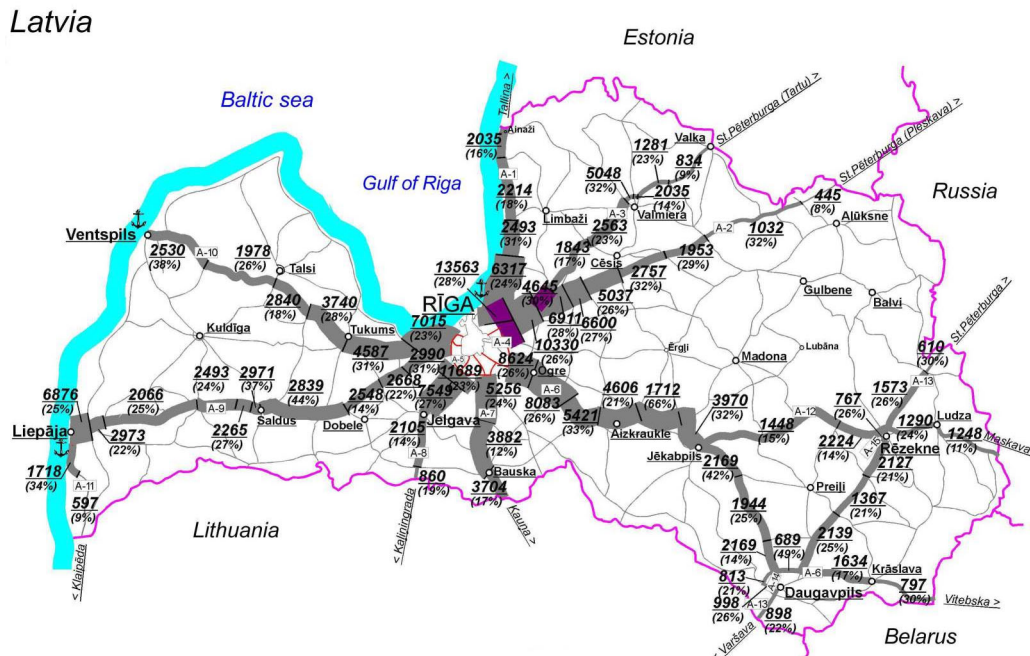
Traffic flow AADT	Main roads	1 <sup>st</sup> class roads	2 <sup>nd</sup> class roads
> 4000	A	-	-
1000 - 4000	A 1	A 1	-
500 - 1000	A 1	B	B
100 - 500	-	C	C
< 100 *	-	-	C 1

\*the regular public bus is served on the low volume road

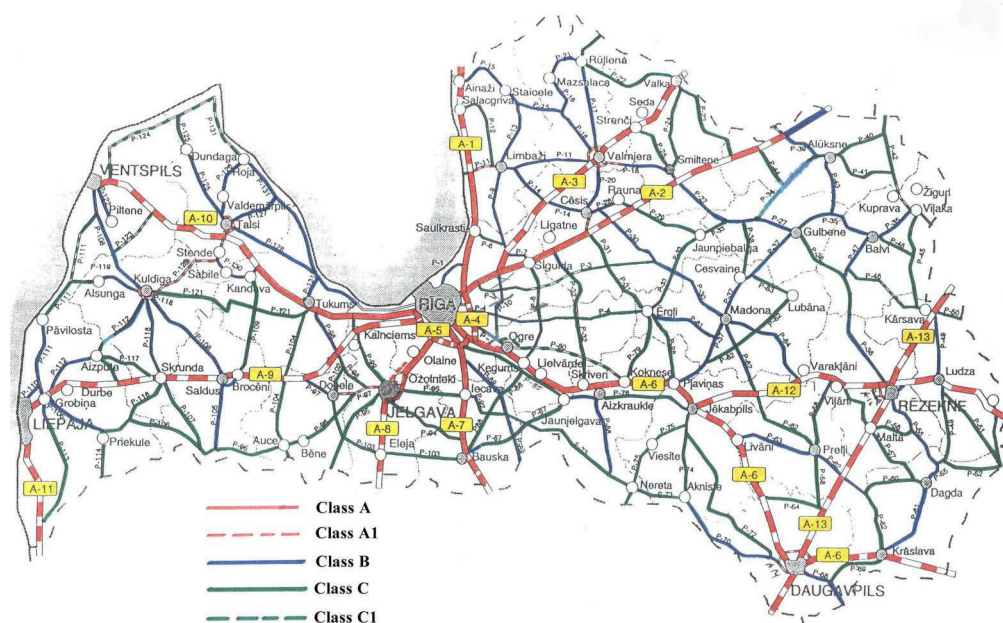
The state roads with AADT < 100 without regular public bus do not have a particular standard, however ploughing is planned three times in the winter season.

Most of main transit roads radiate from Riga. The most loaded are road sections in radius 50 km around the capital. Average daily motor vehicle intensity on state main roads was 3123 with 25% of heavy traffic in 1999. Number of vehicles registered in Latvia as at 01.01.2000. is 701804 vehicles.

Figure 3 Traffic flow on the main state roads



**Figure 4 The level of service on the main and 1<sup>st</sup> class road network in winter 2000/2001**



**Table 3 Winter standard implemented during winter 2000/2001**

Standard class	Implemented km	Share of network %
A	564.1	3
A 1	1301.5	6
B	2199.8	11
C	4111.1	20
C 1	8403.9	41
Without class	3845.6	19

Approximately 260 Lats/km (419 USD/km) were spent in winter 2000/2001

**Table 4 Road conditions in normal winter weather**

Road condition	Maintenance class				
	A	A 1	B	C	C 1
Average compacted snow depth, cm	-	-	4	10	10
Evenness of road surface	Even surface	Some uneven ice spots allowed	Ruts up to 20 mm allowed	Ruts up to 40 mm allowed	Ruts up to 40 mm allowed

**Figure 5 Main road No 2 three hours after snowfall, class A**



After snowfall some amount of loose snow or slush is allowed on the road surface. If the air temperature falls down considerably, then limited depth of ruts in compacted snow is allowed.

**Table 5 Road conditions in changing winter weather**

Road condition	Maintenance class				
	A	A 1	B	C	C 1
	Acceptable conditions				
Average loose snow depth, cm		6	8	10	10
Slush, cm	3	3	4	5	5
Evenness of road surface	Ruts $\leq$ 10 mm	Ruts $\leq$ 20 mm	Ruts $\leq$ 20 mm	Ruts $\leq$ 40 mm	Ruts $\leq$ 40 mm

**Table 6 Maximum time for operation**

Winter operations	Maintenance class				
	A	A 1	B	C	C 1
	Maximum time for operation				
Snow ploughing, hours	3	4	6	24	24
De icing, hours	3	4	No norm	No norm	No norm
Skid prevention, hours	3	4	6	8	No norm
Roughness in compacted snow, hours	-	-	8	8	12

**Table 7 Period of validity of the standard**

Winter maintenance class	Period of validity
A	6.00 – 22.00
A 1	6.00 – 20.00
B	6.00 – 18.00
C	6.00 – 18.00
C 1	6.00 – 18.00

## 5. Development of the routine maintenance contract

The final year of the first five year contract for the state road complex routine maintenance is 2002. Up to 1997, twenty six small and weak routine maintenance contractors were involved in state road winter maintenance. They were non profit state organisations, which carried out routine road works in districts with the network of ~ 700 km of the state roads. Yearly contract of “The enforced unit prices”( the price was determined by the Latvian Road Administration) was used. Big number of old Soviet made low capacity trucks, graders and bulldozers were the main tools. Specialists were used to very cheap resources.

In 1997 these 26 organisations were reformed and 4 regional state joint stock companies organised. “Kurzemes ceļi” has contract for routine maintenance in the western part, “Centrālā reģiona ceļi” in the central part, “Vidzemes ceļi” in north-eastern part, but “Latgales ceļi” in south-eastern part of the country. They are business oriented, 100% state owned companies. Today they operate a network of ~5000 km each, plan their development, purchase machinery, carry out training and education programmes for employees. Main reasons of the reform were the concentration of resources, better use of equipment and personnel.

Non competitive bidding was organised at the end of 1997. Five year routine maintenance contracts were signed in the January of 1998. Unit prices were estimated by negotiation, taking in account previous prices, market prices and fee for mobility. Growing contractors’ capacity and effectiveness allowed to keep the same prices during five years. At the same time the prices for resources increased.

Starting with the winter season 1999/2000 the new agreement was added to the contract, the unit price contract for main road winter service was transformed in the performance based winter maintenance contract.

The Ministry of Transport has prepared new guidelines for the next five year routine maintenance contract. The tender with pre-qualification is selected as a method, and contract will be performance based for all routine operations.

## 6. New winter maintenance technologies in use

Limitation of salt (mainly sodium chloride NaCl) usage due to ecological and economical reasons forced the introduction of wet salt technology. Well known in western countries from the seventies, it was absolutely new in Latvia at the beginning of the nineties. The first salt storage with salt brine mixing equipment was built and spreading equipment purchased in 1996 in the scope of a pilot project in the Riga district with financial support of the World Bank. Today wet salt technology is a major technology for preventive spreading – 5 –10 g/m<sup>2</sup>, de icing - 35 g/m<sup>2</sup> for skid resistance control on the road sections of class A maintenance standard with traffic flow AADT > 3000. The average amount of

salt used during last five years is 266000 tons. In 1990 more than 300000 tons were used. Because of long term (five year) contract, the contractors increased the capacity of the salt storages. Now they have 25 salt brine mixers, and 33 storage buildings with capacity of 30000 tons.

Sorted 20% salt / sand mix is used in road sections with traffic < 3000. On low volume sections secondary ice is forming when using wet salt, because roads never become clean from slush.

After the Lulea Winter Road Congress in 1998, the first experiments with wrinkling of compacted snow coated road surface instead of sand spreading was started. Today this technology is commonly used in the eastern part of the country. Introduction in the western and central regions was not successful due to mild winter temperature and is used to get more even gravel road surface in changing weather conditions.

**Figure 6 Wrinkled surface of compacted snow class B**



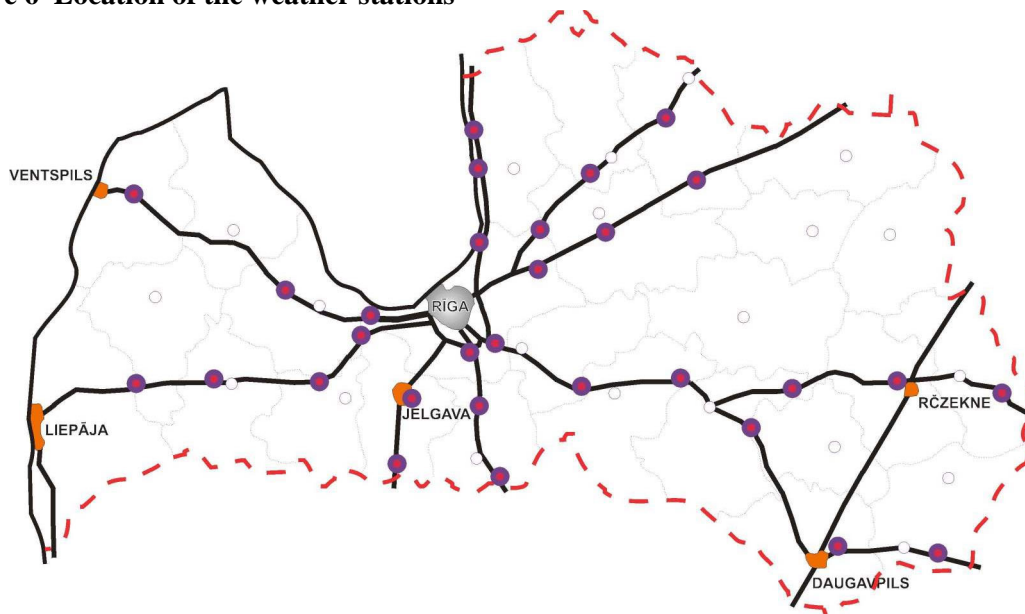
High speed ploughing with side wings is partly introduced due to psychological barrier of operators. They have only got used to high speed ploughing with front ploughs. Only “Latgales ceļi” had widely introduced this method after special training program for trainers and operators in cooperation with the Finnish Road Administration.

## **7. Road Weather Information System**

The Latvian Road Weather Information System (RWIS) consists of 30 road meteorological stations (RMS) placed on the main roads, 6 work stations (WS) and a central computer .



**Figure 6 Location of the weather stations**



The central computer and one of the work stations is located in the office of the Latvian Road Administration, four work stations are in the winter maintenance contractors dispatch centres, and one is used for forecasts and is placed in the office of the Latvia State Hydro Meteorological Service.

Today the Latvian Weather Information System works in the network of common Baltic Road Weather Information System. This system was implemented in 2000 and today it provides weather information for the whole Baltic area.

## **6. Conclusions**

New winter maintenance standards and technology were adopted in relatively short time. To obtain the road user opinion about the state road maintenance, a sociological study was carried out in March, 1999, by independent company “Latvijas Fakti”. In questionnaire drivers were asked to evaluate the changes of winter maintenance during last two years. Improvement was marked in 85.6% of answers.

Another way to see the efficiency of operations is to compare the average traffic safety reports. Latvia has the highest number of fatal road accidents in Europe. In average, during five year period from 1995-1999, 243 fatalities per one million of inhabitants occurred (data from Road Traffic Safety Directorate reports). But if we go through these reports, the increase of road accidents during the winter season cannot be found. The average number of road accidents is 20300, which splits 50.3% to winter, and 49.7% to summer season. From the average 583 fatalities 44% are related to winter, and 56% to summer period.

Both of these sources of information are important for evaluation of the served winter standard.